

Viewpoint

# Biofuels: What a Biopact between North and South could achieve

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## Abstract

With very few exceptions, such as the recent remarks by International Energy Agency (IEA) head Claude Mandil, commentators on the world's energy issues have yet to recognize the enormous contribution that biofuels producers from the South could make to solving the world's greenhouse gas emission problems and problems to do with the peaking of oil supplies. Once the equation between biofuels and high-cost, land-intensive cultivation in the North is broken, and a quite different scenario involving production in the South is adopted, then the possibilities are dramatically changed. The argument of this paper is that a transition to substitution of 20 percent of OECD gasoline needs by 2020 could be met from the South by creating the equivalent of 18 Brazils over the course of the next decade. Such an enormous transition will not occur by itself, or through the operation of market forces alone. It needs an institutional framework, one that guarantees for the countries of the North regular supplies of biofuels produced in a responsible manner, and guarantees for the countries of the South open markets for the biofuels produced. The OECD is in the best position to bring about such an arrangement, through taking the initiative of offering developing countries a 'Biopact' between North and South, thereby creating for the first time a global market for biofuels. The launch of an International Biofuels Forum under the auspices of the UN in early 2007 is a step towards the creation of such an international framework where North-South issues on biofuels may be fruitfully addressed.

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Ethanol produced in Brazil, even when it is imported to Europe [taking into account the energy needed to transport the fuel across the Atlantic] makes sense. If the United States and Europe are serious about biofuels, they must turn to the South for their supplies.

Claude Mandil, Director General International Energy Agency, October 2006

## 1. Introduction

It is rare to hear such sense spoken by a person in authority in energy matters. But Claude Mandil, head of the International Energy Agency, and sister organization

to the OECD, made this point (in French) in an interview published in *La Tribune* in October 2006. In the translation published by Biopact, Mandil is quoted as saying that ethanol is currently made from three main feedstocks: corn in the United States and Europe, sugar beet in Europe, and sugar cane in the developing world, most notably India and Brazil. "The first two methods are the worst imaginable" says Mandil, because they are only commercially viable with permanent subsidies and trade barriers, and their production requires a large amount of fossil fuel inputs, which is not the case for ethanol produced from sugar cane and other tropical biofuels. He then goes on to make the comment quoted above in the epigraph, and adds that the reason that the US and Europe must turn to the South for their ethanol supplies is that the South has the land available, the climate, and the crops. Mandil also notes that careful planning must be undertaken in order to limit environmental damage. He warns that Europe and the US

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do not see the larger picture. They are confusing agricultural with energy policies, mixing them up in a cocktail that he concludes “has no advantages.”<sup>1</sup>

This paper is an extended commentary on Mandil’s remarks, offering support and justification for this perspective. It makes the case that bioethanol and biodiesel offer the prospect of a vast global market and greatly enhanced global trade, provided the WTO acts to classify bioethanol and biodiesel as fuels rather than foodstuffs. While classified as the latter they fall into the net of powerful agricultural protectionist lobbies in both the EU and the US, and constantly run the ideological risk of being seen as competitors for food. The biggest institutional shift to bring about the benefits promised by biofuels is to have them treated as fuels—like petroleum and its derivatives.

In fact the paper goes further, and argues for an explicit and historic ‘biopact’ between the OECD countries (representing the ‘North’) and developing countries that grow biofuels (the ‘South’) to institute a system within the rules of the WTO that favors sourcing by the North of a growing portion of its fuel needs from the South. This Biopact could guarantee markets for fuels grown in the South, and at the same time guarantee the integrity of these biofuel supplies, to ensure that fuels sold in the North meet certain fundamental environmental and biodiversity guidelines. The countries that do meet these guidelines could expect a welcome from international markets; while firms in those that do not could expect to be rigorously excluded. Such a proposal immediately raises several fundamental issues, to be explored in this paper; among them are issues such as how such guidelines could be drafted and implemented; how reliable verification procedures could be set in place; what kind and range of criteria would be included in such an arrangement; and what penalties should be imposed for non-observance. The proposal for a Biopact is designed to address these issues and at least map out possible means for dealing with them.

The core argument of the paper is that a Biopact of this kind would represent a practical and powerful way for the North to act to protect biodiversity and help countries in the South to prevent deforestation, as opposed to the hand wringing that passes for action at the moment. This could be a Biopact with enormous consequences for both North and South, and as such it could help to shape an international regime of peace, security and economic development for the 21st century.

The setting within which these proposals make sense is that of the twin crises of global warming and the imminent peaking of oil supplies, each on their own presenting OECD countries’ transport systems with major problems given their heavy dependence on oil. Coming together they amount to a crisis of unprecedented magnitude—as witnessed by the urgency of recent official reports such as

the Stern report on the economics of climate change and the IPCC Fourth report delivered in February 2007.<sup>2</sup> One comment, from the leading NASA scientist Dr James Hansen, can stand for all: “*I think we have a very brief window of opportunity to deal with climate change ... no longer than a decade, at the most.*”<sup>3</sup>

Yet this setting of climate change and energy insecurity does not make for unanimity of policy direction. The chorus of hostility and disbelief aimed at continued and expanded production of biofuels in OECD countries themselves, with all their attendant problems of energetics, land use and competition with food, signals the need for a drastic change of direction.

That change of direction points South. While most of the alternative energy scenarios of recent years have nodded in the direction of biofuels as potential alternatives to petroleum as liquid fuels, they were generally seen as making a contribution right out into the future because of concerns over the energy efficiency of ethanol, and the net energy yield of the process of producing ethanol, and the unsubsidized costs being uncompetitive with oil. All these conventional views have been overthrown by the success of Brazil in making cane-sourced ethanol, at prices and at levels of energy efficiency that far exceed those obtained by US Mid-west states such as Minnesota with corn-fed and grain-fed ethanol distilleries.<sup>4</sup>

Now the success of Brazil is being propagated to other tropical developing countries, that look to use sugar cane as a feedstock for ethanol production, or other starch-rich crops such as cassava or sweet sorghum, and at a variety of oilseeds for biodiesel production, including hardy non-edibles such as *Jatropha curcas* (and its local varieties such as Kasla in The Philippines).<sup>5</sup> India and China are entering this race as well, as part of their determined efforts to find an industrialization pathway that does not bind them to fossil fuels. These developing countries are discovering that renewable energies, and biofuels in particular, offer them a fresh start in industrialization. As latecomers they enjoy advantages of low costs but also the possibility of drawing

<sup>2</sup>See the Stern report (2006) and the IPCC report (2007) as well as other well-documented assessments such as Pacala and Socolow (2004). For a counter view that all is well, see CERA (2006).

<sup>3</sup>For a news report of Dr. Hansen’s comment, see “NASA: Arctic melting is ‘alarming’”, CBS News, at: <http://www.cbsnews.com/stories/2006/09/14/eveningnews/main2011009.shtml?CMP=ILC-SearchStories>. Dr. Hansen gave an elaborated account of the current threat of global warming in *New York Review of Books* (Hansen, 2006).

<sup>4</sup>Professor Arnold Reitze (2006), writing in the *Environmental Law Review*, makes a strong argument that Americans are turning from oil addicts to alcoholics, in the sense that one obsession is being traded for another. He states categorically that if the US is serious about biofuels, then it should be sourcing them from the South.

<sup>5</sup>For more on *Jatropha*, see: <http://www.biodieseltechnologiesindia.com/> For the applications of sweet sorghum in ethanol production in China, see: <http://www.fao.org/ag/magazine/0202sp2.htm> For the use of indigenous *Jatropha* in The Philippines, where it is known as kasla, see: <http://www.gov.ph/news/default.asp?i=12481> For a general discussion of biodiesel from the perspective of this paper, treating it as a potentially widely traded commodity, see Steenblik (2006).

<sup>1</sup>See the full remarks and comment at: <http://biopact.com/2006/10/iea-chief-europe-and-united-states.html>. For a French summary, see: <http://www.agrisalon.com/06-actu/article-17592.php>.

from the latest technologies and management systems, such as multiple feedstock bioreactors. They can create new industrial blocs based on the biofuel value chain, encompassing the plantations, crushing and processing, distillation and downstream capture and recycling of by-products, at levels of efficiency unobtainable in the North. There is by now widespread agreement that renewable energies generally, and biofuels in particular, are moving from the margins to the mainstream.<sup>6</sup>

But the environmental issues associated with production of biofuels—the issues of deforestation and species loss, of water usage and run-off, of herbicides and pesticides usage and soil degradation and land energetics—all need to be addressed. This paper argues that the best way to meet them is not through arbitrary and one-off actions such as European MPs calling for bans on imports of palm oil from Malaysia, but through an explicit agreement between the North (the OECD countries) and the South, where guarantees on such matters can be formalized and overseen by procedures established as part of the agreement. Such a global agreement is there for the taking: all the OECD countries have to do is agree amongst themselves that it would be desirable, and then establish a negotiating framework within which countries from the South be invited to join with others in participating in such a Biopact. The initiative would lie with the OECD, as the source of the markets for responsibly produced biofuels and as the party looking to guarantee its future supplies. But the South also needs agreement over the emergence of biofuels markets in the North in order to raise the finance needed to make the huge investments involved, and countries in the South would be able to use such an agreement to help stave off the forces pushing for irresponsible biofuel development, through forest clearances, water wastage and illegal runoff. Thus both parties stand to gain enormously from the negotiation of such a Biopact.

This then is the basis of the bargain. The North desperately needs biofuels as a way of dealing with GHG emissions and with the imminent peaking of oil supplies, while the South has the potential capacity to build new industries around biofuels and provide rivers of fuel to the North. Never before have the gains from trade been made so manifest. The issue is: can the two sides overcome the difficulties that stand in the way and reach an accommodation that will serve their mutual interests?

## 2. The current situation

Currently the world consumes petro-oil at the rate of around 84 million barrels per day. The energy contained in this vast quantity of oil is equivalent to 180 exajoule(EJ) per year—that is  $180 \times 10^{18}$  J, a very large number. The OECD is responsible for consuming half of this oil, of

which 58 percent is used in transport. So that makes the OECD responsible for using energy from oil in transport of around 54 EJ per year. This is what eventually needs to be replaced by alternative fuels such as biofuels.

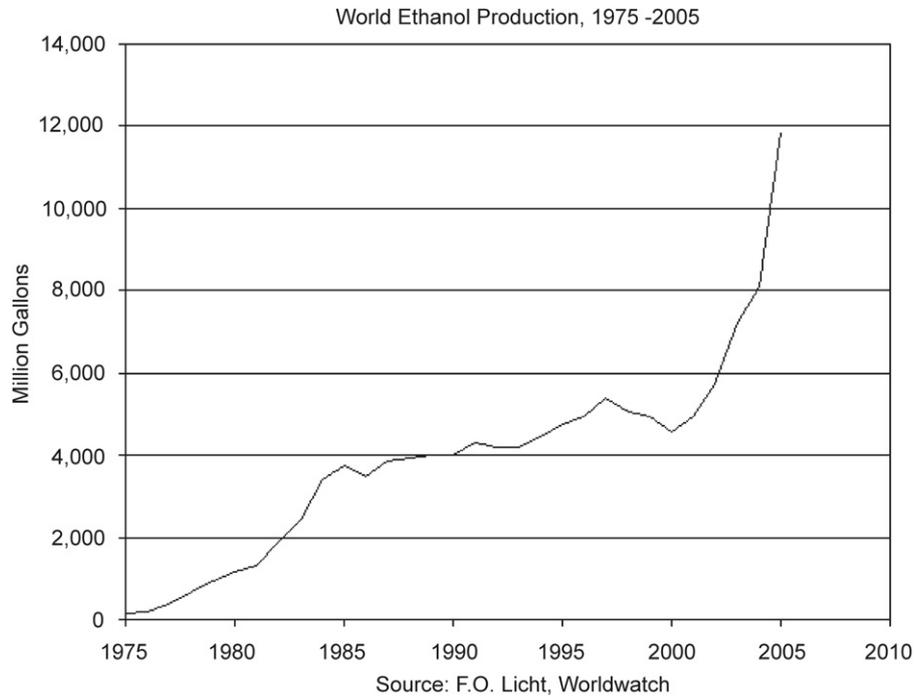
Currently the world produces around 48 billion liters of bioethanol per year, and a smaller amount of biodiesel. This has an energy content, in round terms, of 1 EJ. The South accounts for half of this biofuel output, or 0.5 EJ, so that in principle the South currently meets around 1 percent of OECD transport fuel demand. (It does not do so in practice because the markets in the EU and US are not open to biofuels from the South.)<sup>7</sup> The growth of world ethanol production in recent years is plotted in Chart 1, which also shows that production in 2005 was dominated by Brazil and the US, with China and India also emerging as key producers.

Let us set a target for the South to meet a substantial proportion of OECD liquid fuel requirements within a reasonably short time frame. To be precise, let us specify a medium-term target of 20 percent of the OECD fuel demand for transport to be achieved by the year 2020. This is in fact what the European Union calls for in respect of all renewable sources of energy—and so it is within the thinking of policy makers today.<sup>8</sup> If that is to be the

<sup>7</sup>These data draw on the IEA, such as in its latest *World Energy Outlook* (IEA, 2006) and its report on Biofuels, IEA (2005). The World Bank has addressed the issue through its report, *Potential for Biofuels for Transport in Developing Countries* (October 2005). Other relevant studies on the rising significance of biofuels and their capacity to substitute for petrofuels include Fulton (2004, 2005), and Rosillo-Calle and Walter (2006) as well as Zarrilli (2006) for UNCTAD and Dufey (2006) for IIED. The report by NRDC (2005) canvasses all the issues involved in scaling up a biofuels industry in the US, but never mentions trade; whereas the report from the WorldWatch Institute, WWI (2006), devotes a chapter to encouraging sustainable trade in biofuels, and makes the point: "... markets in [the US and EU] are large enough to accommodate both domestic production and imports (and the more rapidly biofuel-compatible transport infrastructure is phased in, the faster their biofuels markets will grow). International trade may help to ease fuel supply issues, linking a larger number of producers in order to minimize the risk of supply disruption" (pp. 35–36).

<sup>8</sup>The European Commission (EC) proposed in 2001 a mandate that alternative fuels including hydrogen, natural gas, and biofuels including ethanol and biodiesel, substitute for 20 percent of diesel and gasoline fuel by 2020. The biofuel mandate started at 2 percent in 2005 and hit 5.75 percent of fuels sold by 2010 (although this target did not look like being achieved as of 2007). At the beginning of 2007 the European Commission issued more ambitious renewable energy goals, including a commitment to reach 20 percent renewable energy content of all energy consumption by 2020, with biofuels making up no less than 10 percent of transport fuels by 2020. In his State of the Union address for 2007, President George W. Bush also called for a US energy policy that would mandate '20 in 10' meaning a 20 percent substitution of fossil fuels within a decade. Specifically, President Bush called for biofuels (mainly ethanol) supply to amount to 35 billion gallons (133 billion liters) by 2017—compared with world ethanol output of 40 billion liters in 2005. The '20 in 10' goal also included a reduction in fuel use attributable to improving fuel efficiency standards. At the level of states, in September 2006 the Connecticut State Governor proposed a similar mandate, establishing a 20 percent minimum content for renewable fuels by 2020, while in California Governor Schwarzenegger announced in January 2007 that he would issue an Executive Order establishing a low-carbon fuel standard for transport fuels. This Californian measure would reduce carbon intensity of fuels by

<sup>6</sup>Dr. Uwe Franke, head of BP Germany, went on the record at the BioEnergy 2006 conference held at Hanover in November 2006, to the effect that bioenergy will emerge as the leading industry of the 21st century; see: <http://biopact.com/2006/11/deutsche-bank-and-bp-21st-century-will.html>.



World Ethanol Production by Country, 2005		
Country	Production	Production
	Million Liters	Million Gallons
United States	16,214	4,283
Brazil	16,017	4,244
China	3,800	1,004
India	1,700	449t
France	910	240t
Russia	750	198t
South Africa	390	103

Source: Earth Policy Institute, based on F.O. Licht

Chart 1. World ethanol production, 1975–2005. Note that 1 US gallon holds 3.8 liters; the 2005 totals are 11.86 billion gallons, or 44.9 billion liters. Source: Earth Policy Institute.

medium-term goal, then the short-term goal—within the next decade—would translate into a requirement for the South to lift its current production levels from 1 percent today to 18 percent of OECD requirements by the year 2017–2018, i.e. from 0.5 EJ today to 9 EJ by 2017.<sup>9</sup> The South would have to replicate what Brazil currently

achieves 18 times over, within the next decade.<sup>10</sup> This is a rate of growth far higher than even the stunning growth rates in ethanol production of the last few years and it will call for major investments over 10 years of approximately \$432 billion to build over 2000 biorefineries.<sup>11</sup>

(footnote continued)

10 percent by 2020. and thereby replace 20 percent of all fuels with low-carbon fuels by that date.

<sup>9</sup>If we take present consumption levels as benchmark, then just less than 11 EJ would be the goal (one fifth of 54 EJ). But OECD transport consumption of petrofuels would also have risen by the target year of 2020; according to the IEA’s Alternative Policy Scenario, it would have risen by a further 1 EJ, to 55 EJ. So to meet such a moving target, the South would have to raise its biofuel production from the present level of 0.5–11 EJ by 2020—or assuming linearity, to 9 EJ by 2017—an increase of 18 times.

<sup>10</sup>A biofuels output of 18 times current Brazilian levels would amount to 9 EJ energy, equivalent to 432 billion liters of ethanol per year, or 114 billion gallons (US), or 2.5 billion barrels per year, or approx 7 million barrels per day, equivalent in energy terms to approx 5 million barrels of oil per day.

<sup>11</sup>If we take the standardized, modular ethanol refineries being built by the US firm Cilion (founded by Vinod Khosla, discussed below in relation to the proposed contingent tax) as benchmark, where each has an output of 200 million liters of ethanol per year, then this production target would require the building of 5 × 432 or 2160 biorefineries in the South over the course of the next decade. The building of 2160 refineries would call for investment of approximately US\$432 billion (allowing US\$1 to be

Can the South produce 18 Brazils in a decade? Is it a feasible proposition for both North and South to build so many biorefineries?

First, we note the utter infeasibility of the North producing such a biofuel output through its own production. As Claude Mandil stated this year (quoted above) the energetics are against it, the land availability is against it, and the disturbances to the markets for corn and grain (the principal feedstocks in the US), and to sugarbeet, the principal feedstock in the EU, would be far too great. So if the OECD is to move to biofuels as a solution to declining fossil fuel supplies and to concerns over greenhouse gas emissions, then something drastic has to be done to ensure that supplies can be produced in the South.

Second, we note that we are talking here of first generation biofuel production, where the constraints on land availability and infrastructure are the most stringent. Second generation biofuel production, involving production of ethanol via the biochemical breakdown of lignocellulose, and biodiesel from a range of biomass such as plantation forests using fast pyrolysis for production of bio-oil or gasification and the Fischer-Tropsch process for production of synthetic biodiesel. Such technological innovations (now already in the experimental or pilot stage) would drastically increase the biomass available for production of fuel, in both North and South. The remaining four fifths of OECD fuel consumption, as well as the consumption of the rest of the world, could be met post-2017 (or even earlier) by these second generation sources.<sup>12</sup> So we are really talking about the transition arrangements that would apply over the next decade as the OECD countries adjust their transport systems to become biofuel-friendly. The huge surge in production required to lift the South toward the interim goal of 18 Brazils by 2017, and then the extra effort required utilizing second-generation biofuels, is shown in Chart 2. Note how in this

(footnote continued)

invested per liter of ethanol) over a decade. This is a large sum, but may be put into context by considering total Foreign Direct Investment (FDI) flowing into developing countries, which amounted to \$334 billion for just the single year 2005 (UNCTAD, 2006b). If this were repeated over the course of a decade, the cumulative FDI of \$3340 billion would exceed 8 fold the investment needed for biorefineries. In fact the entire enterprise could be funded by the oil industry. Profits of the global oil industry in 2005–2006 were \$140 billion, and profits of Exxon-Mobil, the largest oil company, were \$35 billion in 2005 and \$40 billion in 2006. So Exxon-Mobil on its own could finance the entire biofuels program in the South over a 10-year period, thereby transforming itself from being the world's largest oil company to the world's largest biofuels company.

<sup>12</sup>In supporting the widespread introduction of prairie grasses in the US as a source of second generation biofuels, Vinod Khosla points out that just 19 million acres could supply 39 billion gallons of ethanol by the year 2017 (7.6 million hectares supplying 148 billion liters, at a productivity of 16,500 liters per hectare—higher than is obtained from sugarcane in Brazil today). As he says: “Farmers will be better off, the world will be less dangerously dependent on the Middle East, and we will take a giant step in GHG reductions. There is little downside.” See his Opinion column, “President Bush, please declare a war on oil” in HuffingtonPost.com, 22 January 2007, available at: [http://news.yahoo.com/s/huffpost/20070123/cm\\_huffpost/039326](http://news.yahoo.com/s/huffpost/20070123/cm_huffpost/039326).

Chart the impressive efforts of the last few years seem puny by comparison with what is needed if realistic goals of petrofuels displacement are to be met.

Third, it is worth pointing out that the achievement of such a vast project in the South and the reception by the North of the biofuels produced, would have a dramatic impact in reduction of greenhouse gas emissions. If we extend the trends described above to encompass transport fuels used by the entire world and not just the OECD, this would effectively reduce carbon emissions by 1 giga tonne per year. This is equivalent to one of the seven ‘wedges’ proposed by Pacala and Socolow in their celebrated paper in *Science*, published in 2004, and would thus go one-seventh of the way to solving the world's GHG emissions problem.<sup>13</sup> This in itself is a huge accomplishment.

Fourth, we note that bioethanol is the ideal first generation biofuel to be supplied by the South, because of its potential abundance from tropical crops such as sugar cane, sweet sorghum and starch-rich crops like cassava; because of its high-energy content, amounting to around two thirds of the energy content of petroleum;<sup>14</sup> and the fact that its introduction calls for almost no extra investment in infrastructure, the entire petrofuels distribution and dispensing system being available for substitution by ethanol.

The next decade then provides the window of opportunity for the North to make a start on solving its GHG emissions problem with the substitution of fossil fuels by biofuels, sourced from the South, and the window of opportunity for the South to take advantage of this demand to establish new industrial clusters for the production of export biofuels. So, how could the South scale up in such a massive way in such a short time?

### 3. How can the South produce 18 Brazils over the next decade?

The issues to be addressed in calling for so many Brazils to be produced by the South over the next decade are those of entrepreneurial and investment capacity; land availability (responsibly cultivated land); competition with food supplies; and the effects of monocultures on a vast scale.

<sup>13</sup>The estimates offered here are in line with those provided by Pacala and Socolow (2004), who break down the climate stabilization challenge into seven ‘wedges’ that can be pursued separately and independently with existing technologies. One of their seven wedges is ‘Biomass fuel [to be substituted for] fossil fuel’ where they identify the wedge as calling for ‘100 times the current Brazil or US ethanol production, with the use of 250 million hectares (one sixth of world cropland)’ (p. 970). Each wedge reduces carbon emission rates by 1 giga tonne per year, or when pursued over the 50 years from 2004 to 2054, the reduction in emissions is 25 giga tonnes of carbon. Pacala and Socolow are here effectively stating the issue as substitution of world liquid fossil fuels for transport, up to the year 2050, whereas in this paper I am discussing prospects for substituting for one fifth of OECD liquid fuels used in transport.

<sup>14</sup>The energy content of a ton of oil equivalent is 42 GJ, while that of ethanol (LHV, or lower heating value) is 26.7 GJ, or 64 percent.

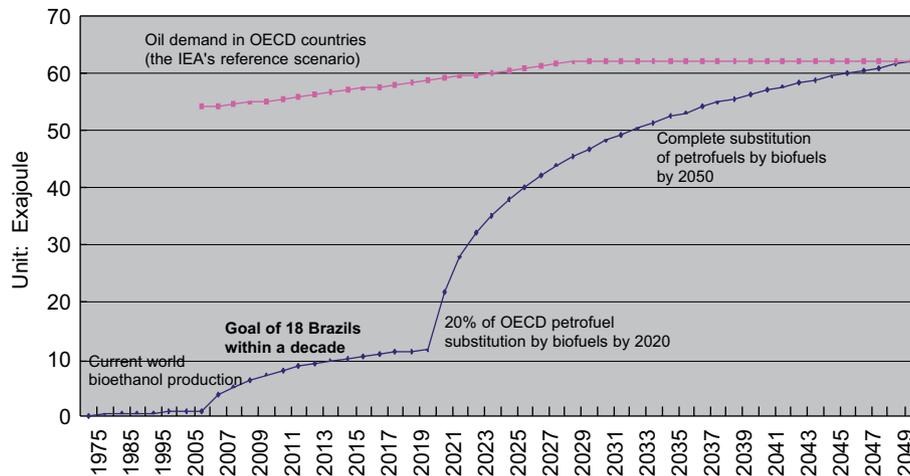


Chart 2. World ethanol production, 1975–2050, as projected. *Source:* Author.

Let us take the issue of land first, since without the land, the whole enterprise collapses.

### 3.1. Land availability

Brazil currently produces nearly 20 billion liters of ethanol in a year from just over 2 million hectares of land—a yield of nearly 10,000 liters per hectare. Let us suppose that this yield could be replicated 18 times over through the countries of the South—a big assumption, but one that could be achieved through South–South cooperation and through the sustained involvement of international agencies such as UNIDO, UNCTAD and the World Bank.<sup>15</sup> If we allow for a less than perfect propagation of Brazil’s yields to other countries, and postulate that other tropical developing countries manage a yield of only 5000 liters ethanol per hectare, then the goal of 18 Brazils would call for 72 million hectares (720,000 km<sup>2</sup>) to be placed under biofuel cultivation—arable land that is available now and not from any new forest clearances. This is an area of land the size of Chile. Are such tracts of land available?

Actually, they are, and in abundance. There are huge swathes of land in Africa, Southeast Asia, the Indian sub-continent and Latin and Central America that are degraded, and not used for any productive purpose or were formerly used for cattle grazing. To be precise, in just the African countries that signed up for a ‘Green OPEC’ in 2006, the Food and Agriculture Organization (FAO) of the United Nations estimates that there are 379 million

hectares of potential arable land available, of which only 43 million are utilized.<sup>16</sup> So in principle, according to FAO data, there are in just a few African countries over 300 million hectares of potentially arable land available for both ethanol and biodiesel production. When the whole of sub-Saharan Africa, South Asia and Southeast Asia are added, as well as Latin and Central America, then the availability of arable land not already cultivated or forested, starts to look very considerable indeed, at over 2 billion hectares of potentially arable land.<sup>17</sup>

This land area is well in excess of the calculated capacity requirements to meet the goal of replenishing OECD liquid fuel requirements. Of course much of the land designated as ‘arable’ is currently forested, and there are very good reasons for wanting to keep it that way—but it is clear from the FAO data that there is scope for drastic scaling up of land use for biofuels in Africa that awaits simply the investment to unleash it—and the promise of a market for

<sup>16</sup>By way of comparison, Europe’s arable land covers 384 million hectares, of which 214 million are under cultivation. These data come from Biopact, ‘A closer look at Africa’s “Green OPEC”’: <http://biopact.com/2006/08/closer-look-at-africas-green-ope.html>.

<sup>17</sup>The FAO Terrastat database indicates 1.1 billion hectares of potentially arable land in sub-Saharan Africa, of which only 158 million hectares was under cultivation in 1994 (and which by extrapolation would indicate that 197 million hectares are under cultivation today). This leaves over 900 million hectares in Africa as being available for biomass cover, including the cultivation of biofuel crops. Likewise in South and Central America there are just on 1 billion hectares of potentially arable land, and just 143 million hectares under cultivation. Faaij and Domac (2006) estimate that up to 1 billion hectares of land could eventually be involved in all biofuel production in a sustainable and responsible manner; this would account for one fifth of the land currently used for agricultural production. Taking the broad view, Smeets et al. (2007) estimate that the bioenergy potential of the tropical South would amount by 2050 to 215 EJ per year, under the mildest assumptions (e.g. no irrigation) and responsible and sustainable land use methods. These are purely technical assessments (and if realized would amount to replication of Brazil’s current efforts 430 times over!) but they indicate the scope for transition to a bioeconomy without taking into account the negative impacts of monoculture.

<sup>15</sup>The World Bank engages with biofuels and renewable energy options under a number of programs, such as the Energy Sector Management Assistance Program (ESMAP); see WB (2005, 2006). UNCTAD is already actively discussing the biofuels option, both in terms of trade and regulatory issues, and in terms of prospects for developing countries; see Zarrilli (2006); UNCTAD (2006a). UNIDO has a program in ‘energy and cleaner production’ and in this capacity made a contribution to a workshop on Biofuels for industrial development and climate mitigation, in Vienna in November 2006.

the product. This is why some sort of Biopact between the OECD and the global South is so important as a means of facilitating this anticipated massive flow of investment in biofuels production to the South.

Take the case of Angola as an example. According to the country's Agriculture and Rural Development Minister, Alfonso Pedro Canga, Angola is not only becoming self-sufficient in food (throwing off the war-torn past) but now looks to be a contributor to the Southern Africa Development Community (SADC) through biofuels. Its 16 million inhabitants grow their own crops on 3.6 million hectares of land, out of a total of 88 million hectares suitable for agriculture. Its biofuel potential through cultivation of crops such as cassava, sweet sorghum, *Jatropha*, and sugarcane would make it a 'biofuels superpower'.<sup>18</sup>

Indeed one might go on the offensive here, and argue that biofuels represent the best prospect yet for greening the planet. Vast tracts of degraded land in the South can be put to productive and green use, while even the margins of the deserts can be cultivated with biodiesel-yielding non-edible crops such as *Jatropha curcas* (in India and now around the world) for biodiesel or sweet sorghum for ethanol production. If a Biopact between North and South can encourage a rolling back of the deserts, and a greening of formerly waste and degraded lands, then this puts efforts to curb deforestation in a different perspective.

So there is no necessary equation between biofuel production and deforestation, as is often assumed by critics. A biopact between North and South would be able to set in place practical measures such as ensuring that poor farmers in the South gain access to technical advice that would enable them to raise productivity on existing lands without venturing into lands that have been illegally cleared. Illegal forest clearing will continue until something tangible and practical is done to stop it; a Biopact regulating production of biofuels in the South is one such way forward.

### 3.2. Responsible cultivation

Quite so, answer the critics—but can these vast tracts of land be put under responsible cultivation—considering such issues as use of water for irrigation, and use of fertilizers, herbicides and pesticides and their run-off effects? Let us look at the case of Brazil to see how things have been accomplished there.

Firstly, sugar cane can be produced in tropical monsoonal climates without any irrigation at all. Regular monsoonal rain is all that is needed to raise 1 crop a year. Of course if greater yield is desired, then some form of added water has to be supplied. But let us keep to the 'high

ground' here (as it were) and assume that all tropical countries can replicate Brazil in producing sugar cane or other starch-rich crops like cassava from rainfall alone. The case of biodiesel is even easier to deal with, because many of the most promising plant varieties, such as *Jatropha curcas* will grow and produce fruit every year even in extremely arid conditions. Sugar cane can be grown from rainfall alone, as verified by the FAO of the United Nations. The world map for rainfed sugar cane cultivation conditions (using very conservative assumptions) provided by FAO is reproduced in Chart 3. Note how the designated areas follow the tropical countries fed by monsoon rains.

Fertilizers are a feature of Northern agri-industrial practice, but they are not essential to Brazilian sugar cane production. In Brazil, the waste products of ethanol production, termed vinasse, are rich in organics, and can be returned to the cane fields which are always close to the mill. The cane plant is used to the full, and what is left after crushing (bagasse) is fed into boilers to provide electric power for the bioreactor, and even for exporting power to the grid (where regulations allow this). So fertilizers are needed but not on anything like the scale used in the North.<sup>19</sup>

In Brazil, a vast R&D effort over 25 years has been poured into improving cane varieties, through breeding and through genetic engineering, to produce high-yielding varieties that are pest resistant. So pesticide use has been reduced to a minimum, while herbicide use has been eliminated through harvesting the total cane, with or without any weeds that grow as well. So pesticides and herbicides do not present a significant problem, and few run-off problems are encountered in Brazil where these matters are dealt with responsibly. Of course there are cowboy operators but their prevalence is minimized by the industry associations that regulate the sugar cane sector in Brazil, such as Copersucar.<sup>20</sup>

The greatest concerns seem to be focused on palm oil production in Southeast Asia, such as in Malaysia, Indonesia and Thailand. There have already been calls by European MPs for a ban on imports of palm oil where there is no certification that the oil has been produced responsibly, and some companies in Europe have already been forced to cancel investments in renewable energy projects involving palm oil.<sup>21</sup> The producers themselves

<sup>19</sup>See the paper by Smeets and Faaij (2005) for a realistic assessment of future demand for fertilizer from bioenergy crop production in the South.

<sup>20</sup>The IEA's Bioenergy Task Force 40, which analyzes international bioenergy and biofuel trade, issued a report in October 2006 on the environmental sustainability of Brazilian ethanol production, finding that it is sustainable under current practices. The criteria of sustainability used by the report are those developed by the Dutch parliament in 2006 (the first such sustainability criteria officially published). The report was commissioned by SenterNovem, the Netherlands Agency for Sustainable Development and Innovation, and prepared by the Copernicus Institute at the University of Utrecht and Brazil's State University of Campinas (Smeets et al., 2006).

<sup>21</sup>See 'Reactions to Euro-MPs' call to ban palm oil, sugar cane biofuels', *Biopact*, 24 October 2006, available at: <http://biopact.com/2006/10/>

<sup>18</sup>See 'Biofuels "superpower" Angola soon to be self-sufficient in food production: FAO,' Biopact weblog, Wed 31 January 2007, at: <http://biopact.com/> For further quantitative details of countries' biofuel potential in the South African Development Community, see Johnson and Matsika (2006) and for the details of the global assessment of biomass potential using the Quicksan method, see Smeets et al. (2007).

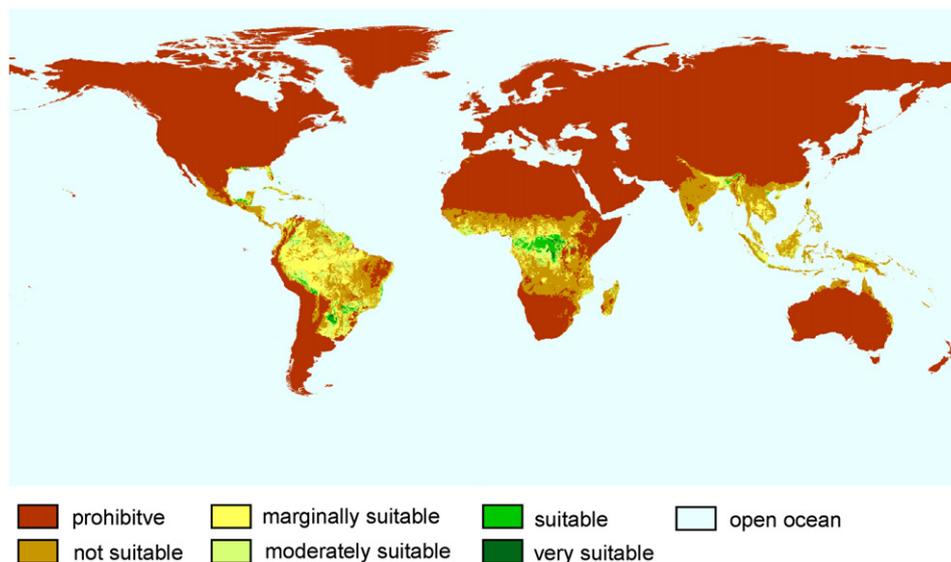


Chart 3. World map of sugar cane cultivation utilizing rainfall only. *Source:* FAO Terrastat.

have already made modest efforts to regulate their own production (such as through the Roundtable on Sustainable Palm Oil production) but clearly there is much more to be done. A Biopact would be able to set much more stringent standards and practicable means for enforcing them.

### 3.3. Competition with food: agriculture and ergoculture

The South will be the first area of the planet to develop a major new use for land, namely the cultivation of energy. This is what we might call *ergoculture*.<sup>22</sup> The issue is: to what extent will ergoculture act to compete with agriculture, or production of food? The best prospects for biodiesel come from non-edible plant varieties such as *Jatropha curcas*, cottonseed, linseed and so on. There is competition under current conditions for biodiesel from soyabeans and palm oil. But the market works to constrain

any competition between biodiesel from these sources and foodstuffs; as the price of oil from these edible sources rises, it becomes less and less attractive as a feedstock for biodiesel. If regulatory incentives are added to this from OECD countries, specifying as part of a Biopact that use of soyabean and palm oil should be phased out (on account of competition with foodstuffs, and because these are the greatest offenders in deforestation), then the South would swing behind non-edibles exclusively as sources for biodiesel.

As for ethanol from sugar cane, again this is a transitional issue for the next decade, until second generation ethanol and biofuels become available from lignocellulose and biomass generally. For the next decade, then, the price of sugar and the price of ethanol are bound to be closely related. Is this such a bad thing? If the North (OECD) wanted to do something about the price of sugar, then all it has to do is make a settlement of the agricultural exports aspects of the Doha trade round that is currently stalled.

The real problem arises when we consider ethanol produced in the US from grain and corn. This is already causing major disruptions to the foodstuffs markets, and to the feed markets for livestock industries both in the US and abroad. Lester Brown surely hits the problem on the head when he calculates that average growth in corn output in the US of around 20 million tons per year cannot hope to meet the demand of the new ethanol distilleries in the US for perhaps 10 times that incremental amount. The result he foresees is rising prices and shortages in the downstream food industry (almost all manufactured foods in the US have their origins in corn), in feedstuffs, and in industries abroad such as poultry and livestock sectors. He counter-proposes against the 3 percent of automotive fuel supplies now coming from ethanol a rise in fuel efficiency standards by

(footnote continued)

[reactions-to-euro-mps-call-to-ban-palm.html](http://business.timesonline.co.uk/article/0,9072-2525637,00.html). The German utility RWE announced at the end of 2006 that it was abandoning plans to operate a power station in the UK with palm oil, citing concerns that the palm oil would be sourced from deforested areas: see 'Concern for rainforest forces RWE to scrap palm oil project', *Timesonline*, 1 January 2007, available at: <http://business.timesonline.co.uk/article/0,9072-2525637,00.html>. On the Roundtable on Sustainable Palm Oil production (RSPO), which is headquartered in Kuala Lumpur, see the rather short document 'Principles and criteria for sustainable palm oil production' (RSPO, 2005) and 'Code of Conduct' (RSPO, 2007). Principle 4 of the 2005 document, for example, refers to 'use of appropriate best practices by growers and millers' and states as Criterion 4.3 that 'Practices minimise and control erosion and degradation of soils'. Other principles are stated with equal brevity, making the document little more than a checklist.

<sup>22</sup>I am coining this term to indicate land used for energy cultivation. It comes from the Greek root *ergon*, meaning work or energy, and the CGS unit for energy, *erg*. Biofuels from crops are one form of ergoculture; banks of solar arrays, and wind farms, are other uses of land for production of energy.

20 percent—far more effective and achieved at a fraction of the cost.<sup>23</sup>

Of course Brown's concerns would be met by the US switching from domestic production of ethanol to imported ethanol produced not from corn and grain but from cassava, sugar cane and other sugar-rich and starch-rich sources. But he does not say this.

A related concern is that land used for biofuels would be taking away land that could be used for edible crops. The answer to this in my view is to ensure that land used for biofuels in countries from the South does not, and is seen not to, displace land used for agricultural activities. Let the two categories be distinct: there is the practice of raising food from land (agriculture) and there is the practice of raising energy (fuels) from land, that I suggest be called ergoculture. As part of a Biopact with the North, the South could be required to ensure that ergoculture does not infringe on any of the lands currently under agriculture, such as by focusing on non-edible biofuel crops such as sorghum and *Jatropha*. This is already the focus of biofuel efforts in China.<sup>24</sup>

Ultimately, the prospects for biofuels in both North and South depend on the physical limits established by photosynthesis. Do these limits set a block to biofuels—as claimed in the illustrious journal *Science* by Hoffert et al. (2002, p. 984) where they state: "... photosynthesis has too low a power density ( $\sim 0.6 \text{ W/m}^2$ ) for biofuels to contribute significantly to climate stabilization." This figure actually corresponds to the energy production and power density of Brazilian sugar cane at the moment. If this yield can be translated across to other tropical developing countries, or even half the yield, it does not seem to present a barrier at all. It really is incumbent on Hoffert et al. to explain why they dismiss Brazilian photosynthetic yields in such a cursory manner.

### 3.4. Entrepreneurial and investment capability

With the exception of a few countries, such as Latin American countries including Argentina, Colombia and perhaps Mexico, and Southeast Asian countries such as Malaysia and The Philippines, countries in the South, and especially in Africa, do not have the entrepreneurial and investment capacity needed to erect huge new biofuel industries. It is in the interests of the North to ensure that they do so, because the North wants the fuels. Building strong industries in the countries of the South will also have the effect of allowing them to escape the trap of poverty, which in itself will help to solve other problems such as illegal immigration from South to North.

<sup>23</sup>Brown concludes "On the food-versus-fuel issue, the world desperately needs leadership—a strategy to deal with the emerging food–fuel competition. As the world's leading grain producer and exporter, as well as its largest producer of ethanol, the United States is in the driver's seat." (Brown, 2006, p. 3)

<sup>24</sup>See 'Biofuels squeeze food crops in China' at CarbonPositive, 19 January 2007, available at: <http://www.carbonpositive.net/viewarticle.aspx?articleID=540>.

In the short term, such countries do not need pre-existing entrepreneurial and investment capacity. Companies can provide it from the North, looking to make investments in biofuel production. Indeed this is likely to be the principal source of investment if the goal of creating 18 Brazils is to be achieved within a decade. The issue for the countries of the South will be to manage the flow of Foreign Direct Investment (FDI) targeted towards biofuel production, and to ensure that the country gains substantial benefit from such FDI.

That such investments will not be in short supply, consider the following snapshots, drawn from the biofuel literature of the past six months.

#### 3.4.1. Swaziland and Zambia: D1 invests in *Jatropha* plantations

D1 Oils is leading the way to building biodiesel industries in both Swaziland and Zambia, through investing in *Jatropha* plantations and processing facilities. Planting will be carried out through contract farming and offtake agreements. D1 has already established *Jatropha* nurseries to raise the seedlings.<sup>25</sup>

#### 3.4.2. Liberia: International Bio Fuels Corp (IBF) to develop biodiesel plant

In September, the IBF (UK) announced plans to establish a large-scale biodiesel and palm crushing facility in Liberia. The plan calls for employment of tens of thousands of small farmers in raising the palm trees and harvesting the fruit. No deforestation is to be allowed.<sup>26</sup>

#### 3.4.3. Nigeria: Nigerian National Petroleum Corporation

Just as Petrobras is leading the way to a biofuels future in Brazil, so in Nigeria the Nigerian National Petroleum Corporation is investing heavily in plantations and facilities for ethanol production, such as from cassava cultivation. The Corporation acts as buyer of the cassava for processing, or in some cases as buyer of the ethanol produced.<sup>27</sup>

#### 3.4.4. Senegal: Bioking invests in *Jatropha* cultivation

The Dutch biodiesel equipment manufacturer BioKing has invested in a *Jatropha* plantation in Senegal, initially covering 15,000 hectares and expected to grow to 60,000 hectares. BioKing presses the seeds produced by local farmers. This Dutch company has developed a containerised biodiesel facility that is suitable for installation anywhere throughout the developing world.<sup>28</sup>

<sup>25</sup>For further details on D1 Oil's strategic plans, see: <http://www.d1plc.com/index.php>.

<sup>26</sup>See the news item in *Biofuel Review*: <http://www.biofuelreview.com/content/view/503/2/>.

<sup>27</sup>For details, see: <http://www.recep.org/index.cfm?articleid=1460>.

<sup>28</sup>On the Senegal investment, see details at: <http://www.biofuelreview.com/content/view/139/2/>; on the containerised (modular) biodiesel processing facility, see: <http://www.biofuelreview.com/content/view/116/2/>.

#### 3.4.5. Chile: Südzucker (Germany) to make major investments in Biofuels

The Südzucker company, Europe's largest producer of ethanol, announced in November 2006 that it had reached agreement with the Chilean government on a series of initiatives to develop biofuels in Chile. The announcement is designed to deliver on the promise by the new government under President Michelle Bachelet to raise the contribution of renewable energy sources in Chile to 15 percent by 2010.<sup>29</sup>

#### 3.4.6. Argentina: Soros investment fund to make major investments

Argentinian federal Planning Minister, Julio de Vido, announced in New York in September 2006 that financier George Soros had committed to making an investment of 'between \$250 and \$300 million' in biofuels production using corn and sugar cane as feedstocks.<sup>30</sup> Argentina could emerge in time as a 'biofuels superpower' to rival Brazil.

#### 3.4.7. China: BeCCo to invest in *Jatropha* using biodiesel facilities

The newly founded biodiesel group BeCCo already has in place substantial plans for building biodiesel facilities in China, and overseeing the cultivation of up to 1 million hectares under *Jatropha*. The company is working closely with local authorities to lease the land and purchase the oilseeds from small-scale farmers. The biodiesel to be produced in large state-of-the-art biorefineries will then be sold to China National Oil Corporation, for distribution as a motor fuel. BeCCo claims to be developing a new hybrid for its Chinese ventures, involving *Jatropha* and another oilseed plant variety.<sup>31</sup>

These examples from the recent press indicate the intensity of interest on the part of companies in the North to invest in biofuel facilities in the South. There can be little doubt that the South has the potential to be able to meet the biofuel requirements of the North if activated by such investments from the North. The key point is that the countries of the South protect their interests by ensuring that such investments are sustainable, that they are created in partnership with local firms, that they foster technology and knowledge transfer, and that they lead to further investments in the value chain. The countries that are likely to contribute to the target of creating 18 Brazils in a decade form a swathe across the entire tropical region.<sup>32</sup>

<sup>29</sup>For details, see the Biopact story at: <http://biopact.com/2006/11/germanys-suedzucker-makes-massive.html>.

<sup>30</sup>For details, see: <http://biopact.com/2006/09/george-soros-to-invest-300-million.html>.

<sup>31</sup>Private communication, revealed at the Great Wall Renewable Energy Forum, held at Beijing, October 2006.

<sup>32</sup>The countries could include: Brazil (doubling its present output); Argentina; Colombia, Venezuela and Ecuador; Central American and Caribbean countries; Nigeria; Congo Republic; Angola, Namibia; Ghana; Senegal, Gambia, Guinea, Togo, Mali, Chad; Namibia, Zimbabwe, Zambia; Kenya, Swaziland, Rwanda; Uganda, Tanzania; Malaysia; Thailand; The Philippines; Indonesia; Vietnam; India; China; South

## 4. How to build Biofuels industries in the South

How then are biofuels industries in the South likely to be established, at the scale and pace needed to supply rivers of ethanol and biodiesel to the North? The key to industrial development will be the FDI targeted at building biofuels industries in the countries of the South. This investment will come largely from OECD countries, but also from more advanced developing countries such as China, India and Brazil.<sup>33</sup> Governments in these countries of the South will have to be involved to ensure that the investment is channeled productively, and that countries in Africa or Southeast Asia do not just end up as raw materials providers without any industrial development induced through downstream processing.

Countries in the South will be able to utilize their latecomer advantages in formulating strategies of entry into the biofuels sector, where they will be able to draw on latecomer advantages such as leapfrogging to the most recent technology and utilizing it with lower costs than in the industrially developed countries.<sup>34</sup> The goal for these countries will be to create a biofuels sector as a 'development bloc' that has upstream and downstream linkages with the rest of the economy.<sup>35</sup>

The export industries induced in this way will be backed by domestic supply infrastructure, which will also help to build the biofuel industrial bloc. The key that unlocks the potential of renewable biofuels for development is—as discovered by Brazil—flex-fuel vehicles. It works like this. Flex-fuel vehicles give motorists a choice—fill up with ethanol or with petrol, depending on the price and personal preference. This choice engenders confidence, and overcomes any lingering doubts about ethanol. This builds consumer demand for ethanol, so bringing competition to the petrol forecourt. The oil companies can swim with the tide, and supply ethanol themselves, or they can go against it, and allow independents to supply the ethanol that motorists demand. Either way, an ethanol market is created. This then leads to realistic policies for supplying

(footnote continued)

Africa; and Indian Ocean islands: Malagasy Republic; Mauritius; La Reunion.

<sup>33</sup>Call these the 'BICs' after the Goldman Sachs report of 2003 on Brazil, Russia, India and China (the 'BRICs') which GS predict will be 4 of the 6 largest economies in the world by 2050 (Goldman Sachs, 2003). All 3 'BICs' are actively developing biofuels industries and investing in plantations and biofuel facilities abroad; Russia is the exception.

<sup>34</sup>On industrial catch-up strategies based on capture of the latecomer effect, see Mathews (2006a). The original exposition was provided by Gerschenkron (1962).

<sup>35</sup>For an exposition of development blocs in a strategic context see Mathews (2006b). The notion of *development bloc* is introduced by the Swedish Schumpeterian scholar Eric Dahmén, in his historical study of the industrial development of the Swedish economy; see Dahmén (1950/1970) as well as Dahmén (1989). The concept has been taken up by others such as Carlsson and Eliasson (2003) where they call it a *competence bloc*, to emphasize not just the supply side but also the demand side of technological propagation and its dependence on industrial competence creation across many interacting firms.

ethanol—either through imports (probably from Brazil) or through local production that gets a kick-start mandated by popular demand. In the tropical parts of the world, such as India or Thailand, there will be sugarcane and starch-rich plants such as cassava providing the feedstocks. The bioreactors built will be at the leading edge of technology, to capture latecomer advantages. They will be flexible, taking a variety of feedstocks and producing a variety of outputs, not just ethanol but also distillers' grains for animal feed, as well as plant wastes that can be fired to produce electric power for the bioreactors that will be collocated next to the grain or corn or cane fields. Entrepreneurial initiatives to produce ethanol from lignocellulose (woody and fibrous biomass) would then be forthcoming, so that alcohol supplies could be produced on a scale that would eventually provide a real alternative to oil and to fossil fuels more generally.

Governments in both OECD countries and developing countries can mandate these changes, by simply requiring that all new vehicles meet flex-fuel standards. The automotive industry is already producing huge numbers of flex-fuel vehicles, and would be enchanted to be given a chance to offer them against local competition in India and China. The rest would follow. As China, India and other developing countries wean themselves off imported oil, and the results of producing ethanol and creating a national biofuels market become apparent, so the pressure to produce other 'green' sources of energy would mount, to the benefit of the countries concerned and to the planet through the reduction in GHG emissions.

The point being made is that by developing their own biofuel industries, developing countries create the best defense against seeing themselves simply exploited as suppliers of raw materials, in a colonial pattern that has been repeated many times in the past. Their best ally in protecting themselves from such an eventuality is to build on their comparative advantages, turning them into competitive advantages.

## 5. Why tropical countries do it better

Brazilian ethanol yields an energy output 8 times the energy input—as compared with 1 or even negative scores for ethanol produced from grain or corn in temperate climates.<sup>36</sup> The yield of ethanol per hectare, currently at around 6000 liters per hectare in Brazil, is twice that obtained from corn or grain in temperate climates. Brazilian ethanol is more competitive than that produced in the US from corn or in Europe from sugar beet, because of longer processing times (the starch has to be rendered into sugars first), higher labor costs, higher transport costs and input costs. But there are also subtle factors at work as well that leverage off these comparative advantages. In

Brazil, a massive R&D effort has been devoted to unlocking the biological secrets of sugar and ethanol. At the *Centro de Tecnologia Canavieira* (Cane Technology Centre), an R&D facility funded largely by the sugarcane industry, the genome of sugar cane *Saccharum officinarum* has been decoded, and used to select varieties that are more resistant to drought and pests and that yield higher sugar content. The Centre has developed some 140 varieties of sugar, which has helped to drive costs down by 1 percent a year, as shown in Chart 4.<sup>37</sup>

Other improvements include using remains of processed cane (bagasse) to power the sugar/ethanol plants (making them energy independent) and using industrial waste from ethanol production (vinasse) as fertilizer for cane fields. The Centre is using satellite imagery to map the location of all canefields in the country (largely concentrated in the SE, in the state of Sao Paulo) to help researchers discover which varieties grow best in which localities. These improvements mean a dramatic increase in the productivity of Brazilian sugar cane: 1 hectare which used to produce 2000 litres of ethanol now produces three times that amount, or 6000 litres, and up to 10,000 liters per hectare is envisaged for the near future.<sup>38</sup>

Vegetable oil yields for biodiesel are also impressive in the tropical South. While corn produced in the North yields 145 kg oil per hectare, and sunflowers 800 kg oil per hectare and rapeseed 1000 kg oil per hectare, the tropical *Jatropha* yields 1590 kg per hectare and palm oil no less than 4000 kg per hectare. The Brazilian biodiesel program utilizes a range of high-yielding oils, as shown in Table 1. Indeed the Brazilian program is a carefully thought through initiative, involving institutional innovations such as the use of a special 'Seal of Social Responsibility' which can be awarded to biodiesel producers if they source their oilseeds from small, family owned farms in the impoverished North-East. The variety of crops utilized is shown in Table 1.

The approach to tapping indigenous resources through developing countries' own R&D, as pioneered in Brazil, is now propagating through the tropical regions. In The Philippines, for example, the Regional Development Council (RDC) is developing *Jatropha* (known locally as Tuba-Tuba or kasla). The RDC is developing this indigenous crop in cooperation with the Philippines Army and the Department of Energy, to complement the efforts underway by foreign investors such as D1. Likewise in southern Africa, there are numerous efforts underway to improve what we should call the *ergocultural efficiency* of biofuel production.<sup>39</sup> Likewise other crops are being actively developed, such as sweet sorghum (*Sorghum bicolor*), a drought-tolerant and water-efficient tropical

<sup>37</sup>The paper by Goldemberg et al. (2004), from which this Chart is drawn, provides a succinct summary of the Brazilian experience with bioethanol.

<sup>38</sup>"As Brazil fills up on ethanol, it weans off energy imports," by David Luhnnow and Geraldo Samor, *The Wall Street Journal*, 16 January 2006.

<sup>39</sup>See Johnson and Matsika (2006) for examples.

<sup>36</sup>See the studies collected in Macedo (2005) as well as the exposition on sustainability of Brazilian sugar cane and ethanol production offered in Smeets et al. (2006).

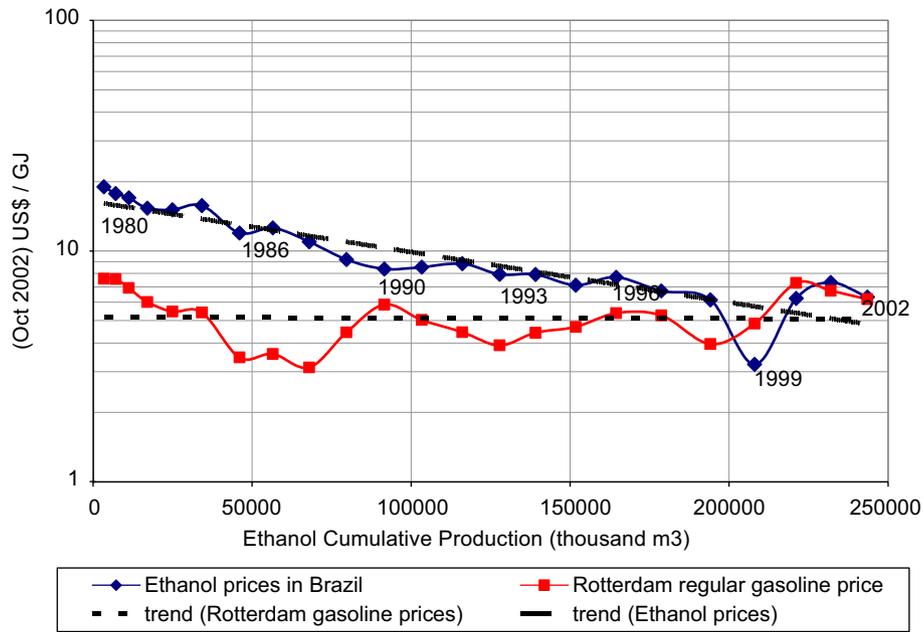


Chart 4. Learning curve for Brazilian ethanol, over 25 years. Source: Goldemberg et al., 2004.

Table 1  
Biodiesel and Brazilian vegetable oil sources

	Castor oil	Sunflower	Soy	Palm	Cotton
Crop yield (kg/ha)	1500	1500	3000	20,000	3000
Oil contents (percent)	47	42	18	20	15
Oil yield (kg/ha)	705	630	540	4000	450
2005 production in Brazil ('000 m <sup>3</sup> per year)	90	23	5600	151	315

Source: Petrobras.

crop that has been shown to produce ethanol in commercial quantities in Andhra Pradesh, India.<sup>40</sup>

There are also international initiatives under way. In November 2006 in Brazil, for example, the International Sugarcane Biomass Utilization Consortium was formed, with a group of developing countries as founder members, and with a focus on the large-scale utilization of biomass from sugarcane for production of fuels and chemicals, i.e. products requiring further processing beyond sugar.<sup>41</sup>

In spite of these achievements, there are many critics of the biofuels option, some of whom appear to be criticizing

biofuels in general but in fact are actually in agreement with the argument of this paper. Let us see how.

### 6. Critics of biofuels—and how to answer them

Having put the case for the OECD countries to enter into a 'biopact' with the South to secure rivers of biofuels over the course of the next decade, let us go back to the critical literature—to the nay-sayers who cast doubt, and sometimes pour scorn, on the prospects for biofuels. Closer inspection reveals that many of these critics are in fact implicitly supporting the remedy proposed in this paper—namely that the OECD countries should abandon the unrealistic goal of trying to become self-sufficient in biofuels and instead enter into a Biopact with the South for massive supplies.

For example, Michael McElroy, Baker professor of environmental studies at Harvard, recently published an article entitled 'The ethanol illusion'—where he makes the very point that it would be completely unrealistic for the US to seek to meet its transport fuel needs by growing corn for ethanol production (McElroy 2006). The energetics of the process is against such a prospect (too much energy used in growing the corn, in transporting it, in providing the fertilisers and pesticides and herbicides, and in producing the ethanol itself). The land use requirements are against it (too little available arable land for fuel crop cultivation). And the industry survives today in the US only thanks to generous tax breaks and subsidies which if withdrawn would lead to its collapse. So what does Professor McElroy suggest as alternatives? He suggests, sensibly enough, that the best immediate option lies in improving fuel efficiency standards and in reducing consumption, probably by a tax on gasoline that could

<sup>40</sup>This was demonstrated by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), as reported at: <http://biopact.com/2006/10/icrisat-succeeds-in-commercial.html>.

<sup>41</sup>The Consortium has been initiated under the auspices of the International Society of Sugar Cane Technologists, by Dr. Jean Claude Autrey, director of the Mauritius Sugar Industry Research Institute and Dr. Peter Rein of the Audubon Sugar Institute at the Louisiana State University.

be recycled in the form of health and social security benefits to those hardest hit by such a regressive measure. He agrees that a technological solution in the form of producing ethanol from lignocellulose would be promising (and sees such a technological fix as resolving the food or fuel dilemma faced by the US). And that is about it. There is not a single sentence in the article suggesting that the South could provide the ethanol that the US seeks. His discussion of Brazil is sound, except that he offers the view that Brazil has already reached the limits of its ethanol production—something that contradicts all responsible opinion, from government to industry, that Brazil could indeed double its output if the market were there. The possibility that Brazil's success could be replicated elsewhere in the South is nowhere considered.

Pimentel and Patzek (2005) are the most cited authors on this topic, so let us look at their arguments. Their most celebrated paper is one published in 2005 in the journal *Natural Resources Research* (vol 14, no. 1, March 2005, pp. 65–76), entitled 'Ethanol production using corn, switchgrass and wood; biodiesel production using soybean and sunflower'. In each case they find that the energy output is less than the energy inputs involved in producing the ethanol or biodiesel. The authors conclude their exposition with the following observations. "Several physical and chemical factors limit the production of liquid fuels such as ethanol and biodiesel using plant biomass materials. For ethanol, they highlight the low fraction of sunlight absorbed by plants in North America, as well as the energy costs of removing the water produced as part of the ethanol fermentation process. Therefore these crops are poor producers of biomass energy" (p. 73).

This study has been widely quoted as meaning that ethanol and biodiesel from biomass sources are non-feasible, period.<sup>42</sup> Yet it is obvious that the findings of Pimentel and Patzek, 2005 are confined to the case of growing such crops in the US, or at least in northern climatic regions, and that under such conditions, there are physical and chemical limits to the efficiency of the processes involved. The authors say nothing about the situation in countries of the South, where the comparative advantages enjoyed by tropical countries negate the exercise of these limits. Therefore it is more sensible to list Pimentel and Patzek (2005) as implicit supporters of the view that the US (and OECD countries more generally) cannot meet their transport fuel requirements through production of ethanol and biodiesel from domestic biomass sources, utilizing current (first generation) conversion technologies—and that they should therefore embark on a massive import program involving ethanol and biodiesel imported from the countries of the South where the

conditions permit it. But they do not say this; it is implicit in their argument, and has to be made explicit.

An article published in *Business Week* in April 2006 'Ethanol: A tragedy in three acts' by Ed Wallace, again turns out to be right in line with the argument of this paper. Wallace (2006) identifies three major stages in the ethanol story in the US, each one characterized by the failure to live up to expectations. Act One was the still-born rise in domestic ethanol production in the US during the 1970s, when 163 ethanol plants were built, driven by tax breaks. Wallace notes that only 74 of these still exist (actually that seems a high number for 30-year-old industrial plants) and that the industry at that point was killed off by low oil prices. Act Two was the Clinton Administration's efforts during the 1990s to enforce oxygenated additives to US gasoline, which after numerous court battles resulted in MTBE becoming the additive of choice. This was unfortunate, as we now know, and the 2000s have seen a reverse trend as MTBE is mandated out of US gasoline. Act Three refers to the current claims made by the US Federal Government and auto majors such as GM that ethanol blends result in lower motoring costs.

The implication is that ethanol is a sham and a fraud, and that the sooner this show 'goes off the road' the better. There is a mention of Brazil, at the very end of the article, where Wallace notes that ethanol produced from sugar cane in Brazil delivers an 8:1 energy gain. But he concludes: "Unfortunately for us, sugar cane isn't a viable crop in the climate of our nation's heartland." So again the question is left hanging: if ethanol can be produced so well in Brazil, why not import it into the US? But this question is not asked in the article. Instead, the point is made that Brazil is also seeking independence from fossil fuel imports through its own oil discovery program and deep-water drilling activities—as if the two activities somehow contradict each other. The point that Brazil is making itself energy independent, and that it is thereby setting an example to the rest of the tropical developing world, seems to be lost on this author—or perhaps the point is not lost but is considered to be best left unsaid.

As a fourth example of the literature hostile to biofuels, consider the essay by Jeffrey McNeely, Chief Scientist at the IUCN, the World Conservation Union, in the BBC's Green Room: 'Biofuels: Green energy or grim reaper?' (McNeely 2006) The conclusion to the article is sound enough. McNeely states: "The bottom line is that biofuels can contribute to energy and environmental goals only as part of an overall strategy that includes energy conservation, a diversity of sustainable energy sources, greater efficiency in production and transport, and careful management of ethanol production." I could not possibly disagree with these conclusions, and nor could any reasonable person. But along the way, McNeely makes sensationalist claims that do need to be addressed.

- (1) The grain required to fill the petrol tank of a Range Rover with ethanol is sufficient to feed one person per

<sup>42</sup>Note that the Pimentel and Patzek (2005) study has been critiqued by numerous authors, notably by Farrell et al. (2006) who provide a framework within which widely disparate estimates of energy gains (or losses) may be measured. But the debate stays within the parameters of the United States; it does not include estimates of energy gains in tropical countries utilizing sugar cane or other feedstocks.

year. Assuming the petrol tank is refilled every 2 weeks, the amount of grain required would feed a hungry African village for a year

Here the assumption is made that ethanol is produced solely from grain, under temperate (North American or European) climatic conditions, and that every grain or corncob is deducted from food supplies. Surely it is clear that ethanol produced from sugar cane or cassava in tropical countries, in addition to or complementing what is currently produced for food, is not susceptible to this criticism.

- (2) Much of the fuel that Europeans use will be imported from Brazil, where the Amazon is being burned to plant more sugar and soybeans, and Southeast Asia, where oil palm plantations are destroying the rainforest habitat of orang-utans and many other species. Species are dying for our driving

Here the notion that biofuels can be equated with deforestation in the South is given its most stark and immediate expression. And yes, to the extent that soybeans (not sugar cane) can be grown in the vast Amazon region of Brazil, or palm oil plantations in formerly rain-forest areas of Indonesia or Malaysia, then it is clearly something to be deplored and counter-acted.<sup>43</sup> Just wringing our hands, in the time-honored approach of western environmental organizations like the IUCN, will clearly do nothing to solve the problem. A more practical proposal is that the North get together with the South to hammer out a Biopact, where it is made abundantly clear that imports of non-responsibly produced biofuels will *not* be allowed, while imports of responsibly produced biofuels will be welcomed. The Biopact might also (desirably) be accompanied by financial incentives to prevent forest clearance, by offering real economic assistance to indigenous peoples to help them resist the blandishments of illegal forest clearance operators.

- (3) Meeting the [EU] 5.75 percent target [for biofuels] would require, according to 1 authoritative study, a quarter of the EU's arable land  
This assertion is based on the assumption that all the biofuels consumed in Europe would be produced in Europe—as we have seen, an absurd proposition.
- (4) Using ethanol rather than petrol reduces total emissions of carbon dioxide by only about 13 percent because of the pollution caused by the production process, and because ethanol gets only about 70 percent of the mileage of petrol.

This assertion is based on authors such as Pimentel and Patzek, 2005 (discussed above) to the effect that the energetics of ethanol and biofuel production in the US is negative. It adds in the completely separate point that the energy content of ethanol is lower than for gasoline. Now motorists in Brazil are completely aware of this effect, and when filling up their flex-fuel vehicles they make the calculations accordingly, depending on current prices of ethanol and gasoline. The fact is, although it is not stated by McNeely, that ethanol produced in Brazil is almost 100 percent greenhouse gas neutral. Imports to the OECD countries would have to subtract the fossil fuel used in shipping, which remains (under western control) one of the dirtiest industries on the planet. Perhaps the inducement of landing ethanol in Europe with minimal loss of GHG neutrality might act as a spur to the shipping industry to move to biofuels itself.<sup>44</sup>

- (5) Food prices are already increasing. With just 10 percent of the world's sugar harvest being converted to ethanol, the price of sugar has doubled; the price of palm oil has increased 15 percent over the past year, with a further 25 percent gain expected next year.

The fact that palm oil prices have increased in Malaysia reflects the 'oil rush' mentality of the country in the first phase of a new biofuel revolution. But the price increases are likely to be short-lived if the EU (or the US) places import restrictions on biofuels from Malaysia that can be demonstrated to be emanating from deforested areas, where orang-utans once flourished. As for sugar and ethanol prices, these are notoriously volatile, a fact that farmers in the South have had to live with for years. A start could be made in controlling these prices if the North would solve the Doha round of trade talks by opening up Northern markets to foodstuffs. It is pretty rich for McNeely as a representative of a Northern environmental group to mention food prices without mentioning that it is the North that is the principal source of price volatility because of its closed markets to foodstuff imports.

- (6) Little wonder that many are calling biofuels 'deforestation diesel,' the opposite of the environmentally friendly fuel that all are seeking.

Need anything more be said? If we are all seeking that 'environmentally friendly fuel' then it is time that Dr. McNeely and others who think like him look to the South to find it.

## 7. A global market for biofuels?

The key obstacle to the scenario painted here is the existence of trade barriers erected by the North that block

<sup>43</sup>Just prior to the UN-climate conference held at Nairobi in November 2006, the Dutch group Wetlands issued a report detailing the 'shocking climate impact of wetland destruction in Indonesia' due to carbon emissions from peatland burning and destruction. See the report at: <http://www.wetlands.org/news.aspx?ID=2817de3d-7f6a-4eec-8fc4-7f9eb9d58828>.

While the link between such illegal destruction and planting of palm oil plantations is indirect, there is clearly sufficient concern to warrant use of a major international instrument such as the proposed Biopact to curb such practices.

<sup>44</sup>A Canadian cargo ship, the Anna Desgagnés, completed a voyage in the Atlantic in July this year, using B20 biodiesel all the way, as part of the Bioship project: <http://biopact.com/2006/10/shipping-industry-waking-up-to.html>.

the emergence of a global market for biofuels. Already there is substantial momentum behind the enactment of subsidies to encourage production of ethanol in northern temperate climates—from corn in the US and from sugar beet in Northern Europe—where the costs of producing the final product are far higher (2–3 times) than in India or Brazil. It would make so much more sense for the developed world to produce ethanol on a small scale for their own energy security, and import the bulk of their supplies from tropical countries in Asia, Africa and Central and South America.

Many of the OECD countries already have erected trade barriers against biofuels from the South, in a mindless expansion of tariff barriers against foodstuffs. The US, for example, operates a tariff of \$0.54c per gallon against ethanol imports, at the behest of corn-belt ethanol producers.<sup>45</sup> In addition there are substantial subsidies paid by state and federal government programs and tax breaks offered to these producers.<sup>46</sup> Despite this, US imports of ethanol have increased dramatically in the last 2 years, as revealed in Chart 5.

The key here is to have ethanol and biodiesel reclassified by the WTO as fuels rather than feedstuffs. As food products they are enmeshed in the culture of subsidization that has bedevilled world trade and is now the principle obstacle to resolving the Doha round of world trade talks. Ethanol and biodiesel are apparently seen by the US and EU as just another foodstuff. But they are different, and should be classified as fuels trading in direct competition with petroleum products. This is what Claude Mandil meant when he stated (above) that the EU and US are confusing agricultural with energy policies. The Brazilian government is reported to be working on a submission to the WTO to have ethanol and biodiesel reclassified as fuels.<sup>47</sup>

A global market with Brazil and tropical developing countries as principal suppliers does not mean that OECD countries, particularly the US and countries of the EU, need abandon their own domestic efforts. For reasons of energy security and rural economic development, there is no reason why a certain set-aside should not be made to ensure continuity of domestic supplies in the short to

medium term. This is essentially the position that the EU seems to be moving towards.<sup>48</sup> As second generation biofuels production gets underway, of course producers in the North will play a leading role in bringing the new fuels to market. Before that time, the next decade provides a window of opportunity for the countries of the North to become biofuel-friendly—to make biofuel outlets available, to build markets for flex-fuel vehicles, and to establish and consolidate standards and specifications for biofuels in line with global standards.

The other element involved in the creation of a global market is the setting of global standards for ethanol, biodiesel and biofuels more generally. The petrofuels market is already well regulated by a variety of standards governing processes and product specifications (such as ASTM D975 for diesel fuel oils), and the same now has to be set in place for biofuels—without national biases. The European biodiesel standard EN 14214, for example, which came into effect in October 2004, is widely perceived as favoring production of biodiesel from rapeseed (the dominant feedstock grown in Europe) and thus making it more difficult for biodiesel produced from other plant varieties elsewhere to comply with the standard.<sup>49</sup> Global standards would avoid such technical national biases that act effectively as non-tariff trade barriers.

The goal of a Biopact should be nothing less than the creation of an unfettered global market for biofuels—on the model of the existing global market for petrofuels. No country erects trade barriers to petroleum imports, because it is recognized that this simply adds costs through the entire value chain. By the same reasoning, no country should add costs to the same value chain emanating from biofuels, and no country should equate energy security with its own domestic production.<sup>50</sup> To bring about this sea-change in attitudes would be one of the principal elements of a Biopact.

<sup>48</sup>A report from the British House of Lords, issued just a week ago, puts the matter well: “If energy security is a nation’s main concern, those countries wanting to replace fossil fuels with biofuels may understandably seek imports from countries such as Brazil. A strong international market in biofuels is extremely valuable. Equally, a strong and competitive European biofuels industry is strategically and economically important. We thus support the European Commission’s twin objectives of maintaining fair market access for imported biofuels whilst fostering a successful domestic biofuels industry. We do not believe that these objectives are incompatible” (House of Lords, 2006, par 73, p. 27).

<sup>49</sup>EN 14214 sets standards in terms of Iodine content that is consistent with production of biodiesel from rapeseed, and makes it difficult for biodiesel produced from other oilseeds to meet the standard. It is actually formulated as being specific to rapeseed methyl esters (RME) biodiesel. In this sense the standard constitutes a non-tariff trade barrier.

<sup>50</sup>Hester (2006) puts it well when she states: “The US is behaving as if protecting its domestic production is synonymous with security. That approach is misguided. It is a contradiction to promote economic integration and free trade, while protecting your own industry with distorting policies. Instead, the US could foster energy security by increasing cooperation with Brazil and Canada” (p. 25). Of course the argument has even greater force if applied to a regime of global cooperation between the North and the South.

<sup>45</sup>It is worth noting that US Secretary of Agriculture, Sam Bodman, stated at the Davos summit meeting in January 2007 that the US “will need to have more imports of ethanol” to meet the new US mandate to cut gasoline use. Speaking to Dow Jones Newswires at the World Economic Forum, Bodman said he does not see subsidies to US farmers remaining in place beyond 2010 or import tariffs on ethanol beyond 2008.

<sup>46</sup>These subsidies are received largely by agro-industrial groups such as the privately owned giants, Cargill or Archer Daniels Midland (ADM). According to a recent report from the European Global Subsidies Initiative, the subsidies paid to US ethanol producers currently amount to US\$5.1 billion per year (GSI/IISD, 2006).

<sup>47</sup>On the WTO classification systems and their relevance to biofuels, see the discussion by Lewandowski and Faaij (2004) and the recent report from the International Food & Agricultural Trade Policy Council, IPC (2006). On Brazil’s recent initiative, see the report at: <http://www.cattlenetwork.com/content.asp?contentid=83808>.

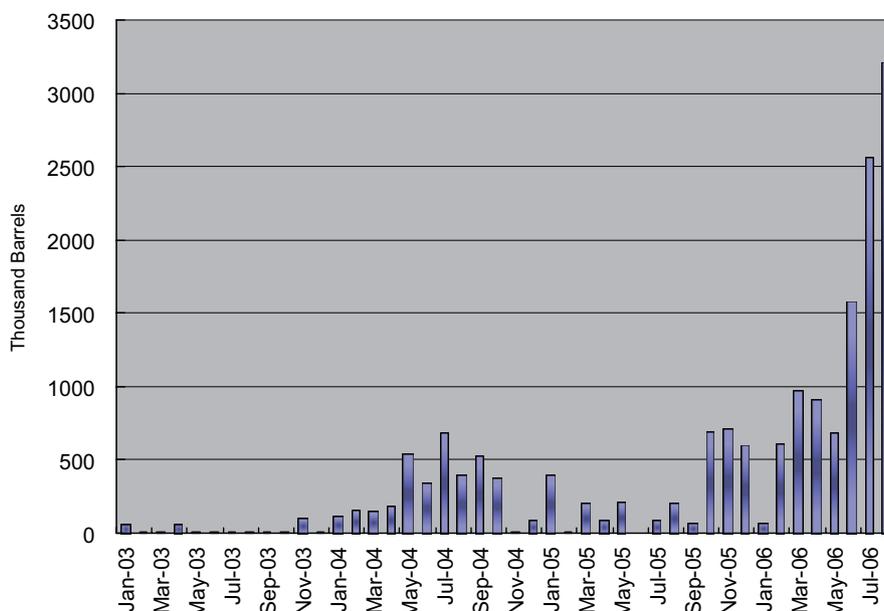


Chart 5. Imports of ethanol into the US, 2004–2005. *Source of primary data:* Form 819, US EIA.

## 8. A possible counter-attack from the oil industry

So far we have discussed the issues as if all that were needed were good-will and understanding. But of course there is another distinct possibility. Let us not be so naïve as to believe that the OECD countries will swing uniformly behind the transition to biofuels, based on even the best possible reasons justifying such a shift. The companies producing steam engines did not campaign for electric motors, and the companies producing propeller-powered aircraft did not campaign for the jet engine. Neither (we might add) did the companies producing stage coaches campaign for the railways—to adapt a famous aphorism of Joseph Schumpeter.<sup>51</sup> Indeed in these cases, history shows that none of the ‘old regime’ companies survived the transition. So it may be in the case of the largest industrial transition of all, namely the shift that is just getting under way from a fossil fuel based industrial system to one based on biofuels, bioenergy and a bioeconomy generally. It is unlikely that the oil companies will lead this transition. Indeed it is highly likely that they will do all in their power to frustrate it.<sup>52</sup>

<sup>51</sup>Schumpeter’s comment was “Add as many stage coaches as you please, you will never get a railroad by so doing” (Schumpeter, 1935/1951, p. 136).

<sup>52</sup>There is a counter view that oil companies are relatively inactive in producing biofuels not through opposition but because the industry is presently structured more as a feedstuffs industry than a fuel industry, and that they are waiting for the second generation biofuels, where raw materials costs will decline and infrastructure demands will rise, to make their entrance. See on this the article “Oil majors set to play ‘bigger biofuels role’” in the Gulf Times, Qatar, available at: [http://www.gulf-times.com/site/topics/article.asp?cu\\_no=2&item\\_no=117510&version=1&template\\_id=48&parent\\_id=28](http://www.gulf-times.com/site/topics/article.asp?cu_no=2&item_no=117510&version=1&template_id=48&parent_id=28).

At the international level, it is already well documented how fossil fuel lobby groups such as the Coalition for Climate Change (CCC) (a group set up to oppose the case for global warming) have acted to slow recognition of global warming, and have moved to block or weaken measures taken to curb it, such as the Kyoto Treaty.<sup>53</sup>

What is less well known is the role played by such fossil fuel interests at the national level, in frustrating national initiatives to move from fossil fuels to a biofuelled future. Let one example stand for many. In June 2006 the Senate of The Philippines voted against a Biofuels Act that had been adopted by the country’s Lower House. At a news conference after the vote, Rep. Juan Miguel Zubiri, sponsor of the measure in the Lower House, lashed out against oil industry influence. He said that Caltex-Chevron had lobbied hard against the measure amongst Senators, arguing for voluntary rather than mandatory provisions. However there is a happy ending to this Philippines story, in that the Senate finally did ratify Rep. Zubiri’s bill in November, opening the way to substantial investment in the country. The writ of Chevron-Exaco had apparently reached its limits.<sup>54</sup>

Not all oil companies are dragging their feet, and some can be expected to be active proponents of a Biopact between the OECD North and the South. First to step up would undoubtedly be Petrobras, the state-owned energy company in Brazil, and now as important a trader in biofuels as it is in fossil fuels. But there are others: BP now claims that its acronym stands for ‘Beyond Petroleum’

<sup>53</sup>For an eye-witness account, see Leggett (2000); the argument is rounded out in his most recent text, Leggett (2005).

<sup>54</sup>For details of this Philippines case, see: <http://www.bic.searca.org/news/2006/oct/phi/13.html>.

while second-ranking oil companies such as Total are already making significant investments in biofuels.

But the recalcitrants amongst the fossil fuel camp have perhaps yet to play their strongest card. Exxon-Mobil has been reaping windfall profits on a staggering scale as the price of oil has climbed in 2005 and 2006.<sup>55</sup> What would stop Exxon-Mobil from suddenly announcing that it will supply oil to all-comers for \$19.99 a barrel, thereby unleashing a savage price-cutting war in the global oil industry? The effect would be predictable. Low oil prices in the 1980s and 1990s destroyed the prospects for an ethanol industry in Brazil (and in the US as well), and low oil prices in the 2000s could have the same effect. Bankrupted oil companies would be collateral damage.

A price-cutting assault is feasible since Exxon-Mobil could afford to ride out the losses, based on its huge war chest of accumulated profits—just as John Rockefeller, the head of its predecessor company Standard Oil, was able to ride out price wars he instigated in America in the early years of the 20th century, in the pursuit of monopoly power. In the end, it was only the US Federal Government, under President Teddy Roosevelt, that was able to stand up to Standard Oil—forcing a divestiture order that was upheld by the Supreme Court in 1911, and unleashing the greatest battle ever fought between the US federal government and big business. Is there a measure that could block such a pre-emptive price-cutting strike by Exxon-Mobil?

Actually there is. Consider the case of a contingent industry tax that only comes into play if the price of oil drops to a certain level—say, \$30 per barrel. If the price of oil stays above that level, then nothing happens; the tax is not put into effect. If the price of oil falls below this level, say to \$25 per barrel, then the tax is applied so that the price is brought up to \$30. Oil companies selling oil for below the minimum set would have to pay the tax—in this case, \$5 per barrel sold—into a special fund that could then be used to promote biofuels, for example by funding R&D. The tax would therefore act as a reverse windfall tax, and would act to keep the price of oil above a predetermined minimum, designed to safeguard investments in biofuel facilities. It would not be used to divert revenues from the oil industry to ethanol producers.<sup>56</sup>

<sup>55</sup>According to the respected *Global Upstream Performance Review 2006* by John Herold, Inc., the oil industry in 2005 enjoyed a revenue gain of \$190 billion over 2004; the Review notes that it has been a challenge for the industry to invest such a huge flow of funds.

<sup>56</sup>The Indian–American venture capitalist Vinod Khosla, founder of a new ethanol producing company in the US (Cilion), has discussed such an eventuality, and proposed the remedy of a ‘contingent tax’ which could be effected by the US to deter such deliberate and provocative price-cutting. It would come into effect at a pre-determined level—as he suggests, \$40 per barrel. As Khosla explains it, the contingent tax is “...a tax which I propose comes into play only if the price of oil drops below \$40 per barrel. I propose we charge a tax on the difference between the price of oil and \$40 such that the effective price of oil does not fall below \$40. I propose we use this tax, if it ever comes into play, to reduce the price of oil when the oil price rises above \$60 per barrel. This could be done by using the

Now while entrepreneurs such as Khosla have considered this measure as something that a future US Administration might want to consider, to guarantee the integrity of investments made in the biofuels industry, the international case has not been considered, presumably because it would seem too hard to have such a measure implemented internationally. But in the context of a North–South Biopact, the situation changes dramatically. The OECD countries in agreeing to such a Biopact have everything to gain by ensuring that the oil industry be held in check and be prevented from aggressively cutting prices in order to destroy biofuel investments. So it would make sense to include the contingency tax proposal as part of the Biopact—to be implemented by each OECD country signing up for the deal.

The contingent tax proposal is just that—a measure designed to deal with a contingency, namely oil prices falling to such a level that investments in biofuels are threatened. If oil prices do not fall, then the contingency does not arise and the tax is never levied. So it is simply a prudent measure of insurance. China’s strategy for its biofuels industry already includes a similar proposal, in the form of a measure to grant subsidies to bioenergy producing companies when international crude oil prices fall below the green alternative’s production cost (and not just a transient fall, but one that is sustained over a period of time). So there is already acceptance of the principle involved.<sup>57</sup>

## 9. Elements of a biopact between North and South

What then would a Biopact between the OECD countries representing the North and a group of countries representing the South actually look like, and how might it come into being? Granted there are colossal blocks that stand in the way, from political and economic objections of the industries that see themselves as losing from such a deal, to the problems inherent in any initiative taken at an international level. There are all too many precedents for failure.<sup>58</sup>

(footnote continued)

“contingent tax” to increase oil reserves, buy futures hedges or other strategies to the extent that funds are available in this ‘fund’. Either the fund will never collect any funds or it will help stabilize prices. This ‘price stabilization’ will reassure investors that their investments in alternatives to gasoline will not be subject to the manipulation of oil prices by the oil producing cartel.” See ‘A near term energy solution’ A White Paper by Vinod Khosla, April 2006, available at: <http://www.khoslaventures.com/presentations/Khosla%20Biofuels%20Article%20v3%203.doc>.

<sup>57</sup>On China’s biofuels policy framework, adopted as part of the country’s 11th Five Year Plan, see Biopact: <http://biopact.com/2006/11/new-elements-in-chinas-ongoing.html>.

<sup>58</sup>The Kyoto Protocol on Global Warming has sparked a renaissance of scholarly analysis of good and bad features of international agreements, with a focus on what works and what does not. David Victor, formerly of the Council of Foreign Relations, has used the experience accumulated with trade agreements to criticize the overly rigid character of the 1997 Kyoto treaty, which he argues contributes to its current difficulties (Victor,

But in this case consider the factors that promote such an initiative. There is the over-riding concern on the part of OECD countries with their high level of fossil fuel usage in transport, and its multiple ill effects, notably in the contribution of giga tonnes each year of CO<sub>2</sub> and other greenhouse gas emissions and the ill-effects of carbon particulates emissions. This is the over-riding objective quandary that OECD countries face, that demands an effective and permanent solution. The possibility of switching to biofuels as such a durable solution presents itself compellingly. It is a solution that demonstrably works, and is available in the short to medium term—unlike alternatives such as hydrogen, electric vehicles and such. Therefore it may be supposed that the means will be found to over-ride objections and move to negotiations with all due speed.

First, some proposals as to how a Biopact might be brought into being. This is not a case where the logic of collective action leads inexorably to failure. On the contrary, here we have a case where the OECD countries, all 30 of them, have a means of reaching a collective negotiating position, through the offices of the OECD itself. They do not have to ask anybody's permission to do this. They can then offer to deal with countries from the South on an agreed set of terms. Those countries that wish to sign up can do so, on the terms offered, and those that do not are under no compulsion to do so. Let us suppose, for the sake of argument, that 50 countries from the South see it as in their interests to be part of a Biopact between North and South. These 50 countries sign the agreement, one by one (or perhaps they form a united front to do so), and then the resulting agreed text and framework can be ratified by the World Trade Organization (WTO), as a multilateral trade agreement involving 80 countries. It can then enter into force under WTO rules, as a binding commitment on the part of both the North and the South.

As to the likely content of such a Biopact, there would probably be several elements considered as essential. The first would be for the parties to declare that biofuels are fuels, and not foods, and that because of their agreement on this point, the WTO would grant biofuels such a status. The second would be that the parties agree not to impose tariffs or other trade barriers in the way of global trade in biofuels. Those countries or entities that have already done so (such as the US and the EU) would agree to dismantle them. Third, a floor price for biofuels would be established through the mechanism of a contingency tax, to counter any potential price-cutting by oil companies aimed at destroying investments in biofuels. Fourth, the OECD countries would agree to fast-track investments in biofuels facilities in the South, which would be the condition needed to allow financing to

materialize. Fifth, the countries of the South would agree that biofuels be produced according to environmentally sound and responsible conditions and procedures, the details of which could be spelt out in a technical addendum to the Biopact.<sup>59</sup> For good measure, a sixth point could establish a set of standards by which biofuels be defined, identified and measured, which would again be spelt out in a second technical addendum, and which would pave the way towards the establishment of global standards for biofuels. No doubt there are other elements that could be included, but these 6 would seem to be a necessary and sufficient set to create the needed global market for biofuels.

Each of these elements can of course be negotiated as a separate matter by different groups of countries at different times. But they clearly support each other; the Biopact as described is a system of self-reinforcing trade relations with built-in compensating mechanisms. It makes sense to negotiate it as a package, and in a way (subject to WTO rules) that enables the package to evolve as experience with its working is obtained.

## 10. Concluding remarks

The argument of the paper may be summarized in the following 9 points.

1. OECD countries need to find alternatives to petrofuels  
This comes from the twin pressures associated with energy security (peaking of oil supplies) and the recognition of global warming with its associated necessity for GHG emissions reduction. Under the circumstances continued use of petrofuels is no longer an option.
2. Too many options are too far off  
Options such as the hydrogen economy and running electric vehicles through electricity supplied by nuclear reactors are just too far off to be of use in solving the present problem. A more immediate option is needed.
3. Biofuels provide an option that is immediate and practicable  
Ethanol is a near-perfect substitute for petrol (gasoline) in the transport sector because it has close to the energy content of gasoline while burning more cleanly (less pollution and untoward health effects) and being

<sup>59</sup>It is beyond the scope of this paper to consider what such a technical addendum would look like. But as discussed in Lewandowski and Faaij (2004) and more recently in the IEA Bioenergy Task Force 40 report on sustainable biomass certification by van Dam et al. (2006), the issues would include specification of the criteria to be met; their variation from region to region; their possible variation over time (becoming more stringent as the global biofuels market expands); and the nature of the certifying authority. It is worth noting that many of the difficulties envisaged by van Dam et al., such as the fitting of a certification scheme into a framework of international law, are by-passed by the Biopact proposal which as a voluntary agreement between countries and certified by the WTO, would be able to set its own procedures and monitor compliance as part of its own dispute-settling mechanisms.

(footnote continued)

2001/2004). From this perspective the proposed Biopact holds promise, as it is basically constructed as a multilateral trade agreement.

- safer for the environment. Biodiesel is a near-perfect substitute for petrodiesel. Both these biofuels can be accommodated by existing infrastructure without the upheavals associated with the introduction of a hydrogen economy.
4. The scale of production required cannot be achieved in the North in a responsible and sustainable manner  
Production in the Northern countries including the US, Europe and Japan cannot reach the scale of production required to make a meaningful contribution to fuel substitution, because of the untoward energetics, land use issues, and competition with foodstuffs.
  5. The South can provide the biofuels in abundance  
Production of both ethanol and biodiesel on the scale required can be accommodated in the South. The land is available, as is the rainfall, particularly in the tropical countries, and much of the cultivation of biofuel crops can be conducted on a sustainable basis, e.g. by recycling wastes from bioreactors back to the fields. But the countries of the South, in Africa, Latin America and South and Southeast Asia, need assurances and assistance in mounting such a huge effort. The assurances would be focused on securing access to the markets of the North, while the assistance would be in the form of Foreign Direct Investment to build the needed biorefineries without necessarily maintaining total ownership of these facilities.
  6. North can secure the needed biofuels from the South  
With suitable guarantees and assistance, the South can provide the biofuels that the North needs. By sourcing biofuels from the South, the North can solve both its energy security problems and GHG emission problems. It would not be a matter of substituting oil dependence on the Middle East for biofuel dependence on Brazil, since the range of countries concerned would be wide; they would have no interest in cutting off supplies; and the countries of the North would maintain their own modest biofuel production capabilities as an insurance. But to reap these benefits, the countries of the North need to open up their markets, which means agreeing to treat biofuels as fuels rather than foodstuffs; dismantling tariffs and subsidies; and ending discriminatory standards. In return they would have the right to demand guarantees that biofuels be produced in a way that does not destroy their energy efficiencies and reverse their contribution to curbing GHG emissions.
  7. A comprehensive trade agreement (or Biopact) would be the best way of ensuring that the goals of both parties are met  
The range of issues that are raised by the prospect of the North sourcing biofuels from the South are such that they would be unlikely to be resolved by market forces alone. A comprehensive agreement, negotiated between the countries of the North (i.e. the OECD) and countries of the South, as a trade agreement to be certified and registered with the WTO, presents itself as an optimal way forward. The difficulties involved in achieving such a trade agreement (or Biopact) should not be under-estimated. What makes the whole process feasible is the driving, objective necessity faced by the North in having to find an alternative to petrofuels, and find one that has an impact within the next decade.
  8. An interim arrangement for the next decade  
The Biopact envisaged would have dramatic results in both the North, where it would facilitate making countries biofuel-friendly (such as through promoting flex-fuel vehicles and making biofuels widely available) and in the South, where the biofuels revolution could help drive industrial development and spell an end to poverty. But the Biopact would not have to last forever. Within a decade the advent of second-generation biofuels from a broad range of biomass inputs (forest products, municipal waste, grasses) would make the countries of the North more self-sufficient in biofuels, and the countries of the South more technologically sophisticated.
  9. A post-Kyoto route to GHG emissions reduction  
The prospect of biofuels consumed in the North and sourced from the South represents a possibly enormous contribution to reducing GHG emissions and one that has immediate effects. And yet it can be achieved without any modification to the existing Kyoto treaty and does not cut across Kyoto commitments in any way. The Biopact would in all probability help to pave the way for a post-Kyoto treaty arrangement that binds all the major countries of the world in a renewed attack on the global warming problem.
- When President George W. Bush delivered his State of the Union address in January 2007, he challenged America with his '20 in 10' proposal, under which Americans would replace 20 percent of their gasoline use with biofuels within 10 years. The President called for supply of 35 billion gallons of 'renewable and alternative fuels' (meaning biofuels) by 2017—but he did not specify that they all had to be produced within the USA. He left the door open to imports being able to make their contribution: "Global production of alternative fuels helps us reach our goal and increase our energy security." A further important milestone was achieved when the US and the EU together with Brazil, India and China launched the International Biofuels Forum, under UN auspices, in early March 2007. This Forum may provide an initial framework within which a global market might be developed for biofuels produced responsibly. Thus the ground is being prepared for an historic accommodation between the US and other OECD countries and the countries of the South where biofuels can be produced efficiently, cheaply and without the threat of terrorism. The US goal of '20 in 10' can indeed be met by promoting the creation of many Brazils in the South. This is an attractive vision for both North and South to embrace.

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