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LEMBAGA PELABUHAN BINTULU



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

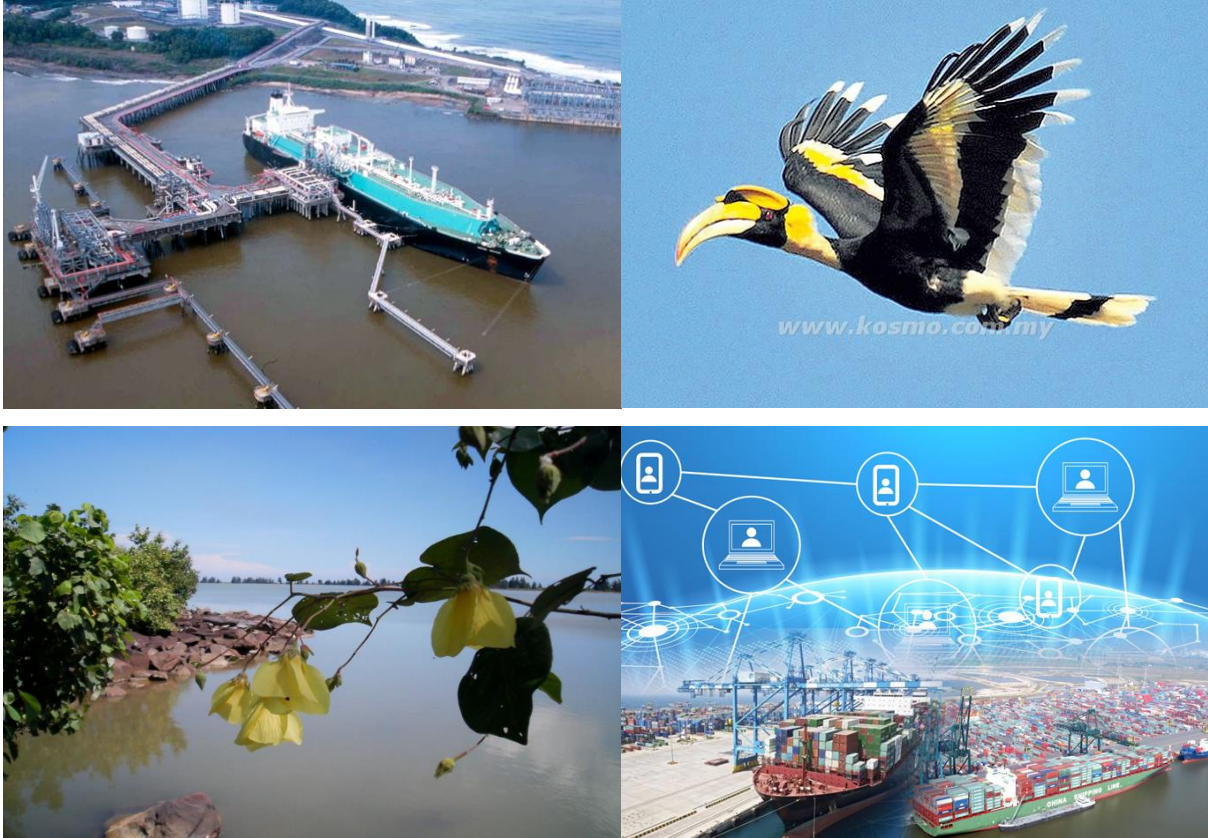
**FINAL BINTULU SMART DIGITAL GREEN PORT
BLUEPRINT REPORT**

Prepared by:

International Green Training Centre Sdn. Bhd.

Date:

26th October 2018



Bintulu
Smart Digital Green Port
Blueprint 2023

Bintulu SDGP Blueprint

is a long-term plan, developed in consultation with all stakeholders that provides direction for the Port Authority to realize sustainability objectives it has for the environmental, social and economic dimensions of its identity. Focus Group Discussions is part of the process of developing the SDGP Blueprint, particularly in the development of a long-term Bintulu Port vision looking 12 years into the future. SDGP demand that new dimensions be considered in the planning process while continuing to meet stakeholder' needs. Rooted in the concept of sustainability make environmental sustainability, economic sustainability and social sustainability the cornerstones of port planning. Preparing for future port, SDGP also embarked into new digital technology, IoT, Big Data, Blockchain and Cloud computing implementation process.

FOREWORD BY MINISTER OF TRANSPORT MALAYSIA



Figure 1 Image of YB Loke Siew Fook, Minister of Transport, Malaysia

- ✓ Malaysia commit 40 & 45% carbon intensity reduction by 2020 & 2030
- ✓ Commit to reduce carbon footprint from transport sector in Biennial Update Report to UN
- ✓ Commit SDG
- ✓ Malaysia a member to IMO
- ✓ All federal ports to be green port
- ✓ Blockchain is internet2, so port need to prepare
- ✓ MOT is serious and working closely with MESTECC, MOHR
- ✓ In line with IR4.0
- ✓ Bintulu to be catalyst for other ports to be SDG
- ✓ Bintulu strategic position; centre of Asian, support BIMP-EAGE,
- ✓ Many benefits; Economy, environment and people

MESSAGE FROM GENERAL MANAGER OF BPA



Figure 2 Image of Tuan Haji Zulkurnain bin Ayub, General Manager of Bintulu Port Authority

The worldwide push to go green is an important aspect in preserving and protecting our environment. The initiative to embark on the Green Port Project Storm from awareness to immense ourselves with the global effort to address climate change, and adopt the SDG goals are most pertinent to the port and the local community. At this moment, the level of awareness and the commitment is rather low and that's not surprising. For profit – drive entity investing in green, needs more persuasion to convince people to invest and develop green initiative, it's hard and challenging because the return of investment is not immediate and some of the benefits are intangible. People cannot relate how the work in Green Port benefits the community, the world population and the planet.

The port systems have been identified as major energy consumers. They represent the systems that have difficulty in the adaption of innovative solutions with regard to energy savings and energy efficiency. The most of port systems are using the outdated technology for the measurement of energy consumption and because of the mentioned facts they do not contribute to energy efficiency, environmental protection and sustainable development. The establishment of this study is one of the strategies to transform Bintulu Port into Smart Digital Green Port which is more efficient. This is in line with the ministry's aspiration to make all Federal Ports become a Green Port.

The idea of having the prefix of Smart Digital is to leverage on technologies, IoT and Big Data in implementing the Green Port actions. We believe that there is significant values in our project and must be shared to realise the full benefit of the project.

Going smart will also makes the project efficient and cost effective. I believe that the collected data has its own value and useful for port development in the future. Future port development shall put sustainability at the forefront and incorporated in the planning.

It reduces requirement for additional resources and not burden the organization to undertake these new tasks which some considered as non – core business or activities. IoT is here today and its present opportunities for BPA to embrace and apply in all aspects, the whole length and breadth of Bintulu Port. Partial application of IoT won't be effective and won't help Bintulu Port to be Smart Green Port.

It will take time and I hope the development of The Smart Digital Green Port Blueprint Project will be the springboard to start the journey in making Bintulu Port truly, full-fledged green port in the next 5 years.

There will be obstacles and challenges to try to win over the hearts of the Green Port sceptics within and outside the organization but this is normal. I expect The Blueprint will provide the information and answers. The Blueprint must be presented in SMART terms which is S – for Specifics, M – Measureable, A – for Achievable, R – for Readshe and T – for Time Bound.

We take this opportunity to express our hope that this framework will be an important step in our efforts to improve the quality of port services.

On the other note, many thanks to Bintulu Port Sdn Bhd for supporting us to make this study successful.

Last but not least, it is my wish that this study would be able to give positive impact on everyone involved directly or indirectly.

ACKNOWLEDGEMENT

The Bintulu Smart Digital Green Port blueprint is the culmination of countless hours of work, as well as invaluable expertise, leadership and creativity offered by various organizations and individuals. It is with great appreciation that we recognize all who are playing a role in building a future sustainable port and our planet.

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ABSTRACT

157 years ago, Bintulu was just a small fishing village in Sarawak. However, in 1867, they created history when the first General Council meeting or now known as Sarawak State Legislative Assembly and earliest General Council meeting held in Malaysia was convened in Bintulu. Now Bintulu Port is known as the largest LNG export terminal in the world. Located strategically at the centre of the Peninsular Malaysia – Singapore – Sarawak – Brunei - Sabah shipping routes and along the busy sea trade route between Far East and Europe gives big advantage to Bintulu Port. Bintulu Port Authority now envisages to create another history with mission to the first full-fledged green port in Malaysia by 2023 and full-fledged digital and carbon neutral port in Asia by 2030.

Growing concern about institutional obligations to address the climate change and the same time to grow business competitively with less negative impact to environment, motivated Bintulu Port Authority to start the strategy to transform into smart digital green port by establishing the blueprint. This afford is in line with the Ministry of Transport's aspiration to make all Federal Ports as green ports. The smart digital green port blueprint development is timely, considering current ICT technology on IoT and Big Data as well as Industry Revolution 4.0 and their application in maritime industry. This blueprint also in line with the State of Sarawak's mission for digital economy implementation 2018 - 2022.

SDGP blueprint provide guidelines on how to implement all the actions with clear strategic direction, objectives and expected outcomes. Strategic direction explains about logistic frameworks, industry trends and movements and critical supply chain which includes winning points such as strategic location, port efficiency, adequate infrastructure, connectivity and range of services provided. Recent demand for LNG as an alternative green fuel and LNG Gassing Up and Cooling Down (GUCD) services offered at Bintulu Port is considered as new strategic direction where more vessel operators and owners will be calling to Bintulu Port in future.

The SDGP blueprint explains about 16 indicators for qualification as green port and 4 main pillar criteria and 32 sub-criteria for smart digital green port; operations pillar, energy consumptions pillar, environment pillar and, organisation and management pillar. SDGP implementation plan explains about role and functions of sustainability team as the project manager for SDGP blueprint. Sequence of actions are shown for easy implementation, monitoring and reporting of SDGP programs and projects. A cockpit chart explains about overall plan and strategy to achieve those mentioned targets. A list of potential projects is included for reference. The proposed projects may or may not be implemented subject to further feasibility study to be conducted by the sustainability team. Guides for monitoring and measuring success of SDGP highlights about measurement criteria, individual project report annual Sustainability Report to be prepared according to GRI standards.

The SDGP blueprint also highlights about benefits of port digitalization programs which covers time savings and transparency of conducts, structured and efficient documentation management, potential door-to-door tracking, and improvement in analytics exercise, better operational integration management, and reduced impact to climate change due to higher efficiency.

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1.0 INTRODUCTION

1.1 History and the Significance

The History

The name of Bintulu was derived from the local native language "Mentu Ulau". Bintulu was a small fishing village when Rajah James Brooke acquired it in 1861. Brooke later built a fort there in 1862. In 1867, the first General Council meeting (now Sarawak State Legislative Assembly) was convened in Bintulu. It is the earliest state legislature system in Malaysia. Bintulu remained a fishing village until 1969 when oil and gas reserves were discovered off the coast. Since then, Bintulu has become the centre of energy intensive industries such as a Malaysia LNG plant, a Shell Middle Distillate Synthesis plant, and a Bintulu combined cycle power plant. The economy has also expanded into oil palm and forest plantations, palm oil processing, wood-waste processing, and cement manufacturing.

Bintulu Port is located in Tanjung Kidurong, Sarawak and occupied an area of 82 hectares, built along side with the development of Malaysia Liquefied Natural Gas plant. On 8th July 1978, the Bintulu Development Authority (BDA) was established by the State government of Sarawak for infrastructure development administration and to promote industrial investment in the area. On 15th August 1981, the Bintulu Port Authority was established at Tanjung Kidurong and started operation on 1st January 1983. Liquefied natural gas are exported to Japan and other countries via Bintulu Port. With the development, administration, marketing and provision of adequate and efficient port services, Bintulu Port aims to be the largest and most efficient port and distribution centre within the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA).



Figure 3 Aerial view of Bintulu Port in 1982

As of 1st January 1993, the operations of Bintulu Port have been privatised under the Ports (Privatisation) Act, 1990 in line with the national privatisation policy. With the said privatisation, Bintulu Port Authority has licensed a port operation company, Bintulu Port Sdn Bhd. (BPSB) to carry out port operation services and related functions at Bintulu Port. Following the privatisation of Bintulu Port operations in 1993, the roles and functions of Bintulu Port Authority was restructured in line with its main functions as a Regulatory Body in overseeing all activities at the port including the use of port facilities and operations by licensed port operations, owner of port properties, acts as trade facilitator, planning and development of the Port.

Nowadays, Bintulu Port has evolved and is equipped with various facilities such as General Cargo Wharves, Bulk Cargo Wharf, Container Terminal, Multipurpose Terminal, Liquid Bulk Cargo Terminal, Palm Oil Terminal, LNG Terminal, LPG Jetty and Coastal Terminal.

The Significance

Bintulu Port is at the doorstep of one of the most dynamic industrial development zones of Borneo and is surrounded by and connected to a network of roads, which provide efficient transport links to other parts of Borneo.

Bintulu Port is strategically located at the centre of the Peninsula Malaysia-Singapore-Sarawak-Brunei-Sabah shipping routes and also along the busy sea trade route between the Far East and Europe at Latitude 03 16'N, Longitude 113 04'E on the northeast coast of Sarawak, Malaysia. Bintulu Port poised to be the main gateway into the BIMP-EAGA Region for container and conventional seaborne trade. Bintulu Port can be approached through a dredged access channel about 6km long, 240 meters wide and a declared depth of 15 meters, one of the deepest depths compared to any other berthing facilities in Borneo.

Bintulu Port is also providing base support services to oil and gas-related companies such as Petronas Carigali Sdn Bhd, Petronas Floating LNG Sdn Bhd and Murphy Oil Sarawak. This involves the provision of storage areas (warehouse and open space), material handling equipment, cargo handling equipment, passenger handling, pilotage, the supply of container carrying units and other services.

The positive growth in manufacturing sectors and higher demand for LNG has strengthen Bintulu Port position as key gateway for Sarawak export market. In addition increase in demand for palm oil from international biodiesel producers also another key factor for Bintulu Port existence.

1.2 Strategic Mission and Vision



Figure 4 Aerial view of current Bintulu port

Bintulu Port is set to be a Smart Digital Green port within time span from 2019 to 2030 with the implementation of programs and projects as concluded by all stakeholders in a comprehensive and structured blueprint with aim to achieve the following mission;

- Full-fledged green port status by year 2023,
- Full-fledged smart digital port status by year 2030, and
- Certified Carbon Neutral port by year 2030

Being geographically situated midway between Sarawak and Sabah along Asia's busy sea trading lanes, Bintulu Port is the import and export gateway for Sarawak and the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA).

Bintulu Port as the deep seaport and the third largest port in Malaysia, has a reputation as one of the most efficient multipurpose ports in the region. It is strategically located to meet oil and gas industry demands and handle a growing volume of general, containerised, liquid and dry bulk cargoes and palm oil products.

The world gas-fired power generation which is considered as clean energy are more in demand due to long-term costs associated with climate change and the impact of air pollution, both on people and the environment will results to more export of LNG and directly increase the productivity of Bintulu Port.

Other strategic advantage of Bintulu Port is their electricity are supplied from Bakun hydroelectric power station which is considered as clean energy and also provides the cheapest tariff rates in Malaysia. This is giving clear advantage for Bintulu Port to operate with less energy cost per unit productivity.

Apart from low tariff rates, Bintulu Port also can enjoy another advantage of the lowest carbon emission factor for electricity used which is only 0.237kgCO₂eq/kWh compared to 0.742kgCO₂eq/kWh in Semenanjung Malaysia (*Roadmap for a green economy in the Heart of Borneo: a scoping study by PWC 2011*). This low emission factor will give big advantage to Bintulu Port to achieve net zero carbon by 2030 and also reduce emission intensity per TEU.

Low emission factor for electrical energy also provides an advantage for local manufacturer to produce green products to meet increasing demand worldwide. The increase of green products export will give another positive impact to Bintulu Port.

Bintulu Port also provides ideal bulking installation terminal for companies seeking superb facilities, faster vessel turnaround times and excellent operational safety. It is also the main export point for edible oil products in Sarawak, handling more than 95 per cent of Sarawak's crude palm oil products.

The current port facilities, human resources and up-to-date operating systems of which being the first to utilised the latest container terminal operating system and take measures to provide the best service.

Last but not least the plan to transform Bintulu Port into full-fledged smart digital green port by year 2030 is in line with the State Government of Sarawak inspiration to promote digital economy and national policy on Industry 4.0. Guided by the SDGP blueprint and with full commitment and support from the managements and staff of Bintulu Port Authority and Operator, Bintulu Port is poised to be the first SDGP with carbon neutral port status in Asia by year 2030.

1.3 Purpose and Approach

Ports are nodal points in global supply chains. At the same time, they are embedded in local and regional communities. As a result, ports must respond to worldwide, regional and local challenges, such as climate change, mobility, digitalisation, migration and social integration.

Purpose

Its purpose is to guide the priorities of SDGP strategic sustainability units and to create a common language and set of measures as a useful and practical basis for monitoring progress against the objectives.

The Blueprint is fully aligned to BPA business strategy and articulates how they will deliver long-term economic, social and environmental outcomes for customers, society and stakeholders.

Approach

Smart Digital Green Port (SDGP) approach is based on smart, green and digitally integrated systems, efficient and competitive through technologies, automation and application of tools, efficiently use of energy and renewable resources, driving the socio-economic development, respectful with the environment, fully compliance to all maritime rules and regulations, secure and seamless for the benefit of citizens, the economy and society. SDGP in such away is a bridge for port sectors to achieve universal sustainability missions namely Sustainable Development Goals by 2030.

The Sustainable Development Goals (SDGs) represent a holistic and integrated approach to protect the environment, improve societal issues and achieve economic at global levels. As globally connected entities and as centres of key economic activity, the port sector is perfectly positioned to take the lead in a significant contribution to the global agenda. With increasing expectations and pressure from stakeholders, the SDG platform provides Port businesses a unique opportunity to increase transparency, trust, and demonstrate responsible operations and management towards environmental, economic and social sustainability.

The World Ports Sustainability Program considers the 17 UN Sustainable Development Goals as a single and indivisible orientation for the sustainable development of ports. The World Ports Sustainability Program will implement the UN SDGs along five themes, each of them covering a non-exhaustive list of potential topics.

i. Climate and Energy

Ports subscribe to the Paris Climate Goal which aims to keep global warming well below 2°C. Building on the output of the World Ports Climate Initiative, port community actors can collaborate in refining and developing tools to facilitate reduction of CO₂ emissions from shipping, port and landside operations. In addition, they can take initiatives to enable energy transition, improve air quality and stimulate circular economy.

Potential initiatives

Energy efficiency, circular economy, bio-based economy, renewable energy, CO₂ and infrastructure, clean ship incentives, deployment of alternative transport fuels

Relevant UN SDGs



ii. Community outreach and port-city dialogue

Port community actors can develop synergies to solve collective active problems in and outside the port area, such as hinterland bottlenecks, training and education, IT, marketing and promotion as well as innovation and internationalisation. Similarly, port community actors strive for dialogue with urban stakeholders to offer innovative cross-over services that contribute to the attractiveness and resilience of port cities.

Potential initiatives

Stakeholder management, sustainability reporting, community outreach, city-port relations, employment, education, spatial planning, nature in ports, port culture, externalities of port operations

Relevant UN SDGs



iii. Governance and Ethics

Principles of good corporate governance are increasingly being introduced to port authorities, regardless of their ownership. Furthermore, all port community actors should be encouraged to uphold high standards of ethics and transparency.

Potential initiatives

Transparency, integrity, equal rights and opportunities, fair trade, anti-corruption, responsible supply chains

Relevant UN SDGs



iv. Resilient Infrastructure

Port and port-related infrastructure aim at anticipating demands of maritime transport and landside logistics, at being resilient to changes in climate and weather conditions and at developing in harmony with local communities, nature and heritage.

Potential initiatives

Port planning and design, public-private partnerships, financing, digitization and automation, climate resilience, working with nature, ecosystems management

Relevant UN SDGs



v. Safety and Security

In ports a mixture of regulatory duties and responsibilities exist related to ensuring safety and security of ship and cargo operations within the port as well as the enforcement of applicable laws and regulations in these fields. With the advance of global terrorism and digitalisation, security problems have obtained an entirely new dimension.

Potential initiatives

Cyber-security, protection of critical infrastructure, ISPS, nautical safety, labor safety, responsible care

Relevant UN SDGs



International Association of Ports and Harbours (IAPH) has introduced World Ports Climate Initiative (WPCI) to support SDG missions.

The World Ports Climate Initiative

Under the International Association of Ports and Harbours (IAPH) the so-called World Ports Climate Initiative (WPCI) has become an international platform for ports to address global warming and air quality issues. The mission of WPCI is to:

- Raise awareness in the port community of need for action
- Initiate studies, strategies and actions to reduce GHG emissions and improve air quality
- Provide a platform for the maritime port sector for the exchange of information thereon
- Make available information on the effects of climate change on the maritime port environment and measures for its mitigation and adaptation

Within the WPCI, the following projects have been initiated which are lead by participating ports or groups of ports:

1. Carbon Foot Print: tools to support ports to reduce their carbon footprint
2. On-shore Power Supply: guidance and good practice with regard to On-shore power supply
3. Environmental Ship Index: a tool to reward clean shipping
4. Intermodal Transport. Guidance and strategies that can be applied to enhance intermodal transport
5. Low Emission Yard Equipment: guidance and good practice
6. Sustainability in Lease Agreements: guidance and good practice.
7. LNG as a fuel: information exchange and co-ordination of further implementation for ports

Figure 5 The Worlds Ports Climate Initiative

Bintulu Smart Digital Green Blueprint was built on the universal platform of United Nations' Sustainability Development Goals, addressing common criteria of sustainability which is environment, economic and social, complying with smart digital green port criteria of operations, energy, environment and, organisation and management pillars.

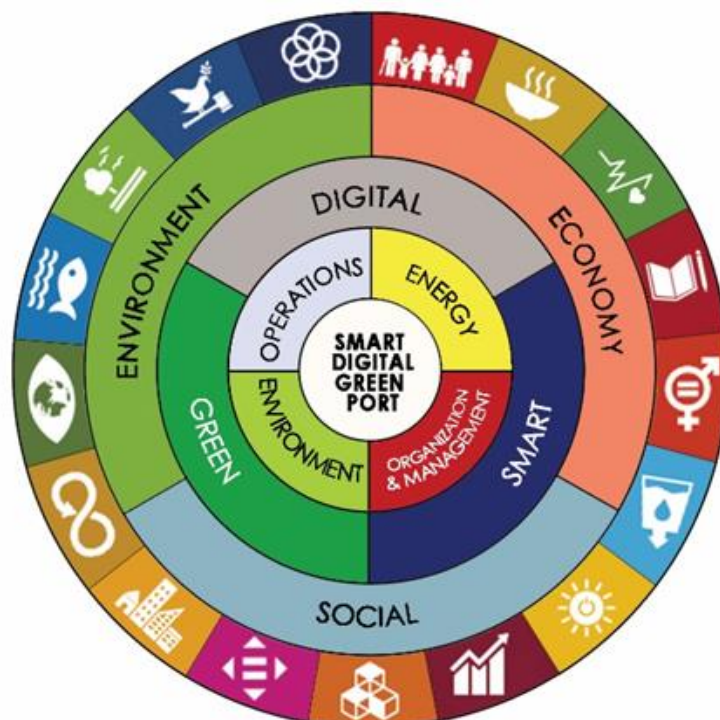


Figure 6 Bintulu Smart Digital Green Port Concept and Approach

Being the first federal ports in Malaysia to plan and execute a structured and comprehensive framework for environmental and economic initiatives to turn Bintulu Port into the first full fledged smart digital green port, the SDGP Blueprint is envisaged to be implemented on SMART concept;

S – Specifics. Very specific in achieving a mission to be the first net zero carbon port in Asia by 2030.

M – Measurable. All smart digital green initiatives will be quantified for baseline, performance monitoring and reporting purposes.

A – Achievable. Proposed initiatives, projects and programs are individually analysed to ensure there are achievable.

R – Readshe.

T – Time Bound. All SDGP initiatives, projects and programs are equipped and monitored according to time schedule.

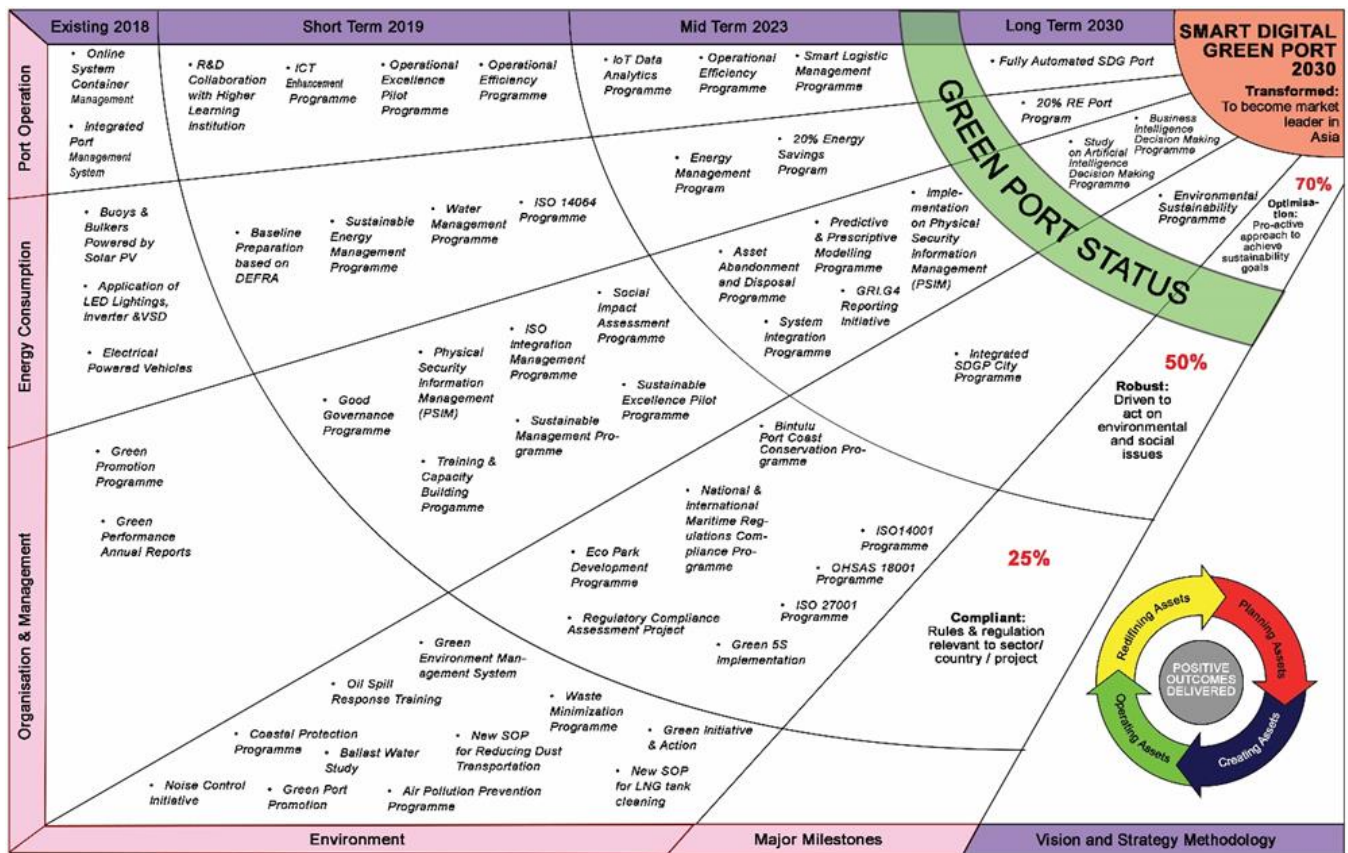


Figure 7 Bintulu SDG Port Blueprint Cockpit Chart

Bintulu Smart Digital Green Port (SDGP) Blueprint Cockpit Chart illustrate of the ultimate specific vision of Bintulu Port Authority to be the first Asia seaport with Zero Carbon status by year 2030 by using new technologies, IoT and Big Data. To be the port of future, Bintulu Port need to transform in a well-planned and coordinated manner and excel in operation efficiency, environmental protections, green economic growth and societal endeavors.

The concept of transformation starts with regulatory compliant, followed by robust action to all environmental issues, next with optimization on pro-active approach to achieve sustainable goals and finally, fully transformed as a port leader. Bintulu Port does not start from zero, various green programs and projects are currently at implementation stage. New short term, mid-term and long-term programs are carefully designed by stakeholders to achieve the ultimate target and to address the universal Sustainable Development Goals, international and national environmental requirements and the smart digital green port criterion namely; efficient operations; conserved energy consumptions, prudence management and organization; and care about environment.

SDGP criteria are positioned in accordance to the Delphi analysis results. Each project will be evaluated using sustainable methodology of life cycle analysis and costing for the environmental, economic and social impact outcomes. All projects will be monitored by a dedicated team to ensure their time bound completion and achieve the desired targets.

1.4 SDGP Policy Statement

Policy statement of smart digital green port is the commitment of BPA to the laws, regulations, and other policy mechanisms concerning environmental, economic and social issues. This policy needs to be integrated with the existing Bintulu Port green policy.

Bintulu Port Green Policy

Bintulu Port believes that the access that ports provide should strive to be better: faster, smarter and cleaner. Faster by investing in their processes and services. Smarter by embracing innovation. Cleaner by being a big port with a small footprint.

The Green Port Policy, which the management adopted in January 2016, serves as a guide and framework for sound and environmentally friendly port operations.

The five principles are;

- Protect the community from harmful environmental impacts of Port operations
- Project the Port as a leader in promoting environmental compliance
- Promote sustainability
- Employ the best available technology to mitigate negative environmental impacts
- Inclusiveness

The Bintulu Green Port Policy includes ten basic elements:

- | | |
|--------------------------------------|----------------------------------|
| 1. Air quality | 6. Ship waste |
| 2. Energy consumption | 7. Port development/land related |
| 3. Noise | 8. Water quality |
| 4. Relationship with local community | 9. Dust |
| 5. Garbage/port waste | 10. Dredging; operations |

The Smart Digital Green Port Policy

The Smart Digital Green Port Policy is a comprehensive and structured approach to reduce the negative impacts to the environment and at same time increase the economy and social aspects for Port operations. The Smart Digital Green Port Policy serves as a guide for decision making and established a framework for environmental and customer friendly, efficient and profitable Port operations. (adoption date). The four guiding principles are;

- i. Project the Port as a leader in promoting smart digital green operations to increase the efficiency and reliability and balance the economic, environment and social obligations
- ii. Employ best practices and technology for sustainable energy utilisations
- iii. Implement environmental compliance activities
- iv. Promote sustainable organisation and inclusiveness management approach

The Bintulu Smart Digital Green Port Policy includes fourteen elements:

- | | |
|--|--------------------------------------|
| 1. Automation and data collection | 8. Relationship with local community |
| 2. Intelligent system | 9. Garbage/port waste |
| 3. Automation of handling and transports | 10. Ship waste |
| 4. Smart infrastructure systems | 11. Port development/land related |
| 5. Air quality | 12. Water quality |
| 6. Energy consumption | 13. Dust |
| 7. Noise | 14. Dredging operations |

1.5 SDGP Regulatory Alignment

The relation between ports and the regulatory framework is not uniform worldwide: in some regions, ports tend to regulate themselves as much as possible, while in other regions, ports rather rely on a strong national legal framework.

In any case, in the Green Port concept, port authorities are proactive orchestrators which, ahead of legislation and based on stakeholder values, determine their future strategies and create the conditions needed for the license to operate and grow. They invest in creating values that meet the demands of the future. In that case the legal framework should at least recognise those needs and support these developments with appropriate legislation and regulations.

Developing initiatives ahead of the regulations is the best way to have regulations in place which would be functioning from operational and societal perspectives and to avoid a cascade of sub-optimal regulations.

At the same time, it is also of great importance that port authorities adhere to existing national and supranational legislation, working together with public authorities when there is a necessity to develop this legislation in more detail. Especially when concerning nature protection and ecosystem developments, effects of measures taken are only visible in the longer term. This calls for stable legislation that, once implemented, can be fine-tuned or corrected but not changed repeatedly.

Port authorities can co-operate with public authorities to ensure that the existing legislation is developed and stabilized to allow for long term sustainable implementation. Evaluation of the legislation can take place when monitoring results are available after several years.

SDGP Blueprint was developed taking considerations to all the above environmental and operational issues and aligning them to the following current regulations;

- SOLAS 1974
- Marpol 73/78
- OSHA 1994
- EQA 1974
- ISPS Code
- Bintulu Port Authority Act 1981
- Port By-Laws
- Merchant Shipping Ordinance, Sarawak 1960
- Merchant Shipping Ordinance, Sarawak 1952
- Port (Privatisation) Act 1990

SDGP Blueprint is dynamic documents as it can be revised and upgraded to include any future acts and regulations imposed by the country or international bodies.

2.0 SMART DIGITAL GREEN PORT

2.1 Definition

“Smart Port” is based on intelligent, green and integrated transport, efficient and competitive through technologies, automation and application of tools, energy efficiency which includes renewable resources, driving force for the socio-economic development of their city or region and resource-efficient, respectful with the environment, secure and seamless for the benefit of citizens, the economy and society.

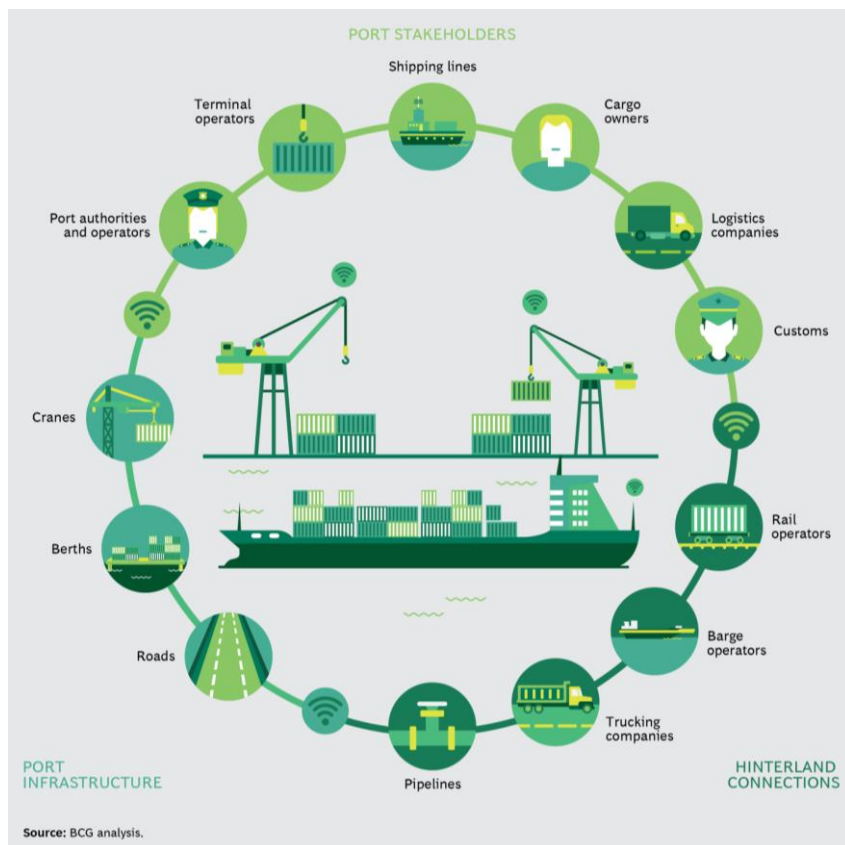


Figure 8 Stakeholders in a Port

“Digital Port” is an extension of Smart Port concept that manage congestion, create business value and increase a port’s competitiveness, the collaborative sharing of data will enhance port operational excellence and quality of service.

“Green Port” is based on three aspects of work and port systems planning that include energy conservation, environmental protection and environmental care.

“Smart Digital Green Port” is the most comprehensive efforts combining all the above concepts with main mission to address environmental issues from port operations, improve efficiency, apply sustainable energy while increase business competitiveness and profitability and enhance social relationships and well-being.

2.2 Strategic Objectives

Strategic objectives are part of strategic plan that normally used as a management tool to improve the performance of an organization and outlines the organization's direction and priorities. As for SDGP, it identifies the objectives for the next five and twelve years. Each of the objectives requires a series of an act or strategy intended to resolve a short fall or improve a situation; a fresh approach to something that the Port will undertake to accomplish that objective. While these objectives are organization-focused and require the coordination of resources throughout the Port, each one will be championed by a designated Team, and the divisions within that stakeholder, as follows;

MANAGEMENT AND ORGANISATION	
1	New branding to Bintulu Port with green, full-fledge digital and carbon neutral port certifications
2	Maximise advantage of low energy emission factor, low energy tariff and port program for digital economy
3	Apply green port measurement indicators and SDGP criteria
4	Adopt latest ICT technologies on big data, blockchain, IoT and cloud computing to economy, environment and social operations.
5	Develop robust policies and systems for operations, environment, safety and security.
6	Increase organisational efficiency
7	Provide certified skills training to workforce
8	Clear communication, knowledge transfer and reporting
9	Improve business performance
10	Invest in community resilience
11	Support and promote local culture
12	Improve green supply chain efficiency and resilience
13	Develop a sustainable ports alliance
14	Explore port city development programs
CLIMATE CHANGE	
1	Examine onshore power supply
2	Focus on greenhouse gas and renewable energy
3	Consider the World Port Climate Initiative
4	Search for carbon neutral prospects
ENVIRONMENT	
1	Promote low sulphur fuels
2	Sustained and consistent environmental monitoring

3	Support ecosystem science and research
OPERATIONS	
1	Address climate change in business operations
2	Resource reduction, reuse and recovery
3	Influence safe and sustainable shipping
4	Review dredging management practices
5	Efficient spatial planning and land use efficiency
6	Prepare sustainable design guideline for port developments

Bintulu SDG Port Progression & Major Milestones

SHORT TERM 2019	MID TERM 2020 - 2023	LONG TERM 2024 - 2030
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Figure 9 Bintulu SDG Port Progression & Major Milestones

Location of SCORE

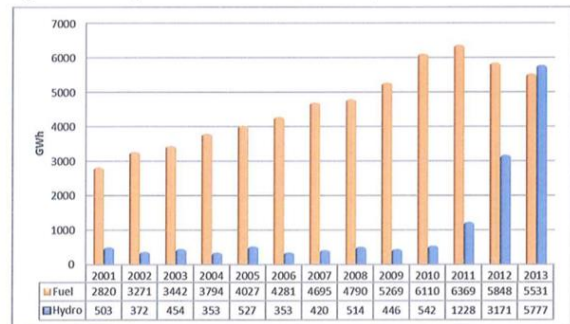


Overview of SCORE



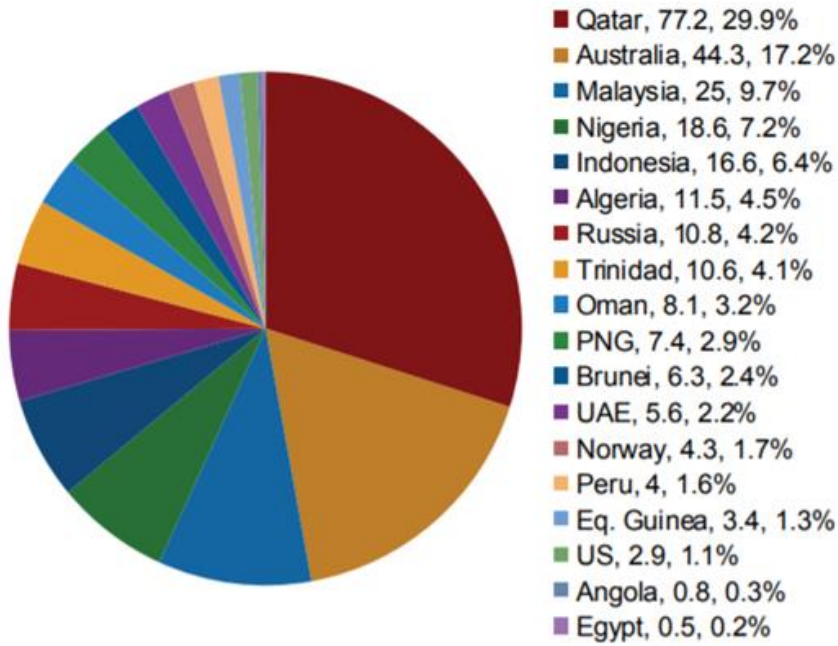
CDM Electricity Baseline 2013

Figure 2: Electricity Generation from Fossil Fuel vs. Hydro for Sarawak



Source: Sarawak Energy Berhad

Figure 3.2: LNG Exports and Market Share by Country (in MTPA)



Note: Numbers in the legend represent total 2016 exports in MT, followed by market share. Source: IHS Markit, IGU

Figure 10 Study on Grid Connected Electricity Baseline in Malaysia Year 2013 by Malaysia Green Technology Corporation

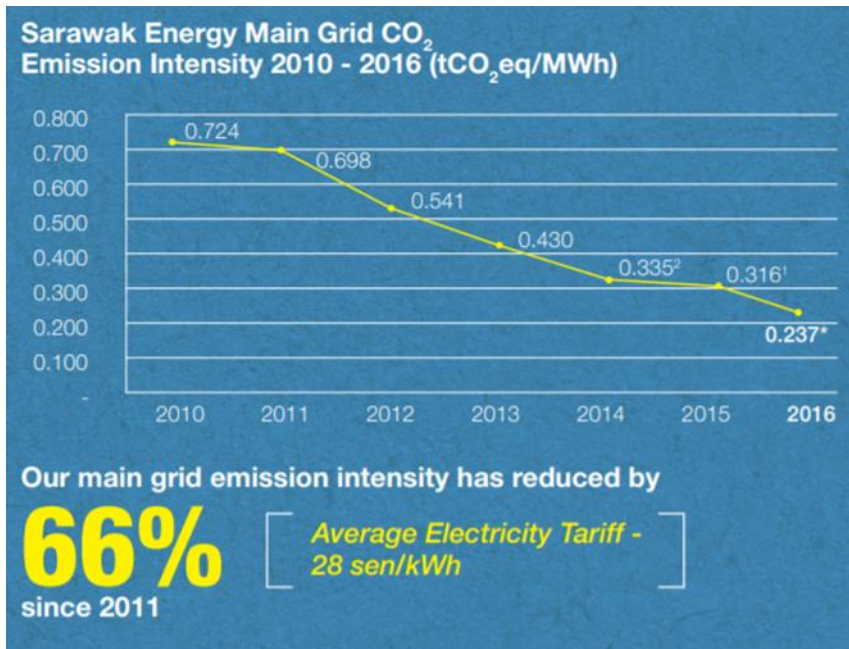


Figure 11 Sarawak Energy Sustainability Report 2016

Comparison on TNB & SEB

No.	Unit (kWh)	SEB	TNB	SEB	TNB
		6% GST(RM)	6% GST(RM)	Total (RM)	Total (RM)
1	100	/	/	18.00	21.80
2	150	/	/	27.00	32.70
3	200	/	/	44.00	43.60
4	300	/	/	75.00	77.00
5	400	6.48	2.96	114.48	122.56
6	500	8.85	5.92	156.35	174.87
7	700	12.6	12.02	222.60	282.67
8	800	14.64	15.17	258.54	338.17
9	900	16.74	18.31	295.74	393.66
10	1000	18.6	21.60	328.6	451.80

Figure 12 Roadmap for a green economy in the Heart of Borneo: a scoping study by PWC 2011

2.3 Strategic Outcomes

A Strategic outcome is a desired societal port or end result to which an organisation's efforts are ultimately directed. Sustainable Team will regularly assess specific program or project needs, problems and opportunities to achieve their strategic goals. By prioritizing work, sustainability Team can allocate resources, time and funding for projects development appropriately. Evaluating progress toward achieving these strategic outcomes involves monitoring and analyzing operational metrics.

- i. Examine the project processes, policies and procedures. List measurable results or outcomes that can be monitored to judge the status of the project. Link each outcome to strategic goals. Select indicators of outcome success to track the extent to which efforts achieve goals based on project and program implementation occurs.
- ii. Create a dashboard or report that compiles the data in order to identify and address project issues. Distribute the report online monthly to share the latest information.
- iii. Analyze the results and provide commentary to explain the trends to the management on a monthly basis. Use the information to influence budget decisions. Projects that do well should be replicated while projects performing poorly should be closely examined to revamp, downsize or eliminate.
- iv. Measure statistics related to outcomes, such as milestone achieved instead of outputs. Cascade performance goals down to each project and employee in your organization so everyone works toward the same higher-level outcomes. Using metrics and data to manage performance ensures consistency and alignment with strategic goals.
- v. Publish and communicate results, even if the results may not initially show success. Transparency can energize employees to focus on the task to improve measurable outcomes, such as compliance with environmental laws.
- vi. Evaluate programs based on data. Use the data to validate why should have that program, how it conducts, and implements projects and generates return on investment.

The following are strategic outcomes specifically designed for SDGP Blueprint;

MANAGEMENT AND ORGANISATION	
1	Certified Green Port status by 2023 & Full-fledged Digital Port and Carbon Neutral Port by 2030
2	Implement low carbon and digitalisation in business operations
3	Sustainability Team monitor and report SDGP performance
4	Implement detail blueprint for ICT implementation and provide adequate infrastructures.
5	Implement robust policies and systems for operations, environment, safety and security.
6	Measure organisational efficiency
7	50% of workforce are certified competent workers
8	Sustainability awareness programs and sustainability reports produced
9	Positive growth in company turnover
10	Implement capacity building programs to local community
11	Implement programs to support and promote local culture
12	Implement sustainable procurement and green supply chain capacity development
13	Implement sustainable ports alliance
14	Closed corporation with BDA for smart digital green port city programs
CLIMATE CHANGE	
1	Onshore power supply installed
2	Measure greenhouse gas emissions and used renewable energy
3	Collaborate with the World Port Climate Initiative
4	Carbon neutral initiatives identified
ENVIRONMENT	
1	Implement low sulphur fuels rules
2	Implement online environmental monitoring
3	Developed eco-part and support ecosystem science and research
OPERATIONS	
1	Implement sustainable business operations
2	Implement sustainable resource management
3	Implement programs for safe and sustainable shipping
4	Implement sustainable dredging practices
5	Apply efficient spatial planning and land use
6	Apply sustainable design guideline for port developments

OBJECTIVES OF THE NATIONAL POLICY ON INDUSTRY 4.0 ARE THREEFOLD: A-C-T

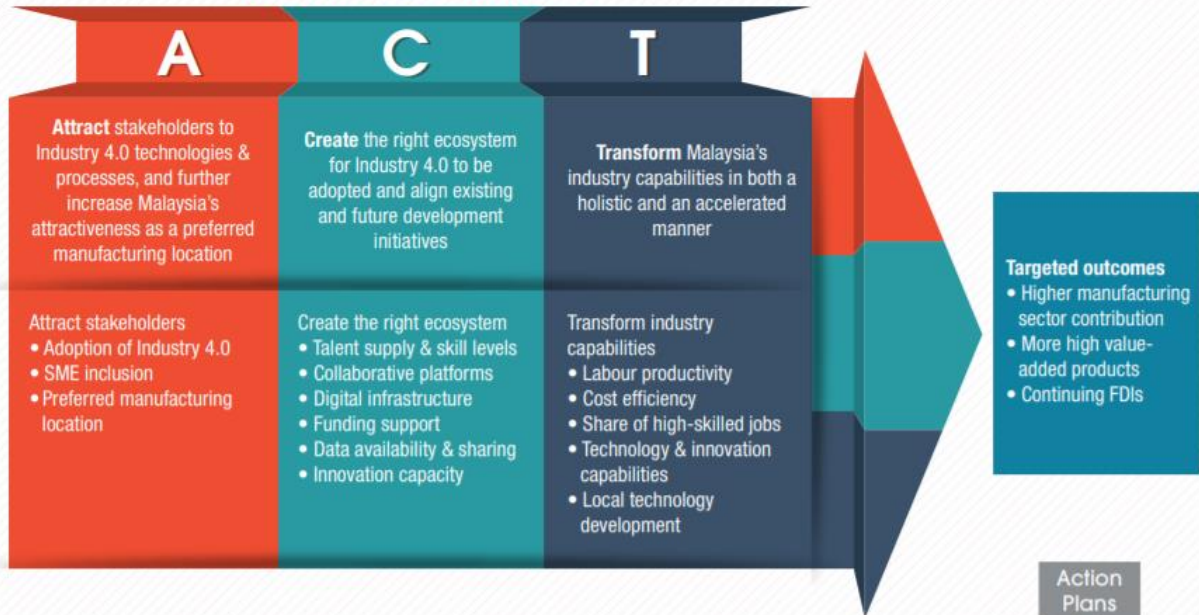


Figure 13 National Policy on Industry 4.0

2.4 SDGP Blueprint Development

Bintulu Port Authority has set an objective to leverage on integrated information system to enhance the effectiveness of port operation by introducing green port initiatives. It is also noted that it is a KPI for Bintulu Port Authority as well as the Minister of Transport Malaysia to implement Green Port initiatives and Steps in Bintulu Port in near future. An open tender was called with the objective of the project is to develop Smart Digital Green Port Blueprint for Bintulu Port. This project is divided into three phases;

- i. Phase 1: Development of Smart Digital Green Port Blueprint, Conduct Green Performance Audit and Identification of User requirement for detail ICT Development;
- ii. Phase 2: Development and Deployment of Online Green Management System and Feasibility Study for Smart Green Port Projects; and
- iii. Phase 3: Measurement and Verification Plan of the Impact on selected Projects.

This SDGP Blueprint document is for Phase 1. The preparation of this blueprint is further divided into 3 sub-phases;

Phase 1A: Development of Smart Digital Green Port Blueprint

Phase 1B: Conduct green performance audit

Phase 1C: Identification of user requirement for detail ICT development

The following is the flow of Steps taken and reports prepared by the green consultants to produce Smart Digital Green Port Blueprint for Bintulu Port Authority.

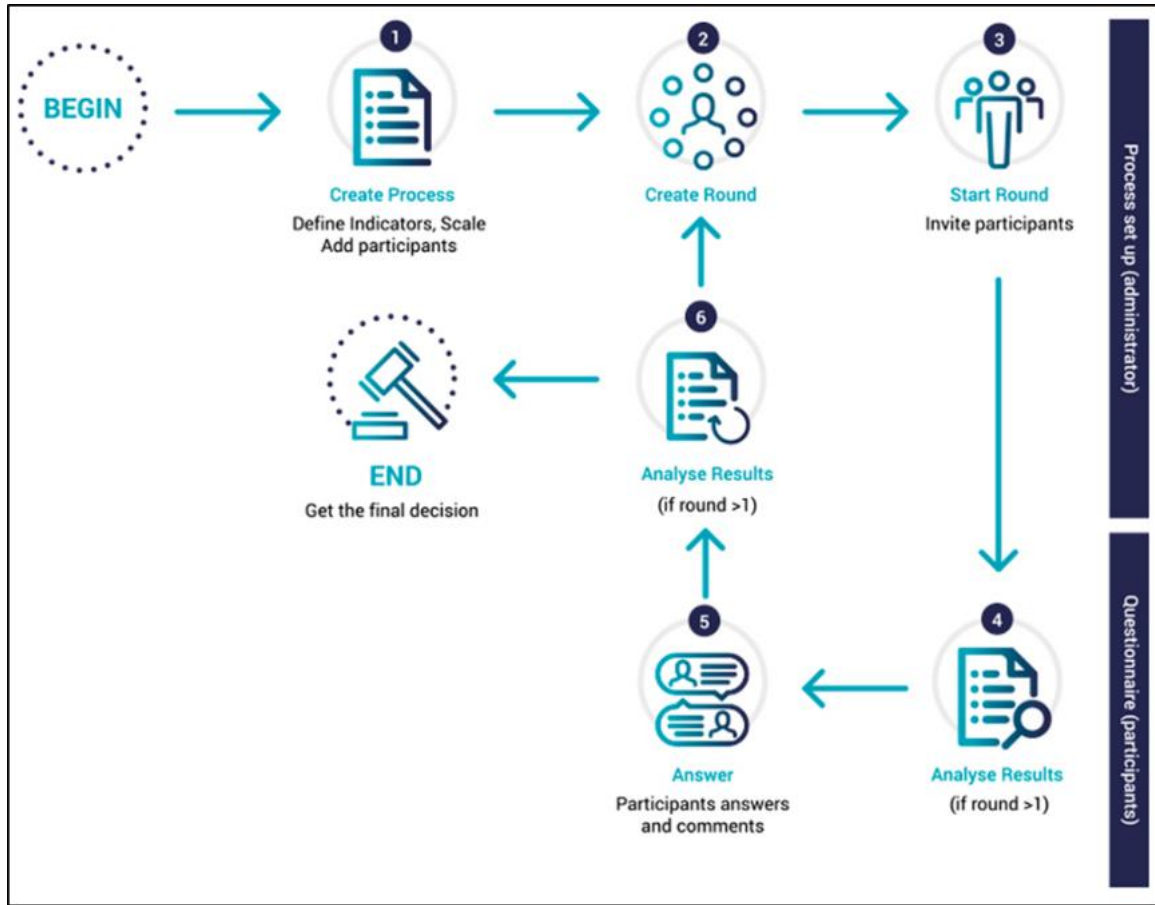


Figure 14 Steps during Producing Smart Digital Green Port Blueprint

Application Delphi Method to Determine Ranking

The Delphi method is a forecasting process framework based on the results of several rounds of questionnaires sent to a panel of experts and the anonymous responses are aggregated and shared with the group after each round. The experts are allowed to adjust their answers in subsequent rounds. Since multiple rounds of questions are asked and the panel is told what the group thinks as a whole, the Delphi method seeks to reach the correct response through consensus.

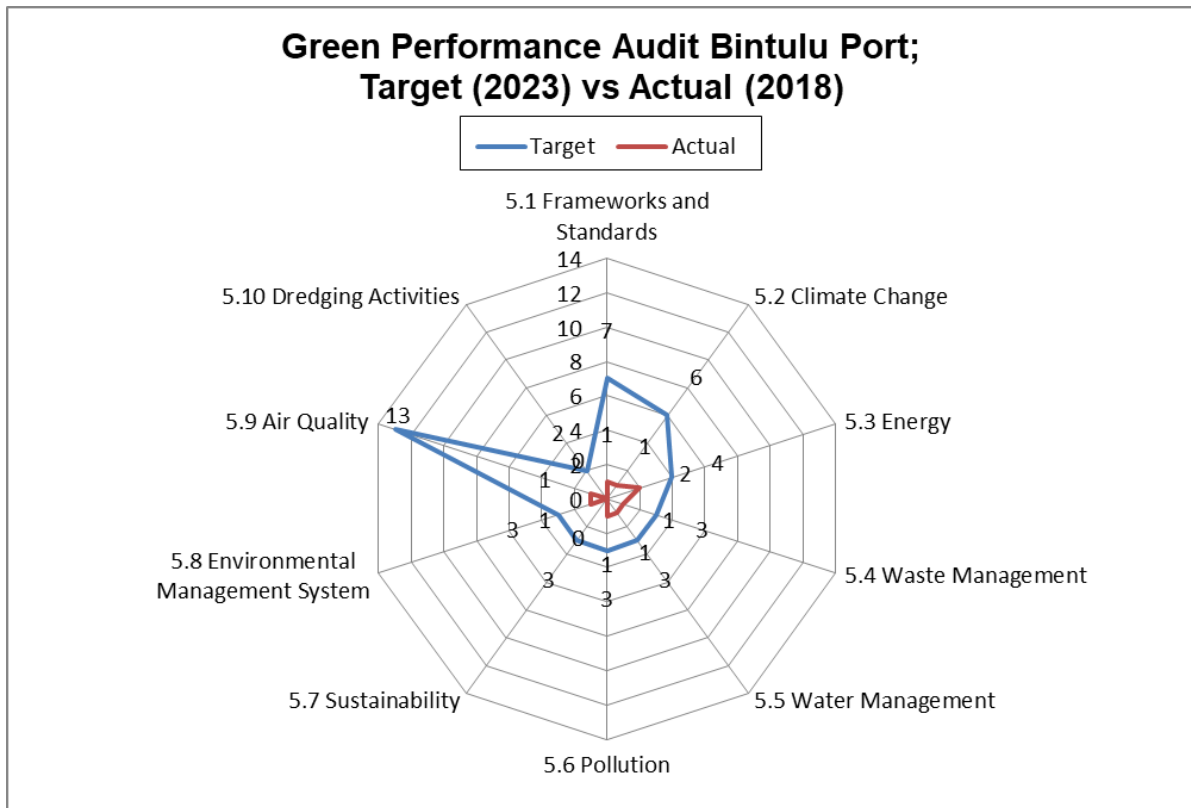


Figure 15 Results of green performance audit

2.5 SDGP Criteria and Indicator

The key rationale for SDGP indicators is the need to provide evidence for monitoring, analysis, benchmarking, and communication. To accomplish this in smart digital green port contexts, the setup for indicator selection needs are based on;

- i. Dynamic and flexible, with due regard to the need for continuity of surveillance;
- ii. Offer a balanced coverage of areas of greatest concern or relevance for SDGP at a global level, while preserving the potential to adapt to port' specific circumstances; and
- iii. Allow for the evolution of indicators (for example, the as new scientific evidence or ICT technology becomes available).

SDGP indicators are selected based on transparent criteria. Ideally indicators would fulfil the following criteria (OECD, 2011);

- Policy relevance: the indicator needs to address issues that are of (actual or potential) public concern relevant to policy-making. In fact, the ultimate test of any single indicator's relevance is whether it contributes to the policy process.
- Analytical soundness: ensuring that the indicator is based on the best available science is a key feature to assure that the indicator can be trusted.
- Measurability: the need to reflect reality on a timely and accurate basis and be measurable at a reasonable cost, balancing the long-term nature of some environmental, economic and social effects and the cyclicity of others. Definitions and data need to allow meaningful comparison both across time and ports.
- Usefulness in communication: the ability to provide understandable, easily interpretable signals for the intended audience.

As for SDGP criteria the methodology applied to define them are based on the following steps;

- i. Consultation of bibliography: All the criteria and key indicators used in the project and included in the SDGP concept must have a robust concept based on reliable bibliography and references (websites, database, reports of relevant organization, etc.) before the beginning of the SDGP, between the foreseen sources to be used in the project and those shown in table,
- ii. Consultation with Bintulu Port Authority (BPA) and port stakeholders: When all the criteria and key parameters were defined on the base of the information supply by the BPA and port operator, some local meetings (group focus discussion) with the stakeholders were held to reach a consensual list of criteria and key parameters,
- iii. The DELPHI methodology was applied to determine the ranking. This is a structured communication technique, originally developed as a systematic, interactive forecasting method which relies on a panel of experts. The selected experts answered questionnaires in two rounds, and
- iv. All the expert panels evaluated the importance of each criterion and the average of which was calculated as a represent the important degree rank for each one.

Table 1 Reviews of Previous Studies on Smart Digital and Green Port development

Factors	Previous Studies
Operation	Zhuo Chen & Myongsop Pak (2017), Gupta et al., 2005; Cai (2010), Zhang et al., (2015), Dong et al. (2011) and Knapp, van de Velden (2011), Glenn Lyons (2016), (Cullinane et al., (2012), Bailey and Solomon (2004); Lam and Notteboom (2014), Gibbs et al., (2014), Acciaro et al., (2014), Wong and Cullinane (1999)
Energy consumption	Chen (2009), Fridgen et al., (2018), Corbett and Fischbeck (1997), Chang et al., (2013, 2014), Cullinane and Bergqvist, (2014), Chang et al., (2018), Smith et al., (2014).
Environment	Berechman and Tseng (2012), T.S. Wang(2014), Chen (2009), Cai (2010), Liu (2004), Maragkogianni and Papaefthimiou (2015), Goulielmos (2000), Stojanovic et al. (2006), Karim and Susan (2007), Yang et al. (2018), (Chang and Wang (2012), Giuliano and Linder (2013), Merk (2014), Gibbs et al., (2014), Davarzani et al., (2015), Erdas et al., (2015) Wang and Notteboom (2015); Styhre et al., (2017).

Factors	Previous Studies
Organization and Management	Lu and Hu (2009), Lam and Notteboom (2014), Santos et al. (2016), van der Lugt et al., (2013), Verhoeven (2010), Giuliano and Linder (2013), Cook and Seiford (2009).

Each SDGP factor will be called as pillar for smart digital green port criteria. To harmonise the criteria and green port indicators, SDGP will be monitoring both indicators and criteria on the same with the help standard measurement and reporting procedures.

SDGP indicators, criteria and their relations are as follows;

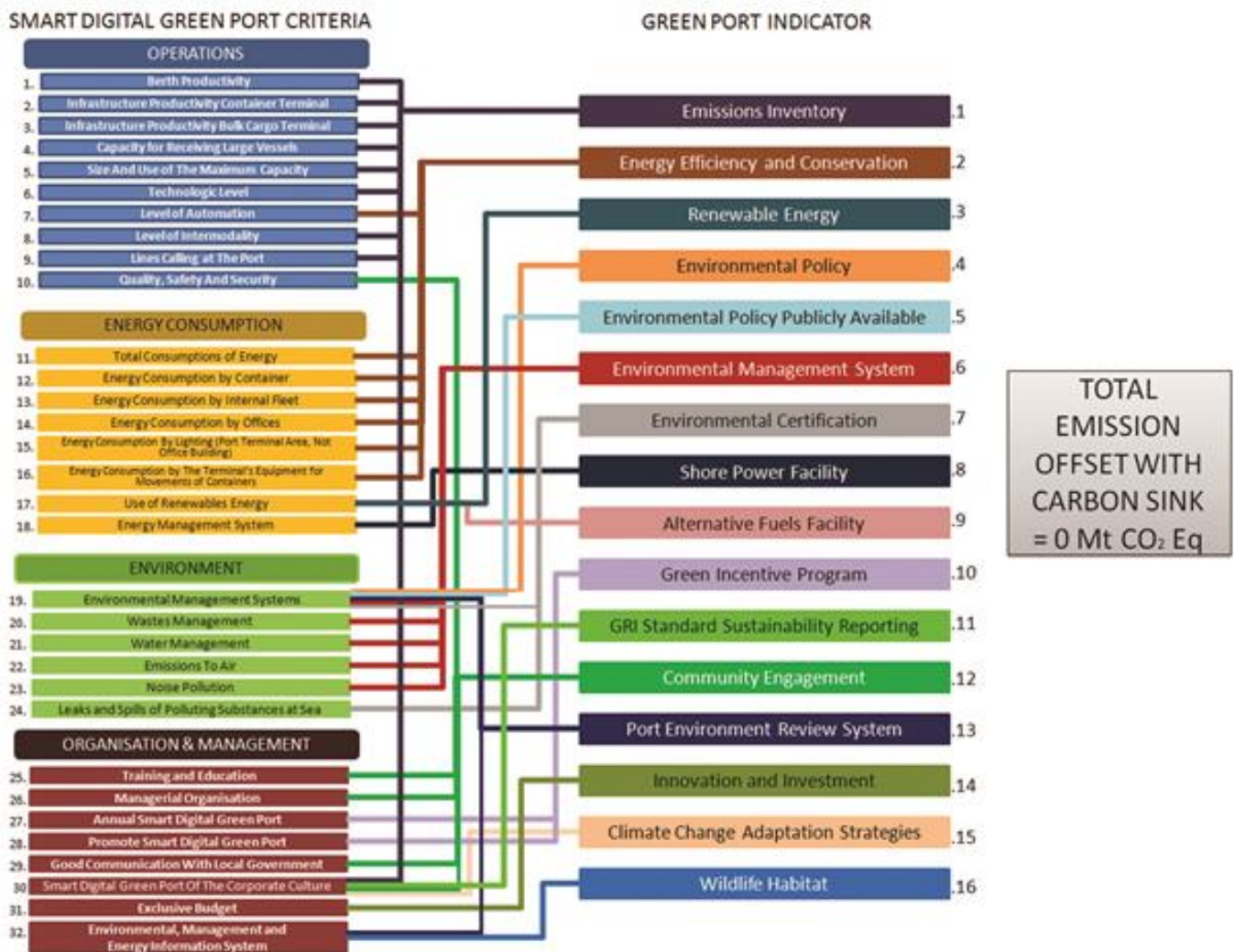


Figure 16 SDGP indicators, criteria and relations

Every individual pillar will be discussed in detail in next chapter.

2.6 Operation Pillar

The operational process of a container / bulk cargo terminals can be considered as a large productive process where the final element is not only a tangible product but rather a specified service. The services to which we refer is the handling and storage of the products of a particular customer. Thus, we are talking either of reception terminals (import and export) or of transshipment terminals, where cargos are transferred from one vessel to another. This service needs to be delivered, i.e. performed, on the date agreed with the customer, and in accordance with the same conditions that the seller, exporter, loader (or any other legal entity considered to be the person putting the cargo at the disposition of the carrier) has contracted with the customer.

The basic objective is to carry out the operations as rapidly as possible, to enable the vessel to spend the minimum time necessary in port and, consequently, to obtain maximum economic utilization as well as Energy and Environmentally efficient.

Measures of port efficiency or performance use a certain form of output relative to input which quantifies various aspects of port operation. Literature lists several benefits associated with a properly used set of port performance indicators (Wong and Cullinane, 1999). These include improving the utilization of port resources, highlighting the cause of congestion as well as providing information for port planning and justification for capital development.

To measure, however, port performance is a very delicate matter and depend on the availability of the information required. Basic criterions for operational dimension are as below;

OP1. Berth productivity

OP1.1 Annual throughput (TEU / year / meter of container quay)

OP2. Infrastructure productivity (container terminal)

OP2.1 Annual TEUs / total terminal area

OP2.2 Annual TEUs / total storage or yard area

OP2.3 Annual TEUs / (total storage or yard area + total dry port storage areas)

OP2.4 Annual TEUs / number of container terminals

OP2.5 Annual TEUs reefers / total number of electrical outlets for reefers (static capacity)

OP3. Infrastructure productivity (bulk cargo terminal)

OP3.1 Annual Tonne / total bulk cargo terminal area

OP3.2 Annual Tonnes / total storage

OP3.3 Annual Tonnes / (total storage + total dry port storage areas)

OP3.4 Annual Tonnes / number of bulk cargo terminals

Table 2 Infrastructure Productivity (bulk cargo terminal)

Container	Bulk	
<ul style="list-style-type: none"> • TEU (20') • TEU (40') 	Dry Bulk: <ul style="list-style-type: none"> • Coal • Iron Ore • Grains • Fertilizer 	Liquid bulk: <ul style="list-style-type: none"> • Crude oil • LNG • Others (oil products, chemicals, bio-fuel, vegetable oils)

OP4. Capacity for receiving large vessels

OP4.1 Length of quay with +14 m depth (m) / total quay length (meters) – only container quay

OP4.2 Length of berth with +14m depth (m) / total berth length (meters) – only bulk cargo terminal

OP5. Size and use of the maximum capacity

OP5.1 Annual TEUs / capacity of the container terminal (static capacity)

OP5.2 Average annual number of hours (container terminals are working)

OP5.3 Annual TEUs / average annual number of hours (containers terminals are working)

OP5.4 Annual Tonnages / capacity of the bulk cargo terminals (static capacity)

OP5.5 Average annual number of hours (bulk cargo terminals are working)

OP5.6 Annual Tonnes / average annual number of hours (bulk cargo terminals are working)

OP6. Technologic level

OP6.1 Number of ICT that the port and terminal operators use and offer to the port community, between next less

- Wireless communication (PMR for voice, Wifi for data,...)
- wire line communications (PABX, FO network,...)
- rfid (container / terminal identification, container / terminal security, entrance system,...)

- optical character recognition (OCR), CCTV (container/terminal/truck identification, security,...)
- global navigation satellite system (GNSS), differential global navigation satellite system (DGNS) – Crain guidance, container/terminal/truck positioning,...)
- terminal operating system (TOS) – command and control integration, logistics support,...)
- port community system
- b2b system (exchange of products, services or information between businesses...)

OP7. Level of automation

OP7.1 Annual throughput in TEU per number of quay cranes

OP7.2 Percentage of automatized quay cranes

OP7.3 Annual throughput in TEU per number of gantries crane

OP7.4 Percentage of automatized yard gantries

OP7.5 Annual throughput in TEU per number of equipment for internal movements (trucks, shuttle, etc.)

OP7.6 Percentage of automatized quayside cranes, yard gantries and equipment for internal movements

OP7.7 Annual throughput in Tonnes per number of bulk cargo terminal

OP7.8 Percentage of automatized bulk cargo terminal

OP7.9 Annual throughput in Tonnes per number of equipment for bulk cargo internal movements (trucks, shuttle, etc.)

OP7.10 Percentage of automatized bulk cargo terminal and equipment for internal movements

OP8. Level of Intermodality

OP8.1 Magnitude of the rail infrastructure (total siding in port area (km) / total terminal area)

OP8.2 Use of the intermodality-railway option (total TEUs transported by rail / total TEUs)

OP8.3 Use of the intermodality-road option (total TEUs transported by road / total TEUs)

OP9. Lines calling at the port (port of calls)

OP9.1 Total number of TEUs / number of carries (only carriers of maritime transport)

OP9.2 Number of main lines / vessels (large ships and tonnage arriving in port and with the large volume of goods) / total number of lines / vessels

OP9.3 Total TEUs per number of vessels that stops in the port

OP9.4 Total number of Tonnes / number of carries (only carriers of maritime transport)

OP9.5 Number of main bulk cargo vessels (large ships and tonnage arriving in port and with the large volume of cargo) / total number of bulk cargo vessels

OP9.6 Total Tonne per number of vessels that stops in the port

OP10. Quality, safety and security

OP10.1 Number of qualities, safety and security certificates or arrangements according any standard that can contribute to improve or certify to ensure the efficiency of the operation (ISO 9001, ISPS code, etc)

List of Proposed SDGP Projects

OPERATION PILLAR			
No.	Term Planning	Proposed Programmes	Proposed Projects
1	SHORT TERM (2019)	R&D Collaboration with Higher Learning Institutions	Bintulu Port Centre of Excellence (BPCoE)
2		Operation Efficiency Program	Worker Competency Training
3		Operational Excellence Pilot Program	Green Belt 6-sigma Project
4			Stabilization of ERP software
5			Replacement of Bulking System (BBSB)
6			Study on Marine Craft Booking System
7	SHORT TERM (2019)	Operational Excellence Pilot Program	Implementation on e-bidding Tender System
8			Application on u-Customs System to Streamline for Goods Clearance Purposes
9			Feasibility Study on The Barcode System for Breakbulk Cargo
10			Recognition of Prior Learning (RPL) project
11			Implementation Online Customer Satisfaction Survey
12			ICT Enhancement Program
13		Sustainable Energy Management Program	Study on setting up Port Receiving Facilities (PRF)
14		Smart Logistics Management Program	Study on Equipment and Container Tracking System
15		IoT and Data Analytics Program	Study on Blockchain Potentials
16			Study on Sensor Network Potentials
17	Operation Efficiency Program	Study on Vessels Berthing Management System	

OPERATION PILLAR

No.	Term Planning	Proposed Programmes	Proposed Projects
18	MID TERM (2020-2023)	Smart Logistics Management Program	Equipment and Container Tracking System Deployment
19			Study on Optimisation of Port of Call Process Coordinated with Inland Transport
20			Installation of IoT Sensors for Logistics
21		IoT and Data Analytics Program	Implementation of Blockchain
22			Implementation of Sensor Network
23		Operation Efficiency Program	Implementation of Vessels Berthing Management

2.7 Energy Pillar

The performance of port infrastructure and services in terms of energy consumption presents an important element to consider for the competitiveness of infrastructure services, port performance and the sustainability of transport and logistics.

This way, energy management by port authorities is presented as key when it comes to achieve the fact of being considered as a smart and sustainable port. There are many factors that have influence into the energy consumption of a port, from those elements whose consumption can be considered as direct and continuous as it is the lighting system of the port terminal area, offices and other facilities, the energy consumption of HVAC system of office buildings, the consumption of facilities of the garage, etc.; to other elements whose consumption can be considered more seasonal, it depends on the volume of activity that exists in the port. Inside this second group, it can be found the energy consumption by cranes, by the internal fleet of the port, or the consumption by the reefers, among others.

For both consumption groups, a deep analysis has to be developed to identify the existing saving possibilities, since the measures to carry out for both cases are too different between them. In the first case, the measures that have to be applied are more standard because they are related with the Steps of energy efficiency that normally are implemented into buildings of the tertiary building sector for its energy demand reduction. In the second case, measures will be more related with Step of operational management and volume of activity of the port. To perform the identification of the measures to apply in each case, the port authorities could proceed to carry out a certification in some of the national or international regulations in this field.

On the other hand, besides the measures for the reduction of energy demand and consumption in a port, Steps for the energy generation (electricity) can be carried out by means of renewable sources for self-consumption inside the port area. Thus, some technologies (wind technology, photovoltaic, marine technologies, etc.) can be applied to cover totally or partially the energy consumption of a specific equipment or facilities, or even for the whole port area.

Criterion selected for Energy Consumption (EC) are;

- EC1 Total Consumption of Energy (Primary Energy)
 - EC1.1 Total energy consumption (primary energy) by port authority per total port area (kWh / m²)
 - EC1.2 Total energy consumption (primary energy) by the container terminals per total terminal area (kWh / m²)
 - EC1.3 Total energy consumption (primary energy) by the bulk cargo terminals per total terminal area (kWh / m²)
- EC2. Energy Consumption by Containers / Bulk Cargo / Ships
 - EC2.1 Total energy consumption (primary energy) per container per total TEUS (kWh / TEU)
 - EC2.2 Total energy consumption (primary energy) by reefer container per total number of reefer container TEUS (KWh / reefer container TEUs)
 - EC2.3 Total energy consumption (primary energy) per bulk cargo per total tonnes (KWh / ton)
 - EC2.4 Total energy consumption (auxiliary and hotel system) per ship (KWh / Ship)

Note: Emission (tons) = $E = P \times LF \times A \times EF$

Where:

E = Emission (tons)

P = Maximum Continuous Rating engine Power (MCR) – KW

LF= Load factor

A = Activity (hours)

EF = Emission Factor (g/kw h)

NO_x : 4.2 g/kw h (s=1% assumed)

SO_x : 10.0 g/kw h

CO₂ : 670 g/kw h

- EC3. Energy Consumption by Internal Fleet (Trucks, Bus or Cars Owned by the Terminal Operators)
 - EC3.1 Total energy consumption (primary energy) by internal fleet per terminal area (kWh / m²)

- EC4. Energy Consumption by Offices (Terminal Operators)
 - EC4.1 Total energy consumption (primary energy) by office buildings per terminal area (kWh / m²)
- EC5. Energy Consumption by Lighting
 - EC5.1 Total energy consumption (primary energy) by lighting system (port terminal area, not office buildings) per terminal area (kWh / m²)
- EC6. Energy Consumption by Terminal's Equipment for Movement of Containers / Bulk Cargo Terminal (Quayside Cranes, Yard Gantry, Forklifts, Ship-To-Shore Cranes and Other Equipment for Internal Movements of Containers)
 - EC6.1 Total energy consumption (primary energy) by the terminal's equipment per total number of TEUS (kWh / TEU)
 - EC6.2 Total energy consumption (primary energy) by terminal's equipment per total terminal area (kWh / m²)
 - EC6.3 Total energy consumption (primary energy) by cranes per total number of cranes (kWh / crane)
 - EC6.4 Total energy consumption (primary energy) by the bulk cargo terminal's equipment per total number of TEUS (kWh / TEU)
 - EC6.5 Total energy consumption (primary energy) by bulk cargo terminal's equipment per total terminal area (kWh / m²)
 - EC6.6 Total energy consumption (primary energy) by pump (LNG tanks) per total number of pumps (kWh / pump)
- EC7. Use of Renewables
 - EC7.1 Percentage of energy from renewable resources managed by the port authority
 - EC7.2 Percentage of energy from renewable resources managed by the port operators
- EC8. Energy Management
 - EC8.1 Number of energy management certificates or arrangements according any standard (ISO 50001, etc, (by port authority and / or terminal operators) / (total number of terminal operators plus one)
 - EC8.2 Percentage of port activities covered by energy management system

Bintulu Port has not started from zero for energy conservations efforts, many initiatives have been introduced such as;

i. Existing shore power initiatives

The port provides shore power which is fully utilized by the tug boats (12 units).

The total capacity of the shore power is approximately 4 MW.

Can reduce diesel combustion emission.



Figure 17 Existing power shore initiative

ii. Existing alternatives fuel initiatives

Usage of LNG in replacement of diesel for boilers – using of clean fuel thus reduction of emission Sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) to the air.

Usage of solar panel for lightings in certain areas, in which is using of renewable energy.



Figure 18 Existing alternative fuel initiative

iii. Existing use of renewable energy initiatives.

Solar panel as a renewal energy source, is utilised since 1998 to power up to 16 units of buoys and transit light.



Figure 19 Existing use of renewable energy initiatives

List of Proposed SDGP Projects

ENERGY CONSUMPTION PILLAR				
No.	Term Planning	Proposed Programmes	Proposed Projects	
1	SHORT TERM (2019)	20% Renewable Energy Port Programme	Baseline calculation on Electric Powered Vehicles based on DEFRA	
2			Baseline calculation on Solar PV Powered Buoys & Bulkiers	
3			Co-Gen Biomass / LNG Power Plant Feasibility Study	
4			Sustainable Energy Management System (EMS)	Baseline calculation on application of LED Lightings, Inverter & VSDs
5				ISO 50001 Energy Management System
6				Energy Audit at Bintulu Port
7			Sustainable Energy Management System (EMS)	Energy Monitoring & Reporting
8				Online Energy Monitoring System
9			Carbon Neutral Programme	Feasibility study with BPSB on the Setting Up Cold Iron Onshore Power Supply (OPS) to Vessels
10	MID TERM (2020-2023)	20% Renewable Energy Port Programme	Renewable Energy Project	
11			Installation of Co-Gen Biomass / LNG Power Plant	
12			IR4.0 adoption	
13			Wireless IoT Network Infrastructure, Automated Renewable Energy Management System	
14	MID TERM (2020-2023)	Sustainable Energy Management System (EMS)	Energy Efficiency Retrofitting	
15			New EE Projects	
16		Carbon Neutral Programme	Cold iron implementation	
17	LONG TERM (2024-2030)	20% Renewable Energy Port Program	Implementation of automated Renewable Energy Management System	

ENERGY CONSUMPTION PILLAR

No.	Term Planning	Proposed Programmes	Proposed Projects
18		Sustainable Energy Management System (EMS)	Sustainable EMS
19		Carbon Neutral Programme	Carbon Neutral Project

2.8 Organisation And Management Pillar

Over the past half century, the shipping industry has reinvented itself time and again, ushering in containerization, larger vessels, and electronic data interchange. Despite the improvements, aspects of port operations remain firmly anchored in the past, dependent on manual and paper-based systems.

However, global trade is not standing still. Ever-increasing vessel sizes and cargo volumes continue to pressure ports and terminals, which must keep innovating just to keep up. Operators that want to maintain a competitive edge must adopt a digital competency and implement smart-port technologies to stay productive, customer friendly, efficient, and competitive. Progressive ports are embracing the same digital breakthroughs that are disrupting other industries. Among those disrupters: connected platforms, cloud-based services, mobile devices and apps, sensors and other Internet of Things technologies, augmented reality, autonomous transportation, blockchain technology, and big data. Thus, organisation and management in the port should proactive providing good support toward training and education, establishing managerial organisation for SDGP development, Issue annual SDGP report, promote SDGP to the public, maintain good communication with the local government, making SDGP policy part of the corporate culture, having regular and exclusive budget for SDGP performance, establishing environmental management and energy management information system, which aim in the improvement of the performance of ports.

Criterion selected relative to the Organization and Management (OM) issues within the context of Smart Digital Green Port (SDGP) development are;

- OM1.0 Organization and Management to Govern the Smart Digital and Green Port
 - OM1.1 Training or education for employers at the operational level
 - OM1.2 Establishing managerial organization for SDGP development
 - OM1.3 Issue annual SDGP report
 - OM1.4 Promote SDGP to the public
 - OM1.5 Maintain good communication with the local government
 - OM1.6 Making SDGP policy part of the corporate culture
 - OM1.7 Having regular and exclusive budget for SDGP performance
 - OM1.8 Establishing environmental management and energy management information system

Amongst existing management initiatives to save water:

Posters / stickers of energy and resources conservation are displayed on numerous strategic locations in the building to remind and create awareness for energy and resources saving.



Figure 20 Existing management initiative to save water

List of Proposed SDGP Projects

Organisation & Management Pillar			
No.	Term Planning	Programmes	Projects
1	SHORT TERM (2019)	SDGP Capacity Building Programmes	Train of Trainers
2		ISO Integration Management Program	Study on ISO ESH Integration Management System (IMS)
3		Sustainable Excellence Pilot Program	Sustainable Excellence Project Management Training & Reporting
4		Social Impact Assessment Program	Social Impact Assessment (SIA) Study
5		Study for Physical Security Information Management Program (PSIM)	Study for Physical Security Information Management Program (PSIM)
6		Integrated Port Information Management Program Implementation	Integrated Port Information Management System
7			Training & Capacity Building Program
8	SHORT TERM (2019)	Good Governance Program	Good Governance Trainings to BPSB staff
9		Sustainable Management Program	Corporate Training Courses to BPA and BPSB
10	MID TERM (2020-2023)	Implementation on Physical Security Information Management Program (PSIM)	Implementation of Physical Security Information Management Program (PSIM)
11		Study on Predictive and Prescriptive Modelling Program	Study for The Big Data Analytics Implementation
12		GRI.G4 Reporting Initiative	Prepare Yearly Sustainability Reports
13			Publication of Sustainability Reports

Organisation & Management Pillar			
No.	Term Planning	Programmes	Projects
14		System Integration Program	Application of ISO System Integration (ISO 14001, ISO 27001, ISO 50001, ISO 14064)
15	LONG TERM (2024-2030)	Study on Artificial Intelligence Decision Making Program	Study on Deployment of Machine Learning Algorithms and Programming KPIs
16		Business Intelligence Decision Making Program	Study on Business Intelligence Decision Making Programme

2.9 Environment Pillar

Environmental performance measurement in the port sector emerged since the last 10 years as a new challenge for port Authorities, which have to contribute to public policy to achieve a safe, efficient and environmentally sustainable in the port sector, operating as a key element for the competitiveness of current economy. Environmental performance indicators can be particularly useful both to the authority and a wide range of stakeholders in providing evidence of progress and the achievement of environmental objectives. In addition, the use of effective EPIs may contribute to cost and risk reduction, review of the effectiveness of an authority's Environment Management System, and act as an early warning system (Puig M., 2012). At the same time some criticalities emerged which are summarized below:

- Environmental Performance Indicators includes three different matrices (soil/waste, air and water) referring to different scientific backgrounds and engaged subjects;
- Port authorities generally do not have a clear, exhaustive and updated overview of Environmental data, this is because many companies are operating in the different Port concession areas and collecting data according to their specific field of activity;
- Available data are often detected with different protocols, unit of measure, based on different time- scales and frequencies. These aspects make difficult to do results comparison and sometime require an ad hoc elaboration.

From a technical point of view, the environmental performance criteria of sea ports depend on some specific factors, the most sensitive criteria in terms of sustainability improvements of ports are the qualitative ones (i.e. pollutants concentration in environmental matrices, especially with reference to water and wastewater).

Amongst the wild species of crocodiles that Bintulu Port wish to preserve their habitats.



Figure 21 Crocodile as one of the species in which their habitats are to be preserved

Criteria and KPIs selected relative to the environmental issue within the smart digital green port concept are;

EV1. Environment Management Systems

- EV1.1 Number of environmental management systems based on international standards – MARPOL, SOALS or ISO 14001 – implemented by port authority or / and port operators / Total number of terminal operators plus one
- EV1.2 Percentage port activities covered by environmental management systems

EV2. Wastes Management

- EV2.1 Number of wastes management plans implemented by port authority or / and port operators / Total number of terminal operators plus one
- EV2.2 Percentage port activities covered by waste management plan
- EV2.3 Total wastes generated by all port activities (Tons) – waste from ships- MARPOL wastes – are not included per total port area
- EV2.4 Total wastes generated by terminal operators per TEU (Ton / TEUS) – The wastes from ship – MARPOL wastes – are not included
- EV2.5 Total wastes generated by ships (MARPOL wastes) disaggregated per kind of wastes and per vessels stops (Tons / vessels stops)
- EV2.6 Total hazardous wastes generated by all port activities disaggregated by sources per total port area – The wastes from ships – MARPOL wastes – are not included (Tons / m2)

- EV2.7 Total hazardous wastes generated by the terminal operators disaggregated by sources and per TEUS - The wastes from ships – MARPOL wastes – are not included. (Tons / TEUS)
- EV2.8 Total wastes collected in a selective way from all port activities (organic, plastics, paper, wood, electronics, etc.) (Tons / m²)
- EV2.9 Total wastes generated that are intended to operations of reuse, recycling and / or valorisation operations disaggregated per kind of wastes per total port area (Tons / m²)
- EV3. Water Management
 - EV3.1 Total water consumption by all port activities per total port area (m³ / m²)
 - EV3.2 Total water consumption by terminal operators per TEUS (m³ / TEUS)
 - EV3.3 Total water consumed by ships per vessel's stops (m³ / vessels' stop)
 - EV3.4 Percentage of the volume of water consumed that come from reuse operations (in all port area) against the total volume of water consumed
 - EV3.5 Total wastewaters generated by all port activities per total port area (m³ / m²)
 - EV3.6 Total wastewaters generated by the terminal operators per TEUS (m³ / TEUS)
 - EV3.7 Percentage of the total volume of wastewaters from all port activities that are treated for reuse against the total volume of wastewaters in the port
- EV4. Emission to Air
 - EV4.1 Number of monitoring systems to access air quality in port area per total port area
 - EV4.2 Greenhouse gas emissions from all port activities per total port area (CO₂ equivalence Tons / m²).
 - EV4.3 Encourage use of low-Sulphur fuel by given the incentives (type of incentives)
 - EV4.4 Numbers of dust control equipment
 - EV4.5 Manual plan for air pollution management
 - EV4.6 Regulation on the emission of the toxic gas

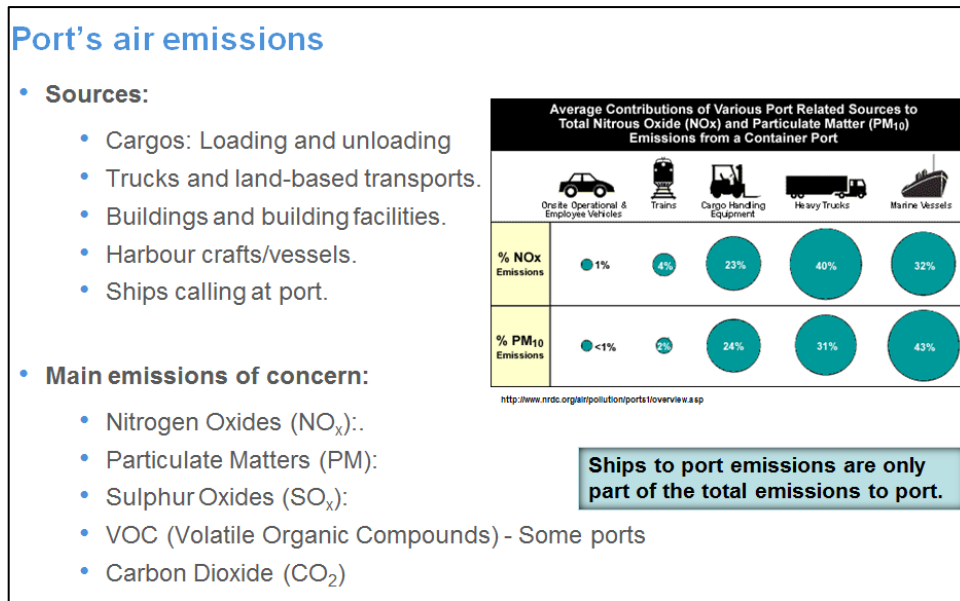


Figure 22 Port's air emissions

EV5. Noise Pollution:

EV5.1 Lden – noise pollution (Lden is an indicator to the overall noise level during the day, evening and night which is used to describe the annoyance caused by exposure to noise. These are long-term averaged sound levels, determined over all the correspondent periods of a year. All of these indicators are defined in terms of A-weighted decibels (dBA, dB(A))

EV5.2 Lnight* - noise pollution (Lnight is an indicator for the sound level during the night used to describe sleep disturbance)

EV6. Leaks and Spills of Polluting Substances at Sea

EV6.1 Total leaks and spills (Tons) of polluting substances at sea per vessels stops

EV6.2 Number of monitoring system to access water quality (temperature, salinity, fecal coliforms, etc.) in port area per total quay berth

EV6.3 Number of fuel spilling contingency plan in port area

EV6.4 Hazard waste management system

EV6.5 Ballast water pollution control system

EV6.6 Waste dumping management

Existing water quality monitoring



Figure 23 Existing water quality monitoring

Existing air quality monitoring



Figure 24 Existing air quality monitoring

Existing sea bed ecology monitoring



Figure 25 Existing sea bed ecology monitoring

We are committed to provide our logistics services and connectivity in an environmentally sound manner to better serve our employees, customers and community towards a sustainable future.

Environmentally sound means:

*Managing our business with ISO certified ESH management systems,
Accounting for the environmental aspects and impacts, health and safety risks of all key stakeholders.*

*Complying to national and international legislations and best practices
Addressing air, water, waste, energy use, carbon footprints, new technology and sustainability reporting as major areas of improvements.*

List of Proposed SDGP Projects

Environment Pillar			
No.	Term Planning	Programmes	Projects
1	SHORT TERM (2019)	Environment Conservation Program	Feasibility Study on Rain Harvesting for Fire Fighting Water Project
2		Bintulu Port Coast Conservation Program	Bintulu Port Coast Conservation Project
3		Environmental Regulatory Compliance	Regulatory Compliance Assessment Project
4		Bintulu Port Oil Spill Response Training Project	Bintulu Port Oil Spill Response Training Project
5		Green 5S Implementation Program	Reactivation Annual Target Setting
6		Pollution Control Technology Program	IoT Environmental Sensor and Network
7	MID TERM (2020-2023)	Water Quality Management	Water Quality Assessment
8		Integrated SDGP City Program	Port City Master Plan Integration
9		IoT and Data Analytics Program	Environmental Management System
10	LONG TERM (2024-2030)	Environmental Sustainability Program	Environmental Eco-system Assessment and Integrated Reporting

3.0 STRATEGIC DIRECTIONS

Strategic direction of SDGP is a course of Step that leads to the achievement of the goals of blueprint's strategy. A strategic direction is one of the most important forces in this blueprint. It establishes the structure for internal and external responsibilities that each stakeholder and staff take on. A clear vision allows each stakeholder to know the SDGP's purpose and objectives. Strategies and tactics allow each stakeholder to understand the part they play in contributing to the achievement of the vision and objectives.

3.1 Logistics Frameworks

In the context of infrastructure provision, ports are no doubt critical elements in the formation of effective gateways since the bulk of international trade is carried out by sea and thus ports can play a critical role in the facilitation of international trade. Over 90 percent of trade volumes are shipped and maritime transport provides low-cost and efficient transportation especially for less time sensitive products. **Ports therefore have significant implications for gateway logistics performance by impacting on the physical distribution of channel in terms of cost, quality of service, timeliness and risk.** Further, ports can improve the gateway logistics performance by providing an efficient, safe and effective trans-shipment service and providing the interface between the sea and land transport between countries and regions. In the light of increasing globalization and internationalization of production and distribution, supply chains are becoming more complex and globalized spanning various continents and regions.

i. Strategic location

To become a gateway port, a port must be strategically located. UNCTAD (1992) states that a port is strategically located, if it has at least one of the following three characteristics: situated on the main maritime routes; situated in or near production and/ or consumption centers; with natural deep-water harbours, natural breakwater and big waterfront and landside development possibilities. Bintulu Port has all the three characteristics as mentioned. Moreover, a good geographical location should also be one where favourable climatic conditions prevail. Harsh weather can obstruct the daily operations at a port and hinder its development.

ii. Efficiency

While the geographical location is a prime factor for a gateway status, it is worth noting that many ports without such good natural conditions have obtained very big market shares by promoting other competitive factors. Competitiveness defines as the ability to get customers to choose a particular service over competing alternatives on a sustainable basis. In the context of sustainability, Bintulu Port will embark into smart digital green port initiatives to enhance their efficiency, productivity and to stay relevant to future digital port business.

Efficiency often means speed and reliability of port services. In a survey conducted, 'on-time delivery' was cited to be a major concern by most shippers (UNCTAD, 1992). In fast-paced industries where products must be moved to the markets on time, terminal operators as vital nodes in the logistic chain must be in a position to guarantee shipping lines very reliable service levels. These include on-time berthing of vessels, guaranteed turnaround time for vessels and guaranteed connection of containers.

iii. Adequate Infrastructure

Infrastructure in its widest context refers not simply to the number of container berths, cranes, tugs and size of terminal area, but also to the quality of cranes, quality and effectiveness of information systems, availability of inter-modal transport (such as roads and railways), the approach channel provided and the preparedness or otherwise of the port management. If the volumes handled far exceed a port's cargo-handling capacity, this will result in port congestion and inefficiency, and thus can turn off port users.

Furthermore, limited access to current information about shipment arrivals due to lack of adequate information system will slow the documentation process and thus the smooth functioning of a port. Without adequate inter-modal links, shipper cannot easily move cargo to and from the port, which could lead to congestion, delays and higher costs.

Apart from upgrading the physical infrastructure and equipment to meet future demand, Bintulu Port also having a plan to upgrade their ICT infrastructure for digital transformation programs under SDGP blueprint.

iv. Connectivity

A recent trans-shipment study by UNCTAD (1992) proposes that veritable grid networks assembled around trans-shipment ports where different trade routes intersect and interconnect have replaced traditional port-to-port routes. Big transoceanic shipping lines begin to take advantage of the flexibility and the scope for modulation allowed by the container technique to reorganize and restructure shipping services to regions of heavy traffic. A gateway port should, therefore, provide comprehensive connectivity to other ports.

Moreover, time is of essence. Containers awaiting trans-shipment at gateway ports are costly and counter-competitive in terms of transit time. Whenever possible, operators should strive for tight connection between feeder and mother vessels. Gateway ports should maintain the same objectives and encourage port users who support such initiatives with attractive incentives. To ensure fast connections, gateway ports which employ single or common user terminal will have advantage over those that require inter terminal transfers.

v. Range of Port Services

Statistics have shown that vessels are calling at a port for more than two purposes. It infers that ports should provide a range of services such as bunkering, pilotage, warehousing, cold storage and other value-adding services. Importantly, they should be integrated so that the port can be a one-time stop for ship owners. Besides choosing from a competitive supply, the present customer also wants to individualize their purchase.

The globalization of industries has resulted in flows of materials and information from a multitude of sourcing and manufacturing points to a diversity of markets with specific requirements of customer service. Consequently, the routing of logistic chains is getting more complex. The integral control of activities is becoming a critical factor for competition.

This supply chain management includes coordinating and streamlining activities of all firms in the chain. A precondition for effective chain integration is the existence of a channel captain, who can bind all parties and activities. With regards to the individualization of the location requirements of activities, the streamlining of operations in logistics chains can result in the spatial separation of activities to relocate every link of the chain at the optimal site. It necessitates the development of centralized warehousing and distribution which are sometimes linked to final assemblage and marketing.

3.2 Industry Trends and Movements

As trade and cargo volumes continue to grow internationally, ports around the globe are looking to new technologies to help manage resources in a more sustainable and cost-effective manner through digitalisation and big data.

By going digital, connectivity and automation will help reduce environmental footprints of the port industry along with intelligent transport systems, which have a huge potential to reduce co2 emissions. According to the United Nations Conference on Trade and Development (UNCTAD), the world shipping fleet grew by 3.5% to carry 1.75 billion deadweight tonnage (DWT) of cargo in 2015.

As ships get bigger and international trade increases, ports around the world are improving maritime infrastructure and enhancing port facilities with smarter, more intelligent designs with the help of technology.

This technological phenomenon falls under the category of the Internet of Things (IoT). IoT is about the connecting of devices and intelligent utilisation of data, which creates visibility for asset management and visibility of where savings potential is.

“Digital ports”

Current trends in automation are focused on automating both equipment handling and operational processes for ports and terminal operators. Through the Internet of Things (IoT), ports are being integrated into a maritime information network, where relevant data is accessible and shared with shipping partners in a secure environment. Automatic processing of cargo information across this maritime network will provide container movement transparency and efficiency, as well as support other port processes associated with the flow of containerised cargo.

One of the greatest areas that can benefit from IoT is in energy efficiency and demand management, indicating that intelligence can be used to improve productivity and energy efficiency.

The use of smart sensors to detect and stop wasted energy in buildings supports the goals of the Port’s climate Step plan and is anticipated to contribute to future declines in greenhouse gas emissions. This collaboration demonstrates how the capture and use of data can reduce energy and save money, which can encourage similar deployments in buildings and communities throughout the region.

“High Demand for LNG”

After its pause from 2012 to 2014, LNG trade has expanded significantly over the past three years and reached almost 29 Mt in 2017. This is an increase of 10% compared to 2016 and the third consecutive year of growth. The Asia-Pacific region is the main demand centre for LNG consumption, accounting for almost three quarters of total LNG imports.

Most of the increase in 2017 is due to a surge in Chinese and European LNG imports. Imports by China increased by 42% in 2017 to 39 Mt, exceeded only by Japan's imports of 83.5 Mt. China surpassed South Korea to become the world's second-largest importer of LNG. The sudden and strong increase in Chinese LNG imports has been driven by government policies designed to reduce air pollution. The Chinese government has implemented policies to convert several million residential households in China's northern provinces, which traditionally rely on coal heating in the winter, to use natural gas-fired boilers instead. The new regulation led to growing imports in preparation of the winter season, reinforced by surging imports at the end of the year due to extreme cold weather in the winter season.

Strict new regulations on shipping fuel are driving ship-owners to utilize liquefied natural gas (LNG) as a greener option, and many ports now are preparing to launch upgraded refuelling facilities in response to the forthcoming big mutation of the shipping industry.

According to International Maritime Organization (IMO) rules which will take effect in 2020, ships will be banned from burning fuels with a sulphur content exceeding 0.5 percent, versus current 3.5 percent, unless they have measures to reduce sulphur emissions. The forced shift of shipping power from heavy fuel oil or the lighter gas oil to LNG aims to reduce air-polluting emissions of nitrogen oxides and sulphur oxides by 90 to 95 percent, according to IMO.

3.3 Critical Supply Chain

Supply chain has seen tremendous transformation in the last decade. A lot of this transformation can be credited to digitization. By introducing advanced technology in the supply chain cycle at various crucial stages, work has become efficient and cost effective.

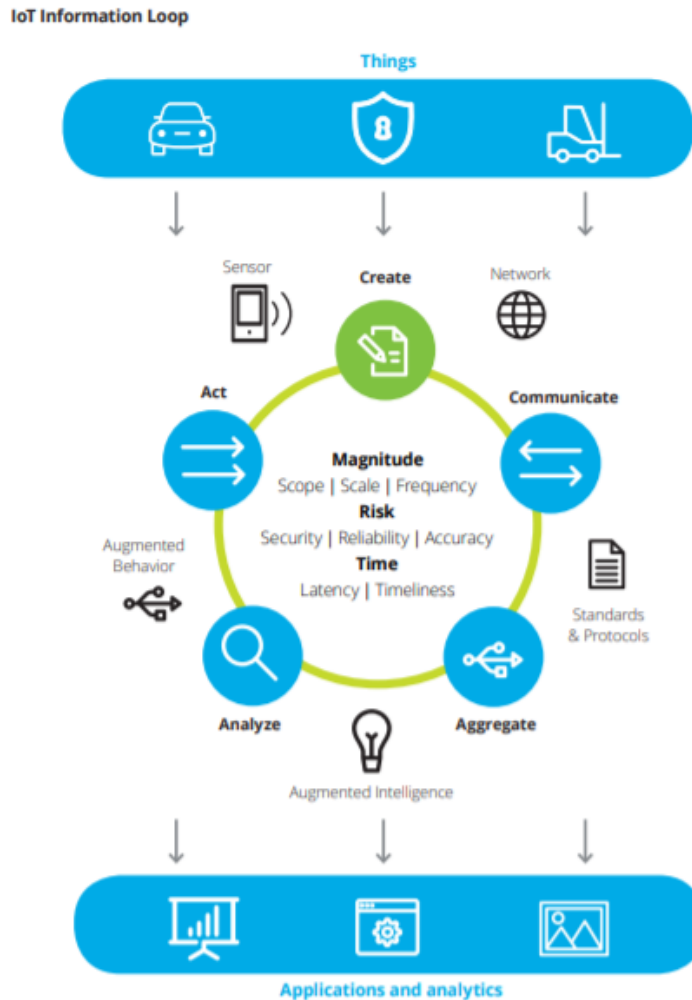


Figure 26 IoT information loop

Some of the main benefits of going digital are;

- i. **Time and Transparency:** A digitized process has to be standardized, else it does not work. Standardization helps create transparency in the system. It reduces the scope for human errors, manipulation of prices and inventory. Digitization will ensure a speedy completion of tasks.
- ii. **Documentation Management:** Documents are a major part of shipping. Maintaining multiple documents and filing them takes up both time and space. Taking the process online will help save on both. In future, it can also help create an integrated documentation platform that can be accessed by all the parties (exporter, importer, shipping lines, ports, banks, storage) involved in the transStep. Thus, paving the way to a paperless system.
- iii. **Door – to – Door Tracking:** New technology is making it possible to track containers on a real time basis. This will go a long way in helping customers provide updates to their business partners and plan further logistics.
- iv. **Improved Analytics:** Availability of data from all touch points and tools to analyze that data to help make better business decisions is one of the main offerings of advanced technology. Shipping lines can use data collected from various sources to offer better services, plan new trade routes, and allocate space.
- v. **Better Operational Integration:** Transporting a shipment from one location to another involves participation of different modes of transportation and handling at different touch-points. If all of the services can be integrated, it will help provide a seamless experience to the shipper and reduce loss arising out of delays and operational inefficiency for the service providers. It will also help various service providers – ports, road & rail transporters, storage, and shipping lines to plan better and ensure maximum utilization of their space and equipment.

4.0 SDGP BLUEPRINT IMPLEMENTATION

Bintulu Port is on a path towards becoming a green port. By adopting the SDGP Blueprint, setting up sustainability team and initiating various green measures, the port has demonstrated its commitment towards a green agenda. Never the less, implementation of the SDGP require for the following key actions;

- Coordination between multiple stakeholders, private sector, community organizations and staffs;
- An adaptive management approach where the steps can be changed if needed (based on monitoring, evaluation of baseline data, and staff feedback);
- Capacity building efforts;
- Knowledge of funding sources, and facility to raise capital; and
- Tools such as a database to keep track of project implementation.

Governance - Bintulu SDGP Committee

STEP 1: Establish a Bintulu SDGP Committee

Since the steps proposed in the SDGP require a multisector approach where numerous stakeholders and agencies need to take the lead on implementation, an institutional mechanism is required to coordinate efforts and to ensure that steps are undertaken in a timely manner. A SDGP Committee should be established, with strong support from the management, and be given the responsibility to overview and advice the implementation of the SDGP.

The proposed composition of the committee is as follows;

- It should be a multi discipline committee with the Bintulu Port GM or his representative as the chair;
- Representatives from the Port Operator;
- It should include representatives from the Sustainability Team, and port departments responsible for operation, legal, human resource, SHE, engineering and ICT;
- One representative from the MOT;
- One expert in SDGP from an academic institution or industry (appointed by the Bintulu Port GM);

- One member from a local environmental NGO (appointed by the Bintulu Port GM);
- One member from the local community nearby Bintulu Port;
- One at-large member appointed by the Bintulu Port GM depending on the needs of the committee (revolving position);

BINTULU SDGP PROGRAMS CONCEPTUAL FRAMEWORK

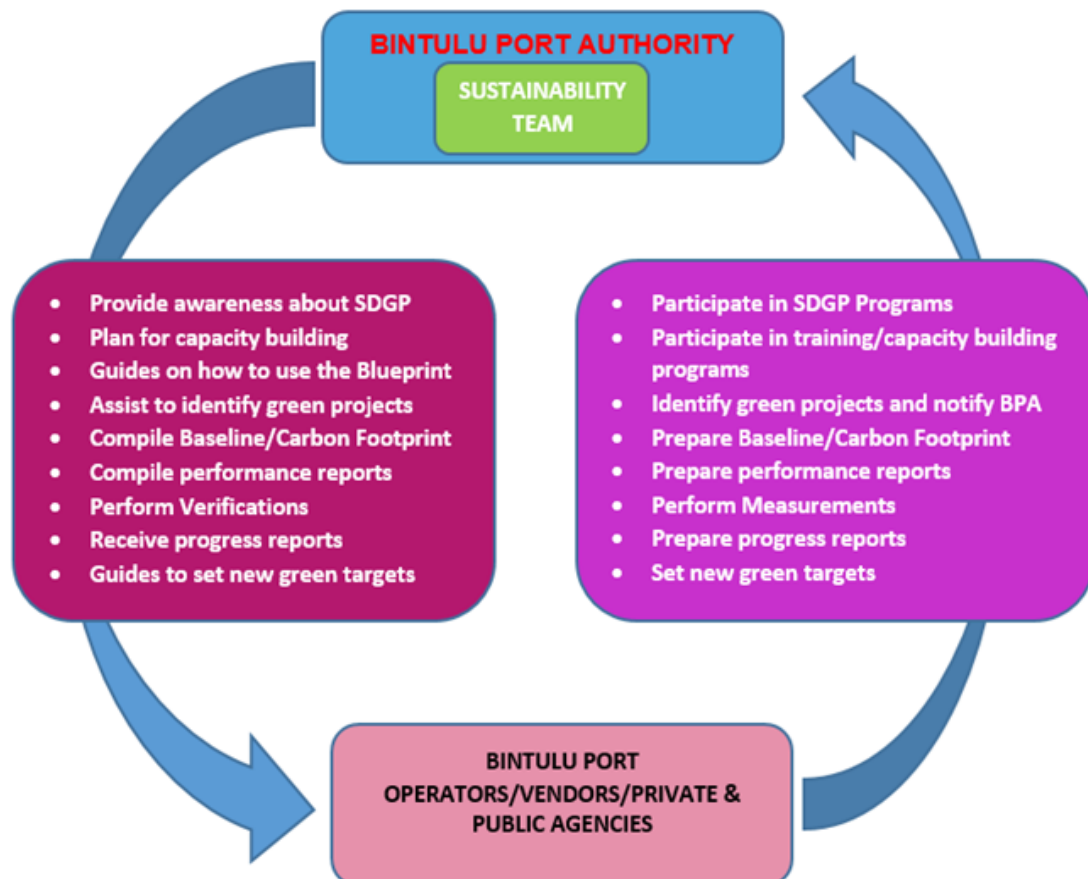


Figure 27 Bintulu SDGP Programmes Conceptual Framework

Bintulu SDGP Stakeholders

The following stakeholders are operating fully or partly within Bintulu Port boundary and need to subscribe to the Bintulu SDGP Blueprint;

1. Bintulu Development Authority
2. Jabatan Laut Malaysia
3. Jabatan Alam Sekitar
4. Jabatan Kastam Diraja Malaysia
5. Jabatan Kesihatan Malaysia
6. Lembaga Sungai Sarawak
7. Bintulu Port Sdn Bhd
8. Biport Bulkera Sdn Bhd
9. Malaysia LNG Sdn Bhd
10. Asean Bintulu Fertilizer Sdn Bhd
11. Petronas Dagangan Berhad
12. Petronas Shell Terminal (PST)
13. Shell MDS (Malaysia) Sdn Bhd
14. Bintulu Adhesive & Chemicals Sdn Bhd
15. Murphy Oil Sdn Bhd
16. BINTULU PORT GMS Cement Sdn Bhd
17. Mastar Corporation Sdn Bhd
18. Syarikat Sebangun Sdn Bhd
19. Bacom Sdn Bhd
20. Behn Meyer AgriCare (M) Sdn. Bhd
21. Best Success Bonded Store Supply Sdn Bhd
22. Leasing Logistics & Owner
23. Destiny Holdings Sdn Bhd
24. Press Metal Sarawak Sdn Bhd
25. Intercargo Sdn Bhd
26. Bintulu Container Sdn Bhd
27. SOP Green Energy Sdn Bhd

STEP 2: Partner with a local university

To set up a SDGP Knowledge Center as a research arm to BP and work collaboratively with the Sustainable team to research and develop knowledge products and training on SDGP practices, baseline data, monitoring and SDGP update.

STEP 3: Prepare baseline data

To ensure that Bintulu Port is on track to become a SDG port, one of the first steps is to establish a baseline of existing conditions. A list of indicators has been identified under each topic area addressed in the SDGP. Under the guidance of the SDGP Committee, and in coordination with existing departments and the Operator, Bintulu Port should establish a process for collecting data for each indicator. The data collection should be based on a consistent methodology that can be replicated over time. If needed, modify the identified targets and indicators in the SDGP after baseline data is collected.

One of the baseline data required for SDGP is carbon footprint. Elements in the carbon footprint management are divided in to three action levels;

- i. Management Decisions
- ii. Carbon Accounting
- iii. Emission Reductions

Action 1 - Management Decisions

- What do BP want a carbon management strategy for?
- Which methodology do BP use?
- What do BP stakeholders want and which policies are relevant for BP?
- What are the objectives, risks and opportunities?
- What is BP communication strategy?
- What is BP emission reduction target?

Action 2 - Carbon Accounting

- a. Establish a carbon footprint, making relevant choices;
 - Ownership: who owns the emission? The owner of the shares or the operator of the installation?
 - Baseline: what is the baseline year, and when are emissions recalculated? Recalculation is necessary when new operations are included or when the calculation methodology improves or changes
- b. Carbon footprint GHG emission sources;
 - Company cars
 - Operational vessels
 - Operational machines
 - Cranes
 - Commuting employees
 - Electricity usage buildings, harbour lighting, lighthouse, cranes, etc
- c. Reported GHG emissions;
 - Mandatory reporting of scope 1 (direct emissions) and scope 2 (energy indirect emissions).
 - Stakeholders may be interested in certain scope 3 emissions (other indirect emissions). This can include the GHG emissions related to subcontractors (e.g. dredging) or business travel and commuting.

Action 3 - Implementing the footprint

- Develop a GHG manual (protocol and emission report)
- Educate and organize people
- Emission reduction considerations;
 - How much can be reduced?
 - Different ways of reducing emissions
 - Against which costs?
 - When and how?

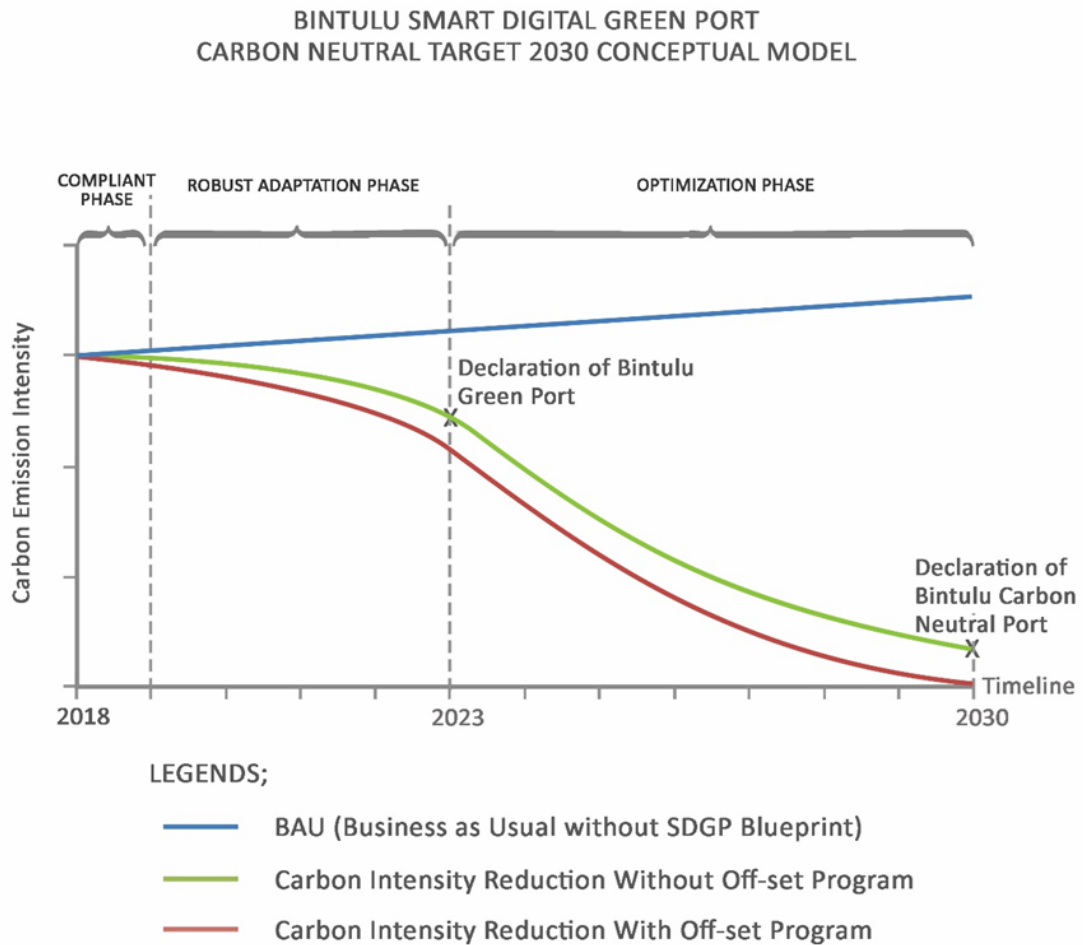


Figure 28 Bintulu Smart Digital Green Port Carbon Neutral Target 2030 Conceptual Model

STEP 4: Prepare SDGP Annual Report

On an annual basis, the Sustainability team should prepare a brief report on the indicators. The purpose of the report will be to monitor the progress being made as a result of implementing the proposed projects. The report should also address whether the proposed projects need modification (based on data analysis) and if additional projects are needed to reach the targets.

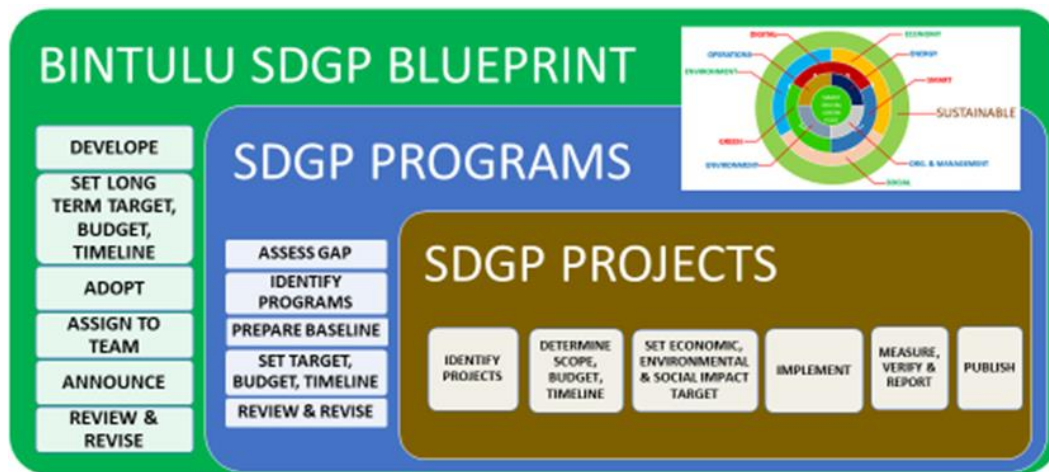


Figure 29 Bintulu SDG Port Blueprint Breakdown Structure

STEP 5: Update the SDGP

After three years from start of this plan, the SDGP Committee should evaluate whether the SDGP needs modification. If needed, the SDGP should be updated to change / delete proposed projects or to include additional projects that may be needed.

Capacity Building and SDGP Partnerships

STEP 6: Continue study tours

Lack of experience (or knowledge) remains one of the biggest limitations towards pursuing SDGP. Bintulu Port has initiated a series of study tours to increase awareness about technologies and green port approaches amongst their staff. Bintulu Port should continue study-tours as one of the approaches for capacity building and raising awareness about new trends in smart digital green port.

STEP 7: Pursue SDGP Partnerships

The SDGP Partnership is to foster peer-to-peer learning between ports that have demonstrated leadership in smart digital green transformation and ports that are seeking to pursue similar efforts. BP will be one of the first ports to benefit from this partnership program.

The purposes of this partnership program will be as follows;

- Develop core capacities at national and local levels;
- Engage “mentors” from “transformed ports”, academia, private sector, local government;
- Share knowledge, practices and processes of change;
- Improve competency in integrated ICT planning, climate resilience, energy efficiency and project management;
- Develop skills and vocational training; and
- Identify innovative financing mechanisms for SDGP.

Raising Public Awareness

The port needs to partner with residents, the private sector, non-governmental agencies and other institutions to realize the vision for a SDG Bintulu Port. An important step towards establishing that partnership is raising awareness about the benefits of pursuing a green path in Bintulu Port.

STEP 8: Develop a long-term public awareness program

The BP should partner with the Department of Environment to establish an expanded and long-term program that seeks to raise public awareness about the SDGP. The ongoing programs provide lessons that Bintulu Port can draw upon to develop a long-term program.

STEP 9: Organize public forums on the SDGP

The Sustainable team should organize regular public forums to discuss various elements of the SDGP. The forums should also provide a platform for engaging residents and institutions in the implementation of some of the proposed projects.

STEP 10: Set up a SDGP column on website

Bintulu Port is already accustomed to disseminating public information through dedicated websites. The Sustainability team, with assistance from the SDGP Committee, should consider setting up a column on website for SDGP. Information on the status of implementation, public awareness events, data and knowledge products related to the SDGP, and monitoring reports, should be provided on that column.

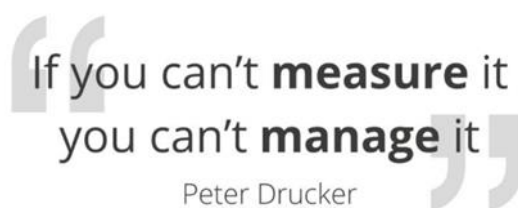
STEP 11: Conduct annual public surveys

The Sustainability team should provide space on the project website for staff comments and prepare a monthly summary of the comments received. In addition, the Sustainability team should conduct an annual public survey (through the website) to gather comments on public perceptions and interests related to the implementation of the SDGP. The comments should be incorporated in the annual monitoring reports and should provide valuable information for the update of the SDGP.

Private Sector Engagement

Implementing projects proposed in the SDGP will require participation from both the public and the private sectors. The private sector can be a key partner in pushing innovation, improving environmental performance, and providing financing for green activities.

5.0 MONITORING AND MEASURING SUCCESS



Monitoring and measuring success of SDGP is a complex issue and is often place-specific, as each port operates within a distinct ecosystem and economic peculiarities. Sustainability team must reconcile how to monitor quantitative indicators of sustainability such as air and water quality, with qualitative measures of human wellbeing and society engagement. The challenges faced normally are;

- Identifying relevant data to measure success under the various indicators
- Bridging the gap between academic understandings of SDGP indicators and supply chain requirements, operational functions and international environmental regulations
- Limited staff, time and resources
- Availability of data from stakeholders

Assessing a BP progress towards a sustainable smart digital green future is essential for a SDGP blueprint. Selection of monitoring and evaluation tools is a challenge for assessment. A one size fits all toolkit would be ideal, for comparative purposes and absolute goals; however, ports and operators are subject to different technical priority and economic conditions that impact. What is essential to both is a baseline assessment of a BP current port in terms of the SDGP criteria and indicators to be measured. Without baseline data, which most sectors have gathered in the process towards developing SDGP, monitoring and evaluation is impossible. The data will guide the selection of indicators used to monitor progress from the SDGP programs.

The primary objective of SDGP Performance Monitoring is to help Sustainability project managers and their teams foresee potential risks and obstacles that if left unaddressed could derail the project. Project Monitoring refers to the process of keeping track of all project-related metrics including team performance and task duration, identifying potential problems and taking corrective steps necessary to ensure that the project is within scope, on budget and meets the specified deadlines.

Secondary objectives include;

- i. Facilitating knowledge exchange and dialogue on sustainability between ports locally and globally.
- ii. Promoting creative solutions and innovative projects used by ports to reduce their environmental impact and increase efficiency and productivity.
- iii. Assist BPA to move from plan-writing to implementation and measuring sustainability targets.

The Sustainability team can use online Self Diagnosis Method to assess environmental management performance (Ecoports, 2017c). Port Environmental Review System (PERS) was developed by ports through an ESPO initiatives. Currently, 32 EU ports have PERS certifications.

BP also can seek various ISO certifications such ISO 50001 (Energy Management), ISO14001 (Environmental Management System), or the Eco-Management and Audit Scheme (EMAS) certifications which they need to work with the certifying body.

SDGP Individual Project Reports

This Bintulu SDGP Individual Project Report is expected to be a short document, regardless of project size and should not be any longer than the template. The primary purpose of this report is to communicate to the stakeholders if the project is on track and to indicate where it is not on track and what is being done about this. This reporting is the practice of measuring, disclosing, and being accountable to internal and external stakeholders for organizational performance towards the goal of SDGP development.

Annual Sustainability Report

Sustainability reporting is a broad term considered synonymous with others used to describe reporting on economic, environmental, and social impacts (e.g., triple bottom line, corporate responsibility reporting, etc.). A sustainability report should provide a balanced and reasonable representation of the sustainability performance of a reporting organization – including both positive and negative contributions.

Sustainability reports based on the GRI Reporting Framework disclose outcomes and results that occurred within the reporting period in the context of the organization's commitments, strategy, and management approach. Reports can be used for the following purposes, among others:

- Benchmarking and assessing sustainability performance with respect to laws, norms, codes, performance standards, and voluntary initiatives;
- Demonstrating how the organization influences and is influenced by expectations about sustainable development; and
- Comparing performance within an organization and between different organizations over time.



Figure 30 Sample of Sustainability Report

Other Certifications

The WPCI “World Ports Climate Initiative” which the most representative association of Ports worldwide regarding the climate change and the reduction of the release of greenhouse effect gases.

In order for BP to maintain the momentum of the SDGP and advance their progress, there are several key notes to keep in mind;

- i. Resources: Ports can be constrained by the availability of data and information; however Sustainable Team must remember that there are other various means to access to resources
- ii. Baseline Data: Connected to resources is baseline data; SDGP have little value in the absence of baseline data. BPA must have a starting point, from which to establish their sustainability goals. Data provides a quantifiable means to measure success
- iii. Clear Vision: need to have a vision of their future in the context of sustainability. Further the vision needs to be shared by all members of the community, to achieve success. Civic engagement is a vital piece in the development of SDGP. As most of the green ports have demonstrated public engagement has played a key role in developing the plan and continues to serve as a tool for evaluating success yearly.
- iv. Knowledge Exchange: The purpose of this report is to highlight the important of integrated sustainability planning and creation of opportunity. Ports may face unique challenges to sustainability, based on their geography, however an opportunity to learn from another port can serve as a starting point for innovation to addressing sustainability challenges specific to their context.

Bintulu Port Authority is committed to SDGP as demonstrated by indicators and plans that have been presented in various precedent reports. Thus, it is hoped that as BP progress they will continue to engage in dialogue that will enable them to share knowledge and ideas related to measuring SDGP performance.

6.0 CONCLUSION

The smart digital green port is the concept introduced by the Bintulu Port Authority to achieve their main missions; to be full-fledged green port, full-fledged digital port and carbon neutral port within time frame from 2023 to 2030. Recognizing current challenges in port operations worldwide with stricter maritime environmental requirements, complexity of logistic supply chain and application of digital technology, BPA top management and the Ministry of Transport Malaysia has decided to commence the first step with development of smart digital green port blueprint.

SDGP Blueprint document is to provide clear guides to Bintulu Port Authority management, sustainability team, and staff and all stakeholders and, importantly the Port Operator on way forward and methodology to implement and manage the programs in order to achieve the missions according to the targeted timelines. SDGP blueprint consist of all elements related to the mission; blueprint strategic mission and vision, SDGP purpose and approach, SDGP policy statement, regulatory alignment, strategic objectives, strategic outcomes, blueprint development process, detail SDGP criteria and indicators, SDGP strategic directions, current logistics frameworks, maritime industry trends and movements, critical supply chain for SDGP, SDGP blueprint implementation methodology, summary matrix of proposed initiatives and, monitoring and measuring success procedures.

The successful implementation of SDGP blueprint will gives BP the following direct and indirect benefits;

CLIMATE CHANGE

- ✓ BPA able to manage their carbon emissions and use the data and information for environmental and economic benefits.
- ✓ Carbon neutral initiatives is still new in Malaysia, BPA can be a leader and mentor to other ports.
- ✓ BPA can collaborate and get certification for green port status from the World Port Climate Initiative (WPCI).

ECONOMY

- ✓ BPA can capitalise on new brand; a Certified Green Port, a Full-fledged Digital Port and Carbon Neutral Port in their promotions and business dealings worldwide. BPA can also form smart digital green ports alliances to position them as champion of new digitally environmental sounds port.
- ✓ Higher economic multiplier due to increase in trade for LNG, Palm Olein and local exports.
- ✓ Applications of smart digital instruments will increase the efficiency and reduce the operations costs.

ENVIRONMENT

- ✓ BP has the opportunity to implement low sulphur fuels rules to be par with other ports.
- ✓ Implementation of online environmental monitoring will help BPA to closely monitor and report the port environmental status.
- ✓ Development of eco-park will be a new signature of Bintulu SDG Port.

SOCIAL

- ✓ SDGP will increase direct and indirect employment in line with increase of port productivity.
- ✓ 50% of workforce are certified competent workers indirectly can solve new minimum wage requirements.
- ✓ BPA able to implement capacity building and promote local culture programs as part of their CSR and CER contributions.

MANAGEMENT AND ORGANISATION

- ✓ BPA able to produce Sustainability Report according to GRI standards with the designated team to manage SDGP projects performance and supported by online monitoring and reporting system.
- ✓ This SDGP blueprint will provide basis for another detail blueprint development specific for ICT implementation.
- ✓ SDGP indicators can indirectly increase and measure organisational efficiency.
- ✓ Implementation of sustainable procurement and green supply chain capacity development will reduce operation costs in long term.
- ✓ BPA can share and work closely with BDA for future smart digital green port city development.
- ✓ BPA can reduce costs and man-hours by integrating all ISO certifications.

REFERENCES

1. Acciaro, M., Vaneslander T., Sys C., Roumboustos A., Giuliano G., Siu Lee Jam J., Kapros S. 2013. Innovative Green Ports: A Framework for the Success of Innovation in Ports in the Area of Sustainability, in The International Association of Maritime Economics (IAME) Annual Conference, 3-5 July, Marseille.
2. Acciaro, M., Ghiara, H., Cusano, M.I. 2014. Energy Management in Seaports: A New Role for Port Authorities. *Energy Policy*, 71 (August). pp 4-12.
3. ANPA (1999), Methodological guide for monitoring and management of environmental aspects in port areas. ECO-information in European ports projects Volume 1.
4. Bailey D., Solomon G., (2004), Pollution prevention at ports: clearing the air. In *Environmental Impact Assessment Review*, vol. 24, no. 7-8, pp. 749-774.
5. Canero, F., Cerban, M.M., Piniella, F. 2011. Optimization of operations in maritime container terminals. *Journal of Maritime Research*, Vol. VIII. No. 3, pp. 29-50.
6. Chiu R.H., Lai I.C., (2014) Evaluation of Green Port Factors and Performance: A Fuzzy AHP Analysis, in *Mathematical Problems in Engineering*, Volume 2014, 1-12.
7. Cullinane, K., Song, D. -W., Ji, P., Wang, T.-F. 2004. An application of DEA windows analysis to container port production efficiency. *Review of Network Economics* 3 (2), pp 7.
8. Cullinane, K., J., P., Wang, T.-F. 2005a. The relationship between privatization and DEA estimates of efficiency in the container port industry. *Journal of Economics and Business* 57 (5), pp 433-462.
9. Cullinane, K., Song, D.-W., Wang, T.-F. 2005b. The application of mathematical programming approaches to estimating container port product on efficiency. *Journal of Productivity Analysis* 24(1), pp 73-92.
10. Cullinane, K., Wang, T.-F, Song, D.-W., Ji, P. 2006. The technical efficiency of container ports: Comparing data envelopment analysis and stochastic frontier analysis. *Transportation Research Part A: Policy and Practice* 40(4), pp 354-374.
11. Darbra R.M., Ronza A., Stojanovic T.A., Wooldridge C., Casal J. (2005) A procedure for identifying significant environmental aspects in sea ports, in *Marine Pollution Bulletin*, vol. 50, no. 8, pp. 866-874.
12. Darbra R.M., Pittam, N., Royston, K.A., Darbra, J.P., Journee, H. 2009. Survey on environmental monitoring requirements of European ports. *Journal of Environmental Management*. Mar; 90 (3), pp 1396-403.

13. ISO- International Organization for Standardization website:
<http://www.iso.org/iso/home/standards/management-standards/iso50001.htm> (last accessed 10/2014).
14. Jemenšek, B. 2011. Study for the improvement of the intermodal transport via Alps for the Transitects project. Prometni institut Ljubljana. Slovenia.
15. Luo M., Yip T.L., (2013), Ports and the environment. In Maritime Policy and Management, vol. 40, no. 5, pp. 401–403.
16. Marconsult. 1994. Major Container Terminals' Structure and Performances: Report. Marconsult (Genova).
17. Piniella, F. 2009. La Seguridad del Transporte Marítimo. Universidad de Cádiz, Cádiz.
18. Piniella, F. 2008. Global Maritime Security: The role of Spain as a Port State. J Marit Res V(3), pp 15- 32.
19. Puig M., Wooldridge C., Darbra R.M., Identification and selection of Environmental Performance Indicators for sustainable port development. Marine Pollution Bulletin Volume 81, Issue 1, 15 April 2014, Pages 124–130.
20. Puig M. (2012), Identification and selection of environmental performance indicators (epis) for use in the management of european seaports, Thesis in School of Earth and Ocean Sciences, Cardiff University.
21. Rios, L., Maçada, A. 2006. Analysing the Relative Efficiency of Container Terminals of Mercosur using DEA. Maritime Economics & Logistics 8 (4), pp 331-346.
22. Song, W.K., Cullinane, K. 1999. Efficiency measurement of container terminal operations: An analytical framework. Journal of the Eastern Asia Society for Transportation Studies, Vol.3, No.2, pp 139-153.
23. Tongzon, J. 2001. Efficiency Measurement of Selected Australian and Other International Ports using Data Envelopment Analysis. Transportation Research Part A: Policy and Practice 35 (2), pp 107-122.
24. Tongzon, J., Heng, W. 2005. Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals). Transportation Research Part A 39 (2005), pp 405–424.
25. Trelleborg Marine Systems. 2010. Barometer Reports: www.porttechnology.org

ABBREVIATIONS

AP	Asia Pacific
BP	Bintulu Port
BPA	Bintulu Port Authority
BPSB	Bintulu Port Sdn Bhd
CLIA	Cruise Lines International Association
CSR	Corporate Social Responsibility
EEC	Energy Efficiency and Conservation
EP	Environmental Policy
EPI	Environmental Performance Indicator
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
ESI	Environmental Shipping Index
ESPO	European Sea Ports Organization
GHG	Greenhouse Gas
GM	Green Marine
GMEP	Green Marine Environmental Program
GRI	Global Reporting Initiative
GT	Gross Tonnages
ICS	International Chamber of Shipping
IMO	International Maritime Organization
ISO	International Organization for Standardization
KPI	Key Performance Indicators
LNG	Liquified Natural Gas
LPG	Liquefied Petroleum Gas
OECD	Organization for Economic Co-operation and Development
OPS	Onshore Power Supply
PERS	Port Environmental Review System
RE	Renewable Energy
SD	Standard Deviation
SDM	Self-Diagnosis Method
TEU	Twenty-foot Equivalent
UNCTAD	United Nations Conference on Trade and Development

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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 tCO₂e, 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 (tCO₂e per tonne throughput) by 2030 relative to the 2023 baseline intensity of 0.00074 tCO₂e 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.

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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 tCO₂e 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 (tCO₂e per tonne throughput) by 2030 relative to the 2023 baseline intensity of 0.00074 tCO₂e/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 Transshipment 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

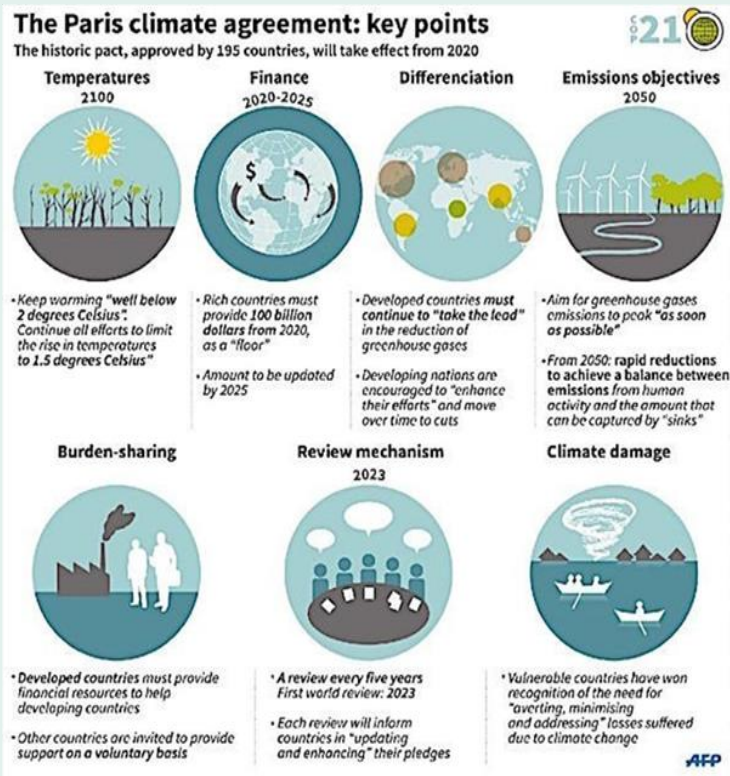
MAXIMIZING THE BENEFITS OF SMART DIGITAL GREEN PORT

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.

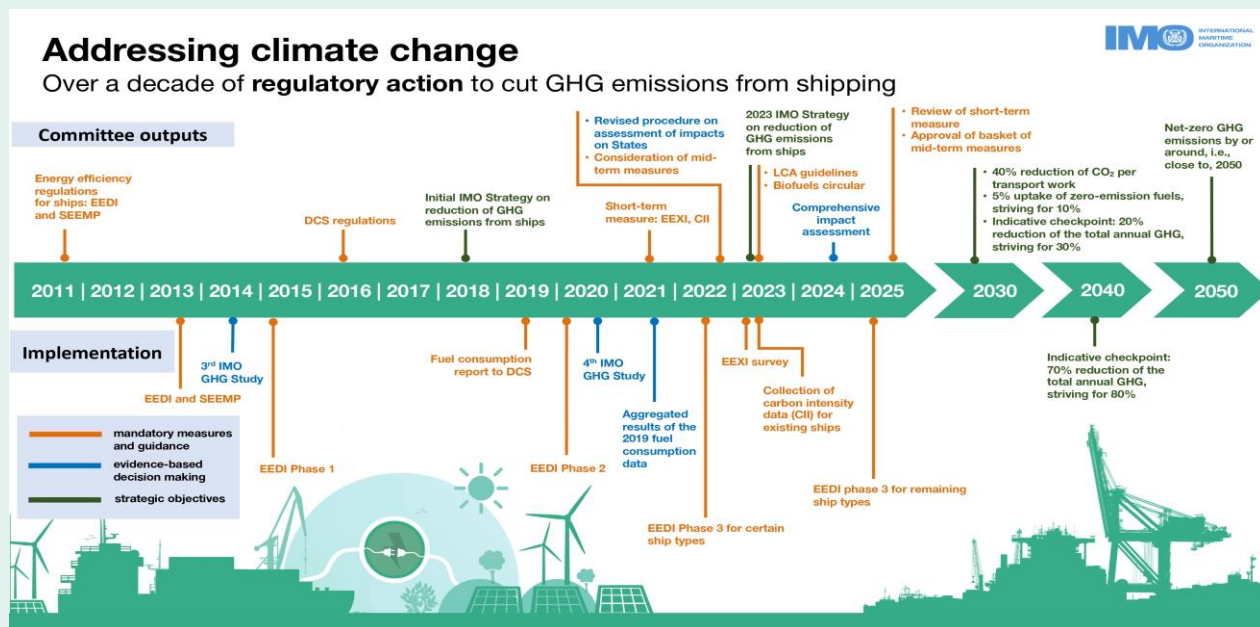
RELEVANT CLIMATE PROGRAMS TO SEAPORT OPERATIONS



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



SARAWAK ASPIRATION

Sarawak aspires to be a developed State by 2030. By 2030, Sarawak will be a thriving society driven by data and innovation where everyone enjoys economic prosperity, social inclusivity and sustainable environment.

“ Our aspiration is, “By 2030, Sarawak will be a thriving society driven by **data and innovation** where everyone enjoys **economic prosperity, social inclusivity and sustainable environment** ”

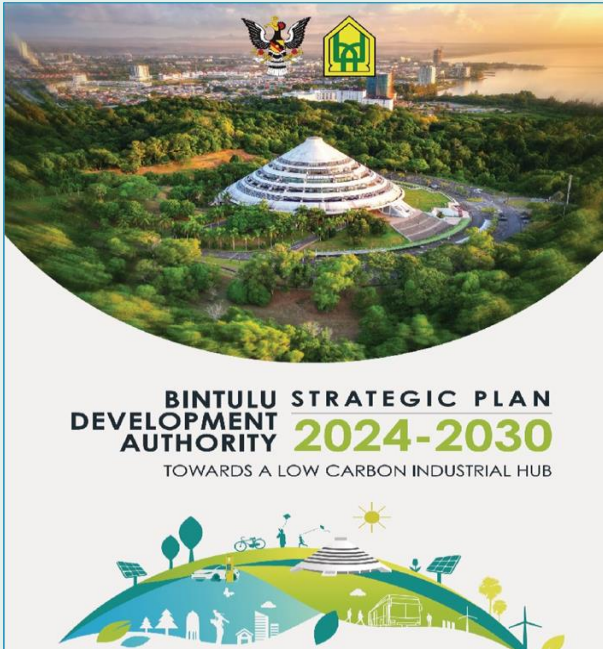
Catalytic Initiatives

1. River Economy
 - Installation of Aids To Navigation (ATON)
 - Salvaging and removal of shipwrecks
 - Hydrographical studies
 - River dredging
2. Land Public Transport
 - Establish an agency under Ministry to handle issues related to public transport
 - Transport master plan for all major cities in Sarawak
 - Kuching Urban Transportation System
3. Grow the Aviation Industry
 - Establish Aircraft Maintenance, Repair and Overhaul (MRO) facilities in Miri to supplement the needs of aircraft repair on the Borneo Island and around the BIMP EAGA region
4. Intermodal Transport
 - Establish intermodal transport at selected locations (from ports to industrial or economic hub and vice versa) to provide seamless logistics services to support growth in the economic sectors

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'S ECONOMIC DRIVERS



INFRASTRUCTURE CONNECTIVITY



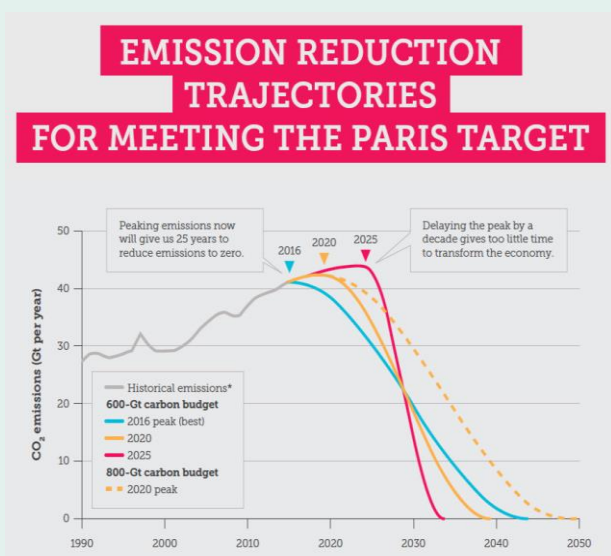
BINTULU PORT AUTHORITY DEVELOPED SMART DIGITAL GREEN PORT BLUEPRINT TO SUPPORT SARAWAK INSPIRATION

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.



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?

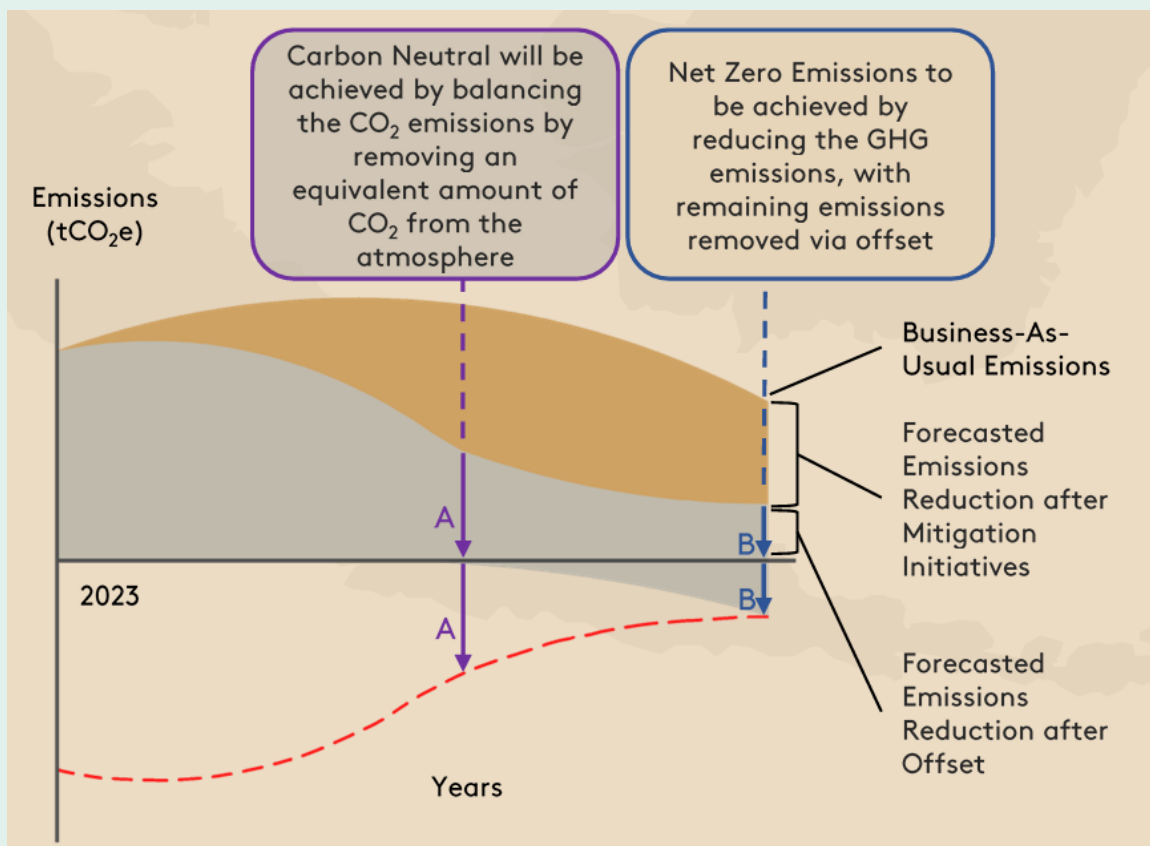
An effort to improve ambient air quality and cut greenhouse gas (GHG) emissions can be scattered, ineffective, or even counterproductive if without a solid strategy. A strategy provides structure, ensuring that actions align with scientific recommendations, economic feasibility, and social acceptance,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

<p>STRATEGY</p> <p>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.</p>	<p>TARGET</p> <p>The target Bintulu Port Operation AERS is achieve certified air ambient quality standards annually, 45% reduction in carbon intensity (tCO₂e per tonne throughput) by 2030 relative to the 2023 baseline intensity.</p>	<p>ACTION</p> <p>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.</p>	<p>RESULT</p> <p>The BPA AERS expected results are; certified ambient air quality standards and verified reductions in carbon intensity (tCO₂e 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.</p>
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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.

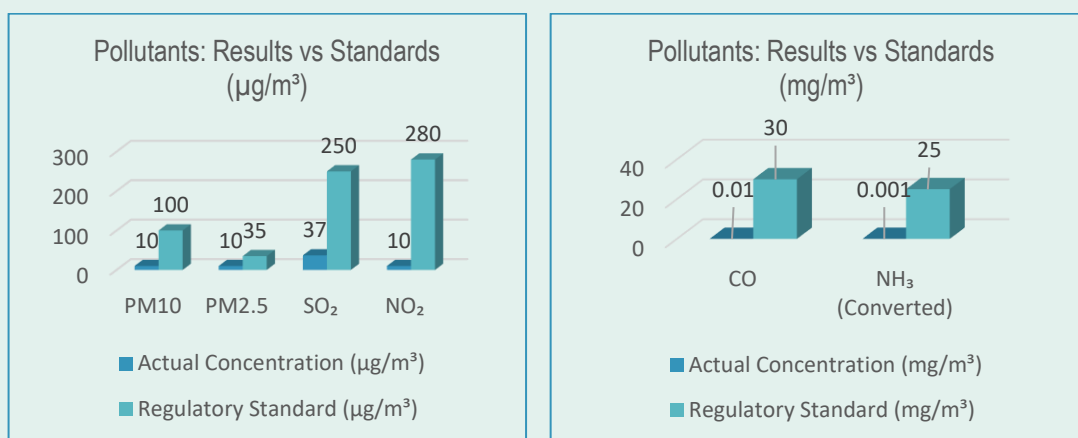
A.7 ESTABLISHING BASELINE FOR AERS

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 (tCO₂e per tonne throughput) by 2030 relative to the 2023 baseline intensity of 0.00074 tCO₂e/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 tCO₂e for Bintulu Port, encompassing emissions from operational sources and organizational activities. Of this, 18,607 tCO₂e is attributed to key operational sources: Heavy Duty Vehicles (HDVs) at 12,254 tCO₂e, Ocean-Going Vessels (OGVs) at 3,694 tCO₂e, and Harbour Crafts at 2,659 tCO₂e. Organisational emissions forms the majority of emissions at 33,430 tCO₂e. In comparison with other ports, Bintulu Port's carbon intensity is at 0.00074 tCO₂e/tonne which is higher than Gladstone Port (0.00067 tCO₂e/tonne) and Jurong Port (0.00053 tCO₂e/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 3 rd 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 3 rd 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 ₂ e)	Scope 2 (tCO ₂ e)	Scope 3 (tCO ₂ e)	Total (tCO ₂ e)
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)	NoX (Tonne)	SoX (Tonne)	PM ₁₀ (Tonne)	VOC (Tonne)	CO ₂ e (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 BUILDINGS AND FACILITIES	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.
	5.0 Existing Building Decarbonization to Low Carbon Building Operations.	5.1 Establish a baseline, apply green building practices and perform 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.



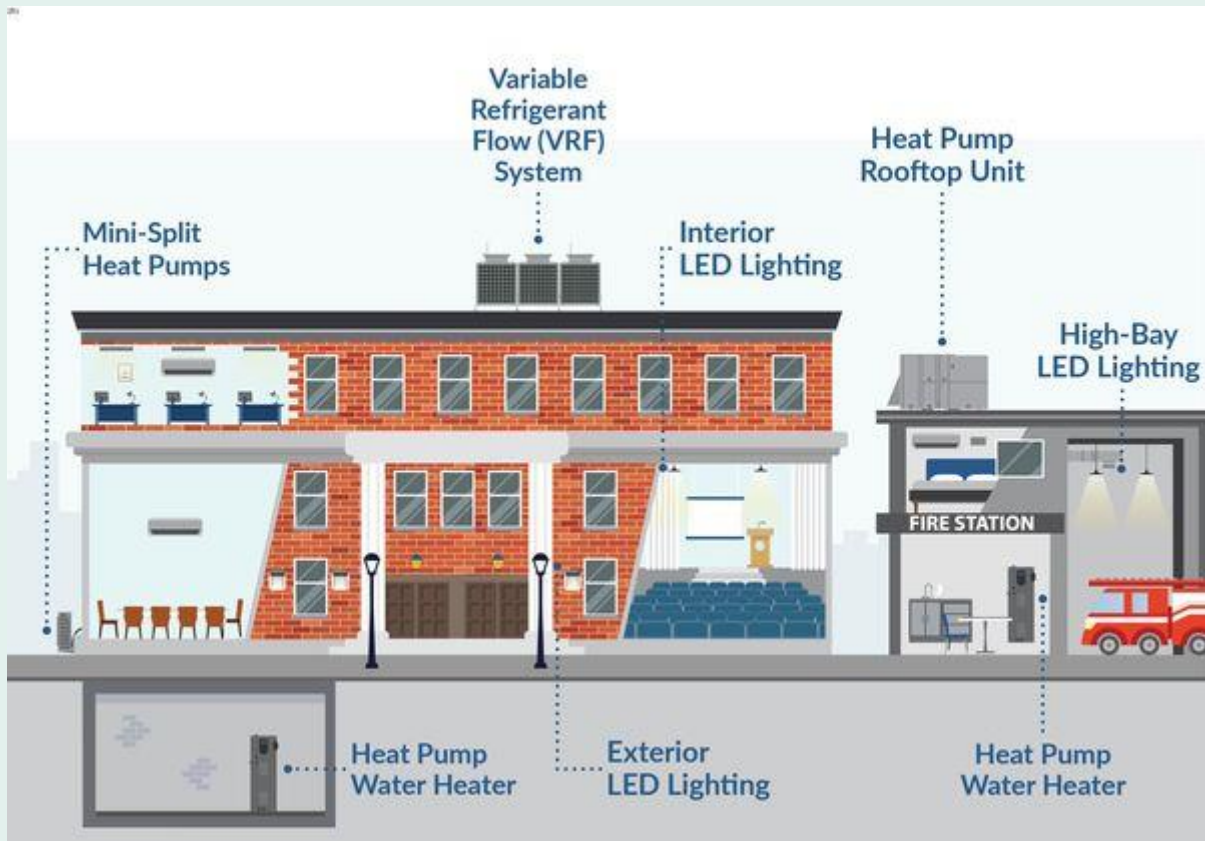
B.2 ENERGY

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

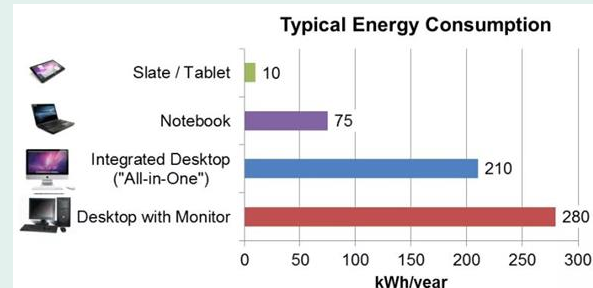


B.2 ENERGY

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



	LEDs 10W/800 LUMENS	CFLs 10W/450 LUMENS	INCANDESCENT 10W/81 LUMENS
ENERGY EFFICIENCY	Best	Good	Average
TYPICAL LIFESPAN	25,000 hrs	8,000 hrs	1,200 hrs
YEARLY COST	\$1.34/yr	\$1.73/yr	\$3.05/yr



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

Departing flights

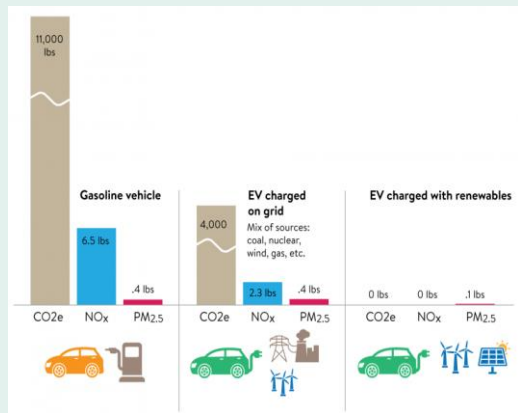
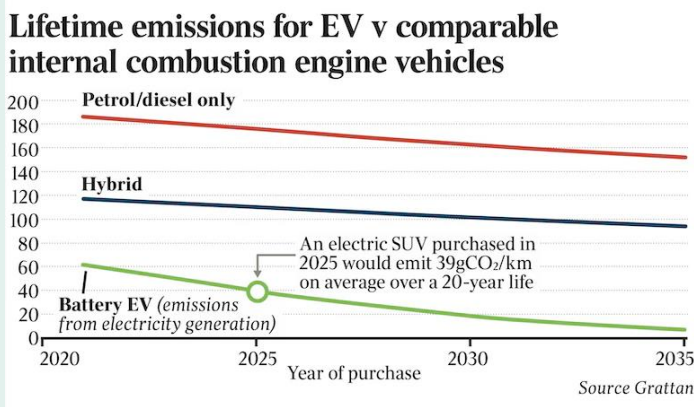
Total price includes taxes + fees for 1 adult. [Additional bag fees](#) and other fees may apply.

	2:40 PM – 12:45 PM⁺¹ Alaska, Aer Lingus	14 hr 5 min SMF–DUB	1 stop 2 hr 47 min SEA	993 kg CO ₂ -19% emissions ⓘ
	2:30 PM – 11:55 AM⁺¹ United, Aer Lingus · Operated by Skywest DBA Uni...	13 hr 25 min SMF–DUB	1 stop 2 hr SFO	1.06 t CO ₂ -13% emissions ⓘ
	11:05 AM – 8:15 AM⁺¹ Air Canada · Lufthansa · Operated by Air Canada ...	13 hr 10 min SMF–DUB	1 stop 2 hr 10 min YVR	1.07 t CO ₂ -13% emissions ⓘ
	8:26 AM – 10:05 AM⁺¹ American	17 hr 39 min SMF–DUB	1 stop 6 hr 20 min ORD	1.08 t CO ₂ -12% emissions ⓘ

	Cost	Carbon Footprint	Time
	£170	92 kg CO₂	1 hr 20 mins
	£125	25.85 kg CO₂	7 hrs 40 mins
	£73	170.7 kg CO₂	7 hrs 38 mins

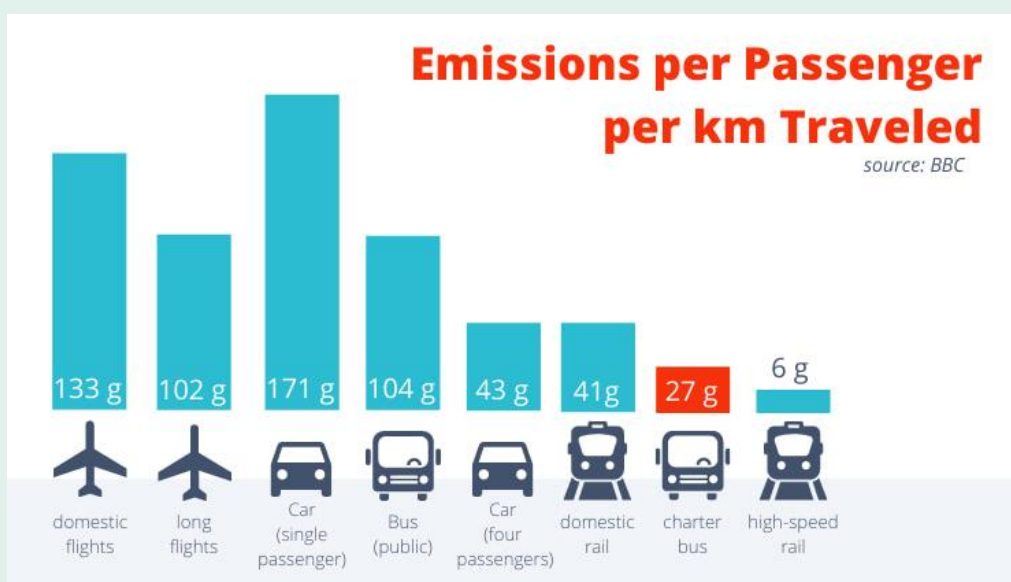
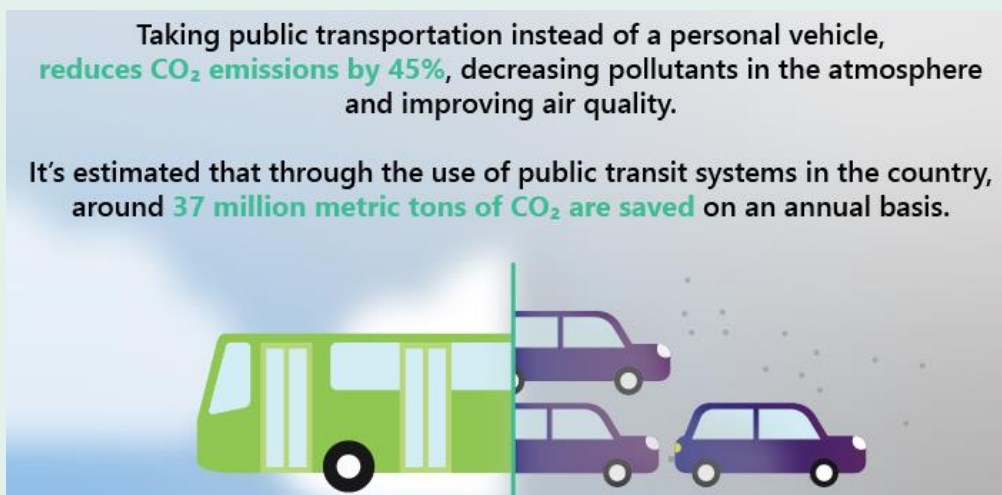
B.3 TRANSPORTATION

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



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



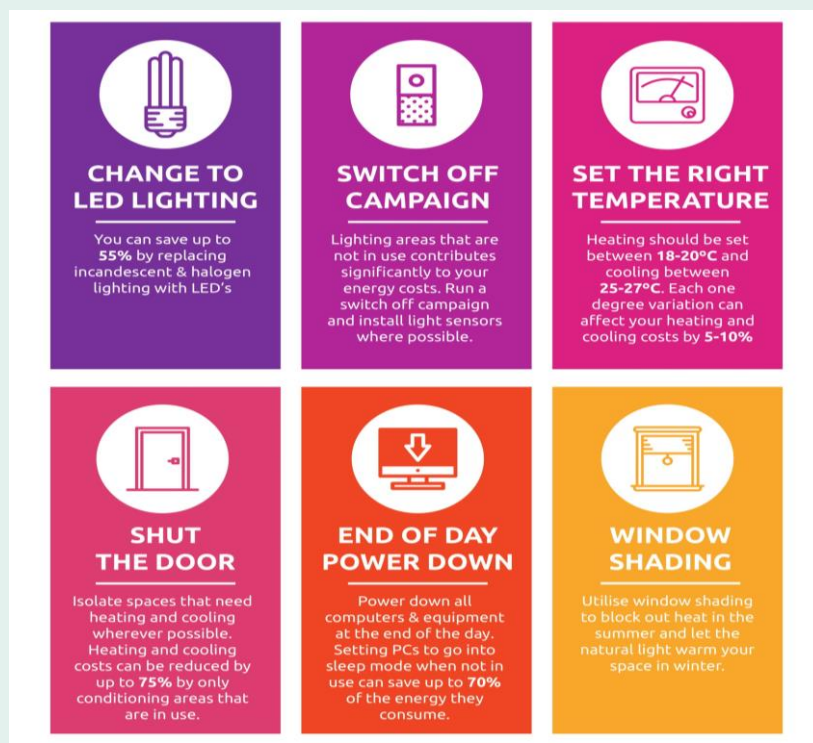
B.3 TRANSPORTATION

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	<p>To provide the following relevant port data and information;</p> <ul style="list-style-type: none"> • 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



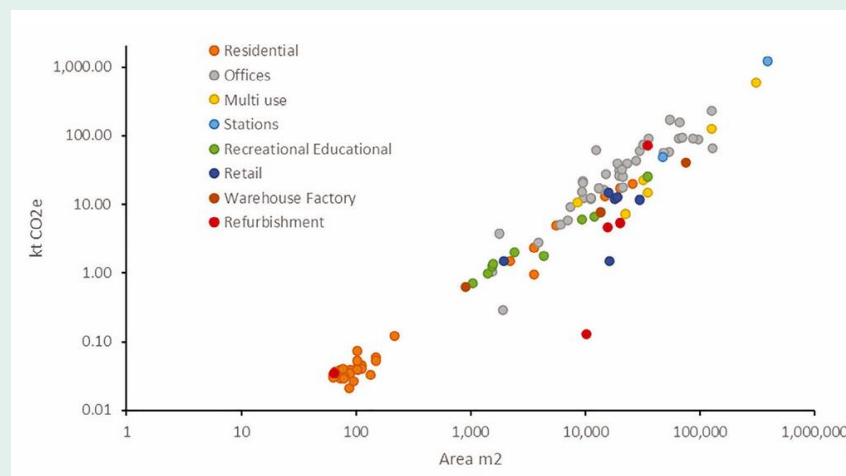
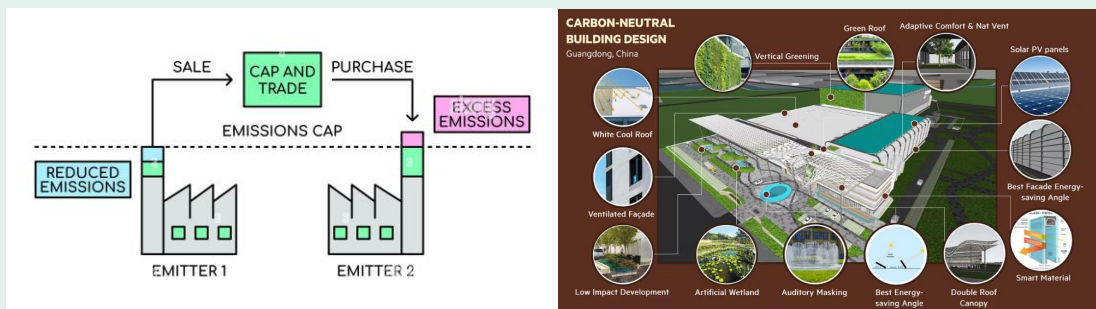
B.4 BUILDINGS AND FACILITIES

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



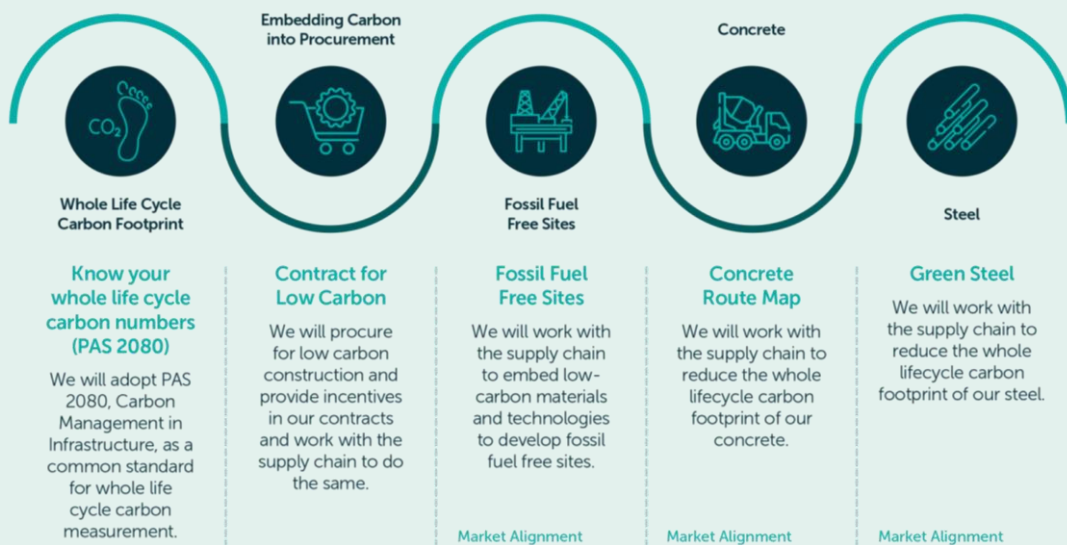
B.4 BUILDINGS AND FACILITIES

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 ₂ e)	% 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

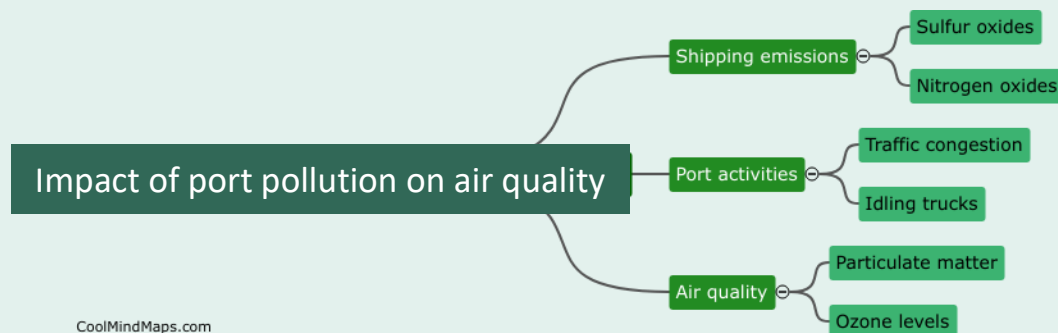
Subtotal BPA (quantified): 528 tCO₂e (1.0% of baseline)

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.

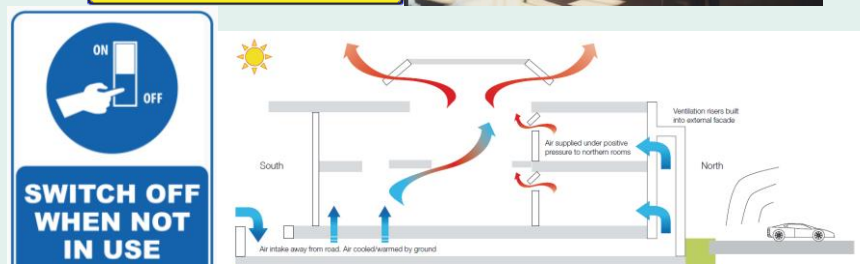


CoolMindMaps.com



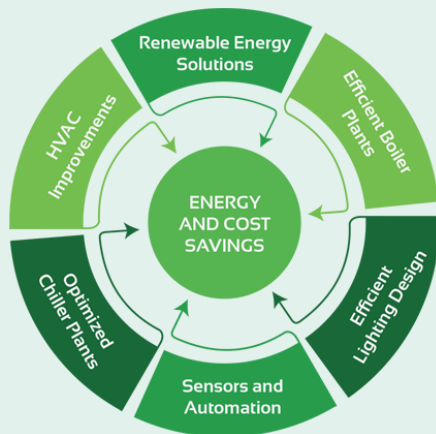
C.2 ENERGY

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



Operational

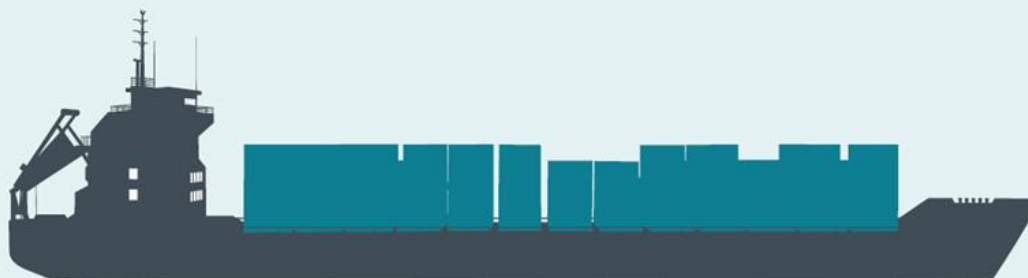
Weather routing **1-4%**
Autopilot upgrade **1-3%**
Speed reduction **10-30%**

Auxiliary power

Efficient pumps, fans **0-1%**
High efficiency lighting **0-1%**
Solar panel **0-3%**

Aerodynamics

Air lubrication **5-15%**
Wind engine **3-12%**
Kite **2-10%**



Thrust efficiency

Propeller polishing **3-8%**
Propeller upgrade **1-3%**
Prop/rudder retrofit **2-6%**

Engine efficiency

Waste heat recovery **6-8%**
Engine controls **0-1%**
Engine common rail **0-1%**
Engine speed de-rating **10-30%**

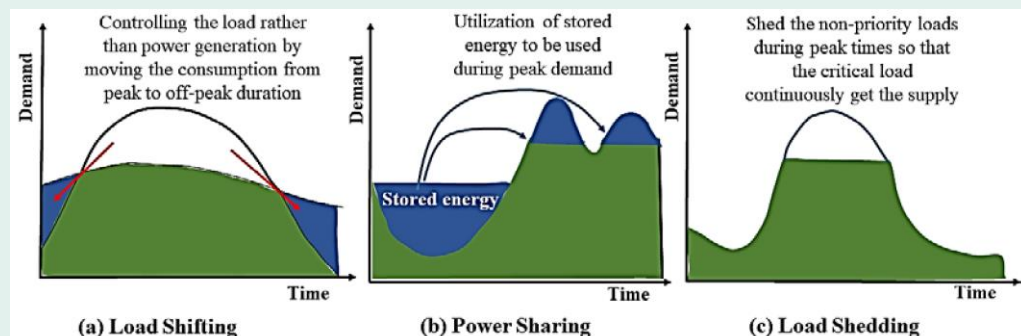
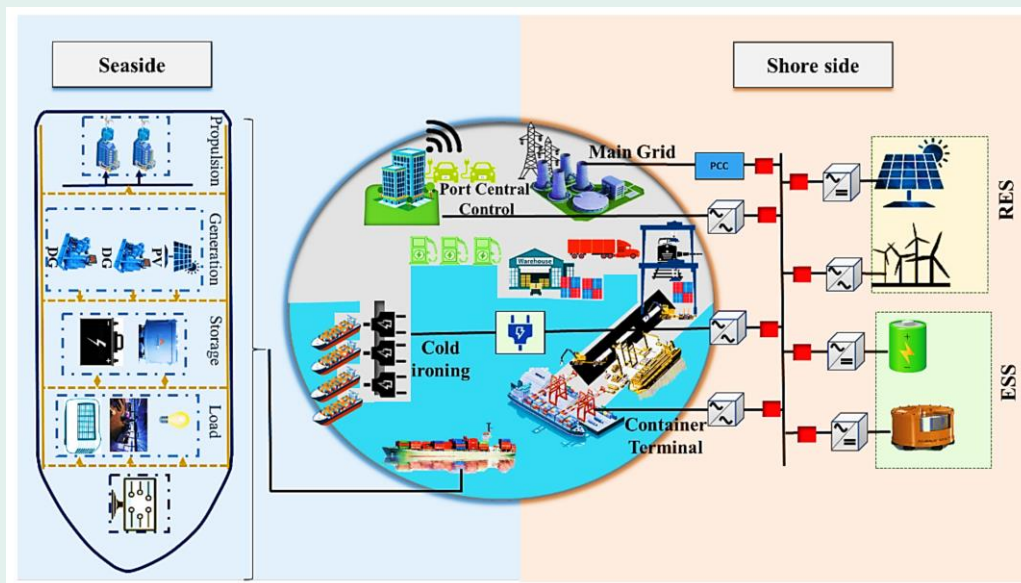
Hydrodynamics

Hull cleaning **1-10%**
Hull coating **1-5%**
Water flow optimization **1-4%**

Figure 1: Potential fuel use and CO₂ reductions from various efficiency approaches for ships (International Council on Clean

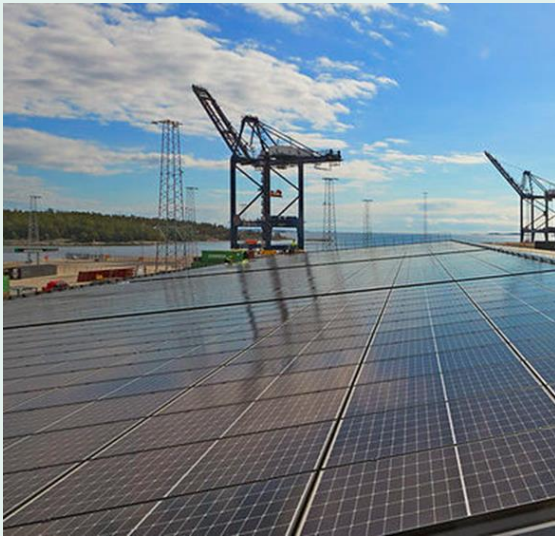
C.2 ENERGY

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

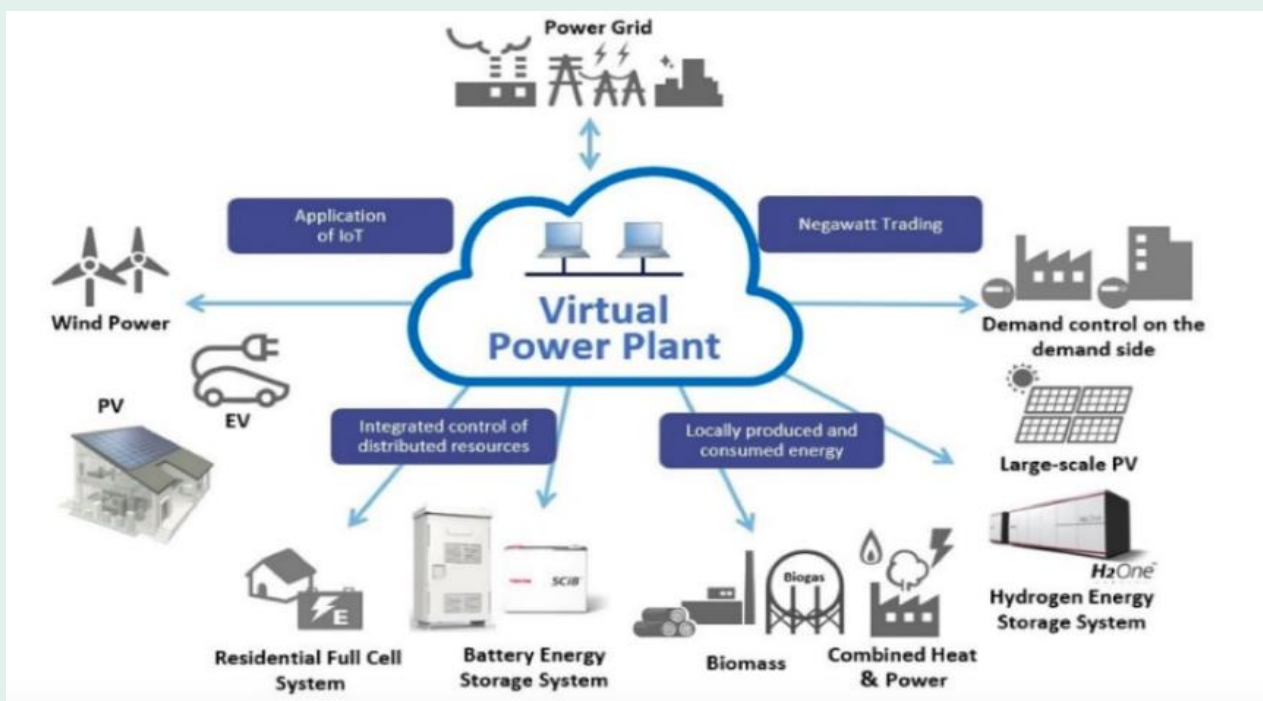


APM Terminals Bahrain to Make First Fully Solar-Powered Seaport



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



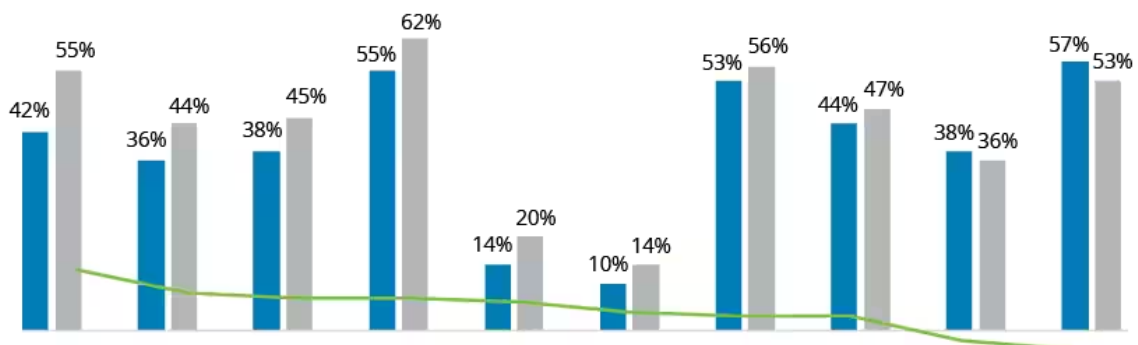
C.2 ENERGY

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

How various industrial sectors are set to move toward electrification

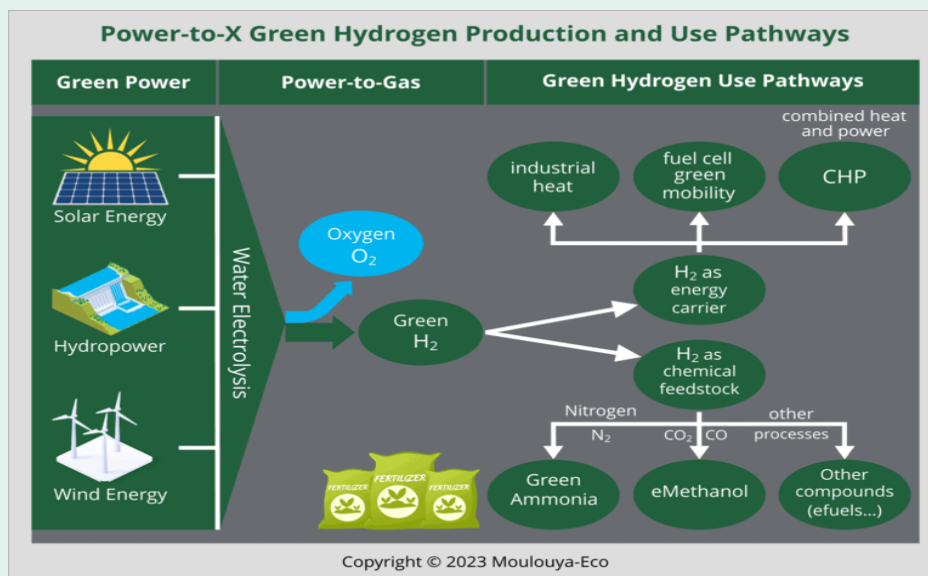
Change in electricity adoption

■ 2020 ■ 2050 — Change in adoption (percentage points)



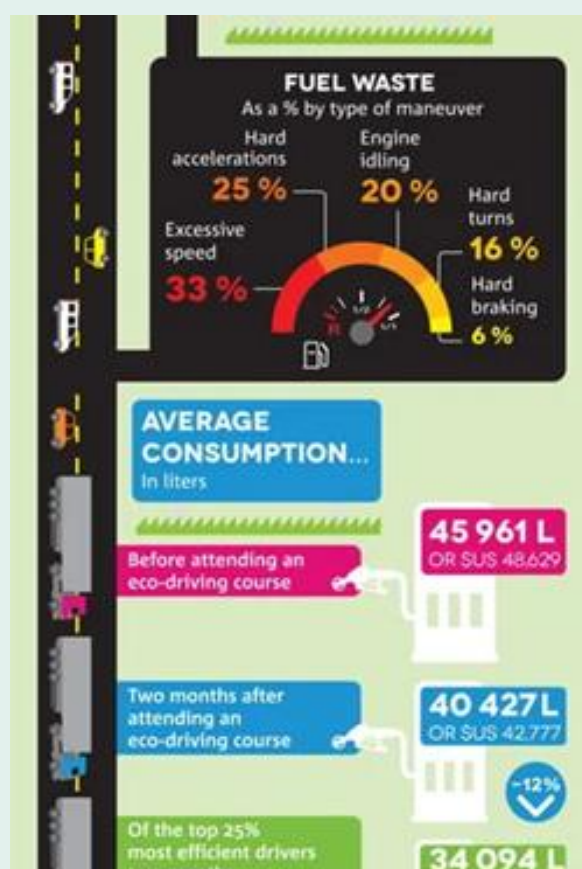
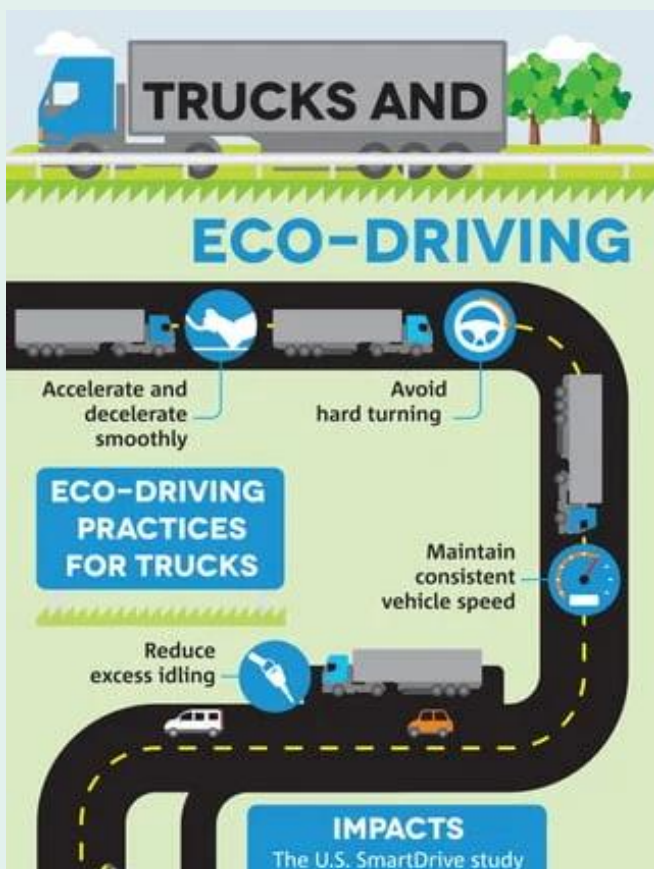
C.2 ENERGY

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

Best departing flights
 Ranked based on price and convenience ⓘ Prices include required taxes + fees for 1 adult. Optional charges and bag fees may apply. [Passenger assistance info.](#) [Sort by:](#) ⚙️

	3:00 PM – 11:24 PM JetBlue	5 hr 24 min LAX-JFK	Nonstop	405 kg CO2e +13% emissions ⓘ	 \$287 round trip
	11:30 AM – 7:51 PM United	5 hr 21 min LAX-EWR	Nonstop	418 kg CO2e +16% emissions ⓘ	 \$289 round trip
	7:05 AM – 3:30 PM Alaska	5 hr 25 min LAX-EWR	Nonstop	269 kg CO2e -25% emissions ⓘ	 \$321 round trip

Avoids as much CO2e as 5,540 trees absorb in a day ⓘ

	Cost	Carbon Footprint	Time
	£170	92 kg CO ₂	1 hr 20 mins
	£125	25.85 kg CO ₂	7 hrs 40 mins
	£73	170.7 kg CO ₂	7 hrs 38 mins

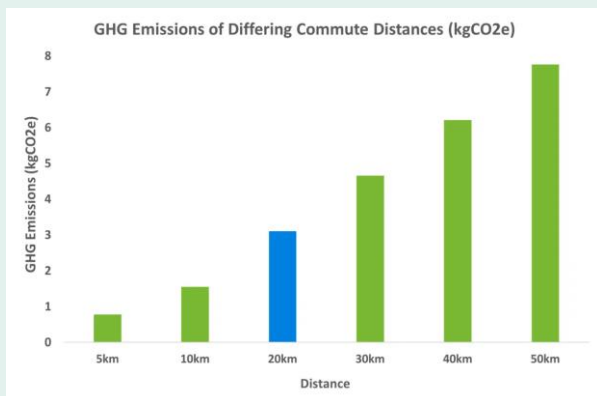
C.3 TRANSPORTATION

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



HOW TO CREATE A CARPOOL GROUP TO WORK

Commuter.org rewards commuters traveling to or from San Mateo County who choose a sustainable commute mode to work. To help congestion, the environment, and quality of life. Use this infographic to form a carpool group that you can use on those traffic-heavy days. we recommend Tuesdays, Wednesdays or Thursdays.

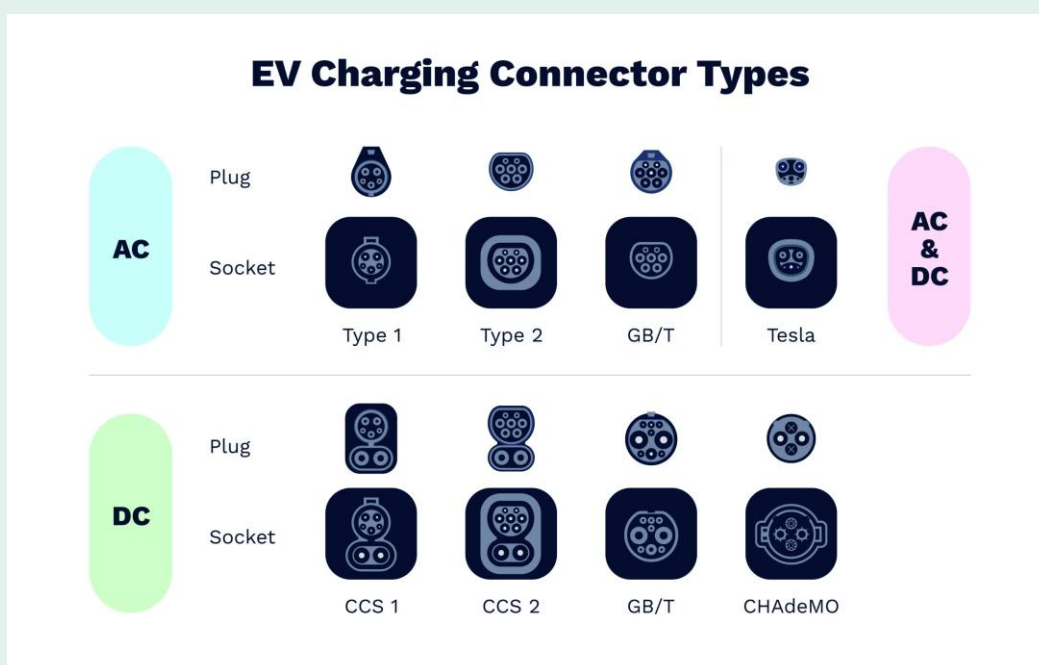
1. Find coworkers who live near one another
Talk to your coworkers! You work at the same place and already feel comfortable with one another. Schedule a carpool mixer, start a slack channel, or suggest starting Carpool Thursdays. Check if your employer will help or offer a carpool benefit.

2. Carpool together! **Tips to get started.** Discuss driver and rider expectations. Find days and times that work best. Choose an easy pickup spot. Determine the cost to drive and split costs with partners.

Start carpooling!
 Don't forget carpoolers are free or discounted in the express lanes and bridges.

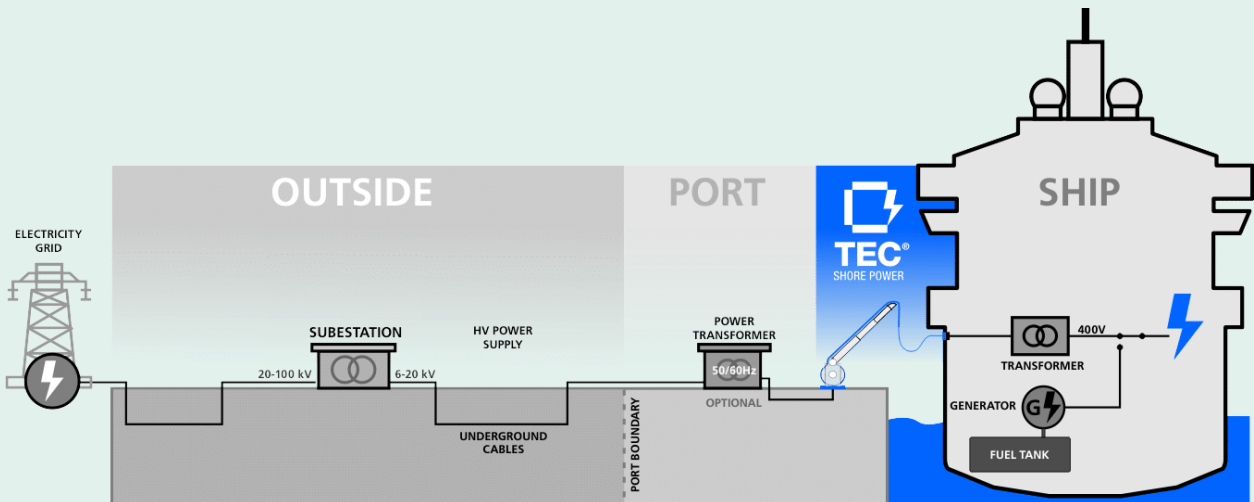
C.3 TRANSPORTATION

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

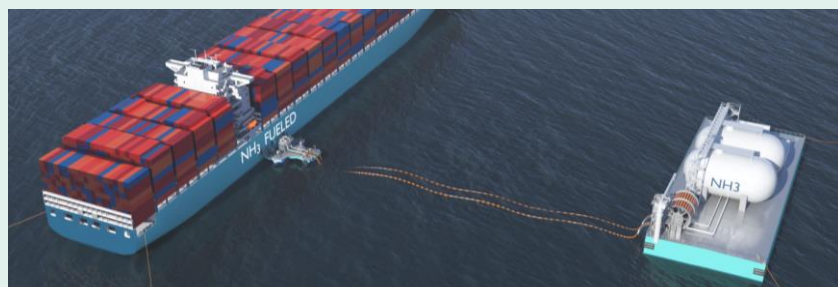
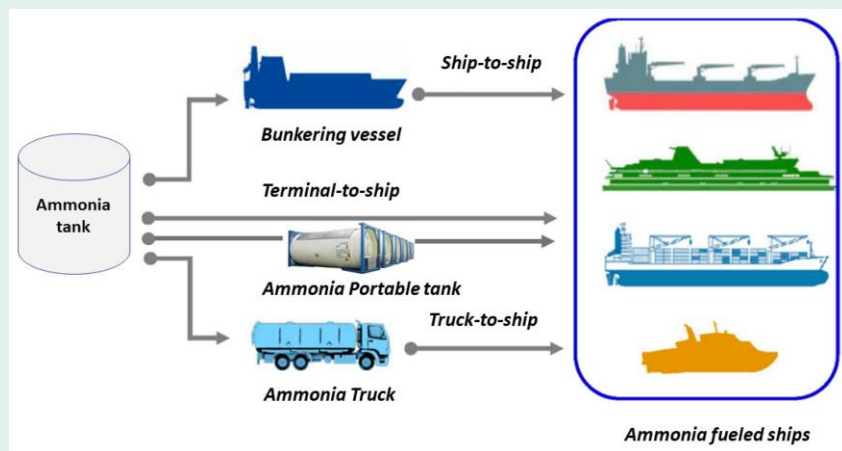
C.3 TRANSPORTATION

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



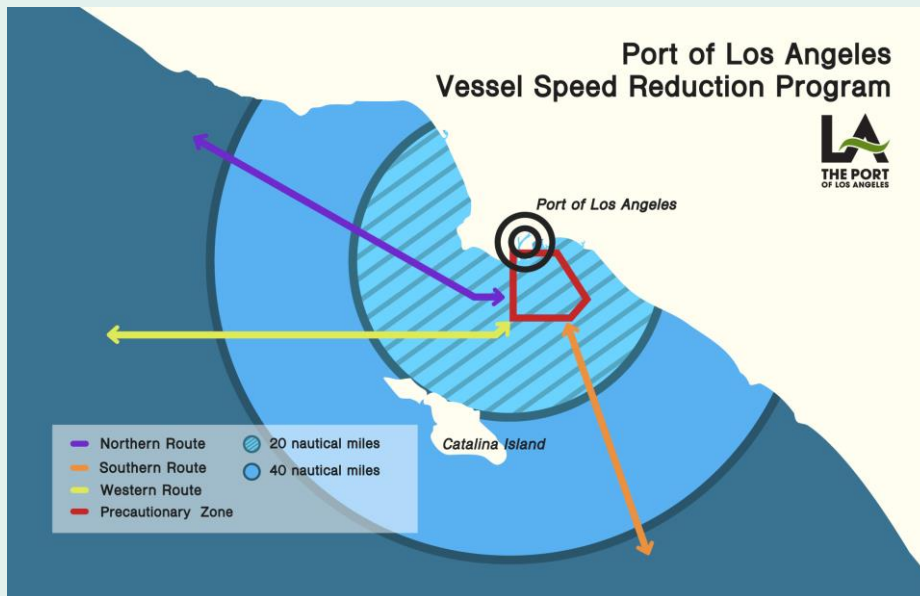
C.3 TRANSPORTATION

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



Major sources of anthropogenic noise at the Port

Commercial Vessels, Cruise Ships and Naval Operations

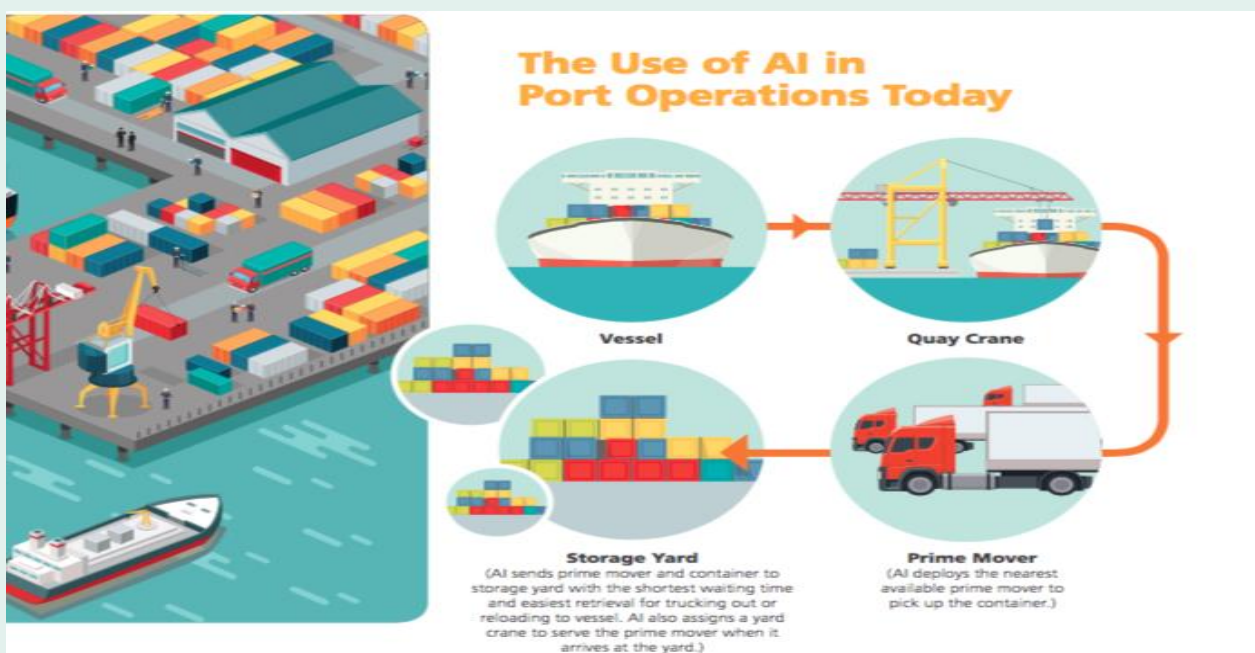


What can you do?

Follow Vessel Speed Reduction guidelines, maintain clean machinery, avoid rapid acceleration, report whale sightings to data collaboratives such as Whale Alert or Happy Whale and reroute around sensitive marine areas when possible.

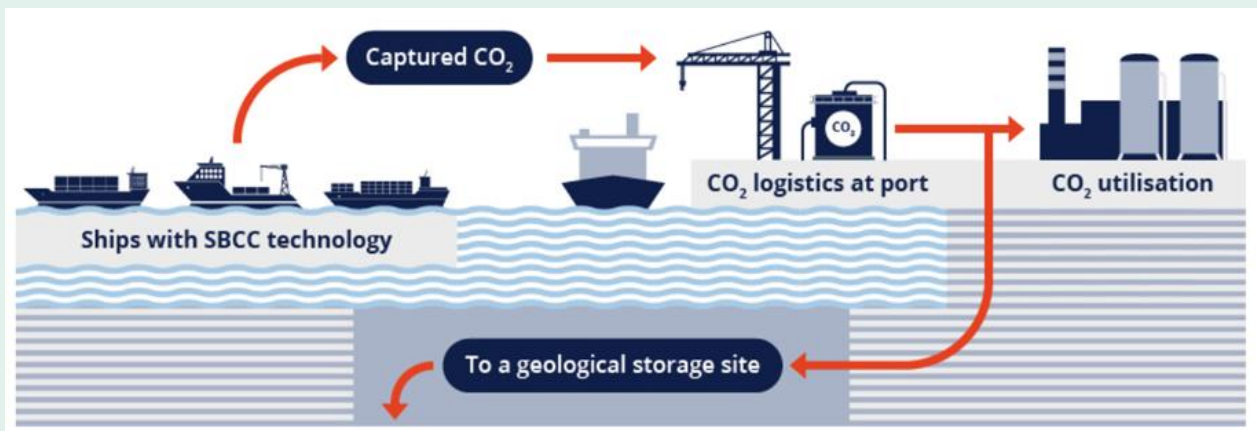
C.3 TRANSPORTATION

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

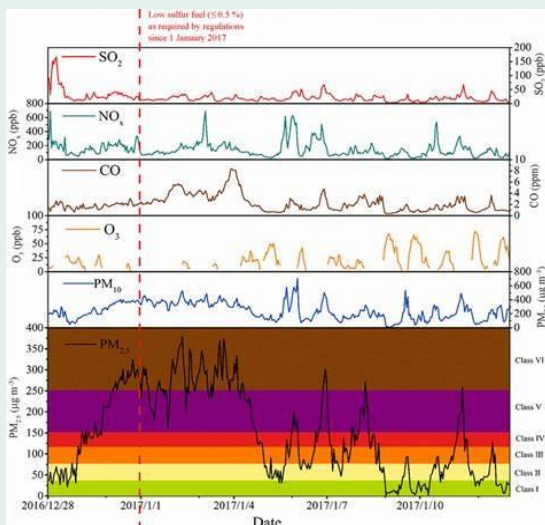
STRATEGY	12.0
ACTION	12.14
Specific Action	Truck Replacement Program (TRP)
Methodology	Launch marketing campaigns to inform truck owners, engage industry stakeholders for support and provide educational resources on the benefits of truck replacement.
Detail Steps	Determine the primary goals, identify 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

Truck Replacement Program

- Part of the Clean Air Strategy to implement a truck replacement program to replace pre-1994 vehicles
- Provide truck owners funding incentives (grants and financing) to replace their older drayage trucks with newer and more fuel efficient models
- Replace trucks that have engines Model Year 1993 or older with newer trucks Model Year 2004 to 2008 that are equipped with 2004 or 2007 EPA emissions-compliant engines

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

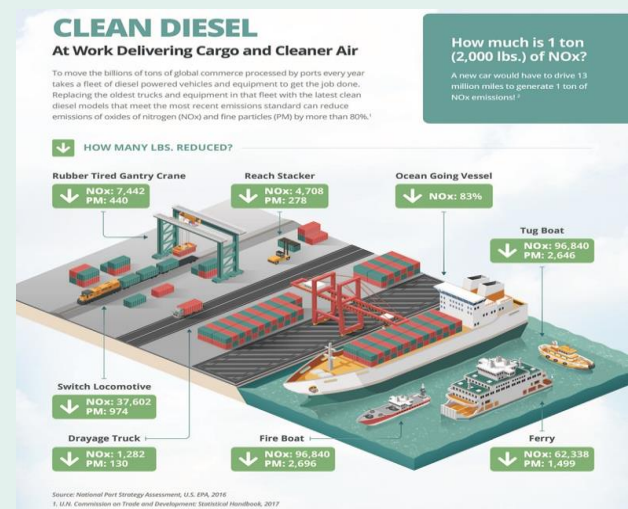


C.3 TRANSPORTATION

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

Ports Sector

- Objective: By 2014, achieve "no net increase" in emissions at ports that are expanding
- Background: US international waterborne freight is expected to triple by 2020
 - Ports are expanding, vessel size is increasing and diesel operations contribute significant emissions to local air quality
- Strategy
 - Partner with American Association of Port Authorities to develop appropriate incentives and programs for all US ports
 - Expand from public fleet leadership to influence tenants and other fleets in ports
 - Work to include cleaner diesel strategies into ISO 14001 (Env. Mgmt Systems) certification
 - Direct emission controls: Cleaner fuels, retrofits, replacements, repower
 - Energy efficiency: Reduced idling, improved queuing, inter-model shifts, on-shore power



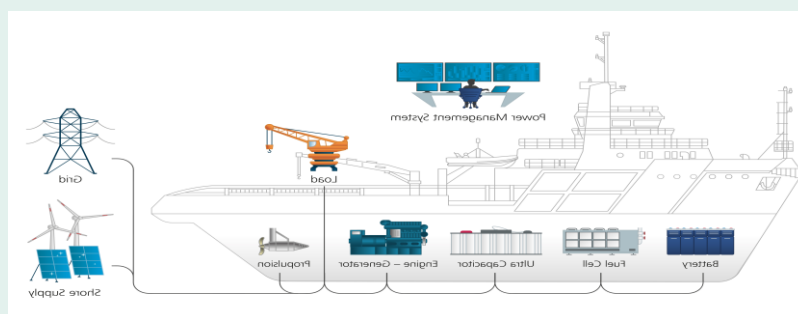
C.3 TRANSPORTATION

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



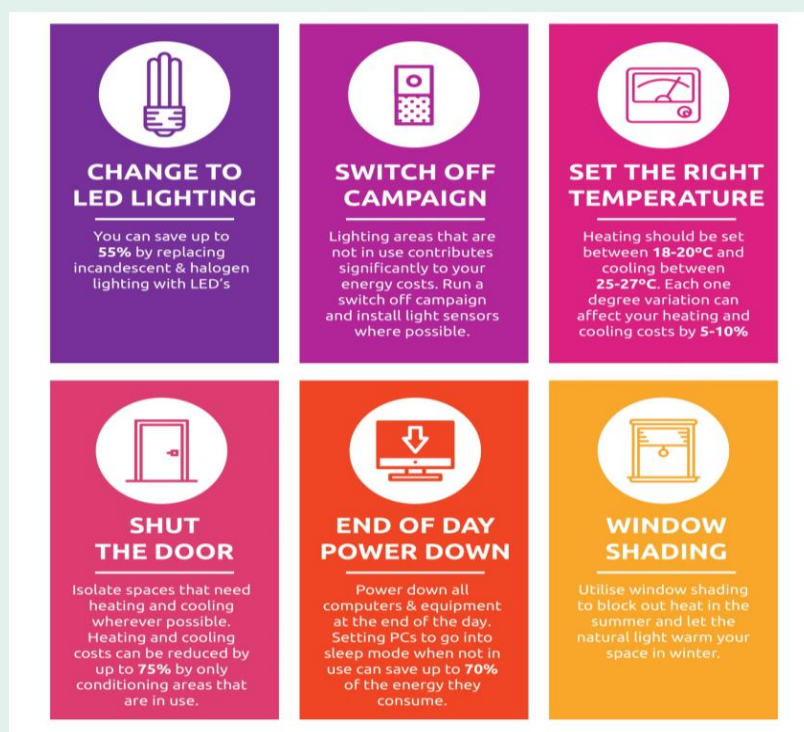
C.3 TRANSPORTATION

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



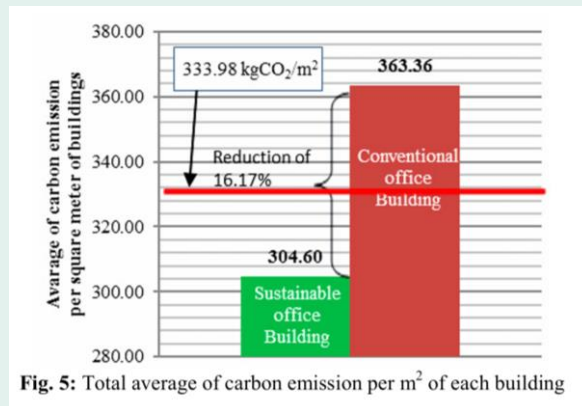
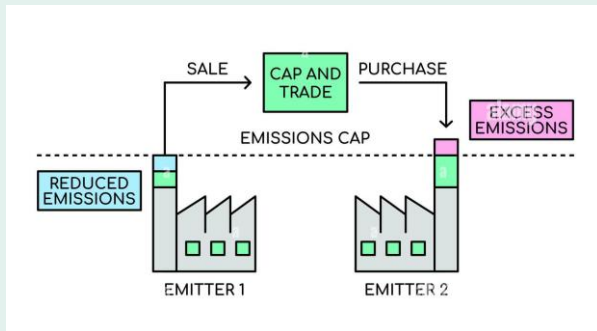
C.4 BUILDINGS AND FACILITIES

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 roster 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



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



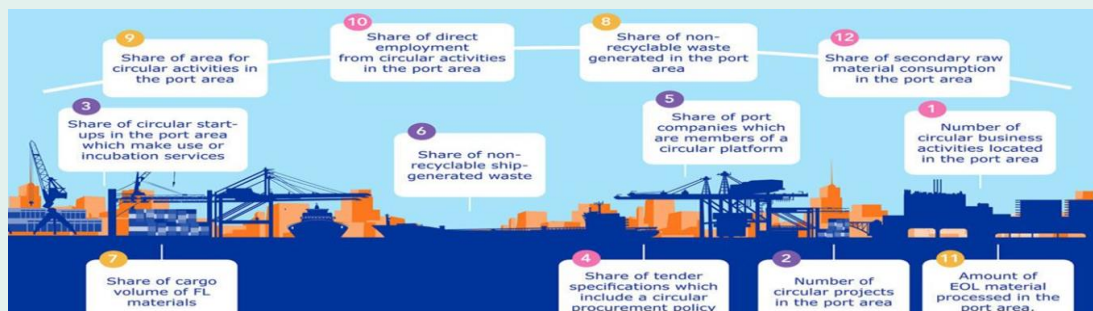
C.5 WASTE

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 ₂ e)	% 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 tCO₂e (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 tCO₂e 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 ₂ e	1.0%	600 tCO ₂ e	1.1%
Operators – Energy	Solar PV (on/off-site), smart energy management	1,007 tCO ₂ e	1.9%	1,730 tCO ₂ e	3.3%
Operators – Cargo Handling	Hybrid RTGs, electric/hybrid terminal tractors & reach stackers	1,059 tCO ₂ e	2.0%	1,307 tCO ₂ e	2.5%
Operators – Heavy Duty Vehicles	AI logistics optimisation, idling control, routing, biodiesel (B20–B30)	1,838 tCO ₂ e	3.5%	2,451 tCO ₂ e	4.7%
Operators – Harbour Craft	Pilot boats on shore power, speed/ops optimisation, biofuel blends	458 tCO ₂ e	0.9%	665 tCO ₂ e	1.3%
Operators – OGV at berth	AI-driven berth efficiency, reduced hoteling, partial OPS	300 tCO ₂ e	0.6%	369 tCO ₂ e	~0.7%
Operators – Circular economy	Biomass pallets, waste minimisation	125 tCO ₂ e	0.2%	150 tCO ₂ e	~0.3%
Operators – Green bunkering	Green fuel bunkering facilities (20–40% uptake of calls by 2030)	225 tCO ₂ e	0.4%	450 tCO ₂ e	0.9%

- **Low-hanging & declared:** 7,298 tCO₂e (14%)
- **Policy-enabled ambition:** 16,000 tCO₂e (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 tCO₂e, 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 (tCO₂e 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.