BINTULU PORT AUTHORITY

BINTULU PORT
AIR EMISSION REDUCTION STRATEGY 2050

March 2025

MESSAGE FROM GENERAL MANAGER BINTULU PORT AUTHORITY

On 28 October 2021, Bintulu Port Authority announced its ambition to achieve net-zero greenhouse gas emissions by 2050.

This ambition reflects our responsibility to align with Malaysia's climate commitments under the Paris Agreement and Sarawak's Post-COVID-19 Development Strategy 2030, while positioning Bintulu Port as a leader in sustainable port development.

Guided by our Smart Digital Green Port (SDGP) Blueprint, over the past year, under the leadership of our Safety, Health and Environment (SHE) we have developed this Air Emission Reduction Strategy (AERS) as a roadmap towards achieving our targets.

The 2023 Air Emission Inventory established a baseline of 52,037 tCO_2e, giving us a clear picture of where reductions are possible and necessary. Based on identified initiatives, early actions are expected to deliver 14% reduction by 2030 compared to the 2023 baseline. With regulatory and financial support, ambition rises to 30% by 2030. By 2050, the AERS maintains a 95% reduction trajectory

In line with Malaysia's Nationally Determined Contribution (NDC), the AERS also aspires to a 45% reduction in carbon intensity (tCO_2e per tonne throughput) by 2030 relative to the 2023 baseline intensity of 0.00074 tCO_2e per tonne. Realising this higher ambition will depend on other factors as well like throughput growth, financing, and regulatory support.

Within BPA's own operations, measures such as energy efficiency improvements, renewable energy deployment, electric vehicles, and low-carbon building practices have been identified as priority areas. Among our operators and tenants, implementation has already begun, with hybrid RTG conversion, electric terminal equipment, solar PV projects, and circular economy initiatives such as biomass pallets. These efforts show shared responsibility across the port community.

Collaboration is essential. More than 80% of emissions are linked to activities outside BPA's direct control, making strong partnerships with operators, tenants, regulators, and shipping lines vital. The AERS provides a common framework that helps align individual efforts with a collective trajectory toward 2030 and 2050. The challenges of decarbonisation are real, but so are the opportunities. By moving early and working together, Bintulu Port can enhance competitiveness, attract environmentally conscious trade, and reinforce its role as a strategic hub for Sarawak and the wider region.

Sincerely,

Mizool Amir Bin Mat Drus
General Manager
Bintulu Port Authority

DISCLAIMER

The information contained in this Air Emission Reduction Strategy Report is provided for informational purposes only. It does not constitute financial, legal, or investment obligations. Readers should seek professional guidance tailored to their specific circumstances. While we have made every effort to ensure the accuracy and reliability of the content, we cannot guarantee its completeness or timeliness. The air emission reduction landscape is dynamic, and methodologies may evolve over time.

This report may contain current and forward-looking statements regarding air emissions reduction targets and strategies. These statements are subject to inherent risks and uncertainties, and actual results may differ materially. Factors affecting emissions reduction efforts include market conditions, regulatory changes, and unforeseen events. The organization and its consultants assume no responsibility for any direct, indirect, or consequential losses arising from the use of this report. Users should exercise due diligence and consider their own risk tolerance before making decisions based on the information provided.

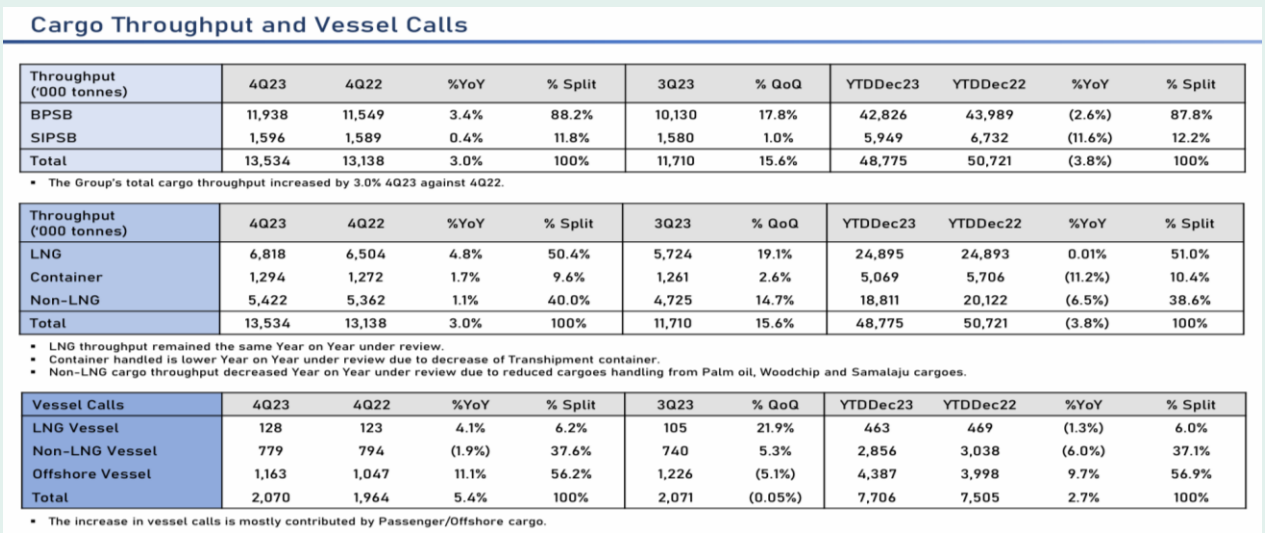
The Bintulu Port Air Emission Reduction Strategy document was prepared by International Green Trends Cockpit Sdn. Bhd. (IGTC) (formerly known as International Green Trainings Centre Sdn. Bhd.) as the deliverable for the Implementation of Smart Digital Green Port Objectives for Bintulu Port Authority contract.

EXECUTIVE SUMMARY

The Bintulu Port Air Emission Reduction Strategy (AERS) provides a comprehensive roadmap to reduce greenhouse gas (GHG) emissions across all port-related activities, supporting Sarawak's statutory target for carbon neutrality by 2050 under the Natural Resources and Environment (Amendment) Ordinance 2019. This strategy aligns with Bintulu Port's Smart Digital Green Port (SDGP) Blueprint and is rooted in the findings of the 2023 Air Emission Inventory, which established a baseline of 52,037 tCO_2e across Ocean-Going Vessels (OGVs), Harbour Craft, Heavy-Duty Vehicles (HDVs), and organisational emissions. The AERS consolidates bottom-up strategies from each sector into an integrated pathway structured around phased implementation. Short-term measures focus on low-hanging fruits such as energy efficiency, B20 adoption in BPA's fleet, B20–B30 adoption in HDVs, hybridisation of RTGs, electrification of terminal equipment, solar PV installations, and pilot boats now drawing shore power. These early and declared initiatives are projected to deliver 14% reduction in absolute emissions by 2030 compared to the 2023 baseline. With stronger regulatory and financial support — including port-wide adoption of B30 fuels, disciplined HDV logistics, expanded OPS (Onshore Power Supply) at berths, and green bunkering facilities — the AERS aspires to deepen reductions to 30% by 2030.

In parallel, the AERS also aspires to a 45% reduction in carbon intensity (tCO_2e per tonne throughput) by 2030 relative to the 2023 baseline intensity of 0.00074 tCO_2e/tonne, in line with Malaysia's Nationally Determined Contribution (NDC).

By 2050, the AERS provides a progressive decarbonisation trajectory aligned with Malaysia's national net-zero aspiration. Achieving this outcome will depend on scaling measures such as smart grid integration, widespread adoption of green fuels for ships, expansion of OPS (Onshore Power Supply), circular economy programmes, and potential deployment of carbon capture solutions. The AERS also highlights the 3P impacts — People, Planet, Profit — demonstrating how environmental stewardship can strengthen workforce capability, enhance community well-being, and improve operational efficiency while reinforcing competitiveness in an evolving global shipping market. With these measures, Bintulu Port is positioning itself as a regional leader in green port transformation, contributing meaningfully to Sarawak's and Malaysia's climate goals while safeguarding Bintulu Port's long-term resilience and competitiveness.



Cargo Throughput and Vessel Calls

Throughput ('000 tonnes)	4Q23	4Q22	%YoY	% Split	3Q23	% QoQ	YTDDec23	YTDDec22	%YoY	% Split
BPSB	11,938	11,549	3.4%	88.2%	10,130	17.8%	42,826	43,989	(2.6%)	87.8%
SIPSB	1,596	1,589	0.4%	11.8%	1,580	1.0%	5,949	6,732	(11.6%)	12.2%
Total	13,534	13,138	3.0%	100%	11,710	15.6%	48,775	50,721	(3.8%)	100%

- The Group's total cargo throughput increased by 3.0% 4Q23 against 4Q22.

Throughput ('000 tonnes)	4Q23	4Q22	%YoY	% Split	3Q23	% QoQ	YTDDec23	YTDDec22	%YoY	% Split
LNG	6,818	6,504	4.8%	50.4%	5,724	19.1%	24,895	24,893	0.01%	51.0%
Container	1,294	1,272	1.7%	9.6%	1,261	2.6%	5,069	5,706	(11.2%)	10.4%
Non-LNG	5,422	5,362	1.1%	40.0%	4,725	14.7%	18,811	20,122	(6.5%)	38.6%
Total	13,534	13,138	3.0%	100%	11,710	15.6%	48,775	50,721	(3.8%)	100%

- LNG throughput remained the same Year on Year under review.
- Container handled is lower Year on Year under review due to decrease of Transhipment container.
- Non-LNG cargo throughput decreased Year on Year under review due to reduced cargoes handling from Palm oil, Woodchip and Samalaju cargoes.

Vessel Calls	4Q23	4Q22	%YoY	% Split	3Q23	% QoQ	YTDDec23	YTDDec22	%YoY	% Split
LNG Vessel	128	123	4.1%	6.2%	105	21.9%	463	469	(1.3%)	6.0%
Non-LNG Vessel	779	794	(1.9%)	37.6%	740	5.3%	2,856	3,038	(6.0%)	37.1%
Offshore Vessel	1,163	1,047	11.1%	56.2%	1,226	(5.1%)	4,387	3,998	9.7%	56.9%
Total	2,070	1,964	5.4%	100%	2,071	(0.05%)	7,706	7,505	2.7%	100%

- The increase in vessel calls is mostly contributed by Passenger/Offshore cargo.

A. INTRODUCTION

A.1 KEY TERMS

AIS	-	The Automatic Identification System, abbreviated AIS, is an anti-collision aid for shipping. Ships carrying AIS equipment on board transmit and exchange information on their identity, position, speed, course, etc. over VHF frequencies.
Arrival	-	Arrival of a ship at the quay.
Single-point buoy mooring loading system	-	A single-point buoy mooring loading system is a tanker designed primarily to transport oil from the single-point buoy mooring at an oilfield to a receiving port for the oil, as an alternative to transporting the oil to the mainland via a pipeline.
ECA	-	Emission Control Areas (ECA) are sea areas where particular attention to emissions is considered necessary.
GHG gases	-	GHGs are gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth's surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4) and ozone (O3) are the primary GHGs in the Earth's atmosphere. Human made GHGs include sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs) and perfluorocarbons (PFCs).
HFC gases	-	HFC gases are a group of fluorine compounds used as refrigerants in refrigeration and freezing systems, heat pumps and air conditioning systems for buildings and vehicles. HFC gases have a strong greenhouse effect and remain in the atmosphere for a very long time.
IMO	-	International Maritime Organization. This is the UN's maritime safety organisation and was created in 1948 in order to ensure safety at sea and prevent pollution of the marine environment.
Approach to Bintulu Port	-	Includes the approach of ships with pilot boarding position located at: Latitude 03°18.0'N Longitude 112°58.5'E.
Docking	-	The operation where a ship docks at a quay.
Boiler	-	The boiler on a ship produces steam to provide heating and power for various needs, such as hot water, warming cabins and cargo, and running equipment like pumps and winches. Most boilers use oil, though some are electric. Ship engines are about 40% efficient, while boilers are more efficient at around 70-80%

MARPOL	-	MARPOL stands for Marine Pollution, and represents the IMO's international marine environmental convention
kW	-	Kilowatts
kWh	-	Kilowatt hours
LNG	-	Liquefied Natural Gas.
LoLo	-	Lift-on/lift-off. Ships with cranes on board for loading and unloading containers.
Manoeuvring	-	The operation that takes place when a ship makes changes of speed and direction before or after docking (speeds of between 0.5 and 3 knots).
MARPOL	-	MARPOL stands for Marine Pollution, and represents the IMO's international marine environmental convention.
MGO	-	Marine gasoil is the most common fuel used in ships that run on diesel in Malaysian waters. MGO meets current SECA requirements for 0.1 per cent sulphur content.
MRV	-	Measurement, reporting, and verification (MRV) is a framework for monitoring and verifying greenhouse gas (GHG) emissions and reduction efforts, often to ensure compliance with regulations or voluntary initiatives. As companies prepare reports on environmental data, emissions are first measured and then verified by a reputable third party to confirm results.
NECA	-	Nitrogen oxide Emission Control Areas (NECA) are sea areas where particular attention to nitrogen oxide emissions is considered necessary.
Recharge	-	A model developed by DNV GL in order to estimate costs for investment in shore power and charging current solutions. This model is based on activity data for the relevant quay/terminal and estimates costs for quayside infrastructure, as well as costs for necessary equipment aboard ships.
RO-RO	-	Is an international transport method wherein cargo (usually non-containerized) is loaded onto a roll-on, roll-off marine vessel.
SCR	-	Selective Catalytic Reduction. Catalytic converter technology on ships, used to reduce NOX exhaust emissions by adding urea.
SECA	-	Sulphur Emission Control Areas (SECA) are sea areas where particular attention to sulphur emissions is considered necessary.

Bintulu sea area	-	Includes the arc of a circle with a radius of 10 n.m. radiating from Tanjung Kidurong in position 03° 16.10′ N, 113° 03.20′ E the inner port and sea area within the boundaries of Bintulu
Groupage	-	Groupage is freight transported in units that can be handled by cranes or vehicles.
Terminal	-	A restricted area at a quay where a specific type of freight is loaded and unloaded.
TEU	-	The twenty-foot equivalent unit is based on the volume of a 20-foot container. These containers are 6.1 m long and 2.4 m wide. Their heights are not standardised, varying between 1.3 m and 2.9 m. The most common height is 2.6 m.
Transit	-	The operation that takes place when a ship travels at a relatively constant speed between two destinations (faster than 3 knots).
Dry bulk shipping	-	Ships that transport dry cargoes, such as grain, metals or coal without load carriers in closed cargo spaces.
Unique arrivals	-	The number of times an individual ship calls at the port over a defined period.
Wet bulk shipping	-	Ships that transport oil and other liquid products that are transported without load carriers in closed cargo spaces.

A.2 BACKGROUND AND CONTEXT

In 2018, the Bintulu Port Authority (BPA) developed the Smart Digital Green Port (SDGP) Blueprint as a strategic framework to transform Bintulu Port into a technologically advanced, sustainable, and environmentally responsible port. This initiative aligns with global efforts to combat climate change, recognizing the urgent need to reduce greenhouse gas (GHG) emissions and mitigate environmental impacts.

The SDGP blueprint aims to enhance sustainability, operational efficiency, and digitalization, which aligns with Malaysia's broader transport and environmental policies. The objectives are in line with the principles of the National Transport Policy (NTP), particularly in promoting green logistics and sustainable port operations. Additionally, the SDGP blueprint supports Malaysia's Nationally Determined Contributions (NDCs) under the United Nations Framework Convention on Climate Change (UNFCCC) by incorporating sustainability-driven port management strategies. It also complements the Sarawak's Post-COVID-19 Development Strategy (PCDS) by integrating economic recovery, environmental responsibility, and technological advancements into port operations.

This Air Emission Reduction Strategy (AERS) report outlines the strategy that BPA can pursue in order to achieve the net-zero target set in the SDGP Blueprint. The AERS plans the progressive intensity reduction for both air pollutants and greenhouse gas (GHG) for Bintulu Port.

PORT FACILITIES AND INFRASTRUCTURE

The Terminals:

General Cargo and Container Terminal:

Berths: Multiple berths with heavy-duty cranes.
Handling Capacity: Extensive facilities for handling conventional cargo and containers.
Storage: Warehouses and open storage areas available.

LNG Terminal:

Specialized Facilities: Dedicated berths for LNG (Liquefied Natural Gas) carriers.
Safety Measures: Advanced safety and containment systems.

Bulk Cargo Terminal:

Focus: Primarily on palm oil, fertilizers, and chemicals.
Conveyor Systems: Efficient systems for bulk handling.

Oil and Gas Terminals:

Specialization: Handling crude oil and petroleum products.
Depth: Deepwater berths to accommodate large tankers.
Infrastructure:
Draft: Ranges from around 11 meters to 14 meters depending on berthing area.
Quay Length: Over 2,000 meters collectively across different terminals.

***Container Facilities*:**

Well-equipped container yards and modern handling equipment.
Road and Rail Links:
Good connectivity with inland transport networks for efficient cargo movement.

Services:

Pilotage:
Mandatory: Pilotage services are compulsory for vessel movements within port limits.
Available 24/7: Pilots available round-the-clock.

Towage & Mooring:

Tugs: A fleet of powerful tugboats is available for assist operations.
Mooring Boats: Equipped for safe and efficient mooring operations.

Stevedoring:

Operators: Experienced stevedoring companies provide loading and unloading services.
Equipment: Modern lifting gear and specialized equipment for different types of cargo.

Bunkering & Supplies:

Bunkering Services: Available for refuelling ships.
Ship Supplies: Provision of fresh water, food supplies, and other essentials.

Security and Compliance:

ISPS Code: Fully compliant with the International Ship and Port Facility Security Code.
Customs and Immigration: On-site facilities ensure efficient clearance procedures.

Environmental and Safety Measures:

Pollution Control: Measures to prevent marine pollution, including waste reception facilities.
Safety Protocols: Comprehensive safety regulations to handle hazardous materials.

Connectivity:

Global Reach: Regular shipping lines connecting Bintulu with major global ports.
Local Industry Support: Strategic port for the regional energy sector, particularly LNG exports from the Petronas LNG Complex.

A.3 THE OBJECTIVE OF AIR EMISSION REDUCTION STRATEGY (AERS)

The purpose of this document is to provide Bintulu Port Authority (BPA), port operator and all stakeholders a strategic reference document to reduce air pollutant and GHG emissions based on the findings of the annual Air Emission Inventory as well as to provide a clear roadmap for Bintulu Port to meet sustainability and decarbonization goals. This strategy is rooted to the findings in the annual Bintulu Port Air Emission Inventory report where baseline and up to date data were established with source and quantity of air pollutant and GHG emissions were identified. This allows the development of actionable reduction strategies to be devised

The AERS would allow Bintulu Port to meet the following objectives:

- Reduce GHG emissions across operational and organizational sources.
- Improve Bintulu Port's air quality, meeting international and domestic standards.
- Align with BPA's own SDGP objectives in getting Green Port certification.
- Support Bintulu Development Authority (BDA) plans to develop Bintulu Climate Action Plan.
- Align with National Transport Policy (NTP) strategy to have a Green Transport Ecosystem.
- Support Malaysia's Nationally Determined Contributions (NDCs) under UNFCCC.

THE BINTULU PORT AUTHORITY AS A DRIVER OF CHANGE

Recognizing BPA as a Major Green Power Port, playing an instrumental role in providing green and clean energy for the future. The strategic location and robust infrastructure position the port as a key player in achieving Sarawak's ambitious green energy goals. This aspiration aligns seamlessly with Sarawak's commitment to environmental sustainability, addressing the global call for reduced carbon footprints. BPA have an important role to play in contributing to the climate ambition and progress of the Sarawak, as well as for the nation

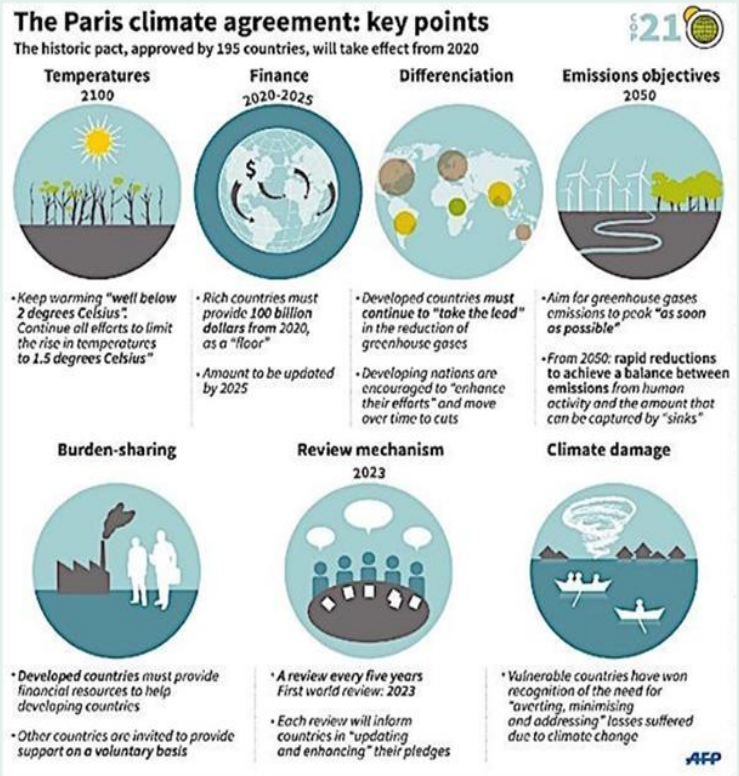
MAXIMIZING THE BENEFITS OF SMART DIGITAL GREEN PORT

Over the coming years and decades greenhouse gas emission reduction efforts will generate a diverse array of benefits.

We believe that investment in climate change mitigation strategies will improve the performance of our operations while creating thousands of high-quality jobs, promoting economic competitiveness, and advancing environmental justice.

Throughout this document, we outline the benefits of each of our strategies and how each will improve our service to tenants and customers and enhance the health and vitality of the region.

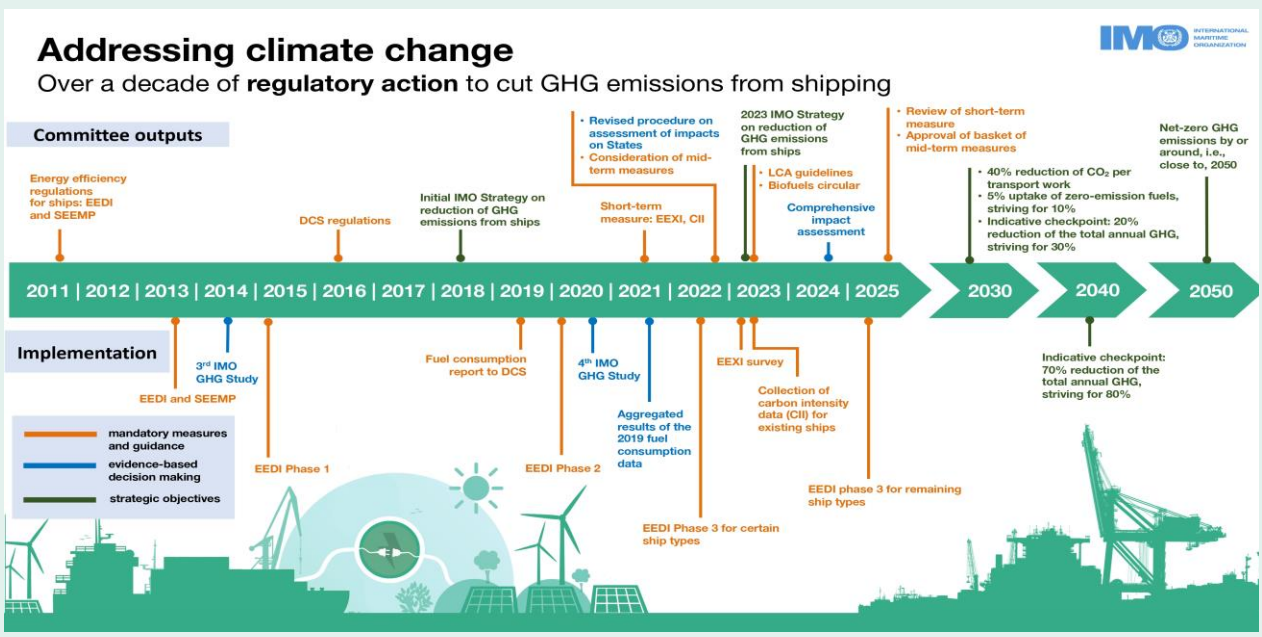
RELEVANT CLIMATE PROGRAMS TO SEAPORT OPERATIONS



CLIMATE CHANGE IMPACTS ON SEAPORTS: A GROWING THREAT TO SUSTAINABLE TRADE AND DEVELOPMENT

Given the critical role of ports in the global trading system and their potential exposure to climate related damage, disruptions and delays, enhancing their climate resilience is a matter of strategic socio-economic importance for the global economy and society as a whole (UNCTAD, 2020a)

RELATIONSHIP IMO's CLIMATE REGULATION AND THE PARIS CLIMATE OBJECTIVES



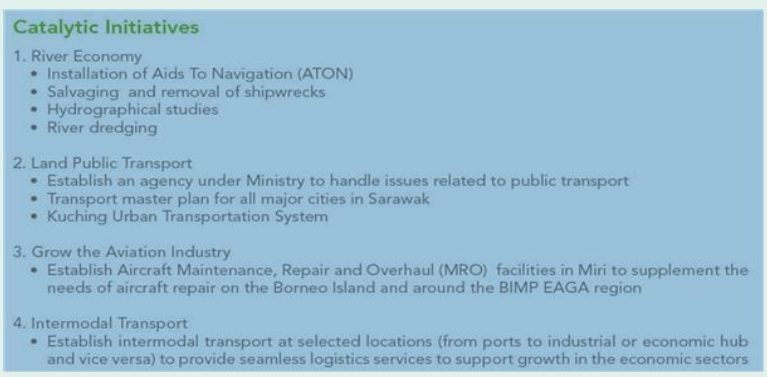
A.4 THE ROLE OF SEAPORT FOR GLOBAL SUSTAINABILITY GOALS

The international commitment to a more sustainable economy, which is reflected in the climate goals of the Paris Agreement and the United Nations' global sustainability goals, are also affecting ports. Sustainability in the sense of the Sustainable Development Goals (SDG) of the United Nations is not limited to ecological sustainability, but also encompasses social and economic sustainability.

Seaports are important hubs in maritime transport chains where cargo is transferred between seagoing vessels and other modes of transport such as road, rail, inland waterway transport or pipelines. Due to their central position within maritime transport chains, seaports contribute to sustainable development in various ways. At the same time, ports can benefit from the associated potential by actively shaping

SDGs MOST RELATED TO PORT OPERATIONS

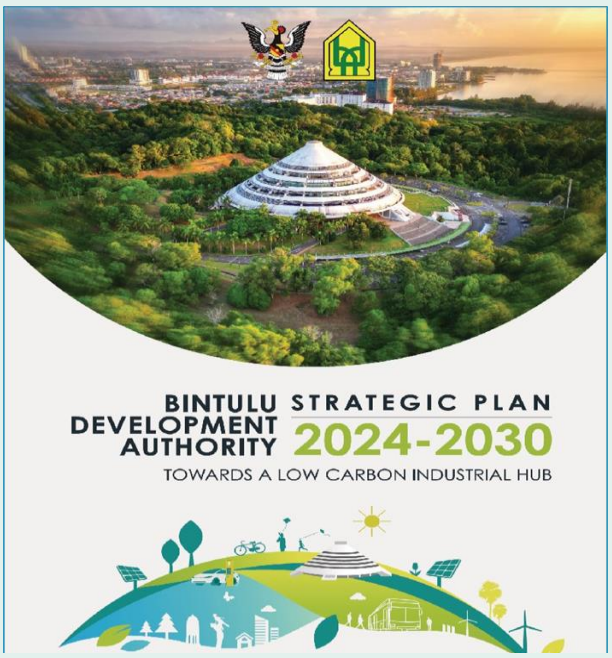
BINTULU PORT IS A KEY DRIVER OF SARAWAK'S ECONOMIC AMBITIONS, WITH A FOCUS ON OPERATIONAL EXCELLENCE, STRATEGIC EXPANSIONS AND LONG-TERM VALUE CREATIONS



The core objectives of Post COVID-19 Development Strategy 2030 (PCDS) are:

- *To change the economic structure by increasing the scale of production to capture efficiencies upstream, increasing downstream activities and growing the services sector to support the primary and secondary sectors' activities in a sustainable manner;*
- *To modernise and increase efficiency driven by both digital and physical connectivity; and*
- *To increase household income to GDP share by creating more jobs and encouraging entrepreneurship.*

Bintulu Port will play a pivotal role in the oil and gas industry, its midstream and downstream activities, edible oils, the proposed supply base, carbon capture utilisation and storage and the production of hydrogen and other biofuels.



BINTULU PORT AUTHORITY DEVELOPED SMART DIGITAL GREEN PORT BLUEPRINT TO SUPPORT SARAWAK INSPIRATION

The SDGP Blueprint was developed on sustainability philosophy, addressing all Sustainable Development related Goals, committing the sustainable principles of economic, environmental and social impact while complying to criteria and indicators to achieve certified smart digital green and carbon neutral port status timely.


LEMBAGA PELABUHAN BINTULU

RESEARCH – FRAMEWORK FOR FORMULATION OF BINTULU FOR TRANSFORMATION OF BINTULU PORT INTO SMART DIGITAL GREEN PORT

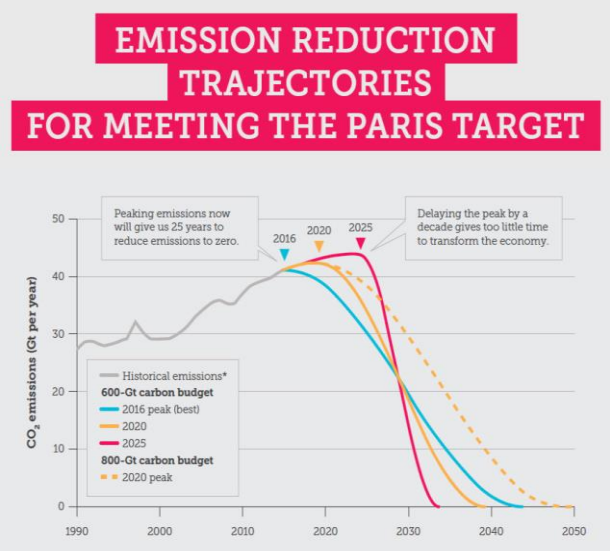
FINAL BINTULU SMART DIGITAL GREEN PORT BLUEPRINT REPORT

Prepared by:
International Green Training Centre Sdn. Bhd.

Date:
26th October 2018

A.5 WHAT IS AIR EMISSION REDUCTION STRATEGY (AERS)?

An air emissions reduction strategy is a set of actions, programs, and policies aimed at improving ambient air quality and reducing the carbon footprint of a specific entity (whether a company, person, municipality, or other level of government) and is undertaken to reach air quality standards and GHG emissions reduction targets



WHY THE NEED FOR AERS?

An effort to improve ambient air quality and cut greenhouse gas (GHG) emissions can be scattered, ineffective, or even counterproductive if without a solid strategy. A strategy provides structure, ensuring that actions align with scientific recommendations, economic feasibility, and social acceptance, and achieve the following:

- Long-term impact
  A well-planned strategy ensures air quality improvement and emissions reductions aren't just short-term fixes but lead to sustainable change.

- Efficiency
  It prioritizes the most impactful areas, focusing on industries, policies, and behaviours that make the biggest difference.

- Economic benefits
  Reducing emissions strategically can create new jobs, foster innovation, and prevent costly environmental damage.

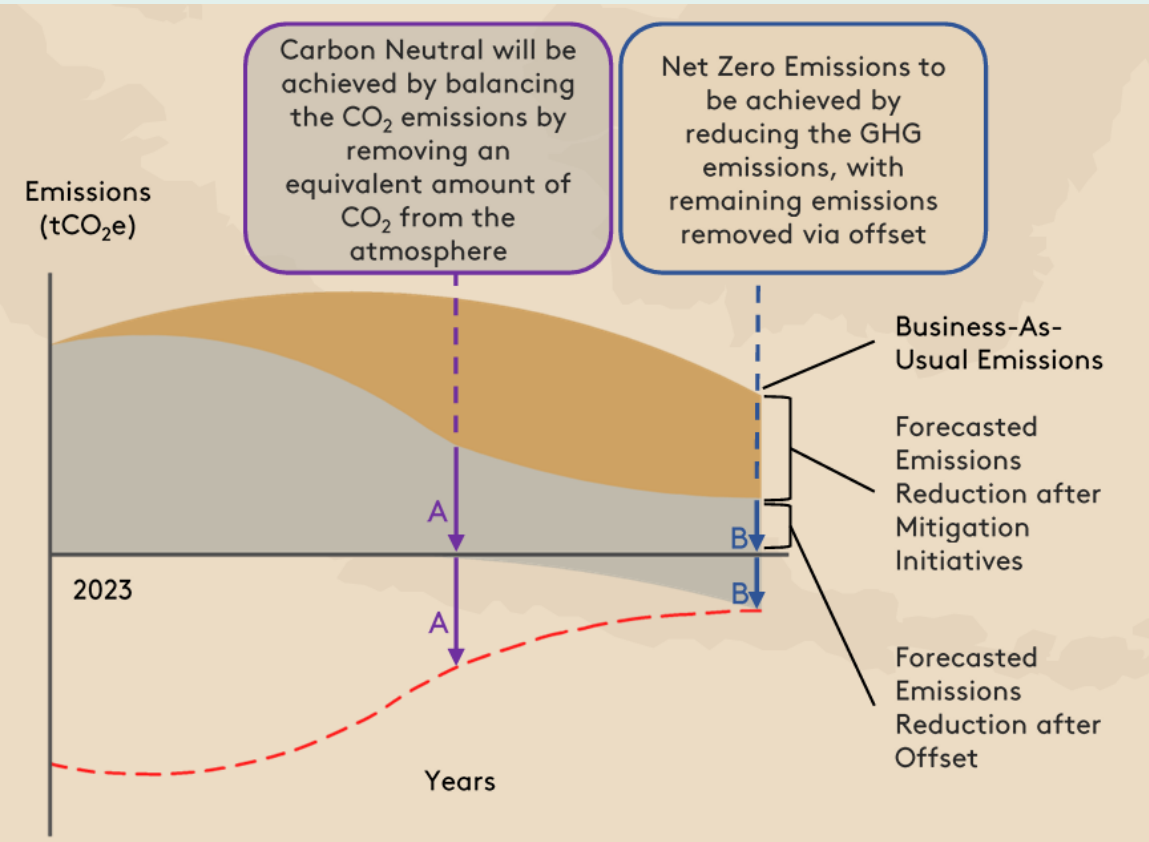
- Global commitments
  Many countries and businesses have pledged to reach net-zero emissions. A clear strategy helps meet those goals efficiently.

- Public health
  Cutting GHGs emissions and improves air quality, reducing diseases linked to pollution and climate change.

APPLICATION OF STAR APPROACH TO REDUCE PORT OPERATIONAL AIR EMISSIONS

The Strategy -Target – Action - Result (STAR) approach is a powerful framework for executing projects or programs with clarity and focus.

STRATEGY Define the overarching goal and approach. Define the vision for the project or program. Identify challenges can be anticipated, and plan how navigate them. A common strategy and specific for every sector will be explained in another chapter.		**ACTION** Overall AERS actions will be divided into BPA Controlled Emissions and Stakeholders' Emissions. A specific action with detail steps, execution plan, stakeholder in-charge, timeline and methodology will be explained in another chapter.	
	TARGET The target Bintulu Port Operation AERS is achieve certified air ambient quality standards annually, 45% reduction in carbon intensity (tCO_2e per tonne throughput) by 2030 relative to the 2023 baseline intensity.		**RESULT** The BPA AERS expected results are; certified ambient air quality standards and verified reductions in carbon intensity (tCO_2e per tonne throughput) in line with the planned targets. AERS Annual Report will highlight the actual performance compared to planned, detailed evaluation on actions and any adjustment needed.



A.6 COMMON AERS STRATEGY

A common strategy for reducing greenhouse gas (GHG) emissions is essential because climate change is a global issue that requires coordinated action and a unified approach ensures that efforts in one organization complement those in another, prevents gaps that could allow emissions to rise elsewhere, resources can be optimized, and solutions can be scaled more effectively, minimizes economic disruptions by creating predictable policies for businesses, allows smooth transition, fosters innovation, enabling faster development of technologies and shared framework for monitoring progress, reporting emissions, and enforcing regulations. Other common AERS strategies are:

i. **Divide** into Port Authority Controlled Air Emission Sources and Port Operator Controlled Air Emissions Sources. Port Authority has direct control over their capital investments and development, operating budget decisions and procurement, and operations and equipment such as buildings and fleet, and is able to act directly to reduce GHG emissions. However, those without direct control such as for port operations, bus service, tenant operations, and vehicular travel to and from, Port Authority will work closely with Operator and Tenants to move the port toward a sustainable and Net Zero future.

ii. **Stakeholder engagement** involves all relevant stakeholders building buy-ins and leveraging diverse perspectives to implement emission reduction strategies.

iii. **Sharing a vision** is crucial in an emission reduction strategy because it provides clarity, direction, and motivation for achieving sustainability goals. A well-defined vision helps guide long-term action to set ambitious yet achievable emission reduction targets, inspires collaboration among industries, policymakers, and communities to ensure that everyone is working toward a common goal, and encourages investment in new technologies and sustainable practices.

iv. The **overarching emission reduction goal** is a broad, long-term target aimed at significantly cutting greenhouse gas emissions to mitigate climate change. This goal aligns with global agreements such as the Paris Agreement, which strives to limit global warming to well below 2°C, preferably 1.5°C, above pre-industrial levels.

v. A **baseline** for reducing greenhouse gas (GHG) emissions is essential because it acts as a reference point for measuring progress. Without a clear starting point, it's impossible to track improvements or evaluate whether reduction efforts are effective and understand their impact over time, define realistic reduction goals and ensure commitments are grounded in actual data, report their emissions reductions to ensure transparency and accountability and make informed choices on how to cut emissions efficiently.

vi. A **well-planned approach** ensures we tackle the root causes effectively and balance environmental protection with economic growth, prevents unnecessary burdens on industries and communities, drives innovation and creates jobs, and ensures fairness, making sure nobody is left behind in the transition.

vii. **Identifying challenges** in emission reduction is crucial because it allows governments, businesses, and individuals to create realistic and effective strategies for cutting emissions without compromising economic stability and development goals, understand technological limitations, financial constraints, and resistance from industries to ensure that clean energy transitions are smooth and beneficial for all stakeholders, prioritizes actions that have the greatest impact and anticipating legal challenges for policymakers and businesses comply while still innovating.

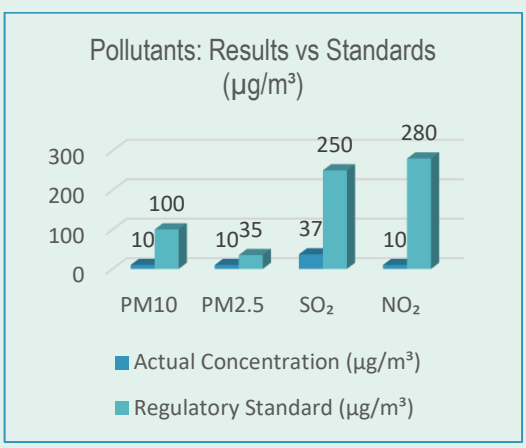
A.7 ESTABLISHING BASELINE FOR AERS

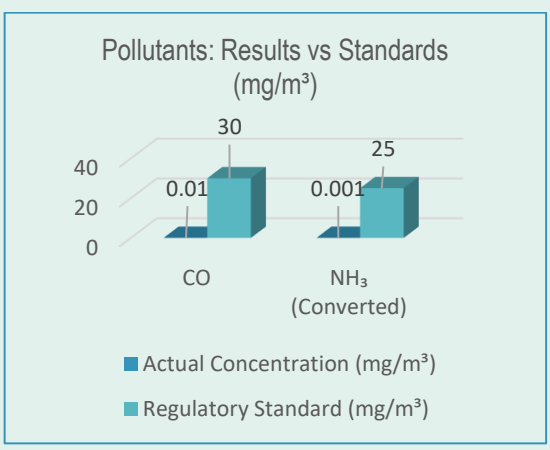
The Bintulu Port's Air Emissions Inventory 2023 were an estimate of the quantity of emissions generated within the operational boundary by all stakeholders related activities and developed as an initial study to prepare for this AERS. However, when the Emission Inventory Management System (EIMS) software and on-site air monitoring system are ready, the current inventory 2023 can be improved.

This section provides a snapshot of the sources and quantities of GHG emissions and air ambient quality status for the year 2023. BPA will continue to prioritize achieving reductions within controlled emissions to drive deeper reductions while also expanding efforts to take on stakeholder emissions. To successfully achieve a 45% reduction in carbon intensity (tCO_2e per tonne throughput) by 2030 relative to the 2023 baseline intensity of 0.00074 tCO_2e/tonne, and to progress toward net-zero emissions by 2050, BPA will play an active role in enabling and supporting agencies and stakeholders to meet their commitments. This AERS seeks to create an action agenda for collaboration with partners and stakeholders.

The baseline exercise established a total carbon footprint of 52,037 tCO_2e for Bintulu Port, encompassing emissions from operational sources and organizational activities. Of this, 18,607 $tC0_2e$ is attributed to key operational sources: Heavy Duty Vehicles (HDVs) at 12,254 tCO_2e, Ocean-Going Vessels (OGVs) at 3,694 tCO_2e, and Harbour Crafts at 2,659 tCO_2e. Organisational emissions forms the majority of emissions at 33,430 tCO_2e. In comparison with other ports, Bintulu Port's carbon intensity is at 0.00074 tCO_2e/tonne which is higher than Gladstone Port (0.00067 tCO_2e/tonne) and Jurong Port (0.00053 tCO_2e/tonne). The ERS will help BPA navigate its way to reduce Bintulu Port's carbon intensity. Full details of the carbon footprint measurement results can be found in the BPA Air Emission Inventory Report 2023.

The Bintulu Port's Air Pollutant Status 2023 at a Glance;





Bil	Pollutant Type	Method	Results
1	PM 10 ug/m3	In-house Method 6020 based on Instrumentation – Direct Reading Aeroqual 500	<10
2	PM 2.5 ug/m3		<10
3	Carbon Monoxide (CO) ug/m3		<0.01
4	Ozone (O_3) ug/m3		<10
5	Sulphur Dioxide (SO_2) ug/m3	Method 704A of air sampling and analysis 3rd Edition	37
6	Ammonia (NH_3) ug/m3	NMAM Method 6015	Not Detected (<1.0)
7	Nitrogen Dioxide (NO_2) ug/m3	In-house Method 6022 based on Method of air sampling and analysis 3rd Edition, Method 818	10.00

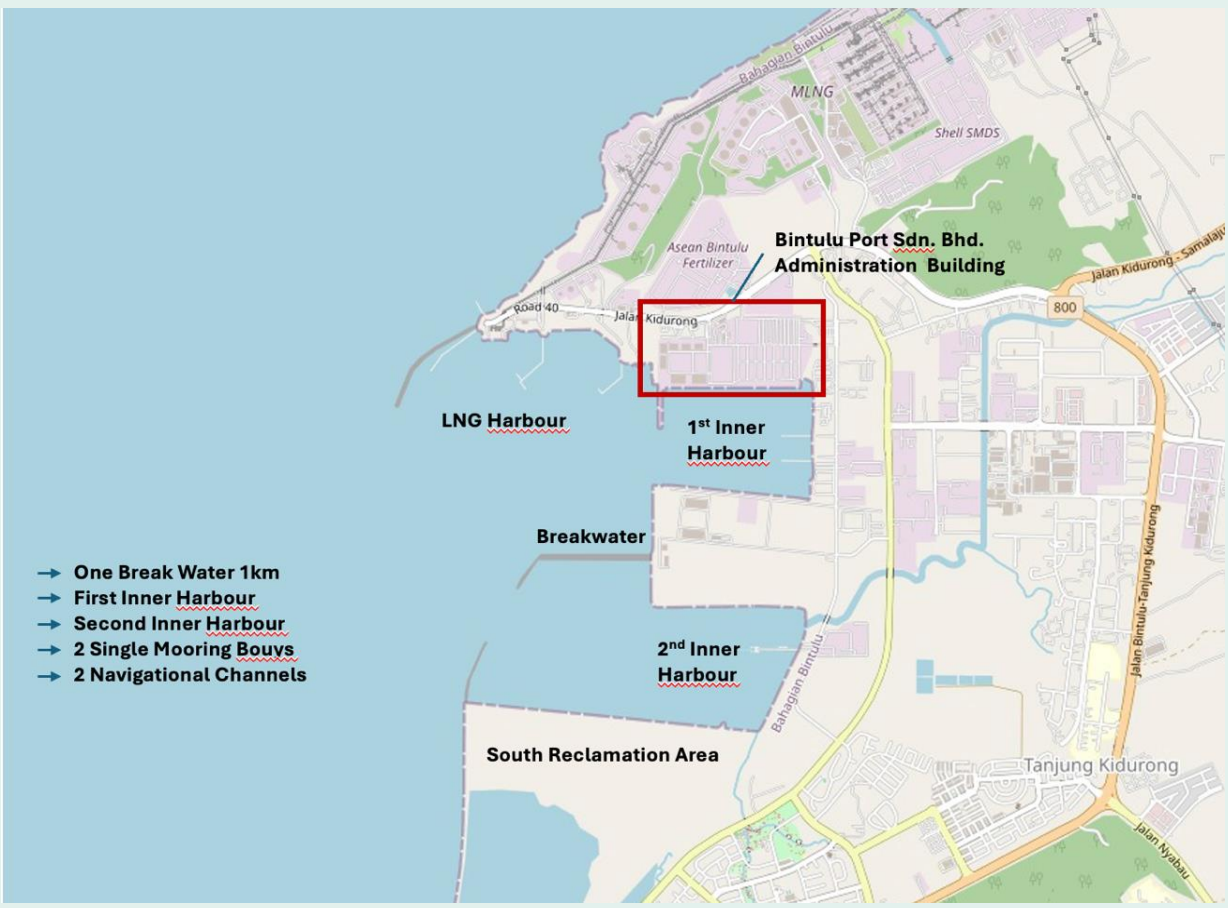
The Bintulu Port's Emissions Inventory 2023 at a Glance;

2023 Maritime Industry-related Emissions by Scope

Bil.	Organisation	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
1	Bintulu Port Authority (BPA)	1,325	389	507	2,221
2	Bintulu Port Sdn. Bhd. (BPSB)	13,515	1,809	431	15,755
3	Biport Bulkers Sdn. Bhd. (BBSB)	6,159	330	119	6,608
4	BPA Tenants	7,535	617	694	8,846
	Total	**28,534**	**3,145**	**1,751**	**33,430**

2023 Maritime Industry-related Air Emissions by Category

Bil	Category	CO_2 (Tonne)	N_OX (Tonne)	S_OX (Tonne)	PM_{10} (Tonne)	VOC (Tonne)	CO_2e (Tonne)
1	Ocean Going Vessel (OGV)	3,694	78	1.14	8.5	1.7	3,694
2	Harbour Craft	2,659	46	0.82	6.14	1.23	2,659
3	Heavy Duty Vehicles (HDV)	12,254	39	0.08	0.77	3.87	12,254



B. PORT AUTHORITY AND AGENCIES - CONTROLLED EMISSIONS

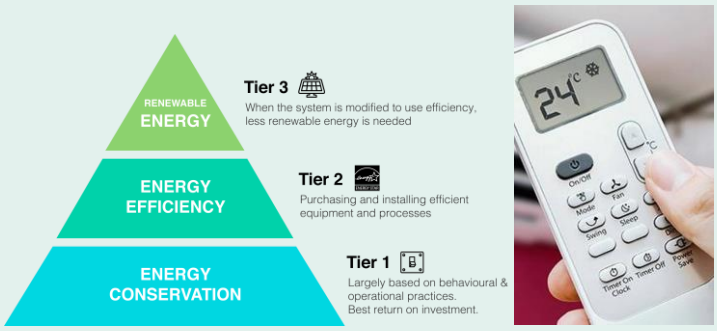
SECTOR	STRATEGY	ACTIONS
1.0 AMBIENT AIR QUALITY	1.0 Ambient air quality meeting International Standards at all time.	1.1 Monitor air quality status on regular basis according to an approved procedure.
2.0 ENERGY	2.0 Reduce 45% emission intensity of energy used by 2030	2.1 Implement Energy Conservation Programs
		2.2 Implement Energy Efficiency Project
		2.3 Use Renewable Energy Source (RES)
3.0 TRANSPORTATION	3.0 Reduce 45% emission intensity of kilometre travelled or litre fuel used reduction by 2030	3.1 Apply eco-driving technique
		3.2 Implement Low Carbon Business Travel
		3.3 Change to Electric Vehicles (EV) for Port Authority and Agencies Owned Vehicles
		3.4 Public Transport for Staff Commute between home and Bintulu Port
		3.5 Install EV Charging Stations (EVCS)
		3.6 Use Biodiesel B20 Fuel for Diesel Powered Vehicles
	4.0 Create connectivity and logistic link between Bintulu Port and Nusantara	4.1 To support the current study by the state government by providing relevant data.
4.0 BUILDINGS AND FACILITIES	5.0 Existing Building Decarbonization to Low Carbon Building Operations.	5.1 Establish a baseline, apply green building practices and perfrom annual MRV.
	6.0 By 2026 All New Buildings and Facilities must comply with carbon cap regulations	6.1 Develop a carbon cap procedure
	7.0 Low Carbon Construction Comments in 2026	7.1 Develop BPA's Low Carbon Construction Procedures

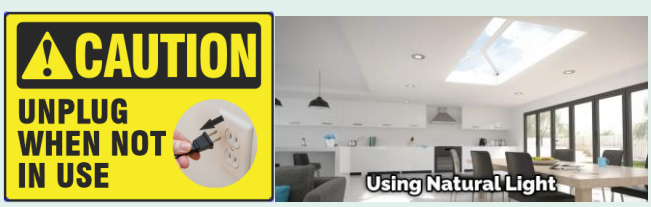
B.1 AMBIENT AIR QUALITY

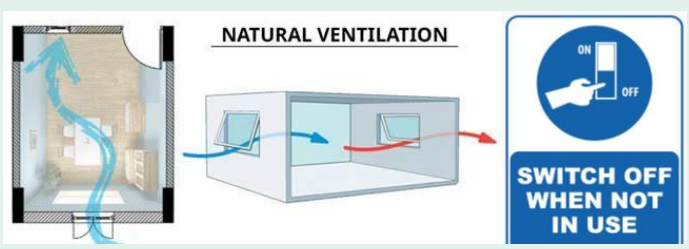
STRATEGY	**1.0**
Goal	Ambient air quality within Bintulu Port operational boundary is meeting International Standards for all measured parameters at all time.
Approach	On-site measurement using Multiparameter Air Quality Monitoring System
Vision	Bintulu Port operating in clean and healthy environment
Potential Challenges	Air pollutants from neighbouring Plants and Facilities
Navigation Plan	Establish Sustainability Neighbourhood Committee to secure support from all stakeholders
ACTION	**1.1**
Specific Action	BPA HSE and Agencies staff to monitor air quality status on regular basis according to an approved procedure.
Methodology	Multiparameter Air Quality Monitoring Systems will be installed at various strategic locations to detect Particulate Matter (PM), Nitrogen Oxides (NOx), Sulphur Oxides (SOx), Carbon Monoxide (CO), and Volatile Organic Compounds (VOCS).
Detail Steps	HSE staff will analyse all data, compare to standards and report to trigger action to reduce transport congestions, douse-off any open burning, inspect non-regular Oil & Gas operations or industry process.
Execution Plan	Upon completion of system installation, HSE staff shall be fully-trained to diagnose the problems and propose immediate solutions, if needed, to call for meeting with all Stakeholders. All data shall be compiled and include in Bintulu Port Air Emission annual report.
Stakeholder In-Charge	BPA
Timeline	6 Months for procurement, installation, commissioning and training.

B.2 ENERGY

STRATEGY	**2.0**
Goal	Reduce 45% emission intensity of energy used by 2030
Approach	Gradually implement energy conservation initiatives, energy efficiency projects, maximum demand management and renewable energy projects
Vision	Net Zero Energy Port status by 2050
Potential Challenges	Low interest for energy conservation, energy efficiency and renewable energy projects due to subsidy and low tariff charges
Navigation Plan	Implement more awareness programs, seminars and trainings to share knowledge and get buy-it about everybody's duty to reduce GHG emissions that cause climate change.
ACTION	**2.1**
Specific Action	Implement Energy Conservation Programs
Methodology	Knowledge sharing through talks, seminar, social media and podcast. Skills development through workshop, pilot project, MRV and awards.
Detail Steps	Develop relevant energy conservation good practice manuals, share manually and online, identify pilot project, share the outcome impact on economy, social and environment.
Execution Plan	Identify energy team for BPA and other agencies, develop work schedule according to steps as proposed, implement, monitor, report and share results
Stakeholder In-Charge	BPA and All Agency's energy team
Timeline	Ongoing

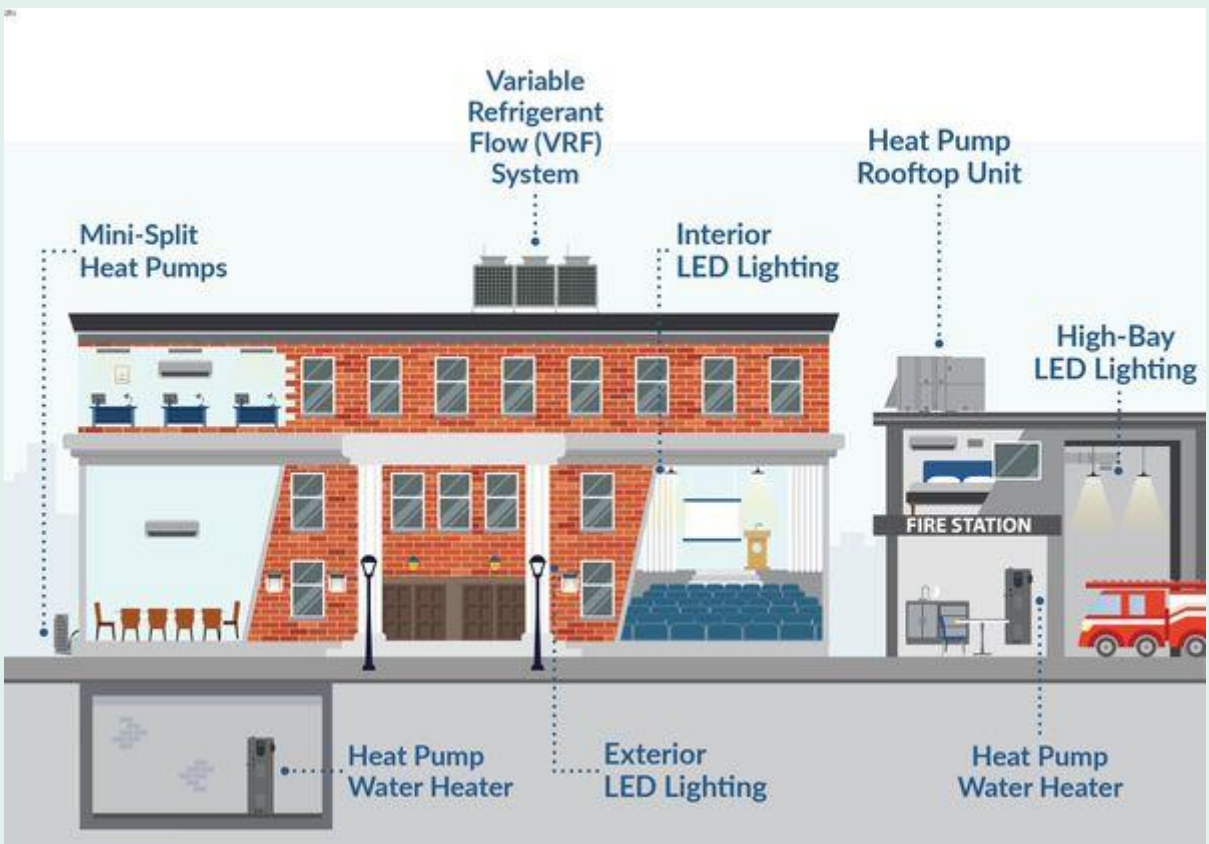


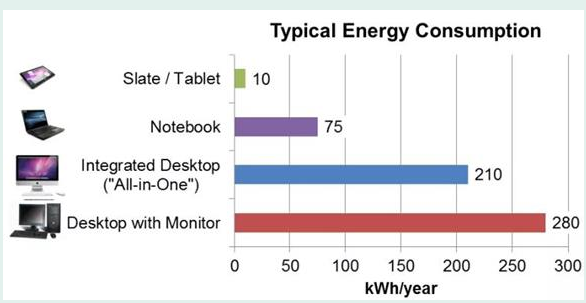




B.2 ENERGY

STRATEGY	**2.0**
ACTION	**2.2**
Specific Action	Implement Energy Efficiency Project
Methodology	Establish baseline, replace with energy efficient equipment and apply MRV
Detail Steps	Execute desk-top energy audit for electricity, fuels and gases, compare with standards, peers and good practice, identify highly efficient equipment, fuels or gases for replacement, perform procurement, installation, testing and commissioning, check actual savings against designed or promised by vendor, perform MRV
Execution Plan	Identify stakeholders, authority, budget and procurement procedures
Stakeholder In-Charge	BPA and All Agencies Engineering & Procurement team
Timeline	Ongoing



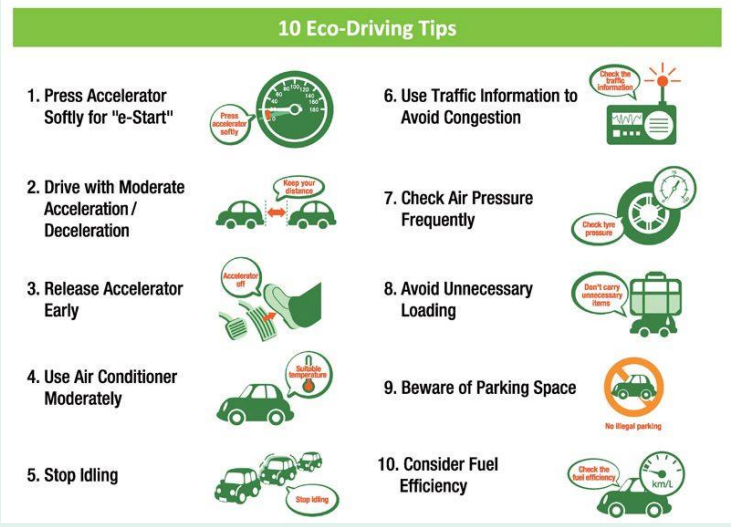


B.2 ENERGY

STRATEGY	**2.0**
ACTION	**2.3**
Specific Action	Develop and Use Renewable Energy Source (RES)
Methodology	Execute thorough study on renewable energy potential, install, commission and apply MRV
Detail Steps	In-house or hire expert to study technical, commercial and legal RES viability, determine outright purchase or apply Energy Performance Contract (EPC), implement the procurement, install and commission, check performance according to standards and agreement, apply MRV and maintenance procedures
Execution Plan	Prepare engineering drawings, procure RE, install, commission and maintain
Stakeholder In-Charge	BPA and All Agencies
Timeline	Ongoing

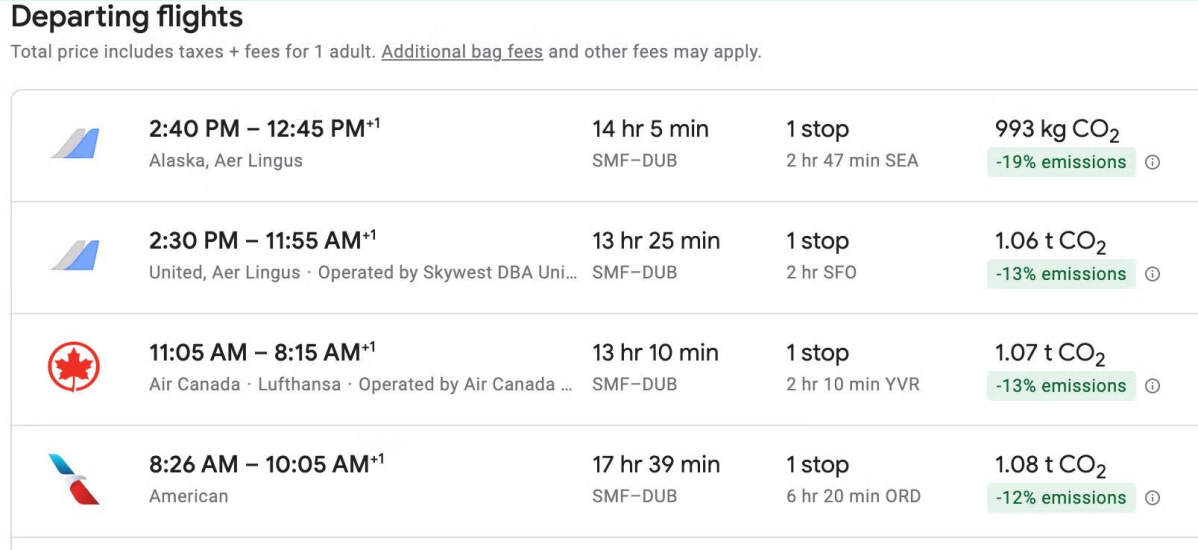
B.3 TRANSPORTATION

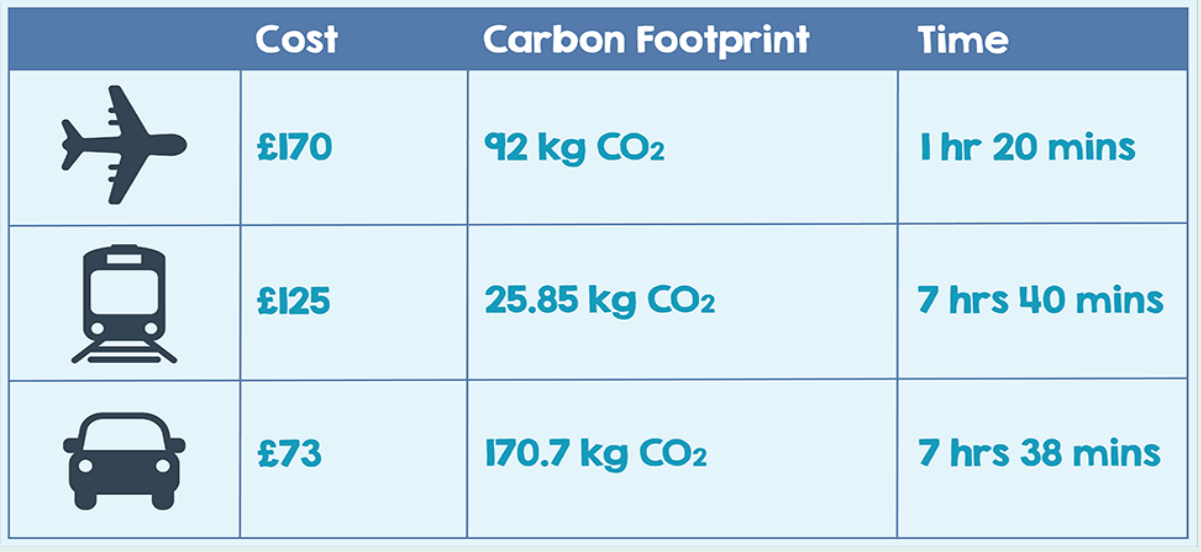
STRATEGY	**3.0**
Goal	45% emission intensity of kilometre travelled or litre fuel used reduction by 2030
Approach	Starts with low hanging fruits; change of behaviour, embed knowledge and skills, followed by low investment and heavy investment in long term.
Vision	BPA and Agencies applied sustainable transportation
Potential Challenges	Low demand for changes due to low fuel rates and inexpensive vehicles
Navigation Plan	Enhanced awareness about obligation to reduce carbon footprint for transportation sector and cost saving benefits.
ACTION	**3.1**
Specific Action	Apply eco-driving technique
Methodology	Knowledge sharing and skills trainings
Detail Steps	Form eco-driving team to lead the initiatives, organise a talk and demonstration on eco-driving technique, apply eco-driving technique by BPA and Agency staff, perform MRV and share the benefits on-line and off-line.
Execution Plan	Each BPA and Agency department to participate, attend the talk and training and apply on daily basis
Stakeholder In-Charge	BPA and Agency Departments
Timeline	Ongoing



B.3 TRANSPORTATION

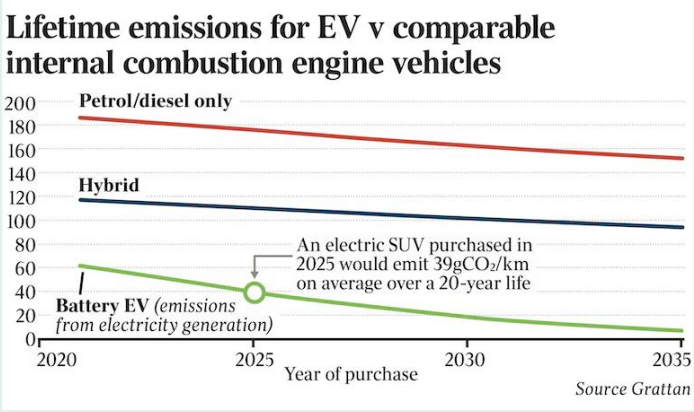
STRATEGY	**3.0**
ACTION	**3.2**
Specific Action	Implement Low Carbon Business Travel
Methodology	Prepare procurement procedure to prioritise low carbon domestic and international travels
Detail Steps	Train purchasing team to compare amount of carbon footprint for every domestic or international travel as published by the airlines or calculate using specific formula, procure the ticket, compile data and input into Emission Inventory Management System (EIMS) software, publish annually
Execution Plan	Organise awareness talk to High Level Management and Procurement Team, provide training to procurement staff for carbon evaluation and calculations,
Stakeholder In-Charge	BPA and All Agencies
Timeline	Ongoing

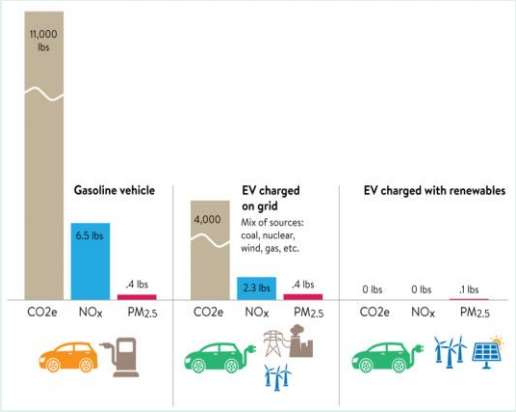




B.3 TRANSPORTATION

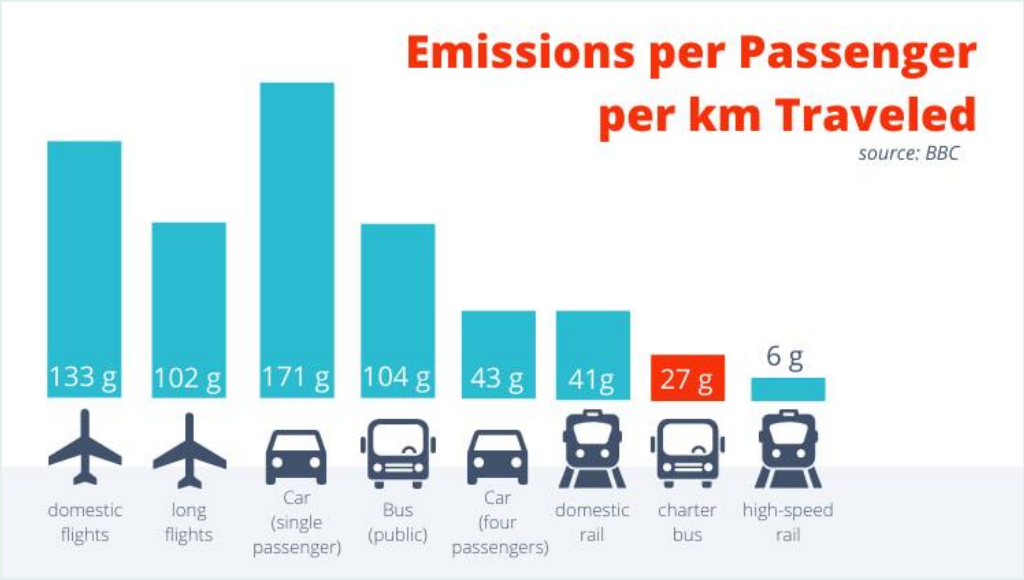
STRATEGY	**3.0**
ACTION	**3.3**
Specific Action	Change to Electric Vehicles (EV) for Port Authority and Agencies Owned Vehicles
Methodology	Prioritise on EV for any vehicle new purchasing or hiring
Detail Steps	Prepare bidding document, call for EV company to tender, select those meeting technical and commercial requirements, use and perform MRV
Execution Plan	Develop company policy for low carbon vehicle purchase or leasing, secure board endorsement and implement
Stakeholder In-Charge	BPA and All Agencies
Timeline	Ongoing





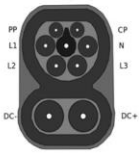
B.3 TRANSPORTATION

STRATEGY	**3.0**
ACTION	**3.4**
Specific Action	Public Transport for Staff Commute between home and Bintulu Port
Methodology	Incentivise staff of using public transport to work or provide alternative transport i.e. bus or van
Detail Steps	Prepare cost – value calculations to evaluate impact from the initiatives, introduce incentive i.e. RM50.00 TnG to staff commuted by public transport, or hire bus or van for staff transit
Execution Plan	Perform evaluation, decision by the top management to issue incentive or hire a vehicle, compile data over one year period, perform MRV and share the benefits.
Stakeholder In-Charge	BPA and All Agencies
Timeline	Ongoing



B.3 TRANSPORTATION

STRATEGY	**3.0**
ACTION	**3.5**
Specific Action	Install EV Charging Stations (EVCS)
Methodology	Perform feasibility study, install and use the most feasible
Detail Steps	Perform technical and commercial feasibility study with and without renewable energy source and locations, invite EVCS company to present their system, chose the one that meet all requirements, determine contract terms, install, commission, use and measure the emissions reduction.
Execution Plan	Study report and recommendations approved by top management, perform procurement, installation, commissioning, use and perform MRV
Stakeholder In-Charge	BPA and All Agencies
Timeline	Ongoing

Type of Charging	North America	Japan	EU & rest of the market	China	All markets except EU	India
AC Type1: 1-3kW Type2: 3-22kW						
Plug Name	J1772 (Type 1)	J1772 (Type 1)	Mennekes (Type 2) IEC62196-2	GB/T		Commando (Type-1): IEC60309 Mennekes (Type-2): IEC62196-2
DC 10-400kW						
Plug Name	CCS1	CHAdeMO	CCS2	GB/T	TESLA	GB/T, CCS2, CHAdeMO

B.3 TRANSPORTATION

STRATEGY	**3.0**
ACTION	**3.6**
Specific Action	Use Biodiesel B20 Fuel for Diesel Powered Vehicles
Methodology	Include in Sustainable Transportation Policy, use and report
Detail Steps	Top management of BPA and All Agencies decide to use Biodiesel B20 to all owned and leased Diesel-powered vehicles, issue instruction to all drivers, use and perform MRV
Execution Plan	Organise talk to procurement team and the drivers about use and the benefits of Biodiesel, ensure daily usage, collect data, perform monthly and yearly MRV
Stakeholder In-Charge	BPA and All Agencies
Timeline	Ongoing

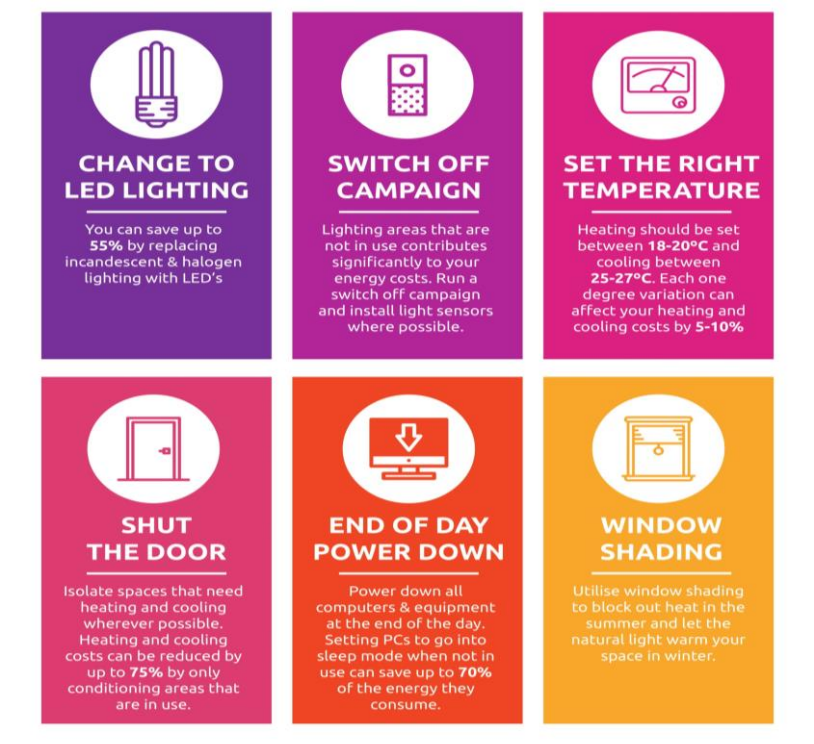
- The EPA's studies conclude that substituting traditional diesel with B20 results in;
  - diesel particulate reduced by approximately 10%,
  - carbon monoxide reduced by 11%
  - hydrocarbon emissions reduced by 21%.
- Supports local jobs and keep US $ in North America
- Increased lubricity & higher cetane number
- Reduces our dependence on Petroleum and foreign oil

B.3 TRANSPORTATION

STRATEGY	**4.0**
Goal	Create connectivity and logistic link between Bintulu Port and Nusantara
Approach	To leverage Bintulu Port's strategic location to facilitate the movement of goods between Sarawak and Indonesia more efficiently is part of Sarawak's broader transport strategy.
Vision	Enhance trade and mobility to boost Sarawak economic growth
Potential Challenges	Depend on government-to-government relationship.
Navigation Plan	Continuous engagements with Putrajaya
ACTION	**4.1**
Specific Action	To support the current study by the state government by providing relevant data.
Methodology	Official engagements for communications and data sharing protocols.
Detail Steps	To provide the following relevant port data and information; • Topographic surveys and geotechnical conditions. • Climate data, including extreme weather conditions. • Water levels and potential flooding risks. • Soil composition and ground-bearing capacity. • Volume and types of cargo handled. • Existing transport and logistics flow. • Intermodal connections between ships, trucks, and future rail • Projected future expansion of the port facilities. • Available space for railway alignment and terminals. • Bridge and tunnel requirements if needed. • Load capacities for tracks, bridges, and supporting structures. • Utilities layout (such as pipelines and power lines) to avoid conflicts. • Port authority regulations and environmental compliance. • Safety measures for operations near heavy machinery and hazardous materials • Emergency access and evacuation routes. • Cost estimates for port re-construction if needed. • Expected demand for rail transport within the port logistics.
Execution Plan	Prepare information and data for future study engagements
Stakeholder In-Charge	Port Authority
Timeline	Ongoing until August 2025

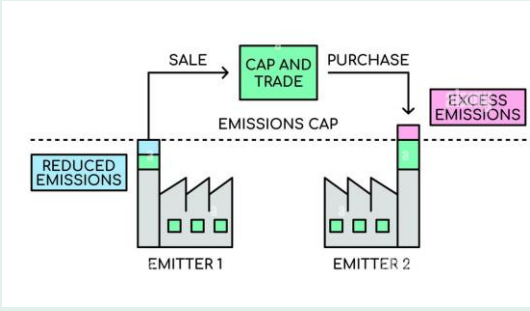
B.4 BUILDINGS AND FACILITIES

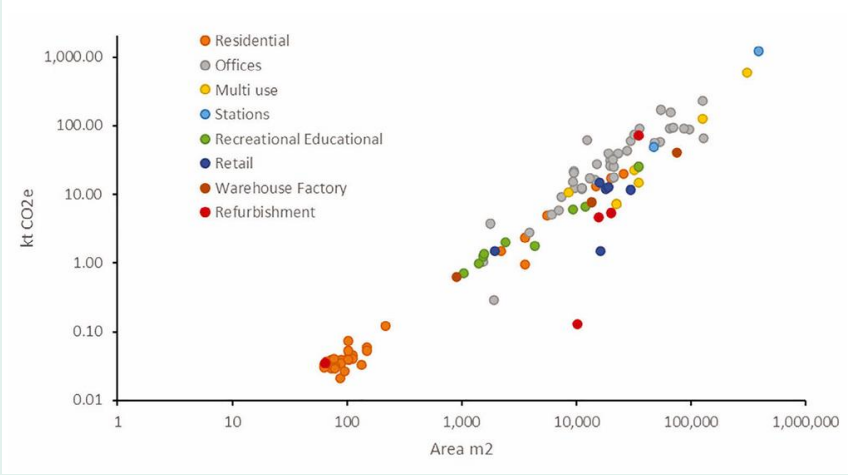
STRATEGY	**5.0**
Goal	Existing Building Decarbonization to Low Carbon Building Operations.
Approach	Start with simple initiatives, no-cost and immediate result.
Vision	Existing buildings operate in a sustainable way.
Potential Challenges	Buy-in and actions for conservation initiatives may take a long period.
Navigation Plan	Regular update and considered as a top management meeting agenda.
ACTION	**5.1**
Specific Action	Establish a baseline, apply green building practices and perform annual MRV.
Methodology	Share knowledge and skills, implement and measure impact
Detail Steps	Establish a baseline for electricity, fuels and gases used, apply green building practices; conserve use of energy and water, apply 3R for waste management, replace them with highly efficient office equipment, maximize natural sunlight and ventilation, measure monthly impacts, prepare annual MRV.
Execution Plan	Arrange regular talks and skills training on energy conservation initiatives, prepare electricity, water and waste baselines, prepare and apply duty roaster for a start, measure impact on a monthly basis, share results with entire staff, perform MRV.
Stakeholder In-Charge	Port Authority and All Agencies' team
Timeline	Ongoing



B.4 BUILDINGS AND FACILITIES

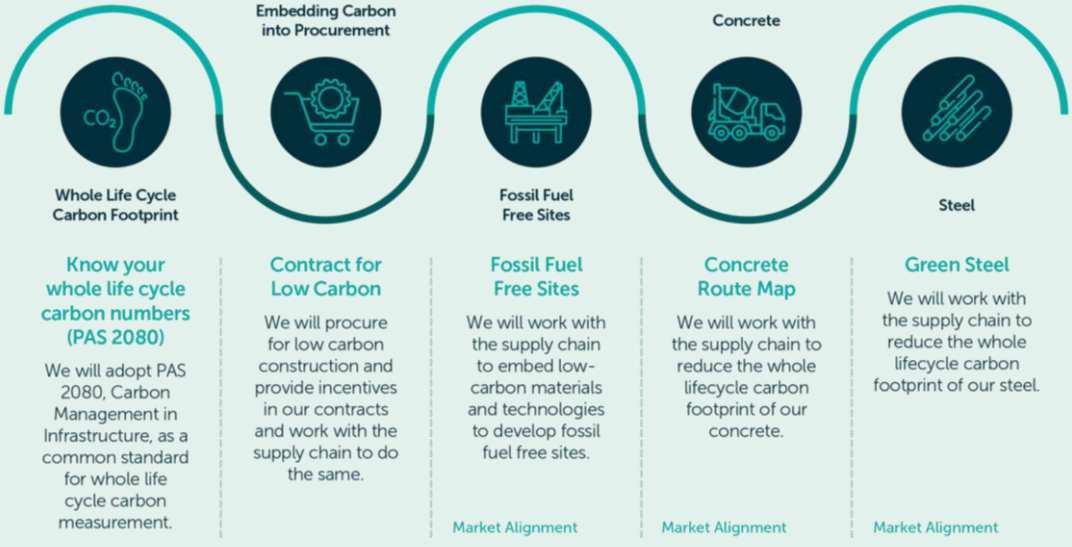
STRATEGY	**6.0**
Goal	By 2026 All New Buildings and Facilities must comply with carbon cap regulations
Approach	Implement Carbon Cap regulations
Vision	All New Buildings and Facilities are Low Carbon by 2030
Potential Challenges	Late national and state regulations on carbon cap
Navigation Plan	Emphasise on commercial and health benefits from low carbon building and facilities
ACTION	**6.1**
Specific Action	Develop a carbon cap procedure
Methodology	Organise a workshop with all stakeholders, determine relevant carbon cap value and implement.
Detail Steps	Prepare a concept paper and present it to the top management. If approved, proceed to call for a workshop with all relevant stakeholders, prepare a conclusion paper and present to top management for endorsement, implement, monitor and prepare MRV annually.
Execution Plan	Documentation and regulation ready by end 2025 for implementation in 2026 onwards
Stakeholder In-Charge	BPA and interested Agencies
Timeline	Start Mid 2025 until Dec 2026





B.4 BUILDINGS AND FACILITIES

STRATEGY	**7.0**
Goal	Low Carbon Construction Comments in 2026
Approach	Education to all stakeholders in supply chain
Vision	Net zero in all phases of built environment
Potential Challenges	Big knowledge, skills, capability and attitude gaps in the construction industry
Navigation Plan	To plan and execute more intensive knowledge, skills and capacity building programs
ACTION	**7.1**
Specific Action	Develop BPA's Low Carbon Construction Procedures
Methodology	Develop procedure with input from all stakeholders and apply
Detail Steps	Assemble a Technical team, prepare terms of reference, organize a workshop with all stakeholders in the built environment supply chain for feedback, conclude recommendations, prepare the procedures and present them to the management for approval.
Execution Plan	Procurement team will include the procedure as part of the tender document and agreement with all Consultants, Contractors, Suppliers and Vendors
Stakeholder In-Charge	BPA
Timeline	The procedure completed and approved by December 2025 and use in 2026 onwards



BPA INITIATIVES (SECTION B): ESTIMATED REDUCTION

Initiative	Type	Reduction Basis	Est. Reduction by 2030 (tCO_2e)	% of 2023 Baseline	Notes
B.1 Governance / Policy	Enabler	N/A	N/A	N/A	SHE Dept KPIs, steering group – no direct cuts
B.2 Capacity Building / Awareness	Enabler	N/A	N/A	N/A	Training & awareness campaigns
B.3 Employee commute	Behavioural	Modal shift, pooling	50	0.1%	Limited impact; symbolic
B.3 EVCS & light fleet electrification	Technology	BPA vehicles	233	0.45%	Pilot scale
B.3 Biodiesel B20 (BPA fleet)	Fuel switch	Company cars & utility vehicles	67	0.13%	Aligned with national B20 mandate; B30 not adopted due to technical/supply risks
B.4 Building O&M efficiency	Efficiency	Scope 1 & 2	178	0.34%	HVAC, lighting retrofits
B.4 Low-carbon standards (new builds)	Enabler	N/A	N/A	N/A	Future-proofing, not quantified

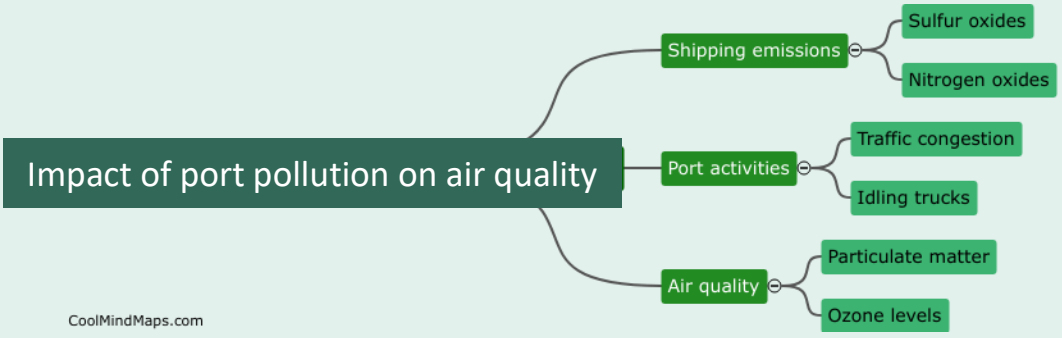
Subtotal BPA (quantified): 528 tCO_2e (1.0% of baseline)

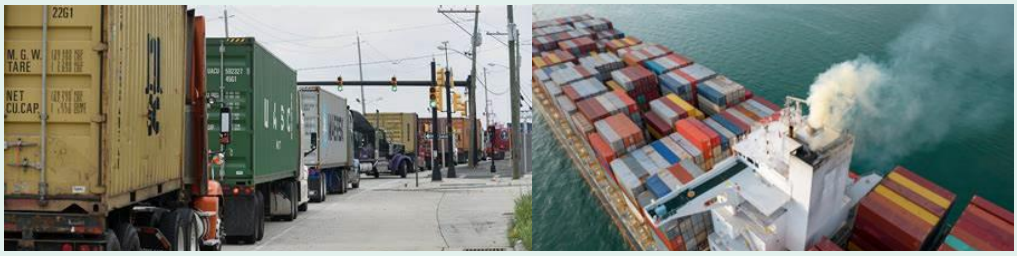
C. PORT OPERATOR AND TENANTS - CONTROLLED EMISSIONS

SECTOR	STRATEGY	ACTIONS
1.0 AMBIENT AIR QUALITY	8.0 Ambient air quality meeting International Standards at all time.	8.1 Port Operator and Tenants monitor air quality status on regular basis according to BPA's procedure
2.0 ENERGY	9.0 Reduce 45% emission intensity of energy used by 2030	9.1 Implement Energy Conservation Programs to all supply chain
		9.2 Implement Energy Efficiency Project
		9.3 Study and Implement Microgrid Power Distribution System
		9.4 Install and Use On-site Solar PV and Wave Renewable Energy Source (RES)
		9.5 Install and Use Off-site Solar Farm Renewable Energy Source (RES)
		9.6 Study and implement Seaport Virtual Power Plant (SVPP)
	10.0 Electrification of industrial processes	10.1 Replacing fossil-fuel-powered technologies with electric alternatives
	11.0 Green hydrogen for industrial processes	11.1 Assess technical and commercial feasibility
3.0 TRANSPORTATION	12.0 Transforms to low carbon transportation	12.1 Apply eco-driving technique
		12.2 Implement Low Carbon Business Travel
		12.3 Change to Electric Vehicles (EV) for Operator and Tenants Owned Vehicles
		12.4 Public Transport for Staff Commute between home and Bintulu Port
		12.5 Install EV Charging Stations (EVCS)
		12.6 Install Shore Power
		12.7 Use Biodiesel B20 Fuel for Diesel Powered Vehicles
		12.8 Install LNG Refuelling Facilities
		12.9 Install Green Ammonia Refuelling Facilities
		12.10 Vessel Speed Reduction (VSR) Program
		12.11 Apply AI for Port Operations
		12.12 Develop CCS Support Facilities
		12.13 Study on the implementation of Maritime Autonomous Surface Ships (MASS) System
		12.14 Truck replacement program (TRP)
		12.15 Congestion Mitigation and Air Quality Improvement (CMAQ) program
	13.0 Diesel Emissions Reduction Program (DERP)	13.1 Prepare project planning for Diesel Emissions Reduction Program (DERP)
	14.0 Decarbonising dredging works	14.1 Optimizing dredging operations, using dredged material beneficially and use renewable energy supply.
	15.0 Electrification of ships	15.1 Assessing vessel suitability, technology, electric propulsion systems, shore-based charging stations.
4.0 BUILDINGS AND FACILITIES	16.0 Existing Building Decarbonization to Low Carbon Building Operations.	16.1 Establish a baseline, apply green building practices and perform annual MRV.
	17.0 By 2026 All New Buildings and Facilities comply with carbon cap regulations	17.1 Develop a carbon cap procedure
	18.0 Low Carbon Construction Comments in 2026	18.1 Develop BPA's Low Carbon Construction Procedures
5.0 WASTE	19.0 Sustainable Waste Management	19.1 Oil removal and water cleaning
6.0 CIRCULAR ECONOMY	20.0 Making Industries 100% Circular	20.1 Implementing closed-loop production systems in port operations.

C.1 AMBIENT AIR QUALITY

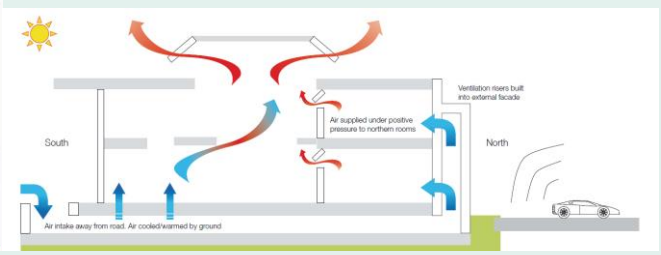
STRATEGY	**8.0**
Goal	Ambient air quality meeting International Standards at all time.
Approach	Comply with BPA's procedures for On-site measurement using Multiparameter Air Quality Monitoring System
Vision	Bintulu Port operating in clean and healthy environment
Potential Challenges	Air pollutants from neighbouring Plants and Facilities
Navigation Plan	To join BPA's Sustainability Neighbourhood Committee to support the efforts
ACTION	**8.1**
Specific Action	Port Operator and Tenants monitor air quality status on regular basis according to BPA's procedure
Methodology	Use data from BPA's Multiparameter Air Quality Monitoring Systems installed at various strategic locations to detect Particulate Matter (PM), Nitrogen Oxides (NOx), Sulfur Oxides (SOx), Carbon Monoxide (CO), and Volatile Organic Compounds (VOCS).
Detail Steps	Port Operator and Tenants HSE liaise with BPA HSE for ambient air quality reports and take action to reduce transport congestions, douse-off any open burning, inspect non-regular Oil & Gas operations or industry process.
Execution Plan	Port Operator and Tenants HSE staff shall be fully-trained and work with BPA HSE to diagnose the problems and propose immediate solutions, if needed, to call for meeting with all supply chain. All counter measure actions shall be compiled and submitted to BPA HSE.
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing after BPA installation and commissioning period.





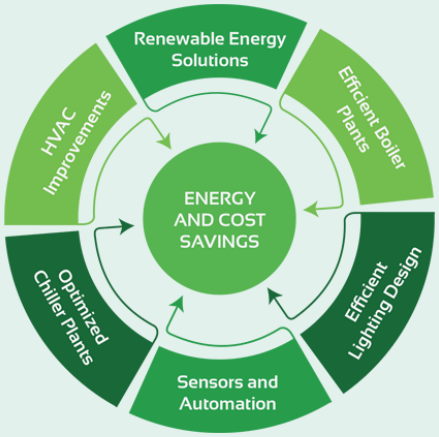
C.2 ENERGY

STRATEGY	**9.0**
Goal	Reduce 45% emission intensity of energy used by 2030
Approach	Gradually implement energy conservation initiatives, energy efficiency projects, maximum demand management and renewable energy projects
Vision	Net Zero Energy Port status by 2050
Potential Challenges	Low interest from supply chain for energy conservation, energy efficiency and renewable energy projects due to low tariff charges
Navigation Plan	Implement more awareness programs, seminars and trainings to supply chain to share knowledge and get buy-it about everybody's duty to reduce GHG emissions that cause climate change.
ACTION	**9.1**
Specific Action	Implement Energy Conservation Programs to all supply chain
Methodology	Knowledge sharing through talks, seminar, social media and podcast. Skills development through workshop, pilot project, MRV and awards.
Detail Steps	Develop Port Operator Energy Conservation Good Practice Manuals, share manually and online with all supply chain, identify pilot project, share the outcome impact on economy, social and environment.
Execution Plan	Identify energy team for Port Operator and Tenant Team, develop work schedule according to steps as proposed, implement, monitor, report and share results
Stakeholder In-Charge	Port Operator and Tenant Team
Timeline	Ongoing actions



C.2 ENERGY

STRATEGY	**9.0**
ACTION	**9.2**
Specific Action	Implement Energy Efficiency Project
Methodology	Establish baseline, replace with energy efficient equipment or system and apply MRV
Detail Steps	Execute desk-top energy audit for electricity, fuels and gases, compare with standards, peers and good practice, identify highly efficient equipment, fuels or gases for replacement, perform procurement, installation, testing and commissioning, check actual savings against designed or promised by vendor, perform MRV
Execution Plan	Identify stakeholders, authority, budget and procurement procedures
Stakeholder In-Charge	Port Operator and Tenant Team
Timeline	Ongoing



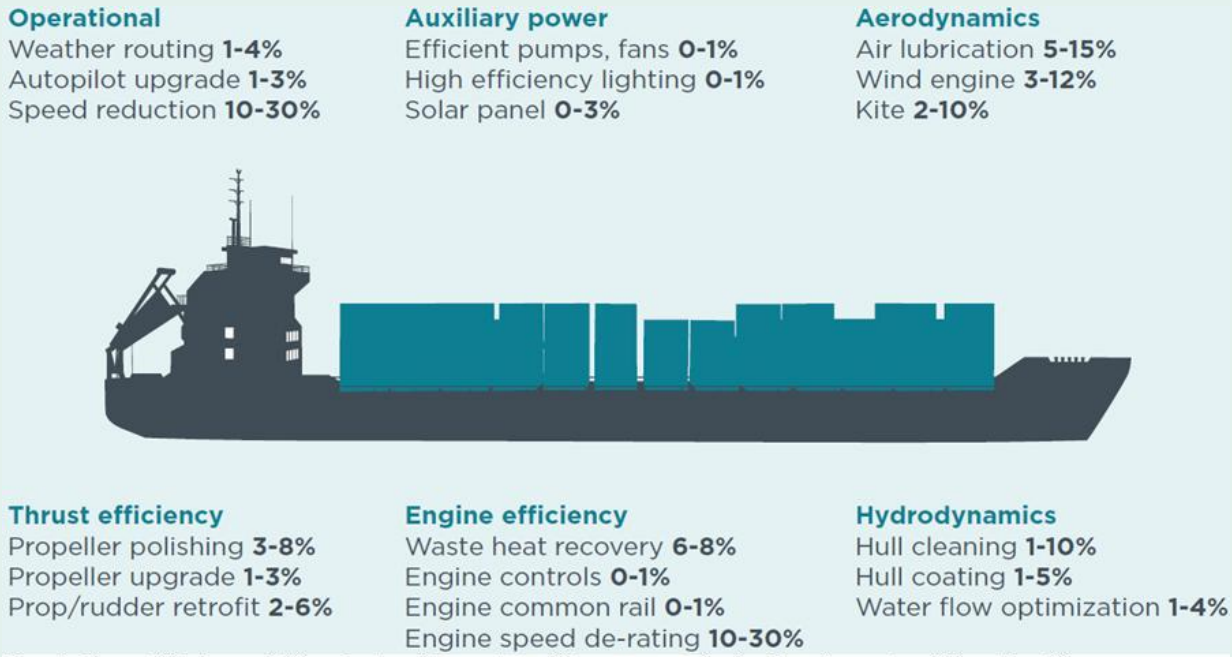
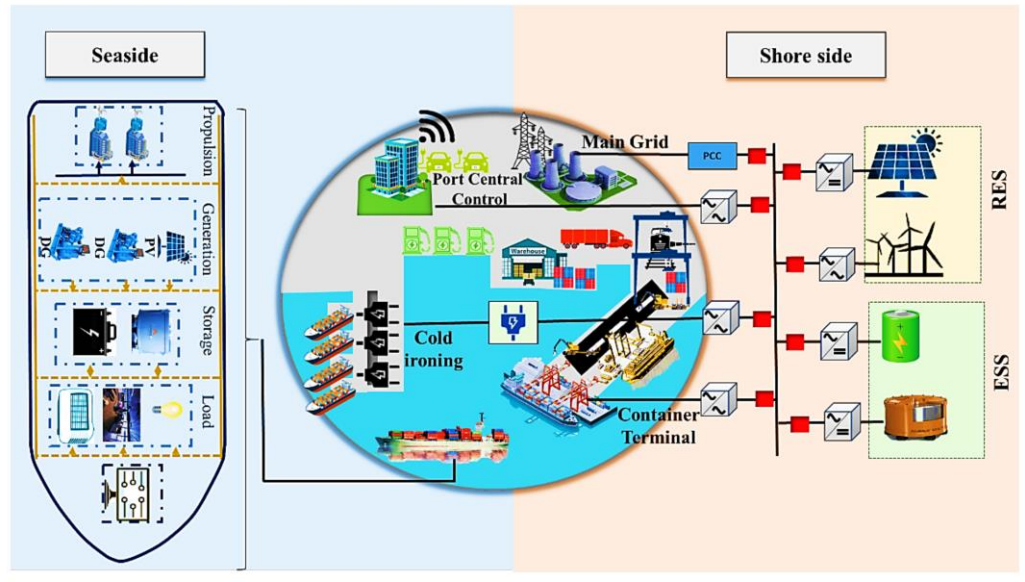
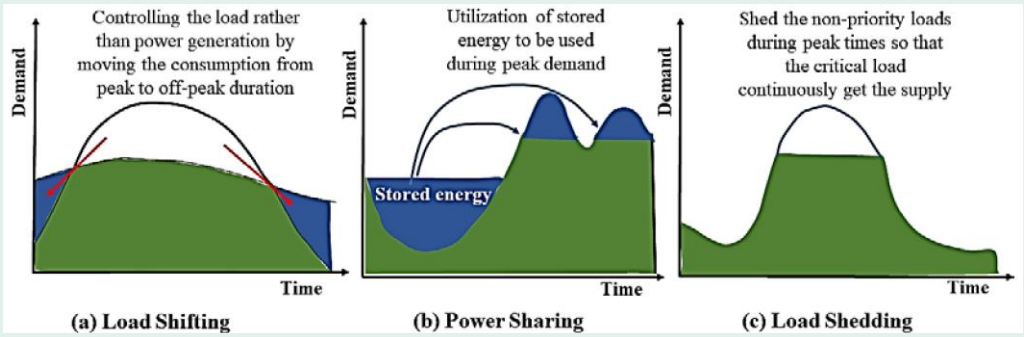


Figure 1: *Potential fuel use and CO_2 reductions from various efficiency approaches for ships (International Council on Clean*

C.2 ENERGY

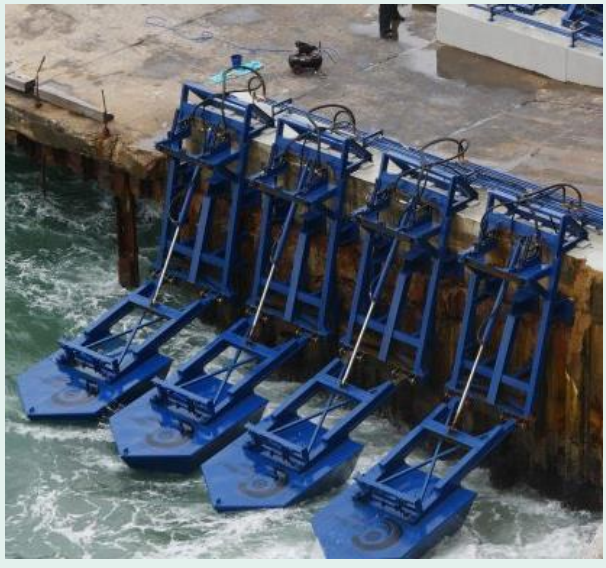
STRATEGY	**9.0**
ACTION	**9.3**
Specific Action	Study and Implement Microgrid Power Distribution System
Methodology	The Microgrid Power Distribution System is to support the implementation of large-scale cold ironing (shore power), full electrification of cranes, improved charging stations, and electrification of other modes of transportation.
Detail Steps	Conduct a study on integrating the microgrid concept into a seaport from both shoreside and seaside as a smart initiative for the green port's vision, determine feasibility in costs and returns, technical and managerial challenges, environmental benefits and legal issues, hire a consultant for front-end design engineering, call for tender, appoint qualified contractor, execute Microgrid Power Distribution project and perform MRV
Execution Plan	Starts with study costs-value comparison, deciding to undertake in-house or appoint a consultant for front-end engineering, prepare tender documents, procurement process, appoint qualified vendors, implement, monitor and perform MRV.
Stakeholder In-Charge	Port Operator
Timeline	Ongoing





C.2 ENERGY

STRATEGY	**9.0**
ACTION	**9.4**
Specific Action	Install and Use On-site Solar PV and Wave Renewable Energy Source (RES)
Methodology	Execute thorough study on renewable energy potential, install, commission and apply MRV
Detail Steps	In-house or hire expert to study technical, commercial and legal RES viability, determine outright purchase or apply Energy Performance Contract (EPC), implement the procurement, install and commission, check performance according to standards and agreement, apply MRV and maintenance procedures
Execution Plan	Prepare engineering drawings, procure RE, install, commission and maintain
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing



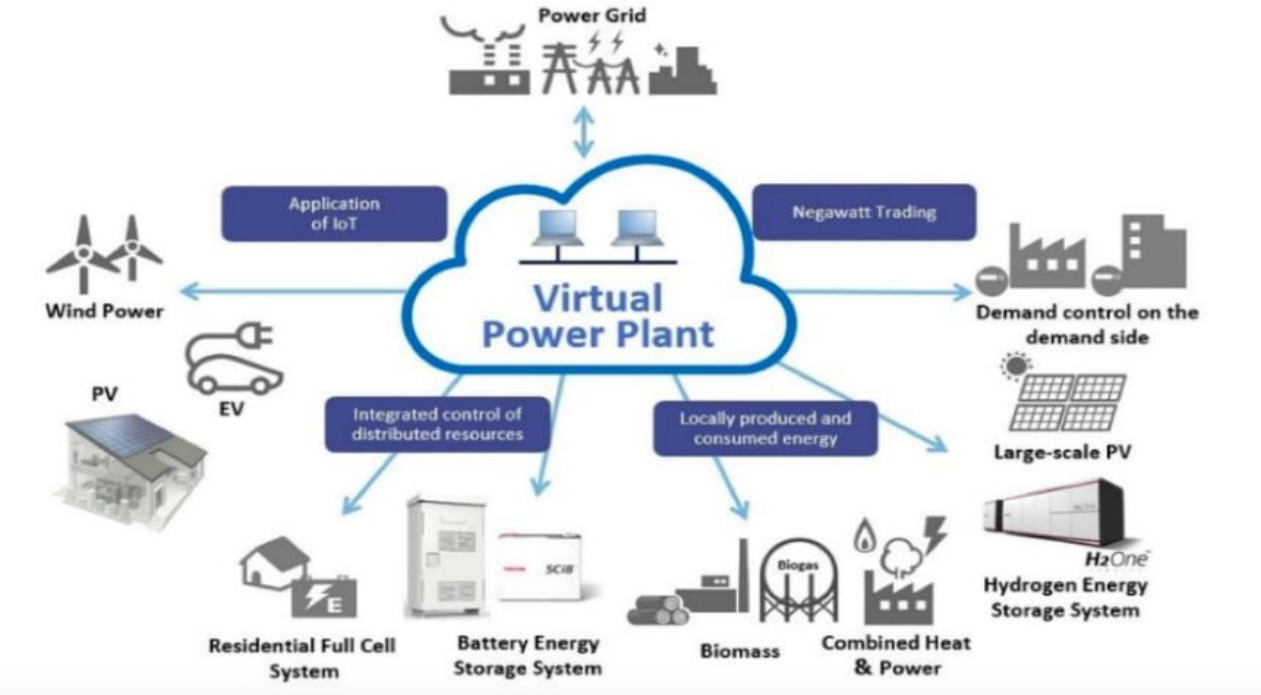
C.2 ENERGY

STRATEGY	**9.0**
ACTION	**9.5**
Specific Action	Install and Use Off-site Solar Farm Renewable Energy Source (RES)
Methodology	Execute thorough study on off-site Solar Farm renewable energy potential, install, commission and apply MRV
Detail Steps	In-house or hire expert to study technical, commercial and legal Off-site Solar Farm RES viability, determine outright purchase or apply Energy Performance Contract (EPC), implement the procurement, install and commission, check performance according to standards and agreement, apply MRV and maintenance procedures
Execution Plan	Prepare engineering drawings, procure RE, install, commission and maintain
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing

APM Terminals Bahrain to Make First Fully Solar-Powered Seaport

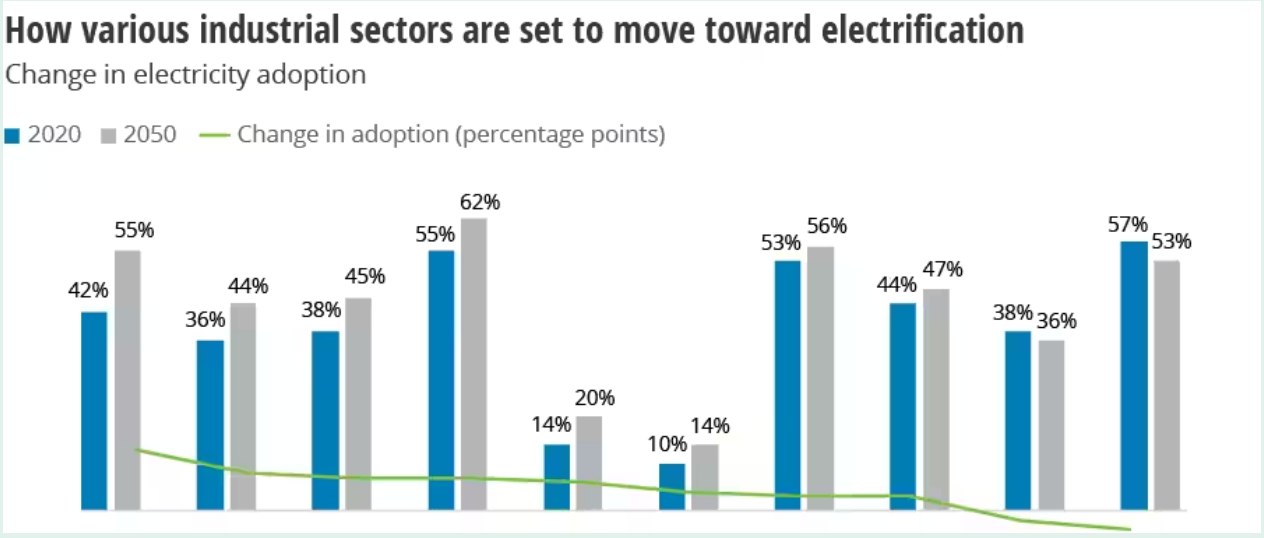
C.2 ENERGY

STRATEGY	**9.0**
ACTION	**9.6**
Specific Action	Study and implement Seaport Virtual Power Plant (SVPP)
Methodology	Establish a seaport virtual power plant (SVPP) system model and an energy service model that leverages the concepts of vessel-to-shore (V2S) and vessel-to-vessel (V2V) for facilitating diverse energy transfer modes among the grid, shore, and vessels.
Detail Steps	Assess Energy Needs & Infrastructure by analysing the current energy consumption of the seaport, identify peak demand periods and potential energy-saving opportunities and evaluate existing renewable energy sources and grid connections. Deploy Distributed Energy Resources (DERs), install solar PV, use battery energy storage systems (BESSs) to store excess energy. Implement Smart Grid & Energy Management Systems by using AI-driven energy management systems to optimize power distribution. Develop a Decentralized Scheduling System to optimize vessel-to-shore (V2S) and vessel-to-vessel (V2V) energy transfer to enhance flexibility. Ensure Regulatory Compliance & Economic Viability and Monitor & Optimize Performance.
Execution Plan	Form a team to study the SVPP potential, hire Consultant for detail study and prepare front-end engineering, procurement exercise, appointment of qualified contractor, installation and commissioning and MRV
Stakeholder In-Charge	Port Operator
Timeline	Ongoing



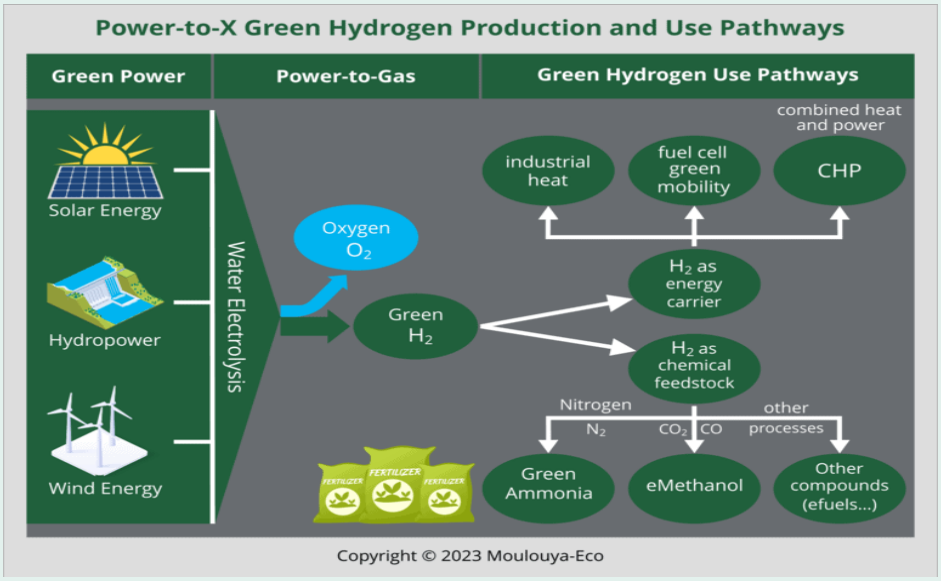
C.2 ENERGY

STRATEGY	**10.0**
Goal	Electrification of industrial processes
Approach	Replacing fossil-fuel-powered technologies with electric alternatives
Vision	To improve industry energy efficiency, reduce costs, and lower greenhouse gas emissions
Potential Challenges	Hard sell to industries due to high investment costs
Navigation Plan	Focus on high energy consumed industries
ACTION	**10.1**
Specific Action	Electrifying industrial processes involves replacing fossil-fuel-powered technologies with electric alternatives to improve energy efficiency, reduce costs, and lower greenhouse gas emissions
Methodology	Starts with comprehensive audits, efficient solutions and perform MRV
Detail Steps	Identify which processes rely on fossil fuels and evaluate their energy consumption, consider electric alternatives such as heat pumps, electric boilers, and induction heating for industrial heating needs, using solar energy to make electrification more sustainable and cost-effective, electrify industrial fleets, machinery, and heating systems to reduce reliance on fossil fuels, implement smart energy management systems to monitor and optimize electricity use, plan to offer incentives for electrification efforts and ensure that electrification solutions can be expanded as technology advances.
Execution Plan	Perform internal preliminary audit, appoint ESCO to perform investment-scale audit, execute costs and emissions savings initiatives and perform MRV
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing



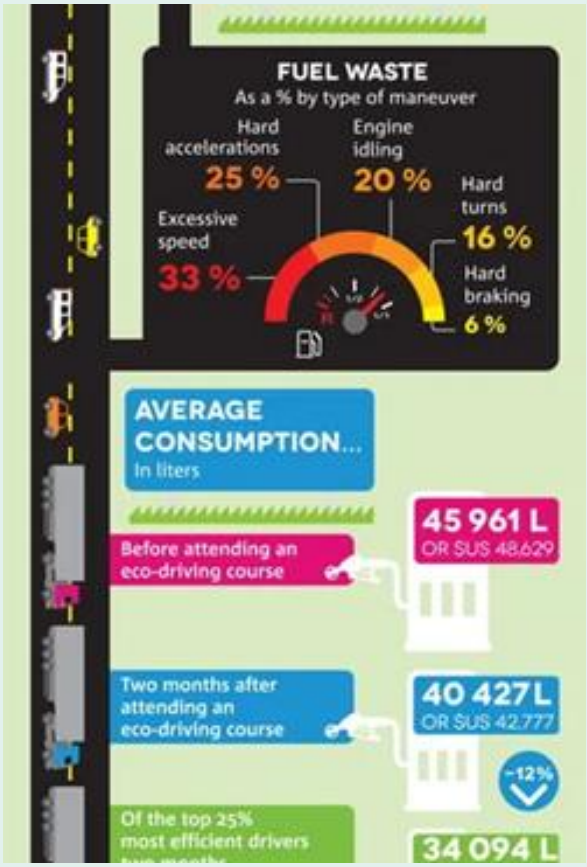
C.2 ENERGY

STRATEGY	**11.0**
Goal	Green hydrogen for industrial processes
Approach	Starts with detail study, assess the green H2 supply, perform costs-value before implement
Vision	To create a new hydrogen economy
Potential Challenges	Still not competitive compared to hydro-powered electricity
Navigation Plan	Continue to explore new green hydrogen technology
ACTION	**11.1**
Specific Action	Assess feasibility, develop infrastructure, optimize energy efficiency, scale production, set a policy and approve new investment.
Methodology	Continue on research, acquire new green hydrogen knowledge and implement when technical and commercially feasible
Detail Steps	Identify industries where hydrogen can replace fossil fuels, such as steel, petrochemicals, cement, and glass, invest in electrolysis technology to produce hydrogen from renewable energy sources like solar, integrate hydrogen into continuous industrial processes to minimize storage needs and improve efficiency, establish large-scale hydrogen facilities, often requiring several hundred to a few thousand megawatts of renewable energy capacity, to secure governments and industries collaboration on incentives, regulations, and funding to make green hydrogen economically viable
Execution Plan	Set a team to study and update the management and the board
Stakeholder In-Charge	Port Operator
Timeline	Long term



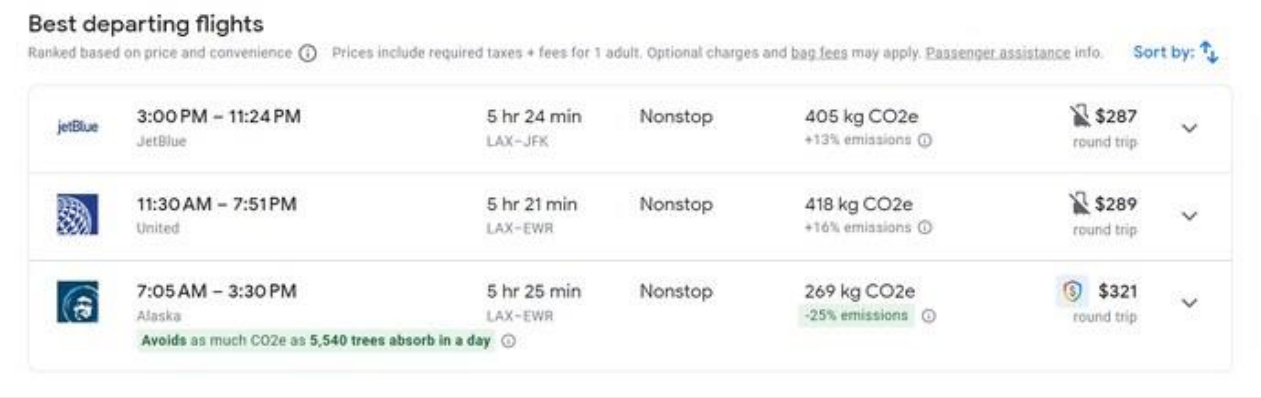
C.3 TRANSPORTATION

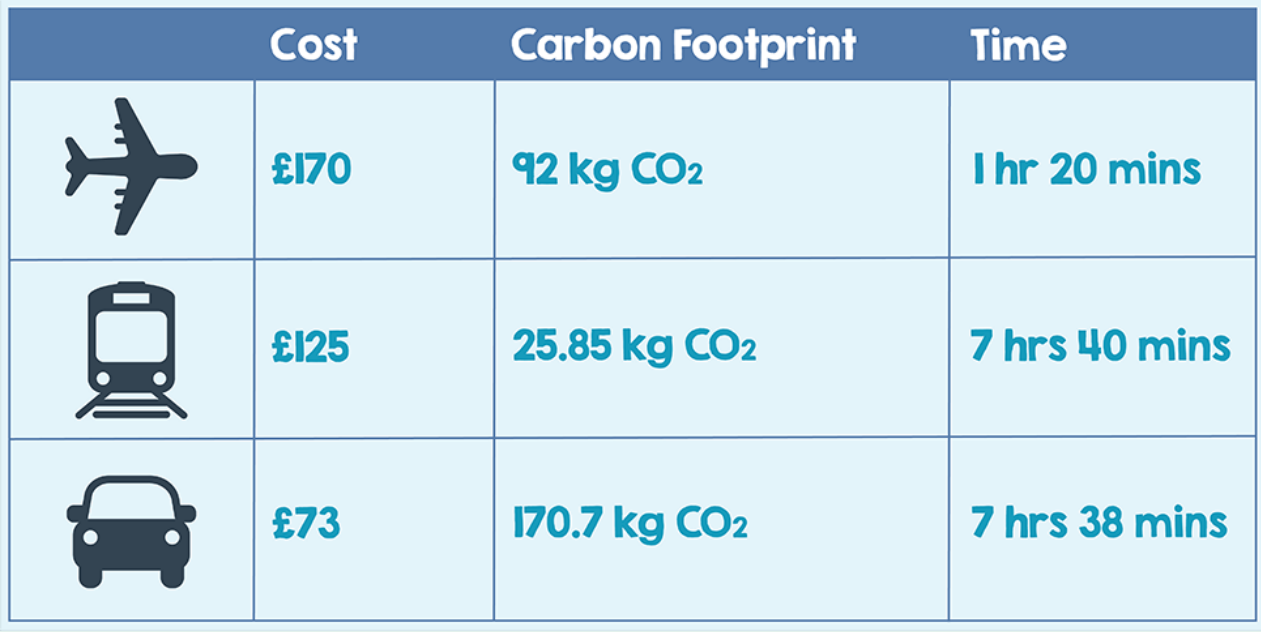
STRATEGY	**12.0**
Goal	Transform to low carbon transportation
Approach	Starts with low hanging fruits; change of behaviour, embed knowledge and skills, followed by low investment and heavy investment in long term.
Vision	BPA and Agencies applied sustainable transportation
Potential Challenges	Low demand for changes due to low fuel rates and inexpensive vehicles
Navigation Plan	Enhanced awareness about obligation to reduce carbon footprint for transportation sector and cost saving benefits.
ACTION	**12.1**
Specific Action	Apply eco-driving technique
Methodology	Knowledge sharing and skills trainings
Detail Steps	Form eco-driving team to lead the initiatives, organise a talk and demonstration on eco-driving technique, apply eco-driving technique by BPA and Agency staff, perform MRV and share the benefits on-line and off-line.
Execution Plan	Each BPA and Agency department to participate, attend the talk and training and apply on daily basis
Stakeholder In-Charge	BPA and Agency Departments
Timeline	Ongoing



C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.2**
Specific Action	Implement Low Carbon Business Travel
Methodology	Prepare procurement procedure to prioritise low carbon domestic and international travels
Detail Steps	Train purchasing team to compare amount of carbon footprint for every domestic or international travel as published by the airlines or calculate using specific formula, procure the ticket, compile data and input into Emission Inventory Management System (EIMS) software, publish annually
Execution Plan	Organise awareness talk to High Level Management and Procurement Team, provide training to procurement staff for carbon evaluation and calculations,
Stakeholder In-Charge	Operator and All Tenants
Timeline	Ongoing



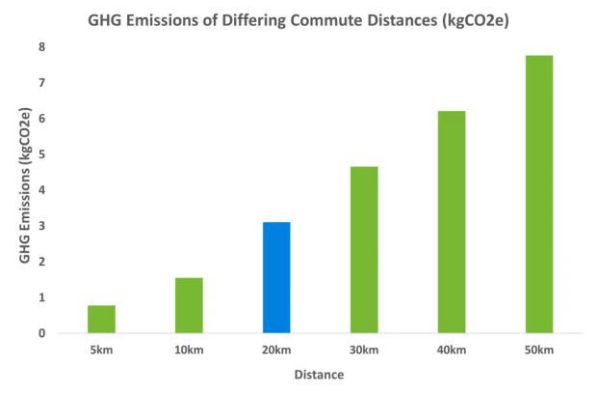


C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.3**
Specific Action	Change to Electric Vehicles (EV) for Operator and Tenants Owned Vehicles
Methodology	Prioritise on EV for any vehicle new purchasing or hiring
Detail Steps	Prepare bidding document, call for EV company to tender for company's car, van, bus, light equipment, truck and prime movers, select those meeting technical and commercial requirements, use and perform MRV
Execution Plan	Develop company policy for low carbon vehicle purchase or leasing, secure board endorsement and implement
Stakeholder In-Charge	Operator and Tenants
Timeline	Ongoing

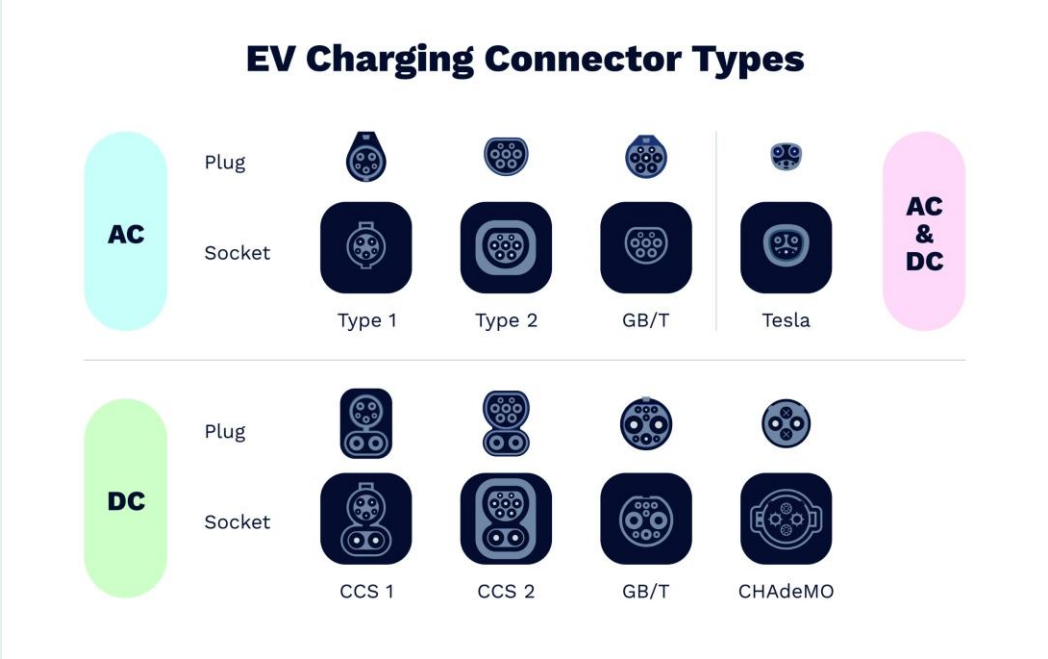
C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.4**
Specific Action	Public Transport for Staff Commute between home and Bintulu Port
Methodology	Incentivise staff of using public transport to work or provide alternative transport i.e. bus or van
Detail Steps	Prepare cost – value calculations to evaluate impact from the initiatives, introduce incentive i.e. RM50.00 TnG to staff commuted by public transport, or hire bus or van for staff transit
Execution Plan	Perform evaluation, decision by the top management to issue incentive or hire a vehicle, compile data over one year period, perform MRV and share the benefits.
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing



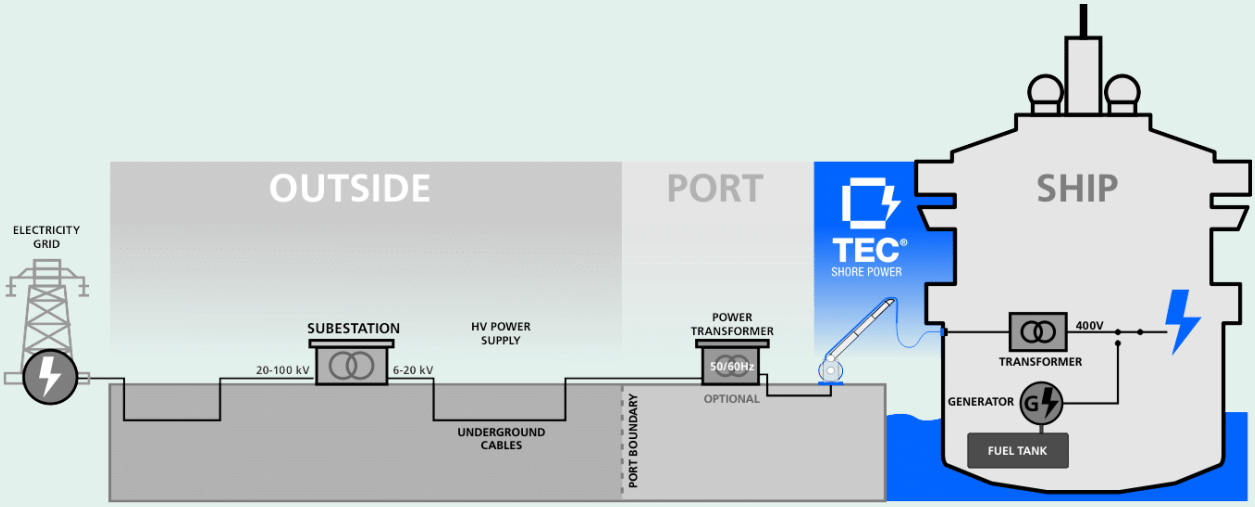
C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.5**
Specific Action	Install EV Charging Stations (EVCS)
Methodology	Perform feasibility study, install and use the most feasible
Detail Steps	Perform technical and commercial feasibility study with and without renewable energy source and locations, invite EVCS company to present their system, chose the one that meet all requirements, determine contract terms, install, commission, use and measure the emissions reduction.
Execution Plan	Study report and recommendations approved by top management, perform procurement, installation, commissioning, use and perform MRV
Stakeholder In-Charge	Port Operator
Timeline	Ongoing



C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.6**
Specific Action	Install Shore Power
Methodology	Perform feasibility study, install and use the most feasible shore power system
Detail Steps	Perform technical and commercial feasibility study with and without renewable energy source and locations, execute front-end engineering, call for tender, appoint qualified vendor, install, testing and commissioning and perform MRV
Execution Plan	Study report and recommendations approved by top management, perform procurement, installation, commissioning, use and perform MRV
Stakeholder In-Charge	Port Operator
Timeline	Ongoing



C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.7**
Specific Action	Use Biodiesel B20 Fuel for Diesel Powered Vehicles
Methodology	Include in Sustainable Transportation Policy, use and report
Detail Steps	Top management of Operator and All Tenants decide to use Biodiesel B20 to all owned and leased Diesel-powered vehicles, issue instruction to all drivers, use and perform MRV
Execution Plan	Organise talk to procurement team and the drivers about use and the benefits of Biodiesel, ensure daily usage, collect data, perform monthly and yearly MRV
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing

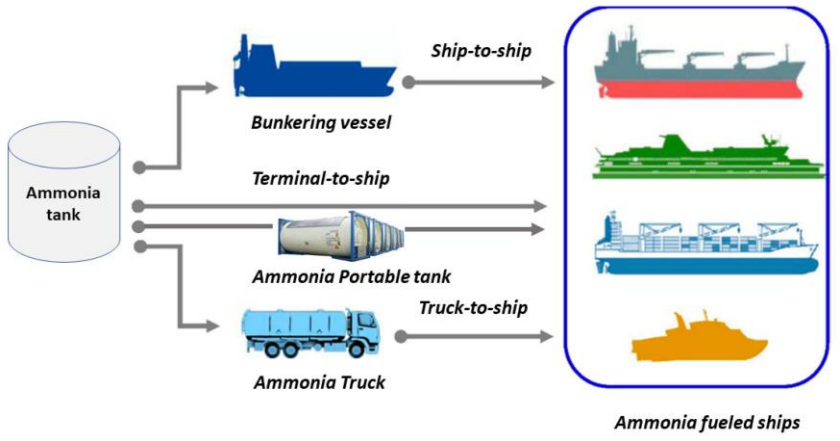
- The EPA's studies conclude that substituting traditional diesel with B20 results in;
  - diesel particulate reduced by approximately 10%,
  - carbon monoxide reduced by 11%
  - hydrocarbon emissions reduced by 21%.
- Supports local jobs and keep US $ in North America
- Increased lubricity & higher cetane number
- Reduces our dependence on Petroleum and foreign oil

C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.8**
Specific Action	Install LNG Refuelling Facilities
Methodology	Install LNG refuelling facilities with careful planning, infrastructure development, and adherence to safety regulations.
Detail Steps	Perform site selection & feasibility study to identify a suitable location within the port that meets safety and operational requirements, conduct environmental and economic feasibility studies, obtain necessary permits and approvals from maritime authorities, environmental agencies, and local governments, build LNG storage tanks, pipelines, and refuelling stations, use truck-to-ship (TTS) or ship-to-ship (STS) bunkering methods, Implement cryogenic leak monitoring, emergency shutdown systems, and operator training to ensure safe handling of LNG and establish LNG supply chains, train personnel, and integrate LNG bunkering into port operations.
Execution Plan	Starts with feasibility study, front-end engineering, call for bidding, appoint qualified EPCC company, implement EPCC contract.
Stakeholder In-Charge	Port Operator
Timeline	Ongoing

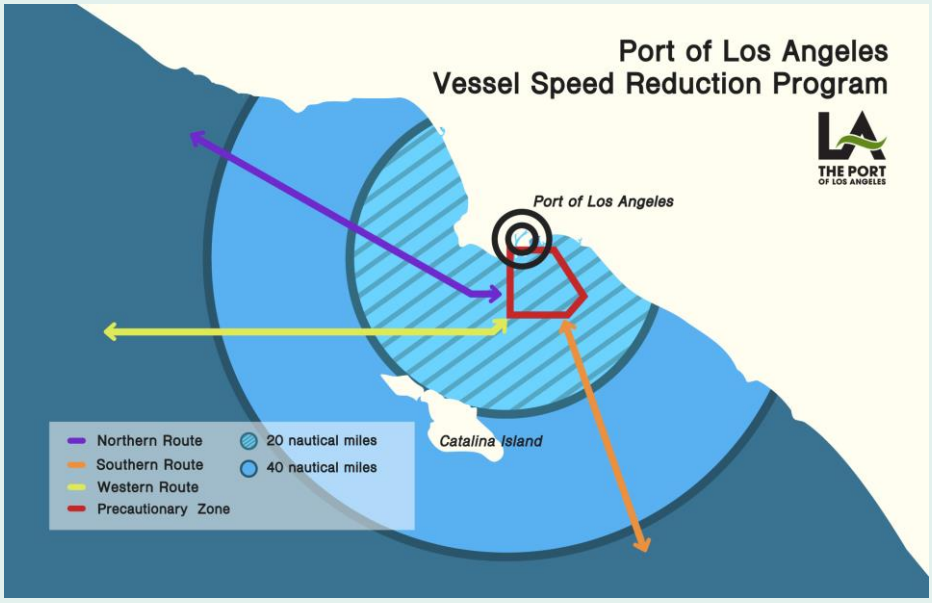
C.3 TRANSPORTATION

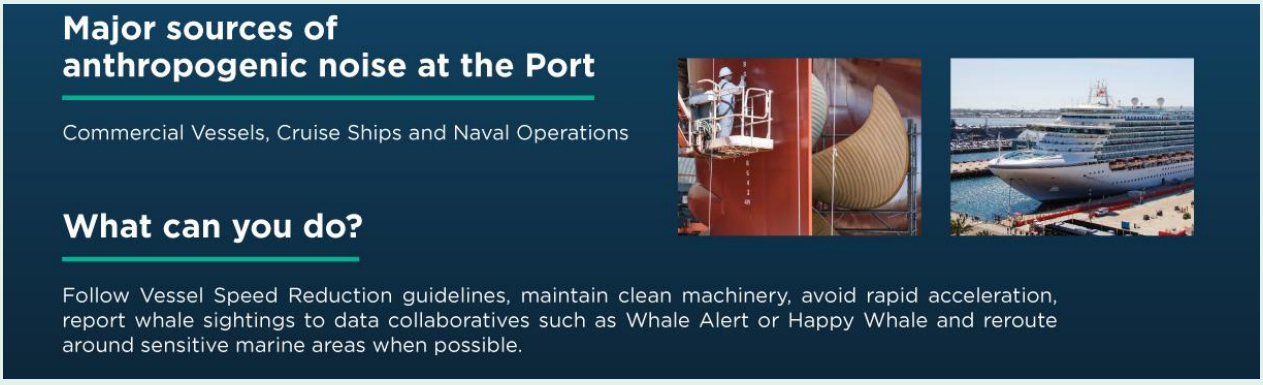
STRATEGY	**12.0**
ACTION	**12.9**
Specific Action	Install Green Ammonia Refuelling Facilities
Methodology	Starts with feasibility study, infrastructure development, safety compliance, supply change and equipped with operation strategy
Detail Steps	Perform feasibility study, identify suitable locations within the port for storage and refuelling, conduct environmental impact assessments and safety evaluations, ensure compliance with maritime regulations and port authority guidelines, construct storage tanks for green ammonia, ensuring proper insulation and safety measures, install bunkering stations with pipelines and transfer systems, develop safety protocols for handling ammonia, including emergency response plans, adhere to international maritime fuel standards, train personnel in ammonia handling and emergency procedures, implement monitoring systems for leak detection and risk mitigation, establish partnerships with green ammonia producers, develop efficient transportation methods for ammonia delivery, ensure seamless integration with existing port operations, regular inspections and maintenance of storage and transfer systems and optimize refuelling efficiency to minimize downtime for vessels.
Execution Plan	Starts with feasibility study, front-end engineering, call for bidding, appoint qualified EPCC company, implement EPCC contract
Stakeholder In-Charge	Port Operator
Timeline	Ongoing



C.3 TRANSPORTATION

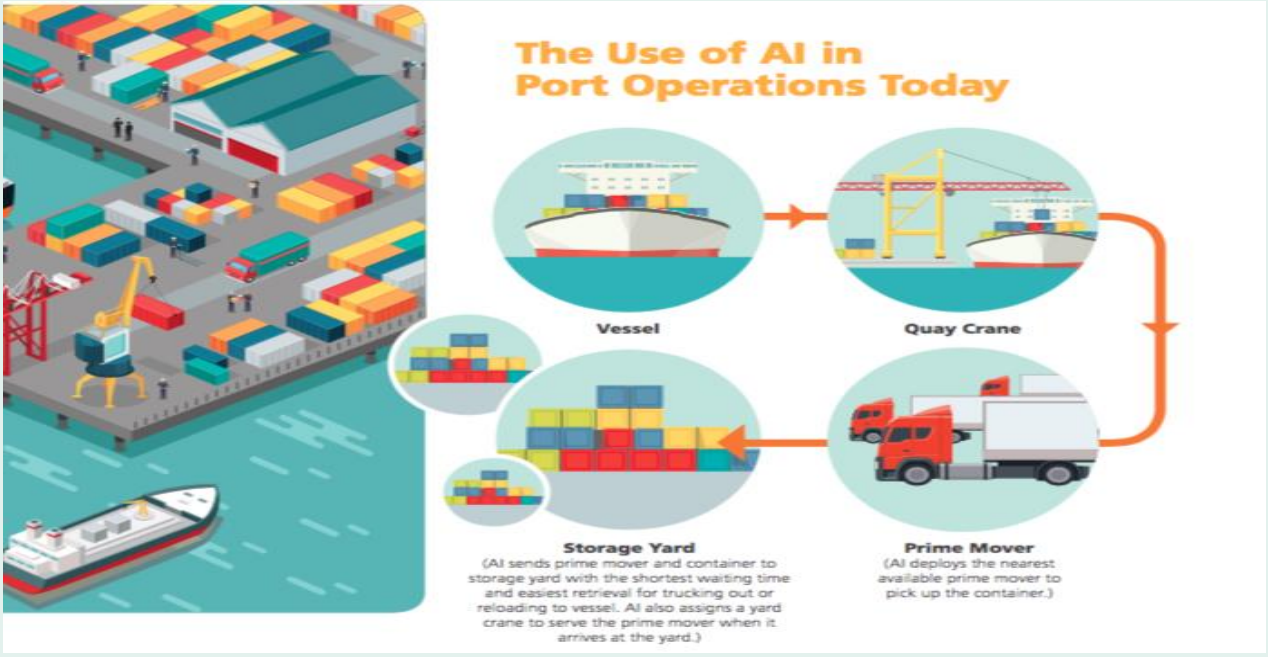
STRATEGY	**12.0**
ACTION	**12.10**
Specific Action	Vessel Speed Reduction (VSR) Program
Methodology	Identify VSR zone, set speed limit, monitor and assess impact
Detail Steps	Starts with defining the VSR Zone, establish a designated area around the port where vessels must reduce speed, set speed limits – determine appropriate speed limits based on vessel type. for example, container ships and cruise ships may be required to travel at 10 to 15 knots, encourage participation by offering financial benefits, such as reduced berthing fees for compliant vessels, use AIS (automatic identification system) data to track vessel speeds and ensure adherence to the program, measure reductions in fuel consumption and emissions to evaluate the program's effectiveness and enhance safety & marine protection.
Execution Plan	Benchmark with other Ports, establish the VSR program and announce
Stakeholder In-Charge	Port Operator
Timeline	Ongoing





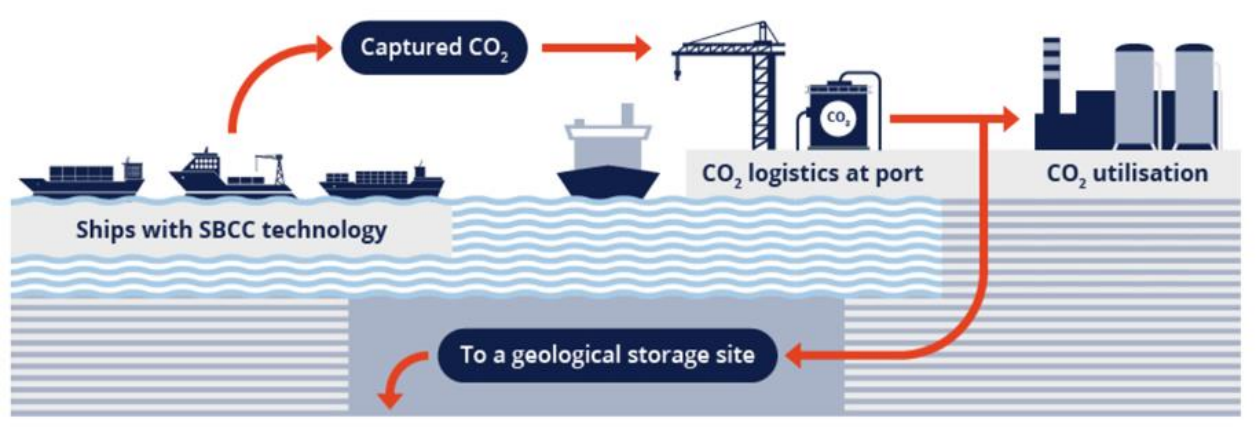
C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.11**
Specific Action	Apply AI for Port Operations
Methodology	Use AI to increase efficiency, reducing costs, and improving safety for Port operations
Detail Steps	Identify Key Areas for AI Integration, example; cranes and autonomous vehicles to streamline loading and unloading, to forecast equipment failures and schedule maintenance, enhance vessel scheduling, berth allocation, and yard planning to minimize congestion, enhance security by detecting unauthorized access or potential threats, optimize inventory management and route planning for smoother operations, collect real-time data, Implement cloud-based storage and edge computing for quick data processing, establish reliable 5G or fibre-optic connection, perform AI Technology selection, use Machine Learning (ML) models for predictive analytics, implement Computer Vision for automated container tracking and security monitoring, deploy Robotics & Automation for cargo handling and autonomous equipment operations, integration with existing systems, ensure AI solutions integrate with existing Terminal Operating Systems (TOS) and Enterprise Resource Planning (ERP), implement APIs for seamless data exchange between AI tools and legacy software, organise a small-scale pilot project to evaluate AI performance, train employees to work alongside AI-driven systems and ensure smooth transition.
Execution Plan	Starts with feasibility study, front-end engineering, call for bidding, appoint qualified AI & ML company, implement EPCC contract
Stakeholder In-Charge	Port Operator
Timeline	Ongoing



C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.12**
Specific Action	Develop CCS Support Facilities
Methodology	Establishing Carbon Capture and Storage (CCS) support facilities to handle the transportation and storage of captured carbon dioxide (CO_2) with EPCC method contracting procedures.
Detail Steps	To plan and develop dedicated CCS Hubs that integrate transport, storage, and injection infrastructure as key transit points for pipelines transporting CO_2 to offshore storage sites, install specialized storage tanks and handling systems for temporary CO_2 storage before transportation to the depleted oil and gas reservoirs or saline aquifers, which serve as permanent CO_2 storage sites and collaborate with steel, chemicals, cement, and power generation industries to support industries decarbonization programs.
Execution Plan	Starts with feasibility study, front-end engineering, call for bidding, appoint qualified EPCC company, implement EPCC contract
Stakeholder In-Charge	Port Operator
Timeline	Ongoing

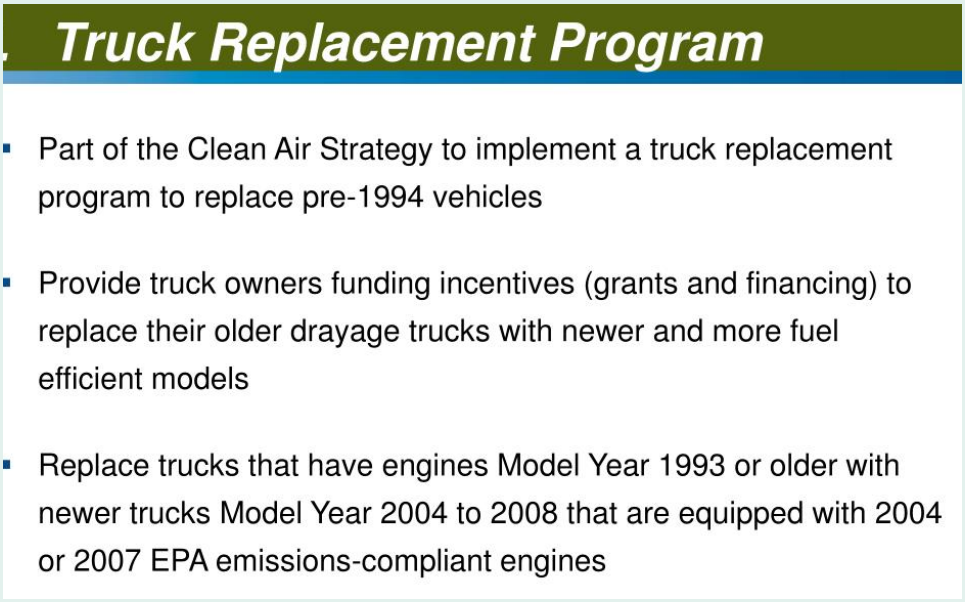


C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.13**
Specific Action	Study on the implementation of Maritime Autonomous Surface Ships (MASS) System
Methodology	To study Maritime Autonomous Navigation System with a combination of technological advancements, regulatory adaptation, and industry collaboration.
Detail Steps	To study the development of Maritime Autonomous Surface Ships (MASS) with AI-driven navigation, sensor fusion, collision avoidance, and situational awareness technologies, ensure regulatory compliance by adapting existing maritime laws like COLREGs, STCW, and SOLAS to accommodate autonomous operations, integrate human oversight with autonomy enhances efficiency and safety, human intelligence remains essential for oversight and intervention, enhance industry collaboration with partnerships between maritime organizations, AI developers, and regulatory bodies for MASS implementation
Execution Plan	Prepare terms of reference and decide to conduct in-house or hire a third party for study and execute the study, discuss the outcomes and decide the way forward.
Stakeholder In-Charge	Port Operator
Timeline	Long Term

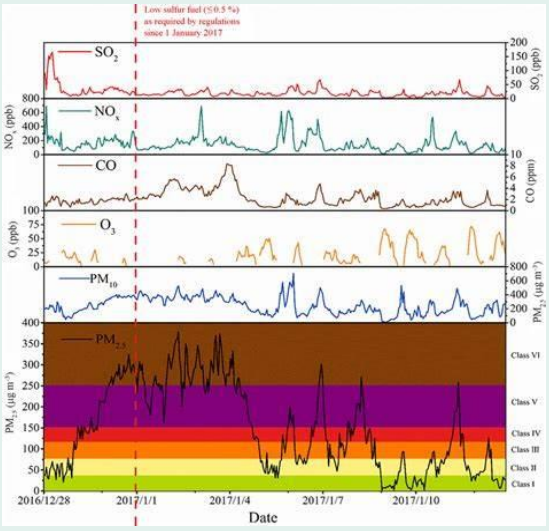
C.3 TRANSPORTATION

STRATEGY	**12.0**
ACTION	**12.14**
Specific Action	Truck Replacement Program (TRP)
Methodology	Launch marketing campaigns to inform truck owners, engage industry stakeholders for support and provide educational resources on the benefits of truck replacement.
Detail Steps	Determine the primary goals, identify the types of trucks eligible for replacement, set criteria for participation (e.g., age of trucks, frequency of use, emissions standards), explore government grants, subsidies, or private funding sources, offer financial incentives to truck owners for replacing older vehicles, consider tax benefits or rebates for participants, define requirements for truck owners, ensure compliance with environmental regulations, require scrapping of old trucks to prevent resale, create a streamlined application system for truck owners, set deadlines for submission and approval, implement a verification process to confirm eligibility, collaborate with truck manufacturers to provide cost-effective replacements, negotiate bulk purchase discounts, ensure new trucks meet modern emission standards, track replaced trucks to ensure continued use in the program, conduct periodic audits to prevent misuse, request reporting on environmental impact and fuel efficiency improvements.
Execution Plan	Define objectives & scope, secure funding & incentives, establish eligibility criteria, develop an application & approval process, partner with manufacturers & dealers, monitor & enforce compliance, request reporting on environmental impact and fuel efficiency improvements and promote awareness & participation
Stakeholder In-Charge	Port Operator
Timeline	Ongoing



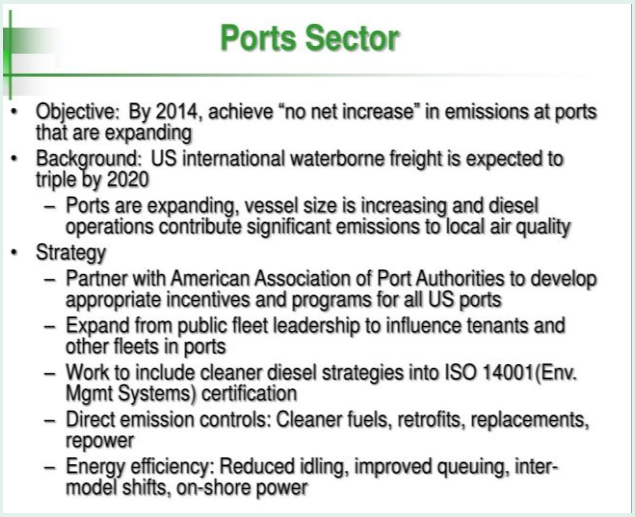
C.3 TRANSPORTATION

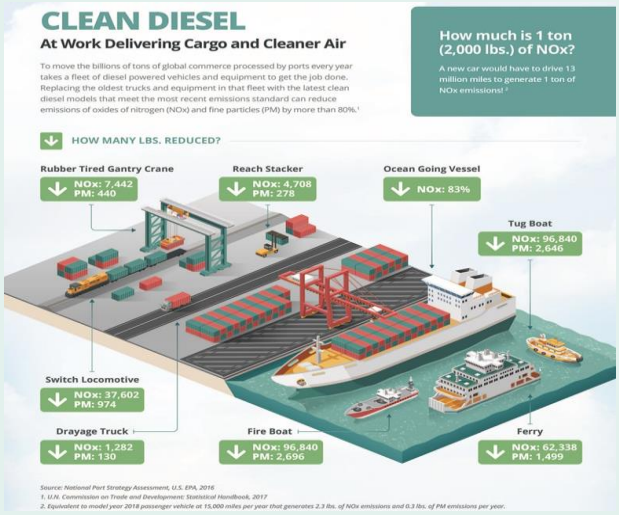
STRATEGY	**12.0**
ACTION	**12.15**
Specific Action	Congestion Mitigation and Air Quality Improvement (CMAQ) program
Methodology	Use Air Quality Sensor online data, identify pollutant sources, find solutions, implement and monitor progress
Detail Steps	Assess Air Quality data from air quality sensors, identify congestion issues, conduct an environmental impact assessment to identify emissions source from port activities, including trucks, ships, and cargo-handling equipment, identify congestion hotspots affecting traffic flow in and around the port, focus on projects that reduce emissions and improve traffic flow, examples include; electrification of port equipment (e.g., replacing diesel-powered cranes with electric ones), truck idling reduction programs (installing shore power for trucks waiting to load/unload), improved freight movement (dedicated truck lanes, optimized scheduling to reduce bottlenecks), alternative fuel adoption (using LNG or hydrogen-powered vehicles), public transit connections for port workers to reduce single-occupancy vehicle trips, find funds are available for nonattainment and maintenance areas that do not meet air quality standards, work with state and local transportation agencies to apply for funding, ensure projects align with Malaysia clean air act requirements, check real-time air quality systems to track improvements, use data analytics to optimize traffic flow and reduce congestion, engage with local communities to ensure transparency and support, submit reports to port authority to demonstrate progress and adjust strategies based on performance metrics and feedback.
Execution Plan	Use data from air quality monitoring sensors, identify congestion issues, develop a CMAQ project plan, secure CMAQ funding, implement & monitor, perform MRV and improvement plan.
Stakeholder In-Charge	Port Operator
Timeline	After BPA's Air Quality Sensors in operations



C.3 TRANSPORTATION

STRATEGY	13.0
Goal	Diesel Emissions Reduction Program (DERP)
Approach	Incentivise the initiatives
Vision	Minimum environmental impact from use of diesel
Potential Challenges	Diesel rate still cheap
Navigation Plan	Explore latest efficient technology to reduce costs and emissions
ACTION	13.1
Specific Action	Starts with awareness of the Program (DERP), create eligibility criteria and funding, identify technologies, prepare project planning and compliance, prepare application process, implementation and perform MRV
Methodology	Study and research on new diesel emissions reduction technology
Detail Steps	Develop Diesel Emissions Reduction Program (DERP), provides funding to reduce harmful emissions from diesel engines, retrofitting, replacing, or upgrading diesel engines to cleaner alternatives, create eligibility criteria and funding, select technologies that supports various emissions reduction strategies, such as exhaust controls, idle reduction technologies, engine repowers, and cleaner fuel use, develop a project plan that aligns with DERP goals and meets regulatory requirements including assessing environmental impact and ensuring compliance with emissions standards, prepare application process for to submit proposals detailing their plans, expected outcomes, and budget considerations and evaluates applications based on their potential to reduce emissions effectively, ensure projects executed efficiently, with ongoing monitoring to measure emissions reductions and ensure compliance.
Execution Plan	Form a team to study
Stakeholder In-Charge	Port Operator
Timeline	Ongoing



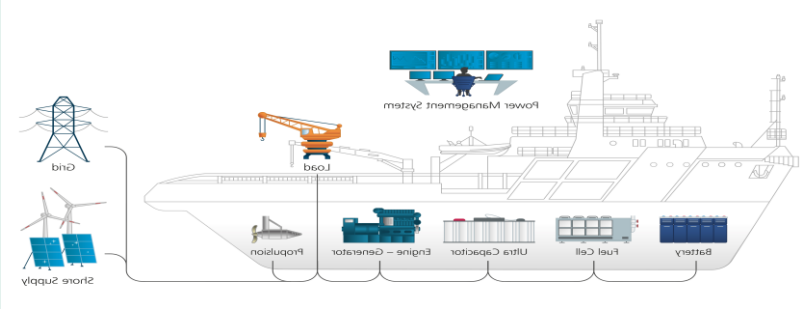


C.3 TRANSPORTATION

STRATEGY	**14.0**
Goal	Decarbonising Dredging Works
Approach	Refining dredging practices to minimize emissions and environmental impact.
Vision	Adopt sustainable development in dredging works
Potential Challenges	Argument about operational efficiency, regulatory compliance, technology, sufficient onshore power supply and supply chain adjustments.
Navigation Plan	Optimizing dredging operations to reduce fuel consumption and emissions while maintaining effectiveness, navigate evolving environmental regulations and international decarbonization targets, which can be fragmented and challenging to implement, implementing new technologies such as electric dredgers, biofuels, and AI-driven efficiency improvements requires research, development, and financial commitment, providing sustainable energy sources for docked dredging vessels to minimize emissions during idle periods is a logistical challenge, ensure maritime ecosystem, including shipping and port operations adapt to new fuel types and sustainability measures.
ACTION	**14.1**
Specific Action	Optimizing dredging operations by using dredged material beneficially, designing efficient port infrastructure to reduce transport emissions and leverage on renewable energy supply.
Methodology	Simulation modelling and technology selection to optimise dredging emission
Detail Steps	Using navigation simulations to model ship movements can help define dredging areas more precisely. Reduce unnecessary dredging, using dredged material and repurposing for environmental benefits, such as habitat restoration, minimizing construction materials and incorporating biodiversity into port structures can lower carbon footprints, relocating dredged material to the shortest practical distance can significantly cut emissions and generate renewable energy on-site to power dredging operations.
Execution Plan	Perform internal research and study team, prepare terms of reference, appoint Consultant, study outcomes and decide on implementation plan.
Stakeholder In-Charge	Port Operator
Timeline	Ongoing

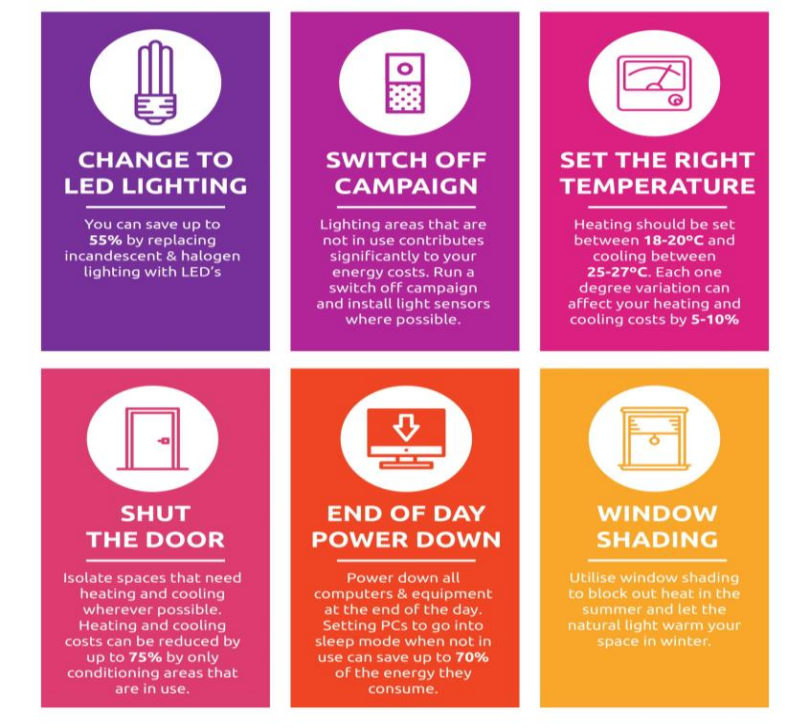
C.3 TRANSPORTATION

STRATEGY	**15.0**
Goal	Electrification of Ships
Approach	Implement in phases involves replacing traditional diesel engines with electric propulsion systems powered by batteries or hybrid solutions.
Vision	Transforming from around 80% of current ocean-going vessels using hybrid diesel-electric systems to fully electric ships.
Potential Challenges	Issues of battery limitations, infrastructure readiness, economic viability, regulatory and safety concerns and operational constraint.
Navigation Plan	Prepare a port upgrading plan to support charging stations and power grids capable of handling large-scale electrification, enhanced Maritime regulations to accommodate electric ships, and safety measures must be to prevent battery-related hazards and priority and short-to-medium-range routes.
ACTION	**15.1**
Specific Action	Assessing vessel suitability and choosing the right battery technology, installing electric propulsion systems, setting up charging infrastructure – shore-based charging stations, integrating Energy Management Systems (EMS) and regulatory compliance
Methodology	Feasibility studies and battery system assessment to support ship electrification
Detail Steps	Assessing Vessel Suitability. Those operating on short routes, like ferries and tugboats, are ideal candidates for full electrification, check alternative battery technologies to improve efficiency and sustainability, check electric motors replace conventional engines, reduce emissions and improve energy efficiency, develop shore-based charging stations to support fast and efficient battery recharging, apply advanced EMS optimize battery usage and ensure smooth operation, meeting international maritime electrification standards, including emissions reduction targets set by the IMO.
Execution Plan	Perform feasibility study, prioritise short-to-medium ranges vessel, install shore power, implement MRV
Stakeholder In-Charge	Port Operator
Timeline	Long term



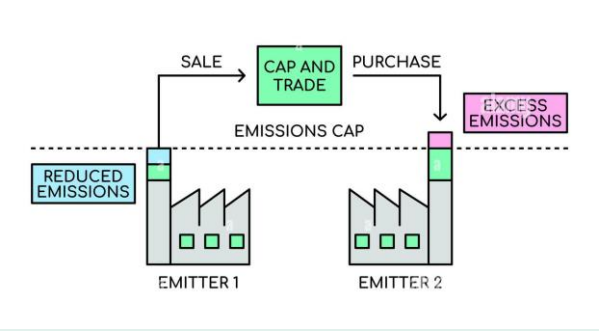
C.4 BUILDINGS AND FACILITIES

STRATEGY	**16.0**
Goal	Existing Building Decarbonization to Low Carbon Building Operations.
Approach	Start with simple initiatives, no-cost and immediate result.
Vision	Existing buildings operate in a sustainable way.
Potential Challenges	Buy-in and actions for conservation initiatives may take a long period.
Navigation Plan	Regular update and considered as a top management meeting agenda.
ACTION	**16.1**
Specific Action	Establish a baseline, apply green building practices and perform annual MRV.
Methodology	Share knowledge and skills, implement and measure impact
Detail Steps	Establish a baseline for electricity, fuels and gases used, apply green building practices; conserve use of energy and water, apply 3R for waste management, replace them with highly efficient office equipment, maximize natural sunlight and ventilation, measure monthly impacts, prepare annual MRV.
Execution Plan	Arrange regular talks and skills training on energy conservation initiatives, prepare electricity, water and waste baselines, prepare and apply duty roaster for a start, measure impact on a monthly basis, share results with entire staff, perform MRV.
Stakeholder In-Charge	BPA and All Agencies' team
Timeline	Ongoing



C.4 BUILDINGS AND FACILITIES

STRATEGY	**17.0**
Goal	By 2026 All New Buildings and Facilities comply with carbon cap regulations
Approach	Implement Carbon Cap regulations
Vision	All New Buildings and Facilities are Low Carbon by 2030
Potential Challenges	Late national and state regulations on carbon cap
Navigation Plan	Emphasise on commercial and health benefits from low carbon building and facilities
ACTION	**17.1**
Specific Action	Develop a carbon cap procedure
Methodology	Organise a workshop with all stakeholders, determine relevant carbon cap value and implement.
Detail Steps	Prepare a concept paper and present it to the top management. If approved, proceed to call for a workshop with all relevant stakeholders, prepare a conclusion paper and present to top management for endorsement, implement, monitor and prepare MRV annually.
Execution Plan	Documentation and regulation ready by end 2025 for implementation in 2026 onwards
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing process



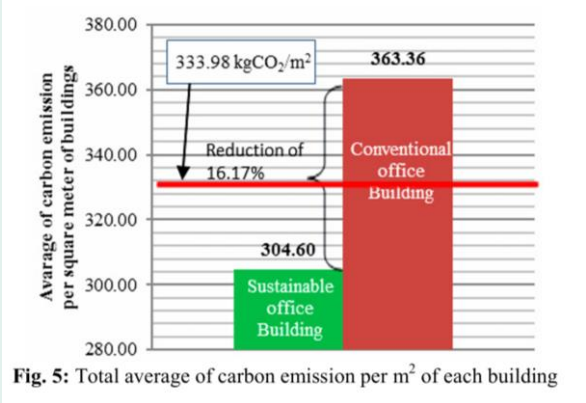


Fig. 5: Total average of carbon emission per m^2 of each building

C.4 BUILDINGS AND FACILITIES

STRATEGY	**18.0**
Goal	Low Carbon Construction Comments in 2026
Approach	Education to all stakeholders in supply chain
Vision	Net zero in all phases of built environment
Potential Challenges	Big knowledge, skills, capability and attitude gaps in the construction industry
Navigation Plan	To plan and execute more intensive knowledge, skills and capacity building programs
ACTION	**18.1**
Specific Action	Develop BPA's Low Carbon Construction Procedures
Methodology	Develop procedure with input from all stakeholders and apply
Detail Steps	Assemble a Technical team, prepare terms of reference, organize a workshop with all stakeholders in the built environment supply chain for feedback, conclude recommendations, prepare the procedures and present them to the management for approval.
Execution Plan	Procurement team will include the procedure as part of the tender document and agreement with all Consultants, Contractors, Suppliers and Vendors
Stakeholder In-Charge	Port Operator and Tenants
Timeline	To use the procedures 2026 onwards

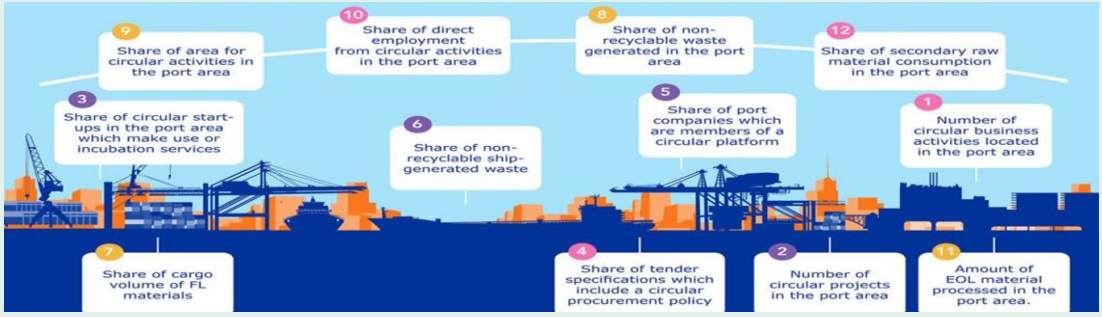
C.5 WASTE

STRATEGY	**19.0**
Goal	Sustainable Waste Management
Approach	Apply multiple techniques to minimize environmental damage
Vision	Port is free from oil spillage and hazardous waste
Potential Challenges	Issues on scale and environmental impact, oil characteristic, containment limitations, port structures, operational disruptions, cost and time and regulatory compliance
Navigation Plan	Plan for clean-up efforts, work around normal port operations and comply with environmental regulations that govern clean-up methods.
ACTION	**19.1**
Specific Action	Apply multiple methods for oil removal and water cleaning; booms, skimmers, sorbents, dispersants, high-pressure washing, bioremediation and or oily water separators
Methodology	Develop Sustainable Waste Management procedures, empower staff with knowledge and skills, and perform simulation exercises.
Detail Steps	Apply floating barriers to contain the spread of oil, preventing contamination of sensitive areas like shorelines and wetlands or machines that skim oil from the water surface, separating it for recovery and disposal or materials that absorb oil, making clean-up easier or chemicals that break up oil slicks into smaller droplets, allowing natural degradation or controlled burning of oil on the water surface to reduce the spill volume or using microorganisms to break down oil naturally or equipment onboard ships that separate oil from water before discharge.
Execution Plan	Equipped relevant staff with required knowledge and skills
Stakeholder In-Charge	Port Operator and Tenants
Timeline	To use the procedures 2026 onwards




C.6 CIRCULAR ECONOMY

STRATEGY	20.0
Goal	To shift away from the traditional linear model and create a system that reduces waste, promotes resource efficiency, and encourages recycling and reuse.
Approach	Implementing closed-loop production systems, industrial symbiosis, and sustainable energy management in port operations.
Vision	Making Port Industries 100% Circular
Potential Challenges	Current multiple obstacles, namely, economic and financial barriers, organizational and cultural resistance, technical and technological, regulatory and governmental constraints, supply chain infrastructure and spatial market demand and consumer behaviour.
Navigation Plan	Explore low investment and good financial returns for companies transitioning to circular systems, developing efficient recycling, waste management, and sustainable energy solutions with advanced technology, develop policies and regulations to support circular economy initiatives, removing legal and bureaucratic hurdles, coordinating circular supply chains across multiple stakeholders, including logistics providers and manufacturers, redesigns processes to accommodate closed-loop material flows and sustainable energy systems.
ACTION	**20.1**
Specific Action	Explore circular chemistry possibility, carbon capture & storage (CCS) spill over, water reuse and exchange option, apply waste-to-value approach, renewable energy integration and digitalization, and smart logistics for circular economy initiatives.
Methodology	Starts with in-house study, expand to port boundary and port business eco-system.
Detail Steps	Studies on opportunities to reuse raw materials instead of relying on fossil-based inputs, converting plastic waste into chemical building blocks, capturing CO_2 emissions and repurposing them for industrial use, mapping industries to share recycling water resources to reduce waste, transforming residual flows into valuable materials through recycling and bio-based raw material processing, using hydrogen, solar, geothermal, and biomass to power port operations and implementing blockchain and IOT for efficient material tracking and waste reduction.
Execution Plan	Form a circular study team consisting Port Authority, agencies, operators, tenants and supply chains, research and learn from other ports, example Antwerp-Bruges and Rotterdam.
Stakeholder In-Charge	Port Operator and Tenants
Timeline	Ongoing



OPERATOR AND TENANTS INITIATIVES (SECTION C): ESTIMATED REDUCTIONS

Initiative	Type	Reduction Basis	Est. Reduction by 2030 (tCO_2e)	% of 2023 Baseline	Notes
C.1 Governance & engagement	Enabler	N/A	N/A	N/A	ESG reporting, MoUs
C.2 Smart grid / demand response	Enabler	N/A	N/A	N/A	Post-2030 enabler
C.2 Solar PV (on/off-site)	Technology	Scope 2	944	1.8%	PPA potential
C.2 Smart energy management	Efficiency	Scope 2	63	0.12%	EMS rollout
C.3 Hybrid RTGs	Technology	RTG diesel	687	1.3%	25% fuel cut assumed
C.3 Electric/Hybrid TTs & RSs	Technology	TT + RS diesel	372	0.7%	30% fleet by 2030
C.3 HDV logistics optimisation (AI)	Ops/IT	HDV fuel	1,225	2.4%	Slotting & routing
C.3 HDV biodiesel (B20–30)	Fuel switch	HDV	613	1.2%	5% net cut
C.3 Harbour craft ops optimisation	Ops	Harbour craft	266	0.5%	Speed & planning
C.3 Harbour craft biofuel	Fuel switch	Harbour craft	133	0.26%	Supply dependent
C.3 OGV at-berth ops / partial OPS	Ops/Infra	OGV hoteling	300	0.6%	5–10% of OGV CO_2
C.4 Circular economy (biomass pallets)	Waste	Subset ops	100–150	<0.3%	Niche but symbolic
C.5 MRV & data systems	Enabler	N/A	N/A	N/A	No direct cuts
C.6 Policy alignment & partnerships	Enabler	N/A	N/A	N/A	Strategic consistency
C.12 Green bunkering (20% uptake)	Fuel infra	OGV fuel	225	0.4%	Early facilities

Subtotal operators/tenants: 4,828 tCO_2e (9.3% of baseline)

COMBINED PATHWAY

The combined pathway for Bintulu Port, presented below, brings together all initiatives from both BPA's own operations and those of operators and tenants. It distinguishes between short-term, low-hanging and already declared measures, and the deeper cuts achievable with regulatory and financial support. This dual-scenario approach ensures transparency: it shows what is realistically achievable with current resources (14% reduction by 2030), and what level of ambition can be reached if enabling conditions are in place (30% reduction by 2030). Both pathways are measured against the fixed 2023 baseline of 52,037 tCO_2e and provide a consistent trajectory towards the long-term goal of 95% reduction by 2050.

COMBINED PATHWAY (2030 REDUCTIONS vs 2023 BASELINE)

Category	Key Initiatives	2030 – Low-hanging & declared	% of baseline	2030 – Policy-enabled ambition	% of baseline
BPA (own operations)	Building efficiency, EVCS & light fleet electrification, biodiesel (B20), employee commute	528 tCO_2e	1.0%	600 tCO_2e	1.1%
Operators – Energy	Solar PV (on/off-site), smart energy management	1,007 tCO_2e	1.9%	1,730 tCO_2e	3.3%
Operators – Cargo Handling	Hybrid RTGs, electric/hybrid terminal tractors & reach stackers	1,059 tCO_2e	2.0%	1,307 tCO_2e	2.5%
Operators – Heavy Duty Vehicles	AI logistics optimisation, idling control, routing, biodiesel (B20–B30)	1,838 tCO_2e	3.5%	2,451 tCO_2e	4.7%
Operators – Harbour Craft	Pilot boats on shore power, speed/ops optimisation, biofuel blends	458 tCO_2e	0.9%	665 tCO_2e	1.3%
Operators – OGV at berth	AI-driven berth efficiency, reduced hoteling, partial OPS	300 tCO_2e	0.6%	369 tCO_2e	~0.7%
Operators – Circular economy	Biomass pallets, waste minimisation	125 tCO_2e	0.2%	150 tCO_2e	~0.3%
Operators – Green bunkering	Green fuel bunkering facilities (20–40% uptake of calls by 2030)	225 tCO_2e	0.4%	450 tCO_2e	0.9%

- **Low-hanging & declared:** 7,298 tCO_2e (14%)
- **Policy-enabled ambition:** 16,000 tCO_2e (30–31%)

All reductions are expressed relative to the 2023 baseline. Absolute emissions will vary from year to year with throughput, but percentage reductions remain benchmarked to this fixed baseline.

Beyond 2030, Bintulu Port Authority does not set absolute reduction percentages independently of national policy. Malaysia's commitment under the Paris Agreement is framed in terms of carbon intensity reduction (45% reduction in emissions intensity of GDP by 2030 relative to 2005), and the Government has expressed a net-zero aspiration for 2050. Accordingly, the AERS presents a progressive trajectory aligned with these national commitments, while recognising that specific long-term absolute reduction percentages will depend on future policy decisions, regulatory frameworks, and technology adoption pathways at the national level.

Strategic Emission Reduction Trajectory (2030 – 2050)

Year / Phase	Key Measures & Enablers	Approximate Reduction vs 2023	Notes
2030 (short–mid term)	Declared initiatives (energy efficiency, B20–B30 adoption, hybrid RTGs, electrification of terminal equipment, solar PV, OPS pilots, pilot boats on shore power)	14% (declared) / 30% (with support)	Already identified in AERS; requires regulatory & financial support for 30% scenario
2040 (scale-up)	Port-wide OPS deployment, >50% of vessel calls on green fuels (methanol, ammonia, LNG-hydrogen blends), smart grid integration, electrified HDVs, widespread circular economy measures, early CCS pilots	70%	Assumes technology cost reduction + enabling policies; aligned with IMO decarbonisation trajectories
2050 (end state)	Full green bunkering infrastructure, near-100% OPS coverage, majority OGVs on zero-carbon fuels, full electrification/hydrogen HDVs & CHE, CCS/circular economy for residuals	95%	Residual 5% addressed through offsetting and negative emissions options

D. CONCLUSION

The Air Emission Reduction Strategy (AERS) provides Bintulu Port with a clear framework to reduce greenhouse gas emissions in line with national and international expectations. Building on the 2023 baseline of 52,037 tCO_2e, the Strategy identifies a dual pathway toward 2030: approximately 14% absolute reduction from declared measures, and up to 30% reduction with stronger regulatory and financial support. In parallel, the AERS aspires to a 45% reduction in carbon intensity (tCO_2e per tonne throughput) by 2030 relative to the 2023 baseline intensity of 0.00074, consistent with Malaysia's Nationally Determined Contribution (NDC).

Looking beyond 2030, the AERS sets out a progressive trajectory aligned with Malaysia's national net-zero aspiration by 2050. Achieving this outcome will depend on scaling measures such as green fuel adoption, expansion of OPS (Onshore Power Supply), smart grid integration, circular economy practices, and potential deployment of carbon capture and other emerging solutions. The Strategy emphasises that long-term absolute reduction percentages will ultimately depend on national policy decisions, international regulatory frameworks, and the pace of technology adoption.

Through this approach, the AERS positions Bintulu Port as a proactive and responsible actor in Sarawak's and Malaysia's sustainability journey. By combining near-term achievable reductions with a long-term aspirational pathway, the Strategy ensures that Bintulu Port strengthens its competitiveness, enhances stakeholder confidence, and contributes meaningfully to collective climate goals while safeguarding resilience and operational excellence for the decades ahead.