



Centre for Energy and
Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA



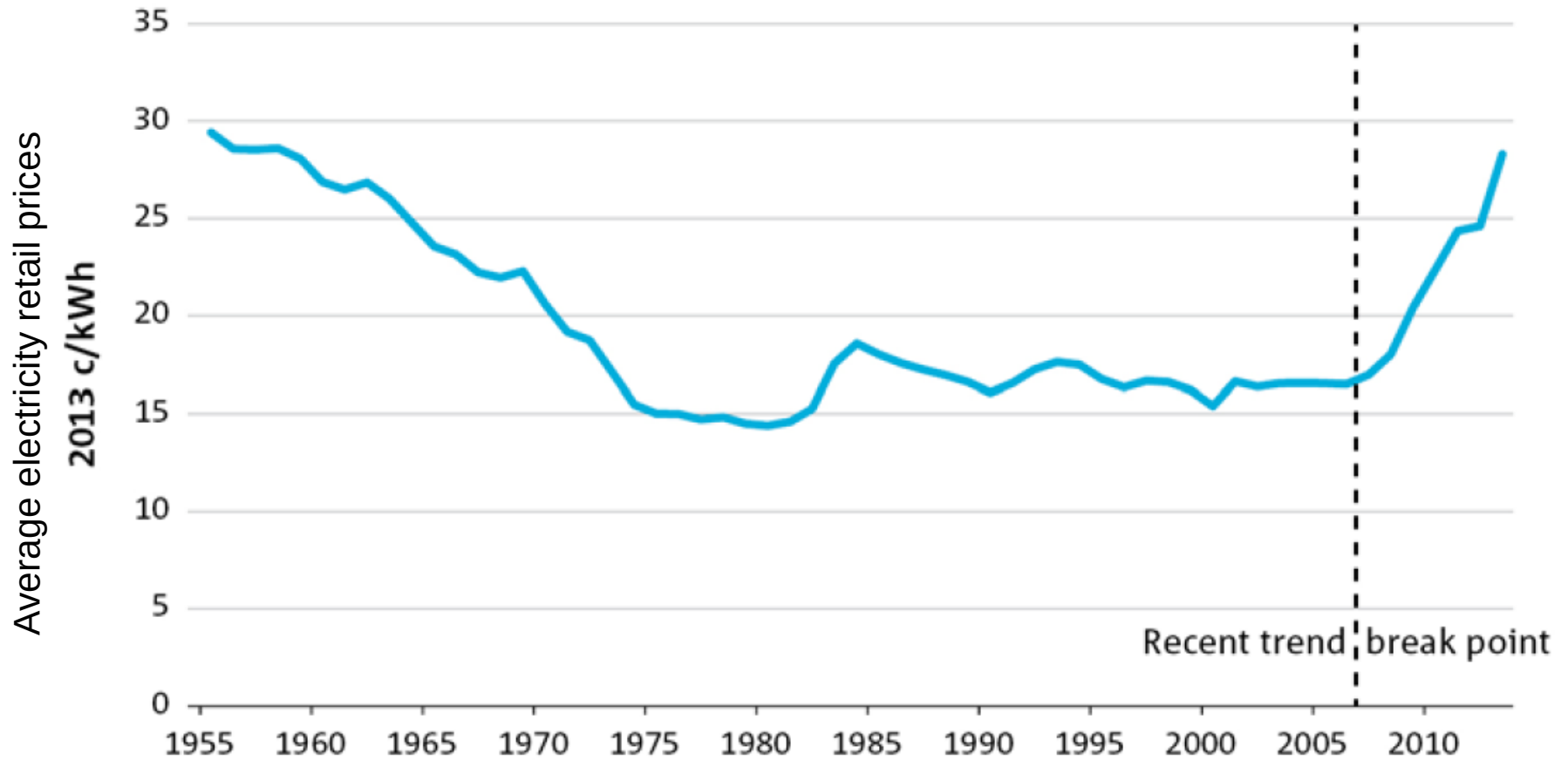
Energy Productivity & Pricing

Markets for energy, renewable energy and carbon

Dr Jenny Riesz
February 2015

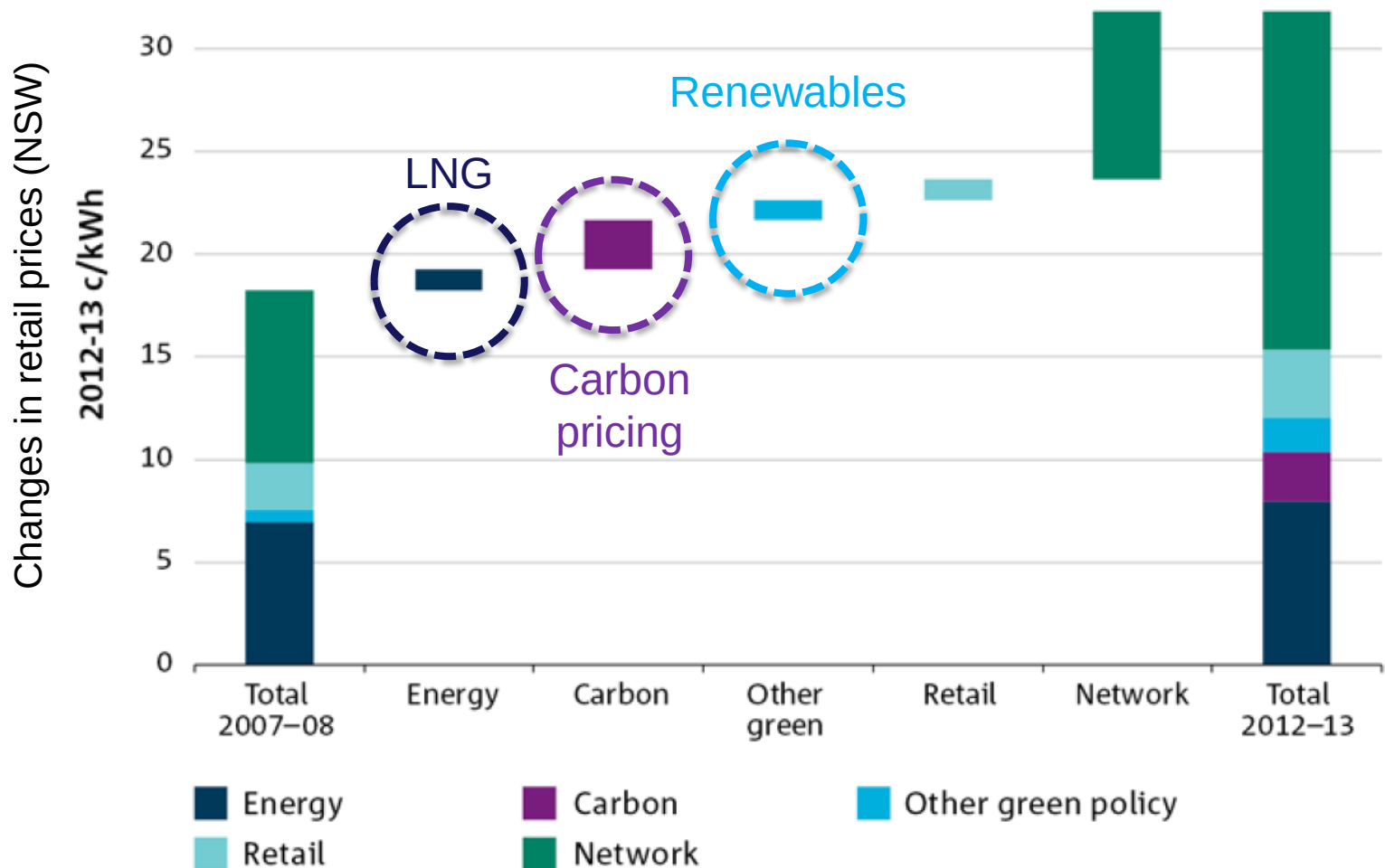


Electricity price rises



Changes in residential retail electricity price components

Causes are complex, various and differ by state, but investment in the electricity distribution system played the largest role.



The market for

RENEWABLES

Renewable Energy Market



Renewables create certificates
(1 MWh = 1 REC)



Clean Energy Regulator sets
Renewable Power Percentage
(RPP) – defines annual liability

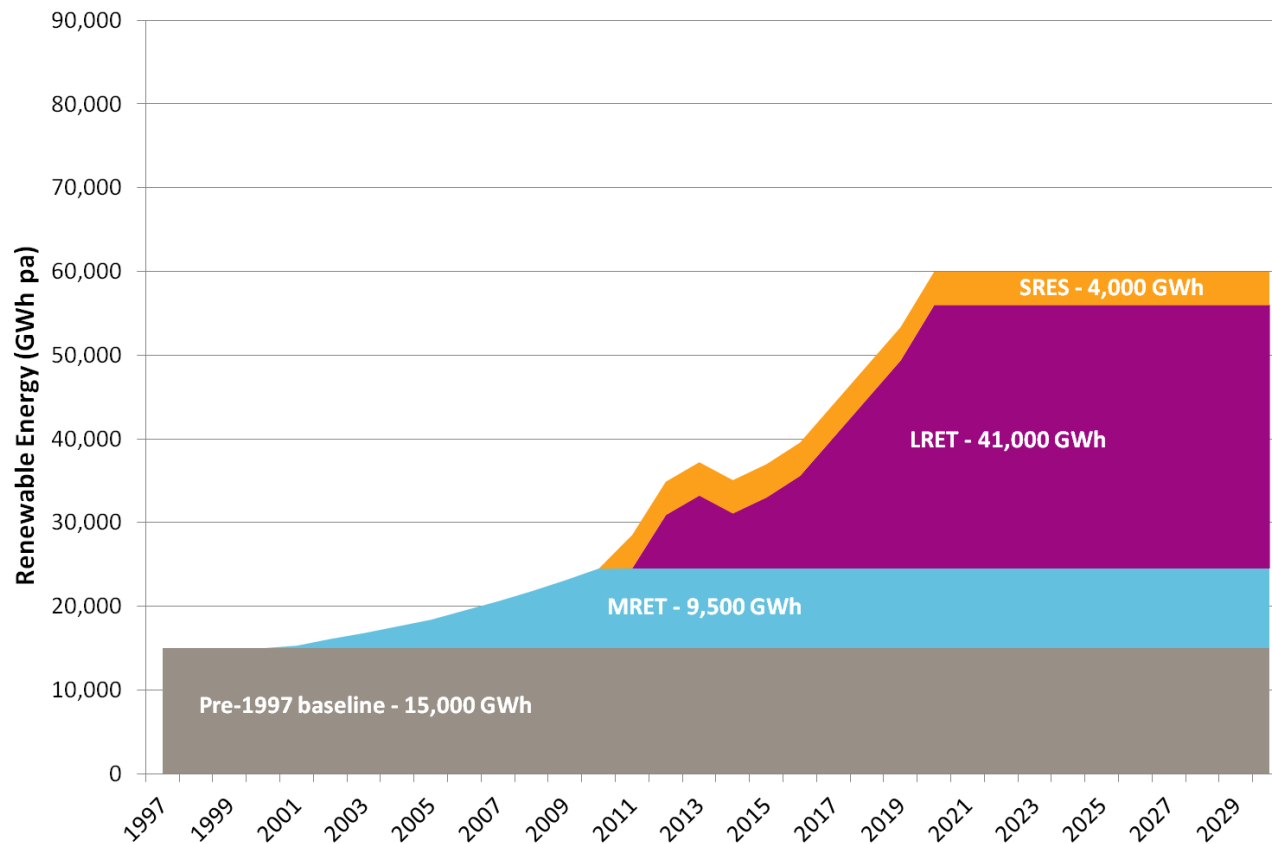


Retailers surrender the RPP of
their electricity sales in RECs

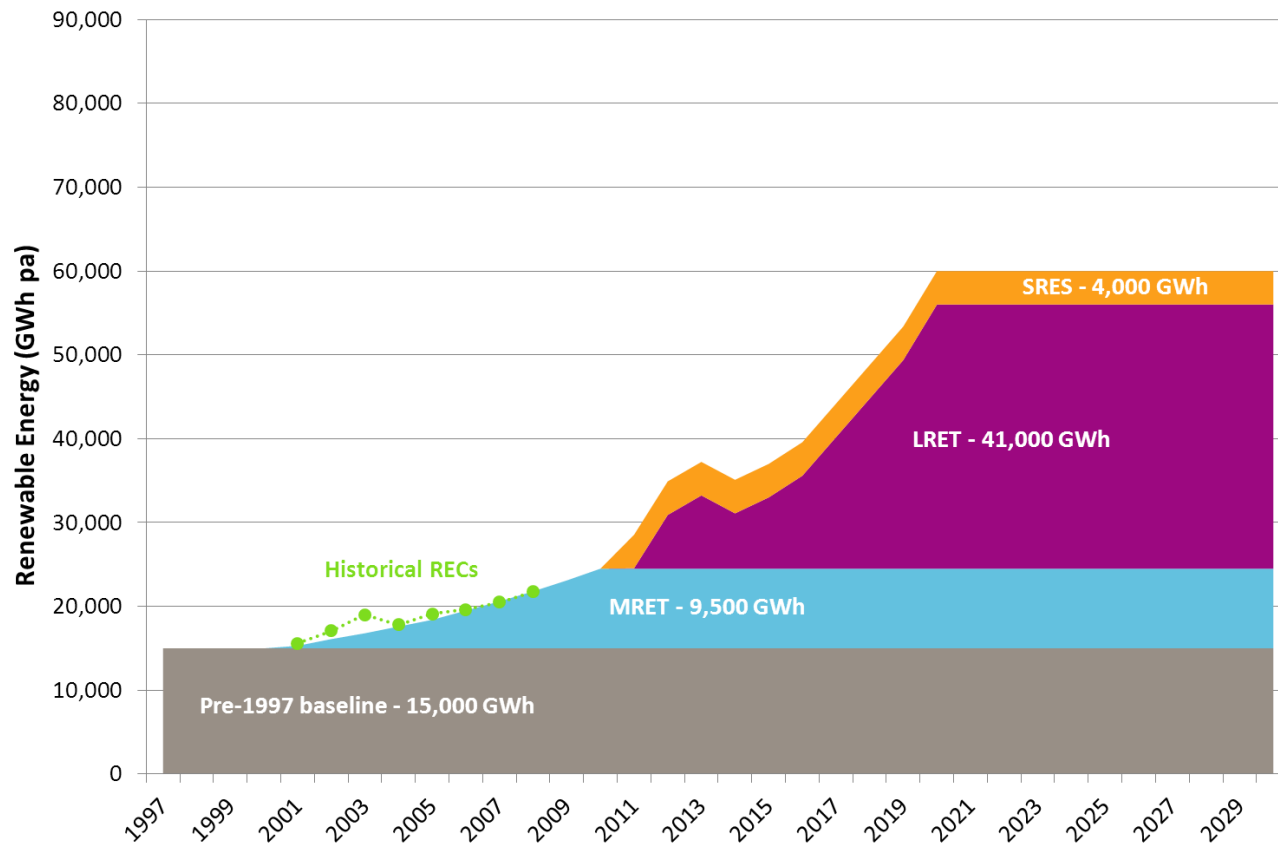
Creates a REC
market



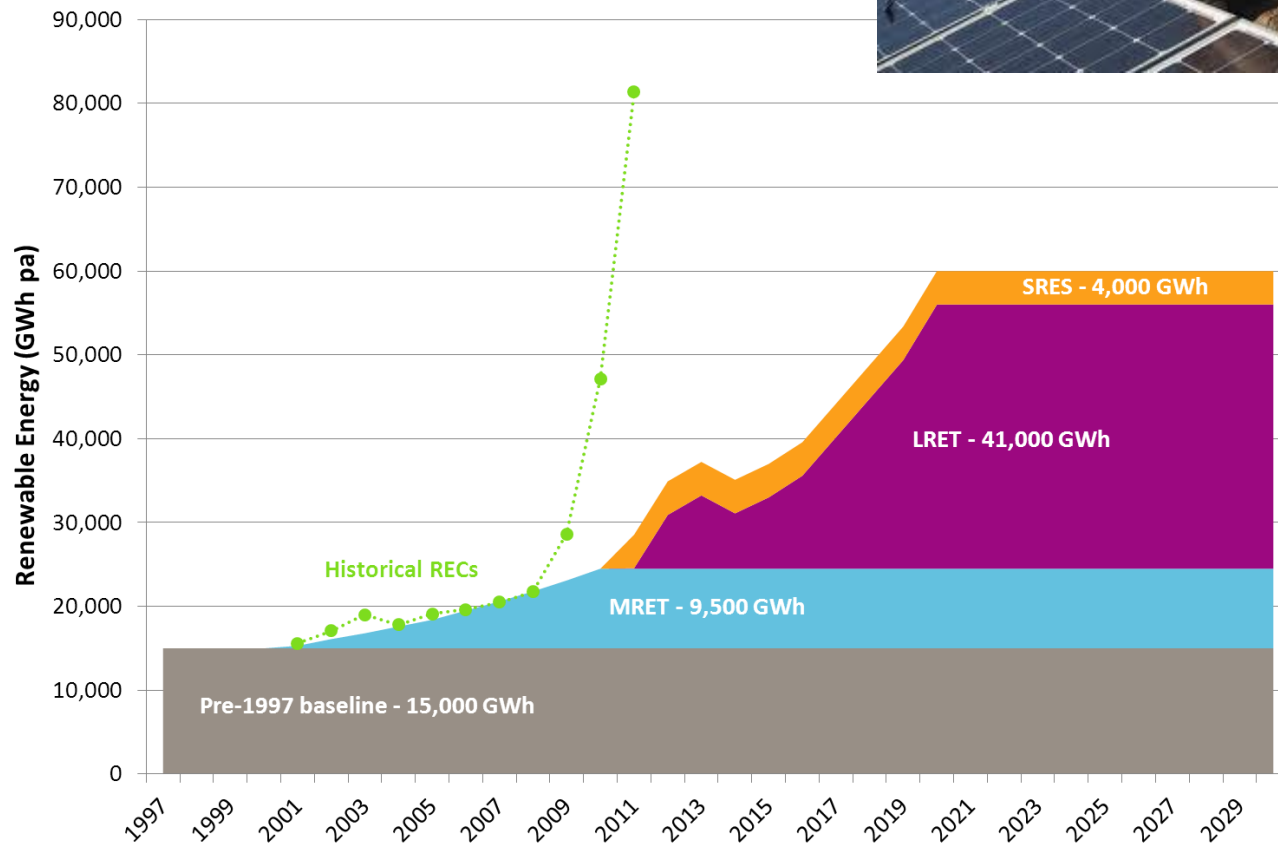
Renewable Energy Target



Renewable Energy Target



Renewable Energy Target



Solar Photovoltaics drivers

International

- Global oversupply of PV modules
- High Australian dollar

Federal

- Solar 5x Multiplier (RET)

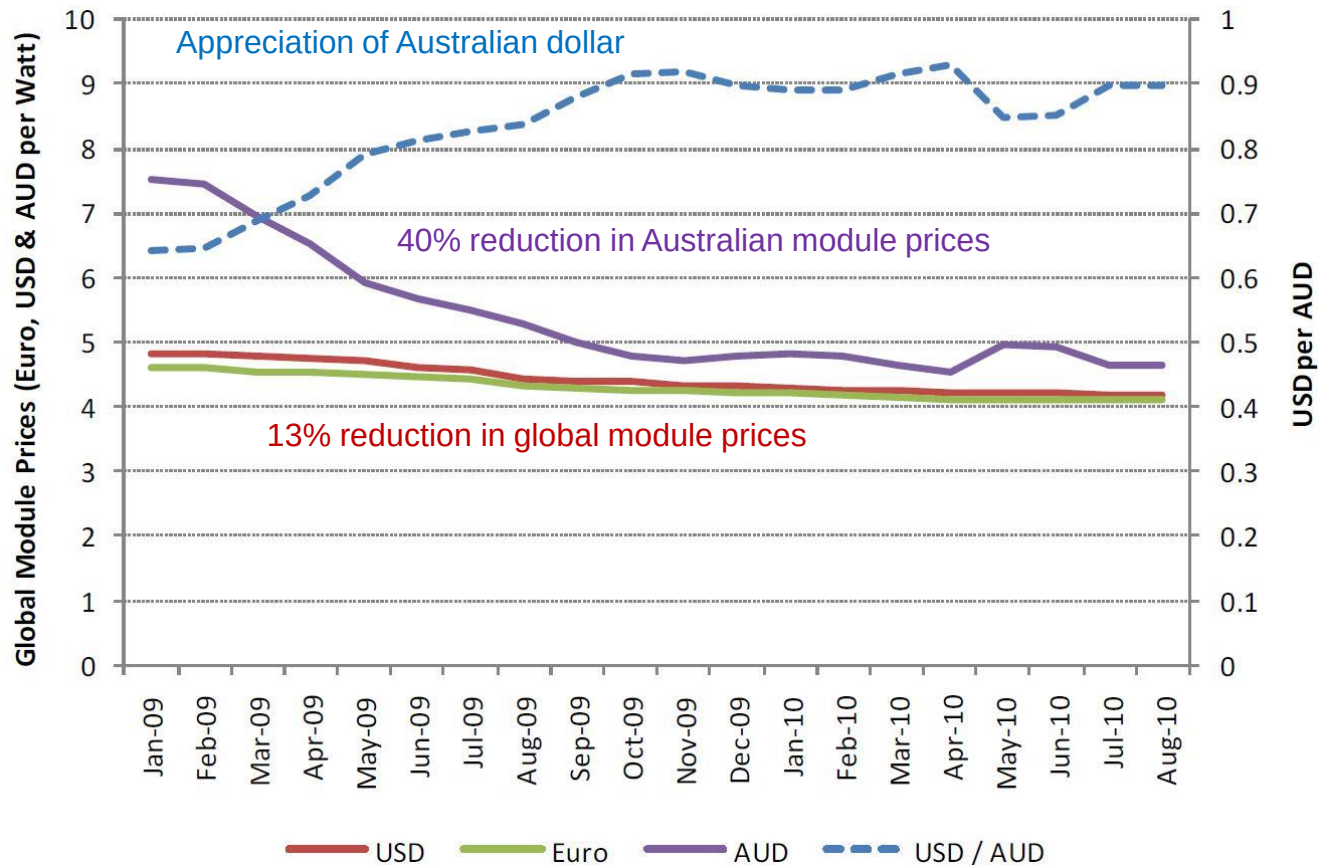
State

- Generous FiTs

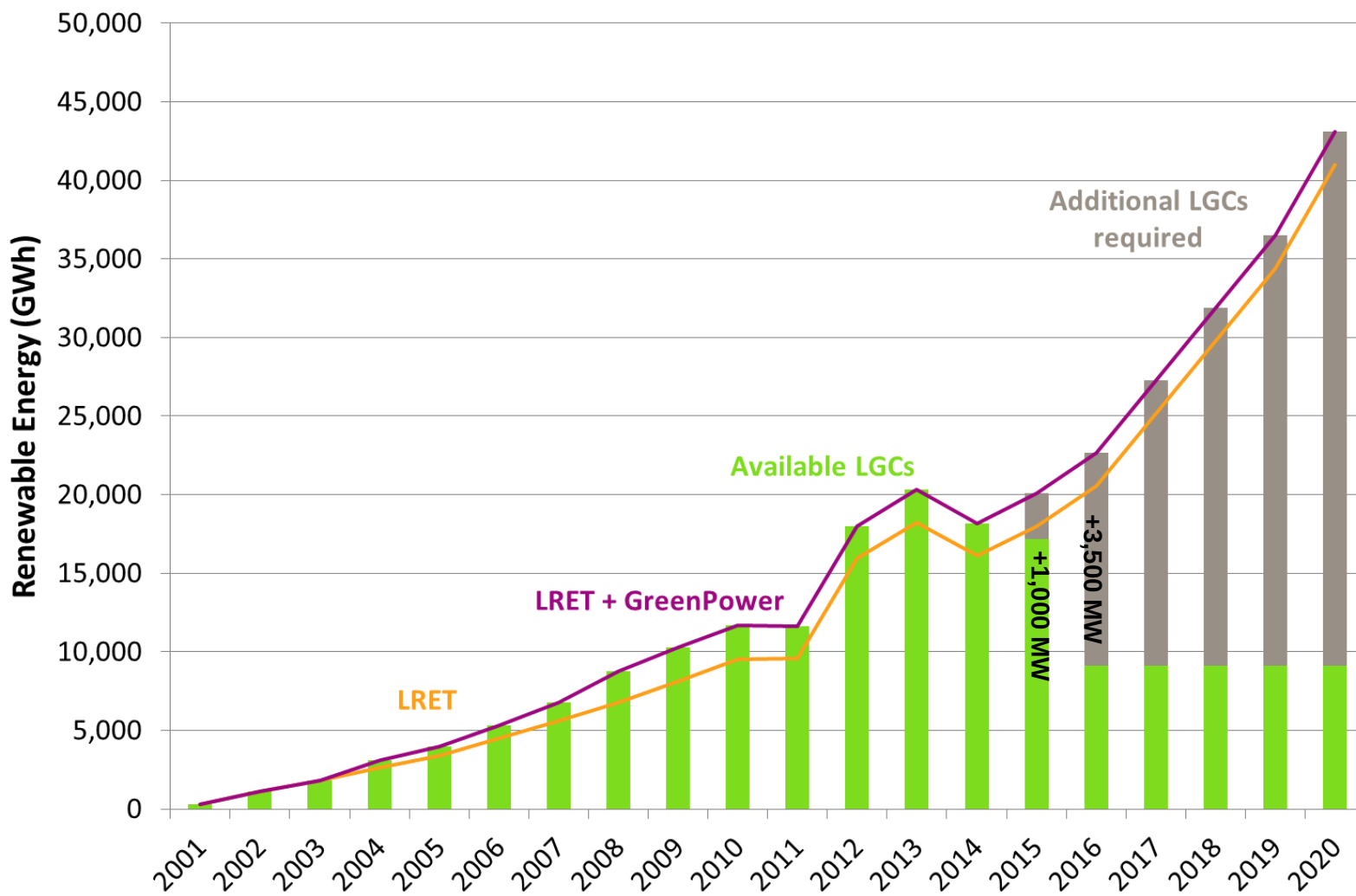
Individual

- Strong support

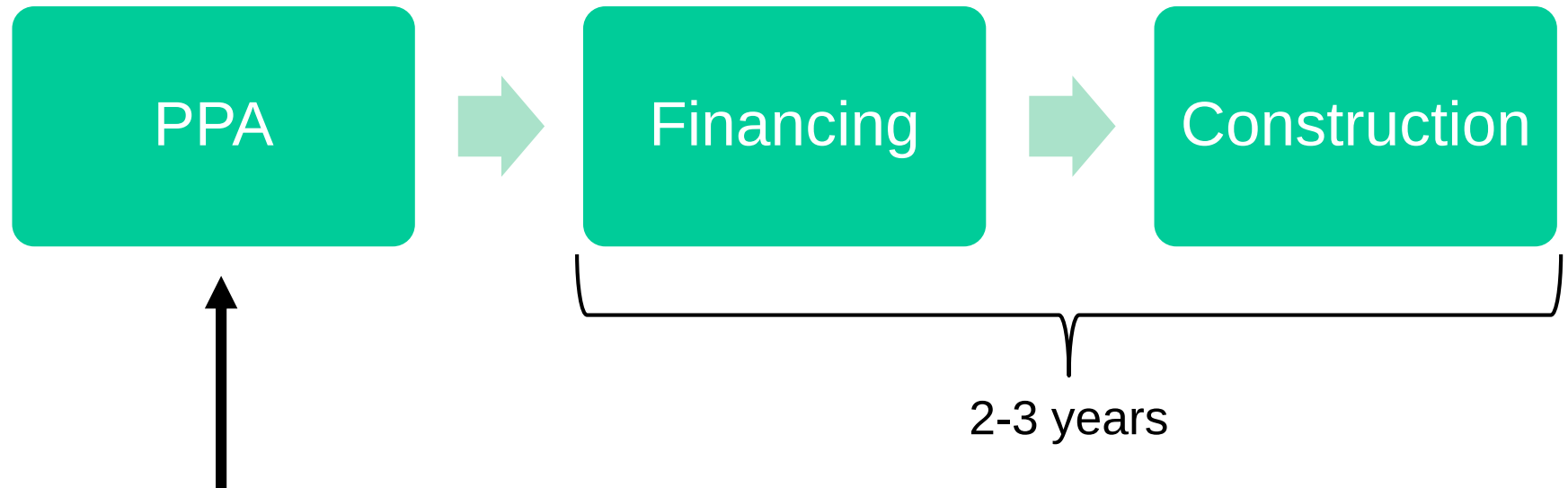
Global PV module retail prices and Australian equivalent



Oversupply until 2015-16?



Renewable project development



Long term PPA
required to secure
project financing
(eg. \$90/MWh for 15yrs)

For project commissioning in 2015-16
needed a PPA in 2013-14

RET Review

- RET Legislation requires biannual review

Climate Change Authority Review – Dec 2012

- Operational - is the scheme working?
- Major lobbying – 8700 submissions, many seeking reduction
- But CCA recommended minor changes only

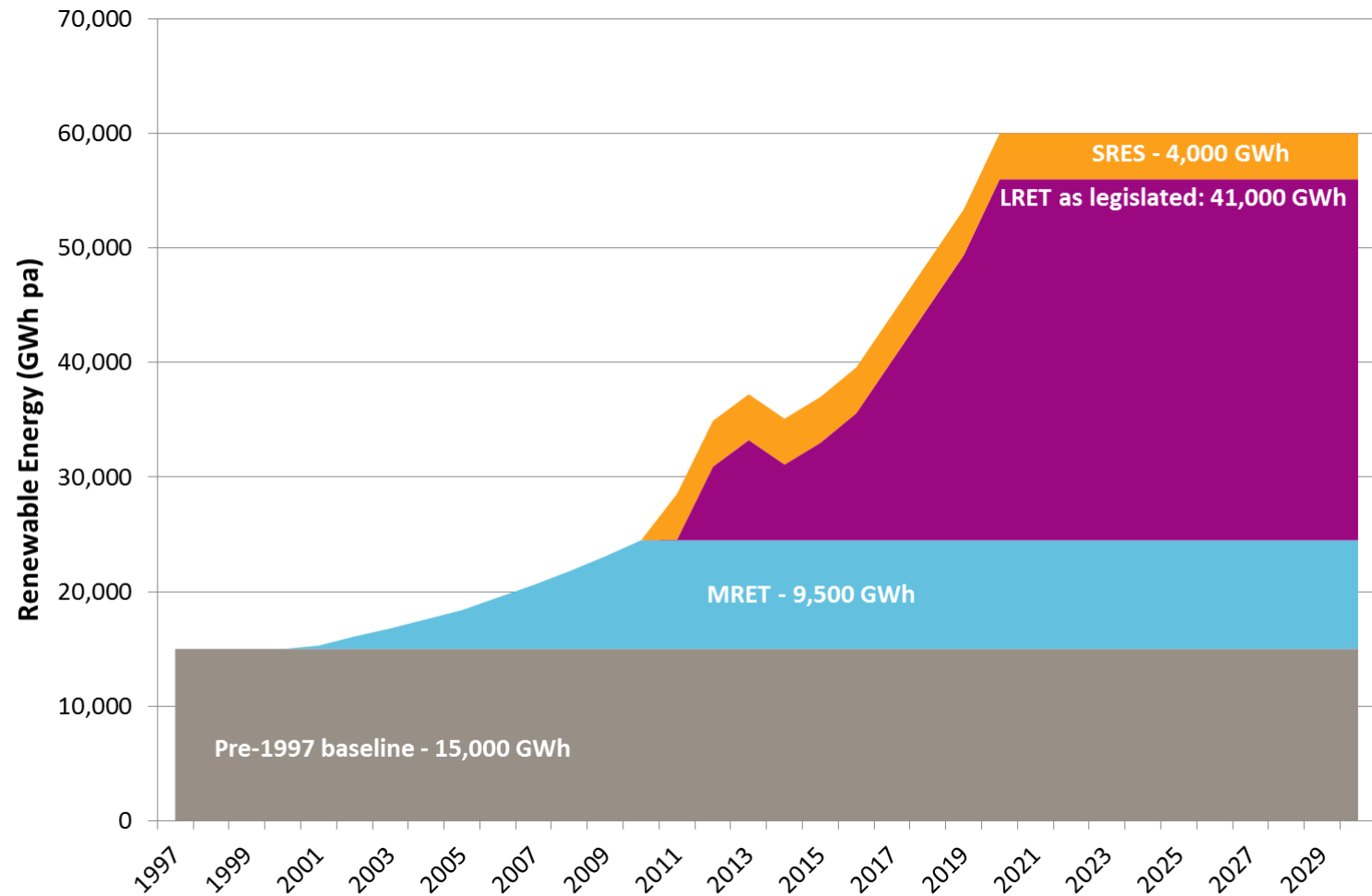
Change of Government

- Initiated another review!

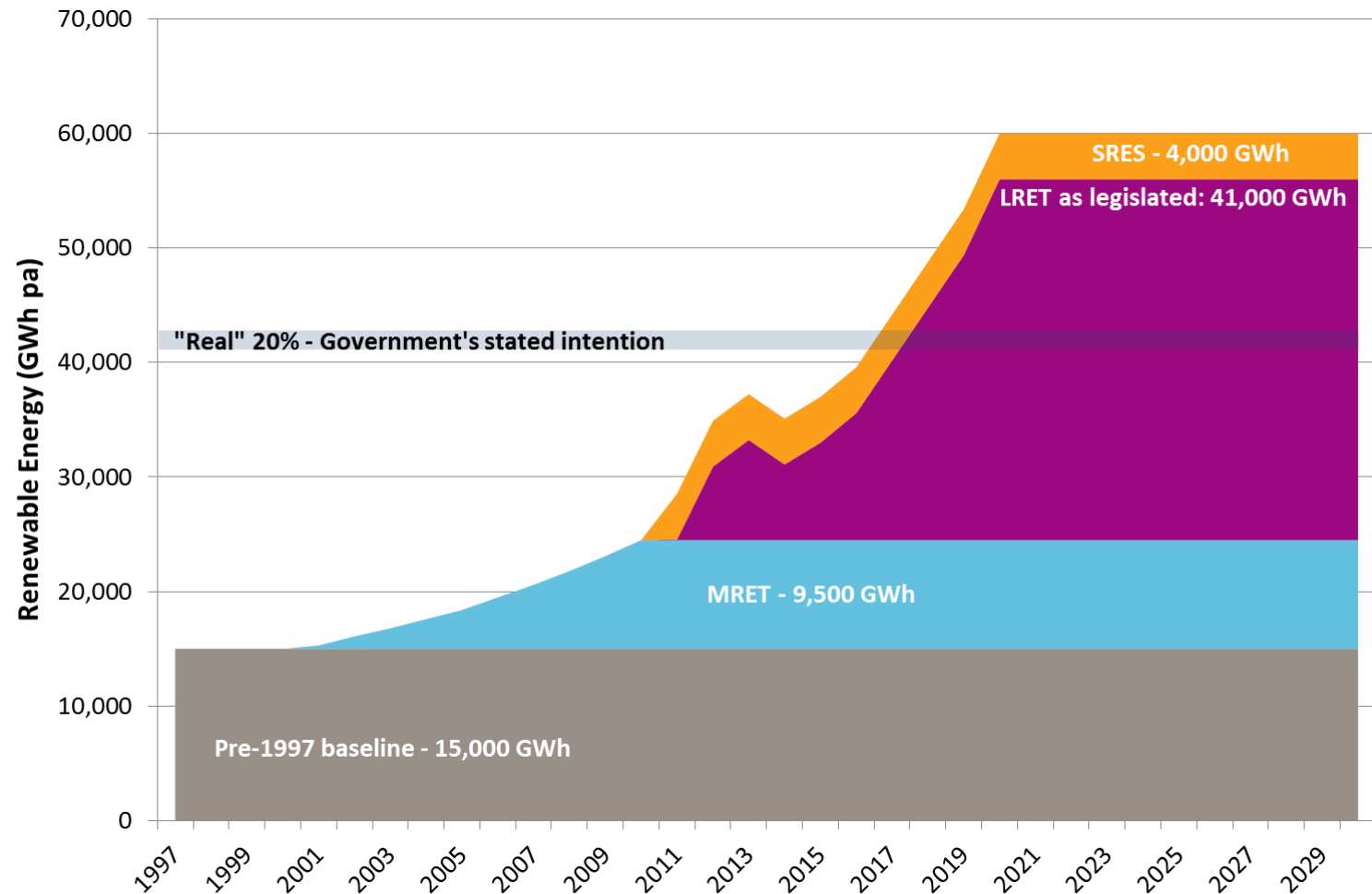
Perpetual uncertainty

- Detrimental to investment

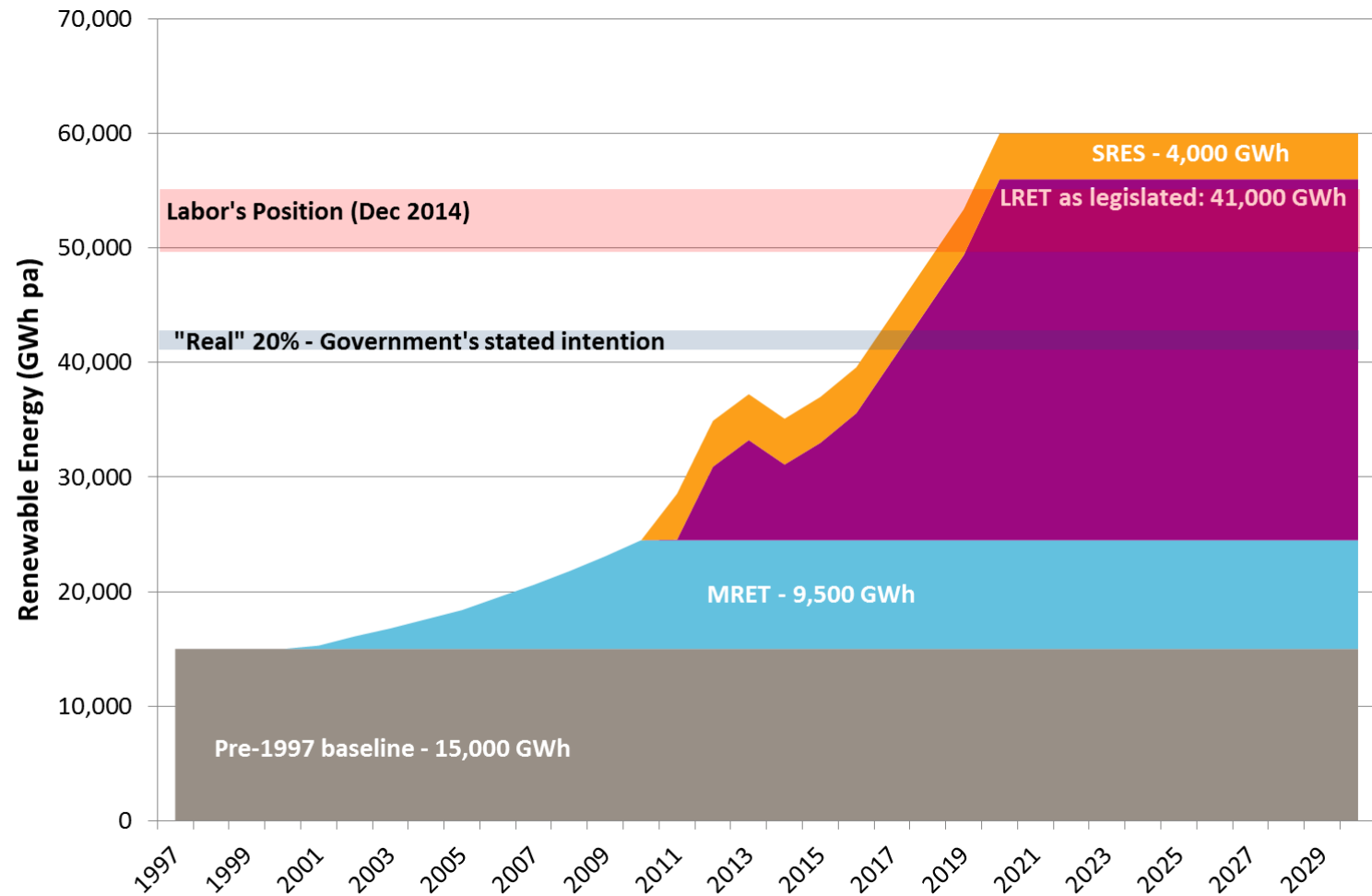
RET Negotiations



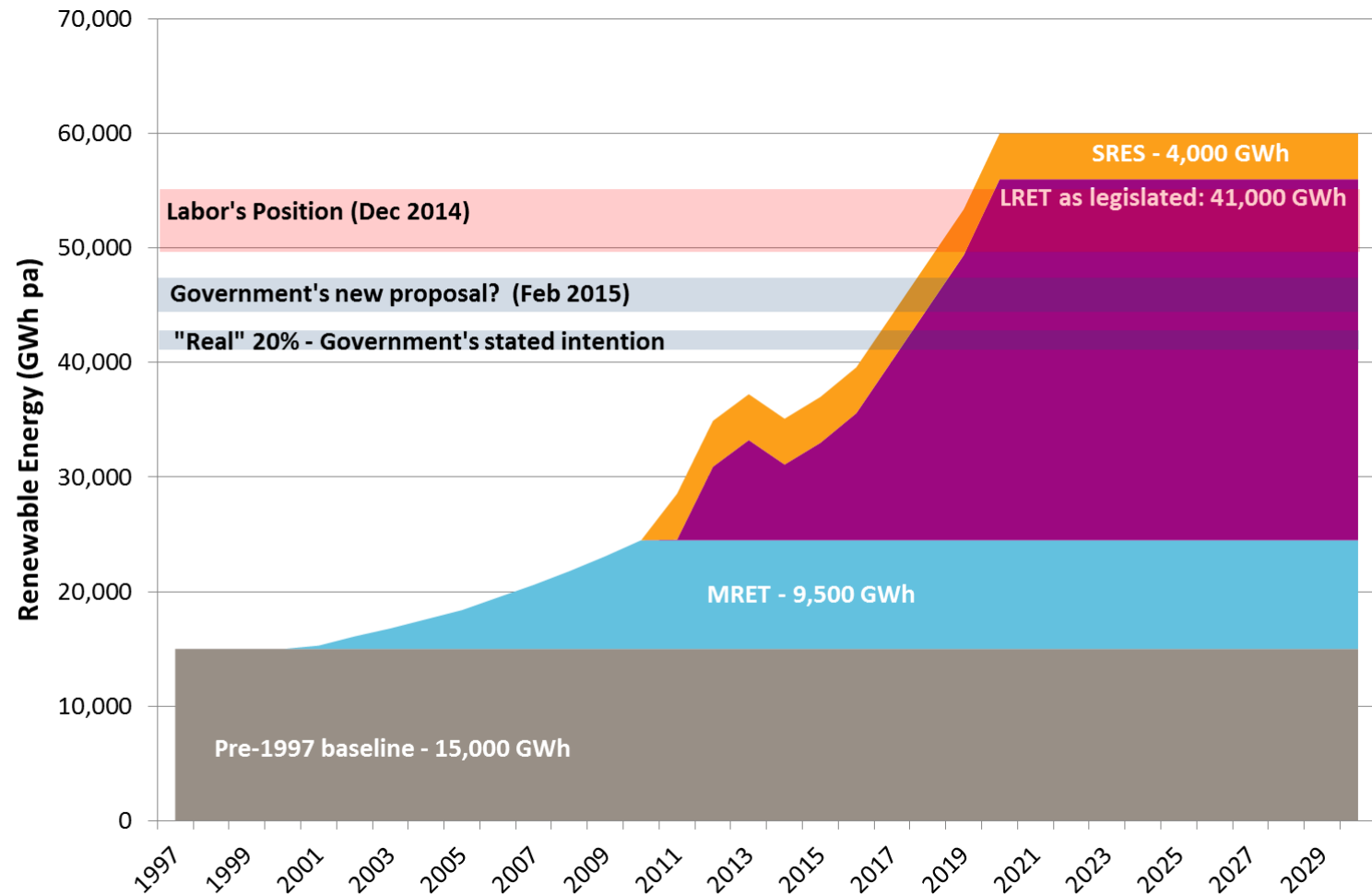
RET Negotiations



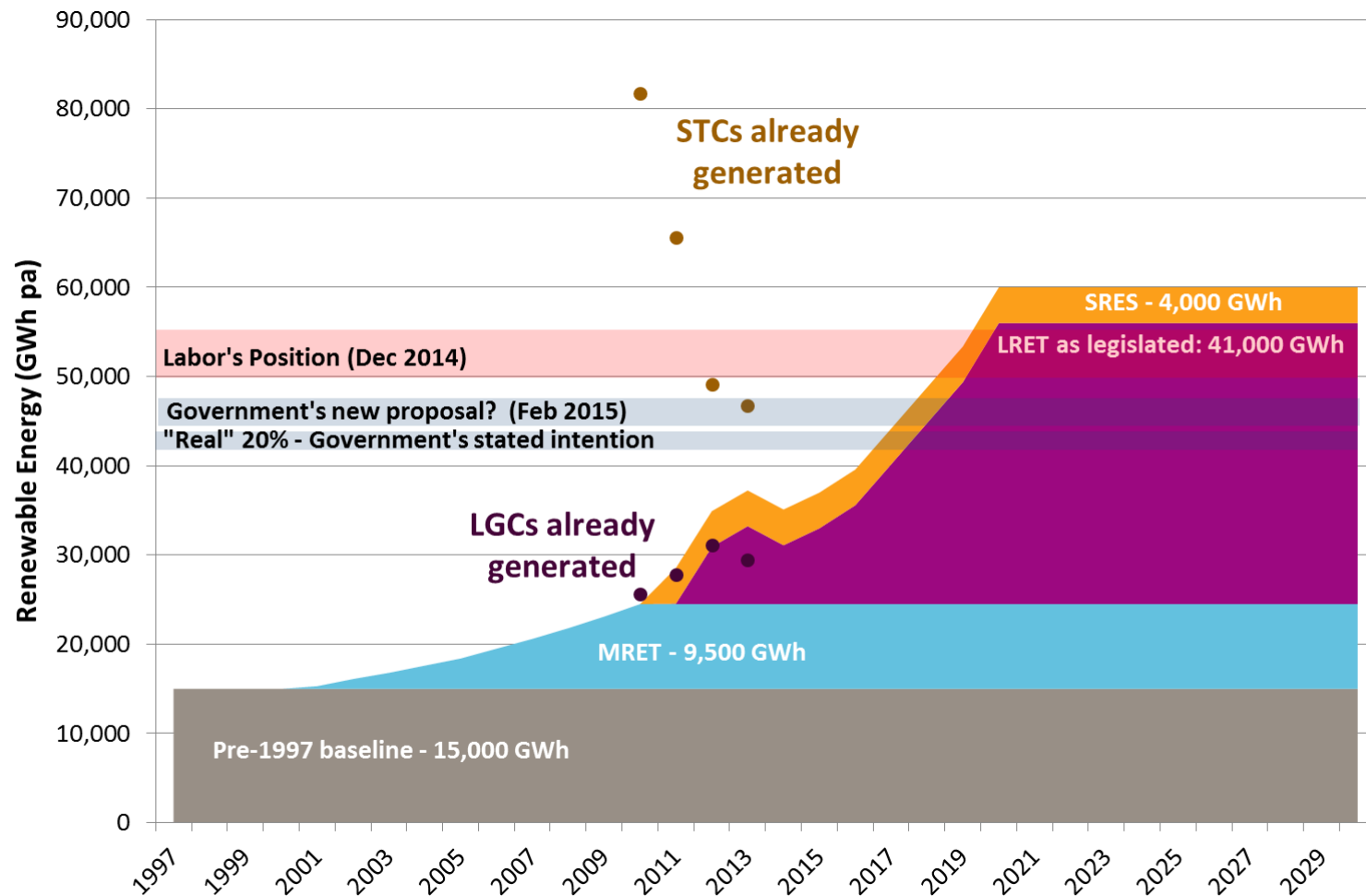
RET Negotiations



RET Negotiations

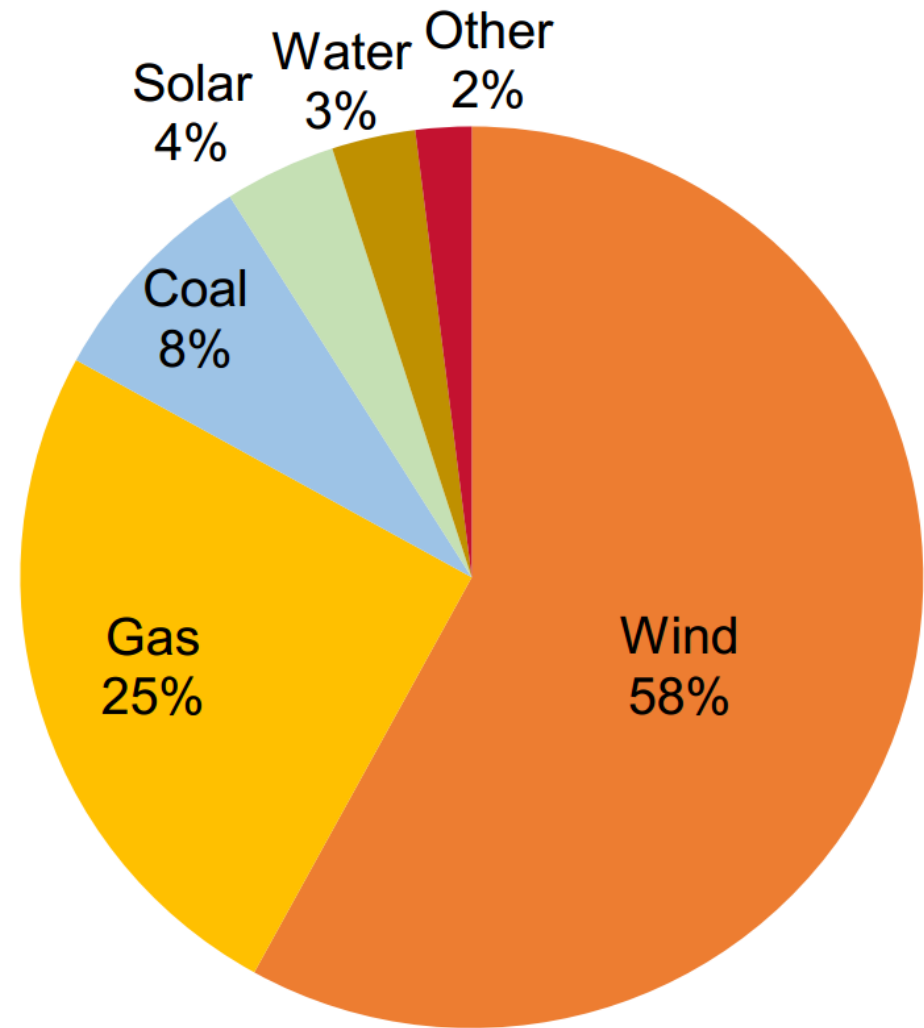


RET Negotiations



Proposed new capacity

- Need ~7.5GW wind to meet original target
 - 1 GW commissioning 2015
 - 14.5 GW proposed
- And solar:
 - 0.219 GW commissioning 2015
 - 1.2 GW proposed

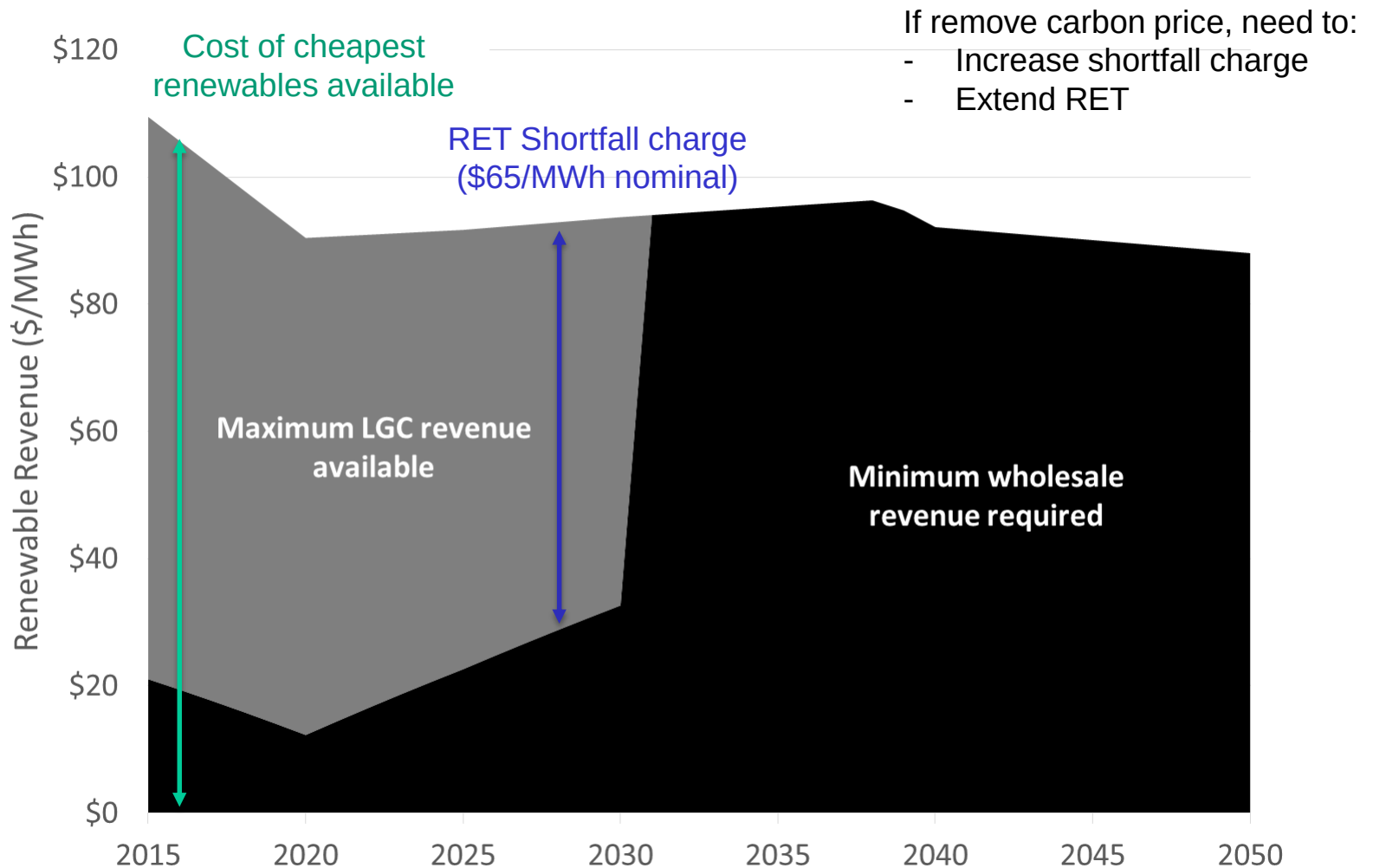


Toowoomba Solar Farm (Bulli Creek)

- Feb 2015 – Planning approved for 2GW
- Negotiating connection agreements
- Needs large-scale investor
- Solar Choice taking on “development risk”, taking projects to “pipeline ready”



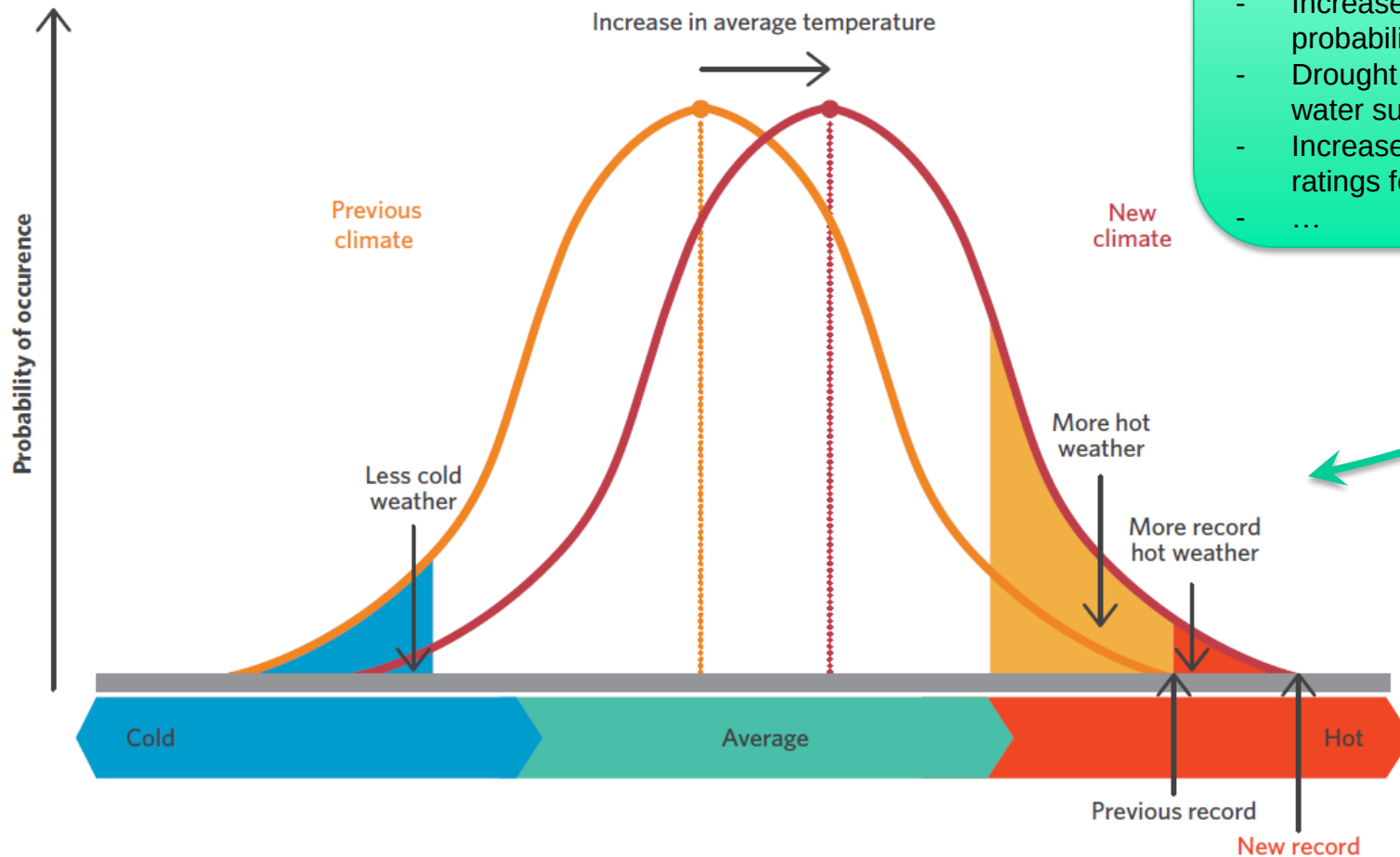
RET may not function without the carbon price



Mechanism and impacts of

CARBON PRICING

Climate averages vs extreme weather



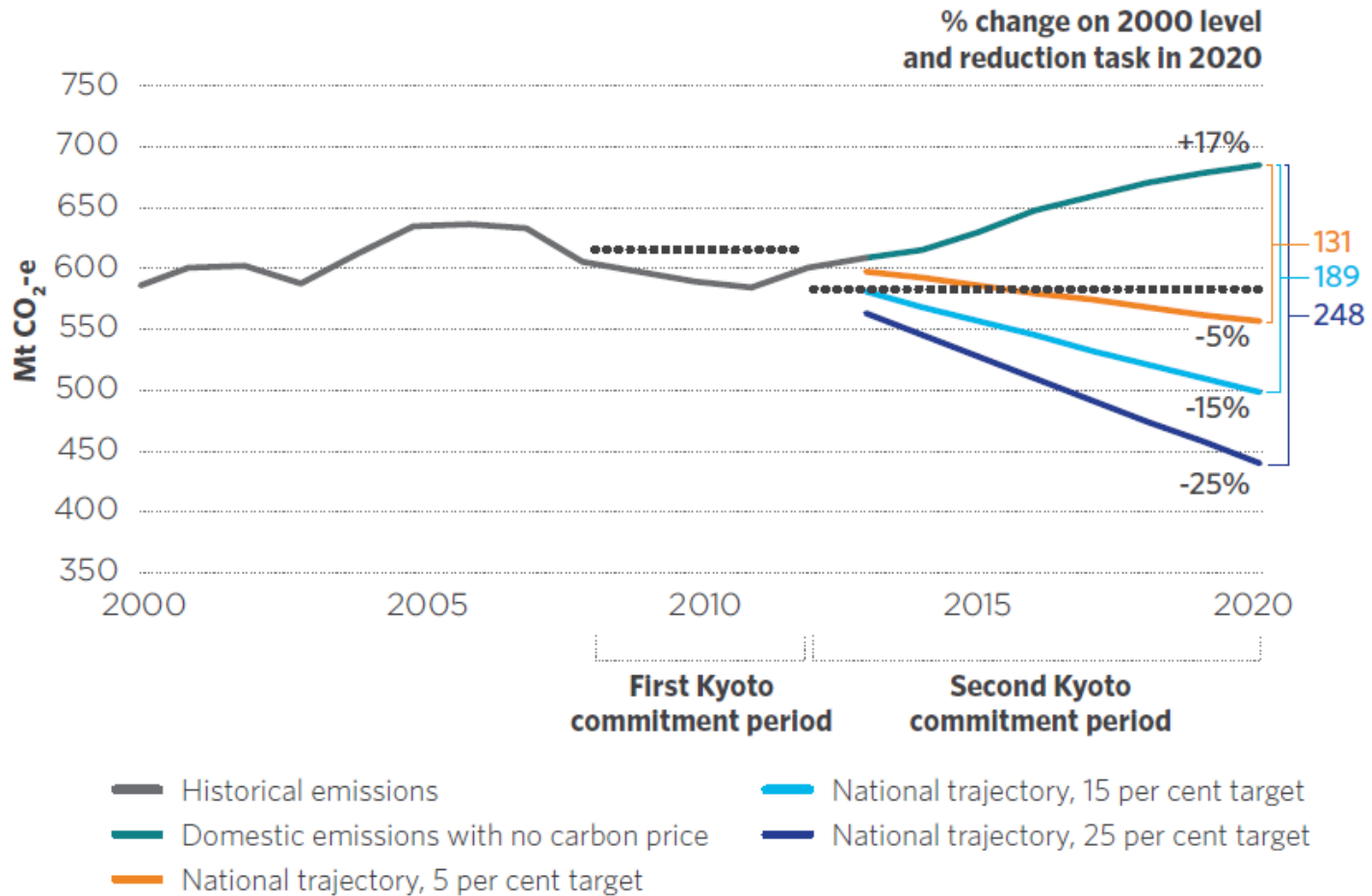
PERFECT STORM impacts on electricity sector:

- Extreme demands
- Power station de-rating
- Transmission lines de-rating
- Increased forced outage probabilities
- Drought reducing cooling water supplies
- Increased temperature ratings for all equipment
- ...



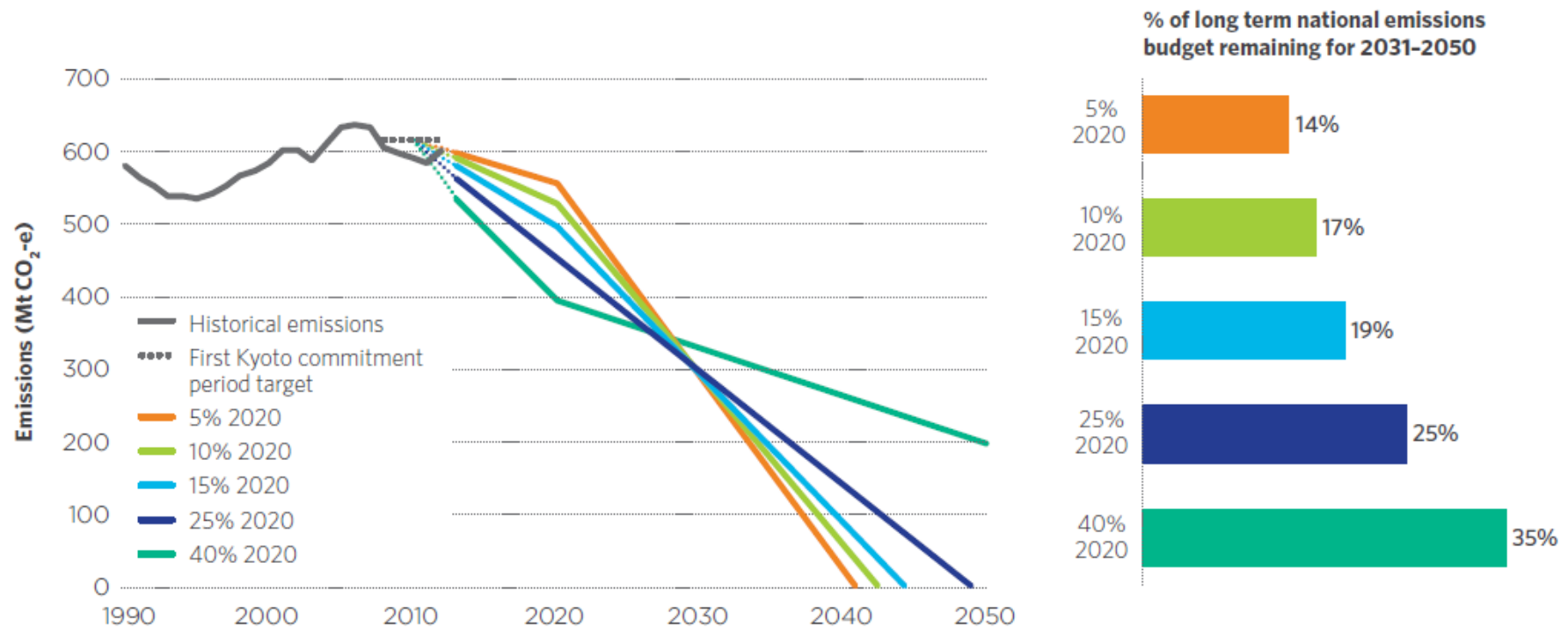
Carbon targets

Bipartisan support for -5% by 2020 target



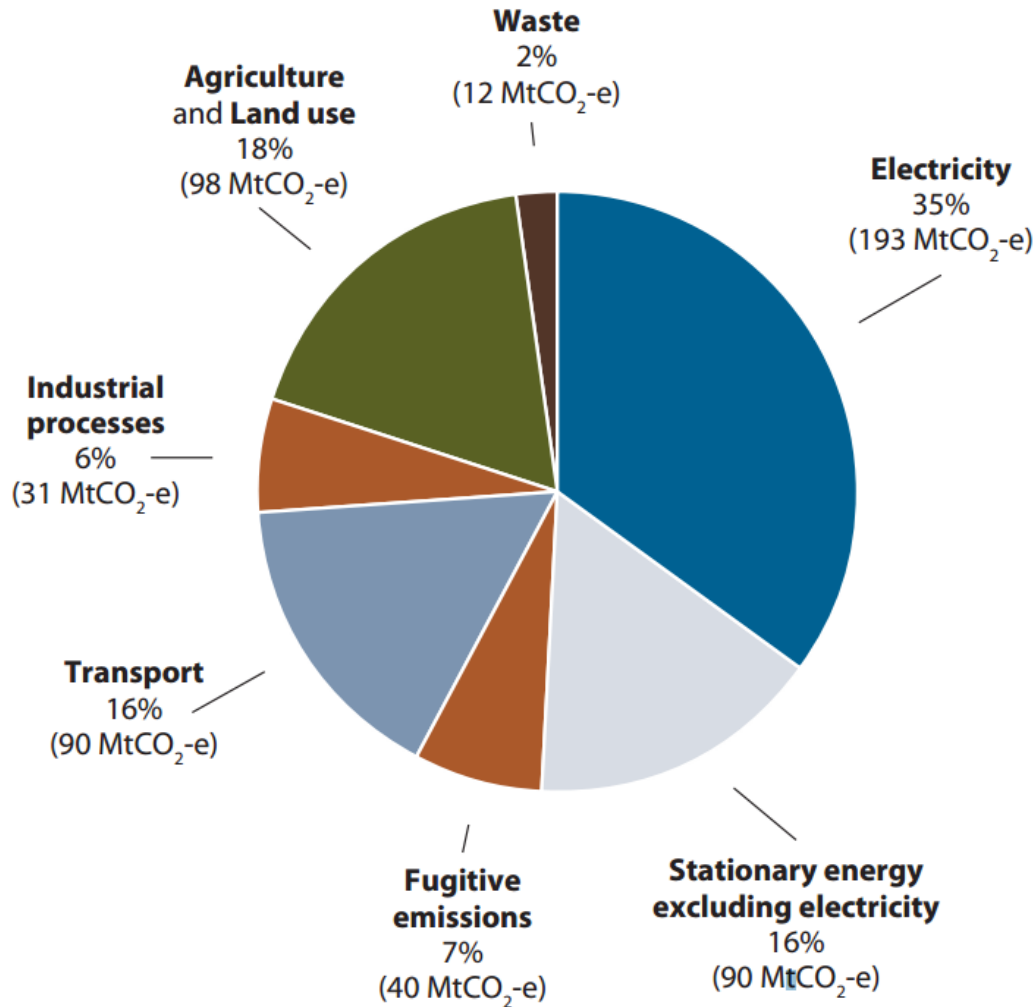
Pathways to 2050 that meet recommended long term emissions budget

-5% by 2020 is likely to be impossibly steep post 2020 to meet recommended budget



-25% by 2020 or -15% by 2020
recommended by CCA

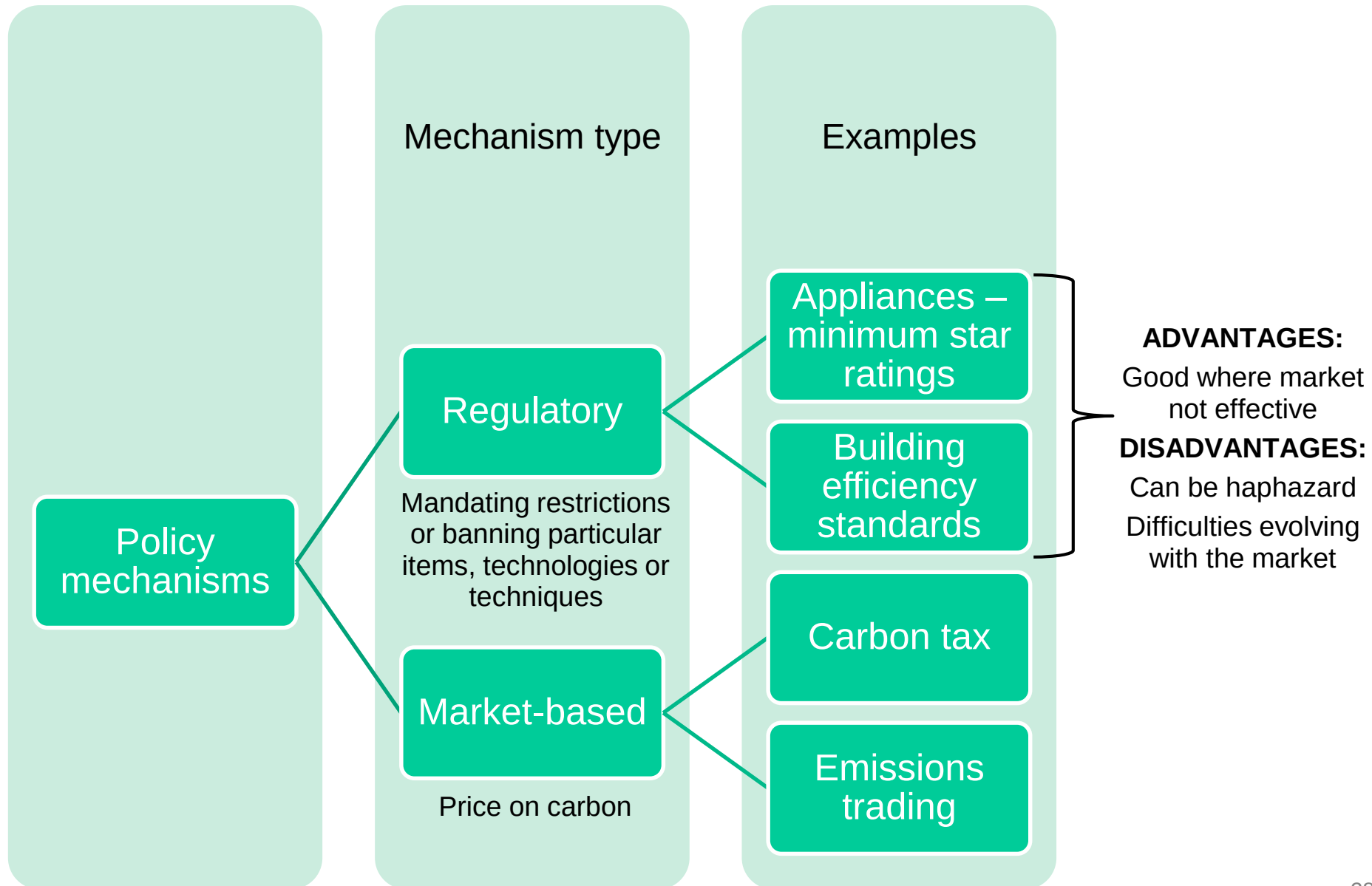
Australia's Greenhouse Emissions (2012)



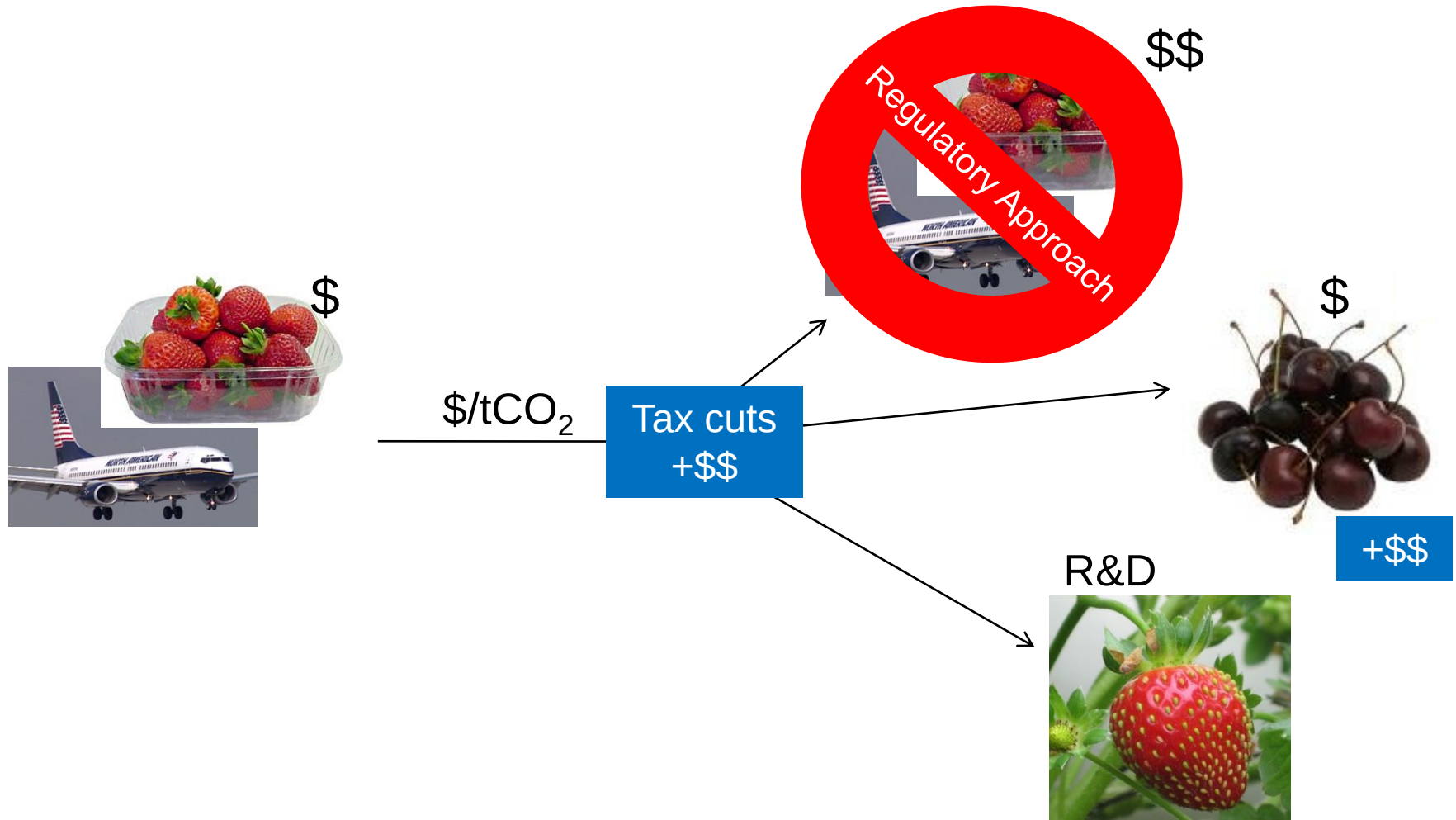
Source: Australian Government, *Australia's National Inventory Report 2012, 2014*.

Note: Figures are expressed using Kyoto Protocol accounting rules in terms of millions of tonnes of carbon dioxide equivalents (MtCO₂-e), using the global warming potentials published in the Intergovernmental Panel on Climate Change's Second Assessment Report.

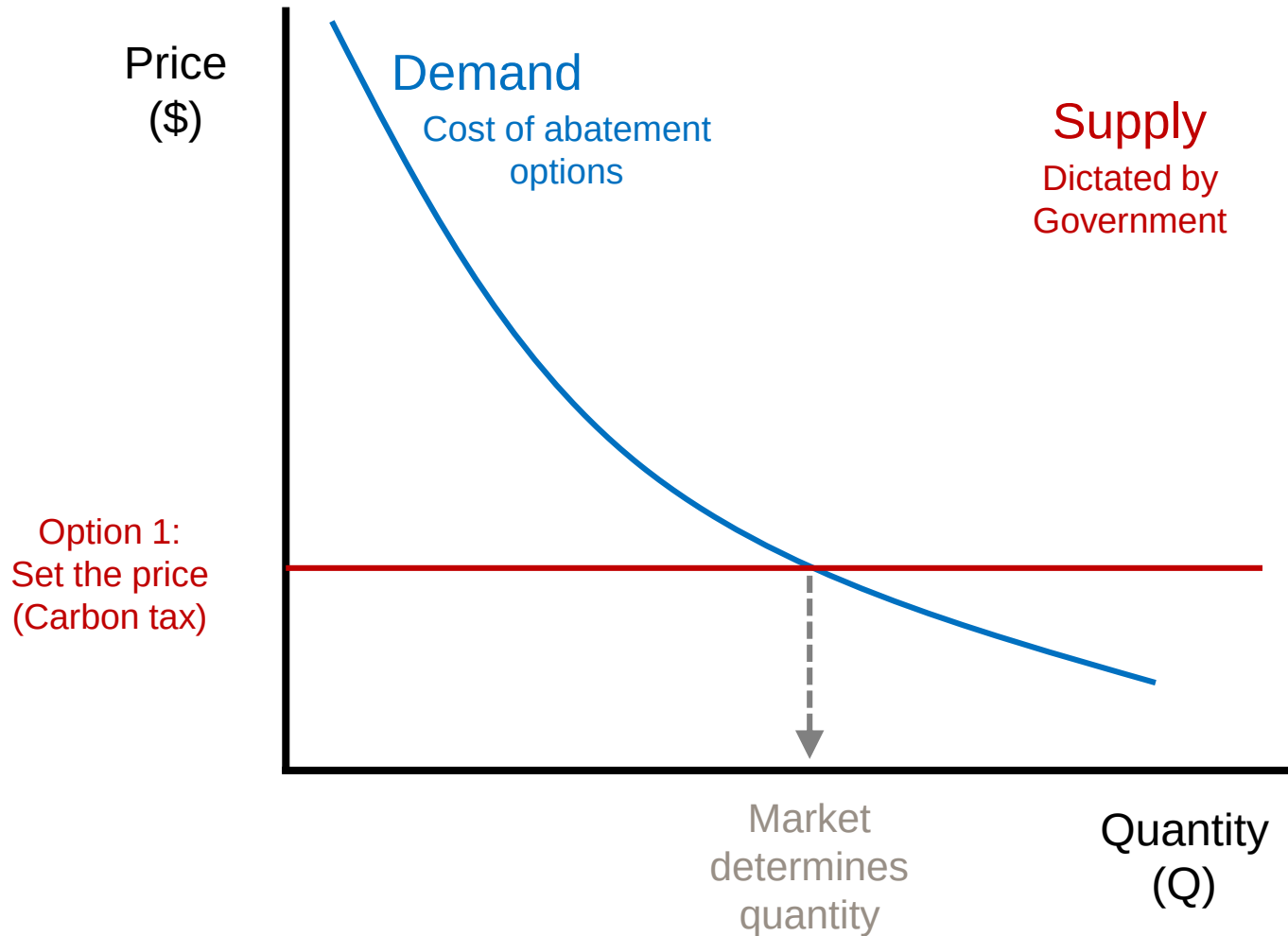
Policy mechanisms



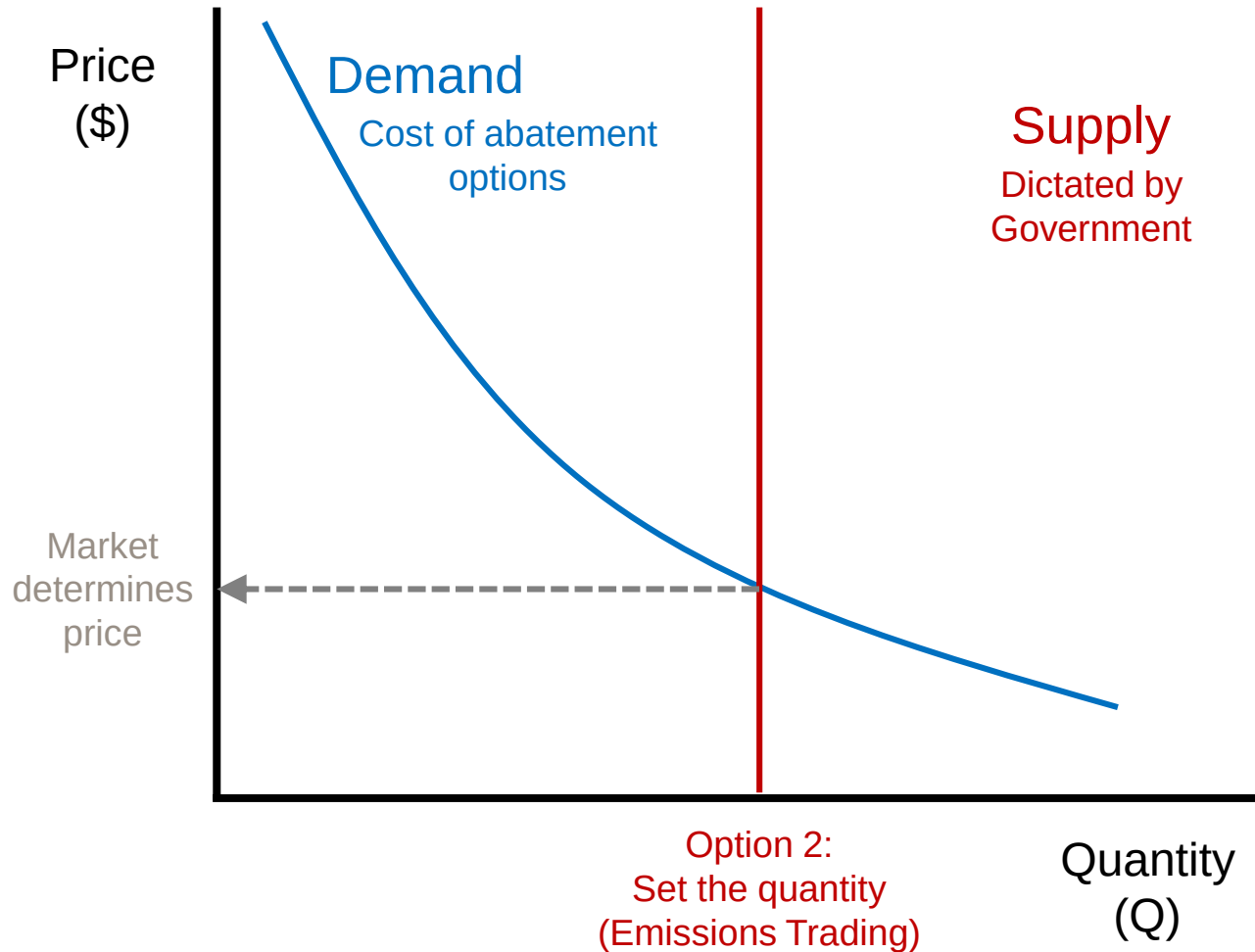
Market based approaches



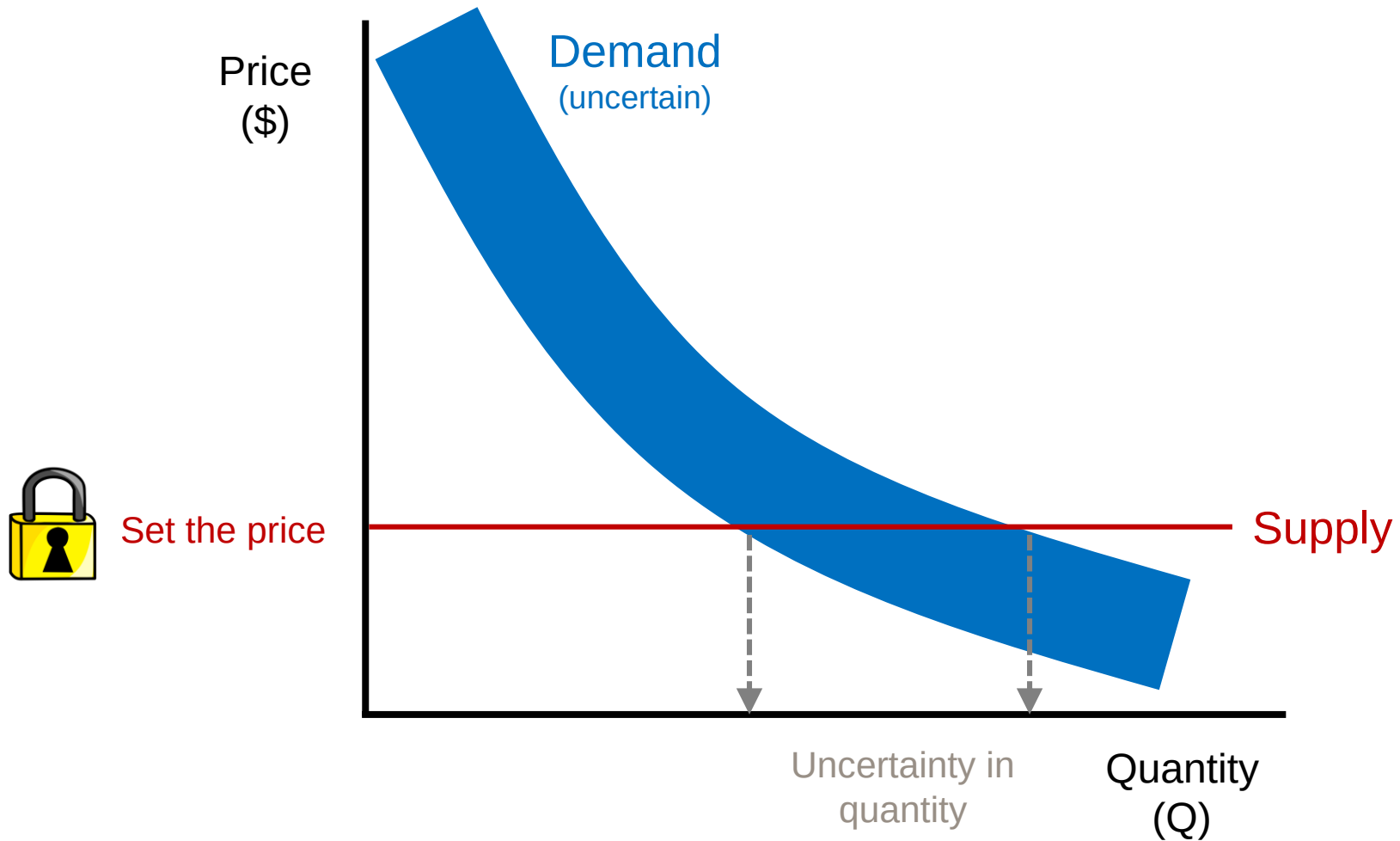
Creating a market for carbon



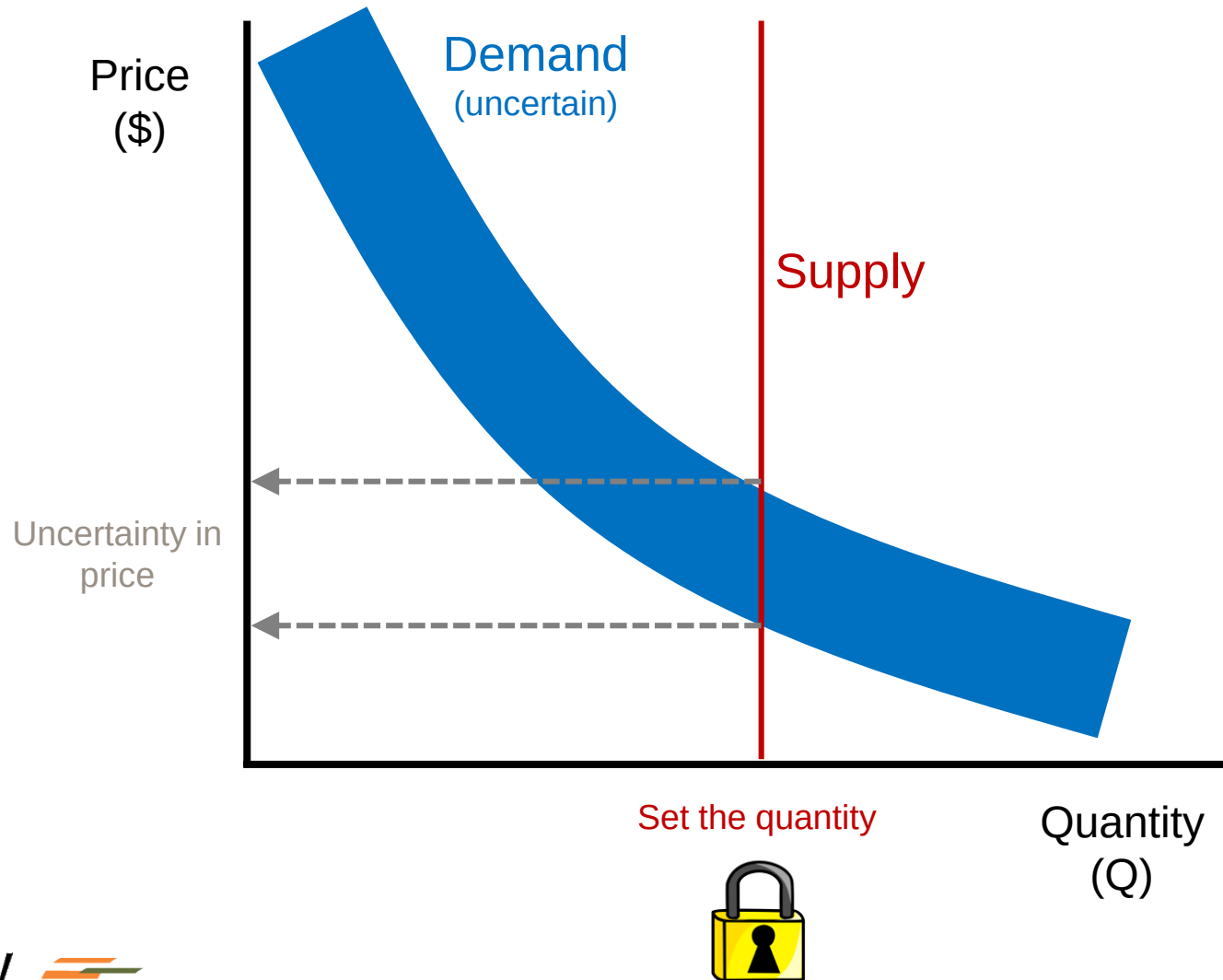
Creating a market for carbon



Creating a market for carbon



Creating a market for carbon



Creating a market for carbon

Which is most important?

Price

Quantity

Carbon tax

Emissions Trading



Price certainty



No guarantee of meeting emissions targets



Price may require adjustment (removes price certainty benefits)



Simpler



Guaranteed to meet targets



No price certainty



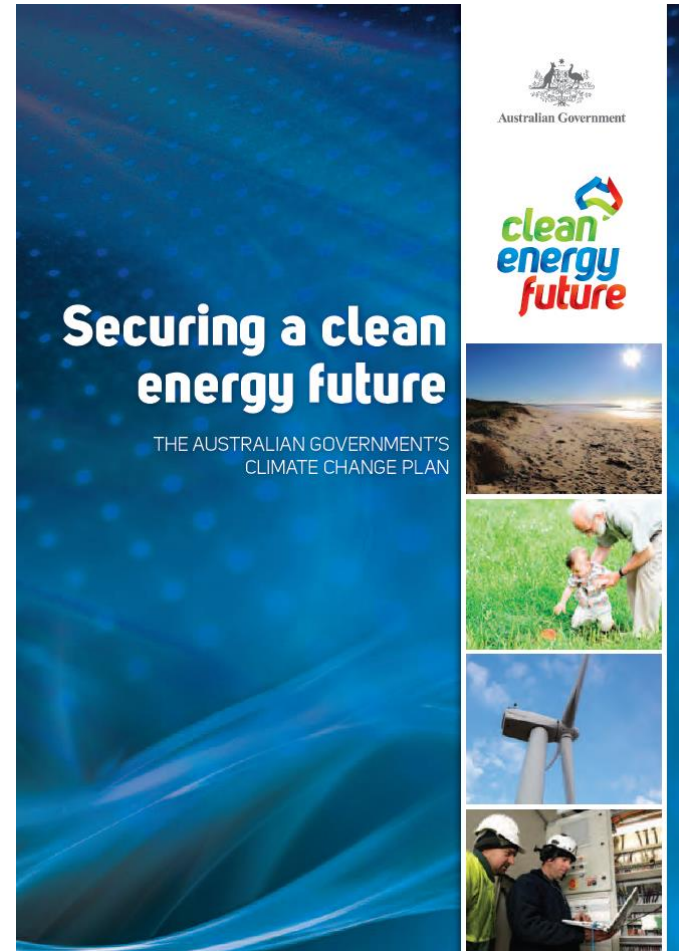
Can experience price volatility (especially at market start)



Can link internationally

Clean Energy Future

- Emissions trading with initial fixed price period
 - (note that it wasn't actually a tax...)
- Operated 1st July 2012 to 1st July 2014



Price of carbon



So no more carbon price?

Must reduce emissions

- Widely agreed that serious emissions reductions are required

Carbon pricing is the most efficient method

- Carbon pricing is generally agreed to be the most economically efficient way to transform the economy across diverse sectors and sources of emissions

Considered likely to return

- Sensible businesses are factoring in a carbon price

Uncertainty inhibits investment

- Lack of a credible carbon reduction mechanism perpetuates uncertainty and delays investment & economic growth

Emissions Reduction Fund

White paper released Apr 2014

Abatement buy-back (specific abatement projects)

- Reverse auction/tender
 - Businesses submit tenders to reduce emissions
 - Govt selects lowest cost
 - Forward contracts
 - Commence April 2015
 - Limited scope (mostly Carbon Farming)
- Funds allocated in budget
 - \$2.55 bn over 4yrs
 - Long term this mechanism implies significant tax increases

“Safeguard mechanism” (large facilities)

- Mechanism to provide incentives not to exceed historical emissions baselines
- No Government revenue
- Commence 1 July 2015
- No detailed design published yet
 - Exposure draft legislation due Jan-Apr 2015
- Outstanding questions:
 - New entrants?
 - Non-compliance penalties?
 - Electricity sector?

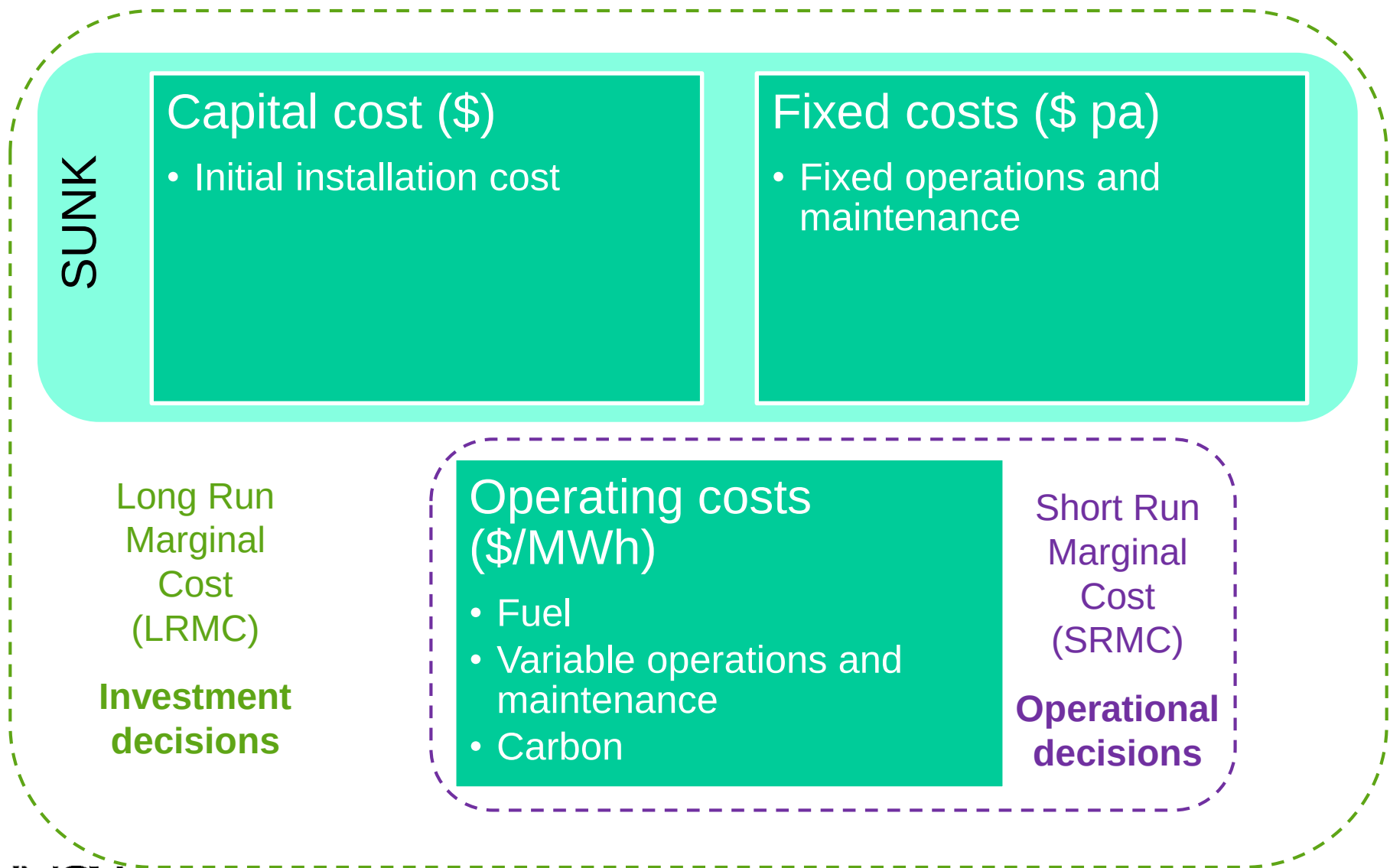
Impacts of the carbon price on electricity sector



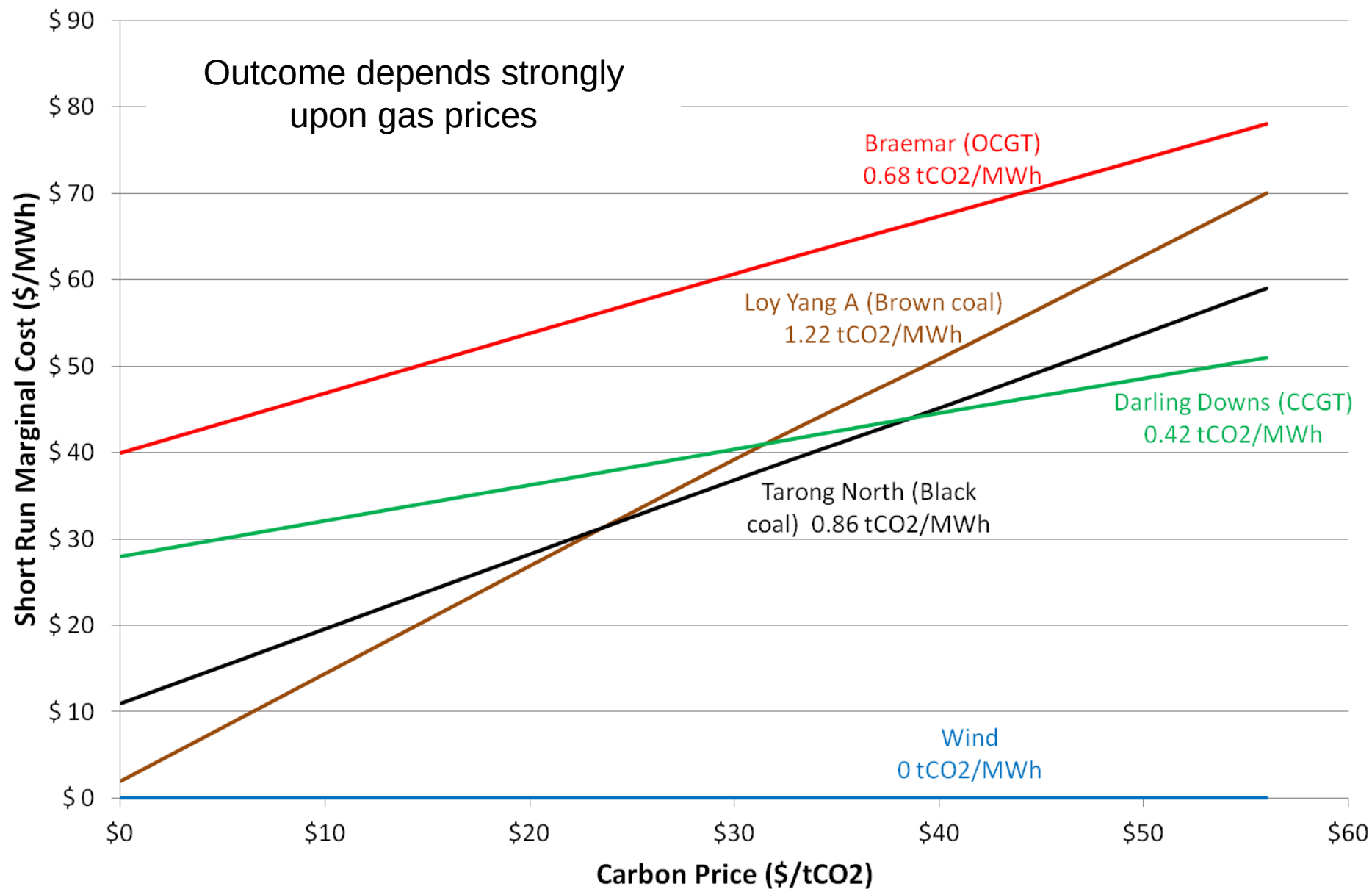
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Impacts of carbon price on electricity sector



Dispatch impacts



Impact of carbon price on electricity market

Generator costs increase

- Proportional to emissions intensity

Increase bid prices

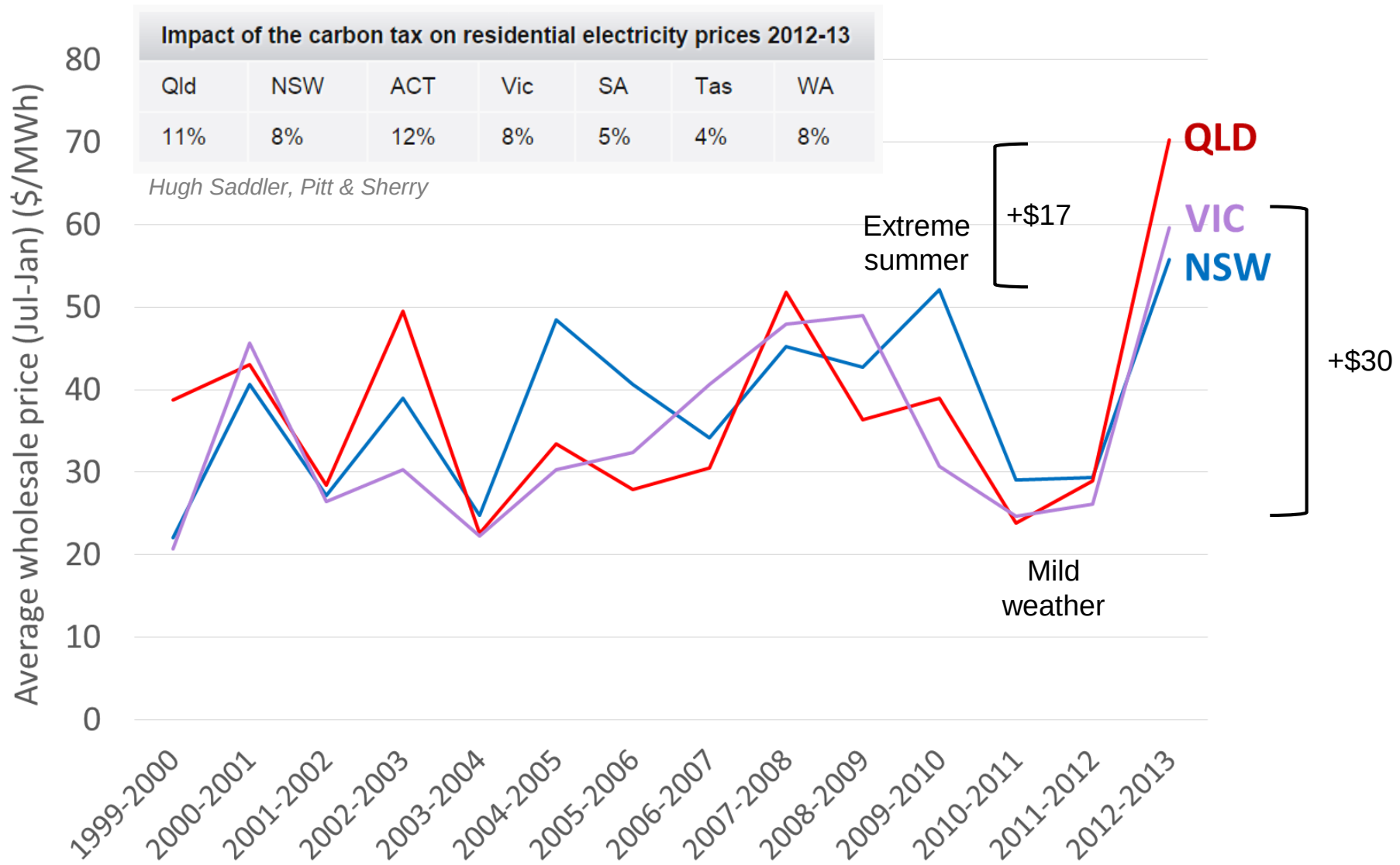
- Assuming a competitive market

Wholesale electricity prices increase

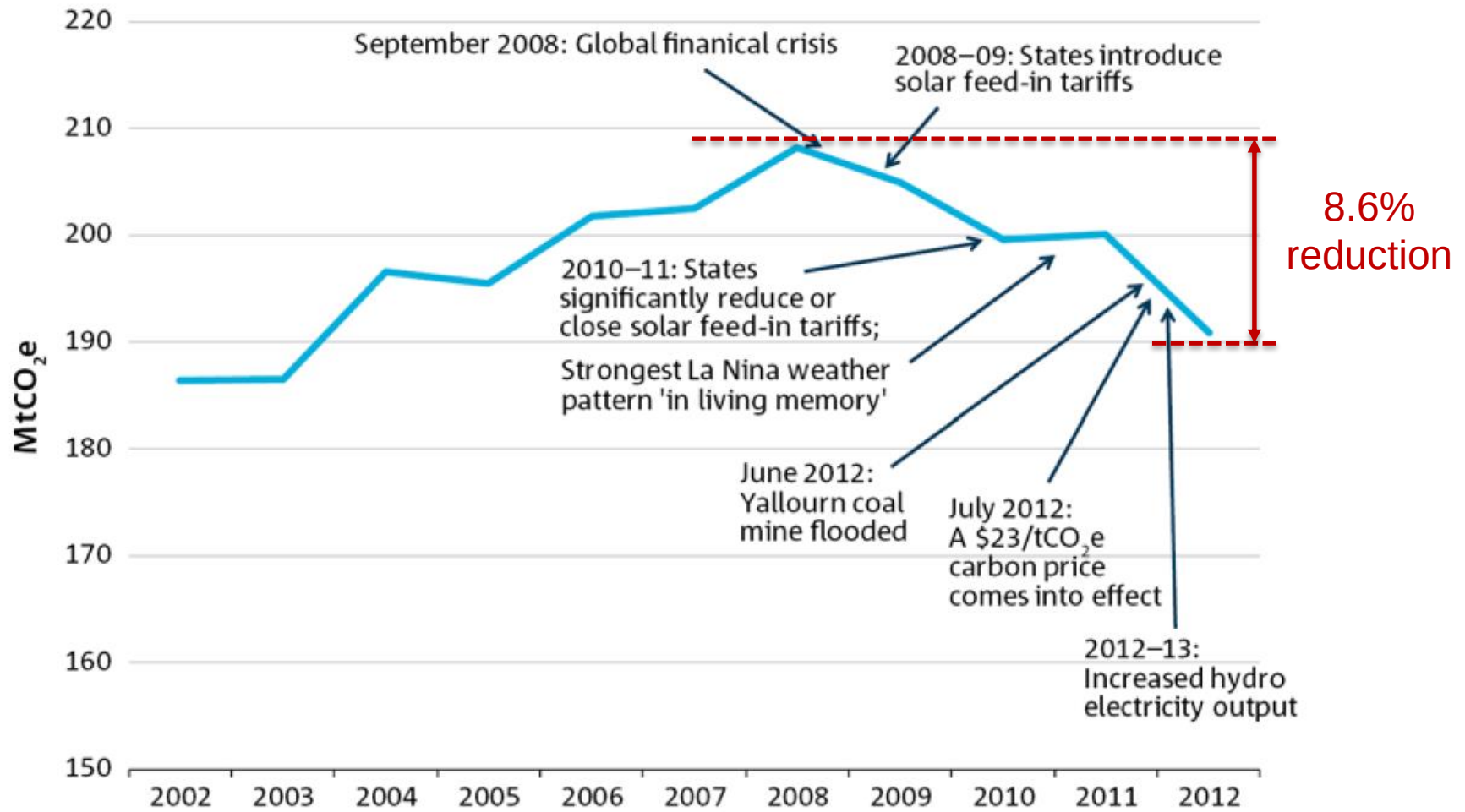
- Average emissions intensity $\sim 1\text{tCO}_2/\text{MWh}$, so $\sim 1:1$ pass through of $\$23/\text{tCO}_2$ carbon price

Cost passed through to consumers

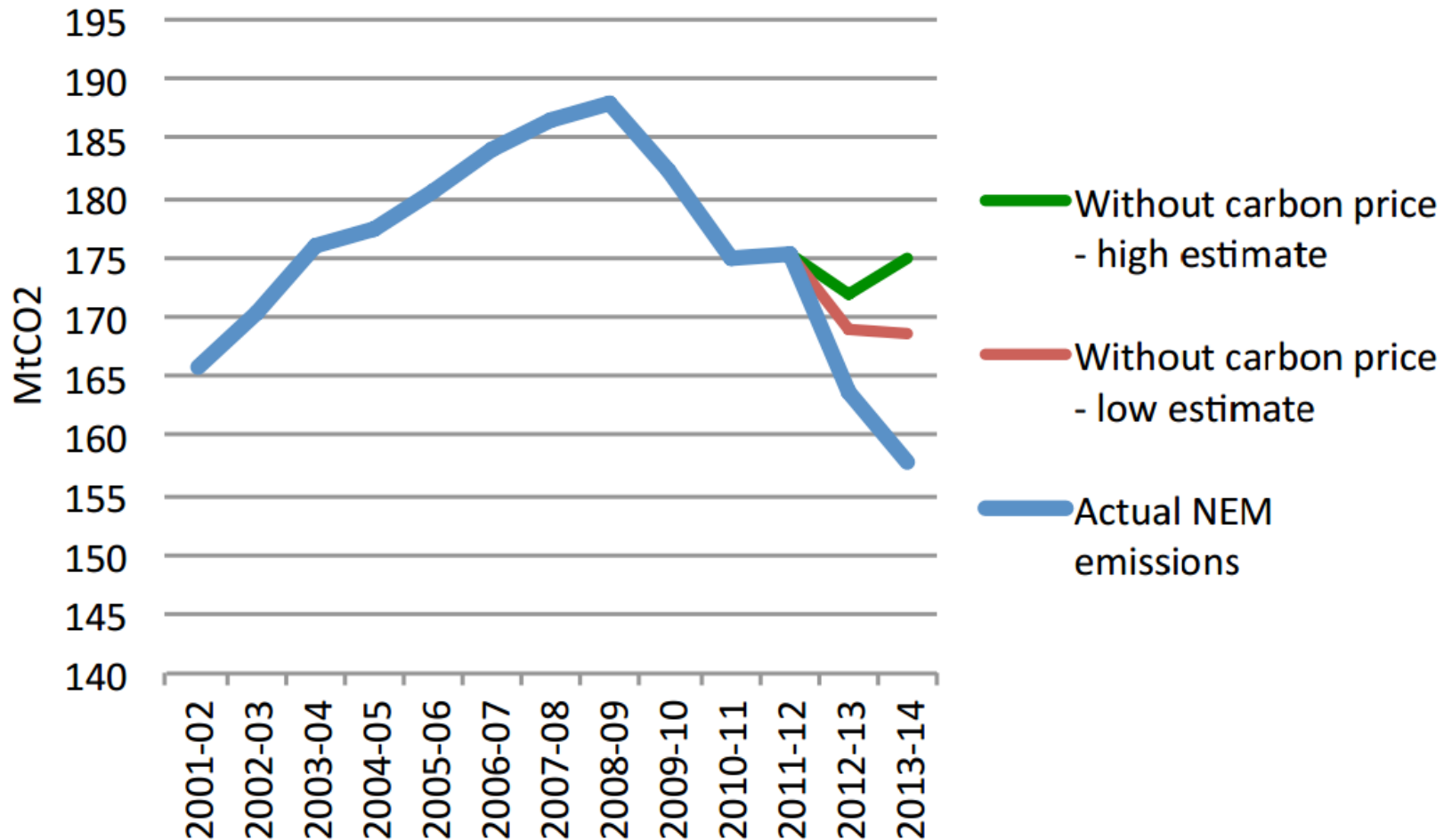
Impact of carbon price on electricity market



Electricity sector emissions

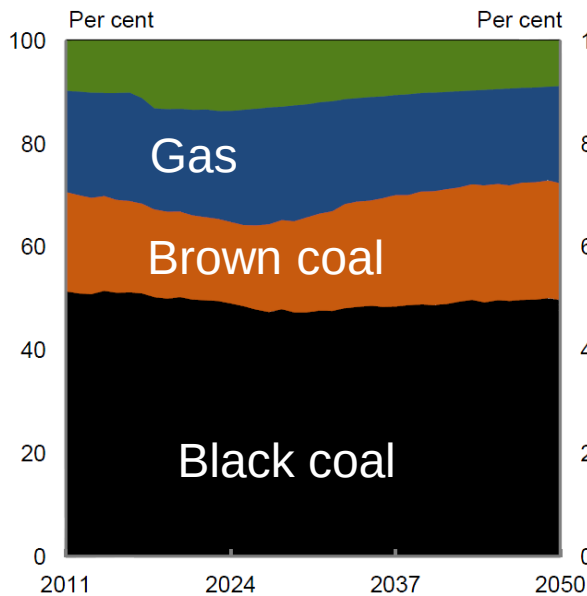


ANU modelling

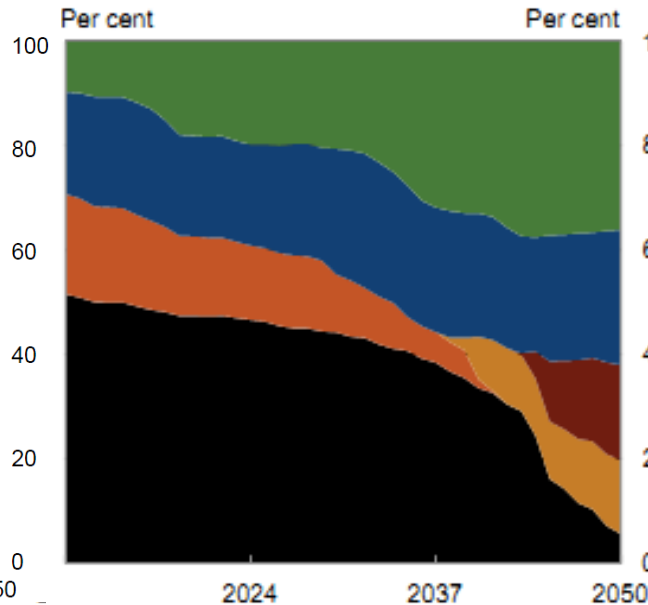


Investment decisions

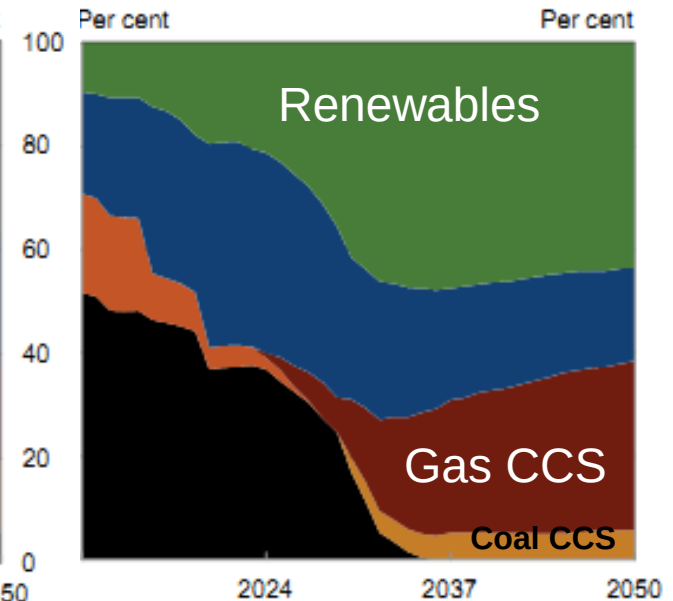
No carbon price



-5% by 2020



-25% by 2020

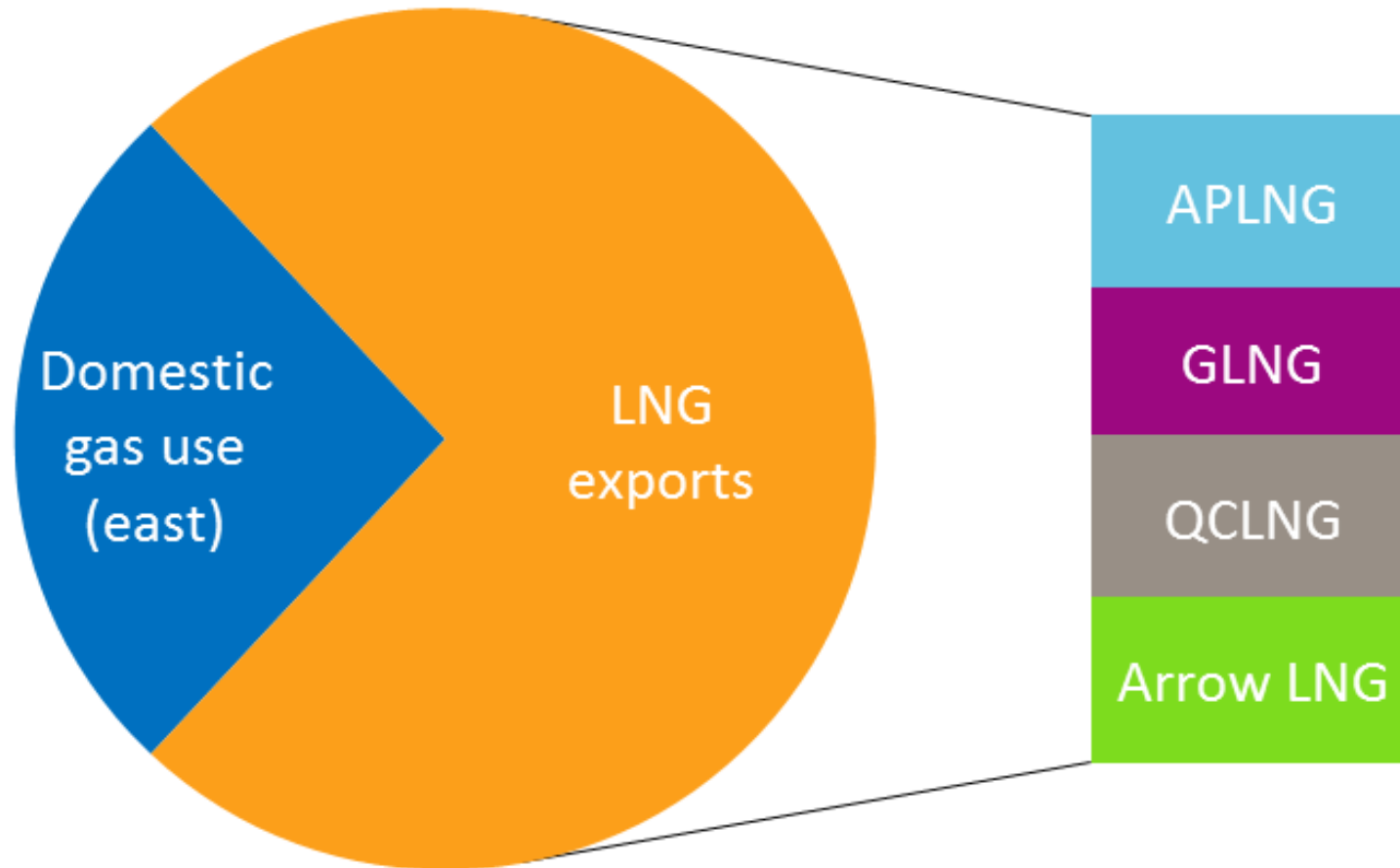


General consensus that a carbon price will drive low emissions investment

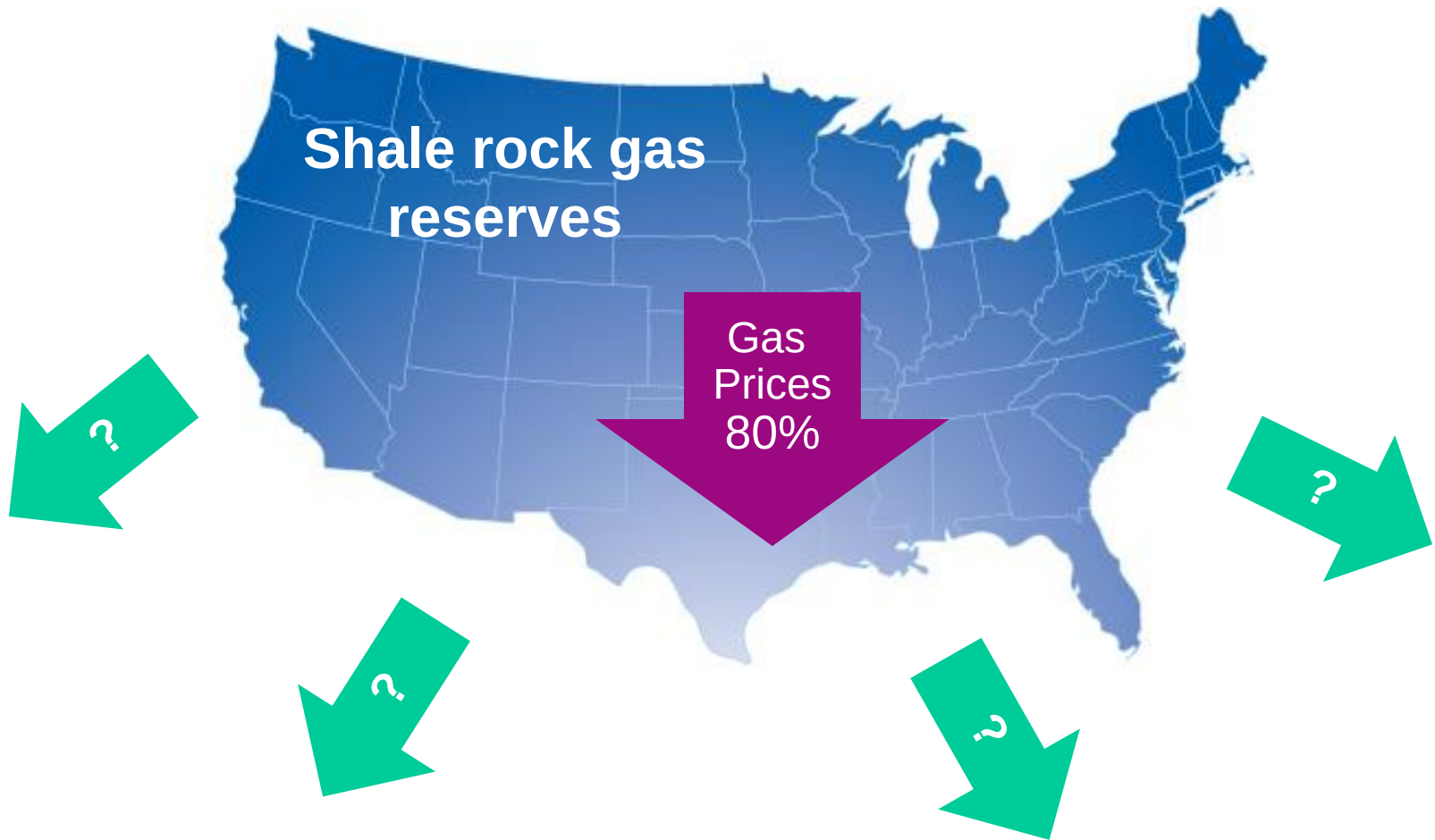
Impacts of **LNG**



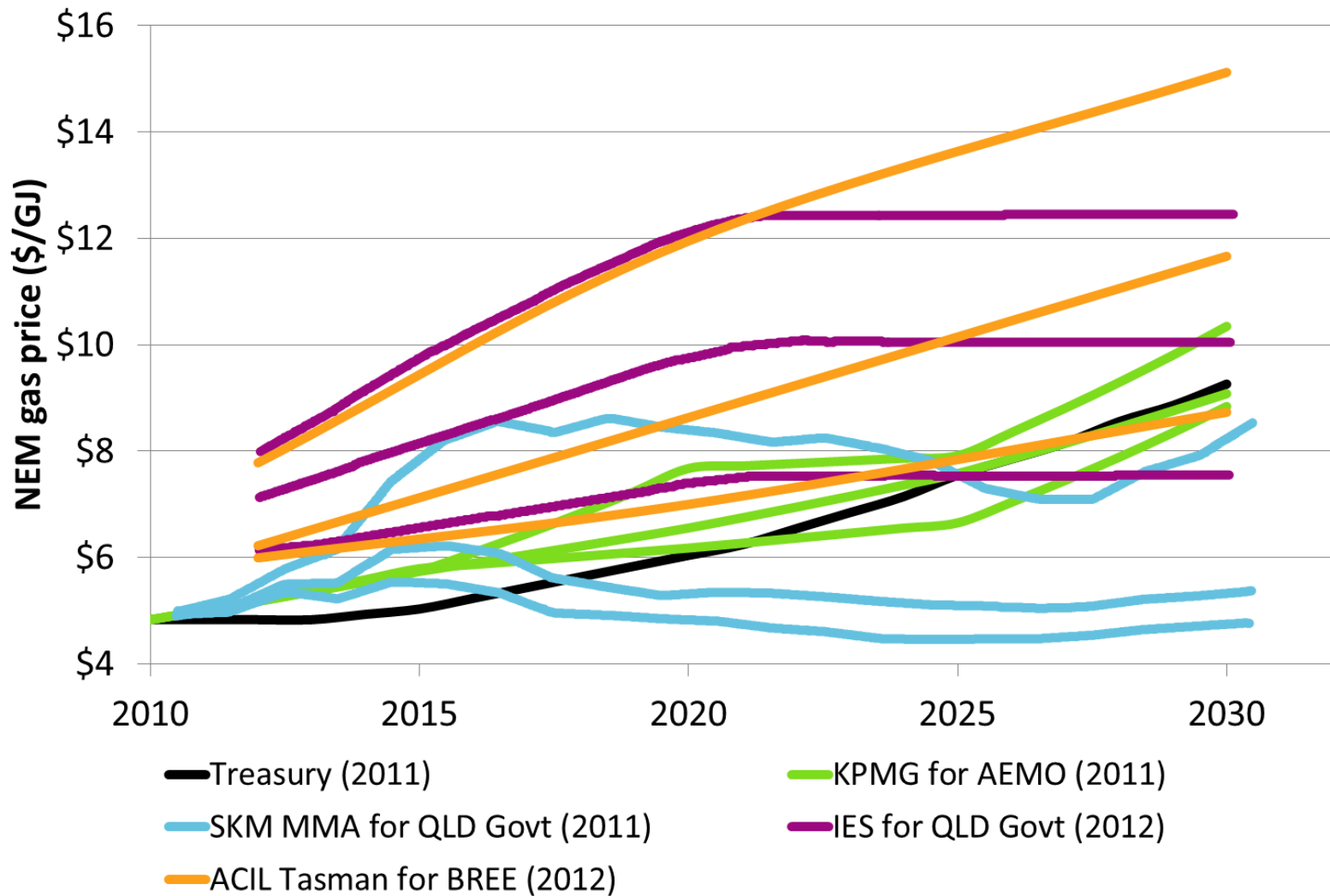
Anticipated LNG exports compared to domestic market



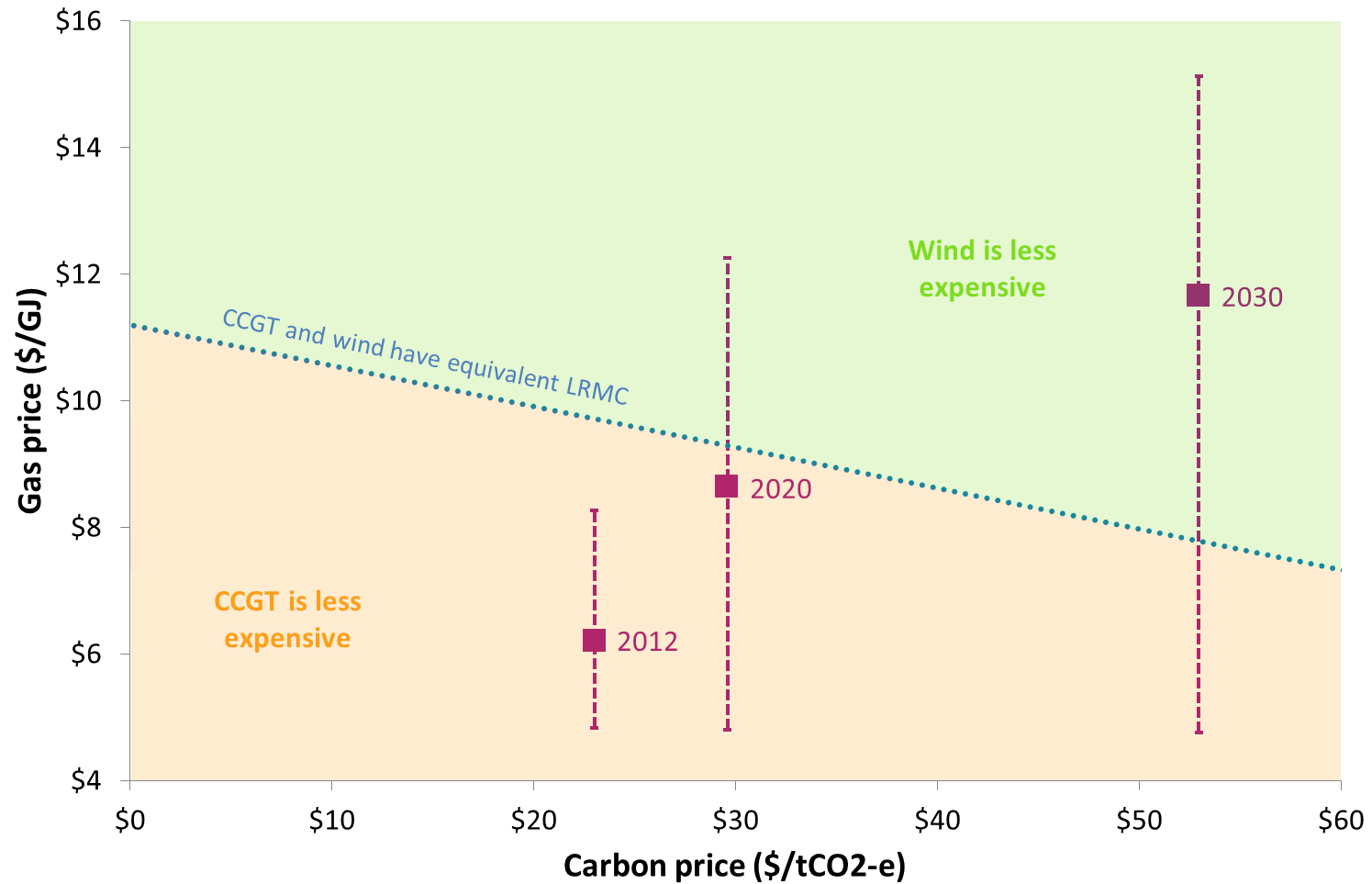
USA and Canada



Significant uncertainty over future gas prices

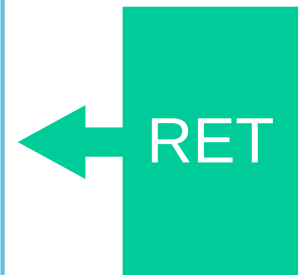
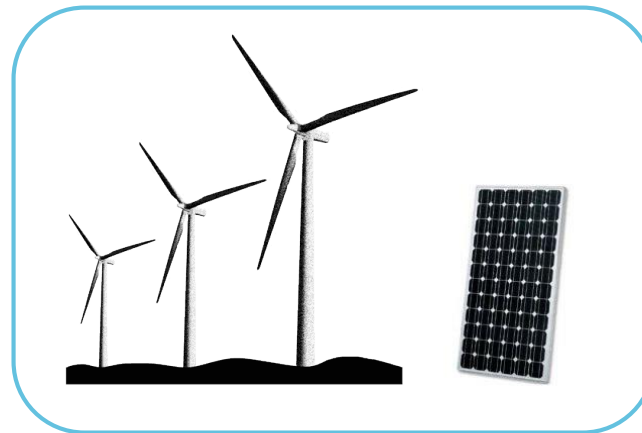


The uncertainty is material

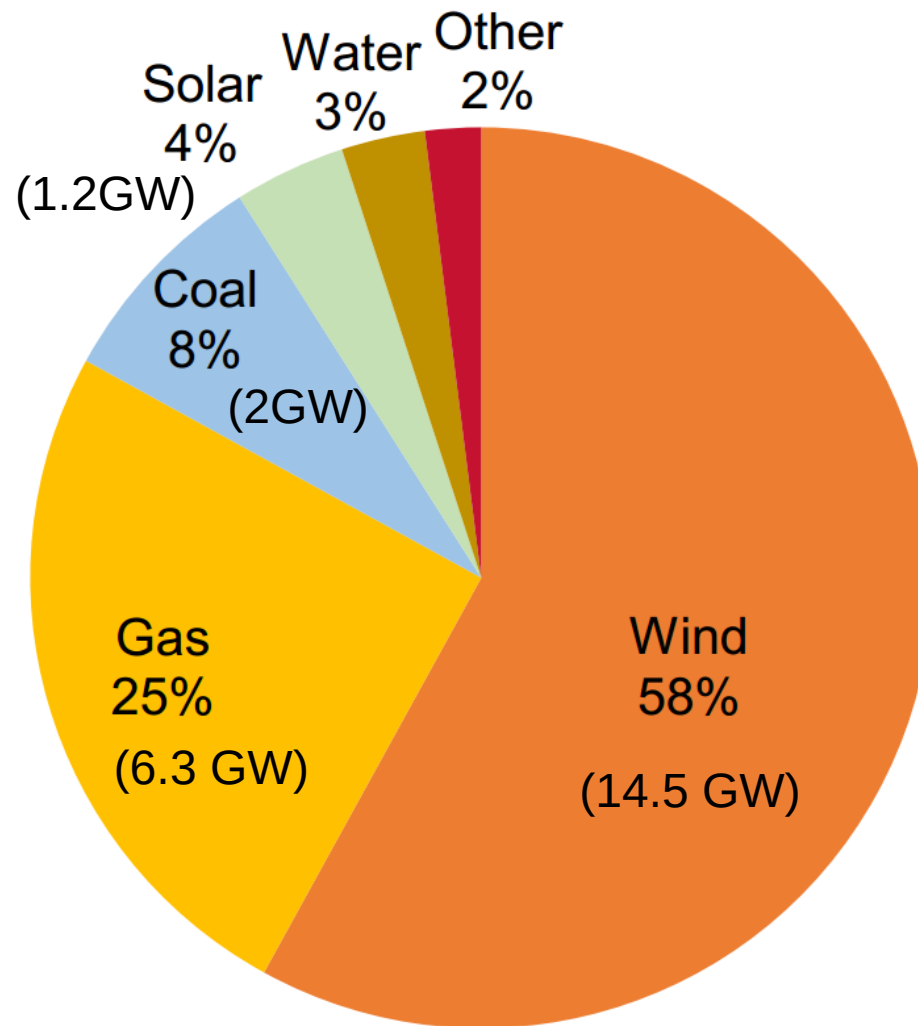


New generation options

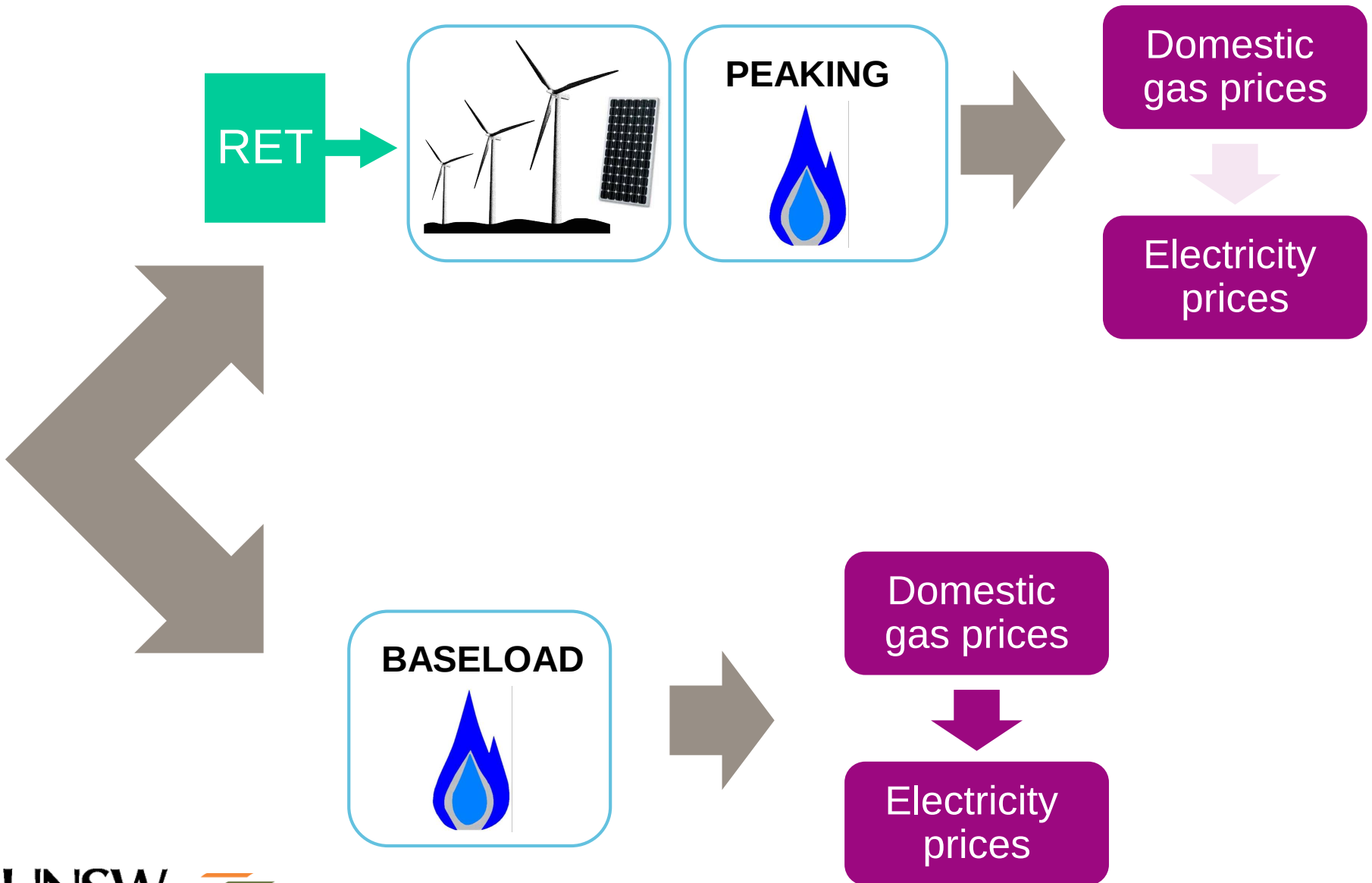
Generation technology	Challenges
Coal	High investment capital risk
Nuclear	Highly politically sensitive
Hydro & Biomass	Resource limitations
Geothermal, tidal, wave, CCS	Not commercially viable prior to 2030
Solar thermal	High cost



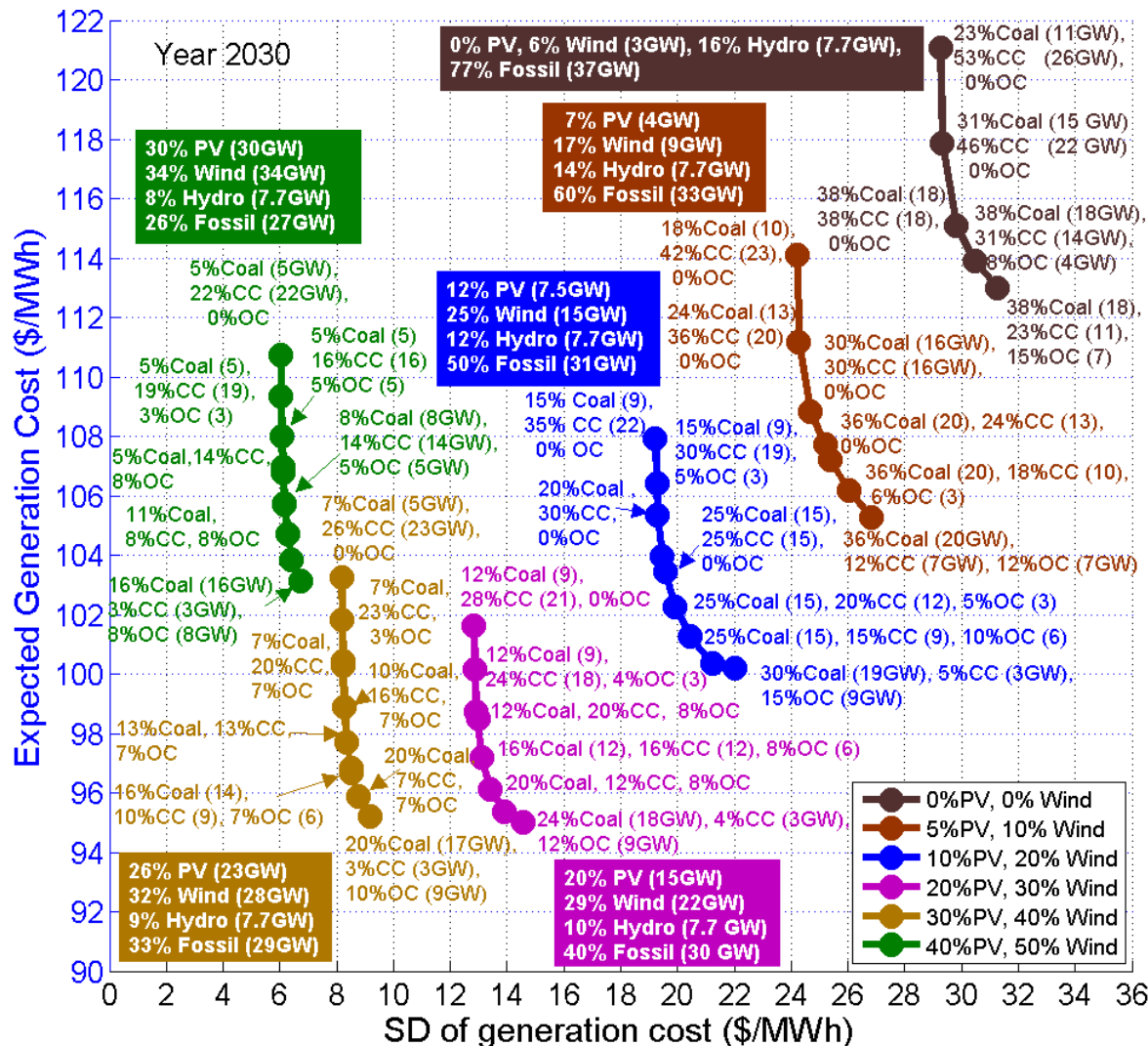
Proposed new capacity



A portfolio approach to risk management



Comparing portfolios of renewables vs gas (2030)



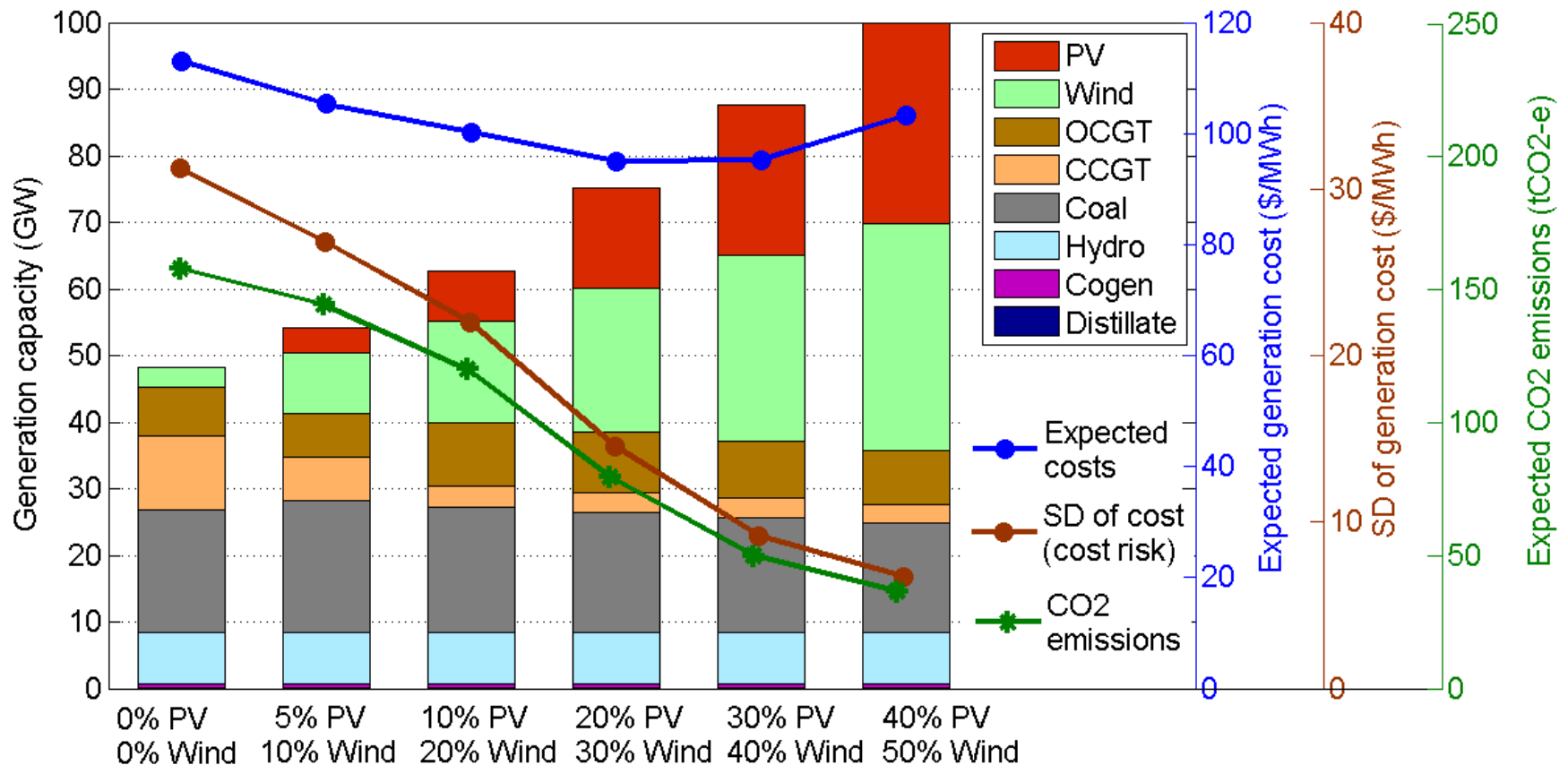
Renewables reduce cost risk

(and also reduce total cost up to a point, depending upon CO₂ and gas prices)

Percentage variable renewables:

0%
15%
30%
50%
70%
90%

Comparing portfolios of renewables vs gas (2030)



International experiences

California

33%
Renewable Energy
by 2020

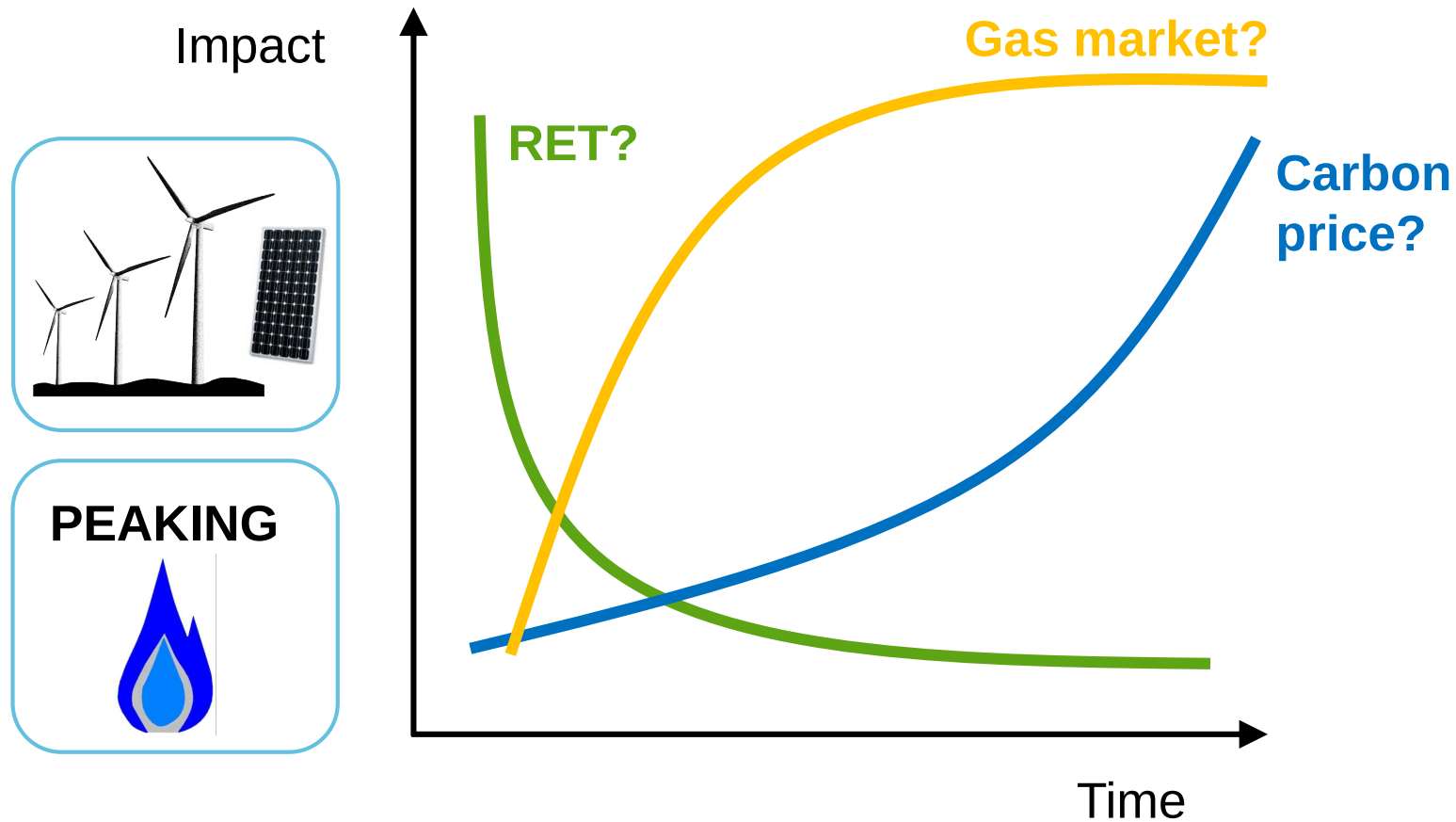
“promoting stable electricity prices by hedging against volatile natural gas prices”

UK

15%
Renewable Energy
by 2020

“[Renewables] will be crucial to help protect consumers from fossil fuel price fluctuations”

Conclusions – Outlook for the electricity sector





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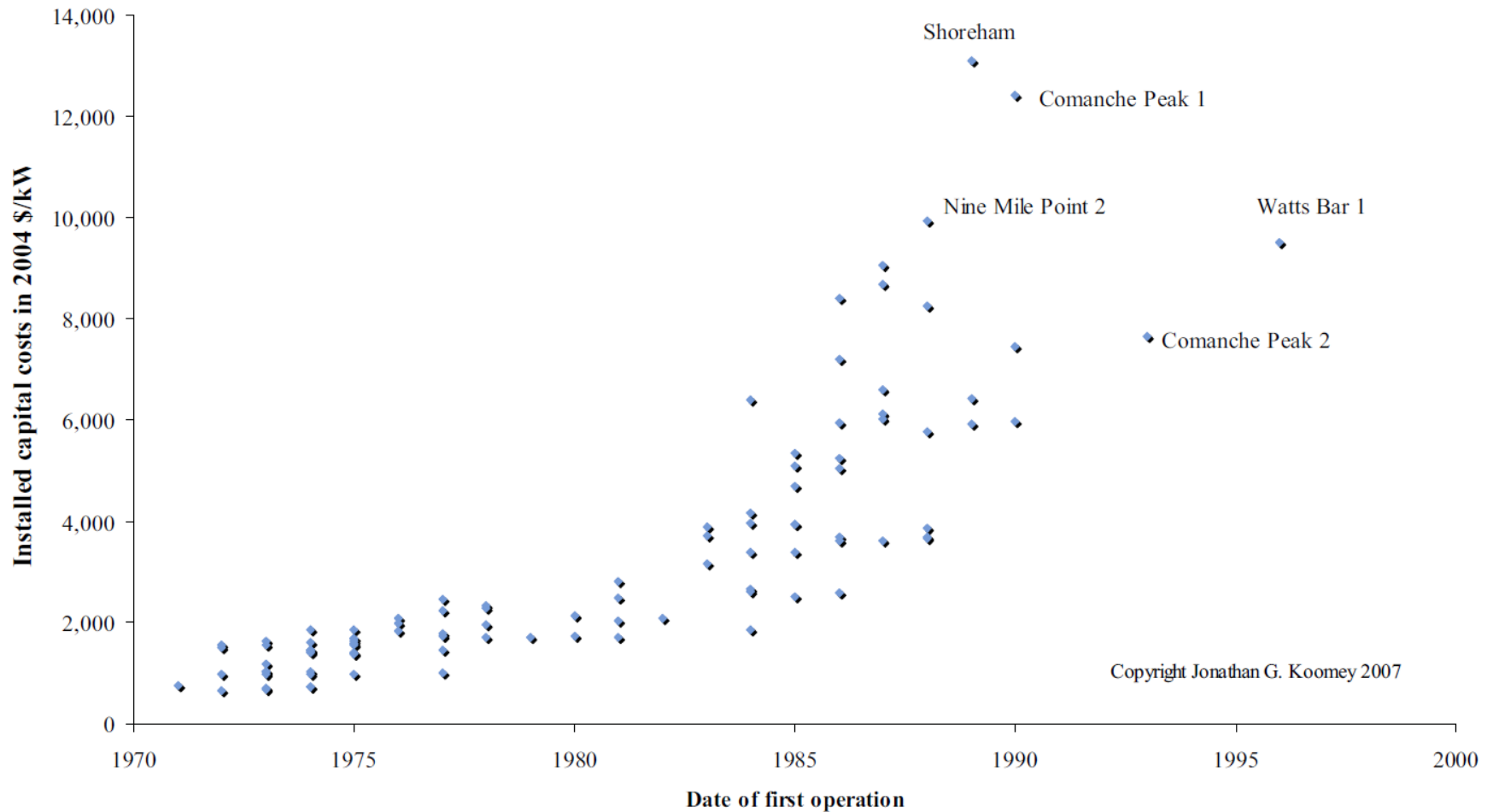
Thank you

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What about nuclear?

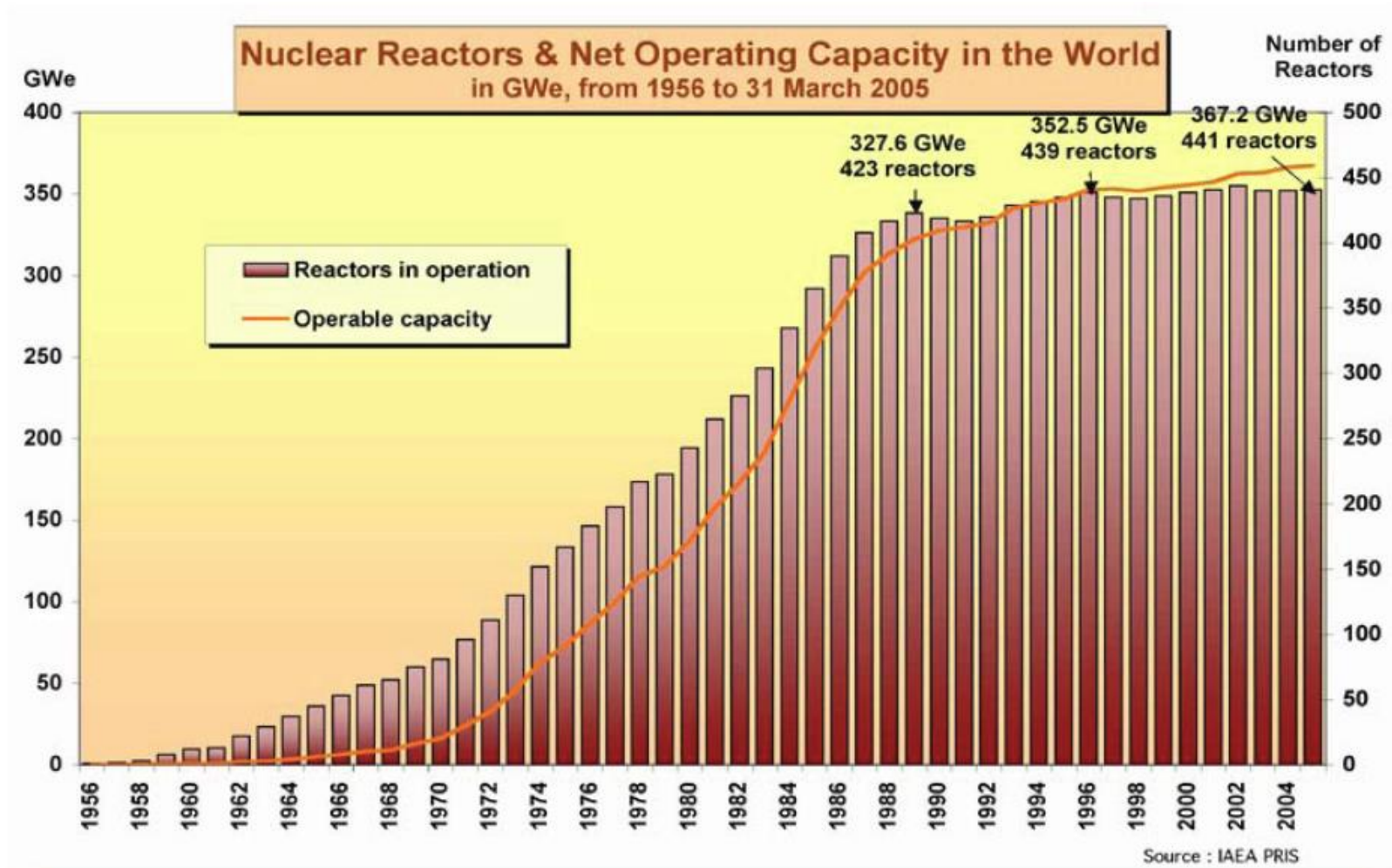


Nuclear costs are increasing



Copyright Jonathan G. Koomey 2007

Investment in nuclear has slowed



Levelised cost of nuclear is high

	Levelised cost (\$/MWh)
Nuclear (UK)	\$154 (£92.50) (Hinkley C, 35yr PPA)
Wind (Australia)	\$80 - \$100 (10-15yr PPA)

- Cost of establishing a nuclear industry?
- Also:
 - No export industry in renewable technologies
 - Inflexible – poor partner with variable renewables