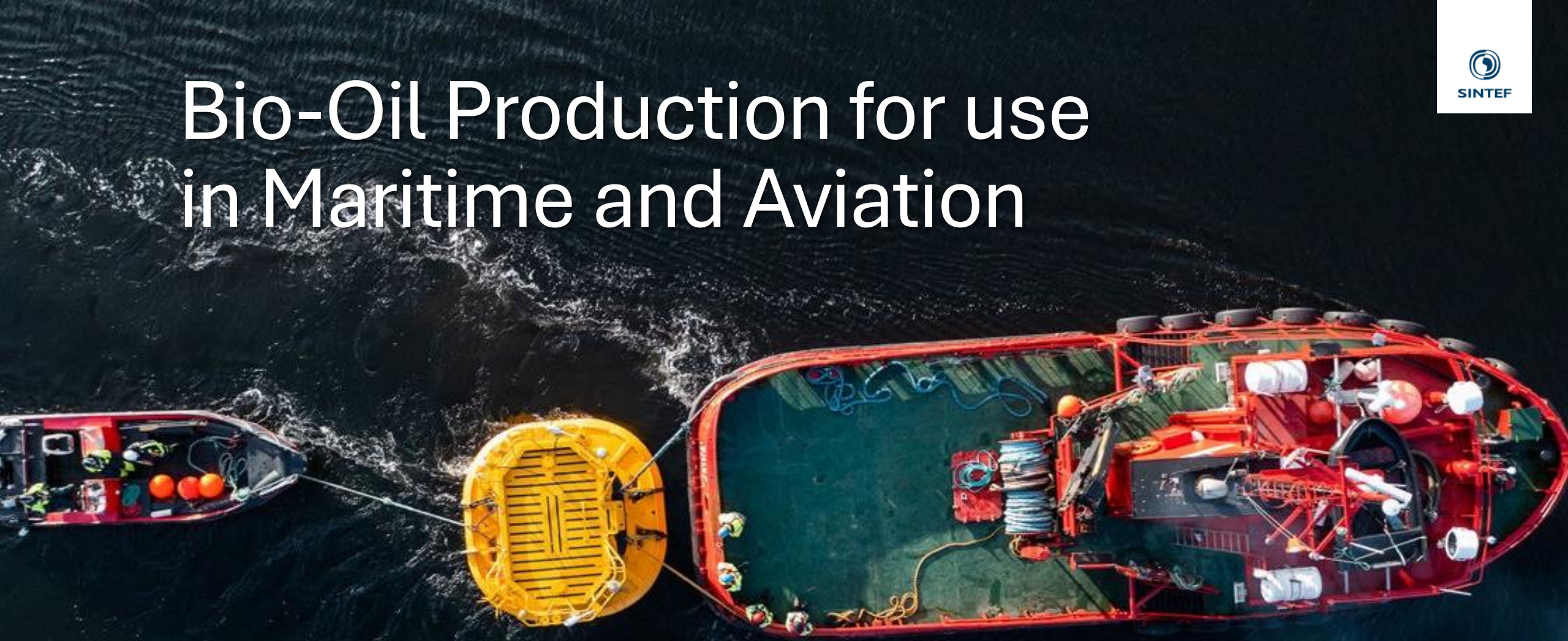
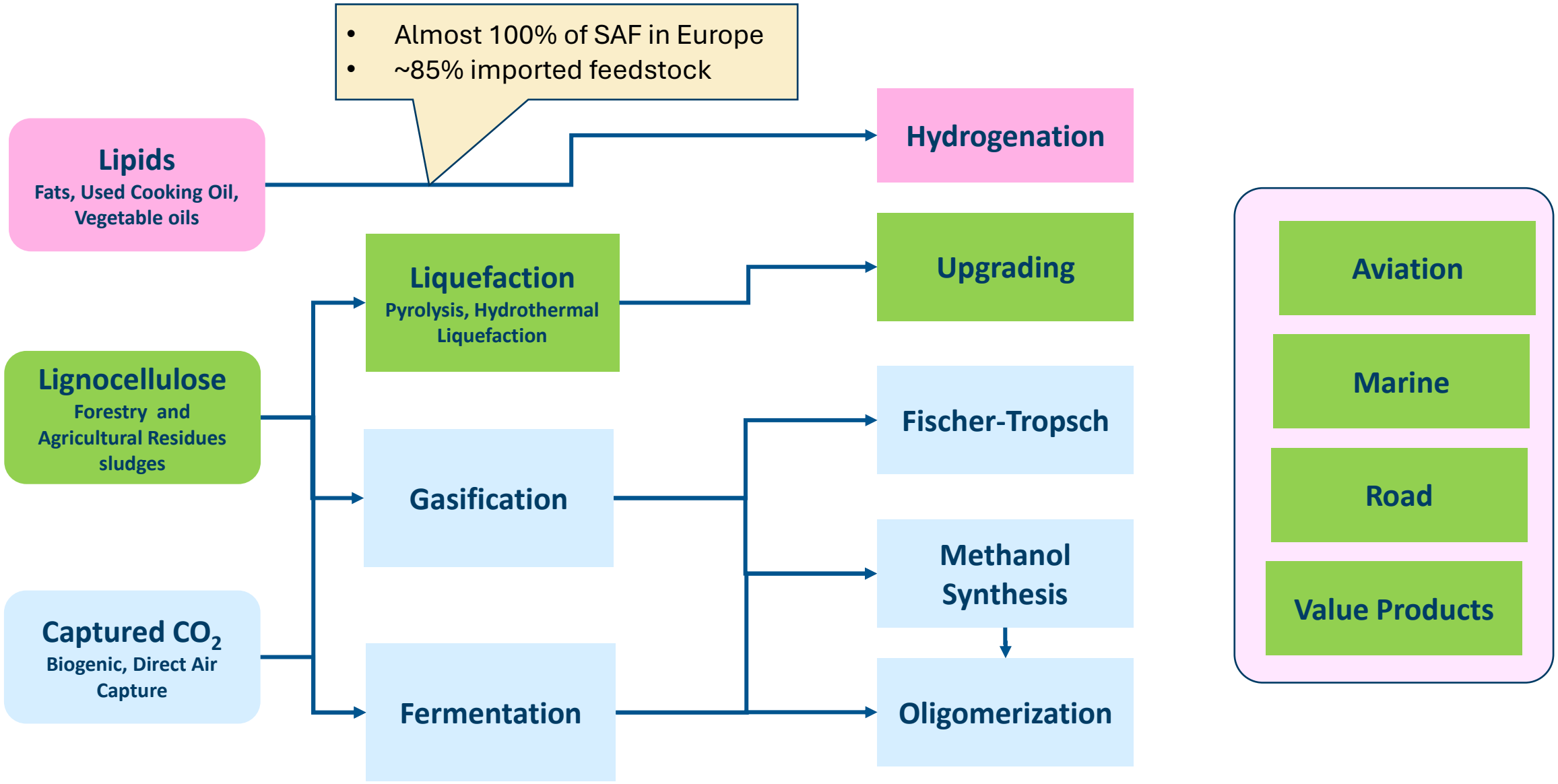
Bio-Oil Production for use in Maritime and Aviation



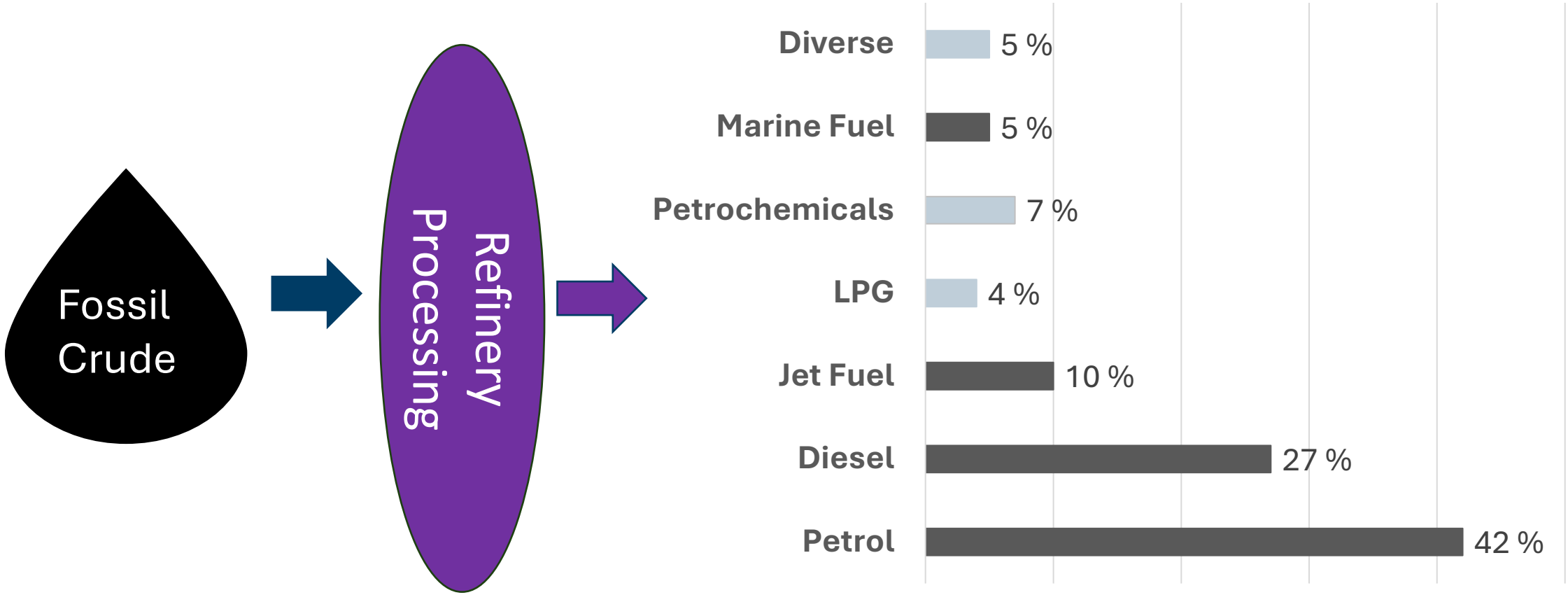
Duncan Akporiaye
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16th Concawe Symposim, 8-9th October 2026

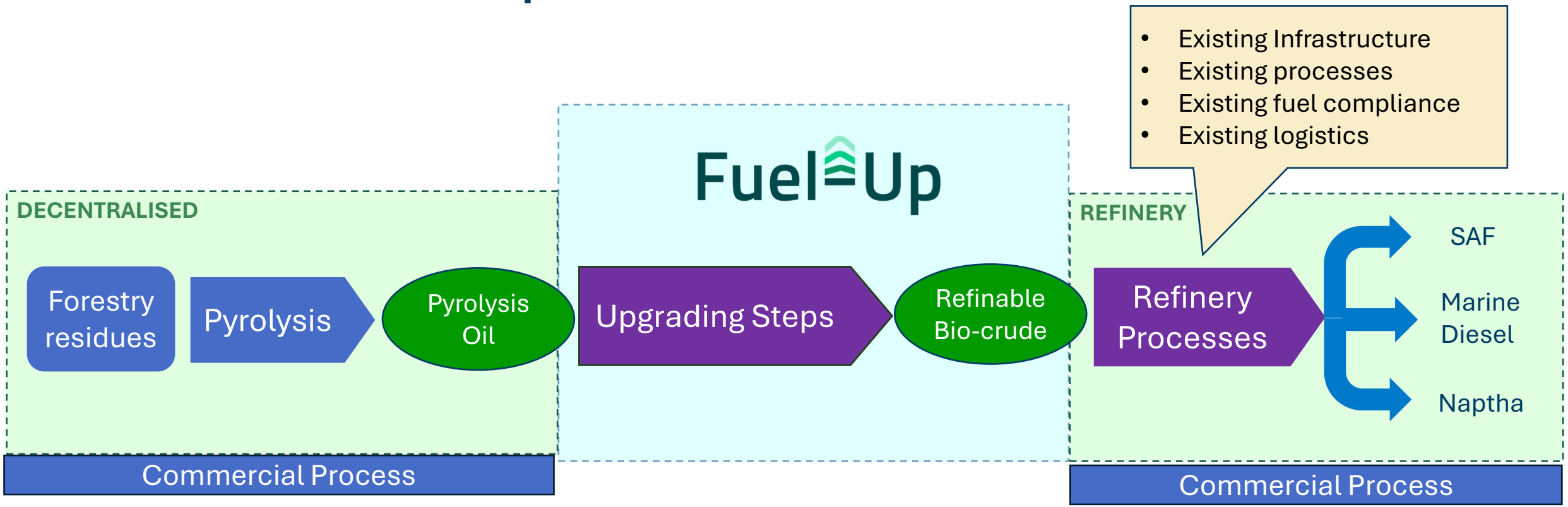
Main Pathways to Fuel Products



Lessons from refineries:
Highly optimised for converting fossil crude to fuels

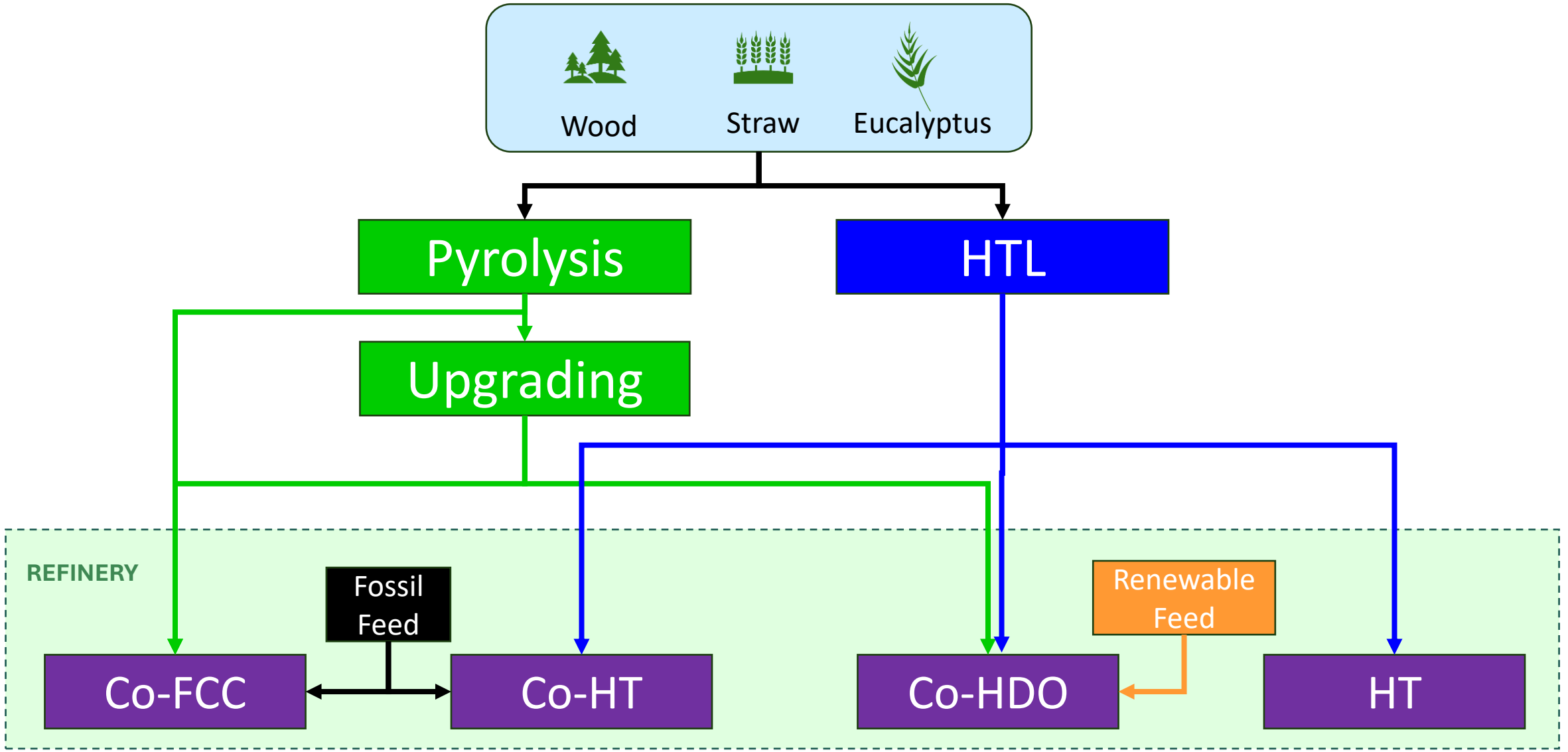


Establishing a pathway to Refineries to facilitate scale-up



Potential points of Integration of bio-liquids in refinery

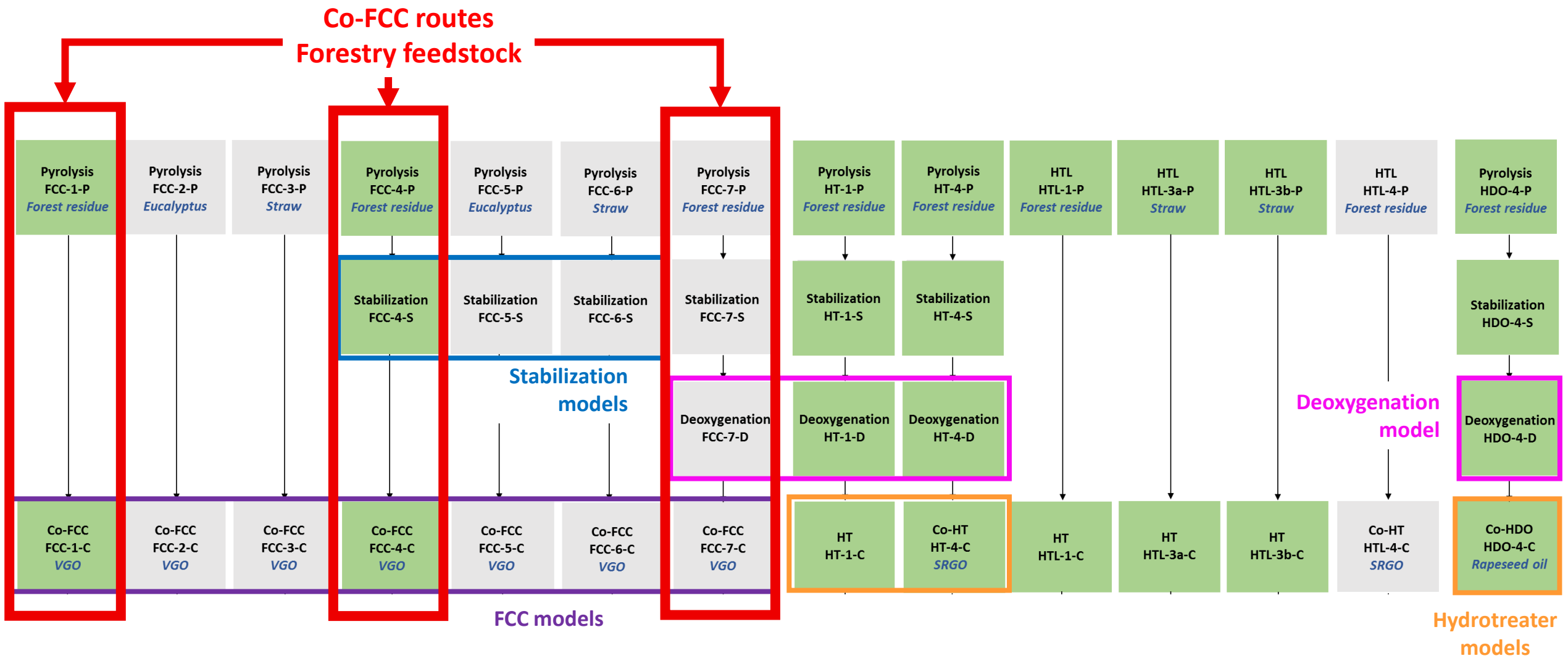
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European Union's Horizon 2020 research and innovation program, GA No. 727531

Exhaustive evaluation of all potential pathways

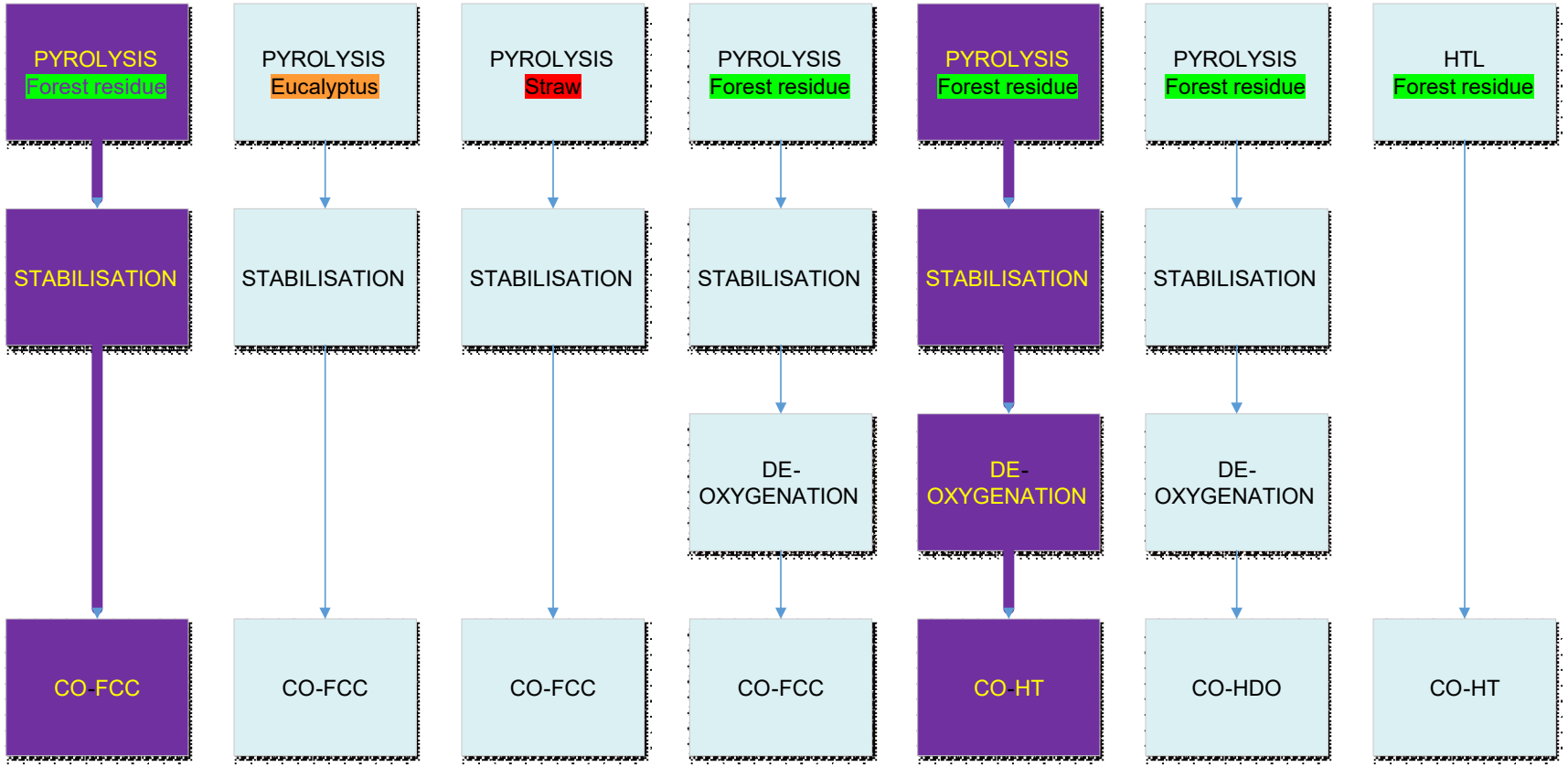
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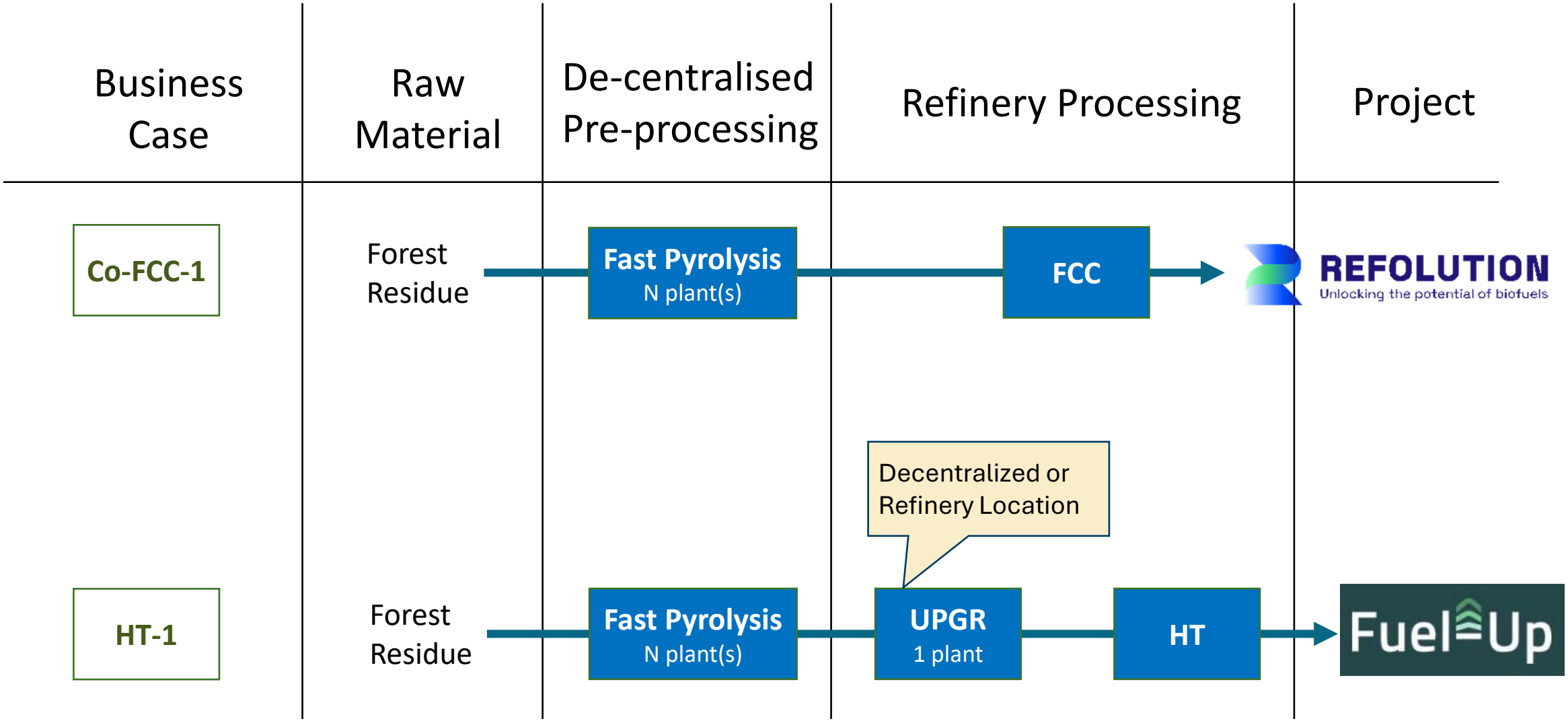
Prioritization of feedstock from different locations

- **Forest residue:**
  - Northern Europe
  - Baltics
- **Eucalyptus:**
  - Southwestern Europe (Spain)
- **Straw:**
  - Central Europe
  - Denmark



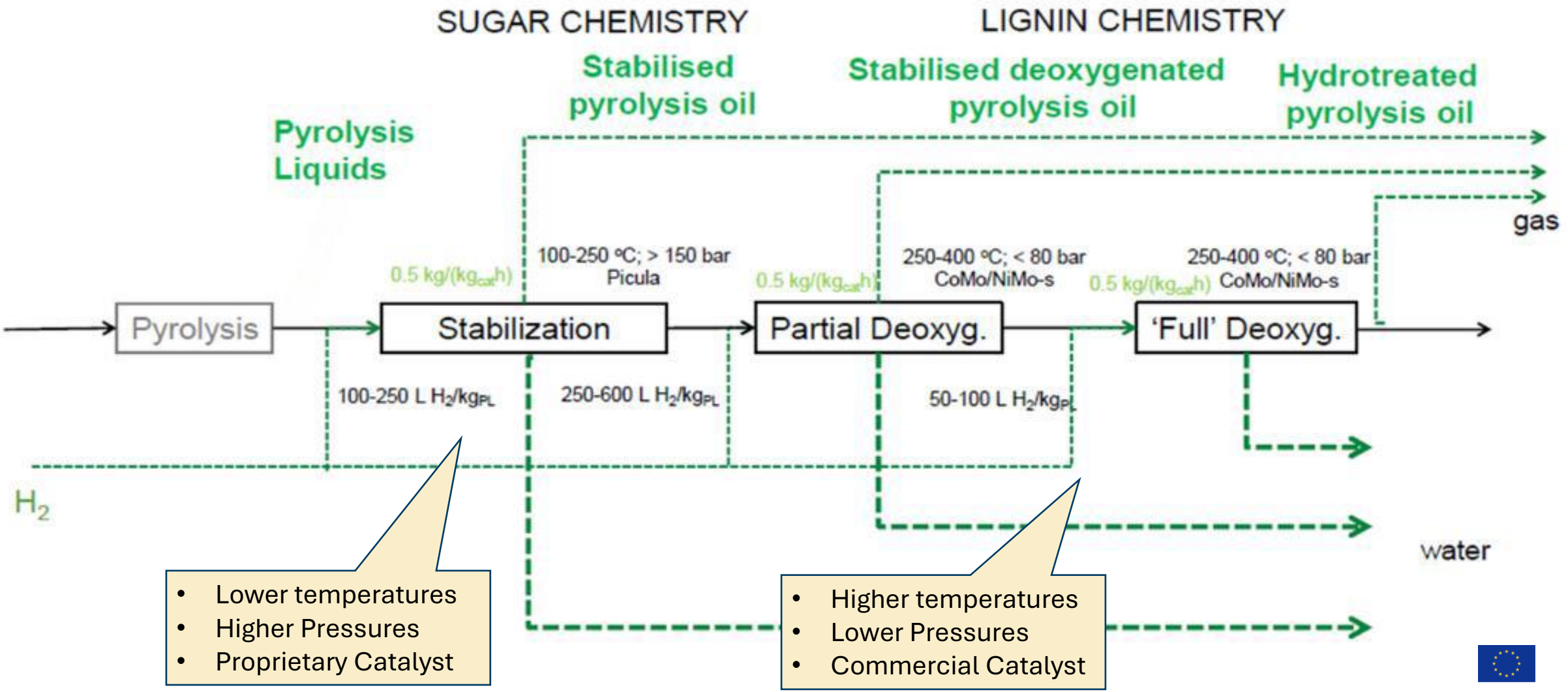
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Developing the most promising Business Cases



European Union's Horizon 2020 research and innovation program, GA No. 727531

Understanding the Chemistry in the Process Steps



- Lower temperatures
- Higher Pressures
- Proprietary Catalyst

- Higher temperatures
- Lower Pressures
- Commercial Catalyst

Fuel Up

Lignocellulose Feedstock

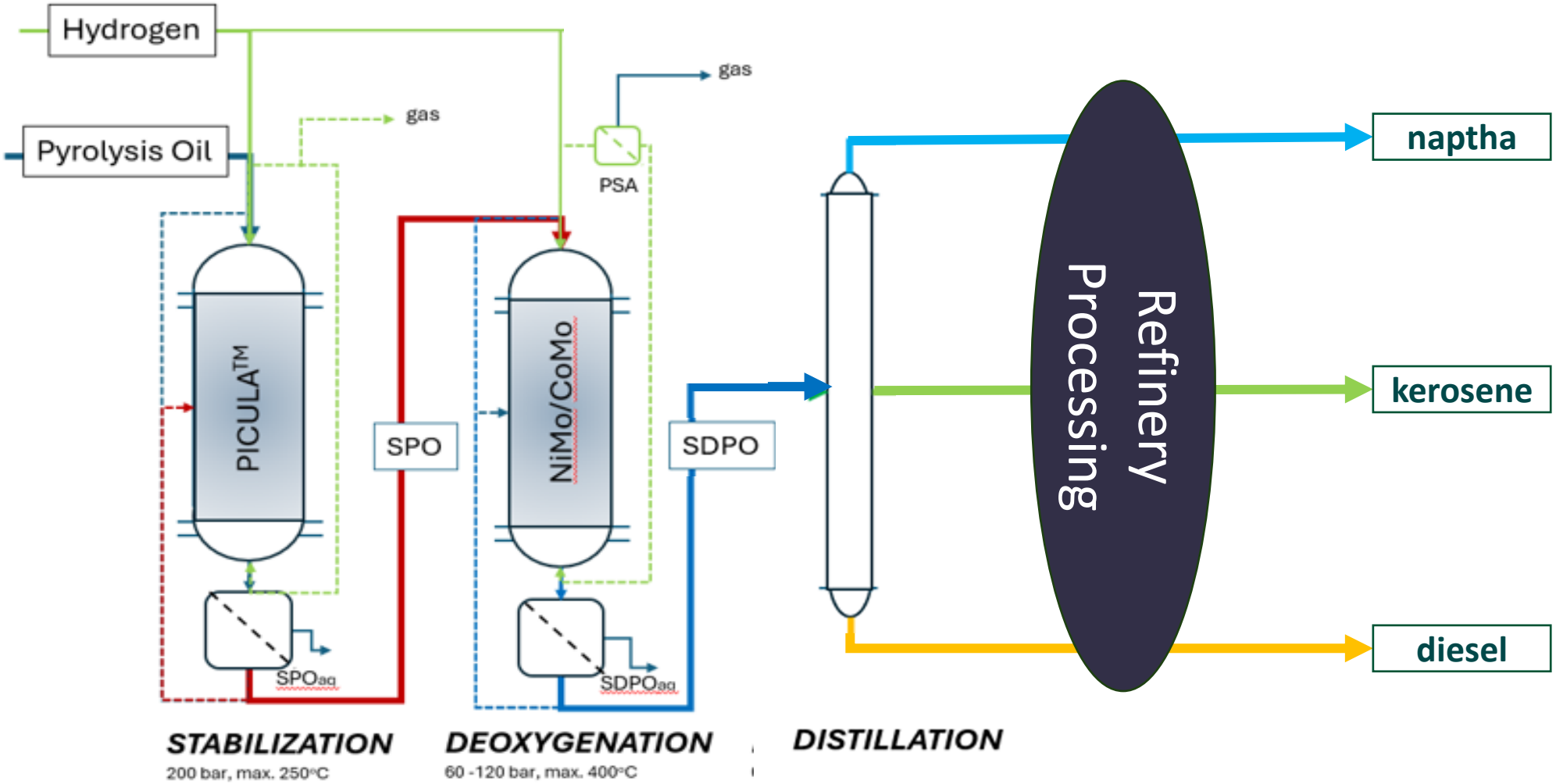
	Carbon/ wt%	Hydrogen /wt%	Water content /wt%	Acid no. mg KOH/g	pH
Pyrolysis → Pyrolysis Oil (PO)	43,9	7,9	20,5	n.d.	n.d.
Stabilisation → Stabilized Pyrolysis Oil (SPO)	54,1	9,3	8,9	35,2	5,29
Deoxygenation → Stabilized Deoxygenated PO (SDPO)	85,5	10,4	0,5	7	3,83

Processing in Refinery

Fractionation → Refinery Processing

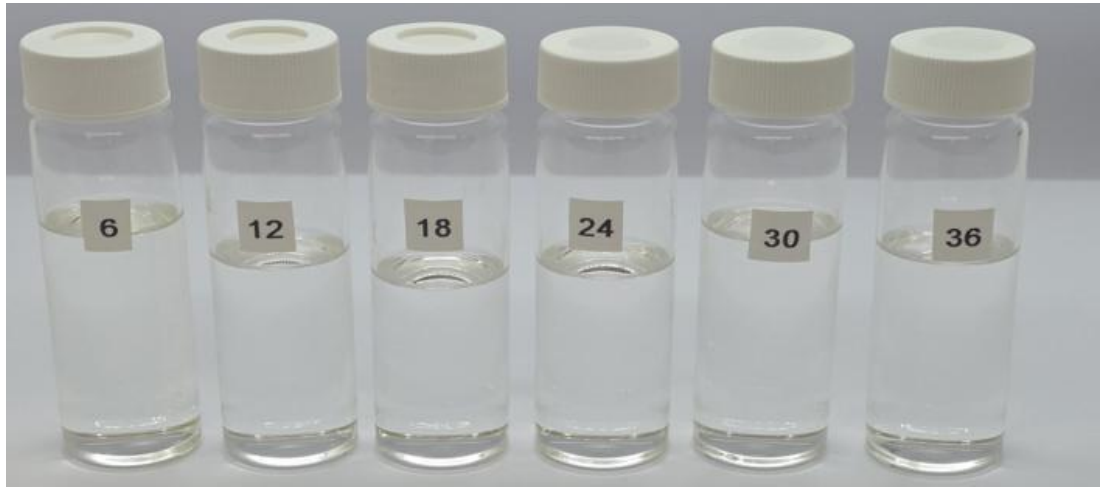
- Kerosene ~50% — Kerosene hydrotreater
  - Co-Processing → SAF
- Naptha ~34% — Naphtha splitter
  - Isomerization
  - Aromatization
- Diesel ~16% — Diesel hydroprocessing
  - Isomerization
  - Aromatization

Upgrading for processing in the Refinery

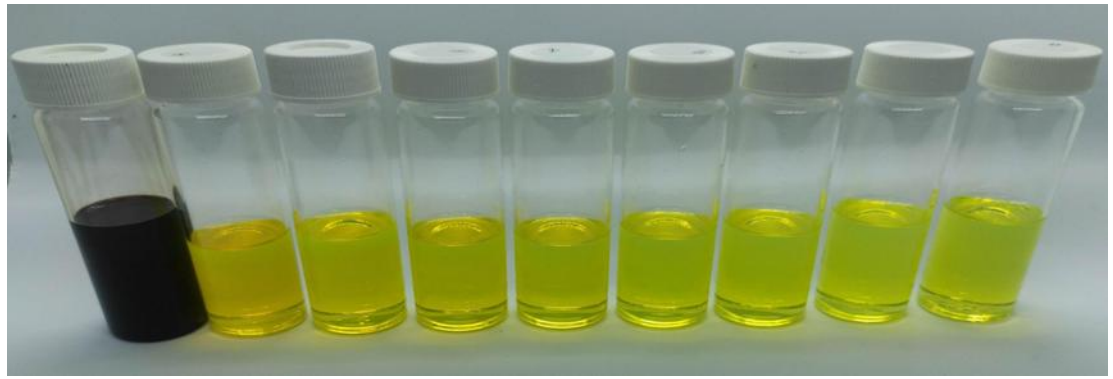


Comparison of Kerosene and Marine diesel specifications

Property	Jet A-1 Specification	Condition I	Condition II
Density (kg/m^3)	775-840	812	825
Flash Point (°C)	≥38	38	39
Freezing Point (°C)	≤−47	−38	−63



Property	ISO 8217:2024 DMA/DMB)	SDPO Diesel
Density (kg/m^3)	≤ 890–900	881
Cetane Number	≥ 40	42.2
Monoaromatics (wt%)	Not specified	49.6
Diaromatics (wt%)	Not specified	4
Triaromatics (wt%)	Not specified	0.2



Benchmarking of Fuel Parameters - Marine

REFOLUTION
Unlocking the potential of biofuels

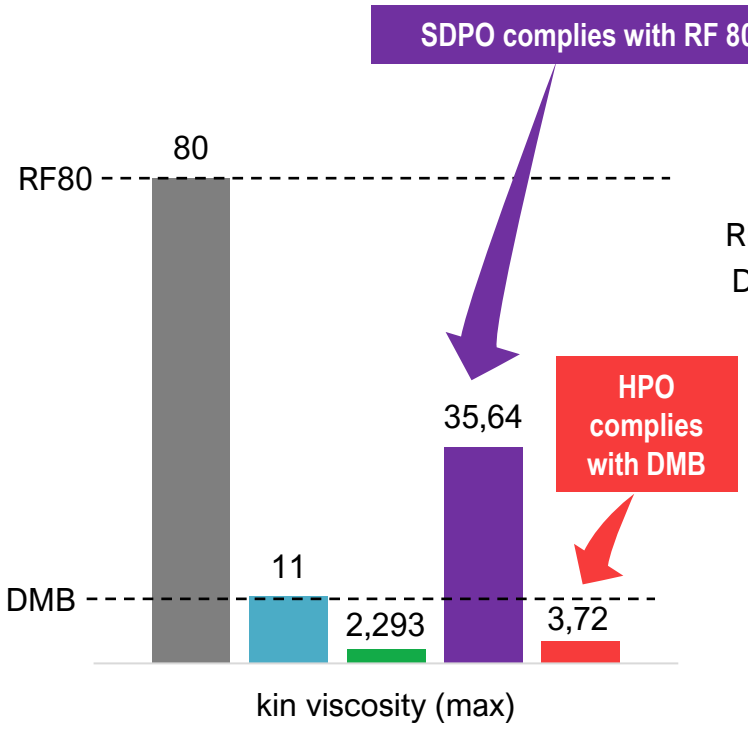
Standard RF80 → Light bio-residual fuel, ISO 8217:2024

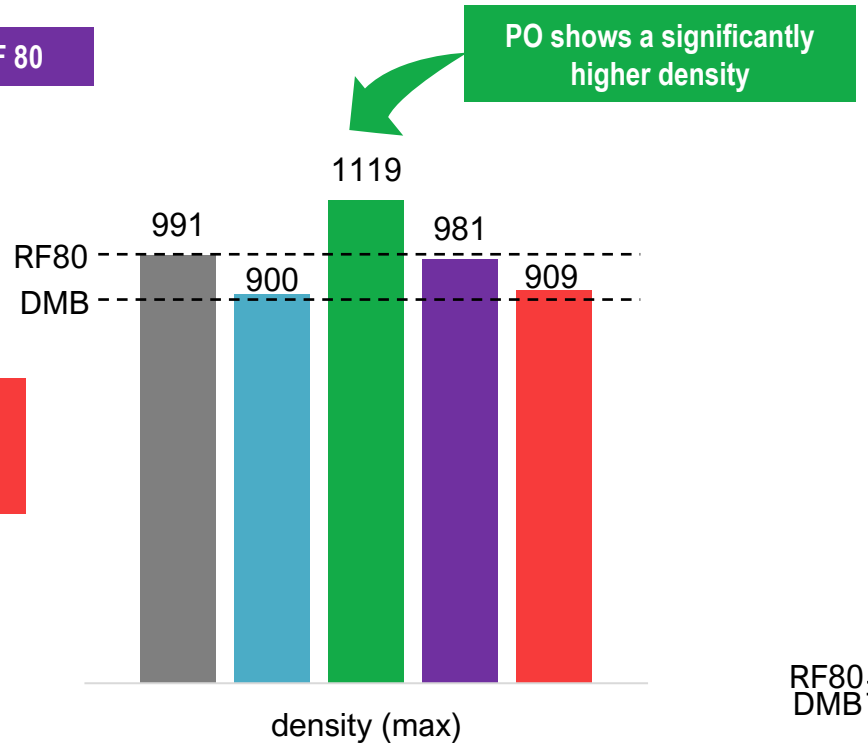
Standard DMB → Marine Gas Oil (MGO), ISO 8217:2024

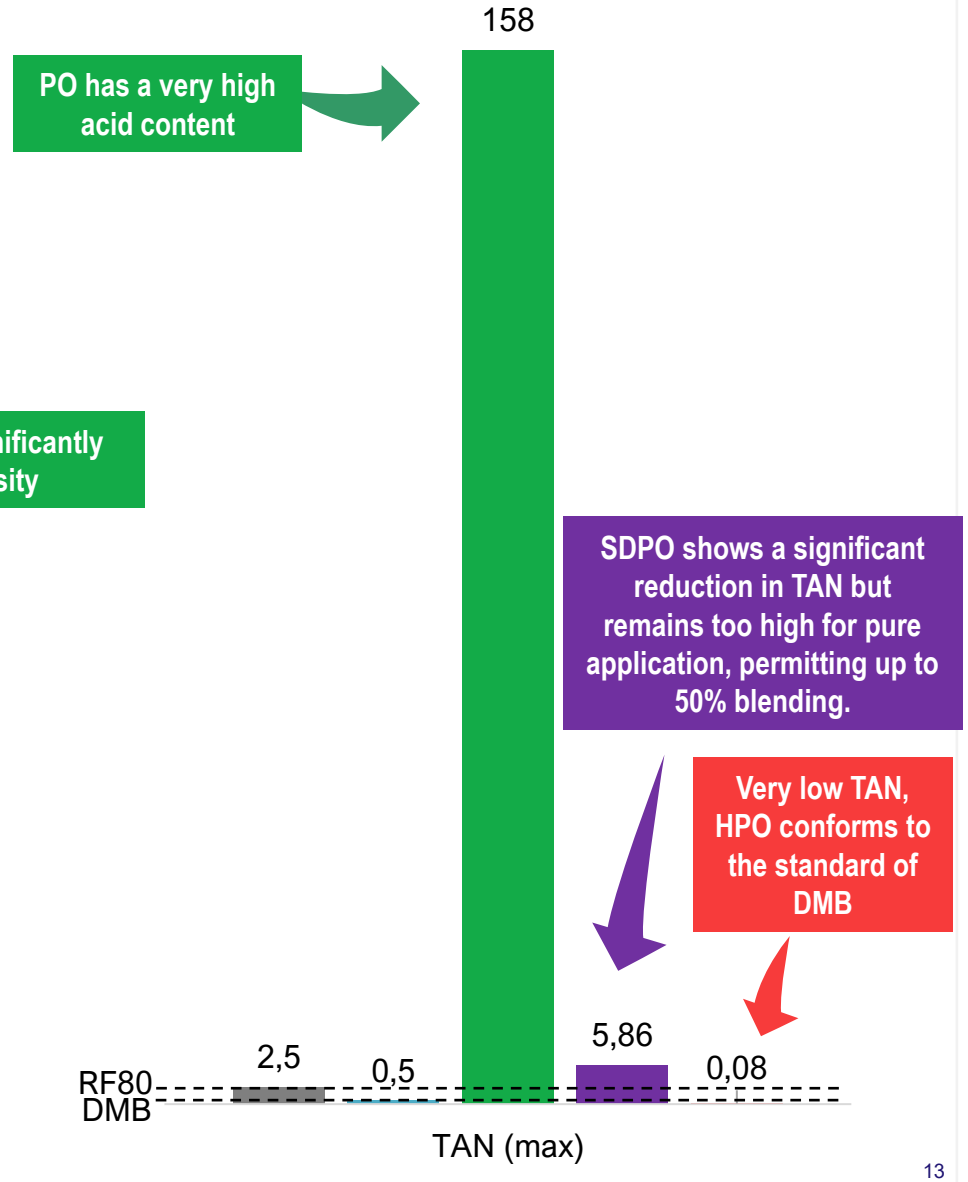
Pyrolysis Oil

SDPO

HPO



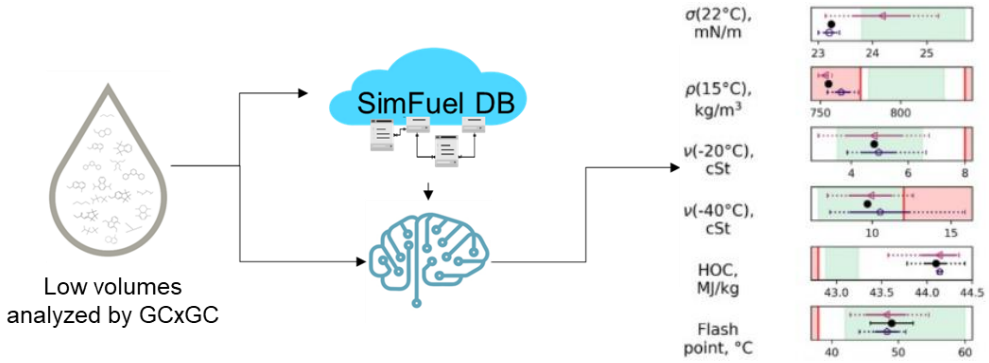




Fuel validation, standardization and certification

Aviation fuels

- Low fidelity assessment with machine learning based property models (SimFuel platform)



- High-fidelity analysis of selected samples in analogy of ASTM D4054[1] Tier 1 and Tier 2
- Development a concerted fuel approval strategy

Marine fuels

- Fuel assessment for samples according to DIN EN ISO 8217
- Stability and blending tests
- Comparative measurement with standard marine fuel (VLSFO[1], MDO[2])
- Documentation of consumption and emission behavior

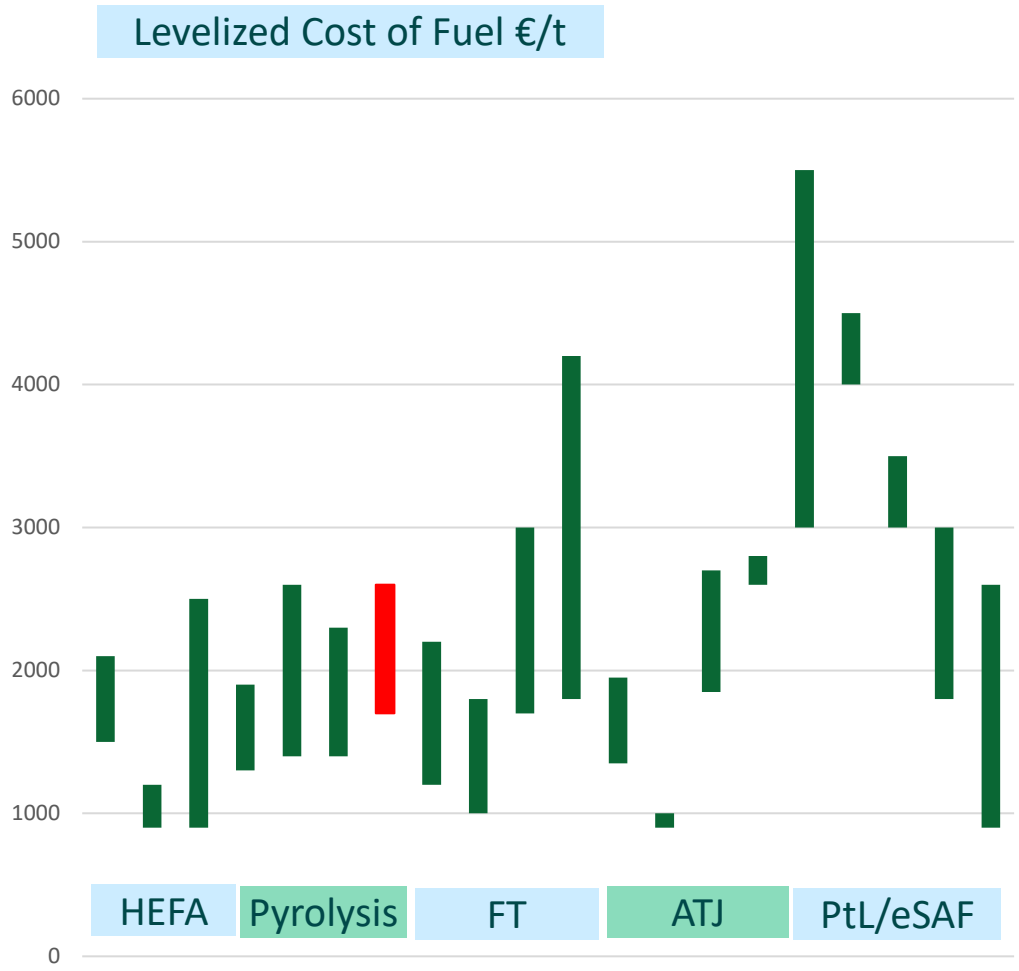


Single cylinder medium speed engine 1VDS 18/15
© LKV Rostock

1 Very low-sulphur fuel oil.
2 Marine diesel oil

Benchmarking with main biofuel routes to SAF

SAF Pathway	Feedstock	TRL	LCOF / MSFP (€/t SAF)	REF	Main Cost Driver
HEFA	UCO, tallow, fats & oils	9	1500-2100	1	Feedstock
			900-1200	2	
			900-2502	3	
Pyrolysis	Co-processing PO hydrotreater	6	1300-1900	1	Feed (PO) Hydrogen (electricity)
	Stand alone	7	1400-2600	3	
	Stand alone		1400-2300	2	
			1700-2600	Pilot Data	
FT	Municipal solid waste	7-8	1200-2200	1	Capex
			1000-1800	2	
	Forestry/residues		1700-3000	1	
			1800-420	2	
ATJ	Ethanol	8	1350-1950	1	Feedstock cost
			900-1000	2	
	Cellulosic alcohols		1850-2700	1	
	Butanol	7	2600-2800	2	
PtL / eSAF	CO2 + green H2	6-7	3000-5500	1	Feed (CO2) Hydrogen (electricity)
	Direct air		4000-4500	2	
	Flue gases	6-7	3000-3500	1	
	2035 target: CO2 + green H2		1800-3000	1	
	Low/high H2 scenarios		900-2600	3	



1. Concawe report 2023: Aviation: technologies and fuels to support climate ambitions towards 2050
2. https://www.ieabioenergy.com/wp-content/uploads/2024/06/IEA-Bioenergy-Task-39-SAF-report.pdf
3. https://op.europa.eu/en/publication-detail/-/publication/cc500efe-fe51-11f0-8da5-01aa75ed71a1/language-en

Summary

Liquefaction routes produce drop-in fuels with promising results meeting Aviation and Marine specifications

Integration with existing refinery processes provides options for using existing infrastructure with potential for achieving production at scale

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REFOLUTION Unlocking the potential of biofuels

OMV NESTE moeve GRACE Talent | Technology | Trust™ btg btg bioliquids btg-neXt advanced pyrolysis biofuel DLR SINTEF cnrs VTT university of groningen Universität Rostock etaflorence renewableenergies

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Fuel Up

btg btg-neXt advanced pyrolysis biofuel Tüpraş SINTEF Ranido Ketjen LIST DLR Avecom Bioproducts & Apps AristEng Greenergize your process! eta



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