Climate Adaptation Research

Science and solutions for Australia and the global community

Economics of adaptation to climate change

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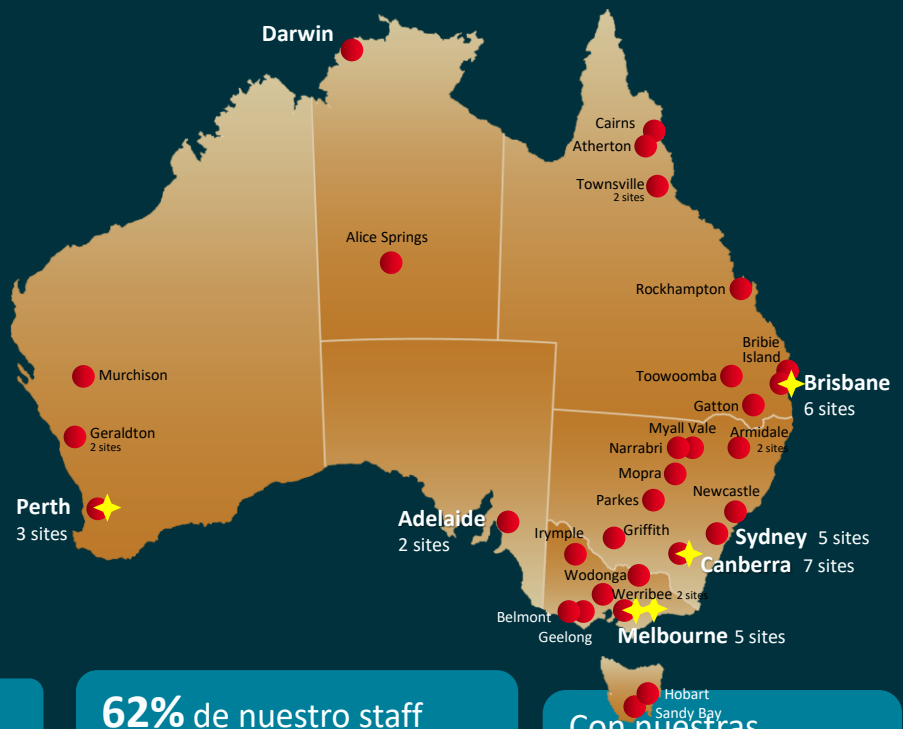
VII Seminario de Ingenieria y Operacion Portuaria, San Antonio 26-28 octubre 2016

Structure

1. **Introduction to CSIRO**
2. Climate hazards and risks to built assets
3. Adapting to climate risks
    a. Systematising decision-making
4. Valuation studies

CSIRO

Personal	**5000**
Temáticas	**8**
Instalaciones	**58**
Presupuesto	**$1B+**



1% mas alto de instituciones de investigación global en 14 de 22 campos de investigación

0.1% mas alto en 4 campos de investigación

62% de nuestro staff posee grados universitarios

2000 Doctores (PhDs)
500 Maestrías

Con nuestras universidades asociadas desarrollamos **650** estudiantes de investigación de postgrado

Programas de ciencias (Temáticas)

AGRICULTURA

BIOSEGURIDAD Y SALUD

PRODUCTIVIDAD DIGITAL

ENERGIA

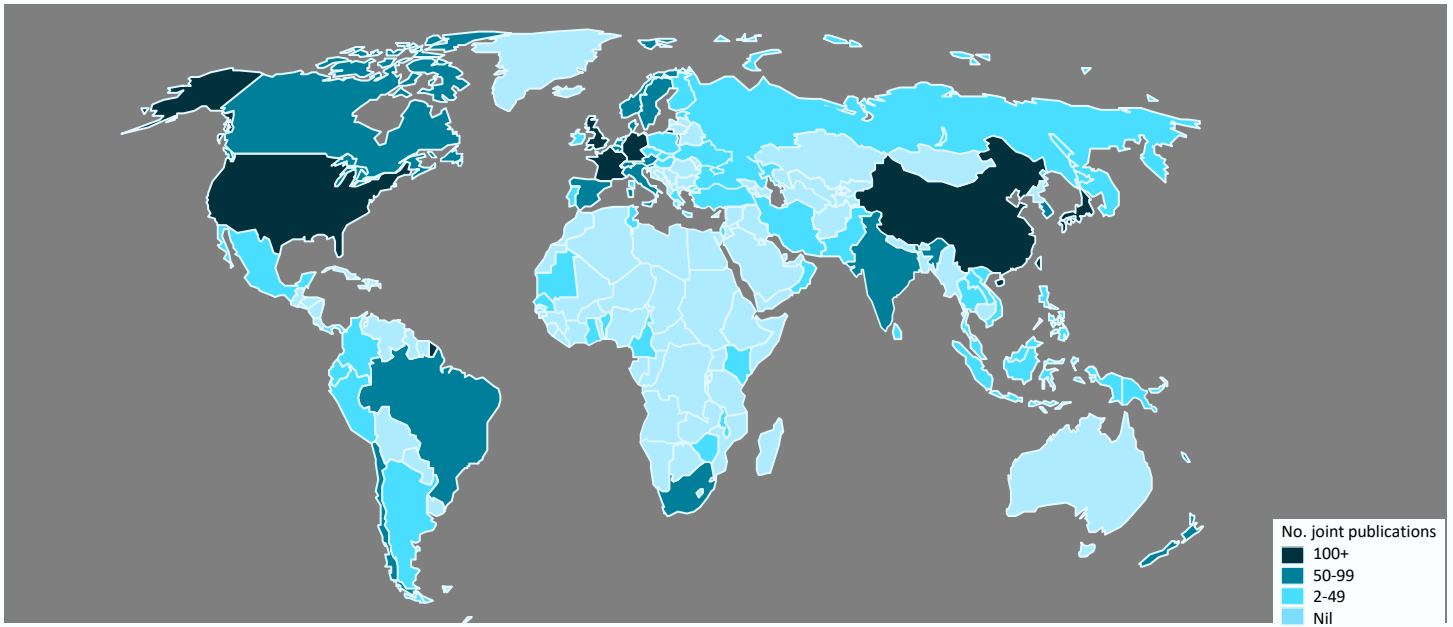
TIERRA Y AGUA

MANUFACTURA-SECTOR FABRIL

RECURSOS MINERALES

OCÉANOS Y LA ATMÓSFERA

Cooperación internacional



Trabajamos con socios en más de 80 países en I+D

- Gobiernos
- Grandes, medianas y pequeñas empresas
- Multinacionales
- Fundaciones internacionales
- Instituciones científicas líderes
- Más de 700 actividades de investigación
- Hacemos publicaciones conjuntas con estas instituciones

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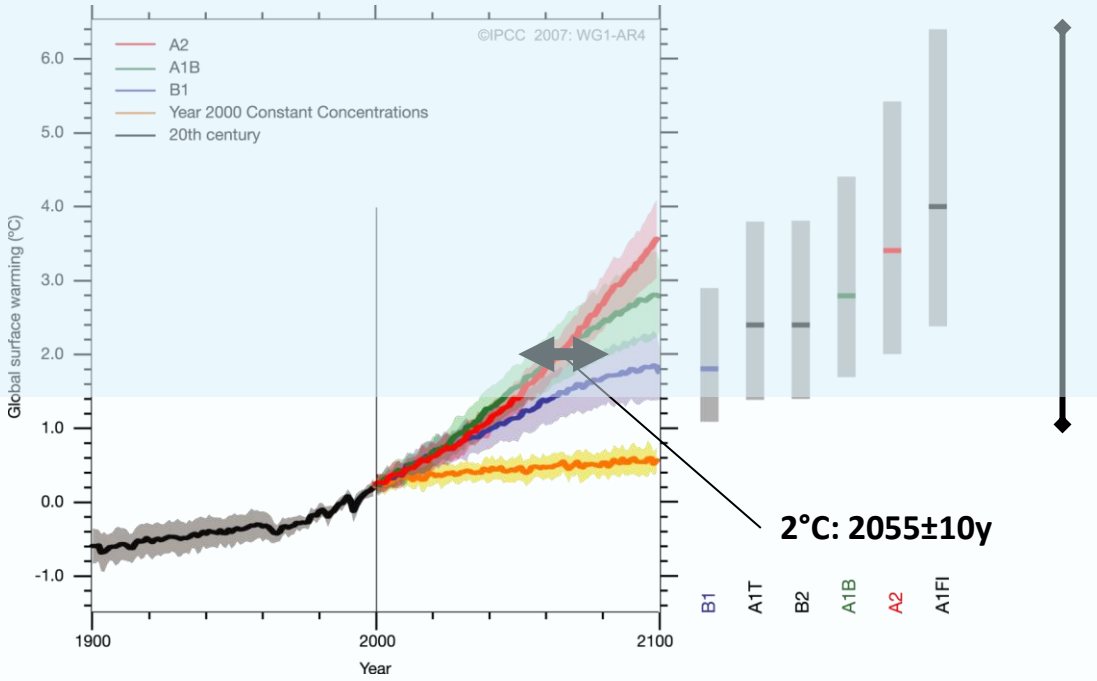
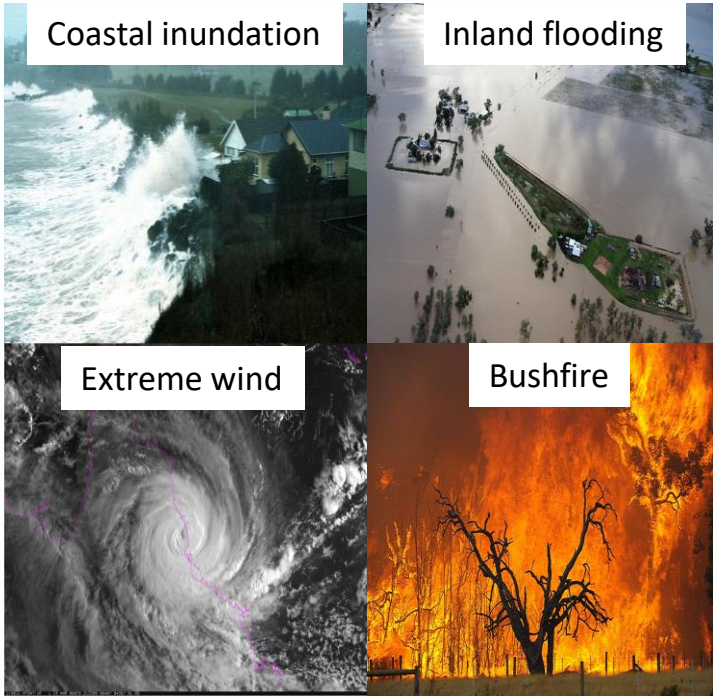
Adapting to a hotter world



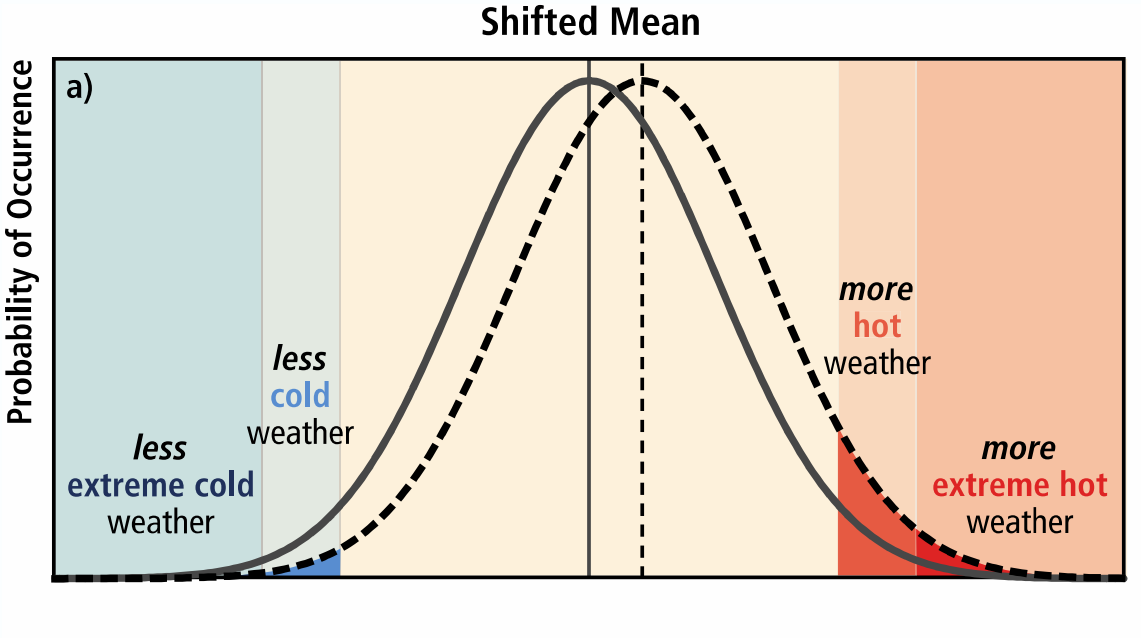
Climatic Hazards and Risks to Built Assets: Challenges to Communities & Industries

- How will the projected climate change affect the change of natural hazards?
- How will the changed climatic hazards affect the built assets?
- What are the adaption options for built asset risk reduction?
- What are the sensible policy stances for implementation of adaptation options?
- How can policies be effectively implemented?



Australia's weather sensitivity is estimated to be 5% of GDP annually

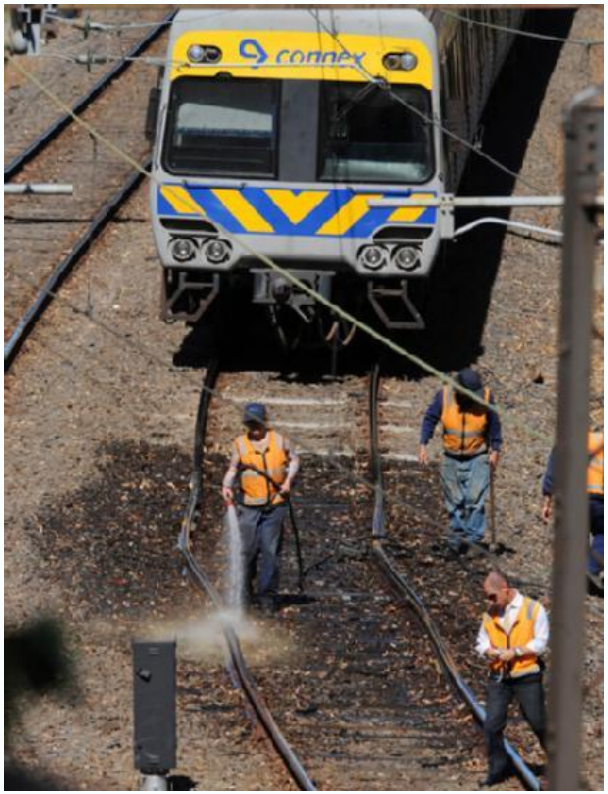
Extremes and infrastructure



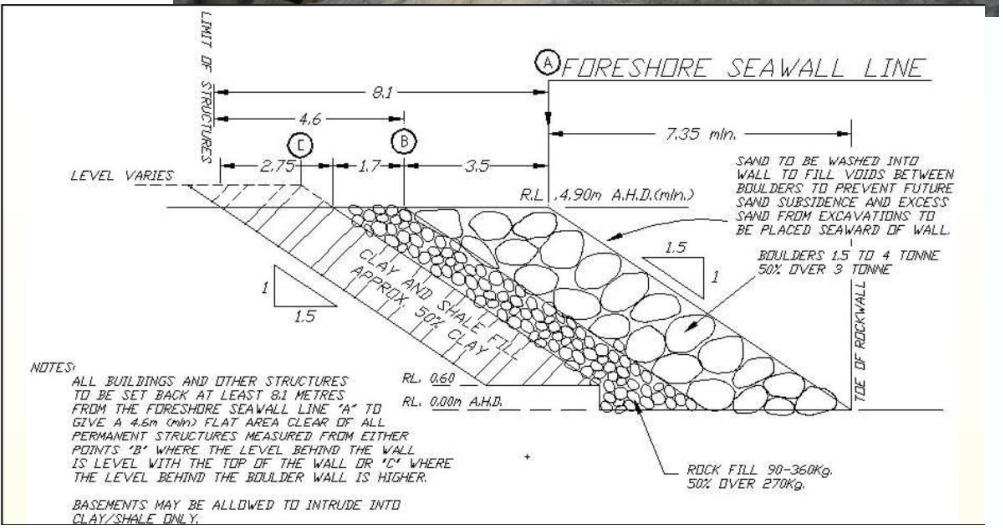
Extreme events cost money and lives

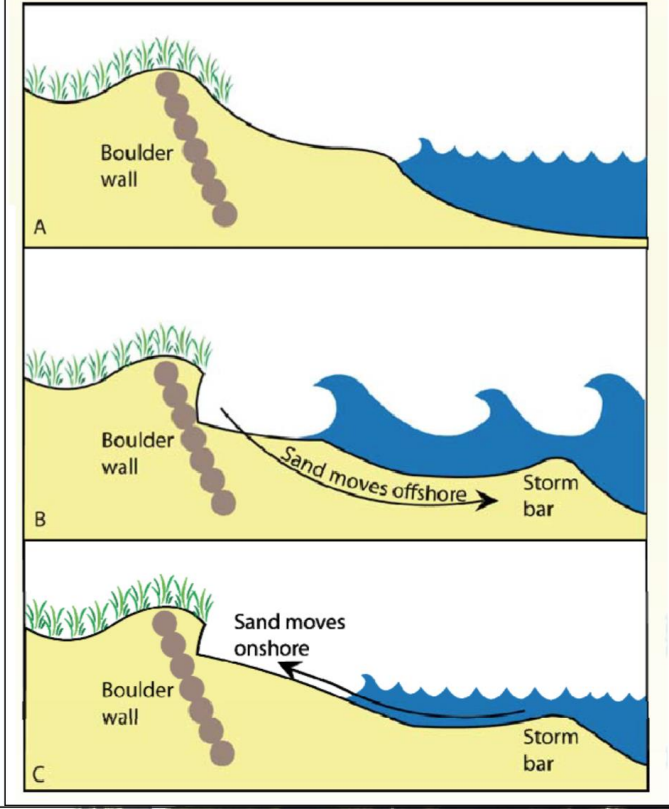
Systemic impacts of extreme events

- Heatwaves
  - Heatwaves in our southern cities are becoming more common and more intense events, with both chronic and acute impacts.
  - Eg. SE Australia heatwave, 28-30th Jan 2009
    - 374 premature deaths in SE Australia + morbidity
    - Power blackouts to >500k buildings – one outage caused $70M load shed in 5h; Basslink overheated
    - Transport disruptions (24% of Melbourne trains cancelled; $5M in fines)
    - Damage to transport infrastructure
    - Damage to fruit and vegetable growers; est. $10M's
    - Loss of economic activity: >$800M
  - The frequency of such events is likely to at least triple in southern Australia by 2070 / within the design life of much of this infrastructure



Gold Coast Planning Scheme





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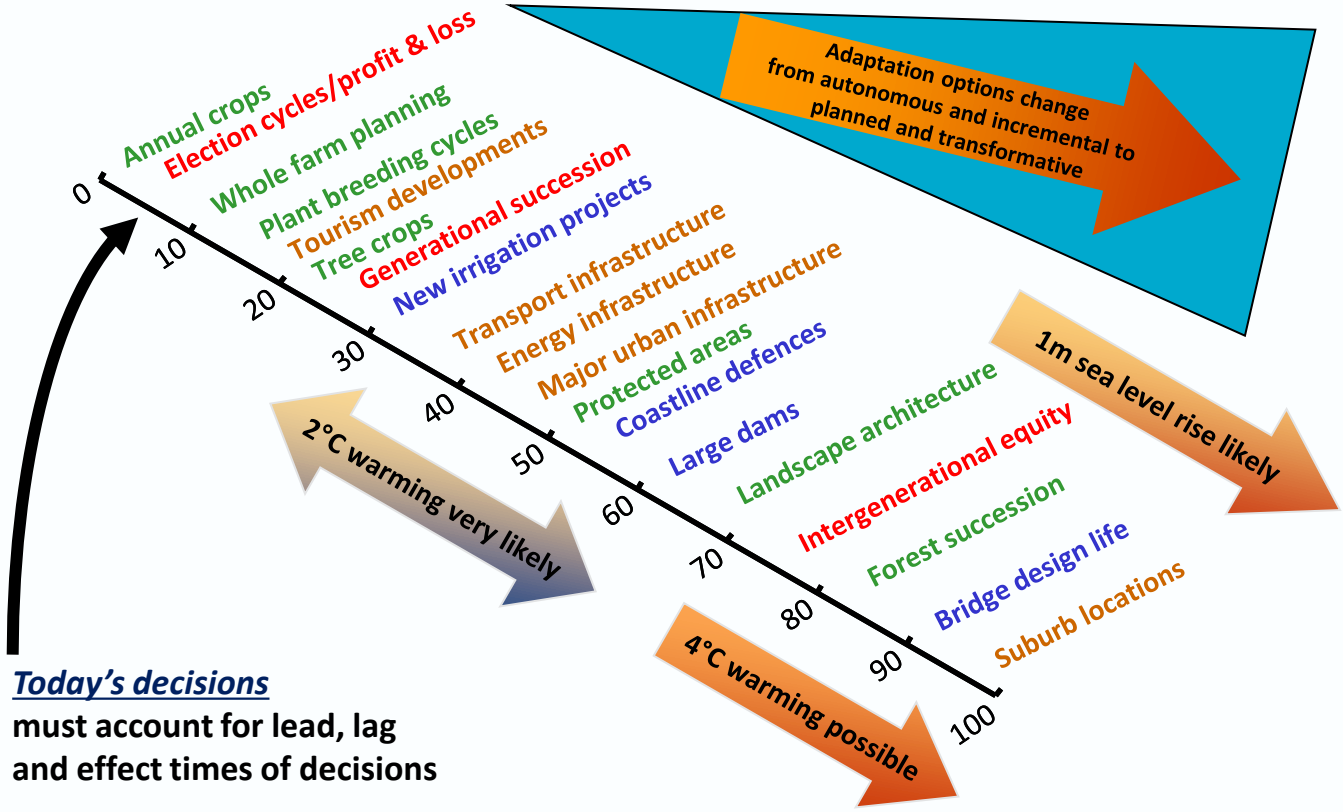
Adaptation timing and priorities



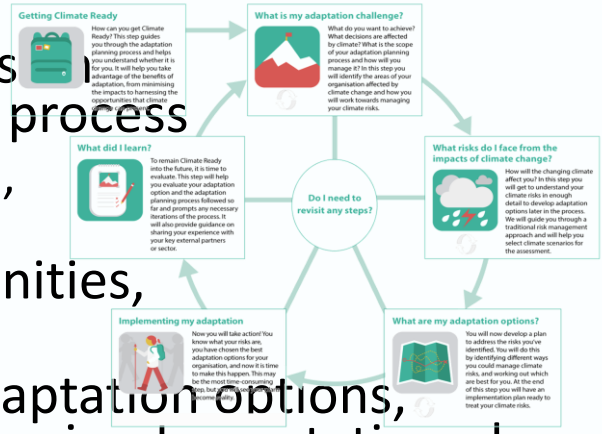
Stafford Smith et al, *PhilTransRoySoc* 2011 (after Jones & McInnes 2004)

Systematising a *decision*-centred approach…

1. Not all decisions (& lifetimes) are equal
2. Not all threats are equal, nor equally uncertain
3. There are many approaches to managing risk
4. Adaptation will not be a once-off action >> adaptation pathways
5. Cycles of incremental and more transformative responses
6. Emerging typologies of what to do, where/when etc

Core steps

1. **SCOPING** – goals, scope, decis areas affected, managing the process
   - Getting the right people involved, choosing approaches
2. **IDENTIFYING** – risks, opportunities, response measures
3. **APPRAISING** – assembling adaptation options, appraising them, developing an implementation plan
4. **IMPLEMENTING** – sign off, timing, actions
5. **MONITORING** – evaluating success, sharing lessons, planning to iterate
   - Critical for emergent effects



“Dynamic Adaptive Policy Pathways”

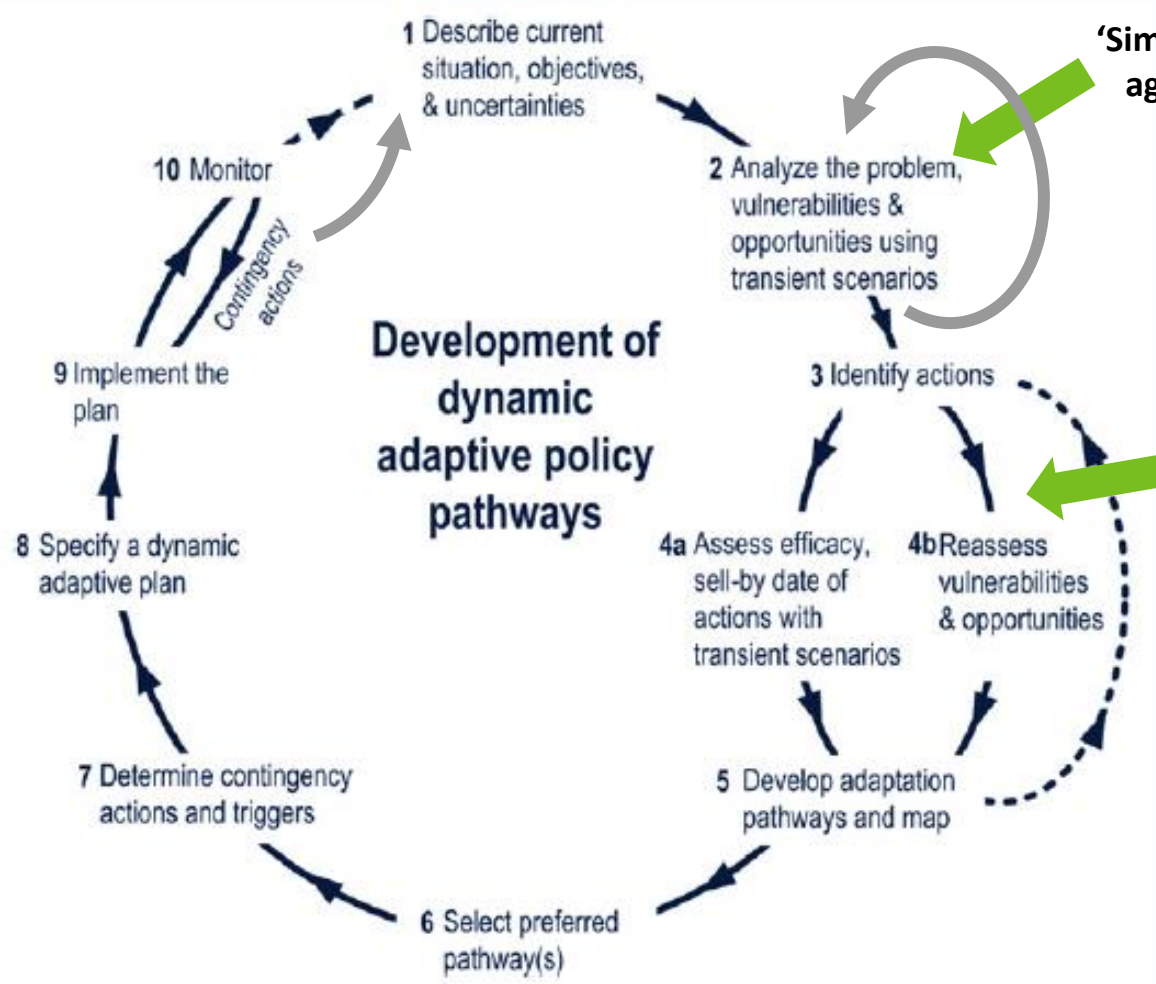


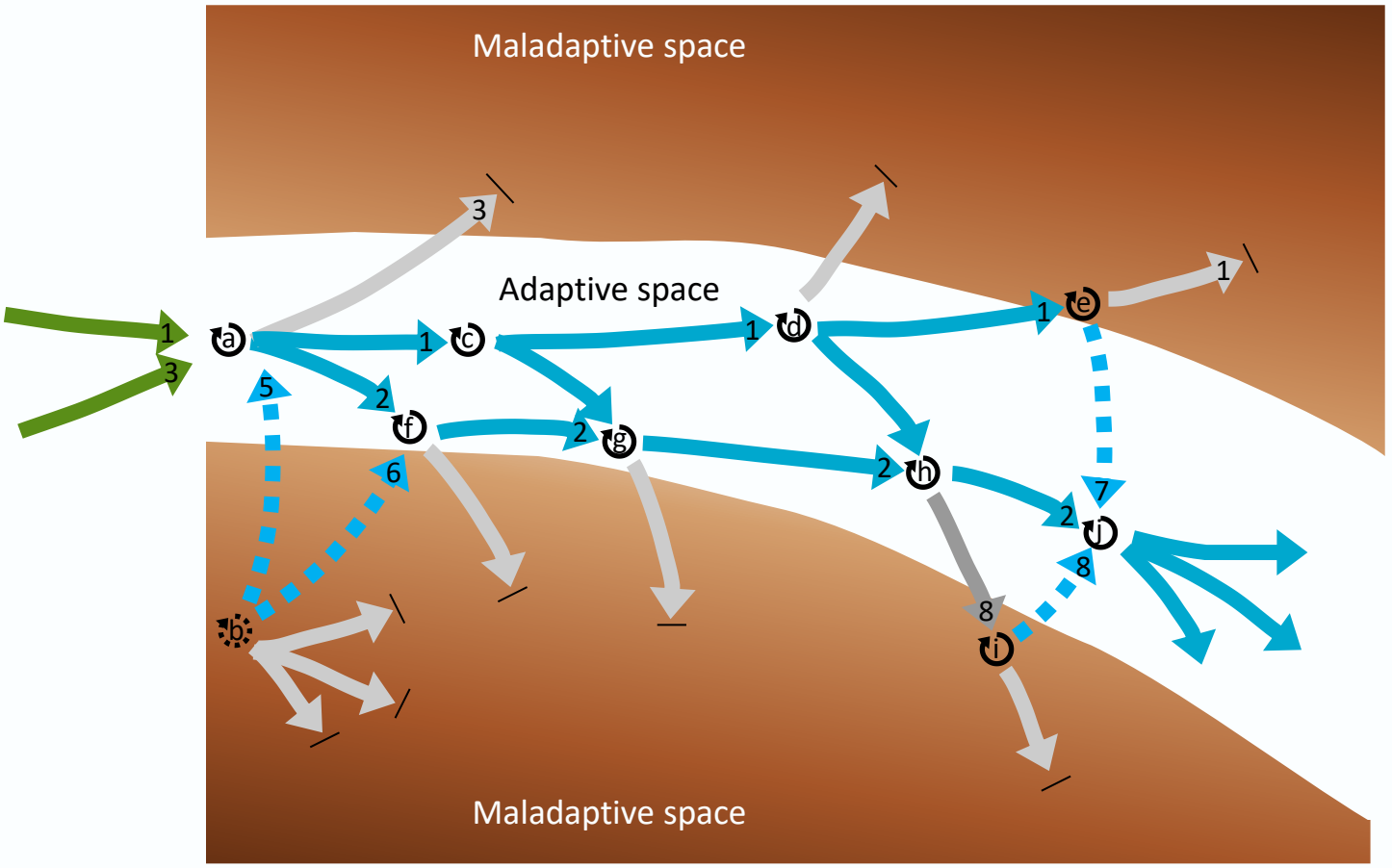
Fig. 4. The Dynamic Adaptive Policy Pathways approach.

‘Simple’ I.V. Assessment, against future *trends*

More detailed I.V. Assessment, for specific decision/ climate variables

Haasnoot *et al*., GEC 2013

Flexible adaptation pathways



Adaptive landscape, affected by changing climate but also other drivers and other actors' responses

Wise *et al*., 2014

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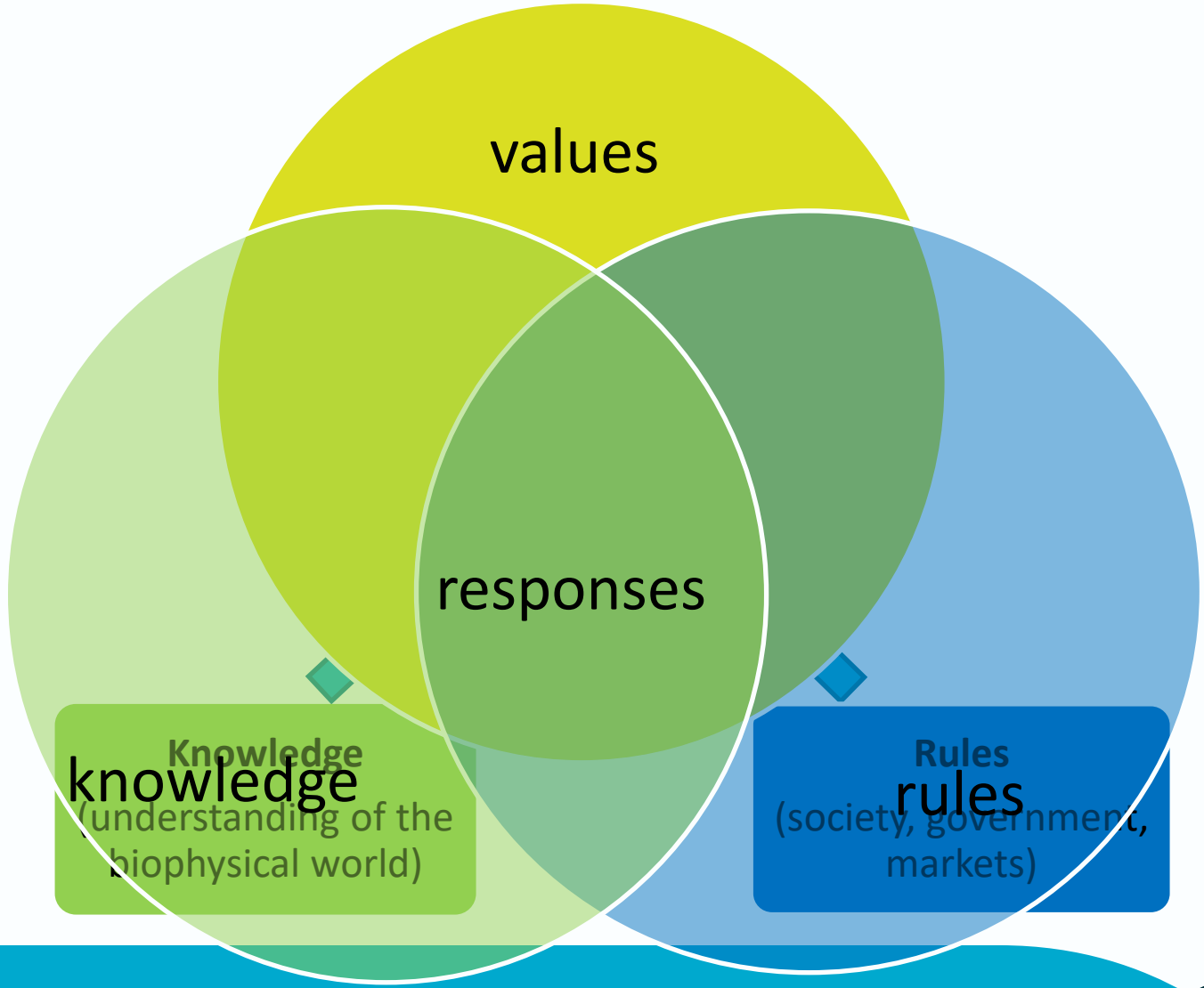
Coastal Adaptation Pathways Projects

1. Approaches to decision-making that can cope with uncertainty
2. Leadership in new approaches to cost-effectively manage asset risk
3. Partnerships to position communities to drive the reform required to manage climate change risks
4. Adaptive capacity of governments, communities and infrastructure and service providers

More information:
http://www.climatechange.gov.au/climate-change/adapting-climate-change/climate-change-adaptation-program/coastal-adaptation-decision

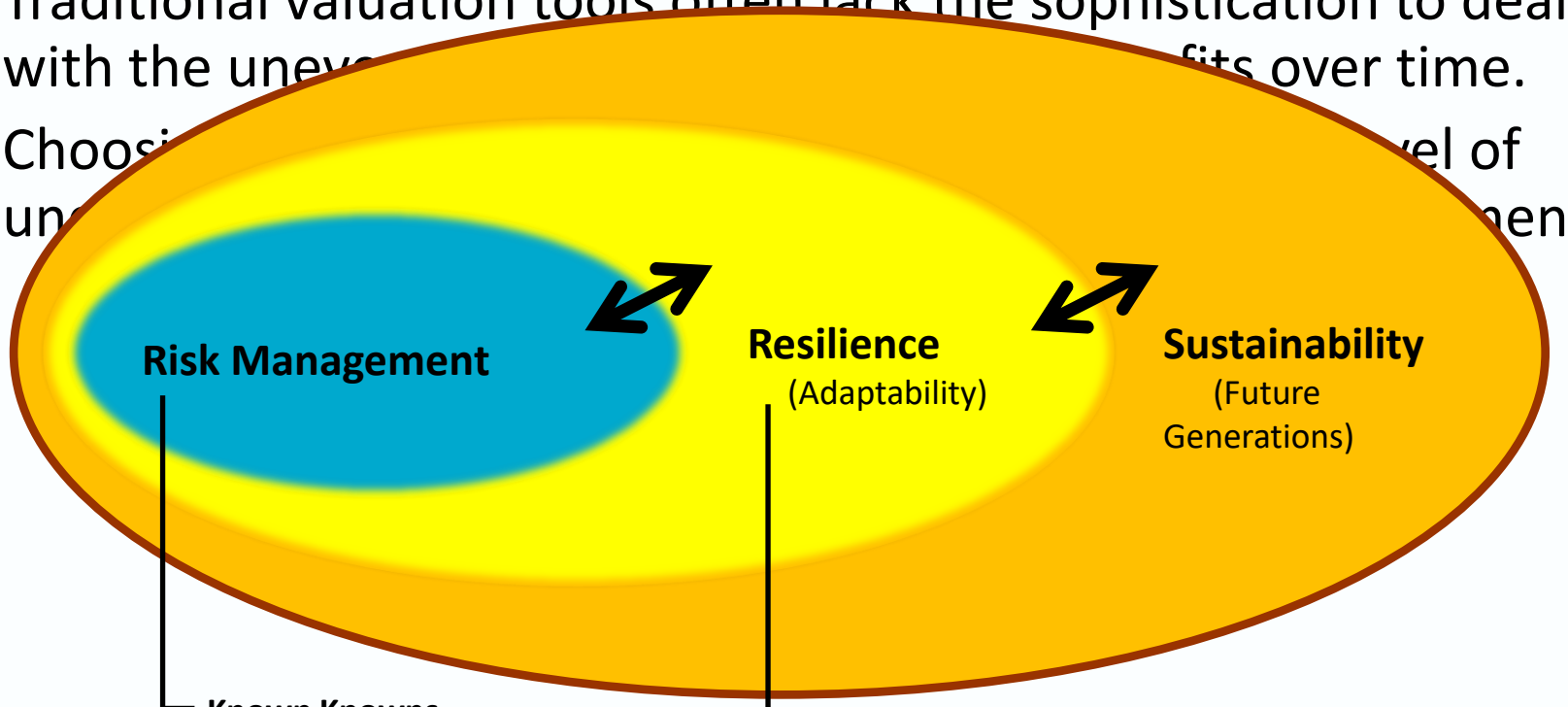
Commencing a valuation study

- Do I have the right information to proceed?
  - Quality and form (e.g. can / should all values be monetised).
- Values – Rules – Knowledge Test
- Values
  - Is there broad consensus on the vision?
  - Is there agreement across stakeholder groups on options?
- Rules
  - Are roles and responsibilities clearly defined?
- Knowledge
  - Is there certainty of knowledge relating to existing hazards?
  - Is there certainty of knowledge relating to future hazards / risks?


values
responses
knowledge
Knowledge
(understanding of the biophysical world)
rules
Rules
(society, government, markets)

Key differences

1. Traditional valuation tools often lack the sophistication to deal with the uneve fits over time.
2. Choosi vel of un ment.



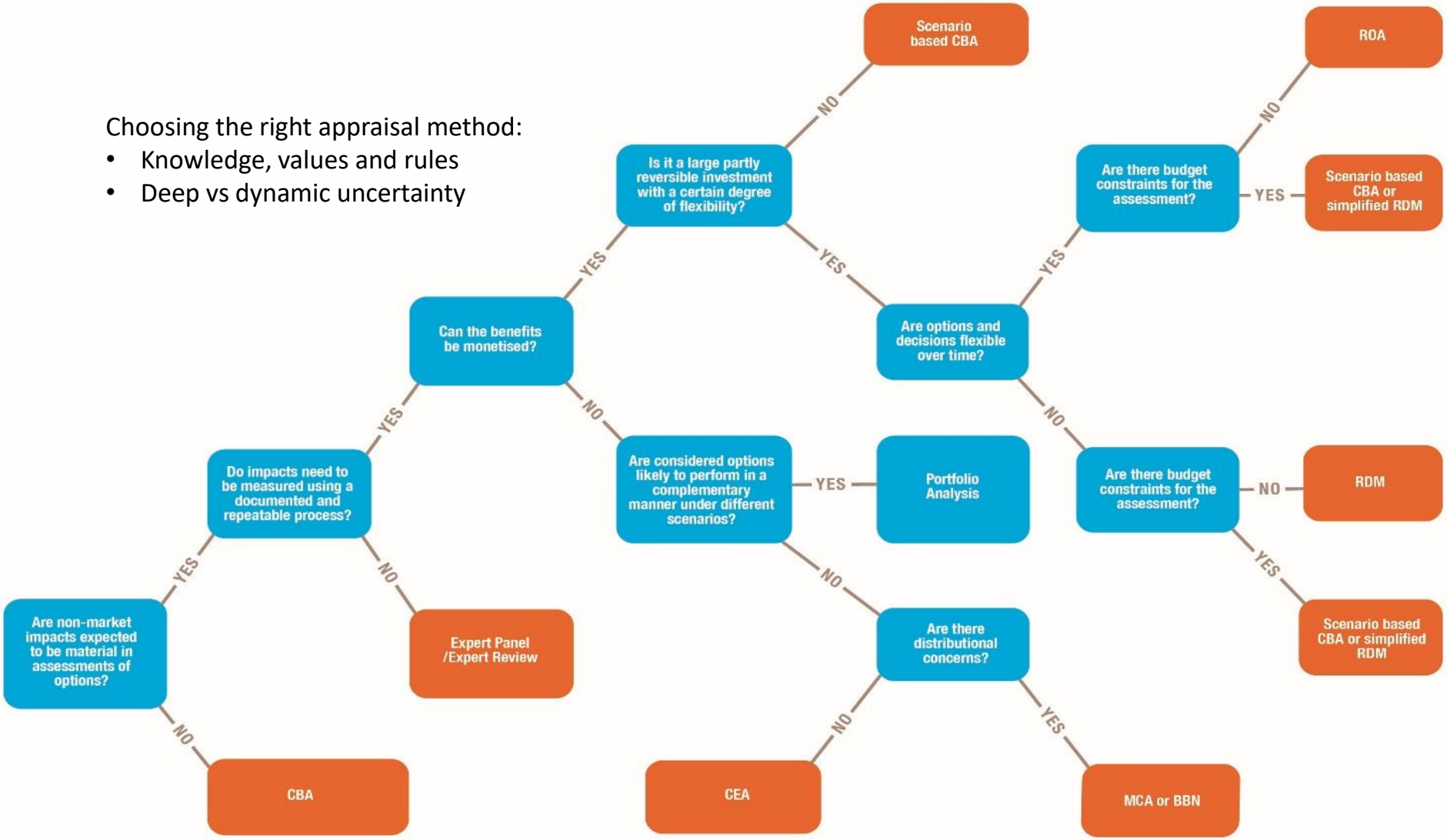
New Zealand Treasury

Valuation of adaptation options

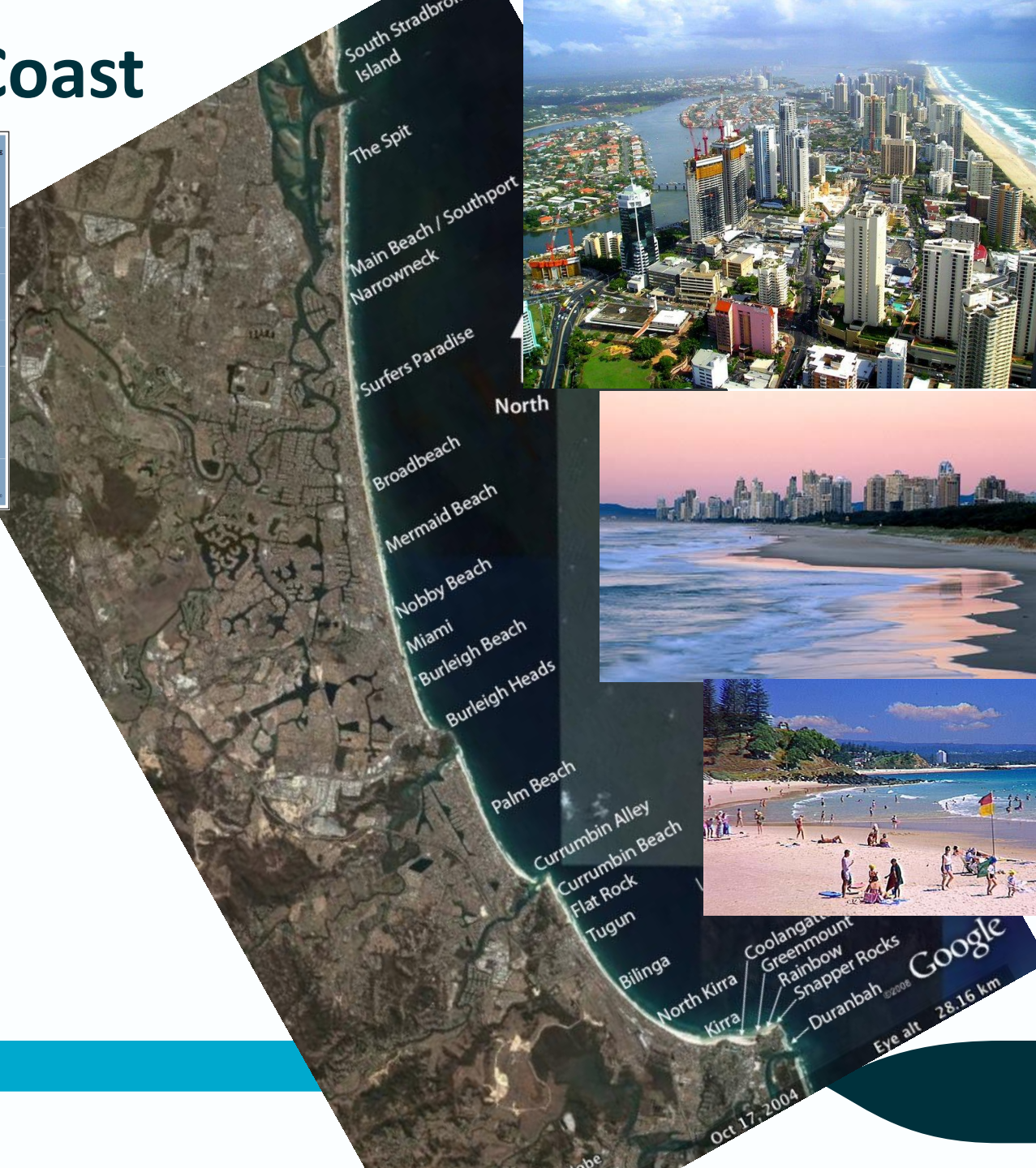
- How to monetise?
  - Replacement cost, cost of avoided damage, benefit transfer, revealed preference (TCM, hedonic pricing), stated preference (choice modelling)
- How to prioritise / sort options?
  - Scenario analysis / planning, multi-criteria analysis, bayesian belief networks
- How to value?
  - Benefit cost analysis, scenario-based BCA, cost effectiveness analysis, portfolio analysis, real options analysis (deliberative), robust decision making (simplified or not)

Choosing the right appraisal method:

- Knowledge, values and rules
- Deep vs dynamic uncertainty

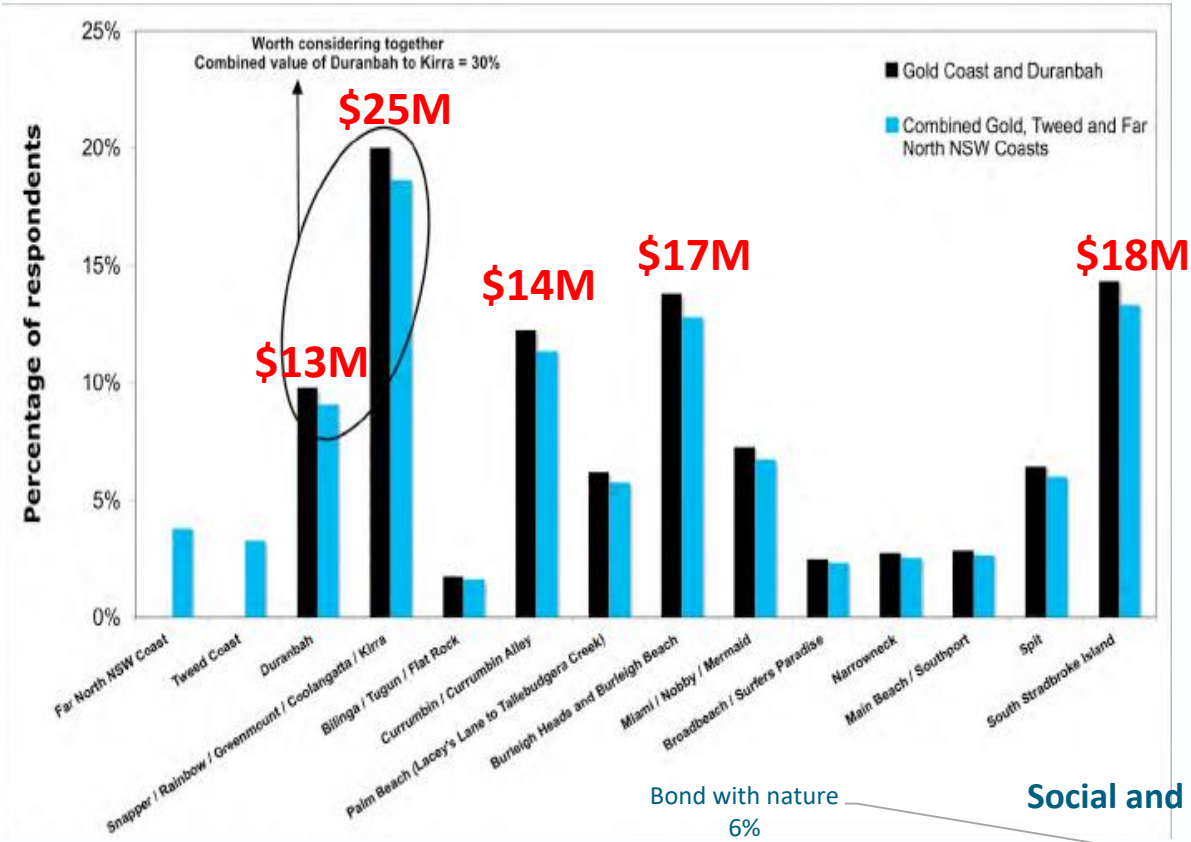


The Gold Coast



Non-market valuation

Surf-onomics



Indicator	Gold Coast
Instrument	Web + face-to-face
Average age	54% = 36 or less
Gender	90% male for online 75% male for f2f
Education (% college or more)	35%
Income	$AUD40-60K
Experience	43% advanced
Sessions per week	2.5
Sessions per year	104
Distance travelled (one way)	60% = 10kms or less
Average expenditure per trip	$AUD25
Expenditure range per visit	$AUD18-30
Annual expenditure	$2-4K

Social and psychological meanings in surfing

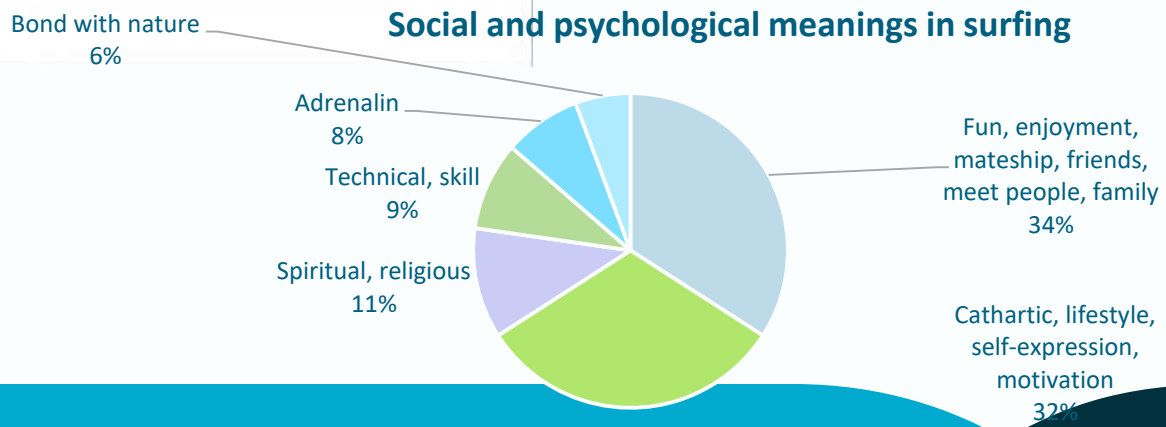


Figure 1: View of The Spit as in Current State (Save Our Spit)

Figure 2: View of The Spit with Cruise Ship Terminal and Cruise Ship Superimposed (Save Our Spit)

Figure 3: Gold Coast Marine Development Project Vision (Government of Queensland, 2004a, p. 8)

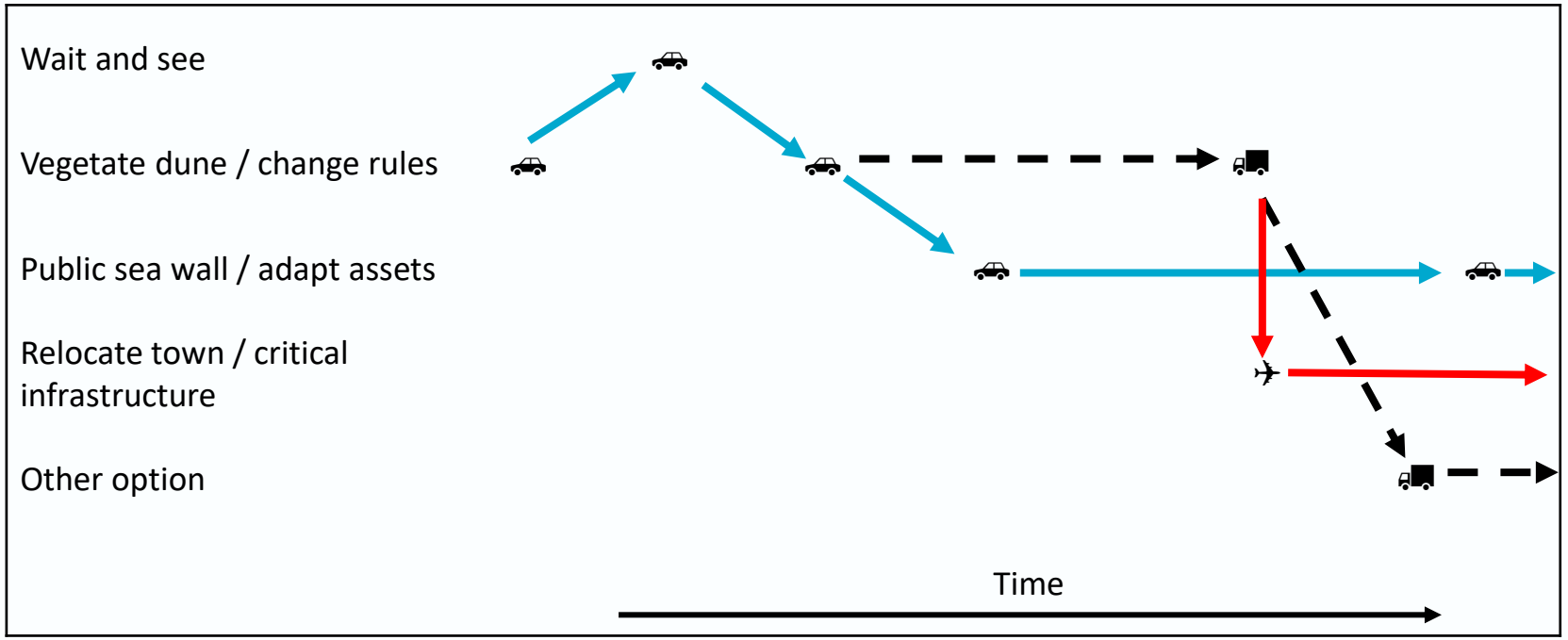
Real Options Analysis and Robust Decision Making

- Sometimes it makes more sense to wait for new information rather than investing immediately. Two novel appraisal approaches are now being applied to adaptation decision-making
  - Real Option Analysis (ROA) - works well for specified resilience so handles dynamic uncertainty e.g. sea level rise, temperature change
  - Robust Decision Making (RDM) – takes a more sensitive approach to managing downside risk (often characterised by deep uncertainties), seeks outcomes that are robust over multiple possible futures

ROA functionality

- ROA can work well provided the following investment conditions are satisfied.
  - The decision is currently reversible but likely to be hard to reverse or irreversible once underway or complete.
  - The investment is large & has a long lifespan
  - The investment likely to be sensitive to changes in climate hazards
  - The investment presents a risk of over or underinvestment (Dittrich et al. 2016; Watkiss et al. 2013).
  - The decision-maker has some flexibility with respect to the timing of the investment (as a single step or in stages) (Dittrich et al. 2016).
  - By waiting, a decision-maker is likely to gain 'valuable' new information regarding the success of the investment (Dittrich et al. 2016).
  - Sufficient resources are available for the assessment.

Hypothetical ROA sequence



Key messages

- Systems view - consider climate variability alongside structural changes to the economy and population growth
- Consideration of the ‘value at risk’ when making decisions
- Deep vs dynamic uncertainty
- Specified vs general resilience
- Confidence vs precision
- Staging or sequencing of responses

CoastAdapt

CoastAdapt is a Coastal Climate Risk Management Tool, which will provide practical guidance on how to manage the risks from climate change and sea-level rise, together with the associated information on physical, social and economic risks.

- Guidance documents
- Information manuals
- Decision Support System
- Case studies / snapshots / videos

CoastAdapt

www.coastadapt.com.au

Australian Government
Department of the Environment and Energy

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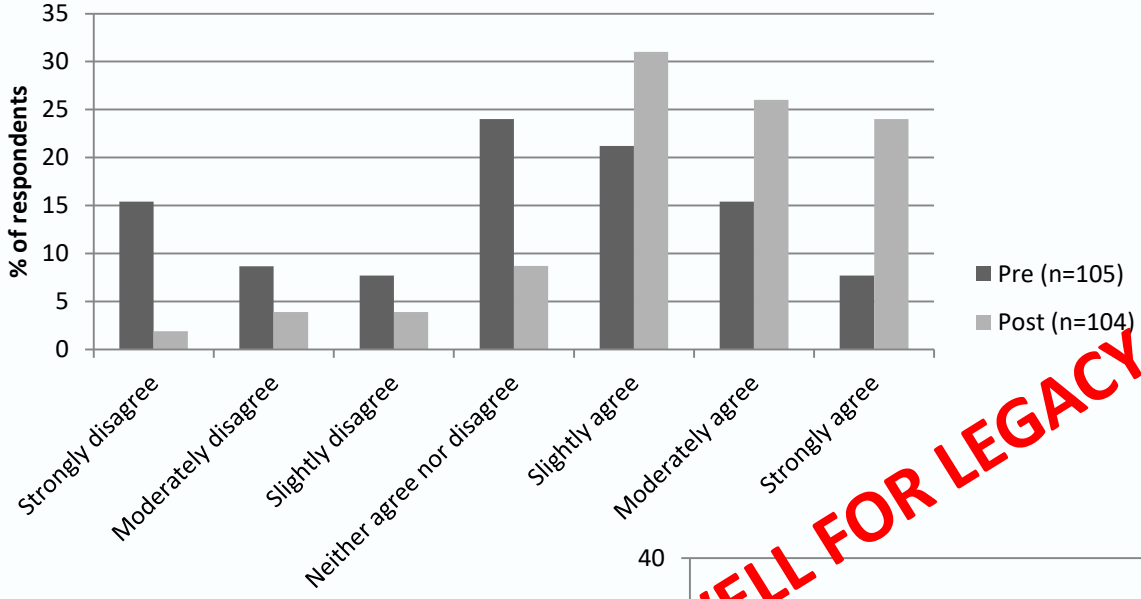
Community is making more sophisticated use of tools and approaches….

- The use of legal instruments
- Community health and sustainability outcomes
- Appropriate knowledge / multiple evidence bases
- Importance of economic information
- Partnership approaches
- Advocacy and the politicisation of issues

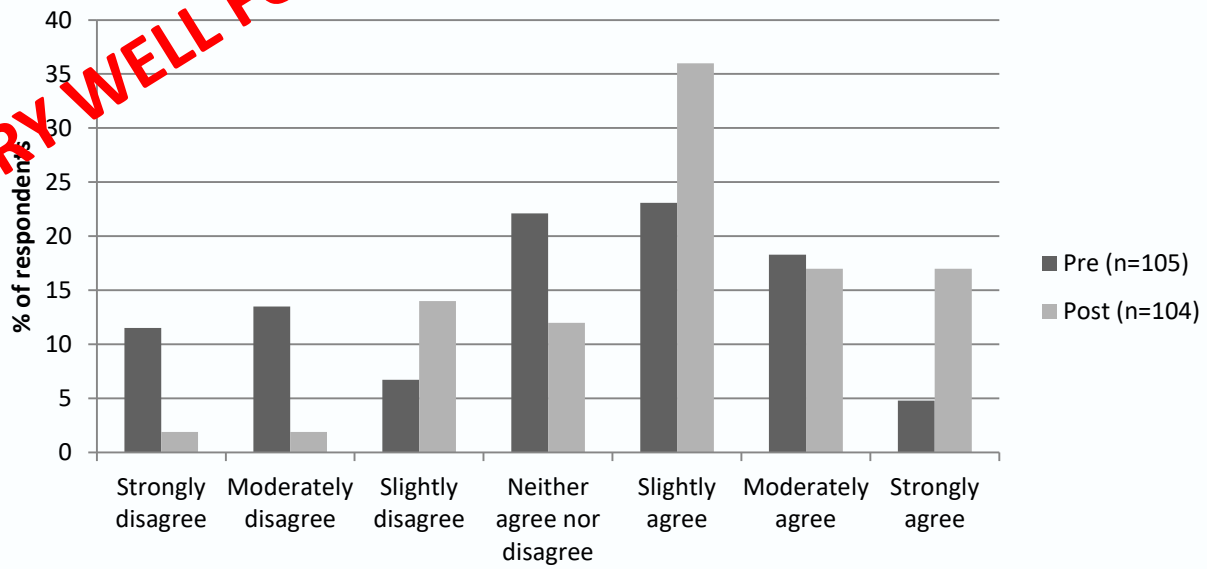
Managing risk and responsibility



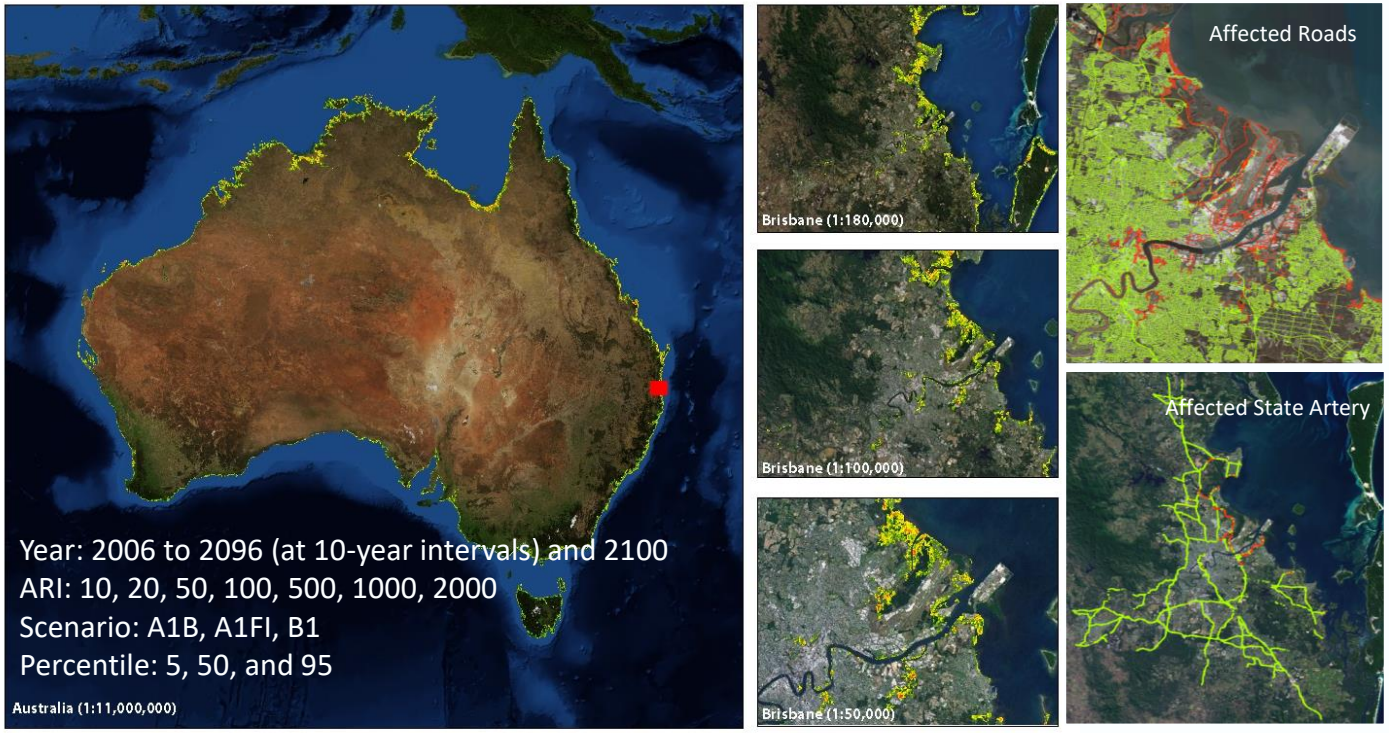
Those who benefit from risk taking related to climate change (e.g. living in an area that is exposed to flooding) should pay the costs

DOES NOT WORK VERY WELL FOR LEGACY ASSETS

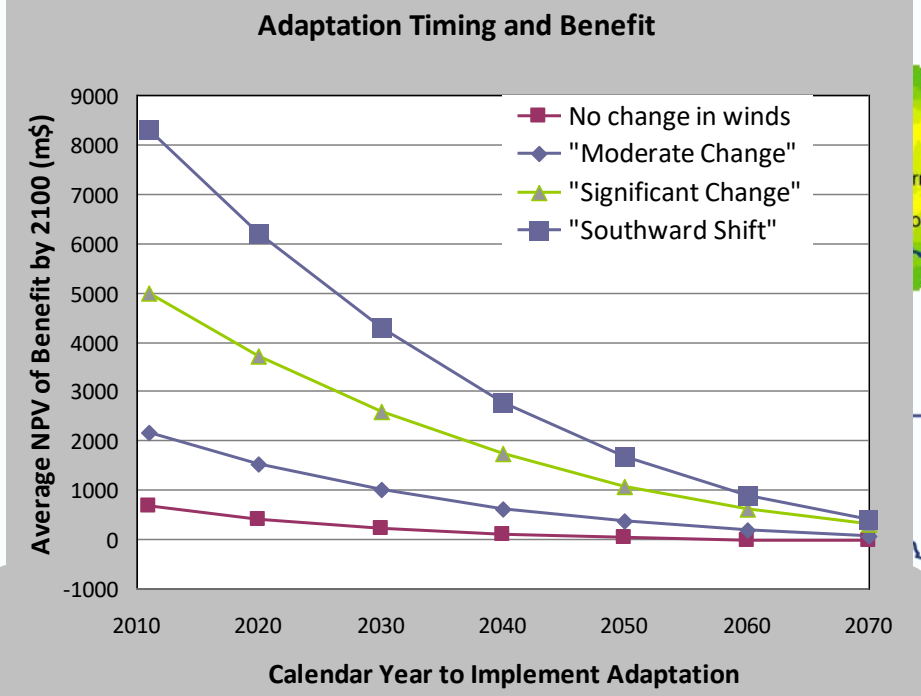
Those who benefit from management strategies to reduce the risk of climate impacts (e.g. construction of a levee bank to reduce flood risk) should pay the costs



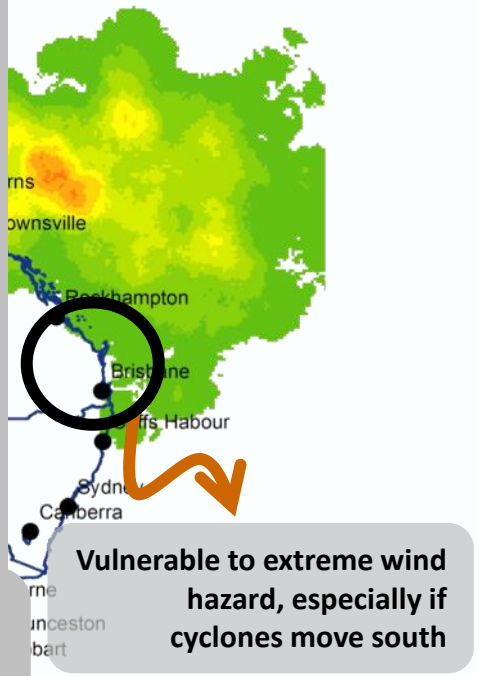
Coastal Inundation: current to future risks



Areas Prone to Extreme Wind Events in Queensland

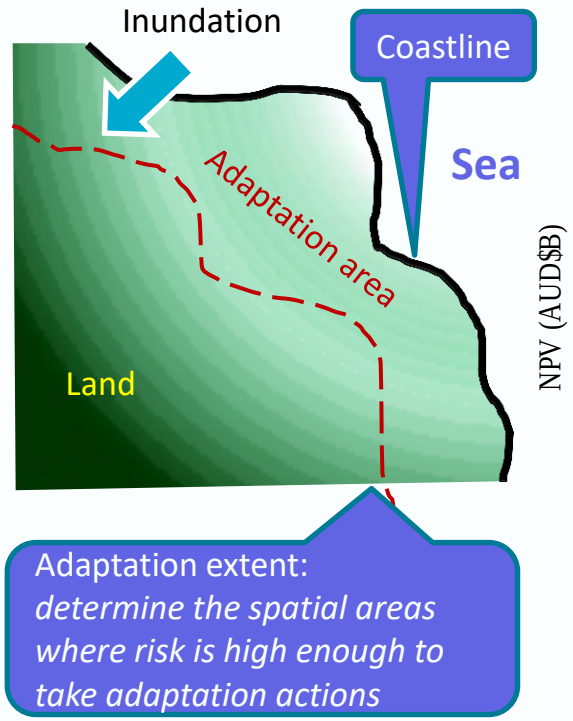


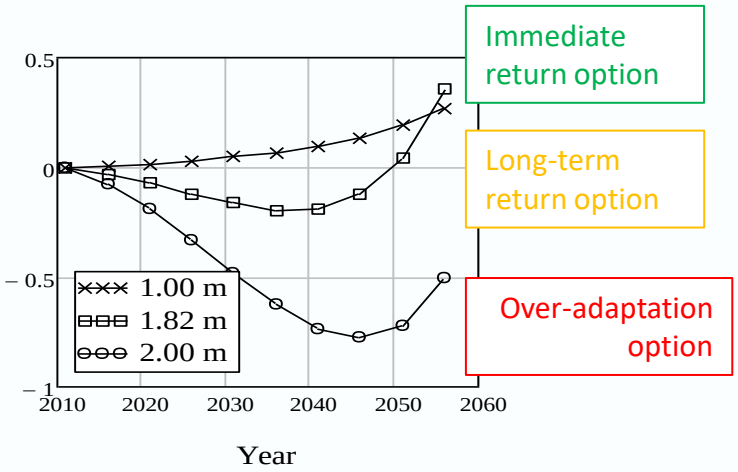
- **Delaying change in standards rapidly reduces NPV**



Vulnerable to extreme wind hazard, especially if cyclones move south

Spatial Flood Planning





Some considerations

- Climate variability and change
- Structural and demographic changes to regions

- General resilience – e.g. economic diversity, risk awareness
- Specified resilience – e.g. protecting specific assets

- ‘No-regrets’ options
- ‘Low regrets’ options
- ‘Robust’ options