

**UNITED STATES OF AMERICA  
ENVIRONMENTAL PROTECTION AGENCY**

<b>Notice of Receipt of a</b>	)	<b>Docket ID No.:</b>
<b>Clean Air Act Waiver Application</b>	)	<b>EPA-HQ-OAR- 2009-0211</b>
<b>To Increase the Allowable Ethanol</b>	)	<b>FRL-8894-5</b>
<b>Content of Gasoline to 15 Percent</b>	)	<b>74 Fed. Reg. 18228 (April 21, 2009)</b>

**COMMENTS OF  
ALLIANCE FOR A SAFE  
ALTERNATIVE FUELS ENVIRONMENT (ALLSAFE)  
AND  
THE OUTDOOR POWER EQUIPMENT INSTITUTE (OPEI)**

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On April 21, 2009, EPA issued a Federal Register notice requesting comments on a fuel waiver submitted by Growth Energy for fuels containing 15% ethanol pursuant to section 211(f)(4) of the federal Clean Air Act. 74 Fed. Reg. 18228 (April 21, 2009).

The Alliance for a Safe Alternative Fuels Environment (“AllSAFE”) is made up of the national consumer and manufacturing associations that consume gasoline and ethanol fuel blends. AllSAFE speaks on fuel-related legislation for over 250 million Americans that own and operate over 400 million products, including recreational boats and marine engines, chainsaws, lawnmowers, motor vehicles, motorcycles, all-terrain vehicles (ATVs), snowmobiles, generators, and related vehicles and equipment. AllSAFE appreciates and understands all the compelling reasons that support expanding the market for renewable fuels, including ethanol. In fact, AllSAFE wants to avoid potential consumer rejection of all ethanol blends (including E85) that could occur if mid-level ethanol blends (above 10% ethanol) ultimately damage consumers and their products – for example, as a result of increased heat and corrosion when mid-level fuels are used in engines, boats, equipment, and vehicles designed for *conventional* gasoline. The use of ethanol blends in these conventional vehicles is totally different from using these fuels in flexible fuel vehicles (FFVs), which are specifically designed to run on any level of ethanol up to *E85*.

Members of AllSAFE include:

**Alliance of Automobile Manufacturers**  
**American Motorcyclist Association**  
**Association of Marina Industries**  
**Association of International Automobile Manufacturers**  
**Boat Owners Association of the United States**  
**Engine Manufacturers Association**  
**International Snowmobile Manufacturers Association**  
**Motorcycle Industry Council**  
**National Marine Manufacturers Association**  
**Outdoor Power Equipment Institute**  
**Personal Watercraft Industry Association**  
**Specialty Vehicle Institute of America**

Most of the individual associations that belong to AllSAFE will be submitting separate comments that address their industries' concerns and the specific impacts of mid-level ethanol blends on their very different engines, vehicles, boats and equipment. These comments will serve as the sole comments of the Outdoor Power Equipment Institute (OPEI). OPEI represents the manufacturers of lawn, garden and forestry equipment (such as chainsaws, lawnmowers and utility vehicles) as well as the manufacturers of engines and other components that are used in these products.

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## **I. OVERVIEW**

Growth Energy’s waiver application requests EPA approval (under section 211(f)(4) of the Clean Air Act) to allow 15% ethanol in gasoline as a “general purpose” fuel for use in on-road and non-road engines, vehicles, and equipment. In its waiver request, Growth Energy never raised directly or indirectly whether EPA should issue a “partial waiver” that would approve the use of E-15 for some limited subset of the on-road, vehicle fleet.

In its notice announcing Growth Energy’s application, EPA requested comments on two very different categories of issues. The first set of issues involves technical responses to Growth Energy’s waiver application in terms of the impacts of E-15 on on-road and non-road engines, vehicles, and equipment. These technical issues are addressed in Sections IV through XI of these comments.

In its notice, EPA unexpectedly also requested comments on a potential “partial fuel waiver” that would in concept only apply to certain newer on-road vehicles. EPA’s novel “partial waiver” concept would be based on somehow bifurcating the national production, distribution, blending, and marketing of separate  $\leq$  E-10 fuels (for non-road products and older automobiles) versus E-15 fuels for some yet-to-be fully defined group of newer automobiles.<sup>1</sup> EPA expressed the hope that misfueling risks could be addressed through unspecified legal authority, controls, and procedures. These “partial waiver” and misfueling issues are addressed in Sections II through III of these comments.

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<sup>1</sup> EPA suggests in its separate RFS II rulemaking that Tier 2 vehicles might be able to accommodate E15 but provides neither data to support this proposal nor a well-defined boundary of the subset, for example, whether it would include all types of vehicles within this group. (See 74 Fed. Reg. 24904, 25016 (May 26, 2009)).

## II. A PARTIAL FUELS WAIVER COULD RESULT IN MASSIVE MISFUELING PROBLEMS

EPA has not developed an administrative record at this time or in this waiver-review proceeding that would indicate that any controls – including incredibly expensive and intricate controls -- could ultimately prevent substantial misfuelings. Under a “partial waiver” for E-15, misfueling would likely occur at even higher rates than when there were separate pumps dispensing unleaded and leaded fuels in the 1970s and 1980s, in part because the pump nozzles will be the same for both E-15 and fuels containing 10% ethanol or less. During this timeframe, the fuel inlets for new motor vehicles were totally redesigned with narrower diameters in order to prevent the insert of the larger diameter nozzles that dispensed leaded gasoline. However, in 1984 (12 years after the initial lead phase-out), EPA concluded that widespread, “intentional misfueling” by consumers continued to circumvent these controls through “funneling leaded gas in the gas tank,” or “removing or damaging the nozzle restriction in the fuel filler inlet of a vehicle.” (See 49 Fed. Reg. 31032, 31034 – August 2, 1984).

In 1982, EPA completed a comprehensive misfueling study based on 2,637 vehicles (comprising the 1975 to 1982 model years of production). EPA concluded that 13.5% of the vehicles (on average across the nation) designed for unleaded fuel were still being misfueled with leaded fuels in 1982. (See 49 Fed. Reg. 31032, 31034 – August 2, 1984). EPA recognized that this misfueling rate probably underestimated actual misfueling. Id. EPA recognized that despite the Agency undertaking “vigorous enforcement of the misfueling regulations, misfueling is expected to persist as long as leaded gasoline with a higher octane rating and a lower price than unleaded gasoline remains available on the market.” (See 49 Fed. Reg. 31035).

Even if EPA similarly requires sophisticated gas inlets and nozzle controls to be in place under a “partial waiver” for E-15, consumers will find a way to misfuel – particularly if E-15 is less expensive than E-10. In EPA’s proposed Renewable Fuels Standard (“RFS-II”) proposal, EPA states it expects that mid-level ethanol blends would be marketed as the less expensive regular-grade fuels. (See 74 Fed. Reg. 24904, 25017 (May 26, 2009)). In this same proposal, EPA also recognizes that (just as occurred with leaded gasoline) many consumers will intentionally misfuel to save only a few cents per gallon. Conservatively, assuming the 13.5% misfueling rate cited above (and roughly 400 million legacy products), over 50 million legacy products would be misfueled with E-15 under a “partial waiver.”

Even assuming EPA can develop a workable system for protecting the legacy vehicle fleet, ALLSAFE cannot envision a practical system to protect off-road engine or equipment from the improper use of a mid-level ethanol fuel. Off-highway engines are generally fueled from portable containers which are in turn fueled at the same time and location as the vehicle utilized to transport the container from the filling station to the off-road equipment location. In fact, many types of non-road products, including lawn, garden and forestry products and off-road vehicles like ATVs and utility vehicles are exclusively refueled from portable containers. Portable fuel containers have a range of opening sizes for refueling of the container and clearly any fuel dispensing nozzle that could be utilized to fill a vehicle could, and would, also be utilized to fill the portable container. Pump labeling warning the user about misfueling will be helpful to guide vehicle owners but will likely have minimal influence on the consumer’s perceived

convenience of filling both the vehicle and portable container from the same nozzle, especially during a single transaction at the fuel retailer.

In addition, off-highway fuel use is a very small percentage of the total fuel delivered by any given fueling station. The incentive for fueling stations to maintain a separate tank and pump for off-highway equipment is minimal and most likely would result in higher unit fuel costs to provide sufficient operating margin for the station to offer off-highway fuel. The additional cost would provide an additional disincentive for consumers to locate and utilize a special off-highway fuel. There is also a strong potential that the reduced volume of fuel required in the marketplace would result in elimination of supply, further eroding special off-road fuel availability. This potential is heightened by the fact that the base fuel utilized for an E15 blend would not be a legally viable fuel for blending and distribution with lower ethanol concentrations required for off-highway engines and equipment.

Even if the market preserves one grade of gasoline as an E10 fuel, as EPA suggests in its RFS II proposed rule preamble, this will not address the concern about misfueling. Indeed, this will likely exacerbate the risk of misfueling because E10 will be uniformly more expensive than E15.

As documented in Sections VI through XI of these comments, misfueling non-road and on-road equipment with E-fuels with ethanol content higher than 10% could cause serious, permanent damage to millions of legacy products, emission – related failures, and increased operating hazards for millions of consumers, notwithstanding that up to E10 is acceptable today for vehicles and some non-road products. (See Dr. Sahu’s Technical Study attached as Exhibit A). There is no meaningful discussion or review of

these adverse impacts in Growth Energy’s waiver application, in EPA’s Notice in response to that application, or even in EPA’s RFS-II proposal which provides more information about EPA’s thinking regarding possible implementation approaches.

### **III. PRACTICAL AND LEGAL REASONS EPA MUST NARROW THE SCOPE OF E-15 WAIVER REVIEW PROCESS**

As explained below, for legal and practical reasons, an individual section 211(f)(4) fuel waiver is an inappropriate and ill-suited process to seek comments and develop an administrative record that would address broad fuel segregation and related misfueling controls across the country at over 175,000 gasoline retailers. If EPA wants to pursue such a “bifurcated fuels” program with different ethanol blends for different products, then EPA should initiate a separate major rulemaking process under section 211(c), rather than bootstrapping these broad issues into the narrow section 211(f)(4) waiver-review process.

First, because of explicit concerns about the adverse impacts of mid-level ethanol on non-road products, in 2007, Congress expanded and strengthened Section 211(f)(4).<sup>2</sup> Congress specifically directed EPA to only approve a fuel waiver if all non-road and on-road engines or vehicles would not be adversely impacted with regard to their applicable emission standards. EPA would be acting in direct contradiction to these new statutory requirements if now it failed to address impacts on any portion of the onroad and non-road vehicle and engine population, by instead relying on an unjustified and vague “partial waiver” concept.

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<sup>2</sup> See Section 251 of the Energy Independence and Security Action of 2007 (EISA).

Second, Section 211(f)(4) is simply designed to address whether a new proposed fuel or fuel additive (when used as a “general purpose” fuel) will likely cause or contribute to an emission-related failure, or operational or “materials compatibility” problems. Section 211(f)(4) does not create the legal authority for EPA to establish a “partial waiver” based on a bifurcated fuel “concept.” When EPA has tried to consider and address other broader public policy issues in an individual fuel waiver determination, the federal courts have: 1) struck down EPA’s expansion of its limited discretion and authority under section 211(f)(4); and 2) directed EPA to address those issues in the context of another, Clean Air Act authority (such as section 211(c)).<sup>3</sup>

Third, Section 251 of EISA amended section 211(f)(4) to allow 270 days in which EPA must either “grant or deny” the submitted waiver application, which is more time than afforded EPA for a waiver decision before the amendment but which remains an expedited schedule. In this case, EPA will be hard-pressed to respond (within the remaining 130 days) to all the legal and technical issues directly raised in the Growth Energy waiver application and in thousands of responsive comments. To date, EPA has not yet proposed a program whereby it could address all the various market issues, so stakeholders have nothing to evaluate. EPA has too little time before the waiver’s December 1 deadline to propose and finalize such a program, with associated compliance and enforcement mechanisms. Without a fully defined implementation program, EPA may be unable to prevent misfuelings and avoid related damage to millions of products and repeated violations of applicable standards under the Clean Air Act.

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<sup>3</sup> Ethyl Corporation v. EPA, 51 F. 3d 1053, (D.C. Cir. 1995); MVMA vs. EPA, 768 F. 2d 385 (D.C. Cir. 1985).

Fourth, Section 211(f)(4) does not provides the regulatory process and legal safeguards needed to address bifurcated fuels and misfueling in a thoughtful manner. In fact, EPA has consistently claimed that Section 211(f)(4) fuel waivers do not rise to the level of a “rulemaking” subject to a “cost-benefit” analysis and the other protections provided under section 553 of the Administrative Procedures Act (APA). However, the absence of such a formal, comprehensive rulemaking (or any related criteria) means that EPA would fail to develop, much less evaluate, the costs, benefits, safety risks, consumer impacts, and practicability of potential controls designed to prevent misfueling and other related liabilities under a bifurcated fuel system and stakeholders would be unable to evaluate EPA’s analyses and program design.

Fifth, it is unclear whether EPA would have the legal authority (under section 211(f)(4)) to adopt or enforce any labels or misfueling controls at a gasoline retailer – given that a fuels waiver is only granted to the “manufacturer” of the new fuels or additives. EPA admits in its Notice that there “may be legal and practical limitations on what a fuel manufacturer may be required or able to do to ensure compliance with the conditions of the waiver, including preventing misfueling.” While EPA has managed market fuel transitions under other Clean Air Act authorities through pump labeling, consumer education and other approaches, it has never in the thirty year history of waiver proceedings established downstream conditions on fuel *retailers* in a waiver proceeding specifically addressed to, and authorizing the production by the *manufacturers* of the fuels or fuel additives. We recognize that EPA has proposed a labeling scheme in its

RFS II rulemaking,<sup>4</sup> but the labeling proposal lacks detail about how it would work with any of the possible waiver outcomes EPA identifies in the waiver notice.

Sixth, EPA should address controls on the “sale” of any bifurcated fuels through a major rulemaking under section 211(c) of the CAA, not through section 211(f)(4). EPA has long recognized that regulation of the “sale” of fuels clearly falls under 211(c). Section 211(c) covers regulatory programs that “control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive...”. Thus, EPA’s proposal -- to issue a bifurcated waiver that would somehow “control the sale or offering for sale” of E-15 -- would fall squarely within the 211(c) provisions.

Seventh, in analogous circumstances, EPA has completed various extensive rulemakings under 211(c) to manage bifurcated fuel markets to minimize the risk of misfueling. When EPA proposed labeling, reporting and other requirements for diesel fuel producers, marketers and retailers under the Ultra Low Sulfur Diesel rule, it did so through a comprehensive 211(c) rulemaking that considered a multitude of related issues, including the cost-effectiveness of the program, misfueling concerns, liability concerns, and the effects upon small businesses. Similarly, EPA engaged in a series of 211(c) rulemakings during the phaseout of leaded gasoline in order to address labels and misfueling controls, including different nozzle and fuel-inlet configurations. Before completing these rulemaking proposals, EPA conducted years of outreach with stakeholders, including the auto industry and the automotive fuel marketing industry, in an effort to determine the feasibility of various control methods to combat misfueling.

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<sup>4</sup> See § 80.1469 – (74 Fed. Reg. at 25143).

Eighth, in all these prior 211(c) rulemakings that involved phasing in new fuels and bifurcated markets, EPA provided engine and equipment manufacturers, fuel distributors and gasoline retailers with the needed lead-time to implement all the different misfueling controls as well as certain accommodations regarding compliance with regulations during the transition periods. It is unclear how EPA could create such a transition process (with future effective dates for misfueling controls) under a section 211(f)(4) waiver – given that these waivers typically would become immediately effective if granted.

Ninth, all the affected stakeholders would need much greater specificity on EPA’s proposed “bifurcation structure,” and on proposed, alternative control measures and their projected costs and impacts – in order to develop meaningful responsive comments. Neither Growth Energy’s waiver application, EPA’s notice of the application nor the RFS II rulemaking provides any details on how EPA could practically bifurcate the fuel supply and avoid misfueling under any conditional waiver. There is no practical means to respond to EPA’s vague “bifurcated fuels” concepts.

Tenth, further complicating this situation is the fact that on May 5<sup>th</sup>, EPA solicited similar, but broader comments on addressing misfueling (under an E-15 “partial waiver” option) as part of its proposed, renewable fuel standards (RFS-II). AllSAFE appreciates the fact that the RFS-II proposal at least generally identifies several different types of potential misfueling controls and recognizes their limitation and challenges. However, the RFS-II proposal does not explain whether or how EPA will integrate or consider comments received over the next few months on the RFS-II proposal in its expedited E-15 waiver review process. It is not clear whether Section 211(o), which is the basis of the

RFS-II regulations, could somehow serve as the legal framework to develop, implement and enforce misfueling controls for mid-level ethanol blends that are specifically approved under a section 211(f)(4) waiver.

EPA admits in its RFS-II proposal that “it is not possible at this time to know the contours of a partial waiver with conditions, or even if one might be appropriate.” (See 74 Fed. Reg. 25017, FN 251 (May 26, 2009)). In that same proposal, EPA also recognizes it is unclear how any conditions in a partial waiver – that would only apply directly to the “manufacturer” of the fuel – could somehow be expanded to essentially regulate the activity of consumers, gasoline retailers, and the manufacturers of all the affected products. (74 Fed. Reg. 25016-25017 (May 26, 2009))

Finally, to the extent EPA wants to pursue a “partial waiver” approach, EPA should initiate a separate future rulemaking process (under section 211(c)) and develop a well-supported, specific proposal and administrative record, that carefully evaluates all the complex issues associated with potentially bifurcating the national fuel supply system through practical and specific proposals to avoid misfueling.

From a legal and public policy standpoint, EPA would need to first adopt a federal regulatory program that addressed misfueling through practical and legally enforceable controls before EPA could ever rely on such controls in any fuels waiver decision under section 211(f)(4). In other words, EPA should not approve any “partial” mid-level ethanol fuel waiver until after EPA had developed and implemented a comprehensive and effective regulatory program under section 211(c) to prevent misfueling.

#### **IV. SECTION 211(F)(4) – FUELS WAIVER CRITERIA**

Pursuant to Section 251 of the 2007 Energy Independence and Security Act (EISA), EPA must consider the impacts of the proposed fuel or additive on all the affected, non-road engines, products, vehicles and equipment, as well as motor vehicles. Off-highway engine/equipment categories requiring evaluation will be significantly greater than on-highway test fleet due to the diversity of engines/equipment included in the off-highway category. For example, handheld lawn and garden equipment engines now include approximately eight different engine design technologies, all of which may be designed to any of three different life categories. This means a possible 24 different engine designs which may be included in multiple application usages. (See illustrative test plans summarized in Section X below). Below in Table 1 is a detailed list of the different types of off-road equipment that must be evaluated by the waiver application.

**Table 1**

**Types of Off-Road Equipment**

**Broad Categories**

- Lawn and Garden
  - Hand-Held (chainsaws, trimmers, blowers, edgers, etc.)
  - Ground-Supported (lawn mowers, rider mowers, etc.)
- Industrial Equipment (generators, forklifts, etc.)
- Snow (snowmobiles, etc.)
- Marine (outboard/PWC, inboard, stern-drive)
- Off-Road Motorcycles
- All Terrain Vehicles

**B. Detailed List**

2-Wheel Tractors	Other Agricultural Equipment
Aerial Lifts	Other Construction Equipment
Agricultural Mowers	Other General Industrial Equipment
Agricultural Tractors	Other Lawn & Garden Equipment
Air Compressors	Other Material Handling Equipment
Air Conditioners	Paving Equipment
Air Start Units	Personal Water Craft
All-Terrain Utility Vehicles	Plate Compactors
Asphalt Pavers	Pressure Washers
Baggage Tugs	Pumps
Balers	Rear Engine Riding Mowers
Belt Loaders	Rollers
Bobtails	Rough Terrain Forklifts

**E-15 Waiver Comments – Guerry DRAFT #17**  
**Recent comments from Auto Alliance and EMA Included**

Bore/Drill Rigs	Rubber Tired Loaders
Cargo Loaders	Sailboat Auxiliary Inboard Engines
Cement and Mortar Mixers	Sailboat Auxiliary Outboard Engines
Chainsaws	Shredders
Chippers/Stump Grinders	Signal Boards
Combines	Skid Steer Loaders
Commercial Turf Equipment	Snowblowers
Concrete/Industrial Saws	Snowmobiles
Cranes	Specialty Vehicles
Crushing/Processing Equipment	Sprayers
Deicers	Surfacing Equipment
Dumpers/Tenders	Swathers
Forklifts	Sweepers/Scrubbers
Front Mowers	Tampers/Rammers
Fuel Trucks	Tillers
Generator Sets	Tractors/Loaders/Backhoes
Golf carts	Transport Refrigeration Units
Ground Power Units	Trenchers
Hydro Power Units	Trimmers/Edgers/Brush Cutters
Lav Carts	Vessels w/Inboard Engines
Lav Trucks	Vessels w/Inboard Jet Engines
Lawn & Garden Tractors	Vessels w/Inboard/Outboard Engines
Lawn Mowers	Vessels w/Outboard Engines
Leaf Blowers/Vacuums	Water Trucks
Minibikes	Welders
Motorcycles	Wood Splitters

Under Section 211(f)(4) of the federal Clean Air Act, the waiver applicant must prove that the use of the fuel additive “will not cause or contribute to the failure of any emission control device or system...to achieve compliance...with the [applicable] emissions standards” – at any point throughout the useful life of the product. Courts have held that EPA must deny waiver applications for fuels or additives that would result in any emission-related failure or exceedance of a standard – even when EPA believes such failures are not “significant.” See MVMA v. EPA, 768 F.2d 385, (D.C. Cir. 1985).

To supplement these comments, we are submitting a comprehensive legal analysis of binding judicial precedent that governs the application of Section 211(f) waiver criteria in this waiver application and any future waiver application. (See “Supplemental Statutory Appendix” attached as Exhibit B). Part I of that analysis documents the

compelling reasons why any EPA approval of the Growth Energy application, or similar action, would not withstand judicial review. Part II of the enclosed analysis documents the functional relationship between Section 211 waivers and the vehicle and engine remedial provisions, such as recall, under other Sections of the CAA. (See Exhibit B).

As explained in the enclosed legal analysis, because in this waiver application, there is evidence of “the potential for harm” to engines, and their emission control devices or systems, “the applicant has the burden of proving that such harm will not occur.” See MVMA, 768 F.2d at 400.

The available test data and studies indicate that E-15 will result in widespread “potential harm” to the types of emission-related components used in non-road and on-road engines, vehicles and equipment. (See Dr. Sahu’s Technical Study attached as Exhibit A, and Sections VI through XI below).

**V. GROWTH ENERGY’S APPLICATION FAILS TO MEET THE MINIMUM CRITERIA THAT EPA HAS SET FORTH AS BEING APPLICABLE TO ANY MID-LEVEL ETHANOL WAIVER.**

**A. EPA Test Program and Waiver Criteria**

To implement Section 211(f)(4), EPA has developed and applied four separate “waiver criteria” in 24 previous waiver applications. The four “waiver criteria” are adverse impacts on: 1) engine exhaust emissions; 2) evaporative emissions; 3) “materials compatibility” with fuel-system components; and 4) the “drivability/operability” of the engine/vehicle/equipment. (Each of these four criteria are applied to the major studies on non-road engines, vehicles and equipment in Section VI through XI, below).

In public presentations<sup>5</sup>, and public letters<sup>6</sup>, EPA has given more specific direction as to the data submission required to support a 211(f)(4) waiver request for mid-level ethanol blends. This data submission can be divided up into four components. These are tests required, test fuel characteristics, fleet composition, and statistical interpretation.

In the recent proposal on the Renewable Fuel Standards (RFS-II), EPA cites to an influential “EPA staff recommendation” on the testing framework needed to support a mid-level ethanol waiver.<sup>7</sup> This 2008 EPA recommendation confirms that a waiver applicant for mid-level ethanol would have to provide test data (on operability, compatibility, exhaust emissions and evaporative emissions) from a representative group of both on-road and non-road engines and equipment categories. In this guidance, EPA has specified that the applicant’s test programs must include “a complete cross-section of the impacted engine/equipment categories,” in order to represent a sufficient number of models in terms of:

- Major sales models;
- Variety of Engine technologies;
- HP range, speed range;
- Applications, markets

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5 Jim Caldwell, Office of Transportation and Air Quality, SAE Government/Industry Meeting, May 13, 2008

6 Christine Todd Whitman, Response to Ethyl Corporation Petitions Denying Reconsideration of Three EPA regulations: CAP 2000, Heavy Duty Gasoline, and OBD/IM, <http://www.epa.gov/oms/standards.htm>, August 23, 2001

7 Mid Level Ethanol Blend Experimental Framework – EPA Staff Recommendations, Karl Simon, EPA Office of Transportation and Air Quality, API Technology Committee Meeting, Chicago, June 6, 2008

For each engine/equipment category (and for each waiver criteria), EPA must evaluate: 1) new equipment/vehicles; 2) legacy equipment/vehicles; and 3) future technologies that will be required for upcoming new emission regulations.<sup>8</sup>

For each test category, the applicant must include durability testing based on field-aging.<sup>9</sup> The applicant must provide “an engine tear down and inspection,” including “wear and deposit” evaluations.<sup>10</sup>

EPA has typically required a fuel waiver petitioner to demonstrate durability impacts through the operation of complete engines and vehicles as operated for their useful lives under actual, real-world conditions. For example, in 2001, the EPA Administrator rejected a petition from Ethyl, a fuel additive manufacturer, to rely on accelerated aging procedures to predict the impact of a new fuel additive

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8 Id.

9 Id.

10 Id.

In its response to Ethyl, EPA explained that in order to show that their fuel additive does not cause additional deterioration to vehicles:

[A] fuel or fuel additive manufacturer would likely evaluate the effect of their fuel or fuel additive by using a whole vehicle aging procedure. A whole vehicle aging procedure would show the effects of the fuel or fuel additive under more real-world driving conditions. Moreover, as stated before, the real-world effects of contaminants or additives are best evaluated after operating vehicles for an extended period of time such that engine and emission control system cycle through a variety of normal operating procedures.

See EPA’s August 23, 2001 Response to Ethyl’s Petitions, at pp. 55-56 cited in FN 15, above).

**B. Growth Energy Application**

Growth Energy has failed to provide test data or cite any studies that would meet EPA’s test criteria outlined above or cited in EPA’s recommended test program.

Table 2 below compares Growth Energy’s application to the EPA waiver requirement for *non-road* products. Table 5 in Section XI below provides a similar comparison of EPA’s criteria to the Growth Energy’s application vis-à-vis *on-road* products. Each EPA requirement is given a reference and an item number and each is discussed individually either below or in the next few sections.

As Table 2 shows, Growth Energy has presented very limited data on an unrepresentative and incomplete group of non-road engines, vehicles and equipment. For example, Growth Energy has failed to cite to any test data or studies that evaluate the impacts of ethanol fuels on the operability or the evaporative emissions of any class or category of non-road engines, vehicles or equipment. Growth Energy has not cited to any

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tests or evaluations of most of the unique plastics, polymers and rubbers (including nylon) which are used in non-road engines and products. Growth Energy has not cited to any test data on evaluations of the impacts on exhaust emissions from any of the non-road categories – except for small spark-ignited engines (SSIE). Even these SSIE exhaust tests did not include a representative or statistically significant group of products. These SSIE tests failed to meet EPA’s recommended test requirements and actually indicate substantial engine durability, operability and emission-related failures

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Item	EPA Requirements for OFF-ROAD	TABLE 1 - OFF-ROAD Growth Energy Petition - Supporting Studies (from www.growthenergy.org)											<a href="#">Orbital Studies[1]</a>	<a href="#">Auto/Oil/AISAFE Test Plan[2]</a>
		DoE/ORNL (10/08)	EERC/MCAR (10/07)	MN/RFA (3/08)					CRC (12/06)	RIT (10/08)	MCRA (7/99)	SU (2004-05)		
	Ref. # Below	[GE-1]	[GE-2]	[GE-3a]	[GE-3b]	[GE-3c]	[GE-3d]	[GE-3e]	[GE-4]	[GE-5]	[GE-6]	[GE-7]		
1	<a href="#">Representative Fleet[13]</a>	No	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		Yes
2	<a href="#">Tailpipe Emissions[7]</a>	See Cmts	No	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No		Yes
2A	<a href="#">Comparison to E0 and E10</a>	See Cmts	No	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No		Yes
2B	<a href="#">Full Useful Life[8]</a>	See Cmts	No	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No		Yes
3	<a href="#">Evaporative Emissions[9]</a>	No	No	N/A	N/A	N/A	N/A	N/A	No	No	No	No		Yes
3A	<a href="#">Comparison to E0 and E10</a>	No	No	N/A	N/A	N/A	N/A	N/A	No	No	No	No		Yes
3B	<a href="#">Full Useful Life[10]</a>	No	No	N/A	N/A	N/A	N/A	N/A	No	No	No	No		Yes
4	<a href="#">Durability[3]</a>	See Cmts	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		Yes
5	<a href="#">Materials Compatibility[6]</a>	No	No	See Cmts	See Cmts	See Cmts	No	N/A	N/A	No	No	No		Yes
5A	<a href="#">Real Use Conditions[4]</a>	No	No	No	No	No	No	N/A	N/A	No	No	No		Yes
5B	<a href="#">Engine Teardown with Rating[5]</a>	No	No	No	No	No	No	N/A	N/A	No	No	No		Yes
6	<a href="#">Safety[11] Simon, Slide 14</a>	No	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		No
7	<a href="#">Oil and Fuel Aging Interaction[12]</a>	No	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		Yes

**N/A** Not Applicable

**No** This report or study did not consider Off-Road or did not consider the EPA Item for Off-Road

[1] [Orbital Engine Studies](#)

[2] [Dr. Sahu's Compability Report attached as Exhibit C](#)

[3] [Karl Simon, EPA OTAQ - Mid Level Ethanol Blend Experimental Framework – EPA Staff Recommendations, API Technology Committee, June 6, 2008 Slide 14 & 18](#)

[4] [Simon, Slide 14, 16, 19](#)

[5] [Simon, Slide 16 & 20](#)

[6] [Whitman; Caldwell, Slides 9 & 12; Simon, Slide 5](#)

[7] [Whitman; Caldwell, Slide 10; Simon, Slides 16, 18 & 19](#)

[8] [Simon, Slides 16, 18 & 19](#)

[9] [Simon, Slides 16 & 18](#)

[10] [Simon, Slides 16 & 18](#)

[11] [Simon, Slide 14](#)

[12] [Simon, Slide 20](#)

[13] [Simon, Slides 14-17](#)

**Study  
Ref.**

**Study Full Title**

- [GE-1] [Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines, Report 1, prepared by Oak Ridge National Laboratory for the U.S. Department of Energy \(October 2008\). This peer-reviewed study regarding the effects of E15 and E20 on motor vehicles and small non-road engines concludes that when E15 and E20 were compared to traditional gasoline, there are no significant changes in vehicle tailpipe emissions, vehicle driveability, or small non-road engine emissions.](#)
- [GE-2] [Optimal Ethanol Blend-Level Investigation, Final Report, prepared by Energy & Environmental Research Center and Minnesota Center for Automotive Research for American Coalition for Ethanol \(October 2007\). This report studied the effects of ethanol blends ranging from E10 to E85 on motor vehicles and found that exhaust emissions levels for all vehicles at all levels of ethanol blend were within the applicable Clean Air Act standards.](#)
- [GE-3] [The Feasibility of 20 Percent Ethanol Blends by Volume as a Motor Fuel, Results of Materials Compatibility and Driveability Testing, prepared by the State of Minnesota and the Renewable Fuels Association \(March 2008\):](#)
- [GE-3a] [The Effects of E20 on Metals Used in Automotive Fuel System Components.](#) The study compared the effects of E0, E10 and E20 on 19 metals and found that the metals tested were compatible with all three fuels;
- [GE-3b] [The Effects of E20 on Elastomers Used in Automotive Fuel System Components.](#) The study compared the effects of E0, E10 and E20 on eight elastomers and found that E20 caused no greater change in properties than E0 or E10;
- [GE-3c] [The Effects of E20 on Plastic Automotive System Components.](#) The study compared the effects of E0, E10 and E20 on eight plastics and found that there was no significant difference in the properties of the samples exposed to E20 and E10;
- [GE-3d] [The Effects of E20 on Automotive Fuel Pumps and Sending Units.](#) The study compared the effects of E0, E10 and E20 on the performance of 24 fuel pumps and nine sending units and found that E20 has a similar effect as E10 and E0 on fuel pumps and sending units;
- [GE-3e] [Demonstration and Driveability Project to Determine the Feasibility of Using E20 as a Motor Fuel.](#) The study tested 40 pairs of vehicles on E0 and E20 and found no driveability or operational issues with either fuel).
- [GE-4] [Fuel Permeation from Automotive Systems: E0, E6, E10, E20 and E85, prepared by the Coordinating Research Council, Inc. \(CRC Report No. E-65-3\) \(December 2006\). This study evaluated effects of E0, E6, E20 and E85 on the evaporative emissions rates from permeation in five newer California vehicles and found that there was no statistically significant increase in permeation rates between E6 and E20.](#)
- [GE-5] [Report to the US Senate on E20 Ethanol Research,](#) prepared by the Rochester Institute of Technology (October 2008). This study evaluated effects of E20 on 10 legacy vehicles. Initial results after 75,000 collective miles driven found no fuel-related failures or significant vehicle problems and documented reductions in regulated tailpipe emissions when using E20 compared to E0.
- [GE-6] [Use of Mid-Range Ethanol/Gasoline Blends in Unmodified Passenger Cars and Light Duty Trucks, prepared by Minnesota Center for Automotive Research \(July 1999\). This one-year study evaluated the effects of E10 and E30 in 15 older vehicles in "real world" driving conditions. It found no effect on driveability or component compatibility from either fuel and found that regulated exhaust emissions from both fuels were well below federal standards.](#)

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[GE-7] [Blending of Ethanol in Gasoline for Spark Ignition Engines: Problem Inventory and Evaporative Measurements, prepared by Stockholm University et. al., \(2004 - 2005\).](#) This study tested and compared evaporative emissions from E0, E5, E10 and E15 and found lower total hydrocarbon emissions and lower evaporative emissions from E15 than from E10 and E5.

**C. Growth Energy has failed to compare differences from EPA certification fuels**

Growth Energy insinuates that the “baseline” fuel should be E-10, and that it only has to prove that there is not a significant difference in performance between E-10 and E-15 fuels. (See p. 5-7 of waiver application). In fact, in many instances, Growth Energy only provides information on the projected impacts of shifting from E-10 to E-15, rather than comparing E-0 to E-15. (See evaporative emissions evaluation on page 23-27 of waiver application).

Carbureted engines must be set at a fairly lean air-fuel ratio to ensure emissions compliance when the engine is run on the EPA “certification” and “confirmatory” test fuel. Indolene (E-0) remains the principal EPA certification fuel used for all on-road and non-road, EPA, engine exhaust certifications. EPA’s emission standards are typically based on test data that has been generated with the engine operating on Indolene or E-0. Many non-road carbureted HH engines experience difficulty running on E-10 fuels – in part because they already have very lean air-fuel ratios in order to meet EPA emission standards when operating on E-0 certification fuel. (See Exhibit A, Section A). Increasing the ethanol content is not viable as long as EPA requires either emission certifications or confirmatory compliance testing to be based on E-0 fuels.

In order to determine the impacts that E-15 would have on EPA’s existing emission-related programs and on certified products, EPA would have to compare E-15 fuels with its E-0 certification fuels.<sup>11</sup> For that reason, CAA Section 211(f)(1)(A) makes it unlawful to introduce into commerce or increase the concentration of any fuel or fuel

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<sup>11</sup> Many non-road manufacturers are currently obtaining EPA evaporative certifications based on California’s certification fuel which also does not contain any ethanol. See Section IX below.

additive which is not “substantially similar” to any fuel or fuel additive utilized in the “certification of any vehicle or engine.”

In its prior waiver-review process, EPA has consistently required the waiver applicant to submit comparison “baseline” tests using on Indolene as EPA’s certification fuel. See EPA’s Guidelines for Section 211(f) Waivers for Alcohol-Gasoline blends, 43 Fed. Reg. 24131, 24132 (June 2, 1978).

EPA (and manufacturers of ethanol) have consistently recognized (for the last 28 years) that E-10 is not “substantially similar” to EPA “certification fuels,” which typically do not contain any ethanol whatsoever. (See 40 C.F.R. § 86.113). For that reason, a waiver application (under Section 211(f)(4)) had to be filed for 10% ethanol. Moreover, EPA has previously recognized that – “consistent with Congressional intent,” even new fuels containing less than 10% ethanol “are best addressed in the Section 211(f)(4) waiver process” (given the substantial “uncertainties” with their environmental impacts). See 46 Fed. Reg. at 38582, 38584 (July 28, 1981).

EPA has also recognized that “Congress intended only to include as ‘substantially similar’ those fuels chemically and physically similar to fuels used in certification.” *Id.* at 38583. According to EPA, “it is not an issue of whether mid-level ethanol blends are substantially similar to a fuel that has received a waiver.” (See 74 Fed. Reg. 25019, FN 260 (May 26, 2009)). Fuels or fuel additives (like E-10) that are ultimately granted a waiver under Section 211(f)(4) do not somehow become “substantially similar” to the EPA certification fuel. 46 Fed. Reg. at 38583. Nor do such “waived” fuels become the “baseline fuel” on which future “substantially similar” of fuel waiver comparisons are

based. Id. Such a flawed approach would allow “incremental creep” which would undermine the purpose of the “fuel waiver” process.

**D. Instead of Conducting Tests on E-15 fuels, Growth Energy Would Inappropriately Require EPA to Extrapolate or Interpolate Results Based on Different Ethanol Blends than E-15**

Throughout its waiver application, Growth Energy relies on test data on the impacts of ethanol-gasoline blends other than E-15. For example, all of the compatibility and driveability studies performed by Minnesota State University (MSU) only considered the impacts of E-20 and not E-15. In other cases, for example, to show evaporative emissions, Growth Energy relies mainly on pre-existing E10 data from conventional vehicles. Growth Energy failed to conduct the required testing with E-15 fuel blends. According to EPA’s waiver precedent, the applicant must submit data on the specific concentration of the requested fuel additive (i.e., E-15); EPA does not contemplate having to extrapolate data based on different concentration levels. See 43 Fed. Reg. 11258, 11259 (March 17, 1978). From a technical standpoint, properties of gasoline-alcohol mixtures are often non-linear, and there can be uncertainties when interpolating or extrapolating results.

**VI. NON-ROAD MATERIALS COMPATIBILITY STUDIES**

The well-established chemical properties and principles that cause mid-level ethanol blends to result in “material compatibility” problems are discussed and documented in Dr. Sahu’s Technical Study attached as Exhibit A (particularly in Sections A, G, D, and F).

**A. Existing Major Studies on Non-road and Marine Small-Engines**

**1. Orbital-Engineering Reports (2003)**

The most comprehensive and complete study on the “materials compatibility” problems with small engines and marine outboard engines is the May 2003-Orbital Engine Report to the Australian Government based on 2,000 hours of extensive “materials compatibility” testing.<sup>12</sup> This report concluded that “E-20 fuel is incompatible with both base engine components and with fuel system components utilized in the Mercury outboard and Stihl line trimmer engine.”<sup>13</sup> Specifically, E-20 caused the following documented problems on EPA-certified outboard marine engines and Stihl line trimmers:

- Severe corrosion, rusting and pitting of metallic and brass components – such as the carburetor body and throttle, piston rings, crankshaft seal housing, crankshaft bearings and surfaces, connecting rod, cylinder liner, throttle blades
- Swellings, distortion and degradation of fuel delivery hose, fuel primer bulbs, fuel line connector, and crankshaft seal

The Orbital report concluded these problems would likely cause: 1) oxides that may dislodge and damage the engine; 2) the loss of intended fuel-air metering and control, and 3) fuel leakage.<sup>14</sup>

## **2. Briggs and Stratton Study (2007)**

In a 2007 study, Briggs and Stratton completed evaluations of the impacts of E-20 on EPA-certified engines – through soaking fuel components and evaluating the heat-related damage caused by:

- Substantial distortion and swelling of elastomers, rubbers and plastics;

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12 Market Barriers to the Uptake of Biofuels Study – A Testing Based Assessment to determine impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on Non-Automotive Engines, Orbital Engine Company, (May 2003).  
(<http://www.environment.gov.au/atmosphere/fuelquality/publications/>).

13 Id. at 20.

14 See 2003 Orbital Report at p. 4-6.

- Metals, epoxy and other materials that dissolved or corroded to the point that several components failed and could cause fuel leaks; and
- Higher operating temperatures resulting in damage to gaskets resulting in a head gasket failure after only 25 hours of light duty testing.<sup>15</sup>

Thus, the Briggs study confirms the conclusions of the Orbital Studies. (See Briggs study attached as Exhibit C).

### **B. Growth Energy’s Application**

To support its claims that there are not “materials compatibility” problems with all non-road products, Growth Energy relies on the following 3 inter-related studies prepared by Minnesota State University (MSU) from March 2008:

- A metals study which allegedly concluded that 18 of 19 tested metals exposed to E-20 were compatible (with problems only observed on Zamak 5);
- An elastomer study which allegedly concluded that the magnitude of the changes observed on eight elastomers exposed to E-20 were “not great enough to represent a concern.”
- A plastics study which allegedly concluded that there was no significant differences for eight plastics exposed to E-20.

### **C. Critique of Growth Energy Waiver**

First, Growth Energy has failed to address any of the comprehensive Orbital compatibility studies, attached to these comments cited above.

Second, the MSU study only focused on components used in automobiles. The Alliance of Automobile Manufacturers (AAM) has thoroughly critiqued the 2008 Minnesota compatibility studies to assess the actual detected compatibility-impacts vis-à-vis motor vehicles. In spite of soliciting information on the types of materials used in non-road applications, MSU did not test most of the plastics, polymers and elastomers that are typically used in *non-road* products. Dr. Sahu has determined that MSU failed to

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15 See Briggs report at p. 3.

evaluate 19 of 22 plastics/polymers/elastomers that AllSAFE had specifically identified as being used in non-road products. (See Dr. Sahu’s Compability Report attached as Exhibit C). All these typical non-road components still need to be evaluated for materials-compatibility. (See Sahu Report attached as Exhibit D).

Third, even for the materials tested by MSU, there are significant technical and interpretive flaws in the MSU report. Some of the major flaws include:

- a. Failure to use E15 fuels as discussed earlier;
- b. Although simple coupon testing was used to simulate actual operating conditions, the metals results still demonstrated that significant corrosion would occur. Real world testing with loads/stresses, temperatures, pressures, etc. associated with actual operations should result in actual operation failures were true fleet testing to be done using these fuels.
- c. Relevance of the test cycles chosen by MSU and associated parameters such as the length of the test; the MSU work does not address how these choices are predictors of compatibility, durability, or functional performance;
- d. The summary-conclusions in most instances that the tested E20 fuel is “compatible” without any discussion of what “compatible” means in each instance. The authors seem to imply that E20 is compatible with the performance of the equipment that uses the tested materials – yet, as noted, the test conditions have no correlation to equipment performance;

e. The repeated statements noting that the degradation associated with E20 are somehow marginally higher than those observed with E10, when in fact, the analysis of the actual test data in the reports does not support this conclusion. For example, when analyzed with a percent-change criteria, 14 out of 19 metal coupons exhibited higher (greater than 50%) measurable mass change. Metals experiencing a reduction in mass indicate both a reduction in the strength of the remaining metal component and an increase in the contamination of the corresponding fuel. The study did not evaluate metal engine or fuel system components to identify if either the reduced physical properties or corresponding contamination of the fuel on contact with the metal components would result in engine or fuel system failure to function or result in an unsafe condition.

f. Elastomers were tested utilizing an arbitrary test time and temperature without any corresponding determination of acceptable elastomer component function. Because none of the elastomers were evaluated for their influence on their related components performance, MSU's conclusion is not justified. Many fuel system elastomer components utilized in off-highway engines are significant for both product operation/function and safety. For example, a gravity feed fuel system relies on the seal of the carburetor fuel inlet needle to seal, preventing additional fuel from entering the carburetor, at the prescribed fuel level. Elastomers are also utilized in crankcase vacuum pulse

actuated fuel pumps that are sensitive to changes in elastomer properties including swell and strength.

## VII. NON-ROAD DRIVABILITY/OPERABILITY STUDIES

“Materials incompatibility” typically results in problems in engine operation and performance. EPA and the federal Courts have recognized that the fuel’s impacts must be considered on both engine emissions as well as engine performance or “drivability.” This is because “drivability can directly result in increased emission due to constant misfires and repeated stalling, and possibility lead to tampering with the emission controls of the vehicle.” See Motor Vehicle Mfrs. Ass’n v. EPA, 768 F.2d 283, 401 (D.C. Cir. 1985). Accordingly, EPA has stated:

EPA believes that harm to emission control devices or systems which adversely effects vehicle performance, such that removal or rendering inoperative of such devices or systems may be reasonably expected, should be considered a basis under Section 211(f)(4) for denying a waiver. **Where the potential for such harm is evidenced, the applicant has the burden of proving that such harm will not occur.** [emphasis added].

34 Fed. Reg. 24132 (June 2, 1978).

The chemical properties and scientific principles that cause mid-level ethanol blends to result in “operability” and drivability” problems are discussed in the study attached as Exhibit A – particularly in Section F, G and H.

### A. Existing Non-road, Small Engine and Marine Studies

#### 1. Orbital Studies (2002 and 2003)

The most comprehensive study on the impacts of mid-level ethanol on the “operability” of small non-road and marine engines is the Orbital Engine’s Report to

Environment Australia entitled “Testing Based Assessment to Determine Impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on Non-Automotive Engines” (January, 2003). (See <http://www.environment.gov.au/atmosphere/fuelquality/publications/>). That report (which was part of the same May 2, 2003 Orbital compatibility report cited above) concluded that E-20 fuel caused the following adverse operational impacts on Stihl line trimmers and on outboard Mercury Marine engines:

- increases in engine misfires and stalling
- difficulty in maintaining constant engine operating speed
- damage to the engine, including piston ring and exhaust port deposits increasing wear rates
- damage to the engine carburetor diaphragm resulting in the loss of internal and external sealing and likely fuel leakage
- corrosion of metallic engine components.<sup>16</sup>

In 2002, Orbital Engine Company prepared a related comprehensive “Technical Assessment” and “Failure Mode and Effects Analysis” (FEMA) on the impacts of E-20 on Stihl line trimmers and Mercury Marine outboards. (See <http://www.environment.gov.au/atmosphere/fuelquality/publications/>). That FEMA analysis concluded that E-20 would cause “material degradation” (like “corrosion or perishing” of the piston, piston rings and crankshaft) in 62% of the total effected “mechanisms.” Other very high percentages of “mechanism failures” included “gumming,” “lubricant deficiency” and “altered combustion.” (See p. 26 of 2002 Orbital Report). According to the Orbital-FEMA report, these “mechanism of failures” caused the following “effects of failure” (at the following “percentage of total effects”):

- A lack of power (32%)

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16 See 2003 Orbital Report at p. 2-3.

- Rough engine operation (19%)
- Fuel leaks (which would be a safety hazard and an evaporative emissions failure) (17%)
- Engine seizure (13%)
- Engine stops (11%)

See 2002 Orbital Report at p. 30.

The problems documented in the Orbital Studies would likely be even more pronounced for more recent EPA-certified products. Since 2004, the EPA exhaust regulations applicable to non-road products (including small engines and outboard marine engines) have become increasingly more stringent, requiring catalysts and other emission-related modifications. Current EPA-certified engines must run under leaner operating conditions.

These leaner conditions result in narrower, acceptable, tolerance limits for increasing the oxygen content in the fuel without causing excessive heat and other operational problems. (See Study attached Exhibit A, Sections A and B).

## **2. Briggs and Stratton Study (2007)**

In its 2007 study, Briggs and Stratton identified the following operability features resulting from E-20 fuels on their EPA-certified engines:

- head gasket failure after 25 hours (due to high temperatures so that gases escaped past the gasket);
- loss of power;
- decreases in RPM stability and audible speed oscillations;
- poor acceleration;

- damages to rubber and plastic fuel system components, causing leaks due to alcohol swelling and degradation.<sup>17</sup>

(See Briggs Study attached as Exhibit B).

### **B. Growth Energy Position**

In its petition, Growth Energy does not address the comprehensive Orbital studies summarized above. In fact, for non-road products, Growth Energy solely argues that the DOE small engine study concluded that “it is not possible to isolate the effects of ethanol on the operability of SNRE [small non-road engines] because of the great variance in performance among small non-road engines, regardless of the fuel used.” On that basis, Growth Energy incorrectly claims that “E-15 will not have a discernable impact on the performance and operability of SNREs.” Growth Energy also claims that the recent DOE study on small engines “concluded that no obvious materials compatibility issues were observed during testing.”

### **C. Critique of DOE Study and Growth Energy Waiver**

In the enclosed 2009 critique of the DOE study (see Exhibit E), Dr. Sahu documents the following operability and performance problems on all the SNREs that were tested in the DOE study:

- Substantially higher temperatures which will cause long-term damage to the engines and their emission-control systems;
- The total failures (at around 25 hours) of the 2 Weed Eater leaf blowers running on E-15;
- The failure of the Weed Eater blower to idle on E-20;
- The degraded performance of the Poulan leaf blower at 30-55 hours on E-15 fuels;
- The stalling, loss of power and abrupt stopping of the Briggs and Stratton 3500 kw generator on E-20<sup>18</sup>;

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17 See Briggs report at p. 3-5.

- The high idle speeds leading to improper clutch engagement both on the Stihl trimmers (in the Pilot study and the complete study).

In its final report, even DOE recognizes that some of these operational problems could directly lead to tampering – which could increase emissions in contradiction to the very purposes of EPA’s fuel-waiver criteria. For example, the DOE contractors had to adjust the “low-idle adjustment” and the “low-speed screws” to prevent unintended clutch engagement. (See p. 3-19 of the DOE study). The similar operational problems with other engines would likely result in owners tampering with their product’s carburetor settings so that they would run “richer” to accommodate E-15. These richer settings could cause an emission exceedance, if those tampered products were run on E-0 fuels.

## **VIII. EXHAUST EMISSIONS STUDIES**

The well-established chemical properties and principles that result in mid-level ethanol blends causing increased exhaust emissions are discussed in the Study attached as Exhibit A, Sections A and B.

### **A. Existing Studies**

#### **1. Briggs and Stratton Study (2007)**

The 2007 Briggs and Stratton study concluded that E-20 caused a 10.5% increase in HC + NO<sub>x</sub> emissions because NO<sub>x</sub> increased by 233%. This increase would apparently constitute a “failure” or exceedance of the EPA standard for that certified engine family.

### **B. Growth Energy’s Application**

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18 The 2008 DOE report hypothesizes that the Briggs engine stalled probably due to the swelling of the elastomeric needle for the carburetor (similar to the same problems discussed above).

For all non-road applications, Growth Energy exclusively relies on the recent DOE small engine report as concluding that E-15 does not cause engines to emit greater combined concentrations of HC + NOx. Accordingly, Growth Energy argues E-15 would not cause an exceedance or failure of an applicable standard.

**C. Critique of Waiver Application and DOE study**

First, Growth Energy has failed to test a representative mix of all the diverse categories of affected non-road engines, equipment and recreational boats. It has only tested a discrete group of small engines which excluded certain sensitive products like chainsaws. Accordingly, Growth Energy would still need to implement a comprehensive test program to evaluate engine exhaust impacts across all these different non-road categories. (See suggested test programs for certain non-road product categories discussed below in Section X).

Second, the DOE report incorrectly indicates that HC+NOx emissions decrease in most cases. However, in every case involving ground-supported lawn and garden products – the use of mid-level ethanol resulted in increased emission levels, and significant increases in emission control deterioration over the useful life of the tested product:

<b>Engine</b>	<b>Figure</b>	<b>HC+NOx new</b>	<b>HC+NOx full life</b>
Briggs & Stratton Pressure Washer	D.3.	Increase w/ increasing ethanol content	Decrease w/ increasing ethanol content <sup>19</sup>
Briggs & Stratton Pressure Washer	D.7.		Increase w/ increasing ethanol content
Honda Generator	D.11.	Increase w/ increasing ethanol content	Increase w/ increasing ethanol content <sup>20</sup>

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19 Decreasing trend line is due to E0 testing of engines after aging with E15 and E20 that were significantly out of compliance due to the aging influence of mid-level ethanol blends.

Third, the DOE test program was flawed and deficient for all the additional technical reason set forth in Dr. Sahu’s 2009 enclosed Critique (See Exhibit C). In particular, DOE’s test program failed to accurately evaluate the increased emissions resulting from the degradation and deterioration of the tested engines and fuel systems over their useful lives. In fact, the significant heat increases documented in the DOE study would adversely impact numerous emission-related components, including pistons, crankshafts, gaskets and catalysts (particularly under off-nominal conditions) as well-established in EPA’s recent Phase III rulemaking record for small engines.

## **IX. NON-ROAD EVAPORATIVE EMISSION STUDIES**

The well-established chemical properties and principles that cause mid-level ethanol blends to increase evaporative emissions are discussed in the Study attached as Exhibit A – particularly Section E.

### **A. Scope of Regulated / Affected Small Engines and Products**

In prior waiver reviews, EPA has concluded that the applicant must evaluate the impacts of the additive or fuel on “emissions technology that is available and imminent, and is reasonably certain to be applied in a prospective model year.” See 43 Fed. Reg. 41426 (Sept. 18, 1978) (an interpretation that was subsequently upheld in the Ethyl decision).

### **B. Evaporative Controls + Baseline Fuels**

Accordingly, Growth Energy’s waiver application would need to submit comprehensive test data on all evaporative-regulated products, including for example:

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20 E0 testing at full life on engines aged with E15 and E20 fuels showed significantly higher emission levels than engines aged on E0 and E10 fuels.

- All the evaporative systems and designs (i.e., fuel tanks, fuel caps and lines) that have been certified, are being certified, and soon will be certified under the new EPA Phase III standards for small engines and lawn and garden products;
- All the additional diurnal (canister) controls mandated by the CARB Tier 3 small engine regulations since these systems will also be EPA-certified for early banking and other purposes.
- Handheld fiberglass tanks that must be certified with EPA in the 2010 MY. These tanks and their regulated caps and gaskets are particularly sensitive to ethanol.

In the 2009 through 2011 model years, EPA evaporative emission certifications for the vast majority of EPA-regulated handheld fuel tanks and caps are based on reciprocal CARB certifications, which in turn, are based on CARB certification fuels. See 40 C.F.R. § 1054.154; 73 Fed. Reg. 59034, 59105 and 59117 (Oct. 8, 2008). Thus, for the next several years, the same EPA and CARB certification fuels for most handheld tanks (and many ground-supported tanks that are being certified under “early banking” provisions) will continue to be based on MBTE, which does not contain any ethanol.

Growth Energy therefore would still need to perform evaporative testing on all these currently regulated (and soon to be regulated) evaporative components using CARB’s MTBE certification fuel as the “baseline fuel.” (See proposed evaporative test programs discussed below in Section X). It is likely that E-15 fuels will cause widespread evaporative emission failures in a substantial number of these EPA- and CARB-certified tank families.

In fact, there are relatively tight compliance margins with certain current EPA-certified, 2009 MY, fuel tank families with evaporative certifications based on MTBE test data from CARB certifications. For example, the enclosed certification application is for a fluorinated, blow-molded, handheld fuel tank that is fairly common. (See Exhibit F

). Using MTBE fuels under the CARB procedures, this EPA-certified, 2009 MY tank family emits 1.95 gr/m<sup>2</sup>/day of HC. (See certification application attached as Exhibit E). Based on this application and the underlying CARB certification, EPA has issued an evaporative emissions certification for the current 2009 model year of this tank family that indicates the applicable EPA certification standard is 2.00 gr/m<sup>2</sup>/day. (See Exhibit E).

If E-15 fuels only increased the certified evaporative emission rate from this tank family by 2.5%, then E-15 fuels would result in an exceedance or failure of the applicable EPA, certified standard. Based on the CARB and EPA test programs summarized below, E-15 would likely increase the evaporative emissions rate for this tank family – compared to its MTBE-based certification – by more than 30% (or more than 10 times the acceptable compliance threshold). OPEI expects that there are many other EPA-certified tank families (based on MTBE certification fuels) that would exceed the applicable EPA standards on E-15.

### **C. Existing Studies**

Because we are not aware of any studies evaluating the impacts of E-15 on any non-road products, below we have included a summary of two E-10 studies that show that the rate of evaporative emissions continues to increase as the concentration level of ethanol increases. In fact, there is every reason to believe that E-15 would result in dramatically greater evaporative emissions than E-10.

## 1. CARB Study

In the context of developing its current Tier-3 evaporative program, CARB conducted extensive evaporative tests comparing its MTBE certification fuels to 10% ethanol. Based on testing 5 lawnmowers in 2003, ARB concluded E-10 would increase diurnal emissions by an average of 36%:

<b>Table 4</b>			
<b>Evaporative Emissions from Off-Road Sources based in ARB’s Five Lawnmower study</b>			
Manufacturer	Diurnal		
	MTBE (g/day)	EtOH* (g/day)	% Diff.
Toro	5.5	7.0	+25%
Lawn Boy	2.1	3.1	+49%
Yard Machine	2.5	3.2	+32%
Craftsman #1	2.2	3.1	+44%
Craftsman #2	2.3	3.2	+40%
Average	2.9	3.9	+36%

## 2. EPA-SAE 2006 Paper

A 2006 paper (authored by Mike Samulski at EPA) documents the substantial evaporative emission increases resulting from **E-10** compared to E-0 fuels used in lawn and garden products.<sup>21</sup> This SAE report confirms that the following types of fuel tanks and seals will be the most adversely impacted by ethanol:

- Permeation rates increased by more than 50% for chainsaws, clearing saws and hedge-clippers made from nylon – 6 with less than 35% glass and NBR O-rings and gaskets.
- Permeation rates increased by 80% for CARB-certified portable fuel tanks made from non-continuous barrier platelets;
- Permeation rate increases of 45% for sulfonated HDPE tanks and 30% for fluorinated HDPE tanks.

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21 “Characterization and Control of Evaporative Emissions from Fuel Tanks in Non-road Equipment.” (SAE #2006-32-0094).

As a result of these documented impacts, EPA stated in the Phase III small engine regulations, starting in the 2012 model year “we are [ultimately] requiring the use of a test fuel containing 10% ethanol . . . because ethanol substantially increases permeation rates for many materials” used in regulated small engines. See 73 Fed. Reg. at 59111.

**D. Growth Energy’s Application**

Growth Energy’s application does not provide any studies that address the impact of E-15 on evaporative emissions from any non-road products which have dramatically less sophisticated and robust evaporative controls than on-road vehicles. Growth Energy fails to evaluate any of these unique and more sensitive tanks, lines and fuel systems used in non-road products. Instead, Growth Energy relies exclusively on studies of motor vehicles.

In order to address all evaporative concerns, Growth Energy argues that EPA should condition its requested waiver so that E-15 would have to conform to the ASTM fuel volatility specification.

**E. AllSAFE’s Critique of Growth’s Position**

First, Growth Energy must conduct confirmatory testing to support the assumption that E-15 would not increase evaporative emissions as long as ASTM fuel volatility specifications are met. Reviewing courts have indicated that assumptions on fuel volatility and evaporative emissions must be supported by confirmatory test data. See Motor Vehicle Mfrs. Ass’n v. EPA, 768 F.2d 283, 401 (D.C. Cir. 1985).

Second, matching volatility is not an adequate measure to control the increasing evaporative emissions due to ethanol.

Third, regardless of the proposed vapor pressure cap, evaporative-permeation emissions for certain materials (like nylon and Viton gaskets) will substantially increase from EPA-regulated products – due to the chemical properties of those materials when exposed to alcohol. (See Section B and C above). Accordingly, Growth Energy would need to conduct a substantial evaporative test program in order to quantify these impacts. (See Section X below).

**X. ILLUSTRATIVE TEST PLANS TO FILL DATA GAPS FOR CERTAIN NON-ROAD PRODUCT CATEGORIES**

Enclosed are two illustrative examples of the types of test plans that would need to be implemented in order to address some of the gaping data gaps discussed above:

- OPEI has developed a proposed exhaust and evaporative test plan for handheld lawn and garden products. This plan has been submitted to the Coordinating Research Council (CRC) for review and consideration for implementation. (See Exhibit G). Lawn and garden handheld engines alone include approximately eight different engine design technologies, all of which may be designed to any of three different life categories. This means a possible 24 different engine designs which may be included in multiple application usages.
- EMA has developed a proposed plan for evaporative and exhaust emissions from ground-supported lawn and garden and utility engines. (See Exhibit H). This plan has also been submitted to the CRC for their review.

Many of the other AllSAFE members have developed similar recommended test plans for their industries that try to account for unique considerations with their affected products.

## **XI. COMPARISON OF GROWTH ENERGY WAIVER TO ON-ROAD CRITERIA**

**[This section was provided in draft by Coleman Jones at GM and I expect additional new revisions from Auto Industries]**

In public presentations<sup>22,23</sup> and public letters<sup>24</sup>, EPA has given direction as to the type of data submission required to support a 211(f)(4) waiver request for the use of mid-level ethanol blends in on-road vehicles and engines. This data submission, as noted above, can be divided into four components: tests required, test fuel characteristics, fleet composition, and statistical interpretation.

Table 5 compares the existing data and proposed test plans to the EPA requirement. Each EPA requirement is given a reference and an item number and each is discussed individually below.

### **TABLE 5 – ON-ROAD: Comparing Growth Energy’s Application to EPA’s Recommended Test Program for On-Road Vehicles**

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22 Jim Caldwell, Office of Transportation and Air Quality, SAE Government/Industry Meeting, May 13, 2008

23 Mid Level Ethanol Blend Experimental Framework – EPA Staff Recommendations, Karl Simon, EPA Office of Transportation and Air Quality, API Technology Committee Meeting, Chicago, June 6, 2008

24 Christine Todd Whitman, Response to Ethyl Corporation Petitions Denying Reconsideration of Three EPA regulations: CAP 2000, Heavy Duty Gasoline, and OBD/IM, <http://www.epa.gov/oms/standards.htm>, August 23, 2001

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**Recent comments from Auto Alliance and EMA Included**

<b>Item</b>	<b>EPA Requirements</b>	<b>Growth Energy Petition</b>	<b>DOE Test Plan<sup>25</sup></b>	<b>Auto/Oil/AllSAFE Test Plan<sup>26</sup></b>	<b>Anything Else?</b>	<b>Orbital Studies<sup>27</sup></b>
	<b>On-Road</b>					
<b>1</b>	<b>Exhaust Emissions<sup>28</sup></b> Using certification Procedures <sup>29</sup>	Limited use of certification procedure	Yes	Yes		Yes
1A	Comparison to E0 and E10 <sup>30</sup>	Some	Yes	Yes		No
1B	Full Useful Life <sup>31</sup>	No	Yes	Yes		Yes
1C	Back to Back Vehicle Pairs <sup>32</sup>	No	Yes	Yes		Yes
<b>2</b>	<b>Evaporative Emissions<sup>33</sup></b>	Yes	Yes	Yes		Yes
2A	Comparison to E0 and E10 <sup>34</sup>	Yes	Yes	Yes		No
2B	Full Useful Life <sup>35</sup>	No	Yes	Yes		Yes
2C	Back to Back Vehicle Pairs <sup>36</sup>	No	Yes	Yes		Yes
<b>3</b>	<b>OBD Testing<sup>37</sup></b>	No	No	Yes		No
3A	Real World Aging <sup>38</sup>	No	No	Yes		No

25 "Mid-Level Ethanol Blends Test Program" presented by Steve Przesmitzki and Brian West to the Biomass Program Infrastructure Peer Review, March 19, 2009

26 See,[insert matrix used on Hill, as updated]

Add orbital cite

28 Whitman; Simon, Slide 5

29 Caldwell, Slide 10; Simon, Slide 9

30 Simon , Slide 8

31 Simon , Slide 5

32 Caldwell, Slide 11

33 Whitman; Caldwell, Slide 10; Simon, Slide 5

34 Simon , Slide 8

35 Simon , Slide 5

36 Caldwell, Slide 11

37 Simon, Slide 10

38 Simon, Slide 10

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**Recent comments from Auto Alliance and EMA Included**

<b>4</b>	<b>Materials Compatibility</b> <sup>39</sup>	Significant Failures	Screening	Yes		Yes
4A	Long Term Mileage Accumulation <sup>40</sup>	No	Partial	Yes		No
<b>5</b>	<b>Driveability</b> <sup>41</sup>	Yes	Yes	Yes		Yes
5A	Older Vehicles <sup>42</sup>	No	No	?		Yes
<b>6</b>	<b>Representative Test Fleet</b> <sup>43</sup>	No	No	Yes		For Australia
	<b>Off-Road</b>					
<b>7</b>	<b>Durability</b> <sup>44</sup>	Yes	Yes	Yes		
7A	Real Use Conditions <sup>45</sup>	No	No	?		
7B	Engine Teardown with Rating <sup>46</sup>	No	No	?		
<b>8</b>	<b>Materials Compatibility</b> <sup>47</sup>	Significant Failures				
<b>9</b>	<b>Tailpipe Emissions</b> <sup>48</sup>					
9A	Full Useful Life <sup>49</sup>					
<b>10</b>	<b>Evaporative Emissions</b> <sup>50</sup>	No	No	Yes		
10A	Full Useful Life <sup>51</sup>					

39 Whitman; Caldwell, Slides 9, 12 & 14; Simon, Slides 5 & 6

40 Caldwell, Slide 12; Simon, Slide 10

41 Whitman; Caldwell, Slide 13; Simon Slide 5

42 Caldwell, Slide 14

43 Simon, Slide 9

44 Simon, Slide 14 & 18

45 Simon, Slide 14, 16, 19

46 Simon, Slide 16 & 20

47 Whitman; Caldwell, Slides 9 & 12; Simon, Slide 5

48 Whitman; Caldwell, Slide 10; Simon, Slides 16, 18 & 19

49 Simon, Slides 16, 18 & 19

50 Simon, Slides 16 & 18

51 Simon, Slides 16 & 18

<b>11</b>	<b>Safety<sup>52</sup></b>					
<b>12</b>	<b>Oil and Fuel Aging Interaction<sup>53</sup></b>					
<b>13</b>	<b>Representative Fleet<sup>54</sup></b>	No	No	Yes		

**Comparison of the Submitted Data and the Various Test Plans to the EPA Requirements.**

This section will compare published EPA data requirements with published or prospective data from other sources. These sources are 1) the information contained in the seven documents submitted by Growth Energy to support their petition for a waiver, 2) data that have been or are proposed to be gathered by the US department of Energy in their “Mid-Level Ethanol Blends Test Program”, 3) data that are being or are proposed to be gathered in the “Auto/Oil E10+ Test Program for Highway “Non-FFVC” Vehicles ”<sup>55</sup>, 4) Data TBD, and 5) the “Market Barriers to the Uptake of Biofuels Study Testing Gasoline Containing 20% Ethanol (E20)” written by Orbital Engine Company for the Australian Department of the Environment and Heritage.

**A. Exhaust Emissions.**

**1. DOE Study**

“Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines, Report 1” published by the US Department of Energy in October 2008. This report has been superseded by a revised version, “Effects of Intermediate Ethanol Blends

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52 Simon, Slide 14

53 Simon, Slide 20

54 Simon, Slides 14-17

55 See CRC’s web site - <http://www.crcao.com/news/index.html>

on Legacy Vehicles and Small Non-Road Engines, Report 1 – Updated”, published in February 2009<sup>56</sup>. This second report will be referenced and termed the “DOE Study”. Within DOE this test program, called Vehicle Task V1, is described as a “Short term ‘quick look’ emissions study of 16 vehicles”<sup>57</sup>.

This report describes emissions tests of four fuels E0, E10, E15, and E20 using the LA92 drive cycle, also known as the unified cycle.<sup>58</sup> This drive cycle was described as “representative of real-world emission changes as it more accurately represents typical acceleration rates and speeds of actual drivers on the road than does the Federal Test Procedure (used for emissions certification testing).” While the results are helpful, the test program does not meet EPA’s requirement to use “certification tests” (Whitman, Simon slide 9); indeed, this test does not relate to any emissions standards, so it would be impossible to determine whether the test’s results show anything about whether vehicles can meet their emissions standards on the test fuels. Testing using certification test protocols such as the FTP is needed to support any conclusions regarding the ability of vehicles to meet their standards when using blends containing more than 10% ethanol.

The DOE report, which summarizes findings to date from DOE’s first phase of a larger program, looked at 16 vehicles from a variety of manufacturers. These 16 vehicles are certified to a variety of different emissions standards. Further, they are about evenly divided between vehicles with control systems that could adjust for ethanol in cold start and those that could not. Nonetheless, these sixteen vehicles are lumped together for statistical analyses to look at the effect of ethanol on tailpipe emissions.

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56 See [http://feerc.ornl.gov/publications/Int\\_blends\\_Rpt1\\_Updated.pdf](http://feerc.ornl.gov/publications/Int_blends_Rpt1_Updated.pdf)

57 Przesmitzki and West, Slide 14

58 <http://www.arb.ca.gov/msei/onroad/briefs/Publication3.pdf>

The grouping of the data in this manner has, as might be expected, produced a data set with a significant amount of scatter. Nonetheless, the authors asserted that increasing ethanol levels in gasoline resulted in reduced carbon monoxide and non-methane hydrocarbon emission with a 95% confidence level. More appropriately, they concluded that the ethanol additions reduced fuel economy in proportion to the volume of ethanol, as would be expected from the literature. They also showed that ethanol, acetaldehyde and formaldehyde emissions would increase with increasing amounts of ethanol added to the gasoline, again in accordance with the literature. In the matter of NO<sub>x</sub> emissions, the pooled data failed to show an increase in emissions; this result is contrary to what would have been expected, based on the literature.

Subsequent analysis done by DOE, which was not included in its report, has shown that the test vehicles that were unable to adjust to the ethanol in the fuel on cold start do have increased NO<sub>x</sub> emissions in the LA92 test cycle.<sup>59</sup> If one subdivides the fleet that DOE tested and looks only at the 2007 vehicles meeting Tier 2 Bin 5 emissions, the latest and most stringent standards, and further looks at those vehicles that do not use long term fuel trims to adjust for the ethanol in the fuel, one find that E15 NO<sub>x</sub> emissions increase by over 45% over the E0 value and 43% over the E10 value. Since the two vehicles of this type that were tested were the Honda Accord and the Chrysler Town and Country, vehicles with very high sales rates, this is a significant discovery that merits further investigation, perhaps by repeating and broadening the testing using the FTP and SFTP cycles.

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<sup>59</sup> Effects of Mid-Level Ethanol Blends on Legacy Vehicles: Tailpipe Emissions using 0 to 20% Ethanol in Tier 1 and Tier 2 Vehicles, 19th CRC On-Road Vehicle Emissions Workshop, Keith Knoll, March 23 – 25, 2009

## **2. ACE Study**

The American Coalition for Ethanol sponsored a study conducted by the Energy & Environmental Research Center (EERC) at the University of North Dakota titled “Optimal Ethanol Blend Level Investigation.” This study looked at tailpipe emissions and fuel economy for four 2007 model year sedans, a Ford Fusion, a Toyota Camry, and “flex-fuel” and conventional versions of the Chevrolet Impala. The study found that all vehicles tested except one met full useful life Tier 2 Bin 5 emissions limits when tested with Federal Emissions Test Fuel (Tier 2) and with E20, E30 or E40, whichever blend appeared to give the best fuel economy. This is not a particularly challenging goal as all vehicles had been driven 31,000 miles or less. The exception vehicle was a “flex-fuel” Chevrolet Impala which failed full useful life NO<sub>x</sub> emissions on both Tier 2 fuel and E20.

The primary claim of this study is that the volumetric fuel economy of these vehicles improves, when measured using the US highway fuel economy test, as a result of adding ethanol to the gasoline. These surprising results are reported without being accompanied by any analysis or energy balance that tries to explain their origin. Further they conflict with a variety of other studies including the DOE report<sup>60</sup> included in the Growth Energy Petition.

There are many test inconsistencies worthy of comment in this study but for the purposes of the Growth Energy waiver request we will limit ourselves to this. An examination of the E0 test fuel economy results shows very large discrepancies with the published EPA data, which are based on the same “Tier 2” gasoline as used by EERC.

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60 [http://feerc.ornl.gov/publications/Int\\_blends\\_Rpt1\\_Updated.pdf](http://feerc.ornl.gov/publications/Int_blends_Rpt1_Updated.pdf)

The test Toyota Camry had a fuel economy of 19.8 mpg using the FTP (city) test procedure and 27.9 mpg using the HWFET (highway) test procedure while the published EPA values were 24 and 32 mpg, respectively, errors of between 10% and 20%. The authors were unable to replicate this published EPA result or the published EPA results for any of the other vehicles tested. When testing the Chevrolet FFV Impala the authors determined a fuel economy of 17.7 mpg versus a published EPA value of 23 mpg. Again, this is an error, this time of 23%. Interestingly, none of these errors or their potential sources is discussed in the paper.

Moreover, experienced researchers know that in 1984 EPA began adjusting the FTP and HWFET test results from its certification database downward, by 10% and 22% respectively, to better approximate real-world fuel economy results for the public <sup>61, 62</sup>. (The EPA adjustment procedures have since been revised but this is not relevant to the ACE Study). The unadjusted numbers, which are what the authors should have matched in their testing on “Tier 2” fuel, can be obtained by dividing the reported EPA FTP data by 0.9 and the reported EPA HWFET data by 0.78. The results of this reverse adjustment, which underscore the discrepancy with the study’s E0 results, are shown in Table 6:

**TABLE 6:**  
**Baseline (E0) Fuel Economy Discrepancies**

Test Vehicle	Test	EPA	EPA	ACE	%Difference	%
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61 <http://www.epa.gov/fueleconomy/420f06009.htm#background>

62 [http://en.wikipedia.org/wiki/Fuel\\_economy\\_in\\_automobiles#Current\\_EPA\\_testing\\_procedure\\_through\\_2007](http://en.wikipedia.org/wiki/Fuel_economy_in_automobiles#Current_EPA_testing_procedure_through_2007)

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	Type	Published Data*	Certification Data	Test Data	(Certification vs ACE)	Difference (Published vs ACE)
Ford Fusion	City	23	25.6	19.8	23%	14%
Ford Fusion	Hwy	31	39.7	27	32%	13%
GM Impala	City	21	23.3	16.2	31%	23%
GM Impala	Hwy	31	39.7	24.5	38%	21%
Toyota Camry	City	24	26.7	19.8	26%	18%
Toyota Camry	Hwy	32	41.0	27.9	32%	13%
GM Impala FFV	City	21	23.3	14.6	37%	30%
GM Impala FFV	Hwy	31	39.7	23.5	41%	24%

\*Provided in the EERC study.

Comparing the EERC data with the certification data for “Tier 2” fuel that should have been replicated shows errors ranging from 26% to 41%. Similarly there is a discrepancy for testing on E85. The EPA data for the FFV Impala is 16 mpg city and 23 mpg highway, equating to unadjusted values of 17.8 and 29.5 mpg, respectively. Again, the authors did not replicate the EPA data using the EPA procedure, reporting 17.7 mpg for the HWFET as opposed to the EPA HWFET value of 29.5 mpg, another 40% error.

The baseline is critical because any changes in the tested fuel economy would be compared against it. If the baseline is artificially low, any fuel economy loss could be converted into an improvement.

In general, fuel economy test results should be reproducible on the same vehicle within 2% to 3% when tested according to the regulations and using best practice. Discrepancies as large as are found in the EERC data, however, raise fundamental questions about the accuracy of the study’s results. Indeed, both the DOE Study and the [INSERT GOES HERE – Ellen will provide] looked at E0 fuel economy and compared the results with the published EPA standards. A discrepancy of over 10% was grounds for investigation or removal of the vehicle from the study. In both studies this was not

necessary. Several theories can be offered for the discrepancies. For example, relative to certification testing, the researchers might have used much higher dynamometer loadings or much more aggressive test driving, or the measurements might have had a fundamental bias for some reason. Whatever the cause, the discrepancies raise significant doubt about the fuel economy results.

The fuel economy values for a vehicle are developed by applying a carbon balance to the tailpipe emissions numbers and fuel properties. Given the extraordinary errors in determining the fuel economy, the whole process of developing data at this laboratory is called into question and one cannot consider the limited EERC tailpipe emissions data as demonstrating that these vehicles will meet their tailpipe emissions standards on any fuel.

### **3. Minnesota Studies**

The Growth Energy Petition included a group of studies collectively known as the “Minnesota Compatibility/Driveability Study”. This study does not have any emissions data to report. This is unusual because an emissions study was planned for this program (see the April 21st 2007 letter from Jewett and Associates to the CRC Performance Committee) and performed (see State of Minnesota Executive Summary<sup>63</sup> and press release<sup>64</sup>).

### **4. CRC Permeation Study**

Growth Energy Petition submitted the CRC Report No. E-65-3, Fuel Permeation From Automotive Systems: E0, E6, E10, E20 and E85 (the “CRC Permeation Study”) as

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63 <http://www.mda.state.mn.us/news/publications/renewable/ethanol/e20execsumm.pdf>

64 <http://www.reuters.com/article/pressRelease/idUS159007+05-Mar-2008+PRN20080305>

part of its demonstration regarding evaporative emissions. While the study provides useful data regarding permeation effects on fuel systems, it lacks important representative fleet data regarding whole vehicle evaporative emission effects as well as regarding evaporative durability.

## **5. RIT Study**

Rochester Institute of Technology (RIT) conducted tests using 10 older gasoline vehicles with varying existing mileage. Emissions testing was conducted using the Federal FTP-75 emissions test on regular unleaded gasoline (baseline) and E20. “All vehicles fell well within the EPA full useful life standards on all regulated emissions components”.<sup>65</sup> Vehicle population, mileage and appropriate EPA emissions certification requirements were not identified in this report. Comparison to full useful life standards may not be appropriate in all cases (if vehicles did not have 120K miles).

Nine of 10 vehicles showed a reduction in carbon monoxide (CO) on E20 (fleet average decrease of 23.3%). 5 of 10 vehicles showed an increase in nitrogen oxide (NOx) with two vehicles increasing over 25% (fleet average decrease of 2.4%). Increased NOx is evidence of the vehicle running lean. 9 of 10 vehicles showed a reduction in total hydrocarbons (THC) (fleet average decrease of 13.7%). 7 of 10 vehicles showed a reduction in carbon dioxide (CO<sub>2</sub>) emissions (fleet average reduction of 3.6%).<sup>66</sup> No statistical analysis was performed on the data, therefore it is unclear whether the results showed an actual statistically significant difference or just a numerical difference.

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65 “Report to the U.S. Senate on E20 Research”, Rochester Institute of Technology, 2007, pg 3.

66 “Report to the U.S. Senate on E20 Research”, Rochester Institute of Technology, 2007, pg 3.

Anecdotal fuel economy numbers calculated from the individual vehicle mileage tracking sheets showed an average increase in vehicle miles per gallon of 3.5% when running on E20.<sup>67</sup> Vehicle fuel economy results were also calculated using the carbon balance method based on data collected during the FTP-75 emissions testing. EPA fuel economy calculations are based on Federal Emissions Test Procedures (FTP-75) and not actual vehicle mileage tracking. Vehicle fuel economy is highly sensitive to human and environmental inputs; therefore the calculated values per the EPA certification procedure are the only values that should be considered. This data showed a decrease in fuel economy proportional to the energy content of the fuel. The fleet calculated fuel economy reduced 6.8% when running E20 (from the gasoline baseline).<sup>68</sup>

## **6. MnCAR Study**

Emissions tests were run at two intervals throughout the one-year project (spring and fall) using the US FTP emissions test but limited to only the hot transient (Hot 505) portion of the drive cycle. This cycle is considered to simulate driving on the highway and city. All vehicles were tested on E10 and E30 fuel. On-road mileage accumulation for 11 of 15 vehicles was on E30 while the remaining 4 vehicles ran on E10. Regulated exhaust emissions were measured (HC, CO and NO<sub>x</sub>) but the results are still being evaluated although conclusions were drawn that there was no apparent trend in vehicle emissions identified and almost all emissions were below federal standards.<sup>69</sup>

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67 “Report to the U.S. Senate on E20 Research”, Rochester Institute of Technology, 2007, pg 4.

68 “Report to the U.S. Senate on E20 Research”, Rochester Institute of Technology, 2007, pg 4.

69 Bonnema, Grant, G. Guse, N. Senecal, R. Gupta, Dr. B. Jones, Prof. K.L. Ready, “Use of Mid-Range Ethanol/Gasoline Blends in Unmodified Passenger Cars and Light Duty Trucks”, Minnesota Center for Automotive Research (MnCAR), July 1999.

Fuel economy data was calculated based on the carbon balance method from the results of the Hot 505 emissions test cycle. There was a reduction in volumetric fuel economy on E30 averaging 8.83% (ranging from 1.28-14.66%) compared to E10; however the reduction in fuel efficiency (BTU/mile) was significantly lower.<sup>70</sup>

Additional note that there was a stubbornness of some vehicles to fully learn a fuel of different ethanol concentrations after 30 minutes of dynamometer driving. And, although 100 miles of highway driving seemed to work much better, some vehicle may have needed even more highway miles.<sup>71</sup>

## **7. Stockholm Study**

“Blending of Ethanol in Gasoline for Spark Ignition Engines, Problem Inventory and Evaporative Measurements”, is called by Growth Energy “The Stockholm Study”. This study is a literature review of information from around the world. It does reference to the 2004 Australian orbital studies that showed significantly greater deterioration in emission control at 80,000 km when operating on E20. Average exhaust hydrocarbons increased by 27% after 50,000 miles again on E20 versus a decline of 11% after aging on E0. Average exhaust carbon monoxide increased by 47% after 50,000 miles on E20 versus a decline of 6% after aging on E0. Average exhaust nitrogen oxides increased by 151% after 50,000 miles on E20 versus an increase of 27% after aging on E0. A detailed analysis showed that catalyst performance deterioration was considerably worse when operating on E20. It also discusses an Environment Canada preliminary report from 2004 showing mixed results for formaldehyde emissions, some vehicles had significant

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70      Bonnema, G et al., MnCAR, July 1999

71      Bonnema, G et al., MnCAR, July 1999

increases and generally consistent increases in acetaldehyde emissions using the U.S. FTP.

## **8. Orbital Studies**

In 2002 The Australian Department of Environment and Heritage commissioned studies of the effects of E20 on the Australian fleet. These studies were carried out by Orbital Engine Company, a powertrain engineering company based in Western Australia. These studies, described as “comprehensive” by Oak Ridge National Laboratory<sup>72</sup>, were published in 2003 and 2004<sup>73,74,75,76</sup>.

The vehicle portion of the study was conducted in 2002-2003 and consisted of a literature review, component tests, and both short and long term vehicle tests. Areas investigated included legislated noxious emissions, evaporative emissions and CO<sub>2</sub> & greenhouse gas emissions. Vehicle operation and driveability, engine durability and vehicle durability were also investigated. These studies, termed the “Orbital Study” will be referenced extensively in the rest of this document.

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72 [http://www.osti.gov/bridge/product.biblio.jsp?query\\_id=0&page=0&osti\\_id=936789](http://www.osti.gov/bridge/product.biblio.jsp?query_id=0&page=0&osti_id=936789)

73 Orbital Engine Company, “Market Barriers to the Uptake of Biofuels Study, A Testing Based Assessment to Determine Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian Passenger Vehicle Fleet” Report to Environment Australia March 2003

74 Orbital Engine Company, “Market Barriers to the Uptake of Biofuels Study Testing Gasoline Containing 20% Ethanol (E20),” Phase 2B Final Report to the Department of the Environment and Heritage, May 2004.

75 Orbital Engine Company, “Market Barriers to the Uptake of Biofuels Study, A Testing Based Assessment to Determine Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian Passenger Vehicle Fleet – 2000hrs Material Compatibility Testing”, Report to the Department of the Environment and Heritage , May 2003

76 Orbital Engine Company, “A Literature Review Based Assessment on the Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian Vehicle Fleet”. Report to Environment Australia, November, 2002

Five new (2001) vehicle pairs were tested on E0 and E20. These vehicles were a Holden (GM) Commodore equipped with a 3.8LV6 built in Flint, Michigan and a 4 speed automatic transmission built in Toledo, Ohio; a Ford Falcon equipped with a 4L V6 and an automatic transmission; a Toyota Camry equipped 2.2L I4 and an automatic transmission; a Hyundai Accent with a 1.5L I4 and a manual transmission; and a Subaru Impreza WRX with a 2.0L turbo H4 and a manual transmission. These vehicles were equipped with three way catalytic converters and closed loop control systems.

The start-of-test tailpipe emissions of the five new vehicles were evaluated on these vehicles using the US FTP procedure which was also the Australian standard emissions test. The vehicles had been driven for 4000 miles prior to test as required. These vehicles exhibited reductions in hydrocarbons of 30% and carbon monoxide of 29%. These vehicles exhibited increases in nitrogen oxides, as expected from the literature. These increases were over 80% in two of the vehicles and averaged 48%.

Four older vehicles were on E0 and E20. They included a 1993 Toyota Camry with electronic fuel injection and a three way catalyst, a 1986 Mitsubishi Magna with a carburetor and catalyst, a 1985 Holden Commodore with a carburetor and a 1985 Ford Falcon with fuel injection.

The tailpipe emissions of the four older vehicles were evaluated on these vehicles using the US FTP procedure which was also the Australian standard emissions test. The vehicles were purchased used and repaired as required for the tests. These vehicles exhibited modest changes in emissions with E20 when compared to gasoline except for carbon monoxide emissions. Here the three vehicles with open loop control systems

exhibited significant reductions and moved the average for all vehicles to a 70% reduction.

**B. Comparisons to E0 and E10**

The DOE study does compare the mid-level blends E15 and E20 to both E0 and E10. The results of the DOE report discussed above apply to comparisons to both E0 and E10.

None of the other studies listed in the Growth Energy petition have data comparing tailpipe emissions of mid-level ethanol blends to E0 and E10.

**1. RIT Study**

The RIT study ran vehicles on regular unleaded gasoline and E20. It is not clear from the report if regular unleaded gasoline is E0 or E10.

**2. MnCAR Study**

This study used only either E10 or E30 for the on-road mileage accumulation portion of the test but all vehicle emissions testing was conducted on both fuels (E10 and E30). No comparisons were performed using E0 or E15 fuel.

**3. Orbital Study**

The orbital studies of on-road vehicles only compare E20 to E0.

**C. Full Useful Life Testing**

None of the studies submitted by Growth Energy contain the full useful life testing that is required under section 211(f)(4). However, the DOE study does report that 7 of 16 models tested do not use long term fuel trims in open loop control. This indicates that they could develop the degradation in catalyst performance seen in the vehicles with the same control approach tested by Orbital engine.

### **1. RIT Study**

Rochester Institute of Technology (RIT) conducted tests using 10 older gasoline vehicles. Existing mileage for each vehicle was not listed and it is unclear from the report if the emissions testing occurred prior to or upon completion of roughly six months (February through September) of on-road mileage accumulation on E20 fuel. Additionally, since the vehicles were taken from the existing fleet, all previous mileage accumulation would have taken place on regular unleaded gasoline (either E0 or E10) and not on the fuel being tested.

The report also indicates a plan to retest the vehicles in March 2009, which would provide roughly 10K-15K miles of aging on the test fuel (E20). This mileage accumulation would still fall short of the full useful life aging requirement (120K). Test results and data were not available in this report.

### **2. MnCAR Study**

Emissions testing was performed at the beginning (baseline) and end of the one-year project time-frame. Vehicle's existing mileage was not given, nor total accumulated miles driven during the test, therefore it is unclear how close to full useful life the testing was performed. Additionally, except for the one-year of test miles accumulated, existing vehicle mileage was obtained on regular unleaded gasoline (E0 or E10), not necessarily the fuel being tested on the emissions test.

### **3. Orbital Study**

The Orbital study looked at five new (2001) vehicle pairs after 50,000 mile durability testing on E0 and E20. These vehicles demonstrated deterioration in regulated

emissions for both E0 and E20, however the deterioration for E20 was significantly greater than for E0.

This table shows the data from the Orbital study. The durability test cycle used<sup>77</sup> is similar to the EPA Standard Road Cycle used for catalyst durability testing in the U.S.<sup>78,79</sup>.

**TABLE 7:  
 Comparative ADR37/01 Emissions data**

	Emission (g/km)	6,400km		40,000km		80,000km		% Difference	
		ULP	E20	ULP	E20	ULP	E20	ULP	E20
Holden	THC	0.120	0.081	0.162	0.155	0.147	0.119	22.5%	46.9%
	CO	0.711	0.728	0.800	0.865	0.845	0.907	18.8%	24.6%
	NOx	0.100	0.083	0.106	0.126	0.134	0.208	34.0%	150.6%
	CO2	256.7	267.6	259.3	265.3	256.8	260.7	0.0%	-2.6%
Ford*	THC	0.126	0.120	0.112	0.142	0.191	0.218	51.6%	81.7%
	CO	2.090	1.710	1.871	2.075	4.731	3.798	126.4%	122.1%
	NOx	0.125	0.265	0.171	0.174	0.457	0.481	265.6%	81.5%
	CO2	256.7	258.8	256.0	253.5	252.4	250.3	-1.3%	-3.3%
Toyota	THC	0.025	0.031	0.030	0.024	0.045	0.027	80.0%	-12.9%
	CO	0.551	0.457	0.873	0.671	1.063	0.895	92.9%	95.8%
	NOx	0.034	0.036	0.039	0.056	0.070	0.047	105.9%	30.5%
	CO2	247.5	248.4	235.1	239.8	235.1	236.6	-5.0%	-4.7%
Hyundai	THC	0.041	0.046	0.049	0.065	0.051	0.112	24.4%	143.5%
	CO	0.304	0.345	0.472	1.155	0.45	1.821	48.0%	427.9%
	NOx	0.15	0.18	0.105	0.488	0.132	0.637	-12.0%	253.9%
	CO2	168.8	172.0	166.4	163.3	166.5	165.8	-1.40%	-3.60%
Subaru**	THC	0.050	0.041	0.079	0.084	N/A	0.104	58.0%	104.9%
	CO	0.388	0.288	0.697	0.936	N/A	1.023	79.6%	225.0%
	NOx	0.059	0.043	0.059	0.048	N/A	0.071	0.0%	11.6%
	CO2	255.6	254.8	250.0	254.3	N/A	250.6	-2.2%	-0.2%

\* AENF002 results are based on tests conducted at 8,900km rather than at 6,400km.

\*\* AENSU05 results are based on tests conducted at 7,600km rather than at 6,400km.

**Table 3.1 – Comparative ADR37/01 Emissions data**

To quote the Orbital study "The emissions durability testing showed deterioration in the regulated tailpipe emissions for all vehicles regardless of the fuel type. There was a

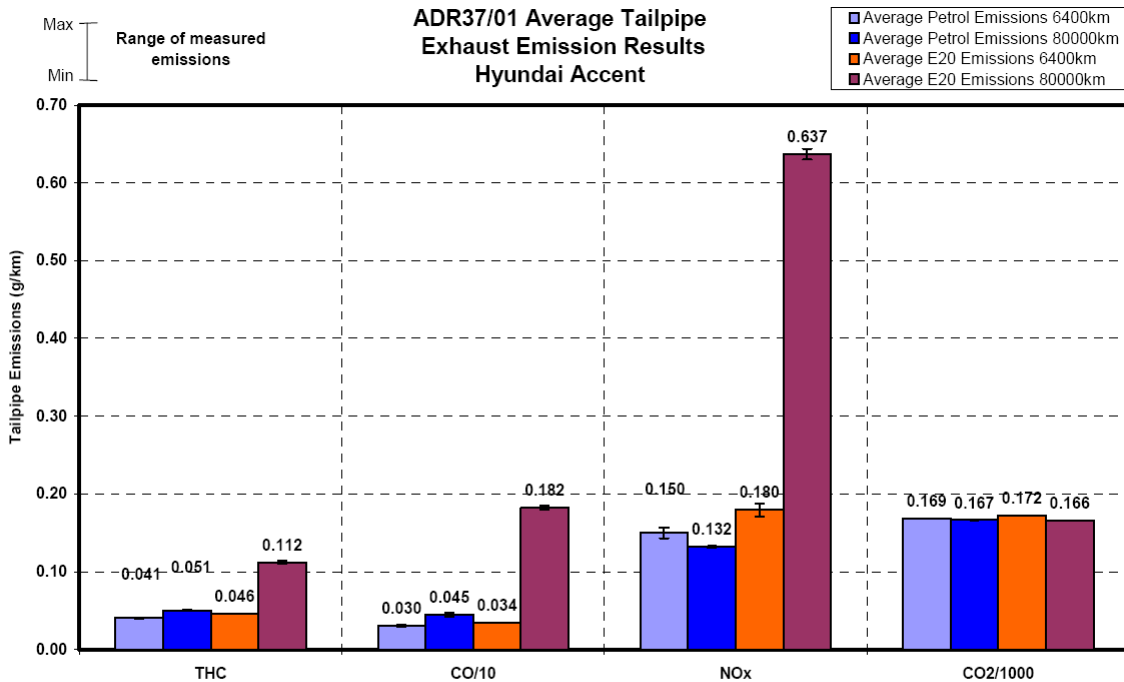
77 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998L0069:EN:NOT>

78 Federal Register / Vol. 71, No. 10 / Tuesday, January 17, 2006 / Rules and Regulations

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<http://fedlaw.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/frame1odgmentattachments/5FB36F840DE1F773CA25747200047194>

significant impact on the regulated tailpipe emission for two vehicles when operated on E20. The vehicles were the Hyundai Accent and the Holden Commodore. As an example of this impact, Figure 1-1 shows the tailpipe emissions for the Hyundai Accent operated on gasoline and E20 after accumulating 80,000km. The NOx value for the E20 vehicle is above the legislative level for ADR37/01 at 80,000km. The E20 Hyundai Accent shows the most pronounced degradation whilst the E20 Holden Commodore follows a similar trend but the absolute levels of degradation are much less.”



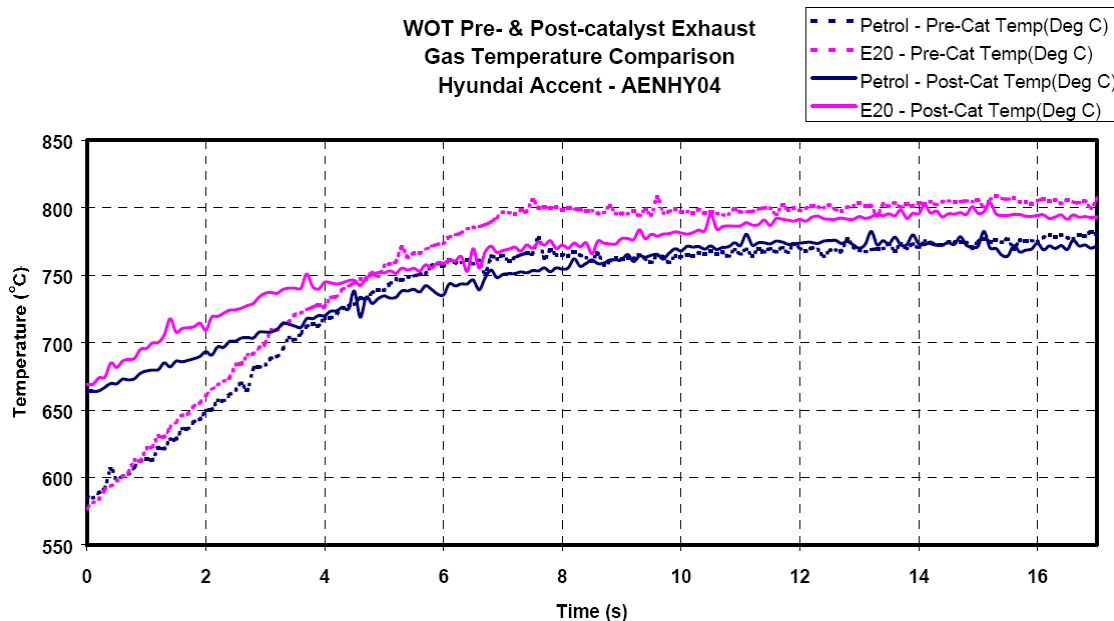
**Figure 1-1 – ADR37/01 Average Weighted Tailpipe Emissions Comparison for the Hyundai Accent ULP v E20 6,400km and 80,000km**

“The increases in tailpipe emissions have occurred due to degradation of the catalyst, the primary cause of which is the increase in the exhaust temperature caused by the use of the 20% ethanol blend during particular modes of operation.

“In the case of the Hyundai and Holden, the engine control systems are not configured to compensate for the extra oxygen introduced by the ethanol in all modes of operation. The extra oxygen increases the oxidation on the catalyst, that in turn increases exothermic reaction, raising the temperature and resulting in thermal degradation of the catalyst.

“In the fleet of vehicles tested, the Hyundai Accent had the smallest capacity engine, and considering that during mileage accumulation all vehicles are driven over the same cycle, the engine in the Hyundai would be operating at a higher duty cycle than vehicles with larger capacity engines. The higher duty cycle equates to higher exhaust temperatures that are further increased with the addition of ethanol to the fuel (16). It is therefore reasonable to conclude that other vehicles within the same class as the Hyundai also have a high probability of failing in the same manner, if the engine control systems cannot compensate in all modes of operation for the extra oxygen introduced with the ethanol.

Below is the graph from the Orbital report showing the Hyundai catalyst temperatures. Note the significantly higher temperatures exhibited on the E20 fuel relative to the E0 fuel.



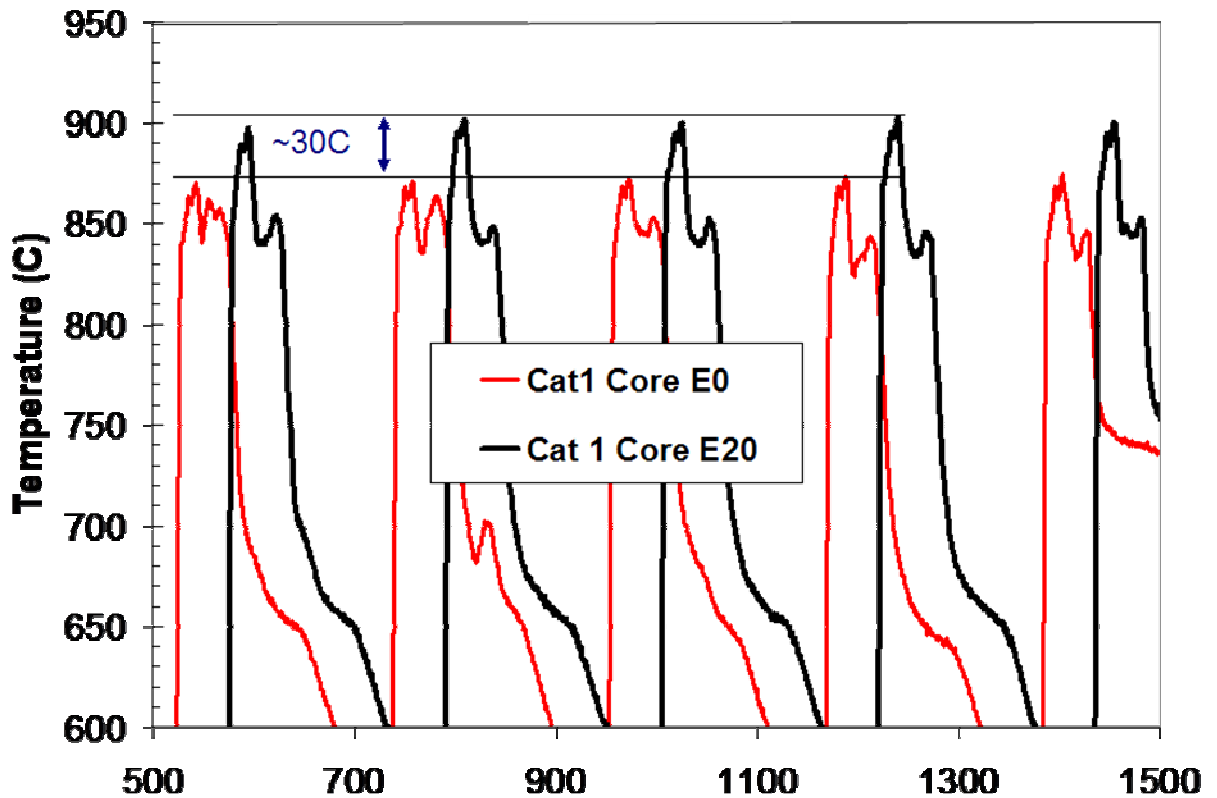
**Figure 5.8 - WOT Exhaust Temperatures Hyundai Accent - AENHY04**

This plot appears to illustrate a 25°C increase in catalyst temperatures. Let us assume that this result applies throughout the entire catalyst durability test (an unlikely event as most of this test occurs when the vehicle is in open loop control and the catalyst temperatures should be similar regardless of the fuel). If we apply this 25°C catalyst temperature increase and use the EPA bench aging time (BAT) equation<sup>80</sup> to typical catalyst temperatures found when running the EPA SRC (standard road cycle)<sup>81</sup> we would see a 40% increase in catalyst deterioration rate or a 30% reduction in catalyst life. However, when we look at the Hyundai, we see much greater reductions in catalyst life due to E20 usage. The reduction in life for hydrocarbons was 85% and CO and NO<sub>x</sub> had still greater reductions. Clearly, the cause of the reduction in catalyst efficiency is more complex than merely the increase in catalyst temperature seen in WOT operation.

80 Federal Register / Vol. 71, No. 10 / Tuesday, January 17, 2006 / Rules and Regulation, p 2830

81 Federal Register / Vol. 71, No. 10 / Tuesday, January 17, 2006 / Rules and Regulation, p 2816

This phenomenon of an engine control system not being able to compensate in all modes of operation has been documented as existing in the US vehicle fleet. The DOE study that is part of the Growth Energy petition found that 7 of 16 vehicles tested had this control design. The figure below illustrates this effect in a vehicle tested in the DOE Study. There is no reason to expect that the vehicle whose catalyst is shown below or any of the other 6 vehicles with similar results would behave differently from the Hyundai or Holden vehicles tested in Australia if they were exposed to the a similar catalyst durability cycle such as the EPA SRC.



4. CRC Study

D. Back to Back Vehicle Pairs

The only study that met the EPA requirement of testing back to back vehicle pairs is the Orbital study.

**1. RIT Study**

This study did not list the details of the vehicles tested, therefore it is impossible to determine whether vehicle pairs were tested. One could assume that back to back vehicle pairs most likely did not exist in the Monroe County vehicle fleet.

**2. MnCAR Study**

This study included 15 vehicles of various makes and models ranging from 1985 through 1998 model year. No vehicle pairs were included in this test.

**XII. NATIONAL IMPACT OF E-15 FUELS BASED ON PREDICTIVE MODELING**

Although emissions test data for on- and non-road gasoline powered vehicles and engines on ethanol gasoline blends above the E10 level are limited, it is possible to estimate the potential impacts on mobile source emissions by extrapolating available algorithms used for purposes of estimating the impacts of gasoline oxygenates on emissions inventories. In order to estimate the potential E15 effect on emissions relative to E10, MOBILE6.2 and NONROAD2008 were used along with input data for estimating emissions on a nationwide basis for calendar years 2010 and 2020. This modeling was performed by Tom Austin of Sierra Research and it is included in the comments submitted by the Motorcycle Industry Council (MIC).

MOBILE6.2 was modified to account for the higher oxygen content of E15 by extending the linear relationships between oxygen content and exhaust HC and CO emissions in the model. As MOBILE6.2 does not account for changes in NO<sub>x</sub> emissions

associated with oxygenates, the model was modified to account for oxygenate impacts on NO<sub>x</sub> emissions using the California Air Resources Board's Predictive Model.<sup>82</sup> Because the Predictive Model includes non-linear relationships between oxygen content and NO<sub>x</sub> emissions, two extrapolation methods were used, the first involved direct use of the relationship and the second involved linear extrapolation of the effects based on the slope near the E10 point. A third method, based on the statistical analysis of vehicle emissions data collected on E0, E10, and E20 fuels under the CRC E-74b program was also used to estimate the potential impact of E15 on exhaust emissions. In this case, MOBILE6.2 was run assuming E0 and then adjusted using the relationships established between oxygen content and emissions from the CRC E-74b data.

Impacts of E15 on non-road emissions were obtained directly from the NONROAD2008 which was specifically configured for that purpose when it was released by EPA in April, 2009. It should be noted that in all cases, no adjustment was made to account for the potential use of E15 to result in greater deterioration of emission control system performance.

With respect to evaporative emissions, the impact of ethanol depends on whether the approximately one pound per square inch increase (psi) in RVP associated with its addition to gasoline at levels that include E15 is allowed to occur or if the ethanol blend is required to meet the same volatility standards as non-oxygenated gasoline. Under existing federal regulations, in those areas of the country where reformulated gasoline is required, the RVP of E15 blends (if they are allowed) would be subject to the same RVP requirements that apply to other RFG blends, including E10 blends. In areas where

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<sup>82</sup> Available at <http://www.arb.ca.gov/fuels/gasoline/premodel/premodel.htm>

reformulated gasoline is not required, the volatility of most ethanol-gasoline blends is required to be the same as non-oxygenated gasoline. There is however a one psi RVP exemption for ethanol gasoline blends sold in non-RFG areas provided that:

The concentration of the ethanol, excluding the required denaturing agent, must be at least 9% and no more than 10% (by volume) of the gasoline.

Given the above language, it appears that E15 blends will not be eligible for the 1 psi exemption absent changes to the existing federal regulations. However, the following language in the waiver application makes it appear that the applicant assumes E15 and E10 will be blended to the same RVP – “The volatility of the two fuels also is essentially identical.”

In fact, the applicant specifically states on page 25 of the application:

Growth Energy proposes that this waiver be granted with a condition requiring E-15 to conform to ASTM fuel volatility specifications for the area and time of year where it is used.

With the requested condition, E15 could even have higher volatility than E10. Since there will obviously be pressure on EPA to allow the same RVP exemption for E15 as is allowed for E10, we have prepared emission estimates with and without accounting for a 1.0 psi RVP waiver.

The analysis also addressed evaporative emissions related to ethanol permeation. For non-road sources, permeation estimates were obtained from the NONROAD2008 model which, in addition to being configured to estimate impacts of E15 blends, includes an algorithm that adjusts permeation emissions as a function of fuel ethanol content. For

on-road vehicles, a methodology developed by Air Improvement Resource, Inc.<sup>83,84,85</sup> was used along with the algorithm from the NONROAD2008 model for adjusting permeation emission rates as a function of ethanol content. With respect to this assumption, it should be noted that it is consistent with the trend of permeation emissions increasing with increasing ethanol content observed in the CRC E-65-3 study, although that effect was not found in that study to be statistically significant at the 95% confidence level.

The results of the emissions analysis are shown in Table 8 for on-road sources. Table 8 presents nationwide summer emissions of VOC, NO<sub>x</sub>, and CO for calendar years 2010 and 2020 assuming that all reformulated and conventional gasoline is either E10 or E15. The difference in emissions associated with the substitution of E15 for E10 is shown both on an absolute and on a percentage basis where positive numbers indicate higher emissions with E15 and negative numbers indicate lower emissions with E15. Finally, the effect of eliminating the one psi RVP exemption is shown.

As shown, if E15 is provided an RVP exemption, the increase in on-road NO<sub>x</sub> emissions estimated using all three methodologies is greater than the estimated reduction in VOC emissions. If E15 is not provided an RVP exemption, the VOC reductions associated with the reduction in volatility are greater than the estimated increases in NO<sub>x</sub>

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<sup>83</sup> “Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory from On-Road and Off-Road Sources,” prepared by Air Improvement Resource for the American Petroleum Institute, March 3, 2005.

<sup>84</sup> “Continuing Ethanol Permeation Issues” presented by Air Improvement Resource to CARB, August 25, 2006. Presentation can be found at <http://www.arb.ca.gov/fuels/gasoline/meeting/2006/mtg2006.htm>.

<sup>85</sup> “Updated Final Report Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory from On-Road and Off-Road Sources, Inclusion of E-65 Phase 3 Data and Other Updates,” prepared by Air Improvement Resource for the American Petroleum Institute, May 24, 2007.

**E-15 Waiver Comments – Guerry DRAFT #15  
Recent comments from Auto Alliance and EMA Included**

emissions using two of the three methodologies. The NO<sub>x</sub> increase still exceeds the VOC reduction for the methodology involving the use of MOBILE6.2 with non-linear NO<sub>x</sub> effects due to oxygenate content. In all cases the higher oxygenate content of E15 leads to greater reductions in CO emissions than estimated with E10.

Method	Fuel	VOC		NO <sub>x</sub>		CO	
		2010	2020	2010	2020	2010	2020
MOBILE6.2 + Linear NO <sub>x</sub> Effect	E10	7393	4772	12231	5696	70718	60878
	E15	7264	4655	12441	5812	66819	57807
	Change (TPD)	-129	-117	+210	+116	-3899	-3071
	Change (%)	-1.7	-2.4	+1.7	+2.0	-5.5	-5.0
MOBILE6.2 + Non-Linear NO <sub>x</sub> Effect	E10	7393	4772	12231	5696	70718	60878
	E15	7264	4655	13016	6195	66819	57807
	Change (TPD)	-129	-117	+785	+499	-3899	-3071
	Change (%)	-1.7	-2.4	+6.4	+8.8	-5.5	-5.0
CRC E-74b	E10	7578	4917	12350	5799	60332	51308
	E15	7537	4870	12637	5978	56527	48021
	Change (TPD)	-41	-47	+287	+179	-3805	-3287
	Change (%)	-0.54	-0.96	+2.3	+3.1	-6.3	-6.4
Additional Change Assuming 1.0 psi RVP Increase Not Allowed in Non-RFG Areas		-489	-269	-	-	-	-

<sup>a</sup>Note plus sign indicates increased emissions with E15.

Table 9 presents the results of the analysis for non-road sources. The results for non-road sources are similar to those observed for on-road sources with estimated NO<sub>x</sub> emission increases associated with E15 being greater than estimated VOC reductions unless there is no RVP waiver available for E15.

<b>Table 9</b>							
<b>Estimated Nationwide Impacts of E15 on Non-Road Gasoline Vehicle Emissions</b>							
<b>(tons per summer day unless noted)<sup>a</sup></b>							
Method	Fuel	VOC		NO <sub>x</sub>		CO	
		2010	2020	2010	2020	2010	2020
NONROAD2008	E10	9273	5033	6503	3800	61116	55326
	E15	9134	4951	6675	3947	53578	48150
	Change (TPD)	-139	-82	+172	+147	-7538	-7176
	Change (%)	-1.5	-1.6	+2.6	+3.9	-12.3	-12.9
	Additional Change Assuming +1.0 psi RVP Not Allowed in Non-RFG Areas	-105	-93	-	-	-	-

<sup>a</sup>Note plus sign indicates increased emissions with E15.

### **XIII. CONCLUSIONS AND RECOMMENDATIONS:**

AllSAFE recommends that EPA deny the waiver request based on the following:

- A partial waiver alone cannot legally or practically control the use of E15 without causing wide-spread misfueling.
- The waiver application does not include most of the information EPA has outlined as required supporting information.
- The data supplied with the waiver application does not support the claims made regarding the emission and operability influence of E15 fuel.
- For non-flexible fuel vehicles, use of E15 fuel is expected to result in “materials incompatibility” and the degradation of critical emission-control components, including catalysts and fuel tank barriers.
- For non-flexible fuel vehicles, use of E15 fuel is expected to cause unacceptable engine and/or equipment “operability”– resulting in an increase in “tampering.”
- For non-flexible fuel vehicles, use of E15 fuel has been demonstrated to result in increased exhaust emission of HC+NO<sub>x</sub> and significantly higher exhaust gas temperatures resulting in engine degradation.
- Use of E15 fuel could result in increased evaporative emissions.
- Use of E-15 fuel would increase national emissions based on well-established predictive modeling.