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Economic Policy Program

Biofuels

Summaries of Analyses in 2008 of Biofuels Policies by International and European Technical Agencies

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Summary: Since January 2008, international institutions, national technical agencies, and major international scientific organizations have released ten major reviews of biofuel policies. This brief summarizes their conclusions, which include:

- World land use competition means liquid biofuels are only capable of making a limited contribution to world energy supplies and greenhouse gas reductions.
- Direct and indirect land use change due to biofuels has a high potential to eliminate or greatly reduce their greenhouse gas benefits.
- Biofuels have contributed significantly to crop price increases and food insecurity in the last few years.
- Relying on biofuels grown on dedicated land is mainly likely to spur biofuel production and create rural jobs outside of Europe where production of feed stocks is cheaper.
- Biomass is more efficiently used for energy and greenhouse gas reductions in electricity production than biofuels.
- Large biofuel mandates should be reconsidered.

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Since January 2008, international and European technical institutions have released ten major reviews of biofuels policies. Within the European Union governance structure, the European Economic and Social Committee, the Joint Research Committee of the European Commission, and the Science Advisory Board of the European Environment Agency have released reports or opinions. International reports have come from the UN Food and Agriculture Organization, the World Bank, the Organisation for Economic Development and Co-operation (OECD), and the International Energy Agency. National technical reviews have come from the Netherlands Environmental Assessment Agency, the U.K.'s Renewable Fuels Agency (the "Gallagher Report"), and the British Royal Society.

This brief summarizes the conclusions of these ten reports, focusing in particular on their findings of environmental advantages and disadvantages, land use effects, and economics. Although the reports do not entirely overlap, they show a high level of agreement and repeatedly offer the following findings:

- World land use competition means liquid biofuels are only capable of making a limited contribution to world energy supplies and greenhouse gas reductions. The most potentially optimistic view presented in the ten reports, which is presented by the International Energy Agency, forecasts liquid biofuels primarily as a long-term energy source for airplanes, ships and heavy trucks if major increases in world agricultural yields free up hundreds of millions of hectares of agricultural land.
- Mandates and subsidies to produce biofuels are significantly more expensive methods than other methods of reducing greenhouse gas emissions and use of fossil fuels even if greenhouse gas calculations ignore land use change.
- If developed carefully, biofuels hold out promise for economic development in the developing world, with particular benefits as a replacement for existing energy uses of wood.
- Direct and indirect land use changes due to biofuels have high potential to eliminate or greatly reduce greenhouse gas benefits. Estimates of indirect land use change need to be incorporated into greenhouse gas accounting to gain an accurate understanding of the green house gas benefits of biofuels. Using wastes, residues, and degraded land provide the best opportunities for environmentally sustainable biofuels.

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- Biofuels have contributed significantly to crop price increases and food insecurity in the last few years and will continue to cause higher crop prices, but the magnitude of impacts will be smaller in the future as markets adjust.
- Relying on biofuels grown on dedicated land will mainly spur biofuel production and create rural jobs outside of Europe where production of feedstock is cheaper. Other renewable fuels and the use of biomass from crop residues will generate greater development benefits in Europe.
- Biomass saves more energy and greenhouse gases if used for electricity production rather than biofuels.
- Large biofuel mandates, including the 10 percent mandate proposed by the European Commission, should be reconsidered.

European Economic and Social Committee

The Use of Energy from Renewable Resources (August 28, 2008)

The goal of the European Commission's proposed directive to require 20 percent renewable energy by 2020 is strategically and politically appropriate and technically and economically feasible, but it is compromised by the agrofuel requirement. The future of private cars lies not with agrofuels but with electric traction powered by renewable energy, which is much more land efficient. Because of land competition, relying on biofuels means that as oil prices rise, the cost of agrofuels will rise as well.

Expansion of agrofuels on arable land will also release carbon dioxide and nitrous oxide and "will in the end be detrimental to climate protection." The 10 percent transport fuel target would reduce greenhouse gas emissions in Europe, even without counting land use change, by only 1 percent, which is "out of all proportion to the costs and associated risks" and represents "an extreme misallocation of resources."

Use of European biomass from such sources as manure and wood chips for electricity produces far cheaper greenhouse gas reductions. The biofuel policy would favor imports from outside the European Union because agrofuel production there is cheaper, and as a result creates "hardly any new jobs" in Europe. By contrast, other renewable fuel strategies, including use of residuals, would build jobs within the European Union. Sustainability criteria lack social elements, environmental criteria are inadequate, and the belief that these criteria would work to protect high carbon areas like rainforests in peatlands is "illusory."

European Commission Joint Research Committee

Biofuels in the European Context: Facts and Uncertainties (May 2008)

Using biomass for electricity saves nearly twice as many greenhouse gases as using biomass for liquid fuel, and those reductions are much cheaper. Converting biofuels has low energy efficiency.

Indirect land use change needs to be factored into an analysis of greenhouse gas benefits from biofuels. Uncertainties regarding indirect land use change mean it is impossible to say whether the impact of biofuels on net greenhouse gases is positive. Most indirect land use change will occur outside of Europe, and emissions from peatlands are particularly large. As a whole, it is reasonable to estimate that 12 percent of rape biodiesel will be replaced by palm on peatlands. For every liter of European rapeseed oil diverted to biodiesel, if only 2.4 percent of that rapeseed oil is replaced by palm oil grown on peatlands, the emissions from the oxidizing peat cancel out the benefits from biodiesel indefinitely, and that is not the worst case. Certification schemes can help reduce environmental effects but cannot prevent indirect land use change.

Emission rates from nitrous oxide in producing biofuels are also critical but uncertain. Inputs into agricultural production outside of the European Union are also uncertain. Each of these uncertain factors by itself also has the potential to "negate GHG savings from the 10 percent biofuel target."

Benefits from fuel security are overstated. If second-generation biofuels do not make significant contributions, imported biofuels will directly supply more than half of European ethanol and 80 percent of biodiesel. Because European vegetable oil production will not keep pace with food demand alone, virtually all biodiesel will come from abroad indirectly.

The net employment effects of European biofuel production are neutral or close to neutral because the increased employment from European biofuels is negated by the adverse employment effects of the taxes needed to pay for them.

One cannot be sure that the net effect of biofuel production is increased fuel security because ethanol could simply increase gasoline exports from European refiners, and biofuels could divert biomass away from stationary burners.

Viewing all costs and benefits, despite uncertainty, "It is obvious that the cost disadvantage of biofuels is so great . . . that even in the best of cases, they exceed the value of external benefits that can be achieved."

UN Food and Agricultural Organization

Status and Projections: Biofuels today provide roughly 1 percent of total transport fuel, and .2 to .3 percent of total world energy, while using 1 percent of world cropland. Existing policies as of 2007 would drive biofuel production to 3.3 percent of transport fuel in 2015 and 5.9 percent in 2030, which would use 14.5 percent of arable land in Europe, 9.2 percent in the United States and Canada and 3.8 percent worldwide. Europe would also import large volumes of biofuels, particularly biodiesel from palm oil made in Malaysia, which is cheaper to produce there than in Europe. (Indonesia will expand biodiesel production for domestic markets)

Greenhouse Gases: "Some biofuels may, under certain conditions, help reduce greenhouse gas emissions," but land use change is a "key determining factor," and for "many locations, emissions from land-use change –whether direct or indirect—are likely to exceed, or at least offset, much of the greenhouse gas savings obtained by using biofuels for transport."

Energy Security: Liquid biofuels can be expected "to displace fossil fuels for transport to only a very limited extent" because of the land required and because "expanding biofuel production quickly bids up the price of agricultural feedstocks and makes them uncompetitive against petroleum-based fuels." If ethanol production used 25 percent of the seven major food crops potentially available, it would supply 14 percent of gasoline, while even a "very modest contribution of biofuels to overall energy supply may yet have a strong impact on agriculture." If government policies pushed biofuels to provide 5.8 percent of world transport fuel in 2030, that would require 52.8 million hectares of world cropland. However, countries with a "large natural-resource base" may be able to develop an economically viable biofuel sector, and feedstocks that use "wood, tall grasses and forestry and crop residues" would increase the fuel potential.

Food Security: Many factors have contributed to rising food prices, including steadily declining cereal stocks since 1995, poor yields in Australia and Canada, and high oil prices, but the growth of biofuels consumed more than half of all cereal growth between 2005 and 2007 and was a significant factor. Although commodity prices will retreat due to increased production, "demand for biofuels is likely to continue its influence on prices well into the future." Food import bills of least developed countries rose by 33 percent for cereals and 67 percent for vegetable oil from 2006 to 2007 although domestic policies have buffered some part of the effect of the increases on consumers. The vast share of poor are net food buyers not sellers —in 12 summarized countries, buyers average 75 percent overall — and food for the poorest households accounts for at least half and often more of total spending.

In the long run, some of these adverse effects in rural areas may be offset because higher crop prices can trigger higher wages and generate multiplier effects from farm production increases. In the absence of trade barriers, biofuel production in developing countries could also provide benefits if it adds to but does not displace food production. Greater competition for land could also lead to displacement of small farmers, so strong policy and legal protections are necessary for biofuels to have the potential to help the poor.

Development Opportunities: Biofuel production provides development opportunities for countries with abundant natural resources, but the opportunities depend upon the elimination of trade-distorting subsidies.

Policies: "There is an urgent need to review . . . biofuels policies [in OECD countries]," which "have not been effective in achieving energy security and climate-change mitigation." "Sustainability criteria and relative certification can help insure environmental sustainability, although they cannot directly address the effects of land-use change resulting from an increased scale of production." Reducing subsidies and mandates will "allow time for improved technologies and yield increases to become effective," and "expenditures on biofuels would be much better directed towards research and development . . . rather than towards subsidies linked to production and consumption."

International Energy Agency

Energy Technology Perspectives (September 2008)

Note: This report is a broad review of possible energy alternatives to reduce greenhouse gas emissions by 2050, of which one chapter discusses energy from biomass.

Biomass today provides roughly 10 percent of world energy of which traditional uses of firewood for heating and cooking make up two thirds. The report develops two scenarios of greenhouse gas reductions, one required to achieve current levels of emissions in 2050 at a cost of up to $50 per ton of CO2 saved. The second, "blue" scenario, would reduce current emissions by 50 percent and would require expenditures up to $200 per ton (and potentially higher if technology does not evolve). In the blue scenario, biomass would rise to 23 percent of total world primary energy. That would make biomass

the world's largest renewable energy source, and is significant. Of this figure, liquid biofuels for transport would provide roughly one fifth, or less than 5 percent of energy overall.

Using energy crop biomass for heat and power provides twice the energy per hectare as using it for biofuels. In the blue scenario, electric or hydrogen fuels are likely to be the dominant fuel for passenger vehicles. But biofuels would be more cost-effective, feasible and desirable for airplane, ship and heavy vehicle transport. Production costs for cellulosic ethanol in an optimistic scenario will drop to $0.65 per liter (gasoline equivalent) by 2015 and to that price for cellulosic biodiesel by 2020, and both prices will modestly decline to roughly $0.55 per liter by 2050. [That price is equivalent to roughly $70/barrel oil.]

Around half of total biomass to reach this goal would derive from residuals and waste products. Providing the other half from energy crops would require 375 to 750 million hectares (depending on whether yields across the landscape average 5 or 10 tons/hectare/year). [This land is equivalent to 25 to 50 percent of the world's total cropland.] Its availability "will depend on the rate of further crop yield improvements" as well as possible diet changes. "Producing biomass for energy purposes at the expense of either food or fibre supplies, or by increasing deforestation, is of little global benefit. Biomass production needs to be sustainable: by being integrated with food and fibre crop production or by being grown on surplus or marginal land."

"More research is needed to understand where and how these conditions can be met in practice." "A full global mapping that helps identify optimal growing areas and promising non-crop sources (such as agricultural and forestry wastes) needs to be developed. Near-term successful deployment of second generation technologies could trigger exploitation of biomass resources (such as forests) in an unsustainable manner."

The World Bank

A Note on Rising Food Prices (July 2008)

Between January 2005 and June 2008, prices for maize rose 300 percent, wheat 127 percent, rice 170 percent, and vegetable oil 200 percent. These increases were "caused by a confluence of factors, but the most important was the large increase in biofuel production from grains and oilseeds in the United States and the European Union. Without those increases, stocks would not have declined significantly and price increases from other factors would have been moderate."

Demand for biofuels consumed 70 percent of the increase in maize production between 2004 and 2007, and one third of the increase in vegetable oil. That raised prices for these products, and other crop prices rose in response to crop-shifting. The United States increased land in maize [corn] production in 2007 by 23 percent, which led to a 16 percent decline in soybean area and contributed to a 75 percent rise in soybean prices between April 2007 and April 2008. This maize expansion also diverted land from wheat and slowed the expansion of wheat production. Despite high wheat prices, the eight largest wheat exporters expanded rapeseed and sunflower area by 31 percent between 2001 and 2007, while wheat area fell 1 percent. If these increased oilseed lands had instead been planted in wheat, wheat stocks would have remained constant between 2001 and 2007 instead of falling by nearly half. Rice prices surged in response to wheat prices, which raised concerns about the adequacy of global grain supplies although there was little change in rice production or stocks.

Although other analyses have pointed to bad crop years, poor yields have not been significant factors overall. Global crop prices began sustained price increases in 2005 although the 2004/05 crop year for grains was 10 percent larger than the average of the three previous years, and a near record crop in 2005/06 was still 9 percent larger. Although droughts in Australia reduced grain exports in 2006 and 2007, and poor crops in the European Union and Ukraine also reduced exports in 2007, those declines were more than offset by large crops in and exports from Argentina, Kazakhstan, Russia and the United States. For example, while global grain supply declined 1.3 percent in 2006, it increased 4.7 percent in 2007.

Rapid income growth in developing countries, also blamed for spurring price increases, has not led to large increases in grain consumption in recent years. Overall, increased international consumption of grains for food of 1.7 percent matched the increase in grain production, and was actually slower in 2000-2007 than in 1995-2000.

The impact of energy prices can be analyzed by estimated increases in the cost-of-production by the U.S. Department of Agriculture for energy-intensive U.S. agriculture, and by increased transportation costs. In total, energy prices contributed 15 to 20 percent to higher U.S. crop prices. The decline of the dollar increased food prices between January 2002 and June 2008 by roughly 20 percent. Collectively, these two factors caused 25 to 30 percent of the total price increases, and most of the remaining 70 to 75 percent increase was due to biofuels.

Organization of Economic Development and Cooperation

Economic Assessment of Biofuel Support Policies (July 2008)

OECD countries have adopted a broad range of subsidies for biofuels including tax credits, investment incentives, blending mandates and trade restrictions. Worldwide, biofuels provided 1.8 percent of transport fuel (36 MTOE) in 2007. Total OECD subsidies amounted to $11 billion in 2006 and will rise to $27 billion per year on average between 2013 and 2017, not counting the effects of the recent U.S. Energy Bill (the Energy Independence and Security Act or EISA) or the proposed EU biofuel directive. Biofuels replace fossil fuels in OECD countries at a cost of $0.80 to $7.00 per litre.

Despite higher fuel prices, the gap between biofuels and fossil fuels has widened in recent years because biofuel feedstock prices also increased by between 86 and 110 percent from 2004 to 2007. Wheat ethanol and biodiesel are particularly uncompetitive with conventional gasoline and diesel.

The feedstock assumed and different assumptions used in lifecycle analysis result in different findings regarding the greenhouse gas benefits of biofuels, not counting land use change. In general, without counting the effects of land use change, sugarcane ethanol reduces greenhouse gas emissions by roughly 85 percent and biodiesel from rapeseed by 40 to 55 percent. Reflecting these estimates, biofuel levels projected for 2015 (not counting recent legislation) would reduce world greenhouse gas emissions by .5 to .7 percent at a cost of $960-$1,700 per ton of greenhouse gases saved (carbon dioxide equivalent.) The costs of reducing greenhouse gas emissions by conserving energy are cheaper, and emissions reductions are often substantially cheaper in other sectors.

In addition, many estimates of direct land use change indicate that conversion of grassland alone will eliminate greenhouse gas benefits for many biofuels, and effects of indirect land use change are "potentially as important." "Deforestation at the global level is a more important factor than emissions from transport." In some circumstances, potential win/win solutions are possible, such as use of short-rotation trees and prairie grasses, but realization of benefits requires careful planning, incentives, research and management support. Because of likely impacts from climate change and strongly increasing food demand over the coming decades, "careful consideration" must be given to the uses of agricultural land. Additional research is needed.

Existing support "and even more so the new legislation" in the United States and the European Union "are likely to accelerate the expansion of land under crops particularly in Latin America and large parts of Africa." Because of biofuel support policies in place in 2007, 12 percent of global coarse grain production and 14 percent of global vegetable oil production could be used for biofuels in the 2013-2017 period, up from 8 percent and 9 percent in 2007, respectively. With the EISA and new EU directive, those figures would rise to 20 percent of world vegetable oil and 13 percent of world coarse grains (such as corn and sorghum). Based on OECD modeling, a removal of all OECD subsidies and mandates would result in a reduction of 16.5 million liters of ethanol and 13.1 million liters of biodiesel, resulting in 6.2 million fewer hectares of cropland on average in this period. By contrast, implementation of EISA and EU directive would increase biodiesel production by 15.6 million liters and ethanol by 19.4 million liters and result in 13 million more hectares of crop production in the world in that period.

"The growth of the global biofuel industry is responsible for an important share of the increase in projected [crop] price levels compared to the historical average." Current biofuel policies, not counting the EISA or proposed EU directive, are projected to increase wheat, maize and vegetable oil prices by 5 percent, 7 percent and 19 percent respectively (even though maize ethanol would remain at 80 percent of present levels even if biofuel incentives were abandoned).

Netherlands Environmental Assessment Agency

Local and Global Consequences of the EU Renewables Directive for Biofuels (July 2008)

Meeting the 10 percent biofuels target of the EU draft directive would probably require 14 million hectares within Europe to produce 57 percent of the biofuels target. Imports would supply the remainder, bringing total world land dedicated to the EU's biofuels up to 20-30 million hectares. The availability of land within Europe depends on the liberalization of agricultural policies, which would reduce crop production in Europe. But that liberalization would also mean little capacity to maintain biofuel production within Europe because ethanol and biodiesel production are cheaper outside Europe. The EU proposal can therefore "be seen as an incentive to produce biofuels outside Europe." Meeting U.S. and EU targets worldwide would require 60 million hectares by 2020, and the increase in land for biofuels would consume 70 percent of the expansion in land area for wheat, maize, oilseeds, palm oil and sugarcane.

The directive does not assure that the 35 percent required reduction in greenhouse gas emissions will be met. Although default

values are chosen with care, part of the problem is that producers may pick and choose among default values. As a result, producers can claim lower emissions from some parts of their process and use default value for other parts that actually cause total emissions to be higher. Nitrous oxide emissions in particular will be higher than default values in some cases.

More importantly, these default values do not cover "displacement" effects and associated greenhouse gas emissions. Projected land area for wheat, maize, oilseeds and sugar is expected to grow by 10 percent between 2000 and 2020, and EU and U.S. policies would increase that growth to 15 percent, an amount that "cannot be offset entirely by further yield growth."

Because of land use change, the net effects of the directive on biodiversity will also be negative. Within Europe, the protection of grasslands should be expanded to recognize the high biodiversity value of many non-natural grasslands. If that protection is clarified, European biodiversity should be protected, but outside of Europe, biodiversity will suffer because of the displacement effect.

Second generation biofuels will also need land and can cause increases in greenhouse gas emissions. These biofuels may not perform better than crop-based biofuels when land use change is incorporated into the analysis and the value of by-products for crop-based biofuels is recognized. The greenhouse gas effects of cellulosic biofuels therefore depend on where they are grown. Second-generation biofuels may be more appropriate for degraded and otherwise idle lands, but the directive does not dictate use of such lands. Wastes and residuals will avoid this land use problem but will not enter the transport sector in large amounts before 2020.

The 10 percent biofuels target should be reconsidered. Although the additional costs of first-generation biofuels may not be high at high oil prices, "the potential to reduce greenhouse gas emissions in 2020 is quite low," "biodiversity losses cannot be excluded and impacts on food security through food price effects are likely." Meanwhile, alternatives for the transport sector exist, and while uncertain, their long-term potential is high.

U.K. Renewable Fuels Agency

The Gallagher Review of the Indirect Effects of Biofuel Production (July 2008)

Without counting land use change, most analyses find that biodiesel reduces greenhouse gas emissions by 40 to 50 percent and ethanol by 20 to 80 percent. These analyses traditionally assume that no land-use change has occurred. However, biofuel production is displacing agricultural production, "accelerating land use change and, if left unchecked, will reduce biodiversity and may even cause greenhouse gas emissions rather than savings."

By 2020, changing diets and demand for biofuels are estimated to increase demand for cropland by 17 to 44 percent. A study commissioned by the Renewable Fuels Association (RFA), "estimates an additional land demand of 200-500 million hectares to 2020, even taking into account anticipated improvement in yield," which compares to 1,500 million hectares in crop use today. Although high yield estimates reduce this demand by 10 percent, those yield gains are uncertain and even so cannot prevent substantial crop expansion. Various targets for biofuels by 2020 would increase land demand by 56 to 166 million hectares. The lower estimates take into account the land use benefits of co-product, and assume significant levels of second generation biofuels and improvements in crop yields. Under different scenarios, biofuels would cause 11 to 86 percent of the additional agricultural land demand in this period.

Different estimates from IASSA and the European Environment Agency differ substantially in their estimates of available new cropland, with some estimates showing not enough land and others enough to meet human demands. Although enough land is probably available, the land use change for food and biofuels will have environmental and greenhouse gas effects.

The EU directive will cause substantial land use change both inside and outside the European Union. European Commission estimates of land availability did not account for land use change outside the European Union. They also assumed availability of set-aside lands, large imports, and substantial levels of second generation biofuels. Although there is potential to improve yields in many areas, including Brazilian pasture land and parts of Africa, agricultural expansion spurred by biofuels will likely move into sensitive lands, including tropical rain forest and peat lands in the absence of effective policies.

More short-term economic models estimate biofuels increase crop prices by 16 to 76 percent depending on the scenario and crop. Longer term general equilibrium models, after markets have had full opportunity to adjust, are generally lower at 5 percent worldwide but as much as 72 percent in some regions for particular crops.

Second-generation biofuels show promise, but that promise depends on their source of feedstock. "Second generation biofuels

using feedstocks grown on existing agricultural land may cause greater net land-use change than first generation biofuels that also produce co-products that avoid land use."

Recommendations: Estimating the impacts of biofuels on land use change and food security has many uncertainties, but the likelihood of adverse impacts on food security, biodiversity and greenhouse gas is sufficiently high that feedstock production must focus on biofuels that do not trigger indirect land use change. "There is a future for a sustainable biofuels industry, but feedstock production must avoid agricultural land that would otherwise be used for food production." Biofuel production should instead focus on residues, wastes and biofuels generated on marginal and idle land, and only a portion of such idle land should be used for biofuel production to manage the risk of indirect land use change. EU criteria do not assure sustainability because they do not address indirect land use change, but a framework for doing so does not now exist and therefore needs to be developed. Because of the potential for sustainable fuels, the RFA recommends continuing to implement biofuels requirements at a slower rate while the European Union develops better analysis for incorporating indirect land use change.

The Royal Society

Sustainable Biofuels: Prospects and Challenges (January 2008)

Biofuels appear at first sight to be renewable and carbon neutral because carbon emitted by burning them was originally absorbed by plants, but the truth is more complex. Transport fuel is expected to grow 1.3 percent per year and biofuels, while having a "limited ability to replace fossil fuels," have the "potential to be an important part" of low carbon alternatives with important caveats. Because biofuels are quite different, each biofuel must be assessed on its own from growth of the plants to end use.

Widespread application of biofuels will have major implications for land use, which must be evaluated on global and regional scales, and "unintended consequences may reduce or override expected benefits." Any major development of biofuels from food crops "would create a direct competition with their use for food and animal feed." The selection of lands is "critical" to the sustainability of biofuels. "Clearing tropical forests or using peatlands for cultivation risks releasing enough greenhouse gases to negate any of the intended future climate benefits," with impacts also on biodiversity. "[S]witching already cultivated land to producing biofuel feedstocks could create shortages in the previously grown crops." These decisions also affect water usage and could generate nitrous oxide and "such opportunity costs and side effects have to be fully factored result into any decision to assign land to biofuel feedstocks."

Because of the complexity of biofuels sustainability, it is essential to establish the frameworks and methodologies for evaluating biofuels at the international level. There are many research needs.

Addendum

European Economic and Social Committee

The European Economic and Social Committee (EESC) is a consultative body that gives a formal platform to representatives of Europe's socio-occupational groups to express their views on EU issues. *http://eesc.europa.eu/index_en.asp*

European Commission Joint Research Committee

The European Commission's Joint Research Centre (JRC) is a department (Directorate-General, DG) of the European Commission providing independent scientific and technological support for EU policymaking. *http://ec.europa.eu/dgs/jrc/index.cfm*

Report URL: *http://ec.europa.eu/dgs/jrc/downloads/jrc_biofuels_report.pdf*

European Environmental Agency Scientific Committee

The Scientific Committee assists the management board and executive director of the EEA by providing scientific advice and delivering professional opinions on any scientific matter in the areas of work undertaken by the Agency. *http://www.eea.europa.eu/about-us/who*

Report URL: *http://www.eea.europa.eu/highlights/suspend-10-per-cent-biofuels-target-says-eeas-scientific-advisory-body*

UN Food and Agricultural Organization

The Food and Agriculture Organization of the United Nations leads international efforts to defeat hunger by assisting developing and transitioning countries to modernize and improve agriculture, forestry and fisheries practices, and ensure good nutrition for all. *http://www.fao.org/*

Report URL: *http://www.fao.org/docrep/011/i0100e/i0100e00.htm*

International Energy Agency

The International Energy Agency (IEA) acts as energy policy advisor to 28 member countries in their effort to ensure reliable, affordable and clean energy for their citizens. *http://www.iea.org/*

Report URL: *http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=2012*

The World Bank

The World Bank is a consortium of institutions that provide financial and technical advice to promote economic development among poorer nations and is administered by member countries. *http://www.worldbank.org/*

Report URL: *http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2008/07/28/000020439_20080728103002/Rendered/PDF/WP4682.pdf*

Organization of Economic Development and Cooperation

The OECD is an international organization of the world's major democratic, economically developed countries that facilitates cooperation among those countries, and assesses and issues reports on a broad ranage of topics. *http://www.oecd.org/*

Report URL: *http://www.oecd.org/document/30/0,3343,en_2649_33785_41211998_1_1_1_37401,00.html*

Netherlands Environmental Assessment Agency

The Netherlands Environmental Assessment Agency provides independent assessments on sustainable development, energy and climate change, biodiversity, transport, land use and air quality. *http://www.mnp.nl/en/index.html*

Report URL: *http://www.rivm.nl/bibliotheek/rapporten/500143001.pdf*

U.K. Renewable Fuels Agency

The Renewable Fuels Agency was set up by the Government to implement the Renewable Transport Fuel Obligation (RTFO), mapping the reduction of the U.K.'s contribution to climate change and its reliance on fossil fuels. It undertook the "Gallagher Report" at the direction of the U.K. government to assess the impacts of biofuels on land use. *http://www.dft.gov.uk/rfa/*

Report URL: *http://www.dft.gov.uk/rfa/_db/_documents/Report_of_the_Gallagher_review.pdf*

The Royal Society

The Royal Society is the leading independent scientific body of the U.K. and the Commonwealth. *http://royalsociety.org/*

Report URL: *http://royalsociety.org/displaypagedoc.asp?id=28914*

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