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Readout from Sino-U.S. Advanced Biofuels Forum

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Report Highlights:
On May 27, 2010, China's National Energy Administration (NEA), the U.S. Department of Energy, and the U.S. Department of Agriculture hosted the fist Sino-U.S. Advanced Biofuels Forum in Beijing. The forum followed the Strategic and Economic Dialogue and provided an opportunity for the two countries to exchange views regarding challenges and breakthroughs in biofuels policy, research, and industry development through presentations by private industry, government, and university representatives. Moreover, it served as a platform for future collaboration and research exchanges. This report provides a synopsis of presentations at the forum.

Summary of China Biofuels Policy Strategies
Including remarks from: Qian Zhimin (Deputy Administrator, National Energy Administration-NEA), James Miller (Under Secretary for Farm and Foreign Agricultural Services, USDA), Shi Yuanchun (Academician, Chinese Academy of Science and Chinese Academy of Engineering), Mark Ginsberg, Sr. (Sr. Executive, Office of Energy Efficiency and Renewable Energy, USDA), Liu Qun (Division Director,

NEA), Dr. Chavonda Jacobs-Young (Director, Office of the Chief Scientist, USDA), Jonathan Male (Sr. Scientist, Office of the Biomass Program, U.S. Department of Energy-DOE), Liu Yongmao (VP, Novozymes China)

Leaders in both the United States and China recognize the urgency for developing renewable energy. The U.S. biofuels mandate presents an opportunity for U.S.-China collaboration in achieving sustainable development of a biofuels program. In 2007, the United States signed a Memorandum of Understanding (MOU) with China to establish a partnership for developing their respective biofuel programs. In May 2009, China's National Energy Administration (NEA) developed a series of seminars to help shape mutual biofuels research and development (R&D) projects. In May 2010, the first annual Sino-U.S. Advanced Biofuels Forum was held, bringing together the energy departments of both countries. In addition, there has been ongoing R&D collaboration between the U.S. and China, including an applied R&D demonstration between the U.S. Department of Energy National Laboratories and Chinese universities, institutes, and companies.

China's Biofuels Outlook

China is the largest consumer of energy in the world. China's oil consumption grew rapidly between 2000 and 2009 (average six and a half percent annually). The country currently faces increasing reliance on foreign oil imports. China has given high priority to developing renewable energy sources such as hydropower, solar energy, wind power, biomass, and related legislative and regulatory pieces. China also aims to account for 15 percent of fuel consumption with non-fossil fuels by 2020. Domestic biofuels development could address China's environmental concerns, support agricultural development, and increase rural incomes.

China's biofuels development outlook faces challenges and growth in the sector is slow, lagging behind both Brazil and the United States. China has a large population, yet faces the constraint of limited (and decreasing) arable land to feed its population. While ethanol production in China continues to use food crops as a feedstock, the government of China is looking to non-food feedstocks for the future. Industry development in the short run will require focusing on "one-and-a-half" generation feedstocks such as sweet sorghum, while shifting from first generation (grain starch) eventually to second generation (cellulosic) feedstocks including some forest residue. The NEA estimates the current supply of non-food feedstock in China is sufficient to produce 10 million tons of biofuel annually.

China has already developed a system of biofuel industry standards, and implemented pilot projects. Small and medium-sized enterprises are currently the principal processors of biofuels, and most are state-owned. Appropriate processing technology will take time to develop, and current plants must be transformed into one-and-a-half generation plants.

While the industry faces some skepticism regarding its development when oil prices are low, and the government is acutely aware of the size of its population and limited arable land, the biofuels industry is promising. Last year, China saved $1 billion from substituting biofuels for foreign oil. Necessary steps for future biofuel development include establishing an R&D platform, improving its standard-setting program, and establishing support programs. All government ministries are guided by and directed to enforce the Renewable Energy Law which specifies industrial policy and a framework for renewable energy. All types of enterprises in the biofuels industry are to have equal investment opportunity, although initial investors will have strong social responsibilities and therefore need to have more

security against risk.

Research Developments and Outlook

Includes remarks from: Zhang Xiaoyang (Chairman, Henan Tianguan Group), Wang Yan (General Administration Manager, Shandong Longli Group), Benny Zhang (Manager, Global Energy Systems, GM), Cynthia Bryant (Marketing Manager-Global Fuels, Novozymes), Lu Ming (Vice Chairman of China National Democratic Construction Association, Standing Member of National People's Congress), Dr. Chavonda Jacobs-Young (Director, Office of the Chief Scientist, USDA), Dr. Zhao Lixin (Director, Energy and Environmental Research Institute, Planning and Designing Academy of the Ministry of Agriculture), Dr. Nancy Ho (Purdue University/Green Tech America, Inc.), Jennifer Holmgren (Vice President, Renewable Fuels and Chemicals Unit, UOP), Mark Stowers (Ph.D., Sr. Vice President of Science and Technology, POET), Wang Guangce (Researcher, Qingdao Institute of Oceanology, CAS), Wu Qingyu (Professor, Algae-Bio Diesel Laboratory, Tsinghua University), Jerry Fiddler (Board Chairman, Solazyme, Incorporated), Jonathan Male (Sr. Scientist, Office of the Biomass Program, DOE)

UOP estimates global energy demand is growing by 1.6 percent per year and will double in 50-60 years. Meeting this demand while decreasing the harmful environmental impacts of fossil fuel emissions will require diversified energy sources, carriers, and technologies. Companies such as GM and Tianguan Group believe biofuels are the most feasible and near term solution for replacing fossil fuel consumption. Biofuels emissions are generally 90 percent lower than those of traditional fuels. The movement for producing ethanol from cellulosic biomass originally began in the 1970s. Today, both the U.S. and China are on a path toward making cellulosic biofuels commercially viable and dedicating much research to cellulosic biomass conversion.

Current Position of Biofuels Research in China

In 2008, corn was the primary raw material for ethanol in China. However, corn ethanol prices remain high. Therefore, China will focus on "one-and-a-half" generation feedstocks such as sweet sorghum, a crop which can be grown on marginal lands and has a high drought tolerance. Aiming to switch feedstocks from food to non-food based, much R&D is also exploring raw materials such as fish oil, cottonseed, rapeseed, and algae. Corn stalk could also become a primary feedstock in ethanol production. The Ministry of Agriculture (MOA) already released standards relevant to corn stalk use for biofuels. However, few stalks have been used for ethanol, as this first requires establishing a highly efficient system of collection, storage, and transport. Moreover, stalk use for ethanol will also require large up-front investment and greater farmer awareness of the economic value of stalks, which are also used on-farm as a heat source.

China's Cellulosic Research

Using cellulosic energy, China could reduce its yearly oil imports by 10 percent, save nearly 32 billion RMB every year, and reduce yearly CO2 emissions by 90 million tons. Thus far, commercial cellulosic feedstock collection for power generation is already taking place, the basic distribution framework for cellulosic feedstock collection is established in certain provinces, and progress has already been made to reduce the cost of enzyme production.

A number of companies are working to advance cellulosic production in China. Novozymes for example, believes China has the potential to become a leader in cellulosic technology. The company

considers solely enzyme cost, and partners with companies around the world such as POET, to synchronize research and ultimately reduce biofuel production costs. Tianguan Group, a major Chinese ethanol producer, worked to develop production and demonstration lines. The company has developed a feedstock pre-treatment line, increased the conversion rate from sugar to ethanol, and bred effective strains. Longli Group produces sugars and partners with Chinese universities to commercialize technologies—especially that of corn cob processing. Longli Group's goal is to optimize the use of raw products. The company has an advantage of achieving high cell conversion rates (as high as 80 percent), and has found a pre-treatment process that avoids the pentose problem.

While China has made certain domestic advances in cellulosic production, many challenges remain. The per unit cost of cellulosic ethanol production is higher than that of oil refining due to challenges in logistics infrastructure, cellulose separation (e.g. hexose and pentose), production facilities, and production technique (profitability). Future advances in China's cellulosic production will require strong financial support including subsidies, tax cuts, and loan guarantees.

Algae as a Long Term Biomass Prospect

A third generation of biofuel feedstock for both the U.S. and China could be found in algal biomass. Both countries are currently researching techniques to eventually use algae as a viable feedstock. Solazymes, Inc., a renewable oil and bioproducts company, tailors lipids based on a specific end fuel purpose. The company won contracts with the U.S. navy to supply algae biodiesel as ship fuel and to develop jet fuel.

China has a long history of seaweed cultivation and is the world's largest seaweed producer. Here, seaweed is cultivated for food, medicine, and bioenergy. There are 12 million tons of algae in China's seas, and giant algae is predicted to be a highly efficient source of ethanol production in the future. Biodiesel production requires either plant oil or animal fat. Algae can be converted into biomass, but to be a commercially viable feedstock, it must grow quickly and possess a high lipid content. Tsinghua University has been working to combine the processes of fermentation and photosynthesis to yield higher conversion efficiency of algae into biomass at a lower cost. Their model includes a combination of fermentation and photosynthesis, and demonstrated robust results that exceeded those of either process alone in terms of cell intensity and oil yield.

U.S.-China Collaboration for Biofuels Development

Includes remarks from: Yue Guojun (Assistant President, COFCO), Lu Xuefeng (Assistant Director General of Qingdao Institute of Bioenergy and Biopressing Technology), Billy Glover (Managing Director, Environmental Strategy, The Boeing Company), Peng Peiyuan (for Aki Nakano Director, Customer Segment, Pratt & Whitney, UTC)

U.S.-China Collaboration for Advanced Biofuels Development

Both China and the United States are large energy consumers and very reliant on foreign oil imports. To maintain large GDP growth, meet employment demand, and sustain economic growth, China will increase its energy demand. China and the U.S. face similar challenges. Nearly one-third of the FY2009 U.S. stimulus package included investment for the future, and the same is the case in China. Regarding biofuel development, the U.S. is between advanced development and commercialization. China is in the developmental stage, which provides numerous opportunities for U.S.-China

collaboration. Biomass sources are varied between the two countries, even with respect to second generation biofuels.

U.S.-China collaboration for biofuel development has already begun. For example, the Qingdao Institute of Bioenergy and Biopressing Technology, an institute researching microalgae as a potential biomass, uses blue algae which grows quickly and produces fatty acids. The institute already signed an MOU with a U.S. company and partnered with a U.S. university. Regarding biofuels for aviation, the first U.S. demonstration flight using biofuel content took place in February of 2008. Following the recent MOU signing on May 26, 2010, China will have a similar demonstration flight within the next year.