Abhi Ganugapati

THE CASE FOR INVESTING IN CLIMATE RESILIENCE

APPLICATION OF A DYNAMIC DECISION TOOL

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The New Zealand Water & Wastes Association Waiora Aotearoa

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17–19 OCTOBER 2023
Tākina, Te Whanganui-a-Tara Wellington

01 The Challenge | Investing in Climate Resilience
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02 Case Study | Flood Resilience Dynamic Decision Model
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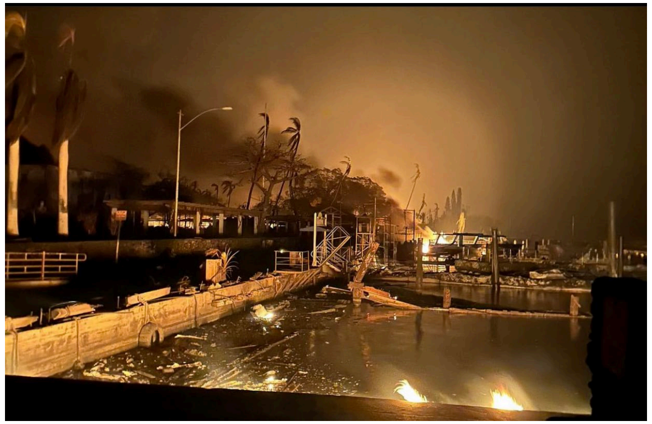
03 Insights | Implications for the Water Sector
Implications and recommendations for decision-makers in the water sector

Extreme weather events | Impacts are being felt around the world

2023 Wildfires in Hawaii



2022 Floods in Pakistan

2021 Texas Cold Snap

2022 Drought across Europe

2015-18 Cape Town drought

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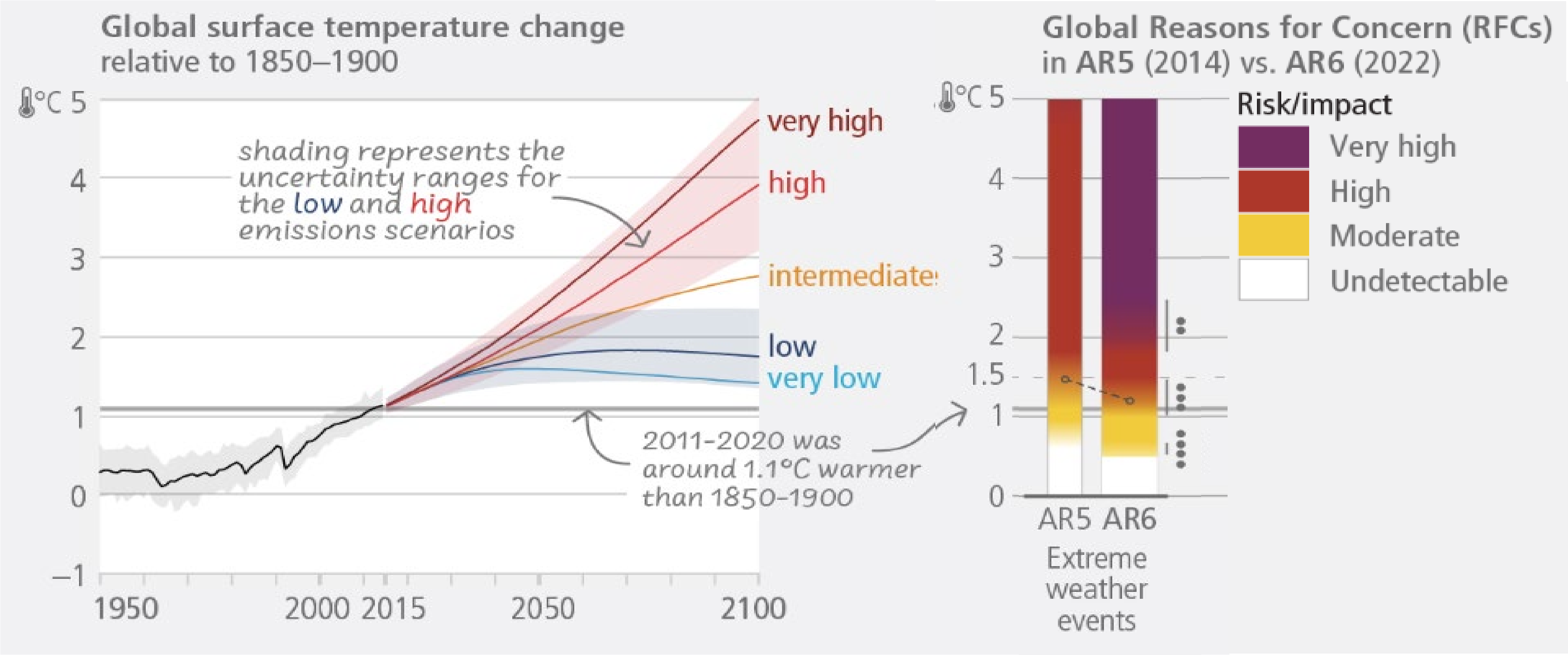
Extreme weather events | Impacts are being felt in our region

2023 Auckland Floods

2023 Cyclone Gabrielle

2019-20 Australian Bushfires

Extreme weather events | Are likely to increase in frequency and severity



Source: *IPCC (2023) AR6 Summary for Policy Makers*

Climate investment | Mitigation receives more investment than adaptation

Mitigation	Adaptation
✓ Compliance and regulatory drivers ✓ Emissions baseline (Scope 1 and 2 emissions) ✓ Clear goals and strategy (I.E Net Zero targets) ✓ Carbon price in business cases to demonstrate return on investment ✓ Ability to measure and verify value	? Uncertainty in the risk profile ? Uncertainty in the spatial impacts ? Uncertainty in the potential scale of damage caused and the cost impacts ? Uncertainty in the value of adaptation options ? Uncertainty in when decisions need to be made (timing)

Making the case | The challenge with a 'traditional CBA'

- Events of this nature are **Low Likelihood, High Consequence**
- For climate resilience investments, a **risk-weighted approach** is typically used to establish the expected value of benefits from taking action:

$$\text{Benefit} = \sum_{i=0}^{n} (Likelihood\ x\ Avoided\ Consequence)$$

- This represents several challenges:
  1. Dynamic nature of climate-related impacts **creates low confidence** in the certainty of evaluated benefits and costs
  2. Does not account for **broader societal, environmental**, or other intangible **costs and benefits**
  3. **Change in frequency and severity** of an event over time

Emerging methods | To assess climate resilience investments

Event Scenario Analysis	Probabilistic Analysis

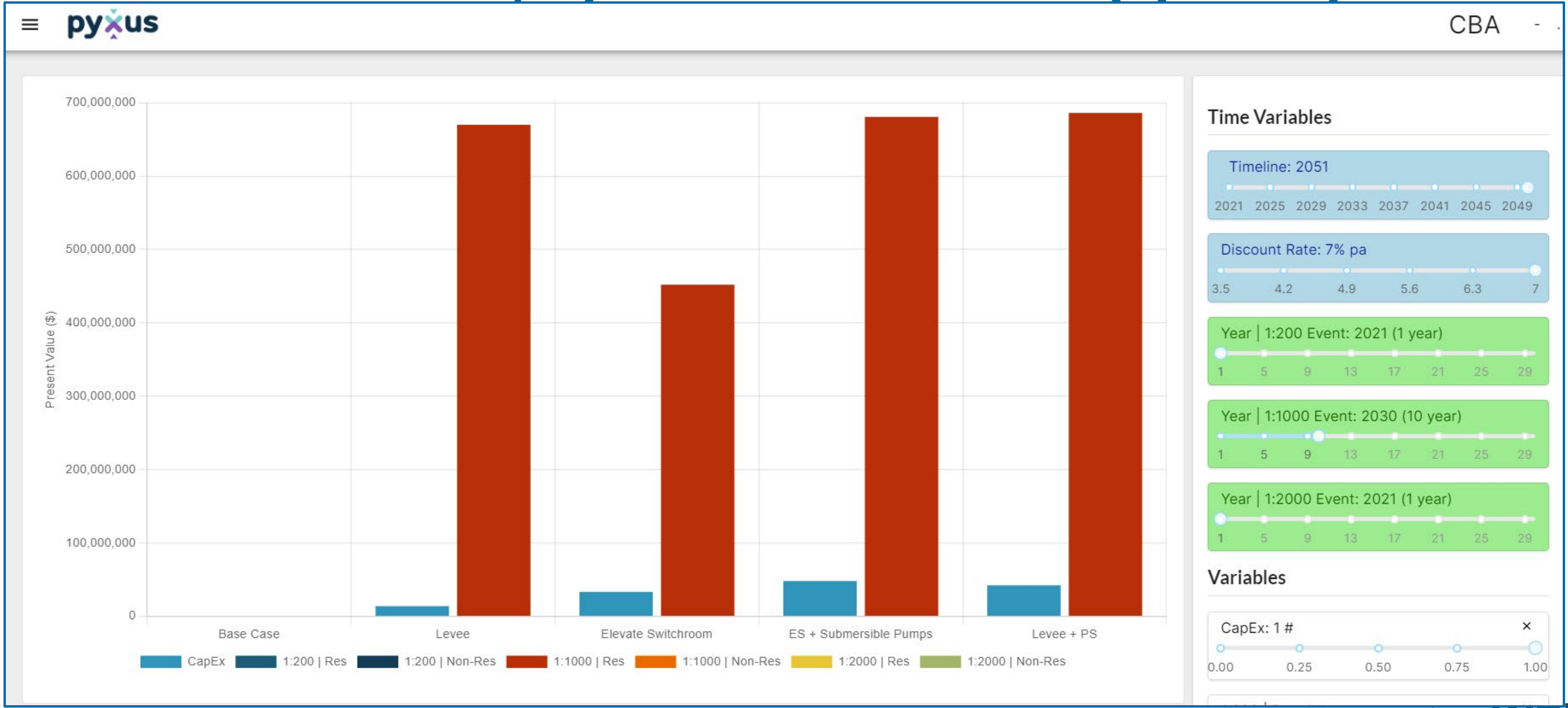
Event Scenario Analysis

- Consider **'what if'** an event was to occur
- Identify **'what might'** the consequences look like
- Evaluate **'so what can we do about it?'**

Probabilistic Analysis

- Identify the variables contributing to uncertainty
- Assess realistic ranges and modelled distributions of each variable
- **Predict the probability** of a variety of outcomes when the potential for random variables
- Run simulations (I.E., 10,000) to present the range of outcomes

Model demonstration | Dynamic decision model (Pyxus.IO)



Emerging methods | The value of a dynamic decision model

A dynamic decision-model has:

- A focus on the key decision to be made and the resulting actions
- Integrates traditional and emerging analytical methods
- Tests sensitivity to variables in a live environment

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Case Study | Climate resilience assessment for critical electrical infrastructure upgrade

- Metropolitan **water treatment facility**
- Responsible for **30% of regional supply**
- **Flood events** had the potential to disrupt supply for **up to 6 months**
- Impacts on community and industry through water restrictions, up to **>$1b depending on duration / severity**

Executive were seeking clear guidance to make an informed decision

Deterministic CBA | Climate resilience options

No.	Options	Capital Cost (approx.)
	Base Case	N/A
(1)	Levee	$15M
(2)	Elevate Switchroom	$35M
(3)	Levee + raw water pump station	$40M
(4)	Elevate Switchroom + submersible pumps	$50M

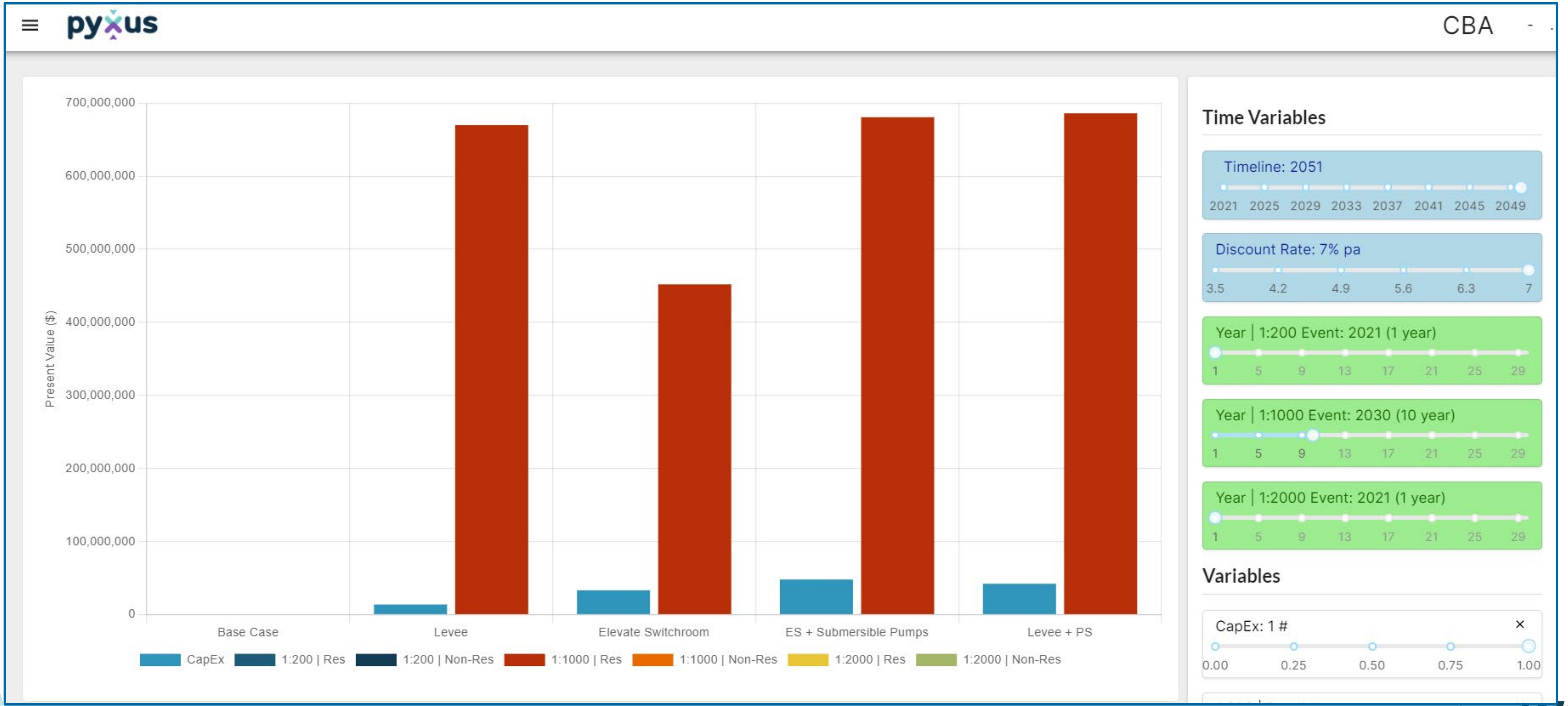
Deterministic CBA | Climate resilience options

No.	Options	Capital Cost (approx.)	NPV and BCR (Deterministic)
	Base Case	N/A	-$102M (0.05)
(1)	Levee	$15M	-$5.0M (0.90)
(2)	Elevate Switchroom	$35M	-$11.1M (0.67)
(3)	Levee + raw water pump station	$40M	-$16.2M (0.66)
(4)	Elevate Switchroom + submersible pumps	$50M	-$19.3M (0.54)

Key questions | How do we consider 'what if' scenarios?

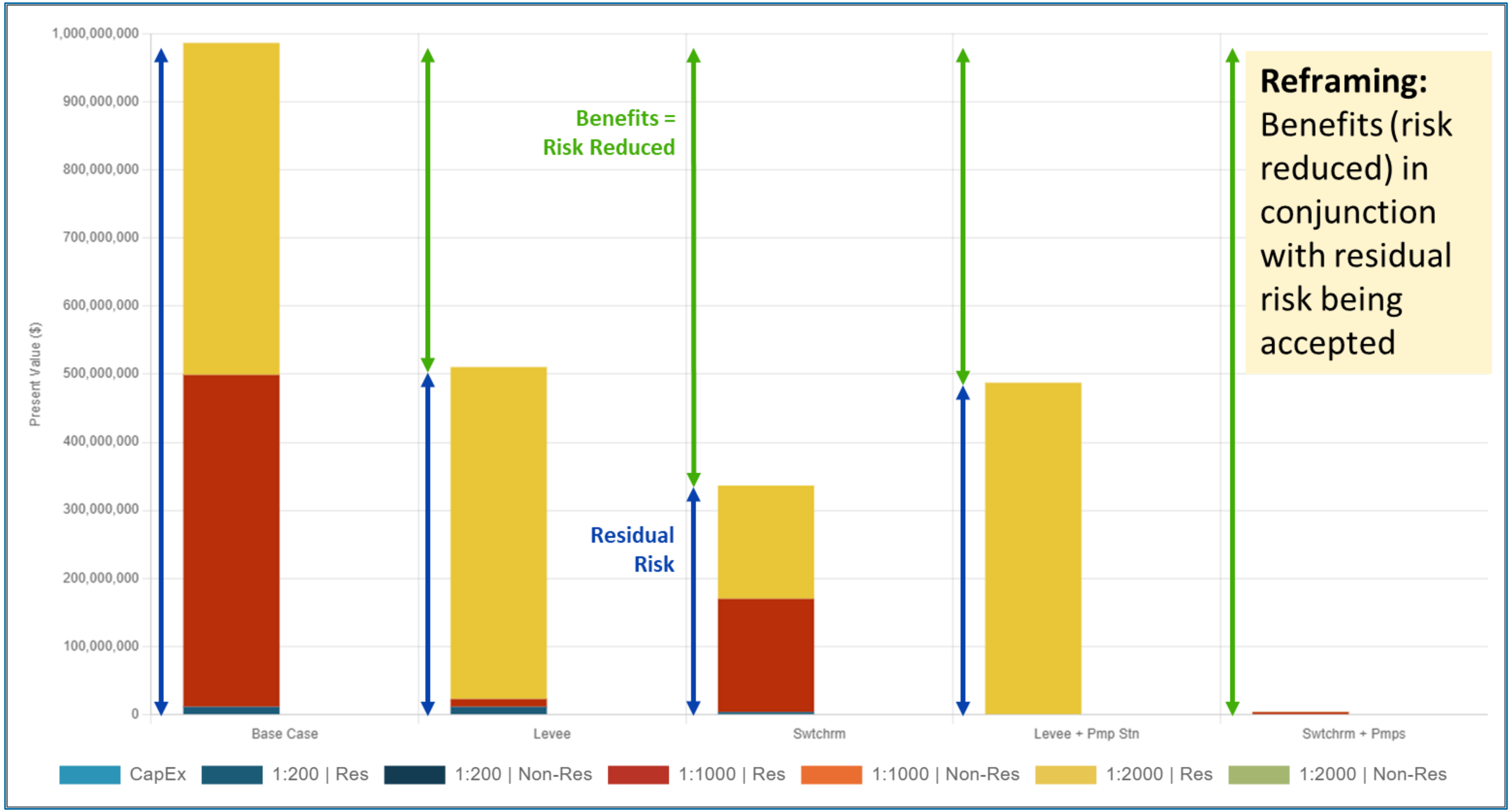
1. How are different scenarios considered (ranges in flood impact)?
2. What are the boundaries of the assessment? What if they change?
3. How are the dynamic nature of climate change considered?
4. What is the residual risk exposure?
5. What are the key drivers in decision-making?

Model demonstration | Dynamic decision model (Pyxus.IO)



02 Case Study

Results | PV of costs and benefits under worst-case scenario



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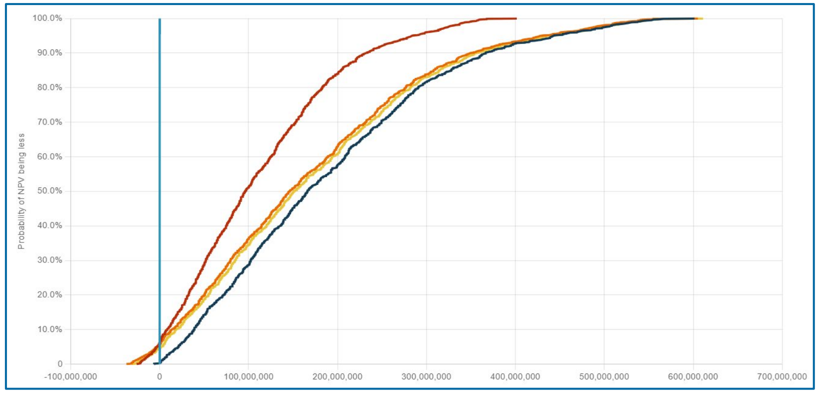
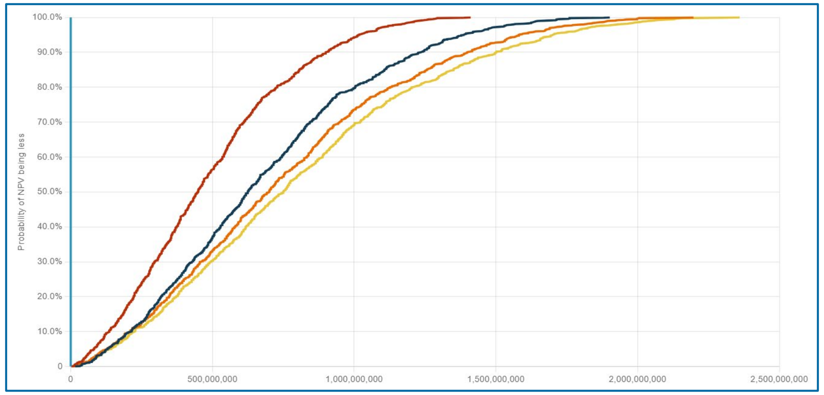
Results | NPV of probabilistic outcomes for 1:1000-year event

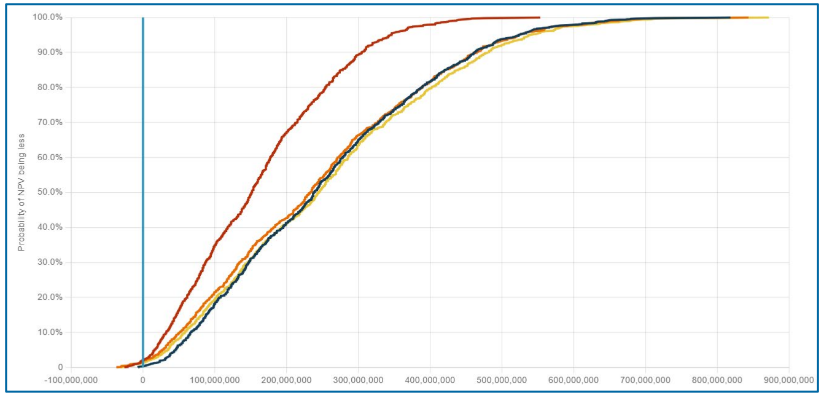
Residential benefits only



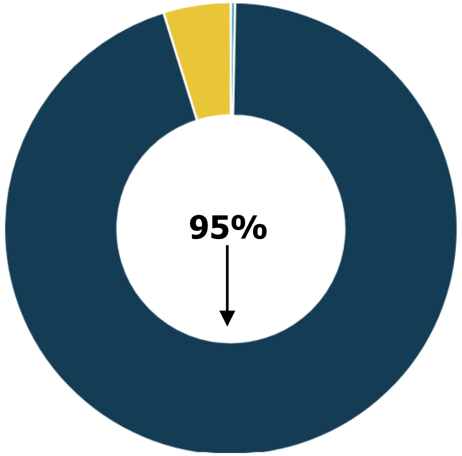
Including Non-residential benefits

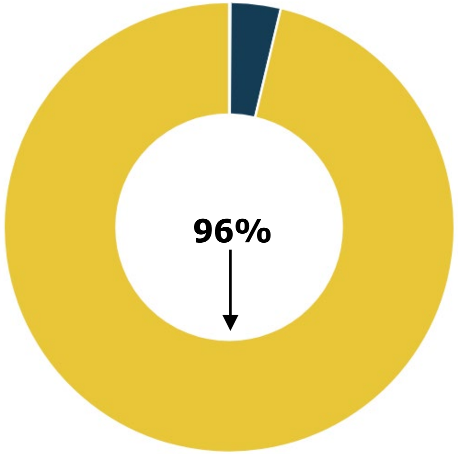


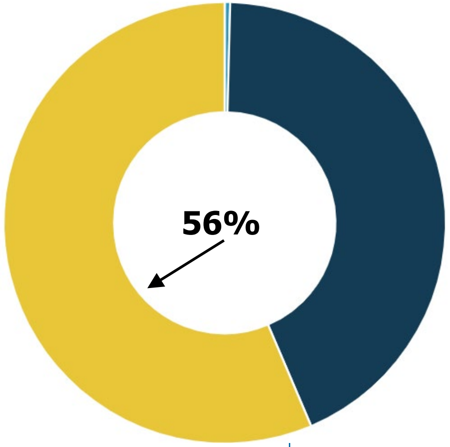
Non-residential benefits 12% value



Base Case | Levee | Elevate Switchroom | ES + Submersible Pumps | Levee + PS







Broadening the benefits changes the performance of options

Results | Probabilistic outcomes across flood event scenarios

Flood event scenario	Best performing option
Excluding non-residential benefits	
1:200-year	Base Case
1:1000-year	**(1) Levee**
1:2000-year	(4) ES + Submersible Pumps
Multiple flood events between 1:200 and 1:1000 year	(1) Levee
Including non-residential benefits	
1:200-year	**(3) Levee + Raw Water Pump Station**
1:1000-year	**(3) Levee + Raw Water Pump Station**
1:2000-year	(4) ES + Submersible Pumps
Multiple flood events between 1:200 and 1:1000 year	(3) Levee + Raw Water Pump Station

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Results | Dynamic Decision Model outcomes

- Conduct an economic review for non-residential benefits review.
- Recommended to construct the levee to provide the most economically viable investment in resilience for up to a 1:1000-year flood event.
- There was the ability to add the raw water pump station once there was further clarification on the inclusion and value of non-residential benefits.

Executive were provided clear guidance to make an informed decision

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Implications and considerations for the industry | Dynamic decision models

1. How is **climate resilience** considered in your organisation's strategy and **strategic planning activities**?
2. How does your organisation **assess the implications of action and inaction**?
3. What **processes and tools** does your organisation utilise? Are they **fit-for-purpose**?
4. How are insights and recommendations **communicated to decision-makers** to engender **buy-in** for a **commitment to action**?

Thank You