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Britain's Loyalty to Nuclear Power

William J. Nuttall*

Abstract

This paper explores Britain's 70 year enthusiasm for civil nuclear power. The 1990s brought moves towards electricity market liberalisation and a 'dash for gas' followed. Both Conservative and Labour Party governments wanted to see nuclear new build, but this proved impossible in the face of market liberalisation and external shocks. UK public policy retreated from electricity market liberalisation with a view to keeping the Nuclear Renaissance alive. UK governments on both sides have been loyal to nuclear power, but the nuclear renaissance has struggled. In Britain the main barrier to nuclear new build has been economics, not politics.

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Sintesi - La fedeltà britannica all'energia nucleare

Il saggio analizza i 70 anni durante i quali la Gran Bretagna ha mostrato sempre entusiasmo per l'energia nucleare civile. Gli anni Novanta hanno portato alla liberalizzazione del mercato dell'energia elettrica, cui è seguita una "corsa al gas". Sia i governi conservatori che quelli laburisti volevano costruire nuovi impianti nucleari, ma ciò si è rivelato impossibile di fronte alla liberalizzazione del mercato e agli shock esterni. La politica pubblica britannica non è andata oltre con la liberalizzazione del mercato dell'elettricità, con l'obiettivo di mantenere in vita il "Rinascimento nucleare". I governi britannici, di entrambe le parti, sono stati fedeli all'energia nucleare, ma il "Rinascimento nucleare" ha stentato a decollare. In Gran Bretagna il principale ostacolo alla costruzione di nuove centrali nucleari è stato di natura economica, non politica.

JEL Classification: P16; P18; N7.

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Keywords: Nuclear power; Electricity markets; Liberalisation; Energy policy.

1. History

Britain was one of the first countries to research and develop nuclear technologies. Although Russia and America both can point to early reactor success, it was the UK that first produced grid-scale quantities of electricity for ordinary citizens, albeit from a set of four reactors at Calder Hall whose primary purpose was plutonium production for the UK's growing nuclear weapons enterprise.

The UK was not just one of the first into civil nuclear energy, it was an early pioneer of nuclear weapons [1], being the third state to detonate an Atomic Bomb (Operation Hurricane test detonation in the Montebello Islands off Western Australia in October 1952) and to detonate a two-stage Megaton yield thermonuclear device (most clearly demonstrated by the Grapple Y test of April 1958).

The UK was an early pioneer of advanced civil nuclear concepts, such as the sodium-cooled fast reactor (Dounreay Fast Reactor [critical 1959] and Prototype Fast Reactor [critical 1974]) and tokamak fusion (at the Culham Laboratory in Oxfordshire).

2. Market Liberalisation

Margaret Thatcher (UK Prime Minister 1979-1990) was by instinct a supporter of nuclear energy. Originally trained in Chemistry at Oxford University she had an appreciation of the power and benefit of science and technology to address societal needs. A greater driving passion, however, was her distrust of the state as an agent of social and economic progress. She was a firm be-

liever in the power and benefit of the market economy and one of her major policy efforts was to seek to liberalise the UK energy market. The journey to liberalisation would turn out to be slow and would mostly be realised under the governments of her successors.

The Thatcher government's ideas for electricity privatisation started to take shape in 1988 and 1989 following the privatisation of gas in 1986. Engineering realities ensured that both transmission and distribution, as natural monopolies, could not be opened to competition. These aspects could be privatised as regulated industries. Gas had been privatised as a contestable market with a dominant incumbent. Thatcher's vision for electricity *privatisation* was managed by her loyal Secretary of State for Energy, Cecil Parkinson. The long-term goal would be for *liberalisation* of the electricity sector – i.e. competition. Such arrangements might be established in power generation and in 'supply'. Given our focus in this editorial, we shall consider the former. A key problem for Parkinson in the late 1980s was the electoral clock. There would be a need to face a general election in 1992. The privatisation policy would need to be complete by then.

Microeconomics suggests that in order to avoid risks of market power in competitive markets there should be at least five players in that market. The problem was that there would be no time to set up five competing companies before the election. The conclusion was that with the tight timeline, only two companies could be established.

Nuclear power represented a particular concern. There were signs that the back-end decommissioning burden frightened investors. At that time nuclear decommissioning was in its infancy and the looming costs appeared to be enormous. Later it would be appreciated that the cost is incurred far in the future and hence discounting greatly attenuates its impact on full lifecycle

costs, or indeed the 'levelised cost of electricity'. (For an excellent primer on nuclear energy economics see: [2]).

It was felt that for engineering reasons all the nuclear power stations should be held together in a single entity. As privatisation plans took shape there would be two competing companies and these were known to the policy-makers as "Big G" and "Little G" – with "G" standing for generator. Given investor anxieties, it was planned that the company holding the nuclear assets should be the larger of the two.

As privatisation (and the 1992 election) approached, it became clear that plans for Big G worried the investors. Their fears around nuclear decommissioning remained and were now at a level that threatened the success of the whole privatisation project. Late in the process it was decided to remove the nuclear assets entirely from the privatisation and to retain the nuclear reactors in public ownership. The enabling Electricity Act was given Royal Assent in July 1989 shortly before Thatcher's premiership ended in November 1990. Her successor as Prime Minister was her Conservative Party colleague, John Major. His government inherited an electricity generation industry comprising two newly privatised generators and two state-owned nuclear generators one in England and Wales and the other in Scotland.

At this stage attention turned to achieving a genuine competitive market without risks of market power. Electricity market design would be a key part of British energy policy for decades to come. By the early 2000s the market had achieved competitive generation led by a group of electricity companies known as the 'Big 6' half of which were truly British enterprises, the other half being subsidiaries of French or German companies.

In the early days of privatisation the English and Welsh electricity market was operated as a 'Pool' energy-only market. Ancillary services (such as grid

balancing or Black Start) were remunerated by other means. In the Pool, day ahead bids would be submitted with all accepted generators receiving the market-clearing price. No payments would be made for capacity readiness at that time. Given the need to run baseload, whatever the market clearing price, there was an incentive, in effect, for nuclear operators to bid a zero price. The nuclear power plants remuneration would be determined by the clearing bids from the fossil-fuel-based generators. In the Pool market the state-owned nuclear operators were pure price-takers.

Later, the nuclear operators were combined and privatised as British Energy, but that did not go well with the company needing to be bailed out in 2002 [3].

The early Pool market was soon replaced by new trading arrangements favouring vertical integration between generators and suppliers (based on contracting). Over time the number of players in the UK electricity industry would gradually increase until coming under serious pressure in the early 2020s.

3. Climate Change

Thatcher's chemistry background ensured that she was a very earlier believer in the threat of anthropogenic climate change. The sense that climate change is a serious looming problem took hold in the UK earlier than in other countries. By 2000 an influential Royal Commission was reporting the need for 60% global greenhouse emissions reductions by 2050 [4]. It was widely understood that the UK civil nuclear fleet was avoiding significant GHG emissions. Meanwhile following privatisation of the rest of the electricity in-

dustry, the UK was busy with a “dash for gas” and the gradual decline of coal-based power generation began.

It is hard to overstate the importance of coal to the United Kingdom in the early twentieth century. It had enabled the industrial revolution and powered the naval and merchant ships of the nineteenth century. In the 1930s it heated homes and powered the fastest trains in the world. After the Second World War coal mining emerged as a bastion of socialist thought. As reflected Thatcher's combative style, she took on her political opponents in the National Mineworkers Union without mercy and following a painful strike in the mid-1980s coal mining went into irreversible decline. Coal was imported to feed the power stations, but over many decades this declined too, in the face of ever clearer environmental realities. By 2023 coal-fired electricity generation contributed only approximately 1% of the UK total [5].

Through the 1990s, while nuclear energy was understood to be a low-carbon option, the economic realities of a liberalising market ensured that nuclear new build was firmly off the agenda. As the realities of a liberalised market came to be understood, two economic considerations were barriers in the path of nuclear investments. Meanwhile one issue receded as a concern. As discount rates altered to reflect more commercial realities, back-end decommissioning reduced in importance. Up front capital costs, however, became more worrying and for nuclear power these costs are higher than for any alternative technology. The other issue was economic risk. In the liberalising market at the turn of the Millennium, put simply, with nuclear investment the substantial risks would be carried by the investors, whereas if investors chose gas then the major risks (gas price volatility) could be passed through to electricity consumers (if gas prices rose then electricity prices rose, as the two prices were closely correlated). It was hardly surprising that investors did not

choose to make expensive and risky choices, noting that the risk could stick with them. The nuclear power ambitions of the engineers were in trouble and the 1990s are today remembered for the *dash for gas*.

4. Nuclear Renaissance 1.0

In 2003 a wave of unrelated serious blackouts occurred around the world including in north-eastern USA, Scandinavia, Northern Italy and London. These events focussed political attention on electricity security. In a speech in May 2006, UK Prime Minister Tony Blair memorably declared [6]: “*Essentially, the twin pressures of climate change and energy security are raising energy policy to the top of the agenda in the UK and around the world. ... These facts put the replacement of nuclear power stations, a big push on renewables and a step change on energy efficiency, engaging both business and consumers, back on the agenda with a vengeance.*” For Britain this speech would mark the beginning of a journey towards nuclear renaissance [7].

The Labour Governments of Tony Blair and Gordon Brown put in place a policy framework around design approval, site selection and public consultation that would be efficient and avoid problems of the past. The planning approval process for the UK’s last nuclear power plant completed in the mid-1990s (Sizewell-B in Suffolk) had taken three years and had received more than 16 million words of evidence [8]. The scale of effort associated with the planning enquiry was greater than for any other construction project in the UK at that time. Labour continued to seek a nuclear renaissance, but progress was slow.

In 2010 a new Conservative-led coalition government had been elected. It was as keen on nuclear renaissance as its Labour predecessors. It could see that, although the policy landscape had been tidied up, the fundamental economic realities remained an obstacle to nuclear renaissance. At this point it is worth being clear that our story here is, in reality, one of *English* nuclear energy politics. Issues of UK nuclear renaissance have, so far, not involved Scotland or Northern Ireland, where different politics applies. In England the Labour Party is divided between an eco-pacifist wing (opposed to nuclear energy) and a stronger industry-strategic faction keen on high-skills jobs in Labour supporting regions. Hence, in the UK, the most relevant voices of political opposition to nuclear energy do not come from the Green-Left, rather they are heard from the market-oriented right. It is the Conservative Party that is more likely to waver in support, but after 2010 it did not waver – it sought to keep the renaissance on track.

5. Lehman's and Fukushima

Two significant blows have hit UK ambitions for nuclear renaissance. The more important was the global financial crisis following the collapse of Lehman Brothers on 15 September 2008. Capital markets were in turmoil, industry sank into recession and demand for electricity fell weakening the case for nuclear new build. As a consequence, by 2010, Tony Blair's nuclear renaissance was effectively dead. In March 2011 there would be the major nuclear accident at Fukushima – Daiichi nuclear power plant in Japan, but this was minor for UK decision making compared to the troubled economic

circumstances and noting that a Conservative-led government was in charge and economics remained the dominant concern.

6. Retreating from Liberalisation

David Cameron's Government did a remarkable thing. It retreated from the Conservative plans of the past. It rolled back on liberalisation and established a mechanism around "contracts for difference" (CfD) that would guarantee revenues for nuclear power developers able to complete their plans. Plants built in the nuclear renaissance would not sell their electricity at market prices. This offer was specifically intended to improve the risk return calculus for investors and indeed EDF Energy pushed ahead with plans to build a very large two reactor nuclear power plant at Hinkley Point C in the west of England. Under the terms of the CfD the engineering risk would rest with the project developers. To a first approximation, they would only be paid once they start selling electricity.

As the Hinkley Point C project moved forward, through a global pandemic and a British departure from the European Union, the costs would fall mostly on the project investors let by French electricity giant EDF.

While HPC continues to move forward (with completion now estimated for the period 2029-2031), the CfD funding regime has proven insufficient to incentivise other projects. In 2024 France, as the owner of EDF, started to express concern regarding its exposure to risk under the CfD arrangement.

Contracts for Difference

Following the financial crisis of 2009 it became increasingly clear that the UK financial sector was in no position to finance nuclear new build in the liberalised energy market context that British governments, first Conservative and then Labour, had spent two decades building. The costs of nuclear new build were simply too great for investors to bear and even more importantly the economic risks were daunting and too difficult to pass through to third parties, such as consumers.

If the Nuclear Renaissance were to be kept alive, there was a need for policy makers to de-risk nuclear new build and this was achieved by the David Cameron led coalition government elected in 2010. In a retreat from market liberalisation, the Energy Act of 2013 would ensure that investors in low-carbon energy technologies would receive a guaranteed, and index linked, price for their power generated. In the area of renewables the guaranteed 'strike price' could be established by a process of competitive bidding, but in the case of nuclear power the anticipated renaissance was simply not strong enough to permit competitive bidding processes and indeed there would soon only one credible prospect for new build – Hinkley Point C. Consequently, the strike price for Hinkley Point C was determined by negotiation and at the time it was announced in 2013 the price guaranteed to HPC developer, EDF Energy, appeared very generous. Political realities at the time ensured that there was a strike price in the area of renewable generation that was higher, but no single renewable power project would match the scale (3.2 GWe) of HPC. The HPC CfD was an expensive choice, but with hindsight from 2024, perhaps not so expensive. The Cameron government ensured that a deal was done and HPC construction started in March 2017. As of February 2024 HPC is expected to start generating by 2031. The project is late and over budget, but the CfD contract should protect UK consumers from the worst of these concerns.

7. Rebuilding the Nuclear Renaissance

In the summer of 2019 and in the midst of a political crisis around “Brexit” Britain found itself with a new flamboyant Prime Minister – Boris Johnson. Boris, as he is known by admirers and detractors alike, had a passion for infrastructure. He was keen to see the Nuclear Renaissance succeed. The Renaissance would need rebirth.

At the time of writing the nuclear vision of the Johnson years endures, despite the 2023 cancellation by Conservative Prime Minister Rishi Sunak of key bits of UK infrastructure including notably the High Speed 2 rail link from Birmingham to Manchester.

At the time of writing in February 2024 one has the sense of another political shift coming over the horizon, and it feels like a return to Labour Government. If history is anything to go by, this should signal only a strengthening of nuclear ambition as the voices of the market-oriented right will be heard less loudly in Britain.

8. Nuclear Renaissance 2.0

So, what are the main elements of Nuclear Renaissance 2.0 in the UK in early 2024?

The most important thing to say is that the Nuclear Renaissance is not just a plan for very large baseload electricity power stations. Hinkley Point C (HPC) is under construction and the plan is for it to be followed by a similar plant Sizewell C (SZC) in Suffolk, That plant would be built using Regulated Asset Base finance which shifts some of the risks during construction away from investors and developers and towards today’s electricity consumers.

Regulated Asset Base

While the contract for difference policy of the 2013 Energy Act had been sufficient to enable the deal for the construction of Hinkley Point C (HPC). It became clear that such arrangements were insufficiently attractive to motivate further projects. Indeed, major British ambitions led by Japanese conglomerates Toshiba and Hitachi were essentially abandoned later in the decade.

The arrangements from 2013 had sought to persuade investors that they would be protected from electricity price risk and other measures protected them against some political risks. Under the CfD they must, however, take all the engineering risk. A project whose engineering case might collapse when 95% complete would be a total loss to the investors. Such realities were simply too daunting to ensure UK Nuclear Renaissance.

As a consequence, the UK Government (no longer coalition, but purely Conservative) offered a new basis for a construction known as Regulated Asset Base. This was a procedure widely used in the water industry and it permits payments during construction for work done properly and satisfactorily. Investors do not need to wait for power generation to receive remuneration. It remains to be seen whether such arrangements will be sufficient to motivate construction of HPC's successor – Sizewell C planned for the Suffolk coast.

HPC and SZC are dominated by considerations of energy policy. Britain has also boosted its technology policy and industrial strategy and it is keen to see smaller nuclear power plant designs emerge at lower cost. Key to such ambitions is the 470MWe Rolls-Royce “SMR” design. Generally, the acronym SMR refers to Small Modular Reactor and while the Rolls-Royce ambitions embrace modularity in construction, the reactor can hardly be described as “small”. The RR SMR proposal is currently shortlisted (early 2024) in competition with smaller SMR designs from international vendors for UK deployment support. The RR SMR ideas are important as they are well suited to nuclear new build deployments at existing power station sites (either nuclear

or coal) making use of established grid connections and water supplies.

UK technological ambition runs deeper than the Rolls-Royce SMR. The UK has coined a term Advanced Modular Reactor (AMR) for non-water-cooled concepts and prominent among such ideas is the development of high temperature gas-cooled reactors (HTGRs) primarily for industrial process heat applications. Such industrial needs must be decarbonised if goals of “Net Zero” are to be met by 2050. Importantly, the idea that the UK might meet its needs for steel and cement on the basis of imports have receded in the face of the new geopolitics, but more about that later. In seeking to develop the HTGR the UK is tapping into historical strengths from the Advanced Gas cooled Reactors (AGR) programme. The AGR having been, in effect, an HTGR ahead of its time.

Finally, it must be observed that the UK is also pushing another aspect of civil nuclear technology policy – nuclear fusion. The UK is seeking to establish a fusion cluster comprising public-private partnership developments and an entrepreneurial start-up ecosystem [9].

Our focus here has been civil nuclear energy. It should be noted that in the 2020 UK military nuclear ambitions are also extremely busy. The UK nuclear deterrent (independent and in support of NATO) is being renewed with new nuclear-powered submarines (the Dreadnought class) and a new nuclear war-head for the submarine-launched missiles. In addition the UK is in partnership with the USA and Australia via the recently announced “AUKUS” partnership which will see Australia deploy nuclear powered submarines, but not nuclear weapons. These parallel industrial developments in the UK, alongside Nuclear Renaissance 2.0, will require the country to boost its level of effort considerably.

It is a very good time to be a young nuclear engineer in the UK, perhaps better than it has ever been.

9. Energy Security and Energy Geopolitics

While one might expect the greatest driver for nuclear renaissance to be the technology's low carbon credentials, and such factors are surely important, I would suggest that a greater driver of UK nuclear ambitions has been concern for geopolitics and energy security. This relationship is as old as nuclear technology. Arguably a major motivation of the first-generation Magnox power programme was international oil security (in the context of the 1953 overthrow of President Mossadegh in Iran and the Suez Crisis of late 1956) and domestic energy insecurity prompted by a recognition of an over dependence on fragile domestic coal production. I would suggest that ambitions for Nuclear Renaissance 2.0 in the UK have been given a significant boost by Russia's renewed aggression against Ukraine and heightened international tension more generally.

10. A comment on BREXATOM

It has been my intention with these remarks to make clear the fundamentally different path being followed by the UK concerning civil nuclear energy policy than is seen in most of the countries of the European Union. Britain's departure from the single market, the customs union and the political structures of the European Union – "Brexit" made it inevitable that the UK would also need to leave the Euratom Community – "Brexatom".

It is probably fair to say that not one British citizen voted in the Brexit referendum of 2016 with thoughts of Brexatom in mind. But the Brexatom

decoupling is now real and complete. Indeed, it is arguably a more complete exit than is seen with any other area of European policy. It is noteworthy that the UK has not associated itself with the Horizon 2020 research programme as relates to Euratom business.

With Brexatom the balance of opinion within the remaining EU member states has shifted further against nuclear energy. France, Finland and Romania are among those most keen. Poland has recently had a keen interest in shifting towards nuclear industry, but it remains to be seen if that focus will be maintained following the results of the October 2023 elections. Noting German decision making over recent years and noting the power of Germany in energy and environment agenda setting, it seems likely that the EU will seek to accomplish its goal of energy transition without recourse to nuclear power. With that said, the recent rise in geopolitical tension has the potential to shift European attitudes.

11. Closing comments on “loyalty”

The title of this article talks of Britain’s loyalty to nuclear power. Loyalty implies enduring commitment even to the point at which the effort exceeds apparent self-interest. The UK has consistently retained such a commitment to nuclear technology, although it must be admitted that civil nuclear power technology did look to be in a parlous state in the mid to late 1990s.

It was an incoming Labour Government elected in 1997 that saw the importance of new nuclear build. As this brief piece explains, despite turbulence and set-backs, English political enthusiasm for nuclear renaissance has been robust and enduring, sometimes despite the observations of economists.

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ECONOMIA ITALIANA 2023/3

Transizione energetica: maneggiare con cura

La grande paura di dover razionare l'energia e di pagare bollette stratosferiche sembra fortunatamente svanita. Tuttavia, la grande questione del cambiamento climatico, con gli eventi naturali estremi che sembrano susseguirsi, è ancora tutta lì, con il suo peso minaccioso. E le politiche di mitigazione, la realizzazione della "transizione energetica", continuano a far discutere i policy makers e scuotono l'opinione pubblica.

Questo volume di Economia Italiana - editor Stefano Fantacone e Alfredo Macchiati - offre al lettore una chiave di lettura degli accadimenti più recenti e delle possibili prospettive della transizione energetica.

Si parte da uno sguardo retrospettivo e in particolare dall'impatto dell'invasione dell'Ucraina sul mercato europeo del gas naturale. Il rilievo assunto dal tema dei prezzi delle energie fossili è analizzato in due saggi, dedicati alla trasmissione dello *shock* energetico sull'inflazione in Europa e in Italia, di **Parco, Primativo e Truzzu** e di **Corsello e Tagliabracchi**. Il contributo di **Fantacone** sposta l'attenzione sugli scenari futuri di crescita, dando conto del processo di diversificazione delle forniture realizzato dall'Europa e dall'Italia e analizzando gli obiettivi di aumento delle rinnovabili fissati in sede europea. Il tema dei costi della transizione energetica, esaminati da una prospettiva macroeconomica, è il nucleo centrale del contributo di **Tomasini**. Il saggio di **Macchiati** valuta l'atteggiamento dell'opinione pubblica verso la transizione: per far accettare i costi del processo di decarbonizzazione occorre porre al centro politiche redistributive e di comunicazione. La politica industriale è destinata a svolgere un ruolo decisivo nella transizione energetica. Gli articoli di **Mosconi** e di **Scianna, Sorgente e Vitelli** esaminano questo nuovo fronte di intervento della Commissione Europea. Il contributo di **Nuttal** consente infine di arricchire i punti di vista sulla controversa questione del nucleare, testimoniando l'esperienza del Regno Unito. Completano le analisi sull'energia le rubriche di **Bella, Masciocchi e Mauro** e di **Carapellotti e Ricci**.

Al di fuori del tema monografico, completano il volume il contributo di **De Arcangelis e Mariani**, *The Italian Economy and the End of the Multifiber Arrangement*, e la rubrica di **Rolleri** su come affrontare le sfide dell'inverno demografico italiano.

ECONOMIA ITALIANA nasce nel 1979 per approfondire e allargare il dibattito sui nodi strutturali e i problemi dell'economia italiana, anche al fine di elaborare adeguate proposte strategiche e di *policy*. L'Editrice Minerva Bancaria è impegnata a portare avanti questa sfida e a fare di Economia Italiana il più vivace e aperto strumento di dialogo e riflessione tra accademici, *policy makers* ed esponenti di rilievo dei diversi settori produttivi del Paese.