Climateworks CENTRE

Southeast Asia Framework for Ocean Action in Mitigation (SEAFOAM) project

Industry and infrastructure

The ocean is the primary passage for international trade, as well as providing a means of domestic freight and passenger travel. Maritime transport is of particular importance to Indonesia, a country consisting of thousands of inhabited islands.

Internationally, Indonesian territory occupies a strategic position for important trade routes between the Indian Ocean, Pacific Ocean and South China Sea. The most significant route is the Straits of Malacca, through which a third of global trade passes and estimated to be the most emissions-intensive trade route in the world (Wang et al. 2021).

These trade routes contribute to the high levels of air pollution that occur within the Indonesian territory. However, Indonesia also has a unique opportunity to lead a transition to a low-emissions future for the international shipping industry.

Industry and infrastructure: action and impact	2025	2030	2050
Domestic maritime passenger transport 	+ Implement a route-specific analysis and commit to priority routes for electrification. + Develop an accurate and disaggregated inventory for the maritime transport sector. + Set a specific target for maritime passenger transport emissions reduction.	+ Reduce GHG emissions as an average across domestic maritime passenger transport by at least 20 per cent, striving for 30 per cent, compared to 2008 levels. + Transition 5 per cent of the domestic fleet to alternative fuel sources. + Identify and commence the transition toward the electrification of at least one suitable high-impact maritime passenger route.	+ In line with international targets, achieve net zero emissions across domestic maritime passenger transport and shipping.
Domestic shipping and ports 	+ Explore low carbon emitting fuels for domestic shipping. + Commit to improvements in energy efficiency across the domestic fleet. + Develop an accurate and disaggregated inventory for the domestic shipping sector. + Set up a specific target for domestic shipping emissions reduction.		
International shipping and ports 	+ Transition to low-emission fuel production and bunkering. + Establish green shipping partnerships.	+ In line with international targets, reduce GHG emissions from international shipping by at least 20 per cent, striving for 30 per cent, compared to 2008 levels.	+ In line with international targets, achieve net zero emissions.
Seabed disturbance 	+ Undertake an assessment of the extent of seabed disturbance from fisheries and other industries, as well as fisheries and industrial maritime vessel emissions. + Formulate and enforce stronger regulations on sand mining and limit sea sand exports.	+ Enhance knowledge on seabed carbon storage and release. + Enhance knowledge of artisanal fishing practices and facilitate conversion of those activities linked to seabed disturbance.	+ At least 50 per cent of seafloor protected via marine protected areas (MPAs) expansion.

Domestic shipping and maritime passenger transport are of particular importance to the more remote and disadvantaged areas of Indonesia. The five provinces most reliant on sea trade in Indonesia are concentrated in the remote east of the country (BPS 2022a; Zen and Yudhistira 2021). In recognition of this, the government introduced the Maritime Highway initiative and Sea Toll program, which subsidise maritime logistics and passenger transport between larger, more economically developed islands and smaller islands (BPK 2015).

Domestic shipping is an integral part of the economy and around five per cent of national transport emissions come from this sector. Domestic shipping emissions are likely to increase as economic growth continues in eastern Indonesia and the government pursues increased connectivity programs to the more remote areas of the country. This may be exacerbated by an imbalance in the flow of goods to these locations.

Passenger transportation by ferry is also vital to Indonesia. In 2021, there were 10 million more domestic trips by boat than journeys made by plane (DEPHUB 2021). Indonesian transport decarbonisation efforts would benefit from including domestic shipping and maritime passenger transport emissions reduction targets and policy commitments in its NDC.

Domestic maritime passenger transport

Domestic maritime transport is a key contributor to the economy. In Asia, the ferry industry supported 73,000 jobs and directly contributed US$3.3 billion to the region's GDP in 2019 (Oxford Economics 2021). Indonesian maritime passenger transport is a key enabler of the movement of people between islands. In 2021, 74 million passenger journeys were made across Indonesian waters, compared with 64 million passenger journeys by aeroplane (DEPHUB 2021).

In an effort to reduce emissions from transportation, Indonesia's NDC has specified an increase in the use of biodiesel blends (Republic of Indonesia 2022b). The Indonesian government retains control of diesel supply across the country, and in February 2023, mandated an increase in the blend of biodiesel from 30 to 35 per cent (Rahmanulloh 2023).

Many vessels operating in the maritime passenger transport sector operate on diesel, and a large portion of this sector is impacted by this emissions reduction policy.

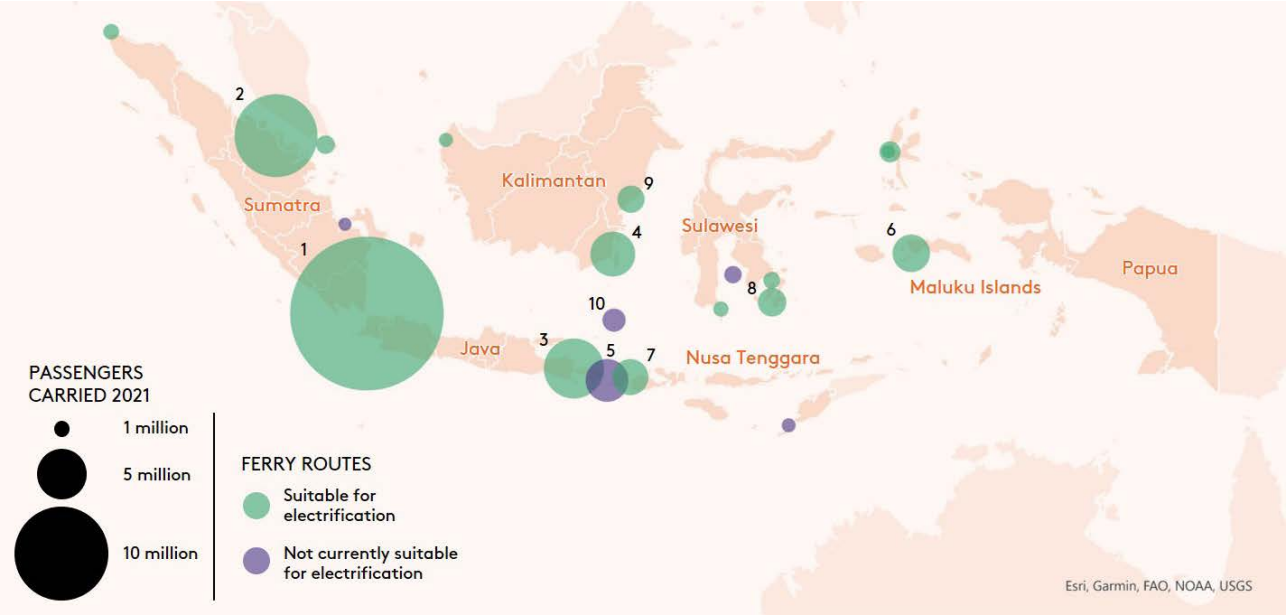
A focus on low–emission production as well as use is needed in relation to the adoption of biofuels. Biodiesel in Indonesia is derived from palm oil, and while its use may lead to reduction in transport sector emissions, there are concerns that the expansion of palm oil production actually drives a net increase in emissions from land use change (LPEM FEB UI 2020; Yasinta and Karuniasa 2021). Moreover, additional measures are needed for those vessels that operate on fuels other than diesel.

It is estimated that in 2018, the combined emissions from passenger ferries and mixed purpose ferries equalled 0.9 per cent of Indonesia's 2019 transport emissions (Abhold et al. 2022). If the emissions from these vessels could be reduced in line with International Renewable Energy Agency (IRENA) decarbonisation pathways, this would achieve a reduction of 0.38–0.51 $MtCO_2e$ annually by 2030 and 1.0–1.5 $MtCO_2e$ annually by 2050.

Electrification is the most promising solution for vessels operating on routes that regularly call at a port. The electrification of ferries is a mature technology and is operational in a number of countries including across Southeast Asia, where significant developments have occurred in passenger vessel electrification. Figure 6 shows major ferry routes with the potential for electrification.

In addition to the opportunity for decarbonised transport, ferry electrification provides the added benefits of eliminating pollution from ferry operation, reduced journey times and reduced noise, resulting in improved passenger satisfaction. Furthermore, electric vessels have been found to lower underwater noise, thus reducing negative impacts of the sector on marine life (Parsons et al. 2019).

FIGURE 6: Commercial ferry routes in Indonesia (data for 10 most travelled maritime routes in 2021)



(Source: DEPHUB 2021)

Note: The map shows the location and level of traffic of major passenger ferry routes in Indonesia, highlighting routes that have technical potential for electrification.

In Indonesia, domestic maritime passenger transport has clear pathways for decarbonisation. Options to reduce maritime passenger transport sector emissions range from the near total elimination of emissions through electrification supported by renewable energy sources, to the introduction of lower emissions fuels.

Indonesia's Second NDC – targets for inclusion

NDC category:	Sub-sector mitigation target	Sub sector non-GHG targets
Targets for inclusion:	+ Reduce GHG emissions as an average across domestic maritime passenger transport by at least 20 per cent (striving for 30 per cent) by 2030, by at least 70 per cent (striving for 80 per cent) by 2040 as compared with 2008 levels, with a goal of net zero emissions by 2050.	+ Transition five per cent of domestic fleet to alternative fuel sources by 2030. + Identify and commit to the electrification of high impact suitable maritime passenger routes.

Current targets and mitigation strategies for the transport sector are primarily based on energy efficiency measures which aim for 15,197,000 electric vehicle units and the adoption of low carbon emitting fuels such as Compressed Natural Gas fuelled public transport. However, these policy measures are focused on land transport, and there is a need for the inclusion of specific emissions mitigation targets for domestic maritime passenger transport. The most relevant major mitigation strategy is an increase in the use of low-emission and sustainably sourced biodiesel blends with the aim of reducing the lifecycle emissions of fuel usage.

Domestic shipping and ports

Indonesia comprises over 17,000 islands, and due to this geography, domestic shipping is a key part of the economy. Around five per cent of national transport emissions come from the domestic shipping sector. In 2021, almost four million tonnes of domestic cargo were unloaded at Indonesian ports, with eight of Indonesia's 34 provinces relying on the sector for over 60 per cent of their trade with other provinces (Figure 7).

Indonesia aspires to become the 'global maritime fulcrum', a policy which has driven growth in the number of ships built and expansion of port infrastructure. However, almost all vessels built or registered in Indonesia are designed to use diesel or other fossil fuels. As the international shipping industry transitions to alternative low-emissions fuels, there is the risk that high cost retrofits will be required to avoid these vessels becoming stranded assets.

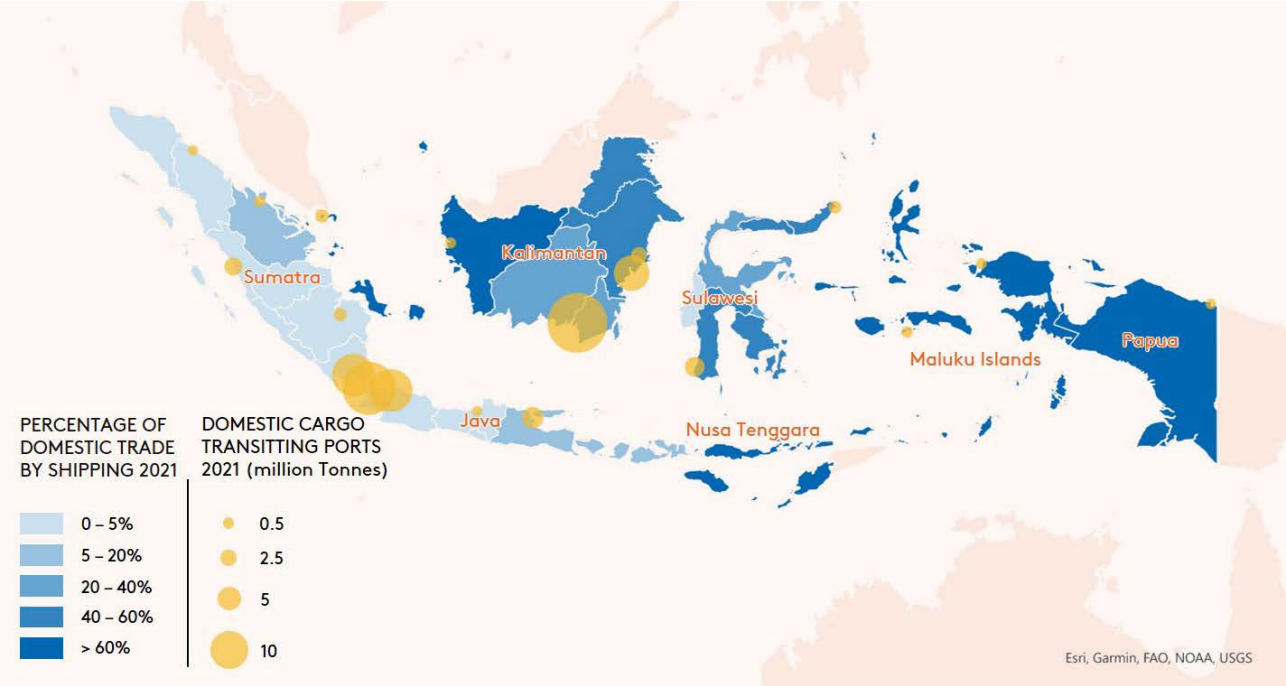
Notwithstanding Indonesia's heavy reliance on domestic shipping, there is a lack of monitoring and reporting frameworks. There is also a lack of detailed data on emissions related to domestic shipping activities, which limits data analysis and the assessment of decarbonisation solutions.

As with domestic passenger freight transport, the government's key decarbonisation strategy is the increased use of biodiesel blends. However, many other options exist for the decarbonisation of this sector, including energy efficiency improvements and a transition to low-emissions fuel and energy sources. There is also scope for energy efficiency improvement in the Indonesian domestic shipping fleet. A study found that 26–78 per cent of oil tankers could meet international energy efficiency regulations through engine technology improvements, weather rerouting and solar panels (Budiyanto et al. 2022).

Operational measures, such as slow steaming and weather routing can have a significant impact. Reducing vessel speed could achieve emissions reductions of 19–23 per cent (Ichsan 2019). Better route design can lead to emissions reduction across the whole transport sector; for example, a new freight shipping route between Java and Sumatra could avoid 24 $ktCO_2e$ annually by reducing the distance higher emitting or lower capacity vehicles travel on land (Arianto et al. 2022).

Low-emissions energy supplies can be used to aid sector decarbonisation with vessels using electricity from the grid while docked or tug boats using batteries charged from the grid. A consortium has announced plans to manufacture e-tugs in the Asia–Pacific region with construction occurring at a shipyard facility in Batam, Indonesia (The Maritime Executive 2022). These decarbonisation solutions could be applied in-country as well as exported to the region, providing the additional benefit of promoting Indonesian manufacturing and investment opportunities.

FIGURE 7: **Indonesia's domestic shipping and ports**



(Sources: BPS 2022a; 2022b)

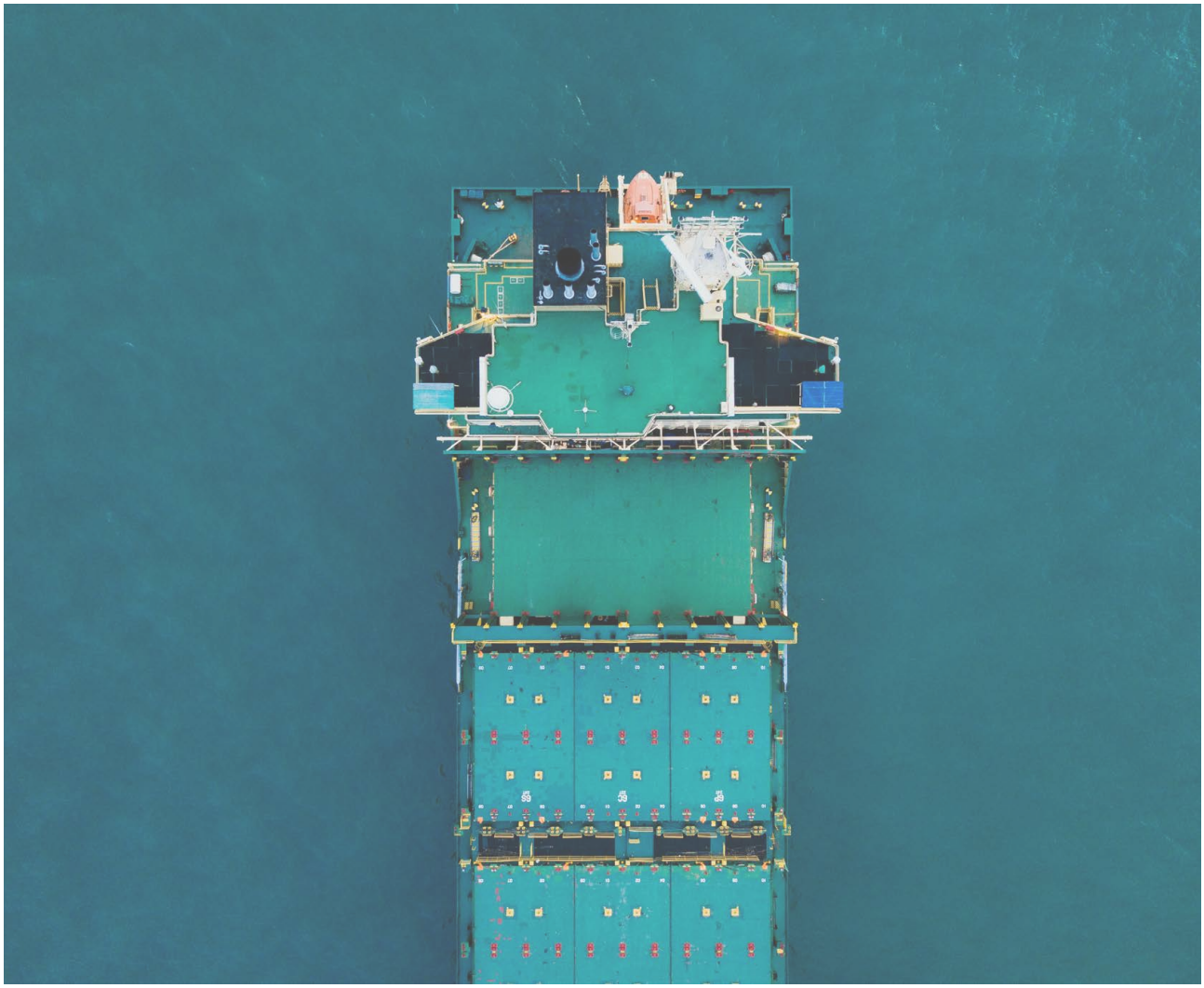
Note: Percentage of domestic trade conducted by shipping for Indonesian provinces and cargo loaded/unloaded at 20 strategic ports.

Domestic shipping is a key part of Indonesia's economy. If emissions from this sector were reduced in line with IRENA decarbonisation pathways, they would achieve a reduction of 1.9–2.6 $MtCO_2e$ annually by 2030 and 5.2–7.4 $MtCO_2e$ annually by 2050.

Indonesia's Second NDC – targets for inclusion

NDC category:	Sub-sector mitigation target	Sub sector non-GHG targets
Targets for inclusion:	+ Reduce GHG emissions as an average across domestic shipping by at least 20 per cent (striving for 30 per cent) by 2030, by at least 70 per cent (striving for 80 per cent) by 2040 as compared with 2008 levels, with a goal of net zero emissions by 2050.	+ Transition five per cent of domestic shipping fleet to alternative fuel sources by 2030. + Identify shipping routes for the deployment of low net production and low-emissions alternative fuels.

This is an opportunity for Indonesia to become a world leader in increasing global ambition to reduce the sector's GHG emissions. A target at least as ambitious as the International Maritime Organization's (IMO) should be set for the domestic maritime freight sector. This would be well supported by a commitment to the transition of 5 per cent of domestic shipping fleet to alternative fuel sources by 2030.



International shipping and ports

The international shipping industry is a key part of Indonesia's economy. In 2021, goods worth US$223 billion were exported from Indonesian ports (BPS 2022b), equivalent to about 19 per cent of the country's GDP that year (UNCTAD 2022) (Figure 8). Indonesia is the third largest supplier of seafarers in the world, with the sector providing employment for around 900,000 Indonesians (UNCTAD 2022). International shipping is regulated by the IMO, not the Paris Agreement. Indonesia's active involvement within this forum will be important for decarbonising and securing a low-emissions future.

In 2018, GHG emissions from Indonesia's maritime exports were estimated to be 25 $MtCO_2e$, while imports contributed 13 $MtCO_2e$, together representing 3.6 per cent of international shipping emissions globally (UNCTAD 2022).

Reducing emissions from international shipping activities in line with IRENA 2021 targets would achieve an annual emissions reduction of 10.3–13.9 $MtCO_2e$ by 2030 and 28.3–40 $MtCO_2e$ by 2050.

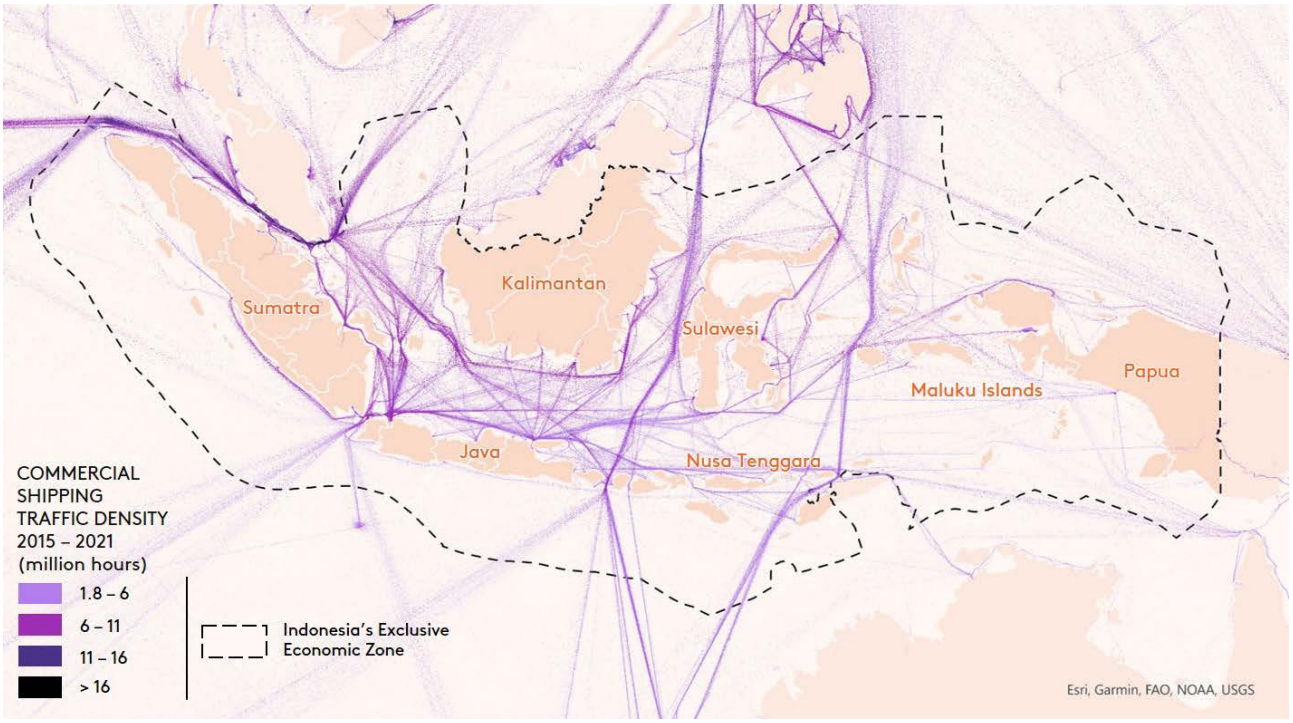
The shipping sector is heavily reliant on fossil fuels such as diesel, heavy fuel oil and marine gas, with low-emissions alternatives at early stages of commercial readiness. Vessels have an operational lifespan of between 30 and 50 years, meaning that many existing vessels will require costly retrofits. The cost of upgrades to onshore infrastructure to support the transition to a decarbonised shipping sector are high. In spite of

these challenges, a global movement towards international shipping decarbonisation is slowly progressing.

To become a hub for international maritime trade and leverage its unique strategic position, Indonesia must develop facilities to produce and supply low-emissions alternative fuels such as hydrogen and ammonia. The concept of Green Shipping Corridors (DfT UK 2022) aims to facilitate partnerships between multiple ports, operators and other stakeholders to accelerate emissions reductions and ensure that vessels can continue to operate on important trade routes. Engagement with this could attract investment from the shipping industry and provide new funding to assist with the development of renewable energy resources and the decarbonisation of Indonesia's energy system (Smith et al. 2021).

Indonesian ports can also act to reduce their own emissions impact. In a 'green port' (Arof et al. 2021), indicators are used to consider environmental impacts across a variety of areas including air quality, water quality, waste management, dredging activities and port development. Individual ports have the ability to reduce emissions and control environmental impacts within their waters through the control of fuel types, measures preventing discharge of wash water, the prioritisation of ships based on environmental performance (International Transport Forum 2018), and the use of technology systems to reduce ship waiting and turnaround times. Once docked, vessel emissions can be reduced through 'cold ironing', where vessels are connected to an onshore power source, rather than the use of onboard auxiliary engines for power (Zis 2019).

FIGURE 8: Commercial shipping traffic density in Indonesia and surrounding areas 2015-2021



(Sources: Marine Regions 2019; World Bank 2023)

Note: International shipping is integral to Indonesia's economy with maritime exports valued at 19 per cent of Indonesia's GDP leaving the country in 2019. The sector is intrinsically linked to the energy sector and decarbonisation plans between the two sectors have the potential to be mutually beneficial.

Indonesia's Second NDC – targets for inclusion

International shipping emissions are not included in Indonesia's national accounts. Under international shipping plans, Indonesian commitments should align with internationally agreed targets to reduce GHG emissions by at least 20 per cent (striving for 30 per cent) by 2030 and by at least 70 per cent (striving for 80 per cent) by 2040, as compared with 2008 levels. These progressive targets would support a strengthened goal of net zero emissions by 2050.

Seabed disturbance

The seabed is one of the most significant stores of carbon on the planet, with nearly twice as much carbon stored in the sediment of the seabed than in soil on land.

However, the global seabed remains widely underexplored, hampered by both inaccessibility and governance complexities. The resulting scientific uncertainties and gaps in knowledge mean that the impacts of seabed disturbance are often overlooked, which leads to the unaccounted release of carbon stored in the ocean seafloor.

The most common activities associated with sedimentary carbon disturbance are bottom trawling, dredging and various forms of seabed mining. Few regulatory safeguards are in place for these activities, which means there is scope for improvement across the entire process from assessment, to management, implementation and monitoring.

Discussions about Indonesia's seabed have largely focused on mining, shipping and fishing activities. More recently, the seabed has been recognised as a significant carbon sink through sequestration by blue ecosystems such as seaweed and kelp (Hurd et al. 2022). New marine protected areas may need to consider seabed carbon storage as a key part of the conservation imperative (Atwood et al. 2020; Howard et al. 2017).

Bottom trawling

Seafood is a major source of nutrition for people, particularly in Southeast Asia where fish contribute to a large portion of dietary protein. Harmful fishery practices, however, have severe negative consequences on the environment. Bottom-trawling is a globally dominant fishing practice that involves dragging weighted nets along the seafloor to catch fish (He et al. 2021).

Analysis based on data from Sea Around Us (2019) on bottom-trawled fish catch in Indonesia's three Exclusive Economic Zones areas – Central, Eastern and Indian Ocean – shows that during the period of 2010–2019, around 1.04 Gt of CO_2 emissions resulted from bottom-trawling activities.

Seabed mining and dredging

Shallow water mining creates seabed disturbance due to its intensity and the practices used, such as dredging, which severely alter seabed ecosystems.

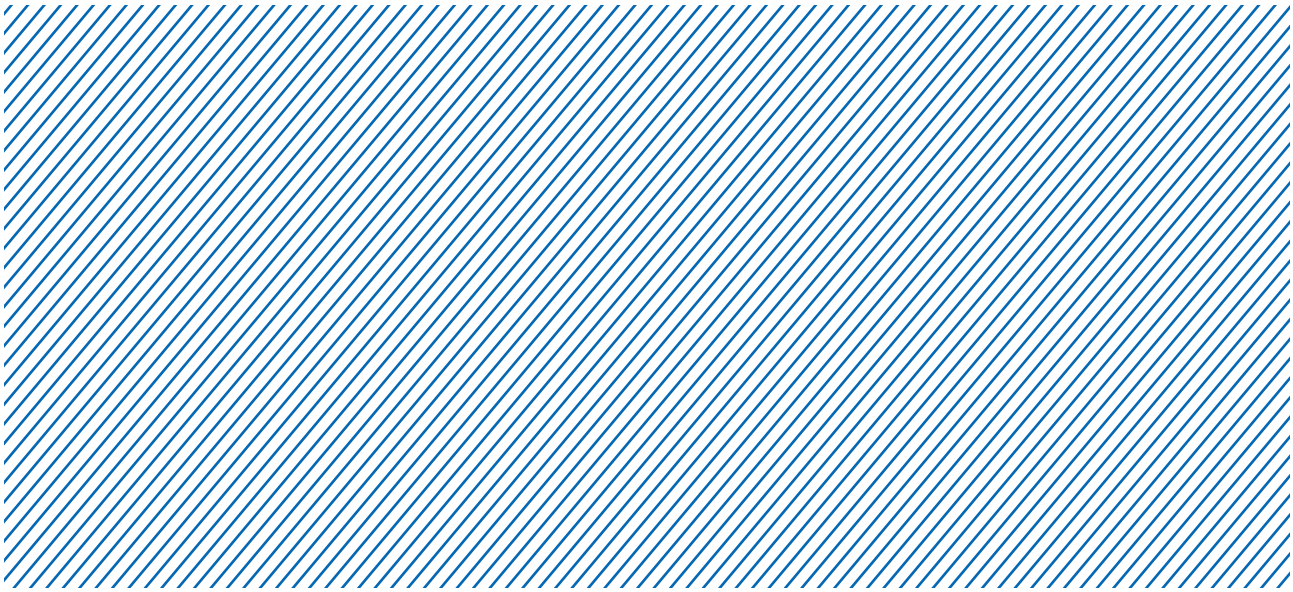
Operations in shallow waters in Indonesia appear considerably under-regulated. Tin is one of the key minerals extracted in seabed mining activities and Indonesia also has an industry in more traditional sand mining.

To date, Indonesia has not participated in international seabed management activities. Seabed governance is of critical importance for an archipelagic nation such as Indonesia, and national seabed regulations are still undergoing formulation (Widiastuti 2022).

Indonesia's Second NDC – targets for inclusion

Indonesia's 'Enhanced NDC' does not contain any existing commitments to limit seabed disturbance.

The formulation and implementation of strong regulations on sand mining is critical, as well as limitations on sea sand exports. There is also the need to fill the substantial knowledge gaps on seabed carbon storage, release and flux, as well as further understand the extent of artisanal fishing practices, particularly those linked to seabed disturbance. With an increased understanding, seabed disturbance would be a future area for inclusion in a new Ocean Use and Ocean Change sector in Indonesia's NDC.



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