ITAKA

Collaborative Project

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D3.6 Procedures & Guidelines for mass balance accounting

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Executive summary

Until recently, SJF has been produced and delivered into-wing as a specific batch, via segregated supply chains. Reporting of physical use of SJF by an airline for such deliveries is straight-forward. To move SJF to a commercial-scale product, avoiding segregated downstream supply chains is a key element of reducing cost without compromising safety or performance. Fully integrating SJF into conventional jet fuel storage and airport distribution systems imply that SJF will be used by all aircrafts refueling from those systems.

On January 22nd 2016, the start of SJF at Oslo Gardermoen Airport was announced by the ITAKA consortium and Air BP. The majority of this SJF was supplied directly into Oslo's fuel hydrant system, and as such became part of the airport's common storage and distribution system without having to rely on a segregated infrastructure. It was the first time SJF was supplied via non-segregated infrastructure. Although physically supplied to theoretically all airlines fuelled via Oslo's hydrant system, the fuel was allocated only to those airlines that paid for the SJF.

Airlines need to report their SJF use, either for the airline's own internal reporting purposes or for (voluntary) reporting related to a sustainability scheme. In the case of the SJF deliveries at Oslo airport, reporting/accounting was both required for airline's internal reporting purposes and for reporting by the airline of the SJF under EU-ETS. This report describes how reporting/accounting was done for these SJF deliveries.

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Abbreviations

AFQRJOS = Aviation Fuel Quality Requirements for Jointly Operated Systems

ASTM = American Society for Testing and Materials

EI = Energy Institute

EU RED = European Union Renewable Energy Directive

EU ETS = European Union Emission Trading Scheme

GFS = Gardermoen Fuel Services

HEFA = Hydro-treated Esters and Fatty Acids

JIG = Joint Inspection Group

MCA = Monument Chemical Antwerp

OLT = Oslo Lufthavns Tankanlegg

OSL = Oslo Gardermoen Airport

PoS = Proof of Sustainability

SJF = Sustainable Jet Fuel

Definitions

ASTM: originally known as the American Society for Testing and Materials, this international standards organization develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services. ASTM International works with aircraft and engine manufacturers, government authorities and fuel suppliers to set the standards for aviation fuels such as the required characteristics for jet fuel.

ASTM D1655: Standard Specification for Aviation Turbine Fuel. This specification defines the minimum property requirements for Jet A and Jet A-1 aviation turbine fuel and lists acceptable additives for use in civil operated engines and aircrafts. Specification D1655 is directed at civil applications, and maintained as such, but may be adopted for military, government or other specialized uses.

ASTM D7566: Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons. The main part of this standard contains the specifications for synthetic jet fuel blended with Jet A or Jet A-1. Once certified, the blended jet fuel batch is automatically recertified to ASTM D1655 and considered a drop-in fuel batch. Blending is only allowed after the neat synthetic jet fuel batch is certified to the applicable Annex of D7566. Each Annex belongs to a specific synthetic jet fuel production pathway; a total of five pathways are currently certified.

DefStan 91-91: "Defence Standard 91-91", the Aviation Turbine Fuel (Kerosene Type, Jet A-1) standard developed by the UK Aviation Fuels Committee (AFC) on behalf of the Ministry of Defence (MOD). Developed for use in the UK, but today also used in many European countries.

HEFA: Hydro-treated esters and fatty esters / the technology to treat triglycerides with hydrogen under increased pressure and temperature to convert them into hydrocarbons.

JIG: Joint Inspection Group. Established by numerous oil companies that share jet fuel infrastructure to and at airports, and developed a set of standard/guidelines which govern the operation of the shared fuel infrastructure.

EI 1530: Quality assurance requirements for the manufacture, storage and distribution of aviation fuels to airports. EI/JIG 1530 provides a standard for maintaining aviation fuel quality, from production through (sometimes complex) distribution systems to airports. It provides mandatory provisions and good practice recommendations for the design/functional requirements of facilities, and operational procedures.

AFQRJOS: The Aviation Fuel Quality Requirements for Jointly Operated Systems are the agreed specification requirements for jet fuel supplied into jointly operated locations. It comprises the most stringent specifications of both ASTM D1655 and DefStan 91-91.

Nabisy: The German governmental web application for sustainable biomass (Nachhaltige Biomasse System, Nabisy), operated by the Federal Office for Agriculture and Food (BLE), serves to

prove the sustainability of bioliquids and/or liquid or gaseous fuels from biomass, pursuant to EU Directive 2009/28/EC (EU RED).

1 Introduction

Until recently, SJF has been produced and delivered into-wing as a specific batch, via segregated supply chains. Reporting of physical use of SJF by an airline for such deliveries is straight-forward. To move SJF to a commercial-scale product, avoiding segregated downstream supply chains is a key element of reducing cost without compromising safety or performance. Fully integrating SJF into conventional jet fuel storage and airport distribution systems imply that SJF will be used by all aircrafts refueling from those systems.

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Airlines need to report their SJF use, either for the airline's own internal reporting purposes or for (voluntary) reporting related to a sustainability scheme. In the case of the SJF deliveries at Oslo airport, reporting/accounting was both required for airline's internal reporting purposes and for reporting by the airline of the SJF under EU-ETS. This report describes how reporting/accounting was done for these SJF deliveries. This report does not intend to present *the* reporting/accounting method but describes the process developed and used for the SJF deliveries at Oslo airport.

2 Reporting/accounting SJF supply via co-mingled systems

Reporting/accounting needs to demonstrate a) that SJF has been used by the airline that claims the use (and accompanying emission benefits) and b) the sustainability of the SJF.

Reporting of physical use of SJF so far has been straight-forward. Traceability reporting by means of quantity and quality reporting and transport/transfer documentation, starting at the refinery and ending at the transfer of SJF into the aircraft that could be linked by matching batch numbering on all relevant documentation, can fairly easy demonstrate SJF use by an airline.

Reporting of SJF supplied via co-mingled systems is another story. The SJF batch actually loses its 'SJF identity' from the moment it is mixed with the other fuel batches. This moment can be different depending on the exact supply chain, eg:

- **SJF inserted in co-mingled system at airport:** The blended SJF can be inserted in a co-mingled system when it arrives at the airport and is received into the co-mingled storage facilities. The SJF can end up in many different aircrafts, but will be used at the airport where it is delivered.
- **SJF inserted in co-mingled depot outside airport with direct connection to airport:** The blended SJF can be inserted in a co-mingled system at a storage terminal outside the airport. Many airports get their fuel from off-site storage terminals that are connected via a pipeline to the airport. In case all the jet fuel stored at that terminal is delivered to the airport, the SJF inserted in the co-mingled pool at this terminal will be fueled at the specific airport. An example is for instance the Oiltanking Amsterdam storage terminal; all jet fuel that is stored there goes via a direct pipeline to the Schiphol.
- **SJF inserted into co-mingled systems outside airport with connections to multiple airports.** There are also depots/systems that supply to multiple airports. In such a case the SJF inserted there, can end up in multiple aircrafts and at multiple terminals, in some cases also in different countries.

So, SJF can be inserted into 'the aviation system' at different points in the supply chain and travelling onwards through that supply chain without the possibility to be physically tracked as SJF anymore. It is therefore necessary to:
a) demonstrate that a certain amount of SJF has actually been entered into the aviation system
b) allocate the use of SJF to a certain airline.

In this, a) and b) should be somehow coupled; verification of the SJF quantity entering in the system (a) should be coupled to some sort of system that allows the airline to claim use of SJF (b).

3 Reporting SJF delivered at Oslo

The traceability of an SJF batch starts at its production; the SJF is given a unique batch number that travels through the entire supply chain and is shown on all relevant documentation accompanying the SJF batch. As such the SJF delivered can be traced back to its origin (also see the ITAKA D3.5 report). In case of supplying SJF via non-dedicated infrastructure, the SJF batch at a certain moment is co-mingled with other batches and hence the physical presence of SJF gets somehow uncoupled from its administration.

Administration/reporting SJF delivery at Oslo airport

The SJF that was supplied at OSL was produced by Neste from feedstock supplied by the Camelina Company. The fuel was blended on ship by Neste and Air BP and subsequently stored in a shore tank at the ST1 terminal in Gävle (Sweden). From there on the fuel was trucked to OSL for supply into the co-mingled storage system of OSL (managed by OLT) and (a smaller part) for supply to segregated KLM/Embraer flights. A schematic overview of the supply chain is shown below.

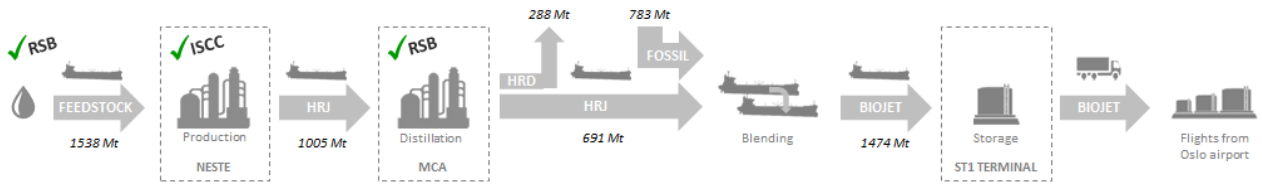

Figure 1. Schematic overview of supply chain SJF for Oslo

OLT's jet fuel administration only registers "Jet A-1" as the fuel type, the system does not allow to introduce a second type like "Sustainable Jet A-1". It does however register volumes and the batch numbers of all incoming jet fuel, and since the documents throughout the paper trail of an SJF batch is linked by means of among others batch numbers, this batch number registration can demonstrate that SJF has been delivered at the Oslo airport tank farm. For the ITAKA SJF deliveries at OLT, volume and batch number registration was based on the road tanker loading documentation provided by the ST1 terminal.

OLT's administration subsequently only registers the *volume* that is delivered from their tank farm into the aircraft, thereby not referring to batch numbers anymore. The same holds when GFS fuels aircrafts; only the volume and "Jet A-1" is mentioned on the fuel ticket, no batch or SJF reference.

So strictly speaking, the SJF coming in at Oslo airport can be traced, but the SJF delivered to airlines flying from Oslo airport cannot be traced at an aircraft level anymore.

However, the SJF can still be administratively linked to the airline having the SJF contract in place at the specific airport. This can be done via the contract, the invoices and delivery documents up to the airport, further supported by a traceability package tracing the delivery back to its origin. Agreements should be made with the airline on what level of detail and documentation they need.

In case the SJF deliveries do not take place under a certification scheme, reporting requirements are not determined by the rules of such certification schemes, but should be the result of the suppliers' agreement with the airline.

Reporting SJF consumption under EU ETS

In case SJF deliveries do take place under a (voluntary) certification scheme, the procedures of the certification scheme and subsequent claiming process (claim GHG savings under EU ETS or in another way receive government support or count towards national renewable energy targets) require certain reporting/accounting to demonstrate delivery of SJF (and its sustainability).

The ITAKA SJF that was delivered at Oslo airport was delivered under a fully EU-RED compliant supply chain (see figure 3 in chapter 3). This enabled Lufthansa as one of the one airlines that received SJF at Oslo airport, to claim the GHG savings of the ITAKA SJF batch under EU ETS for its intra-European flights. The below summarizes the process followed.

Demonstrate fuel delivery

In order to proof sustainability of the fuel delivered, evidence on the SJF supply and use are required. It was in this case AirBP, as supplier to the airline, to demonstrate the supply, and the following documents were used for the SJF deliveries at Oslo:

- SJF procurement records
- SJF import documents at ST1 terminal in Gävle
- Proof of Sustainability (PoS) from supplier Neste, confirming the SJF's EU RED compliancy of the entire chain
- Transport documents to OLT, i.e. loading documents from ST1 terminal and Bill of Ladings of road transports to OLT
- PoS to AirBP's customers (e.g. airlines)

In addition, Air BP as supplier also holds an administration of their jet fuel inventory. One of the requirements following from their ISCC sustainability certification is that they need to keep an administration of their sustainable biomaterials, hence Air BP held a separate SJF administration.

Aboe process will be audited by Air BP's independent ISCC certification body.

Demonstrate fuel consumption

It is the responsibility of the airline to prove the SJF reception through the PoS provided by their supplier, and the use of the SJF on intra-European flights by comparing their fuel consumption on all flights with intra-European flights (non-reportable vs. reportable flights), using EU ETS standard procedures for reporting fuel usage.

With the supply of SJF into the commingled fuel pool at OSL, full traceability of the SJF to specific airlines was only possible on paper as in practice the SJF molecules end up in the entire fuel system. EU ETS recognizes this difficulty and EU ETS verifiers allow airlines to use a mass balancing approach for demonstrating their sustainable fuel use. This mass balancing method should show the amount of SJF used compared to the total fuel use, and with this the jet fuel emission factor is lowered using following formula:

$$Emission\ factor = 3{,}15\ \frac{MT\ CO_2}{MT\ jet\ fuel} \times \left(1 - \frac{Total\ delivery\ of\ SJF\ to\ tank\ farm}{Total\ fuel\ consumption\ of\ all\ relevant\ flights\ after\ first\ delivery\ of\ SJF}\right)$$

With this method EU ETS doesn't require an analysis of the SJF blend (the emission factor of certified SJF equals zero in EU ETS), the mixing ratio of the SJF in the fuel pool needs to be proven instead, e.g. by using the mass balance approach (fuel in = fuel out).

Nabisy

Although the SJF was consumed at Olso airport, with Lufthansa being a German based airline, they are required to report under EU ETS through the German authorities. The *Bundesanstalt für Landwirtschaft und Ernährung* (Federal Office for Agriculture and Food, BLE) developed *Nabisy*, a web-based system for sustainable fuel users.

In Nabisy, the use of sustainable fuels is reported by the airline by means of forwarding the Proof of Sustainability within the Nabisy system to the *Deutsche Emissionshandelsstelle* (German Emissions Trading Authority, DEHSt). To do so, the airline first needs to receive the PoS in the Nabisy system from their supplier.

(International) Fuel producers can register a sustainable fuel batch in the system (by providing data on the biofuel), and (international) fuel suppliers can subsequently forward sustainable batches in the Nabisy system to a next supplier or end-user with a PoS; they can split a sustainable fuel batch to multiple receivers with Partial Proofs of Sustainability (PPoS), or combine multiple sustainable batches from different producers.

For the ITAKA deliveries, this implied that Neste, Air BP Sweden, Air BP Norway and Lufthansa all had to be registered at Nabisy so that the complete supply chain was covered in the system. Neste registered the entire fuel batch in Nabisy, based on the PoS they issued with supplying to Air BP and the Saybolt independent surveyor report of the blending and transfer at Gävle. They subsequently forwarded the fuel to Air BP Sweden, which subsequently forwarded the fuel batch in monthly parts to Air BP Norway. Air BP Norway then supplied the final Proofs of Sustainability to Lufthansa.

From an EU ETS auditor's perspective, the PoS stream in Nabisy is not offering sufficient evidence as there is no fuel batch numbers in Nabisy. So, there are actually two paper chains that need to be connected at some point:

- The Nabisy PoS stream, forming a closed chain as the original PoS number is stated on all downstream PoS
- The proofs of delivery (production, independent surveyor and transport documents), forming a closed chain based on batch numbers

Neste made a connection between both streams by formally declaring the original PoS in Nabisy is linked to the actual fuel transfer to Air BP, based on the volume registered in Nabisy and the identical volume plus fuel batch number stated on their ISCC PoS to Air BP. Figure 2 gives a schematic overview of the document chains.

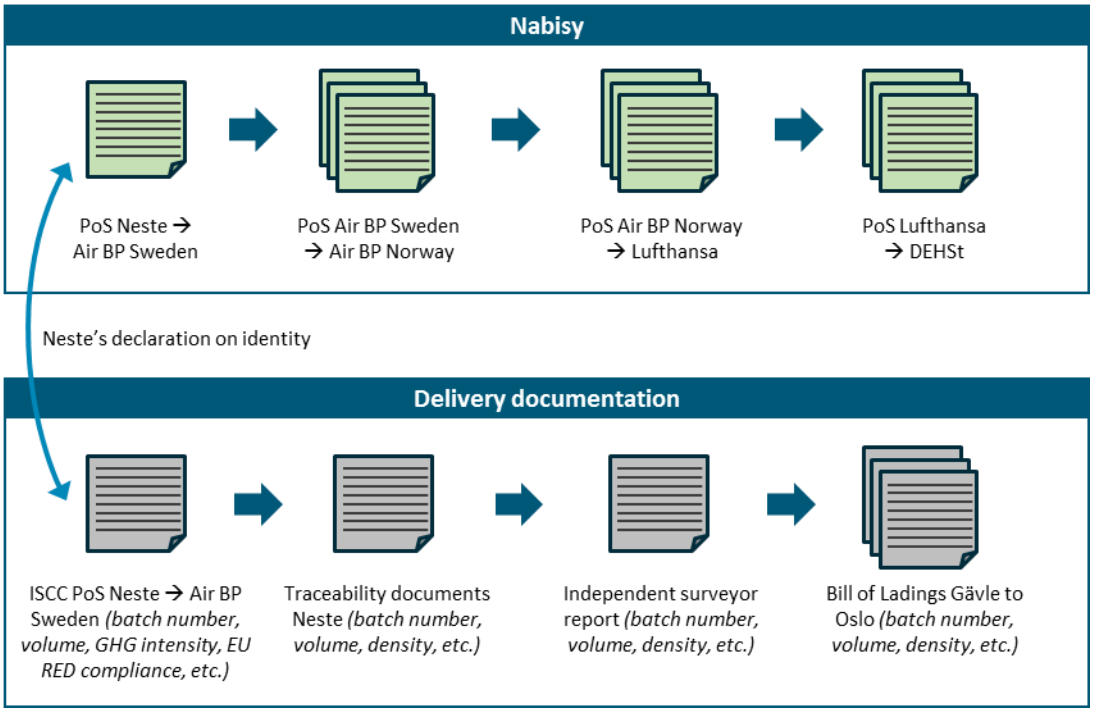

Figure 2. Schematic overview of PoS and delivery documents chains.

Conclusion & Reflection

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This report did not intend to present *the* reporting/accounting method but described the process developed and used for the SJF deliveries at Oslo airport.

Annex A – Proof of Sustainability

Proof of Sustainability

For bioliquids pursuant to Arts. 15 et seqq. of the Biomass electricity sustainability ordinance (Biomassestrom-Nachhaltigkeitsverordnung (BioSt-NachV)), or for biofuels pursuant to Arts. 15 et seqq. of the biofuels sustainability ordinance (Biokraftstoff-Nachhaltigkeitsverordnung (Biokraft-NachV))

Number of the proof of sustainability: EU-BM-13-16010101

Interface:	Recipient:	Certification system:
EU-BM-13-SSt-10001299	Air BP Sweden AB, Solna, EU-BM-13-Lfr-10005416	ISCC System GmbH, www.iscc-system.org, EU-BM-13

1. General information on biomass / biofuels:

Type, potential parts: 100.00% HVO

Country of cultivation / Country of origin*: ES

Quantity (t/kWh/m3): 896.062 m³

Energy content (MJ): 30,466,108

The bioliquids / biofuels have been produced from residues or by-products, with by-products not arising from agriculture, forestry, fisheries or aquaculture. ☐ yes ☒ no

Advice: If Yes has been indicated, no further particulars are required for

2. Sustainable production of biomass and/or sustainable production of biofuels pursuant to Arts. 4-7 BioSt-NachV/ Biokraft-NachV:

The biomass complies with the requirements pursuant to Arts. 4-7 BioSt-NachV/ Biokraft-NachV. ☒ yes ☐ no

3. Greenhouse gas savings pursuant to Art. 8 BioSt-NachV/ Biokraft-NachV:

☒ The greenhouse gas emissions savings potential has been complied with as follows:

- Greenhouse gas emissions (g CO2eq/MJ): **44.5** Comparator for fossil fuels (g CO2eq/MJ): 83.8
- Compliance with the savings potential when used ☒ for electricity generation ☒ as fuels ☒ for combined electricity/heat generation ☐ for heat generation
- Compliance with the greenhouse gas savings when used in the following countries/regions (e.g. Germany; EU): Schweden

The proof of sustainability is valid without signature. The interface is responsible for accuracy of the proof. Identification of the proof takes place by means of its non-recurring number.

Place and date of issuance: Espoo, 29.03.2016

Delivery/shipment based on a mass balance system pursuant to Art. 17 BioSt-NachV/ Biokraft-NachV**:

☒ Delivery/shipment has been documented in a mass balance system.

- ☐ Documentation has been carried out by means of the database of the BLE:
- ☒ Documentation has been carried out according to the requirements of the following certification system: ISCC System GmbH
- ☐ Documentation is carried out pursuant to Art. 17 para. 3 Biokraft-NachV.
- ☐ Documentation has been carried out by means of the following electronic database:

Last supplier (name, address):

***Advice:** In the case The proof of sustainability contains materials from multiple countries of cultivation or countries of origin, the only two countries with the highest ratios are displayed.

****Advice:** to be completed by the last supplier

Blank by the Federal Office for Agriculture and Food