Update on the IMO Future Fuels & Technology Project (FFT Project)

Air Pollution and Energy Efficiency Team

Marine Environment Division, IMO Secretariat

5 | 5 | 2023

Study on the readiness and availability of low- and zero-carbon technology and marine fuels

Summary slide deck of final report, 5 May 2023

Tim Scarbrough
Ricardo

Tore Longva
DNV

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Introduction and context

- Study is part of Future Fuels and Technology project (FFT Project)
- **Aim**: assess state of availability and readiness of low- and zero-carbon ship technology and marine fuels
- **Context**: provide evidence for use in revision of Initial GHG Strategy
- Study **conducted** January to March 2023
- **Published**
  - Full report with 2 page executive summary https://www.imo.org/en/OurWork/Environment/Pages/Future-Fuels-And-Technology.aspx
  - 28 page summary submitted as MEPC 80/INF.10 https://wwwcdn.imo.org/localresources/en/MediaCentre/WhatsNew/Documents/MEPC80.INF10.pdf

Part A: What Are Possible Pathways To Decarbonise?

- Decarbonisation scenarios
- Sector energy demand

Part B: How Could We Meet These Pathways?

- Technology/commercial readiness
- Potential availability of fuels

Part C: is it feasible to meet these decarbonisation scenarios?

- Feasibility assessment
- Conclusions

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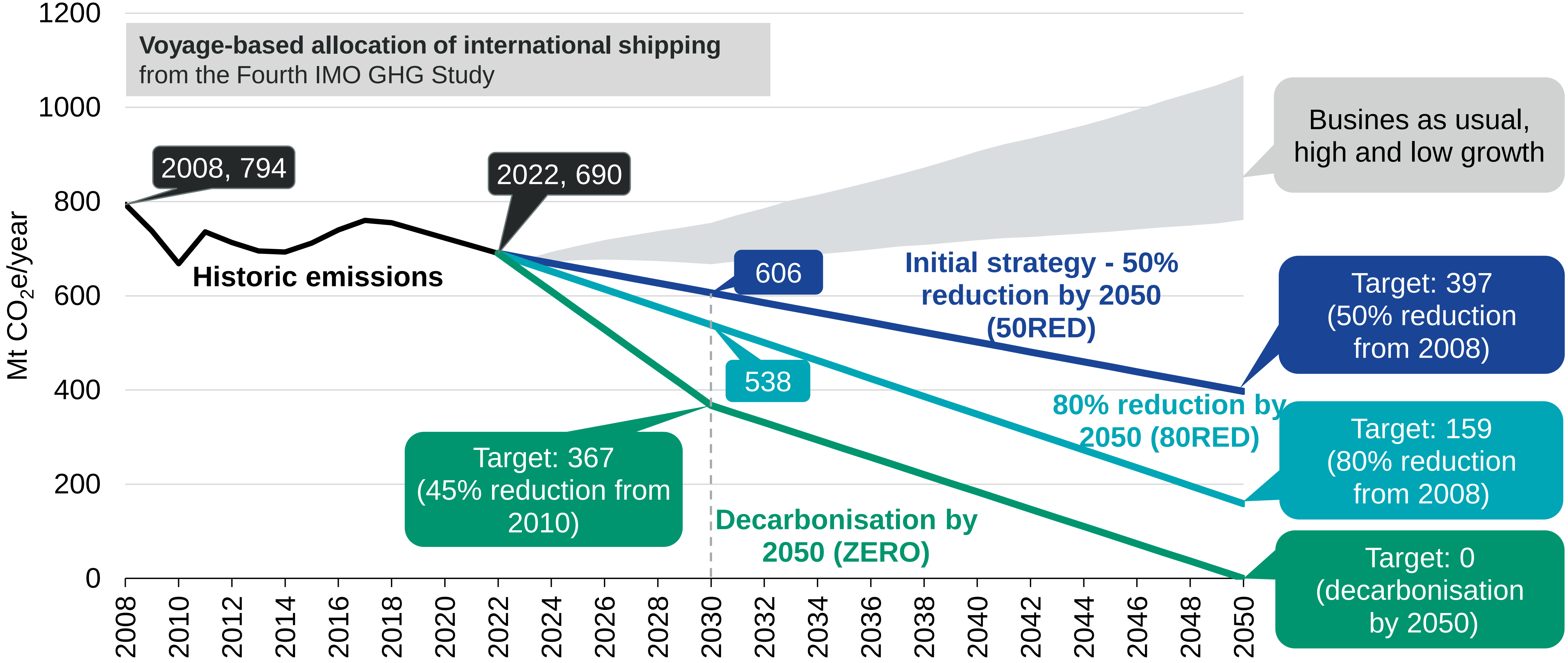
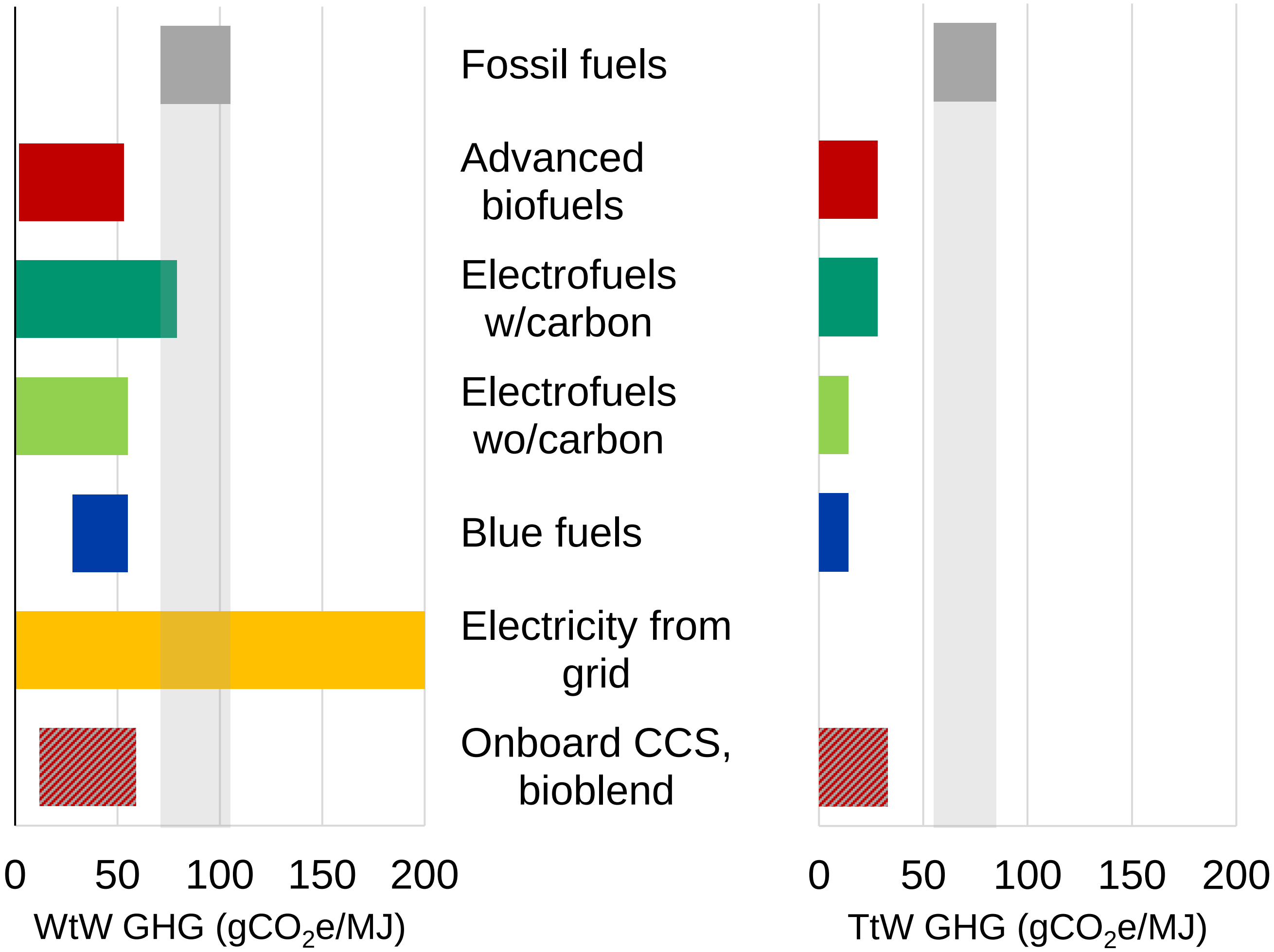
Three working decarbonisation scenarios as options to bound the potential Revised Strategy

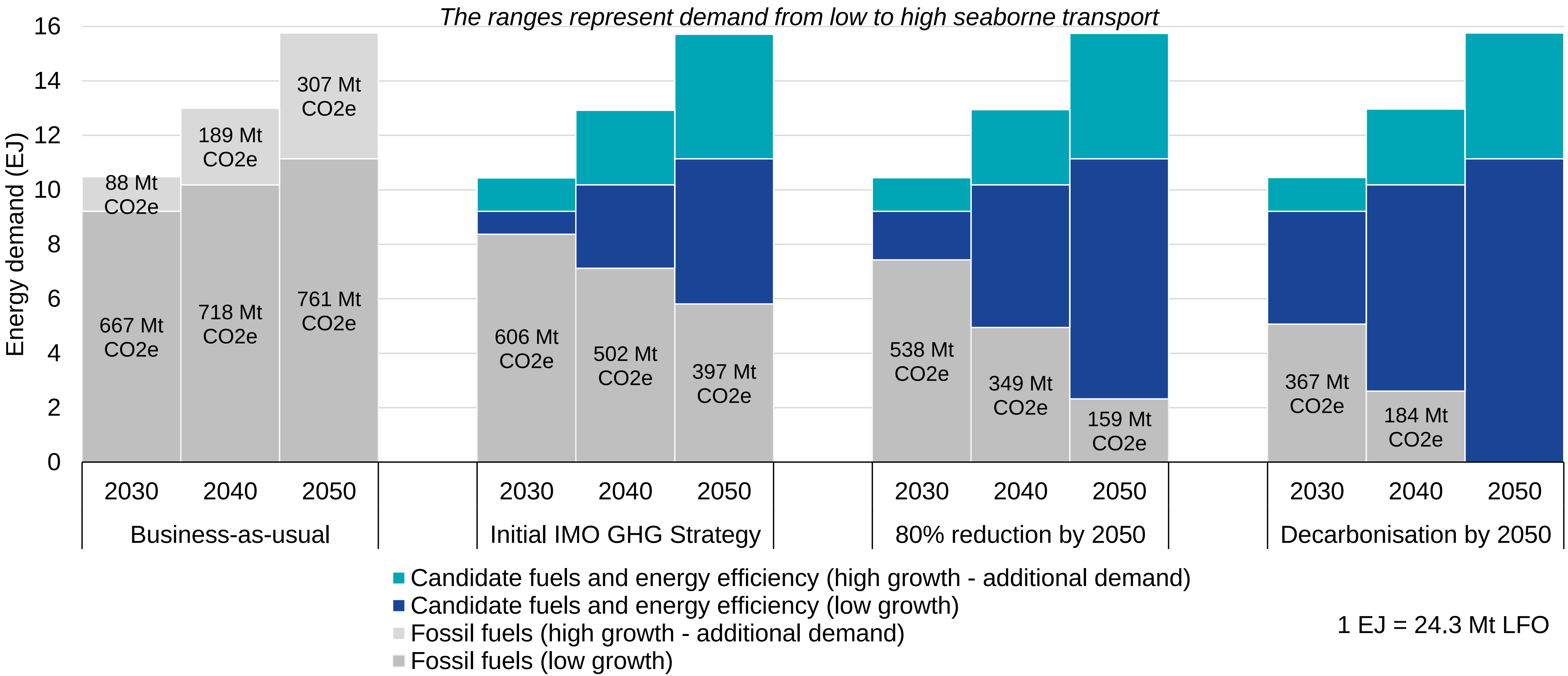


Candidate fuels identified based on well-to-wake and tank-to-wake GHG emissions



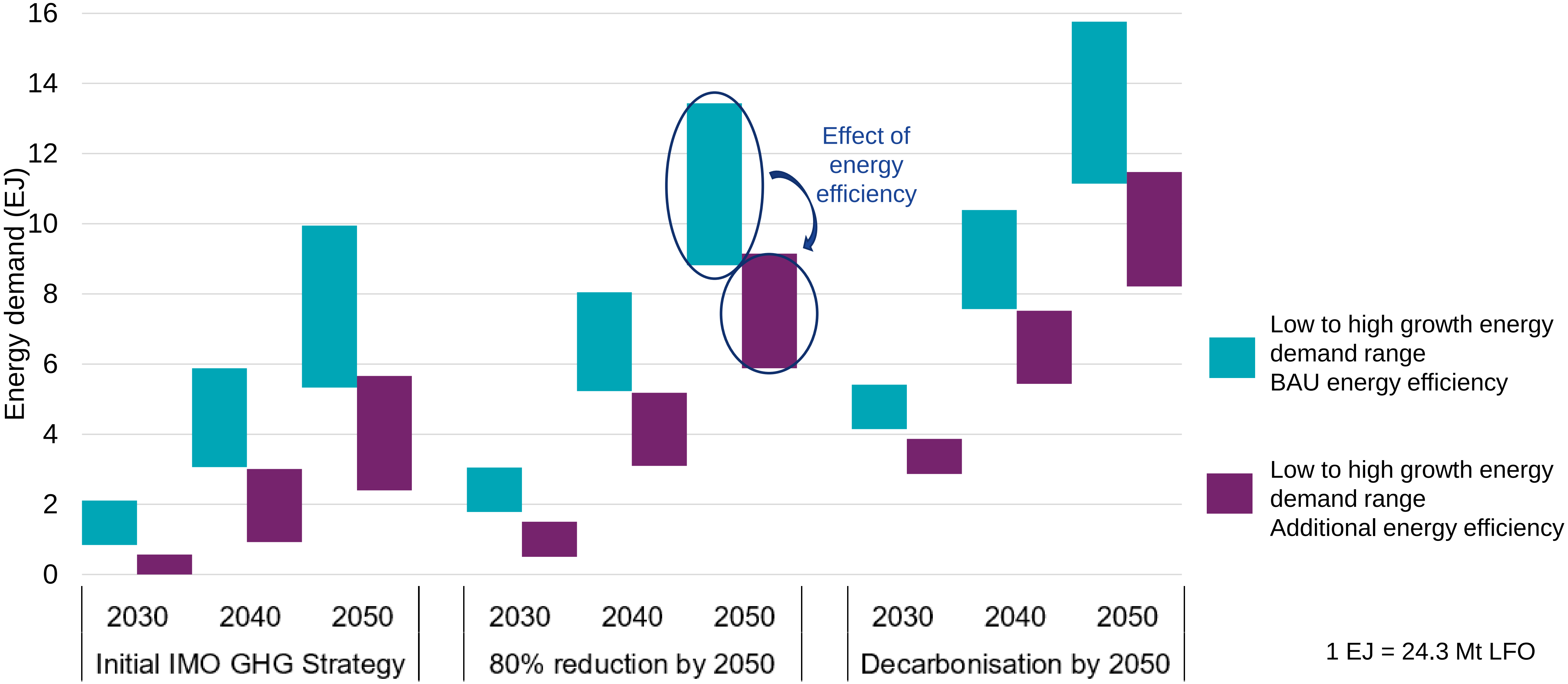
1. Candidate fuels identified from review of WtW and TtW emissions
2. Candidate fuels have significantly reduced WtW emissions.
3. For the purpose of achieving the targets, candidate fuels are assumed to have zero TtW GHG emissions
4. No carbon credits / offsets from other sectors
5. Includes CO_2, CH_4 and N_2O, based on GWP100
6. Not prejudging whether Revised GHG Strategy should cover WtW or TtW

GHG reduction targets determine maximum amount of fossil fuel and minimum energy to be supplied by candidate fuels or energy demand reduction



1 EJ = 24.3 Mt LFO

30% speed reduction and implementing all available energy efficiency measures can reduce energy demand by 15-27% but still high demand for candidate fuels to meet the decarbonisation ambitions



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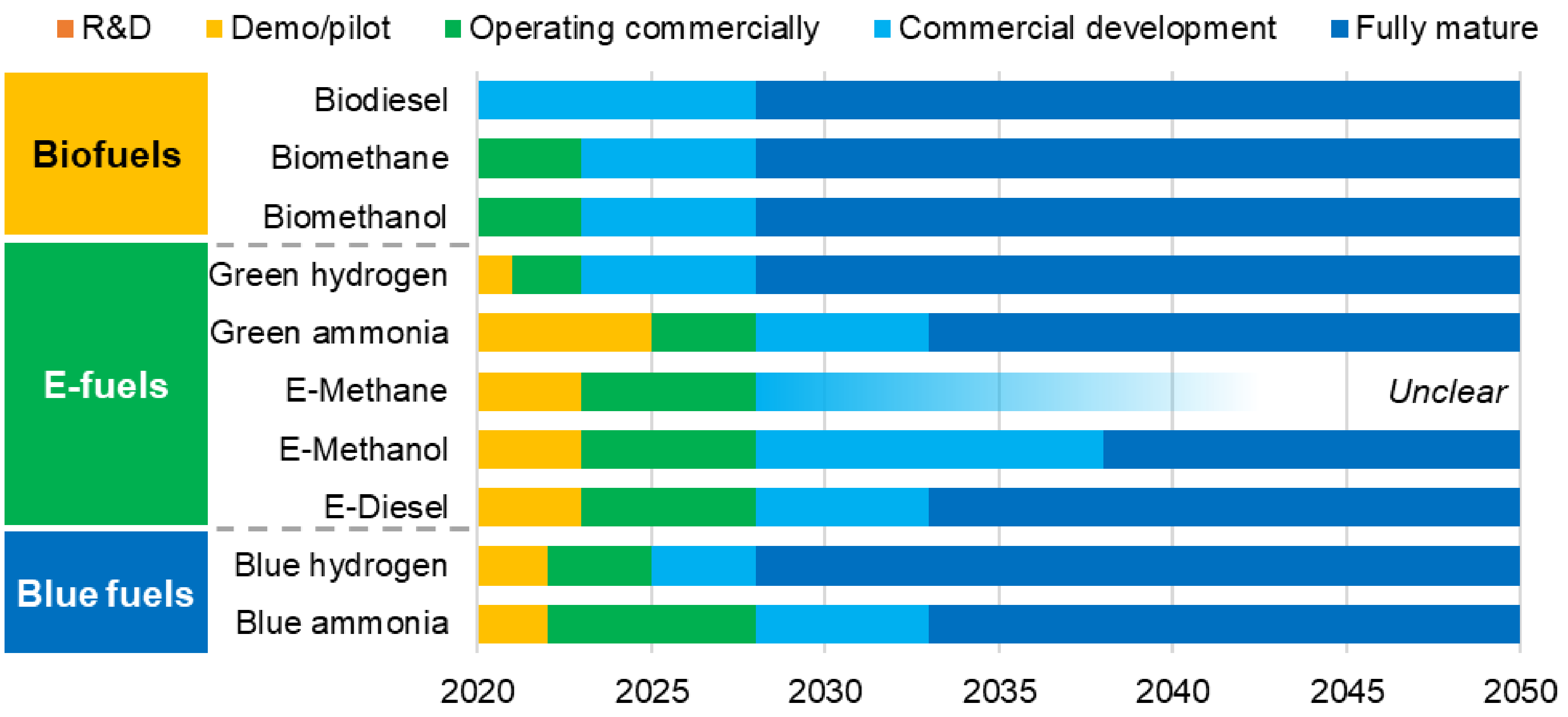
Technology Readiness Levels (TRL) extended to accommodate Commercial Readiness Level (CRL)

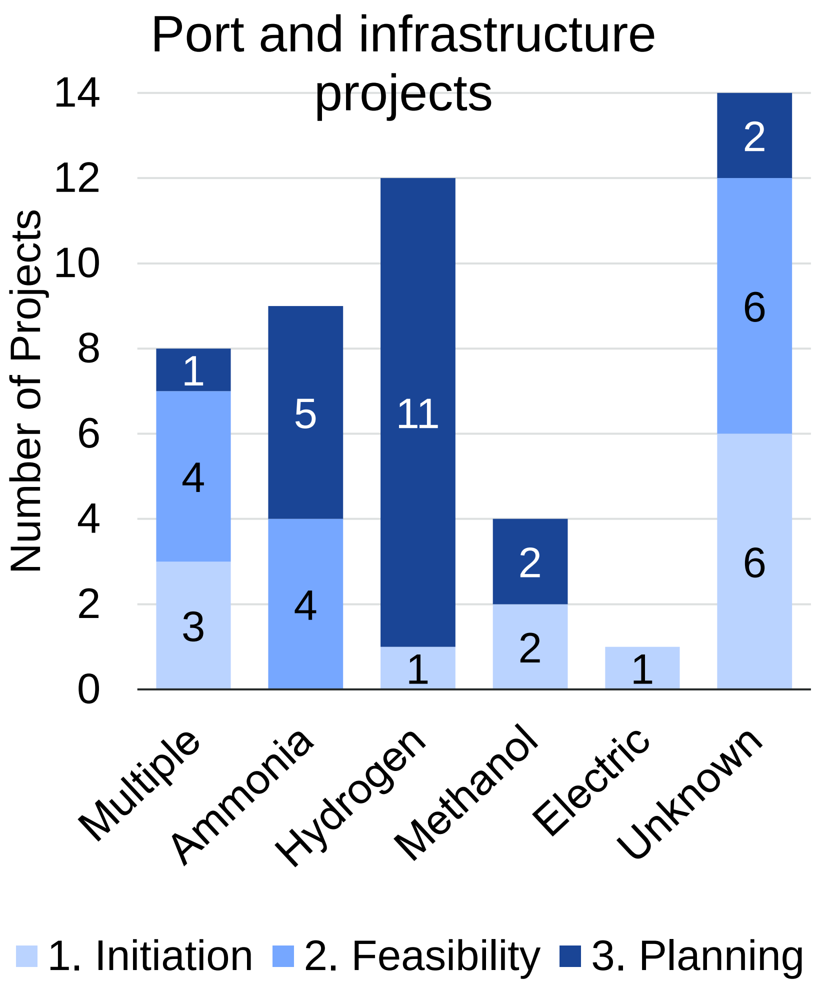
Maturity	Rating	Description of readiness level
Basic research	TRL1	Basic principles of scientific research observed and reported
	TRL2	Invention and research of practical application
	TRL3	Proof of concept with analytical and experimental studies to validate the critical principles of individual elements of the technology
Development	TRL4	Development and validation of component in a laboratory
	TRL5	Pilot scale testing of components in a simulated environment to demonstrate specific aspects of the design
	TRL6	Prototype system built and tested in a simulated environment
Demonstration	TRL7	Prototype system built and validated in a marine operational environment
	TRL8	Active commissioning where the actual system is proven to work in its final form under expected marine operating conditions
Deployment: early adoption	TRL/CRL9	Operational application of system on a commercial basis – technically ready but limited number of vessels/first-of-a-kind facilities
	CRL10	Integration needed at scale: solution is commercial but needs further integration efforts to achieve full potential – may be 100's or a few 1000 vessels or small number of at-scale facilities, small share of market
Mature	CRL11	Proof of stability reached, with predictable growth

The technologies and fuels needed to meet the demand will be commercially ready in time, and earlier than shown if a clear signal of demand is given

- Technology Readiness Levels (TRL) extended to accommodate Commercial Readiness Level (CRL)
- Reviewed 100+ literature sources and consulted / validated with stakeholders
- Evaluated forecast readiness (TRL/CRL):
  - Energy saving and efficiency technologies
  - Fuel production pathways
  - Propulsion tech: engines and fuel cells
  - Onboard carbon capture
- These graphics are forecasts based on today's situation (ambition, policies)

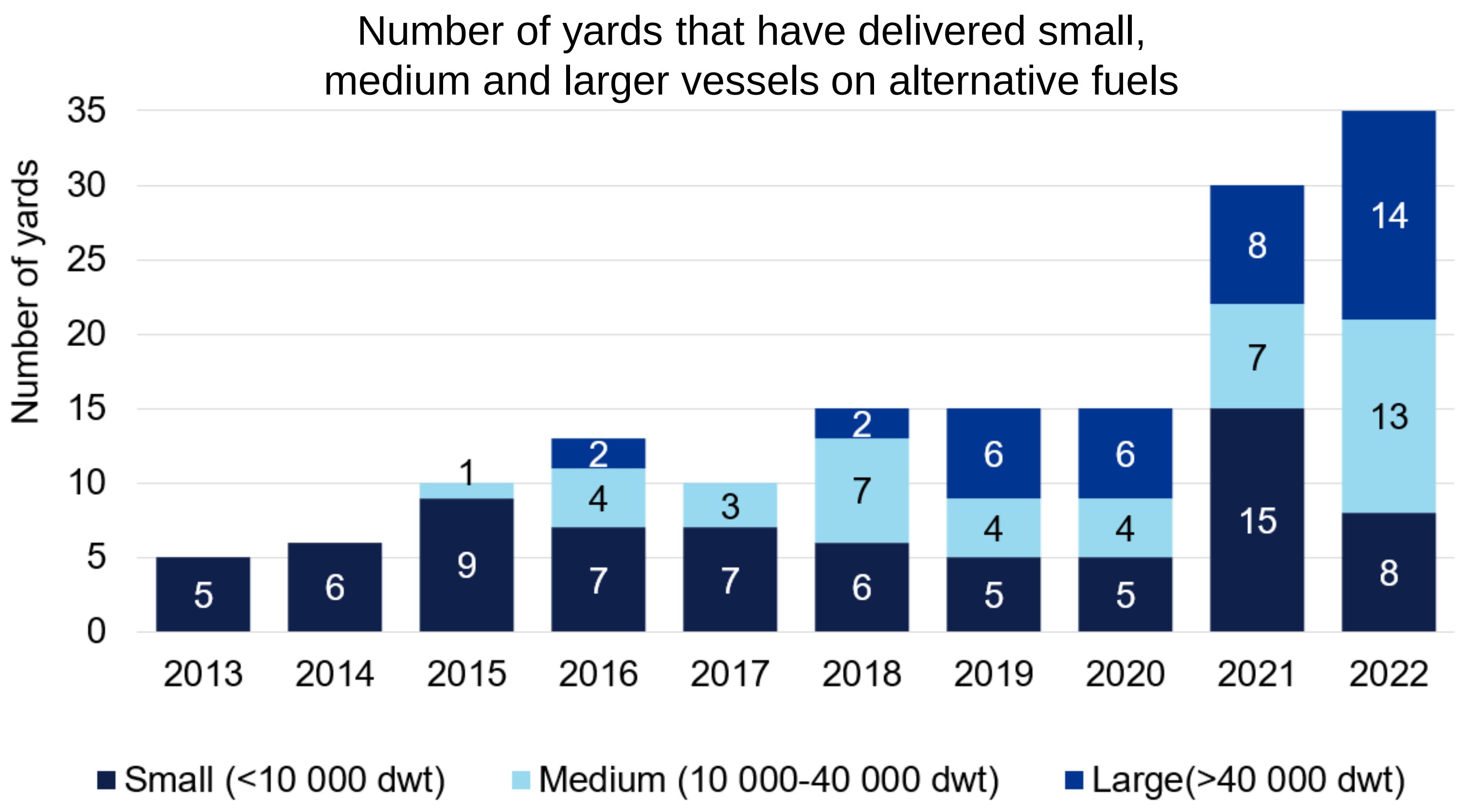


Existing orderbook drives demand for bunker facilities
48 candidate fuel production projects identified



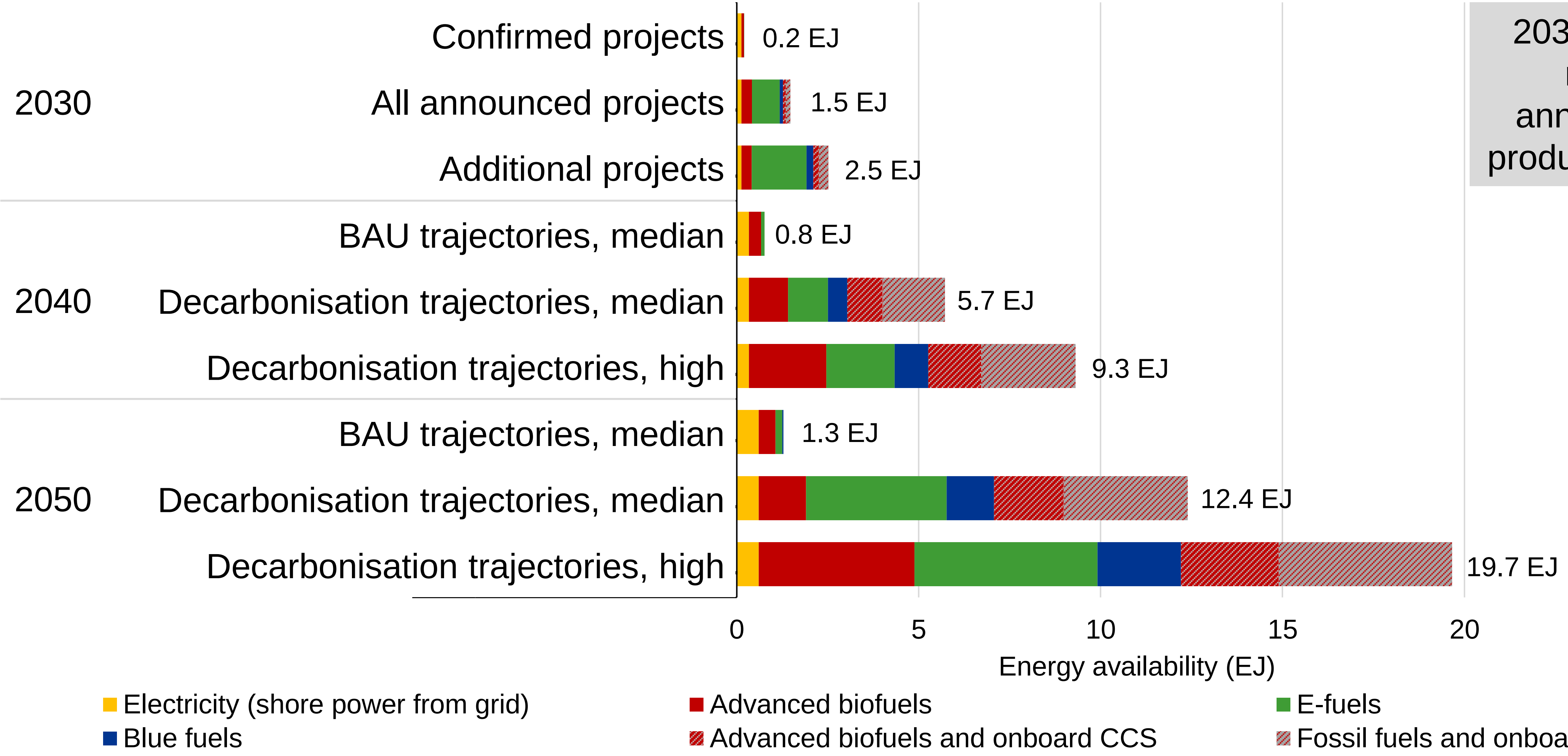
Fuel types	**Distribution and storage**	**Bunkering infrastructure**
Fuel oils (e-diesel, bio-diesel)	Can use existing distribution and storage facilities for conventional fuel	Can use existing bunkering infrastructure
Gaseous fuels (e-methane, bio-methane)	Can use existing distribution and storage facilities for LNG	Can use existing LNG infrastructure
Methanol (e-methanol, bio-methanol)	Existing storage and distribution infrastructure: methanol terminals, already traded by ships	Successful demonstration bunkering operations, ship-to-ship bunkering possible. Partially developed bunkering infrastructure.
Ammonia (e-ammonia, blue ammonia)	Existing storage and distribution infrastructure: ammonia terminals, already traded by ships	No bunkering infrastructure today, and no bunkering operations demonstrated. Barriers remaining to be solved.
Hydrogen (e-hydrogen, blue hydrogen)	No existing distribution infrastructure	No existing bunkering infrastructure Local bunkering demonstrated. Barriers remaining to be solved.

Shipyards can scale up to match candidate fuel roll-out



- Increasing number of alternatively fuelled vessels being built
- Diversifying number of shipyards delivering candidate-fuelled vessels
- Historically yards have been able to increase production significantly in a short time
- Capacity to scale up the production and installation of energy converters, energy efficiency technologies and onboard CCS plants over short time periods once demand is clear

Potential for significant availability of energy to achieve decarbonisation scenarios but depends on firm demand



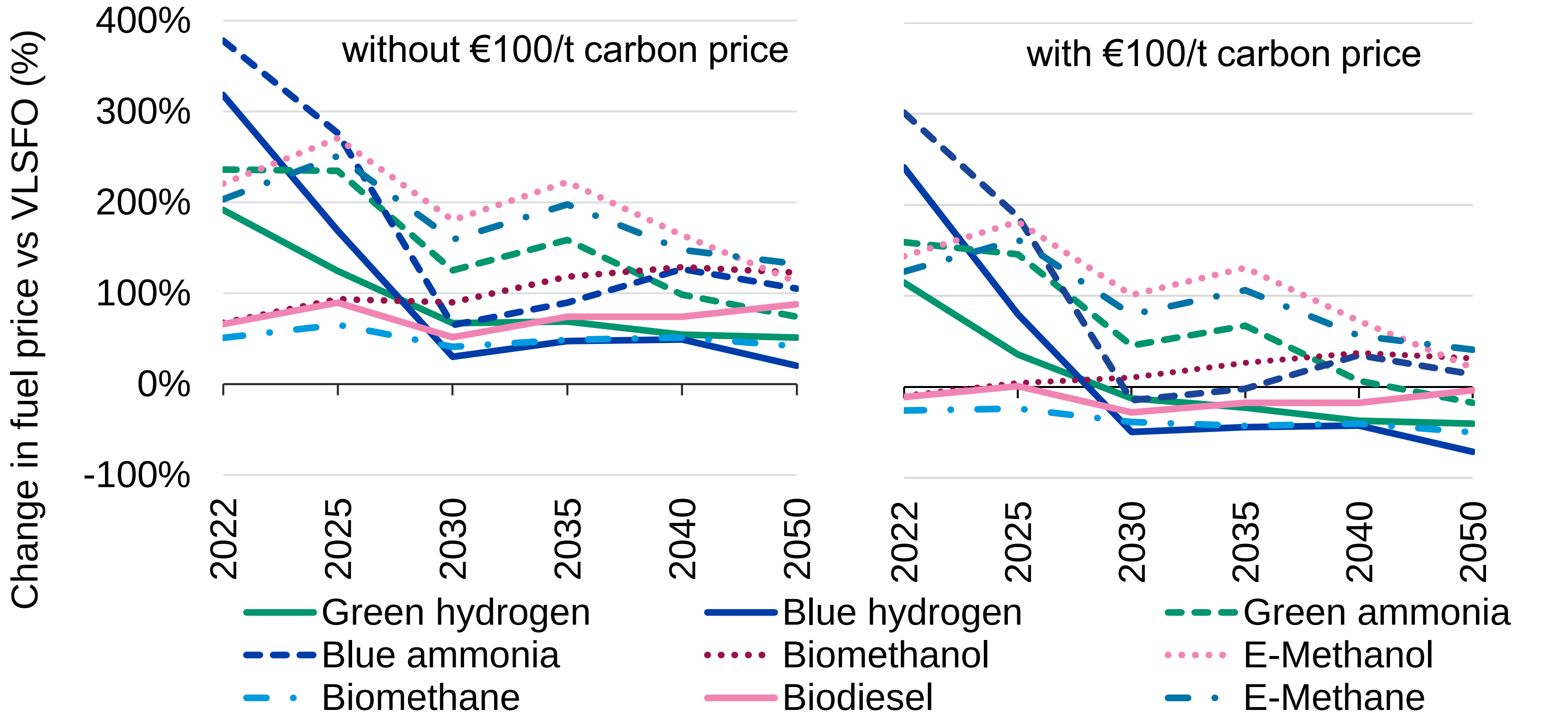
2030: Based on review of announced fuel production projects

2040 and 2050: Based on review of energy system forecasts, e.g. IEA, IRENA

If there is a clear signal of demand, the price differential of candidate fuels is not a barrier to their uptake for the shipping industry

Higher prices of candidate fuels on their own are not a barrier: the barrier is the current uncertainty, in the absence of a clear demand signal, of when and by how much fuel prices could change

Forecast costs relative to VLSFO accounting for additional energy efficiency measures



The increased capital costs of vessels using candidate fuels will not be a significant barrier to adoption

Upfront costs of some alternatively fuelled vessels can already be managed today

The high capital costs of onboard carbon capture systems are anticipated to be a barrier to adoption

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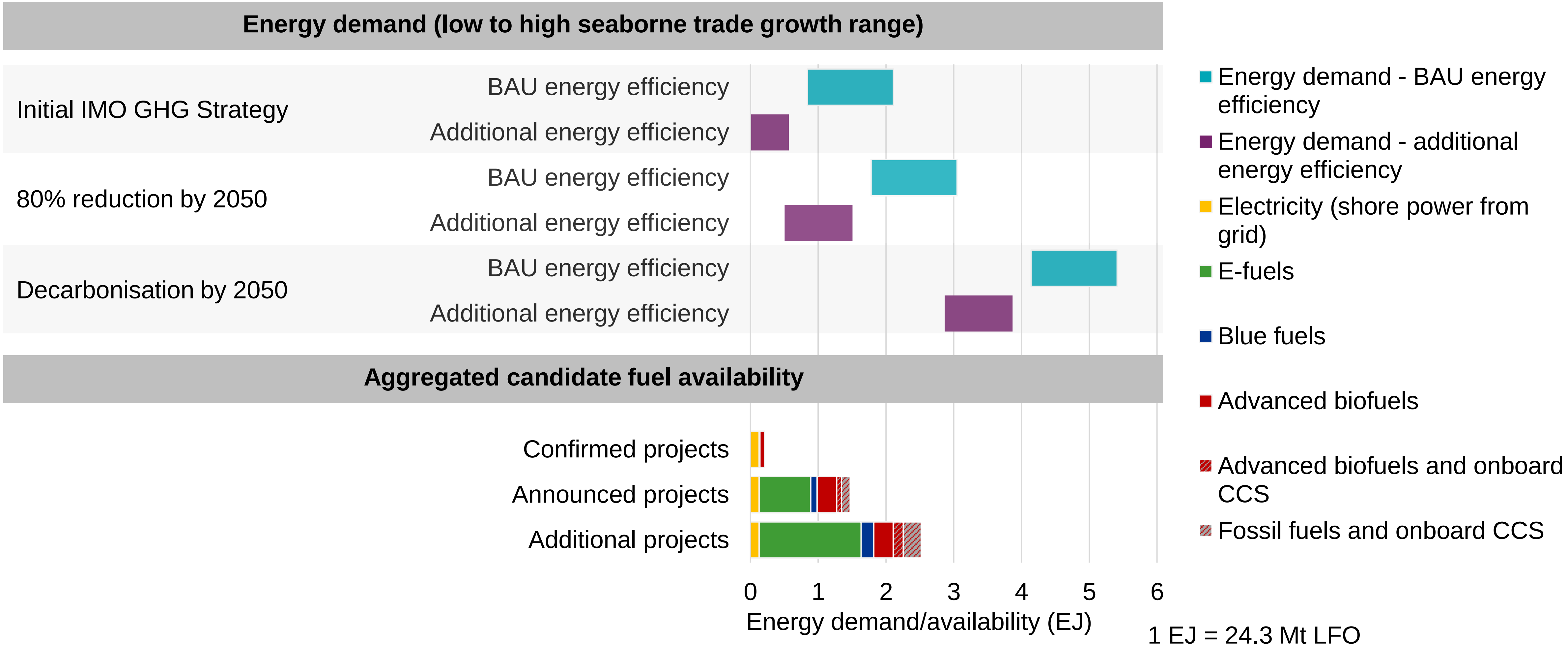
2030 feasibility			
	Initial IMO GHG Strategy:	✓	Feasible with increased policy ambition
	80% reduction by 2050:	✓	Feasible with increased policy ambition
	Decarbonisation by 2050:	✗	Major gaps



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2040 feasibility			
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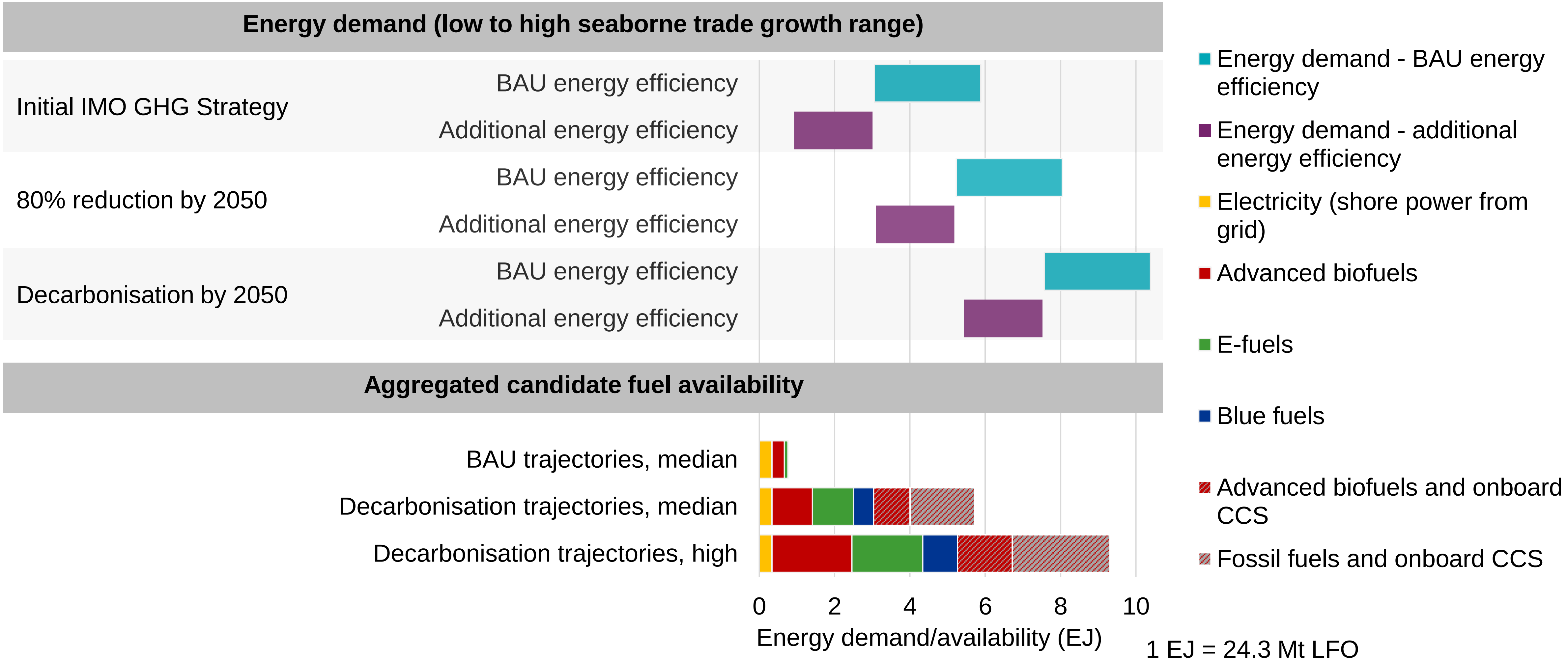

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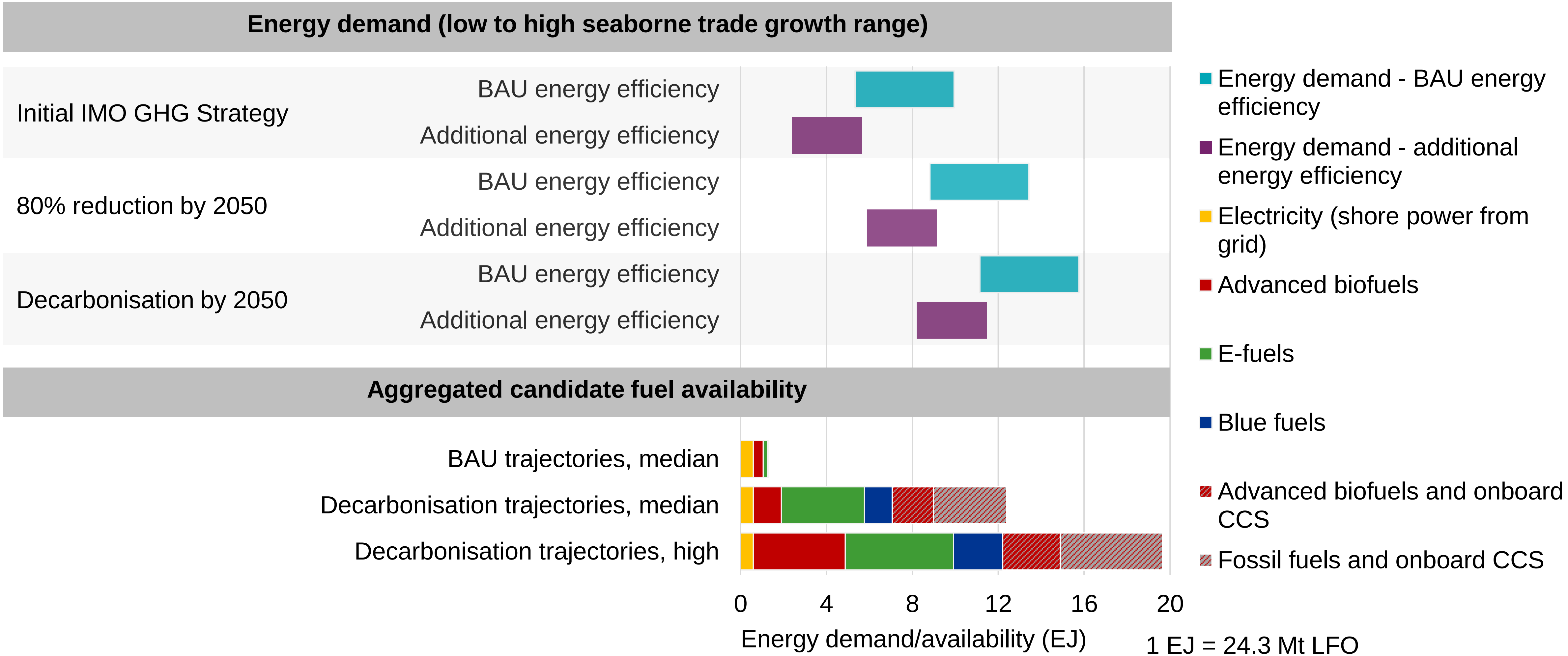
2050 feasibility			
	Initial IMO GHG Strategy:	✓	Feasible with increased policy ambition
	80% reduction by 2050:	✓	Feasible with increased policy ambition
	Decarbonisation by 2050:	✓	Feasible with increased policy ambition



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Conclusions

Achieving a more ambitious decarbonisation pathway than business as usual is feasible, with a strengthened level of ambition and implementation of further GHG reduction measures

- Not limited by commercial readiness of alternative fuels and technologies, nor infrastructure or shipyard readiness
- Current forecasts of readiness would accelerate if increased demand is agreed
- A clear signal of demand is needed to enable sufficient supply of candidate fuels, and needed very soon to enable meeting interim targets of decarbonisation scenarios
- The higher cost of candidate fuels than conventional fuels is not a barrier to deployment if the demand signal is clear.
- All three decarbonisation scenarios are expected to be feasible in 2040 and in 2050 if policies to transition the sector to a more ambitious decarbonisation pathway are agreed and implemented very soon

Decarbonisation scenario	2030		2040		2050	
Initial IMO GHG strategy	✓	Feasible with increased policy ambition	✓	Feasible with increased policy ambition	✓	Feasible with increased policy ambition
80% reduction by 2050	✓	Feasible with increased policy ambition	✓	Feasible with increased policy ambition	✓	Feasible with increased policy ambition
Decarbonisation by 2050	✗	Major gaps	✓	Feasible with increased policy ambition	✓	Feasible with increased policy ambition

Thank you – any questions, comments, follow-ups:

Ricardo
30 Eastbourne Terrace, London, W2 6LA, UK

Tim Scarbrough
Associate Director

+44 1235 753 159
Tim.Scarbrough@ricardo.com

www.ricardo.com

DNV

Tore LONGVA, MSc
Senior Principal Consultant, Regulatory Affairs

tore.longva@dnv.com
Mobile: +47 957 00 428
DNV, Veritasveien 1, 1322 Høvik
www.dnv.com

IMO INTERNATIONAL MARITIME ORGANIZATION

Ji-man Seo
Senior Professional Officer (FFT Project Manager)
Subdivision for Protective Measures
Marine Environment Division

4 Albert Embankment
London SE1 7SR
United Kingdom
www.imo.org

Switchboard: +44 (0)20 7735 7611
Email: JSeo@imo.org