Victorian Parliamentary Inquiry into Nuclear Prohibition

Simon Holmes à Court
Senior Advisor
Climate and Energy College
Melbourne University

8 September 2020

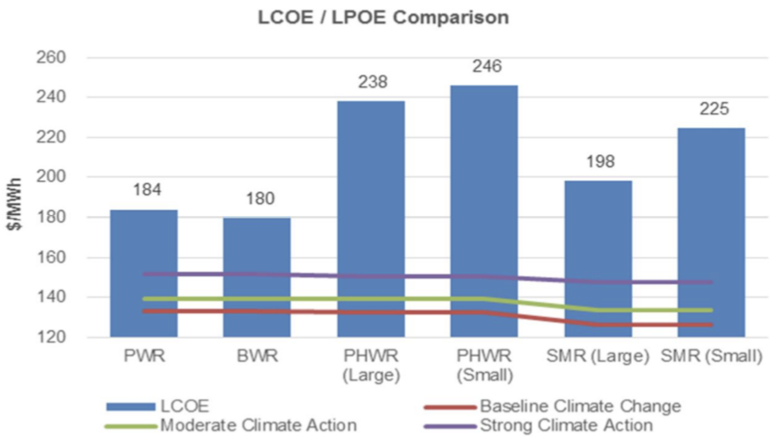
Thank you for the opportunity to provide input into Victoria's Parliamentary Inquiry into Nuclear Prohibition.

My comments are constrained to the power sector.

1. Current nuclear power products are a poor fit for the Australian market.

Just four years ago, modelling commissioned by the South Australian Nuclear Fuel Cycle Royal Commission (SANFCRC) effectively determined that nuclear power did not make economic sense in Australia.

The modelling, from global engineering firm Parsons Brinkerhoff, projected that electricity from a range of nuclear technologies could deliver power in the range of $180–$246/MWh. This range is significantly *above* the Royal Commission's (notably high) projected prices for South Australian electricity under a range of future assumptions.



Nuclear advocacy group Bright New World has rightly pointed out that the cost of nuclear power is heavily impacted by the cost of capital and project capital expenditure.

In their submission to this inquiry, BNW claims that the Royal Commission found that nuclear could be viable "with an 8% reduction in capital or finance obtained at 7% nuclear". This is misleading. BNW omitted to note that this finding was for the highly unlikely scenario of a carbon price in excess of $150/tCO2 (in 2015 dollars) after 2040.

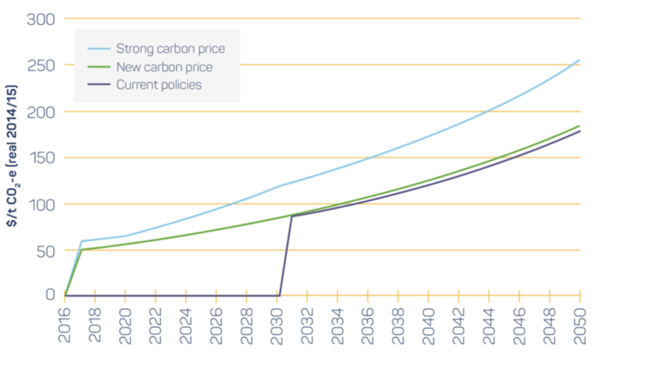


Figure G.2: Assumed carbon prices under the Current Policies, New Carbon Price and Strong Carbon Price scenarios

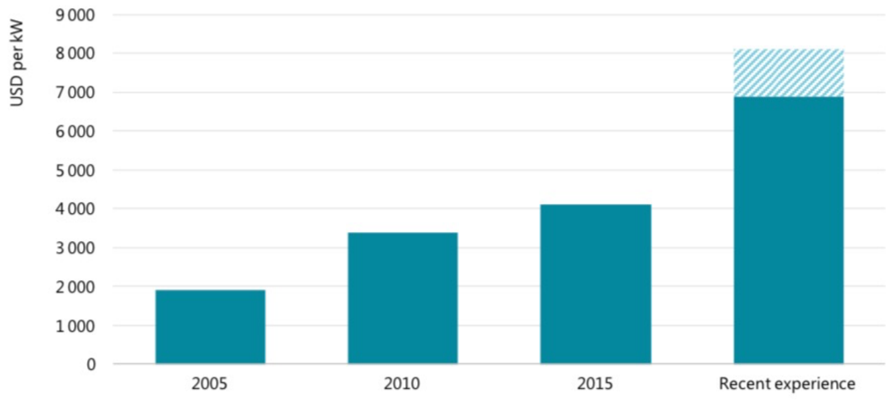
Source: Ernst & Young

While the assumptions that underpinned the South Australian analysis would be slightly different in each state, any variance is not sufficient to tip the balance in favour of nuclear power development in Victoria.

There are strong indications that conditions for the global nuclear sector have deteriorated since the 2016 SANFCRC.

The May 2019 International Energy Agency report *Nuclear Power in a Clean Energy System* showed that the construction costs of nuclear power plants in the US and Western Europe has increased significantly in recent years.

Figure 9. Projected overnight construction cost of nuclear power capacity and recent United States and Western European experience



Source: IEA analysis based on IEA/NEA (2005, 2010 and 2015 editions), Projected Costs of Generating Electricity.

Construction costs of new nuclear power plants in the United States and Western Europe have turned out to be much higher than projected.

Only five nuclear projects have begun construction in North America and Western Europe this century. None of these are yet complete. Apart from VC Summer in South Carolina, which was cancelled, all are over-budget and behind schedule:

Plant	First announced	Initial projected completion	Initial projected cost (bn)	Current projected completion	Latest projected cost (bn)	Years late	Over-budget
Flamanville, France	2004	2012	€3.3	2022	€19.1	10	479%
Olkiluoto, Finland	2005	2010	€3.0	2020	€11.0	10	267%
Hinkley Point C, UK	2006	2017	£16.0	2025	£22.9	8	43%
Vogtle, GA, USA	2006	2016	$14.0	2022	$27.5	6	96%
VC Summer, SC, USA	2008	2017	$9.8	*cancelled*		*cancelled*	

Costs for these new plants are currently in the range US$8,100–US$13,700/kW (A$11,334–A$19,100/kW).

Each of the four remaining projects have estimated completion costs in excess of highest estimate in 2019, and since these plants are still under construction, there is a strong possibility of further delays and cost overruns.

South Korea, Russia and China have generally had more success in nuclear construction in recent years. Costs in these countries are generally not available and not particularly applicable to Australia given significantly different labour and capital markets and nuclear expertise. Regardless, the trend for schedule delays has also been seen in those markets.

In recent weeks the United Arab Emirates has started up the first of the four units in their Barakah plant, the first nuclear power station in the Middle East. While we'll likely never know the true, final cost of the Barakah project (built by South Korea's KEPCO), we do know that it began generation three years behind schedule. It's notable that even in a regime unhindered by our deliberative democratic process and labour protections, it took the UAE 12 years from decision to operation, supporting claims that Australia would struggle to start up a single power reactor before 2040.

In the 2019 federal *Inquiry into the prerequisites for nuclear energy in Australia*, Dr Ziggy Switkowski (chair of the Commonwealth's 2006 inquiry into the viability of a domestic nuclear power) told the committee that the 'window for large gigawatts to go in nuclear generators has now closed for Australia':

> Switkowski explained that this was in part due to the mixed views in the community in relation to nuclear energy. Dr Switkowski added that:
>
> > Given that the investment in a power station, particularly a big one, would begin at US$10 billion and go up from there, and it would take around 15 years to make it work, you can't progress without strong community support and bipartisanship at the federal level — and there is not too much evidence of that.

Australia almost built a nuclear reactor at Jervis Bay at the beginning of the 1970s. The project was abandoned on economic grounds in June 1971.

The 2016 SA Royal Commission again found nuclear power to be uneconomic, and the 2019 federal Inquiry failed to establish any prospect for viability of current nuclear offerings.

Meanwhile the cost of alternatives, namely renewable energy, has become significantly cheaper, with the effect of reducing future price scenarios.

2. The only prospect for nuclear power in Australia is Small Modular Reactor technology.

As above, the only nuclear project under construction in North America are the two Westinghouse AP1000 reactors at the Alvin W. Vogtle Electric Generating Plant in Georgia.

When complete, the 2234MW Vogtle Plant will have cost around A$40bn, which is close to the combined value of AGL Energy, Energy Australia and Origin Energy, Australia's three biggest "gentailers".

It is noteworthy that the approximate cost of a single 1000MW nuclear power plant would exceed the balance sheet of every one of our electricity companies — and there is plenty of reason to believe that the first nuclear power station in Australia would cost more than in the US, where labour rates are lower and a nuclear supply chain already exists.

Before deregulation, a government may have been in a position to make a $20bn+ investment decision for an asset that wouldn't begin to generate a single watt of power for a decade, however privatisation has brought a new set of investment parameters.

Even our largest power companies would struggle to finance a nuclear power station of the type currently on offer and it is inconceivable that they would 'bet the farm' on a single project that has the potential to blow out in both time and cost and sink the owner.

Many representations have been made to this Inquiry that Small Modular Reactors (SMRs) are where the sector's opportunity lies.

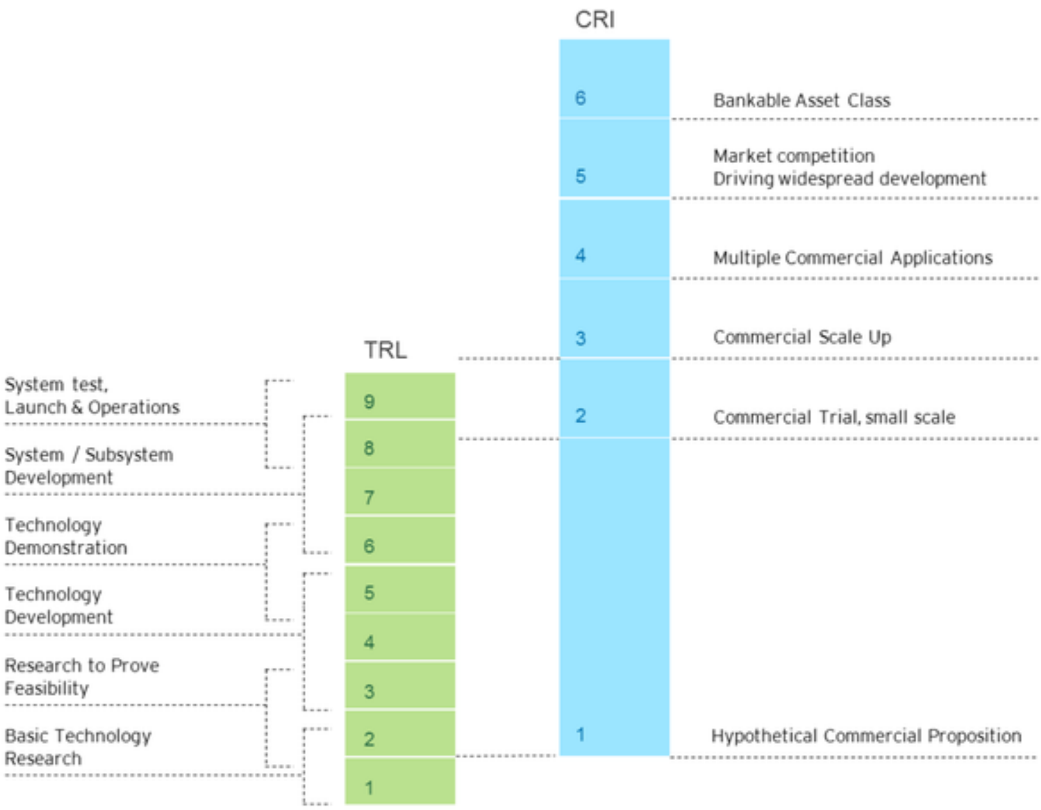
It is true that if the nuclear sector can deliver mass produced reactors that can be installed in, say, three years and cost under, say, $1bn and if the final product can produce energy at a cost comparable with other technologies, then the product could be of interest to energy investors.

3. Small Modular Reactor technology is not yet commercially ready.

Unfortunately, SMRs do not yet exist at a level of readiness suitable for commercial deployment.

The Australian Renewable Energy Agency frequently evaluates new technologies and uses a framework adapted from NASA — the Technical Readiness Level scale. Projects generally start with basic technology research (level 1) and gradually, through research, development and deployment, mature through to system test, launch and operations (level 9). Only as a technology becomes highly mature does it start to mature through a Commercial Readiness Index scale.

A technology can't generally be considered commercial until it has reached the top of the CRI scale and become 'bankable'. Programs like ARENA and the CEFC have been essential to accelerating technologies through the TRL/CRI process, however there is only limited scope for shortcuts.



With increasing recognition of the challenge and opportunities to decarbonise the electricity sector, and in response to the hurdles faced by large-scale nuclear, there has been a resurgence in interest in small modular reactors in recent years.

There is no shortage of SMR concepts, but in general they sit low down on the TRL scale. Most are little more than "paper reactors", designs that are many years and billions of dollars away from market readiness.

NuScale Power is generally recognised as the SMR developer closest to market and scored a major win at the end of August with the US Nuclear Regulatory Commission (NRC) certifying the safety of the design, the first time that an SMR has achieved this important milestone.

Despite having spent over US$950m on development to date, NuScale has a long and commercially risky path ahead. The completion date for NuScale's pilot project, which still needs to formalise a large Department of Energy grant and pass through two more lengthy NRC approval processes, has slipped six years over the past six years and is not expected to be completed until mid-2030.

Only 30% of the capacity of the $6.1bn pilot project has been sold and the participating utilities have several opportunities to withdraw if the project doesn't meet a rigorous economic competitiveness test. On the current schedule, NuScale won't have nailed down a "class 1" project cost estimate until late 2024 and won't have a final construction contract until 2025.

While NuScale is standing on the shoulders of the nuclear giants before them, the innovative design has never been fully tested. It's likely to work, but it's typical that new designs encounter teething problems that add to cost and push out schedules.

If all goes well and once the next customer can be found, NuScale will proceed to constructing a second plant, which is expected to be cheaper. NuScale's submission to this inquiry states that n-of-a-kind costs will not be attained until the eighth plant. At that stage the product will have reached a high commercial readiness, perhaps CRI4 or CRI5.

Putting aside social licence and regulatory issues particular to Australia, NuScale's product is unlikely to find market interest here until a high level of commercial readiness has been achieved. Certainly, it would be challenging to secure finance in a liberalised energy market (like our own) before the technology reaches CRI6 and there are several years of operational data.

A small number of SMR developers may have built pilot projects (CRI2) by the end of the 2020s, but at this stage it is difficult to see SMRs at CRI6 before the end of the 2030s.

The world of technology development is beset with overly optimistic claims used to drum up media attention and investment. It is very common for public perception of commercial readiness to run many years in front of actual progress.

SMRs are not commercially ready now and nor will they be for perhaps two decades.

Given the high level of public interest, I recommend that CSIRO, in consultation with ARENA, periodically provide an assessment of the commercial readiness of the leading SMR technologies under development.

4. Victoria's nuclear prohibition is a distraction, but maybe worth lifting under the right conditions.

Energy policy in Australia has been hobbled for at least a decade as hostage to an unnecessary culture war mainly revolving around carbon emissions. Followers of nuclear technology would argue that energy culture wars started decades before our "carbon wars".

Victoria's nuclear prohibition mirrors the Federal prohibition (section 140A of the EPBC). These prohibitions are a touchstone issue in these energy and climate culture wars and serve no real purpose as there is currently no economically viable nuclear power technology (as set out in 1. above) and nor is there likely to be one any time soon (as set out in 3. above).

At the Federal Inquiry, I argued that given the Federal prohibition is not stopping development, the prohibition is purely symbolic. Conversely, since lifting the prohibition would change nothing, it can likewise be argued that lifting the prohibition would be purely symbolic.

The Federal prohibition is just 47 words:

140A No approval for certain nuclear installations

> The Minister must not approve an action consisting of or involving the construction or operation of any of the following nuclear installations:
>
> (a) a nuclear fuel fabrication plant;
>
> (b) a nuclear power plant;
>
> (c) an enrichment plant;
>
> (d) a reprocessing facility.

Nuclear regulation is incredibly complex. Removing the Federal prohibition would involve replacing one short section of the Federal EPBC with hundreds, if not thousands, of pages of new regulations.

Likewise, if Victoria removed the prohibition on nuclear power nothing would change, other than the need for new regulations that wouldn't be tested for a couple of decades, at least.

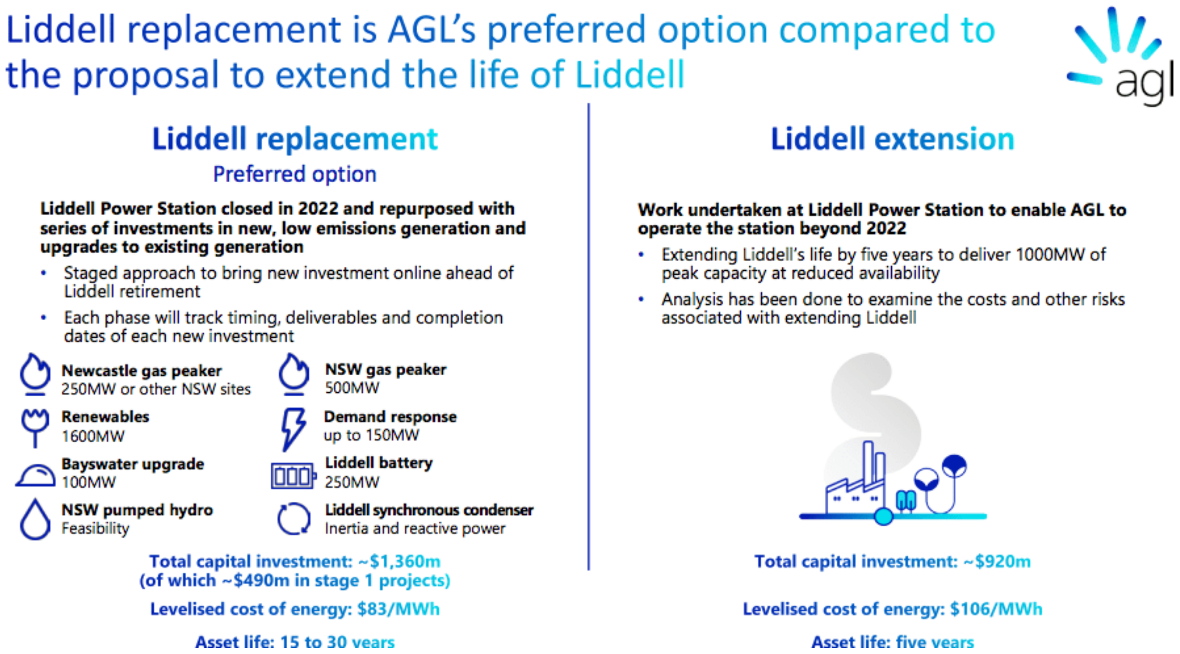
5. For a low carbon future, nuclear energy might be helpful, but is not required.

Thirteen coal power stations have closed in Australian since, with 19 remaining. Most will likely close in the 2030s, towards the earlier part if Australia is to meet its share of limiting global warming to 1.5°C.

There is a common, but false, perception that as these 'baseload' generators are retired they must be replaced with generators sharing similar generation profile, and that only nuclear energy is a drop-in replacement.

Energy transition is a relatively new study of the challenges, opportunities and mechanisms for transitioning our energy systems from predominantly fossil-fuels to predominantly renewables. A large body of academic work concludes that not only can modern power grids provide reliable power without 'baseload' generation, but in many markets (including Australia) the cheapest path forward is to use a portfolio of variable renewables with dispatchable energy sources.

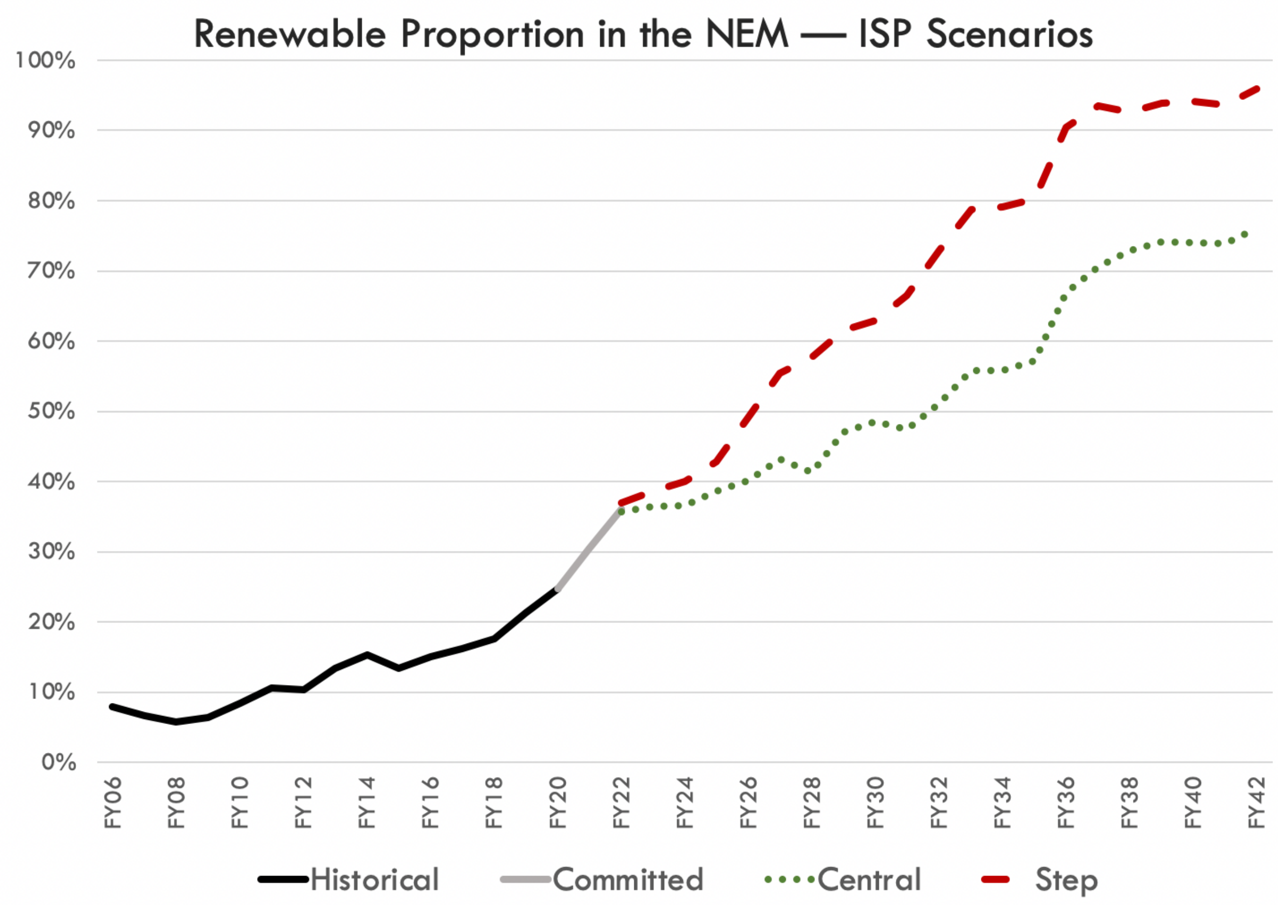
AGL's 2017 plans for the replacement of the Liddell power station provides a clear example:



AGL showed that a relatively low (but not zero) emissions portfolio will costs less than a coal plant life extension.

The Australian Energy Market Operator's 2020 Integrated System Plan shows this on a whole-of-grid scale.

The ISP outlines several paths forward for the National Electricity Market (NEM), all of which project a significant increase in the proportion of energy provided by renewables. The primary difference between the scenarios is the speed of transition — under the Central scenario two of Victoria's three coal power stations close in the 2040s, under the Step-change scenario all would close a decade earlier.



source: AEMO, OpenNEM, projection

Our largest energy company and our energy market operator have both shown that ‘baseload’ generation is not required in the long term for a reliable power system. I would urge the committee not to fall into the trap of believing that coal must be replaced “like for like”.

The Step-change scenario is the only pathway in the ISP that follows a decarbonisation pathway close to what is needed for Australia to do its share of achieving the Paris Agreement target.

Under the Step-change scenario, by 2042 renewable energy would supply 96% of power in the NEM, and more than 99% in Victoria. If this scenario is achieved, our grid will have shed 95% of its emissions, with a grid-average emissions intensity of around 30 kgCO2/MWh, a level lower than France’s nuclear-dominated grid today.

In other words, by the time Australia could build its first nuclear power station, our whole grid can, and likely will, be almost completely decarbonised.

While this transition will no doubt be complex and throw up many challenges, the pace required to realise this outcome is no faster than we have experienced in recent years.

As such, the Inquiry should keep in mind that *if* cheap nuclear ever were to be developed it *might* be useful, but it is certainly *not* necessary for an energy system that delivers affordable, reliable and clean energy. In the meantime, we should keep a watching brief on international nuclear developments and be prepared to act if and when there is a compelling case for change.

A compelling case has not yet been made.

Thank you for the opportunity to contribute to this Inquiry.