



Addressing the financial and technical challenges of shipping decarbonisation
航运脱碳：资金与技术挑战及应对

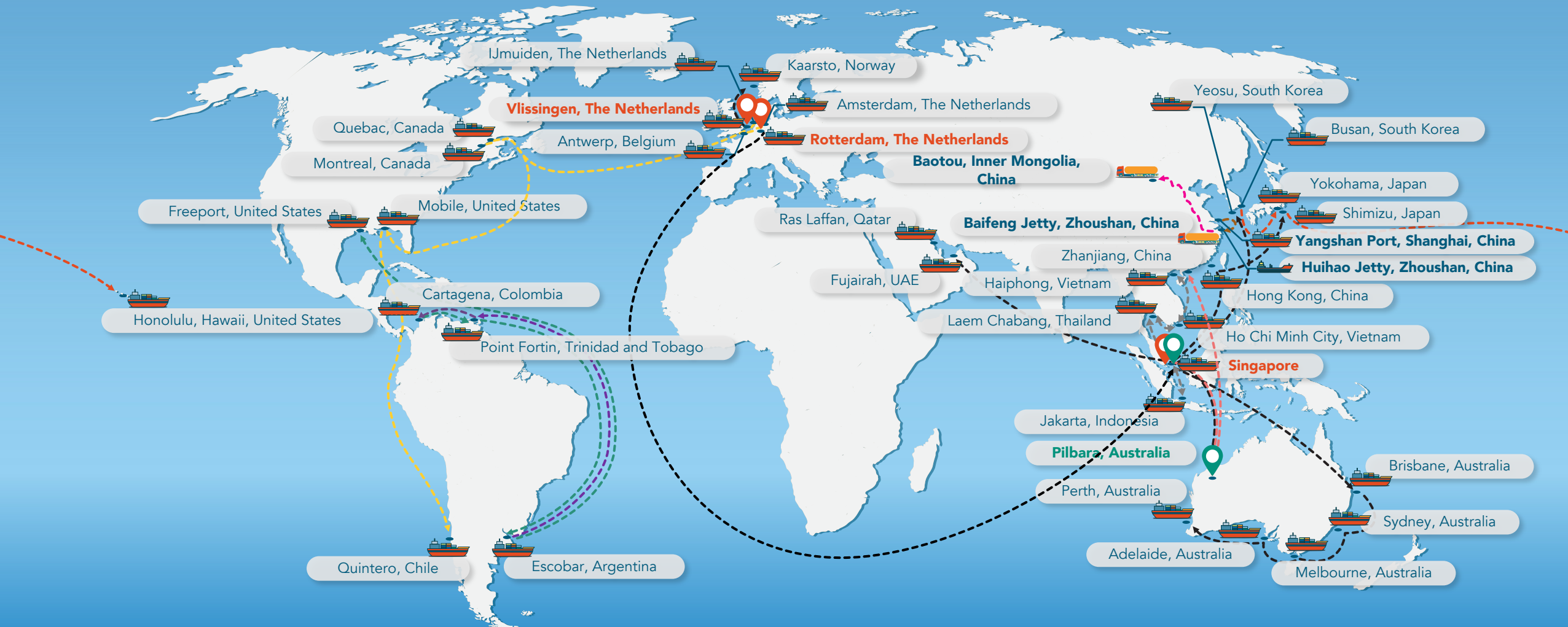
Demonstrating solutions through pilot projects
通过试点项目展示解决方案

Shane Balani, Global Centre for Maritime Decarbonisation (GCMD)
全球海事脱碳中心

Partners support our mission



Global engagement and systemic impact



Impact at a glance

GCMD	Enabling ammonia as a marine fuel	Assuring the quality, quantity and emissions abatement of drop-in green fuels	Unlocking the carbon value chain	Scaling adoption of energy efficiency technologies
130+ Partners supported	4,000 cbm of ammonia transferred in the Pilbara	6 Supply chain trials at commercial conditions	20% Assessed CO ₂ savings with OCCS on <i>Stena Impero</i>	USD 35M Successfully closed for first-of-a-kind vessel retrofit fund
17 Reports published	700-800 cbm/hr transfer flow rate	14,400 MT of biofuels bunkered	1st end-to-end value chain unlocked for onboard captured and LCO ₂ with downstream utilisation	3 Additional layers of blended capital crowded in to address financing gap
>90,000 Hits on GCMD's GFI calculator in the first two weeks of release	7 ppm ammonia measured inline before hose disconnection	~30% GHG emissions reduced	2 Regulatory milestones achieved, strengthening commercial case for OCCS	~2.2M Data points captured per hour through sensorising four vessels



Alternative fuels

Ammonia as a marine fuel

To **showcase lightering** and **simulate bunkering operations** before ammonia-fuelled vessels are available

Four areas of focus:

01

Safety + risk
assessments

02

Operational
procedures

03

Safety
protocols

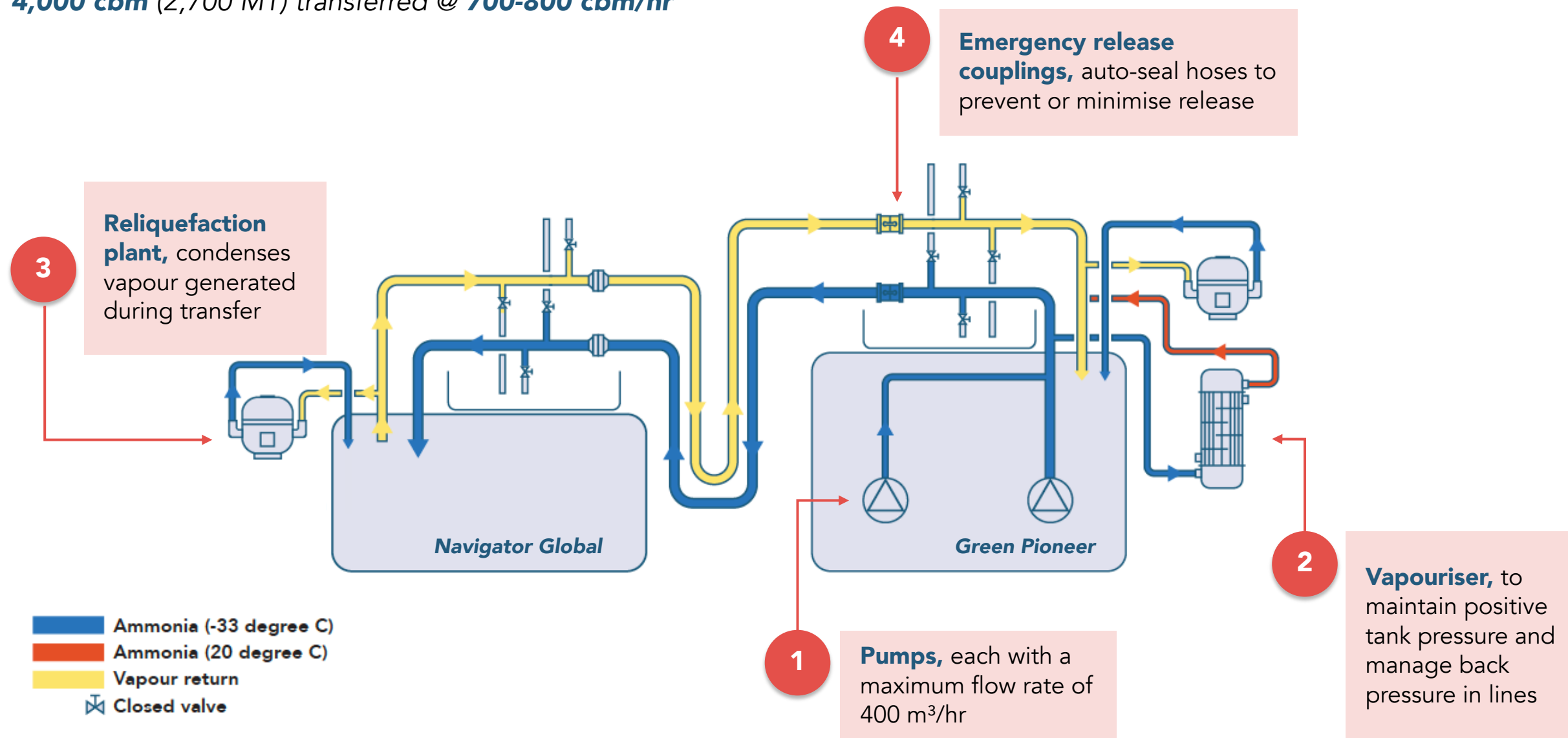
04

Emergency
response
protocols



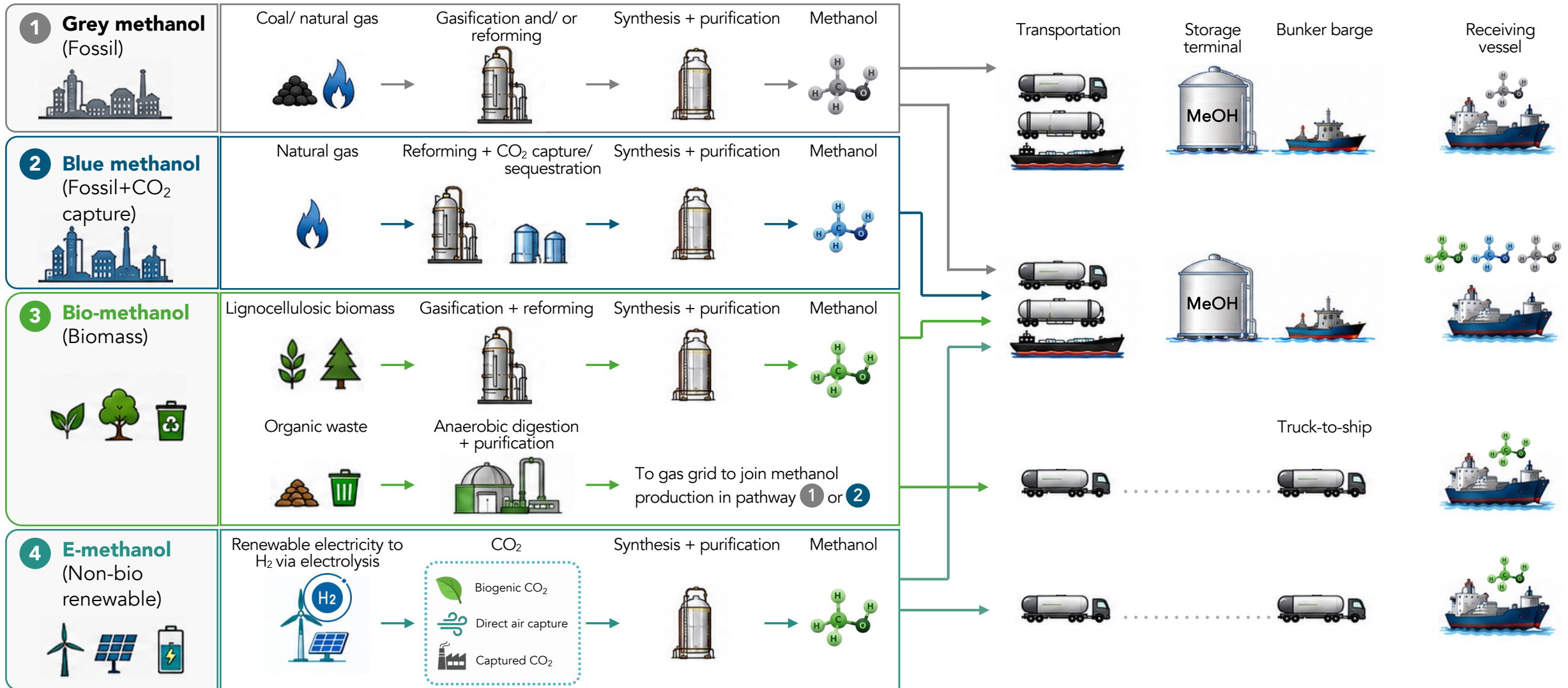
Liquid ammonia transferred between vessels

4,000 cbm (2,700 MT) transferred @ **700-800 cbm/hr**



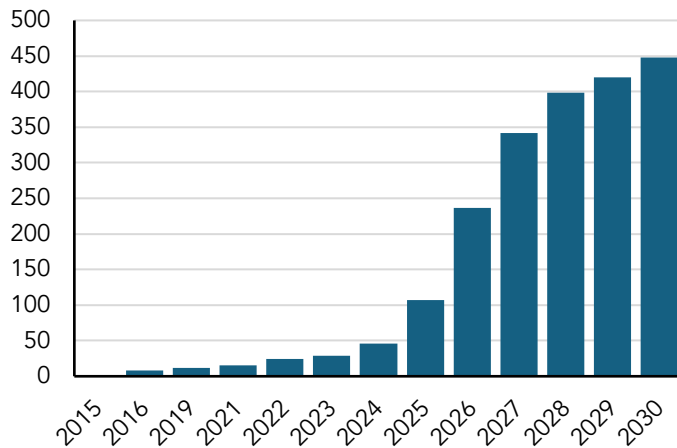
Potential methanol pathways in marine fuel supply chains

Identical molecule from multiple pathways in shared fuel network(s)



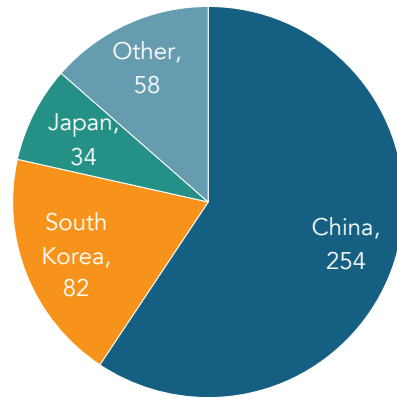
Enabling sustained adoption of methanol dual-fuel vessels

Methanol-capable vessels



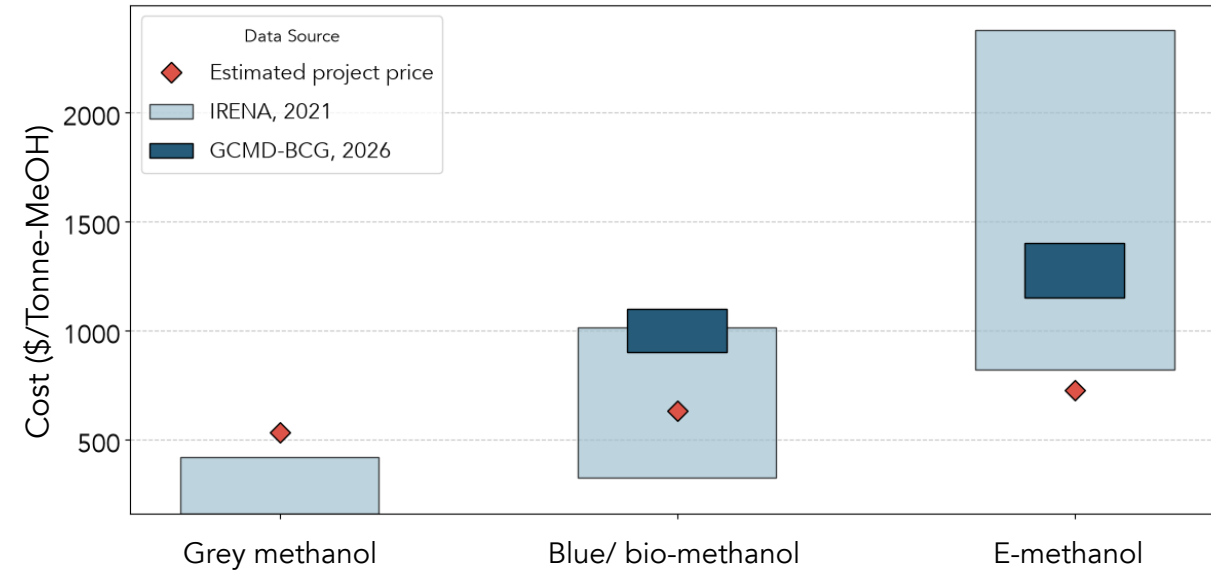
- + Methanol vessels are entering the fleet at scale, following sustained ordering activity post-COVID.

Yard location



- + Engines are delivered under shipyard license agreements, with one-year warranties mandating minimum fuel use.

Fuel cost



- + E-methanol remains limited in availability, due to weak demand and high cost compared to conventional fuels and lack of sufficient regulatory incentives.

What needs to be addressed for sustained adoption?

- + **Technical:** Assess technical performance of methanol DF vessel through intermittent operations over extended periods
- + **Commercial:** Validate life cycle GHG emissions reductions through MRV

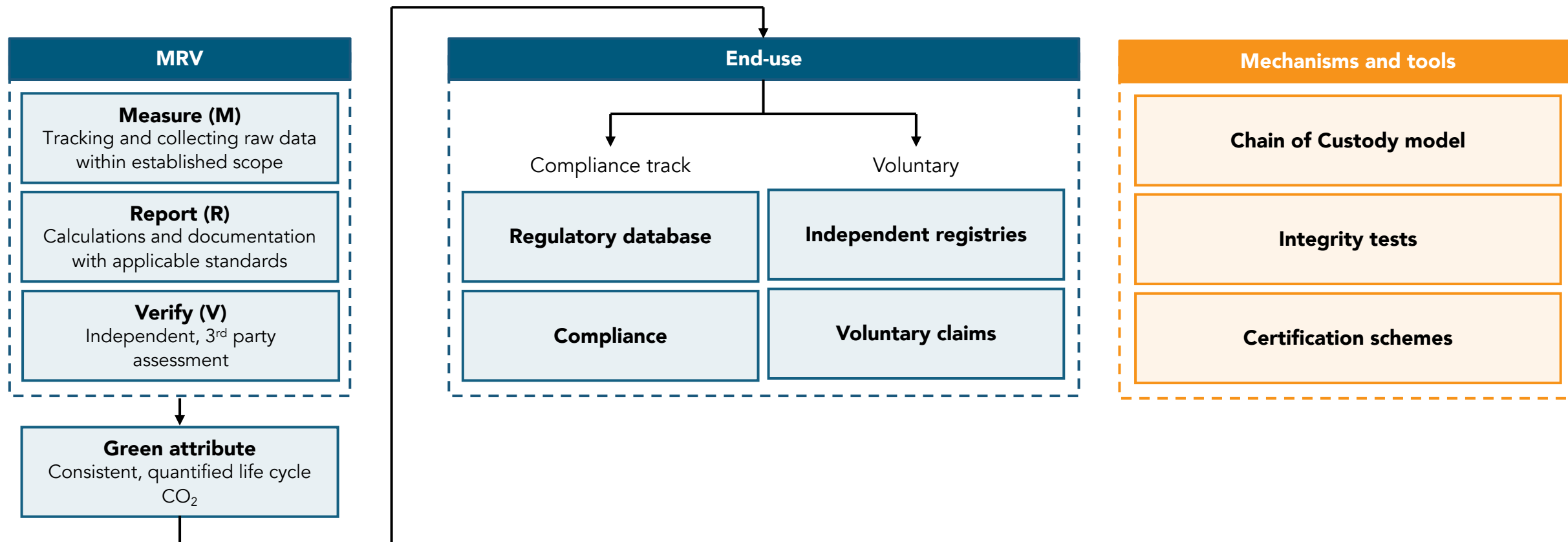
MRV provides credibility for voluntary and compliance markets

Robust MRV

Ensures quality, quantity, and traceability of emissions reductions

Certification and claims

With MRV in place, certification schemes and tools enable regulatory compliance and voluntary claims



Onboard Carbon Capture and Storage

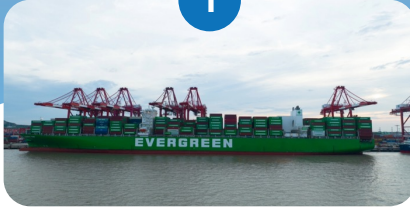
World's first StS offloading of onboard captured + liquefied CO₂, its transport and utilisation

Pilot completed June 2025

The
sequence
of events



1



Port of Rotterdam,
The Netherlands

The *Ever Top* began its voyage

2



Port Klang, Malaysia to
Yangshan Deepwater Port

SMDERI-QET's OCCS system activated;
CO₂ captured and stored enroute

3

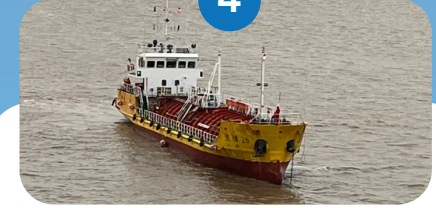


Yangshan Deepwater Port

Vessels moored at berth

25.4 MT LCO₂ transferred @ 4-6 m³/hr
★ LCO₂ sample collected for quality testing
before transfer

4



Yangshan Deepwater Port
to Zhoushan

The *Dejin 26* in transit

The journey



7



Baotou

Captured CO₂ used as feedstock

★ LCO₂ sample collected from Baorong's
regular vendor for quality benchmarking

6



Zhoushan to Baotou

LCO₂ transported 2,200 km overland

★ LCO₂ sample collected for quality testing
before transfer

5



Huihao jetty, Zhoushan

LCO₂ offloaded; CO₂ reclassified from
"hazardous waste" to "hazardous
cargo"

★ LCO₂ sample collected for quality testing
before offloading

Energy efficiency technologies

Shipowners' dilemma

The uncertain payback period of Energy Efficiency Technologies (EETs)



Performance uncertainty

How much fuel savings will the technology actually deliver when vessel routes and weather conditions are unpredictable?

Measurement uncertainty

How can the fuel savings attributable to the EET be accurately measured?

Market risk

How will volatile fuel prices and evolving emissions regulations, such as the IMO NZF, affect the value of fuel savings and expected ROI?

Split incentives

How can costs and benefits be shared between shipowners and charterers?

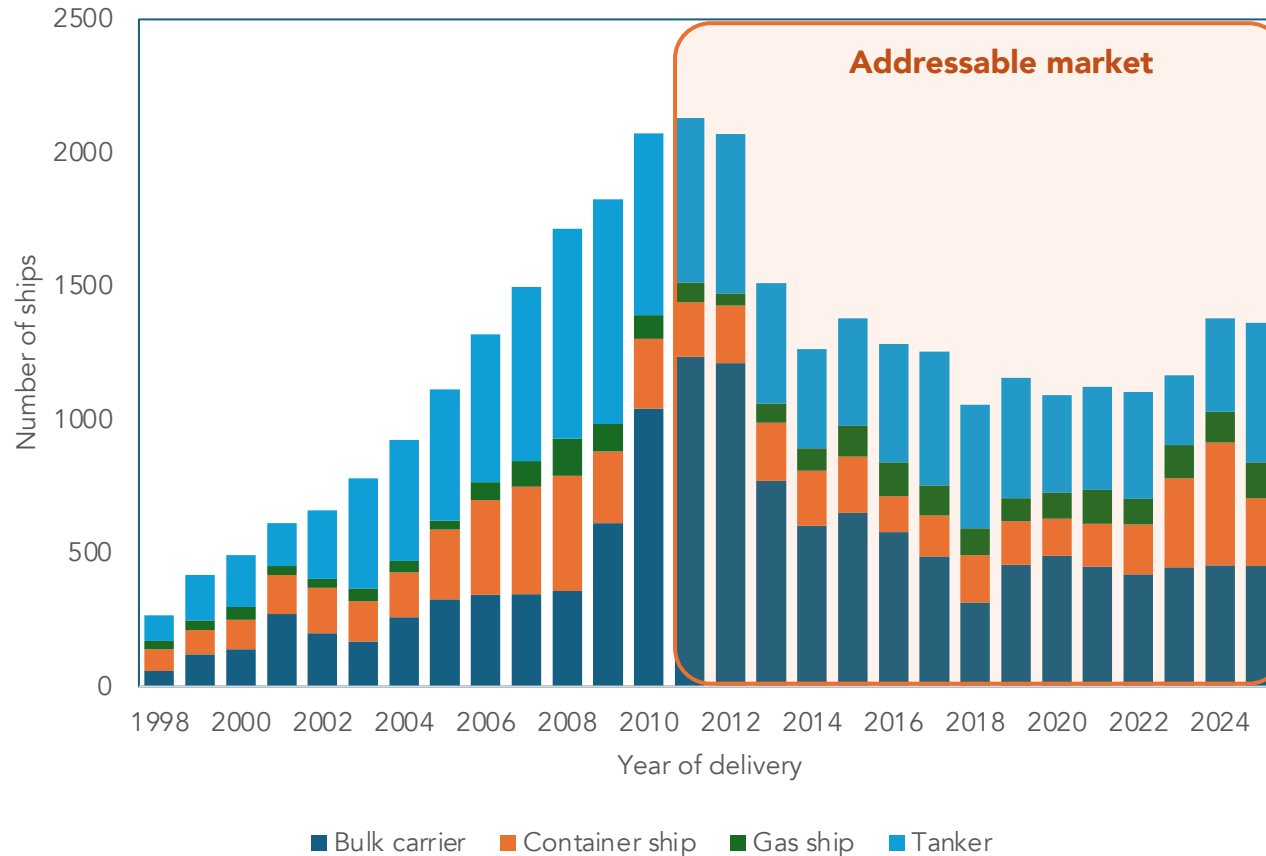
High capex

How can high capex, often borne by the shipowner, be financed without complex security structures tied to ship mortgages?



USD 20B¹ addressable market to meet industry targets

Based on an estimated fleet of 20,300 vessels of suitable age and size



Factors driving uptake

Scale of retrofits: **2,000** vessels expected to be retrofitted by **2030**

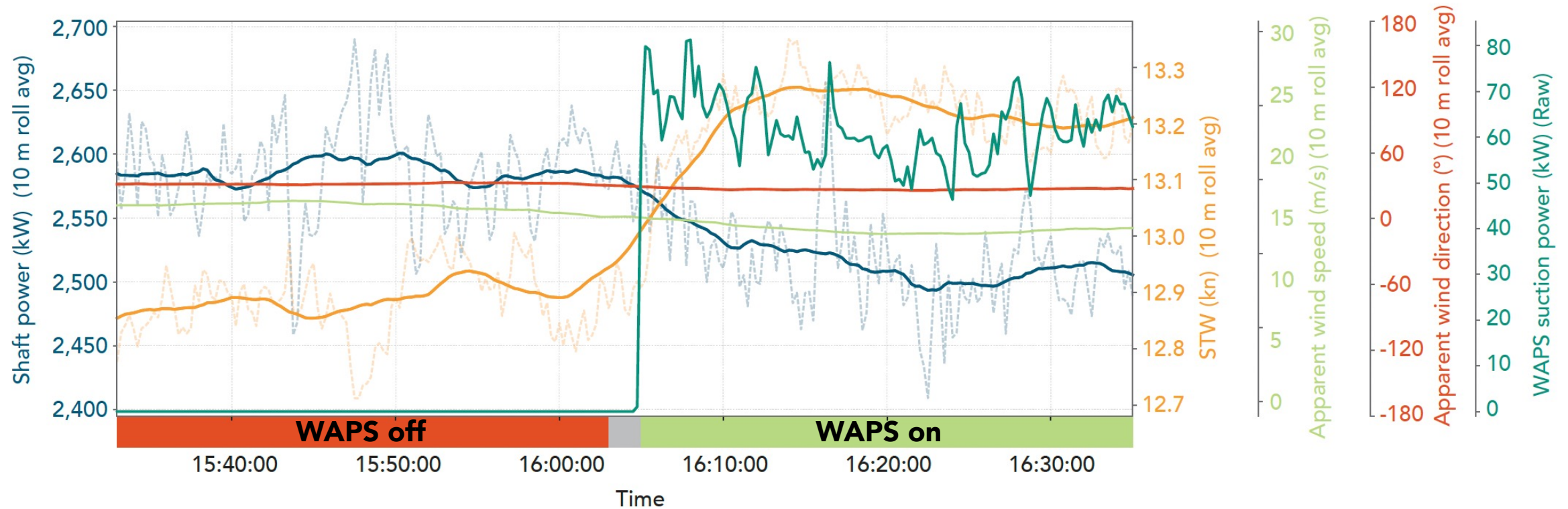
Fleet dynamics: Older tonnage remains active with orderbook backlogs and future fuel uncertainty

Investment case: Efficiency gains on less efficient vessels make a stronger business case for EETs

Room to grow: **72** commercial vessels with WAPS and **271** with ALS as of **2025**

Fuel savings highly volatile

Data from a representative on-off test from the Pacific Sentinel



Data collection on the Pacific Sentinel

Data acquisition system

Automatic high-frequency data-gathering system connected to a suite of dedicated sensors

Recording frequency

Every 15 seconds; uploaded to cloud for analysis

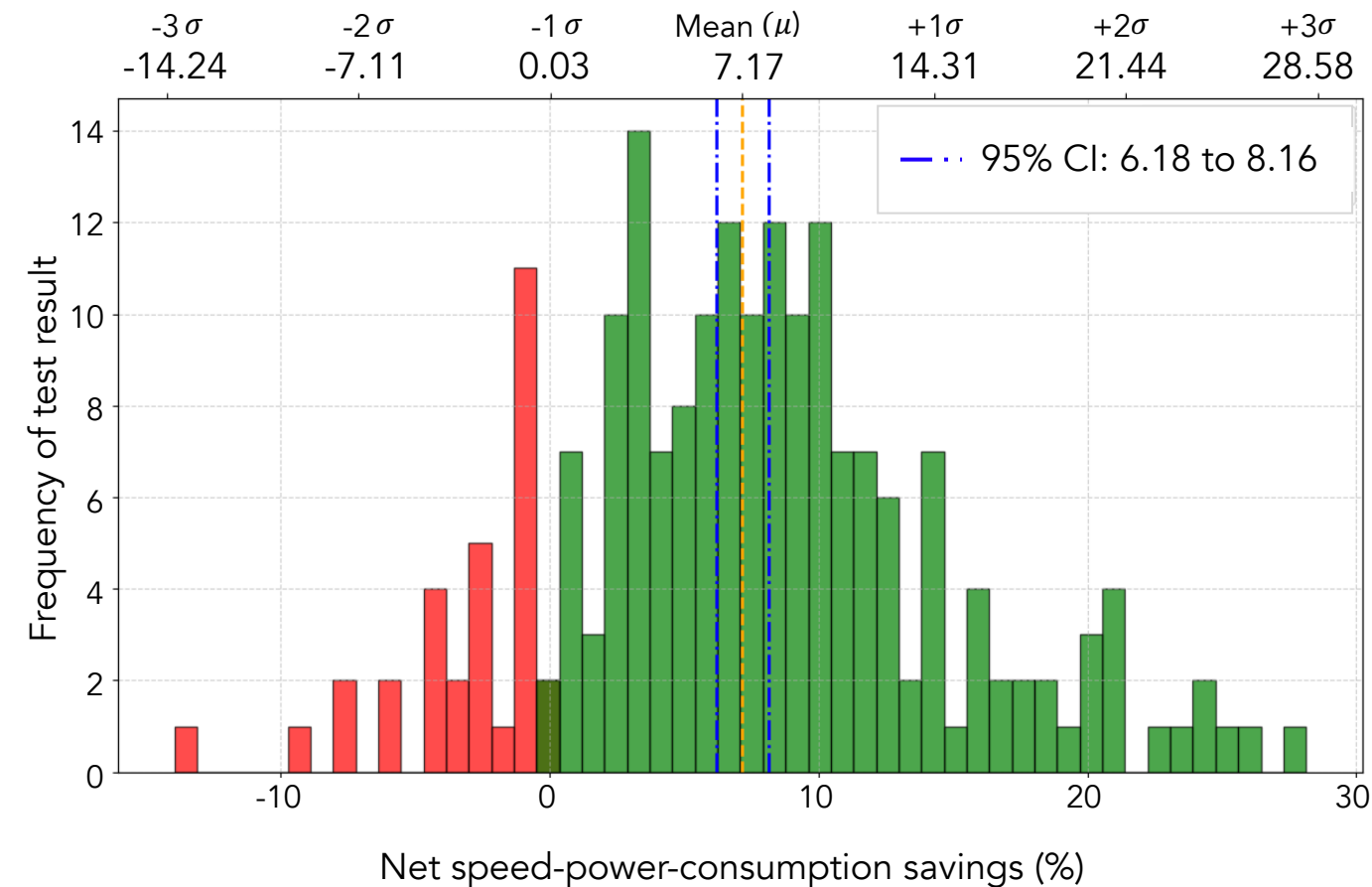
Parameters monitored

- + Speed through water
- + Shaft power
- + Fuel flow for main and auxiliary engines, boilers
- + Navigational data
- + Suction sail status
- + Wind conditions

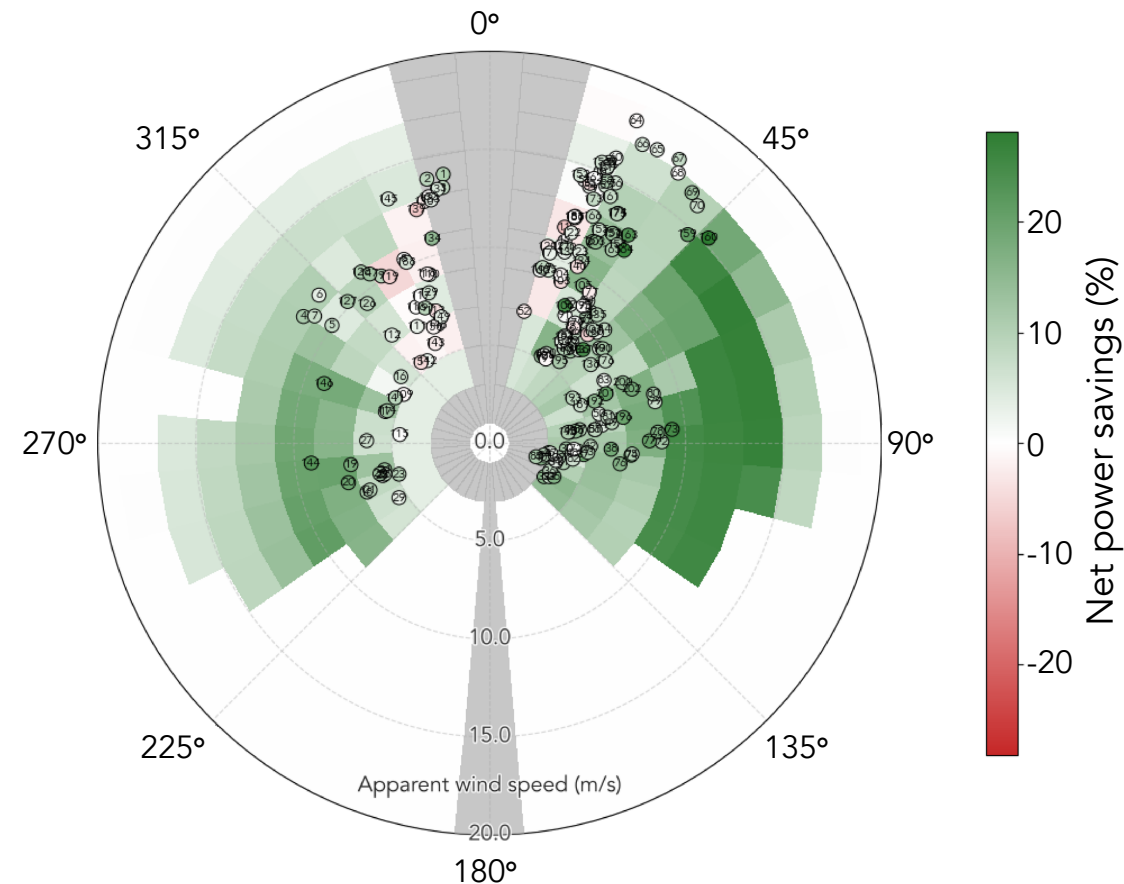
Tracking weather conditions + test results to build certainty

- + **276 million** data points collected and processed during a 4-month window
- + **3,000** on-off transitions identified; **203** valid transitions used to quantify performance after data screening

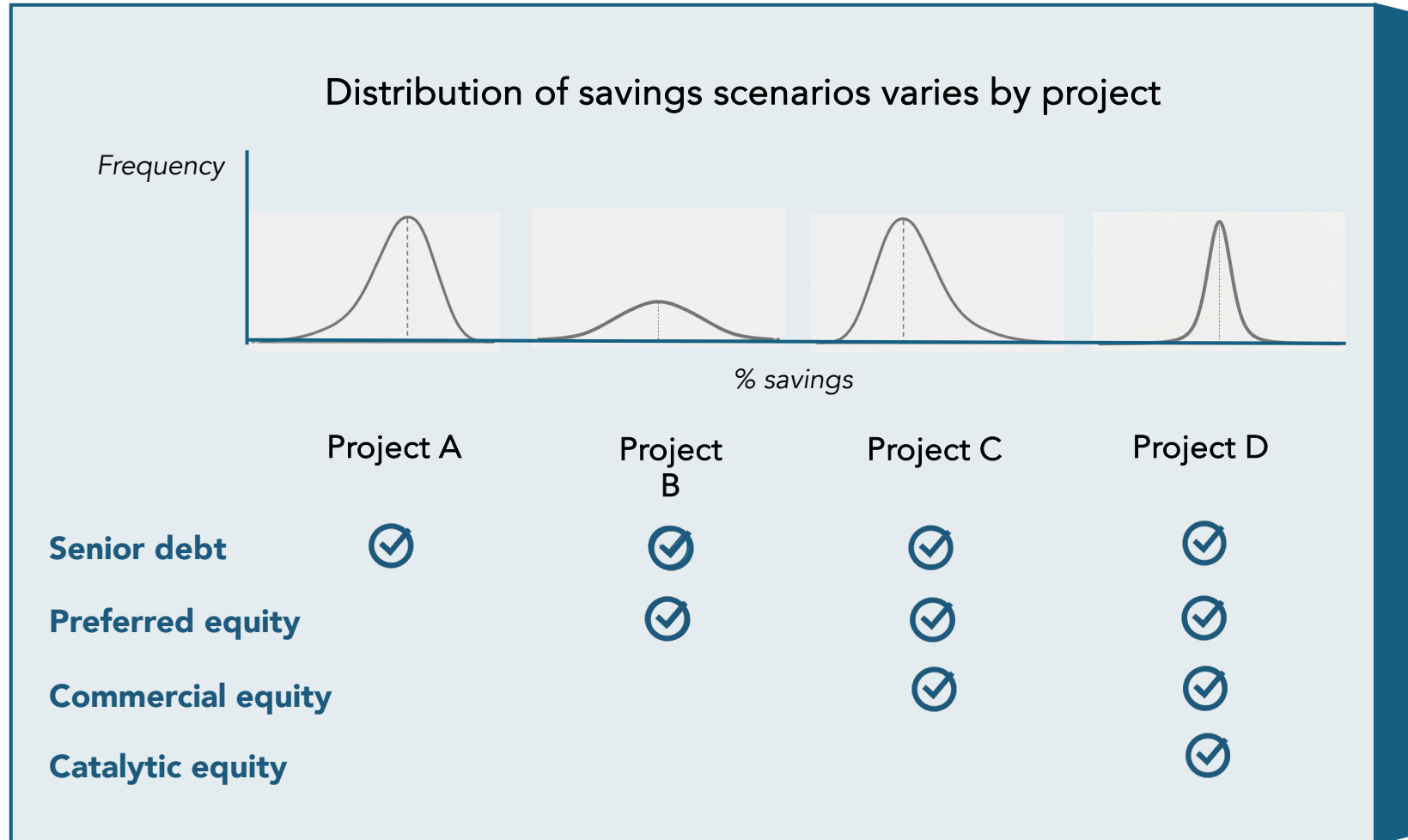
Distribution of instantaneous power savings from on-off tests



Polar heatmap of power savings



Blended financing + project diversification lower risk

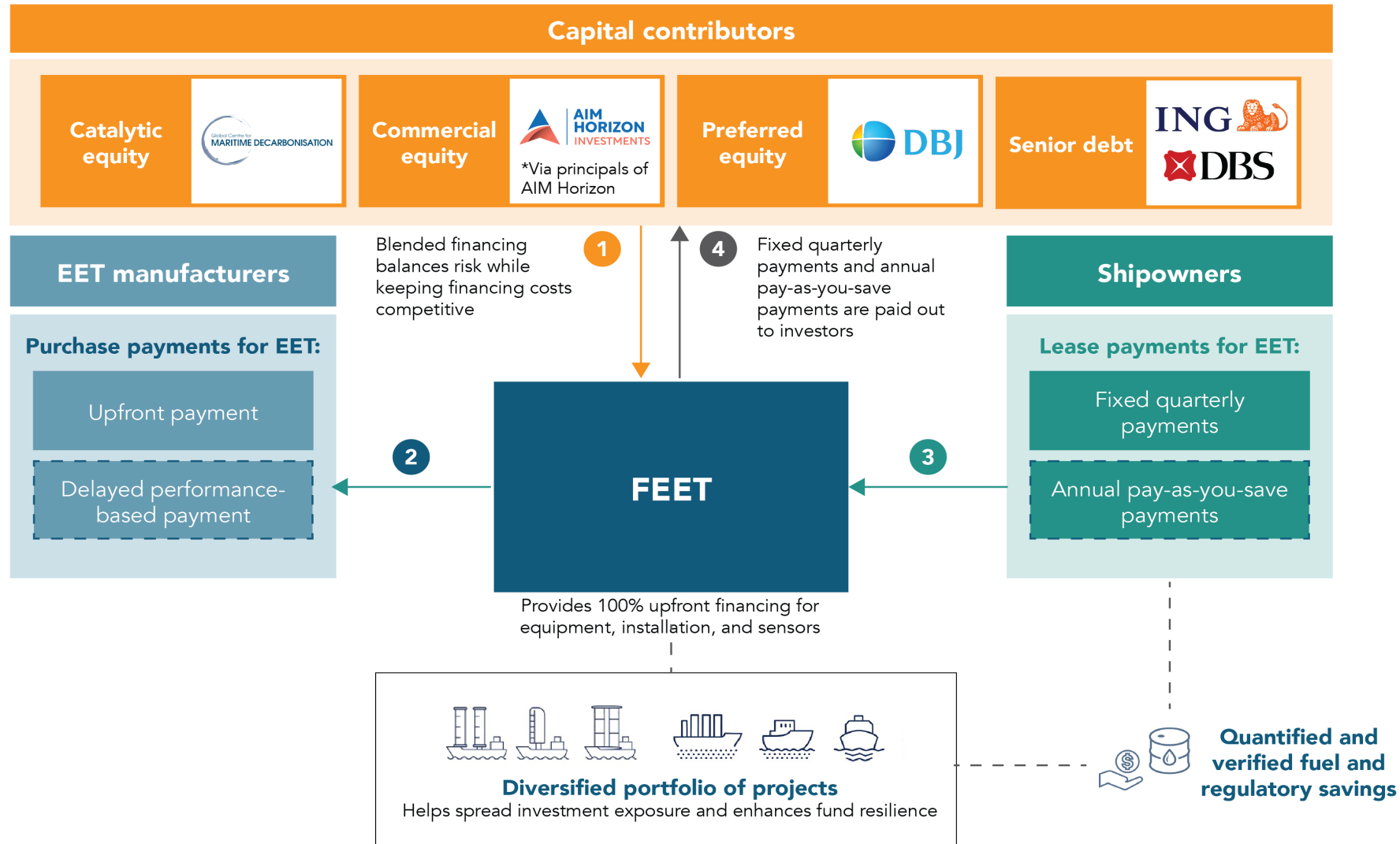


✓ Likely to receive payout contribution

- + **Project diversification** through complementary EETs, regional exposure, ship types and trading patterns
- + **Portfolio savings** less influenced by vessel utilisation or operating conditions of individual projects
- + **Blended finance** leverages senior debt to lower costs and equity investors to absorb risk
- + **Payments** flow through investor waterfall to provide risk-adjusted returns

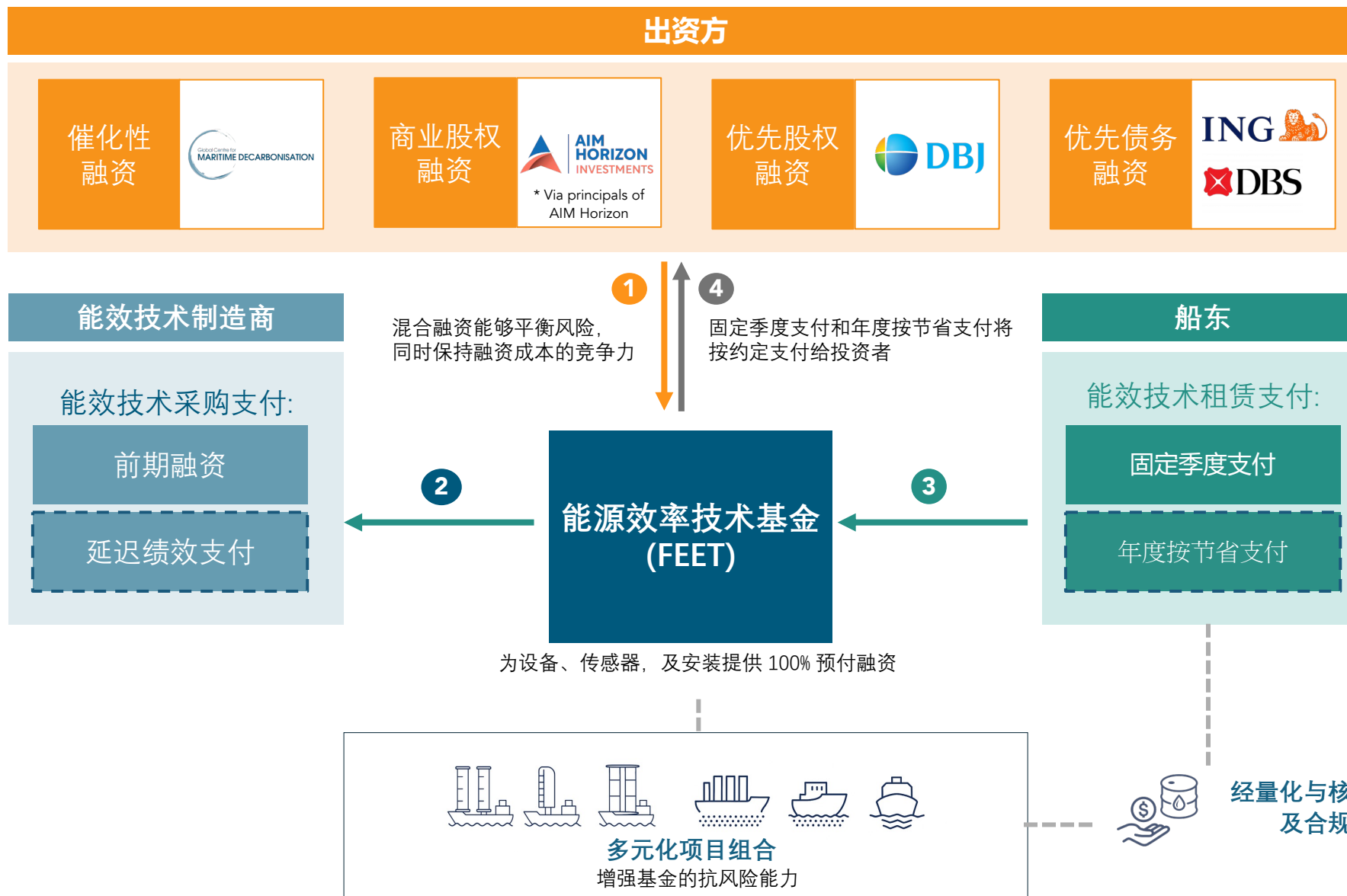
Fund for Energy Efficiency Technologies (FEET)

Featuring a pay-as-you-save repayment mechanism to accelerate EETs adoption



能源效率技术基金 (FEET)

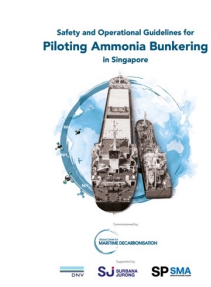
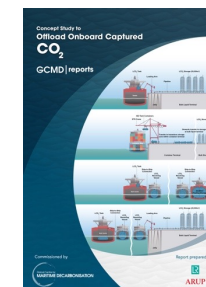
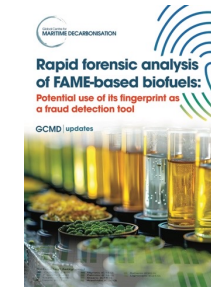
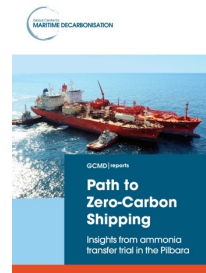
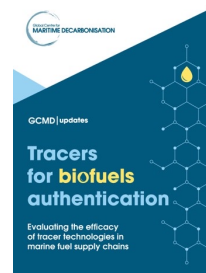
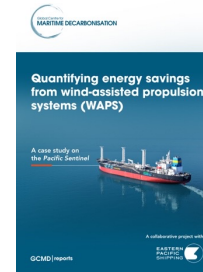
采用“边省边付”还款机制促进能效技术的推广



Thank you!



Scan the QR code to
download GCMD reports
and papers





 8 Robinson Road #06-01 | Singapore 048544

 www.gcformd.org

 projects@gcformd.org

 +65 6979 7660



Follow us on
LinkedIn for
updates