NUCLEAR FOR CLIMATE AUSTRALIA

Full Decarbonisation of NSW Electricity 10th October, 2020

The $32 billion renewables plan for NSW announced by Energy Minister Matt Kean would, if implemented, consign our state to high power prices with only a modest reduction in carbon emissions. If directed to nuclear energy it would fully decarbonise the NSW grid and provide low cost, reliable energy 24/7.

The NSW Energy and Environment Minister is proposing to:

- Assist the private sector in developing 12 gigawatts (GW) of VRE (variable renewable energy) and 2 GW of pumped storage.
- Provide out of market assistance to VRE in the form of floor prices on energy, land leasing assistance, power purchase guarantees and subsidies to pumped storage projects.
- Facilitate the delivery of 12 Gigawatts of VRE and 2 GW of pumped storage.

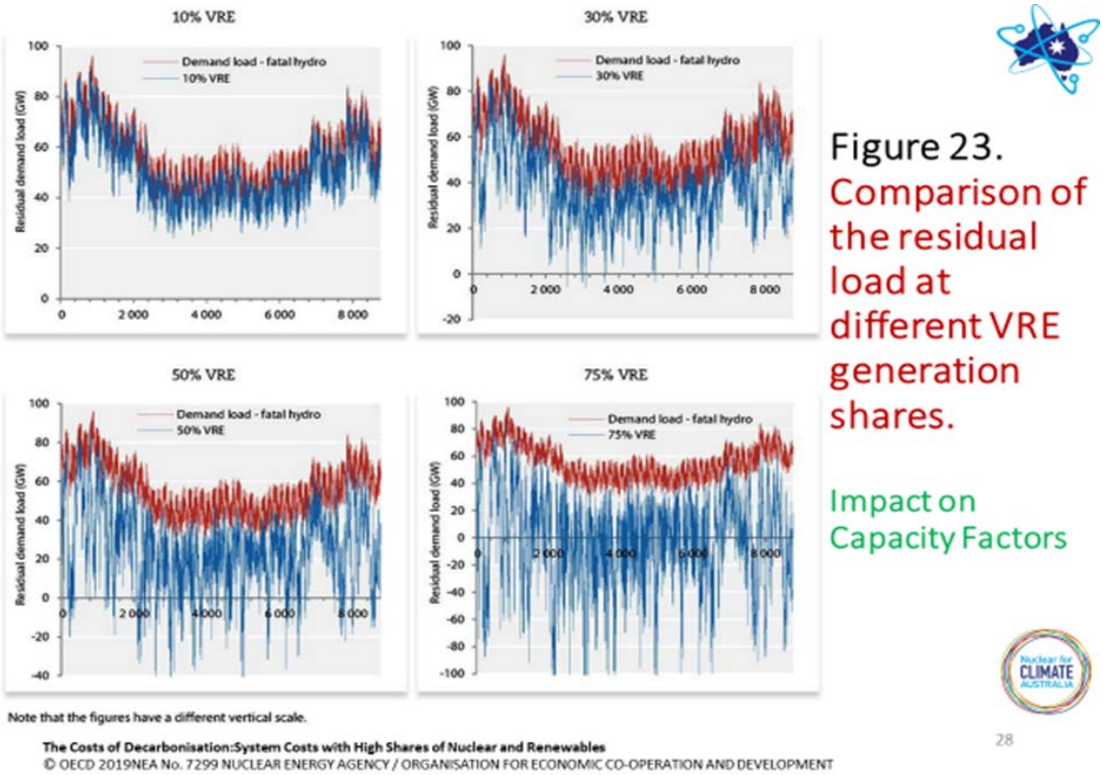


Figure 1 - Comparison of residual load at different levels of VRE

In the last 12 months NSW generated 63.62 terawatt-hours (TWh) of electrical energy (not including roof top solar). **Of this 55TWh came for fossil fuels – mainly coal.**

On a yearly basis the 12GW of VRE will generate about 30.8TWh or 56% of the energy currently generated by fossil fuels. Problem is that at high levels of VRE as shown in **Figure 1** the coal must try to ramp down or "steam off" – keep burning some coal but dump the energy if VRE is to have

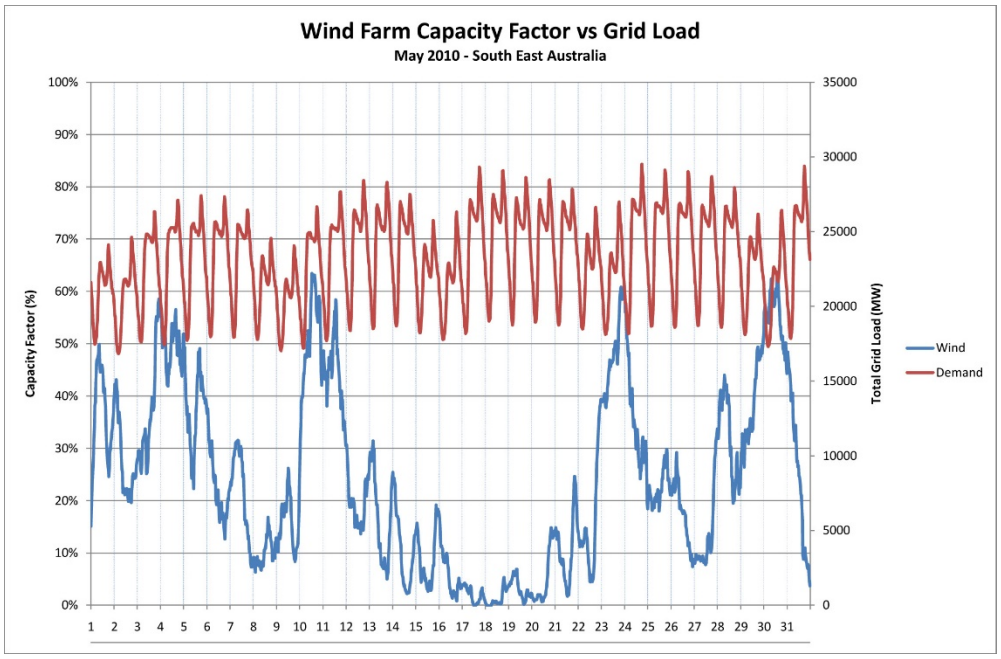
priority access. The gas turbines take an opportunistic approach. They supply to match the huge ramp rates caused by wind and solar fluctuations and make a financial killing. **VRE is an invitation to Gas.**

Coal plants can't leave the system – they must supply energy throughout the evening periods because the pumped hydro at 2GW is not sufficient to meet instantaneous after-hours demand. As we have seen in Western Australia with increasing solar PV, they have been forced to keep the existing state-owned Synergy going with payments of $656 million in 2019 and a further $700 million in 2020. **Works out at $700 per family per year or about $19/MWh.**

This is where NSW is headed. A system reliant upon VRE is like a juggler keeping many balls in play. The system needs to balance:

a. Gas turbines and fast start diesel engines to match huge ramp rates caused by VRE.

b. Gas and coal to keep the lights on at night and during wind droughts shown in the following image.



c. Ancillary services such as spinning capacitors and batteries to provide voltage and frequency control.

d. Pumped storage to the degree this is possible in a drought prone land.

e. Very large grid expansion to allow all these varying generators to meet the demand

f. And if all else fails then we "put up the white flag" on our economy and revert to demand response from industry.

Carbon Emissions reductions.

Advocates of VRE forget that the reason for our energy transition is to reduce carbon emissions. Figure 2 shows that in South Australia where fugitive methane emissions are likely to be in the 1.4% to 2%

range the actual emissions intensity is above 400 gr CO2/kWh while be should be aiming for less than 50 gr CO2/kWh.

Since the Rio conference, our governments have been well informed about the extremely low emissions intensity of nuclear energy. The evidence is clear. We see it daily in the emissions profile of France which generates electricity with an emissions intensity of only 35 gr CO2e/kWh in 2019 from a grid supplied with 75% nuclear energy. **Refer to Figure 3**

Despite this stark example, within Australia the ongoing sway of the Variable Renewable Energy message is very strong. No nation has achieved emissions reductions of the level required to address climate change using predominantly wind and solar. Studies carried out by MIT and the OECD consistently find that for deep carbon reductions systems that exclude nuclear produce electricity at twice the cost of those that include it.

The ultimate expression of this failure can be seen in policies such as the German Energiewende where despite spending some €150 billion up to 2015, the actual emissions reductions have remained stubbornly high. By 2025 it's been estimated by the Düsseldorf Institute for Competition Economics (DICE) that over €520 billion will be spent in the electricity sector alone.

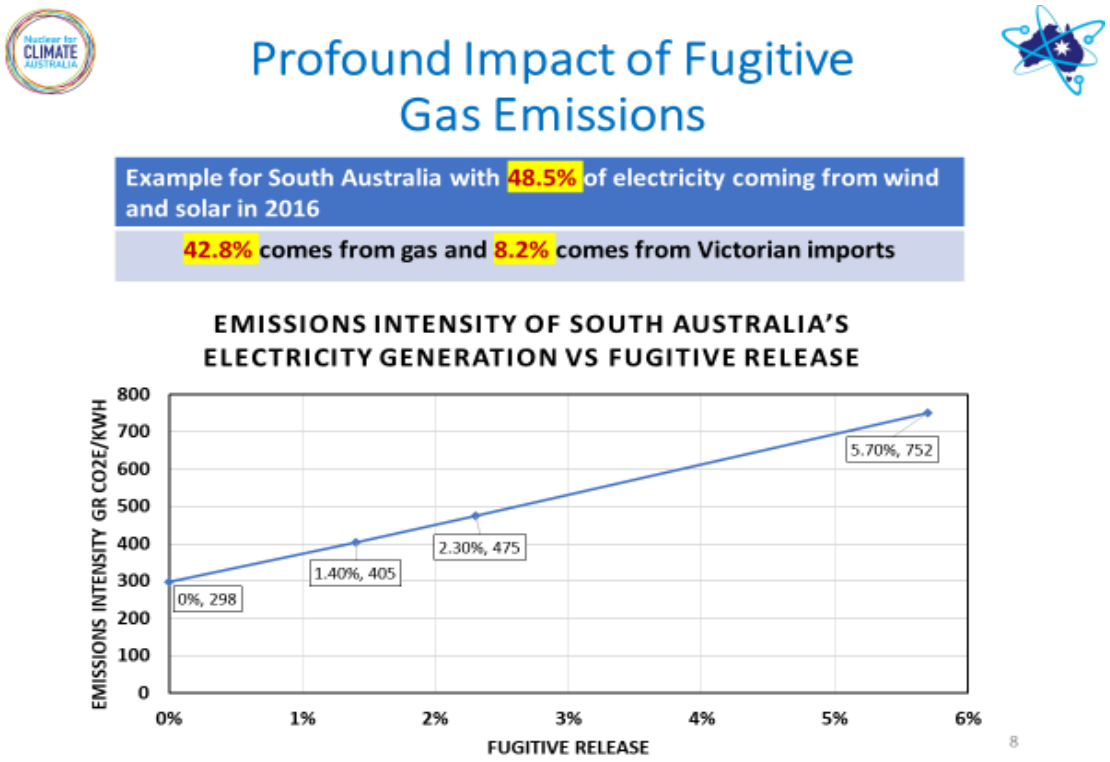


Figure 1 - South Australian emissions

To meet the goals of ecologically sustainable development and protect our natural environment we cannot afford to go down the exclusively renewables route.

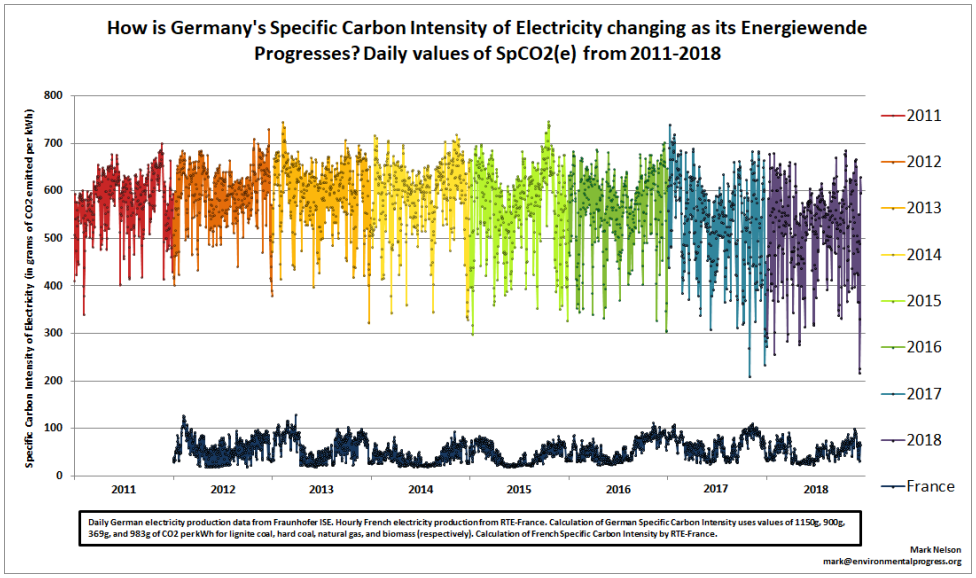
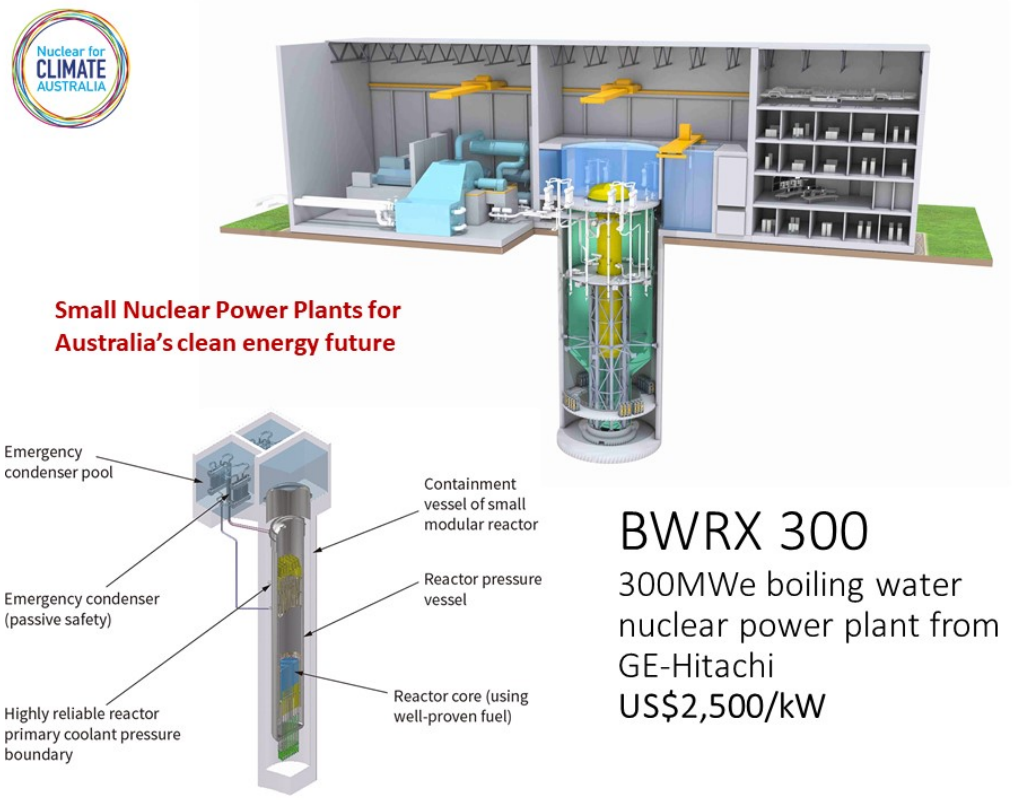


Figure 2 - French electricity emissions intensity vs German

The Nuclear Solution

For Matt Kean's $32 billion we could build 25 small 300MW nuclear power plants in NSW located on the existing grid with NO major grid upgrades.

They could fully decarbonise the NSW electricity system and generate all the 55TWh currently generated by gas and coal.



These plants would have world class safety:

- Designed to mitigate loss-of-coolant accidents (LOCA) enabling simpler passive safety – Emergency Planning Zone EPZ limited to site boundary
- They will be competitive with the levelized cost of electricity of natural gas and renewables
- Passive cooling: designed to allow steam condensation and gravity to cool the reactor for a minimum of seven days without power or operator action – **No Fukushima effect**
- Quick Deployment: Deployable as early as 2027, thanks to proven know-how, supply chain, components, certified fuel and simpler construction techniques.

Where? In the upper Hunter to replace Bayswater and Liddell, in the mid North Coast at Eraring, Munmorah and Vales Point, in the west at Mt Piper and Wallerawang and a couple in the Illawarra

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