Case study

# Accelerating maritime decarbonisation in Southeast Asia

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Australian Government
Department of Foreign Affairs and Trade

Partnerships for INFRASTRUCTURE
AN AUSTRALIAN GOVERNMENT INITIATIVE

## Acknowledgement

This publication has been funded by the Australian Government through the Department of Foreign Affairs and Trade and the Partnerships for Infrastructure (P4I) initiative. P4I partners with Southeast Asia to drive sustainable, inclusive and resilient growth through quality infrastructure. More information about P4I is available at partnershipsforinfrastructure.org.

Partnerships for Infrastructure acknowledges Aboriginal and Torres Strait Islander peoples as the traditional custodians of Country throughout Australia, and we pay our respects to Elders past and present. P4I also recognises early connections between Southeast Asia and the First Nations peoples of Australia.



## About this case study

The maritime transport sector, vital to global trade and economic development, must urgently address its growing emissions while preserving competitiveness and operational efficiency. As international trade volumes continue to expand, transformative action on emissions reduction has become imperative across the shipping value chain. To advance this agenda in Southeast Asia, the Australian Government, through Partnerships for Infrastructure (P4I), has established strategic collaborations with key government authorities and operators responsible for maritime policy and infrastructure operations in Malaysia, Thailand and Vietnam.

These collaborations align with Australia's efforts to develop its first Maritime Emissions Reduction National Action Plan (MERNAP).[1] Specifically, one of the MERNAP Issues Papers highlights the importance of developing 'green shipping corridors' to create environmental and economic win-wins throughout the region.[2] The collaborations also support Australia's Southeast Asia Economic Strategy,[3] which highlights the importance of strengthening regional partnerships, transferring clean technology expertise, investing in renewable energy, and building resilient, sustainable and inclusive supply chains.

**Cover image:** Docked container vessel at Tanjung Pelepas Port, Malaysia. Source: Shutterstock

[1] Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (DITRDCSA), *Charting Australia's maritime emissions reductions*, DITRDCSA website, n.d., accessed 4 June 2025.

[2] Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA), *MERNAP Issues Paper 4: Green shipping corridors and partnerships*, DITRDCA, March 2024. Green corridors are specific shipping routes where a combination of public and private actions catalyse the technological, economic and regulatory feasibility of operating zero-emissions ships. See Global Maritime Forum, *Green Corridors: Definitions and approaches*, Global Maritime Forum, 25 August 2022.

[3] Department of Foreign Affairs and Trade (DFAT), *Invested: Australia's Southeast Asia Economic Strategy to 2040*, DFAT, September 2023.

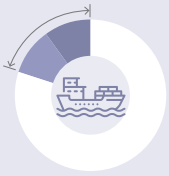

Shipping containers at the Port of Laem Chabang in Chonburi, Thailand. Source: P4I

## Southeast Asia's strategic role in global maritime decarbonisation

Around 80 to 90% of international trade moves by sea,[4] the most energy-efficient transport mode over long distances.[5] However, international shipping accounted for nearly 3% of global greenhouse gas emissions in 2018.[6] The majority of these emissions stem from the industry's over-reliance on the combustion of fossil fuel–based marine fuels (**99%** of the fuel mix in 2022).[7]

Within the maritime transport sector, '[c]ontainer shipping is responsible for over a quarter of international shipping's energy consumption'.[8] Total seaborne trade is projected to grow by an average of 2.4% annually from 2025 to 2029.[9] Without significant intervention, emissions will continue to rise.[10] Rethinking fuel production and supply for vessel propulsion could have a significant impact on emissions. Another key area for decarbonisation is port operations, such as cargo handling and storage, which currently rely heavily on diesel equipment, contributing substantially to greenhouse gas emissions and local air pollution.

Southeast Asia's waters include critical maritime trade routes such as the Malacca, Singapore and Lombok straits and the South China Sea. In terms of container volume (measured in TEU),[11] 10 Southeast Asian ports ranked among the world's top 50 in 2023 (Table 1), and port calls are steadily increasing.[12]



International shipping accounts for nearly **3%** **of global greenhouse gas emissions**

Current fuel use **99% fossil**

Container shipping **25%+** **of shipping's total energy consumption**

Seaborne trade is expected to grow by **2.4%** **annually** **(2025–2029)**

SEA has **10** **major ports**

[4] International Renewable Energy Agency (IRENA), *A Pathway to Decarbonise the Shipping Sector by 2050*, IRENA, October 2021, p 10.

[5] World Trade Organization (WTO), *The Carbon Content of International Trade* [Trade and Climate Change information brief no. 4], WTO, September 2021, p 8.

[6] International Maritime Organization (IMO), *Fourth IMO Greenhouse Gas Study 2020*, IMO, 2020, p 112.

[7] World Economic Forum (WEF), *Net-Zero Industry Tracker: 2024 edition*, WEF, December 2024, p 52.

[8] E Criswell, S Deyon and L Laffineur, *Shipping – Trade, Climate, and Net Zero Pathways: Scenarios and implications for developing countries and climate-resilient development*, Forum on Trade, Environment, & the SDGs (TESS) and Global Maritime Forum, January 2025, p 3.

[9] United Nations Conference on Trade and Development (UNCTAD), *Review of Maritime Transport 2024: Navigating maritime chokepoints*, UNCTAD, 2024, p 6.

[10] IMO, *Third IMO Greenhouse Gas Study 2014*, IMO, 2014, p 20.

[11] The twenty-foot equivalent unit (TEU) is used to quantify port activity, encompassing both throughput and capacity, to provide a more precise depiction of the volume of cargo transiting through a port.

[12] UNCTAD, Review of Maritime Transport 2024: Navigating maritime chokepoints, UNCTAD, 2024, pp 95–96.

**Table 1: Southeast Asian ports in the world's top 50 container ports, by volume, 2023**

| Global rank | Port name | Country | Cargo volume (million TEU) |
|---|---|---|---|
| 2 | Singapore | Singapore | 39.01 |
| 11 | Klang | Malaysia | 14.06 |
| **15** | **Tanjung Pelepas*** | **Malaysia** | **10.48** |
| **16** | **Laem Chabang*** | **Thailand** | **8.87** |
| 25 | Ho Chi Minh City | Vietnam | 7.40 |
| 26 | Tanjung Priok | Indonesia | 7.29 |
| 33 | Hai Phong | Vietnam | 5.57 |
| **34** | **Cai Mep*** | **Vietnam** | **5.48** |
| 36 | Manila | Philippines | 5.21 |
| 49 | Tanjung Perak | Indonesia | 4.10 |

TEU = twenty-foot equivalent unit

* P4I has ongoing initiatives at Tanjung Pelepas, Laem Chabang and Cai Mep ports, as well as at Map Ta Phut and Bangkok ports in Thailand.

Source: Lloyd's List, *One Hundred Ports 2024*, Lloyd's List, 2024.

As the shipping industry accelerates its decarbonisation efforts, efficiency in transhipment and refuelling is becoming increasingly important. The adoption of alternative low-emission fuels is expected to reshape port competitiveness. Ports that invest early in alternative fuel bunkering infrastructure are likely to stand out as preferred hubs for shipping lines,[13] helping them comply with tightening regulations (Box 1). The International Maritime Organization (IMO) targets zero or near-zero emission technologies to represent at least 5% of international shipping energy by 2030.[14] Meeting this target requires between 7 to 48 million tonnes of 'carbon-neutral fuels' worldwide,[15] with demand concentrated at ports capable of safe handling, customs clearance, and 'lifecycle' (that is, from fuel production to the end use by a ship) emissions verification.

Many Southeast Asian countries have net-zero plans, ambitious renewable energy targets and sufficient availability of land in proximity to existing port infrastructure, making them well-positioned for the production and storage of low-emission fuels (such as methanol and ammonia produced through electrolysis – see page 6 for an overview of the main alternative fuels). Production could take place near ports with refuelling facilities. The shift to low-emission fuel bunkering could therefore present an opportunity for first-mover Southeast Asian ports to develop the necessary infrastructure to produce these fuels and strengthen their renewable energy industries ahead of emerging competitors.

P4I collaborates with the Ministry of Transport and the Port of Tanjung Pelepas in Malaysia; Thailand's Ministry of Transport, specifically the Office of Transport and Traffic Policy and Planning, the Marine Department, and the Port Authority of Thailand; and Vietnam's Maritime and Waterways Administration under the Ministry of Construction to conduct feasibility studies aimed at better understanding the technical and commercial landscape, as well as the regulatory changes needed to develop alternative low-emission fuel bunkering.


P4I representatives meet with staff from the Port of Laem Chabang (ranked 16th globally for container throughput in 2023) in May 2025 to support Thailand's maritime decarbonisation. Source: P4I

[13] 'Bunkering' means the supply of fuels for use by ships and 'low-carbon bunkering' refers to the supply of fuels that have low greenhouse gas emissions across their life cycles.

[14] IMO, *2023 IMO Strategy on Reduction of Greenhouse Gas Emissions from Ships*, IMO, July 2023.

[15] DNV, *Maritime Forecast to 2050: Energy transition outlook 2024*, DNV, 2024.

Box 1

## Critical factors shaping global maritime decarbonisation

All stakeholders in the global shipping value chain – ship owners, cargo owners, ports and financiers – are under pressure to decarbonise. This is driven by a variety of measures and trends, as outlined below.

### 2025 IMO net-zero framework

The **2025 IMO net-zero framework** establishes mandatory emissions limits and greenhouse gas pricing across the maritime transport sector. The framework will be incorporated into a new chapter of Annex VI (Prevention of Air Pollution from Ships) to the **International Convention for the Prevention of Pollution from Ships (MARPOL)**.[16] The IMO's regulation on **greenhouse gas fuel intensity** will mandate stringent well-to-wake emissions thresholds for maritime fuels,[17] requiring large ships over 5,000 gross tonnage (representing around 85% of greenhouse gas emissions) to progressively decarbonise from 2027 onwards. Thailand is a party to MARPOL but has yet to ratify Annex VI,[18] unlike Vietnam and Malaysia, which have both done so. This regulatory framework will help shipping stakeholders (including shipping companies, ports and fuel suppliers) better assess compliance costs and investment opportunities in clean technologies.

### EU regulatory schemes with a global impact

From 1 January 2025, the **FuelEU Maritime** regulation sets limits on the greenhouse gas intensity of the energy used by ships calling at European Union (EU) ports,[19] complementing the existing EU Emissions Trading System. FuelEU Maritime applies to ships on **Southeast Asia – Europe trade routes** (50% of energy used falls under its scope). The regulation includes **methane ($CH_4$)** and **nitrous oxide ($N_2O$)** emissions on a well-to-wake basis.[20]

### Emerging industry shifts

**Multiple low-emission industry coalitions** have emerged over the past 5 to 10 years. The most significant one for the sector, **Zero Emission Maritime Buyers Alliance (ZEMBA)**, is an initiative of Cargo Owners for Zero Emission Vessels (coZEV). In February 2025, the initiative launched a tender seeking bids for e-fuel supply.[21] In 2024, Hapag-Lloyd – one of the world's leading container shipping companies – won the first tender, aiming to transport goods from major retailers such as Amazon, Patagonia, Bauhaus, New Balance, Nike and REI through liquefied biomethane (bio-LNG).[22] **Major shipping lines** (such as MSC, Maersk, CMA CGM and Hapag-Lloyd) have published **net-zero targets** and are beginning to shift their investment patterns accordingly. Maersk is investing in dual-fuel vessels, including dual-fuel LNG and dual-fuel methanol. Additionally, ammonia-fuelled ships are appearing in order books, and several shipping lines are retrofitting existing vessels to operate on dual-fuel methanol.[23]

### Trends in the financial sector

The increasing regulatory pressure is driving new **disclosure frameworks** such as the **Poseidon Principles** – a global framework for responsible ship finance – aligning financial institutions' maritime portfolios with IMO objectives.[24] At the same time, investor demand for environmental, social and governance (ESG) commitments is growing.[25]

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[16] IMO, 'IMO approves net-zero regulations for global shipping', IMO, 11 April 2025.
[17] Well-to-wake emissions are the total greenhouse gas and particle emissions from the production and use of a fuel for a vessel. They consist of upstream production processes like hydrogen production or biofuel cultivation (that is, well-to-tank emissions), and onboard combustion (that is, tank-to-wake emissions).
[18] IMO, 'Strengthening emission limits in Thailand', IMO, 26 June 2019; IMO, 'Ratifications by State' [Excel file], at IMO, *Status of Conventions*, IMO website, n.d., accessed 5 June 2025.
[19] European Commission, *Decarbonising maritime transport – FuelEU Maritime*, European Commission website, n.d., accessed 5 June 2025.
[20] European Maritime Safety Agency (EMSA), *Fuel EU Maritime Regulation*, EMSA website, n.d., accessed 5 June 2025.
[21] Zero Emission Maritime Buyers Alliance (ZEMBA), *ZEMBA e-fuel-focused tender now accepting bids* [media release], ZEMBA, 25 February 2025. 'E-fuels', also known as electrofuels, are a type of synthetic fuel made using electricity as the main energy source. When the electricity comes from renewable sources, the well-to-wake emissions of e-fuels can be very low.
[22] ZEMBA, 'Hapag wins tender from leading brands to provide biomethane shipping', ZEMBA, 17 April 2024.
[23] DNV, *Maritime Forecast to 2050: Energy transition outlook 2024*, DNV, 2024.
[24] Poseidon Principles Association, *Poseidon Principles* [website], n.d., accessed 5 June 2025.
[25] International Chamber of Shipping (ICS), 'Cross-industry demand for ESG reporting impacts shipping', ICS, 19 May 2023.

# Southeast Asia navigates emerging alternative maritime fuel pathways

This section provides an overview of alternative maritime fuels and examines progress in Australia and Southeast Asia in supporting alternative fuel development.

## Alternative maritime fuels and technologies: options and trade-offs

A number of alternative fuels are being considered or trialled by the international shipping industry to replace existing conventional fuels. The main low(er)-carbon maritime fuels are listed below.[26] Most of these fuels can be produced from multiple feedstocks using different production pathways, which significantly influence their actual well-to-wake emissions. Recent IMO and EU regulations provide a clear, yet evolving classification of alternative fuels. IMO's draft regulation on greenhouse gas fuel intensity will mandate that alternative maritime fuels achieve well-to-wake emissions of no more than **19 g $CO_2$/MJ by 2030**, dropping to **14 g by 2035.**

- **Liquefied natural gas (LNG)** – While readily available, **LNG is projected to be noncompliant with IMO's 2030 fuel intensity target**. It offers improvements in local air quality (compared to conventional fuels), but greenhouse gas mitigation benefits remain uncertain.[27]
- **Biofuels** – While readily available, there is high demand in other applications and potential feedstock issues due to competition with food security (when using the biodegradable fraction of biomass products). The EU has excluded food and feed crops (including virgin palm oil) from counting towards compliance in its FuelEU Maritime regulation. **Advanced biofuels** from waste-based sources or residues from food and feed crops may be eligible under specific conditions.
- **Methanol** – can be produced from fossil fuels such as natural gas (grey methanol), with $CO_2$ recycled/reused or captured and stored (blue methanol) in the short term. In the long term, it can be produced from electrolysis of water using renewable electricity (renewable e-methanol) and from biomass or biogas (biomethanol). Renewable e-methanol (also known as green methanol) and biomethanol have significantly lower lifecycle emissions than conventional methanol.
- **Hydrogen** – can be produced from fossil fuels (grey hydrogen), with $CO_2$ offset or captured and stored (blue hydrogen). In the long term, it can be produced from electrolysis of water using renewable electricity (green hydrogen). Green hydrogen has significantly lower well-to-wake emissions than grey or blue hydrogen.
- **Ammonia** – can be produced from fossil fuels (grey ammonia), with $CO_2$ recycled/reused or captured and stored (blue ammonia). In the long term, it can be produced from electrolysis of water using renewable electricity (renewable e-ammonia). Renewable e-ammonia (also known as green ammonia) has significantly lower well-to-wake emissions than grey or blue ammonia.

While all alternative fuels have lower emissions than the fuel oil currently used in the shipping industry, fuels produced using renewable electricity (for example, green hydrogen, green ammonia and renewable e-methanol) have the lowest emissions.[28] In the near term, ports may focus on infrastructure investment that builds bunkering capacity for the fuel(s) that will continue to be used, even as production pathways evolve over time. The new IMO regulation will change the economics: compliance is likely to drive capital investment while penalties make inaction expensive.

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[26] Adapted from International Renewable Energy Agency (IRENA), *A Pathway to Decarbonise the Shipping Sector by 2050*, IRENA, October 2021.

[27] N Pavlenko, B Comer, Y Zhou, N Clark and D Rutherford, *The Climate Implications of Using LNG as a Marine Fuel* [working paper], International Council on Clean Transportation, January 2020.

[28] More information about alternative fuels and their emission profiles can be found in Partnerships for Infrastructure (P4I), *Charting maritime decarbonisation: Low-carbon bunkering opportunities in Southeast Asia* [brief], P4I, August 2024.

## Outlook – Australia advances alternative maritime fuel infrastructure through strategic initiatives

Australia has launched several initiatives to support alternative fuel development, including investment in 7 hydrogen hubs and implementation of policies promoting biofuels and e-fuels (e-hydrogen, e-ammonia and e-methanol). Overall, government funding demonstrates sustained commitment that focuses on unlocking private investment, improving regulatory frameworks, and supporting strategic sectors like green metals and low-emission transport fuels. Several ports – Newcastle, Pilbara and Melbourne – have begun studying the feasibility of providing hydrogen, ammonia and methanol bunkering services.[29] The Port of Melbourne, for example, has recently signed a memorandum of understanding with major industry partners to assess the commercial viability of creating a green methanol bunkering hub at the port.[30] The collaboration will examine the potential for transporting green methanol from production facilities in Bell Bay, Tasmania, and Portland, Victoria, to Melbourne for bunkering operations.[31]

> ***"Port of Melbourne is exploring methanol at the moment because it is proving to be a practical pathway to maritime decarbonisation - capable of reducing lifecycle greenhouse gas emissions by 60-90% depending on how it's produced, whilst leveraging existing technology and the port's current infrastructure. With proposed strategic low carbon methanol suppliers nearby and growing industry adoption of methanol-capable vessels, Port of Melbourne and its industry partners are in a strong position to navigate this emerging market and work towards the remaining requirements to establish a competitive bunkering hub to support decarbonisation of the maritime supply chain."***
>
> — Shaun Mooney, Executive General Manager Commercial, Port of Melbourne


Representatives from the Port of Melbourne visit the Port of Tanjung Pelepas during Malaysia Maritime Week in June 2023. Source: P4I

[29] Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA), Maritime Emissions Reduction National Action Plan, *MERNAP Issues Paper 2: Energy sources and technologies*, DITRDCA, December 2023.

[30] Partners include Maersk, ANL (a subsidiary of CMA CGM), Svitzer and Stolthaven Terminals, as well as energy developers HAMR Energy and ABEL Energy. For more information, see Port of Melbourne, *Low Carbon Methanol in Melbourne: Feasibility study*, Port of Melbourne, 2025.

[31] Port of Melbourne, *Green methanol MoU signed with Melbourne port* [media release], Port of Melbourne, 26 April 2023.

Representatives from P4I, along with officials from the Ministry of Transport (MOT), Marine Department (MD), Port Authority of Thailand (PAT), and the Office of Transport and Traffic Policy and Planning (OTP), joined a site visit to Sahathai Terminal in Samut Prakan, Thailand. Source: P4I

## Uneven progress: alternative fuel development across Southeast Asia

Singapore has made notable progress in supporting the bunkering of alternative fuels, while other countries in the region are well-positioned to develop bunkering services for alternative fuels.

### Singapore

In Southeast Asia, countries such as Singapore have proactively prioritised the bunkering of specific alternative fuels,[32] notably LNG, ammonia and methanol,[33] driven by the increasing number of dual-fuel vessels being ordered by shipping lines such as Maersk.[34] Singapore has, in recent months, introduced safety standards for methanol bunkering[35] and successfully conducted an ammonia bunkering pilot.[36]

Together, Australia and Singapore have established a Green and Digital Shipping Corridor,[37] with collaboration in a number of areas related to the bunkering of alternative fuels. In addition, the Australia–Singapore Low-Emissions Technologies (ASLET) initiative for maritime and port operations – co-delivered by CSIRO, Australia's national science agency, and the Maritime and Port Authority of Singapore – provides funding for applied research, pilot projects and demonstration programs.[38]

### Malaysia

Besides Singapore, other countries in the region are well-positioned to support the decarbonisation of the shipping sector, notably via the bunkering of alternative fuels, but the potential has not been sufficiently investigated. Based on P4I analysis for the Port of Tanjung Pelepas and Port Klang in Malaysia (as well as the Port of Singapore), Figure 1 shows that a majority of weekly shipping services that pass through the Malacca Strait are stopping within the Asian region (accounting for around 71% of stops).

[32] Singapore is not a P4I partner country.

[33] Maritime and Port Authority of Singapore (MPA), *Singapore is ready for methanol bunkering for container vessels at Tuas Port with first successful simultaneous methanol bunkering and cargo operation* [media release], MPA, 27 May 2024.

[34] T Jay, 'Maersk finalizes order for 20 dual-fuel vessels to advance decarbonization goals', Global Trade, 4 December 2024.

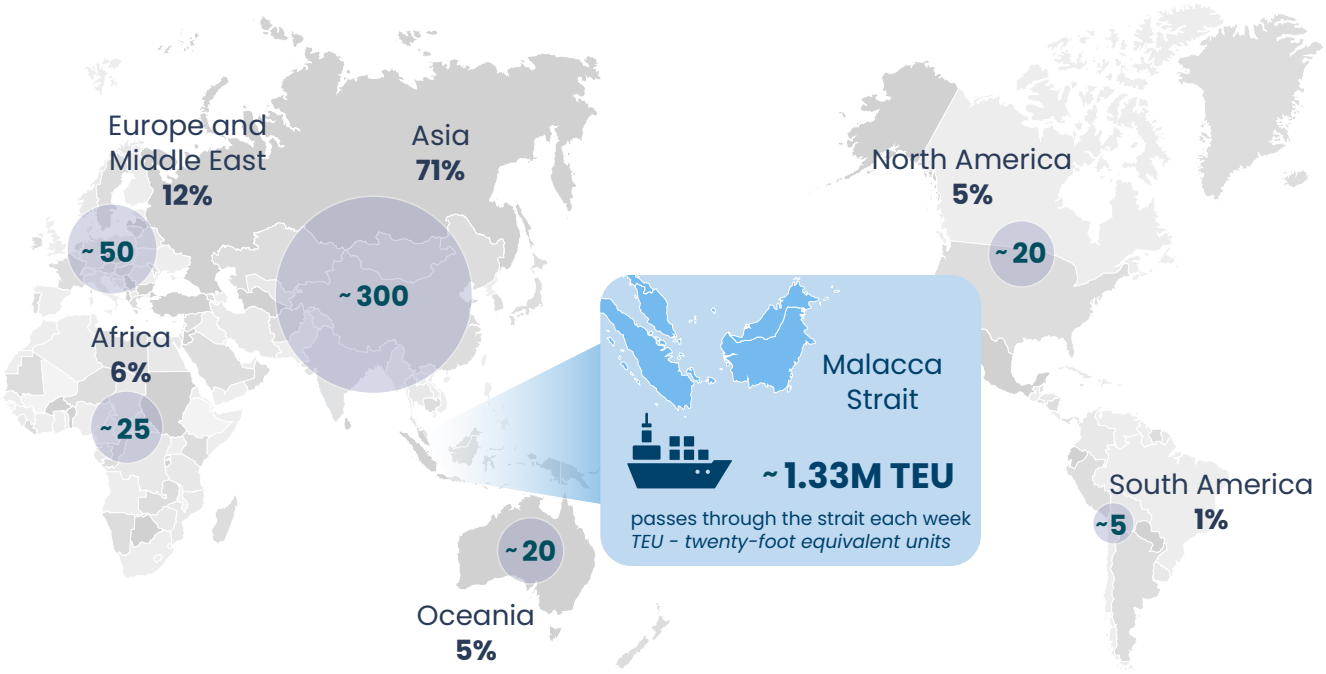
[35] MPA, *Singapore launches new standard on methanol bunkering, paves way for maritime industry's transition to sustainable alternative fuels* [media release], MPA, 10 March 2025.

[36] MPA, *World's first use of ammonia as a marine fuel in a dual-fuelled ammonia-powered vessel in the Port of Singapore* [media release], MPA, 15 March 2024.

[37] Department of Foreign Affairs and Trade (DFAT), *Singapore and Australia Green and Digital Shipping Corridor*, DFAT, March 2024.

[38] CSIRO, *Australia–Singapore Low-Emissions Technologies (ASLET) initiative for maritime and port operations*, CSIRO website, n.d., accessed 3 June 2025.

**Figure 1: Weekly shipping services passing through the Malacca Strait, by destination, February 2024**




TEU = twenty-foot equivalent unit

**Notes**

TEU is used to quantify port activity, encompassing both throughput and capacity, to provide a more precise depiction of the volume of cargo transiting through a port.

The ports used for this analysis are the Port of Singapore, and Port Klang and the Port of Tanjung Pelepas in Malaysia.

The analysis identified 304 weekly services relating to the period from 5 to 9 February 2024. Some services had more than one regional destination. The numbers of services to each region (shown in circles) are approximate.

Source: Alphaliner Database (accessed February 2024).

While major ports in Malaysia currently lack bunkering services, this has not prevented the country from attracting transhipment traffic. However, the current absence of bunkering services represents a missed opportunity, and Malaysian ports could leverage their position to develop alternative fuel bunkering capabilities. The Port of Tanjung Pelepas has been leading the charge to introduce alternative fuel bunkering. In 2024, the port conducted successful pilots for both LNG[39] and methanol bunkering[40] in February and November, respectively. Introducing alternative fuel bunkering at the Port of Tanjung Pelepas alone could contribute up to RM250 million to annual GDP and support nearly 300 green jobs.[41]

Maersk's methanol-ready vessels have already begun stopovers at the Port of Tanjung Pelepas. The frequency of visits is expected to intensify over time since methanol (and ammonia)-powered ships require additional bunkering stops due to the fuels' lower energy density compared to conventional fuels. As such, both green methanol and green ammonia offer strong future prospects to drive sustainable growth in Malaysia, aligning with the nation's energy transition objectives.[42]

[39] MMC Ports, 'PTP concludes first successful simultaneous operations of LNG bunkering in Malaysia', MMC Ports, 15 February 2025.

[40] MMC Ports, *Port of Tanjung Pelepas completes first methanol bunkering operation* [media release], MMC Ports, 25 November 2024.

[41] P4I analysis in collaboration with the Malaysian Ministry of Transport and the Port of Tanjung Pelepas, conducted in 2024.

[42] Ministry of Economy, *National Energy Transition Roadmap*, Ministry of Economy, August 2023.

## Assessing green bunkering infrastructure and decarbonisation pathways in Southeast Asia

Without investment in alternative low-emission fuel bunkering (green bunkering) and low-emission port operations, global shipping lines may choose to use ports that are further along in their decarbonisation efforts, in order to meet stricter regulations and growing pressure from cargo owners. This could mean lost economic opportunities, as well as falling behind in adopting new technologies that support clean energy and industrial growth.

P4I is supporting Malaysia, Thailand and Vietnam in assessing the technical, commercial and socio-economic potential of providing alternative fuel bunkering services, as well as the necessary regulatory requirements to enable their deployment in Malaysia (Table 2).

**Table 2: P4I's maritime decarbonisation initiatives with partner countries**

| Partner country | Malaysia | Vietnam | Thailand |
|---|---|---|---|
| **Port(s)** | Tanjung Pelepas | Cai Mep | Laem Chabang<br>Map Ta Phut<br>Bangkok |
| **P4I's engagement** | 1) Green bunkering feasibility study (completed)<br>2) Regulatory framework analysis (ongoing) | Green bunkering assessment (ongoing) | Mapping of decarbonisation pathways, including a green bunkering assessment and the exploration of a green corridor with another ASEAN port (ongoing) |

## Policy reforms and market development for maritime decarbonisation

The decarbonisation of global shipping operations necessitates unprecedented capital mobilisation. UNCTAD estimates that '[s]caling up fuel production, distribution and bunkering infrastructure to supply 100 per cent carbon-neutral fuels by 2050 will require annual investments of around [US]$28 billion to [US]$90 billion'.[43] While public (climate) finance mechanisms are emerging in Europe and other regions, much of the future required investment will need to come from the private sector. Developing countries may also benefit from the IMO Net-Zero Fund (part of the 2025 IMO net-zero framework), once established.[44]

Port operators play a crucial enabling role by providing necessary infrastructure and access to alternative fuels, requiring a comprehensive overhaul of the complex value chain from production and processing to distribution, handling, storage and utilisation. This transformation demands clear, supportive regulatory frameworks to guide and accelerate industry adoption.

P4I is currently assisting the Malaysian Ministry of Transport and the Port of Tanjung Pelepas in preparing a roadmap for developing Malaysia's alternative fuel regulatory framework. P4I analysis found that Malaysia has strong regulatory frameworks for traditional (petroleum-based) marine fuel, but the current regulatory framework does not adequately cover alternative fuels such as methanol, ammonia and hydrogen. Amending regulations requires coordinated efforts across multiple government actors. While the Ministry of Transport is charged with advancing green bunkering (as per the National Energy Transition Roadmap), its authority does not extend to all required regulatory reforms. Successful implementation will require inter-agency cooperation. For example, the Petroleum (Safety Measures) Act 1984, which regulates the safe production, processing and storage of fuels, falls under various ministries, including the Ministry of Energy Transition and Water Transformation (PETRA) and the Ministry of Science, Technology and Innovation (MOSTI).

[43] UNCTAD, *Review of Maritime Transport 2023: Towards a green and just transition*, UNCTAD, 2023, p xxvii.

[44] IMO, 'IMO approves net-zero regulations for global shipping', IMO, 11 April 2025.

Some of the **key necessary regulatory changes identified to date** include:

- adopting IMO and emerging industry standards for safe handling and bunkering of methanol and ammonia
- clarifying and streamlining the process of obtaining bunkering licences and permits for methanol and ammonia
- longer-term legislation to define green fuels and to harmonise their use as a fuel with existing legislation and regulations.

> ***"While bunkering services are generally limited across most Malaysian ports, we at Port of Tanjung Pelepas (PTP), as the country's premier transhipment hub and one of the region's leading terminals, recognise the importance of staying ahead by offering wider fuel options and developing future-ready, high-value alternative bunkering infrastructure. P4I's support to both PTP and the Malaysian Government is timely, as it will help unlock new commercial opportunities for the Malaysian port industry and reinforce Malaysia's global position as a key maritime country"***
>
> — Khairul Amalin Abd Rahman, Head of HSSE [Health, Safety, Security and Environment] and Sustainability Division, Port of Tanjung Pelepas

The roadmap – expected to be finalised by July 2025 – will provide clarity on roles and responsibilities for enabling green bunkering in Malaysia.

## Seizing the maritime decarbonisation opportunity in Southeast Asia

Southeast Asia holds a strategic position in international shipping, with 10 of the world's top 50 container ports and control over vital corridors like the Malacca Strait. This geographic advantage creates opportunities to support the maritime industry's decarbonisation, including the transition to alternative low-emission fuels. Financing this transition will require updates to regulatory frameworks to attract necessary investment.

Despite varying regulatory maturity across the region, Southeast Asian countries share common drivers and potential to become early-mover hubs for alternative fuel bunkering. Malaysia's economic analysis demonstrates this potential, projecting RM250 million in GDP contributions from a single port's alternative fuel operations. Countries that delay infrastructure investment risk losing market share as shipping lines increasingly prioritise ports that align with stricter emissions regulations and growing sustainability requirements of cargo owners.

Through the P4I initiative, key maritime stakeholders in Malaysia, Vietnam and Thailand are gaining insights to make informed decisions about alternative fuel bunkering capabilities and adapt their regulatory frameworks to support these objectives.

## Partnerships for Infrastructure

Partnerships for Infrastructure (P4I) is one of Australia's flagship infrastructure development initiatives in Southeast Asia. P4I partners with Cambodia, Indonesia, Laos, Malaysia, Philippines, Thailand, Timor-Leste, Vietnam and the Association of Southeast Asian Nations (ASEAN) to attract quality investment, address infrastructure gaps, and drive inclusion and climate-resilient development.

P4I does this by providing infrastructure advisory services, facilitating technical knowledge exchanges, building partners' technical capacity, and supporting government-to-government and other partnerships between Australian and Southeast Asian organisations.

Delivered through a single team, P4I is led by the Australian Department of Foreign Affairs and Trade in collaboration with Ernst & Young, Adam Smith International, The Asia Foundation and Ninti One.

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