



EU has a target of 2 million tons of biobased aviation fuel in 2020, corresponding to 3–4% of the jet fuel. Photo: BriYYZ, Creative Commons licence

Will biofuel aircrafts take off?

Over 1600 commercial flights have been made with biofuel in the tanks. The first hubs for bio jet fuel have been established in Norway and Sweden, and Scandinavian airlines have started to fly commercially with biofuel. Is flying with renewables no longer simply a naïve idea?

At an SNS-organised workshop in Copenhagen in April, Kes McCormick gave a presentation about bioeconomy in Europe. One of the topics he covered was aviation fuel. News & Views was inspired to learn more, since it turns out that the Nordic countries are doing rather well in this respect.

Nordic initiatives

Kes McCormick is Associate Professor at the International Institute for Industrial Environmental Economics in Lund. As a bioeconomy



Kes McCormick: Biofuels form part of a broader strategy to shift away from fossil fuels. Photo Mats Hannerz.

researcher, with his feet in both the political and environmental sciences, he is also supporting NISA - the Nordic Initiative for Sustainable Aviation – with research on bio jet fuels. NISA was formed to promote and develop a more sustainable aviation industry, specifically focusing on sustainable fuels for the aviation sector.

– The aviation industry is looking seriously at bio jet fuels as they need access to liquid fuels that are sustainable and with secured costs. There are test flights happening now with bio jet fuels and there is a lot of interest in commercialising these fuels, he says.

The goal of NISA is to accelerate the development and commercialisation of sustainable aviation fuels. The actors behind the initiative are the Nordic airports, Nordic airlines and the aviation authorities. The aircraft manufacturers Boeing and Airbus are also supporters.

The Nordic Council of Ministers is also active in biofuels for aircraft. Denmark, which holds the Presidency of the Council in 2015, put forward a proposal concerning research into Nordic options for the use of advanced biofuels for aircraft. The outcome of this proposal will be presented at a conference in 2016.



First Nordic flights

Worldwide, over 1600 commercial passenger flights have been made with blends of up to 50% biofuel, according to IATA (the International Air Transport Association). The first Nordic commercial flights with biofuel mixed into the conventional jet fuel were made in November 2014. One Boeing 737 took off from Stockholm to Östersund with a 10% biofuel mixture, and similar flights were made to Oslo from Tromsø and Bergen with SAS and Norwegian.

Biofuel is one way to reduce emissions

Aircrafts' share of total carbon emissions amounts to 3% in the EU and 2% globally. However, aviation is responsible for additional climate impact because of nitrogen oxide emissions. Although scientists are still debating the magnitude of that effect, a rule of thumb is that an aircraft's total emission effect is twice that of its carbon emissions.

Replacing conventional jet fuel with biofuel is considered the main way to reduce the impact. IATA believes that there will be no viable alternatives to liquid hydrocarbon fuels within the next few decades. Unlike ground transport, electric power and solar energy have severe limitations, and can only be used for shorter distances, and only in the far future.

Several technological processes

The demands on a new fuel are extreme – an aircraft cannot afford an engine failure due to contaminated, volatile or freezing fuel. The conventional jet fuel kerosene is lighter than diesel but heavier than gasoline. It has to withstand very low temperatures without freezing, as well as high temperatures without becoming a gas.

The current bio jet fuels are often based on plant oils, algae or used cooking oil. The latter is relatively cheap but can only support the production of small volumes. In order to increase the volume produced, new

feedstocks, such as forest residues, are required.

There are many technologies that can be used to produce jet fuel from biomass. Two methods that can be highlighted are:

1. Bio jet derived from Fischer-Tropsch synthesis from a syngas based on thermo-chemical biomass gasification, FTSPK. This process can use most types of organic material. Forest residue is a highly suitable resource.

2. The alcohol to jet method, ATJ. Bioethanol can be refined to jet fuel. Alcohol can be produced from various raw materials, for example lignocellulose in wood and energy crops, but also algae.

Competitive prices – in pilot studies

Fuel is the largest cost for aircraft operators. The question is whether it is possible to produce bio-based jet fuel at competitive costs.

Yes, say pilot studies undertaken both in Sweden and Norway. The Swedish study from 2009 aimed to investigate the pre-requisites for a biorefinery that could support the Arlanda airport, providing 50,000 tonnes of bio jet fuel per year. The biorefinery, it was proposed, should be built in conjunction with existing combined heat and power plants or pulp mills, which collect large amounts of biomass already. Cost analyses indicated that bio jet fuel

production would be competitive in relation to current oil prices.

A more recent feasibility study was undertaken in Norway in 2013. The country's aviation sector wants to reduce emissions by 10–15% in the period 2020-2025. The study calculated a need for 190–250 million litres of bio jet fuel per year to meet the reduction targets. This corresponds to forest residues and pulpwood with an energy content of 6–8 TWh.

The study estimated the price of bio jet fuel today to be almost twice the price of conventional jet fuel. However, it is predicted that the price will drop as the industry learns more, and should be comparable with conventional jet fuel around 2025.

Cleaner alternative

The Swedish Bioenergy Association (Svebio) is coordinating much of the bioenergy development in Sweden. Gustav Melin, CEO, admits that bio jet is currently more expensive than conventional fuel, but costs can go down.

– I estimate that we can produce bio jet for 1 Euro per litre if we can just scale up production, he says.

Tomas Ekbohm, biofuel expert at Svebio adds another argument:

– Besides being a sustainable alternative, bio jet is a much cleaner product. Conventional jet fuel contains sulphur, salts, aromatics and other negative components. You can actually drink bio jet!

Tofte – one of the projects for upscaling bio jet fuel in Norway. Foto Bjoertvedt, Wikipedia Commons.



“First in the world”

There are many projects around the world setting up biofuel hubs at airports. Several media releases in the last year claim the hubs to be “the first in the world”. Who was the first can, of course, be debated, but Norway took an important step when, this year, Oslo airport began to offer regular deliveries of biofuel. The fuel will initially come from used cooking oil, but the industry is looking for large-scale production based on forest residues.

Two concrete industrial initiatives for biofuel in Norway are Tofte (Statkraft and Södra) and Follum (Viken Skog/Treklyngen). Both consider the possibility of producing bio-diesel and bio jet fuel in biorefineries.

Karlstad Airport in Sweden has been announced as the first “bioport”

in Sweden, with bio jet fuel available from 2015. Looking outside the region, Los Angeles airport (LAX) will establish a biorefinery that will produce fuel initially based on plant oils and used cooking oil. When the demand is scaled up, they will look for forestry feedstocks. GreenSky London is another up-scaled bio jet fuel project, in which British Airways has bought bio jet production from Solena Fuels.

Do we have enough resources?

Now back to Kes McCormick. One question that arises is if aviation turns to biobased fuels – will we have enough resources? It turns out that it is not easy to get a definite answer:

– There are many calculations and models that try to understand how much biomass we can produce

and use for biofuels. However, the results depend on key decisions and assumptions. In my opinion, biofuels cannot be our only solution. But they can form part of a broader strategy (including biofuels, electric vehicles, public transport, smart urban planning and changes in consumption patterns) to shift away from fossil fuels, he says.

Sources:

“Bærekraftig biodrivstoff for luftfart”. Report from Avinor, 2013.

“Pilot study of bio-jet A-1 fuel production for Stockholm-Arlanda Airport.” Tomas Ekbohm et al. 2009. Värmeforsk.

www.skynrg.com; www.sas.se;

www.lfv.se; www.iata.org;

www.norden.org; Nordic Initiative for Sustainable Aviation; www.avinor.no; IATA report on alternative fuels 2014

Researchers need to think cross-sectorially!



Jonas Rönnerberg, Inga Bödeker and Alex Giurca from SNS, and Geir Oddsson from the Nordic Council of Ministers agree on the set up of ideas and networks within the framework of SNS. Photo Mats Hannerz

On 29 April 2015, SNS arranged a Matchmaking Day, hosted by the Nordic Council of Ministers in Copenhagen.

– We forecast more and more calls for funding that require cross-sectorial research. Research on sustainability needs to account for so many aspects today, including social aspects, climate adaptation, wood technology and ecosystem services. It is, therefore, not enough to gather a group of close colleagues from

a single field, says Inga Bödeker, secretary of SNS.

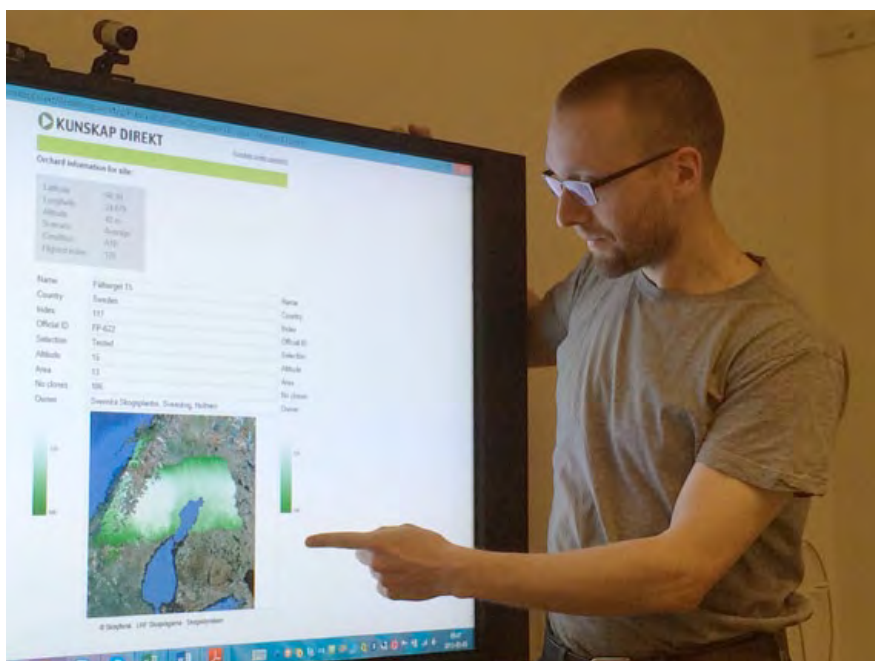
She suspects that researchers and stakeholders from different backgrounds, such as forestry, agriculture and the energy sector, may currently be working on similar projects without knowing each other. The Matchmaking Day was one way to establish new contacts between researchers from different fields.

The event gathered together 47 participants, who discussed, in

detail, new possibilities and networks around five central research topics: Ecosystem services, Climate, Social aspects of forests, Technology and Bioeconomy.

Most of the participants were from the forest sector, but there were also researchers and stakeholders representing agriculture, fisheries and the energy sector. Several ideas came up that will eventually form the basis for new networks or research projects. Examples of ideas included social aspects of continuous cover forestry, forestry in buffer zones between agricultural fields and conservation areas, better use of by-products from sawmills, trade-offs between different ecosystem services, and the sustainability of different crops.

“Our goal is to broaden our research community and expand beyond its current borders to include new groups of researchers and stakeholders from other fields and backgrounds”



Borderless use of reforestation material

Mats Berlin presents a map of the optimal area for using the seed orchard 'Pålberget'. The lighter the colour, the higher yield. Scots pine seedlings from this orchard do best in the interior of northern Fennoscandia. South and north of the marked area growth is sub-optimal, and local Scots pine would grow as well or better there.

What is unique about the map is the data that supports it. Finland and Sweden have been able to combine their huge collection of field data into

one common database. News and Views No. 1 2013 reported on the project that assembled 15,000 data entries from several hundred thousand Scots pine trees. The growth records from the field were then combined with climate data – current as well as predicted future climate.

The transfer functions developed from the data have been implemented in the tool Planter's Guide 2, which is intended for use by managers and breeders in Finland and Sweden.

– The project with Scots pine turned out to be more laborious than we expected, says Mats Berlin. But the functions developed are valid for

both Sweden and Finland, and the web tool is fully functional. However, at this stage, *Planter's Guide 2* is only available for research purposes, awaiting slight adjustments and end-user evaluation before a public release.

Norway spruce next

Breeders in the region are now pushing the cooperation further and will take on the economically most important tree species - Norway spruce. The spruce project has been running for two years and involves partners from Sweden, Finland, Norway, Estonia and Latvia. So far, more than 300 field trials have been identified for the analyses. The data on growth and survival will, as in the Scots pine project, be used to establish transfer functions.

– The Norway spruce project covers a more climatically variable geographic area, which is more challenging. Furthermore, the performance of Norway spruce is largely dependent on its phenology (growth rhythm). In particular, damage from late spring frost must be considered in the southern part of the region, says Mats Berlin.

The researchers have, therefore, struggled to identify experiments where the phenology of the spruce trees can be linked to performance in the field.

The outcome of the Norway spruce collaboration will probably be presented as a web-based tool, similar to that for Scots pine.

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