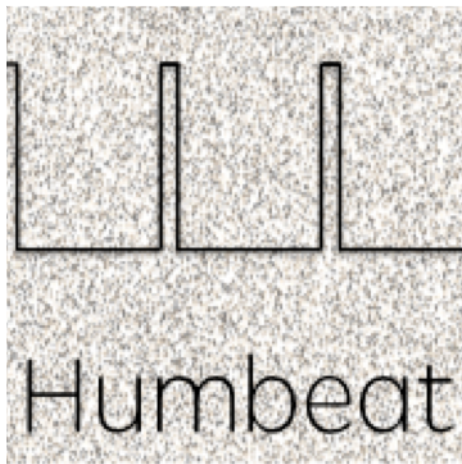


Nuclear plant projects in free energy markets must be worth the wait

New nuclear will not be the first technology to market in the “new energy” race. Nor is it likely to be cheapest. In order to be a successful proposition, new nuclear needs to promise to be the **best** technology to support low-carbon energy systems. Nuclear propositions must be relevant to their future markets, and nuclear power projects must demonstrate to consumers, investors and policy makers that they will be “worth the wait”.



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Si.Gillett@humbeat.co.uk

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Introduction

This article has taken longer to write than intended. Sometimes, and hopefully in the case of this article, taking one's time can be beneficial ... At other times, missing the moment, or missing the point, can both wipe out any chance of success.

New nuclear power projects will take time to develop; they must therefore not risk missing their moment. Ensuring nuclear remains relevant against the energy system long-view will help manage this time-related risk, and ensure that nuclear propositions do not miss the point.

Should energy systems consist? Or exist?

We'll start with a quote from a UK political party's 2017 general election manifesto. "We will form our energy policy based not on the way energy is generated but on the ends we desire – reliable and affordable energy, seizing the industrial opportunity that new technology presents and meeting our global commitments on climate change"¹.

Setting aside the rhetoric inevitably contained within such a document, the quote neatly expresses a growing vision. Marking a significant change from the times when national power boards wrote and delivered long-term plans for power generation, we might simply say that in the future, even more so than now, "market rules apply". After first movers take ground, a race to cut costs alters the playing field. Only if (or when) product quality suffers through over-competitive cost-cutting, will more tailored products be able to carve out their place. So (albeit not exclusively): *first*, then *cheapest*, then *best* will win the day.

True, strategic investments must be made to ensure the operation of national power systems now, next year, next decade ... but in today's political climate is energy policy *really* still the long-game it used to be? And if not, what does this mean for nuclear power, the long-game player?

Nuclear power offers low-carbon baseload power at high reliability, with contributions to electricity system diversity and strength being convenient additional products. This is a key differentiator for nuclear against intermittent power generators, isn't it? So even though project development times for new nuclear power plants are significantly longer than e.g. Solar or wind installations ... and nuclear capital costs are higher ... nuclear power will always be worth the wait ... Won't it?

Well, here are two recent examples which challenge that statement.

¹ <http://www.world-nuclear-news.org/NP-UK-parties-make-scant-reference-to-nuclear-power-19051701.html>

Innovative technologies can solve anything!

A Twitter feed was reported on in March of this year, following a major power outage in South Australia (“SA”). The cause of the outage: debatable, of course, but an increasing reliance on renewable (intermittent) generation has been cited as a contributory factor. Dispatchable generation in SA and neighbouring Victoria has reduced; a common global occurrence. SA increasingly relies on long-distance transmission wires for back-up power when its renewable power output is low. Add in a powerful Southern storm, and parts of SA went black just when it's consumers needed power the most.

Cue grenade lobbing, finger pointing and naval gazing ... except on the global Twitter stage, where Elon Musk (of Tesla) enters Stage Left, with a promise of action: “I can fix South Australia power network in 100 days or it's free”.

Musk committed to install the amount of battery storage that would be required to prevent power shortages and therefore blackouts for consumers².

Now, doesn't that sound kind of appealing, and a great boost for innovative battery storage technology? Tesla's install may prove battery capability and contribution to grid stability, a hotly debated topic right now on the global stage. Of course, caveats to Musk's statements are bound to emerge down the track, and battery performance is yet to be tested at this commercial scale. But on the significantly positive side, for SA consumers at least, Tesla is publicly attempting a big solution to the intermittent renewables challenge. Right now!

Tesla can only learn and grow (more) from this experience, can't they? They may win “first” advantage. And with bundled storage service costs reducing all the time (recent PPAs in the US have been reported at “less than \$45/MWh”³), “cheap” may also be within reach.

So what? Well, it seems almost banal to have to write it. But conventional solutions – newly-built, locally-sited dispatchable power plants, including the nuclear proposition of Small Modular Reactors (“SMR”) – may not get so much as a look-in as part of a future energy system solution if Tesla and others continue to innovate and deliver as they are already doing.

² <https://www.theguardian.com/technology/2017/mar/10/elon-musk-i-can-fix-south-australia-power-network-in-100-days-or-its-free>

³ <http://www.utilitydive.com/news/updated-tucson-electric-signs-solar-storage-ppa-for-less-than-45kwh/443293/>

Maybe innovative technologies can solve everything!

With market opportunity and credentials available for successful green technologies, no-one should be surprised when innovators *really* disrupt energy markets. The pace of change will very likely accelerate further when technology breaks down scale and “use-case” barriers.

Another example. Black Start by battery has just been demonstrated at-scale. A battery system was used to energise a CCGT in California, then immediately began absorbing the CCGT’s output until the plant could be synchronised with the grid⁴. This demonstration showcases another benefit of battery storage, on top of others which are already recognised: (synthetic) system inertia; load flattening (baseload proxy); frequency response; reactive power ... Batteries, solar and wind installations, combined in power parks, will likely soon demonstrate at-scale propositions throughout the entire domain of operability service needs foreseen by “Grid 2.0”.

So what does all of this mean for new nuclear power projects?

New nuclear will not be first, nor likely cheapest

Nuclear’s licensing process is expected to be rigorous and *is*po facto takes its time. Any nuclear project success requires absolute operational safety, and the public’s confidence. A rigorous and robust global regulatory process is fundamental to these requirements, especially because of previous high-consequence events. For Light Water Reactor (“LWR”) designs, the safety-security framework has developed both in response to events, and through the sharing of international best practice. It is hard to see how public confidence will be upheld if any established regulatory processes are lightened, therefore the LWR licensing journey will not shorten in the coming years. New LWR will not be “first”. But what about “cheapest”?

The licensing process and its requirements on operating plant (those safety measures required in order to reduce the risk of harm to below an acceptably low level, including multiple safety systems and pre-planned evacuation zones) is costly. Of course, safety is paramount and cost-to-safety is irrelevant, except for would-be investors when their projects tip uneconomic.

Advanced Reactors, such as lead- or salt- cooled reactors have inherent risk profiles which are different to those of the LWR. They may therefore have an opportunity to differentiate themselves from past nuclear failures and failure mechanisms, achieving lower build costs as a result. For this to happen, not only

⁴ <http://www.utilitydive.com/news/california-muni-iid-completes-first-us-demonstration-of-black-start-battery/443099/>

must the science stack up, but the public must also be willing to accept Advanced Reactor technology.

In the absence of government-guided energy generation policy, commercially-minded project developers and operators will be in competition to gain approval and win public support for *their* technologies. Although there *may* be a cost opportunity for Advanced Reactors, project developers must wait in line through the licensing process. Because of each regulator's need to develop technical knowledge and capacity to assess each of the broad range of Advanced Reactor designs currently being proposed, the wait for Advanced Reactor approval might be significantly longer than for its LWR competitors.

New nuclear must demonstrate it is worth the wait

Commencing the regulatory approval process for a new reactor commits companies, regulators and national bodies to a substantial investment of resources. In order to commence the process, parties will, on balance, need to be reasonably confident that the process will be worthwhile.

Some believe there are benefits in operating GW-scale, low carbon baseload nuclear power plants, which support grid stability and local economies by virtue of their presence. Others believe a more distributed, “Small Modular Reactor” capability will make important energy and economy contributions. Others still believe that nuclear power has no place in our energy future.

To maintain their relevance for future energy systems, nuclear projects must promise and promote capabilities which energy systems and national economies desire. These capabilities must differentiate them from competing technologies, even those that have been wound forward through 10 or 20 years of innovative development.

No reactor yet under development will be commercially operational for the best part of a decade. SMRs are not expected to be operable before 2030. As time moves on, and innovation outside of the nuclear industry overcomes more technical barriers, differentiation will be harder and harder to achieve.

Without possessing such capabilities, or achieving such clear differentiation, nuclear projects will not secure their relevance and consequentially neither promise nor achieve any competitive edge.

To succeed as part of the energy system of the future, new nuclear projects must demonstrate that they are unequivocally worth the wait, and therefore definitely worth the risk.