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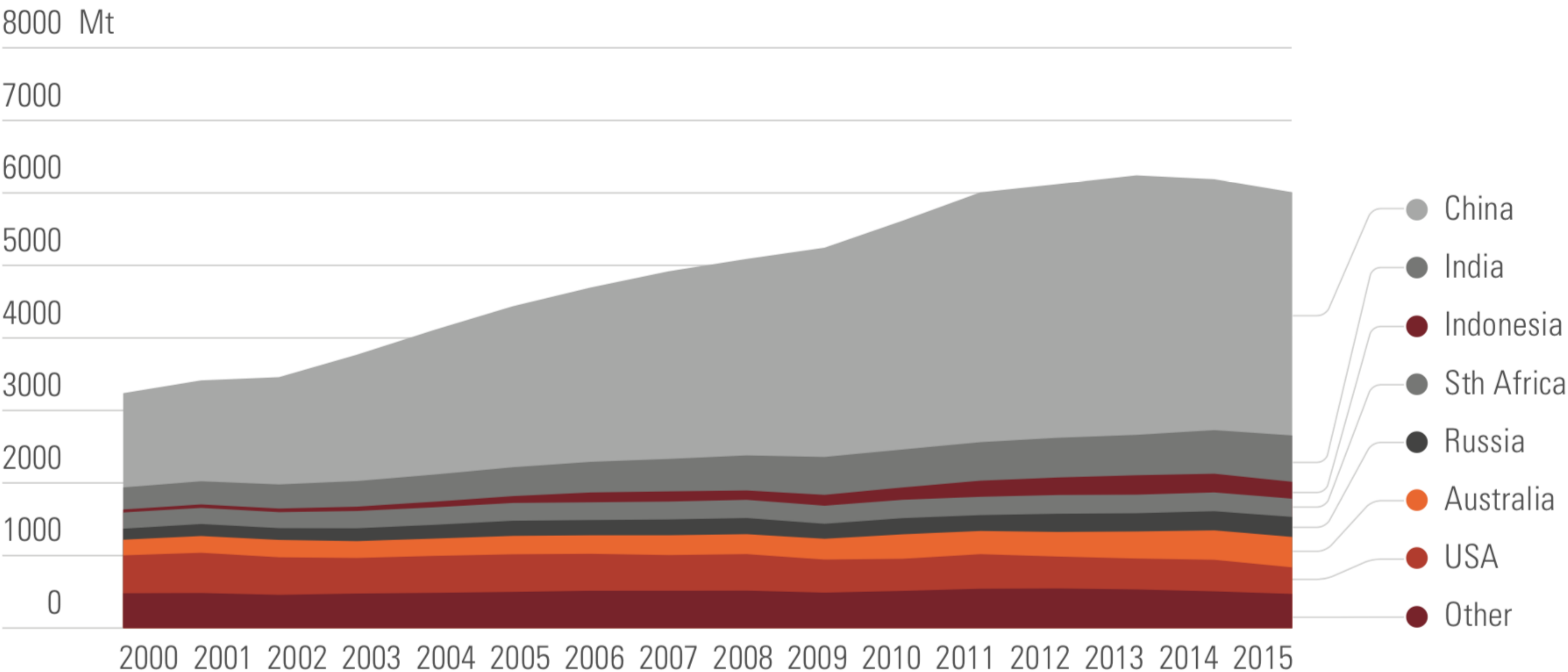
Coal transition – Australia

Crawford School of Public Policy, ANU

coaltransitions.org

Coal production and exports

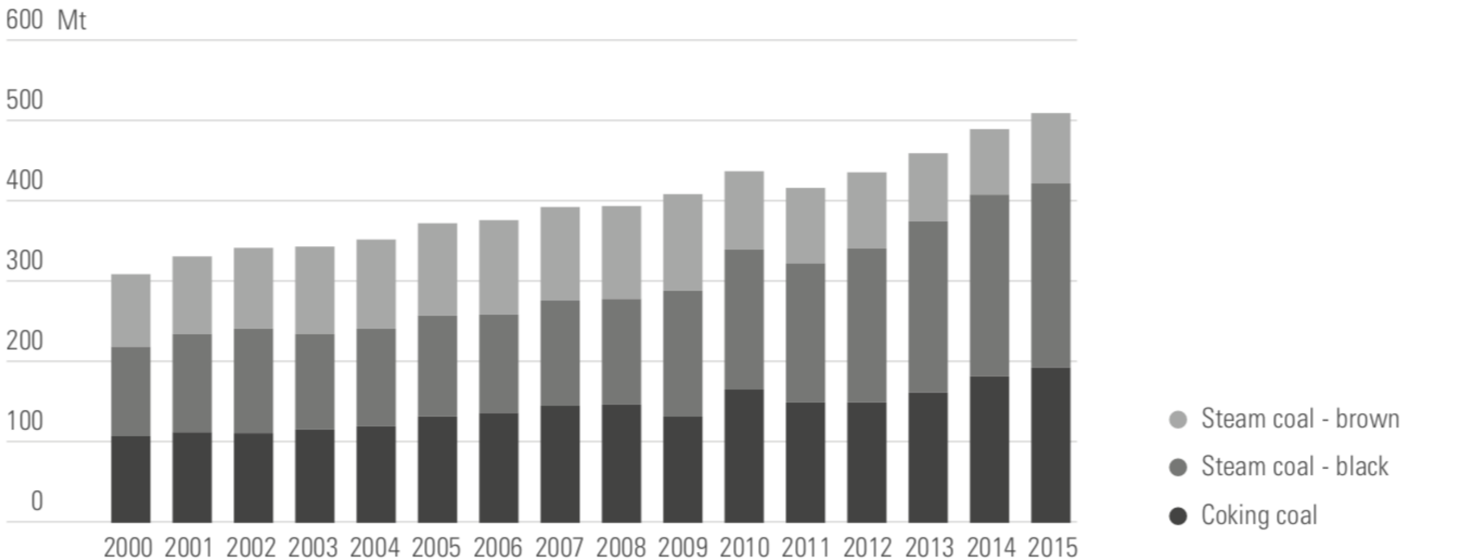
Figure 1. World coal production by top producing country



Source: IEA coal Statistics 2016.

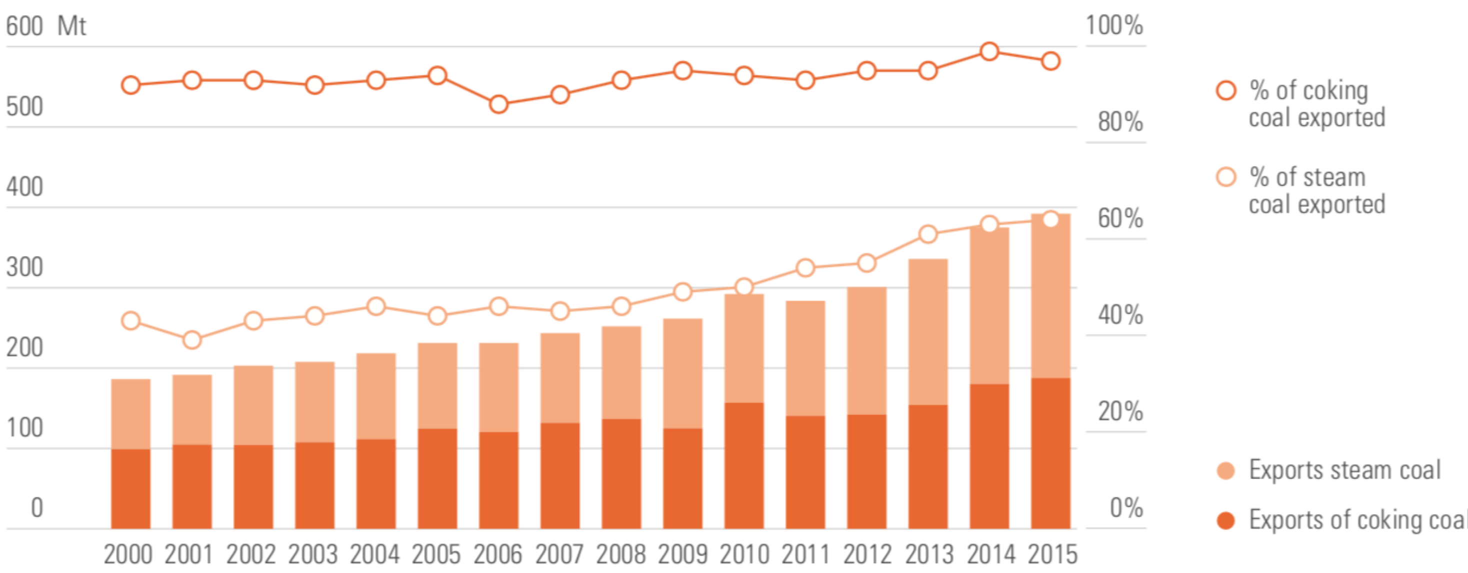
Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Figure 2. Coal production in Australia, 2000 to 2015



Source: OCE (2016).

Figure 3. Exports (Mt) and export share, steaming coal and coking coal, Australia 2000-2015



Source: Coal Transitions in Australia
(Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

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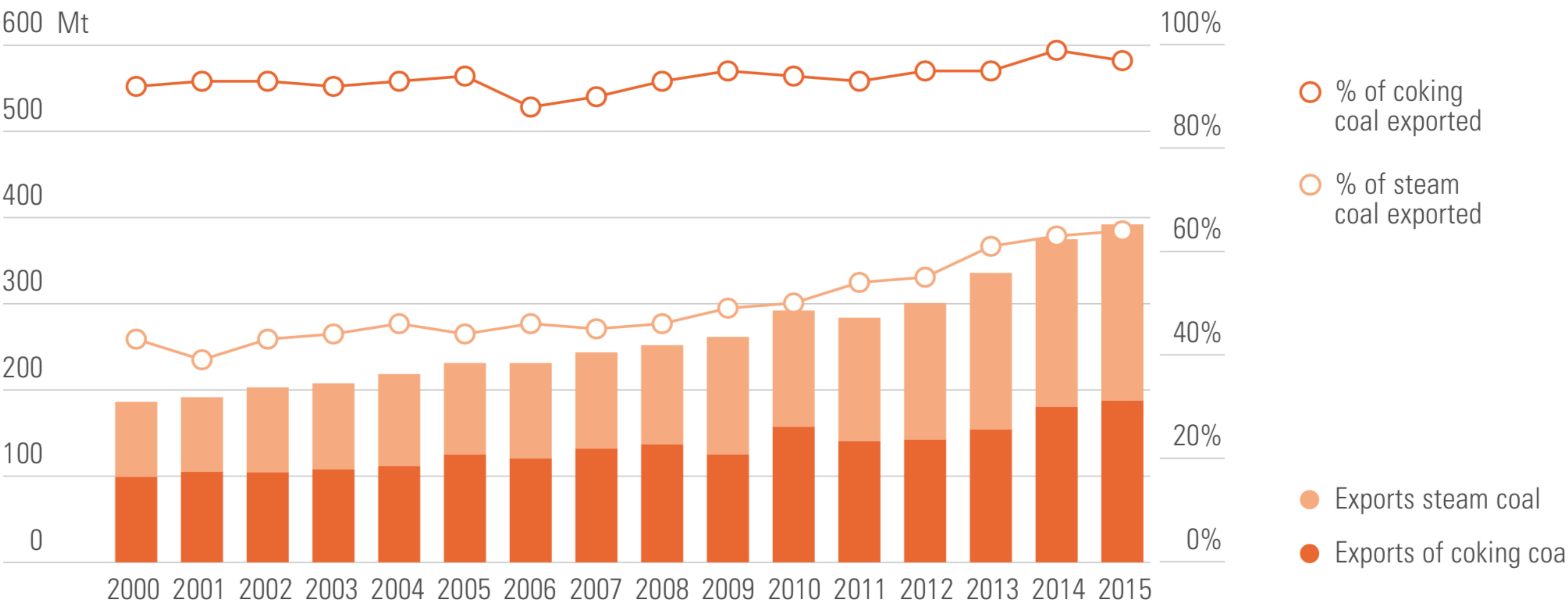
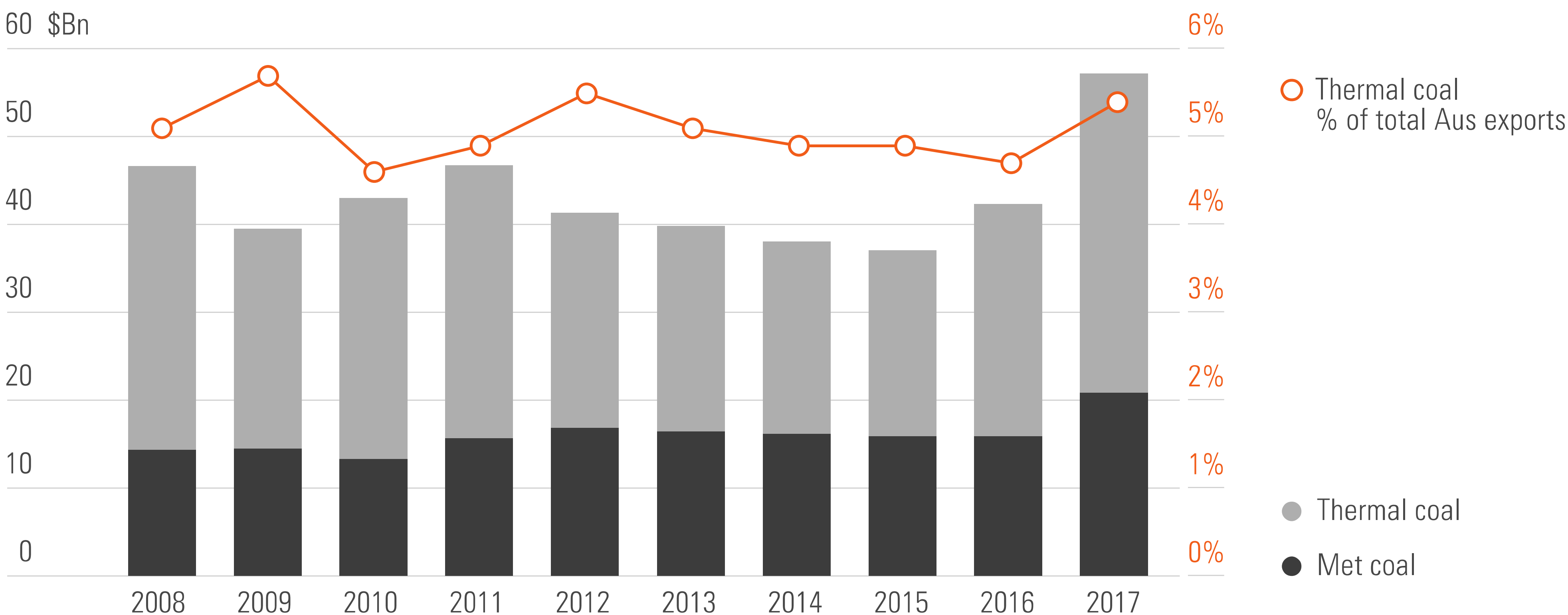


Source: OCE (2016).

Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

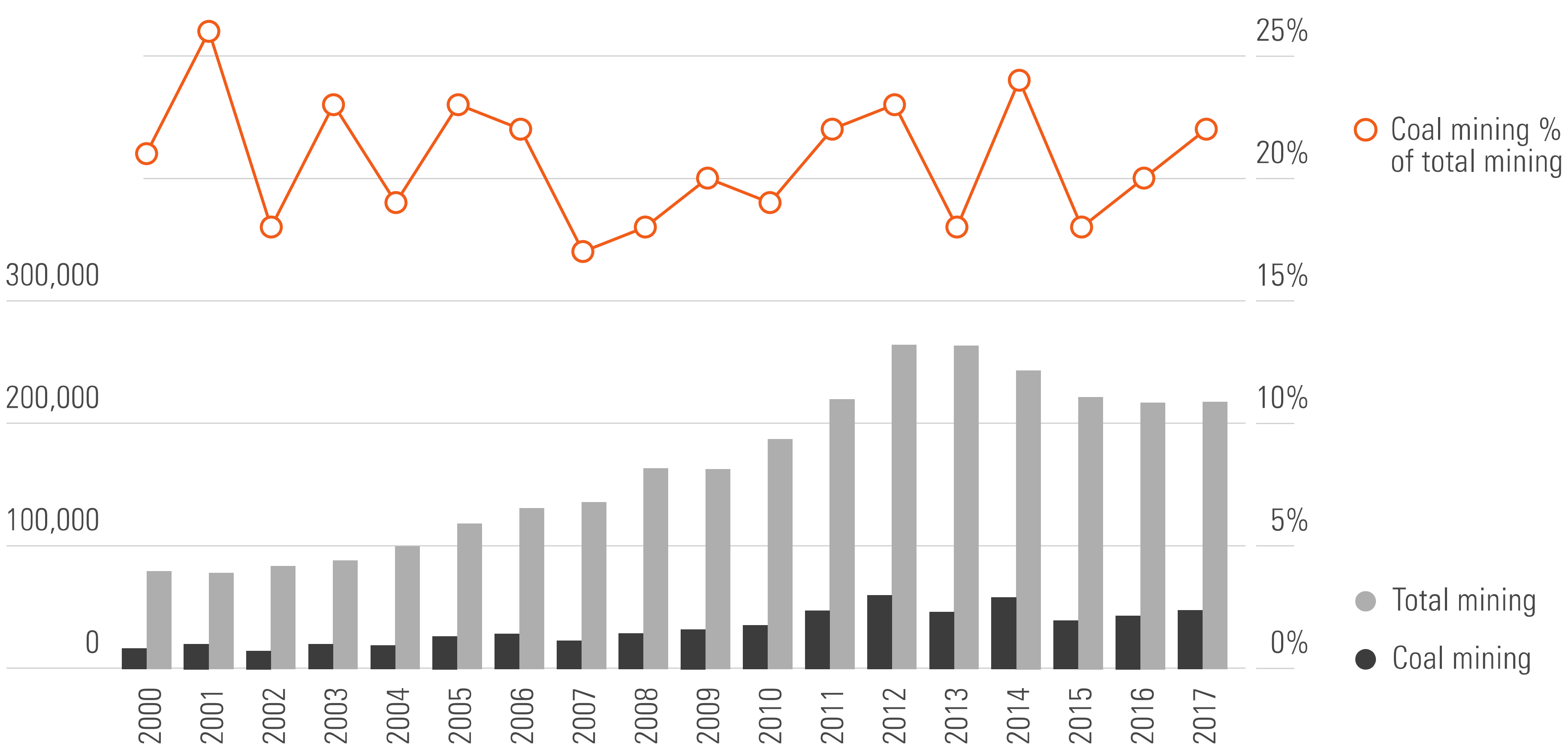
Figure 8. Coal exports and thermal coal as a percentage of all Australian export value (right axis)



Sources: ABS, International Trade in Goods and Services, cat. No. 5368.0 and Department of Industry Innovation and Science, OCE (2017)

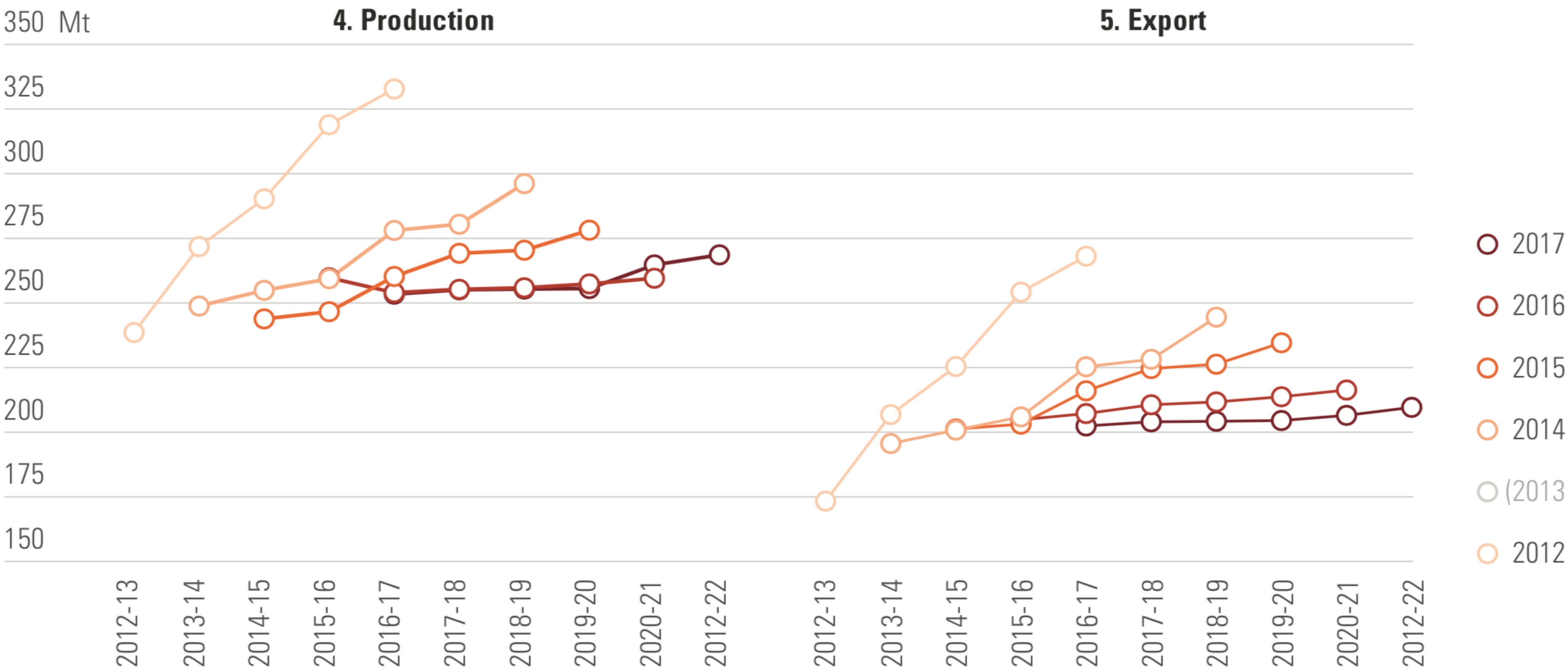
Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Figure 9. Annual coal mining employment as a share of total mining employment and overall employment (right axis)



Sources: ABS, International Trade in Goods and Services, cat. No. 5368.0 and Department of Industry Innovation and Science, OCE (2017).

Figure 4-5. OCE Australian Thermal Coal production outlooks, March quaters, 2012 to 2017



Source: Office of the Chief Economist, Resource and Energy Quarterly, March Quarter forecasts, 2012 to 2017.

Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Large downside risks for thermal coal exports

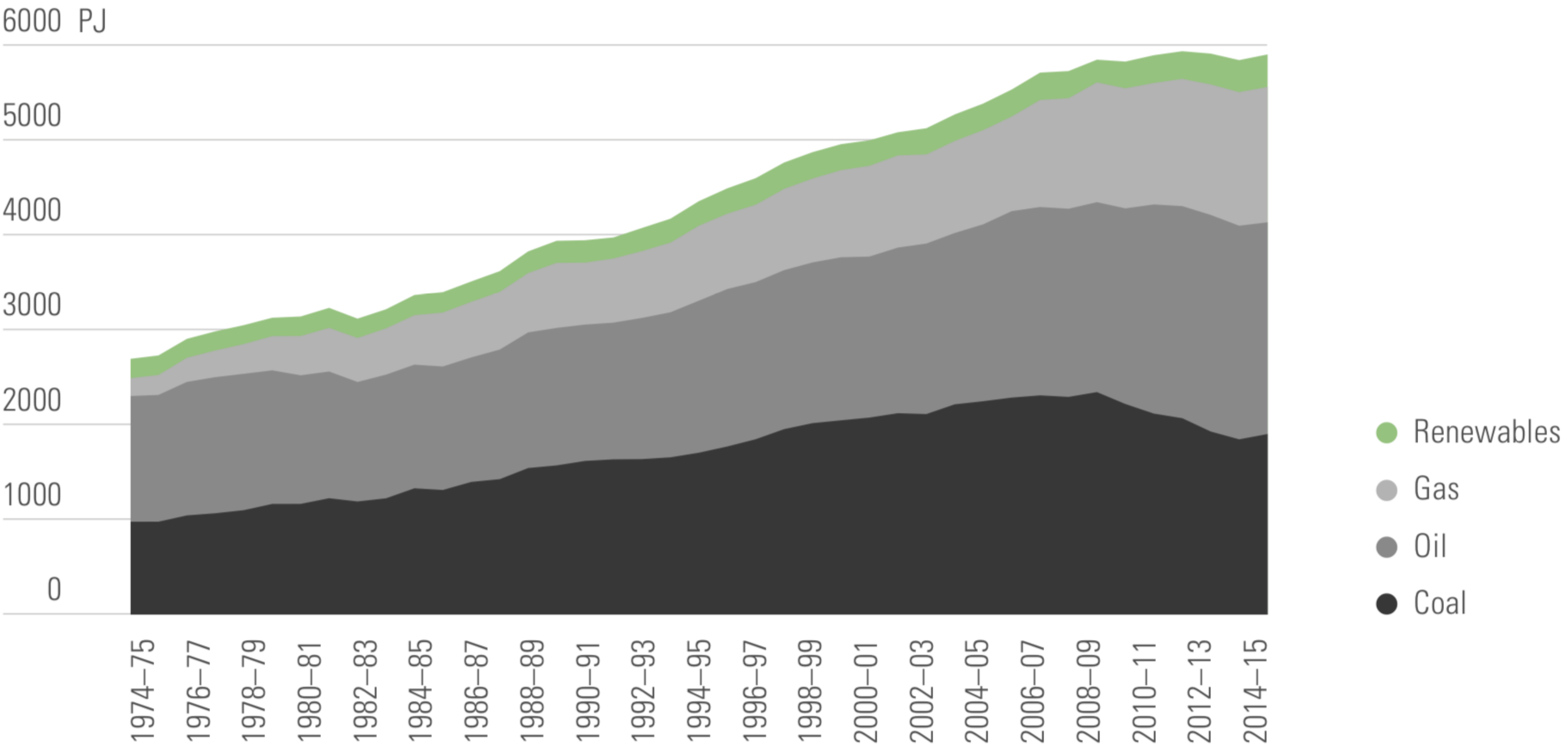
- Coal use globally set to plateau & decline
  - Renewables are increasingly cheaper; CO2; local air pollution concerns
- Imports are the *residual* for key importers incl China, India
  - Govts might favour domestic producers when coal demand falls
- Quality/cost
  - (some of) Australia’s coal is low sulfur, high calorific; but also high cost

Implications for policy

- Do not support/subsidize coal
- Prepare for likely downturn:
  diversify economies, support communities, prepare fiscally

Domestic coal use

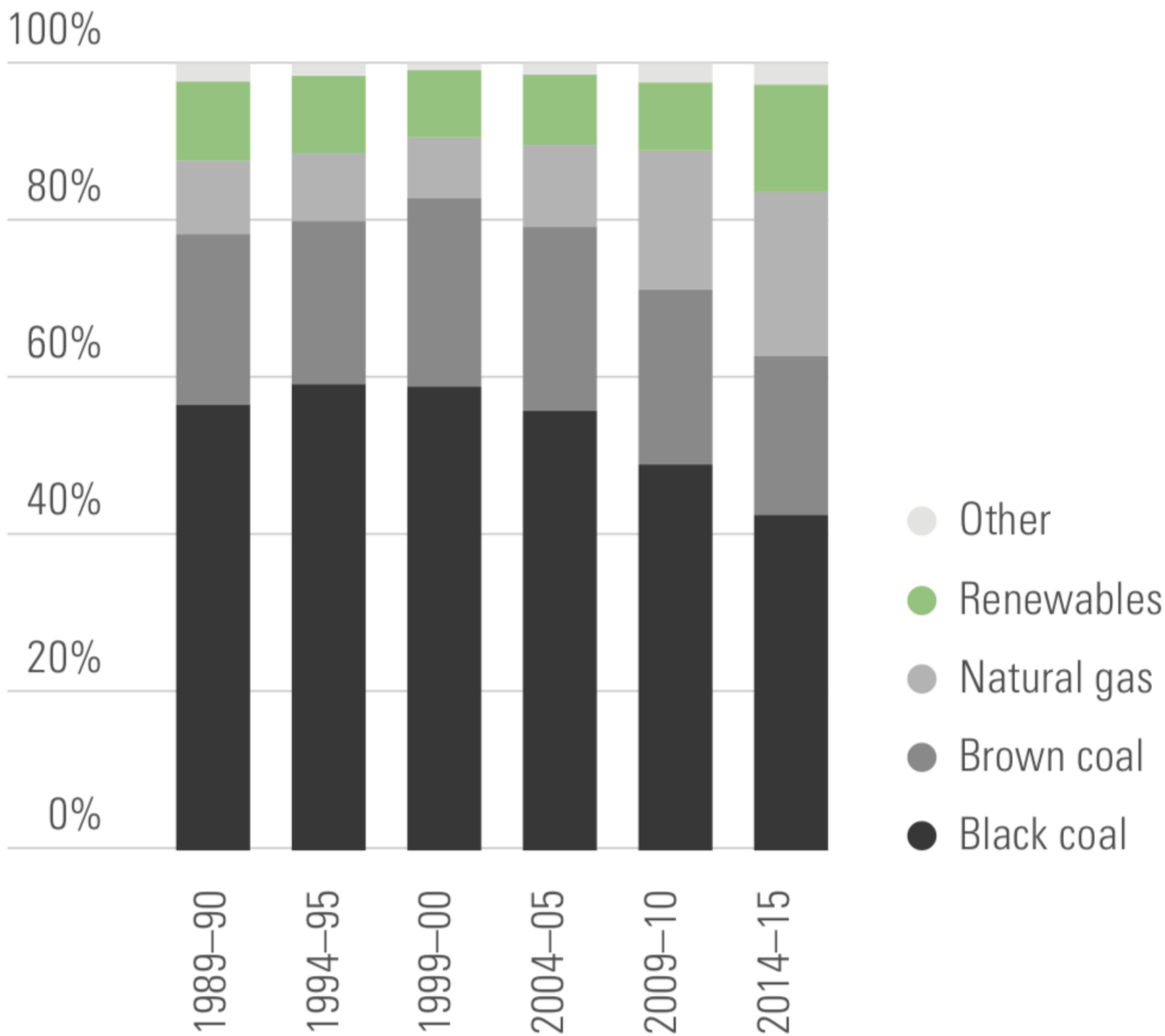
Figure 6. Australian energy consumption by fuel type, FY ending 1975 to 2015



Source: OCE (2016).

Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Figure 7. Australian electricity generation fuel mix



Source: OCE (2016).

Source: Coal Transitions in Australia
(Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Table 1. Australia's remaining coal fired power station fleet in the National Electricity

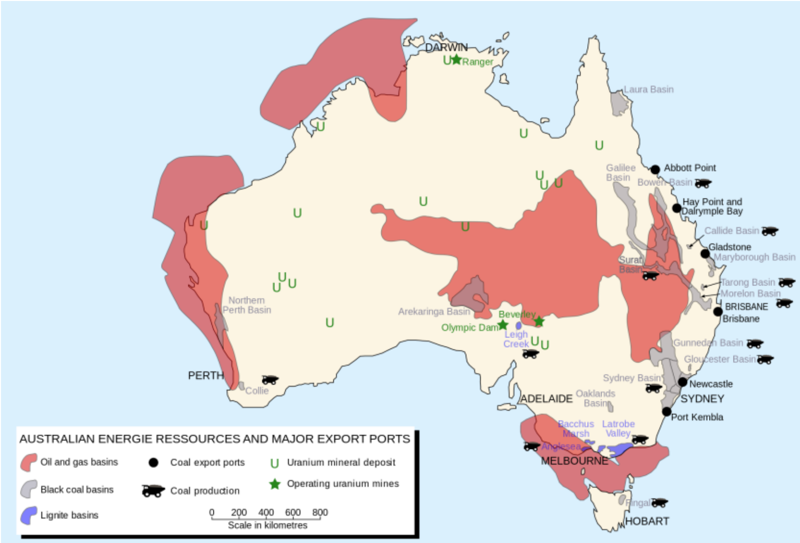
Name	State	Fuel	Comissioned from	Comissioned to	Capacity MW (nameplate)	Age in 2018 from	Age in 2018 to
Liddell	NSW	Black	1971	1973	2,000	45	47
Gladstone (QAL)	QLD	Black	1973	1973	25	45	45
Yabulu (Coal)	QLD	Black	1974	1974	37.5	44	44
Yallourn W	VIC	Brown	1975	1982	1,480	36	43
Gladstone	QLD	Black	1976	1982	1,680	36	42
Vales Point B	NSW	Black	1978	1978	1,320	40	40
Eraring	NSW	Black	1982	1984	2,880	34	36
Bayswater	NSW	Black	1982	1984	2,640	34	36
Tarong	QLD	Black	1984	1986	1,400	32	34
Loy Yang A	VIC	Brown	1984	1987	2,210	31	34
Callide B	QLD	Black	1989	1989	700	29	29
Mt Piper	NSW	Black	1993	1993	1,400	25	25
Stanwell	QLD	Black	1993	1996	1,460	22	25
Loy Yang B	VIC	Brown	1993	1996	1,026	22	25
Callide C	QLD	Black	2001	2001	810	17	17
Millmerran	QLD	Black	2002	2002	851	16	16
Tarong North	QLD	Black	2002	2002	443	16	16
Kogan Creek	QLD	Black	2007	2007	750	11	11

Source: Updated from Australian Energy Council (2016).

Source: Coal Transitions in Australia
(Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Recent coal power plant closures

- Northern (S.Australia), Hazelwood (Victoria)
- Hazelwood (Latrobe Valley)
  - Lignite, 1,600MW, 5% of Australia's electricity, 1.5kgCO2/KWh, commissioned 1964-71
  - Closure announcement Nov 2016, closure March 2017



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Hazelwood closure programs – Latrobe valley

- ~$400m spending by State govt, also federal govt
  - Worker retaining, job-seeking assistance; job creation
  - Local infrastructure, energy efficiency, public service jobs in the area
- Pooled redundancies (worker transfers between the four power plants in the areas)

Table 2. Australia's coal fired power station closures to 2017

			Year commissioned				Age at closure	
Name	State	Fuel	from	to	Year of closure	Capacity (MW)	from	to
Hazelwood	VIC	Brown	1964	1971	2017	1760	46	53
Northern	SA	Brown	1985		2016	546	31	31
Playford	SA	Brown	1960		2016	240	56	56
Anglesea	VIC	Brown	1969		2015	160	46	46
Redbank	NSW	Black	2001		2014	144	13	13
Wallerawang C	NSW	Black	1976	1980	2014	1000	34	38
Morwell	VIC	Brown	1958	1962	2014	189	52	56
Munmorah	NSW	Black	1969		2012	600	43	43
Collinsville	QLD	Black	1968	1998	2012	180	14	44
Swanbank B	QLD	Black	1970	1973	2012	500	39	42

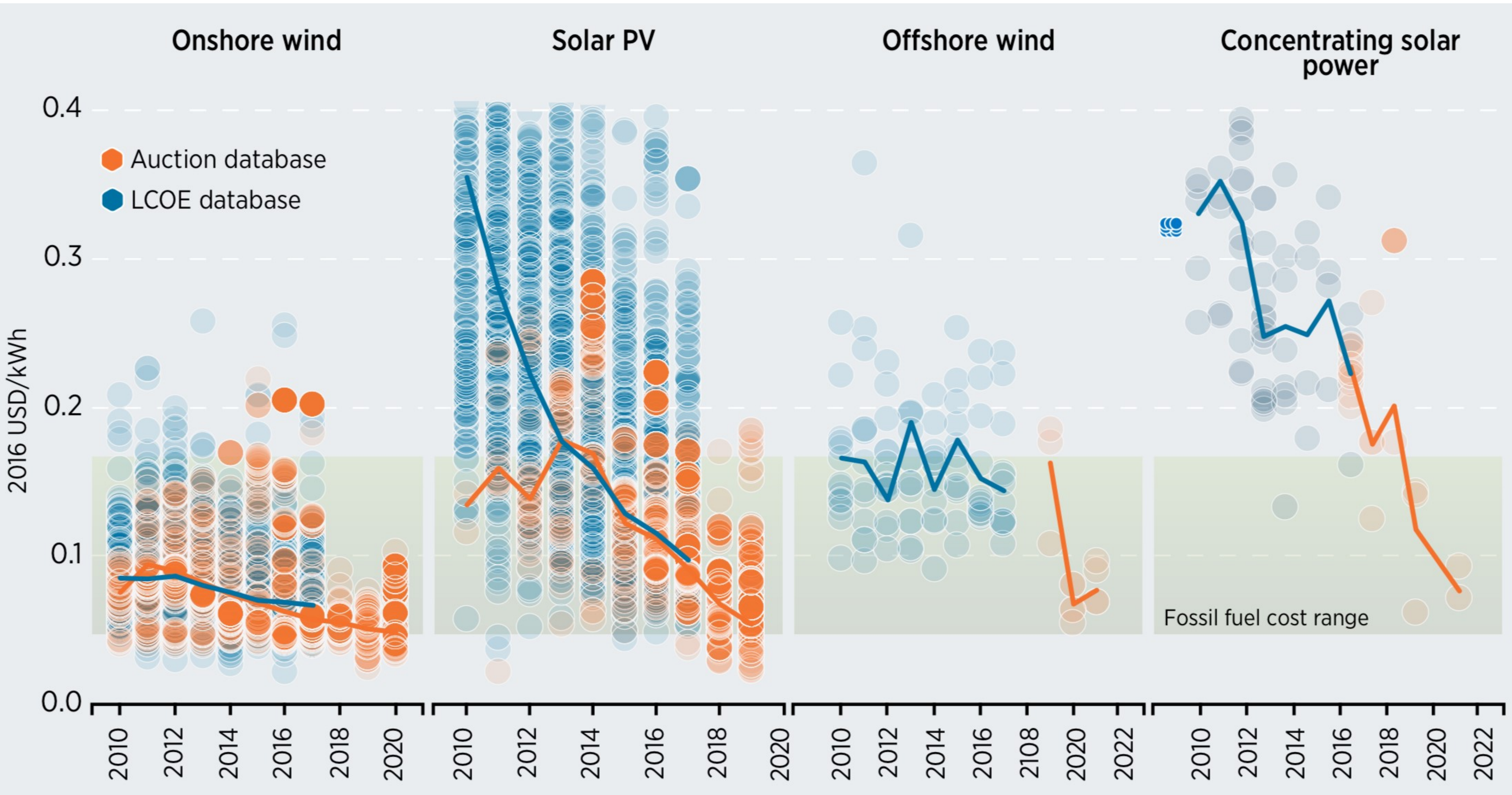
Source: Updated from Australian Energy Council (2016).

Average age at closure:
40 years; 42 years capacity-weighted

Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

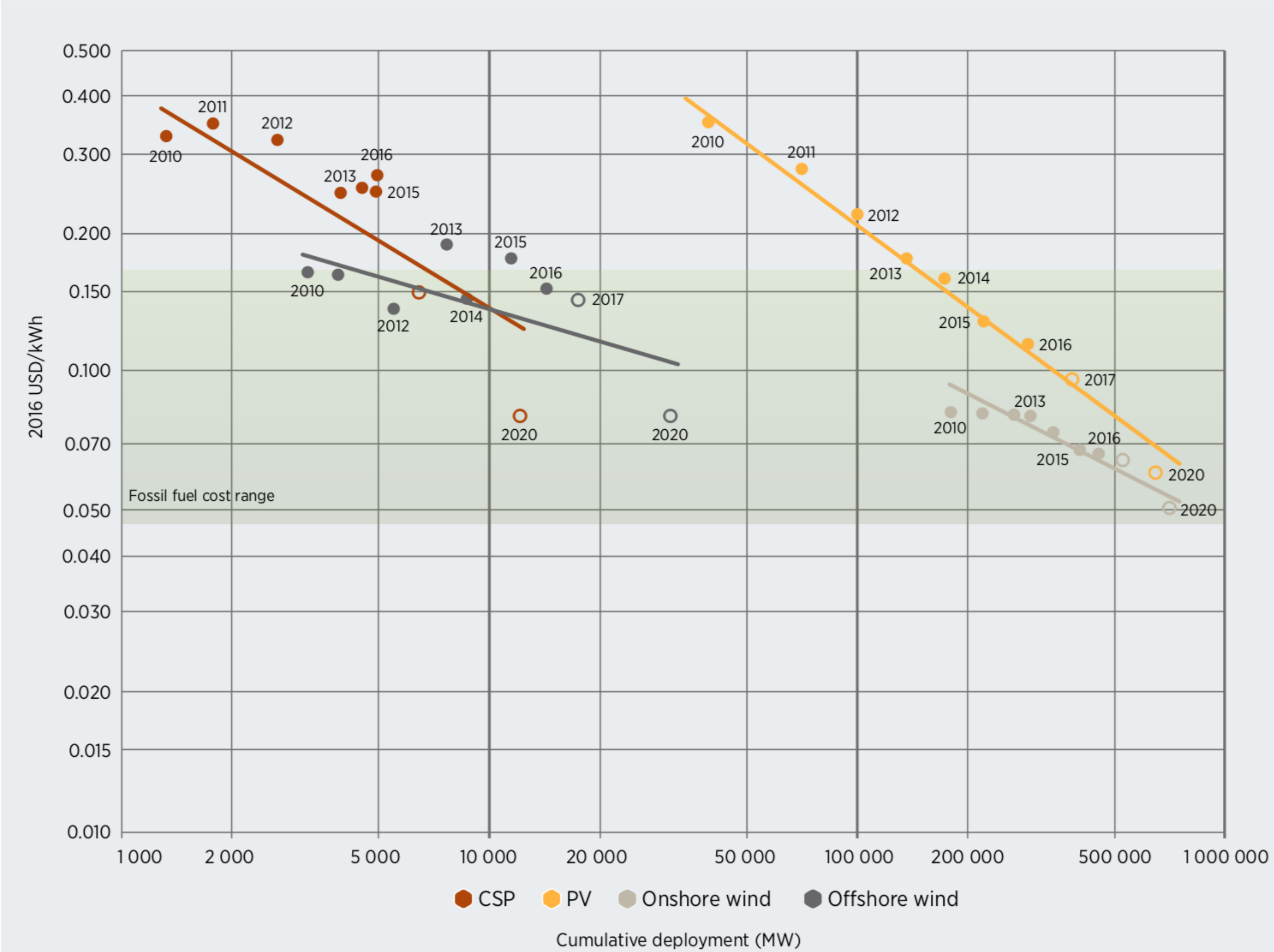
Rapid rise of renewables

- Current project pipeline dominated by renewables
- New (commercial) coal plants are out of the question
  - More expensive than new renewables+firming; carbon risk
  - Large industrial users increasingly invest in own renewables
- New renewables costs are nearing operating costs of some existing coal plants
  - PV A$50-55/MWh in early 2018, was A$135/MWh in 2015
  - Wind a little cheaper still
  - Balancing intermittent REN in high-REN system: perhaps A$20-30/MWh
  - Future PV ~A$20/MWh, total system costs $40-50MWh? (if financing costs can be contained)



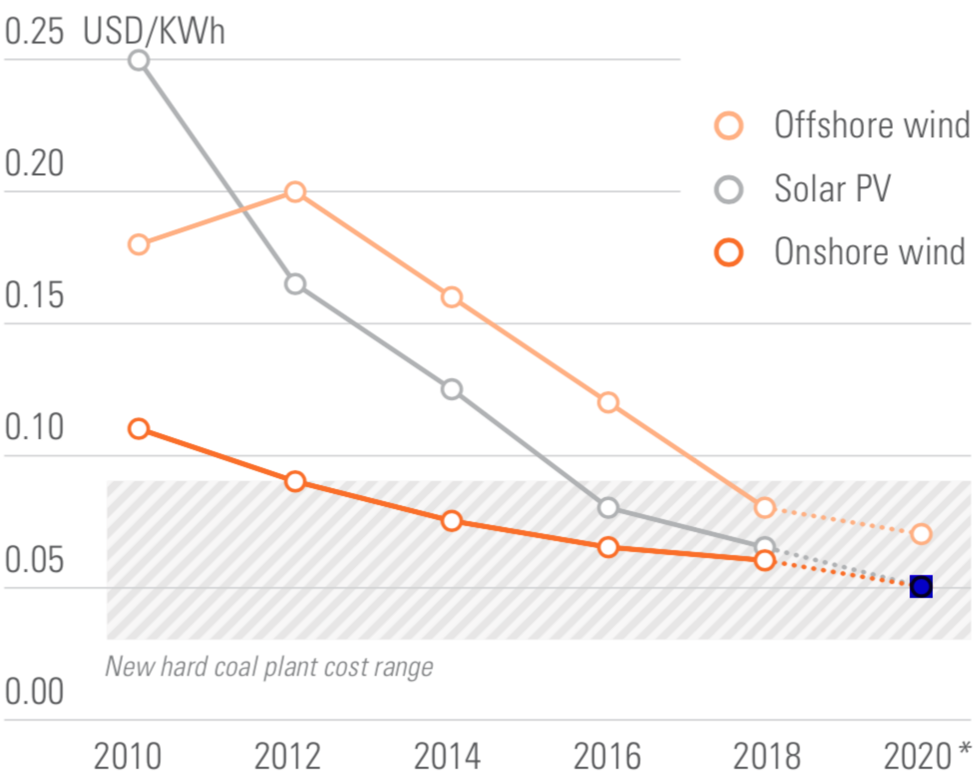
Source: IRENA Renewable Power Generation Costs 2017 report

Figure 2.14 Global weighted average CSP, solar PV, onshore and offshore wind project LCOE data to 2017 and auction price data to 2020, 2010-2020



Source: IRENA Renewable Power Generation Costs 2017 report

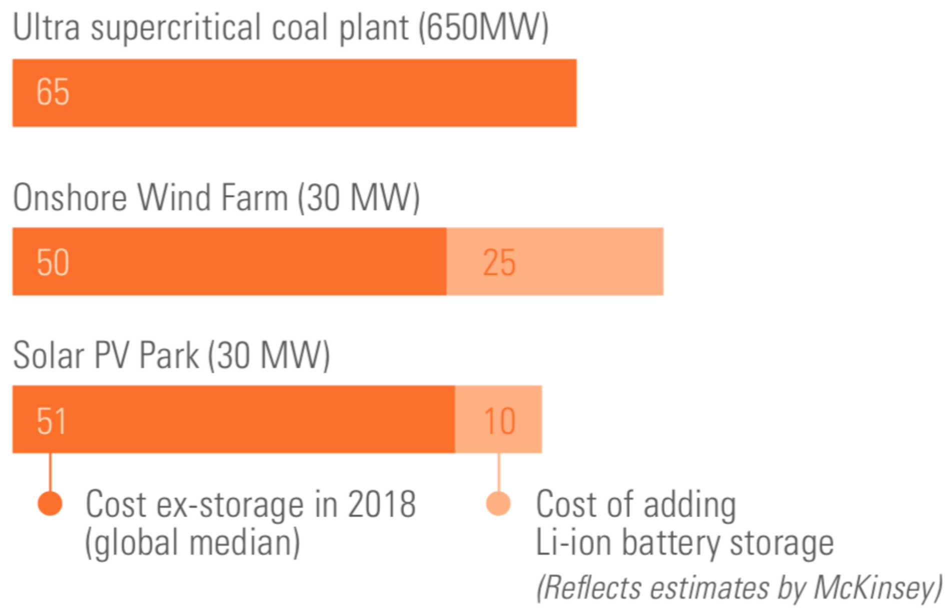
Figure 7. The increasing competitiveness of renewable energy with hard coal technologies (global median auction results)



* forecast

Source: IDDRI, based on data from IRENA, World Coal Association.

Figure 8. Current cost estimates of supercritical coal *vs* cost of onshore wind and solar PV with Li-ion battery use as capacity firming

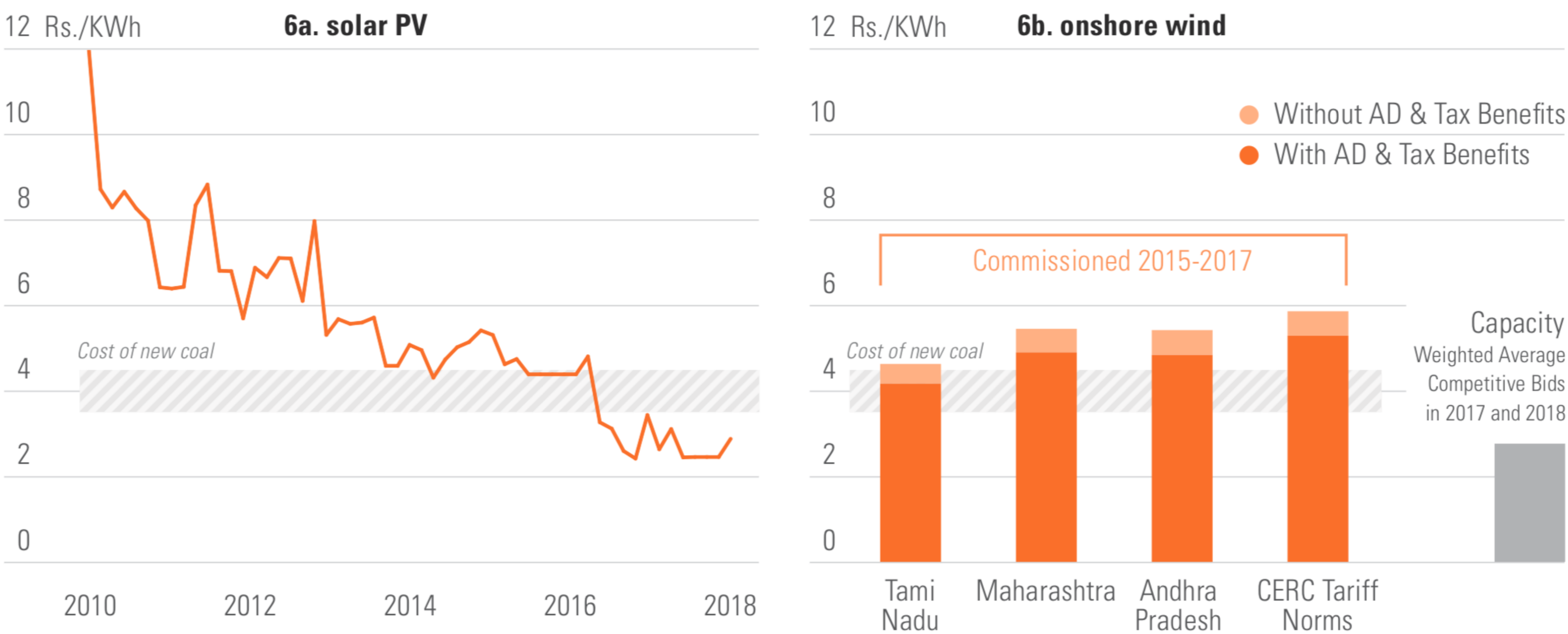


NB. Figures reflect global averages for auctions for different installation sizes and not necessarily represent local costs in all locations, which can be significantly lower (or higher).

Source: IDDRI based on data from IRENA, 2018; McKinsey, 2018.

Source: Implementing coal transitions: Insights from case studies of major coal-consuming economies (Sartor) 2018, coaltransitions.org

Figure 6. Renewables costs versus new coal in India (Levelised cost, Rs/Kwh)



Source: Coal Transitons, based on tariff orders from CERC and SERCs and results of competitive bidding

Source: Implementing coal transitions: Insights from case studies of major coal-consuming economies (Sartor) 2018, coaltransitions.org

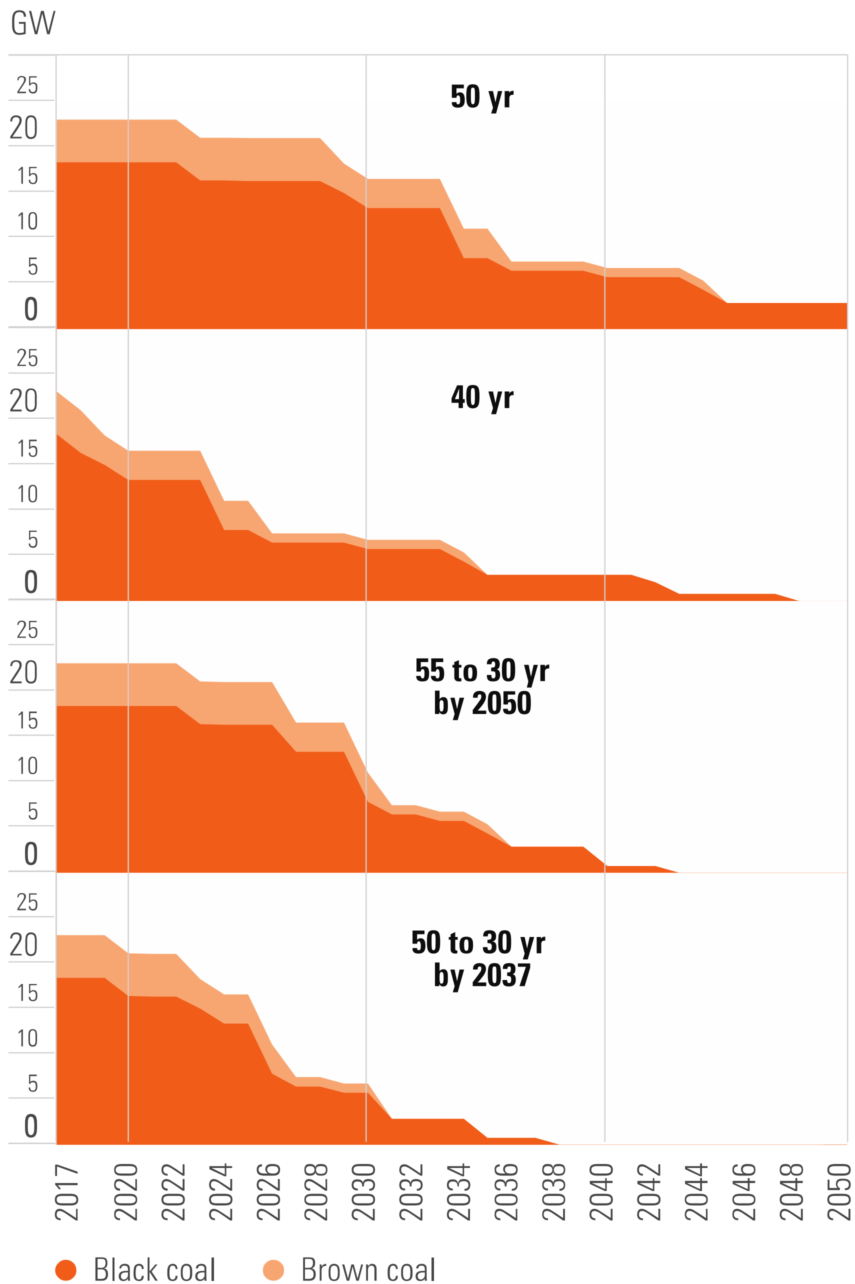
Deteriorating economics of coal plants

- Less capacity utilisation
  - Wind, solar dispatched first
- Lower prices
  - New capacity additions at zero marginal cost mean lower wholesale prices
- More ramping
  - Peakier residual demand requires more load following, more stress on equipment

→ Earlier retirements

→ Retirements will tend to occur at short notice when major repairs become necessary

Figure 10. Brown and black coal capacity remaining with different age based coal retirement trajectories



Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Figure 11. Moderate scenario: Coal fired capacity in the Australian National Electricity Market

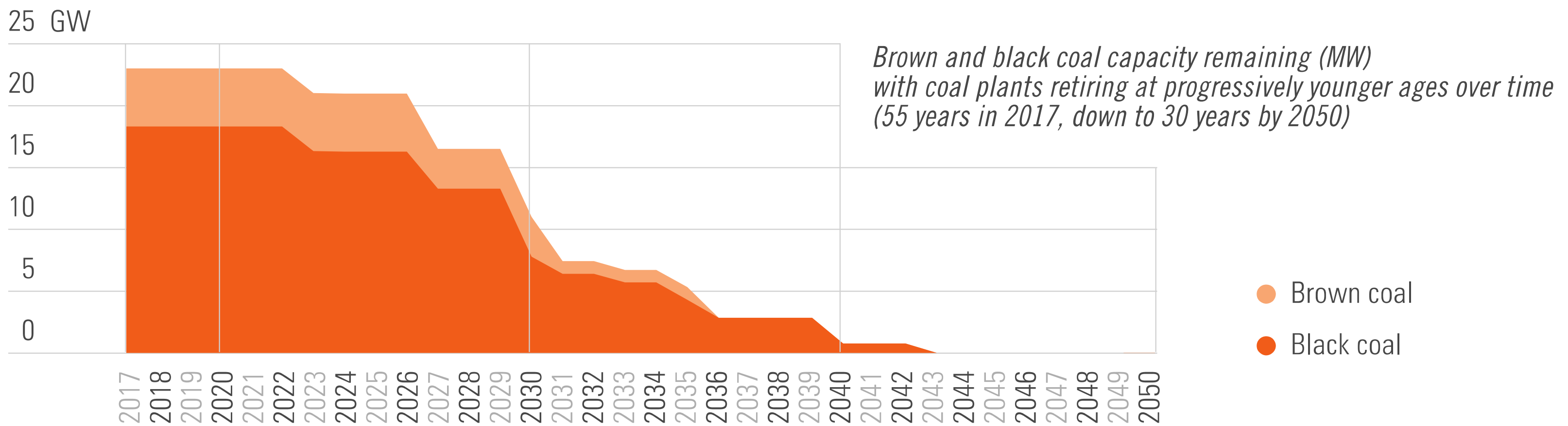
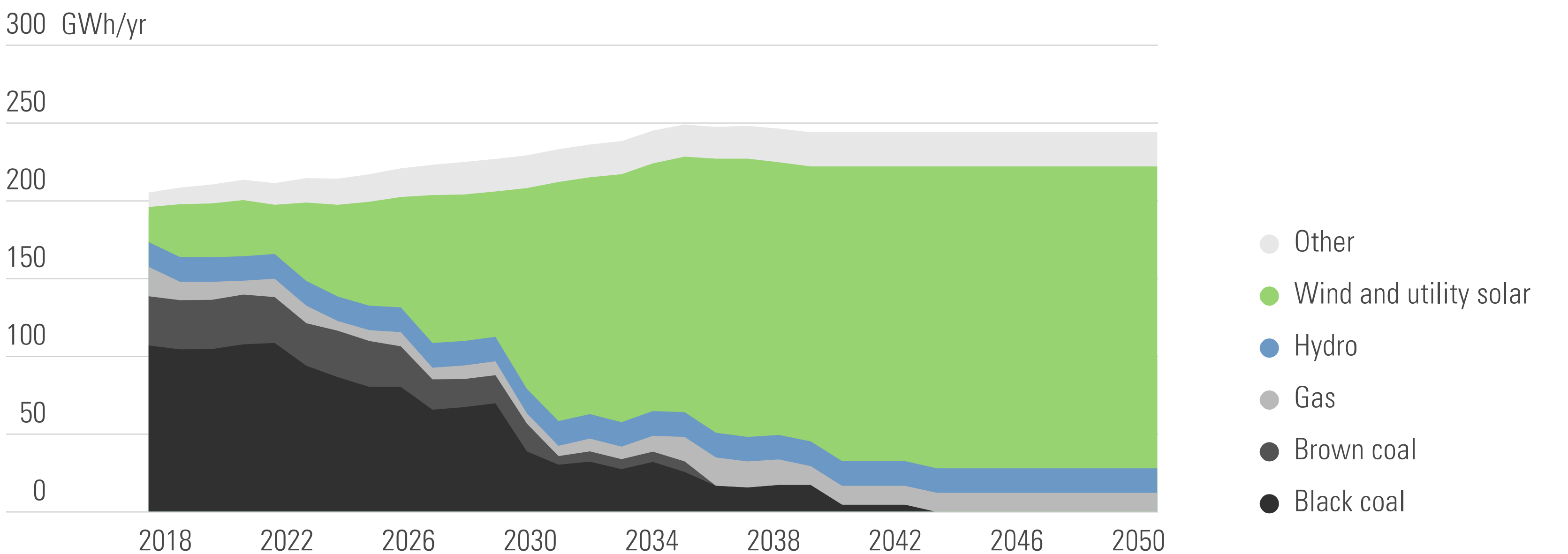


Figure 12. Electricity generation in the Moderate Scenario by generation type

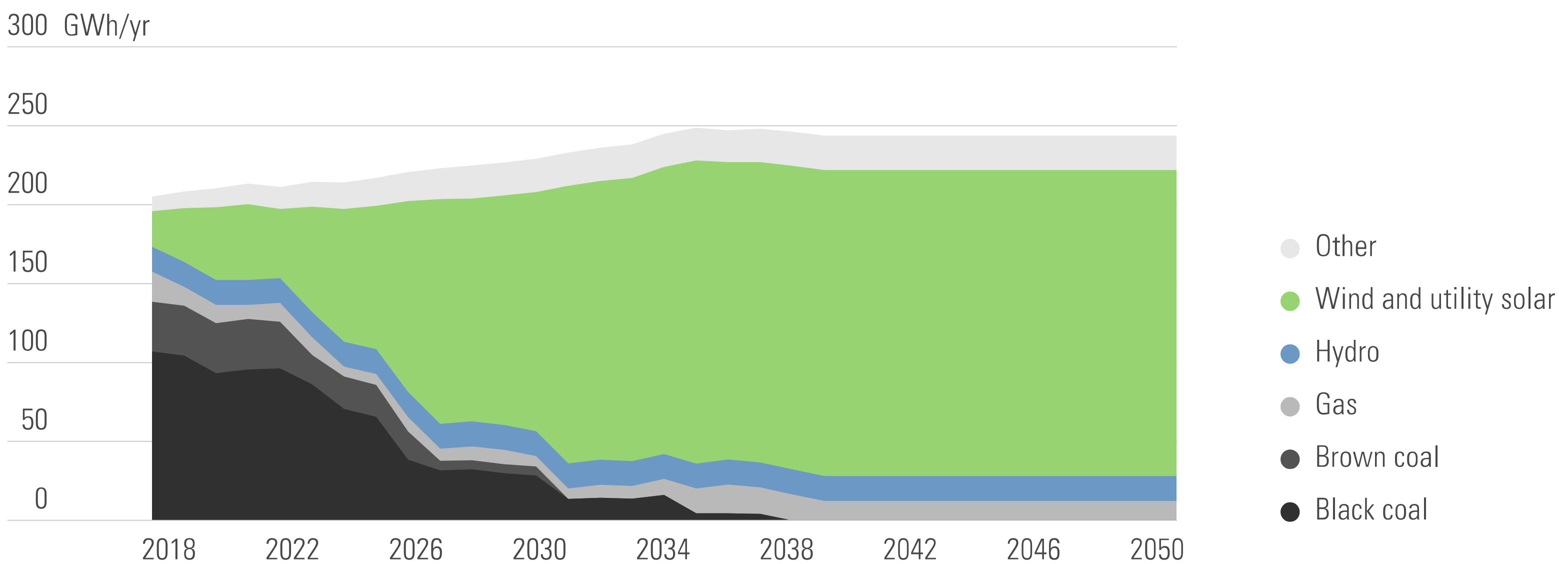


Note: We do not attempt to estimate the mix of wind and solar generation in this scenario which is focussed on coal transition. Renewables other than wind and solar may become commercial over the modelling horizon, and as such, the generation labelled wind and utility solar should be interpreted as a proxy for future renewables. "Other" includes rooftop solar PV.

Source: Crawford School of Public Policy, ANU.

Source: Coal Transitions in Australia
(Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

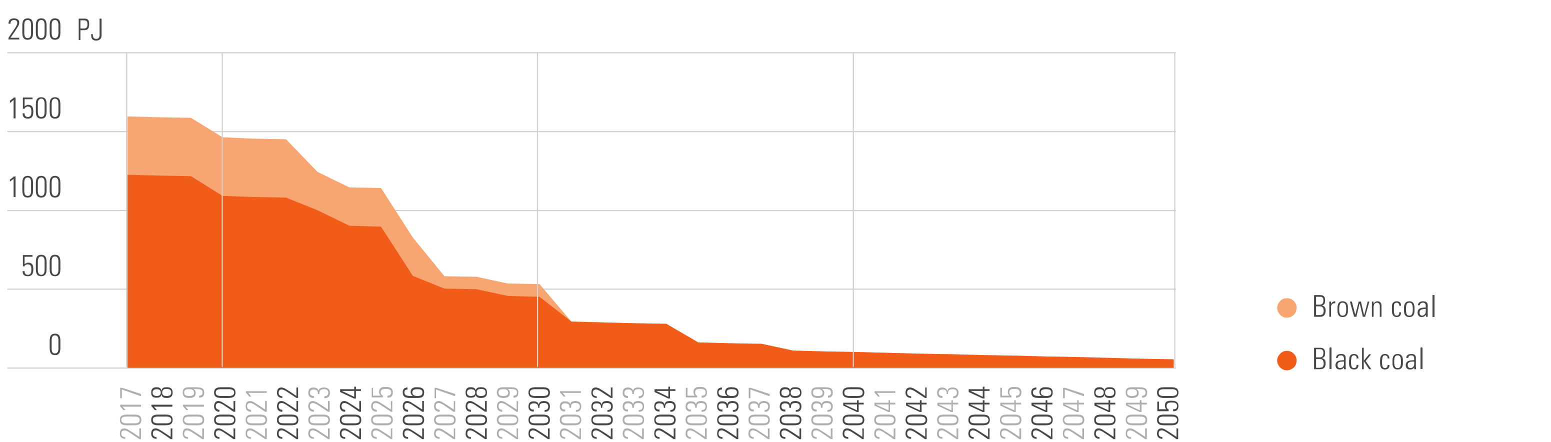
Figure 15. Electricity generation in the Fast Scenario by generation type



Note: We do not attempt to estimate the mix of wind and solar generation in this scenario which is focussed on coal transition. Renewables other than wind and solar may become commercial over the modelling horizon, and as such, the generation labelled wind and utility solar should be interpreted as a proxy for future renewables. "Other" includes rooftop solar PV.

Source: Crawford School of Public Policy, ANU.

Figure 16. Australian thermal coal consumption (PJ), Faster Scenario



Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

Table 3. Selected data from scenarios

Coal capacity remaining, GW

	2020	2025	2030	2040	2050
Moderate	23113	21050	11050	750	0
Faster	21,113	16,570	6,740	0	0

Coal generation (NEM), % of total

	2020	2025	2030	2040	2050
Moderate	65%	48%	15%	2%	0%
Faster	60%	26%	6%	0%	0%

Thermal coal demand, PJ

	2020	2025	2030	2040	2050
Moderate	1659	1355	747	142	53
Faster	1,470	1,059	454	43	0

Emissions from coal use, $MtCO_2$

	2020	2025	2030	2040	2050
Moderate	176	162	95	18	10
Faster	163	128	59	10	5

Source: Coal Transitions in Australia (Jotzo, Mazouz and Wiseman for IDDRI/CS) 2018, coaltransitions.org

CO2 emissions reductions

National emissions reductions required under Paris NDC, 2030 cf 2017: ~150MtCO2-e

Our scenarios, reductions in coal emissions 2030 cf 2017: ~85-140MtCO2

Transitions can be rapid

Roles for policy

- Stable, predictable policy for carbon
  - to guide transition & lower financing costs
- Mechanism for greater predictability of coal power exit
  - Timely replacement investment, avoid price spikes & reliability concerns
  - More time to prepare local economies/communities
- Communities
  - Anticipating & building consensus
  - Economic diversification
  - social and community support, ideally in collaboration with industry
- Market and regulatory settings to facilitate new investment
  - Storage (PHS, batteries; hydrogen?); frequency control etc
  - Transmission infra, decentralized energy resources, demand response

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