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Brexit and Article 50 of the Treaty of the European Union: Implications for UK Energy Policy and Security

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Abstract: This paper articulates the potential implications of Brexit on energy policy and security in the United Kingdom (UK). Given the uncertainties associated with the decision to leave the European Union (EU), the need to consider its potential effects on the UK's energy sector becomes even more pertinent. Through the lens of a few widely reviewed trade regimes in the light of Brexit, it can be observed that while UK energy policies are unlikely to change drastically, Brexit nevertheless threatens the UK's capacity to safeguard its energy supply. The uncertainties following Brexit could arguably starve the UK's upstream petroleum, electricity, and renewable energy sectors of their required investments. Both short and long-term impacts could result in UK residents paying more per unit of energy consumed in a "hard Brexit" scenario, where the UK exits the Internal Energy Market (IEM) and must trade with the EU under World Trade Organisation rules. While a hard Brexit could aid the growth of the nascent shale gas industry, a negotiated withdrawal that includes some form of access to the IEM (a "soft Brexit") would be more beneficial for the future of energy security in the UK.

Keywords: BREXIT; UK; energy policy; European Union

1. Introduction

A historic referendum was held on 23 June 2016, wherein the British people voted to exit the European Union (EU), a decision generally referred to as "Brexit". It is a new phenomenon for a member state to exit the EU. The closest to this uncharted path in the history of the Union was the 1985 referendum by Greenland, a sovereignty of Denmark with overseas territory geographically located outside Europe. The procedural articulation of a member state's intent to leave the Union is provided in Article 50 of the Treaty of the European Union (TEU). This allows for a two-year negotiation of the terms of withdrawal and possible relationship structure regarding, inter alia, energy and trade regimes, post notification of intent by the exiting party. The strategic direction of the so-called "divorce" is then negotiated, and different stakeholders contribute to the process at different levels both before and during the dialogue.

In the weeks before the Brexit referendum, there were warnings from major multinational energy companies including BP, Centrica, and Shell that a vote to leave the EU could potentially result in significant long-term damage to the economy of the United Kingdom (UK). Also, the UK Treasury in its report on the implications of Brexit concluded that the UK would be better off in the EU. The report argued that the economy would be 6.2% larger, British families would be £4300 richer, and tax receipts would be healthier in the EU [1]. Although these pre-referendum statements did not affect its outcome,

their impact on the whole post-referendum negotiation process, particularly in shaping the final outcome of the UK and EU energy trade policy framework, should not be underestimated.

The immediate aftermath of the referendum results caused shock waves across different markets of the EU member states. Moreover, the value of the pound sterling was significantly lowered against all other major currencies in the financial maelstrom that followed the result [2–4]. The pound has yet to fully recover from this slump [5]. The results also triggered a major realignment of economic and political forces signaling unexpected international consequences [6]. The International Monetary Fund predicted that Brexit would cause a reduction in the UK's economic growth by 0.9% in 2017 and a 0.1% reduction in global economic growth in both 2016 and 2017 [7]. As the dust settles following the referendum and the triggering of Article 50 on 29 March 2017, there is still considerable uncertainty about the future of Britain's trade and industry.

These uncertainties are already hampering the growth and productivity of the UK's economy. In its November 2017 Inflation Report, the Bank of England (BOE) issued a warning about the implication of Brexit. According to the BOE: "Uncertainties associated with Brexit are weighing on domestic activity, which has slowed even as global growth has risen significantly. And Brexit-related constraints on investment and labour supply appear to be reinforcing the marked slowdown that has been increasingly evident in recent years in [relation to] the rate at which the economy can grow without generating inflationary pressures" [8]. The UK government commissioned a study to determine the predicted impact of Brexit on the UK's industries. However, this report has remained a secret, as it is believed that its release would undermine the ongoing negotiations between the UK and the EU. However, from the outset, it is likely that there will be detrimental impacts on the UK's industries, and the energy sector in particular, which constitutes a significant part of its economic activities, both with other EU member states and non-EU members. The UK's notice of withdrawal from the EU also included the intention to withdraw from the European Atomic Energy Community (Euratom), a decision that some commentators argue poses a significant risk [9].

One of the immediate fallout of Brexit was the dramatic merger of the Department of Energy and Climate Change (DECC) with the Department for Business, Innovation, and Skills to form a new Department of Business, Energy, and Industrial Strategy (BEIS). BEIS, in keeping with the mandate of the defunct DECC, will work under the National Energy Policy (NEP) to ensure that the UK has access to secure, clean, and affordable energy supplies while meeting international standards on climate change. It also has the responsibility of ensuring that the nation invests in clean energy and energy efficiency projects that will drive down carbon emissions. The UK's energy policy therefore aims to ensure energy security regarding economic growth, the security of supply, and environmental sustainability [10,11]. This is in line with the energy policy of the EU, which is based on three pillars: competition, security of supply, and sustainability. The security of energy covers aspects such as availability of supply, affordability, and sustainability, and is a major issue in the policy agenda of every industrialised nation, including the UK [12].

The UK and the other EU-27 members have closely intertwined energy relations entrenched in the Internal Energy Market (IEM). Their energy systems are operated in line with the principles and treaties of international networks, including the International Energy Agency, the International Renewable Energy Agency, the Energy Charter, the World Trade Organisation (WTO), and the recently articulated European Energy Union. The resulting international agreements and directives are transposed into domestic legislation with an overriding impact on the national policy frameworks. The energy and climate change policies of both the UK and the EU have independently and collaboratively evolved over the decades. Moreover, the influence of the UK as a strong advocate of market liberalisation has also helped shape the direction of EU energy policies, to the extent that it must be considered on both sides of the Brexit negotiation process. Table 1 below lists some of the relevant UK and EU energy-related policies and regulations that are likely to be affected by Brexit. The UK's energy is linked to the EU through shared regulations, physical infrastructure (electricity and gas interconnectors), trade relations, management, and a shared workforce [13]. Despite these existing connections with the

EU, the UK energy policy has been described as being unfit for purpose, as it will fail to meet its key goals [14]. Although the UK was formerly a front-runner in the liberalisation of the EU energy market, it has arguably become a “prisoner of its ideological past” [14], bound between a liberated market and central control. In recent years, there has been a paradigm shift towards intervention, but years of inadequate planning have increased the UK’s vulnerability to future energy security crises [15,16]. Exiting the EU without access to the Energy Union could potentially make a bad situation worse.

Table 1. Related European Union (EU) and United Kingdom (UK) Energy Policies.

UK Regulations, Policies, and Obligations	EU Regulations, Policies, and Obligations
Petroleum Act 1998	2020 Energy Strategy
Energy Act 2013	2020 Energy Strategy
Climate Change Act 2008	2050 Energy Strategy
Planning Act 2008	2030 Framework for Climate and Energy
Renewables Obligation	Energy End-Use Efficiency and Energy Services
Carbon Emissions Reduction Target	Renewable Energy Directives
Renewable Energy Directives	Energy Performance Building Directive
Energy Efficiency Scheme	Industrial Emission Directive
-	EU Emission Trading Schemes
-	Global Fuel Economy Initiative

The United Kingdom remains one of the largest contributors to the EU budget, with a gross contribution of €14,870 million in 2011. Excluding intra-EU trading, the UK represents 19.4% of EU exports [17]. This directly reflects on the UK’s significant contribution across the sectors. The UK energy sector is significant to the overall economic growth of the nation, and is second only to the contribution made by the financial sector. Moreover, the energy sector has several connections with the EU through trading, directives, and energy unity. The eventual exit from the EU is likely to result in the UK no longer being part of the EU Internal Energy Market (IEM), which ensures no restrictions in relation to the flow of power and gas between the EU member states. This free flow is essential for the UK to meet its energy demands [18]. At present, the UK would remain a member until at least 2019 and most probably longer, depending on the negotiations following the triggering of Article 50. However, during the transition period, uncertainties will remain about the future of the UK’s energy policy and its implications. While withdrawal from the EU is unlikely to change the UK’s energy policy significantly due to the close alignment between their energy policies and frameworks [19], the key issue will be the uncertainties generated by the exit negotiations. This is likely to affect short-term investments, as investors will be hesitant due to the anticipated uncertainties in the negotiations. A clear process with timings is essential for ensuring investors’ confidence [20]. As the negotiations for the divorce begins, far-reaching implications are predicted for the economy and the energy industry. The UK is a major European ally, and its departure is likely going to force major changes in the EU’s energy and climate policies, with an overriding impact on many of the UK–EU energy regulations.

One of the key drivers of the referendum was the desire to control migration to the UK [21]. This will have further implications based on the experience of Switzerland, which was denied access to the EU energy market due to the decision to impose restrictions on immigration in 2014, following a referendum mandating the imposition of a quantitative limitation on migration. Depending on the agreement reached during the negotiations, the UK is likely to be excluded from the single market (including the IEM, unless this can be negotiated independently) on the grounds of the freedom of movement of persons, which is one of the four fundamental principles determining inclusion into the single market. The UK House of Lords EU Committee noted that the potential impact of Brexit on energy would depend on whether the UK stays within the IEM. Therefore, exclusion from the EU single market would have far-reaching implications for various areas of the UK energy market.

Currently, the lack of a clearly formulated plan has resulted in ongoing debates and uncertainties about the manner of Brexit. The Prime Minister Theresa May had claimed that “Brexit means Brexit”,

and that the UK would focus on a global Britain that trades freely with the rest of the world [22]. However, her insistence that “Brexit means Brexit” has been compromised by her failure to form a majority government. According to Henokl [23], the hard-Brexit stand of the current government is no longer set in stone following rising uncertainties regarding the timing and direction of the exit negotiations. UK politicians have used various terms, including “hard”, “soft” and “grey” Brexit to describe the various options for a future relationship with the internal market. In the Brexit White Paper, the UK stated that it “will be considering all future options for the UK’s future relationship with the EU on energy, in particular to avoid disruption to the all-Ireland single electricity market” [24,25]. However, the EU has criticised the ambiguity in the position papers produced by the British government regarding the negotiation of the exit deal. The need for clarity in the UK’s position is not only required for a successful Brexit, it is also essential for the direction of the markets and the different industries connected to the energy sector.

The extent to which exiting the EU will impact on energy security and policies is very much open to debate. Brexit is full of “unknowns”, and whilst its full effects on the UK’s economy remain a matter of conjecture, it is not yet known what type of exit deal will be reached. In this paper, the potential implications of Brexit and the triggering of Article 50 of the Lisbon Treaty on the future of UK energy policy and security will be reviewed, in addition to examining options for exit negotiations in line with some possible trading models and their potential consequences.

2. The IEM, Brexit Options, and Implications of Post-Brexit UK–EU Trade Models

The IEM was first introduced in 1988 in the “working document on Internal Energy” to help remove any barriers to free trade and encourage the movement of energy within the EU [20]. These cross-border electricity and gas interconnections allow tariff-free energy trading across the EU. The primary aim was to ensure energy security (supply, affordability, and sustainability), as expressed in Article 194(1) of the Treaty on the Functioning of the European Union (TFEU) [26,27]. The liberalisation of the gas and electricity markets in the 1990s led to the launch of EU Framework Strategy for an Energy Union in 2015. This was primarily aimed at creating an effective cross-border IEM addressing market access, interconnection, security of supply, regulation, and the cross-border EU gas network. The IEM is also part of a broader community under the Energy Community Treaty, which brings together the EU and other contracting states, including the Ukraine, Albania, and other countries in southeast Europe and the Black Sea region. Under this arrangement, the EU and the contracting states are able to trade energy across borders and co-develop infrastructures without legal or trade barriers.

The UK has been a leading force in shaping EU market liberalisation policies over the years. Their involvement in defining the internal energy market was broadly achieved through the following three policy instruments [28]: first, the appropriation of existing competition laws to the energy sector; second, the removal of barriers to competition and trade through specific energy directives; and third, the articulation of internal market directives with extensive impacts on the energy sector, akin to the directive on public procurement [29]. These policy initiatives have allowed for the harmonising of tariff trading. Since the UK imports about 60% of its gas, the majority of which is from continental Europe and Norway, access to the IEM is required to maintain its energy security.

The UK’s participation in the IEM post-Brexit will depend on the nature of the agreement reached with the EU’s negotiators. One extreme post-Brexit option would involve quitting the EU without a deal in place and no further preferential access to the IEM, or that no agreement is concluded within the negotiation timeframe (hard Brexit). The other extreme would involve the UK continuing to have a close relationship and ties with the EU and remain in the IEM with the adoption of the regulations thereto, including some degree of free movement (soft Brexit). Between these two extreme options is a grey Brexit, which would allow the UK to maintain some level of relationship with the EU in various areas of trade, as governed by EU regulations. This would mean that the UK would have partial or no access, save for a form of cooperation with the EU-27 [30]. In a soft Brexit scenario where the UK

retains preferential access to the IEM, it is unlikely that Brexit would significantly impact UK energy policies and security, as the current situation would continue. However, the UK would probably lose the long-term leadership role that it had played in the liberalisation of the EU energy market, and may also lose opportunities to lobby and influence the EU regulations with which it may have to comply.

The discourse of the possible implications of Brexit on the UK energy market will be crucially underlined by the direction or model that the EU and the UK government adopts following the negotiations. However, regardless of the model, seeking a free trade deal with the EU will ultimately involve the UK accepting some form of legally binding obligations in exchange for access to the single market [31]. This would be even more evident in any significant involvement in the IEM. Various considered and plausible models that the UK and EU could adopt may include the World Trade Organisation, the European Economic Area (EEA)/European Free Trade Association (EFTA)-Norway, Switzerland, Turkey, the Comprehensive Economic and Trade Agreement (CETA), and more recently, the Association Agreement, which is premised on the Deep and Comprehensive Free Trade Area and includes trade agreements between the EU and Ukraine, Georgia, and Moldova.

With the WTO model involving a unilateral withdrawal (hard Brexit), the UK's future tariff schedule would need to be considered relative to the broader membership of the WTO. However, it would be possible to retain the EU's Most Favoured Nation (MFN) tariff schedule in situ, or else consider those commodities and services that have better liberal rates in the tariffs between individual EU and non-EU member states. Under the WTO regime, the UK will grant the same MFN market access and charge similar tariffs to other WTO members. Also, the UK export to both the EU and other WTO members would be subject to MFN tariffs, which would potentially raise the cost of exporting to the EU. Also, under the terms of this regime, the free movement of labour between the UK and the EU would cease, as would the right of access to EU service providers. The UK would effectively return to its mid-Atlantic status.

The trade negotiations between the UK and the EU would be bilateral or intergovernmental. It is possible that with Brexit, the UK could more quickly negotiate and reach agreements with different countries under terms that would facilitate the national energy policy agenda. In further consideration of the WTO model, Emerson [31] and Mustilli et al. [32] accentuated that the UK would restrict its access to the single market if broader free trade deals were not negotiated and reached with the EU outside the WTO framework, since individual EU member states would be obliged to adhere to the terms of the EU's agreements with the UK, restricting bilateral agreements between the UK and the respective EU member states. This could be prolonged and time consuming. Moreover, the main challenge to such a negotiation would be that the UK, despite its optimism, may be at the back of the queue if the examples of other countries are worthy indications.

Alternatively, the UK could adopt the approach of a negotiated withdrawal by reaching a form of agreement with the EU (soft or grey Brexit), as stipulated in Article 50(2) of the TEU. One such trade agreement regime that the UK could consider is the EU-Swiss model. Under this model, both contracting parties would have unrestricted access to trade and the movement of people. Pursuant to Article 13 of the European Economic Community and the Swiss Confederation Free Trade Agreement, a complete "prohibition on any quantitative measures" would inhibit trade, suggesting that the issue of migration, which was a central issue in the referendum, remains integral to this model. However, the safeguard clause under Article 28 articulates the following: "where one or more member states of the community or Switzerland is in difficulties or is seriously threatened with difficulties as regards its balance of payments, the contracting party concerned may take the necessary safeguard measures. It shall inform the other contracting party forthwith. . . ." Such a clause enshrined in the agreement could be used to mitigate these concerns. The major challenge this model would face in relation to the UK-EU post-Brexit relationship is that it underscores the free movement of its citizens as a prerequisite for any trade alliance. This conditionality makes this model very unlikely considering the issues that triggered Brexit.

The UK could also decide to join the European Economic Area (EEA) with Iceland, Liechtenstein, and Norway. Under this arrangement, the UK would have access to the single market, but not to agriculture or fisheries. However, some contribution would have to be made to the EU in addition to complying with most environmental regulations, with no voting rights or ability to influence them. Moreover, the EEA arrangement does not provide access to EU trade deals with non-member states. The UK could also consider the EU–Turkey model (Customs Union), which allows the UK to retain the EU’s common external tariff. Under this model, the UK exports to the EU would not be subject to customs control, but there would be restricted access to people and services.

Another option is the Comprehensive Economic and Trade Agreement (CETA) model akin to the EU–Korea agreement, which offers a possible comprehensive approach to implementing post-Brexit relations between the EU and the UK. Although CETA has not been fully ratified by both contracting parties, it has a detailed framework that considers the major trade aspects of two advanced economies with comparable strong regulatory standards. However, the downside of implementing this framework within the EU–UK context is that CETA does not incorporate the market regulations that a country such as the UK would require to access the IEM.

A more realistic model adaptable to preserving UK interests and meeting her concerns would be the three-freedom model (free movement of goods, services, and capital, but not people). This model is similar to the Association Agreement model that the EU currently holds with Moldova, Ukraine, and Georgia, which allows the extensive inclusion of these associate states in the single market, with the exception of the free movement of people. As an integration-orientated agreement, it includes concepts, principles, and provisions of EU laws that are to be interpreted and applied with the fundamental assumption that the third state is part of the EU [33]. Table 2 summarises the various options and implications for access to the single market.

Table 2. Possible Options for the UK–EU Relationship Post-Brexit. FTA: Free Trade Agreement, EEA: European Economic Area; CETA: Comprehensive Economic and Trade Agreement; WTO: World Trade Organisation.

Possible Exit Model	Financial Contribution to the EU	Compliance with the EU Legal System	Influence over EU Rules	Access to Single Market			
				Goods	Services	People	Capital
EU Membership	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EU–SWISS FTA Model	Yes	Yes	No	Yes (partial)	Yes (partial)	Yes	yes
EEA	yes	yes	No	Yes (partial)	yes	yes	yes
CETA	No	No	No	Yes (partial)	Yes (partial)	Yes (partial)	Yes (partial)
Custom Union	No	No	No	Yes (partial)	No	No	Yes (partial)
Association Agreement	No	Yes partial	No	Yes (partial)	Yes	No	Yes
WTO	No	No	No	No	No	No	No

However, the impact on every sector of the UK and EU economies is undefined. The agreed regime would certainly have far-reaching impacts on the different sectors, not least the petroleum industry, the electricity market, the renewable technology sector, not to mention the impact on the future direction of environmental policies. The EU and UK are very much aware that undermining each other in the negotiation process will consequently undermine the collective good, and to this end, the importance of negotiating a regime that is beneficial to the general interest requires the fostering of a conducive model that will benefit both parties. This will require compromise from both sides. Taking hard lines could potentially escalate the uncertainties and worsen the current precarious situation for all concerned.

3. Potential Impacts of Brexit on the UK's Energy Sectors

As discussed in the preceding sections, the overall impact of Brexit on the UK's energy policy and security will be dependent on the nature of the agreement reached with the EU. In the following section, the potential implications of Brexit on different sections of the UK energy industry will be articulated.

3.1. Impacts of Brexit on the UK Oil and Gas Industry

With the triggering of Article 50, and as the UK begins to negotiate its exit deal with the EU, there are likely to be high degrees of political, economic, commercial, and legal uncertainties. However, no immediate change to the legal and regulatory regime governing the petroleum industry is expected in the short to medium term [34]. The major regulatory frameworks that govern the UK petroleum industry are derived from domestic policies such as the Petroleum Act of 1998, with the EU having no significant effect on upstream petroleum activities. Hence, the UK's upstream oil and gas policy is unlikely to change radically as a result of Brexit [18]. The oil and gas sector is majorly cyclical in nature, with its varying degrees of uncertainty usually controlled and influenced by the international market. Since the EU has a limited influence on the petroleum market, the UK is likely to have total control over its oil and gas sector [34]. However, this state of affairs is likely to hold only in the short to medium term, as future barriers may arise as a divorce deal is agreed between the UK and the EU.

The uncertainties already created by Brexit are likely to significantly impact the levels of investment in the UK continental shelf (UKCS), as investments may be delayed until some of the uncertainties are resolved during the two or more years of negotiations. Planned projects are also likely to be delayed as a result, with a faster decline of investment in the continental shelf. This may result in a decline in adequate common use infrastructures, resulting in exploration becoming uneconomic and the "UKCS entering a self-perpetuating cycle of decline", according to LaMaster and Hammerson [34]. Additionally, the effect of Brexit on the devaluing of the pound against major currencies makes investment in the UKCS less attractive, as most fields are marginal. The European Investment Bank (EIB) is a major investor in the UK energy sector. Any exit term that excludes the UK from the single market is likely to have a negative impact on the willingness of the EIB to continue to invest in the UK at the same rate as when it remained part of the EU.

Another major uncertainty would be the UK's future access to the EU Internal Energy Market (IEM). The UK exports its oil products to the EU while remaining a net importer of refined oil and gas, with a significant amount coming from the EU. With the UK currently being part of the IEM, there are no restrictions in relation to the flow of power and gas between the EU member states; hence, the UK still enjoys zero import and export tariffs. It also opens new markets for consumers at a reduced cost, as wholesale energy prices are lower on the continent. This is quite beneficial to the UK's energy security and sustainability. If the final deal excludes the UK from the IEM, and results in the UK entering into World Trade Organisation (WTO)-governed deals, this will have significant far-reaching implications for the country's energy security and sustainability. Brexit could lead to households paying more for each unit of energy they consume, at least in the short term, due to costlier taxes and tariffs on energy imports. Moreover, this could be exacerbated due to starved investments in exploration and development projects in the UKCS. If the UK is excluded from the IEM, there will probably be an urgent need for policy change in the sector. Also, the drop in the value of the sterling against the US dollar and the Euro following the Brexit vote will stimulate gas exports through the interconnectors if the sterling resets at a lower level against other major currencies. This will translate to a higher cost of importation of liquefied natural gas (LNG) from the Middle East. Further implications could be that the British public would bear the brunt of higher wholesale energy prices and increased government taxes.

Another key area where Brexit could impact the petroleum industry is the availability of skilled personnel [35]. The UK North Sea operation and emerging shale gas business relies heavily on a skilled labour force from the EU and beyond. According to Virley [10], it is crucial that skilled workers from

the continent can contribute to the progress of the oil and gas sector in the UK without any border restrictions. As the British government negotiates an exit deal, the petroleum industry would request the guaranteed free movement of labour to ensure their ability to meet the challenges associated with a specialist skilled workforce. New restrictions on EU staff or UK staff working in Europe would be damaging to the industry.

Furthermore, another possible consequence of the Brexit vote could be the second call for a referendum by the Scottish National Party (SNP). If Scotland becomes an independent nation, most of the oil and gas fields in the UKCS would come under an exclusive Scottish economic zone. As this possibility builds momentum, uncertainties are likely to be created for investors, resulting in a decline in investment over the next two years as London and Brussels negotiate a deal. If a second Scottish referendum is triggered and the UK splits into independent countries, there will be questions as to whether London or Edinburgh would be laying claim to North Sea oil. Further uncertainties will probably ensue that will have far-reaching and potentially damaging effects on the struggling North Sea petroleum industry, especially at a time when the industry is going through periods of painful restructuring as a result of the crash in oil prices. Although the call for independence has had a setback with the recent election resulting in the Scottish National Party losing significant seats, the outcome of the Brexit negotiations could nevertheless trigger another wave of agitation to leave the UK.

3.2. Impacts of Brexit on the UK Electricity Market

Most of the UK's electricity regulations either implement EU directives or are directly imposed by them, including the Electricity Directive, the Electricity Regulation, the Regulation on Energy Market Integrity and Transparency (REMIT), the Renewables Directive, and the regulation creating the Agency for the Cooperation of Energy Regulators (ACER). In November 2016, the EU proposed major modifications with new regulations in the "winter package" aimed at fostering greater cooperation between regulators and transmission system operators at both regional and continental levels. While most of these regulations are closely enmeshed in the UK's electricity framework, post-Brexit, the UK will still require a re-assessment of the framework for energy regulation, and may still require some form of agreement with the EU in order to function effectively.

The UK electricity system is one of the oldest in the world, and its infrastructure is aging fast, with over a dozen power plants due to be decommissioned in the next decade. Over 100 billion pounds of investment is therefore required over the next few years to replace its ageing electricity generation and transmission infrastructure. The UK government puts the value at £140 bn of investment needed by 2030 [36], while some observers put the figure even higher. With the current economic climate and post-Brexit uncertainties, attracting such a huge investment will be more difficult considering that four of the top six energy suppliers in the UK are in the hands of EU owners [37]. Already, some of the investors behind the currently planned power generation projects are reconsidering their decisions.

Wholesale electricity prices are lower in continental Europe compared to the UK. This is mainly because electricity is more expensive to generate in the UK than in most EU states. Currently, the UK electricity market is connected to the Republic of Ireland, France, the Netherlands, and continental Europe [38]. The gas and electricity networks are linked through interconnectors that allow them to flow through the transmission systems of the UK and other EU countries. The interconnectors facilitate both the integration and trading of energy within the Union. There are four currently operational interconnectors: IFA1 in France; Moyle and EWIC, which are both in Ireland; and BritNed in the Netherlands, which provide the UK with an additional 4000 MW of electricity capacity. A further 14,000 MW capacity is planned [39]. According to McHarg [19], access to these cross-border flows of gas and electricity is required to ensure the continued security of supply in the UK, considering that the country is a net importer of electricity with increasingly tighter supply margins and a rapidly ageing electricity production infrastructure. It has been estimated that the economic cost of reversing the decades of energy market integration with the EU could be up to £1 bn a year [40]. Moreover, Ireland is connected to the IEM through the UK. Should the UK exit the Energy Union, this would

cause acute consequences for Ireland, resulting in both economic losses and political instability [39,41]. The Single Electricity Market (SEM) that is currently regulated by the Irish Commission for Energy Regulation was established in 2007, and operates between the Republic of Ireland and Northern Ireland. The SEM is subject to the EU's energy regime, and if this remains the case post-Brexit, a part of the UK (Northern Ireland) would continue to be subject to EU laws. If the SEM is revoked as a result of Brexit, this would cause significant political tension between the Republic of Ireland and Northern Ireland, and potentially reverse over a decade of energy integration [42]. Froggart et al. [43] described this scenario as one of the sharp dilemmas of Brexit.

Furthermore, a hard Brexit that would require the UK to exit from the IEM will probably have a significant impact on UK energy security. In the medium to long term, there will be concerns with interconnection, and hence energy security [44]. Interconnectors link substantial amounts of energy to the UK through countries such as France and the Netherlands, and are sometimes more reliable than local UK generation [20]. Moreover, the electricity interconnection is attractive to investors in the electricity sector as a result of Carbon Price Support (CPS), which is a significant determinant of wholesale electricity prices. It accounts for nearly 15% of the current market wholesale prices [45]. 'Brexiting' the Energy Union without a similar support mechanism would also make investments in electricity interconnection less attractive. The UK would then have to resort to local energy production, mainly from coal, which is currently a costlier alternative to importing from the EU. Although the National Grid has assured UK customers that Brexit will not have any direct impact on the national electricity security supply, according to Villanacci [46], it will be difficult for the UK government to maintain generation margins. With a potential hard Brexit, the UK would also lose access to cross-border energy balancing and capacity market integration [39]. The House of Commons' Energy and Climate Change Committee posited in a report that the UK was "heavily reliant on Europe" for imports of gas and electricity, and a hard Brexit deal could leave the UK vulnerable to an energy crisis [47].

The UK Energy Act of 2013 put in place the Electricity Market Reform (EMR) to encourage investment in low-carbon electricity generation [48]. The ultimate aim of the EMR is based on the energy trilemma: the security of supply, sustainability, and competition to ensure the reduced cost of electricity to the consumer. This was also meant to create a stable, long-term electricity market that would stimulate investors' confidence and improve the attractiveness of the UK energy sector. The purpose of the EMR would come under threat if the UK exits the single market, as this would potentially affect the availability of EU funding for planned UK infrastructural investments.

Summarily, in the short term, the currency fluctuations post-Brexit will probably result in an increase in wholesale energy and consumer prices [49]. According to the Energy Institute [50], electricity prices are forecast to rise, despite anticipated lower costs for natural gas. This predicted rise was attributed to the cost of new innovation and the limits of the existing generation, which indicates concerns for the security of supply in the UK. The uncertainties of Brexit and the potential exit from the single market may cause further increases. In a hard Brexit scenario where the UK leaves the EU internal market, it will no longer benefit from tariff-free access to EU markets. This implies that the EU common customs tariff (MFN tariff) would apply to UK imports and exports. Post-Brexit, the EU would probably apply fees and taxes to electricity or gas piped into the UK, with little room for manoeuvre, as the UK is currently a net importer of energy. Any electricity trade between the UK and the EU involving any form of tariff would lead to increased costs that would translate to higher energy bills for consumers [39]. However, amidst the potential negative impacts of Brexit on the supply of electricity to UK customers, 'brexiting' the EU could be an opportunity for major domestic electricity market reforms that will not be constrained by any EU laws and regulations.

3.3. Impacts of Brexit on UK Renewable Energy and Climate Change Policies

Over the years, the UK has developed exemplary renewable energy schemes, mainly supported by the government. Some of these have inspired technological growth and development and the

increased acceptance and use of renewable energy in the UK. The Renewable Obligation encouraged suppliers to source an ever-increasing amount of their electricity from renewable sources, providing some incentive to them in the form of financial rewards for the life of the assets. A similar programme was also developed to encourage small producers under the feed-in tariff (FiT), which is designed to support small-scale renewable installations up to 5 MW. Generators are then paid a tariff for every unit of electricity they produce, with any excess being sold to the National Grid for further financial reward [51]. As part of the electricity market reforms, a new scheme named the feed-in-tariff with a Contract for Difference (CfD) is being developed to support renewables and low-carbon technologies. Currently, renewable energy accounts for more than 21% of all of the electricity capacity produced internally. This is projected to rise to about 30% by the year 2020, playing a significant role in electricity generation in the UK [52]. Also, the UK is a global leader in offshore wind energy developments, with approximately 5/12 of global offshore wind capacity as of 2015. It has been projected that the UK will deliver up to 50 GW of offshore wind energy by 2035 [53].

However, the general appeal for investment in renewable energy in the UK has diminished to an all-time low in recent years. This has been attributed to the future uncertainties of supplies and market prices. Also, the premature cessation of the renewables obligation, the present government's choice of nuclear and gas over renewable energy, and now Brexit, are the major contributory factors to the decline [37,54]. Consequently, it will become increasingly difficult to find adequate investors to finance renewable energy projects in the UK post-Brexit [55]. In addition, Brexit is estimated to raise trade costs [40], and trade costs are necessary for the home market effect. According to Ottaviano et al. [56], a rise in trade cost is likely to cause a 3.1% drop in the GDP of the UK in the long term.

The UK economy relies significantly on the EU for trade, both within the Union and globally. It also receives significant funding for renewable energy from the European Research Council. Since 2007, the EIB has invested more than £7 billion in UK renewable energy projects, making it the largest recipient of EIB funding [57]. Post-Brexit, it is unclear as to what kind of relations will exist between the UK and the EIB. Non-EU countries have received only about 12% of funding from the EIB [56]; hence, this suggests that there may be a significant reduction in the funding available to the UK should they exit the single market. However, the UK is a major shareholder in the EIB, with nearly 17%. It is therefore difficult to speculate on the medium to long-term impact of Brexit on EIB investments in the UK. The possibility of withdrawal to support renewable projects that have already been earmarked for funding is unlikely, as Brexit negotiations may last beyond the planned two-year period due to the complexities that will be involved. It can therefore be argued that the impact of the UK exiting the EU on the renewable energy sector will be more related to the potential lack of investment due to the uncertainties of Brexit, and the lack of preferential access to the IEM in a hard Brexit scenario. Hence, Jensen and Snaith [58] have posited that there are greater advantages for the UK to remain in the single market.

There may be far-reaching implications for the renewable energy sector should the UK exit the single market. Various EU initiatives in energy infrastructure investments, combined electricity trading, and price harmonisation are likely to be jeopardised. Also, the UK will lose out on research and innovation funding for energy from the Eight Framework programme and the European Research Council, with a budget of £75 billion and a projection to run until 2020. While investment would continue to diminish from the EU with an exit from the single market, conversely, this could afford the UK government more flexibility in funding its renewable energy projects and obligations.

Furthermore, the EU Renewable Energy Directive (RED) sets targets for every member state as to what percentage of energy consumed should be sourced from renewables by the year 2020. The UK was not in favour of the ambitious target set by the EU, and hence argued that market forces should instead promote renewable energy. According to the National Grid, the UK is likely to miss its 2009 agreed EU RED target of 15% [59,60]. Therefore, an exit from EU would allow the UK to miss its 15% target without facing any sanctions.

Climate change was not cited as a reason for the UK population voting to leave the EU. However, Brexit may have potential implications for the UK's climate change policies, as they were developed in line with the EU's climate policy as part of the United Nations Convention on Climate Change (UNFCCC). The EU climate change regulations are centered on three key frameworks: the Emission Trading Scheme (EU ETS); emissions not covered by the ETS; and frameworks promoting energy efficiency, renewable energy, and carbon capture and storage. The UK has been playing a leading role in the commitment to cut greenhouse gas emissions, with an 80% reduction commitment by 2050, as enshrined in the UK Climate Change Act, 2008 (CCA). However, the Climate Change Act is national legislation, and will not be directly affected by Brexit. Therefore, the UK is unlikely going to change direction in this regard during the exit negotiations or after leaving the EU. In fact, after the Brexit vote, the UK government recently approved the recommended fifth carbon budget, covering the periods 2028–2032. Post-Brexit, the UK would probably not be obliged to comply with European energy and climate directives. However, the commitments are unlikely to change. Also, with the US exiting the Paris Accord, the UK has a major role to play in championing emissions reduction on the global stage. It is currently unclear as to whether the UK will remain with the EU ETS or implement its own national trading schemes and carbon taxes post-Brexit. The Energy and Climate Change Committee has warned that another alternative measure to the EU ETS could be costly, complicated, or politically difficult to implement [19,61].

If the UK decides to back out of its current climate and renewables commitments, it may have a greater negative impact on the EU than the UK, as the remaining EU-27 members will find it more challenging to deliver their commitments under the Paris Agreement. With the UK (a strong advocate for emissions regulations) exiting the EU, the balance of power within the EU-27 would shift towards the climate change sceptic member states, particularly with the increasing significance of Poland. According to Niblock [62], the UK's absence in the EU “will echo through global climate discussions in ways that may complicate or even drag down progress” in the fight against climate change on the global stage.

3.4. Impact on Shale Gas Development (SGD)

Shale gas development (SGD) in the EU has been hampered by several factors, including environmental concerns and the call for regulatory reforms within the EU [63]. The member states of the EU are consequently looking at SGD in a different light. While some member states, such as France, have called for a total ban, others such as Poland and the UK are early adopters, with the remainder states are in the group of “contemplators” [64]. Issues related to SGD have been debated in the EU parliament, and there remains a divide between supporters and opponents of SGD. However, a resolution by the EU Parliamentary Committee on Environment, Public Health and Food Safety (ENVI) showed optimism for the potential of SGD to improve energy security among member states of the EU, but requested a review of existing EU regulations to cover its potential environmental consequences. Some members of the European Parliament (MEPs) who were not convinced by the resolution offered an amendment to place a moratorium on any new fracking operations in the EU [64]. Other committees have also debated the issues, with a similar divide evident among MEPs.

With the potential of technically recoverable shale gas reserves of 150 to 1130 billion cubic meters [65,66], and the decline of the previously vast North Sea gas field, SGD could play a significant role in reducing the UK's dependence on gas imports from the EU and the rest of the world. Consequently, the UK government has given the go ahead for SGD, despite opposition from local authorities and environmental pressure groups. With the EU's plan to regulate SGD, some commentators are of the opinion that Brexit could help the growth of the shale gas industry, because of the drive for energy security and the potential higher cost of energy in a hard Brexit scenario. Also, the nascent industry could be aided by the falling pound. In a soft Brexit scenario, where for example the UK joins Iceland, Liechtenstein, and Norway to become part of the EEA, the UK

would have to comply with most of the EU environmental regulations, and may be restrained in the development of its shale gas resources, while being unable to influence their shaping.

3.5. Impacts on EU Energy Project Funding

In a hard Brexit scenario where the UK exits the IEM, UK interconnectors may lose their designation as interconnectors, and hence their status as Projects of Common Interest (PCIS) [39]. PCIS benefit from EU funding, as they are considered vital in the achievement of the Energy Union's objectives. Several UK projects have obtained PCI status, and many more have made applications. It remains uncertain whether they would be considered as PCI post-Brexit, particularly if the UK exits the IEM. A hard Brexit would result in the UK losing access to the Connecting Europe Facility (CEF), with an estimated investment fund of 5.35 billion Euros in connectivity projects covering the IEM by 2020.

Furthermore, as previously alluded, the UK would lose access to the EU clean energy innovation fund if it exits the Energy Union. The UK currently receives a large chunk of EU energy-related funding through the Financial Instrument for the Environment (LIFE+) and Horizon 2020 research funds. There would also be no access to the EU's €1.6 billion funds for low-carbon projects (2004–2020). Over the last 16 years, Britain has benefitted in more than £37 billion of funding from the EIB for low-carbon innovation projects. However, the uncertainties created by Brexit have lowered the confidence of low-carbon investors [61,67]. Therefore, researchers in the UK remain uncertain about the future of funding for energy research. Although the Prime Minister has made assurances of filling any gaps in EU funding generated as a result of Brexit, it is apparent that the UK would be better off remaining in the IEM, as negotiations begin on a settlement deal with the EU.

3.6. Implications for the Nord Stream II Pipeline Projects

The Nord Stream II (NS2) pipeline is proposed to transport gas from Russia through the Baltic Sea to Germany. The project is one of the most contentious and debated energy projects in Europe. Despite enthusiasm in Berlin, several of the Baltic States and Poland are against the proposed development, as they argue that it will increase Russia's dominance in gas supply to the EU, which is against the EU's goal of diversifying energy supplies and reducing the dependence on gas from Russia. Currently, the EU is proposing to legislate all of the pipelines that bring gas to the Union. This is to ensure that all of the pipelines importing gas meet the principles of non-discriminatory tariffs, transparent reporting, and ownership unbundling. One of the implications of Brexit to the EU's Energy Union is for the solidarity principle. With fierce contentions between EU member states regarding the NS2 pipeline project, the absence of the UK as a tempering member of the Union would be felt as the proposal is debated. The UK has been a major voice against the NS2 project, and departing the EU will weaken the resistance that Berlin would encounter in Brussels as they push for the actualisation of the project. The other potential implication of the NS2 project is likely to be related to structure and pricing [68]. The NS2 project will impact the north–south gas competitiveness within the EU, ensuring that the interconnectors to the northwestern market are liquid. However, it could undermine the gas diversification efforts in southeastern Europe. Furthermore, with continuing disagreements and fierce oppositions to the NS2 project by Poland and the Baltic States, and the possibility that the UK post-Brexit could be free from all EU regulations such as the EU's Third Energy Package, the diversion of the NS2 pipeline project from Germany to the UK remains a possibility.

4. Conclusions

It began as a dream for some, but now as a reality, Brexit is here to stay. Its short, medium and long-term implications for the UK economy are now immanent, and the full implications and options for energy security must be understood. The uncertainties that have ensued following the Brexit referendum and the triggering of Article 50 of the TEU have already caused a drop in the growth and productivity of the UK economy. At present, the UK's energy policy and security are closely

intertwined and entrenched in the IEM. While the energy policies and climate change commitments under the Paris Agreement are unlikely to change significantly, as the UK has been a major advocate of emission reduction on the global stage, an exit from the EU with no preferential access to the IEM would increase the vulnerability of the UK to an energy security crisis, making an already bad situation worse. The post-Brexit uncertainties that could spur the reduction of investment flows into the UK energy sector, including renewable energy, could in turn stimulate an increased dependency on foreign gas and electricity imports, and as a consequence see UK consumers pay more per unit of energy. Post-Brexit the UK would also lose access to significant funding for energy infrastructure from the EU. Appropriating the right measures, including the correct policy initiatives, and ensuring that the UK maintains some form of preferential access to the IEM would go a long way to mitigate the potentially negative effects of Brexit on the energy sector.

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