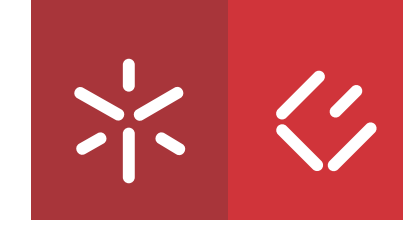




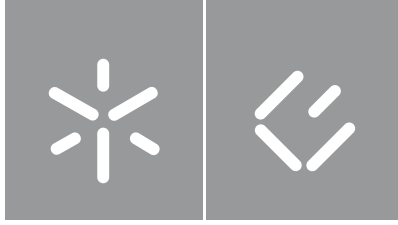
Magda Matos Maranhão Peixoto

Post-Brexit UK-EU economic  
relations: challenges in trade and the  
energy sector

Universidade do Minho  
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challenges in trade and the energy sector

Master's dissertation  
Master's in International Business

Trabalho efetuado sob a orientação da  
Professora Doutora Maria Helena Almeida  
Silva Guimarães

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## **Acknowledgements**

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Completing this dissertation marks the end of an important stage in my life, marked by the contribution of several people.

A very special thanks to my supervisor, Professor Maria Helena Guimarães, for her availability and dedication, constant encouragement throughout this work, and for sharing the knowledge that made this dissertation possible.

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## Abstract

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In 2016, the United Kingdom (UK) held a referendum, allowing its citizens to remain within or leave the European Union (EU). Most British voters opted to vote in favour of the UK's exit from the EU, and the outcome became known as Brexit. This dissertation delves into the Brexit phenomenon, examining its impact on economic relations between the EU and the UK, focusing on the trade flows and the energy sector. The study evaluates the consequences for the UK economy from 2016 to 2023. Concerning trade, the dissertation focuses on non-tariff measures (NTMs) resulting from Brexit; pertaining to the energy sector, the main impacts and challenges were surveyed, particularly the consequences of Brexit to the UK energy market and its governance, as well as on the implications for the Integrated Single Energy Market (IEM) market between the UK and the island of Ireland (Northern Ireland and the Republic of Ireland). The analysis was made with the backdrop of the European Single Market and the EU Internal Energy Market (IEM). The UK withdrawal from the EU brought up NTMs that have created difficulties in trade flows between the two parties and resulted in a decrease in trade volumes between the UK and the EU; this was compensated. Regarding the energy sector, Brexit caused an increase in energy prices, a decrease in FDI in the UK energy sector and a consequent increase in public investment, as well as the emergence of non-tariff measures in this sector.

**Keywords:** Brexit, Energy Sector, European Union, Internal Energy Market, Non-Tariff Measures, Trade flows, United Kingdom.

## Resumo

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Em 2016, o Reino Unido realizou um referendo que permitiu aos seus cidadãos optarem por permanecer ou sair da União Europeia. A maioria dos eleitores britânicos optou por votar a favor da saída do Reino Unido da União Europeia, e o resultado ficou conhecido como Brexit. Esta dissertação aprofunda o fenómeno do Brexit, analisando o seu impacto nas relações económicas entre a União Europeia e o Reino Unido, com enfoque nos fluxos comerciais e no sector energético. O estudo avalia as consequências para a economia do Reino Unido de 2016 a 2023. No que respeita ao comércio, a dissertação foca-se nas medidas não tarifárias resultantes do Brexit; no que respeita ao sector energético, foram salientados os principais impactos e desafios, em particular as consequências do Brexit para o mercado energético do Reino Unido e a sua governação, bem como as implicações para o Mercado Único Integrado de Energia entre o Reino Unido e a ilha da Irlanda. A análise foi efetuada tendo como contexto o mercado único europeu e o mercado interno da energia da União Europeia. A saída do Reino Unido da União Europeia levou ao aparecimento de medidas não-tarifárias que dificultaram o comércio entre as duas partes e resultaram numa diminuição dos volumes de comércio entre o Reino Unido e a União Europeia. No que diz respeito à energia, o Brexit provocou um aumento dos preços da energia, uma diminuição do IDE no sector da energia e um consequente aumento do investimento público no sector da energia bem como o surgimento de medidas não-tarifárias no setor.

**Palavras-chave:** Brexit, Fluxos comerciais, Setor Energético, União Europeia, Mercado Interno da Energia, Medidas Não-Tarifárias, Reino Unido.



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## Abbreviations and Acronyms

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EEA	European Economic Area
EIB	European Investment Bank
ETS	Emission Trading System
EU27	27 European Union countries
EU	European Union
EURATOM	European Atomic Energy Community
FDI	Foreign Direct Investment
G7	Group of seven
GB	Great Britain
GBP	Great British Pound
GDP	Gross Domestic Product
I-SEM	Integrated Single Electricity Market
IEM	Internal Energy Market
NTM	Non-tariff measures
OECD	Organisation for Economic Co-operation and Development
OFGEM	Office of Gas and Electricity Markets
SDAC	Single-Day Ahead Coupling
SEMO	Single Electricity Market Operator
TCA	Trade and Cooperation Agreement
UNCTAD	United Nations Conference on Trade and Development
UK	United Kingdom
WTO	World Trade Organization

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## Introduction

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The relationship between the United Kingdom (UK) and the European Union (EU) has been a complex journey defined by crucial moments and decisions.

The UK was invited to be part of the EU when the European Coal and Steel Community was created during World War II. The invitation was declined due to various factors, such as a wish to preserve economic autonomy and a failure to comprehend the impending significance of the community entirely (Henley et al., 2020). The UK finally joined the EU, which was then called the European Economic Community, on August 1<sup>st</sup>, 1973. The European integration process advanced consistently over several decades, encompassing political, economic, and monetary fronts. It has resulted in a significant economic union, establishing the third-largest economy globally after the United States of America and China. Achieving the current level of integration required considerable political determination (Buigut & Kapar, 2023).

However, on June 23<sup>rd</sup>, 2016, the UK citizens voted to exit the EU, and, as a result, the UK is no longer a member of the EU as of January 31<sup>st</sup>, 2020. This “divorce” has remained one of the biggest challenges in the EU's history, making the UK the first independent country to leave the union (Fleissig & Swofford, 2023).

The UK's withdrawal from the EU became known as “Brexit” and, while not entirely unexpected, signifies a substantial economic and political upheaval for the EU, standing out as one of the most impactful votes of the 21st century (Buigut & Kapar, 2023). This decision significantly transformed the political and economic dynamics between the UK and the EU concerning trade flows and the energy sector. The initial difficulty stemmed from the uncertainty of the process unravelling after four decades of economic and political integration, which posed a legal challenge and raised valid questions about the future stability of the EU itself. Greenland's exit in 1982, for example, could not offer a practical lesson due to its smaller economic size and dependence on a single industry—fisheries.

Following the referendum, the UK Government invoked Article 50 of the Treaty on the EU on March 29<sup>th</sup>, 2017, setting off a withdrawal period during which the UK and the EU negotiated to determine the terms of departure and to adjust their governance structures accordingly, leading to the complete finalisation of the UK's exit process.

Brexit reintroduced trade and migration barriers between the UK and the EU. While the Trade and Cooperation Agreement (TCA), negotiated after Brexit, avoided customs duties, trading between both parties is now subject to non-tariff measures (NTMs). These measures result in border controls, rules of origin controls, diversion on product standards and safety regulations, workers' rights, and environmental protection, all considered critical sources of losses for the UK's post-Brexit economy (Garcia-Lazaro et al., 2021). For instance, since January 1<sup>st</sup>, 2021, VAT and, where applicable, excise charges (e.g., on alcoholic beverages, tobacco products, etc.) are payable at the time of importation (even for online sales). Moreover, UK producers intending to cater to both EU and UK markets must comply with two sets of standards and regulations, subject to scrutiny by EU organisations, as there is no conformity assessment equivalency. The dissertation will address these non-tariff challenges which arose from Brexit in the UK-EU trade.

Brexit carries other significant implications for the UK and the remaining EU member states, spanning various economic, social, and political spheres. In the energy sector specifically, numerous potential effects were anticipated, encompassing aspects such as investment uncertainty, access to finance, gas market dynamics, supply security, nuclear power considerations (including the UK's participation in EURATOM), energy efficiency policies, and the supply chains underpinning all energy industries (Lockwood et al., 2017). The transition period to the complete withdrawal of the UK from the EU had implications for energy governance between the UK and the EU, leading to various challenges and uncertainties. These issues, in turn, prompted a broad array of concerns related to energy justice - a people-centred framework that addresses unfairness and disparities within the energy industry, acknowledging who should have a say in the planning and implementing energy systems and considering the consequences of such systems for various stakeholders. In particular, the impact of Brexit prompted contemplation on the allocation of responsibilities within the UK energy system governance, considering factors such as government involvement, contributions from civil society, and market dynamics. Additionally, the potential for disruptions in consumer pricing emerged as a significant consideration, entailing complex and uncertain mechanisms (Muinzer et al., 2022).

Given the significance of Brexit in reshaping UK-EU relations and its impact on various sectors, this dissertation aims to investigate the dynamics of trade flows and the energy sector and their challenges from 2016, the year of the UK's decision to exit the EU, until 2023. The primary objective of this study is to analyse the impact of Brexit on trade flows, and the energy sector, with a specific focus on the NTM, applied to both sectors that surfaced post-Brexit. The aim is to discern the nature and origins of these

NTMs resulting from Brexit on both the trade and energy sectors and comprehend their implications on energy prices, foreign direct investment (FDI), and public investment. Thus, this dissertation thoroughly examines the interplay between the trade and the energy sector and the ramifications of the Brexit process.

Regarding the methodology, considering the goals of this dissertation, the inductive method was the most appropriate for this research as it facilitated the exploration and analysis of new perspectives and patterns within the data collected. Conducting this research using data obtained from administrative records inherently involves the analysis of secondary sources since the data contained in these records was initially collected for another purpose rather than specifically for this research purpose. The data collection used archival and database research, such as those of Statista, the House of Lords, and the World Trade Organization (WTO).

By analysing the interaction between Brexit and these NTMs, this research offers perspectives on the changing dynamics of UK-EU relations and the challenges the energy industry faces in adjusting to the post-Brexit environment. The purpose is to understand how these obstacles have influenced trade flows, energy prices, FDI flows, and public investment. The independent variables are (1) the introduction of NTM by the EU and the UK and (2) the customs laws that have been in place since Brexit. As for the aspects that are influenced by these elements and serve as dependent variables, we use (1) the impact on trade flows between the EU and the UK, (2) the impact on energy prices in the UK, (3) the effect on the UK's FDI flow and public investment on the energy sector.

The expository path starts with this introduction, serving as the foundational preamble for the subsequent chapters. Moving into Chapter 1, this dissertation examines how Brexit and the TCA have affected trade, beginning with an overview of the TCA. It discusses Brexit's influence on the UK's trade interactions with the EU and the repercussions on EU trade and NTMs following Brexit. Chapter 2 provides an overview of the energy sector in the UK, Ireland, and the EU, considering previous energy market frameworks such as the Internal Energy Market (IEM) and the Integrated Single Electricity Market (I-SEM) while also analysing current market structures. The final chapter focuses on post-Brexit UK-EU relations within the energy sector. It assesses the impact of the TCA on the energy sector, particularly examining the case of Northern Ireland and the challenges and consequences of departing from the IEM. This section systematically explores the emergence of NTM after Brexit and its significant effects on energy prices, FDI flows, and public investment. It finishes with a conclusion and references to future work on this subject.

## **1. Trade implications from Brexit and the Trade and Cooperation Agreement (TCA)**

---

In the aftermath of the severe repercussions of the financial crash in 2008 and rising public apprehension regarding immigration, Prime Minister David Cameron pledged to hold a Brexit referendum if he secured victory in the 2015 election. The ensuing campaign, marked by populism, emotion, and a lack of substantial evidence, featured the impactful slogan "Take back control". Ultimately, a diverse range of motivations led voters to choose, by a margin of 52% to 48%, in favour of the UK's departure from the EU (Henley et al., 2020).

On March 29<sup>th</sup>, 2017, the UK government invoked Article 50 of the Treaty on the EU, initiating a withdrawal period during which the UK and the EU engaged in negotiations to determine the terms of departure and make necessary adjustments to their governance arrangements before the UK's exit became fully completed. As of January 31<sup>st</sup>, 2020, the UK formally left the EU. Due to the process's complexity, a transition phase lasted until December 31<sup>st</sup>, 2020. During this time, both parties engaged in negotiations that resulted in "The EU-UK TCA".

From January 1<sup>st</sup>, 2021, the end of the transition period, there were some inevitable changes, such as the ending of the free movement of persons and the UK citizens losing the possibility to work, study, establish businesses, or reside in the EU freely. They now require visas for extended stays within EU territories, passport stamps are necessary, and EU passports ceased to be recognised for UK residents. The unrestricted movement of goods also ended: UK exports entering the EU are subject to customs inspections and regulations. UK agricultural and food shipments must possess health certificates and undergo sanitary and phytosanitary checks at border inspection posts in EU member states, adding expenses and delays for UK businesses (European Commission, 2020).

The free movement of services was also affected, requiring the UK service providers to adhere to the regulations of each EU member state or relocate within the EU to maintain their operations. Mutual recognition of professional qualifications no longer exists, and UK financial services firms forfeit their financial services passports (European Commission, 2020).

## 1.1. The TCA

On December 24<sup>th</sup>, 2020, the EU and UK negotiators reached a preliminary TCA text to govern their post-Brexit relationship. Both parties signed the agreement on December 30<sup>th</sup>, 2020, provisionally applied from January 1<sup>st</sup>, 2021, and formally enforced from May 1<sup>st</sup>, 2021.

The agreement sets out the terms of the relation between the UK and the EU in areas such as trade in goods and services, digital trade, intellectual property, public procurement, air and road transport, energy, fisheries, social security coordination, law enforcement and judicial cooperation in criminal matters, collaboration and participation in specific Union programs. Essentially, it consists of 4 main pillars (Ioannides, 2023):

- A Free Trade Agreement between the EU and the UK representing a comprehensive economic and social partnership covering various aspects beyond trade, including investment, competition, environmental protection, climate change, tax transparency, transportation, fisheries, data protection, and social security coordination. It eliminates tariffs and quotas on compliant goods, ensures a level playing field with solid enforcement mechanisms, safeguards fisheries and resources, maintains transport connectivity with fair competition, promotes energy trade and sustainability, and protects the rights of citizens working or moving between the EU and the UK. It ensures zero tariffs for compliant goods, maintains high standards in various areas, including environmental protection and labour rights, and allows the UK to develop its fishing activities while protecting European fishing communities. It also guarantees continued connectivity in transportation and establishes fair competition in energy trading. Additionally, it safeguards social security rights for EU citizens and UK nationals in the EU. Lastly, it permits the UK's participation in select EU programs until 2027, contingent on financial contributions (European Commission, 2020). Regarding the trade of goods, the TCA made a tariff-free and quota-free basis possible between the UK and the EU.
- A framework for economic, social, and environmental cooperation, committing both parties to maintain equally high labour, social standards and environmental protection, including combating climate change and ensuring tax transparency. It also establishes joint management of fish stocks in the respective EU and UK waters and, in transportation, aims for sustainable connectivity while maintaining competition standards and safeguarding passenger and worker rights. On energy, the TCA prioritises fair competition and renewable energy production (Ioannides, 2023).



- A partnership for citizens' security creates a framework for law enforcement and judicial collaboration in criminal and civil matters, emphasising the importance of strong cooperation among national law enforcement and judicial authorities to combat cross-border crime and terrorism. It establishes new operational capabilities, recognising that the UK will have different resources as a non-EU member outside the Schengen area. It also establishes that security cooperation can be halted if the UK violates its commitment to upholding the European Convention on Human Rights and domestic enforcement.
- A horizontal agreement on governance that aims to provide clarity and legal certainty for businesses, consumers, and citizens. It establishes a Joint Partnership Council responsible for overseeing the agreement's application and addressing any issues. Enforceable dispute settlement mechanisms ensure that the rights of businesses, consumers, and individuals are upheld, preventing regulatory autonomy from being used for unfair subsidies or competition distortion. Additionally, both parties can retaliate across various sectors in case of agreement violations, ensuring a level playing field across all aspects of their economic partnership.

Although the EU-UK TCA will only partially replicate the level of cooperation during the UK's EU membership, it surpasses typical free trade agreements. It establishes a strong foundation for maintaining the longstanding friendship and cooperation between the two entities (European Commission, 2020).

Overall, the TCA arrangements represent a step down from the previous customs union and single market. It excludes the UK from the single market, resulting in the cessation of the free movement of people and introducing customs and border controls between the UK and the EU.

Unlike other major economies, the UK has yet to fully recover to pre-pandemic levels. Researchers like Jun Du et al. (2022) attribute this underperformance partly to the EU-UK TCA. Although the agreement maintains tariff- and quota-free trade, it struggles to prevent non-tariff measures from increasing. Small UK businesses, especially those with limited product ranges, seem to be particularly affected, experiencing a decline in trade. Moreover, there are indications of export concentration on fewer products and also fewer exporters. This reduction in trading capacity hints at potential long-term challenges for UK exports and productivity (Ioannides, 2023).

## **1.2. Brexit's impact on UK-EU trade**

The UK was an essential part of the EU, being the second-largest economy and the third-largest member-state in terms of population (Henökl, 2017). In 2016, the UK was leading EU economy, generating about 16% of the EU GDP; therefore, given the “weight” of the UK in the EU economy, leaving the EU greatly impacted trade between both parties (Ioannides, 2023).

The truth is that Brexit did not only impact the UK and the EU trade. With the EU accounting for nearly half of the UK's international commerce, any significant change in the UK-EU trade relationship will likely impact trade with non-EU nations (Kren & Lawless, 2022).

Recent studies show that approximately two-thirds of the British believe Brexit has harmed the UK's economy. Interestingly, even among those who supported the “leave campaign,” only one in five individuals hold a positive view of its impact. Overall, the Office for Budget Responsibility, an independent government body, forecasts that the UK's economic prospects will be 4% lower than if the country had opted to remain in the EU. It is essential to recognise that while financial considerations weigh heavily in this assessment, many voters viewed Brexit as a matter of sovereignty above all else (David, 2023).

### **1.2.1. The impact on the United Kingdom's (UK) trade flows with the European Union (EU)**

A study by Buigut and Kapar (2023) indicates that Brexit has considerably and adversely impacted UK-EU trade. During the referendum phase, UK-EU trade decreased by approximately 10.5% on average, and the transition phase resulted in an additional 15% reduction. The referendum and transition period have led to a 13% decrease in UK-EU trade compared to pre-Brexit. Furthermore, the TCA contributed a further 24% reduction. This suggests that a substantial part of the TCA's trade effects occurred during its negotiation in 2020, as businesses started to adjust in anticipation of its implementation. The significant impact of the UK's decision to leave the EU is evident since the EU is the UK's largest trading partner, representing 46% of UK trade in 2020 (Buigut & Kapar, 2023).

Hale & Fry (2023) state that leaving the EU made the UK less open to trade as the TCA implemented new trade barriers with the EU. They also suggest that over a 10-to-15-year span, a decline in the UK's trade openness by approximately 5% - 20% can be anticipated. The reduction in trade openness is considered one of the contributing factors to the contraction of the UK economy in the aftermath of Brexit.

As the UK economy grapples with the repercussions of the pandemic and the challenges posed by the rising cost of living, the UK in 2023 stands as the lone Group of Seven (G7) economy yet to fully rebound to its pre-pandemic output level (Kren & Lawless, 2022). The UK experienced a growth rate in trade behind the average of the rest of the countries of the G7 during the period spanning from 2019 to 2022. Economic growth also trailed behind the averages of the countries of the Organisation for Economic Co-operation and Development (OECD) and the 27 European Union countries (EU27), which impacted not only consumption and investment but notably exports with sluggish growth and imports – the most subdued growth among all OECD countries (Du et al., 2023).

Trade statistics indicate that Brexit has precipitated a substantial reduction in trade from the UK to most EU member-states. Du et al. (2023) add that Brexit hurt UK goods exports, which continue to decrease, especially for smaller firms. When the British Chambers of Commerce surveyed 500 firms in January of 2023, more than half said they were still grappling with the new system, and the red tape has deterred some small exporters from doing business in the EU altogether. A study based on customs classifications shows that the variety of goods the UK exports has diminished (David, 2023). According to an Institute of Directors survey, since January 1<sup>st</sup> 2021, 17% of enterprises that formerly traded with the EU have ceased operations, either temporarily or permanently, and roughly a quarter have had to relocate operations or employees. To adapt, several businesses have launched Europe-only websites or established distribution centres on the continent to supply their clients (Akram et al., 2021).

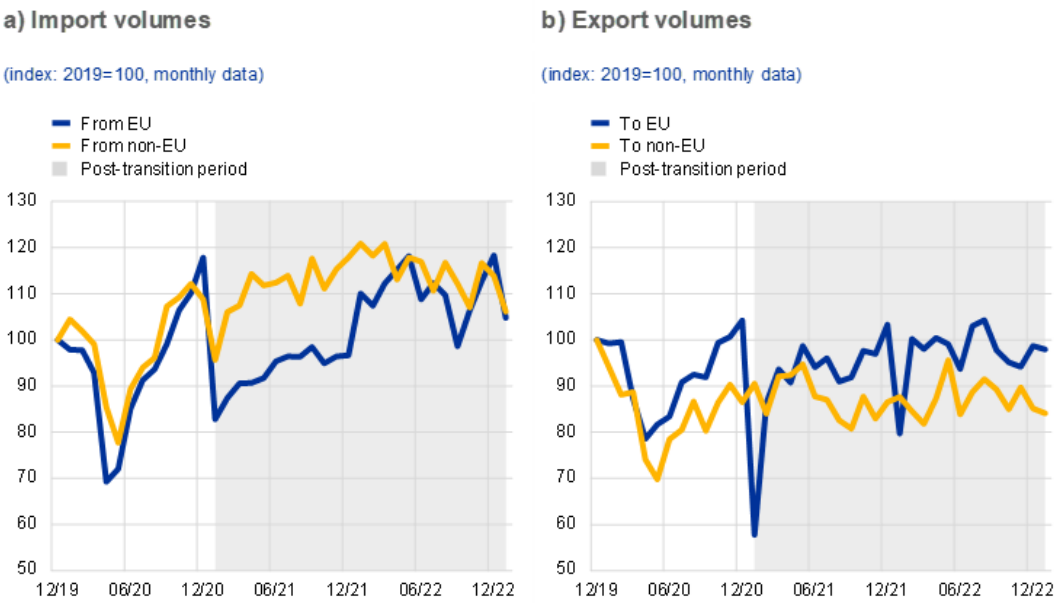


Figure 1 - UK trade in goods with EU and non-EU countries, 2019-2022

Source: European Central Bank

Figure 1 illustrates the import (a) and export (b) volumes of goods between the UK and EU and non-EU countries, differentiating the transition period of TCA implementation, which concluded on December 31<sup>st</sup>, 2020, and the subsequent post-transition period up to 2022. Import volumes began to decline from both EU and non-EU countries in December 2019, coinciding with the onset of post-Brexit negotiations, having a sharp drop due to the first lockdown resulting from the Covid-19 pandemic. That drop reached a minimum in May 2020 before commencing an upward trajectory. The conclusion of the transition period precipitated a significant decline in imports, particularly from the EU, with a gradual recovery after that. However, import volumes from the EU exhibited a notably slower recovery pace than those from non-EU countries.

Export volumes followed a similar trajectory to imports until the conclusion of the transition period. However, there was a notable decrease in export volumes to the EU immediately after the transition period's conclusion. According to the House of Commons (2023), this decline could be explained by anticipation of future trade challenges from early 2020 to late 2021 as firms try to avoid the new border processes. While export volumes to the EU experienced a relatively swift recovery and maintained stability after that, exports to non-EU countries remained essentially unchanged, aside from a downward trend observed in the initial phase of the TCA negotiations.

It is important to note that although export volumes to non-EU countries remained the same as in the transition period, import volumes followed a slight upward trend after the transition period. This trend can be explained by the new trade agreements that the UK made with non-EU countries after Brexit, such as Japan and Australia.

The consequences on trade align reasonably well with earlier forecasts, as exports of goods and services from the UK to the EU declined by 14% between 2020 and 2021. After Brexit, while there has been some recovery since then, exports of goods and services to the EU remain below 2019 levels, when they were approximately £170 billion. Following the COVID-19 lockdowns, EU and UK exports to the rest of the world and UK exports to the EU experienced a rebound. However, EU exports to the UK declined (Buigut & Kapar, 2023).

Nevertheless, the robust performance in service exports underscores the UK's advantageous position within high-value sectors, such as consultancy. These sectors encounter minimal trade obstacles, and interestingly, the pandemic has facilitated the widespread adoption of remote service delivery (Hale & Fry, 2023).

The imports of goods and services from the EU saw a sharp decline by 20% in 2020, in the post-transition period. Still, unlike exports, the import of goods recovered to pre-pandemic levels in 2022, reaching £274 billion, with an increase of 1.4% compared to 2019, when adjusted for inflation. Regardless, the UK has yet to fully implement border controls on goods imported from the EU, as introducing these controls has repeatedly been postponed (Ward & Webb, 2023).

### **1.2.2. The impact on EU countries**

Some of the UK's EU partners performed poorly on trade after Brexit. For instance, in early 2022, Germany and France were the slowest performers compared to the UK, with imports only growing by 16%-21%, respectively. However, several other EU countries with lower dependency on UK trade saw significant trade growth. For instance, Belgium and Poland recorded 48% and 37% trade growth rates, respectively. Additionally, Belgium, Poland, and Switzerland had an import growth above the world's 30% growth, with 44%, 47%, and 43%, respectively (Du et al., 2023).

Similarly to the EU's overall trade landscape, the contractions observed in trade flows of individual EU member states to the UK are notably less pronounced than those witnessed in trade flows from the UK to the EU. However, it is essential to note that these reductions remain (Kren & Lawless, 2022).

On the other hand, Brexit has stimulated trade among the remaining EU27. Estimates indicate that the referendum phase led to an increase of approximately 1,5% in intra-EU trade, and the TCA contributed an additional boost of around 4,5%. This implies that a portion of EU-UK trade has shifted to other EU countries as businesses in the remaining EU member states avoid the non-tariff barriers introduced by the TCA (Buigut & Kapar, 2023).

### **1.2.3. Post-Brexit Non-Tariff Measures (NTMs)**

The implementation of Brexit on January 1<sup>st</sup>, 2021, and the subsequent conclusion of the transition period brought significant changes in trade arrangements between the UK and the EU. Firstly, there were regulatory changes in the UK, some with potential discrepancies with the EU regulations and directives regarding fundamental requirements, which amount to NTM. While the global use of tariffs has declined, NTMs have become increasingly significant in influencing various aspects of trade, including the diversity and quantity of traded goods and services and their pricing and quality, as acknowledged by the WTO. The United Nations Conference on Trade and Development (UNCTAD) defines NTM as “political measures

different from the standard customs tariffs and that have an economic impact on international trade of goods, changing the quantities that are commercialised, the prices or both” (Du & Shepotylo, 2022).

NTM can be categorised in various ways, and different institutions offer diverse classifications of these measures. However, in this study, we adopt the UNCTAD classification (UNCTAD, 2019), which divides NTMs into three primary categories: technical measures, non-technical measures, and export-related measures. These main categories are subdivided into additional classifications, as shown below.

#### Technical measures

Technical measures refer to product-specific properties like characteristics, technical specifications, and production processes. They are designed to regulate health, safety, and environmental protection, address national security issues, and include conformity-assessment procedures, such as certification, inspection, and quarantine of goods. Their main goal is to meet public policy concerns and address market externalities that are not trade-related.

##### 1. Sanitary and phytosanitary measures

These measures limit the use of certain substances to guarantee food safety and hinder the spread of diseases or pests. They aim to safeguard human, animal, and plant health by addressing risks from additives, contaminants, toxins, and diseases. These measures also protect the environment, consumer interests, and animal welfare.

##### 2. Technical barriers to trade

These measures involve regulations and conformity assessment procedures other than sanitary and phytosanitary measures. Technical regulations are related to product attributes such as technical standards and quality criteria, manufacturing techniques, labelling and packaging, environmental conservation, consumer well-being, and national security.

##### 3. Pre-shipment inspection and other formalities

These measures related to mandatory pre-shipment inspections before export to ensure control over quality, quantity, and pricing. It also includes other customs procedures, such as requirements for goods to pass through specified customs ports.

#### Non-technical measures

They are often trade-related, such as quotas and subsidies. However, they also cover various other measures, such as finance, competition, intellectual property, and government procurement measures.

1. Contingent trade-protective measures

They refer to actions taken to mitigate the negative impact of imports in the importing country's market to address unfair foreign trade practices. These measures cover anti-dumping and countervailing duties as well as safeguard measures.

2. Non-automatic import licensing, quotas, prohibitions, quantity-control measures, and other restrictions

These include import control measures, such as quantity restrictions through non-automatic licensing, predetermined quotas, or prohibitions, regardless of the good's diverse sources or specific suppliers.

3. Price-control measures, including additional taxes and charges

Price-regulation measures are implemented to manage or influence the prices of imported goods. Examples include measures intended to uphold domestic prices of specific products in the face of lower import prices, to set domestic prices for certain products due to fluctuations in domestic markets or instability in foreign markets, and to enhance or maintain tax revenue. This category also encompasses NTM that elevates the cost of imports in a comparable fashion to tariffs, which are known as para-tariff measures.

4. Finance measures

Finance measures aim to regulate foreign exchange access to stipulate payment terms, potentially elevating import costs similarly to tariff measures. This category also encompasses measures that impose restrictions on payment terms.

5. Measures affecting competition

Measures impacting competition involve providing exclusive or unique preferences or privileges to a restricted group of economic operators. These measures predominantly involve monopolistic practices, exclusive importing agencies, compulsory national insurance or transport and state trading.

6. Trade-related investment measures

These measures refer to obligations to buy or utilise specified minimum levels or types of products originating domestically or limitations on the acquisition or utilisation of imported goods determined by the volume or value of local product exports.

## 7. Distribution Restrictions

They occur when the importing country imposes constraints on the distribution and sale of goods, including domestic distribution channels.

## 8. Restrictions on post-sales services

Actions limiting exporters' capacity to offer post-sales services through their preferred or chosen channels within the importing country.

## 9. Subsidies and other forms of support

Any governmental action or policy entailing a financial transfer to identifiable beneficiaries, creating or having the potential to create an advantage for them, falls under this classification. These measures are categorised into support for enterprises and final consumers or households. For this classification, measures or practices by the government include the central, subcentral, or municipal levels.

## 10. Government procurement restrictions

Government procurement restrictions refer to the limitations that bidders may encounter while attempting to sell their products to a foreign government.

## 11. Intellectual property

Actions concerning trade-related intellectual property rights involve legislation encompassing patents, trademarks, industrial designs, integrated circuit layouts, copyrights, geographical indications, and trade secrets.

## 12. Rules of origin

Rules of origin pertain to the general laws, regulations, and administrative decisions employed by importing countries' governments to ascertain the origin of goods. These rules are crucial in applying trade policy tools like tariffs, anti-dumping and countervailing duties, origin marking, and safeguard measures.

### Export-related Measures

While the previous measures were related to imports, NTM can also be applied to exports, although they are less frequent. They include a wide range of measures applied to exported goods by the national government, including export taxes, quotas, and prohibitions.



According to the World Bank, these policies have a restrictive impact of almost twice that of tariffs (Szczepański, 2017) and impact commercial dynamics, trade partnerships, commercialised products, and trade volumes. Although some NTM, such as health certificates, and compliance with processual complexities, such as checks on goods, are required to safeguard public health or the environment, they also considerably impact trade, introducing costs to businesses.

Many of these NTMs occur in UK-EU trade after Brexit, resulting in UK producers facing compliance costs. As the UK will no longer be part of the Customs Union or the Single Market, its goods are scrutinised upon entering the EU. This process leads to a time cost associated with demonstrating compliance, handling required paperwork, and navigating diverse border-crossing formalities. Both cost factors are new for the UK producers engaged in trade with the EU compared to the EU membership situation (Sheperd & Peters, 2020).

These NTMs can be illustrated with some actual examples of these measures in UK-EU trade. According to the "rules of origin" agreement, for British businesses to benefit from tariff-free trade, around 50% of a product's value must now come from the UK alone to meet the value-added requirement for tariff-free export to the EU. This refers to the site where the commodities were grown or manufactured entirely or where the last significant manufacturing operation was completed (Akram et al., 2021). This measure is categorised as a "rule of origin" since the EU imposes a specific origin for goods so that they can be traded in the EU without additional tariffs.

Following Brexit, the EU mandated that exporters of animal-origin foods must have consignments inspected by veterinarians and obtain export health certificates before shipping, which means that exporters of animal-origin foods have been obliged to pay fees to obtain approval by veterinarians before shipping their goods. These additional costs have led to a significant decline in exports, particularly affecting smaller producers, with the value of meat products sent to the EU decreasing by 17% since 2019 and over the year 2023, exporters of meat to the EU have incurred expenses exceeding £58 million (Simpson, 2024). This is an example of a "pre-shipment inspection" measure since, for animal origin, the UK to the EU, exporters must obtain approval from veterinarians in the UK.

Other challenges and difficulties food exporters encounter at the border are also related to handling VAT. While small exporters theoretically can utilise the EU's online Import One-Stop Shop to facilitate VAT charging, it necessitates collaboration with a "fiscal representative" in the EU, thereby increasing expenses. Additionally, some businesses interviewed by The Guardian indicated that this system's effectiveness varied, with inconsistent outcomes (Stewart, 2022). These technical measures can

be classified as “technical barriers to trade” since they involve regulation and conformity assessment procedures for the businesses/companies that want to export to the EU.

Recently, the UK introduced a new phytosanitary measure for importing plants from the EU. As this post-Brexit requirement, the plants can only be shipped with phytosanitary certificates, resulting in extra costs for companies and delays in deliveries. It is categorised as a phytosanitary measure since, without the certificate, the plants can't enter the UK (Simpson, 2024).

A drug shortage in the UK was verified in the pharmaceutical sector. This problem affects countries worldwide due to COVID-19, inflation and the war in Ukraine, but Brexit made it worse for the UK. Since the UK left the EU, the UK had to start approving drugs itself as Brexit also implied the exit from the European Medicines Agency. This caused some companies to remove the UK from their supply chain, disrupting the smooth supply of drugs and slowing the process of legalising and approving medicines. This can also be categorised as a “Rule of origin” since it is a regulation imposed by the UK since the EU's legalisation and approval are not enough for the drug to be commercialised in the UK (Campbell, 2024).

Regardless of whether it manifests as a "hard Brexit" or a "soft Brexit"<sup>1</sup>, the results from Sheperd and Peters's (2020) research demonstrate shifts in exports and imports for both the UK and EU nations. Noteworthy is the observation that while both scenarios result in GDP declines, the effect is notably more significant in the scenario involving tariffs and NTM, amounting to approximately 2.5 times the magnitude of the tariffs-only scenario.

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<sup>1</sup> A “hard Brexit” refers to the scenario of a complete split between the UK and the EU, losing access to the single market and exiting the Customs Union. The UK must negotiate its trade deals instead of benefiting from EU-wide agreements. On the other hand, a “soft Brexit” is a middle ground where the UK retains certain EU privileges without being a full member. Similar to countries like Iceland, Norway, and Liechtenstein, the UK would not have political representation in the EU. However, they could maintain access to the single market and enjoy reduced border checks for goods traded between the UK and the EU.

## **2. An overview of the energy sector in the EU, the UK and Ireland**

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### **2.1. The Internal Energy Market (IEM) of the EU**

Energy holds a central position in every kind of economic activity, which makes it an essential topic in the context of European economic policies and Single Market integration. The initial attempts to formulate an European energy policy can be traced back to the European Coal and Steel Community in 1952, an institution created to facilitate the free movement of coal and steel. Similarly, in 1957, EURATOM aimed to establish a unified market for nuclear energy, demonstrating a longstanding commitment to fostering nuclear energy capacity development across Europe. Finally, in 1988, the European Commission released a Green Paper titled “The Internal Energy Market (IEM)”, marking the first step towards shaping an integrated energy market and laying down its foundational principles and general direction (Fiedler, 2015).

In 1996, the EU introduced its initial directives to standardise and open its IEM. This market resulted in the expansion of the Single Market to include the energy sector. It aimed to challenge and dismantle the monopolies in energy and gas markets across various EU and European Economic Area (EEA) countries (that, besides the EU27, includes Iceland, Liechtenstein and Norway) by increasing healthy competition and thereby driving down consumer prices. As time progressed, legislative measures expanded the market's reach, facilitating the exchange of energy supplies among EU member states and the EEA (Reland, 2021). The directives addressed vital aspects such as market access, transparency, regulation, consumer protection, interconnection support, and ensuring sufficient energy supply. The primary objectives included expanding consumer and energy community rights, alleviating energy poverty, clarifying the roles and responsibilities of market participants and regulators, and ensuring the security of electricity, gas, and oil supply. Additionally, the directives sought to promote the development of trans-European networks for gas and electricity achieved by implicitly allocating capacity to interconnectors<sup>2</sup> that links neighbouring countries' electricity grids (*Brexit Effect De-Coupling the Energy Market*, 2021).

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<sup>2</sup> Interconnectors are high-voltage electrical cables that run across land and under the sea, connecting neighbouring countries and facilitating bi-directional electricity transfer. These infrastructures enhance the utilisation of renewable energy sources, ensure access to sustainable electricity generation, and bolster the security of electricity provision.

This liberalisation process unfolded through successive energy packages, starting with the First Energy Package in 1996 (electricity) and 1998 (gas), which allowed consumers to choose their gas and electricity suppliers. Later, in March 2000, the Lisbon European Council introduced a fresh approach focused on enhancing competitiveness and fostering economic growth. The strategic objective was to transform the EU into the world's most competitive and dynamic knowledge-based economy. This new strategy emphasised eliminating obstacles hindering competition and trade within the IEM, resulting in the Second Energy Package in June 2003 (Fiedler, 2015). This package and the Third Energy Package of 2009 expanded liberalisation by introducing reforms like unbundling<sup>3</sup>, independent regulators, and enhanced consumer rights. The Fourth Energy Package of 2019 focused on clean energy, renewable sources, consumer incentives, and regulatory empowerment through new electricity market rules. In 2021, the Fifth Energy Package was implemented in response to geopolitical concerns aiming to reduce reliance on Russian fossil fuel imports, prioritise energy efficiency, diversify energy sources, and expedite the transition to renewable energy following Russia's gas supply disruption caused by its invasion of Ukraine in 2022 (Ciucci, 2023).

## **2.2. The UK's energy sector**

The UK's energy sector currently provides energy to over 26 million households and businesses, supporting employment for more than 619,000 persons. Furthermore, it substantially contributes to the economy, adding approximately £83 billion annually, equivalent to 5% of GDP (Authority of the House of Lords, 2019).

In 2000, the UK achieved energy self-sufficiency and enjoyed a surplus in energy in 2004, exporting more than it imported. However, this dynamic shifted by 2010, with over a quarter of the UK's energy requirements being met through imports, and since then, the UK has consistently functioned as a net energy importer. The dependence on imported energy from Norway, interconnectors to Western Europe, and liquefied natural gas sourced from Qatar and the USA have steadily increased.

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<sup>3</sup>Unbundling refers to splitting or breaking up a business operation into several parts. The aim is to increase productivity, better performance, raise capital, or market expansion.

In 2015, fossil-fuelled boilers accounted for 88% of domestic space and water heating. The National Energy Action highlighted the escalating dependence of the UK on energy imports. Supporting this perspective, the British Ceramic Confederation asserted that this growing reliance on imported energy underscores the critical need to prioritise energy trade and enhance collaborative energy partnerships with neighbouring nations (Authority of the House of Lords, 2019). To mitigate this reliance on conventional fuels and reduce carbon emissions, investing in renewable heat systems could partially fulfil the heating demand while advancing the country's climate goals. One notable success for the UK is deploying wind power on the national grid, contributing up to 20% of the required generating capacity on high wind days. In 2019, the UK led in installed offshore wind capacity (>5GW) compared to other nations (Authority of the House of Lords, 2019). However, in that same year, the Durham Energy Institute emphasised that the current indigenous resources in the UK are insufficient to satisfy the nation's requirements for heat and power.

The industrial sector emerges as a significant electricity consumer, particularly with industrial electric motors consuming over 60% of the total electrical energy in the UK. Despite these achievements, the UK's dependence on energy imports from external sources escalates, necessitating reliance on non-UK suppliers in the energy market. With insufficient domestic production to meet heat and power demands, the UK's susceptibility to global oil and gas supply shifts is heightened, underscoring the need for strategic energy planning and diversification efforts. This increased dependence makes the UK increasingly vulnerable to supply fluctuations, where even minor adjustments in energy imports could have significant repercussions (Hogg et al., 2017).

The UK relies on the EU for approximately 5-10% of its electricity supply and a variable share ranging from 4% to 12% of its gas requirements. The UK, with Germany and Italy, collectively consume over half of the EU's gas demand. A substantial portion, approximately 45%, of the UK's energy consumption is dedicated to heating, with the majority supplied by gas and oil. In 2019, 8% of the electricity supply in the UK was sourced from interconnectors, which increased to 9% in the first half of 2020 (Reland, 2021).

### **2.3. The Integrated Single Energy Market (I-SEM) of Northern Ireland and Ireland**

The energy governance of Northern Ireland and the Republic of Ireland is closely interconnected as the electricity sector functions within a unified wholesale market called the I-SEM. The I-SEM is overseen

by the Single Electricity Market Operator (SEMO), a collaborative venture between the two system operators in Ireland – System Operator for Northern Ireland and EirGrid Plc in the Republic of Ireland. SEMO is responsible for the financial coordination essential to the I-SEM's functioning, effectively controlling electricity generation and sales across the island of Ireland. For example, SEMO establishes the technical rules dictating participation and the procedures for regular electricity auctions, among other aspects. The regulatory oversight of the I-SEM is carried out by the Single Electricity Market Committee, consisting of three representatives from the Republic of Ireland, three from Northern Ireland, and two independent members. This committee aims to safeguard the interests of electricity consumers throughout the island by fostering effective competition among generators and traders (Whitten & Robb, 2022).

The I-SEM operates seamlessly due to the physical connection of the electricity grids in the Republic of Ireland and Northern Ireland and, each year, manages financial flows of approximately €3.5 billion. Consequently, wholesale electricity generated anywhere on the island of Ireland, regardless of its location north or south of the border, becomes part of the I-SEM (Whitten & Robb, 2022). A 'North-South Interconnector' has been established between Tandragee (Northern Ireland) and Louth (Republic of Ireland), complemented by two standby interconnectors. Additionally, planning approval has been granted for constructing another significant interconnector between Tyrone, in Northern Ireland, and Cavan, in Ireland (Muinzer et al., 2022b).

Northern Ireland operates and regulates the electricity supply and the energy market independently from the rest of the UK. The Utility Regulator in Northern Ireland takes on the regulatory role equivalent to OFGEM (Office of Gas and Electricity Markets) in Great Britain (GB). Unlike GB, Northern Ireland does not have an energy price cap. Instead, the Utility Regulator oversees price regulation and controls, allowing immediate implementation of price increases. The regulatory framework in Northern Ireland is more responsive to changes, enabling suppliers to announce price increases as needed, with approval from the Utility Regulator (Whitten & Robb, 2022).

However, the island of Ireland relies on the British market for electricity and gas, which is crucial for ensuring its energy security. As highlighted by the Aldersgate Group, the island's sole physical links to mainland Europe for gas and electricity are through connections with the UK. Consequently, according to information provided by Energy UK, approximately 88% of the island of Ireland's energy requirements are sourced from imports, with around 40% of the gas utilised on the island imported from GB (Authority of

the House of Lords, 2019). Therefore, it remains crucial to maintain and enhance the connections with the UK and the IEM.

#### **2.4. Current market arrangements**

Over nearly five decades of EU membership, the UK energy markets have become closely interconnected with the markets of the other EU27. This integration has been facilitated by establishing electricity interconnectors and gas pipelines that link the UK with France, the Netherlands, Belgium, and Ireland. Before 2010, the UK and the EU had only three interconnectors: the IFA interconnector linking England and France, the North-South interconnector connecting the Republic of Ireland and Northern Ireland, and the Moyle interconnector connecting Scotland and Northern Ireland. In 2011, the BrtiNed interconnector became operational, linking the Isle of Grain in England and Maasvlakte in the Netherlands and, in 2012, opened a connector between Wales and the Republic of Ireland called the East-West interconnector. In 2019, a new interconnector called Nemo Link was established to link England and Belgium. As of 2021, two more interconnectors have been activated: the IFA2 interconnector, strengthening the connection between England and France, and the North Sea Link interconnector, linking England to Norway (Deaney, 2022). In 2022, the ElecLink interconnector began operation, strengthening the link between England and France (see Figure 2).

Most of the interconnectors are operational, meaning that are already functional and generating revenue, or under license, therefore they are approved but not yet operational, and have future revenue potential. The interconnectors marked as 1<sup>st</sup> Cap and Floor are the ones that are in the first phase of a regulatory framework that limits profits and losses, and the 2<sup>nd</sup> Cap and Floor are in the second phase. OFGEM created the Cap and Floor framework to unlock beneficial investment in interconnectors (Cap and Floor Regime: Unlocking Investment in Electricity Interconnectors, 2016). The ones marked as “Outside the Cap ad Floor” are not subject to this framework, which allows for more flexibility but also entails more significant risk.

Until 2027, it is expected that seven more interconnectors will be built that will connect the UK with Denmark, Germany, and Morocco.

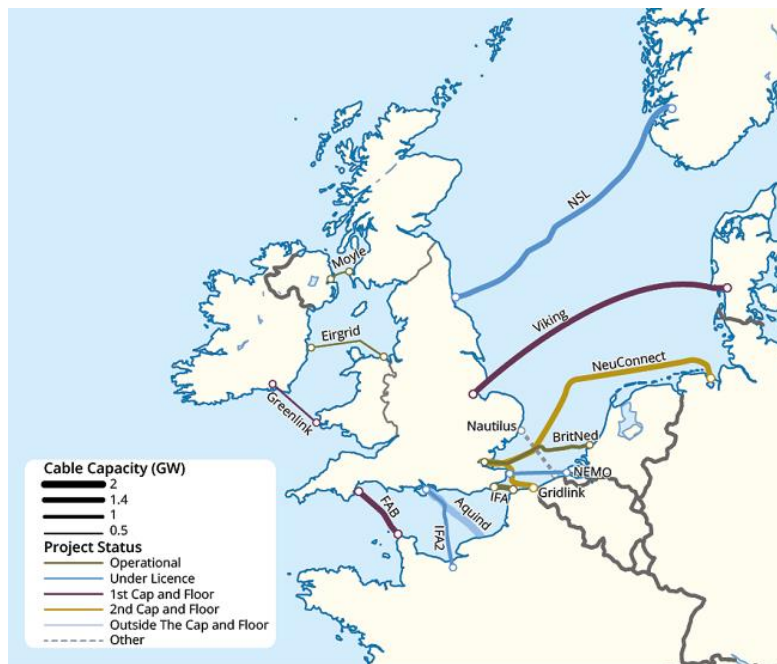


Figure 2 - Interconnectors between the UK, Ireland and the EU.

Source: The Crown Estate

### 3. Post Brexit UK-EU relations in the energy sector

#### 3.1. The TCA and the energy sector

Over time, the energy markets of the EU and UK have become closely intertwined through the construction of interconnections, such as electricity cables and gas pipelines. The fundamental challenge regarding energy in the context of Brexit revolves around the UK's desire to maintain the economic advantages of continued participation in the increasingly interconnected European electricity market. It encompasses specific topics such as infrastructure, governance, policy, regulation, and financial matters. However, under current European legislation, achieving this entails renouncing autonomy by adhering to legislation and regulations formulated collectively at the EU level. The Durham Energy Institute highlighted the UK's inability to fulfil its heat and power demands solely through domestic resources, underscoring a growing reliance on energy imports, as noted by the National Energy Action. The British Ceramic Confederation emphasised that this escalating interdependence on energy reinforces the significance of maintaining robust energy trade relationships with the EU and enhancing collaborations with neighbouring nations. Energy UK assured that the uninterrupted flow of gas and electricity would persist commercially



despite Brexit. However, it cautioned that operational efficiency would diminish without a comprehensive trade agreement or membership providing access to the IEM. Georgina Wright from Chatham House echoed concerns, emphasising that while energy trade between the UK and the EU and other countries would likely persist even without an agreement, the efficiency of such transactions could be compromised. RWE, a major energy company, concurred with these assessments (Hogg et al., 2017). The National Grid – an energy company operating in the UK - warned that if the UK were to be excluded from the IEM without any alternative policies, it could pose a risk to the UK economy by the early 2020s, arising from the risk of losing the advantages of harmonised trading arrangements with the EU (Authority of the House of Lords, 2019).

The UK-EU relationship now faces a new chapter marked by changes in trading mechanisms and regulatory frameworks, which impact the energy costs British consumers bear (Gallardo, 2022). The country become less integrated into EU energy markets, potentially resulting in higher prices and less reliable supply. Supply risks would intensify, particularly concerning issues such as importing gas through subsea pipelines or electrical interconnectors linking the UK to other EU nations.

After the completion of the transition period, the UK and the EU's agreement on energy matters is now comprised of the EU-UK TCA, the UK-EUROTAM Nuclear Cooperation Agreement (focused on cooperative efforts in the safe and peaceful use of nuclear energy), and the revised Withdrawal Agreement released on October 19<sup>th</sup>, 2019. The energy-related provisions within the TCA are set to expire on June 30<sup>th</sup>, 2026. However, there is the possibility for an extension by mutual agreement in the Partnership Council established under the TCA, extending the termination date to March 31<sup>st</sup>, 2028 (*The Impact of Brexit on the Energy Sector*, 2021). This agreement establishes a framework for UK-EU energy cooperation and acknowledges the UK's new status as a third-country entity separate from the EU (Muinzer et al., 2022b). These provisions promote trade and investment in energy and raw materials between the EU and the UK while bolstering energy supply security and environmental sustainability (Delivorias, 2023). The TCA also sets the stage for regulatory cooperation across several key energy domains, although at a reduced level compared to what would have been maintained had the UK remained within the IEM. Areas of collaboration outlined within the TCA include network development, supply security, risk preparedness, and emergency planning. Additionally, frameworks for technical partnership are to be established between UK transmission system operators and their counterparts in the European Network of Transmission System Operators for Electricity and Gas. Similarly, there are provisions for cooperation between the Agency for the Cooperation of Energy Regulators and OFGEM, the

GB's energy regulator. Moreover, the TCA introduces the formation of a novel institution, the Specialised Committee on Energy, tasked with supervising collaborative efforts between the UK and the EU across various fronts. This Committee oversees the implementation of technical procedures to ensure efficient utilisation of electricity and gas interconnectors, electricity trading arrangements, network development, and supply security. Its mandate also includes monitoring the effectiveness of these measures to ensure alignment with the objectives outlined in the TCA (*The Impact of Brexit on the Energy Sector*, 2021).

Regarding the EURATOM, the UK's departure from the EU involves exiting the nuclear common market, which provides robust assurances for the secure and peaceful utilisation of nuclear energy and ensures the security of the atomic energy supply. This departure also terminates the collaborative framework facilitating the sharing of expertise, research, infrastructure, and financial resources related to nuclear energy. In light of this, on December 31<sup>st</sup>, 2020, EURATOM and the UK concluded a distinct agreement, independent of the TCA, to foster cooperation concerning nuclear energy's safe and peaceful application (Delivorias, 2023).

Additionally, following Brexit, the UK has also opted out of the EU's solidarity mechanism for energy, thereby freeing itself from prior obligations to cooperate with the EU during energy crises. Consequently, the UK also forfeits its eligibility to receive aid from the EU during significant energy shortages. The UK is no longer bound by the Security of Supply Regulation, which mandates Member States to assist each other in energy supply unless the flow is restricted through a third country. This exemption mainly affects Ireland, as the EU would still be obligated to help, provided the UK does not impede transit flows. However, according to Gallardo (2022), the TCA needs more specificity as it only mentions the potential for coordinated mitigation and restoration measures. Thus, the degree of coordination during crises remains discretionary among the parties involved.

*The allocation timings*

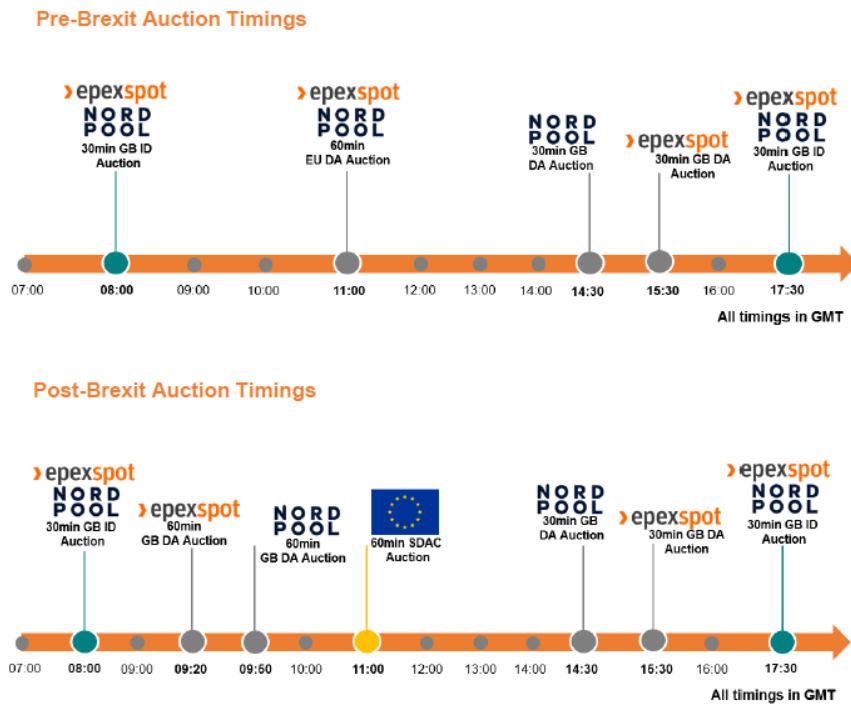


Figure 3 - Auction timings pre and post-Brexit.

Source: Energy UK

Pre-Brexit, the allocation capacity and the electricity flow between the UK and Europe were governed by European legislation, integrating the UK market into the Europe-wide Single Day Ahead Coupling (SDAC). The SDAC process involved aggregating pricing data from generators, traders, and retailers across the EU to determine competitive market prices in each country and simultaneously to decide the direction of interconnector flows. This system streamlined the determination of daily energy prices across EU markets and optimised the redistribution of energy flows among interconnected markets – market coupling. Under SDAC, energy supply and interconnector capacity were sold simultaneously through implicit allocation, ensuring uniformity across all market operators (see Figure 3, on “Pre-Brexit Auction Timings”). This unified approach enhanced trading efficiency compared to separate markets for supply and capacity (Roberts & Matson, 2021). In 2017, the cost savings generated by SDAC were estimated at £100 million annually for the UK, representing less than half a per cent point of total household energy bills at the time (Reland, 2021).

As agreed in the TCA, a new post-Brexit model for streamlined electricity trading across interconnectors was developed. Traders are now required to daily procure interconnector capacity and power separately through what is known as "explicit auctions", conducted prior to the determination of

daily prices (see Figure 3, on “Post-Brexit Auction Timings”). The explicit auctions are known for their inefficiency as these auctions necessitate separate transactions for power purchase, sale, and interconnector capacity use.

Under the new process for GB-NL power transfer via the Britned cable, for example:

1. Traders participate in an auction for interconnector capacity between 08:50 and 09:10 daily.
2. They subsequently engage in power trading in GB on EPEX (closing at 09:20 GMT) or N2EX (closing at 09:50 GMT) and separately in the Netherlands at 11:00 GMT, when the countries belonging to SDAC trade (marked with the EU flag).
3. Traders can designate power flow to fulfil their trades using the Britned capacity purchased between 10:30 GMT and 13:30 GMT.

Traders face the challenge of acquiring interconnector capacity rights before knowing the electricity prices in either country. The efficient price of interconnector capacity depends on the price spread between the two countries. Therefore, traders risk misjudging the price differential when bidding for capacity, potentially undervaluing it. Consequently, there is a societal risk of underutilising interconnector capacity (D. Roberts & Matson, 2021). With the shift to explicit auctions for purchasing interconnector capacity and power separately, coupled with the need for businesses to re-register with the EU, the process has become more cumbersome, and the flow of electricity through interconnectors has become less efficient, leading to a loss of cost efficiencies (Reland, 2021).

This restructuring of electricity systems carries significant consequences for markets, infrastructure, and economic, social, and political frameworks (Ball et al., 2022). While commercial incentives for greater interconnection persist due to price differentials between the UK and EU/EEA countries, continuing this trend hinges on the political will post-Brexit, with uncertainties surrounding the imperative for enhanced interconnection (Virley CB, 2016). The UK energy negotiations might destabilise interconnection projects reliant on shared regulation. Energy UK stressed the importance of maintaining the convergence of market rules to optimise interconnector utilisation. Ofgem noted that many projects are joint ventures requiring cooperation from multiple governments, regulators, and grid companies, and uncertainty regarding future market arrangements could also impact infrastructure development (Authority of the House of Lords, 2019).

As part of the withdrawal agreement between the UK and the EU, the “Northern Ireland Protocol” ensured that the I-SEM would remain intact. However, the effect of the GB electricity market leaving the

IEM has still resulted in a decrease in the use of the IEM's interconnectors that link the island of Ireland with GB (Hewitt, 2021).

### **3.2. The specific case of Northern Ireland**

The UK is now covered by two distinct electricity markets: GB, which includes England, Scotland, and Wales, and the island of Ireland, which together compose the I-SEM. The cross-border electricity flows through interconnectors will no longer adhere to EU legislation, which previously facilitated efficient trade and cross-border cooperation in operating the electricity system and is now conducted without using existing tools designed for the EU Single Market, such as EU market coupling, as these tools are reserved explicitly for EU member countries.

The growing interconnection of the UK with mainland Europe and the framework of the electricity market in Northern Ireland will demand collaboration with the IEM since approximately 10% of the electricity supply in the UK comes from imports through interconnectors, and nearly half of these imports originate from France (*The Impact of Brexit on the Energy Sector*, 2021). In August 2016, Arlene Foster and Martin McGuinness, Northern Ireland's first minister and deputy first minister, respectively, communicated with UK Prime Minister Theresa May in a letter outlining crucial concerns for the Brexit negotiations. The third priority on their agenda was energy supply to Northern Ireland, emphasising that energy was deemed a "key priority" due to the inherent challenges related to cost and supply, primarily arising from Northern Ireland being a "small and isolated market" (Whitten et al., 2023).

Having exited the EU through the Brexit process, Northern Ireland presents significant complications in its position within the recently established I-SEM. Specifically, the Republic of Ireland is under the standard supervision of the European Commission due to its membership in the EU. However, the Commission's involvement in Northern Ireland is limited due to the UK's departure from the EU. Additionally, the Republic of Citizens in the Republic of Ireland can influence EU energy regulations through their elected representatives. In contrast, Northern Irish citizens cannot, as they are no longer part of the EU. This discrepancy highlights a significant democratic deficit in Northern Ireland regarding energy governance (Muinzer et al., 2022b).

For these reasons and due to the geographical connection between the Republic of Ireland, an EU member-state, and Northern Ireland, part of the UK, specific concerns arose that required clarification

across various areas, including the energy sector. Consequently, the "Protocol on Ireland/Northern Ireland" was established and signed to address these issues. As per this protocol, Article 9 outlines measures to ensure the continuous operation of the I-SEM post-UK withdrawal. According to it, various EU legislation currently applies in Northern Ireland, as outlined in Annex 4 to the Protocol (UK and EU, 2020). Annex 4 enumerates four EU Directives and three EU Regulations that apply to the UK concerning Northern Ireland, specifically in electricity generation, transmission, distribution, supply, wholesale electricity trading, and cross-border electricity exchange.

In addition, there is an ongoing EU objective to integrate the island of Ireland's market into the EU's Target Model, which originated from the EU's Third Energy Package. The EU target model, envisioned as a solution to structural issues within the IEM and aligned with the EU's climate change objectives, operates on a "flow-based method" that calculates electricity capacity and directs energy most efficiently to where it is needed. The goal is to interconnect all electricity markets among member countries in a single grid through market coupling. Additionally, regional wholesale markets are established on a zonal basis, considering variations in electricity generation and allocation across European countries, leading to zonal pricing that reflects these differences.

### **3.3. Challenges and consequences of the UK leaving the Internal Energy Market (IEM)**

#### **3.3.1. The Non-Tariff Measures on the energy sector post-Brexit**

The UK is an external entity in the international energy trade, as transactions are no longer facilitated through EU single market mechanisms, and NTM has been implemented. As mentioned, the TCA established a unique system for connecting energy markets, meaning that the UK conducts its auctions before Europe, and electricity flows must be assigned explicitly. This measure falls under the category of "Distribution Restrictions". For example, UK traders must buy capacity on the French interconnector in a separate auction to import electricity from France. They then hope the market price difference is higher than what they paid for the capacity. As previously explained, "Distribution Restrictions" refer to limitations imposed by the destination country on distribution channels or sales of products. In this instance, the UK faces a limitation imposed by the EU, restricting its access to energy with the most favourable prices due to the lack of integration with the market.

In addition, the EU's Regulation on Energy Market Integrity and Transparency forbids insider trading and energy market manipulation and makes provisions for market monitoring by regulatory authorities. If UK entities, such as utility companies and those trading gas and power, engage in trading activities within the EU, they must register with an EU regulatory authority to ensure uninterrupted cross-border trade and trade within the EU wholesale energy markets (Brexite Industry Insights Energy, 2019). The indicated requirement introduces additional expenses and complications to cross-border trading, reducing its appeal to British business (Pye, 2021). This measure can be categorised as a “technical barrier to trade” since it is an authorisation requirement for UK companies to participate in energy transactions within the EU. According to the UNCTAD, these measures include requirements, authorisations, permits, approvals, or licenses related to a consignment and must be issued from a relevant government agency before the importation can occur to comply with applicable technical regulations or conformity assessment procedures.

In abandoning its membership in the EU, the UK might also isolate itself from various European Research and development funding streams and lose the opportunity to share best practices from innovative grid deployment trials. During 2014-2020 alone, the EU allocated £1.6bn of funding to incentivise the development of smart grid technologies and their integration with energy storage (Hogg et al., 2017). While the UK has chosen to rejoin Horizon Europe (H2020) starting January 2024, it is essential to note that its involvement does not mirror the pre-Brexit era. As a non-EU member, the UK lacks influence in Horizon's governance. Additionally, UK researchers may face restrictions in participating in energy projects with national security implications, as such decisions will be made on a case-by-case basis (Tozer et al., 2023). This can be categorised as an NTM, namely a “subsidy and other forms of support” since the EU funding benefits the EU member-states and thus not the UK, giving the EU a possible advantage in energy trade.

### **3.3.2. The impact on energy prices**

Energy bills are influenced by more than just the amount of gas and electricity used, prices are also affected by factors like the wholesale cost of energy, the expenses of delivering it to homes, and the operational costs of energy suppliers. In addition to the actual energy usage, consumers also pay standing charges imposed by suppliers to cover the costs associated with supplying energy, such as maintaining wires and pipes. Standing charges typically comprise around 16% of household gas and electricity expenses (Shoffman, 2024).

Throughout the past years, the energy market has encountered notable challenges from the usual supply and demand dynamics, compounded by various global events that have exacerbated price increases. The profound impacts of the pandemic, which induced significant disruptions in global supply chains and demand patterns, alongside the ramifications of the conflict in Ukraine, have been instrumental in shaping this landscape. Energy providers consistently grapple with concerns regarding price fluctuations, prompting them to participate actively in futures market trading (D. Roberts & Matson, 2021).

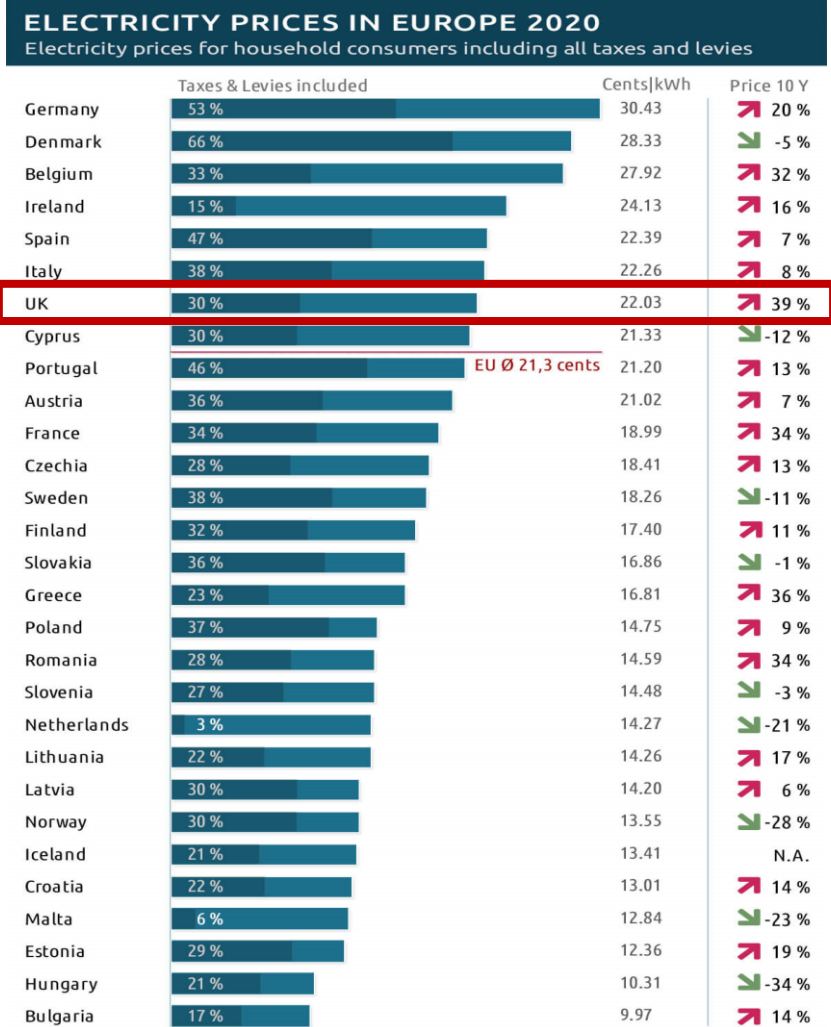


Figure 4 - Electricity prices in Europe in 2020.

Source: STROM-REPORT, 2021

The repercussions of Brexit have been substantial, with the UK energy industry contending that it has led to a significant annual increase in the energy expenses of British households, amounting to hundreds of millions of pounds (Gallardo, 2022). Energy bills in Britain surged by up to £1.1 billion (\$1.4 billion) in



2022 (Werber, 2023). According to data from Eurostat (see figure 4), gathered by Strom-Report, the UK registered one of the highest energy prices in Europe in 2020. It was also the country with the most significant increase in energy prices in the last ten years – 39% (Electricity Prices in Europe - Who Pays the Most?, 2021).

Concerning specifically energy for businesses, despite implementing a price cap for households since 2019, there has never been a price cap on energy for business. Instead, the government has introduced a couple of discount schemes. The first scheme, the Energy Bills Relief Scheme, ran for six months from October 1, 2022. It was then replaced by the Energy Bills Discount Scheme on April 1, 2023, scheduled to operate until March 31, 2024. However, funding for this scheme was drastically reduced, and prices have not exceeded the required threshold since December 18, 2022, before the scheme even began. As a result, despite the decline in wholesale prices, energy costs remain high (L. Roberts, 2024).

As explained before, the UK lost access to the IEM following Brexit. Presently, the prices for interconnector power are determined daily through a fragmented array of arrangements, as outlined in a report by Energy UK published on May 15th, 2023. According to the report, these resulting inefficiencies incurred costs ranging from £130 million to £370 million for the UK in 2022. A significant challenge arises from interconnectors, namely the underwater cables responsible for transmitting electricity to the UK from countries such as Norway and France. Previously, the sale of electricity to the UK via these interconnectors was governed by the EU's IEM, ensuring efficient price calculations across the bloc (Werber, 2023). Past studies have already shown that transitioning to explicit trading arrangements across interconnectors could increase wholesale costs, ranging between 0.25% and 0.70%. Based on various estimates, this shift was projected to incur expenses ranging from £90 million to £250 million up to 2021. However, when applying the same methodology to the year 2022, an analysis conducted by Energy UK anticipates costs to land somewhere between £130 million and £370 million. This variation is attributed to the higher wholesale prices observed during the specified timeframe (Truelove, 2023).

Inefficient cross-border trading arrangements lead to higher average wholesale market prices, particularly in a market with significant interconnector capacity, and this ineffective interconnection increases prices on both sides of the channel. However, given that the UK market is smaller and has been a net importer of electricity, the impact on wholesale prices has been more pronounced.

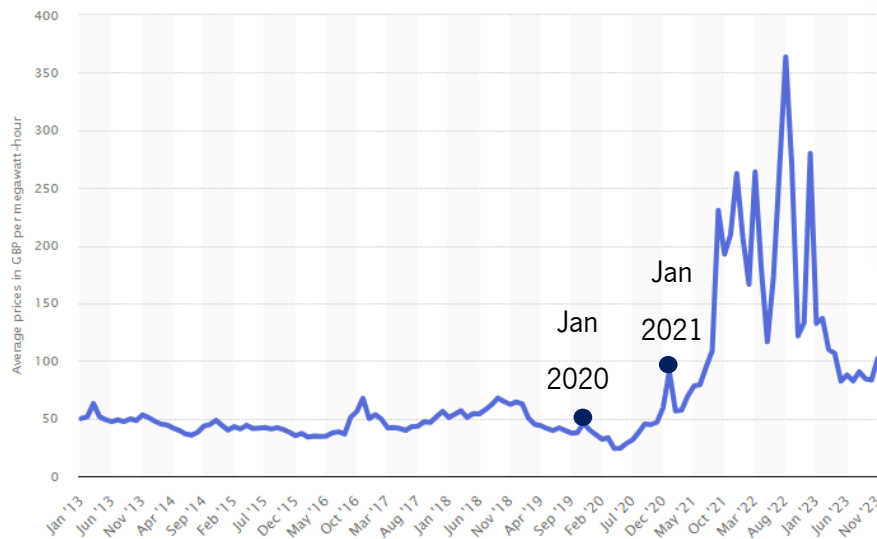


Figure 5 - Average electricity prices per megawatt-hour, in GBP.

Source: Statista 2024

Regarding the average electricity prices (see Figure 5), after a downward trend in the average price, there was a slight increase in January 2020, and then the downward trend continued. This slight increase corresponds to the date of the UK's official exit from the EU, which can be explained by some uncertainty regarding the state of the market and relations between the two parties.

In January 2021, there was a sharper spike in the average energy price. This corresponds to the moment when the transition period ended and the TCA came into force. It can be explained by some generalised insecurity and anticipation. This pic was only the start of a significant instability in Europe's electricity prices. Between 2021 and June 2023, the European countries felt a generalised insecurity in electricity prices due to the economic rebound in 2021, coupled with the tightening of the energy market after the Russian invasion of Ukraine. The UK, heavily dependent on natural gas for its electricity production, experienced among the highest electricity prices globally. Additionally, the price surge was partially attributed to the increasing carbon prices introduced by the UK ETS in May 2021 (Statista Research Department, 2024). After this period of instability in electricity prices, they fell and stabilised but remained above pre-Brexit prices. This decrease can be explained by suppliers' increased confidence that they will be able to supply energy despite all the geopolitical and commercial difficulties.

### **3.3.3. The impact on foreign direct investment (FDI) and public investment**

#### FDI

The energy sector was one of the first industries in which FDI occurred on a large scale globally. Currently, FDI in the energy sector is motivated by two key trends. Firstly, the ongoing shift of the energy sector from traditional hydrocarbon sources to renewable alternatives demands substantial investment in new infrastructure to produce environmentally friendly electricity, hydrogen, or biofuels, as well as for the transportation of these energy sources to consumption areas. Secondly, there is a pressing need to enhance the intelligence and efficiency of existing energy infrastructure through digitalisation, requiring considerable investment. These investments are often reliant on FDI. As a result, there has been a notable surge in FDI in renewable and alternative energy sectors globally, even amidst the challenges posed by the pandemic. However, overall FDI levels have experienced a significant decline (Fleischmann et al., 2022).

In 2020, several EU initiatives aimed at stimulating investment in energy infrastructure served as crucial funding sources for projects in the UK. For instance, between 2010 and 2020, investments in UK energy projects from the European Investment Bank (EIB) amounted to €13.334 billion. The British Ceramic Confederation highlighted the EIB as the primary source of financing for energy infrastructure projects in the UK since the existence of the IEM, pointing to concerns regarding investment in the sector. Centrica further underscored this point, stating that the EIB has disbursed loans totalling more than €37 billion for various energy infrastructure endeavours in the UK since 2000. As per insights shared by Georgina Wright of Chatham House, the EU stood as a considerable source of energy investment, with the UK annually receiving an estimated €2.5 billion in energy loans and grants from the EU until Brexit. Energy UK further expanded on this notion, highlighting the diverse funding channels facilitated by the EU for the energy sector. These avenues encompassed initiatives such as the European Energy Programme for Recovery, Connecting Europe Facility, Horizon 2020, Cohesion Fund, and support from institutions like the EIB and the European Fund for Strategic Investment. Collectively, these avenues would present financing prospects valued at billions of pounds (Authority of the House of Lords, 2019). However, Article 151 of the Withdrawal Agreement clarified that moving forward, the UK and its projects within the country would no longer automatically qualify for financial assistance from the EIB designated for EU member states. While the Political Declaration accompanying the Withdrawal Agreement acknowledged the UK's intent to establish a cooperative relationship with the EIB, it did not directly outline the governance framework for such a relationship in the future. That means that it might be possible that there will be potential for participation in EIB-funded programs summarised in Part 5 of the TCA,

contingent upon the agreement of an additional protocol (*The Impact of Brexit on the Energy Sector*, 2021).

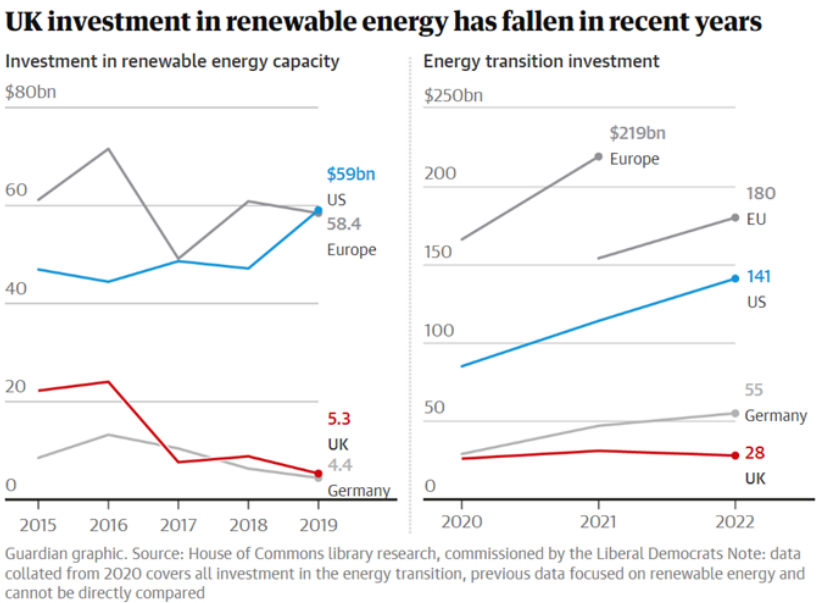


Figure 6 - UK investment in renewable energy and energy transition.

Source: The Guardian

According to the research shared by the House of Commons, up to 2020, UK investment in renewable energy investment peaked at \$24 billion in 2016, only to sharply decline to just \$7.6 billion in 2017. There was a modest recovery in UK renewable spending to \$8.8 billion in 2018, but it fell again to \$5.3 billion in 2019 (see Figure 6, on “Investment in renewable energy capacity”) (Harvey, 2023).

Regarding the energy transition investment (see Figure 6, “Energy Transition Investment”), the UK was also below the EU, Europe, the United States of America and Germany. The EU has consistently increased its investment in energy transition over time, whereas the UK, despite starting earlier, has not shown the same growth. Instead, the UK's investment has remained relatively steady. In 2022, in the aftermath of Russia's invasion of Ukraine, investment in transitioning away from fossil fuels across the EU experienced a notable increase of \$26 billion to reach \$180 billion. However, from 2021 to 2022, the UK suffered a decrease in the energy transition of 10%, from \$31bn to \$28bn, while countries like the United States of America and Germany saw an increase of 24% and 17% respectively (Harvey, 2023). This decline in investment corresponds to the period when the UK officially left the EU and no longer belongs to the IEM, illustrating the impact of Brexit on the UK’s energy sector.

Compared to Germany, which is similar to the UK's GDP, economy, and population, the UK's investment is notably lower. Germany has consistently invested more in energy transition than the UK and has seen slight growth over time.

The dataset used by the House of Commons encompasses all forms of investment associated with transitioning the energy sector, including renewable energy, electric vehicles, electrified heating technologies like heat pumps, hydrogen infrastructure, energy storage solutions, and carbon capture and storage initiatives. Previous data collected by the House of Commons Library up to 2020 primarily focused on renewable energy investments, rendering direct comparisons with earlier years difficult. Nonetheless, it also indicates a significant decline in the UK's investment in renewable energy after Brexit (Harvey, 2023).

Public Investment

The UK has emerged as a global leader in attracting FDI in the renewable energy sector since 2007 (see Figure 7), excelling in capital expenditure and job creation despite the relatively limited job opportunities (*Overview of Greenfield Foreign Direct Investment (FDI)*, 2023). Moreover, it is essential to note that the UK stood out from the rest of the world from 2019 onwards. This may be a result of the British government's need to invest more in the domestic energy market in response to the challenges the energy market is facing, such as the war in Ukraine, which resulted in a considerable drop in electricity prices, and due to the decrease in FDI in the energy sector after Brexit.

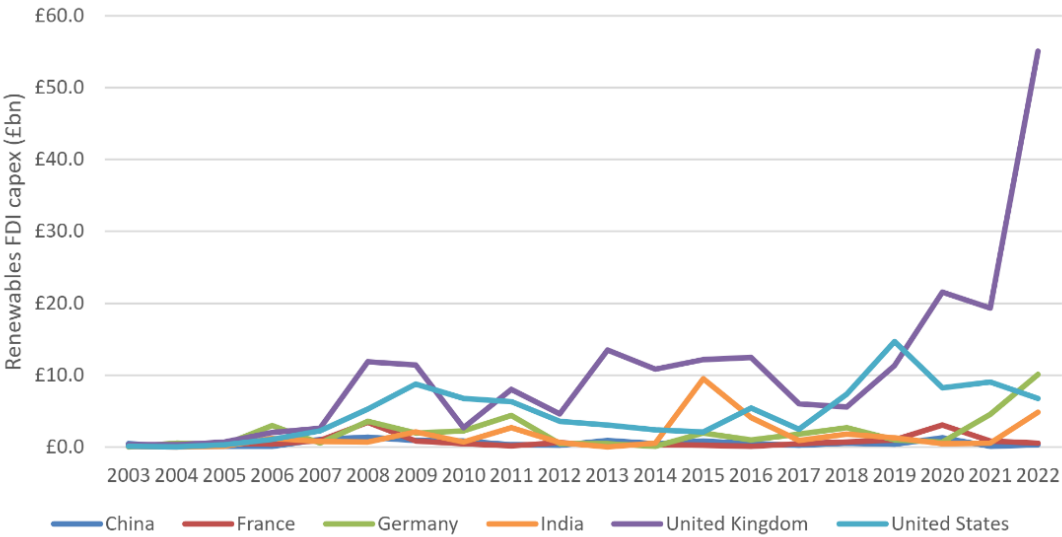


Figure 7 - Renewables FDI capital expenditure, selected countries, in £ billions.

Source: The Guardian

With increasing demand for renewable energy sources and intensifying international competition within supply chains, the government ensures that the UK maintains favourable conditions for additional investment and expansion. Thanks to the UK's prominent position in clean technologies worldwide, exemplified by initiatives like the flagship Contracts for Difference scheme and the recent allocation of £20 billion towards carbon capture, usage, and storage development, the country has garnered £200 billion in investments since 2010. It is anticipated that an additional £100 billion will be attracted by 2030, contributing to the creation of up to 480,000 skilled jobs nationwide (Department for Energy Security and Net Zero, 2023).

Regarding public investment, significant initiatives aimed at expediting connections and swiftly enhancing capacity on the electricity grid have been unveiled, complemented by a £960 million investment in eco-friendly industries. This investment serves to fortify UK energy security while fostering enduring cost savings for households and businesses. Moreover, the government has pledged £960 million to the Green Industries Growth Accelerator, which aims to expedite the advancement of manufacturing capabilities in pivotal net zero sectors. These sectors include offshore wind, networks, carbon capture, usage and storage, hydrogen, and nuclear technologies (Department for Energy Security and Net Zero, 2023).

#### **3.3.4. Other effects**

The effects of Brexit on energy governance between the UK and the EU have given rise to many challenges and uncertainties. Brexit prompts reflections on the distribution of responsibilities within UK energy system governance, spanning market dynamics, governmental roles, and civil society involvement. Moreover, as pointed out above, it raises concerns about potential disruptions in consumer pricing due to complex and uncertain mechanisms (Muinzer et al., 2022). Other effects of Brexit can be pointed out.

##### Carbon Border Adjustment Mechanism (CBAM)

On October 1<sup>st</sup>, 2023, the EU introduced the CBAM, which is a carbon tariff on products that contain carbon-intensive materials, such as steel, cement, and some electricity imported into the EU. This mechanism imposed significant challenges for cross-border energy trade between the UK and the EU since it risks labelling all UK electricity exports as fossil-fuel sourced, potentially discouraging low-carbon imports and undermining Net Zero efforts. It figures has a complex issue also to Northern Ireland as under the “Northern Ireland Protocol's Single Energy Market Annex”, any EU CBAM would need to extend

to Northern Ireland and GB, requiring detailed discussions between the UK and EU to ensure Protocol compliance. Furthermore, price differences between the UK Emissions Trading System (ETS) and the EU ETS could make it challenging for UK companies to compete in the EU market (Delivorias, 2023).

#### Cross-sector differentiated impacts

Access to the IEM emerges as a critical concern, with investors scrutinising the broader implications of Brexit on the energy landscape. However, it is essential to acknowledge that different sectors within the energy industry will experience varying degrees of impact. For instance, in the upstream oil and gas sector, which operates globally and is driven by oil prices, Brexit may have limited direct effects, particularly if EU safety and environmental regulations are incorporated into UK law through the 'Great Repeal' Bill. The Great Repeal Bill has three main aims: to repeal the European Communities Act of 1972, thus ending EU law supremacy and the jurisdiction of the Court of Justice of the EU; to convert all existing EU laws into UK law to maintain continuity post-Brexit; and to grant the government powers to rectify laws that may no longer function properly after this conversion of EU laws. Similarly, the effects of regulated networks managed by entities like OFGEM may be marginal. In contrast, the power generation sector could face more substantial impacts, given the significant role of EU regulations in shaping its operations. EU targets, such as the 2020 Renewables Targets, have significantly influenced the UK's renewable energy growth in recent years, raising uncertainties about the sector's trajectory post-Brexit.

#### Human resources

Human resources are another dimension that has suffered consequences, especially in the nuclear energy sector. The UK has considerable dependence on EU workers in this area since the EU/EEA employees comprise 1-5% of the energy industry's workforce. Companies such as EDF Energy clarified that without access to EU labour, it would be challenging to complete the construction of the new nuclear power facility at Hinkley Point (Authority of the House of Lords, 2019).

## Conclusion

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This study sheds light on the impact of Brexit on trade flows and the UK energy sector. By evaluating the consequences experienced by the UK and the EU in terms of trade flows and the challenges facing the UK energy sector, the analysis provided an in-depth examination of the complex and multifaceted implications of Brexit on economic relations between the EU and the UK, focusing on trade dynamics and the energy sector, two critical economic domains. Through an analysis spanning the period from 2016 to 2023, we have explored the challenges and transformations that have unfolded in the wake of the Brexit referendum and identified valuable insights into the tangible effects of Brexit.

Although the TCA avoided most of the tariff measures that could emerge due to Brexit, it has been unable to do the same with NTMs. Many NTMs emerged that impacted the trade flows between the UK and the EU, such as bureaucracy, extra registrations, and the need to relocate companies. Many companies felt lost with the new regulations and had extra costs trying to meet these new regulations.

Regarding the energy sector, energy prices were impacted, the NTMs in this sector surfaced, and public investment and FDI were impacted. The UK's departure from the IEM has introduced uncertainty, resulting in reduced investment and higher capital costs. Various stakeholders, including industry, higher education institutions, and the public sector, acknowledge that the primary obstacle to future investment and innovation in the energy sector arises from the inconsistent energy policy framework and the lack of uniformity in regulations, subsidies, taxes, pricing policies, among others. Consequently, there has been a decline in FDI and a subsequent rise in public investment to compensate for the decrease in FDI. Moreover, the repercussions of the UK's withdrawal from the EU extend beyond its boundaries, potentially influencing neighbouring EU member states and the electricity market across the entire EU. It is essential to recognise that these impacts on energy prices, FDI, and public investment in the energy sector may have been partially influenced by other events, such as the COVID-19 pandemic and the war in Ukraine. This implies that while there has been an increase in energy prices, public investment in the energy sector and a decline in FDI within the sector, pinpointing the exact impact of Brexit on these aspects is challenging.

From a temporal standpoint, it is projected that Brexit's repercussions will vary over time, resulting in immediate economic and financial changes and also requiring enduring structural changes whose impact may only become apparent in the distant future. As the passage of time post-Brexit occurs and the design



of formal and informal ties with the EU, the Single Market and the IEM will evolve, these impacts may either be more robust or, instead, they may be absorbed by the UK economy.

Brexit is a process that is still unfolding, requiring constant analysis of its impact on the UK but also on the EU. One critical future analysis would be to assess how the NTMs can be overcome to ease trade flows between both parties. Also, in the energy sector, it would be essential to analyse how the UK could become more integrated into the IEM without being part of the EU, drawing lessons from countries like Norway or Switzerland, which have achieved significant integration into the IEM without EU membership, can provide valuable insights. In both policy areas, moves of closer ties with the EU still keep the UK outside the economic bloc and impede it from reaping the full benefits that only a member state can, and that was arguably the primary reason behind the UK's interest in entering the EU.

By addressing these challenges and opportunities, future research can contribute to a deeper understanding of the implications of Brexit on trade flows and the energy sector and drive inform policy decisions to foster closer economic ties between the UK and the EU.

Discussing the various challenges Brexit requires acknowledging that it is an evolving process with multiple complex aspects. The nature of the EU-UK relationship, marked by continuous updates and new agreements, makes certain gathered information quickly become obsolete. Furthermore, the absence of comprehensive data regarding the impact on energy prices and foreign direct investment highlights the ongoing developmental phase of Brexit studies. Recognising that reaching a thorough comprehension of Brexit's implications requires both temporal distance and ongoing research efforts is crucial. Only through a combination of hindsight and continued analysis can we hope to grasp the lasting effects of this historic event fully.

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