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Sector Adaptation Practices and Barriers

Climate Change and Urban Adaptation Science and Practice-Exploring Challenges

APN Workshop 9-11 December 2014

Overview

- Introducing RPS
- Insights on sector climate risk work - energy, water, property & local government and climate risk and resilience
- Findings
- What's different about our approach
- Barriers
- Lessons learnt

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Introducing RPS

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New name, new capabilities, new reach...

Manidis Roberts joined international consultancy RPS in July last year and from 1 July 2013 will be known as RPS.

Our local teams and your local advisors remain the same.

We employ more than 5,000 people across the UK, Ireland, Netherlands, the United States, Canada, Australia and Asia Pacific and undertake projects in many other parts of the world.

RPS has similar origins to Manidis Roberts in the environmental and planning disciplines.

With local knowledge and national expertise supported by international experience, we have the capability to deliver first-rate services where and when they are needed.

RPS is an international consultancy providing world-class local solutions in **infrastructure, urban growth, natural resource management, energy** and **mining**.

Insights – sectors approach

The Climate Institute

Coming Ready or Not

Managing climate risks to Australia's infrastructure


Australia should
be well-placed to adapt
to the changing climate,
but our readiness is

- **Government policy is fragmented.**
- **The business response is uneven.**
- **Infrastructure is highly interdependent, but action on adaptation is isolated at the organisational level.**
- **Concern about climate change has fallen among those sectors most exposed.**

Annual costs of unmitigated climate change on Australia's infrastructure would reach nearly $9 billion in 2020 and $40 billion in 2050.

2008 Garnaut Review

Sector Snapshots

Sector	Sample impacts	Action underway	Readiness rating
Water	• Systems stressed by flooding • Supply risks for water users	• Coordinated action taking place • Sector-wide collaboration on modelling impacts and responses • Investigation of interdependencies with electricity and telecommunications	**Relatively advanced preparation**
Property 	• Damage and destruction of property by flood, bushfire • Degradation of foundations • Impaired health and productivity	• Widespread examples of early action but uncoordinated at industry and government levels • Regulation and planning suffers from gaps, inconsistency, conflict across and within jurisdictions	**Early preparation**
Electricity 	• Damage from flood/fire • Strain/collapse in heatwaves • Impaired health and productivity	• Action is at early stages. • Examples of cooperation among networks • Regulatory framework an obstacle to action.	**Underprepared**
Road + Rail 	• Flood-induced washouts • Heat induced rail buckling, road cracking • Impaired transportation of people and goods	• Action is at early stages. • Fragmentation of responsibility an obstacle • Regulation and planning suffers from gaps, inconsistency across & within jurisdictions	**Underprepared**
Financial Services	• Insurers directly exposed to increasing costs of extreme events • Investors exposed to impacts on assets	• Action is at early stages • Action not yet translated into market signals	**Underprepared**

Sector Snapshot: Property

HOW BIG IS THE PROBLEM?

Risk Scenario	Impacts	Risk
Floods and storm damage	Fatalities and injuries	EXTREME
Coastal flooding and storm surge	Higher rebuilding, maintenance, insurance costs	EXTREME
Higher bushfire risk due to hotter, drier conditions	Loss of use of buildings	EXTREME
Degradation of foundations due to hotter, drier conditions	Impact on property prices	HIGH
	Community anger	
	Failure of foundations	

Risk ratings derived from the likelihood and consequences of such impacts under a high emissions scenario. These are ascribed to the sector as a whole – individual infrastructure assets' risk profiles will vary substantially.

ACTION INDICATORS

Who's Acting

Incremental Change

Readiness Rating

EARLY PREPARATION

Sector Snapshot: Road + Rail

HOW BIG IS THE PROBLEM?

Risk Scenario	Impacts	Risk
Coastal flooding + storm surge due to sea level rise	Damage + failure of coastal roads, tunnels, bridges	HIGH
Buckling + damage of rail track due to high temperatures + heatwaves	Temporary or permanent loss of access to transport routes + services	HIGH
Storm + flood damage	Cost of rebuilding or moving roads and transport	MODERATE HIGH
Road degradation	Higher insurance + maintenance costs	MODERATE HIGH
	Community anger	

Risk ratings derived from the likelihood and consequences of such impacts under a high emissions scenario. These are ascribed to the sector as a whole – individual infrastructure assets' risk profiles will vary substantially.

ACTION INDICATORS

Who's Acting

Incremental Change

Readiness Rating

UNDERPREPARED

Sector Snapshot: Finance

Mercer found climate change presented a systemic risk worth about 10% of a typical portfolio . Their assessment below shows positive and negative impacts on asset classes of four climate change scenarios.

ASSET CLASS	LISTED EQUITIES				FIXED INCOME			COMMODITIES		REAL ESTATE	PRIVATE EQUITY			INFRASTRUCTURE	
SCENARIO	GLOBAL	EMERGING MARKET	SUSTAINABLE	EFFICIENCY/RENEWABLES	GLOBAL	EMERGING MARKET DEBT	INV GRADE CREDIT	AGRICULTURAL	TIMBER	UNLISTED	LBO	VENTURE CAPITAL	EFFICIENCY/RENEWABLES	CORE/UNLISTED	EFFICIENCY/RENEWABLES
Regional Divergence	/	/	+	+	/	/	/	/	/	/	/	/	+	/	+
Delayed Action	–	–	+	+	/	–	–	/	+	–	–	–	+	–	+
Stern Action	+	+	+	+	/	+	+	+	+	+	+	+	+	+	+
Climate Breakdown	/	–	–	–	/	–	+	–	–	–	/	/	–	–	–

+ Positive
/ Neutral
– Negative

Action Plan- Business

1. **Assess exposure and vulnerability to climate risk impacts.**
    - Identify material climate risks for your **operations, supply chain, customers, employees as well as interrelated infrastructure systems.**
    - Determine how resilient your business is.

2. **Implement a Climate Risk Management Plan**
    - Establish a 3-5 year plan to manage climate adaptation requirements.
    - Embed ongoing management of climate risk into your business.

3. **Disclose material climate risks to the market**
    - Ensure shareholders and investors are informed of material climate risks and risk management strategies to protect shareholder value.

4. **Collaborate to build capacity**
    - Participate in cross-industry and public discussions to build understanding and resilience.

Action Plan- Government

1. **Refresh the National Climate Change Adaptation Framework**
    - Work across jurisdictions to develop agreed approaches for including climate risk in planning, development and approval processes
    - Coordinate between levels of govt to improve consistency in practical requirements for infrastructure planning and development
    - Sector-specific guidelines for assessment of climate risk in key regulated industry sectors
    - Investigate a national initiative to identify climate risk impacts for interdependent infrastructure

2. **Expand analysis of infrastructure interdependencies to climate risk**
    - Expand the approach taken by CIPMA to all other key infrastructure assets and sectors
    - Work with asset owners and operators to better manage cross-sectoral interdependencies and climate risk impacts

3. **Publish a National Resilience Report Card**
    - Develop a national adaptation scorecard and report on progress
    - Publish resources for small business and the community

4. **Deliver leadership through collaboration**
    - Collaborate with govt and private sector to build skills and capacity
    - Establish city-wide taskforces with public and private participation for each major city

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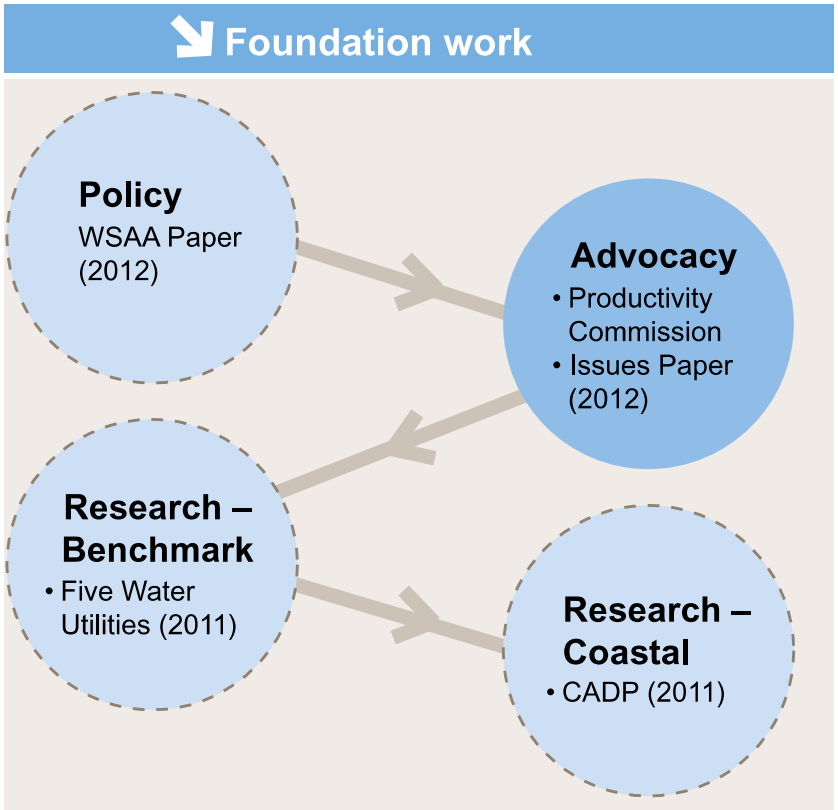
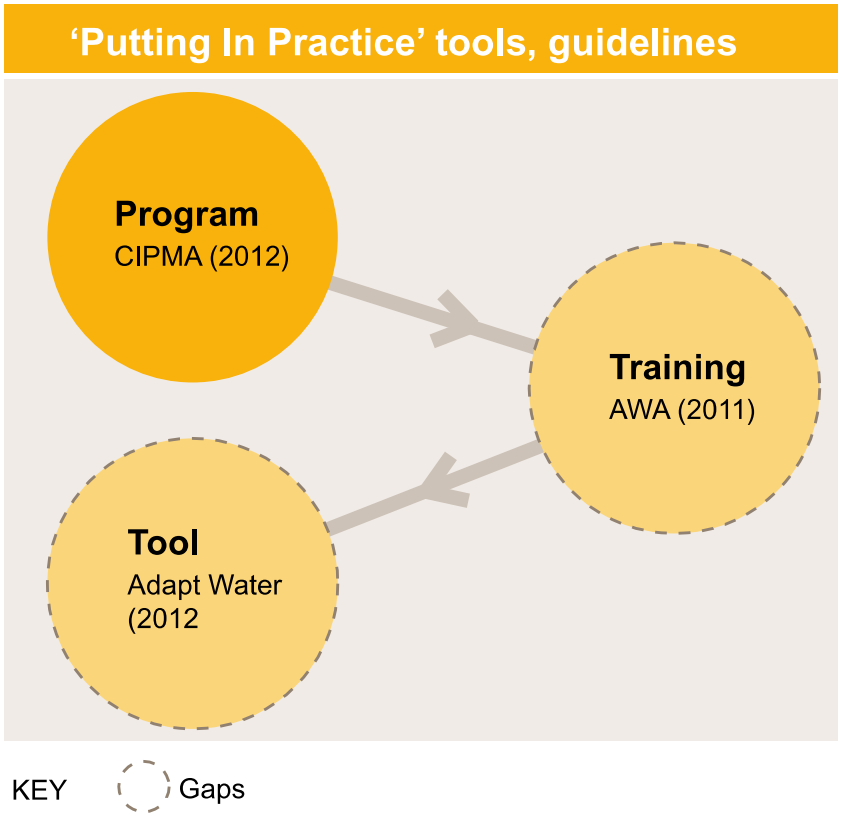
Insights – water

Comparing the water sector response

WATER INDUSTRY – CLIMATE RISK RESPONSE





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Insights – energy

Sector Snapshot: Electricity

HOW BIG IS THE PROBLEM?

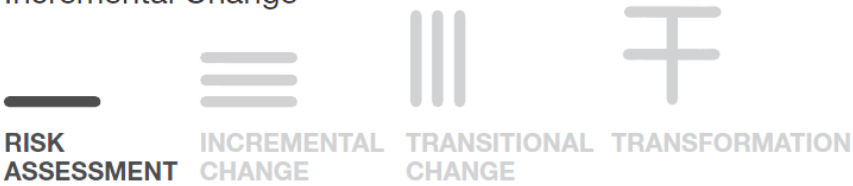
Risk Scenario	Impacts	Risk
Hotter, longer heatwaves increase peak load days	Fatalities, injuries Blackouts	EXTREME
Drier conditions + more lightning strikes increase risk of bushfire ignition from transmission lines	Community anger Need for additional supply	EXTREME
More extreme rainfall + wind intensity increase storm and flood damage	Higher supply, maintenance, repair and insurance costs	HIGH
Hotter, drier conditions impair water use	Higher prices	HIGH

Risk ratings derived from the likelihood and consequences of such impacts under a high emissions scenario. These are ascribed to the sector as a whole – individual infrastructure assets' risk profiles will vary substantially.

ACTION INDICATORS

Who's Acting

Incremental Change



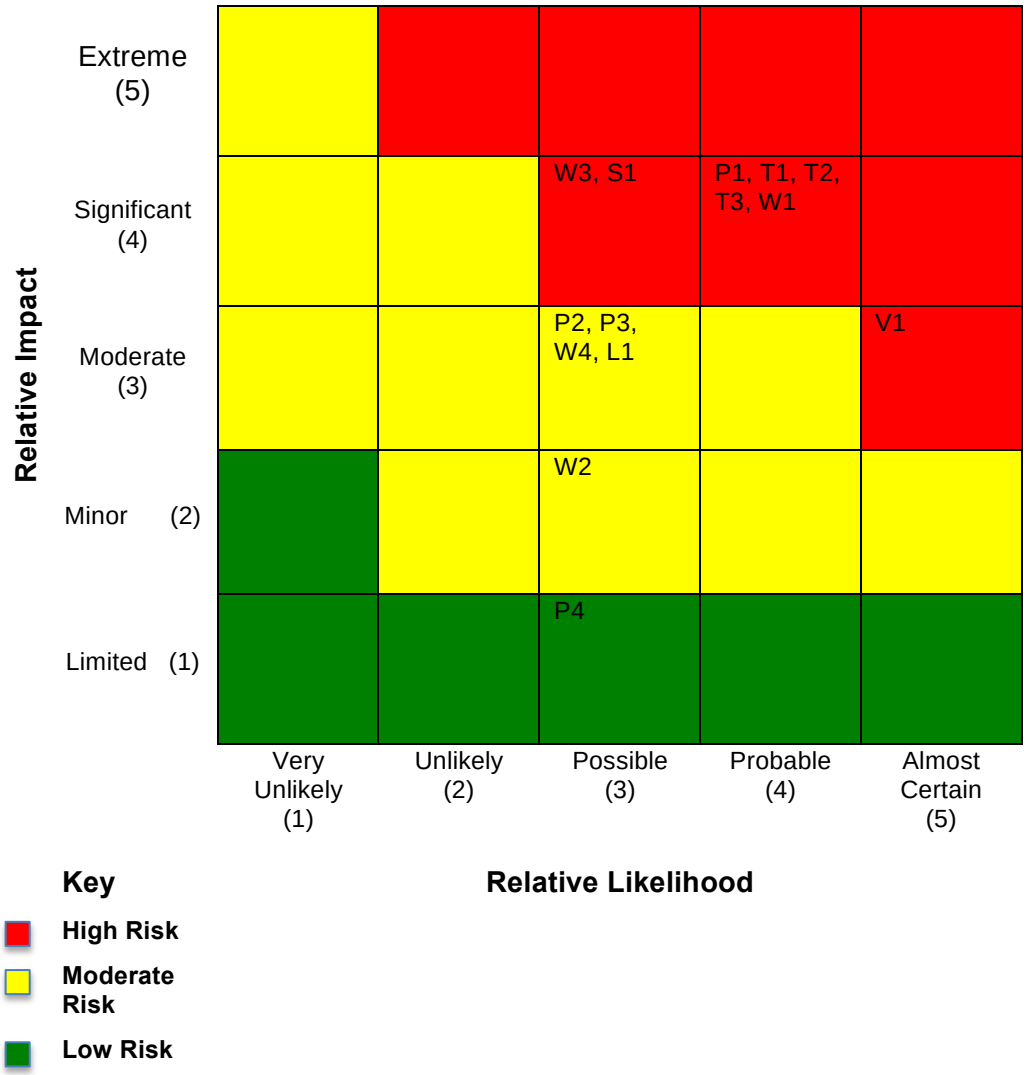
Readiness Rating

UNDERPREPARED

Progress amongst energy networks

- Physical impacts - asset planning and design standards (sea level, flooding and temperature) and designing for asset life (Victorian DNSPs, Powerlink, Energex/Ergon, Transgrid)
- Interdependency (electricity, transport, water and communications with government planning and adaptation decisions) (Endeavour Energy)
- Demand forecasting (including mean & extreme temperature changes)

Priority network asset vulnerabilities



Effects of climate change more apparent and recognised by UK Government

- 2007 Floods review by Lord Pitt
- Resilience studies by Cabinet Office, DECC, Defra etc
- Climate Change Act and Adaptation Reporting Power
- National Adaptation Programme

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132kV substations – flood mitigation works

Pitt Review

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Our approach

Our approach

- Engagement
- Translation
- Communications
- Decision centred adaptation

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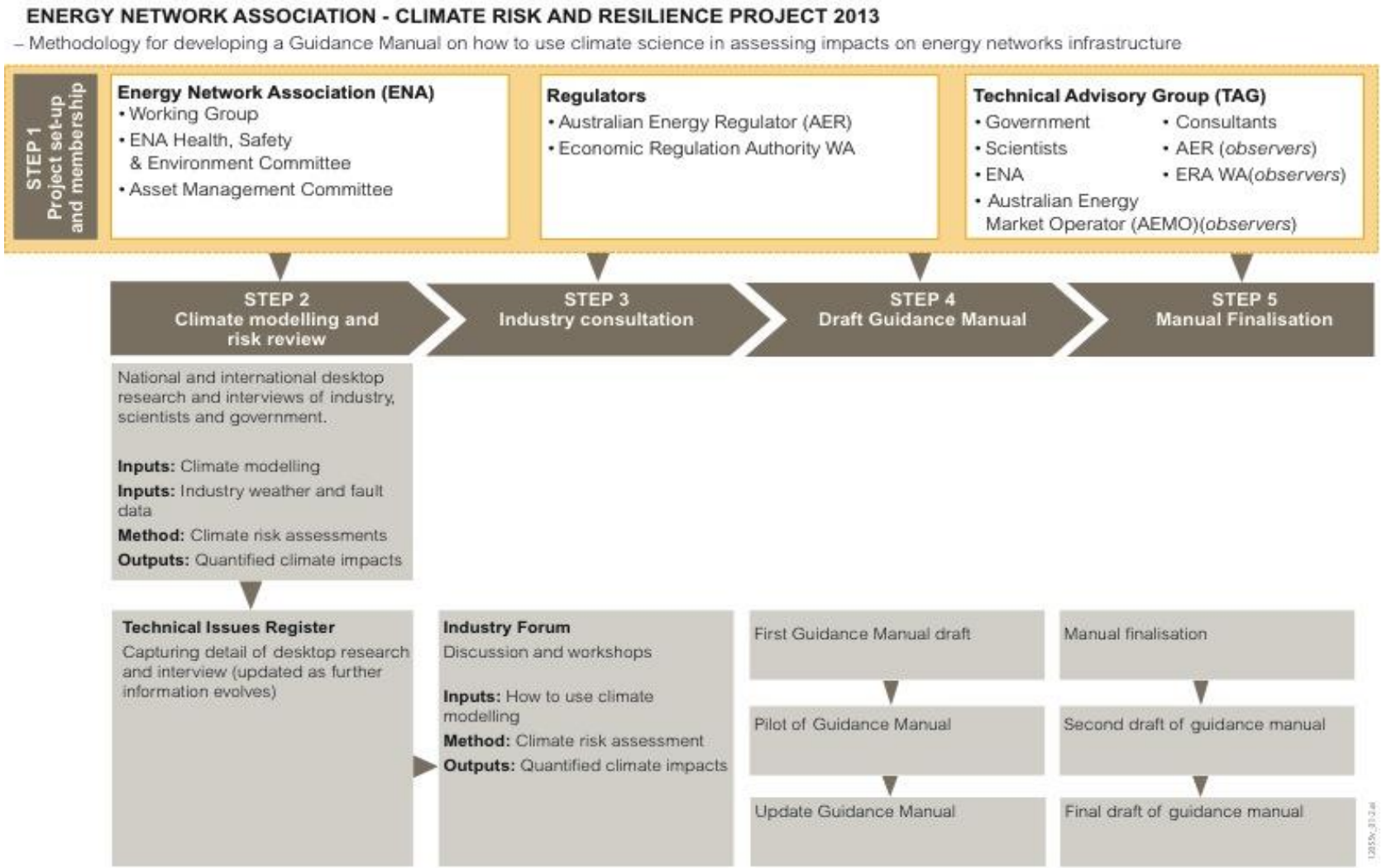
Engagement

The project overview



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Communication

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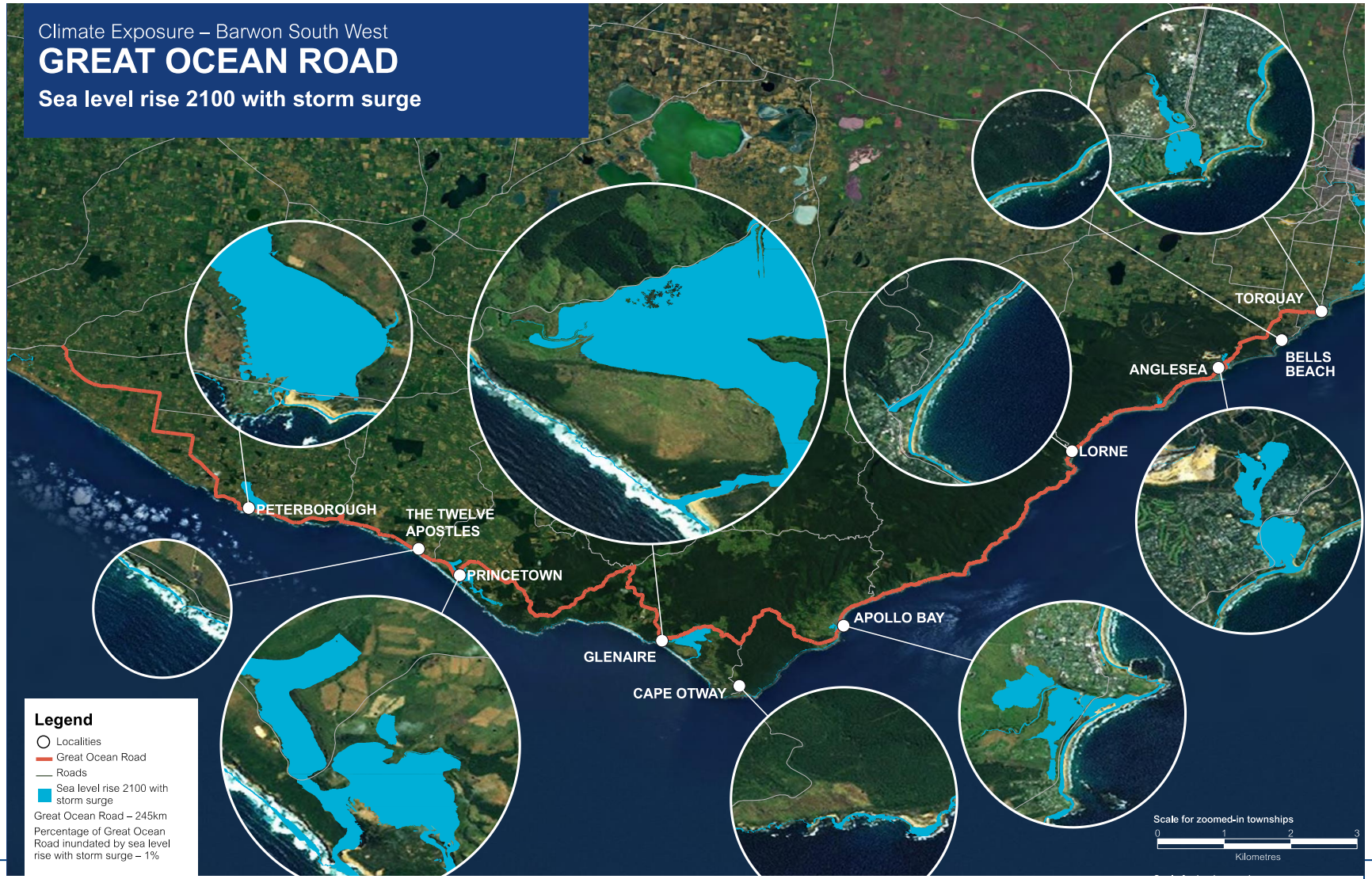
Climate Exposure – Barwon South West
GREAT OCEAN ROAD
Sea level rise 2100 with storm surge
TORQUAY
BELLS BEACH
ANGLESEA
LORNE
PETERBOROUGH
THE TWELVE APOSTLES
PRINCETOWN
APOLLO BAY
GLENAIRE
CAPE OTWAY
Legend
Localities
Great Ocean Road
Roads
Sea level rise 2100 with storm surge
Great Ocean Road – 245km
Percentage of Great Ocean Road inundated by sea level rise with storm surge – 1%
Scale for zoomed-in townships
0 1 2 3
Kilometres

Dashboard

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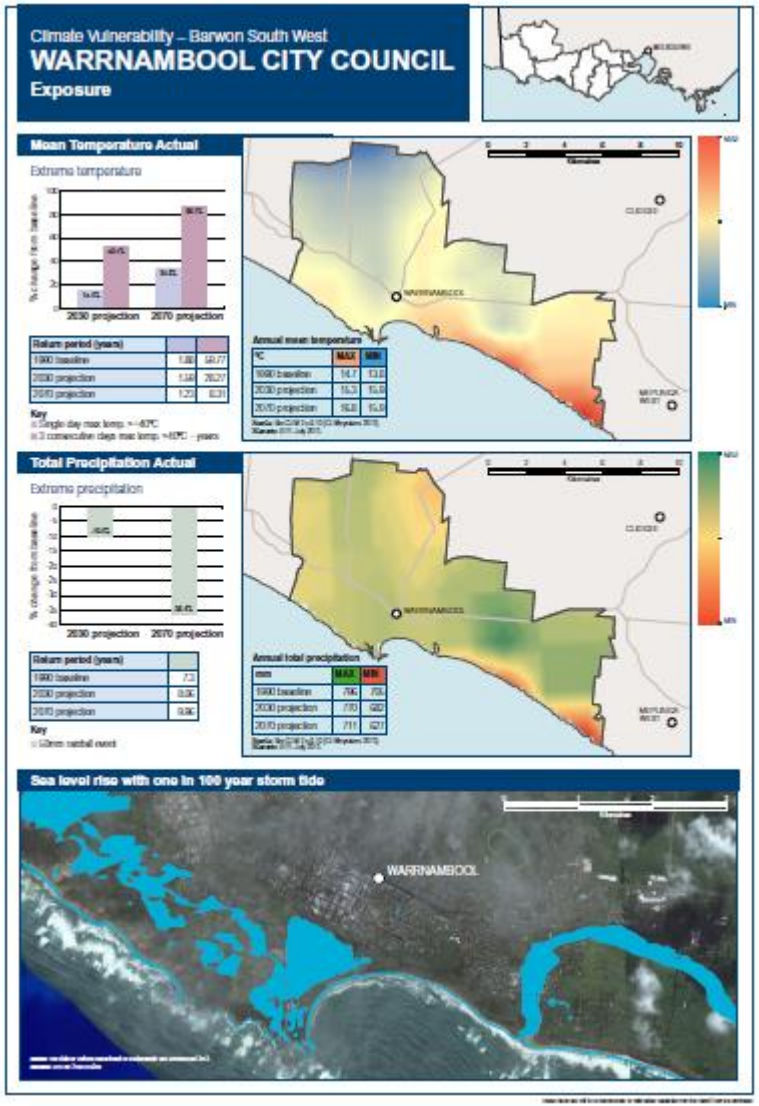
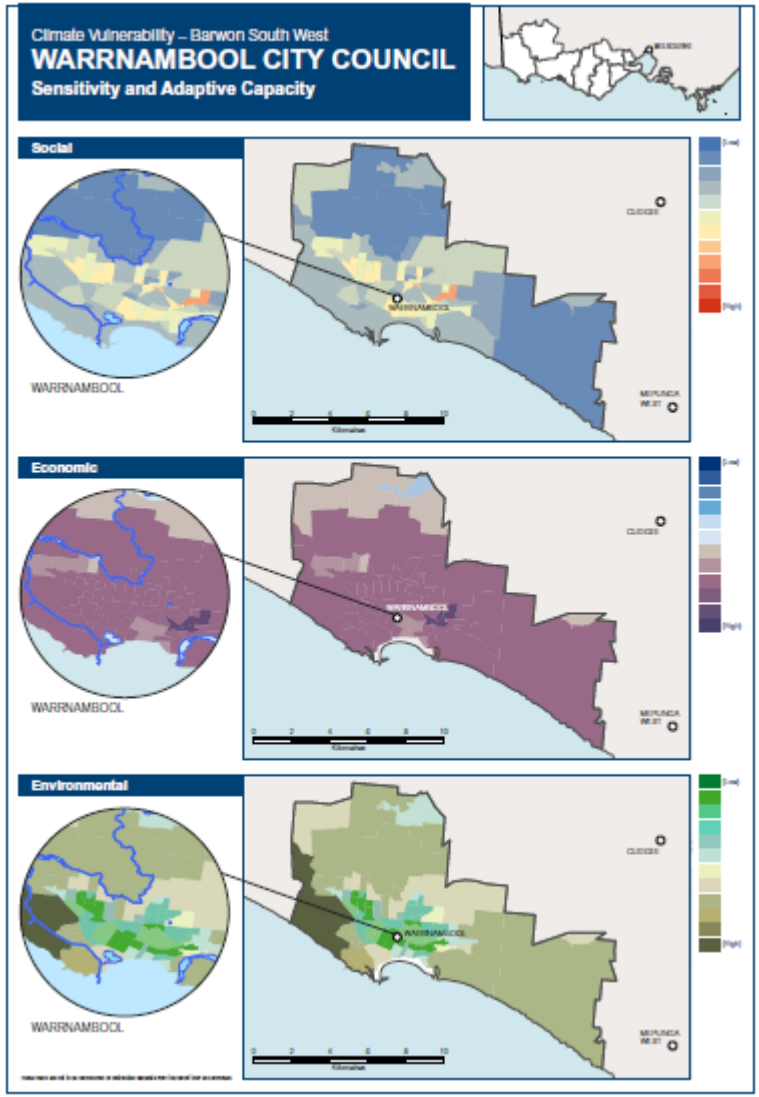
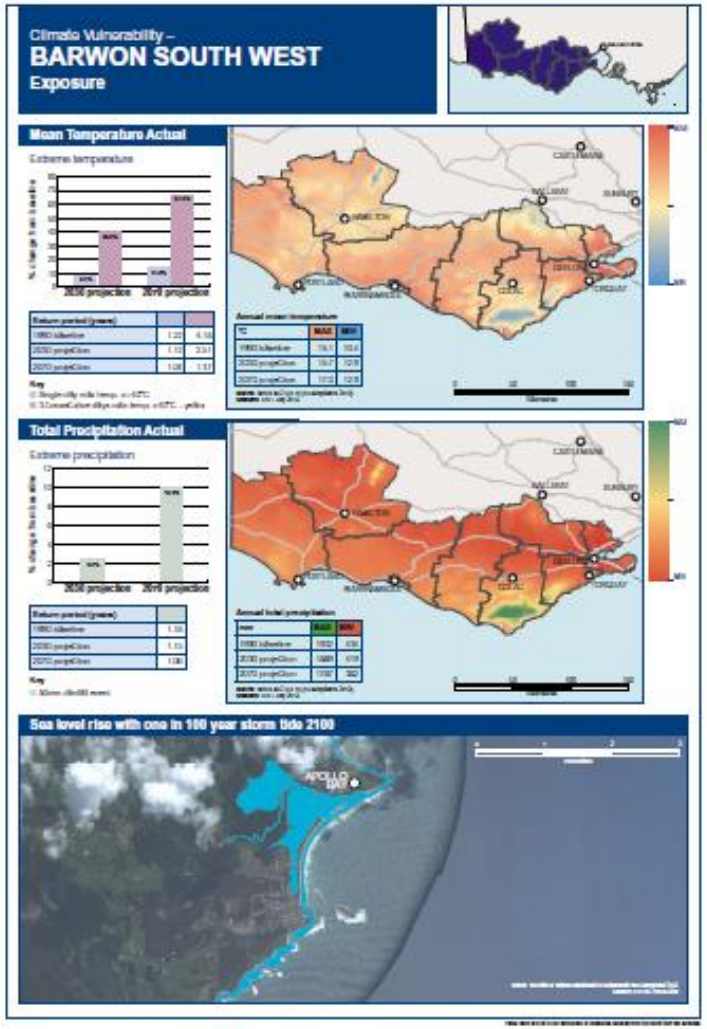
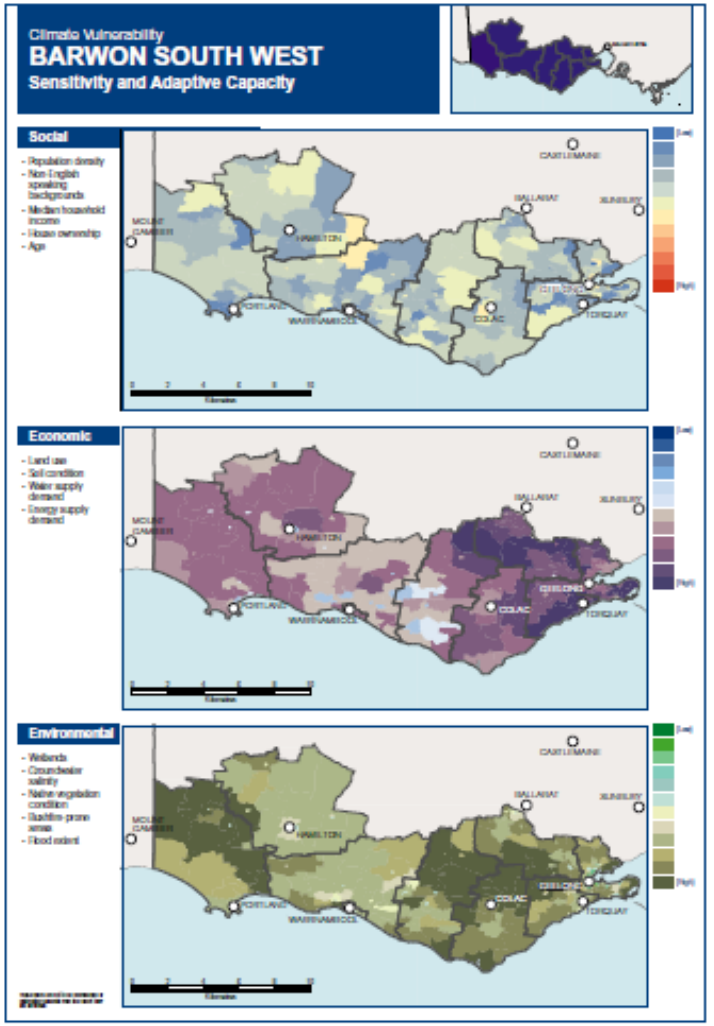




Dashboards


Climate Vulnerability –
BARWON SOUTH WEST
Exposure
Mean Temperature Actual
Total Precipitation Actual
Sea level rise with one in 100 year storm tide 2100
APOLLO BAY


Climate Vulnerability
BARWON SOUTH WEST
Sensitivity and Adaptive Capacity
Social
Economic
Environmental

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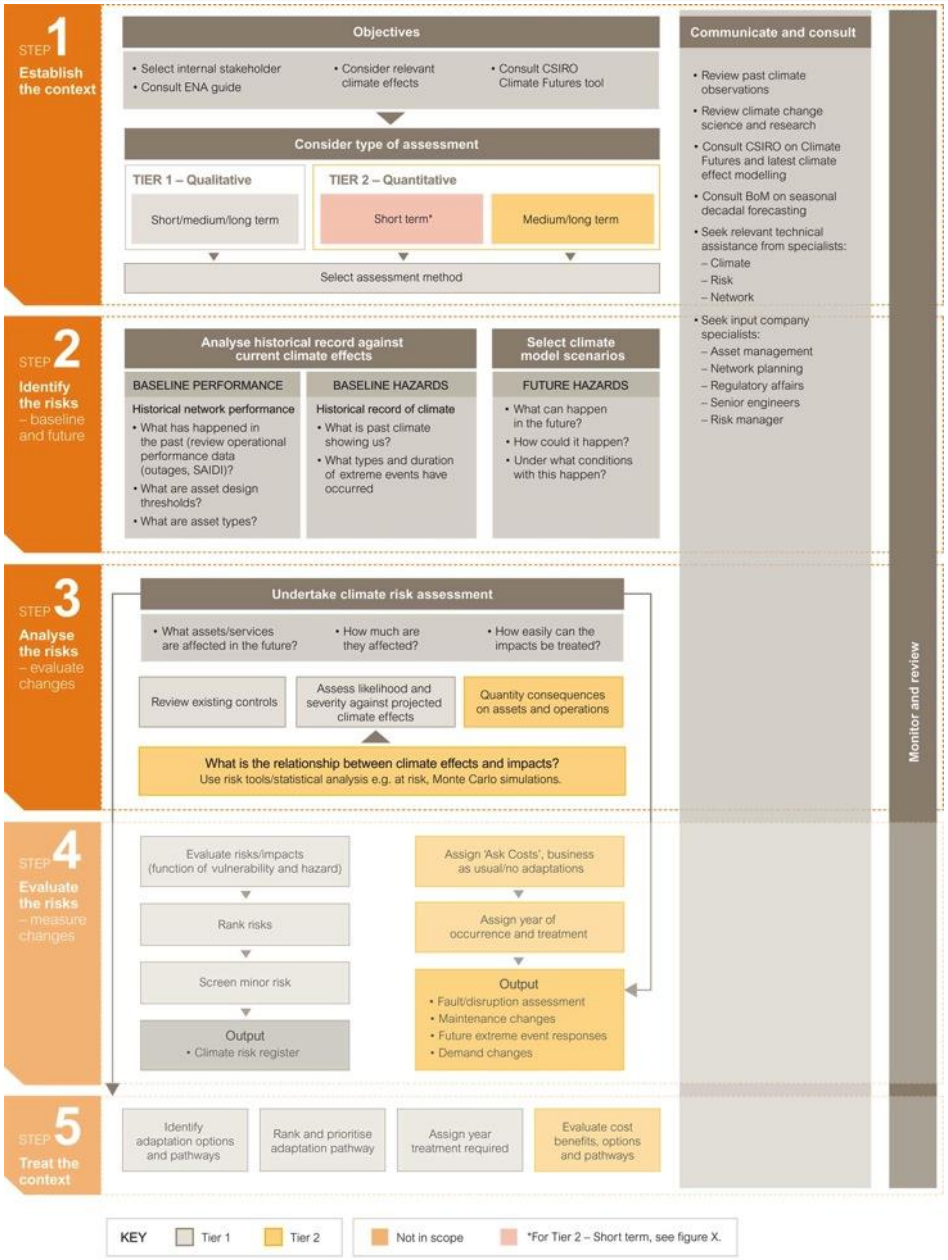
Translation – Manuals, Guidance, Decision trees

Decision Tree for network risk assessments – Tier 1 & 2 & short term



Summary of approach – climate scenarios

- After analysing all GCMs pick three to use over two time scales that cover the following climate futures:
  - » Most likely
  - » Least change
- Lower likelihood potentially high impact
- Use a high emission scenario (A2)
- Use the climate variables of mean and extreme temperature, mean precipitation and sea level rise.
- Use existing network data to inform what secondary climate variables are to be assessed.
- Use a downscaling tool if a finer spatial scale is required
- Use a temporal period appropriate for the climate variables selected.

Table 5.1 of the Climate Change in Australia – Technical Report (CSIRO & BoM 2007) lists the climate variables, years, models and emission scenarios currently available.

Availability and confidence level of climate variable data in Australia

		Confidence		
		Low	Medium	High
Availability	Low	Lightning**	Hail	Bushfire weather* Snow*
	Medium		Extreme wind Extreme precipitation* Cyclones*	
	High		Mean precipitation Mean wind speed Relative humidity Evaporation	Mean and extreme temperature Sea level rise

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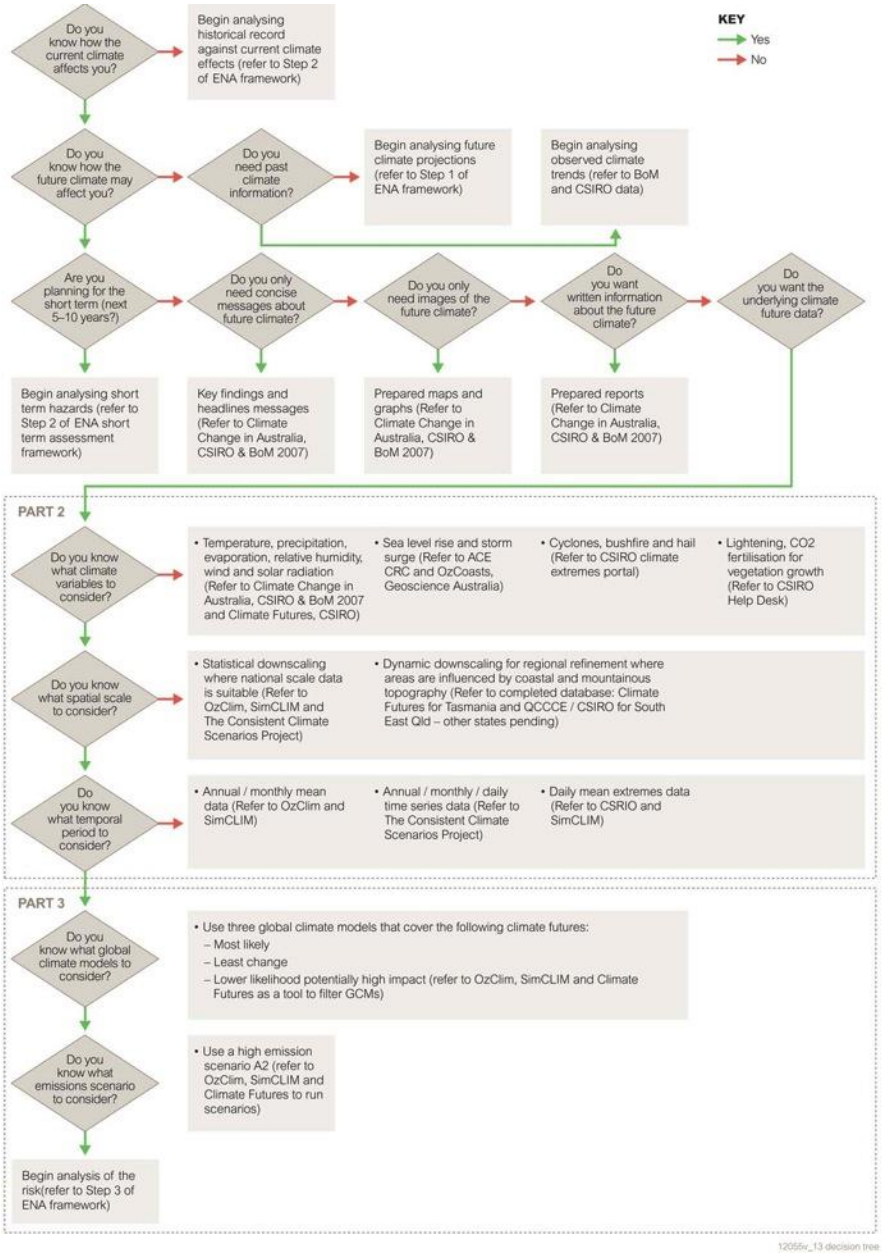
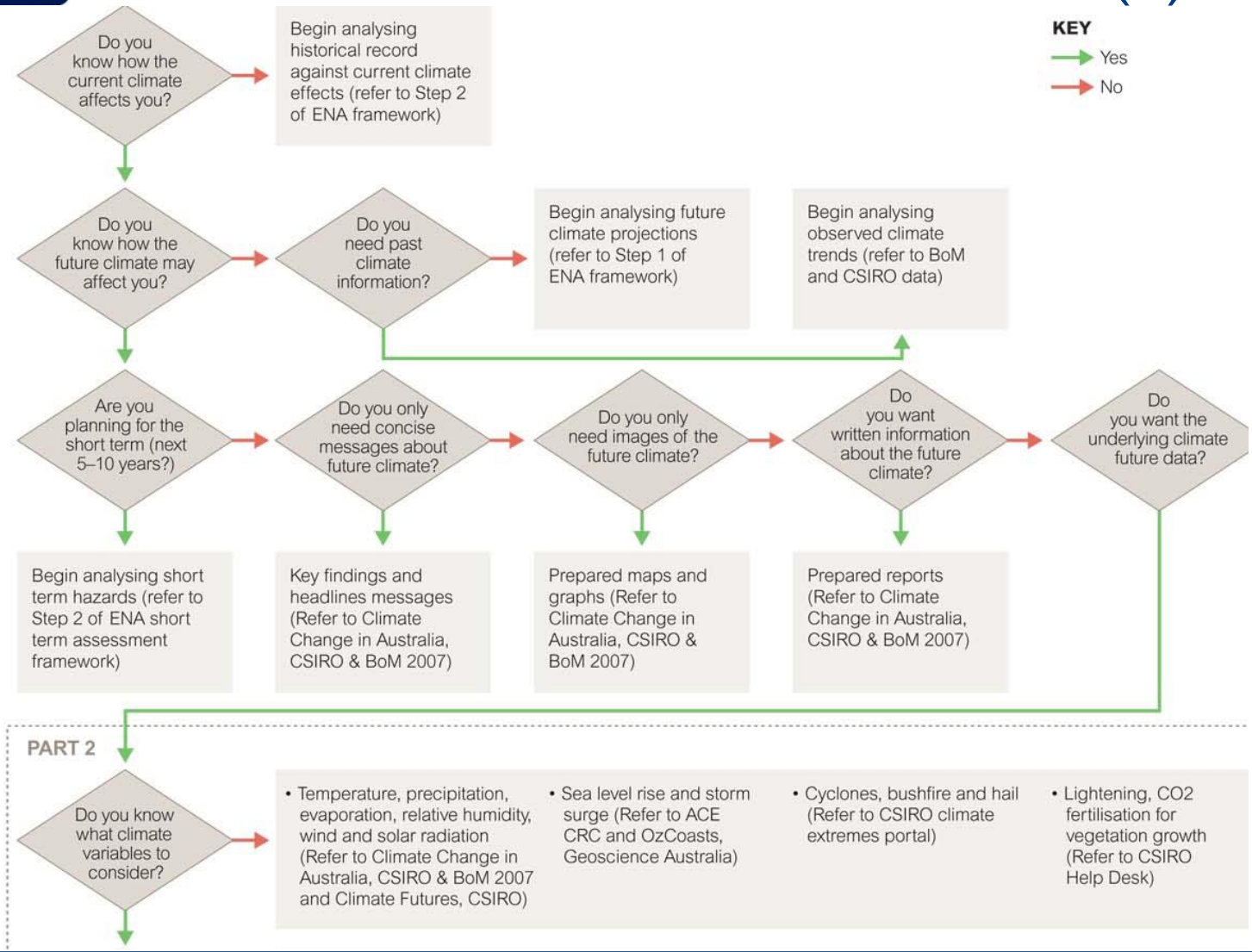
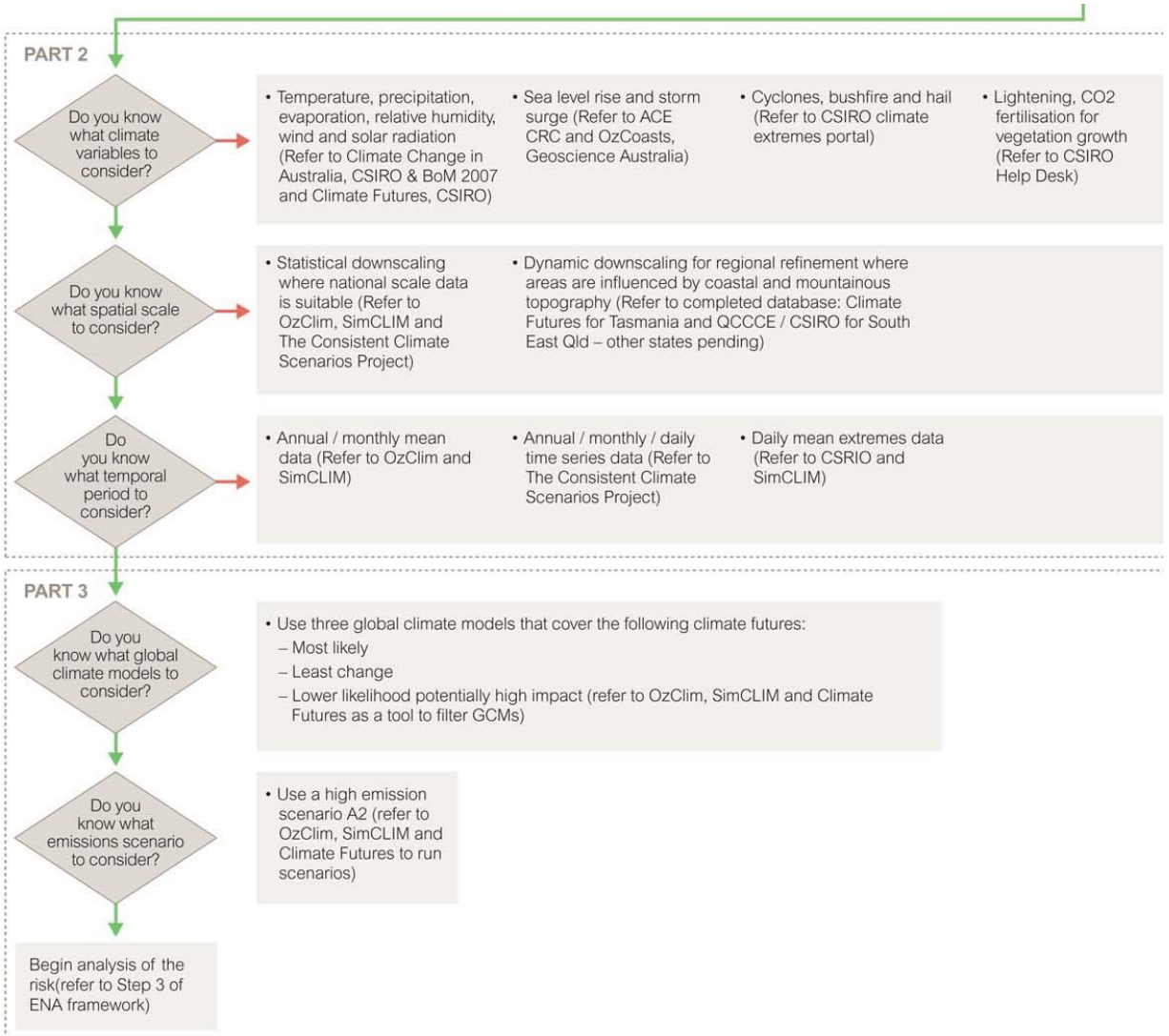
Climate Scenarios Decision Tree



Climate Scenarios Decision Tree (1)



Climate Scenarios Decision Tree (2)



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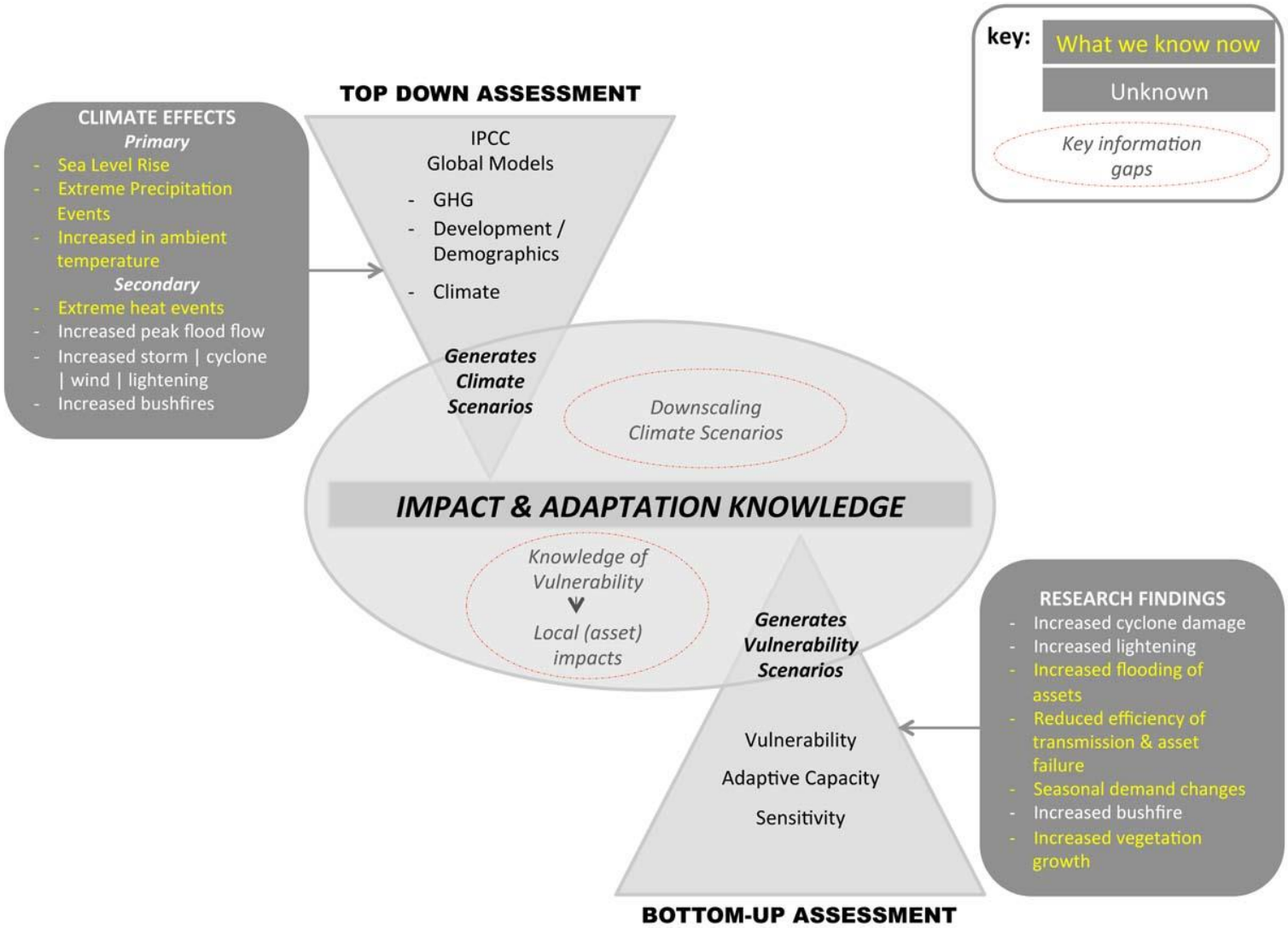
Decision centered adaptation

Decision centered adaptation



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Barriers

Key barriers to adaptation (local govt.)

- Leadership – where there is no mandate, legislative requirement, job requirements (descriptions) or public demand
- Resources – where there is limited financial, technological, information, staff expertise and time
- Communication & information – about the problem, solutions and their implications
- Values and beliefs – how people perceive, interpret and think about risks and their management, what information and knowledge they value, what concerns have credibility etc. (these have a pervasive influence through decision-making process)

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Technical & regulation issues – a ‘wicked’ challenge

Feedback on the Industry Forum

"I hope that the discussions and presentations bear fruit for the effort that ENA & Manidis Roberts invested. It seemed to me that the whole climate change adaptation topic was bogged down over the inability to agree on a set of projections and that no-one, Regulator, Government or Network Operator was going to make any progress until that was sorted out. Hopefully, hearing that message from someone else may help."

Phil West, Western Power UK

AER historical position

- AER considered that the impacts of climate change will be gradual and will emerge progressively over time, and as such the large proposed step-change increase in capital expenditures proposed was unjustified. These impacts can instead be dealt with progressively as they arise.
- The **models** are not fit for short term forecasting and the claimed effects have been rejected on this basis.
- AER accepts that climate scenarios used for Victorian effects on DNSPs are plausible – suitable for broad considerations but not short term forecasting.
- "The DNSPs had not established with certainty that any particular modeled scenario has higher or lower probability – simply being plausible is not persuasive".
- An immediate change in technical design and operations not established – AER was not convinced that industry design bodies are actively pursuing changes to design standards – a prudent operator would not unilaterally amend design.

Technical issues

- Climate Science:
  - » Fit for purpose
  - » GCMs (‘cherry picking’)
  - » Emission scenarios
  - » Extreme event modeling
  - » Downscaling

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Lessons learnt

Lessons learnt

- **Importance translation** – helps deal with climate uncertainties and acceptable risk, navigate the climate science – 'fit for purpose'
- Need for ongoing **engagement** –all relevant parties
- **'Business as usual'** and importance getting on with it….

- **Barriers :**
  - » **Resources -** Industry needs better understanding weather and impacts relationship as well as impacts projected to change in future with uncertainty estimated, $s – such as Ofgem innovation fund
  - » **Leadership/mandate -** regulatory frameworks – short term focus and limitations of methods
  - » **Values and beliefs** – most pervasive

Any questions?

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The end

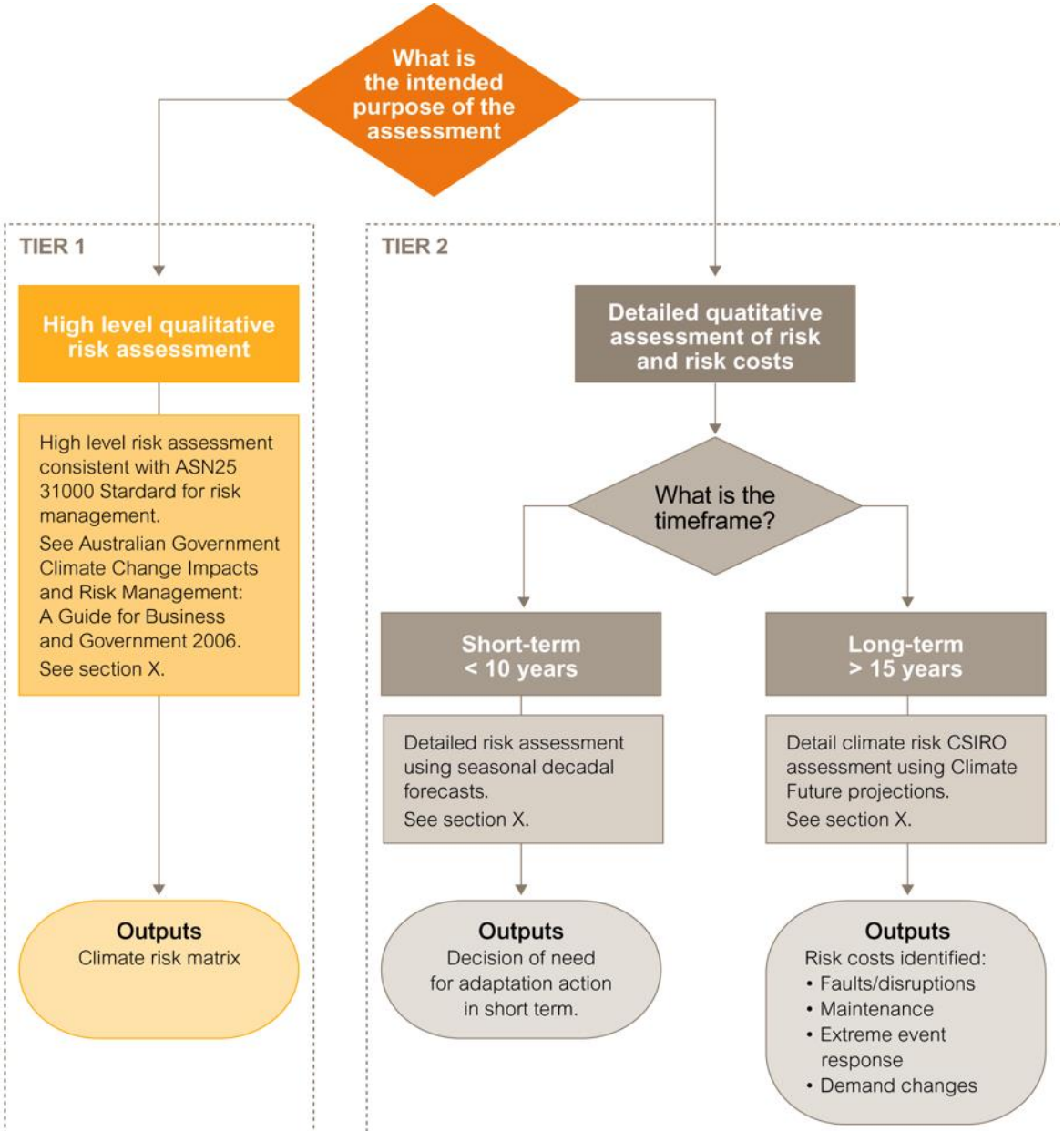
Technical issues log

Technical Issue	Response (Who, How, What) Reference approaches
Climate Science	
Fit for purpose models	• Working Group to devise criteria • Aim of ENA Guidance Manual
Principles of decision-making under uncertainty	• See World Bank paper on decision-making and climate change (2012) • ENA Industry Forum
Using GCMs	• CSIRO to advise.
Emissions scenario uncertainty	• CSIRO to advise. • How did UK Met Office deal with this?
Short term forecasting *Need daily data* *Using climate model (30yr) for short term forecasting* *Demand forecasting needs near term variability*	• See UK Met Office lesson learnt and approach. • BOM to advise on natural climate variability modelling. • ENA WG to advise on the timeframes or the Guidance Manual.
Downscaling *Availability, accuracy and variations in downscaled climate models* *Using regional climate models* *Pattern downscaling versus statistical downscaling*	• See Wilby 2012. Need to choose scenario technique to match intended application. Assessing adaptation for new infrastructure needs to be easy to apply, reflect local conditions, use recent patterns climatic change, use tools which are freely available, regional downscaling. One option to begin with evaluation to highlight vulnerability sensitivity infrastructure.
Climate variables – availability of downcaled projections (60 km grids) for Australia	• See: CSIRO Pacific Island – Climate Futures Web based tool.
Some climate variables more variable than others	• Ditto above.
Impacts	
Understanding impacts – thresholds, procedures and remedial actions	• Use UKCCRA (2012) established 37 main climate drivers for the energy sector as starting point. • Experts in Australian energy network industry input required. • See CSIRO Energy Futures project.
Regional variations in impacts	• Need to be evaluated.
Uncertainty in projections leads to uncertainty in impacts (produces range of outcomes)	• CSIRO to advise.
Climate change scenarios (multiple)	• CSIRO K Hennessey (2012) new method proposes – 3 scenarios – **Representative Climate Futures** (RCF) – Most likely, high risk and least change scenarios used. Created for each region.
Methods for estimating future probability of impacts or faults	• Experts in Australian energy network industry input required.
Uncertainty in vulnerability particular assets	• Ditto above

Technical issues log (contd.)

Extreme events *Need extreme event statistics (seasonal averages in CMs)* *Return periods longer than 10yrs needs caution*	• More research on available tools and modelling.
Gradual versus extreme event impacts	• SEE UK Met Office and energy sector and regulator response. • Also issue for ENA Industry Forum
Gradual impacts should warrant progressive action & prudent TNSP regularly study impacts	• Ditto above
Interdependencies and cross sector links	• UK CCRA used a mapping process (bespoke on-line tool) to investigate main sector interactions. • Separate exercise by ENA - Interdependency mapping may need to be undertaken.
Adaptive capacity of sector	• SEE UK Met Office and energy sector and regulator response. • Experts in Australian energy network industry input required. • Also issue for ENA Industry Forum
Assessment approaches	
Options: · Probabilistic risk approach · Event Model · Hyrid Also: Climate Informed Decision Analysis Weather faults approach	• SEE UK Met Office and energy sector and regulator response. • CSIRO to further advise. • See CIPMA approach. • See AdaptWater approach. • Also issue for ENA Industry Forum.
Flexibility – regions and businesses	• Ditto above.
Establishing a step change in impact and performance	• Ditto above (method needs to be tailored to focus on impacts where the greatest investment needed).

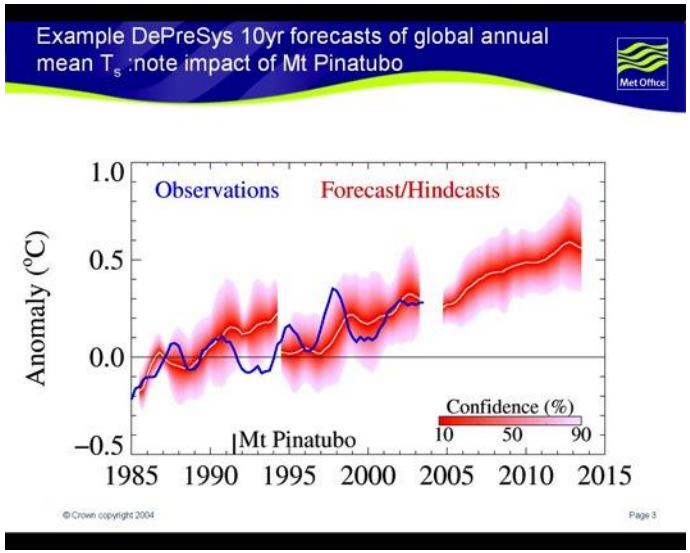
Decision Tree for network risk assessments – Tier 1 & 2, short & long term etc

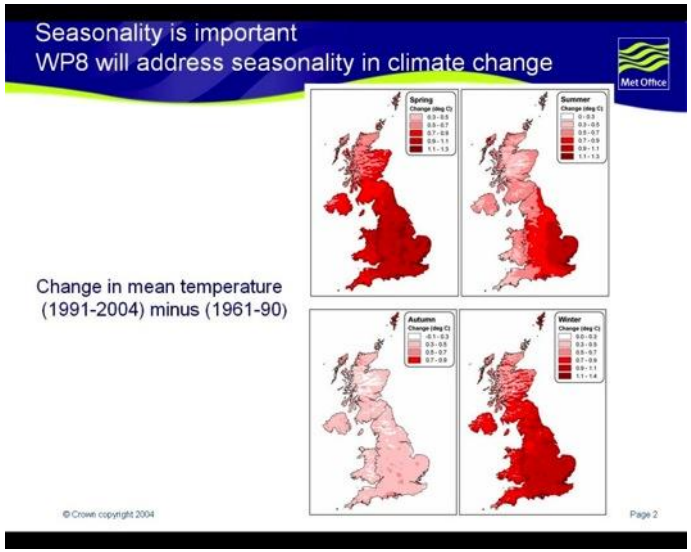


UK Met Office work

- UK Electricity Industry collaborated in commissioning major research work by Met Office on climate change impacts on network "EP2" in 2007.
- Operators advised ratings formulae – Met Office provided the climate data to input to them
- Network Operators funded this £554k research through Ofgem Innovation Funding Initiative

  (Ofgem allows up to 0.5% of annual regulated revenue to be spent through an "Innovating Funding Initiative" (IFI). Research and development under the IFI programme)





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Need for longer term Regulatory Focus

Climate Resilient Infrastructure: Preparing for a Changing Climate

At present, there remains a strong emphasis on short-term value for money, which combined with the uncertainties around the specific impacts of climate change, mean that adaptation requirements are not yet being fully addressed by economic regulators on a systematic and

consistent basis. So while in principle the economic regulatory framework is able to fund appropriate adaptation measures, in the context of securing climate resilience infrastructure for

those sectors governed by economic regulation, there is a need for a longer-term focus.

HM Government May 2011
Page 52, Pitt Review

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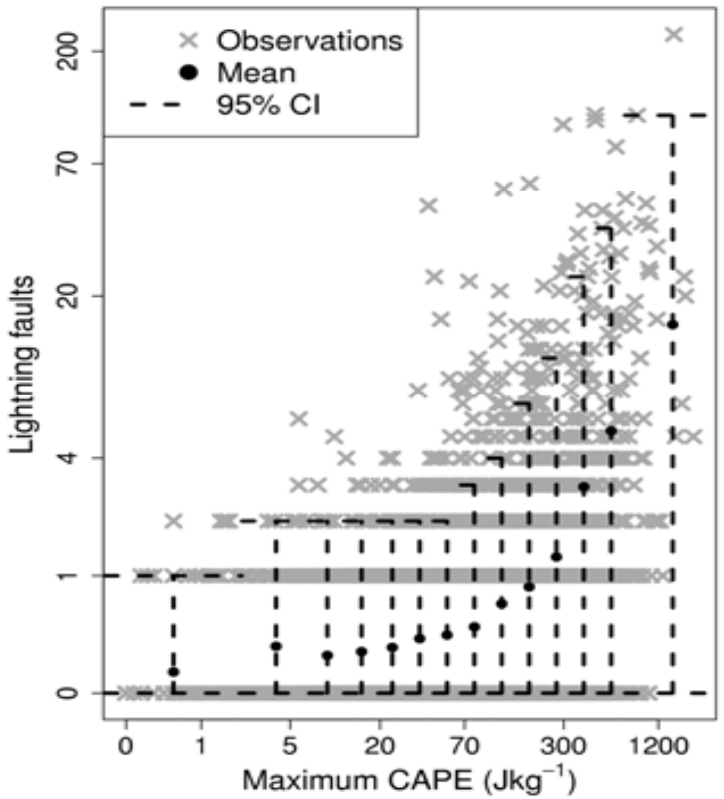
Met Office
Hadley Centre

Example Hazard results: Lightning faults



- Lightning is the second most common cause of weather-related faults across the distribution network and the primary cause in the transmission network.
- Since observations & climate projections of lightning strikes are unavailable, CAPE was found as a good alternative proxy.
- As convection in the atmosphere increases (and hence CAPE) the likelihood of lightning strikes increases.
- The relationship is non-linear and the uncertainty associated with estimating lightning faults can be high.

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