

## **ROBERT S DUTCH**

### **A Christian perspective on the place of nuclear energy in achieving net zero and national security**

#### **ADDITIONAL INFORMATION**

##### **The UK's nuclear industry**

The Net Zero All-Party Parliamentary Group (NZ APPG) report *Net Zero Roadmap: Getting to Net Zero by 2050 – or sooner* (2021) shows the immensity of the challenge and the APPG's desire to urgently embed and accelerate the Government's net zero policy. The report recognises nuclear energy's role, alongside renewables, in the electricity system and its potential in producing green hydrogen.<sup>1</sup> This is discussed further in the Nuclear Energy APPG report *Net Zero Needs Nuclear: A Roadmap to 2024*. The report sees nuclear as meeting its twin goals of levelling up the economy and cutting carbon emissions, while WNN notes that the Nuclear APPG recognises that the UK's nuclear industry: 'has helped avoid the equivalent of six years of national carbon emissions.'<sup>2</sup>

In the UK, people are accustomed to a secure electricity supply system keeping the lights on. But what if we have blackouts? For example, the Royal Academy of Engineering's (RAE) *Living without electricity: One city's experience of coping with loss of power* tells the story of the many unexpected and unwanted outcomes on 100,000 people of a 24-hour blackout in Lancaster from Storm Desmond in December 2015.<sup>3</sup> Also, in November/December 2021, Storm Arwen caused destruction leaving over one million customers without power and thousands without power for days.<sup>4</sup> We need a resilient electricity supply system that meets rising demands in a low-carbon world while functioning in extreme weathers.

The former Central Electricity Generating Board (CEGB) had a long-term construction programme to operate its Magnox fleet of reactors, alongside its coal- and oil-fired plants, in order to 'keep the lights on.' Its first nuclear plants were officially opened in 1963 at Berkeley (on the River Severn) and Bradwell (in Essex). Subsequent Magnox nuclear plants were built and operated in England, Scotland, and Wales. All are now closed having reached the end of their productive lives. Previously, the CEGB also operated a fleet of Advanced Gas-cooled reactors (AGRs) and one Pressurised Water Reactor (PWR) at Sizewell B (East Suffolk). Over time they became owned and operated by EDF.

Eventually, at its peak (around 1995) 25% of the nation's electricity was generated by firm and clean low-carbon nuclear energy in the days before renewables' rapid growth. Indeed,

from 1983-1998 of the low carbon electricity supplied to the grid over 90% came from nuclear power.<sup>5</sup> This historic data shows the major contribution by nuclear power. If these plants had not operated the nation would have had more fossil-fired generation emitting more greenhouse gases and air pollution.

The AGRs are approaching, or have reached, the ends of their operating lives. Three are permanently shutdown (with 6 reactors). Dungeness B started generating in 1983 and in 2018 began an extended outage but in June 2021 EDF decided not to restart the plant which had operated for ten years longer than its original design life. During its life the plant's low-carbon electricity avoided emissions of almost 50 million tonnes of carbon dioxide and injected over £1billion into Kent's economy. Its best generation year (2016) produced enough electricity for around 2 million homes.<sup>6</sup>

In Scotland, Hunterston B's reactors 3 and 4 ceased generation in November 2021 and January 2022 respectively. It was a productive station that began generation in 1976 with an expected life of 25 years but supplied low-carbon electricity for almost 46 years – equivalent to supplying every Scottish home for almost 31 years. And: 'The carbon avoided ..., when compared to gas generation, is like taking every car off Scotland's roads for 19 years.'<sup>7</sup> Hinkley Point B, the CEGB's first operating AGR, started generating in early 1976 when the author was a member of the health physics commissioning team. It closed in July 2022, despite speculation that the Government would request a life extension.<sup>8</sup> It operated for almost 46 years – saving around 100 million tonnes of CO<sub>2</sub> discharges – an amazing achievement.<sup>9</sup>

The closure dates for the remaining AGRs are: Hartlepool and Heysham 1 (2024), Heysham 2 (2028), and Torness (2028). Once Hartlepool and Heysham 1 are closed the UK's nuclear capacity will fall to around 3.65 GWe (gigawatts electrical). However, in September 2022, EDF announced it would examine short extensions to both plants. But currently, it is expected that by 2028 all AGRs will be shutdown leaving only Sizewell B operational and the new Hinkley Point C. EDF is leading a programme to examine extending the operational lifespan of Sizewell B.<sup>10</sup> EDF's nuclear stations prevent millions of tonnes of carbon dioxide emissions annually (compared to direct emissions of combined cycle gas turbines).<sup>11</sup>

### ***From Industrial Strategy to British Energy Security Strategy***

In 2017 the Government's *Industrial Strategy* White Paper identified Grand Challenges including nuclear energy as vital in our ongoing energy mix. Since then, reports, such as the *Clean Growth Strategy* (2017), the *Ten Point Plan for a Green Industrial Revolution* (2020) and the Energy White Paper *Powering our Net Zero Future* (2020) reaffirm the Government's

commitment to pursue large-scale nuclear reactors, small modular reactors, and advanced modular reactors.

In September 2021, Sir John Armitt, Chairman of the National Infrastructure Commission (NIC), wrote to the Chancellor of the Exchequer and the Secretary of State regarding ‘National Infrastructure Commission advice on nuclear power plant deployment.’ It began: ‘You asked in your letter ... for the National Infrastructure Commission’s advice on whether an additional new nuclear plant, beyond the proposed Sizewell C project, is needed to deliver the sixth Carbon Budget. The Commission’s view is that it is not.’ The letter, and advice, argued that after Sizewell C no new nuclear was needed in the next 15 years as firm power to support variable renewables. Nevertheless, the Commission recognised nuclear as a firm low carbon power source which may have a place ‘in a 2050 net zero emissions power system,’ but not in the short term to 2035 as it ‘would be too risky.’<sup>12</sup>

But when the Government released its *British Energy Security Strategy: Secure, clean and affordable British Energy for the Long term* (April 2022) this did not follow the NIC’s advice.<sup>13</sup> Yet Armitt welcomed the Government’s ambition.<sup>14</sup> The strategy focuses on future build with the Government planning large increases in renewables while aiming to approve a fleet of eight new reactors plus SMRs. The strategy notes nuclear supplies 15% of our electricity while it ‘is the only form of reliable, low carbon electricity generation which has been proven at scale and returns more than a hundred times as much power as a solar site of the same size. We can only secure a big enough baseload of reliable power for our island by drawing on nuclear.’<sup>15</sup> The civil nuclear industry looks to be expanded with 24 GW by 2050 – 25% of projected electricity demand (which is likely to double today’s capacity) and three times more than the current installed capacity. The strategy included the Government’s launch of the Great British Nuclear (GBN), for supporting the UK’s new nuclear projects.

In July 2023, the House of Commons Science, Innovation and Technology Committee published a comprehensive forward-looking report, *Delivering nuclear power*, with clear conclusions and many recommendations.<sup>16</sup>

### **Sizewell C Power Station (SZC) and hydrogen production**

Sizewell C aims to offer cogeneration in a low-carbon energy hub. Using cogeneration will reduce the plant’s waste heat and make it more efficient. For hydrogen production, a demonstrator plant with electricity from Sizewell B power station is proposed. Hydrogen can also be generated by local offshore wind in accordance with the Ten Point Plan.<sup>17</sup> The UK’s NIC launched its *Hydrogen Roadmap* (2021) indicating how large reactors and SMRs can make

a major contribution to the production of green hydrogen (along with renewables).<sup>18</sup> And in June 2022 the UK Hydrogen and Fuel Cell Association's report *The role for Nuclear-Enabled Hydrogen in delivering Net Zero* gave key messages on nuclear-enabled hydrogen's considerable potential: heating homes, creating jobs, fuelling hydrogen buses, decarbonising shipping, and aviation emissions.<sup>19</sup>

SZC will be an important addition to the energy mix in achieving national energy security as was evident in winter 2022/23. Despite all the renewables which have been built, while the nation tries weaning itself off gas, coal plants were put on standby. During a cold spell on 12<sup>th</sup> December 2022, *the Financial Times* reported: 'National Grid asks "contingency" coal plants to fire up as cold grips UK.'<sup>20</sup> The weather conditions had reduced wind generation. On that Monday wind supplied less than 4% compared to an average of around 28%. Gas generation rose to 58% compared with an average of 42% over 12 months. Again, in January 2023, coal plants were asked to start warming up as a standby measure in the cold snap.

### **Small modular reactors (SMRs)**

In the US, the Nuclear Regulatory Commission has given approval to NuScale's SMR a pressurised water reactor called VOYGR which is a single 77 MWe unit. It is available in modules of 4, 6 or 12 power plants. A six-unit module is to be constructed at Idaho National Laboratory.<sup>21</sup> China started construction of a demonstration SMR plant in July 2021. It is a 125 MWe pressurised water reactor called the ACP100 (or Linglong One) which is multi-purpose supplying: electricity, heating, seawater desalination and steam. In 2016 the International Atomic Energy Agency (IAEA) passed the design in its safety review. The UK's Parliamentary Office of Science and Technology's note on *Small Modular Reactors* (July 2018) provides background.<sup>22</sup>

In March 2022, the Department for Business, Energy & Industrial Strategy (BEIS) asked the independent regulators to begin a Generic Design Acceptance (GDA) for the Rolls-Royce SMR which will assess its standard PWR design and fuel against criteria for safety, security, and environmental protection. Besides completing the GDA the proposed operator must obtain a site licence and various consents to begin construction.<sup>23</sup> The regulators work on behalf of the public and in 2022 the Office for Nuclear Regulation's (ONR) *Chief Nuclear Inspector's annual report on Great Britain's nuclear industry* stated: 'I am pleased to report that overall, during 2021/22, Great Britain's (GB) nuclear industry has once again achieved the high standards of safety, security and safeguards compliance'.<sup>24</sup> The ONR will only issue a Design Acceptance Confirmation (DAC) if the design meets the specified standards.<sup>25</sup>

The consortium aims to build 16 SMRs with up to 10 by 2035.<sup>26</sup> This is welcome news. A Nuclear Industry Association spokesperson said the UK needs this SMR design ‘to for strengthening our energy security.’<sup>27</sup> Moreover, there is interest abroad. For example, Rolls-Royce SMR and Poland’s state-owned Industria have signed a memorandum of intent to cooperate on deployment of SMR technology to help decarbonise industry and provide clean energy. Initially, there are plans for ‘up to three’ SMRs to produce low-carbon hydrogen.<sup>28</sup> Rolls-Royce SMRs may also be operating in the Czech Republic in the early 2030s.<sup>29</sup>

With large nuclear fission reactors, SMRs and advanced modular reactors potentially being built it is imperative to consider locations for new sites and engage with local communities and stakeholders. Manchester University's Dalton Nuclear Institute’s paper *Siting implications of nuclear energy: a path to net zero* (2022) provides nine key recommendations for participants to deliver net zero using nuclear energy. Rolls-Royce SMR has identified four potential sites for 16 GWe which is a considerable commitment to the *Energy Security Strategy* of having 24 GW by 2050.<sup>30</sup>

### **Interconnectors and batteries**

In October 2022, Great Britain’s electricity interconnectors with other countries stood at 8.4 GW but are expected to almost double by 2025. National Grid sees them playing an essential role in achieving net zero with the benefits of sustainability, reliable (security of supply) and affordability. But in 2011, Peter Dolan’s paper ‘Edging towards a credible energy strategy’ asked: ‘What are the chances that a large cold zone of high pressure is fixed over Western Europe for several days so that no significant wind is generated anywhere in Western Europe?’ As we reduce our dependence on fossil fuels and rely more on wind ‘the intermittency challenge’ remains.<sup>31</sup> Too much dependence on interconnectors can weaken our national security. And if we use France’s nuclear-generated electricity from interconnectors why not build our own nuclear plants with supply chains and skilled staff? Virginia Crosbie MP, spoke about the risks associated with energy imports citing the fire at the French interconnector in Kent which produced ‘soaring energy prices in the UK. We usually import 3 GW of power from France—enough to supply 3 million homes. That fire showed how fragile our energy security is.’ Besides that, she addressed uncertainties with Russian gas supplies even before Russian’s invasion.<sup>32</sup> This argument is strengthened by the observation that normally the UK is an importer of electricity, although for the first time in 2022, the UK became a net exporter of electricity as Norway experienced low hydro availability and France’s nuclear plants required maintenance and repairs, thus reducing their electricity generation.<sup>33</sup>

Besides interconnectors the UK needs energy storage. This is not straightforward nor cheap, but it is essential, as Roulstone and Cosgrove have shown. They model the UK's electricity system doubling in 2050, even with efficiencies, to over 600 TWh with very high usage of variable renewables (perhaps 70%), overcapacity, a baseload (perhaps nuclear), interconnectors and energy storage (e.g. batteries).<sup>34</sup> It is a complex consideration of the issues, costs, and options. Moreover, some residents are concerned over the safety aspects of high intensity battery-storage fires.<sup>35</sup>

### **An international perspective post-Fukushima**

Like Germany, Belgium, began to phase-out its nuclear power plants although they accounted for around half of the nation's electricity. The phase-out originally scheduled all reactors to be closed by the end of 2025. The first reactor, of seven, to be closed, was shutdown in September 2022. However, the International Energy Agency (IEA) urged a rethink. Belgium has agreed to delay shutdowns and two nuclear plants will close but be restarted in 2025 for ten years. This extension is welcomed but also queried by the Belgian Nuclear Society (BNS) because of the climate challenges. BNS concludes: 'Relying more on gas, in these circumstances and for the next decades, does not seem compatible with societal sustainability, searching for the best balance between environment protection, security, affordability and reliability of clean energy supply.'<sup>36</sup>

France's nuclear plants normally supply around 75% of electricity production. However, back in 2014 under president Francois Hollande's government, a decision was made to cap its nuclear capacity at 50% of total output by 2025. Current reactors would not be closed but if new ones came online then older plants needed to close. This date has now been moved to 2035. In February 2022, president Emmanuel Macron announced a nuclear renaissance in France. Current plants, subject to safety, should have life extensions and six new reactors would be built, with an option of eight more later.<sup>37</sup>

South Korea is an example of a nuclear phase-out being cancelled and reversed. South Korea has several operating nuclear reactors but the former President Moon Jae-in's policy was to phase-out nuclear. However, following the election of President Yoon Suk-yeol in May 2022 this phase-out policy was reversed. New nuclear build is commencing for both the country and exports. In 2017, the construction of two units at Shin Hanul nuclear plant was suspended but the new Korean government called for it to resume. Unit 1 of Shin Hanul entered commercial operation in December 2022. Unit 2 is expected to enter commercial operation in September

2023. The aim is to establish a minimum of 30% of the country's energy from nuclear by 2030 to support energy security and greenhouse gas emissions.<sup>38</sup>

Moreover, Korea is involved with building new reactors overseas. Korean designed AP-1400 reactors have been built in the United Arab Emirates (UAE) at Barakah through the vendor Korea Electric Power Corporation (KEPCO). Construction of units 1 and 2 started in 2012 and they began commercial operation respectively in April 2021 and March 2022. Unit 3 commenced commercial operation in February 2023, while unit 4 completed hot functional tests in July 2022. Together the four units will generate around 25% of the country's electricity while preventing millions of tonnes of annual carbon emissions – thus contributing to the UAE's net zero policy.<sup>39</sup>

Poland has decided to move from using fossil fuels to start building nuclear plants. In October 2022, Poland's Prime Minister announced that the US-based firm Westinghouse had been chosen to build the nation's first reactors. Then on 31<sup>st</sup> October, Polish and Korean officials agreed that Polish companies would meet with Korean Hydro and Nuclear Power (KHNP) to produce joint plans for a new nuclear plant using its APR-1400 technology.<sup>40</sup> Poland aims to build six large reactors to reduce its dependency on coal plants.

The Czech Republic aims to build new reactors. KHNP is one of three vendors bidding to build a new reactor (for electricity and heat) in the Czech Republic using its APR-1400 pressurised water reactor. The Czech Republic uses nuclear power to generate 34% of its electricity. Moreover, mainly from the current energy crisis there has been an increase to 72% in public support for nuclear generation.<sup>41</sup>

The US is involved in developing SMRs while cooperating with Canada through the nations' regulators. The 2022 US Inflation Reduction Act provides support for new nuclear and current plants and was welcomed by nuclear industry representatives.<sup>42</sup> Moreover, a Coal-to-nuclear transition is under consideration following a 2022 study sponsored by the US Office for Nuclear Energy and written by the Argonne National Laboratory, Idaho National Laboratory, and Oak Ridge National Laboratory. It addresses *Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants* and found that hundreds of retired and operational coal plants could be converted to advanced nuclear power plants with many community benefits. Further studies can build on this to investigate specific plants.<sup>43</sup> In June 2023, the US and UK announced the Atlantic Declaration for a Twenty-First Century U.S.-UK Economic Partnership. It includes a civil nuclear partnership on nuclear energy and a Joint Standing Committee on Nuclear Energy Cooperation.<sup>44</sup>

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**Robert Dutch was a scientist/engineer in the nuclear power industry and holds a classics-theology PhD. He wrote *Let There Be Light! Nuclear Energy: A Christian Case*.**

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<sup>1</sup> NZ APPG. *Net Zero Roadmap: Getting to Net Zero by 2050 – or sooner*, 13 December 2021. Accessed 24 March 2022 at [NZ-APPG-Roadmap-Report-2021-1.pdf \(netzeroappg.org.uk\)](#)

<sup>2</sup> WNN. ‘UK must commit to at least 10 GW of new nuclear, says APPG’, 30 June 2021. Accessed 4 March 2023 at [UK must commit to at least 10 GW of new nuclear, says APPG : Nuclear Policies - World Nuclear News \(world-nuclear-news.org\)](#)

<sup>3</sup> RAE. *Living without electricity: One city’s experience of coping with loss of power*, May 2016. Accessed 18 June 2022 at [living-without-electricity \(raeng.org.uk\)](#)

<sup>4</sup> Ofgem. *Storm Arwen Report*, 9 June 2022. Accessed 9 February 2023 [Storm Arwen Report | Ofgem](#)

<sup>5</sup> Roberts, T., & Clark, H. *Nuclear electricity in the UK: special feature*, undated. BEIS p. 65. Accessed 1 March 2023 at [Nuclear electricity in the UK.pdf \(publishing.service.gov.uk\)](#)

<sup>6</sup> EDF. ‘Dungeness B: EDF decides to move Dungeness B into defuelling phase’, 7 June 2021. Accessed 11 March 2022 at [EDF decides to move Dungeness B into defuelling phase | EDF \(edfenergy.com\)](#)

<sup>7</sup> EDF. ‘Hunterston B: Zero-carbon electricity generation ends at Hunterston B’, 7 January 2022. Accessed 11 March 2022 at [Zero-carbon electricity generation ends at Hunterston B | EDF \(edfenergy.com\)](#)

<sup>8</sup> WNN. ‘EDF Energy confirms Hinkley Point B shutdown plan’, 1 June 2022. Accessed 3 June 2022 at [EDF Energy confirms Hinkley Point B shutdown plan : Corporate - World Nuclear News \(world-nuclear-news.org\)](#)

<sup>9</sup> Harvey, D. ‘Hinkley B: UK’s most productive nuclear power plant closes,’ BBC News, 1 August 2022. Accessed 29 August 2022 at [Hinkley B: UK’s most productive nuclear power plant closes - BBC News](#)

<sup>10</sup> EDF. ‘EDF to examine extensions for Hartlepool and Heysham 1,’ 28 September 2022. Accessed 9 December 2022 at [EDF to examine extensions for Hartlepool and Heysham 1 : Corporate - World Nuclear News \(world-nuclear-news.org\)](#)

<sup>11</sup> EDF. ‘Nuclear Power,’ undated. Accessed 4 March 2023 at [Nuclear power - generating low carbon electricity in the UK | EDF \(edfenergy.com\)](#)

<sup>12</sup> Armitt, J. ‘National Infrastructure Commission advice on nuclear power plant deployment’, 24 September 2021. Accessed 1 March 2023 at [Advice-on-nuclear-power-plant-deployment.pdf \(nic.org.uk\)](#)

<sup>13</sup> BEIS & Prime Minister’s Office. ‘British energy security strategy’, Policy paper 7 April 2022. Accessed 9 December 2022 at [British energy security strategy - GOV.UK \(www.gov.uk\)](#)

<sup>14</sup> Mallows, R. ‘Commission welcomes "scale of ambition" of Energy Security Strategy’, 7 April 2022. Accessed 21 June 2022 at [Commission welcomes "scale of ambition" of Energy Security Strategy - NIC](#)

<sup>15</sup> HM Government. *British Energy Security Strategy: Secure, clean and affordable British Energy for the Long term*, April 2022 pp. 20-21. Accessed 20 June 2022 at [British energy security strategy - GOV.UK \(www.gov.uk\)](#)

<sup>16</sup> House of Commons Science, Innovation and Technology Committee. *Delivering nuclear power*, Eighth Report of Session 2022–23, HC 626 31 July 2023. [Delivering nuclear power \(parliament.uk\)](#)

<sup>17</sup> EDF Energy. *Sizewell C: Our Commitments to Britain*, 2021, pp. 9-10. Accessed 24 June 2023 at [sizewell c - our commitments to britain final 2.pdf \(edfenergy.com\)](#) The report indicates job opportunities.

<sup>18</sup> WNN. ‘UK nuclear industry launches 'hydrogen roadmap'’, 17 February 2021. Accessed 23 June 2022 at [UK nuclear industry launches 'hydrogen roadmap' : Energy & Environment - World Nuclear News \(world-nuclear-news.org\)](#)

<sup>19</sup> UK HFCFA. *The role for Nuclear-Enabled Hydrogen in delivering Net Zero*, June 2022. Accessed 20 June 2022 at [The-Role-for-Nuclear-Enabled-Hydrogen-In-Delivering-Net-Zero.pdf \(ukhfca.co.uk\)](#)

<sup>20</sup> Sheppard, D. ‘National Grid asks “contingency” coal plants to fire up as cold grips UK’, 12 December 2022. Accessed 12 December 2022 at [National Grid asks 'contingency' coal plants to fire up as cold grips UK | Financial Times \(ft.com\)](#)

<sup>21</sup> NuScale. ‘NuScale Reaches Key Milestone in the Development of the Carbon Free Power Project’, Press release 9 January 2023. Accessed 4 March 2023 at [NuScale Reaches Key Milestone in the Development of the Carbon Free Power Project | NuScale Power](#)

<sup>22</sup> The Parliamentary Office of Science and Technology. *Small Modular Nuclear Reactors*, POSTnote 580 July 2018. Accessed 25 March 2022 at [POST-PN-0580.pdf \(parliament.uk\)](#)

<sup>23</sup> ONR & EA. ‘Generic Design Assessment (GDA) of new nuclear power stations’, updated 21 June 2021. Accessed 20 June 2022 at [Generic Design Assessment \(GDA\) of new nuclear power stations \(onr.org.uk\)](#)

<sup>24</sup> ONR. *Chief Nuclear Inspector’s annual report on Great Britain’s nuclear industry*, October 2022, p. 6. Accessed 13 February 2023 at [Chief Nuclear Inspector’s Annual Report on Great Britain’s Nuclear Industry 2021/22 \(onr.org.uk\)](#)



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- <sup>25</sup> ONR. ‘Rolls-Royce SMR Limited to enter Step 1 of GDA’, 1 April 2022. Accessed 13 February 2023 at [Rolls-Royce SMR Limited to enter Step 1 of GDA - Office for Nuclear Regulation - News \(onr.org.uk\)](#) Two other regulators are: The Environment Agency and Natural Resources Wales.
- <sup>26</sup> WNN. ‘Rolls-Royce hopes for UK SMR online by 2029’, 19 April 2022. Accessed 29 April 2022 at [Rolls-Royce hopes for UK SMR online by 2029 : New Nuclear - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>27</sup> WNN. ‘Rolls-Royce SMR design accepted for review’, 7 March 2022. Accessed 28 March 2022 at [Rolls-Royce SMR design accepted for review : Regulation & Safety - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>28</sup> Gould, D. ‘Industria selects Rolls-Royce SMR for use in Polish green energy projects’, Press release 8 February 2023. Accessed 16 February 2023 at [Industria selects Rolls-Royce SMR for Polish green energy - Rolls Royce SMR \(rolls-royce-smr.com\)](#)
- <sup>29</sup> Gould, D. ‘Factory-built nuclear power plants could be operating in Czech Republic by early 2030s’, Press release 25 January 2023. Accessed 16 February 2023 at [Factory-built nuclear power plants could be operating in Czech Republic by early 2030s - Rolls Royce SMR \(rolls-royce-smr.com\)](#)
- <sup>30</sup> Rolls-Royce. ‘Rolls-Royce SMR prioritises four NDA sites for 15 GW of new nuclear power’, 9 November 2022. Accessed 15 December 2022 at [Rolls-Royce SMR prioritises four NDA sites for 15 GW of new nuclear power - Rolls Royce SMR \(rolls-royce-smr.com\)](#)
- <sup>31</sup> Dolan, P. ‘Edging towards a credible energy strategy,’ *Nuclear Future* 7(6), 35-41 (p. 41).
- <sup>32</sup> UK Parliament. *Small Modular Reactors and Energy Security*, debated 19 January 2022. Accessed 4 March 2023 at [Small Modular Reactors and Energy Security - Hansard - UK Parliament](#)
- <sup>33</sup> IEA. *Electricity Market Report 2023*, February 2023, p. 89. Accessed 12 February 2023 at [Electricity Market Report 2023 \(windows.net\)](#)
- <sup>34</sup> Roulstone, T. & Cosgrove, P. ‘UK energy systems for zero-carbon in 2050’, University of Cambridge, *Nuclear Future* (2022) 18(2), 54-58. Accessed 19 May 2022 at [\(PDF\) UK energy systems for zero-carbon in 2050 \(researchgate.net\)](#)
- <sup>35</sup> For example, Mountain, J. ‘What fire risks should be considered when working with batteries and power storage facilities’, *Electrical Review*, 13 April 2021. Accessed 23 June 2022 at [What fire risks should be considered when working with batteries \(electricalreview.co.uk\)](#) Also, see: Oliver, A. ‘UK’s giant battery “farms” spark fears of explosions that can reach temperatures of 660C - even worse than the Beirut port blast - with one expert calling them “potential bombs”’, *MailOnline*, 10 July 2021. Accessed 4 March 2023 at [UK's battery 'farms' spark fears of explosions | Daily Mail Online](#) This refers to a report by co-author Wade Alison (emeritus physics professor, Oxford University); Fordham, E., Allison, W., & Melville, D. ‘Safety of Grid Scale Lithium-ion Battery Energy Storage Systems’, 5 June 2021. Accessed 23 June 2022 at [\(PDF\) Safety of Grid Scale Lithium-ion Battery Energy Storage Systems \(researchgate.net\)](#)
- <sup>36</sup> BNS. *BNS POSITION STATEMENT: Why not more than two reactors for more than ten years?* May 2022. Accessed 24 June 2022 at [Microsoft Word - BNs position paper LTO final \(bnsorg.be\)](#)
- <sup>37</sup> WNN. ‘France outlines plans to speed new nuclear’, 4 November 2022. Accessed 4 November 2022 at [France outlines plans to speed new nuclear : New Nuclear - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>38</sup> WNN. ‘South Korean APR-1400 starts commercial operation’, 7 December 2022. Accessed 12 December 2022 at [South Korean APR-1400 starts commercial operation : New Nuclear - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>39</sup> WNN. ‘Third Barakah unit begins commercial operation’, 24 February 2023. Accessed 28 February 2023 at [Third Barakah unit begins commercial operation : New Nuclear - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>40</sup> WNN. ‘Initial Patnów site assessment under way’, 11 November 2022. Accessed 12 December 2022 at [Initial Patnów site assessment under way : New Nuclear - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>41</sup> WNN. ‘Competition officially begins for Dukovany new build’, 30 November 2022. Accessed 12 November 2022 at [Competition officially begins for Dukovany new build : New Nuclear - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>42</sup> WNN. ‘Inflation Reduction Act passed by the US House’, 15 August 2022. Accessed 20 February 2023 at [Inflation Reduction Act passed by the US House : Energy & Environment - World Nuclear News \(world-nuclear-news.org\)](#)
- <sup>43</sup> Griffith, A. ‘Could the Nation’s Coal Plant Sites Help Drive a Clean Energy Transition?’ US Office of Nuclear Energy 13 September 2022. Accessed 12 December 2022 at [Could the Nation’s Coal Plant Sites Help Drive a Clean Energy Transition? | Department of Energy](#)
- <sup>44</sup> Department for Business & Trade, Foreign, Commonwealth & Development Office and Prime Minister’s Office. ‘The Atlantic Declaration’, Policy paper updated 23 June 2023. Accessed 24 June 2023 at [The Atlantic Declaration - GOV.UK \(www.gov.uk\)](#)