Global Centre for
MARITIME DECARBONISATION

GCMD | scopes

Pay-As-You-Save

Closing the data-financing gap to turbocharge maritime Energy Efficiency Technologies (EET) retrofits

MARCH 2024

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Stalling progress: Why energy efficiency technologies (EETs) are not scaling faster in shipping

Improving energy efficiency is a no-regrets approach when it comes to minimising fuel consumption and its associated costs.

For shipping, where green fuels are limited in availability, have lower volumetric energy densities than conventional fossil fuels, and command hefty premiums, using less fuel of any kind becomes increasingly important to achieve industry decarbonisation targets.

The Carbon Intensity Indicator (CII), with its increasingly stringent annual targets, also encourages immediate action to lower fuel consumption per unit distance travelled through energy efficiency measures.

From 2008 to 2022, the industry realised a commendable 32% energy efficiency gain through both technical levers, such as using larger and more efficient ships, and operational levers, like slow steaming and optimised routing. However, given comparable increases in seaborne trade during this same period, shipping's absolute emissions have not seen a marked decrease (Figure 1).

What does this mean?

The volume of seaborne trade is projected to grow 2-3% year-over-year to 2030. In parallel the International Maritime Organization (IMO) is targeting a 20-30% reduction in emissions relative to 2008 levels during this same period. This translates to a need to reduce emissions by 76% relative to the business-as-usual scenario in 2030, as shown in Figure 1.

Achieving this target is challenging, even after accounting for the 32% efficiency improvement that the sector has already realised. Assuming the sector can deploy 10% green fuels to further reduce emissions[1], there remains a huge burden of emissions reduction to meet IMO's 2030 stretch target. We believe this gap can be closed by broader deployment of EETs.

[1] Based on current demand, 10% of shipping's fuel consumption equates to 21MT of VLSFO equivalent per year. Considering an average gravimetric energy density difference of 2.3 times for methanol or liquefied ammonia, this equates to approximately 50MT of either fuel per year.

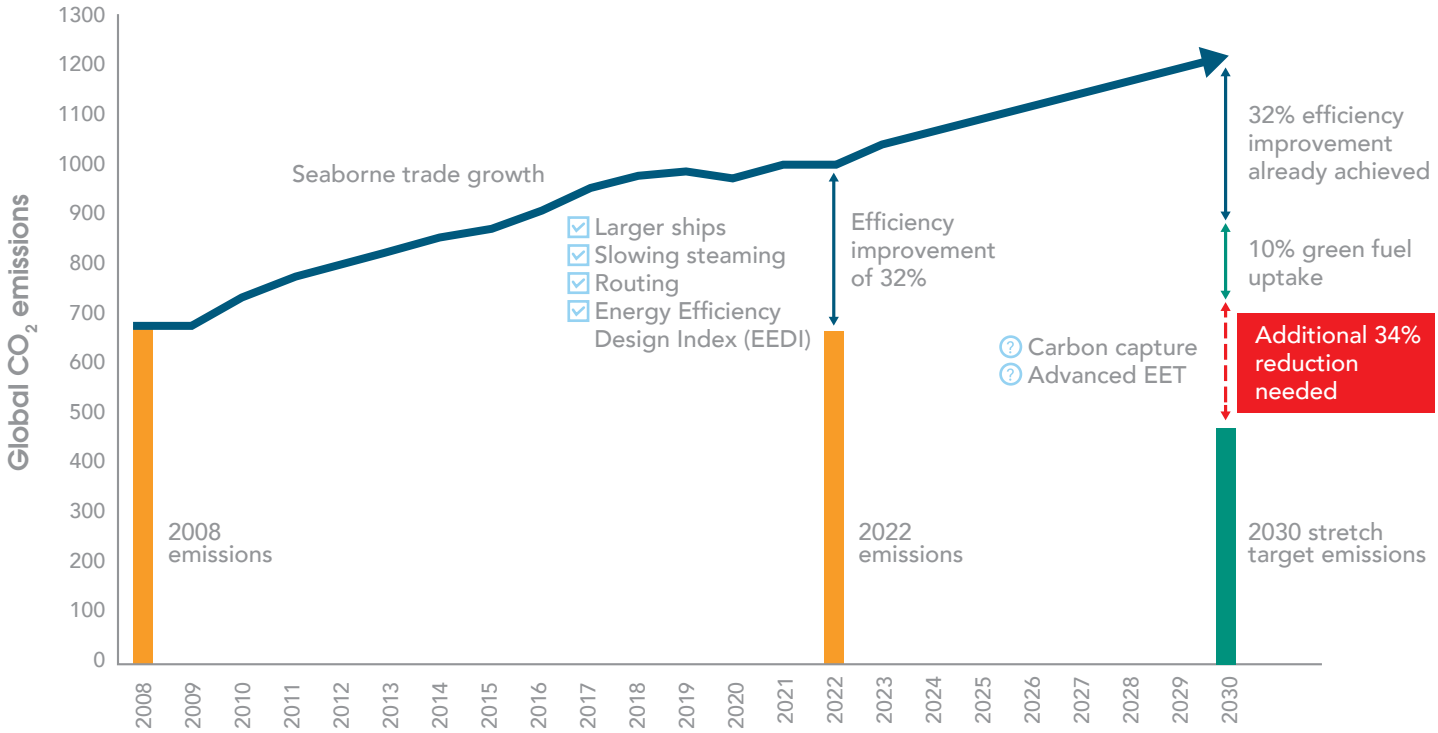

Figure 1: Achieving 2030 stretch targets[2]

The state of EET adoption today

The 2023 GCMD-BCG Global Maritime Decarbonisation survey, which asked shipowners and operators on their current and planned use of common energy efficiency measures, revealed a significant disparity in adoption rate levels.

Established levers, mainly those with high technology readiness levels (TRL) and low CAPEX, such as advanced hull coatings, see 84% of the respondents indicating that they have either already adopted these technologies on their fleet, or have plans to do so (Figure 2).

Inevitably, solutions with lower technical maturity and higher CAPEX, such as wind-assisted propulsion or air lubrication, see dramatically lower levels of uptake, with select owners piloting them on a trial basis (Figure 2). This low uptake contrasts the fact that many of the solutions can have a positive net present value alongside strong potential to decarbonise shipping. This conundrum can be broadly attributed to a risky business case, further undermined by two variables, which this paper explores.

[2] GCMD analysis, UNCTAD review of maritime transport 2023, IMO DCS fuel consumption report 2019-22, Review of Evidence On Emissions Reduction Pathways MEPC 79/INF.29, Report on annual carbon intensity and efficiency of the existing fleet MEPC 81/6/1, IMO 4th GHG Study

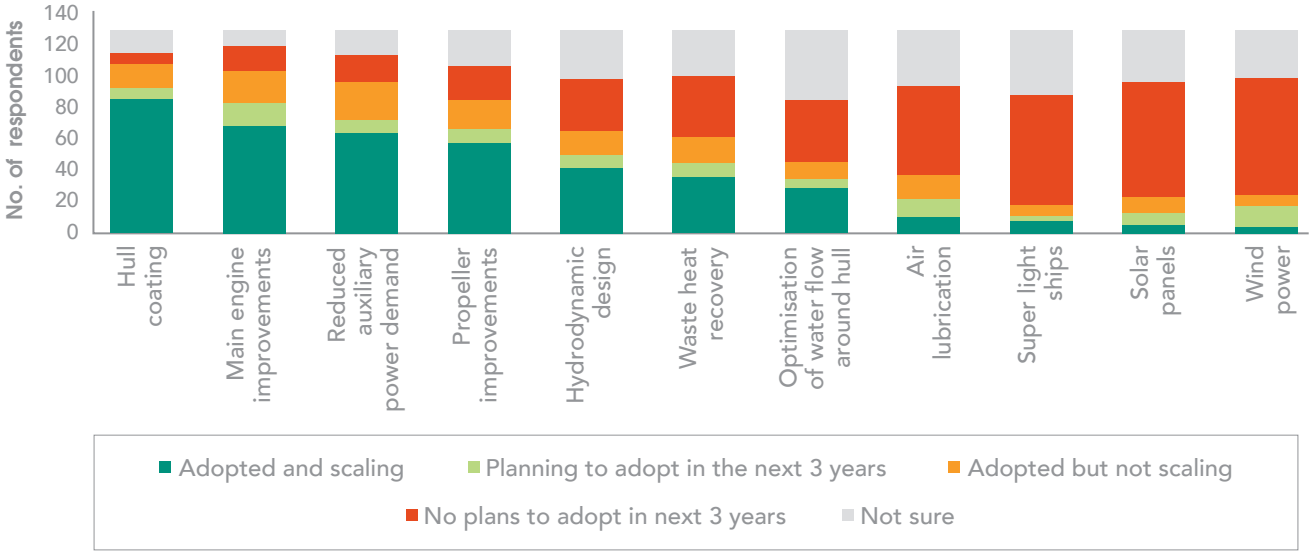

Figure 2: Uptake levels of select technical measures and devices[3]

The data-financing gap that is plaguing EET adoption

The business case for the CAPEX outlay on any energy efficiency device must be reconciled with a reduction in OPEX through fuel savings. Fuel savings are, however, inherently variable, and difficult to predict due to the variance in operating profiles of the vessels. This creates uncertainty in the time needed for the device to generate a return on the investment. For unproven technologies, the risk runs higher yet, with the likelihood of never recouping the investment.

Empirical evidence from real-world trials can overcome the uncertainty surrounding specific EET adoption. This process of confidence building, however, takes time. And for the more expensive technologies, the number of trials will be further limited, with even less public sharing of findings, the combination of which makes it difficult to generate enough evidence to mitigate the financial risk of adoption in time to decarbonise the industry in line with the IMO-issued targets.

The inability to accurately predict variable performance is a key barrier.

Compounding this risk is the split incentive problem, where investment in an energy efficiency technology is made by one party (e.g., shipowner) but fuel savings are accrued by a different party (such as a time-charterer).

[3] 2023 GCMD-BCG Global Maritime Decarbonisation Survey

Particularly so in the case of dry bulk vessels, this charter party chain can include multiple charterers or operators on different time- or voyage-based contracts, each attempting to maximise their profit, often achieved through pooling and trading strategies of which fuel savings form an integral component. This scenario is depicted illustratively in Figure 3.

There is no incentive to ensure that the savings realised from the deployment of energy efficiency technologies are returned to the investor in a timely or fair manner.

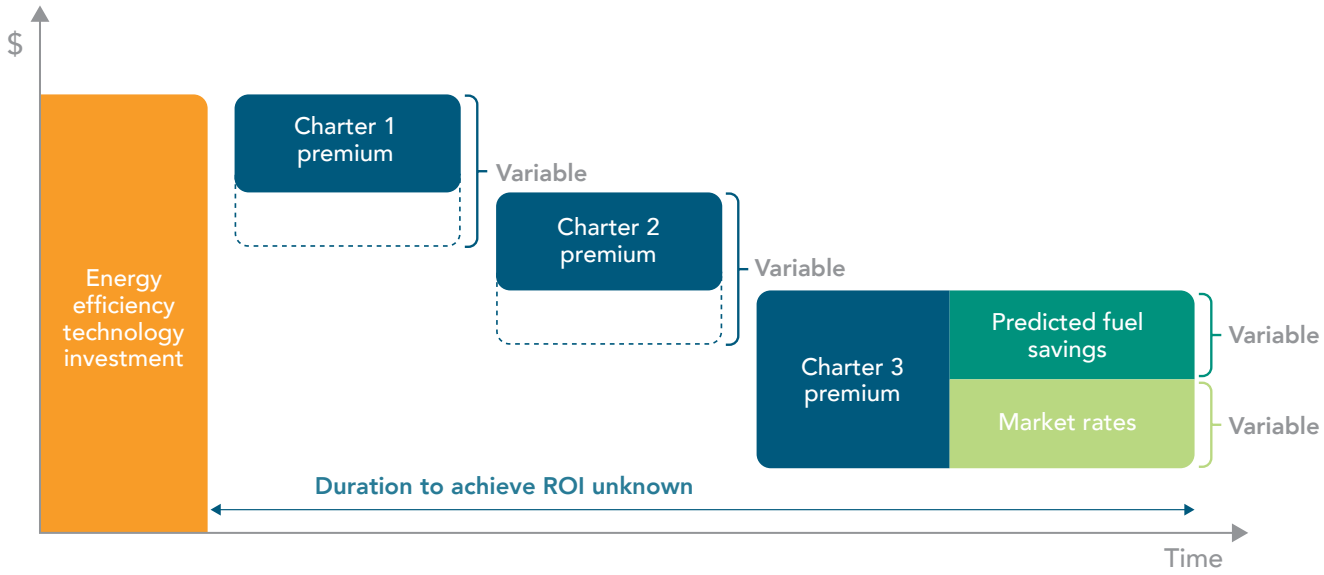

Figure 3: Unknown investment period arising from numerous variables and misaligned charter premiums

As a result of these compounded risks, vessel owners have placed an upper limit on retrofit investments for installing EETs. Consistent across all ship types, data from the GCMD-BCG survey show shipowners willing to invest up to a ceiling of approximately USD 5 million in CAPEX and expecting a maximum 5-year payback period with this level of investment, as seen in Figure 4.

Investments for installing EETs falling outside these limits are considered too risky. This applies even in cases where the specific EET has a positive net present value and high decarbonisation potential.

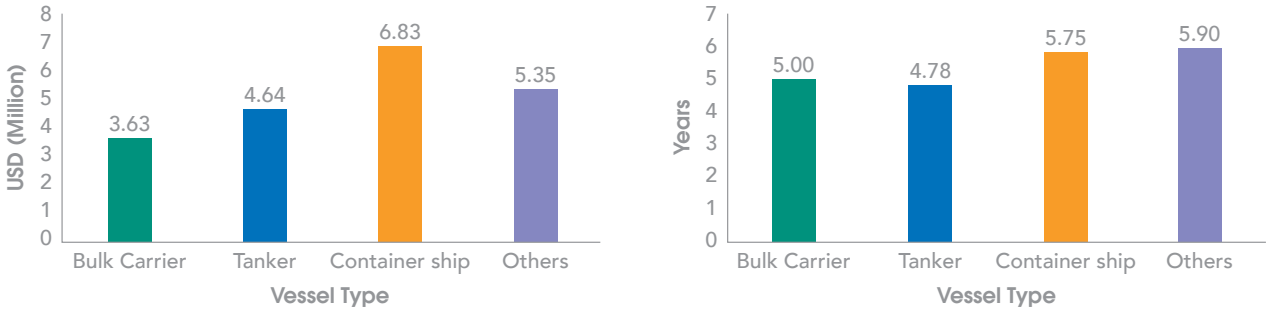

Figure 4: Maximum CAPEX investment and targeted payback periods expected by shipowners across major ship types[4]

One option to de-risk EET adoption is to deploy innovative financing models that have been effectively deployed in other sectors.

Pay-As-You-Save: How it works and its potential to spur EET adoption

PAYS is a financing model that has been successfully used in other sectors to accelerate the adoption of energy efficiency solutions. Applied to the building sector, PAYS works by redistributing upfront installation costs and then recouping them through the tangible savings achieved on the tenant's monthly energy bill.

In this model, building owners can install energy-efficient upgrades without needing substantial upfront investment. Instead, the investment is made by a third party, such as a financier or energy service provider, while the payback to the financier is spread over time and is directly linked to the realised energy savings. This creates a shared risk and reward model, with the building owner, tenant and the financier benefiting from lower energy consumption and carbon emissions whilst simultaneously increasing the value of the building.

[4] 2023 GCMD-BCG Global Maritime Decarbonisation Survey

UOB U-Energy programme[5]: Incentivising building retrofits to reduce energy consumption and emissions

Launched in 2020, U-Energy is Asia's first integrated financing platform that drives the development and adoption of energy efficiency projects for buildings and homes in Singapore, Malaysia, Thailand and Indonesia.

This programme connects Energy Service Companies (ESCOs) with commercial and industrial building owners to offer common energy efficiency projects, such as the installation of LED lighting, retrofitting of chiller plants and air conditioners, replacement of hot water systems for more efficient ones and introduction of energy management systems.

To finance the projects, building owners can opt to take up the "energy-as-a-service" model offered by UOB.

In the "energy-as-a-service" model, UOB pays the upfront costs of a building retrofit with an ESCO partner. Shared savings realised from lower electricity bills are used to pay back the initial investment in the equipment under a long-term contract with the provider. In some cases, the ESCOs guarantee a specified amount of savings to further de-risk the investment through a useful backstop option.

In 2022, UOB extended SGD 10.8 million (USD 7.8 million) of green loans to support Measurement & Verification (M&V) in two energy efficiency retrofitting projects for the upgrading of the air conditioning system in Singapore's Changi Airport. Upon completion, the upgraded system will achieve 30 per cent energy savings, or approximately 15.8 gigawatt-hours (GWh) per year, equivalent to a reduction of more than 6,000 tonnes of carbon dioxide-equivalent in GHG emissions annually.

Quantifiable energy savings open up opportunities for innovative financing models that relieves building owners from hefty upfront cost and uses the realised savings as the main benchmark for payback.

[5] UOB sustainability report 2022

For PAYS to be effectively applied in the maritime sector, a complete solution built on a shared risk approach is critical, one on which multi-party collaboration agreements among partners that span the entire value chain has to be developed. (See figure 5)

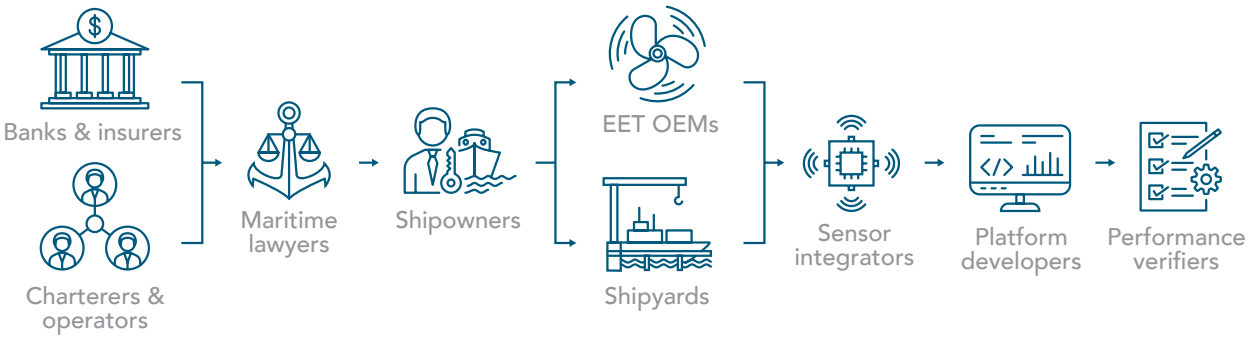

Figure 5: Stakeholders in the value chain

In the GCMD-BCG survey, more than 50% of the survey respondents indicated PAYS as a viable pathway to encourage broader adoption of EETs.

To specifically enable PAYS in the maritime sector, three types of collaborative agreements must come together, namely agreements that specify the terms for technology installation, data validation, and data-driven financing.

1. Technology installation agreement

One critical element that can enable broader EET adoption is an accurate evaluation of the technology's true impact on fuel savings.

Robust data collection and analysis to that end are crucial. A collaborative agreement between the EET solution provider, the shipyard that will be installing the technology, and the shipowner can facilitate this process.

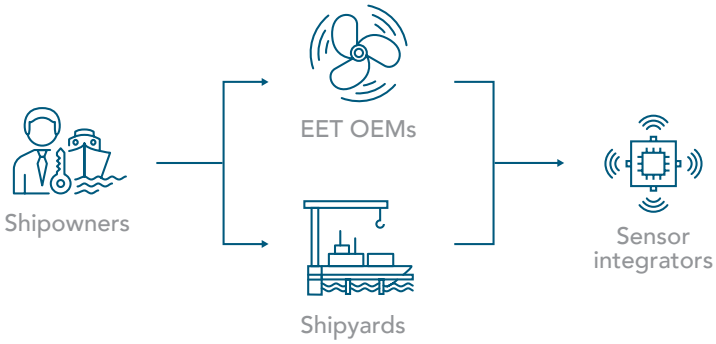

Figure 6: Value chain partners involved in a technology installation agreement

Ideally, this agreement needs to establish the minimum fuel savings expectations of the solution across different routes, speeds, and other key variables that can impact its performance. In reality, this level of specification may be challenging, given the heterogeneity in vessel type, size, age, and the routes they ply. The nascency of the solution further adds to this challenge. A compromise may be reached among the stakeholders by specifying a minimum level of acceptable fuel savings for the fleet on which the solution will be deployed.

This threshold should be established considering the specific operational conditions of the vessel(s) on which the EET will be installed. With the typical range of fuel savings defined, it will also be important to articulate the probabilities of fuel savings beyond the typical range.

Through learning by doing, this fuel savings band can be adjusted and the agreement tailored to cover an increasingly wider range of routes, speeds, and other operating conditions.

To facilitate data collection, the technology installation agreement should also cover the deployment of appropriate IoT sensors, upon which the data can form the basis for validating fuel savings that is specified in the data validation agreement.

2. Data validation agreement

Facilitating transparent sharing of real-world validated performance data is crucial for financing and charter party agreements. A secure data platform could play an instrumental role to store, process, and analyse EET performance data, under scenarios that either account for or isolate the external variables that can impact its performance.

Underpinning the platform's effectiveness is a data validation agreement between stakeholders, including the EET solution provider, the shipowner and operator, data verifier, communications provider, and the data platform architect. This agreement establishes processes to ensure secure data collection and authenticate data provenance. It should also specify the data repository platform.

Figure 7: Value chain partners in a data-financing agreement

The agreement should also specify the standards and guidelines by which the data is analysed to quantify actual fuel savings. Once established, this agreement can prescribe a process by which data flows from the vessel for analysis and verification by the EET manufacturer and third parties, before the resulting fuel savings is authenticated and shared with commercial partners.

This agreement should also consider how relevant parties can access authenticated data for certified emissions reduction credits, for example for compliance with EU Emissions Trading Scheme (ETS), or for carbon credits generation, if additional and valuable, to support the scaling of EET adoption.

3. Data-driven financing agreement

Legal frameworks for ship financing today typically prioritise the senior mortgage holder's interests, disincentivising other stakeholders to make investments for EET installation given the risk of default or the resources required to develop these complex legal agreements.

New contractual structures should be developed to balance stakeholder interests while keeping financing affordable. Such structures require financing mechanisms that can facilitate equitable sharing of risks at the initial CAPEX investment stage and sharing of fuel savings revenue downstream.

A data-driven financing agreement, between financiers, insurers, charterers, vessel owners and the data architects, can establish a clear link between financing and data quality standards.

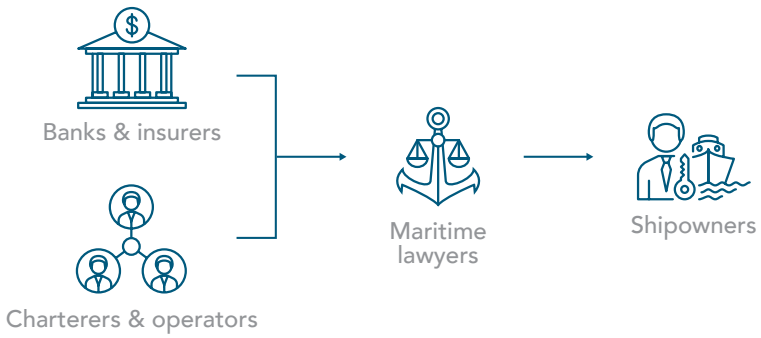

Figure 8: Value chain partners involved in a data-driven financing agreement

Importantly this agreement will need to consider the acceptable variance and frequency of aggregated data collection to align with the technology payment schedule and the charter party agreement.

As EETs will have inevitable performance variance, insurance packages may need to be developed to hedge against the risk of EET underperformance, for example during unexpected downtime. In this way, the insurer in one such PAYS scheme plays the role of the ESCO (see case study on UOB's U-Energy programme) to backstop against underperformance.

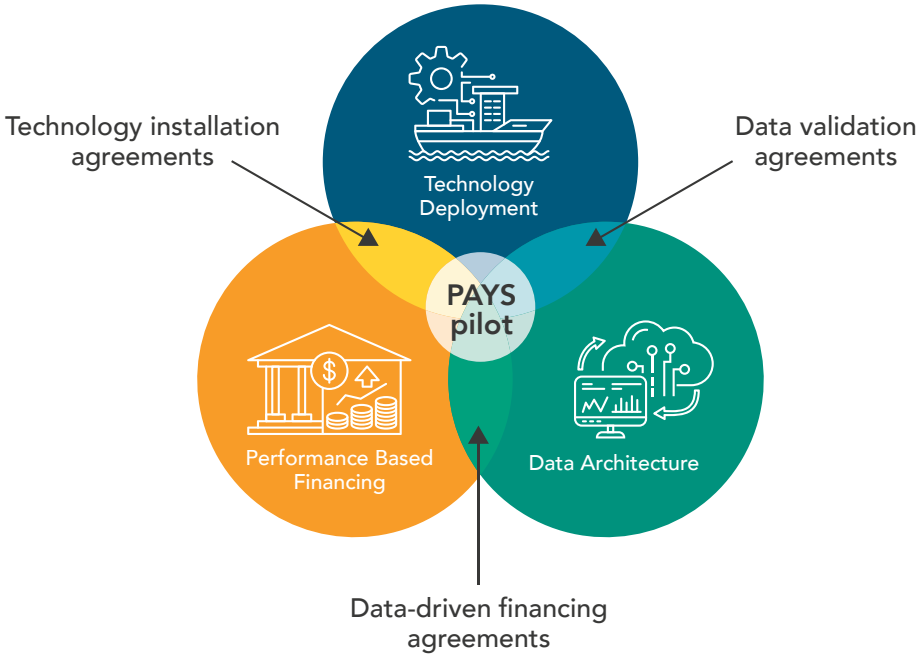

Figure 9: Three agreements needed to enable PAYS in shipping

Through a series of real-world pilots that will iteratively test key variables, a portfolio of contracts, methodologies and data sets that are applicable across a range of EET installations can be developed. (Figure 10)

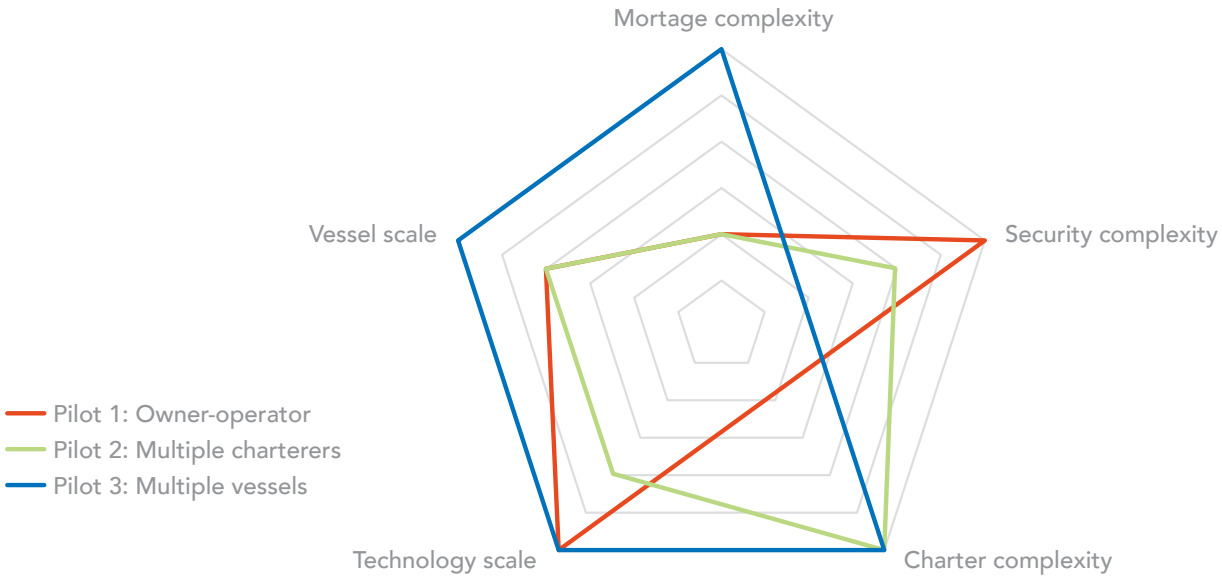

Figure 10: Increasing number of pilots to enable the broader adoption of a portfolio of EET solutions

Desired outcome for a PAYS pilot model

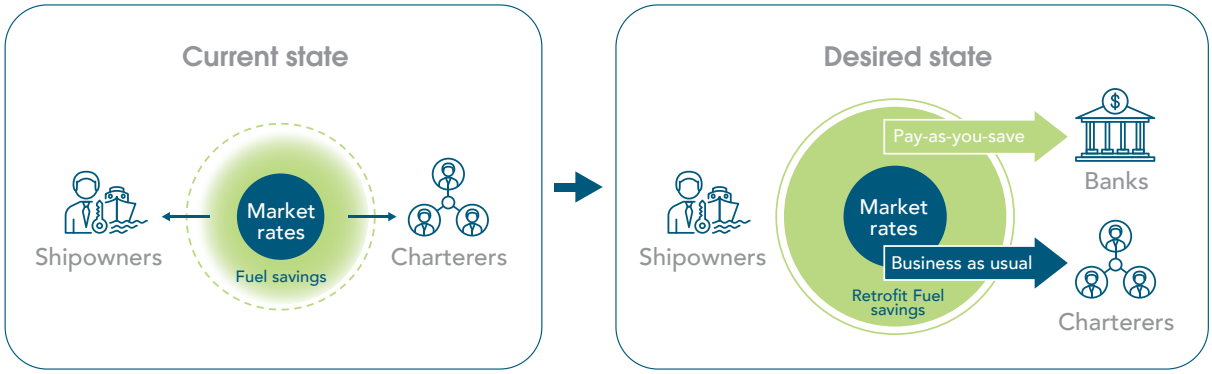

Figure 11: Desired system state for a PAYS enabled model

In summary, while EETs are critical for global emissions reduction and business profitability, their success hinges not just on the technologies themselves, but also on overcoming commercial barriers that are a result of business-as-usual operations in the industry. Accurate measurements of actual fuel savings attributable to the adoption of EETs and their certification are critical to scaling EET adoption, as shown in Figure 11.

Drawing reference from successful PAYS models in other sectors, new commercial and contractual structures can be developed to stimulate third party investment into EETs, overcoming split incentives and turbocharging adoption beyond the level we are seeing today.

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About the Global Centre for Maritime Decarbonisation

The Global Centre for Maritime Decarbonisation (GCMD) was established as a non-profit organisation on 1 August 2021 with a mission to support the decarbonisation of the maritime industry by shaping standards, deploying solutions, financing projects, and fostering collaboration across sectors.

Founded by six industry partners namely BHP, BW Group, Eastern Pacific Shipping, Foundation Det Norske Veritas, Ocean Network Express and Seatrium (formerly Sembcorp Marine), GCMD also receives funding from the Maritime and Port Authority of Singapore (MPA) for qualifying research and development programmes and projects. To-date, over 100 centre- and project-level partners have joined GCMD contributing funds, expertise and in-kind support to accelerate the deployment of scalable low-carbon technologies and lowering adoption barriers.

Since its establishment, GCMD has launched four key initiatives to close technical and operational gaps in: deploying ammonia as a marine fuel, developing an assurance framework for drop-in green fuels, unlocking the carbon value chain through shipboard carbon capture and articulating the value chain of captured carbon dioxide as well as closing the data-financing gap to widen the adoption of energy efficiency technologies.

GCMD is strategically located in Singapore, the world's largest bunkering hub and second largest container port.

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