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Advanced biofuels: what future do they have in transportation? Summary

Didier Houssin, Chairman of IFPEN: opening speech

François Kalaydjian, Director of Economics and Technology Intelligence (IFPEN): leading the round-table discussions

The regulatory context of the French strategy

Anne-Florie Coron, Sub-Director for Procurement Security and New Energy Products, Directorate-General for Energy and Climate (French Ministry for Ecological and Inclusive Transition)

The French regulatory context underpins the framework for the French Energy and Climate Strategy that was published early in 2019. The framework for this strategy has two parts:

- the national low-carbon strategy, whose goal is to achieve carbon neutrality by 2050, and that concerns all sectors;
- the Multi-Year Annual Energy Programming that sets the goals for 2023-2028 as regards energy efficiency, procurement security, and renewable energy development.

In implementing this strategy, decarbonizing the transport sector is a fundamental issue for achieving carbon neutrality, which involves an approach built on three main pillars: reducing consumption, electrifying usages, and, when internal combustion engines are unavoidable, developing advanced biofuels and bio-Natural Gas for Vehicles (bio-NGV). Liquid biofuels are particularly relevant for air transport. Indeed this solution is being discussed under a "green growth" partnership bringing together all of the businesses in the air transport sector and the French State with a view to developing aviation biofuels.

Two bills are contributing to putting in place the legislative framework for energy:

- The bill for the French framework law on mobility and transport (*Loi d'Orientation des Mobilités*), which is in the process of being passed, lays out a framework for the development of eco-mobility and eco-transport (cycling, public transport, etc.) and makes provision for public funding and support for bio-NGV production units. The goal is not to have any light vehicles powered by fossil energies on the road by 2040.
- The French law on energy and climate (*loi énergie-climat*) will set targets for decarbonization, and in particular for achieving carbon neutrality by 2050.

As regards incorporating biofuels, incentive tools exist (in the form of an incentive tax set every year in the French budget law (loi de finances)) for land transport, and a similar tool should be proposed soon for air transport. The aim is to meet the targets of the RED II Directive that makes for provision for advanced biofuels to represent 3.5% of consumed transport energy by 2030.

The issue of biomass procurement

Patrice Mangin, Director of I2E3 (Innovations Institute in Ecomaterials, Ecoproducts, and Ecoenergies - Canada)

The issue of resource procurement is of considerable importance. This issue is strongly linked to the societal acceptability of projects and to their impacts on biodiversity. As regards biodiversity, the issue is simple if we talk in terms of metrics (number of individuals counted), but it becomes more complex if we talk in terms of species diversity. And changes in the species present can be due to many factors (changes in habitat, in climate, etc.).

The aim of the Bioénergies La Tuque (BELT) project is to build the first bio-refinery in Canada for refining residue from forest logging. It represents an 800 million euro investment, and aims to replace from 5% to 7% of

the fossil fuels used for transportation in Quebec with advanced biofuels. The goal is to produce fuels of the "drop-in" type.

Among the stakeholders consulted, BELT is working in particular with the Atikamekw First Nations Community, who have very good knowledge of the resource. Making procurement secure for a period of at least 25 years is also key for a plant that is going to produce for from 40 to 50 years.

Regulations are also another key factor for the development of advanced biofuels. For example, in North America, advanced biofuels enable carbon credits to be obtained and projects to reach financial equilibrium. However, without robust legislation, such projects do not hold water because the starting capital investment is too high.

Incentives (or "mandates" in Quebec) are also ways of promoting biofuels, by requiring a certain percentage of advanced biofuels in fossil fuels. This creates the market and puts all producers on an equal footing.

Today, a high demand for biofuels is being observed. For example, Neste has installed multi-fuel stations in Finland and has found that the public are ready to accept a higher price for advanced fuels.

French advanced biofuel technologies on the verge of entering the market

Jean-Christophe Viguié, Head of the Biofuels Program (IFPEN)

For decarbonizing the transport sector, biofuels represent an option of choice for several reasons:

- they can be rolled out without requiring massive new infrastructures to be built;
- they can be used in current vehicles because they mix with conventional fuels, often up to high contents;
- they can be used alone or in combination with new technological options such as hybridization;
- and, finally, in the short or medium terms, they represent the only technical option for decarbonizing certain sectors such as air transport.

Advanced and conventional biofuels are two options that are complementary. Conventional biofuels are already an industrial reality in France: They are incorporated at 7% to 8% in fuels and they account for 25,000 jobs. However, they come from raw materials that can be in competition with food use (beet sugar, corn starch, wheat starch, or rapeseed oil). That is why, as of the 2000s, major R&D work was launched for developing new technologies for producing advanced biofuels using lignocellulosic resources. IFPEN committed fully to this work and began participating in two major projects in France:

- Futurol™ (demonstrating production of advanced bioethanol, using technology validated over more than 10 different types of biomass); and
- BioTfueL® (demonstrating production of synthetic biodiesel and of synthetic biokerosene approved by ASTM for being incorporated up to 50% in aircraft tanks).

It is important to develop this type of project jointly with manufacturers in order to fully understand their issues and their goals. These technologies will make it possible to produce fuels with greenhouse gas emissions reduced by from 85% to 90% compared with the fossil fuel reference. In order to roll out these technologies today on an industrial scale, it is necessary to have a regulatory framework and it is desirable to help the first manufacturers who are going to commit to such projects; it is also necessary to have a tax framework that is

dedicated and stable for the products; and finally vehicle emission regulations that take into account the full Life-Cycle Analysis (LCA) of the vehicles and not merely the CO_2 emissions at the exhaust pipe.

For biojet fuel, since the fuel is not currently taxed, and without an incorporation target or a dedicated tax system, it is difficult to include biofuels in it since, while they have environmental performance more favorable than that of fossil fuels, they remain more costly than fossil fuels.

France has key assets for developing the advanced biofuel sector because it has an industry that produces conventional biofuels, a refining industry, considerable lignocellulosic resources, and advanced biofuel production technologies. Advanced biofuel production units could either be incorporated into conventional biofuel production units, or into oil refineries, so that synergies could be found and the major investments required could be reduced. As regards biomass, the issue in France is not so much quantity as mobilization. Finally, advanced biofuel production units are also the gateway to biorefineries: for example, in an advanced bioethanol unit, it is possible to co-produce second-generation sugars, which will serve as the basis for the platform molecules used to build the advanced products. Projects are currently in progress in various regions of the world (India, and Eastern Europe) for developing such industrial facilities. Since they take 4 or 5 years to complete, we need to start them today. These units will make it possible create industrial and agricultural & forestry jobs and to decarbonize transport.

Issues and opportunities in the aviation sector

Nicolas Jeuland, Head of Foresight for Low-Carbon Fuels (Safran)

The air transport sector is currently the focus of much discussion regarding its environmental footprint. Much has already changed in 50 years, and a present-day aircraft emits 80% less greenhouse gas per passenger kilometer compared with the first generations. The entire aviation industry is working flat out to continue to reduce the environmental footprint of aviation and has set itself ambitious targets. Sustainable alternative fuels, including advanced biofuels, are clearly part of the solution.

However, the aviation sector has to take into account a certain number of constraints.
Firstly, it is necessary to make sure that any technological development for alternative energy makes it possible to continue to perform the primary mission of this sector, namely to transport passengers safely and efficiently over long distances. Any alternative energy development should therefore take place with an eye being kept on maintaining an optimum level of safety, and on maintaining performance (range, cold resistance, etc.).
By way of example, a battery-powered electric aircraft will not exist for a very long time yet for medium-haul and long-haul flights because, currently, even the best batteries do not make it possible to fly such distances in view of the energy density of such batteries and therefore of the weight taken on board.

Safety is a fundamental element. It is inconceivable for the development of an alternative energy to take place to the detriment of optimum flight safety. That is why the second-generation biofuels, namely "drop-in" fuels, are of particular interest to us, because their energy content is very high and their compatibility with all aircraft/airports is already guaranteed at blend levels that can be as high as 50%. Advanced biofuel production channels are already certified internationally, and biofuels can therefore be incorporated safely into all aircraft across the world at levels of up to 50%.

The main difficulty for the aviation sector lies in international flights:

- This international concept implies coordination between countries. It is essential for a fuel that is deemed to have an environmental benefit in one country to be considered in the same way in another country. That is discussed at an international level within the ICAO. That organization has enabled genuine progress to be made, such as international frameworks and schemes like CORSIA, the only international body that enables the aviation industry to offset its emissions.
- Fuels account for 40% of the operating costs for an airline. It is therefore important for the mechanisms put in place to develop such biofuels (currently 2 to 3 times more expensive than conventional fuel production channels) to take into account the aspects of local distortions in competition and of any negative effects related, for example, to particular fuel purchasing strategies (known as "tankering" strategies, e.g. filling up the aircraft's tanks for more than one flight, resulting in making the aircraft heavier and in increasing the emissions, or indeed making stops at airports at which the fuel is low-cost).

The bottom line henceforth is that these fuels should arrive on the market under economic conditions that are acceptable for everyone. And to achieve that, a strong message will be necessary from the public authorities, in particular so as to give manufacturers vision over the long term (regulations, and sustainability criteria) that enables them to invest in biojet fuel production units. Doubtless, mechanisms for supporting demand should also be put in place to "set the wheels in motion".

Listen to all of the discussions (in French):

The point of view of Renault Truck (in French):

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