IATA Sustainable Alternative Fuel—Advocacy

1st Edition

NOTICE

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Table of Contents


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Section 1—Motivation for Creating a Sustainable Alternative Fuel (SAF) Communication Strategy

Aviation plays an essential role in the economy of today. In 2015 the world's airlines will carry over three billion passengers and 50 million tonnes of freight. Providing these services generates 8.7 million direct jobs within the air transport industry and contributes over $600 billion to global GDP. In fact, if air transport were a country, its GDP would rank it 21st in the world. Further, the role of aviation in society has been increasing. In 2014 the world celebrated 100 years of commercial aviation where around 65 billion trips have been made. It is forecast that it will take just 15 years for the next 65 billion trips to be made. However, one less desirable outcome of producing these economic and social benefits is the associated environmental footprint. For aviation to continue to provide and grow these considerable economic and social benefits it must transition to environmentally sustainable growth.

Air transport accounts for around 2% of global man-man CO_2 emissions. While far lower than the road sector, it has not deterred aviation from actively seeking solutions to minimize its environmental impact. In recent years commercial aviation has developed the technical ability to use liquid fuel not derived from fossil oil, a fuel that can be produced sustainably.

Despite the technical feasibility, deployment has largely been limited to demonstration or research flights, or flights specifically sponsored by environmentally conscious corporates. Communication is needed to improve understanding and engagement of necessary stakeholders. Governments have an important role to play. Without effective policy settings, the deployment of commercial sustainable aviation fuel will not achieve its potential.

This communications document is designed to support the deployment and development of alternative fuels that offer equivalent levels of safety and performance and compare favorably on cost with petroleum based jet fuel, and that offer environmental improvement and security of energy supply for aviation. Further, it outlines some key considerations for policy makers.

1.1 Essential Facts

1.1.1 Introduction

Demand for aviation services will grow further. In fact, this is forecast to grow at around 5% per annum largely thanks to the expanding middle class from developing economies. Aviation’s license to grow further, however, will be dependent on the ability to do so sustainably. Sustainable alternative fuels will play a large role in this. While technically feasible, there exists a number of challenges and impediments to the large scale deployment of biojet fuel in the aviation sector. A joint effort is needed by all stakeholders, including consumers, corporations and governments to guarantee the successful deployment of alternative aviation fuel. In addition, these measures will help reduce dependence from fossil energy.

1.1.2 Alternative Fuels

Alternative fuel and biofuel are at times confused terms. The common perception many have is ‘road transport biofuels’, in particular ethanol and biodiesel. However, sustainable alternative fuels are different and even more technically sophisticated. “First generation” biofuels are used largely in the road transport sector. These are generally produced from oils or fats using transesterification. Chemically it consists mostly of fatty acid methyl esters (FAME). These feedstocks can be used as food for humans and animals, raising important questions about their sustainability. In response to these concerns, the aviation industry has been focusing from the beginning on the use of advanced-generation biofuel sources that are truly sustainable. This attitude is found throughout the different stakeholders in aviation, contrary to the situation in the road transport sector.

1.1.3 Aviation and SAF

Several pathways are being considered for the development of sustainable alternative fuel (“biojet fuel”).

The industry is unlikely to rely on a single feedstock, or source of the fuel. Some feedstocks are better suited to some climates and locations than others. Therefore, it is expected that ultimately there will be a portfolio of various SAF sources developed and a variety of regional supply chains to meet the demand of global aviation. Sustainability criteria are of high importance to the aviation sector. Many airlines require SAF to pass globally recognized sustainability standards such as those from the Round Table on Sustainable Biomaterials (RSB) or the International Sustainability and Carbon Certification (ISCC). For the certification of a sustainable biofuel under RSB it is verified that the fuel product, mainly focusing on the biomass feedstock, has met criteria focused around long-term global environmental, social and economic (triple bottom line) sustainability considerations.

1.1.4 Definition of Drop-In Alternative Fuel

A drop-in alternative fuel is one that is completely interchangeable and compatible (can be mixed over a range of percentages) with a particular conventional (typically petroleum-derived) fuel. A perfect drop-in fuel does not require adaptation of the fuel distribution network or the vehicle or equipment engine fuel systems, and can be used "as is" in vehicles and engines that currently operate on that particular fuel. Some alternative fuels may become "drop-in" only after blending with conventional fuel to a certain prescribed proportion.[1]

In the case of SAF, fit for use product must meet the technical standard of the global standards body ASTM International[2]. ASTM has established a standard (D7566) for the manufacture of aviation turbine fuel that consists of conventional and synthetic blending components. This standard is complementary to the existing ASTM standard D1655 for regular fossil derived jet kerosene. At a technical level, alternative Aviation turbine fuel manufactured, certified and released to all the requirements of standard specification D7566, meets the requirements of Specification D7566 and shall be regarded as Specification D1655 turbine fuel. Put simply, this means that a jet fuel derived from non-fossil feedstock that meets the D7566 certification is, on technical fit-for-use grounds, 100% equivalent to fossil derived kerosene. This is an important distinction from ethanol and biodiesel used in the road transport sector.

This certification pathway is necessary to guarantee meeting the high safety requirements of aviation. Prospective producers need to satisfy this process before commercially selling sustainable aviation fuel. The majority of sustainable aviation fuel certification efforts to date have been funded by the United States Federal Aviation Authority. Greater global coordination, including support from government would be a proactive development in expanding biojet fuel production.

[1] *Bret Strogen - United States Department of Defense*

[2] American Society for Testing and Materials

1.1.5 Considerations for SAF Suppliers

Aviation fuel buyers are a concentrated, coordinated group of purchasers who may be willing to enter under the right conditions, into long-term off-take agreements and offer a stable customer base for producers. In 2014 it is estimated the aviation industry with spent approximately $210 billion on kerosene generating nearly $24 billion in upstream profits.

Many airlines will only accept SAF accompanied by a greenhouse gas (GHG) Life Cycle Analysis (LCA) performed in accordance with recognized guidance that shows reduction in greenhouse gases over standard petroleum (with other aspects of sustainability also being beneficial). 28 airlines are members of the Sustainable Aviation Fuel Users Group (SAFUG) and represent 33% of global aviation fuel demand. This group has committed to only using sustainable aviation biofuel.[3]

[3] http://www.safug.org/

Section 2—Why are Airlines Interested in Commercial-Scale Alternative Jet Fuel Production?

The development of SAF could provide a very large part of the industry's emissions-reduction strategy. Research has shown that, on a full carbon lifecycle basis, using the equivalent quantity of low-carbon alternative fuels could reduce CO_2 emissions by around 80% compared to the jet fuel they replace.

Since the first biofuel flight in a commercial aircraft took place in 2008, there has been a huge amount of work by the aviation industry. Certification through the global fuel standards agency ASTM has allowed airlines to operate using biofuels and more than 1700 commercial flights on alternative fuels have flown since 2011.

Many of the technical hurdles facing aviation in its move towards sustainable aviation fuels have been overcome and much of this work has been achieved within the industry. Now, commercialization and scaling up of the supply of alternative aviation fuels is the most important task. But airlines and the rest of the industry cannot do it alone – political support and financial investment will have to come from a number of stakeholders.

2.1 Reduced Dependence on Oil Supply

Commercial-scale production of SAF can bolster the supply of liquid fuel to the airline industry. Given current technology perspectives, there are no practical options foreseen in the next few decades to power the vast majority of aircraft engines other than with liquid fuels. As competition for petroleum-based products intensifies due to increased demand from other industry sectors across the globe and the possible scarcity of this non-renewable resource in future decades, there are concerns that aviation may find it difficult to meet its energy needs over time. Furthermore, alternative jet fuel production facilities need not be situated in the same locations as conventional refineries allowing greater geographic diversification of production.

2.2 Regional Economic Expansion

Commercial-scale production of SAF has the potential to generate jobs and spur economic activity, especially in rural areas where feedstocks can be cultivated. In addition, the growth of a domestic SAF industry would help net crude importers reduce exposure to foreign crude oil and refined products, freeing up resources to be invested domestically. Alternative jet fuels could help obligated parties under the scenario of a potential price on carbon emissions or market based mechanism.

2.3 Environmental Benefit

Fossil fuels as a resource are finite. Further, the imperative to address the externalities of consuming fossil fuel is one the aviation industry understands and takes seriously. In fact the aviation industry takes a globally leading position on sustainability demonstrated by its goal of carbon-neutral growth from 2020 and a halving of CO_2 emissions by 2050 relative to a 2005 baseline. Once economically viable and commercially available at scale, SAF could improve local air quality and reduce aviation-related life-cycle greenhouse gas (GHG) emissions, advancing aviation’s longstanding commitment to minimize environmental impact.

Section 3—Sustainable Alternative Fuel Investment

Investing in a new sector typically carries a higher level of financial risk meaning the cost of funding increases. Higher funding costs place pressure on the feasibility of business cases. This is what financial markets refer to as the 'valley of death' problem. This implies a road block in the innovation sequence, meaning some technological efforts do not mature to the commercialization phase. Substantial capital is required to develop SAF refining and processing capacity, and often without the right policy framework, projects that are capable of generating socially desirable commercial products or processes are unable to obtain financing at the intermediate stage of the innovation sequence. Some of the 'valley of death' impediments include:

1. **Construction –** what is the cost and time to complete?
2. **Technology –** what if the technology does not work at industrial scale, or fails to yield the promised production?
3. **Feedstock –** will it be available at the presumed cost?
4. **Policy –** if the project's viability depends on government policy/assistance, will that policy remain constant throughout the facility's economic life?
5. **Financial –** have the economic assumptions such as the cost of debt and equity, the cost of production, and the selling price of all of the fuel products been realized?
6. **Engineering –** is the engineering and design of the plant appropriate?
7. **Management –** what experience does management have and what happens if it proves inadequate for the task?

It is possible to either minimize or eliminate a number of these risks. While the appetite to invest equity in this sector will likely remain situational, reducing these risks can unlock the necessary debt and private equity capital required to develop production capacity. Recent evidence suggests that when all stakeholders including policy makers address these issues, positive financial agreements can be achieved. Examples include British Airways and Cathay Pacific, both committing to significant off-take agreements and also taking an equity position in the technology.[4]

[4] Refer to the IATA biojet fuel roadmap document under Policy / Economics and Financing strategies

Section 4—Effective Policy

4.1 What is Effective Policy

In the case of SAF the policy objective should be to increase the deployment and uptake while reducing the net CO_2 impact. Policy should address environmental, economic and social criteria.

This section outlines some suggested steps that policymakers can consider in helping their air transport system grow with less carbon-intensive fuel, whilst in many cases also investing in green growth jobs and a new sustainable industry.

4.2 Research

There are many different types of feedstock and pathways that enable feedstock to be converted into biofuel, and important technological developments will unlock still more pathways.

The aviation industry is unlikely to rely on a single feedstock, or source of the fuel. Some feedstocks are better suited to some climates and locations than others. Therefore, it is expected that ultimately there will be a portfolio of SAF feedstock sources developed and a variety of regional supply chains.

Much of the current research and development (R&D) work on alternative fuels is focused on biodiesel and bioethanol projects for land transport. Ultimately, this will delay land transport's switch to more sustainable energy sources, such as electricity and hydrogen fuel cells. A shift to R&D of drop-in fuels and a stronger focus on aviation fuels is desirable. Also the automotive sector would benefit from drop-in fuels, which do not have the same blend percentage limitations as current biodiesel and bioethanol.

Policy enablers include providing funding programs for existing or new research projects by universities, research institutions and industry, broadening or re-focusing research of advanced fuels to include aviation-specific projects.

4.3 De-risk Public and Private Investment in Sustainable Alternative Fuels

To be economically viable, sustainable alternative fuel must be priced at a level competitive with the fossil alternative plus the price of carbon. Presently, most alternative fuels for aviation are not cost competitive with current jet fuel. Over the long term, conventional jet fuel is forecast to become more expensive. By contrast, SAF will become less expensive as the industry develops. Policies incentivizing SAF development and use, can hasten this trajectory and achieve greater emissions reductions in a shorter timeframe.

A better appreciation of the scope for reduction in the price of sustainable aviation fuel is gained by examining the cost drivers. For the HEFA pathway it is estimated that 80% of SAF production costs relate to the cost of feedstocks. As technology to harvest and process these feedstocks progresses, as agronomy and plant breeding produce cultivars with better, more robust yields, and as sustainable biomass become available in commercial quantities the price will drop. Since aviation biofuel testing started a few years ago, prices for these feedstock inputs have already dropped significantly. Support for research and development will enable continued improvements for feedstock pathways.

Production is the second major component of the total cost of the fuel. The oil industry has already established refining infrastructure and thus currently has a limited need for additional capital investment. However, in the case of SAF, the production infrastructure has yet to be developed and some of what needs developing could be synergistic with existing petroleum infrastructure, but not all.

There are also significant subsidies in place for biodiesel and bioethanol production in Europe and the US, which incentivizes redirecting biofuel feedstock into the automotive rather than the aviation sector and thus could hamper the establishment of alternative aviation fuel production.

These incremental upfront capital investment costs are a potential barrier to commercialization. In this context, governments can play a role in reducing this risk through measures such as loan guarantees, tax incentives, grants and co-financing for pilot and demonstration projects. They can also provide a level playing field with road transport fuels by providing equivalent support for the production of aviation fuel.

4.4 Provide Incentives for Airlines to Use Alternative Fuels from an Early Stage

Few industries are as competitive as aviation. This produces excellent outcomes for state economies and consumers. Producer surplus has historically trended below the weighted average cost of capital meaning both consumers and national economies, receive the benefits of aviation below the true cost. The impact of this situation is the aviation sector is often cautious making a business decision involving unquantified risk or potentially subjecting an airline to a competitive disadvantage. Hence, airlines need encouragement to use SAF from an early stage.

The aviation industry has committed to ambitious goals for reducing emissions. SAF is an important part of the plan to reach these goals and the industry and its partners have made significant progress. There is confidence that SAF can be a very significant part of every airline’s future. From policymakers, the industry is looking for the right set of legal, fiscal and policy responses to ensure this new energy stream can be incorporated into business as usual as quickly as possible.

4.5 Robust International Sustainability Criteria

Sustainability standards are being established that will provide suppliers, investors and customers with clear guidelines as to what is considered to be a sustainable fuel.

Sustainability is not just a matter of the choice of feedstocks – it is also a matter of how they are cultivated, harvested, processed and transported. Some key sustainability criteria for aviation fuels could include the following elements:

- will not displace, or compete with, food crops or cause deforestation
- minimize impact on biodiversity
- produce substantially lower life-cycle greenhouse gas emissions than conventional fossil fuels
- will be certified sustainable with respect to land, water and energy use
- deliver positive socioeconomic impact

As a global transportation sector, aviation needs a harmonized standard to ensure that sustainability criteria are equally applied across the industry. A patchwork of standards would inhibit the development of a commercially viable market. While there is a myriad of standards in place, both regulatory and voluntary, a critical element will be for aviation fuel stakeholders to enable greater cooperation between standards to increase transparency, decrease the cost of compliance, increase end-user visibility to the biomass, and increase the incentives for next generation fuel pathways. It is also vital that a unified accounting structure be established to verify the origin and sustainability credentials of these new fuels for aviation. The proposed ICAO global MBM will be an ideal driver to achieve this.

The development of an accepted set of globally harmonized standards will help ensure that investment is directed at fuels that meet acceptable sustainability criteria, thus minimizing this form of risk. Criteria need to be mutually recognized around the world. For aviation, global standards are needed wherever possible, due to operational routing of aircraft, common global equipment and worldwide fuel purchasing requirements.

4.6 Foster Local Opportunities

Sustainable aviation fuel does not only bring environmental benefits for aviation, it can also foster the development of a new industry. Given the diversity of feedstocks that aviation is considering, there are few places that could not support some development of a new, sustainable, energy industry. These can range from growing large quantities of jatropha, halophytes or camelina in the most appropriate environments, to establishment of algae farms on land or off-shore, to biofuel facilities in cities utilizing municipal waste.

By bringing the aviation industry, government, energy, agriculture and academic expertise in a country or region together, as it is already successfully done in multi-stakeholder initiatives such as the ones listed in Section 5.3, analyze the optimum opportunities that exist in each country for aviation biofuel production, including the most effective feedstock sources and infrastructure requirements. Regional development banks can play a proactive role in developing this process.

4.7 Policy Equality

Only in 2009 was the first production pathway for aviation fuel approved by the technical standards body ASTM. This put the sector some years behind ground transport. It has also created a policy imbalance. Many countries provide subsidies for the production of ethanol or biodiesel. This is one reason why the majority of renewable fuel produced hitherto has been for the ground transport sector, and it continues to be more profitable for a feedstock producer to produce for this sector rather than for aviation.

It is vital to provide a level policy playing field to enable aviation demand to compete equally. Additionally, aviation has no alternative at this stage, to a liquid drop-in fuel where the road transport sector has other non-liquid fuel options available such as electricity and fuel cells. The level policy playing field needs to be applied with medium to long-term policy certainty, allowing debt and equity investors to make plant financing decisions.

Section 5—Selected SAF Fuel Success Stories

5.1 United / AltAir

In June 2013 United Airlines and Alt Air Fuels executed a landmark agreement in the commercialization of biojet fuel. United have agreed to purchase 15 million gallons (45,000 tonnes) of lower-carbon renewable jet fuel over a three year period with the option to purchase more. Significantly, the airline is purchasing the advanced biofuel at a price reported competitive with traditional petroleum based jet fuel, and intends to use the biofuel on flights operating out of its Los Angeles hub (LAX).

Alt Air fuels have displayed commercial innovation by using idled refining equipment and retooling it to produce biojet fuel. The facility will convert non-edible natural oils and agricultural wastes into approximately 30 million gallons (90,000 tonnes) of low carbon advanced biofuels and chemicals per year.

5.2 British Airways / Solena

Solena Fuels, in partnership with British Airways has committed to building the world's first facility to convert landfill waste into jet fuel. British Airways has made a long-term commitment to purchase all 50,000 tonnes per annum of the jet fuel produced at market competitive rates. The sustainable jet fuel produced each year will be enough to power all the British Airways flights from London City Airport twice over with carbon savings the equivalent of taking 150,000 cars off the road. The facility is due to be completed in 2017 and will generate significant Gross Domestic Product for the British economy in both construction and operation.

This is an excellent example of generating a local solution. Some key features include negative cost feedstock (the City of London is paying Solena for taking the waste and thus avoiding landfill), a significant off-take agreement and additional equity investment from British Airways, and support from Barclays Bank for CAPEX financing.

5.3 SkyNRG – Green Lane Program

The JFK Green Lane program was initiated in March 2013 and has successfully executed 26 weekly flights undertaken by KLM between JFK and Schiphol using a 777-200 aircraft. The sustainable fuel that was used for the flights had to meet very strict sustainability criteria and SkyNRG has installed an independent Sustainability Board consisting of leading NGOs and scientists advising on all feedstock and technology decisions. The program has demonstrated the feasibility of flying regular flights on sustainable jet fuel. It also showed that it is possible to organize and coordinate a complex supply chain, demonstrating cooperation between numerous public and private parties.

In total it is forecast the program realized approximately 232 Mt of $C0_2$ savings.

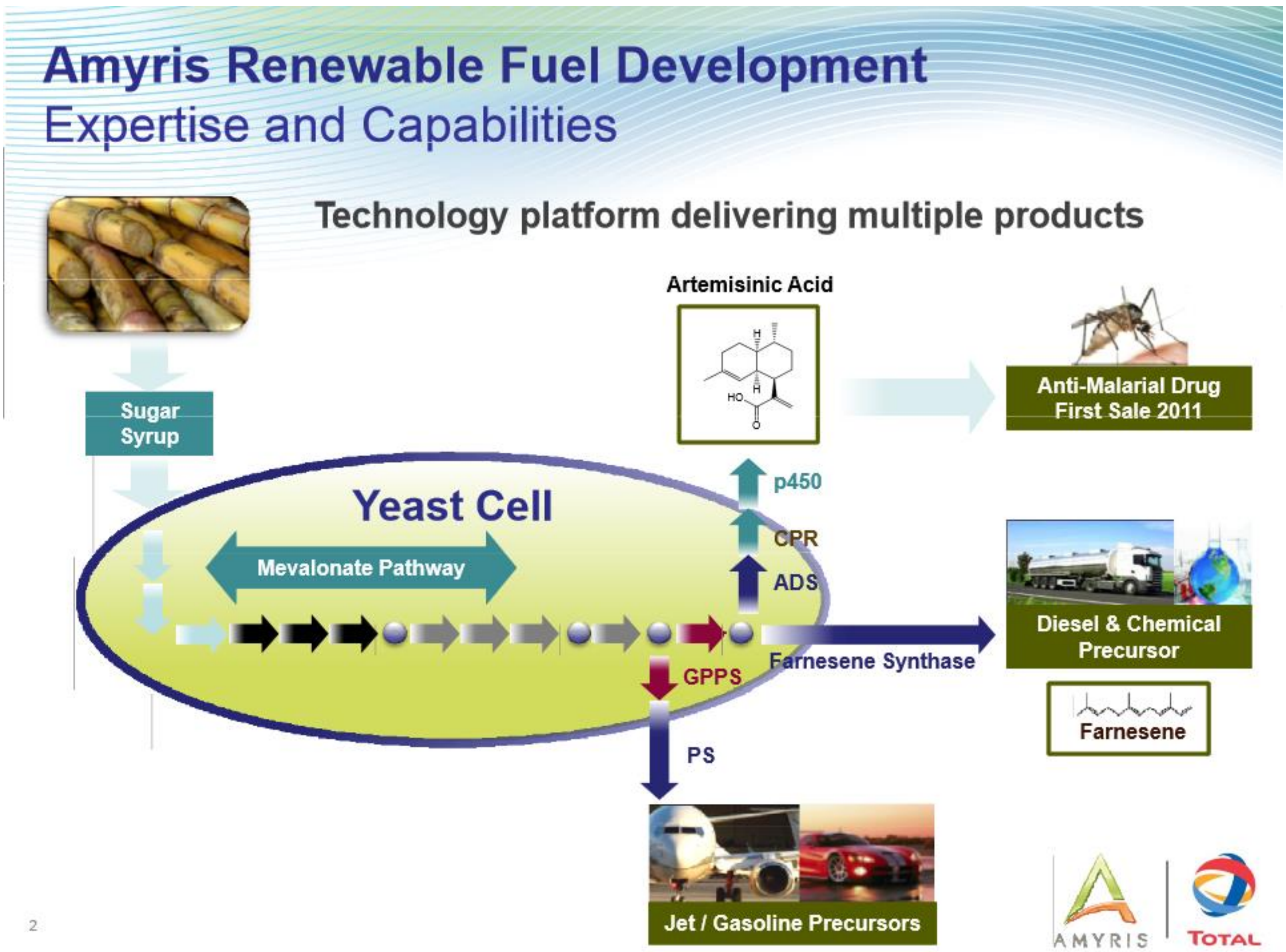
In support of this, the Dutch Ministry of Economic Affairs, Schiphol Group, SkyNRG, Neste Oil and the Port of Rotterdam signed in 2013 a declaration of intent aimed at large-scale use of sustainable fuels and the creation of a bioPort for jet fuels in the Netherlands.

5.4 Total / Amyris

Amyris and Total have formed a joint venture to produce and market renewable diesel and jet fuel from Amyris's renewable farnesene. TOTAL is Amyris's largest investor, holding approximately 18% of its outstanding common stock, and is taking the most proactive stance of the traditional oil industry.

The joint-venture is a first step towards the commercialization of jet fuels. It is expected the process will be scaled up further over the next few years driving the unit cost of production lower. Total is extremely experienced in traditional fossil fuel supply, operating in more than 130 countries and is aiming to become a key supplier in renewable fuels.

Total aims to be active in the development phase and maintain control all along the supply chain. This will allow the company to supply fuels from the field to the plane.



5.6 Cathay Pacific / Fulcrum

Cathay Pacific has become the first airline investor in US based sustainable biofuel developer Fulcrum. Cathay Pacific has also negotiated a long-term supply agreement with Fulcrum for an initial 375 million US gallons of sustainable aviation fuel over 10 years (representing on an annual basis approximately 2% of the airline's current fuel consumption) that meets all the airline's technical requirements and specifications. Fulcrum plans to commence construction of its first commercial plant in 2015 and to build large scale, waste-to-renewable jet fuel plants at multiple locations, including locations strategic to the Cathay Pacific network, primarily in North America.

Section 6—How Can IATA Help

6.1 Key IATA Contacts

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Manager Biofuel Deployment Project

6.2 What IATA Can Do

IATA's role representing the global community of international airlines is to:

- Bring together different stakeholders from industry and policymakers in the alternative fuel area and facilitate cooperation and partnerships between them
- Provide policy support at national, regional (e.g. EU) and international (UN) level to create the necessary framework for the commercialization of sustainable aviation fuels
- Work towards removing obstacles to the realization of a cost-competitive, sustainable aviation jet fuel market
- Promote the use of sustainable aviation fuels in compliance with robust sustainability criteria
- Raise public awareness for related industry efforts
- Play a leading role in standard setting for alternative drop-in fuels in the areas of technical certification and logistics, and provide related technical support
- Create a platform for knowledge exchange, both amongst airlines and for external partners (e.g. airports)

6.3 Useful Links of Initiatives around the World

Businesses from across aviation's value chain are coming together in projects around the world to help with the commercialization of alternative aviation fuels. Below is a list of such initiatives and links to their websites:

- ABRABA - Aliança Brasileira para Biocombustíveis de Aviação (Brazil)
- aireg - Aviation Initiative for Renewable Energy in Germany (Germany)

- AISAF - Australian Initiative for Sustainable Alternative Fuels (Australia & the United States)
- Bioqueroseno (Spain)
- Biofuelnet (Canada)
- CAAFI - Commercial Aviation Alternative Fuels Initiative (United States)
- MASBI - Midwest Aviation Sustainable Biofuels Initiative (United States)
- NISA - Nordic Initiative for Sustainable Aviation (Denmark, Sweden, Norway, Finland, Iceland)
- PBB - Brazilian Biojetfuel Platform (Brazil)
- SAFN - Sustainable Aviation Fuels Northwest (United States)

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