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28 April 2017

Peggy Danaee
Secretary
Standing Committee on the Environment and Energy
PO Box 6100
Parliament House
Canberra ACT 2600
Via email: moderngrid@aph.gov.au

Dear Peggy,

Submission to The Standing Committee on the Environment and Energy inquiry into Modernising Australia's Electricity Grid

Please find enclosed a submission by the Australian National University Energy Change Institute to The Standing Committee on the Environment and Energy inquiry into Modernising Australia's Electricity Grid.

The ANU Energy Change Institute combines leading research and teaching on the science, engineering, policy, law, sociology and economics of moving to a sustainable and dominantly renewable energy future. The Institute comprises more than 200 staff and PhD students from all 7 Colleges of the University, and over $100 Million in infrastructure and facilities, supported by a major portfolio of external grant funding.

We hope that this submission is useful in informing your inquiry into the future prospects for modernising Australia's electricity grid.

Finally, we would like to thank you for the opportunity to meet with members of the Committee on March 30th. Please contact us at the above address for any queries regarding this submission.

Yours sincerely,

Professor Ken Baldwin,
Energy Change Institute Director

Professor Andrew Blakers,
Research School of Engineering
Energy Change Institute

SUBMISSION TO THE STANDING COMMITTEE ON THE ENVIRONMENT AND ENERGY INQUIRY INTO MODERNISING AUSTRALIA'S ELECTRICITY GRID

BY THE AUSTRALIAN NATIONAL UNIVERSITY ENERGY CHANGE INSTITUTE (ANU ECI) 28 April 2017

Overview

Government policy uncertainty over the last decade has disincentivised investment in the energy sector – and this has pushed up the cost of finance and hence the cost of electricity supply.

What is needed is a bipartisan approach to national energy policy to drive much-needed investments that will fifty years or more, over which time we will see the complete decarbonisation of the economy.

Government energy policy therefore needs to sit within an overarching framework of climate policy, for which the energy sector is the most rapid pathway to decarbonisation.

It is widely recognised by economists in Australia and around the world that the most efficient way to decarbonise is to employ a carbon-pricing mechanism.

The interim report of the Finkel review of the NEM recommended one type of carbon pricing mechanism – an emissions intensity scheme for the energy sector.

This was based on recommendations by the Australian Energy Market Commission, the Australian Energy Market Operator, the Climate Change Authority and almost universally by big business.

Many major corporations – energy generators, manufacturers and financial institutions – now operate their own projected internal price on carbon so they can plan for an inevitable decarbonised future.

Australia may be forced into implementing a carbon pricing mechanism by other countries which will place a price at their borders on Australian imports with a high carbon content.

In addition to carbon pricing, we need to establish much-needed environmental goals in the National Electricity Objectives to achieve decarbonisation.

The energy industry agrees that there is no economic or environmental argument for building a new coal-fired power station in Australia, and the Australian taxpayer should not foot the bill to subsidise one.

Gas will also play a role as a transition fuel, chiefly by helping to meet peak electricity demand.

Increases in Australian gas prices in the short-to-medium term driven by overseas markets will increase the adoption of cheaper renewables such as solar and wind, and will also accelerate electrification to replace domestic and industrial gas use.

As the penetration of renewables increases, there is a need for overcapacity and for storage to address intermittency, and for increased network infrastructure.

Careful attention therefore needs to be paid to smart-grid software, power engineering technologies and strong network interconnection to optimise the integration of renewables with storage, along with demand side response.

A suggested pathway to 100% renewable electricity follows.

Professor Ken Baldwin,
Director, ANU Energy Change Institute

100% renewables pathway

Deployment of wind, solar photovoltaics (PV), pumped hydro energy storage (PHES) and increased high voltage (HV) interconnectors between the states allows the National Electricity Market to reach 100% renewable electricity with high reliability and at zero net cost. Wind and PV will replace retiring coal and gas plant at lower cost than the alternative replacement (new coal and gas).

1. Wind and PV constitutes nearly all new generation capacity in Australia, and half the world's new generation capacity (equal to the combined amount of coal, oil, gas, nuclear, hydro and all others)
2. Pumped hydro energy storage (PHES)* constitutes 97% of worldwide energy storage.
3. Wind, PV, PHES and HV interconnectors combine to ensure affordable grid stability.
4. The cost of both wind and PV continues to fall rapidly. There is no end in sight to cost reductions.
5. According to our studies, the cost of electricity ($/Megawatt-hour) from single new-build generators is approximately:

Wind	$65/MWh (in 2016) falling to $50/MWh (2020s)
Solar PV	$79/MWh (in 2016) falling to $50/MWh (2020s)
Supercritical black coal	$66/MWh
Gas	$78/MWh

6. We have modeled the cost of electricity in a 100% renewable electricity system (90% wind and PV plus existing hydro and bio). The cost includes not just the wind and PV, but also pumped hydro storage and high voltage interconnectors between states.
7. At 2016 prices the whole-system cost is $93/MWh. At 2020s prices the cost is $75/MWh.
8. About two thirds of Australia's fossil fuel generators will reach the end of their technical lifetimes by 2036, and will need to be replaced.
9. Wind and PV, supported by HV interconnectors and PHES, will be decisively cheaper in the 2020s than new coal and gas.
10. PHES offers ancillary services including high-inertia, fast-ramping and synchronous capacity for frequency and voltage support.
11. Wide distribution of wind and PV over a million square kilometres to access different weather, coupled with increased HV interconnection and PHES, confers high reliability at modest cost.
12. Any desired degree of grid stability can be achieved at modest cost by adding more off-river PHES at multiple locations (and/or demand management).
13. Rooftop PV will continue to expand as costs continue to reduce.
14. Several thousand people will be employed during 2017 and 2018, and beyond, constructing several gigawatts (GW) of new ground mounted PV, and several more GW of wind, in regional areas.
15. What needs to be done?
    a. Provide a clear retirement schedule for existing coal and gas power stations to allow for smooth uptake of PV and wind. This retirement schedule should be consistent with the national emissions reduction target. Retirement could be accomplished through carbon pricing, an emissions intensity scheme or similar.
    b. Commence planning for large scale construction of PHES and HV systems in the 2020s
    c. Encourage large scale uptake of electric vehicles and electric heat pumps (for low temperature space and water heating).

* PHES can provide effectively unlimited storage at modest cost, even in dry states such as South Australia. There are hundreds of potential sites outside national parks in all states. Pairs of reservoirs, typically 10 hectares each, are separated by an altitude difference of between 300 and 700 metres, in hilly terrain or ex-mines outside national parks and away from rivers, and joined by a pipe with a pump/turbine. Water circulates between the upper and lower reservoirs in a closed loop to store and generate power. Very little water is required relative to conventional fossil fuel power stations. Existing hydro systems can be fitted with more tunnels, generators and pumps to accomplish the same task.

Professor Andrew Blakers
Research School of Engineering, ANU