

Towards Sustainable Port Development in Western Indian Ocean Region



In-Person Stakeholder Meeting

Date: 13th and 14th April 2023

Venue: Dar es Salaam

In response to a request by the Nairobi Convention, the Secretariat in collaboration with other partners, is undertaking a baseline study and scenario analysis, and developing a toolkit for green port development in the Western Indian Ocean region through *'Decision CP.9/13'* (Enhancing cooperation, collaboration, and support with partners').

This will be the 2nd in-person stakeholder meeting, comprising of port management authorities, Focal Points, WIOSAP Regional Task Force members, RECs and WIO-C members, following a virtual stakeholders meeting held with MTCC representatives on 17 March 2022, and the 1st in-person meeting held in August 2022 in Dar es Salaam.

During the 1st in-person meeting the following was obtained:

- Inputs on specifics pertaining to the Situation Assessment, namely location of ports (existing, planned and proposed) in WIO countries, and agreement on major commercial ports for consideration in geo-spatial analysis of environmental issues; input on supporting legislative and institutional frameworks in different countries; and scope of port development in region and potential environmental impacts
- Input on the key driving forces and issues engendering sustainability in port development for consideration in Scenario Analysis
- Input on tools for inclusion in the Toolkit for Green Port Development in the WIO region.

Based on the above inputs, a final draft Situation Assessment report has been prepared, as well as a draft Scenario Analysis for Sustainable Port Development and a draft Toolkit for Green Port Development in WIO region (see Appendix: Concept Note for further details). Draft reports are available [on this link](#) for review, validation and comments.

The Objectives of the 2nd in-person meeting are to:

- Present and obtain feed-back on the draft Situational Assessment
- Present and obtain feed-back on the draft Scenario Analysis for Sustainable Green Port Development
- Present and obtain feed-back on the draft Toolkit for Green Port Development in WIO region

The envisaged Outcomes of this Meeting include:

- Comments and input for consideration in final draft Situation Assessment
- Comments and input for consideration in final draft Scenario Analysis for Sustainable Port Development
- Comments and input for consideration in final draft Toolkit on Green Port Development.

PROPOSED AGENDA

Day 1:

TIME	ITEM	PRESENTER
09:00 – 09:30	Opening remarks and Introduction	Nairobi Convention/ MTCC
09:30 – 10:30	Presentation: Short Towards Sustainable Port Development in WIO Region Project (overview)	CSIR
10:30 – 11:00	<i>Tea/Coffee Break</i>	
11:00 – 12:00	Presentation: Overview of final draft Situation Assessment	CSIR
12:00 – 13:00	Plenary Discussion: Feed-back on Situation Assessment	MTCC facilitate
13:00 – 14:00	<i>Lunch</i>	
14:00 – 15:00	Presentation: Description of geo-referenced outputs on habitat change in specific ports	CSIR/NCS (Jane)
15:00 – 15:30	Plenary Discussion: Feed-back on geo-referenced findings	MTCC facilitate
15:30 – 15:45	Introduction to Day 2	CSIR
15:45 – 16:00	Closure of Day 1	Nairobi Convention/ MTCC

Day 2:

TIME	ITEM	PRESENTER
09:00 – 09:30	Opening remarks and Re-cap of Day 1	Nairobi Convention/ MTCC
09:30 – 11:30	Presentation: Description of Scenario Analysis method and preliminary Scenario outputs	CSIR
10:30 – 11:00	<i>Tea/Coffee Break</i>	
11:00 – 13:00	Break-away groups and feed-back: Comments and opinions on preliminary Scenario outputs	CSIR facilitate
13:00 – 14:00	<i>Lunch</i>	
14:00 – 14:30	Presentation: Toolkit for Green Port Development	CSIR
14:30 – 15:30	Plenary Discussion: Feed-back on Toolkit for Green Port Development	MTCC facilitate
15:30 – 15:45	Way Forward	Nairobi Convention/ MTCC
15:45 – 16:00	Closure of Day 2	Nairobi Convention/ MTCC

APPENDIX: CONCEPT NOTE

1. Background information

The WIO Region is experiencing an unprecedented pace of development in various economic sectors. This brings with it demand for large infrastructural developments driven by huge financial inflows from different funding streams. Most of these developments are concentrated in coastal zones with rich natural resources. While the region has an opportunity to define sustainable trajectories for these investments, they have the potential, if poorly planned and implemented, to significantly impact on the integrity of critical habitats and the resource base that future developments and coastal livelihoods depend on. In the WIO Region coastal communities are strongly reliant on coastal resources for their lives and livelihoods. The *Agenda 2063* masterplan for Africa focuses on frameworks that will drive African nations towards becoming global power houses through sustainable and inclusive development. Further, the 2050 Africa's Integrated Maritime (AIM) Strategy provides a broad framework for the protection and sustainable exploitation of the African Maritime Domain (AMD) for wealth creation. The WIO region has a gross marine product of US \$20.8 billion dollars (WWF, 2017); this showcases the economic value of its delicate ecosystems and highlights the need to focus on sustainable development within marine environments. Through utilising tools such as marine spatial planning (MSP), strategic environmental assessments (SEA) and ecosystem-based management (EBM), port developments can continue to meet both economic and environmental goals in collaboration with national, regional and international stakeholders.

Through '*Decision CP8/10.4*' and '*Decision CP.9/10*', Nairobi Convention resolved to support Marine Spatial Planning, and Blue and Ocean Economy to promote sustainability. During the 10th Nairobi Convention's Conference of Parties meeting held in November 2021, '*Decision CP.10/8*' (Area-based Planning Tools for Sustainable Blue Economy') and '*Decision CP.10/9*' (Monitoring of the marine and coastal ecosystems') were endorsed, signifying the convention's commitment to ensure the sustainability of both the ocean economy and the ecosystems services derived from the marine and coastal resources. In addition, Nairobi Convention requested the secretariat in collaboration with other partners, to undertake a baseline study and scenario analysis, and develop a toolkit for green port development and expansion in the Western Indian Ocean region through '*Decision CP.9/13*' (Enhancing cooperation, collaboration, and support with partners'). This decision was further emphasized in '*Decision CP.10/12: Projects and Partnerships*' that urge contracting parties to establish partnerships and programmes on ocean action taking advantage of the opportunities offered by climate change financial mechanisms and arrangements.

The goal of the WIOSAP project is to improve and maintain the environmental health of the region's coastal and marine ecosystems through improved management of land-based stresses. This highlights the need to protect the environmental assets of the WIO coastal regions to provide essential goods and services and is part of the region's commitment to the Nairobi Convention and UN's 2030 Sustainable Development Goals. Component A in particular focuses on the protection, restoration and management of critical coastal habitats and ecosystems.

Therefore, the Nairobi Convention Secretariat, through WIOSAP project, has commissioned the Council for Scientific and Industrial Research (CSIR, South Africa) and the Maritime Technology Cooperation Centre (MTCC) to undertake a project, in consultation with regional port partners and other stakeholders, aimed at advancing sustainable port development in the region. *The project's objectives are to map existing and planned ports in the WIO region, develop and compare sustainable development scenarios in port operations and develop a tool kit for green ports development.* The outputs generated from this work will enable national governments to support and guide the

development of new policy options for sustainable port development in the WIO region. Key deliverables of this project are explained below.

2. Situation Assessment

The purpose of the Situation Assessment is to contextualise the status of port development and operations in the WIO region in terms of current, and potential future, effects on the coastal marine environment. Following valuable input from stakeholders at the virtual meeting (March 2022) and 1st in-person meeting (August 2022), a final draft Situation Assessment report has been compiled including:

- Chapter 1: Introduction, providing the background and purpose of this assessment
- Chapter 2: Overview of Ports in WIO region, providing a concise summary of all documented ports in each of the 10 WIO countries.
- Chapter 3: Port Legislation and Authorities, providing a concise summary of the key legislation and authorities pertaining to port management in each of the each of the 10 WIO countries.
- Chapter 4: Overview of Key Environmental Impacts, providing and overview of key activities & associated environmental problems typically encountered in ports, as well as the environmental & socio-economic impacts, stemming from such problems
- Chapter 5: Detailed Assessment of Selected Case Studies, providing specific geo-referenced change encountered in a selection of ... ports across the WIO regions (representative of various port types but also aimed at representation across countries). The purpose of this exercise is to obtain insight into some of the real change that has occurred in important coastal habitats because of port development in the WIO region over the past two decades
- Chapter 6: Concept of Green Ports, introducing the rationale and international perspective on green port development, largely to inform the content of the Toolkit for Green Port Development
- Chapter 7: Recommendations for the Way Forward.

3. Preliminary Scenario Analysis

At the 1st in-person meeting (August 2022), the proposed method for the Scenario Analysis was presented to stakeholders, and their input on specifics were sourced. Based on the valuable input obtained from this meeting, the Scenario Analysis method was refined, and a preliminary analysis have been undertaken.

A qualitative scenario analysis approach was adopted, using easily understandable narratives to describe a range of generic future scenarios for port development in the WIO region. These scenarios were expressed as anticipatory scenarios, describing specific visions of anticipated futures rather than following an exploratory approach requiring an evaluation of outcome trends into the future. The 7-step process comprises:

Step 1: Define perspective and context of scenario exercise

For this study the context of the scenario analysis was to *Conduct scenario analyses on development options from business-as-usual to options that incorporate environmental considerations to make a business case for sustainability/limiting impacts to the environment arising out of planned/proposed port development.*

Step 2: Identify key external and internal driving forces likely to shape future outcomes

Based on input from stakeholders at the 1st in-person meeting (August 2022), both external and internal driving forces were included. For this study the proposed external driving forces were fixed (Table 1) to focus on possible outcomes for internal driving forces (i.e., that which is within the control of port authorities) (Table 2).

Table 1: Possible Key external driving forces to influence port planning, development & operation outcomes by 2035/50

EXTERNAL DRIVING FORCE	EXPECTED OUTCOME BY 2035/50
Climate Change	0.5 m SLR (from 2000 to 2050, assuming a ~1m rise by 2100 - Horton et al. 2020) together with a probable increase in occurrence and intensity of sea-storms
Shipping traffic in WIO Region	Shipping traffic to increase markedly, as would associate port traffic
Societal pressure	Local societies, supported by international non-government organisations (NGOs), are increasingly empowered to challenge environmental and social decline
International market views	Increased international pressure for environmental/social accountability in ports, and therefore more effective competition in port market as 5 th generation ports

Group sessions at the 1st in-person meeting (August 2022) were used to identify the key internal driving forces and associated issues most relevant to ports in the WIO region (Table 2).

Table 2: Summary of internal driving forces and identified issues

CATEGORY	IDENTIFIED
1: Corporate culture & policy	Management commitment to adopt policies (environmental assessments, greener ports)
	Climate resilience response
	Private sector involvement (port ownership & terminal operators)
	Strategic spatial planning (e.g., link to zone of influence)
	<i>Political will and support (not sure that this would markedly change over scenario period - 2030-50? Change in port behavior most likely to be driven by external driving forces e.g., climate change, societal pressure, global demand for social/environmental accountability to secure market share)</i>
2: Institutional arrangements	Dedicated environment department (execution/enforcement)
	Cross-sectoral collaboration/coordination of authorities
	Multi-stakeholder involvement/participation from role-players (port users)
	Local community acknowledgement/conflict
3: Technological development	Energy efficiency
	Renewable energy
	Waste management
	Vessel logistics (turnover time)
4: Operational efficiency	Environmental auditing/monitoring (enforcement of policies)
	Securing Funding
	Operational training & capacity development towards greener ports
	Disaster preparedness training & capacity development
	<i>Safety & security (while this certainly relates to well-being of employees and port users, this is not considered central to the focus this project, i.e. environmentally sustainable (greener) ports)</i>

Step 3: Identify key sustainability criteria (or indicators) by which to measure future outcomes

For this analysis, the focus was specifically on status indicators as these ultimately reflect the true outcomes of sustainability efforts. Representing the three common pillars of sustainability (environment, social and economic) the sustainability indicators chosen for this scenario analysis were verified with stakeholders at the 1st in-person meeting (August 2022) (Table 3).

Table 3: Summary of key sustainability indicators

INDICATOR	MOTIVATION
ENVIRONMENT	
GHG emissions	Dedication towards climate change mitigation
Status of air quality	Dedication to manage and control atmospheric emissions
Status of port environmental quality	Dedication to manage and control wastewater, solid waste, and hazardous waste
Status of biodiversity & habitat intactness	Dedication to manage port infrastructure development and operations to protect biodiversity and habitat integrity (e.g., implementing biodiversity trade-off policies)
SOCIAL	
Community Well-being vs Conflict	Dedication towards considering community needs, and their involvement in port matter that may affect their livelihoods
Port-City Collaboration vs Conflict	Dedication to consult and collaborate with adjacent urban centers
ECONOMIC	
Climate resilience	Dedication to withstand increased climate such as increased storminess, SLR etc.
Competitiveness (license-to-operate)	Level to which port environmental and social practices enable competitiveness (linked to international and client pressures re sustainability)

Step 4: Construct possible future scenarios

Insufficient measured data were available on ports in the WIO region to perform a detailed, quantitative scenario analysis. It was therefore decided to present scenarios as narratives, comprising a combination of trajectories across the four driving forces. Based on the key issues identified within the different internal driving force categories by stakeholders at the 1st in-person meeting (August 2022), possible trajectories were developed for consideration in the construct of the future scenarios (by 2030/50) for port development in the WIO region (Table 4).

Table 4: Summary Potential internal driving force trajectories for consideration in the construct of the future scenarios (by 2030/50) for port development in the WIO region

DRIVING FORCE	DRIVING FORCE TRAJECTORY
Corporate culture and policies	A ‘Doing nothing’: Effective environmental monitoring/auditing and disaster intervention preparedness (e.g., oil spills) are lacking due to inefficient funding, lack of training and capability development. Lack of management dedication to environmentally operational efficiency. (A) Effective environmental monitoring/auditing and disaster intervention preparedness (e.g., oil spills) are lacking due to inefficient funding, lack of training and capability development. Lack of management dedication to environmentally operational efficiency.
	B ‘Going Greener with climate change mitigation/adaptation’: In response to global demand for environmental accountability to secure/grow their market share, port managers implement and enforce overarching policies for greener ports focusing on energy efficiency and renewable energy. These are also reflected in lease agreements with private sector tenants. Lost revenue and rising infrastructure maintenance costs because of climate change impacts convince port authorities to act to increase climate resilience of port infrastructure and operations. However, pollution, waste and wastewater management and control remain neglected. Ports still disregard societal responsibilities, reflected in uncoordinated spatial planning for port development and expansions impacting adjacent communities/cities.
	C ‘Going Greener with improved pollution management’: In response to global demand for environmental accountability to secure/grow their market share, port managers implement and enforce overarching policies for greener ports focusing on pollution (waste and wastewater management and control). These are also reflected in lease agreements with private sector tenants. Energy efficiencies and renewable energy issues remain neglected and port authorities fail to act to increase climate resilience of port infrastructure and operations. Ports still disregard societal responsibilities, reflected in uncoordinated spatial planning for port development and expansions impacting adjacent communities/cities.
	D ‘Supporting sustainable ports’: In response to global demand for environmental accountability to secure/grow their market share, port managers implement and enforce overarching policies for greener ports. These are also reflected in lease agreements with private sector tenants. Lost revenue and rising infrastructure maintenance costs because of climate change impacts convince port authorities to act to increase climate resilience of port infrastructure and operations. Pressure from increasingly empowered communities/cities and resulting delays in development projects (with serious cost implications) necessitates port authorities to undertake joint, strategic, and integrated spatial planning of port development and expansion.
Institutional arrangements	A ‘Doing nothing’: Silo-based management within authorities prevails, with no dedicated port environmental department, resulting in uncoordinated planning and management, often with costly consequences (duplication of efforts, critical issues not addressed). No formal institutional

DRIVING FORCE		DRIVING FORCE TRAJECTORY
		structures in place to coordinate activities across port users, risking potential detrimental environmental, social and economic consequences, especially during disasters and emergencies. No forums are in place as platforms to facilitate communication and collaboration between port authorities and adjacent communities/cities.
	B	'Going Greener with climate change mitigation/adaptation': The financial and logistical value of functional cross-sectoral institutional structures for cooperative port environmental planning and operations is acknowledged. Dedicated port environmental departments are established and resourced, focusing on climate change mitigation/adaptation. These helps drive increased climate resilience of port infrastructure and operations. Increasing global pressure on ports (and port tenants) to account for their social and environmental responsibilities necessitates the establishment of dedicated institutional structures to communicate, coordinate and audit port user performance. Integrated climate change forums are established within port structures. However, dedicated forums to facilitate collaboration/communication between port authorities and adjacent communities/cities are still lacking.
	C	'Going Greener with improved pollution management': The financial and logistical value of functional cross-sectoral institutional structures for cooperative port environmental planning and operations is acknowledged. Dedicated port environmental departments are established and resourced, focusing on pollution management. However, integrated climate change forums are not established within port structures, and climate resilience of port infrastructure and operations is not increased. Increasing global pressure on ports (and port tenants) to account for their social and environmental responsibilities necessitates the establishment of dedicated institutional structures to communicate, coordinate and audit port user performance. Dedicated forums to facilitate collaboration/communication between port authorities and adjacent communities/cities are also still lacking.
	D	'Supporting sustainable ports': The financial and logistical value of functional cross-sectoral institutional structures for cooperative port environmental planning and operations is acknowledged. Dedicated port environmental departments are established and resourced. Increasing global pressure on ports (and port tenants) to account for their social and environmental responsibilities necessitates the establishment of dedicated institutional structures to communicate, coordinate and audit port user performance. Integrated climate change forums are established within port structures. These helps drive increased climate resilience of port infrastructure and operations. Pressure from increasingly empowered communities/cities (which otherwise object to and delay development projects with serious cost implications) necessitates port authorities to establish dedicated institutional structures to facilitate collaboration with society at large.
Technological development	A	'Doing nothing': Energy efficient technologies (e.g., no cold ironing) are not implemented and no investment is made in renewable energy. Ports remain strongly reliant on fossil fuels. Innovative waste and wastewater management technologies are also absent, resulting in coastal water and air pollution. Vessel turnover times are long due to poor vessel traffic management and inefficient traffic and cargo handling technologies.
	B	'Going Greener with climate change mitigation/adaptation': In response to global demand for environmental accountability to secure/grow their market share, port managers implement and enforce overarching policies for greener ports focusing on energy efficiency and renewable energy. These are also reflected in lease agreements with private sector tenants. Lost revenue and rising infrastructure maintenance costs because of climate change impacts convince port authorities to act to increase climate resilience of port infrastructure and operations. However, pollution, waste and wastewater management and control remain neglected. Ports still disregard societal responsibilities, reflected in uncoordinated spatial planning for port development and expansions impacting adjacent communities/cities.
	C	'Going Greener with improved pollution management': Pressure from empowered adjacent communities/ cities necessitates port investment and implementation of innovative waste and wastewater management technologies to combat coastal water, air and land pollution. Port authorities fail to act to increase climate resilience of port infrastructure and operations and energy efficiencies and renewable energy issues remain neglected. Investment in renewable energy sources and technologies to improve port energy and logistical efficiencies is not made. Customer dissatisfaction remains high and port loses competitiveness.
	D	'Supporting sustainable ports': Pressured by global demand for environmental accountability and to secure/grow their market share, ports focus on globally visible technological interventions linked to energy efficiency and renewable energy sources (this might also occur due to fossil fuel becoming increasingly expensive). Customer dissatisfaction (e.g., because of long vessel turnaround time) forces port authorities to invest in technologies for improved efficiencies. Pressure from empowered adjacent communities/cities (which otherwise result in increasingly costly legal conflicts) necessitate port authorities to implement innovative waste and wastewater management technologies to combat coastal water, air and land pollution.
Operational efficiency	A	'Doing nothing': Effective environmental monitoring/auditing and disaster intervention preparedness (e.g., oil spills) are lacking due to inefficient funding, lack of training and capability development. Lack of management dedication to environmentally operational efficiency.
	B	'Going Greener with climate change mitigation/adaptation': Global pressure for greater environmental accountability necessitates port authorities to implement and enforce environmental monitoring/auditing processes (focusing on energy efficiency and renewable energy sources). Improved environmental practices open selected funding opportunities with investors interested in sustainable port development (e.g., public-private partnerships). Lost revenue and rising infrastructure maintenance costs because of climate change impacts convince port authorities to

DRIVING FORCE		DRIVING FORCE TRAJECTORY
		act to increase climate resilience of port. Investment is also made in training and capacity development to focus on energy efficiency and renewable energy, but not on pollution (waste and wastewater management and control).
	C	'Going Greener with improved pollution management': Global pressure for greater environmental accountability and growing need to acquire port environmental certification (e.g., ISO14001) compel port authorities to implement and enforce environmental monitoring/auditing processes focusing on pollution (waste and wastewater management and control). Improved pollution management enables port authorities to identify polluters and direct cost recoveries to their accounts (polluter pays principle) leading to improved compliance with regulations. Improved environmental practices open selected funding opportunities with investors supporting sustainable port development (e.g., public-private partnerships). However, energy efficiencies and renewable energy issues remain neglected and port authorities fail to act to increase climate resilience of port infrastructure and operations. Investment in training and capacity development focusses on pollution (waste and wastewater management), but not energy efficiency and renewable energies.
	D	'Supporting sustainable ports': Global pressure for greater environmental accountability and growing need to acquire port environmental certification (e.g., ISO14001) compel port authorities to implement and enforce environmental monitoring/auditing processes. Higher port traffic increases the risk of costly disasters, necessitating authorities to invest in improved disaster preparedness procedures. Improved pollution management enables port authorities to identify polluters and direct cost recoveries to their accounts (polluter pays principle) leading to improved compliance with regulations. Significantly improved environmental practices open lucrative funding opportunities with investors wanting to support sustainable port development (e.g., public-private partnerships). Port authorities acknowledge the value of greener ports and the critical importance of adequately trained and motivated staff, to secure long-term (sustainable) economic growth.

Using combinations of the potential driving force trajectories, a series of possible future scenarios for port development in the WIO region was then constructed (Table 8).

Table 5: Proposed future scenarios (by 2030/50) constructs for port development in the WIO region, combining possible internal driving force trajectories

SCENARIO		COMBINATION OF INTERNAL DRIVING FORCE TRAJECTORIES	
1	'Doing nothing'	Corporate culture and policies	(A) 'Doing nothing'
		Institutional arrangements	
		Technological development	
		Operational efficiency	
2	'Fixing only institutions'	Corporate culture and policies	(A) 'Doing nothing'
		Institutional arrangements	(D) 'Supporting sustainable ports'
		Technological development	(A) 'Doing nothing'
		Operational efficiency	
3	'Fixing only policies & institutions'	Corporate culture and policies	(D) 'Supporting sustainable ports'
		Institutional arrangements	
		Technological development	(A) 'Doing nothing'
		Operational efficiency	
4	'Fixing only policies & technologies'	Corporate culture and policies	(D) 'Supporting sustainable ports'
		Institutional arrangements	(A) 'Doing nothing'
		Technological development	(D) 'Supporting sustainable ports'
		Operational efficiency	(A) 'Doing nothing'
5	'Going Greener with climate change mitigation/ adaptation'	Corporate culture and policies	(B) 'Going Greener with climate change mitigation/ adaptation'
		Institutional arrangements	
		Technological development	
		Operational efficiency	
6	'Going Greener with improved pollution management'	Corporate culture and policies	(C) 'Going Greener with improved pollution management'
		Institutional arrangements	
		Technological development	
		Operational efficiency	
7	'Fixing only policies, institutions & technologies'	Corporate culture and policies	(D) 'Supporting sustainable ports'
		Institutional arrangements	
		Technological development	(A) 'Doing nothing'
		Operational efficiency	
8	'Fixing only policies, technologies & operations'	Corporate culture and policies	(D) 'Supporting sustainable ports'
		Institutional arrangements	(A) 'Doing nothing'
		Technological development	
		Operational efficiency	(D) 'Supporting sustainable ports'
9	'Supporting sustainable ports'	Corporate culture and policies	(D) 'Supporting sustainable ports'
		Institutional arrangements	
		Technological development	
		Operational efficiency	

Step 5: Define anticipated effect of driving force trajectories on selected sustainability indicators

As input to the scenario analysis process, matrices were constructed to rate the anticipated influence, or effect, of each internal driving force trajectory driving force on the selected sustainability indicators. This was necessary to ensure that in the analysis process, a common understanding was had on possible individual internal driving force trajectories, which were then integrated based on the combination of trajectories selected for each scenario. The anticipated influence of internal driving force trajectories was rated using a 5-point scaling system (-2 to +2) where:

- -2 = strong negative influence expected
- -1 = some negative influence expected
- 0 = no marked influence expected
- 1 = some positive influence expected
- 2 = strong positive influence expected.

Table 6: Anticipated influence of driving force trajectories on selected sustainability indicators (-2 = strong negative influence; -1 = some negative influence; 0 = no marked nett influence; 1 = some positive influence; 2 = strong positive influence)

INDICATOR	EXPECTED INFLUENCE OF TRAJECTORY			
	[A]	[B]	[C]	[D]
CORPORATE CULTURE & POLICIES				
1 GHG emissions	-2	2	-2	2
2 Status of Air Quality	-2	1	1	2
3 Status of Port Environmental Quality	-2	-2	2	2
4 Status of Biodiversity & Habitat Intactness	-2	-2	2	2
5 Community relationship	-2	-1	1	2
6 Port-City collaboration	-2	-1	1	2
7 Climate resilience	-2	2	-2	2
8 Competitiveness	-2	1	0	2
INSTITUTIONAL ARRANGEMENTS				
1 GHG emissions	-2	1	1	2
2 Status of Air Quality	-2	1	1	2
3 Status of Port Environmental Quality	-2	1	1	2
4 Status of Biodiversity & Habitat Intactness	-2	1	1	2
5 Community relationship	-2	-1	-1	2
6 Port-City collaboration	-2	-1	-1	2
7 Climate resilience	-2	2	-2	2
8 Competitiveness	-2	1	0	2
TECHNOLOGICAL DEVELOPMENT				
1 GHG emissions	-2	2	-2	2
2 Status of Air Quality	-2	1	1	2
3 Status of Port Environmental Quality	-2	-2	2	2
4 Status of Biodiversity & Habitat Intactness	-2	-2	2	2
5 Community relationship	-2	-1	2	2
6 Port-City collaboration	-2	-1	1	2
7 Climate resilience	-2	2	-2	2
8 Competitiveness	-2	1	0	2
OPERATIONAL EFFICIENCY				
1 GHG emissions	-2	2	-2	2
2 Status of Air Quality	-2	1	1	2
3 Status of Port Environmental Quality	-2	-2	2	2
4 Status of Biodiversity & Habitat Intactness	-2	-2	2	2
5 Community relationship	-2	-1	2	2
6 Port-City collaboration	-2	-1	1	2
7 Climate resilience	-2	2	-2	2
8 Competitiveness	-2	1	0	2

Step 6: Determine expected outcomes of future scenarios

Assuming external driving forces (Table 1) to remain the same across all scenarios, internal driving force outcomes were analysed based on the combination of trajectories allocated. First, the anticipated influence of selected trajectories on each of the sustainability indicators were obtained using the pre-derived ratings (Table 6). Weightings were then allocated to reflect the relative influence of internal driving forces to obtain indicator ratings per scenario using weighted averages. In turn, the indicators within the environment, social and economic domains were weighted to obtain domain ratings per scenario using weighted averages. Finally, domain ratings were weighted and averaged to obtain an overall sustainability rating per scenario. To provide for easier interpretation, the indicators, domain, and overall sustainability ratings were normalized within a range from 0 to 100, where scores below 50 were indicative of a negative sustainability trajectory and score above 50 a positive sustainability trajectory.

Figure 1 presents a comparison of the expected sustainability outcomes of various future scenarios (by 2030/50), where scores above 50 represent more sustainable positive trajectories, while scores below 50 are indicative of less sustainable negative trajectories. Scenario 1 ('Doing nothing') and Scenario 9 ('Supporting sustainable ports') represent the two extreme situations where port authorities either disregard any actions towards sustainable development (Scenario 1), or where port authorities diligently implement interventions to achieved sustainability (Scenario 9). While these extremes are unlikely to be realistic outcomes, it provides the relative end points against which to better calibrate intermediate interventions (i.e. Scenarios 2 to 8).

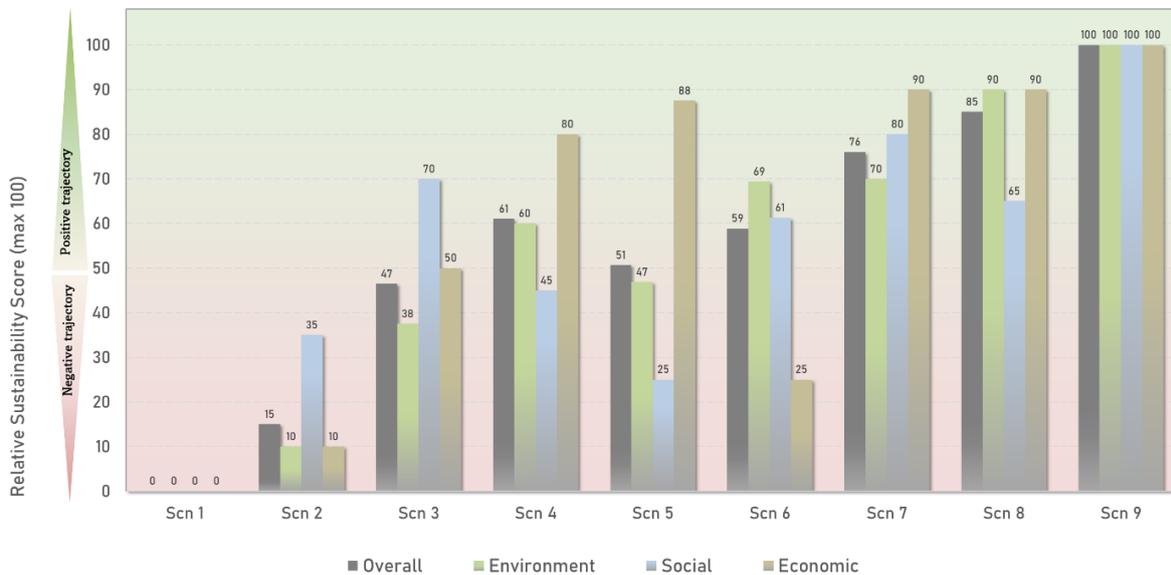


Figure 1 Comparison of overall sustainability performance among selected future scenarios for port development in the WIO region

Figure 2 schematises the outcomes per indicator for each of the scenarios. As expected, the Worst Case (Scenario 1), is unlikely to result in any sustainability, with 'Sustainable Ports' can be viewed as the 'ideal sustainability outcome'. Scenario 2 ('Fixing only institutions') presents a situation where port authorities only address institutional matters, but not deal with any important interventions within the other key driving forces, that is corporate culture & policies, technological development, and operational efficiencies. Evident from the outcome of Scenario 1 is that very little is likely to be achieved with 'only talking'.

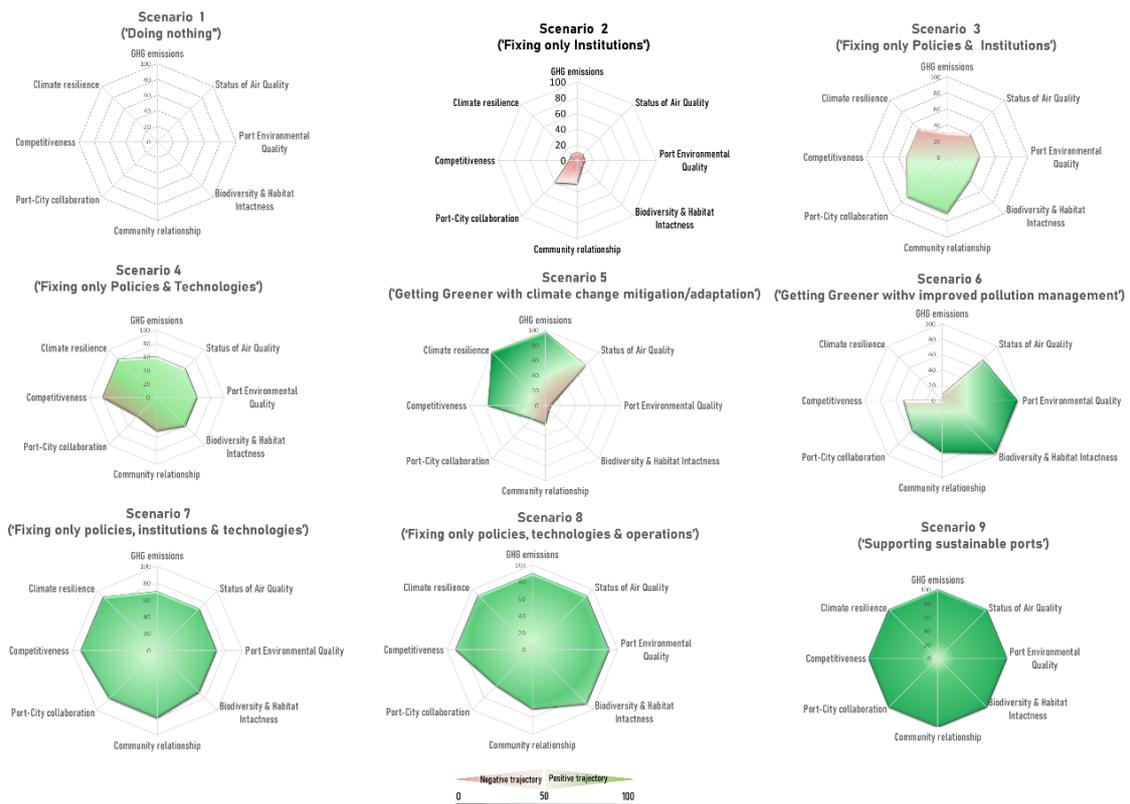


Figure 2 Comparison of expected overall influence of various future scenarios on selected sustainability indicators

Scenario 3 ('Fixing only institutions and policies'), also introduces the establishment of policies supporting sustainability, but again 'only talking' and having 'legislation on paper' is unlikely to achieved marked progress without addressing practical implementation through, for example technological developments and operational efficiency. In Scenario 4 (only fixing 'Policies and Technologies'), the influence of practical implementation becomes apparent, although in this scenario lack of institutional progress in terms of community and port-city relationships, are still visible. Scenario 5 ('Getting Greener with climate change mitigation /adaptation') present as situation where port authorities strongly focus on addressing issues of pertaining to climate mitigation and adaptation, showing its effect on reducing *GHG emissions* and *Climate resilience*. However, lack of attention to the management and control of emissions, waste and wastewater, the influence of pollution remains clear. On the other hand, Scenario 6 ('Getting Greener with improved pollution management'), where authorities tend to focus on emission, waste and wastewater management and control, the influence of pollution is markedly reduced, although the lack of effort towards climate mitigation and resilience remains an issue.

The value of combining technological developments or operational efficiencies, with supporting policies and sound institutional arrangement, for sustainable development in ports, becomes evident in Scenario 7 ('fixing only policies, institutions, and technologies'). Even more so, if technological developments and operational efficiencies are combined with support policies as depicted in Scenario 8 ('fixing policies, technologies, and operations'). The overall ratings in Figure 1 also reiterates the greater positive trajectory gained through the incorporation of practical implementation aspects, as represented by technological developments and operational efficiencies (e.g. Scenarios 7 and 8), rather than focusing on policy development and institutional interventions alone (e.g. Scenarios 2 and 3).

4. Toolkit for Green Port Development

To best contextualise guidance on sustainable port development, it is useful to conceptualise the different sequential stages in the port planning and development cycle that is site selection, master planning, design, construction, operations, and monitoring.

Key to sustainable ports is bridging the traditional disconnect between natural environmental issues and port planning and development, as well as acknowledging the multi-use benefits from its natural capital. This requires early consideration of the natural environment in port planning and design, and not only focusing on environmental performance in the operations and maintenance stages, embracing multi-use valuation (ecosystem services) that gives purpose to the need for environmental protection. To assist in practically bridging this disconnect, Taljaard et al. (2021) posed an Integrated Port Management (IPM) framework conceptually positioning and aligning environmental processes within the traditional port development cycle, but also the need for coordination and continuity across such environmental processes (Figure 3).

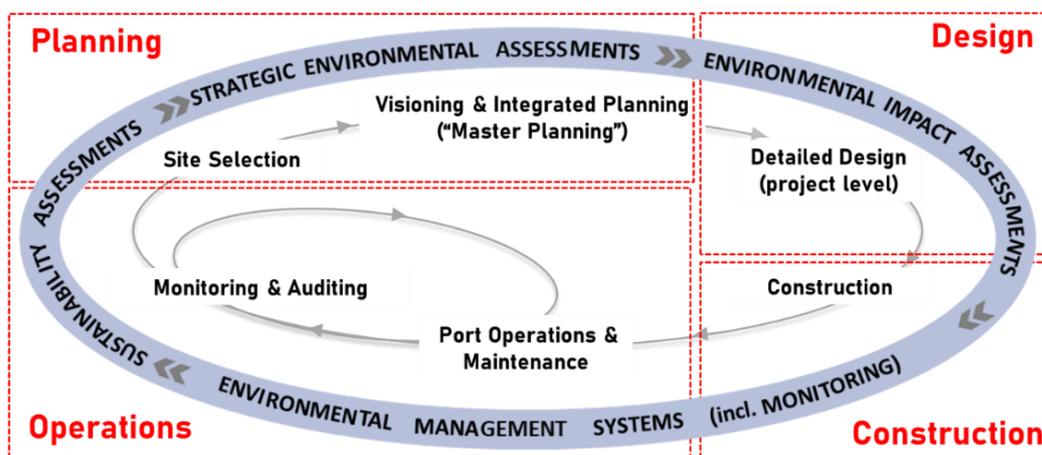


Figure 3 Integrated Port Management Framework, conceptualizing alignment between the traditional port planning and development cycle, and key environmental assessment and management processes

The traditional development cycle comprises six key sequential stages, that is site selection, master planning, design, construction, operations, and monitoring, presented in a cyclical, logical order in the IMP framework. It recognizes the different time frames in port planning and management in a nested loop arrangement. The larger cycle, involving site selection, planning, design, and construction of new or expansive port infrastructure, representing stages typically occurring at 5-year (or longer) intervals (i.e. longer time scales). The smaller cycle (operations and maintenance, and monitoring and auditing) is nested within the larger cycle, and represents stages that occur continuously, on much shorter (i.e. day-to-day) time scales. To effectively address environmental matters in ports, it must be effectively integrated into existing planning and decision-making processes. Therefore, it is important that environmental aspects are pro-actively aligned and incorporated in all stages of port planning and operation, from the early planning stages through design, construction and into operation. To achieve this, the various environmental processes need to become aligned and integral to traditional port planning and development stages as proposed in the IMP framework.

To assist port operators with easy contextualisation of useful sustainable environmental tools that could be implemented within the context of the IMP Framework, the Toolkit for Green Ports presented here has been organised in accordance with the key stages in the framework. The table below

summarises the various tools offered in the Green Port Toolkit within each of the four stages, that is planning, design, construction, and operations:

SECTION	TOOLS
A: Rationale	<i>Rationale for Green Port Development (see main report)</i>
B: Planning	B.1 Site selection and Master Planning
	B.2 Planning for Climate Change
	B.3 Guidance on Strategic Environmental Assessment
C: Design	C.1 Guidance on Environmental Impact Assessment
	C.2 Concept of Nature-based Solutions
	C.3 Design for Biodiversity Offsets
	C.4 Building-with-Nature Design Approach
	C.5 Ecological Enhancement Options
	C.6 Ecosystem Restoration
D: Construction	D.1 Dredge Management (also relevant in Operations)
	D.2 Construction Environmental Management Plans
	D.3 Considerations for Port Decommissioning
E: Operations	E.1 Guidance on Environmental Management Systems
	E.2 Circular Economy in Ports
	E.3 Examples: Sustainable Port Development Actions
	E.4 Securing External Finance for Port Development Projects
	E.5 Sustainable Use of Materials and Land
	E.6 Energy Efficiency Management
	E.7 Management of Carbon Footprint
	E.8 Management of Water Consumption
	E.9 Waste Management
	E.10 Ballast Water Management
	E.11 Guidance on Sustainable Hull Cleaning
	E.12 Towards Improving Port Environmental Quality
	E.13 Marine Litter Clean up Technologies
	E.14 Oil Spill Contingency Planning
	E.15 Environmental Monitoring and Evaluation
	E.16 Environmental Information Systems
	E.17 Effective Capacity Development
	E.18 Introduction to Natural Capital Accounting
	E.19 Sustainability Performance Index (linked to SDGs)

It may not be practically possible for ports in the WIO region to implement all the tools in this Green Port Toolkit at once, due to human and financial resource limitations. However, by committing to a focussed, on-going process towards aligning environmental matters early on in port planning and development, and in the operational and maintenance phases as is contextualised in the IPM framework, port operators can incrementally achieve environmental sustainability, incrementally implementing key priorities specific to their port environment, and supported by the tools in this Toolkit. Ideally, the IPM Framework, as well as the guidance and best practice proposed in Green Port Toolkit should be adopted and embedded in national policies pertaining to sustainable port management, as appropriate.

5. Policy Brief

A Policy Brief will be prepared as a final deliverable to this study, giving future recommendations for green port development in the WIO region. It will be directed at policymakers, proposing specific policy and technical recommendations, motivated and supported by the different deliverables produced as part of this project.