



SUMMARY AND COMPARISON OF ALTERNATIVE FUEL OPTIONS

GREEN VOYAGE
2050



What have we looked at so far?

Availability

Feedstock and
production
infrastructure

Applicability

Existing fleet and
bunkering
infrastructure

Technology maturity

TRL (production
and use)

Energy density

Requirement of
space for fuel
storage

Economic

Cost – fuel,
bunkering and
ship modifications

Safety

Safety in
operation and
toxicity

Standards

Existence of
standards and
certifications

Global sustainability

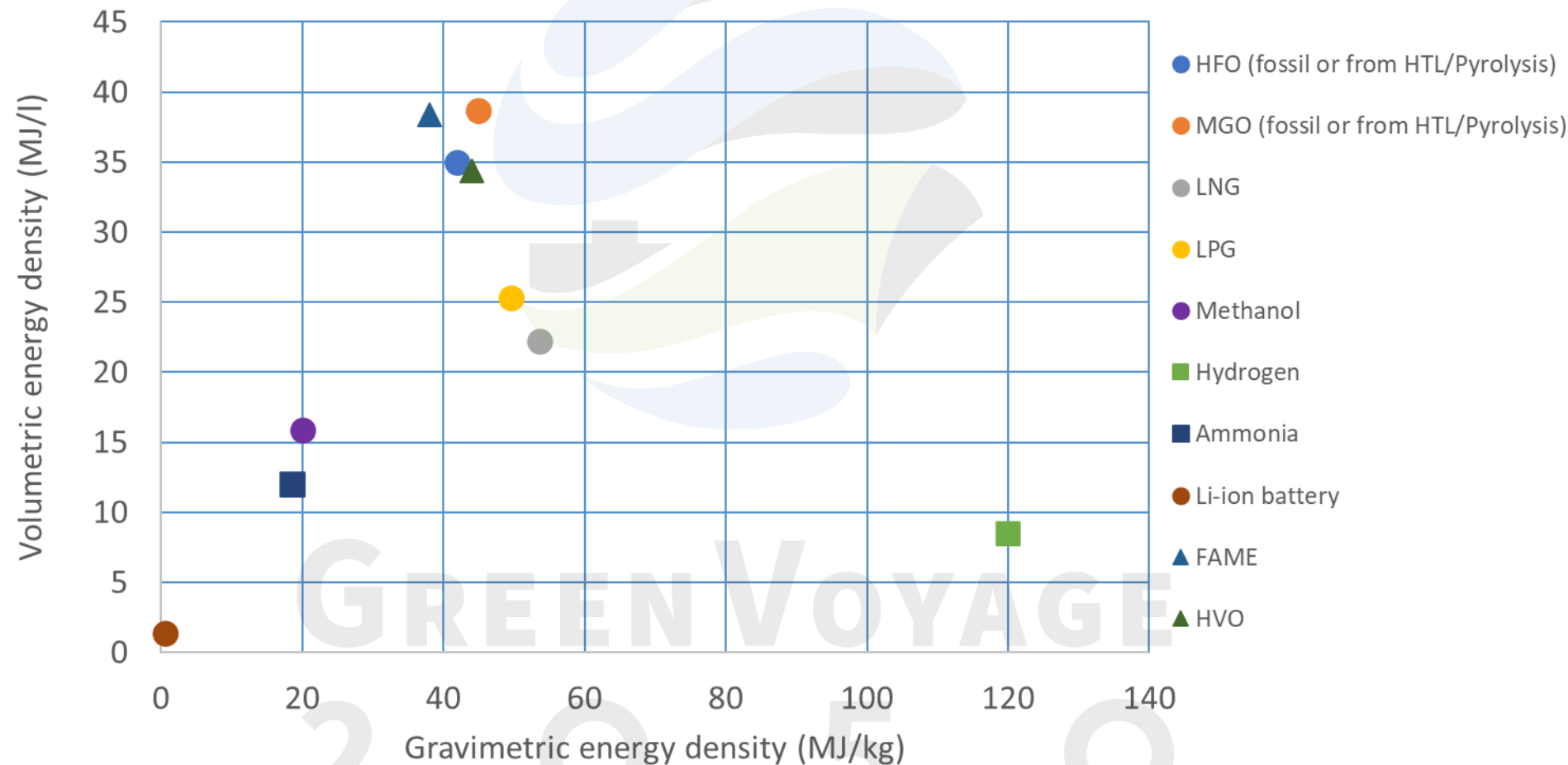
Direct and
indirect GHG

Local sustainability

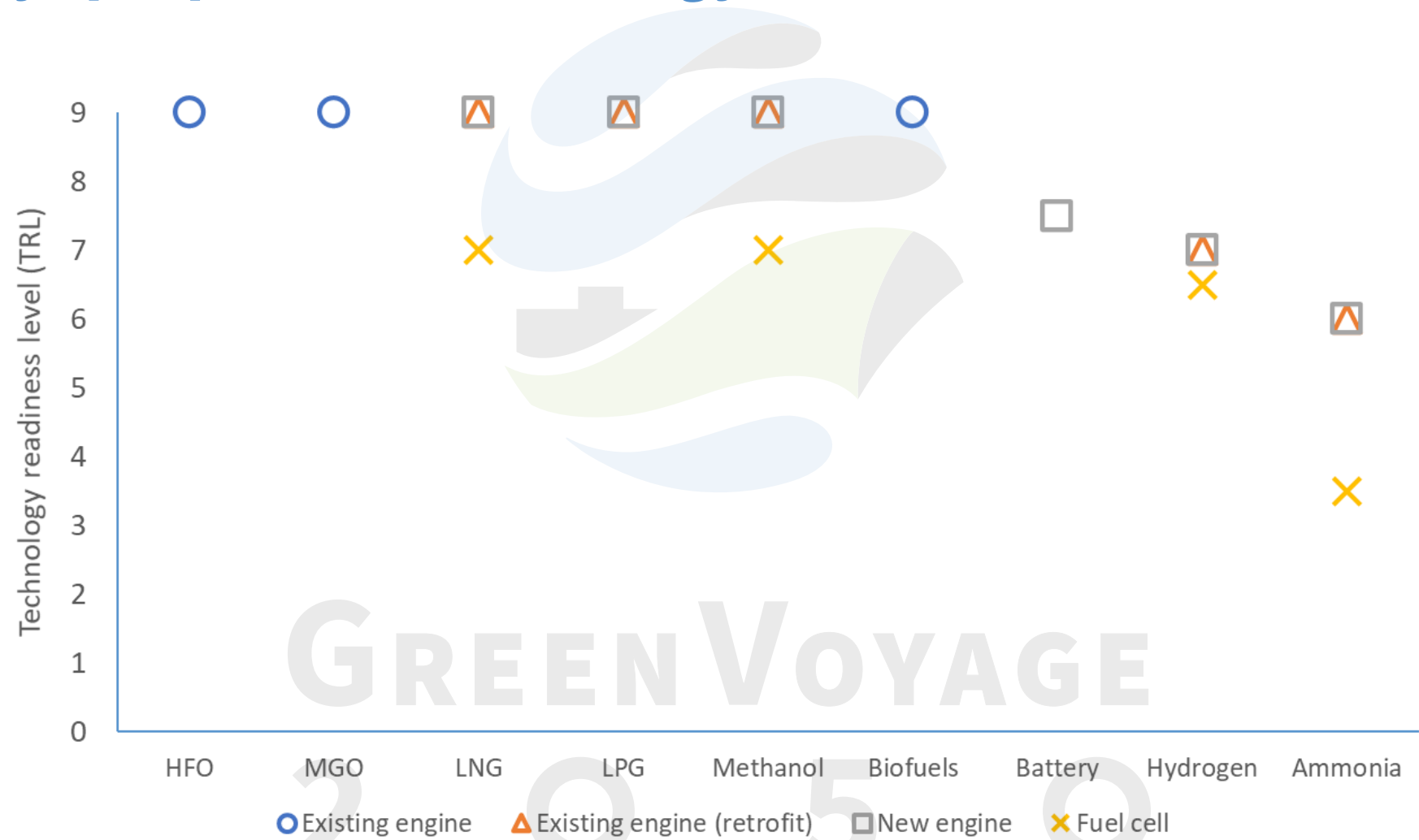
Air pollutant
emissions,
impacts on water



Summary: Energy density



Summary: propulsion technology readiness level



Fuel cost – summary of key drivers

Fuel production route	Fuel type	Key cost drivers	Cost reduction potential
Fossil + CCS	Blue methanol	- Natural gas price - CCS CapEx - CO₂ capture cost (methanol only)	High for CCS
	Blue hydrogen		
	Blue ammonia		
Biofuels	Bio-methanol	- Feedstock cost - Conversion equipment CapEx	Medium
	HTL and pyrolysis oils	- Feedstock cost - Conversion equipment CapEx - Hydrogen cost	Medium/High
	HVO	- Feedstock cost - Hydrogen cost	Low
	FAME	Feedstock cost	Low
	Bio-hydrogen + ammonia	- Feedstock cost - Gasifier cost (bio-hydrogen)	Medium

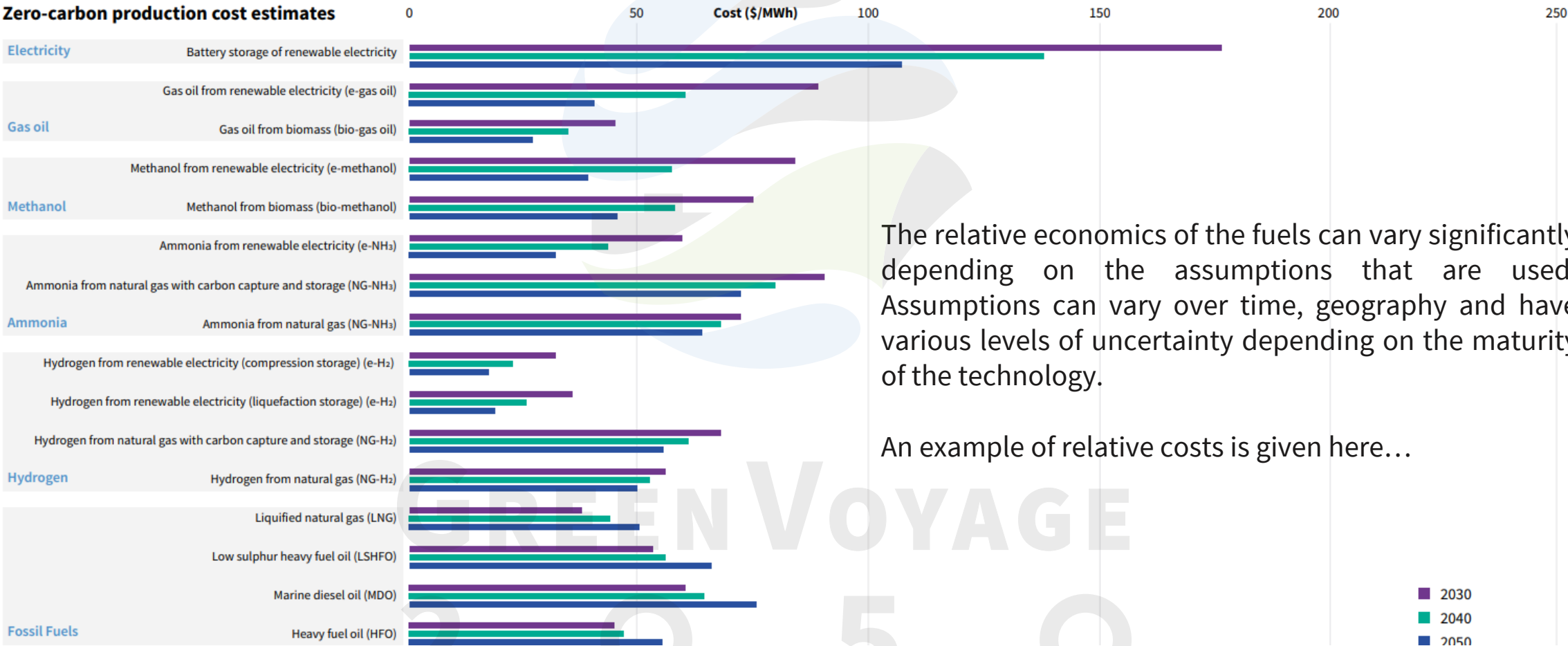


Fuel cost – summary of key drivers

Fuel production route	Fuel type	Key cost drivers	Cost reduction potential
E-fuels (with carbon)	E-methanol	- Green electricity cost - Electrolyser CapEx and utilisation - CO2 capture cost	Medium/high
	E-LNG		
E-fuels (without carbon)	Green hydrogen	- Green electricity cost - Electrolyser CapEx and utilisation	High
	Green ammonia		
Battery		- Cost of electricity - Battery CapEx	Medium



Summary: production cost



The relative economics of the fuels can vary significantly depending on the assumptions that are used. Assumptions can vary over time, geography and have various levels of uncertainty depending on the maturity of the technology.

An example of relative costs is given here...

Source: Zero-Emission Vessels: Transition Pathways (Fuel production cost estimates and assumptions), Lloyds Register and UMAS, 2019

