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OF

Rice University

Biomass to Chemicals and Fuels: Science, Technology and Public Policy

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When I joined the Baker Institute as its founding director in 1994, I knew that energy issues would be an important part of our institute's work. We were located in Houston, the energy capital of the world. Secretary Baker and I, with our long experience in the Middle East, understood first hand the importance of the vital links in the energy market supply chain. Like many who were in public service in the 1970s, we understood the direct impact secure energy supplies have on daily life and prosperity in America and abroad.

With the decline in domestic oil production and continued strong increases in oil demand, the U.S. is more dependent on foreign oil than ever before. In 2005, America imported around 11 million barrels a day, or about 60% of the roughly 20 million barrels consumed each day. This is up from 35% in 1973. The share of imported oil is projected to grow to close to 70% by 2020, with the United States becoming increasingly dependent on Persian Gulf supply.

In light of this growing dependence on imported oil and in the wake of the aftermath of Hurricanes Rita and Katrina, the United States has witnessed some of its highest oil prices to date. Crude oil prices have been extremely sensitive to both internal and external conflicts involving the world's oil producing countries. Environmental trends have further complicated the energy picture.

More than two thirds of total petroleum use in our country is transportation related. The transportation sector –personal automobiles, buses, trucking and planes-- will constitute over 70% of the future increase in oil demand. As a result, American policy makers have become acutely aware of the need to offer long term strategies, particularly those in the transportation sector, that would prevent gasoline shortages in the future and lessen America's vulnerability to oil supply shocks from abroad.

With the rise of gasoline prices, the problem of decades of underinvestment and an ongoing shortage of refining capacity in the United States has become more widely understood. Public discussion of the state of the U.S. refining industry focused on two elements: the difficulties of expanding domestic capacity to meet rising U.S. gasoline demand and the possible dangers of having so much U.S. refining capacity concentrated in one geographical region –the US Gulf coast-- that is vulnerable to weather-related disruptions.

As debate gathers momentum on how to solve our gasoline woes, biofuels have come front and center as a potentially environmentally-friendly means to supplement the U.S. transportation fuels supply system. Today, the United States produces 255,000 barrels a day of primarily corn-based ethanol. Though U.S. ethanol production is almost equal to Brazil's, ethanol still only represents a meager 3 percent of the 9.1 million barrels of

gasoline Americans consume every day. To have biofuels play a more important role in the US energy equation, new policies and new technologies will be needed.

The major obstacle to expanding the role of biofuels is lack of infrastructure. American car makers have expressed a willingness to increase production of flex-fuel cars that can run on ethanol fuel. However, current U.S. ethanol production is concentrated in the Midwest region and difficulties remain with the ethanol distribution system in other parts of the country. Indeed, of the 563 E-85 ethanol fuel pumps in the U.S., over 45% of them are located in two states, Minnesota and Illinois.

Congress has supported our domestic ethanol industry with a generous 51-cent-per-gallon federal tax credit for ethanol refiners and blenders, as well as the 54-cent-per-gallon tariff placed on imported ethanol. However, questions remain about the viability of relying on corn-based ethanol as the salvo to our fuel diversity solution. Other, perhaps more efficient and effective, options need to be investigated and it is this search for a more thoughtful understanding of the potential of biofuels that has led us to convene today's conference.

There are many biofuel alternatives currently under study in the United States. Cellulosic ethanol is one feedstock thought to have the most long-term viability, yet this alternative is far from cost-effective using present technology. Investment is also increasing in facilities to produce biodiesel fuel from waste oil and oil-rich plants as well as ethanol produced from agricultural waste. We will hear today from practioners and scientists about the state of play in the biofuels industry. Our keynoters include industry leaders whose companies are making a commitment to large scale biofuels plants as well as scientists searching for breakthroughs that can raise the efficiency and cost-effectiveness of biofuels manufacturing.

I am pleased to say that Rice University is committed to this effort to find breakthroughs in biofuels capability. Not only are our engineering and biology groups deeply involved in critical research in this area, but our students are practicing what we preach. For those of you that took the Rice shuttle bus to our building today, you will have an opportunity to give a round of applause to the students who manufactured the fuel for those buses from the waste oil from our cafeteria's and campus kitchens. Our students are studying the environmental impact of biodiesel with the support of the Baker Institute, Rice's George R. Brown School of Engineering and the Shell Center for Sustainability.

Today's "Biomass to Chemicals and Fuels: Science, Technology and Public Policy" conference is aimed to investigate the potential for biofuels to contribute to U.S. energy security and to highlight the research and development of new technologies and scientific breakthroughs needed to make biofuels a viable alternative to oil based fuels. This conference, like our nanoscience and energy series, is also part of a broader campaign to

reinvigorate public interest in the physical sciences. A bipartisan effort to address our energy security dilemma through revolutionary technologies could generate an excitement and idealism similar to the one that swept the nation – and particularly our young people – the height of the space program in the 1960s and 1970s.

At present, oil and natural gas-based businesses represent the core of Houston's energy sector. Oil and gas represent over half of the type of energy used to meet the world's primary energy requirements but the growing supply challenge means that we will need improved technologies to find and use fossil fuels more efficiently.

Over the longer term, investment is likely to rise in alternative fuels and technologies. Houston will need to position itself to acknowledge the important role that non-fossil energy and new energy technologies are going to play in the world's energy supply and participate in this new energy future. Working together with Rice University and other Texas universities, our energy industry will be preparing our country prepare for the transition to a broader spectrum of energy sources by promoting the fundamental analysis and science needed to bring us to a sustainable energy future that is less dependent on foreign supplies.

To quote my friend and colleague, the late Richard Smalley, the Nobel Laureate and a founding father of nanoscience, "What is needed is a vast effort, capable of providing twice the amount of energy we consume today. We will need to develop a clean, affordable answer that can serve as the basis for sustained economic prosperity for 10 billion people. Current technology will not be able to accomplish this. We need stunning new discoveries in underlying core science and engineering to enable an answer."

This conference could not be more timely. I have just returned from the Clinton Global Initiative meetings in New York City where I was the personal guest of former President Clinton as a member of the CGI's Advisory Board on Mitigating Ethnic and Religious Conflict. How to meet increasing energy needs and the challenges of global climate change were key subjects that were addressed. People are beginning to not only talk the talk but walk the walk. At the CSI, Sir Richard Branson committed his Virgin business empire to spending $3 Billion over the next ten years to help combat global warming. Renewable energy would be the focus of the investment, particularly in the research and development of biofuels.

Today's conference, organized by the Baker Institute and the Rice Departments of Chemical and Biomolecular Engineering, Civil and Environmental Engineering and the Energy and Environmental Systems Institute, has brought together policy-makers, scientists, opinion-shapers, and business leaders to showcase potentially revolutionary breakthroughs in the biomass area.

I would like to thank Engineering Dean Sallie Keller-McNulty and our Rice engineering faculty, Kyriacos Zygourakis, George Bennett, Ramon Gonzalez, and Pedro Alvarez for their work in organizing the wonderful panel of presentors for the coming two days. Also, I commend my energy team, Amy Jaffe, Kenneth Medlock and Matthew Chen for their

creativity and passion in marrying Rice science together with our public policy programs. And we are especially thankful to Shell and our Energy Forum members for their generous support of our energy science and technology policy program.

It is our hope that Rice University can play a leadership role in building the bridge to our sustainable energy future. And there is no better example of that than our keynote speaker, Andy Karsner, the current assistant secretary of renewable energy at the US Department of Energy. I am proud to say that Andy, who has worked tirelessly to bring new energy technologies into the electric power and transportation sector, is graduate of Rice University!

(Introduce Karsner from his bio)