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1. Nuclear Finance Delay

The UK's Nuclear Industry Association (NIA) has been lobbying hard for the government to come up with a financing mechanism to support investment in new build projects. The government announced in June 2018 that it would review the viability of a Regulated Asset Base model, but it has yet to respond to a public consultation on the Treasury's proposal that took place between 22nd July and 14th October last year. (1)

(See Nuclear Finance nuClear News No.116 May 2019 http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2019/04/NuClearNewsNo116.pdf Nuclear Finance: From No Subsidies to Nuclear Tax, nuClear News No.118 July/August 2019http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2019/07/NuClearNewsNo118.pdf and Nuclear Finance. nuClear News No.119 November 2019 http://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2019/11/NuClearNewsNo119.pdf)

The BBC reported that the NIA had sent a confidential letter to Chancellor Rishi Sunak because of fears that the government would ditch plans to pay for new nuclear plants through a levy on energy bills in the March Budget. (2) In the event there was only mention of nuclear fusion in the Budget.

The Theberton and Eastbridge Action Group on Sizewell C (TEAGS) (now called Stop Sizewell C) said the letter exposed the vulnerability of new nuclear projects and highlighted growing worries the Treasury may ditch plans for a new funding model, on which EDF Energy's business case for Sizewell C depends. Opponents of the Regulated Asset Base (RAB) funding model – dubbed the 'Sizewell Surcharge' - say it would expose bill-payers to huge costs. Paul Dorfman, founder of the Nuclear Consulting Group, said new nuclear projects had experienced "*vast cost and time over-runs*". "*Under RAB, the plan is for the burden of risk to pass to hard-press UK consumers and taxpayers,*" he added.

More than 46,000 people have signed a petition opposing the plans to finance new nuclear station in this way. Alison Downes of TEAGS said "*Based on its other projects, it will be impossible for EDF to accurately predict how much Sizewell C will cost and how long it will take to build*". (3)

In the letter NIA chairman, Dr Tim Stone, wrote: "*To enable the investment required for large-scale electricity infrastructure, there is an urgent need for the introduction of a new, robust financing mechanism which ensures investor confidence, reduces the cost of capital, and provides very significant value to the consumer. The timing of the implementation of such a financing model is critical in ensuring the stability of the UK nuclear supply chain and workforce, and in delivering value for money to the national economy.*" He added: "*Without the right policy framework and investment model in legislation, then replacing this capacity and underpinning our future power needs becomes impossible to achieve*." (4)

Stone says the business case for Sizewell C is dependent on the transfer of operations in a timely fashion from Hinkley Point C. The Horizon site Wylfa Newydd, which was suspended in January 2019, also depends on a more favourable financial model. "*Work being undertaken by the*

industry towards achieving the 30% reduction in new build costs by 2030 can only be realised with a programme of new build activity to address those cost reductions."

"*The real efficiency gains will be made when they move from Hinkley to Sizewell C, in terms of replication and digital design*," says Mott MacDonald nuclear global practice leader Mark Liddiard. A 20% cost saving would effectively knock £4bn off the original price for Hinkley, and could partly be achieved simply by reusing Hinkley designs. (5)

Stone goes on to say that the National Infrastructure Commission advice that only one more large-scale nuclear power station after Hinkley was needed is *"fundamentally flawed*" because it takes no account of the new net zero by 2050 commitment.

The BBC believes the Treasury has taken a dim view of the plan to finance plants through a levy on customer bills. Its accounting experts have said that because the plan would see the government picking up the bill for big cost overruns, the total cost could count as part of government borrowing. The new government has also shown a willingness to shake up energy policy by opening the door to the construction of new onshore wind farms.

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1. World Nuclear News 5th March 2020 https://www.world-nuclear-news.org/Articles/UK-industry-urges-fresh-approach-to-funding-new-bu
2. BBC 5th March 2020 https://www.bbc.co.uk/news/business-51733117
3. East Anglian Daily Times https://www.eadt.co.uk/business/nuclear-industry-association-pushes-for-rab-funding-to-support-edf-energy-s-sizewell-c-1-6549703
4. NIA letter to the Chancellor for the 2020 Spring Budget https://www.niauk.org/wp-content/uploads/2020/03/NIA-letter-to-the-Chancellor-for-the-2020-Spring-Budget.pdf
5. Construction News 10th Feb 2020 https://www.constructionnews.co.uk/civils/sectors-civils/the-road-ahead-for-nuclear-the-future-for-the-uks-stuttering-station-builds-10-02-2020/

2. "Greenest Ever" Budget Fails to Impress

The budget was touted in advance as the "*greenest ever*" but despite commitments on planting trees, reducing plastic waste, building flood defences and capturing carbon it failed to live up to expectations. The Committee on Climate Change, which advises the government on how to meet its legally binding commitment to achieve carbon neutrality by 2050, said the budget was a "*realistic start*" but that it did not "*close the climate policy gap*". There was no support, for instance, for more public transport, walking and cycling, insulating homes. *The Times* said Greenpeace's criticism was predictable but the Chancellor also came under fire from the Conservative think tank Bright Blue, which said freezing fuel duty for the tenth year in a row was "*a serious mistake, for environmental, fiscal and political reasons*". (1)

The Chancellor hinted that further green infrastructure and R&D plans would be announced as part of the delayed National Infrastructure Strategy and the autumn's Spending Review. The Government's long-awaited 30-year National Infrastructure Strategy (NIS) was supposed to be published alongside the budget has been delayed until "*before May*". The NIS will outline how £100bn will be spent over this parliament. Investments are expected to be used to "level up" regions. There have already been calls for the NIS to bolster plans on energy efficiency, zero-carbon infrastructure and resources. Carbon Brief is reporting that the £9.2bn in support for energy efficiency in existing homes, schools and hospitals pledged in the Conservative election manifesto could be allocated in the NIS. However, green groups are calling for a greater focus on renewable energy, which was noticeably absent from Budget announcements.

The Budget confirmed plans for a new £270m Green Heat Network Fund to run between 2022 and 2025.(2) he Budget did commit the Government to spending £800m on Carbon Capture and Storage (CCS) on at least two UK sites, one by the mid-2020s, a second by 2030, (3) although one analyst described the announcement as putting CCS lower down pecking order than potholes. (4)

The Solar Trade Association (STA) complained the Budget was thin on measures to tackle climate change and support the transition to a low carbon economy, but welcomed the decision to hold a review of business rates, which are the main barrier to the deployment of large rooftop PV, and an extension to the Renewable Heat Incentive. (5)

The Chancellor also announced £900m for research on "nuclear fusion, space and electric vehicles". The red book elaborates on this, stating this money will "ensure UK businesses are leading the way in high-potential technologies", including the commercialisation of nuclear fusion technology".

The government will consult on a new "*low-carbon heat support scheme*" to replace the RHI from April 2022. It said this would give grants to "*help households and small businesses invest in heat pumps and biomass boilers, backed by £100m of new exchequer funding*". Separately, a new "green gas levy" will be applied to consumer gas bills, subject to consultation. This will support the production of "biomethane", for use in the gas grid, from food waste and other biomass. The Treasury expects the levy to initially cost £1 per household per year, rising to £5 by 2025.

There's £500m over the next five years for EV charging infrastructure. The budget increased the Climate Change Levy (CCL) on gas from 2022-23, while freezing the rate for electricity. iNews dubbed this a new "boiler tax". (6) There will be an additional 30,000 hectares of trees, "a forest larger than Birmingham", over the next five years. This appears to be far off the afforestation targets suggested by the Committee on Climate Change (CCC). (7)

National Infrastructure Strategy

The NIS is reportedly being refocused to reflect a likely increase in resources and better integrate the UK's net zero by 2050 goal. The strategy is the government's formal response to the National Infrastructure Assessment, which was published two years ago by the independent commission and called for a sharp increase in low carbon infrastructure spending covering everything from smart grids and renewable energy projects to rail links and energy efficiency upgrades. (8)

The latest delay could have been informed by the recent Appeal Court ruling that the government's approval for Heathrow expansion should have considered the implications for the Paris Agreement. And there is now a fresh legal challenge on the HS2 high speed rail project by campaigner and broadcaster Chris Packham, which aims to deploy similar arguments to those which saw the approval for Heathrow expansion ruled illegal. (9)

Separately, the National Infrastructure Commission, which produced the original National Infrastructure Assessment, has published a new report detailing how increased investment in new technologies such as low carbon hydrogen generation could be the best way to deliver low cost power to UK consumers while delivering net zero greenhouse gas emissions by 2050. The latest modelling results show that a highly renewable power system, combined with flexible technologies including hydrogen powered generation, could be substantially cheaper than alternatives that rely heavily on a fleet of nuclear power plants.

The modelling suggests consumers could see electricity bills up to 30% lower than under alternative energy mixes if hydrogen power generation proves as effective as the projections suggest.

The report separately notes cost reductions in bringing renewable technologies on stream over the past 10 years, while costs of building and running nuclear power stations have not fallen consistently, even in countries that have built fleets of similar designed reactors. When considered alongside the potential for bioenergy with carbon capture and storage to run baseload - providing a constant, reliable flow of power - this weakens the case for committing to a new fleet of nuclear power stations now, the report concludes.

"*Making decisions now, such as committing to a fleet of nuclear power plants, rules out a more diverse future generation mix and the potential this has to reduce costs to consumers*," the Commission's report notes. "*Policy decisions that lock the UK consumer into paying for large scale programmes with long construction times risk missing opportunities that may emerge*."

The NIC report, *Net Zero: Opportunities for the power sector,* supports the Commission's previous recommendations about developing a flexible energy system. The Commission

suggests that the level of uncertainty in long term modelling and the rapid pace of technological change means it is unwise to shut down options before it is necessary. (10)

The Commission recommends that the government take action to ensure the UK is running on at least 50% renewable generation by 2030, as part of the transition to a highly renewable system. A renewables-based system looks like a safer bet at present than constructing multiple new nuclear plants. But a large amount of uncertainty does remain. Cancelling the nuclear programme entirely risks a 'stop start' approach which is likely to be highly inefficient. Agreeing support for no more than one more nuclear plant before 2025 allows the UK to pursue a highly renewable mix without closing off the nuclear alternative.

But the report noted that there had been cost reductions in renewable power technologies over the past ten years, while "*costs of building and running nuclear power stations have not fallen consistently, even in countries that have built fleets of similar reactors*". Given the potential for other non-intermittent technologies to complement renewables this "*weakened the case for committing to a new fleet of nuclear power stations*". (11)

1. Times 12th March 2020 https://www.thetimes.co.uk/article/budget-2020-sunak-fails-to-lead-way-on-climate-change-8r8nzqp93
2. Business Green 11th March 2020 https://www.businessgreen.com/news/4012265/budget-chancellor-promises-green-infrastructure-blitz
3. Edie 12th March 2020 https://www.edie.net/news/11/Does-the-Budget-put-the-UK-on-course-for-net-zero-emissions-/
4. Energy Voice 13th March 2020 https://www.energyvoice.com/otherenergy/228349/disappointment-as-chancellor-puts-ccs-lower-down-pecking-order-than-potholes/
5. Energy Live News 11th March 2020 https://www.energylivenews.com/2020/03/11/budget-2020-industry-responds/
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7. Carbon Brief 11th March 2020 https://www.carbonbrief.org/budget-2020-key-climate-and-energy-announcements
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10. NIC 6th March 2020 https://www.nic.org.uk/wp-content/uploads/Net-Zero-6-March-2020.pdf
11. Times 7th March 2020 https://www.thetimes.co.uk/article/advisers-raise-doubts-over-new-nuclear-plants-8hd85cr6d

3. Bradwell B – more horrendous than we ever imagined

The Office for Nuclear Regulation announced in February that it had completed Step 3 of its Generic Design Assessment (GDA) for the UK HPR1000 nuclear technology which the Chinese Company CGN is intending to build at Bradwell in Essex. General Nuclear System Limited (GNSL) (CGN 66.5% and EDF Energy 33.5%) then started its first stage public consultation exercise on 4th March 2020. This will run for 12 weeks until 27th May 2020. It was intended to include 15 public exhibitions and events, but many of these have been cancelled due to the Corona Virus, although the end date for the consultation remains 27th May.

Step 3 of the GDA was essentially a review by ONR of the arguments (or 'reasoning') supporting the Requesting Party's (RP's) claims regarding the safety and security related aspects of the proposed design. It was intended to improve ONR's knowledge of the design; assess the safety and security arguments; progress the resolution of issues identified during Step 2; identify whether any significant design or safety case changes may be needed; and identify major issues that may prevent ONR issuing a Design Acceptance Conformation (DAC) and attempt to resolve them; and thereby achieve a significant reduction in regulatory uncertainty. (1)

ONR will now move on to Stage 4 which is a more detailed assessment of the design and supporting evidence provided by CGN. This will continue to be open to public comment. During this phase the Environment Agency, joint UK nuclear regulator together with the ONR, will also undertake its own public consultation. At the end of Step 4 ONR will judge whether a DAC should be issued for the design. If there are generic technical issues that remain outstanding, and depending on their significance, ONR may issue an interim DAC (iDAC), or may judge that neither a DAC, nor an iDAC, are warranted. CGN is hoping to complete Step 4 in 23 months taking us to January 2022. (2)

ONR said the assessment to date had not identified any fundamental safety or security shortfalls that would prevent it issuing a Design Acceptance Confirmation (DAC) for the UK HPR1000 design. However, it did identify a number of areas for which further substantiation is needed from the Requesting Party; these have been captured as Regulatory Observations. "*Although progress so far is encouraging, a lot of work by the Requesting Party is still required*". (3)

Less than a week after ONR's announcement the Blackwater Against New Nuclear Group (BANNG) learnt that GNSL, was about to launch its pre-application public consultation for planning permission - long before detailed discussions with ONR are concluded.

Prof. Andy Blowers, Chair of BANNG commented that "*the Chinese developers are taking a risk in trying to present the public and politicians with an apparent 'fait accompli' well before major design and environmental hurdles have been crossed*".

Step 4 of the GDA process is when all the tricky issues facing the Bradwell B project must be confronted, including the cooling system, site suitability, security, coastal defence, impacts on marine and terrestrial environments and so on. It is a long and intensive process between the

developer and the independent regulators, the Office for Nuclear Regulation (ONR) and the Environment Agency (EA). It is not expected to be concluded for another two years. A pre-application should follow, not overlap, Step 4 of the GDA. (4)

GNSL announced that the consultation would run for 12 weeks - 4th March to 27th May. It was to include 15 public exhibition events, but two-thirds of these have been cancelled. (5) BANNG has written to GNSL urging them to terminate the consultation altogether. (6)

The Bradwell B plans are more horrendous than feared, according to BANNG, because of the scale of the devastation presented in the Chinese developer's glossy brochure. Prof. Andy Blowers said: "*The scale is enormous, the power station if built will cover an area around 230 times Trafalgar Square. Foundations for the power station will extend down to 60 feet below the ground and the two reactors and turbines will be constructed on a 'nuclear island' 25 feet above sea-level. Directly opposite Mersea Island will be cooling towers 200 feet high (higher than the remaining buildings of Bradwell A) and 500 feet wide. A building close to Bradwell Village in which the highly radioactive spent fuel will be stored for upwards of 150 years is also included*".

Peter Banks, BANNG's Co-ordinator said: "*...people need to make the strongest possible protest against these plans now, before it is too late. Apathy is not an option! Contrary to the impression the developer wishes to convey, Bradwell B is not a done deal*." (7)

BANNG has produced a crib sheet for responding to the consultation:
https://www.banng.info/wp/wp-content/uploads/2020/03/STAGE_ONE_ACTIONS.pdf

The National Infrastructure Planning Inspectorate is expecting a planning application for Bradwell B to be submitted in 2022. (8)

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1. Summary of the Step 3 Assessment of the UK HPR1000 Reactor, ONR February 2020 http://www.onr.org.uk/new-reactors/uk-hpr1000/reports/uk-hpr1000-step-3-summary-report.pdf
2. Times 14th Feb 2020 https://www.thetimes.co.uk/edition/business/china-designed-nuclear-reactor-is-cleared-to-face-last-hurdle-xjckwzz7d
3. World Nuclear News 13th February 2020 https://www.world-nuclear-news.org/Articles/UK-HPR1000-moves-to-final-design-assessment-stage
4. BANNG 18th February 2020 https://www.banng.info/news/press-release-18th-february-2020/
5. Bradwell B website https://bradwellb.co.uk/
6. BANNG 19th March 2020 https://www.banng.info/news/banng-press-release-19th-march-2020/
7. BANNG 10th March 2020 https://www.banng.info/news/press-releases/banng-press-release-10th-march-2020/
8. Reuters 5th March 2020 https://www.reuters.com/article/britain-nuclear/uks-bradwell-b-new-nuclear-plant-planning-application-expected-in-2022-idUSL8N2AY1OA?rpc=401&

4. Wylfa Newydd decision in hands of Alok Sharma

The decision on whether Wylfa Newydd gets the planning go-ahead now lies in the hands of new Energy Secretary Alok Sharma after Andrea Leadsom was axed in Boris Johnson's cabinet reshuffle.

A decision on Wylfa is due before March 31. Former BEIS Secretary Ms Leadsom had been expected to give a decision on the Development Consent Order application in October. But she deferred the decision for six months to obtain additional information on environmental and other impacts on Anglesey.

It is hoped by those who support the scheme that securing planning for the site will give the project fresh impetus and help drive through a new deal to fund the plant. (1)

While the Applicant was finalising updates requested by the Secretary of State, comments were invited from the Applicant and Interested Parties. The Secretary of State may decide to issue a further consultation with interested parties if required once all of the information is compiled. (2) Greenpeace responded saying the analysis used by Horizon to demonstrate the 'urgent need' for nuclear new build is out dated and must not be given significant weight in the determination of the Application. Horizon says "*the principle of the need for new nuclear power stations, and that this need is urgent, is firmly established in NPS EN-1 and…EN-6*", and further that EN-1 and EN-6 are the "*primary policy basis*" for the determination of the Application. This is simply not the case. Greenpeace demonstrates how the landscape has changed in the last two years, and why the argument that nuclear new build is both necessary and urgent is in itself out dated, meaning that significant weight should not and cannot be placed on the policy support for new nuclear on this basis. (3)

Under the headline "*Japanese offer nuclear power on the cheap*" *The Times* said Duncan Hawthorne, Chief Executive of Horizon Nuclear Power, a subsidiary of Hitachi, has written to Dominic Cummings, Boris Johnson's adviser, claiming Wylfa could produce electricity at £55/MWh – almost half the price of Hinkley Point C. It could produce 20 TWh/year enough to meet the entire power needs of Wales. (4)

The new Tory MP for Ynys Môn, Virginia Crosbie, used her maiden speech to highlight how the revival of Wylfa Newydd could "transform" the island's economy. She says we must embrace the economic and political opportunities of decarbonisation, and Wylfa Newydd has the potential to deliver thousands of high skilled employment and training opportunities and to start the reverse of two decades of economic decline on the island. (5)

The North Wales Daily Post says Wylfa could still happen but your electricity bills could end up paying for it. The under-secretary of state for industry confirmed to the House of Commons in February that a new energy White Paper will be published soon, adding that ministers had worked "extremely hard" during negotiations with developers Hitachi and that the Government had been ready to contribute "*significant investment*" while being mindful of a need to represent

value for money. Nadhim Zahawi said, "*The Wylfa site remains a potential location for new nuclear development, and Hitachi has stated that it is keen to discuss future options for the site with us, based on alternative funding models*."

1. Business Live 13th Feb 2020 https://www.business-live.co.uk/economic-development/new-energy-secretary-alok-sharma-17742535
2. National Infrastructure Planning Inspectorate 25th Feb 2020 https://infrastructure.planninginspectorate.gov.uk/projects/wales/wylfa-newydd-nuclear-power-station/
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4. Times 8th March 2020 https://www.thetimes.co.uk/edition/business/japanese-offer-nuclear-power-on-the-cheap-l8cqvg6q2
5. North Wales Chronicle 7th Feb 2020 https://www.northwaleschronicle.co.uk/news/18219426.ynys-mon-mp-highlights-wylfa-newydd-maiden-speech/
6. Daily Post 7th Feb 2020 https://www.dailypost.co.uk/news/north-wales-news/multi-billion-pound-anglesey-nuclear-17705808

5. Sizewell's threatened coast

EDF is poised to submit its formal planning application to build Sizewell C, according to *The Telegraph*. It was said to be putting the final touches to the paperwork in mid-February for its application for a Development Consent Order to the National Infrastructure Commission (NIC). The NIC is expected to take about a year to approve or reject the application.

The Telegraph reported that "*sources familiar with the project said EDF hoped to file the application as soon as the end of this month although it could be delayed until March*." At 79 acres (32 hectares), the Sizewell site is significantly smaller than the 111 acre (45 hectare) site at Hinkley Point, fuelling concerns about congestion during construction as well as the environmental impact. Sizewell is surrounded by protected marshland and bird habitats including RSPB Minsmere to the north. (1)

Suffolk Wildlife Trust has serious concerns about the effect upon wildlife of Sizewell C and, despite years of working closely with EDF, is far from convinced the company is taking the impacts seriously. It will be impossible wholly to mitigate or compensate for much of the negative impact on wildlife. The current plans suggest that we will lose between 20 and 30 acres of nationally important land that is supposedly protected by its Site of Special Scientific Interest status. This equates to covering roughly 10 football pitches of rare fen habitat in concrete. Invariably there will be devastating habitat loss for birds such as kingfisher and for rare mammals such as water vole and otters. EDF has made little attempt to minimise these losses. (2)

Suffolk Preservation Society says Sizewell C will cause environmental damage on an unprecedented scale in a highly sensitive location, much of which is designated an Area of Outstanding Natural Beauty. The construction phase will bring massive disruption to communities in East Suffolk over many years and will permanently change landscapes. Suffolk's environment is remarkably undeveloped and is characterised by a sense of remote wildness. The tranquillity provides a high quality of life for residents and is a major draw for tourists. However, this isolation is fragile and could easily be lost forever. The impact of a development such as Sizewell C upon heritage sites – including an abbey, churches, farmhouses and other vernacular buildings that contribute to the special qualities of Suffolk – will be considerable. The intrusion of new roads to cope with a massive increase in HGV traffic, spoil heaps, borrow pits, and accommodation for up to 3,000 workers will be felt across numerous locations. Development of the Sizewell site cannot be at unlimited cost to the quality and character of our county and its communities. (3)

Friends of the Earth add that two enormous pipes, each bigger than a double-decker bus, would such in water at 130,000 litres per second needed for cooling the reactors. Many tonnes of fish would be killed. (4)

Talking to the NFLA Conference held in Saxmundham on 14th March; Linda Pentz-Gunter of Beyond Nuclear said at the moment when we are looking at the Climate Crisis which is clearly upon us, which will involve sea level rise and increasing storm surges, to put a nuclear power station on a beach is some sort of level of insanity. You can walk away from a wind farm and the

wind turbines will keep spinning but you cannot call your workforce home from a nuclear power plant. It cannot be abandoned. To go ahead and build another structure that cannot be abandoned is also some sort of level of insanity. (5)

(1) Telegraph 15th Feb 2020 https://www.telegraph.co.uk/business/2020/02/15/edf-poised-submit-planning-application-20bn-nuclear-power-plant/
(2) For more on Suffolk Wildlife Trust see their presentation to the NFLA conference on 14th March here https://www.nuclearpolicy.info/wp/wp-content/uploads/2020/03/SWT_Sizewell_C_threats_to_protected_species_habitats.pdf
(3) Telegraph 23rd Feb 2020 https://www.telegraph.co.uk/opinion/2020/02/23/letterstory-supporting-constituencies-wont-happy-see-hs2-completed/
(4) Watch FoE's video here: https://youtu.be/2p6q_Vx_EQQ and Stop Sizewell C video here https://youtu.be/F9zLp1pjiB8
(5) NFLA 19th March 2020 https://youtu.be/XuHYnsAXjaU

6. Nuclear Nonsense

According to the Nuclear Industry Association (NIA) we could need a quadrupling of current nuclear capacity to meet the UK's net zero 2050 target. Current capacity, which will all have closed by 2050, is almost 9GW. This means the NIA is hoping that the industry will be able to build the equivalent of over ten Hinkley Point Cs over the next 30 years.

The upcoming Energy White Paper is the perfect chance, according to NIA, to inspire confidence in the nuclear sector: "*creating a compelling vision to bind the industry together, and a pathway to significant cost reductions, building on commitments within the Industrial Strategy*".

The energy white paper has been a long time coming. It was originally supposed to be published in early summer 2019, but has been consistently pushed back. In October, then energy secretary Andrea Leadsom told the BEIS select committee that the white paper would be published in Q1 on 2020 (so before the end of March). It will include details on the country's path to achieving net zero emissions by 2050, including which technologies will receive support.

The NIA favours giving support to Small Modular Reactors, 4th Gen Advanced Reactors, and Nuclear Fusion. But these "*represent the exciting future*". But in the meantime: "*we must capitalise on the large-scale power generation that's available today*", which means getting on with building Wylfa, Sizewell C, and Bradwell B, "*making Net Zero by 2050 look easy*". (1)

The most recent explanation of Government policy was probably by Baroness Bloomfield of Hinton Waldrist to the House of Lords on 24th February. She said:

"*The energy White Paper will still be published at the end of this quarter …We have also been investing in new technologies for small and advanced modular reactors, which have significant potential to support a secure, affordable and decarbonised energy system. Although Horizon has suspended plans for Wylfa in Ynys Mon, the consent order is still live until the end of March and we are working hard to develop models that could work for Sizewell C and Bradwell, which would be a different form of reactor altogether*."

She also said that through the nuclear sector deal launched in 2018 the industry is "*committed to deliver a 30% reduction in the cost of new-build projects by 2030*."

"The truth is that we need everything. If we are to reach zero carbon by 2050, we need a combination of renewables, energy conservation, carbon capture and storage, and battery technologies, as well as nuclear. As far as I know, the energy White Paper will address a number of these issues. Overall, the nuclear strategy will fall into three cross-cutting themes, as set out in the paper, that will result in greater economic opportunity: nations, regions and places; mobilising capital; and harnessing innovation."

"The Government's policy is firmly to encourage the development of both AMRs and SMRs in a number of sites, including—the noble Lord's own passion—Trawsfynydd and the site in Cumbria. He will have seen the announcement that Rolls-Royce is looking at both sites. We are still investing a lot of R&D money in consortiums that aim to provide small nuclear reactors that contribute to the national grid … we are determined to make our new nuclear projects a success and to develop

small and advanced modular reactors. Our investment in hydrogen fuel cells might also assist in the development of cars powered not just by electricity but by hydrogen."

According to NIA the Committee on Climate Change says due to their inherent variability, renewables should only be relied upon for 57% of our electricity generation, with 38% being 'firm low carbon power like nuclear', and 5% from hydrogen. (3) Nuclear currently generates just under 20% of our electricity. "*To double this share will be quite the task, especially when demand itself is also due to double. Therefore, to reach Net Zero we could be looking at the quadrupling of nuclear capacity.*"

As we point out in nuClear News No.118 the CCC argument about firm power is based largely on cost – it says you can only go so far with the proportion of our energy supplied by renewables before costs start to rise. And the CCC is relying on its own estimate of nuclear costs in 2050, believing they will be 28% lower by then.

Lord Deben, chair of the CCC is sceptical about the government's proposals for reducing nuclear costs. He says:

"*We have to have the same scepticism about costs because in the end the public are going to have to pay for this. EDF are still quoting figures that are frankly not competitive in today's world and also figures that one isn't sure will be met. Like HS2, there's no harm in having a very close look at the figures, there may be other ways of doing this*."

He says nuclear is a "transitional" power source. "*By the time you get to the need for the next nuclear power stations, there will be alternative ways of doing this. If we get better at balancing the grid and the amount of baseload energy, the need becomes smaller. Nuclear isn't the best way of getting that base energy because you can't turn it on and off: you have to use it all the time. If you are really concerned about what happens when the sun doesn't shine and the wind doesn't blow, you install in people's homes hybrid boilers that can run on electricity or gas*." (4)

At a Spectator Energy Summit last spring, chaired by Andrew Neil, Phil Graham, Chief Executive, National Infrastructure Commission argued there isn't a strong case for more than one more new nuclear plant beyond Hinkley Point C because the cost of renewables is low and getting lower. (5)

The other thing which Government and industry keeps getting wrong is forecasts of future energy demand. As we have reported here many times, the incoming Conservative-LibDem Coalition Government of 2010 was officially planning on the basis of a doubling or possibly even a tripling of electricity consumption by 2050. The 2005 Energy White Paper was expecting that by 2020 electricity consumption would have increased by 15%. In reality it has decreased by 16%. Nowadays primary energy demand is expected to continue falling by a further 11% by 2025. But after that projections revert to the bad old days.

Imperial College says electricity demand may bottom out towards the end of the 2020s and then begin growing. But on the other hand: "*it may continue its gradual decline*". Nine million electric vehicles on UK roads require 8GW of extra generating capacity if people charge them up when they like. But smart charging could cut that to well below 4GW according to National Grid. Even

if increases in electric vehicles meet the most aggressive scenarios National Grid's modelling suggests the transmission system will not require a wholesale upgrade. (6)

Some in the electricity industry are literally salivating at the prospects of EVs and, more broadly, the electrification of the transport sector to boost electricity demand. But research by Redburn suggests the electrification of the cars won't dent the established trends towards reduced electricity consumption because more energy-efficient lighting and motors will offset any increases in demand caused by EV electricity consumption. Motors are the world's biggest electricity-using product, ahead of lighting, accounting for an astonishing 30-35% of world's electricity consumption. Not surprisingly, as motors get more efficient, demand for electricity can be expected to fall, all else being equal. It may take roughly 15 years for the entire installed motor base to be replaced with the new more efficient motors, but this will reduce global electricity demand by 0.7% per annum. A similar scenario applies to lighting – currently accounting for roughly 22% of the global electricity demand. More efficient types of lighting, such as light emitting diodes (LEDs), currently only account for 20% of new global lighting sales. Redburn expects the global lighting electricity consumption to halve in the next five years. This alone should reduce global electricity demand by 2.3% per annum. (7)

The other great fallacy is the idea that "*we need everything*". This suggests that we have infinite amounts of money to spend on energy projects, which is obviously nonsense. Resources are scarce, so we need to make choices. Because climate change is a serious and urgent problem then we must spend our limited resources as effectively and quickly as possible - best buys first, not the more the merrier. For each pound we spend we need to buy the maximum amount of "solution" possible. (The "least cost" solution) On both criteria, cost and speed, nuclear power is probably the least effective climate-stabilizing option on offer. In fact, investment in more expensive nuclear power will, in effect, worsen climate change because each pound we spend is buying less solution than it would do if it were spent on energy efficiency. (8)

Nuclear advocates defend their preference by counting carbon but not cost. But to protect the climate, we must save the most carbon at the least cost and in the least time, counting all three variables—carbon and cost and time. Costly options save less carbon per pound than cheaper options. Slow options save less carbon per year than faster options. Thus, even a low- or no-carbon option that is too costly or too slow will reduce and retard achievable climate protection. (9)

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7. Innovating to Net Zero

A new report by Energy Systems Catapult (ESC) has found Net Zero by 2050 is possible if the UK supports innovation and scales-up across three essential areas – Low Carbon Technology, Land Use and Lifestyle. (1) But the report says we couldn't go climate neutral much before 2050 as demanded by Extinction Rebellion. Achieving net zero significantly earlier than 2050 in modelling exceeds even the most speculative measures, with rates of change for power, heat and road transport that push against the bounds of plausibility. (2)

The Innovating to Net Zero report modelled 100s of potential pathways to 2050 – ramping up or down different technologies and behaviour changes – to understand the combinations, interactions and trade-offs of competing decarbonisation approaches.

Meeting the UK's Net Zero target will require unprecedented innovation across the economy. Innovation not just in new technologies, but in new ways of deploying existing technologies, new business models, new consumer offerings, and, crucially, new policy, regulation and market design.

Britain will have to eat far less meat and dairy than previously thought to achieve climate change targets, with households required to reduce consumption by up to half, The public must move to a far more plant-based diet even if there is massive expansion of wind and solar farms and development of carbon capture and storage systems. Another proposed change was curtailing growth in flying, as the ESC said that it would be difficult to find alternatives to fossil fuel for aircraft.

The ESC said that the overall 2050 net zero emissions target could not be achieved unless there was big investment in power stations that captured carbon and stored it underground. These power stations could reduce overall emissions if they burnt crops planted for bioenergy, the report added. It said that electricity generation would need at least to double by 2050, with up to four times more capacity in offshore and onshore wind farms, up to five times more solar power or up to 32 new nuclear plants. The gas network supplying homes and businesses would have to switch to piping hydrogen instead of natural gas by 2045 if it were to continue operating. The alternative was to use electric heat pumps and communal systems to heat homes. The report acknowledged that "significant technological and behavioural innovation" was required to meet the challenges. (3)

ESC says the government urgently needs to invest in three key technologies: carbon capture and storage with bioenergy crops; hydrogen for a wide variety of uses; and advanced nuclear power.

Controversially, the report calls for small, modular nuclear reactors to support three-quarters of heating in cities through district heating systems.

The report's author, Scott Milne, said: "*Whichever pathway the UK takes, innovation, investment and inducements across low-carbon technology, land use and lifestyle are essential to achieve net zero.*"

However, the report warns that the public do not appear ready for substantial lifestyle changes. It warns, for instance, that if people's homes are better insulated, they may choose to spend the same amount on heating to deliver a warmer home. It says: "*Early evidence suggests a general willingness to adopt new technologies (such as new heating or mobility) as long as these can deliver the same experiences as before. "Conversely, approaching the subject of dietary change or aviation often elicits a more resistant and emotional response*."

David Lowry points out that ESC made substantial use of research and energy modelling done by the now defunct Energy Technologies Institute, which was a public-private partnership between global energy and engineering companies and the UK Government. Mike Middleton, Practice Manager for Nuclear at ETI –which he had joined in April 2013 – transferred to ESC as Practice Manager for Nuclear at ESC in summer of 2019. On arriving at ESC, Middleton wrote the following nuclear cheer-leading article, titled: "*New nuclear can earn its place within the energy mix*" He said new nuclear does not need to be expensive and can earn its place within the energy mix driving a Net Zero economy. (4)

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8. An expert's case for nuclear power

The Vox website talked to Jessica Lovering, a fellow with the Energy for Growth Hub and formerly the director of energy at the Breakthrough Institute (founded in 2003 by Michael Shellenberger and Ted Nordhaus) about the role of nuclear power in a world concerned with climate change.

Vox distils her ideas into four key takeaways.

1. *Nuclear power provides about 10 percent of the world's electricity and despite the growth of renewable power in recent years continues to be the world's largest source of zero-carbon electricity*.

Global Primary Energy consumption in 2018 was 13,864.9 million tonnes of oil equivalent (mtoe)

Oil 4662.1

Natural Gas 3309.4

Coal 3772.1

Nuclear 611.3

Hydro 948.8

Renewables 561.3

Which means that nuclear is providing about 4.4% of global primary energy. (2)

In order to contribute to a significant reduction in global greenhouse gas emissions the Massachusetts Institute of Technology (MIT) estimates we would need to build around 1,000 Gigawatts (GW) of nuclear capacity by 2050. That would mean a new reactor coming online every 10 days on average every year until 2050. This would triple global nuclear capacity, but it would still be supplying less than 13% of the world's energy demand for 2018. (3)

We have just 10 years to make massive and unprecedented changes to global energy infrastructure to limit global warming to moderate levels, according to the UN's Intergovernmental Panel on Climate Change (IPCC). (4) It takes around 10 years to build a nuclear reactor, compared to 2-5 years for wind and solar. Hinkley Point C – the only new nuclear power station being built in the UK is not expected to start generating electricity until 2025 – 27, assuming it is built on time. Similar reactors being built in France and Finland are 10 or 11 years late. (5)

Total UK primary energy demand in 2018 was 2,324TWh. Electricity generated was around 333TWh (1 TWh = a billion units of electricity). Nuclear generated around 65TWh. So nuclear power only generated under 3% of our energy. (6)

Electricity generation in 2018 was some 63TWh (16%) lower than in 2005, a reduction equivalent to 2.5 times the expected output of Hinkley Point C. This is despite the UK population increasing by 10% from 60 million to 66 million people. (7) Total installed UK nuclear capacity is around 8.9GW. Yet an accelerated programme of LED lighting installation could, on its own, reduce peak electricity demand by almost 8GW. Cost-effective investments in domestic energy efficiency alone between now and 2035 could save around 140TWh of energy – roughly equivalent to the output of six power stations the size of Hinkley Point C, according to a report by the UK Energy Research Council. Such a programme could save an average of £270 per household per year and deliver net benefits worth £7.5bn to the UK, and could reach £47bn, if benefits such as health improvements and additional economic activity are counted.

In a briefing for the Leonardo Dicaprio Foundation, Mark Jacobson puts the timing issue in sharp relief:

"*Nuclear power plant takes on average about 14-1/2 years to build, from the planning phase all the way to operation. According to the World Health Organization, about 7.1 million people die from air pollution each year, with more than 90% of these deaths from energy-related combustion. So, switching out our energy system to nuclear would result in about 93 million people dying, as we wait for all the new nuclear plants to be built in the all-nuclear scenario. Utility-scale wind and solar farms, on the other hand, take on average only 2 to 5 years, from the planning phase to operation. Rooftop solar PV projects are down to only a 6-month timeline. So, transitioning to 100% renewables as soon as possible would result in tens of millions fewer deaths*." (8)

In a letter to the New Scientist, Paul Dorfman, University College London Energy Institute, Tom Burke, E3G; Steve Thomas, University of Greenwich, UK; Jonathan Porritt, environmental campaigner; and David Lowry, Institute for Resource and Security Studies say Michael Shellenberger's view that nuclear power is necessary to prevent climate change is truly dangerous. Climate change poses a number of unique challenges to humanity. One of the most difficult is that the world not only needs to get to a specific place – a carbon-neutral global energy system – but also must get there by a specific time – the middle of the century. Otherwise the policy fails. You simply couldn't build enough nuclear reactors fast enough, even to replace the existing reactors that will reach the end of their life by 2050, let alone to replace fossil fuels in the existing electricity system or in the more electricity-intensive global economy we are currently building. This would be true even if we were willing and able to overcome all the other unsolved problems that nuclear reactors face. These include their affordability, accidents, waste management, nuclear weapons proliferation, the scarcity of talent and system inflexibility. (9)

2. *Since virtually every plan to reduce greenhouse gas emissions is relying on large-scale electrification of things like surface transportation and home heating, rich countries need to replace more than 100 percent of their current coal-, oil-, and gas-fired electricity generation to achieve a zero-carbon economy. Poor countries, meanwhile, are going to want to continue to develop economically and significantly increase the total amount of electricity they make and consume*.

The 2005 Energy White Paper was expecting that by 2020 electricity consumption would have increased by 15%. In reality it has decreased by 16%. Nowadays primary energy demand is expected to continue falling by a further 11% by 2025. But after that start increasing again. Imperial College says electricity demand may bottom out towards the end of the 2020s and then begin growing. But on the other hand: "*it may continue its gradual decline*". (10) Research by Redburn, for instance suggests the electrification of the cars won't dent the established trends towards reduced electricity consumption because more energy-efficient lighting and motors will offset any increases in demand caused by EV electricity consumption. (11)

The impact of decarbonising heat on electricity demand is hard to predict because there are so many different ways of doing it. There will undoubtedly be more heat networks, and using hydrogen rather than methane gas may play a role, and there will be more heat pumps powered by electricity. The Committee on Climate Change's (CCC's) central scenario for 2030 anticipates electricity demand of 365TWh, up around 8% on 2018 levels. This allows for 2m heat pumps and 20TWh for EVs. Demand from road transport could eventually reach more than double this level, if the whole UK fleet switches to EVs. But cost-effective investments in domestic energy efficiency alone between now and 2035 could save around 140TWh of energy – roughly equivalent to the output of six power stations the size of Hinkley Point C, according to a report by the UK Energy Research Council. Such a programme could save an average of £270 per household per year and deliver net benefits worth £7.5bn to the UK. (12)

A similar, if less extreme version of the UK decoupling of GDP and electricity use has been taking place in many other developed countries as their economies shift away from energy-intensive industries towards services and high-value manufacturing. This includes the US, where electricity demand has been flat for a decade after more than half a century of uninterrupted growth.

3. *The biggest problem with nuclear power is not safety but financial cost, specifically the huge up-front expenses associated with building safe reactors. Better regulatory policy could make it easier to reuse the same reactor designs (as in South Korea), but a promising nuclear future is based on innovation and new reactor designs*.

A report by Steve Thomas at al argues that, as with the much-heralded 'nuclear renaissance' of recent times, SMRs will not be built in any significant scale. The authors note that the two main rationales for SMRs – promised lower overall project costs and lowering the risk of cost overruns by shifting to an assembly line approach – are more than offset by the loss of scale economies that the nuclear industry has pursued for the past five decades. Indeed, many of the features of the SMRs being developed are the same ones that underpinned the latest, failed generation of large reactors. Reactor cost estimates will remain with a large degree of uncertainty until a comprehensive review by national nuclear regulators is completed, the design features are finalised and demonstration plants are built. Whether the economies claimed from the use of production line techniques can be achieved will only be known if reactors are built in very large numbers, and at significant cost.

Spending so much time and effort pursuing such an uncertain technology, at a time when the 'climate emergency' has now reached the political and public lexicon in requiring urgent

attention, does not appear to be an effective use of taxpayer resources. Abundant evidence shows that renewable energy supply, storage, distribution and management technologies are being developed ever cheaper and swifter at a time when real urgency is required across society and government. SMRs are no answer to creating low-carbon economies by 2030 or close to that date. Governments should consider this report carefully and not be diverted by an unproven technology inherent with much of the failings of its large reactor 'big brother'.

In the overall view of the report authors, the prospects for SMRs in the UK and Worldwide is limited and not worth the huge levels of effort or finance being proposed for them. (13)

Jim Green looks at Advanced Nuclear Reactor Designs in Nuclear Monitor No.881. He concludes that the 'advanced' nuclear sector – comprising pretty much everything except large conventional reactors – isn't 'advanced' and it isn't advancing. (14)

4. *At the current margin, new renewable electricity is cheaper than new nuclear electricity. But as renewables grow and grow that cost calculus will shift, because questions about storage and land consumption will become more important the more we rely on renewable energy. The long-term case for nuclear is, like hydropower, as a complement to renewables that allows us to keep adding solar and wind without needing to fully solve problems related to the intermittency of renewable sources*.

As we saw above, Horizon Nuclear surprised everybody by claiming it can build Wylfa Newydd to supply electricity at almost half the price of Hinkley Point C - £55/MWh. (15) Meanwhile, New York State's third annual land-based renewable electricity procurement round has selected 21 large-scale projects totalling 1.3GW to be built over the next few years. The weighted average award price for is £16.17/MWh of production over the 20-year term of the awarded contracts.

A number of studies show that a 100% renewable energy system is deliverable. The myth that a very high level of renewables can't be integrated into the electric grid is being demolished by the clean tech and battery storage revolution. Abstracts of 42 Peer-Reviewed Published Journal Articles supporting the idea that energy for electricity, transportation, building heating/cooling, and/or industry can be supplied reliably with 100% or near-100% renewable energy at difference locations worldwide are available here http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/100PercentPaperAbstracts.pdf

Mark Jacobson and his team from Stanford University, reckon that 100% of all global energy can come from renewable sources (with biomass excluded) by 2050 with full grid balancing. (16) A new report by LUT University in Finland and the Energy Watch Group (EWG) in Germany outlines a cross-sector, global 100% renewable energy system. (17) An article published in Energy in May 2019 found that 180 studies on 100% renewables had been published since 2004. The authors of that paper say that six months later the number has jumped to 280. (18)

Jacobson et al say there are multiple solutions for matching demand to wind, water and solar (WWS) supply, including batteries, pumped storage, heat pumps and heat storage. (19) Their study matches 2050 power demand with 100% WWS supply, storage, and transmission for 20

world regions encompassing the 139 countries for which 2050 roadmaps have previously been developed. Here we are talking about renewables supplying electricity and direct heat for all energy sectors, including transport. The study assumes efficiency improvements compared with Business As Usual (BAU) and it assumes that all energy, not just electricity, is decarbonized by 2050. Grid balancing solutions include heat storage in rocks and water; cold storage in water and ice; pumped hydropower; batteries; hydrogen storage; and demand response.

Key elements of the solution applicable to different cases are to:

(1) produce heat directly from solar and geothermal heat resources and from electricity;

(2) store electricity as heat after current electricity demand is satisfied and electricity storage is full;

(3) if thermal energy storage is used, store excess heat in water and underground rocks when current heat demand is satisfied;

(4) if thermal energy storage is used, produce cold directly from electricity and store excess cold in water and ice;

(5) produce hydrogen from excess electricity after all electricity and heat storage are full, and store excess hydrogen;

(6) store excess CSP (Concentrated Solar Power) electricity in a phase-change material and remaining excess electricity either in pumped-hydro storage, as heat in underground rocks, or as hydrogen;

Jacobson says:

"*Nuclear advocates claim nuclear is still needed because renewables are intermittent and need natural gas for backup. However, nuclear itself never matches power demand so it needs backup. Even in France with one of the most advanced nuclear energy programs, the maximum ramp rate is 1 to 5 % per minute, which means they need natural gas, hydropower, or batteries, which ramp up 5 to 100 times faster, to meet peaks in demand. Today, in fact, batteries are beating natural gas for wind and solar backup needs throughout the world. A dozen independent scientific groups have further found that it is possible to match intermittent power demand with clean, renewable energy supply and storage, without nuclear, at low cost.*" (20)

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9. Nuclear Power and Climate Change

The Santa Barbara Independent has provided a useful reminder that nuclear power is not zero- or even low carbon.

The newspaper says the idea that nuclear plants generate carbon-free electricity is a "*preposterous public relations lie*", because virtually every part of the process requires the burning of vast amounts of fossil fuels — from the mining of radioactive uranium ore to the transportation, milling, and enrichment of the ore into yellowcake, a high-grade uranium powder; and the manufacture of fuel-rods. Furthermore, a tremendous amount of greenhouse gasses are emitted during both the construction and decommissioning of nuclear plants along with the guarding of nuclear fuel and storage of spent fuel rods.

In a 2008 study called "*Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey*," the author, Dr. Benjamin K. Sovacool, professor of Energy Policy at the University of Sussex in the United Kingdom, analysed more than 100 prior studies to arrive at a best estimate of the emissions from nuclear plants. His research found that the mean value of carbon emissions over the lifetime of a nuclear reactor is 66 grams per kilowatt-hour of electricity. (2) This compares with about 9 or 10g/kWh for wind or 32g/kWh for solar PV or 443g/kWh for a gas-fired power station.

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10. Virtual Power Plants (VPPs)

A Virtual Power Plant (VPP) is a catch-all phrase for different technologies that tie decentralised systems together to mimic the effect of an old-school centralised power plant. Battery storage systems in homes, for instance, can be amalgamated and controlled in unison to relieve pressure on electricity grids and make the most of generation from renewables. But it is worth noting that the same effect can be produced in other ways, such as by businesses changing their demand for electricity when supply is short.

Two VPP trials have just ended, and the results are encouraging. One in the north of England saw 36 homes with batteries, 27 of them also with solar panels, pooled together to create a VPP. Surprising as it may seem, there are so many homes with solar panels in South Yorkshire that in some areas local electricity networks are struggling to accommodate more solar without costly upgrades to their grids. It is an issue elsewhere in the UK too, because the country has more than 900,000 homes with solar power, connected to local electricity grids that were only designed for power to flow one way.

The batteries in the two-year trial by Northern Powergrid and Moixa allowed 25 per cent more renewable energy to be used at times of peak energy demand. There were no big concerns over how the batteries degraded over time: it was estimated that after a decade the batteries should still have 80 per cent of charge left, which was seen as good. But Simon Daniel of Moixa, which made and managed the batteries for the trial, says he also learned a lot about how people behave and how to fit the tech into their lives. Yoga classes were used to engage residents at the project's outset. And it turns out – perhaps unsurprisingly – that people hate having their broadband interrupted to get the technology installed. Those taking part saw their energy bills fall by up to £60 a year. (1)

The trial saw 40 community homes managed by Energise Barnsley and Berneslai Homes receive batteries that were connected using energy technology firm Moixa's software to form a virtual power plant (VPP) in Oxspring, Barnsley. The software connected and managed the smart batteries, along with electric vehicle charging and the 27 sets of solar panels within the network. Northern Powergrid found that the system reduced demand for electricity during peak times, when power is most expensive and dirtiest, by 25%. This helped manage grid constraint, reducing the need for costly improvements to the wider network. (2)

Another project in South London was run by UK Power Networks (UKPN) and Powervault with batteries fitted in 45 homes in the St Helier estate, which could be topped up either via the grid or household solar panels, and later used by the network firm. Independent analysis found that the average household's carbon emissions were effectively 20 per cent lower, based on them using more electricity from renewable sources. The households involved were paid, and those with certain energy tariffs were able to buy and store electricity when it was cheaper. (3)

Now Powervault – the firm behind the batteries used in the trial – has secured a second commercial contract to operate a similar 'virtual power plant' system in St. Helier. (4)

- In Orkney, despite the islands' significant renewable energy resources and generation capacity, a constrained network is causing high levels of 'curtailment' – where wind turbines are switched off to protect the network from overloading. This limits the economic efficiency of existing turbines, and the ability to install more capacity that will be required as the demand increases to support electric vehicles, and the amount of electrified heating systems. This opportunity to harness the excess renewable energy generated that is currently wasted, along with a will to increase the amount of low carbon energy and reduce fuel poverty, forms the main driver for a demonstration project called 'Reflex'. Domestic and large-scale batteries with smart controls are being installed to optimise the charging and discharging cycles, along with flexible heating systems for hot water storage and smart chargers. The local leisure centre plans to use a hydrogen-fuelled combined heat and power plant (CHP) and up to 600 new electric vehicles are being introduced to the islands. (5)

- Peterborough City Council has unveiled a plan to host the UK's largest smart, low-carbon city energy system including renewable electricity generation, energy storage and heat networks. Supported by the UK Government's UK Research and Innovation (UKRI) arm, the £2m scheme will see additional solar and energy-from-waste electricity generation capacity installed across the city-region. To help overcome the variable outputs of these generation methods, the scheme, called the Peterborough Integrated Renewables Infrastructure project (PIRI), will also see battery storage capacity installed and businesses and households encouraged to flex their energy demands. A more flexible energy system will not only enable more renewable generation on the local grid but support the shift to electric transport. As for heat, PIRI includes plans for a "next-generation" heat network to be installed to serve businesses and flats in the city centre. Heat networks fed by ground-source or air-source technology are not intrinsically "net-zero" and do produce emissions but are considered less carbon-intense than individual gas boilers. Once PIRI is up and running, Peterborough City Council has said it will provide other local authorities with details of the plan, that they may use it as a "blueprint" to deliver against their own climate and energy commitments. (6)

- Currently, over 99% of large-scale electricity storage is handled by pumped hydro dams, which move water between two reservoirs through a pump or turbine to store or produce power. However, there are limits to how much more pumped hydro can be built due to its geographical requirements. One promising storage option is pumped thermal electricity storage. This relatively new technology has been around for about ten years, and is currently being tested in pilot plants. Pumped thermal electricity storage works by turning electricity into heat using a large-scale heat pump. This heat is then stored in a hot material, such as water or gravel, inside an insulated tank. When needed, the heat is then turned back into electricity using a heat engine. These energy conversions are done with thermodynamic cycles, the same physical principles used to run refrigerators, car engines or thermal power plants. (7)

- Britain's first solar-powered "fuelling station" for electric cars is being built near Braintree in Essex, and is expected to open in the summer, allowing 24 motorists to

charge vehicles at the same time. The site will be the first of 100 being built across the UK over the next five years. Gridserve, the green energy company, which is behind the plan, said that power for charging vehicles would come from a solar canopy that shades vehicles on the forecourt. Two large-scale solar farms — one already built near York and another being developed in Hull — will also supply power to the nationwide forecourt network. (8)

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11. Trawsfynydd and Moorside on the wish list for SMRs

Rolls-Royce says the first of its planned small nuclear reactors could be built at Trawsfynydd – the site of a Magnox reactor, which closed in 1991, near Snowdonia National Park. Their chief technology officer Paul Stein says there is a "high probability" that Trawsfynydd would be the site of the first such reactor, which would be assembled from pre-manufactured components.

Stein said: "*Trawsfynydd is a great first site for the* [reactor]. *Right now the jury's out – there are a number of great sites around the country – but two of the three sites [under consideration] are in Wales*." He added: "*With so-called brownfield sites, where there has been a nuclear reactor, we know the local population is happy, there is a skilled local population that used to run the plant, there's a grid connection and the seismic condition of the site* [is suitable]."

Wylfa in Anglesey has previously been identified by Rolls-Royce as another potential site for SMRs. However, in a statement, Horizon Nuclear, the Hitachi subsidiary still hoping to build two new reactors on the site, said there were "no plans" to deploy a miniature nuclear reactor at Wylfa Newydd. Speaking to CN last month, Mott MacDonald nuclear global practice leader Mark Liddiard said that Moorside, where Toshiba cancelled a planned nuclear build last year, would be a suitable site for SMRs. (1)

North Wales Minister Ken Skates has emphasised the Welsh Government's commitment to the Trawsfynydd site in Gwynedd, and its future potential in developing small modular reactors and other associated technologies. He says: "*The Welsh Government's commitment to Trawsfynydd is an important step towards not only reaching the UK's net zero emissions target by 2050, but also bringing prosperity to local communities. Just like Anglesey with the Wylfa Newydd project, Gwynedd stands to reap the economic, jobs and growth benefits from the opportunity in Wales to help reach net zero – adding to the 60,000 already directly employed in the UK's civil nuclear industry who are providing clean, reliable and constantly available electricity to power our future*." (2)

A Northern Powerhouse campaign - spearheaded by the NP11 – the North's business-led voice comprising its 11 local enterprise partnerships (LEPs) – and the North West Nuclear Arc consortium, is championing the case for establishing the North of England as a world-leader in Small Modular Reactor (SMR) technology. David Levene, strategic coordinator at NP11 says "*Sites in Cumbria, North Wales and Tees Valley have all been highlighted as potential test-beds for the Small Modular Reactor programme being brought forward by Rolls-Royce. We also have world-leading expertise in advanced metal production in Sheffield, already sought after by nuclear sites the world over, while the North West is home to cutting-edge modular design at Cammel Laird." (3)*

According to the NP11 the Northern Powerhouse needs further investment and policy support in order to harness the "*immense opportunity*" for the region to harness a 'new wave of low carbon next-generation nuclear energy". It notes this would also allow the region to cement its position as a "*global centre of excellence for decommissioning*" and states it would have a wide

range of transformative socio-economic impacts, including securing high-value jobs in remote coastal communities, establishing the North of England as a world-leader in Small Modular Reactor (SMR) technology and safeguarding a reliable source of energy that can be used to decarbonise the energy system.

Plans to develop SMRs in Cumbria by Rolls-Royce should not be seen as a "*saviour of the county*", according to John Coughlan, chief executive of TSP Engineering, in Workington. TSP Engineering is also developing its own version of the technology, but if Rolls Royce goes ahead in Cumbria, the reactors will be shipped in from elsewhere and built on the site. So, you are probably looking at a large number of short-term construction jobs – say 1,000 – then only about 60 to 100 people with a permanent position there. (5)

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12. Radioactive Waste Update

RWM has published its approach to Geological Disposal Facility (GDF) site evaluation in England and Wales. It says a GDF will only be built where there is both a willing community and a suitable site. The 'Siting factors', guided by government policy and legislation, will inform the conversations RWM will be having with communities and evaluations of site suitability. There are six siting factors, which cover:

Safety and security – safety and security must be assured and endorsed by independent regulators. A GDF will not be built unless RWM and the Regulators are satisfied it is safe.

Community – communities are at the heart of the process to site a GDF, and RWM will consider social and economic opportunities, community wellbeing, and how a GDF can align with the host community's vision.

Environment – RWM describes a GDF as "*a major environmental protection endeavour*." Construction of a GDF will need to meet independent regulatory requirements.

Engineering feasibility – RWM will need to ensure there is scope for sustainable design and the ability to construct and operate a GDF in a location.

Transport – the safe and secure transport of waste, people and other materials.

Value for money – RWM has a duty to ensure that value for money is delivered.

So, no mention of calls to establish the areas which are most geologically suitable rather than relying on engineered barriers in an area where geology may not be particularly suitable.

Cumbria Trust has pointed out that during the last search process, which ended in January 2013, the Nuclear Decommissioning Authority (NDA) offered repeated assurances that only the UK's nuclear waste would be buried in a UK Geological Disposal Facility (GDF). Yet the NDA has accepted 4 tonnes of plutonium from Germany in a 'commercially advantageous arrangement'. A half-hearted attempt was made to claim that there was no breach of trust, since plutonium did not form part of the UK's nuclear waste inventory, which while technically correct at the time, it was widely understood that plutonium was expected to be reclassified as waste at a later stage. It now appears that the NDA is offering to take ownership of a much larger quantity – 19 tonnes of plutonium from Japan, in exchange for a substantial payment. The UK and Sellafield where it is stored will then be faced with the problem of what to do with it. It is almost inevitable that it will be reclassified as waste at some point, but it generates too much heat to begin to be buried until the year 2136 according to the NDA.

Meanwhile, the number of outstanding scientific and technical issues associated with geological disposal seems to be getting longer, rather than shorter. (3)

Steel Corrosion

Research findings, published in a recent issue of "Nature Materials", show that corrosion of nuclear waste storage materials accelerates because of changes in the chemistry of the nuclear waste solution and the way the materials interact with one another. "*This indicates that the current models may not be sufficient to keep this waste safely stored*," The research focussed on storage materials for high-level nuclear waste.

The plan at the moment is to mix liquid nuclear waste with other materials to form glass or ceramics and then encasing those pieces of glass or ceramics inside metallic canisters. The canisters are then buried deep underground in a repository. But researchers found that when exposed to an aqueous environment, glass and ceramics interact with stainless steel to accelerate corrosion, "*Under specific conditions, the corrosion of stainless steel will go crazy*," says the researcher, "*It creates a super-aggressive environment that can corrode surrounding materials.*" (4)

New form of uranium

Other research has discovered that in conditions that prevail underground a new chemical form of uranium can temporarily occur, while small amounts of uranium are released into solution. If uranium is in solution, it could make its way into groundwater. Prof Samuel Shaw, a mineralogist at the University of Manchester and one of the authors of the study, led by University of Manchester's Prof Katherine Morris and published in the journal Environmental Science and Technology explains that wherever you bury waste, there will be a wide variety of microbes living under the ground as well. Since no man-made barrier can be expected to withstand degradation for hundreds of thousands of years, radioactive waste will be in contact with groundwater containing these microbes and the chemicals they produce.

Uranium can have different oxidation states, which describe the number of electrons the element has when it forms a compound. Some oxidation states are more environmentally mobile than others. In the presence of sulphides, which are created by microbes underground, uranium should not be mobile, but reports have suggested small amounts of uranium are released into surrounding water – results no one has yet been able to explain.

To investigate further, Shaw and his team studied samples subject to conditions designed to mimic a geological disposal unit. The study shows that uranium passes through this previously unknown chemical form under environmental conditions by binding to sulphur atoms that can dissolve as it is immobilised. About 1 to 2% of the uranium passes into solution for a couple of hours during the process. (5)

It remains unclear what the implications of this finding are for a proposed GDF. For Dominik Weiss, an environmental geochemist at Imperial College London, UK, the research raises an important issue. "*The question now is if these complexes really lead to increased mobility. The work is important as it clearly shows us that we still need to learn much about the aqueous geochemistry of uranium if we want to conduct thorough risk assessments*."

Glacial Erosion

The half-life of Chlorine-36 is 300,000 years and neptunium-237 boasts a half-life of a whopping 2 million years. All this radioactivity amounts to a huge amount of maintenance to ensure that our radioactive waste is being properly managed throughout its extraordinarily long shelf life and isn't endangering anyone. So, we had better make sure we fully understand what goes on during the process of glaciation. Yet new research has overturned previous findings about the link between glacial flow and erosion rates. Researchers hope this will help us find a safer site, but surely begs the question 'what else have we got wrong?'

"*In many countries, otherwise ideal sites for the development of deep geological disposal facilities are in areas that have previously been covered by ice. This means that those sites will likely experience glaciation, and glacial erosion, in the future …Advancing ice during future glacial periods could, over many hundreds of thousands of years, remove many hundreds of metres of bedrock. This would likely affect the environment of the disposal facility beneath, where nuclear waste can remain dangerous for over 100,000 years*." (6)

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2. Cumbria Trust 24th Feb 2020 https://cumbriatrust.wordpress.com/2020/02/24/is-cumbria-about-to-become-the-worlds-plutonium-dump/
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