Request for Information (RFI) DE-FOA-0001460: Co-Optimization of Fuels and Engines

Category 1: Input on Stakeholders' Perspectives and Interest in the Optima Initiative

The following response is prepared by Dean Drake of the Defour Group LLC (D4) and Gary Herwick of Transportation Fuels Consulting (TFC). The primary contact on this response is Dean Drake, Defour Group LLC, 215 S. Main St. #758, Linden, MI 48451. Mr. Drake can be reached by phone at (586) 668-5861 or by e-mail at dean@defourgroup.com. This response reflects our organization's background in and research for the automotive and ethanol industries.

1) *Please provide information regarding activities you are currently working on that may support and/or complement the Optima Thrust I (SI) work.*

Three consulting groups – the Defour Group LLC (D4), Transportation Fuels Consulting (TFC) and Air Improvement Resource (AIR) – have been conducting economic and air quality analyses as well as providing technical support to the corn ethanol industry under grants provided by the Minnesota Corn Research and Promotion Council. The results and conclusions of our first report, "The Economics of Eco-Performance Fuel,"[1] were presented to corn grower groups throughout the country. This work helped forge a consensus that the best use of ethanol in gasoline was as an octane booster, and that higher octane mid-level blend fuels could provide a cost-effective method for automakers to increase the efficiency of future spark ignition engines.

Based on that report, subsequent research is focusing on the:

- Economics of converting motor vehicle fuel from 100% gasoline (E0) to a 10% ethanol – 90% gasoline blend (E10). Over the last decade, gasoline has evolved from E0 to E10. While this transition has been largely transparent to the consumer[2], the way motor vehicle fuel is produced has changed significantly. Refineries no longer produce finished gasoline and ship it to retailers. Today, most of the gasoline produced at refineries is Blendstock for Oxygenate Blending (BOB) that is shipped to terminals where the ethanol is added. Only after this blending does the finished gasoline have the octane rating necessary to be a commercial fuel.

  Using actual gasoline BOB and ethanol price information[3] from around the U.S., the Defour Group (D4) conducted the most comprehensive analysis of the value added by ethanol in ethanol blend fuels. A formal report on this study will be issued early in 2016.

- Impact of direct-to-retail (D2R) production and sales of high level flex fuel ethanol blends such as E85. One option open to oil companies for blending ethanol into gasoline in the production of high level ethanol blends (E51 to E85) that can be used in Flexible Fuel Vehicles(FFVs). Traditional flex fuel ethanol blends are produced at the blending terminal. Historically, sales of E85 per pump have been much less than regular gasoline.

[1] "The Economics of Eco-Performance Fuel", April 22, 2014, Thomas Darlington, AIR, David Aldorfer, D4, Dean Drake, D4, Gary Herwick, TFC and Thomas Walton PhD, D4

[2] 10% ethanol – gasoline blends have been available since at least the 1920's. As a result, nearly all internal combustion engines have been designed to use this blend.

[3] The data used are from the Oil Price Information Service (OPIS) weekly newsletter from May 5, 2014 through the end of 2015. This timeframe allowed the analysis of price and value changes at both high and low crude oil prices.

Recently, however, several ethanol producers around the country have begun producing their own flex fuel at the ethanol plant and shipping it directly to retailers. D2R simplifies the production and distribution process and allows the ethanol producer to sell the Renewable Identification Numbers (RINs), thus enabling D2R flex fuel to be sold for significantly less than traditional E85.

D4 has been working with a large ethanol producer who has been producing and selling flex fuel to13 area retailers, some for over two years, to understand the impact of pricing and marketing flex fuel independently of the major oil companies. The results of this research, to be published in 2016, will provide useful insights into what is required to shift consumers from E10 to other ethanol blend fuels.

- Test work being done by the Coordinating Research Council (CRC) and Oak Ridge National Laboratories in developing mid-level blend high octane fuels. The National Corn Growers Association (NCGA) agreed to provide additional funding to expand the scope of testing being conducted on vehicles optimized to use high octane mid-level blend fuel. The NCGA also appointed Gary Herwick of TFC to be National Corn Growers Association representative on the CRC Performance Committees. This change reflects the new reality in U.S. transportation n fuel since the widespread use of E10 and the elimination of direct subsidies for corn ethanol: corn ethanol is now an essential source of fuel in the United States.

2) *Please provide information regarding potential new activities that could support and/or complement the Optima Thrust I (SI) work.*

Based on current and projected capabilities, D4, TFC and AIR can make significant additional contributions to the development and introduction of high octane mid-level blend fuels and optimized vehicles. Specific areas we can offer to outside parties include:

- Using government computer programs to independently evaluate the costs and effectiveness of high octane mid-level blend fuels and optimized vehicles compared to other technologies for improving vehicle fuel economy. In the analysis for the April 22, 2014 report, the costs and benefits of high octane mid-level blend fuels and optimized vehicles were calculated using a D4 developed program called VOLSIM, which used data from the 2017 – 2025 fuel economy rulemaking to simulate the results that would be expected using the National Highway and Traffic Administration (NHTSA) VOLPE model.

  While this in-house model could reasonably approximate the results used in the rulemaking, it is not a generally accepted tool. Currently, Minnesota is considering a proposal for AIR to work with NHTSA and EPA to obtain and run the government's computer models that will be used in for the mid-term review of the 2017 – 2025 standards. This capability will allow the ethanol industry to independently compare the costs and benefits of new fuels and vehicles to other options for reducing greenhouse gases and improving fuel economy.

- Calculate the cost effectiveness of new fuel blends. In order for high octane fuel and optimized engines to be cost effective, the fuel must be cost competitive with today's regular grade gasoline. The cost difference between high octane premium and regular grade blendstock has averaged 28 cents per gallon in 2015. Optimizing a car to run on

premium fuel (even if the problem of mis-fueling could be overcome[4]) would be a losing proposition for the consumer: the additional lifetime fuel cost would add over $1,000 to the cost of owning the vehicle. For a new fuel to be accepted in the marketplace and provide the desired benefits, it would need an octane rating of today's premium grade gasoline while costing less than other alternatives, such as today's regular grade gasoline.

The current effort to quantify the consumer value of E10 could provide a basis for evaluating the consumer benefit of new high octane mid-level blend formulations. This would be a quicker and much less costly way to evaluate the costs and benefits of different blend fuels than the more traditional approach of extensive refinery modeling.

- Evaluate possible changes in FFV fuel usage as mid-level blend fuels become more widely available. Currently, few owners of FFVs actually use high level blend fuels outside areas with D2D E85 programs. As blender pumps become more available and the Optima fuel (if a mid-level blend) is rolled out, FFV owners will likely start using a wider blend of fuels ranging from E15 through E85. Changes in the fuel economy regulations giving auto manufacturers credits for FFVs should be revised to reflect this multi-blend universe.
- Develop possible strategies and regulatory language to best enable the success of the Optima fuel. Defour Group and Transportation Fuels Consulting associates worked with the California Air Resources Board in the development of the state's first Low Vehicle Emission Standards, were involved in the development of reformulated and low sulfur gasoline specifications and, more recently, worked with numerous organizations developing renewable fuels.

Finally, additional research by the agency or others is needed to assess possible technologies to address mis-fueling. In order for vehicles to get the greatest benefit from a high octane fuel, the vehicle must only operate on high octane fuel. When unleaded gasoline was mandated, vehicle manufacturers were required to install hardened restrictors in the vehicle's fuel filler neck and fuel retailers needed to use special hoses and a smaller diameter nozzle to prevent mis-fueling. Even with that technology, mis-fueling happened. Modern gasoline pumps today dispense multiple grades of gasoline through a single nozzle, each with a different octane. If fuel with octane ratings below 98 RON remain available in the marketplace after automakers start building vehicles designed to run on Optima fuel, then some technique needs to be found to prevent low octane gasoline being used in vehicles requiring high octane fuel.

[4] The simplest and most cost effective way for automakers to utilize a high octane fuel is to redesign engines to incorporate higher compression ratios, making spark ignition engines more like diesel engines. Unfortunately, engines with the optimum compression ratio for high octane gasoline would be severely damaged if run on today's 87 octane gasoline. The only foolproof way to prevent misfueling with a sub-standard octane fuel is to raise the octane level of all gasolines in the marketplace. Misfueling occurs when a vehicle is fueled with the wrong fuel. This can occur inadvertently, as has been the case with gasoline-powered vehicles being misfueled because the owner used the wrong hose. This can also occur intentionally, as was the case in the 1970's when unleaded gasoline cost more than leaded gas. In the case of vehicles designed to run only on high octane gasoline, people would be reluctant to pay for traditional premium gasoline. If another low cost formulation such as a high octane mid-level blend fuel, then consumers would be tempted to use 87 octane regular grade gasoline. Unfortunately, this would degrade performance and eventually lead severe damage to the engine.