Panel 5: Airports as an Enabler of Greener Aviation

Annual Safety Conference 2022

EASA Airport Safety & Environmental
Sustainability through Innovation

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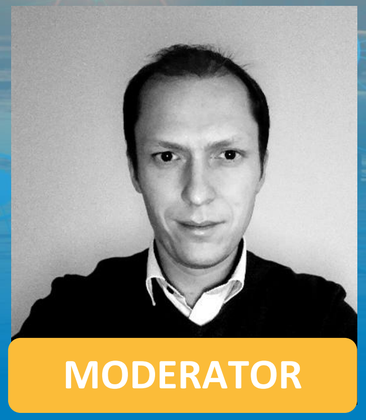
PANEL 5: AIRPORTS AS AN ENABLER OF GREENER AVIATION



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Head of Ground Operations & Airport Safety
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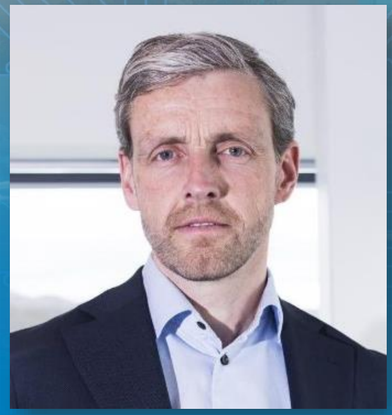

Jan Petter Steinland
Director Strategic Analysis & Transformation
CAA Norway

Jonathan Wood
VP Renewable Aviation
Neste

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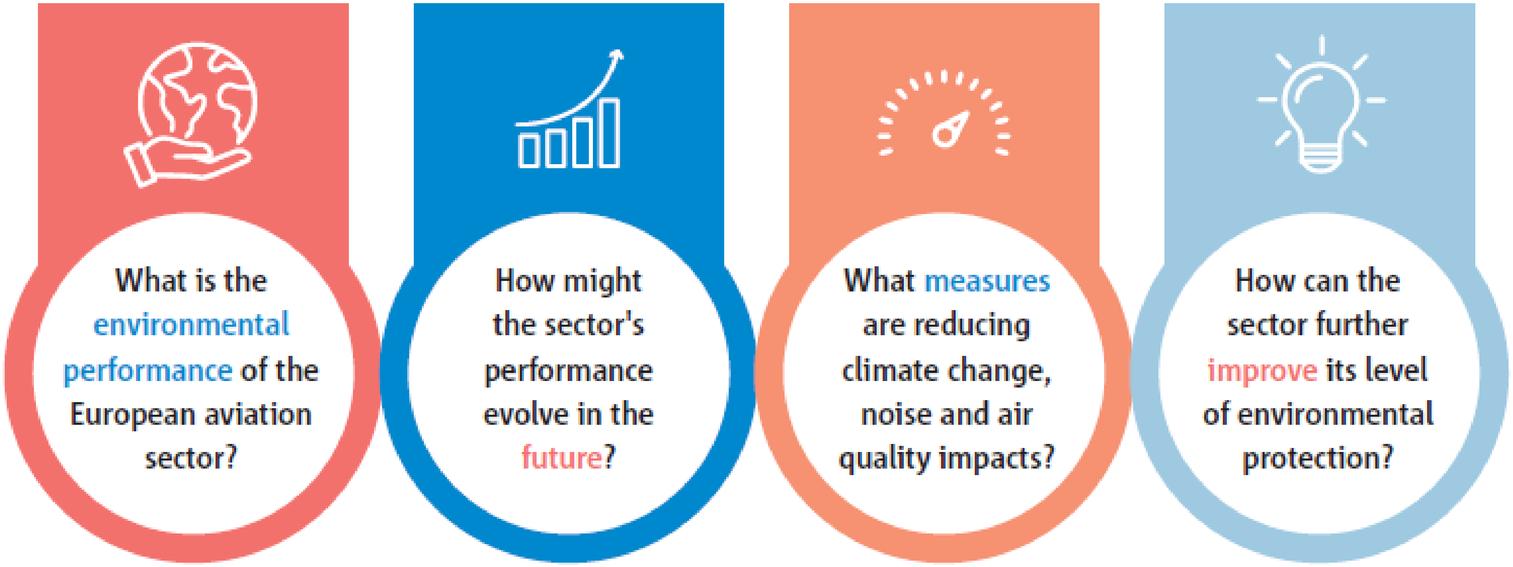
European Aviation Environment Report (EAER) 2022

- **Independent, objective and accurate** source of information
- Support to **evidence-based policy-making**
- **Recommendations** on how to further improve the level of environmental protection



Fostering green airport operations and infrastructure

EAER 2022 – Airport recommendations #2

“To incentivise and enable the development and implementation of necessary green airport infrastructure and operations (e.g. standards on supply of SAF / hydrogen / electrification)”

Full report: https://www.easa.europa.eu/eco/eaer

Blandine Landfried

Head of Climate and Sustainable Air Transport, Groupe ADP

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GROUPE ADP
SHARING NEW HORIZONS

IMAGINING THE SUSTAINABLE OF TOMORROW FACILITING THE SUPPLY OF « CLEAN » ENERGY

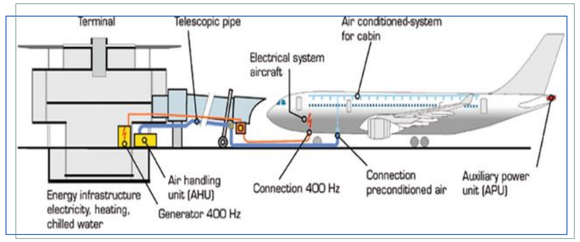
EASA ANNUAL SAFETY CONFERENCE 2022

OUR CONVICTION

The future and development of our business depends on an **ACCELERATED ENVIRONMENTAL TRANSFORMATION**

BE A PIONEER IN THE IMPLEMENTATION OF NEW ENERGIES

TOWARDS INTENSIVE ELECTRIFICATION



Electricity (400 Hz) and Air Condition Unit to limit APU use

GSE Electrification

Electric Taxi

Electric and Hybrid Aircraft

➔ RENEWABLE ELECTRICITY

Guarantee of origin

Corporate Power Purchase Agreement

BE A PIONEER IN THE IMPLEMENTATION OF NEW ENERGIES

SUSTAINABLE AVIATION FUELS

7 **Sustainable Aviation Fuel chains** certified to date, others to come

Infrastructures already able to operate with Sustainable Aviation Fuels in CDG and ORY

Sustainable Aviation Fuel used on a continuous basis in LBG since mid-2021

GMR:
Development of a project in India of sustainable aviation fuel production (FASEP project)

"2025 Pioneers" strategic roadmap

Demonstration of SAF integration

BE A PIONEER IN THE IMPLEMENTATION OF NEW ENERGIES

HYDROGEN

1. HYDROGEN TERRITORIAL ECOSYSTEMS

H2 Hub Airport

AIRBUS · GROUPE ADP · AIRFRANCE KLM GROUP · Région îledeFrance · CHOOSE PARIS REGION

NUEVO PUDAHUEL : launching studies (April 2022) for a **hydrogen territorial ecosystem**

PARIS : preparation of ecosystems on the 3 platforms

2. PREPATING THE ARRIVAL OF THE LIQUID HYDROGEN AIRCRAFT

IN PARTNERSHIP with Airbus and Air Liquide, Group ADP investigates the feasibility **to deploy hydrogen infrastructure** to refuel future liquid hydrogen aircraft

A TRIPARTITE COOPERATION TO PREPARE THE LH2 AIRPORT INFRASTRUCTURES

A MOU between Airbus, Groupe ADP et Air Liquide officially signed and publicly announced in June 2021 at the Paris Air Forum and completed in Q1 2022.

International panel study – LH2 supply chain study for airports :

- **Patterns of hydrogen supply**: cost, footprint, energy requirements, timeline

Paris Case study for making CDG and Orly « hydrogen-ready » :

- **LH2** volumes assessment
- Definition of the **LH2 supply chain** and characterization of the **associated issues at the territorial and national levels**
- LH2 **storage and distribution** configurations at airport
- **Pre-sizing** and **implementation studies** of LH2 infrastructures
- Evaluation of **COSTS**

CDG

ORY

AIRBUS GROUPE ADP Air Liquide

STRATEGIC KEY LEARNING ABOUT LH2 INTEGRATION AT AIRPORTS

Supply chain patterns

- A clear list of possible **supply chains** has been defined, that includes **LH2 trailers, pipelines, and on- and off-site production and liquefaction.**
- The threshold effects among these options and their variations depending on **the type of airports** are understood.

Infrastructure feasibility at airports

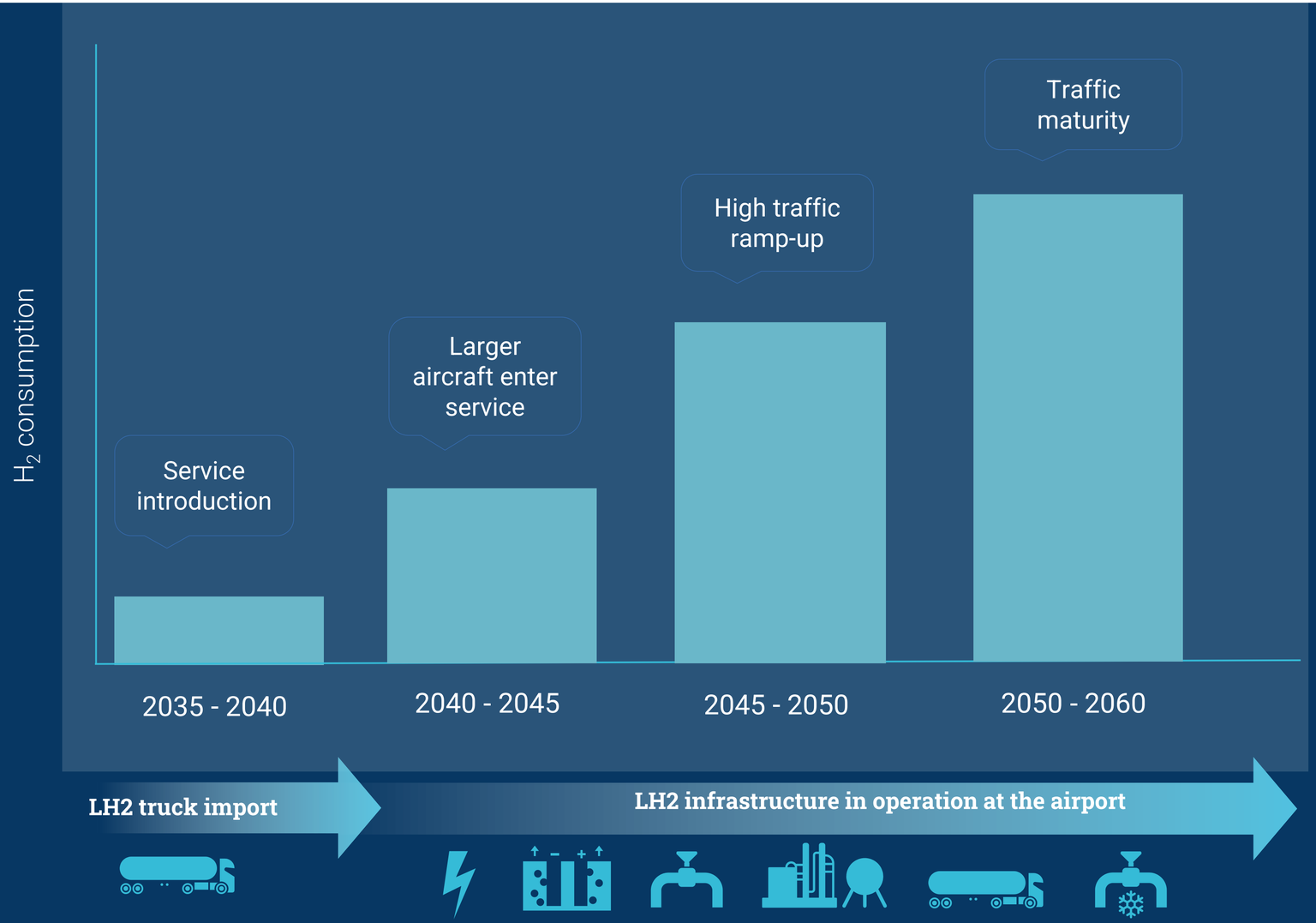
- The **integration** of the infrastructure in most airports **seems feasible**
- Integration challenges identified in few airports: large airports **in an urban environment and little spare surfaces available** (10% of the 30 airports studied)

Cost assessments

- A **first high-level assessment** shows a very high degree of cost variability, depending on LH2 demand volumes during ramp-up phase and electricity costs.
- **Understanding the drivers .** of this variability and how to mitigate them will be crucial for the **development of hydrogen aviation.**

AIRBUS GROUPE ADP Air Liquide

A TYPICAL H2 ROADMAP FOR A LARGE AIRPORT



CDG

Up to

600 flights LH_2 & 700 LH_2 Tons

Per day at maturity (hyp. 2060)
High scenario from Airbus market model

Up to

1.7 GW & 13.8 TWH/Year

Electric power & energy needed at maturity (hyp. 2060)
Estimate of electricity needs for electrolysis & liquefaction.
Electrolysis represents 1.5 GW and 12 TWH/year

ORY

Up to

300 flights LH_2 & 350 LH_2 Tons

Per day at maturity (hyp. 2060)
High scenario from Airbus market model

Up to

0.8 GW & 6.9 TWH/Year

Electric power & energy needed at maturity (hyp. 2060)
Estimate of electricity needs for electrolysis & liquefaction.
Electrolysis represents 0.7 GW and 12 TWH/year

- Dedicated **LH2 infrastructure** when truck traffic is becoming too important
- Several phases of **infrastructure building** required on ~ 30 years

AIRBUS GROUPE ADP Air Liquide

HYDROGEN
LARGE AIRPORT LH2 FARM LAYOUT

Truck loading bay

LH2 tank farm +
departure of cryo-pipes

Liquefier module

Electrolyser module

Electrical Transformers &
Electrical rooms module

AIRBUS GROUPE ADP Air Liquide

Peter Esteie

Head of Ground Operations & Airport Safety, Airbus

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ZEROe

Towards the world’s first zero-emission commercial aircraft

Peter Esteie, Head of Ground Operations & Airport Safety, Airbus

AIRBUS

Ecosystem Partnerships Strategy

Airport Ecosystem

Energy Providers

Airlines

Regulatory Bodies

Non-aviation

H2 Alliances

Investment Funds

Airbus acts as facilitator and catalyst, bringing together all major players across the Ecosystem

Timeline

2021	2023	2025	2028
Understand	Partner	Prepare EIS	Global deployment phase
Engage with leading airlines, energy providers, infrastructure & airports, non aviation sector, etc.	Develop partnerships & projects in strategic regions with high market potential	Deploy hydrogen hubs at airports globally	Deploy hydrogen infrastructure globally

Images: ICAO, Lufthansa Group, Daimler trucks

AIRBUS

Main topics studied by these partnerships:

- Local and global H_2 supply chain studies
- Adaptation of airport infrastructure for H_2
- Hydrogen Hub @Airport
- Airline network studies
- H_2 aircraft operations
- Communication/advocacy

Ambitious partnership strategy with hydrogen industry, airports and airlines to jointly build a roadmap of hydrogen supply for aviation

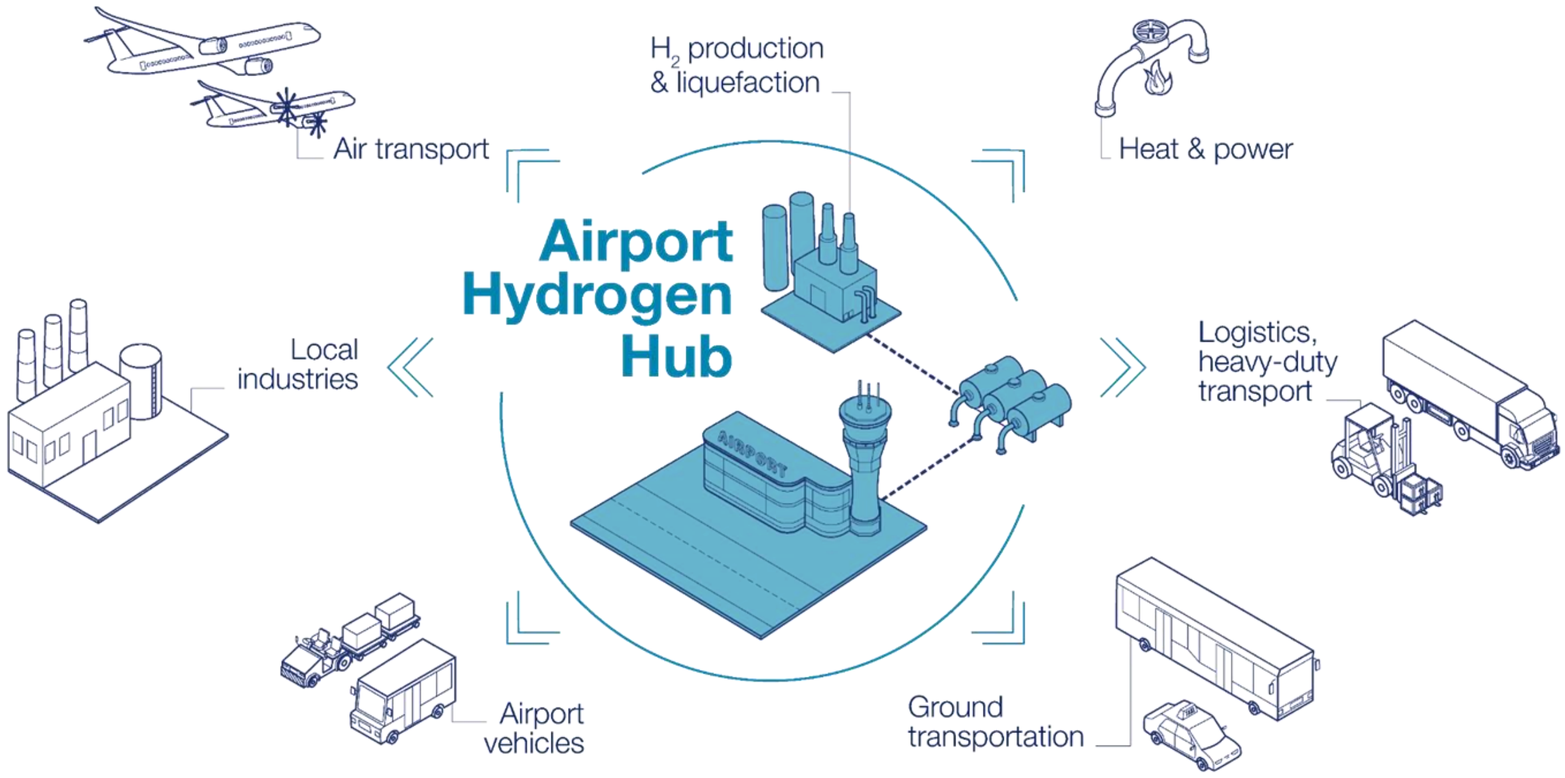
AIRBUS

Why Airports as Hydrogen Hubs?

- Airports are heavy goods transport hubs (machinery, buses, trucks, ….and aircraft)
- Heavy transport requires hydrogen for decarbonisation
- Airports hydrogen hubs which will also prepare for zero emission aviation

Airport hydrogen hubs will:

- Prepare regulations and standards for the handling of hydrogen at airports
- Ensure that a large number of airports worldwide are supplied with LH_2 by 2035
- Foster efficiency improvements and cost reductions in hydrogen liquefaction, storage and distribution



Thank you

Mikko Viinikainen

VP Sustainability & Environment
Finavia Corporation

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FINAVIA

for smooth travelling

Net Zero Carbon Finavia Roadmap

Mikko Viinikainen, VP Sustainability and Environment, Finavia Corporation

FINAVIA
for smooth travelling

Finavia is an airport company that leads and develops 20 airports in Finland.

We work to improve Finland’s connectivity.

At Helsinki Aiport, we are part of global competition.

Our customers consist of airlines and passengers.

We develop the customer experience at our airports to ensure smooth travel.

Sustainability is important to us.

Finavia’s airports are carbon neutral.

FINAVIA
for smooth travelling

Use of energy in Finavia’s operations at its airports

Consumption of energy in Finavia’s operations

- Vehicles and machinery, 25GWh
  - Passanger cars, vans, buses, trucks, snow removing and other machinery
- Heating, local or district heating, 55GWh
  - Terminals, machinery shelters etc.
- Electricity, 80GWh
  - Lighting, air conditioning, machinery etc.
- Other use
  - Emergency power generators

Energy efficiency is prioritized in investments

Improving energy efficiency is paramount

Environmental Management Systems Helping Airports

Environmental Management System
ISO14001

Commitment by top management

Creates the platform for the "Monitoring and measuring engine" to gather data for evaluation of performance and improvents

EMS is a tool, not a proof of performance

Airport Carbon Accreditation
ACA

Industry-specific guidance on measuring and reducing CO_2-emissions

Practical means for engaging stakeholders

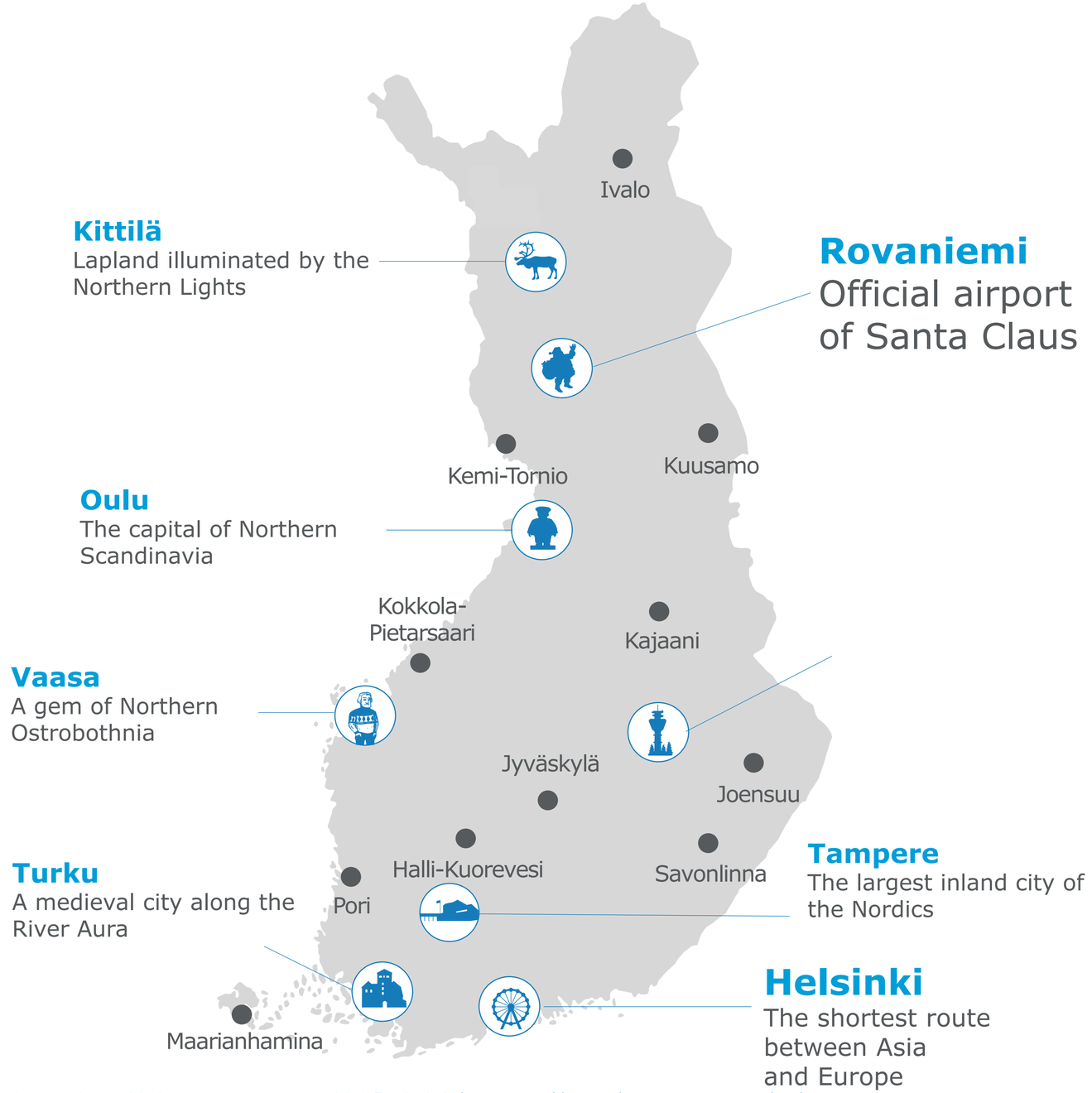
Forms a basis to voluntarily exceed the air transport industry's general goals regarding CO_2

Sustainability Assessment of Buildings
BREEAM (LEED)

Major steps in energy efficiency can only be made cost-efficiently in new infrastructure projects

Airport's goal-setting on certification pushes designers to apply ambitious technical criteria instead of business-as-usual standards

FINAVIA
for smooth travelling



Helsinki and four airports in Lapland are on Airport Carbon Accreditation (ACA) Level 4+

Finavia's operations at all of its airports are carbon neutral.

But we are aiming at Net Zero Carbon emissions.

FINAVIA
for smooth travelling

Further CO_2 reduction measures

- Vehicles and machinery, 25GWh
  - Switching to electric machinery, when feasible
  - Switching to renewable fuels only (others)
- Heating, local or district heating, 55GWh
  - Switching to geothermal power
  - Sourcing green district thermal energy where available
- Electricity, 80GWh
  - Increased production of solar electricity
  - Continuing the sourcing of wind power for the rest of the consumption
- Other use (e.g. emergency power)
  - Use of renewable fuels only
- The remaining emissions: carbon removals (elimination credits)

Carbon Neutral Today – Net Zero Carbon Tomorrow

Gradually, in 2023-2025 Finavia will switch to using of renewable energy only and will eliminate the residual CO_2 emissions by carbon capturing measures.

- Lapland Airports in 2023
- Helsinki Airport in 2024
- The whole airport network in 2025

Finavia will be a Net Zero Carbon airport operator in three years.

Thank you!

www.finavia.fi

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Jan Petter Steinland

Director Strategic Analysis & Transformation, CAA Norway

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CAA NORWAY

Airports as Enablers for Greener Aviation

Jan Petter Steinland

Director Strategic Analysis & Transformation

CAA NORWAY

CAA NO mission – aviation should be safe, of benefit to society and *sustainable*

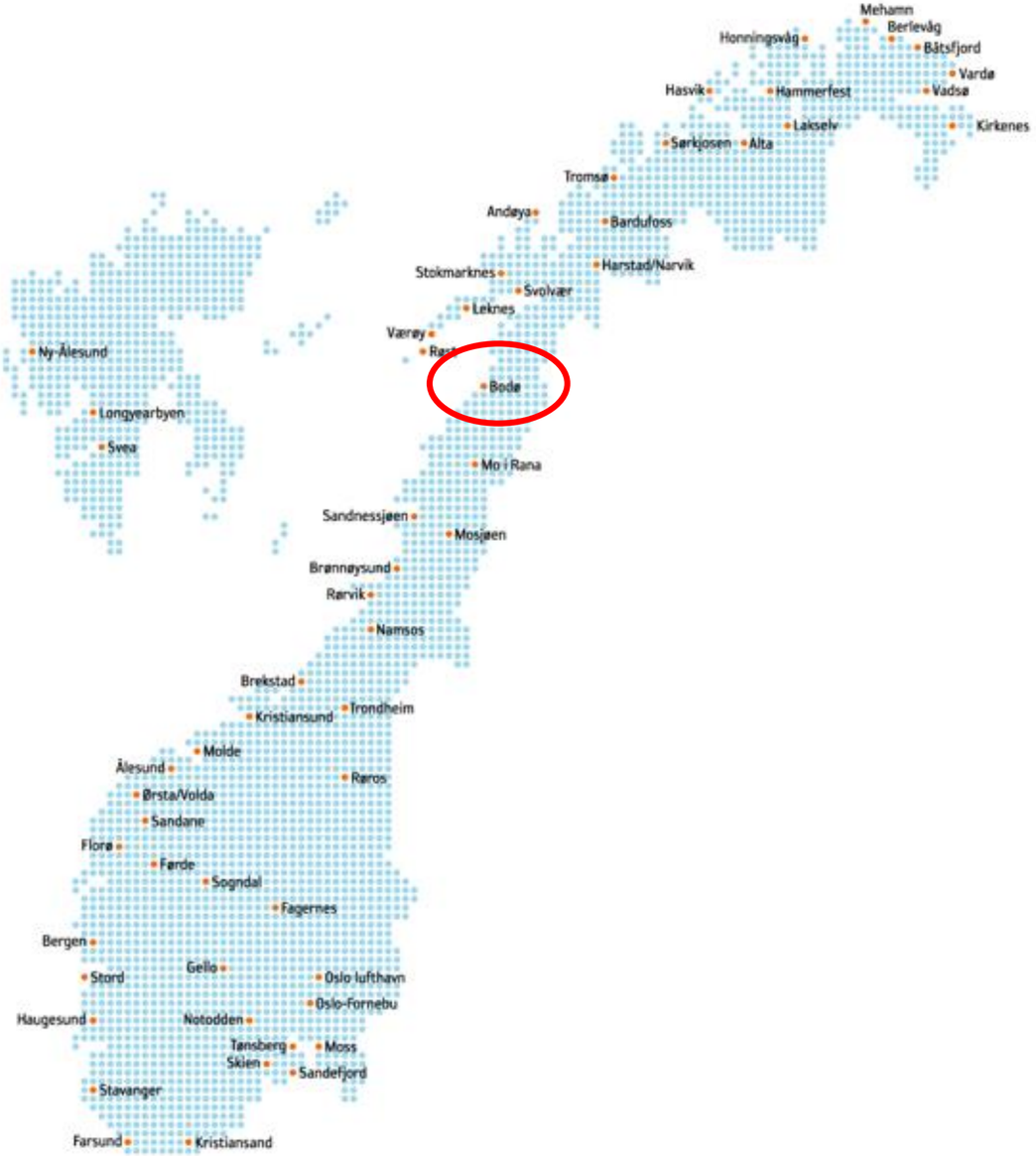
56
airports

45
heliports

69
air worthiness and maintenance organisations

24
AOC holders

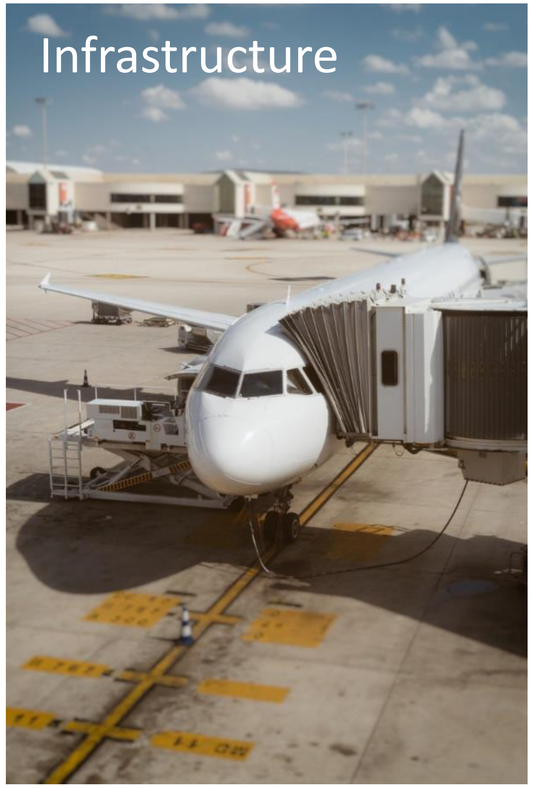
CAA NORWAY

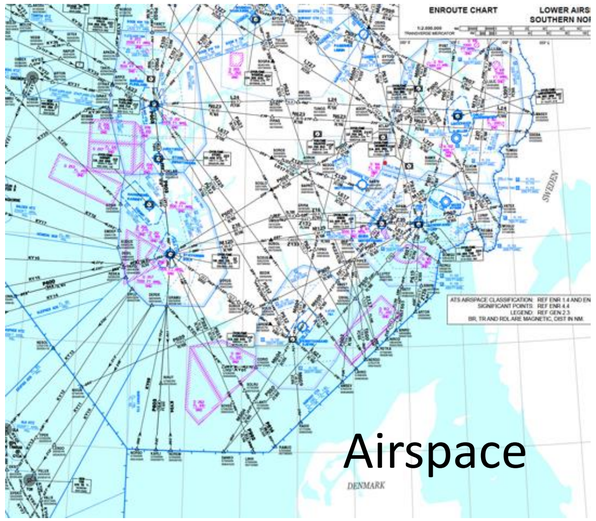


Ministry of Transport

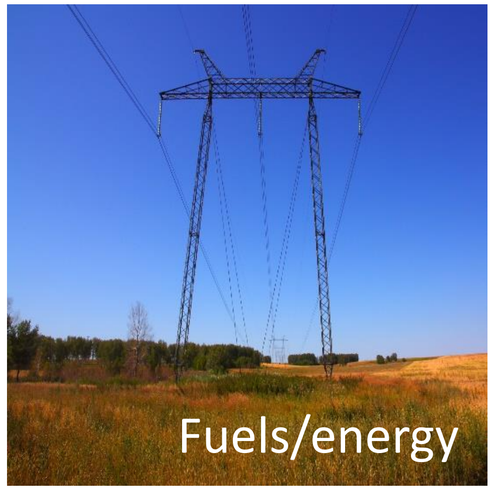
- New Aviation Strategy in the making – social, economic and environmental sustainability
- aviation is key to maintain the societal structure in Norway
- new zero- and low emission technologies in demand for commuter/regional aviation
- financial bodies for resarch & innovation to support phasing in of new technologies
- Public Service Obligations routes and possible climate criteria
- CAA Norway & state-owned Avinor have missions to support this work

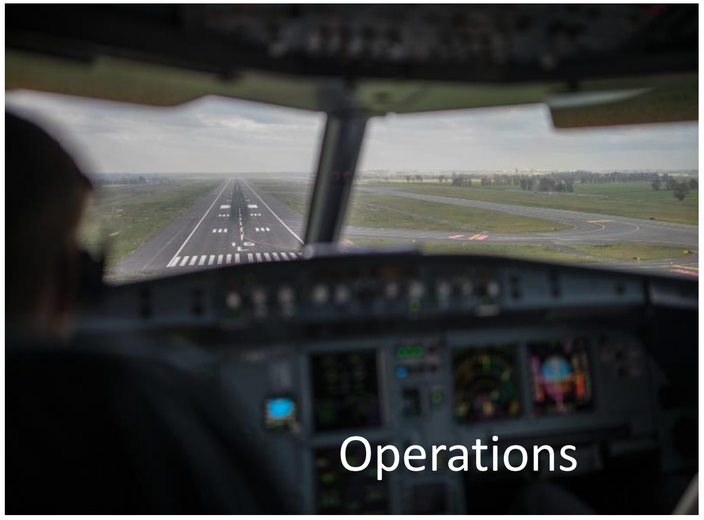
CAA NORWAY





A full eco-system
in transformation





EASA
European Aviation Safety Agency

Rules

GREEN AVIATION Norway

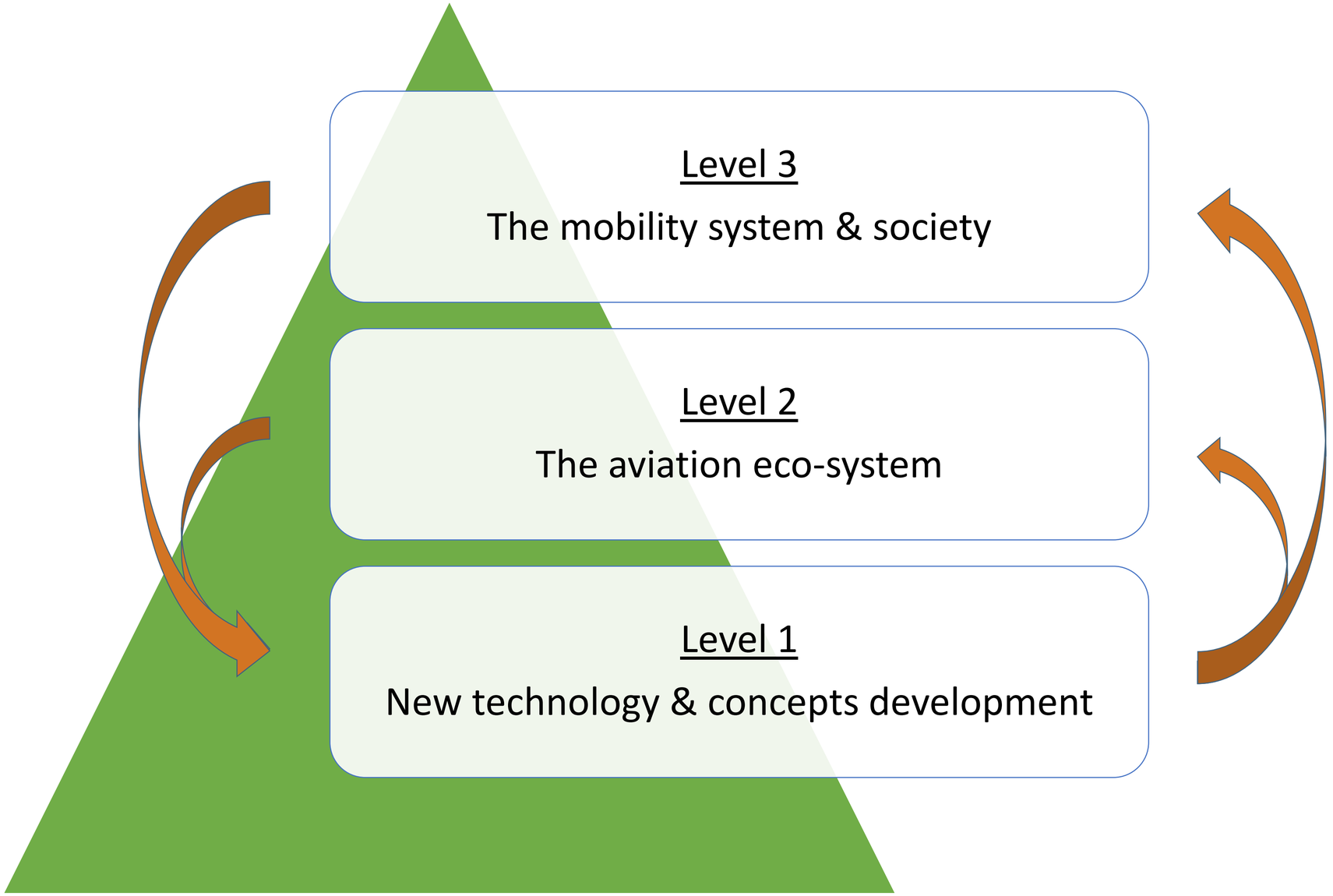
- Triple helix – government, industry, science
- Join forces nationally to succeed internationally
- Coordination & facilitation
- Open, including, cross-sectorial
- Mobilising key stakeholders

GREEN AVIATION NORWAY

Faster emission reductions, green jobs, better mobility

CAA NORWAY AVINOR SINTEF Norsk Industri

Why the collaborative approach?



CAA NORWAY

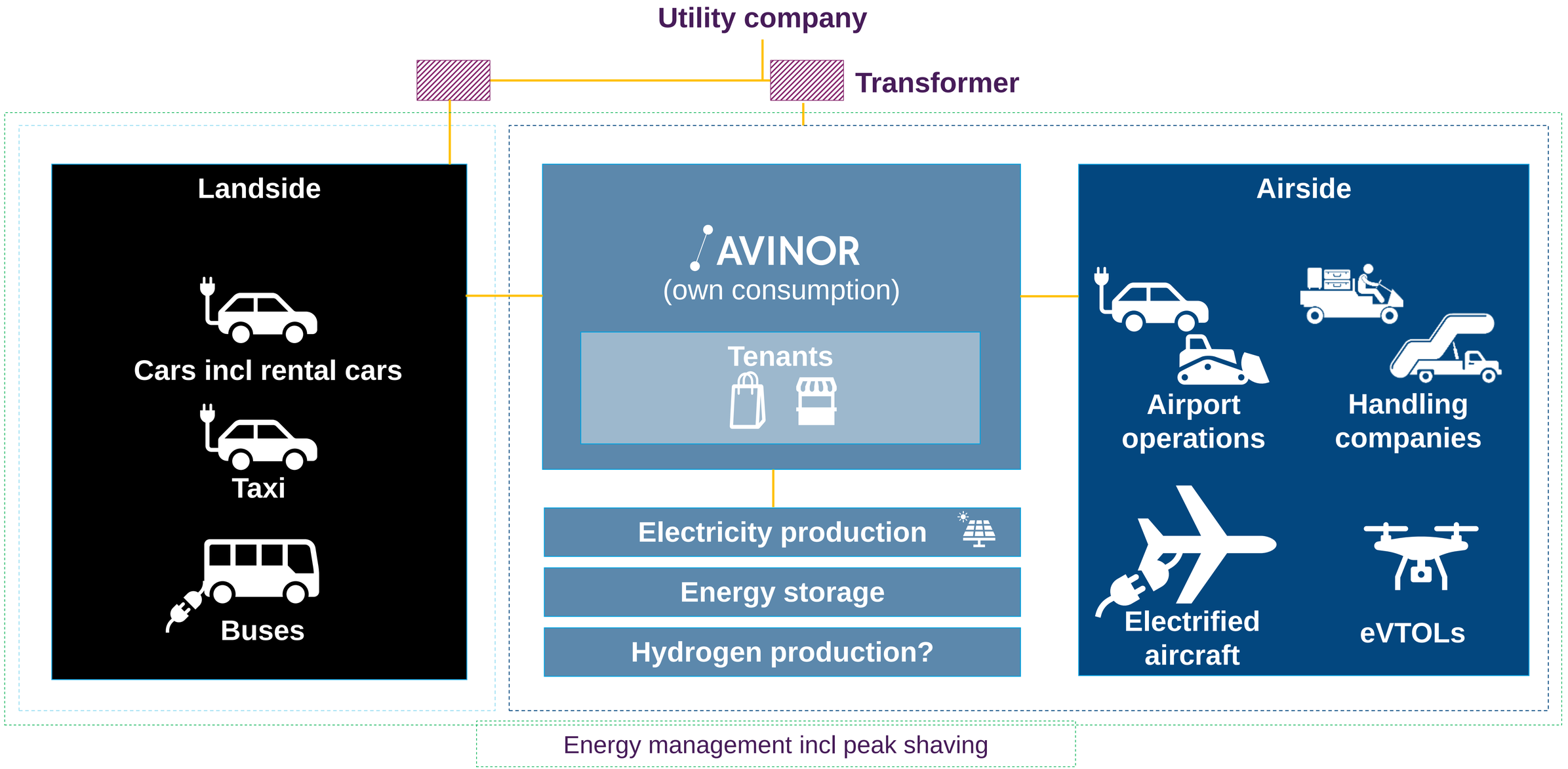
Fossil-free airport operations by 2030 (Avinor)

Photo: Avinor

Future electricity supply to airports

- First mapping carried out in 2020 - will be updated regularly
- 25+ utility companies serving Avinor’s 40+ airports
- Possible to deliver adequate charging for aircraft at all airports (based on a set of consumptions)
- Charging directly from grid most economically favourable at (almost) all airports
- Stationary batteries/energy storage relevant at some airports. Expect this market to develop
- Costs not insignificant!
- Exploring financing and business models

Planning for increasing charging needs



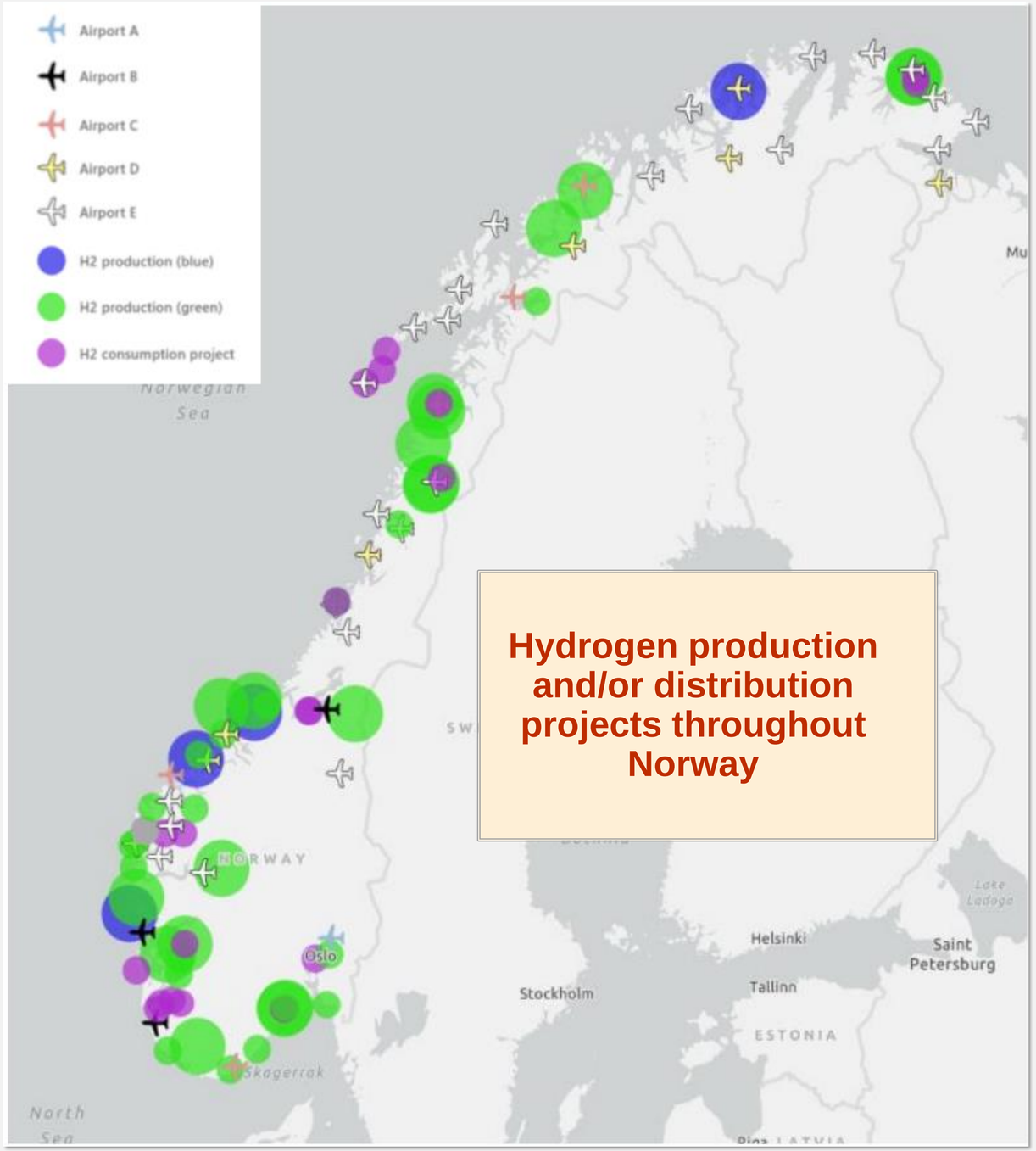
DNV

LOGISTICS AND MARKET PREFEASIBILTY STUDY

Hydrogen supply to Norwegian airports

Avinor AS

Report No.: 2022-0463
Date: 4/22/2022



Hydrogen production and/or distribution projects throughout Norway

Sustainable Aviation Fuels (SAF)

- 2014: First jet biofuel flights in Norway
- 2016: OSL #1 hub in the world to drop in SAF in main fuel farm and distribute in hydrant and dispenser system.
- 2020: Norway introduced drop-in mandate (0,5% advanced jet biofuel)
- Today
  - both e-fuels and advanced biojetfuel factories in the pipeline
  - possible increase blending mandate

CAA NORWAY

As an EASA Member State:

CAA NORWAY

Safe development, testing and integration of new technologies – possibly in a sandbox format

Provide guidance & develop own competency

A driver for international collaboration

Analysis & input to regulatory development

CAA NORWAY

Thank you for your time.

Jonathan Wood

VP Renewable Aviation, Neste

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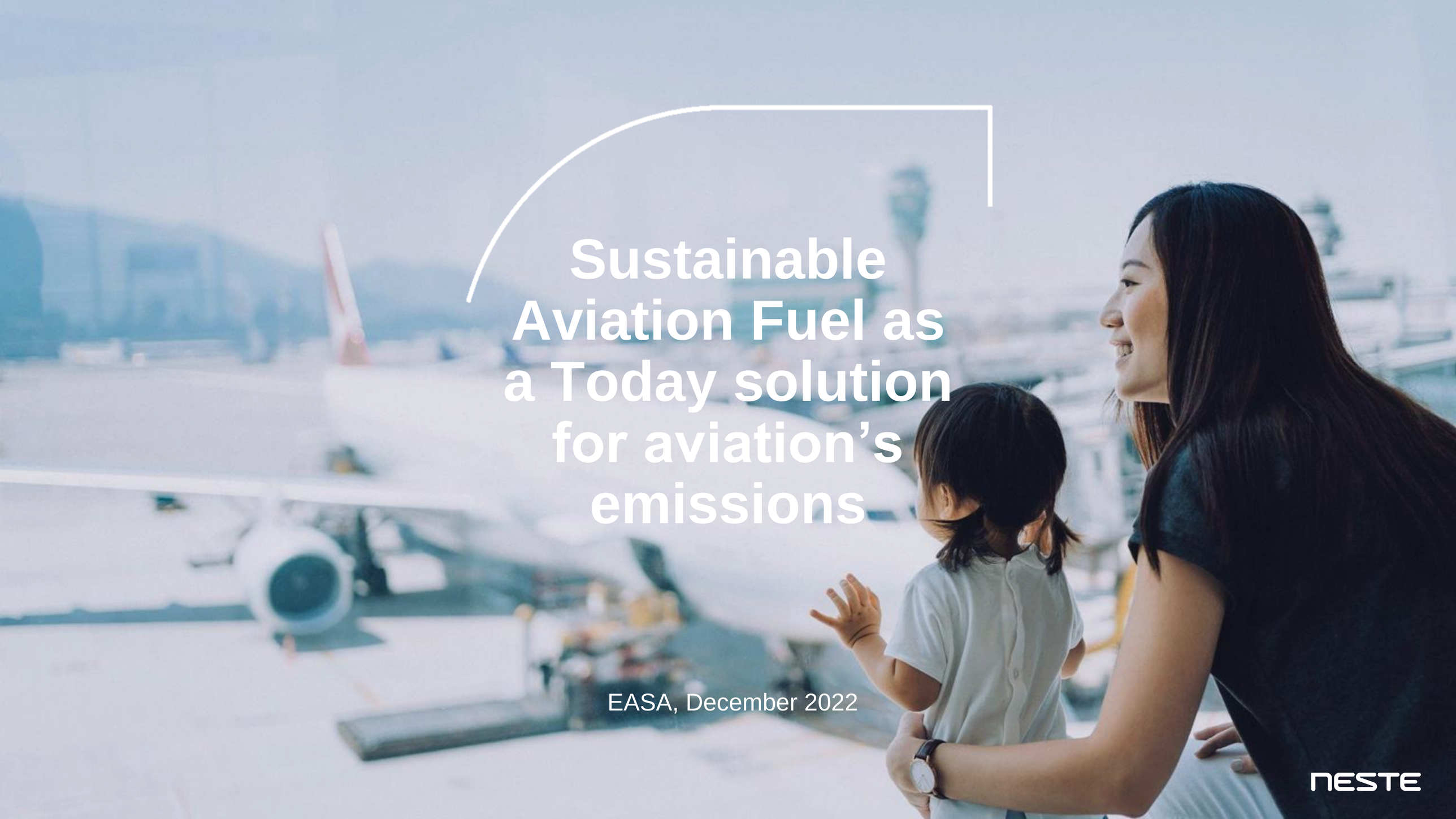
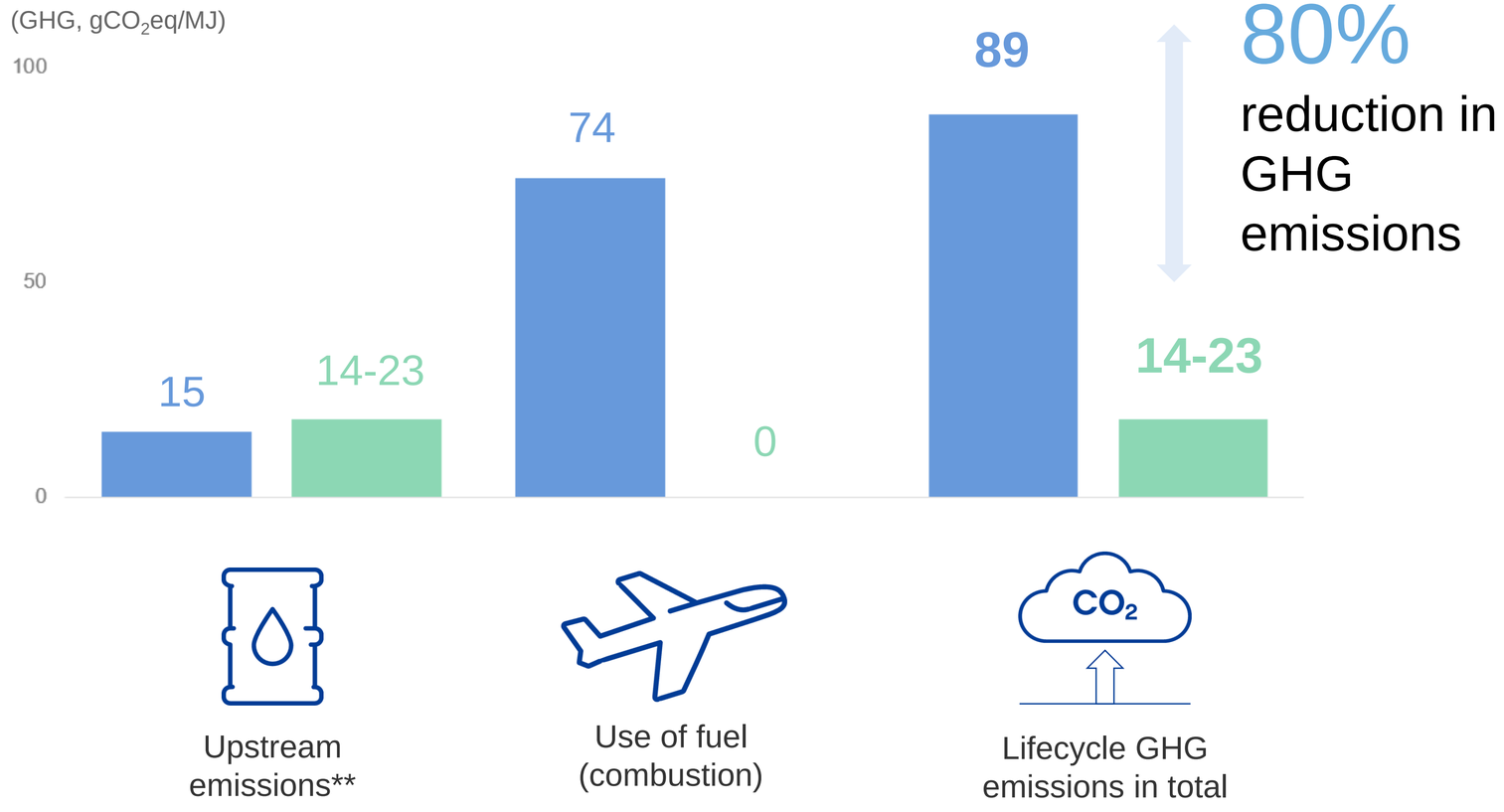
Sustainable Aviation Fuel as a Today solution for aviation’s emissions

EASA, December 2022



SAF can reduce the GHG emissions up to 80%* over the lifecycle compared to fossil jet fuel



NESTE MY
Sustainable Aviation Fuel

Made from

100%

waste and residues, eg used cooking oil

Drop-in solution requiring

zero

additional investment in infrastructure

Non CO2 benefits:

50-70% less particulates

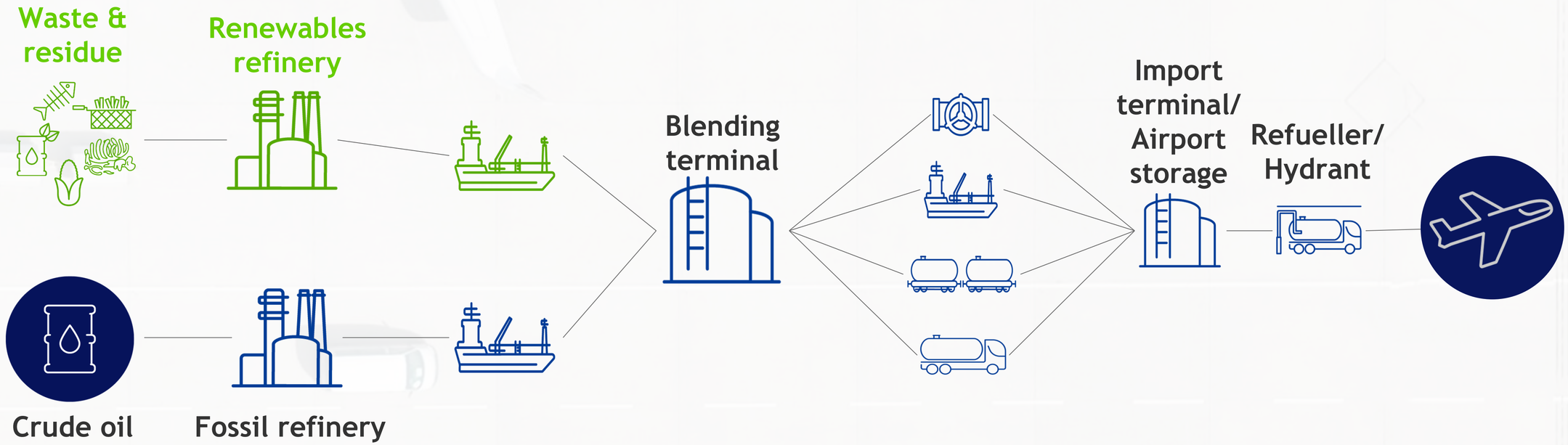
NESTE

The fuel lifecycle extends from raw material extraction to the consumption of the fuel.
* According CORSIA LCA methodology
**Production of feedstock, transports, refining

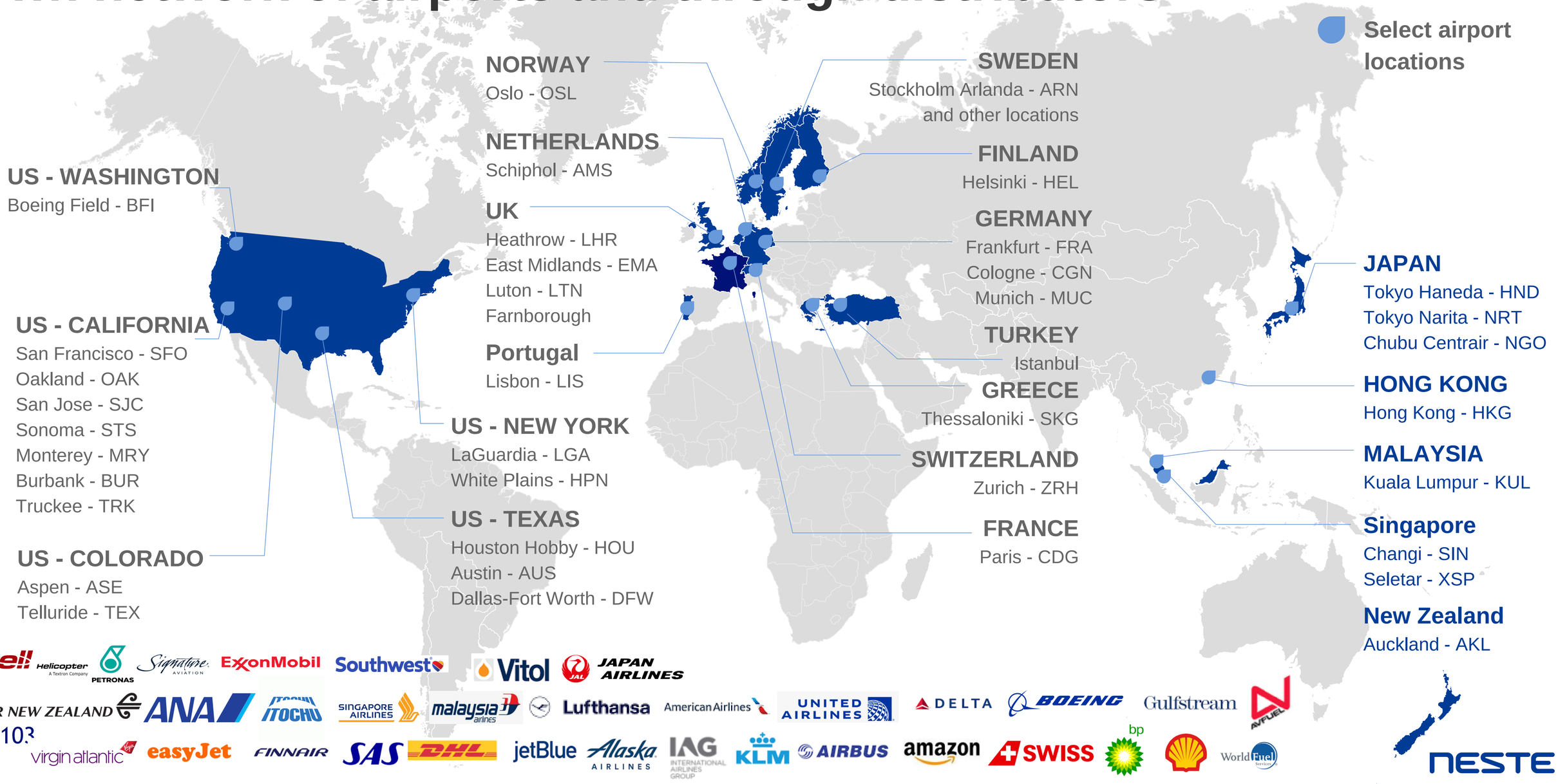
- Fossil jet fuel
- Neste MY SAF from waste and residues


Neste MY
Sustainable Aviation Fuel
Fossil Jet Fuel

SAF can be supplied using existing Jet supply chain infrastructure



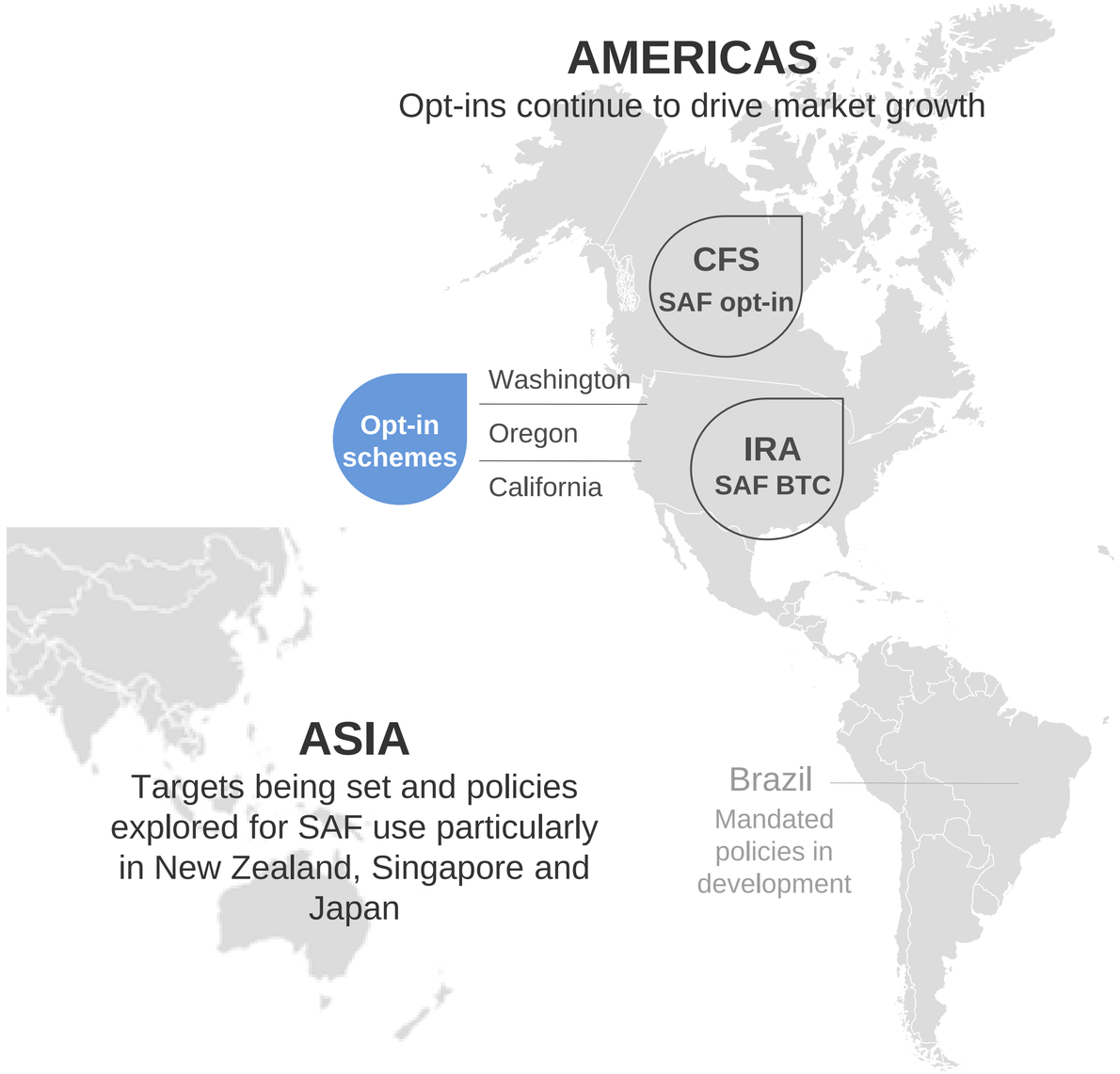
Neste’s SAF is available globally, both through Neste’s own network of airports and through distributors



Continuing growth of the SAF market will require policy support to create demand certainty for investments

AMERICAS

Opt-ins continue to drive market growth

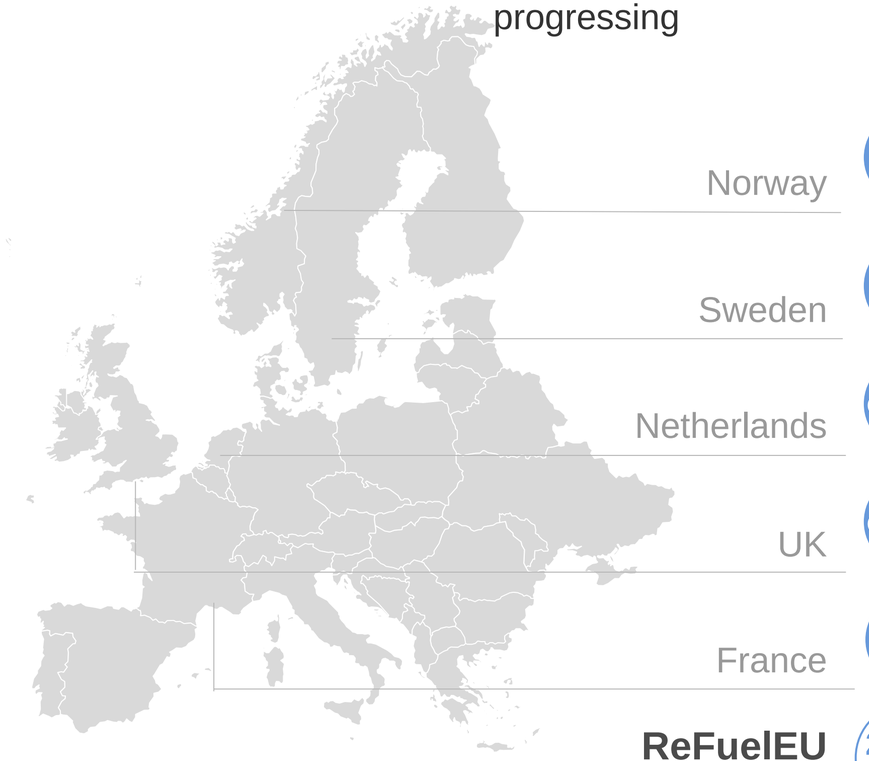


ASIA

Targets being set and policies explored for SAF use particularly in New Zealand, Singapore and Japan

EUROPE

Regulation and commitments are progressing



	2022	2030
Norway	0.5%	30%
Sweden	1.7%	27%
Netherlands	opt-in	14%
UK	opt-in	10%
France	1%	ReFuelEU
ReFuelEU Proposal for SAF % of aviation fuel at EU airports	2% by 2025	6%

2022 2030 % of SAF required in fuel volume

Neste’s Sustainable Aviation Fuel capacity will reach 1.5 Mt by end of 2023, and 2.2 Mt by H1 2026

2019
100,000 tons, sustainable aviation fuel capacity

2023
1.5 Mt of SAF capacity through investments in Rotterdam and Singapore

H1 2026
Additional 0.7 Mt of SAF capacity through further investments in Rotterdam

Beyond
Continuing growth with current and new technologies

Note: 300 Mt of fossil fuels are burned every year to fuel airplanes (in 2019)

Realization of full potential will requires scale up of new technologies (3-stage roadmap)

1 **Up to 10% of global jet fuel use**

2 **Potential exceeds global jet fuel use**

3 **Technical potential “unlimited”**

POWER-TO-LIQUIDS (CO_2 capture)

TECHNOLOGIES NEAR COMMERCIALIZATION (Gasification/Fischer-Tropsch, Alcohol to Jet - municipal solid waste, lignocellulosic, etc.)

HEFA[1] (waste and residue oils and fats as raw materials)

Neste SAF scale up

- Current: 100 kton/a in Porvoo
- 2023: 1 Mton/a in Singapore (under construction)
- 2023: 450 kton/a in Rotterdam (feasibility study on-going)
- SAF capacity included in future renewable refineries

Source: Neste estimates

[1] HEFA = Hydroprocessed Esters and Fatty Acids

Neste has developed a solution to enable aviation's end customers to reduce their emissions by paying for SAF. We can apply this model to drive additional emission reductions over and above regulatory requirements

SAF Solution for Corporate

Direct corporate SAF transactions and via GBTs

BCG

REED & MACKAY
A TripActions Company

TripActions

SAF Solution for Business Aviation

First solution for private jet charters in June 2022

VICTOR
FLY SMARTER

SAF Solution for Cargo

Solution for shippers in collaboration with freight forwarders

SCAN GLOBAL LOGISTICS

NESTE

Airports have taken initiative to accelerate SAF uptake through SAF incentive schemes

Schiphol

- Purpose to "*stimulate production and use of SAF*"
- Total value €15m over 2022-2024
  (€2.5m in 2022, €5m in 2023, €7.5m in 2024)
- Incentive 500 €/t for biofuel
  €1000/t for e-fuel
- Payable to applying airlines
- Funding through airport charges (e.g. noise, pollution, NOX levy, night time take off/landing)

Heathrow

Making every journey better

- Aim to support goal of becoming "*leading hub for the development and deployment of SAF*"
- Total value 10 MGBP in 2022, SAF share to rise from 0.5% in 2022 to 2% in 2024
- Incentive intended to cover half the net SAF premium vs fossil jet (ca 600 $/t)
- Payable to applying airlines, allocation based on ASK
- Funding through NOX charge

Swedavia Airports

- Airlines can invest in SAF to lower their CO2 emission charge (introduced in Jan 2022)
- Reduced offtake and landing fees with use of SAF
- Incentive program to cover up to 50% of cost of SAF (total funds available amount to 20 MSEK in 2022)

Thank you