Brown coal exit: A market mechanism for regulated closure of highly emissions intensive power stations

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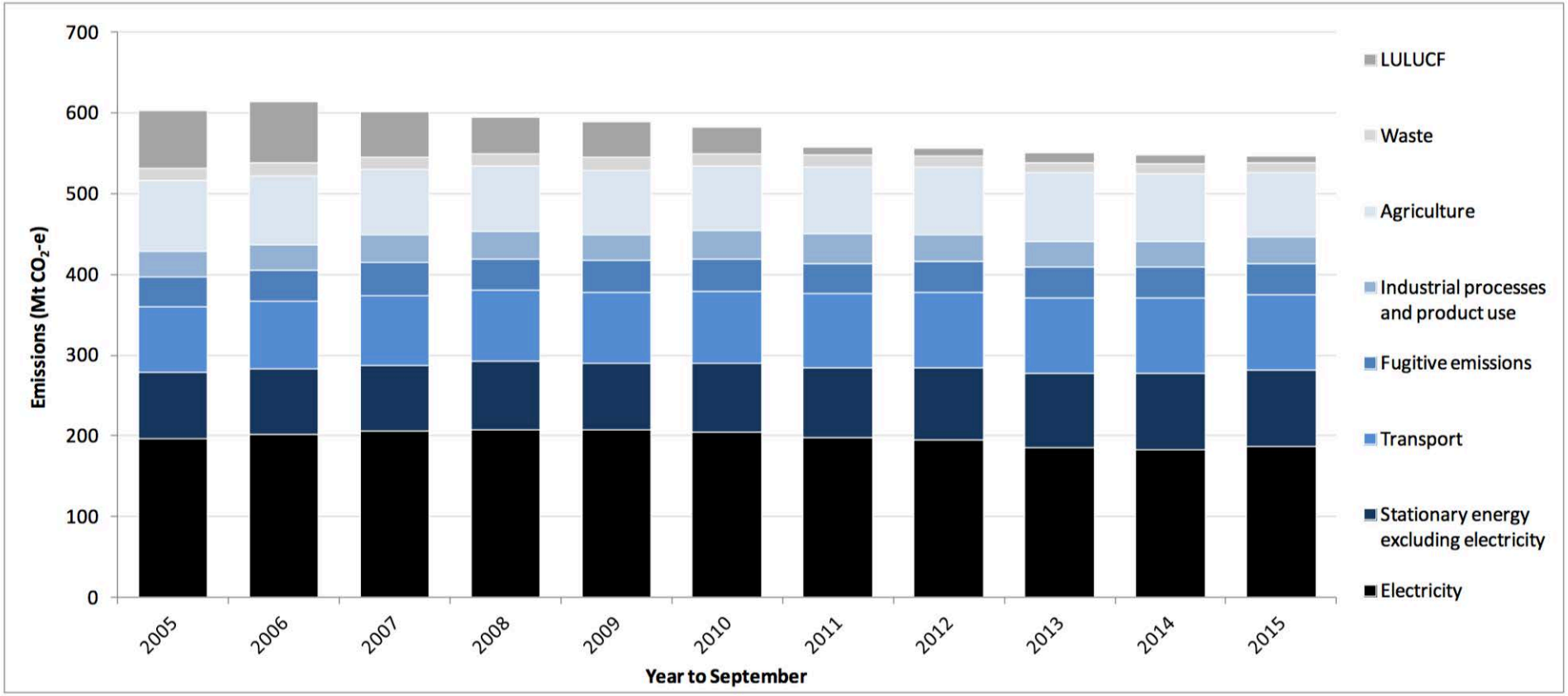
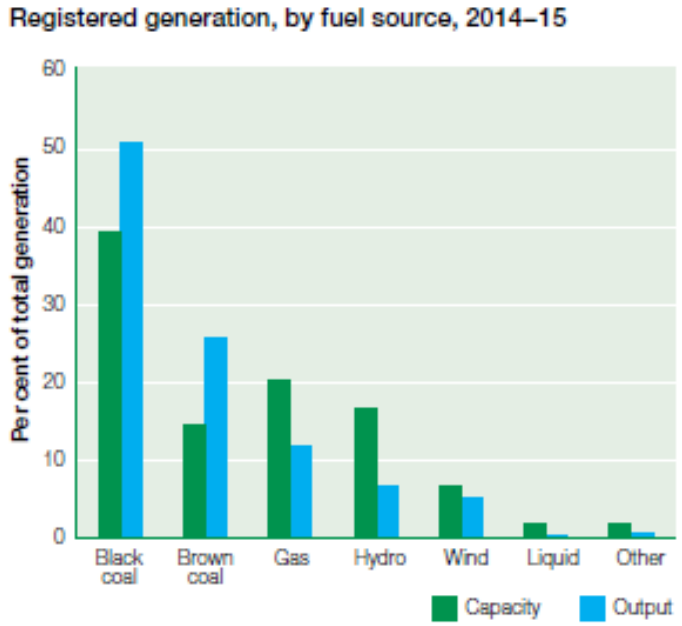
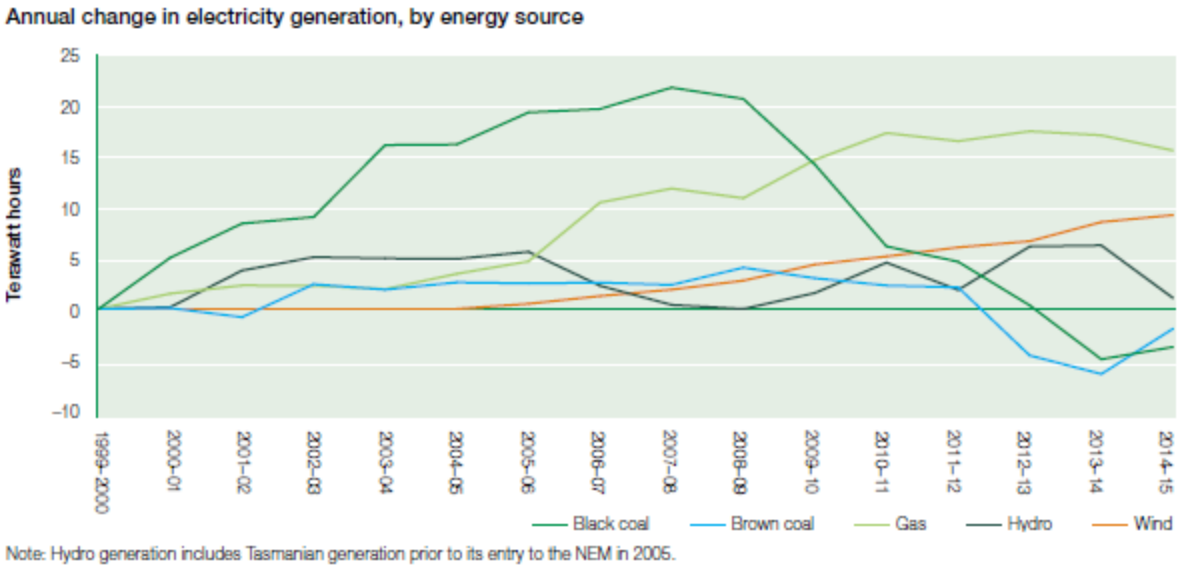
Figure 5: Emissions by sector, Australia, annual, year to September 2005 to 2015



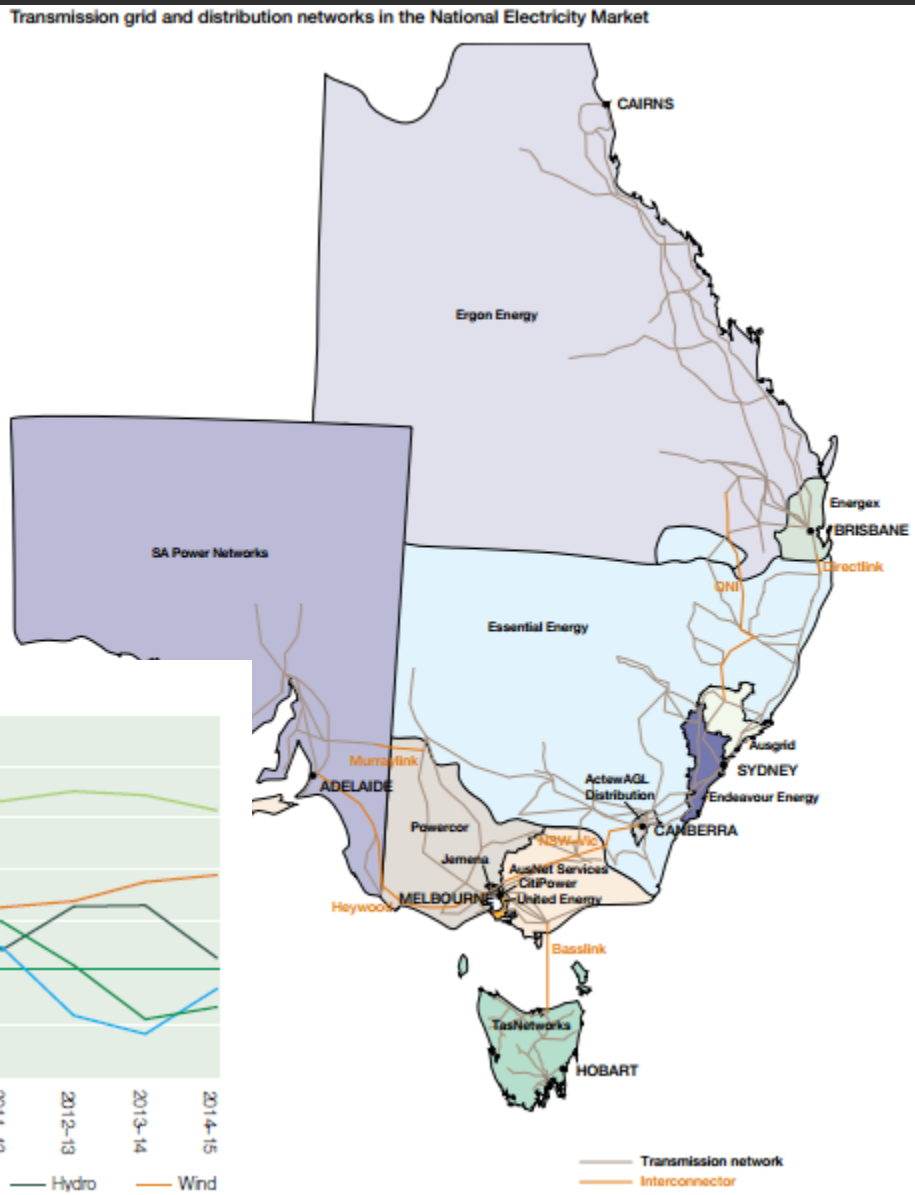
Source: Department of the Environment.

NEM overview



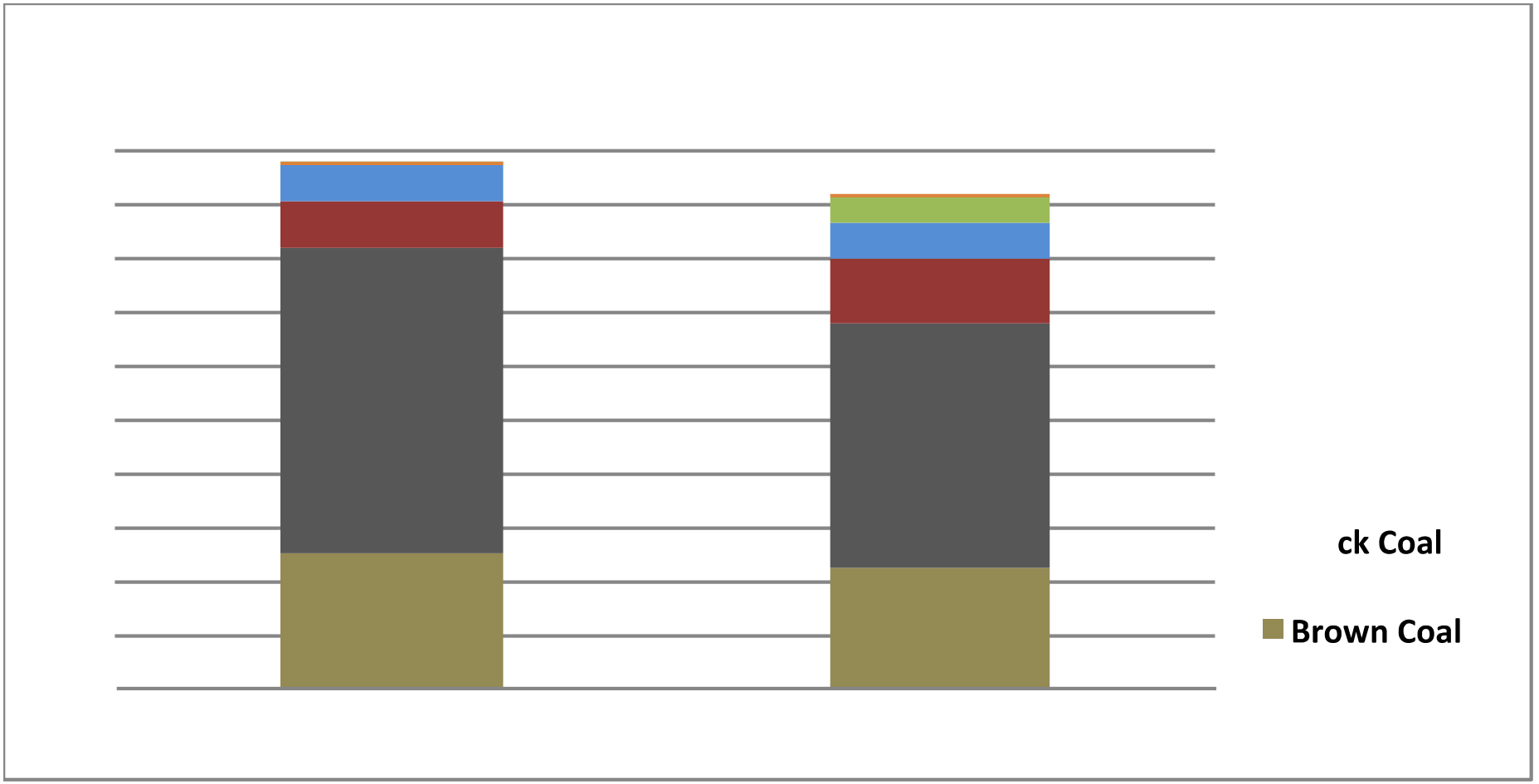


Note: Hydro generation includes Tasmanian generation prior to its entry to the NEM in 2006.



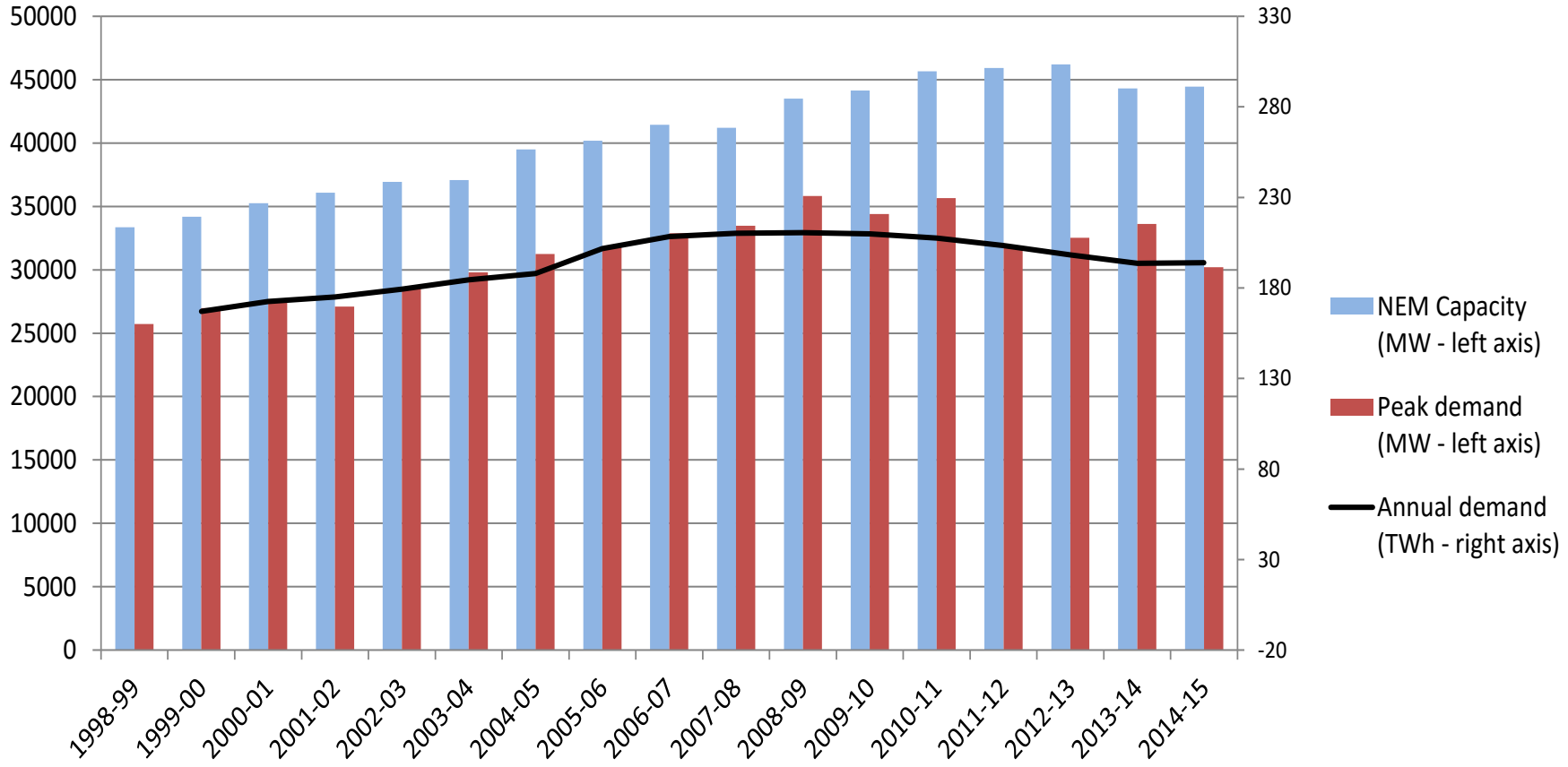
Source: Australian Energy Regulator: State of the Energy Market 2015.

Problem in absence of carbon price:
One or more black coal power stations could exit, rather than lignite stations



Jotzo&Mazouz Nov 2015, “Brown coal exit: a market mechanism for regulated closure of highly emissions intensive power stations”, CCEP wp, *Economic Analysis and Policy*

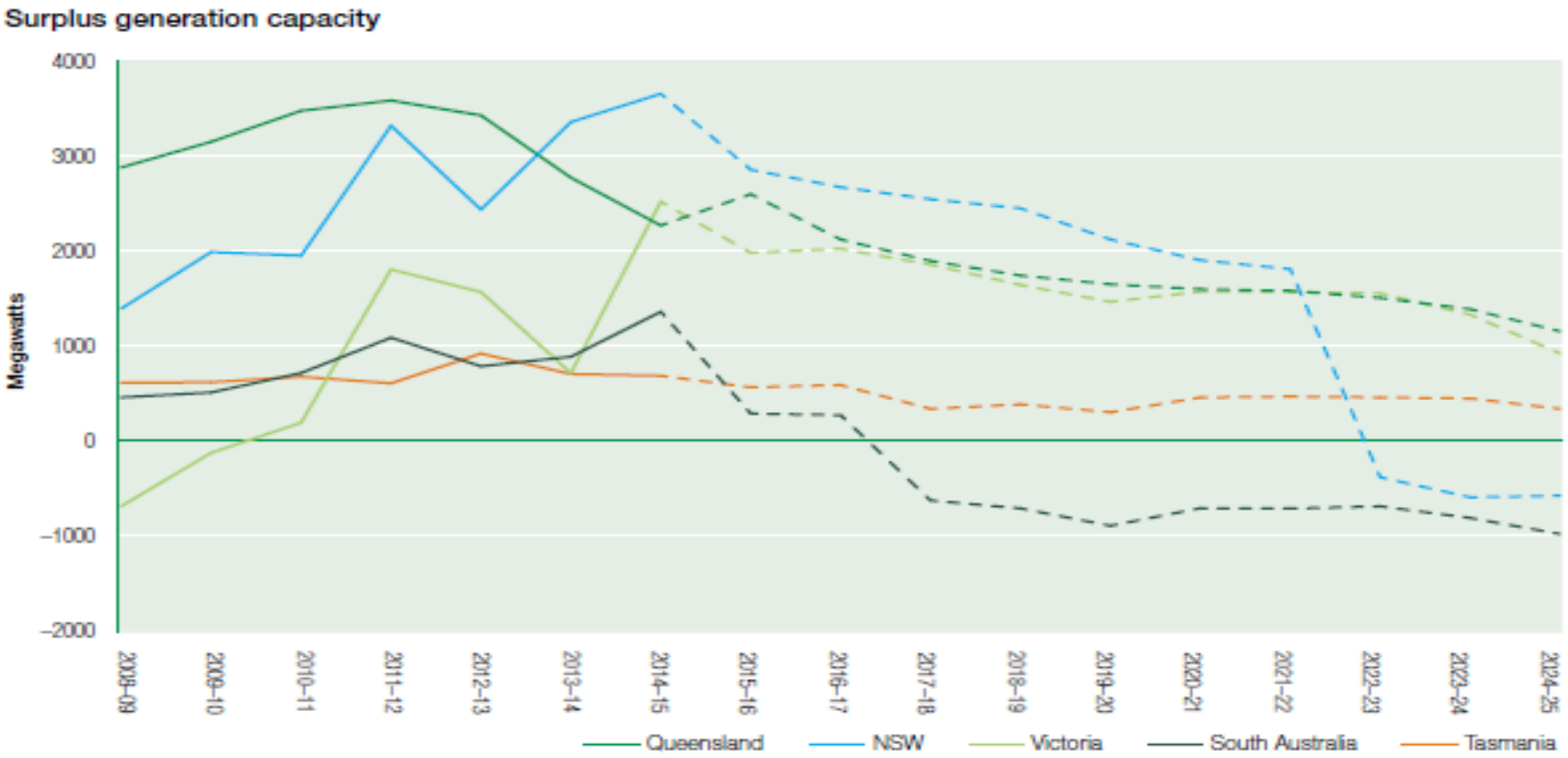
Capacity and demand in the NEM



Over Capacity

AER 2015: https://www.aer.gov.au/wholesale-markets/wholesale-statistics/generation-capacity-and-peak-demand and author calculations

Surplus generation capacity in the NEM: who might exit and when?



Source: AER 2015 (https://www.aer.gov.au/wholesale-markets/wholesale-statistics/generation-capacity-and-peak-demand)

AEMO 2015 Electricity Statement of Opportunities: The 2014 ESOO reported surplus generation capacity of 7,400 MW in the NEM by 2023-24.The mkt responded by notifying the withdrawal of 4,550 MW of capacity by 2022

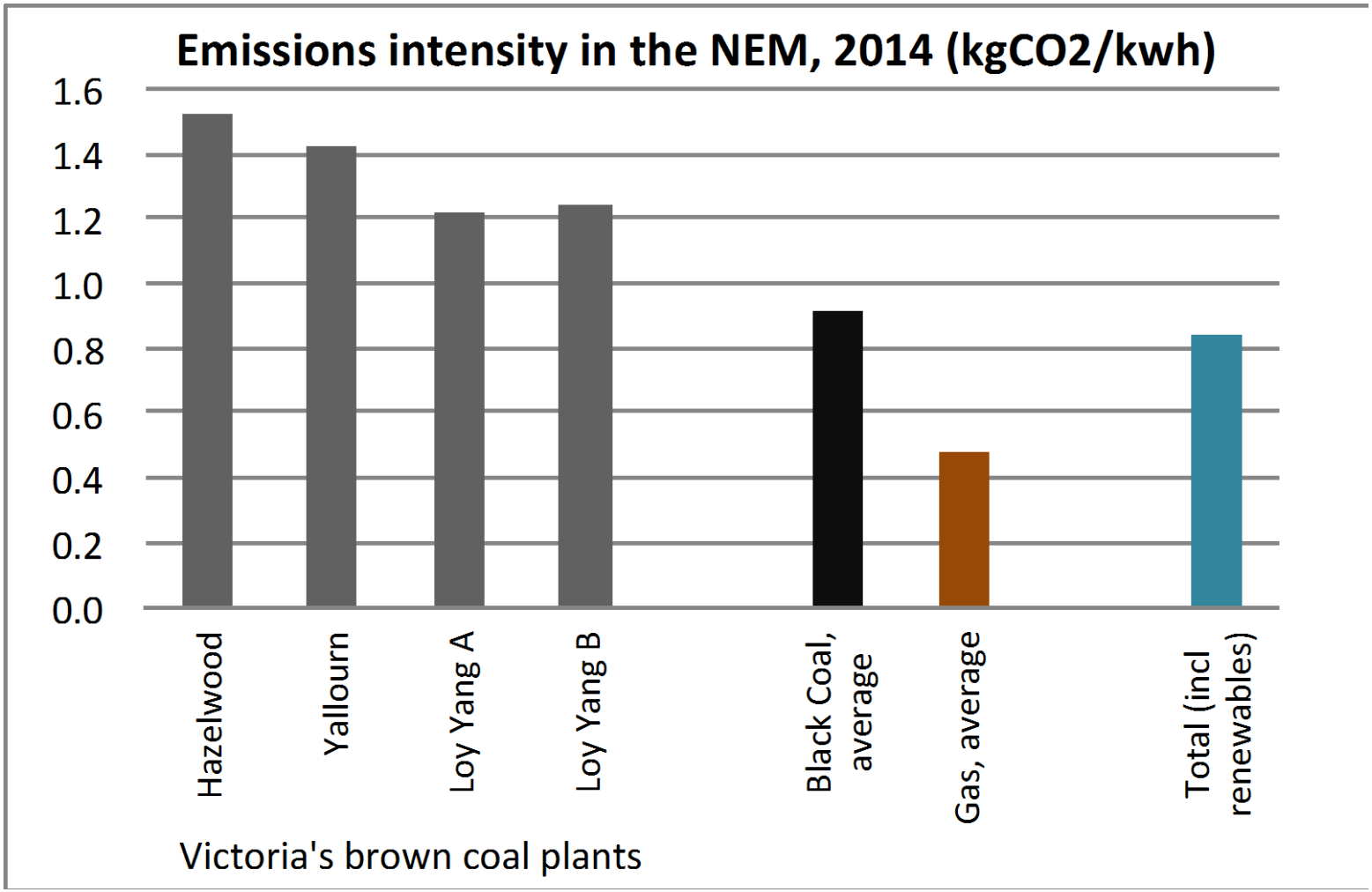

Emissions intensity in the NEM, 2014 (kgCO2/kwh)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Hazelwood
Yallourn
Loy Yang A
Loy Yang B
Black Coal, average
Gas, average
Total (incl renewables)
Victoria's brown coal plants

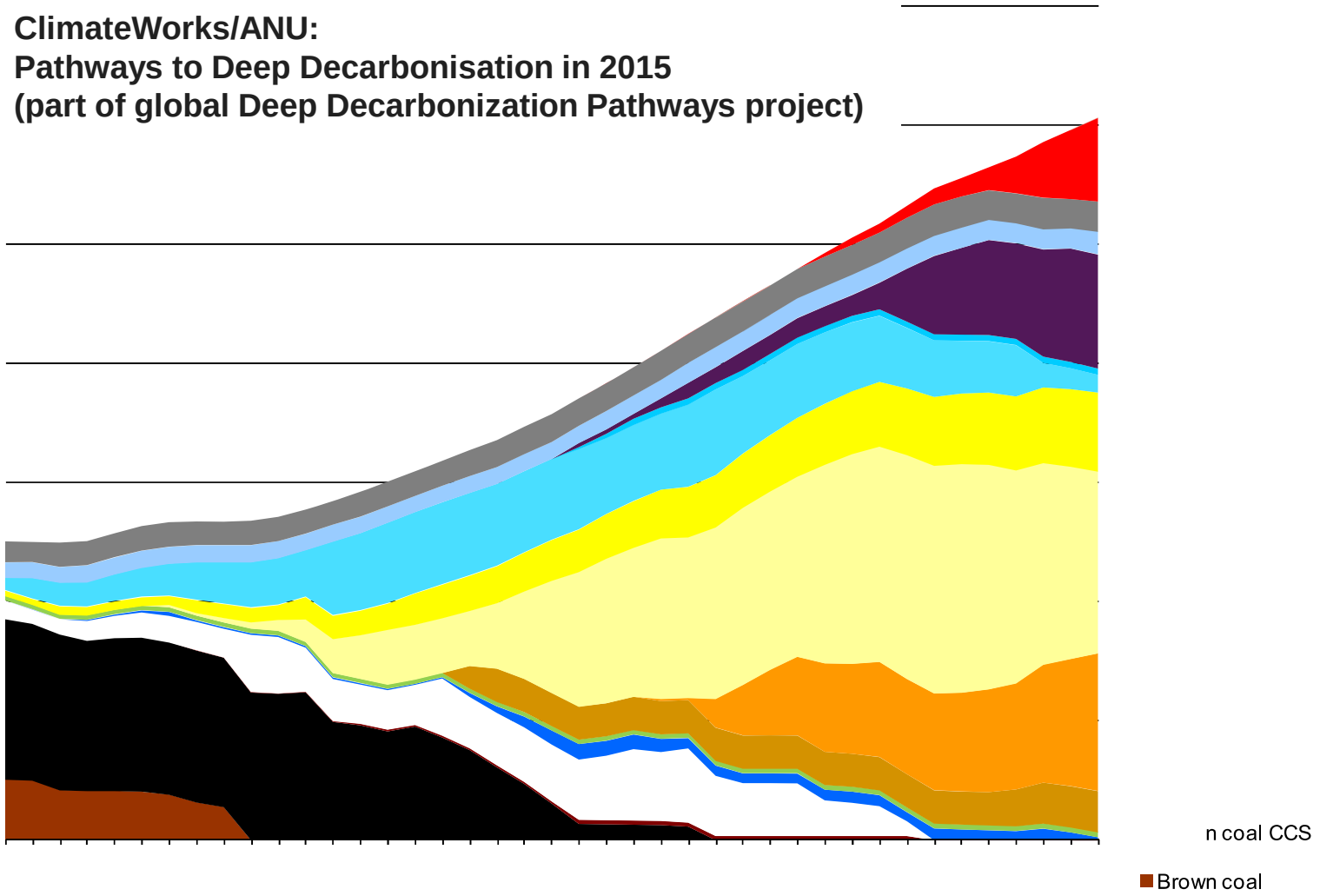
Table 1: The four large brown coal generators in Victoria

	Hazelwood	Loy Yang A	Loy Yang B	Yallourn
Owner (Nov 2015)[a]	GDF Suez	AGL	GDF Suez	Energy Australia
Year commissioned[a]	1964 to 1971	1984 to 1988	1993 to 1996	1974 to 1982
Capacity, MW[b]	1,760	2,295	1,200	1,585
Capacity utilisation rate, 2014 (%)[b]	70.8	80.0	71.5	77.1
Electricity dispatched, 2014 (GWh)[b]	9,819	14,630	6,952	9,749
CO2 emissions, 2014 (kt)[b]	14,944	17,702	8,606	13,814
Emissions intensity, 2014 (tCO2/MWh dispatched)[b]	1.52	1.21	1.24	1.42

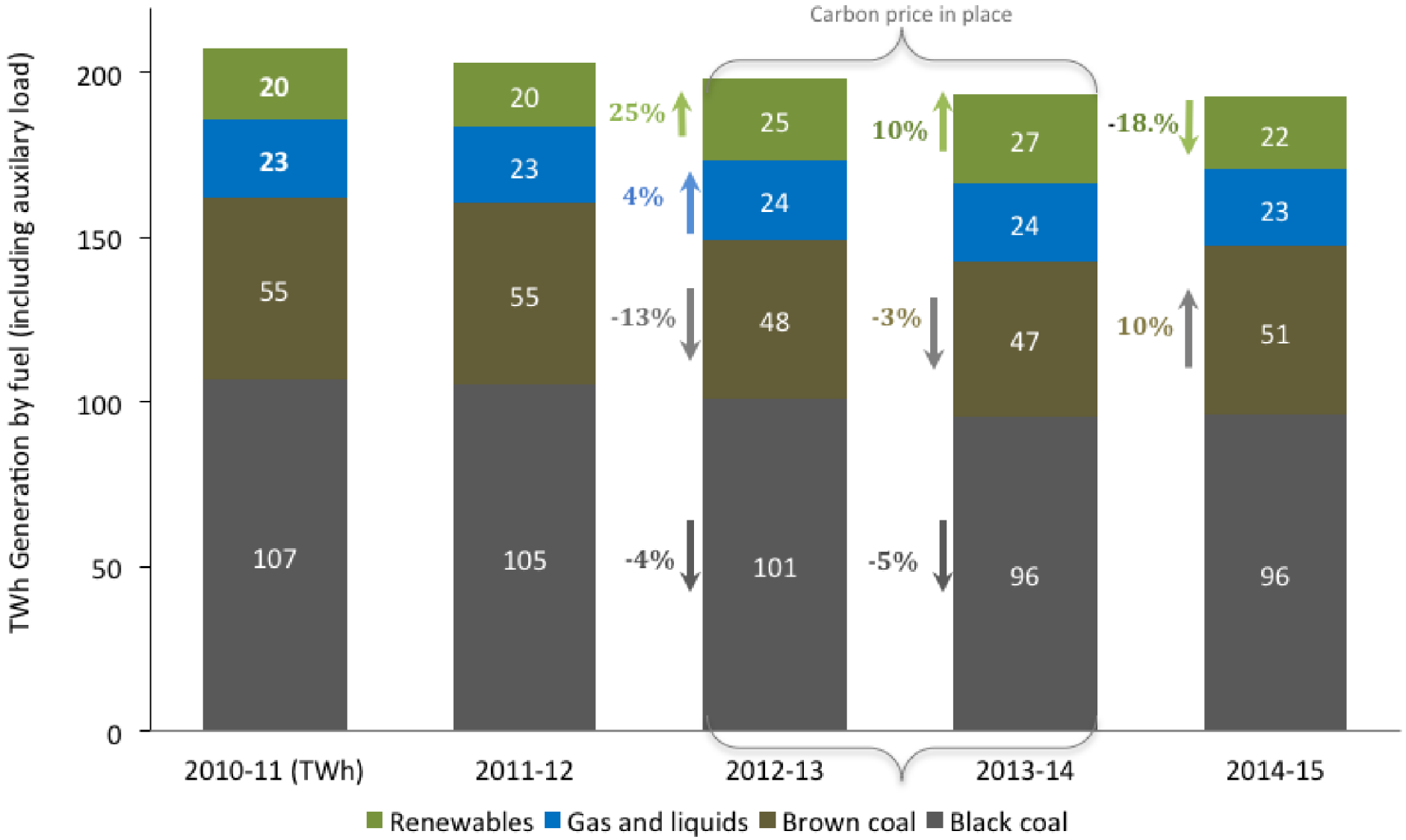
Notes: **a**) Sourced from the respective company websites: Hazelwood - GDF Suez (2015a); Loy Yang A – AGL (2015); Loy Yang B – GDF Suez (2015b); Yallourn – Energy Australia (2015). **b**) The third party software NEMSight from Creative Analytics was used to extract the relevant AEMO data (Creative Analytics 2015).

Decarbonisation of electricity supply:
A 100% renewable electricity grid by 2050

Figure 2.10 – Projected national electricity generation by technology, *100 percent renewable grid*, 2010–2050



Fuel mix in the National Electricity Market before, during and after the carbon price



Source: UPDATED FROM O'Gorman and Jotzo (CCEP working paper 1411, ANU)

A proposal for a specific policy intervention while there is no carbon price:

Avoiding the wrong exit pathway

Context:

- Policy uncertainty
- Investment climate
- Electricity market design for high renewables penetration

Traditional approaches to plant closure – with problems:

Negotiated payments to operators

- Information asymmetry – extracting rents from government?
- Politically difficult esp if on-budget payments
- Australia's failed 'contract for closure' scheme

Direct regulation to force exit (eg CO2 standard)

- Information asymmetry – which is the best plant to close?
- Could be politically difficult

Germany: paying for exit while power prices are falling?

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PITFALLS FOR VATTENFALL

Low-Down Brown Coal Blues

BY JÜRGEN FLAUGER AND KLAUS STRATMANN

The Swedish power company Vattenfall has found no buyer willing to pay the price for its nearly worthless lignite division in Germany. Their only hope be creating a foundation to manage the unwanted operations.

IS ARTICLE

ATTERS

fficulty to sell its
operations shows
d in sight to the the
utilities face in

-owned utility
been ordered by
overnment to exit
ess due to climate

Farewell to brown coal without tears: how to shut high-emitting power stations

November 19, 2015 6.11am AEDT

Loy Yang power station in Victoria's Latrobe Valley. Takver/Flickr, CC BY-SA

Accepted Manuscript

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The idea:

An industry-funded, competitive exit payment mechanism

1. No government outlays
2. The beneficiaries of exit – remaining generators – pay the exiting plant
3. Breaks the deadlock

The proposal:

Competitive bidding process for power station closure

1. Plants bid over the payment they require for closure
   - Including site remediation
   - Plus structural assistance to communities; renewable energy at site?
2. Regulator chooses the best (most cost effective) bid
   - Indicator: $/tCO2 expected to be saved
   - Regulator may choose not to accept any bids
3. Remaining generators pay for exit
   - In line with their future CO2 emissions, over some period of time
   - Other models possible – consider incentive effects and price uplift

Who pays?

Incentives to bid low are strongest, future profitability of high-emitting plants lowered, limited (no?) scope for collusion

Incentives to bid low exist but less pronounced, price uplift higher (gas), some scope for collusion?

Payments made by remaining brown coal power stations

Payments by all remaining generators in proportion to CO2 emissions

Payments by all remaining generators in proportion to electricity sent out

Market mechanism for exit is a source of revenue

Assuring **site rehabilitation**

- to agreed (perhaps especially high) standard

Providing money for **structural adjustment** programs

- eg local infrastructure, business development, retraining

Could support low-carbon power investment

- Eg solar or gas with CCS on site

VIC State government should like this

Illustrative magnitudes

CO2 savings per year

Depends on what replaces the exiting plant, scenarios:

100% black; 70% black and 30% brown (this is very much on the high side)

Hazelwood exit: 5-6 MtCO2/year

Yallourn exit: 4-5 MtCO2/year

Conservative estimates, eg no substitution into gas

~1% of annual national emissions

For how long? Depends on counterfactual

How high might the bids be?

"Two is enough for competition"

Exit bid > expected future profits

- Taking into account price uplift and payments to exiting plant
- Taking into account other future policies, eg carbon price or regulation
- Rehabilitation costs will be incurred anyway
- Adjusted for market and policy risk: bird in the hand
- Taking into account the effects on the full portfofio owned by the company

Analysis needed

Modelling for this proposal

- Price uplift, output by plant, state-by-state analysis
- Bidding strategies under exit scheme

Mechanism design

- Design for effectiveness and political acceptability
- How much capacity to target (here illustrated with 1 plant)

Conclusion

Brown coal exit mechanism

A specific proposal for a specific situation

Longer term policy settings

RET or other renewable energy support?

A long-term ‘exit mechanism’, eg by regulation?

Better: a price on carbon

Policy predictability to support investment climate

Market structure and regulatory settings

Energy-only market for a renewables-heavy system?

Cost-effective integration of local generation and storage

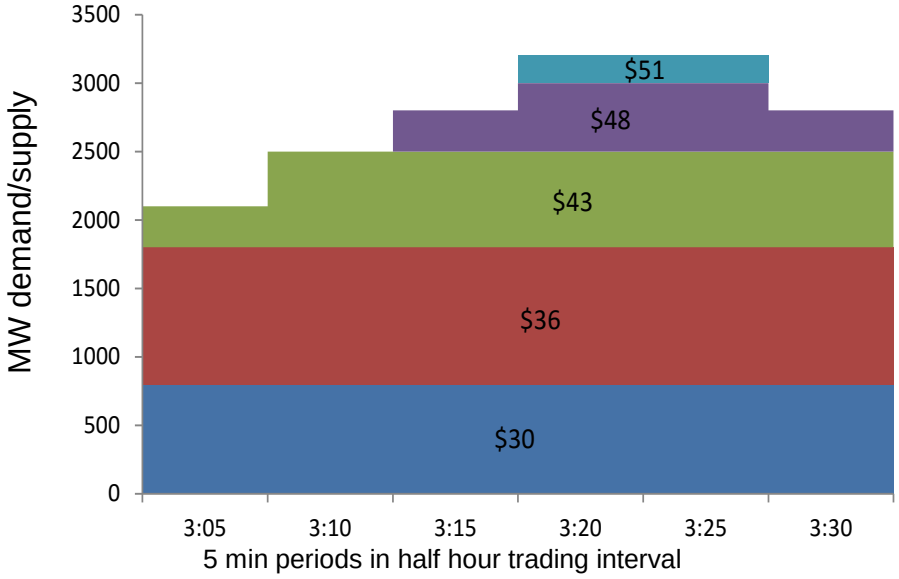
Demand-side management

What would happen to prices in the NEM?

Stylized bid stacks for hypothetical half hour trading interval.

- Demand averaged over the half hour trading interval is 2,750 MW (from 2100 MW at the five minute period to 3:05 to 3,200 MW at the periods to 3:20 and 3:25)
- Generators get dispatched from lowest cost to highest cost to meet demand. The price setting plant is the highest cost plant dispatched

Before exit of low marginal cost plan: The wholesale spot price for the half hour trading interval is $47 per MWh (illustrative!)



After exit: The wholesale spot price for the half hour trading interval is $54 per MWh (illustrative!)