Australian Government | Partnerships for INFRASTRUCTURE

Charting maritime decarbonisation:

Low-carbon bunkering opportunities in Southeast Asia

About the research

In 2023, Partnerships for Infrastructure (P4I) did a feasibility study with Malaysia's Ministry of Transport to explore the growing potential for low-carbon bunkering to drive green growth and unlock new economic opportunities.[1] The study focused on the Port of Tanjung Pelepas and highlighted the potential for Malaysia to become a regional hub for green bunkering. This brief outlines some of the key results of the study. It aims to deepen understanding in Southeast Asia and Australia of the emerging importance of low-carbon bunkering within the region as part of broader global efforts to decarbonise shipping and meet international climate commitments.

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 respect to Elders past and present. P4I also recognises early connections between Southeast Asia and the First Nations peoples of Australia.

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

Global climate commitments and current trajectories for international shipping

With current climate policies and measures, the world is on track for a temperature increase of 2.7°C by 2100.[2] This is despite the 2015 Paris Agreement, where the global community agreed to hold increases in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C.[3]

To strengthen their climate commitments, Southeast Asian countries are updating their nationally determined contributions (NDCs) and climate policies.[4] For example, in 2021 Malaysia pledged to reach net zero by 2050 'at the earliest' and promised to cut greenhouse gas emissions intensity by 45% (against GDP) by 2030.[5] For its part, Australia has committed to achieving net zero emissions by 2050 and has legislated its net zero targets.[6]

In certain sectors, global decarbonisation efforts are yielding significant success. In the power sector, for example, installations of renewable energy increased by almost 50% in 2023 – the fastest growth rate in the past 20 years.[7] In other sectors, especially those considered hard to decarbonise, emissions continue to rise and much more needs to be done to achieve the Paris Agreement goals.

One such sector is international shipping, where emissions accounted for almost 3% of greenhouse gas emissions in 2018.[8] As 80% of international trade in goods is by sea,[9] emissions from international shipping are projected to continue to increase as demand for transportation of manufactured goods grows. Estimates suggest emissions could increase by up to 3 times current levels by 2050 unless action is taken.[10]

Measures to reduce emissions from international shipping are generally not included in country-level NDCs to the Paris Agreement. Rather, the International Maritime Organization (IMO) has traditionally been responsible for reducing global emissions from the shipping sector.[11] In 2023, the IMO outlined its strategy to 'to peak GHG [greenhouse gas] emissions from international shipping as soon as possible and to reach net-zero GHG emissions by or around, i.e. close to, 2050'.[12] Australia and all Southeast Asian countries are among the 176 member states of the IMO.[13]

Increasingly, other drivers are propelling the shipping industry to decarbonise. From 2024, international shipping is included in the European Union (EU) Emissions Trading System, covering 50% of emissions from voyages starting or ending outside of the EU.[14] This means shipping companies operating within EU waters or at EU ports as part of their itineraries may face increased operational costs due to emission allowances should they delay the transition to low-carbon fuels. Additionally, many corporations are decarbonising their supply chains as part of net zero commitments and transition plans and are actively seeking to reduce emissions from transportation of goods.[15] Some shipping companies, such as Maersk, have also made net zero commitments (see Figure 4 on page 11).[16]

But the scale of the challenge requires greater action: oil-based fuels have traditionally accounted for 99% of shipping fuels.[17] While incremental reductions in greenhouse gas emissions can be made through energy efficiency measures, a more fundamental change is required to meet net zero targets: switching to alternative, low-carbon fuels. This switch will require investment in new ships; in new bunkering infrastructure at ports such as facilities, equipment and systems used for the supply and storage of fuel for ships; and in the capital-intensive production of the low-carbon fuels.

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[2] C Stockwell, *Projected warming almost unchanged for two years as governments push false solutions over climate action* [media release], Climate Action Tracker, 5 December 2023, accessed 1 June 2024.

[3] UN Climate Change, *The Paris Agreement*, Secretariat of the United Nations Framework Convention on Climate Change website, n.d., accessed 1 June 2024.

[4] International Energy Agency (IEA), *Policies database*, IEA website, n.d., accessed 1 June 2024

[5] Tuan Ibrahim Tuan Man, 'Malaysia – high-level segment statement COP 26' [conference statement], *United Nations Climate Change Conference (high-level segment)*, Glasgow, 9–10 November 2021, accessed 1 June 2024.

[6] *Climate Change Act 2022*, Federal Register of Legislation website, accessed 1 June 2024.

[7] IEA, 'Executive summary', in *Renewables 2023: Analysis and forecast to 2028* [revised version], IEA, January 2024.

[8] International Maritime Organization (IMO), *Fourth IMO greenhouse gas study 2020*, IMO, 2021.

[9] UN Trade and Development (UNCTAD), *Review of maritime transport 2023, UNCTAD*, 2023, p 55.

[10] J Garcia Valencia and A Swift, *The shipping industry won't meet its decarbonization goals without investing more in low-carbon fuels*, World Resources Institute, 25 October 2023, accessed 1 June 2024.

[11] European Federation for Transport and Environment, *Don't sink Paris: legal basis for inclusion of aviation and shipping emissions in Paris targets*, Transport and Environment, September 2021.

[12] IMO, *2023 IMO strategy on reduction of greenhouse gas emissions from ships*, IMO resolution MEPC.377(80), adopted 7 July 2023, subparagraph 3.3.4.

[13] IMO, *Member states*, IMO website, n.d., accessed 1 June 2024.

[14] European Commission, *Reducing emissions from the shipping sector*, European Commission website, n.d., accessed 1 June 2024.

[15] Cargo Owners for Zero Emission Vessels (coZEV), *Amazon, Electrolux, Philips, and over 20 other major global companies launch historic tender to accelerate deployment of zero-emission shipping* [media release], coZEV, 12 September 2023, accessed 1 June 2024.

[16] Maersk, *Maersk becomes first to have climate targets validated by SBTi under the new maritime guidance* [media release], Maersk, 9 February 2024, accessed 1 June 2024.

[17] IEA, *International shipping*, IEA website, n.d., accessed 1 June 2024.

In addition to sending clear policy signals, governments will need to change existing regulations and guidelines to enable the switch to low-carbon bunker fuels. The areas for policy and regulatory change include bunkering operations; importing, storing and handling low-carbon fuels; permits and licensing; safety requirements; inspection, monitoring and compliance; and emissions standards.

Australia's commitment to decarbonising regional shipping

Australia's share of global sea freight is around 14%, and ships carrying Australian sea freight (irrespective of flag) contribute around 4% of global CO_2 emissions from international shipping.[18] Australia therefore has a critical role in supporting decarbonisation efforts in the sector.

The Australian Government has introduced incentives and policies to promote development of alternative energy sources such as biofuels and electrofuels, also called 'e-fuels' (e-hydrogen, e-ammonia and e-methanol). This includes investing in 7 hydrogen hubs domestically.[19] It is also developing a Maritime Emissions Reduction National Action Plan (MERNAP) as part of a wider net zero plan. The MERNAP will consider different areas of activity needed to decarbonise the sector, including regulations, energy provision, and skills and training, as well as – crucially – international partnerships.[20]

In parallel to these domestic policy developments, Australian ports are exploring and developing low-carbon bunkering services. For instance, the Port of Newcastle, Pilbara Port and the Port of Melbourne (Australia's largest container and general cargo port) have initiated studies to assess the viability of providing hydrogen, ammonia and methanol bunkering services.[21] The Port of Melbourne has signed a memorandum of understanding with partners to explore the feasibility of establishing a green methanol bunkering hub using fuel produced at production sites in the region.[22]

Australia is also a signatory to the Clydebank Declaration, which seeks to establish at least 6 green shipping corridors[23] around the world by 2025 and more by 2030.[24] At the 27th United Nations Climate Change Conference (COP 27), the Australian Government reiterated its commitment under the Green Shipping Challenge to work towards decarbonising shipping through practical projects.[25] Additionally, Australia's International Development Policy, released in August 2023, commits to supporting decarbonisation and climate resilience in the region.[26]

Examples of cooperation include the memorandum of understanding on establishing a green and digital shipping corridor between the Maritime and Port Authority of Singapore and Australia's Department of Infrastructure, Transport, Regional Development, Communications and the Arts, signed on 5 March 2024.[27] Malaysia and Australia have also announced their mutual interest in cooperating on green shipping.[28] In November 2023, the Australian High Commission in Malaysia, the Malaysian Ministry of Transport and the Port of Tanjung Pelepas co-hosted a roundtable on low-carbon bunkering, with 60 representatives from key Malaysian government ministries and industry stakeholders.[29]

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[18] Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA), *Green shipping corridors and partnerships*, MERNAP [Maritime Emissions Reduction National Action Plan] issues paper 4, DITRDCA, March 2024.

[19] DITRDCA, *Energy sources and technologies*, MERNAP issues paper 2, DITRDCA, December 2023.

[20] DITRDCA, *Green shipping corridors and partnerships*.

[21] DITRDCA, *Energy sources and technologies*.

[22] Port of Melbourne, *Green methanol MoU signed with Melbourne port* [media release], Port of Melbourne, 26 April 2023, accessed 2 June 2024.

[23] A 'green shipping corridor' is a shipping route between 2 or more major port hubs on which low-carbon-emission ships and other emissions reduction programs are deployed.

[24] UK Government Department for Transport, *COP26: Clydebank Declaration for green shipping corridors*, Department for Transport website, accessed 1 June 2024.

[25] C King, C Bowen and P Conroy, *Australia rises to Green Shipping Challenge at COP27* [media release], Minister for Infrastructure, Transport, Regional Development and Local Government website, 8 November 2022, accessed 1 June 2024. See also Green Shipping Challenge, *Green Shipping Challenge* [website], n.d., accessed 1 June 2024.

[26] Australian Government Department of Foreign Affairs and Trade (DFAT), *Australia's International Development Policy*, DFAT, August 2023.

[27] DFAT, *Singapore and Australia green and digital shipping corridor*, DFAT website, n.d., accessed 2 June 2024.

[28] A Albanese and Anwar Ibrahim, *Joint statement for the 2nd Australia–Malaysia Annual Leaders' Meeting*, Prime Minister of Australia website, 4 March 2024, accessed 2 June 2024.

[29] Partnerships for Infrastructure (P4I), *Maritime roundtable navigates future of green fuels in Malaysia*, P4I website, 7 November 2023, accessed 4 July 2024.

Mobilising finance to bridge investment needs in Southeast Asia

While the transition to a clean energy economy represents a significant challenge for Australia and Southeast Asian countries, it is also a source of economic opportunities. Southeast Asian countries are well placed to benefit from this opportunity – both in supply of low-carbon bunker fuels at ports, and in the wider supply chain of renewable energy and fuel production. Meeting the demand for the production and bunkering of low-carbon fuels has the potential to generate skilled jobs and attract additional investment in the future, but up-front investment costs for production are very high.

According to the International Energy Agency, annual clean energy investment needs in Southeast Asia are estimated to reach US$171–185 billion for the period 2026 to 2030 and US$208–244 billion for the period 2031 to 2035. Low-emission fuels are expected to represent 7% of global clean energy investments in the period 2026 to 2030, and 8% in the period 2031 to 2035.[30] A growing number of public, private and blended funding sources and instruments are available to Southeast Asian countries, and the energy sector is a high priority.

However, accessibility remains a bottleneck,[31] and facilitating investments in key locations will be of critical importance. Recent International Monetary Fund analysis showed that greater domestic and international private sector engagement will be necessary to meet the climate investment needs of emerging and developing economies, including in Southeast Asia.[32]

As stated in *Invested: Australia's Southeast Asia Economic Strategy to 2040*, there is significant scope for Australia to contribute to Southeast Asia's infrastructure and low-carbon technology needs through both public and private investments. These needs represent a significant opportunity for Australian and other regional investors to drive economic growth through investment and trade.[33] At the ASEAN–Australia Special Summit in March 2024, Australia announced a range of initiatives, including an A$2 billion Southeast Asia Investment Financing Facility – providing loans, guarantees, equity and insurance – to catalyse Australian private sector investment in the region, particularly in infrastructure and low-carbon energy.[34]

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[30] IEA, 'Executive summary', in *Scaling up private finance for clean energy in emerging and developing economies*, IEA, 2023.

[31] United Nations Development Programme (UNDP) et al., *Guidebook on how to access climate finance for member states of the Association of Southeast Asian Nations*, UNDP, 2023.

[32] International Monetary Fund (IMF), *Global financial stability report*, IMF, October 2023.

[33] DFAT, *Invested: Australia's Southeast Asia economic strategy to 2040*, DFAT, September 2023.

[34] Australian Government Department of the Prime Minister and Cabinet (PM&C), *Outcomes summary*, PM&C website, 6 March 2024, accessed 12 July 2024.

Economic benefits of low-carbon bunkering in Southeast Asia

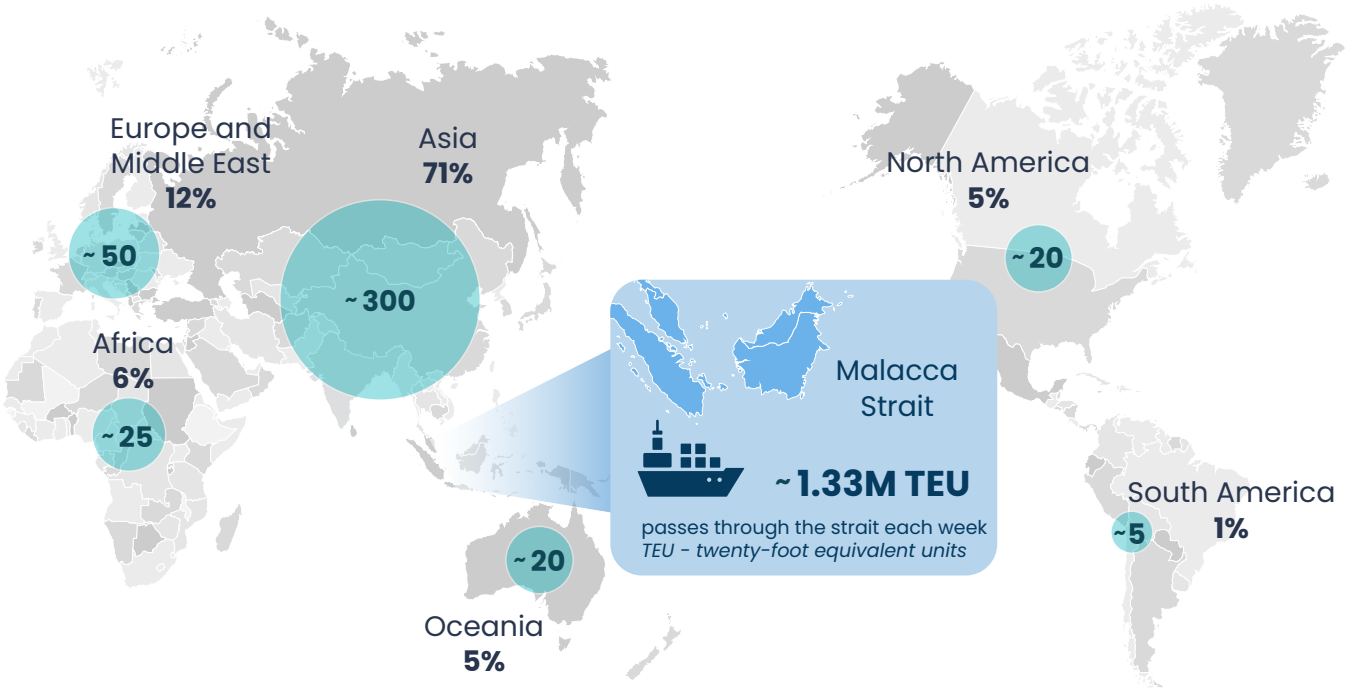
In its most recent review of maritime transport, UN Trade and Development suggested that geopolitical tensions and other factors are influencing growing shifts in global supply chains, including in Southeast Asia. Major companies are diversifying operations to remain agile, including by relocating production from China to Southeast Asia. Manufactured goods then need to be shipped from, or from close to, these new production locations to other parts of the world. This has implications for port operations and development, containerised shipping demand and supply patterns, as well as shipping costs and rates.[35]

If they take the necessary enabling actions, Southeast Asian countries stand to benefit not only from the shift in production, but also from a growth in shipping through their ports and the development of new infrastructure and ancillary services to enable this. Currently, bunkering services are not a major value-added service at Southeast Asian ports (except Singapore), despite the significant production of fossil fuels in the region and Southeast Asia's critical location on global shipping routes.

Southeast Asia is home to one of the most important global routes in the world: the Strait of Malacca.[36] Our recent analysis (see Figure 1) of the 304 weekly services passing through the Malacca Strait showed that:

- most weekly services are stopping within the Asian region (accounting for 71% of stops)
- Europe and the Middle East is the second largest region where these services are stopping (accounting for 12%)
- Africa (6%), the Americas (6%) and Oceania (5%) comprise the remainder of the stops.

Figure 1: Mapping of weekly services passing through the Malacca Strait



Notes

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.

The ports used for this analysis are the Port of Singapore; Port Klang, Malaysia; and the Port of Tanjung Pelepas, Malaysia. The 304 weekly services relate 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).

[35] UNCTAD, *Review of maritime transport 2023*, UNCTAD, 2023.

[36] International Renewable Energy Agency (IRENA), *A pathway to decarbonise the shipping sector by 2050*, IRENA, 2021.

Many Southeast Asian countries have sufficient land space, meaning production and storage of low-carbon fuels could take place close to the ports in which the fuels are used. The switch to low-carbon bunker fuels could therefore represent an opportunity for first-mover Southeast Asian ports to begin providing green bunkering services, which could enhance their attractiveness as a starting point or intermediate stop for vessels on a scheduled journey. These ports and surrounding economies stand to significantly benefit from the inward investment and other economic advantages that the switch to low-carbon fuels could bring.

This transition could also promote inclusive growth and economic empowerment by creating diverse employment opportunities and encouraging the inclusion of women and other vulnerable groups in the energy and maritime industries (see Box 1).

Box 1

Increasing gender-equitable employment opportunities in the bunkering sector in Southeast Asia

Across Southeast Asia, the gender employment gap remains persistently high, including in the male-dominated maritime and logistics sectors. Recent studies indicate that closing this gap would significantly boost the region's collective gross domestic product.[1]

This could include taking action to increase gender-equitable employment opportunities in the maritime and logistics sector. A 2021 survey by IMO and WISTA International of 513 companies in the sector included responses from 5 companies in the bunkering industry: among these, 10% of the workforce were women, and only 9% of these women occupied core roles such as specialist, technical and operational ones.[2]

To advance sustainable development and promote gender equity, targeted measures that address the root cause of the gender imbalance are needed. Issues such as limited training opportunities, prevalent sexual harassment and lack of family-friendly policies typically push women out of the energy, maritime and logistics sectors. Interventions such as targeted training and upskilling programs provide the opportunity to bolster the number of women entering these sectors, thereby supporting more inclusive economic outcomes. As countries explore policy changes to enable low-carbon bunkering and fuel production, integrated and inclusive approaches should be considered from the start. This will support the mobilisation of sustainable finance from public, private and blended sources.

[1] See, for example, L Woetzel et al., *The power of parity: advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.

[2] IMO and WISTA International, *Women in Maritime Survey 2021*, IMO and WISTA International, May 2022.

Alternative fuel options and emissions profiles

The shipping industry remains heavily reliant on fossil fuels. About 99% of its current fuel use is:

- heavy fuel oil
- marine gas oil
- very-low-sulphur fuel oil, which has appeared more recently in response to tightening regulations about sulphur content.[37]

These fuels are generally produced from the remnants of oil refining and have a tar-like consistency, as well as impurities such as sulphur, nitrogen and wax,[38] which lead to high levels of local air pollutants when burned. They also have a high carbon content, leading to relatively high emissions of greenhouse gases per unit of fuel.

The low(er)-carbon fuels listed below and in Figure 2 are options to decarbonise the industry.

Liquefied natural gas (LNG) offers improvements in local air quality, but greenhouse gas mitigation benefits remain uncertain. LNG is likely to be used in niche applications such as pre-existing routes or in specific vessel types only. Biomethane (produced from anaerobic digestion of organic matter) and e-methane (produced from green hydrogen) have lower emissions than natural gas.

Hydrogen, in the short term, can be produced from fossil fuels such as natural gas (grey hydrogen), where the carbon dioxide (CO_2) produced may be offset or captured and stored (blue hydrogen). In the longer term, it can be produced from electrolysis of water using electricity produced from renewable sources (green hydrogen).

Ammonia, in the short term, can be produced from fossil fuels such as natural gas (grey ammonia), where the CO_2 produced may be offset or captured and stored (blue ammonia). In the longer term, it can be produced from electrolysis of water using electricity produced from renewable sources (green ammonia).

Methanol, in the short term, can be produced from fossil fuels such as natural gas. In the longer term, it can be produced from electrolysis of water using electricity produced from renewable sources (e-methanol) and from biomass or biogas (biomethanol).

Figure 2: Overview of existing, emerging and third-horizon fuels by production process

Emissions profile	Fuel types	Production process	Fuel (oil)	Liquefied natural gas	Methanol	Other	Ammonia (liquefied)	Hydrogen (liquefied)	Hydrogen (gas)
Low emissions ↑	Power-to-X (PtX) (Electrofuels or 'e-fuels')	Conversion of renewable electricity into fuel	E-diesel (E-MGO)	E-LNG (E-methane)	E-methanol	'Other' includes battery and nuclear propulsion	Green ammonia	Green hydrogen	
	Biofuels	Conversion of biomass (plant or waste) to fuel	Biodiesel (Bio-MGO, HTL pyrolysis oil blends)	Bio-LNG (biomethane)	Biomethanol				
Offsetting or capturing ↑	Blue fuels with offsets	Conventional fuel for which CO_2 has been captured and stored or offset	Fuel oil (with offset)	LNG (with offset)	Methanol (with offset)		Blue ammonia	Blue hydrogen	
High emissions ↑	Fossil fuels	Refining of fossil fuels	Fuel oil (HFO + scrubber LSFO + MGO)	LNG	Methanol		Grey ammonia	Grey hydrogen	

Horizons:
Defined as technology readiness (both production and engines) combined with potential usage in the maritime industry

Third horizon | Emerging | Existing

CO_2 = carbon dioxide; HFO = heavy fuel oil; HTL = hydrothermal liquefaction; LNG = liquefied natural gas; LSFO = low-sulphur fuel oil; MGO = marine gas oil.

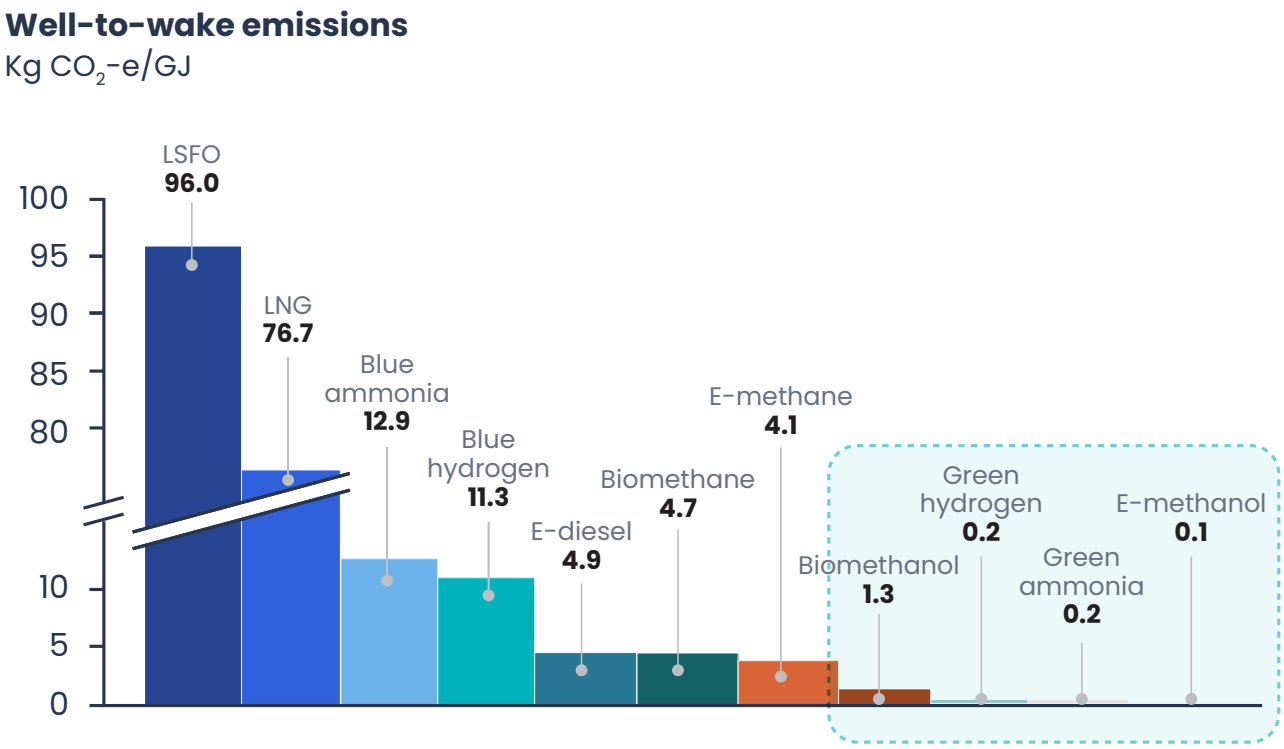
Sources: IRENA, *A pathway to decarbonise the shipping sector by 2050*, IRENA, 2021; Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, *Industry transition strategy 2021*, Center for Zero Carbon Shipping, October 2021.

[37] IRENA, *A pathway to decarbonise the shipping sector by 2050*; IMO, 'IMO 2020 sulphur limit implementation – carriage ban enters into force', IMO website, 2 March 2020, accessed 1 June 2024.

[38] B Cuffe, *What is bunker fuel? A complete guide*, Brookes Bell website, 9 January 2024, accessed 2 June 2024.

As illustrated in Figure 3, the production method of alternative fuels has a major impact on well-to-wake emissions.[39] While all alternatives have lower emissions than the fuel oil currently used in the industry, fuels produced using renewable energy (for example, green hydrogen, green ammonia and e-methanol) have the lowest emissions.

Figure 3: Well-to-wake emissions impact summary to 2050



kg CO_2-e/GJ = kilograms of carbon dioxide equivalent per gigajoule; LNG = liquefied natural gas; LSFO = low-sulphur fuel oil.
Source: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, *Documentation and assumptions for NavigaTE 1.0*, Center for Zero Carbon Shipping, March 2022.

P4I's green bunkering feasibility study with Malaysia's Ministry of Transport concluded that the most viable short-term option for low-carbon bunker fuels for Southeast Asian ports is methanol (see Box 2), with ammonia and hydrogen being attractive options in the longer term.

A World Bank study similarly recognised that fuels such as green methanol and blue methanol would require smaller changes to the existing fleet and fuel supply infrastructure.[40] However, the researchers noted that economic challenges associated with production of these fuels would result in higher fuel costs compared with alternatives, concluding that ammonia and hydrogen could be prioritised in certain countries.

[39] Well-to-wake emissions are the total emissions of greenhouse gases and particles from the production and use of a fuel for a vessel. These include pollutants emitted upstream (that is, well-to-tank emissions) and downstream (that is, tank-to-wake emissions).

[40] World Bank, *Charting a course for decarbonizing maritime transport*, World Bank website, 15 April 2021, accessed 2 June 2024.

Box 2

Deep dive on methanol – a low-carbon fuel option in the short term

Technical overview: Methanol is an organic chemical and is a light, volatile, colourless, flammable liquid. Bunkering operations alongside working container terminals could therefore be deemed high risk due to the high flammability.

Methanol has a low energy density by volume, meaning that methanol vessels are likely to make more frequent bunkering stops, which could result in more distributed bunkering locations for methanol than traditional marine fuel. Southeast Asian ports are well positioned on the Asia–Europe shipping corridor to capture this potential demand.

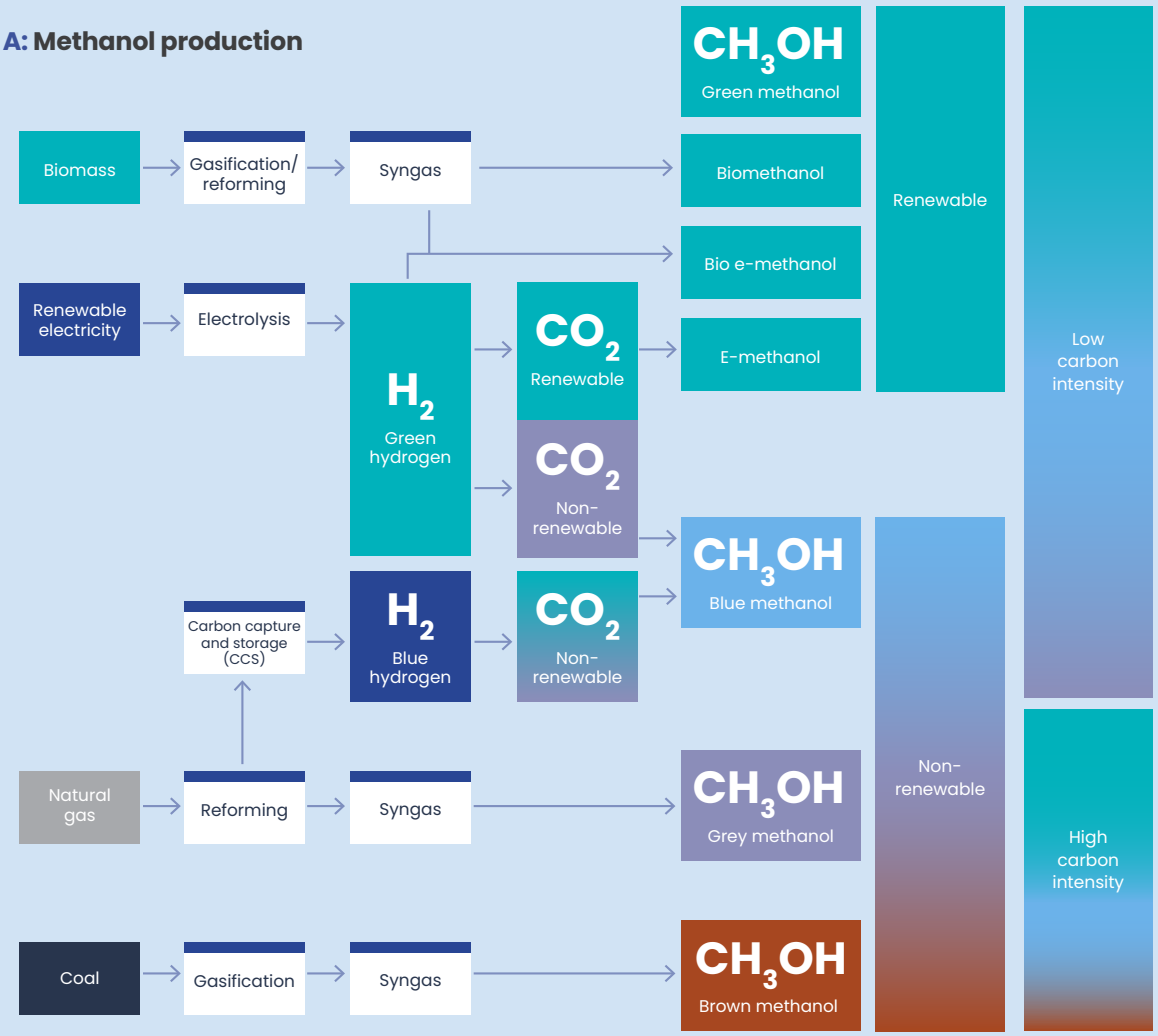
Switching to methanol from fuel oil would lead to a reduction in local air pollutants such as sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter – thereby helping to tackle Southeast Asia's growing air pollution problem.

Global annual methanol production capacity currently exceeds 100 million tons, with over 90% used in the chemical industry, and is mostly produced from coal or natural gas.[1] Emissions associated with methanol could be reduced through greener production methods:

- from biomass – for example, agricultural waste (biomethanol)
- from hydrogen derived from renewable electricity combined with CO_2 – to be considered green methanol, the CO_2 should be captured from renewable sources (for example, bioenergy with carbon capture and storage, or direct air capture) rather than fossil fuels.

Figure A illustrates the different ways methanol can be produced.

Figure A: Methanol production



Source: International Renewable Energy Agency (IRENA), *A pathway to decarbonise the shipping sector by 2050*, IRENA, October 2021.

While it offers near-term benefits, methanol is, and will likely remain, the highest-cost low-carbon fuel due to the need to use captured CO_2 in the production process. In the longer term, ammonia is expected to become a lower-cost fuel and also offers lower carbon intensity.

Commercial insights: In the short term, however, methanol also allows ports and shipping companies to use an existing production and distribution infrastructure, thereby significantly reducing costs associated with production and supply. Existing vessels can be converted with methanol engines, as can existing fuel oil bunkering infrastructure, allowing for a lower-cost switch. Methanol also offers flexibility as all new methanol vessels have dual-fuel engines, meaning that at any time shipping lines can switch back to using marine fuel oil. Appetite for methanol dual-fuel ships among major shipping lines is growing: nearly all major liners have open orders for several ships. In fact, 81.5% of all new orders in the second half of 2023 and at the beginning of 2024 were for methanol dual-fuel ships.[2]

But supply for green methanol is currently very limited, with most announced production facilities still in the development phase. In the short to medium term, supply may not be able to meet demand, which may favour bunkering locations close to fuel production hubs (for example, China, Europe and the United States). This means that emission reductions may not be realised until greater supply of green methanol is available.

[1] Sustainable Ships, *The state of methanol as marine fuel 2023*, Sustainable Ships website, n.d., accessed 2 June 2024.

[2] AXSMarine, *Alphaliner* [weekly newsletters], AXSMarine, accessed February 2024.

Fuel selection – key considerations for Southeast Asian ports and policymakers

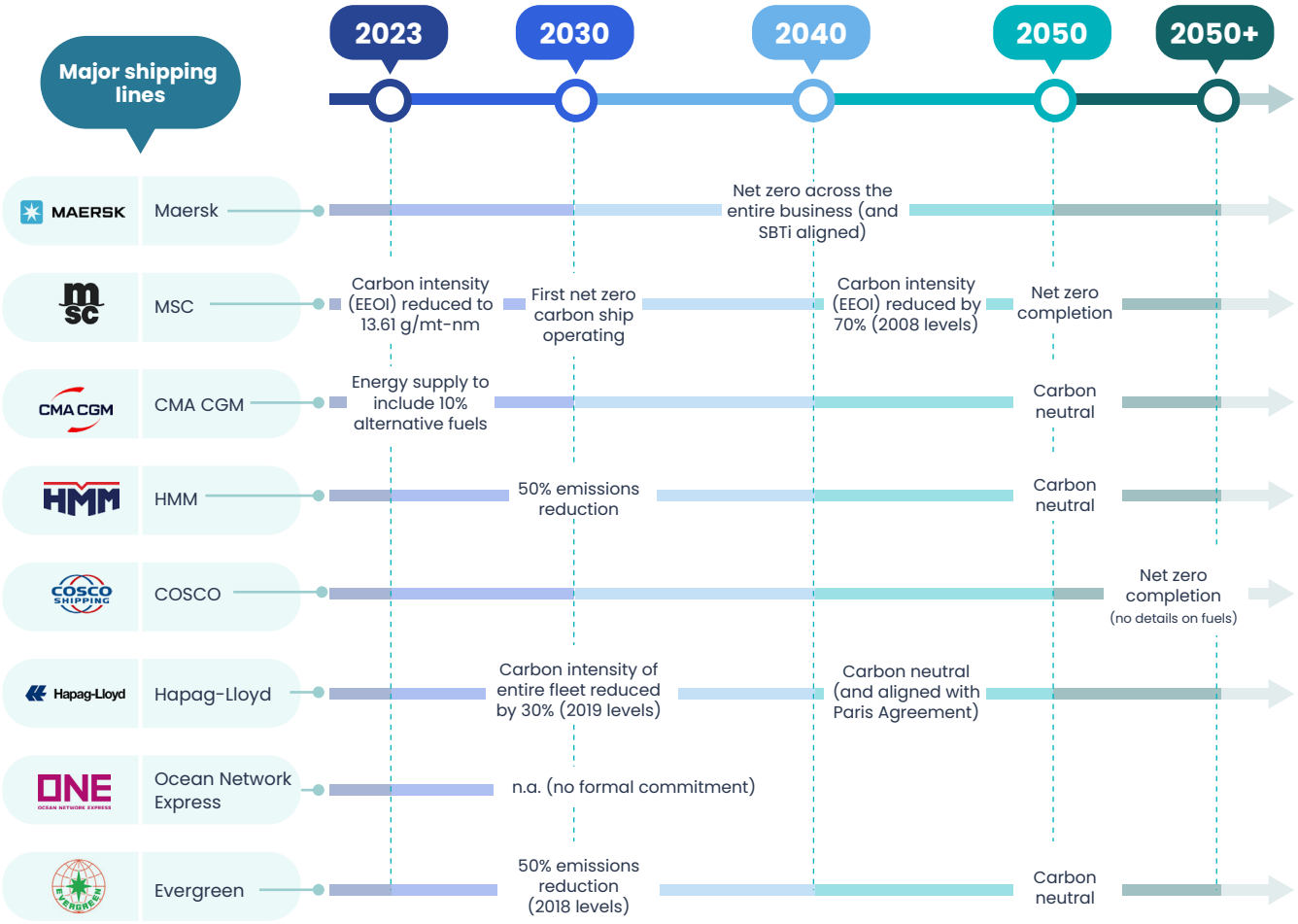
While heavy fuel oil and marine gas oil currently make up the vast majority of bunker fuels, a more diverse landscape of bunker fuels will emerge as the industry decarbonises, with many shipping companies predicting multifuel fleets over the coming decades.[41] For Southeast Asian ports, picking which fuel or fuels of the future to back is a critical decision. Investing in the infrastructure to store fuels and undertake bunkering services, as well as identifying partners to produce and supply enough of the chosen fuel(s), will require significant time and resources. And once a decision has been made, a port will be locked into that technology for decades to come. Several factors should be considered:

- **Supply of fuel:** not all fuels are commercially available at present, particularly those derived from renewable energy such as e-methanol, green ammonia and green hydrogen.
- **Demand for fuel:** shipping companies are also picking which fuels to back. These choices will be influenced by their decarbonisation pledges and commitments, as illustrated in Figure 4. Their decisions will result in significant expenditure on new vessels that will be in service for several decades. Currently, there is stronger demand for methanol and liquefied natural gas (LNG) vessels, while ammonia vessels are expected to be more in demand after 2030. A small amount of LNG is already used, with almost 200 ports equipped with LNG bunkering facilities globally.[42]
- **Cost:** fuels derived from natural gas currently cost less than biofuels or fuels derived from renewable energy, but longer-term costs should also be considered.
- **Emissions intensity:** a key consideration is the emissions from current methods of production, as well as the potential to reduce emissions in the future through alternative production methods.
- **Other ports:** Singapore is studying methanol and ammonia as sustainable fuel options. Other ports globally (including in Australia) are considering LNG, ammonia and methanol.

[41] Getting to Zero Coalition, *The shipping industry's fuel choices on the path to net zero*, Global Maritime Forum, April 2023.

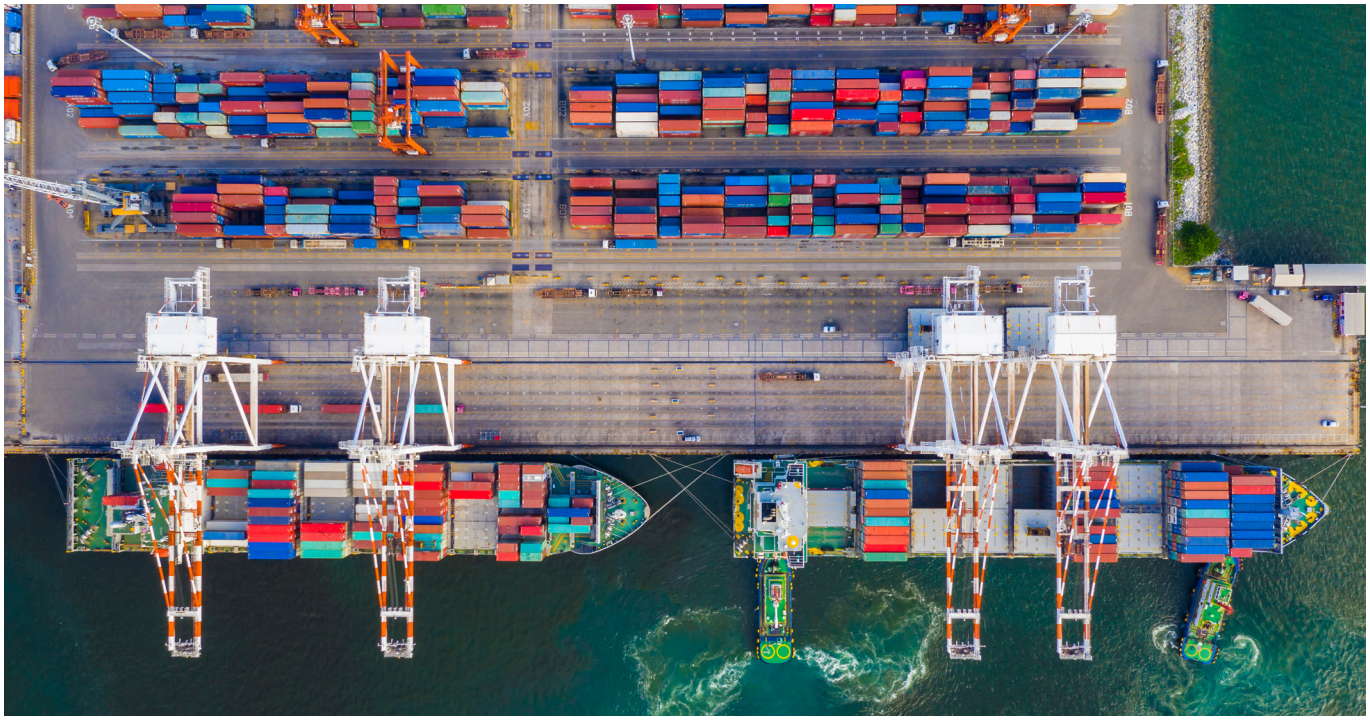
[42] IRENA, *A pathway to decarbonise the shipping sector by 2050*.

Figure 4: Decarbonisation pledges and commitments of major shipping lines



EEOI = energy efficiency operating indicator; g/mt-nm = grams per metric ton and nautical mile; SBTi = Science Based Targets Initiative.

Sources: Interview with Maersk Head of Fuel Innovation, March 2023; and individual company websites (accessed March 2023) and announcements in 2023.



Conclusions

The challenge of decarbonising the shipping sector is immense, but so too is the climate, social and economic imperative. The current international shipping fuel mix is almost entirely dependent on fossil fuels, and energy efficiency measures alone will not be sufficient. Studies estimate that meeting net zero goals in the shipping industry will require as much renewable energy as is currently produced worldwide.[43] This underscores the urgency of creating an environment focused on deploying low-carbon vessels, producing alternative fuels and establishing necessary supply facilities in key trading ports. Southeast Asia, home to the Strait of Malacca – one of the most travelled international shipping routes – is well positioned to support and benefit from this transition. Ports that invest in bunkering facilities may see their attractiveness increase, generating economic opportunities far beyond coastal zones.

Australia and Southeast Asia share an ambition and imperative to decarbonise their economies and combat climate change. This includes the need to decarbonise shipping. There is a range of alternative fuels to consider, each with specific trade-offs, requiring countries to make strategic choices for bunkering and fuel production. By leveraging its expertise, experience and advanced renewable energy technology, Australia can play an important role in supporting regional decarbonisation efforts. Collaboration on low-carbon bunkering projects will not only help achieve climate targets but also enhance economic resilience and energy security across the region.

[43] A Mehta, 'In the voyage to net-zero, which green shipping fuel will rule the seas?', *Reuters*, 15 May 2023, accessed 2 June 2024.