Nuclear Insecurities **Gordon Taylor** **2022-06-18**

According to BBC News, the Energy Security Strategy proposed by the UK Government includes eight new nuclear reactors to boost production. [1] This is completely wrong for reasons including:

1) National Insecurity
Only the Hinkley Point C nuclear power plant (npp) is under construction, and thus may be able to deliver power before 2030, albeit with a huge public subsidy for 35 years, giving a cost twice that of renewables such as offshore wind. Also, net energy delivered to the UK would only start many months later, after repayment of the embedded energy of the materials and the operating energy of construction. Any nuclear power plants built with Chinese involvement – as proposed for Bradwell - would reduce UK national security. [2]

Russian troops took over the closed Chernobyl nuclear power plant in Ukraine from 24 February to 31st of March. The four operating nuclear power plants are also at risk from land or aerial bombardment, whether by accident or design. So nuclear plants reduce energy and national security as they are targets for attackers – whether rogue states like Russia and North Korea or terrorists with drones or shoulder-launched missiles. Renewable power and insulated buildings present no such big and lethal targets.

2) Fuel Supply Insecurity
Uranium fuel for nuclear power is depletable like the fossil fuels coal and gas, so the cost of fuel must rise as it is consumed. Also, uranium fuel is not indigenous to the UK, but must be imported and some 46% of the world's supply comes from Russia and Kazahkstan. [3] [4] So under sanctions, the world resource will be reduced by 46%, with the cost rising much faster, and be economically exhausted much sooner. This would increase the insecurity of nuclear fuel supply, and hence of nuclear energy production in the UK and worldwide.

3) Carbon Insecurity
Nuclear power is not low carbon, but incurs high carbon emissions for mining, refining, fuel manufacture and for waste storage. As uranium is depleted, the carbon intensity of nuclear power will soon exceed that of gas-fired electricity. [5] [6] With the world uranium resource reduced by some 46% by sanctions, this will occur even sooner. Also, remaining radioactivity prevents the recycling of much of the concrete and steel in a nuclear plant. This increases the 'cradle to grave' carbon cost and also the amount of waste requiring storage, with yet more carbon cost. So all npps would have to be shut down to meet the UK's national and international zero carbon targets.

4) Economic Insecurity
Npps are subject to little or no price competition, due to the cost and time required for regulators to evaluate each design. Also they are very complex one-offs, subject to weather and component delays, with no opportunity for 'learning' from series production. Instead, they are liable to 'specification creep' during the very long construction times, often due to safety concerns arising after the design and evaluation. Hence most new npps exhibit the delivery insecurities of huge delays and cost overruns. EdF has already demonstrated both with the EPRs in Olkiluoto, Finland, Flamanville, France, and Hinkley Point C, UK.

Nuclear is so costly that almost no-one will finance it except autocratic states like Russia, China and India. Now the UK government is proposing to impose nuclear power and to finance it via a so-called 'Regulated Asset Base' model, charging all electricity consumers without their being asked. [7] Yet renewables are readily financed by the private sector in democratic states such as Denmark and Germany, and even when deployed in the UK. Also the high cost of nuclear power means that it must be run continuously, save when refuelling or for maintenance. However this would force the curtailment of much wind and solar electricity output, and so destroy their (private sector) business case, raise energy costs and increase carbon emissions.

5) Capacity Insecurity
Talk of Hinkley Point C providing 7% of UK electricity is not a virtue, but 'too many eggs in one basket'. It comprises 2 x 1600 MWe npps, but close-coupled, so many 'common-mode' failures could occur. Hence the UK Short Term Operating Reserve (STOR) would have to be increased to 3,200 MWe. But Dinorwig of 1800 MWe took 10 years to build and without a STOR of 3200 MWe, any unplanned outage of Hinkley Point C would subject the GB grid to massive capacity insecurity and blackouts.

6) Natural and Climate Change Insecurity
All the nuclear power sites in the UK are coastal for cooling by seawater. So they are vulnerable to sea level rise and storm surge. Also, Hinkley Point C and Sizewell C are on convergent channels – the Severn Estuary and the southern North Sea - that magnify the effects of storm surges. The government has overlooked the floods in the Bristol Channel in 1607 and in Canvey Island and the Netherlands in 1953. [8] [9] So all UK nuclear power sites must be decommissioned and clearly completely of radioactive material by 2100 at the latest, by which time sea level rise may be appreciable, to avoid it being washed into the sea and polluting the planet. Such decommissioning would take at least 50 years, so all npps must be shut down by 2050, making them already 'stranded assets'.

All governments must also consider the impact of solar storms, especially the major storm expected in 2025. [10] This could bring down electricity grids, affecting up to 400-odd npps worldwide. The duration of the grid outages could exceed not just the on-site batteries of 4 to 8 hours, but even the standby diesel generators of days to weeks. So to avoid many meltdowns with major radioactive releases, all npps worldwide would have to be brought to cold shutdown, taking weeks, beforehand.

7) Disastrous Insecurity
All fission npps give off 'decay heat' after shutdowns, whether operational or in emergencies. If the npp loses both the grid connection and the standby generators from whatever cause, after the batteries are exhausted in 4 to 8 hours, decay heat causes the reactor cores and spent fuel pools to overheat, whereupon all containments may be breached in hours to days. This happened at Fukushima, where three reactors discharged major radioactive releases to the air, groundwater and sea. [11]

The probability of a given radioactive release is assessed by assigning probabilities of failure to each link (e.g. a pump or pipe or valve) in the billions of possible chains of events. However some threats from hostile states and terrorists, such as airliners, missiles, drones and cyber attacks, were not anticipated when many existing npps were designed. The same may apply to natural disasters, such as earthquakes, storm surges and sea level rise, and to new npps. So not all the chains of failures can be identified and even fewer are considered in practice. Therefore the probability of a major radioactive release is an underestimate, logically unknowable, and must be taken as inevitable. [12] Hence npps suffer disastrous insecurity from an unknowable number of threats.

The magnitude of a 'worst case' release is about 100 times those from Chernobyl and Fukushima. [13] The cost of such a release has been put at about E 6000 billion. [14] [15] This is about three times the UK GDP, but is uninsurable. Yet the size and number of npps has increased, and they are often clustered together, as at Chernobyl, Fukushima and Hinkley Point C. Also spent fuel in the cooling pools has been increased with re-racking, instead of using the more costly off-site dry cask storage and secure underground repositories. So the potential radioactive releases are now even larger. Even 69 years after the opening of Calder Hall in 1956, the UK still has no long-term repository for nuclear waste, and both the means and the cost are unknown. So the UK should cease adding to the nuclear waste stockpile, and phase out all nuclear power immediately, as in Germany. Also, after the next major radioactive release anywhere in the world, all npps, whether old or new, incomplete or operating, would become 'stranded liabilities' and most likely be shut down immediately, with energy insecurity seen as the lesser of two evils.

8) Human Insecurity
Chernobyl resulted in fallout over 40% of western Europe, while 2400 km away in the UK, the fallout on hill farms in Scotland and Wales resulted in compensation being paid for 25 years. The Fukushima disaster caused the evacuation of some 100,000 citizens, the loss of many livelihoods including farming and fishing, and the loss of up to 8% of the Japanese land area for decades. So the human and economic consequences of major radioactive releases are such that the populace experiences life-threatening human insecurity and demands immediate shutdowns of all npps in the country. Since the Fukushima disaster in 2011, hardly any of the 50-odd npps in Japan have been re-started, while the cleanup is expected to take over forty more years.

9) Investment Insecurity
Most countries have long decided against nuclear power. Following Fukushima in 2011, Germany, Italy, and Switzerland, later joined by Belgium and Spain, have also decided against or are phasing it out, showing that other solutions are possible. For Germany, several independent studies show that 100% of electricity could be supplied from renewable energies. [16] The German government appointed an 'Ethics Commission for a Safe Energy Supply'. [17] It accepted their findings and adopted the 'Energiewende' (Energy Transition). My analysis for the UK shows that wind power could supply up to 75% of electricity with the balance from gas-fired power, before 'Power-to-Gas' long term storage is required to reach 100% renewable energy. [18]
Also, UK energy security could be increased by electricity storage for hours to days. This would enable renewable electricity from periods of surplus, otherwise wasted by curtailment, to be supplied during periods of low wind and sun. Some 95% of existing electricity storage uses Pumped Hydro, and the UK has ample sites – notably in the mountains of Wales and Scotland. [19]
Other forms of low cost electricity storage are under development for flat locations, such as Denmark, England and Ireland. [20]
So new supply should be from wind and solar farms which are ethical, sustainable and secure investments, much cheaper to finance and much quicker to deliver. Conversely, npps would suffer massive investment insecurity.

10) Business and Jobs Insecurities
Most countries are addressing energy security and climate change concerns with demand reduction and increased energy efficiency, along with supply from renewable energies. The scope for demand reduction has been shown by Cullen, Allwood et al at Cambridge as 80%. [21] For all energy-using products, savings are usually possible until the energy used is about twice the thermodynamic minimum required for each task. An excellent example is lighting, where the savings achieved between incandescent and LED lights is about 90%. Moreover, the UK imports most of it's end-use equipment, appliances and lighting, and much industrial machinery, which is renewed after 5 to 15 years. As the energy use is reduced for newer units, so the electricity demand in the UK is falling. In Germany, energy saving is supported by policy, and electricity demand is expected to fall 50% by 2050. So the grid can be balanced significantly by demand reduction and electricity savings, which are much quicker and cheaper to deliver. Conversely, npps would cause business insecurity with insecure and uncompetitive power and prevent opportunities in the sustainable energy technologies that could be sold at home and abroad.

Claims that building Hinkley Point C would offer e.g. 25,000 jobs are not a virtue. UK industry is not able to build npps so the imported content would be very high. Most UK nuclear power jobs would be low-skilled and last less than the construction time, leading to job insecurity. Meanwhile overseas companies such as Vestas and SiemensGamesa are investing in UK manufacture of wind turbines for both UK and overseas markets. This reduces the imported content and increases high-skilled UK jobs in manufacture, supply chain, sales and marketing, installation, and operation and maintenance.

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