



Advancing Port Decarbonization in Indonesia: Global Evidence and a Practical Framework

Acknowledgement

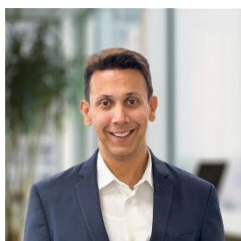
We extend our heartfelt gratitude to the partners and contributors who shaped this note on advancing port decarbonization in Indonesia. It would not have been possible without their engagement and shared commitment to accelerating the transition to zero-emission freight in Indonesia.

At the heart of this note is a simple insight. The viability of electric trucks and cleaner terminal equipment can only be understood through real-world evidence, shaped by route type, duty cycle, utilization and charging access. We are grateful to everyone who helped us ground the analysis in Indonesia's operating context.

We are especially grateful to WRI Indonesia, our ecosystem collaborator, for its support and inputs. These included its transport emissions inventory and its work on Green Corridor activation and port decarbonization, which anchored this note's evidence base and its link to national roadmaps. We also thank ViriyaENB for its support and input in making this work possible. Its commitment to advancing zero-emission freight in Indonesia has been central to taking this effort forward.

We also thank Kalista, Pustral UGM and ICCT Indonesia for the support they extended in helping us understand Indonesia's medium- and heavy-duty vehicle (MHDV) landscape. Their insights on the fleet, the policy environment and operating realities shaped how this note frames the opportunity for electric drayage. Pustral UGM contributed academic rigor, and ICCT Indonesia contributed policy and regulatory perspective.

To all our partners, thank you for walking this path with us toward a more sustainable, inclusive and low-emissions freight future for Indonesia's ports.



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Foreword

Indonesia's growth ambitions run through its ports. Pelindo handled 19.8 million TEU in 2025, and national logistics costs equal 14.29 percent of GDP against a target of 9 percent by 2045. Lowering that cost and decarbonizing the way cargo moves are the same task. Trucks are about 3.7 percent of Indonesia's vehicles yet emit about 31.7 percent of its road transport emissions, and many of those trips begin at the port gate.

No single organization can deliver a zero-emission port and freight system. It needs an ecosystem approach: one shared emissions baseline, coordinated action by ports, operators, shippers and energy providers, and decisions grounded in evidence. A port is a connected freight system that runs from the berth to the industrial cluster, not a terminal boundary alone.

This note, prepared by Smart Freight Centre, applies that thinking to Indonesia. It draws on SFC's Electrifying Drayage Alliance roadmaps for Los Angeles–Long Beach, New York–New Jersey and Rotterdam. Like SFC's Data Partnership Program, it is use-case driven and starts from operational data. Where electric trucks and cleaner terminal equipment make sense depends on route type, duty cycle, utilization and charging access. It sets out five connected pillars for the Tanjung Priok port cluster as a first pilot designed for replication at other ports.

This work fits our collaboration with SFC. We bring convening reach and our work on Green Corridor activation and port decarbonization. SFC brings its global freight-emissions frameworks and its shipper-coalition and data model. Together we can aggregate demand from shippers and logistics operators so that pilots become investable programs.

Early signals are already visible: electrified cargo-handling equipment and shore power at Pelindo terminals, a Green Port agenda led by the Ministry of Transportation, and an electric container truck trial between Tanjung Priok and Cikarang. Global experience shows that concessional finance and blended risk-sharing, not technology cost alone, turn pilots like these into repeatable, bankable models.

We invite ports, operators, shippers, energy providers, government and funders to build on this momentum and help move Indonesia's ports from isolated pilots to a measurable, financeable decarbonization program.



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Executive Summary

Ports sit where the world's hardest-to-abate freight flows meet. International shipping emitted about 1 billion tonnes of CO₂e in 2018, close to 3 percent of global anthropogenic emissions [39], and almost every container that crosses the quay continues its journey by truck, rail or barge. Policy and markets are now converging on the port: the IMO has committed to net-zero shipping emissions by or around 2050 [40]; the European Union will require large container and passenger ships to use shore power in its main ports from 2030 [41][42]; Singapore and India have set harbor-craft and port targets for 2030 [43][44]; and electric trucks reached 9 percent of global truck sales in 2025, with one in four trucks sold in China electric [45]. This note draws on Smart Freight Centre's global evidence base, including the Electrifying Drayage Alliance (EDA) roadmaps for Los Angeles–Long Beach, New York–New Jersey and Rotterdam, to set out a practical framework that port authorities across the globe can apply.

Indonesia shows why this matters for fast-growing emerging-market gateways. Pelindo handled 19.8 million TEU in 2025, a 5 percent increase on the previous year [1], and is already electrifying cargo-handling equipment, expanding shore power and testing electric drayage between Tanjung Priok and Cikarang [2][16][17]. The task is to turn these early signals into a measurable, financeable port decarbonization program.

Why Ports are a Global Decarbonization Priority

- Ships at berth emitted about 18 million tonnes of CO₂ a year in the ITF's global assessment (2011 data), alongside NO_x, SO_x and particulates released next to port cities; without action, in-port emissions were projected to rise up to fourfold by 2050, fastest in Asia and Africa [46].
- Before the IMO's 2020 sulphur cap, shipping emissions were linked to roughly 400,000 premature deaths and 14 million childhood asthma cases a year, concentrated in coastal regions [47].
- Green shipping corridors grew to 84 initiatives in 2025, with 25 new launches increasingly led by China, India, Brazil and other emerging economies; ports' power and fuel infrastructure is a recurring enabler [48].
- Finance is organizing around ports: the C40–IFC–IAPH Global Port Sustainability-Linked Loan Initiative, launched in November 2025, targets USD 1 billion of green port investment within three years and 50 investment-ready zero-emission port projects by 2030 [49].
- Zero-emission trucks are scaling fastest in Asia: electric trucks were 9 percent of global truck sales and 25 percent of sales in China in 2025, where total cost of ownership is already competitive with diesel [45].

Why This Matters for Indonesia

- Trucks make up a small share of Indonesia's vehicle fleet but a disproportionate share of its emissions. WRI Indonesia's 2024 inventory for the National Transport Decarbonization Roadmap (by WRI Indonesia and the Ministry of Transportation, forthcoming 2026) shows that trucks are 3.7 percent of registered vehicles but produce 31.7 percent of road transport emissions [32].
- Logistics costs equal 14.29 percent of GDP, against a national target of 9 percent by 2045 [29]. More efficient gates and trucking are a competitiveness gain as well as a climate one.
- Fossil fuels supplied 82 percent of Indonesia's electricity in 2024 and coal alone 62 percent in 2023 [33][34], so electrification must be paired with cleaner power.
- Clean-air action in Jakarta could avoid more than 10,000 deaths and save nearly USD 3 billion a year in health costs [36].

Why Drayage and Terminal Electrification Matter Now

- Drayage trucks generate approximately 50 percent of a container port's own greenhouse gas emissions, the single largest lever most port authorities control (Port of New York and New Jersey) [22].
- Electric trucks eliminate 100 percent of tailpipe air pollutants (PM2.5, black carbon, NOx) regardless of grid mix and cut greenhouse gases by roughly 47 percent against diesel on US and European grids (EDA methodology, GLEC v3.2) [24].
- Los Angeles–Long Beach has moved from pilots to 548 electric drayage trucks by mid-2026, targeting 2,000 trucks by 2030, with costs already down by up to 15 percent per mile under the right operating conditions [8][25].
- New York–New Jersey's roadmap shows utilization, not sticker price, decides the business case: with high utilization and a USD 150,000–175,000 subsidy, electric trucks already compete with older diesel trucks [22].
- Rotterdam's carriers, logistics providers and charging operators found market coordination, contract length, operational incentives, and charger location to be the binding constraints, not vehicle technology [9].
- The Port of Los Angeles has cut diesel particulate matter by 90 percent, SOx by 98 percent, NOx by 73 percent and GHG by 18 percent since 2005, and GHG per unit of cargo by 40 percent (2024 inventory), evidence that coordinated port action compounds over time [26].
- Asian evidence points the same way: an ICCT case study of drayage at the Port of Tianjin found the five-year total cost of ownership of battery-electric trucks 9 percent below diesel, and 10 percent below for battery-swap trucks [50].

What This Note Proposes for Indonesia

A five-pillar framework: measure and disclose; decarbonize terminal operations; electrify drayage and improve utilization; build energy and charging readiness; and coordinate, finance and scale, anchored in a practical three-layer emissions accounting boundary.

The Ask

Smart Freight Centre is seeking partners (government, port authorities, financiers and philanthropic funders) to back a first port cluster pilot: one common emissions baseline, one terminal electrification package, one to three electric drayage routes, one coordinated charging plan and one annual progress dashboard. Global experience shows that concessional finance and blended risk-sharing structures, not technology cost alone, are what convert a promising pilot into a repeatable, bankable model.

1

The Global Case for Port Decarbonization



1.1 Purpose and Scope of This Note

This note sets out a practical, evidence-based pathway for port decarbonization that port authorities in any market can apply, using Indonesia as its first use case. It focuses on port emissions accounting, terminal electrification, zero-emission drayage, charging readiness, clean energy and coordinated implementation, and draws on Smart Freight Centre's Electrifying Drayage Alliance (EDA) roadmaps for Los Angeles–Long Beach, New York–New Jersey and the Port of Rotterdam, on the EDA methodology for estimating emissions and air-quality impacts in port drayage, and on Indonesian public reporting and industry summit discussions, including the Indonesia Zero Emission Heavy Duty Vehicle (IZEHDV) Summit 2026.

Indonesia, the first use case, has a strong case for acting now. Pelindo handled 19.8 million TEU in 2025, a 5 percent increase on the previous year [1], and is already expanding electrified cargo-handling equipment, shore power and solar generation [2]. The Ministry of Transportation is advancing a Green Port agenda [3], and a live heavy-duty electric container truck trial already connects Tanjung Priok to a logistics centre in Cikarang [17]. The task now is to connect these signals into one coherent, measurable framework, treating the port as a connected freight system that reaches from the berth to the industrial cluster rather than as a terminal boundary alone.

Key Messages for Indonesia:

- **Build one common emissions baseline before setting port-specific reduction targets.**
- **Treat terminal operations and drayage as one connected decarbonization problem, not two separate projects.**
- **Prioritize short, repeatable, high-utilization truck routes for early electric drayage – the best route is rarely the shortest one.**
- **Plan grid capacity, charging locations and clean electricity together with fleet deployment, and use public-private collaboration to move from isolated pilots to repeatable models.**

1.2 A Practical Emissions Accounting Boundary

A single corporate inventory is not sufficient for every port decision. Corporate reporting should follow a recognized organizational method such as ISO 14064 or the GHG Protocol [4]. Freight transport emissions should use an activity-based method consistent with ISO 14083 and the GLEC Framework [5][6]. A port-wide air emissions inventory can then add ships, cargo equipment, on-road vehicles, rail and other mobile sources [11].

Figure 1, based on the GLEC Framework V3.2 and ISO 14083, sets out a practical three-layer boundary. Port-controlled emissions sit with the port authority and terminal operator. Port-related mobile emissions (ships at berth, harbor craft, drayage trucks, rail and tenant equipment) are a shared influence across ports, carriers and tenants. Freight-chain emissions extend beyond the gate to shippers, logistics providers and carriers, with the port providing data and infrastructure support. Measuring at all three levels, without double-counting, is what lets a port move from counting electrified assets to managing verified emissions performance.

A practical port emissions accounting boundary

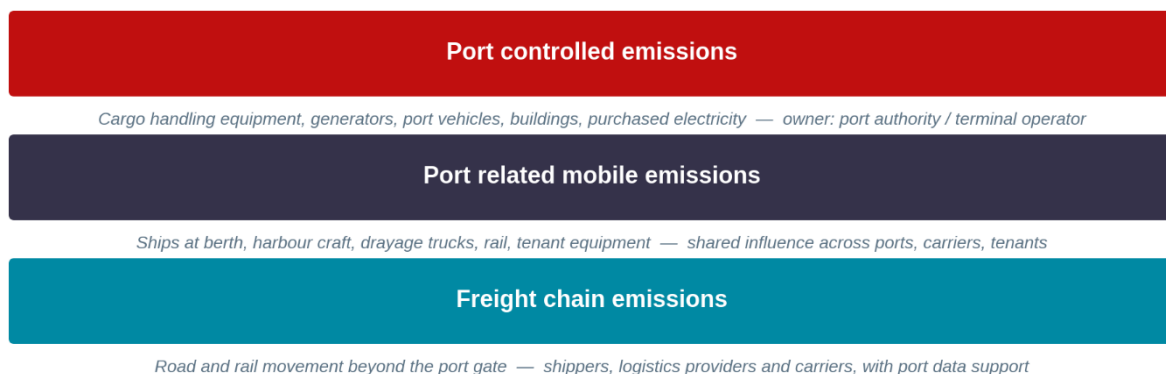


Figure 1: A practical port emissions accounting boundary

1.3 Why Drayage Deserves Early Attention

Drayage is often well suited to early truck electrification because routes are short, repeatable and concentrated around fixed logistics hubs: the same truck can return to the same depot, port or warehouse several times a day. This creates real opportunities for planned charging and high vehicle utilization. Yet the business case is sensitive to waiting time, congestion, operating hours and charging access, and ports can influence every one of these conditions through gate rules, appointment systems and infrastructure planning. Global experience shows just how material drayage is to a port's own footprint.

At the Port of New York and New Jersey, heavy-duty drayage trucks account for approximately 50 percent of port-related greenhouse gas emissions [22], making the sector the single largest lever available to a port authority pursuing its own climate and air-quality goals.

The pattern is not confined to OECD ports. In China, battery-electric heavy freight trucks have already reached total cost of ownership parity with diesel in certain cases [45], and ICCT's case study of drayage at the Port of Tianjin found battery-electric trucks 9 percent cheaper than diesel over five years [50]. For ports in South and Southeast Asia this shows the economics can close in Asian operating conditions, not only in subsidized Western markets.

50%

**Drayage trucks
generate about half
of a container
port's CO₂
emissions**

**“Heavy-duty drayage trucks account
for approximately 50 percent of port-
related greenhouse gas emissions.”**

Port Authority of New York and New Jersey
cited in
EDA 2030 Roadmap, Ports of NY & NJ, 2026

1.4 The Port and Hinterland System: Five Use Cases

A port rarely decarbonizes through one intervention. Emissions arise from equipment at the berth, from the terminal yard and gate, and from the trucks, rail and industrial clusters that the port connects to inland. Figure 2 sets out five recognizable use cases across this system, each with its own emission-reduction lever and each generating the operational data that later supports charger planning and route selection.

Port and hinterland decarbonisation use cases

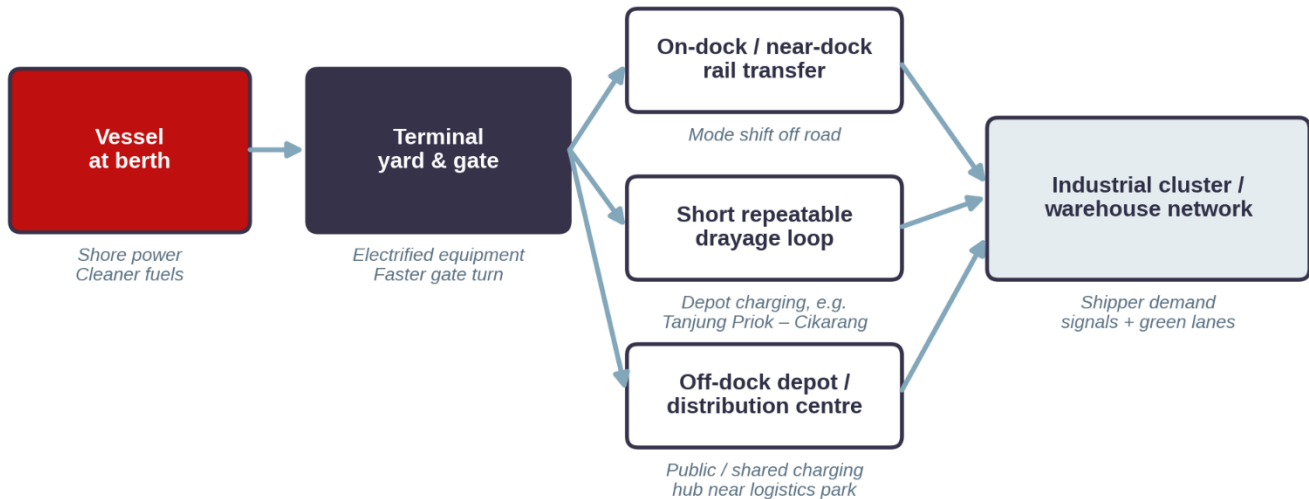


Figure 2: Port and hinterland decarbonization use cases

Four elements tie these use cases together: a common gate and route dataset (transactions, dwell time, lane frequency); charging and shore-power planning aligned to real duty cycles rather than distance alone; demand visibility from shippers and logistics providers; and one coordinating body that can see across the whole system.

In Indonesia, Tanjung Priok already illustrates several of these use cases at once: shore power and electrified prime movers at the terminal [2][16], an electric container truck trial on the short, repeatable Cikarang corridor [17], and road and rail links, including the Cibitung Cilincing Toll Road and the planned New Priok Eastern Access, that connect the port to industrial clusters east of Jakarta.

1.5 Policy and Markets are Converging on the Port

Port Decarbonization is moving from voluntary leadership to regulatory and commercial expectation. The IMO's 2023 GHG Strategy targets net-zero emissions from international shipping by or around 2050, with indicative checkpoints of at least 20 percent (striving for 30 percent) by 2030 and at least 70 percent (striving for 80 percent) by 2040, against 2008 [40]. Negotiations on the IMO Net-Zero Framework, which would give the strategy legal force through a global fuel standard and emissions pricing, were adjourned in October 2025 and are due to resume in December 2026 [51]. Regional and national rules are not waiting, and several apply directly at the berth and the gate.

WRI Indonesia's 2024 inventory of Indonesian-flagged vessels finds that 96 percent of their emissions come from domestic voyages. The inventory uses a bottom-up, voyage-based approach consistent with the IMO's allocation between domestic and international shipping, drawing on Inaportnet port-call records and IMO Data Collection System fuel data. For Indonesia, national port and domestic shipping policy, not IMO rules alone, will determine most of the maritime abatement. Table 1 summarizes the signals most relevant to port authorities and terminal operators.

Table 1: Selected Global Policy and Market Signals for Port Decarbonization

Jurisdiction or initiative	Signal	What it means for ports
IMO (global)	Net zero by or around 2050; 2030 and 2040 checkpoints; zero or near-zero fuels at least 5 percent (striving for 10 percent) of shipping energy by 2030 [40]	Ports must plan hore power and alternative fuel bunkering and will be asked for verified at-berth data.
European Union	FuelEU Maritime: container and passenger ships above 5,000 GT must use shore power at TEN-T ports from 2030, extending to all EU ports with shore power from 2035. AFIR: shore power at qualifying TEN-T ports and heavy-truck charging every 60 km on the core network [41][42]	Carriers calling in Europe will expect comparable infrastructure elsewhere on their networks.
Singapore	All new harbor craft must be fully electric, B100-capable or net-zero-fuel compatible from 2030; net zero for domestic harbor craft by 2050 [43]	The regional hub is setting the benchmark for Southeast Asian ports.
India	Harit Sagar Green Port Guidelines: 30 percent lower carbon emissions per tonne of cargo by 2030 and 70 percent by 2047; shore power for port craft at all major ports [44]	A large emerging-market peer with port-level intensity targets.
China	One in four trucks sold in 2025 was electric, with TCO parity in some heavy freight uses [45]	Asian proof that electric drayage economics can close at scale; Tianjin drayage TCO 9 percent below diesel [50].
Port of Rotterdam	Climate transition plan targets 55 percent lower port-area emissions by 2030 against 1990 [20]	Port authorities are taking responsibility beyond their own operations.
Green shipping corridors	84 initiatives worldwide, 25 launched in 2025 [48]	Ports are the physical nodes for zero-emission fuel and power supply.
Port finance	C40–IFC–IAPH Port Sustainability-Linked Loan Initiative: USD 1 billion target in three years; 50 investment-ready zero-emission port projects by 2030 [49]	Bankable port projects need baselines and KPIs, which this framework provides.

For Indonesian ports, whose largest customers are global carriers and multinational shippers already reporting under these regimes, early action is as much about competitiveness and access to capital as about compliance.

2

Global Evidence in Numbers: Ports Already Acting



2.1 Global Emissions and Air-Quality Evidence

Smart Freight Centre published a screening-level methodology for comparing diesel and battery-electric drayage across two dimensions: greenhouse gases (CO₂e) and local air pollutants (PM_{2.5}, black carbon and NO_x) [24].

Electric trucks eliminate 100 percent of tailpipe air pollutants because there is no combustion at the point of use: a direct, immediate benefit for port workers and the communities that live closest to terminals and drayage corridors.

The climate result depends on the grid. Using GLEC Framework v3.2 regional electricity factors, an electric truck cuts greenhouse gases by roughly 47 percent against diesel in Europe and by a comparable margin in the United States, but can produce more greenhouse gases than diesel on a coal-heavy grid such as China's national average [6][24]. The same dynamic applies to Indonesia's Java-Bali grid, given that coal supplied 62 percent of national electricity in 2023 [33]. This is not a reason to wait: electrification should be paired with a deliberate move toward renewable charging, because operational knowledge and route learning are valuable now, even where today's grid savings are modest.

Electrifying drayage: global emissions evidence (EDA methodology, GLEC v3.2 grid factors)

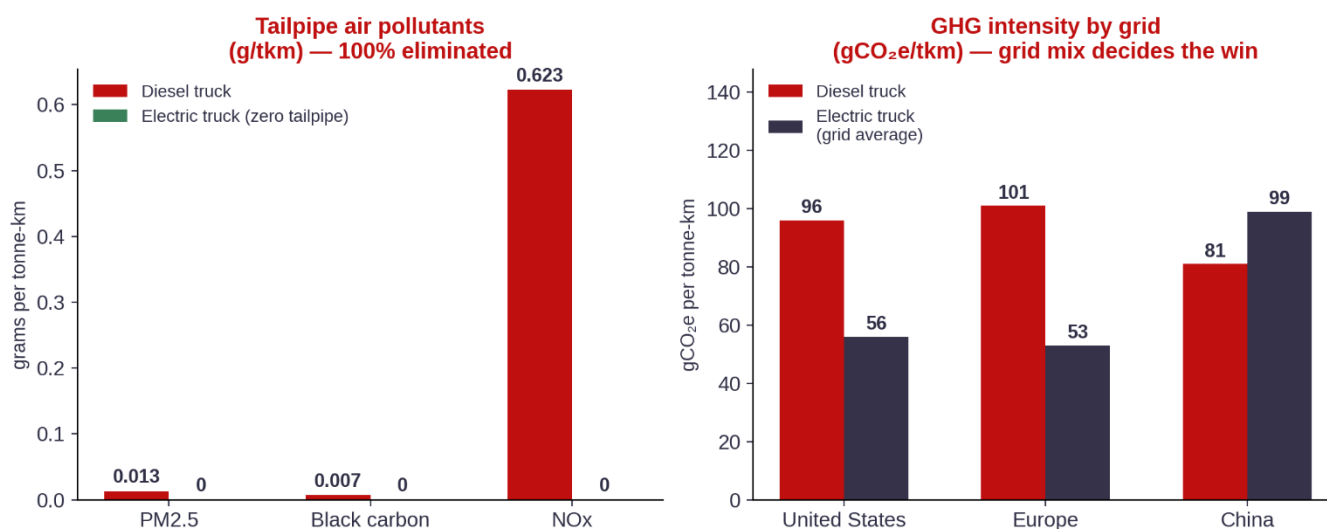


Figure 3: Electrifying drayage: global emissions evidence (EDA methodology, GLEC v3.2 grid factors)

2.2 Los Angeles–Long Beach: a 2,000-Truck Ambition

The San Pedro Bay Port Complex, the largest container gateway in the United States at around 20 million TEU a year, is one of the world's most mature electric-drayage markets. By mid-2026, 548 electric drayage trucks were operating across the complex, supported by 102 operational chargers and a further 92 planned by the end of the year [25]. The Electrifying Drayage Alliance's 2030 Roadmap sets a shared ambition of 2,000 electric drayage trucks, around 10 percent of the region's drayage fleet, built across five pillars: **strengthening demand signals, expanding vehicle and charging readiness, optimizing port and terminal operations, enabling supportive market conditions, and coordinating, measuring and scaling deployment** [8].

The roadmap's most important finding is economic, not technical. Under the right operating conditions (available purchase incentives, high utilization and access to operational measures such as the APM Terminals Green Lane), electric drayage has already reached, and in some cases surpassed, cost parity with older diesel trucks, with a cost reduction of up to 15 percent on a dollar-

per-mile basis [25]. The challenge from here is no longer proving that electric drayage works; it is making these favorable operating conditions the default rather than the exception.

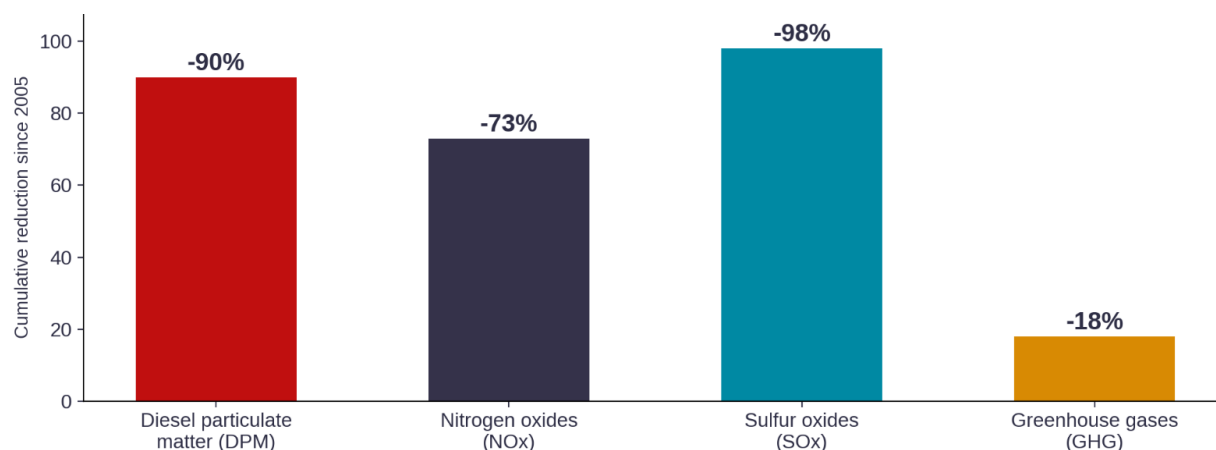


Figure 4: Port of Los Angeles: cumulative port-wide emissions reductions, 2005–2025 (2024 inventory)

2.3 New York–New Jersey: a Demand-Led Roadmap

The Port of New York and New Jersey is the largest container port on the US East Coast, handling approximately 8.9 million TEU a year across Port Newark, the Elizabeth-Port Authority Marine Terminal, Port Jersey and Howland Hook. Its EDA 2030 Roadmap starts from an earlier market stage than Los Angeles–Long Beach: an estimated 13 to 20 electric drayage trucks were operating as of mid-2026, against a shared ambition of at least 250 trucks by 2030, backed by around 12 participating drayage providers and eight priority freight corridors [22].

Total cost of ownership analysis prepared for the roadmap shows why utilization is treated as the central economic variable. A new battery-electric truck (about USD 290,000) still costs roughly twice a new diesel tractor and far more than a second- or third-hand diesel truck still legally operating as drayage. However, with a zero-emission truck subsidy of USD 150,000–175,000 and around 250 operating days a year, the roadmap finds electric trucks can already be cost-competitive with older diesel trucks once utilization and charging access are secured [22].

The roadmap is explicit that it creates no procurement commitment, volume allocation or pricing coordination: all commercial decisions remain with individual companies. Its value is coordination: a shared direction, a common set of indicators and an annual review cycle across six pillars, so that demand signals, vehicle readiness, terminal operations, market conditions and financing move together rather than in isolation.

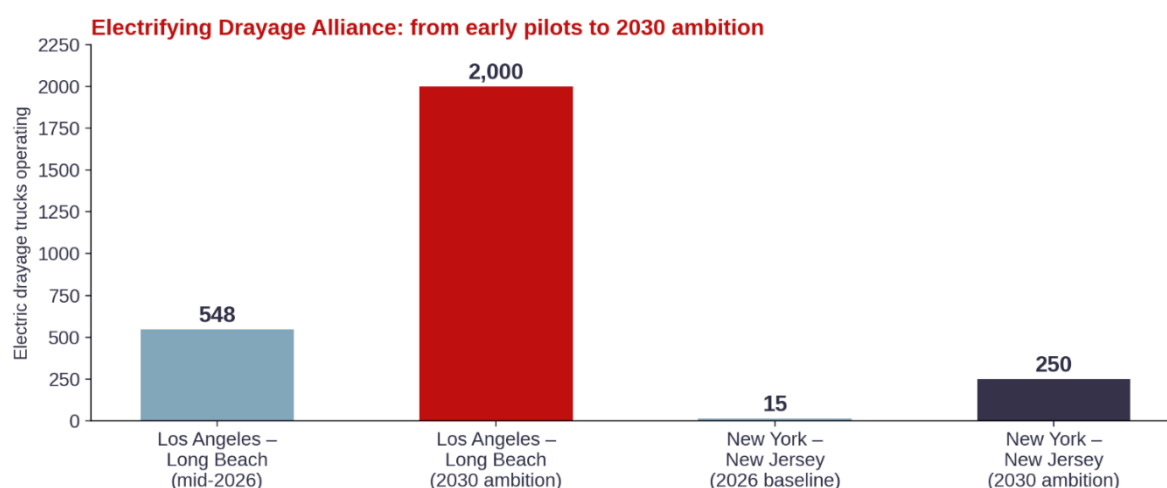


Figure 5: From early pilots to 2030 ambition: electric drayage truck deployment, Los Angeles–Long Beach & New York–New Jersey

2.4 Rotterdam: Market Readiness is the Real Constraint

A March 2026 Smart Freight Centre workshop with Rotterdam carriers, logistics providers and charging-infrastructure operators reached a blunt conclusion: electric drayage is technically viable today and already running at small scale, but scaling is blocked by structural market conditions, not by the vehicles themselves [9]. Participants pointed to a fundamental mismatch: carriers need four-to-five-year customer commitments to justify financing an electric truck, while most customers will commit for no more than a year alongside a roughly 1.5-times upfront cost premium, uncertain electricity pricing and unclear residual values.

Two findings travel especially well to Indonesia.

- First, **operational incentives**: reduced waiting time, priority access and reliable terminal information mattered more to participants than small financial subsidies.
- Second, **charging infrastructure** existed but was not yet usable at scale: fragmented pricing, limited roaming and a mismatch between charger locations and real freight flows meant that availability alone did not translate into utilization.

Rotterdam's own conclusion was that the technology is not the bottleneck; system-level coordination across carriers, customers, infrastructure and ports is.

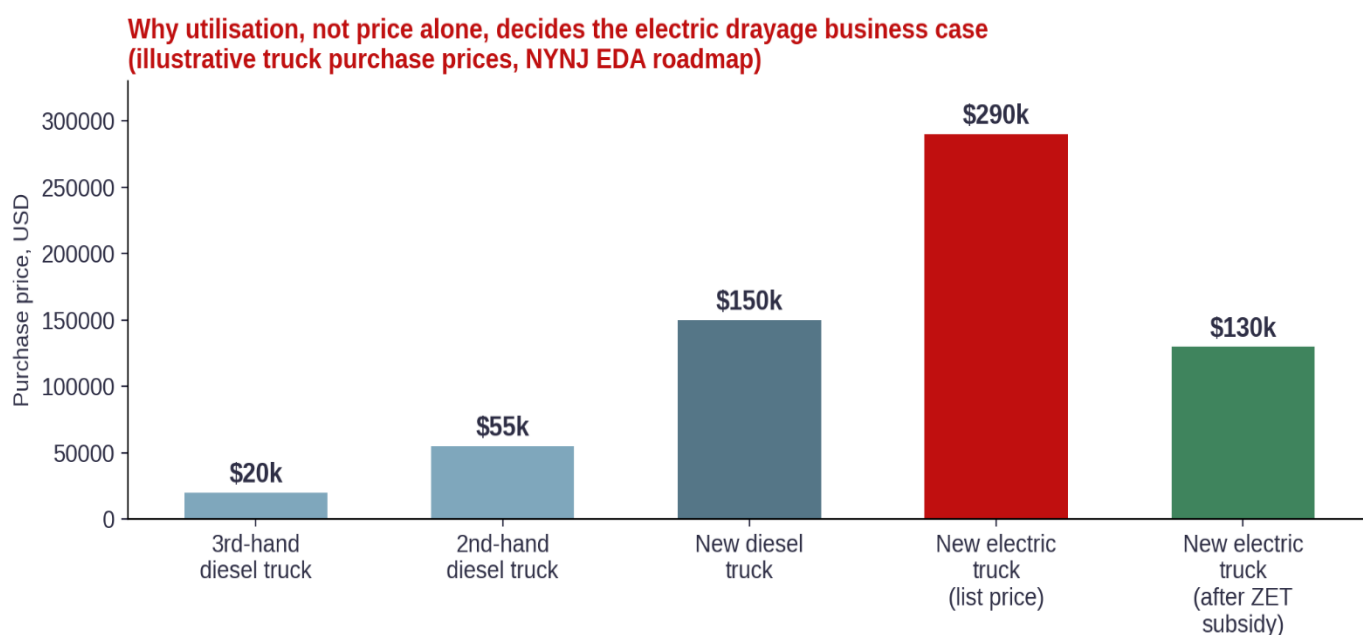


Figure 6: Illustrative drayage truck purchase prices: utilization and subsidy design, not price alone, decide the business case.

Key Lessons from International Port Initiatives

The three ports draw the same conclusion: scale comes from coordinated operating conditions rather than from vehicle technology alone.

Table 2: International Lessons and Their Relevance to Indonesia

Lesson	Evidence	Implication for Indonesia
Measure first	Los Angeles' annual inventory makes 20 years of reductions visible.	Build one common baseline before setting targets.
Utilization decides the business case	NY–NJ: subsidy plus about 250 operating days a year makes electric trucks competitive.	Choose short, repeatable, high-utilization routes; track trips per day and queue time.
Operational incentives beat small subsidies	Rotterdam: waiting time, priority access and terminal information mattered most. LA–LB: Green Lane.	Test priority appointments and gate handling before building new infrastructure.
Demand signals unlock finance	Rotterdam: four-to-five-year carrier needs versus one-year customer commitments.	Use route nominations and non-binding interest to give carriers confidence.
Charging must follow freight flows	Rotterdam: chargers existed but were under-used.	Map depots and truck dwell locations with PLN before siting chargers.
Clean electricity multiplies the benefit	EDA: about 47 percent GHG cut on European grids; smaller or negative on coal-heavy grids.	Plan renewable charging together with electrification, given the Java-Bali grid.

3

Adapting Global Practice to Indonesia



Indonesia does not need to invent port decarbonization practice from scratch. The Electrifying Drayage Alliance roadmaps for Los Angeles–Long Beach, New York–New Jersey and Rotterdam show consistently that the enabling conditions demand signals, utilization, charging access and coordinated financing matter as much as the vehicles themselves. Asian peers confirm the direction of travel: Singapore's harbor-craft mandate, India's Harit Sagar targets and the rapid uptake of electric trucks in China show the transition is not confined to OECD ports [43][44][45]. This section assesses Indonesia's starting position against that evidence and sets out what transfers directly, what needs local adaptation, and who needs to act.

3.1 Indonesia's Starting Position in Numbers

Before assessing readiness, the table below sets out the Indonesian freight and port system in numbers.

Table 3: Indonesia's Freight and Port System: Key Indicators

Indicator	Figure	Why it matters
Port throughput	Pelindo handled 19.8 million TEU in 2025, up 5 percent [1]. Tanjung Priok handled 8.30 million TEU in 2025 [28].	Rising volumes raise emissions unless action is taken. Tanjung Priok is the proposed first pilot cluster.
Logistics costs	14.29 percent of GDP, against a national target of 9 percent by 2045 (Bappenas, 2023) [29].	Efficient gates and trucking are a competitiveness issue as well as a climate one.
Logistics performance	Rank 61 of 139 countries, score 3.0, in the World Bank LPI 2023. Malaysia scored 3.6 and Singapore 4.3 [30].	Shows the gap to regional peers that better port and hinterland operations can help close.
Transport emissions	Transport is 27 percent of energy-sector greenhouse gas emissions. Road transport uses about 90 percent of transport energy [31].	Road freight is the main lever within transport.
Trucks	Trucks emit about 31.7 percent of road transport emissions from 3.7 percent of vehicle stock. There were about 5 million trucks in 2024, projected to reach 12 million by 2060 [32].	A small share of vehicles drives a large share of emissions, so each truck replaced has high leverage.
Electricity	Fossil fuels supplied 82 percent of electricity in 2024 [34]. Coal alone supplied 62 percent in 2023 [33]. The Java–Madura–Bali grid factor was about 0.62 tCO ₂ /MWh in 2016–2018 data, an indicative and dated figure [37].	Electric trucks cut emissions only as fast as the grid cleans up, so charging must be paired with clean power.
Air quality	In Jakarta, clean-air action could avoid more than 10,000 deaths and nearly USD 3 billion in health costs a year (2.2 percent of regional GDP; 2019 baseline) [36].	Eliminating tailpipe emissions is a co-benefit that funders and city governments can measure.
Climate policy	Net zero emissions expected by 2060 [10] or sooner; the President has since signaled net zero before 2050 and a coal phase-out by 2040 [52]. WRI Indonesia and the Ministry of Transportation's National Transport Decarbonization Roadmap projects that transport emissions could fall to 28–73 MtCO ₂ e by 2060, depending on the scenario (49 MtCO ₂ e in the moderate scenario) [32]. Switching to cleaner fuels and energy (biofuel, electricity, hydrogen and gas) is the largest source of reduction [31].	Trucks alone emit close to that level today.

Indicator	Figure	Why it matters
Electric truck trial	Three-week trial from 23 February 2026 between Tanjung Priok and a Cikarang logistics centre: 6×4 tractor with a 423-kWh battery, range of up to 200 km at 80 percent battery use, and one mid-route charge at a 320 kWh DC charger [17].	Proves the route is technically feasible. The next step is a multi-truck pilot with measured utilization.

Three points stand out.

- **First, ports are a high-impact entry point for freight electrification.** Trucks account for only around 3.7 percent of Indonesia's vehicle stock but contribute about 31.7 percent of road transport emissions, or roughly 48 MtCO₂ annually. Tanjung Priok alone sees thousands of truck movements linked to major industrial clusters such as Cikarang and Cibitung. Electrifying these concentrated flows can deliver significant emissions and air-quality benefits while creating clear demand for vehicles and charging infrastructure.
- **Second, port drayage is well suited to electric trucks.** Routes are repetitive, distances are predictable and vehicles return to known locations, making charging easier to plan. WRI survey data put average urban very-heavy-truck mileage at about 46,000 km a year, around 180 km per operating day, within the range demonstrated in the Tanjung Priok–Cikarang trial, making this port drayage already technically feasible. Existing systems such as Pelindo's truck booking platform can further align truck movements with charging and terminal operations.
- **Third, heavy-duty vehicle electrification can strengthen national energy security.** Approximately 87.4 percent of Indonesia's diesel consumption originates from the transport sector, while 48.4 percent of national diesel requirements remain dependent on imports. WRI Indonesia's HDV transition analysis indicates that accelerating freight electrification could substantially reduce diesel import dependency, with potential savings reaching IDR 161 trillion under the modeled transition scenario. [WRI Analysis]

3.2 Assessment of Indonesian Port Readiness

Indonesia shows a mixed but promising readiness profile. Port equipment electrification and solar are already being deployed. Shore power is expanding. Corporate emissions accounting is becoming more structured. A real heavy-duty electric container truck route has been tested from Tanjung Priok to Cikarang. At the same time, road congestion, grid planning, financing and coordination remain material constraints, the same constraints that Rotterdam carriers identified as the binding factor even in a market with far more mature charging infrastructure.

WRI Indonesia's financial assessment of electric freight operations along the Jakarta–Bandung corridor highlights the economic challenges of early electric truck adoption. Despite higher initial acquisition costs, electric trucks offer potential long-term operational cost advantages compared with diesel vehicles. The analysis reinforces the importance of high vehicle utilization, predictable freight demand, and appropriate financing mechanisms in improving the commercial viability of electric HDVs.

Table 4: Indonesian Port Readiness: Current Signals and Implications

Readiness dimension	Current signal	Implication
Emissions accounting	Pelindo reports ISO 14064-based inventory development and sustainability indicators [2]. A national inventory exists but port related emissions are missing	Strong starting point. Add common port-wide source inventories and freight accounting consistent with ISO 14083/GLEC.
Terminal electrification	262 electrified cargo-handling equipment units reported for 2025; NPCT1 has seven electric prime movers [2][16].	Move from equipment counts to energy and emissions performance at port and terminal level.
Shore power and clean energy	Pelindo reports 10 OPS facilities and solar at 58 locations in 2025 [2].	Prioritize sites using vessel calls, berth time, grid capacity and renewable energy potential.
Electric drayage	Tanjung Priok to Cikarang trial (three weeks from 23 February 2026; 423 kWh truck with up to 200 km range) demonstrates real route testing [17].	Develop repeatable pilots with multiple trucks, demand partners and defined charging plans, mirroring the LA–LB approach of moving from single pilots to a scaled ambition.
Hinterland connectivity	Tanjung Priok links to industrial clusters through the Cibitung Cilincing Toll Road and planned New Priok Eastern Access.	Use major port–industrial corridors as candidates for electric drayage zones.
Mode shift	WRI Indonesia analysis for the Ministry of Transportation estimates that moving freight from road to rail in Java and Sumatra could cut 2.4–3.2 MtCO ₂ by 2030	Prioritize rail-connected dry ports and freight rail links to major ports.
Digital operations	National Logistics Ecosystem and port digitalization provide a data foundation [13][14].	Use existing systems for gate, route and activity data rather than creating parallel reporting.

Readiness should be assessed port by port

A national framework should be common, but implementation should be local. Ports have different cargo profiles, terminal systems, land constraints and power access. A first wave should therefore prioritize ports with high freight volumes, strong data availability, willing terminal partners and identifiable drayage routes.

Tanjung Priok is a logical early candidate because it combines large freight activity (8.30 million TEU in 2025 [28]), nearby industrial clusters, existing port electrification and a recent electric container truck trial, much as San Pedro Bay's early-mover status made it the natural first EDA roadmap.

Other ports should be selected to test different operating contexts: an integrated industrial port, a bulk and energy port, and a major container gateway outside Jakarta. The objective is to test the framework across different source profiles, not to create a ranking of ports.

Minimum readiness screen for a pilot port

- At least 12 months of basic energy, equipment and cargo activity data.
- Truck gate transaction data and enough lane information to identify frequent drayage movements.
- A terminal operator willing to test operational changes.
- A utility engagement pathway for grid and connection assessment with PLN.
- At least one shipper or logistics provider able to identify recurring freight demand.
- A clear local lead for data, stakeholder coordination and implementation tracking.

3.3 Transferability of International Best Practice

Not every EDA lesson transfers at the same speed. Practices that depend mainly on data and process – emissions inventories, demand signals, and dashboards transfer with high confidence. Practices that depend on capital-intensive infrastructure – public charging networks, large-scale shore power, need more local adaptation, particularly given Indonesia's current grid capacity and financing conditions.

Table 5: International Practices: Indonesia Fit and First Steps

Global practice	Indonesia fit	Required adaptation	First practical step
Annual port emissions inventory	High	Use national fuel and electricity factors. Build from existing Pelindo systems. Add port-related mobile sources.	Pilot one common inventory template at selected ports.
Electric cargo equipment	High	Prioritize equipment with high use, suitable duty cycles and grid access.	Create equipment transition plan by asset class and replacement year.
Shore power	Medium to high	Select berths using vessel dwell, connection standards, demand and grid readiness.	Screen high-use berths and shipping partners before capital investment.
Electric drayage	Medium, with strong pilot potential	Focus on frequent routes with predictable demand and charging windows, as the LA–LB roadmap prioritizes its highest-utilization lanes.	Aggregate lane data and select one to three high-utilization routes.
Green lane or priority processing	Medium to high	Use virtual priority first where terminal layout is constrained, following the APM Terminals Green Lane model from Los Angeles.	Test priority appointment or gate handling for pilot electric trucks.
Public or shared truck charging	Medium	Location must match freight flows, not distance alone — Rotterdam's experience shows chargers can exist and still be under-used if poorly located. Land, grid and tariff need early assessment.	Map depots, logistics parks and truck dwell locations with PLN.
Demand signals from cargo owners	High	Use non-binding interest, route nominations and electric options in procurement.	Create a standard lane-data template and shipper engagement process.

4

Proposed Framework for Indonesia & Key Recommendations



The proposed framework has five connected pillars. It is designed to work at a port cluster level and to remain consistent across different port types. The sequence starts with data and moves toward implementation and scale.

4.1 Five Connected Pillars

Table 6: The Five-Pillar Framework at a Glance

Pillar	Objective	Core actions
Measure and disclose	Create a trusted baseline for port and freight emissions.	Define boundaries; collect fuel, power and activity data; quantify corporate and port-wide sources; align drayage accounting with ISO 14083 and GLEC.
Decarbonize terminal operations	Reduce diesel use and improve terminal energy efficiency.	Electrify cargo equipment; improve equipment dispatch; expand solar and clean power; assess shore power at suitable berths.
Electrify drayage and improve utilization	Create viable zero-emission freight movements between port and inland nodes.	Map routes; screen duty cycles; engage shippers and carriers; test electric trucks; use priority gates or appointments; monitor truck productivity.
Build energy and charging readiness	Provide electricity where and when port and truck operations need it.	Create a load forecast for equipment, shore power and trucks; assess grid and land; plan depot and shared charging; use smart charging and storage where useful.
Coordinate, finance and scale	Turn pilots into repeatable market models.	Create a port working group; identify finance and incentives; publish annual dashboard; document lessons; replicate proven measures.

How the framework works

The pillars are interdependent. Better emissions data identifies priority sources. Route data helps charging planners understand future load. Terminal improvements increase truck productivity. Demand visibility supports financing. Annual monitoring shows whether the interventions are reducing emissions and improving operations.

Baseline data package

A selected pilot port should build one baseline dataset that can support both emissions accounting and implementation. It should include cargo throughput, ship calls, berth hours, equipment inventory and fuel use, electricity use, solar generation, truck gate transactions, truck turn time, main drayage lanes, depot locations, current grid connections and planned capital investments.

The baseline should use a single reporting year where possible. Data gaps should be recorded rather than hidden. Estimates can be used when direct data are not available, but the source and confidence level should be stated. Commercial route data can be anonymised and aggregated before it is used for public planning.

Prioritization test

Each proposed measure should be screened against five questions: emissions impact, operational benefit, investment need, implementation complexity and ability to scale. Quick wins should be

implemented early. Larger investments should move forward only when demand, grid, land and operating requirements are sufficiently clear.

One pilot port, one common emissions baseline, one terminal electrification package, one to three electric drayage routes, one coordinated charging plan and one annual progress dashboard. This creates a complete system test rather than a stand-alone vehicle pilot.

4.2 Key Recommendations

- Adopt a common national port emissions framework that combines corporate reporting, port-wide mobile sources and freight transport accounting.
- Use a small number of pilot ports to test the method before wider rollout. Choose ports that represent different operating contexts.
- Move from counting electrified assets to measuring energy use, operational performance and verified emissions impact.
- Make truck utilization a core electric drayage metric. Measure queue time, trips per day, daily distance and charging downtime, the same variable every EDA roadmap treats as decisive.
- Demand aggregation is the key to higher utilization and cost-effective operations.
- Create stronger freight demand signals through route nominations, relevant procurement questions and longer visibility where companies can provide it, addressing the short-contract mismatch Rotterdam carriers flagged as their binding constraint.
- Test low-cost port measures such as priority appointments, reliable container readiness information, and reduced waiting before building dedicated infrastructure.
- Use financing models that reduce high upfront cost and match repayment with vehicle use. Leasing, truck-as-a-service and risk-sharing should be tested where appropriate, alongside purchase subsidy design comparable to the New York–New Jersey zero-emission truck subsidy. In Indonesia, upfront cost is estimated at 42–52 percent of an electric truck's total cost of ownership [32].
- Publish a compact annual dashboard. Keep commercial information confidential but disclose aggregate progress and implementation lessons.
- Treat renewable electricity as part of electrification planning. The climate benefit of electric equipment and trucks increases as electricity becomes cleaner, which is material for Indonesia given the Java-Bali grid's current emissions factor (fossil fuels supplied 82 percent of national electricity in 2024) [34].
- Link pilots to international platforms that bring finance and visibility: green shipping corridor partnerships, the C40–IFC–IAPH port sustainability-linked loan initiative, and the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles, whose signatories target 30 percent zero-emission truck and bus sales by 2030 and 100 percent by 2040. Indonesia is not yet a signatory [48][49][53].

5

Conclusion and Way Forward



Indonesia already has important elements of a port decarbonization transition. Pelindo is electrifying equipment, expanding shore power and solar, and strengthening emissions accounting. The government is advancing the Green Port agenda. Electric container truck trials are beginning to connect the port with inland logistics activity. The opportunity now is to bring policymakers, financiers and port operators together and integrate these efforts into one implementation framework.

The strongest next step is a practical port cluster pilot. It should establish a common emissions baseline, select high-value terminal measures, identify viable electric drayage routes, plan the required energy infrastructure and track outcomes through a simple dashboard. The pilot should be designed for replication from the start.

Global practice suggests that scale comes from **coordinated operating conditions rather than technology alone**: Los Angeles–Long Beach moved from pilots to 548 trucks and a 2,000-truck ambition, New York–New Jersey showed how subsidy design and utilization shape the business case, and Rotterdam found that market coordination, not technology, is the binding constraint. Evidence from Tianjin, Singapore and India shows the same conditions can be created in Asian ports. Ports can help by making truck movements more predictable, improving gate efficiency, planning electricity capacity and convening the organizations that hold different parts of the solution. Shippers and logistics providers can add demand visibility. Carriers can provide operational data. Utilities and finance partners can reduce infrastructure and investment risk.

A successful Indonesian model should remain flexible. Different ports will need different solutions. The common elements should be the accounting method, readiness assessment, decision criteria, indicators and review process. This can allow Indonesia to build a portfolio of port decarbonization projects that improve both emissions performance and freight efficiency, a portfolio Smart Freight Centre and WRI Indonesia stand ready to support through the first phase and beyond. The same approach can then be adapted by other fast-growing ports across Southeast and South Asia.

Way forward: Launch a first wave around data-ready port clusters. Complete baselines and route screening first. Then pair investment with operational pilots and clear progress metrics. Use the results to refine national Green Port guidance and a repeatable port decarbonization toolkit.

6. References

- [1] Pelindo. "Kinerja 2025 Tumbuh, Pelindo Naik Tiga Peringkat di Fortune Indonesia 100," 2026 (media coverage). <https://www.hotfokus.com/pelindo-naik-tiga-peringkat-di-fortune-100-sofyo-bukti-kerja-keras-mulai-berbuah/>
- [2] PT Pelabuhan Indonesia. Sustainability Report 2025. <https://www.pelindo.co.id/investor/laporan-keberlanjutan>
- [3] Ministry of Transportation, Indonesia. "Green Port dan Eco Airport Jadi Langkah Kemenhub Wujudkan Transportasi Hijau Berkelanjutan," 20 July 2026. <https://www.dephub.go.id/post/read/green-port-dan-eco-airport-jadi-langkah-kemenhub-wujudkan-transportasi-hijau-berkelanjutan>
- [4] ISO. ISO 14064 series, greenhouse gas quantification and reporting. <https://www.iso.org/standard/66453.html>
- [5] ISO. ISO 14083:2023, greenhouse gas emissions arising from transport chain operations. <https://www.iso.org/standard/78864.html>
- [6] Smart Freight Centre. GLEC Framework for Logistics Emissions Accounting and Reporting, Version 3. <https://www.smartfreightcentre.org/en/our-programs/emissions-accounting/global-logistics-emissions-council/>
- [7] Smart Freight Centre. Port and Terminal Solutions to Enable Electric Drayage Adoption, 2026. <https://www.theclimatepledge.com/us/en/joint-action/electrifying-drayage-alliance>
- [8] Smart Freight Centre and The Climate Pledge. EDA 2030 Roadmap, Los Angeles and Long Beach, 2026. <https://www.theclimatepledge.com/us/en/joint-action/electrifying-drayage-alliance>
- [9] Smart Freight Centre. Driving Electric in the Port of Rotterdam, workshop summary, 18 March 2026. <https://www.theclimatepledge.com/us/en/joint-action/electrifying-drayage-alliance>
- [10] Republic of Indonesia. Second Nationally Determined Contribution, 2025. https://unfccc.int/sites/default/files/2025-10/Indonesia_Second%20NDC_2025.10.24.pdf
- [11] US EPA. Port Emissions Inventory Guidance. <https://www.epa.gov/state-and-local-transportation/port-emissions-inventory-guidance>
- [12] Smart Freight Centre and The Climate Pledge. Electrifying Drayage Alliance Guidelines for Developing Local Roadmaps, 2026. <https://www.theclimatepledge.com/us/en/joint-action/electrifying-drayage-alliance>
- [13] World Customs Organization. "National Logistics Ecosystem: Indonesia's holistic approach to trade facilitation," 31 October 2024. <https://mag.wcoomd.org/magazine/wco-news-105-issue-3-2024/national-logistics-ecosystem-indonesia/>
- [14] Pelindo. "Pelindo Dorong Sinergi Maritim Asia Tenggara di ASEAN Ports and Logistics 2025," 2025. <https://www.pelindo.co.id/media/747/pelindo-dorong-sinergi-maritim-asia-tenggara-di-asean-ports-and-logistics-2025>
- [15] World Bank. Indonesia Economic Prospects: Managing Risks, Unlocking Productivity, June 2026. <https://openknowledge.worldbank.org/entities/publication/ffaef27-ed9b-491a-b4e4-350c6129edb6>
- [16] New Priok Container Terminal One. "Officially Launches Operations of Seven Electric Prime Movers," 3 February 2026 (as reported by WorldCargo News, 25 February 2026). <https://www.worldcargonews.com/cargo-handling-equipment/2026/02/electric-tractors-land-at-tanjung-priok/>
- [17] PT Nusatama Berkah Tbk. Electric container truck trial from Tanjung Priok to Cikarang, 26 February 2026. <https://nusatama.com/ntbk-and-kalista-support-toyota-tsusho-indonesia-in-accelerating-sustainable-logistics-through-electric-container-truck-trials/>
- [18] J. Marine Science and Engineering. "Trace-Driven Offline Digital Twin Framework for Tactical Operational Planning and GHG Assessment at Tanjung Priok International Container Port, Indonesia," 2026. https://www.researchgate.net/publication/406914632_Trace-Driven_Offline_Digital_Twin_Framework_for_Tactical_Operational_Planning_and_GHG_Assessment_at_Tanjung_Priok_International_Container_Port_Indonesia
- [19] Port of Los Angeles. Annual Inventory of Air Emissions. <https://portoflosangeles.org/environment/air-quality/air-emissions-inventory>
- [20] Port of Rotterdam Authority. Climate transition plan for the port area and Port Authority, 2026. <https://www.portofrotterdam.com/en/news-and-press-releases/climate-transition-plan-port-area-and-port-rotterdam-authority>
- [21] Port of Rotterdam Authority. Climate targets and GHG Protocol inventory approach. <https://www.portofrotterdam.com/en/about-port-authority/port-authority-society/co2-emissions-reduction-by-the-port-authority>
- [22] Smart Freight Centre and The Climate Pledge. EDA 2030 Roadmap, Ports of New York and New Jersey, 2026. <https://www.theclimatepledge.com/us/en/joint-action/electrifying-drayage-alliance>
- [23] Maritime and Port Authority of Singapore. Maritime Singapore Green Initiative and Green Port Infrastructure Programme. <https://www.mpa.gov.sg/maritime-singapore/sustainability/maritime-singapore-green-initiative>
- [24] Smart Freight Centre and The Climate Pledge. EDA Methodology for Estimating Emissions and Air Quality Impacts in Port Drayage, 2026. <https://www.theclimatepledge.com/us/en/joint-action/electrifying-drayage-alliance>
- [25] Smart Freight Centre and The Climate Pledge. EDA 2030 Roadmap, Los Angeles–Long Beach, Release 1, 14 August 2026. <https://www.theclimatepledge.com/us/en/joint-action/electrifying-drayage-alliance>
- [26] Port of Los Angeles. "Port of Los Angeles Strategies Continue to Deliver Clean Air Gains," press release, 16 October 2025. (2024 inventory). https://portoflosangeles.org/references/2025-news-releases/news_101625_air_emissions
- [27] IEEE Spectrum. "Seaport Electrification Could Slash Emissions Worldwide." <https://spectrum.ieee.org/port-electrification>
- [28] Indonesia Shipping Gazette. "Tanjung Priok Port Posts Container Steady Growth in 2025, to 8.30 million TEUs," 2026. <https://indoshippinggazette.com/2026/tanjung-priok-port-posts-container-steady-growth-in-2025-to-8-30-million-teus/>
- [29] ANTARA News. "Bappenas aims to lower Indonesia's logistics costs to 9% of GDP," 14 September 2023. <https://en.antaranews.com/news/293688/bappenas-aims-to-lower-indonesias-logistics-costs-to-9-of-gdp>
- [30] Jakarta Globe. "Luhut Calls World Bank's Logistics Performance Index Unfair," reporting World Bank LPI 2023 results. <https://jakartaglobe.id/business/luhut-calls-world-banks-logistics-performance-index-unfair>
- [31] WRI Indonesia. "Indonesia's Path to Net-Zero Emission: Measuring Road Transport Emissions as the Foundation for a Sustainable Transport Policy." <https://wri-indonesia.org/en/insights/indonesias-path-net-zero-emission-measuring-road-transport-emissions-foundation>

- [32] WRI Indonesia and Ministry of Transportation. National Transport Decarbonization Roadmap, 2024 inventory (forthcoming 2026).
- [33] Ember. Indonesia's expansion of clean power can spur growth and equality, October 2024. <https://ember-energy.org/app/uploads/2024/10/EN-Report-Indonesias-expansion-of-clean-power-can-spur-growth-and-equality.pdf>
- [34] Ember. Indonesia country profile (2024 data, updated April 2026). <https://ember-energy.org/countries-and-regions/indonesia/>
- [35] Climate Policy Initiative. "Highlights from Indonesia's JETP Comprehensive Investment and Policy Plan." <https://www.climatepolicyinitiative.org/highlights-from-indonesias-jetp-comprehensive-investment-and-policy-plan/>
- [36] Vital Strategies. "New Study: Clean Air Action in Jakarta Could Protect 10,000 Lives and Save Billions in Health Expenditures," 27 February 2023. <https://www.vitalstrategies.org/new-study-clean-air-action-in-jakarta-could-protect-10000-lives-and-save-billions-in-health-expenditures/>
- [37] Japan Joint Crediting Mechanism. Additional information on calculating emission factors, Indonesia (2016–2018 data). https://www.jcm.go.jp/jc/wp-content/uploads/sites/3/JCM_ID_PM037_ADD1.pdf
- [38] Indonesia Business Post. "Indonesia to tighten fiscal policy on electric vehicles starting 2026." <https://indonesiabusinesspost.com/5843/markets-and-finance/indonesia-to-tighten-fiscal-policy-on-electric-vehicles-starting-2026>
- [39] IMO. Fourth IMO GHG Study 2020. <https://www.imo.org/en/ourwork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx>
- [40] IMO. 2023 IMO Strategy on Reduction of GHG Emissions from Ships, Resolution MEPC.377(80), July 2023. <https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx>
- [41] European Union. Regulation (EU) 2023/1805 (FuelEU Maritime), Article 6; see also Lloyd's Register, "Zero-emission requirements for energy used at berth." <https://eur-lex.europa.eu/eli/reg/2023/1805/oj>
- [42] European Union. Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure (AFIR). <https://eur-lex.europa.eu/eli/reg/2023/1804/oj>
- [43] Maritime and Port Authority of Singapore. Maritime Singapore Decarbonisation Blueprint: Working Towards 2050, 2022. <https://www.mpa.gov.sg/maritime-singapore/sustainability/maritime-singapore-decarbonisation-blueprint>
- [44] Ministry of Ports, Shipping and Waterways, India. Harit Sagar: Green Port Guidelines, May 2023. [https://shipmin.gov.in/sites/default/files/Harit%20Sagar%20-%20Green%20Port%20Guidelines%20\(May%202023\).pdf](https://shipmin.gov.in/sites/default/files/Harit%20Sagar%20-%20Green%20Port%20Guidelines%20(May%202023).pdf)
- [45] International Energy Agency. Global EV Outlook 2026, executive summary and "Trends in other EV modes," 2026. <https://www.iea.org/reports/global-ev-outlook-2026/executive-summary>
- [46] International Transport Forum (OECD). Shipping Emissions in Ports, Discussion Paper 2014-20, 2014. <https://www.itf-oecd.org/sites/default/files/docs/dp201420.pdf>
- [47] Sofiev, M. et al. "Cleaner fuels for ships provide public health benefits with climate tradeoffs." Nature Communications 9, 406, 2018. <https://www.nature.com/articles/s41467-017-02774-9>
- [48] Getting to Zero Coalition and Global Maritime Forum. Annual Progress Report on Green Shipping Corridors 2025: At a Crossroads, November 2025. <https://globalmaritimeforum.org/report/annual-progress-report-on-green-shipping-corridors-2025/>
- [49] C40 Cities. "C40 supported by IFC and IAPH to unlock sustainable finance for ports and tackle critical funding gap," 4 November 2025. <https://www.c40.org/news/c40-supported-by-ifc-and-iaph-to-unlock-sustainable-finance-for-ports-and-tackle-critical-funding-gap/>
- [50] ICCT. Electrifying on-road freight: A case study of drayage trucks in the city of Tianjin, China, January 2025. <https://theicct.org/publication/drayage-trucks-tianjin-china-jan25/>
- [51] National Law Review. "IMO Net-Zero Framework: MEPC 84 Advances Negotiations Amid Political Headwinds," 2026; IMO, "IMO net-zero shipping talks to resume in 2026." <https://natlawreview.com/article/imo-net-zero-framework-mepc-84-advances-negotiations-amid-political-headwinds>
- [52] Climate Action Tracker. Indonesia: net zero targets. <https://climateactiontracker.org/countries/indonesia/net-zero-targets/>
- [53] Global Commercial Drive to Zero. Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles: signatories. <https://globaldrivetozero.org/mou-nations/>

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Smart Freight Centre (SFC) is a globally active non-profit organization for climate action in the freight sector. Our goal is to mobilize the global logistics ecosystem, in particular our members and partners, in tracking and reducing its greenhouse gas emissions. We accelerate the reduction of logistics emissions to achieve a zero-emission global logistics sector by 2050 or earlier, consistent with 1.5°C pathways.

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