

**Exploring the Risks and Impacts of
Climate Change on Australia:
Sectoral impacts
Infrastructure and Insurance**
*Australian Climate Roundtable
27 April 2020*



Topics

Time	Topic
09:00 am	Start
09:05 am	Welcome, Overview and Purpose
09:10 am	Speaker 1: Kate Bromley, QIC – Overview of the impacts of climate change on infrastructure
09:30 am	Discussion
09:45 am	Speaker 2: Nicola Falcon, AEMO – Case study – Impacts of climate change on electricity sector
10:05 am	Discussion
10:20 am	BREAK – mute if you keep Skype running
10:30 am	Speaker 3: Mark Leplastrier, IAG – Climate change and the insurance industry
10:50 am	Discussion
11:10 am	Facilitated discussion: Implications for the Australian Climate Roundtable
12:00 pm	Close

Overview and Purpose



AUSTRALIAN CLIMATE ROUNDTABLE

KATE BROMLEY, HEAD OF RESPONSIBLE INVESTMENT

April 2020

QIC

A longstanding heritage with an established platform enabling us to become the visionary asset manager we are today.

- \$80 billion in funds under management¹
- Over 110 clients including government, pension plans, sovereign wealth funds, universities and insurers. Spanning Australia, Europe, UK, Asia, Middle East and US
- Established in 1991 by the Queensland Government to serve its long-term investment responsibilities
- Over 1000 employees with offices in Brisbane, Sydney, Melbourne, New York, Los Angeles, Cleveland, San Francisco, London and Copenhagen



● GLOBAL INFRASTRUCTURE

● GLOBAL REAL ESTATE

● GLOBAL PRIVATE CAPITAL

● GLOBAL LIQUID STRATEGIES

● GLOBAL MULTI-ASSET

¹ As at 30 June 2019. All figures in AUD.

We believe that environmental, social and corporate governance (ESG) factors can have a material impact on the long-term outcomes of investment portfolios and the assets that we invest in.

OUR AIM

- To deliver innovative yet pragmatic ways to integrate ESG considerations across the full range of asset classes we invest in, and, to keep pace with the expectations of our stakeholders.
- Strong support from the QIC Board and Executive; CEO and executives sit on the ESG Advisory Committee, chaired by a QIC Board member.
- Responsible Investment team reports to Executive Director, Client Solutions & Capital.
- Supported by ESG champions across the business to integrate ESG into day to day operations.



Supporting our over-arching strategy is our ESG Framework. This framework provides a common platform for our teams to address what we believe are the most material ESG issues for our investment portfolios. Our six areas of focus are:

Climate Risk	Environmental Sustainability	People	Community	Corporate Governance	Active Ownership
<ul style="list-style-type: none">• Adaptation to physical impacts• Impacts of transition to a low carbon economy	<ul style="list-style-type: none">• Environmental impacts• Resource efficiency• QIC's own footprint	<ul style="list-style-type: none">• Workplace health and safety• Labour rights• Human rights in supply chains• Diversity and inclusion	<ul style="list-style-type: none">• Community engagement• Indigenous partnerships	<ul style="list-style-type: none">• Board leadership• Culture• Transparency and disclosure• Risk management	<ul style="list-style-type: none">• Active asset management• Corporate engagement• Proxy voting

Infrastructure is a diverse asset class. We look to assess how well prepared portfolio companies are in understanding and preparing for current and evolving climate risks.

TRANSPORT

- Physical risk to the asset can occur directly or in the form of supply chain disruption.
- Direct impacts can result in a disruption to operations as well as physical damage to an asset.
- Changing weather patterns and extreme weather events could have operational impacts, e.g, intense rainfall increasing the rate of sedimentation, leading to more frequent dredging at a port.

UTILITIES

- The nature of utility assets can provide a natural hedge against physical climate impacts.
- Some assets can have a material portion of their asset base underground (e.g. gas storage, gas pipelines).
- Renewable energy generation assets can be located and engineered to be robust to a range of physical extremes.
- Electricity distribution networks can be exposed through large and diverse geographical footprints.

ENERGY

- With the energy sector being a key contributor of greenhouse gas emissions in most developed economies, the strategic impacts of climate change in the form of energy and climate change policy are also a material consideration.

OVERVIEW OF CLIMATE-RELATED ISSUES

The long-term nature of infrastructure assets requires that investors understand the risk and opportunities arising from the impacts of climate change.

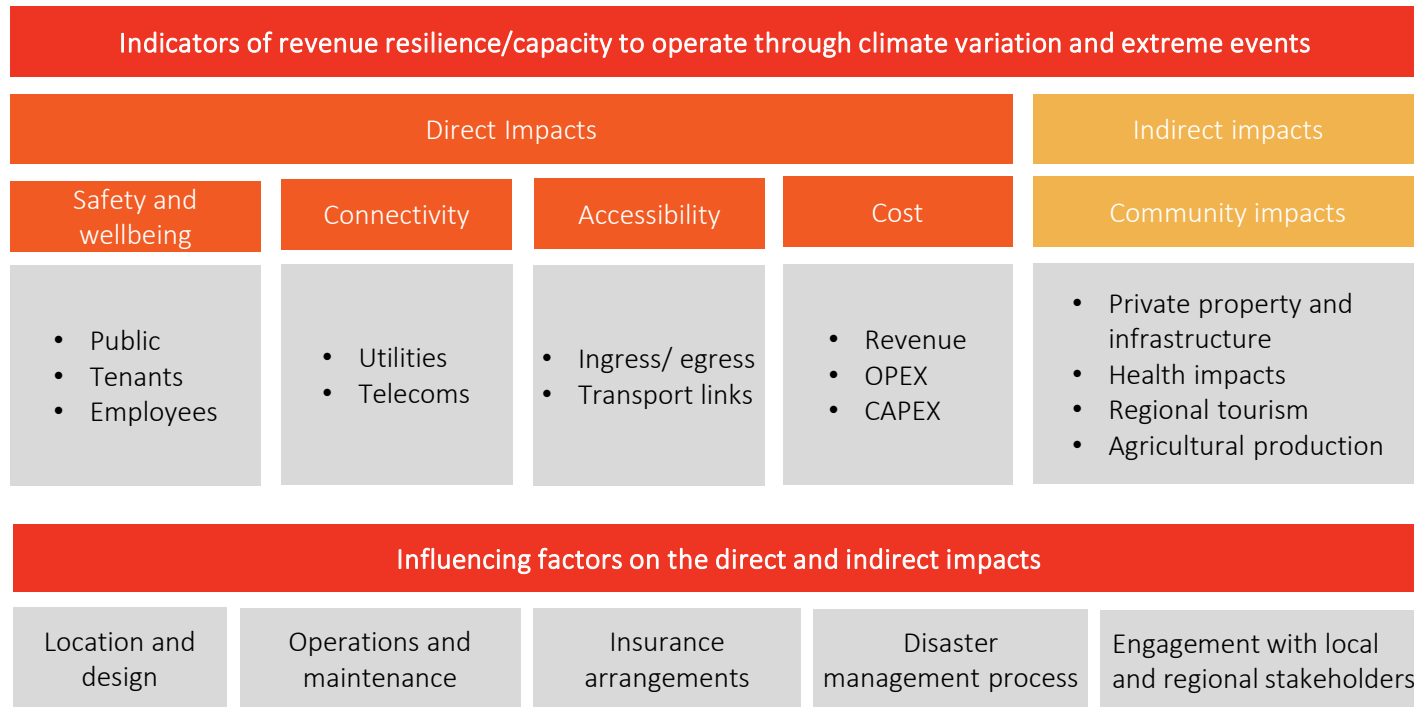
Issue	Potential impact
Damage to physical assets	<ul style="list-style-type: none"> • Increased capital costs to rectify damage • Potential loss of revenue if services disrupted
Increased adaptation costs	<ul style="list-style-type: none"> • Increased capital costs to implement adaptation strategies • Increased operational and maintenance cost • Incorporate assessment of climate risks into maintenance cycles • New facilities incorporate climate resilience in design
Operational disruption	<ul style="list-style-type: none"> • Adverse revenue impacts from weather disruption • Additional operations and maintenance costs • Higher insurance costs • Infrastructure interdependencies
Employee safety	<ul style="list-style-type: none"> • Extreme weather can increase risk to works e.g. extreme heat days can result in risk of heat stress for workers which could increase the risk of injuries on site and in turn lower productivity.
Increased weather volatility	<ul style="list-style-type: none"> • For example, changes in temperatures may reduce agricultural production in any given area, and consequently reduce demands on related infrastructure such as ports and rail.
Reputational risk	<ul style="list-style-type: none"> • Failure to provide services or restore services in a timely manner can materially impact the businesses reputation and social license to operate. In addition, there is a risk of fines being levied, operating licenses lost or increased regulatory oversight
Regulatory change / Policy uncertainty	<ul style="list-style-type: none"> • Increased regulatory focus on resilience in infrastructure could cause exposure to increased capital expenditure to implement adaptation strategies.
Macroeconomic risks	<ul style="list-style-type: none"> • Disruptions in global supply chains • International conflict from resource scarcity

PHYSICAL RISKS AND OPPORTUNITIES

We assess the climate resilience of portfolio assets both from a physical and revenue resilience perspective. Understanding climate projection is only part of the process to understanding climate risk, the impact on the business is key.

Asset specific approach

- Physical climate risk is highly location specific which is why we are developing an asset-specific assessment that combines historical analysis, scenario analysis and modelling.
- Developed a repeatable process designed to systematically assess a consistent set of climate variables at asset level to understand the direct and indirect impacts of climate change.



ACTIONS TO BUILD RESILIENCE

We're interested in how variations in the climate bear out in terms of revenue resilience, safety and wellbeing and our reputation as a fund manager and our clients' reputation.

Determining our approach

- After an initial climate risk assessment of our assets we undertook industry engagement to build our asset-specific resilience assessment
- Significant gaps between what Global Climate Models are designed to do and demands from businesses
- We use the TCFD categories of physical climate risk (chronic and acute) to determine our actions in building the physical resilience of our assets

Physical climate risk actions



KEY ISSUES FOR INFRASTRUCTURE IN BUILDING PHYSICAL RESILIENCE



STANDARDS AND GUIDELIENS

- No set guidance or standards for assessing the physical resilience of infrastructure
- Standards currently applied to infrastructure assets and portfolios include ISCA's Infrastructure Sustainability rating, the Green Building Council of Australia's Green Star rating, and the Global Real Estate Sustainability Benchmark (GRESB) Infrastructure Fund Assessment.



CLIMATE CHANGE IMPACTS AT REGIONAL/LOCAL LEVEL

- Climate change impact at larger geographical scales and over the long-term are well understood, however there are nuances and difficulties at understanding the impacts at a regional and local level. Different infrastructure projects, and classes of infrastructure assets, face unique challenges.
- Planning for these risks may mean building infrastructure to different standards, or considering different options for the nature, operations or location of an asset.



BEYOND THE PHYSICAL IMPACTS

- Some infrastructure assets face many impacts beyond just the physical: economic losses, businesses disruption, supply chain shocks, ripple effects, city construction and design (urbanisation with increase of non-permeable surfaces/lack of drainage creates additional flood risk)



INFRA IN A NET ZERO CARBON FUTURE

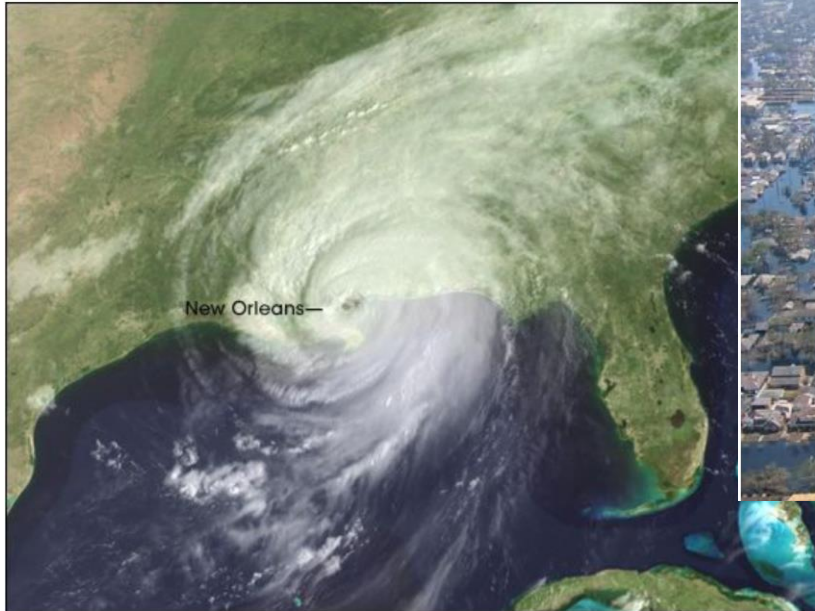
- 70% of GHG in Australia directly attributable or influenced by infrastructure
- Infrastructure assets built and managed today will still be operating in 2050 when countries are expected to reach net zero emissions under the Paris Climate Agreement. All Australian states and territories have set commitments or aspirations to reach net zero emissions by 2050.
- Infra that is unprepared for net zero emissions risk becoming 'stranded' assets and face unanticipated losses of value



ASSOCIATED COSTS

- Responding to climate change risks is becoming critical for accessing capital markets – flow on impact to insurance premiums, credit risks and portfolio value-at-risk
- Infrastructure that is incompatible with net zero emissions in 2050 will face a restricted pool of financing and insurance.
- Infrastructure that aligns with sustainability outcomes, such as net zero emissions, can sometimes involve higher upfront capital costs than traditional infrastructure – often more than compensated for by savings in operational costs (energy use and maintenance).

Hurricane Katrina 2005



“Hurricane Michael officially more powerful than Hurricane Katrina. Hurricane Katrina killed more than 1,000 people due to infrastructure failures and mismanagement of emergency resources, not because of where it sat on the records charts.”

Live Science 2018

CASE STUDY: BRISBANE AIRPORT - CLIMATE RESILIENT DESIGN

Brisbane Airport's New Parallel Runway was designed for the ongoing continuity and long-term viability of operation of the runway.

Key climate considerations and design features

- **Runway height** - the height above sea level of the runway became the major climate change related design issue. The final design had to take account of historic and projected severity and frequency of sea level rise, storm surge and local/regional flood event as well as the cost of mitigation (e.g. raising the height of the runway).
- **Sea level rise** and increased frequency of cyclonic events was addressed by incorporating a 400 mm allowance + 500 mm additional wave set up freeboard in the hydrological modelling
- Consideration of **temperature increases** in future decades was accounted for in the ultimate length planning for both the existing main runway and for the new runway, each of which had significant additional lengths available to be added in the future



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Climate impacts on the electricity sector

Nicola Falcon, GM Forecasting
Australian Climate Roundtable April 27

Agenda

1. Electricity system vulnerabilities to climate change
2. Quantification system/customer impact challenges
3. Heat case study example
4. Options for building power system resilience

Electricity sector vulnerabilities

Individual electricity sector assets have climate vulnerabilities that may damage equipment or reduce cashflows.

The electricity system as a whole is particularly vulnerable to **coincident and compound** climate impacts, potentially impacting system reliability during extreme weather conditions when customers are most vulnerable.



Electricity sector vulnerabilities

Hazard	Electricity System Implications
Temperature (increases in average, maximums & heatwaves)	Reduces generator and network capacity, and increases failure rates while simultaneously increasing customer demand for cooling load. Increases the rates of electrical asset deterioration, increasing failure rates or maintenance/replacement costs. Extreme temperatures require consideration for asset design specifications.
Bushfire (increase in the frequency and magnitude of fire danger weather)	Poses a threat to all assets, with a particularly high operational risk to transmission lines due to smoke. Requires consideration in line route selection and design.
Wind (possible reduction in average and likely increase in the frequency and magnitude of destructive gusts)	Affects wind generation output, plant profitability and design specifications. Requires consideration for network capacity assessments, design specifications and failure rates.
Precipitation / Dam inflows (likely reduction in average, likely increase in extreme precipitation events and flooding)	Reduces water available for hydro generation. Increases requirement for desalination loads. Extreme events require consideration for asset design specifications and expected failure rates.
Coastal Inundation (increase in sea level)	Some low-lying generation, distribution and transmission assets may be impacted.

Quantifying customer outcomes

The electricity sector is highly quantitative and regulatory processes require a customer focus in decision making.

The availability of strategic system redundancy and operational flexibility means that the relationship between climate impacts and customer outcomes is highly non-linear.

But low probability high impact 'tail risks' are likely to become more probable, and possibly higher impact as coincident climate impacts arise.

AEMO makes investment recommendations on behalf of society, we therefore need to make prudent decisions to minimise these risks considering substantial uncertainty, including climate uncertainty.

Severe cyclones are spreading further south and it could mean tens of billions in damages

Background Briefing By Geoff Thompson

Updated 6 Mar 2020, 12:16pm

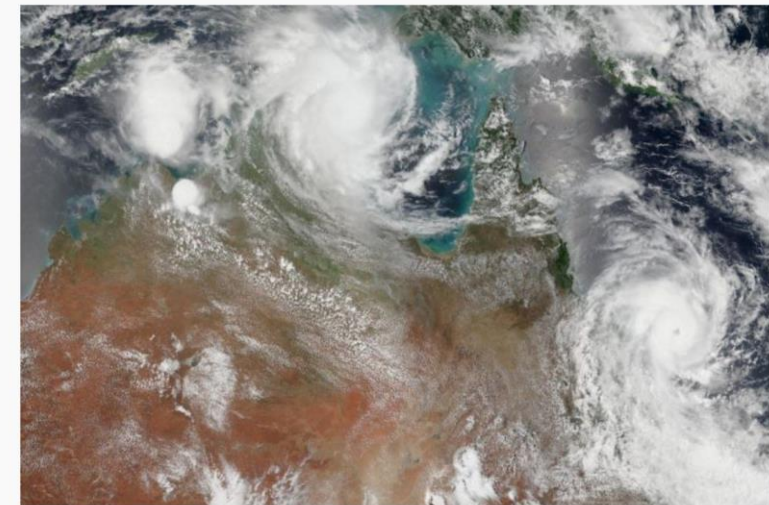


PHOTO: Australia's largest general insurer is warning climate change has dramatically increased the risk from severe cyclones. (Supplied: NASA)

The chance of a devastating category four cyclone hitting Brisbane, the Gold Coast and northern NSW, causing tens of billions of dollars in damage, is higher than ever, according to Australia's largest general insurer.

These severe cyclones, with wind speeds of up to 225-279 kilometres per hour, are more powerful than most houses in these areas can withstand.

RELATED STORY: 'Life is tough enough': Northern Australians ditch insurance as premiums soar

RELATED STORY: ACCC wants insurance overhaul for northern Australia as prices soar

RELATED STORY: Sophie felt lucky when a bushfire narrowly missed her home — then her insurance bill arrived

Key points

Heat case study

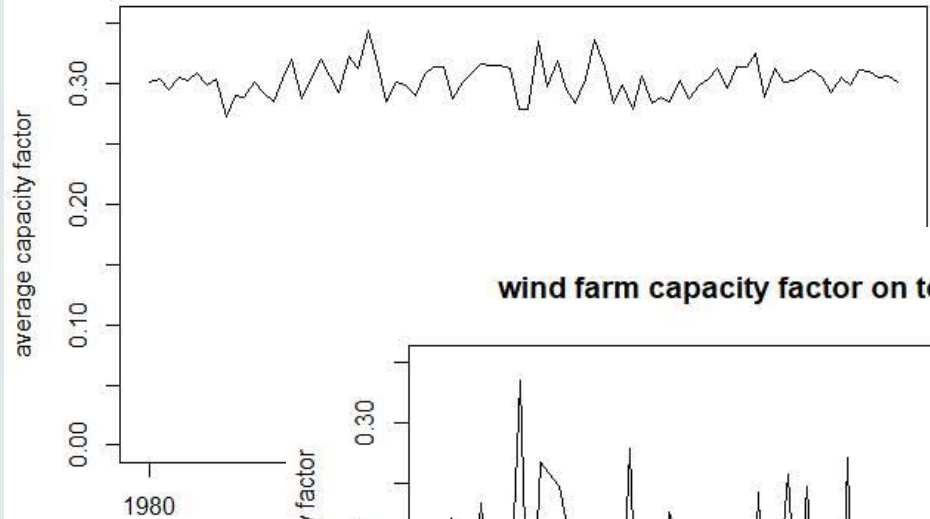
Early work to identify electricity sector vulnerabilities identified heat impacts on solar and wind farms as a major risk, given that both reduce output as temperatures rise.

The vulnerability impacts reliability and investment risks.

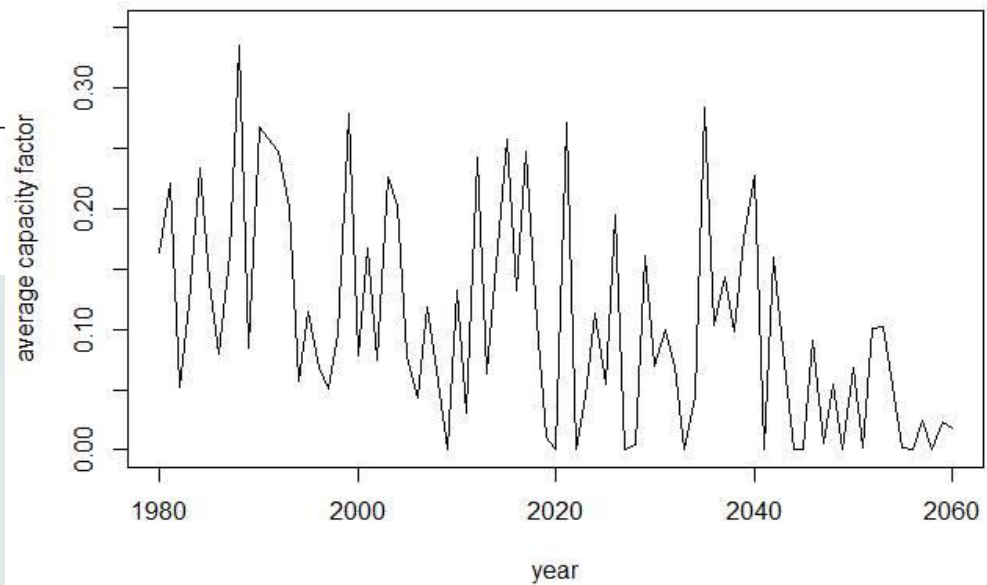
- Investment may be impacted by reductions in revenue for owners (output.price).
- System reliability may be impacted if output is lower than expectation during peak demand periods. (Peak demand and peak price occurs in high temperature periods).

Heat case study

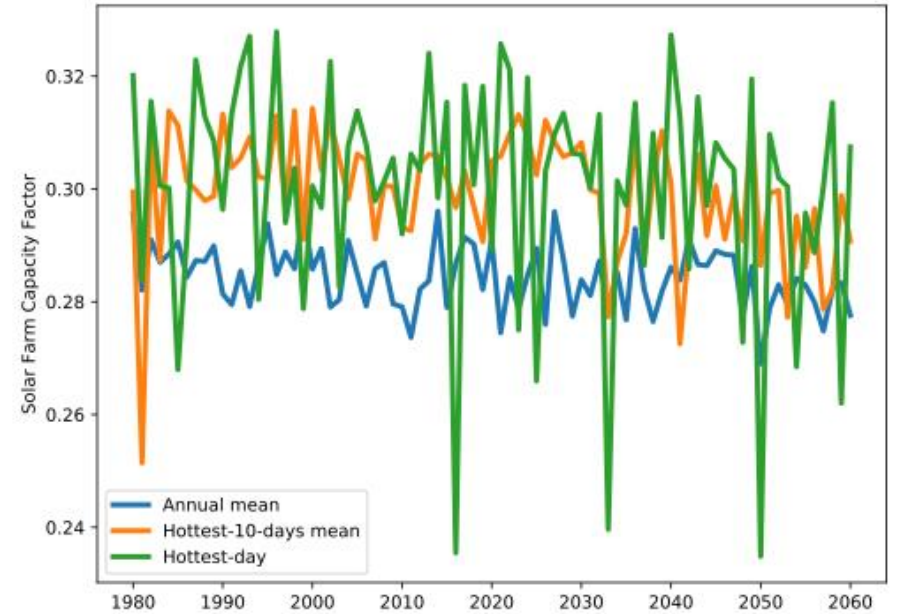
average annual capacity factor



wind farm capacity factor on top 3 hottest days



Solar Farm Output – Broken Hill



Heat case study

Investment Risks

- Average output shows no significant trend and reductions in peak demand are unlikely to be material investment given the relatively few periods in questions.
- Can be mitigated with more robust specifications, at a cost.

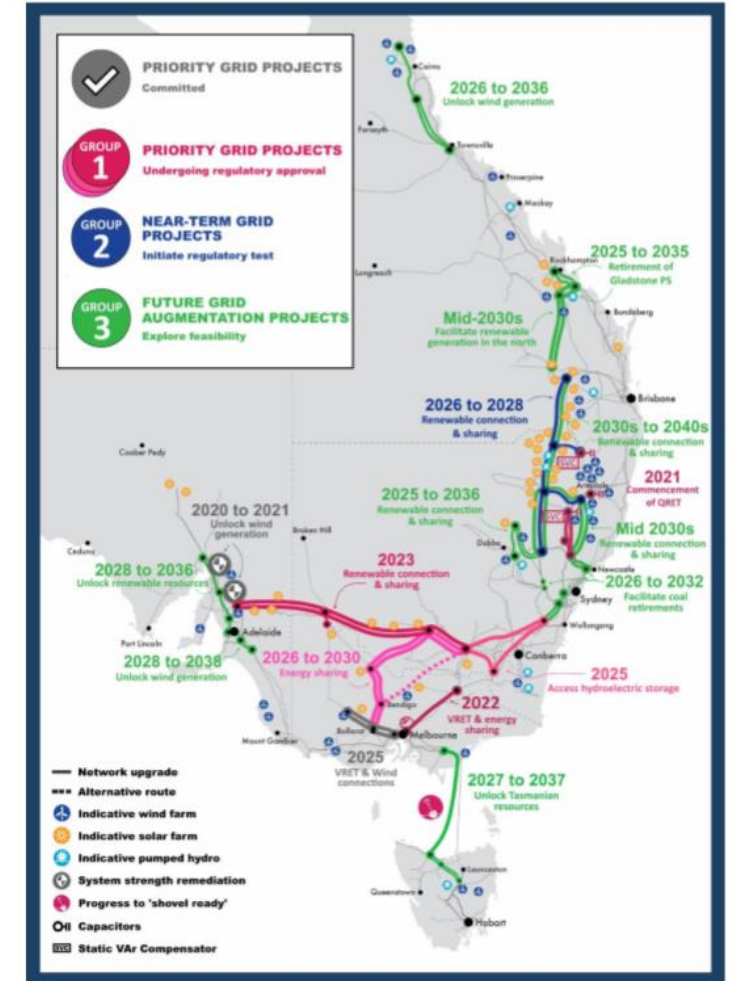
Reliability Risks

- Reductions in output during peak demand may decrease system reliability, increasing outages experienced by customers.
- Can be mitigated with more dispatchable generation capacity, or transmission investments to link generation in regions with less impact, at a cost.

The Integrated System Plan

- The Integrated System Plan (ISP) is a whole-of-system plan that provides an integrated roadmap for the efficient development of the National Electricity Market (NEM) over the next 20 years and beyond.
- Its primary objective is to maximise value to end consumers by designing the lowest cost, secure and reliable energy system capable of meeting any emissions trajectory determined by policy makers at an acceptable level of risk.
- The 2020 ISP integrates the effect of reducing dam inflows on hydro output, and the effect of increasing temperatures on customer demand.
- In the longer term, once climate data is available, all identified climate risks would be managed and mitigated alongside other uncertainties like renewable generation developments, customer demand, and asset performance.

Figure 1 The development paths for the NEM in the Draft 2020 ISP¹⁷



Options for building power system resilience

Investments that maximise power system resilience at little additional cost to consumers are ideally prioritized – do no harm



Increase asset design specifications



Increase system redundancy and operational flexibility



Increase system restoration capability



Build tolerance in other infrastructure (water, telecommunications, social etc)



Build societal tolerance of high impact outages

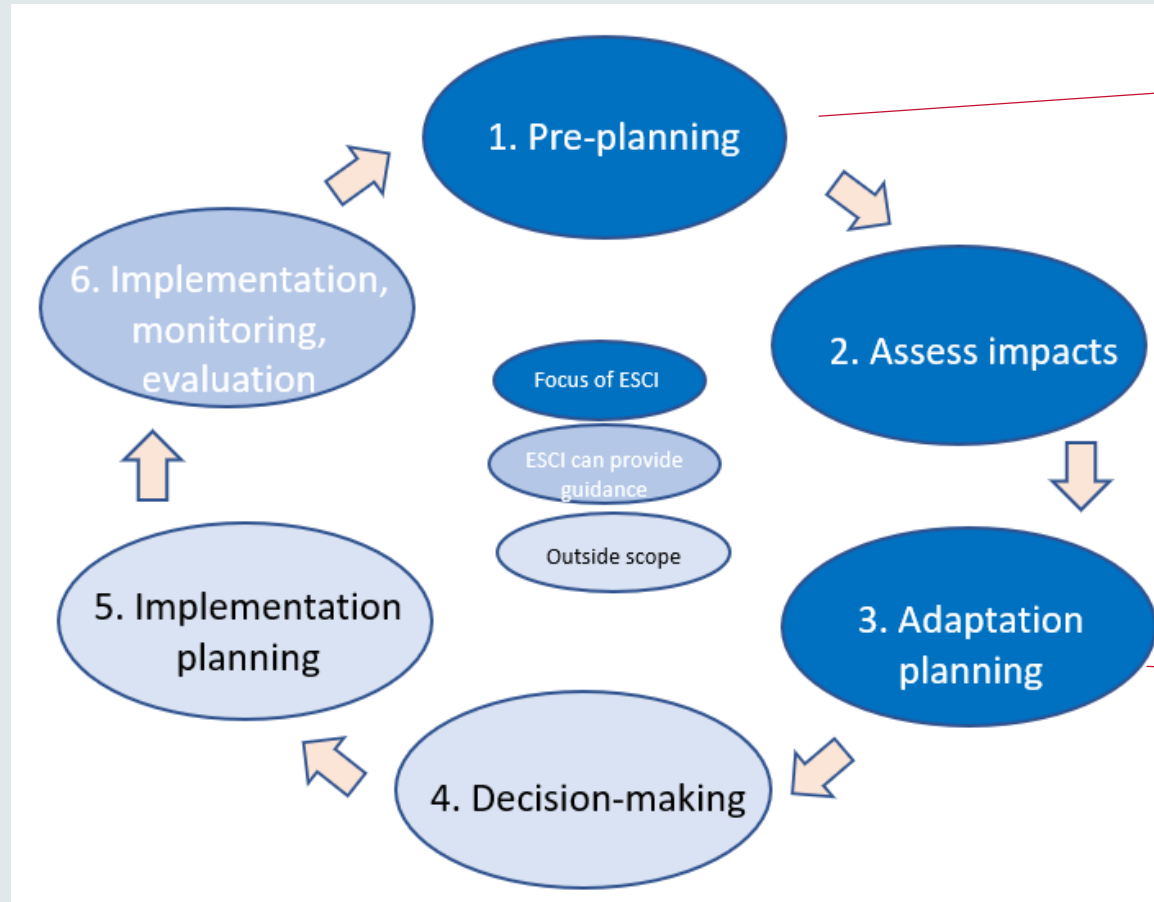
Without tailored climate information, it may remain challenging to justify the geographic diversity and fuel/technology diversity required to minimise the joint probability of simultaneous climate and other operational impacts

Electricity Sector Climate Information (ESCI)

Collaboration between AEMO, CSIRO and BOM, over three years from 2018-19 to 2020-21.

- Funded by the Department of Environment and Energy (now Department of Industry, Science, Energy and Resources) for \$6.1m.
- Designed to uplift climate risk management for AEMO and the broader electricity sector.
- Incorporates risk frameworks, guidelines, training and tailored data products.
- Involving numerous target users including AEMO forecasters, planners and operations, NSPs and generators.

Electricity Sector Climate Information (ESCI)



Understand decision-making processes and identify vulnerabilities:

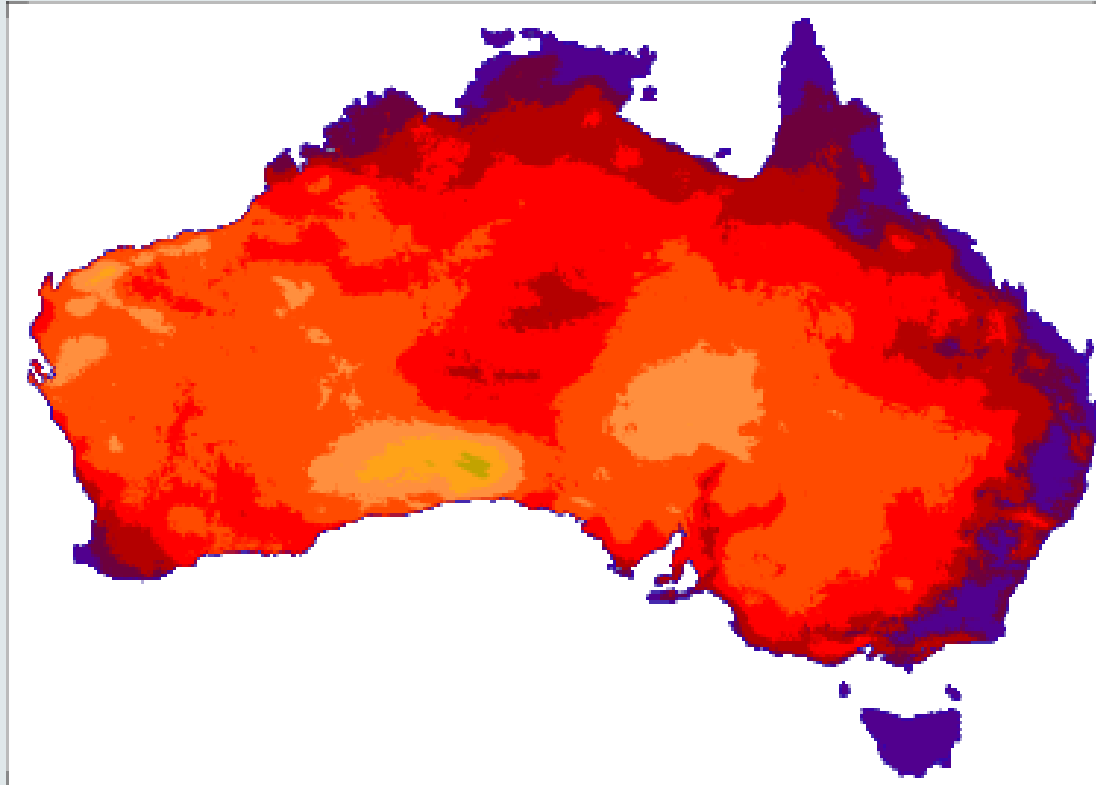
- Operating risk
- Reliability and security
- Investment risk

Use tailored climate information to scan for and quantify physical impacts

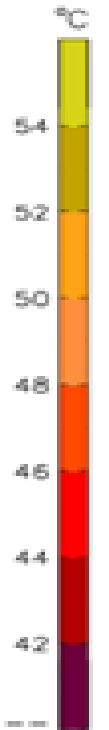
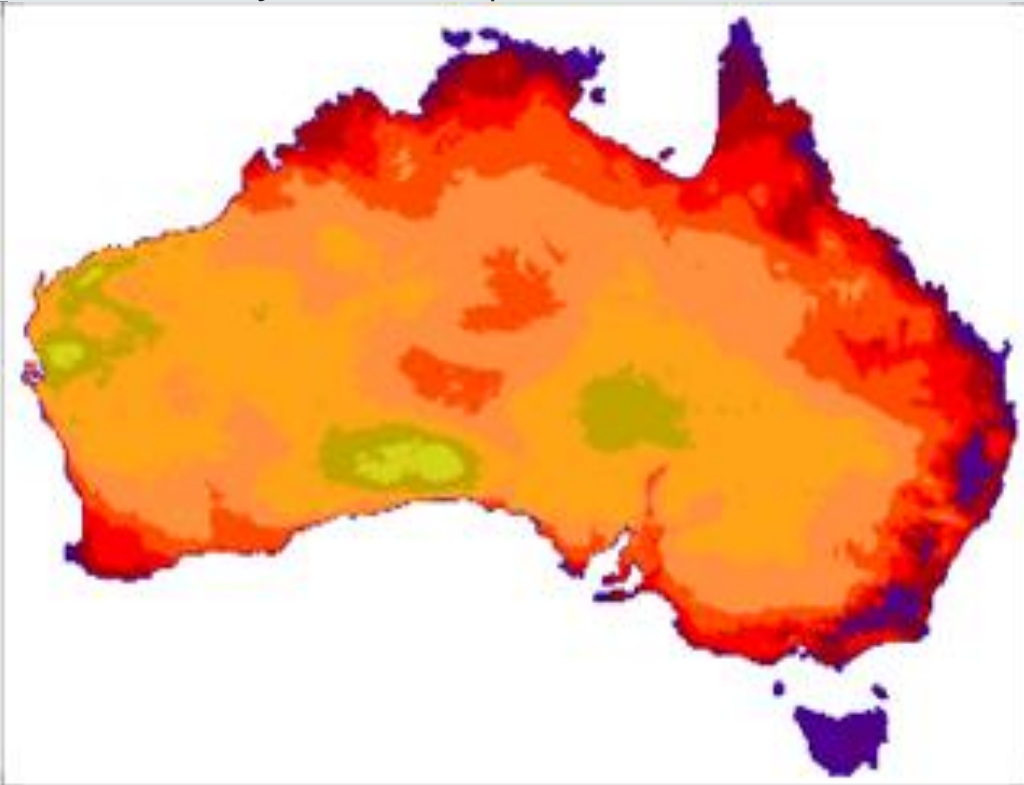
Generate adaptation pathways
Quantify and evaluate against objectives
Identify system changes needed

Electricity Sector Climate Information (ESCI)

1in10yr max temp 1961 – 2020



1in10yr max temp 2021 – 2080



Questions

Break

Mute your microphone





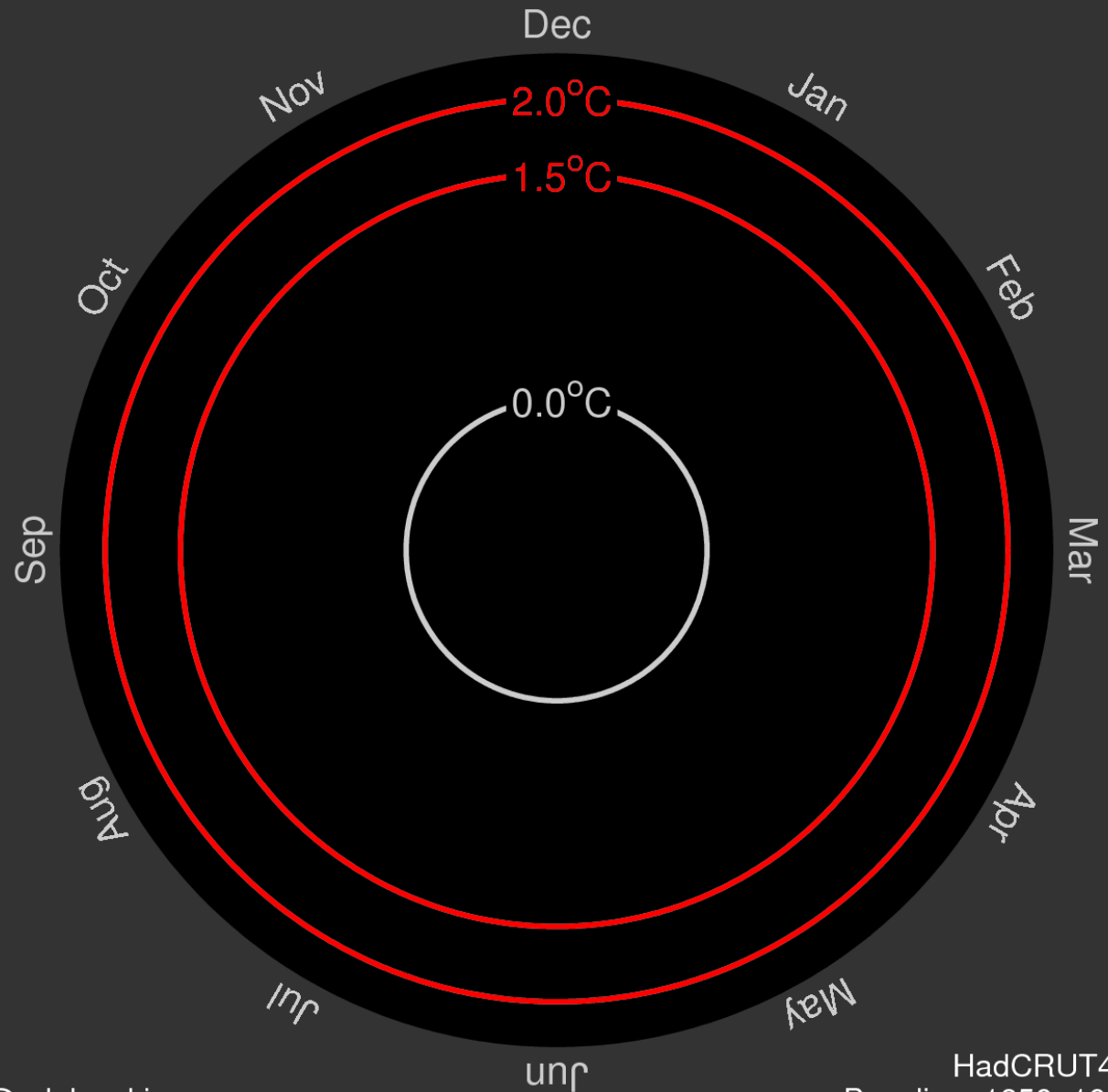
Severe Weather in a Changing Climate

Mark Leplastrier
Executive Manager Natural Perils

27th April 2020



Global temperature change (1850–2017)



@ed_hawkins

HadCRUT4.6
Baseline: 1850–1900



Severe Weather in a Changing Climate

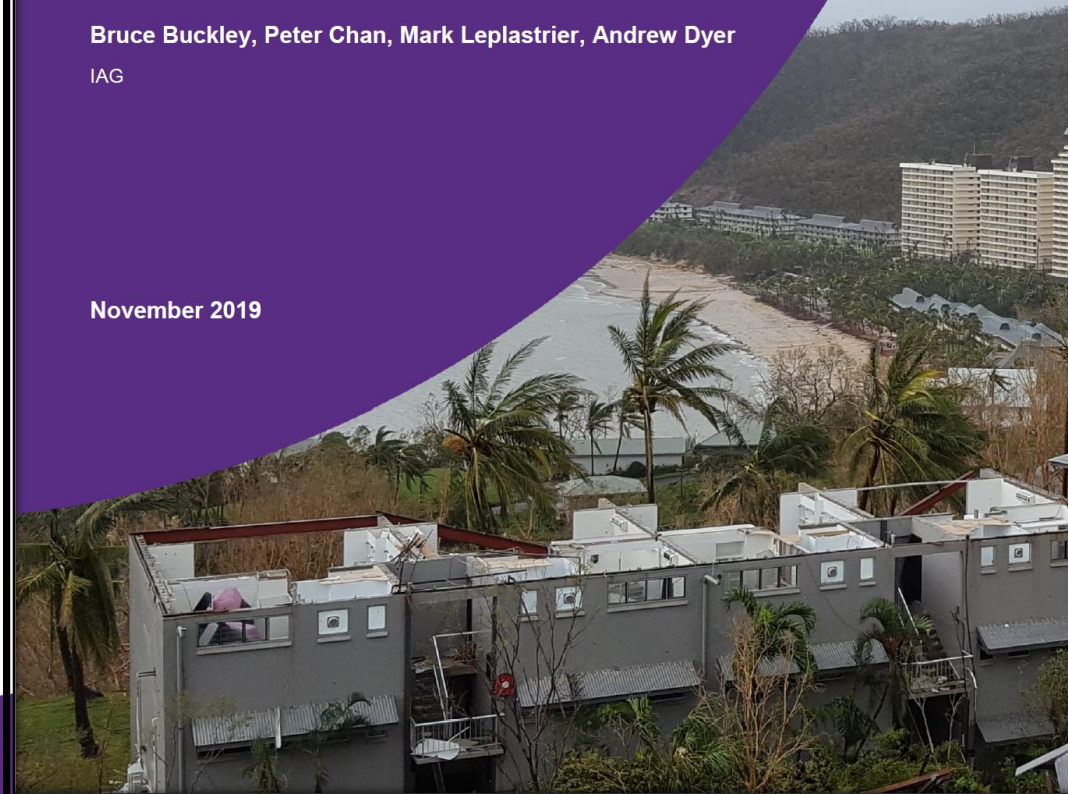
Cindy Bruyère, Greg Holland, Andreas Prein, James Done

Capacity Center for Climate and Weather Extremes,
National Center for Atmospheric Research, USA

Bruce Buckley, Peter Chan, Mark Leplastrier, Andrew Dyer

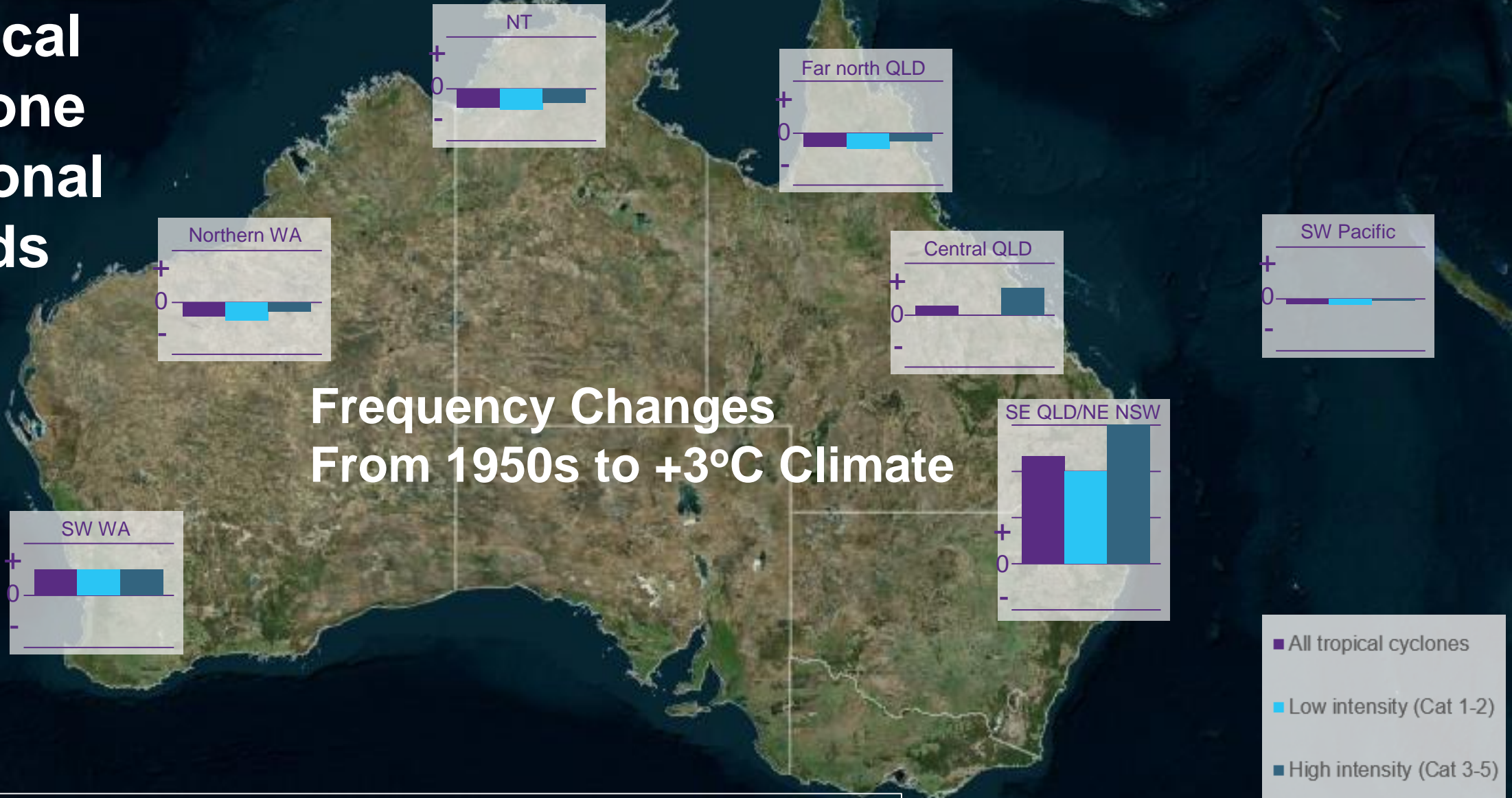
IAG

November 2019



Tropical Cyclone Regional Trends

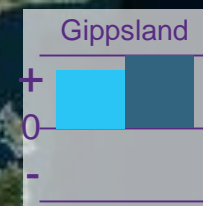
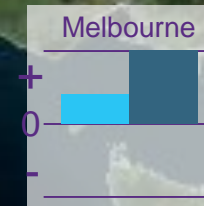
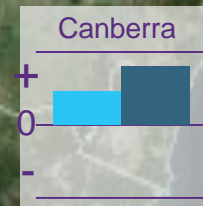
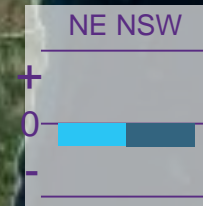
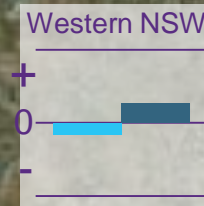
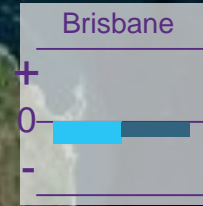
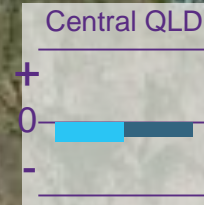
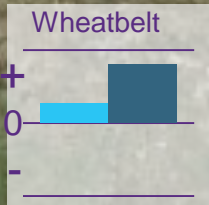
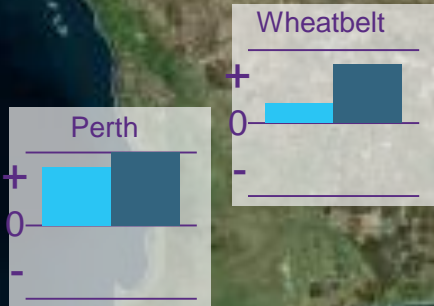
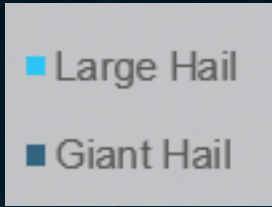
Frequency Changes From 1950s to +3°C Climate



Note: Cyclone Categories relate specifically to the wind component. Trends exclude the increasing storm surge & intense rain components of all tropical cyclones.

Severe Thunderstorms Hail Regional Trends

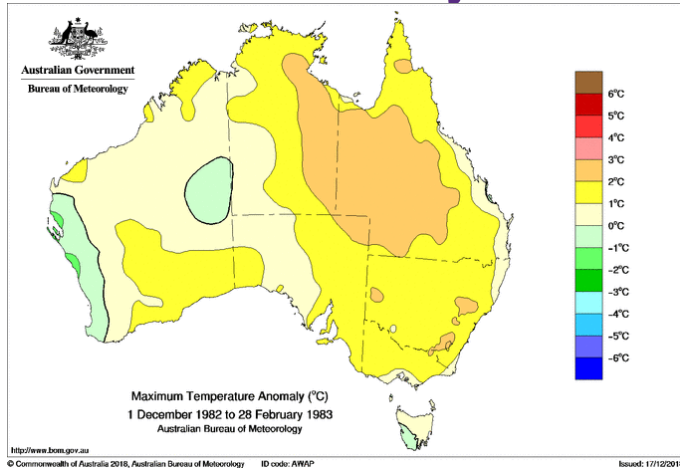
1990-2010 → +3°C



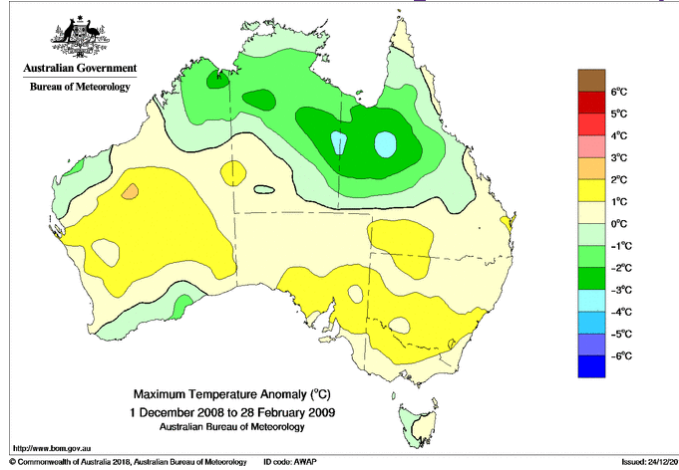
Note: Trends on this map exclude the general increasing wind squall and intense rain components of thunderstorms nationwide.

Bush Fires: Rainfall & Temperature Comparisons

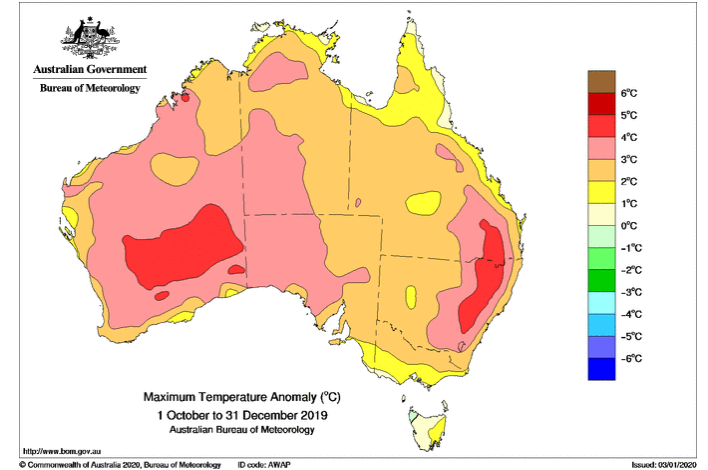
Ash Wednesday 1983 (l) Black Saturday 2009 (c) East Australia 2019-20



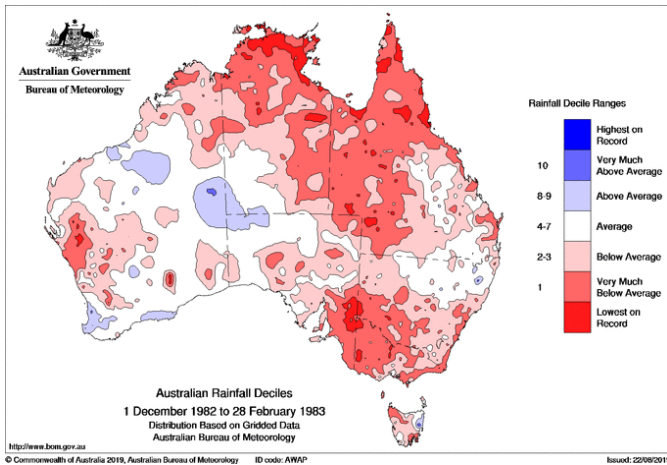
Max Temp Anomaly Dec 1982-Feb 1983



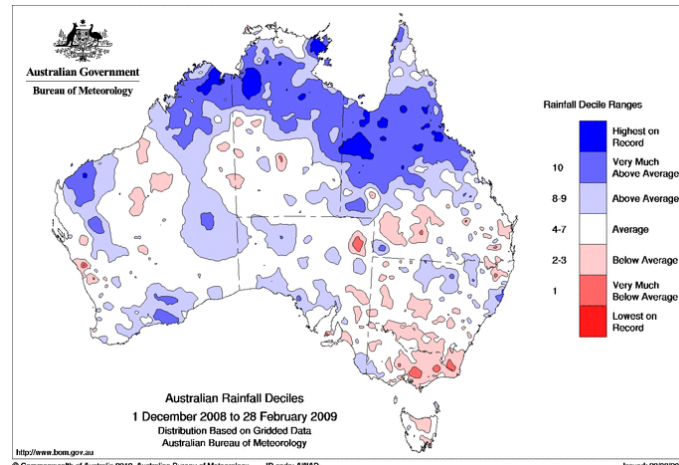
Max Temp Anomaly Dec 2008-Feb 2009



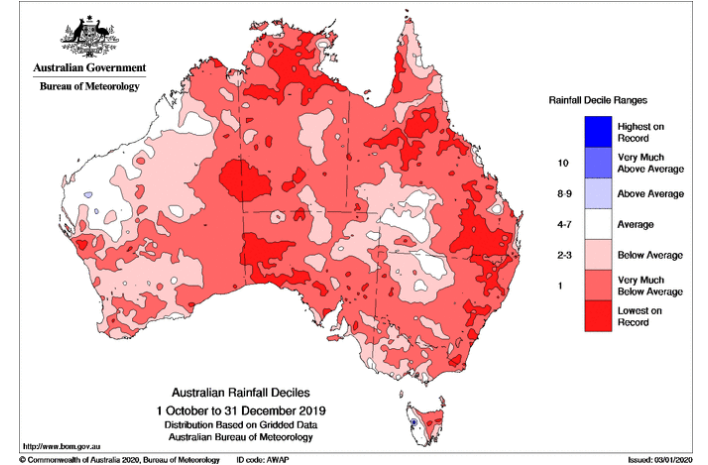
Max Temp Anomaly Oct-Dec 2019



Rainfall Deciles Dec 1982-Feb 1983

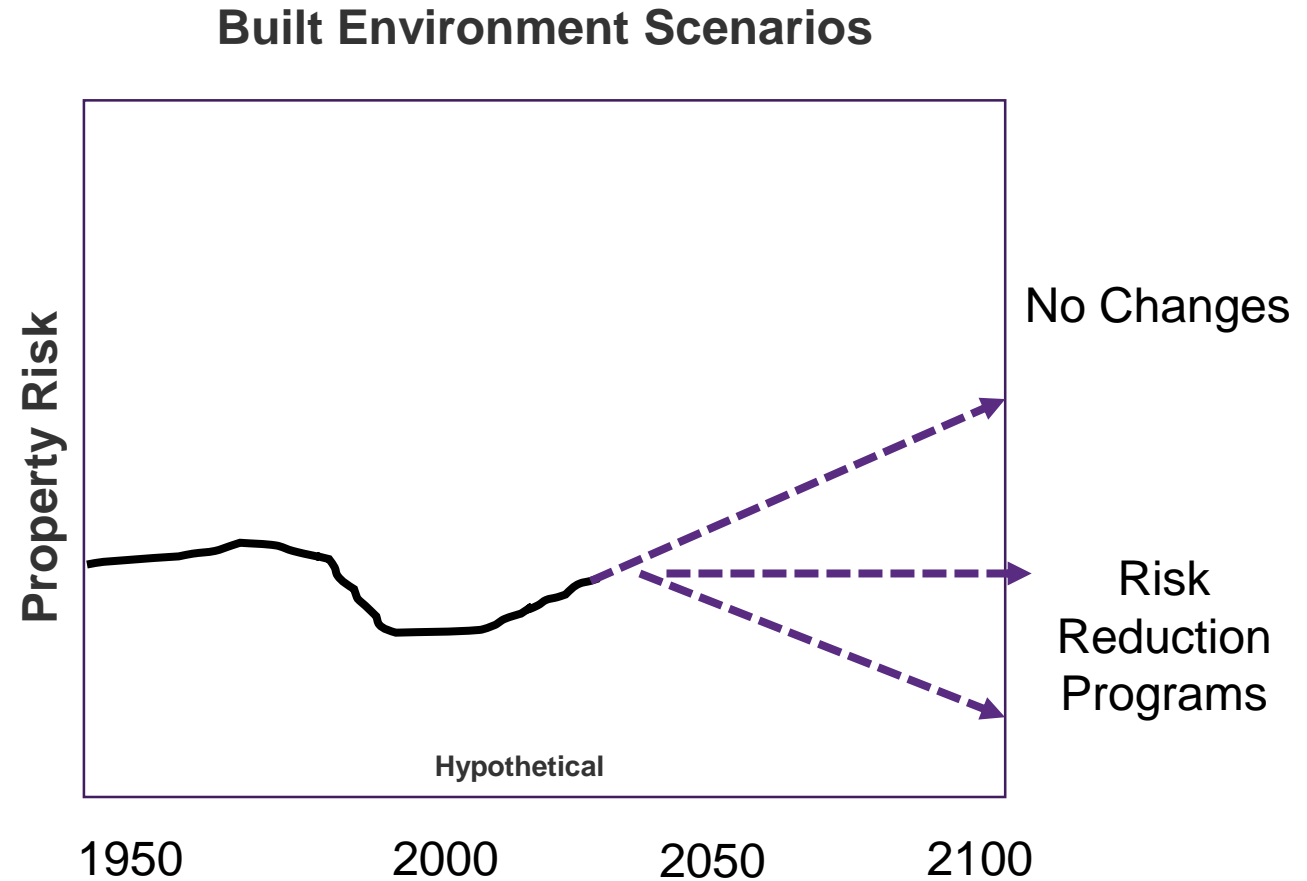
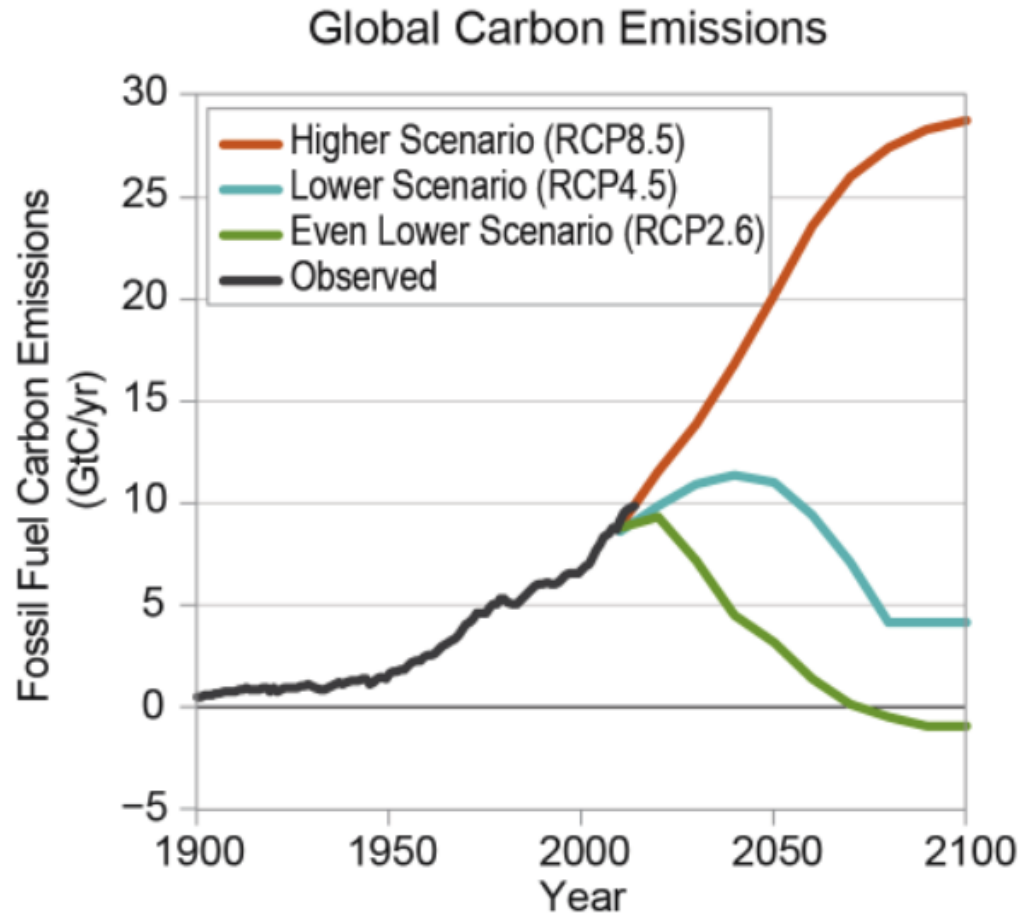


Rainfall Deciles Dec 2008-Feb 2009

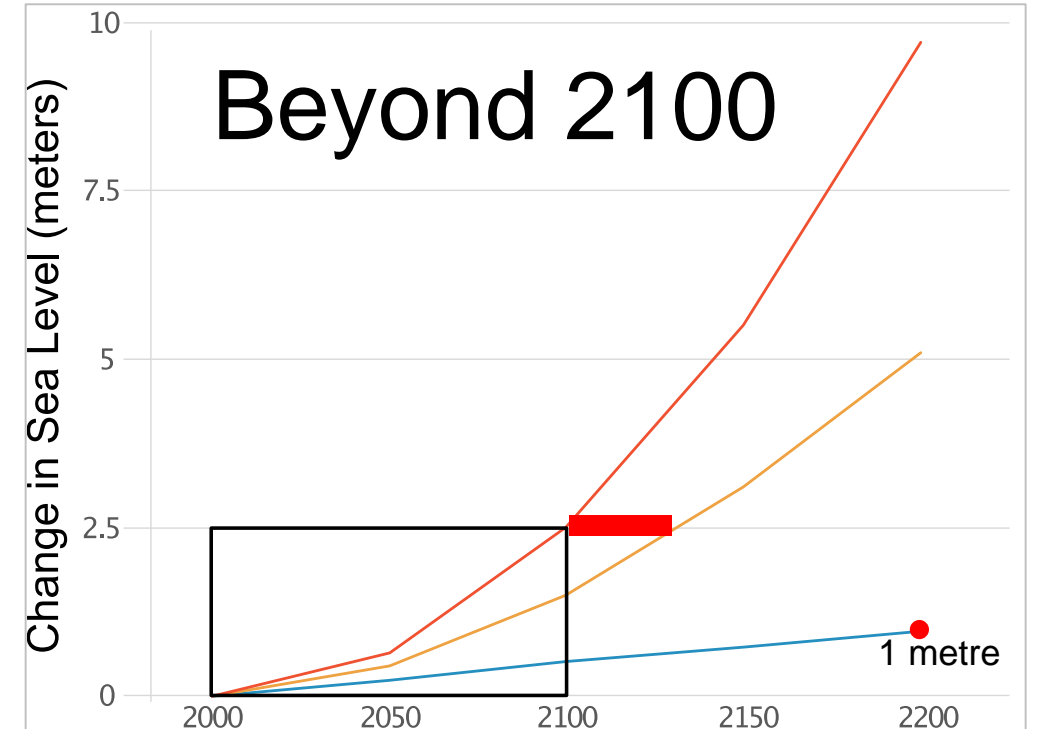
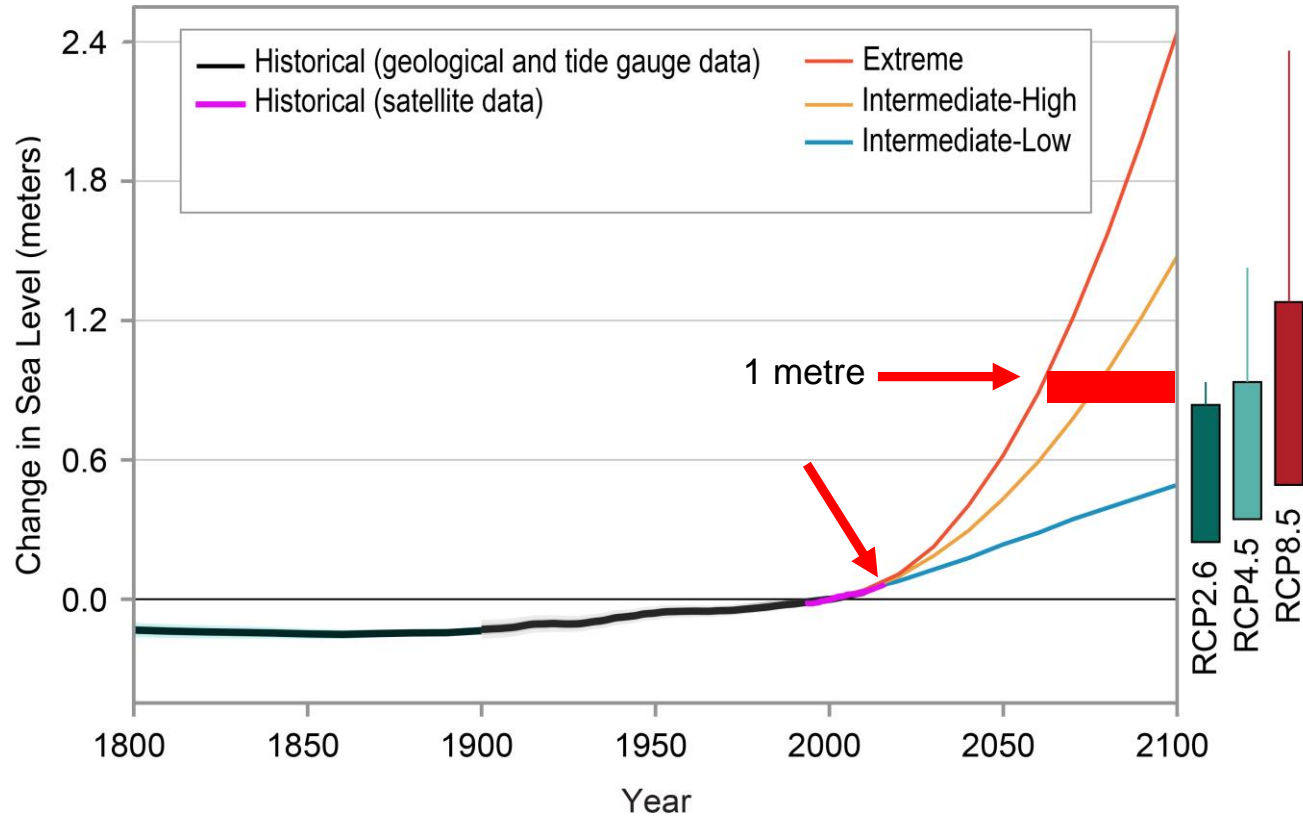


Rainfall Deciles Oct-Dec 2019

What do we assume about the future built environment?



Sea levels will continue to rise



Worldwide more than **100 million** people live within **1 metre** of high tide



Changes to cladding Standard AS1562.1 now includes minimum requirements of material, strength, thickness and fastener spacings for all flashings for all wind regions

As well as a new garage door testing and design requirements for cyclone regions.

Retrofitting of existing building stock to resist severe wind loads (cyclonic regions)



Retrofitting of existing building stock to resist severe wind loads (cyclonic regions)



Insurers providing discounts up to ~20%

Property-level Peril Risk Assessment

Scientific Review



Change in Weather Extremes

- Storm surge frequency/intensity
- Sea level rise
- East Coast Low frequency
- Rainfall annual maxima
- Rainfall 20-year intensity
- Rainfall footprint area
- Hail frequency >2.5cm
- Bushfire danger index
- Cyclone wind speed
- Cyclone latitude
- Cyclone lifespan
- Cyclone proportion cat 4/5
- Cyclone rainfall intensity
- Cyclone frequency
- Cyclone size

Catastrophe Models

- Tropical Cyclone
- Bushfire
- Storm / Hail / East Coast Low
- Flood / Storm Surge

Property Snapshot

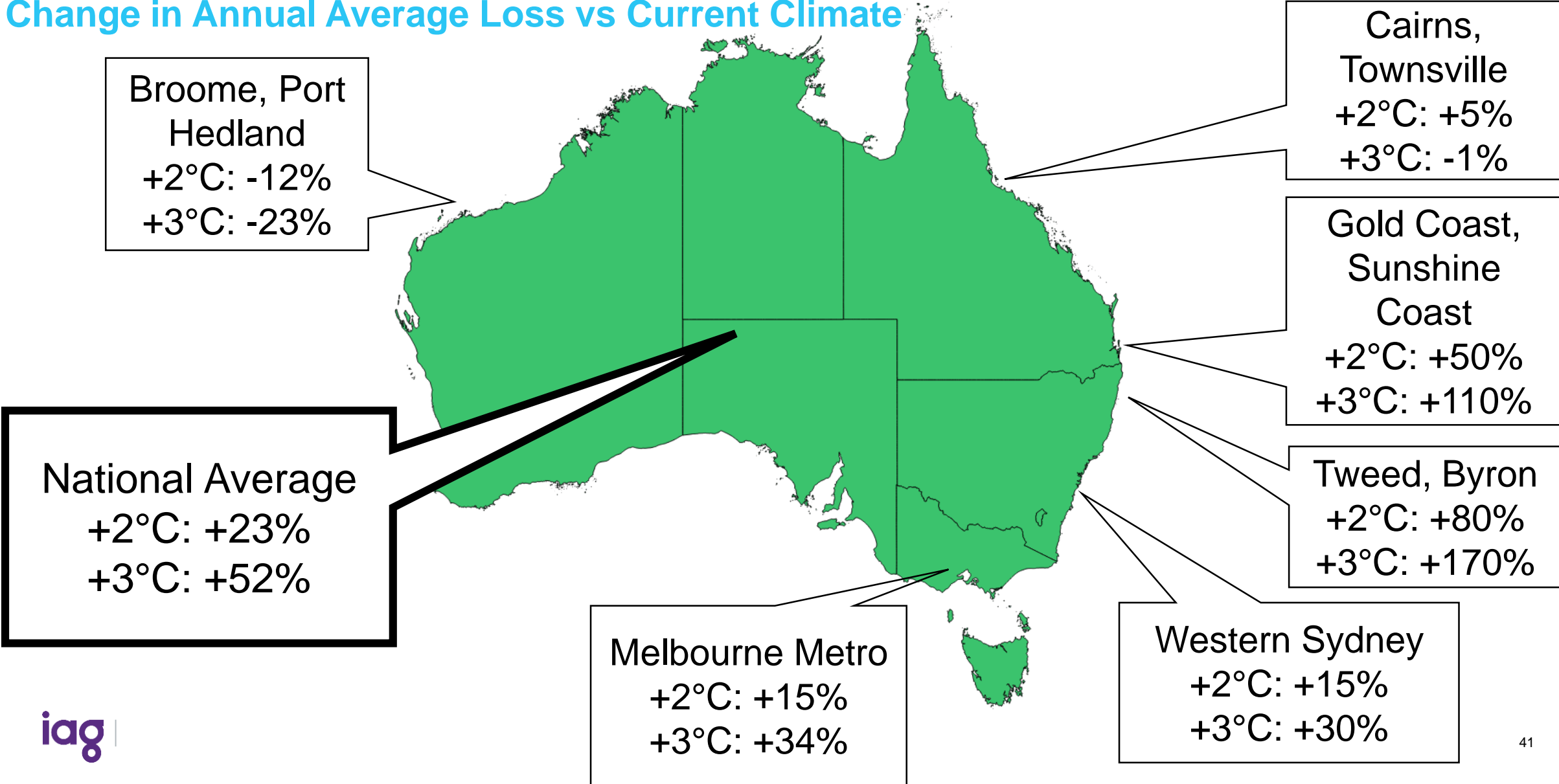
- Domestic property
- Current building stock

Impact on Peril Risk

- National
- Community
- Individual property

Regional Variations in Climate Sensitivity

Change in Annual Average Loss vs Current Climate



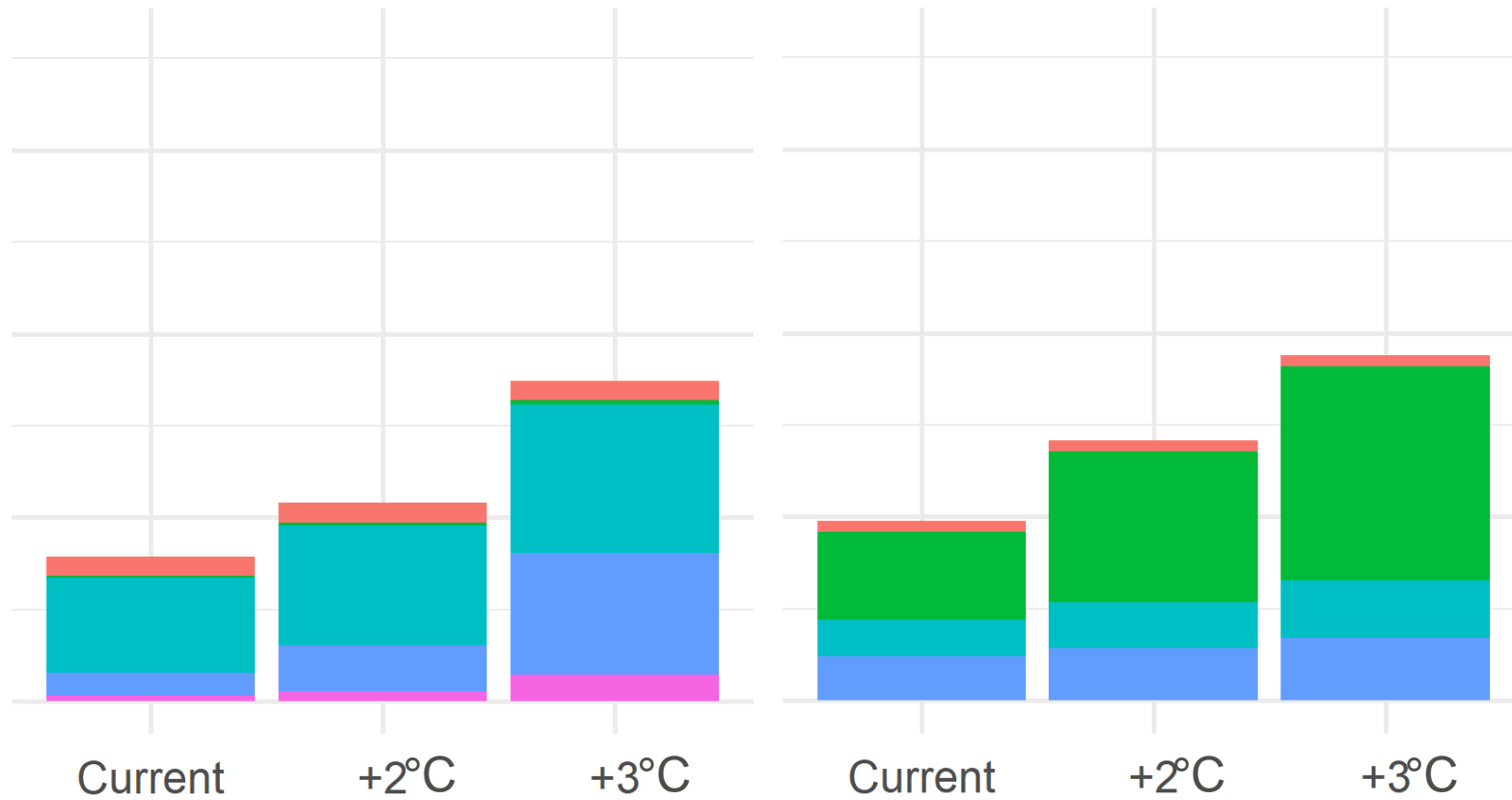
Regional Variations in Climate Sensitivity

Average Annual Loss per property: Current, +2°C and +3°C scenarios

LAKE MACQUARIE NSW

MURRINDINDI VIC

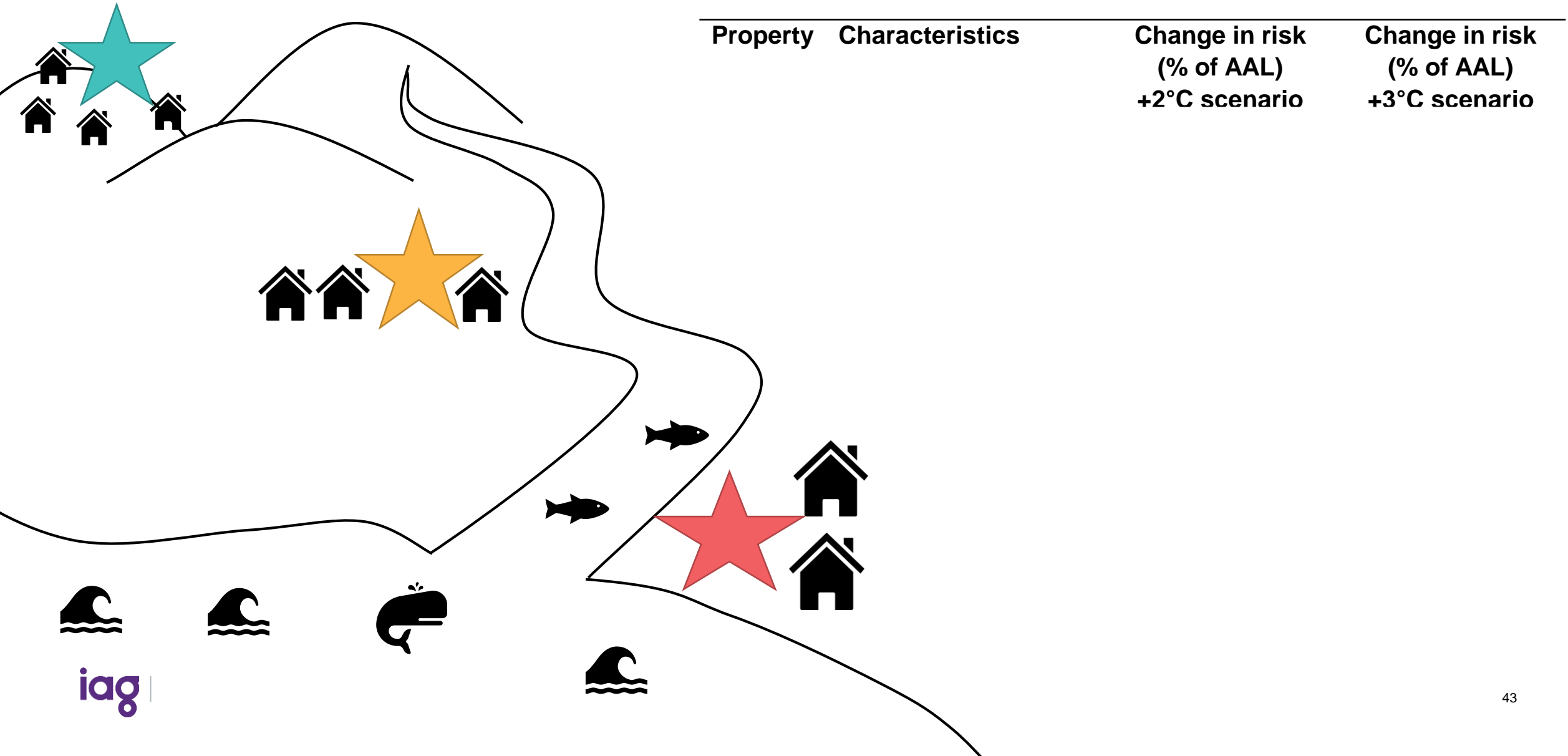
Average Annual Loss (\$)



Peril

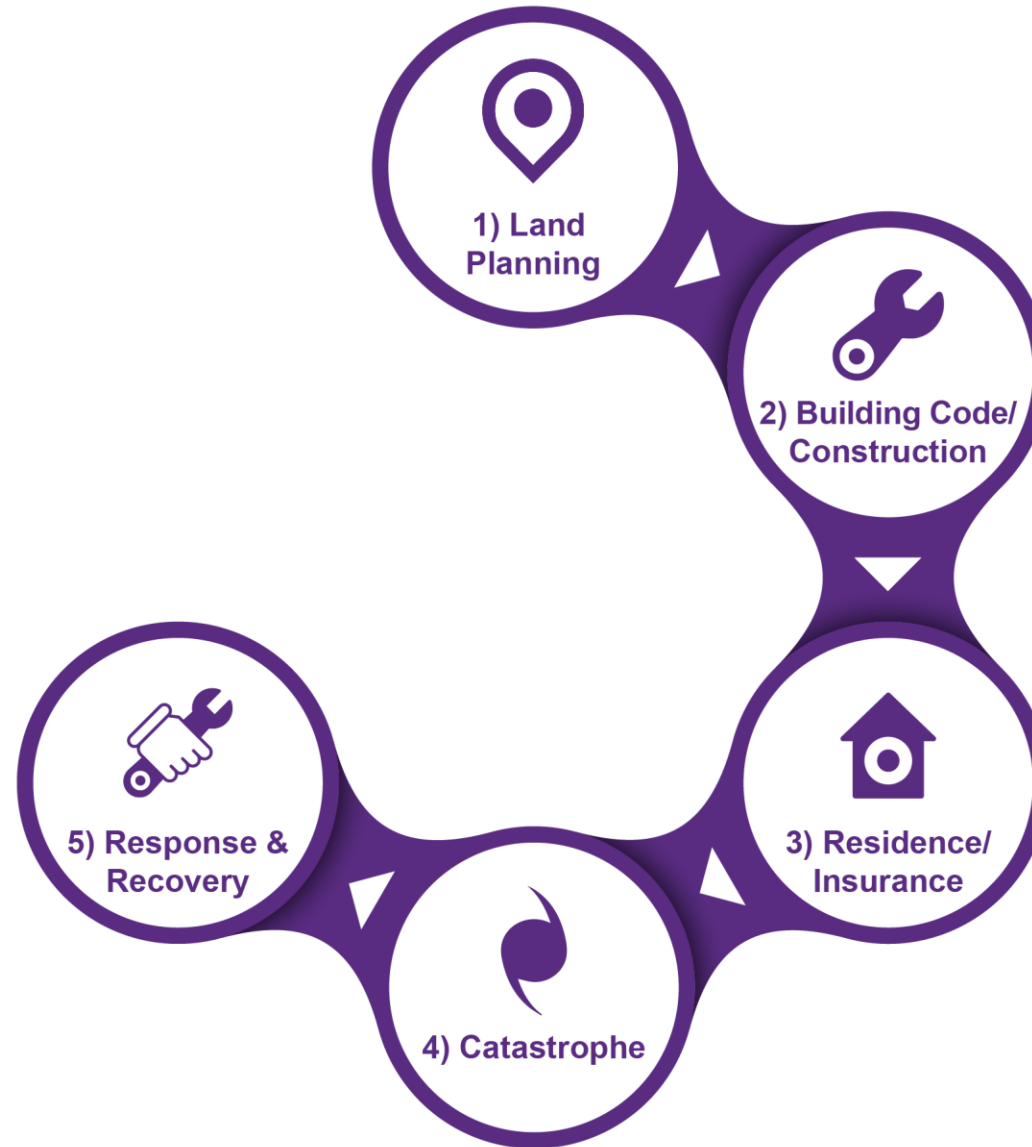
- EQ
- CYCLONE
- BUSHFIRE
- STORM_HAIL
- FLOOD
- STORM_SURGE

Variation Within Regions: Hyper-local Sensitivity



Driving risk reduction

Life cycle of a property



Driving risk reduction

Ideal life cycle of a property



iag



Severe Weather in a Changing Climate

Download report and presentations on IAG website
<https://www.iag.com.au/severe-weather-changing-climate>



Discussion: implications for the Australian Climate Roundtable



Close



Close

- Next workshop set for Tuesday 12 May 9am-12pm
 - Again by video
 - Topic is Sectoral Impacts: Human Health, Disasters and Communities
- Welcome feedback on the format and process to:
 - Tennant.reed@aigroup.com.au
 - Rachael.Wilkinson@aigroup.com.au