Press release

nova-Institut GmbH (www.nova-institute.eu)
Hürth, 11 March 2020

Can the European Union's kerosene demand be met by the amount of biomass produced in the EU?

At the "1st European Summit on CO_2-based Aviation Fuels" in Cologne 23 March 2020, all aspects of aviation fuel from CO_2 will be comprehensively presented and discussed – especially in comparison to bio-based solutions. In order to make participation possible despite travel limitations, the entire conference is also offered as a webinar. (www.co2-chemistry.eu/aviationfuels).

Regarding climate change and tackling its mitigation there is no question that the aviation industry has to reduce its greenhouse gas impact and has to shift to alternative fuels. If the European Union wants to achieve its ambitious climate goals, it needs to uncouple it growing kerosene demand from fossil resources. In 2018, the consumption of aviation fuel and kerosene in the EU amounted to 62.8 million tonnes[1] which is equivalent to 2,895 million GJ[2]. How can this large quantity, 99.9% of which is currently produced from fossil sources, mainly crude oil, be shifted to alternative raw materials? Is it possible to produce this amount with biomass from the EU? Or is Power-to-Liquid (PtL) the only realistic alternative?
The following table gives an overview of the aviation fuel / kerosene yields per hectare for different crops and calculates the required areas under cultivation.

Table 1: Different biomass sources and PtL production pathways of jet fuel and kerosene: Yields per hectare and area demand in the European Union

Production pathway	Jet fuel yield (GJ/ha*a)	Jet fuel / kerosene demand in the EU, 2018 (million GJ)	Area required for the entire coverage of the EU jet fuel / kerosene demand (million ha)	Current area cultivated in the EU (million ha)	How much of the current area is needed to fulfil the jet fuel / kerosene demand in the EU
Maize (AtJ)	56	2,895	51.7	8.3	x6.2
Sugar beet (AtJ)	149	2,895	19.4	1.7	x11.2

1 Fig. 7, https://www.fuelseurope.eu/dataroom/static-graphs
2 http://w.astro.berkeley.edu/~wright/fuel_energy.html

Rapeseed oil (HEFA)	48	2,895	60.3	6.9	x8.7
Sunflower oil (HEFA)	31	2,895	93.4	4.0	x23.2
PtL PV	580-1070	2,895	5 - 2.7	no data	no data
PtL wind	470-1040	2,895	6.2 - 2.8	no data	no data

Notes to the table:
AtJ: Alcohol-to-Jet fuel (based on bioethanol)
HEFA: Hydroprocessed Esters and Fatty Acids
PtL: Power-to-Liquid
PV: Photovoltaic
Crop yields based on FAOSTAT 2016, yields biomass to jet fuel / kerosene based on UBA 2016: Power-to-Liquids – Potentials and Perspectives for the Future Supply of Renewable Aviation Fuel.

The table clearly shows that it is impossible to cover the EU's kerosene demand with domestic biomass when switching to first-generation bio-based alternatives, e.g. maize. The current area in the EU under this energy crop yielding high amounts of starch is currently 8.3 million ha. 51.7 million ha would be needed to cover the kerosene demand with maize, this is 6.2 times the current area under maize. The EU's total agricultural area is 107 million ha (2017[3]) and is used primarily for food and feed production. This means finding an additional area of 51.7 million ha to meet the kerosene demand with maize is inconceivable. Of course, further agricultural land is available, but estimated to be at a few million ha only and less arable due to poor soil resulting in lower yields. Other agricultural crops show similar results. Even the inclusion of second-generation raw materials such as wood, short rotation coppice (SRC) or straw does not produce better results. For example, the yield of SRC per ha is in the same order of magnitude as for agricultural crops. To go the bio-based kerosene route, it will be necessary to import over 95% of the biomass.
For the Power-to-Liquid route, the situation is considerably more relaxed. With the help of solar or wind energy, only comparatively small areas of between 2.7 and 6.2 million ha are needed to fully cover alternative kerosene demand. These areas can be in the arid deserts and semi-deserts, on existing buildings in the case of photovoltaic (PV) or on off-shore plants in the case of wind energy. Even combinations of wind and agriculture are possible. This is a much more realistic option.
On the other hand, renewable electricity is needed for a variety of competing applications (household and industrial electricity demand, transport), so in reality the PtL option will also rely on imports from regions with high output yields of solar energy, e.g. the Sahara. Due to the high solar radiation, only 1.8 million ha of the Sahara surface are needed to meet the EU alternative kerosene demand via photovoltaics and CO_2. Based on the fact that the Sahara has a total area of 920 million ha, only 0.2% of the Sahara's surface would be sufficient for this purpose.

[3] https://ec.europa.eu/info/news/eu-agricultural-outlook-arable-land-area-continue-its-decline_en

Takeaway message

The high demand for aviation fuel / kerosene in the European Union can only be met to a very small extent by domestic biomass. If this path is taken, more than 95% of the biomass must be imported.
Covering the demand via Power-to-Liquid with the help of solar and wind energy and CO_2 is comparatively easy due to the considerably higher efficiency of the land use. It is expected that this will result in the use of a mix of domestic renewable energies and imports from North Africa. It should be noted that covering only 0.2% of the Sahara's surface area with photovoltaics would be sufficient to cover the EU's entire aviation fuel / kerosene requirements.

Conference on CO_2-based Aviation Fuels

There are still many questions to be answered. What is the best technology? How to provide cost effective green energy, hydrogen and CO_2? What are the best strategies to implement CO_2-based aviation fuels? What about the Carbon Offsetting and Reduction Scheme (COR-SIA) and the European Emissions Trading System (ETS)? How to ensure aviation standards are met? What is required politically in terms of regulations and international support? If these questions and the sustainability of aviation is your concern, the "1st European Summit on CO_2-based Aviation Fuels" 23 March, 2020, Cologne, Germany, is the event to attend. This summit is for decision makers in politics, organisations, airlines and the respective industries. You are cordially invited by the International Association for Sustainable Aviation (IASA) and nova-Institute to take part in this essential summit.
The aviation summit is one day prior to the 8th edition of the established "Conference on Carbon Dioxide as Feedstock for Fuels, Chemistry and Polymers", 24-25 March, 2020, Cologne, Germany. In order to make participation possible despite travel limitations, both conferences are also offered as a webinar. The online participants can see the presentations, listen to the talks and ask questions. More information and registration are available at www.co2-chemistry.eu

Find all nova press releases, visuals and more free for press purposes at www.nova-institute.eu/press

Responsible for the content under German press law (V.i.S.d.P.):

Dipl.-Phys. Michael Carus (Managing Director)
nova-Institut GmbH, Chemiepark Knapsack, Industriestraße 300, DE-50354 Hürth (Germany)

Internet: www.nova-institute.eu – all services and studies at www.bio-based.eu
Email: contact@nova-institut.de
Phone: +49 (0) 22 33-48 14 40

nova-Institute is a private and independent research institute, founded in 1994; nova offers research and consultancy with a focus on bio-based and CO_2-based economy in the fields of food and feedstock, technology, economy, markets, sustainability, dissemination, B2B and B2C communication and policy. Every year nova organises several leading conferences on these topics. nova-Institute has 35 employees and an annual turnover of more than 3 million €.

Get the latest news from nova-Institute, subscribe at www.bio-based.eu/email