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THE CLIMATE DRIVER:

WHAT THE GLOBAL CLEAN ENERGY GOAL MEANS FOR NUCLEAR ENERGY AND ENERGY-DEPENDENT INDUSTRIES

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The Energy Policy Institute of Australia (EPIA) is Australia's only independent and apolitical energy policy body. EPIA focusses on high-level policy, governance and regulatory issues affecting the national interest, the economy as a whole, the environment and the community.

The Institute advocates that Australia must maintain a secure investment climate and be internationally competitive, whilst moving towards and contributing as much as it can to global efforts to build a low-carbon society.

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Key Points

- *The climate has become the main driver of change in the energy industry.*

- *In many countries, this has led to renewable energy becoming the fastest-growing form of low-carbon energy. However, power systems were never designed for renewable energy. Intermittency poses a challenge to power systems that is growing faster than the share of renewables.*

- *Modern nuclear energy is now recognised as an essential technology in future low-carbon energy systems.*

- *Nine countries that are members of the Clean Energy Ministerial forum have already signed on to the Nuclear Innovation: Clean Energy Future ('**NICE Future'**) initiative, with Canada positioning itself to play a prominent part.*

- *Nuclear energy is not only a low-carbon response to climate change but it represents a market opportunity to supply 20% of the world's electricity by 2050.*

- *Australia has much to gain by joining the international NICE Future initiative and pursuing industrial-scale, fit-for-purpose, low-carbon energy solutions.*

Introduction

The climate has become the main driver of change in the energy industry. This has brought the main focus of energy policymakers onto clean, or low-carbon, energy, precipitating challenges and opportunities for all forms of energy.

How to 'clean up' energy systems was the focus of a novel international conference on 'Advancing Clean Nuclear Energy' held in Tokyo in November 2018.

In many countries, renewables have become the fastest-growing form of clean, or low-carbon, energy. However, energy systems were never designed for non-dispatchible, weather-dependent renewables and typically require firming up with dispatchible resources or storage systems of one type or another.

The climate doesn't 'mind' how you clean up your energy systems so long as you do.

It has long been the view of the Energy Policy Institute of Australia that technology neutrality must be the overarching principle of energy policy. Apart from investing in renewables, there is great scope for investing in other clean technologies if they are safe and affordable. These include, in addition to nuclear energy, new and more efficient processes and systems for reduction of consumption, storage systems, carbon capture use and storage (CCUS) for coal and gas-fired generation, hydrogen, bioengineering and other technologies.

In addition to taking a technology-neutral approach, there appears to be much unrealised scope for collaboration amongst hitherto competing technologies and industry sub-sectors.

The Tokyo conference on Advancing Clean Nuclear Energy highlighted how nuclear energy is now recognised as an essential technology in future low-carbon energy systems.

Collaboration in the Nuclear Industry

The nuclear industry recognises that safety requirements and competition with other technologies require the continuing development of more innovative reactor designs and safety systems. Since 2000, four collaborative international initiatives have been organised:

(i) 2000: International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)

In 2000, INPRO was established by the Vienna-based International Atomic Energy Agency (IAEA) to support IAEA members in planning and collaborating on innovative reactor design, fuel cycles and sustainable development of nuclear energy systems. INPRO publishes many valuable reports and studies on the IAEA website. It presently has 41 members.

(ii) 2001: The Generation IV International Forum (GIF)

In 2001, nine countries, led by the United States, established the GIF as a cooperative body to carry out research and development of innovative 'next generation' nuclear energy systems. The GIF now has a membership of 14, with Australia having signed up as the most recent addition in 2017.

The GIF recognises that nuclear energy has become a key technology in the fight against climate change and that many of the challenges facing the nuclear industry need to be overcome by greater innovation and cooperation.

(iii) 2010: The International Framework for Nuclear Energy Cooperation (IFNEC)

In 2010, IFNEC was established under the auspices of the International Atomic Energy Agency (IAEA). Its membership comprises 34 participant countries, including Australia, and 31 observers. IFNEC provides a forum to explore mutually beneficial approaches for the use of civil nuclear energy around the world.

IFNEC's charter is to ensure civil nuclear energy meets the highest standards of safety, security and non-proliferation.

(iv) 2018: The 'NICE Future' Initiative

The most recent collaborative initiative, called the Nuclear Innovation: Clean Energy Future ('NICE Future') initiative, was established in May 2018. It ran its first conference jointly with IFNEC in Tokyo in November 2018. The name of the new body might seem a little quirky but its serious intent is quite apparent.

NICE Future has been promoted by the intergovernmental Clean Energy Ministerial (CEM) forum, an intergovernmental forum to boost the role that nuclear energy plays in clean energy systems. NICE Future will run in parallel to the commitments of individual countries under the Paris Climate Change Agreement but will be separate from those commitments.

Fifteen out of 25 CEM members have joined, or have expressed interest in joining, the NICE Future initiative. Australia is not one of them but, in the author's opinion, it would have much to gain by joining.

The 2018 Tokyo Conference on Advancing Clean Nuclear Energy

The Tokyo conference was co-sponsored by IFNEC and NICE Future. It featured 42 speakers and attracted delegates from all continents.

Japan will hold the G20 Presidency in 2019. With memories of the 2011 Fukushima tsunami still fresh in everyone's minds, delegates in Tokyo heard of Japan's progress in returning to service many of its nuclear power plants that had been shut down for safety checks.

What made the Tokyo conference novel was its overriding emphasis on clean energy, as distinct from clean nuclear energy. NICE Future addresses nuclear energy holistically, within the context of broader clean energy systems, as opposed to focussing on nuclear. The idea is to move discussion of nuclear energy away from traditional, nuclear-only fora into a broader, cross-sectoral discussion of clean energy. This is timely, if not overdue. Delegates in Tokyo were enthusiastic about the idea.

A Japanese delegate, perhaps understatedly, described nuclear as a 'practical option' for decarbonising energy systems. He could also have called it a slow and prudent option, explained by

the fact that the nuclear industry is technically very complex and the most highly regulated in the world. This is largely counterbalanced by the long lives of nuclear energy plants of 60 to 80 years.

In the author's opinion, nuclear industry regulatory processes need speeding up, but without compromising safety. This highlights the need for greater international collaboration, innovation and standardisation.

Stimulated by participation in the Tokyo NICE Future conference, the nuclear energy industry is now looking at an opportunity for nuclear energy to supply 20% of the world's electricity by 2050 - in addition to supplying heat for water desalination and other industrial uses. The 20% share discussed in Tokyo may be conservative; the World Nuclear Association's Harmony Goal envisages a share of 25%.

Canada's Call to Action: The Next Wave of Nuclear Innovation

Canada is positioning itself to be the most innovative country in the nuclear industry. This is demonstrated by its publication in November 2018 of *'A Call to Action: A Canadian Roadmap for Small Modular Reactors.'*

The Canadian Roadmap starts by acknowledging nuclear energy as *'a strategic asset.'* Its declared purpose is '*to chart a vision for the next wave of nuclear innovation … [because] SMRs could help Canadians achieve a low-carbon future.'* As it explains:

> *'Markets around the globe are signalling a need for smaller, simpler, and cheaper nuclear energy in a world that will need to aggressively pursue low-carbon and clean energy technologies to meet climate change goals.*
>
> *SMRs respond to these needs: they are smaller nuclear reactors that involve lower capital investment and modular designs to control costs; they can compete with other low-cost forms of electricity generation; they incorporate enhanced safety features; and they could enable new applications, such as hybrid nuclear-renewable energy systems, low-carbon heat and power for industry, and offset diesel use in remote communities and mine sites.'*

In contrast with Canada, Australia has a legislative ban on commercial nuclear energy that stifles innovation and constrains its low-carbon options.

The Most Widespread Climate Policy Intervention: Subsidies for Renewables

Increasingly over the past two decades, the climate or, more precisely, the desire to control climate change, has been driving policymakers globally to intervene in electricity markets and influence choices about what type of energy to use and what type of technologies to employ. The most widespread intervention has been to subsidise investments in variable renewable energy (VRE) as the most socially acceptable form of clean, or low-carbon, energy. This has however been at the cost of increased intermittency, unreliability and instability in power systems.

On the positive side for VRE, its increased deployment has enabled its direct costs to come down substantially. This has reinforced the hope of renewables advocates that power systems could eventually run on 100% renewables.

If only it were that straightforward. Apart from being weather-dependent, the level of VRE that can be absorbed within a particular power system depends on the availability of other resources, storage solutions, grid interconnections and other system characteristics. As a result, VRE tends to increase total system costs, as explained in the box below:

SYSTEM EFFECTS OF NUCLEAR ENERGY AND VRE

Electricity generating power plants do not exist in isolation. They interact with each other and their customers through the electricity grid as well as with the wider natural, economic and social environment. This means that electricity production generates costs beyond the perimeter of the individual plant. Such external effects or system effects can take the form of intermittency, network congestion or greater instability but can also affect the quality of the natural environment or pose risks in terms of security of supply. Accounting for such system costs can make significant differences to the social and private investor costs of different power generation technologies.

This study focuses on the system effects of nuclear power and variable renewables, such as wind and solar, as their interaction is becoming increasingly important in the decarbonising electricity systems of OECD countries. In particular, the integration of variable renewables is a complex issue that profoundly affects the structure, financing and operational mode of electricity systems in general and nuclear in particular. The present study, overseen by the Working Party on Nuclear Energy Economics (WPNE) of the OECD Nuclear Energy Agency (NEA), presents an overview of the most important system effects, proposes methodologies to assess them and provides systematic empirical cost estimates.

The introduction of significant amounts of variable renewables generates a number of hitherto unaccounted for impacts that are composed inter alia of the increased costs for transport and distribution grids, short-term balancing and long-term adequacy. The deployment of electricity from variable renewables is also significantly affecting the economics of dispatchable power generation technologies, in particular those of nuclear power, both in the short and the long run.

Source: OECD Nuclear Energy Agency, *Nuclear Energy and Renewables: System Effects in Low-carbon Electricity Systems,* Paris 2012.

The NICE Future Initiative

Over the last decade, nuclear providers have come to realise that they need to collaborate more closely in building and operating clean energy systems. Perhaps their collective response could have been faster.

In hindsight, IFNEC's own charter may have been too narrow. However, this no longer matters because IFNEC now supports the NICE Future initiative.

The initiative has three strategic objectives:

- first, to bring nuclear energy from traditional, nuclear-only fora to broader, multilateral discussions on clean energy;

- second, to discuss the role of nuclear energy in integrated clean energy systems of the future; and

- third, to ensure energy policymakers are informed of the opportunities and challenges of the full range of options needed to meet global clean energy goals— covering technology feasibility, economics and financing, and stakeholder perspectives.

Conclusion: What Will Now Happen in the Nuclear Industry?

No-one knows exactly. However, the global nuclear industry is looking at a market opportunity to supply 20% of the world's electricity by 2050. Without a contribution of this scale from nuclear energy, global climate goals will be significantly more difficult to achieve.

Technology neutrality is likely to become more deeply entrenched as a central principle of energy policy. This may help an increasing number of countries to recognise nuclear energy as a low-carbon option.

The criticality of managing climate change makes it imperative for the entire energy industry, and all energy-dependent industries, to be more actively involved in international climate and energy discussions and related technological developments.

As mentioned in the introduction, apart from investing in renewables, there is merit in investing in nuclear energy and other clean technologies if they are safe and affordable. As well, there appears to be much unrealised scope for collaboration amongst hitherto competing technologies and industry sub-sectors. All manufacturers of energy-intensive products have a vested interest in such collaboration to maintain or improve their international competitiveness.

In this author's opinion, so far as concerns nuclear energy, some specific actions that are warranted include:

i. The nuclear industry should adopt innovation and collaboration as its catch-cry.

ii. Energy-dependent industries should not wait for solutions to be presented to them by governments or by traditional energy sources. They should set up industrial parks and industrial-scale research centres to design and pursue low-carbon, fit-for-purpose solutions, with nuclear energy as one of the possible solutions.

iii. Whether or not it is a member of the NICE Future initiative, each country should consider whether its energy industry will be capable of providing low-carbon, reliable nuclear energy, utilising modern, innovative technologies as discussed at the Tokyo conference (bearing in mind that modern nuclear plants have 60-80 year lives).

iv. For each country, looking at a 30-50 year time horizon may be expedient, setting long-term goals and working backwards.

v. The potential for regional approaches and regional institutions should be examined and, where practicable, bridges between countries for collaboration on scientific research, development and prototype deployment should be established or extended.

vi. Best-practice technical regulation, in particular safety regulation, will be indispensible. Countries embarking on nuclear energy for the first time may seek guidance from the IAEA and ask other countries to share their experience.

vii. The fundamental principles of electricity market design will need to be looked at afresh. For instance, VRE and base load energy generation are very different and may be best served by separate markets with rules that are conducive to investment in each. Multi-purpose reactors supplying both electricity and heat do not necessarily need to be governed by the same market rules.

viii. The future financing of nuclear power plants, with their high capital costs, should be more closely studied. Financing will increasingly depend on proven, *n*th-of-a-kind technology, greater standardisation of regulations, long-term certainty of market design and credit-enhancement mechanisms.

Planning has commenced for a second conference of the NICE Future initiative in the final quarter of 2019.

With the release of its 2018 Roadmap, Canada is one country that is not waiting around.

If Australia is not to be left behind in responding to the global clean energy goal, it should sign up as a member of the NICE Future initiative. If it cannot be in the forefront of change in the nuclear sector, it should at least be a fast follower.

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About the Author

Robert Pritchard *is Executive Director of the Energy Policy Institute of Australia. He attended the 2018 Tokyo Conference on Advancing Clean Nuclear Energy.*

Robert has over 40 years' experience in Australia and other countries as a lawyer, director and adviser to industry, governments and organisations on energy projects, policies and technologies. This includes serving as chairman of the St Baker Energy Innovation Fund and SMR Nuclear Technology Pty Ltd and as a member of the advisory committee for the CSIRO Energy Transformed Flagship.