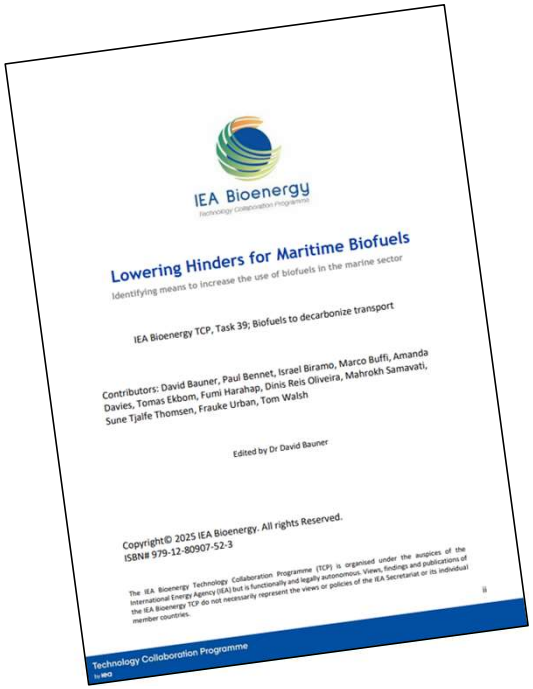


Lowering Hinders for Maritime Biofuels – identifying means to increase the use of biofuels in the marine sector

Global Biofuels Alliance

Task 39 - Biofuels to Decarbonize Transport

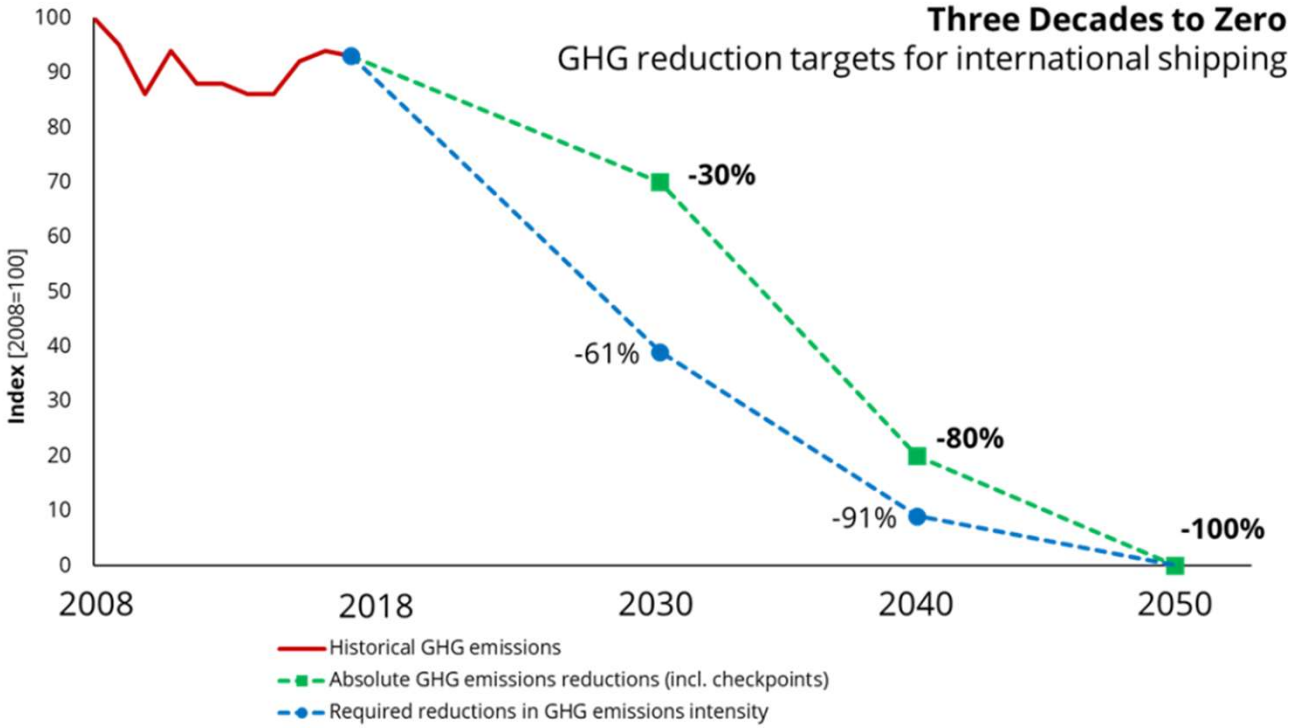
T3 Project-Maritime Biofuels

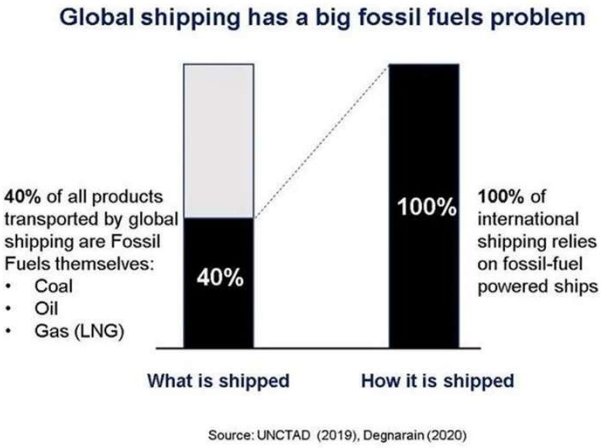
Tom Walsh CEO, NTL Renetech Bioresources Ltd, Ireland

Agenda

- Background
- 2024-2025 Report highlights
  - Outline
  - Reference group
  - Biomass Sourcing
  - System level scenario outlook
  - Innovation
  - Maritime Fuel qualities
  - IMO and EU regulations
  - Market development and Investment
- Program of work 2025-2027
  - Case studies
- Conclusion

Background



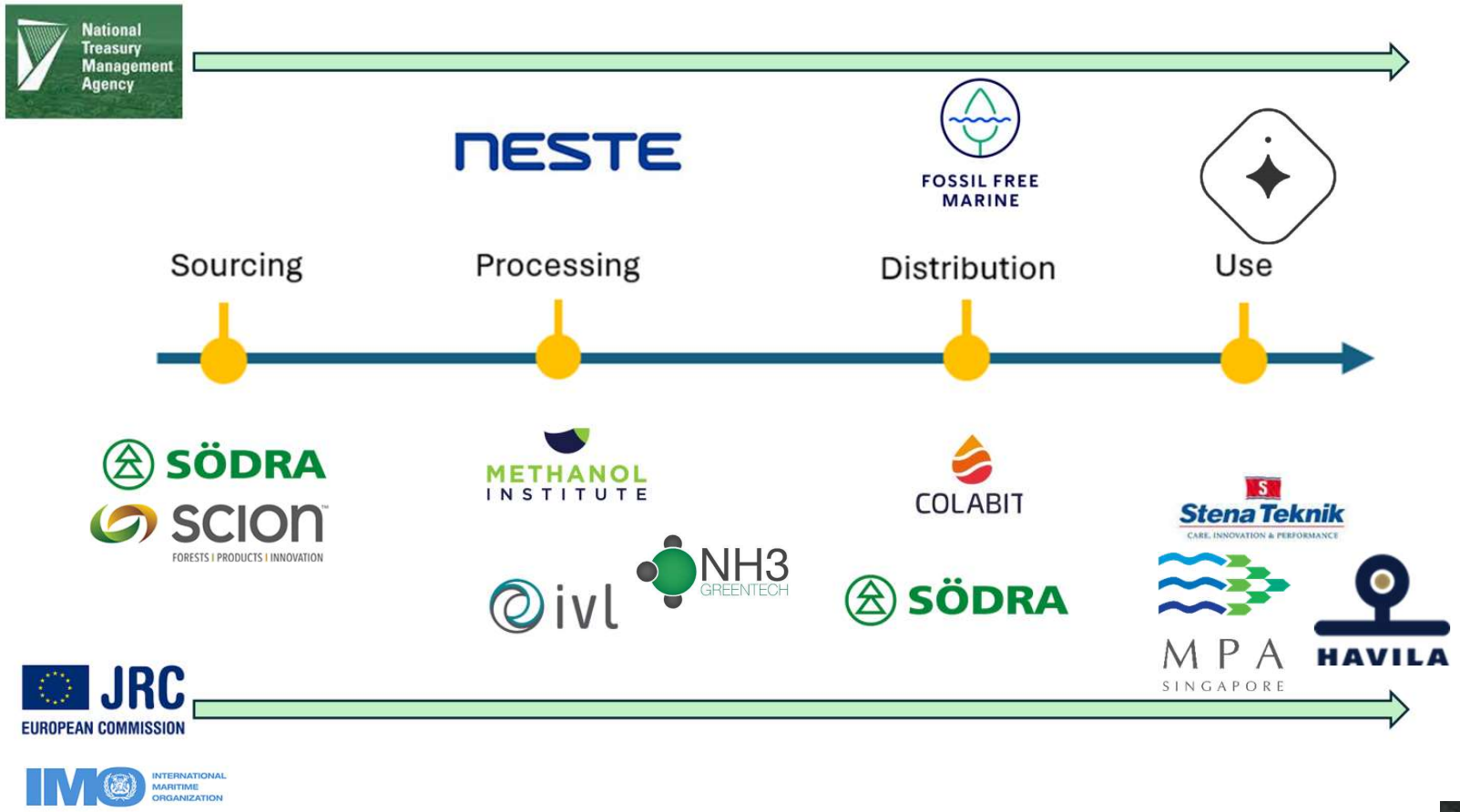


A new climate deal for shipping: Three decades to zero. (2023, June 13). World Bank Blogs. https://blogs.worldbank.org/transport/new-climate-deal-shipping-three-decades-zero

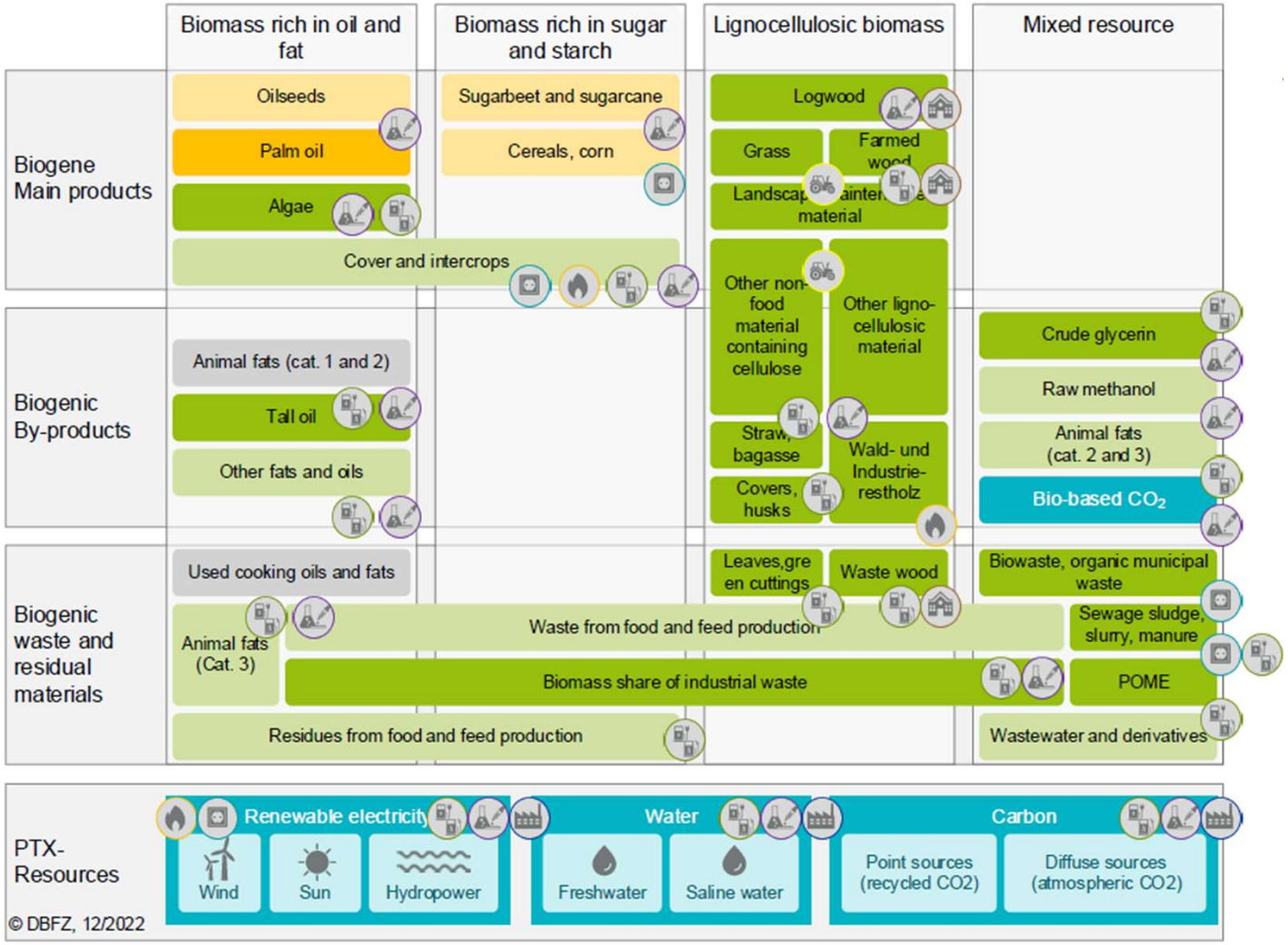
2025 Report outline

Report link
https://www.ieabioenergy.com/wp-content/uploads/2025/04/IEA-Bioenergy-TCP-Task-39-T3-Maritime-Biofuel-Hinders-Report-revised.pdf

Reference group and interviewees



Biomass sourcing

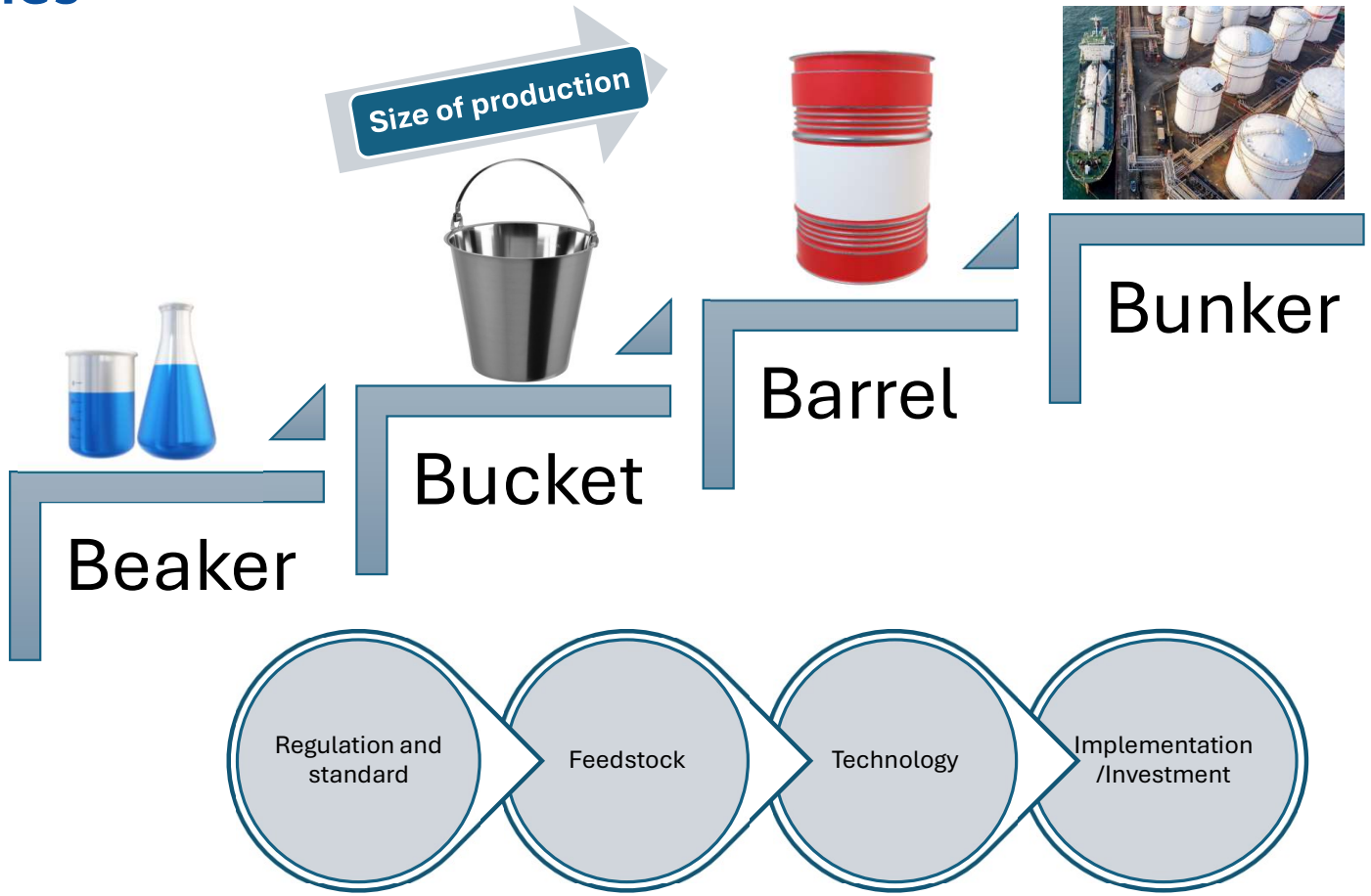


Systems level scenario outlook

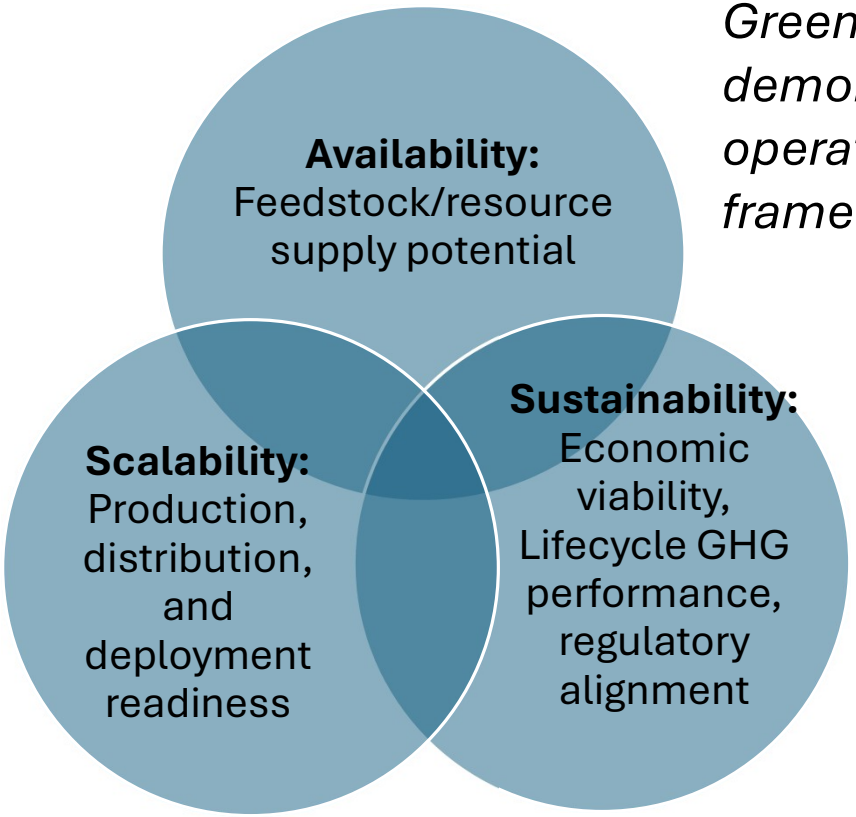
Economic growth	International trade	Climate policy	Carbon price	Fossil fuel use	Increased use of biofuels	GHG emissions
High	High	Strong	High	Medium	Medium to high	Medium
		Medium	Medium	High to medium	Medium to low	Medium
		Weak	Low	High	Low	High
Medium	Medium	Strong	High	Medium	Medium	Medium
		Medium	Medium	Medium	Medium	Medium
		Weak	Low	High	Low	High
Low	Low	Strong	High	Low to medium	High to medium	Low to medium
		Medium	Medium	Medium	Medium	Medium
		Weak	Low	High to medium	Low to medium	Medium

Source: Frauke Urban (KTH, Sweden), Mahrokh Samavati (Ramböll), Fumi Harahap (Ramböll)

Innovation ladder - from lab scale to commercial fuel use in engines

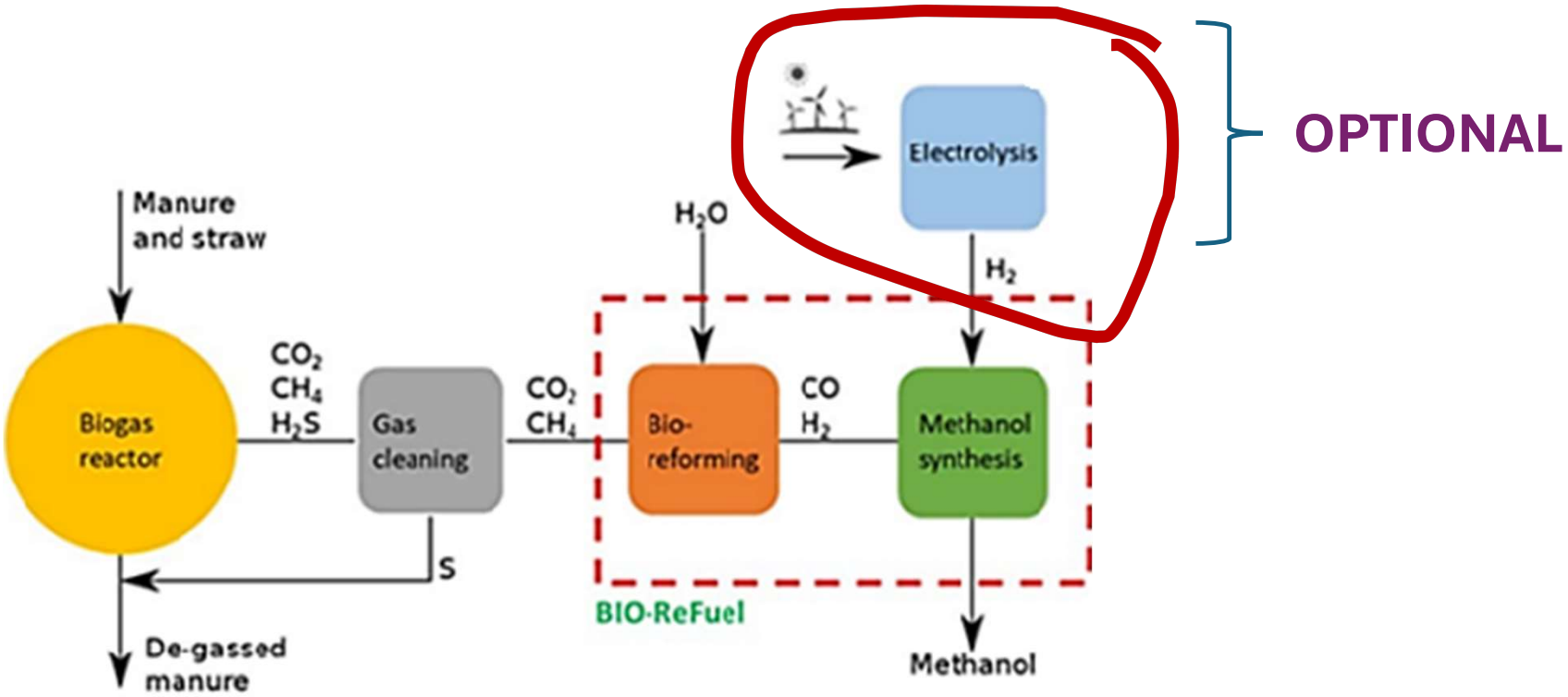


Sustainability-Availability-Scalability Framework for Marine Biofuels Evaluation



Green Corridors serve as demonstration platform to operationalize this framework

Innovation example: Producing methanol from Anaerobic Digestion, with or without adding hydrogen



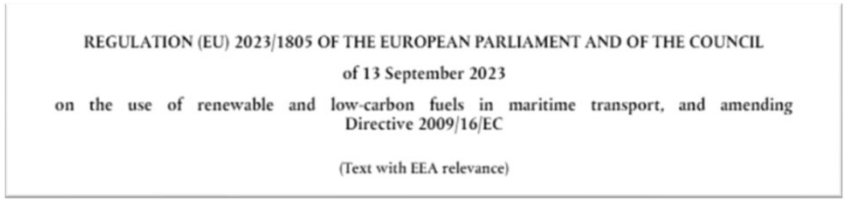
Source: DTU (2024)

List of fuel characteristics - fossil vs biofuels

Fuel type	Volumetric energy density	Gravimetric energy density	Carbon intensity	SO_x Emissions
	[MJ/L]	[MJ/kg]	[TCO_{2e}/TJ]	
HFO	38	39	77-87	High
MGO	37	43	87	High
LNG (liquid)	21	49	63	None- Low
RNG (liquid)	21	49	~10	None- Low
Methane (gas)	0.034	50	< ~10	None
Ethanol	16	20	24, 34**	None
DME	21	27	NA	None
Biodiesel	19	29	60 (oil crops)	None
Biocrude	35	38	NA	None-Low
Pyrolysis Oils	16	17-20	NA	NA
HVO	25	33	8-25	None
Methanol*	16	20	~0, ~10 (wood)	None
H2* (liquid)	8.5	120	~0	None
Ammonia* (liquid)	13	19	~0	None
Batteries**	1.3	0.7	~0	None

Simonsen, Weiss, van Dyk, van Thuijl, and Thomsen (2021); *Progress towards biofuels for marine shipping; Status and identification of barriers for utilization of advanced biofuels in the marine sector*. IEA TASK 39, June 2021 (here)

Regulation


REGULATION (EU) 2023/1805 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 13 September 2023

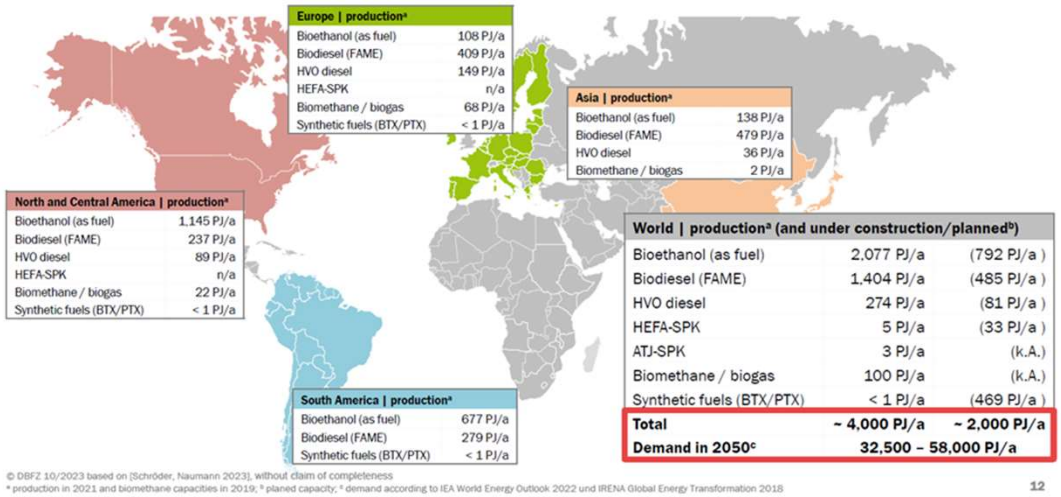
on the use of renewable and low-carbon fuels in maritime transport, and amending Directive 2009/16/EC

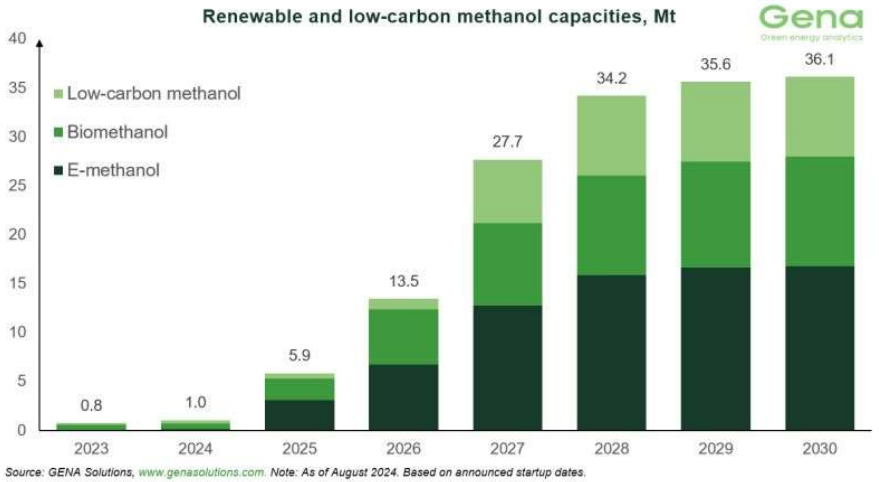
(Text with EEA relevance)

- IMO CII, EEDI, EEXI
- New Chapter 5 of MARPOL Annex VI containing regulations on the IMO net-zero framework, including:
  - a goal-based marine fuel standard regulating the phased reduction of the marine fuel's **GHG intensity**; and
  - economic mechanisms to incentivize the transition to net-zero.
- EU ETS (Emissions Trading System) for ships > 5000 gross tonnes
- FuelEU Maritime Directive – on-board ship GHG intensity
- European Energy Taxation Directive – bunker fuel tax
- RED III sets a binding combined sub-target of 5.5% for advanced biofuels and RFNBOs (min. 1%) by 2030
- Singapore Workshop Agreement 2:2022 (marine biofuel)
- ISO 8217, 2024 - modification including non-fossil sources (e g methanol)
- International Sustainability and Carbon Certification (ISCC)

IMO; Hararap, Frauke et al, 2023

Renewable fuel in the international market

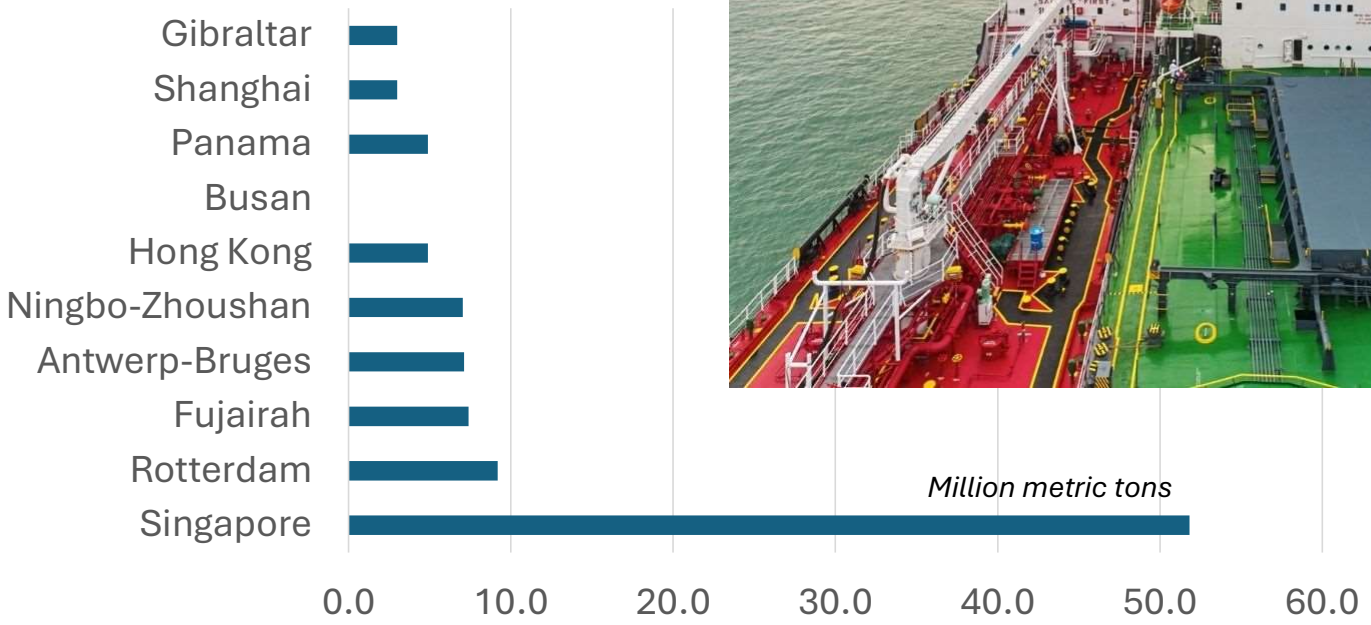




Renewable fuel in the international market projected upto 2050 (Source DBFZ (2023))

Coming green methanol pipeline globally as of August (MI, 2024)

World's largest bunkering ports 2023

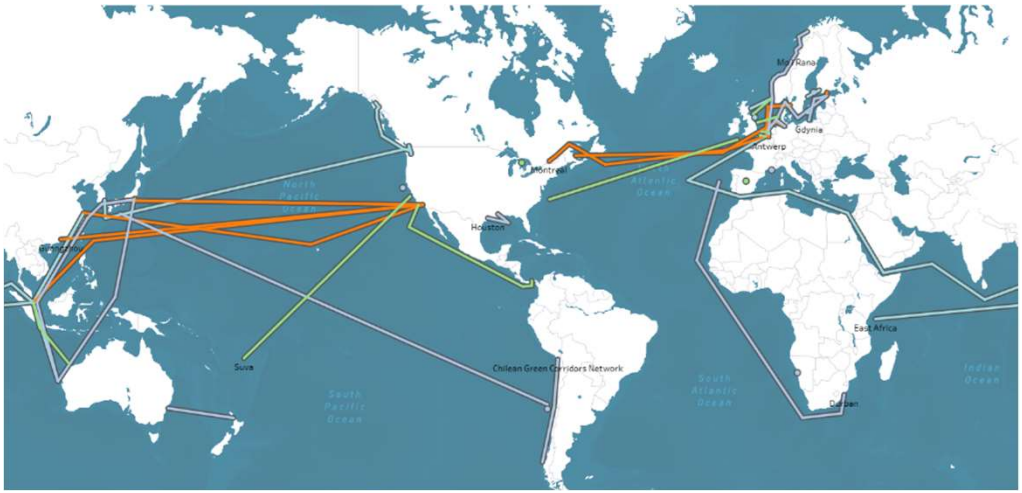


Source: web page of respective port

Creating Markets for Biofuels

	Challenges		Opportunities		*Strategies*
	Technical	**Economic**	**Technical**	**Economic**	
BIOMASS SOURCING	Local access to biomass for regional supply, scaling	Funding, Scaling,	Clear certification for feedstocks, development of biogas substrates (for methane and methanol production) supply	Incentives for certification, supply and methane production	Develop regional certification rules with all stakeholders
BIOFUEL PRODUCTION	Regional capability,	Funding, offtake risk	investment in sustainable production, biogenic CO_2 for methanol production	Incentives, credit line, regional supply (less transport)	Supply contracts, investment support
DISTRIBUTION & BUNKERING	Matching supply and demand, certification, feeder vessels and fueling methods	Securing regional profitability, competition from aviation and bioplastics markets	Assessing the market - early entry may render significant demand	Incentives for biofuel distribution bunkering, blending. investment for efficiency	Certification, economic incentives, carbon pricing, regulation
BIOFUEL USE	Vessel compatibility, safety (e.g. for bio-ammonia), availability, leakage (methane and hydrogen)	Securing adherence (shadow fleet minimization) by market actors, oversee economic viability for fleets	Green corridors, e-fuels Energy efficiency measures such as efficient hull design, sails and hull cleaning	EEXI, EEDI, Incentives	IMO roadmap adherence, initial economic support for sustainable biofuels

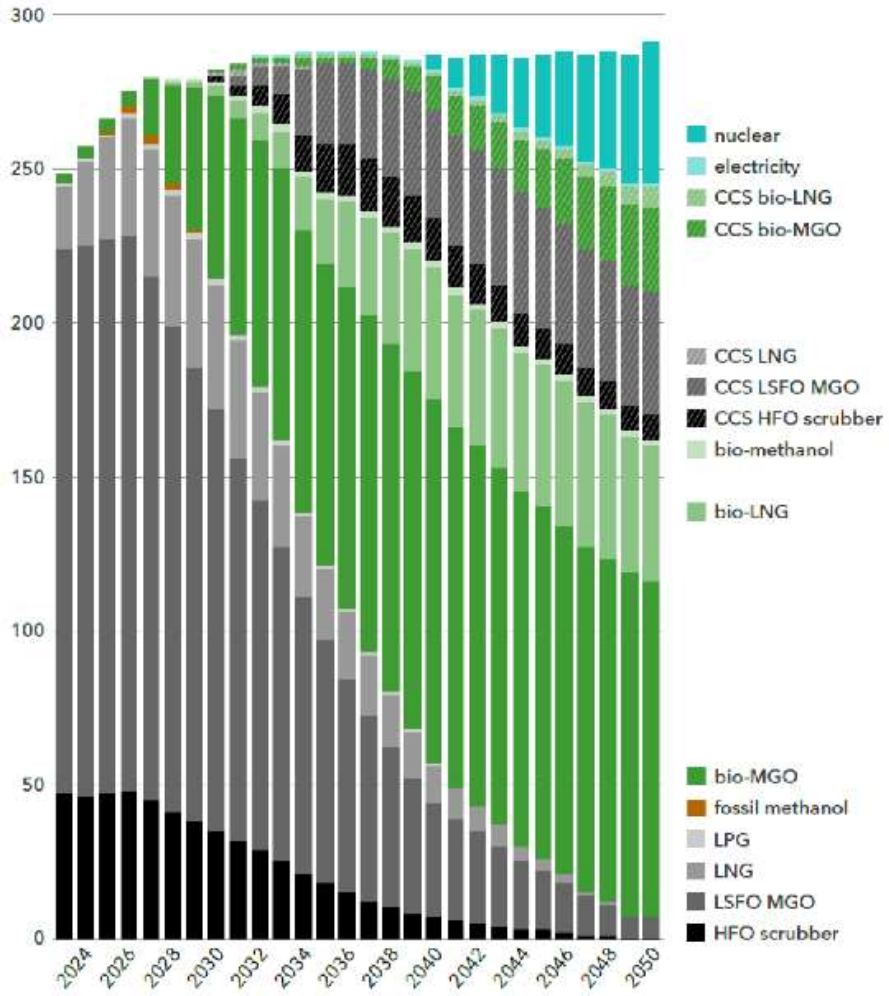
Green Corridors: Operationalizing Biofuel Transitions



- Analyse full value chains in real-world shipping
- De-risk adoption: Port-to-port fuel certainty
- Align standards, investments, and policy incentives
- Coordinate market stakeholders (port, fuel, engine, operator)
- Serve as models for broader scale-up
- Support policy: EU ETS, FuelEU Maritime, IMO GHG rules

DNV biofuel scenario (2024-08)

- Bio-methanol and bio-MGO dominate
- Rapid phase-out of fossil methanol
- Slow phase-out of (fossil) LNG
- Nuclear for near-shore
- BECCS for bio-LNG and bio-MGO as feasible
- CCS for LNG,MGO and HFO as feasible



Energy Transition Outlook 2024; Maritime Forecast to 2050; Det Norske Veritas, August 2024

Program of Work - Six Projects (2025 to 2027)

		P1 - Implementation Agenda (including Emerging Markets)	P2 - Advanced Biofuels Demonstration	P3 - Biofuels for Heavy Duty Transportation	P4 - SAF	P5 - Marine Biofuels	P6 - Synergies of biomass and electricity- based technologies for fuels
		Leader: Germany	Leader: Austria	Leader: Sweden	Leader: USA	Leader: Ireland	Leader: Germany
SP1 - Conversion Technologies, Markets and Deployment	Technologies and Deployment (Leader: Germany)	P1. 1	P2.1	P3.1	P4.1	P5.1	P6.1
SP2 - System Aspects, Biomass Supply, Sustainability	Sustainability, Certification, Sourcing, LCA, TEA, Efficiencies, Policies (Leader: Austria)	P1.2	P2.2	P3.2	P4.2	P5.2	P6.2
SP3 - Outreach and Dissemination	Cross-cutting activities, partnerships, preparation of dissemination materials, factsheets, infographics, press releases, dashboard, database and Task 39 Magazine (Leader: Sweden)	P1.3 (Biofuture Platform, UNIDO)	P2.3 (Task 33, Task 34, Task 42)	P3.3 (AMF, Sustainable Combustion TCP, IETS)	P4.3 (Task 33, Task 34, AMF TCP, Sustainable Combustion TCP)	P5.3 (IMO, Task 33, Task 34, DNV, AMF TCP, Sustainable Combustion TCP)	P6.3 (Task 33, Task 34,Task 37, Task 40, Task 45, AMF, Hydrogen TCP, possibly an Intertask activity)
Countries		Brazil, EU, Germany	Austria, China, Germany, USA	Brazil, USA, Sweden, Ireland	Belgium, Brazil, China, EU, Germany, Japan, the Netherlands, Sweden, USA, Norway	Brazil, EU, Ireland, the Netherlands, New Zealand, Sweden, Norway	Austria, Germany, USA

Biomethane (2025): Drop-In Renewable Gas for Marine Use

- Availability: Municipal & agricultural waste; proven digester technology
- Scalability Barriers: Feedstock aggregation, methane slip, small-medium scale
- Sustainability: Cost competitiveness, high GHG reduction if methane capture is optimized
- Infrastructure Synergy: Compatible with LNG vessels & port systems
- Green Corridor Example: Viking Line Group-LBG trial, Rotterdam-Singapore Green and Digital Shipping Corridor (GDSC) initiative.
- Technology Examples: Havila Voyages methane-electric hybrid cruise ships, Wasaline transition to 2030 in agreement with Gasum.
- Next Steps: Policy credits for avoided emissions; methane slip reduction

Bio-Ethanol (2026): Liquid Biofuel with Global Supply Potential

- Availability: Abundant 1G & 2G feedstocks (corn, sugarcane, residues)
- Scalability Barriers: Engine compatibility, safety codes (IGF), cost
- Sustainability: Must avoid food vs. fuel conflict; RED II certified
- Infrastructure Synergy: Uses existing tanks, pipelines, barges
- Industry Activity: Wärtsilä-Raízen trials
- Mitigation: Incentivize dual-fuel retrofits; fast-track IMO code adoption

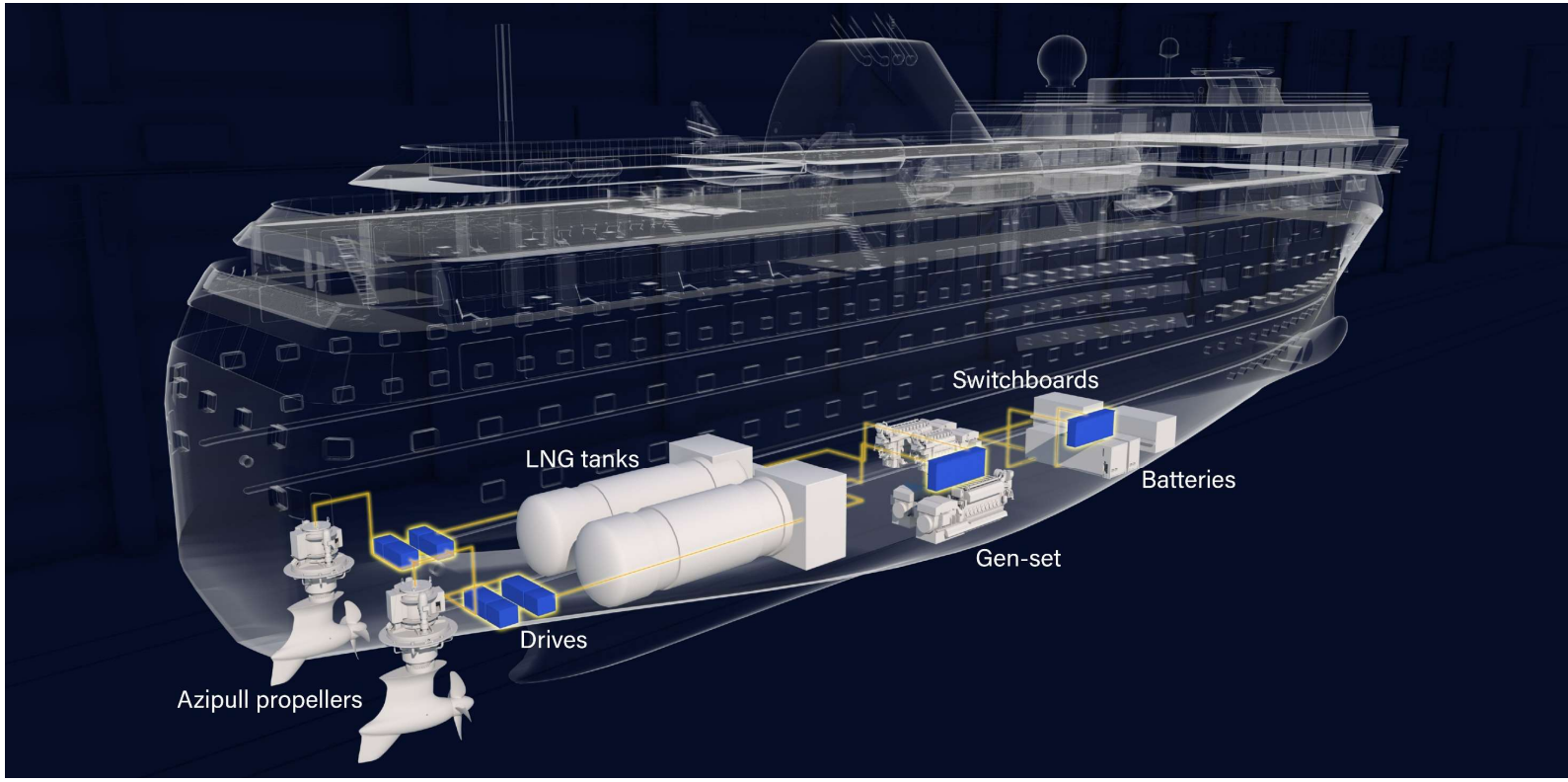
E-Methanol (2027): Synthetic Fuel for Last Mile Decarbonization Efforts

- Availability: Tied to renewable electricity & captured CO_2
- Scalability Barriers: Electrolyzer cost, CO_2 sourcing, CAPEX intensity
- Sustainability: Zero-carbon pathway if powered by green inputs

- Infrastructure Synergy: Ambient liquid- fits existing bunkering
- Market Signal: European Energy e-methanol plant, Maersk's methanol ships - EU FuelEU regulation support
- Mitigation: Targeted green corridors - LCOF + MAC metrics to assess cost-effectiveness

Plug-in hybrid - LNG/LBG & battery

Havila Voyages, Norway - existing ship



Wind-assisted Propulsion Systems under implementation for 2024-2025 - EU supported projects

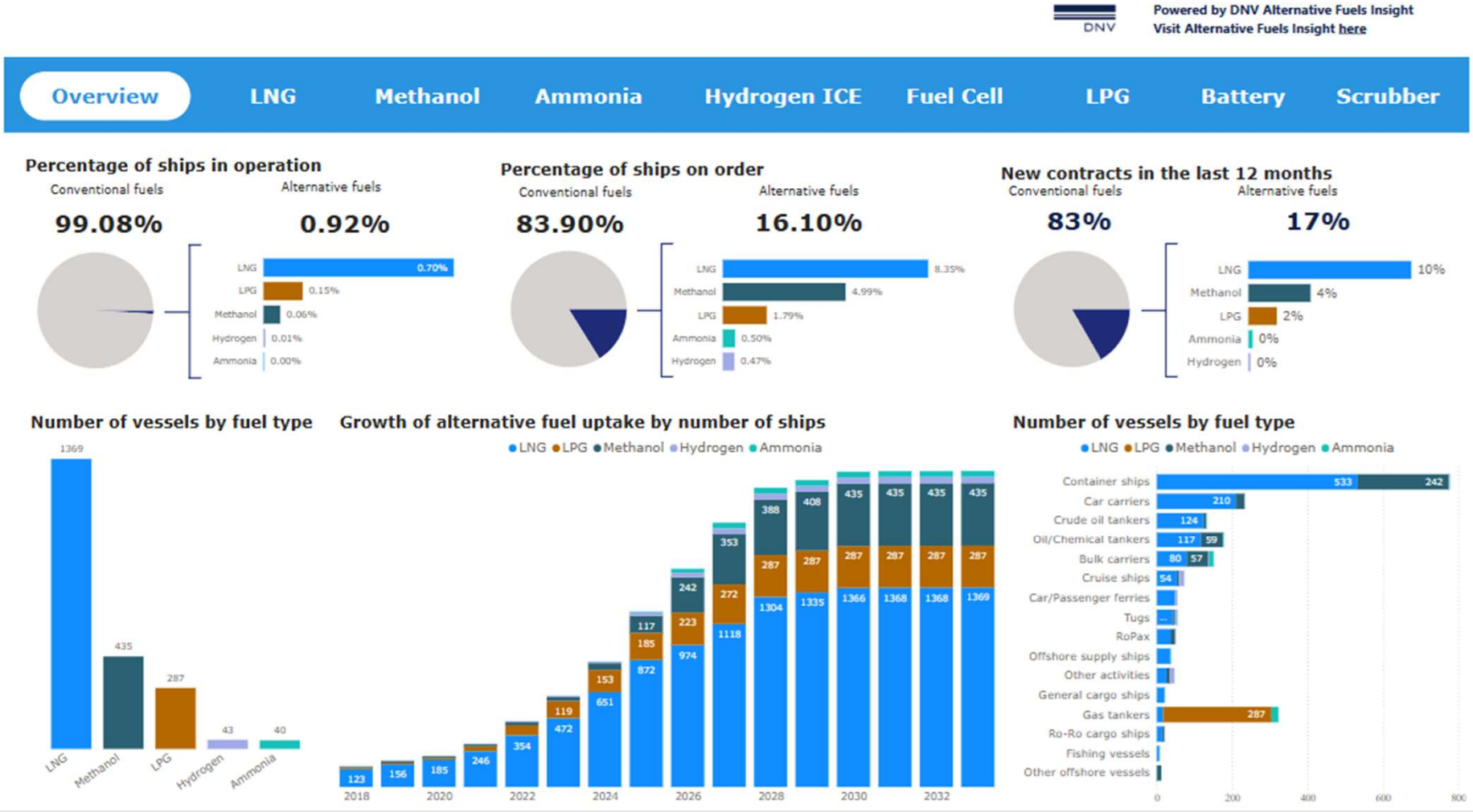
7-10% reduction of fuel consumption for one wing on a RO-RO vessel is possible

52 seagoing ships now in operation and 97 newbuilds with WAPS ordered (as of January 2025)
DNV, 2025

Maersk invests in dual fuel methanol vessels and Green Methanol production

- Maersk has taken delivery of 18 new dual-fuel vessels with a total of over 300 000 TEU
- Maersk has agreed with Japanese energy company ENEOS and A.P. Moller Holding to jointly invest $100 million in green methanol project developer C2X, primarily to fund the final development phase of the Beaver Lake Renewable Energy (BLRE) plant in Louisiana, with a planned production of 500,000 metric tons of green methanol per year.

IMO FutureFuels by DNV – focus on ships and molecules



https://futurefuels.imo.or

Source: FF webpage August 21, 2025

Key recommendations

- **Availability, Scaleability and Sustainability** should be the framework for analysis and implementation across each biofuel value chain from feedstock to production technology to biofuel use. **Green Corridors** is an integrated means to test and demonstrate.
  - **Research, innovation and commercialisation policy** should focus on the **bucket to barrel** sector if it is to have an impact in terms of availability by 2030.
  - **Risk Mitigation**: Electric, Biofuels and Efficiency measures go hand in hand. The combustion engine will not go away quietly. Scenario planning - what if the lights are switched off?

Thank you!

Tom Walsh

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Contributors: David Bauner, Paul Bennet, Israel Biramo, Marco Buffi, Amanda Davies, Tomas Ekbom, Fumi Harahap, Dinis Reis Oliveira, Mahrokh Samavati, Sune Tjalfe Thomsen, Frauke Urban, Tom Walsh

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Technology Collaboration Programme

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