Summary of the March 2010 Forum
Center for BioEnergy Sustainability (CEBS)
Review of Technical Issues Surrounding EISA's Biofuel Goals, the RFS2

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The Fuels, Engines, and Emissions Research Center develops and uses extraordinary diagnostic and analytical tools for engine/emission-control R&D from bench scale to vehicles. It has a technically diverse staff of 40 scientists and engineers. Biofuels are of interest because of energy security. The United States consumes about 20 million barrels per day of petroleum yet only produces about 7 millions bpd. The Energy Independence and Security Act (EISA) requires that the country will use 36 billion gallons of renewable fuels per year by 2022. Ethanol is a key component to this strategy. The Renewable Fuels Standards (RFS2) establishes specific annual volumetric requirements for biofuels. U.S. ethanol production is on the rise, with 11 billion gallons used in 2009.

The GREET model of Argonne National Laboratory allows one to do a lifecycle analysis of fuel production and use and to model the whole process from well to wheel. With GREET, most of the recent corn ethanol studies show a net positive energy balance. A lot depends on the assumptions used in the analysis. General Motors and Sandia National Laboratory modeled the supply chain for large-scale biofuels to see if 90 billion gallons per year (bgy) could be made and marketed. They looked at many processes and found that 90 bgy of ethanol can be produced without a significant decrease of cropland and with significant greenhouse gas savings. They found no theoretical barriers to reaching 90 bgy ethanol production. It would take 20 years, require capital availability, would be cost-competitive with gasoline if oil were more than $90 per barrel, and the greenhouse gas savings would be significant and relatively insensitive to the production technology path.

There are three end-use challenges to EISA compliace via ethanol utilization: (1) E85 ethanol can only be used in flex-fuel vehicles (FFVs). The United States currently uses >98% of its ethanol as E10. There are only ~2000 E85 stations and only about 7-8 million FFVs. DOE estimates that ~100 million flex fuel vehicles and ~60,000 E85 fueling stations would be needed to allow E85 to be the EISA pathway. (2) Ethanol has a tank mileage loss because of its lower energy density, which can discourage consumers from choosing it, particularly if not priced competitively on a cost per unit energy basis . (3) Increasing the legal limit of ethanol in gasoline for non-FFVs from E10 to E15 or E20 raises concerns about vehicle emissions, vehicle durability, and material compatibility in vehicles and the fueling infrastructure. For the future, optimized FFVs can have improved ethanol fuel economy over today's "ethanol tolerant" FFVs. Current FFVs suffer a 25 to 30% drop in fuel economy with E85. Ethanol has a high octane number, high latent heat of vaporization, and an extended lean-combustion limit, which can be exploited with advanced engine technology to close the E85/gasoline fuel economy gap. Saab built an E85-optimized car that had emission and fuel-economy benefits. Experiments with a research engine at ORNL showed that increased compression ratio can improve ethanol-optimized efficiency. While gasoline fueling suffers a power loss, gasoline efficiency is also improved.

What is to be done with all the ethanol being produced until all American cars are E85 capable? The nation is about to hit the E10-blend wall. That is to say, ethanol production is reaching 10% of gasoline consumption. The Environmental Protection Agency is considering the

effects of moving the legal limit of ethanol in gasoline from E10 to E15. The emission, safety, and other effects of this transition are being looked at. It has been found that regulated tailpipe emissions from legacy vehicles are largely the same, although catalyst temperatures on about half the vehicles are increased under high loads. A large 82 vehicle test program is underway to investigate the long-term effects of E15/E20 fueling on the legacy fleet.

There was recently no Underwriters Laboratories (UL) certification for fuel pumps to dispense E15 or E85. A fuel system designed for gasoline or E10 may not withstand the aging effects of handling E15 to E85. ORNL worked with UL to develop a testing protocol to allow UL to list equipment for blends other than E10. Guaranteeing the fungibility of biofuels and traditional fuels will require similar testing. Fungible fuels can/will/should play an important role in EISA compliance. Meeting the greenhouse-gas targets will require a combination of solutions.

Q&A: Older cars can be converted to FFVs, but post-manufacture conversion is not cheap and could lead to material incompatibilities. It would not be difficult to design a fleet of vehicles that could use E85, but that transition could not be made in one model year. U.S. manufacturers are committed to making FFVs 50% of their new sales in the future if the fuel-distribution infrastructure exists.

Presentation Slides