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Abstract

Over the past few years, biofuels made from organic crops have been widely touted by European leaders as a solution for reducing dependency on oil and gas in transportation and for mitigating climate change, arguably this century's greatest challenge. In that time, biofuels have come to dominate not only the debate on renewable fuels but government support for them as well. From financial investment to political capital, much has been expended to breathe life into a viable European biofuel industry. Yet, despite the tremendous political support, there is now strong evidence to indicate that biofuels produced from agricultural harvests are more costly than fossil fuels in several alarming ways.

While the European Union (EU) alleges that its biofuels policy is a necessary and environmentally friendly measure to address the urgency of climate change and energy security worries, it has put forward little in the way of countering the mounting evidence lodged against its policy. Accordingly, this paper questions to what extent the EU biofuels policy fulfills the promise of providing environmentally friendly and secure energy supplies. In light of the growing body of new research in the field, this paper posits that increasing the use of biofuels derived from crops in the EU is poor policy on sustainable development grounds and bears the high risk of long-term global consequences, the likes of which are still being uncovered.

1. Introduction: The Debate on Biofuels

> *"To some commentators, promoting biofuels is a stroke of genius. When they hear the word 'biofuels', in their mind's eye they see shiny modern production plants, cities that can breathe freely again, and happy farmers with good wage packets in their pocket — even in poorer countries.*
>
> *To others, promoting biofuels is not a stroke of genius but an act of madness. When they hear the word 'biofuels', they see rainforests crashing to the ground. They see valuable crops used to feed SUVs (sport utility vehicles) instead of people."*[1]

The debate over biofuels has become increasingly polemical in recent years. Although initially lauded by many, biofuels have come to engender sharp rebuke from a growing population of skeptics. Numerous empirical studies have surfaced warning of the negative impacts of a rising demand for biofuels derived from food crops (so-called 'first generation') on the environment, food prices, and developing countries. In October 2007, the UN Special Rapporteur on the Right to Food publicly branded biofuels a crime against humanity.[2] Still, the EU has embraced an ambitious program designed to foster five-fold growth in biofuel production through the year 2020. Promoting a combination of greater domestic investment and increased international trade, EU leaders hope to further develop biofuels as an important part of a larger framework for addressing climate change and energy insecurity.[3]

Proponents of biofuels and of the EU's policy have argued that not only would increasing the use of biofuels reduce domestic reliance on oil — most of which is sourced from politically unstable regions — but greater use would also produce fewer greenhouse gas (GHG) emissions compared to conventional fuel. Biodiesel, for example, emits "80% fewer hydrocarbons, 60% less CO_2, and 50% less particulate matter [when burned] than petroleum diesel".[4] Derived primarily from oilseed crops, biodiesel is the most common type of biofuel produced in the EU, presently accounting for over 80% of total production. In addition to its lower emissions during combustion, it is also sulfur free, biodegradable, and non-toxic. And in contrast to ethanol, a grain-derived

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1 M. Fischer Boel, European Commissioner for Agriculture and Rural Development, "Biofuels: not a magic wand, but a valuable policy tool", SPEECH/08/145, 2008 World Biofuels Markets Congress, Brussels, 13 March 2008.

2 "UN independent rights expert calls for five-year freeze on biofuel production", *UN News Report*, 26 October 2007, www.un.org/apps/news/story.asp?NewsID=24434&Cr=food&Cr1=# (retrieved 28 April 2008).

3 Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport, 8 May 2003, *Official Journal of the European Union*, L 123/42, 17 May 2003.

4 B. Buczek and L. Czepirski, "Applicability of used rapeseed oil for production of biodiesel", *Inform Magazine*, March 2004, vol. 15, p. 186.

biofuel that must be mixed with standard gasoline, pure biodiesel is a direct substitute for petroleum in powering engines.

The many promising traits of biodiesel come with a caveat. Critics of biofuels have raised several issues that cast a shadow of doubt over their sustainability. They cite rising global food prices, especially during 2007 and 2008, as evidence that policies that divert food production for use in biofuel manufacture are egregiously misguided and stealing food from the millions who continue to go hungry around the world. A chorus of non-governmental organizations (NGOs), including Greenpeace and Oxfam International, has launched campaigns targeting biofuels, arguing that the environmental profiles of these theoretically carbon-neutral alternatives are not as positive as purported and, in some cases, actually worse than fossil fuels.[5] Furthermore, although biofuel production in the EU has grown considerably since the adoption of the 2003 Directive on renewable fuels, crop-based biofuels as an industry are highly reliant on government support to remain commercially viable and analysis suggests they have only limited potential as alternative fuels. As an example, a report by the research consultancy LMC International concluded that, even if all carbohydrates in the world were converted to ethanol, production would only reduce global oil consumption by 40%.[6] The European Commission's own Joint Research Centre concluded in March 2008 that investment in biofuels would cost European taxpayers between €33 and €65 billion by 2020 while generating a negative net benefit over the years.[7] Given these conditions and that the transportation sector worldwide has the highest demand for fossil fuels, biofuels as they currently exist do not seem well suited for attaining substantive reductions in traditional fuel use without incurring even more substantial costs.

For the EU, the challenges posed by its biofuels policy are particularly sensitive. Over the course of the 1990s, the EU assumed a progressively assertive role in advocating greater attention to and action on environmental issues. Its push for greater emissions reductions standards during the 1997 negotiations on the Kyoto Protocol[8] included notable attempts to bring developing countries into the framework. Since that time, climate change and sustainable development have factored in increasingly prominent ways in common policies ranging from agriculture to trade. An aggressive

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5 "Another inconvenient truth", Oxfam Briefing Paper, *Oxfam International*, June 2008, www.oxfam.org.uk/resources/policy/climate_change/downloads/bp114_inconvenient_truth.pdf (retrieved 18 August 2008).

6 Quoted in *ibid.*, p. 14.

7 R. Edwards et al., "Biofuels in the European Context: Facts and Uncertainties", Joint Research Centre of the European Commission, March 2008, ec.europa.eu/dgs/jrc/downloads/jrc_biofuels_report.pdf (retrieved 20 November 2008).

8 The Kyoto Protocol to the United Nations Framework Convention on Climate Change, signed in 1997, stipulates that signatories must reduce their collective emissions by 5.2% below 1990 levels by 2012.

goal that would reduce the EU's carbon footprint by 20% by 2020,[9] for example, is a testament to this reach for 'green' leadership. The rush to boost biofuel production coincides with these efforts to address more vigorously what are ultimately long-term security by-products of an oil-dependent world.

1.1 Responding to Energy Insecurity

The EU is heavily reliant on foreign imports for energy and will see its dependency on foreign oil grow to 80% over the next 25 years.[10] Much of this supply is imported from Russia with whom the EU has an uncertain relationship. As continued enlargement has encroached eastward, bringing Western European influence closer to former Soviet territories, Russia has felt its sway over the region challenged, and the 2008 Russo-Georgian conflict only highlights the ongoing struggle to maintain peace and stability in Eastern Europe and the Balkans. Energy cooperation, in this context, has become a particularly delicate subject. More recent EU members, especially those from the enlargement to 25 states in 2004, have ardently pushed for a more concrete partnership with Russia that includes greater guarantees for the supply of oil and gas.

The energy situation is further complicated by new evidence that points to the Middle East as the region that will supply most of the future increases in global demand for oil (currently rising by 1.6% per year[11]). Oil consumption around the world has increased by 20% since 1994,[12] and new supplies are not expected to be found in non-OPEC countries.[13] For the EU, this means having to cope with decreasing long-term energy security compounded by sharply rising internal demand for energy and oil. The drive to develop alternative sources of energy is in part due to recognition by EU leaders of the precariousness of an increasing dependency on foreign oil suppliers, especially politically difficult ones. As a means of correcting this imbalance, biofuels, and more specifically first-generation biofuels, are at present the only mass-producible alternatives for use in transportation — so long as more advanced technologies, such as fuel cells and liquid hydrogen, remain prohibitively costly.[14]

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9 J.M. Barroso, President of the European Commission, "20/20 by 2020: Europe's Climate Change Opportunity", SPEECH/08/34, European Parliament, Brussels, 23 January 2008, p. 4.

10 Commission of the European Communities, *Green Paper: A European Strategy for Sustainable, Competitive, and Secure Energy*, COM (2006) 105 final, Brussels, 8 March 2006, p. 3.

11 *Ibid*.

12 *Ibid*.

13 R. Dannreuther, *International Security: The Contemporary Challenges*, Cambridge, Polity, 2007, p. 90.

14 "WWF Position on Biofuels in the EU", World Wildlife Fund (WWF), July 2007, assets.panda.org/downloads/wwf_position_eu_biofuels.pdf (retrieved 10 April 2008).

1.2 Countering Climate Change

Like energy, climate change has become a hot button issue from circles academic to political. In its Fourth Assessment Report, the Intergovernmental Panel on Climate Change concluded with over 90% confidence that global warming is due to the dramatic increase in anthropogenic GHG concentrations in the atmosphere.[15] Over the next two decades, global GHG emissions are set to rise between 25% and 90%,[16] depending largely on the success of human efforts to cap and reduce emissions. The EU currently contributes 16% of total emissions, but with demand for energy growing, projections for 2030 show a significant increase in this level, with most of the growth coming from the transportation sector. Despite the fact that overall EU-27 emissions actually decreased by 7.9% between 1990-2005,[17] the current outlook for Europe forecasts EU-27 levels at 14% greater than 1990 baseline levels if action is not taken.[18] These figures do not take account of any potential setbacks in progress on climate change initiatives resulting from the recent upheaval of global financial markets.

Studies have shown climate change to be a destabilizing factor on its own in many developing countries, and it will pose security problems for several EU Member States as well over the course of the century if the present rate of emissions is not reversed. Malta, for example, a low-lying island country, is expected to face threats of partial submersion and fresh water shortages as the sea level of the Mediterranean rises. Already, the Maltese are being forced to rely on polluting desalinization plants for half of their potable water supply as traditional fresh water sources dwindle due to saline intrusion.[19] In the Netherlands, where just less than a third of all land is below sea level, changes in temperature and seasonal precipitation will likely lead to increased flooding and coastal erosion during winter months. In the summer, lower water levels could have

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15 Intergovernmental Panel on Climate Change, "Summary for Policymakers", in *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf (retrieved 15 August 2008).

16 S. Dimas, European Commissioner for the Environment, "EU Leadership in Energy for Sustainable Development", Side Event, United Nations Commission for Sustainable Development, New York, 10 May 2007.

17 "Biofuels for transport", *EurActiv.com*, 31 March 2009, www.euractiv.com/en/transport/biofuels-transport/article-152282 (retrieved 27 April 2009).

18 Commission of the European Communities, Directorate-General for Energy and Transport, "EU-25 Energy and Transport Outlook to 2030", January 2003, ec.europa.eu/dgs/energy_transport/figures/trends_2030/5_chap4_en.pdf, p. 109 (retrieved 15 April 2008).

19 "Malta highly vulnerable to climate change", *Malta Media News*, 4 April 2007, www.maltamedia.com/artman2/publish/local/article_1321.shtml (retrieved 1 May 2008).

an economic impact on the Dutch shipping industry, as access to Rotterdam, Europe's largest port, is made more difficult.[20]

1.3 Are Biofuels the Right Response?

For these reasons, a study of the EU's biofuels policy is of particular relevance today. First, the policy is an attempt to respond in a sustainable way to security threats posed by climate change and fossil fuel dependency. But as mounting data shows, the policy is open to reproach and calls into question the EU's role as a green leader. Despite a barrage of negative publicity and credible reports from the Organization for Economic Co-operation and Development (OECD), the UN Energy and Overseas Development Institute (UN Energy), and others urging the EU to reconsider its promotion of biofuels made from food crops, the EU has held fast in its support for biofuels. While acknowledging that the first generation of these can be produced in a way that could negate any emissions savings during consumption and even contribute to further resource degradation and biodiversity loss, the EU has stated its belief that sustainable production can be achieved through properly conceived policies and careful management.[21]

Second, an analysis of the EU's biofuels policy is all the more relevant in view of the extent to which the biofuels issue spans multiple policy areas. At the International Biofuel Conference in July 2007, no less than five commissioners represented the European Commission: Agriculture, Energy, Environment, External Relations, and Trade. What can be inferred from this activity at the senior level is that, while biofuels legislation is conceptually concerned with reducing European dependence on oil and global warming-inducing emissions, it also has clear implications for expanded trade with feedstock-producer nations if the EU is to meet its stated targets. It has additional implications for sustainable farming, farming subsidies, and food security, as well as for sustainable development in developing countries where much of the raw material for biofuel production will be grown.

With so many cross-linked areas being affected, a more holistic assessment of the potential costs of employing first-generation biofuels is needed. Biofuels were billed as a panacea to two of the most difficult challenges the world faces today, but research has come to weigh in against them, instead depicting a new scenario in which these alternative fuels undermine real progress toward a more sustainable future. As the EU has left open the question of what basis it used in deciding to commit its support, this

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[20] A.K. Tank et al., "Climate Change in the Netherlands", www.knmi.nl/kenniscentrum/de_toestand_van_het_klimaat_in_Nederland_2003/climatereport.html (retrieved 1 May 2008).

[21] A. Piebalgs, European Commissioner for Energy, "The future of biofuels", SPEECH/09/171, eBio 1st European Bioethanol Fuel Conference, Brussels, 1 April 2009.

paper takes the opportunity to ask whether that support is still justified. Or more precisely, does the EU biofuels policy live up to its promise of providing a greener, more reliable alternative to conventional fuels? In taking stock of the burgeoning academia in this field as well as insight gleaned from extensive press coverage and EU pronouncements, this paper argues that the policy's heavy reliance on first-generation biodiesel, primarily, and ethanol, secondarily, ultimately negates the value of pursuing alternative fuels, with too many externalities arising to be overlooked. In the wake of the Climate and Energy Package passed in December 2008, it would be most beneficial for policymakers to refocus efforts on three primary areas: (i) achieving the greatest quality rather than quantity of alternative fuels, as the current policy now does; (ii) providing strong incentive for industry to immerse itself in the development of next-generation alternative fuels; and (iii) seriously engaging automotive manufacturers to bring automobiles up to speed with the significant improvements in emissions standards that are needed.

The following sections take a critical view of biofuels and of the EU biofuels policy. Beginning in section 2 with a breakdown of the state of biofuels in the EU today, section 3 moves to focus more closely on the policy itself, with particular regard to its emphasis on the quantity of biofuels produced and new sustainability criteria. section 4 presents a selection of the key problems associated with biofuels, including environmental degradation and rising food prices. Finally, section 5 offers a summary assessment of the biofuels policy and considerations for moving the debate on alternative fuels forward.

2. Biofuels in the EU

The concept for an EU biofuels initiative was born from a 1997 European Commission White Paper on renewable sources of energy for the future.[22] The thrust of the Action Plan outlined was a benchmark share of 12% renewable energy in the EU's overall energy profile by the year 2010. In 2001, the Commission extended this effort by setting a new overall target of 20% by 2020.[23] This was accompanied by a general target to reduce GHG emissions within the EU by an equal 20% below 1990 levels by the same year. In addition, a 20% general target in energy consumption reductions was established to follow the same schedule. The EU's plan, dubbed the '20/20 by 2020 Vision', is an acknowledgement of the link between energy and climate change and the necessity to address both comprehensively. In targeting renewable energy, the EU

[22] M.J. Jank et al., "EU and U.S. Policies on Biofuels: Potential Impacts on Developing Countries", *The German Marshall Fund of the United States*, 2007, www.gmfus.org//doc/GMF_US-EU_Final.pdf (retrieved 21 January 2008), p. 4.

[23] Barroso, "20/20 by 2020", *op.cit*.

hoped on the one hand to reduce its reliance on imported oil and gas, both high-carbon energy sources, and on the other hand to benefit environmentally from the low- to zero-carbon quality of new sources, which include wind, solar and geothermal energy as well as biofuels. With a 20% reduction in emissions by 2020, the EU hoped to paint a broader picture for the general effort to combat climate change that also "sends an unambiguous signal to any doubter in industry"[24] that the EU intends to pursue an aggressive, long-term strategy.

The use of biofuels in Europe did not begin, however, with the EU's policy. Several countries, in particular France, Germany, Spain and Sweden, began experimenting with biofuels in the early 1990s. The 1997 Commission White Paper was, however, the first major step toward a common policy on biofuels.[25] As the EU focused attention increasingly on questions of energy security and climate change, biofuels became highly prized for their capacity to be produced in the short term using existing technology and crops common to many parts of the world. Today, biofuels are considered a cornerstone of the EU's renewable energy agenda. The following section weighs the use of biodiesel and ethanol in the EU, as well as the rising importation of palm oil due to biofuel demand.

2.1 Biodiesel

While for standard transport fuels the ratio of diesel use to gasoline is only slightly more in favor of the former, the production of biofuels in the EU is heavily weighted toward biodiesel,[26] which accounts for over 80% of total production. Of the Member States involved in such production, Germany is the definitive leader with over half of the market share. The next largest producers, France and Italy, account for 15.5% and 12.4% of total production, respectively.[27] Most of this biodiesel production is derived from rapeseeds that are turned into rapeseed oil (also known as canola oil) before being mixed in varying degrees with diesel fuel. Rapeseeds have been primarily used in preparing animal feed in Europe, but they also contribute to a variety of other food products such as vegetable oil and margarine. As they are grown abundantly across the Continent, they have been increasingly used as biofuel feedstock. The seed is now the preferred feedstock since other alternatives, such as sunflower and soybean oil, are required in larger amounts to produce the same quantity of fuel and provide lower energy yields during combustion.

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24 Dimas, *op.cit*.

25 Commission of the European Communities, Communication from the Commission, *Energy for the Future: Renewable Sources of Energy, White Paper for a Community Strategy and Action Plan*, COM (1997) 599 final, Brussels, 26 November 1997.

26 Jank, *op.cit*.

27 *Ibid*.

But rapeseed oil is itself only a moderately productive feedstock. The amount of rapeseed allocated for biodiesel has had to increase substantially to meet new demand, and rapeseed oil prices have risen in kind. While just over 40% of the EU's annual rapeseed yield is set aside for biofuel manufacture, nearly two-thirds of the oil derived from processing these seeds must be used in the subsequent production.[28] The upward pressure on rapeseed and rapeseed oil prices caused by this increasing demand has made EU biodiesel a cost-inefficient product. As a result, EU food producers have begun to turn to other oils produced mainly in developing countries that are both cheaper and higher-yield generating. EU imports of other vegetable oils rose by over 50% during the four-year period (2003-2006) following the adoption of the biofuels Directive.[29]

2.2 Palm Oil

Of the most common types of vegetable oil substitutes (palm, soybean, and sunflower), palm oil has been the most in demand. It is produced largely in Southeast Asia and now comprises roughly half of the EU's vegetable oil imports. The German Marshall Fund notes that, while "the majority of the imported palm oil is used by the food industry [...] the share of imports of palm oil for industrial use has multiplied by 3.4 between 2001 and 2006".[30] Certain 'technical norms', however, limit the degree to which foreign-produced oils can be used in biodiesel production,[31] thus palm oil is principally being imported to compensate for the shortfall in domestic vegetable oil supply that has resulted from the increasing use of oilseed feedstock for biodiesel. As the EU strives to increase the incorporation rate of biodiesel into the transportation sector, the domestic production of rapeseed oil is being used to an even greater degree for non-food purposes. The shortage that results is being supplied by eager developing countries, many of which are using unsustainable methods to ramp up production to a dismaying extent. Estimates indicate that the EU will need to import almost 90% of its food-related oilseed demand in 2012 if this pattern continues.[32] This means that substitute oils will continue to be imported into the EU primarily in response to the indirect effect European biofuel demand is having on other markets. The 'EU Strategy for Biofuels' highlights that, although the EU is the leading producer of biodiesel, "there is no

[28] *Ibid.*, p. 5.

[29] *Ibid.*, p. 7.

[30] *Ibid*.

[31] *Ibid*.

[32] *Ibid*.

significant trade" in this alternative fuel at the moment.[33] This reinforces the notion that palm oil is being principally imported to the EU for non-biofuel purposes.

The heightened demand for this crop is inducing tremendous pressure on the environment in Southeast Asian countries, such as Indonesia, Malaysia, and the Philippines, where the majority of palm oil is cultivated. Unsustainable methods of sourcing palm oil in these countries are now of major concern. Critics of the EU biofuels policy point to the large-scale deforestation underway in Indonesia, especially, as proof that developed country demand for crop-based biofuels can have indirect effects that are difficult to quantify but significant in their impact on sustainable development. It is not only the feedstock being grown for biofuel production that is of concern, but also those crops and oilseeds brought into cultivation to replace the feedstock that provokes worry, as section 4 will elucidate.

2.3 Ethanol

Slightly less than 20% of EU biofuel production consists of ethanol. The EU, although ranked fourth in terms of worldwide production, produces nearly three times less ethanol than it does biodiesel. Germany is the leading producer with 28% of production, followed closely by Spain with 26% and France with 16%.[34] Production is carried out using a composition of feedstock primarily including cereals, such as wheat and corn, but also sugar beet.

European ethanol, however, is not particularly efficient in its input-to-output ratio. Most ethanol-producing crops require a significant amount of water to be grown. They also require extensive use of nitrogen-based fertilizers, the main ingredient of which produces a GHG (nitrous oxide) that is nearly 300 times more concentrated than carbon dioxide and fourth on the list of GHGs most harmful to the environment.[35] Corn ethanol, in particular, shows little promise in reducing emissions and has one of the lowest emissions savings profiles at only 13% in some cases, even before factoring in the effects of land-use change and polluting fertilizers.[36] Overall, first-generation ethanol is a poor investment in terms of cost to benefit.

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33 Commission of the European Communities, *Communication from the Commission: an EU Strategy for Biofuels*, COM (2006) 34 final, Brussels, 8 February 2006, p. 6.

34 Jank, *op.cit*., p. 7.

35 Oxfam, *op.cit.*, p. 7.

36 "Agrofuels: Towards a Reality Check in Nine Key Areas", *Biofuelwatch et al.*, 2007, www.biofuelwatch.org.uk/docs/agrofuels_reality_check.pdf (retrieved 25 August 2008), p. 10.

3. The Biofuels Directive: Choosing Quantity over Quality?

In 2003, the EU issued its Directive on the promotion of the use of biofuels and other renewable fuels for transport.[37] The policy was agreed upon as a means of stimulating Member State and private sector action in further developing and increasing the production of biofuels to help meet the 12% renewable energy objective. The Directive established uniform percentage goals for all Member States to meet by the end of two pre-determined periods. The first goal was set at a non-binding 2% for 2005 with a second non-binding goal envisaged at 5.75% for 2010. The newest approved target mandates 10% biofuel incorporation by 2020. The Directive also provided for a modest farm subsidy under the auspices of the EU's Common Agricultural Policy (CAP) and permits Member States to devise tax incentives to foster sector development.[38] These three elements — volumetric targets, subsidies, and tax incentives — form the substance of the EU's biofuels policy. In January 2008, the Commission began discussing a fourth element: sustainability criteria. As neither farm subsidies nor tax incentives have been shown to appreciably influence the quality of biofuels produced beyond the effect of targets by volume, however, this paper does not elaborate on their relation to biofuel production. Instead, the following sections pay specific attention to volumetric targets and sustainability criteria.

3.1 Volumetric Targets

While the Commission has issued percentage targets to create an internal market for biofuels, its policy does not enumerate specific procedures or regulations for reaching such targets. Member States are free to decide how best to incentivize increased biofuel production within their national markets. They are also free to decide what target level to set for internal biofuel consumption, and this has led to some policy discrepancies between the more and less interested Member States. According to the German Marshall Fund, this "non-harmonization of policies at the EU level has encouraged Member States to act as free-riders and to elaborate their own action plans and instruments independently of the policies carried out in the rest of the EU".[39] Although European Commissioner for Energy Andris Piebalgs believes that the contention of a free-rider problem is overcome by applying a targeted percentage to each Member State,[40] only two EU members (Germany and Sweden) had met or

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37 Directive 2003/30/EC, *op.cit*.

38 Jank, *op.cit*., p. 4.

39 *Ibid*.

40 A. Piebalgs, European Commissioner for Energy, "Biofuels and renewable energy for tackling climate change", SPEECH/07/37, eBio General Assembly, Brussels, 25 January 2007, p. 5.

exceeded the 2% target by the end of 2005. France and Austria neared 1% each, while seven Member States had made no progress.[41]

The Commission argues that "by specifying outcomes without specifying how they should be achieved, targets leave room for flexibility and experimentation at the Member State level".[42] Countries are assigned a percentage goal by which to reduce emissions, but it is incumbent upon the individual country to adequately incentivize the realization of the target. The underlying logic is that universal prescriptive measures for achieving the targets set would not take into account particular market conditions in each Member State and would constrain innovation in the sector by preemptively deciding on the 'best' methods. Commonly referred to as a 'market-based approach', the Commission believes this method of setting targets by volume for biofuels use gives sufficient leverage to the private sector to develop the most efficacious measures and cost-efficient solutions.

Problems abound, however, under a target-based scheme that emphasizes quantity over quality. As a rule of thumb, the cheapest modifications that result in reductions will be made first, while more costly reduction plans will be adopted later.[43] The Institute for Agriculture and Trade Policy corroborates that

> without any quality control, the use of quantitative targets to boost biofuel use will tend to reward the least energy efficient, if cheapest, response, rather than forcing an outcome that is good for climate change, good for biodiversity, and that provides a new source of capital for investment in rural areas, particularly in developing countries.[44]

This is a clear problem with the EU biofuels policy. At present, the least costly — and only — means of reaching the short-term goals set by the Directive involve the use of first-generation biofuels. Second-generation biofuels remain too expensive and the technology has not been fully mastered, even for small-scale production. The EU, however, was counting on the future availability of these more advanced biofuels in setting its targets. It has marketed the biofuels policy to the public using the promise of next-generation alternative fuels, but they are not likely to be ready for mass production

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41 *Ibid*.

42 *Ibid*.

43 K.S. Gallagher et al., "Policy options for reducing oil consumption and greenhouse-gas emissions from the U.S. transportation sector", Harvard University, 27 July 2007, belfercenter.ksg.harvard.edu/files/policy_options_oil_climate_transport_final.pdf (retrieved 25 February 2008).

44 S. Murphy, "The multilateral trade and investment context for biofuels: Issues and challenges", International Institute for Environment and Development, London and Institute for Agriculture and Trade Policy, Minneapolis, April 2008, www.iatp.org/tradeobservatory/library.cfm?refID=102282 (retrieved 1May 2008), p. 11.

in the short term, and perhaps not for many more years to come. Thus, first-generation biodiesel and ethanol are the only viable alternative fuels available for the foreseeable future. The EU's volumetric targets give economic incentives to biofuel and feedstock suppliers to produce maximum quantities of the *current* generation of biofuels rather than investing in more advanced biofuels or other alternative fuels with less downside risk. Moreover, a Harvard University study found unsurprisingly that "the larger the volumes [of the targets set] and the shorter the time period [during which they must be met], the greater will be these externality impacts" around which the debate over biofuels is centered.[45]

European Commission President José Barroso claims that the Directive is meant to promulgate the development of a biofuels industry that will use first-generation biofuels as a stepping-stone to next-generation fuels.[46] However, Agriculture Commissioner Mariann Fischer Boel has stated that, "if second-generation fuels develop more slowly than expected, imports [of first-generation biofuels] will simply have to rise".[47] The future of the biofuels policy is contingent on an indeterminate timeframe for developing more advanced alternative fuels. The type of swift substitution that the Commission seemed to have in mind when it launched the Directive is an unrealistic scenario. It is far more likely that the use of crop-based biofuels will continue at the expense of better biofuel development as parties to biofuel production become more heavily invested in the current generation. In a sign of the preponderant interest in first-generation biofuels, a June 2008 report by Oxfam International confirmed that, in 2006, the EU spent only 2% (roughly €91 million) of its €3.7 billion biofuels support scheme on R&D.[48]

3.2 Sustainability Criteria

The biofuels policy, as it was conceived in 2003, did not include any criteria for assessing sustainability or ensuring that production would be environmentally friendly and in line with the aims of sustainable economic and social development. This is most likely due to policymakers' early overconfidence in the promise of biofuels and corresponding lack of attention to potential pitfalls. Recently, however, the EU has taken steps to rectify this oversight. Backed by the European Parliament's Committee on Industry, Research, and Energy in September 2008 and formally adopted in a plenary session that December, the new criteria are a key component of the EU Climate and Energy Package and are reflective of the political back-and-forth that began in

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45 *Ibid*.

46 J.M. Barroso, President of the European Commission, "Keynote speech on biofuels", SPEECH/07/470, International Biofuels Conference, Brussels, 5 July 2007.

47 Fischer Boel, *op.cit*.

48 Oxfam, *op.cit.*, p. 18.

January 2008 when the Commission first engaged the issue of sustainability criteria. Because the criteria will determine which biofuels can count toward the 5.75% and 10% targets, they are important to supporters of biofuels and those financially invested in biodiesel and ethanol variants — all of whom are anxious for a sense of direction from European policymakers.

The latest revisions to the policy usher in three principal measures, while reinforcing overall support for biofuels. Chief among these measures is the minimum mandatory GHG emissions savings requirement. During early negotiations, a proposal that all biofuels consumed within the EU provide at least a 35% GHG savings gained wide backing, but some members of the European Parliament called for a stiffer 50% mandatory minimum savings. In an apparent compromise and simultaneous nod to the growing external pressure to modify or repeal the policy, the EU settled on an initial 35% savings requirement that will scale up in 2017 to 50% for existing biofuel plants and to 60% for new plants.[49] These quantitative standards are complemented by a second measure that sets out appropriate but vaguely defined conditions concerning the conversion of areas rich in carbon or biodiversity to biofuel plantations. The final measure requires that biofuel suppliers in the EU and in third countries report on their efforts to comply with the criteria, and adds that the EU will release its own assessment of progress every two years.

At first glance, the new measures appear to address the substantive issues. However, the minimum percentage savings requirement cannot be taken at face value without understanding the methods for calculating the savings. Land-use change is the preeminent factor that has the potential to decide a biofuel's fate. Early negotiations over sustainability criteria excluded land-use change altogether from consideration. The Package as agreed in December 2008 acknowledged the impact direct land-use change can have on GHG savings, but it failed to include indirect land-use change. The Commission has instead scheduled a proposal for indirect land-use change to be released in 2010. Without factoring in the many elements of indirect land-use change, both biofuels grown in the EU and those imported will have more favorable emissions profiles that belie the stretch of their impacts.

Delving further, problems could also arise in reasonably assessing whether land cultivated for biofuel growth is in fact meeting sustainability criteria. A plantation currently being operated in a supposedly eco-friendly fashion, for example, may be situated on land that was earlier deforested for the specific purpose of biofuel production. Deciding whether to recognize the biofuel produced on the plantation would require evaluating both direct and indirect, as well as past and present, conditions related to production there. It would likely be too difficult to assess present

[49] Piebalgs, "The future of biofuels", *op.cit*.

sustainability on a case-by-case basis taking into account past conditions as, at some point, a line would have to be drawn, thereby incorporating a sizeable degree of subjectivity into the process.

Additionally, as the criteria constitute the basis for qualifying not only biofuels produced within Europe, but also and especially those produced outside of Europe, developing countries — with which the EU will need to expand trade to meet its goals — have expressed concern that market access and, therefore, revenue potential will be restricted by the new criteria and that the criteria will try to impose higher standards on domestic operations from afar. The EU may encounter difficulties, as such, in extending its concept for biofuels governance abroad. Legally speaking, the criteria may give rise to trade infringements, for while the EU may institute standards to govern production carried out on its own territory, judging imported fuels and feedstocks on the basis of how they were produced is a practice generally banned by the General Agreement on Tariffs and Trade (GATT).

Ensuring compliance will also undoubtedly be a major obstacle. In Indonesia, for example, two studies published in 2006 found that "palm oil plantations which comply with the [Roundtable on Sustainable Palm Oil] principles and criteria are virtually non-existent".[50] Worse yet, of the plantations that purport to sustainably produce palm oil, nearly all employ environmentally damaging practices on land that is to be prohibited from cultivation by the EU's new criteria.[51]

In all, implementing and enforcing the criteria may prove less straightforward and more arduous than EU policymakers have envisioned. Without legally binding requirements, the criteria border on voluntary commitments that, as with the Indonesian example, may or may not be observed. And until a clearer picture of the Commission's stance on indirect land-use change is available, it will be difficult to assess from a base standpoint whether the sustainability criteria have a chance at countering or preventing some of the serious and widespread problems with first-generation biofuels. The probable verdict is that they contain insufficient means for enforcing compliance and underestimate the complexity of a biofuel's GHG profile.

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50 "Final analysis of proposed HECO-NRDC sustainability criteria for Hawaiian electric company's procurement of biodiesel from palm oil", compiled by H. Curtis et al., August 2007, www.lifeofthelandhawaii.org/docs/2/HECO_palm_oil_biofuel_concerns_ August_07.pdf (retrieved 15 May 2008), p. 13.

51 *Ibid*.

4. The Realities of Food for Fuel

Recent studies have shown that biofuels have an impact across a broad spectrum of sensitive issues, including the environment, food prices, and water supplies. The impact in these areas can be detrimental, underscoring a now widely held tenant that the first generation of biofuels does not keep its promise of a greener future. On the contrary, further research more than suggests that biofuels of this type are contributing to the phenomenon of global warming in addition to fostering volatility in global food prices and worsening global water shortages.

4.1 A Bleak Future for the Environment

Critics of the biofuels policy have waged an uphill battle in trying to persuade the EU that its policy will lead to an increase in CO_2 emissions in addition to other environmentally damaging side effects. In January 2008, at the time of the review of the 2003 Directive on biofuels, a coalition of 17 NGOs, including Oxfam and Friends of the Earth, called on Energy Commissioner Piebalgs to revise the Directive on the grounds that it risked endangering savannahs and grasslands.[52] In April 2008, a second group, this time led by Greenpeace and the European Environmental Bureau (EEB), urged the EU to forego its 10% biofuels target altogether. Claiming that volumetric targets were a misguided policy choice, they argued additionally that measures for ensuring sustainability were lacking and that the policy did not adequately take into account its influence on land use and other indirectly caused events.[53] These groups agree that the environmental repercussions of existing biofuel production, let alone increased production, outweigh the potential benefits of using biofuels in transportation.

Evidence suggests that these claims capture the current reality of the biofuel situation. The extent to which biofuels are environmentally sustainable is dependent on several variables, including the way in which the land for the feedstocks is prepared and what type of land it is. It depends on the process of cultivation and the amount of water, types of pesticides, and fossil fuel-produced fertilizers that are needed. It also depends on how the feedstocks and fuels are transported. In short, there are potential environmental impacts spanning the length of the supply chain, or the so-called 'life cycle'. Negative inputs over the course of the biofuel production cycle can add up to a virtual environmental profile that, as biofuel critics attest, is worse than that of oil or gas. Carbon dioxide, nitrous oxide (N_2O), and sulfur dioxide (SO_2) emissions — typically thought of as the consequences of fossil fuel combustion — can be equaled and even

52 J. Rankin, "NGOs tell EU to come clean on biofuels", *European Voice*, 10 January 2008, p. 2.

53 J. Rankin, "Conservationists tell EU to drop biofuels target", *European Voice*, 3 April 2008, p. 4.

exceeded through the production and use of biofuels when full life cycle emissions are taken into account.

The difficulties begin with the search for land. There are two possibilities for growing the necessary feedstock: either existing farmland is converted or new arable space must be cleared. The first option converts productive land currently used for growing food, which means that new land must be found to compensate for the displaced food production or the yield of the remaining farmland must rise proportionally. In practice, this conversion translates into new land being cleared to the detriment of forests, rainforests, grasslands, and other important 'carbon sinks', natural reservoirs that sequester carbon dioxide indefinitely. The destruction of additional forests releases CO_2 that had been absorbed back into the atmosphere.

In farming, the act of plowing also triggers a release of CO_2 from the soil.[54] To reduce this effect, a method known as 'no-tillage' agriculture has developed, but a 2006 study of its use in corn and soybean production in Argentina revealed a greater release of N_2O despite a reduction in emitted CO_2.[55] In the end, both practices — traditional plowing and no-tillage agriculture — can contribute considerably to an increase in the level of emissions. Furthermore, removing carbon neutralizers, such as trees and grasses, to make way for new plantations leads to a short-term increase in emissions in addition to a long-term diminished carbon sequestration rate. In this way, the production of biofuels negatively impacts the global carbon cycle as it triggers deforestation and other forms of natural resource destruction. The methods of production employed can lead to other distinct environmental damages as well. According to a study by UC Berkeley researchers, deforestation "can exacerbate flooding and soil erosion, affect the water cycle and offshore fisheries and lead to the loss of recreation and [...] food sources".[56]

In Indonesia, peatland rainforest, an important carbon sink, is being cleared at an alarming rate. Over 72% of the country's forests have already been lost as palm oil growers and commercial loggers proceed in chopping at a rate of 4.4 million acres per year.[57] This is especially alarming because peatlands harbor some 550 billion tons of carbon or 30% of the planetary total. As these lands are drained for energy crop

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54 European Environment Agency, "Transport biofuels: exploring links with the energy and agriculture sectors", 2004, reports.eea.europa.eu/briefing_2004_4/en/EEAbriefing_4_2004 (retrieved 16 April 2008), p. 3.

55 "Agrofuels: Towards a Reality Check in Nine Key Areas", *op.cit.*, p. 9.

56 R. Sanders, "Rich nations' environmental footprint falls on poor", *UC Berkeley Press Release*, 22 January 2008, www.berkeley.edu/news/media/releases/2008/01/22_ecosystem.shtml (retrieved 23 January 2008).

57 "Indonesia fastest forest clearer in the world", *Terra Daily*, 3 May 2007, www.terradaily.com/reports/Indonesia_Fastest_Forest_Clearer_In_World_999.html (retrieved 5 May 2008).

production, large quantities of carbon enter the atmosphere. Unfortunately, the Indonesian territory accounts for approximately 60% of all tropical peatlands, making the archipelago an important link in the chain of global emissions. In calculating the total amount of emissions released as a result of this disastrous practice, it is estimated that a biofuel plantation would not achieve a net reduction in emissions for some 423 years,[58] well beyond the climate change 'tipping point' that many scientists believe will come around 2050.

The British organization Biofuelwatch notes that "much of the 'evidence' presented for agrofuels to reduce greenhouse gas emissions ignores the larger picture of 'land-use change' (usually deforestation), soil erosion, and nitrous oxide emissions".[59] Without taking these factors into account, no study can adequately assess the true impact biofuels will have on the environment. Comparing the GHG profiles of corn ethanol to standard gasoline at the point of combustion, for example, is only one important measurement in a set of values that need to be weighed together to provide a realistic snapshot of eco-friendliness.

4.2 Rising Food Prices: Are Biofuels to Blame?

Environmental degradation is only one side to the story being played out as the growth of crop-based biofuels continues. Food security has also monopolized much of the discussion over biofuels in recent years. World Bank statistics indicate that, during the 2006-2008 period, food prices increased by 83% across the board.[60] As prices for food staples such as rice, soybeans and wheat shot up, there grew almost as quickly a notable backlash against biofuels made from food crops. Riots in many developing countries around the world drew renewed attention to food security issues. For these countries, fluctuations in food prices are acutely felt, and most do not have the means with which to protect themselves in times of extreme volatility. But while the UN Special Rapporteur for the Right to Food has referred to the production of biofuels as tantamount to "mass murder",[61] present analysis has yet to conclusively delineate the price relationship between biofuels and food staples. In fact, informed opinion is generally coalescing around the idea that biofuels were not the lone protagonist during the three-year period and are not likely to be so in the future. On the contrary, the

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58 *Ibid*.

59 "Agrofuels: Towards a Reality Check in Nine Key Areas", *op.cit.*, p. 10.

60 A. Morales, "Biofuel rule will do more harm than good, Oxfam says", *EcoEarth.info*, www.ecoearth.info/shared/reader/welcome.aspx?linkid=96974&keybold=environmental+sustainability (retrieved 15 April 2008).

61 "Food price rises are 'mass murder' - U.N. envoy", *Reuters India*, 20 April 2008, available in.reuters.com/article/worldNews/idINIndia-33134320080420 (retrieved 6 May 2008).

production of biofuels was contributing to what was already a perfect storm of worldwide events that led finally to staggering increases in food prices in 2008.

Drought, hoarding and speculation, and tremendous economic growth in the world's most populous developing countries are the three principal elements that contributed to the upward trend in food prices. First, drought in many regions led to food shortages that drove prices higher as smaller supplies were reported. In Australia, for example, where rice growing had traditionally been a productive business, crop yield fell by an extraordinary 98% as persistent drought for the past several years made the water-intensive process of cultivation extremely difficult.[62] In the spring of 2008, the price of rice on the global market doubled in just three months. Rice farmers in Australia began turning to other crops, such as wine grapes, that require less water. And while demand for rice, like most commodities, has still not yielded to the ebb in current supplies, the production of wine is far more profitable than that of rice ($2,000 an acre for wine versus $240 for rice[63]), leaving it unlikely that many of the farmers who switched from rice to wine production will return to rice. These shortages have put pressure on rice exporters. While over 90% of the world's rice supply is intended for domestic consumption,[64] exporters relying on domestic production have had to look to the international market to find the rice needed to meet client demand. As these companies purchase rice from abroad, global stores of rice — already at a painful low — are further depleted, leaving those countries that must import rice to satisfy internal demand (i.e., net importers) in difficult and costly situations. To make matters worse, stock-to-use ratios for grains, in general, have been declining steadily over the past several years. For the 2005 fiscal year, global wheat inventories were tallied at 25% of total use, but for the 2008 fiscal year, global stores were estimated at 20%.[65] Grain prices on the whole were reflecting this market strain in 2007 and 2008.

Producers who witnessed the daily increases in prices had a financial incentive to hold on to their stocks, selling down the road what they would normally have sold more immediately. This economic phenomenon led to a second factor in rising food prices known as hoarding. Hoarding creates the appearance of smaller supplies relative to demand, thereby pushing market prices upward. Entrepreneurial farmers or distributors may hoard if they feel it will encourage prices higher. The effect of hoarding was compounded by investor speculation on commodities that steepened the upward

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62 K. Bradsher, "A drought in Australia, a global shortage of rice", *The New York Times*, 17 April 2008, www.nytimes.com/2008/04/17/business/worldbusiness/17warm.html?_r=1&oref=slogin (retrieved 1 May 2008).

63 *Ibid*.

64 *Ibid*.

65 B. Tomek, "Food, fuel, and feed prices — the perfect storm?", agfinance.aem.cornell.edu/Publications/ADSystems/TomekPS.pdf (retrieved 28 August 2008).

trajectory of world prices but was and is nevertheless difficult to quantify with any certainty.

The third factor during the period of escalating food prices was a product of rising demand for meat and dairy in populous developing countries, such as China and India. As per capita incomes rise, consumption patterns have begun to change in response to increased purchasing power. This impacts the types of food individuals in these countries purchase. Whereas traditional diets have been more centered on rice and other grains, the appetite for meats, for example, is expanding and will continue to grow with the accumulation of wealth. *The Economist* states that, "the Chinese consumer who ate 24kg (44lb) of meat in 1985 will scoff over 50kg of the stuff this year. That in turn pushes up demand for grain"[66] as grains are used to feed the livestock. Statistics show that it requires "four kilos (eight pounds) of grain to produce one kilo (two pounds) of pork, and two kilos (four pounds) of grain to yield a kilo (two pounds) of beef."[67] The net result is that more and more grain is required to produce foods, with less grain available for direct human consumption.

Given these many factors, the extent of the impact that biofuels have on food prices is difficult to ascertain concretely. The International Food Policy Research Institute estimates that about 30% of the recent sharp increases in food prices were caused by the production of biofuels.[68] In 2008, the World Bank published a study attributing 75% of the increases to the production of biofuels. Although these figures differ greatly, both findings clearly purport that biofuels played an important role in escalating food prices. The studies sketch out a scenario in which the price of animal feed has a strong influence on the price of food products for which the animal feed is used during production. If this is true, it follows that anything that raises feed prices, such as diverting grain crops to biofuel production, will raise the final prices of food products to consumers.

4.3 Greater Strain on Water Supplies

In addition to its impacts on the environment and food prices, the EU biofuels policy poses serious questions for sustainable water usage. In its present reliance on crop-based feedstocks, the policy is essentially promoting the cultivation of water-intensive foods. As it stands, agriculture utilizes nearly 70% of global water through

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66 "The end of cheap food", *The Economist*, 6 December 2007, www.economist.com/research/articlesBySubject/PrinterFriendly.cfm?story_id=10252015 (retrieved 21 April 2008).

67 "Biofuels under attack as world food prices soar", *AFP*, 20 April 2008, afp.google.com/article/ALeqM5g-Ne1sszDrfWVIbhtdxhklb_tGdQ (retrieved 1 May 2008).

68 Morales, *op.cit.*

irrigation and other means.[69] And although innovations in farming methods, such as drip irrigation, offer opportunities for increased efficiency and water conservation, less than 1% of irrigated land worldwide currently benefits from such technology. Moreover, the impact of biofuel production on water supplies has not been given full consideration by major biofuel policies: "the water-related consequences of large-scale biofuel production and the potential need for policy guidance in this area have yet to be fully explored". [70] Part of this problem stems from the fact that it is not an easy task to assess the true water requirements of biofuel crops from start to finish. The problems encountered in calculating total water usage mirror the difficulties in accounting for the sum of carbon emissions generated, first, through the production cycle, and, later, during consumption. At issue in both cases is the fact that neither the total amount of carbon released nor the total amount of water used is "physically embodied in the final product".[71] But the water requirements of energy crops are high, leaving little doubt that increasing the amount of crops under cultivation in order to grow biofuels will lead to further strain on global water resources. Together with environmental degradation and deteriorating food security, a global water crisis is susceptible to the resource-intensive supply chain for biofuels. The EU should give serious consideration to the potential for impacting global water supplies when judging the effectiveness of its biofuels strategy.

5. Conclusions: Good in Principle, Bad in Practice

> *"We're rushing into biofuels, and we need to be very careful. It's a little frightening to think that something this well intentioned might be very damaging."*[72]

The objective of this paper has been to assess whether biofuels of the type currently utilized in the context of the EU biofuels policy live up to the promise of a greener and more reliable alternative to conventional oil and gas for transportation.

Looking at the market for renewable fuels, it is clear that biofuels dominate, with advanced technology such as liquid hydrogen garnering investment but lending few indications of large-scale production in the near future. Of the biofuels produced today,

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69 Dannreuther, *op.cit*., p. 81.

70 S. Hughes, L. Partzsch & J. Gaskell, "The development of biofuels within the context of the global water crisis", *Journal on Sustainable Development Law & Policy*, vol. 7, no. 3, 2007, p. 58.

71 *Ibid.*

72 Jason Hill, co-author of a study in the journal *Science* on the negative environmental impacts of biofuel crops, quoted in A. Zarembo, "Biofuel crops might increase carbon emissions", *Los Angeles Times*, 8 February 2008, articles.latimes.com/2008/02/08/news/sci-biofuel8.

nearly all are derived from crops grown in the EU and imported from around the world. This type of first-generation technology has been so labeled because it makes use of existing inputs and requires only minor modifications to existing production and refining processes. While this reduces the need for R&D and offers upfront cost savings, greater research into next-generation biofuels and other alternative fuels is what is needed.

At a minimum, it can be said that the production of first-generation biofuels encompasses significant complexity and wide-ranging implications, some of which have been addressed in this paper. Indeed, first-generation biofuels present serious issues with regard to the environment, global food prices, and water resources. These issues raise the important question of whether employing biofuels will in fact help to achieve the goals the EU has outlined — reduced GHG emissions and less dependence on foreign oil in the transportation sector — or whether they will exacerbate problems that stall real progress. Research into the externality effects, such as increased deforestation in some countries and food riots in others, paints a grim picture of the suitability of first-generation biofuels to the more sustainable path the EU has vowed to embark upon.

Initially awash in hope over the promise biofuels appeared to hold, European policymakers have since come under heavy fire for their persistence in supporting what seems to many to be a step backwards rather than forward. That support has been further reaffirmed with the approval of the Climate and Energy Package in December 2008, and Energy Commissioner Piebalgs has stated "the European Commission continues to believe that the case for biofuels is strong".[73] But with the arrival of the Package, there has also been a modest re-appraisal of the contribution from first-generation biofuels. In the 2003 Directive on renewable fuels, only biofuels, and not liquid hydrogen or natural gas, for example, were formally targeted. First-generation biofuels were heavily promoted with the expectation that second-generation biofuels, from synthetic sources or food and plant waste, would soon be developed, shifting market forces in their favor in the process. This has proven to be a faulty premise on which to condition the biofuels policy, in addition to drawing too narrow a scope to promote broad innovation. The new Package seeks a more diversified approach to renewable fuels, placing greater emphasis on second-generation biofuel development and including more significant incentives for other alternative fuels. It represents a step in the right direction, and the inclusion of sustainability criteria that increase in stringency over time has the potential, albeit limited, for encouraging the development of better biofuels and not simply more biofuels.

But with the EU's revised approach to biofuels come many of the same criticisms. First, determining the emissions profiles of first-generation biofuels requires extensive

[73] Piebalgs, "The future of biofuels", *op.cit*.

analysis stretching from the type of fertilizers used to grow the crops to the method of transporting the refined product to the intended market. Accurate calculations require full and reliable information, and as was touched upon earlier, this poses a complication, especially with regard to plantations in developing countries. Second, meaningful calculations need to take account of both direct and indirect land-use change. The sustainability criteria in the Package include provisions on environmental and social sustainability, but the Commission has not yet clarified its position on factoring indirect land-use change effects into its GHG savings profile. The Commission's eventual position will thus be critical to the relevance and reliability of the percentage savings attributed to biofuel variants. Third and finally, the measures prohibiting the conversion of high-carbon and highly biodiverse land into energy crop plantations assume the forthright compliance of producers. But as was shown, many developing countries have a long way to go to reach sustainable production methods, and in some cases, fraudulent claims of sustainability are being used to allay concern and attract investment. How the EU intends to combat this and other problems inherent in complying with and enforcing sustainable biofuel production standards on what is now a global scale is of great interest.

In July 2007, then-European Commissioner for Trade Peter Mandelson proclaimed that the EU biofuels policy was above all "an environmental policy driven by the greenest outcomes".[74] But the story that has played out strikes a sharp discord with the romanticized notion of biofuels, and in aggregate, the EU biofuels policy risks undoing a great deal of the progress that has been made in stemming climate change to date. To improve its stance, the EU needs to rethink its support for biofuels beyond the recent attempts to prop up the existing policy. Biofuels of the type in use today are already old technology. The future of alternative fuels in the EU and elsewhere rests with materials for which neither humans nor ecosystems are in competition, such as food waste or algae — not with crops that governments must label either 'food' or 'fuel'.

Furthermore, to get past the problem of import dependency, the EU should look to fuel technology that can be harnessed and employed within its 27 Member States. Presently, with the biofuels target at only 10% per Member State, the EU will need to receive at least 20% of the required feedstock in imports. Extrapolating this ratio for more sizeable targets of 30% or 40% biofuel incorporation pits the EU's dependency on foreign feedstocks at 60%-80%. Couple that with the 90% reliance on foreign oilseeds for food products that the EU will face in the coming years, and it becomes readily apparent that first-generation biofuels are less a solution to reliance on foreign oil than they are a mere substitute.

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[74] P. Mandelson, European Commissioner for Trade, "The biofuel challenge", International Biofuel Conference, SPEECH/07/467, Brussels, 5 July 2007.

Reprieve from foreign dependency can be partially achieved by widening the scope of inquiry to include more stringent vehicle emissions and fuel consumption standards. The EU has made progress on this front with the passage of revisions to the Fuel Quality Directive and improved emissions requirements from automakers, but it needs to be more aggressive in its efforts. Without sufficient incentive, auto manufacturers are not likely to budge much from the status quo, which could mean years more of only marginal improvement. Policies that vigorously stimulate investment not only in improved combustion engines but especially in hybrid and electric vehicles will bring the EU closer to realizing its goals of reduced dependency on imported oil and decreased environmental pollution. There will also be market opportunities in mass-producing new automotive technology. It is predicted that China will have approximately 600 million cars on the road by 2050, while the US currently has 150 million. Marshalling European automotive know-how could pave the way to export opportunities with China and other developing countries as they search for ways to meet the demands of rapid growth whilst mitigating their own environmental impact.

Each of these suggestions is feasible, but the EU has been reluctant to draw too fine a line in any one area. With biofuels, it saw a golden opportunity. Now a "valuable policy tool",[75] the early opinion on biofuels was that they were a multi-pronged policy solution. This fundamental mischaracterization of how to address the climate and energy issue was symptomatic of the overconfidence in the promise of biofuels that was, and still is to a degree, common of EU policymakers. It is understandable that EU leaders originally felt pressured to quickly formulate a response to looming security questions, but in so eagerly adopting biofuels, the EU created a policy whose effects had not been fully explored. As a result, the current iteration of the biofuels policy is plagued by many oversights that sully the EU's image as an environmental leader.

Today, policymakers are eager to pronounce the dawn of a 'new global industrial revolution' with the 2008 Climate and Energy Package, but their actions indicate that the sorely needed paradigm shift has not yet occurred in their own thinking. Ultimately, the EU must realize that there is no vaccine, no cure-all for the ailments that the first wave of global industrialization swept in more than 150 years ago. It is only with clear and forward-thinking direction, private sector ingenuity, and perhaps a bit of good fortune that the climate and energy condition can be managed in order to provide security and stability over the long term.

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[75] Fischer Boel, *op.cit*.

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