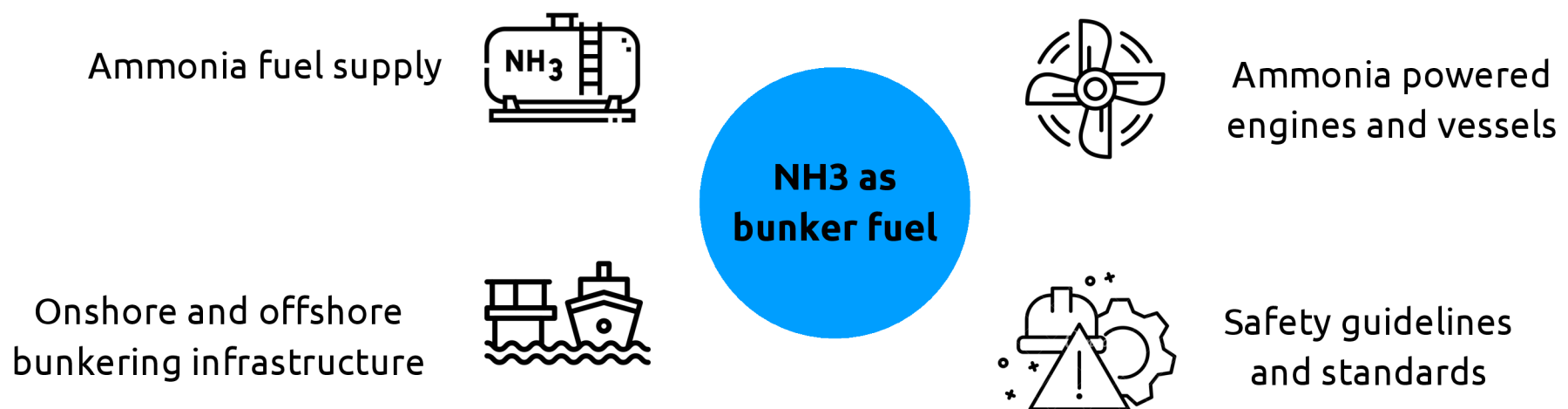


Enablers of ammonia bunkering

December 5, 2024

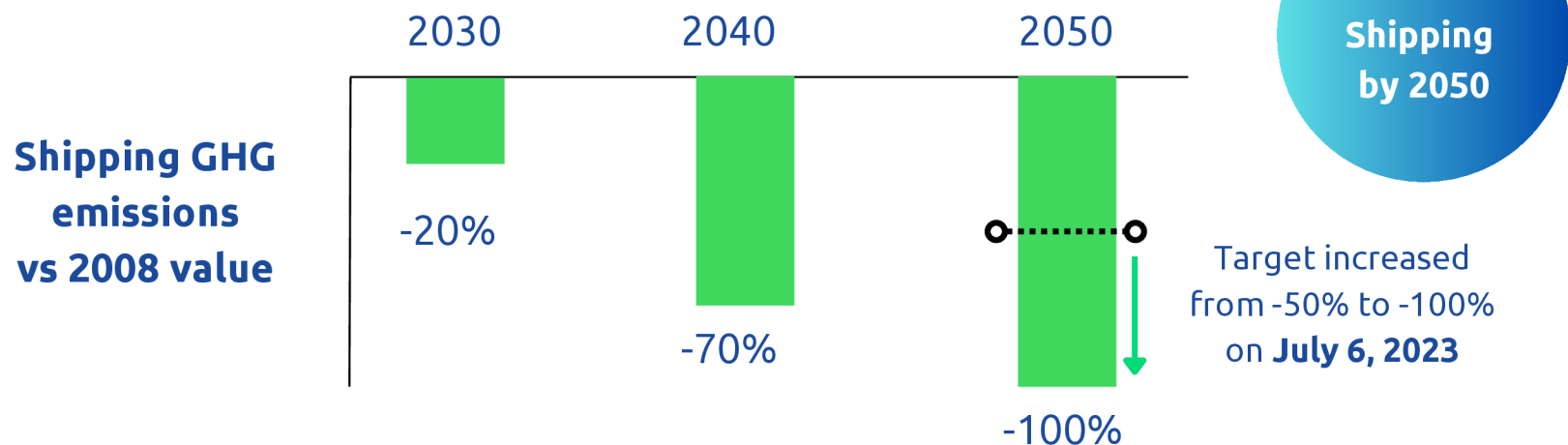


- ➔ **Ammonia bunkering contributes to IMO's 2050 target for net-zero emissions shipping**
- ➔ **Several enablers should come together to facilitate the transition to ammonia bunkering**
- ➔ **Future ammonia bunkering hubs will emerge where affordable and scalable ammonia supply is available**

Targets and regulations are driving demand for net-zero shipping



Decarbonisation Targets adopted on July 6, 2023



In 2025, IMO is anticipated to adopt a framework that will:

- 1) Phase in the mandatory use of low-emission fuels
- 2) Introduce a global maritime GHG emissions pricing mechanism



EU's binding regulation on maritime transport

EU Emissions Trading System (ETS)

Since January 2024, the EU ETS has been extended to cover CO₂ emissions from all large ships (of >5,000 GT) entering EU ports

FuelEU Maritime

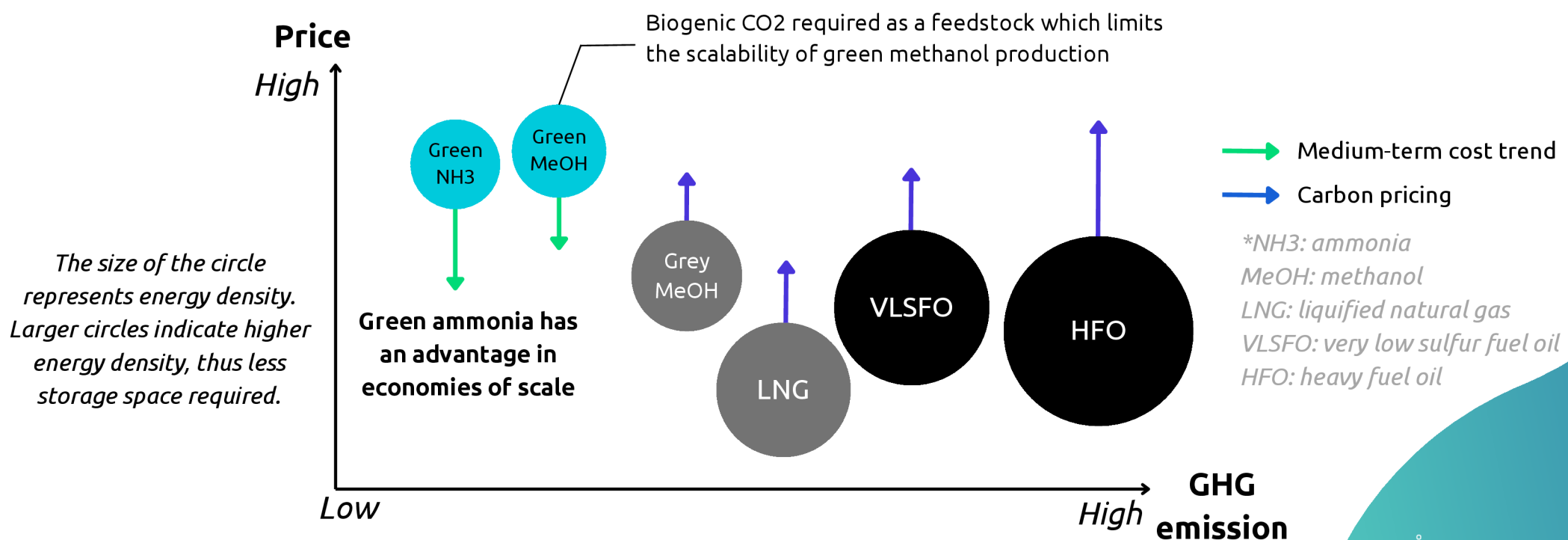
From 2025, large ship owners have to **reduce at least 2% emission intensity of energy used onboard** compared to 2020 levels, introducing renewable and low-carbon fuels

Why use ammonia for bunkering fuel?

There are several options to decarbonize the shipping industry

Short term	Medium to long term
1) Design modifications for new vessels to increase operational efficiency 2) Slow steaming 3) Switch to LNG	Alternative zero emissions fuels such as green ammonia and e-methanol

In order for alternative maritime fuels to replace conventional crude-derived bunkers, it needs to be **cost-effective**, **widely available** and **scalable** in terms of supply



Four enablers to make ammonia bunkering happen



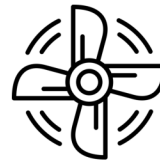
Ammonia fuel supply

Cost-competitive green ammonia, produced from regions with cheap and abundant renewable electricity, should be widely available and deployed

[Example]



Global portfolio of large-scale green ammonia projects



Ammonia-powered engines and vessels

The technology readiness of ammonia combustion engine and onboard handling and storage should reach a commercial level (TRL 8-9)

[Example]



First ammonia-ready engine tested in March 2024



Ammonia bunkering infrastructure

There needs to be an existing or new infrastructure to safely transport, store, and load ammonia to the vessel

[Example]



Developing bunkering facilities at Port of Salalah



Safety guideline and standards

Safety measures on how to handle ammonia should be established and recognized by reputable authorities

[Example]

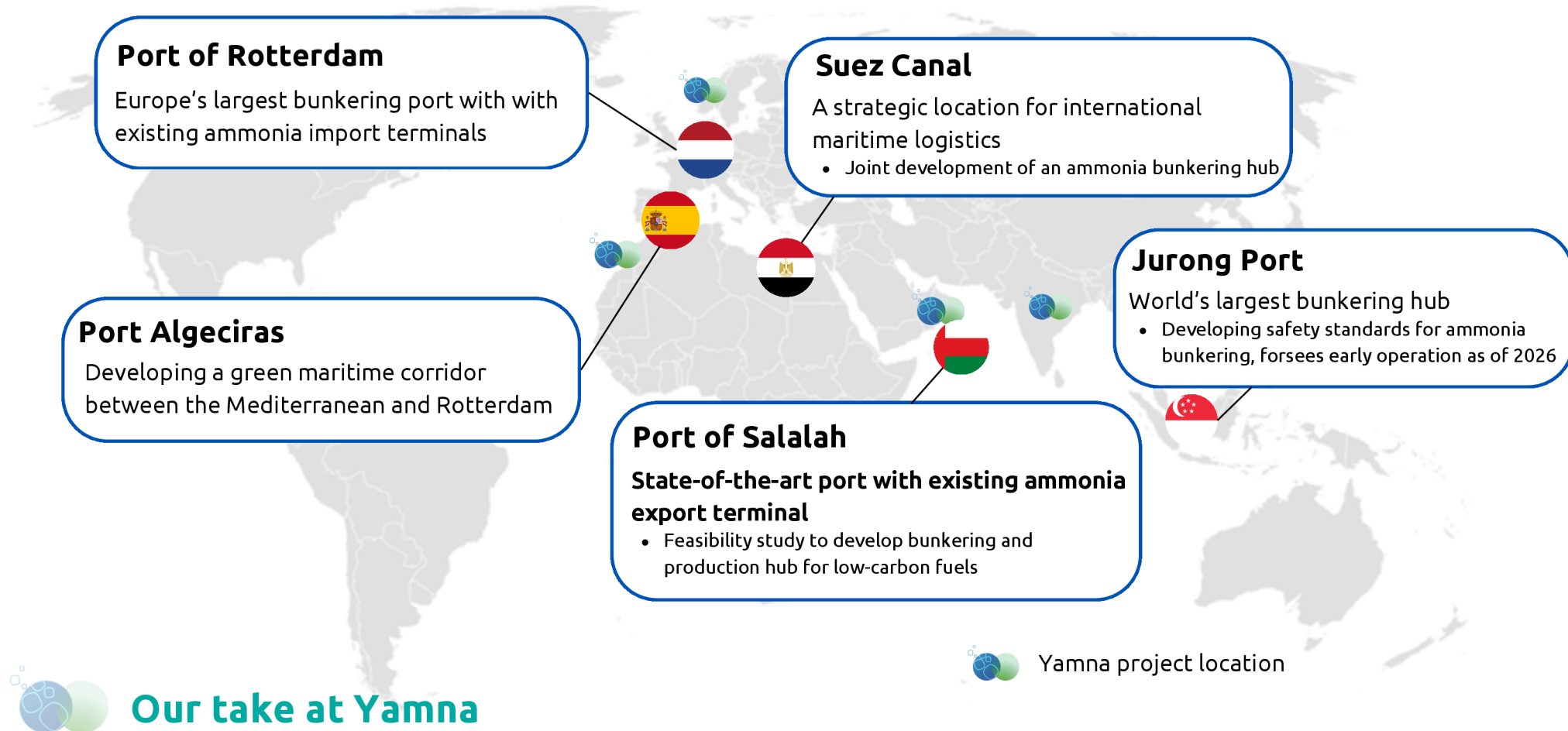


Finalized the interim guidelines for use of ammonia as a marine fuel (to be approved in December 2024)

All four components must come together, though some may advance faster than others, to establish the complete value chain for ammonia bunkering.

Potential green ammonia bunkering hubs in the making

Potential ammonia bunkering hubs identified by Yamna



Our take at Yamna

We are contributing to global efforts on developing ammonia bunkering value chain by:

1. Producing cost-competitive green ammonia
2. At locations that are well-connected to existing and future bunkering hubs
3. With a capacity to supply a large volume of green ammonia