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UNITED STATES SENATE

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Chairman Inhofe, Ranking Member Boxer, and members of the committee, thank you for the opportunity to appear here today to discuss the Renewable Fuel Standard (RFS).

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The main points of my testimony are as follows:

1. The RFS program is not expected to achieve the legislated target that calls for 36 billion gallons of renewable motor fuels use by 2022. This is not a new or surprising finding – all of EIA's Annual Energy Outlook (AEO) Reference case projections since the present RFS targets were enacted in the Energy Independence and Security Act 2007 (EISA) have suggested such a shortfall. For example, AEO2010, which was developed and published in the second half of 2009, already projected a shortfall of over 10 billion RFS credits relative to the legislated target for 2022. In AEO2015, the shortfall is projected at more than 18 billion credits. Virtually all the projected shortfall is in the category of advanced biofuels, which includes cellulosic biofuels.

2. Substantially increased use of biofuels can only occur if they can be used in forms other than the low-percentage blends of ethanol and biodiesel that account for nearly all of their current use. There are four potential alternative pathways (1) Increased use of ethanol blends above 10% by volume, (2) Increased use of biodiesel blends above 5% by volume, (3) the advent of drop-in biofuels, such as renewable gasoline, diesel, or jet fuel that can be used as direct replacements for their petroleum-based counterparts, and (4) the development and use of new renewable fuel components, such as biobutanol, that might be more easily blended in increased volumes. To date, none of these options has achieved a significant market role.

3. The premise that advanced biofuels, particularly liquid cellulosic biofuels, would be available in significant quantities at reasonable costs within 5 to 10 years following adoption of the 2007 RFS targets has not been borne out. The supply of liquid cellulosic fuels (including primarily cellulosic ethanol and renewable fuel oil) in 2015 was 2.6 million ethanol-equivalent gallons, less than 0.1 percent of the 3 billion ethanol-equivalent gallon legislated target for that year. Renewable compressed natural gas and renewable liquefied natural gas, which were approved for the RFS program in mid-2014, are available in much greater quantity than cellulosic liquids; in 2015, their total supply was 126 million ethanol gallon equivalents. Unlike liquid cellulosic fuels, cellulosic biogas does not displace petroleum consumption and is mainly obtained from landfills and other biogas recovery facilities that exist independently of the RFS program.

4. Ethanol faces demand, distribution system, and regulatory challenges that make it difficult to increase its use as a motor fuel regardless of its source. Ethanol potentially has three distinct roles in motor fuels markets: (1) providing octane; (2) adding volume to motor fuel; and (3) providing energy content. Ethanol has achieved considerable market success in the first two roles, when blended into

gasoline up to 10% by volume (E10), where it is supported by market forces that are largely independent of RFS program requirements. While its use in these two roles also provides some energy content, additional use of ethanol as a source of energy content faces a significantly higher economic hurdle, as shown in Figure 1, and is therefore more directly dependent on the implementation of the RFS.

With the possible use of mid-level blends such as E15 and higher-percentage blends such as E85, where ethanol provides a larger proportion of the energy in each gallon of fuel, one important behavioral question is when consumers start to notice the impact of ethanol's lower energy content per gallon on the range provided by a tankful of fuel and factor that impact into their buying decisions. Experience in Brazil, where high-percentage ethanol fuels are widely sold, suggests that consumers consider energy-content pricing (top line in Figure 1) rather than simply buying the cheapest gallons. In fact, the range penalty associated with less energy-dense fuels may require that they be sold at a discount to their relative energy value to be attractive to most buyers.

Although the Environmental Protection Agency (EPA) has granted two partial waivers allowing the use of E15 in model year 2001 and newer light-duty vehicles, very few gasoline retailers currently sell E15. This situation may reflect concerns related to automobile warranties, potential liability for misfueling, infrastructure costs, consumer acceptance, and restrictions in franchise and other marketing agreements. Also, E15 does not qualify for the one pound Reid Vapor Pressure (RVP) waiver that was legislated for E10, so it would not be an environmentally compliant fuel for general use in summer months when made using the most prevalent summer gasoline blendstocks.

E85 is more widely available at retail fuel stations, but can only be used in designated flex-fuel vehicles (FFVs). In the *Annual Energy Outlook* 2015, EIA projects there will be about 16.3 million FFVs in use in 2016, about 7 percent of the overall light duty vehicle fleet. Manufacturers built flex fuel capability into these vehicles in order to receive credits towards compliance with fuel economy standards under provisions that are being phased out under the implementation of future Corporate Average Fuel Economy (CAFE) and greenhouse gas emissions standards promulgated by the National Highway Traffic and Safety Administration (NHTSA) and the EPA.

5. The projected declining trend in motor gasoline use in recent EIA AEOs, including AEO2015 (Figure 2) reflects a significant change from earlier projections of growth (AEO2007) or stasis (AEO2010). AEO2015 projections for diesel use do not reflect the recently proposed fuel economy and greenhouse gas standards for heavy duty trucks, which if finalized, would significantly reduce the projection for diesel fuel use. Changes in the projections for gasoline use since AEO2007 mainly reflect higher vehicle fuel economy standards adopted subsequent to its release, together with slower economic growth, higher gasoline prices, and possible changes in consumer behavior. Lower gasoline demand has likely affected the timing of some current RFS compliance challenges that are briefly discussed later in this testimony. However, in contrast to the issues raised in my previous points, it is not a cause of the persistent past and projected shortfall of the RFS program relative to its legislated targets.

6. Actual and projected reliance on oil imports (Figure 3) is significantly lower than it was when the expanded RFS program was enacted in 2007. Recent and projected reductions in net import dependence primarily reflect a combination of more robust domestic petroleum production and the effects of the significant lowering in petroleum demand and its projected growth, as discussed

previously. Biofuels volumes in response to the RFS program have played only a small part in reducing projected net import dependence given the expectation of continued use of ethanol as an octane and volume source independent of RFS program requirements.

7. The near-and longer-term costs of the RFS program will depend on the price of oil, the prices of agricultural commodities used to produce biofuels, and future RFS implementation decisions. Several different cost concepts are potentially relevant. All else equal, lower oil prices tend to raise the cost of RFS compliance. As noted above, current volumes of ethanol are applied almost exclusively as a source of octane and volume in E10 gasoline, uses that are largely independent of RFS implementation. As illustrated by Figure 1, ethanol is more expensive than gasoline on an energy-equivalent basis, so significant uses of ethanol beyond those uses would require leverage from the RFS program.

Current use of biodiesel is more directly influenced by the RFS program. In its November 2015 final RFS rule, EPA set the renewable volume obligation for biomass-based diesel (biodiesel plus renewable diesel) at 1.9 billion gallons for 2016 and 2 billion gallons for 2017; this volume obligation is calculated in biodiesel gallon equivalents rather than ethanol gallon equivalents. As shown in Figure 4, biodiesel is significantly more costly than petroleum-based diesel under recent market conditions. Between August 2015 and January 2016, the difference between the Gulf Coast spot market prices of biodiesel and petroleum-based diesel averaged $1.25 per gallon. Despite this, a combination of biodiesel tax credits (BTC) and the implementation of the RFS itself enable the blending of the biodiesel volumes required by the RFS program. The most common raw material for biodiesel production in the U.S. is soybean oil. Soybean oil prices, along with costs of other inputs required and the value of byproducts from the biodiesel production process, can be used to estimate the cost of soy-based biodiesel production.

Based on Chicago Mercantile Exchange soybean oil prices, the difference between biodiesel production cost and Gulf Coast diesel averaged $1.15 per gallon between August 2015 and January 2016. For the month of January 2016 alone, when oil prices fell markedly, the difference between biodiesel production cost and Gulf Coast diesel averaged $1.55 per gallon.

Assuming that the average premium for biodiesel relative to petroleum diesel in 2016 as a whole are the same as the differences calculated above for the 6-month period ending January 2016, the extra cost of using 1.9 billion gallons of biodiesel rather than cheaper petroleum-based diesel would range from $2.2 billion to $2.4 billion, or 1.0 to 1.1 cents per gallon of gasoline and diesel fuel based on the volume of gasoline and diesel consumption assumed in EPA's RFS rule for 2016. Costs would be higher to the extent that additional biodiesel is consumed to meet the advanced or total biofuels targets. This cost is borne by both gasoline and diesel consumers served by the refiners and blenders that are obligated parties under the RFS program, by the Treasury, and by taxpayers more generally when the cost of the BTC is considered.

While the RFS is likely a key driver of biodiesel use given current oil prices and biodiesel costs, it is possible that biodiesel use could be competitive with petroleum diesel prices independently of the RFS if oil prices were higher; alternatively, competitive parity with petroleum diesel independently of RFS obligations might also be attained through lower costs for biodiesel inputs.

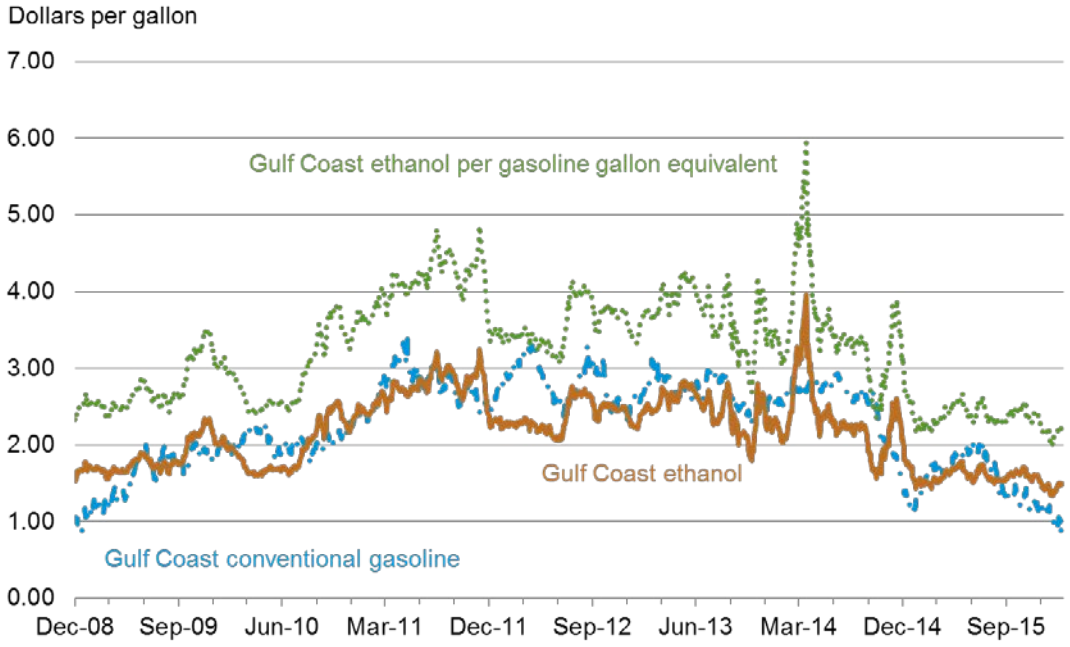
At the retail level, EIA expects diesel fuel prices to be most affected by the RFS program. Typical biodiesel blending yields only about one-third of blenders' RIN obligation under the RFS, a shortfall that diesel blenders make up by purchasing RINs. In contrast, at current levels of the RFS renewable volume obligation (RVO), E10 gasoline is close to RIN-neutral; blending an additional gallon of this fuel generates

roughly the same number of RINs that must be surrendered to meet the current RVO. Looking forward, however, the ramp up in the legislated targets through 2022, if confirmed through the EPA rulemaking process, would significantly increase the RVO for each gallon of motor fuel that is sold. In this setting, E10 gasoline would become more like diesel fuel is today in having an RVO that significantly exceeds the RINs generated by blending the fuel.

8. EIA remains actively engaged in matters related to the RFS program. We collect monthly data on biodiesel and ethanol production, as well as weekly and monthly data on ethanol blending. EIA also provides input to EPA on short-term forecasts for motor fuels use and cellulosic biofuels production, consistent with the statutory requirement for EIA to provide this information a month prior to the deadline for EPA to issue its annual rule implementing the RFS program for the following calendar year. Most recently, EIA provided information covering 2014 through 2016 for the EPA's final rule covering those three years. EIA also includes biofuels as part of its Annual Energy Outlook, Short-Term Energy Outlook, and has also published several Today in Energy and This Week in Petroleum articles on the subject. Later this spring, EIA will initiate monthly estimates of ethanol movements by rail in order to better understand the flow of ethanol from producing regions to blending terminals.

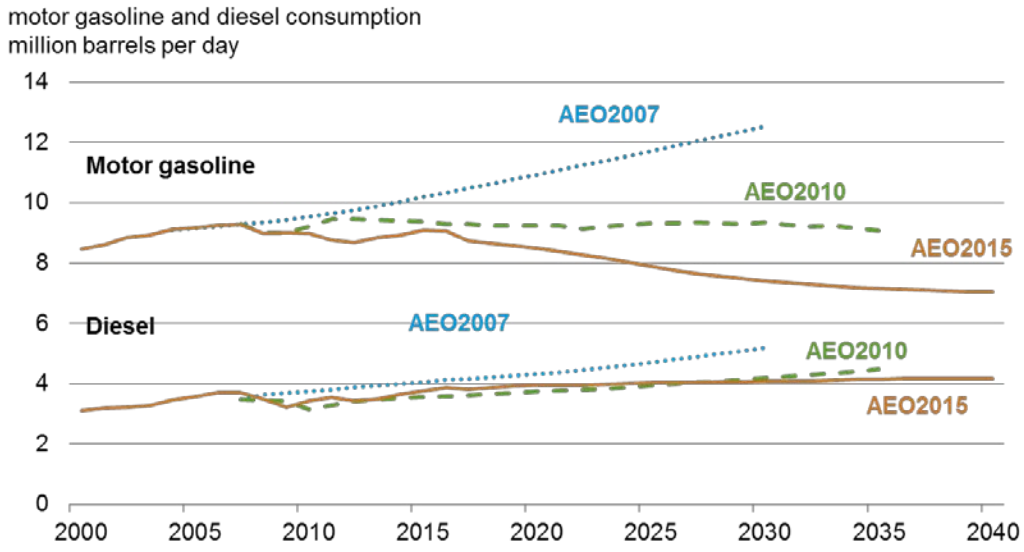
Thank you for the opportunity to testify before the Committee.

Figure 1: Ethanol and gasoline prices on the Gulf Coast



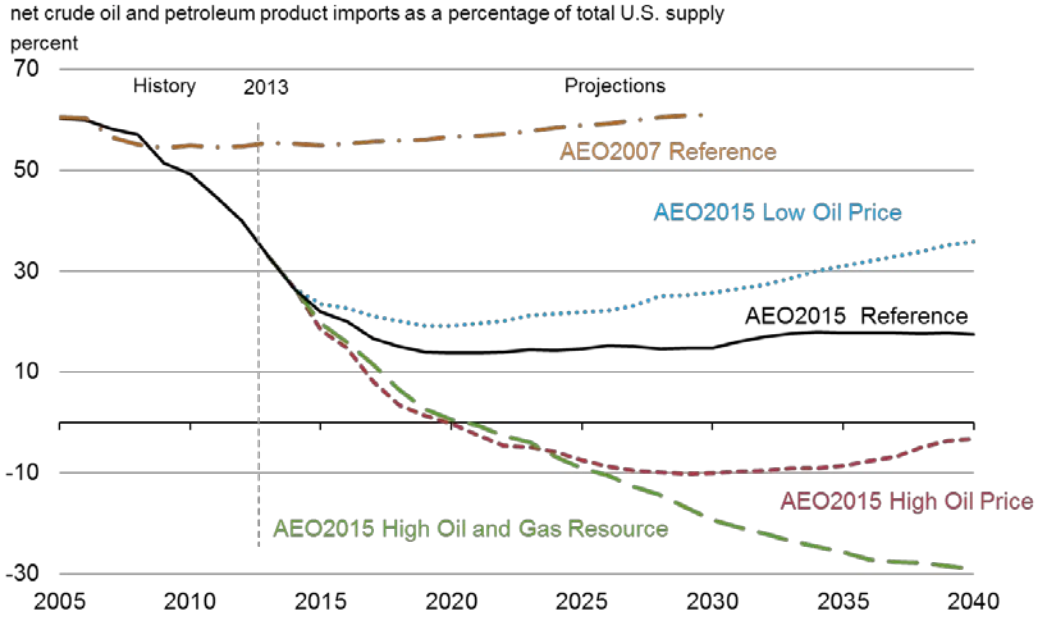
Note: 1 gallon of gasoline contains the energy of 1.5 gallons of ethanol
Source: Oil Price Information Service, Thomson Reuters

Figure 2: The gasoline and diesel demand outlook has changed significantly since the expanded RFS was passed, mainly due to efficiency policies and economic weakness; proposed new heavy-duty truck standards, if finalized, could lower future diesel use



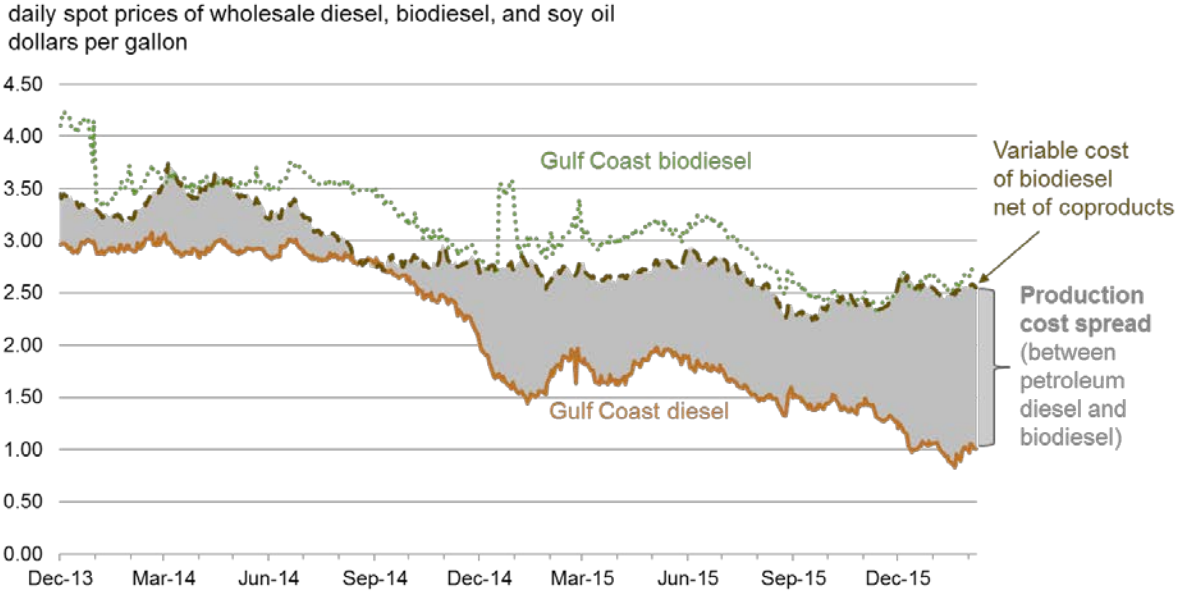
Sources: EIA Annual Energy Outlook 2007, Annual Energy Outlook 2010, Annual Energy Outlook 2015

Figure 3: Projected oil import dependence, an important motivation for adoption of the expanded RFS in 2007, has declined significantly with the advent of tight oil



Source: EIA, Annual Energy Outlook 2007 and Annual Energy Outlook 2015

Figure 4: As oil prices have declined, the gap between petroleum diesel and biodiesel production costs has grown



Sources: Oil Price Information Service, Argus, CME, Thomson Reuters, and Bloomberg