

The ShipFuels Matrix & A shipowner perspective

Concawe Symposium – 8th October 2026

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The ShipFuels Matrix

Background and objective

- **Background**
  - The maritime sector develops numerous lower-carbon fuel options in parallel…
  - … but faces challenges to identify the most favorable options due to fragmented and inconsistent information
- **Objective**
  - Create a large source of information for maritime fuel options that covers a broad range of topics while being coherent at the same time
  - Enable transparent, back-to-back comparisons across numerous fuel pathways, and understand their implications across the whole value chain: feedstocks, conversion technologies, fuels and applications



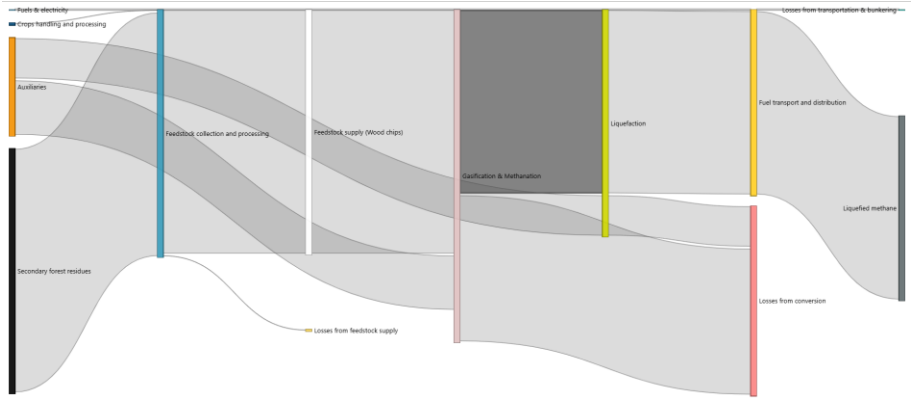


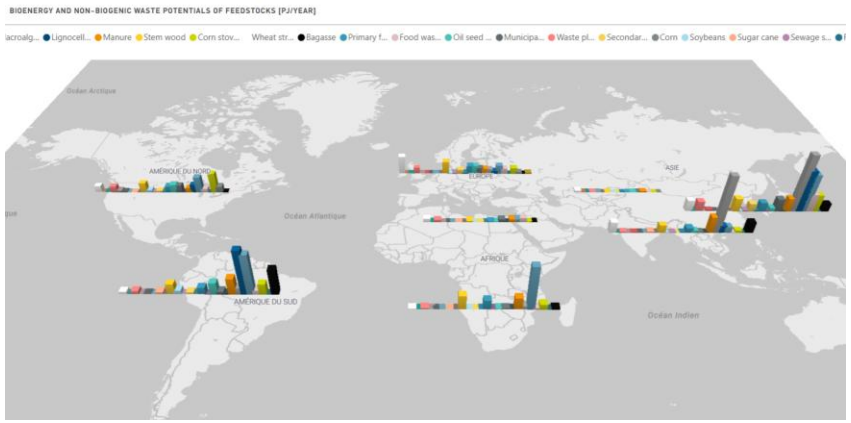


The ShipFuels Matrix

A guiding tool through the numerous maritime fuel options

- A tool commissioned by **CMA CGM, ARAMCO and CONCAWE,** developped by **LBST**
- A **dynamic online tool**, consisting of a modular fuel database covering the whole value chain
  - **Feedstocks**
  - **Conversion processes**
  - **Final fuels**
  - **Applications**
- **500+ fuel pathways** described and characterized using a common set of **environmental, technical and operational** indicators
  - GHG emissions, energy efficiency, technology maturity, fuel properties, biomass availability, water consumption, etc.





The ShipFuels Matrix: a guiding tool for Shipowners, Energy players and policymakers To make informed decisions about the energy transition

Pathways Overview

46 feedstocks, 33 processes, 17 final fuels and 8 propulsion systems forming 569 pathways

Feedstocks	Count	Conversion processes	Count	Final fuel/ electricity	Count	Propulsion systems	Count
Vegetable oil from oil crops	4	Transesterification, Hydrotreating	2	Ammonia	1	Slow speed Diesel ICE	1
Waste oils	5	Raw Glycerol conversion	2	Electricity	1	2-stroke Diesel cycle dual fuel ICE	1
Sugar & starch crops	4	Fermentation 1st gen	1	Ethanol	1	Fuel cell (PEMFC)	1
Agricultural residues	3	Methanol synthesis	1	FAME	1	Otto dual fuel, medium speed	1
Residues for anaerobic digestion	4	Methanol-to-Diesel (MTD)	1	FAEE	1	Otto dual fuel, slow speed	1
Algae for anaerobic digestion	1	Fischer-Tropsch synthesis	1	HTL-based diesel	1	Lean-burn spark ignited (LBSI)	1
Woody biomass incl. SRF	6	Haber-Bosch synthesis	1	LH2	1	Catalytic NH3 electrolysis + Fuel cell + electric motor	1
Other residues	5	Pyrolysis & upgrading	1	Liquefied methane	1	Battery electric propulsion	1
Non-bio-waste	2	HTL & upgrading	1	Methanol	1		
Sewage sludge	1	Anaerobic digestion	1	Paraffinic diesel (e.g. HVO)	1		
Miscanthus	1	Gasification, Pyro-gasification, hydrothermal gasification	3	Pyrolysis-based diesel	1		
PV electricity	1	Water electrolysis	1	Straight vegetable oil	1		
Wind electricity (onshore)	1	Co electrolysis of water and CO2	1	FAME residues	1		
Wind electricity (offshore)	1	H2 & CH4 liquefaction	2	CNSL	1		
CSP electricity	1	Methanation	1				
Hydro electricity	1	SMR w CCS, ATR w CCS	2				
Nuclear fuel	1	CO2 capture technologies	3				
Coal	1	Biomass power stations	4				
Natural gas	1	Fossil power stations	4				
HFO and diesel for electricity	2						
Number of feedstocks	**46**	**Number of conversion processes**	**33**	**Number of final fuels/electricity**	**14 (+ 3 fossil)**	**Number of propulsion systems**	**8**

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Merit mapping of each pathway

Besides GHG and energy, merit mapping spans environmental, technical and operational dimensions

	Feedstock	Process (conversion)	Final Fuel Transport & handling	Application (use in assets)
Energy efficiency and process maturity	• Bioenergy potential (GJ/yr) • Seasonality of availability • Production limited by industry?	• Process technical maturity (TRL)	• Energy efficiency	• Propulsion efficiencies (max.) • Onboard carbon capture
Operability (at industrial scale)		• Opportunities of scaling-up the units (up to x kt/yr/unit)	• Energy density (by volume and by mass) • Storage conditions • Regulatory readiness • Max. blending ratios	• Refuelling duration • Co-activity during refuelling • Suitability for operations • Fuel consumption of different ship types
Potential impact on the environment (qualitative risk assessment)	• Feedstock culture and crop consequences on water consumption • biodiversity, and risk / neutral / beneficial		• Safety risks (explosion, fire, etc.) • toxicity risks (danger to the environment and to human health in case of spillage) • Pollutants / emissions	• Pollutant emission limits (IMO) • Well-to-Wake GHG emissions

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Shipfuels Matrix live demo

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To get access

Access the tool online: www.concawe.eu/shipfuels-matrix/

Access the accompanying report: www.concawe.eu/publication/shipfuels-matrix-merit-mapping-of-maritime-alternative-fuels/

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