2022-10-05 Nuclear Nonsense **Gordon Taylor**

The new UK government appears to support the previous government's proposal of building new nuclear power plants. (See: 2022-09-01 UK's Boris Johnson goes nuclear with swansong energy investment, https://www.reuters.com/business/energy/uk-invest-700-mln-pounds-new-nuclear-plant-pm-johnsons-swansong-2022-09-01/).
The Labour party proposes to include nuclear in it's new 'green' energy policy. 'The idea at its core is to build a self-sufficient power system run entirely by cheap, homegrown renewables and nuclear, by the end of the decade'. (See: 2022-09-25 https://www.theguardian.com/politics/2022/sep/24/keir-starmer-unveils-green-growth-plan-to-counter-liz-trusss-tax-cuts).
However, such proposals are nonsense for reasons including:

1) Nuclear power is far from cheap and is not homegrown in the UK. Most of the plant would be imported, like the funding and the fuel, which adds greatly to the cost, and construction times are well over ten years. So it could make no contribution by 2030 (the Labour plan) and very little by 2050 (the Conservative plan).

2) Nuclear power faces effective exhaustion of the uranium fuel when it's carbon intensity exceeds that of gas-fired power. (See: 2017 Climate change and nuclear power: An analysis of nuclear greenhouse gas emissions, Storm van Leeuwen, p 49, https://www.stormsmith.nl/Resources/nucl%26climate2017.pdf). Exhaustion can be defined by the Energy Return (as nuclear electricity) On the Energy Invested (EROEI) (in the building of the nuclear power plant, then the mining, refining, enrichment, manufacture, operation and maintenance, followed by decommissioning, with defuelling, short-term storage (cooling ponds, dry casks) and long-term-storage (e.g. geological repository). As this last is essentially for all future time, and energy cannot be discounted, this incurs an energy debt which is near-infinite, so the EROEI is almost zero. While an EROEI of 1.0 would be the theoretical break-even point, more like 3.0 would be needed to earn a net financial return or profit.

3) Nuclear power proposals usually fail to recognise that the output of a nuclear power plant (e.g. MWe) over the operating duration (e.g. hours, years) may be much less than intended due to:

a) the available uranium resource being reduced by sanctions on Russia, where Russia and Kazakhstan account for some 46% of the world supply. (See: 'Uranium from Russia, with love', Nick Meynen, 2016-08-04, http://www.theecologist.org/News/news_analysis/2987988/uranium_from_russia_with_love.html and 'List of countries by uranium production', https://en.wikipedia.org/wiki/List_of_countries_by_uranium_production). This could lead to all nuclear plants outside Russia running out of fuel by 2050.

b) the plant failing to be completed, due to running out of capital and other reasons. (See: 2013-02-10 Gone Fission: 11 Unfinished Nuclear Power Plants, https://weburbanist.com/2013/02/10/gone-fission-11-unfinished-nuclear-power-plants/).

c) the plant failing to be completed on time. This is usual, with over-runs of multiple years for the EPRs in Finland, France, and the UK (Hinkley Point C). (See: 2022-05-19 New one year delay at UK Hinkley Point nuclear plant: EDF, https://www.france24.com/en/live-news/20220519-new-one-year-delay-at-uk-hinkley-point-nuclear-plant-edf).

d) the plant failing to deliver the design output, due to initial technical faults, later deterioration and shortage of cooling water for those located on rivers. (See: 2022-08-30 Analysis: France braces for uncertain winter as nuclear power shortage looms, https://www.reuters.com/world/france-braces-uncertain-winter-nuclear-power-shortage-looms-2022-08-30/).

e) the plant being shut down earlier than intended, due to it or any of the other 400-odd ageing nuclear power plants worldwide suffering a disastrous radioactive release. This happened in Japan after Fukushima, and about 20 of the available nuclear plants are still shut down. (See: List of nuclear power plants in Japan, https://en.wikipedia.org/wiki/List_of_nuclear_power_plants_in_Japan and Nuclear Power in Japan (Updated September 2022), https://world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-power.aspx). The WNA article may be upbeat, but the final decision on restarting is taken not at National but at Prefectural level, and following their experience after Fukushima, the Japanese people are widely opposed to restarting nuclear plants.

f) all the 400-odd nuclear power plants worldwide being affected by solar storms, especially the major storm expected in 2025. This could bring down electricity grids, outlasting not just the onsite 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 nuclear plants worldwide would have to be brought to cold shutdown, taking weeks, beforehand. (See: 2021-07-29, 'Think last year was bad? Just wait until the sun starts spewing plasma', Matt Smith, https://wired.me/science/sun-solar-storm-2025-impact-on-earth/).

g) all the UK nuclear plants being shut down around 2050, for decommissioning to be completed by 2100, to avoid flooding by sea level rise and storm surge and radioactive material being washed into the sea and polluting the planet. Thanks to the unwise location of two new nuclear plants on convergent channels, – Hinkley Point C on the Severn Estuary and Sizewell C on the southern North Sea – which magnify the rise, these will have to be shut down and decommissioned first.

4) While Risk is often defined as Probability times Consequences, when the latter impact whole countries and populations of millions, they should be the decisive consideration. Yet nuclear power is uninsurable (save for token amounts), so it operates only when national governments carry the risk.
'Swiss Re wrote: 'The anticipated extent of loss from a nuclear accident was generally believed to justify a special liability regime. Such a regime would both ensure proper compensation for the public and foster the development of the nuclear power industry, which would otherwise be faced with an overwhelming burden. Accordingly, the operators' interests were secured by limiting their liability in time and amount, and the liability regime was introduced in the Paris Convention on Third Party Liability in the Field of Nuclear Energy [of 1960] and in the Vienna Convention on Liability for Nuclear Damage [of 1963].' 191
The Paris and Vienna Conventions were prompted by the Price-Anderson Act of 1957 in the USA and followed by the Nuclear Installations Act of 1965 (plus later amendments) in the UK, saying that the risk would be carried by the State. Such 'Statutory Indemnities' are described by the UK Government as 'unquantifiable'. This means 'unlimited', so must be taken as 'infinite'. 192
The German Renewable Energy Association published on 2011-05-11 a study commissioned from 'Versicherungsforen Leipzig GmbH' on the calculation of an adequate insurance premium for the operators of nuclear power plants. 193 This found that the mean insured sum payable for a nuclear disaster could be 6090 billion euros. If passed on to consumers and spread over 50 years, the additional cost of electricity in euros per kWh would be 8.71 for each individual nuclear plant or 0.51 for all 17 plants in Germany and if spread over ten years, 67.3 or 3.96. (At 1 euro = £ 0.88, these are 766, 45, 5922 and 348 p/kWh). The study concluded that 'in practical terms, nuclear disasters are not insurable'. It has been reported briefly in English. 194',
(See: 2012-04-11 The Real Lessons of Fukushima, http://cms.energypolicy.co.uk/nuclear/244 Page 58).
In 2011, 6090 billion Euros was roughly 1.5 times the annual GDP of Germany or over twice that of the UK. (See: https://www.macrotrends.net/countries/DEU/germany/gdp-gross-domestic-product and https://www.statista.com/statistics/281744/gdp-of-the-united-kingdom/).

As noted above, the UK government liability for nuclear risks is expressed as 'unquantifiable'. (See: Department for Business, Innovation and Skills resource accounts 2009-10: including the consolidated resource accounts for the year ended 31 March 2010 (HC 211, Session 2010-11), Presented to Parliament 26 July 20, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/31923/10-p102-bis-resource-accounts-2009-10.pdf Page 171). This conceals the true money, energy and GHG costs of nuclear power.

5) The UK government also pays for all nuclear decommissioning and the storage of nuclear waste. (See: 2022-05-20 UK nuclear power stations' decommissioning cost soars to £23.5bn, https://www.theguardian.com/environment/2022/may/20/uk-nuclear-power-stations-decommissioning-cost). This also conceals the true money, energy and GHG costs of nuclear power.

6) After use, the materials of nuclear plants are radioactive so cannot be recycled - making them even more unsustainable. This also increases the amount of nuclear waste and thus the true money, energy and GHG costs of nuclear power.

7) There is much evidence of nuclear harm to the health of all living things – plants, animals and humans, in this and all future generations – via damage to DNA. This is from radioactive releases from nuclear power plants in 'normal' operation, nuclear disasters such as Chernobyl and Fukushima, and the inevitable nuclear waste. This last will remain harmful until the Earth is absorbed by the dying Sun. (See: A Primer in the Art of Deception, Paul Zimmerman, 2009, http://www.energypolicy.co.uk/A-Primer-in-the-Art-of-Deception.pdf). This has almost 800 pages, including a bibliography of 54 pages. The Table of Contents has many striking chapter headings. These include: ' The Most Heinous Crime in History: The Betrayal of Mankind by the Radiation Protection Agencies', 'A Short History of Radiological Warfare', and 'The Mentality of Genocide'.

The harms from nuclear power, nuclear bombs and uranium ordnance have been studied by many other researchers, including Professor Dr Chris Busby. He is the Scientific Secretary of the European Committee on Radiation Risk. (See: 2010 Recommendations of the European Committee on Radiation Risk. http://euradcom.eu/wp-content/uploads/2016/04/ecrr2010.pdf). The Committee includes 24 professors and some 16 Doctors (PhDs). (See Page 183 ff). Here are two videos:

2011-11-23 Chris Busby The Cause of Congenital Anomaly and Cancer in Iraq, https://www.youtube.com/watch?v=vyENkohbDl0 . This is an interview with a Swedish lady particularly concerned at the birth defects and more from uranium shells and bullets.

2011-12-20 Dr Chris Busby on Sky Fallujah, Fukushima and Radiation, https://www.youtube.com/watch?v=vwYDPUszF4s . This is an interview with Theo Chalmers of Sky TV.

Risk (i.e. consequences, such as nuclear harms) is often related to the external radiation dose, usually measured as gamma. But this overlooks the alpha and beta internal radiation dose from inhaled and ingested gases, liquids and particles, which can harm DNA, leading to cancers, heart disease, still-births and malformations and more, including genetic. This last means passing down through generations after the original parental exposure until the progeny die out due to early death or infertility. (See: 2010 Recommendations of the European Committee on Radiation Risk, The Health Effects of Exposure to Low Doses of Ionizing Radiation, http://euradcom.eu/wp-content/uploads/2016/04/ecrr2010.pdf Page 96).

Genetic harm has been established repeatedly in UK courts of law by Dr Chris Busby, acting on behalf of military service veterans who were exposed to radioactive fallout from A- and H-bomb tests. 'I am expert witness in the on-going case of the Nuclear Test Veterans vs. MoD in the Royal Courts of Justice and have successfully overturned Ministry of Defence decisions in more than 6 Pensions Appeals relating to Nuclear Test Veterans. I have been retained on this issue for a further 16 cases which are currently awaiting trial'. (See: 2014-01-01 'Collected Submissions on the Proposed Forsmark Nuclear Waste Repository', https://www.mkg.se/uploads/Aktbilagor/297_Nacka_TR_M_1333-11_aktbil_297.pdf, logical page 41).

See also the documents on my 'Nuclear' page: http://cms.energypolicy.co.uk/nuclear/
The latest is: 2022-08-13 Nuclear Power And Weapons Are Killing Us, http://cms.energypolicy.co.uk/nuclear/352
This is a document of 4 pages, with references (links).

8) Hundreds of different radionuclides are produced by nuclear power plants, and released during defuelling and refuelling, notably from ruptured fuel cans. Such 'operational' radioactive releases may be permitted or not, yet are only self-reported. (See: 2012 '2 Effluent Releases from Nuclear Power Plants and Fuel-Cycle Facilities', https://www.ncbi.nlm.nih.gov/books/NBK201991/ and 2012 Analysis of Cancer Risks in Populations Near Nuclear Facilities: Phase 1, https://www.ncbi.nlm.nih.gov/books/NBK201996/pdf/Bookshelf_NBK201996.pdf).

9) Nuclear reactors contain far more radioactive material than any nuclear bomb. One type of bomb can contain about 15 kg of highly enriched uranium and another about 4 kg of plutonium. (See: 2009-09-22 https://www.livescience.com/5752-hard-nuclear-weapons.html). The Fukushima nuclear cores contained about 83,200 kg (R1) and 145,600 kg (R2 & R3) UO_2 fuel. (See: 2011-08-10 http://www.jaif.or.jp/ja/wnu_si_intro/document/2011/el-jaby_fukushima_canadianresponse.pdf Slide 14). So a major radioactive release from a nuclear power plant could render uninhabitable huge swathes of land, leading to migrations far larger than any in history and cause collective human harm vastly greater than a nuclear war.
After Chernobyl, the UK government paid compensation for 26 years to hill farmers in Scotland and Wales, some 2400 km away. This was for measures to reduce the radioactivity, which increases in the food chain from grass to sheep meat. (See: 2019-06-03 How Chernobyl made Welsh sheep radioactive and paralysed some farms for 26 years, https://www.walesonline.co.uk/news/wales-news/how-chernobyl-made-welsh-sheep-16360676).

If a nuclear release falls out on a neighbouring country and/or it's marine economic zone, this could do unquantifiable economic damage and render part or whole uninhabitable. (See: 2013-06-07 The Consequences of Major Nuclear Releases, http://cms.energypolicy.co.uk/nuclear/291). This mentions three reports originating from within the 'nuclear community'. Recompense would be impossible, yet many countries neighbouring the UK, like the vast majority of countries worldwide, are non-nuclear. They will not accept a technology that is capable of such disastrous consequences.

10) Nuclear waste is progressively more expensive to store in a) spent-fuel pools, typically at or near the nuclear plant, for about five years, waiting for decay heat from the fuel rods to fall sufficiently, b) dry casks for indefinite periods, waiting for transfer to c) a 'geologic repository'. Locating such depends on suitable geology and public acceptance, which is a very rare combination, so only one has been built – in Finland, for its own use. Moreover, even dry casks are very expensive, so the capacity of spent fuel pools has often been increased by 're-gridding', to hold four or more times the original amount of spent fuel rods. However, this requires the insertion of plates of moderating material (usually boron) to avoid the fuel rods now in closer proximity reaching 'critical mass', leading to a nuclear melt-down and/or explosion. Also, the contents of the spent fuel pool then weigh much more, so are at greater risk from structural failure, particularly in earthquakes. This increases the risk and consequences of a nuclear disaster involving a spent fuel pool, which has not occurred so far, but is dreaded. (See: 2016-08-16 Reducing the Danger from Fires in Spent Fuel Pools, https://scienceandglobalsecurity.org/archive/sgs24vonhippel.pdf and 2017-03-22 Economic Losses From a Fire in a Dense-Packed U.S. Spent Fuel Pool, https://scienceandglobalsecurity.org/archive/sgs25vonhippel.pdf and 2017-05-26 Nuclear safety regulation in the post-Fukushima era, https://sgs.princeton.edu/sites/default/files/2019-11/lyman-schoeppner-vonhippel-2017.pdf). This last includes: 'To reduce the risk and invest in infrastructure, Congress could consider allocating $5 billion for casks to store spent fuel. The federal government is already reimbursing nuclear utilities almost $1 billion per year for casks needed to store older spent fuel because the Department of Energy has not fulfilled its commitment to remove the fuel to an underground repository or interim storage site'.

11) All nuclear facilities, including reactors, weapons plants, power plants and surface waste stores, are prime targets for attacks by terrorists or rogue states. Hence they reduce both national and energy security. The UK has been operating nuclear reactors for weapons and power nearly as long as the US, and has also failed to build any high level waste repository.

12) There is a fundamental conflict between nuclear and renewable power on the same grid system. Nuclear power is usually funded by public monies (in authoritarian states), by private companies operating in monopoly markets (e.g. in the US) or by overseas companies (e.g. in the UK). It is very costly, so to recover the money and energy outlay as quickly as possible, it is run as often as possible. As the load is finite, this often leads to curtailing of renewable power. But this destroys the business case of renewable power, which is usually funded by private companies, either indigenous or overseas. So they would be deterred from funding the expansion of renewable power, which – apart from energy saving – is the lowest cost and fastest scalable option for meeting climate change targets.

13) No UK plans for nuclear power have mentioned the German Ethics Commission Report of 2011, following Fukushima. (See: 2011-05-30 Germany's energy transition – A collective project for the future, produced by the Ethics Commission for a Safe Energy Supply, https://archiv.bundesregierung.de/resource/blob/656922/457334/784356871e5375b8bd74ba2a0bde22bf/2011-05-30-abschlussbericht-ethikkommission-en-data.pdf). This found that: 'The withdrawal from nuclear energy is necessary and recommended to rule out future risks from nuclear in Germany. It is possible because there are less risky alternatives'. 'The Ethics Commission has come to the conclusion that a safe energy supply can be achieved which provides more jobs in business and manual trade without compromising environmental protection, whilst also avoiding a power shortage and having to import nuclear energy'. The German government decided to phase-out nuclear power between 2011 and end 2022 and ramp-up low-carbon alternatives. As the scientific laws are universal, this action is relevant worldwide.

14) All the above show that nuclear power is a nonsense. Yet new plants would incur opportunity costs in time, money, energy and GHG which can be spent only once. They could not then be spent on sustainable options that have been proven to work. These include energy savings and increased energy efficiency, which have a technical potential of about 80%. This huge proportion arose because the world stock of energy using devices was created while fossil energy was cheap and climate change not a concern. However, these options are all consistent with the laws of thermodynamics and with real and realisable devices. (See: 2022-06-14 Energy Transition Technologies, http://cms.energypolicy.co.uk/allsectors/350).

Sustainable and proven power supply options include hydro power, solar photovoltaic power, and wind power, onshore, offshore and floating. Although most sites for hydro power on rivers are already harnessed, most countries have considerable potential for solar PV, both ground-mounted and on buildings, as well as for wind power. In countries with high population densities, such as the UK, the potential for onshore wind power may be limited. However, like most countries, the UK has an offshore 'economic zone', with great potential for offshore wind power, and at costs that have fallen sharply. Sites for floating offshore wind power, with greater sea depths, are even more extensive. Feasibility is already proven and costs are already falling fast. (See: 2013-10-09 Electricity from Wind and Storage, http://cms.energypolicy.co.uk/electricity/241).

15) Security of supply and sustainability with renewables can be assured with sufficient storage on a daily, weekly and annual scale. This may be in pumped hydro, renewable hydrogen or electrofuels or high temperature heat for electricity, and low temperature heat for space and water heating. (See: 2020-01-22 Development of a Global Atlas of Off-River Pumped Hydro Storage, http://cms.energypolicy.co.uk/electricity/337 and
2013-10-09 Electricity from Wind and Storage, http://cms.energypolicy.co.uk/electricity/241 and
Stiesdal Storage, https://www.stiesdal.com/storage/ and
2020 Scaling Up Pit Thermal Storages, https://online.flippingbook.com/view/176051822/8).
These have the advantage of increasing the demand for, and thus improving the business case for, renewable power.

16) Of the three possible carriers for heat in buildings, electricity, gas, and hot water (district heating), only this last can harness all the reject heat from energy conversions and renewable heat. This can be considerable in amount and is low-carbon. District heating is being deployed at scale in most European countries and elsewhere. (See: The Case for District Heating: 1000 Cities Can't be Wrong, https://projects.bre.co.uk/dhcan/pdf/PolicyGuide.pdf). It is most advanced in Denmark, where it already supplies 56% of residential and service sector buildings. (See: 2022-04 Something is sustainable in the state of Denmark: A review of the Danish district heating sector,
https://www.sciencedirect.com/science/article/pii/S1364032122000466/pdfft?isDTMRedir=true&download=true).
'The German government has announced the start of a €3 billion subsidy scheme put in place until 2026 that will support the construction of district heating grids that use at least 75% renewable energy'. (See: 2022-09-15 Berlin kicks off €3 billion district heating subsidy scheme, https://www.euractiv.com/section/energy/news/berlin-kicks-off-e3-billion-district-heating-subsidy-scheme/).

So energy saving measures, renewable supply, storage and district heating should be included in a rational energy policy.

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