NRDC ISSUE BRIEF

JANUARY 2015
IB:15-01-A

Aviation Biofuel Sustainability Scorecards

AUTHOR: Debbie Hammel

NRDC
NATURAL RESOURCES
DEFENSE COUNCIL

About NRDC

The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 1.3 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Livingston, and Beijing. Visit us at www.nrdc.org and follow us on Twitter @NRDC.

NRDC's policy publications aim to inform and influence solutions to the world's most pressing environmental and public health issues. For additional policy content, visit our online policy portal at www.nrdc.org/policy.

Acknowledgments

NRDC thanks the Packard Foundation for the generous contributions that made this report possible.

The author of this report would like to thank the following individuals for their contributions toward reviewing an early draft. Their review does not constitute an endorsement of the findings:

Patrick Mazza, *MROC (Independent consultant)*

Ausilio Bauen
Director, *E4tech consulting and*
Senior Research Fellow, Imperial College London

Robert Boyd, Manager, *Biofuel Deployment Project, Aviation Environment*

NRDC acknowledges the role of Suzanne Hunt of HuntGreen LLC in the analysis and preparation of this report.

NRDC Director of Communications: Lisa Benenson
NRDC Deputy Director of Communications: Lisa Goffredi
NRDC Policy Publications Director: Alex Kennaugh
Design and Production: Tanja Bos

EXECUTIVE SUMMARY

BLOOMING RAPE

ASSESSING SUSTAINABILITY

The aviation industry has committed to hold its carbon emissions steady after 2020 and cut net carbon emissions to half of the 2005 level by 2050. Achieving these goals will require low-carbon fuels, and aviation must drive technology and policy advances to build an aviation biofuel industry with sustainability in the foreground.

In order to ensure that aviation biofuels deliver on their promise of long-term sustainability, aviation must leverage its market power and commit to robust sustainability standards in biofuel sourcing. This will incentivize upstream biofuel operators to pursue compliance and certification under prevailing sustainability standards.

With this *2014 Aviation Biofuel Sustainability Scorecard*, the Natural Resources Defense Council rates progress by the industry and individual airlines on this front. With our first scorecard, in 2013, we did not identify individual airlines by name because the aviation biofuels industry was so new. This year we have decided to publish individual airline scores because some are reporting significant progress, and we believe there is value in highlighting these leading companies as potential models to support positive momentum across the sector.

THE CRUCIAL ROLE OF CERTIFICATION

It is crucial that the emerging aviation biofuel industry be built on a foundation of sustainability. Biofuels produced within a framework of sustainability criteria can provide environmental, social, and economic benefits. When produced in an unsustainable manner, they can cause severe damage to land, water, air quality, wildlife, and local communities and can even generate more greenhouse gases than their petroleum counterparts. In order to ensure that aviation biofuels deliver on their promise of long-term sustainability, the aviation industry must leverage its market power. Airlines must commit to robust sustainability standards in biofuel sourcing. This will incentivize upstream biofuel operators to pursue compliance and certification under prevailing sustainability standards.

These market signals are critical in driving adoption of sustainable practices through the supply chain. Biofuel operators are making long-term design, employment, and operational decisions to optimize production for the requirements of their marketplace, and many are now focusing on aviation as a key market. Sending a clear signal that production must be compatible with sustainability standards and independently audited and verified through credible certification programs will cause operators to proactively build this into their planning and operations.

Aviation is seeking new fuels not only to reduce carbon emissions, but also as a hedge against oil price volatility and supply shocks. Aviation biofuels are environmentally preferable to competing alternatives such as unconventional fossil fuels (coal to liquids, tar sands, oil shales, etc.). Unconventional fossil fuels can produce significantly more carbon pollution than conventional petroleum fuel and are associated with significant negative environmental impacts including land disturbance and water pollution.

Despite powerful drivers and significant targets for biofuel adoption, we recognize that a number of economic, political, and market challenges lie ahead. Financing and scaling biofuel production are key challenges, and many airlines are economically constrained in their ability to support and invest in biofuel supplies. We also acknowledge that some of the airlines trying to lead on aviation biofuels face real geographical constraints in gaining access to these fuels in the early stages of the industry's development. The political and regulatory landscape is also uncertain and often skewed toward ground transport. Nonetheless, the aviation biofuel market continues to progress quickly and promises to advance biofuel development in general. Hence, the sustainability of aviation biofuel industry development is of critical importance.

SURVEY RESULTS

- We sent questionnaires to 32 airlines that have used biofuels or are publicly claiming they plan to use them, and received responses from 17. Among the highlights of our findings:
- The top-scoring carriers on the Sustainability Scorecard were Air France-KLM, British Airways, United Airlines, Virgin Atlantic, Cathay Pacific, and Alaska Airlines.
- Only one airline is a direct member of the Roundtable on Sustainable Biomaterials (RSB).[1] Sixteen of the 17 respondents are members in the Sustainable Aviation Fuel Users Group (SAFUG), which is a member of the RSB and represents their interests.[2]
- All of the respondents except one have committed to RSB certification via their SAFUG membership.
- Two airlines disclosed the total volumes of biofuel used in 2013. Four airlines disclosed that they used no biofuels in 2013, six airlines have disclosed volumes in the past or intend to in the future, and several have obligations under the Carbon Disclosure Project.
- One airline reported that 100 percent of the biofuel it used in 2013 and 2014 was sustainably sourced. The other airline that disclosed biofuel use in 2013 did not source biofuels certified or verified as sustainable.
- Two airlines monitor the life-cycle GHG emissions of their biofuels, and nine airlines have in the past or intend to in the future. The two airlines that currently monitor disclosed their numbers, and eight airlines said that they had disclosed them in the past or intend to in the future.
- Two airlines assess the potential ILUC (indirect land use change) risks associated with their biofuel supplies; two have in the past or said that they would in the future, and five are actively engaged in researching and working to avoid ILUC in general.
- One airline has two full-time staff people focused on biofuels, and three other airlines have one.

RECOMMENDATIONS

While members of the aviation sector have made some important progress to implement their sustainability commitments over the past year, NRDC believes there are enormous opportunities to do more, particularly now that credible sustainability standards, such as those adopted by the RSB, are now fully operational in the marketplace. Therefore, our recommendations from last year are still relevant and worth repeating:

1. The airlines must now send clear market signals notifying current or potential suppliers of the importance of sustainability certification.
2. If they are using biofuels, airlines should make a public commitment to source 100 percent certified-sustainable biofuel.
3. SAFUG and its 28 member airlines should make a firm commitment to use the certification framework created by the RSB.
4. The airlines should strive for total transparency in the volumes, greenhouse gas profile, and sustainable certification used in aviation biofuel sourcing.
5. Airlines that do not already have dedicated biofuels staff should hire specialists to focus on this fuel.

INDUSTRY CARBON COMMITMENTS

The global aviation sector currently produces approximately 2 percent of annual anthropogenic CO_2 emissions. While this may sound like a small number, it translates to more than 650 million metric tons released into the atmosphere annually. If significant progress is not made to unlink industry growth from emissions growth, they will double or triple over the next several decades. Projections indicate that with business as usual, the sector is on track to grow by 300 percent and generate more than 5 percent of global emissions by 2050.[3]

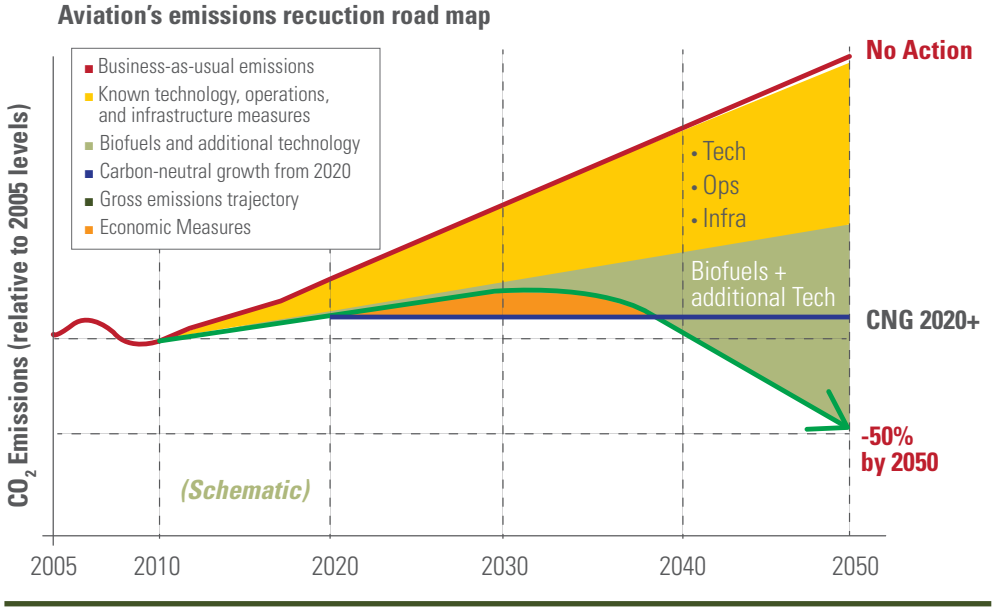
According to the International Air Transport Association (IATA), the sector is indeed making progress in decoupling growth in flying from growth in emissions; the group reports that aviation is growing at about 5 percent per year and emissions from the sector at about 3 percent. This may be partially attributed to the greenhouse gas reduction targets that the industry set in 2009 when the 240 IATA-member airlines collectively committed to:

- improving fuel efficiency by 1.5 percent per year, on average, between 2009 and 2020;
- holding carbon emissions steady from 2020 onward;
- reducing net emissions by 50 percent by 2050 compared with 2005.

There is broad agreement that aggressive efficiency improvements alone will not be enough to achieve carbon-neutral growth from 2020 onward and that low-carbon fuels will have to play a significant role. In fact, airlines are relying on aviation biofuels to help them meet these aggressive targets. See Figure 1.[4]

One of the essential elements of expanding the potential renewable jet fuel pool is technical certification of more production pathways by the American Society for Testing and Materials (ASTM).[5] The technical standards that are relevant include the ASTM Petroleum Standards, the ASTM D1655–09 Standard Specification for Aviation Turbine Fuels, and several others. Before a new type of aviation fuel is approved, it must go through a highly involved process that "includes the prerequisite testing and required interactions with the engine and airframe manufacturers; standards organizations; and airworthiness agencies such as the FAA and EASA."[6] The Commercial Aviation Alternative Fuels Initiative (CAAFI) and its members have been working to accelerate the time- and resource-intensive process of testing and technical certification.[7] In 2009 Fischer-Tropsch synthetic paraffinic kerosene (FT-SPK) and in 2011 hydroprocessed esters and fatty acids (HEFA) were approved as synthetic blending components for use in jet fuel. Both can be blended up to 50 percent with conventional jet fuel. In June 2014, ASTM approved renewable farnesane as a blending component (up

Figure 1. The Aviation Industry's Long-term Targets



Source: Air Transport Action Group (ATAG).

to 10 percent) in jet fuels, and stakeholders are optimistic that one or two more pathways will be approved during the next year. Those are likely to be alcohol-to-jet (ATJ-SPK) and hydrotreated depolymerized cellulosic jet (HDCJ), and possibly renewable diesel (possibly as a modification to the HEFA annex in the ATSM standard).

In early 2014, Boeing started to push publicly for ASTM approval for blending renewable diesel fuel with jet fuel. This would have the potential benefit of expanding airlines' access to fuel since there is much greater renewable diesel production than there is renewable jet fuel (though there would be competition from other fuel buyers). Additionally, renewable diesel generally benefits from more policy supports and can be easier and less expensive to make.

Compared with IATA's 240 member airlines, the Sustainable Aviation Fuel Users Group (SAFUG) currently has only 28 members; however, those airlines collectively account for about one-third of global jet fuel demand.[8,9] The airlines profiled in this report represent most of the airlines that are leading the charge for aviation biofuels, having made public commitments to biofuels through their participation in SAFUG or having used biofuels already. There are a few additional airlines that are working on understanding this nascent fuel industry and scoping procurement options but are not publicizing their efforts yet. Delta Airlines, for example, has not made a public commitment to source aviation biofuels, but it did announce in June that it had joined the initiative of the Carbon War Room (CWR) to unlock financing for commercial-scale, sustainable aviation biofuel production, as has Virgin Atlantic.[10]

SUSTAINABLE FUEL ADOPTION

- In the past five years, more than 40 commercial airlines around the world have flown an estimated 600,000 miles powered at least in part by biofuels:[11]
- In 2008, Virgin Atlantic became the first airline to fly a plane on a biofuel blend, kicking off a flurry of demonstration flights and, more recently, the first series of commercial flights.[12]
- Between 2008 and 2011, at least 10 airlines and several aircraft manufacturers performed flight tests with various blends containing up to 50 percent aviation biofuel.[13]
- Since the certification of HEFA fuels in 2011, 19 airlines have performed more than 1,600 commercial passenger flights with blends of up to 50 percent biofuel from used cooking oil, jatropha, camelina, and algae.[14]
- Lufthansa successfully completed a six-month series of commercial flights in the second half of 2011 to study the long-term effect of aviation biofuel on engines, noting no adverse effects.
- Between 2013 and March 2014, KLM conducted 26 long-haul flights demonstrating that it is possible to organize and coordinate a complex supply chain and fly regularly scheduled flights on aviation biofuel blends.[15]
- Now that many of the "firsts" have been achieved (e.g., the first transatlantic flight on biofuels, the first 100 percent biofueled flight), biofuel flight activity has slowed while the airlines try to figure out how to obtain cost-competitive, commercial-scale volumes of these new fuels.[16]

Several airlines have chosen specific aviation biofuel suppliers:

- British Airways is investing in Solena Fuels and hopes to use all of the jet fuel Solena plans to produce from municipal solid waste in the U.K.
- Cathay Pacific has made a strategic equity investment in Fulcrum, which plans to convert municipal solid waste into sustainable aviation fuel.[17]
- Virgin Atlantic has a deal with LanzaTech for fuel made from steel mill emissions in China (see "Case Study: Virgin Atlantic").
- United Airlines and World Fuels Corporation signed a deal for 5 million gallons of fuel per year for three years from AltAir Fuels (see "United Airlines and AltAir Fuels") to be made from beef tallow in California.

CASE STUDY: VIRGIN ATLANTIC

Virgin Atlantic has partnered with LanzaTech, a company that is gearing up to make sustainable fuel from waste carbon monoxide (CO) gases (from heavy industrial facilities like steel plants) by using a patented microbe in a fermentation-like process. In a second-stage chemical process, the alcohol is converted into jet fuel.

LanzaTech has successfully commissioned and run two pre-commercial- scale plants in China. One of these plants is set to scale up to make jet fuel for Virgin Atlantic, and, notably, it received RSB certification in November 2013. RSB is widely recognized as the gold standard sustainability certification scheme for biofuels.

LanzaTech is confident that it can produce a fuel at a price on par with kerosene, which is crucial, since fuel costs represent such a high proportion of an airline's operational costs.

Virgin Atlantic and others are currently pursuing ASTM International approval for this new aviation fuel. If all goes according to plan, Virgin Atlantic could be buying and uplifting all of its fuel out of Shanghai as a 50:50 mix, which is likely to be the blend permitted by ASTM International for this type of alcohol-to-jet fuel. While there are still a significant number of hurdles to overcome, the program is advancing, with uptake of commercial quantities anticipated within two to three years.

- Alaska Airlines and Hawaii Bioenergy have a contract for biofuel produced in Hawaii starting in 2018.
- KLM and a number of other airlines have signed up to SkyNRG regional BioPots.[18]

Federal governments, too, are becoming active promoters and buyers of aviation biofuels. The U.S. Department of Defense has purchased large test volumes of aviation biofuels and has set ambitious goals for commercial procurement. The U.S. Air Force is currently saying that it aims to "increase use of cost-competitive drop-in alternative aviation fuel blends for non-contingency operations to 50 percent of total consumption by 2025."[19]

The U.S. Navy has a goal of procuring 336 million gallons of advanced alternative fuels annually by 2020.[20,21]

In addition, an interagency biofuel partnership of the U.S. Department of Energy, the Navy, and the Department of Agriculture was created to utilize Title III of the Defense Production Act.[22] This will allow the pooling of up to $510 million in combined resources in order to fund the design, construction, and commissioning of one or more commercial-scale biorefineries to make military-compatible drop-in jet fuel and/or diesel fuel.[23] In September 2014, a total of $210 million was awarded to Emerald Biofuels, Fulcrum BioEnergy, and Red Rock Biofuels to cofinance the construction of commercial-scale, advanced biorefineries within the United States.[24]

The European Union is promoting an aviation biofuel target of 600 million gallons per year (2 million tonnes) to be achieved by 2020 via its Biofuels Flightpath Initiative.[25]

This represents about 3 to 4 percent of total jet fuel use in Europe. The U.S. civil aviation sector has also set an ambitious target of 1 billion gallons per year by 2018 for commercial flights.[26] Even one-tenth of this projected growth would represent dramatic development for the aviation biofuels industry.

STAKEHOLDER ENGAGEMENT

Multi-stakeholder groups consisting of airlines, airports, aircraft manufacturers, governments, and biomass and biofuel producers and suppliers across the world are supporting the development of aviation biofuels. These include the Commercial Alternative Aviation Fuel Initiative (CAAFI) in the United States, the Brazilian Alliance for Aviation Biofuels (ABRABA), the Aviation Initiative for Renewable Energy in

Germany, Bioqueroseno in Spain, Plan de Vuelo in Mexico, and the Australian Initiative for Sustainable Aviation Fuels.[27,28] Similar projects are under way in China, Indonesia, Italy, Israel, New Zealand, Qatar, Scandinavia, Romania, and the United Kingdom, among others.[29]

Original equipment manufacturers (OEMs) in partnership with airlines have been organizing and investing in road maps and case studies to evaluate feedstock options, technologies, commercialization requirements, logistics and infrastructure needs, and regional policy measures focused on market acceleration. These initiatives include:

- Australia's Flight Path to Sustainable Aviation Fuels, followed by a feasibility study prepared by Qantas Airways Ltd. in conjunction with the Shell Company of Australia and other partners, to examine Australian feedstock and production capacity to make sustainable aviation fuel[30]
- Midwest Aviation Sustainable Biofuels Initiative (MASBI) in the Midwest United States
- Sustainable Aviation Fuels Northwest (SAFN) in the northwestern United States
- Nordic Initiative for Sustainable Aviation
- Sustainable Aviation Biofuels Brazil
- Japanese Initiatives for New Generation Aviation Fuels
- Sustainable Aviation consortium in the U.K.
- BIOjet Abu Dhabi Flightpath to Sustainability in the United Arab Emirates

Nonprofit organizations are also an important part of the landscape. NRDC, the National Wildlife Federation, the World Wildlife Fund, the International Council on Clean Transportation, and many others are studying the sustainability, regulatory, and policy aspects of this challenge. Entrepreneurial NGOs like Environmental Entrepreneurs and the CWR are analyzing and informing the advanced biofuels market. CWR is developing innovative means of unlocking finance for the most promising, most sustainable aviation biofuels supply chain cmpanies.

FUEL STANDARDS

Generally speaking, around the world, national policy supports for transportation fuel are focused on ground transportation, putting the aviation industry at a considerable disadvantage. In fact, the Netherlands is the only E.U. member state that recognizes the use of aviation biofuels as counting toward E.U. renewable energy goals.

In the United States, the Renewable Fuel Standard (RFS2)

CASE STUDY: UNITED AIRLINES AND ALTAIR FUELS

In June 2013, United Airlines executed a definitive purchase agreement with AltAir Fuels for cost-competitive, sustainable, advanced biofuels at commercial scale, representing a historic milestone for aviation.

United, which has collaborated with AltAir Fuels since 2009, agreed to buy 15 million gallons of renewable fuel over a three-year period, with the option to purchase more. The airline is purchasing the advanced biofuel at a price competitive with traditional, petroleum-based jet fuel, and AltAir expects to begin delivering up to 5 million gallons of renewable fuel per year to the airline starting in the first half of 2015. United will use the biofuel on select flights operating out of its Los Angeles hub.

With United's strategic partnership, AltAir Fuels has retrofitted part of an existing petroleum refinery near Los Angeles to become an advanced biofuel refinery. The facility will convert nonedible natural oils and agricultural wastes into approximately 30 million gallons of advanced biofuels and chemicals per year. According to United, the jet fuel is expected to achieve at least a 50 percent reduction in greenhouse gas emissions on a life-cycle basis.

AltAir applied to the RSB for certification in May of this year.

was designed primarily for ground transportation fuels. However, while aviation biofuels are not subject to the volumetric quotas, aviation biofuel producers can now qualify for financial credits (using the RIN mechanism) in the U.S. marketplace that offer substantial incentives to ramp up production. In addition, the standard's requirement for advanced biofuels drives technology and economics in ways that benefit the growth of aviation biofuels. Of 36 billion gallons of biofuel required per year by 2022, 21 billion gallons must be in the advanced category, beyond first-generation corn ethanol. But the investment certainty that the RFS2 was meant to supply has been destabilized by political opposition to corn ethanol, undermining the policy for all biofuels under the program. Moreover, policy flaws and unforeseen changes in the fuel market have resulted in extreme RIN volatility that required volumetric adjustments.

In the hope of ensuring that biofuels deliver on their promise of sustainability, the United States, E.U., and other governments are instituting sustainability standards and life-cycle greenhouse gas reduction thresholds in their biofuel and carbon emissions policies (see "Biofuel Sustainability Polices and Regulations"). Many investors and biofuel developers are emphasizing sustainability and greenhouse gas reduction in their investment decisions. As discussed below, the E.U. Emissions Trading Scheme is a carbon cap-and-trade system that includes aviation as of 2012. Qualifying biofuels that are compliant with Renewable Energy Directive (RED) criteria will not have emissions allowance obligations. Discussions are ongoing regarding whether and how to differentiate among biofuels on the basis of their carbon intensity, and how the emissions allowance system can reflect these differences.

REFUELING OF COMMERCIAL AIRLINE

BIOFUEL SUSTAINABILITY POLICIES AND REGULATIONS

In the United States, the **Renewable Fuel Standard** (RFS2) mandates the use of biofuels—increasing from 9 billion gallons per year in 2008 to 36 billion gallons per year by 2022. It establishes Renewable Identification Numbers (RINs) that are assigned to each gallon of biofuel according to its technology/feedstock pathway and associated emissions reductions. It requires that eligible biofuels demonstrate threshold greenhouse gas reductions, and it offers several classes of qualified feedstocks and associated criteria such as land use change. While the RFS2 did not initially extend to jet fuel, it has driven considerable investment in second-generation biofuel, including aviation biofuel pathways.[31]

The European Union's **Renewable Energy Directive** (RED) establishes renewable energy mandates (20 percent of E.U. energy by 2020), including a renewable transport fuels target (10 percent of road and rail energy). A fuel's eligibility is contingent on criteria such as land use change and greenhouse gas reduction thresholds. The European Commission is considering a cap on food-crop-based biofuels as well as a voluntary advanced biofuels target and ILUC factor reporting. The directive recognizes several certification systems, including the Roundtable on Sustainable Biomaterials, whose certification qualifies a biofuel as RED-compliant. It does not explicitly recognize aviation biofuels as counting toward meeting the transport target, although they do count toward the overall renewables target.[32]

OTHER DRIVERS

For a number of years, the trend toward inclusion of aviation in government carbon tax and carbon emissions trading programs helped make biofuels the focus of alternative aviation fuel research. Aviation is now included in a carbon emissions trading program in New Zealand, in the European Union Emissions Trading System (EU ETS), and in a pilot emissions trading program in Shanghai. At the same time, a global carbon reduction framework and market-based measures are being pursued by the International Civil Aviation Organization with greater urgency than in years past.[33] The inclusion of airlines in these trading programs has been a significant driver of the airline industry's desire to develop biofuels. For example, the E.U. trading system counts biofuels as a zero-emission source, so any use of biofuels that meet E.U. RED sustainability criteria would count toward an airline's compliance obligation. However, because of significant pressure from China, India, and other countries as well as aviation industry groups, the EU ETS requirements were suspended for flights in 2012 to and from

non-European countries. For the period 2013–2016, the EU ETS has also been amended so that only emissions from flights within the European Economic Area fall under the EU ETS. Also, exemptions for operators with low emissions were introduced.[34]

In addition to emissions reductions, the rising cost and price volatility of jet fuel are increasingly motivating airlines to source and encourage the development of alternative fuels. Fuel costs represent severe economic challenges to their profitability and long-term viability. Between 2003 and 2013, fuel went from 14 percent of average airline operating expenses (at $28.8/barrel Brent crude oil) to 30 percent (at $108.8/barrel Brent crude oil).[35]

AVIATION BIOFUEL OBSTACLES

With the proliferation of regional initiatives and steady progress in technical certifications, it may look like smooth sailing for the aviation biofuels industry, but significant challenges remain.

Despite powerful drivers and significant targets for biofuel adoption, a number of economic, political, and market challenges lie ahead. Financing and scaling biofuel production are key challenges, and many airlines are economically constrained in their ability to support and invest in biofuel supplies. The political and regulatory landscape is also uncertain and often skewed toward ground transport. Securing sufficient supplies of sustainably produced feedstocks at competitive prices is also a critical challenge for advanced biofuel producers, who face competition from ground transportation (e.g., biodiesel) and other markets.

The transport fuel industry is enormously capital intensive. It is inherently difficult for new companies or those with unproven technologies to raise the amount and type of capital necessary to scale up. This has created a catch-22 situation that has been preventing the renewable jet fuels industry from achieving commercial scale: Producers can't obtain the financing they need to scale up their operations unless they can show that they have guaranteed buyers for their fuels. But airlines are reluctant to commit to purchasing large volumes of renewable fuels unless they are confident that the supply will be dependable and affordable and won't have negative environmental impacts. With fuel being the airlines' largest operating cost, they are highly sensitive to price, and therefore the high cost of early advanced fuels is a large obstacle.

As described earlier, a few airlines have signed off-take agreements with producers and several have invested in biofuel companies, but significant work remains to be done to address these overarching challenges.

AVIATION BIOFUEL SUSTAINABILITY CERTIFICATION: OUTLOOK AND CONCERNS

The aviation biofuel market continues to progress quickly and promises to advance biofuel developments in general. Hence, the sustainability of aviation biofuel production is of critical importance.

Until recently, the sustainability performance of fuel suppliers and major end users in the biofuel supply chain has been difficult and resource-intensive to determine. Only relatively small volumes of sustainable-certified biofuel are commercially available, and the markets are relatively immature. In many cases it can be difficult to delineate between those suppliers and end users that are focused on delivering and utilizing sustainable biofuels and those that are not. Also, few sustainability certification options have been available until recently, and operators have had to navigate differing regulatory and voluntary standards. It has been difficult to identify and compare the sustainability performance of biofuels sourced by major end-users on a company-by-company basis. However, with the introduction of biofuel and biomass sustainability standards over the past several years, we can now illuminate the relative performance of major biofuel suppliers and end-users using objective criteria and information.

The premier biofuel sustainability certification option is the Roundtable on Sustainable Biomaterials (RSB).[36] The RSB is an international, multi-stakeholder standards organization that has developed a feedstock- and technology-neutral global standard for biofuel sustainability, covering all aspects of the supply chain. Since the certification was launched in 2012, 14 companies around the world have been certified, and the number is steadily increasing. Other emerging multi-stakeholder (but feedstock-specific) international standards include Bonsucro, an international sugarcane supply chain sustainability standard; the Roundtable on Sustainable Palm Oil (RSPO); and the Roundtable on Responsible Soy (RTRS).[37],[38],[39] RSB and Bonsucro are currently the only two biofuels standards to achieve full membership in the ISEAL Alliance, an international organization that helps to ensure best practices in standards organizations and certification systems.

Airlines have generally engaged in standards development through participation in industry organizations working on this topic. SAFUG and CAAFI are the two primary such bodies. Through SAFUG there have been a number of important efforts to create regional road maps for aviation biofuel commercialization, and some collaborative organizations have been formed among airlines, local biofuel developers, policymakers, non-government organizations, and other stakeholders to study and promote regional development of aviation biofuels (for example, SAFN and MASBI). These have proved to be critical initiatives for communicating the importance of sustainability and connecting market participants across the supply chain.

PALM OIL FRUITS

SUGAR CANE

SOYBEAN PLANTS

Airlines address sustainability verification and certification in other ways as well, such as through the formation of independent sustainability advisory boards that evaluate the sustainability performance of the biofuels they source. However, while these methods can prove useful, this approach runs counter to important goals regarding transparency, harmonization, and clarity around sustainability evaluation, certification, and communication, and instead risks fragmentation and confusion. It is also resource and labor intensive.

Arguably the greatest difficulty in developing a responsible biofuel industry lies in identifying which technologies and supply chains truly deliver on biofuels' promise of

sustainability, and in directing incentives and investments to these while simultaneously discouraging the development of socially and environmentally detrimental fuel production systems.

Biofuels have tremendous potential to achieve the environmental, economic, and energy security goals upon which government support policies are predicated. They can convert waste streams into valuable resources and can integrate with existing, or provide new, economically viable agriculture in regions and communities with otherwise marginal or degraded lands.

However, the rush to develop first-generation biofuels has raised important questions about the long-term sustainability and environmental impacts of the biofuel industry. Concerns ranging from greenhouse gas emissions and land use change (such as destruction of native forests and grasslands for new crop growth) to impacts on critical habitat, biodiversity, labor rights, water consumption, and food security have understandably eroded government and public support. Of these, direct land use change and indirect land use change (ILUC) are perhaps the most important factors. Land use change impacts, and ILUC impacts in particular, are complex, requiring the best available science and land use planning to ensure they are accounted for adequately.

Fritsche, Hennenberg, and Hünecke (2010) found that the life-cycle emissions reduction impacts of biofuels can vary by more than 200 percent depending on assumptions regarding direct and indirect land use change.[40]

Despite this variability, ILUC factors are important to include in policy in a scientifically supportable way, and this variability should not delay their adoption. Some airlines, such as British Airways, are taking on this issue directly, focusing on those pathways that avoid or mitigate direct and indirect land use change and partnering with NGOs and others to research the use of waste products.[41]

The sustainability certification schemes launched in 2011 and 2012 are an attempt to clarify these issues for producers, downstream buyers, governments, and the public at large, whose confidence will be crucial to the success of the biofuel industry. Biofuel operators and investors are now keeping regulatory compliance, end-user requirements, and new market opportunities (e.g., aviation) in mind when making operational and certification decisions. Biofuel purchasers should be aware of these certification schemes and should make efforts to mitigate financial, regulatory, and reputational risks through the adoption of credible voluntary sustainability certification in their procurement activities.

NRDC'S AVIATION BIOFUELS SCORECARD

To assess the current state of aviation biofuel sustainability certification, and to support the use of certification in the aviation fuel supply chain, NRDC is publishing this report and Scorecard as part of an ongoing effort that began with our initial aviation biofuel sustainability survey in 2013, which formed the basis for continuing measurement, monitoring, and communication on this important topic.

This analysis focuses on airlines that have used, or are making public claims of plans to use, biofuels in their operations, and evaluates them in terms of their actions in using and promoting sustainably produced biofuels through their sourcing activities. In the initial aviation biofuels Survey in 2013, due to the very early stage of the aviation biofuels industry, we did not identify individual airlines by name. This year, we have decided to publish individual airline scores because there appears to be some significant progress on the part of some airlines, and we believe there is value in highlighting these leading companies as potential models to support positive momentum across the sector. In other words, this report is an effort to give credit to the companies that are leading and to encourage others to join them.

In this report we evaluate the airlines' use of leading sustainability certification standards (and in particular the RSB), participation in industry initiatives to promote sustainability certification, public commitments to sustainability certification in sourcing, and the monitoring and disclosure of important sustainability metrics.

In the current policy and financial context, it is companies and their partners that are the critical drivers of this emerging industry. In addition to the airlines surveyed and discussed in this report, the OEMs and new companies specifically formed to facilitate aviation biofuel market development, like SkyNRG, have also been driving progress. Whether and how the industry continues to develop will depend heavily on these early adopters and trendsetters.

We recognize that aviation biofuels development is happening in some geographical regions and not as quickly—or not at all—in others. We acknowledge that some airlines that are trying to lead on aviation biofuels face real geographical constraints in gaining access to these fuels in these early stages of the industry's development. In order to address this issue, some airlines in more remote regions have funded feasibility studies and made other efforts to lay the groundwork for future aviation biofuels production in the regions where they operate. Some organizations, like the Carbon War Room, are working on facilitating aviation biofuel deals such as a book-and-claim system through which airlines in remote regions could purchase, and get credit for helping to enable the production of, sustainable aviation biofuels in other parts of the world.

Airlines are large fuel buyers and potential strategic partners of biofuel companies. Their purchasing power could have a leveraged impact across the biofuel production landscape; these signals would reach far upstream and across multiple operators. Airlines that are engaging directly in the marketplace—through investments, partnerships, and other development activities—can have a direct role in the use of certification throughout the supply chains in which they are direct participants. Airline commitments to the use of sustainability certification are also critical for ensuring the ongoing viability and success of the certification systems themselves, which require broad adoption and recognition to be successful over the long term.

We plan to continue building on this Scorecard effort over time in order to:

- encourage the use of credible certification, and thus help ensure that the advanced biofuels industry develops sustainably,
- highlight positive industry and company performance, and
- identify areas for improvement.

This will include monitoring airlines against past claims and current performance, publishing a scorecard for each airline using biofuels, and ranking the relative performance of each airline with respect to its support and use of sustainability certification in their biofuel sourcing activities.

SCORECARD CONTENT

NRDC's Scorecard addresses five key areas of airline activity related to the use and development of sustainable-certified aviation biofuels:

1. **Airline membership in sustainability standards organizations or other groups working to promote sustainability certification in aviation biofuel development.** Four multi-stakeholder standards organizations—the RSB, Bonsucro, RTRS, and RSPO—are given special consideration. These organizations cover biofuels derived from all feedstocks, sugarcane, soy, and palm oil, respectively. Membership in SAFUG and CAAFI are also given consideration. These groups are working to support the development of aviation biofuels sustainability standards and risk mitigation recommendations. Notably, all SAFUG members, for example, have signed a pledge indicating support for the RSB and other standards engaged in the ISEAL best-practices approach.

2. **Airlines' public commitments to the use of sustainability certification in biofuel sourcing.** Because all airlines in the study have already used or have made public commitments to use aviation biofuels, the Scorecard rewards airline commitments to the use of certification. RSB certification is given the most weight, due to its ISEAL membership and the rigor of its standards, and also because it is most relevant to the aviation sector: It is global, covers all biofuel technologies and feedstocks, and is designed to benchmark to relevant national biofuel sustainability regulatory requirements. As a globally operating industry, the airlines should, we believe, harmonize around the RSB. Using a variety of standards could hinder rather than help this young industry; for instance, if different airlines favor different standards, producers would be burdened with the need to obtain multiple certifications to supply multiple airlines. The other internationally recognized multi-stakeholder initiatives are given secondary consideration. Other credible sustainability evaluation mechanisms being pursued by several airlines are assigned value as well, but ranked lowest among the three options for the reasons mentioned previously in this report

3. **Airline disclosures related to biofuel use, sustainable-certified biofuel use, and percentage of sustainable-certified biofuels used relative to total biofuel use.** Airlines are encouraged to disclose their use of biofuels and their use of sustainability certification. This is our most important metric for commitment to the use of certification, and accordingly this category is assigned more weight than all others in the Scorecard. It is important to mention here that commercial sourcing activity today has a higher impact in our evaluation than simple commitments to certification. This reflects our belief that airlines have a powerful opportunity to influence the development of the aviation biofuels industry via their procurement requirements. The requirement that biofuels be certified by a credible sustainability scheme is an easy way for airlines to have powerful positive impacts on the development of the nascent aviation biofuels industry.

4. **Airlines' monitoring and disclosures related to the life-cycle greenhouse gas emissions profile of the biofuels they source.** Airlines are encouraged both to monitor this information through credible means and to disclose it to the public.

5. **Airline actions to determine the indirect land use change impacts of the biofuels they source, and to engage in efforts to better understand, manage, and avoid ILUC impacts in biofuel production.** Airlines are encouraged to engage both internally and externally on this issue.

This year we added a question about how many staff members devote some or all of their time to aviation biofuels. Airlines' responses did not affect their scores; rather, we wanted to give Scorecard readers a sense of the very limited staff available within airlines to develop their biofuels strategies/programs.

SCORECARD METHODOLOGY

We evaluated airline performance on the basis of responses to questionnaires submitted to a list of airlines that had used biofuels, or made public commitments to use biofuels, as of December 2013. We consulted public data (including company websites, regulatory filings, and public statements) to confirm or question the responses, and where necessary, we contacted the airlines to seek clarification or correction. Still, while we were diligent in our efforts to verify responses, we cannot warrant that all data used to calculate scores were accurate.

The Survey is populated largely by verifiable data and publicly available information; however, the final evaluation is necessarily determined by unverified data provided by each company, such as total volume of biofuel use, and NRDC's assessment of a company's intentions and actions for sustainable biofuel.

The Scorecard was weighted toward transparency and actual implementation of commitments. In practice, for example, this means that public commitments to use sustainable biofuels received a higher score (2 for yes) than simply membership in an organization that is working on sustainability (1). Given RSB's superior rigor, higher scores were given to public commitments to RSB (2 for yes) than for commitments to other systems (1.5 for Bonsucro, RTRS, or RSPO) or "other credible mechanisms" (1). Likewise, implementation of these commitments (e.g., having a contract in place for future delivery of sustainable biofuels) and actual biofuel use—and especially use of sustainable-certified fuels, based on volume used—received higher scores as well. Disclosure is central to transparency and therefore received additional points.

As mentioned previously, Air France/KLM, Cathay Pacific, United Airlines, Virgin Atlantic, British Airways, and Alaska Airlines all have contracts or off-take agreements in place for renewable fuel to be delivered in the future. Since specific information regarding these particular deals was in the public domain, we decided to give these companies credit for the planned uptake of these fuels. We will include this question to all airlines in subsequent versions of the survey to ensure we are capturing a full picture of the natural progression from test/demo flights to forward purchasing.

Finally, higher points were awarded to companies that are actively monitoring and disclosing GHG emissions and ILUC impacts. Lesser points were awarded to those that have done so in the past or intend to do so in the future.

RESULTS

Thirty-two airlines were identified and surveyed in this effort.[42] Of these, 17 responded.[43] One airline declined to participate, one sent a case study but did not fill out the survey, and the remaining airlines were unresponsive. Only airlines that provided responses were scored. In the future, we will endeavor to evaluate and score, based on publicly available data, the performance of all airlines using or making commitments to use of biofuels.

NRDC's evaluation of airline performance is contained in Table 1. The airlines that responded to the survey appear across the top of the table. Performance is ranked from left to right (highest to lowest). The questions we posed to the individual airlines (see Appendix 1 for the questionnaire) appear in the first column, and the possible responses and their corresponding numerical scores appear in the second column. Final scores for each airline appear at the bottom of the table along with the total possible maximum score achievable (23).

The results of the survey clearly identify three distinct performance clusters: the top six performers with scores ranging from 13 to 20 (the "Top Flight" group); then a drop-off to a middle range of performance with scores from 6 to 8.5; and finally a lower cluster of scores ranging from 2 to 4.5. The top performers include Air France/KLM (which has clearly established a lead position in the category), British Airways, United Airlines, Virgin Atlantic, Cathay Pacific, and Alaska Airlines.

Below are the summary findings of the survey:

- Only one airline is a direct member of the RSB, though 16 of the 17 respondents are members of SAFUG, which is a member of the RSB and represents their interests.
- All but one of the respondents have committed to the RSB via their SAFUG membership and have not specifically committed to other regional or feedstock-specific standards such as Bonsucro, RTRS, or RSPO. A few airlines are relying on SkyNRG's sustainability standards while RSB certification ramps up.
- Two airlines disclosed the total volumes of biofuels used in 2013, four airlines disclosed that they used no biofuels in 2013, six airlines have disclosed volumes in the past or intend to in the future, and several have obligations under the Carbon Disclosure Project.[44]
- One airline reported that it used 100 percent sustainable biofuels (as a proportion of its total biofuel use) in 2013 and 2014. The other airline that disclosed biofuel use in 2013 did not source biofuels certified or verified as sustainable. These were the only survey respondents that used any biofuel at all in 2013. Two airlines reported that they monitor the life-cycle GHG emissions of their biofuels, and those airlines disclosed their numbers. Nine airlines have monitored biofuel GHG emissions in the past or intend to in the future, and eight airlines said they had disclosed them in the past or intend to in the future.
- Two companies reported that they assessed the potential ILUC risks associated with their biofuel supplies; two had in the past or said they would in the future, and five say they are actively engaged in researching and working to avoid ILUC in general.
- One airline has two full-time staff members focused on biofuels, and three airlines responded that they have one. All of the other airlines that responded to this question said they have one or several people who devote some time to this issue.
- The following airlines received our survey but did not respond:
  AeroMexico, Air China, American Airlines, Avianca Taca, Cargolux, Etihad (sent news articles about a demo flight but did not fill out the survey), FedEx, Gulf Air, LAN, Lufthansa, Qatar, SAS, Southwest, TAM, US Airways

Four key takeaways emerged from the analysis:

1. Only two of the airlines that responded to the survey used biofuels in 2013, but a number of respondents stated their intention to disclose volumes and sustainability certification once they do get access to aviation biofuels.
2. Only two airlines have made contractual commitments to use RSB certification in their sourcing efforts. This has not changed from last year, although more airlines have joined SAFUG, which requires a commitment to support the RSB.
3. The two respondents that sourced biofuels in 2013 were KLM and GOL. KLM's fuel, procured by the broker SkyNRG, was not fully certified but was verified by an independent sustainability advisory board as RSB-compliant. GOL used about 790 kilograms of biofuel, which was not verified or certified as sustainable.
4. Less than half of respondents said they were researching or monitoring the life-cycle greenhouse gas emissions of biofuels and ILUC; last year a majority of respondents were doing so.

TABLE 1 SUSTAINABLE AVIATION SCORECARD

		POSSIBLE SCORE:	Air France - KLM	British Airways	United Airlines	Virgin Atlantic	Cathay Pacific	Alaska Airlines	Virgin Australia	Air New Zealand	GOL	Qantas	TUI Travel	ANA	Japan Airlines	Jet Blue	Singapore	South African Airways	Finnair
1. MEMBERSHIP IN LEADING SUSTAINABILITY INITIATIVES																			
1.1 Is the company a member of the RSB, Bonsucro, RTRS or RSPO?	Yes/No	1 for yes 0 for no	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1.2 Is the company member of SAFUG, CAAFI?	Yes/No	1 for yes 0 for no	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
2. COMMITMENT TO SUSTAINABLE BIOFUELS: (1,2)																			
2.1 Does the company have a public commitment to 100% RSB certified biofuels?	Yes/No	2 if yes 1.5 if vague commitment 0 if no target	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
2.2 Does the company have a public commitment to 100% certified biofuels under Bonsucro, RTRS or RSPO?	Yes/No	1.5 if yes 1 if vague commitment 0 if no target	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2.3 Does the company have a public commitment to 100% sustainable biofuels using other credible mechanisms?	Yes/No	1 if yes 0.5 if vague commitment 0 if no target	N/A*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2.4 Does the company have a contract in place for future delivery of sustainable biofuels.	Yes/No	0 if no; 6 if yes	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0
3. VOLUME DATA																			
3.1 Does the company disclose the total volume of the biofuels it uses in a year?(3)	Yes	1 if yes 0.5 if they have in the past or intend to in the future 0 if no	0.5	0.5	1	1	0.5	1	1	1	1	0.5	0.5	0	0	0	0	0	0.5
3.2 Does the company disclose how much sustainable biofuels it uses in a year?	Yes	1 if does 0.5 if they have in the past or intend to in the future 0 if does not	0.5	0.5	1	1	0.5	1	1	0	1	0.5	0	0	0	0	0	0	0.5
3. How much sustainable biofuels has the company used in the last year as a proportion of its total use of biofuels?	Data	6 for 75-100% 4 for 25-75% 2 for >0-25% 0 for no use Add 1 extra point if RSB is used	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. GHG																			
4.1 Does the company monitor the full life-cycle GHG performance of its biofuels?	Yes/No	1 if yes 0.5 if they have in the past or intend to in the future 0 if no	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0	0	0	0	0	0.5
4.2 Does the company disclose the full life-cycle GHG performance of its biofuels?	Yes/No	1 if yes 0.5 if they have in the past or intend to in the future 0 if no	1	0.5	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0	0	0	0	0	0	0.5
5. ILUC																			
5.1 Has the company assessed the ILUC impacts of its biofuels use?	Yes/No	1 if yes 0.5 if they have in the past or intend to in the future 0 if no	0	1	0	1	0.5	0	0.5	0	0	0	0	0	0	0	0	0	0
5.2 Is the company actively engaged developing measures/ avoiding/researching ILUC?	Yes/No	1 if yes 0 if no	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0
		TOTAL SCORE:	**20**	**14**	**14**	**14**	**13.5**	**13**	**8.5**	**7.5**	**7**	**6**	**4.5**	**4**	**4**	**4**	**4**	**4**	**2**
		OUT OF POSSIBLE:	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**

(1) Members of the Sustainable Aviation Group (SAFUG) were awarded 2 points in Section 2.1 for their public commitment to RSB. SAFUG members have pledged to advance the development, certification, and commercial use of drop-in sustainable aviation fuels through verifiable means that are consistent with internationally-recognized sustainability standards such as those developed by the Roundtable on Sustainable Biomaterials (RSB). (2) Scores for Section 2.1-2.3 are not additive. The highest, single score is assigned in a case where multiple standards are used. NRDC recognizes the RSB as the premier global standard (maximum of 2 points). (3) Scores awarded even if disclosure indicated zero use.

*KLM and Air France AF and KL are investigating sustainability risks using advice of an independent Sustainability Board with SkyNRG however, since points are not additive and they have made a commitment to RSB they were assigned the maximum 2 points for that commitment.

CONCLUSIONS AND RECOMMENDATIONS

The aviation biofuel industry is only just emerging. Despite facing enormous challenges and competition from the petroleum industry, which has more than a century of profits and momentum driving it, the pace of activity toward commercialization of aviation biofuel is accelerating. The aviation industry now has the benefit of experience, having witnessed the powerful backlash to the first generation of biofuels due to competition for agricultural land and commodity feedstocks. The controversial debates over "food versus fuel" and the impacts of direct and indirect land use change appear to have made aviation stakeholders much more sensitive to the fact that biofuels can be beneficial or destructive, depending on how they are produced.

The first deals and transactions have largely been pursued in conjunction with SkyNRG's sustainability review and/or with waste feedstock: for instance, Cathay Pacific has a deal with Fulcrum, which plans to use municipal solid waste; the same is true of Solena in a deal with British Airways. Virgin Atlantic and LanzaTech plan to use steel mill emissions, and United Airlines and AltAir will use beef tallow. The small batches procured by SkyNRG have been derived mostly from waste oils. There are also a plethora of sustainable aviation biofuel initiatives around the world. Yet the aviation industry's interest in sustainability will be undermined if the airlines fail, in the procurement process, to require that biofuels be produced via credible, rigorous sustainability schemes. If airlines do not require sustainability certification, they could lose an historic opportunity that is now within their grasp to help launch a new, truly sustainable transportation fuel industry.

Another consideration is that technical certification via ASTM of alternative jet fuel production pathways is required before airlines can use these new fuels. As more production pathways are certified, the choices for airlines will multiply and potential feedstock options will expand.

While the aviation sector has made some important progress to implement its sustainability commitments over the past year, our findings this year indicate that there is enormous opportunity to do more, particularly now that credible sustainability standards, such as the RSB, are fully operational in the marketplace. Therefore, our recommendations from last year are still quite relevant and worth repeating:

1. **It is important that airlines send clear market signals now,** notifying current or potential suppliers of the importance of sustainability certification. Projects are now being designed, funded, and developed with aviation as a target end-user, and these projects should address sustainability certification from the start. Failure to engage today and send clear signals risks exposure for all parties in the future once these supplies begin to scale.

2. Airlines that are using biofuels should **make a public commitment to source 100 percent certified-sustainable biofuel.** This would build on the industry's positive work to date in studying and using sustainable biofuels.

3. A robust requirement around certification is a necessary next step. The RSB certification standard is global, robust, and appropriate for aviation biofuels, and **we recommend the principal use of RSB certification in aviation biofuel sourcing**.

4. **SAFUG and its member airlines should make a firm commitment to the use of the RSB.** SAFUG members have played a critical leadership role—and sent a positive market signal—by indicating their early support for the RSB. Their initial efforts have raised awareness and appear to be gaining traction in the marketplace. At the same time, the number of RSB certifications is growing and the scheme has secured important government recognition.[45] It is important for SAFUG members to

aggressively implement their commitment to use RSB sustainability certification for their procurement of biofuels if they are to increase momentum, prompt real market development, solidify their leadership position, and reap the benefits of their early commitments.

5. **Airlines should aim for total transparency in disclosing biofuel volume, greenhouse gas profile, and sustainable certification used in sourcing.** We were discouraged by the failure or refusal of some airlines to respond to our survey questionnaire. Transparency serves the dual purpose of building confidence among important stakeholders and sending a clear and consistent message to potential suppliers in the marketplace who are watching to see if airlines are fully committed to sourcing certified biofuels.

6. **Airlines that do not already have dedicated biofuels staff should hire specialists to focus on this new and advanced fuel industry.** It takes a significant investment of time to understand the complexities of the biofuels landscape, keep up to date, and engage with the essential sustainability assurance schemes. This is challenging to staff members who can devote only a portion of their time to these tasks. In order to engage effectively, airlines that want to be leaders in the transition to aviation biofuels need to have staffers who are experts in these issues.

The Scorecard reveals that the aviation sector has made progress in implementing its biofuel sustainability commitments over the past year. In addition, it is clear that a handful of airlines are emerging as leaders and becoming models for their sector. The emergence of sustainability standards, and in particular RSB certification, provides these companies with the tools to ensure that their environmental objectives result in positive outcomes and do not inadvertently result in new or greater negative impacts on the environment. While the aviation sector is poised to take actions that could reduce its carbon emissions and protect our land, water, air, and communities, making sure these positive outcomes materialize requires that the airlines adopt credible and independent sustainability certification for 100 percent of their biofuel sources. Airlines need to act now on this opportunity to help launch a new, truly sustainable transportation fuel industry.

APPENDIX A: AIRLINE QUESTIONNAIRE

Please fill out the questionnaire below completely and accurately. We request that you return this questionnaire by January 17, 2014, to hchin@nrdc.org.

MEMBERSHIP

1. Is the airline a member of any of the following: Roundtable on Sustainable Biomaterials, Bonsucro, Roundtable on Responsible Soy, or Roundtable on Sustainable Palm Oil? ❑ YES ❑ NO
2. Is the airline a member of the Sustainable Aviation Fuel Users Group? ❑ YES ❑ NO
3. Is the airline a member of the Commercial Alternative Aviation Fuel Initiative? ❑ YES ❑ NO
4. Is the airline a member of any other consortia or organizations working to support alternative fuel development or sustainability certification? ❑ YES ❑ NO
   If so, please specify.

_____

_____

_____

PUBLIC COMMITMENTS

1. Has the airline made commitments to use sustainable-certified biofuels? ❑ YES ❑ NO
   By when?_____
2. Using which certification systems, or other sustainability verification mechanisms?

_____

3. If other, please explain in detail.

_____

_____

What percentage of the airline's biofuel use has it publicly committed to be sustainably sourced? _____%

BIOFUEL VOLUMES

1. Does the airline publicly disclose the total volume of biofuels it uses in a year? ❑ YES ❑ NO
2. In what format(s) or media are these figures disclosed?

_____

3. Does the airline publicly disclose whether, and using what certifications/other mechanisms, the biofuels it sources are sustainable? ❑ YES ❑ NO
4. In what format(s) or media are these figures disclosed?

_____

5. How much biofuel was sourced by the airline in the last year, and how much of that biofuel was verified sustainable according to the above certifications/verification mechanisms? _____
6. Please describe any additional information and/or projects your airline is currently working on related to your efforts to identify and implement aviation biofuels.

_____

_____

_____

_____

GREENHOUSE GAS ASSESSMENTS

1. Does the airline monitor the full life-cycle greenhouse gas emissions of its biofuels? ❑ YES ❑ NO
2. How are these measured, or what procedures are used to validate a third-party measurement?

_____

3. Are these figures disclosed publicly? ❑ YES ❑ NO
   In what format(s) or media are the figures disclosed?

_____

LAND USE

1. Has the airline assessed the potential indirect land use change impacts of its biofuel use? ❑ YES ❑ NO
   If yes, how so?

_____

2. Is the airline developing measures to evaluate and avoid indirect land use change? ❑ YES ❑ NO
   If yes, please describe these measures.

_____

AIRLINE STAFF DEDICATED TO AVIATION BIOFUELS

1. How many of the airline's staff devote some of their time to aviation biofuels? _____
2. How many of the airline's staff, if any, devote all of their time to aviation biofuels?_____

ADDITIONAL CONSIDERATIONS

1. Are there any additional issues that you would like to highlight, or information that you would like to share, related to aviation biofuels?

_____

_____

_____

_____

_____

_____

GLOSSARY

ATAG: The Air Transport Action Group is an international trade association representing the global air transport supply chain (www.atag.org).

ASTM International: This group, formerly known as the American Society for Testing and Materials, develops international voluntary consensus standards. ASTM's diverse members deliver test methods, specifications, guides, and practices that support industries and governments worldwide (www.astm.org).

ATJ-SPK: Alcohol-to-jet-fuel synthetic paraffinic kerosene is made via alcohol oligomerization, which involves linking short-chain alcohol molecules (e.g., ethanol or butanol) together to form jet-fuel-range hydrocarbons. There are several chemistries that can be employed to oligomerize alcohols. In each of these processes, water and/or oxygen are removed from the alcohol molecules, and hydrogen is added. The starting alcohol volume is reduced during the conversion to hydrocarbon jet fuel (that is, it takes approximately two gallons of ethanol to make one gallon of renewable jet fuel).

Bonsucro: This is a global, multi-stakeholder, voluntary sustainability certification scheme for sugarcane. It was born out of the Better Sugar Initiative in 2008 and started certifying sugar producers in 2011 (bonsucro.com/site/).

CAAFI: The Commercial Aviation Alternative Fuel Initiative is a coalition, with funding for one full-time director from the United States FAA, working with commercial airlines to advance the emerging alternative fuels industry. It is most notable for its work to accelerate the testing and technical certification of new types of renewable jet fuels (www.caafi.org).

Drop-in Fuel: Renewable fuels which can be blended with petroleum products, such as gasoline, and utilized in the current infrastructure of pumps, pipelines and other existing equipment.

EU ETS: The European Union Emissions Trading Scheme is a significant element of the European Union's policy-based effort to curb and reduce industrial greenhouse gas emissions (ec.europa.eu/clima/policies/ets/index_en.htm).

FT-SPK: Fischer-Tröpsch synthetic paraffinic kerosene is a type of jet fuel made by gasifying biomass using heat and controlled amounts of oxygen and steam and then using the FT process to turn the vapors (called synthetic gas, or syngas, and consisting of carbon monoxide and hydrogen) into liquid fuels. The process is most often used to create FT diesel, a fuel for compression-ignition engines, but is also used to make FT kerosene for jets.

HEFA: Hydroprocessed esters and fatty acids, sometimes also called HRJ (hydroprocessed renewable jet), are produced by "refining" natural oils (e.g., vegetable oils and animal fats) much like petroleum is refined today.

HDCJ: Hydrotreated depolymerized cellulosic jet is produced by subjecting biomass (typically lignocellulosic biomass) to high temperatures and pressures in the absence of oxygen. This allows for the depolymerization of biomass without combustion and produces liquids (pyrolysis oil), solids (biochar), and gases.

IATA: The International Air Transport Association is a global trade group comprising approximately 240 airline members, as well as manufacturers, air traffic controllers, and airports. IATA supports industry-wide fuel efficiency targets of 1.5 percent improvement per year through 2020 (www.iata.org).

ICAO: The International Civil Aviation Organization (ICAO) is a specialized agency of the United Nations, created in 1944 to promote the safe development of international civil aviation. The Kyoto Protocol calls for aviation emissions to be limited and reduced via ICAO (www.icao.int).

ILUC: Indirect land use change, as described in an IUCN report, refers to the displacement of an existing land use practice with another. This can occur on a spectrum from local to global. Many human activities have the potential to cause ILUC, particularly the conversion of natural lands (e.g., forests) for agricultural use; this can result in massive GHG emissions, habitat destruction, potential biodiversity loss, and other negative impacts. For biofuels that use feedstocks from the land base (as opposed to waste feedstocks), this is an important concern.

ISEAL Alliance: This global association works with established and emerging sustainability standards and certification efforts, providing guidance and delivering programs designed to mitigate social and environmental impacts. Its Codes of Good Practice are global references for developing standards, and following them is seen by some certification professionals as essential to demonstrate credibility (www.isealalliance.org).

OEM: Original equipment manufacturer, a company that originally produced a product or good. OEMs in the aviation industry include airplane and engine manufacturers.

Renewable Diesel: This is defined as a substitute for conventional diesel fuel, produced from nonpetroleum renewable resources.

RFS: The Renewable Fuel Standard program, created under the Energy Policy Act (EPAct) of 2005, established the first renewable fuel volume mandate in the United States. As required under EPAct, the original RFS program (RFS1) required 7.5 billion gallons of renewable fuel to be blended into gasoline by 2012. Under the Energy Independence and Security Act (EISA) of 2007, the RFS program was expanded (RFS2) to include diesel, increase the volume of renewable fuel required to be blended into transportation fuel from 9 billion gallons in 2008 to 36 billion gallons by 2022, establish new categories of renewable fuel and set separate volume requirements for each, and apply life cycle greenhouse gas performance threshold standards to ensure that each category emits less greenhouse gas than the petroleum it replaces.

RIN: A renewable identification number is a 38-character number assigned to each physical gallon of renewable fuel produced or imported for the purpose of tracking its production, use, and trading as required by the U.S. Environmental Protection Agency's Renewable Fuel Standard (RFS) for obtaining financial credits .

RSB: The Roundtable on Sustainable Biomaterials is the principal international multi-stakeholder initiative to define sustainable biofuels and develop a voluntary, third-party certification scheme (http://rsb.org/).

RSPO: The Roundtable on Sustainable Palm Oil is a global, multi-stakeholder voluntary sustainability certification scheme for palm oil and its derivatives. It was founded in 2004 and began certifying in 2008 (www.rspo.org/).

RTRS: The Roundtable on Responsible Soy is a global, multi-stakeholder voluntary sustainability certification scheme for soy and its derivatives. The RTRS Association was created in 2006 and certification began in 2011 (www.responsiblesoy.org).

SAFUG: The Sustainable Aviation Fuel Users Group is an alliance of 27 airlines that (with the participation of OEMs) represent approximately 32 percent of global jet fuel demand. The members pledge to procure only sustainable renewable jet fuels. SAFUG's mission is to accelerate the development and commercialization of sustainable aviation biofuels (www.safug.org).

ENDNOTES

1 Email correspondence from Barbara Bramble, RSB Board chairwoman, June 14, 2014. Swiss Airlines is a member of the RSB. However, because the airline has not made any public announcements about their intent to use biofuels, it was not included in this survey.

2 The International Air Transport Association (IATA) and the two big aircraft manufacturers (Airbus and Boeing) are also members of RSB.

3 Air Transport Action Group, "Facts and Figures," www.atag.org/facts-and-figures.html (accessed November 21, 2014).

4 Air Transport Action Group. *Green Flight Times* #5, January–May 2011, www.atag.org/our-publications/archived-publications.html (accessed November 21, 2014). This URL leads to downloadable Edition #4, not #5. Please reconcile.

5 ASTM was created in the U.S. in the late 1800s. It is now the primary international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services. Is this endnote necessary, given the ASTM listing in the Glossary?

6 ASTM International, http://www.astm.org/Standards/D4054.htm (accessed November 2014). Incomplete citation; need publication title, author (if given) and date (if given).

7 www.caafi.org/information/pdf/Path_to_Aviation_Alternative_Fuel_Readiness_May_2013.pdf. Incomplete citation

8 Sustainable Aviation Fuel Users Group (SAFUG), www.safug.org/safug-pledge/(accessed June 16, 2014). Incomplete citation

9 SAFUG is an alliance of 28 airlines that (with the participation of OEMs) represent approximately 32% of global jet fuel demand. The members seek to lower the carbon intensity of their fuels overall by supporting the development, certification, and commercial use of lower carbon renewable fuels, derived from environmentally and socially sustainable sources. Airline members have pledged to advance the development, certification, and commercial use of drop-in sustainable aviation fuels through verifiable means that are consistent with internationally-recognized sustainability standards such as those developed by the Roundtable on Sustainable Biomaterials (RSB)**.** This note largely repeats the information in the text. Is it really needed?

10 The Carbon War Room is a global nonprofit, founded by Sir Richard Branson and a team of like-minded entrepreneurs, that aims to accelerate the adoption of business solutions that reduce carbon emissions at gigaton scale and advance the low-carbon economy. See www.carbonwarroom.com.

11 Navigant Research., "Biofuels' Share of the Aviation and Marine Fuel Market Will Surpass 6 Percent in the United States by 2024," press release, July 15, 2014.

12 BBC News, "Airline in First Biofuel Flight," last updated February 24, 2008, news.bbc.co.uk/2/hi/uk/7261214.stm.

13 International Air Transport Association (IATA), "Fact Sheet: Alternative Fuels," www.iata.org/pressroom/facts_figures/fact_sheets/pages/alt-fuels.aspx (accessed June 17, 2014).

14 The airlines involved are KLM, Lufthansa, Finnair, Interjet, Aeroméxico, Iberia, Thomson Airways, Air France, United Airlines, Air China, Alaska Airlines, Thai Airways, LAN, Qantas, Jetstar, Etihad, Porter, Gol and Air Canada.

15 IATA. "Fact Sheet: Alternative Fuels."

16 www.ara.com/fuels/ARA-Fuels-News.html (accessed November 18, 2014). Incomplete citation. The first 100 percent biofueled flight was made in 2012 with fuel produced by a company called ARA. ARA used a process it calls catalytic hydrothermolysis coupled with hydroprocessing, which results in an aviation biofuel that includes aromatics and other compounds that should enable it to be used without blending with conventional jet fuel. According to ARA, the U.S. Department of Defense is currently testing ARA's jet fuel unblended and may create a military specification for it.

17 Cathay Pacific," Cathay Pacific Invests in Sustainable Biojet Fuel Developer,"press release, August 7, 2014, www.cathaypacific.com/cx/en_HK/about-us/press-room/press-release/2014/Cathay-Pacific-invests-in-sustainable-biojet-fuel-developer.html A(accessed August 31, 2014).

18 SkyNRG, skynrg.com/our-services/bioport-development/ (accessed June 17, 2014). Incomplete citation
SkyNRG, a company that spun out of KLM, is "teaming up with airlines and airports around the world to create the structure and the market pull that will enable regional sustainable jet fuel supply chains to get financed and built." It calls these regional supply chains "BioPorts." SkyNRG http://skynrg.com/our-services/bioport-development/ Accessed June 17, 2014.

19 "U.S. Air Force Energy Strategic Plan," presented to the Interagency Working Group for Alternative Fuels June 19, 2013, by Megan McCluer, Office of the Deputy Assistant Secretary for Energy. See www.safie.hq.af.mil/energy/strategy.

20 Email correspondence from Britt Boughy, U.S. Navy, June 16, 2014. The process will begin in 2015, when the Navy, through its partnership with the U.S. Department of Agriculture (USDA), plans to acquire at least 37 million gallons of neat biofuels at cost-competitive rates blended at 10% to 50% as part of its Inland/East/Gulf Coast bulk fuel solicitations for JP-5 jet fuel and F-76 marine diesel fuel. USDA Commodity Credit Corporation (CCC) funds can be used to defray premiums associated with feedstock costs.

21 Environmental Entrepreneurs, "The Economic Benefits of Military Biofuel Programs," www.e2.org/ext/doc/E2MilitaryBiofuelSynopsis.pdf.

22 This program is the Defense Production Act Title III Advanced Drop-in Biofuels Production Project.

23 Email correspondence from Britt Boughy, U.S. Navy, June 16, 2014. At the time of publication, we were told that Phase 1 front-end engineering and design had been completed by four companies. One or more of them will be selected to move into Phase 2, construction and commissioning, by the end of summer 2014. Phase 1 preliminary results indicated the potential to produce m 160 million gallons of drop-in jet or diesel fuel at a weighted average price below $3.50/gal.

24 America's Navy, "Departments of the Navy, Energy and Agriculture Invest in Construction of Three Biorefineries to Produce Drop-In Biofuel for Military," September 19, 2014, www.navy.mil/submit/display.asp?story_id=83417.

25 European Commission, "Launch of the European Advanced Biofuels Flightpath," ec.europa.eu/energy/renewables/biofuels/flight_path_en.htm (accessed November 21, 2014).

26 United States Aviation Greenhouse Gas Emissions Reduction Plan Submitted to the International Civil Aviation Organization, June 2012, www.faa.gov/search/?omni=MainSearch&q=+United+States+Aviation+Greenhouse+Gas+Emissions+Reduction+Plan. Accessed November 21, 2014. Citation is incomplete, and URL leads not to article but to search results.

27 IATA, "Fact Sheet: Alternative Fuels." The Aviation Initiative for Renewable Energy in Germany has set a target of 10% of alternative aviation fuel for 2025. IATA, Fact Sheet: Alternative Fuels.

28 http://aisaf.org.au/. Incomplete citation. In August 2014, the Australian Initiative for Sustainable Aviation Fuels reverted to being an initiative of the Sustainability Program at the United States Studies Centre.

29 Ibid. Indonesia passed a law mandating aviation biofuels at 2% commencing in 2016, rising to 5% by 2025.

30 Qantas Airways, "A Feasibility Study of Australian Feedstock and Production Capacity to Produce Sustainable Aviation Fuel," public report, June 2013, www.qantas.com.au/infodetail/about/environment/aviation-biofuel-report.pdf.

31 U.S. Environmental Protection Agency, "Renewable Fuel Standard (RFS)," www.epa.gov/otaq/fuels/renewablefuels/.

32 European Commission, "Renewable Energy," ec.europa.eu/energy/renewables/index_en.htm.

33 See: International Civil Aviation Organization, 38th Assembly, Resolution A38-18.

34 European Commission, "Reducing Emissions from Aviation," ec.europa.eu/clima/policies/transport/aviation/index_en.htm (accessed June 27, 2014).

35 ATA, "Fact Sheet: Fuel," updated June 2014, incorporating IATA Economics, "Industry Financial Forecast Table," www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fuel-fact-sheet.pdf.

36 http://rsb.org/ Notes 37-40 are incomplete.

37 http://www.bonsucro.com/

38 http://www.rspo.org/

39 http://www.responsiblesoy.org/

40 Fritsche, U., K. Hennenberg, and K. Hünecke (2010), *The "iLUC Factor" as a Means to Hedge Risks of GHG Emissions from Indirect Land Use Change.* Öko Institute, Darmstadt, Germany.

41 "Wasted: Europe's Untapped Resource, An Assessment of Advanced Biofuels from Wastes and Residues," europeanclimate.org/wp-content/uploads/2014/02/WASTED-final.pdf (accessed September 26, 2014).

42 US Airways and American Airlines were going through a merger at the time this report was written and were therefore counted as one airline. KLM and Air France responded jointly and were counted as one airline.

43 Etihad Airways provided articles and a case study but did not fill out the survey.

44 Several airlines have disclosure obligations under the Carbon Disclosure Project, and other initiatives in which they have credibly committed to disclosing details of their biofuel sourcing.

45 The RSB is recognized by the EU under the Renewable Energy Directive, and by New South Wales, Australia.

Natural Resources Defense Council
40 West 20th Street
New York, NY 10011
212 727-2700
Fax 212 727-1773

Beijing

Chicago

Los Angeles

Livingston

San Francisco

Washington

www.nrdc.org