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Exploring Domestic Reasons for Cooperation on the Hinkley Point C Nuclear Power Project

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Abstract: As a result of the Chernobyl nuclear power plant accident in 1986, the British public generally has a negative attitude towards nuclear power, coupled with the lobbying of Greenpeace and other organizations opposed to nuclear energy. Since the completion of the Sizewell B nuclear power plant in 1995, the UK has not built a single new nuclear power plant and has been lagging behind in nuclear energy construction. With climate change and security of supply issues coming to the fore, it was not until the 2006 Energy White Paper that the government put nuclear energy back on the agenda. It took another decades of planning, review and approval before the UK finally signed an agreement with Electricité de France for the construction of the Hinkley Point C nuclear power station in 2016. The UK has not built a new nuclear power project for more than 20 years, and this paper analyzes the attitudinal preferences of different actors within the UK behind the cooperation on the Hinkley Point C nuclear power project, based on an understanding of the context and current situation of the UK in terms of climate change and security of energy supply.

Keywords: Climate Change; Energy Security; Hinkley Point C; Emissions Reduction; Nuclear Energy.

1. Introduction

Hinkley Point is located in Somerset, a county in the southwest of England, and has historically had two nuclear power plants, A and B. The Hinkley Point A nuclear power plant is located in Somerset, a county in the southwest of England, and has a history of two nuclear power plants. Hinkley Point A was built in 1957 and closed in 2000 due to the deterioration of the material properties of the reactor pressure vessel. Hinkley Point B Nuclear Power Station was built in 1976 and in 2007 British Energy expected it to be able to operate until 2016, after the acquisition of British Energy by Électricité de France (EDF)it was announced that the plant would be able to operate safely until 2020, Hinkley Point B Nuclear Power Station was shut down after 46 years of operation and providing 3% of the UK's electricity needs. Hinkley Point C (HPC) is a three-way partnership between the UK government, EDF and China General Nuclear Corporation (CGN) to build a nuclear power plant using the European Pressurized Water Reactor (EPR) to generate electricity, with EDF and CGN as the investors with 66.5% and 33.5% stakes in the project respectively.

2. Background and Current Situation

(1) Climate change challenges

Since the age of industrialization, human activities have caused an increase in global greenhouse gas emissions, of which CO2 is an important anthropogenic greenhouse gas. In 2007, the Intergovernmental Panel on Climate Change released an assessment report, which stated that global greenhouse gas emissions increased by 70% from 1970 to 2004, and that CO2 emissions increased from 21 to 38 billion tons, an increase of almost 80%; GHG emissions come mainly from the combustion of fossil fuels, with CO2 emissions accounting for 56.6% of all GHGs in 2004, and of the different sectors, energy supply emits the most CO2 gases, accounting for about 30%.[1] The increase in greenhouse gas emissions leads to an increase in global average temperature, inducing extreme weather events such as snow melting, heavy rainfall and windstorms, affecting the entire climate system and ultimately affecting a wide range of human production and living activities. The UK, as a maritime island nation floating in the Atlantic Ocean, is more sensitive to the negative effects of climate change such as sea level rise. Rising sea levels can exacerbate flooding, storm surges and other coastal zone hazards, jeopardizing some of the island nation's critical infrastructure and habitats, with consequent losses to the economy. In order to respond to climate change and keep temperature changes within certain limits, the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol have established the obligation of countries to share the responsibility of reducing emissions based on their basic national circumstances.

In addressing the challenge of climate change and responding to support the global reduction of greenhouse gas emissions, the United Kingdom's 2003 Energy White Paper stated that by 2050, the United Kingdom's CO2 gas emissions will be reduced by 60% compared with the 1990 emission level.[2] In addition, in 2005, the UK Chancellor of the Exchequer commissioned Sir Nicholas Stern, former Chief Economist of the World Bank, to conduct an assessment of the economic impacts of climate change. Nicholas Stern delivered a review of The Economics of Climate Change to the UK government in 2006, which concluded that climate change will have an economic cost of 5%—20% of global GDP if measures are not taken to combat warming.[3] To further address the challenge of climate change, in 2008 the UK passed a Climate Change Act, which states that the UK's 2050 target is to reduce CO2 gas emissions by at least 80% from 1990 levels.[4] Moreover, the Act provides for the establishment of an independent statutory body, the Committee on Climate Change (CCC), which is responsible for reporting to the UK Parliament on the impacts of climate change and the progress of emissions reductions, as well as advising the government on emissions reduction targets.[4]

As the UK's emissions reduction efforts increase, the government's efforts to meet the promised emissions reduction targets will require further collaborative planning and implementation of emissions reduction measures across all sectors and industries, and a shift to low-carbon economic development. As the energy sector accounts for the largest share of CO2 emissions, the road to emissions reduction will require a major restructuring and reform of the UK's energy system to ensure the security of the UK's energy supply.

(2) Fossil Energy Issues

Historically, the UK has relied on domestic sources for most of its energy needs, with fossil fuels such as oil, coal and natural gas having a direct impact on almost the entire energy system. in the mid-20th century, the UK relied heavily on coal to supply its energy needs, and by the 1970s, with the discovery and exploitation of oil and gas in the North Sea, oil and gas were gradually replacing some of the coal as part of the energy supply system. Nuclear energy, fueled by uranium ore, has gradually come to play a role in the UK's energy system since the 1950s. As can be seen in Figure 1, the UK's energy system is heavily dependent on fossil fuels such as oil, gas and coal. On the one hand, the transportation sector is almost entirely dependent on oil; on the other hand, the power sector is highly dependent on fossil fuels of the coal and natural gas type. In the power sector, nuclear energy provides about 20% of the electricity, and renewable energy sources such as wind, solar, and hydro contribute 5% of the electricity. Almost all other UK sources of electricity for everyday home heating, business and other heat require coal and natural gas to provide. Of these, coal meets about 1/3 of the UK's electricity needs.

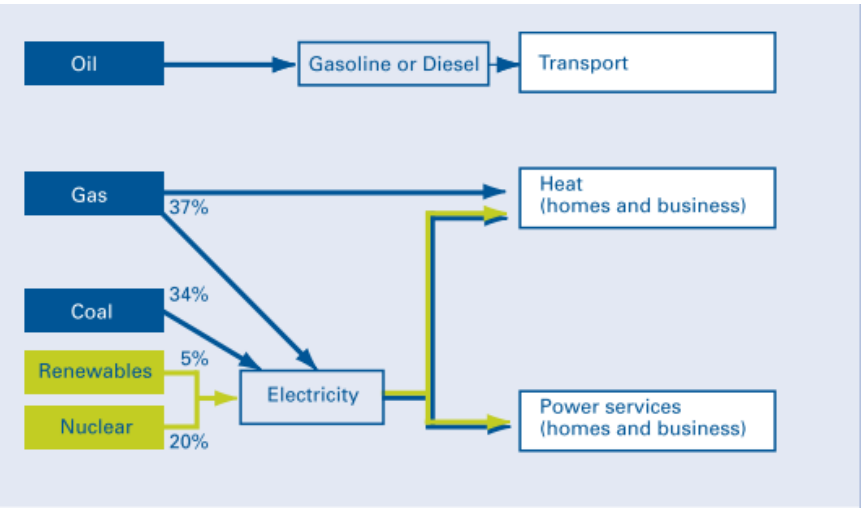

Fig 1. The UK Energy System (2006)
Sources: DTI, The Energy Challenge: Energy Review-A Report 2006

The security of energy supply in the UK is heavily influenced by fossil fuel prices and supply uncertainty. Fossil fuels such as coal, oil and gas play a crucial role in the UK's energy mix, and with the decline in indigenous coal reserves and oil and gas production from oil and gas fields, the UK has become more reliant on imports for its energy supply, and more susceptible to fluctuations in energy prices. Coal production in the UK has fallen dramatically over the past decade, while imports of coal have increased. in 1995, the UK produced at least 50Mt of coal, by 2005, UK coal production had fallen to around 20Mt.[5] in 2003, the UK relied on imports for nearly half of its coal,[2] by 2005 3/4 of total coal consumption, around 44Mt, required imports from countries such as South Africa, Russia, Australia and Colombia, among other countries.[5] Oil and gas production on the UK Continental Shelf (UKCS) peaked in 1999, and has been on a gradual decline since then, with the UK importing 90Mt of oil and 14Mt of gas in 2004, and becoming a net importer of natural gas in the same year.[5]

Global oil and gas reserves are mainly concentrated in Russia, Central Asia, the Middle East and North Africa and other countries and regions, with the economic development of other developing countries and emerging economies brought about by the growth of global energy demand, exacerbated inter-regional or inter-country competition for energy demand. A World Energy Outlook 2006 report released by the International Energy Agency points out that fossil energy sources will remain dominant by 2030, with global primary energy demand growing by more than 50%, at an average annual rate of 1.6%.[6] The UK must cope with these intense energy competitions and will need to bear the pressures and risks associated with rising energy prices. As oil and gas are integral to the UK's energy mix, the UK will become increasingly reliant on imported oil and gas in the future in the face of rising global demand and prices and politicized energy supplies, as well as growing reliance on oil and gas majors and regions.

(3) Emission reduction and security of supply

The UK power industry will face the challenge of increased demand for electricity and a reduction in existing generating capacity. 2008 CCC released a report entitled "Building a Low Carbon Economy: The UK's Contribution to Combating Climate Change", which showed that in 2006, the UK emitted a total of 695MtCO2,[7] and that in order to achieve the carbon emissions reduction target of 80% by 2050, it would be necessary to reduce the emissions to less than 139MtCO2. In the same year, the UK's transportation sector emitted 169MtCO2, of which vehicles accounted for 69Mt, or about 40%, of the largest CO2 emissions.[8] Decarbonization of the transport sector in the future will require advancing the development and use of new energy vehicles that rely on electric power, and with the promotion of the use of electric vehicles, the demand for electricity in the UK will increase in the future. The Department of Energy and Climate Change (DECC) has released information that predicts that the UK's overall electricity demand will double from current levels by

2050.[8] Because of EU environmental legislation, emissions of sulphur dioxide, nitrogen oxides and dust are restricted and some of the UK's large fossil fuel plants will be withdrawn from closure. Coal meets about 1/3 of the UK's electricity demand and the closure of some coal-fired plants will cut into the UK's existing generating capacity. Nuclear energy has provided about 1/5 of the UK's electricity in the past, and most of the UK's nuclear power stations will need to be decommissioned and closed over the next 20 years because of the ageing and decommissioning of nuclear reactors. If existing nuclear power stations do not extend their lifespan, based on published lifetime estimates, there will be only one nuclear power station left in the UK in working order after 2023.[9] The decommissioning of nuclear power stations will significantly reduce the share of nuclear energy in electricity generation, and the decommissioning and closure of nuclear and coal power stations will mean a significant reduction in the UK's ability to generate and supply electricity until other measures to build new capacity are implemented. In order to fill the "gap" in generating capacity, the 2007 UK Energy White Paper made it clear that UK energy companies would need to invest in 30-35GW of new generating capacity over the next 20 years.[10]

The 2006 World Energy Outlook report noted that in 2005, 40% of global CO2 emissions were from electricity generation,[6] and a 2007 Department of Trade and Industry consultation paper on the future of nuclear energy noted that about one-third of the UK's CO2 emissions come from electricity generation, with the vast majority of these emissions coming from coal-fired and gas-fired power plants.[10] According to a statistical map of electricity generation and emissions from the UK power sector (Figure 2), in 2006 around 70% of the UK's relevant CO2 emissions came from coal-fired power generation, 28% from gas-fired power generation, and nuclear and renewables plus other forms of power generation accounted for just 2% of CO2 emissions. Combined with Figure 1, it can be seen that carbon reduction in the energy sector has been mainly from transport, power generation and heating, and with the gradual electrification of the energy required for transport, the UK's emissions reductions have focused mainly on the power sector. The National Audit Office (NAO), which is responsible for scrutinizing the government's public expenditure to the Parliament, submitted information to the Parliament in June 2012, which showed that the UK's electricity generation generated 146 million tons of CO2 in 2011, and that the UK's transition to a low-carbon economy and the achievement of the government's commitment to 80% of the carbon emissions by 2050 will require a significant reduction in CO2 generated from fossil fuel electricity generation, and that the power sector will be almost completely decarbonized by 2030.[11] The pathway to the 2050 carbon emissions target will primarily involve the deployment of investment in low carbon forms of electricity generation (renewables and nuclear) and the adoption of low carbon technologies (Carbon Capture and Storage - CCS) to reduce carbon emissions from fossil fuel generation.

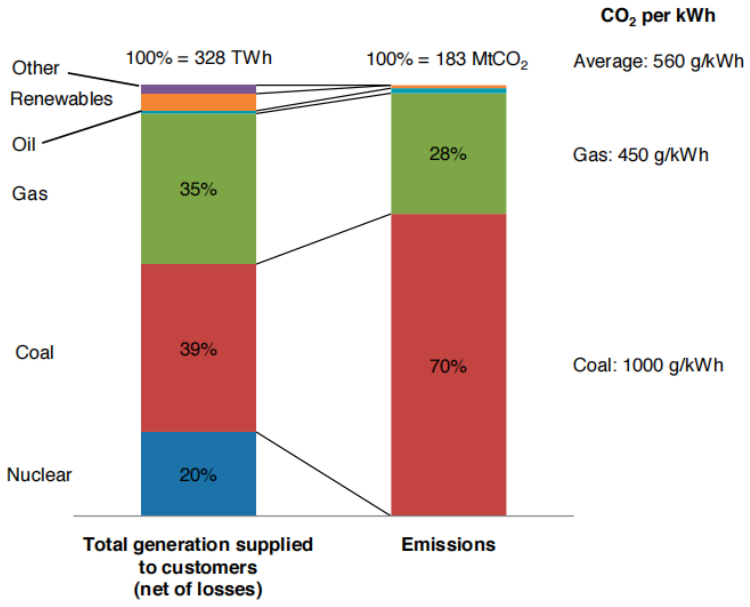

Fig 2. UK power sector generation and emissions, 2006
Sources: CCC, building a low-carbon economy – the UK's contribution to tackling climate change, 2008

3. Low Carbon Power Generation and Nuclear Industry

(1) Low-carbon power generation cost comparisons and power generation investment market dilemmas

The characteristics of power generation and the amount of carbon emissions differ between energy sources. Renewable energy sources such as wind, solar, and wave power can provide low-carbon power generation, but because they rely on external forces, power generation is characterized by intermittency. Nuclear energy is also a fuel source for low-carbon electricity generation, and once established in normal operation can continue to provide electricity for a long period of time, but nuclear power plants have a long construction period, high upfront investment costs, and safety regarding the management of radioactive waste generated by nuclear power has been one of the public's concerns. Fossil-fueled power generation has a high degree of flexibility in that it can be brought online quickly when demand is high and shut down when demand is low. However, until fossil fuel power generation can be operated efficiently through carbon capture and storage (CCS) technology, such power plants have high CO2 emissions from the power generation process. The life-cycle CO2 emissions of gas-fired power plants are 385g/kWh,

the life-cycle CO2 emissions of coal-fired power plants are 755 g/kWh, and a range of estimated CO2 emissions for the nuclear life-cycle range from 7-22g/kWh of electricity generation.[12] According to information published in the 2007 Government Nuclear Energy Review document, the average cost of onshore wind power is between £60/MWh and £83/MWh, while the cost of gas-fired power is £37/MWh; the UK government looks at previous nuclear power generation cost data and sees that the high-cost case is £44/MWh and the low-cost case £30/MWh, assuming that the The cost of new nuclear power generation is £38/MWh. Comparison of the land area required for deploying nuclear power plants and renewable energy power generation: a nuclear power plant with a capacity of 1GW is expected to occupy 25-75 hectares; onshore wind power generation of the same capacity is expected to require 180 hectares of land. ccs, if applied to coal-fired or gas-fired power generation, can reduce up to 90% of the CO2 emissions. CCS, if applied to coal-fired or gas-fired power generation, can reduce CO2 emissions by up to 90%, but at that time CCS technology was not yet commercially available on a large scale in the world.[13]

In 1988, under the Conservative Party led by Margaret Thatcher, the UK gradually privatized its electricity and energy markets to encourage competition, and the UK now relies on private investment for its electricity. In response to the challenges of climate change and security of energy supply, the UK is transitioning to a low carbon economy. As a result of the privatization of the electricity market, investment in the construction of new low-carbon generating capacity faces problems of market failure and investment disruption. First, the market itself will not reduce the production of greenhouse gases associated with fossil fuel combustion. Fossil fuel generators do not bear the full cost of carbon emissions, and investors do not have sufficient incentives to invest in low carbon generation projects, which inhibits effective investment in low carbon generating capacity; secondly, nuclear investors do not have the means to derive the full benefits and returns from the market in terms of reduced future nuclear costs and security of supply, which combined with the higher risk of nuclear investment undermines investor confidence; and lastly. Finally, the UK's lack of incentive to develop low carbon technologies has made it impossible to secure sufficient investment in low carbon technologies.[14]

(2) Historical overview of the nuclear industry and the plight of nuclear energy

After the end of World War II, the UK was a world leader in nuclear fission R&D and nuclear technology development. The Magnox reactor (a first-generation technology system) was developed in the 1950s, and second-generation advanced gas-cooled reactors (AGRs) in the 1960s and 1970s. Since the 1970s, the dominant technology deployed globally has been second-generation light water reactor systems (pressurized water (PWR) or boiling water (BWR) systems), followed by third-generation systems. It was only in the late 1970s that the UK began to turn its attention to light water reactor system technology and built the UK's first pressurized water reactor, Sezwell B, which began operation in 1995.[15] Since then, with the privatization of the British nuclear industry, widespread safety concerns from the Chernobyl accident, and lobbying by organizations opposed to the construction of nuclear energy, no new nuclear energy has been deployed for construction within the UK, and the Sezwell B plant has become the last nuclear power plant in the UK.

The UK's nuclear energy sector consists of more than 200 companies involved in a wide range of activities from energy production to decommissioning and participation in the supply chain, employing around 40,000 people.[15] The 2013 government's Nuclear Industrial Strategy document states that the UK's nuclear energy workforce is currently aging, with up to 70% of highly skilled workers expected to retire by 2025.[16] As the UK has not invested in building new nuclear energy capacity for more than 20 years, this, combined with a lack of investment due to a failure of the market itself, has resulted in a decline in the UK's nuclear industry's capacity for R&D and related expertise.

4. Attitudinal Preferences of Various Actors

(1) Governments and lobby groups

The Government's 2003 Energy White Paper stated that there was no prospect of deploying any new nuclear power stations in the UK. However, in 2006, the government's energy white paper for that year stated that nuclear build would need to be considered in due course in the future, and investment in the construction of new nuclear energy was listed as a topic of discussion for the government. By 2008, the government's energy white paper clearly emphasized support for restarting the nuclear power program. The white paper stated that "additional nuclear capacity will be needed in a low-cost, low-emission electricity system in 2050, and new nuclear power stations are in the public interest. Energy companies should be allowed to invest in new nuclear power plants, and the government needs to take aggressive steps to promote new nuclear energy."[12] The 2011 National Energy Overarching Policy Statement also expressed the Government's support for nuclear power generation to play a more important role in the UK's energy system. The Government believes that new nuclear power stations help to ensure a diversity of technologies and fuel sources, increase the resilience of the UK's energy system, reduce the risk of supply disruptions and sudden, sharp rises in electricity prices that can occur when a single technology or fuel dominates electricity generation, and that nuclear power has its own unique advantages in terms of energy security compared to traditional fossil fuels or renewable energy sources.[17]

The shift in government attitudes came about as a result of a series of public relations blitzkriegs by the nuclear industry, which deployed dozens of lobbyists, including former politicians such as Brian Wilson, the former energy minister, who hoped to promote the UK's 'nuclear renaissance'.[18] Through media and advertising campaigns, they publicized the intermittent shortcomings of renewable energy, the political fragility of overseas gas imports, and the fact that "green" nuclear energy was the only viable way to meet CO2 reduction targets, as Keith Parker, then chief executive of the Nuclear Industries Association (NIA), had done. Keith Parker, then chief executive of the NIA, organized a series of talks with industry experts and leaders to explain the benefits of nuclear energy to politicians and energy journalists.[19] John Hutton, Business Secretary under the Conservative Party's previous Labour government, called in 2008 for the UK to become a world leader in the development of nuclear energy technology and to "dramatically increase" the amount of electricity generated by nuclear power, and said that the

benefits of nuclear energy to the UK economy would be comparable to those of North Sea oil in the 1980s, and would provide a major boost to the UK's economy. He also stated that the benefits of nuclear energy to the UK economy would be comparable to North Sea oil in the 1980s, and would provide the UK with £20 billion of economic wealth and 100,000 new jobs.[19]

When the Conservative Party came to power after 2010, Prime Minister David Cameron, Chancellor of the Exchequer George Osborne, and Energy Minister Ed Davey were all very supportive when it came to nuclear power at Hinkley Point.On October 21, 2013, the UK government and EDF entered into a When a commercial agreement was reached on key terms of the proposed investment contract, Prime Minister David Cameron stated that the project would not only bring 25,000 jobs to the UK, but would also benefit the UK as well as the South West of England.[20] The Chancellor of the Exchequer, George Osborne, has said that Chinese investment in the UK is welcome after visiting a nuclear power station in Guangdong province at the invitation of the Chinese authorities.[21] The Chancellor of the Exchequer has also shown a friendly attitude towards China on many occasions. George Osborne's main reasons for supporting Chinese investment in the HPC are: on the one hand, the construction of nuclear power stations is expensive and prone to cost and time overruns, and on the other hand, EDF, which is responsible for overseeing the project, is under enormous financial pressure. Construction is well over budget and suffering from delays, and Chinese equity could help share the financial burden; the other side of the coin is that the UK's account deficit is large, with more money flowing out of the UK than coming in, making investment from overseas particularly important for the UK.In the first quarter of 2016, the UK's account deficit was 6.9% of GDP, second only to the fourth quarter of 2015 when it hit a 7.2% all-time high and needs foreign funding to help fill the balance of payments gap.[22] Green groups have criticized the HPC nuclear power project for jeopardizing safety and requiring subsidies, arguing that the government should be more supportive of renewable energy generation. Faced with a challenge from green groups, UK Energy Minister Ed Davey countered, "Onshore or offshore wind cannot fill the energy gap created by the first wave of power station retirements. HPC is estimated to generate as much electricity as 6,000 onshore wind turbines. Excluding nuclear build, an increase in the share of electricity generated by renewables would also need to take into account the cost of improved grid configuration, and the resulting costs would not be cheaper than nuclear.[23]

(2) UK public opinion

The push to restart nuclear power construction in the UK is not always a credit to the nuclear energy lobby and the support of the government, but the gradual improvement of public opinion towards nuclear power construction in the UK is also a factor. As can be seen in Figure 3, negative attitudes towards nuclear power in the UK have gradually improved since 2001, with over 40% of the population in favor of nuclear power in 2010, and under 20% against. Although support for nuclear power in the UK dropped to around 30% in 2011 due to the Fukushima accident, public support for nuclear power has risen again as the government has become more transparent in its information on the nuclear industry. Overall, public opinion on new nuclear energy in the UK is much more supportive compared to the last Labour administration.

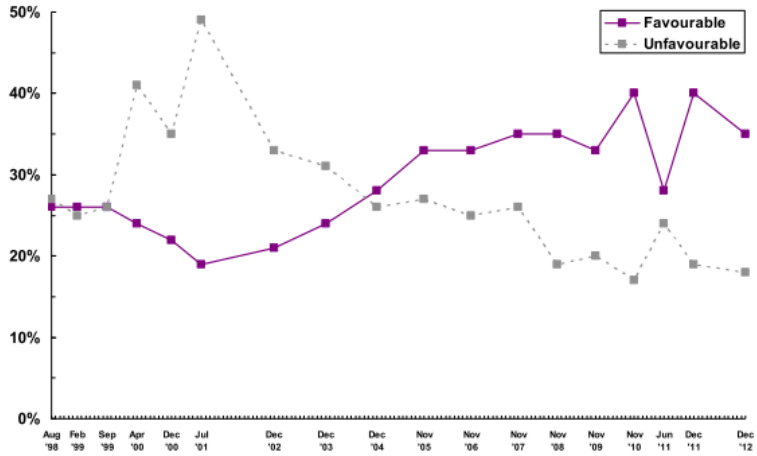

Fig 3. UK public opinion of nuclear power
Source: HMGovernment, Nuclear Industrial Strategy -The UK's Nuclear Future (2013).

(3) Major investor

EDF, a major investor, has faced widespread public concern in the UK about whether the implementation price is too high, and EDF chief executive Vincent de Rivaz told the BBC that HPC is a worthwhile investment that will provide the UK with 24/7 "baseload" electricity and will save customers 10% on their bills. It will also save customers at least 10% on their bills. In addition, the investment will create 25,000 jobs in the UK, boosting the country's industrial capacity.[24] David Cameron stepped down and on July 13, 2016, Theresa May began her tenure as Prime Minister of the United Kingdom. When Theresa May's government announced on July 28, 2016 that it was scheduled to sign a final contract with EDF on 29 July 2016 for cooperation on the HPC nuclear power project, it suddenly announced a suspension of the contract and a review of the entire investment project based on concerns about China. One month after the termination of the suspension of the HPC nuclear power project, EDF's Chief Executive Officer, Vincent de Rivaz, published an open letter in the Sunday Telegraph on 27 August 2016 stating that CGN is trustworthy as a long-term partner of EDF. De Rivaz also stated that the average auction price for offshore wind power projects as low carbon generation is £137/MWh, compared to the competitive price of £92.5/MWh for the new nuclear power at HPC, and that renewable energy sources such as wind and

solar have an intermittent nature in the generation process and are unable to meet the UK's electricity demand in the winter peak period. Derivaz's open letter provided a detailed explanation on the safety and cost issues that the British public focuses on, and urged the UK government to make a decision on the Hinkley Point project as soon as possible.[25] Eventually, on September 15, 2016, the UK government signed the final cooperation contract with EDF.

5. Conclusion

In the middle of the 20th century, Britain's ability in nuclear energy had been far ahead in the world, and after the Chernobyl nuclear power plant accident, the UK went through a 20-year hiatus on new nuclear power. In 2016, the UK reached a cooperation with EDF on the construction of the HPC nuclear power plant, and reopened the nuclear power program. The reason for this is mainly based on addressing the challenges of climate change and security of energy supply, the UK government's need to achieve an 80% reduction in emissions by 2050, a significant reduction in carbon emissions from fossil energy sources, and dealing with the realities of the uncertainty of future fossil energy prices, the rise in demand for electricity, the decline in existing generating capacity, the failure of investment in the low-carbon electricity market, and the comprehensive consideration of the economic costs of new generating capacity On this basis, the nuclear industry and a number of pro-nuclear energy construction groups lobbied the government and the public, and ultimately pushed for successful cooperation on the HPC nuclear power project.

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