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report

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IEA Bioenergy Task 39

Alternative Fuels for Aviation

Overview on Current Initiatives and Identified Research Needs

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Alternative Fuels for Aviation

Overview on Current Initiatives and Identified Research Needs

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Report

Table of Content

1 Why Sustainable Alternative Fuels for Aviation are Important

Taken from: http://www.icao.int/icao/en/Env2010/ClimateChange/AlternativeFuels.htm

The anticipated gain in efficiency from technological and operational measures in aviation does not offset the overall emissions that are forecast to be generated by the expected growth in traffic. To achieve the sustainability of air transport, other strategies will be needed to compensate for the emissions growth not achieved through efficiency improvements.

A promising approach toward closing this GHG emissions mitigation gap is the development and use of sustainable alternative fuels for aviation. Although such fuels already exist, they are not yet available in sufficient quantities to meet the overall fuel demand for commercial aviation.

Drop-in fuels are substitutes for conventional jet fuel that are completely interchangeable and compatible with conventional jet fuel. The reduction in GHG emissions from the use of drop-in fuels developed from renewable, sustainable sources is the result of lower GHG emissions from the extraction, production and combustion of the fuel. Sustainable drop-in alternative fuels produced from biomass or renewable oils offer the potential to reduce life-cycle greenhouse gas emissions and therefore reduce aviation’s contribution to global climate change.

Over the short and medium-term horizon, aviation will be heavily dependent on drop-in liquid fuels and the development and use of sustainable alternative fuels will play an active role in improving the overall security of supply, and will stabilize fuel prices.

The Situation Today

For some time now, sustainable alternative fuels for aviation have been the focus of the aviation industry. Today, various consortia for the development of such fuels have been established and new initiatives are underway.

During 2009, the qualification of some types of fuels was completed, and currently the qualification of others is well advanced. Of particular importance is the ASTM D-7566 Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons that was approved on 1 September 2009, since it was the first new jet fuel approval in 20 years!

In November 2009, ICAO held a Conference on Aviation and Alternative Fuels (CAAF) to showcase the state-of-the-art in aviation alternative fuels. The Conference also addressed the key issues of sustainability, feasibility, economics, production, and infrastructure. At the Conference, States agreed to develop, deploy and use sustainable alternative fuels to reduce aviation emissions. To facilitate, on a global basis, the promotion and harmonization of initiatives that encourage and support the development of sustainable alternative fuels for aviation, the Conference established an ICAO Global Framework for Aviation Alternative Fuels (GFAAF).

Current Challenges

Today, sustainable alternative fuels offer the potential to reduce aviation environmental impacts, but are not yet available in quantities sufficient to meet the overall demand by commercial aviation. The cost and availability of sustainable alternative fuels for aviation remain key barriers to their large scale adoption.

The testing of new fuels and the establishment of new production facilities require significant capital investment. In addition, since aviation represents less than 5% of the world's liquid fuel consumption, it is possible that fuel producers may initially target larger markets. If the use of alternative fuels is to be part of a comprehensive strategy for minimizing the effects of aviation on the global climate, regulatory and financial frameworks need to be established to ensure that sufficient quantities of alternative fuels are made available to aviation.

As requested by CAAF, ICAO has entered into preliminary discussions with the World Bank and Inter-American Development Bank to facilitate a framework for financing infrastructure development projects dedicated to aviation alternative fuels and incentives to overcome initial market hurdles. Furthermore, the adoption of alternative fuels by aviation might be simpler than for other sectors due to the relatively small number of fuelling locations and vehicles. The definition of sustainability criteria will determine the types of feedstocks and processes that will be used to produce alternative fuels in the future. Currently, there is no set of internationally accepted sustainability criteria; however, this issue is not exclusive to aviation.

2 Technology Options

Taken from: http://www.swafea.eu/AlternativeFuelsinAviation/tabid/73/Default.aspx

Aircraft alternative fuel potential - What are the options?

Several requirements need to be satisfied for fuels to be suitable in commercial aviation. Aviation fuels need to deliver a large amount of energy content per unit of mass and volume, in order to minimize fuel carried for a given range, the size of fuel reservoirs, and the drag related to the fuel storage. Aviation fuels also need to be thermally stable, to avoid freezing or gelling at low temperatures and to satisfy other requirements in terms of viscosity, surface tension, ignition properties and compatibility with the materials typically used in aviation.

A number of potential alternative fuels may be considered for aviation. These can be derived from coal, natural gas or biomass. Not all of them, however, would significantly reduce GHG emissions. The most likely alternative fuels for aviation are those with similar characteristics to conventional jet fuel. This can also be obtained by blending of different fuels.

The presently most mature technologies are presented below.

Biodiesel - Hydrotreated Vegetable Oils (HVOs)

Oils and fats constitute a first family of raw material that can be considered for aviation fuel.

Biodiesel-like fuels derived from vegetable oils are presently the most developed biofuels (with also ethanol for automotive industry). They are not generally suitable on their own for commercial aviation applications. Indeed conventional fatty-acid methyl esters (FAME) freeze at normal aircraft cruising temperatures; they are also not thermally stable at high temperatures in the engine.

However, vegetable oils can be hydro-treated to produce a HVO fuel that consists almost totally of hydrocarbons, and compared to FAME (fuel containing oxygen), HVO is much closer in properties to conventional jet fuel. Hydro-treating can be carried out at refineries. It's today a promising way to obtain "drop-in" fuel for aviation but at a higher cost than biodiesel.

For this last reason, further improvements of FAME are still explored considering both the production process and various kinds of oil.

Fischer-Tropsch (F-T) fuels from fossil feedstocks

Synthetic fuels are high-quality fuels that can be derived from natural gas, coal or biomass. These fuels are typically produced via a gasification step, through the formation of a synthesis gas (mainly CO and H_2) and its conversion to liquid hydrocarbon fuels via the Fischer-Tropsch (F-T) process. The F-T process is technically mature, and synthetic jet fuels from coal, natural gas or other hydrocarbon feedstock are chemically similar to conventional kerosene jet fuels – and ideally suited to supplement or replace them. They have high energy density and exhibit excellent low-temperature and thermal stability. They can even provide an efficiency increase compared to conventional jet fuel [1]. Coal-derived fuel from Sasol was first approved in South Africa (as 50% blend with Jet-A1 and then as neat product) and, in September 2009, generic Fischer-Tropsch fuels were approved for 50% blend with Jet-A1 by the American Society for Testing and Materials (ASTM) in its new D7566 standards. Certification of 100% synthetic paraffinic kerosene (SPK) derived from the Fischer-Tropsch process is expected to be achieved in 2011. Apart from the high cost of production, the main drawback with synthetic fuels produced from fossil fuel is the CO_2 emitted during the manufacturing process. If synthetic fuels are to contribute to GHG emission reductions, CO_2 from the manufacturing process must be captured and stored (CCS). But even with this technology implemented the life cycle analysis of these fuels do not show significant reductions of CO_2 emissions in comparison to conventional jet fuel.

Fischer-Tropsch (F-T) biomass-to-liquid (BTL) fuels

Biomass-to-liquids (BTL) processes using F-T technologies are progressing and are likely to be deployed within the next five to ten years. These fuels offer big advantages, as they come along with the production from completely renewable feedstocks and offer therefore a high CO_2 reduction opportunity. Compared to conventional fossil fuel and according to some analyses focusing on road diesel BTL fuel, CO_2 savings can exceed to more than 80% on a life-cycle basis [2]. Regarding their fuel characteristics and usability in a jet engine, Fischer-Tropsch fuels from biomass show almost the same performance as synthetic FT-fuels derived from coal (CTL) and natural gas (GTL) and are therefore highly applicable for the usage in aircrafts.

What about liquid hydrogen?

Hydrogen is a potential non-CO_2 emitting fuel for aircraft, but its use poses a number of significant technical challenges. It would most likely be stored on board as a cryogenic liquid (LH_2) to minimize volume. Nonetheless, a number of significant modifications would be required to both engine systems and airframe designs to accommodate liquid cryogenic fuels. Insulation requirements and pressurization issues make it impossible to store LH_2 in aeroplane wings, as is done with kerosene jet fuels. In addition, though LH_2 has a very high energy density per unit mass (weight), its volumetric energy density is only one-quarter that of current jet fuel. The storage tanks needed for the large volume of cryogenically cooled hydrogen would increase the weight of large commercial aircraft by over 10% [3]. Modifications would also be necessary to the fuel management system and temperature controls. In sum, use of LH_2 would require a completely different aircraft design, and would pose significant challenges for the engine. It would also require substantial modifications to airport infrastructure. Being gaseous at ambient temperature, H_2 would also be fundamentally different from jet fuel, requiring a completely different fuel distribution infrastructure. Overall, LH_2 is not promising as an alternative fuel for aviation in the near future or the medium term. It could only be viable in the long term if there were significant technological developments, entirely new aircraft designs and substantial infrastructural change.

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[1] Karagozian, et al., “Report on Technology Options for Improved Air Vehicle Fuel Efficiency: Executive Summary and Annotated Brief “, USAF-SAB, Washington DC, May 2006, Report Number SAB-TR-06-04

[2] Wang, M., Wu, M., Huo, H., “Life-cycle energy and greenhouse gas results of Fischer-Tropsch diesel produced from natural gas, coal, and biomass,” Center for Transportation Research, Argonne National laboratory, presented at 2007 SAE Government/Industry meeting, Washington DC, May 2007

[3] Daggett, D., Hadaller O., Hendricks, R., Walther, R., “Alternative Fuels and Their Potential Impact on Aviation”, Prepared for The 25th Congress of the International Council of the Aeronautical Sciences (ICAS), Hamburg, Germany, September 3–8, 2006, Report Number ICAS–2006–5.8.2 or NASA/TM—2006-214365

3 Initiatives, Links and Documents

3.1 International Civil Aviation Organisation (ICAO)

A specialized agency of the United Nations, the International Civil Aviation Organization (ICAO) was created in 1944 to promote the safe and orderly development of international civil aviation throughout the world. It sets standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as for aviation environmental protection. The Organization serves as the forum for cooperation in all fields of civil aviation among its 190 Member States.

Among numerous activities to support the implementation of alternative aviation fuels, ICAO has set up and frequently updates a list of related activities worldwide: Sustainable Alternative Aviation Fuels Activity (SAAFA): http://www2.icao.int/en/SAAFA/

ICAO website : http://www2.icao.int/en/home/default.aspx

ICAO Report on Alternative Aviation Fuels :
http://www.icao.int/icao/en/env2010/Pubs/EnvReport2010/ICAO_EnvReport10-Ch5_en.pdf

Conference on Aviation and Alternative Fuels (CAAF) 2009: www.icao.int/caaf2009/

ICAO Global Framework for Aviation Alternative Fuels (GFAAF):
http://www.icao.int/icao/en/Env2010/ClimateChange/Index_Gfaaf.html

European Initiatives

3.2 Advisory Council for Aeronautics Research in Europe (ACARE)

Launched at the Paris Airshow in June 2001, the ACARE comprises about 40 members with a clearly defined and commonly agreed terms of reference, including representation from the Member States, the Commission and stakeholders, including manufacturing industry, airlines, airports, service providers, regulators, the research establishments and academia.

ACARE's main focus is be to establish and carry forward a Strategic Research Agenda (SRA) that will influence all European stakeholders in the planning of research programmes, particularly national and EU programmes, in line with the Vision 2020 and the goals it identifies. After publication of SRAs in 2001 and 2004, ACARE has published a “Report of the High Level Group on Aviation Research”, the Flightpath 2050.

ACARE website: http://www.acare4europe.com/html/introduction.asp

Flightpath 2050: Europe´s Vision for Aviation:
http://www.acare4europe.com/html/documentation.asp

3.3 European Aviation Safety Agency (EASA)

The European Aviation Safety Agency promotes the highest common standards of safety and environmental protection in civil aviation in Europe and worldwide. It is the centrepiece of a new regulatory system which provides for a single European market in the aviation industry.

In 2008 a report was commissioned which investigated Safety Implication of Biofuels in Aviation. The report focussed on ethanol admixed to gasoline products.

EASA website: www.easa.eu.int

Report “Safety Implication of Biofuels in Aviation”: http://easa.europa.eu/safety-and-research/research-projects/docs/miscellaneous/Final_Report_EASA.2008-6-light.pdf

3.4 EU Project: SWAFEA – Sustainable Way for Alternative Fuels and Energy for Aviation

SWAFEA is a study for the European Commission's Directorate General for Transport and Energy to investigate the feasibility and the impact of the use of alternative fuels in aviation.

The SWAFEA team involves 20 European and international organisations, representing all players in alternative aviation fuels: aircraft and engine manufacturing, air transport, oil industry, research and consulting organisations covering a large spectrum of expertise in the fields of fuel, combustion, environment as well as agriculture.

Our work foresees a strong interaction between the SWAFEA team and the aviation community as well as the fuel sector, NGOs and the public. Participation to the discussions within this project is therefore highly welcome.

SWAFEA website: http://www.swafea.eu/Home/tabid/38/Default.aspx

SWAFEA Report “State of the Art on Alternative Fuels in Aviation” Executive Summary: http://www.swafea.eu/LinkClick.aspx?fileticket=ytqgDKzdx08%3d&tabid=77

SWAFEA Final Report:
http://www.swafea.eu/LinkClick.aspx?fileticket=lIISmYPFNxY%3d&tabid=77

3.5 Alternative Fuels and Biofuels for Aircraft Development (Alfa-Bird)

ALFA-BIRD is a project co-funded by the EU in the 7th Framework Programme for Research and Technological Development, started in July 2008. ALFA-BIRD is an R&D project aiming at viable technical solutions. Its objective is to investigate and develop a variety of alternative fuels for the use in aeronautics, motivated by the need to ensure a sustainable growth of the civil aviation, regarding the impact of fossil fuels on climate change, and in the context of oil prices that are highly volatile and increasing in the long term.

The main challenge in the project work is developing fuels that meet the very strict operational constrains in aviation (e.g. flight in very cold conditions), and are compatible with current civil aircraft, which is a must due to their long lifetime of almost 50 years. To address this challenge, ALFA-BIRD gathers a multi-disciplinary consortium with key industrial partners from aeronautics (engine manufacturers, aircraft manufacturers) and fuel industry, and research organizations covering a large spectrum of expertise in fields of biochemistry, combustion as well as industrial safety. Bringing together their knowledge, the consortium will develop the whole chain for clean alternative fuels for aviation. The most promising solutions will be examined during the project, from classical ones (plant oils, synthetic fuels) to the most innovative, such as new organic molecules. Based on a first selection of the most relevant alternative fuels, a detailed analysis of 4 new fuels is performed with tests in realistic conditions.

Alfa-Bird website: www.alfa-bird.eu-vri.eu

Projection of the fuel market to the mid term (2025): http://www.alfa-bird.eu-vri.eu/filedown.aspx?file=6439

3.6 Other European funded projects

DREAM – Validation of Radical Engine Architecture Systems

DREAM project is the response of the engine community to commercial and environmental pressures that have come about mainly as a result of two main factors: The political pressure to reduce CO2 and the increased cost of Jet A-1 fuel.

DREAM website: www.dream-project.eu

ECATS – Environment Compatible Air Transport System

The Network of Excellence ECATS is an expert group contributing to environmentally compatible air transport. With initial funding from the European Commission ECATS' scope is to contribute to the environmental goals of the Vision 2020 for Aeronautics and the Strategic Research Agenda (SRA)

ECATS website: www.pa.op.dlr.de/ecats

Clean Sky Joint Technology Initative (JTI): www.cleansky.eu

Optfuel: www.optfuel.eu

3.7 European Advanced Biofuels Flight path Initiative

The European Commission's services, in close coordination with Airbus, leading European airlines (Lufthansa, Air France/KLM, & British Airways) and key European biofuel producers (Choren Industries, Neste Oil, Biomass Technology Group and UOP), have launched an exciting new industry wide initiative to speed up the commercialisation of aviation biofuels in Europe.

The initiative, labelled "European Advanced Biofuels Flight path" is a roadmap with clear milestones to achieve an annual production of two million tonnes of sustainably produced biofuel for aviation by 2020. The "Biofuels Flight path" is a shared and voluntary commitment by its members to support and promote the production, storage and distribution of sustainably produced drop-in biofuels for use in aviation. It also targets establishing appropriate financial mechanisms to support the construction of industrial "first of a kind" advanced biofuel production plants.

The Biofuels Flight path is explained in a technical paper, which sets out in more detail the challenges and required actions. The key findings of the technical paper were presented to the stakeholders during a Workshop "Achieving 2 million tons of biofuels use in aviation by 2020" held in Brussels on 18 May 2011.

Flight path website: http://ec.europa.eu/energy/renewables/biofuels/flight_path_en.htm

Press release “Launch of the European Advanced Biofuels Flightpath”:
http://ec.europa.eu/energy/renewables/biofuels/doc/20110622_biofuels_flight_path_launch.pdf

Technical paper “2 million tons per year: A performing biofuels supply chain for EU aviation”:
http://ec.europa.eu/energy/renewables/biofuels/doc/20110622_biofuels_flight_path_technical_paper.pdf

3.7.1 Workshop "Achieving 2 million tons of biofuels use in aviation by 2020"

Brussels, 18 May 2011

This Workshop was organised by the European Commission in cooperation with Airbus. The purpose was to discuss with all key stakeholders a road map for accelerating the deployment of paraffinic sustainable biofuels in the aviation sector and ensuring that the EU will reach their commercialisation by 2020. The target is to reach a bio-kerosene contribution of 2 million tons per year by 2020.

The workshop has been attended by about 100 participants from the aviation sector, the biofuel producers industry, NGOs, various organisations and representatives from the European Commission (DG ENER, MOVE, RTD).

Event website:
http://ec.europa.eu/energy/technology/events/2011_05_18_biofuels_in_aviation_en.htm

3.7.2 Biofuels FlightPath 2nd Workshop: "Progress and benchmarking of paraffinic value chains"

Brussels, 20 September 2011

This Workshop was organised by the European Commission in cooperation with Airbus. The purpose was to discuss with key stakeholders the status of the biofuels technologies in view of their commercialisation.

The Technology Readiness for biofuels use in aviation was applied by EADS Innovation work and Airbus to four value chains as a first step to initiate the debate with the biofuel technology developers and stakeholders. This was followed by the presentation of a technology benchmarking template developed by DG ENER for paraffinic sustainable biofuels. The biofuel technology developers were invited to complete the template and submit it to the European Commission, DG ENER, to be evaluated under 7th Framework Programme (7PF) confidentiality rules.

The target of the Biofuels FlightPath is to reach a bio-kerosene contribution of 2 million tons per year by 2020. The workshop has been attended by about 80 participants from the aviation sector, the biofuel producers industry, NGOs, various organisations and representatives from the European Commission.

Event website:
http://ec.europa.eu/energy/technology/events/2011_09_20_biofuels_flightpath_en.htm

3.8 European Biofuels Technology Platform

The Mission of the European Biofuels Technology Platform is to contribute:

- to the development of cost-competitive world-class biofuels value chains,
- to the creation of a healthy biofuels industry, and
- to accelerate the sustainable deployment of biofuels in the EU

through a process of guidance, prioritisation and promotion of research, technology development and demonstration. Research needs for biofuels for road transport, marine and aviation have been laid down in the 2010 update of the Strategic Research Agenda.

ETP Biofuels website: www.biofuelstp.eu/

Strategic Research Agenda Update 2010: http://www.biofuelstp.eu/sra.html

North American Initiatives

3.9 Commercial Aviation Alternative Fuels Initiative (CAAFI)

The Commercial Aviation Alternative Fuels Initiative (CAAFI) seeks to enhance energy security and environmental sustainability for aviation through alternative jet fuels. CAAFI is a coalition that focuses the efforts of commercial aviation to engage the emerging alternative fuels industry. It enables its diverse participants – representing all the leading stakeholders in the field of aviation – to build relationships, share and collect data, identify resources, and direct research, development and deployment of alternative jet fuels. The Fuel Readiness Levels that CAAFI has developed have been accepted by ICAO.

CAAFI website: www.caafi.org

Roadmap: http://www.caafi.org/information/roadmaps.html

Fuel Readiness Level: http://www.caafi.org/information/fuelreadinesslevel.html

3.10 Sustainable Aviation Fuels Northwest

Sustainable Aviation Fuels Northwest (SAFN) is the nation's first regional stakeholder effort to explore the opportunities and challenges surrounding the production of sustainable aviation fuels.

The initiative was launched in July 2010 by Boeing, Alaska Airlines, the operators of the region's three largest airports – Port of Seattle, Port of Portland and Spokane International Airport – and Washington State University, a center for advanced biofuels research. Climate Solutions, a Northwest clean-energy nonprofit, was retained to manage a stakeholder process that included more than 40 organizations ranging across aviation, biofuels production, environmental advocacy, agriculture, forestry, federal and state government agencies, academic research and technical consultancies.

SAFN website: http://www.safnw.com/

Report "Powering the Next Generation of Flight":
http://www.safnw.com/wp-content/uploads/2011/06/SAFN_2011Report.pdf

Report Executive Summary:
http://www.safnw.com/wp-content/uploads/2011/05/SAFN_ExecSummary.pdf

3.11 Sustainable Bioenergy Research Project (SBRP)

The Sustainable Bioenergy Research Project was launched to demonstrate the commercial viability of using integrated saltwater agriculture to provide biofuels for aviation.

3.12 Other North American Projects

OMEGA Partnership

Omega is a publicly funded partnership that offers impartial, innovative and topical insights into the environmental effects of the air transport industry and sustainability solutions

OMEGA website: www.omega.mmu.ac.uk

Air Transport Action Group: www.enviro.aero

Green Air Online: Independent Reporting on Aviation and the Environment: www.greenaironline.com
Greenpower Conferences: Information about events focusing on renewable energy, climate change and sustainability: www.greenpowerconferences.com

South American Initiatives

3.13 Brazilian Alliance for Aviation Biofuels (Aliança Brasileira para Biocombustíveis de Aviação – ABRABA)

The Brazilian Alliance for Aviation Biofuels was formed to promote public and private initiatives to develop and certify sustainable biofuels for aviation.

Australasian Initiatives

3.14 Sustainable Aviation Fuel Users Group

The Sustainable Aviation Fuel Users Group was formed in September 2008 with support and advice from the world's leading environmental organizations such as the Natural Resources Defense Council and the Roundtable for Sustainable Biofuels (RSB). The group is focused on accelerating the development and commercialization of sustainable aviation biofuels.

SAFUG website: http://www.safug.org/

3.14.1 Data collection for Bio-SPK jet fuel

A cross-industry team consisting of Boeing, Honeywell/UOP, Air New Zealand (ANZ), Continental Airlines (CAL), Japan Airlines (JAL), General Electric, CFM, Pratt & Whitney, and Rolls- Royce participated in a series of tests flights with a bio-derived SPK (Bio-SPK) to collect data to support eventual certification of Bio-SPK jet fuels for use in commercial aviation pending the necessary approvals. A summary of the data collected from the Bio-SPK research and technology program, as well as a discussion about the additional data that is being generated to support fuel approval, are provided by the report “Evaluation of Bio-Derived Synthetic Paraffinic Kerosenes (Bio-SPK)”: http://www.safug.org/assets/docs/biofuel-testing-summary.pdf

3.14.2 Flight path to Sustainable Aviation

The Sustainable Aviation Fuel Road Map was initiated by the Australasian grouping of the Sustainable Aviation Fuel Users Group (SAFUG), including Air New Zealand, Boeing, Qantas and Virgin Australia, together with the Defense Science and Technology Organization (DSTO) and CSIRO. The group invited CSIRO to facilitate the study. A broad range of stakeholders from the aviation and bio-derived fuel industries, New Zealand and Australian Governments, and non-government organizations were also invited to co-fund and participate in the study. The Australasian grouping of SAFUG, CSIRO and all the participating organizations extend their sincere thanks to the many organisations that provided their expertise to the group through presentations at road map study workshops and other informal discussions.

Report: http://www.csiro.au/files/files/p10rv.pdf

4 Research Needs

Aviation absolutely depends on fuel qualities meeting stringent quality requirements and is also extra sensitive with regard to energy density of fuel. Standardisation is therefore a crucial issue for the sector, as is fuel-engine compatibility. Furthermore, there is a strong need to demonstrate the production of suitable alternative aviation fuels. Fuel certification is a very costly and very long process and will only be undertaken if there is belief in the ability of the technology to produce sufficient quantities of suitable fuel. The “Fuel Readiness Level” as defined by CAAFI will be considered before a certification process is started.

Several groups have identified and published research needs.

> ACARE has gathered all relevant stakeholders and produced a vision report: Flightpath 2050. Currently ACARE is in the process of writing an update to its Strategic Research Agenda which shall guide and support future actions in public and private funding programmes towards the Vision including future European Commission Research Framework Programmes.
>
> The SWAFEA report states that BTL and HRJ pathways will be available in the short term to produce jet quality fuels, but that they face a lack of price competitiveness with conventional jet fuel. In addition, biomass availability and production development appear as the critical bottlenecks for biofuel ramp-up and for achieving emissions reductions targets. Research needs are laid down in the document.
>
> The European Biofuels Technology Platform has considered aviation biofuels when writing its Strategic Research Agenda Update. There will not be dedicated biojet production processes or facilities, but different finishing for different end-use. Thus, concerning feedstock issues, conversion issues and sustainability issues, research needs are the same for all biofuels, regardless of the end-use. There are some special research needs when it comes to diversion (finishing of the fuel product to meet jet standard requirements) and to market and regulation. These research needs are laid down in the SRA document.

Research needs identified in these reports and at an expert meeting include:

- Improve yields of energy crops
- Intensify research on algae
- Investigate biomass pre-treatment methods
- Improve biomass gasification into good quality syngas
- Develop FT catalysts to achieve aromatics in the fuel

- Investigate additives to gain aromatics
- Fine-tune processes that are already developed for road transportation
- Verify fuel-engine compatibility for HVO, BTL and other bio hydrocarbons
- Investigate the structure of the costs throughout the pathway in order to identify where to focus
- Improve energy efficiency of biofuels production
- Demonstrate logistics and management of airport supply with biofuels.

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