

BAIN PRESENTATION | April 1<sup>st</sup>, 2025

# ON THE WAY TO **Net Zero**

**Forum on the  
decarbonization of  
the maritime transport**



**First global outlook on the  
maritime decarbonization  
solutions, including mix and  
total cost estimates for  
alternative fuels through 2050**  
detailed by region and segment, with a  
focus on the cruise sector



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## The maritime sector: ambitious emissions reduction targets


### The global ambition



### Regional trends

#### “FAST MOVERS”

**-80%**   
Carbon intensity  
by 2050

**-100%**   
Carbon intensity  
by 2040  
To be implemented  
by EPA by 2026,  
subject to new  
administration policy

**Net-  
zero**   
by 2050

#### “FOLLOWERS”



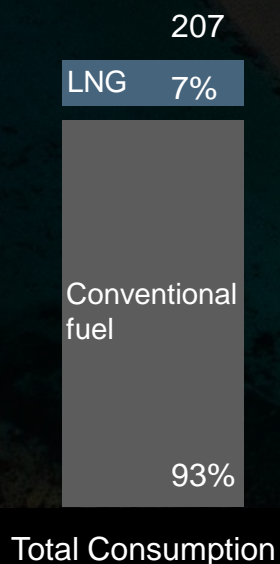
No clear pathway  
yet for RoW



**Shipowners:** owners are adapting by focusing on mature and available technologies and making their fleet more flexible in anticipation of future uncertainties (dual fuel)

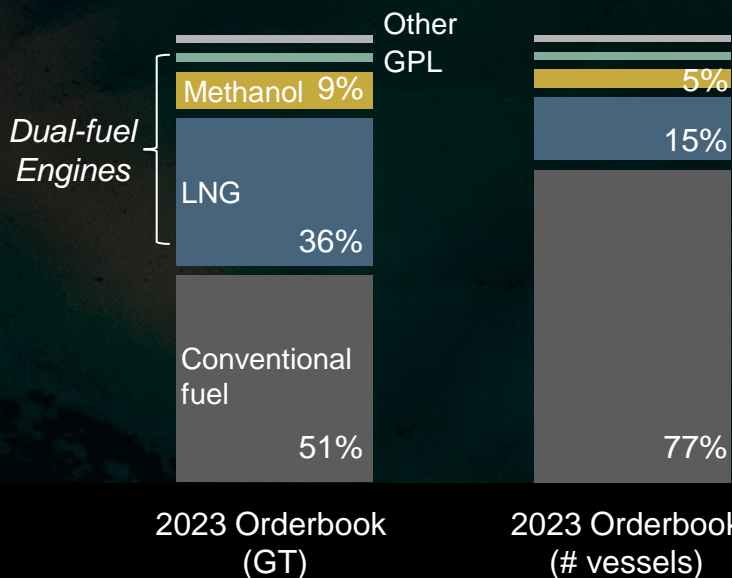
**~90% of consumption from traditional fuels**

Fuel consumption for ships >5.000 GT (Mtoe, 2021)



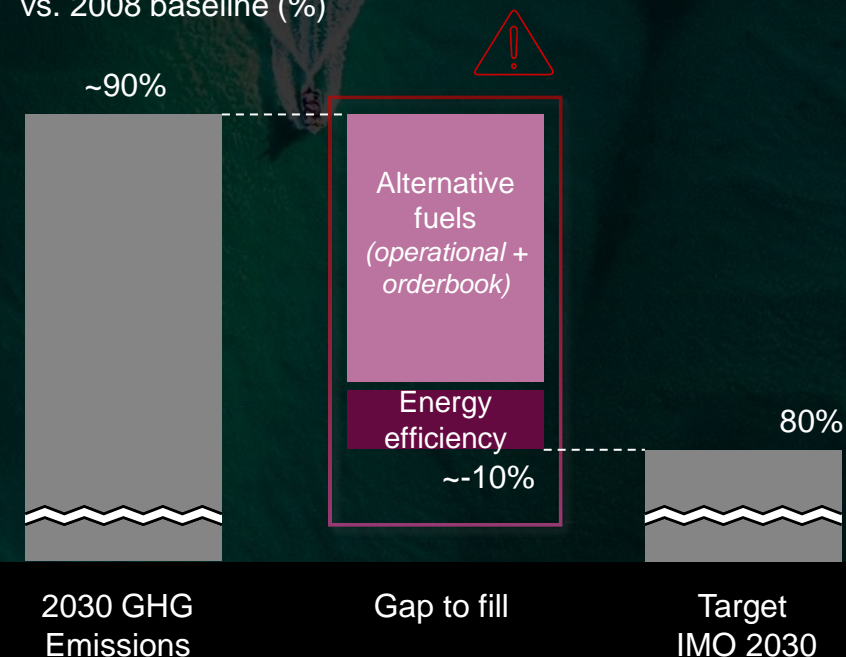
**New ship orders increasingly favor dual fuel, LNG, methanol**

Fuel uptake in world fuel on order (% of GT, 2023)



**Effort is yet not enough: ~10% gap to fill by 2030**

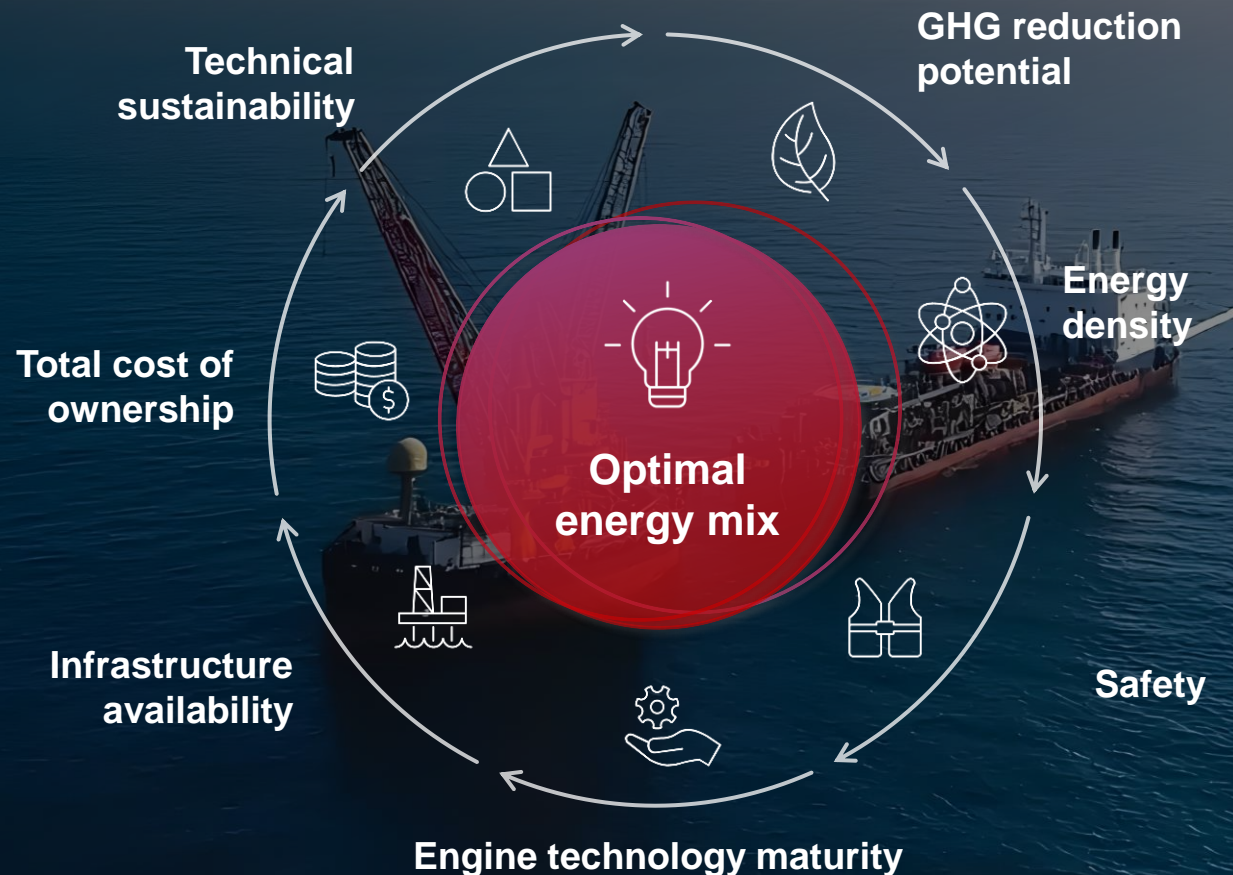
2030 GHG emissions vs. 2008 baseline (%)





**Methodology:** to define the fuel mix required for decarbonization, we assessed 3 different scenarios across 7 dimensions

**Factors analyzed by fuel type**



**Three scenarios assessed with varying degrees of:**



**Regulatory and policy uncertainty**











**Macroeconomic and price volatility**



**Availability of feedstock and fuels**



**Solutions compared:** no clear winner emerges; biofuels and bio-LNG are more mature alternatives; synthetics contribute significantly to achieving Net Zero

	FUEL	MATURITY	KEY POINTS	GHG REDUCTION POTENTIAL
Conventional Fuel	HFO, MGO, MDO		Conventional fossil fuel	0%
LNG	Fossil LNG		Transitional fossil fuel with mature technology, infrastructure under development, but <b>limited emission reduction capacity</b>	Max 20% <sup>1</sup>
	Bio-LNG		Produced from biomass, same key points as Fossil LNG, but with limited supply (~20 Mtoe by 2050), <b>also available via mass-balance</b>	90-120%
Bio-Fuel 2G	Bio-diesel (HVO)		Drop-in fuel, easy to handle and store, synergistic with existing infrastructure, <b>limited feedstock and strong competition</b>	80-90%
Methanol	Bio-methanol		Produced from biomass, easy to manage and store, with synergies in the chemical infrastructure; <b>limited feedstock and strong competition</b>	80-90%
Synthetic Fuels	e-Methanol		Produced from <b>green hydrogen and captured CO<sub>2</sub></b> , same key points as bio-methanol, <b>but biogenic CO<sub>2</sub> limitations from 2040</b>	90-100%
	e-Ammonia		Zero-carbon fuel with synergies in chemical and LNG infrastructure, <b>but concerns over safety and social acceptance</b>	90-100%
	Green Hydrogen		Zero-carbon solution, but limited by <b>low energy density and requires new bunkering infrastructure</b>	90-100%

Note: (1) Depending on engine type and related slip emissions



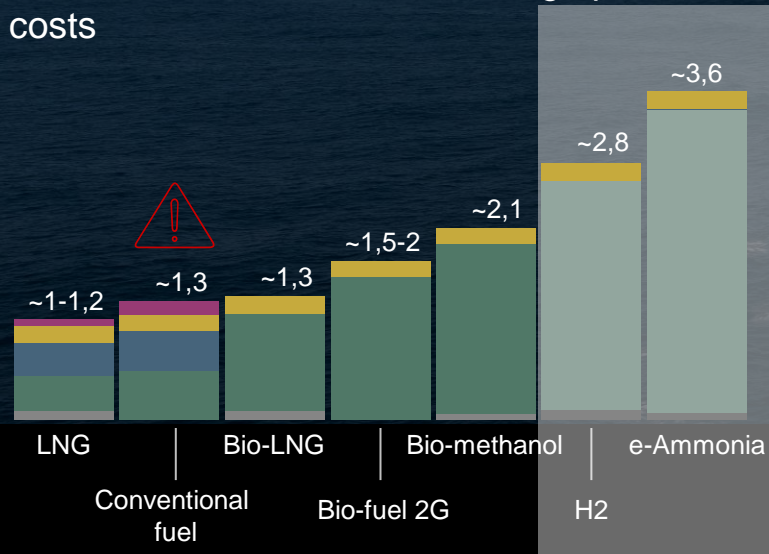


# Expected "Total" Cost evolution: in the short term, biofuels and bio-LNG are more competitive; synthetic fuels to become competitive only after 2040

"Total" Cost - Europe | k\$/t fuel oil

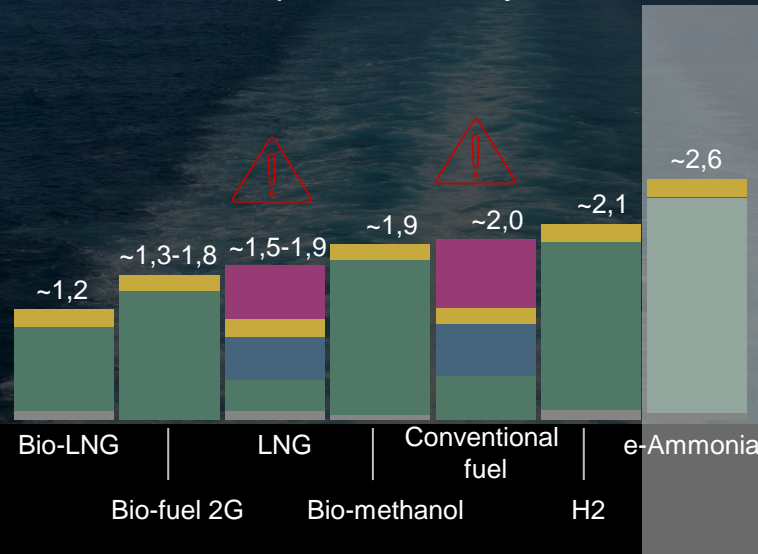
2030

**Synthetic fuels not competitive in 2030** due to lack of infrastructure and/or high production costs



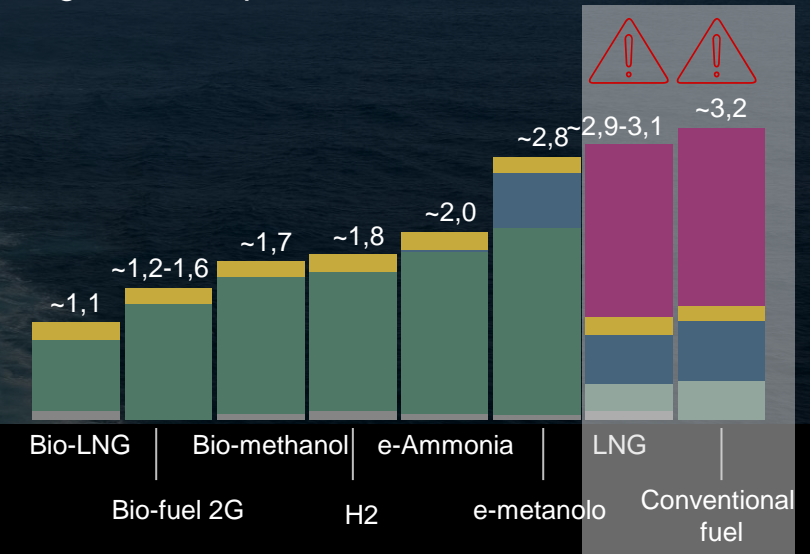
2040

**Synthetic fuels catching up vs. bioenergy,** but limited competitiveness by 2040



2050

**Fossil fuels not competitive in 2050** due to high FuelEU penalties



**Legend:** ■ Delta ship capex vs. conventional fuel ■ Fuel ■ CO2 Costs ■ Opex ■ FuelEU penalties ⚠ On their own, not compliant with current emission limits



**Outlook on fuel mix:** biofuel is the most attractive and resilient solution; LNG remains relevant until 2040, while a more diversified mix will be needed by 2050

### Fuel mix Europe | %

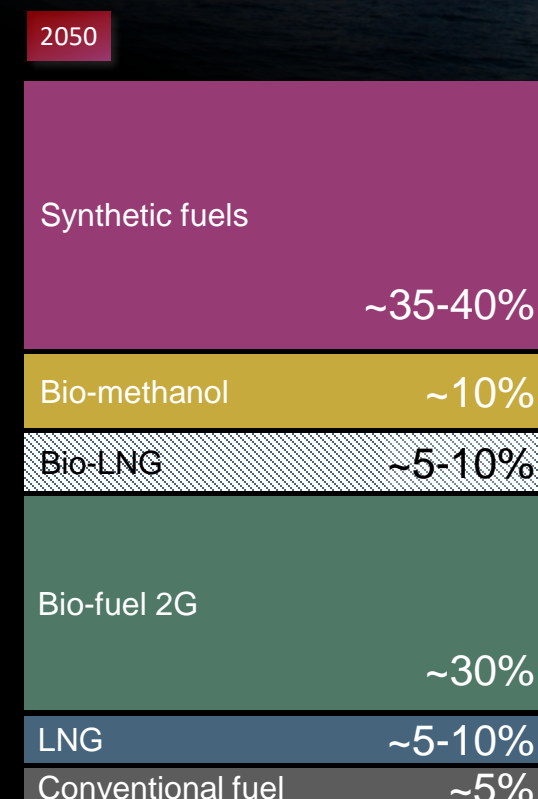
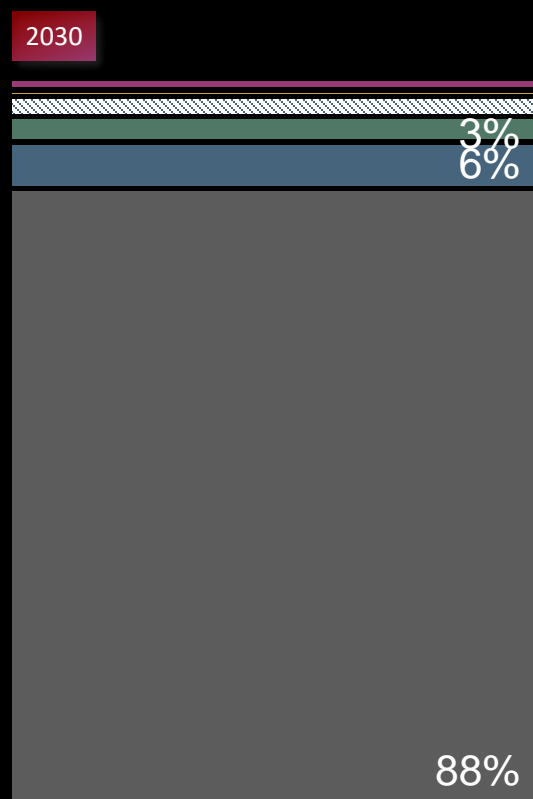
Estimate based on 2023 order book



-80%



~50 Mtoe



Saving GHG 2050



Bunkering demand by 2050





# Focus on cruise sector: higher penetration of synthetic fuels and H<sub>2</sub>

## Fuel mix Europe – Cruise | %

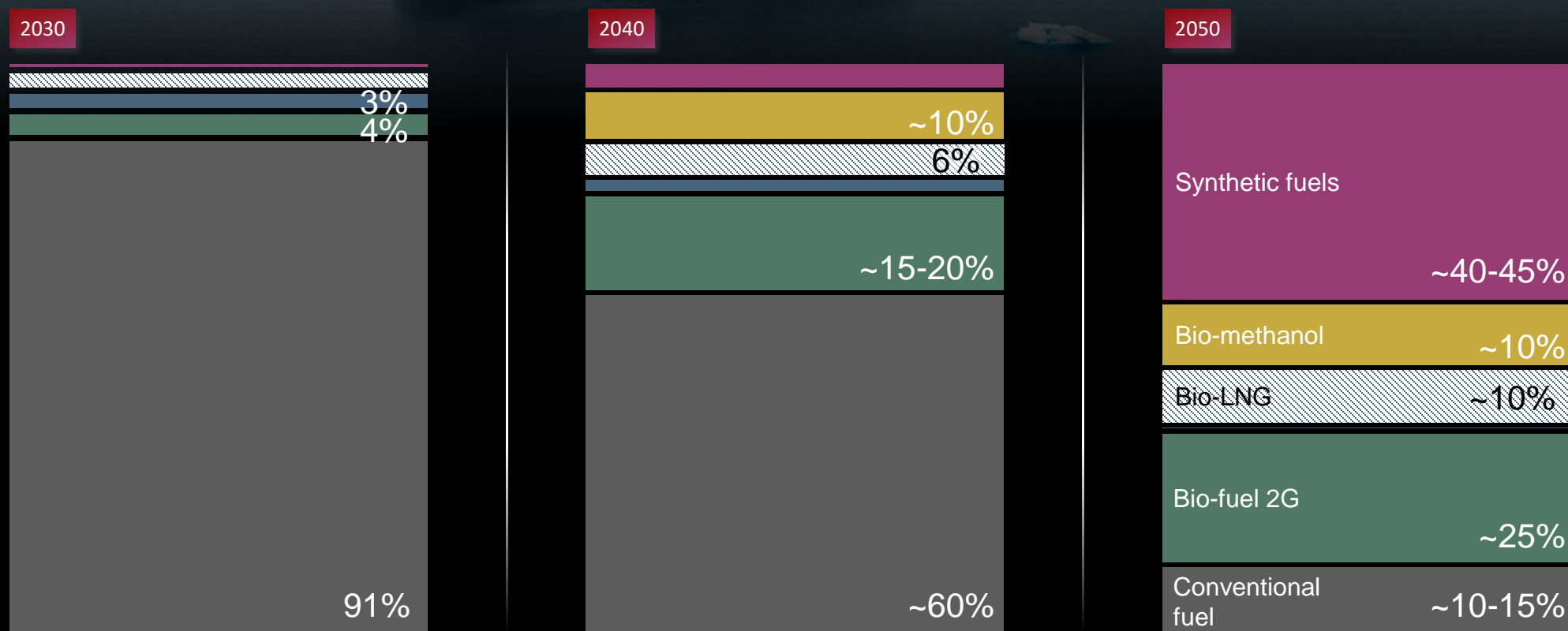
Estimate based on 2023 order book



-80%



~4 Mtoe



Saving GHG 2050



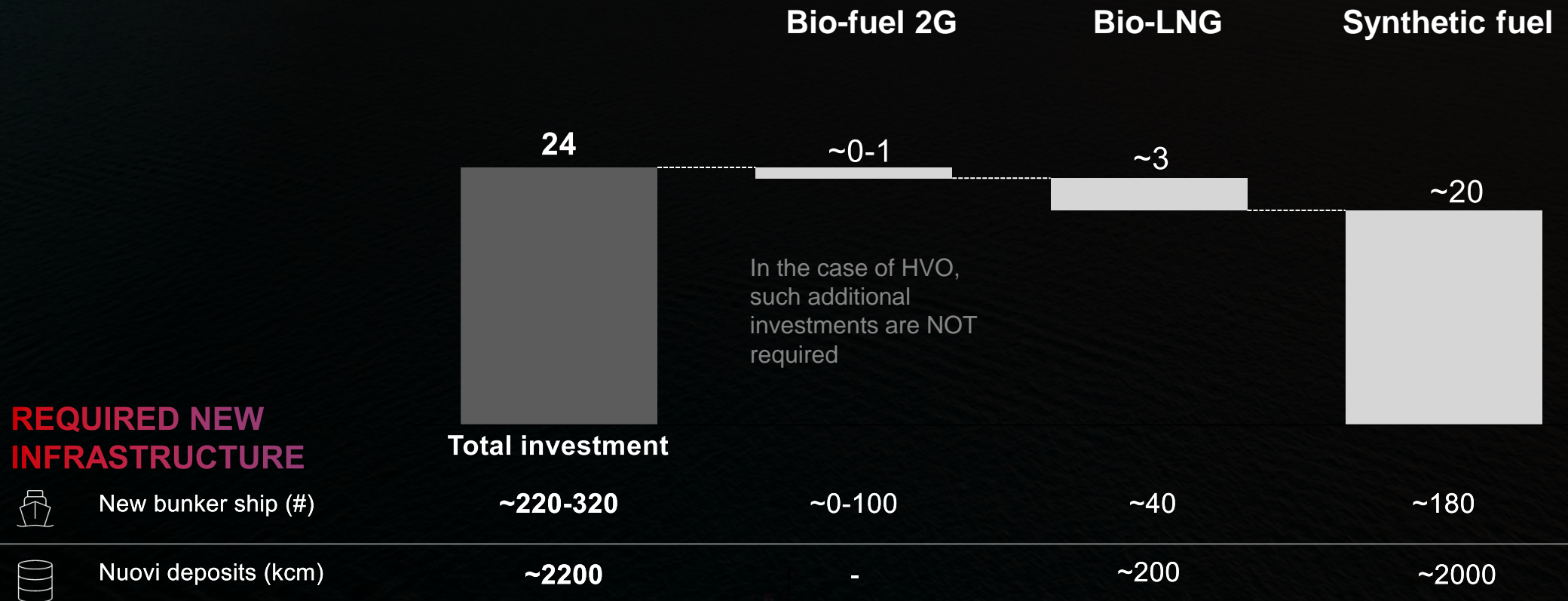
Bunkering demand by 2050





**Port adaptation cost:** \$24B needed to upgrade ports for bio-methanol/ synthetics supply; limited investment required for bio-LNG and marginal for bio-fuels

### Port adaptation costs at 2050 (Bn\$)





# Implications for the port system: new balances by 2050



## **Clear potential for “Multifuel Mega Hubs”**

Only few and larger ports, typically sitting in local industrial clusters, will likely be able to offer the full range of alternative solutions, mainly in Northern EU, Spain MED and US



## **Smaller Ports as “Fuel Specialists”**

Smaller and less integrated ports, often located near urban areas, are expected to specialize in 2-3 alternative fuels based on geographic factors and the types of vessels they serve



## **Fleet operators as responders**

Fleet operators will align their engine technologies and routing strategies with the availability of alternative fuels at competitive costs, as well as the readiness and flexibility of ports



# A “pact” across the value chain

1

**Ports: catalyze the transformation** and develop a flexible offer with a selective choice of 1–2 alternative fuels

2

**Fuel suppliers: adopt a customer-centric model** and ensure volumes, flexible supply agreements, and a reliable distribution supply chain

3

**Shipowners: define routes and technologies** by confirming multifuel technology choices and fuel supply partnerships; develop hub & spoke route models

4

**Shipbuilding:** continue to be a **driver of innovation**, with **targeted investments** to accelerate and concretely support fleet renewal

5

**Engineering and certification:** provide **efficient and cutting-edge services** to speed up port upgrades, retrofit certifications, alternative fuels, and training of operators and crews.

**Bain is ready to do its part and facilitate collaboration across the value chain**

THANK YOU

