

Rambøll

Sustainable Aviation Fuels (SAF) for Greener Skies

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Bio360 Expo
Nantes

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Biofuels/Bio2X



Bright ideas.
Sustainable change.

bio360
24-25 janv/jan 2024 Nantes FR
l'événement Biotransition / the Biotransition event

A banner for the Bio360 event, featuring the event logo, dates, location, and a row of icons representing various biotechnology and sustainability topics.

Agenda



About
Ramboll



SAF trends
and routes



Selected
references



Take-aways



Rambøll in brief

- Independent architecture, engineering, and consultancy company
- Founded 1945 in Denmark
- More than 18,000 employees
- Present in 35 countries
- EUR 2.2 billion revenue
- Owned by Rambøll Fonden – The Rambøll Foundation

Geographical footprint: 300 offices in 35 countries

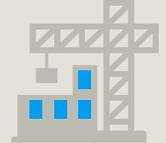


Australia	3	Japan	1
Austria	1	Malaysia	3
Belgium	3	Mexico	2
Brazil	6	Netherlands	1
Canada	2	New Zealand	1
China	3	Norway	17
Cyprus	1	Poland	1
Denmark	14	Qatar	1
Faroe Islands	1	Romania	1
Finland	23	Saudi Arabia	1
France	4	Singapore	2
Germany	16	South Africa	1
Gibraltar	1	Spain	2
Greenland	3	Sweden	30
Hong Kong	2	Switzerland	1
India	11	UAE	2
Ireland	1	UK	17
Italy	2	US	64

- Across the world, **Ramboll combines local experience with a global knowledgebase to create sustainable cities and societies**. We combine insights with the power to drive positive change to our clients, in the form of ideas that can be realised and implemented.
- We work multidisciplinary across our seven markets:



Transport



Buildings



Environment & Health



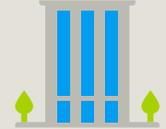
Energy



Water



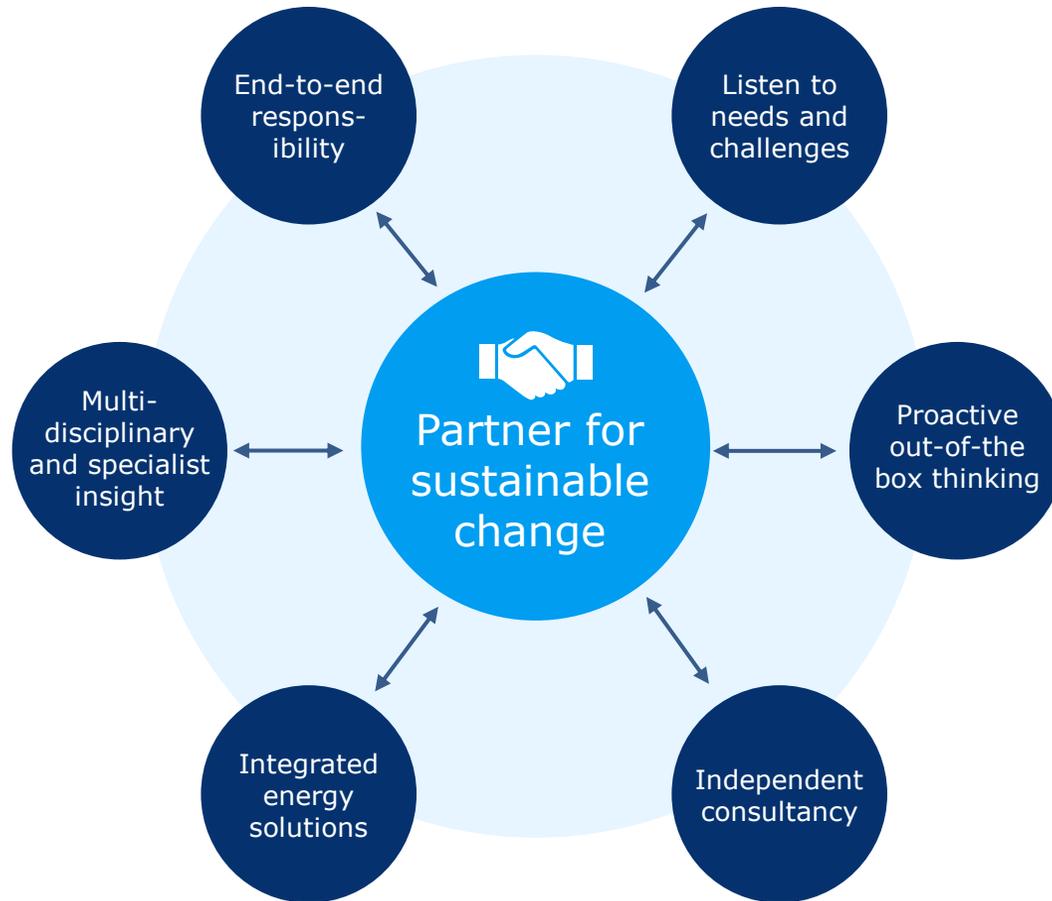
Management Consulting



Architecture & Landscape



We help our clients think, design and implement their green energy transition

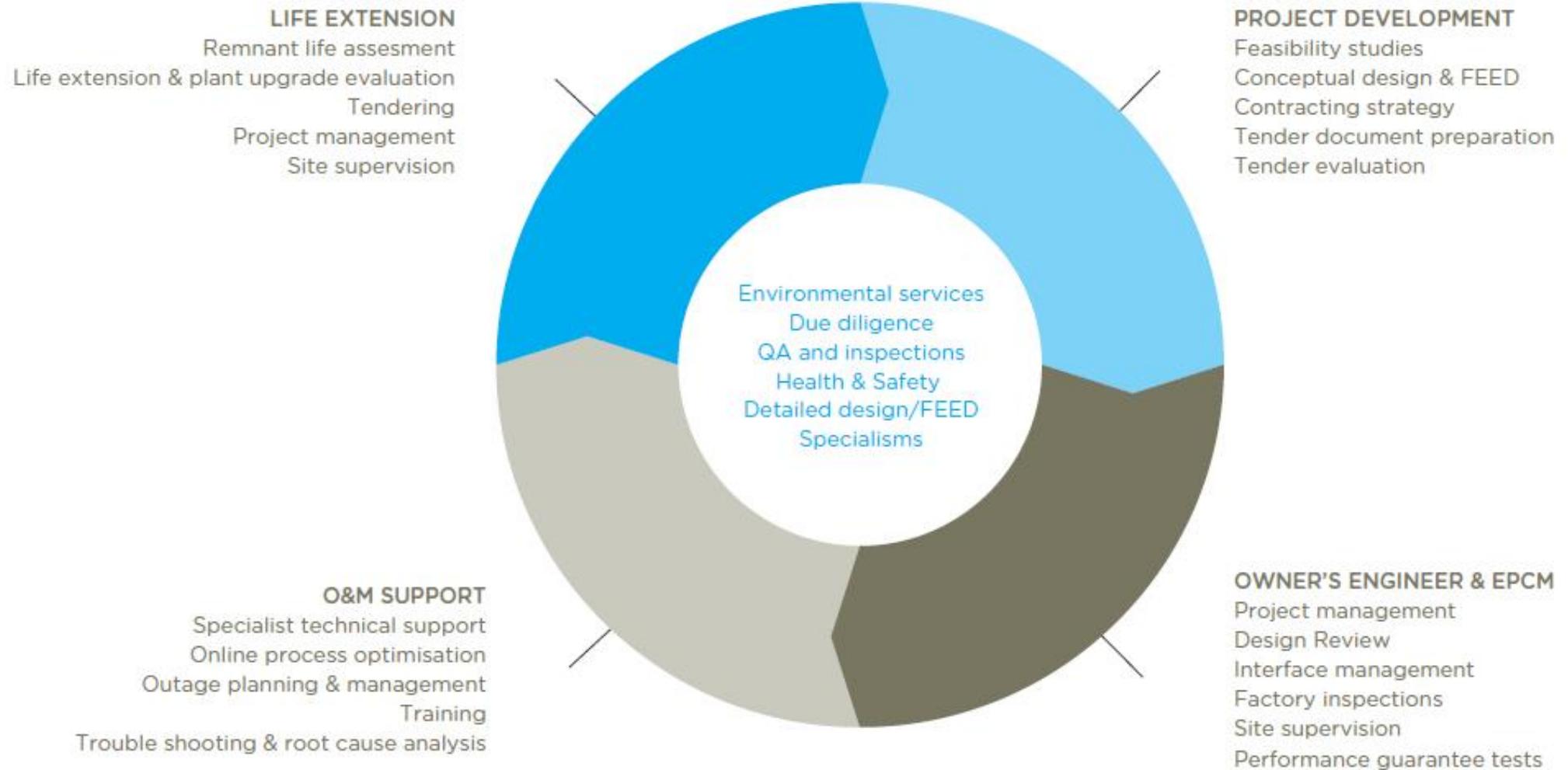


❖ **reduce carbon footprint**

❖ **navigate the integrated energy system**

❖ **implement smart and innovative energy solutions**

Rambøll energy – full project life cycle services

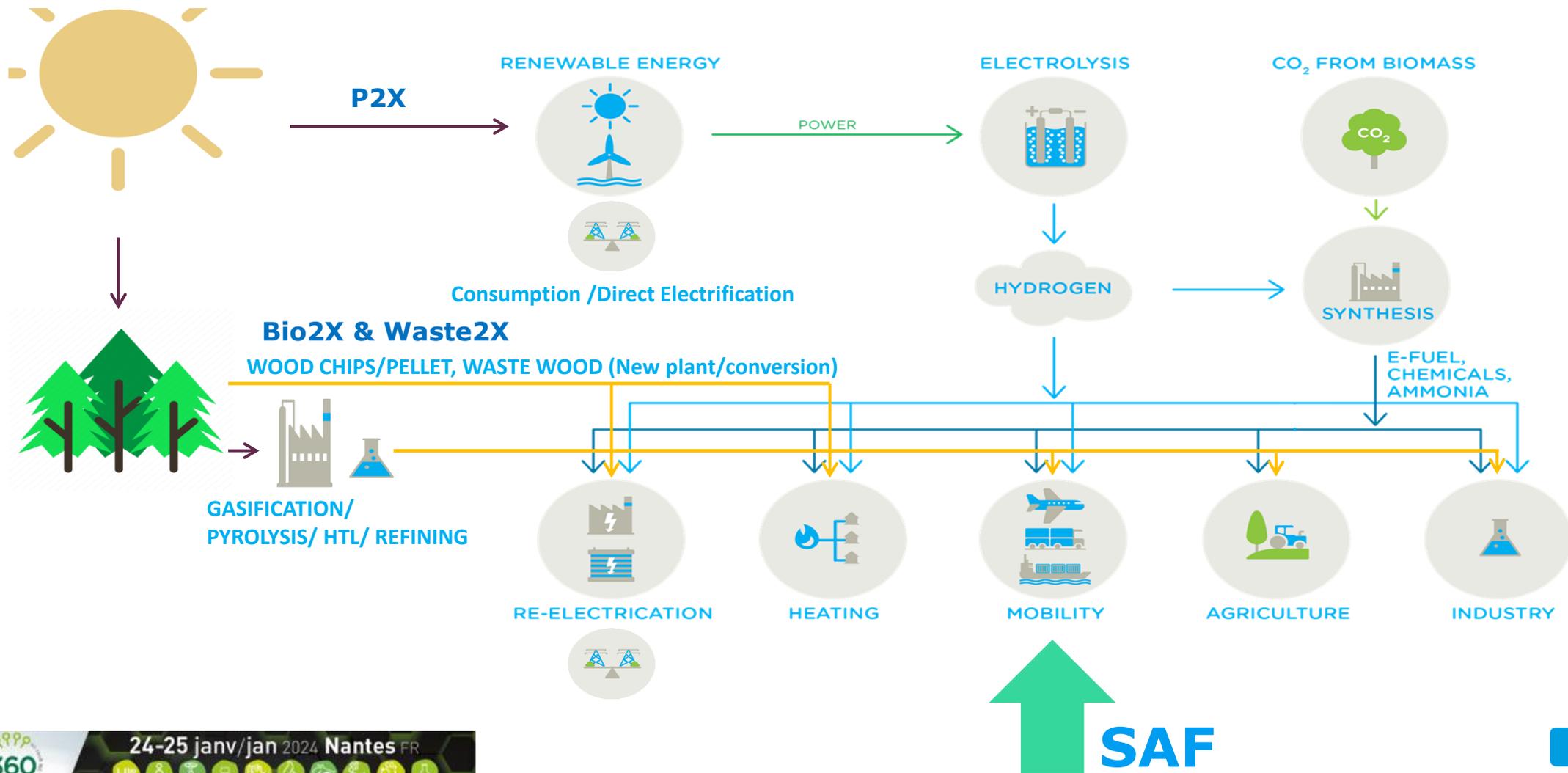


Rambøll Energy - Fields of expertise

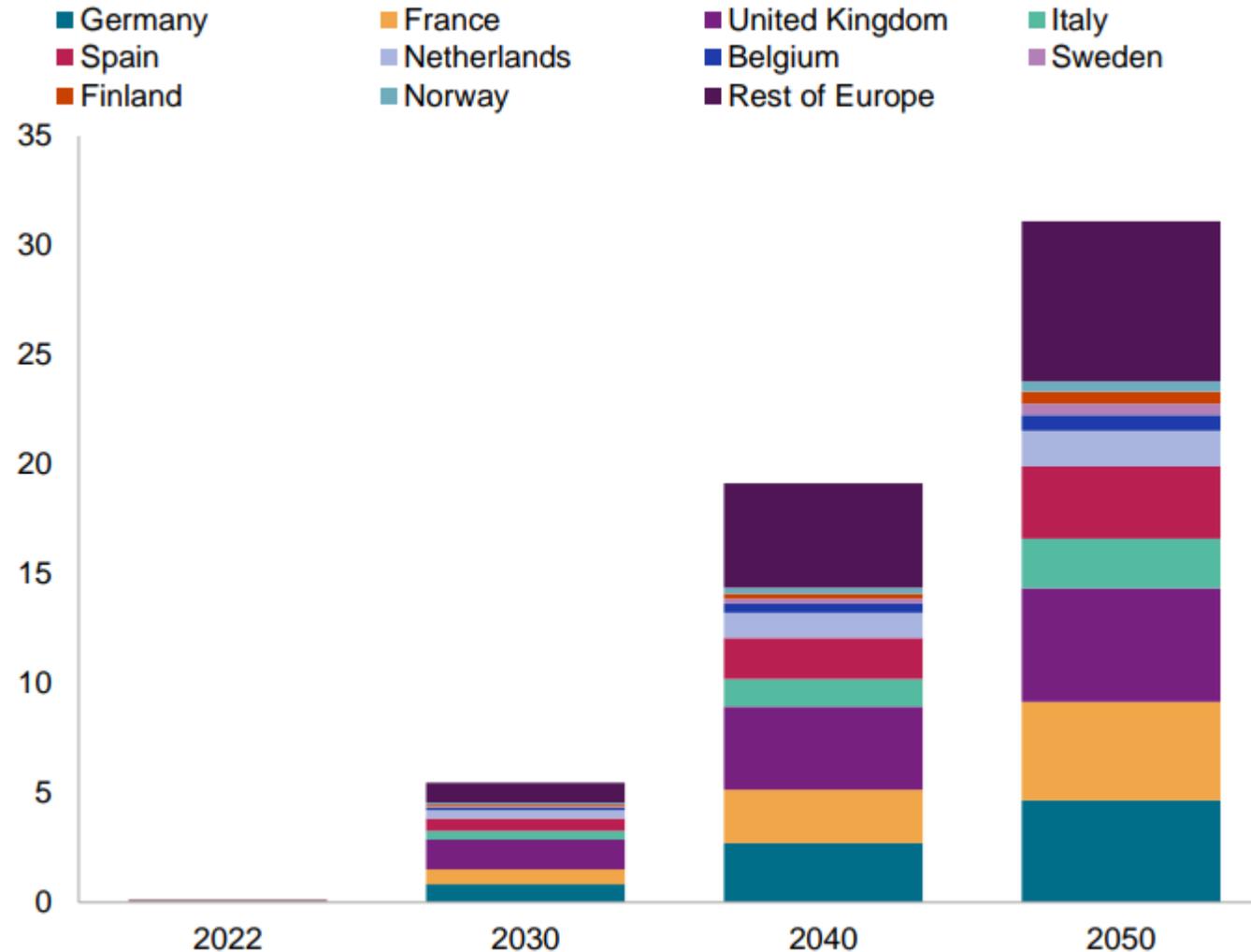
- Wind & solar
- Biofuels and Bio-to-X
- Green hydrogen and Power-to-X
- Carbon capture, CCUS & BECCS
- Fuel cells
- Datacenters
- Energy infrastructure
- District energy & heating
- Biogas
- Waste-to-energy
- Energy-intensive industries
- Thermal power generation
- Power transmission and distribution



Advanced sustainable fuels Power/Bio-to-X

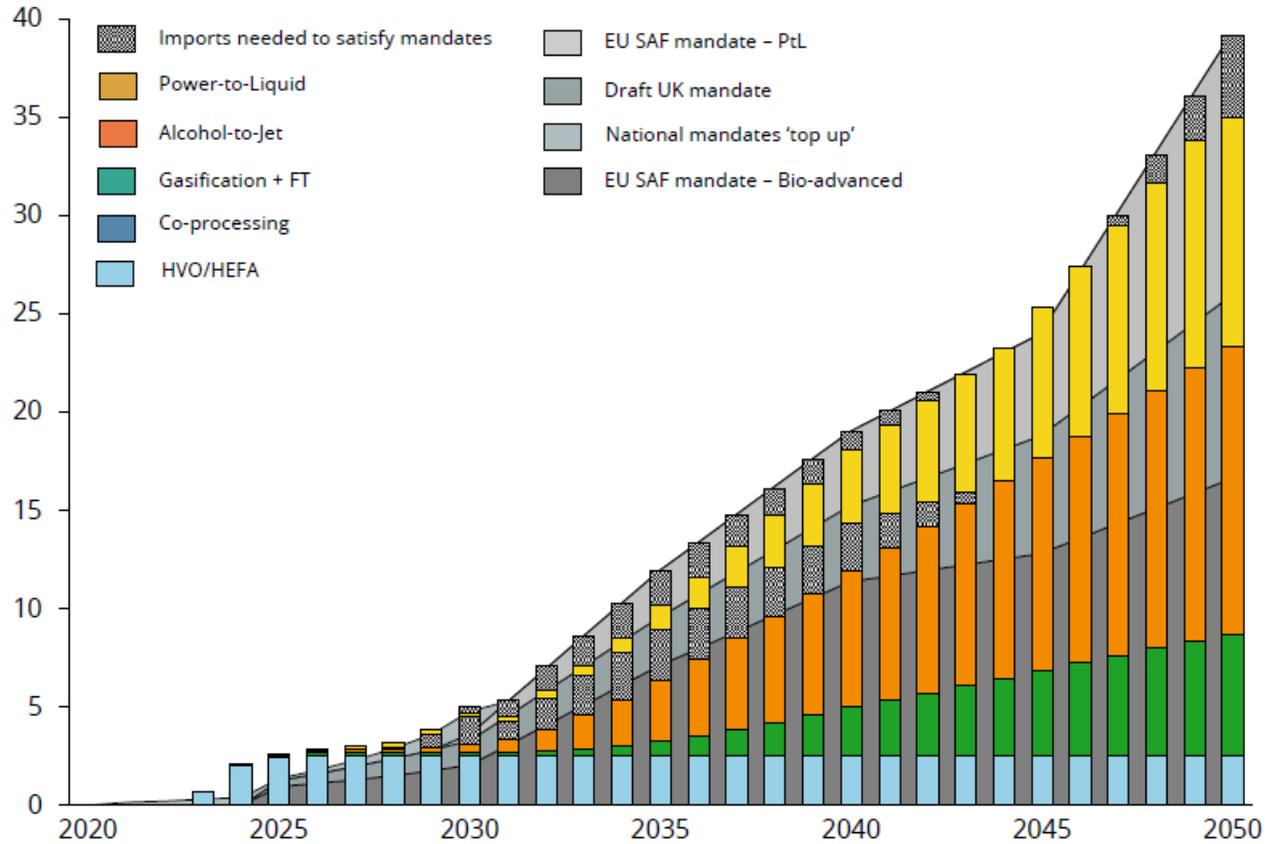


Europe SAF demand by country (million metric tons)

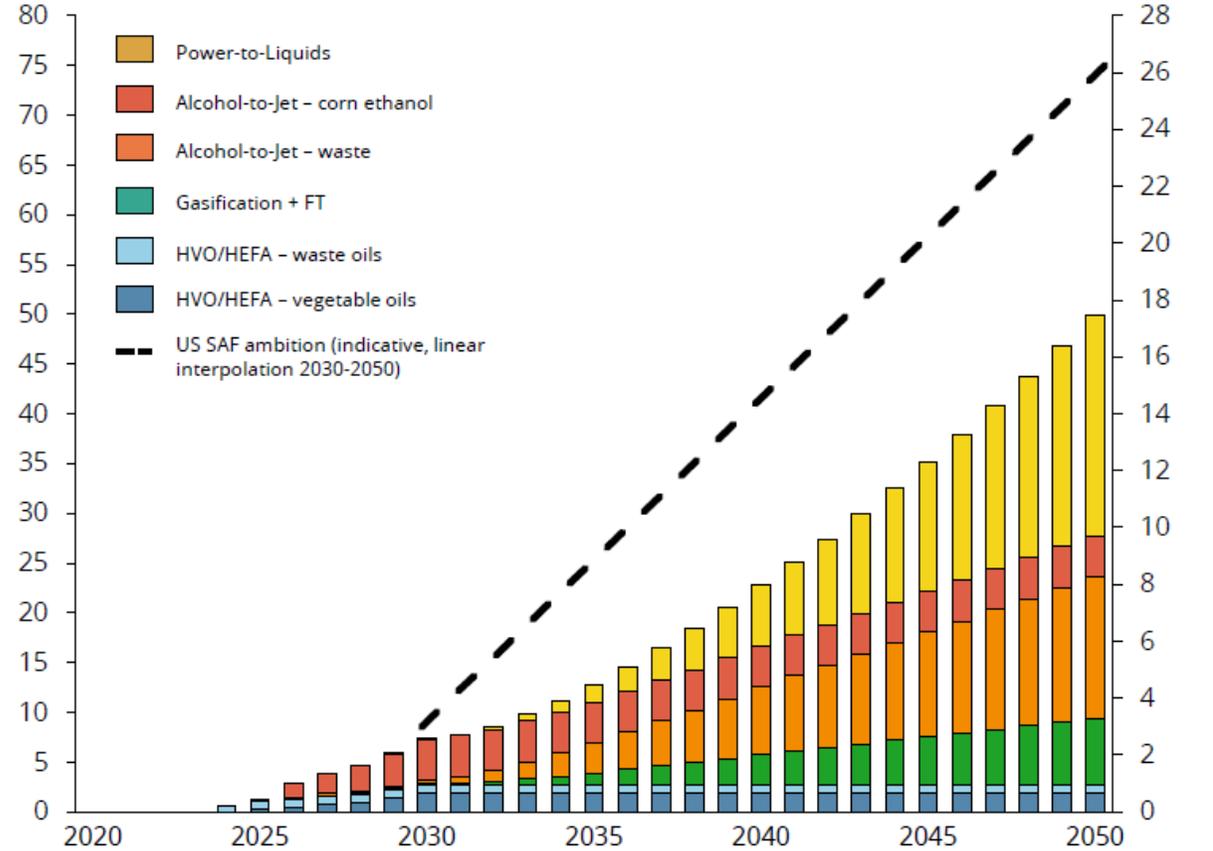


SAF in Europe and US

European SAF supply (Mt SAF)



US SAF supply (Mt SAF)



Key takeaways

➤ About 400 SAF plants are needed by 2050.

➤ About 750 SAF plants are needed by 2050.



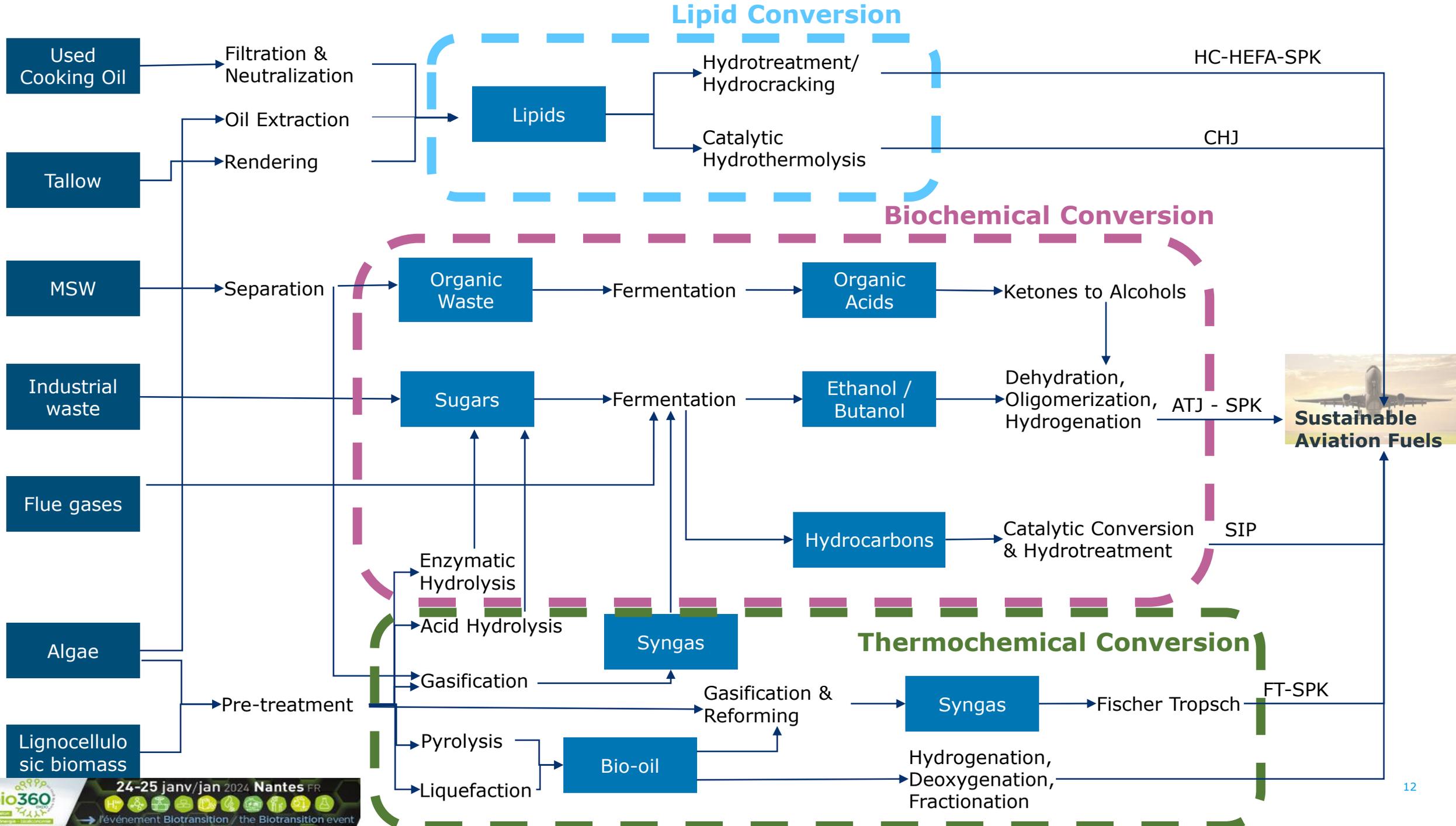
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Certified processes for SAF production

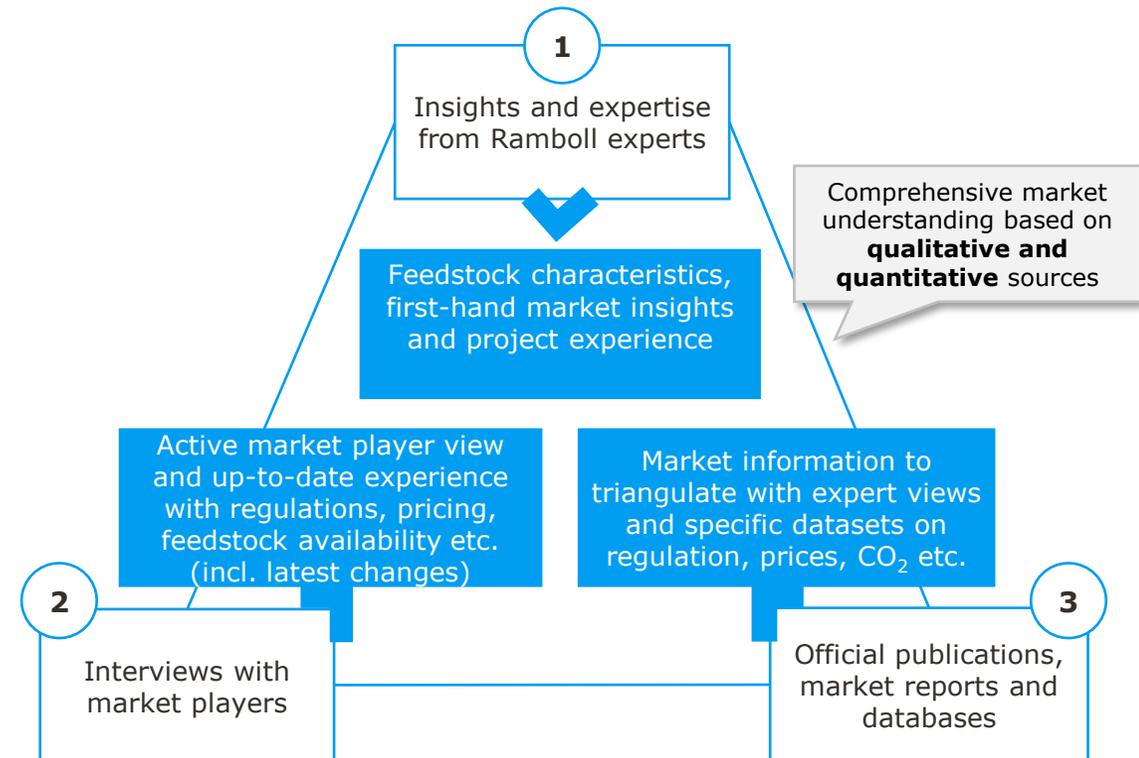
The **ASTM D7566 certified SAF** can be blended with fossil aviation fuel up to 50%, if produced by approved methods:

Fuel Name	Date Certified	Blend level
Fischer-Tropsch Hydro-processed Synthesized Paraffinic Kerosene (FT-SPK)	2009	50%
Synthesized Paraffinic Kerosene from Hydro-processed Esters and Fatty Acids (HEFA-SPK)	2011	50%
Synthesized Iso-Paraffins from Hydro-processed Fermented Sugars (HFS-SIP)	2014	10%
Synthesized Kerosene with Aromatics Derived by Alkylation of Light Aromatics from Non-Petroleum Sources (FT-SKA)	2015	50%
Alcohol-to-Jet Synthetic Paraffinic Kerosene (ATJ-SPK)	2016	50%
Catalytic Hydro-thermolysis Jet (CHJ)	2020	50%
Synthesized Paraffinic Kerosene from Hydro-processed Hydrocarbons, Esters and Fatty Acids (HC-HEFA-SPK)	2020	10%



We combine in-house expertise, market player viewpoints and acknowledged literature to offer robust market assessments

- **Available feedstocks** in the area?
 - How much do they **cost**?
 - Stable composition of the feedstock throughout time?
- What is the best **route to produce SAF** based on the available feedstock?
 - Key off-takers?
- What is the **cost of electricity and/or H₂** in the area?
 - Changes in the future?
- Expected market **sale price** of SAF?
 - Do all forecasts agree?
- **Regulations** around SAF?
 - **Subsidies** for SAF production?





Commercial assessment of investment opportunities in SAF (among other bio/e- fuels) – Confidential Client

The challenge

Support the client on how can address available opportunities related to SAF.

Our approach

- Identifying, mapping and matching of relevant and attractive supply and technology options → high-level analysis of availability, readiness, trends.
- Detailed analyses of the 10 best options incl. implications of regulatory framework developments, trends and drivers, availability and product flows, sourcing complexity, relevant value chain players.

The result

Recommend relevant opportunities across the value chain, based on maturity, economy, strategic fit, expected growth, and infrastructure readiness.

P2X concept and market study for a large European utility company – Confidential Client

- **Concept study to investigate PtX products such as green hydrogen and SAF (among other derivative products).**

Purpose of the study:

1. Overview of the opportunities, technical solutions, and locations for the proposed Power-to-X plant.
2. Reduce the number of concepts to investigate at later phases before offering a final selection of preferred concept/solution and sites.
3. High-level market analysis on SAF in a range of Northern European countries that estimated the expected demand and prices in the future.



Market study of European offtake potential for a P2X plant in Estonia – Confidential Client

The challenge

Determine the viability of selling SAF (among other products) in the Baltics, Poland, the Benelux region and the Nordics.

Our approach

Identifying market trends and drivers of SAF (among other fuels).

The result

Detailed forecasts of market volumes and price levels per region for 2030 and 2050, providing valuable insights and a solid decision-making tool to the client.



Aviation Biofuels in Norway

Client: **Norwegian Aviation Industry**
represented by Avinor, SAS, Norwegian and The
Federation of Norwegian Aviation Industries to:

- Investigate and assess possibilities for profitable and sustainable production of Jet A-1 biofuel.
- Sustainable feedstock supply and new certified biofuel production technologies.
- Policy instrument study measuring what it takes to implement sustainable aviation biofuel at Norwegian airports.

SAF projects need to be properly developed to cover the market demand by 2050



Successful collaborations



Competitive feedstock supply chain



Synergy between Bio- & Power-to-X



Off-take partners



Proven technical concept



Investment & Subsidies



Secure feedstock resources

Thank you!

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