



DEMO-SPK | Research and Demonstration Project on the Use of Renewable Kerosene at Airport Leipzig / Halle

Use of multiblend JET A-1 in practice – insights from the DEMO-SPK project

IEA AMF SAF | Seminar on Part 1: Supply & Operation | November 03, 2022

Franziska Müller-Langer

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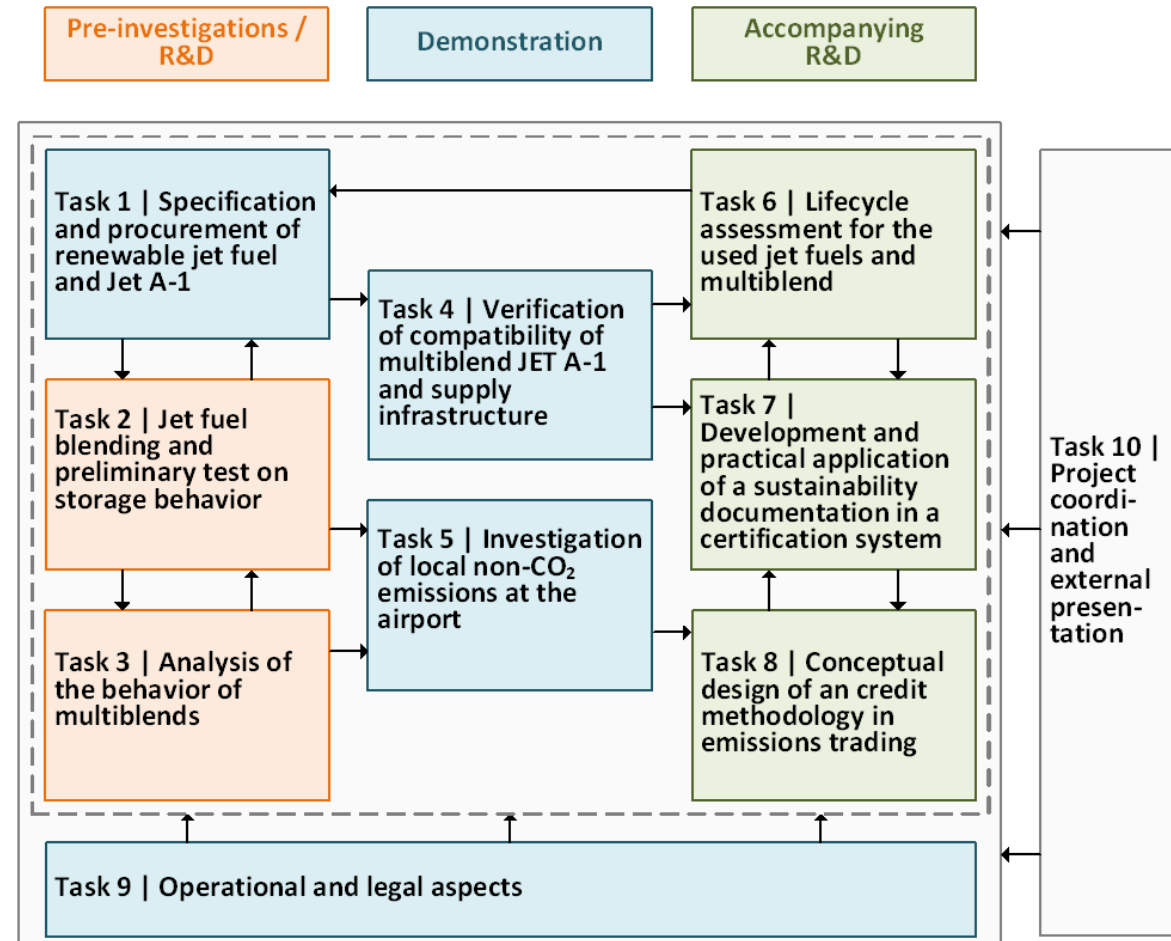
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DEMO-SPK in a nutshell

Project in a nutshell



- First time to gain scientific insights in the field of multiblends.
- R&D&D of implementing multiblend JET A-1 into practice as starting point of increasing shares of renewable jet fuel, as this will lead to fuel from different pathways being mixed



Project duration:
11/2016 –
06/2020

And many others like amyris, Gerlach, Panalpina, Varo Energy, Faudi ...

DEMO-SPK in a nutshell

Key results



Thanks to the participation of more than 20 international partners from industry and science, DEMO-SPK has been the first of its kind to succeed in:

- supplying nearly 600 tons of multiblend JET A-1 and utilizing this in flight operations at the Leipzig/Halle airport
- through the use of multiblend JET A-1 in aircraft instead of pure fossil-based JET A-1 fuel
 - reducing particle emissions in ground runs by approx. 30 to 60 %
 - reducing CO2 equivalent emissions by approx. 35%
- preparing FT-SPK using PTL (power-to-liquid) so that key requirements of the ASTM specifications can be met
- development of three different approaches for SAF sustainability verifications and SAF accounting aspects in GHG regulation systems like the EU ETS
- recommendations related to improve operational supply chain

Basic setup | Two-stepped approach



First, blending at lab and at small tank (several 100 liter) scale

- Four different multiblends
 - ATJ / HEFA / fossil Jet A-1
 - HEFA / SIP / fossil Jet A-1
 - ATJ / SIP / fossil Jet A-1
 - ATJ / HEFA / SIP / fossil Jet A-1
- To determine maximum achievable blend ratios
- Required to order right volumes of fuel
- To demonstrate fuel properties and storage behaviour



Source: manual of the storage tank TA 950

Second, blending at commercial scale and fueling at Leipzig/Halle airport

- One multiblend
 - ATJ / HEFA / fossil Jet A-1
- To demonstrate safety of large scale use of multiblends
- To identify legal and regulatory obstacles
- To demonstrate reduction of particle emissions by multiblend



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Fuel properties



- On-spec binary blends can be blended in any ratio
- Based on these binary blends
 - one multiblend containing all three synthetic fuels and
 - three multiblends each containing two synthetic fuels were prepared
- The blends were prepared
 - in lab-scale to initially confirm that they meet the requirements according to ASTM D7566
 - in 0.9 and 0.4 m³-scale for 6-month storage stability studies
- After blending as well as after storage all multiblends were tested according to ASTM D7566
- Additionally, during the storage the fuel was analyzed periodically to monitor changes and to exclude separation of the fuels
- No alterations of physico-chemical properties were observed during a 6 month storage



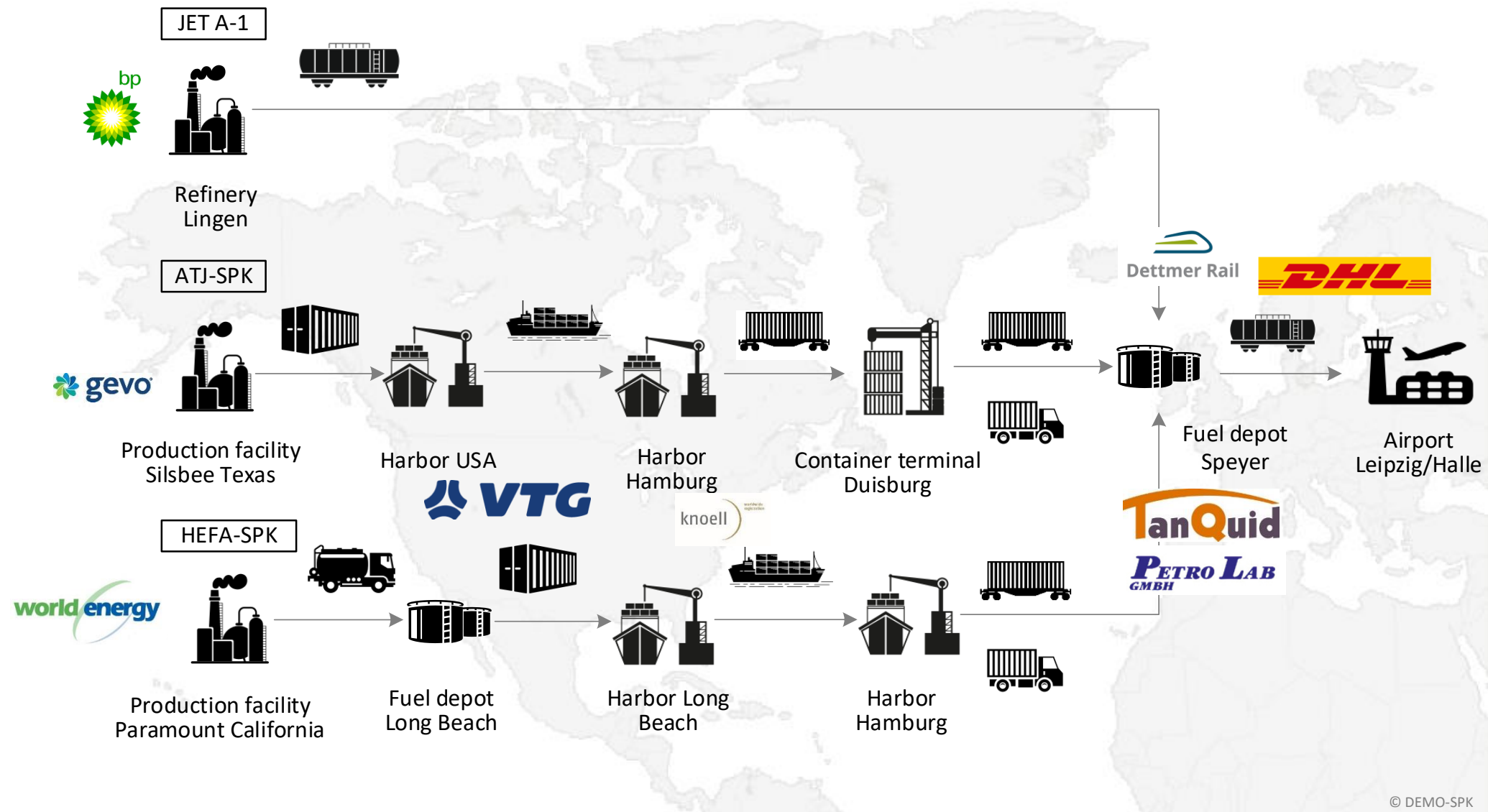
Tanks for storage stability studies
Source: manual of the storage tank TA 950



Preparation of multiblends at WIWeB
Source: WIWeB GF 430

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Demonstrated supply logistics



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Multiblend JET A-1 production



- Purchase of internationally available renewable Synthetic Paraffinic Kerosene (SPK) acc. ASTM D7566 and of conventional JET A-1 with low sulphur and medium aromatics content ex German refinery
- Manufacture of multiblend JET A-1 acc. ASTM D7566, Table 1, Part 1 and 2 using common standards (EI/JIG STANDARD 1530) in a tank farm
 - a. Infrastructure adjustments for SPK products and blending procedures needed
 - b. Use of dedicated pipes for multiblend JET A-1





- No adjustments of airport infrastructure with regard to fuel storage and delivery required
- Fuel supply chain operations acc. high-quality standards and procedures:
 - sealed coated railcars
 - supply into an emptied fuel tank incl. settling time
 - standard conditions applied for all quality controls and fuel filtration
- Special conditions for A/C emission testing: storage and delivery in dedicated dispenser trucks for JET A-1 reference fuel and multiblend JET A-1, respectively



Tank storage DHL/EAT Leipzig (©DHL)



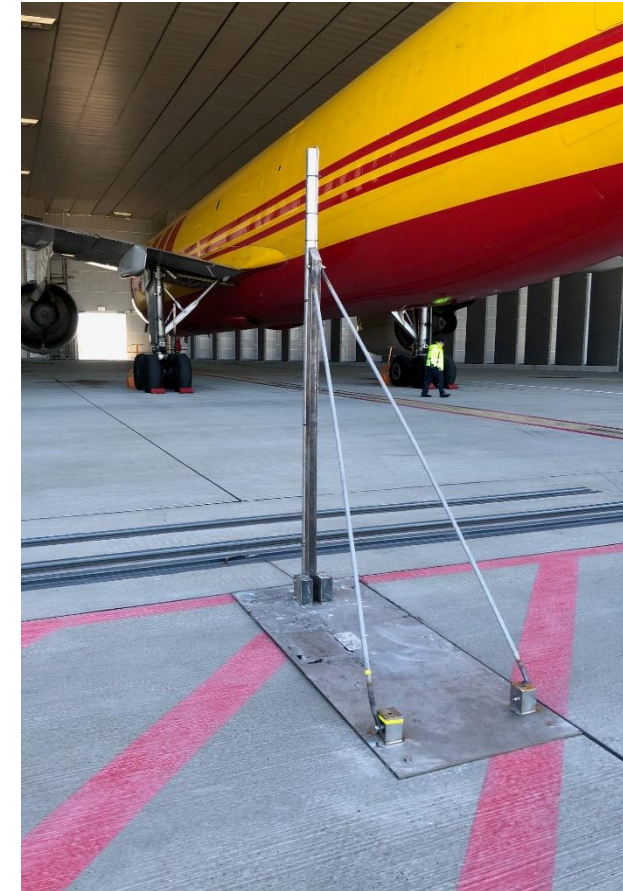
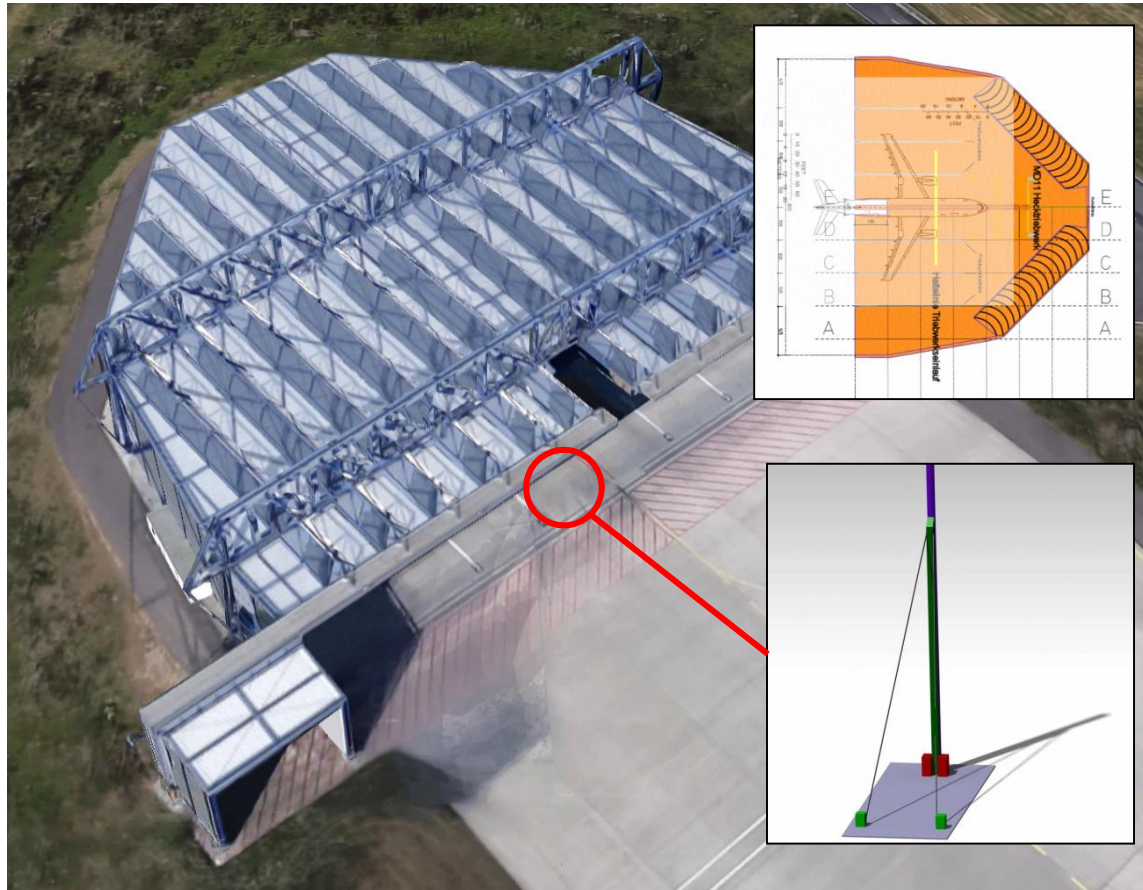
Multiblend JET A-1 fuelling (© DEMO-SPK 2018)

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Experimental setup emission testing



- A300-600 (freight version) with 2 x Pratt & Whitney PW4158 engines
- Sampling at 20 m behind the engine exit plane



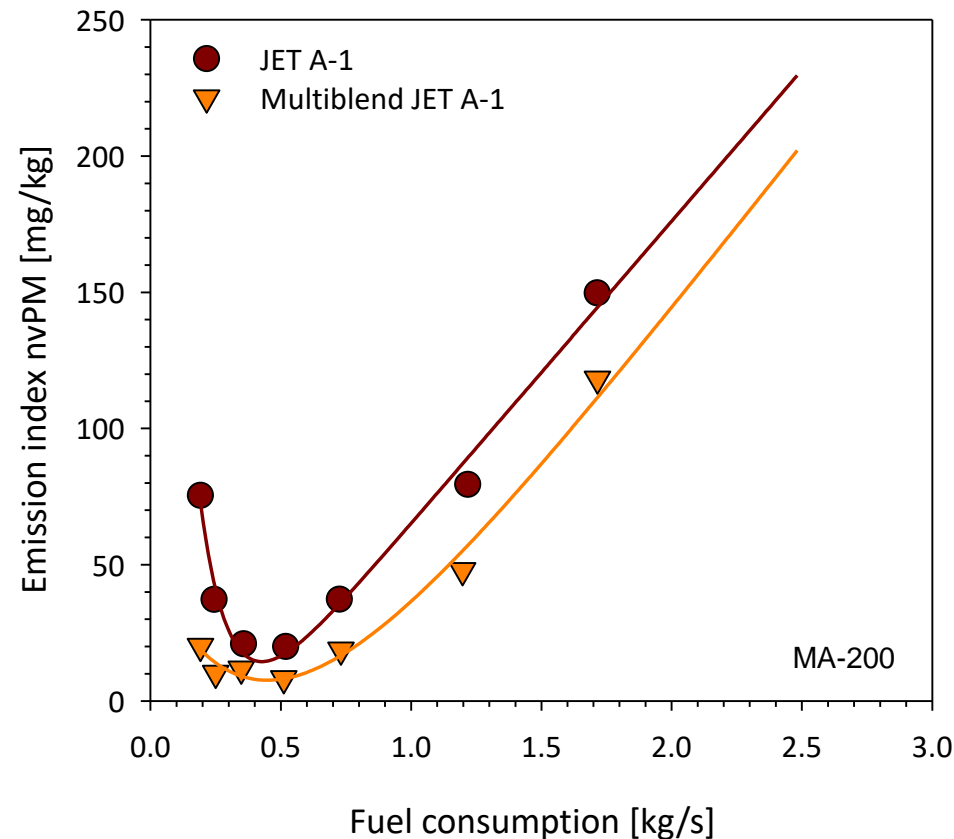
Engine testing facility airport Leipzig/Halle (© Google/DLR/DEMO-SPK)

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Emission reduction



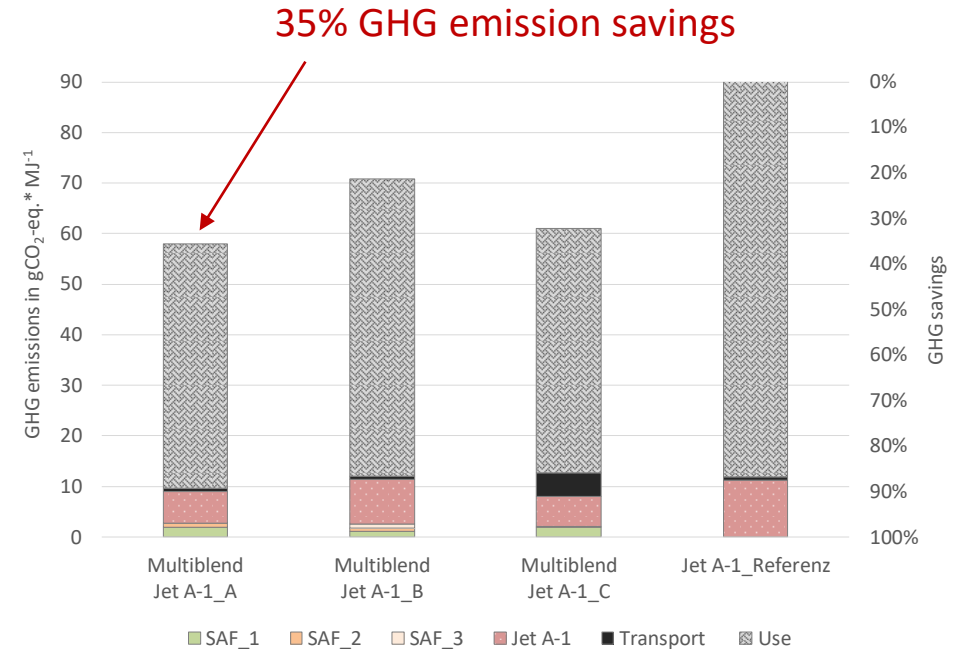
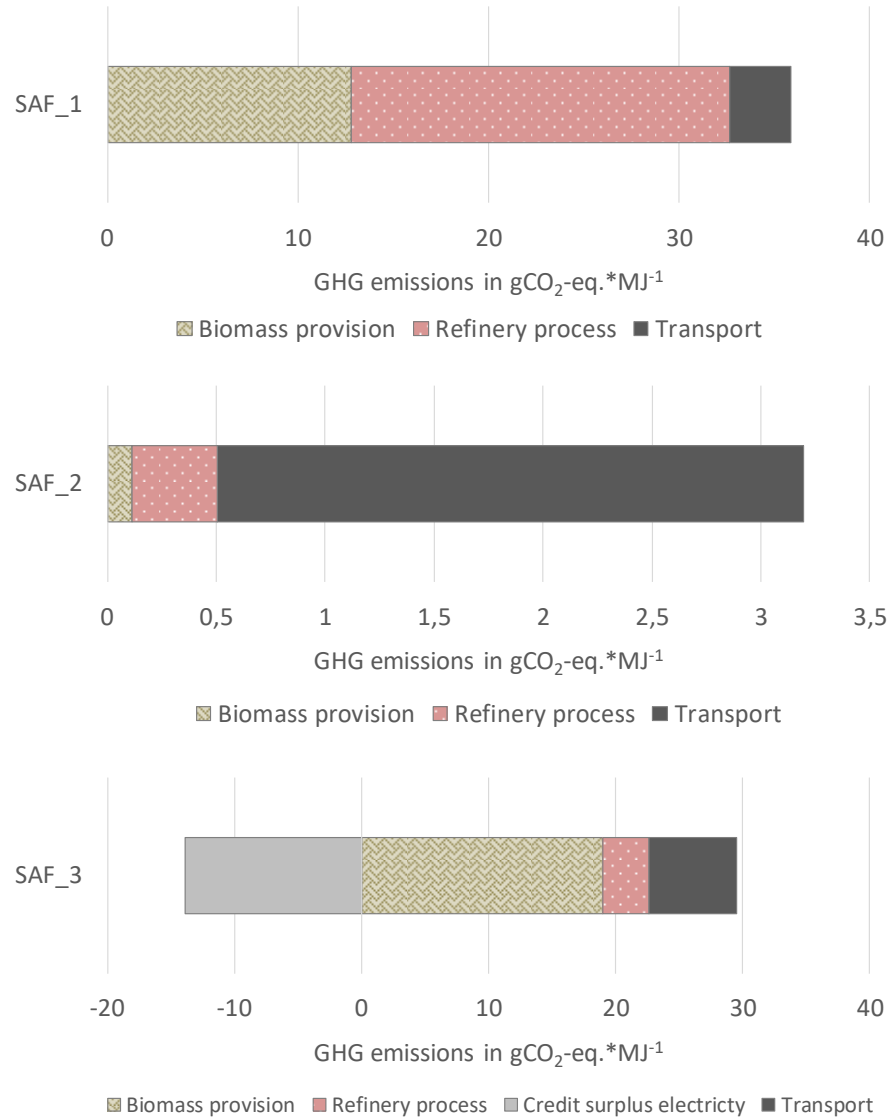
- The particle mass reduction decreases with increasing power setting
- The PN emissions were reduced by **37%** and the PM emission were reduced by **29%** by the multiblend JET A-1 compared to the reference JET A-1 based on the LTO cycle



Landing and take-off cycle (LTO)

Taxi	26 min	7% thrust
Take-Off	0.7 min	100% thrust
Climb	2.2 min	85% thrust
Approach	4.0 min	30% thrust





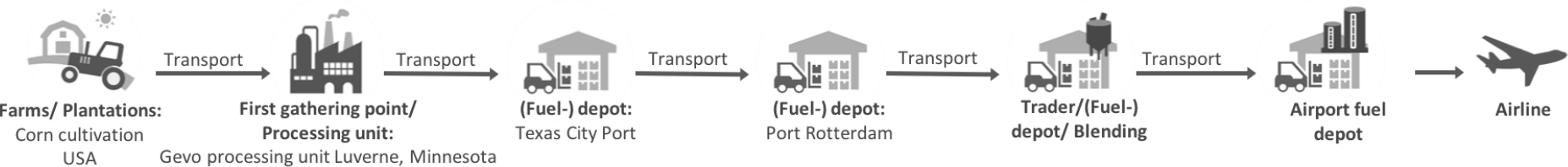
- Significant differences between the SAF
- Influencing factors: feedstock; processing at the refinery (mostly energy), uses of wastes and residues
- Results for SAFs range between: 3 up to about 36 gCO₂-Eq./MJ SAF

DEMO-SPK in a nutshell

Sustainability certification | applicability for DEMO-SPK chains

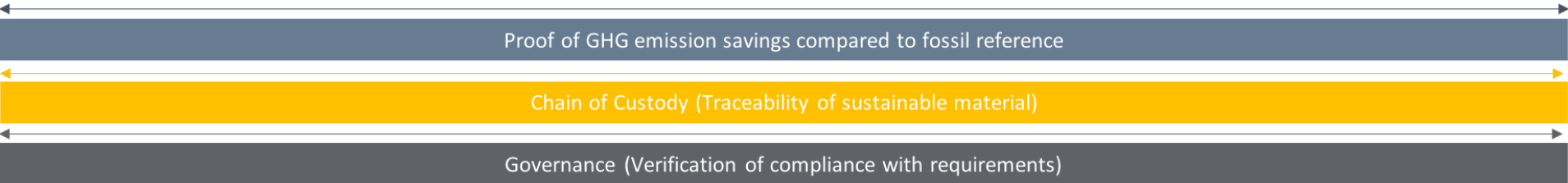


- Sustainability documentation must be implemented & forwarded throughout the entire chain
- Sustainability requirements apply to the cultivation of raw materials
- GHG emission savings and traceability must be ensured along the whole supply chain

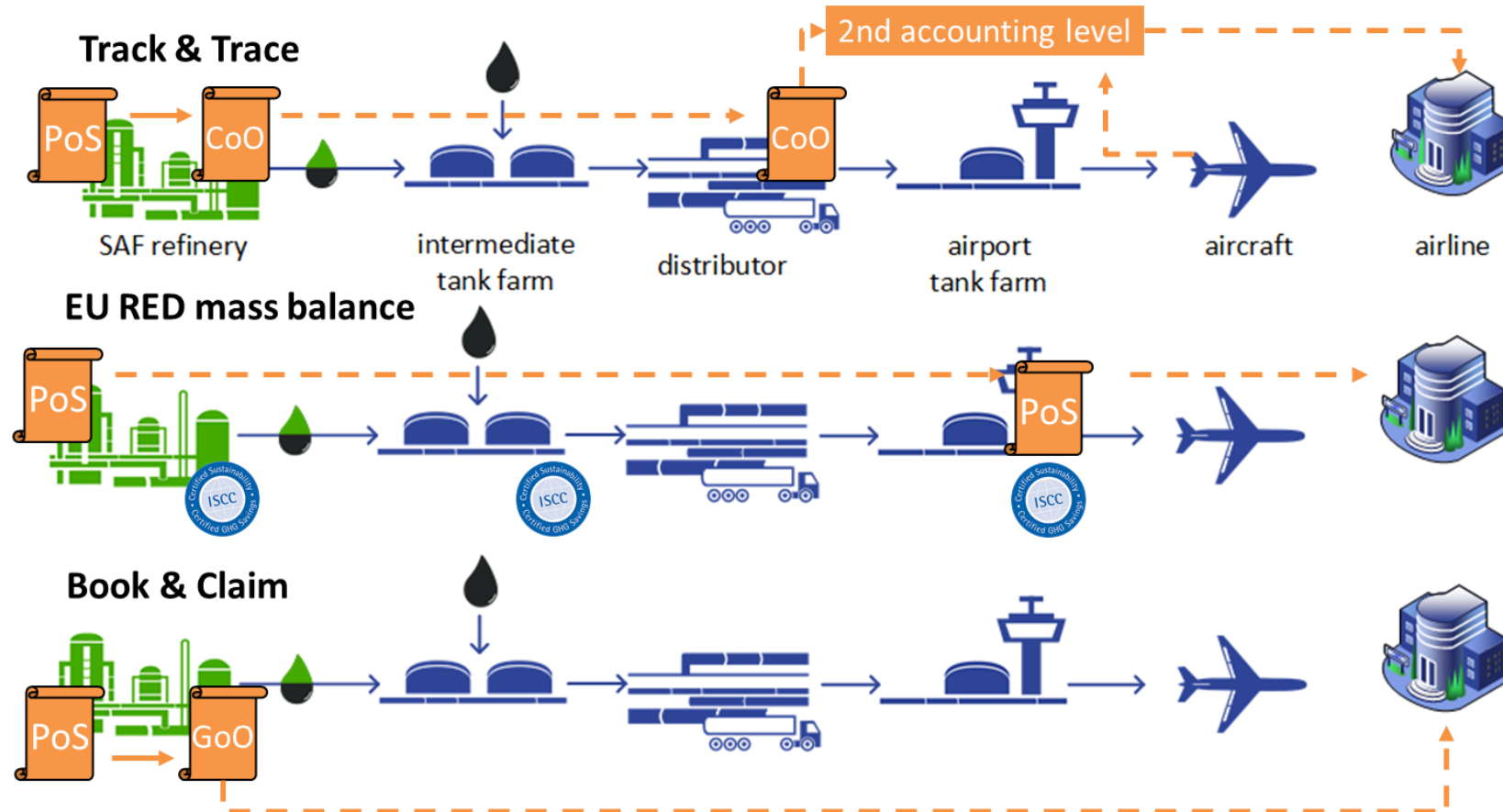


Raw material	Farms/ Plantations	First gathering point/ Processing unit: <i>Isobutanol and renewable aviation fuel</i>	(Fuel-) depot: Texas City Port	(Fuel-) depot: Port Rotterdam	Trader/ (Fuel-) depot/ Blending	Airport fuel depot
Maize/ Corn	<ul style="list-style-type: none">• Approx. 150 farms• Option: Coverage under certification of First Gathering Point	<ul style="list-style-type: none">• The Gevo processing unit is also first gathering point (FGP)• An audit at the FGP includes a sample-based audit of farms• A processing unit converts input materials by changing their physical and/or chemical properties	<ul style="list-style-type: none">• If stored in port, the warehouse may be part of the supply chain.	<ul style="list-style-type: none">• If stored in port, the warehouse may be part of the supply chain.	<ul style="list-style-type: none">• Point of blending (e.g. refinery or fuel depot)• Blending of fossil kerosine with Gevo renewable aviation fuel	<ul style="list-style-type: none">• Provision of blend to respective airline

Sustainability requirements



Chain-of-custody options



- For the considered Chain-of-Custody options the **merits of each option** need to be assessed in detail, e.g. in terms of the administrative and implementation burden involved.
- SAF accounting involves **various industry/regulatory stakeholders** without a single responsible one. Hence, the matter of implementing a suitable Chain-of-Custody concept needs to be **pursued on a regulatory level** – initiative is required today.

Contact project coordination

DBFZ Deutsches Biomasseforschungszentrum
gemeinnützige GmbH

Dr.-Ing. Franziska Müller-Langer |
franziska.mueller-langer@dbfz.de | +49-341-2434-423

Dipl.-Ing. Stefan Majer |
stefan.majer@dbfz.de | +49-341-2434-411

For further information on DEMO-SPK please see
<https://www.dbfz.de/news/ergebnispraesentation-demo-spk>
<https://onlinelibrary.wiley.com/doi/full/10.1002/ceat.202000024>
<https://www.mdpi.com/2076-3417/12/7/3372>
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