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PANELISTS

Katharine Cross
Water-Cities

Kari Davis
AGWA

Diego Juan Rodriguez
World Bank

Marc Tkach
MCC

Andrew Warren
Deltares

AGENDA

- Welcome and Introduction
  Katharine Cross, Water- Cities

- Bottom-up risk assessment approaches-CRIDA
  Kari Davis, AGWA

- Resilient Decisions in Urban Water Utilities
  Diego Juan Rodriguez, World Bank

- Q&A session

- CRIDA Case Study: Iolanda WTP, Zambia
  Marc Tkach, MCC

- Planning for Improved Resilience in Drinking Water Infrastructure
  Andrew Warren, Deltares

- Moderated Discussion and Q&A from audience

- Closing - How to join Climate Smart Water Community of Practice
  Katharine Cross, Water- Cities

WEBINAR INFORMATION

- This webinar will be **recorded and made available "on-demand"** on the IWA website.
- Following the webinar, you will be sent a **post-webinar email** with the on-demand recording, presentation slides, and other information.

- **'Chat' box**: please use this for general requests and for interactive activities.
- **'Q&A' box**: please use this to send questions to the panelists.

  (We will answer these during the discussions)

***Please Note:** Attendees' microphones are muted. We cannot respond to 'Raise Hand'.*

Planning for an uncertain future - Climate Risk Informed Decision Analysis

Kari Davis (*kari.davis@alliance4water.org*)
Alliance for Global Water Adaptation
USA

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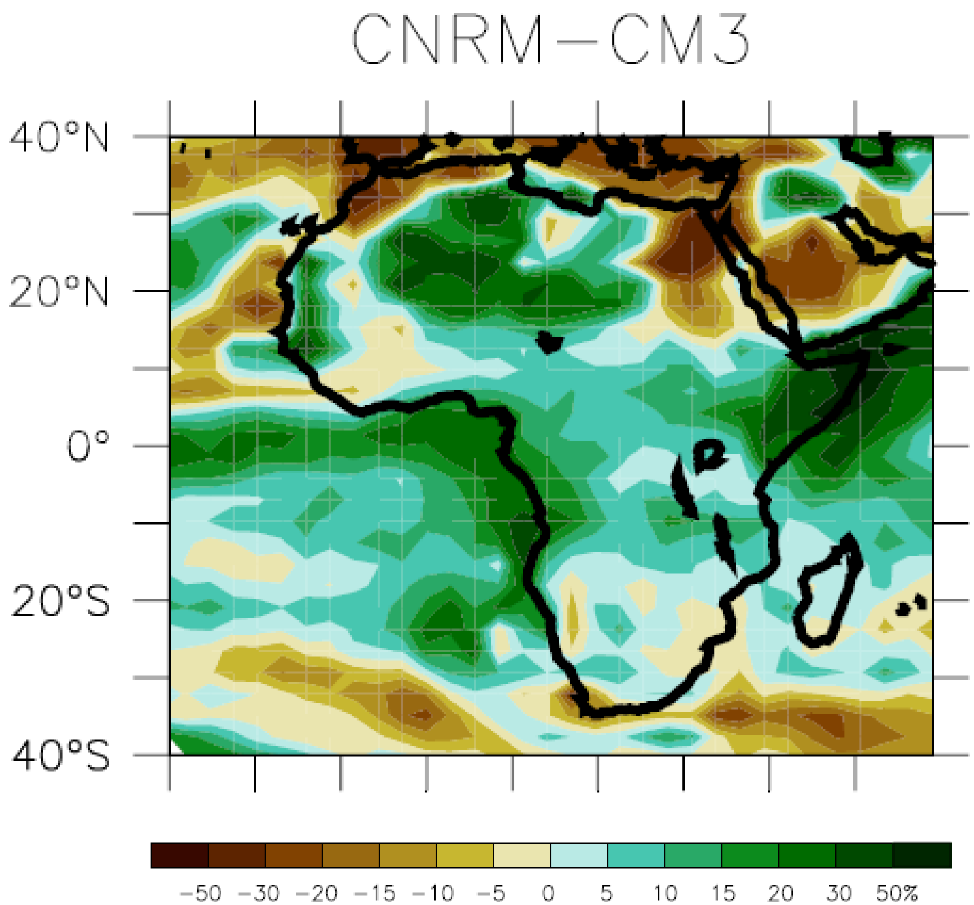
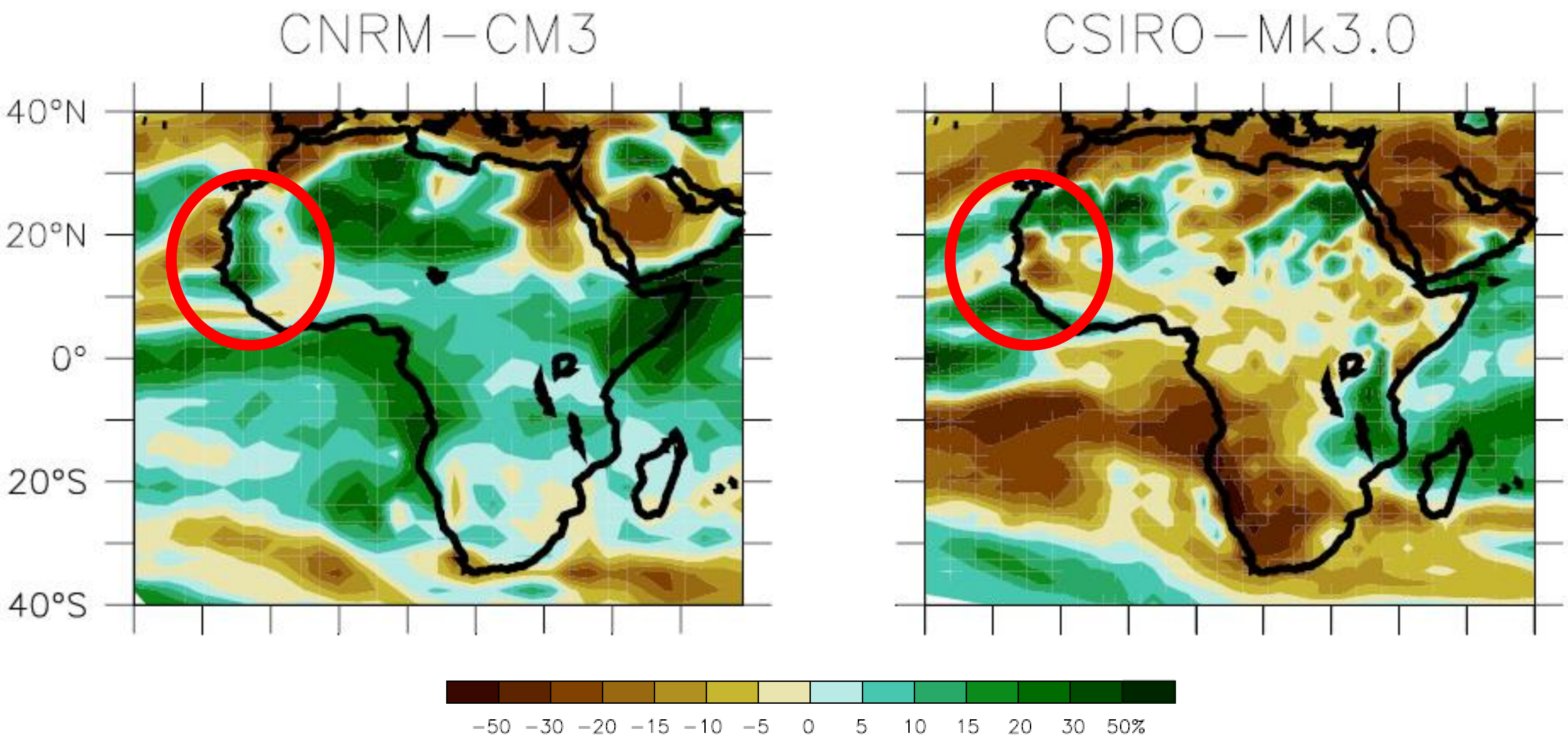
CLIMATE MODELS PROJECT FUTURE CLIMATE CONDITIONS...



The Meteo-France model, from IPCC

from S. Hallegatte, World Bank

...BUT THEY CAN DISAGREE WITH EACH OTHER...



from S. Hallegatte

from IPCC

...AND THERE ARE MANY MODELS...

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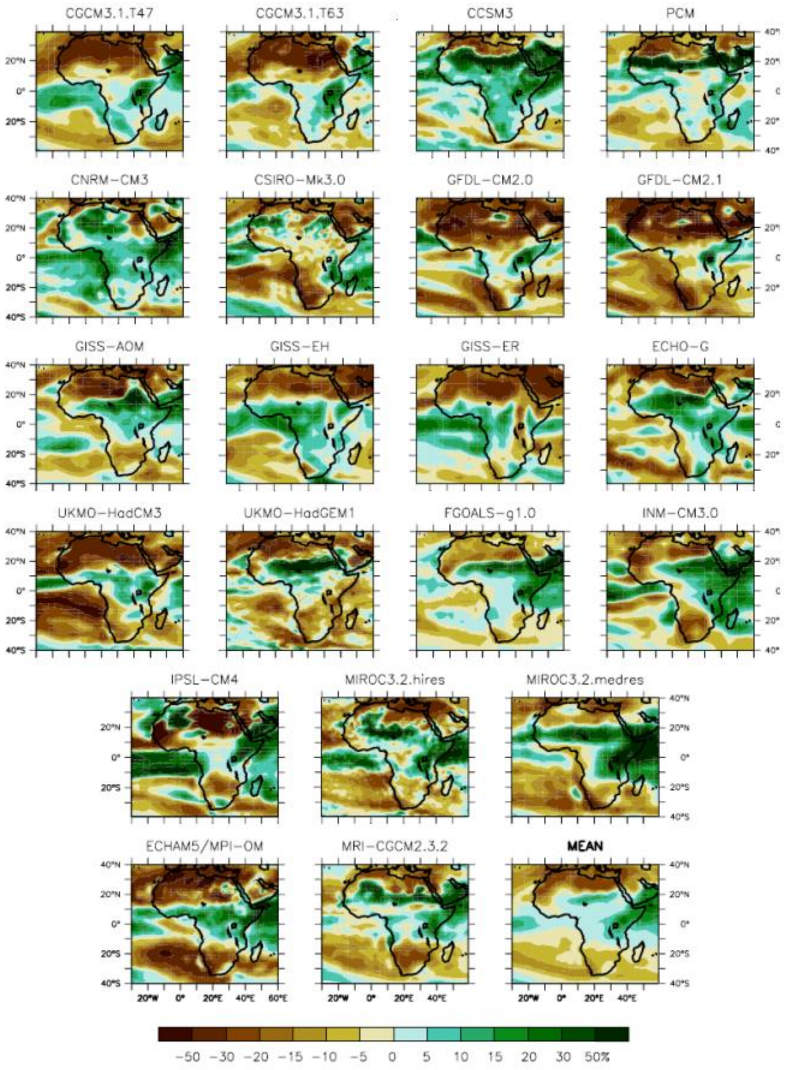


… AND FUTURE CLIMATES ALSO DEPEND ON CLIMATE POLICIES AND SOCIO-ECONOMIC TRENDS.

WE KNOW THE FUTURE IS UNCERTAIN…SO WHAT CAN WE DO?

Cascade of uncertainty

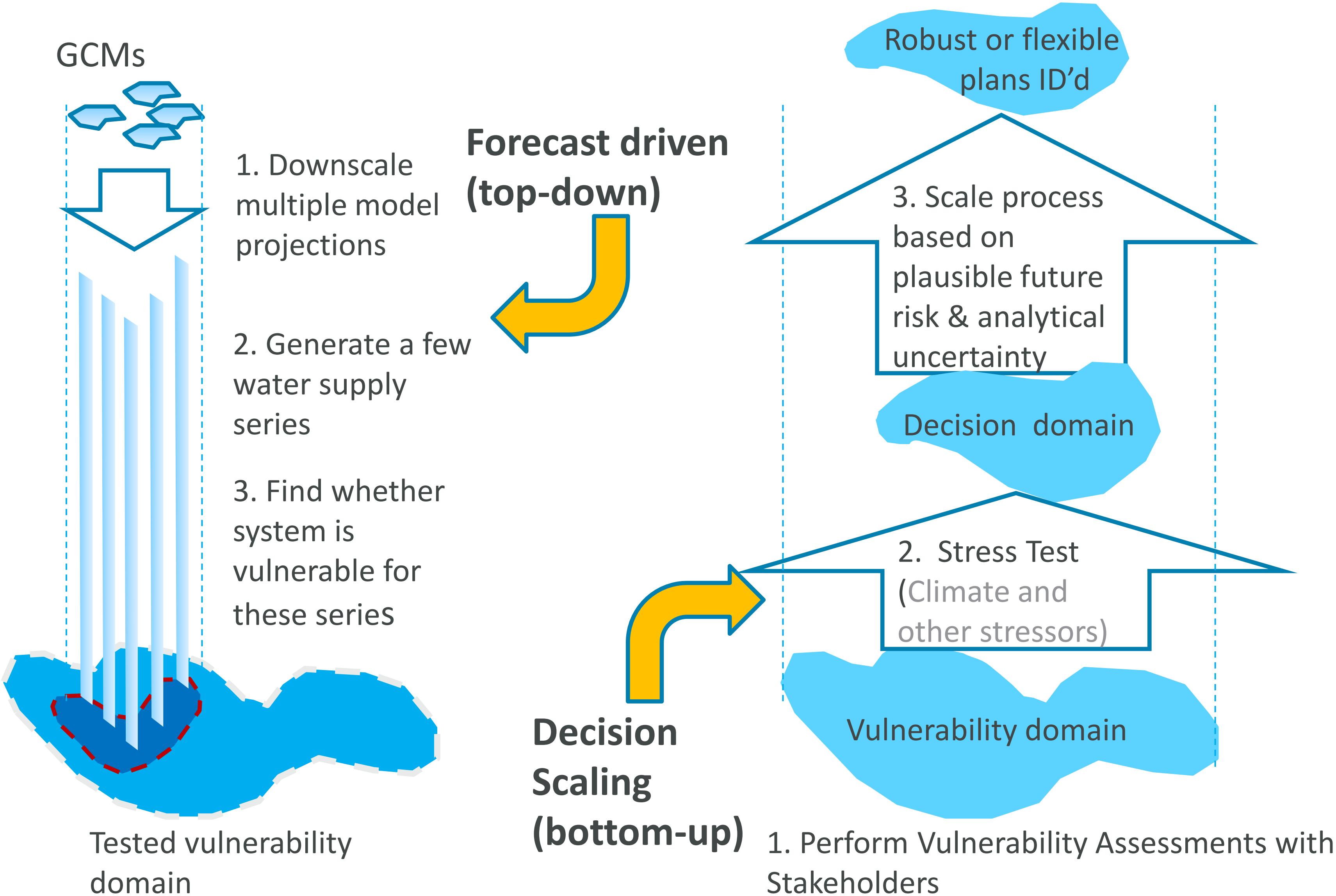
Wilby and Dessai (2010)

Including Climate Change in Hydrological Design at the World Bank (2011)

"We hire a contractor to help assess climate change impacts. On completion an inch thick report is produced to state that the future is uncertain" **Luis Garcia, World Bank**

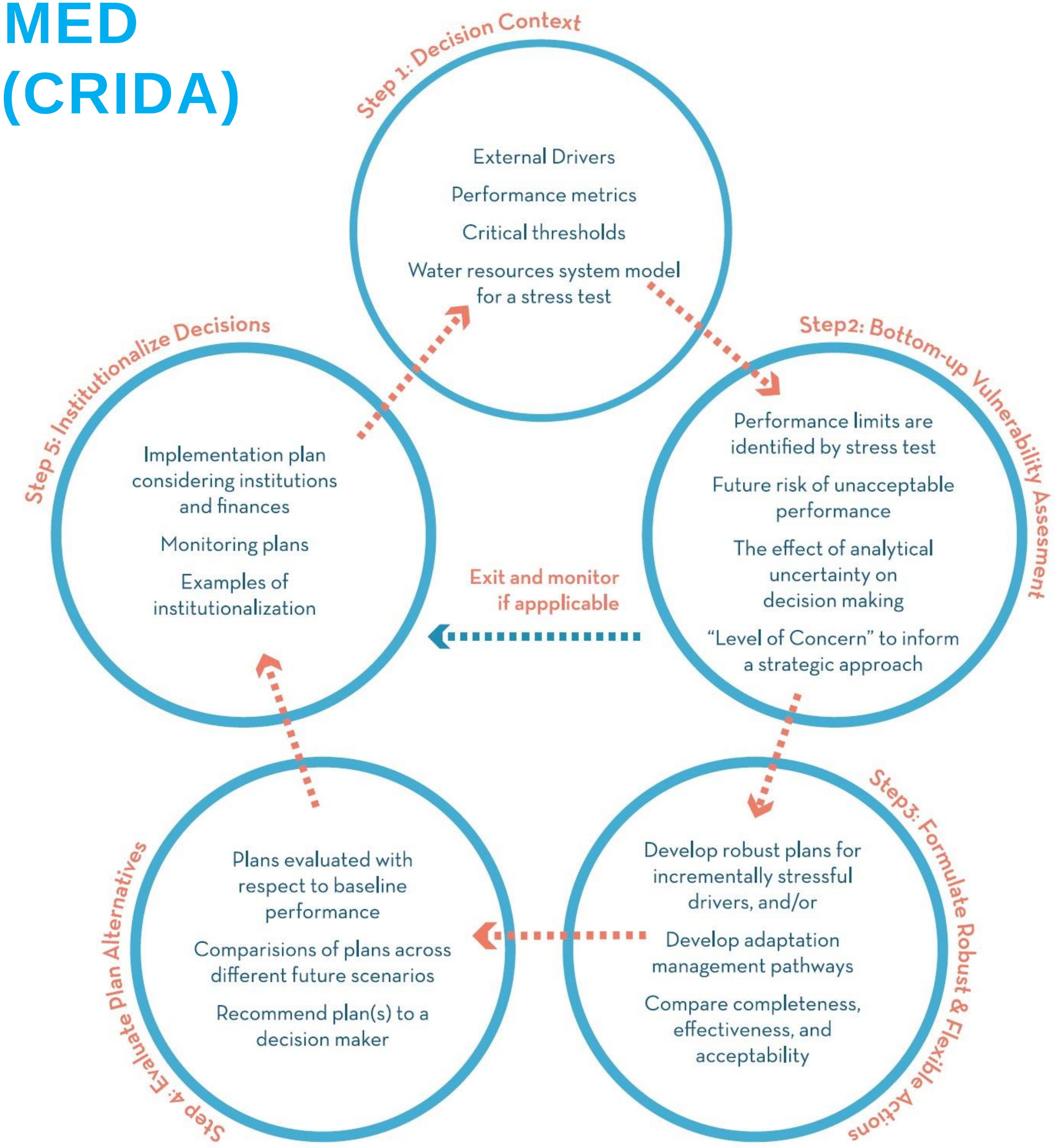
Climate driven

Performance driven



CLIMATE RISK INFORMED DECISION ANALYSIS (CRIDA) APPROACH

- Generate plans that mitigate against future unknown scenarios in a way that doesn't require us to predict the future
- Identify vulnerabilities to potential future scenarios
- Provide a collaborative framework for risk informed decision making under deep uncertainty.



GET INVOLVED AND LEARN MORE

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UNESCO Open Learning

AGWA Guide

CRIDA in Spanish

Thank you

Kari Davis
kari.davis@alliance4water.org
Alliance for Global Water Adaptation, USA

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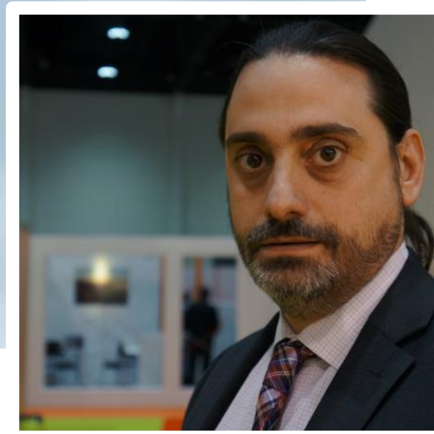
Resilient Decisions in Urban Water Utilities

DIEGO J. RODRIGUEZ
WORLD BANK, SOUTH AFRICA

THE WORLD BANK



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INDEX

- Uncertainty and Climate change
- Predict and act
- Decision making under uncertainty
- Results in practice

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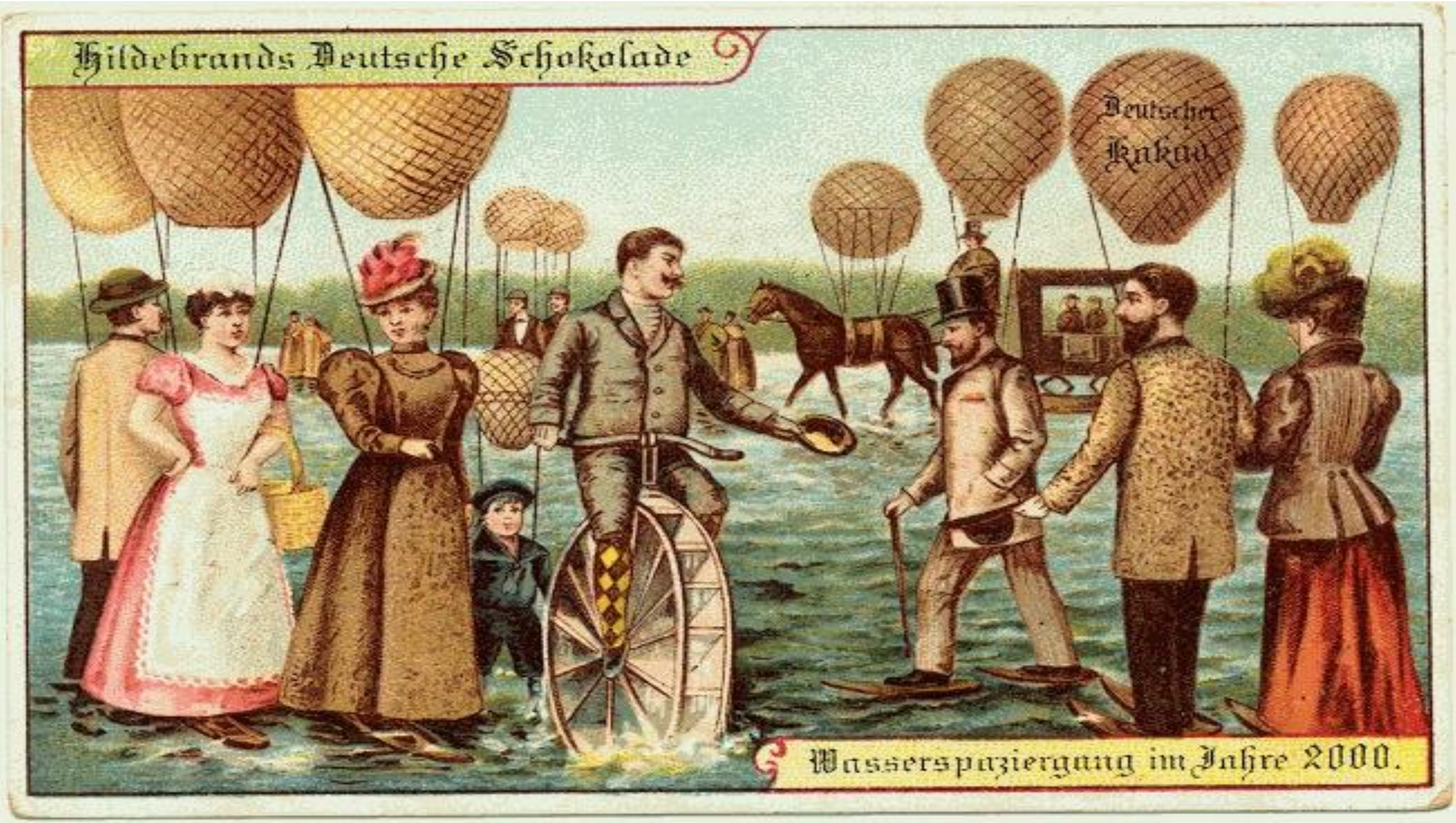
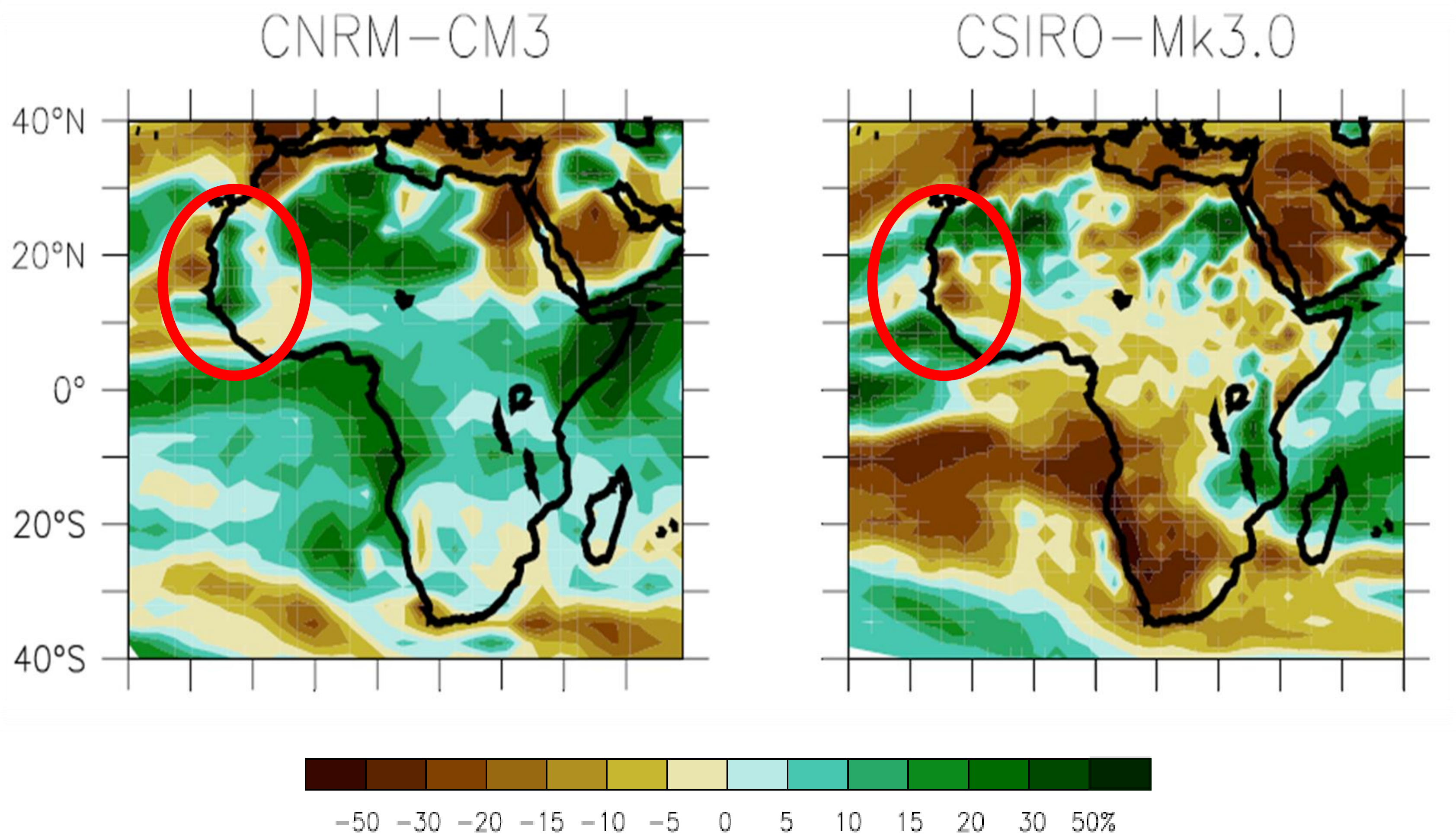
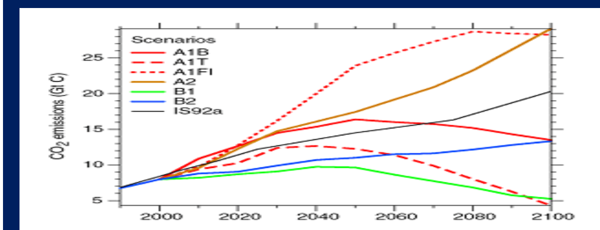


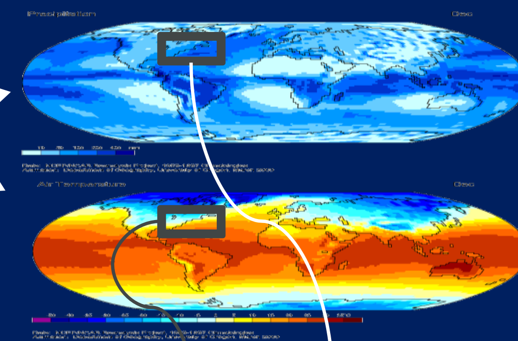

CNRM−CM3
CSIRO−Mk3.0
40°N
20°N
0°
20°S
40°S
−50 −30 −20 −15 −10 −5 0 5 10 15 20 30 50%

Uncertainty in many other issues

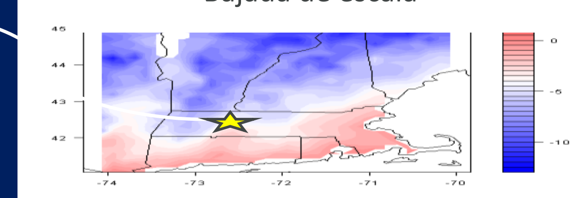
Emissions scenarios



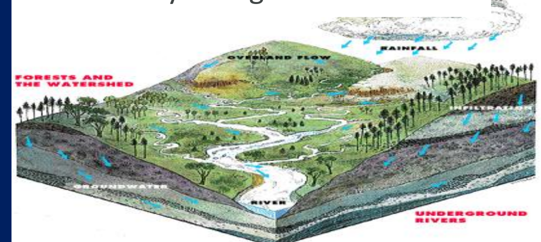
GCM



Bajada de escala

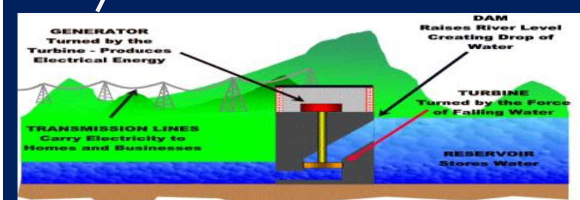


Hydrological model



Desempeño del sistema bajo escenarios de futuro de cambio climático

Modelo de sistema



Wisconsin Valley Improvement Company

Predict and act

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'Optimal' decisions for only one scenaro may not be optimal for other scenarios

Selection of actions and investments for that ONE scenario

Select ONE future scenario

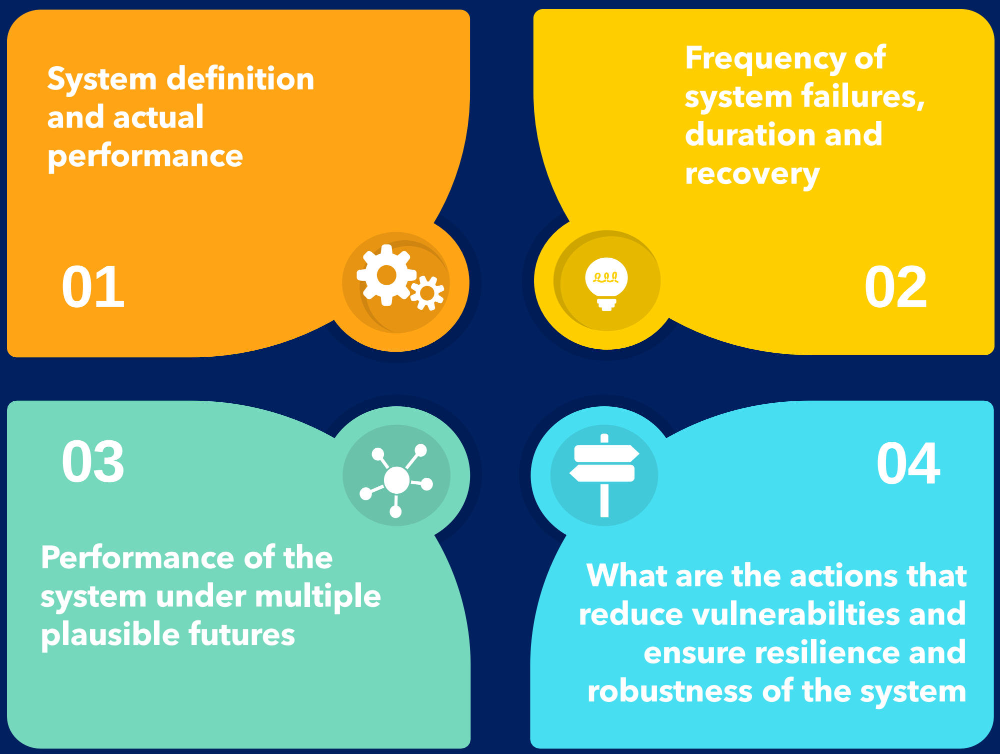
Scnearios: Select 3 future scenarios

Some understanding of the system

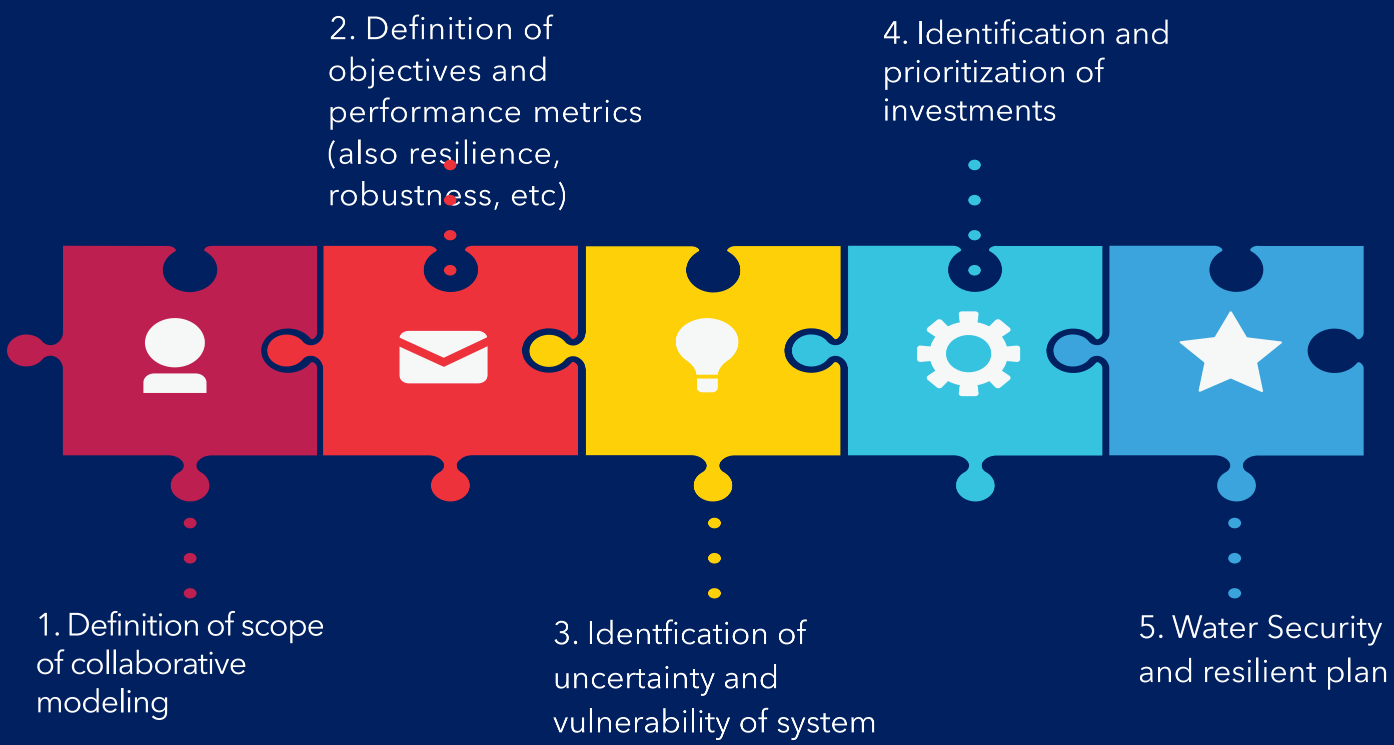
Source: clarin.com

We do not try to predict future conditions, we plan and invest with robustness and flexibility

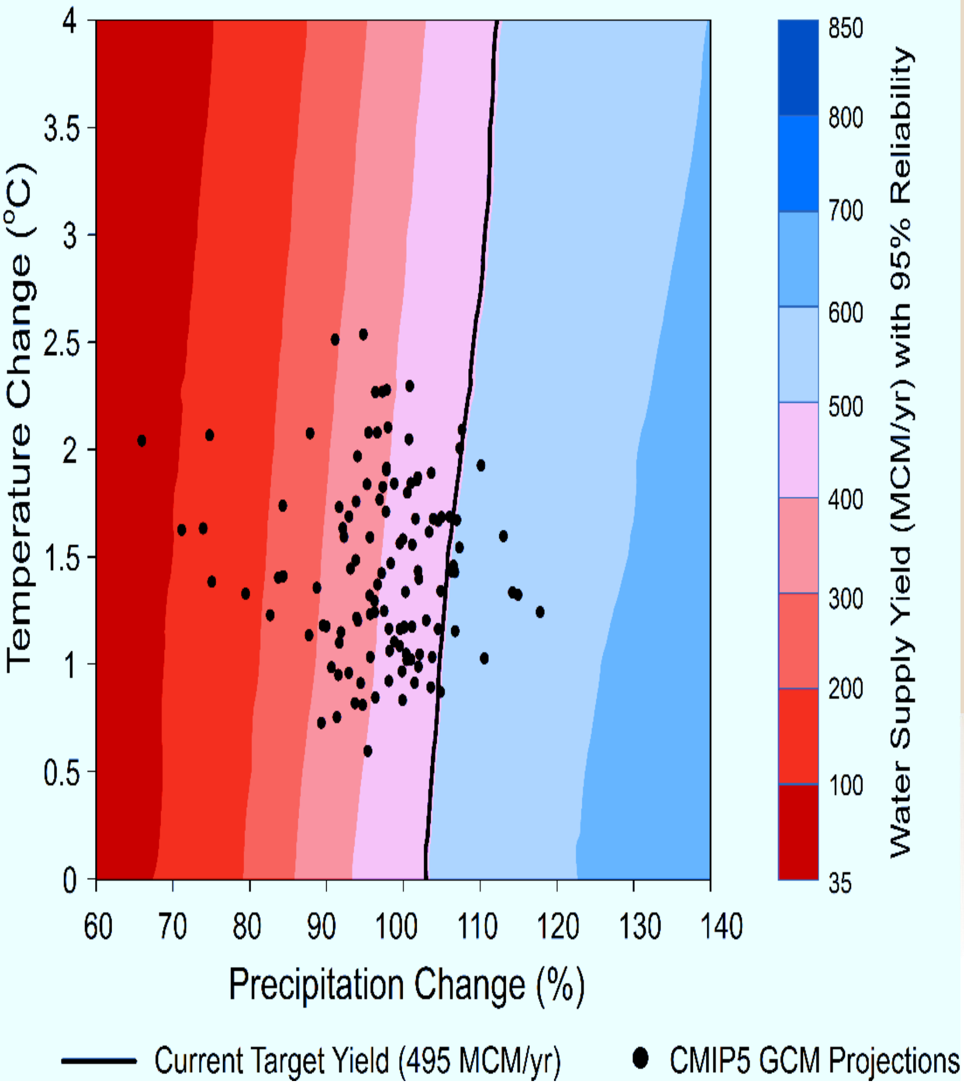
The methods decision making under uncertainty ask, "What are the limitations/vulnerabilities of our plans and investments and how could we overcome them?"

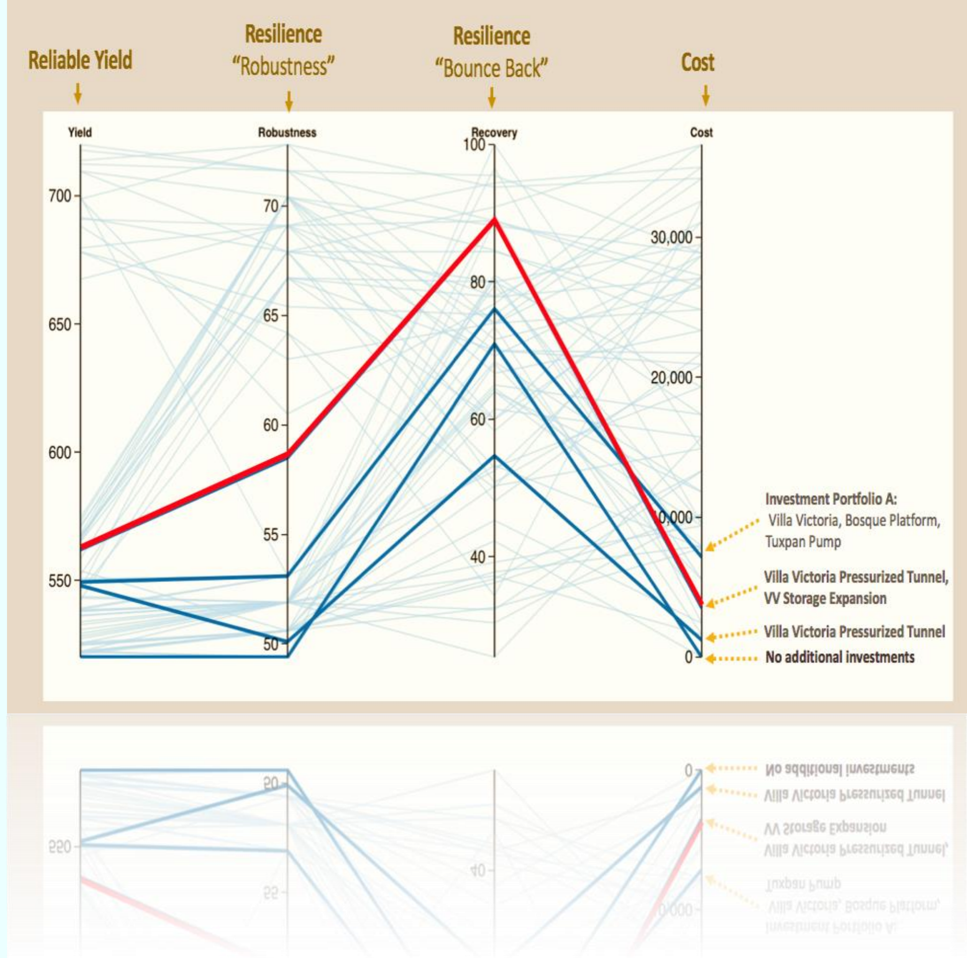


Resilience of what, for what, and how to address it

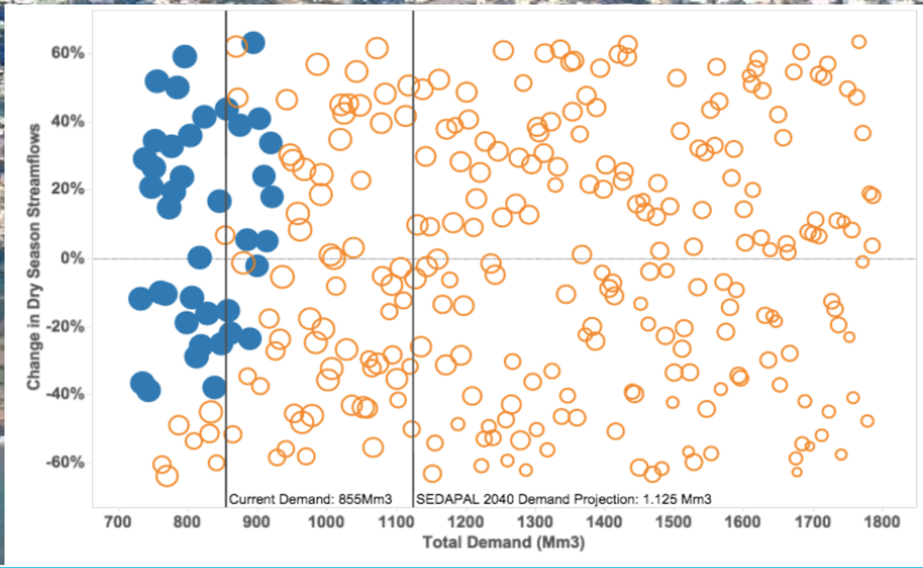


Variables are maximized and minimized and exchanges are visualized

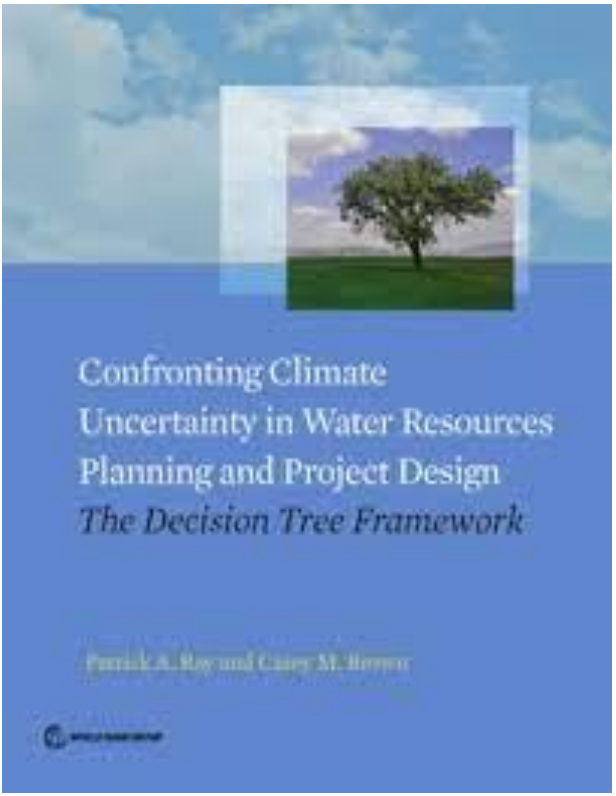


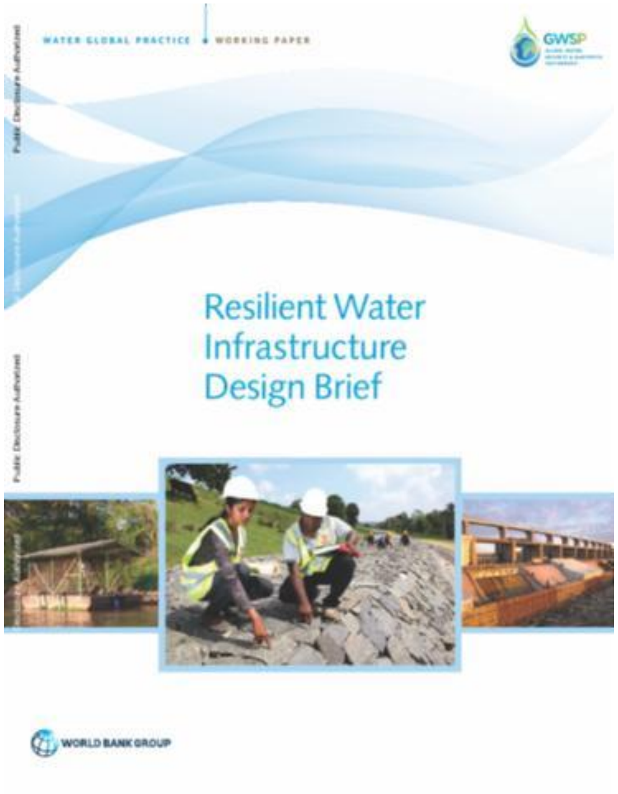


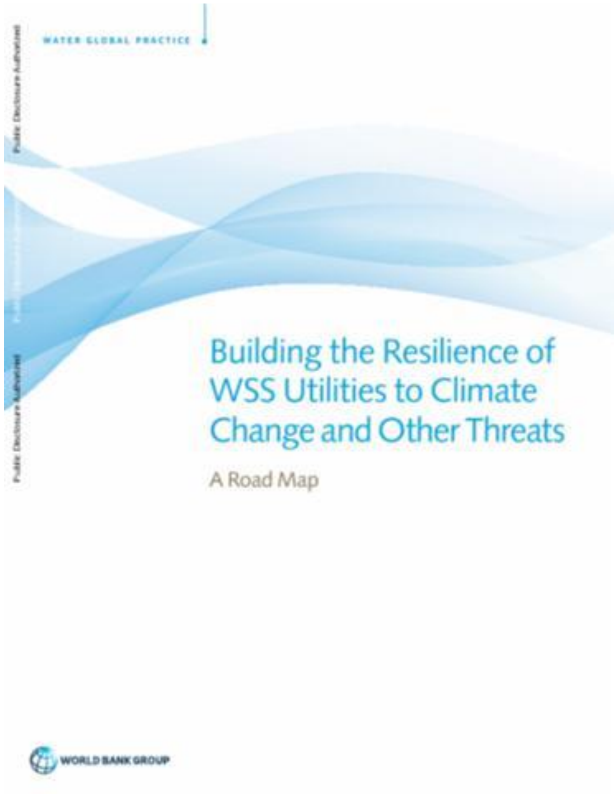
In Lima, Peru study resulted in USD 600 million in savings

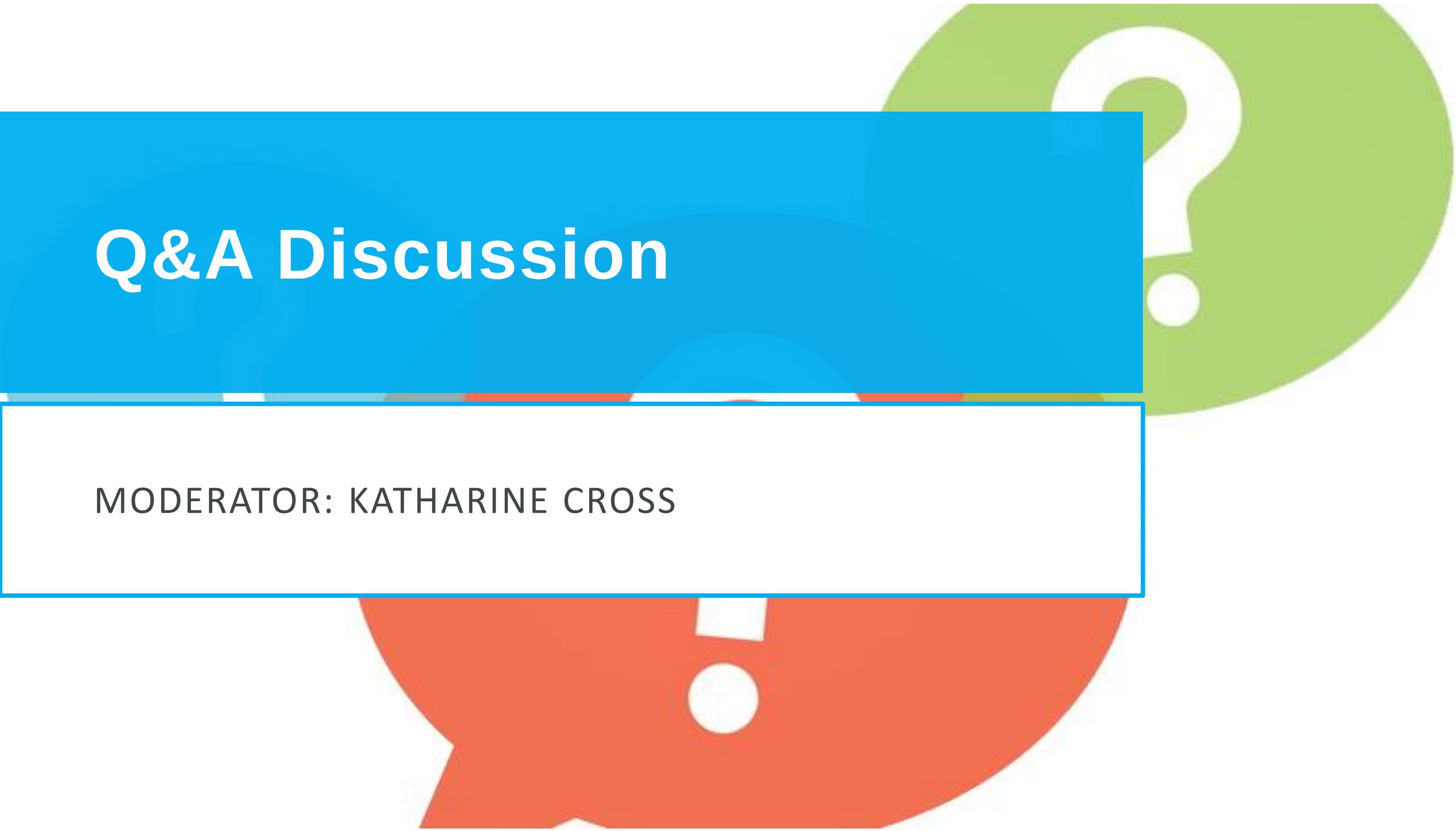


THANK YOU


Confronting Climate Uncertainty in Water Resources Planning and Project Design
The Decision Tree Framework


WATER GLOBAL PRACTICE
WORKING PAPER
GWSP
Resilient Water Infrastructure Design Brief
WORLD BANK GROUP


WATER GLOBAL PRACTICE
Building the Resilience of WSS Utilities to Climate Change and Other Threats
A Road Map
WORLD BANK GROUP



Q&A Discussion

MODERATOR: KATHARINE CROSS

CRIDA Case Study: Iolanda WTP, Zambia

MARC TKACH PE
MILLENNIUM CHALLENGE CORPORATION
UNITED STATES

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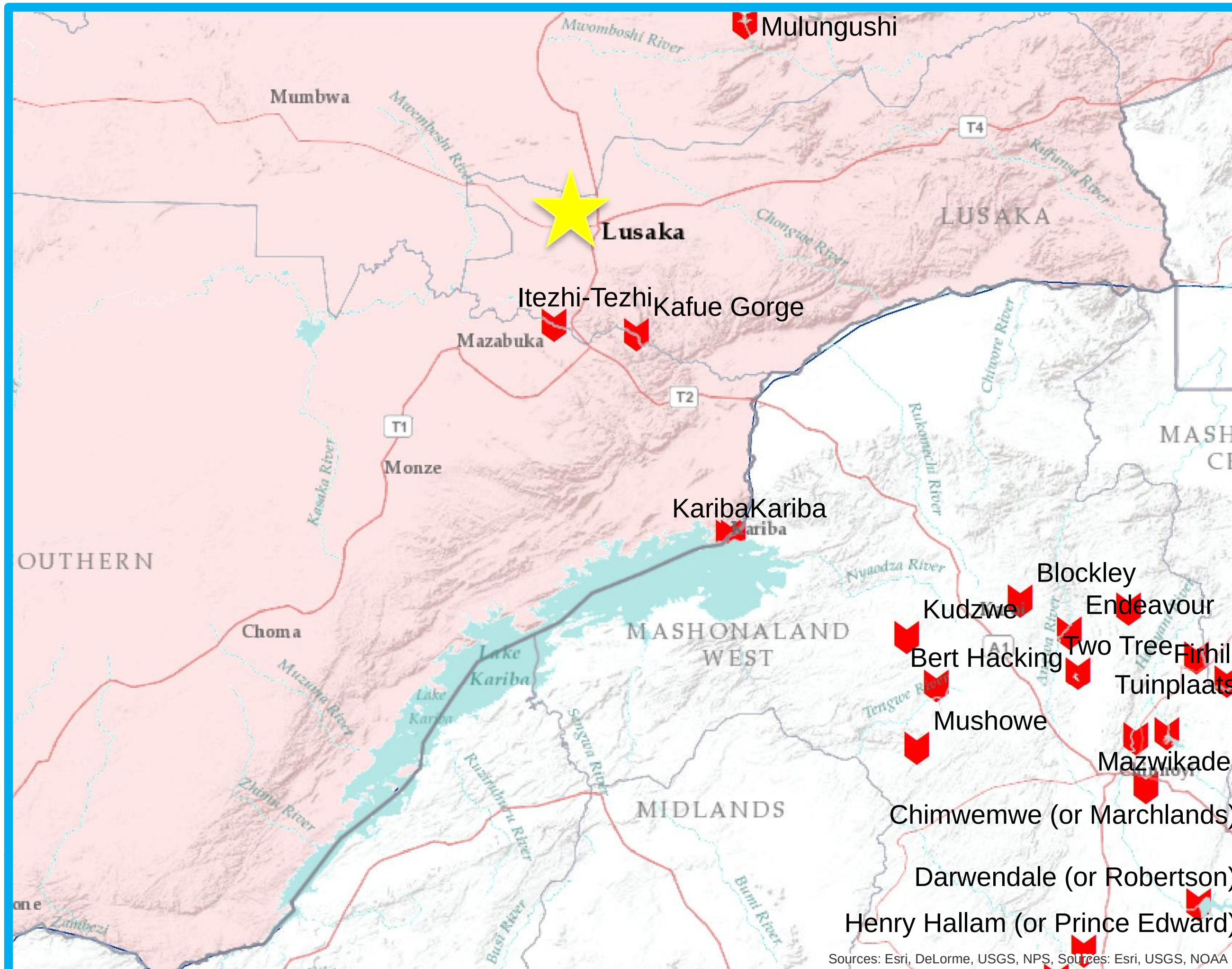
OVERVIEW

- Rehabilitation of Iolanda WTP
  - 24 MLD
  - Hydropower Dependent
- $20M USD
- Increase throughput
- Scope
  - Replace high-lift pumps
  - Repair structural issues
  - Re-establish chemical treatment scheme
  - Replace filter media
- Climate Impact to Investment?

CASE STUDY BACKGROUND

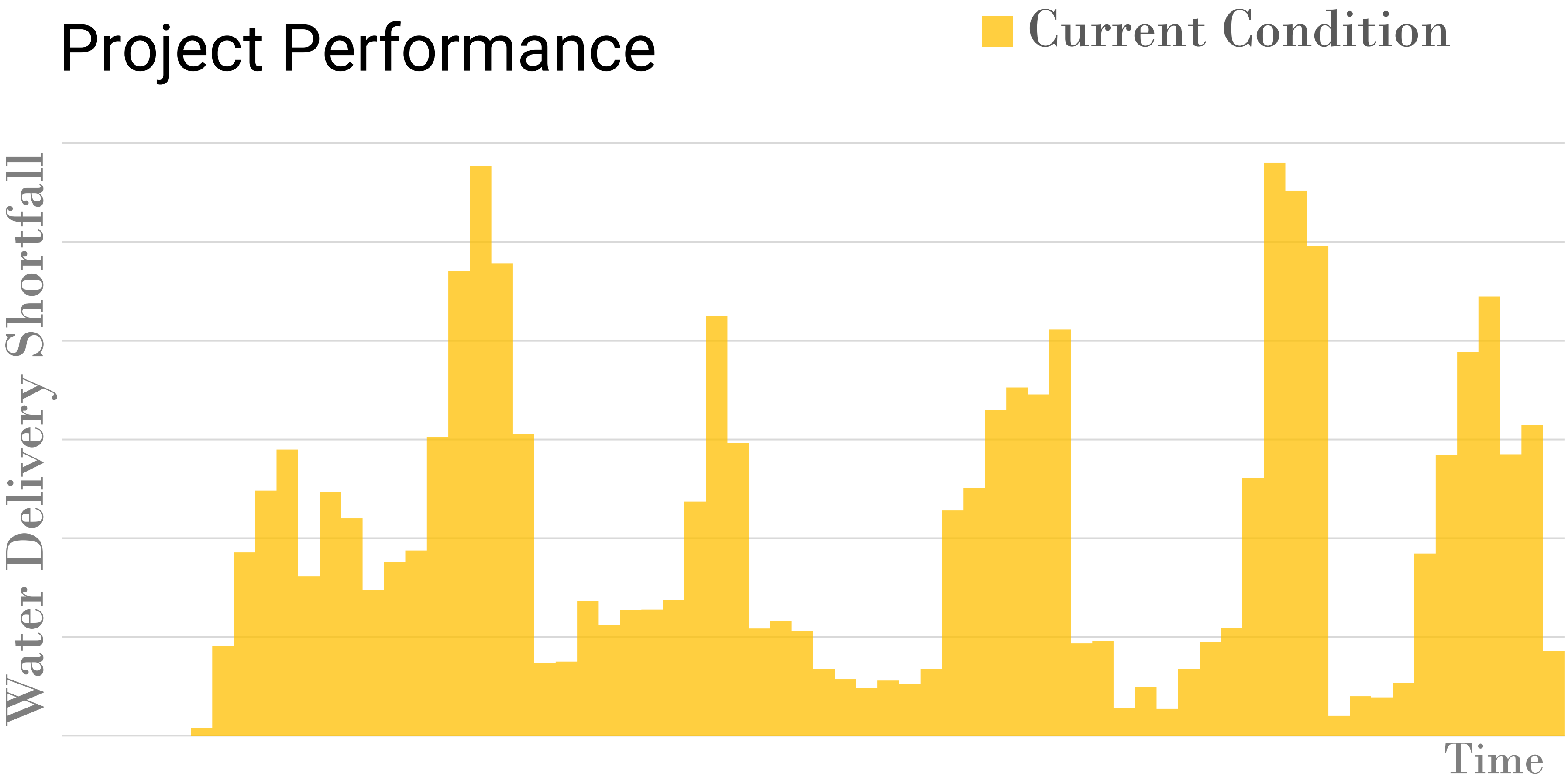


CRIDA FRAMEWORK

1. The Decision Context: What is the Performance Threshold?
2. The Bottom-Up Vunerability Assessment
3. Formulate Adaptive Responses
4. Select the Adaptive Response
5. Institutionalize the Resilience Plan

1. DECISION CONTEXT

The plant's current performance is unacceptable. There is need to define a baseline level of investment (e.g. the investment one ought to make regardless of climate change)



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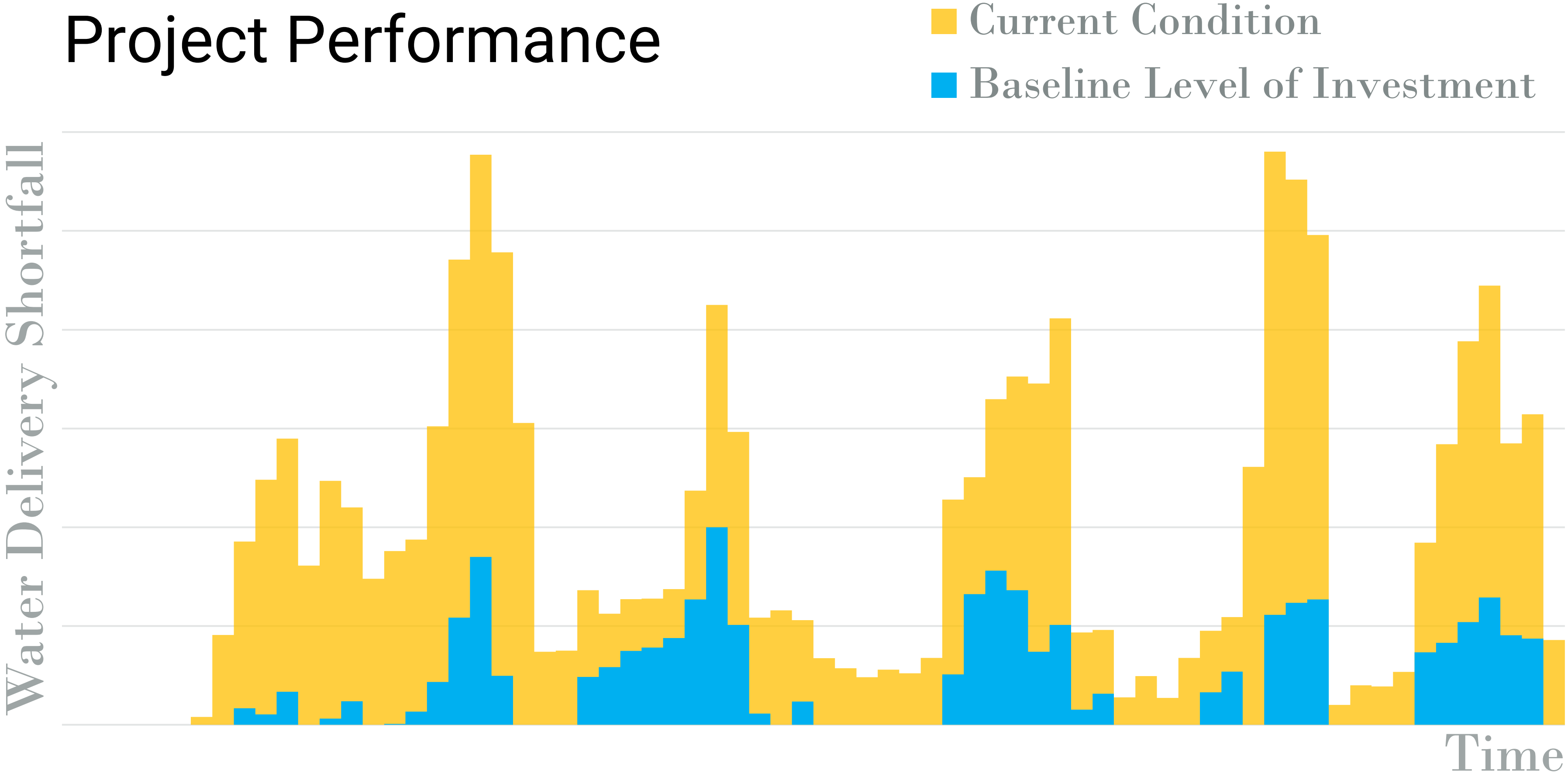

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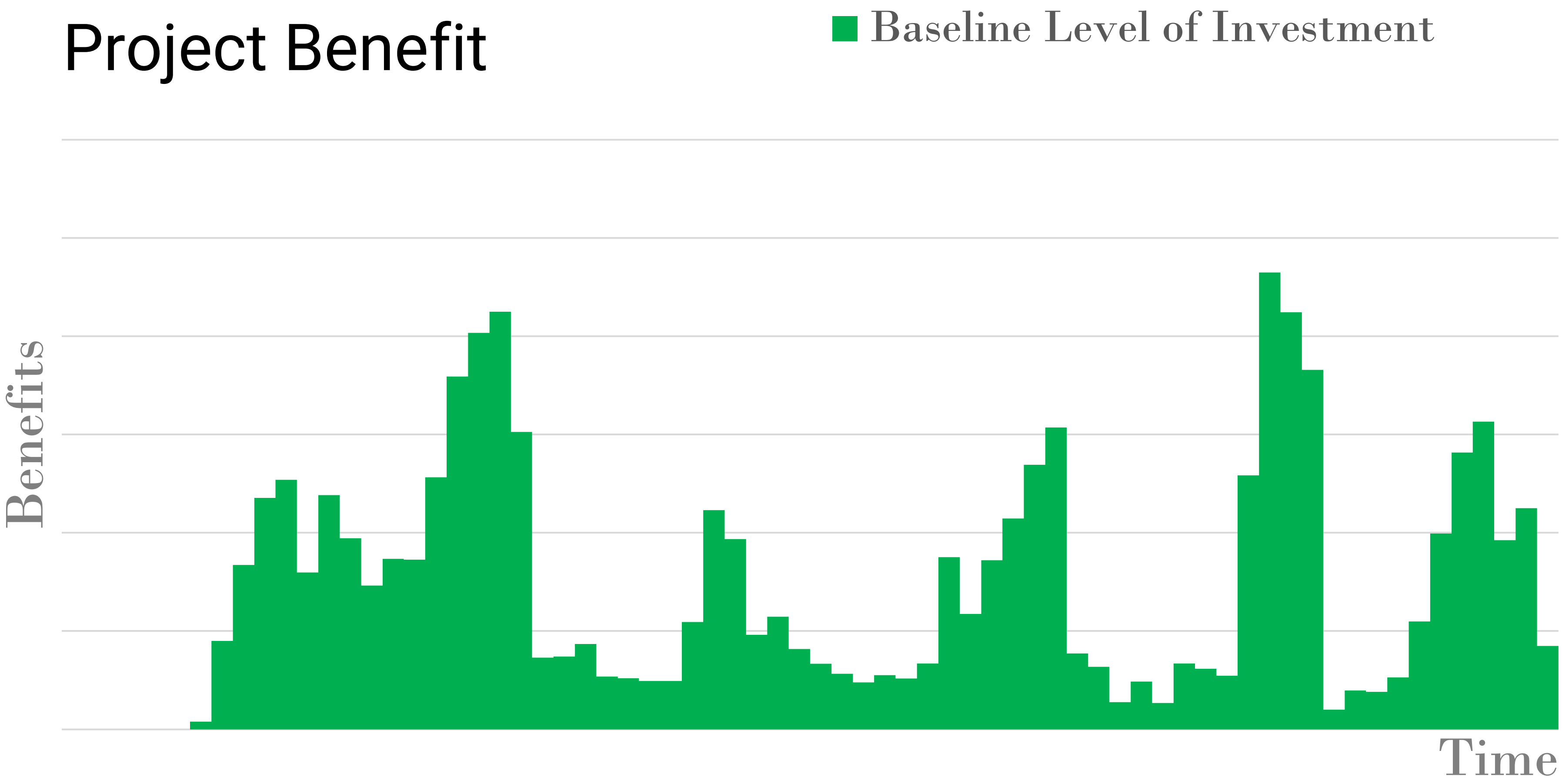

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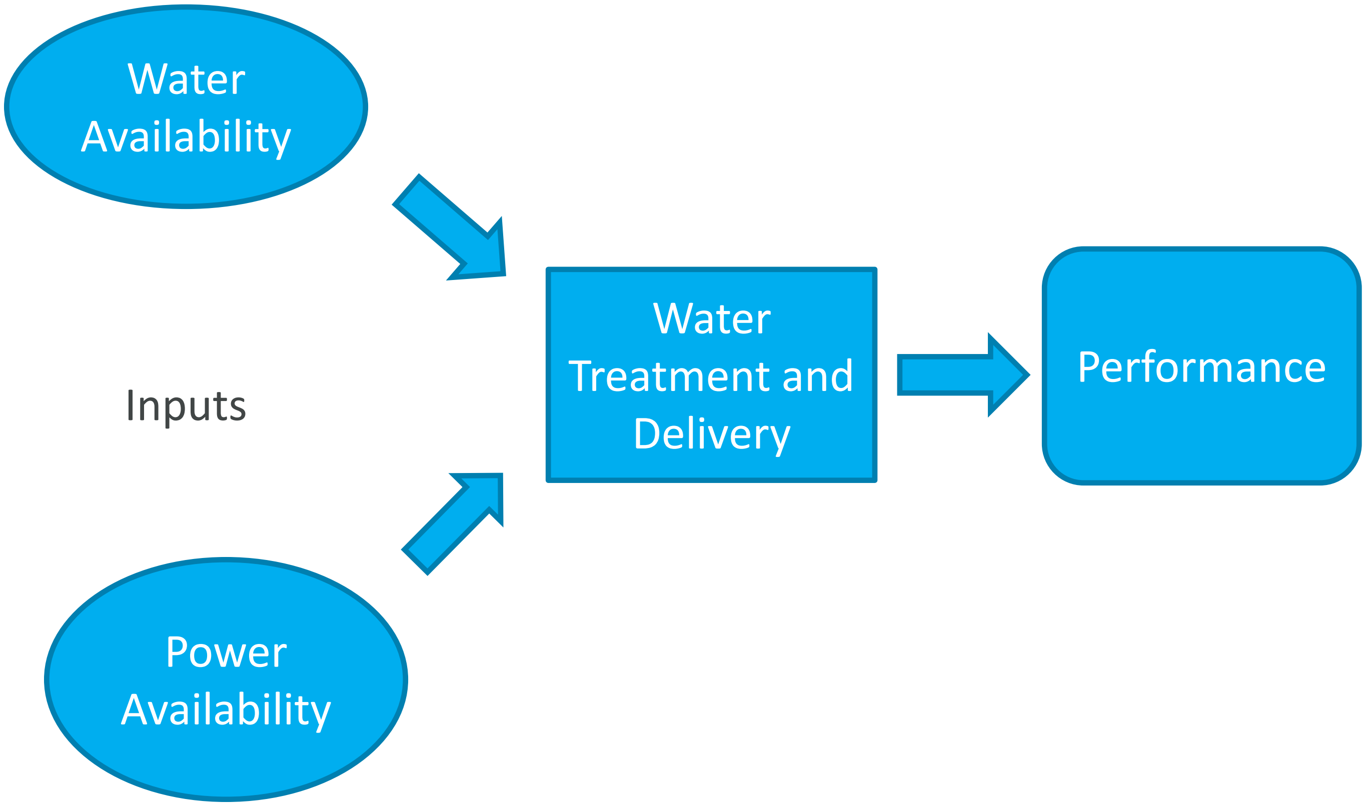

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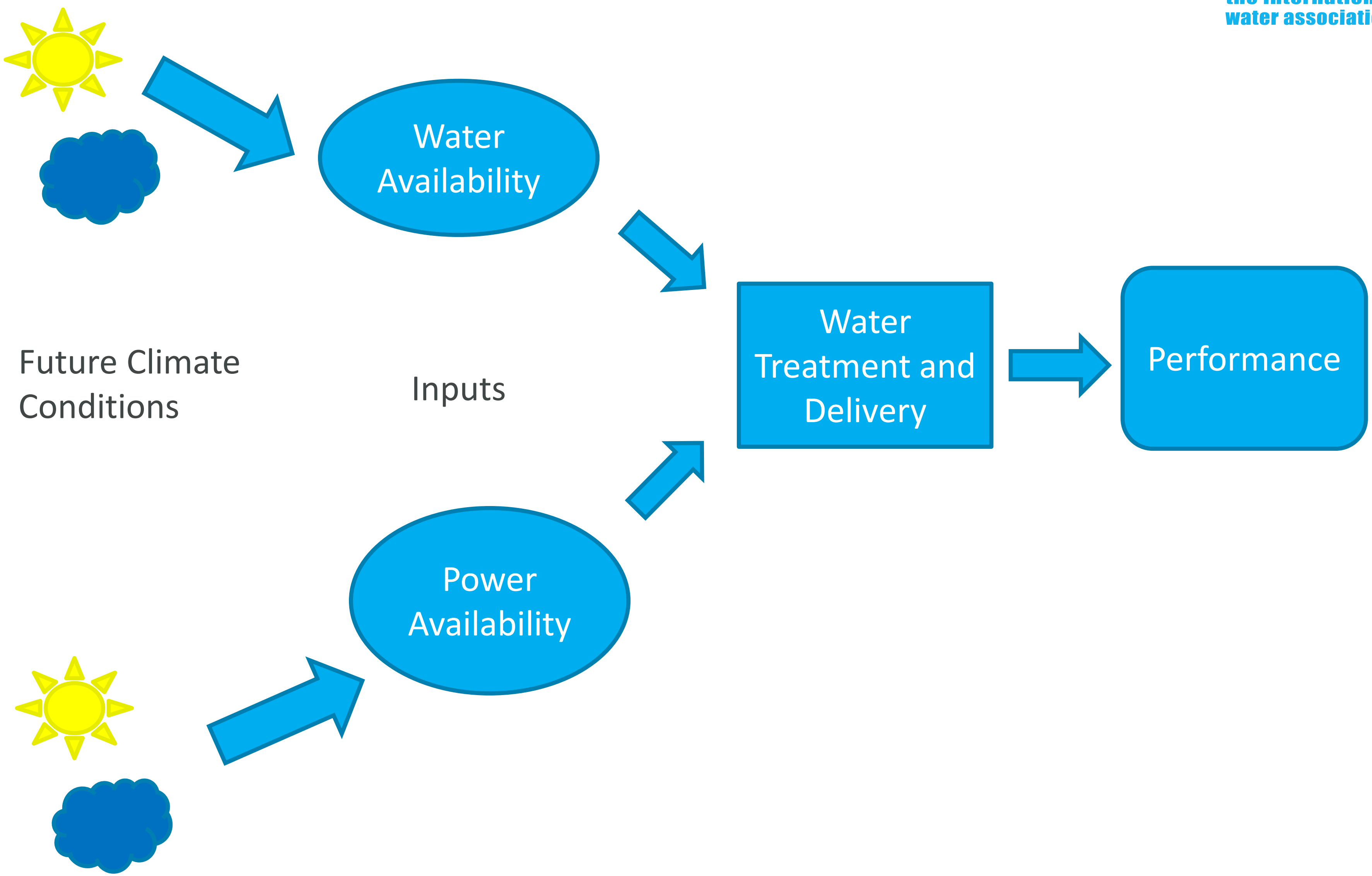
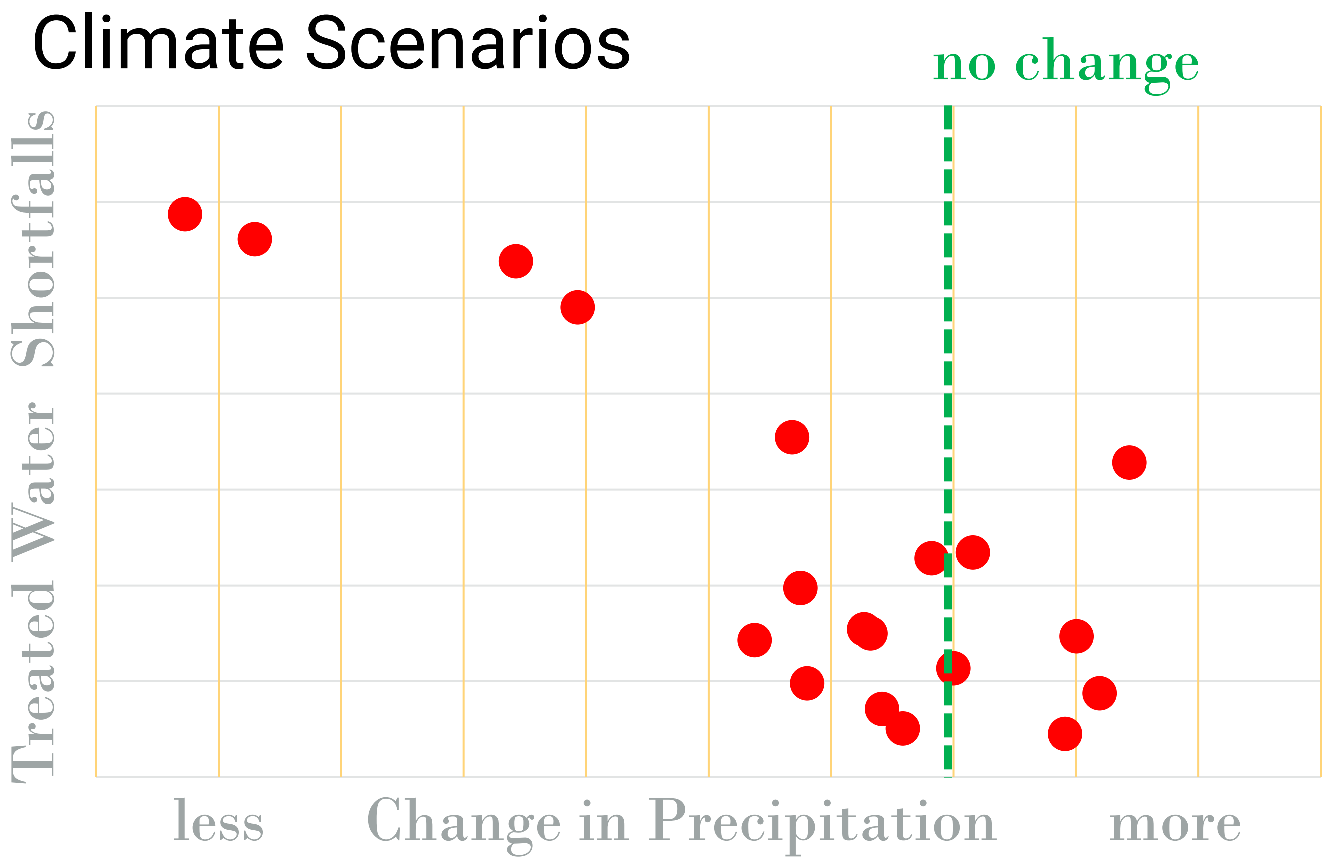


2. BOTTOM UP ASSESSMENT

- Create a set of climate scenarios (stressor conditions) and test performance under those scenarios. (In this case 24 scenarios based on 12 GCMs and 2 emission scenarios. However, these can be independent of any/all GCMs).



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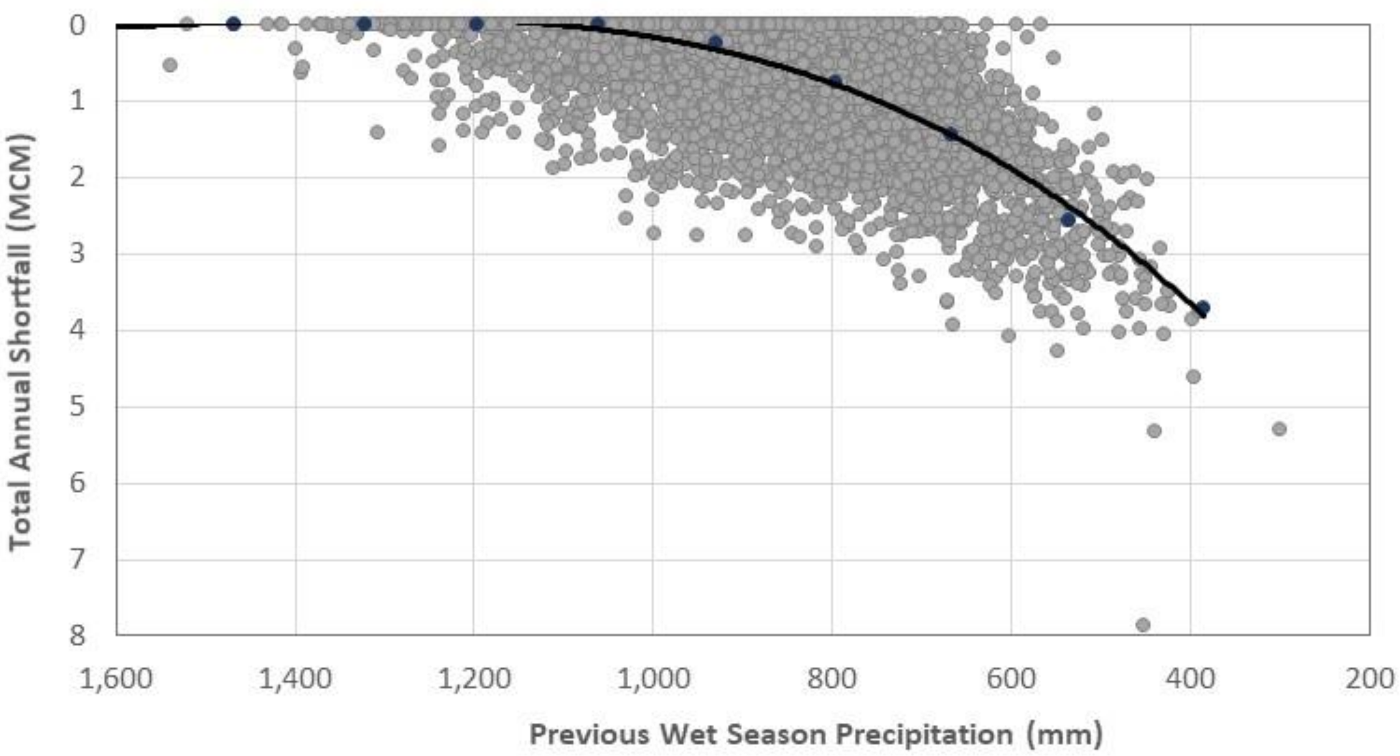

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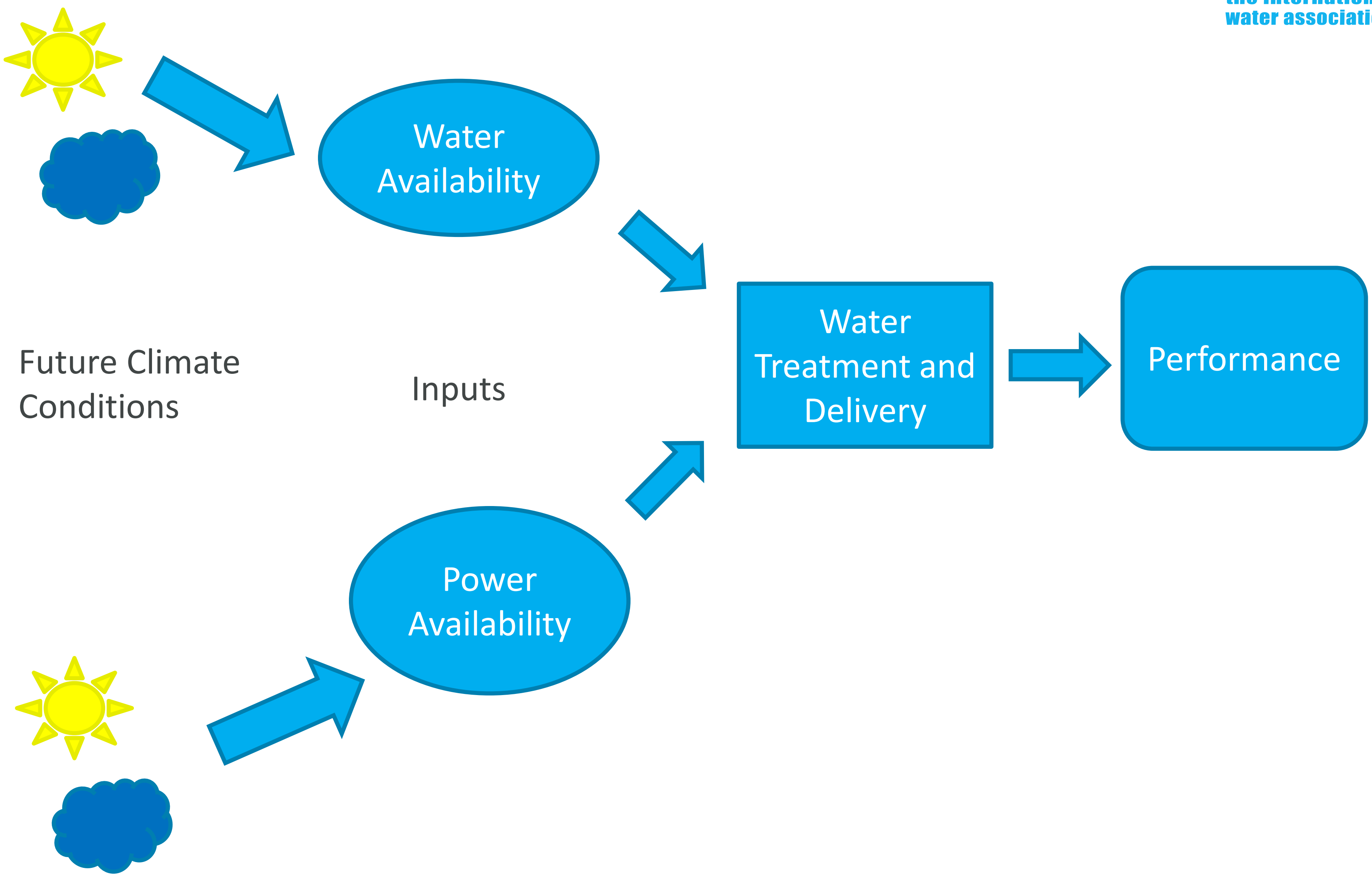

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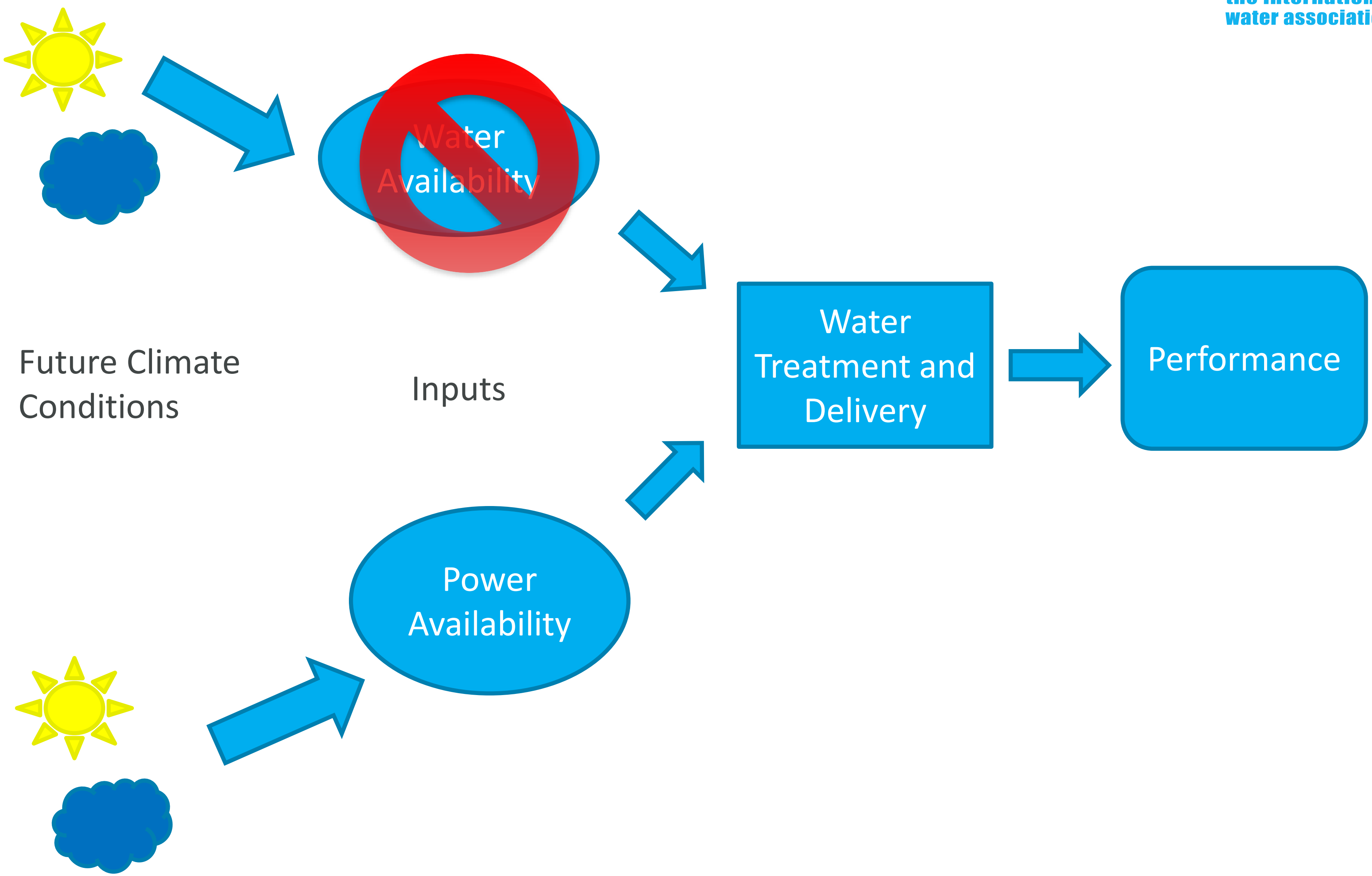

3. FORMULATE RESPONSES

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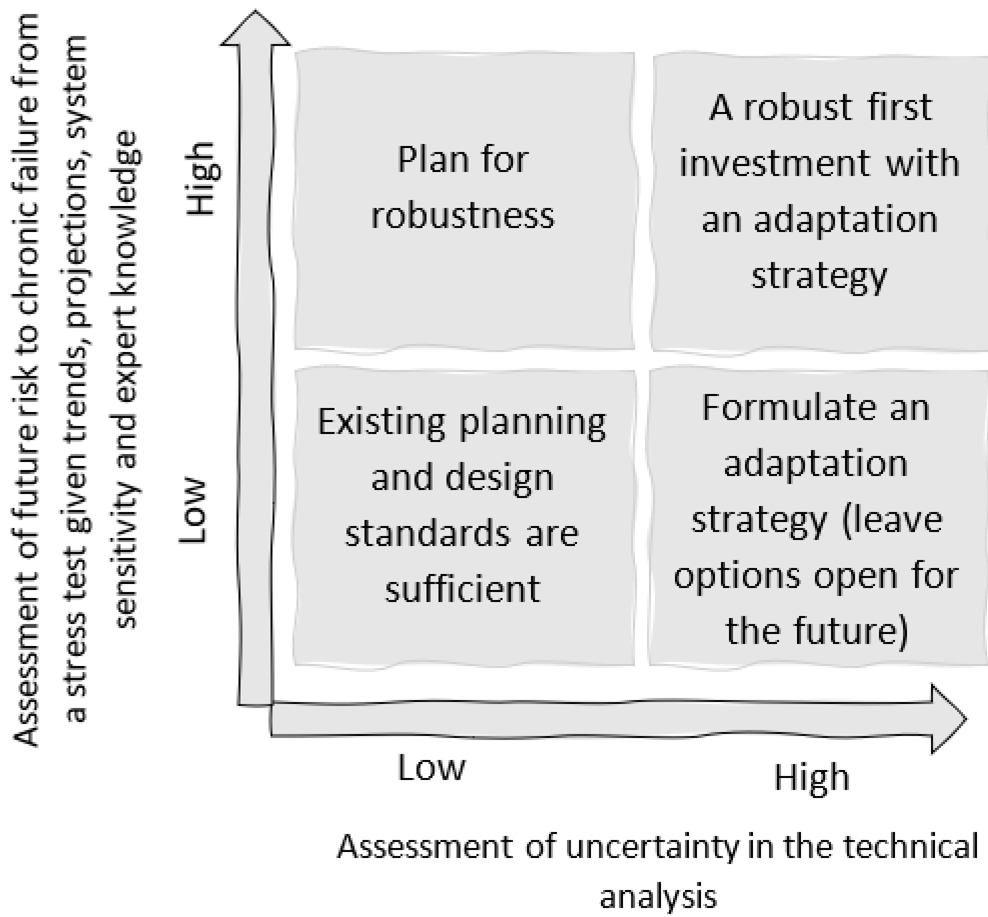
Climate Risk

- High climate risk should favor robust strategies

Analytical Uncertainty

- The analysis is based on poor quality data, low resolution models, and there is relatively little convergence in the GCM predictions.

- This favors flexibility (adaptive solutions).



3. FORMULATE RESPONSES

Generators for Pumps

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Generators for Pumps

New Power Agreement

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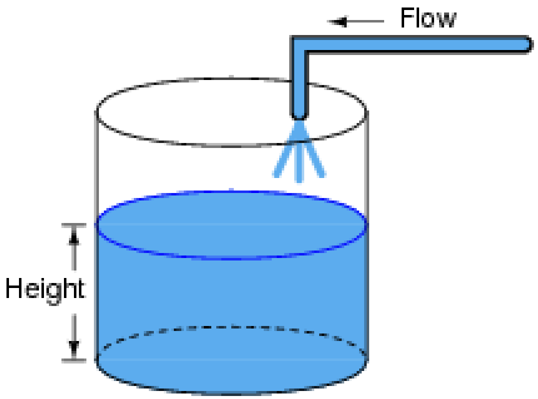
Generators for Pumps

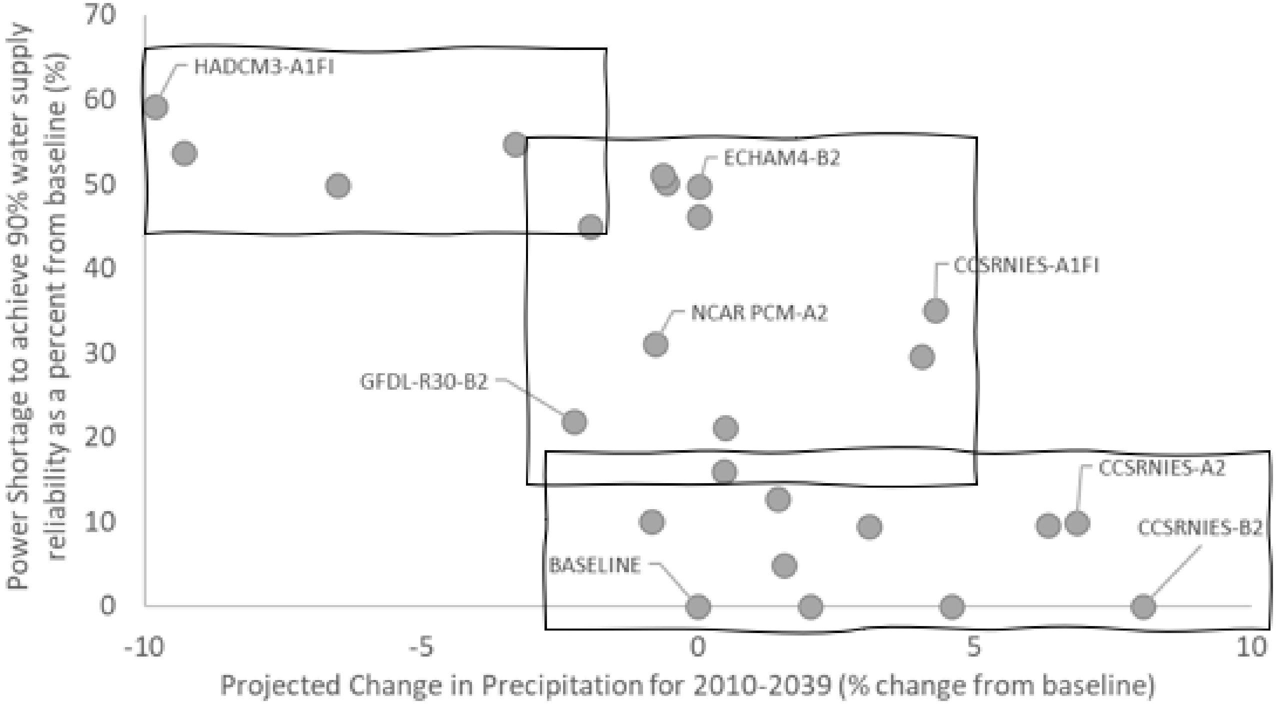
New Power Agreement



Greater Storage

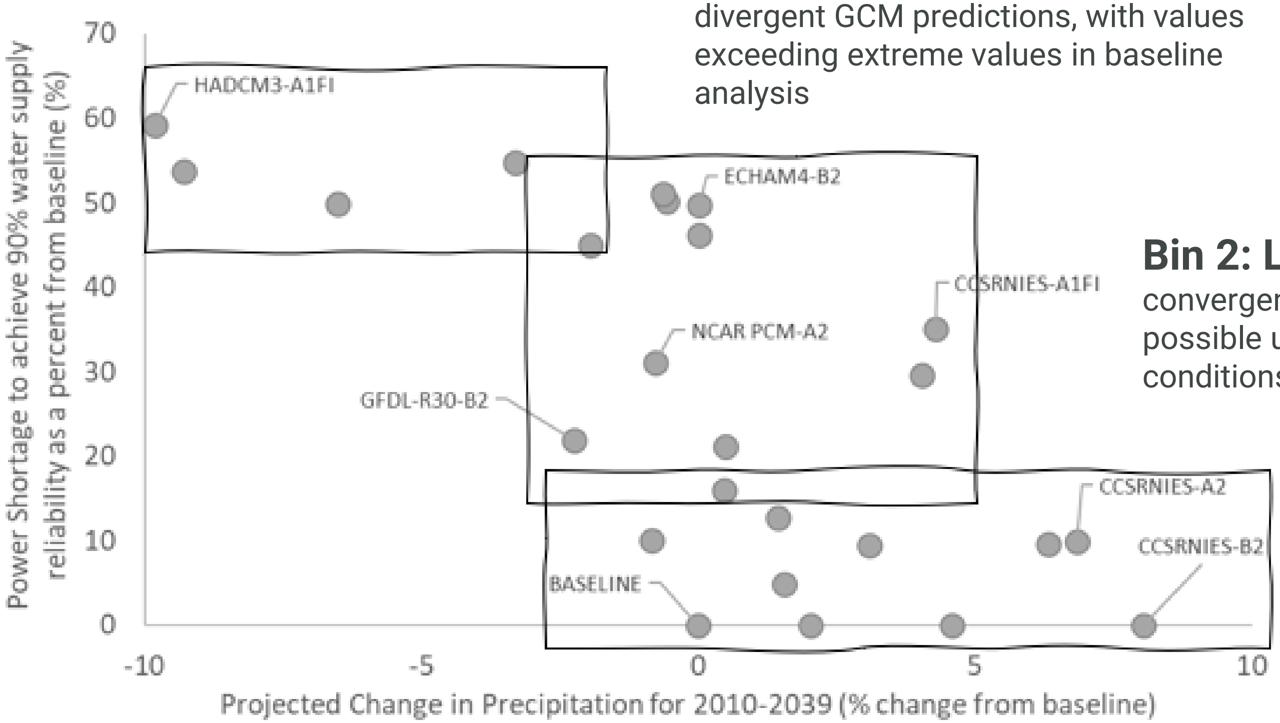
4. SELECT THE RESPONSE

Climate Scenarios



4. SELECT THE RESPONSE

Climate Scenarios



Bin 1: Less Likely Scenarios
divergent GCM predictions, with values exceeding extreme values in baseline analysis

Bin 2: Likely Scenarios
convergent GCMs, values possible under baseline conditions

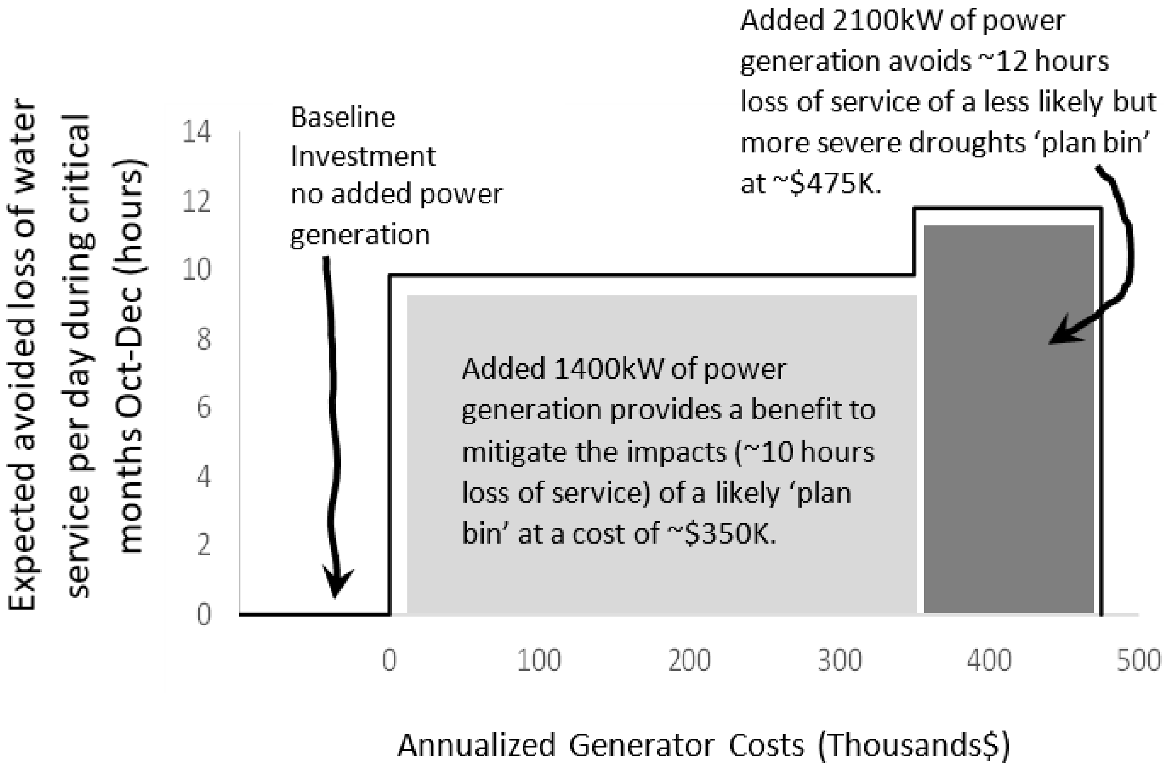
Bin 3: Below Baseline
performance improved under climate scenario

4. SELECT THE RESPONSE

Robustness via Incremental Cost Analysis

Being Cost Effective in Uncertainty

- Decision-makers evaluate added investments of robustness with respect to avoided losses under each bin.



5. INSTITUTIONALIZE THE RESPONSE

Considerations:

- Timing
- Institutional Asset Management
- Budgeting

Now

Planned

KEY OUTCOMES

- Participatory
- Based on Performance Metrics
- Simple Modeling
- Time Savings / Inexpensive
- Realistic Solutions

Planning for Improved Resilience in Drinking Water Infrastructure

Andrew Warren

andrew.warren@deltares.nl

23 November 2021

Problem: DWI Resilience

the international water association

Supply risks

- Climate change
- Source pollution
- Production site failure
- Increased competition for resources (inc. environment)

Demand risks

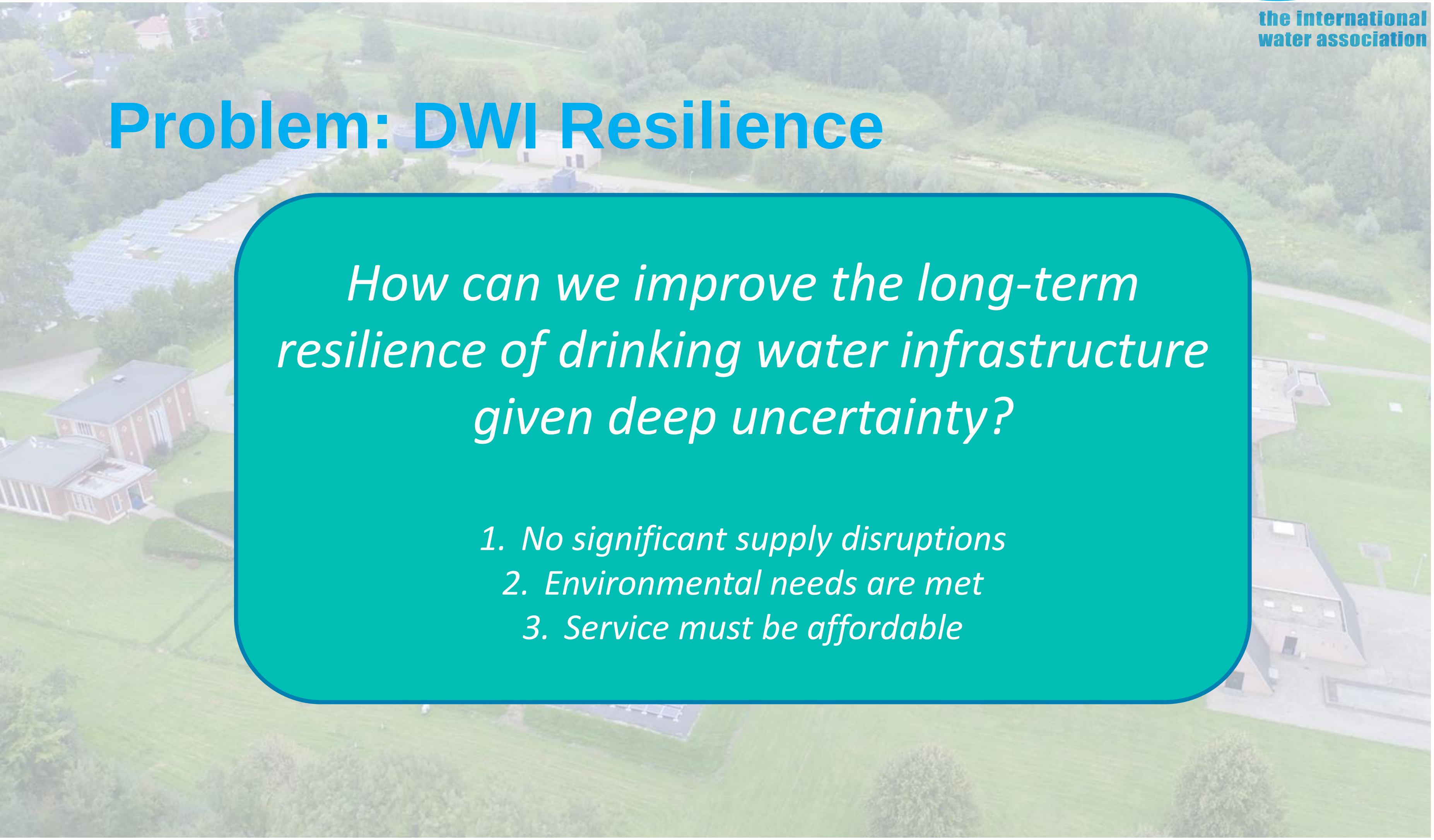
- Demand growth/decline
- Demand spikes
- Independent abstractions
- New technologies

Network risks

- Heterogenous network arrangements
- Network connections
- Pipeline failures

Problem: DWI Resilience

Supply risks	D	Network risks
		
• Climate change • Source pollution • Production site failure • Increased competition for resources (inc. environment)		eterogenous network arrangements Network connections Pipeline failures

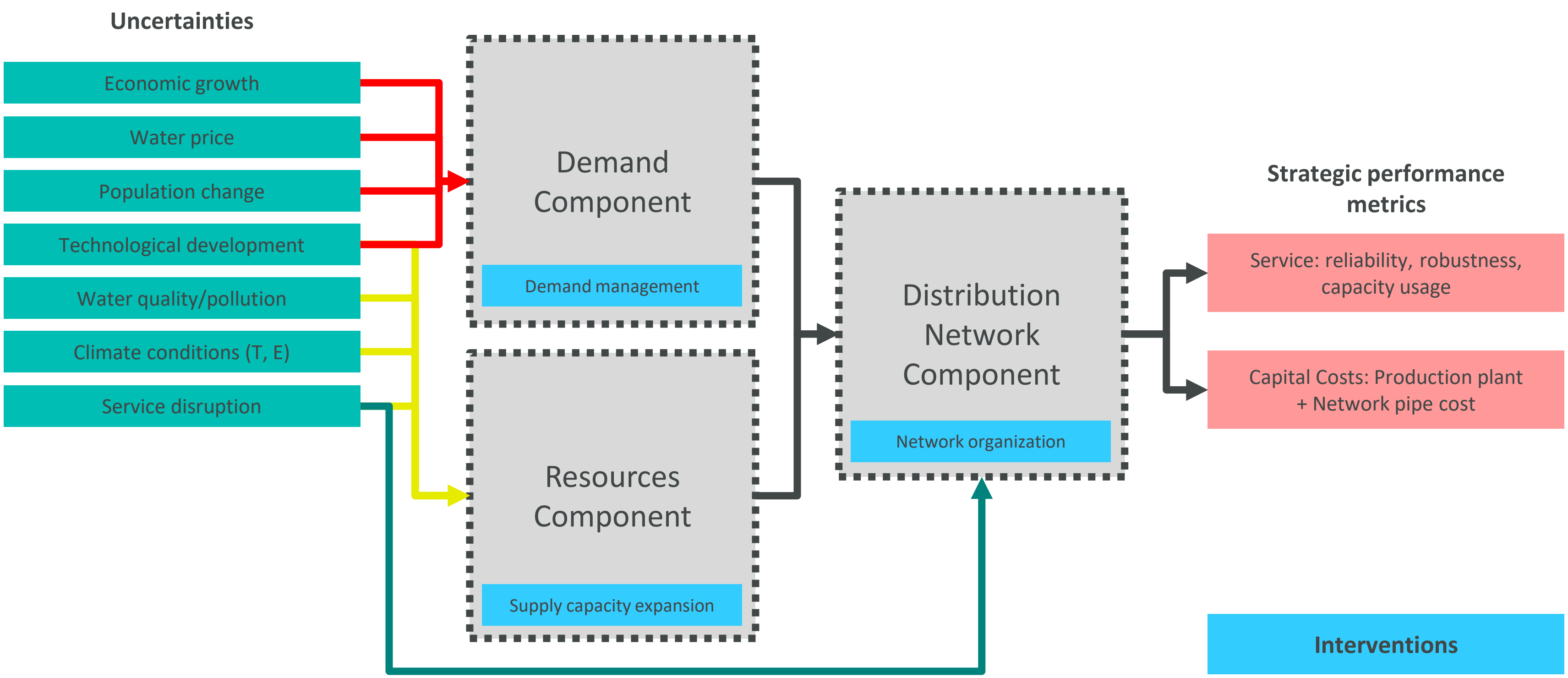


Problem: DWI Resilience

How can we improve the long-term resilience of drinking water infrastructure given deep uncertainty?

1. *No significant supply disruptions*
2. *Environmental needs are met*
3. *Service must be affordable*

Long-term planning toolkit for resilient DWI



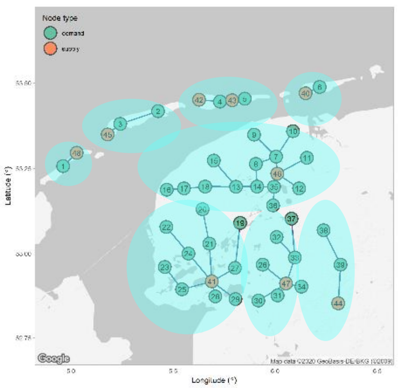
Objective of the toolkit

- To **explore** impacts of potential infrastructure modifications to **improve system resilience**, across a wide range of **plausible uncertain futures**

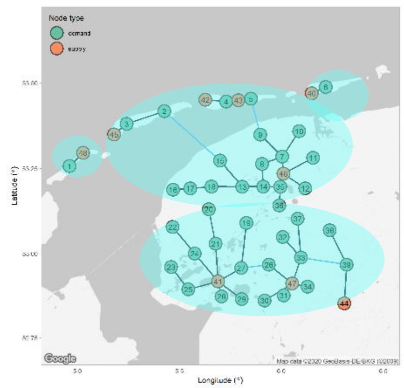
- Key questions:
  - What would be an “ideal” or “improved” arrangement for my infrastructure?
  - How does this compare to the current status of my infrastructure?
  - Which are the most critical (existing) links?
  - Where should I place new links?
  - Which are the most critical (existing) production sites?
  - Where should I place new production sites?

- Key outcome:
  - Sequenced interventions to manage infrastructure into the future in the face of future supply and demand uncertainties

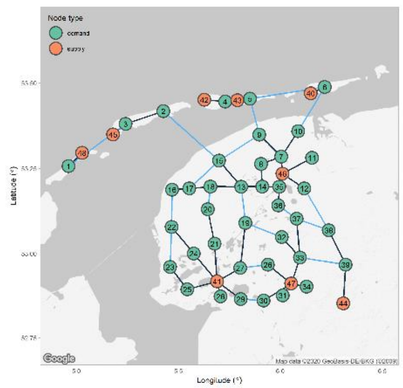
Usage #1: Network arrangement screening



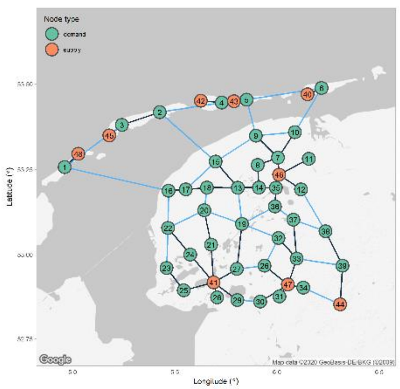
1. Isolated



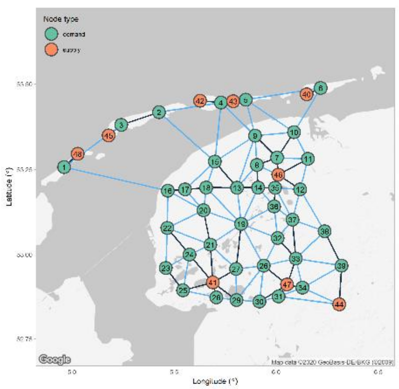
2. Sparse



3. Connected

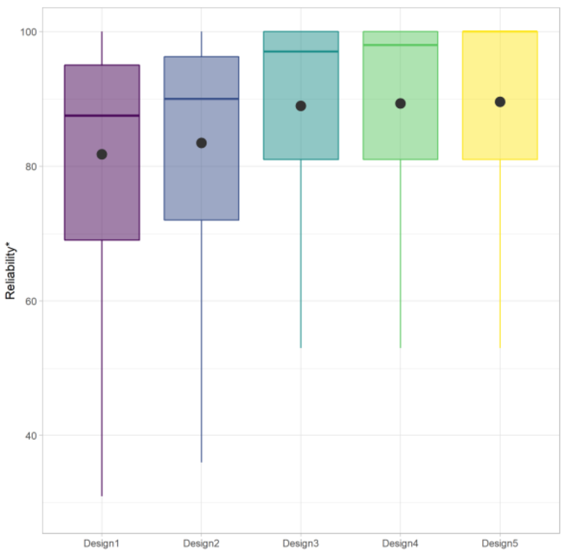


4. Redundant

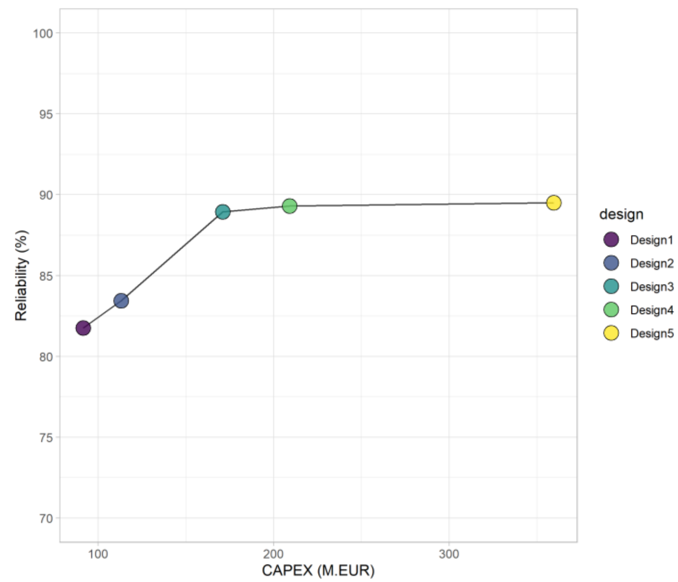


5. Meshed

Example results (network arrangements):
Reliabilities across potential futures ensemble



Reliability:
Satisfaction percentage of system-wide demand for a given future state
(100% indicates no shortage)



Trade-off comparison between reliability and CAPEX

Usage #2: Criticality assessment & transition pathways

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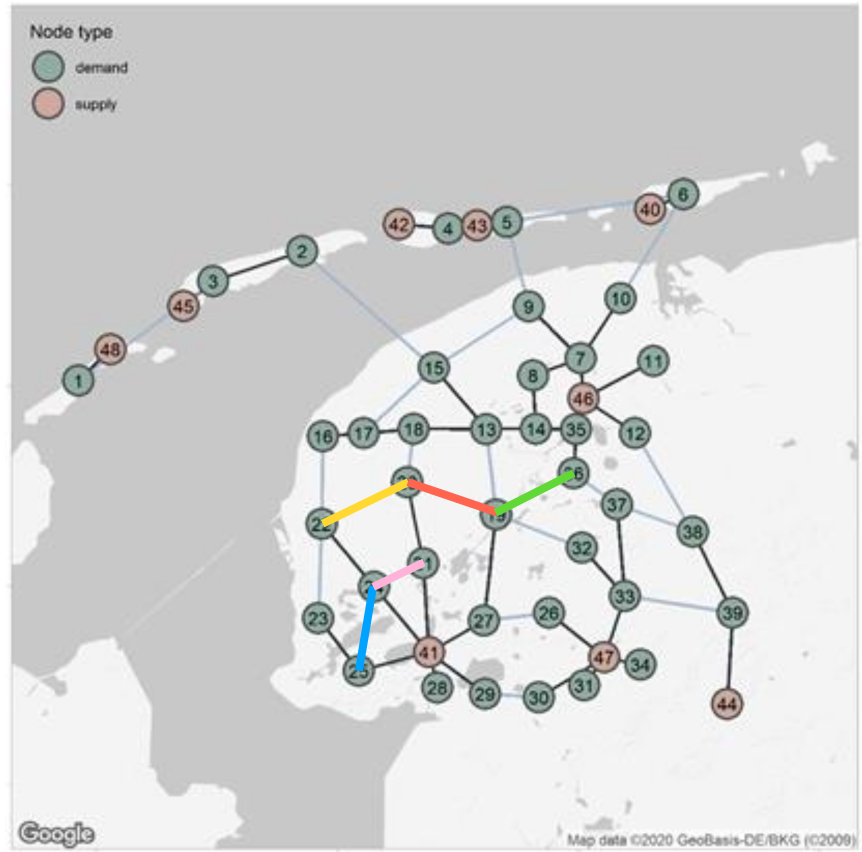
- Prioritise options for network modification
  - e.g. Say we are given the limitation that in the next 10 years we can only add 2 connections or supply nodes to the network…

    → what would be the best choice?

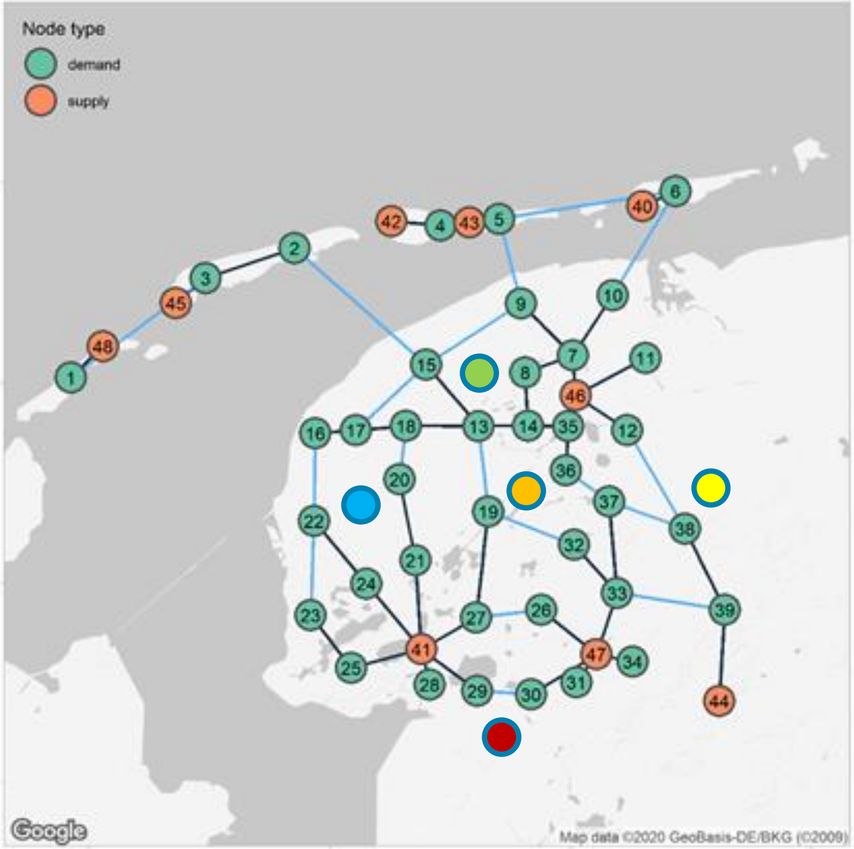
  - Option A: link node 22-20
  - Option B: link node 20-19
  - Option C: link node 19-36
  - Option D: link node 25-24
  - Option E: link node 24-21



Usage #2: Criticality assessment & transition pathways

- Prioritise options for **new production sites**
  - e.g. Which of my potential new sites should I develop? Which exhibit the least risks/most flexibility?
    - Quantity deficit
    - Quality deficit
    - Affordability deficit
    - Operational considerations (i.e. reliability & network structure)

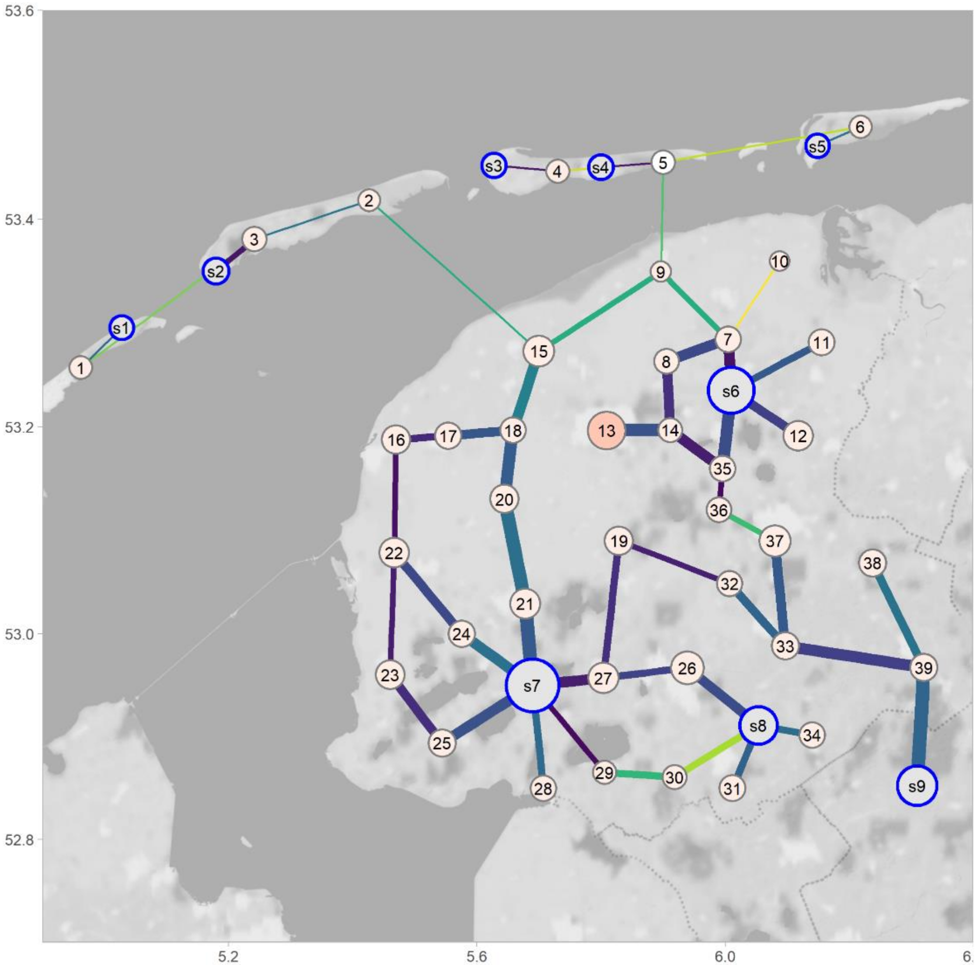
Option 1: connect to which node(s)?
Option 2: connect to which node(s)?
Option 3: connect to which node(s)?
Option 4: connect to which node(s)?
Option 5: connect to which node(s)?

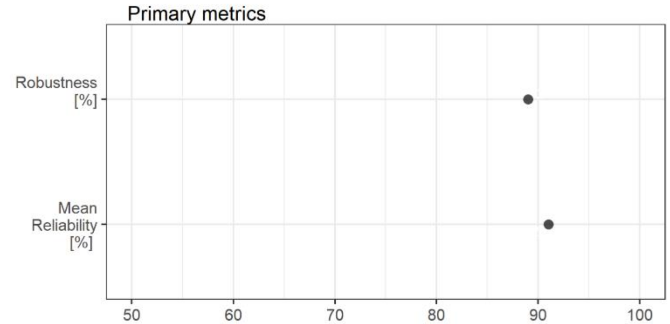


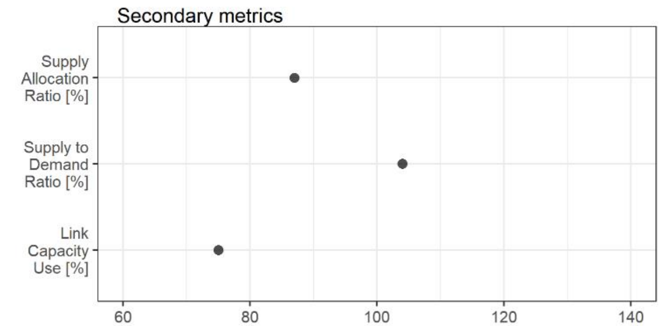
Usage #2: Criticality assessment & transition pathways

Network Metric	value
T. Demand [m3]	4951
Available Sup. [m3]	5200
Allocated Sup. [m3]	4946
Reliability [%]	100
Link usage [%]	82

p0 | at time: Now



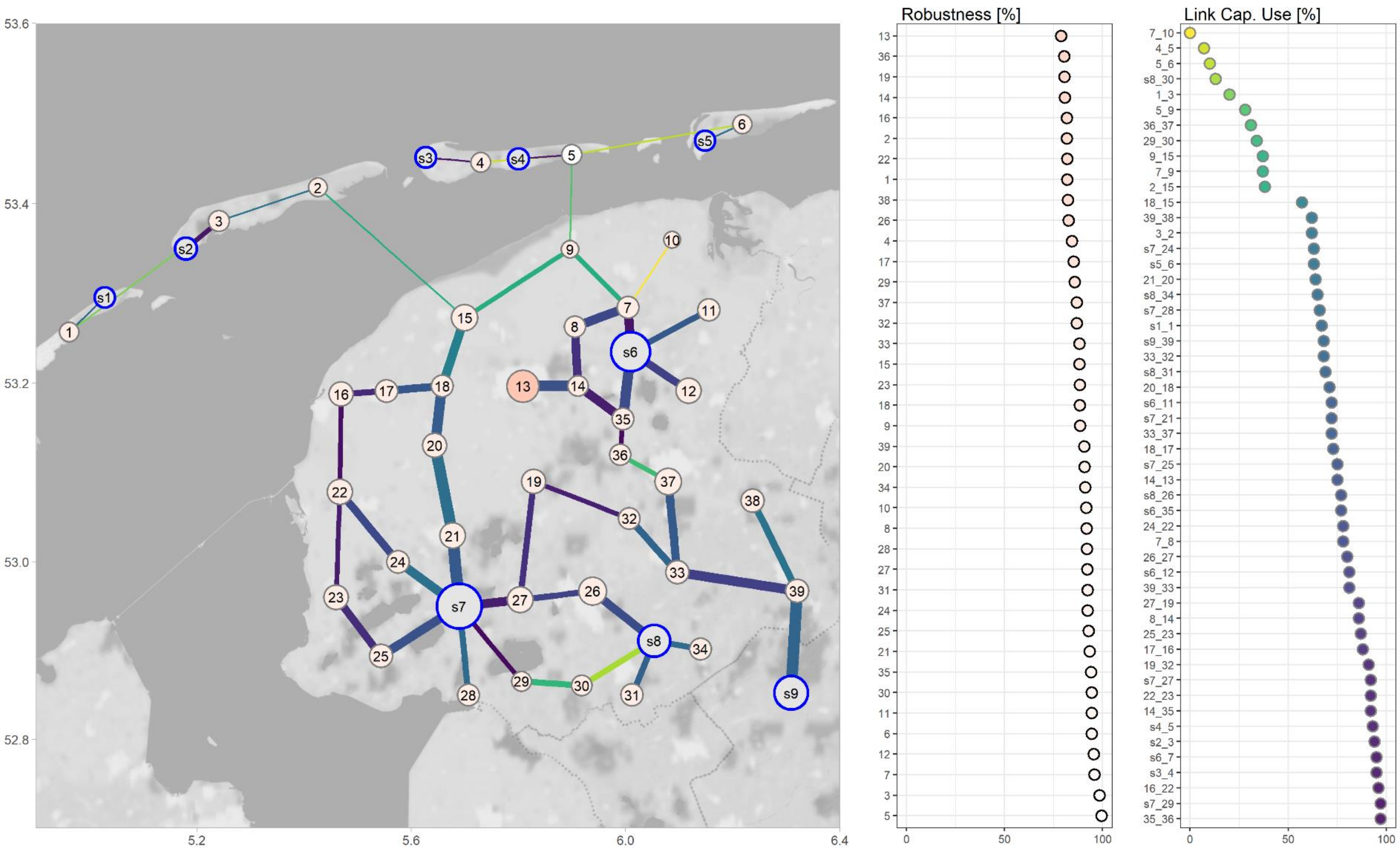




Scenarios

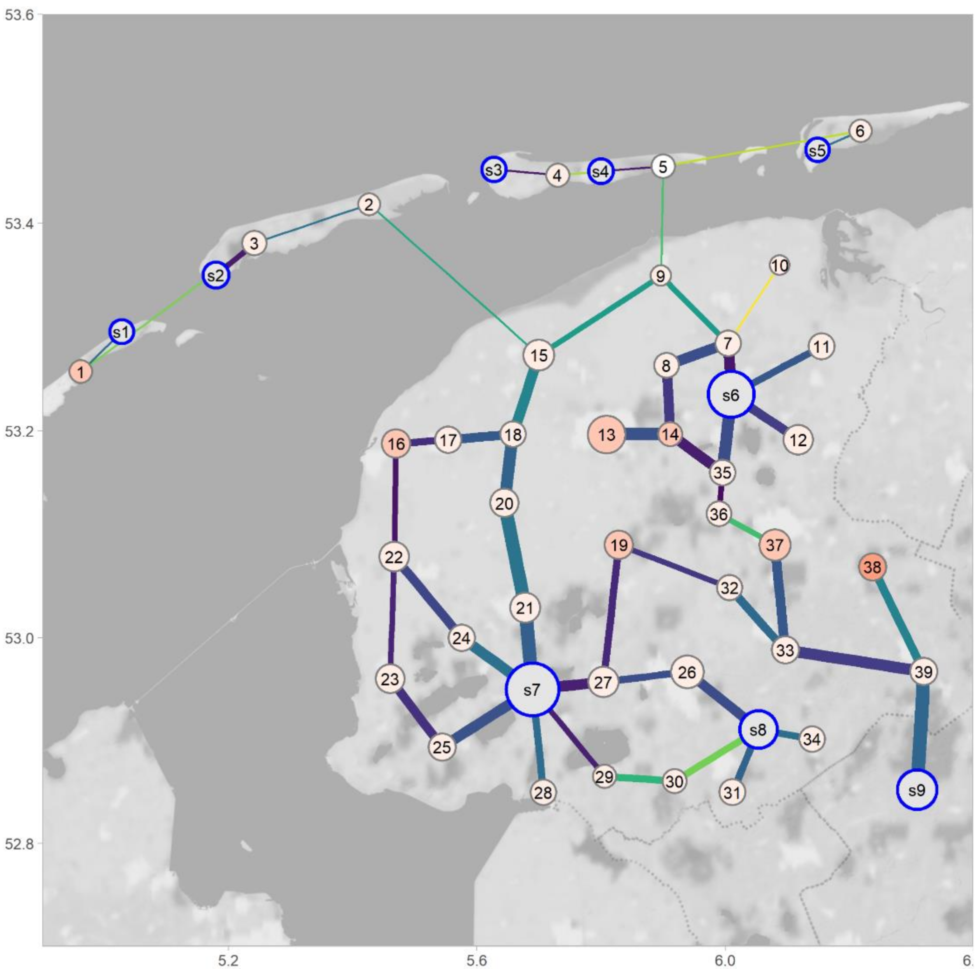
2	Uniform Demand Increase	6	Sea Level Rise	10	Angry Nature
3	Uniform Demand Decrease	7	Decentralisation	11	Angry Farmer
4	Migration West to East	8	Declining Indusry		
5	Urbanisation	9	Increasing Industry		

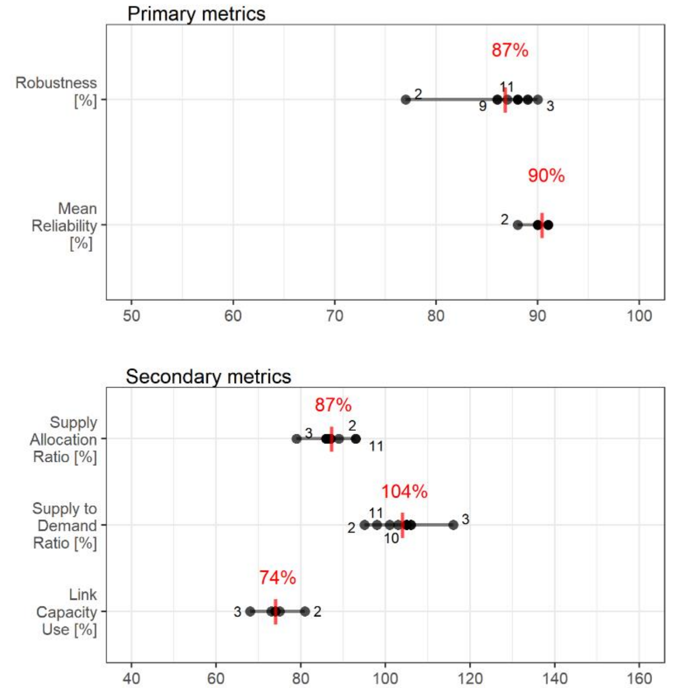
p0 | at time: Now



What may happen if we don’t adapt?

p0 | at time: +10 years



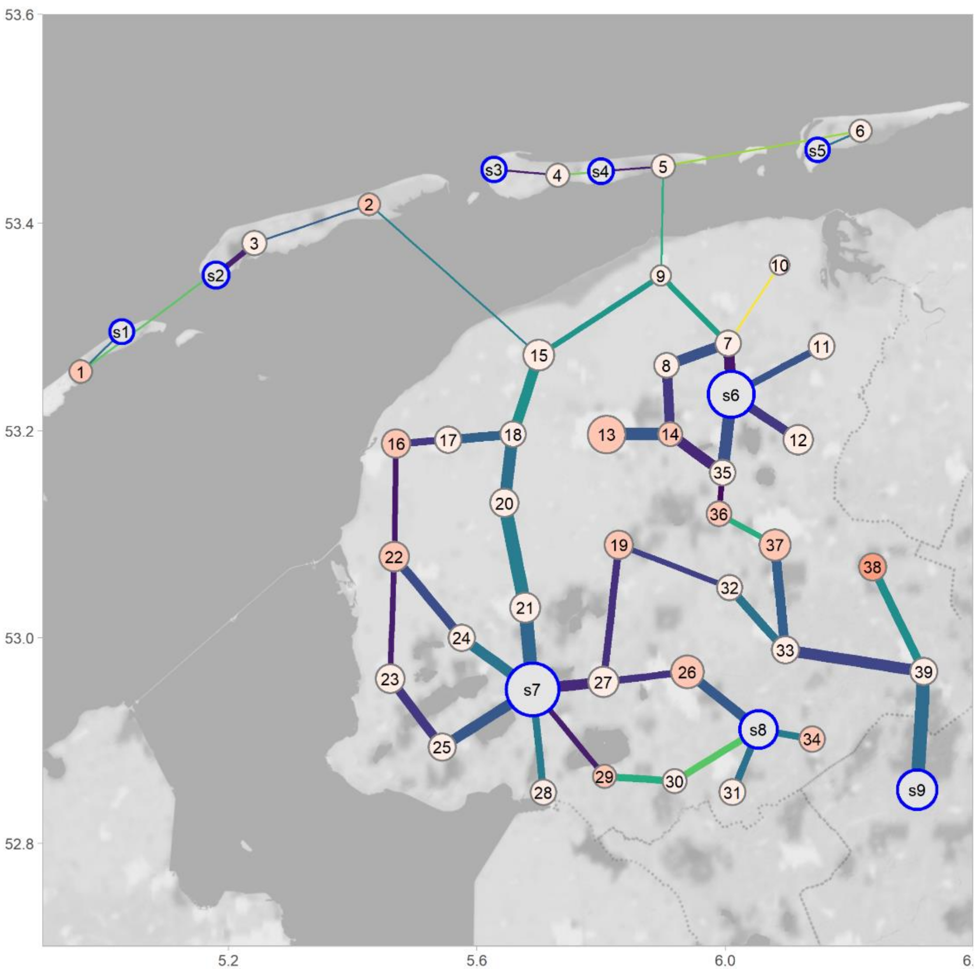


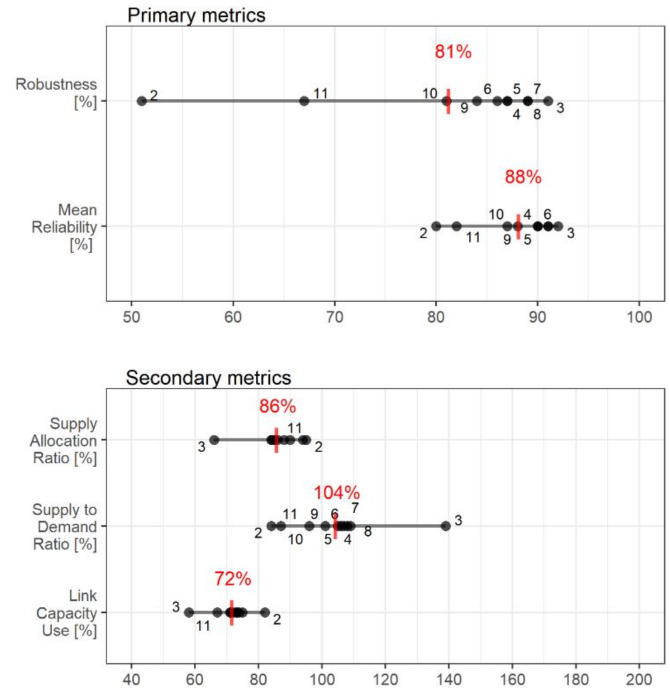
Scenarios

2 Uniform Demand Increase
3 Uniform Demand Decrease
4 Migration West to East
5 Urbanisation
6 Sea Level Rise
7 Decentralisation
8 Declining Indusry
9 Increasing Industry
10 Angry Nature
11 Angry Farmer

international
water association

p0 | at time: +25 years

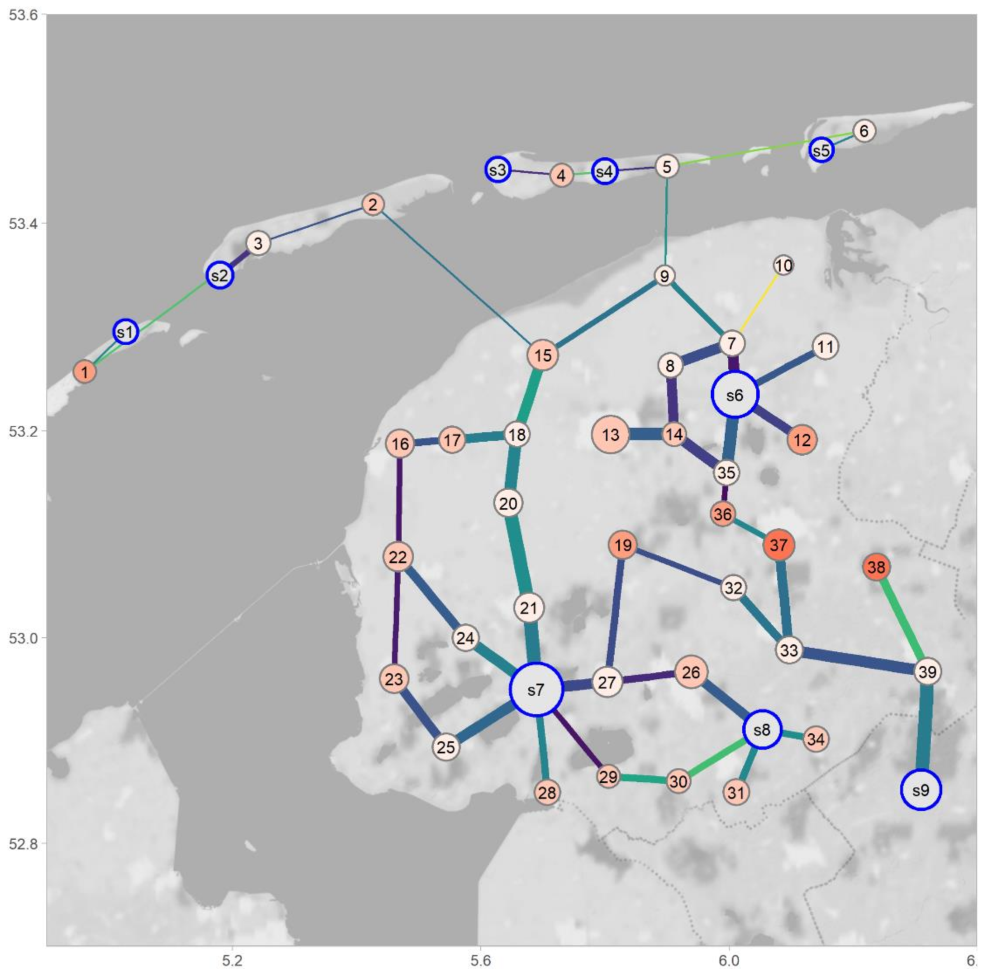


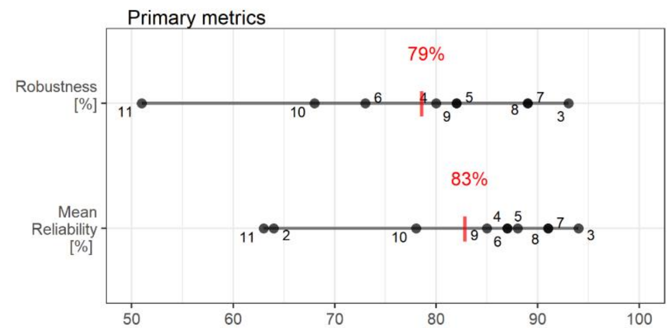


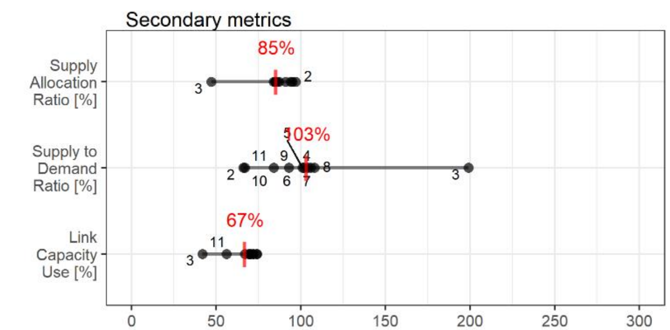
Scenarios

- **2** Uniform Demand Increase
- **3** Uniform Demand Decrease
- **4** Migration West to East
- **5** Urbanisation
- **6** Sea Level Rise
- **7** Decentralisation
- **8** Declining Indusry
- **9** Increasing Industry
- **10** Angry Nature
- **11** Angry Farmer

p0 | at time: +50 years







Scenarios

2 Uniform Demand Increase

3 Uniform Demand Decrease

4 Migration West to East

5 Urbanisation

6 Sea Level Rise

7 Decentralisation

8 Declining Indusry

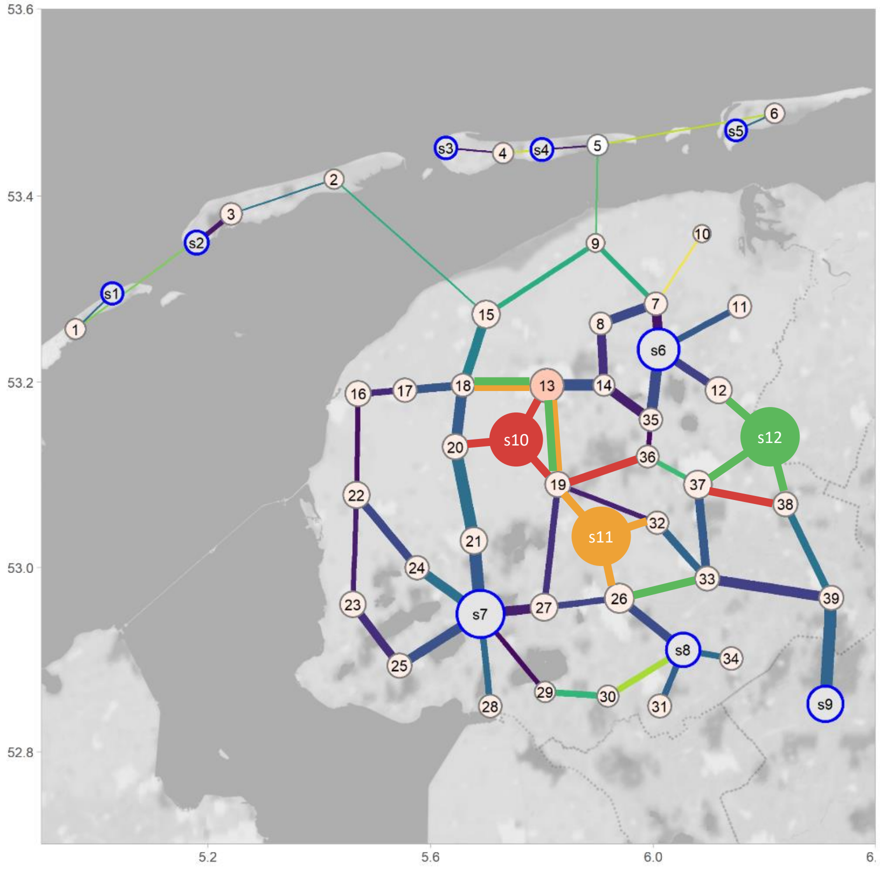
9 Increasing Industry

10 Angry Nature

11 Angry Farmer

Improvements with new infrastructure portfolios…

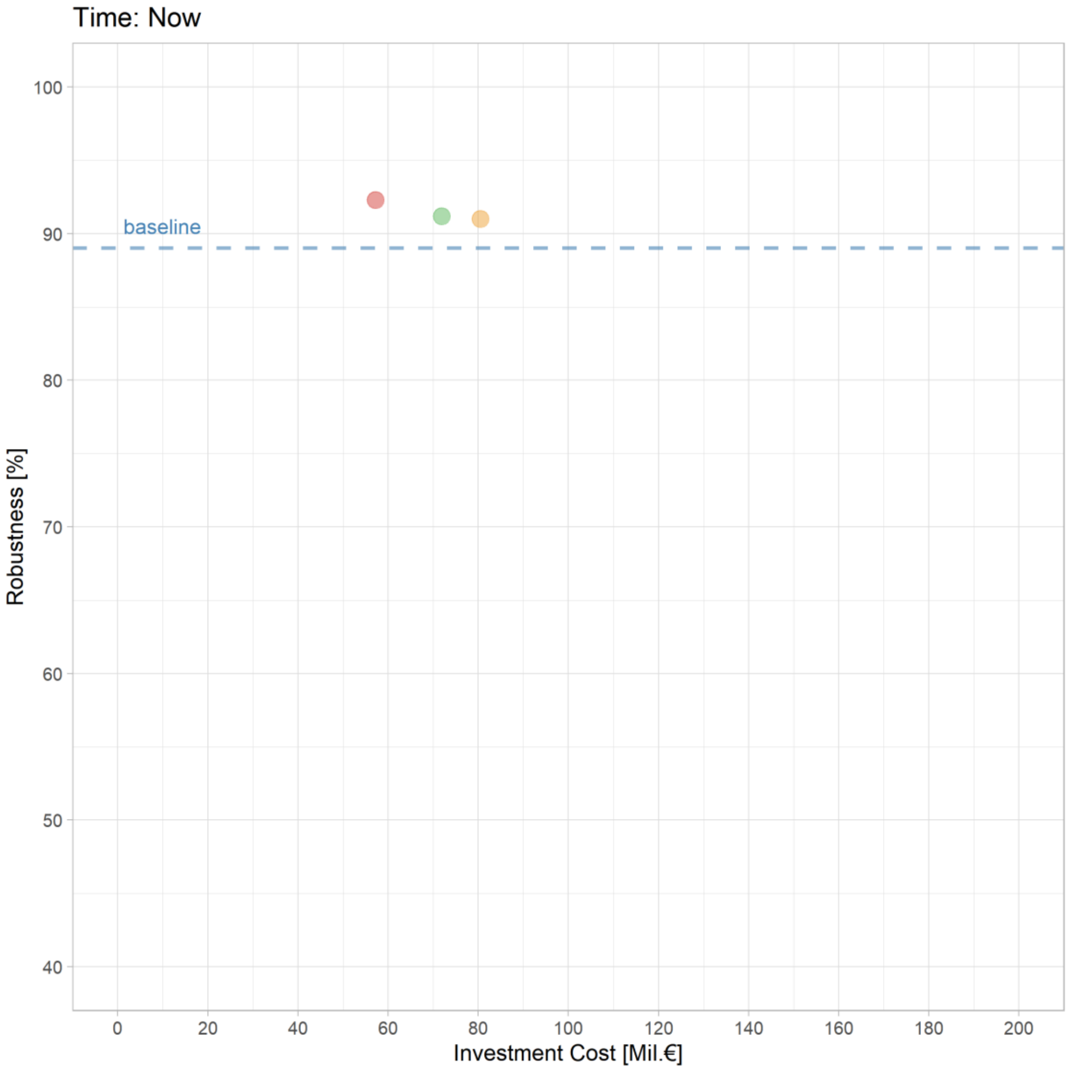
Portfolios



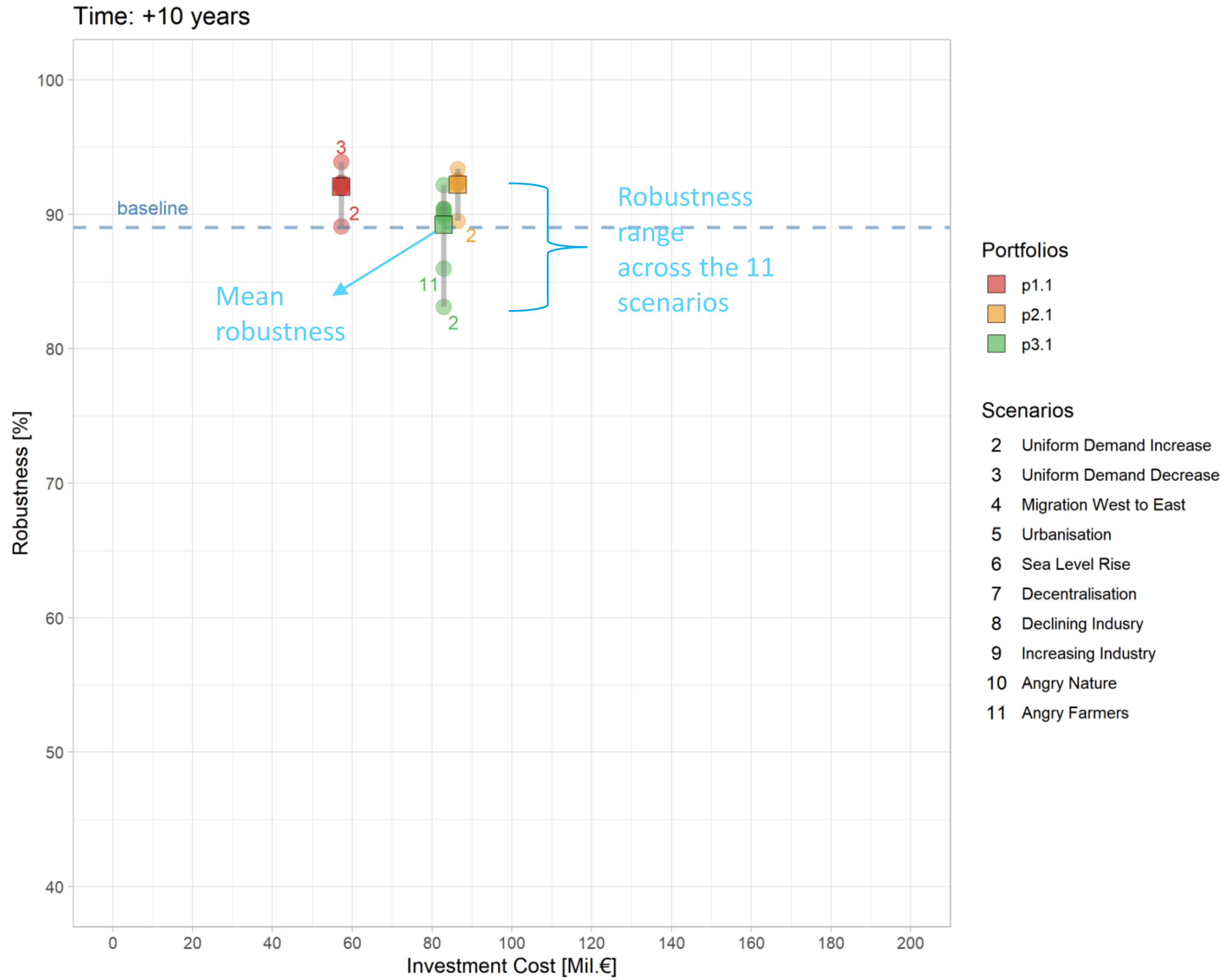
Portfolio 1 € 78 million

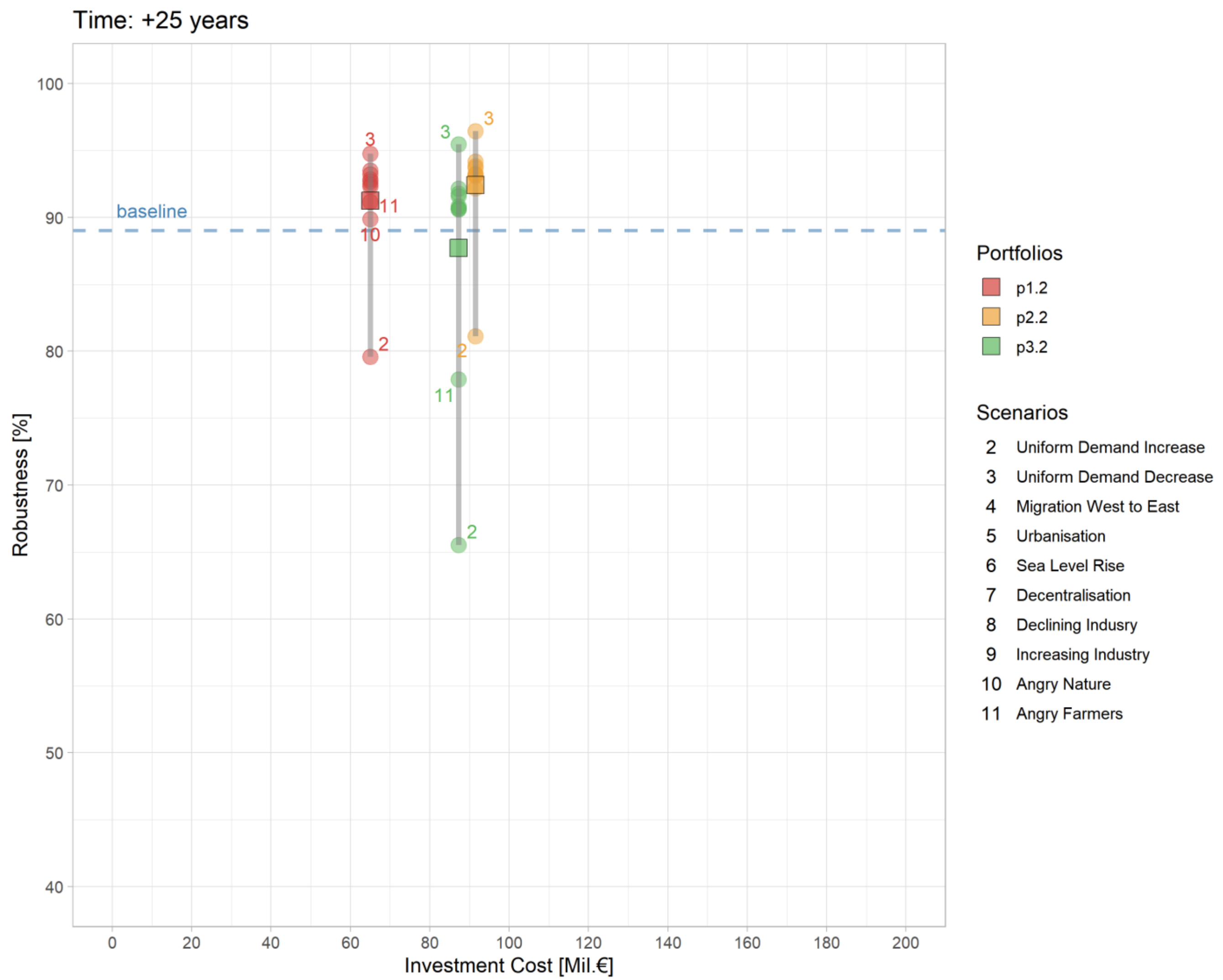
Portfolio 2 € 178 million

Portfolio 3 € 105 million



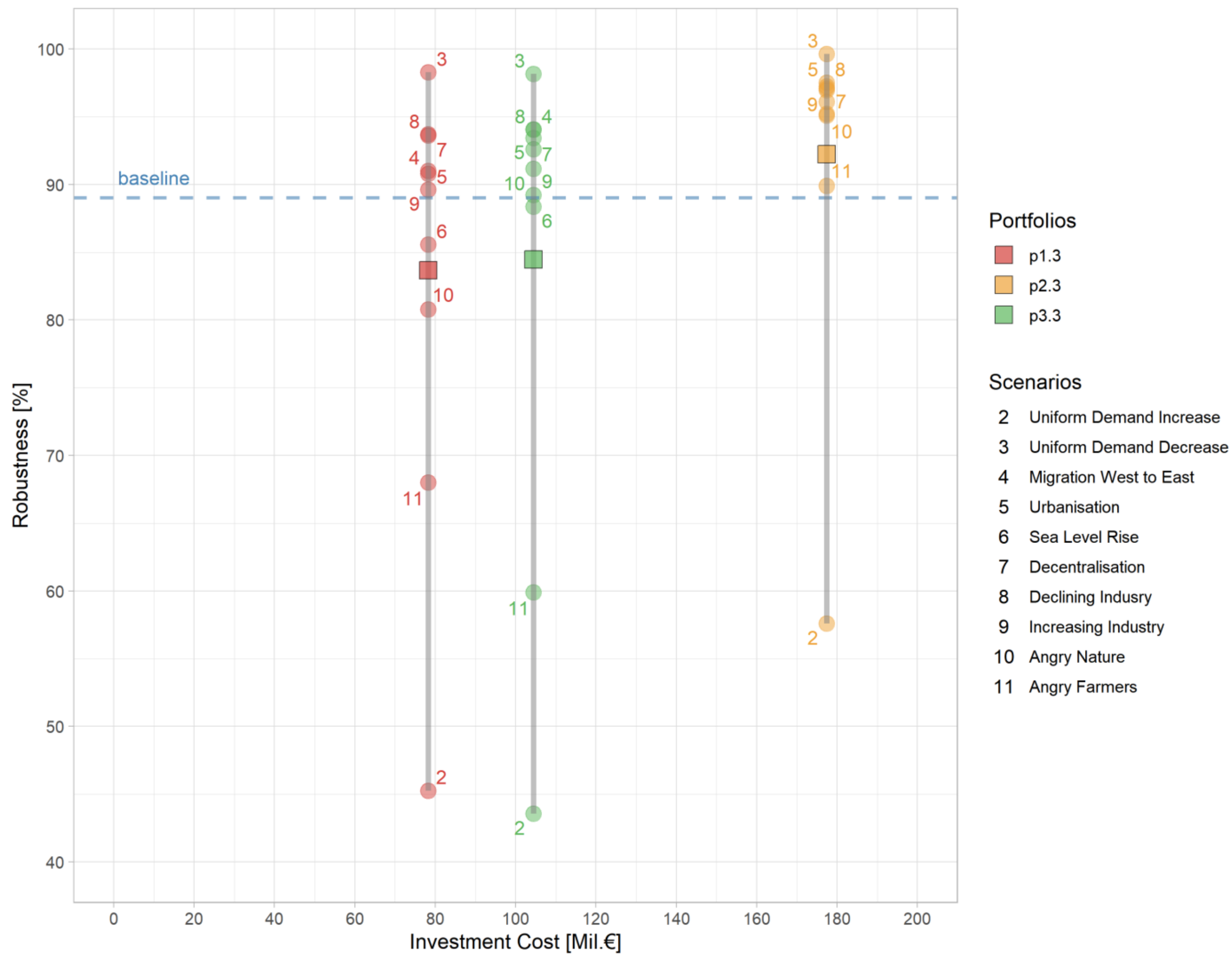
Time: Now
baseline
Robustness [%]
100
90
80
70
60
50
40
0
20
40
60
80
100
120
140
160
180
200
Investment Cost [Mil.€]


Time: +10 years
Robustness [%]
Investment Cost [Mil.€]
baseline
Mean robustness
Robustness range across the 11 scenarios
Portfolios
p1.1
p2.1
p3.1
Scenarios
2 Uniform Demand Increase
3 Uniform Demand Decrease
4 Migration West to East
5 Urbanisation
6 Sea Level Rise
7 Decentralisation
8 Declining Indusry
9 Increasing Industry
10 Angry Nature
11 Angry Farmers

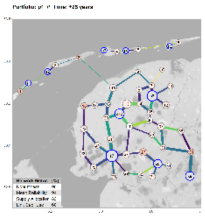


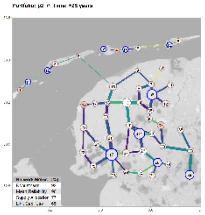
Time: +25 years
baseline
Robustness [%]
Investment Cost [Mil.€]
100
90
80
70
60
50
40
0
20
40
60
80
100
120
140
160
180
200
3
11
10
2
3
2
11
2
3
Portfolios
p1.2
p2.2
p3.2
Scenarios
2 Uniform Demand Increase
3 Uniform Demand Decrease
4 Migration West to East
5 Urbanisation
6 Sea Level Rise
7 Decentralisation
8 Declining Indusry
9 Increasing Industry
10 Angry Nature
11 Angry Farmers

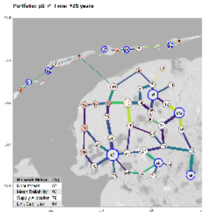
Time: +50 years

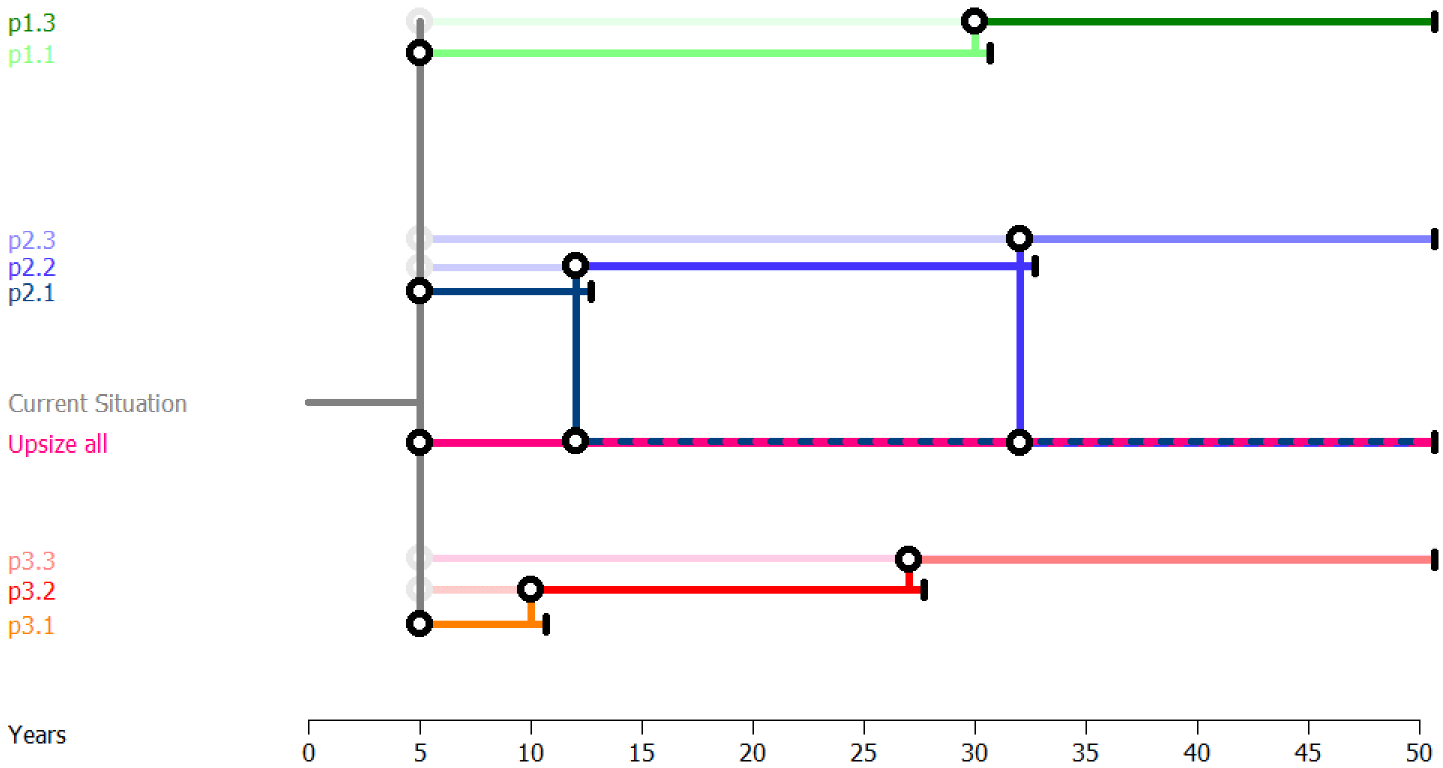


ADAPTATION PATHWAYS









Map generated with Pathways Generator, ©2015, Deltares, Carthago Consultancy

EVALUATION (T = 50)

the international water association

e.g. via scorecard

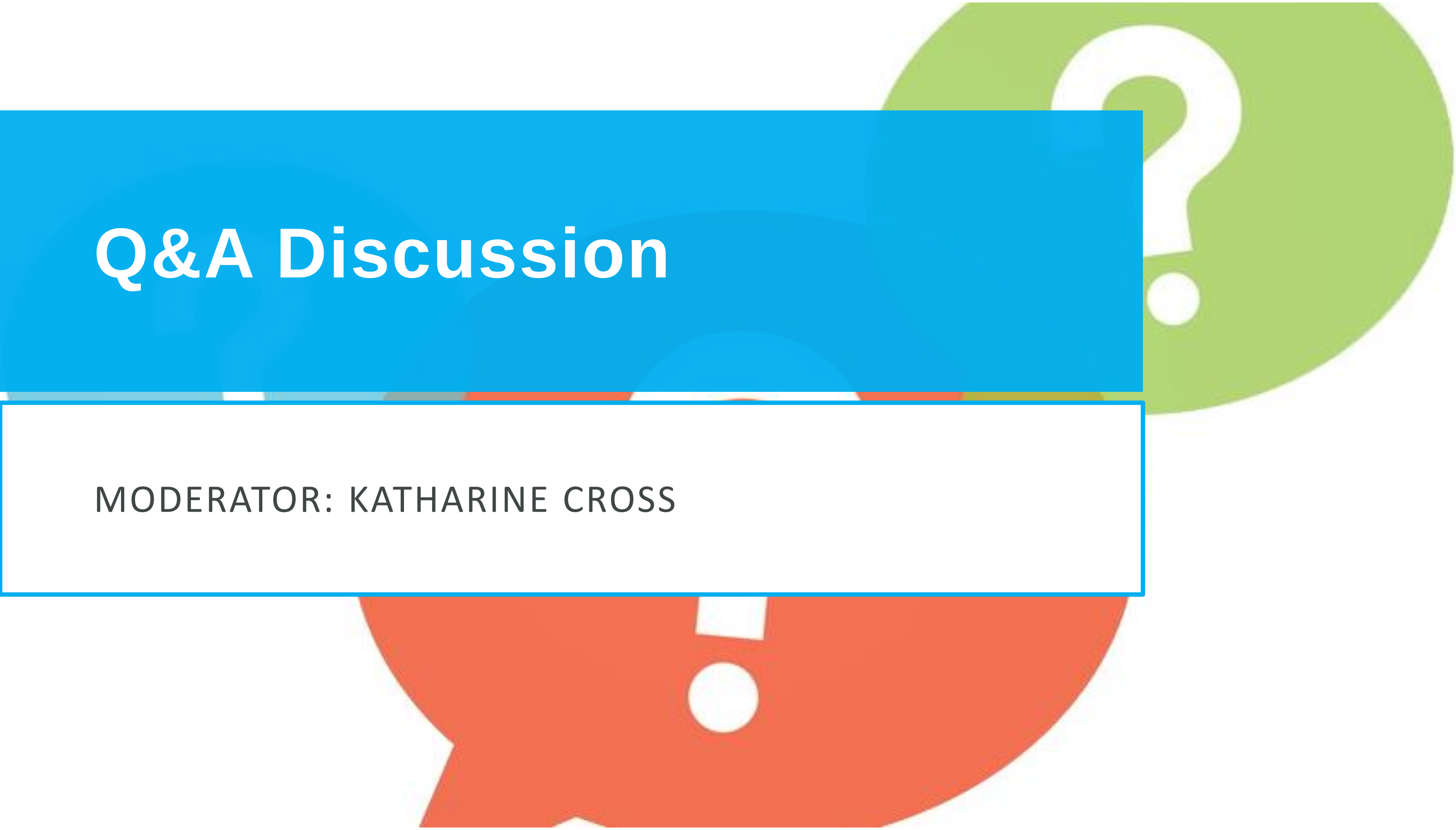
Portfolio	Mean Robust	Min Robust	Cap Costs	Energy Costs	Env. impacts	Soc. impacts
P1	83%	45%	€78m	€€	-	---
P2	92%	58%	€178m	€€€€	-	--
P3	84%	43%	€105m	€€€	--	-

Thank you

andrew.warren@deltares.nl

www.deltares.nl | pathways.deltares.nl

the international water association

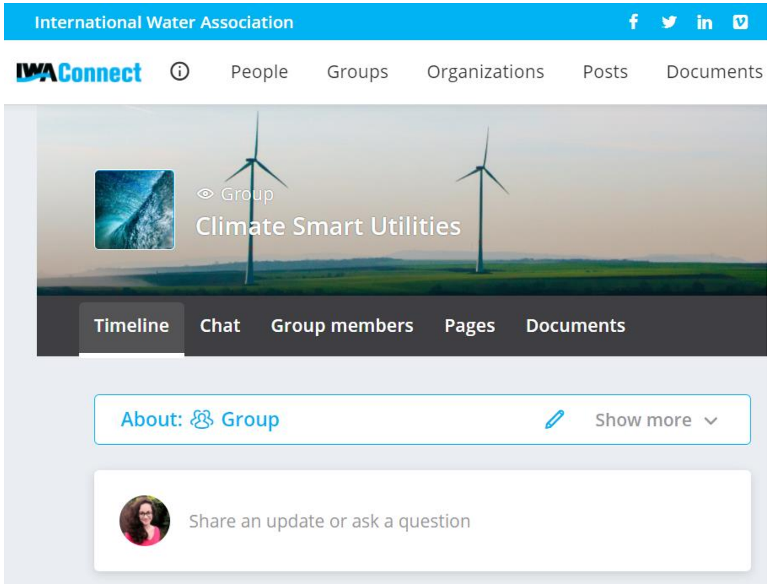


Q&A Discussion

MODERATOR: KATHARINE CROSS

JOIN THE CLIMATE SMART UTILITIES COP

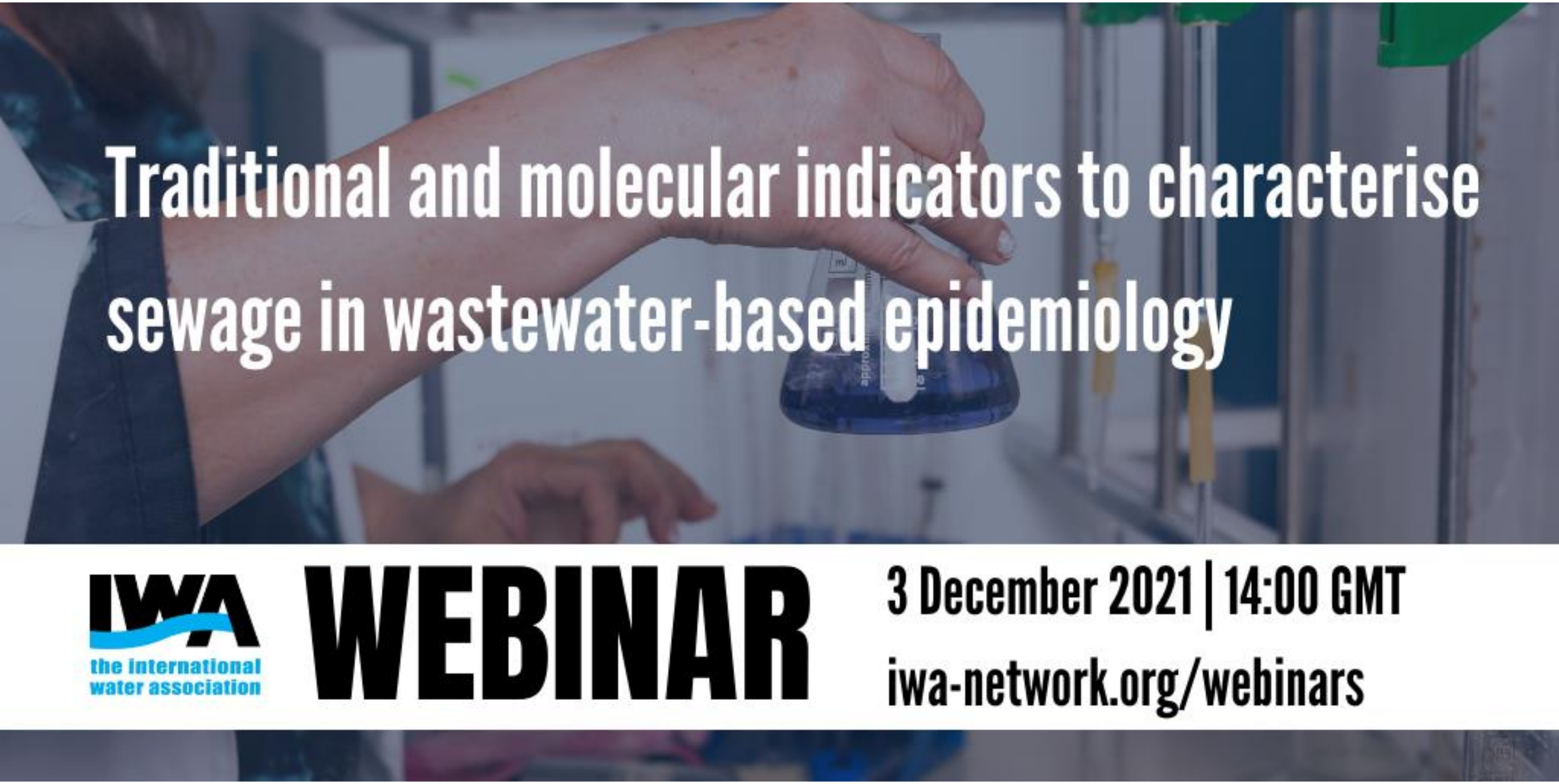
- The IWA Climate Smart Utilities **community of practice (CoP)** is aiming to provide value to those working in **utilities**, to support those who are the main **actors of change** towards urban water systems that are **climate resilient and carbon neutral**.



- Climate Smart Utilities group *(open to all)*
- Integrating climate adaptation in asset management and planning *(open to IWA members and utilities representatives)*
- Reducing the carbon footprint of assets *(open to IWA members and utilities representatives)*
  - GHG monitoring: having a shared tool and approach

https://iwa-connect.org/group/climate-smart-utilities/timeline

Join us on IWA Connect!



https://iwa-network.org/learn/traditional-and-molecular-indicators-to-characterise-sewage-in-wastewater-based-epidemiology/

https://iwa-network.org/learn/intensifying-biological-treatment-through-selection-processes/

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Learn more at

http://www.iwa-network.org/iwa-learn/