Written evidence submitted by Mr Neil Crumpton[1]

The evidence below is written as a member of Pobl Atal Wylfa B / People Against Wylfa B (PAWB) on behalf of PAWB. The response mainly responds to Question 1 of the consultation but touches on other questions.

Q1

- What role can, or should, nuclear power play in achieving net zero and UK energy security?

Summary

PAWB does not think that new-build nuclear power should play a role in Welsh, UK or global Net-Zero policies for the reasons set out below.

The UK's political parties should be showing the world how to build a safe, secure and resilient Net-Zero energy system using indigenous renewable energy sources - not misleading its population into believing that nuclear is needed to meet baseload power or the lights will go out, or that nuclear energy is a necessary climate solution. The UK's offshore wind resources alone exceed Net-Zero and foreseeable UK energy demand.

It is also misleading the British public to say that nuclear energy is needed for energy security or national 'security'. The West's current uranium ore and enriched fuel dependency on Russian and Chinese-sphere countries is considerable, and just four coastal nuclear sites, vulnerable to co-ordinated attack by terrorists or the latest and future weapons, are planned to comprise a substantive 12 GW of 'baseload 'power (and inertia). The additional 20 GW of back-up generating capacity (widely dispersed) for the additional renewables (mostly offshore wind) in a 'no-further nuclear build' scenario would provide significantly greater Grid resilience than centralising up to 20 GW of nuclear capacity (which should be viewed as pre-deployed radiological bombs).

The thinking behind the recently announced British Energy Security Strategy indicates no consideration of such defence and Grid resilience issues or awareness of NATO's uranium dependency. It is not a security strategy, it is a policy which could have been written by nuclear industry secondments to BEIS.

The case against nuclear energy is getting stronger by the month as renewable energy and related system technologies advance and as nuclear stations and projects globally are beset by construction delays, technical problems, cost increases and now even occupation and hostile use by Russian forces in Ukraine. The ideological fixation with nuclear energy by senior minsters in both the Conservative and Labour parties, egging each other on to build new nuclear capacity, is a threat to British Energy security and is showing a superficial understanding and reckless attitude, to a complex dangerous radio-toxic technology with WMD potential, on the world stage.

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[1] Neil Crumpton, retired electrical engineer, PAWB rep and deputy NGO co-Chair BEIS-NGO nuclear Forum. Graduated in electrical engineering Liverpool 1977, worked on naval guided missile radar systems for Marconic (UK and Argentina) 1977-1980, offshore oil and gas seismic survey in various locations worldwide 1981-1983, transport and energy campaigner for Friends of the Earth Cymru 1994-2010, campaigner (CCS and carbon-negative technologies) Bellona Foundation 2011, consultant to fuel cell company 2012.

The BEIS Dynamic Dispatch Model (DDM), which is used to show 2050 Grid system cost comparisons of different electricity generating scenarios, calculates that the current 24 GW nuclear policy has only a £ 0.0 to 0.15 pence /kWh cost saving over a 'no-further nuclear build' policy (ie '5 GW' comprising the 3.24 GW Hinkley Point C + licence extension of the existing 1 GW Sizewell B station) - see Fig 11, page 24 BEIS 'Modelling 2050 ’report.

Such a theoretical ’saving ’of 1.6 % on 2050 annual system cost (ie £ 62 / 63 billion at most) is well within the error bars of the programme and inputs and is no way justification of a 24 GW policy considering the several major defence, energy (uranium) security, Grid resilience, waste-disposal, non-proliferation, public health risks and other downsides of nuclear energy. The National Infrastructure Commission (NIC) and Climate Change Committee (CCC) have both warned BEIS not to over rely on the DDM for policy-making and to consider other modelling.

Nor does or can the DDM factor defence risks, the ethics of intergenerational waste and non-proliferation, or the potential public health risks and costs of scenarios. The DDM modelling and inputs are also only partly transparent, making ‘value for money' assessments and political and public scrutiny impossible on what are the most expensive projects in British history - this is NOT informed democracy (ie major policy by secretive departmental computer model.

Relatively small changes in inputs or DDM methodology (eg in offshore wind CfDs, wind’s carbon intensity over 60 years, Biomass Strategy use of 'bio-gases ’in dispatchable / back-up, electrolyser efficiency and hydrogen storage costs) could easily swing the DDM outputs 1.7 % to showing ‘renewables+CCS ’scenarios being low-cost than further nuclear. It seems unlikely that the 24 GW nuclear policy would suddenly be reversed and a new British Energy Security Strategy policy announced. It seems more likely that the minsters would have a quiet word with the modelling team staff.

The Regulated Asset Base (RAB) funding mechanism is essentially a subsidy to aid developers ’ financing costs but importantly would cover the costs of construction delays, operational problems, and even possible design issues (Taishan 1 EPR is still off-line for a year and counting). About half the reactors in France are currently offline due to stress corrosion issues (in the newer designs) and lack of sufficient cooling waters in drought-stressed rivers. Any potential RAB contracts should include such possible delays and operational down time possibilities (including weather-related) in their value for money assessments. Every year of Hinkley Point C delay has meant and continues to mean over 9 million tonnes CO2 emissions NOT avoided which is undermining HMG’s compliance to the 4th Carbon Budget or 2030 NDC.

The 24 GW nuclear ‘strategy' would generate 189 TWh per year which is a massive 7 % of current global nuclear generation of 2,650 TWh per year for a population of 0.7 % in 2050. Its over twice the UK's 1990s peak in nuclear output of around 80 TWh per year. As global higher-grade uranium resources diminish, eliminating NATO’s currently high uranium fuel dependency on Russian and Chinese spheres for security reasons, poses significant challenges. It would require a 2-4 fold step increase in uranium mining in Australia, Canada, the US and Greenland where the political rights of indigenous peoples are rightly increasing, and in countries like Niger and Namibia where exploitative practices could increase.

Chinese consumption of uranium is set to increase significantly by 2030. BEIS ministers and officials appeared to have had no geo-political awareness of such significant issues. Nuclear energy is likely to supply between just 2 to 5 % of global 2050 energy (final) demand. So the avoidable

global risks posed by nuclear energy technologies will be disproportionate to the energy supplied. Targeting such a small market UK modular reactor export hopes are likely to be limited, as well as unwise.

Earth's cost-effective renewable energy resources well exceed foreseeable future global energy demand. There is no climate or security need for nuclear energy and this complex radio-toxic technology should be phased out for a safe and more secure world and to meet climate goals more quickly and reliably.

The sections below provide further detail to the content appearing in this Summary of Evidence

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The nuclear baseload myth - a false prospectus

Since the civil nuclear power re-assessment and public consultations initiated by then prime minister Tony Blair in around 2006-7 all energy ministers and some prime ministers (with the possible exception of Charles Hendry) have routinely stated that nuclear power, supplying baseload electricity, is 'crucial', 'key', 'critical 'or 'of absolute need'.

The Telegraph 21st July 2015 : UK Energy Secretary *Ms Rudd suggested the price was worth it because nuclear was reliable, unlike renewables. 'We have to have secure base-load, so you should not be surprised that we are prepared to pay more for that in order to ensure nuclear is part of the mix. The requirement for nuclear is absolute," she said* to the Energy Select Committee.

That is, nuclear baseload is deemed necessary to ensure reliable electricity supply. Nuclear industry representatives, union bosses and other nuclear advocates have also re-iterated and reinforced this view in the media, as have some BEIS officials. It has been said that nuclear industry advisers seconded to BEIS, DECC and BERR have had significant influence on policy. NGOs on the BEIS-NGO nuclear Forum have voiced their concerns about the baseload myth increasingly over recent years.

However, the July 2022 BEIS announcement of a Nuclear Fuel Fund 'initiative 'continues feeding the false prospectus by carefully crafted implication in its opening lines of the Introduction which states : '*Nuclear is the only form of reliable, low-carbon generation which has been deployed at scale to date.* '

Actually, that statement is also inaccurate as biomass and biomethane power stations and large hydro-electric power stations, have and are operating at scale.

Consequently, most public and politicians and media may think that nuclear is necessary to supply reliable baseload (even though currently Natural Gas is supplying most of UK baseload as only about 4.5 GW of nuclear capacity is generating (https://www.edfenergy.com/energy/power-station/daily-statuses) and UK baseload demand is probably around 15 GW at this time.

However, this deemed crucial need for a nuclear baseload is a false prospectus. A baseload demand is not a 'thing 'and does not require a baseload generating technology. Any generating technologies can supply some or all of baseload demand when they are generating (particularly large deployments of offshore wind turbines) and 'back-up 'generating schemes fuelled by **low-**

carbon gas or liquid fuels can supply Grid demand when variable or intermittent sources cannot. Low-carbon gases can provide firm or dispatchable power when the wind does not blow or sun shine. Lights won't go out, nuclear is an option, not a necessity.

The likely low-carbon, and carbon-negatively produced, fuels comprise 'Green 'hydrogen, bio-methane, synthetic H-C fuels, and ammonia. The fuels would be produced using electricity which is excess-to-Grid demand. This electricity would be used to power electrolysers producing 'Green' hydrogen and Direct Air Capture (DAC) schemes which extract carbon dioxide from the air which can then be sequestrated or 'stored' underground or under seabed (DACS) or 'used 'ie synthesised to low-carbon gaseous or liquid fuels (DACU). If the low-carbon fuels are then used in CCS-fitted generating schemes the result is carbon-negative electricity generation and Greenhouse Gas Removal (GGR) system needed to meet Net-Zero policy.

Similarly bio-energy sources (eg bio-wastes) can be used in carbon-negative dispatchable electricity generation (BECCS) eg gasified to Green hydrogen, or used to make synthetic liquid H-C fuels for ease of storage for power generation, Jet-Zero aviation fuel or other uses including industry and surface transport. Fuels can be used in gas turbines, gas-engines and or fuel cells as each technology has its operating niches. The BEIS 'Biomass Strategy 'has not been published yet but is due this year.

Furthermore, it is only a matter of degree how much dispatchable hydrogen-fired electricity back-up is needed (in GW and TWh/y generated) to avoid the lights going out in future decades. It is not a binary choice ie hydrogen-fired generating back-up is 'unproven or not necessary' in nuclear scenarios. The current British Energy Security Strategy which puts forward a target of 24 GW of nuclear capacity will not supply a demand which may peak at 70-90 GW by 2050.

Even retaining much of the existing CCGT and OCGT fleet (totalling maybe 25-30 GW) for occasional back-up duties still means that tens of GW of new 'firm 'back-up capacity is needed. Around 20 GW more back-up capacity would be needed in the renewables scenarios, which may cost around £ 10 billion over 30 years (not much more than the increases in Hinkley C or the Sizewell C construction cost).

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The BEIS Dynamic Dispatch Model (DDM) and 2050 Net-Zero electricity scenarios

The Government's dynamic dispatch modelling BEIS 'Modelling 2050 'compares 'nuclear-inclusive ' scenarios (in multiples of 5 GW) to 'no-further-nuclear build '(5 GW) scenarios which comprise mixes of renewables including significant contributions from offshore wind. The latter scenarios comprise renewables AND CCS. 'Renewables 'scenarios alone are more costly and may not include carbon-negative Greenhouse Gas removal (GGR) technologies needed to achieve Net-Zero.

The DDM's minimum nuclear scenario is 5 GW which essentially would comprise the 3.24 GW Hinkley Point C project (commissioning around 2027-29) and the 1 GW Sizewell B station (assuming its licence may be extended to 2050).

The BEIS report published Dec 2020 called 'Modelling 2050 'shows **a nuclear cost-benefit of between £ ZERO and just 0.15 pence per kWh in 2050** see Fig 11 page 24 - see coloured bar graphs :

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/943714/Modelling-2050-Electricity-System-Analysis.pdf

Both the CCC and NIC warned Business Secretary Kwarteng not to over-rely on the limited DDM computer model for policy-making. There are obvious questions about it - and who can seriously say £ 0.0 to 0.15 p/kWh is not well within the error bars of any 2050 modelling.

So Business Secretary Kwasi Kwarteng considers the following issues to be of total less value than £ 0 to 0.15 p/kWh :

i) defence and security : large radio-toxic infrastructure is likely to be, and has been, a target of military action - emerging and future weapons are likely to make nuclear power stations even more vulnerable (eg hypersonic missiles and rail-gun projectiles, tsunami torpedos, swarmed drones, Artificial Intelligence within energy and defence networks by say 2050). The use by Russian forces in Ukraine of nuclear facilities as un-attackable 'nuclear-shield' positions in war-zones is an alarming evolution in this set of concerns
ii) rad-waste long term storage (copper canister corrosion issue still unresolved)
iii) routine emissions (debate continues over dose and public health risk) and possible major accidents (costing tens to hundreds of £ billions)
iv) terrorism (eg small extremist suicidal groups, unknown or unprovable proxies/cyber, disgruntled employee)
v) WMD-proliferation * (spread of dual-capability nuclear materials, skills and technology acquired as a supposed 'climate solution ’following leaders eg UK)
vi) uranium fuel procurement (usually on indigenous lands leaving radio-toxic legacy) currently high dependency by NATO on Russian and Chinese-spheres
vii coastal or river sited nuclear stations (for cooling) causing planning issues including siting in or affecting designated areas - Heritage Coast, AONB, National Trust, Habitats Directive areas (Terms at Wylfa and Minsmere Reserve, Sizewell), coastal sites have risks to sea level rise and storm surge, rivers in southern England may run dry in summers

CCC and IPC advice to BEIS Secretary Kwasi Kwarteng
The CCC 6th Budget Methodology report ** page 157 states :

'For the analysis underpinning this report we used the BEIS Dynamic Dispatch Model (DDM). We supplemented this with additional analysis to reflect the use of evidence and analyses that were not supported by the model.'

'The CCC provided external inputs that covered demand, flexibility assumptions, capacity ranges, costs, and carbon values. As a result, our analysis does not share the same assumptions - or results - as other analyses undertaken by BEIS.’

** https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-Methodology-Report.pdf

The National Infrastructure Commission’s (NIC) response of 21st Sept 2021 to minister Kwasi Kwarteng following his questions relating to nuclear energy and the 6th Carbon Budget period (2033 to 2037 and UK law for a 78% reduction in emissions by **2035** on 1990 levels). Note also that global Natural Gas prices have risen recently and may well not fall back to what the DDM model

has used - with adverse implications for grey and blue hydrogen fired generation using Natural Gas and beneficial implications for Green hydrogen production from renewables.

see NIC report especially paras 15 to 17 on page 3 : https://nic.org.uk/app/uploads/Advice-on-nuclear-power-plant- deployment.pdf

Considering the NIC's specialist response, The NGOs on the BEIS-NGO nuclear Forum put the following questions questions to the energy minister Greg Hands MP in March :

Does the minister accept the views of the NIC in its response of 24th Sept 2021 (see : https://nic.org.uk/app/ uploads/Advice-on-nuclear-power-plant-deployment.pdf) to BEIS ministerial questions which essentially make the points that :

i) with reference to the BEIS DDM electricity supply model that '*there is inherent uncertainty in such complex and long-term modelling*', especially as regards costs, and warns against over-interpretation of cost outputs in informing policy decisions - see para 15 of the NIC response

ii) nuclear baseload is not needed to achieve a reliable electricity system (in which supply can meet demand at all times and weathers) and that the 6th Carbon Budget emission reductions can more reliably be achieved by building dispatchable hydrogen-fired generating capacity and even carbon-negative biomass generating capacity (ie BECCS) - see para 16 of the NIC response

iii) that reliance on the DDM model alone '*increases the risk of error*' and that using more than one model and outputs '*can significantly boost the robustness of decision-making*', and that greater transparency would '*also aid robustness*' - see para 17 of the NIC response

Oral responses to these questions were given at the March BEIS-NGO Forum meeting by Greg Hands and nuclear directorate officers to the effect that other models were considered but without specification to what models or with what implications. The 'historic' decision to build a £ 150+ billion 24 GW nuclear power system rather than no further nuclear build (ie 5 GW) based on a 0.1 to 1.7% swing in the 2050 forecast of a computer model (with on-going inputs and updates), despite the numerous intractable and new problems with nuclear energy, and warnings from official advisers, shows, in PAWB's view, an ideological attitude and attachment to nuclear energy for reasons that are hard to fathom, not least considering the defence downsides.

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NATO and wider-world uranium ore and enriched fuel dependency on Russia-sphere and Chinese Belt & Road sphere

In 2021 'Russian-sphere' countries produced **54 %** global uranium (Kazakhstan 41 %, Uzbekistan 7%, Russia 6 %). In addition, China currently produces 4% (and consumes 13 % of global uranium) but has a massive but probably unachievable nuclear power station construction programme of an additional 147 GW by around 2035. (https://www.bloomberg.com/news/features/2021-11-02/china-climate-goals-hinge-on-440-billion-nuclear-power-plan-to-rival-u-s).

Russia also has of global uranium fuel enrichment facilities (which process ores and yellowcake to reactor fuel).

The major western democracies (US, Europe, Canada and UK) consume around 65 % of current global uranium production based on 2020 generation / demand (US 30.9 %, Europe 29.2 %, Canada 3.6 %, UK 1.8 %). In addition, Japan, South Korean and Taiwan consume another 8.8 % bringing the total consumption of western democracies and allies to about 74 % (1,890 TWh/y electricity) of 2020 global uranium demand (2,553 TWh/y electricity), see : https://world-nuclear.org/information-library/facts-and-figures/ nuclear-generation-by-country.aspx . Note that actual uranium production was only supplying about 74 % of demand (use) in 2020 so demand is used as a proxy for dependency in this analysis.

So the 'West 'and main allies are collectively highly dependent on Russian uranium with current exposure being at least 32 % (74 - [100 - 58]) of electricity generated requiring Russian-sphere uranium. Kazakhstan, which may want to distance itself from Putin after the Ukraine invasion, may try to move towards China's Belt & Road sphere and and a fuel fabrication plant is being built in Kazakhstan with 49 % Chinese equity. China will need such a secure producer for its massive nuclear energy expansion : https://www.geopoliticalmonitor.com/kazakhstan-pivots-from-russia-amid-ukraine-war/ : https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/kazakhstan.aspx

Either way, in electricity terms that's currently about 817 TWh/y electricity dependency (2,553 x 32 %) on Russian-sphere or future Russian-Chinese 'new-world-order 'spheres : (https://www.newsweek.com/russia-promotes-new-world-order-china-1693445).

For comparison, Europe imported 1,654 TWh/y thermal of Natural Gas from Russia in 2021 (158 bcm see https://www.iea.org/reports/russian-supplies-to-global-energy-markets/gas-market-and-russian-supply-2). If all that Russian gas import was used for electricity generation (some will be used for heating, etc) it would be equivalent to 890 TWh/y electricity dependency (1,654 x 54 % power station efficiency).

So the Western democracies and main allies are currently nearly as energy dependent (92 %) on Russian-sphere uranium as they are on Russian gas in terms of electricity generation. That alarming point has not been broadcast by any UK media - perhaps it is too alarming. Although probably all NATO countries have several years worth of uranium fuel stockpiled it is possible that Putin could use uranium (ore and or enriched fuel) as a counter-sanction eg by buying up Kazakhstan and other output for near-future sale to China.

These uranium dependency figures and concerns were presented by the Forum NGOs to energy minister Greg Hands MP in early March 2022 (and again in April). Yet there is no mention, or even evidence of serious assessment, of the security of future uranium supplies in the British Energy Security Strategy published in April 2022. Minister Hands stated UK uranium dependency on Russia is very low. However, uranium is a global commodity, like Natural Gas, and NATO exposure is high.

If other countries followed the UK's nuclear baseload necessity 'example' or at least doubling their use of nuclear energy then the pressure for uranium mining in the major (non Russian/Chinese-sphere) producer countries particularly Australia, Canada, the US, Namibia and Niger would increase by a factor of roughly four, high-grade ores are declining and indigenous people's political power is rightly increasing.

The Chinese aim to build an additional 147 GW by 2035 is a major strategic issue in itself. 147 GW would generate around 1,150 TWh/y (147 x 8.76 x 0.9) which is 43 % of global nuclear electricity output in 2021 of 2,653 TWh/y. So China alone would be consuming around half of all current uranium supply. China, as well as Russia, has nuclear interests in Uzbekistan : https://www.world-nuclear-news.org/Articles/Rosatom-and-Uzbekistan-sign-MoU-on-nuclear-infrast

An Australian-Chinese attempt to develop an 'open-pit' rare earth / uranium mine in Greenland has run into considerable political problems, with some pro-independence Inuit opposing the development. It could be sign of things to come : https://news.mongabay.com/2021/07/red-carded-australian-miner-signals-intention-to-play-on-in-greenland/

Meanwhile, at the Commonwealth Summit, in Kigali Rwanda in June, Prince Charles spoke about reconciliation with indigenous people in Canada : https://www.cbc.ca/news/politics/commonwealth-indigenous-reconcilliation-1.6500076 . In July Russian foreign minister Lavrov went on a tour of African states (Congo, Uganda, Ethiopia) speaking of US hegemony, colonialism and safeguarding their sovereignty in a multi-polar world : https://www.aljazeera.com/news/2022/7/27/lavrov-denigrates-wests-stance-towards-africa-on-ethiopia-visit

The British Energy Security Strategy has a 2050 target of 24 GW of nuclear capacity generating about 190 TWh/y, which is equivalent to 7 % of current global nuclear electricity production for 0.7 % of forecast 2050 global population. The considerations above does not suggest that the considerable global share of uranium required for such a UK expansion to generate baseload electricity demand (which underpins the whole UK economy and life support systems) is very secure. In contrast, utilising UK Continental Shelf offshore wind resources would be very secure.

Offshore windfarms around Wales

Plans by BP and a German company to build 3 GW of offshore wind capacity (called Mona and Morgan) out in the eastern Irish Sea between Liverpool bay and the Isle of Man. The scale of such proposals needs to be understood in terms of its ability to supply Wales indigenous, safe, low-carbon power.

3 GW of offshore wind would generate just over 14 TWh/y (3 x 8.76 x 0.53 capacity factor). Current (2021) UK electricity demand is 334 TWh/y. So pro-rata per capita Wales demand is 15.6 TWh/y. So, in gross terms, the two windfarms alone would supply the equivalent of 89 % of 'Wales demand' assuming industry demand is spread across UK although industrial demand in Wales is relatively high - though the products at least go UK wide.

The actual % supplied or delivered when needed would be reduced somewhat as some wind electricity would be needed to produce hydrogen for storage and subsequent back-up electricity generation when the wind is not blowing sufficiently to cover demand. The round trip "power-to-gas-to power' efficiency is currently about 33 %, though the 'reject 'heat (66 % of energy at useful 60+ C temperatures from fuel cells and electrolysers) could be used around industrial sites and District Heat networks. Latest electrolyser efficiency is claimed to be over 90 % (up from 75-80 %) so round trip could rise to above 40 %.

For example, if 4 TWh/y of electricity of 14 TWh from wind is needed for hydrogen fired back-up at 40 % round-trip then actual reliable supply (when needed) would be 11.6 TWh/y (14 - 4 + 4 x 0.4) or 74 % of current Wales demand, with 2.4 TWh/y of useful temperature heat from the electrolysers and gas-turbines/fuel cells. By 2050, Uk electricity demand is forecast rise to possibly double (the BEIS High Demand scenario is 672 TWh/y in 2050). So the two windfarms would then be reliably suppling roughly 37 % of 2050 electricity demand.

In addition to the Mona and Morgan plans, there are proposals for an Awel y Mor scheme in Liverpool Bay which may be around 400 MW generating 1.25 TWh/y, and there are existing schemes Gwynt y Mor (576 MW) generating about 1.8 TWh/y, North Hoyle 60 MW, Rhyl Flats 90 MW together generating about 0.45 TWh/y.

The total output of all these planned and existing schemes would be about 17.5 TWh/y. After including some round-trip hydrogen-fired back-up these schemes alone would be supplying the equivalent of much or all of current Wales demand (of 15.6 TWh/y).

The Crown Estate has also put forward several sites for up to 4 GW of floating offshore windfarms off the SE Wales and Cornish coast. Assuming 2 GW is built in Welsh waters by 2035 the output could be around 10 TWh/y. A large scheme named Rhiannon was proposed off NW Anglesey and could be re-submitted and future floating schemes can exploit deeper waters further offshore.

So, just offshore wind schemes in 'Welsh waters ’by 2050 could probably supply much or all of pro-rata Wales electricity demand of around possibly 31 TWh/y in 2050. There is no necessity for nuclear power in Wales or the UK. The Mona and Morgan schemes have been given CfD contracts of £ 37.35 / MWh (without RAB).

The BESS offshore wind target is creditably up to 50 GW by 2030, up from about 12 GW offshore currently. Even assuming only 30 GW is additionally deployed by 2030 indicates that the UK capacity to build and deploy offshore wind is at least 30 GW per decade and could be scaled up further. So by 2050 well over 100 GW could be deployed around UKCS with HVDC interconnections to Ireland and mainland Europe for net export.

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National Defence considerations of the 24 GW nuclear infrastructure vs additional renewable energy deployment (mostly offshore wind)

In June 2022 several campaign groups opposing nuclear energy projects from around the UK called on whoever becomes the next PM to carry out a Defence Implications Review of Johnson’s 24 GW new nuclear power station policy within the British Energy Security Strategy (BESS). The groups said that the unnecessary new nuclear infrastructure would put the UK at a strategic, if not existential, century-long risk to emerging threats, posed by autocratic regimes, smarter next-generation weapons, cyber, suicidal terrorists and Artificial Intelligence. A review should also consider NATO countries and the wider-world’s currently high dependency on uranium from Russian-sphere regimes and future Chinese 'Belt and Road' policies.

Grid Resilience is a benefit of renewables back-up. By dispersing and decentralising the additional back-up schemes (not required in nuclear scenarios), needed to supply electricity demand at times of no wind and sun, a high Grid resilience could be built providing additional energy security. Much

of the back-up would operate for relatively few hours per year and is essentially 'redundancy by design'. The additional back-up would comprise around 20 GW of dispersed mainly small hydrogen-fired or other low-carbon fuel fired generating capacity eg located on industrial sites and estates around the UK. Electrolysers and hydrogen tank stores could also feature close by or connected by dedicated H2 pipeline. There has been a 150 miles hydrogen pipeline network along the Rhur since 1938 : https://en.wikipedia.org/wiki/Hydrogen_pipeline_transport.

The National Grid's generating infrastructure and regional transmission networks would then be much harder to disrupt or take down by malicious action or regional natural disasters. In contrast, larger centralised and usually coastal nuclear stations would offer a small number of highly radio-toxic targets which are vulnerable to conventional future weapons and a co-ordinated attack. The nuclear stations could be used by even non-nuclear weapon states, groups or unknown proxies, to threaten or conduct nuclear terrorism, disabling the UK's power network for years or causing regional radioactive devastation for decades.

Just four nuclear generating sites, which could well be sanctioned in the next few years, would likely comprise around 12 GW of firm capacity (ie 3.24 GW HPC + 3.24 GW SZC + 1 GW SZB (IF extension) + 2.2 GW Westinghouse (Wylfa ?) + 2.2 GW (Oldbury, Bradwell ?). A co-ordinated attack on just these sites, even if no radio-toxic containments were breached) would severely degrade UK electricity supply.

Emerging and future weapons include hypersonic missiles, high energy rail-gun projectiles (which can penetrate through several metres of concrete), swarmed drones, tsunami torpedos, Artificial Intelligence (within energy, defence systems say y 2050) :https://builtin.com/artificial-intelligence/risks-of-artificial-intelligence , undersea infrastructure disruption (to inter-connectors, pipelines, comms - note offshore windfarms could carry sensors etc to become no-go areas for hostile weapons/activity).

Defence Secretary Ben Wallace's recent overall security view that '*… threat is global, multi-domain, above and below the threshold of open conflict. '*: https://www.gov.uk/government/speeches/defence-secretary-speech-at-rusi-land-warfare-conference-2022 .

Surely, the Russian invasion of Ukraine should have changed the calculus of future UK and NATO defence strategy. Seemingly, not a bit of it, Conservative Government and Labour Opposition support for a new and expanded nuclear sector carries on regardless as if in a parallel universe despite 'the *defence of a country's people being a top priority of any government*'.

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Technical Issues with EdF's EPR reactor design

The troubled build history of the "EPR" reactor, for example the decade-long delay in deployment of Olkiluoto 3 in Finland, is well known. The Flamanville 3 reactor in France - which was to take 5 years to build and cost €3.2bn - is predicted to cost €12.7bn, taking 17 years to complete, and fuel loading has been pushed back to the second quarter of 2023.

Fuel failure and "abnormal vibrations" forced Taishan 1 offline in July 2021. It is still offline at the time of writing this evidence. EDF has stated of Taishan :

"*In addition, a phenomenon occurring between the assemblies and a component enclosing the core has been identified, which would be linked to hydraulic stresses*", (p 116), a design issue prompting warnings that identical problems could exist in other EPRs, such as those planned for Hinkley and Sizewell. French regulators have expressed concern.

Karine Herviou of IRSN is reported as saying "*the EPR has a problem with the design of its tank: the circulation of water under high pressure does not work as expected and leads to vibrations that prematurely wear out the fuel assemblies*".

In December l'Autorité de sûreté nucléaire (ASN) said the start up of Flamanville 3 was conditional on the resolution of Taishan 1. The government may throw billions at a reactor design which has yet to prove it is safe to operate commercially.

On 12 June the Sunday Times reported that an EDF spokesman claimed 'the issue with fuel assemblies at Taishan has been investigated and is understood' and "a solution would be applied to Hinkley and Sizewell"'. At the time of writing, NGOs understand that ASN has not received EDF's final analysis of the Taishan 1 problem, and the Office for Nuclear Regulation (ONR) has not confirmed that solutions have been identified. We urge the Welsh Affairs Committee to press for confirmation or denial of EDF's claim that both issues - fuel assemblies and vibration - have been resolved.

A nuclear new-build programme means the UK Government is sanctioning a new, much hotter and more radioactive 'high burn-up 'waste stream. Highly dangerous spent nuclear fuel from EPRs will remain onsite, close to, and hazardous to, host communities for decades awaiting - possibly in vain - a suitable Geological Disposal Facility (GDF) to be made available. No site has yet been identified, or how much a facility would cost the non-legacy wastes from an expanded new-build programme. According to Professor Claire Corkhill, the existing specifications for a GDF could not accommodate 24GW of new build. So it is possible that two or more GDF sites may need to be developed. Meanwhile, the issue of copper-corrosion in the KBS waste storage canisters to be used in the Swedish and Finnish GDF sites continues (tests on copper in a non-oxygen environment show signs of corrosion after several years not several hundred thousand years).

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Modular reactors vs offshore wind export opportunities

Rolls Royce (RR) modular reactor exports are being talked up by some Conservative and Labour senior ministers eg Poland and Turkey (Memorandum of Understanding). While some countries may be interested in buying a RR modular if it is successfully built and demonstrated by the early 2030s it is not evident that there would be a large global market for nuclear energy in general or RR modulars in particular given the current progress in renewables and related back-up and storage technologies. Non-proliferation considerations would or should also apply.

An export market for floating offshore wind designs, hydrogen-fired back-up generating technologies and Direct Air Capture / fuel synthesis technologies (RR have been awarded a DAC demo recently) could become best sellers to a very wide market globally. Note that Friends of the Earth Cymru gave energy evidence to the Welsh Affairs Committee in October 2011 (as a report

called 'Bridge over Nuclear Waters') which included detailed sections of low-carbon and carbon-negative synthetic fuels.

Even the optimistic nuclear generating forecast for 2050 by the World Nuclear Association (forecasting a doubling of nuclear generation by 2050 from 2,650 TWh/y to around 6,000 TWh/y) suggests the market is small compared to non-nuclear energy technologies. Global 2050 energy demand is likely 120,000+ TWh/y in 2050. So nuclear energy is a small 5 % market, much of it in China and Russia. Whereas offshore wind, PV and hydrogen-fueled back-up systems are a significant part of the 95 % non-nuclear global energy market. The UK should be showing leadership in exporting safe, and secure renewable energy technologies and systems.

It is unclear why Turkey would want nuclear energy as its southern latitude and high terrain provides significant opportunities for exploiting low-cost solar PV and wind resources. Turkey is over three times the size of the UK with a population just 28 % larger than UK and also has a significant sea areas. The lowest PV prices in Turkey are currently lower than £ 20 / MWh :

https://www.pv-magazine.com/2021/05/28/turkeys-pv-tender-concludes-with-lowest-price-of-0-021-kwh-and-1-gw-of-allocated-capacity

Poland is a country with 33 % more land area than the UK and with just 57 % of the UK population with an offshore wind resource of 28 GW.

Both Poland and Turkey are geographically near Russia so nuclear facilities could be exploited in any Ukraine type invasions of countries around Russia.

Similarly, many if not most countries globally have lower population densities than UK (for large-scale onshore wind) and many have higher solar insolation. The future deemed need for nuclear energy is not evident and countries wanting to develop nuclear energy may be doing so to provide an option to develop a nuclear weapons capability.

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