D8.1.3 Instrumental Overview of Innovative Instruments on Sustainable Aviation Biofuels Policies in the EU
WP 8 Dissemination
1 July 2018

REPORT, PENDING REVIEW

T8.1. – The Legal and Policy Framework for Aviation Biofuels
Task 8.1.1 Comparative Benchmarking
Biological Fully Synthetic Jet (BFSJ) grant n°612763
Authors: VUB (Filip Sedefov, Harri Kalimo, Eleanor Mateo, Ólőf Söebech)
Table of Contents

Abstract ........................................................................................................................................... 3
1 Introduction ...................................................................................................................................... 4
2 Innovation in different types of instruments .................................................................................. 5
3 Rationales behind policy instruments .......................................................................................... 6
4 Regional feedstock perspectives .................................................................................................... 8
5 Policy drivers .................................................................................................................................. 9
6 Stakeholders ................................................................................................................................... 12
7 Conclusions ...................................................................................................................................... 14
List of Interviews .............................................................................................................................. 16
Annex 1 Instrument preliminary systemisation ................................................................................. 17
Abstract

This document provides insights into innovative policies to optimise the use of environmentally and economically sustainable biofuels in the aviation sector. The focus of this deliverable is on developments in eleven front runner jurisdictions: Brazil, Denmark, Finland, Germany, Indonesia, Japan, Mexico, the Netherlands, Norway, Sweden and the United States. The report builds on previous WP8 deliverables. 24 expert interviews and desktop research highlighted a number of innovative and particularly relevant policy initiatives. Further systemisation and analysis lead to observations from three angles: the regional feedstocks, policy drivers and the biofuels value chains. While our findings indicate that the aviation biofuels sector may be ready to reach for sustainability goals and to use SAF, the aviation biofuels policies do not yet offer sufficient support and incentives for the market to take-off. Important policy gaps to advance the uptake of aviation biofuels remain to be exploited due to the challenging disconnect between, on the one hand, the great diversity in the technological environments, policy drivers and value chains at the local and national level, and, on the other hand, the global nature of the aviation industry. There seems to be limited public and civil society support as well as political will, to profoundly challenge the political economy of the sector.
1 Introduction

This research is conducted as a part of the European FP7 funded project titled Production of fully synthetic paraffinic jet fuel from wood and other biomass: BFSJ. Within Work Package 8, Task 8.1.1 focuses on comparative benchmarking, within the legal and policy framework for aviation biofuels. This deliverable D8.1.3 aims to provide an overview of innovative aviation biofuels in the EU and beyond and to provide insight into how the policy environment has been evolving as well as where it may be heading.

Mobility remains an important challenge for sustainable development. The global growth economy is intrinsically linked to vast movements of people and goods, yet these movements cause a severe stress on the climate, natural resources and other aspects of the environment. Aviation is a particularly challenging form of mobility: air transport is increasing rapidly, while there appear to be no obvious short to medium-term technological alternatives to liquid hydrocarbon, similar to electricity or hydrogen in road and maritime transport. Within this timeframe, sustainable aviation biofuels to replace fossil fuels seem to offer the most promising option to reduce carbon emissions in the sector. A number of governments and other stakeholders worldwide have therefore been developing sustainable biomass-based jet fuel pathways. New initiatives are emerging to support the supply and demand of such Alternative Jet Fuels (AJF) to create a properly functioning market.

In this report, our objective is to provide. We have explored through an extensive desktop research and (24) expert interviews the most innovative policies that are in place globally to promote AJF specifically or as a part of broader schemes on biofuels or renewables. Our analysis is comparative: we scrutinised in a benchmarking study on eleven leading countries the types of instruments under development and in operation, the stakeholders implicated by the instruments, as well as the main drivers behind the policies. The countries chosen for a closer analysis were in view of the experts the most proactive in stimulating the uptake of AJF. The deliverable does not intend to be exhaustive, but rather aims at identifying, analysing and systematising the instruments that can be described as the most innovative ones, and that can thereby offer benchmarks and ideas for policy development in the field. A specific policy can be innovative either conceptually or by its scope of application if, for example, it has not previously been used to promote AJF uptake or it has been adapted for that purpose. Moreover, the analysed policies were in the view of the interviewed experts the most promising for promoting the sustainable development of the field.

Our analysis starts off by systemizing AJF policies along the types of instruments that are in use (Section 2). We then reflect on the systemization from theoretical perspectives (Section 3), which leads to three main angles of observation: a regional feedstock perspective (Section 4), the perspective of policy drivers (Section 5) and a value chain perspective (Section 6).

The analysis concludes that there are various interesting isolated developments and a potential convergence of interests regionally. However, the outlook at the vital international level is not particularly encouraging. Important policy gaps to advance the uptake of aviation biofuels remain to be exploited. We argue that the main reason for the gaps is the challenging disconnect between,

---

1 ICAO forecasts indicate that air traffic volumes will grow by an average of approximately 4.5% annually over the next 15 years. See IHLG (Industry High Level Group) Aviation Benefits Report 2017.
2 These include the following: Brazil, Denmark, Finland, Germany, Indonesia, Japan, Mexico, the Netherlands, Norway, Sweden and the United States.
on the one hand, the great diversity in the technological environments, policy drivers and value chains at the local and national level, and, on the other hand, the global nature of the aviation industry. There is limited public and civil society support, and consequently political will, to profoundly challenge the political economy of the sector.

2 Innovation in different types of instruments

Policy instruments are traditionally grouped into five types: regulatory, economic (i.e. market-based), informational, cooperative (i.e. voluntary), as well as government performance –related instruments. We identified multiple innovative measures to promote AJF in four of these five categories, but only very few instruments in the category of information targeted at the customers and final consumers of AJF.

Regulatory instruments refer to the traditional command-and-control approach to environmental policy. They entail the largest amount of state control and tend to offer little to no flexibility to the obligated parties with regard to compliance. Blending or drop-in mandates are an example of such regulatory instruments in the biofuels sector: the suppliers of the fuels are mandated to blend a predetermined minimum percentage of biofuel together with their supply of fossil-based kerosene. Norway and Indonesia have pioneered the establishment of mandate policies for AJF with the former on its way to setting up a 1% blending obligation as of 2019 and the latter already implementing a 2% obligation in 2018. Although such policies have so far been dogged by tough political negotiations and, particularly in Indonesia, poor enforcement, blending mandate policies appear to work well in forcing the creation of a market. The relatively aggressive blending mandates in the road transport sector over the past ten years have made Indonesia a major biofuels producer and exporter. The application of mandates in the AJF sector can be considered innovative and, importantly, demonstrates strong will by public authorities to integrate biofuels in the jet fuel supply chain.

Economic instruments use positive and negative financial incentives and price signals to influence actors’ behaviour. They adopt a flexible and efficiency-oriented approach to achieving the desired effects. Economic instruments can be of either the regulatory (mandatory) or voluntary kind. The European Union’s Emissions Trading System (ETS) is perhaps the most prominent example of a regulatory market-based instrument in use today. This cap-and-trade system has been innovatively connected to the aviation sector by making the scheme applicable to all intra-EEA flights. The scheme indirectly stimulates AJF development by setting a cap on the greenhouse gas emissions from the flights while assigning an emission factor of zero to any flights using biofuels. A further, more innovative example, can be found in Norway where public authorities have considered the establishment of a landing fee reduction system whereby landing charges at

5 Böcher, M. 2011. A theoretical framework for explaining the choice of instruments in environmental policy, Forest Policy and Economics 16 (2012), p. 15. Böcher reiterates a traditional classification of environmental policy instruments, classifying them as informational (e.g. labels, environmental information), cooperative (e.g. voluntary agreements, certification), economic (e.g. taxes, tradable permits, subsidies), and regulatory (e.g. direct control). The instruments range from low to high in terms of the amount of government intervention they imply.


7 See Indonesia MEMR, Regulation 12/2015.


9 See Böcher 2011 at 14.

airports would be reduced or altogether waived for flights using an AJF blend. The schemes are a voluntary market-based instrument: the lower landing tax creates a financial incentive to blend in biofuels, but the aircraft operators are free to decide whether they would like to benefit from the scheme or not. While restrictions stemming from international aviation law have put the establishment of this mechanism on hold, conceptually, it constitutes an important step forward that could be further explored should such obstacles be overcome in the future.

Cooperative approaches make use of coordination mechanisms between private actors, or between private and public actors, to establish networks for negotiations, mediation and stakeholder events. Although these approaches do not perhaps constitute policy instruments as such, they often benefit from financial support from the state for their establishment. They have been experimented with extensively in the aviation biofuels sector in the United States, as will be explained in Section 6 (Stakeholders) below. U.S. schemes such as the Commercial Alternative Aviation Fuels Initiative (CAAFI) have played an important role in streamlining the development of the sector. The extensive scope of the AJF value chains render cooperation between stakeholders indispensable.

Government performance or procurement mechanisms can play an instrumental role in promoting AJF in terms of creating the much needed demand stability for producers’ long term investments. Through Title III of the Defence Production Act (DPA), the United States Department of Defence, together with other federal institutions and agencies has been central in driving biofuels demand by setting up goals to increase alternative fuel consumption in all its equipment. In 2014, it awarded funding to three biorefineries – Emerald Biofuels, Fulcrum Bioenergy and Red Rock Biofuels – all of which aim at commercially producing aviation biofuels from plant oils, municipal waste and woody biomass respectively. At the same time, the use of informational instruments has, as said, been very modest in promoting AJF. The gap is closely related to the absence of civil society and consumer engagement in the issue.

3 Rationales behind policy instruments

Although policy instruments have characteristics that allow them to be systemised along the above noted traditional categories, most instruments have in fact multiple dimensions. This makes it difficult to categorise the instruments unequivocally. Moreover, the instruments are rarely used independently, but are usually a part of tailor-made policy packages. In fact, an important innovative aspect of AJF promotion are precisely the pragmatic combinations of instruments to develop the sector.

---


12 See article 15 of the Chicago Convention which limits State’s ability to impose additional charges.


14 www.caafi.org/about/caafi.html


6
Böcher\textsuperscript{16} and Kalimo\textsuperscript{17} amongst others have offered perspectives on the factors involved in the choice of environmental policy instruments, which go beyond the traditional “public choice” and “naïve instrumentalism” approaches. Both authors have argued that mere instrumentalism does not accurately and fully account for the various processes involved in defining and choosing a particular policy scheme for a specific objective. A combined approach that involves as many of the essential influencing factors as possible is necessary. Kalimo has highlighted the varying degrees of harmonisation and levels of policy-making as a factor\textsuperscript{18}, while the analytical framework developed by Böcher suggests that policy choices are influenced by factors pertaining to existing institutions in the broad sense, such as policy path dependency. The latter author also lists as influencing factors discourses on instrumental alternatives, the problem structure (perception of the problem in political spheres) as well as the situations and positions of the different actors involved. These frameworks can be usefully applied to the case of AJF to explain the developments in the field,\textsuperscript{19} such as the composition and variety of instruments currently in use and our conclusion on the lack of strong single policy frameworks nationally and internationally.

More specifically, Böcher’s institutional factors imply for aviation biofuels path dependency with the command-and-control policies that have historically been used in the conventional biofuels sector. The path dependency could explain the perception that policy instruments such as blending mandates are effective also in stimulating AJF. We explore the context specific nature and the path dependency of the aviation biofuels instruments further in Section 4.

As regards Böcher’s “discourses on alternative instruments”, the general shift in environmental policy from command-and-control regulation to a more market-based approach is visible also in the biofuels sector. The economic efficiency discourses could thus entail a shift from the planning of blending mandates to more market-oriented instruments such as offsetting measures, green certificates and credits, or to additional taxes or tax breaks. Specific examples of such measures in the AJF field include the ICAO offsetting measures under CORSIA\textsuperscript{20} and the green certificate schemes such as the United States RINs\textsuperscript{21} or Dutch HBE’s\textsuperscript{22}. Despite their novelty, sustainable AJFs are also an integral part of the broader biofuels sector and, further, of the energy and security policies. They are therefore closely linked to the developments and debates taking place at the more general level. These types of economic and security considerations are analysed in more detail in the Section 5 on Policy Drivers.

There has also been a dramatic shift in what Böcher calls the problem structure of biofuels. Especially in the European Union, the environmental benefits of biofuels production and use have been called into question over the past years. This has in turn led to the alteration of the positions of various actors and created a complex network of differently positioned stakeholders. Policy making at the national and international levels has thus become increasingly difficult, even though a careful attribution between the different levels of policy-making would be required. The result is

\textsuperscript{16} Böcher 2011, pp. 15-17.
\textsuperscript{17} Kalimo 2006, 658-76.
\textsuperscript{18} Kalimo 2006, 658-76.
\textsuperscript{19} Böcher 2011, pp. 15-17.
\textsuperscript{20} CORSIA means that airlines are allowed, and from 2027 required to compensate for their CO2 emissions, but that they can offset their own reductions by purchasing on a carbon market credits that represent reductions in other, more efficient projects. CORSIA is briefly discussed in Section 6 below.
\textsuperscript{21} The US Renewable Identification Numbers (RINs) are a system similar to the EU’s Emissions Trading albeit specifically targeting renewable fuels. A mandatory volume of renewable fuel in transport is set each year by the US Environment Protection Agency and suppliers must demonstrate compliance by handing in the number of RINs corresponding to that volume. RINs can be traded between suppliers so that the mandate is fulfilled as efficiently as possible. Revenues from a surplus of RINs offer additional financial support to renewable fuel suppliers.
\textsuperscript{22} Similarly, in the Netherlands, HBE credits are allocated and can be traded by those suppliers having a surplus.
a lack of clear-cut objectives, and ambiguous policies at various jurisdictional levels. Private or private-public cooperation networks attempting to incrementally push AJF development forward have proliferated. These kinds of stakeholder perspectives form the contents of the final Section 6, before the Conclusions.

4 Regional feedstock perspectives

The raw materials available as feedstock for the production of AJF vary greatly by geographic region. The feedstock in turn determines which of the certified production pathways can be used, and countries (or regions) have often had long standing policies in place to support such pathways. There is thus technological regional path dependency on the types of policy instruments that are in place to support AJF.

Three main categories of raw materials feedstocks exist: oils, lignocellulosic biomass, and sugar and starch biomass. When developing its bioenergy industry, each country or region will naturally play to its strengths in terms of the local availability of biomass, even though feedstock can to some extent also be imported. Broadly speaking, this would entail a stronger focus on starch and sugar-based feedstocks in countries such as the US and Brazil, that already traditionally grow corn and sugar cane. Lignocellulosic biomass is abundant in the EU in the form of e.g. organic waste or wood residues from the Nordic forest industry, albeit some of the agricultural produce such as sugar beet and rape seed is also diverted to biofuel production. Oil-based feedstocks such as animal fats, palm and jatropha oil are prominent in South-East Asian countries such as Indonesia. In general terms, it is essential to diversify the sustainable feedstocks further to offer a robust supply of biomass-based products to develop the markets.

With the emergence of the advanced second, third or fourth generation biofuels the feedstocks will however drastically change. The suitability of policy instruments that have been designed for pathways that are intertwined with the agricultural sector, in particular, may be ill-suited for supporting the latest generations of non-land use based biofuels. Indeed, strong links to agriculture may even constitute important barriers for the development of sustainable AJF pathways, as was demonstrated by how the recasting of the European Renewable Energy Directive (RED) was connected to the EU’s Common Agricultural Policy CAP. Concerns that lead to such obstacles may, nevertheless, not be fully founded. Those advanced crop-based lignocellulosic pathways that result in low or zero indirect land-use change effects, may reach adequate levels of sustainability, and complement and increase agricultural resource-efficiency rather than altogether preclude raw material production. Generally speaking, in the interest of maximising production capabilities and regional supply chains, neutrality of support policies in terms of the production pathways has been advocated by many stakeholders in the value chains. We revert to the issue while discussing the drivers behind the policies in Sections 5 and 6.

A number of different processing technologies are available for the conversion of raw biomass-based materials into jet fuel. So far, the precise qualities and maximum blending ratios of AJF involving five different production pathways have been certified under the American Society for Testing and Materials (ASTM) standard D1655 as equivalent to conventional jet fuel (i.e. drop-

The difference in these processing technologies lies in the type of raw material or feedstock that serves as input. The availability of the feedstocks themselves is, as said, contingent on the natural resources available in a given region, which usually entails the existence of policies supporting the production of such feedstock, whether for use as a biofuel or something else.

In Brazil for instance, several decades of strong government incentives targeting the production of bioethanol for uses in the road transport sector have stimulated the development of a robust sugar cane industry along with a solid harvesting and transport infrastructure. As a result, the focus has been on developing these pathways, such as the DSHC (direct sugar to hydrocarbons), which have the most potential in utilising the resources and mechanisms already in place. Because feedstock production, harvesting, transportation and pre-processing are already relatively streamlined, it appears natural that the policy instruments specifically targeting the AJF sector would rather also be targeted towards optimising the later stages of the AJF production chain. Instruments of this kind include supporting research and development for the relevant pathway(s), scaling-up the production of biojet fuel and mandating specific blends to distributors and end-users.

Thus, the policy development has been more a matter of integrating the back-end technologies necessary to produce AJF into the biomass value chain and redistributing the resources therein, than drastically increasing biomass production or promoting completely different types of feedstock or processes. Within the framework of its new bioenergy policy (RenovaBio and Biofutures Platform), Brazil is thus planning to integrate AJF with the pre-existing biomass value chain and to specifically target AJF production and commercialisation through innovative emissions reduction certificates called CBIOs. AJF producers can sell the CBIOs renewable fuel units to conventional fuel producers to help the latter meet planned renewable fuel obligations. In the Netherlands, a similar innovative scheme in the downstream end is in place: companies that supply renewable energy to the Dutch transport sector can claim the delivered renewable energy in their account in the Energy for Transport Registry (REV), and receive Renewable Energy Units (HBEs) in return. The impact of the HBEs in bridging the significant price gap between the biofuel and the fossil fuel may be a decisive incentivising factor for the market to emerge.

5 Policy drivers

The rather simplistic technology-based reasoning described above explains to a certain extent why there is such a large diversity of biofuels policies globally. Equally important are, however, the drivers behind the policies. Three imperatives emerge as essential drivers in many policy discussions: environmental sustainability, energy independence (security of supply), as well as

26 The American Society for Testing and Materials (ASTM) standards D1655 (Standard Specification for Aviation Turbine Fuels), D4054 (Standard Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives) and D7566 (Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons) are used to certify that aircraft are able to operate safely and reliably on drop-in alternative fuels. The pathways certified by ASTM under these standards so far include the following: synthesis gas FT synthetic paraffinic kerosene (FT-SPK), hydprocessed lipids (HEFA-SPK), biochemical sugars (HFS-SIP or DSHC), synthesis gas FT synthetic paraffinic kerosene including aromatics (FT-SPK/A), and isobutanol conversion (ATJ-SPK).
economic benefits such as employment and economic growth. The importance of each of these three drivers varies between the countries and regions.

The primary objective of many biofuels policies is that of reducing emissions from the aviation sector, but the other drivers will influence the attainment of that objective, acting as either supplementary drivers or constraints on the uptake. The extensive nature of the biofuel and AJF value chains means that there is usually more at stake than reduced emissions and sustainability in the strict sense, and that the instruments used to promote AJF must be adapted to this complexity in all aspects of biofuels production and use. This leads to rather extensive toolboxes of policy instruments, which in turn presupposes a careful coordination to maintain the coherence of the efforts. Further complicating the coordination task is the multi-level nature of the involved policies: a crucial issue that we revert to in the concluding Section.

Many policy instruments are driven by the economic objectives of stimulating supply and boosting demand for AJF. Collaborative networks and information sharing, for example, are often driven by the need to better connect the demand and supply to form functioning markets, and hence a thriving bio-economy. The US Commercial Aviation Alternative Fuels Initiative (CAAFI) is an example of an initiative which has been particularly prominent in its efforts to streamline the aviation biofuel value chain. CAAFI has so far been successful in creating stakeholder networks (both US and foreign) as well as with setting up valuable information sharing tools, such as the Fuel Readiness Level (FRL) framework, used to track the development, progress and risks affecting fuels under development and an ASTM Users Guide, designed to assist producers of new fuel technologies through the lengthy and costly ASTM certification procedure.

Financial support for research and development is aimed at driving down the cost of AJF by improving technologies, streamlining production processes and thereby increasing the supply on the market. Such schemes exist in all of the eleven analysed countries: to give an example, in the United States the Department of Energy is, through its Bioenergy Technologies Office (BETO) and national laboratories (such as the National Renewable Energy Laboratory), directly funding and carrying out cutting-edge research on new conversion technologies, taking them through the laboratory, pilot and demonstration stages respectively. Many networks for collaboration and information sharing have been established with the same aim of facilitating contacts between industry stakeholders, thus also setting the stage for sufficient investments in research and development and offtake agreements in the sector.

There are also initiatives aimed at driving the commercialisation phase, simply making sure that AJF are actually available for purchase at the aircraft refuelling points. The Oslo and Bergen airports in Norway have been working towards developing a supply chain able to deliver AJF directly to the airport re-fuelling facilities, thus offering a supply of a blend for all arriving and departing aircraft. This initiative marked the first time a blend containing aviation biofuel was delivered directly an airport’s fuel supply system.

The demand-side of the AJF economy has also been specifically targeted by innovative policy instruments in some countries. Northern-European countries have been particularly active in this area. For instance, Swedish government-owned airport operator Swedavia has pledged to procure

---


amounts of aviation biofuel sufficient to cover its employees travel. The 450 tonnes of alternative fuel thus purchased by Swedavia was used to refuel aircraft at Arlenda airport of Stockholm, further integrating the logistics and supply chain leading up to the fuel delivery.\textsuperscript{33}

The operation of economic policies targeted at boosting supply, demand and collaboration between stakeholders such as the ones mentioned above, seem quite instrumental in creating a market for AJF. These activities funded and carried out by government bodies need to play an important role in absorbing a significant part of the scale-up and commercialisation-related risks and potentially increase the cost-competitiveness of AJF, therefore also reducing the need for specifically targeted subsidies. The price disadvantage of sustainable biofuels to fossil fuels appears too substantial for a commercial market of sufficient scale to emerge.

The crucial question in terms of the economic objectives is, as in all sustainable consumption and production policies, their relation to the environmental sustainability objectives. Economic drivers may be a crucial tool in making the sector more environmentally sustainable. There is however always the risk that the economic objectives such as profitability and jobs are not mutually supportive to environmental aims, and overtake, or at least take priority over, the environmental goals. Even green consumption is still consumption, and the rebound effects of more sustainable policies require careful attention.

Ultimately, the driver of developing sustainable aviation fuels must remain naturally that of reducing emissions and thus decreasing the aviation sector’s effects on climate change. Hence, an important part of promoting aviation biofuels (as with any biofuel) is making sure that these alternative fuels deliver the expected environmental improvements. Policy instruments to guarantee the environmental sustainability of AJF exist or are currently being planned in the majority of countries analysed. Member states of the European Union are for example subject to stringent and harmonised sustainability criteria contained in the Renewable Energy Directive, which set up minimum greenhouse gas emissions savings requirements for all biofuels produced or imported into the EU.\textsuperscript{34} Similarly, in the United States, minimum emissions savings requirements must be reached in order to qualify under the Environmental Protection Agency’s Renewable Fuel Standard RFS II.\textsuperscript{35} There are nonetheless also countries such as Brazil and Indonesia, that until recently either did not have any sustainability criteria geared towards biofuels production in place, or exempt the latter from their scope of application.\textsuperscript{36} In other words, the environmental drivers of the AJF policies were to large extent absent, and this influenced the types of instruments that the countries have in place.

The lack of stringent sustainability requirements, comparable to those in the European Union or the United States, may stem from the fact that the biofuels policies have been driven by social and security objectives. Countries such as Brazil have a long history of developing, producing and using biofuels, mainly in the road transport sector. These policies pre-date any climate change mitigation or emissions-related agreements at the international level. Environmental considerations are only now – in the explicit references to sustainability certification in Brazil’s

\textsuperscript{33} See Swedavia press release 2017, “Inaugural fuelling with Swedavia’s aviation biofuel at Stockholm Arlenda airport today ”. Available at: https://www.swedavia.com/about-swedavia/for-press/inaugural-fuelling-with-swedavias-aviation-biofuel-at-stockholm-arlenda-airport-today/#gref. Other airports such as Los Angeles LAX and, more recently Geneva Airport have undertaken similar initiatives aimed at testing and optimising aviation biofuel supply by integrating such fuels directly into the supply logistics.

\textsuperscript{34} See article 17 and following of Directive 2009/28/EC on the promotion of energy from renewable sources.


latest bioenergy legislation - appearing in the policy landscape. The biofuels sector was developed as a way to ensure energy independence and security in the wake of the 1970s oil crisis. The driver to insulate a nation from fossil fuel imports from third countries, in particular in cases of political crises, remains an important one. The security objectives have been a fundamental strategic driver also in for example the United States. Biofuels strategy has been closely related also to the U.S. agricultural policy and the social objective to create jobs in rural, poor communities, as is the case in Brazil. For the aviation sector specifically, however, AJF public procurement activities by the US Department of Defence for the flights and ground fleet of the U.S. military forces can be instrumental to the sector’s development.

As can be seen, the environmental, economic, social and security drivers of AJF policies are closely interrelated. Their reciprocal effects may be either positive or negative. Understanding well these interrelationships, and managing them appropriately, is an important challenge. The challenge is exacerbated by the very international nature of the sector. If the environmental objectives of AJF are shared, then international alignment seems obvious in cases where the environmental harm is also international in scope. Carbon emissions are the natural example, while biodiversity related considerations might be much more local, and hence more difficult to align. On jobs and growth, the interests of countries may well be in competition with one another, and dissimilar in substance depending on the national stakeholder constellations – the policy implications are to be discussed in more detail under Section 6 below (Stakeholders). Security of supply drivers represent views that, while similar in their general objectives, are inward looking and engrained in the particular national (security) circumstances.

6 Stakeholders

Moving from the macro-level observations to the micro-level of the involved stakeholders, our observations on the innovative instruments can be further refined. The value chains in the biofuels sector tend to be complex, which further increases the versatility of the types of policy instruments used, whatever the predominant feedstocks or policy drivers in a particular country or region. A stakeholder perspective also brings forth further explanatory factors for the gaps in the evolution of policy instruments, such as the novelty of many of the actors and especially the political economy of the sector. Of particular importance are the differences between the mostly local, small scale actors in the upstream parts of the value chain, and the massive international actors – especially the oil refiners and the airline industry – in the downstream parts. Conspicuously absent are the voice and actions of the civil society (the green NGOs) and the consumers.

The multiple country overview shows that some instruments apply to a single type of a stakeholder in the value chain, whereas others apply or target many stakeholders. Matters are further

37 See Chapter VI, articles 18 and following of Law No. 13.576 of 26th December 2017 (RenovaBio) establishing a national biofuels policy. Despite the historical lack of any control regarding the environmental sustainability of biofuels in Brazil, the new bioenergy legislation explicitly refers to sustainability certification by certified inspection bodies. It does not, however, go so far as to establish specific sustainability criteria.


complicated from an economic perspective: interests may be similar globally on certain layers of the value chain (such as airlines), but differ drastically on others (the production in countries with 1st, 2nd or 3rd generation feedstock, for example).

For instance, although the obligation to demonstrate compliance with policies establishing sustainability criteria or standards apply to producers and importers only, the necessary life-cycle nature of any biofuel sustainability analysis means that all stakeholders situated upstream of the production or distribution phase must undertake actions to ensure sufficient sustainability. Even the operators down-stream are affected, where their sales are contingent upon respecting the sustainability criteria. For example, only AJF that meets the RED sustainability criteria can be counted towards the directive’s targets and be subject to support schemes in the EU Member States. From the viewpoint of the full industry value chain, it becomes apparent that many of the instruments used to promote AJF are addressed to the “traditional” actors in the process, i.e. feedstock producers, pre-processers, producers and distributors. These are indeed the stakeholders benefiting from instruments: financial support for research and development and green certificate schemes, but also those that are subjected to blending mandates where these exist.

However, in the specific case of biofuels in the aviation sector, there exist important players who are not yet targeted by policies in any substantial manner. Airlines -- beyond intra-EU air-traffic, which is a part of the European Emissions Trading Scheme (ETS) -- are perhaps the most important layer of the value chain in this respect. Airlines could greatly contribute to increasing the demand of AJF. In this respect, ICAO’s CORSIA measure is not necessarily as helpful as was initially hoped for. It is feared that the cost of offsetting may be much lower than that of purchasing AJF, leading those obligated under the scheme to systematically choose offsetting. This would limit the potential of CORSIA to help create an AJF market.

Airports are another important stakeholder that is still often overlooked in the value chain. In comparison with road transport, the number of airports to which the AJF needs to be supplied is very small, and the required modifications to existing infrastructure are in fact very limited. Thus, innovative instruments to target that crucial node in the value chain could be an efficient leverage for the uptake of AJF. The Norwegian authorities and national airport operator Avinor have been considering introducing a scheme whereby airlines flying on sustainable fuels are awarded reduced landing fees in Norwegian airports. The Parliamentary proposal suggests a 25% discount in landing fees for flights using a 25% biofuels blend. These plans have nevertheless been affected by potential limitations stemming from international law. In addition, a blending requirement of 1% drop-in sustainable kerosene will apply from January 2019 and will increase to 30% by 2030.

A further important stakeholder is the above noted American Society for Testing and Materials, ASTM. The quasi-monopolistic position of ASTM in certifying aviation fuels for the American, but equally for the European markets, grants it a powerful position in the implementation of biofuels policies. The interviews conducted within this research make it clear that ASTM’s policies have direct repercussions on, not only the safety of flights, but on the economic interests of various stakeholders in the sustainable aviation biofuels value chain.

---

40 See Section 2 above and Article 15 of the Chicago Convention which limits State’s ability to impose additional charges.

The final consumers (i.e. the passengers) are in many environmental policy areas in a decisive role in driving the green demand. Economic (dis)incentives or awareness raising informational tools, typical to many goods and services markets, are however largely missing in terms of air travel. Even the green NGOs are strikingly silent. The few instances where these downstream actors are targeted represent, in fact, the policy instruments that might qualify as the most innovative in terms of promoting alternative fuels in the aviation sector. The Fly Green Fund based in Sweden is one of very rare examples where measures targeting end-users are being implemented. Within this framework, corporate and private customers can pay a premium on top of their flight ticket, the amount of which is optional but which guarantees that a certain percentage of their flight will utilise AJF.

These measures, aimed at the downstream stages, can be essential in ensuring AJF commercialisation and market uptake. Interestingly, schemes such as Indonesia’s and Norway’s planned blending mandate will share and/or shift the burden of compliance from producers or distributors to the airlines themselves, who will thus have no choice but to share the burden of the cost of AJF along with the rest of the value chain. In fact, this might bode well for developments at the international level, where the progress in developing coordinated policies for AJF has been very slow. ICAO’s CORSIA offsetting scheme, as explained above, attests to this. One reason for this could be the lack of strong commitments and action from major AJF stakeholders such as airline companies that are highly organised and capable of influencing policy at the international level through powerful lobbying bodies such as the International Air Transport Association (IATA). Inversely, small-scale AJF producers that are new on the market and often only able to operate locally or simply have usually not moved past the pilot stages of AJF development, are undoubtedly less able to influence international-level decision-making in bodies such as ICAO. Broadening the responsibility borne by airlines for the emissions they generate in a logic similar to that of the “polluter should pay” principle, might in fact push for the development of stronger policies for AJF at the supranational level.

7 Conclusions

Various types of innovative policy instruments to promote AJF exist in an international comparison: regulatory command-and-control measures, economic and voluntary (cooperative) instruments as well as government performance–related tools. Information instruments targeted at the consumers are largely absent, however. The gap was considered to reflect the broader lack of civil society and public engagement in the promotion of sustainable aviation biofuels.

After a systemization of the most recent AJF policy instruments, they were on the basis of the theoretical framing of Böcher analysed in this deliverable from three angles: a regional feedstock (Section 4), policy driver (Section 5) and value chain stakeholder (Section 6) perspectives.

The analysis concludes that there are various interesting isolated developments and potential convergences of interests regionally. However, the outlook at the vital international level is not particularly encouraging from the viewpoint of deploying AJF. The analysis revealed important policy gaps in the advancement of the uptake of aviation biofuels. There is great diversity in the regional feedstocks, and this has led to numerous idiosyncratic policies. These policies in turn have created path dependencies that often hinder the shift to advanced biofuels, while the policies’ diverging contents and complicated value chains obfuscate the endeavours to draft common

---

regional and international rules and markets on AJF. The differences are further exacerbated by the variance in the drivers behind the national policies. Economic interests tend to compete with one another, while security of supply considerations make the national views inward-looking. The countries’ understanding on the importance and contents of sustainability criteria in AJF used to differ greatly. Here, convergence seems to be emerging, however, as many private initiatives such as the Roundtable for Sustainable Biomaterials (RSB) have progressed lately.

Overall, the fragmentation and divergences in the pathways, drivers and stakeholder positions have led to great uncertainty. The uncertainty, in turn, translates into a sluggish development of the AJF. This seems a poor short to mid-term solution for greening the aviation sector, whatever the longer term vision on the evolution of the air transport sector may be.

Finally, the stakeholder perspective made apparent how in the global political economy of the AJF, the major international actors in the value chain – especially the airlines and oil companies -- influence the developments. Innovative policy proposals that would include multiple small scale downstream stakeholders, such as technology developers, AJF suppliers and airports, are not duly considered. To bridge the gap from local and national policy innovation to the crucial international levels of governance, the civil society and the consumers in this international sector would need to become much more prominent. Only they seem capable of instigating the political will that the transformation calls for.

Technically speaking, the aviation biofuels sector is thus ready to taxi. In terms of governance, however the aviation biofuels policies do not yet offer sufficient support and incentives for the market to take-off.
### List of Interviews

1. Civil servant - policy experts USA
2. Civil servant - airport & sustainability expert Sweden
3. Civil servant - airport & sustainability expert Sweden
4. Civil servant - airport expert Norway
5. Civil servant – policy expert Brazil
6. Civil servant - policy expert Norway
7. Aviation biofuel industry expert Netherlands
8. Civil servant - legal expert Norway
9. Civil society - biofuels expert Sweden
10. Civil society - biofuels expert Sweden
11. Network - aviation biofuels expert Denmark
12. US civil servant - policy expert USA
13. Civil servant- airport & sustainability expert Denmark
14. Industry representatives/end user Finland
   Environmental NGO sustainable mobility expert
15. Norway
16. Civil servant- policy expert Denmark
17. Civil servant - policy expert USA
18. R&D expert - academia USA
19. Network – aviation biofuels expert USA
20. Network- aviation biofuels expert Sweden
21. Civil servant- policy expert Sweden
22. Energy engineering and design company Sweden
23. Network - industry representatives/end users USA
24. Civil servant - airport & sustainability expert Sweden
## Annex 1 Instrument preliminary systemisation

<table>
<thead>
<tr>
<th>Name of Instrument</th>
<th>Countries where found</th>
<th>Aim of instrument</th>
<th>Trade law observations</th>
<th>Stakeholders - who is targeted/where in value chain?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DK</td>
<td>PI</td>
<td>NO</td>
<td>SE</td>
</tr>
<tr>
<td>Sustainability criteria</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Energy taxation (not aviation specific)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part of ETS</td>
<td>1</td>
<td>P</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Blending mandate for road transport</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Blending mandate specifically for aviation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>P</td>
</tr>
<tr>
<td>Feed-in tariffs (DISincentive)?</td>
<td>1</td>
<td>1</td>
<td>?</td>
<td>1</td>
</tr>
<tr>
<td>Landing fee reductions for flights using (X %) SAF</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green voluntary public procurement (for SAF)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial support to R&amp;D</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Financial support for production and processing</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Financial support for construction of plant</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Financial support to establishing network</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>P</td>
</tr>
<tr>
<td>Name of Instrument</td>
<td>Who operates/implements the instrument</td>
<td>Drivers</td>
<td>Type of instrument</td>
<td>Core theme: Greening/pushing/creating the market</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------</td>
<td>---------</td>
<td>--------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>E.g. Government, private, Public-private...</td>
<td>Improve = ensure sustainability</td>
<td>Regulatory, Market based, Performance of Gov’t &amp; public institutions, Compulsory Information Instrument, Voluntary Information Instrument, Voluntary Instrument, Voluntary agreements, Cooperative approaches, Funding, Awareness raising Campaigns, other</td>
<td>REG</td>
</tr>
<tr>
<td>Sustainability criteria</td>
<td>Government; private party (eg RSB)</td>
<td></td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Energy taxation (not aviation specific)</td>
<td>Government</td>
<td></td>
<td></td>
<td>m</td>
</tr>
<tr>
<td>Part of ETS</td>
<td>Government</td>
<td>reduce CO2 emission of the industry</td>
<td></td>
<td>m</td>
</tr>
<tr>
<td>Blending mandate for road transport</td>
<td>Government</td>
<td>Increase energy security/diversify energy supply / environment protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blending mandate specifically for aviation</td>
<td>Government</td>
<td>Increase energy security/diversify energy supply / environment protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed-in tariffs (DisIncentive)?</td>
<td>Government</td>
<td>Diversify source of energy/ climate change mitigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landing fee reductions for flights using (X %) SAF</td>
<td>Government</td>
<td>Increase SAF use by airlines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green voluntary public procurement (for SAF)</td>
<td>Public-Private / (Public)</td>
<td>make SAF more price competitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial support to R&amp;D</td>
<td>Government, Private</td>
<td>Promote R&amp;D in technologies and business models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial support for production and processing</td>
<td>Government, private</td>
<td>Stabilize supply of SAF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial support for construction of plant</td>
<td>Government</td>
<td>support large-scale production/commercial production of SAF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial support to establishing network</td>
<td>Government, Private</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name of Instrument</td>
<td>Countries where found</td>
<td>Aim of instrument what does it set out to do? expressed goals/targets/outcome</td>
<td>Trade law observations</td>
<td>Stakeholders - who is targeted/where in value chain?</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>-----------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Financial support to renewable energy (electricity) production (O:Incentive)</td>
<td>P</td>
<td>Financial incentive to support production of RED</td>
<td>n/s</td>
<td>Feedstock, pre-process (bioethanol) - Producer</td>
</tr>
<tr>
<td>Tax on NOx</td>
<td>I</td>
<td>Economic incentive to improve the sustainability of SAF / use of SAF</td>
<td>x</td>
<td>Transformation/conversion (refinery) - distribution -</td>
</tr>
<tr>
<td>Tax relief on biofuels / tax on CO2</td>
<td>I I I I</td>
<td>Economic Incentive to improve the sustainability of SAF</td>
<td>x x x x</td>
<td>airport - airline - end user (individual, corporate, public)</td>
</tr>
<tr>
<td>Relief from import duties for biofuels</td>
<td>I</td>
<td>Economic incentive to increase the supply of Biofuels</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Levy in exports of palm oil based products</td>
<td>I</td>
<td>Economic incentive to maintain biofuel resources within the country</td>
<td>x x x</td>
<td></td>
</tr>
<tr>
<td>Distinct state tax for blending</td>
<td>P</td>
<td>(economic incentive to promote higher SAF blend / use?)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Individual or corporate purchases of SAF for their flights</td>
<td>I</td>
<td>Increasing demand of SAF and hence boost the supply</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Green certificates/biometrics</td>
<td>I</td>
<td>making the market efficient</td>
<td>x x</td>
<td></td>
</tr>
<tr>
<td>Putting biofuel on the market for purchase</td>
<td>I I</td>
<td>Increasing the supply of SAF available on the market - to integrate the value chain</td>
<td>? x</td>
<td></td>
</tr>
<tr>
<td>Voluntary initiatives by the industry</td>
<td>I I I I I I I I</td>
<td>ensuring supply chain viability of SAF</td>
<td>x x x x x x x x</td>
<td></td>
</tr>
<tr>
<td>Fiscal incentives specific to road transport biofuels (O:Incentive)</td>
<td>D</td>
<td>Incentivize biofuel production, but shifts use of raw materials for developing biofuels for road transport</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Name of Instrument</td>
<td>Who operates/implements the instrument</td>
<td>Drivers</td>
<td>Type of Instrument</td>
<td>Core theme: Greening/pushing/creating the market</td>
</tr>
<tr>
<td>--------------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Financial support to renewable energy (electricity) production (DISincentive)</td>
<td>Government</td>
<td>Diversify source of energy/ climate change mitigation</td>
<td>Regulatory, Market based, Performance of Gov't &amp; public institutions, Compulsory Information Instrument, Voluntary Information Instrument, Voluntary Instrument, Voluntary agreements, Cooperative approaches, Funding, Awareness raising Campaigns, other</td>
<td>M</td>
</tr>
<tr>
<td>Tax on NOx</td>
<td>Government, i.e. state-owned airports</td>
<td>Support more sustainable fuels/ climate change mitigation</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Tax relief on biofuels /tax on CO2</td>
<td>Government, i.e. state-owned airports</td>
<td>Support more sustainable fuels/ climate change mitigation</td>
<td>m</td>
<td>M</td>
</tr>
<tr>
<td>Reliefs from import duties for biofuels</td>
<td>Government</td>
<td>Stabilize supply of feedstock for SAF production</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Levy on imports of palm oil based products</td>
<td>Government</td>
<td>Stabilize local supply of SAF/ energy security</td>
<td>m</td>
<td>M</td>
</tr>
<tr>
<td>Distinct state tax for blending</td>
<td>Government</td>
<td>Increase blending ratio</td>
<td>m</td>
<td>M</td>
</tr>
<tr>
<td>Individual or corporate purchases of SAF for their flights</td>
<td>i.e. commercialize SAF</td>
<td></td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Green certificates/biokeros</td>
<td>Government</td>
<td></td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Putting biofuel on the market for purchase</td>
<td>Government</td>
<td>Commercialize SAF</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Voluntary initiatives by the industry</td>
<td>Public-Private</td>
<td>Commercialize SAF</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Fiscal incentives specific to road transport biofuels (DISincentive)</td>
<td>Government</td>
<td>Energy security/ climate change mitigation</td>
<td>M</td>
<td>n/a</td>
</tr>
</tbody>
</table>