FUEL FOR THOUGHT

As Ricardo Hausmann slowly spun an old National Geographic globe — all deep blue sea and green-gold land, with national borders left to the imagination — his fingers drew the contours of the next agricultural revolution: along the old Gold Coast of western Africa, across the equator into the Democratic Republic of Congo, circling the small islands of the Caribbean, dropping down to the vastness of Brazil, curving over to landlocked Paraguay.

Biofuel land. That's how Hausmann, director of the Center for International Development, sees these far-flung places. At the Kennedy School of Government, he and other experts are mapping the future of this amply hyped but still nascent technology. As Hausmann puts it, "We are at the Betamax stage of the industry. There will probably be a VHS stage and a DVD stage."

These days, Kennedy School researchers are less interested in the state of the art than in how biofuels will ripple across global institutions and individual lives. Under the leadership of Henry Lee MPA 1974, director of the Environment and Natural Resources Program, they are asking: What will these fuels mean for energy self-sufficiency? Economic development? Foreign exchange? For the rich and for the poor? According to Lee, "There are people who are incredibly positive about biofuels: 'This is going to be a boon for the economies of these countries.' There's another group that says: 'This is going to be an enormous environmental and economic tragedy.' Under what scenarios is it a tragedy, and under what scenarios is it a boon?"

Considering the pros and cons of the biofuels industry

BY MADELINE DREXLER
ILLUSTRATION BY DAVID POHL

Biofuels are liquid and gas forms of energy, mostly for transportation, made from plants and other carbon sources. In theory, because the carbon released when biofuels are burned is balanced by the carbon consumed by the plants harvested to make the fuel, biofuels can help curb global warming. In practice, the technology has a long way to go. Scientists have not yet concocted a perfectly "carbon neutral" product that doesn't increase net carbon dioxide — the main culprit among greenhouse gases.

Common biofuel sources today include a variety of starch crops (e.g., sugar cane, sugar beets, corn, and other cereals) and oil crops (e.g., rape seed, jatropha, and palm oil). These "first generation" technologies are expected to give way to more complex processes, such as synthesizing fuel from the cellulose in switchgrass, wood, and biomass.

Just how prominent biofuels will be in the next few decades remains murky. The World Energy Outlook 2007 suggests that, under optimum conditions, they will supply about 7 percent of the world's road-transport fuels by 2030. In his 2007 State of the Union address, President George Bush set a goal of 35 billion gallons of alternative fuels by 2017 — nearly five times the current target.

As the industry surges with investment dollars and new entrepreneurial players, Kennedy School scholars are analyzing it from several angles. The most wide-ranging project spins off of a May 2007 workshop convened, in part, to assist the Global Bioenergy Partnership, a collaboration of the G8 + 5 nations that promotes renewable energy. Having delved into policy questions, researchers have begun publishing a series of reports on their findings. Kennedy School academics are also developing a supply curve for biomass feedstocks to a biorefinery and assessing the economics of converting biomass into energy liquids similar to diesel.

In all these studies, one conclusion is inescapable: Biofuels will change the paradigm of agriculture. Today's worldwide surplus of arable land will suddenly become more precious. More pointedly, the economies of fuel and food will be closely tethered. Food prices will rise, and trade patterns will change.

In the United States, corn ethanol is the darling of corporate planters and agriculture state lobbyists. But because of fossil fuels used in growing, processing, and transporting it, corn ethanol barely shaves off net carbon emissions, compared with petroleum-based fuels. It produces only two-thirds of the energy of conventional gasoline. And an exploding corn ethanol industry means higher prices for dairy and livestock farmers, whose animals feed on the grain.

By contrast, ethanol made from sugar cane produces more energy and far less greenhouse gas than corn. In Brazil, the world's largest exporter of both sugar and ethanol, sugar-based ethanol is a major industry.

If sugar ethanol becomes the preferred first-generation fuel, many parts of the developing world could reap the benefits. In the Caribbean and Africa, where American and European protectionism forced industries to disinvest from sugar cane, a hot market for sugar ethanol could persuade leaders to enlarge their agricultural frontier.

Demand for biofuels could also lift the prospects of west African nations, such as the Democratic Republic of Congo, which are blessed with land but have neither the governance nor infrastructure to launch a biofuels industry today. "For some of these countries, biofuels could represent exports that are larger than their current total exports," Hausmann explained. "And it's a renewable industry — not like diamonds, gold, or oil."

While Hausmann and others have focused on such global repercussions, Daniele Cesano, a research fellow in sustainability science at CID, has explored small-scale projects where biofuels can boost rural development and ease poverty. In Pintadas, a village in Brazil's semi-arid northeast, Cesano and colleagues are testing whether biodiesel made from the castor bean and other indigenous plants can generate electricity for local businesses and crop irrigation. While maintaining their skills as subsistence farmers and herders, the villagers would benefit from a steady source of electricity, and from learning to cultivate plants that might someday be sold on the larger biodiesel market.

In a similar vein, the Kennedy School's 2007 Roy Family Award for Environmental Partnership went to Hybrid Systems for Rural Electrification in Africa. A project that delivers renewable electricity to African villages, it combines solar technology with modified diesel motors running on jatropha oil. "Capital-intensive projects give more economic return. But economies of scale can cause big problems in the environment," Cesano explained. "We need a system designed on the human dimension."

Will biofuels help reverse climate change? Will they course through a global pipeline, as oil does today? Robert Lawrence, professor of international trade and investment, sees unfettered biofuel trade as key to enlightened climate policy. Today the United States slaps a tariff on cheap, climate-friendly Brazilian sugar-based ethanol, while bestowing tax breaks to U.S. producers of environmentally dubious corn ethanol, on top of federal subsidies to corn growers. "If you really care about the environment, you'd want people to consume as much biofuels in their gas as you could. You wouldn't put a tariff on imports from Brazil," Lawrence said. Added Hausmann, "U.S. policy reflects the idea that ethanol competes with American farmers — not that ethanol competes with Gulf oil." Center for International Development Senior Research Fellow and co-chair of the Global Bioenergy Partnership Corrado Clini takes this view a step further, noting that "'carbon neutral' and sustainable bioenergy can contribute both in meeting the increasing energy demand in the short medium term, and in reducing the global carbon emissions. Taking into account that the tropics are the most suitable area for the effective and sustainable development of biofuels, the world should facilitate the free trade of biofuels, overcoming the present barriers while driving the economic growth of the developing countries."

Kennedy School researchers have not focused on biofuels' ecological impact, but are working with colleagues in Harvard's Faculty of Arts and Sciences and internationally to explore these issues. Nevertheless, protecting the earth is a non-negotiable part of their analysis. If countries cut down swaths of rainforest or pasture land to plant sugar for biofuel, would carbon escape into the atmosphere and cancel out any possible benefits from the resulting biofuel? Would land clearing devastate habitats?

Given these economic, trade, and environmental conundrums, how should policymakers press forward with biofuels?

First, with research and development to ensure a rich array of second- and third-generation technologies. Second, by avoiding the temptation to lock in existing processes that are neither energy efficient nor environment-friendly nor supportive of broad development goals. Finally, by creating a broad framework for evaluating technologies and informing debate.

The Kennedy School is uniquely suited to helping achieve that dispassionate perspective, Lawrence said, because it can "invite people to sit around the table in a neutral academic setting, rather than in fora where they have to adopt political postures."

"A technology is not a policy," he added. "Why do you want these biofuels? One motive is environmental. A second is energy security. A third is economic development. A fourth is: 'Let's help our farmers.' I would hope that one of the contributions the Kennedy School could make is clarifying people's thought processes." His own view: "The goal of biofuels should be the environment. And then the chips should fall where they may."

According to William Clark, professor of international science, public policy, and human development, "A great deal of what research does in influencing policy is not so much to get this individual to do A instead of B, but to change the terms of the debate. That is, making it clear what's at stake and what isn't. Improving the knowledge base, so that in what is bound to be — and should be — a highly political debate, there is as little confusion as possible. And so that various actors…enter into the arena with the best chances of seeing their own self-interests correctly."

Having traveled across the globe — not the stateless, blue-and-green, presumably unpolluted globe sitting in his office, but the real globe, teeming with politics — Ricardo Hausmann senses an infectious enthusiasm for biofuels. "Everybody wants in. But right now it's a high-risk proposition because you don't know if you're investing in Betamax or in VHS."

Despite that uncertainty, Hausmann is optimistic: "I have no doubt that if the world opted for a biosolution, that solution would exist."

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FACT Nikolaus August Otto, inventor of the combustion engine, created an 1860 prototype to run on ethanol.

Rudolf Diesel designed the diesel engine to run on peanut oil. In 1912, he said: "The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in the course of time as important as the petroleum and coal tar products of the present time."

Henry Ford built his legendary 1908 Model T to run on ethanol, gasoline, or a combination of the two. "The fuel of the future," he predicted, "is going to come from fruit such as that of sumac out by the road, or from apples, weeds, sawdust — almost anything."

In 2004, Harvard University began fueling the diesel vehicles in its fleet with a soybean/diesel oil mix. In 2006, the university converted one of its recycling trucks to run on waste vegetable oil from Annenberg Dining Hall.