

Richard Branson and the Virgin Group's biofuel investment:

From palm oil and soya biodiesel in trains to synthetic biology for aviation fuels

by Almuth Ernsting, January 2008

Summary:

In 2006, Richard Branson pledged to invest \$3 billion dollars in ten years in 'renewable energy'. A large proportion of this investment will be in agrofuels. Virgin Group and their subsidiaries are investing both in U.S. corn ethanol refineries and in U.S. biotech/synthetic biology companies which are seeking to develop 'second generation' agrofuels. This research involves engineering microbes which can efficiently turn biomass into butanol or other fuels similar to petrol or kerosene. Richard Branson is a member of the Steering Committee of the Energy Future Commission, which has been lobbying the U.S. government for large-scale agrofuel expansion, including for higher Department of Defense investment into developing jet fuel from biomass.

In the UK, Virgin Trains are running the first commercial train using a 20% biodiesel blend, and they hope to roll biofuel use out to all their train services after an initial trial. The biodiesel is supplied by Greenergy Biofuels Ltd, who use soya, palm oil and rapeseed oil

In February 2008, Virgin Atlantic Airways intend to launch the first ever test flight of a commercial airline using a biofuel blend, between Heathrow and Amsterdam. There is, however, no evidence that the industry is close to a technical breakthrough which would allow for commercial use of biofuels in aircraft. Whilst suitable biofuels can probably be produced already, the process takes more energy than it generates. Virgin are working closely with other fuel companies, airlines and U.S. government departments, NASA and other research institutions to produce 'alternative fuels'. Coal-to-liquid kerosene, probably with biomass co-firing, is the most 'advanced' alternative fuel, promoted in particular by the U.S. Air Force. Virgin has not invested in those 'synfuels', but supports the development through the Commercial Aviation Alternative Fuel Initiative, despite the fact that synfuels from coal will have significantly higher carbon dioxide emissions than kerosene from oil.

Nonetheless, investment by members of the aviation industry into biofuels for aviation research is highly significant: It suggests a new corporate alliance between aviation and biotechnology/synthetic biology.

The climate, social and environmental impacts of Virgin agrofuel investment and of the biofuel policies for which Richard Branson has helped to lobby will be severe.

Corn ethanol expansion in the U.S. is pushing up the world market price for soya because it is causing many U.S. farmers to switch from soya to corn production.

The rate of Amazon destruction has been shown to directly correlate with the price of soya and deforestation rates are beginning to rise again, after a recent fall, which coincided with lower soya prices, threatening a severe and irreversible acceleration of climate change. Corn expansion is directly causing more emissions of nitrous oxide (a greenhouse gas nearly 300 times as powerful as carbon dioxide), more soil erosion, more nitrogen pollution of water, decimating marine life in the Gulf of Mexico and elsewhere. Soil, wetland, and wildlife conservation programmes in the U.S. are under severe threat from corn expansion and significant biodiversity losses are likely.

Soya and palm oil monocultures are being rapidly expanded for agrofuels because both are increasingly used for biodiesel, including, by Virgin Trains, and also as an indirect impact of corn ethanol and other biofuels: U.S. soya farmers are switching to corn for ethanol and growing less soya, thus pushing up the price of soya and making it more profitable for soya businesses in South America to expand. Rapeseed oil is increasingly used for biodiesel in the EU and the food and cosmetics industry are therefore switching to palm oil. Soya and palm oil monocultures are linked to large-scale deforestation, thus accelerating global warming, to the displacement of local communities, human rights abuses, high levels of agro-chemical use, biodiversity losses and loss of people's food sovereignty.

Biofuels are pushing up global food prices whilst, at the same time, accelerating the advance of large-scale agribusiness monocultures at the expense of small farmers, pastoralists and forest communities. All of these consequences further reduce communities' control over and access to land and their ability to provide food for themselves and their country's population.

Any breakthrough in second generation agrofuels, including agrofuels for aviation, threatens to further increase the industry's overall impact on the biosphere and on communities, particularly in the global South: A large and fast-growing new market (jet fuel) would be created, industrial tree plantations would be expanded, forest and agricultural 'residue' would be removed at ever increasing rates. This would threaten a further collapse in soil fertility biodiversity and risk severe and unpredictable impacts on ecosystems if genetically engineered trees are used. The risks of synthetic biology research, supported by Virgin, have not been evaluated and could be severe.

In the meantime, Virgin's global warming impact from burning fossil fuels is increasing due largely to their

aviation expansion.

Virgin investment in agrofuel refineries:

“People may debate the impact of global warming, but there is no doubt about the diminishing supply of oil”

Shai Weiss, Managing Partner of Virgin Green Fund, tinyurl.com/24az6r

Richard Branson first declared an interest in biofuels in 2004, after meeting with Ted Turner, founder of the United Nations Foundation.

In 2006, Richard Branson pledged to invest \$3 billion dollars over the next decade in order to ‘fight global warming’. This will include all the profits from his 51% share in Virgin air and rail companies, as well as money from subsidiary companies, such as his online train booking company sold in 2006. \$400m is to be invested by 2010. The bulk of this investment is expected to go into agrofuel refineries and research. In order to manage the investment into ‘renewable energy’, Branson founded Virgin Fuels, which made several major agrofuel investments (see below). The Virgin Fuel team are now the management team of the investment fund **Virgin Green Fund**. The agrofuel investments already made by Virgin Fuels are managed by the Virgin Group, not by the Virgin Green Fund. Virgin have invested \$100 million into the Virgin Green Fund, which is run as an independent business which will investment mainly in established companies in the U.S. and in Europe.

Current agrofuels investments by the Virgin Group:

VBV LLC (Virgin Bioverda): This is a joint venture between Virgin Group and Bioverda Ltd, which is a wholly-owned subsidiary of the Irish company NTR plc. The company’s aim is “to exploit opportunities in the biofuels sector with particular focus on U.S. based Ethanol” (tinyurl.com/27nmev). VBV has so far invested in Ethanol Grain Processors and Indiana Bio-Energy (see below). Additional projects are planned in North America and Europe.

Ethanol Grain Processors(EGP): U.S. company building a 100 million gallons/year corn ethanol refinery in Tennessee which is to open at the end of 2008. VBV are the majority owner, and have six out of eleven seats on the EGP Board.

Indiana Bio-Energy: U.S. company building a 100 million gallon/year corn ethanol refinery in Indiana, to open in the second half of 2008. VBV are the majority owner, with other local investors.

Cilion: Californian company formed in June 2006 as a partnership between Western Milling, one of California’s largest grain milling companies, and venture capital firm Khosla Ventures. Virgin has invested \$60m in Cilion and the Managing Partner of Virgin Green Fund, Shai Weiss, is on the Board of Cilion. Other investors include the private equity firm Yucaipa Companies and the venture capital investment

bank Advanced Equities Inc. Aims to build seven corn ethanol refineries in the U.S. with a total capacity of 440 million gallons per year. Other investors include Khosla Ventures, Yucaipa Companies and Western Milling. Virgin has invested \$60m (tinyurl.com/2a7e3v and www.cilion.com).

Synthetic biology/GM fuel research*:

“If you back a lot of horses, it’s more likely you’re going to win.”

Vinod Khosla, tinyurl.com/yp323y

Virgin Green Fund as well as Khosla Ventures has invested an undisclosed amount in the Californian biotech/synthetic biology company **Gevo**, which was founded by researchers at the California Institute of Technology. Gevo’s aim is the development of second-generation agrofuels from solid biomass, such as butanol and isobutanol, which might be used in planes as well as in unmodified engines (unmodified car engines cannot be used with more than 10% ethanol). Gevo are trying to engineer new microbes for agrofuel production. Synthetic biology involves “the design and construction of new biological parts, devices and systems that do not exist in the natural world and also the redesign of existing biological systems to perform specific tasks” (tinyurl.com/24g7eo). Essentially, it means creating new life-forms. Gevo are planning a demonstration plant. Virgin Green Fund managing partner Shai Weiss is on Gevo’s Board of Directors.

In June 2007, it was reported that Richard Branson met with the U.S. synthetic biology company **Amyris Biotechnologies** to discuss future cooperation, probably with regards to future biofuel supplies for Virgin aircraft. Amyris aim to develop synthetic-biology derived biofuels, including biobutanol. They state that the initial feedstock would be Brazilian sugar cane. Amyris have had funding from venture capitalist firms Kleiner Perkins Caufield & Byers and Khosla Ventures (tinyurl.com/ywee6w).

* For detailed information about synthetic biology in general and in relation to biofuels, see <http://www.etcgroup.org/en/>.

Biofuel in Virgin Trains:

In June 2007, Virgin launched the UK’s first train which runs on a biofuel blend – 20% biodiesel. This is a trial by Virgin Trains, the Association of Train Operating Companies (ATOC) and the Rail Safety and Standards Board (RSBB). Richard Branson was granted a special concession by the Treasury to reduce the duty rate for biodiesel blends for the trial. The fuel is provided by Greenergy Biofuels Ltd, a company using soya, palm oil and rapeseed oil as feedstocks. If the trial is successful and biodiesel blend fuel duty is permanently lowered, Virgin Trains intend to use biodiesel blends on all their trains.

Developing biofuel for aircraft:

“It is important that the airline industry is being seen to do something”, Steve Ridgway, CEO of Virgin Atlantic Airways (tinyurl.com/2w9dxk).

Virgin Atlantic have announced their intention to launch the first ever test flight of a commercial airliner using a biofuel blend in February 2008, between Heathrow and Amsterdam. This is a joint project with Boeing and General Electric. Eight different types of biofuels will be tested and the company hopes for large-scale commercial use from 2012 (tinyurl.com/2h66qa). Regardless of such a test flight, there is no evidence of any immediate breakthrough which would make it possible to commercially use biofuels in aircraft.

The biofuels which are commercially available at present are not safe to use in aircraft, except for very low blends of biodiesel. This was confirmed by a 2003 Imperial College report (tinyurl.com/2msp9d), which stated that methanol, ethanol and biogas are unsafe to use at all, and that biodiesel can only be blended in low percentages. Even if just 10% of biodiesel is blended with kerosene, the fuel will become hazy or cloudy at -29°C rather than at -51°C. Adding more than 2% methyl esters would increase the freezing point above legal limits.

There are, however, ‘second generation’ types of biofuels which may be compatible with jet engines and which can already be produced, but which are not yet commercially viable because their energy balance is still very poor.

In October 2006, the Commercial Aviation Alternatives Initiative (CAAFI) was formed in the U.S. by U.S. aviation industry trade association, U.S. government departments, NASA, fuel suppliers and various universities. Virgin Fuels and Shell are the only companies with a UK base involved in this initiative. According to CAAFI “at the moment, the largest single driver for adoption of alternative fuels by industry is the high cost of petroleum (tinyurl.com/3cn4ru). The most advanced ‘alternative fuel’ is Fischer-Tropsch kerosene from coal to liquids (‘synfuels’). Co-firing of biomass with coal is likely. The U.S. Air Force is committed to meeting nearly half of their total fuel requirement from synfuel by 2016. They seek to offset the increased carbon dioxide emissions from burning coal rather than oil by co-firing with 10-18% biomass. Meeting the Air Force’s target alone will require nearly 5 million hectares of land for poplar and/or switchgrass monocultures (tinyurl.com/2ntnrr).

Virgin, on the other hand are involved in a different line of research and development: They are looking at biofuels which involve different fermentation processes than ethanol and which are chemically more similar to kerosene or petrol. The Virgin investment in Gevo (see above) and their negotiations with Amyris suggest that they are particularly interested in biobutanol.

Biobutanol is made by fermenting the same feedstocks that are used for ethanol production, but using a different process and a bacterium called *Clostridium*. Biobutanol uses more energy than it produces: The bacteria needed for fermentation do not thrive in liquid with more than 1-2% butanol, hence a very dilute solution is produced. An 8% butanol solution is needed to efficiently separate it from water, but it is highly toxic to microorganism and would kill those needed for fermenting the biofuel. It is therefore only possible to make an extremely dilute solution and large amounts of energy are required for distillation, i.e. for producing fuel. Any technological breakthrough thus depends on finding or, more likely, engineering micro-organisms that can thrive in high-butanol solutions. This is where synthetic biology comes in. In the UK, Du Pont and BP are also working in this field, though not in partnership with Virgin.

According to industry expert Robert Rapier, a breakthrough still appears to be ‘at least ten years away’ (tinyurl.com/3bjmnl). A successful Virgin test flight in 2008 would not mean that biobutanol is any closer to becoming a viable option – the energy expended on this fuel will still be greater than the energy gained.

There have been reports of Richard Branson discussing the purchase of aviation fuel from algae with New Zealand-based developer Aquaflow Bionomic Corporation (tinyurl.com/2bl47d) – but Aquaflow confirm on their website that they cannot supply any algae oil, not even commercial samples, and there is no evidence that the technology actually works.

In summary, although Virgin Atlantic may carry out a successful test flight using biofuel, probably biobutanol, significant technological breakthroughs are required before biofuel can become commercially available for aircraft. The research involves synthetic biology, i.e. engineering microbes which can successfully ferment biobutanol or similar fuels. Virgin are investing in this line of research and entering into business partnership with biotech/synthetic biology firms.

Lobbying for biofuels:

Richard Branson states that his decision to invest in biofuels was influenced by Al Gore, Ted Turner, founder of the United Nations Foundation and other leading members of the UN Foundation, (tinyurl.com/2xreyn). The United Nations Foundation was set up in 1998 with a \$1 billion dollar donation by Ted Turner. It aims to “strengthen and support the UN and its causes through a blend of advocacy, grantmaking and, partnerships” and it is in a strong position to inform – or influence- UN decisions. One of the organisations funded by the United Nations Foundation is the Energy Future Coalition. Richard Branson joined the Coalition’s Steering Committee in 2006. The Energy Future Coalition lobby the U.S.

government for large-scale biofuel expansion and in particular for

- \$1 billion Department of Defense funding for research and development of biomass conversion to petroleum substitutes;
- Shifting funds from agriculture export subsidies to bioenergy subsidies;
- Tripling of bioenergy research and development funding to \$500 m a year;
- Greater incentives for biofuels, technical support by the Environmental Protection Agency (tinyurl.com/29wfbu)

They also lobby for government support for 'clean coal', fuel and energy efficiency. The Coalition funds the "25x25 – America's Energy Future", a lobby group which calls for 25% of all of the U.S. energy demand to be met from U.S. bioenergy by 2025.

Impacts on climate, people and the environment

Virgin's investment in biofuels does not signify a reduction in their fossil fuel use. According to calculations by George Monbiot, Virgin Atlantic's planes produced 7.4 million tonnes of carbon dioxide in 2005/06 (tinyurl.com/2twmom). The global warming impact of flights is about three times that of its carbon dioxide emissions alone. Those figures do not include emissions caused by Virgin's other aviation companies, including Virgin Blue and Virgin Charter, which offers private jet travel. In March 2006, Virgin Atlantic announced a 3-year growth plan, with a 10% projected increase in business travel in just one year (tinyurl.com/365dkk). Virgin Galactic is seeking to provide the world's first space tourism flights. Virgin's aviation expansion exceeds any possible reductions in fuel use from improvements in fuel efficiency.

Virgin's biofuel investment, and Richard Branson's role in lobbying for further U.S. biofuel expansion, are likely to lead to an overall increase, not a reduction, in greenhouse gas emissions, as well as having serious impacts on communities and the environment

Virgin is directly investing in *corn ethanol* refineries. Corn ethanol, according to a recent study by Nobel laureate Paul Crutzen and others (tinyurl.com/2elcyc) has life-cycle greenhouse gas emissions which are up to 50% higher than those for mineral petrol, due to nitrous oxide emissions linked to fertiliser use. Even before that study was published, scientists disagreed whether corn ethanol had, at best 13% less greenhouse gas emissions than petrol (tinyurl.com/ywlj5f), or considerably more (tinyurl.com/6yoec). U.S. farmers are rapidly expanding the area under corn, converting both other cropland (in particular soya) and land under natural vegetation in order to meet the growing ethanol demand. The direct impacts¹ include:

- More soil erosion: On more than half of the best cropland in the U.S., soil is eroding about 27

times faster than the natural rate. Soil erosion rates for corn production are 100-2500 times higher than for pasture. Ethanol refineries use large amounts of corn stover (the leaves and stalks of corn), which would normally be left in the soil to maintain soil fertility, so soil erosion is further increased. There is strong pressure to grow corn on land currently protected under the Conservation Reserve Programme, which was set up to reduce erosion.

- Nitrogen pollution: Nitrogen run-off from fields has created a large and growing Dead Zone in the Gulf of Mexico, with such low oxygen levels that marine life is suffocated. Scientists predict that this zone will grow, partly due to increased corn ethanol production (tinyurl.com/32mlmn).
- Biodiversity losses: There are strong pressures for allowing corn production on land set aside for wildlife conservation. Amongst the most vulnerable ecosystems in the U.S. are the remainders of the tall-grass prairie in the Midwest, 97% of which has already been destroyed (tinyurl.com/2b26sz).
- Freshwater depletion: Producing one gallon of ethanol requires around 1700 gallons of freshwater. In parts of Texas, Oklahoma and Kansas, ground water levels have already dropped by over 30 metres (tinyurl.com/yr62t2). There is strong lobbying for growing corn on land currently protected for water conservation.

The indirect impacts, however, are even more serious: U.S. farmers switching from soya to corn are driving up the global price of soya (tinyurl.com/24jrql). The rate of Amazon destruction directly correlates with the market price of soya (tinyurl.com/37mpss). There is strong evidence that the increase in Amazon destruction in 2007 is directly linked to high soya prices and to corn ethanol expansion in the U.S. (tinyurl.com/2bnkwb).

*Palm oil*², one of the feedstocks used by Virgin Trains, is the main cause of forest permanent forest loss in Malaysia and Indonesia, according to the United Nations Environment Programme (UNEP). Indonesia is planning to expand palm oil monocultures from 6.5 million hectares to 26 million hectares in the next 20 years. UNEP predict that 98% of Indonesia's forest will be destroyed by 2022, the lowland forest much sooner (tinyurl.com/2bog68). Orangutans and thousands of other species are likely to become extinct. Some 45 million Indonesians, many of them indigenous peoples, depend on the forest for their food and livelihood. Palm oil expansion might eventually lead to the employment of 10 million jobs, but far greater numbers of people will lose their livelihoods and are at risk of becoming destitute. Palm oil plantations are increasingly displacing small farmers and community land, too. The destruction of South-east Asia's peatlands is the largest single source of carbon dioxide

emissions in the world, making Indonesia the 3rd biggest emitter of greenhouse gas emissions.

Palm oil expansion elsewhere, including in Papua New Guinea, Cameroon, Uganda, Colombia, Ecuador and the Brazilian Amazon, is also linked to deforestation. In Colombia serious human rights abuses, including evictions, death threats, assassination attempts and murders have been documented in the palm oil areas, with clear links between plantation companies and paramilitaries. Pesticide use, including Paraquat, results in serious health problems, including deaths, of villagers and plantation workers.

Soya, another feedstock used by Virgin Trains, is the main driver of Amazon destruction. Soya expansion is accelerating deforestation not just in the Amazon, but also in the Atlantic Forest, the Paranaense forest and the Chaco and Yungas forests in Paraguay and Argentina. Already, Brazil is the 4th biggest emitter of greenhouse gases and 80% of those emissions are due to deforestation. There are worrying signs that deforestation may have pushed the Amazon forest to the brink of collapse, with severe droughts during each of the last three years. Up to 80% of the rain over the Amazon basin is recycled by the trees and then pushed southwards and westwards, and there are strong indications that the rainfall cycle will collapse without sufficient dense and unbroken canopy cover. In the worst case, the Amazon could die-back in an irreversible cycle of mega-fires and drought. This could release as much as 100-120 billion tonnes of carbon held in vegetation and soil, and disrupt rainfall patterns over large parts of the planet, accelerating global warming out of human control.

In South America, soya plantations displace communities and reduce the amount of food being grown. There are many reports of evictions and other human rights abuses associated with soya monocultures. 150,000 – 200,000 households in Argentina and 90,000 in Paraguay have already been displaced by soya. Soya monocultures involve high levels of agro-chemical use – synthetic fertilisers as well as herbicides and pesticides, which have serious impacts on human health as well as on biodiversity. Soil erosion and water depletion linked to soya are undermining the basis of agriculture in large parts of South America.

Rapeseed oil is the third feedstock used by Virgin Trains. According to the study by Paul Crutzen mentioned above (tinyurl.com/2elcyc), rapeseed biodiesel is linked to greenhouse gas emissions which are up to 70% higher than those of mineral diesel, due to nitrous oxide from fertiliser use. Oilseed rape cultivation is being rapidly expanded in Europe, whilst per hectare yields have been falling in recent years due to 'extreme weather events'. Further expansion is expected with the recent abolition of current targets for set-aside land, which will bring over 3 million hectares

of EU land into production. Conservation organisations have warned that this will have a devastating impact on bird and insect populations, with European farmland birds already having declined by 50% since 1977 (tinyurl.com/2jhvs2). The RSPB warns: "We already have reports of set-aside that has existed for years being ploughed up... The decline in farmland bird populations has been levelling off, in part because of set-aside. Without it, or compensatory measures, numbers may well tumble further."

A 2006 report by the United Nations Food and Agriculture Organisation shows that Europe's increasing use of rapeseed oil in biodiesel is one of the main causes of rising palm oil prices (tinyurl.com/2kmgb5). There is thus a clear link between rapeseed biodiesel and the serious impacts of palm oil expansion in the global South.

Agrofuel use and food security: The UN Food and Agriculture Organisation has warned of critical food shortages in nearly 40 countries linked to high and, in some cases, record food prices (tinyurl.com/2gsc63P). Global food prices rose 9% in 2006 and around 40% 2007. Extreme weather events, which are in line with climate change predictions, have led to severe harvest losses in some regions, including Australia, Eastern Europe and Morocco, however overall grain production is expected to reach record levels for the year 2007/2008 (tinyurl.com/24jrql). At the same time, however, demand for grain and vegetable oil is rapidly rising. Whilst demand for food and feed is increasing, the rate of growth in the biofuel sector is significantly higher. Food and feed demand for coarse grains (including maize), for example, has grown by 1.4% respectively in the last year, but demand for 'other uses' (namely biofuels) has grown by 14%.

At the same time as the price of traded agricultural commodities is rising, monoculture plantations are expanding rapidly and displacing farming communities, forest peoples and pastoralists, leading to a loss of food sovereignty as communities have less and less access to and control over land for producing food. In Argentina, for example, soya monocultures have decimated the cultivation of vegetables, pulses, potatoes, sweet potatoes, rice, etc. as well as the country's livestock and dairy production, leading to a steep increase in malnutrition rates (tinyurl.com/39aya2).

The UN Special Rapporteur for the Right to Food has therefore called for a 5-year moratorium on biofuel production, calling biofuels "a crime against humanity" (tinyurl.com/2rxkrt).

Aviation biofuels and synthetic biology investment:

A technological breakthrough which allowed for commercial use of biofuels in aviation would open up a large new market at a time when the growing demand for agrofuels for road transport is already leading the conversion of tens of millions of hectares of natural

ecosystems and community land to agrofuel monocultures. Biobutanol is expected to initially rely on the same feedstocks as ethanol. Even the European Heads of State, when recommending a 10% biofuel target for road transport by 2020 acknowledged that this could not be sustainably met without second generation agrofuels.

Despite Richard Branson's claims of being motivated by a desire to find 'low greenhouse gas' fuels, Virgin Fuel, through their membership of the Commercial Aviation Alternative Fuel Initiative, are supportive of the development of coal-to-liquids jet fuel, which will considerably increase carbon dioxide emissions, compared to oil-based kerosene.

A breakthrough in biomass-to-liquids research would make it possible to use a far larger range of feedstocks. Current investment trends and studies on energy balances suggest that industrial tree plantations will be one of the main sources of second general agrofuels. Already, tree plantations are linked to large-scale evictions of communities, destruction of natural ecosystems, including old-growth forests, falling water tables, high biodiversity losses, soil erosion and agrochemical poisoning of people and land. Those impacts would be magnified by a shift towards liquid transport fuels from wood. GE trees are being developed specifically for second generation agrofuels, despite high and unpredictable risks to the environment and in particular to natural forests (tinyurl.com/396b24).

Forest and agricultural 'residues' would become another important feedstock, leading to more soil erosion, greater impact of droughts (since water retention of soils is reduced and more of the heat is absorbed by bare soil), and significant biodiversity losses.

Synthetic biology research is advancing without being regulated by any international or government body, and without proper assessment of the risks involved. 38

References

1) For full references on corn ethanol, see "The False Impact of Biofuels", International Forum on Globalisation and Institute for Policy Studies, Jack Santa Barbara, <http://www.ifg.org/pdf/biofuels.pdf>

2) For full references on agrofuel impacts, see Agrofuels: Towards a Reality Check in Nine Key Areas, http://www.biofuelwatch.org.uk/docs/agrofuels_reality_check.pdf ;

Agrofuel Special Issue (July 2007), Seedling, Grain, <http://www.grain.org/seedling/?type=68>;

The Real Cost of Agrofuels, Global Forest Coalition and Global Justice Ecology Project,

<http://www.globalforestcoalition.org/img/userpics/File/publications/Therealcostofagrofuels.pdf>

civil society organisations warned in an Open Letter in 2006 that "this potentially powerful technology is being developed without proper societal debate concerning socio-economic, security, health, environmental and human rights implications" (tinyurl.com/24hlsr). The accidental release of engineered microbes could have potentially serious effects: According to a report by the Ministry of Environment in New Zealand, a trial of a genetically modified soil bacterium, with the aim of increasing ethanol production, resulted in the death of wheat plants (tinyurl.com/ytqufu).

Impacts of increased U.S. government support for biofuel expansions for which Richard Branson has been lobbying:

Following strong industry lobbying, including by the Energy Future Coalition, in which Richard Branson is a Steering Committee member, the U.S. government has now approved the Renewable Fuel Standard which will increase biofuel use 5-fold by 22, mandating the use of 15 billion gallons of corn ethanol (requiring 34 million acres for production). A civil society declaration for a moratorium on U.S. incentives for agrofuels, U.S. agroenergy monocultures and the global trade in agrofuels (tinyurl.com/27xa3d) warns: "The social, economic and environmental impacts of this expansion would be unprecedented, threatening sensitive lands—including forests, wetlands and native grasslands—and harming biodiversity, soil health, water quality and wildlife habitat." Another 21 billion gallons are to be 'advanced biofuels', defined so broadly as to mean any biofuels not made from corn. The Moratorium Call states: "The environmental and social impacts of imported agrofuels will be particularly harmful with palm oil-based fuel produced in Southeast Asia or Latin America, and sugarcane ethanol and soy-based diesel from sources grown in Brazil and throughout South America, where environmental destruction and the violation of labor and land rights are serious and widespread problems."