ECO-SKIES

THE GLOBAL RUSH FOR AVIATION BIOFUEL

The Oakland Institute

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Acknowledgments

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Overview

The aviation industry has high hopes for biofuels. As its profits are increasingly threatened by erratic fossil fuel prices, and as consumers are more and more concerned with the role of aviation in climate change, biofuels are being billed as the path to both profitability and sustainability. Unfortunately, emerging evidence suggests that as airlines rush to procure biofuel, they do so at the expense of people and the environment. Since commercial biofuel flights began in 2011, airlines have embraced feedstocks that are either economically unviable, environmentally dangerous, or both. In looking to the future, the ambitious goals of the aviation industry to reduce emissions by 2050 are impossible without an unprecedented expansion in biofuel production. This expansion, however, will only exacerbate the global land grabbing trend, a phenomenon that has already threatened food security and land rights throughout the developing world.

Biofuels in the Aviation Industry

The production of biofuels is now the largest single purpose of land deals in the developing world. Since 2000, as many as 37 million hectares have been purchased or leased in Africa, Asia, and Latin America as part of biofuel projects—more than all the other drivers of land investment combined.[1] As low-income countries are encouraged to embrace commercial agriculture as a path out of poverty, the Oakland Institute has been at the forefront of exposing how these dreams of economic development often morph into nightmares of food insecurity, forced displacement, and environmental damage. But amid this unprecedented rush for land, there is evidence that another variable is emerging that could aggravate the already fraught relationship between energy needs and land rights: the growing demand by airlines for commercial quantities of aviation biofuel. As airlines are caught between economic constraints on one side and environmental problems on the other, they are beginning to see biofuels as the answer to both challenges at once.

The World Economic Forum (WEF) estimated that in 2007 the commercial aviation industry accounted for $426 billion of global gross domestic product (GDP) and 5.6 million jobs worldwide. Tourism and other industries that rely indirectly on aviation accounted for another $620 billion and $490 billion respectively—making it responsible for a grand total of 33 million jobs and 3.2% of global GDP. By 2030, growing middle classes in India and China could cause all of these numbers, along with air traffic itself, to more than double.[2] Although the airline industry has always struggled to recoup the cost of capital-intensive investments, rising fuel prices have become a major threat to the profitability of the industry and are now a crippling 33% of total expenses.[3] Total fuel costs rose from $44 billion in 2003 to $189 billion in 2008. After a brief lull following the financial crisis, prices rose again to $176 billion in 2011 and were expected to be as high as $207 billion in 2012.[4]

In addition to profitability problems, there are a growing number of voices from environmental protection organizations criticizing commercial aviation as an especially dangerous contributor to climate change.[5] Although commercial flying only represents around 2% of global CO_2 emissions,[6] the non-CO_2 effects of jet fuel combustion (heat trapping properties of contrails, water vapor, nitrous oxide, and soot aerosols) makes flying responsible for an estimated 4.9% contribution towards climate change as whole.[7]

These challenges notwithstanding, airlines continue to maintain that there is no trade-off between future growth and future sustainability—and for them, biofuels are an integral means of achieving both. Unlike fossil fuels, which are prone to erratic price spikes, biofuels are renewable and conceivably less vulnerable to geopolitical instability. Also unlike fossil fuels, which release CO_2 that has been sequestered in the earth, biofuels are hypothetically carbon neutral. Combined with shorter routes and more fuel efficient fleets, biofuels are now being marketed as answer to commercial aviation's dual dilemma.

The Promise of Biofuels

In June 2011, the American Society for Testing and Materials (ASTM) International, a group that sets global technical standards for a variety of products, came to a preliminary decision on aviation biofuels.[8] After three years of testing, it ruled that commercial airlines be allowed to blend standard petroleum jet fuel at levels up to 50% with renewable fuels made from "hydroprocessed esters and fatty acids." This basically refers to fuel made from oil-containing vegetal and animal products, such as recycled fat from abattoirs, inedible oilseeds like jatropha, and crops like soy and palm, which are also used for food.[9] Two days before the final decision, KLM Royal Dutch Airlines launched the first-ever commercial biofuel flight. More than a year later, 16 airlines representing every region of the world have followed suit, most offering only single flights, but some offering dozens or even hundreds over fixed periods of time (see table 1).

BOX 1: BIOFUEL MANDATES

Governments around the world are turning to biofuels as a way of securing future energy supplies and reducing CO_2 emissions. In theory, fuel derived from biomass is carbon neutral, since the CO_2 absorbed by growing plants is simply re-released when the fuel is combusted; in actuality, emissions can creep into every stage of the production process, from land clearing and fertilizer use to refining and transportation. No biofuel is perfectly carbon neutral, and many are even dirtier than fossil fuel when factors like land use change are considered. But this ambiguity has not stopped efforts by governments to increase biofuel consumption.

- **The Renewable Fuel Standard (RFS)** is a US federal mandate that sets steadily increasing quotas for biofuel production in the country. By 2022, it will require a total of 36 billion gallons: 15 billion from corn ethanol, 16 billion from cellulosics like switchgrass and algae, 1 billion from plant oil or animal-derived biodiesel, and 4 billion from any so-called "advanced" biofuel not made from corn starch.[8]

- **The European Union Renewable Energy Directive (RED)** aims to reduce greenhouse gas (GHG) emissions within the EU by 20% from 1990 levels by 2020. This includes a mandated 10% reduction in transportation emissions, with 7% coming from biofuels and 3% coming from vehicle electrification.[11] Reaching this target could cause biofuel demand within the EU to reach 29.6 million metric tons by 2020, more than doubling the 13.9 million ton estimate from 2010.[12]

Aside from the EU, as of July 2011 a total of 21 countries have passed legislation mandating the use of biofuel, contributing to a possible demand of 60 billion gallons by 2020. Interestingly, since these initiatives apply almost exclusively to ground transportation, this estimate does not include demand generated by aviation.[13] But although governments have not yet required airlines to use biofuels, renewable aviation fuel is nonetheless becoming a policy objective.

- **The European Advanced Biofuel Flightpath** is a public-private partnership that brings together the European Commission with airlines like KLM and Lufthansa, airframe manufacturers like Airbus, and biofuel producers like UOP and Neste. It aims to make 2.5 billion liters of aviation biofuel available by 2020 *in addition* to all the fuel required by RED.[14] This would mean an estimated 3.5 million hectares of feedstock, roughly equivalent to the size of Belgium.[15]

- **The European Union Emissions Trading System (EU ETS)** is a "cap and trade" mechanism that has been extended, as of January 1, 2012, to all airlines flying to and from the EU. It permits them a certain level of CO_2 emissions based on their size—the "cap"—but requires them to purchase allowances from other ETS members if they pollute beyond that.[16] In addition, it provides a de facto subsidy for aviation biofuels, which under the ETS are treated as carbon neutral. This means that if airlines run biofuel flights, the fuel they use is not counted towards their CO_2 caps, even if the fuel itself offers nowhere near zero emissions.[17]

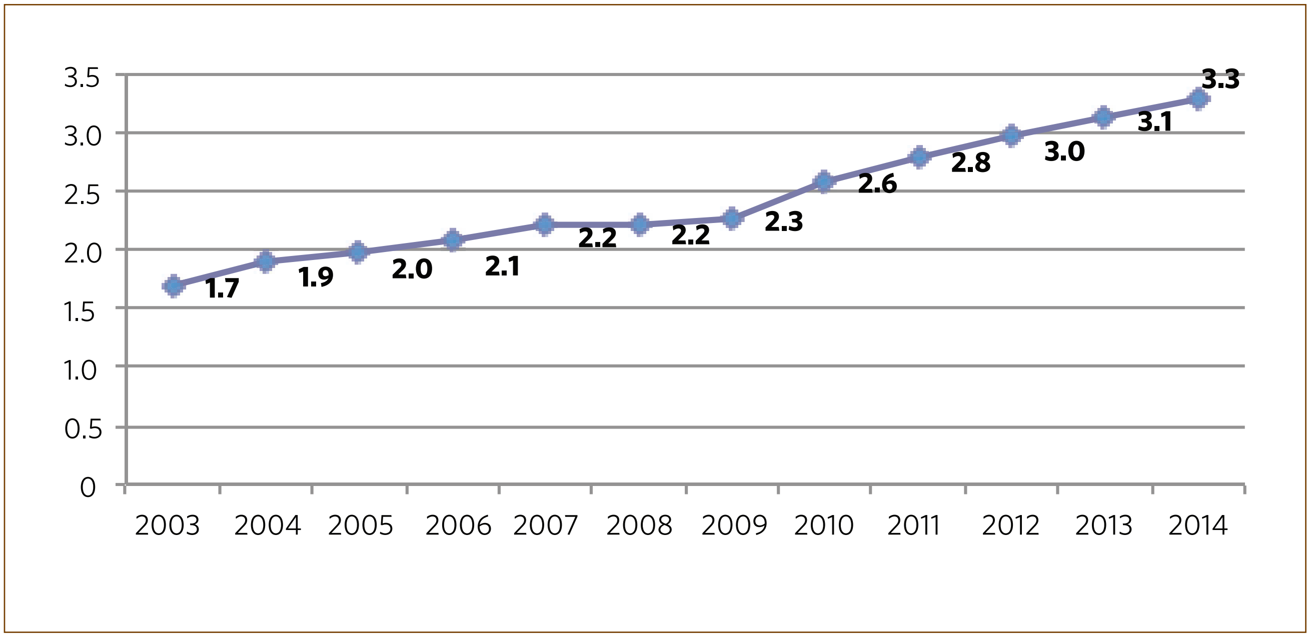
A bulldozer clears natural forest for an oil palm nursery, Cameroon. © Jan-Joseph Stok / Greenpeace

TABLE 1: COMMERCIAL BIOFUEL FLIGHTS AS OF MAY 2012[18]

	AIRLINE	PROVIDER	BLEND	FEEDSTOCK(S)	DATE(S)	NUMBER/DESTINATION
1	Lufthansa	Neste	50-50	Jatropha, Camelina, animal fats	7/15/2011 thru 12/27/2011	1187, four daily between Hamburg and Frankfurt
2	Lufthansa cont.	Neste	50-50	Jatropha, Camelina, animal fats	1/12/2012	1, from Frankfurt to Washington DC, first commercial transatlantic flight
3	KLM Royal Dutch Airlines	SkyNRG	50-50	Used Cooking Oil (UCO)	First ever, 30 June 2011	June: 1 from Amsterdam to Paris
4	KLM Royal Dutch Airlines	SkyNRG	50-50	UCO	two months starting from 2/21/2012	February-March 2012: 200 flights from Amsterdam to Paris (four daily)
5	Alaska Airlines	SkyNRG	20-80	UCO	Three weeks from 11/9/2011	Alaska Air:11 daily flights from Seattle to D
6	Horizon Air	SkyNRG	20-80	UCO	Three weeks from 11/9/2011	64, six daily from Portland and Seattle during three weeks
7	LAN Chile/Air BP Copec	SkyNRG	N/A	UCO	3/7/2012	1, from Santiago to Concepcion
8	Finnair	SkyNRG	50-50	UCO	7/20/2011	1, Amsterdam to Helsinki
9	Finnair cont.	SkyNRG	50-50	UCO	N/A	4, Amsterdam to Helsinki
10	Qantas Airlines	SkyNRG	50-50	UCO	4/13/2012	1, Sydney to Adelaide
11	Air France	SkyNRG	50-50	UCO	10/13/2011	1, Toulouse to Paris
12	Thompson Airways	SkyNRG	50-50	UCO	7/28/2011	1, Birmingham to Palma
13	Thai Airways	SkyNRG	N/A	UCO	12/22/2011	1, Bangkok to Chiang Mai
14	Etihad Airways	SkyNRG	N/A	UCO	1/24/2012	1, Seattle to Abu Dhabi
15	United Airlines	Solazyme	40-60	Algae	11/7/2011	1, Houston to Chicago
16	Porter Airlines	Honeywell UOP	50-50	Camelina, Brassica carnita	4/17/2012	1, Toronto to Ottawa
17	Iberia Airlines	Airports and Auxiliary Services (ASA)	25-75	Camelina	10/3/2011	1, Madrid to Barcelona
18	Interjet	ASA	27-73	jatropha	7/25/2011	1, Mexico City to Tuxtla Gutierrez
19	Aeromexico	ASA	30-70	jatropha	8/2/2011	1, Mexico City to Madrid
20	Aeromex cont.	ASA	25-75	camelina	Starting 9/27/2011, running one flight per week up to 52 flights	52, Mexico City to San Jose, Costa Rica, with one flight per week

Considering there are 10 million flights per year in the US alone,[19] the roughly 1,500 biofuels flights that were flown by May 2012 are a negligible amount of air traffic. The fuel itself is still too scarce and too expensive for serious commercial use.[20] But this has not stopped airlines from waxing enthusiastic about what increased production in the future could do for price stability. Even if commercial quantities of aviation biofuel were roughly as expensive as jet fuel is today, it would still be invaluable as a hedge against price fluctuations. So long as the entire business is dependent on rapidly diminishing fossil fuel reserves that are prone to erratic price spikes, it is impossible for airlines to make effective long-term financial plans. Trading finite fossil fuels for renewable biofuels could make these shocks a thing of the past.[21]

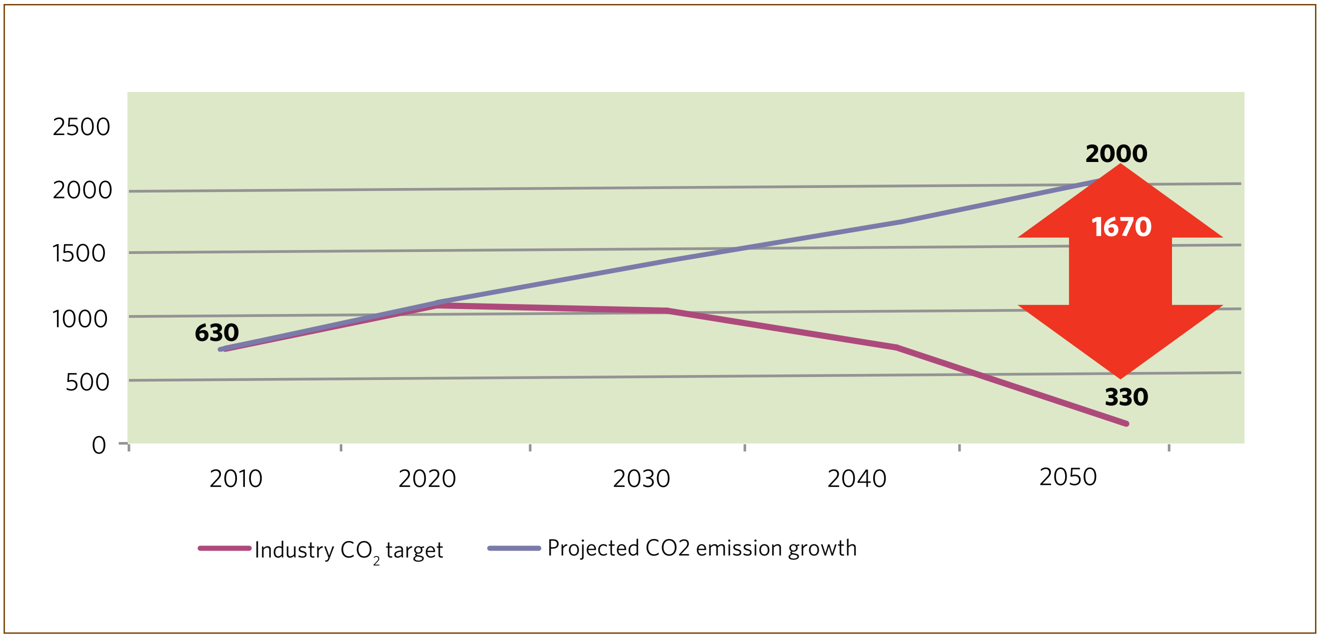
FIGURE 1: WORLD PASSENGER TRAFFIC (ACTUAL AND PROJECTED - ANNUAL PASSENGERS IN BILLIONS)[22]



Yet, price stability aside, biofuels still have an enormous strategic appeal to airlines. Thanks in large part to the rise of China and the expansion of Asia-Pacific routes, the industry continues to grow. In 2011, an estimated 2.8 billion commercial passengers took flight,[23] but that number is expected to reach 3.3 billion by 2014 (see figure 1).[24] The growing role of aviation in commercial shipping means that air cargo is expected to increase by almost 50% from 2009 levels, reaching 38 billion metric tons by 2014.[25] However, if nothing is done, this growth is certain to collide with a guarantee made by the industry's main trade group, the International Air Traffic Association (IATA): by 2020, it has promised to achieve carbon-neutral growth; by 2050, it has promised to cut CO_2 emissions by 50% from 2005 levels, which equates to 330 million metric tons of annual emissions (see figure 2).[26] Unfortunately, the challenge of continuing to grow while emitting less is formidable. Even if the industry continues to invest in more fuel-efficient carriers, it will still miss the 2050 target by 85% if it does nothing else.[27] Other sources of carbon abatement, such as cabin weight reduction, more efficient flight paths, or emissions trading systems, are insignificant compared to the potential of aviation biofuel, which could save over 1 billion metric tons of CO_2 annually by 2050—more than all of the other potential sources of carbon abatement combined. In fact, if the IATA is to reach its target, roughly 75% of the carbon savings must come from biofuels.[28] This means that the airline industry will require 13.6 million barrels of biofuel per day, roughly seven times the amount of first generation biofuel currently being produced.[29] In effect, this means that airlines must pin their hopes for price stability, future growth, and sustainability on a massive and currently unprecedented expansion of biofuel production. This has troubling implications.

Since the food crisis of 2008, when biofuel expansion contributed 20 to 40% to price hikes that forced an additional 100 million people worldwide into hunger,[30] many companies involved in the biofuel supply chain have been eager to publicize their social and environmental responsibility. For its part, the airline industry has responded by founding the Sustainable Aviation Fuel Users Group (SAFUG). The members, including British Airways, Lufthansa, KLM, and 20 others, have all signed a non-binding pledge to only pursue biofuels in a way that protects biodiversity, does not compete with food, and ensures "significant" life cycle GHG reductions.[31] In theory, through SAFUG and the IATA's membership in the Roundtable on Sustainable Biofuels (RSB), the industry has further committed to many of these same principles a second time, and also to additional standards such as legal land use, social and rural development, human and labor rights, and soil, air and water conservation.[32]

FIGURE 2: GAP BETWEEN CO2 EMISSION FORECAST AND INDUSTRY CO2 TARGETS 2010-2050 (MILLION TONS)[33]



These promises are essential for airline public relations; naturally, they are given pride of place whenever new biofuel flights are announced. Nonetheless, there are still reasonable questions about the social and environmental costs of the flights that have already flown, and even more pointed questions about the possible costs if aviation biofuels are ever fully commercialized. As it stands, a growing number of firms are considering business models that will enable feedstocks like jatropha and camelina (see boxes 4 and 5) to be grown and refined in bulk specifically for aviation. In addition to posing questions about the current market and its limitations, it is essential to look into the possible consequences of these new models and at whether they are indeed capable of delivering a sustainable future for aviation.

SkyNRG and Recycled Cooking Oil

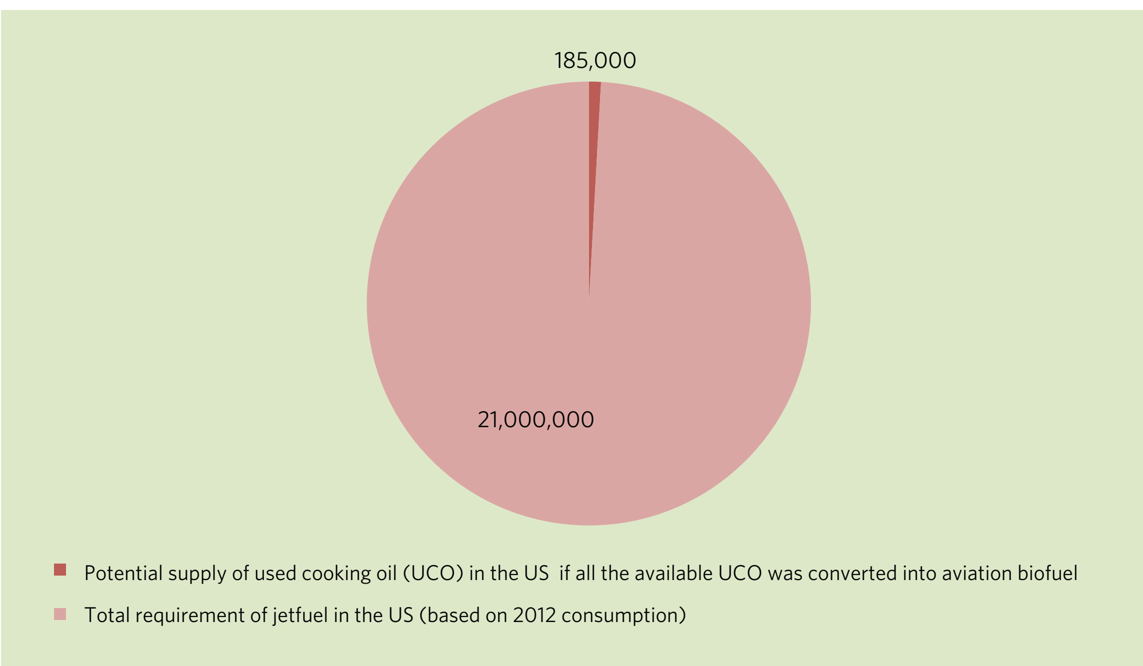
One of the most recognized names in the world of aviation biofuel is SkyNRG, a Netherlands-based firm that specializes in marketing and supply chain logistics. Since the ASTM ruling in 2011 permitting airlines to blend up to 50% biofuels with standard petroleum jet fuel, a majority of airlines that have flown commercial biofuel flights have done so with fuel provided through SkyNRG. In partnership with a US firm called Dynamic Fuels, SkyNRG has offered its clients the opportunity to go “frying high”[34] by supplying them with a biofuel made from used cooking oil (the leftover grease seen most often in the deep fryers of fast food restaurants). Admittedly, most of SkyNRG’s customers have only bought fuel in small amounts. Air France, Thai Airways, Thompson Airways, Qantas, LAN Chile, and Etihad Airways only procured enough to run single flights, whereas the outlier, Finnair, used it to run four. Of SkyNRG’s partners, the only major exceptions have been KLM and the sister companies, Alaska Airlines and Horizon Air: the latter used a 20-80 blend to run 75 flights over three weeks in November 2011, while the former used a 50-50 blend to run 200 flights over two months starting in February 2012.

In many ways, the fuel SkyNRG offers is an impressive product. Not only does it offer 60% less CO_2 emissions than fossil fuel equivalents, but it also greatly reduces other pollutants like sulfur and nitrous oxide.[35] The fact that it is not an agricultural product is another advantage, as it cannot be directly linked to controversial practices like GHG-emitting land clearances, the displacement of food crops, or the unsustainable use of nitrogen fertilizer. In this way, it avoids two of the bloodiest flashpoints in the biofuel debate: food versus fuel and indirect land use change (ILUC). This makes it an exceptionally noncontroversial way to demonstrate sustainability. But perhaps most of all, it has a powerful psychological appeal. It connects eating French fries with flying on vacation, and makes it seem as though the green economy can be achieved through mutually enabling acts of consumption. The idea that planes can be powered with the same oil that McDonald's uses to make its fries makes sustainability something novel and convenient that requires nothing in the way of lifestyle change.

Unfortunately, upon close examination, used cooking oil has significant limitations. So far, the most overlooked problem has been the consequences for animal feed. In 2000, the US Census Bureau estimated that 75% of all recycled fat and grease products, including used cooking oil, were being utilized for their high calorie content as filler in animal feed.[36] However, in 2002, it was estimated that diverting used cooking oil and certain types of tallow toward biofuel production could remove as much as 2.9 billion pounds of fat from the livestock and pet food industries.[37] Ten years later, as the price of used cooking oil has quadrupled[38] and 471 million pounds of it — one third of all the US production[39] — are being put toward biodiesel,[40] this projected problem seems to have been realized. The danger is that amid these skyrocketing prices, livestock producers will replace used cooking oil with something more affordable but less sustainable. There are admittedly a number of alternatives, including additional corn, distillers' grain, and gluten feed, but an increasingly cheap and appealing option is palm kernel meal, a byproduct of the notoriously dirty palm oil industry whose expansion is destroying rainforests and livelihoods, mainly in Indonesia and Malaysia, but increasingly in Africa and Latin America as demand grows (see box 3).[41] If the commercialization of used cooking oil for aviation was to increase demand for palm products, then SkyNRG's claims to sustainability would be much less plausible.

Aside from indirect effects, the overwhelming problems with SkyNRG fuels have to do with price and scalability. When Alaska Airlines and Horizon Air organized their 75 flights, they paid $17 per gallon of biofuel compared to $3.14 per gallon of regular jet fuel. Concerned that the traveling public would bolt if these costs were passed along to them, the airlines absorbed the loss. So long as the price remains exorbitantly high, they have no plans to run further flights in the immediate future.[42] Kati Ihamäki, Finnair's Vice President for Sustainable Development, hit the nail on the head when she said that the three main obstacles blocking the widespread use of aviation biofuels were, "price, price, and price."[43] Regrettably, especially in the case of used cooking oil, these lower prices are unlikely to materialize. As the US government's Energy Information Agency (EIA) notes, there is simply not enough of it on the planet to make for a viable commercial market capable of competing with fossil fuels.[44] SkyNRG claims to be "painfully" aware of this problem, and as such is considering new feedstocks like camelina, jatropha, algae, and a relative of palm called babasu.[45] The fact remains, however, that the gap between total aviation needs and available used cooking oil is even more immense than acknowledged by the company.

FIGURE 3: HOW MUCH USED COOKING OIL COULD BE AVAILABLE FOR THE AVIATION INDUSTRY IN THE US? (IN MILLION GALLONS)[46]



Some quick calculations make this abundantly clear. Start with the fact that in 2010 the US produced 1,403.6 million pounds of used cooking oil.[47] This makes for a lot of French fries, but converting every drop into aviation biofuel would still only produce about 185 million gallons (see figure 3).[48] Again, this seems like a large number, but last year the US alone consumed roughly 21 billion gallons of jet fuel.[49] This means that diverting *all* the used cooking oil in the US would keep American planes in the air for less than three days, while at the same time unleashing possibly dangerous indirect effects on livestock food supplies. According to the IATA, the global commercial aviation industry consumed 71 billion gallons of jet fuel in 2011,[50] meaning that it would take 540 billion pounds of used cooking oil to meet total global demand. This is roughly equivalent to the output from 41.5 million McDonald's, or 1,400 times the number of McDonald's that currently exist.[51] Such an enormous gap between potential demand and available supply means that no airline can seriously contemplate used cooking oil as a path to sustainability.

Neste and the Palm Oil Path

These problems of scale are not lost on Neste Oil. The Finnish firm has already invested billions in four refineries—two in Finland, one in Amsterdam, and one in Singapore—that require 2.5 million metric tons of feedstock to meet annual capacity.[52] In theory, these facilities are meant for biodiesel, but the production processes are similar enough that a transition to aviation biofuel would not be difficult. This makes sense given Neste's stated desire to become one of the world's premiere providers of aviation biofuel.[53] Unlike SkyNRG, which has dealt almost exclusively in used cooking oil, Neste believes that biofuel production can only be viable if it uses feedstocks that are currently available in commercial quantities: mainly food grade and non-food grade vegetable oils.[54] In order to feed its new biorefineries, Neste cannot afford to wait years for experimental new inputs like microbial oil and algae; it needs affordable feedstocks in bulk or else it faces a loss on its investments.

BOX 2: HERAKLES FARMS: AN EXAMPLE OF THE RUSH TO EXPAND PALM OIL PRODUCTION IN AFRICA

Corporations and investors have been turning their attention to Africa in recent years, seeking to acquire land to grow oil palms in what is seen as the "next frontier" of industrial agricultural production.[55] This rush is most evident in Western and Central Africa, where an estimated 2.6 million hectares has either been planted with palm or set aside for that purpose. Unfortunately, a majority of these future projects will take place on partly forested land, leading to worrying consequences in terms of environmental damage and local livelihoods.[56]

In September 2012, the Oakland Institute and Greenpeace International released a report and documentary film detailing one of the most egregious examples of this phenomenon. The 73,000 hectare palm oil project developed in Southwest Cameroon by Herakles Farms, a US-based agri-business firm, was initiated in violation of Cameroonian law. Herakles' local subsidiary began clearing forests and planting seedlings prior to submitting an Environmental and Social Impact Assessment.[57] The project, which could disrupt food supplies and livelihoods for as many as 45,000 area residents, has been resisted by local activists and NGOs since 2010.[58] It will also result in massive destruction of rainforest in an area of exceptional ecological richness and diversity, having been recognized as a global center of biodiversity by the World Wildlife Fund and Conservation International. In August 2012, the firm decided to withdraw from the Roundtable for Sustainable Palm Oil (RSPO), the body that promotes global social and environmental standards for palm oil production, because of its difficulties complying with RSPO standards and grievance mechanisms.[59] However, the project is still moving ahead.[60]

Fruit of an oil palm tree. © Jan-Joseph Stok / Greenpeace

In this race for scale, Neste has embraced the rapidly expanding and highly controversial palm industries in Indonesia and Malaysia, which together make up 87% of the world market.[61] In 2011, 76% of Neste's feedstocks were palm or palm-related, leaving waste fats (19%) and various oilseeds like camelina and jatropha (5%) a distant second and third.[62] Economically, this makes a great deal of sense. Palm, the cheapest and most abundant source of vegetable oil, yields 1,572 gallons per hectare, twice as much as coconut, four times as much as rapeseed (canola), and twelve times as much as soy.[63] In environmental terms, however, it is a veritable nightmare. It has been estimated that 10% of the deforestation in Malaysia and Indonesia in the last 20 years has occurred due to palm plantations.[64] This has created a panoply of other problems, from biodiversity losses (the near extinction of certain rare species of orangutan) to human rights violations (the well-documented abuse and dispossession of indigenous tribes). Through the destruction of rainforest, the industry is already responsible for an estimated 2.057 million metric tons of CO_2 emissions,[65] but this is certain to increase as demand for palm oil is projected to more than double by 2030 and triple by 2050.[66] Perhaps most dangerous of all, the amount of palm plantations established on peat bogs, which can sequester as much as ten times the CO_2 per hectare of standard rainforest,[67] is projected to triple over the next 20 years — destroying ecosystems that could help counter global warming.[68] Although Neste claims it is responding to these challenges by trying to procure as much sustainably-produced palm oil as possible, the firm is notoriously opaque when it comes to its own palm providers, and to its indirect role in deforestation *vis a vis* increases in overall demand. In fact, it has vigorously lobbied in the US against policies that would regulate the indirect land use effects of the expanding palm industry (see box 3).

BOX 3: NESTE'S SUSTAINABLE PALM?

Neste guarantees that all of its palm oil is 100% traceable to the areas of its growth. However, it refuses to disclose those locations to the public,[69] only admitting that its palm products come from "Southeast Asia."[70] Neste is equally opaque about suppliers. Greenpeace Finland estimates that it purchases palm oil from at least ten different corporations, but the only one it publicly acknowledges is the Malaysian IOI Group, which has been repeatedly implicated in illegal rainforest clearances and human rights violations against indigenous groups.[71]

In 2011, Neste was proud to report that 83% of its palm oil was certified by either the Roundtable on Sustainable Palm Oil (RSPO) or the EU-approved International Sustainability and Carbon Certification (ISCC) system.[72] But neither of these schemes is perfect, to say nothing of the remaining 17% that receives no external certification at all. The RSPO is widely seen as having a weak complaints procedure, and has failed to protect many forested areas, including carbon-rich peat lands.[73] Additionally, some of the RSPO's most senior members have been implicated in illegal evictions and other crimes against indigenous groups.[74] The ISCC is a general criteria for sustainable biomass that the EU accepts for certifying RED biofuel (see Box 1), but it contains no provisions for indirect land use changes, making it a poor tool for evaluating the environmental consequences of palm oil.[75]

Through lobbying, Neste has taken a direct hand in shaping environmental policy to its own ends. This was made especially clear when the EPA was deciding whether to include palm oil–based biofuel in the RFS mandate system (see box 1, above). Ultimately, the EPA came to an initial decision that, owing largely to land use changes, renewable diesel and biodiesel made from palm only saved between 11 to 17% of CO2 emissions compared to fossil fuel, making them ineligible for the minimum 20% requirement set by RFS.[76] The Union of Concerned Scientists and other groups claim that this is a conservative estimate and that palm fuel is in fact dirtier than fossil fuel.[77] This has not stopped Neste from hiring the lobbying powerhouse Holland and Knight, one of the richest names on K Street, to reverse the EPA's decision.[78] The American Legislative Exchange Council (ALEC), a conservative group infamous for drafting sample legislation that advances the interests of its corporate members, has jumped on the bandwagon as well. In a comment to the EPA, it said that the decision "… marks an abandonment of the free trade principles that have been so beneficial to so many."[79] This is an interesting stance given the group is currently writing legislation to reverse state-level renewable energy targets, as well as legislation that would undermine the RFS system as a whole.[80] A final judgment is pending.

Lufthansa and the Broken Promises of Jatropha

Amid all of the above controversy, it comes as no surprise that when the German airline Lufthansa partnered with Neste, it did everything possible to keep palm out of its fuel tanks. Instead, Neste provided 800 metric tons of biofuel that was derived in different parts from animal fats from Finland (5%), jatropha from Mozambique and Indonesia (15%), and camelina from the US (80%).[81] Using a 50–50 blend, Lufthansa ran four flights a day between Hamburg and Frankfurt for a period of six months starting in July 2011. The bill came to €6.6 million ($9.5 million), roughly double the cost of standard jet fuel, but the German government provided a subsidy of €2.5 million through the Federal Ministry for Economics and Technology.[82] The resulting 1,187 flights saved 1,500 metric tons of CO_2 and brought Lufthansa the distinction of flying more commercial biofuel flights than all of its competitors combined.

BOX 4: JATROPHA

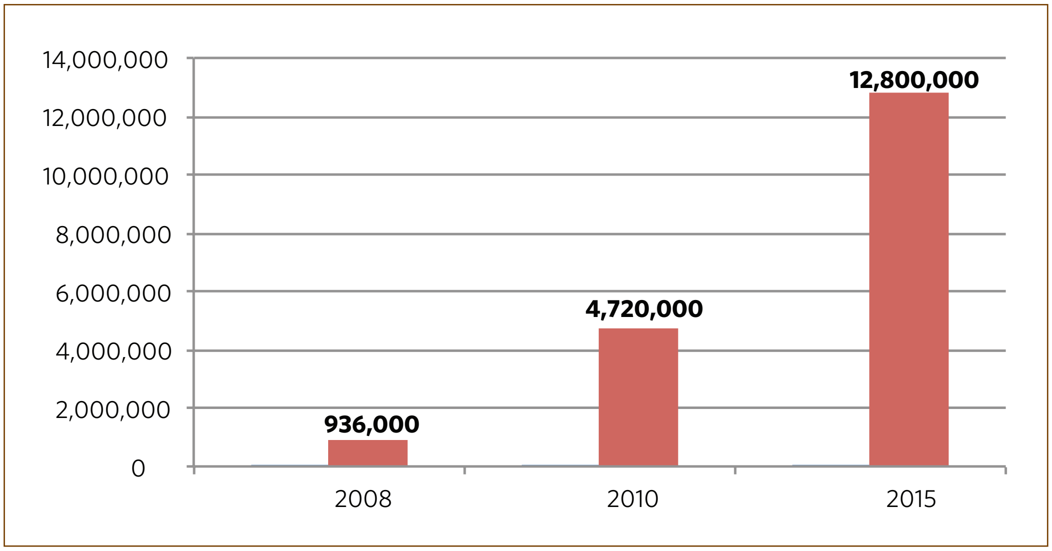
Jatropha curcas is an inedible shrub that can grow in tropical and sub-tropical climates.[83] In the past, it has been used as a hedge around food crops because its toxic properties deter grazing animals; however, oil from its seeds has also been used to make soap, candles, and lamp fuel.

One-year-old jatropha in Sun Biofuels plantation, Tanzania.
© The Oakland Institute

When commercial investment began in the mid-2000s, jatropha was hailed by many as a biofuel wonder crop. Its high-yielding oil seeds were supposed to offer 40 times the net energy of soy, all on marginal land with no need for irrigation, fertilizer, or pesticide.[84] Advocates said that unlike so-called first generation feedstocks, jatropha would not compete with food; it would help satisfy growing transportation needs while at the same time providing much-needed rural development in some of the world's poorest countries. This seemed to make it a win-win proposition.

The view from the present is altogether different. Although jatropha can survive on marginal land, no one now maintains it can thrive there. Seed yields vary from 1.5 to 7.8 metric tons per hectare, though the higher end is likely to require better than marginal soil, fertilizer, pesticide, and as much as 20,000 liters of water per liter of fuel.[85] The tendency of jatropha to perform better on better soil makes the claim that it will not displace food crops uncertain at best. In terms of life cycle GHG emissions, the evidence is once again mixed. There is no reliable general estimate, but specific projects calculate CO2 savings of up to 39% compared to fossil fuels, while others are possibly six times dirtier if land use change is considered.[86] In spite of this ambiguity, jatropha production is increasing, from 936,000 hectares in 2008 to nearly 13 million hectares projected by 2015 (see figure 4).[87]

FIGURE 4: SCALE OF JATROPHA PLANTATIONS, 2008-2015 (HECTARES)[88]



BOX 5: CAMELINA

Camelina sativa is an oilseed in the same family as canola. The plant is already used to make salad dressing, cooking oil, soap, and beauty products, while its meal, rich in omega-3 and protein, makes an ideal feed for cattle, poultry, and even fish.[89]

There is little research about the biofuel implications of camelina, largely because commercial production is still limited. Oil yields are below one metric ton per hectare, less than palm, rapeseed, and most estimates for jatropha, but this could conceivably be improved as agronomists gain experience. Initial evidence suggests it matures quickly, requires relatively few inputs, and performs well in temperate climates. Similar to claims made about jatropha, defenders are keen to point out that it can be grown either on marginal land or in rotation with wheat, exempting it from food versus fuel concerns.[90] At best, this is only partially true. The RAND Corporation noted that in 2008 camelina production dropped sharply in response to high wheat prices, suggesting the two crops were in fact in competition.[91] It is also undeniably a source of edible vegetable oil, meaning that its expansion to commercial scale could have unforeseen consequences for the price and availability of certain food products.[92]

The biggest uncertainty remains life cycle GHG emissions. Even though camelina-based biofuel production could reach 1 billion gallons by 2025,[93] there is almost no information about the possible land use changes this could entail. Despite the fact that in the US fallow and marginal lands are under increasing pressure due mainly to ethanol demands, it is nonetheless assumed that there is enough extra space to grow commercial quantities of camelina responsibly.[94]

In January 2012, the Environmental Protection Agency (EPA), which is responsible for evaluating the sustainability of new feedstocks, added camelina to the RFS; however, it was removed only three months later pending further review after serious questions were raised about the EPA's methodology. According to a coalition of environmental groups, including the Clean Air Task Force and Friends of the Earth, the EPA did not sufficiently consider the possible indirect effects of large-scale camelina production. Even though one study suggests that up to 2 million hectares of camelina could be grown sustainably in the US, the EPA assumed that as many as 3.2 million hectares would actually be planted. The coalition also alleged that the EPA failed to consider the increased demands on fallow and marginal land that RFS ethanol mandates are already creating, and how increased camelina production could make that problem even worse.[95]

After nearly a year of review, the EPA over-ruled these concerns in February 2013. Although the EPA promises to revisit the decision if camelina expands unsustainably onto new land, it specifically cites the demand for aviation biofuel as potentially leading to that outcome.

In terms of sustainability, Lufthansa says that its membership in both SAFUG and the RSB gives it the wherewithal to participate in biofuels responsibly. All of the feedstocks it uses are traceable back to their respective areas of growth, though the locations themselves are not publicly available. It promises that no rainforests are cleared, food crops displaced, nor unsustainable agricultural practices used.[96] But this has not stopped questions from emerging, particularly in reference to its two jatropha providers: the now-defunct Sun Biofuels in Mozambique and Jatoil Waterland in Indonesia.

Before UK-based Sun Biofuels went into bankruptcy administration in August 2011, it provided 30 metric tons of jatropha oil from Mozambique that would be refined by Neste for use in Lufthansa's flights.[97] There is no detailed information about what happened after Sun Biofuels's Mozambique holdings were sold during bankruptcy proceedings,[98] but the overall report on the company's practices in Mozambique prior to this is relatively good. The 2,256 hectares of jatropha it planted were in an abandoned tobacco field, so no additional CO_2 was released through the opening of new land. Previous work by the Oakland Institute suggests that the project created 1,500 jobs at slightly higher than minimum wage, though many of them were only seasonal. On the downside, pesticides used in the project flowed into local dams when it rained, killing fish and robbing locals of a major source of protein.[99] Much more problematic, though, were Sun's practices in the Kisarawe district of neighboring Tanzania. As the result of a 8,000 hectare jatropha project, locals experienced water scarcity and lost access to land that they had previously used as a source of wild food, wood, and medicine. This increased their dependence on subsistence agriculture and required them to go great distances to purchase or collect these same goods, often at a far greater cost. Now the bankruptcy has left locals with nothing after they were promised jobs, wells, health clinics, and roads.[100] Even though the jatropha ultimately used by Lufthansa did not come from this site, these accounts certainly reflect poorly on Sun Biofuels's overall credentials as a responsible business, and on Lufthansa's commitment to supply chain accountability.

The remainder of the jatropha came from Indonesia through a joint venture called Jatoil Waterlands. The principal partners—Waterland International, a Dutch firm that invests in biomass, and Jatenergy, an Australian energy firm that is active almost exclusively in coal—provided 200 metric tons of raw jatropha oil from the Grobogan district of central Java. Regrettably, evidence compiled by Friends of the Earth–Netherlands suggests that the local farmers paid dearly for this. Whereas Jatoil Waterland had promised that jatropha would be a veritable "money tree" offering 400% returns,[101] local farmers who have given up maize production to grow jatropha have seen a drop of nearly 70% of their income. Farmers in the area were actually forced to grow jatropha by the State Forest Company, the government entity that holds title to 35% of the area's land, and which shares the profits with Jatoil Waterland.[102] This case constitutes clear evidence that the production of biofuels caused the displacement of food crops, in clear violation of Lufthansa's procurement guarantee.

One of the major obstacles Lufthansa faced was a simple matter of scale: it wanted more jatropha than was available to buy. This was made painfully clear not long after the sale was complete in a statement released by the CEO of Jatenergy, who said, "We can't produce enough jatropha oil at the moment to meet demand."[103] This is unfortunate for Lufthansa because, like many in the aviation industry, it sees jatropha as an ideal feedstock. Admittedly, much of this enthusiasm is based on arguments that are questionable at best: the idea that jatropha can produce high yields on marginal land without interfering with food supplies--all without water, fertilizer, or pesticide — has been widely discredited (see box 4). But when refined into jet fuel, jatropha oil has other benefits more specific to aviation, such as a lower freezing point, which is invaluable at high altitudes, and a higher energy density, which allows for more thrust from less combustion.[104]

Of course, these relative advantages are irrelevant if the product itself is unavailable. This has led rising firms like BioJet and JATRO AG to begin implementing a new business model based on the vertical integration of production. Relying mainly on jatropha, but with the largely untried camelina in a secondary role, BioJet in particular is positioning itself as a future force in the aviation biofuel market. The idea of one firm owning and refining feedstocks as part of a single supply chain is a bold and potentially game-changing maneuver, but its long-term implications are still largely unknown.

New Business Models and the Expansion of Biofuel Production

The airline industry projects a razor-thin 0.5% profit margin for 2012.[105] This makes it abundantly clear that the industry cannot and will not pay exorbitant fees for biofuel. As much as they like the idea of sustainable growth, it is impossible for airlines to afford six times—or even two times—the price of fossil fuel equivalents. This has led to the widespread insistence, voiced by individual airlines, lobbies, and even the World Economic Forum, that the only path forward requires government support, involving some combination of direct funding, tax incentives, and public-private partnerships.

However, another business model is emerging that its defenders claim can provide abundant supplies of affordable aviation biofuel. At least two firms, JATRO AG and BioJet, have taken a vertical integration approach to develop the production of biofuels, with ambitious goals to supply the lucrative aviation fuel market.

Based in Germany, JATRO AG is rapidly expanding across Southeast Asia, having secured hundreds of thousands of hectares for jatropha through government concessions in Indonesia, Thailand, and Vietnam.[106] The full extent of its holdings is not known, but in 2011 alone it secured a 100,000 hectare plantation in central Vietnam through a joint venture with a furniture and timber company.[107]

BioJet, headquartered in Barbados, is a much larger player; it is present in over ten countries, and has announced that it could offer 1 billion gallons of aviation biofuel over the next ten years at a price equal to petroleum jet fuel—a promise no other provider has dared to make.[108]

To date, most biofuel companies have only specialized in one segment of the supply chain. JATRO AG and BioJet intend to control the entire production process, from feedstock growth to refining capacity. This strategy is a response to what has so far been the Achilles heel of the entire biofuel industry: feedstock affordability. Feedstocks are a whopping 85% of the total costs associated with biofuel production. Controlling the production of feedstock makes therefore sense for biofuels firms that do not want to be subject to the arbitrary and unpredictable price variations that may be decided by their suppliers.[109]

BioJet is investing in enough jatropha and camelina to make impressive amounts of fuel. Since it purchased Abundant Biofuels in 2011, BioJet has become the world's largest private jatropha developer. In the next three years, it will have a 1 million hectare project reaching harvesting potential in the Philippines, and is able to acquire an addition 3 million acres in the same country on short notice.[110]

Counting all of BioJet's national subsidiaries and joint ventures, it will be the world's largest camelina producer by 2014. Planned projects currently include 1 million hectares in Argentina, 100,000 hectares in Laos, 200,000 hectares in Turkey, and 300,000 hectares on Native America land in the US in partnership with the Council of Energy Resource Tribes (CERT; see box 6).[111]

Box 6: The Council of Energy Resource Tribes (CERT)

The Council of Energy Resource Tribes (CERT) is composed of 53 Native American nations in the US and four in Canada. In the US, it collectively controls 30% of the coal west of the Mississippi, 40% of total uranium deposits, and 10% of known oil and gas reserves.[112] Even though it is invested overwhelmingly in non-renewable resources, CERT is eager to use government support to embrace cleaner energy. "We were once sustainable," says CERT representative Robert Martin, "we want to rebuild sustainability."[113]

In 2012, BioJet and CERT announced an official partnership to pursue $1 billion worth of aviation biofuel projects on tribal lands over the next ten years.[114] This includes planting an estimated 300,000 hectares of camelina, as well as three separate refining projects: one wood-based in the Northwest, one camelina-based in the Southwest, and one camelina- and natural gas-based in the Rocky Mountains.[115] It is unclear if all required funding for these projects has been secured yet, but there are numerous advantages afforded to tribal business ventures that BioJet and CERT hope to capitalize on. Aside from exemption from state and local taxes, the Department of the Interior guarantees up to 90% of tribal development loans,[116] while the Department of Indian Energy runs a grant program that has disbursed between $2 and $11 million for tribal energy projects every year since 2002.[117] As part of Obama's stimulus program, there is an additional $2 billion in tribal bonding authority that the partnership would like to access.[118] In general, the Obama administration is especially friendly to the goals of tribal energy development, and has signed legislation granting tribes the authority to create their own land leasing regulations for energy projects.[119]

Biojet's first batches of feedstock are expected in late 2014, with capacity continuing to expand through 2015 and 2016.[120]

Even with these seemingly massive investments—the firm has a project presence of $1 billion or more in five separate countries—BioJet claims it only seeks to eventually control a fractional 2 to 3% of the entire aviation fuel industry.[121] This raises crucial questions not only about the sustainability of BioJet but about the overall dangers of pursuing commercial aviation biofuel production.

As the world's largest private biofuel developer, BioJet has clearly embraced jatropha, a feedstock that has a checkered reputation at best when it comes to life cycle GHG emissions and food crop displacement. Considering Lufthansa struggled in 2011 to procure socially and environmentally responsible jatropha, it seems reasonable to wonder whether expanding production will have similarly deleterious effects. Evaluating the company's camelina projects is more difficult, if only because they are still mainly in the planning phases. However, as detailed in Box 5, there are legitimate concerns that the expansion of camelina production may have a substantial impact in terms of displacement of food crops and is likely to create additional pressure on land use. The fact that BioJet is jumping full force into a feedstock that has only just been added to the RFS amidst some controversy is difficult to overlook.

Conclusion

Considering there are already legitimate concerns about BioJet's embrace of certain feedstocks to corner 2 to 3% of the market, what happens when demand for those same feedstocks spikes as firms imitating BioJet's success seek to carve out their share of the remaining market? This raises several key concerns:

Biofuel mandates that apply only to ground transportation are already a rising burden on available land resources. In order to reach current RFS ethanol quotas, fallow and marginal lands are under increasing pressure mainly through new corn planting, while reaching the RFS target for 2022 could "...require harvesting 80% of all biomass in the US, including all agricultural crops, grasses, and forests."[122] Naturally, none of this factors in the possible role of expanded camelina production for aviation biofuel. Yet, rapid increases in demand as the result of additional vertically integrated production projects could only aggravate the land use problems that mandates have already created.

According to the World Economic Forum, the IATA's emissions target for 2050 would require 13.6 million barrels of biofuel per day for aviation alone; however, the International Energy Agency (IEA) projects that only 15.8 million barrels per day will be produced across all sectors at that time.[123] This means that reaching commercial aviation's self–imposed target would leave only a fraction of biofuel behind for road transport, electricity, and heating. If aviation drives demand by pursuing this goal, and other sectors continue to generate demand as well, the combined rise in demand could create similar pressures on food supplies and sustainable land use.

To meet current aviation needs, let alone future increases in demand, it would take 270 million hectares of jatropha,[124] roughly equivalent to one-third of Australia or 25 times the amount expected to exist in 2015.[125] Even a quarter of the required area would still be a Texas-sized chunk of land that could no longer grow food. Considering the sheer quantities of biofuel required compared to the amounts that currently exist, it is impossible to look into the future and guarantee that the drive to procure commercial quantities will not result in unsustainable, food security-threatening land grabs. There is already massive pressure on land resources in the developing world, with an estimated 83 million hectares being acquired between 2000 and 2010.[126] Further investments in jatropha in the amounts required would undoubtedly aggravate this already worrying trend.

Commercial aviation is eager to embrace biofuels not just as a way of cutting costs, but also as a way of appealing to sustainability-conscious consumers. But this could create problems of its own. If airlines begin to compete with each other over whose use of biofuel is more expansive, it could trigger a green race to the bottom as carriers strive to use more and more biofuel than their competitors. This, in turn, could lead to airlines into the arms of more widely available but also more problematic feedstocks, with palm topping the list.

These dangers all suggest that the entire discussion about sustainable aviation has been going in the wrong direction. Until now, the dominant discourse has been about how supply chains and technologies can be transformed so that current levels of consumption and future prospects for growth can be maintained. And yet, the consequences of pursuing aviation biofuels on a commercial level are as potentially threatening to human rights as the worst consequences of climate change. The airline industry, hungry for price stability and a green image, is in danger of creating an unprecedented demand for biofuel that could have catastrophic consequences for land rights, food security, and GHG emissions.

In the short term, it is more important than ever to heed calls from the UN to abolish subsidies and other incentives for feedstocks that are ethically and environmentally uncertain. Even Jose Graziano da Silva, the chief of the UN's Food and Agriculture Organization (FAO), has called for the suspension of biofuel mandates as growing demand for food, feed, and fuel could wreak havoc on the prices of sugar, maize, and oilseeds.[127] In the specific case of aviation, this includes the European Union Emissions Trading System (EU ETS) and its carbon neutral rating for biofuels, as well as federal funding for CERT projects in the US that even the federal government has acknowledged use feedstocks that have unknown effects.

But most important, the long-term trajectory of the rush for aviation biofuel needs to be acknowledged for what it is: a false solution to the climate crisis that is either unobtainable or dangerous. On the one hand, if the IATA is to reach its 2050 target, it would require an astronomical amount of land and nearly all of the biofuel expected to exist at that time. This makes reaching it an unlikely, or at least very challenging, proposition. On the other hand, expanding production to reach that goal, or even expending production to make commercial markets viable, is a threat to sustainable land use and food security. The global rush for land is already an acknowledged source of hunger and GHG emissions; adding another driver of demand would only make the problem worse.

This makes it abundantly clear that the efforts of the aviation industry to combat climate change are ill-conceived at best or hypocritical at worst. The growing number of sustainability-conscious consumers should not find these promises convincing, nor use them as an excuse to keep current lifestyles in motion. But neither should they be convincing to governments, who are well-positioned to withdraw the plethora of taxpayer incentives that encourage these and other dead-end solutions to climate change.

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