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The NABC Completes its Stage II Plans

The first year of research by the National Advanced Biofuels Consortium (NABC) was completed in August 2011. Stage I efforts focused on determining whether technical and economic barriers could be overcome to develop a pilot-ready process in three years for six biofuels technology pathways. Over the first year, the NABC performed feasibility studies to determine which of the six approaches would move on to the next stage. The second stage will further develop the selected technologies to a pilot-ready state over two years. DOE will continue to invest in research and development of other promising pathways for drop-in biofuels outside of these NABC selections.

In September 2011, the NABC announced the initial selection of two "drop-in" biofuels technology pathways that will advance to the next development stage: Fermentation of Lignocellulosic Sugars (FLS) and Catalysis of Lignocellulosic Sugars (CLS).

The NABC also identified two additional technology pathways that demonstrated considerable promise for achieving drop-in biofuels but were missing key data to fully complete the feasibility study. These two technology pathways, Catalytic Fast Pyrolysis (CFP) and Hydrothermal Liquefaction (HTL), were given three months to generate the missing data, at which point the NABC Leadership Team would determine whether they were ready to proceed into Stage II. In December, UOP, the lead partner for CFP, decided to pursue development of this promising technology outside of the NABC, noting, "The NABC…can claim success for creating this partnership and any resultant technology." This incubation of technology and bringing together of key participants is tantamount to what the consortium's overarching goals are. UOP does plan to remain in the consortium, providing their expertise to other strategy teams.

After receiving the notification from UOP, the Leadership Team performed a due diligence to determine if CFP was viable going forward inside the NABC without UOP leadership and determined that it was not, leaving three options for NABC going forward into Stage II:

1. Work on Fermentation of Lignocellulosic Sugars (FLS) and Catalysis of Lignocellulosic Sugars (CLS) only. This option is most true to the original solicitation intent, but misses promising thermal routes that have the potential to fully capture the potential of refinery integration.

2. Work on FLS, CLS, and Hydrothermal Liquefaction (HTL), HTL being the technology that was down-selected at the end of the Stage I extension. This option has the benefits of option 1 and provides a thermal route; however there is a greater risk that HTL may not achieve pilot-ready status by the end of Stage II.

3. Conduct a two-tiered approach with FLS and CLS on the pilot-ready track (Tier I) at the end of Stage II, and HTL and Hydropyrolysis (HYP) on a track solely focused on addressing the primary technical and economic barriers that were identified in Stage I (Tier II). This option is the best mix of routes and allows the consortium to focus resources where they will have

the greatest probability of providing the best benefits. The challenges to allocating resources between the two tiers are manageable.

Based on an analysis of the benefits and negatives of each option, the Leadership Team made the decision that option 3 provided the best value to DOE and the NABC partners, and the Governance Board and DOE approved the decision. The NABC's Stage II strategy development teams are:

Tier I

- **Fermentation of Lignocellulosic Sugars (FLS)**, led by Amyris. The FLS technology focuses on converting biomass into sugars that can be biologically and chemically converted into a renewable diesel fuel. This renewable diesel is certified by the U.S. Environmental Protection Agency to be blended up to 35% with conventional diesel.
- **Catalysis of Lignocellulosic Sugars (CLS)**, led by Virent. The CLS technology focuses on converting biomass into sugars that can be chemically and catalytically converted into an array of gasoline and diesel fuel components. Preliminary tests of these fuel components look encouraging for their use as drop-in fuels for both gasoline and diesel.

Tier II

- **Hydrothermal Liquefaction (HTL)**, led by PNNL. The HTL technology focuses on conversion of wet biomass at elevated temperatures in a condensed phase reaction medium. During Stage I, bio-oil yields of about 50% on a carbon basis were achieved. The resulting bio-oil was readily upgraded to a hydrocarbon product consistent with gasoline and diesel.
- **Hydropyrolysis (HYP)**, led by RTI. The HYP technology is similar to CFP, but focuses on using a reactive gas to cap the reactive species formed in pyrolysis vapor to produce a quality bio-oil for refinery integration.

Supporting these teams are the cross-cutting teams including Refinery Integration, Engineering and Economic Analysis, Sustainability Analysis, Feedstock Logistics, and Fundamentals & Modeling.