

論説

Boon or a Bane?: 'New Build' Initiatives in the United Kingdom and the Japanese Civilian Nuclear Technology Exports

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In this paper I intend to analyse the various nuclear power related export projects the Japanese companies have undertaken since the 11 March 2011, Fukushima crises, (3.11 disaster), particularly looking at the forays the Japanese nuclear companies had made to participate in the United Kingdom's (UK) civilian nuclear industry. Japan and the UK, both are industrially advanced nations; while Japan is envisaging a revival of its existing nuclear sector, post Fukushima crises, in spite of a negative public opinion; the UK is pursuing a revival of its nuclear power generation sector, with the acquisition of new third generation nuclear reactors, from elsewhere. On the other hand, countries such as Italy, Germany, Switzerland and Taiwan had decided to stop their reliance on nuclear energy. Looking at the recent developments in the domestic contexts in the UK and in Japan, the paper intends to analyse the inroads the Japanese nuclear companies had tried to make venturing into the new nuclear projects, which were floated since 2008, when plans for a revival was proposed there. The case of the excessive reliance on nuclear energy in both Japan and the UK, two highly industrialised nations are explored. An effort has also been made to highlight the issues, Japanese companies had encountered in the changed international scenarios, and a boom in the new technologies in renewables pitching against highly risky and expensive nuclear power.

In section one, I will first look at the nuclear energy policy in Japan, especially looking at the flip flops in the state's energy policy, post the 3.11 disasters. Further I would argue that the change in policy from a complete NO to nuclear energy to a full

reliance on it by 2015, is also tied to the fact that the Japanese Prime Minister Abe Shinzo relies on the export of nuclear related technologies also to be a major factor in his plans to revive the Japanese economy. In section two, first I will be looking at the state of affairs of the UK's nuclear energy industry, to explain the relevance of the increased interaction with UK and Japan in the nuclear energy sector, both at the governmental and the industry levels in the past ten years. In section three, I will be looking at the current debates and developments in the UK's energy industry, which increasingly tends to favour more of renewables in the energy mix, because of the sheer spate of innovations and cost reductions associated with it. In section four, I will be analysing the factors which tends to make the UK's current plans to rely on nuclear energy increasingly redundant.

1. Nuclear Energy Policy in Japan, post the Fukushima Crises.

Post Fukushima crises, Japan had gone back and forth on the issue of the continuance of its reliance on nuclear energy to meet its electricity demands. There has been a varied response to this issue, and opinions are divided across sections of society, academia, bureaucracy and politicians. Post Fukushima Japan had resorted to a full shut down of all its nuclear reactors by May 2012, and Japan could endure two summers without generating electricity from its nuclear reactors, albeit with conservative measures in place. The Democratic Party of Japan¹⁾ (DPJ), who was in power until 2012, initially decided to phase out nuclear power by 2039. But Prime Minister (PM) Abe Shinzo of the Liberal Democratic Party (LDP), who came to power in December 2012, decided to reinstate nuclear energy into the energy mix, much to the consternation of the anti-nuclear voices in Japan. The Strategic Energy Plan²⁾ 2014, the first plan to be released after the Fukushima crises, mentions Japanese government's intentions to continue with its reliance on nuclear energy, as a base load power source (METI, 2014, p. 22). In July, 2015 the Japanese government

1) Democratic Party of Japan (DPJ) is now known as the Democratic Party (DP).

2) "Basic Act of Energy Policy, 2002", stipulates the government to frame long term energy policy, and accordingly five such documents have been released, ie. beginning in 2003. The second plan, released in 2010, just prior to the Fukushima Daiichi disaster, had envisaged a 50 per cent share for nuclear power by 2030.

released its policy document forecasting the share of nuclear energy to be 20-22 per cent share of Japan's projected electricity generation in the year 2030 (METI, 2015). And finally in July 2018, with the cabinet approval of the fifth edition of the Basic Energy Plan, the focus on nuclear and renewables were emphasised at least until the year 2030 and then scenarios for many years beyond until 2050, with a focus on achieving energy transitions and decarbonisation efforts as necessitated by the 2015 UNFCCC Paris was also laid out (METI, 2018).

The restart of nuclear reactors and export of nuclear energy technologies is a key element of the LDP government's growth strategy to revitalise the Japanese economy (Prime Minister's Office, Japan, 2014). An early start of Japan's nuclear reactors was very much a necessity for the Abe government to realise the goal of infrastructure and technology exports, as part of its strategy to revive the Japanese economy. Until August 2019, the government had restarted nine reactors, in spite of a negative public opinion and tackling multiple legal cases in the host prefectures, where these idled reactors are situated. To achieve the plans envisaged in the 2014 Basic Energy Plans, of a 20-22 percent share of electricity to be generated from nuclear alone by year 2030, Japan needs to restart all the existing operable reactors (Asahi Shinbun, 2019). The Abe administration has pushed for exports of nuclear technology and knowhow across the world as part of reviving the Japanese economy. Earlier on, Prime Minister Abe had initiated a sales push of nuclear related technologies and initiated cooperation between the Visegrad countries in June 2013, and entering into negotiations with a wide range of countries like Brazil, Saudi Arabia, UAE, Turkey, among others (Hudson, 2013). This has resulted in a nuclear cooperation agreement with India and a memorandum of cooperation with the UK in November 2016 and December 2016 respectively. As on May 2018 Japan has concluded cooperation pacts with thirteen countries and an organisation.

2.1 The current revival of nuclear energy in the UK.

The UK has been a pioneer in the development of nuclear technologies both in the civil and military spheres, right from the 1940s. In fact the UK's Calder Hall graphite moderated reactor was the first ever to be connected to the power grid in 1956 (Ramana, 2012, p. 23). Electricity generated utilising nuclear energy peaked in the

UK in 1998, and since then has been going through a decline. In 2018 the share of nuclear energy in the total electricity generated in UK stands at 19.5 percent (Govt of UK , 2019, p. 89). The UK is increasingly moving away from coal and gas, and towards renewables. The share of renewables in the electricity generation mix is increasing on year on year basis, steadily and in 2018 it is an all-time high of 33 percent mainly from wind and solar energy, compared to 29.2 percent in 2017. The share of low carbon generation, ie. both nuclear and renewables put together, is also at an all- time high of 52.6 percent in 2018.

Post the Chernobyl disaster, no new reactors were sanctioned, and the last reactor to be built in the UK was the Sizewell B plant, which began generation in 1995. Except for this reactor, which is a pressurised water reactor (PWR), all the rest of the reactors, are the old generation reactors ie. AGRs (advanced gas cooled reactors), to be closed down in the next ten years (Heffron, 2013, p. 605). Currently UK has fifteen reactors with a total generating capacity of 10 GWe. All of its fleet of AGR reactors were built in the 1970s, and scheduled to be decommissioned in the 2020s. Basing on the threat of a looming power shortage in the years ahead, and also basing nuclear as a clean energy, the UK government released a White paper on nuclear energy in January 2008, which paved the way for the new nuclear power plant construction projects in the UK now [Govt. of UK, 2008]. The white paper further bases, the 'New Build' initiative to be funded by the private sector companies themselves. Further on to give more impetus to nuclear technology development and research in the UK, as part of the new industrial strategy, funding has been enhanced to boost research and development of modular nuclear reactors [Govt. of UK, 2017].

2.2 'New Build' Initiative in UK.

The UK government has initiated a plan to build new nuclear reactors, often referred to as the 'New Build' initiative. The plan envisages to build new reactors, with the help of private businesses to generate 16 GWe by 2030, through building twelve new nuclear reactors at five sites (Govt. of UK, 2013, p. 7). Though the 2008 Energy White Paper planned for power output from 2019 onwards from the new builds, the plans are not anywhere near to it. Japanese nuclear vendor companies such as Hitachi and Toshiba foresaw immense opportunities in this New Build

initiative to get a foot hold on the UK nuclear reactor market.

The first of the sites, Hinkley Point C was awarded to EDF Energy³⁾ and its nuclear reactor manufacturing partner, Areva has plans to build its European Pressurised Reactor (EPR) there. This GBP 18bn project is massive enough to provide 7 percent of the electricity output of the UK, if the project gets completed by 2025. The project itself has run into multiple controversies and delays over the years, when EDF Energy revealed that it cannot raise enough funds for the project. The project could be revived only after bringing in the Chinese state run nuclear company China General Nuclear Power Group (CGN), to fund GBP 6bn for the project. More over the deal was finally clinched at a CfD price of GBP 92.5, to be paid to NNB Generation Company, the operator of the Hinkley Point C power project, for the next 35 years, which an inquiry conducted by the UK National Audit Office have questioned. The audit report, points out the UK government has “locked consumers into a risky and expensive project with uncertain strategic and economic benefits” (UK National Audit Office, 2017). Further the report raises, the issue of relying on unproven reactor designs, while agreeing on such massive projects. In fact the ‘first pour’ of concrete, the first mile stone in the beginning of construction of the project, had started only in the first of the designated power plant sites, the Henkley Point C in Somerset, only in March 2017.

Interestingly, the Areva’s European Pressurised Reactor (EPR) reactor was not operational anywhere else in the world when the Hinkley Point C project was finalised. And the ones under construction in Olkiluoto-3 in Finland, Flamanville in France and the Taishan 1 and 2 in China were encountering design and safety issues, cost overruns and were marred by multiple delays. In a push to revive the nuclear power generation in the UK, the apparent dangers in getting exposed to a design and technology which was not in operation elsewhere, were overlooked. Subsequently, in December 2018, the first EPR reactor, the Taishan 1 has come online. The completion

3) British Energy the company which was running UK’s nuclear reactors, were taken over by the French nuclear company EDF in September 2008. And the new entity known as EDF Energy is constructing the new nuclear plants at Hinkley Point C, Sizewell C and Bradwell-on-sea in Essex. The Hinkley Point C nuclear power plant is being built by NNB Generation Company (HPC) Limited (NNBG), is owned 66.5 percent by EDF and 33.5 percent by China General Nuclear Power Group (CGN) (UK National Audit Office, 2017).

of the Olkiluoto-3 nuclear plant, a 1.6 GW reactor, which was already delayed by more than 10 years, was again further delayed until 2020 (Reuters, 2019). The Flamanville EPR reactor project is encountering further delays, due to faulty welding, which will further delay the project (World Nuclear News, 2019). The two reactors planned for Hinkley Point C, is of the same design as the one which is under construction at Flamanville.

2.3 Attempts by the Japanese nuclear companies for an entry into the 'New Build' initiative.

The Japanese nuclear companies, Hitachi and Toshiba tried to enter into the 'new build' initiatives in the UK making huge investments there, but both of them decided to exit the projects towards the end of 2018. Hitachi exited the project, owing to disagreements with the UK government on the pricing of the electricity generated from the projects and also owing to its inability in raising its share of project finances. While Toshiba's exit was tied to the losses it suffered in the international ventures it undertook elsewhere in the United States.

Horizon Nuclear Power⁴⁾, a wholly owned subsidiary of Hitachi Ltd., had plans to build, its advanced boiling water reactors (ABWR) at Wylfa Newydd in the Isle of Anglesey and Oldbury in South Gloucestershire. Two ABWRs with a minimum generating capacity of 2700 MWe were planned for both the Wylfa Newydd and the Oldbury sites. The company had planned to start construction of the Wylfa Newydd project by the end of this decade and to complete it by mid 2020s, had it got the project contract. While the Oldbury project was in its early planning stages, when Hitachi decided to exit from the UK New Build initiatives. The Hitachi and the UK Government could not come to a deal on the pricing of the project, even after the UK side agreed to shoulder about two thirds of the estimated 3 Trillion yen (USD23.5 billion), cost through direct government investments and loan guarantees. Hitachi Ltd could not raise the rest one third, from Japanese power companies and government financial institutions resulting in the suspension of the project. Owing to this Hitachi Ltd. suffered an estimated 300 bn Yen of losses, including capital expenditures, pay roll costs and research costs (Yomiuri Shinbun, 2019).

4) Horizon Nuclear Power was acquired by Hitachi Limited in October 2012.

Another Japanese nuclear reactor company, Toshiba held 60 per cent stakes in NuGen, the company which is developing the site at Moorside in Cumbria. The technical assistance for reactor design and construction were being provided by Westinghouse, the embattled US nuclear reactor manufacturer which is owned by Toshiba itself. NuGen had plans to construct three of the AP1000 model, Westinghouse designed reactors in the Moorside project. The whole project itself was marred by uncertainty since Westinghouse has filed for Chapter 11 bankruptcy protection in the courts in the US. More over the Toshiba stocks have lost its value, after the news of the Westinghouse debacles (The Gaurdian, 2017). Finally, in December 2018, Toshiba decided to exit from its international projects in the UK, and focus on domestic projects in Japan. The callous state of affairs in a company which holds a sizeable share of the nuclear reactor market in the world, shows the unviability of these big projects and the very nature of the UK's ambitious plans to build economically viable nuclear power plants.

2.4 The pricing model under criticism

When the UK Govt. had announced the New Build initiative in 2008, it claimed that the finances for the new projects could be entirely raised from private sector alone, and that it had no plans to subsidise the projects. Later on with the problems encountered by EDF in financing the project at Hinkley Point C, the UK government decided to assist the funding of these new builds. The UK government brought in the 'contract of difference' (CfD)⁵, to enable private developers to build and operate the new nuclear power plants to be built under the initiative. The CfD offered, developers greater certainty and stability of revenues, by setting a strike price that the developer receives for a set period [IAEA, 2018]. Currently after the report from the National Audit Office, this mode of financing the projects is under review

5) According to the Contract of Difference, the UK Govt. will arrive at a 'Strike Price' (the cost of electricity covering the project and operating costs), with the nuclear operator on a 'per megawatt hour' basis, before the project is awarded. And any difference between the 'reference price' (the average price of electricity in the UK market), and the strike price will be settled between the two parties. If the 'reference price' is lower, the government will pay the difference, or on the contrary if it is higher, the operator pays to the government.

and a new model called the Regulated Asset Based⁶⁾ (RAB) model is being evaluated to finance the new projects.

2.5 Brexit⁷⁾ and the British Nuclear Industry

The fall out of the British exit from the European Union (EU), also is going to have its repercussions in the UK nuclear industry as well. Apart from job losses, reduced funding for research and development through the Euratom⁸⁾ programme, the movement of goods from the nuclear vendor companies from within the EU to the UK is also going to be affected and this will cause further delays for the on-going new build projects in the UK. At the time of writing this paper, the politicians are still undecided over the course of action post October 2019 regarding BREXIT, the UK has to work out new agreements with the other members of the European Union, since until now the modalities for their interaction and cooperation among members of the EU, in the nuclear energy sector were determined by the Euratom. The UK has to negotiate new modalities with International Atomic Energy Agency (IAEA) as well for inspections of its nuclear installations, which is being conducted by the inspectors from the Euratom until now. All these are additional burden in terms of costs, and are going to take considerable amount of time and effort to sort out, to begin new processes up to the requirements and stipulations of the IAEA (Froggatt, Wright, & Lockwood, 2017). Analysts predict that the British exit from the EU is going to delay the nuclear power plants under construction in the UK, since EDF, the French state owned energy giant owns EDF Energy, the company developing Henkley Point C, the first nuclear power plant to be built under the New Build Initiative. Brexit is going to affect the movement of personnel and reactor components in between the EU nations and UK (The Gaurdian, 2017).

6) The Regulated Asset Based Model, incentivises the operator by assuring returns, even during the construction phase is on, but penalises the operator, upon breach of contracts (Govt. of UK Department of Business Energy and Industrial Strategy, 2017, page: 70).

7) The British exit from the 28 member European Union is commonly referred to as Brexit.

8) The 1957, Euratom Treaty, one of the three founding treaties of the European Economic Community, established the European Atomic Energy Community (EAEC) (Froggatt, Wright, & Lockwood, 2017, p. 36).

3. Renewables in the UK

The UK had taken a decision to revive its nuclear industry in 2008, as charted out in the energy white paper on nuclear energy. The white paper has also emphasised on an ideal mix of renewable energy also to be a part of the energy mix. But in the recent years, innovations in the renewable energy sector, particularly in the harnessing of wind energy localised to the UK, has driven down electricity costs. As part of the push for renewables, the UK government had been subsidising the solar industry there. But in October 2015, the UK government decided to cut down subsidies to the tune of 87 per cent for solar power, just as it was on the verge of becoming cheaper than gas. The UK government also for the first time acknowledged that nuclear power in the UK was being subsidised, though until then it had been repeatedly denying any form of subsidies on the nuclear industry (Carrington, 2015). In fact the 2008 Energy White Paper which announced the UK government's decision to embrace nuclear power, had mentioned that "the industry will meet the full costs of decommissioning and the full share of waste management and disposal costs" (Govt. of UK, 2008, p. 7). In spite of this, the UK government is obliged to pay a higher price for the electricity from nuclear power due to contractual obligations (Lucas, 2016). This higher costs are eventually going to be passed on to the general public, which has raised questions on the viability of UK's current New Build initiative. In fact, the UK's National Audit Office, has undertaken a review of the entire process of pricing of electricity in the nuclear projects awarded to EDF at the Henkley Point C and is in favour of the Regulated Asset Based model, which reduces the strike price lower than what is calculated as per the Contract of Difference (CfD) mode of calculation practiced earlier.

4. Conclusion

After the March 2011 Fukushima crises and the ensuing irradiation of vast swaths of land in the Tohoku region, academics have concluded that this would be a decisive event, which would take Japan to correct its course from nuclear indulgence. Also looking at the negative public opinion towards nuclear energy, in the aftermath of the

disaster, this seemed to be the logical step to which the Japanese government seemed to be concluding, at least initially. The turn of events by the middle of the year 2012, changed the narrative from a complete shutdown of the nuclear facilities to one of restarts of the reactors. With no new reactors being built in Japan, the Japanese government looked at nuclear technology exports, basing it as an alternative to revive the domestic economy in Japan. But all of those plans have been blocked now, with the cancellation of projects in Vietnam, the 2018 cancellation of the ventures that Hitachi and Toshiba planned in the UK and then the cancellation of Mitsubishi's⁹⁾ projects in Turkey. With these cancellations, the Japanese nuclear companies, have no ongoing projects, outside Japan, as on August 2019.

While in the UK after an initial rethink in the aftermath of the Fukushima disaster, the earlier 2008 plans initiated to revive the nuclear industry there, was reinstated. But the safety measures, necessitated to be added to the new nuclear projects, after the Fukushima disaster, had made new projects extremely costly. While the costs of electricity generated from solar photo voltaics and wind are going down, owing to the economies of scale and the advent of new technologies, making new nuclear projects economically unviable. A recent study in May 2019, by the International Energy Agency had further revealed the unviability of new nuclear power projects at a time when the renewable prices are falling [IEA, 2019]. It calls for an extra-ordinary efforts to innovate financing options for new builds, without which new nuclear cannot sustain the coming reductions in renewable prices. The study on the other hand, further emphasises, that extending the life of existing nuclear facilities is still an economically viable option for nations where nuclear power facilities exist. In the Japanese case this might be relevant, for a possible restart, of the existing nuclear plants shut down since 2012, albeit with new safe-guards in place and after winning legal battles in the host prefectures.

Though there had been multiple studies, which suggests the unviability of new nuclear plants, like the one mentioned above, the UK has locked itself into nuclear

9) Japanese and the Turkish governments in alliance with a consortium involving Mitsubishi Heavy Industries and an alliance of French businesses had entered into a tie up to build four reactors in Sinop, by the Black sea in Turkey in 2013. But this project finally was scrapped in December 2018, owing to the escalation of costs upto USD44 bn (5 trillion Yen) [Nikkei Asian Review, 2018].

technology yet again with the 'New Builds' Initiative. While in the Japanese case, the reactors which were shut down, had to be retrofitted with new safety systems, to make it in line with the Nuclear Regulatory Agency's recommendations post Fukushima crises. Thus both the UK and Japan, are locking themselves to a continued reliance on nuclear technology, for their energy requirements and thereby entrapping themselves into a system which looks increasingly riskier and uneconomical.

The drawbacks of relying on such systems, as explained by William Walker, is that they tend to get 'entrapped' into the mesh of contracts, political and financial commitments that has been formed and enforced over time, and hence cannot exit from obsolete, or high-risk technologies which are detrimental to the public good, once they get locked-in to a form (Walker, 2000). Though the UK Audit office pointed out that the cost of electricity generated from nuclear energy is very high compared to that of the renewables in the UK (UK National Audit Office, 2017), once such complex systems are initiated, and after it crosses a threshold, a decision whether or not to abandon or continue, becomes difficult to conclude, just because of the sheer amount of the capital costs involved in such projects.

Further, Charles Perrow in his analysis of high risk industries, has categorised nuclear energy reactors, as having the highest of risks, and recommends a total abandoning of nuclear power generation, which he classifies as a 'tightly coupled' process [Perrow, 1999, page: 349]. He analyses the nuclear accident at Three Mile Island in detail and concludes that the very nature of the various 'tightly coupled' processes involved in nuclear power generation: from the design and construction of the plants, the civil concrete works, and the manufacturing of massive steel boilers which are used in the reactors, the chances of error, which he calls as 'incidents', is very normal. And an error in any of these 'tightly coupled systems', will invariably lead to a cumulative failure, and hence the risk of accidents cannot be completely eliminated.

Thus the mesh of commercial contracts, the huge capital costs, made by the plant operators and vendor companies, very long lead times and societal commitments for new jobs and facilities in the rural areas, where the reactor sites are located, will lock in governments to adhere to the earlier plans, even if it is not economically viable anymore. Parallels to this can be cited in the restarts of nuclear power plants in the

Japanese case as well. The reliance on nuclear power has locked in both the UK and Japan in these high risk and complex technological systems, and this entrapment is preventing them from seeking other economically viable options to cater to their energy demands.

Bibliography

- Asahi Shinbun. (2019, July 15). Retrieved from Asahi Shinbun: <http://www.asahi.com/ajw/articles/AJ201907150030.html>
- Carrington, D. (2015, October 22). *Government finally admits it is subsidising nuclear - while cutting help for renewables*. Retrieved May 19, 2017, from The Gaurdian: <https://www.theguardian.com/environment/damian-carrington-blog/2015/oct/22/hinkley-point-uk-energy-policy-is-now-hunkering-in-a-nuclear-bunker>
- Findlay, T. (2011). *Nuclear Energy and Global Governance: Ensuring safety, security and non-proliferation*. London and New York: Routledge.
- Froggatt, A., Wright, G., & Lockwood, M. (2017, May). *Staying Connected, Key Elements for UK-EU27 Energy Cooperation After Brexit*. Retrieved May 30, 2017, from Chatham House: <https://www.chathamhouse.org/publication/staying-connected-key-elements-uk-eu27-energy-cooperation-after-brexite>
- Govt of UK . (2019, July). *Digest of United Kingdom Energy Statistics 2019 DUKES*. Retrieved May 1, 2017, from Government of UK, Department of Business Energy and Industrial Strategy: <https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019>
- Govt. of UK. (2008, January). *Meeting the Energy Challenge: A White Paper on Nuclear Power*. Retrieved April 28, 2017, from Deptmt of Business Enterprise and Regulatory Reform: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228944/7296.pdf
- Govt. of UK. (2013). *The UK's Nuclear Future*. Retrieved April 21, 2017, from Govt. of UK Industrial Strategy: Govt. and Industry in Partnership: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/168048/bis-13-627-nuclear-industrial-strategy-the-uks-nuclear-future.pdf
- Govt. of UK. (2017, December 7). *Government to support development of next-generation nuclear technology*. Retrieved from <https://www.gov.uk/government/news/government-to-support-development-of-next-generation-nuclear-technology>
- Govt. of UK. (2018, November 111116). *End of reprocessing at Thorp signals new era for Sellafield*. Retrieved from <https://www.gov.uk/government/news/end-of-reprocessing-at-thorp-signals-new-era-for-sellafield>
- Govt. of UK Department of Business Energy and Industrial Strategy. (2017, June 21). *Hinkley Point C: Report by the Comptroller and Auditor General*. Retrieved from <https://www.nao.org.uk/wp-content/uploads/2017/06/Hinkley-Point-C.pdf>
- Heffron, R. J. (2013). The application of contrast explanation to energy policy research:UK nuclear energy policy2002-2012. *Energy Policy*, 55(2013), 602-516.
- House of Lords Science and Technology Committee Nuclear Research and Technology: Breaking the cycle of indecision*. (2017, May 2). Retrieved May 10, 2017, from www.parliament.uk:

- <https://www.publications.parliament.uk/pa/ld201617/ldselect/ldsctech/160/16002.htm>
- Hudson, P. J. (2013, June). *Rising and Shining: The coming bloom in Indo-Japanese Economic Relations*. Retrieved April 21, 2017, from www.icsin.org: <http://www.icsin.org/uploads/2015/04/06/49c29a3e3e23ae9ecbbae219e1e32e47.pdf>
- IAEA. (2018, January 10). *Financing and Managing Nuclear Energy Risks: The UK Mode*. Retrieved from IAEA: <https://www.iaea.org/newscenter/news/financing-and-managing-nuclear-energy-risks-the-uk-model>
- IEA. (2019, May). *Nuclear Power in a Clean Energy System*. Retrieved from International Energy Agency: https://webstore.iea.org/download/direct/2779?fileName=Nuclear_Power_in_a_Clean_Energy_System.pdf
- Lucas, C. (2016, September 15). *Its Absurd that Hinkley is going ahead while, cheaper and cleaner options are blocked*. Retrieved May 25, 2017, from The Gaurdian: <https://www.theguardian.com/commentisfree/2016/sep/15/absurd-hinkley-point-c-cheaper-cleaner>
- METI. (2015, July). Retrieved April 20, 2017, from www.meti.go.jp: http://www.meti.go.jp/english/press/2015/pdf/0716_01a.pdf
- METI. (2018, July). Retrieved from <http://www.enecho.meti.go.jp/>: https://www.enecho.meti.go.jp/en/category/others/basic_plan/5th/pdf/strategic_energy_plan.pdf
- METI, J. (2014, April). *Strategic Energy Plan*. Retrieved April 21, 2017, from <http://www.enecho.meti.go.jp/>: http://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/4th_strategic_energy_plan.pdf
- Nikkei Asian Review. (2018, 12 4). *Japan to scrap Turkey nuclear project*. Retrieved from Nikkei Asian Review: <https://asia.nikkei.com/Economy/Japan-to-scrap-Turkey-nuclear-project>
- Perrow, C. (1999). *Normal Accidents: Living with high-risk technologies*. New Jersey: Princeton Univeristy Press.
- Prime Minister's Office, Japan. (2014, June). *Japan Revitalization Strategy - Japan is Back*. Retrieved April 22, 2017, from <http://japan.kantei.go.jp/link/org/index.html>: http://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/en_saikou_jpn_hon.pdf
- Ramana, M. (2012). *The Power of Promise: Examining Nuclear Energy in India*. New Delhi: Penguin Viking.
- Reuters. (2019, April 10). *Update 2, Fresh setback for Finland's delayed Olkiluoto 3 reactor*. Retrieved from Reuters: <https://www.reuters.com/article/finland-nuclear/update-2-fresh-setback-for-finlands-delayed-olkiluoto-3-reactor-idUSL8N2IS3EX>
- Strategy, G. o. (2016, December 22). *UK and Japan stenghten civil nuclear ties*. Retrieved May 1, 2017, from Government of UK: <https://www.gov.uk/government/news/uk-and-japan-strengthen-civil-nuclear-ties>
- The Gaurdian. (2017, January 27). *Brexit will delay new British nuclear power stations, warns experts*. Retrieved May 1, 2017, from The Gaurdian: <https://www.theguardian.com/business/2017/jan/27/uk-exit-eu-atomic-treaty-brexit-euratom-hinkley-point-c>
- The Gaurdian. (2017, April 21). *Reactor goes here... the GBP18bn Hinkley Point C starts to take shape*. Retrieved May 01, 2017, from The Gaurdian: <https://www.theguardian.com/business/2017/apr/21/hinkley-point-c-edf-somerset-nuclear-unions-brexit>
- The Gaurdian. (2017, March 28). *UK Nuclear plans could be hit by Westinghouse financial crisis*. Retrieved April 5, 2017, from The Gaurdian: <https://www.theguardian.com/business/2017/mar/28/uk-nuclear-westinghouse-bankruptcy-toshiba-us>
- The Japan Times. (2018, June 5). *British Government. Hitachi to begin full negotiations on*

- nuclear plant in Wales*. Retrieved from The Japan Times: <https://www.japantimes.co.jp/news/2018/06/05/business/britain-may-invest-directly-hitachis-welsh-nuclear-plant/#.XXLwuigzY2w>
- UK National Audit Office. (2017, June 23). *Report Hinkley Point C* . Retrieved from National Audit Office: <https://www.nao.org.uk/report/hinkley-point-c/#>
- Walker, W. (2000). Entrapment in large technology systems: institutional commitment and power relations. *Research Policy*, 29, 833-846.
- World Nuclear News. (2019, June 20). *Weld Repairs to delay Flamanville EPR start up*. Retrieved from World Nuclear News: <http://world-nuclear-news.org/Articles/Weld-repairs-to-delay-Flamanville-EPR-start-up>
- Yomiuri Shinbun. (2019, 01 18). 日立、英原発計画を凍結 日本、輸出案件ゼロに 3000億円損失 発表. *Yomiuri Shinbun*, p. 1. Retrieved from The Yomiuri Shinbun.