Coordinating research and innovation in the field of sustainable alternative fuels for aviation

Deliverable 5.4: Report on Compilation, Mapping and Evaluation of R&D Activities in the Field of Policies, Incentives and Regulation (Final Report)

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Report on Compilation, Mapping and Evaluation of R&D Activities in the Field of Policies, Incentives and Regulation (Final Report)

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(chapters 5.2 and 5.4)

EXECUTIVE SUMMARY

There are currently a number of barriers that are limiting the development and implementation of alternative fuels for aviation. Political action can be used to try to break these barriers and to promote the development and deployment of low-carbon sustainable alternative fuels. Only if relevant volumes of alternative fuel production are reached and are incentivized, the scale up will break many of the barriers that currently exist for large scale deployment. However, due to the particularities of aviation, the types of policies that can be implemented to promote alternative fuels are more limited than in other ways of transport. It is important to highlight the fact that aviation biofuels are currently in a less favourable position compared to other means of transport due to the level of maturity of the market. This has to be considered when addressing political action if from Europe there is a willingness of scaling up the market.

Analyzing the set of policy options, there are various alternatives, although not all the measures are appropriate in all cases since policy implementation has to be evaluated in terms of efficacy, efficiency, flexibility and equity. Usually, command and control policies have successful results in terms of efficacy and efficiency, but introduce less flexibility and equity and can be controversial when economic cost needs to be assumed by a certain stakeholder. On the opposite side, market based measures introduce a higher level of flexibility for the entities/operators under a specific policy/legislation.

In a first step, the existing policy actions have been reviewed to learn about the possible impacts, even if those policy options were not directed specifically to aviation fuels. The analysis has been at international level, but also at European level. At international level, the actions are varied, but there are few policies that have had a direct effect on aviation biofuels. At European level, the main action is focused on the EU RED and the FQD directives. Both directives have been transposed quite unequally in different European Member States (MS). Some MS have in addition further incentives for alternative fuel production.

In general, it is observed that up to date, very few countries (i.e. Indonesia) have implemented any aviation specific legislation meaning that any aviation alternative fuels produced are under the framework of general renewable energy legislation. In general, the action of many states is focused in promoting uptake agreements and deployment/demonstration projects (i.e. EU and US). Due to the fact that aviation biofuels have a lower maturity than alternative fuels for other ways of transport, stakeholders have identified the need to implement measures that could level the playing field for aviation biofuels. In fact, in Europe there is currently a lack of specific objectives for aviation alternative fuels. Having more specific goals could be a first step to try to push forward the upscale of alternative fuels which are currently technically viable.

In a second step, an analysis of the policy options has been carried out in order to understand the different options that could eventually contribute to the scale-up of aviation biofuels. Parameters such as ease of implementation, administrative effort, impact on bringing the product to the market, and impact on the industry have been reflected in the report. Different possibilities of policy actions have been included in the report, with a

qualitative analysis of their impact and affected stakeholders. In addition, the impact of specific objectives or mandates on production, demand, feedstock required and emissions saved were modeled. This analysis has shown that a 3.3% objective would be required in order to achieve the 2 million tons of the European Advanced Biofuels Flightpath objective. The results obtained indicate that it will be difficult to promote the use of feedstock used in value chains that have low maturity since the price gap with the most mature technologies will be big and therefore, specific incentives or policy actions are needed if the price gap is to be closed.

From the stakeholder discussions it is clear that in any case, the assurance of sustainability criteria is a key element for aviation and is very sensitive to the public opinion and perception. It is clear that communication is essential in order to give the public correct and transparent information and this could be improved in terms of information of the requirements of the different EC approved voluntary schemes.

It is a key conclusion that in order to assure deployment, Europe needs to put in place measures that incentivize the creation of small/local value chains that help to create confidence at a small scale production as a first step towards a larger scale production. Public-private partnerships are proving to be an interesting option where institutional support can be shown. Creating a firm initial market without trying to make it too large at an early scale will help to create investor confidence. The implication of national administrations is considered a key element since they can act as facilitators towards deployment.

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LIST OF ABBREVIATIONS

AFTF	Alternative Fuels Task Force
ATAG	Air Transport Action Group
BAT	Best Available Techniques/Technologies
BGY	Billion Gallons per Year
BLE	Federal Agency for Agriculture and Food (Bundesanstalt für Landwirtschaft und Ernährung)
CAEP	Committee on Aviation Environmental Protection
CDM	Clean Development Mechanisms
C-JF	Core-JetFuel - Coordinating research and innovation in the field of sustainable alternative fuels for aviation
GHG	GreenHouse Gas
ENVI	European Parliament Committee on Industry Research and Energy
GMBM	Global Market Based Measure
EEA	European Economic Area
EMTS	EPA-Moderated Transaction System
EU	European Union
EU ETS	European Union Emissions Trading Scheme
EPA	Environmental Protection Agency
EISA	Energy Independence and Security Act
FAA	Federal Aviation Administration
FQD	Fuel Quality Directive 98/70/EC
IATA	International Air Transport Association
ISCC	International Sustainability & Carbon Certification
ICAO	International Civil Aviation Organization
ISUM	ITAKA Scale Up Model

ILUC	Indirect Land Use Change
LCFS	Low Carbon Fuel Standard
MBM	Market Based Measure
MRV	Monitoring, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Actions
NEa	Dutch Emissions Authority (Nederlandse Emissieautoriteit)
NEN	Netherlands Standardisation Institute
NGO	Non-Governmental Organization
NTA	Netherlands Technical Agreement
RED	Renewable Energy Directive 2009/28/EC
RES	Renewable Energy Sources
RFS	Renewable Fuel Standard
RIN	Renewable Identification Number
RTFCs	Renewable Transport Fuel Certificates
RTFO	Renewable Transport Fuel Obligation
RVO	Renewable Volume Obligation
SCRC	Specific Circumstances and Respective Capabilities
SUSTAF	Sustainable Aviation Fuels Expert Group
TGAP	French General Tax on Polluting Activities (Taxe générale sur les activités polluantes)
TRL	Technology Readiness Level
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction: Biofuels for Aviation Policies

One of the key drivers for the exploitation of biofuels for aviation is how different polices can help to generate demand, offer, or reduce the price gap. There are currently a number of barriers that may limit the development and implementation of alternative fuels for aviation but one of the most complicated obstacles to overcome for aviation biofuels development is probably the price gap with fossil fuel due to several causes such as low technology matureness, poor biomass yields or competition for feedstock and refining capacity with other uses (such as road transport or shipping) less quality strict than aviation fuel standards considering the certification process.

However, several international organizations (ICAO, ATAG, IATA, EU) have identified that to address the targets set on reducing aviation GHG emissions (carbon neutral growth from 2020), the sustainable alternative fuels need to play a relevant role, as the other available basket of measures (air traffic improvements, fleet and operational efficiency, aircraft technology improvement) are estimated not to be enough on their own (see figure 1).

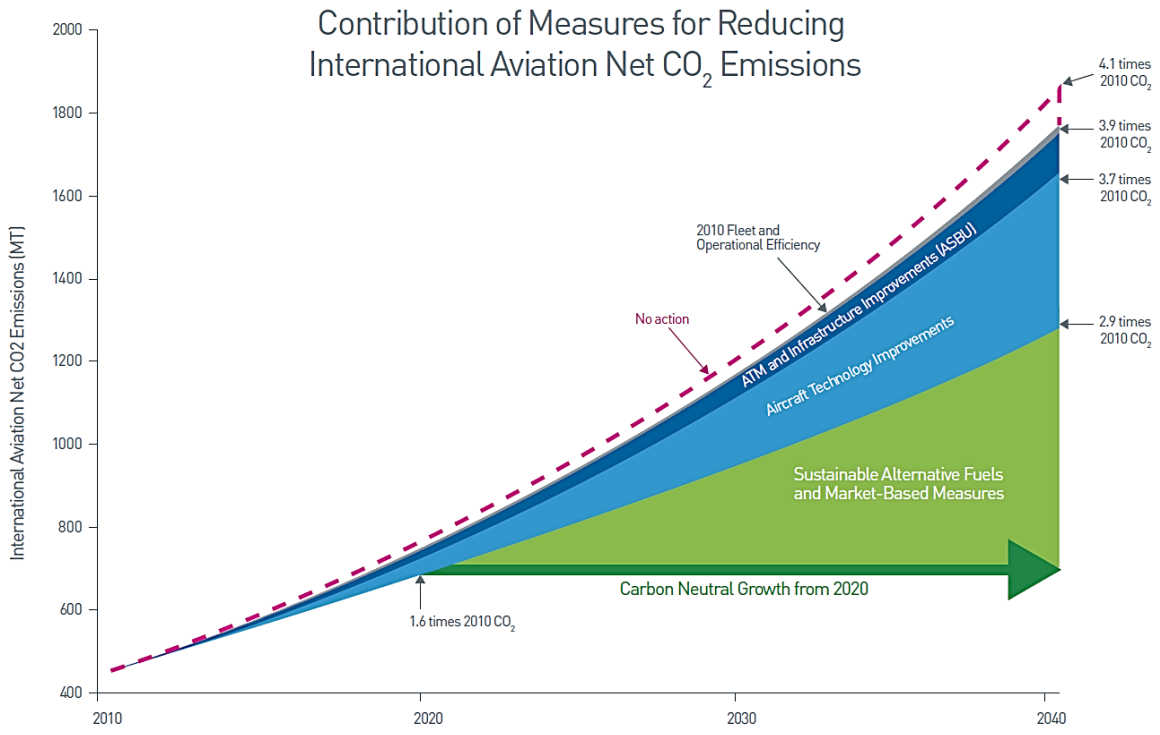

Figure 1: CAEP/9 trends assessment

As a consequence there is a policy interest on the promotion of the development and deployment of low-carbon sustainable alternative fuels, including research and operational initiatives undertaken jointly with stakeholders.

As stated in the Renewable Energy Directive (RED) 2009/28/EC of 23 April 2009, on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC: "*The control of **European energy consumption** and the increased **use of energy from renewable sources**, together with energy savings and increased energy efficiency, constitute important parts of the package of measures needed to reduce greenhouse gas emissions and comply with the Kyoto Protocol to the **United Nations Framework Convention on Climate Change**, and with further Community and international greenhouse gas emission reduction commitments beyond 2012. Those factors also have an important part to play in **promoting the security of energy supply**, **promoting technological development and innovation** and providing **opportunities for employment and regional development**, especially in rural and isolated areas.*

*In particular, increasing technological improvements, incentives for the use and expansion of public transport, the use of energy efficiency technologies and the use of energy from renewable sources in transport are some of the most effective tools by which the Community can **reduce its dependence on imported oil** in the transport sector, in which the security of energy supply problem is most acute, and influence the fuel market for transport".*

Most of renewable sources are yet not profitable without incentives but the GHG externalities have to be considered so, they require policy intervention for their promotion. Only reaching relevant volumes of biofuel production and incentivizing the scale up will break many of the barriers that currently exist for alternative fuels for aviation. In particular the different policies to be implemented should also target how this promotion is made, trying to limit the possible negative effects and fostering those side effects that are really desired (as regional development, technology innovation or security of energy supply).

Particularities of Aviation-Specific Biofuels

Biofuels mandates and policies are applied in several regions of the world to the transport sector but usually those policies don't consider specific targets or mandates for the aviation sector. Aviation has a number of particularities which may reduce its competiveness for feedstock in comparison with other means of transport and therefore the penetration of alternative fuels can take place at a different pace if we compare it, for example, with road transport.

The types of policies to be implemented for air transport fuels are therefore more limited than in other ways of transport. Aviation is a global sector that requires agreements for flights between two different countries. The Chicago Convention and a large number of air services agreements such as rules on fuel taxation have to be considered in this regard. The Chicago Convention[1] (Article 24) exempts from taxing any fuel on board an aircraft upon arrival and retained on board when leaving the territory of another ICAO Member State. As aviation fuel benefits from this tax exemption internationally, it is not possible to use taxes (or tax exemptions) as a way to control the type of fuel to be used as it has been done previously in road transport in some regions. The possibility to uplift fuel in different countries is also a particularity to be considered in this area, especially when we talk of attributing environmental benefits to alternative fuel.

Another particularity of the sector is the long time that it takes for new aircraft designs to be marketed, estimated in around 20-30 years since conceptual design, to have later on a life of more than 20 years. Those long times make it difficult to make quick adaptations to new technologies. As a result, it is really important to set short, medium and long term strategies/polices, especially for aircraft and engine manufacturers, in order to avoid changes that could block new products or affect fleet

[1] http://www.icao.int/secretariat/legal/List%20of%20Parties/Chicago_EN.pdf

renewals. This situation reveals the importance of “drop-in” fuels that are compatible with the current technology and infrastructure.

Lastly, another particularity is of aviation biojet is the high level of requirements in terms of certification, which is an expensive and long process and is required in any case before its commercial use.

In a global framework, air transport takes as a reference the guidelines given by ICAO as reference for the future regulations in aviation, even when some cases individual States may implement their own measures when there is not a specific ICAO guideline in the topic. Therefore, ICAO discussions and negotiations need to be considered when legislating or taking political action in aviation alternative fuels.

2 Existing Biofuel Policies

Policies are key instruments on pursuing environmental objectives, especially when it covers the implementation of new emerging technologies.

As a basis to evaluate the different options that can be used in this area, we can classify the environmental policies using the types described below (Gómez, 2011.).

An option is direct intervention, by the execution of public projects (e.g.: direct purchases by the US Air Force). However, policies more commonly act intending to modify the stakeholder’s rational behaviour by:

- Providing more information regarding the Best Available Technologies (BAT)
- Persuading involved sectors to reach voluntary agreements, promoting best practices, etc.
- Using command and control measures
- Using Market Based Measures (MBM)

Command and control

The command-and-control policies can be described as an imposed obligation that following stablished criteria, affects all the stakeholders involved. This type of policies reduces the stakeholder’s options by making some alternatives that are no longer legal. It is not strictly related with the instrument of application (law, directive, etc.) as legal instruments are applied also for market-based measures and other policies.

Command and control policies, often guarantee efficacy on the target, but they usually don’t consider its efficiency (efficacy vs. its costs). These measures are usually inflexible and with poor or questionable equity. Therefore, for the implementation of command and control measures, it is important to carry out an evaluation of the costs in order to determine the impact that they will have on the stakeholders.

Market-based measures (MBM)

In comparison with command and control policies, market-based measures often introduce more flexibility to the system. Basically, they allow the stakeholder involved to choose between “pollute and pay” or “don’t pollute and be rewarded”. The decision will be made on a market basis, looking to what is more cost-efficient for the stakeholder and as consequence at broader level, for the society.

There are several types of market-based measures:

- Taxes or cannons: imposed to pollutant substances, use of defined resources or products, spills, products, etc. There are several variations depending on how they are calculated and applied.
- Subsidies, soft loans or fiscal reductions.
- Fines or sanctions in case of breaking the limits.
- Deposits (financial guarantees) made to the authorities as guarantee of compliance (i.e. in case of environmental risk).
- Markets creation to adjust stakeholder's behavior, being the most representative example the use of a cap and trade system. A cap and trade system can work by using allowances and/or offsetting mechanisms.

The set of options is quite broad. However, not all the measures are appropriate in all cases. There are some indicators or criteria to compare the different policy options:

- Efficacy: it refers to whether or not the objective has been achieved without causing additional or alternative environmental problems of other type, in other place or in other time.
- Efficiency: it consists in maximizing the efficacy minimizing the costs. It is important to consider costs for the industry as well as the cost of monitoring/control/verification and how the policy changes with different fluctuations in the economy (inflation, unemployment, etc.)
- Flexibility: especially relevant in environmental legislation, where problems and technologies change rapidly. This criterion controls how the measures adapt to the reference changes, i.e.: new technologies available, new scientific findings or economic fluctuations. Changes are easier when the authorities and departments involved are more limited. For example, a tax is usually less flexible than a cap and trade, as tax value is fixed by the authorities (and recalculated, published, etc.) and the cost of the allowance adapts to the market changes by itself.
- Equity: the instruments are always going to affect some sectors negatively and have positive impacts on others. It is important to measure how those impacts are distributed within the society.

On further detail, according to Turner et al. (1994), ideally, any policy instrument should:

- Have the highest economic efficiency on resources assignation.
- Require limited information for implementation, it should be cheap and easy to update.
- Limit the administrative burden.
- Be socially fair (comply with the equity principle).
- The instruments used should be those in which effects are less uncertain.
- Be flexible, quickly adaptable to technology, climatology or market circumstances changes.
- Generate dynamic incentives for continuous improvement.
- Be policy accepted, by not affecting too drastically the socioeconomic structure.

3 Description and Analysis of Current Ongoing Policies & Regulation

3.1 ICAO Level Political Discussions

A wide range of environmental regulations apply today to the air sector, and International Civil Aviation Organisation (ICAO) has an important role in setting the main principles and framework for the individual state's regulations since many of them are based on international agreements and conventions. ICAO is the reference for international harmonization and agreements in the aviation sector, helping to set a level playing field and minimizing possible conflicts between countries.

The ICAO took a position regarding sustainable alternative fuels during the 38th Session of the ICAO Assembly, held from 24 September to 4 October 2013, by adopting Resolution A38-18: *Consolidated Statement of continuing ICAO policies and practices related to environmental protection – Climate change*. The principles of this resolution are recognition of sustainable alternative fuels as a key part of the basket of measures under consideration to stabilize emissions from international aviation. However, there is not currently any agreed regulation at ICAO level for the GHG mitigation on international aviation or particularly on the use of alternative fuels. Still, there are commitments set by the industry, ICAO and other entities such as FAA, so this is currently a topic under discussion.

In 1997, Kyoto Protocol tasked the ICAO with addressing international aviation emissions, which resulted in the national aviation emissions being included in the individual compromises of the States. After years of discussions with low progress on this issue, the **38th ICAO General Assembly** agreed to develop and work on a **global MBM framework** (GMBM) for the aviation sector by the next **ICAO General Assembly** in **2016**. The final goal of this GMBM framework is to implement a system, by 2020, which would enable the international aviation industry to reach carbon neutrality in their emissions growth from 2020 onwards. **Alternative fuels have been recognized by ICAO as one of the instruments that could play a role towards this emissions reduction and neutrality.**

Many questions are still to be answered with respect to how the global MBM will operate in practice, and significant work is now underway in ICAO to design the details of the scheme and make the 2013 agreement a reality, while describing the role that Sustainable Aviation Alternative Fuels would have in such a scheme that will require not only technical but also policy work. Several working groups are working in parallel and in coordination to address different aspects such as the design of the scheme, accountable entities obligations, adjustments and exemptions criteria for emission units eligible for the scheme. Additionally the ICAO is working on the development of recommendations for Monitoring, Reporting and Verification (MRV) procedures in a GMBM.

Negotiations will have to address the concerns of States with developing and growing aviation industries, how to achieve sustainable growth and how to accommodate outstanding growth. ICAO will have to identify the major issues and problems, including for Member States, and make a recommendation on a global MBM scheme that appropriately addresses them and on key design elements, including a means to take into account special circumstances and respective capabilities, and the mechanisms for the implementation of the scheme from 2020 onwards**.**

A successful proposal would need to be politically feasible and acceptable for all the parties concerned so that a consensus can be reached in time for the decisions to be taken on a GMBM at the 2016 ICAO Assembly. At this point, the role of sustainable alternative fuels in the emission accounting for a global system will have to be defined and therefore the result of the negotiations could have an important impact on the implementation and use of these fuels.

There are currently considerations to introduce aviation alternative fuels as a way of reducing the accounted emissions and therefore reduce the obligations/commitments in a possible GMBM, what is still under discussion in the ICAO debate. It would be important to note that taking into account that sustainable aviation alternative fuels development is not happening in some geographical regions as quickly as in others, a commonly-agreed integration for such fuels could allow operators to gain emissions credit for purchase of sustainable alternative fuel wherever they may source that fuel. ICAO

work in the potential integration of sustainable alternative fuels in GMBM will have to take into account that the 'drop-in' nature of alternative fuel will allow it to be blended into the conventional airport fuel systems (the non-dedicated system) and distributed to all aircraft refueling from those systems with no barriers.

Alternative fuels are considered as gap *filler* in the basket of measures identified for carbon emissions reduction: technology, operations and alternative fuels. These three types of measures have not been considered enough to achieve the emissions reduction objectives and therefore alternative fuels development can be the key in the achievement of such objectives. However, there are still a number of open discussions such as sustainability criteria for eligibility of fuels to be considered in the scheme or the current lack of scale up which is making hard to implement elements directed to alternative sustainable fuels in the context of GMBM.

In addition to the GMBM discussion, ICAO created in July 2012 the Sustainable Aviation Fuels Expert Group (SUSTAF) with the intention to work in preparation for the 38th ICAO Assembly, with the mandate to analyse the challenges for the development and deployment of alternative fuels in aviation and to issue recommendations to support industry and States. The group, consisting of 45 experts from different States, NGOs, industry and other United Nation entities, released a document of findings identifying the challenges for deployment as well as the variety of options for States to address sustainability.

As a result of the recognition of alternative fuels as a key part of the basket of measures under consideration by ICAO Member States to stabilize emissions from international aviation during the 38th ICAO Assembly and in order to respond to the mandates of the 38th ICAO Assembly, the Alternative Fuels Task Force (AFTF) was created in November 2013 within the Committee for Aviation Environmental Protection (CAEP). The objective of this group has been to assess the range of potential emissions reductions from the use of alternative fuels to 2050 and work on the development of a methodology to assess fuel life cycle emissions to be able to estimate the emissions associated to a projected future scenario for alternative fuels production. This group is also working on the development of a methodology to assess lifecycle emissions from alternative fuels for use in the GMBM MRV system. Results are expected to be made public for the next Assembly discussions.

3.2 EU Policies

3.2.1 EU RED

The European Union published the Renewable Energy Directive (RED 2009/28/EC) in June 2009[2]. This legislation settled down a common objective: 20% of the energy used by 2020 should be obtained from renewable sources (20% RES), including 10% of the total transport fuel used in the EU (10% RES-T). It also specifies that, this 10% must be largely covered by biofuels and bioliquids, and therefore, the Directive sets certain sustainability criteria referring to the protection of land with high ecological value, greenhouse gas emission savings, and the socio-economic impact. For each Member State the RED sets out the share of energy to be achieved from renewable resources up to 2020. Biojet fuel use can, in principle, count towards the 2% RES target although the current contribution of biojet fuels to the objectives is almost zero. The directive allows Member States to

[2] http://www.biofuelstp.eu/biofuels-legislation.html. Last accessed: 10/04/2015

allow biojet fuel to account towards the RED target in their national legislation althouch currently, the Netherlands is the only country to have actively implemented this provision in its legislation.

Additionally, it determines that specific sustainability criteria that must be adopted for biofuels in order to be considered a renewable and sustainable energy source. The Directive defines that the minimum greenhouse gas emission savings from the use of biofuels must be of at least 35% for the short period. The savings must be at least 50% for the new installations constructed between 2017 and 2018 and 60% from 2018 on.

Regarding the compliance with sustainability criteria, the European Commission strongly encourages the industry, Governments and NGOs to use the voluntary schemes to demonstrate the origin of the biofuels and their GHG capacity of reduction. However, the Directive gives operators three different options to prove that their biofuel or bioliquid complies with the requirements:

- by providing the national authority with data, in compliance with requirements that the Member State has set (Member States must provide a national system according to the regulation),
- by using a voluntary scheme that the Commission has recognized for the purpose, or
- in accordance with the terms of a bilateral or multilateral agreement concluded by the Union and for which the Commission has recognized for the purpose (the Commission shall seek to make bilateral agreements for third countries that guarantee that sustainability criteria are similar to those under the EU law).

In any case, when an economic operator submits evidence or information of certification under a voluntary scheme recognized by the Commission, the Member State shall not require the supplier to provide further evidence of compliance with the sustainability criteria. Nevertheless, when using a voluntary scheme, operators must arrange an independent auditing process for the information to be provided to the national authority.

Since 19 July 2011, the EC has recognized 19 voluntary schemes up to now that apply directly in 27 EU Member States. Schemes include the Assessment report and the Commission Implementing Decision.

For the calculation of the greenhouse gas impact of biofuels the RED gives default values of 22 biofuel production pathways that may be used. For other production pathways, operators have to do their own calculations according to a given methodology described in the RED. Disaggregated default values may be used for some factors (e.g. for the transportation of biofuels). Total GHG emissions are the sum of lifecycle emissions from cultivation, processing and transportation of biofuels.

The directive indicates that Member States shall designate the supplier or suppliers responsible for monitoring and reporting life cycle greenhouse gas emissions per unit of energy from fuel and energy supplied. There has been a recent and important modification of this part of the directive by specifically mentioning that in the case of suppliers of biofuels for use in aviation Member States may permit such suppliers to choose to become contributors to the lifecycle reduction obligation to comply with the specific emissions reduction targets. Currently, only the Netherlands allows suppliers to contribute to the general emissions reduction objectives with aviation alternative fuels.

Aim	20% of the energy used by 2020 should be obtained from renewable sources, allocating 10% to the transport sector
Administration responsible for its implementation	National Authorities
Type of policy measure / regulation	Directive - Legislation
Timeframe	From 2009 to 2020
Geographical scope	European Union, but also applies to imported biofuels and biomaterials
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet development)	Alternative fuel production
Revisions and updates of the policy	There have been 34 modifications since its publication, mainly referred to recognition of new Voluntary schemes.
Applicability	Different in every member state of the European Union after the transposition of the regulation in each National System of the member states
Relevant or affected stakeholders (i.e.: feedstock producers, fuel producers, logistics companies, etc.)	All

3.2.2 Fuel Quality Directive (FQD)

The European Union adopted Directive 2009/30/EC to modify the previous Fuel Quality Directive (98/70/EC). This update amended a number of elements of the petrol and diesel specifications as well as introducing in a requirement on fuel suppliers to reduce the greenhouse gas intensity of energy supplied for road transport (Low Carbon Fuel Standard). Similarly to the RED Directive, the FQD includes the sustainability criteria that must be met by biofuels if they are to count towards the greenhouse gas intensity reduction obligation.

The guidelines for GHG emission reduction calculation for biofuels are already included in Annex IV of the directive. However, there are a number of elements still under discussion, and to be further developed under this legislation. In particular, a number of measures for article 7a of the directive

consider indirect land use change for biofuels and bioliquids. To do so, the Commission had a remit to submit, by 31 December 2010, a report to the European Parliament and to the Council reviewing the impact of indirect land use change on greenhouse gas emissions and addressing ways to minimize that impact. After carrying out a public consultation and elaborating this report, the measures to be implemented were discussed and in October 2012, the Commission launched a proposal for the modification of the Directive with the aim of starting a transition to biofuels that deliver substantial greenhouse gas savings when considering indirect land-use change emissions are reported.

Therefore, the sustainability criteria in the RED and in the FQD are harmonized. Member states have the ability to transpose the directives into their national legislation with limited ability to adopt stricter criteria.

Aim	To amend a number of fuel specifications as well as introducing a requirement on fuel suppliers to reduce greenhouse gas intensity of biofuels.
Administration responsible for its implementation	National Authorities
Type of policy measure / regulation	Directive - Legislation
Timeframe	From 2009
Geographical scope	European Union
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet development)	Fuel production and supply
Applicability	Different in every member state of the European Union after the transposition of the regulation in each National System of the member states
Relevant or affected stakeholders (i.e.: feedstock producers, fuel producers, logistics companies, etc.)	Mainly fuel producers and suppliers, but indirectly all.

3.2.3 Latest EU RED and FQD modifications and New Legislation

EU RED and FQD modifications

In October 2012, the Commission made a proposal with the objective of starting a transition towards a biofuels policy that would deliver more ambitious emissions saving while taking into consideration the emissions associated with indirect land-use change.

On 9 December 2014, the Transport, Telecommunications and Energy Council adopted its first-reading position on the proposal to reduce the climate impact of biofuels by amending the Renewable Energy Directive and the Fuel Quality Directive, to reflect concerns over the sustainability and GHG-reduction benefits of some biofuels. The negotiations were covered by the European Parliament Committee on Environment, Public Health and Security (ENVI) and the Committee on Industry, Research and Energy also discussed the amendment during its meeting on 22nd January 2015. On April 2015, a consensus was met between the Council and the Environmental Commission of the Parliament for the reform of the Renewable Fuel directive. On 9 September 2015 Directive (EU) 2015/1513 was approved amending Directive 98/70/EC (FQD) and amending Directive 2009/28/EC (RED).

The modifications relevant to aviation alternative fuels can be grouped into the following topics:

- Introduction of a limitation to the share of biofuels produced from cereal and other starch-rich crops, sugars, oil crops and other energy crops grown on land:

After negotiations on the final value, a **7% cap** for conventional biofuels has been introduced with the aim to mitigate the indirect land-use change in the amendment of Directive 98/70/EC (FQD). This cap establishes a maximum percentage for the use of conventional biofuels (from energy crops grown on land) on the final consumption of energy in transport in 2020. According to the Parliament, the cap should also apply to the financial support granted to conventional biofuels. The cap would apply both to the RED and to the FQD in order to ensure consistency between the two policies. This limit would affect those biofuels produced from cereal and other starch-rich crops, sugars and oil crops and other energy crops grown on land. It aims to reduce greenhouse gas emissions that result from the growing use of agricultural land to produce biofuel crops.

- ILUC Factors

Due to the lack of scientific consensus in the first elaboration of the RED directive, the inclusion of ILUC was postponed for a further stage. It was proposed to make use of estimated ILUC factors for the final GHG calculations of certain feedstock introducing new Annexes to the RED and the FQD. In the last modification of the FQD and RED carried out in September 2015, it was included that Member States shall ensure that fuel suppliers report annually to the authority the volumes of biofuels derived from cereals and other starch-rich crops, sugars and oil crops, and the life cycle greenhouse gas emissions per unit of energy, including the provisional mean values of the estimated indirect land-use change emissions in new Annexes to the RED and FQD. Therefore ILUC is currently a requirement but only for reporting purposes.

- Inclusion of a binding minimum percentage of advanced biofuels

In order to encourage the transition to second and third generation biofuels, the amendment includes the possibility of introducing incentives for advanced biofuels by inviting member states to promote the consumption of such biofuels and requiring them to set national targets for advanced biofuels. In the

last modification of the FQD carried out in September 2015 the proposal is to have an indicative objective of 0.5% advanced biofuels with the possibility that each Member State could fix its own objective within 18 months following the approval of the Directive.

- Introduction of new Annex IX

This Annex includes a list of feedstock for advanced biofuels that shall be considered to be twice their energy content towards the targets. The objective is to incentivize the production using the feedstock included.

- Inclusion of the possibility of aviation biojet accounting towards objectives

Member States may allow suppliers of biofuels for use in aviation to choose to become contributors to the reduction obligation laid down in the FQD as long as they satisfy the sustainability criteria.

Implementation of Article 7a of the Fuel Quality Directive

The Fuel Quality Directive (FQD) requires a 6% reduction between 2010 and 2020 in the greenhouse gas intensity of all the petrol, diesel and biofuels used for transport. The EC published a proposal on Article 7a: Proposal for a Council directive on laying down calculation methods and reporting requirements pursuant to Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels. This legislation is currently under co-decision, and provides a methodology for calculating the greenhouse gas intensity of fuels and energy supplied other than biofuels for fuel suppliers' reporting. It also sets out the baseline calculation standard and greenhouse gas intensity reduction.

3.2.4 Relevant Current Individual State of the State's Implementation of the RED and Sustainability Criteria

The current state of transposition of the RED directive is slightly unequal in different Member States. Most of them have a partial transposition in place but there is major difference between states in the treatment of sustainability schemes and in the development of their own national systems. Some of the Member States have developed national systems while some rely only on the voluntary schemes adopted by the EC for showing compliance with sustainability criteria.

Some states with relevant activity regarding aviation alternative fuels have been selected below in order to show how the RED and the FQD obligations have been treated in different countries.

3.2.4.1. Finland

Finland has transposed the RED through the Act on the Promotion of Renewable Energy Generation (1396/2010) which entered into force on January 2011 and which grants tax incentives to producers of renewable energy. Finland's target for transport biofuels is 20% for 2020, an objective which is based on the government's assessment of the availability of raw materials and the technological competence to produce enough 2nd generation biofuels that are eligible for "double-counting". The Act on the Promotion of Renewable Energy Generation (1396/2010) is currently in force and partly satisfies Finland's requirements under RED.

In addition to this, Finland Act on Promoting the Use of Biofuels in Transport (446/2007) promotes the use of biofuels in transport and sets an obligation for transport fuel distributors to distribute biofuels for consumption.

Regarding the sustainability criteria, Finland approved the Act on sustainability of biofuels and bioliquids (393/2013) which specifies procedures to be complied with in verifying compliance with sustainability criteria. It contains the EU sustainability criteria at high level and fuel suppliers can use EC recognized voluntary schemes to demonstrate compliance with the sustainability criteria since there is no specific national system.

Regulations/policies in place addressing alternative aviation fuels / biofuels	- Act on the Promotion of Renewable Energy Generation (1396/2010) - Act on Promoting the Use of Biofuels in Transport (446/2007) - Act on Sustainability of Biofuels and Bioliquids (393/2013)
Total biofuel production target	No specific target for transport biofuels but by 2010, the use of bioenergy energy sources was aimed to be 30 per cent higher than in 2001. Additionally, Finland aims to increase the use of renewable energy by at least 25% by 2015 and 40% by 2025.
Sustainability schemes/criteria that have been implemented on national level	None in place

3.2.4.2. France

The French government transposed the RED and the FQD in 2011 through a single national legislation, the order 2011-1105 on renewable energies and biofuels. Additionally, this order was developed through the 2011-1468 decree dated November 9, 2011.

Regarding sustainability requirements, a transition period was in place until May 2012 during which economic operators had to provide evidence that they intended to join a voluntary scheme or to use the services of independent auditors. They were granted time until 31 December 2012 to provide evidence of independent certification of sustainability. The French system recognizes the use of EC approved voluntary schemes, including the one developed and created by the French industry in 2011, the 2BS voluntary scheme (2BSvs). The 2BSvs was created by a consortium of stakeholders and currently allows sustainability claim of operators that are required to comply with the RED criteria.

Those operators who have to demonstrate compliance with the sustainability criteria are fuel suppliers, who benefit from a tax reduction depending on the incorporation rate of biofuels. Basically, the French administration has defined that if suppliers do not achieve a minimum amount of biofuels they will have to pay a tax (TGAP, General Tax on Polluting Activities) correlated to the lack of biofuel the supplier missed to incorporate. Suppliers must report to the Customs Authority within the framework of the French national system. In addition to using voluntary schemes recognized by the European Commission, it gives the option for fuel suppliers to provide verified information to the Ministry of

Energy and Ecology. Verifiers who check the information reported by economic operators will be recognized by the Ministry of Energy and Ecology, through a validation procedure ("agrément") and later an accreditation procedure.

Regulations/policies in place addressing alternative aviation fuels / biofuels	- Order nº 2011-1105 on the transposition of Directives 2009/30/CE and 2009/30/CE about renewable energies and biofuels. - 1468 decree dated November 9, 2011 to implement order nº 2011-1105
Total biofuel production target	In 2014, due to the TGAP, France should reach 7.35 % in volume of on Road Diesel and 7% on Gasoline.
Sustainability schemes/systems at have been implemented on national level	- - 2BSvs, although it is not a scheme created by the administration, but rather by a group of French economic operators involved in grain production and biofuel supply chain - Verification through the Ministry of Energy and Ecology

3.2.4.3. Germany

The first steps Germany carried out for the transposition of the RED and the FQD were taken by the German Federal Government through the Biofuels Sustainability Ordinance (Biokraft-NachV) and the Biomass Electricity-Sustainability Ordinance (BioSt-NachV) which entered into force in November and August 2009 respectively.

In order to assure the compliance regarding the sustainability criteria, the German system is based on the use of its own voluntary schemes where fuel suppliers are required to demonstrate the compliance of the biofuel sold with the sustainability criteria. Apart from their national schemes, Germany accepts the use of any other scheme approved by the European Commission.

The Federal Agency for Agriculture and Food (BLE) is responsible for collecting all the information on sustainability certificates via the "Naisby" database. This database that works with a web application is a system that collects the relevant data about the sustainability of each biofuel. The final results obtained from the Naisby database are published annually in an Evaluation and Empirical Report.

Regarding the national objectives of biofuel production, the Biofuel Quota Act was amended in 2009 to include an energy quota requirement in 2014 of 6.25% of the total sales of fossil fuels. However, the German quota system has changed in the last years. Firstly, it changed from an energy based commitment framework to a stepwise increasing greenhouse gas reduction commitment from 2015 on. In October 2014 the German parliament decided to modify the quotas as following:

- 2015-2016: from 3% to **3.5%**
- 2017-2019: from 4.5% to **4%**
- 2020 on: from 7 to **6%**

Regulations/policies in place addressing alternative aviation fuels / biofuels	- Renewable Energies Sources Act: Law giving preferential treatment to renewable sources of energy. - Biofuels Sustainability Ordinance (Biokraft-NachV): Ordinance on the requirements for sustainable production of biofuels - Biomass-electricity sustainability Ordinance (BioSt-NachV): Ordinance on the requirements for the sustainable production of liquid biomass for electricity production. - Regulatory Provision on the Biomass Electricity Sustainability Ordinance (BioSt_NachVwV): Regulatory provision on the recognition of certification systems and certification bodies following the requirements laid down in the Biomass Electricity Sustainability Ordinance - Federal Inmission Control Act (BlmSchG) of 2009: Law on the protection from harmful environmental impacts caused by air pollution, noise, concussion and similar harmful effects
Total biofuel production target	Energy based objective: • 2015-2016: 3.5% • 2017-2019: 4% • 2020 on: 6%
Sustainability schemes/criteria that have been implemented on national level	There are currently 2 German schemes (although other Commission approved schemes are accepted). • REDCert DE: This certification was founded in 2010 by associations and organizations in the German agricultural and biofuel sector and approved as a certification system on 20 July 2010, by the BLE. The certifications are performed by independent certification bodies that verify sustainability. • ISCC DE: Also created and approved by the BLE in 2010 and developed through a stakeholder process and the ISCC Association Both these systems are also recognized by the European Commission.

3.2.4.4. Italy

The transposition of Directive 2009/28/EC in Italy was carried out through the Legislative Decree no. 28 of March 2011. This decree, states that from 1 January 2012, the biofuels used in transport will be counted towards the achievement of national targets and may receive support tools if they meet the sustainability criteria referred to in the RED.

Regarding these sustainability criteria, the transposition of Directive 2009/30/EC into national law was carried out through the Legislative decree no.55 of March 2011. This decree is designed to define the specifications of petrol, diesel and gas oil, and introduces a mechanism to control the emissions of greenhouse gas emissions. In order to verify the compliance with the sustainability criteria, the economic operators who are part of the supply chain must join the National Biofuel sustainability Certification System that should be created by the Minister Environment and Protection of Land and Sea, the Minister of Economic Development and the Minister of Agriculture and Forestry. However, this definition has not been completed up to the current date. The Italian system is therefore voluntary scheme based. After the verification, economic operators in biofuel supply chain need to provide different types of verified information, depending on the stage in the supply chain. Depending on the different competences, different information items are reported to the Agriculture, Environment and Industry Ministries. Verified information is required on an annual basis

One of the most relevant Italian policies is the Italian Decree on Advanced Biofuels approved in October 2014. This decree sets a milestone in the European political action for biofuels since it is the first mandate for use at European national level. This Decree establishes a mandate for use while updating conditions, criteria and for consumption of biofuels, including advanced biofuels. The decree also makes a clear definition of what is considered as an advanced biofuel under the Italian legislation and explicitly indicates the fact that those advanced biofuels will count double towards the national objectives**. In fact, clear mandates (and not only objectives) are set year by year even beyond 2010 which is the current EC objective.**

Regulations/policies in place addressing alternative aviation fuels / biofuels	- Legislative Decree no. 28 of March 2011, Implementation of Directive 2009/28/EC on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC - Legislative decree no.55 of March 2011, Implementing Directive 2009/30/EC, amending Directive 98/70/EC, as regards to the specifications of petrol, diesel and fuel oil, as well as the introduction of a mechanism to control and reduce emissions of greenhouse gases, amending Directive 1999/32/EC as regards to the specifications of fuel used by inland waterway vessels and repealing Directive 93/12/EEC - Italian Decree on Advanced Biofuels, October 2014.
Total biofuel production target	Mandates (not only targets) according to the Italian Decree on Advanced Biofuels • 2015: 5% • 2016: 5.5% • 2017: 6.5 % • 2018: 7% with at least 1.2 % advanced biofuels

	• 2019: 9% with at least 1.2 % advanced biofuels • 2020: 10% with at least 1.6 % advanced biofuels • 2021: 10% with at least 1.6 % advanced biofuels • 2022: 10% with at least 2 % advanced biofuels
Sustainability schemes/criteria that have been implemented on national level	None in place

3.2.4.5. Spain

Sustainability criteria from the EU RED, were transposed to the Spanish legislation through the Royal Decree 1597/2011 as well as the implementation of a national sustainability verification system and double counting of a number of biofuels towards the national objectives. All the sustainability requirements contained in the RED directive were reflected in this legislation and the Spanish administration took a first step towards the development of national verification system with this legislation. In 2011 when this legislation entered into force, a transition period was established in order to give enough time to develop this national verification system.

However, Law 11/2013 lowered the national objectives as of 2013 on (from 7% to 4.1%) and established a grace period for the application of a national verification system for the sustainability criteria until there is a new order of the Energy Secretary of State. This means that currently the Spanish operators have to comply towards a percentage of biofuel production but the sustainability criteria established in the RED directive are not being verified yet. However, operators can still comply with the RED requirements of sustainability proof through the use of one of the Commission-approved voluntary schemes.

Regulations/policies in place addressing alternative aviation fuels / biofuels	- Royal Decree 1597/2011, establishing sustainability criteria for biofuels and bioliquids, the National Verification System Sustainability and the double value of certain biofuels for purposes of computation are regulated - Law 11/2013, regulating measures to support entrepreneurs and stimulate growth and job creation (only articles 41 regarding national objectives and 42 regarding a grace period for the application of a national verification system).
Total biofuel production target	4.1% from 2013 onwards
Sustainability schemes/criteria that have been implemented on national level	None in place

3.2.4.6. The Netherlands

In 2011, the Dutch parliament incorporated the provisions of the EU Directive on Renewable Energy into national legislation. Implementation, inspection and enforcement of this legislation is under the responsibility of the biofuels executive organization of the Dutch Emissions Authority (Nederlandse Emissieautoriteit, NEa). This legislation is incorporated in the Dutch Environmental Management Act which contains most of the national environmental legislation. The Netherlands has implemented the RED through the Decree on Renewable Energy in Transport of 18 April 2011 and the FQD through the Fuels and Air Pollution Decree of 8 April 2011.

Regarding the national objectives, the Netherlands will implement the EU Directive by gradually increasing the proportion of energy from renewable sources. The targets for use of biofuels have increased in the last years up to 5.5% in 2014 and the total obligation of bioenergy content for fuel suppliers in 2020 will be 10%. In addition to this, the Fuels and Air Pollution Decree determines that fuel suppliers will reduce the lifecycle GHG emissions of the transport fuels that they sell by 2% in 2014, 4% in 2017 and 6% in 2020. An important item to stand out from the Dutch regulation is that aviation alternative fuels can be accounted towards the compliance of the national objectives.

In order to meet the sustainability criteria and therefore to account towards the renewable energy obligation in transport, the Dutch legislation accepts the use of EC-approved sustainability schemes. Additionally based on Dutch and European sustainability criteria, a voluntary certification system for biomass for energy purposes has been developed by a diverse group of stakeholders. The criteria have been described as verifiable requirements in the Netherlands Technical Agreement (NTA) 8080. NTA 8080 is the international standard of sustainability criteria for solid, liquid and gaseous biomass. This voluntary agreement is set up by a broad stakeholder panel representing market players, government and civil society organizations, under the supervision of NEN (Netherlands Standardization Institute) who is the independent owner of the certification scheme. In 2013, a broad group of stakeholders started with the update of NTA 8080. It addresses a number of current issues, including Carbon Debt, indirect land use change (ILUC) and cascading uses of biomass. On the basis of consensus among stakeholders these issues are being translated into sustainability requirements. For greenhouse gas calculation, NTA 8080 has its own tool, the SenterNovem CO2-tool.

The Netherlands promotes the use of biofuels by imposing a supply obligation on permit holders of an excise warehouse to release a certain percentage of biofuels per year of their total fuel release. Under the Decree, the annual target applies to the obligated registered parties. These parties may also meet their target through purchasing **biotickets**. Biotickets are contracts between market parties regarding the purchase and sale of biofuel allowances, and are not attached to the physical biofuel consignments. Suppliers may voluntary open an account at the national register (NEA-register) to profit from the sale of biotickets. Any excess of the target may be sold as biotickets to other obligated registered parties.

In addition to the national transposition of the EU **RED the Dutch government is using the "Green Deals" policy as a means of favoring the use of biofuels in aviation through the Green Deal of KLM with the Government.** The objective of the "Green Deals" is to remove obstacles and barriers for citizens, companies, local councils and stakeholder organizations in the initiatives for the use of sustainable and efficient energy.

In particular, the KLM Green Deal is a public-private partnership in which the Ministry of Infrastructure, along with other private partners, is participating in the KLM's Corporate BioFuel Programme. This program works through the payment of a surcharge by the participants that compensates the price difference between biofuels and traditional kerosene. The investment is used to purchase biofuel which is then added to the fuel system at Amsterdam Schiphol Airport. Within this program, KLM

made an agreement with WWF-Netherlands in which the company pledged to operate 1% of all their flights on sustainable biofuel by the year 2015.

Regulations/policies in place addressing alternative aviation fuels / biofuels	- Dutch Decree on Renewable Energy in Transport of 18 April 2011 - Fuels and Air Pollution Decree of 8 April 2011 - KLM and Ministry of Infrastructure Green Deal
Total biofuel production target	Biofuel obligations for fuel suppliers based on energy content: • 2010: total obligation of 4% • 2011: total obligation of 4.25% • 2012: total obligation of 4.5% • 2013: total obligation of 5% • 2014: total obligation of 5.5% • 2020: total obligation of 10% Reduction of the lifecycle GHG emissions for transport fuels: • 2% by 31 December 2014 • 4% by 31 December 2017 • 6% by 31 December 2020.
Sustainability schemes/criteria that have been implemented on national level	NTA 8080→ NTA 8081 (Certificatieschema voor duurzaam geproduceerde biomassa ten behoeve van energiedoeleinden) Certification scheme for sustainably produced biomass for energy applications

3.2.4.7. United Kingdom

The main policy in the UK regarding the implementation of alternative fuels is the Renewable Transport Fuel Obligation (RTFO) which encourages the production of biofuels. According to this policy, fuel suppliers that produce at least 450,000 litres of fuel a year must be able to show that a percentage of the fuel they supply comes from renewable and sustainable sources. The RTFO was first published in 2007 and implemented in 2008 and is intended to deliver reductions in carbon dioxide emissions from the transport sector by encouraging the supply of renewable fuels. The 2007 order was amended in December 2011 to transpose the transport elements of the EU RED to the national legislation. It was amended again in 2013 to implement the related requirements of articles 7a-e of the EU Fuel Quality Directive 2009/30/EC.

Under the RTFO, those parties supplying biofuel must meet specified sustainability criteria in order for their fuels to be recognized as biofuels entitled to the benefit of the Renewable Transport Fuel Certificates (RTFCs). Obligated fuel suppliers are required to redeem a number of RTFCs in proportion to the volume of fossil fuel that they have produced in a certain period. The British Department for Transport launched the Renewable Transport Fuel Obligation Guidance which includes several parts describing RTFO functioning, carbon and sustainability guidance, guidance for verifiers, voluntary schemes and a list of waste and residues which double count towards the RTFO objectives.

Both the national system and voluntary schemes can be used to prove sustainability criteria. The national system is the RTFO Biofuel Sustainability Standard. To demonstrate compliance with the full RTFO Biofuel Sustainability Standard, parties must carry out an independent third party audit against the RTFO Biofuel Sustainability Standard criteria. The compliance with the RED criteria can also be proved by using one or more voluntary schemes. In order to report a voluntary scheme for compliance purposes, the version of the scheme being used should be recognized by the European Commission or the RTFO Administrator as meeting the requirements. Where a voluntary scheme does not meet all of the criteria required by the RED, then suppliers will need to demonstrate compliance with other criteria through another voluntary scheme.

There are a number of aspects of the FQD that the UK government has not yet transposed to the national legislation such as the publication of a methodology to calculate the contribution of upstream emission reductions and assign this to fuel suppliers as well as a methodology to allow joint reporting by suppliers.

Regarding national production targets, RTFO is also Britain's main policy instrument for meeting the EU goal that 10 percent of transport fuel should come from renewable sources by 2020. The RTFO has gradually increased every year to require that 5% of Britain's fuel supply by volume is made up of renewable fuels from April 2015. It does not specify the type of renewable fuels but the only requirement is to comply with the sustainability criteria.

Regulations/policies in place addressing alternative aviation fuels / biofuels	- Renewable Transport Fuels Obligation (RTFO) order - 2011 No. 243 The Promotion of Use from Energy Renewable sources
Total biofuel production target	5 % according to the RFTO
Sustainability schemes/systems at have been implemented on national level	RTFO Biofuel Sustainability Standard

3.2.5 EU ETS

On 20 December 2006 the EU Commission adopted a proposal legislation to include aviation in the European Emissions Trading Scheme. This inclusion meant that all the flights performed to or from a European Member State, Iceland, Liechtenstein or Norway were included under the system independent of the nationality of the operator. From 2012, airlines operating in the EU aerodromes had to summit to the authorities a number of emission allowances equivalent to the tonnes of CO_2 emitted during the year, meaning that they could purchase and sell emission allowances. The scheme was designed to cover every flight with origin or destination in the EEA region. However, in April 2013, the EU took the decision to temporarily suspend enforcement (until 2016) to those flights operated in or to non-European countries, while continuing to apply the legislation to flight within and between countries in Europe. This action was taken to facilitate the negotiations for a global MBM at ICAO level.

To follow up their annual emissions, operators need to implement a monitoring, reporting and verification system of their annual emissions, meaning that they should have the procedures in place to carry out the annual reporting to the Member State Competent Authority. Aircraft operators have to account the volume of fuel consumed during the flights which are included in the scheme and a standard emission factor shall be used to calculate the volume of emissions. However, for accounting purposes, the emissions produced from the use of biofuels account as zero, as a way of incentivizing biofuel use.

For biofuels to be zero emissions rated in the EU ETS, they will have to demonstrate that they meet minimum GHG savings and the sustainability requirements listed under the RED related to the protection of land with high biodiversity value and land with high carbon stock. However, the current impact of EU ETS on biofuel uptake is currently low since the carbon price is low and it is unlikely that this will have an impact on airlines to decide on using alternative fuels.

The MRV guidelines for biofuels in the context of the EU ETS rely on simplified procedures based on Fuel Purchases but it requires airport level reporting. The biojet reported cannot exceed the total fuel usage of an airline for their flights departing from a specific airport that is within the EU ETS. This is to avoid that airlines could exempt emissions on routes not subject to the EU ETS.

For administrative purposes, each aircraft operator is administered by a Member State. Those operators based inside the EEA are administered by the Member State that has issued it Air Operating Licence while those from third countries are administered by the Member State with the largest attributed emissions in the base year.

Two pieces of documentation are required to demonstrate compliance:

- Fuel purchase records that indicate the biomass fraction, net calorific value and emission factor or carbon content of the fuel, and
- Certificate of sustainability demonstrating compliance with the RED

Aim	To reduce the climate change impact attributable to aviation by including emissions from aviation activities in the Community scheme
Administration responsible for its implementation	EU Member States
Type of policy measure / regulation	Legislation: Directive 2008/101/CE modifying Directive 2003/87/EC.
Timeframe	2012 onwards
Geographical scope	2012: All flights with origin *or* destination in the EU + EEA states 2013-2016: All flights with origin *and* destination in the EU + EEA states
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet	Aircraft emissions

development)	
Revisions and updates of the policy	- Regulation 421/2014 of the European Parliament and of the Council of 16 April 2014: Introduces the following temporary exemptions to Directive 2003/87/EC • For all emissions from flights to and from aerodromes located in countries outside the European Economic Area (EEA) in each calendar year from 1 January 2013 to 31 December 2016 • For non-commercial aircraft operators emitting less than 1 000 tons CO_2 per annum from 1 January 2013 to 31 December 2020
Applicability	The modifications of the legislation have made the applicability of the regulation being delayed. In terms of biofuel use incentivizing the effect is still low since the commercial availability of aviation biofuel is limited.
Relevant or affected stakeholders (i.e.: feedstock producers, fuel producers, logistics companies, etc.)	- Aircraft operators

3.3 United States & Canada

3.3.1 Renewable Fuel Standard, RFS

The RFS program was created under the Energy Policy Act (EPAct) of 2005 establishing a renewable fuel mandate that requires transportation fuel sold in the U.S. to contain a minimum volume of renewable fuels.

For the original program (RFS1) the objective was to reach 7.5 billion gallons of renewable fuel to be blended into gasoline by 2012. In 2007 under the Energy Independence and Security Act (EISA), this amount of renewable fuel volume was increased to 36 billion ethanol-equivalent gallons for a variety of fuel categories after the program had been revised under a new name, RFS2. The EISA also introduced renewable fuel categories and the requirement to apply lifecycle greenhouse gas performance threshold standards to ensure that each category of renewable fuel emits fewer greenhouse gases than the fossil fuel it replaces. Therefore RFS2 defined minimum GHG emissions reductions required for each category based on their 2005 conventional fuel baselines ranging from 20 to 60% depending on the categorization (see fuel categorization below). The calculation for standard emissions reductions incorporated direct and significant indirect emissions including ILUC.

The RFS program regulations specify the types of renewable fuels eligible to participate in the program and the procedures by which renewable fuel producers and importers may qualify for the EISA objectives through approved fuel pathways. Environmental Protection Agency (EPA) establishes the volume requirements for each category based on legislated volumes and fuel availability. EPA must track the compliance of the objectives through the RIN (Renewable Identification Numbers)

system. Traceability of each gallon of renewable fuel produced under RFS2 is maintained by assigning a unique RIN 38-character number, which also serves as a means to offset higher production costs of these fuels to make them cost-competitive with conventional fuels. Refiners, blenders, and importers can meet their obligations by either selling required biofuels volumes or purchasing RINs from parties that exceed their requirements. All RIN generation, trading, and use for compliance must be done through the EPA-Moderated Transaction System (EMTS). All renewable fuel operators who wish to qualify for the RINs must register under RFS in order to assure compliance.

The RFS provides a process (the new biofuels petition) to evaluate new fuels and feedstock and determine the appropriate renewable fuel category if the requested pathway is not already approved for RIN generation. Regarding emission thresholds, four renewable fuel categories have been established with different requirements. These are separated but nested categories, and each one has a specific objective of production:

- Total Renewable Biofuel: Mandate of production of 36 billion gallons by 2022 with a lifecycle GHG emissions reduction of at least 20% relative to conventional fuels.

- Biomass-Based Diesel: Mandate of production of 21 billion gallons by 2022 with a lifecycle GHG emissions reduction of at least 50% relative to conventional fuels. This is a subcategory of the total renewable fuels mandate that includes biofuels produced by non-corn feedstock.

- Cellulosic and agricultural waste-based biofuel: Any fuel derived from cellulose, hemicellulose, or lignin—non-food-based renewable feedstock. Mandate of production of 16 billion gallons by 2022 with a lifecycle GHG emissions reduction of at least 60% relative to conventional fuels.

- Advanced Biofuel: Any fuel derived from renewable feedstock. This may include sugarcane or sugar beet-based fuels; renewable diesel co-processed with petroleum; and other biofuels that may exist in the future. Both biomass-based diesel and cellulosic biofuel that exceeds volumes in their respective categories may be used to meet this category. Fuels in this category must demonstrate life cycle GHG emissions reductions of 50% compared to the baseline.

Although up to date no RINs have been claimed from aviation alternative fuels, according to the Aviation Biofuel Sustainability Survey by NRDC[3] the policy has driven considerable investment in second generation biofuel and is therefore relevant to aviation.

Aim	To establish mandatory minimum volume of biofuels: - 4 billion gallons of renewable fuel in 2006 - 7.5 billion gallons by 2012 - 36 billion gallons by 2022
Administration responsible for its	EPA

[3] NRDC (2013). Aviation Biofuel Sustainability Survey. Natural Resources Defense Council. March 2013. www.nrdc.org/energy/aviation-biofuel-sustainability-survey/files/aviation-biofuel-sustainability-survey-IB.pdf

implementation	
Type of policy measure / regulation	Mandate
Timeframe	2007 (start of RFS1) to 2022 (RFS2)
Geographical scope	US (Although biofuels and biomass produced in Canada are also eligible for RINs)
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet development)	alternative fuel production
Revisions and updates of the policy	February 2010, release of RFS2
Applicability	Objective of volume of biofuel use for 2012 achieved through the application of: - Compliance Standards - Tracking system based on renewable identification numbers with credit verification and trading - provisions for treatment of small refineries - general waiver provisions
Relevant or affected stakeholders (i.e.: feedstock producers, fuel producers, logistics companies, etc.)	Directly affected: The mandates are applicable to: - retail fuel blenders - exporters (not for biofuels producers or importers) Companies that supply gasoline or diesel transportation fuel for the retail market are obligated to include a quantity of biofuels equal to a percentage of their total annual fuel sales—referred to as a renewable volume obligation (RVO)

3.3.2 Californian Legislation: Californian Low Carbon Fuel Standard

The California Global Warming Solutions Act of 2006 requires GHG emissions in California to be reduced to 1990 levels by 2020. The Californian climate policy implements an emissions trading system within California along with complementary policies to meet this objective. These complementary policies applied through laws and regulations don't directly address aviation-related emissions; and yet, they are estimated to lower 71% of the targeted emissions (55 million tonnes of CO2e). The cap-and-trade system, on the other hand, is estimated to cover the rest. Among these complementary policies is the Low Carbon Fuel Standard (LCFS), which essentially is targeting to reduce the carbon intensity of gasoline sold in California by 10% by 2020. This is relevant in terms of

the ethanol blended into gasoline. In accordance with this policy, regulated parties must meet the average carbon intensity requirements for its transportation fuel, respectively, in each calendar year.

This policy has resulted in Brazilian sugarcane ethanol to be imported into California and corn ethanol to be exported into Brazil, as Brazilian sugarcane ethanol production with transportation has a lower GHG footprint. Another complementary policy regulates the tailpipe emissions standards for cars and trucks aiming to lower emissions by 30% in 2016 relative to 2009, and 34% in 2025 relative to 2012. These reductions will also reduce the transportation emissions of the aviation biofuels. Another set of complementary measures has been implemented regarding new building energy standards, which also apply to new airport terminals. These measures correspond to 15% of the previous 71%. Renewable Portfolio Standard, as another complementary policy, requires electricity corporations to expand their renewable resource portfolio to 33% by 2020, which will also affect the aviation biofuel footprints.

There are concerns regarding the fact that the Californian cap-and-trade system might cause “leakage” in the other states. Furthermore, the marginal carbon abatement cost through these complementary policies has been estimated to be several times higher than the cost of carbon in the cap-and-trade market, showing that these policies are not very cost-effective compared to an emissions trading scheme.

Aim	- Reduction the carbon intensity of gasoline sold in California by 10% by 2020 - Creation of a market for clean transportation technology stimulating the production and use of alternative fuels in California
Administration responsible for its implementation	California Air Resources Board (CARB). The University of California Berkeley and Davis campuses have played a major role in supporting the establishment and implementation of the LCFS.
Type of policy measure / regulation	State Governor’s Executive Order (Order S-01-07)→ binding obligations for regulated parties in California
Timeframe	In April 2009, rules and carbon intensity reference values were released for the LCFS. 2010 was a reporting year, while 2011 was the first year of formal implementation where petroleum fuel producers and importers had to reduce the carbon content of their fuel by 0.25%. The reduction requirements will increase to the full 10 percent reduction in 2020.
Geographical scope	State of California
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet development)	Fuel production (carbon intensity)

Revisions and updates of the policy	-
Applicability	One standard was established for gasoline and the alternative fuels that can replace it, and a second similar standard is set for diesel fuel and its replacements. The regulation is based on an average declining standard of carbon intensity that is expected to achieve 16 million metric tons of greenhouse gas emission reductions by 2020.
Relevant or affected stakeholders (i.e.: feedstock producers, fuel producers, logistics companies, etc.)	Petroleum importers, refiners and wholesalers

3.4 Brazil

Brazil has been for long one of the most proactive countries in Biofuel production. Starting in 1975, Brazil began a national program, PROALCOOL, to promote ethanol production, setting a goal to produce 3.5 billion litres of ethanol by the year 1980. Having a strong sugar cane production industry, Brazil's ethanol industry is based on this raw material.

Although there is specific legislation to incentivize biofuel production, there is no specific legislation covering sustainability requirements of biofuel production. Instead, generic environmental protection laws can be related to agricultural practices, deforestation, climate change, and conservation environmental impact assessment and working conditions.

PROALCOOL started with public sector subsidies which incentivized farmers to plant more sugar cane, investors built distilleries to convert the crop to ethanol, and automakers to design cars to run on 100 percent alcohol. Additionally, the government financed a distribution network to get the fuel to gas stations and kept alcohol prices low. The subsidies where gradually withdrawn during the 1990s and price control was reduced when cheap oil prices and ethanol shortages caused consumers to switch back to gasoline. Today the percentage of the mixture of ethanol with gasoline is set at 25%.

The following sets of incentives have been granted throughout the existence of the program:

- Financing producers – increasing of production capacity
- Gas stations obliged to sell ethanol
- Maintenance of strategic reserves of ethanol
- Reduction of taxes for vehicles that moved by hydrous ethanol
- Guarantees for purchase to farmers by the state-owned oil company Petrobras
- Provision of low-interest loans for firms producing ethanol from sugarcane or other agricultural products for fuel

These incentives have allowed farmers to plant crops without fear of lost investment allowing the sector to grow rapidly. In addition, the government ensured that ethanol would always fetch a price of at least 59% of gasoline at the pump.

The creation of the PROAALCOL program is the most important milestone in biofuel policies in the country. However, currently there is no specific policy directly related to aviation biofuel production or to the aviation industry.

Aim	To promote Brazil's national sugar economy and establish a mandate to produce 3.5 billion litres of ethanol from sugarcane by 1980
Administration responsible for its implementation	Coordination among various Ministries: - Ministry of Agriculture - Ministry of Science and Technology - Ministry of Industry and Commerce - Ministry of Mines and Energy - Ministry of Finance and Planning - Ministry of Environment
Type of policy measure / regulation	Presidential Decree no 76.593, Proalcool, including several taxes, agricultural planning, agreements with industry.
Timeframe	1974 onwards
Geographical scope	National
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet development)	Alternative fuel production Automotive Industry
Revisions and updates of the policy	- 1999: Liberalization of alcohol (hydrous price with reduction of subsidy) - 2000: End of subsidy for alcohol (hydrous) and total deregulation of the sector
Applicability	- Evolution: • Growth of ethanol production: • 1975-76: 600 million litres/year • 1986-87: 12.3 billion litres/year • 1987-1997: stagnation phase, public resource shortage and decreasing investments for internal production of energy. • 2000: End of subsidy for alcohol (hydrous) and total deregulation of the sector • From 2000 on productivity growth: >3% per year
Relevant or affected	Feedstock producers, logistics, refiners, research centres, automobile

stakeholders (i.e.: feedstock producers, fuel producers, logistics companies, etc.)	industry, fuel distributors, and the gas stations

3.5 Australia, Biofuels Act 2007

The *Flight Path to Sustainable Aviation* was launched in 2011 by Australia and New Zealand to determine the feasibility of the Australian and New Zealand aviation sector taking up bio-derived aviation fuels, the benefits of doing so and the challenges that the sector faces to achieve this objective. Although *Flight Path to Sustainable Aviation* does not make specific policy recommendations, the study provides input to strategic policy and investment decision making for both the study participants and other stakeholders such as government and industry.

However, specific biofuel Policies have not been implemented in Australia with the exception of the State of New South Wales, the Biofuels Act 2007, first demanded a 6% and 2% ethanol and biodiesel mandate respectively. The biodiesel mandate was expected to grow to 5% but the government decided to suspend it due to the lack of available feedstock. In order to qualify towards these objectives producers will have to comply with the criteria of the Roundtable of Sustainable Biomaterials voluntary scheme, since there is no specific regulation regarding sustainability requirements.

Aim	To provide a minimum ethanol and biodiesel content requirement respect of petrol and diesel fuel sales in the State of New South Wales
Administration responsible for its implementation	New South Wales Authority /Minister
Type of policy measure / regulation	Biofuels Act 2007
Timeframe	2007
Geographical scope	New South Wales State
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet development)	Alternative fuel production
Revisions and updates of the policy	- 2009 No 11 Biofuel (Ethanol Content) Amendment Act 2009 - 2012 No 30 Biofuels Amendment Act 2012
Relevant or affected stakeholders (i.e.:	Fuel Suppliers and retailers

feedstock producers, fuel producers, Logistics companies, etc.)	

3.6 Indonesia: The Alternative Fuels and Renewable Energy for Airports Initiatives

In the framework of "T*he Indonesian Aviation Green Initiatives on Mitigation of Climate Change and Reduction of Green House Gas Emissions*", the Indonesian DGCA (Directorate General of Civil Aviation) in close cooperation with National stakeholders, is developing the "*The Alternative Fuels and Renewable Energy for Airports Initiatives*". These initiatives are under the alternative fuels NAMA for aircraft operation and will be implemented in two stages: a pre-implementation phase from 2013 to 2016, a second phase of mandate implementation.

The pre-implementation phase includes a pilot study, research and development, testing and certification, feasibility studies for investment and cultivation of raw materials, establishment of manufacturing and production and quotas, study of distribution and quality assurance and risk management study. The second phase consists of a mandate for implementation of 2% of alternative fuel mix in 2016-2018, and an increase in the mix in 2018-2020. The implementation of the program will be evaluated through a Monitoring, Reporting and Verification system.

The estimated potential emissions reduction by implementing 2% sustainable alternative fuels will reach 0.323 – 0.379 $MtCO_2$/year in the period 2016-2017, and increase to 0.583 – 0.729 $MtCO_2$/year in the period 2018-2020. Thus the potential accumulation of carbon emission reduction up to 2020 aims to achieve 2.725 $MtCO_2$ or contribute to reduce 17% of total emissions in the air transport sector.

Aim	Achieve a total of 7.5 MW renewable energy capacity (3% of Total Capacity) by 2020, implementation of a sustainable alternative fuel mix of 2% in 2016-2018 and considered feasible, an increase to a 3% mandatory mix for all carriers in 2018-2020
Administration responsible for its implementation	Indonesian DGAC
Type of policy measure / regulation	National Policy with some specific regulation in place (Presidential Decree on the National Action Plan on GHG emissions reduction & the Decree of Ministry of Transportation for sub-sector of air transportation) and further regulations to be yet developed.
Timeframe	Two phases: • 2014-2016: Pre-implementation phase • 2016-2020: implementation phase

Geographical scope	National
Working point (e.g. alternative fuel production, aircraft emission, fleet emission, fleet development)	Fuel production
Revisions and updates of the policy	N/A
Applicability	At the pre-implementation phase the following items are to be developed: • the development of an industrial pilot study, • research and development activities, • testing and certification, • feasibility studies for investment, • development and cultivation of sustainable raw materials, • manufacturing and production • definition of quotas, price level and economic markets, • distribution and quality assurance, as well as Risk Management
Relevant or affected stakeholders (i.e.: feedstock producers, fuel producers, logistics companies, etc.)	Feedstock producers, logistics, refiners, research centres

4 Comparison between EU and US Legislation

A comparison of the USA RFS2 with the European RED and FQD shows that there are similarities and differences in both regulations although they have led to fairly similar outcomes in terms of which biofuels are considered sustainable, with some exceptions.

A common aspect of both policies is that they have adopted legal definitions and criteria for determining the sustainability of biofuels on the basis of scientific knowledge, although there is not necessarily a strict consensus on the nature of these criteria. These sustainability criteria can be divided into those that deal with GHG emissions requirement and those that deal with other environmental aspects. This division is not strict and there are items that will both benefit decarbonisation and tackle other environmental aspects related with the protection of biodiversity or water concerns. Additionally, both regulations try to establish minimum amounts of biofuel production, considering that their approaches differ in a number of aspects.

In the table below, a comparison between both regulations has been included:

Criteria	**RFS2**	**RED**
Target basis	Volume	Energy
Target year	2022	2020
Transportation basis	Road	Road (note that aviation biojet has recently allowed to account towards the reduction obligation laid down in the FQD as long as they satisfy the sustainability criteria. Currently only the Netherlands has transposed this to its national legislation)
Fuel volume	36 BGY (increases yearly)	10%, with double counting of fuel volume from waste and residues
Aviation fuels	Not mandated but account towards target and eligible for incentives	Aviation biofuels may account towards national objectives, however currently only the Netherlands has included this option
Fuel categories that qualify	I. Advanced biofuels II. Biomass-based diesel III. Cellulosic biofuel IV. Renewable fuel	None
Fossil comparator (g/MJ)	87.5 (value being used as fossil jet fuel comparator. (Allen, et. al, 2009) RFS2 defines comparators only for gasoline and diesel)	83.8 (not specific to any fuel type)
Minimum GHG savings	Fixed *I-50%, II-50%, III-60%, IV-20%*	Variable *See Grandfathered GHG savings below*
Grandfathered GHG savings	0%, if construction started • *before Dec 19, 2007 for renewable fuel facilities* • *between Dec 19, 2007 and Dec 31, 2009 for ethanol facilities fired with natural gas or biomass*	• **35% until Jan 1, 2017 and then 50%** Exceptions • 0% until Apr 1, 2013, if construction started on/before Jan 23, 2009 • From 2018, 60%, if production started after Jan 1, 2017

Entity conducting LCA	Pathways analysed by EPA	Pathways analysed by the EC resulting in “default values” Actual values can be calculated
Emissions accounting in LCA	Energy-based allocation for fuel products and system expansion (i.e. displacement) for everything else	System expansion (i.e. displacement) for electricity and energy for everything else
LCA Calculations	EPA values used for each feedstock type	Given standard values may be used or actual values can also be calculated.
LUC in LCA	Both dLUC and iLUC are considered under domestic (i.e. U.S.) and international LUC factors	dLUC factors are considered. iLUC is considered for reporting purposes
Incentives[4]	Tradable RINs (Renewable Identification Numbers) via EMTS (EPA Moderated Transaction System)	No direct ones, although states need to reach their national targets. In addition the EU ETS accounts biofuel emissions as 0. The proposed Biotickets system in the Netherlands could set an incentive.
Traceability	RINs	Mass-balance system or physical segregation
Other sustainability criteria	Need to demonstrate that the land where the feedstock was obtained from had been cleared prior to Dec 19, 2007, and was maintained actively on that day. Renewable fuel producers must meet applicable recordkeeping and reporting requirements to demonstrate feedstock meet RFS sustainability criteria.	Need to demonstrate compliance by using one of the schemes recognized primarily by the Member State, or by the EC. In order to account towards the objectives, biofuels and bioliquids will not be made from raw material obtained from: - land with high biodiversity value. - land with high carbon stock, namely land that had one of the following statuses in January 2008 and no longer has that status: ○ wetlands ○ forested areas ○ land spanning more

[4] Some US States and EU Countries have their own additional means of incentivizing, such as subsidies or Tax exemptions.

		than one hectare with trees higher than five metres and a canopy cover of between 10 % and 30 % - land that was peatland in January 2008
Auditing	Internally or independently	Independently only through different alternatives: • National Schemes • Approved Voluntary Schemes

An important item to stand out in terms of incentives is that the RFS gives direct incentives to producers of sustainable biofuels through tradable emissions units (RINs) without any proof of biofuel use from operators. The incentive mentioned in the table above for RED is not direct, that is, there is not a direct generation of allowances under the RED, but rather, aircraft operators will not have to buy allowances for the emissions produced from the use of alternative fuels under the EU ETS.

5 Assessment of Renewable Fuel Policies

5.1 What is the purpose of this assessment?

There are various ways in which aviation renewable drop-in jet fuels could be incentivized as it has been presented in the previous section of this document. Some require more administrative effort, some put a higher level of responsibility from producer's side and in other cases it can require a very strong compromise from the Member States in terms of policy action. However, it will be important to take into consideration that:

- None of them alone will allow creating a solid renewable jet-fuel market. More than a single measure, in order to achieve a relevant level of deployment, a clear strategy needs to be designed, which requires the commitment of the administrations and stakeholders. The strategy needs to be specific to aviation alternative fuels since it has a number of particularities as explained in previous sections of this report.
- Each of them will require efforts and significant investment, either from private parties or through public grants.
- A common strategy that considers public and private parties will be key for large scale deployment

The purpose of the policies assessment is to evaluate the future potential reward of the possible measures to be taken in order to help in the decision-making process. The current policy scenario combined with the level of development of the pathways has proved not to be enough to impulse a strong aviation alternative fuels sector. This adds to the fact that some of the technologies are not fully mature. It must be taken into account when legislating that for full matureness to be achieved a more consolidated market will be needed.

In any case, the robustness with which the administration acts will very much depend on the actual objectives for aviation alternative fuel production that are specifically set for the aviation sector. That is, if the objective is to increase the level of deployment in aviation because the potential range of emissions reduction in this sector is limited with other measures, then a stronger set of measures is required. Alternatively, if the objective is to let the alternative fuels market regulate itself among the whole transport sector and that the feedstock is used in the sector where the price of production is lower, then specific aviation-focused measures may not be the best way forward. What is important is to assume in the future policy that having a significant level of deployment will require a high initial investment from either public and/or private parties and a significant effort from industrial stakeholders.

The final objective of this evaluation is to present the possible options and help to point to the direction that shows most potential for our future, but it is also important to take into consideration that decisions at policy level can very much vary depending on the final objective that wants to be achieved in Europe.

The purpose of this assessment is therefore to try to assess the reward of the policy options, with the implicit limitations that imply the fact that the level of implementation will very much depend on a range of different factors, and not only a specific policy. For the case of specific mandates, the number of production facilities and other economic impacts has been estimated, in order to be able to see the level of political action that will be required.

5.2 Main barriers to biojet fuel uptake

The biojet fuel market is still developing with small volumes available and a limited number of flights currently using biojet fuels. There are a number of key barriers that need to be removed before the biojet fuel market can reach full commercialization:

- No or too low price on the external costs (as environmental impacts/damage) of conventional (fossil) fuels use are considered;
- Limited supply due to lack of production capacity;
- High feedstock and production costs;
- Lack of direct sectorial policy support;
- Concerns about sustainability.

The key barriers mentioned above are all linked; for example if market incentives were available for the supply of biojet fuels, then the demand for biojet fuels would increase, and as result production capacity would increase and prices wouldlikely decrease. Vice versa, if the prices would decrease, for example through learning and innovation, then the market would also become more attractive to airlines leading to an increase in demand for biojet fuels. Finally, policy measures related to biojet fuels, discussed in this memo, become more acceptable if concerns about sustainability are satisfactorily addressed.

5.2.1 Biojet fuel production capacity is limited

Global and European biojet fuel production capacity is limited. Biojet fuels produced via the Fischer-Tropsch (FT) process, via the hydroprocessing of oils and fats (HEFA), or via the direct sugar to hydrocarbons (DSHC), now called Synthetised Iso-Paraffins (SIP) route, are all certified to the international ASTM jet fuel technical specifications when blended up to a certain percentage with fossil jet fuel. Current production capacity is mainly based on the HEFA route, and although biojet fuel could in principle be produced in the same facilities, in most cases only biodiesel is produced. Existing biofuel policy measures are geared towards the use of biofuel in road transport rather than in aviation.

The lack of perspective for a short or even long term biojet fuel market limits the motivation to invest in production capacity.

5.2.2 Biojet fuel costs are high

The production costs of biojet fuel are more expensive than the production costs for fossil kerosene, especially with the current very low oil prices and if no external costs (e.g. GHG impacts) are included. Fuel costs are a substantial part of the operating costs for airlines, which means that it is not realistic for airlines to unilaterally use significant amounts of biojet fuel for their operations without affecting their competitiveness.
The costs of biojet fuel production depend strongly on the feedstock price. In 2014 when Jet A1 prices were around 0.73 €/litre, incentives of around 0.38 – 0.67 €/litre biojet fuel would be needed to make biojet fuel competitive with fossil kerosene in the current market / technology conditions (SQ Consult, 2014). With current (November 2015) fossil fuel prices of 0.32 €/litre this would mean incentives of 0.77 – 1.07 €/litre biojet fuel are needed[5]. The price gap between fossil and biojet fuel depends on many factors including feedstock prices, oil prices, biofuel policy and markets. Therefore the cost gap ranges mentioned above are highly variable and should therefore be regarded as indicative.

5.2.3 Lack of policy support

The use of biojet fuel can be counted towards the target of renewable energy in transport in the RED. To date, only the Netherlands has transposed this specific element of the Directive into national regulation so that biojet fuel supply is counted towards fuel supplier's obligations. Also, the European Emissions Trading Scheme (ETS) for intra-European flights provides a small incentive to reduce carbon emissions from aviation, which can be realised using biofuels. Still, the RED and the ETS together do not provide a sufficient incentive to bridge the cost gap between fossil and biojet fuels.

5.2.4 Concerns about sustainability

Legislation in several countries demands compliance with sustainability criteria for biofuels used in transport, most prominently the RED and the US Renewable Fuel Standard (RFS2). Any biojet fuel reported within these systems would also have to comply with the sustainability criteria. Furthermore, over the last few years several voluntary schemes have emerged for the certification of biomass sustainability, driven in large part by their acceptance in the RED as a means of demonstrating compliance. Examples include the Biomass Biofuel Sustainability Voluntary Scheme (2BSvs), Bonsucro EU, International Sustainability & Carbon Certification System (ISCC EU), the Roundtable on Sustainable Biomaterials (RSB EU RED), and the Roundtable on Sustainable Palm Oil (RSPO RED). These legislative frameworks and voluntary schemes all aim to ensure sustainable biofuels, but differ in the scope and details of the sustainability criteria that they cover.
Biofuels are frequently the subject of debate concerning sustainability. The sustainability of biojet fuel must therefore be convincingly demonstrated by voluntary schemes and any environmental and social sustainability concerns should be avoided. Airlines are typically prudent about sustainability because they are particularly vulnerable to public opinion and therefore use biofuels certified against stringent

[5] Conversion from 1 USD per gallon to 0.249 € per liter.

sustainability standards. The Sustainable Aviation Fuel Users Group (SAFUG) "pledge"[6] demonstrates a high level of sustainability ambition of the aviation industry. Socio-economic impacts, including minimising competition with food, and the preservation of water quality are covered, in addition to GHG savings and the protection of highly biodiverse areas.

5.3 What should be the objective of any Policy action?

Several caveats should be taken into consideration when trying to incentivize renewable drop-in jet fuels. These aspects are essential and therefore must be taken into consideration when defining a strategy:

- Safety: This is implicitly required by the "drop-in" requirement and it is the purpose of the certification process to guarantee the safe characteristics of a particular fuel. This is currently exclusively carried out by the American Society of Testing and Materials (ASTM) and the British DEF STAN 91-91 (Ministry of Defense Standard 91-91) and is an expensive and long process. The level of investment for the certification of new fuels currently made in Europe is fairly low.
- The volumes to be produced need to feed the current demands in significant quantities and therefore a significant amount of feedstock sourcing will be needed.
- The environmental balance must be significantly better than fossil jet fuel. The target in terms of emissions should be compliant with the RED directive. Any renewable drop-in jet fuel pathway that would not perform well in terms of any sustainability requirement will not succeed, especially since there is a high adversity from the airlines to use any product that does not guarantee certain sustainability criteria.
- The production must be profitable when compared with the production of fossil jet fuel. This is currently one of the most difficult barriers to get over. Incentives, finance support, or accounting towards the global alternative fuels objectives can contribute to make these fuels more attractive from a market point of view.

5.4 Analysis of policy options to support biojet fuels uptake in the EU

With the objective of analyzing the possible options and the possible way forward at EU level several policy options have been considered for the elaboration of this deliverable. Since it is not possible to assess performance indicators at a pre-implementation phase, a qualitative description of a possible implementation has been done. The impacts will of course very much depend on the details of how each single policy is designed. For this work, several options were considered and, of all the possible options, those that were considered feasible have been analyzed.

It should be noted that, for each policy, a more in-depth impact assessment analysis should be carried out once the details of implementation are defined.

Therefore, in this analysis, Ecofys and Senasa have agreed to assess the following policy options:

A. Counting of biojet fuels towards the obligation of fuel suppliers in EU Member States;

[6] http://www.safug.org/safug-pledge/

B. Global Market-Based Measure with revenue generation geared towards biojet fuels;
C. Separate mandate for aviation biofuels;
D. Stimulating innovation and projects in the supply chain;
E. Cooperation between major airports / airlines.

These identified options will be assessed in the same manner covering the following aspects:

- Description;
- Type of policy measure;
- Actions required for implementation;
- Target action group;
- Target stakeholders;
- Impact assessment;
- Ease of implementation

Tables 5.4.1 to 5.4.5 below were elaborated by Ecofys and make a review of these aspects.

5.4.1 Counting of biojet fuels towards the obligation of fuel suppliers in several EU Member States (opt-in)

Description	The Renewable Energy Directive (RED) allows biojet fuels to be counted towards the mandate for renewable energy in transport. The RED sets the ceiling of the mandate and the rules on which fuel types can be counted towards the obligations, but the Member states are responsible to transpose the directive into national legislation. The Netherlands is so far the only European Member State that has explicitly installed an opt-in for biojet fuels to count in the fuel supplier's obligation, thereby creating a level playing field for road biofuels and aviation biofuels. Most Member States have designed national biofuel policies so that it only stimulates the use of biofuel in road transport. Fuel suppliers are not stimulated to produce and sell biojet fuel to comply with their obligations on renewable energy in transport. By stimulating other Member States to provide a level playing field for road biofuels and biojet fuels the value of delivering biofuels to the aviation sector would increase for fuel suppliers, thereby bridging (part of) the costs gap for the airlines. Note that the measure does not put an obligation on airlines to use biofuels or to fuel suppliers to use biojet fuels. The measure can be taken by individual Member States without damaging the competitive position of airlines.
Type of policy measure	Counting biojet fuels towards the obligation of fuel suppliers in all Member States is a **regulatory measure**
Role of the European Commission	The role of the European Commission could be to stimulate and support the Member States in adapting their national legislation to include biojet fuels. The Commission cannot demand Member States to change their national policies, but could rather inform Member States about the possibilities to create a level

	playing field. Possible actions are: • Using conferences and other public appearances to inform Member States and the public about the possibilities for a biojet fuel opt-in in national biofuel policy. • In 2016 / 2017 an impact assessment on renewable energy in transport will be published to analyse different policy scenarios for the post 2020 period. The Commission could mention the inclusion of biojet fuels in overall biofuel policy as a good example, or analyse the case of the Dutch opt-in, to give attention to this possibility and inspire Member States to take similar action. • By the end of 2017 the Commission will report to Parliament on the implementation of Directive (EU) 2015/1513, including a section on *"promoting sustainable biofuels after 2020 in a technology-neutral manner, in the context of the 2030 framework for climate and energy policies"*. The report could include a section on technology neutrality and a level playing field for bio energy end use by including a section on the opt-in for biojet fuels. • The Concerted Action Renewable Energy Sources (CA-RES) is the official regular meeting between the European Commission and the Member States to discuss the implementation of the RED. CA-RES is an instrument of the Intelligent Energy Europe (IEE) Programme, which supports the transposition and implementation of the RED. The working group on biofuels could be asked to discuss the opt-in for biojet fuels, similar to how this was done in the Netherlands. • The Renewable Fuels Regulators Club (REFUREC) is the informal network of Governmental institutions responsible for regulating biofuels, meeting regularly to discuss the implementation of the RED. In light of the upcoming ICAO proposal on a market based measure for the aviation industry, in which the use of biofuels may play a significant role, a discussion with Member States during a REFUREC meeting could be initiated by the Commission.
Target action group	Key target groups are • European Commission • Member States • CA-RES • REFUREC
Target stakeholders	Aviation fuel suppliers including new fuel suppliers that specialise in biojet fuels.
Impact assessment	**Impact to deployment** Creating a level playing field for biojet fuels and road biofuels will bridge part of the cost gap, although biojet fuels will still remain significantly more expensive

	than fossil fuels. The inclusion of biojet fuels in national legislation would help to bridge around 15 – 50% of the costs gap for biojet fuels[7]. Creating an opt-in will therefore not create the market by itself, as fuel suppliers can more cost-effectively fulfil their obligation by putting biofuels in road transport. **Impact to airlines** Airlines would still pay a premium on the biojet fuel they purchase. The premium would however be smaller as the fuel suppliers can use the biojet fuel delivered as part of their renewable energy obligations. **Impact to EC and Member States** Member states will need to set up a system that allows biojet fuels to be counted towards the obligation of the fuel suppliers.
Ease of implementation	The RED allows the use of biojet fuel to be counted towards the obligations of fuel suppliers. Furthermore, the Dutch opt-in system provides a blueprint of how the biojet fuel opt-in can be created at limited or no costs. The main barrier for implementation is therefore to convince the Member States to change their policy, rather than other barriers that could hamper the implementation. The measure can also be introduced outside of the EU in countries that have a biofuels obligation for (road) transport. This would increase global demand for biofuels and hence over time (scale, learning, innovation) reduce production costs.

5.4.2 Global Market-based Measure (MBM) with revenue generation geared towards innovation in the aviation sector

Description	In 2013, the International Civil Aviation Organization (ICAO) adopted a Resolution in which it was decided to develop a Global Market-Based Measure (MBM). From 2020 onwards this measure - a global levy, global emissions trading, or global mandatory offsetting – will regulate carbon dioxide emissions from international aviation. The GMBM is likely to be an offsetting scheme, with the details depending on ICAO's next General Assembly in 2016, where the 191 Member States will vote on adopting the Resolution. In a global offsetting scheme greenhouse gas (GHG) emissions can be offset through the reduction, removal or avoidance of emissions. An offset "cancels out" or "neutralizes" emissions from one sector through the reduction of emissions in a different sector or location. The standard measurement used is one tonne of CO_2, or CO_2-equivalent. Offsetting operates through the creation of emissions units, which quantify the reductions achieved. These emissions

[7] Ecofys expert estimation. The price of fossil jet fuel is highly variable and biojet fuel is still a developing market with uncertain and variable prices.

	units, which can be created outside the international aviation sector, can be bought, sold or traded. A number of provisions could be added to the offsetting scheme that would help to further stimulate the uptake of biojet fuel: • In an offsetting system biojet fuel could be used to reduce the emissions from airlines activities by accounting with lower emission factors, as an alternative to buying offsets. To maximise the impact of using biojet fuels it could be considered to account for biojet fuels as having very low or no GHG emissions similarly to what was proposed in the EU ETS system. This would require easily implementable accounting systems, currently under development at the ICAO CAEP groups. • It could be considered that a part of the total offsets used by airlines need to be generated in sectors (in)directly linked to the aviation industry such as airports. In 2015, ICAO and the UNFCCC cooperated to develop a methodology for generating CDM credits from using of electric aircraft taxiing systems. ICAO and the UNFCCC secretariat are also cooperating in the development of a methodology covering the supply and use of solar power for aircraft operations at airport arrival and departure gates. • Another possibility is to stimulate biojet fuels through generating a revenue stream from an offsetting system. The revenue stream from an aviation MBM could be used as a source for climate financing needed to limit the global temperature increase, or used for stimulating innovation in the aviation sector. In the case of an offsetting scheme one way to create a revenue stream could be by applying a transaction fee to each purchased offset unit (tCO_2). In case there is revenue generation, it would be the individual States that would decide the use of it so this would be a decision at Member State level. These projects could include projects that stimulate innovation in biojet fuels. The option of revenue generation is one of the design options that was considered in the MBM design process at ICAO.
Type of policy measure	This measure is a **market based measure.**
Role of the European Commission	The MBM design is organised though the ICAO Committee on Aviation Environmental Protection (CAEP), which has set-up two working groups to implement this: (1) the Environment Advisory Group (EAG) and (2) the Global MBM Task Force (GMTF). Additionally, the Alternative Fuels Task Force (AFTF) is working to develop an LCA methodology to calculate the emissions reduction of alternative fuels to be considered in the MBM. The MBM design will be presented at the ICAO General Assembly in September 2016. It seems likely that an offsetting scheme without revenue generation will be proposed, but the design of the MBM is currently still ongoing. It is unlikely that the European Commission can now change the current proposed design of developing an offsetting scheme, as the discussions are

	already advanced and dealing with the technical details of the offsetting scheme. However, the European Commission and its Member States could strive to keep revenue generation on the agenda for the coming years when the system is evaluated and possibly revised. We estimate that changes would at the earliest come into place after 2020, when the original MBM design will be implemented. The ICAO General Assembly, which takes place every three years, would most likely have to vote on any major changes to the MBM design.

Target action group	• ICAO Committee on Aviation Environmental Protection (CAEP)
	  ○ Environment Advisory Group (EAG)
	  ○ Global MBM Task Force (GMTF)
	• European Commission
	• Member States

Target stakeholders	• Airlines • Aviation research stakeholders
Impact assessment	**Impact on deployment** The main impact of designing an MBM with revenue generation is that funds will be made available stimulating innovation in the biojet fuel supply chain and reverting directly in the sector. Innovation in feedstock production, conversion technology, logistics or business models helps to drive down the price of biojet fuels and decrease the costs gap. A MBM, which is expected for 2020, will help to bridge some of the cost gap. Current carbon prices do not provide a large contribution yet, as they will decrease the costs gap by 1-5 %, which is not enough to create a market for biojet fuels. As prices for biojet fuel come down and the price of carbon increases, a more significant effect of the MBM on the use of biojet fuel is expected[8]. The transaction fee will be added to the price of carbon, thereby slightly increasing the price of carbon credits. A higher carbon price leads to higher costs for using fossil fuels, and therefore will help to decrease the costs gap. The transaction fee should however in principle be small compared to the costs of the carbon credit itself; we therefore believe that the direct effect of the transaction fee will be smaller than the impact of the carbon price, but indirect effects through increased innovation in the biojet fuel supply chain could be significant. **Impact on airlines** Airlines would be impacted in terms of MRV. If alternative fuels can be used to reduce the accounted emissions, demonstration of sustainability requirements documentation is needed. It would be important that the MRV and sustainability requirements demonstration by operators are easy to implement

[8] Ecofys expert estimation. The price of fossil jet fuel is highly variable and biojet fuel is still a developing market with uncertain and variable prices.

	and demonstrate. Otherwise, the incentive to use alternative fuels would decrease due to the administrative complexity. **Impact on EC and Member States** Some impact is expected in terms of administrative work for the Member States. The details and responsibilities of the administrative work are still to be defined at ICAO level but administrations will need to have the appropriate administrative and legislative framework adapted to the details of the scheme.
Ease of implementation	An offsetting scheme would not be in conflict with the agreement that fuel used in international aviation is typically not taxed, which is derived from the 1944 Chicago convention Article 24. A transaction fee on top of the costs for offsetting emissions could however be in conflict with Article 24 that states: *"Aircraft flying to, from or across, the territory of a state shall be admitted temporarily free of duty. Fuel, Oil, spare parts, regular equipment and aircraft stores retained on board are also exempt custom duty, inspection fees or similar charges".* To amend the Chicago convention two thirds of the votes in the ICAO General Assembly are required. The implementation of an MBM with revenue generation is not likely to take place before 2020. If such a system would be established it will likely be several years after 2020, when the offsetting system that is currently being designed is evaluated and possibly revised. International agreement will be needed on adding a revenue generation element to the existing offsetting scheme, which could be difficult to achieve.

5.4.3 Separate mandate for aviation biofuels

Description	The RED obligates Member States to supply 10% renewable energy in transport in 2020. The renewable energy can in principle be delivered in all modes of transport, so also including aviation. Most Member States have designed national biofuel policies so that only biofuels in road transport are counted. Fuel suppliers are therefore not stimulated to produce and sell biojet fuel to comply with their obligations on renewable energy in transport. A separate mandate for aviation biofuels could be developed that obligates aviation fuel suppliers to blend a small percentage of biojet fuel in the total amount of fuel sold. Due to the fact that biojet fuel would be blended into the joint hydrant system at an airport, all airlines will be charged with the additional price for biojet fuel. We would recommend to start with a very low mandate, e.g. 0.5-1% of annual EU aviation fuel demand, as the market needs time to develop a functioning supply chain. The mandate could be slightly increased over time. Implementing a separate mandate for aviation biofuels requires significant time (see also the section on role of European Commission) as well as production capacity. Only certified sustainable biojet fuel should be eligible to be counted towards the mandate. The targets of the RED will expire in 2020, but it is assumed that the sustainability criteria will continue to be mandatory as part of,

	for instance, the FQD, which will be prolonged. The mandate for aviation biofuels should be part of any directive that incorporates the sustainability criteria for biofuels after 2020.
Type of policy measure	A separate mandate for aviation biofuels is a **regulatory measure.**
Role of the European Commission	In order to strive for implementing a separate mandate for aviation biofuels the European Commission would have to start a comprehensive legislative process, by first formally proposing the idea of a mandate towards the European Parliament and the Council of Ministers. Such a proposal requires an agreement within the European Commission first and needs to be supported by an impact assessment clearly stating the effect of a mandate. The impact assessment presumably would include several policy scenarios: 1. Binding mandate on EU level to be incorporated into national law 2. Indicative mandate on EU level with opportunity for Member States to make it binding at national level 3. Allowing Member States to set a target without any mandate on EU level. This option, however, could create problems with the internal market. The Council of Ministers has the first reading in the European Parliament, which in advance will also assess the proposed mandate by the European Commission. If there is no agreement in the European Parliament in the first reading a trialogue between the Council of Ministers, the European Parliament and the European Commission will be started. Such a trialogue could take several years – as seen in the discussion on the ILUC directive[9] - until a final decision has been reached. If the European Commission is interested in a separate mandate for aviation biofuels in 2020, the process should ideally start in 2016, in order to have a fully-fledged proposal including an impact assessment beginning of 2017. A mandate for aviation biofuels would have to be developed within the context of a MBM or the ETS, in case the European Commission decides to extend the ETS to flights in and out of the EU. Another option could be that individual Member States impose a mandate on aviation biofuels, however, there might be EU free market barriers that stand in the way of unilateral action.
Target action group	• European Commission • European Parliament • Council of Ministers
Target stakeholders	• Fuel suppliers • Airlines
Impact assessment	**Impact on deployment** A separate mandate for aviation is the most progressive option to stimulate

[9] The EC proposed the "ILUC Directive" as amendment to the RED in 2012 and the final agreement was reached in October 2015.

	supply of aviation biofuels. It would kick-start the development of a biojet fuel market, as a firm and predictable demand for biojet fuel is created. Introducing a separate mandate in an upcoming market does hold the potential risk of destabilising the market, as a proper supply chain has to be established. A further risk is that a strong mandate would be difficult to apply unilaterally as it could lead to jet fuel consumption leakage to nearby countries that do not have the obligation. Therefore it is crucial to start with a low mandate and provide sufficient time to allow the sector to scale up production capacities to avoid high prices by a few existing producers. **Impact on airlines** A mandate will lead to higher fuel prices, as the premium for adding the biofuels will be spread over all fuels sold in the sector. Imposing a stringent mandate holds the risks of impacting the competitiveness of airlines that are very active in the region to which the mandate applies. **Impact on European Commission and Member States** Implementing a mandate will require the European Commission and the Member States to enforce the requirements and set up an administrative system that tracks and monitors all biojet fuel supplied to the aviation sector.
Ease of implementation	Implementing a separate mandate for aviation fuels is a time-consuming legislative process. Most of the airlines are currently opposing a mandate for biojet fuels, especially due to the associated high costs and competition risks, and will try to lobby against this option within their Member States. There will be slightly less opposition against the mandate if the biojet fuel used would also reduce the costs for carbon offsetting within the MBM. Otherwise the mandate could be seen as a discriminating factor, especially for airlines with their major hub in the EU.

5.4.4 Stimulating innovation and projects in the supply chain

Description	To reduce the costs for biojet fuel, innovation is needed throughout the supply chain. Policy makers can stimulate innovation by e.g. removing barriers or providing funding to research, innovation and pilot projects. Innovation can range from the availability of sustainable feedstock to improved conversion technology and the development of market models. Also, policy makers could facilitate and / or provide funding to projects that scale-up the biojet fuel availability and integration of the supply chain. Increasing the number of initiatives is important for the biojet fuel market to grow.
Type of policy measure	Stimulating innovation and projects in the supply chain would be a **non-regulatory measure.**
Role of the European	The European Commission is already using the Horizon 2020 funding program to stimulate R&D development. The Horizon 2020 work program 2016 & 2017

Commission	entails the following topics: LCE-20-2016-2017 “Enabling pre-commercial production of advanced aviation fuels” and MG-1.1-2016 “Reducing energy consumption and environmental impact of aviation”. In addition, the European Commission could use the Horizon 2020 program and other funding programs to fund showcase projects for integrating biojet fuels in the supply chain at airport level. Furthermore, the European Commission could encourage Member States to tender projects on biojet fuels in their national funding programs.
Target action group	• European Commission • Member States
Target stakeholders	• Airlines • Fuel Suppliers • Research institutions (public and private)
Impact assessment	**Impact on deployment** The impact of this policy option is limited in the short term, as long as the policy environment is not changed to stimulate the use of biojet fuels. Successful showcase projects can encourage policy makers to address biojet fuel, and market actors to invest in new production projects. **Impact on airlines** No or a very limited impact on airlines is expected, although engagement, support (economic or other) and compromise to use the fuel in flight tests would benefit individual projects. **Impact on EC and Member States** Funding projects on biojet fuels clearly demonstrates the interest of the European Commission in alternative fuels. Also the European Flight Path Initiative established by the European Commission as a dialogue forum with the aviation sector shows commitment. However, the original target of 2 million tonnes of biojet fuels in 2020 is out of reach. Whereas the technical feasibility of biojet fuels has been successfully demonstrated, other barriers - especially the price gap and feedstock availability to jet fuels remain unsolved. Therefore, the European Commission should focus on stimulating showcase projects for a commercial biojet fuel supply chain or project aiming to reduce production and feedstock costs.
Ease of implementation	The European Commission is already promoting biojet fuel development, by for instance the European Flight Path Initiative, the CORE-JetFuel project and the above mentioned Horizon 2020 program Therefore, the European Commission is very much aware of the barriers for biojet fuel development and could continue to use its funding programs to remove these barriers.

5.4.5 Cooperation between major airports / airlines

Description	In recent years airlines (KLM, Lufthansa, Air France mainly) and aircraft manufacturers (Boeing, Airbus, Embraer) have been a driving force in showing the feasibility of using biojet fuels in commercial operation. Now that technical feasibility has been proven, the challenge is to scale-up to larger volumes and develop a mature market. Difficult market conditions make it challenging for individual airlines to push this market forward, therefore an airport-led approach in which airports would use their position in between fuel supplier, airlines and national government would act as a aggregators for biojet fuel demand. In practice this would mean that the airport (or airline) could choose to, on a voluntary basis, ensure that a certain percentage of biojet fuel is blended in the total pool of fuel sold at the airport. Instead of an individual airline having to set up dedicated supply chain to buy a certain amount of biofuel, the airport would supply a small percentage of biofuel to all aircraft taking off at the airport. This paradigm shift will allow for more efficient supply chains as well as larger volumes, both reducing the costs for biofuel significantly. At the same time, the additional costs for using a small amount of biojet fuel translates only into a small additional cost per passenger, which could be charged on all passengers using the airport (via landing fees, parking tickets or airport revenue streams). This option was suggested by Ecofys in 2012 when advising the Dutch Ministry of Infrastructure and the Environment on the topic of aviation biofuels. An airport-led approach for biojet fuels is currently in the early phases of development by Carbon War Room, a US based NGO focusing on climate change.
Type of policy measure	This type of action is a **voluntary measure.**
Role of the European Commission	Voluntary action from airports cannot be directly influenced by the European Commission. Individual airports or a group of airports can decide to blend biojet fuel in their total fuel supply to decrease the GHG emissions from aircraft taking off and landing. The European Commission can promote an airport-led initiative primarily through its communication with sector organisations, selected airports and the aviation society at large. Furthermore, the European Commission could consider how to facilitate the forming of an airport-led initiative, e.g. by providing resources or funding.
Target action group	• Airports
Target stakeholders	• Airlines
Impact assessment	**Impact on deployment** The impact on the amount of biojet fuel used and the impact on the costs per passenger depend on the height of the (voluntary) airport mandate. Airports are in the position to significantly increase the volumes of biojet fuel

	consumption and thereby stimulate the market development and innovation. **Impact on airlines** Some airlines have a single airport from which a large share of their operations take place. There is a risk that these airlines have a larger increase in costs than their competitors. This risk can be mitigated by creating a dialogue between airlines and airports or seeking non-aeronautical sources of funding for the additional costs, e.g. increased parking fees. **Impact on EU and Member States** No or a very limited impact on EU and member States is expected. However, administrations can have an active role in promoting or facilitating this type of initiatives helping in some way to ease implementation.
Ease of implementation	This measure is a voluntary measure and therefore does not require a legislative process, which makes it easier to implement than a regulatory measure. On the other hand, airports need to be willing to set a blend percentage. A high blend percentage could compromise the competitive position of the airport. If a group of major European hub airports decides to all implement a percentage of biojet fuel blending, the impact on the competitive position could be limited. As an example it could be explored if e.g. in Western Europe the four largest airports, London Heathrow, Paris Charles de Gaulle, Frankfurt and Amsterdam Schiphol could make an agreement to blend a small percentage (e.g. 1%) of biofuel with the fossil fuel supply. This would increase volumes significantly without disturbing the hub-competition that these airports have amongst each other. Also careful consideration should be given to the fact that airlines typically have one hub airport from which they operate. If this airport would set a voluntary blending mandate the airline that uses this airport as its hub airport would feel a larger impact on its operating costs than other airlines, resulting in a competitive disadvantage. A dialogue between airport and airlines that operate from the airport is needed before this measure is implemented.

5.4.6 Review of measures

The table below aims to be a review of some of the features of each or the previously mentioned measures, marking in green the positive items of each one of them and in red those items that would need to be assumed in a possible application of the policy.

	Ease of implementation/ applicability	Cost	Administrative Effort	Impact on bringing the product into the market by the policy alone	Impact on industry/airlines	Timescale of impact
Counting of biojet fuels towards the obligation of fuel suppliers in several EU Member States (opt-in)	High	Low	Medium	Low	Low	Short term
Global Market-based Measure (MBM) with revenue generation geared towards innovation in the aviation sector	Low	High	High	Low	High	Medium term
Separate mandate for aviation biofuels	Low	High	Medium	High	High (although dependent on who are the obligated parties)	Short term
Stimulating innovation and projects in the supply chain	Medium	High	Medium	Medium	Low	Long term
Cooperation between major airports / airlines	Medium	Medium	Low	Medium	Low	Short term

Advantages and Disadvantages

For each of the proposals, the following strengths and challenges (from the perspective of alternative fuel uptake) have been identified. (Note that some of the measures would have other direct advantages and disadvantages from the perspective of emissions reductions, i.e.: GMBM):

	Advantages	Disadvantages
Counting of biojet fuels towards the obligation of fuel suppliers in several EU Member States (opt-in)	- Low administrative effort in implementation - No direct costs for industry	- Low capacity of bringing alternative fuels to the market as a standalone measure.
Global Market-based Measure (MBM) with revenue generation geared towards innovation in the aviation sector	- Experience from EU ETS can help in implementation	- Need to set up the administrative capacity to assure compliance. - High complexity in implementation of the system - Low capacity of bringing alternative fuels to the market as a standalone measure
Separate mandate for aviation biofuels	- Guarantee that the target is met. - It stimulates innovation and production with the objective of trying to create fuel at a lower price. - If the mandate is at EU level, it creates a level playing field for all member states.	- Could cause market destabilisation if the objective is higher than what the industry can produce/if the market is not sufficiently mature (this causes industry opposition) - Risk of distortion impacts for EU carriers operating outside the EU. - Need to set up the administrative capacity to assure compliance. Target compliance can be assured by a mass balance approach.
Stimulating innovation and projects in the supply chain	- Direct increase in knowledge of technologies and pathways necessary for new developments	- Investments risk not having a direct return - Requires a high involvement from private partners and risk assumption from the investor's point of view
Cooperation between major airports / airlines	- Beneficial in terms of fuel logistics - Direct implication of users (airlines)	- Requires a high compromise from stakeholders and investment.

5.5 The Impact of Mandates

As mentioned in previous sections, predicting the effects and the effectiveness of a particular policy is a complex task since the effects are not only dependent on the policy itself but rather on a number of factors which in some cases are out of the range of control of the administrations (i.e.: price of crude oil, public perception and acceptance of alternative fuels, level of competition for feedstock with other uses, technology maturity level, etc.). A significant implementation of alternative aviation fuels will only occur when the industry is able to overcome several of the currently existing barriers, the price gap being one of the most significant, but not only.

It is possible though to model how different objectives (through specific mandates) would impact in terms of production, demand, or feedstock required. In this regard the ISUM model that is being developed under the ITAKA project aims to assess the economic and environmental impact of large-scale production of bio-kerosene from actual data obtained during the project, with the possibility of being able to modify several assumptions (such as economic variables, production objectives, etc.). The model has been built by introducing data related to production costs, airport traffic and estimation of fuel demand. This model is still under development at the point in which this report was written but it is currently possible to make the simulation of obtained results for different mandates or objectives of biofuel production and with different scenarios. The author of the model has been consulted in order to generate the possible effect of different scenarios.

The model consists of several blocks and it has been designed to allow obtaining predictions for different scenarios changing several parameters. The first block allows generating those scenarios. Agricultural, industrial assumptions are introduced and requirements for the commercial production of a certain volume of alternative fuel can be changed. The second block allows introducing economic assumptions that would result in the different scenarios. Finally, the last block consists of the results which reflect the impact of environmental and socioeconomic nature of the commercial scale production of bio-kerosene in a predetermined timeframe regarding the use of conventional fossil kerosene.

For the elaboration of this report, the author of the model has been asked to give the predictions for specific scenarios. In particular, the situation in terms of production has been analysed to be able to achieve the scenario of 2 Million tons for the year 2020 defined by the Biofuels Flight Path Initiative.

Several hypotheses need to be taken into account, such as a general efficiency gain per year as well as the approval year of various technologies. In addition to the various hypotheses, several assumptions need to be considered in the various scenarios. First of all, economic assumptions need to be introduced. As such, the historic trends of biofuel prices have been considered and therefore, due to the large price variation that fuel price has suffered in the last years, the average value of the last 5 years has been used (2.03 €/gal). It is true that price assumptions introduce a high level of uncertainty, since the current oil prices are historically low compared to previous years, which is why an average value has been taken.

Secondly, assumptions regarding technology development and pathway approval also need to be introduced in the model. In this regard, approval years, for the different technologies have been assumed in the design of the model but these variables can be modified in the future in light of the technical progress, in case there should be any substantial changes. A general efficiency gain (in terms of fuel consumption and production) of 1% per year is also assumed. In addition the model considers a growth in the number of both European and extra-European flights in order to estimate the future demand in Europe.

An exemplary scenario has been included below to understand some of the outputs that the model can give:

Year of implementation:	2018
Target year:	2030
Percentage of biojet mandate/objective	1%

For each scenario, the model gives a level of market penetration based on the estimated price of a specific pathway (combination of feedstock plus technology). Based on this market penetration, the model gives the conversion technology demand for each pathway. For this scenario, with an objective of 1% of the production in 2030, the model predicts a total demand just below 601.000 tonnes in 2020, therefore well below the objective of 2 million tonnes for that year. As it can be observed in the graph, even with the approval of SIP, the penetration in the market will still be low due to its high price that would delay its penetration.

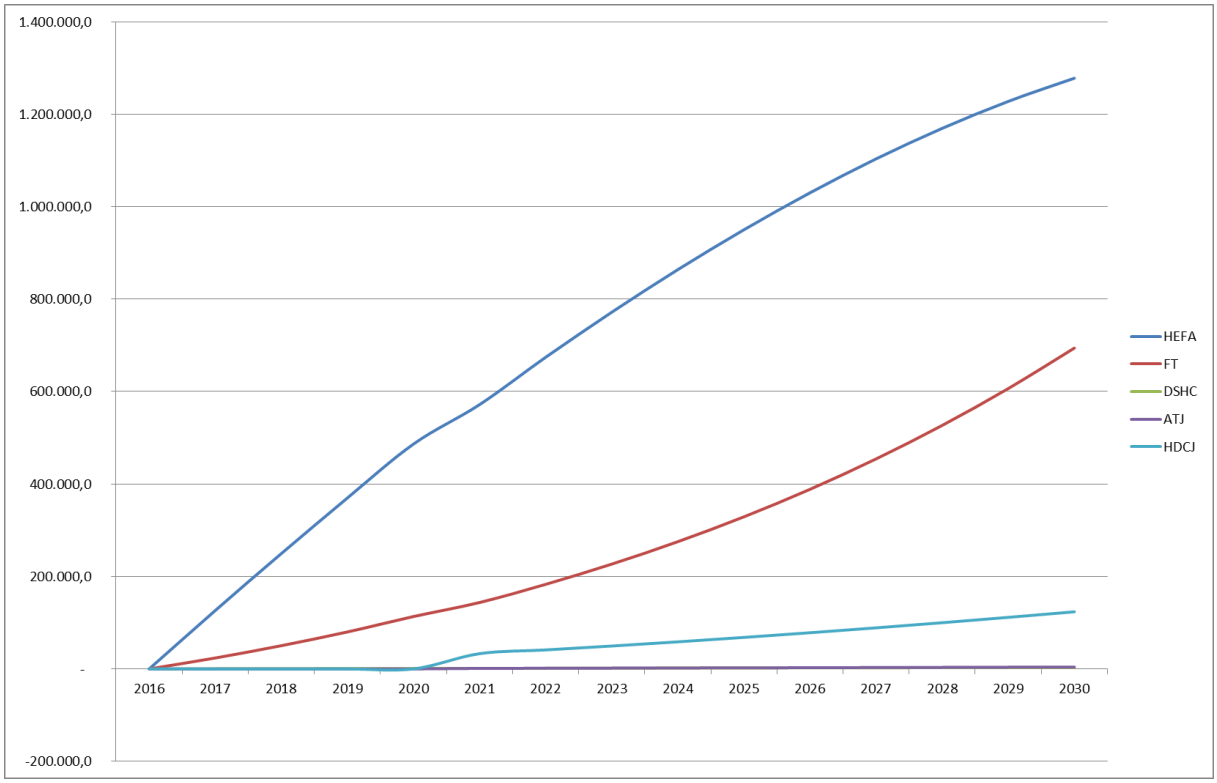

Figure 2: Conversion technology demand (tonnes) for the exemplary Scenario

A prediction for the amount of fuel produced with each feedstock can also be obtained with the model. The prediction is obtained using the market prize predictions and therefore predicting the market penetration comparing the cost associated to the whole value chain and comparing it with the cost of conventional fuel. Other feedstock has been considered that do not appear in the graph below but due to the low level of market penetration that the model gives they are not shown in the graph.

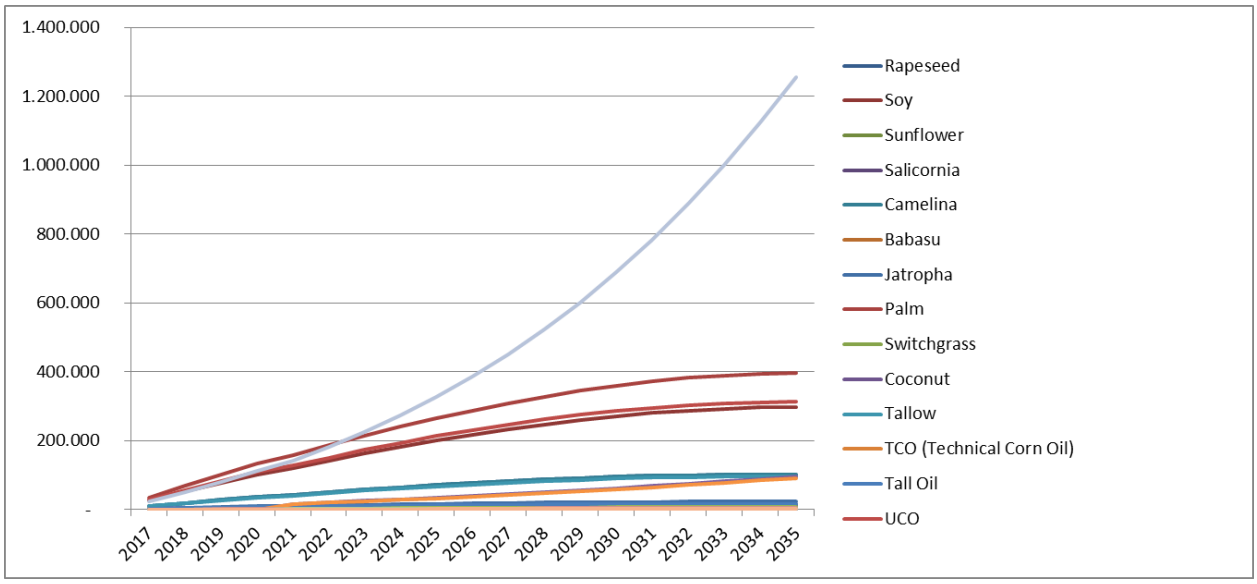

Figure 3: Quantity of Fuel Produced per Feedstock Type (tonnes) for the Exemplary Scenario

Lastly, the market share per technology can be obtained from these previous data. Figure 4: Percentage of Market Share per Technology shows the situation that would occur in scenario 1, in which the share of the technologies approved last, even after certification would not reach a significant level.

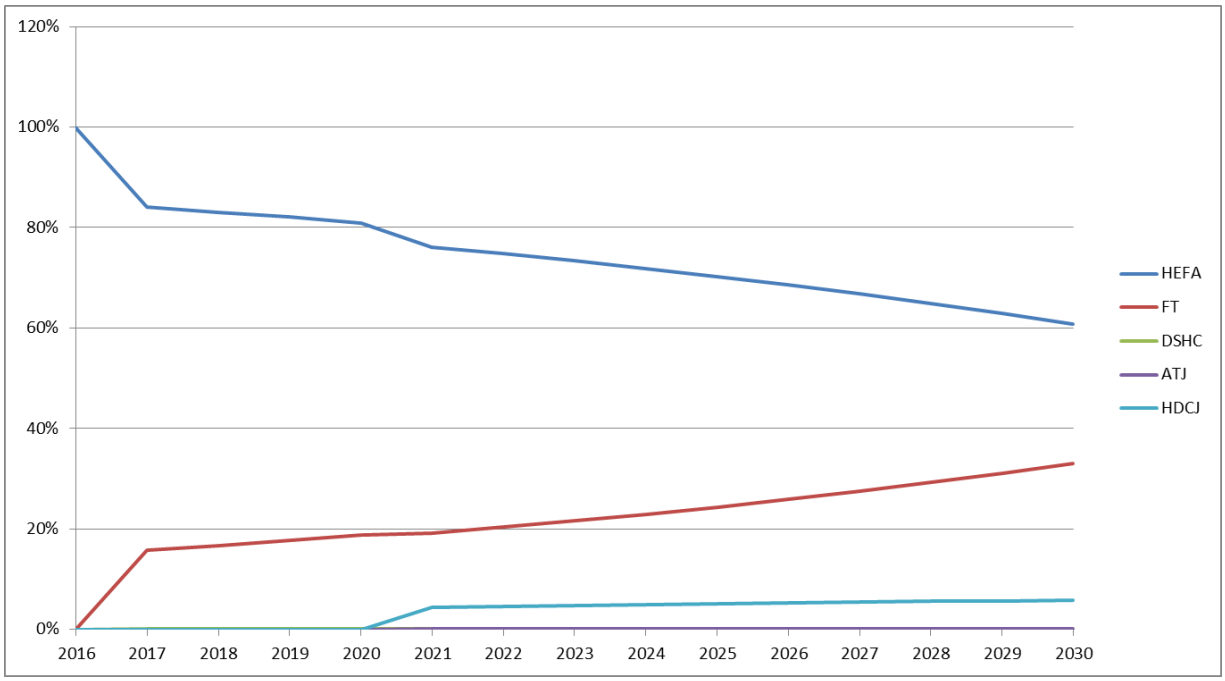

Figure 4: Percentage of Market Share per Technology for Exemplary Scenario

The model has been used to predict the percentage needed to achieve the 2 million tonnes objective in 2020. The target year is still 2030, since it is considered that a longer term and stable policy is required to create confidence in the market, but this target year may be changed in the model.

Year of implementation:	2018
Target year:	2030
Percentage of biojet mandate/objective	3.3%

It has been observed that in order to achieve the 2020 objective set by the Flightpath, a 3.3 % requirement would be needed for a target year of 2030. The same assumptions as in the previous scenario have been made. The conversion technology demand has been estimated as follows:

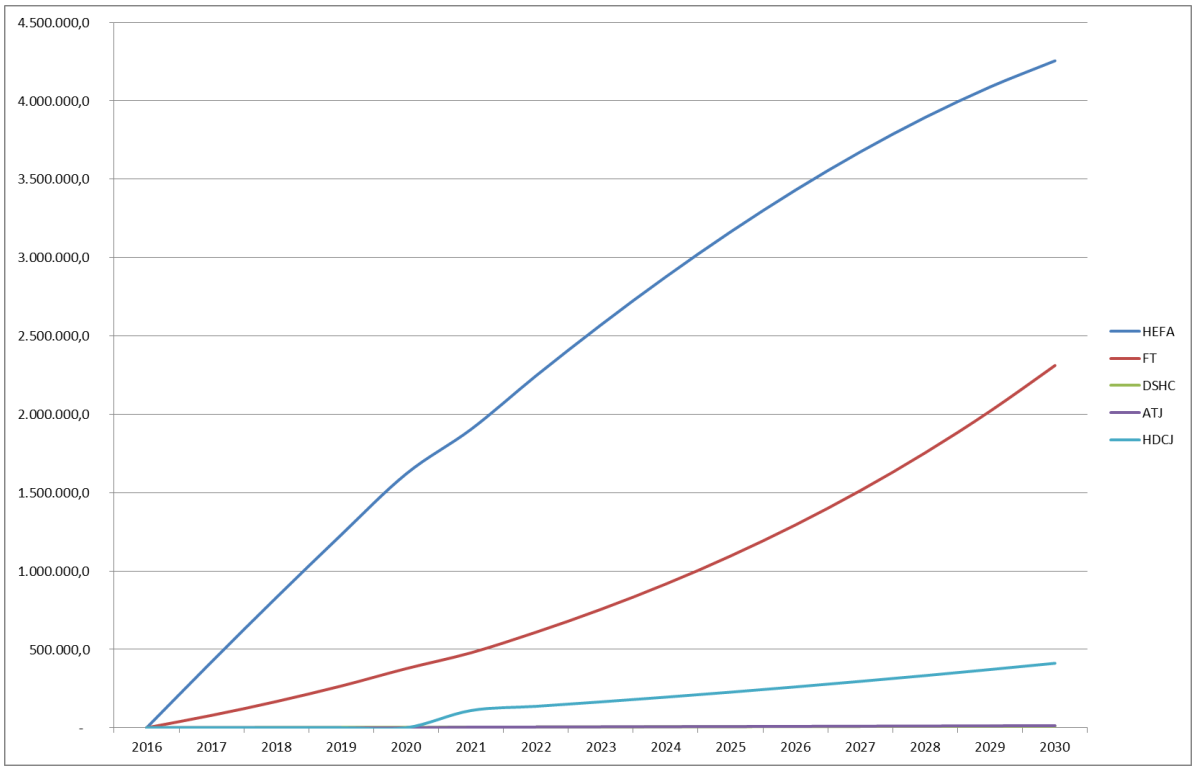

Figure 5: Conversion technology demand (tonnes) for the achievement of the 2 Mt objective with a target year of 2030

Similarly to the previous scenario, we can see that even after approval of certain technologies, it would be difficult to increase the demand of those ones in which the price difference with the more consolidated ones is high.

The quantities of feedstock required with such a demand have been reflected on the figure below. As we can see, without any market intervention, many of the feedstock would be left out since the production capacity or the prices would not be competitive enough. This scenario could of course be changed with some sort of intervention/incentive or regulation for feedstock that is considered to have lower environmental impact or emissions.

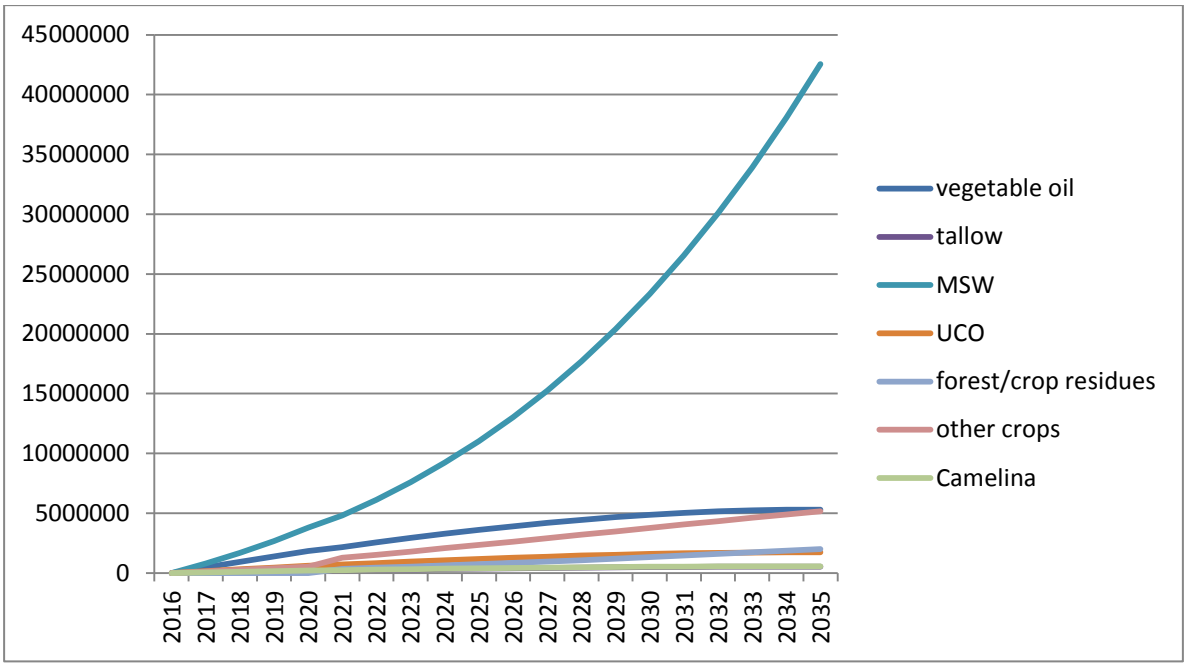

Figure 6: Quantity of Fuel Produced per Feedstock Type (Tons) for the achievement of the 2 Mt objective with a target year of 2030

The market share remains similar to the previous scenario, even with a much higher objective, as shown in the figure below:

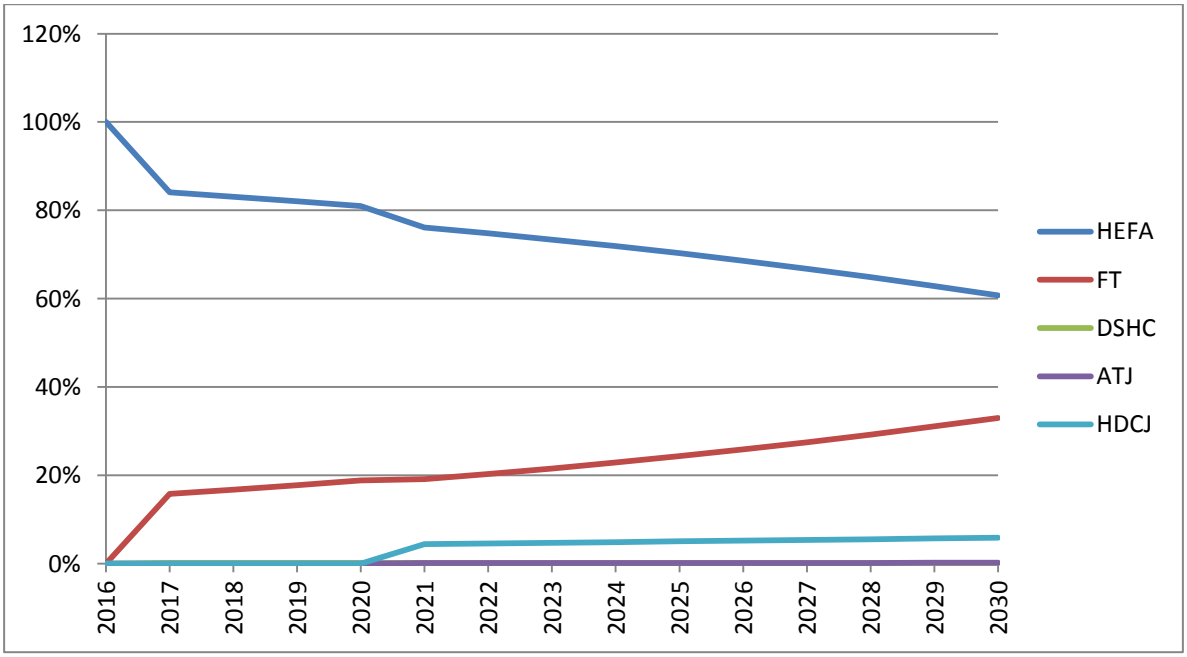

Figure 7: Percentage of Market Share per Technology for the achievement of the 2 Mt objective with a target year of 2030

One of the most relevant analyses is the amount of emissions that would be avoided with the production of such volumes of alternative fuels. For this scenario, the amount of emissions saved in 2020 would be just below the 5 million tonnes of CO_2.

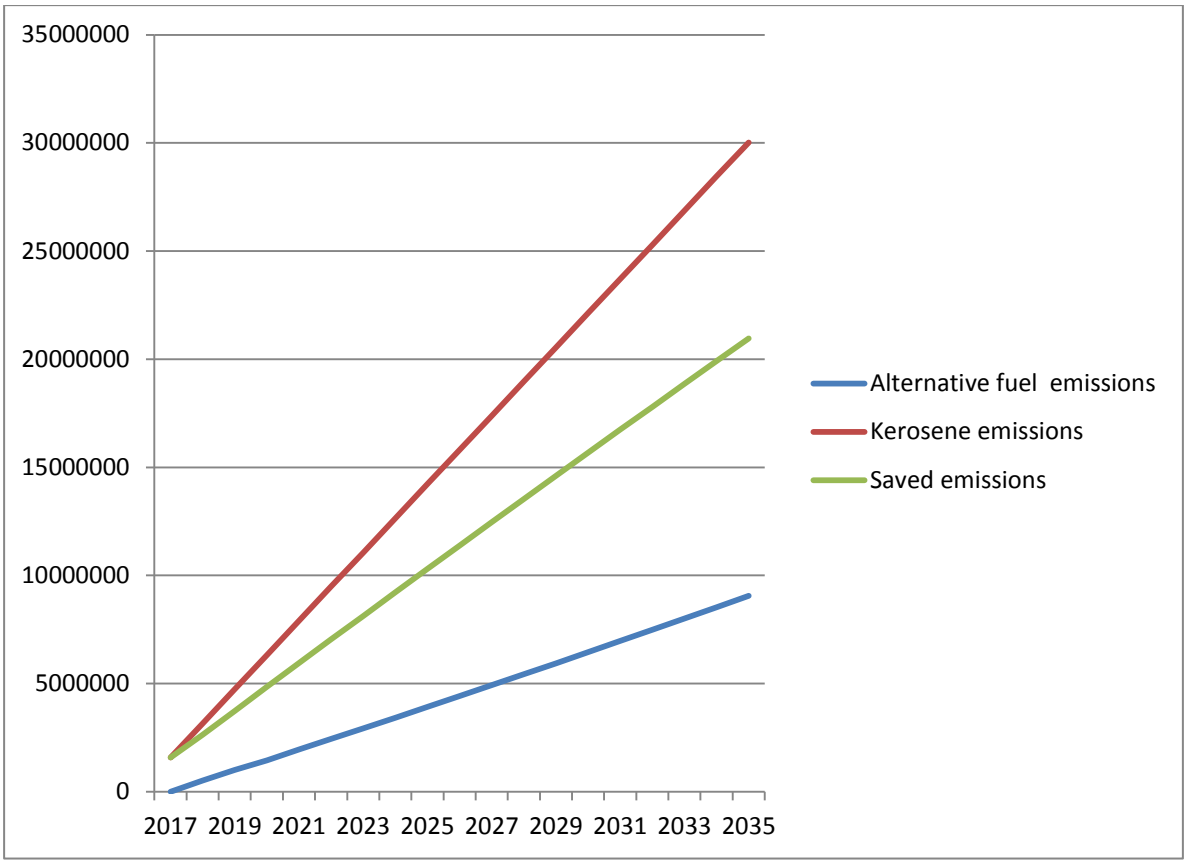

Figure 8: Amount of emissions saved by the use of the predicted volumes of alternative fuels in a scenario aiming to achieve 2 Mt of production and a target year of 2030

Source: ISUM Model carried out in the framework of the ITAKA project. Note that as a model, variables and assumptions can be modified in order to adapt to possible future scenarios.

5.5.1 Conclusions Extracted from the Analysis of the Impact of Mandates

Several conclusions can be extracted from the previous analysis.

- Even with a mandatory objective, those technologies with a lower level of development will always be in clear disadvantage even after their certification due to the large price difference. If certain technologies want to be encouraged because the feedstock is considered better in terms of sustainability, then specific measures need to be taken to overcome the price gap, not only with fossil fuel but also with other cheaper alternative fuels. Putting limits to the amount of certain feedstock that can be used to produce alternative fuel is not an incentive strong enough to encourage the use of better performing feedstock. In fact, better performing feedstock should be incentivised in some way to encourage its use. Therefore, the price gap with conventional fuel needs to be closed, but tending to incentivise those with better environmental performance in order to avoid possible negative impacts.
- Vegetable oil is currently the most accessible feedstock and therefore if any objective or mandate is established it would be the most demanded feedstock in the market (even with the limitation established by the latest modification of the RED of a 7% cap for conventional biofuels from crops grown on land, since there is still margin for these feedstock to grow).
- Setting a specific target is a measure that assures achieving an alternative fuel objective, but it is not enough to encourage the development of the most novel technologies/better performing objectives, but rather to encourage the cheapest option which is not necessarily the one that has the greatest environmental benefit. Specific measures need to be applied to encourage those pathways that have the greatest environmental benefit in order to move towards a best environmental performance.

6 Current Policy Gaps

The analysis of the legislation in place and the possible policy options, the meetings, teleconferences and stakeholder events organized by the CORE-JetFuel project have allowed the partners to get to know some of the political discussions among various stakeholders. Despite of the efforts carried out by public and private entities, the market penetration of biofuels for aviation has been a slow process up to date. Technical maturity of some pathways and economic viability are the two main reasons for this, but it is also true that political action can also lead to a more favorable environment for aviation alternative fuels development as it has happened with previous experiences with alternative fuels. Aviation biofuels are currently in a disadvantageous position if we compare them with other means of transport that have a longer maturity in the market and for which the legislation was thought in the first place. This situation can be compensated through the implementation of policies that could facilitate the scale up of alternative fuels for the aviation sector and de-risk investments in this regard.

After the analysis carried out and with the input from stakeholders, the following policy gaps have identified:

Aviation Biofuels in Europe vs. Biofuels for other ways of Transport:

To the current date, road transport has largely benefited from the push effect of the renewable transport energy policy in the incorporation of alternative fuels to the market. This policy has led to the creation of a biodiesel industry in the EU to meet the demand created by the individual national obligations. Aviation alternative fuels have not benefited from this effect in first place because it has entered later in the market and secondly, because to the present date only the Netherlands has included it recently in the types of fuel eligible to contribute to the renewable transport target.

It is a general feeling among the sector that there is a lack of aviation-specific political initiative and that in general, the European Legislation (EU RED and EU FQD) includes a set of policies that do not take into consideration the very specific barriers for implementation of alternative fuels in aviation. Road transport biofuels are more established in the market and therefore, it is very complicated for aviation to compete for the feedstock needed for a large volume of production. The use of feedstock for biofuels for other means of transport is a more secure business and aviation can only compete with these ways of transport if there is some sort of advantage for aviation biofuel production. The lack of demand currently prevents producers from taking the risk of producing biofuels for an immature market. In fact, many of the deployment initiatives currently in place happen because there is a specific compromise between an airline and the rest of the stakeholders of the value chain to assure the use of a certain batch. If the demand is not assured in some way, the investment can be considered too risky. Specifically, stakeholders have expressed their concerns regarding the lack of specific aviation objectives, fuel use or GHG emissions reduction through biofuel use.

It needs to be noted that, even if the national legislations are amended to allow accounting aviation biofuels towards the national targets, it will be difficult that such a measure alone will have a significant effect, since road transport alternative fuels currently have a lower cost differential with fossil. It will, however, create a positive sign in the market and is a required first step to be combined with other measures.

Member State Transposition of the EU RED and Applicability

Most member states have, in general, established clear volume goals for biofuel use. However, not all states have established their own sustainability schemes at national level, meaning that the transposition is unequal in some aspects. Most of the states in which no specific national scheme is in place have a system which is mainly based on voluntary schemes.

Some states such as Germany have switched their national objectives from volume based to emission based. This way, those biofuels with higher GHG savings will have a higher market price, and therefore show increased demand, meaning that the market will naturally favour fuels which are more efficient in terms of emissions. In addition, this way forward does not necessarily ban any feedstock from being used (as long as they comply with the other sustainability requirements) but will directly benefit those with higher GHG emissions reduction. This system reduces also controversy that can be generated by the multiple counting of some feedstock such as waste or algae.

The existence of a high number of voluntary and national schemes has in some cases lead to controversy in terms of level of stringency of the different standards, as well as their maturity and recognition in the market. Due to this, some of the operators that require certification have opted by certifying themselves with different schemes leading to an increase in administrative burden.

ILUC issues with the EU Legislation:

The recent legislative updates regarding LUC and ILUC consideration have generated long discussions regarding how it should be treated and how its negative effects can be avoided. The latest update of the FQD and RED intends to favour more heavily second generation biofuels by establishing a limit in the amount of first generation biofuels (those energy crops grown on land), by establishing a limit to cereal and other starch-rich crops, sugars and oil crops and from crops grown as main crops primarily for energy purposes on agricultural land. The decision to introduce default ILUC values in the lifecycle analysis has been postponed after the modification of the FQD and RED at the end of 2015 (Directive 2015/1513) although ILUC values must be calculated for information purposes. The establishment of limitations to the production of biofuels based on certain crops has caused a lot of discussion among the industry with the argument that limitations may threaten investments in Europe.

Some stakeholders have expressed that feedstock management practices are much more relevant than the feedstock type itself for the GHG balance. However, there are stakeholders that consider that environmental safeguards should be introduced to avoid an excess LUC. Discussions on the future consideration of the limits to sustainability considerations are still an important source of uncertainty for investments, even after the latest modification of the RED. It is very important to consider that legal certainty is a key issue for the development of the sector.

Sustainability criteria in Europe and other legislations

One of the concerns expressed mainly by airlines is the fact that, considering international characteristics of business, it is important to have a certain level of the harmonization of the sustainability criteria. Since operators can buy fuel in different regions and it is important for them to be able to account for the use of biofuels and the possible benefit derived from its use (such as the benefit that they obtain under the EU ETS for biofuel use, or the benefit of using alternative fuels in a GMBM if it is agreed at ICAO level). It is therefore important for airlines entering non-EU jurisdictions that the fuel purchased complies with sustainability criteria.

Some lessons of the problems that can arise due to the lack of mutual recognition of sustainability criteria can be learnt from the experience in demonstration projects, such as ITAKA. Biofuels produced in Europe can be exported to the US and be accounted to generate RINs. To do so, the products used in the refining plant need to be compliant with requirements of RFS2 in addition to the EU RED requirements. This can result in double administrative work. Mutual recognition/harmonization of sustainability criteria in this case could facilitate the process of import/export of biomass and biofuels eliminating extraordinary requirements for foreign products, so reducing uncertainty regarding offer availability of biomass and biojet.

EU ETS influence

The EU ETS legislation in place considers emissions from biofuel combustion as zero in order to introduce incentivize to its use. However, currently this incentive does not yet compensate the additional costs of biofuel use. It is very difficult to get airlines to assume this extra cost in the current competitive aviation market in Europe, and this is preventing investments that could shorten the gap. Although some European airlines have expressed their desire to carry out flights with biofuels, they are far from having a regular use of biofuels for specific routes, and there are no oil companies producing or offering the product in the EU on a larger scale. Therefore, unless the price of CO_2 allowances increases, the zero emission factor established for biofuel will not be a sufficient incentive to encourage biofuel use. In addition, the reduced EU-ETS scope to include only the intra-EEA flights (i.e. the so called “stop the clock”) has lowered its incentivizing power.

Internalization of external costs of conventional fuels

As the prices for EU ETS are very low and as kerosene is exempted from fuel taxes, the external costs of conventional (fossil-based) jet fuel are not or at a very low level considered. This applies mainly for greenhouse gas emissions, but also for other external costs related to the fossil origin of the fuel. This leads to an additional imbalanced price gap between conventional and bio-based jet fuels if external costs are not considered.

The Industry’s view regarding sustainability assurance

Airlines and industry representatives have expressed their concerns regarding the assurance of sustainability of a commercial biofuel. The industry, and in particular, the airlines are very exposed to the public opinion, and therefore want to make sure that any biofuel they use has a guarantee of

compliance of all the sustainability criteria. This becomes a particularly delicate matter in a globalized industry that can purchase biofuel anywhere in the world and thus, under different regulations. In this regard, a good communication strategy with the public and NGOs is essential in order to avoid misinterpreted information to the public. The industry has expressed its desire to move towards globally harmonized sustainability criteria that could facilitate compliance with current regulations and ensure that the biofuel that can be purchased in different regions has a guaranteed sustainability quality.

Need to Fully Understand the Potential in Europe

One of barriers for aviation biofuels commercialization is the limitation of viable and suitable feedstock. In order to incentivize investments, it is important to understand the real potential for feedstock production in Europe, at least for those value chains that have a higher TRL, such as for HEFA, DSHC/SIP or ATJ. Availability of biomass can only be modelled and will largely depend on the levels of productivity that can be achieved on the available land. A recent report from JRC[10] details the available feedstock from agriculture, waste and forestry under a 2020 reference scenario, and estimates that approximately 267 Mtoe of bioenergy potential is available. Only 8% of the potential comes from waste, the rest is evenly split between forestry and agriculture. The sustainability criteria is considered in the report as a key driver when assessing the final amount of biomass available for energy and will therefore impact the considered potential in the future.

The sector will be very interested by a very relevant project called the Biomass Policies project[11],that will release its results in 2016. This project aims to develop integrated policies for the mobilization of “resource efficient” indigenous bioenergy ‘value chains’ in order to contribute towards the 2020 bioenergy targets. In this regard, several stakeholders during the CORE-JetFuel workshops suggested that the biomass strategy in the EU should be holistic and take into consideration all the possible uses of biomass, including alternative aviation fuels, to decide which uses are best at EU level.

Risk of Investments

Investments in aviation alternative fuel are currently too risky to be interesting enough for private stakeholders. Lowering such risk would result in more initiatives and projects going on and being finalized (since there are a lot of announcements of projects but many of them do not reach an end).

7 Conclusions

From the previous section, the policy analysis and input received during the project, we can select a number of items for which some recommendations can be given. Drawing some conclusions from the previous sections, the following issues have been identified along with some possible solutions:

Need for stability. Directive 2015/1513/EC approved in September 2015 intended to solve the existing issues with respect to LUC considerations. It is still a highly debated topic which generates certain mistrust for investors as well as diminished confidence of the final user (airlines). In addition, there is quite a concern with the fact that the renewable energy targets will change after 2020 and the

[10] JRC. The JRC-EU-TIMES model. Bioenergy potentials for EU and neighboring countries. Joint Research Centre, European Commission. (2015) https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/jrc-eu-times-model-bioenergy-potentials-eu-and-neighbouring-countries

[11] http://www.biomasspolicies.eu/

10% target of their transport fuels for 2020 will not be continued after this date. Therefore although EU countries have already agreed on a new renewable energy target of at least 27% of final energy consumption in the EU as a whole by 2030, there are no specific targets planed for the aviation sector, not even for the transport sector as a whole.

- **Possible solutions in terms of policy stability**:
  - Define regulations in a way to enable enough flexibility for state-of-the-art and future technologies or pathways to be readily incorporated. It needs to be considered that new innovative technologies may come up in the future.
  - Establish partnerships between public and private sector that offer security for investment in the long term avoiding the effects of possible legislative changes, such as grandfathering. It is important that the national administrations get involved in alternative fuel uptake, dedicating efforts and promoting voluntary off-take agreements.

Trade/harmonization issues

Internal (EU level): There are currently a large number of national and voluntary sustainability schemes which could be generating confusion and difficulty in trading in the EU market. For instance, it occurs that in some cases, the final user or buyer of a specific feedstock, raw material or fuel can require the seller to be certified under a specific scheme even though they have already been certified under another. This leads to some feedstock producers or refiners to obtain certification under multiple schemes, increasing the administrative costs and complexity.

- **Possible solution**:
  - Some sustainability schemes make more emphasis on certain criteria and even have requirements that are not included in the EU RED. It would be important to make sure that the final user is aware of the requirements of each scheme. This could be done by establishing a benchmark of the different standards.

External: The existing differences on sustainability criteria with other states outside the EU and with different regulations cause difficulty in trading.

- **Possible solutions**:
  - Establish mutual recognition agreements with non EU countries at least until the market is more mature.

Sustainability: As mentioned above, one of the main barriers for not adopting stronger policies is the lack of certainty that alternative fuels can be produced at large scale in a way that can guarantee sustainability, mainly due to previous experience with road transport fuels. In this discussion, often the sustainability aspects of fossil jetfuels are not considered, as the use of fossil kerosene certainly has many negative environmental impacts. There is a permanent discussion in the biofuels debate between those who want to push further for deployment and those who want to establish safeguards to guarantee sustainability in the future. It is important to point out that the sustainability of the agricultural phase does not depend entirely on the type of feedstock but also on the practices used for the production. For this reason, environmental integrity safeguards are important, but if they lead to an

increase in costs, then those alternative fuels that have a better environmental performance should be more strongly incentivized in economic terms.
The lack of harmonized sustainability criteria is also an issue for airlines. It would therefore be important to dedicate efforts in working towards a higher level of harmonization at ICAO level where this discussion can be approached at a global level in order to reach some sort of common understanding.

Decreasing the Price gap: Successful deployment of biojet fuels will be difficult to accomplish with market forces alone. The price gap is still high, especially for aviation biofuels, due to the fact that the production requires the latest available technologies and there is a lack of experience at all levels of its implementation (feedstock production phase, production and logistics). In addition, aviation is very stringent on final product quality and is willing to use a more restricted set of feedstock than other ways of transport in order to target only the most sustainable ones. Due to the immaturity of the market, the barriers for the production and use of aviation fuels are comparatively higher for other sectors such as road transportation or fixed installations. The only incentive for aviation in place at European level is based on the EU ETS for aviation. However, the price of the allowance is currently around 7€/tonne, meaning that an airline can save around 21 € per tonne of biofuel used[12]. Considering that the current price gap can be higher than 1000 €/t[13], the incentive is much too low to overcome the administrative/demonstration/compliance barriers of the "new" types of fuel (separate documentation for the fuel purchase, sustainability certificates, imputation to defined flights, monitoring procedures for EU ETS etc.). Individual European States have additional incentives, such as tax exemptions or subsidies. However, even with those subsidies to production of biofuels, it is highly unlikely that the feedstock is used for aviation biofuels due to its lack of competitiveness and lack of margin in terms of revenue compared with other uses for which the production is more mature and it is more secure to invest in.

- **Possible solutions**:

  i. Establish public-private partnerships with investors where the conditions and requirements are fixed and secured independent of the changes on the regulatory process (grandfathering). For this purpose, the role of the national administrations/public organisms is key in order to act as facilitators.

  ii. Carrying out public purchases of innovative products (defense, fire-fighting, etc.) to create a market

  iii. Incentivize and promote at similar levels feedstock and technology development. It is important to consider that there is not a clear winning technology, so diversification is still important at this level.

  iv. Establish Incentives could be introduced for production/consumption, there are several options for this but a system similar to biotickets in the Netherlands could contribute to reducing the price gap. However, for this to occur, individual states will need to maintain national objectives after 2020 for alternative fuel use in the transport sector.

[12] This estimation has been done using the 3.15 t CO2/t fuel consumed established in Annex III of Commission Regulation No. 601/2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
[13] Taking reference price of 550 €/t of conventional fuel

v. Learn from lessons of other programs/projects and analyze what is replicable in terms of incentives

Obligations and Incentives, and Decreasing Investment Risk

The proposal of an obligation is a controversial issue. In case an obligation for production or consumption at EU level is proposed, several items would need to be defined. First of all, who would be the obligated parties, and what would be the options for compliance. Secondly, there would be a need to implement the necessary administrative resources to enforce and follow up compliance. It is important to note that including aviation in a general mandate or share for transport will not be sufficient to incentivise uptake due to the lower price differential of road transport alternative fuel compared to fossil fuels.
In addition it needs to be considered that, although it is an effective way of achieving a deployment objective, it does not incentivize nor assure the better performing technologies in environmental terms, so this has to be considered to introduce additional measures that avoid possible negative effects. Specific additional measures would need to be applied to encourage those pathways that have the greatest environmental benefit in order to move towards a best environmental performance.
In such a case, some flexibility needs to be introduced in order facilitate compliance, which could be achieved through a system similar to the RINs system in USA or the Biotickets in the Netherlands.
The impact on airlines, price tickets and demand of possible obligations requires further analysis depending on the intended timeline, and therefore, an in-depth impact analysis with all the design details of the policy would be required for the implementation of a specific target.
It is clear that while investments on other uses other than aviation seem to be more interesting in economic terms, the level of aviation alternative fuel production will remain low. Incentives and de-risking of investments have demonstrated to be an effective strategy both in off-take agreements in Europe as well as in the EU. It is currently very difficult to make investments on aviation alternative fuels attractive since the level of risk and the ease of obtaining a return on the investment is very low, especially in comparison with other alternatives. Purchase agreements or national/supranational financing programs could be a way of de-risking such investments.

Greater Integration of the Aviation Alternative Fuel Policy in a General Transport Alternative Fuel Strategy

Developing a common integrated strategy along with other ways of transport which could also be the target for alternative fuel use would be key in order to prioritize uses. The current availability of feedstock is limited and therefore it is important to have a strategy to define where this feedstock could be used, either for its environmental benefit or for economic reasons.

Counting biojet fuels towards the obligation of fuel suppliers in all Member States

As shown in the previous analyses, counting of biojet fuels towards the fuel suppliers' obligation is not a measure that will result in a strong impact in terms of deployment of fuels but it is, however, a necessary measure for to putting aviation alternative fuels at a level playing field with other alternative fuels. It is therefore a necessary first step before taking other measures which shows support and compromise from the individual national administrations. Counting with a strong institutional support, which is well reflected in the decision-making is essential for aviation alternative fuels deployment.

The Strenghths of Public-Private partnerships

Public-private partnerships can build on institutional support as a second step forward. The implication of the administration in the promotion of voluntary off-take agreements is a key element to create

small local or regional value chains. Public-private partnerships can start the establishment of value chains with small volumes to build a higher level of confidence in terms of supply, technical performance of the biofuels and airport logistics and distribution. After a period of technical progress, currently implicated stakeholders demand a greater policy support to create a faster market deployment and these types of initiatives are proving to have positive results in several regions, if not in terms of large deployment, at least as a way of getting to know the actual deployment of certain value chains. Creating a firm initial market without trying to make it too large at an early stage will help to create investor confidence.

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