Submission to:

The House of Representatives Standing Committee on the Environment and Energy

Inquiry into Current Circumstances and Future Need and Potential for Dispatchable Energy Generation and Storage

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Summary

"There is no sustainable energy future in the absence of nuclear energy." –

Fatih Biro, Executive Director, International Energy Agency (IEA) in Paris.

"When will they ever learn?" – ballad "Where have all the flowers gone?" by Bob Dylan.

"From MacQuarie Uni Student JA applying to join the Australian Nuclear Association - "I have a strong passion for climate action and I truly believe that nuclear power is an essential component of achieving a green energy future."

The two laws which prohibit nuclear power in Australia must be repealed to allow nuclear power to be considered on its merits and contribute to our economy.

a) Current and Future Needs

Already Australia is finding itself under increasing international pressures, most recently from the US Biden Administration, to set achievable targets to reduce our net greenhouse gas emissions to zero by 2050 and by 40% by 2030. Climate Change is a real and present scientific and political threat which Australia would do well to heed. See article "Climate Change a security threat..", Nick O'Malley, SMH April 19, 2021.

As a result of public pressure, as much as the cost advantage, all states have a strong program of investments in Renewable Energy, Solar and Wind, mainly financed by the private sector which is way ahead of Government in this endeavour. However, renewables while cheap are intermittent and unreliable sources of energy for households and business. The huge need is to find a firming source of energy that is available when the sun is not shining and the wind is not blowing. The Government is placing its reliance on the fossil fuels, gas and coal. Banks and commentators recognise that these will become stranded assets. Other nations may begin to put sanctions on us. Of course, the Government argues this will not happen but governments have been wrong many times in the past.

Gas prices have tripled since 2008 because of the decision to charge consumers world parity prices. In the absence of nuclear, the States are turning to battery storage or pumped hydro. Large batteries are expensive and short-lived: 15 years max. They consist of toxic materials: electrodes made of cobalt and manganese. We are going to be hit with a disposal problem

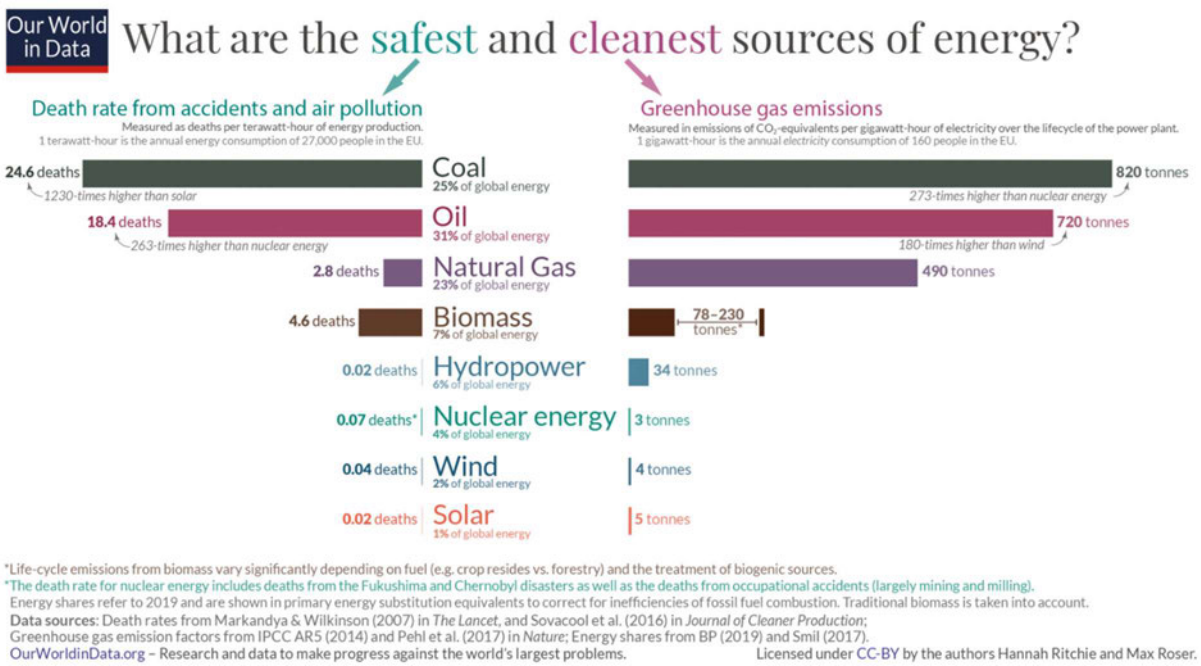
down the track if we place all our eggs in this one basket. Pumped hydro is also expensive and prospective sites are limited. It is not a solution.

Although coal is favoured by the present government, as well as having the largest greenhouse gas emissions of any fuel as shown by figure 1, a major concern is pollution causing degradation of the environment, and health problems, including emphasima, for the population. I have lived in Leeds, Yorkshire in 1980s during the Chernobyl accident, and I vividly recall the buildings and walls blackened by coal fumes in previous years. It was then and now a clean city, free of coal burning.

The "firming" option in front of our noses, that the Government needs to take seriously is nuclear power. Nuclear has almost zero emissions, is long-lived (typical 80 year reactor lifetime), and is becoming increasingly competitive, cost-wise. Small Modular Reactors which are due to become available during the next decade are a game changer for the nuclear industry. Unfortunately, previous inquiries, most recently GenCost, quote grossly inflated and incorrect costs. I believe this is specifically to try and rule out nuclear in favour of renewables, which they believe are more politically acceptable. However, already nuclear power is becoming well accepted by the general public with 55% approval rating in the recent True North Poll.

Unfortunately, the response to Covid has shown that much of the population is ultra-conservative and regard nuclear, which they clearly do not understand, as something to fear. This fear and ignorance are unreasonable, considering the fact that most OECD countries embrace nuclear power as an important part of their energy systems, with over 450 nuclear reactors around the world. Nuclear energy is by far the safest and cleanest source of energy. There have been no deaths from a nuclear accident since Chernobyl 35 years ago.

Figure 1 : from OurWorldinData.org (Hannah Ritchie & Max Rosser, 2020)



As shown in figure 1, the number of deaths from nuclear accidents is a small fraction, (1/330, or 0.07 deaths per teraWatt hour of energy produced, none since Chernobyl), when compared to coal-mining (24.6 deaths/ terawatt hour), or aircraft or industrial accidents. Yet these few are trumpeted loud and long by the media and others to assert nuclear is "dangerous". Most of us still fly, despite the risk of flying. Clearly, some balance is needed in discussing the meaning of risk and an acceptance of the fact of natural radiation background to which we are all exposed, instead of the media hype and public scare campaigns by anti-nuclear interests.

Though people may debate the cost of nuclear energy, the current legislative bans on nuclear power effectively place it off the table for public consideration here in Australia, as a business investment and as an option for electric power companies. By maintaining the ban on nuclear power, nuclear technology cannot be costed in an Australian context. This has resulted in large and unaffordable investments in batteries and impractical carbon capture and storage.

The two laws which must be repealed to allow Australians to consider nuclear power on its merits are in the Environmental Protection and BioDiversity Conservation Act (already recommended by a HoR Committee), and in the ARPANS Act. Both were introduced in 1998 as a compromise to the Greens and now defunct Australian Democrats, neither majority parties.

Maintaining the ban on nuclear power also runs counter to the experience of power reactor operations overseas which have proved it is the most reliable, sustainable and safest source of electricity when compared to all others. What is desperately needed in this country is for the two federal laws to be repealed which ban nuclear power in Australia, and to allow demonstration reactors to be built by business with due consideration of social licence.

The South Australian State blackout in September 2016 and similar events in Texas show how vulnerable the electricity supply is to extreme weather events. These events show how important it is for the energy mix to include technologies like nuclear which are independent of weather.

b) <u>System Integration and Grid Transmission</u>

<u>Advantage of Nuclear Generation</u>:

<u>Energy Storage and grid transmission</u> are major problems for renewables that are largely solved by nuclear. The intermittent nature of solar and wind generation results in the need for energy storage over significant time periods. The Government knows that and is trying to push for gas to become the major dispatchable electricity generator. However, gas must be phased out by 2050, and the rest of the developed world are not buying the Australian gas policy and may threaten us with sanctions. On the other hand, nuclear is available 24/7, has almost zero greenhouse emissions and is competitive cost-wise.

Because nuclear has a small site footprint, it can be sited in locations where coal-fired stations have been closed, leaving grid transmission intact. The same operating principle of rotating steam turbines applies. All the associated grid and high voltage transmission lines

can be retained and synchronous generation would continue, allowing nuclear and gas-fired generation to be used at the same site.

New technology: Small modular reactors up to ~500 MWatts will become available over the next decade. They are ideal as load followers, because their start-up times and ability to vary in output on short time scales lend themselves to system integration with renewables. That is, they are capable of providing for "firming" needs in power generation. They are ideal also to be sited near smaller communities like Port Augusta and Broken Hill. They can be used for dispatchable "back up" power near our cities.

The second promising modality is molten salt reactors, both large and small modular types, which are Generation IV. They use a molten chloride or fluoride of uranium or thorium as fuel and coolant. Molten salts are thermally very stable which makes them superior to water as a coolant. This permits a lower pressure and higher temperature operation. These features contribute to lowering cost and increased safety and efficiency. Unfortunately since the pioneering work at Oak Ridge in 1965 -69, not much has been done until recently so these reactors are unlikely to be commercially available until the 1930s. Today these reactors are being revisited by the US, Canada, China, UK and Russia in multiple billion dollar private-public ventures.

Disadvantage of Renewables: The cost of grid transmission and integration of non-synchronous power with existing systems, as well as the need for energy storage over substantial time scales, are major costs to the renewables industry and detract from their recognised cost advantage. As the percentage of renewable generation is increased beyond 50%, system instability becomes an issue, and can result in power blackouts. In South Australia the Government is introducing legislation to enable them to disable home solar from the grid because excessive power is produced when it is not needed, causing instability. Solar power is most readily generated during cloudless, daylight hours, whereas the greatest power need is in the late afternoon and evening, for air conditioning, home entertainment and cooking. During winter solar becomes problematic. However, household generation offers much extra capacity if storage is available.

Wind power is generated away from cities in elevated rural locations. It takes over valuable agricultural and pastoral land to the detriment of faming communities. Not only that, the large rotating blades cut down large threatened birds like eagles and hawks . The blades produce unwanted low frequency noise problems which disturb the sleep and cause psychological problems for farmers. In ten years' time the disposal of the enormous areas of degraded silicon panels in use and the toxic metals in wind generators will become a more serious problem than nuclear waste which is minimised by the new designs. Clearly both solar and wind power have major disadvantages as the renewable percentage is pushed up, which will ultimately limit their usefulness. At some stage there is bound to be a public backlash.

c) Existing, new and emerging technologies.

Nuclear power has been around since the early 1950s, so Generation I and II reactors are not new technology. However, what is not generally recognised by government or

uninformed people are the major new developments in this technology, with the development of Small Modular Reactors and Generation 3 and 4 systems with increased passive safety and lower cost including molten salt reactors. All reactors produce very low greenhouse gas emissions, being ideal solutions to the climate crisis.

In August 2020 the US Nuclear Regulatory Commission issued a final safety evaluation report for NuScale's SMR. This is a major milestone in the deployment of SMRs. The first SMR is likely to be commissioned in Idaho in 2026.

Previously most power reactors have been large: up to 1.2 GWatts, requiring long construction times and high cost in some overseas locations where extended construction times have been the norm. These designs are used for cities where they can replace coal generators. The older designs lacked sufficient safety systems and presented a waste disposal problem. Old, outmoded designs with these problems would never be constructed at present. The lack of skilled construction workers has added to construction delay and cost.

However, recent experience with the four 1.1 GWatt Korean-built, Generation III reactors under construction in the United Arab Emirates, provides clear evidence of the competitive cost and construction times of modern nuclear compared with coal-fired power stations.

There are currently a number of Small Modular Reactors (SMRs) being developed, ranging from the 60MWatt NuScale, to the Hitachi BWRX 300 MWatt hybrid and 440MWatt Rolls Royce design coming into factory production, in contrast to the on-site construction used for larger reactors. This mode of construction reduces cost and construction delays. All new designs are passively safe, enabling them to shut down automatically in the event of a malfunction or accident, and air-cool without water or external power being required.

d) Efficiency, cost, timeliness.

The widespread use of large battery systems, favoured by the renewables industry suffers from energy inefficiencies, due to double energy transfer, cost and the limited time power is available in the event of a power failure. Hence hospitals choose to use diesel backup systems instead of batteries. Nuclear power, in particular from SMRs avoids this disadvantage.

e) Scaling Applications for Various End Uses:

Large cities require GigaWatt energy systems to supply industry, transport and households. At present these are usually coal-fired, except in South Australia. There will likely be a transition to gas over the next decade. At the same time there will be increasing demand for gas for export and in the Australian economy. This can only aggravate tensions in the community over fracking, damage to ground and artesian water and devastation of prime agricultural land. How much better to replace the large dispatchable power generators by 1.2 GWatt nuclear power generators. Korea has already supplied three such reactors to United Arab Emirates for a very competitive price. Couldn't Australia do likewise?

f) Australia's research and innovation policies

Technological progress has been a key driver of change around the world and our Government is on record in favouring a technological solution to carbon abatement. It just needs to accept that the solution they seek is nuclear energy. There is increasing awareness that, in addition to electricity generation, other sectors of industry have to be decarbonised. Electric vehicle manufacture is a promising possibility in South Australia. Australia has an opportunity to develop a modern manufacturing industry and export possibility according to ACE-Electric Vehicle Managing director Greg McGarvie. Already electric vehicle recharging sites are becoming common. Enormous amounts of clean, low-carbon electrical energy will be needed for transport in coming years. This cannot be provided only by unstable renewables.

Rolls Royce is looking to manufacture SMRs overseas as well as in UK and is considering Singapore and Australia as possible factory sites. See the SMR Global Status Report, March 2021, by SMR Nuclear Technology Pty Ltd, Sydney, NSW.

Other countries, like Israel, are investigating the multipurpose use of SMRs, including for process heat, hydrogen production and desalination. These are obvious applications here in Australia for inexpensive excess electricity. Renewables alone cannot meet this goal for the reasons previously quoted.

Australia has been a powerhouse in research and development. With appropriate planning and funding, ANSTO could contribute to the international effort to develop and prototype advanced Generation IV fast reactors which can be utilised to burn nuclear waste.

g) Opportunities for Australia to Grow and Export Zero Emission Power

As the world turns away from gas as a primary energy source over the next decade, Australia's gas exports will dry up unless replaced by hydrogen generated from our excess electrical energy. Already, the excess energy from rooftop solar could be redirected this way. Hydrogen, while it is a fire hazard, is an easily transportable carbon-free fuel for which the only waste product is water vapour.

h) Other Relevant Matters

Small modular reactors could be of great benefit to outback communities and mining operations such as Roxby Downs and Olympic Dam. Australia can benefit from overseas experience as it seeks to expand its nuclear generation capability.