

Impacts of Government Policy on Intermittent Generation Penetration



8th Dec 2009

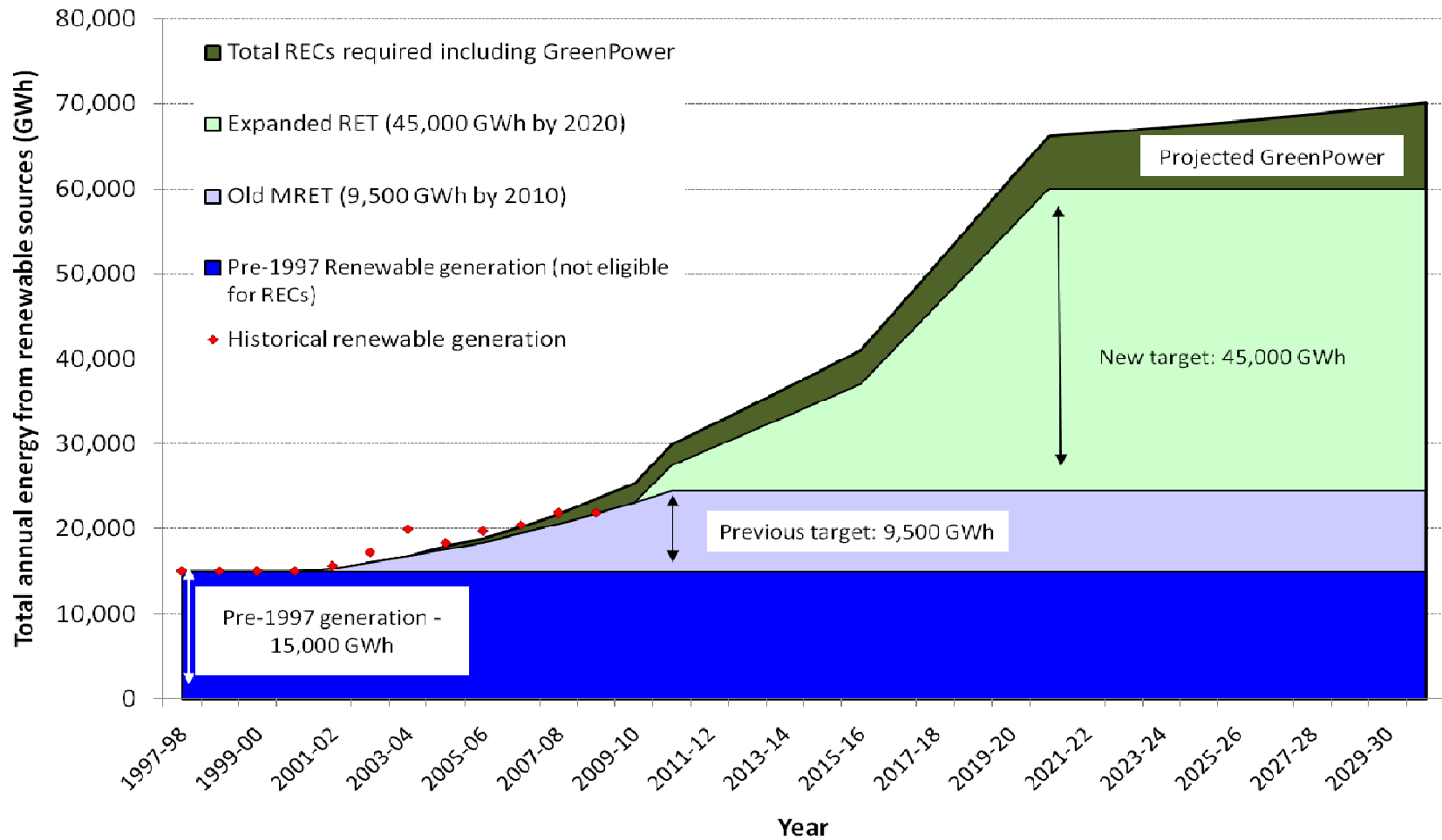
Dr Ian Rose, Dr Joel Gilmore

Perth

Broad Methodology

- **Identify existing and future policy drivers**
- Decide on key drivers and correlations
- Construct scenarios / outlooks
- Assess renewable resource
- Develop planting schedules

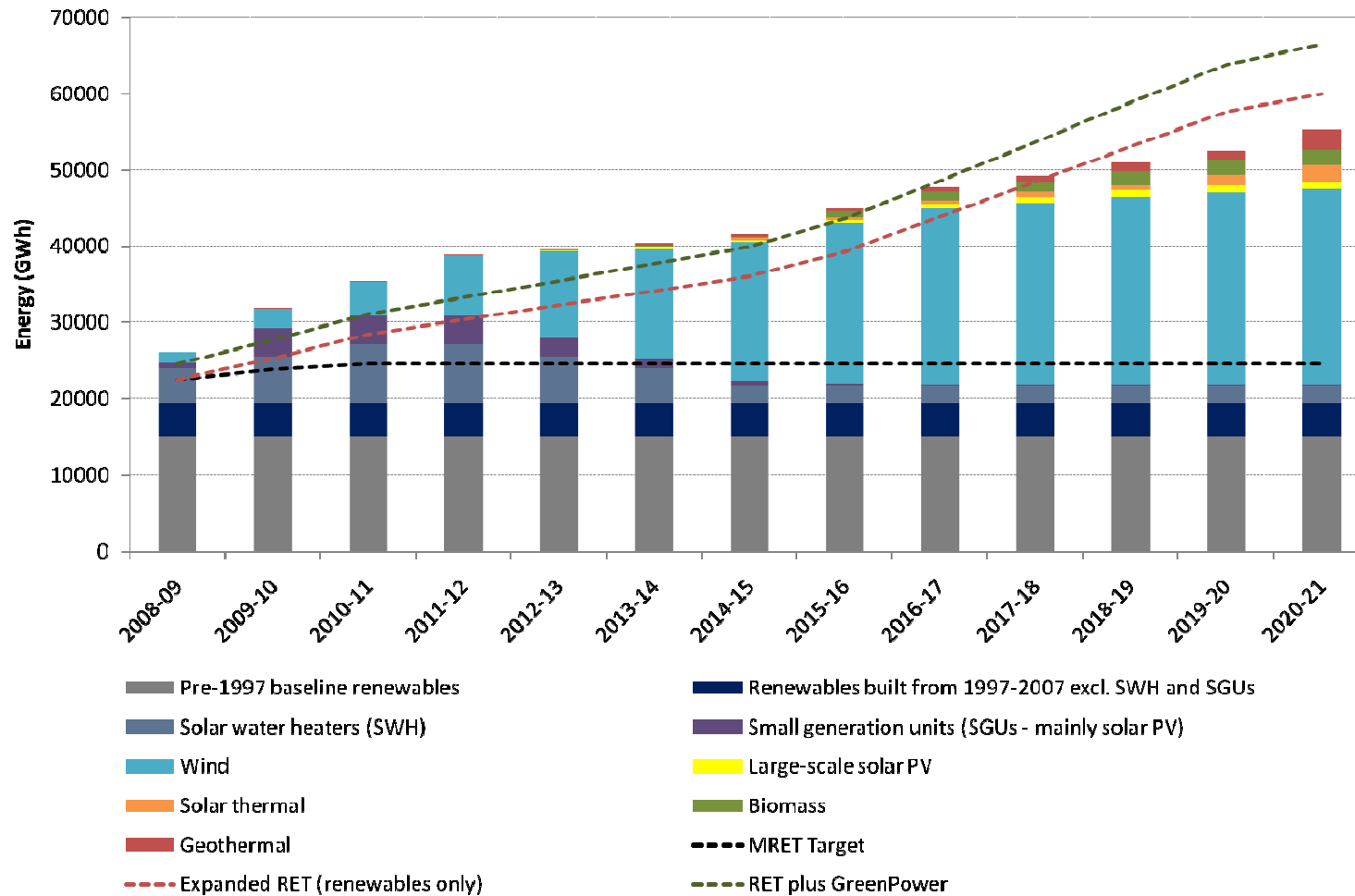
Renewable Energy Target



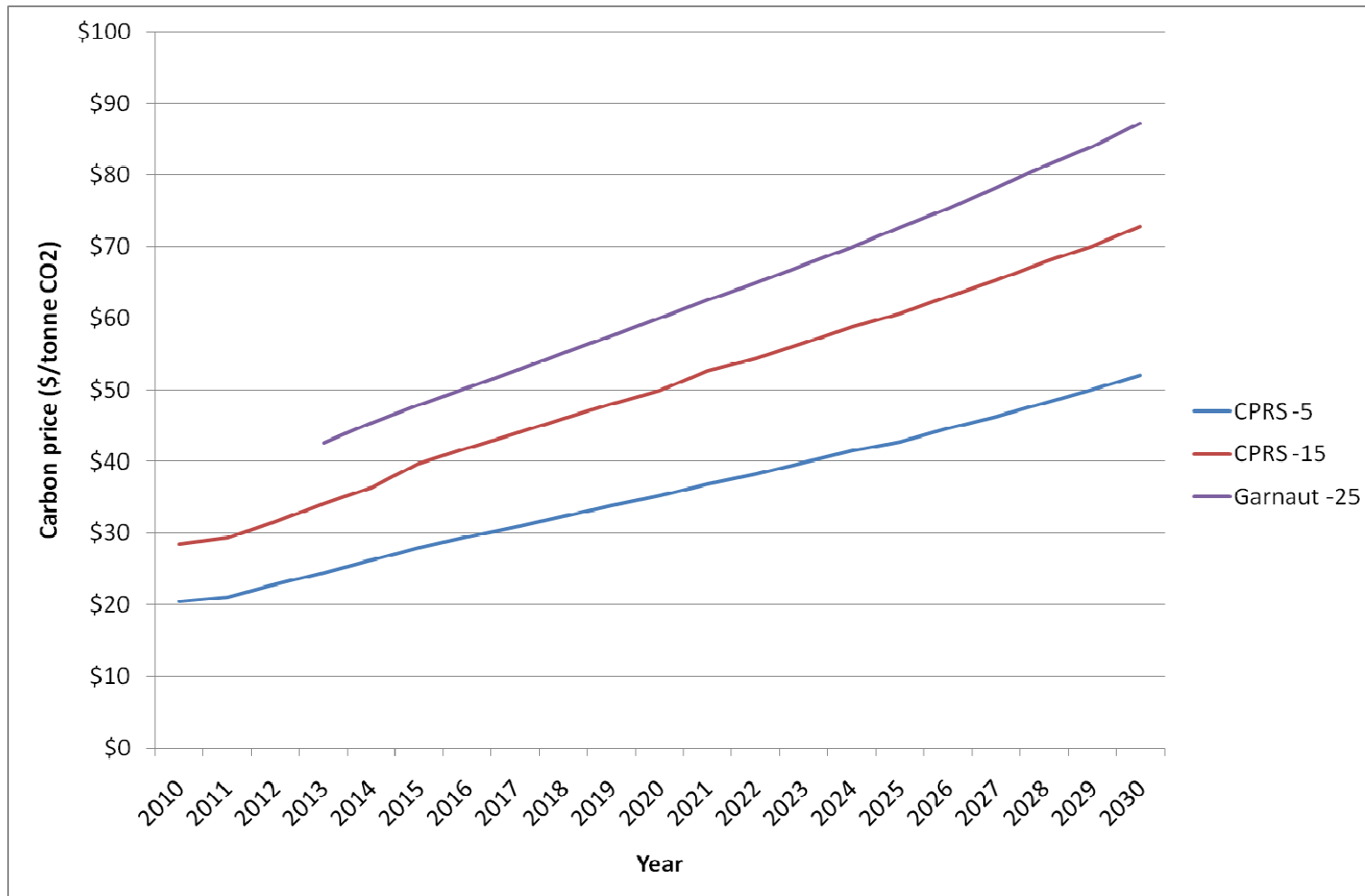
Spot REC Prices (End Mth)



Breakdown of RET



Emissions Trading Scheme



Clean Energy Initiative

- Major investment in:
 - CCS (\$2.4 billion over 9 years)
 - Solar power (\$1.6 billion over 6 years)
- Plus
 - \$300 million Renewable Energy Demonstration Program
 - \$15 million Biofuels research
 - \$50 million Geothermal Drilling
 - \$150 million for new initiatives



Australian Government

Department of Resources, Energy and Tourism

Solar Flagships Program

- \$1.5 billion in funding for 1000 MW
- Two rounds:
 - 400 MW of solar thermal and solar PV
 - Applications in 2010
 - Second round 600 MW of any tech
- May include hybridisation
- Must be grid connected



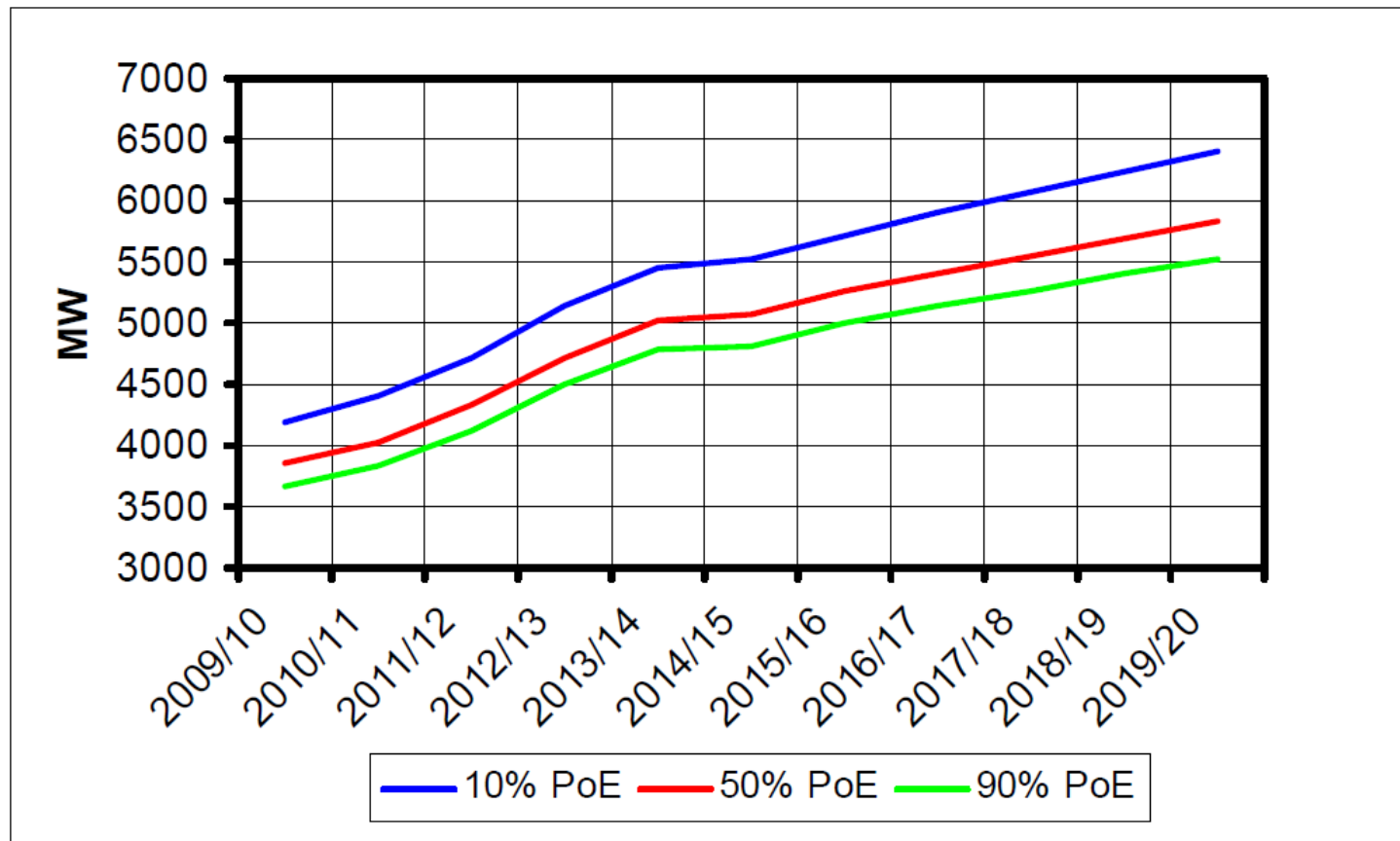
CCS Flagships

- \$2.4 billion in funding
- Multi-user infrastructure for storage
- Developing integrated CCS
- Aim for 1000 MW of low emissions gen



Demand Growth (Med)

Figure 16 - Forecast Maximum Demand - Expected Economic Growth



Demand growth (LMH)

Figure 17 - Impact of Economic Growth on Maximum Demand for the 10% POE Forecast

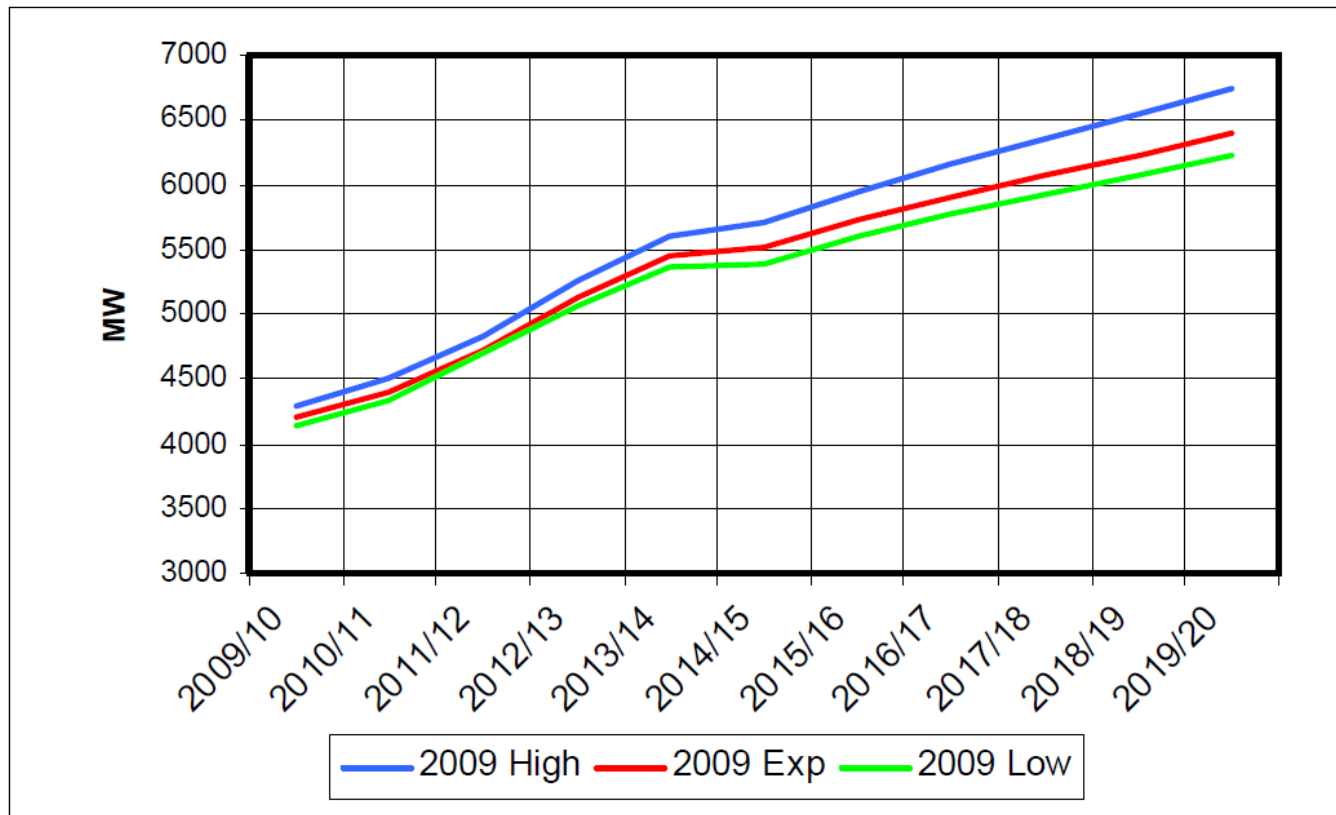


Figure 18 - Forecast Sent-Out Energy

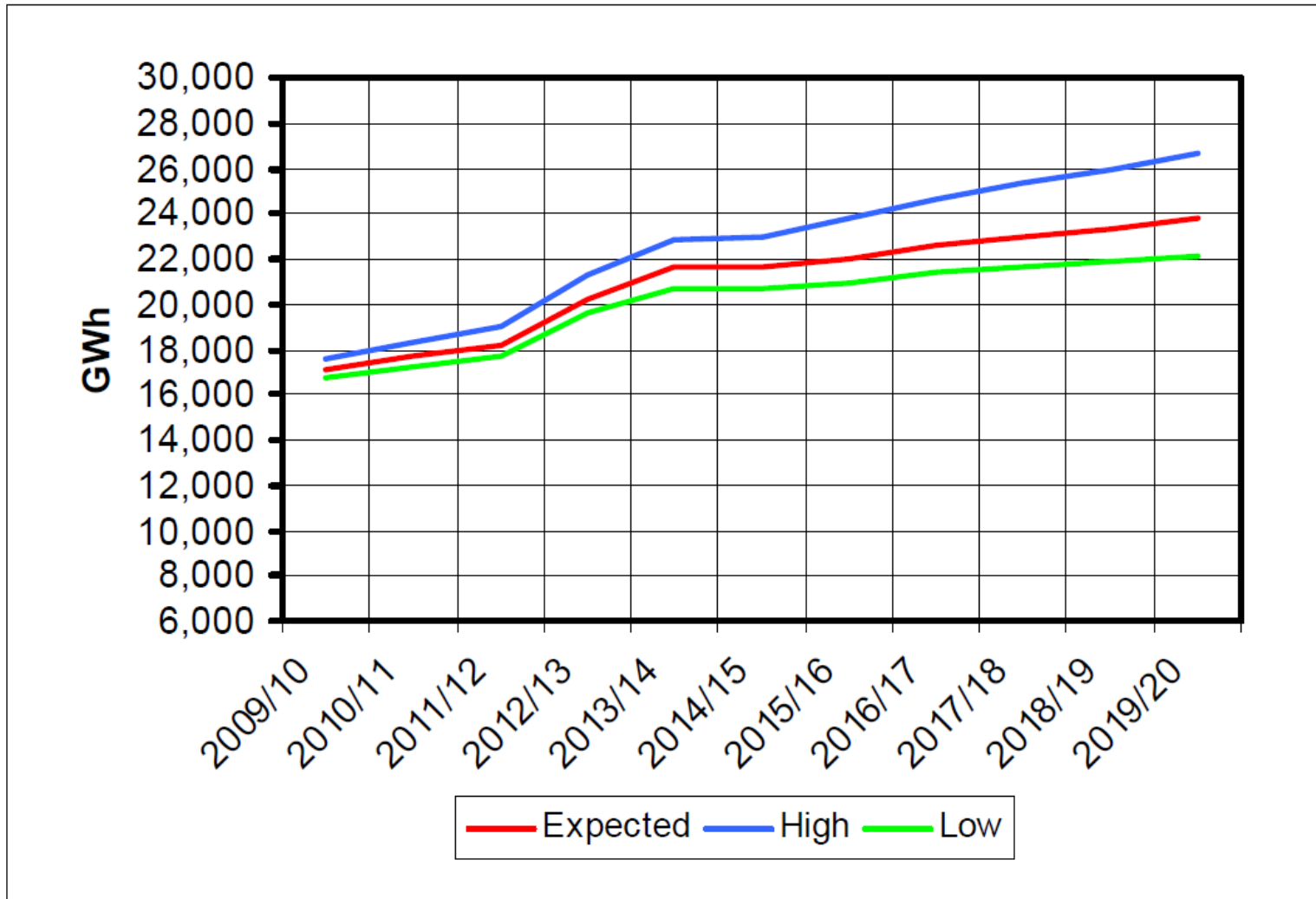
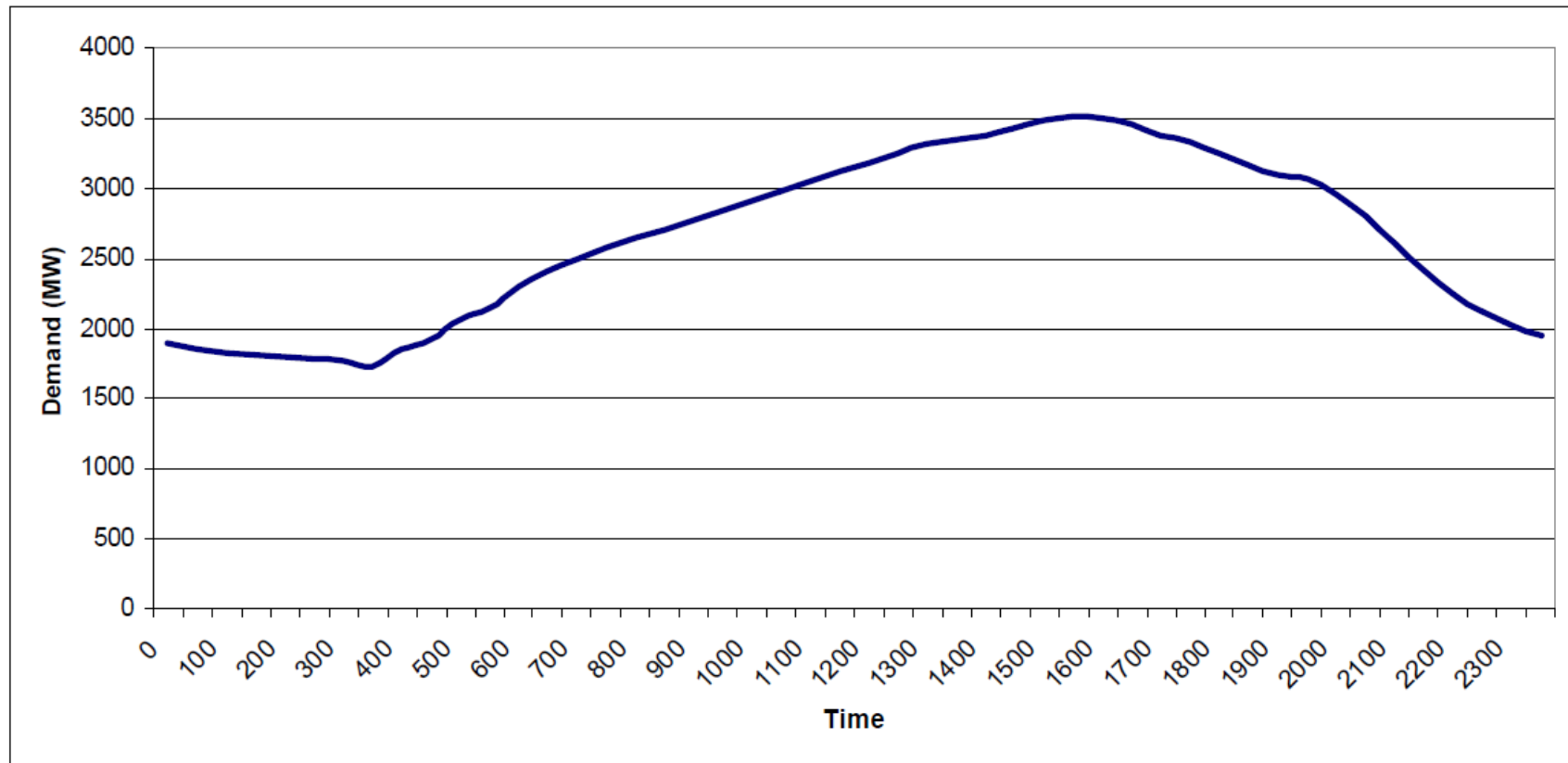


Figure 5 – Daily Load Curve 2009 Peak Demand Day



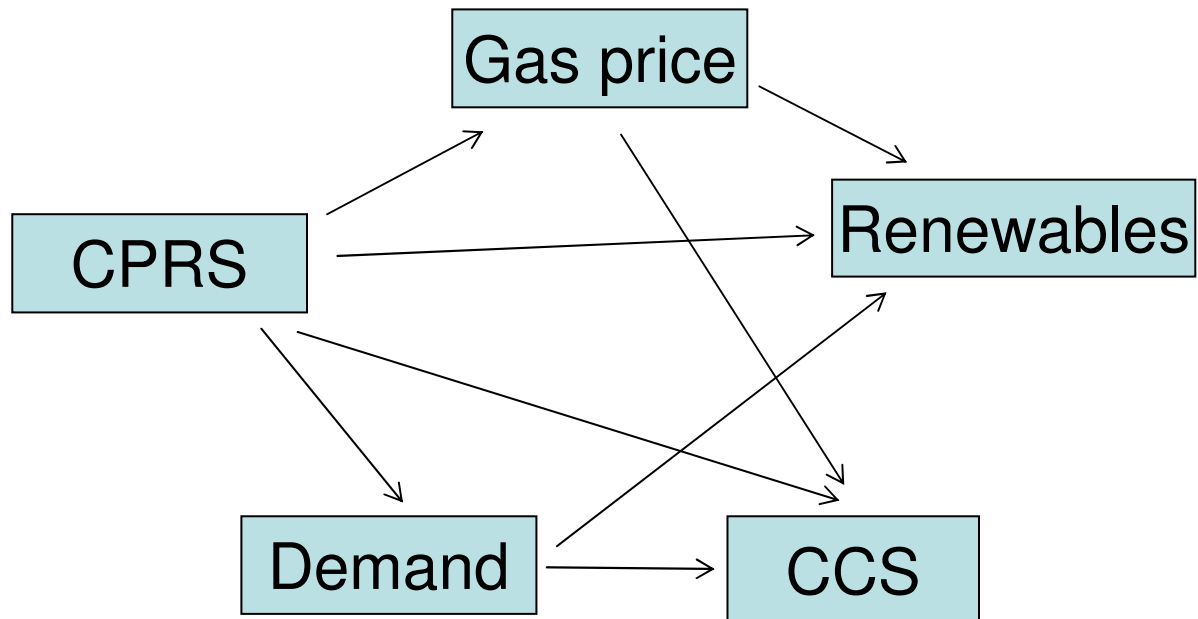
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Scenario drivers

CPRS	Demand	Gas price	Renewables	CCS
CPRS -5%	Low Growth	High	Mainly wind	Available
CPRS -15%	Med. Growth	Moderate	Mix of techs	N/A or Expensive
CPRS -25%	High Growth			

Driver dependencies:



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Scenario 1: Strained Transmission

CPRS	Demand	Gas price	Renewables	CCS
CPRS -15%	Low Growth	High	Mainly wind	Not avail

- Government promotes renewables and climate change
 - Energy efficiency
 - Rapid connection procedures
- Emerging techs not yet cost/technologically effective
 - RET met mostly by wind
- Demand met by gas plant, plus some CCS-ready coal plant
- Explores high penetration of intermittent renewables

Scenario 2: Business as Usual

CPRS

Demand

Gas price

Renewables

CCS

CPRS -5%

Med Growth

Moderate

Mainly wind

Not avail

- Limited federal and international climate change policies
 - Only moderate emissions reductions targets
 - Limited R&D in geothermal or other renewables, or CCS
- RET is met by wind, backed by gas
- Minor new investment in coal
- Scenario explores “minimal disturbance” world

Scenario 3: Low carbon world

CPRS	Demand	Gas price	Renewables	CCS
CPRS -25%	Low Growth	Moderate	Mix	Avail

- Strong global commitment to climate change
 - Heavy investment in R&D → CCS, solar, geothermal, wave
 - WA Government provides incentives for renewables in SWIS
- Demand is met by renewables, CCS and gas
- Older coal plants are retired from 2020 to 2030

- Explores a carbon constrained world

Scenario 4: Coal world

CPRS

Demand

Gas price

Renewables

CCS

CPRS -5%

High Growth

High

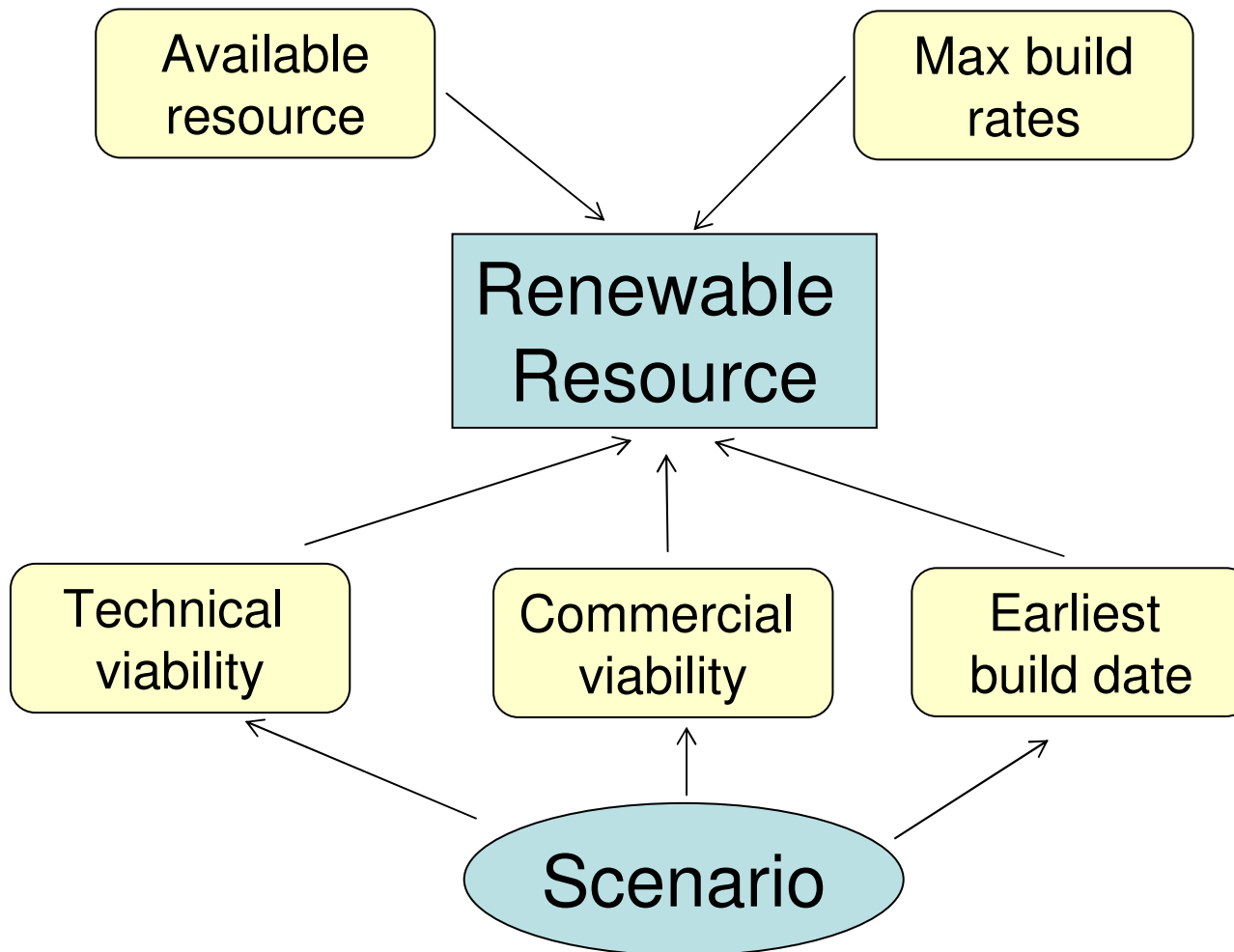
Mainly wind

Only late

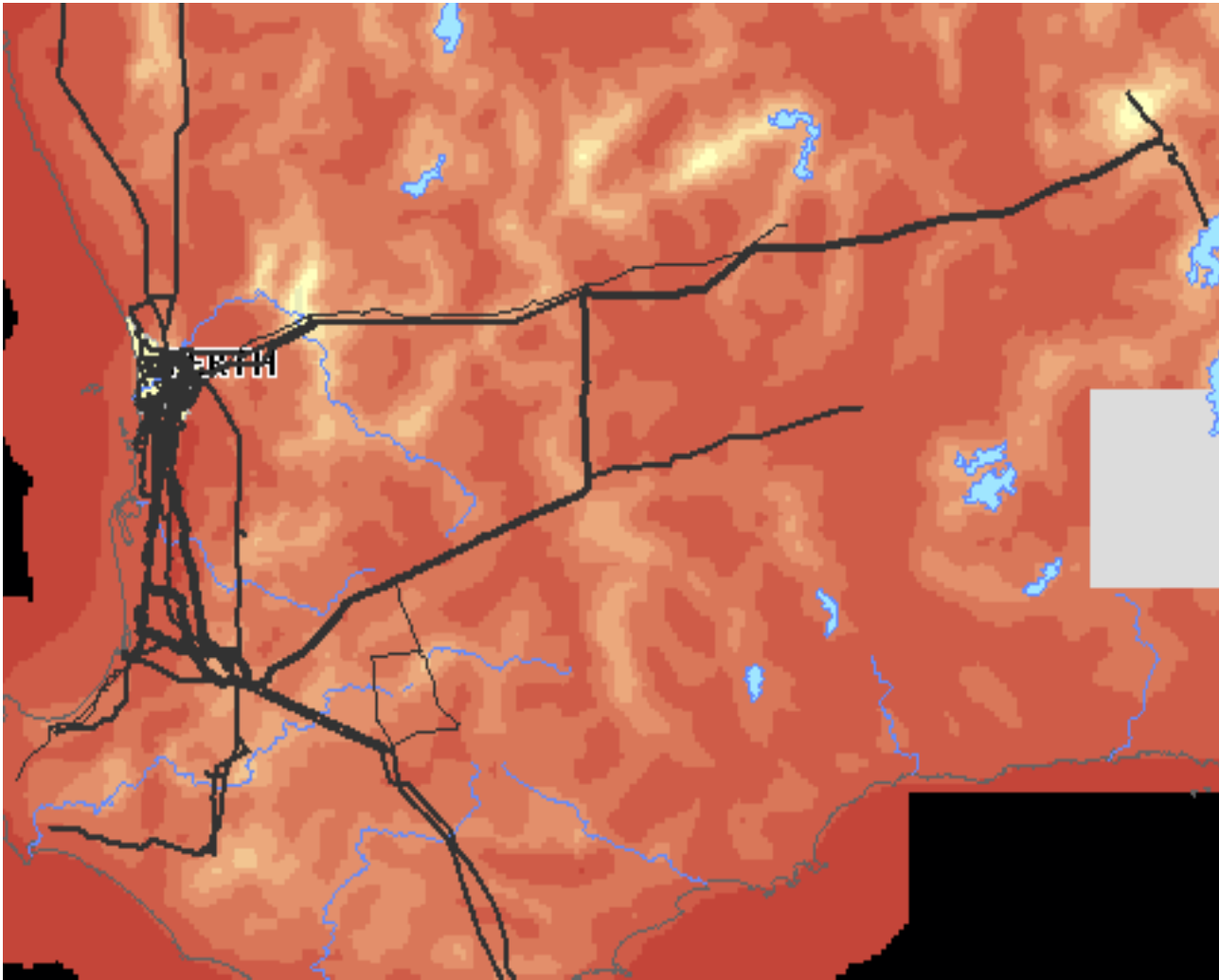
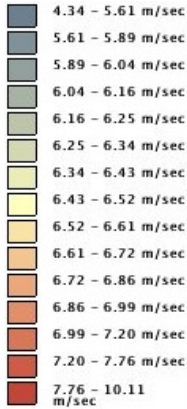
- Limited federal and international climate change policies
 - Wind is major contributor to RET
 - Limited development of renewables post-2020 (mainly pilot projects)
- Strong economic growth, including WA LNG exports
- High gas price and low carbon price favours coal
 - Plants able to be retrofitted with CCS when available
- Explores continued development of coal

Broad Methodology

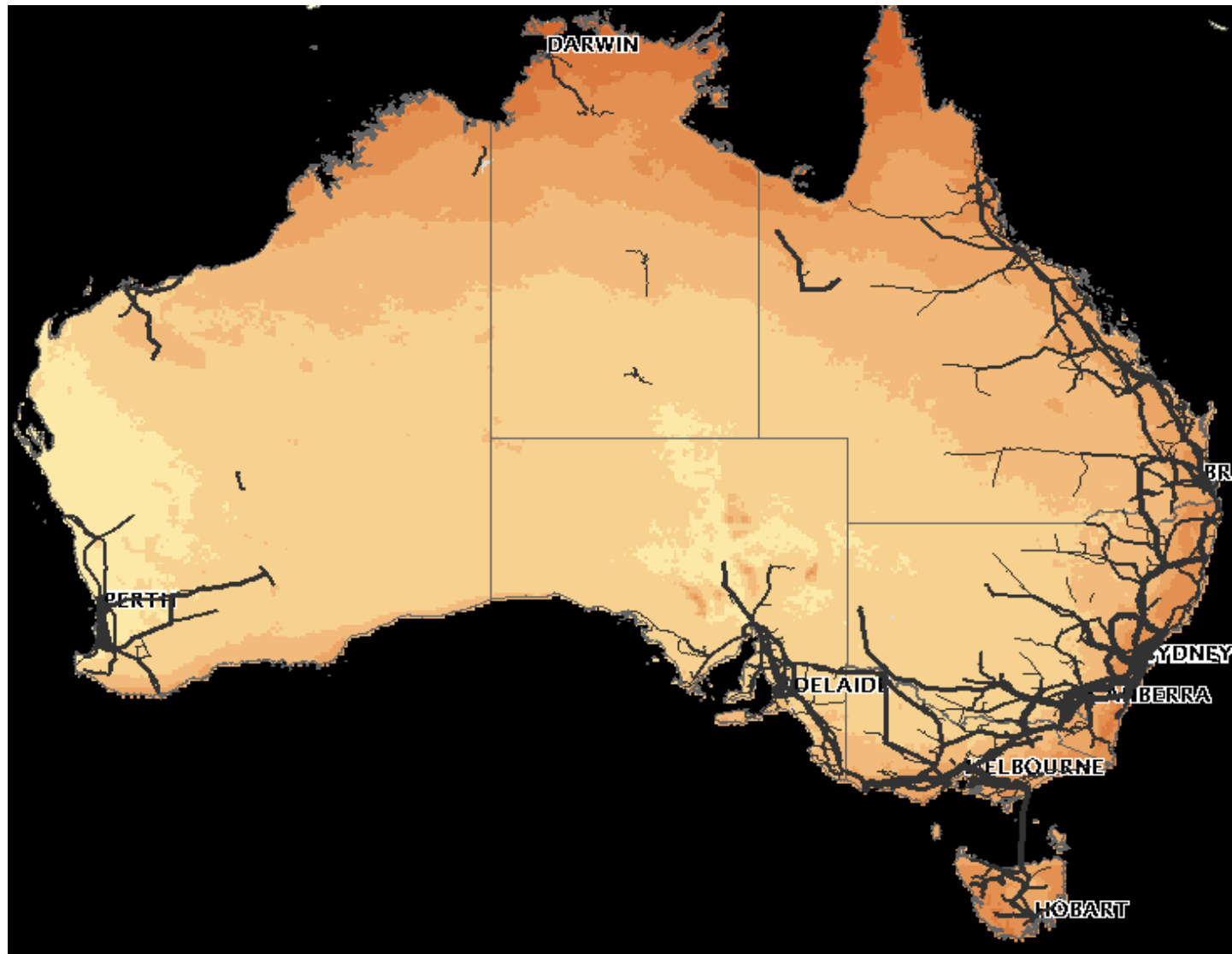
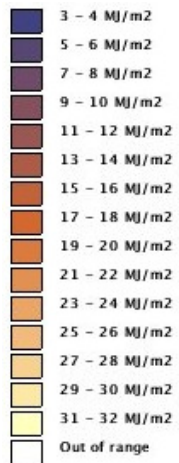
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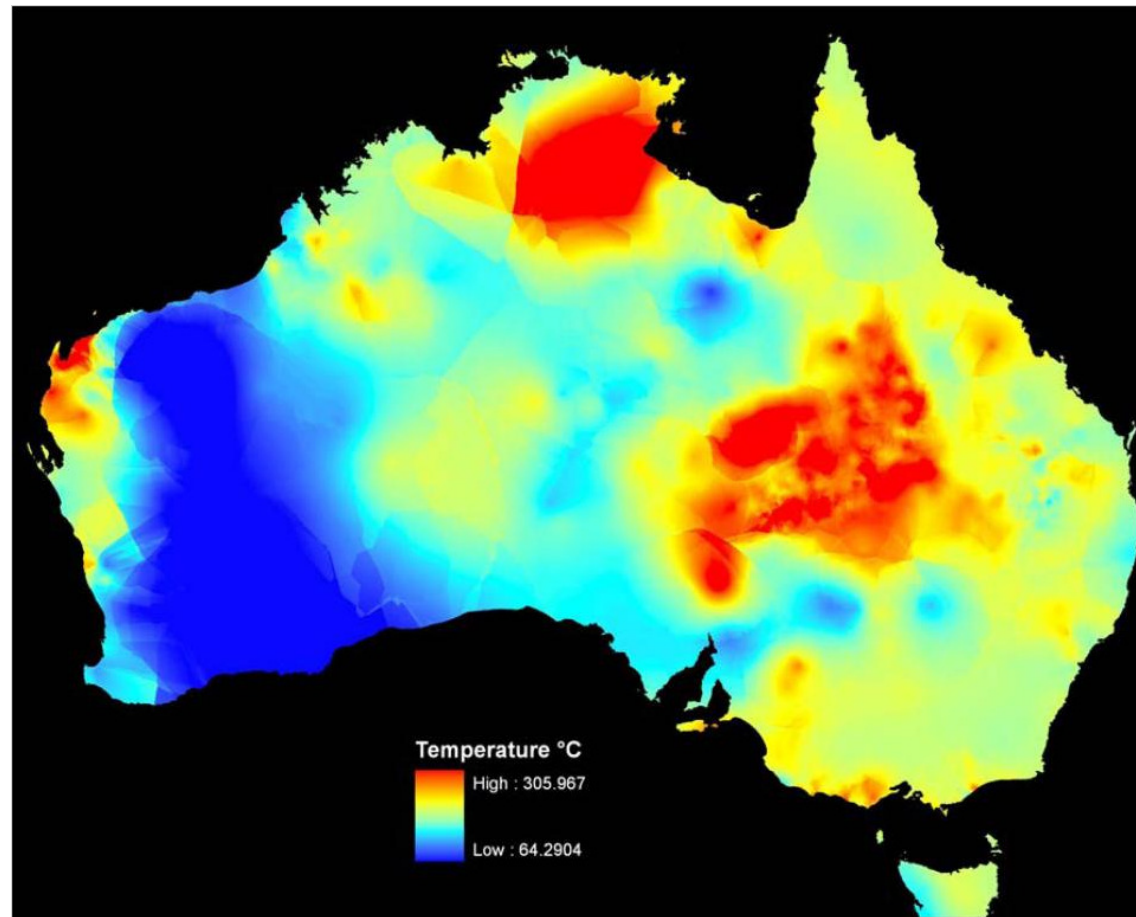
Wind Resource



Solar Resource



Geothermal



Modelled crustal temperature at 5 km depth, using Austherm data, OZ SEEBASE™ depth to basement and basement temperature gradient defined by heat flow provinces. The temperature data contained in this image has been derived from proprietary information owned by Earth Energy Pty Ltd ABN 078 964 735.

Other technologies

- Biomass
 - Likely to be cost effective, but limited in capacity
- Wave
 - Shows great potential, particularly in WA
 - Costs are likely to be high in short term
- Energy storage options
 - Improved batteries, ultracapacitors
 - Plug-in vehicles

CCS

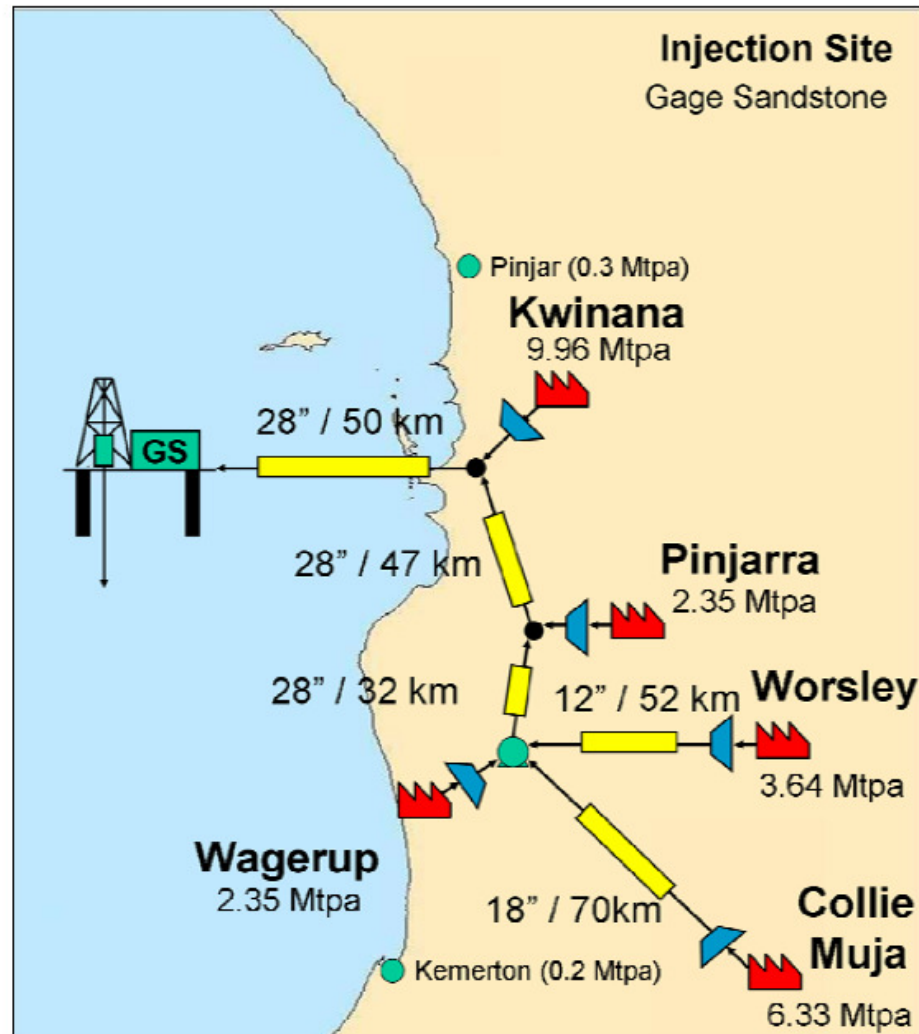


Figure 1 — Regional emission hubs together with a schematic representation of a network for the injection of CO₂ in the Gage sandstone. Also shown are the annual CO₂ emissions pipeline lengths and diameters

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Planting Schedule

- List all existing, committed and proposed projects
- List renewable generation options in each year
 - Considering geographical and transmission constraints
- Determine new plant required to meet:
 - Demand target
 - RET
 - Retirements
 - Emission targets
- Construct plant based on scenario assumptions