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Frank Jotzo
Associate Professor
The Australian National University
Deputy Director,
Crawford School of Public Policy
Director,
Centre for Climate Economics and Policy
+61 2 61254367 frank.jotzo@anu.edu.au
Canberra ACT 0200 Australia

Commonwealth of Australia, The Senate
Environment and Communications References
Committee

Submission to inquiry into the retirement of coal fired power stations

I welcome the opportunity to share insights from our analysis on retirement of coal-fired power stations.

This submission focuses on policy mechanisms to encourage the retirement of coal-fired power stations from the National Electricity Market, including measures to support structural adjustment in the affected regions, and the potential role of federal government.

The submission draws on recent and ongoing research that I have led or been involved in, in particular earlier work on deep decarbonisation (with ClimateWorks Australia, as part of a global collaboration); a proposal for a mechanism for exit of brown coal fired power stations (with Mr Salim Mazouz); and a new research project on coal transitions (with Prof John Wiseman, and as part of an international consortium).

A brief summary of this submission:

1. Replacing coal-fired power with carbon-free alternatives is essential to help decarbonize the economy. Australia's ageing coal fired power fleet can be replaced by a predominantly renewable power supply.
2. Policy mechanisms at the federal level are needed to facilitate a timely transition, to promote investor confidence, and to minimize economic and social disruption in the transition. A price on carbon emissions is the best primary policy instrument, eg in the form of emissions trading or as a baseline-and-credit scheme in the power sector.
3. To achieve orderly transition in the power sector, additional policies to facilitate exit of high emissions power stations may be needed. These may include a market mechanism for closure, regulated closure with flexibility, and industry compacts. Funding to support structural adjustment in affected regions can ease the transition.
4. Research is needed to fully understand the options available to Australia and to inform policy processes.

Attachments:

- Submission text
- Jotzo, F. and Mazouz, S. (2015), Brown coal exit: a market mechanism for regulated closure of highly emissions intensive power stations. *Economic Analysis and Policy* 48: 71-81.
- Coal Transitions project summary

Sincerely,

Frank Jotzo

Commonwealth of Australia
The Senate Environment and Communications References Committee

Submission to inquiry into the retirement of coal fired power stations

Frank Jotzo, Crawford School of Public Policy, The Australian National University

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1. Opportunities for low-carbon transition in Australia's power sector

Replacing coal-fired power with carbon-free alternatives is one of Australia's most important options to reduce greenhouse gas emissions, and it can be done predominantly through renewable power.

Australia's electricity sector is dominated by coal fired power, on the whole using relatively old and inefficient plants. As a result, the emissions intensity of Australia's electricity supply is very high in international comparison.[1]

This presents a significant opportunity to reduce Australia's carbon footprint. Australia's power station fleet is ageing and will need to be replaced over coming decades. The abundance of renewable energy resources in Australia readily allows the transition to a power system built on renewable energy, with electricity storage to manage variability and potentially some use of natural gas (possibly with carbon capture and storage).

Deep decarbonisation pathways

Achieving a low-emissions economy requires a low-carbon or zero-carbon electricity system. As shown in the Deep Decarbonisation Pathways Project, other pillars of decarbonisation are electrification of transport and energy use in buildings and industry, with greater energy efficiency, as well as emissions savings in industry and agriculture and carbon sequestration on the land (Denis, Jotzo et al 2014)[2].

Various analyses have shown the viability of an electricity system based on renewables in Australia. Modelling prepared by the CSIRO for the Australian Deep Decarbonisation Pathways report[3] shows a scenario where electricity supply transitions to renewables during the 2020s and 2030s and is carbon-free by 2050, while electricity demand increases substantially to accommodate electrification and economic growth (Figure 1).

The energy mix in coming decades under a low-emissions trajectory is subject to assumptions about technological development and the evolution of technology costs, however there is high confidence that some form of renewables would be the mainstay of a cost-effective low-carbon system in Australia.

The overall average costs of power supply in this scenario increase over time relative to today's wholesale prices. However the increase is compensated for by greatly improved energy efficiency. Electricity costs as a share of national income decline over time even with rapid decarbonisation.

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[1] In 2014, Australia's electricity generators emitted on average 735 grams of carbon dioxide per kilowatt-hour of electricity, compared to 681 gCO2/kWh in China, and between 400-500 gCO2/kWh in

[2] Denis, A., Jotzo, F., Ferraro, S., Jones, A., Kautto, N., Kelly, R., Skarbek, A. and Thwaites, J. (2014), *Pathways to deep decarbonisation in 2050: how Australia can prosper in a low carbon world*, ClimateWorks/ANU.

[3] Graham, P. and Hatfield-Dodds, S. (2014), Electricity sector, in *Pathways to deep decarbonisation in 2050: how Australia can prosper in a low carbon world – Technical Report*, ClimateWorks/ANU.

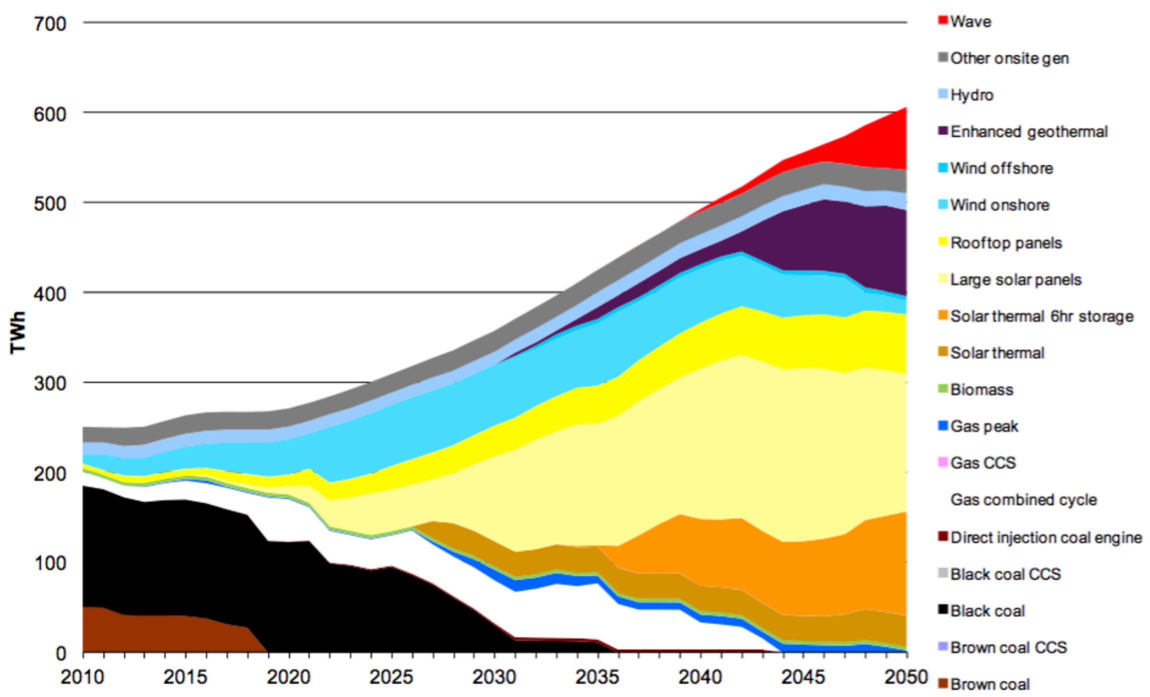
Coal phase-out

In this scenario, black coal fired electricity is largely phased out by the early 2030s, while the more emissions intensive brown coal fired plants are all closed by 2020.

The very rapid phase-out of coal (and in particular brown coal) fired plants is because the deep decarbonisation scenario is compatible with the Climate Change Authority's two-degree carbon budget for Australia. This requires emissions not only to be reduced by a certain percentage at a certain date (eg to meet emissions reductions targets at 2030) but to limit cumulative emissions over time. Therefore early emissions savings are as important as those occurring later on. Overall national emissions in the deep decarbonisation scenario are reduced to net zero by 2050, with the help of significant amounts of land-based carbon sequestration.

Figure 1: Australia's electricity supply in the deep decarbonisation scenario

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



Source: Graham and Hatfield-Dodds 2014.

2. Policy mechanisms to drive a low carbon transition

Policy mechanisms at the federal level are needed to facilitate a timely transition, to promote investor confidence, and to minimize economic and social disruption in the transition.

Australia's energy sector has been exposed to significant investment uncertainty due to pervasive policy uncertainty and climate policy reversals for over a decade. Such uncertainty has detrimental effects on the investment climate and potentially on the cost effectiveness of investment (Jotzo, Jordan and Fabian 2012)[4]. For an effective and efficient low-carbon transition, stable and predictable policy settings are needed.

Carbon pricing

The consensus in the global economics literature and policy analysis is that a price on carbon emissions is the best primary policy instrument to achieve this, coupled with ancillary policy approaches such as standards and regulation, and state support for R&D. Carbon pricing can take different forms, eg a carbon tax, economy-wide emissions trading, or more sector-focussed approaches.

A growing number of countries, now including China, are implementing broad-based emissions trading schemes.

Baseline-and-credit

In the recent Australian policy debate, a baseline-and-credit scheme (or 'emissions intensity scheme') in the power sector has been mooted.[5] Such a scheme would create a price on carbon in the power supply sector. Government would set a baseline (benchmark) emissions intensity for the power sector which declines over time; generators operating above the benchmark would need to cover their excess emissions by purchasing credits from those generators that operate below the benchmark.

The effectiveness of such a scheme depends on the stringency of the policy settings, in particular how quickly the baseline declines and whether emissions credits from other mechanisms can be used in the power sector. A stand-alone baseline-and-credit scheme could be effective in the power sector, provided government underpins the scheme with significant ambition.

However it is less economically efficient than an economy-wide carbon price, for example as it may arise from comprehensive emissions trading. This is because emissions reductions would be achieved at different marginal cost in different sectors of the economy: relatively cheap emissions reductions opportunities go unused in one part of the economy, while relatively expensive options are implemented in another. These considerations for cost-effectiveness should be considered in light of overall effectiveness.

Specifically, a baseline-and-credit scheme for the power sector does not create the same price signal on the demand side as on the supply side, because carbon price pass-through to consumers is suppressed. This means losing incentives for energy efficiency, unless other complementary policy instruments are applied on the demand side.

[4] Jotzo, F., Jordan, T. and Fabian, N. (2012), 'Policy Uncertainty about Australia's Carbon Price: Expert Survey Results and Implications for Investment', *Australian Economic Review* 45(4): 395–409.
[5] Wood, T. and Blowers, D. (2016), *Climate phoenix: A sustainable Australian climate policy*, Grattan Institute; Climate Change Authority (2016), Towards A Climate Policy Toolkit.

3. Policy mechanisms to facilitate orderly exit of high emitting power stations

To achieve orderly transition in the power sector, additional policies to facilitate exit of high emissions power stations may be needed. These may include a market mechanisms for closure, regulated closure with flexibility, and compacts with industry.

There are two reasons why policies geared two support the exit of high emissions intensive power stations may be needed. Firstly, driving the transition through a price instrument alone may stretch the political bounds of a baseline-and-credits scheme, as high prices mean large transfers between different types of electricity generators. An economy-wide ETS meanwhile may operate at lower prices than would be required to effect early phase-out of coal fired power.

Secondly, without additional policy mechanisms there is no provision for power station exit to occur in an orderly, predictable manner. Just as observed in the recent cases of the closure of the Northern power station in South Australia and the announced closure of the Hazelwood station in Victoria, closures of entire stations would likely occur suddenly, typically at the point when major refurbishment becomes necessary.

Sudden exit without system-wide coordination can be suboptimal from a system-wide perspective as it may not provide sufficient time to deploy alternative generating capacity. It also foregoes options to structure closures in a manner that minimizes social adjustment costs, for example by way of pooled redundancies across several plants.

Market mechanism for closure

A market mechanism for closure of emissions intensive power stations was proposed by Jotzo and Mazouz at the end of 2015 (see attachment), to significant interest in Australian energy industry and policy circles.[6]

Under such a mechanism, plants would bid competitively over the payment they require for closure, the regulator chooses the most cost effective bid, and payment for closure is made by the remaining power stations, for example in proportion to their carbon dioxide emissions. Government would need to regulate or legislate to implement the levy on the remaining generators. The remaining power providers would, on average, recoup the payments through higher capacity utilization and to an extent through higher wholesale prices.

The mechanism could overcome adverse incentive effects for plants to stay in operation in anticipation of payment for closure and solve the political difficulties and problems of information asymmetry that plague direct government payments for closure and direct regulation for exit.

A market mechanism with industry funding would also provide a direct source of funding for structural adjustment packages, and for high-level site rehabilitation.

Figure 2: A market mechanism for coal fired power plant closure – simplified representation

[6] Jotzo, F. and Mazouz, S. (2015), Brown coal exit: a market mechanism for regulated closure of highly emissions intensive power stations. *Economic Analysis and Policy* 48: 71-81.

Regulated closure

Orderly exit could also be achieved through regulated closure, for example by placing a cap on operational lifetimes of existing plants, as proposed by the Climate Institute[7]; or by imposing a maximum allowable emissions intensity at generator level, with this level declining over time. Such a scheme would force the exit of individual generators according to a timetable determined by government or a regulating agency.

The lack of flexibility however would increase costs relative to a market solution, as a hard age limit or emissions intensity limit may not result in the cost-effective sequence of closures. Regulated closures could potentially be combined with flexibility options such as trading of operation rights between generators.

Regulated closure in itself would not provide a source of funding for structural adjustment.

Industry compacts

In some other countries, notably Germany, orderly phase-out of industries including coal mining and steel production was achieved through negotiated agreements between industry and governments. Such arrangements may or may not involve taxpayer funded industry assistance. They do require active involvement by governments to help coordinate businesses while avoiding collusive behaviour.

Industry compacts can provide high levels of predictability as closures can be agreed according to a timetable. They allow significant extent of collaboration between businesses, for example through pooled redundancies and re-deployment of younger workers to plants that remain operational.

These upsides need to be weighed against potential excess costs to the economy and the risk of creating excess rents to participants.

Structural adjustment funding

Funding to support structural adjustment in affected regions can ease the transition.

Structural adjustment funds could be established from within the electricity industry, and used to support regional infrastructure, start-up businesses, retraining and worker mobility.

A principle to adhere to in allocating structural adjustment funding is that this should be reserved for activities and investments that go beyond the existing obligations of the owners and operators of power stations, such as retrenchment payments and site rehabilitation.

A levy on generators remaining on the grid to support structural adjustment around plants that leave the system would amount to only relatively minor imposts on the power industry as a whole, and on electricity consumers. In the example given in Jotzo/Mazouz, a fund of $400m to $1b might result in retail electricity price increases in the order of 1-2%, limited to one year.

An industry-financed fund for structural adjustment resulting from coal fired power station exit could be created irrespective of the particular mechanism used to facilitate closure. Indeed it could be established irrespective of whether a closure mechanism is established.

[7] The Climate Institute (2015), A switch in time: Enabling the electricity sector's transition to net zero emissions.

4. Coal Transitions research

The extent research on options to facilitate closure of coal-fired power stations in Australia has been relatively limited, and concentrated on policy mechanisms at the macro scale.

Additional research is needed to fully understand the options and provide input to policy. Areas for improved understanding include

- how policy mechanisms for power station closure would interact with other policy mechanisms, such as baseline-and-credit or the renewable energy target;
- how predictability of exit can be achieved without unduly compromising cost effectiveness, including the potential role for industry compacts;
- what options exist to provide effective support for structural adjustment, and how to raise funds for structural adjustment ideally without relying on public budgets.

Analysis of experiences with industrial transitions in other countries, including past and present coal industry transitions, will help in assessing suitable options for Australia. Lessons can also be drawn from past industrial and resource transitions in Australia.

My current research work includes the role of Chief Investigator for the Australian contribution to a new international project on 'Coal Transitions' (see attachment). On issues of particular interest to the Committee, including transition of coal fired power in the Latrobe Valley, the research work is jointly led by Prof John Wiseman of the University of Melbourne and myself.

This international research project, led by IDDRI and Climate Strategies and in partnership with research teams from China, India, South Africa, Poland and Germany aims to:

- promote deeper understanding amongst relevant national and international stakeholders of the implications of global climate mitigation activities for the future of coal production and consumption;
- support societally acceptable transition away from coal, to marry coal phase out with economic renewal and a just transition in key countries;
- promote knowledge and acceptance of new narratives on the future of coal, enabling conditions, and concrete steps for national coal phase out strategies;
- promote exchange, learning and more coordination on transition policies at the international level.

We will be happy to appraise the members of the Committee and their colleagues on insights that will come from the research.