Exploring the Risks and Impacts of Climate Change on Australia: Macroeconomic risks

Australian Climate Roundtable
26 May 2020

Topics

Time	Topic
09:00 am	Start
09:05 am	Welcome, Overview and Purpose
09:10 am	**Economic and financial stability impacts of climate change: a central banks perspective** Alex Heath, Head of Economic Analysis Department, Reserve Bank of Australia
09:30 am	Discussion/Q&A
9:40 am	**Modelling the macroeconomic impacts of climate change** Prof Tom Kompas, University of Melbourne
10:00 am	Discussion/Q&A
10.10 am	**The application of macroeconomic and systemic financial climate risks** Dr Alan Rai, Director, Baringa Partners LLP
10:30 am	Discussion/Q&A
10:45 am	**Break**
11:00 am	Facilitated discussion: Implications for the Australian Climate Roundtable
12:00 pm	Close

Overview and Purpose

RESERVE BANK OF AUSTRALIA

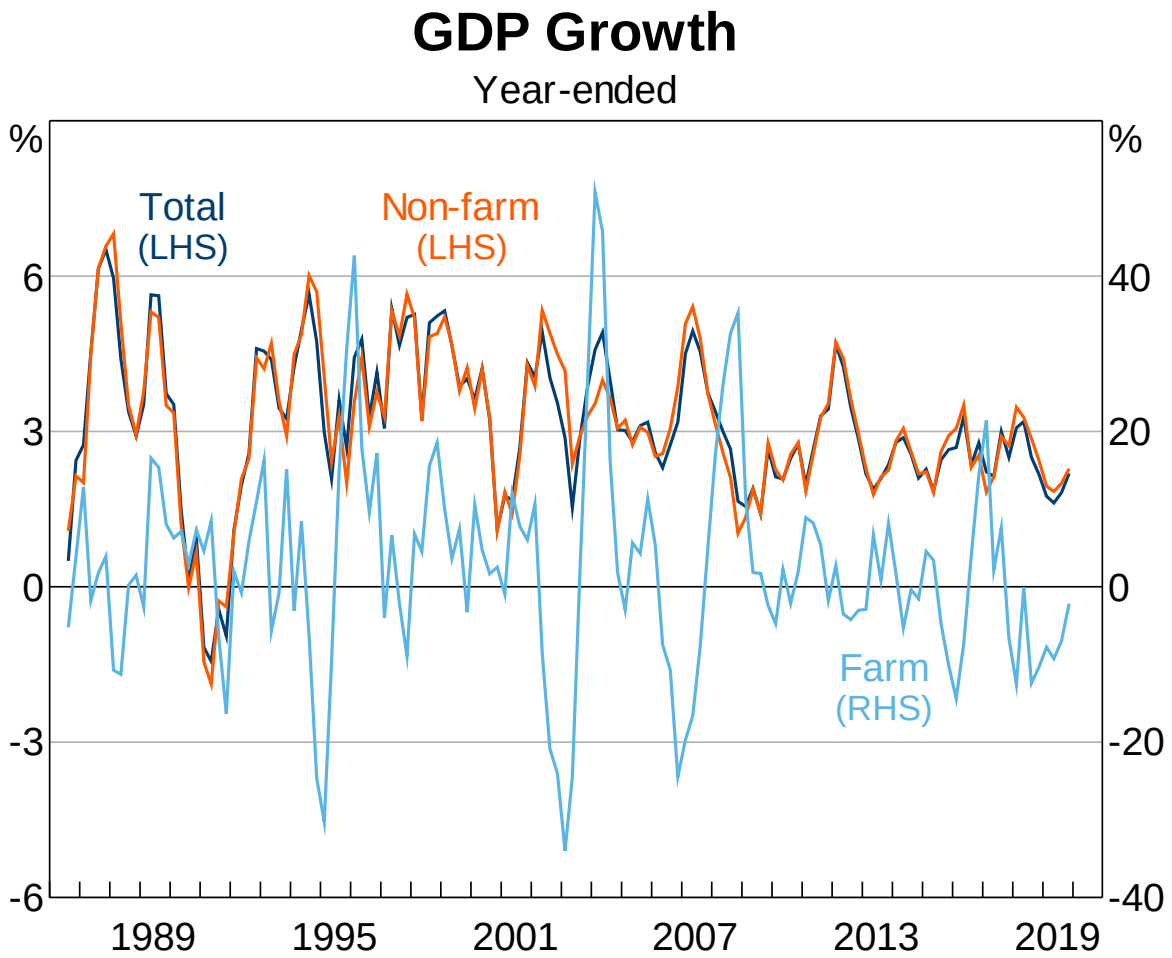
The Macroeconomy, Financial Stability and Climate Change

Alex Heath

Head of Economic Analysis Department

26 May 2020
ACR Roundtable

Climate events have always affected Australian macroeconomic variables



Climate change is more challenging …

- Trends vs cycles
- The nature and persistence of shocks
- Changes in behaviour and expectations ↔ changes in prices
- Policy responses
- History is not very helpful

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- ➢ Parallels with today's modelling challenges
- ➢ Work with the Network on the Greening of the Financial System (NGFS)

Climate change and financial stability

- Council of Financial Regulators Working Group on Climate Change Risk
  - Raising awareness of climate change as a financial risk
  - Support for the TCFD
  - Data and knowledge gaps
  - Risk vulnerability exercise (scenario analysis)

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- NGFS

Some challenges with scenario analysis

- Translating science outputs into scenario inputs
  - Recognising regional differences
- What is the right level of aggregation/disaggregation?
- How do we translate the results into behavioural responses?
- How do we integrate this information with macro models and think about policy responses?

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Discussion/Q&A

Modelling the macroeconomic impacts of climate change

Prof Tom Kompas, University of Melbourne
(PDF presentation)

Country Inequality, Australia and the Economic Damages from Global Warming

Tom Kompas

School of Biosciences
School of Ecosystem and Forest Sciences
Melbourne Sustainability Society Institute
University of Melbourne

May 22, 2020

Introduction: Where are we now?

- Climate change is happening faster than we thought.
- More destructive hurricanes are developing; devastating fires burn on every continent except Antarctica; the ice is melting and sea-level rise is accelerating – threatening island nations, major cities, and coastal areas.
- Water supplies are shrinking in many parts of the world and droughts are threatening farms, livelihoods and food security.
- The ocean is warming and becoming more acidic, destroying coral reefs and harming fish populations.
- Record-high temperatures are making many parts of the planet unlivable, and the number of climate refugees is growing rapidly.

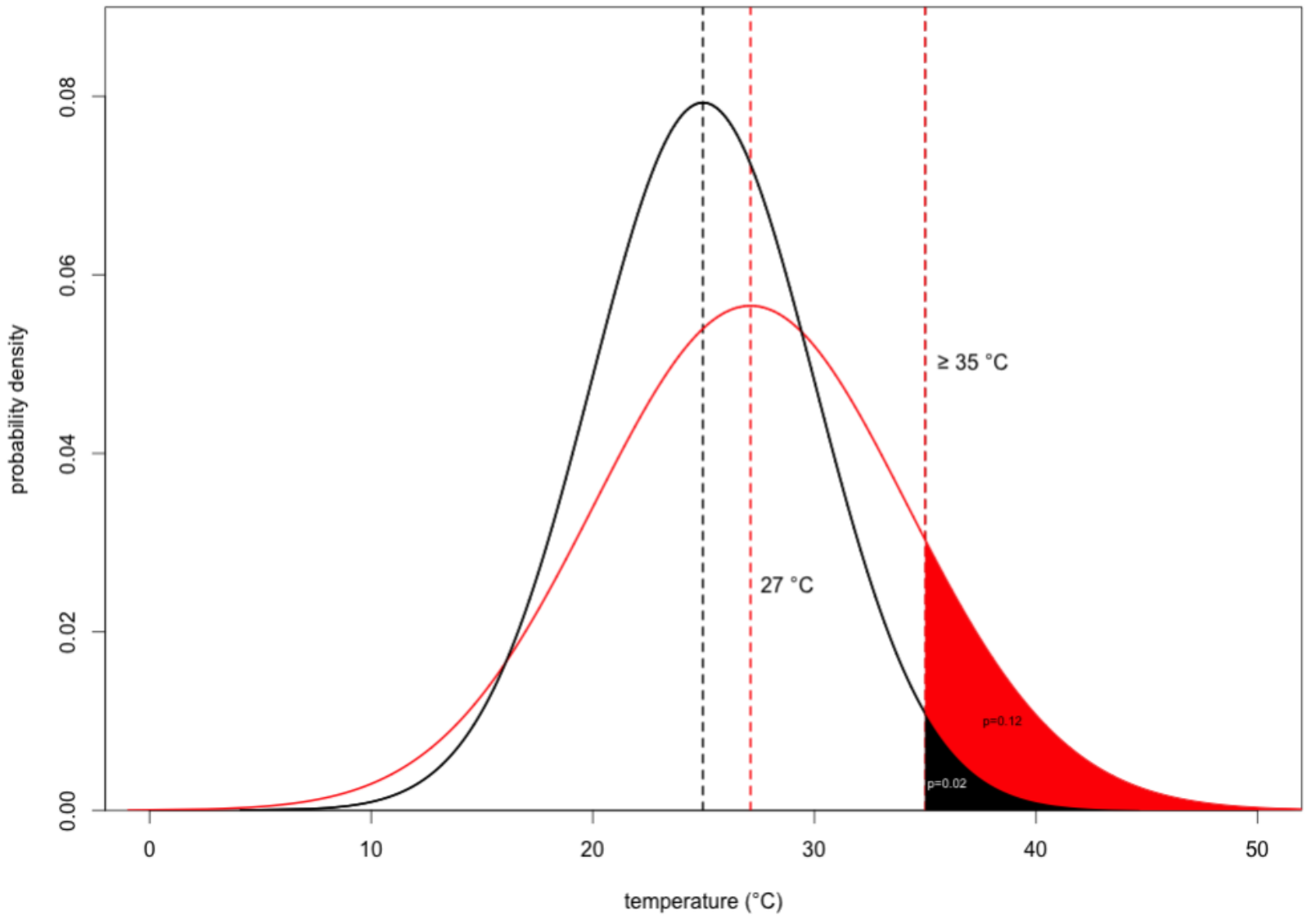
Modeling Economic Damages and the Costs of Emissions Reduction: CGE/GTAP

- (139 country model, GTAP-INT): 57 commodity groups, including paddy rice, wheat, cereal grains, vegetable, fruits and nuts, bovine cattle, sheep, goats, horses, sugar cane, milk, wool, forestry, fishing, coal, oil, gas, meat products, vegetable oils and fats, dairy products, textiles, beverages and tobacco, wood products, paper products, chemical, rubber, leather products, plastics, metal products, electronic equipment, machinery, manufactures, air transport, motor vehicles, electricity, construction, business services, defense, public administration, dwellings, communication, financial services, construction, transport, recreational and other services, etc.
- (GTAP-R/GTAP-IAM, 30-60-139 region/country model): Energy and power components in the GTAP-R, IAM/GTAP-EP model included: Coal, oil, gas, oil products, fossil fuel electricity, renewables, non-fossil electricity, etc.

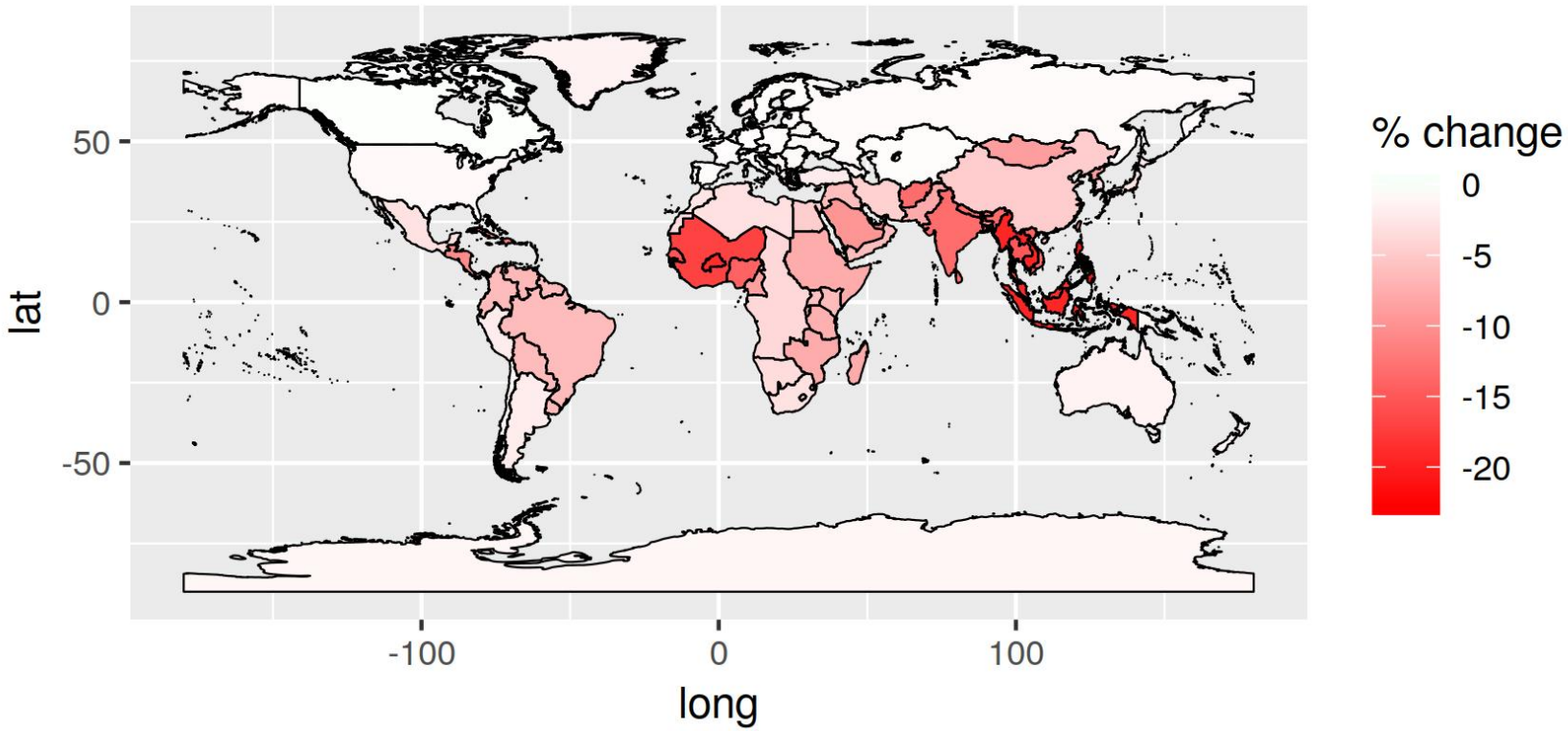
Damages from Climate Change

- Using damage functions, we solve a large dimensional global climate and trade model to account for (some of) the effects of global warming **(e.g., loss in agricultural and labour productivity, the impact of sea level rise on land area, and human health effects) for 139 countries**, by decade and over the long term. (Fires, some floods, infrastructure damage from sea level rise (except for AUS, later in the presentation), tropical storms (except for USA), pollution, etc. not yet included.)

Average Global and Changes in Extreme Temperatures



Climate Change Impacts – Long Run; 4^oC Path, $\%\Delta$ GDP



Source: Authors' calculation.

Estimation of long term GDP loss per year in 2100 and forward under global warming scenarios ($US billion/year)

	4°C	3°C	2°C
World Total	**-23,149**	**-9,593**	**-5,659**
Sub-Saharan Africa	-8,073.68	-2,889.66	-1,927.78
India	-4,484.96	-2,070.06	-1,149.36
Southeast Asia	-4,158.88	-2,073.09	-1,166.23
China	-1,716.91	-701.75	-394.59
Latin America	-1,371.81	-576.65	-259.82
Rest of South Asia	-1,157.92	-469.98	-283.78
Middle East and North Africa	-1,032.27	-451.96	-241.12
United States of America	-697.77	-223.83	-168.48
Japan	-253.18	-54.43	-23.02
South Korea	-81.44	-14.72	-7.86
Russian Federation	-24.49	-10.88	-6.53
United Kingdom	17.78	4.06	0.35
Germany	23.85	5.38	2.46
France	26.92	7.11	1.80
Vietnam	-247.09	-106.0	-63.58

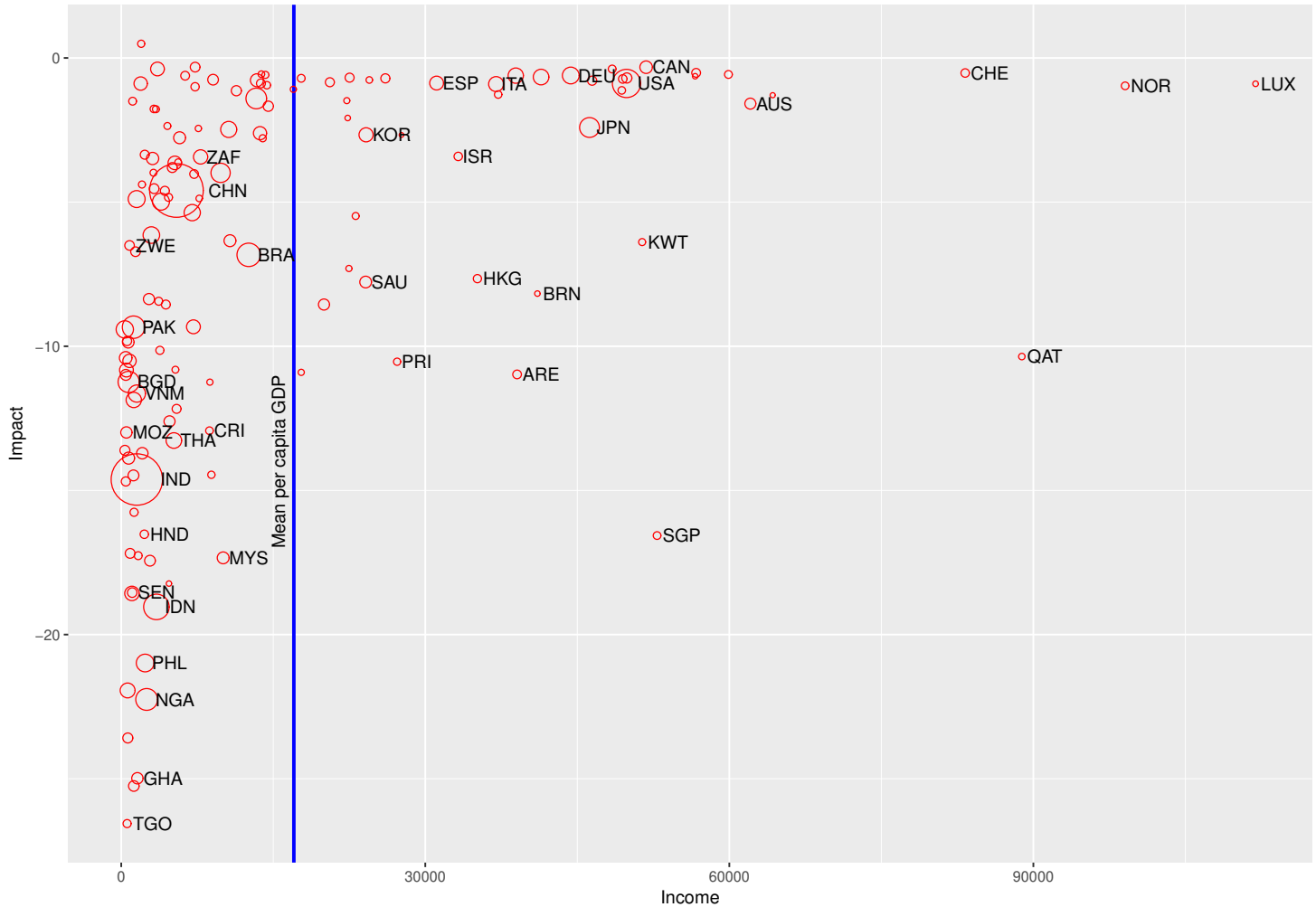
Sources: Authors' calculation

What do these BIG Numbers Mean?

- Global long term economic damages in 2100 (albeit with limited damage functions) at 3^{o}C are \$US 9.5+ trillion per year and at 4^{o}C losses are \$US 23+ trillion per year.
- Long-run annual losses in GDP (on average) range from 2-6% depending on SSP and/or assumptions on economic growth.
- **The real point**: Some country losses are especially severe. GDP losses, for example, at 4^{o}C, for Cambodia, Sri Lanka, and Nicaragua are over 17%, for Indonesia 19%, for India 14%, Thailand 17%, Singapore 16%, the Philippines 20%, and for much of Africa the losses range from 18 to over 26% of GDP. Global losses in GDP during the Great Depression (1930s) were 15%. (China 4.6%, USA 0.9%)

Distributional Effects of Climate Change at 4°C, %Δ GDP

Figure: Climate change impacts by country against income and %Δ GDP impact/damages (circle area = country population size).



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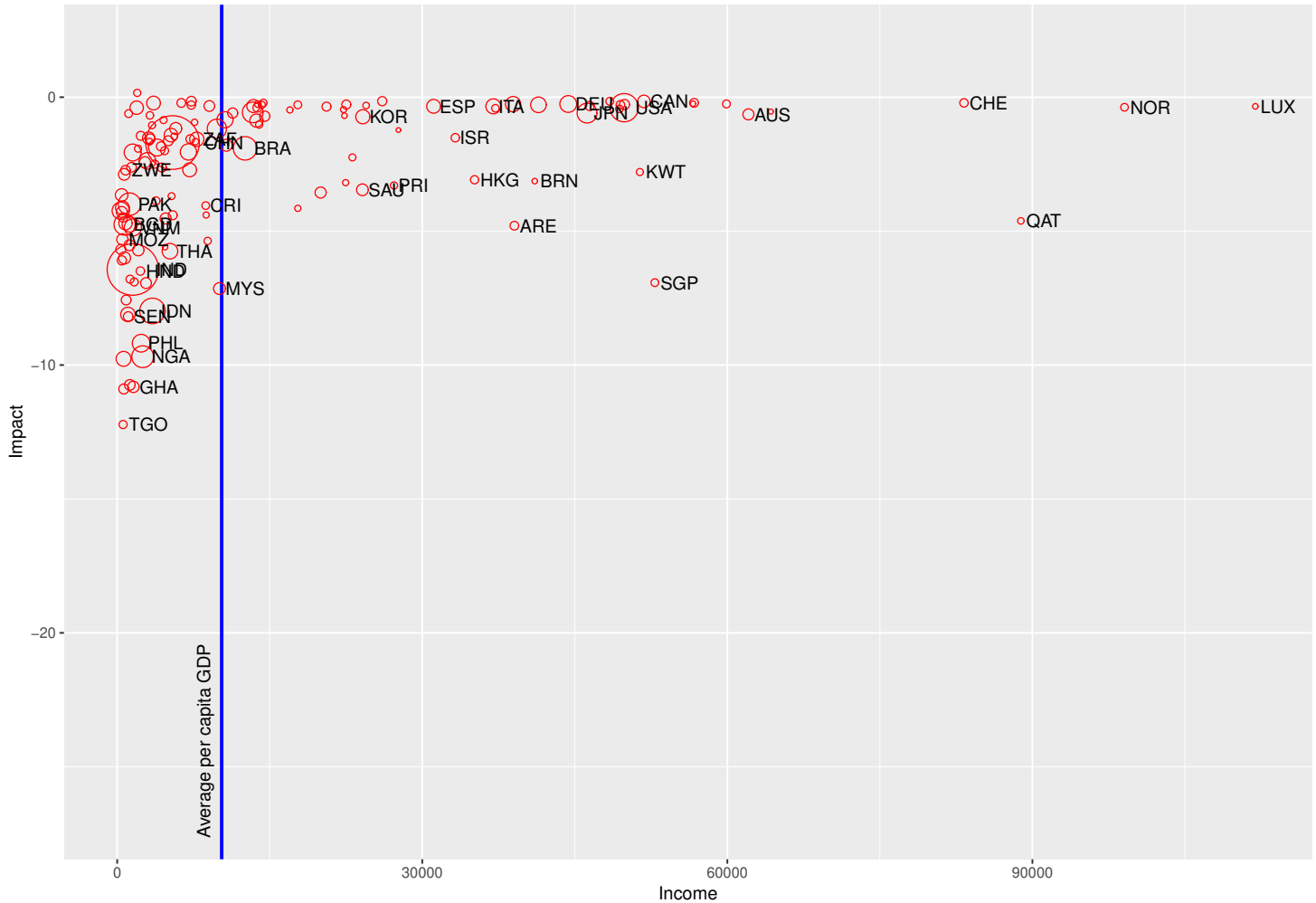

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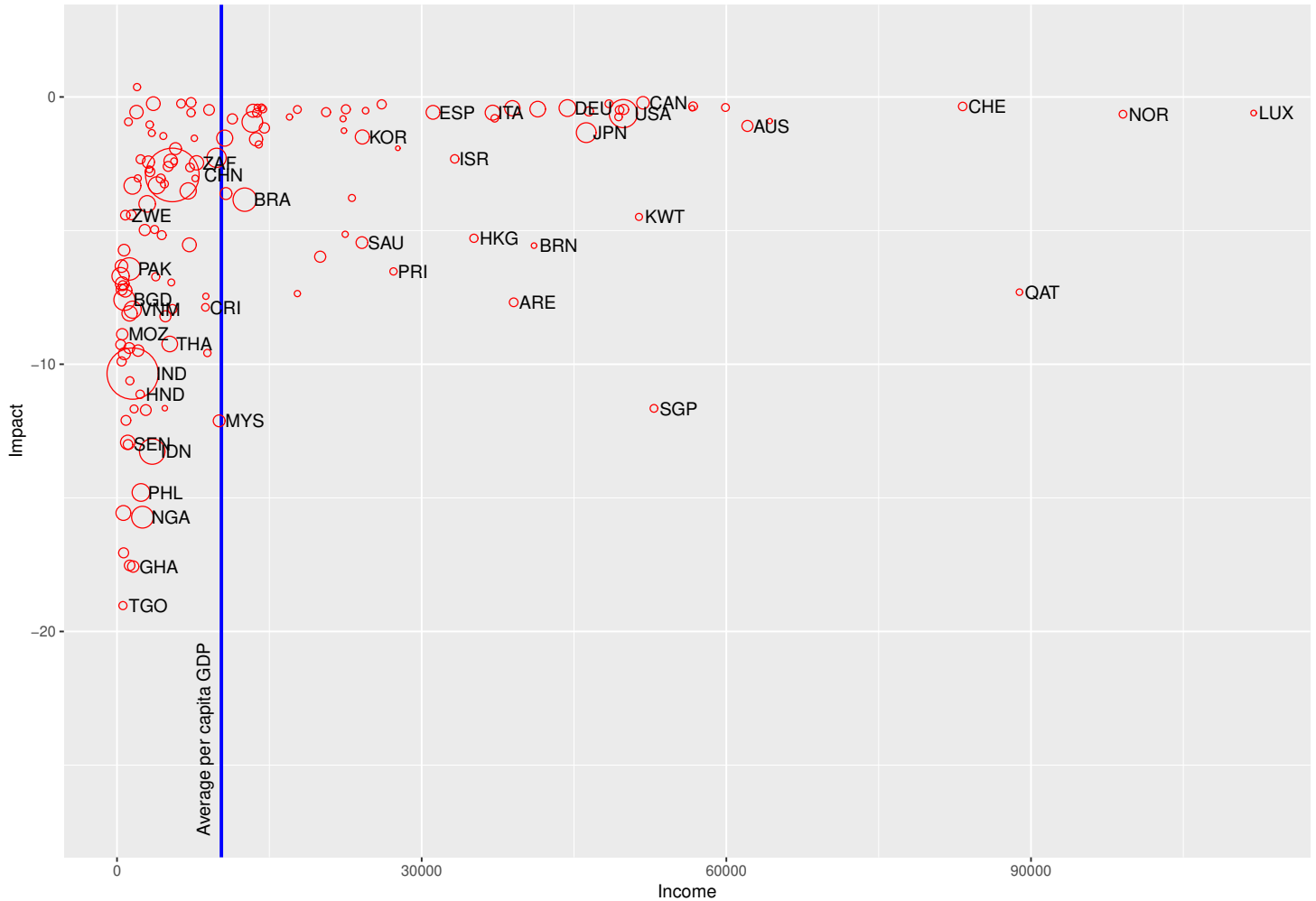

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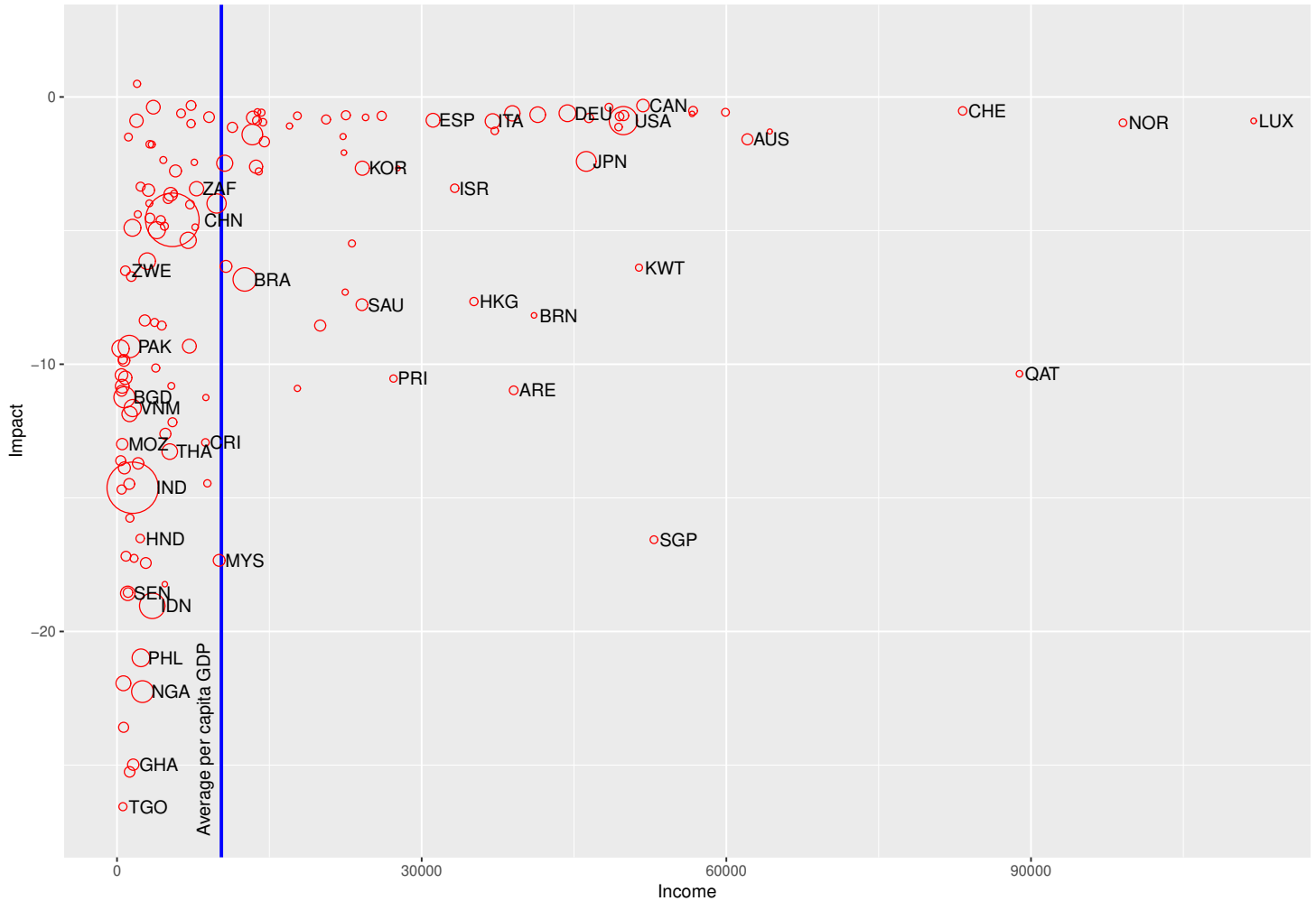


Source: Authors' calculation.

Cumulative Losses in GDP from 2017-2100 (bill. USD)

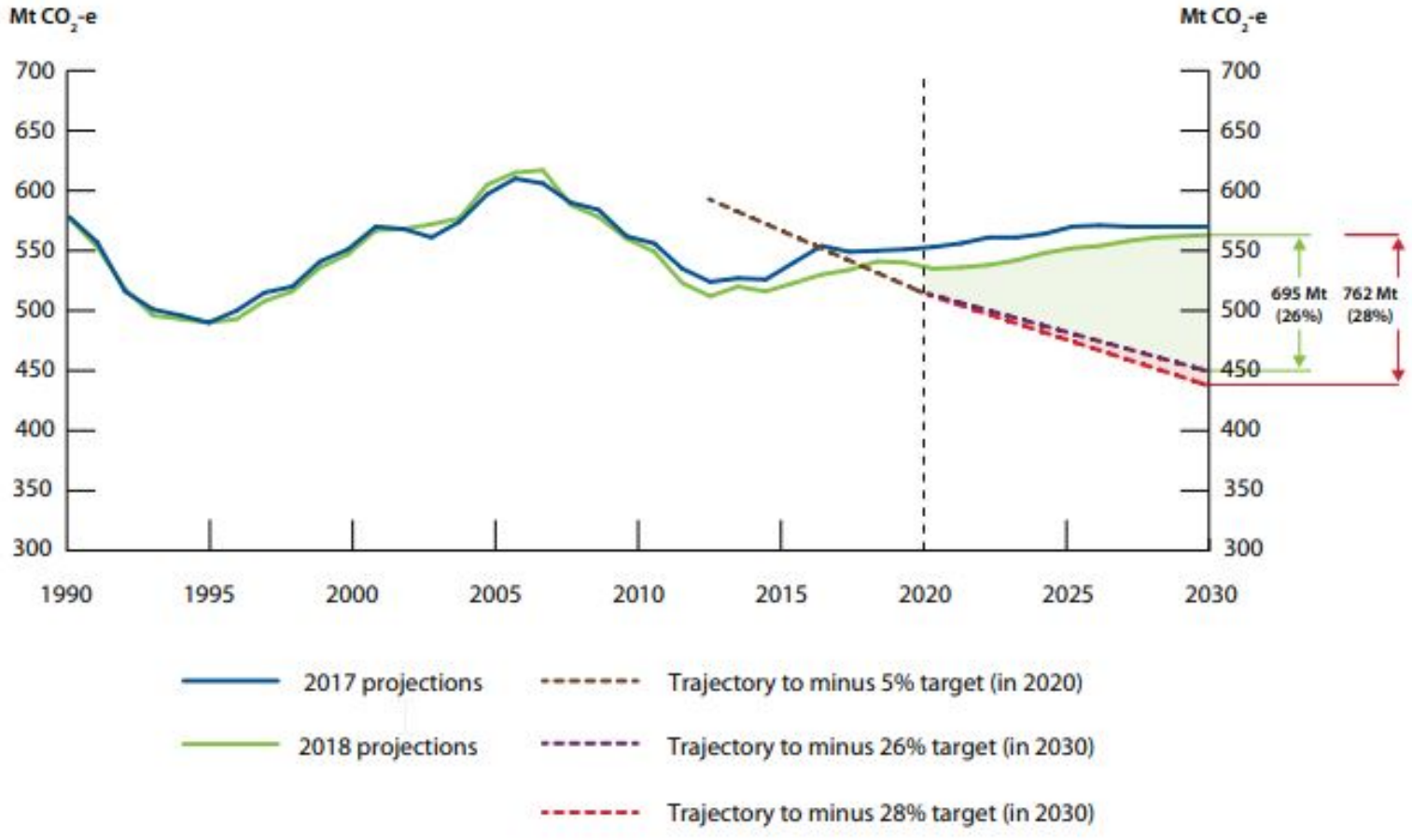
	Impacts (GDP)		
	4°C	3°C	2°C
World Total	-604460.42	-271250.18	-171745.14
Sub-Saharan Africa	-177398.70	-67745.57	-49231.04
India	-131574.85	-65495.65	-39665.53
Southeast Asia	-118076.85	-62233.61	-37692.25
China	-64024.08	-28239.51	-16947.87
Latin America	-39444.52	-17240.66	-8529.39
Rest of South Asia	-29243.05	-11482.45	-8357.61
Middle East and North Africa	-25582.51	-12400.73	-7021.93
United States of America	-14401.80	-5699.37	-4334.33
Japan	-6625.19	-1716.01	-624.83
Mexico	-3133.90	-1289.18	-486.12
Australia	-2898.86	-1097.39	-695.97
Vietnam	-7418.66	-3369.44	-2234.69

Source: Authors' calculation.

Costs of Emissions Reduction in Australia?

Overall change since the 2017 projections

Figure 4 Australia's emissions trends, 1990 to 2030



Damages or Avoided Costs (BAU)

- Included: Losses in agricultural productivity, losses in labour productivity, limited human health effects, sea level rise (inundation effect), sea level rise: Infrastructure damages, limited biodiversity losses.
- Not counted: Damages to major environmental assets, bush fires (and some floods), more intense tropical storms. etc. The cost of damages to environmental assets, a large portion of fire and flood events, the effects of pollution and losses in biodiversity are not captured.
- (2020-2050 BAU/RCP 8.5) Infrastructure damages $611 billion; productivity losses (agric and labour) $151 billion; biodiversity losses (WTP): $116 billion.
- **Total: $878 billion USD ($1.34 trillion AUD).**
- Added? Bushfires: $48 Billion AUD 2 or 3 times a decade (48x2.5x3), or $360 billion AUD. (Total: $1.89 trillon AUD)

Costs of Emissions Reduction

- Included: The cost of transition from fossil fuels to renewables (energy, transport, etc.), changes in net exports, deadweight losses from a price on carbon (or equivalent renewable target), cost of land-use changes, cost of negative emissions technology (NET).
- Key drivers: Rapidly falling price of renewables, changes in resource efficiency.
- **Example Target: 70% share of renewables in end-use energy consumption in 2050. (ROW on Paris target.)**
- (2020-2050 target): Deadweight loss/change in GDP ($31.65 billion) and cost of energy transition ($40.76 billion): $72.41 billion USD ($106.81 billion AUD).
- **Or: $106/$80977 = .0013 or 0.13% of cumulative GDP.**

Final Thoughts

- Model dimension matters: Averaging across countries and extremes in impacts distorts overall and country-specific damages; severe damages occur even though standard damage functions are very limited in scope and impact (e.g., severe weather effects and 'natural disasters' that are climate change induced are excluded).
- The severe falls in GDP in the long term will put many governments in fiscal stress. Tax revenues will fall dramatically and increases in the frequency and severity of weather events and other natural disasters, which invoke significant emergency management responses and expenditures, indicate that pressure on government budgets will be especially severe.

Thank you!

- Thanks for listening!
- www.tomkompas.org
- tom.kompas@unimelb.edu.au

Discussion/Q&A

Break

Mute your microphone

Embedding a climate risk framework within financial institutions

Presentation to the Australian Climate Roundtable

Dr. Alan Rai

May 2020

Our global footprint

We support our international clients from our offices around the world

London
Founded in 2000
Managing Partner: Adrian Bettridge

Düsseldorf
Founded in 2011
Office Lead: Henning Boettger

New York
Founded in 2016
Office Leads: Brad O'Brien, David Shepheard

Abu Dhabi
Founded in 2016
Office Lead: Stephen Haw

▲ **Baringa office locations**
UK | USA | Germany | UAE | Australia

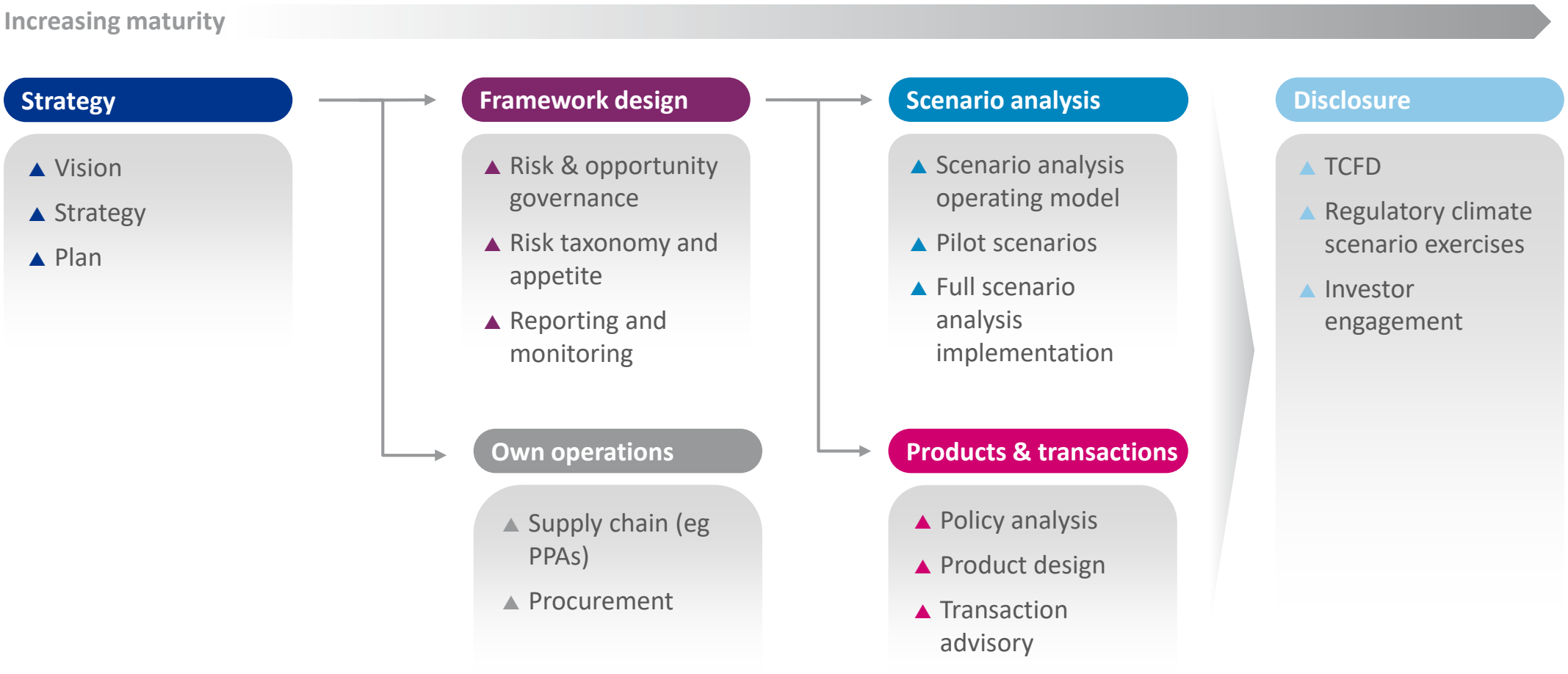
▲ **Secondary office locations**
Belgium | Ireland | Singapore

● **Baringa Client Project Locations**

Sydney
Founded in 2018
Office Lead: Peter Sherry

Typical climate change journey

We support our clients on the journey all the way from initial strategy formulation, via detailed expert-led support, through to disclosure



Scenario analysis: The overall framework

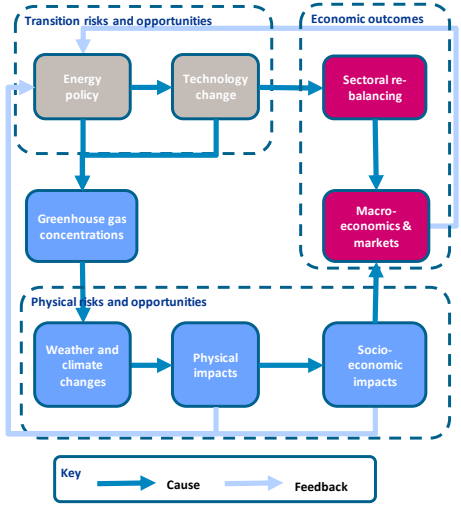
Start: clear, rich narrative; then: develop and assess transition scenarios; and: translate into financial impacts

The "English essay"

The "Maths question"

1 Build a coherent narrative

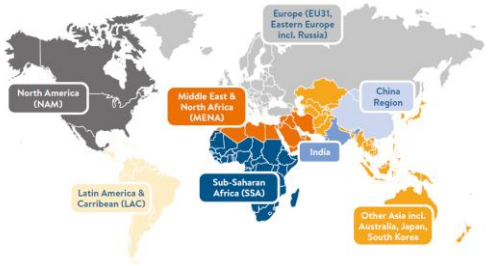
- ▲ Holistic narrative
- ▲ Tailored to your portfolio
- ▲ Coherent view of transition & physical risks



2 Develop Scenarios

Energy transition

- ▲ Global, with ability to zoom
- ▲ Projected over 30 years
- ▲ All sectors



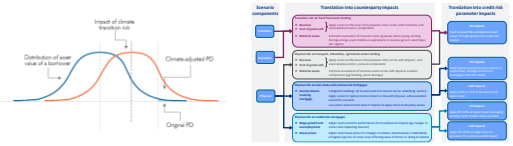
Physical risk

- ▲ Multiple scenarios
- ▲ Multiple hazards
- ▲ Geo-spatial granularity

3 Impact assessment

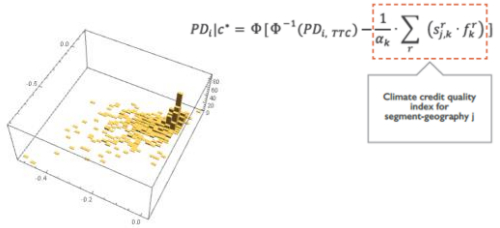
Asset impact assessment:

- ▲ Credit (bonds and loans)
- ▲ Equity
- ▲ Property



Liability impact assessment

- ▲ Claims levels (insurers)

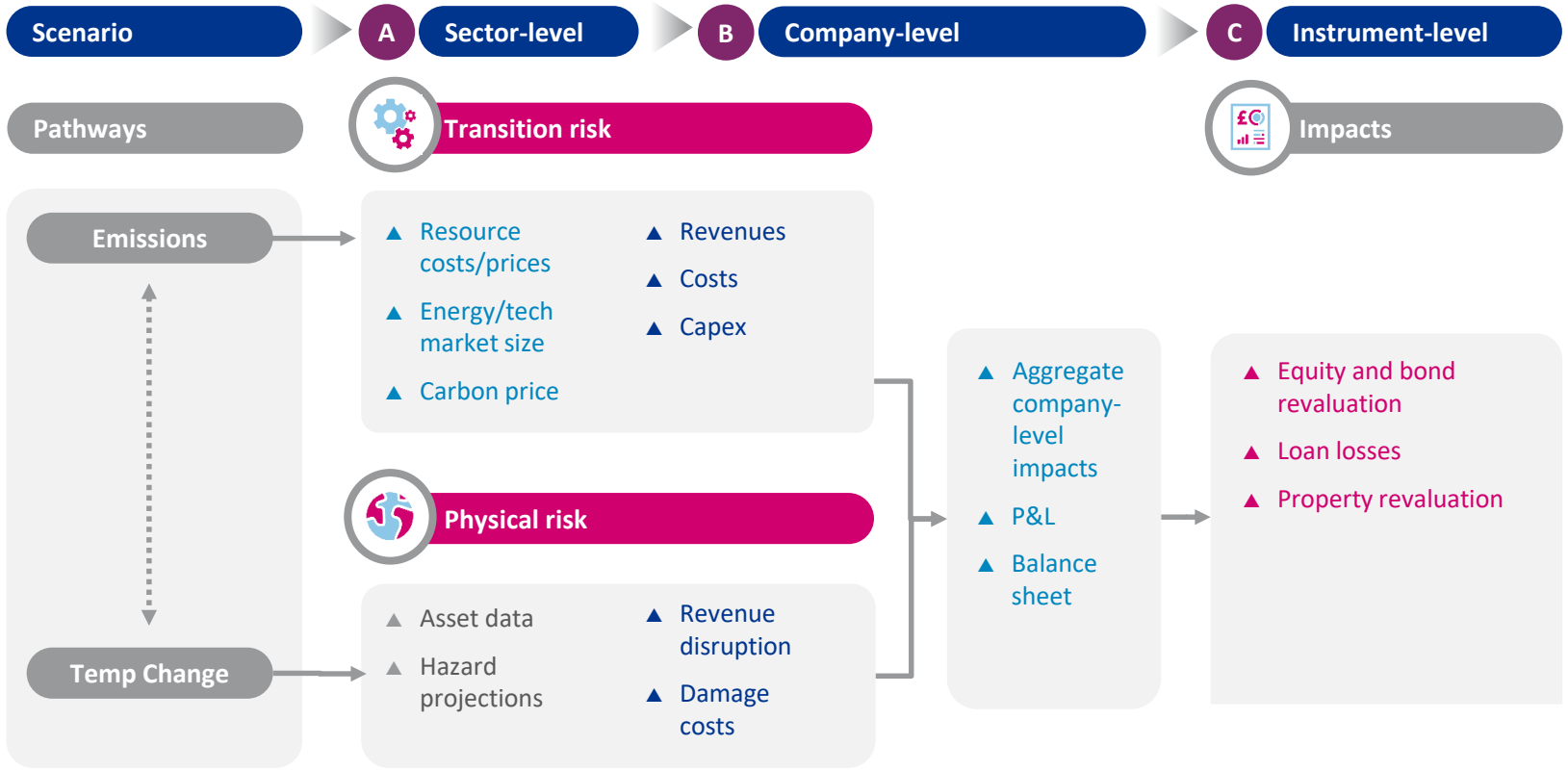


The Maths question: Modelling scenarios

Baringa

Baringa's climate scenario modelling framework integrates transition and physical risk scenarios into aggregate and instrument-level impacts on financial statements

Baringa's Climate Change Scenario Model



Use cases

Portfolio modelling & reporting	• Regulatory reporting (Stress Testing) • Risk reporting & disclosure (TCFD)
Client reporting	• Client portfolio analysis • Portfolio temperature alignment
Strategic reporting	• ESG / stakeholder relations • Balance sheet and portfolio optimisation
Commercial direction	• Business strategy • Modelling financed emissions • Commercial decisions
Instrument / asset level results	• Security valuation & credit scoring • Loan / asset / mortgage pricing • Transaction / asset due diligence

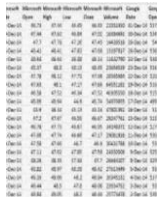
Who is our model for?

- All **Financial Services firms globally**, including **Banks, Insurers, Asset Managers, Wealth Managers.** Users across these organisations (e.g. front office, risk, strategy and ESG)
- **Pension funds, Infrastructure funds and other investor groups** that want to understand how their investments are impacting the Climate
- **Governments, Regulators, Think tanks and NGOs** who want to understand how they can use this information to drive the changes needed to mitigate and adapt to Climate Change
- **All companies and individuals** who want to understand how Climate Change will impact their organisations and investments

How clients engage with our model

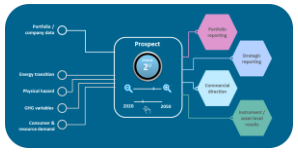
Our model translates our clients portfolio into detailed climate scenario results, enabling them to spend the bulk of their time interpreting the results and determining their management strategy

Client provides portfolio data in standard template

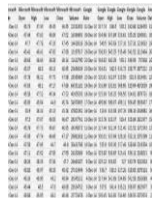


Client configures scenarios (with Baringa support as required)

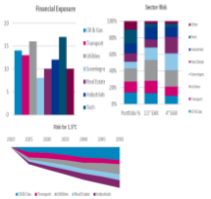
Baringa runs portfolio data through the Model



Our Model generates detailed output files supporting rich MI



Generate MI and discuss internally with key stakeholders



- Strategy & decision-making
- Portfolio optimisation
- ICAAP / ORSA
- BES, LIST and GIST participation

Portfolio optimisation, informing key decision-making processes

Granular, data-driven insights at multiple levels:

Overall portfolio
- Overall risk profile and hotspots
- Areas of opportunity
- Temperature alignment

Specific sectors
- Transition pathways
- Outlier companies

Funds
- Risk-return profile
- Investment strategy
- Temperature alignment

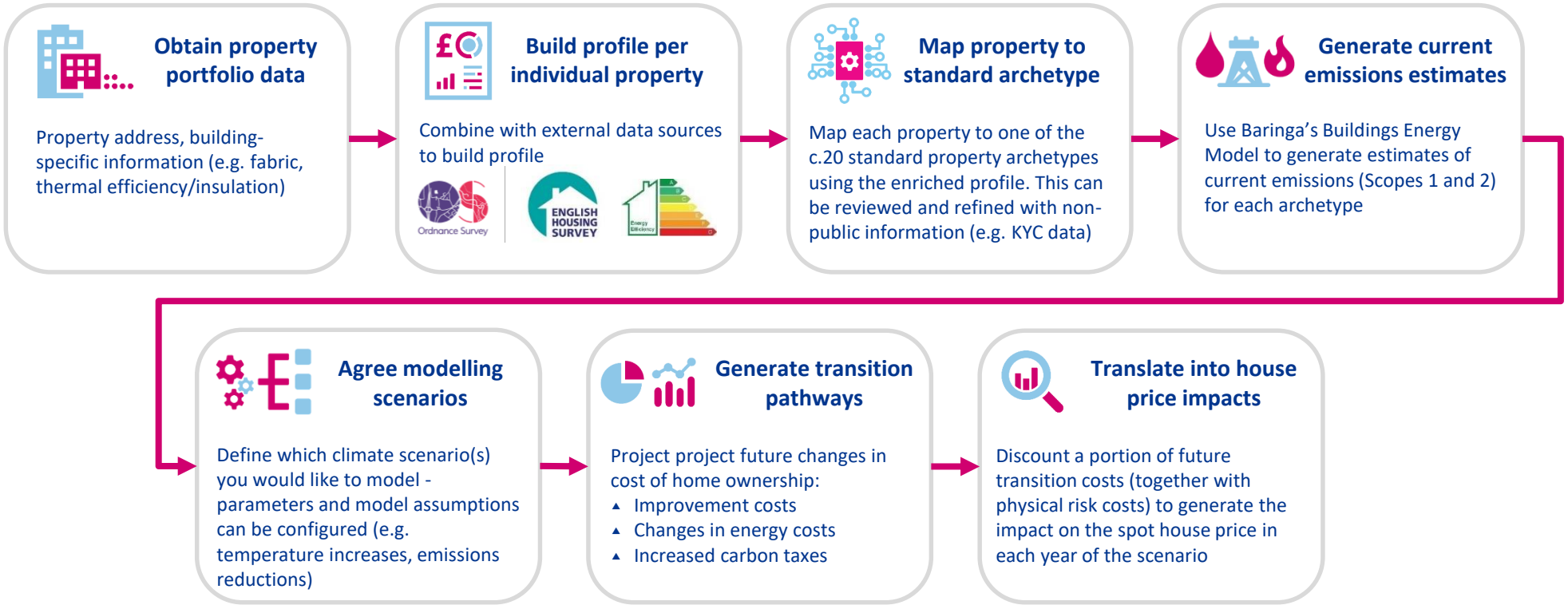
Companies
- Potential P&L and balance sheet impacts
- Instrument impacts
- Physical assets held, and their exposure to a wide range of hazards
- Temperature alignment

Individual physical asset level
- Exposure to a wide range of hazards
- Adaptation options
- Supply chain vulnerabilities

Application: generic residential mortgage portfolio

Leveraging our Building Energy Model for mortgages

Our Building Energy Model estimates scope 1 and 2 emissions and transition pathways for individual properties, and translates these into projected house price changes in a given scenario



Application: specific (a large South European bank)

Our understanding of their requirements

This bank requires support to develop its climate change scenario analysis approach in order to meet the requirements of the upcoming Bank of England Biennial Exploratory Scenario (BES)

Their requirements

- This bank had not yet determined its approach to transition risk; nor had it determined how to bring together physical and transition risks to generate the required scenario outputs
- Required support to:
  - Develop a comprehensive target state for climate change risk stress testing including:
    - Scenario modelling requirements
    - Process map (including identifying how it will perform counterparty-level assessment of companies' mitigation and adaptation plans[1])
    - Climate data flow and storage
    - Roles and responsibilities across the different teams
  - Conduct a gap analysis of current state vs target state
  - Create a detailed roadmap to prepare for the BES execution
  - Provide internal training for key stakeholders
  - Scope out the work required to develop a framework of metrics and targets
  - Assess the interaction between scenario analysis and annual credit reviews

Critical Success Factors

- ✓ Leading climate change consultancy with a deep understanding of banking risk management
- ✓ A methodical, tried and tested approach that is proportionate to complexity
- ✓ Full transparency and knowledge transfer with the bank's staff to enable them to "own" the process
- ✓ Upskill and develop knowledge of the team on Climate Risk throughout the project
- ✓ Clear understanding of what is needed to deliver against the BES requirements

[1] The Bank of England's discussion paper requires individual counterparty-level modelling for 80% of this bank's nominal corporate exposure (i.e. around 600 of its clients, most of which are unlisted mid-market companies)

How Baringa is helping

Baringa is supporting this bank's comprehensive review to determine the appropriate scenarios and delivery plan required for the submission of BES in H2 2020

	Weeks 1-4	Weeks 5-6	Weeks 7-8
	Target state definition	**Gap analysis**	**Roadmap & training**
ACTIVITIES	▲ Work with key stakeholders (e.g. Enterprise Risk Management, Credit Risk, FP&A, front office) to develop target state for climate change scenario analysis: – Detailed scenario modelling framework – Data and technology – Process map – Roles and responsibilities ▲ Define approach to unlisted clients ▲ Define approach to counterparty-level assessment ▲ Define approach to temperature alignment	▲ Work with key stakeholders to conduct gap analysis against: – The target state – Approach to unlisted companies – Approach to counterparty-level assessment of up to 80% of corporate exposure – Temperature alignment approach	▲ Create detailed roadmap to prepare to participate in the BES from Q3 2020 ▲ Review with key stakeholders and refine as appropriate ▲ Deliver training sessions on the modelling approach (modelling assumptions, design, and interpretation) ▲ Deliver Board training on key topics (eg climate change risk, regulation and impacts on key sectors) ▲ Assess work to deliver metrics and targets by year-end ▲ Assess potential interaction between scenario analysis and annual credit reviews
OUTPUTS	▲ Target State Operating Model Document ▲ Documented approach to unlisted entities ▲ Documented approach to counterparty-level analysis for up to 80% of nominal corporate exposure ▲ Documented approach to measuring temperature alignment	▲ Documented gap analysis, identifying all activities required to deliver the target state	▲ Roadmap to deliver the scenario analysis target state, and to build a framework of metrics and targets ▲ Documented agreement on the interaction between scenario analysis and annual credit reviews ▲ Training sessions for Board (1 to 2) and staff
BENEFITS	▲ **Engaged stakeholders** across multiple functions ▲ A **shared understanding** across key stakeholders of the intended target state	▲ **Clear understanding** of the work required to be ready to participate in the BES	▲ A clear, tangible **way forward** ▲ Confidence that you will meet **Bank of England expectations**

Ongoing support that can be provided:

- ✓ Execution of the bank's roadmap
- ✓ Climate change "scenario analysis as a service," with fully integrated transition risk and physical risk analysis
- ✓ Expert advisory support in identifying transition risks and opportunities in your portfolio
- ✓ Implementation of metrics and targets
- ✓ Incorporation of climate risk and opportunities in strategy, risk management and product design
- ✓ Sustainability disclosure benchmarking and strategy
- ✓ Sustainability target setting
- ✓ Design and implementation of Power Purchase Agreements (PPAs)

Discussion/Q&A

Discussion: implications for the Australian Climate Roundtable

Close

Close

- Workshop Series 2 will focus on transition and is under development
  - Similar format (but may involve some in person later in the year, subject to health advice)
- Welcome feedback on the format and process to:
  - Tennant.reed@aigroup.com.au
  - Rachael.Wilkinson@aigroup.com.au