Masterclass on Climate Resilient Infrastructure Public-Private Partnerships

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Module 3 Enabling Objectives

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At the end of this Module, participants will be able to:

- Identify the objectives and output, and describe the steps of the appraisal of resilience options.
- Characterize blue, green and gray infrastructure, and discuss the advantages and disadvantages of each.
- Define nature-based solutions and explain their potential co-benefits and added value.
- Discuss gender-related planning factors in climate resilience of infrastructure systems.
- Identify physical, social and institutional resilience options.
- List financial and qualitative criteria for prioritizing resilience options.
- Discuss the co-benefits stemming from climate-resilient infrastructure projects.

Module 3 Enabling Objectives (continued)

- Describe how to use the benefit-cost analysis to evaluate the economic feasibility of options and add context to the uncertainty of investment decision-making.
- Explain reasons and approaches for engaging and communicating with stakeholders throughout the climate resilience process.

Module 3 - Identification and prioritization of climate adaptation and resilience options

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Outline

Intro to Adaptation Solutions

Identifying Adaptation Solutions
(Nature-based Solutions)

Analyzing & Prioritizing Adaptation Solutions
(Stakeholder Engagement and Communication)

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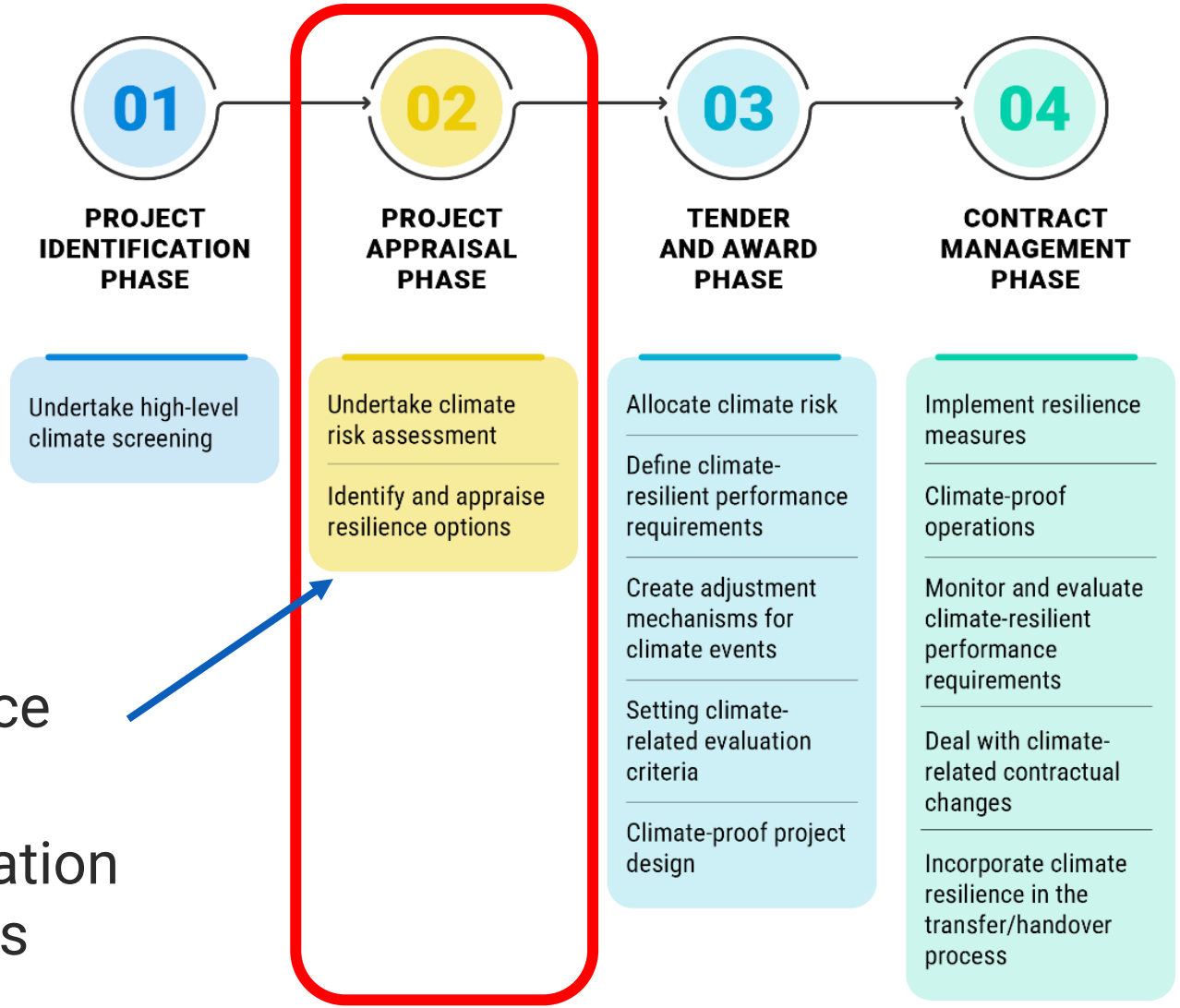

....still in Project Appraisal Phase

Resilience Options

≈ Adaptation Solutions

What is an Adaptation Solution?

- Something extra, to deal with climate change
- To ensure resilient infrastructure
  - Avoid additional costs later
  - Avoid mal-adaptation

Climate change adaptation
The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities

Example of a climate change adaptation solution: Installation of additional culverts under a road to deal with a forecast increase in rainfall intensity in future.

Resilience Options Identification and Appraisal

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GOAL Conceive appropriate adaptation measures to strengthen the project's resilience

02

PROJECT APPRAISAL PHASE

Undertake climate risk assessment

Identify and appraise resilience options

1. Establish objectives for climate resilience
2. Identify applicable resilience options and associated co-benefits
3. Conduct economic analysis of applicable resilience options
4. Combine technical and economic evaluation to prioritize preferred resilience options, valuing risks and benefits

Identify adaptation solutions

Analyse & prioritize adaptation solutions

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Identify adaptation solutions

Analyse & prioritize adaptation solutions

Establish Objective for Climate Resilience

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What is the objective?

e.g. Improve resilience of infrastructure and communities to future climate risks.

e.g. Enable access to additional or preferential funding sources that require explicit incorporation of adaptation solutions.

Climate Resilience

The capacity of social, economic and environmental systems to cope with a hazardous climatic event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure

Identify Applicable Adaptation Solutions

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STEP 1: Make a **LONG-LIST** of adaptation solutions that may be applicable, per climate risk (hazard/asset combination).

How to make a Long-list?

1. Brainstorm within project team
2. Invite ideas from stakeholders
3. Look at similar projects in similar environments

What to consider when making the Long-list?

1. Consider sector-specific resilience strategies (energy, water, transportation), international best-practices and industry-guidelines. For example, National Guidelines, Design Manuals, NAPs, policies, etc.
2. Consider solutions through infrastructure as well as solutions for infrastructure
3. Consider what different approaches to adaptation may be advisable, and think of solutions that would be in line with those approaches?
4. Consider different categories of solutions
5. Consider Nature-based Solutions (NbS)

Approaches to adaptation

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Mitigation of climate related hazard events
(e.g., drainage, temperature, wind – related)

Exposure Prevention (Avoidance)
(e.g., increase the elevation of the rail /roads, zonation for buildings)

Pulling of our hazard Areas (Retreat)
(e.g., redirection of spatial development, resettlement of objects of interest)

Create Protective Structures (Protect)
To keep climate threats physically away from an asset of interest (e.g., breakwater direction/ alignment, habitat strip, dykes, etc.)

Accommodate System of Interest (Robust)
To become more robust to climate threats (e.g., breakwater heightening, quay wall heightening, climate proof construction materials etc.)

Categories of Solutions

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Physical

Structural (grey/green/hybrid) NBS, technologies, systems

- Move or raise the level of infrastructure to avoid exposure (e.g. to sea level rise)
- Create protective structures (e.g. flood embankments)
- Strengthen physical infrastructure
- Modify existing stormwater drainage design to include increased intensity of rainfall
- Waterproof critical infrastructure (e.g. electrical/mechanical items)
- Select material/equipment to accommodate changing climate/ more severe weather conditions
- Install real-time monitoring infrastructure

Social / Behavioral

Operations, educational, information, people, behavior

- Capacity building
- Raise awareness of climate change and disaster risk reduction amongst the workforce and stakeholders (e.g. circulate risk assessment results).
- Provide training
- Prioritise asset inspection
- Modifying working practices (e.g. staff scheduling)
- Data management and information-sharing protocols
- Establish Early Warning Systems
- Adaptive management
- Increase maintenance activities

Institutional / Governance

Governance, economics, policy, regulation, and programs

- Address climate change impacts through governance: policies, plans and guidelines (e.g. Development of a climate adaptation plan for a sector)
- Incorporate climate change knowledge into development plans
- Include climate change aspects into contracts
- Revise codes of practice
- Revise health & safety policy
- Enforce regulations
- Improved land-use planning and zoning of assets
- Provide incentives

Identify Applicable Adaptation Solutions

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STEP 2: Describe options on LONG-LIST and identify their direct benefits and co-benefits

Climate hazard	Resilience option	Direct benefits	Co-benefits
Flooding	Restoring wetlands near railways to act as natural flood buffers	Reduces flood impacts on railway systems Protects against severe disruptions	• Support integrity of ecosystems • Maintain or enhance biodiversity, soil quality and water quality of the site area and its surroundings • Reduced cost of repair
	Implementing bioswales and vegetated drainage systems along rail corridors and station areas	Prevents waterlogging Protects rail ballast integrity Controls erosion	• Supports integrity of ecosystem • Maintains or enhances biodiversity, soil quality and water quality of the site area and its surroundings • Recharges groundwater in adjacent areas • Reduced cost of maintenance and repair
Extreme heat	Use of heat-resistant rail materials and expansion joints to accommodate thermal stress	Reduces rail deformation Ensures service continuity	• Increases asset lifespan, reducing the need for replacement

Source: GCA Climate-Resilient Infrastructure Officer Handbook, 2025

Co-benefits of adaptation options

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Co-benefits: Any benefits that the resilience options for the project are likely to generate in addition to its primary objectives

Example from a project aiming to improve water quality

Co-benefit	Description
Water re-use	Use of treated wastewater for beneficial purposes (as an alternative to existing water supplies).
Temperature regulation	Increased regulation temperatures and humidity during hot weather conditions (for example through transpiration or ventilation)
Biosolids	Increased nutrient-rich organic often used as fertiliser
Biodiversity (fauna)	Increased variability among living (animal) organisms from all sources
Biomass production	Increased collection of above-ground plant material through regular harvesting and removal.
Carbon sequestration	Increased removal of carbon from the atmosphere and depositing it (i.e. carbon sinks)
Biodiversity (flora)	Increased variability among living (plant) organisms from all sources
Pollination	Increased opportunity for animal pollination (essential for the development of fruits, vegetables and seeds)
Food source	Increased food from wild plants and animals, including biomass of non-cultivated plant species used for food production; and non-domesticated animal species and their outputs used as raw material for food production.
Recreational opportunities	Increased use of area for leisure activities by humans
Aesthetic value	Increased appreciation of ecosystems and species by humans (i.e. landscapes and cultural spaces)
Storm peak mitigation	Increased water storage capacity during storms through infiltration, retention and detention by the system
Flood mitigation	Increased regulation of water flows through properties of ecosystems, thereby managing hydrological systems and avoiding (damage from) floods.
Temperature regulation	Humidity and localized temperature regulation through ventilation and transpiration

Suggestion: Link resilience option co-benefits to SDGs

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Resilience co-benefits (mitigation co-benefits, adaptation co-benefits)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Benefit from emerging business opportunities by creating new products and services that help individuals, businesses, cities and governments cope with the impacts of climate change									+				+				
Improve the sector's response and preparedness for short- and long-term risks to operations, logistics and supply chains.	+	+	+						+		+		+		+	+	+
Strengthen the risk reduction approach of ICT companies, including the identification of long-term risks for physical operations and climate proofing the ICT supply chain.									+				+				
Minimize potential disruptions in the provision of ICT services.								+	+		+		+				+
Reduce operational costs and improve efficiency through measures aimed at withstanding, recovering and adjusting to short- and long-term climatic impacts.								+	+				+				
Strengthen corporate social responsibility programmes and companies" reputation through the adoption of adaptation strategies that offer social advantages and benefits at the community/user level, particularly in developing countries.									+				+				+

Note: + denotes co-benefits

Identify Applicable Adaptation Solutions

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STEP 3: Make a **SHORT-LIST** of adaptation solutions

How to make a Short-list?

Qualitative evaluation, e.g. using a Multi-Criteria Analysis (MCA), based on:

- Technical effectiveness
- Social & Environmental impacts,
- Institutional complexity
- Etc…

Validation with stakeholders
(of criteria, weight factors, and scoring)

#	Nature-based Solutions	Nature-based Solutions scoring						
1	Shellfish reefs	0	0	+	0	+	++	++
2	Enhanced breakwaters	0	0	++	+	-	+	+
3	Double dike system	+	+	++	++	++	-	+
4	Sediment transfer (reuse of dredged material)	+	+	+	+	+	-	+
5	Mangrove rehabilitation	++	0	++	++	++	--	+
6	Wide green dike	++	++	+	++	0	-	0
7	Hanging and floating structures	0	0	+	0	+	++	+
8	Tidal flat restoration	+	0	++	+	++	-	0
9	Adaptive housing	0	0	0	++	0	-	++
10	Room for rivers	0	++	0	++	++	-	--
11	Retention basins	++	++	0	++	++	--	0
12	Green embankments	0	+	++	+	+	+	+
13	Rainwater collection and storage at buildings	0	0	0	+	+	++	+

Legend

Risk Reduction / Damage Prevention:
- Coastal flooding
- River flooding
- Erosion
- Damage

Feasibility / Complexity
- Social impact
- Environmental impact
- Institutional complexity

- Large Scale positive and long-lasting impact
- Limited positive impacts
- No significant impact
- Mild negative impact
- Substantial negative impacts

- Highly feasible and easy to implement
- Moderately feasible and manageable to implement
- No significant implications
- Some challenges and limitations in implementation
- Difficult to implement or requires significant resources

Example: MCA on (Nature-based) solutions for a Port Project

Source: Royal HaskoningDHV, 2022

Example of Solution Identification - Port of Banjul in The Gambia

Possible adaptation solutions identified and grouped per Project asset….

Asset: Port Access Road

Key climate hazards

Potential measures

1. Climate resilient pavement
2. Add buffer storage for extreme events
3. Add parking for flexible operations
4. Prevent truck overloading
5. Climate based road maintenance
6. Mangrove flood protection
7. Climate stakeholder collaboration

Benefits

Decrease port downtime due to road damage / closure. Less damage and emergency maintenance costs over time.

Source: Royal HaskoningDHV, 2022

Example of Solution Identification - Port of Banjul in The Gambia

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….and per Project Stage

Asset: Port Terminal Stage: Design

Key climate hazards

Potential measures

1. Flood safe terminal area level
2. Climate proof flood defence
3. High precipitation drainage system
4. Heat resilient power supply
5. Climate based terminal maintenance
6. Climate resilient zoning of assets

Benefits

Decrease chance of flooding. Prevents damage to equipment, cargo, buildings.

Source: Royal HaskoningDHV, 2022

Example of Solution Identification - Port of Banjul in The Gambia

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….and per Project Stage

Asset: Port Terminal Stage: Operation

Key climate hazards

Potential measures

1. Heat resistant equipment
2. Weather protective staff facilities
3. Climate based staff scheduling
4. Extreme event working conditions
5. Climate monitoring equipment
6. Climate data collection & analysis
7. Capacity building climate awareness

Benefits

Up to date climate change information and knowledge sharing. Ensure worker safety and wellbeing. Decrease downtime due to equipment failure.

Source: Royal HaskoningDHV,

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A different kind of infrastructure...

Grey infrastructure – Grey infrastructure are built up, engineered and physical structures.

Often made of concrete or other long-lasting materials.

Blue infrastructure – Blue infrastructure can be also characterized by well-functioning biophysical systems, but primarily related to water.

This includes water bodies, including ponds, wetlands, rivers, lakes, and streams, as well as estuaries, seas, and oceans.

Green infrastructure – Green infrastructure involves healthy and well-functioning biophysical systems, primarily related to green spaces, that support biodiversity, natural ecological processes and to which some management and restoration may apply.

They are represented, by healthy oyster reefs, coastal salt marshes, mangroves, coral reefs, sea grasses, sand beaches and dunes in the coast environment and mainly by forests, parks, street trees, and grasslands inland.

A different kind of approach... Nature-based Solutions (NbS)

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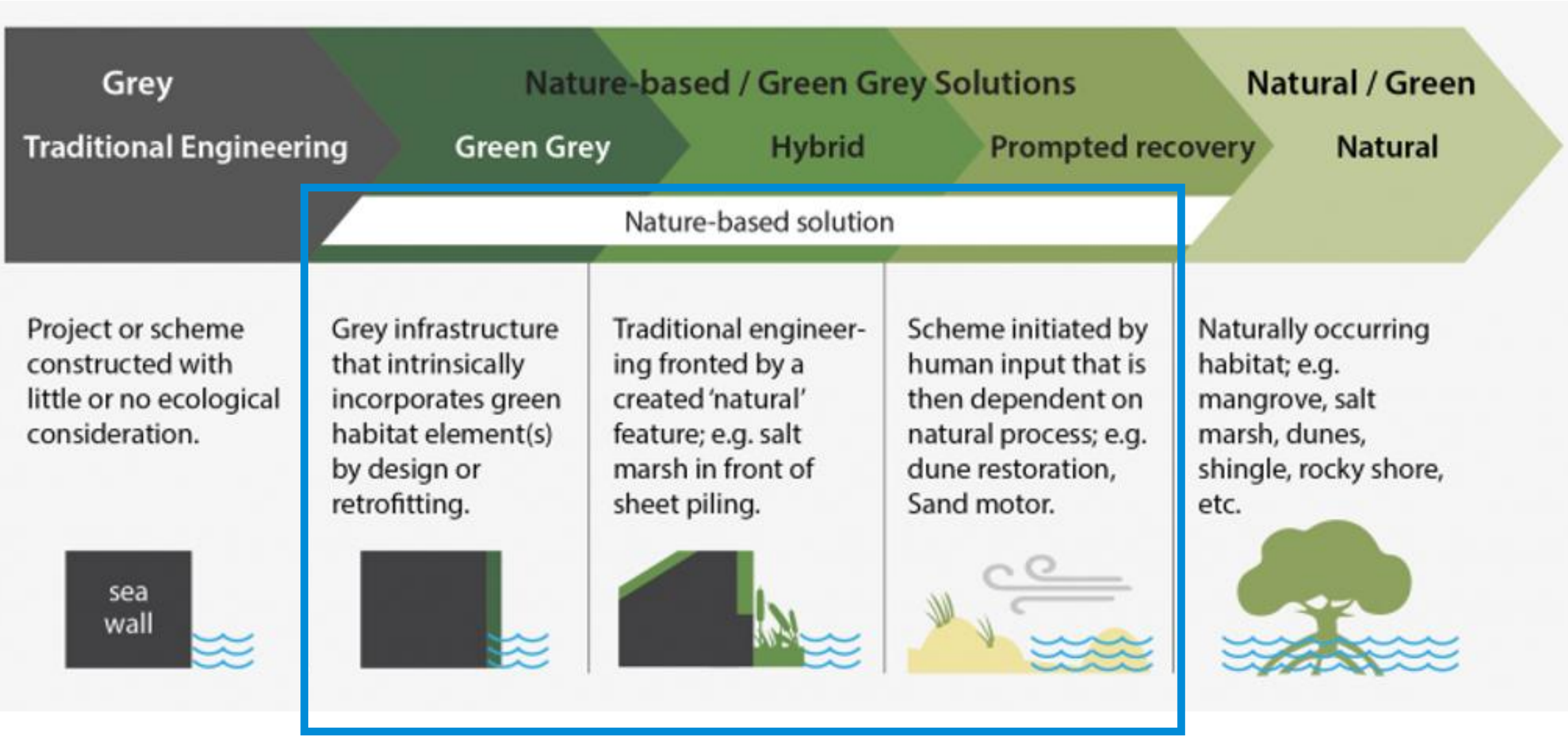


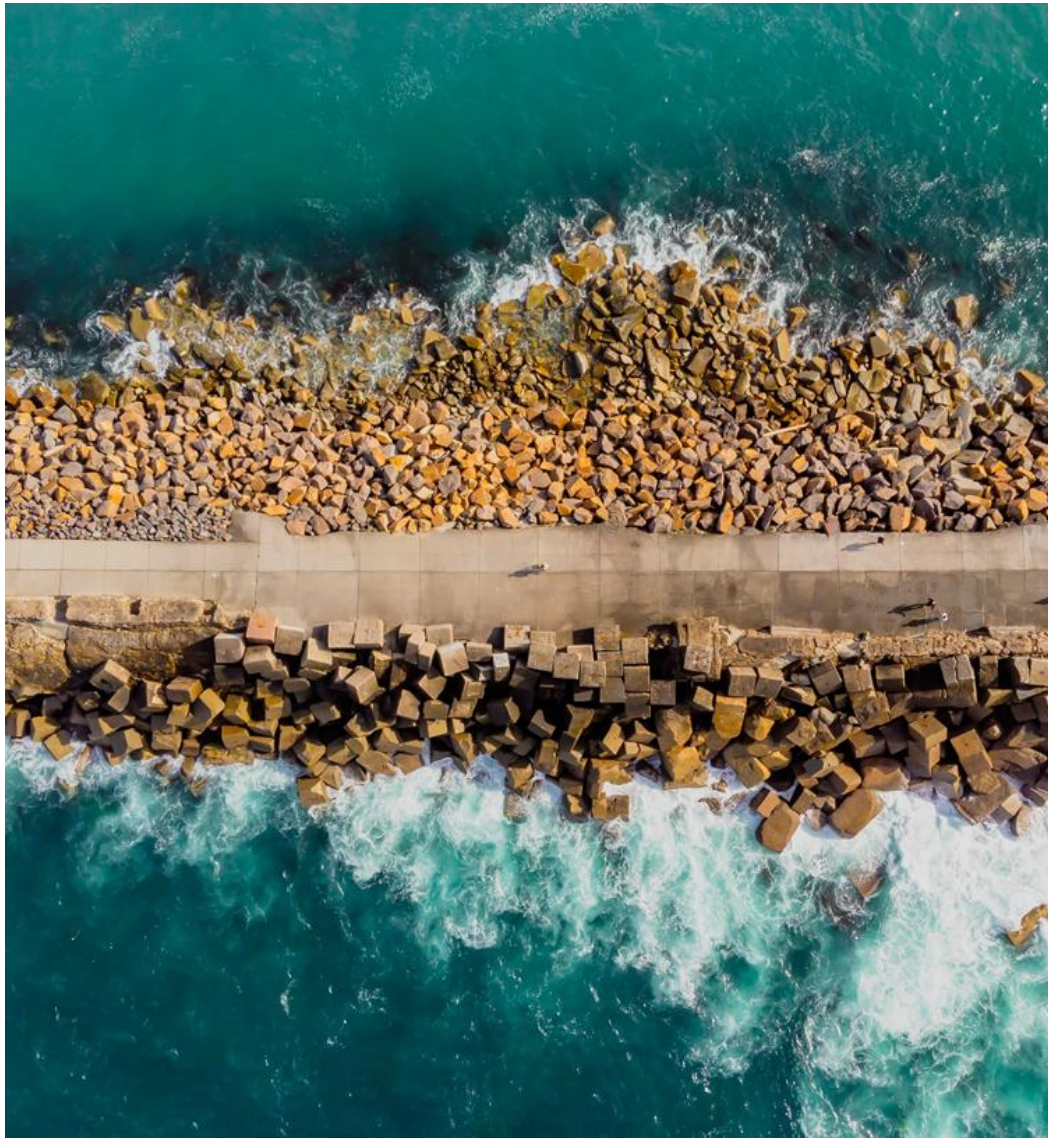
Naylor, LA.,! Kippen, H,! Coombes, MA., et al. (2017). Greening the Grey! a framework for integrated green grey infrastructure (IGGI).University of Glasgow report. URL:

Nature-based Solutions

Nature-based Solutions is an approach, that:

- uses the power of natural processes
- in innovative ways
- to tackle socio-ecological challenges
- leading to resilient and sustainable solutions
- that are more adaptable to changes in the environment.

Results in integrated solutions which benefit society, biodiversity and the economy



Steps in the Nature-based Solution approach

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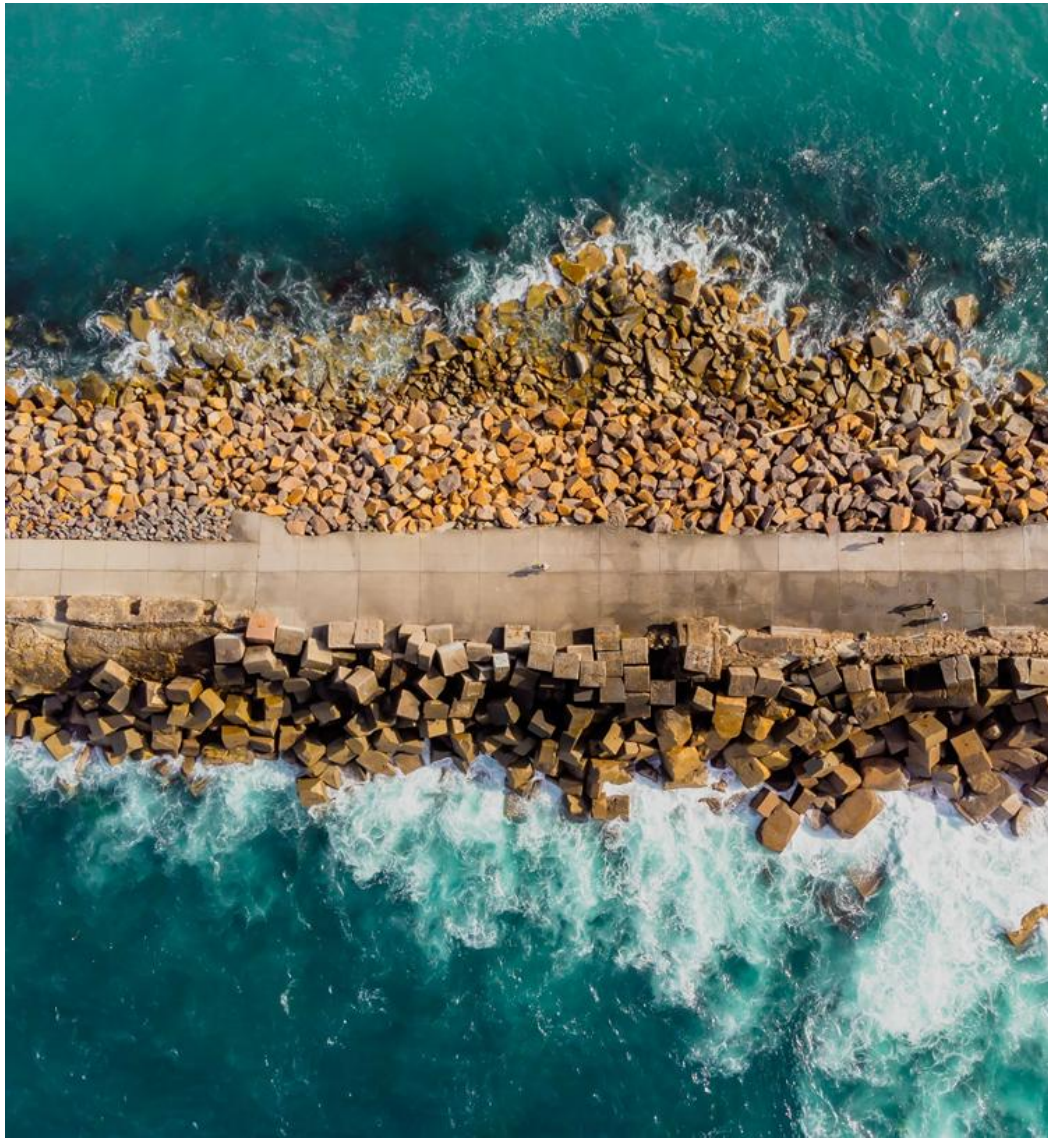
1. Understand the system and it's challenges (physical, ecological, societal)
2. Identify design alternatives with added value/co-benefits for nature and humans
3. Evaluate the different alternatives and select the best (integral) solution
4. Refine the solution
5. Prepare for implementation

Broad system understanding (physical, ecological, societal) is key to obtain integrated (design) solutions which benefit society, biodiversity and the economy



Pros and cons of Grey Infrastructure vs Nature-based Solutions

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Grey Infrastructure

- ✓ Can provide strong resilience to environmental hazards
- x Often costly to construct and maintain;
- x Has low flexibility;
- x Can lead to system lock-ins, path dependency and even maladaptation.

Hybrid Grey/Green Infrastructure (Nature-based Solutions)

- ✓ Can provide multiple co-benefits such as carbon sequestration, biodiversity, recreation, psychological well-being and water- control opportunities
- × Relies on healthy, functioning ecosystems
- × May require large amounts of land-use
- × Performance can be unreliable.

Potential added value/co-benefits of Nature-based Solutions

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Wide range of additional benefits depending on environment and type of solution, examples are:

- **Net biodiversity gains**
  - Ecosystem/habitat restoration
  - Enhancing biodiversity
- **Improving water quality and waterbody conditions**
  - Reducing soil erosion
  - Addressing pollution control
  - Filtering function (e.g. by wetlands)
- **Climate change mitigation**
  - Carbon storage
- **Economic gains**
  - Habitats (forest, tidal flats) catering for wood, fish, crabs etc.
- **Improving quality of living**
  - Reducing heat in urban environments
  - Recreational space (parks, beaches)

Example: Urban Nature-based Solutions to Reduce Flood Risk and Strengthen Resilience in the City of Kigali, Rwanda

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In Kigali, a city in Rwanda that faces floods and has experienced rapid, and resultingly unsustainable, urban development, there is a need for sustainable and effective flood management.

The application of nature-based solutions (NbS) has the potential to complement more traditional grey flood reduction measures, while improving spatial quality and strengthening livelihoods in urban neighborhoods.

The model results indicate that the application of city-wide NBS can substantially reduce the peak runoff and flow velocity, as well as the flood and erosion damage caused during peak runoff. For Kigali, measures that delay and dampen the flood waves are most effective in reducing the run-off peak.

Together with proposed measures is a landscape analyses to indicate the right NbS and suitable locations

FIG. 1.1.5 NBS strategy for Kigali: Protect and rehabilitate the natural forest and wetland system (the backbone of the storm water management system) and include NBS in ongoing developments, so the flood risk reduction system can grow over time in a cost effective way (the 1000x1 principle) (Defacto urbanism 2021).

Source: Royal HaskoningDHV, 2024

Example: Kigali, Rwanda

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Emergency Overflows/ Retention Area - Open or multifunctional areas that temporarily store water when drains overflow

Type of mechanism:

- Storm water (S, M, L)

Type of intervention:

- Delay runoff

Impact on water system:

Additional benefit (water):

Additional benefit (social, ecological and urban):

Type of applicable area:

- ~~Very steep~~ / ~~steep~~ / gentle / flat slope
- Agriculture / urban / industry / nature

Scale of implementation:

- Urban
- Neighbourhood

Activated Edge - Multifunctional space for storing water and protecting the wetland border

Type of mechanism:

- River floods (L, XL)

Type of intervention:

- Delay runoff
- Store water

Impact on water system:

Additional benefit (water):

Additional benefit (social, ecological and urban):

Type of applicable area:

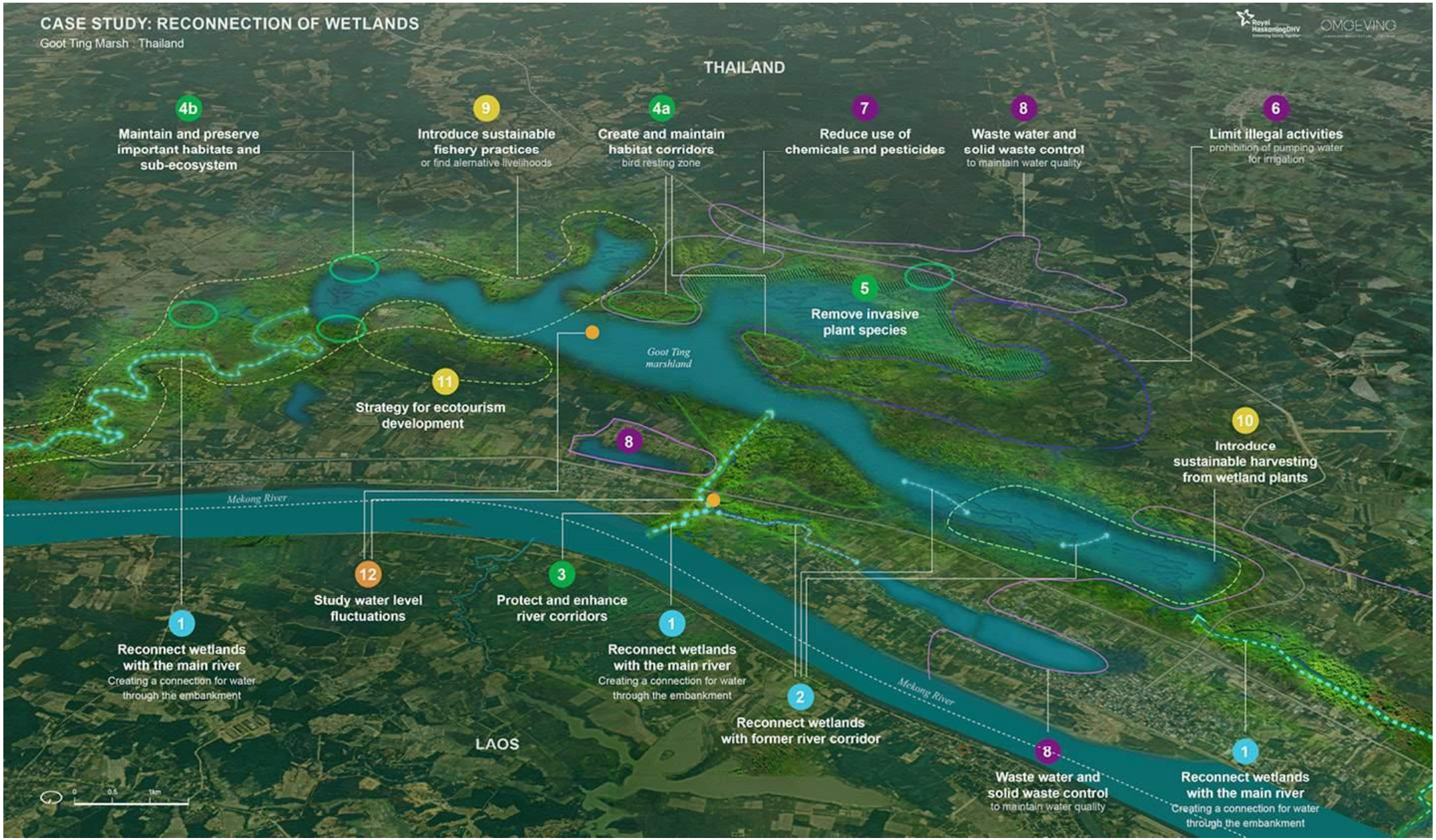
- ~~Very steep~~ / ~~steep~~ / gentle / flat slope
- Agriculture / urban / industry / ~~nature~~

Scale of implementation:

- Regional
- Urban

Source: Defacto, 2024

Case study: improve riverine wetland ecosystems



Source: Home | WWF

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Resilience Options Identification and Appraisal

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Analyse Adaptation Solutions

How to choose which adaptation solutions to implement?

⇒ Compare different adaptation solutions

Methods of comparison:

- Multi-criteria analysis (MCA)
- Cost-benefit analysis (CBA)

But in a PPP construct, adaptation solutions must provide Value-for-Money !

⇒ So an **economic Cost-benefit analysis** is required

Conduct economic analysis of applicable resilience options

Cost-Benefit Analysis

What is a Cost-Benefit Analysis?

Short-listed measures are quantitatively evaluated in a Cost-Benefit Analysis (CBA), in which costs and benefits are identified and (where possible) given a monetary indication, to develop the investment rationale (business case).

Net Benefit = Benefits – Costs

Benefits = reduction of the future climate risk (direct and indirect impacts) + additional co-benefits

Costs = lifetime CAPEX and OPEX

Generally, Net Present Value (NPV) is used as the main indicator. i.e. Costs and Benefits over the life-time of the project are all converted to a NPV.

The CBA can be undertaken for each short-listed measure individually, or for a grouped package of measures.

Prioritize preferred resilience options

Rank the adaptation solutions according their net benefits and prioritize them on this basis

Net Benefits = Benefits - Costs

Undertake a **sensitivity analysis** to see if the prioritization changes under different scenarios, such as:

- Different climate change scenarios
- Different discount factors

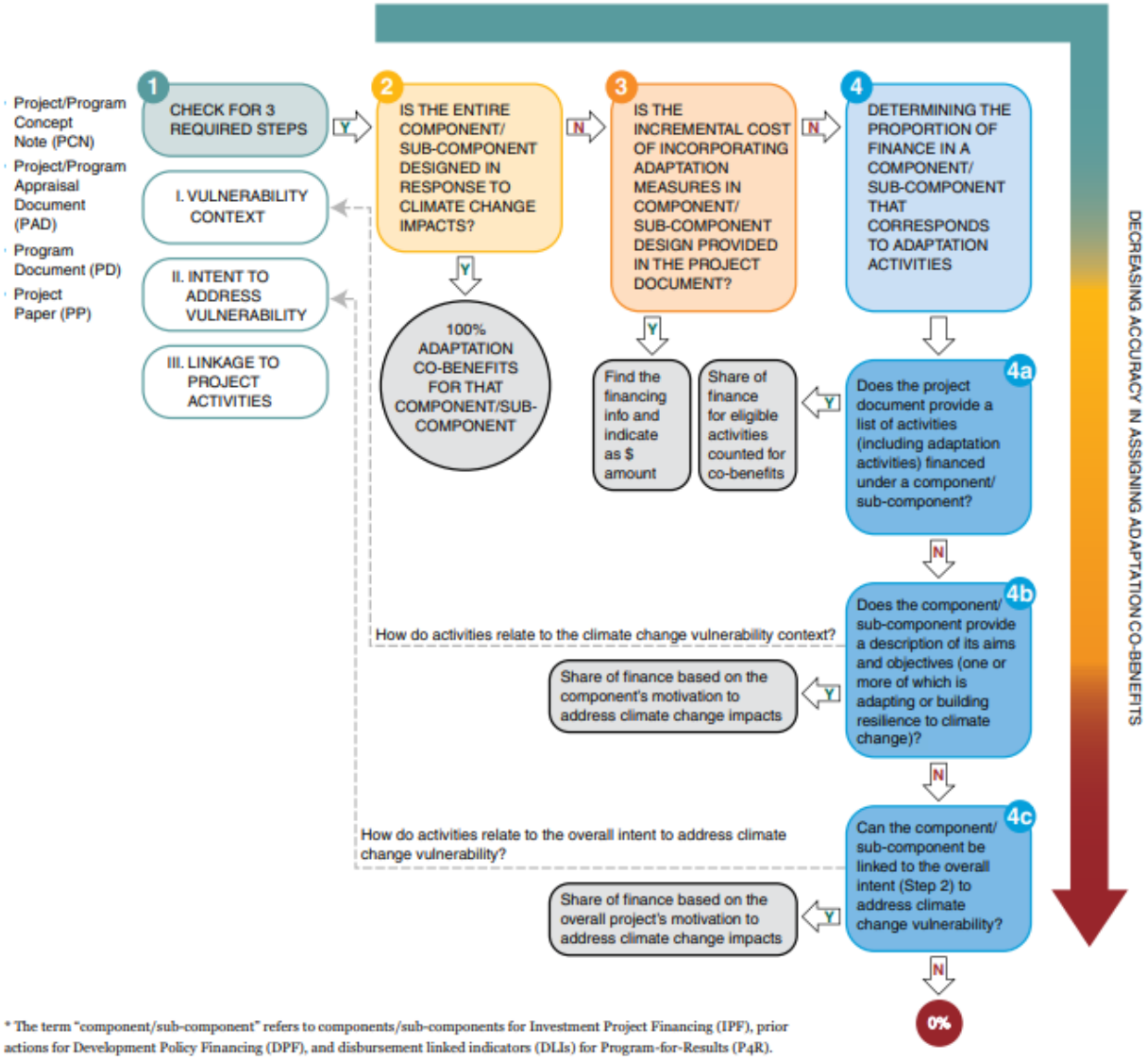
However, this is not necessarily the only criterion to prioritize the options…

NPV not necessarily the only criterion…..

- Quantitative Financial Indicators:
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - External Rate of Return (ERR)
  - Profitability Index or Return on Investment (ROI)
- Qualitative Indicators:
  - Social Equity
  - Scalability and innovation
  - Stakeholder utility
  - National and international policy alignment
  - Capacity for implementation

The goal is to find what is relevant and applicable, instead of just following a single methodology blindly

Financial Calculation of Co-Benefits



* The term "component/sub-component" refers to components/sub-components for Investment Project Financing (IPF), prior actions for Development Policy Financing (DPF), and disbursement linked indicators (DLIs) for Program-for-Results (P4R).

Figure 1: The World Bank's approach to calculating adaptation co-benefits, as per the Joint MDB Methodology

Complicated!

Qualitative Assessment of Co-benefits

CAT. (CATEGORY)

- Water-based
- Substrate-based

POTENTIAL CO-BENEFITS

- H High
- M Medium
- L Low
- Biodiversity (fauna)
- Biodiversity (flora)
- Temperature regulation
- Biomass production
- Aesthetic value
- Recreation
- Biosolids
- Flood mitigation
- Storm peak mitigation
- Carbon sequestration
- Pollination
- Food source
- Water reuse

CAT.	SYSTEM	TYPE		SIZE requirement per p.e.	INFLUENT WATER (application)	POTENTIAL CO-BENEFITS (L=low, M=medium, H=high)											
Water-based	Ponds	Anaerobic:	Classical	0.2m²	Raw, primary treated	M	L	L					L	L			L	M
			High-rate			M	L	L					L				L	M
		Intensified (Surface Aerated)		1-5m²	Raw, primary treated, secondary treated	L	L				L		L	L			H	H
		Aerobic	Facultative	1-3m²	Raw, primary treated	M	L	L			L		L	L			L	L
			Maturation	3-10m²	Secondary treated	M	L	L			L		L	L			H	L
	In-stream restoration			-	Secondary treated, river diluted, CSO discharge	H	H		H		M	L	H	H		M		
	Surface flow wetlands	Natural		-	Secondary treated	H	H	L	H	H	H	H	H	H	M	H	H	
		Floating		N/D	Greywater, primary treated	H	H	L	M		M	H	H	M	M		M	
		Free water surface		3-5m²	Greywater, secondary treated	H	H	L	M		M	H	H	M	M		H	
	Ponics technologies	Hydroponics		NA	Secondary treated, river diluted, special applications						M		L			H	H	L
		Aquaponics		NA	Secondary treated, river diluted, special applications						M		L			H	H	M
Substrate-based	Soil infiltration systems	Slow-rate		60-740 m²	Greywater, primary treated, secondary treated	L	L	L		L			L				H	
		Rapid-rate			Greywater, primary treated, secondary treated, river diluted	L	L	L		L			L				H	
	Building-based systems	Rooftop treatment wetland		170m²	Greywater, primary treated	M	H	H		M	M	L	H	L	H	L	H	
		Living walls		1-2m²	Greywater	M	H	H			M	L	H	L	H	L	H	
	Zero-discharge systems	Willow systems		30-75m²	Greywater, primary treated, secondary treated	M	M		M		H	H	M	M	H			
	Subsurface flow wetlands	Vertical-flow treatment wetland	Vertical Flow TW	4m²	Greywater, primary treated	M	L				L	M	L	L			H	
			French VFTW	2m²	Raw	M	L			L	L	M	L	L			H	H
			Combined Sewer Overflow (CSO) TW	-	CSO	M	L			H	L	M	L	L			H	
		Horizontal-flow treatment wetland TW		3-10m²	Greywater, primary treated, secondary treated	M	L				L	M	L	L			H	
		Intensified treatment wetland	Aerated	0.5-1m²	Greywater, primary treated	L	L				L	M	L	L			H	
			Reciprocating	3m²	Primary Treated	M	L				L	M	L	L			H	
			Reactive media in TW	0.2-1m²	Phosphorus elimination	M	L				L	M	L	L			H	
	Sludge treatment reed beds			N/D	Sludge treatment	M	L				L	M	L	L			H	H

Example: MCA with potential solutions for improving water quality in the Black Sea

(Source: RHDHV, 2024)

Some key points to remember on adaptation options

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Resilient options must be able to **adaptively transform Infrastructure** to overcome unexpected events and grow into unforeseen roles.

Resilient options must be **environmentally integrated** so that it does not cause any other damage

Infrastructure must be **protected by design** from the hazards that could face an asset once delivered.

Any resilience action must be aligned with **Locally-led Adaptation**. Communities should have awareness and a sense of ownership.

Resilience must be **a shared responsibility,** with focus on collaborative data and knowledge sharing regarding an asset

Resilient options requires **continuous learning** to optimize the ability of infrastructure to cope with what's ahead.

Outline

Intro to Adaptation Solutions

Identifying Adaptation Solutions

(Nature-based Solutions)

Analyzing & Prioritizing Adaptation Solutions

(Stakeholder Engagement and Communication)

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Why engage stakeholders?

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1. **Provide input**

   Provide more detailed information to input into project preparation processes, such as climate risk assessments

2. **Render support**

   Support the prioritization of resilience options and understanding of willingness to pay for resilience

3. **Understand and optimize value/benefits**

   Help to understand whether the project will deliver value for society, particularly by identifying and optimizing co-benefits that arise from different resilience option

4. **Mitigate risks**

   Mitigate risk by engaging a range of stakeholders to better understand inter-dependencies, commonalities and trade-offs of a project, thereby potentially highlighting any issues and securing buy-in through participatory planning processes

How do we engage?

- Project identification
  - High-level climate risk screening
- **Project appraisal**
  - **Climate and disaster risk assessment**
  - **Developing future scenarios for scenario analysis**
  - **Identifying resilience options**
  - **Valuing resilience co-benefits**
- Tender and award
  - Developing performance requirements
  - Identifying evaluation criteria
  - Allocating risk
- Contract management
  - Supporting M&E of performance requirements
  - Dispute resolution

Most critical phase to engage stakeholders:

- Local stakeholders
- Stakeholders that can implement additional resilience options to boost co-benefits

Integrating the End User

- **End users play integral roles in the design and delivery of climate-resilient infrastructure because:**
  - They are primary beneficiaries – they will be faced with the shocks and stresses of climate change in addition to pre-existing socio-economic circumstances
  - Climate change has a disproportionate impact on vulnerable and marginalised groups and without sufficient consultation and participatory processes, communities could be excluded from resilience benefits

- **PPP contractor to build resilience in communities and stakeholders through:**
  - Early warning systems - help them to prepare for hazards and support them to be resilient. EWS must be stakeholder-specific to be fully effective and have the desired outcome of boosting resilience
  - Placing emphasis on the partnership of PPPs - working across levels to increase resilience for all stakeholders

Discussion questions

- What is your experience in stakeholder engagement?
- How have you handled difficult issues in stakeholder communication?

Recap of this Session

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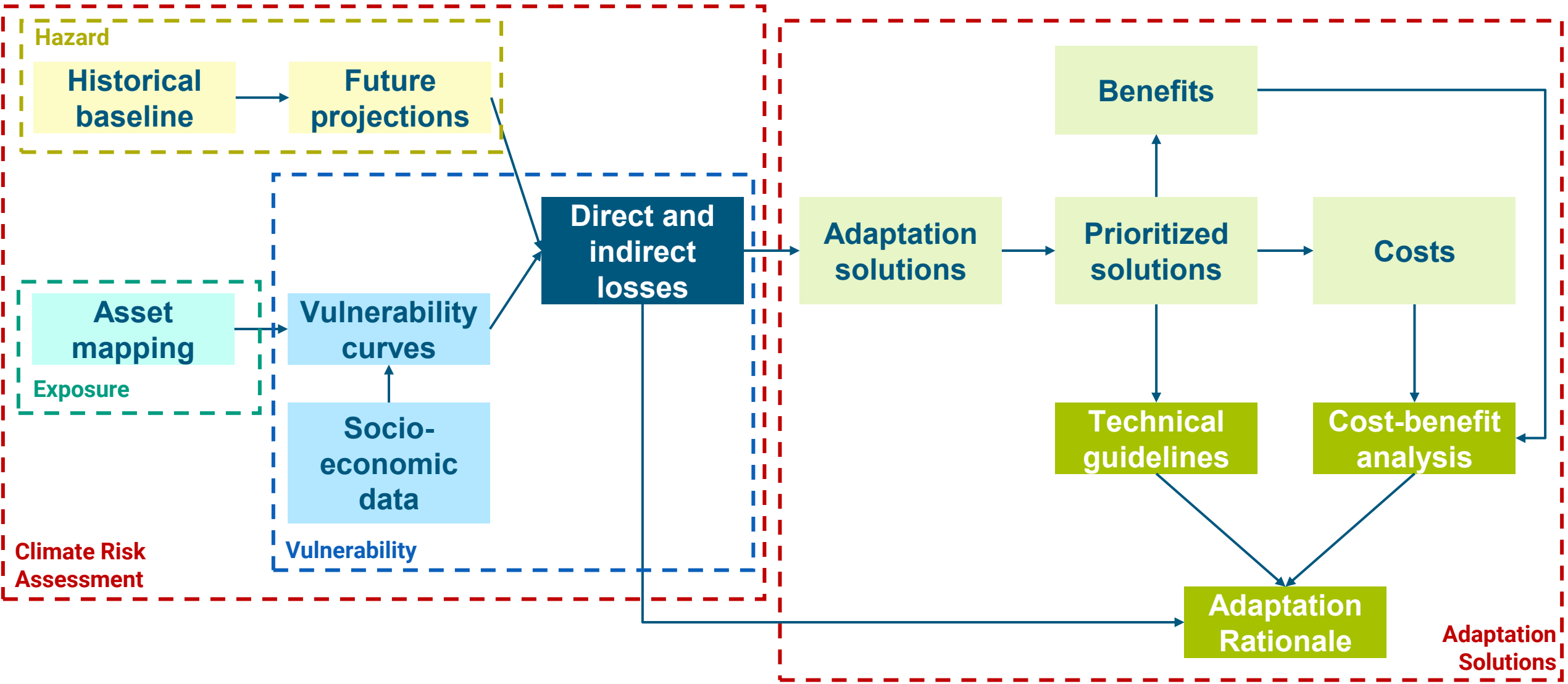
Adaptation Solutions: Overview of Interlinkages



Recap of Module 3 - Identification and prioritization of climate adaptation and resilience options

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1

Identify and describe a Long-list of possible adaptation solutions

2

Adaptation solutions can be **physical, social/ behavioural or institutional**

3

Nature-based Solutions are combinations of grey & green/blue infrastructure

4

Short-list adaptation solutions using Multi-Criteria Analysis

5

Analyse and prioritise adaptation solutions using economic Cost-Benefit Analysis

6

Stakeholder engagement is critical throughout this process!

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