Impact of climate change on demand

Linking the science to decision making

Sydney WATER

The impact

Infrastructure development in Sydney should plan for a marginal increase of;

- **2.23% (in 2020-2040),**

- **4.4% (in 2060-2080),**

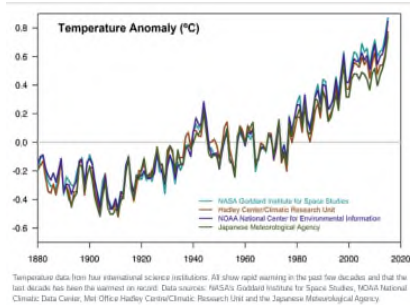**In demand for water, due to climate change**

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The problem

Climate change alters weather

Weather is the strongest factor driving fluctuations in water demand (Up to 50GL a year).

Therefore climate change would Influence demand

**By how much and when …?**

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Demand forecasting

- Demand is forecast, at four to five year, and 50 year time scales, to inform

  - pricing proposals to the Independent Pricing and Regulatory Tribunal (IPART), and

  - capital investments in infrastructure.

- The (regression) model considers, population, dwelling characteristic and weather as input,

- The model is developed using actual weather, but forecasts are generated assuming average (30 year) climatic conditions.

- This is likely to under forecast demand, in light of climate change
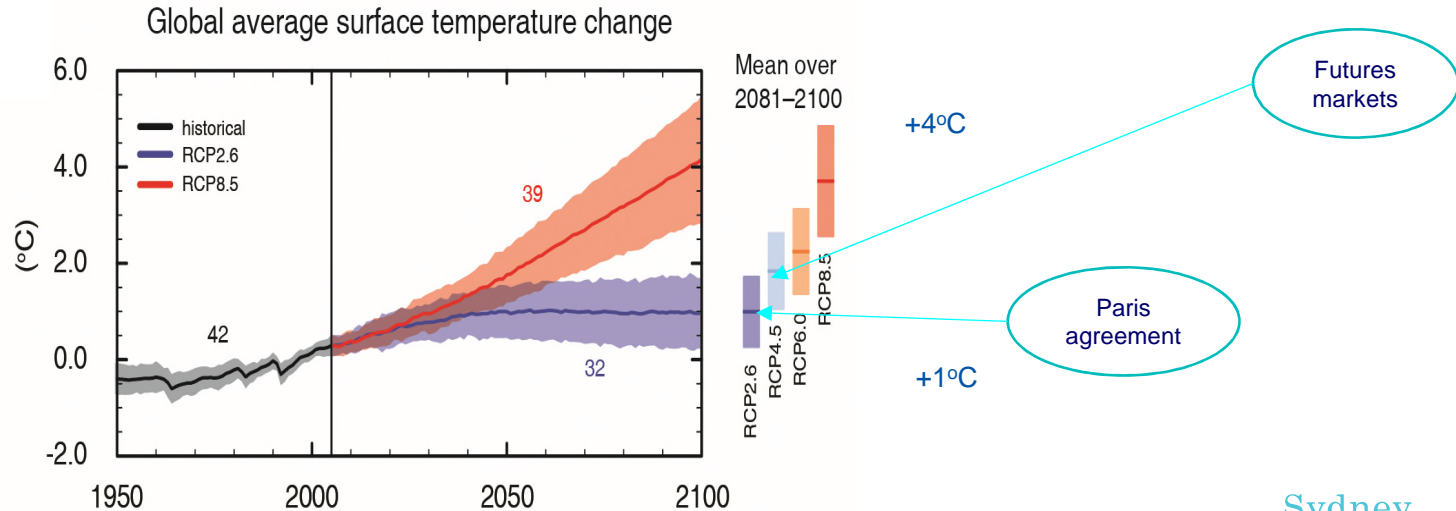
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Global (climate change) scenarios

It is not clear how the global socio-economic systems will respond to emissions in the future.

Special Report on
Emission Scenarios
(SRES) - IPCC

A1B − ~ 4.8 deg

A2 − ~ 3.7 deg

B2 − ~ < 2 deg
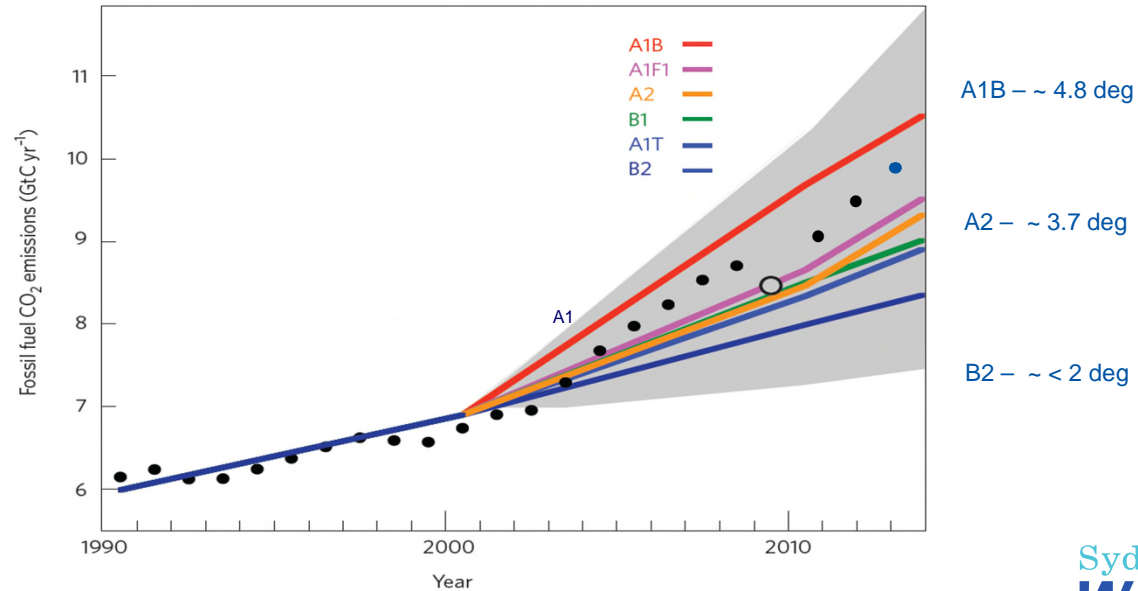
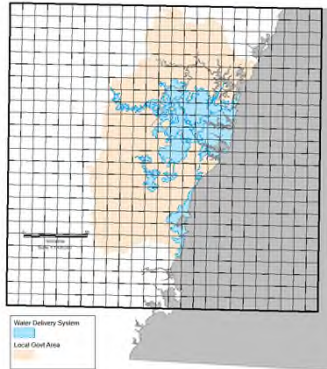# Global (climate change) scenarios

Representative Concentration Pathways (RCP), considers incorporates potential mitigation scenarios.

How does it impact Sydney

NSW and ACT Regional Climate Modelling (NARCliM)

A joint project by the NSW Government and the University of New South Wales to downscale outputs of global climate models.


- 4 global models (CCCM3.1, ECHAM5, CSIRO-Mk3.0, MIROC3.2)
- 3 downscaling methods
- 12 projections
- A2 Emission Scenarios

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Integrating with demand forecasts by

- Integrating NARCLiM outputs with Sydney Water's demand forecasting models.

- But climate models typically predict averages, whereas demand is mostly driven by extreme events (severity and frequency)

  - Build a 'weather generator' that develops Monte-Carlo simulation, of daily weather scenarios based on, NARCLiM projections

- And NARCLiM does not produce a single projection, but generates 12 equally likely projection scenarios (which one to use).

  - Develop a decision framework to select an output base on the risk tolerance of the decision it informs.

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Integrating the models
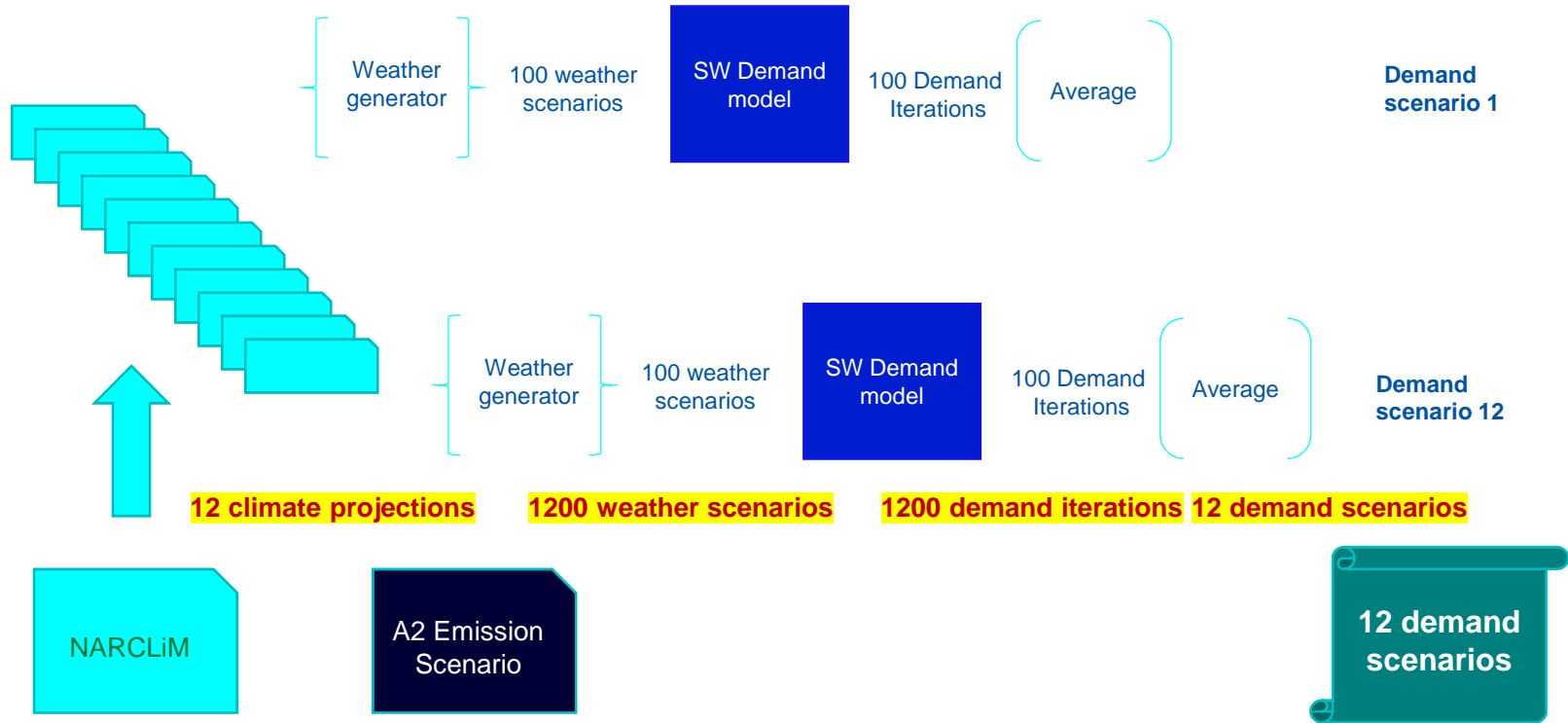
Choosing one of the 12 projections

- Is a policy, rather than a scientific, decision.

- Do not have to use the same projection for all decisions/purposes.

- Use the projection most appropriate to the risk tolerance of the decision it informs
   (Eg. if cost of error is too high, use the worst case scenario)
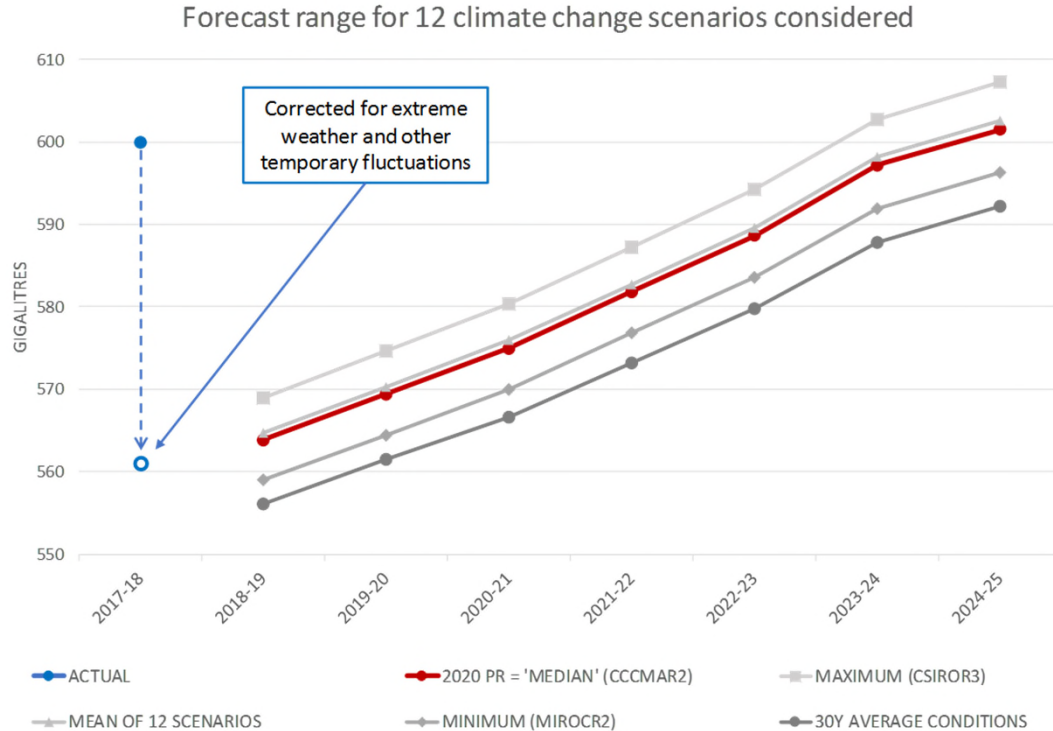
Select scenario where,

1. **Overall cost of error is minimal**

2. **Ability to respond to error is maximum**

3. **Impact of error is (nearly) equitably distributed among stakeholders**
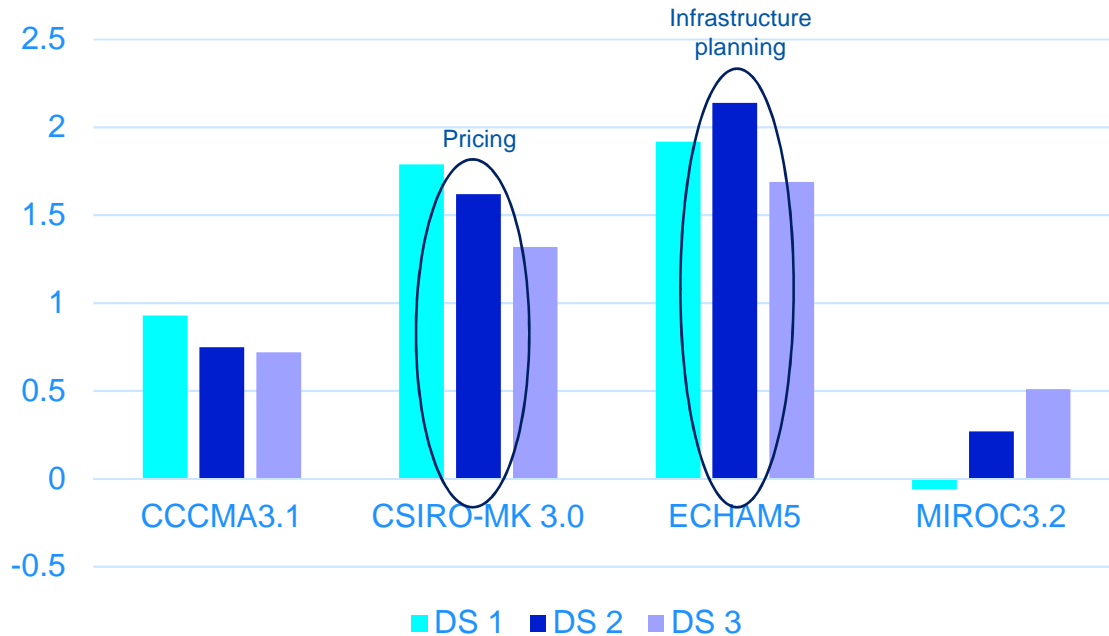
Choosing one of the 12 projections

Eg. Pricing & Investment in infrastructure

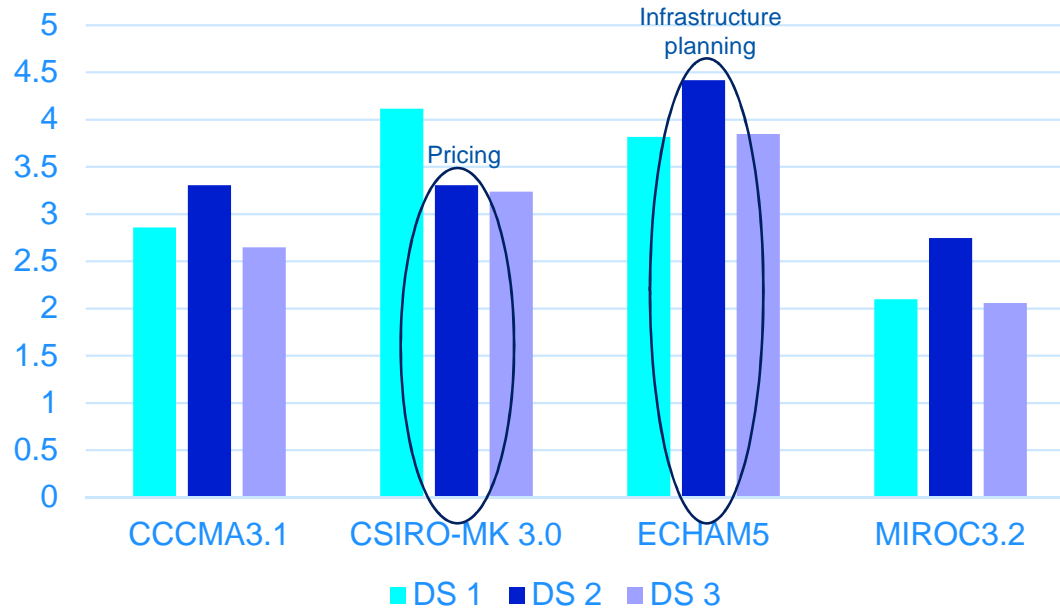| Decision	Direction of error	Impact of error on NSW Govt (SW)	Impact of error on customer	Ability & speed to respond	Projection to use
Retail price determination	Over forecast	Loss of revenue		High	Middle case
	Under forecast		High price	High	
Infrastructure/water security planning	Over forecast	Wasted investment		Potential to catch up in time	Worst case
	Under forecast		Service failure /constrain	Slow	

Potential impact on the short term (experimental – draft only)

Forecast range for 12 climate change scenarios considered

Corrected for extreme weather and other temporary fluctuations

Y-axis: GIGALITRES (550, 560, 570, 580, 590, 600, 610)

X-axis: 2017-18, 2018-19, 2019-20, 2020-21, 2021-22, 2022-23, 2023-24, 2024-25

Legend:
- ACTUAL
- 2020 PR = 'MEDIAN' (CCCMAR2)
- MAXIMUM (CSIROR3)
- MEAN OF 12 SCENARIOS
- MINIMUM (MIROCR2)
- 30Y AVERAGE CONDITIONS

Percentage increase in demand 2020-2040 over 1990-2010

Percentage increase in demand 2060-2080 over 1990-2010

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