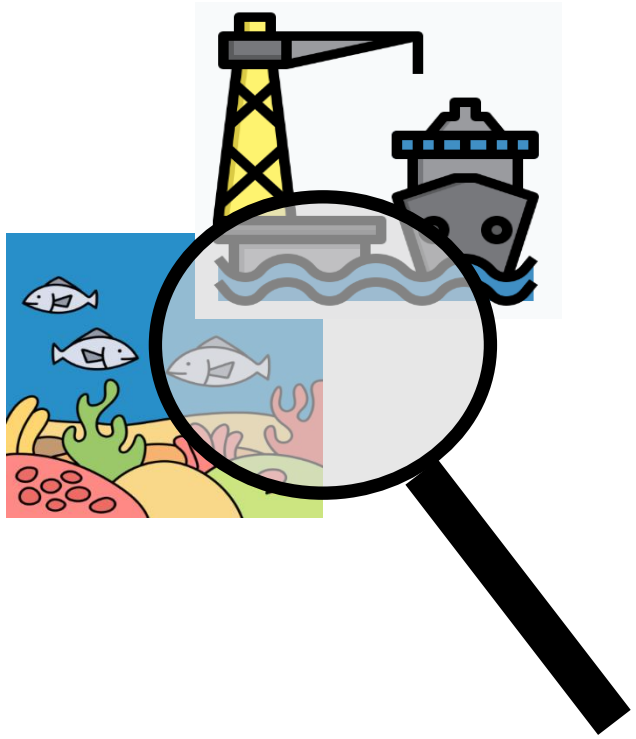
Towards Sustainable Port Development in Western Indian Ocean

Day 2: Scenario Analysis – exploring Possible Futures for Port Development

Purpose of Scenario Analysis

- Glimpse into **Possible Futures**…
- Demonstrates **how and why things could turn out** – better or worse – thereby being better prepared for possible futures
- Gain better **understanding of major variables** that may significantly impact and shape future – positive or negative
- Provides **insights** that could help to deal with **uncertainty and planning** towards achieving a desired outcome



Approach

- Numerous approaches for Scenario Analysis
- Exploratory (look at trends) vs Anticipatory (future end point)

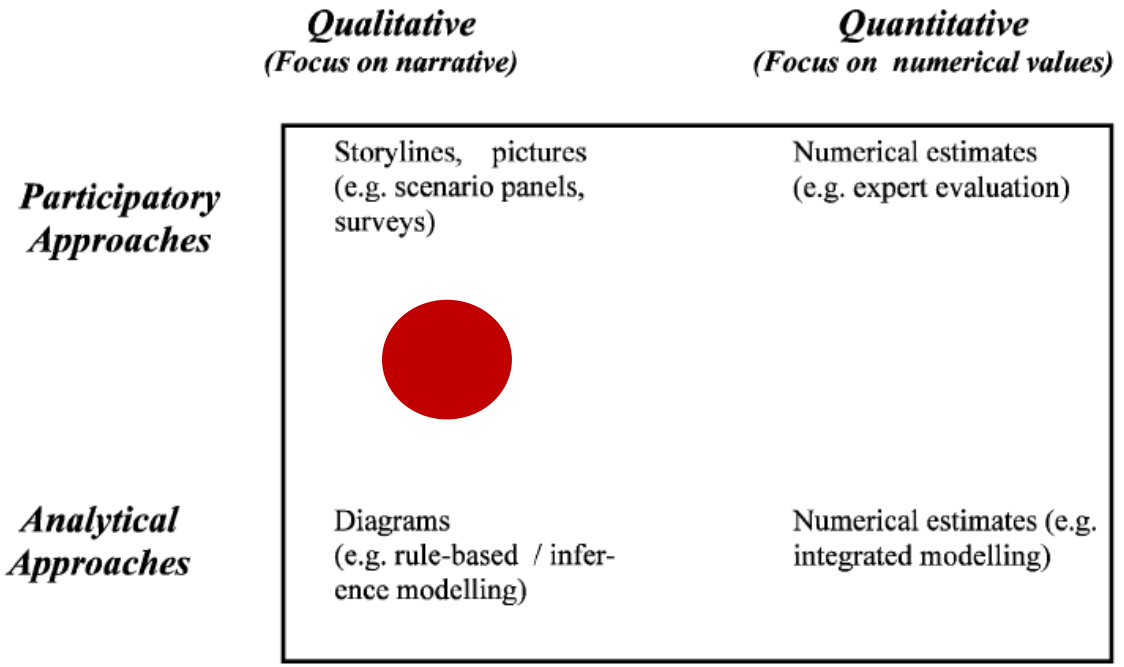
- Qualitative vs Quantitative (depending on data availability)
- Participatory (sourcing from experts) vs Analytical (rule-based & numerical models)

	Qualitative ***(Focus on narrative)***	***Quantitative*** ***(Focus on numerical values)***
Participatory Approaches	Storylines, pictures (e.g. scenario panels, surveys)	Numerical estimates (e.g. expert evaluation)
Analytical Approaches	Diagrams (e.g. rule-based / inference modelling)	Numerical estimates (e.g. integrated modelling)

Approach…

- Qualitative (narrative) (limited quantitative data on ports in region)
- Participatory vs Analytical hybrid (scoring system based on expert opinion)
- Anticipatory outcome: *"Anticipated situation by 2035 under various scenarios"*

- Six-step method using Excel spreadsheet model
- For this study, a set of 'typical' scenarios for WIO region analysed (i.e., not country or port-specific)
- Spreadsheet model - countries and ports can customise and apply own scenarios



Scenario Analysis: Step 1

Step 1: Define goal, perspective & context

Develop scenarios from ‘business-as-usual’ as well as options incorporating environmental considerations as business case for sustainability (or limiting environmental impacts) from future port development

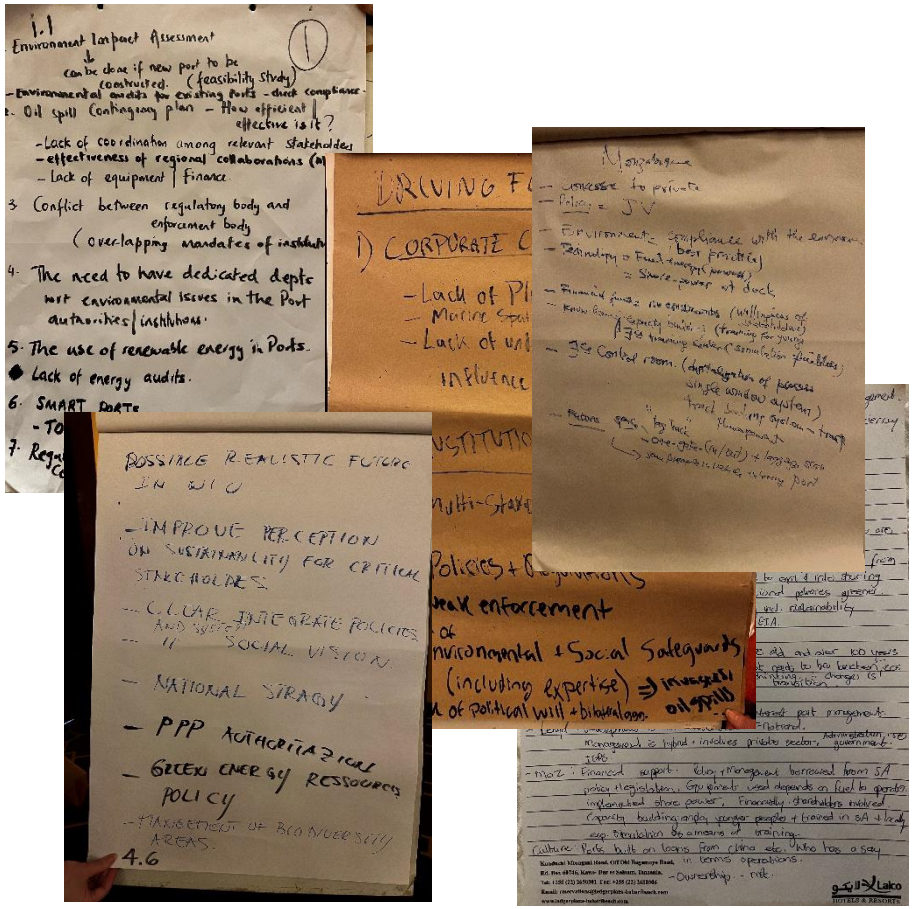
Scenario Analysis: Step 2

Step 2: Identify key driving forces likely to shaping future outcomes

- Workshopped at 1st stakeholder meeting (Aug 2022)
- Needed to distinguish between external and internal driving forces
- At workshop focused on internal driving forces (which port authorities can influence) organised in:
  - Corporate culture and supporting policies (corporate commitment & policies)
  - Institutional arrangements (internal and port-city-community arrangements)
  - Technological development (fuel use, energy and effectiveness of technologies)
  - Operational efficiency (capacity, skills, funding monitoring)

Scenario Analysis: Step 2…

- Break-away groups tasked to identify key issues within each of driving forces



	A	B	C	D	E
1	Group	Internal Driving Force	Theme	Issue	Comment
2	1	1: Commitment & policy	Legislation & policies	Environmental processes	Environmental Impact Assessment: (1) EIAs can be done for new ports to be constructed (feasibil Environmental audits for existing portd - check compliance
3	2	1: Commitment & policy	Legislation & policies	Environmental processes	Present: SEA and EIA community of ....
4	2	1: Commitment & policy	Legislation & policies	Environmental processes	Future: SEA and EIA
5	5	1: Commitment & policy	Legislation & policies	Environmental processes	Commonalities: EIA/SEA ES&IA
6	1	1: Commitment & policy	Legislation & policies	International conventions	Regulations/ratification and domestication of conventions
7	5	1: Commitment & policy	Legislation & policies	International conventions	Commonalities: Conventions (international)
8	3	1: Commitment & policy	Legislation & policies	Port Policy: Climate change	Threat: Climate change
9	2	1: Commitment & policy	Legislation & policies	Port policy: General	Future: Operational policies greener
10	2	1: Commitment & policy	Legislation & policies	Port policy: General	Mozambique: Policy and management borrowed from SA policy and legislation
11	2	1: Commitment & policy	Legislation & policies	Port policy: General	Mozambique: Policy = JV ?
12	3	1: Commitment & policy	Legislation & policies	Port policy: General	Policies and regulations
13	4	1: Commitment & policy	Legislation & policies	Port policy: General	Current causes: Lack of policy
14	4	1: Commitment & policy	Legislation & policies	Port policy: General	Future: Clear integrated policies and systems
15	4	1: Commitment & policy	Legislation & policies	Port policy: General	Lack of alignment between regulations and port policies
16	4	1: Commitment & policy	Legislation & policies	Port policy: General	Future: National strategy
17	5	1: Commitment & policy	Legislation & policies	Port policy: General	Commonalities: Policies - local
18	5	1: Commitment & policy	Legislation & policies	Port policy: General	Challenges: ... Maritime national policies not adopted
19	4	1: Commitment & policy	Legislation & policies	Private sector involvement	Future: PPP Authorisation
20	2	1: Corporate culture & policy	Legislation & policies	Private sector involvement	Kenya:Management is hybrid and involves private sector
21	2	1: Corporate culture & policy	Legislation & policies	Private sector involvement	Kenya: Consider management hybrid between governance and private sectors
22	2	1: Corporate culture & policy	Legislation & policies	Private sector involvement	Mozambique: Consession to private
23	2	1: Corporate culture & policy	Legislation & policies	Private sector involvement	Mozambique: Ownership risks
24	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Lack of planning (e.g. landuse)
25	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Marine spatial planning
26	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Future: Will have more ports closer together
27	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Future: Improved planning and design
28	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Threats: social tradeoffs competition for space
29	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Threats: Understanding influence zone around ports by managers (e.g. dredging)
30	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Threats: Lack of planning (both exisitng and new), costly
31	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Threats: Lack of land-use planning
32	3	1: Corporate culture & policy	Legislation & policies	Spatial planning	Lack of understanding of broader influence zone of port
33	4	1: Corporate culture & policy	Legislation & policies	Spatial planning	Challenges: Land-based/urban problems
34	4	1: Corporate culture & policy	Legislation & policies	Spatial planning	Challenges: Ports are sensitive areas (pollution, contamination)
35	4	1: Corporate culture & policy	Legislation & policies	Spatial planning	Future: Management of biodiversity areas
36	4	1: Corporate culture & policy	Legislation & policies	Spatial planning	Limited area for development

Scenario Analysis: Step 2…

- Key issues identified:

Corporate culture and supporting

- Management commitment to adopt policies
- Private sector involvement
- Strategic spatial planning
- *Political will and support*

Institutional arrangements

- Dedicated environmental department
- Cross-sectoral collaboration/coordination
- Multi-stakeholder involvement/participation
- Local community acknowledgement/conflict

Technological development

- Energy efficiency
- Renewable energy
- Waste management
- Vessel logistic (turn-over time)

Operational efficiency

- Environmental auditing and monitoring
- Securing funding
- Training and capacity development (green port and disaster preparedness)
- *Safety and security*

Scenario Analysis: Step 2…

- Identified key external driving forces:

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 associated port traffic

Societal pressure

Local societies are becoming emancipated and empowered to stand up against environmental and social decline, supported by international non-government organisations

International market views

International pressure for environmental/social accountability to effectively compete in port market (5th generation ports)

Largely outside influence of port authorities –assumed same across scenarios

Scenario Analysis: Step 3

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

Environment	• Greenhouse gas emissions (air quality)
	• Port environmental quality
	• Biodiversity & habitat intactness
Social	• Community well-being/collaboration
	• Port-city collaboration
Economic	• Extent of climate resilience (adaptation)
	• Level of competitiveness (license-to-operate)

Scenario Analysis: Step 4

Step 4: Define possible outcomes for selected (internal) driving forces by 2030/59

Internal driving forces (& key issues)

Corporate culture and supporting

Technological development

Institutional arrangements

Operational efficiency

What could 'stories' be under possible outcomes

Possible outcome, when…

'Doing nothing' [A]

'Going greener with climate change migration/adaptation' [B]

'Going greener with improved pollution management' [C]

'Supporting sustainable ports' [D]

Scenario Analysis: Step 5

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

Qualitative rating system:

-2	Strong negative influence expected
-1	Some negative influence expected
0	Negative/positive influences balance out
1	Some positive influence expected
2	Strong positive influence expected

Scoring:

INTERNAL DRIVING FORCE CATEGORY 1: CORPORATE CULTURE & POLICY

	INDICATOR	OUTCOME'S EXPECTED INFLUENCE			
		A	B	C	D
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	Competitiveness	-2	1	0	2
8	Climate resilience	-2	2	-2	2

Weighting:

INTERNAL DRIVING FORCE CATEGORY	WEIGHTING (EXPECTED RELATIVE INFLUENCE) OF DRIVING FORCE CATEGORY ON SPECIFIC INDICATORS							
	1	2	3	4	5	6	7	8
	GHG emissions	Status of Air	Status of Port	Status of Biodiversity	Community relationship	Port-City collaboration	Climate resilience	Competitiveness
1. Corporate culture and policy	0.20	0.30	0.30	0.30	0.40	0.30	0.40	0.20
2. Institutional arrangements	0.10	0.10	0.10	0.10	0.30	0.40	0.10	0.10
3. Technological development	0.40	0.30	0.30	0.30	0.10	0.10	0.40	0.30
4. Operational efficiency	0.30	0.30	0.30	0.30	0.20	0.20	0.10	0.40

INDICATOR	WEIGHTING
GHG emissions	0.25
Status of Air Quality	0.25
Status of Port Environmental Quality	0.25
Status of Biodiversity & Habitat Intactness	0.25
Community relationship	0.50
Port-City collaboration	0.50
Climate resilience	0.50
Competitiveness	0.50

DOMAIN	WEIGHTING
Environment	0.60
Social	0.20
Economic	0.20

Weighting of driving force categories vs sustainability indicators

Weighting of indicators within each of Environment, Social and Economic domains

Weighting of Environment, Social and Economic domains' contribution to final score

Scenario Analysis: Step 6

Step 6: Build anticipated scenarios and determine expected sustainability outcomes

Build nine future scenarios (using combinations of [A] to [D] for various driving forces):

1. Do nothing (e.g., selecting all [A]'s)
2. Fixing only institutions
3. Fixing only policies & institutions
4. Fixing only policies & technologies
5. Getting greener with climate mitigation/adaptation
6. Getting greener with improved pollution management
7. Fixing only policies, institutions & technologies
8. Fixing only policies, technologies & operations
9. Supporting sustainable ports (e.g., selecting all [D]'s)

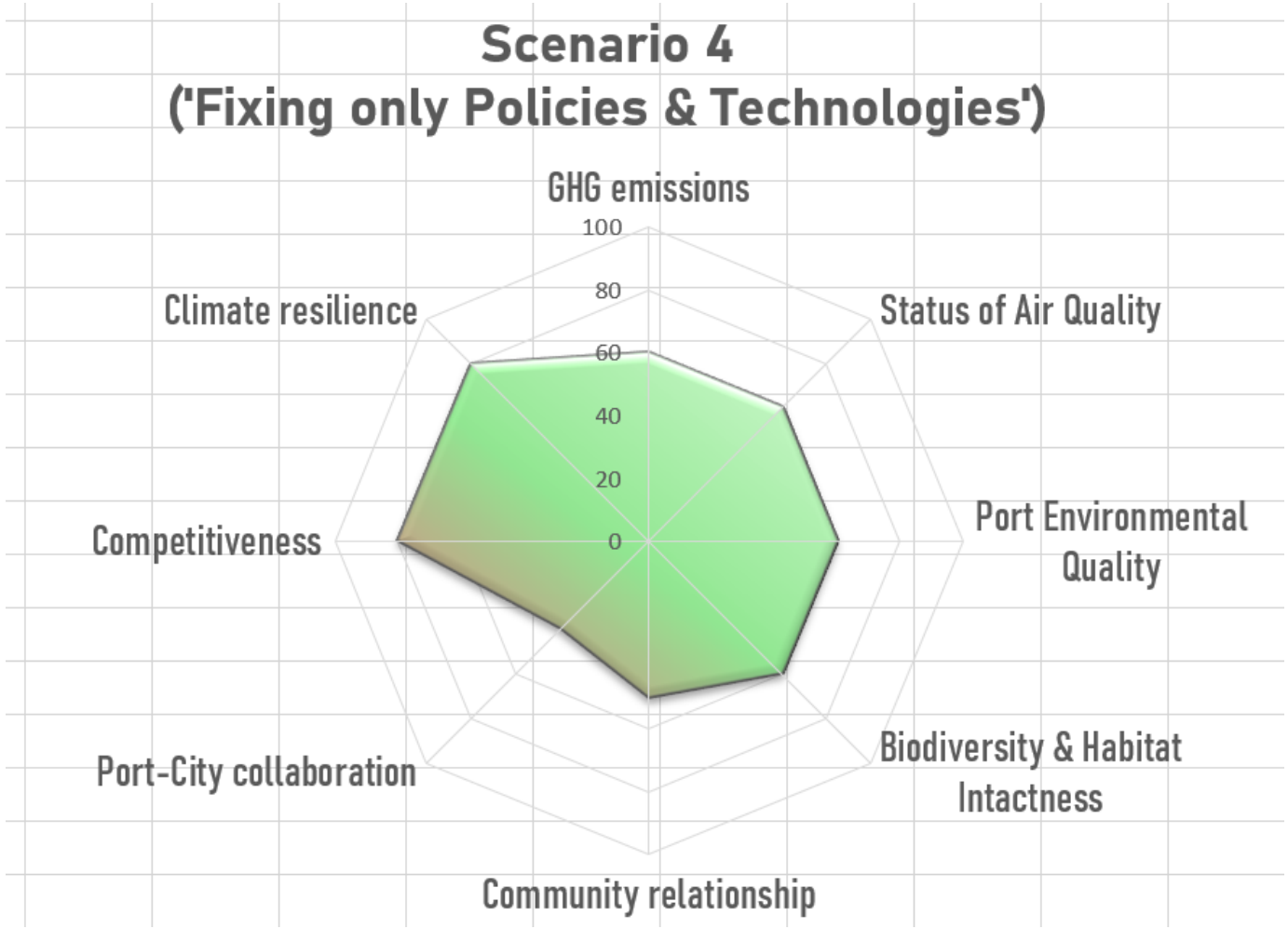
INTERNAL DRIVING FORCE CATEGORY		SCENARIOS 1 Doing nothing	2 Fixing only Institutions	3 Fixing only Policies & Institutions	4 Fixing only Policies & Technologies	5 Getting Greener with climate mitigation/ adaptation	6 Getting Greener with improved pollution managment	7 Fixing only Policies, Institutions & Technologies	8 Fixing only Policies, Technologies & Operations	9 Supporting Sustainable Ports
1 Corporate culture and policy		A	A	D	D	B	C	D	D	D
2 Institutional arrangements		A	D	D	A	B	C	D	A	D
3 Technological development		A	A	A	D	B	C	D	D	D
4 Operational efficiency		A	A	A	A	B	C	A	D	D
COMPARATIVE SCENARIO ANALYSES										
INDICATOR	WEIGHT	1	2	3	4	5	6	7	8	9
ENVIRONMENT	0.60	-2.00	-1.60	-0.50	0.40	-0.13	0.78	0.80	1.60	2.00
1 GHG Emissions	0.25	-2.0	-1.6	-0.8	0.4	1.9	-1.7	0.8	1.6	2.0
Corporate culture and policy	0.20	-2	-2	2	2	2	-2	2	2	2
Institutional arrangements	0.10	-2	2	2	-2	1	1	2	-2	2
Technological development	0.40	-2	-2	-2	2	2	-2	2	2	2
Operational efficiency	0.30	-2	-2	-2	-2	2	-2	-2	2	2
2 Status of Air Quality	0.25	-2.0	-1.6	-0.4	0.4	1.0	1.0	0.8	1.6	2.0
Corporate culture and policy	0.30	-2	-2	2	2	1	1	2	2	2
Institutional arrangements	0.10	-2	2	2	-2	1	1	2	-2	2
Technological development	0.30	-2	-2	-2	2	1	1	2	2	2
Operational efficiency	0.30	-2	-2	-2	-2	1	1	-2	2	2
3 Status of Port Environmental Quality	0.25	-2.0	-1.6	-0.4	0.4	-1.7	1.9	0.8	1.6	2.0
Corporate culture and policy	0.30	-2	-2	2	2	-2	2	2	2	2
Institutional arrangements	0.10	-2	2	2	-2	1	1	2	-2	2
Technological development	0.30	-2	-2	-2	2	-2	2	2	2	2
Operational efficiency	0.30	-2	-2	-2	-2	-2	2	-2	2	2
4 Status of Biodiversity & Habitat Intactness	0.25	-2.0	-1.6	-0.4	0.4	-1.7	1.9	0.8	1.6	2.0
Corporate culture and policy	0.30	-2	-2	2	2	-2	2	2	2	2
Institutional arrangements	0.10	-2	2	2	-2	1	1	2	-2	2
Technological development	0.30	-2	-2	-2	2	-2	2	2	2	2
Operational efficiency	0.30	-2	-2	-2	-2	-2	2	-2	2	2
SOCIAL	0.20	-2.00	-0.60	0.80	-0.20	-1.00	0.45	1.20	0.60	2.00
5 Community relationship	0.50	-2.0	-0.8	0.8	0.0	-1.0	0.7	1.2	0.8	2.0
Corporate culture and policy	0.40	-2	-2	2	2	-1	1	2	2	2
Institutional arrangements	0.30	-2	2	2	-2	-1	-1	2	-2	2
Technological development	0.10	-2	-2	-2	2	-1	2	2	2	2
Operational efficiency	0.20	-2	-2	-2	-2	-1	2	-2	2	2
6 Port-City collaboration	0.50	-2.0	-0.4	0.8	-0.4	-1.0	0.2	1.2	0.4	2.0
Corporate culture and policy	0.30	-2	-2	2	2	-1	1	2	2	2
Institutional arrangements	0.40	-2	2	2	-2	-1	-1	2	-2	2
Technological development	0.10	-2	-2	-2	2	-1	1	2	2	2
Operational efficiency	0.20	-2	-2	-2	-2	-1	1	-2	2	2
ECONOMIC	0.20	-2.00	-1.60	0.00	1.20	1.50	-1.00	1.60	1.60	2.00
7 Competitiveness	0.50	-2.0	-1.6	0.0	1.2	1.0	0.0	1.6	1.6	2.0
Corporate culture and policy	0.40	-2	-2	2	2	1	0	2	2	2
Institutional arrangements	0.10	-2	2	2	-2	1	0	2	-2	2
Technological development	0.40	-2	-2	-2	2	1	0	2	2	2
Operational efficiency	0.10	-2	-2	-2	-2	1	0	-2	2	2
8 Climate resilience	0.50	-2.0	-1.6	0.0	1.2	2.0	-2.0	1.6	1.6	2.0
Corporate culture and policy	0.40	-2	-2	2	2	2	-2	2	2	2
Institutional arrangements	0.10	-2	2	2	-2	2	-2	2	-2	2
Technological development	0.40	-2	-2	-2	2	2	-2	2	2	2
Operational efficiency	0.10	-2	-2	-2	-2	2	-2	-2	2	2

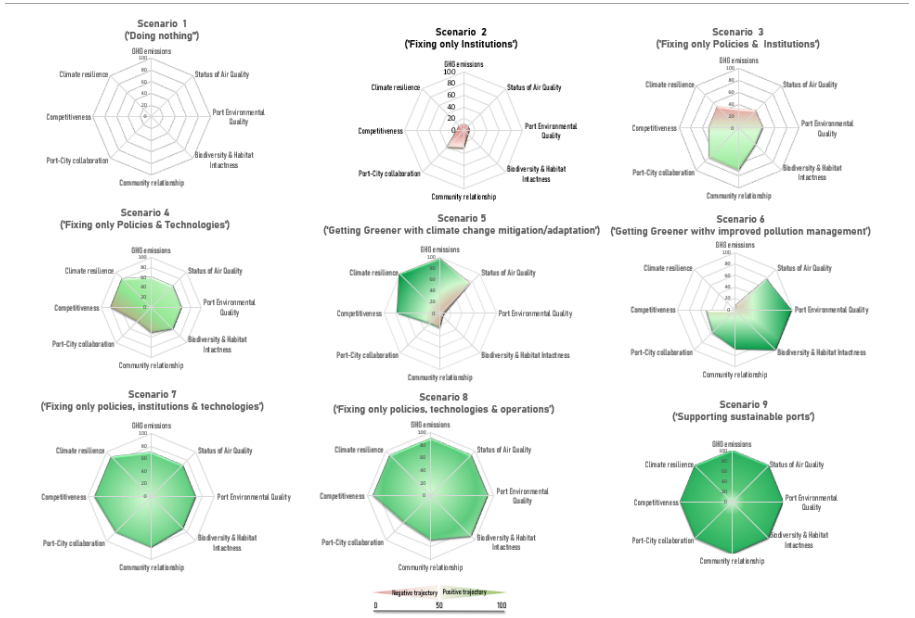
Scenario Analysis Output:

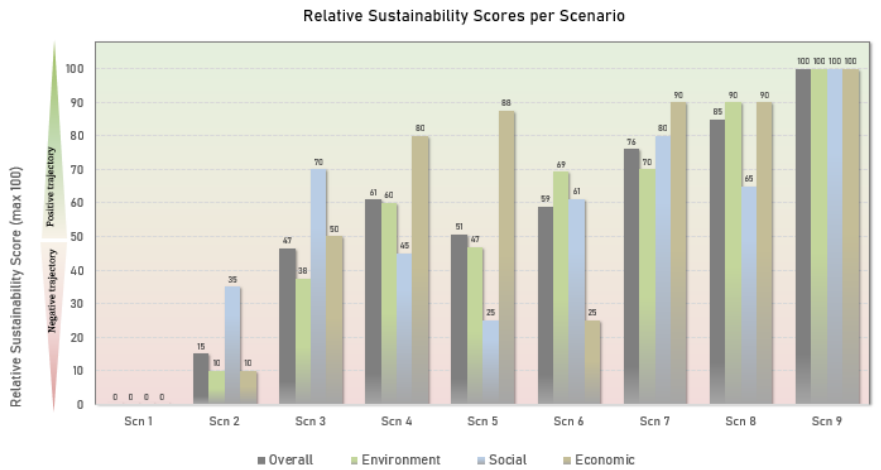
Indicator	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
GHG emissions	0	10	30	60	98	8	70	90	100
Status of Air Quality	0	10	40	60	75	75	70	90	100
Port Environmental Quality	0	10	40	60	8	98	70	90	100
Biodiversity & Habitat Intactness	0	10	40	60	8	98	70	90	100
Community relationship	0	30	70	50	25	68	80	70	100
Port-City collaboration	0	40	70	40	25	55	80	60	100
Competitiveness	0	10	50	80	75	50	90	90	100
Climate resilience	0	10	50	80	100	0	90	90	100
Environment	0	10	38	60	47	69	70	90	100
Social	0	35	70	45	25	61	80	65	100
Economic	0	10	50	80	88	25	90	90	100
OVERALL SCORE (100 max)	**0**	**15**	**47**	**61**	**51**	**59**	**76**	**85**	**100**

Comparative sustainability scores across Scenarios

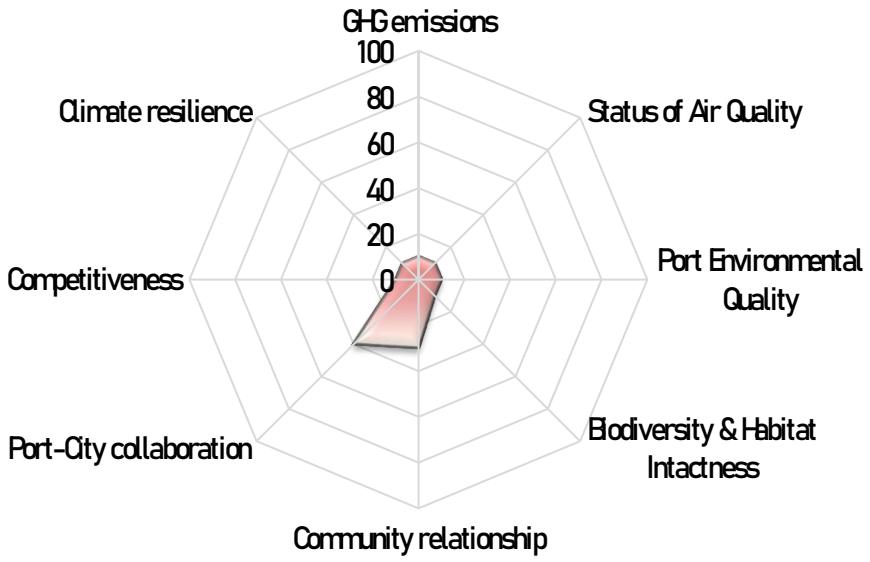
Visualisation of Scenario Sustainability Outcomes:



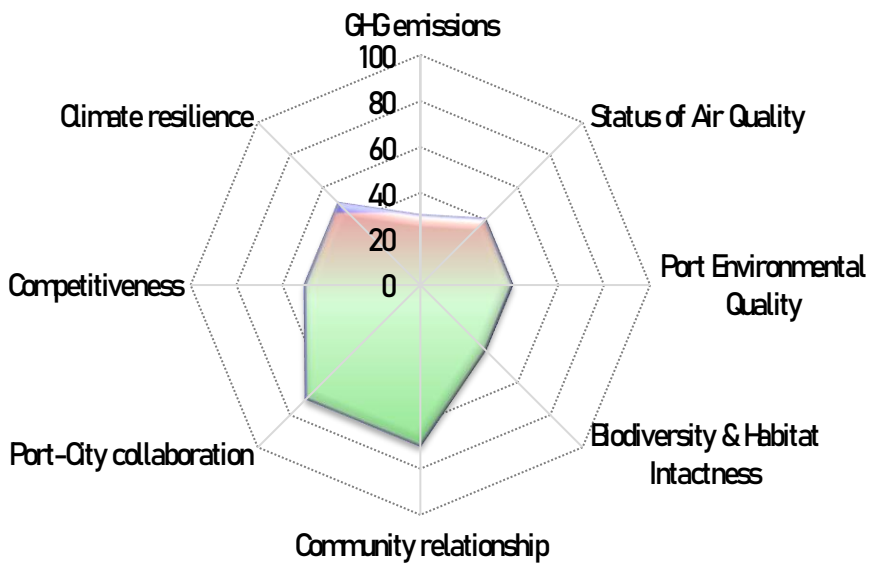




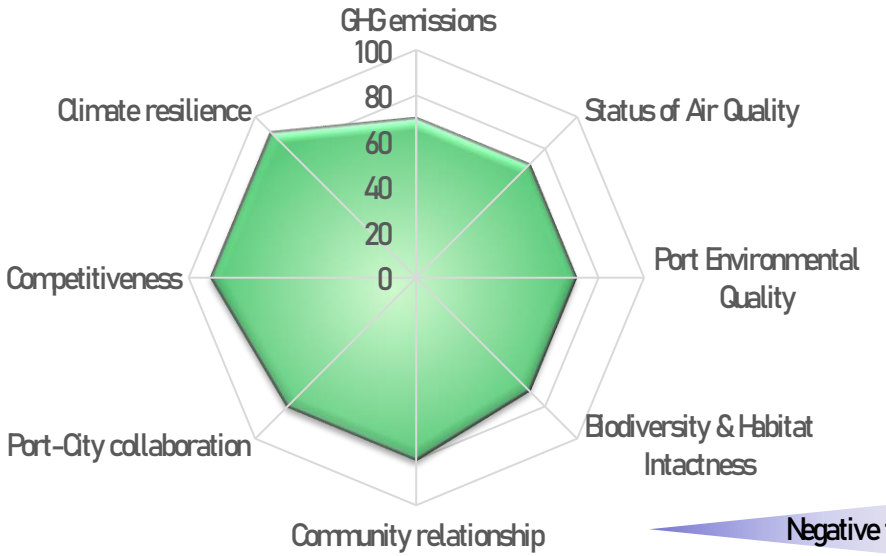
Scenario 2
('Fixing only Institutions')



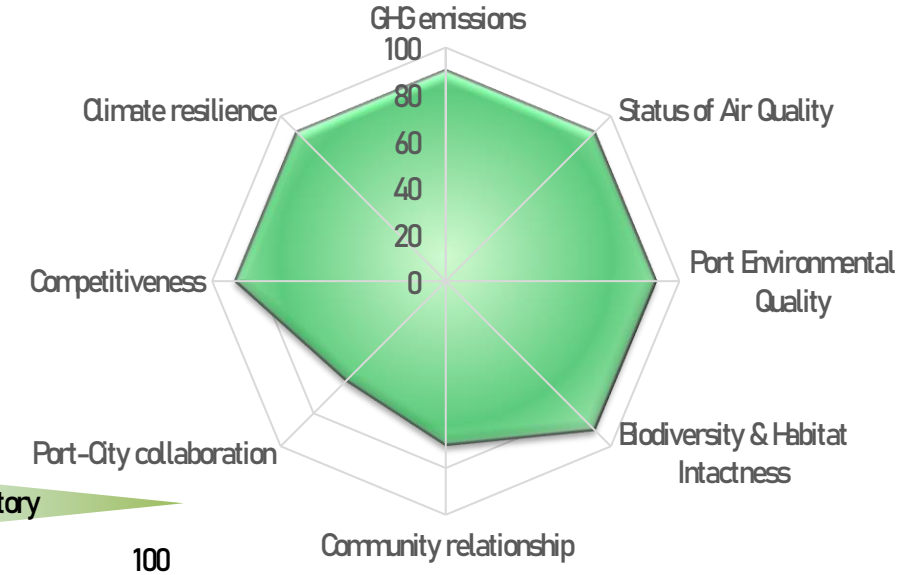
Scenario 3
('Fixing only Policies & Institutions')

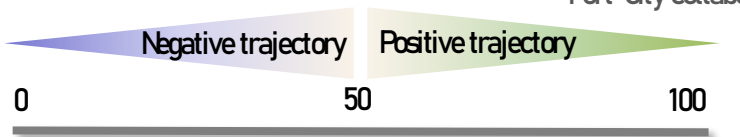


Scenario 7
('Fixing only policies, institutions & technologies')



Scenario 8
('Fixing only policies, technologies & operations')



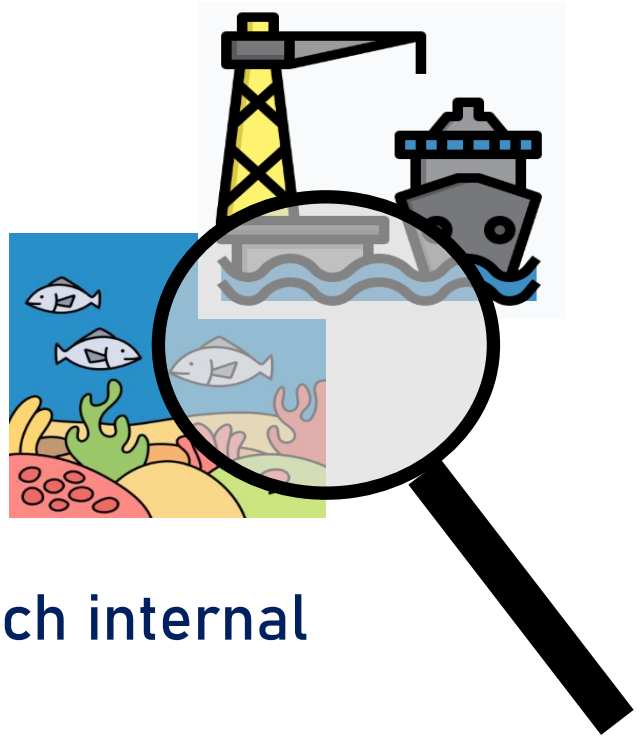


Break-away Groups…

Consult Chapter 3 in Scenario Analysis Report or Spreadsheet

1st In-person meeting we workshopped and reached consensus:

- Internal driving forces and key issues
- Sustainability indicators



In today's Group sessions, please discuss and feed-back:

1. External driving forces (did we capture major ones?)
2. Are we missing any driving force options ([A] to [D]) under each internal driving force categories?
3. Did we get weighting of Internal driving forces vs Indicators correct?
4. Any we missing any typical 'WIO' scenario in [A] to [D] combination in the Scenario Analyses?

Break away Groups…

Steven Weerts - sweerts@csir.co.za
Susan Taljaard - staljaar@csir.co.za