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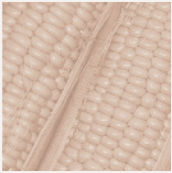
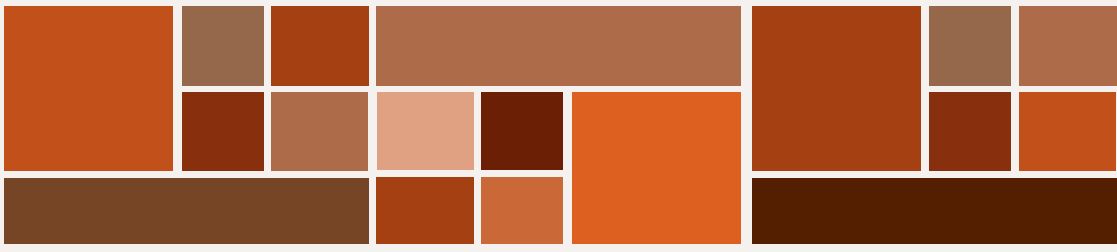


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FOOD,  
FUEL,  
AND  
THE  
FUTURE?

Edited by: Kent H. Hughes  
and Elizabeth A. Byers

# BIOFUELS:



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## FOOD, FUEL, AND THE FUTURE?

including:

### **"BIOFUELS: THE CURRENT STATE-OF-PLAY"**

A POLICY BRIEF BY C. FORD RUNGE, ROBBIN S. JOHNSON, AND CALESTOUS JUMA



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## Introduction

THE Program on America and the Global Economy (PAGE) and its Global Energy Initiative together with the Brazil Institute, have held a series of conferences that have focused in whole or in part on various developments in the field of biofuels. In the July 23, 2010 conference, PAGE turned to two scholars, C. Ford Runge and Robbin S. Johnson, both with ties to the University of Minnesota, to provide the current state of play in the development of biofuels, particularly in the United States.

The Runge-Johnson presentation was followed by a panel putting biofuels in an international context. Alexandros Petersen, a Senior Fellow at the Atlantic Council, provided an overview of the European approach to biofuels. Joel Velasco, Chief Representative in North America for União da Indústria de Cana-de-Açúcar (UNICA) (Brazil's Sugarcane Industry Association), discussed the current and future prospects for sugarcane ethanol in Brazil and international markets. Carl Wolf, an analyst with BCS, Inc., and an advisor to the U.S. Department of Energy, gave an overview of United States-China cooperation in developing biofuels.

In addition to corn and sugar cane, there is extensive research being conducted in alternative feed stocks for ethanol and or biodiesel. Alternatives include wood chips, waste paper, switch grass, and other non-food crops, and, more recently, algae. PAGE will return to the question of biofuels in future reports and conferences.

## Conference Summary

With nations looking more and more to other, non-traditional sources of energy, the Program on America and the Global Economy (PAGE), the Brazil Institute, and the Global Energy Initiative (GEI) sponsored a comprehensive assessment of the current state of one of those possible sources: biofuels. As moderator **Kent Hughes**, Director of PAGE and GEI, pointed out, biofuels are of considerable importance as they “involve our innovation system... and have implications for food security, for the environment, and energy security.”

On the first panel, “Biofuels: The Current State of Play,” **C. Ford Runge** and **Robbin S. Johnson** of the University of Minnesota commented upon the role of biofuels within the United States. Their presentation, based on a policy brief written in conjunction with **Calestous Juma** of Harvard University, highlighted the pillars of U.S. biofuels policy and provided suggestions to make it more effective. (The paper appears on page 9.)

According to Runge, national biofuels policy in the United States is currently comprised of: a 45 cent per gallon “blenders’ tax credit,” a 54 cent per gallon tariff on imported ethanol, and a biofuels production mandate calling for 36 billion gallons by 2022. Runge argued that these “excessive and indefensible subsidies to the biofuels sector” are the most expensive way to reduce greenhouse gas (GHG) emissions compared to efficiency and systems management strategies. Not only do these credits and mandates replace market signals, they funnel a great deal of money to a minor contributor: “even if every bushel of corn the United States produces were dedicated to biofuels, it would only support about 15 percent of vehicular energy demand.” Runge said.

Johnson highlighted the complexity of the debate by pointing out that “biofuels policy is really farm policy masquerading as energy policy.” Johnson argued that while biofuels can play a part in future energy policy it should not be looked at as a possible sole source of energy. According to Johnson, “we would like to entertain the notion that after a third of a century of pursuit of biofuels as farm policy, the future is more likely to be shaped by the role that it can play constructively in a broader energy policy in this country.”

Johnson also did not shy away from mentioning the environmental problems associated with corn-based ethanol production. He specifically highlighted the nitrogen runoff in the Gulf of Mexico, nitrous oxide emissions from fertilizer, and the extra burden placed on water resources. Moreover, Johnson argued that with the market for gas-based fuels shrinking, biofuels are not a long-term strategy for capping GHG emissions. While the two panelists reiterated their hopefulness about biofuels role in a range of energy alternatives, Runge commented that “we are also somewhat skeptical of the relative importance that biofuels will play in the national energy portfolio.”

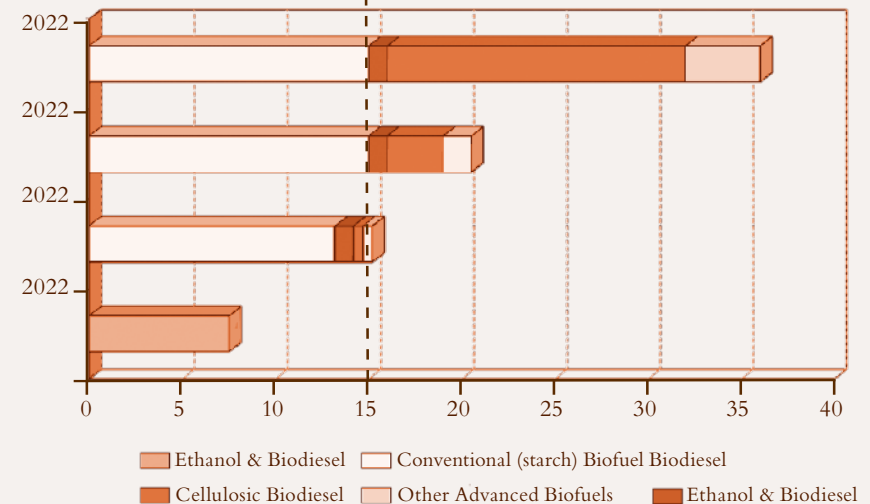
Runge and Johnson then offered five policy responses that are needed in order for the United States to reach a long-term ethanol policy: replace the blenders’ tax credit with a subsidy varying inversely with price, phase out the tariff on imported ethanol, impose a five year moratorium on mandates, introduce conservation-inducing “negative pollution taxes” and credits like hybrid vehicle rebates, and shift subsidies from cellulose refining plants to cellulosic research and development.

The next panel, “Biofuels in an International Context,” was moderated by **Paulo Sotero**, Director of the Brazil Institute, and featured several panelists who were able to describe the increasingly global role of biofuels. The first speaker, **Carl Wolf**, Analyst, BCS, Inc., who also serves as a consultant to the U.S. Department of Energy, summarized the Memorandum of Understanding (MOU) for Biofuels Cooperation between the United States and China.

Wolf opened his remarks by illuminating some of the objectives and goals of the Department of Energy’s Biomass Program, which include making biofuels cost-competitive with petroleum as well as creating an environment conducive to maximizing the production of biofuels. He also highlighted several of Obama’s presidential directives with regard to biofuels-- conducting breakthrough R&D, the creation of 50-75 jobs at each new biorefinery, and reducing GHG emissions.

Wolf went on to describe the Energy Independence and Security Act of 2007 (EISA). Its mandated production targets call for a 15 billion gallon per year cap on conventional biofuels, in order to stimulate the development and the production of advanced biofuels (renewable fuels other than ethanol derived from corn starch).

15 BGY cap on conventional (starch) biofuel

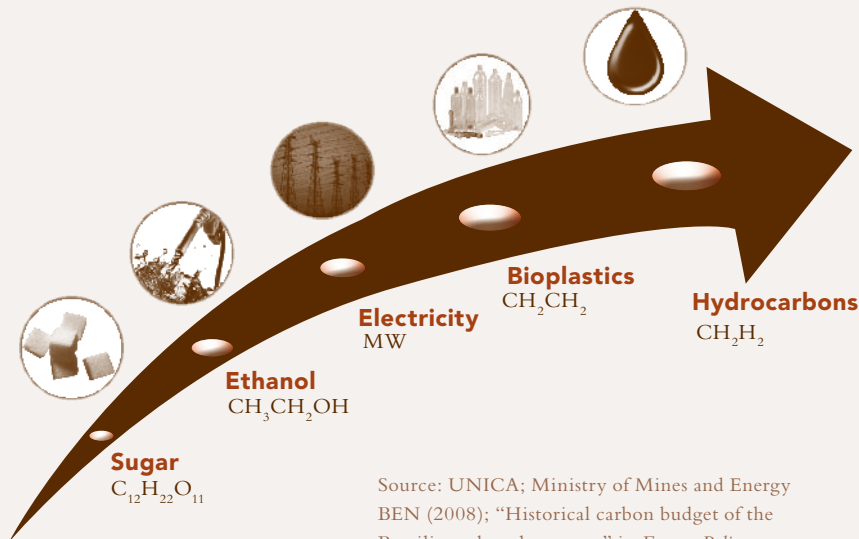


Source: U.S. Department of Energy’s Office of the Biomass Program

Wolf stressed that attainment of these goals and collaborating with China are not mutually exclusive; on the contrary, Wolf argued that cooperation makes economic, diplomatic, and environmental sense. The U.S.-China Memorandum of Understanding (MOU) for Biofuels Cooperation, signed in 2007, has heralded the full engagement and collaboration between the two countries on clean energy technology R&D as well as “the deployment of commercial technologies that will spur economic growth, lower greenhouse gas emissions, and promote sustainable development.” According to Wolf, the bioenergy technology exchange between the two nations is comprised of applied research and development between U.S. and Chinese laboratories and institutions as well as between U.S. and Chinese industrial entities.

Wolf quoted U.S. Secretary of Energy Stephen Chu’s remarks emphasizing the benefits of the MOU: “We can create new export opportunities for American companies and ensure that we remain on the cutting edge of innovation. This partnership will also be a foundation for broader partnerships with China.” Ultimately, Wolf argued that “the harmonization of biofuels policies and standards will help establish global markets and facilitate economic growth.”

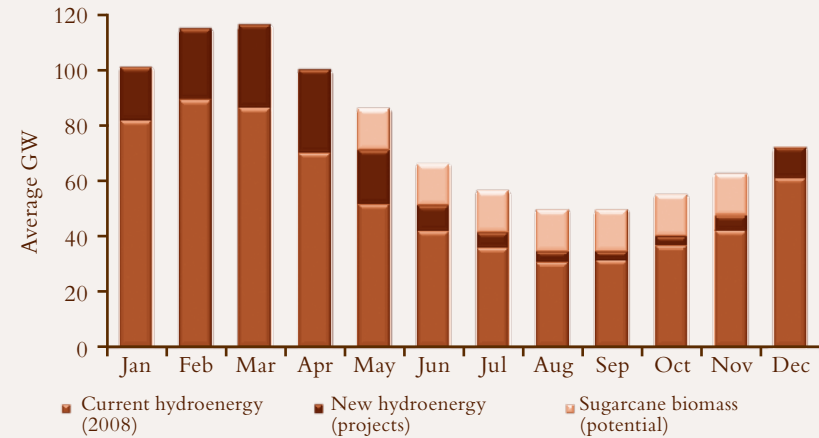
**Joel Velasco**, UNICA’s Chief Representative for North America, described the state of biofuels in Brazil, highlighting sugarcane’s role as a sustainable solution for bioenergy and its prospects for the international market. Velasco opened his remarks by introducing UNICA, the Brazilian Sugarcane Industry Association, which includes 120 producers and is responsible for 60 percent of both ethanol and sugar production in Brazil. He stated that, “sugarcane is Brazil’s number one source of renewable energy, and 600 million tons of CO2 emissions have been avoided thanks to the use of ethanol.” Velasco went on to point out that Brazil does not only extract sugar and ethanol from sugarcane; further refinement yields electricity, bioplastics, and hydrocarbons.



Source: UNICA; Ministry of Mines and Energy BEN (2008); “Historical carbon budget of the Brazilian ethanol program” in *Energy Policy*, Volume 37, Issue 11

Furthermore, according to Velasco, satellite mapping has shown that sugarcane can be produced on 160 million more acres of Brazil’s land, and given the yield and efficiency gains of the economies of scale associated with sugarcane production, Velasco argued that ethanol prices will continue to drop. Moreover, UNICA has also “urged the federal government to prohibit sugarcane cultivation in sensitive biomes such as the Amazon forest and Pantanal wetlands and on native vegetation (e.g., cerrado and grasslands).”

In addition, Velasco highlighted the unique complementary relationship between sugarcane production and hydroenergy in Brazil. Essentially, during the dry season (April–November), sugarcane biomass has the potential to save 4 percent of reservoir stocks for every 1,000 megawatts of bioelectricity generated.



Source: Nivalde J. de Castro et. al. From CCEE andEPE

However, Velasco was quick to admit that Brazil is a specific country with particular endowments and production efficiencies that other countries, like the United States may not have. Nevertheless, he stressed that “sugarcane is not only a Brazilian story” but a global one, and identified four principles for a “viable biofuels value chain: feedstock performance, technology neutrality, sustainability, and open competition.” Velasco emphasized that there are one hundred countries that have the ability to produce biofuels and could potentially compliment the mere 20 oil producers providing fossil fuels today.

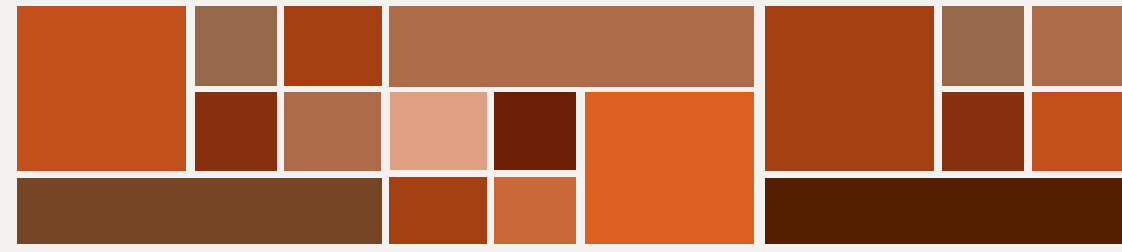
**Alexandros Petersen**, a Senior Fellow at the Atlantic Council, rounded out the discussion by describing the viewpoint of the European Union. The European Commission has outlined seven overarching goals for biofuels development. Petersen listed these seven strategic policy areas found in *An E.U. Strategy for Biofuels*: “stimulate demand for biofuels, ensure their environmental benefits, develop the production and distribution of biofuels, expand feedstock supplies, enhance trade

opportunities for biofuels, support developing countries, and support research and innovation.” However, according to Petersen, these goals have not come to fruition in part due to the “perennial EU problem of creating ambitious and detailed goals without prior debate.” Petersen pointed out that in laying out such grand objectives, the EU managed to please neither developing countries, industry, nor NGOs.

Furthermore, according to Petersen, “no EU member state is a champion of biofuels,” a fact that does not bode well for their future in the European Union. The fact that biofuels are primarily a transport sector need, combined with the negative perceptions that biofuels are linked to famine and that biofuels are bad for the environment, has led many member states to prefer other renewable energy sources. Thus, Petersen predicts that biofuels will eventually be edged out by other renewable sources of energy, like wind and solar power, as they are more popular in the European Union, recipients of more research and development funding, and championed by specific member states.

Nevertheless, Petersen did point to the recent biofuels cooperation pact between the European Union, Mozambique, and Brazil as an opportunity for the European Union to reach the goals outlined in its strategy. The agreement is driven by the European Union target of having 20 percent of its energy demand come from renewable sources by 2020, Brazil’s desire to expand production and its bioethanol expertise, and Mozambique’s recent role as a leader in African biofuels production. Under the pact, the European Union and Brazil will help Mozambique develop bioenergy projects.

Ultimately, each panelist supported the need to see biofuels in a global context. They all agreed that open international markets, harmonization of domestic policies, and sustainability must be present for effective biofuels policy. Furthermore, while it is vital to discuss biofuels policy, the closely related aspects of energy, agriculture, and trade policies should not be ignored.



## BIOFUELS: The Current State-of-Play

**C. Ford Runge<sup>a</sup>**  
**Robbin S. Johnson<sup>b</sup>**  
**Calestous Juma<sup>c</sup>**

Prepared for The Woodrow Wilson Center for Scholars,  
Washington, D.C.

July 23, 2010

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## INTRODUCTION

Biofuels policy in the United States remains controversial and much-debated. In the months since BP’s catastrophic deepwater oil rig explosion, the international debate over energy, ever inclined to drift on the winds of current events, has been captured by the fiasco in the Gulf and the environmental destruction from the errors of BP, Transocean and Haliburton. Knowing not how to respond, politicians including President Barack Obama have called for new, non-petroleum-based “clean” energy.

We shall argue that this raises the broader question of how not only to design a full portfolio of energy choices in the United States, including the role of biofuels, but also how best to think through energy portfolio choices. This brief will review the state of play in both spheres. In particular, the tragedy in the Gulf, which should not be underrated, in no way condones the excessive and indefensible subsidies to the biofuels sector. It does, however, afford an opportunity to rethink the role of government policy in the interface between energy and climate change.

## U.S. BIOFUELS POLICY

The pall cast over America’s energy future by the spill in the Gulf has worked in odd ways. On the one hand petroleum extraction and consumption, upon which the entire industrial enterprise is clearly staked for now (and in the reasonably foreseeable future), has risks. We already knew about air pollution and the climate hazards of an oil economy, but the risks of undersea extraction were largely ignored. The reaction to what has happened in the Gulf indirectly seems to endorse alternative energy sources. Yet the irony is that well before the BP disaster, the use of petroleum-based nitrogen fertilizer to grow corn, nearly a third of which now goes to make ethanol, had polluted the Gulf of Mexico. Nitrogen fertilizer is made from natural gas. After the surge in corn plantings in 2007 and 2008, the hypoxic or “Dead Zone” in the Gulf caused by run-off of nitrogen reached its largest extent in 25 years. The BP spill simply added to the Gulf’s ecological problems.

Meanwhile, the non-market-based stimulus to the biofuels sector in the United States shows no sign of abating, despite the fact that even if every bushel of corn the United States produces were dedicated to biofuels, it would support only about 15 percent of vehicular energy demand. The most intrusive support is usage mandates, which have diverted corn from food/feed to fuel use regardless of supply conditions or price levels. Far from moderating this policy, President Obama has called for an increase in the currently mandated level of biofuel production under the 2007 Renewable Fuels Standard (RFS) from 36 billion gallons by 2022 (including 15 billion gallons of corn ethanol) to 60 billion gallons by 2030.

While mandates replace market signals, the federal blenders’ tax credits provide added subsidies to the sector and badly distort those signals. In addition, a 54 cent a gallon tariff on imported – mainly Brazilian – ethanol keeps less expensive sugar-based ethanol from competing in the U.S. market. As well, there are an estimated 200 state and local subsidies to biofuels nationwide. Koplow estimates that if current laws are maintained until 2022, the biofuels industry will receive more than \$60 billion per year, a six-fold increase over the \$9.5 billion in support received in 2008. Cumulative subsidies between 2008 and 2022 are expected to total \$420 billion. If the “Obama Plan” mandating 60 billion gallons by 2030 comes to pass, subsidies in that year will be \$125 billion, and cumulative support from 2008 to 2030 will be in excess of one trillion dollars.

Summary of Subsidy to Biofuel Industry through the Tax Credits and RFS (in billions)	
In Year 2008	\$10
In Year 2022	\$60
<i>Cumulative Between 2008 and 2022</i>	\$420
Summary of Subsidy to Biofuel Industry through the Tax Credits and RFS under “Obama Plan” (in billions)	
In Year 2030	\$125
	> \$1,000
Koplow, 2009	

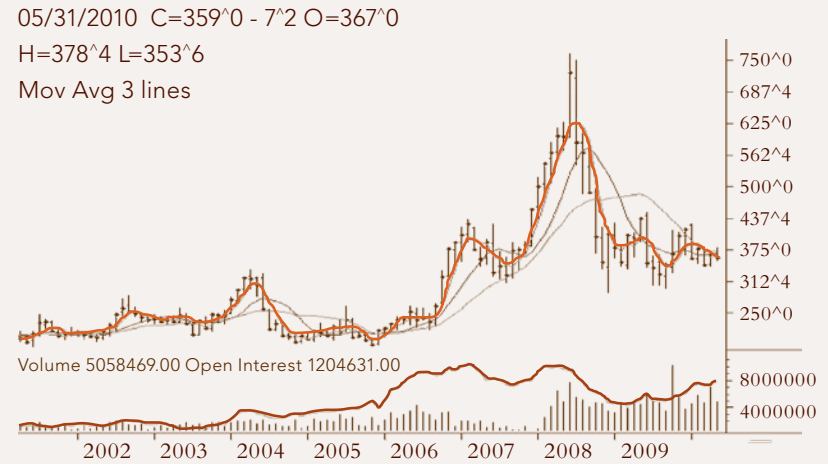
In principle, the mandated blending of biofuels will switch from corn-based ethanol (which tops out at 15 billion mandated gallons) to cellulosic alternatives based on feedstocks such as switchgrass. However, this year's mandated cellulosic blend had to be scaled back by 95 percent because the cellulosic fuel was simply commercially unavailable. In May 2010, USDA issued a critical assessment of the difficulties of cellulosic alternatives. U.S. production capacity for cellulosic fuels was estimated to be only 10 million gallons in 2010, compared to the 100 million gallons mandated for the year 2010 in 2007. The costs of cellulosic ethanol are estimated to be three to four times those for corn ethanol plants. The report noted that the costs of growing feedstocks for cellulosic plants are likely underestimates, and that "dedicated energy crops would need to compete with the lowest value crop such as hay which has had a price exceeding \$100 per ton since 2007." The leading cellulosic ethanol producer, Fiberight, is expected to have a production capacity of 130 barrels a day in 2010. Even a small oil refinery produces 60,000 barrels per day. Production capacity for cellulosic biofuel is forecasted by USDA at 291.4 million gallons by 2012, compared with a mandated 1,000 million gallons.

As a result of these costs and production shortfalls, Koplow (2009, p. 6) describes "a bizarre policy dynamic: the government will need to boost subsidies to cellulosic crops enough so the return to farmers is higher than that from the federally subsidized corn they are currently growing." From the taxpayer's point of view, he writes, this is the "equivalent of betting against oneself in a card game."

In an open letter to President Obama dated June 16, the Renewable Fuels Association, a lobbying arm of the biofuels industry, noting that Obama's June 15 address from the Oval Office failed specifically to mention biofuels, proposed several measures to reinforce existing subsidies. These included extending existing tax incentives; raising ethanol blend levels from the current 10 percent to 12 and ultimately 15 percent or higher; mandating the production of flexible fuel vehicles; and offering new loan guarantees to cellulosic ethanol producers.

In our previous assessments of biofuels policy we emphasized the effect of displacing corn for feed and food use for fuel, and the consequent upward

pressure on corn prices. A cursory examination of corn price charts shows that, after 2007, corn prices achieved highs in 2008, and have now settled at a higher plateau in the range of \$3.50-\$4.00 per bushel.



Early in June, the Food and Agriculture Organization of the UN noted that, although the FAO Food Price Index fell from 174 points in January 2010 to 164 points in May 2010, it remained 69 percent higher than in 2004. The specific role of biofuels in rising food costs is significant: the inflexibility of mandates helps cause price spikes when supplies are tight (see 2008 in the above chart); and the increasing diversion of corn to fuel over time pushes up long-term price trends. Biofuels policy has done little to provide more flexibility in response to such price effects. Nor has it confronted the fundamental question of an efficient distribution infrastructure, since ethanol is water soluble and cannot be moved in petroleum-dedicated pipes or containers.

U.S. biofuels policies also have a disproportionate effect globally. The decision in 2007 to double the corn-based ethanol mandate from 7.5 to 15 billion gallons pushed global fuel use of grains sharply upwards since America accounts for nearly 90 percent of world ethanol consumption.

As a result, grains used for biofuels reached 125 million tons in 2009-10, with FAO annual growth rates in the three preceding years of 15, 24 and 36 percent compared to non-industrial demand growth averaging about 2 percent per year. Roughly 8 percent of global grain production is now committed to heavily subsidized fuel use.

**FAO FOOD PRICE INDEX**

2000	90		2009	MAY	152
2001	92			JUNE	151
2002	90			JULY	147
2003	98			AUGUST	152
2004	111			SEPTEMBER	153
2005	115			OCTOBER	157
2006	122			NOVEMBER	169
2007	154			DECEMBER	172
2008	191		2010	JANUARY	174
2009	152			FEBRUARY	170
				MARCH	163
				APRIL	165
				MAY	164

Source: FAO

Yet, corn-based ethanol produces little net energy gain—20 to 30 percent by most credible estimates. And its effects on greenhouse gas emissions are seen as increasingly troublesome, both because of heavier nitrogen fertilizer use adding to nitrous oxide emissions and because of pressure to convert new lands to cropping, resulting in a “carbon debt” measured in decades to centuries, depending on the land converted and the conversion method used.

Finally, current U.S. biofuels policy is neither a cost-effective strategy for reducing greenhouse gases nor a reliable bridge to the supposed promise of “second generation” biofuels. Koplow estimates the cost of reducing carbon emissions through U.S. ethanol policy at \$500 per ton, among the most expensive of all available options. And the current structure of the U.S. ethanol industry—fermentation plants clustered largely in the heart of the Corn Belt—is ill-suited to a cellulosic-based strategy likely to require chemically-based breakdown of cellulose and lignin from wood or grass products grown on marginal lands far from the Corn Belt or the use of waste byproducts or algae also sourced far from existing plants.

**RE-THINKING BIOFUELS’ ROLE IN ENERGY POLICY**

This track record leads naturally to the question: What could prompt a re-thinking of U.S. biofuels policy specifically and energy policy more generally? American biofuels policy is now more than a third of a century old, and a variety of cracks are appearing in its façade. Any one of these cracks or several combined may prompt a return to the energy-policy drawing board:

- (1) in a newly debt-burdened America, the excessive costliness of current biofuels policies will prove troublesome, relying as it does on operating subsidies to specific companies and commodities rather than on “public goods” investments accessible to all and favoring the least-cost solutions;
- (2) in a national debate over the appropriate regulatory role of government, biofuels policy will look increasingly disruptive, relying as it does on mandates that displace market signals with unrealistic political goals that already have lifted and spiked food prices, driving tens of millions in poor countries into debilitating hunger;
- (3) in a re-examination of alternative energy sources, biofuels will be found wanting on two scores, being both an inefficient replacement of petroleum as an energy source and a high-cost strategy for reducing greenhouse gas emissions;

- (4) in a re-consideration of environmental pollution problems, biofuels will emerge as a major contributor to pollution through nitrogen run-off, as a threat to biodiversity through pressure on land conversion and water scarcity and as a worrisome contributor to nitrous oxide emissions (which are 296 times more forcing as a greenhouse gas than carbon);
- (5) in an assessment of long-term solutions, biofuels will look less attractive because of the need for a costly separate distribution system to avoid problems from water solubility;
- (6) as more comes to be understood about “next generation” biofuels, corn-based ethanol will come to seem more like a barrier than a bridge, given likely differences in location, processing technologies and feedstocks for the two industries and the necessity of overcoming current ethanol and farm subsidies to launch a new industry;
- (7) as skepticism mounts over the technological and economic feasibility of next generation biofuels because commercial production proves continuously elusive and its costs increasingly burdensome, the whole biofuels pathway will be re-examined; and
- (8) as practical, medium-term solutions become more attractive, attention is likely to shift away from quickly replacing petroleum-based liquid fuels to finding more efficient ways to improve fuel use; already rising fuel economy means that U.S. gasoline use probably peaked in 2007 and will decline going forward; a McKinsey study showed that most reductions in carbon emissions between now and 2030 can come cheaply and from existing technologies; and de-carbonizing the U.S. economy will be a gradual and incremental initiative.

If some or all of these changes in thinking develop over the coming years, it will mean a re-framing of U.S. biofuels policy. How might that be done in a thoughtful way? A first step certainly would be freezing the mandates and ending their escalation, as they take policy increasingly away from what is achievable or affordable. And from the standpoint of the ethanol industry itself, its share of transport fuel usage is more reliably

grown through market-based competition than mandate-based sourcing shifts. This is especially true given all of the technological and economic uncertainties surrounding next-generation biofuels.

Second, the blender’s tax credit was recently reduced from 51 cents to 45 cents per gallon. This credit should continue to be phased down in measured but clearly committed steps. Consideration also might be given to replacing it with a subsidy that varies inversely with corn prices, rising to promote surplus disposal when corn prices fall but phasing out as corn prices rise. This would make corn-based ethanol more of a balance-wheel in farm policy than a de-stabilizer in food policy.

Third, the biofuels market needs to be opened and internationalized to promote greater efficiency and competitiveness. This would reward low-cost producers while also providing more breadth and diversity to the potential market. The United States, accounting for 87 percent of ethanol consumption, needs to set the tone and direction if it is serious about ethanol as a transport fuel.

In addition to putting ethanol on a more realistic foundation, these changes would free up substantial resources for research into a broader array of clean energy alternatives. These should include not just new energy sources but also improved energy storage and distribution technologies and more efficient energy-usage approaches. Dedicating the current \$10 billion annual cost of the U.S. biofuels policy to such a three-pronged research agenda (let alone the six-fold increase in spending that is looming under a continuation of the current course) is likely to produce more usable, cost-effective energy and climate-change solutions.

This approach requires moving government back out of its current, inappropriate role of distorting or replacing market signals and back into its more appropriate role of investing in public goods to create new market opportunities. Such a shift, however, is likely to be more cost-effective. And, while the transition may be difficult, the resulting policy course also is likely to enjoy more broad-based support.

## Endnotes

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- <sup>5</sup>Runge and Senauer, Foreign Affairs; Runge, C. Ford and Robbin S. Johnson, "Ethanol: Train Wreck Ahead?", Issues in Science and Technology (Fall)(2007): 25-30.
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- <sup>7</sup>Op. cit., note 2.

## Panel Biographies

**Robbin S. Johnson** retired from Cargill effective January 1, 2007. He now is President of the Cargill Foundation and Senior Adviser, Global Policy Studies, at the University of Minnesota's Humphrey Institute of Public Affairs. Johnson joined Cargill in 1971. He was named an assistant vice president in 1976, vice president, Administrative Division, in 1982 and was elected Corporate Vice President, Public Affairs, in 1993. In June 2000 he was elected Senior Vice President, Corporate Affairs, in which role he worked with Cargill's senior leadership team on public policy and communications strategies and served on the Corporate Center and the Corporate Affairs Committee. Johnson graduated from Yale University in 1968 with a bachelor's degree, did graduate study as a Rhodes Scholar at Oxford University in England from 1968 to 1970 and attended Yale Law School from 1970 to 1971.

**Calestous Juma** is Professor of the Practice of International Development and Director of the Science, Technology, and Globalization Project at Harvard Kennedy School of Government. He also directs the Agricultural Innovation in Africa Project funded by the Bill and Melinda Gates Foundation. He is a former Executive Secretary of the UN Convention on Biological Diversity and Founding Director of the African Centre for Technology Studies in Nairobi, and he also served as Chancellor of the University of Guyana. He has been elected to several scientific academies including the Royal Society of London, the US National Academy of Sciences, the Academy of Sciences for the Developing World, the UK Royal Academy of Engineering and the African Academy of Sciences. He has won several international awards for his work on sustainable development. He holds a PhD in science and technology policy studies and has written widely on science, technology, and environment. Among others, he serves on the boards of WWF International and the One Laptop per Child (OLPC) Foundation. He is the lead author of *Innovation: Applying Knowledge in Development*. He is co-editor of *Engineering Change: Towards a Sustainable Future in the Developing World*. He is editor of the peer-reviewed *International Journal of Technology and Globalisation* and *International Journal of Biotechnology*.

**Alexandros Petersen** is an international energy consultant and Senior Fellow with the Atlantic Council's Dinu Patriciu Eurasia Center. Previously he served as Fellow for Transatlantic Energy Security and Associate Director of the Council's Energy and Environment Program. He came to the Council from the Woodrow Wilson International Center for Scholars, where he served as Southeast Europe Policy Scholar and The Center for Strategic and International Studies, where he was an Adjunct Fellow with the Russia and Eurasia Program. Before that, he served as Program Director of the Caspian Europe Center in Brussels and Senior Researcher at the International Institute for Strategic Studies in London. Petersen regularly provides analysis for publications such as *The Economist*, *Wall Street Journal*, *International Herald Tribune*, *Washington Times*, *Moscow Times*, *Kyiv Post*, *Hurriyet*, and *Georgia Today*, among many others. Petersen received a BA in War Studies with First Class Honors from King's College London and an MSc in International Relations from the London School of Economics.

**C. Ford Runge** is the McKnight Professor of Applied Economics and Law at the University of Minnesota, where he also holds appointments in the Hubert H. Humphrey Institute of Public Affairs and the Department of Forest Resources. His teaching and writing interests concentrate on trade and natural resources policy. Professor Runge received his Ph.D. in agricultural economics at the University of Wisconsin, his M.A. in economics as a Rhodes Scholar at Oxford University, and his B.A. at University of North Carolina-Chapel Hill. He has served on the staff of the House Committee on Agriculture, and as a Science and Diplomacy Fellow of the American Association for the Advancement of Science, working with USAID on food aid and trade.

**Joel Velasco** is Chief Representative in North America of Brazil's Sugarcane Industry Association (UNICA). Based in Washington, DC, Mr. Velasco oversees UNICA's efforts to expand the North American sugar and bioenergy markets, with a particular focus on low-carbon, advanced biofuels. Previously, he was Managing Director of Stonebridge International, an advisory firm. Prior to that, he served as Senior Advisor to the U.S. Ambassador to Brazil. From 1994 to 1997, Mr. Velasco served

as a personal aide for Vice President Al Gore. A dual-national of Brazil and the United States and fluent in both languages, he worked on a broad spectrum of issues ranging from trade to regional security. Educated both in Brazilian and American schools, Mr. Velasco received a masters degree at the Georgetown University School of Foreign Service, focusing his studies on the political-economy of the Southern Cone, and earlier earned a B.A. in Political Science from Hampden-Sydney College in Virginia.

**Carl Wolf**, an Analyst at BCS, Incorporated, provides international policy and project management consulting to the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), and the Office of the Biomass Program, and works on-site at the Department of Energy Headquarters in Washington, DC. Mr. Wolf has experience providing policy and data research and analysis support to several clients, including the State of Maryland and the U.S. Department of Energy, including the Office of Biomass Program, the Biomass Research and Development Initiative, the Industrial Technologies Program, and the EERE International Office. Mr. Wolf has also been involved in the development of several publications, and has participated or been engaged in several strategic energy meetings between DOE and other countries' energy agencies.

**Kent H. Hughes** is the director of the Program on America and the Global Economy (PAGE) and *Wilson Center on the Hill*. He has also served as a Public Policy Scholar at the Wilson Center. Hughes has held positions as Associate Deputy Secretary of Commerce, President of the Council on Competitiveness, and Chief Economist to Senate Majority Leader Robert Byrd. As director of PAGE, Hughes is an expert on international trade, finance, and the global economy; U.S. competitiveness; and science and technology policy. His publications include *Building the Next American Century: The Past and Future of American Competitiveness* (2005) and *Innovation in the United States: The Interplay of History, Institutions, and American Culture* (2006). Hughes holds a B.A. in Political and Economic Institutions from Yale University, an LL.B. from Harvard Law School, and a Ph.D. in Economics from Washington University in St. Louis.



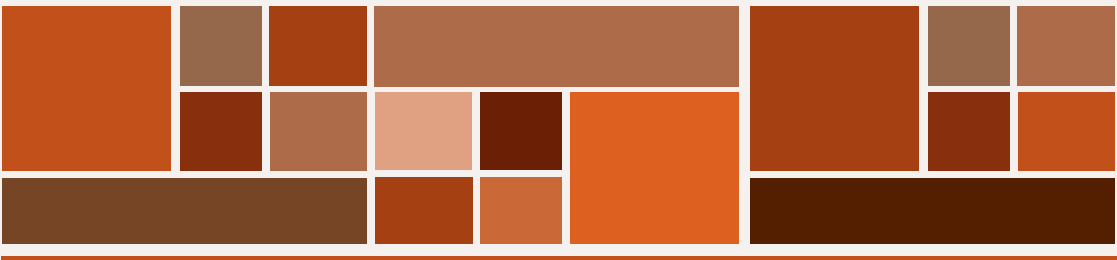
**Paulo Sotero** is the director of the Brazil Institute of the Woodrow Wilson Center. Prior to joining the Center, he was the Washington correspondent for *Estado de S. Paulo*. He has also been a regular commentator and analyst for the BBC radio Portuguese language service, Radio France Internationale, and is a contributor to newspapers, magazines and scholarly journals. From 2003 to 2006, he served as adjunct lecturer at Georgetown University Center for Latin American Studies. In 2009, he joined the adjunct faculty of the Elliott School of International Affairs, George Washington University. He started his career in journalism at *Veja* weekly magazine in 1968 and held positions in Recife, Paris, Lisbon, São Paulo, and Brasília. In Washington, he worked also as correspondent for *Istoé* weekly magazine and the financial daily *Gazeta Mercantil*. He is a member of the Maria Moors Cabot Prize Board, the Grupo de Conjuntura Internacional, a forum of discussion on Brazilian foreign and trade policies at the University of São Paulo, and the Fernando Braudel Institute of World Economics.

## About the Program on America and the Global Economy

The Program on America and the Global Economy (PAGE), brings together experts from the public and private sectors to explore three interrelated areas: globalization, innovation, and long-term U.S. economic growth. Its conferences and publications focus on examining the effects of current global economic developments on key economies and developing regions; highlighting the potential of technological innovation in the United States and around the world to respond to major global challenges and to meet international goals of sustainable growth, global health, and energy security; and emphasizing the key building blocks of long-term U.S. economic prosperity: investment, innovation, life-long learning, and global engagement.

## About the Brazil Institute

Created in June 2006 as part of the Wilson Center's Latin American Program, the Brazil Institute strives to foster informed dialogue on key issues important to Brazilians and to the Brazilian-U.S. relationship. The Brazil Institute works to promote detailed analysis of Brazil's public policy and advance Washington's understanding of contemporary Brazilian developments, mindful of the long history that binds the two most populous democracies in the Americas. The Institute honors this history and attempts to further bilateral cooperation by promoting informed dialogue between these two diverse and vibrant multiracial societies. Our activities include: convening policy forums to stimulate nonpartisan reflection and debate on critical issues related to Brazil; promoting, sponsoring, and disseminating research; participating in the broader effort to inform Americans about Brazil through lectures and interviews given by its director; appointing leading Brazilian and Brazilianist academics, journalists, and policy makers as Wilson Center Public Policy Scholars; and maintaining a comprehensive website devoted to news, analysis, research, and reference materials on Brazil.



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