

CHAPTER II

PRIVATE SECTORS AND ENERGY LANDSCAPE

IN THE UNITED KINGDOM

In order to achieve energy security and fulfill its principles of availability, affordability, accessibility, and acceptability. A country should not neglect the role of private sectors as the executors in the current higher standards of social, economic, and environmental requirements.

2.1 Meet the Executors: Private Sectors

The discussion of energy security and its relations with sustainable or renewable energy can be continued as long as it is viable, but to make this into reality, there is a strong need to take into account the role of its executors which are private sectors. The private sector is the key to achieving long-term energy security, their role is crucial for the advancement or for the transformation towards renewable and sustainable energy.

The World Economic Forum (WEF) mentions the crucial role of the Private Sector in this type of movement called the “*energy transition*”, the private sector can lead the global energy transition which will help for the advancement of sustainable and renewable energy for the current and future use. In 2018, the Brookings Institution demonstrated the role of the private sector especially the private capital investments in funding sustainable infrastructure, many notable

names of the largest energy companies in the whole wide world are working closely with researchers to innovate the tools to support the energy transition (World Economic Forum, 2020). The Asian Development Bank (ADB) showed the same result in line with the statement made by the World Economic Forum, by examining private investment in renewable energy, the results showed that Feed-in-tariffs (FITs) have a great impact in driving private investment in renewable energy (Azhgaliyeva, D. et.al, 2021). Numerous private sectors have identified the renewable energy sector as a better cost-effective option to decarbonize their operation (Adib, 2019).

In this kind of situation where fossil fuels are depleting faster and the world demands something more sustainable to be relied upon, the private sectors notably the energy sectors can take the leading role in the process called the “*energy transition*”. Echoing what has been mentioned by the President Director of INEOS Aromatics Indonesia Mr. Fahrurrozi Zaini:

“Of course, there will be a lot of things that private sectors can do to make sure that they can drive the energy transition from fossil fuels to renewable, and this is of course economic motives... Every company can transfer their energy requirements, by doing this, they can transfer themselves from fossil fuels dependent to renewable...and then when they can...that can also help the government to release their burden and make the stability of energy supply more stable”

The private sector's leading role is actually because of its role as an executor in the energy industry, they can take the leading role to start or begin the process of energy transfer and the advancement of renewable or sustainable energy to achieve energy security. If companies aim to transfer their energy requirements and efforts towards producing, using, and later distributing energy based on renewable fuels, it also helps the government to ease their burden. This crucial role is important to ease the government's role or effort to secure energy, companies release the government burden by creating an active energy transfer that aligns with the government initiative.

From both global and domestic market perspectives, using and producing more renewable energy through private sectors or companies will help stabilize the energy supply to meet the ongoing energy demand. When many companies have transferred their specialties towards producing and using renewable energy, the supply of energy becomes more stable since the supply is abundant. Within 10-15 years, this can be a very good potential alternative to fossil fuels or to diversify the energy industry. In addition, the potential job creation through private sector is also influential for the economic aspect of a country (Sucofindo, 2024)

2.1.1 Petrochemical, Oil and Gas Private Sectors

There are three notable names among companies in the petrochemical, oil, and gas private sectors. those names are INEOS, Royal Shell, and British Petroleum. Other than these prominent names, many companies are taking part in these, including but not limited to British Gas, Tullow Oil, EnQuest, Centrica, and many others. However, those three

names INEOS, Royal Shell, and British Petroleum have been really important both domestically and beyond the borders of the United Kingdom. they are well-known for their service of selling fossil fuel commodities and transforming them into refined petroleum chemicals or refined oil & gas products that can be easily used by the public masses.

2.1.2 Mining

In the mining industry, there are several notable company names owned by the British, notable names are Eurasia Mining, Greatland Gold, Petropavlovsk, Hochschild Mining, Kaz Minerals, Antofagasta, Glencore, Anglo-American, Rio Tinto, and last but not least the BHP Group as the largest mining firm which produces coal, petroleum, natural gas, nickel, iron ore, and uranium. By controlling these resources, three names rose which are Glencore, BHP, and Rio Tinto become the world biggest mining company (NS Energy, 2021). However, many of what has been mentioned above have been seen conducting their mining operations in overseas territory notably in the Russian Federation.

2.1.3 Electricity

In recent years 60% of energy United Kingdom imported energy supply from other countries including but not limited to Qatar, Sweden, Netherlands, Norway, and OPEC Countries. However, there are several executors whose role is to fulfill the electricity demand, for instance, British Gas, E. ON, Npower, Scottish Power, Scottish and Southern Energy, and EDF Energy. There are also several companies which also supply a smaller

amount of energy which are Bulb Energy, Ovo Energy, Pure Planet, Tonik, Cooperative Energy, Green Star Energy, Tonik, and Utilita Energy (Ben Gallizzi, 2023; Buswell, G., 2024)

2.2 Meet INEOS

2.2.1 History of INEOS Company

INEOS Group is a global company that comprises 36 businesses with over 190 sites in 29 countries around the world, they also introduce its products of petrochemicals, oil and gas, polymers, Businesses, and Markets. However, INEOS formed its companies by acquiring a British Petroleum site in 1998 which started as a petrochemical company. The business has been growing by acquiring manufacturers and sites inside the United Kingdom, among the Commonwealth countries, and across the globe. Its significant acquisitions are Dow Chemical's Global Ethanolamine in US & Canada in 2003, BASF's United States acquisition, Chevron Phillips Cumene plant in Port Arthur both in 2005, Joint Venture between Nova Styrenics and INEOS in 2007, Joint Venture to form INEOS BIO first advance *waste-to-fuel* refinery in 2011, Grangemouth plant acquisition in 2014, and recently just launched a New Clean Hydrogen Business to comply with the NET Zero Carbon Emissions (INEOS, 2024).

Although this company is the face of the might of the British Energy Private sector towards the domestic and international community, the company is owned by the wealthiest individual in the United Kingdom Sir Jim Ratcliffe who invested 1 billion GBP or the equivalent of 1.33 Billion

USD for its United Kingdom energy assets, However, the company has never freed from critiques over company's decision on several matters. In 2010, INEOS moved its headquarters from the UK to Switzerland, but it moved to the United Kingdom in 2016. They have been accused of greenwashing by using sport as their media to create new brands, as of now the company owns multiple sports clubs such as Manchester United, the New Zealand rugby team, and the 8th-time World Champion Mercedes AMG F1 team. This greenwashing accusation has been protested by several media, especially over their fracking expansion which poses' serious impacts on water supplies and public health risks (Corlett, 2021; Armstrong, 2023)

2.2.2 Business Operations

INEOS fundamentally is a global chemical company which has 36 businesses across 29 countries, however mainly the business comprises in three different industries which are Chemicals, Energy, and Consumer Brands

2.2.2.1 Chemical Business Operations

INEOS has several branches of business in chemical industry as follows:

- INEOS styrolution: a leading global producer for styrenics, polystyrene, ABS standard, and styrenic specialties.

- INEOS Inovyn: which become the manufacture choice in producing chlorovinyls.
- INEOS Hydrogen: Provides alternative fuels in the form of hydrogen.
- INEOS Acetyls: Manufacture and produce acetic acid.
- INEOS Aromatics: Global producer in Purified Terephthalic Acid and Paraxylene technology

2.2.2.2 Energy Business

INEOS group has a diverse portfolio in many form of both conventional and non-conventional energy as follows:

- INEOS Energy, produces and trade Liquified Natural Gas, Carbon Credits, Oil and Gas, CCS, Hydrogen and Low Carbon Energi
- Energy Trading & Shipping, business which provides feedstocks, energi and finansial risk management.
- INEOS Shale UK, shale gas sector which has shale exploration areas across the United Kingdom.
- INEOS FPS, manages and runs the Forties Pipeline System (FPS) to transport liquid oil and gas.
- Petroineos, Bilateral joint venture between PetroChina and INEOS in a comprehensive range of energy product.

2.2.2.3 Consumer Brands

- INEOS Grenadier, a newly made car brand based in the United Kingdom which serves the market with 4x4 transports
- INEOS Hygieneics, provide solutions for household and personal care to eradicate viruses and to elevate hygiene for the public masses.
- Belstaff, a clothing with a British heritage, serves the luxury market and spread the culture of the British.

2.2.3 Sustainability

Although several parts of INEOS are still making business on conventional or fossil energy, however INEOS group has a strong stance and intention in advancing renewable and sustainable energy, and achieving net-zero by 2050. In 2023, INEOS Group Holdings has been considered at level '3' in ESG entity rating by Sustainable Fitch-London, the main key drivers are sustainability-related investments for future generations which aim to create better and lower emissions in manufacturing processes (Sustainable Fitch London, 2023). In addition to that, INEOS has made several significant investments for the betterment of the United Kingdom's energy landscape, included in its 6 billion EUR investment plans are advancement of technology to drive the new hydrogen economy inside the United Kingdom and throughout the European Continent (INEOS, 2023)

Statement made by the Chairman and the CEO of INEOS Group Jim Ratcliffe:

“I am fully committed to INEOS playing a key role in that (renewables & sustainable energy) transition.”

Recently they have announced a plan to increase investment in Blue Hydrogen technology and Carbon Capture Technology, quoting from the statement of Jim Ratcliffe:

“We have announced ambitious plan ...to drive development of a new hydrogen economy. In addition to investment in blue hydrogen allied to carbon capture technology at our major site at Grangemouth in Scotland, ... announced series of green hydrogen plants throughout Europe”

There are key notable events and improvements that shows a strong intention to move towards renewable and sustainable energy. According to the INEOS sustainability report 2023, several measures made by INEOS are

- a. INEOS fully supports the UK Government for Acorn Carbon Capture and Storage Project;
- b. INEOS Inovyn’s Antwerp hydrogen production has been given certificate of PLUS scheme under the ISSC (International Sustainability & Carbon Certification)
 - i. INEOS become the Europe’s largest operator of industrial electrolysis to produce renewable hydrogen.
 - ii. Produces 400.000 tonnes of hydrogen a year;

- iii. Utilise hydrogen to produce derivatives as a feedstock including methanol and ammonia, this will be the future alternative fuels;
- iv. Robust 6 Billion EUR plan in advancing the new hydrogen economy inside the United Kingdom and across the Europe.
- v. Joint Venture to form INEOS BIO first advance *waste-to-fuel* refinery in 2011 followed by Grangemouth plant acquisition in 2014

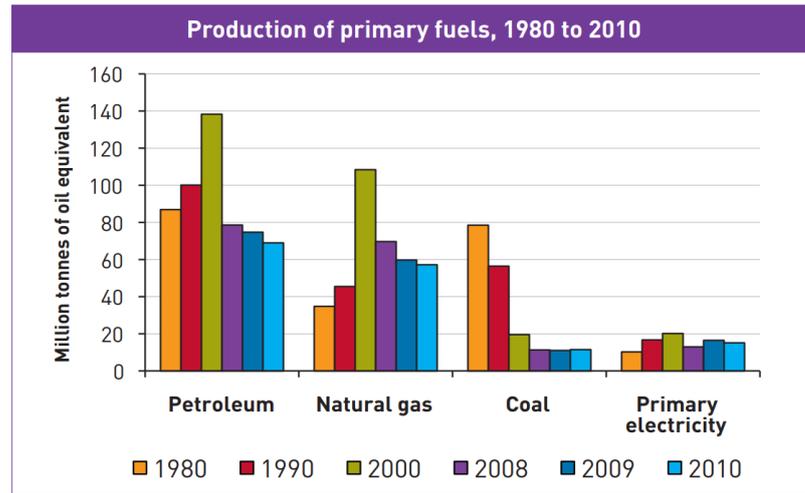
(INEOS, 2023; INEOS Group, 2023)

2.3 The energy landscape pre-Brexit

2.3.1 Availability

The nature of the United Kingdom's energy landscape before Brexit can be best traced from as early as 2000 to be compared to the UK energy landscape nowadays, the United Kingdom is a modern global north country that was self-sufficient in energy, peak season can be seen within the 2004 era (Durham University, 2016). Since 2005, there has been potential growth in the electricity sector in the same era employment has also declined slower than usual (UK gov, 2011). Since 2004, the energy landscape of the UK is continuously growing which led to the growing spur of investment in the energy sectors, specifically in the electricity sector, and oil and gas sectors a few years afterward. In the case of a natural gas, peak performance in

producing this substance can be best described and shown in the record all-time high in the year 2000.



Graph 2.1 Production of Primary Fuels 1980-2010 pre-Brexit

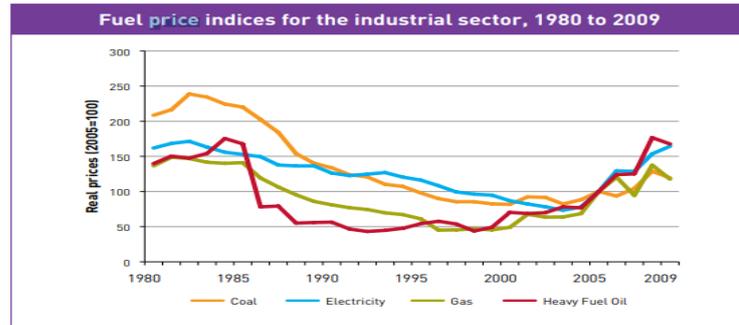
Source: His Majesty's Government the United Kingdom Government

	Million tonnes of oil equivalent					
	1980	1990	2000	2008	2009	2010
Petroleum	86.9	100.1	138.3	78.6	74.7	69.0
Natural gas	34.8	45.5	108.4	69.7	59.7	57.2
Coal	78.5	56.4	19.6	11.3	11.0	11.5
Primary electricity	10.2	16.7	20.2	13.0	16.5	15.1
Renewables	0.0	0.7	2.3	4.5	5.0	5.3
Total	210.5	219.4	288.7	177.0	167.0	158.1

Table 2.1 Primary Energies Availability in Production

Source: His Majesty's Government the United Kingdom Government

2.3.2 Affordability



	Real prices, 2005 = 100					
	1980	1990	2000	2007 ⁽¹⁾	2008 ⁽¹⁾	2009 ⁽¹⁾
Coal	208.4	133.7	81.6	104.3	128.7	119.4
Electricity	161.8	126.2	86.9	128.6	153.5	164.3
Gas	136.5	81.1	48.9	94.4	137.5	117.6
Heavy fuel oil	139.7	56.4	70.3	125.1	176.6	167.6
Industrial prices	152.4	108.0	76.2	121.7	155.1	155.5

(1) Includes the Climate Change Levy that came into effect in April 2001.

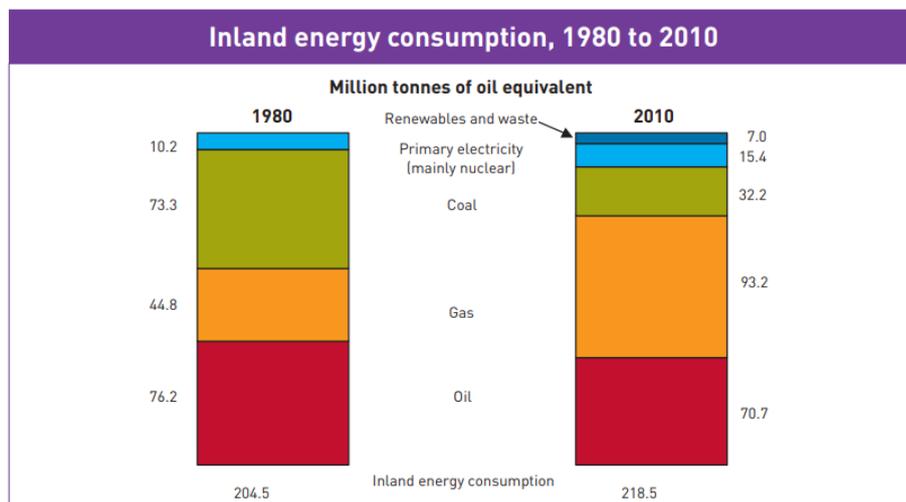
Graph 2.2 Fossil Fuel Price 1980 to 2009 Trends

(UK Government, 2010)

Within the course of 2000 to 2010, there were some dynamics in the prices of Fossil Fuels due to the nature of fossil fuels which are more volatile than sustainable and renewable energy. This dynamic was caused by many external factors, one notable external factor was the 2008 market crash which at that time influenced the sharp and unprecedented surge of oil prices. Over a decade, fossil fuel prices were affecting the United Kingdom heavily, average prices of electricity increased to 45 % following the increase of heating oil to 108% and oil to 104% from normal price (UK Government, 2010).

2.3.3 Accessibility

Since 2004, there has been a steadily growing investment in the energy industries inside the United Kingdom in total amount invested energy industry is 14% in gas, 40% in oil and gas extraction, 44% substantial growth for electricity investments, and 2% in coke and coal extraction, nuclear fuels and refined petroleum (UK GOV, 2011). There is also a steady growth of accessibility in line with purchasing power, it is clearly shown from the Inland Energy Consumption graphic presented by HM Government (His Majesty's Government) that from 1980 to 2010 there are huge growth in the purchasing of Natural and any other form of Gas, substantial growth on dependency towards gas from 44.8 million tonnes in 1980 to 93.2 million tonnes in 2010 pre-Brexit.



Graph 2.3 The Inland Energy Consumption, 1980 to 2010 pre-Brexit

Source: His Majesty's Government the United Kingdom Government

2.3.4 Acceptability

	Million tonnes of oil equivalent					
	1980	1990	2000	2008	2009	2010
Conversion losses:			53.8	52.8	50.1	50.0
Distribution losses and energy industry use:	(62.1)	66.4)	20.7	18.7	17.9	18.3
Final consumption:						
Industry	48.3	38.7	35.5	30.9	26.6	27.5
Domestic	39.8	40.8	46.9	45.5	43.0	48.5
Transport	35.5	48.6	55.5	58.5	56.1	55.7
Services ¹	18.7	19.2	21.5	19.2	17.7	18.4
Total final energy consumption:	142.4	147.3	159.4	154.0	143.4	150.1
Total inland primary energy consumption²	204.5	213.7	233.9	225.6	211.5	218.5
Temperature corrected total inland consumption	206.2	221.6	239.6	226.7	213.0	212.3

(1) Includes agriculture
(2) Excludes non-energy use

Table 2.2 of Acceptability of the available energy to the masses/industries

Source: His Majesty's Government the United Kingdom Government

Table 2.1 shows that there is still a gradual increase in the acceptability aspects from the masses and the industries towards the available energy that the United Kingdom could serve. Total consumption of energy had increased over time, especially in terms of transport and other services, at least the gradual increase had taken into account of 5-10 Million tonnes increase in energy consumption (UK GOV, 2011)

2.4 The Energy Conditions Landscape After Brexit

2.4.1 Availability

From the availability point of view which we need to take into account a security of supply perspective, Brexit indeed bringing a

significant infamous impact on the British energy supply, several actions and measures have been taken by His Majesty's Government the Government of the United Kingdom to ensure there are enough energy for the whole country through external cooperation that needs to be made with the rest of European countries. Although the United Kingdom has formally left the European Union, some exceptions of trading capabilities still allow the United Kingdom to cooperate with the European Union through the European Union (EU) – the United Kingdom (UK) Trade and Cooperation Agreement (TCA). This Trade and Cooperation Agreement (TCA) brings or allows cooperation to be made by both parties in a certain timeframe to exchange gas and electricity network development plans, development of energy infrastructure, and interoperability of energy infrastructure across borders (Norton Rose Fulbright, 2021).

There is a huge decline in the United Kingdom's internal production on producing liquefied natural gas (LNG) which is very important to the society inside the United Kingdom. In response to that, as a form of anticipation the United Kingdom government has made three large import terminals for producing a very large amount of Liquefied Natural Gas (LNG) two of them are located in Milford Haven in Wales and the other is at Grain in the region of Kent (UK Energy Research Centre, 2022). It is shown that 40% of the United Kingdom's energy is coming from the inside or domestic production which sadly fell by 17 percent in the recent years of 2021.

Imports are one of the ways for His Majesty's Government of the United Kingdom to acquire energy to fulfill domestic needs, accounted for 39% of the total supply from pipeline imports from Norway out of 64% percent imports, Liquefied Natural Gas is also accounted for 17% of supply and 28% Gas imports, and imports via the interconnectors accounted only remaining only 4% of supply and 8% of imports. For now, the Middle East is the biggest friend of import of His Majesty's Government accounted for the biggest supplier to import Liquefied Natural Gas (LNG) to the United Kingdom which is Qatar. In recent years, in response towards the European Union's attitude towards the United Kingdom, several other countries have also accounted for significant imports such as the United States of America and the Russian Federation which accounted for 5.8% of total gas imports and 3.6% of total supply (UK Energy Research Centre, 2022).

2.4.2 Affordability

It is indeed the era of the United Kingdom's energy downturn. back then, European countries benchmarked their prices towards the United Kingdom's National Balancing Point (NBP) as the virtual trading point to be trusted for setting gas prices, but since many reasons affected the relations, that role in setting up or benchmarking the prices now held or played by the Dutch Title Transfer Facility (TTF). Therefore, there are price wars that need to be faced by the United Kingdom traders which led to traders offering a price that is quite higher than the ones set by the Dutch Title Transfer Facility (TTF) (UK Energy Research Centre, 2022). Due to

the United Kingdom's measures to ensure that the natural gas capacity and consumption in the United Kingdom is sufficient, imports have made very significant progress in achieving those missions, but the United Kingdom also needs to face the price competition on the global Liquefied Natural Gas spot market. This role is currently affected by many global problems especially the changing nature of European wars in the Ukraine.

The energy price cap has been increased substantially since the middle of 2021 which will hurt the finances of consumers and the government which needs to spend on energy security bills. Within the year 2021 to 2022, the increase in electricity prices has soared high to the level of 769 GBP with a 36% increase compared to the year 2010. The energy price cap increased by 12 % in October 2021 and later added an increase of 54% in April 2022, the ultimate peak of the energy price cap surge is 80% in October 2022. On average for direct debit customers, the consumer has experienced a 700 GBP increase across a year with the following peak of October cap to 1.600 GBP. According to the Office of Gas and Electricity Markets (OFGEM) just recently in 2024, Ofgem has made a statement of its plan to change the energy price effective from 1 October to 31 December 2024, which the plan will affect electricity and gas bills for Direct Debit Consumer / Typical Household increase up to 149 GBP per year or around 12 GBP per month, however, compared to last year the new cap is 6% cheaper. Electricity rates of its newer plan will affect the average price to 24.50 pence per kilowatt hour (kWh) with a daily charge of 60.99 pence per

day, gas rates will be on average 6.24 pence per kilowatt hour (Balton & Stewart, 2024; OFGEM, 2024).

2.4.3 Accessibility

Brexit has carried significant damages to loss in acquiring and managing the energy market, as a result of the United Kingdom formally leaving the European Union, the membership of the United Kingdom in the internal energy market (IEM) cannot be extended after the period 31 December 2020 at 11.00 PM GMT +1 the United Kingdom Time (Norton Rose Fulbright, 2021). As a result of it, the transmission, generation, distribution, trading, and supply of electricity and energy across borders is highly affected.

Although it is affected severely by the British Exit from the European Union, in addition to the EU-UK Trade and Cooperation Agreement (TCA), several other measures such as ENER 16 regulate and allow the United Kingdom and the European Union to cooperate on the security of supply of natural gas, electricity, and other related influential information regarding the risk related to energy and how to mitigate if an emergency happens in the near future. In addition to that, several other plans such as ENER 18 and ENER 17 that help both parties to recognize and acknowledge the integrity of electricity networks and national gas could affect both parties by experiencing disruption in cross-border supply, by acknowledging these, the EU principles of Regulation on risk preparedness

could be deployed fully and thoroughly if applicable (Norton Rose Fulbright, 2021).

This Brexit also impacted interconnectors which always remained physically connected from the European Union to the United Kingdom, interconnectors are always important to distribute energy and to reduce costs for imports to be made cheaper and way more flexible. Due to the British Exit, the United Kingdom has lost access to implicit day-ahead and intraday market coupling arrangements on GB electric interconnectors which in most cases can no longer enjoy electrical energy together.

The consumer has been affected the most from accessing adequate energy due to the price increase, however, the government has taken multiple measures to help by announcing the Energy Price Guarantee which to some extent limits the price cap in the year after its announcement 2021 to present. However, according to the Office of Gas and Energy Market (OFGEM), the ones who are covered by the energy price cap for electricity and gas need to meet the following criteria (OFGEM, 2024):

- Direct Debit;
- Prepayment Meter;
- Economy 7 Meter;
- Standard Credit (payment will be made when the object of energy has been delivered).

2.4.4 Acceptability

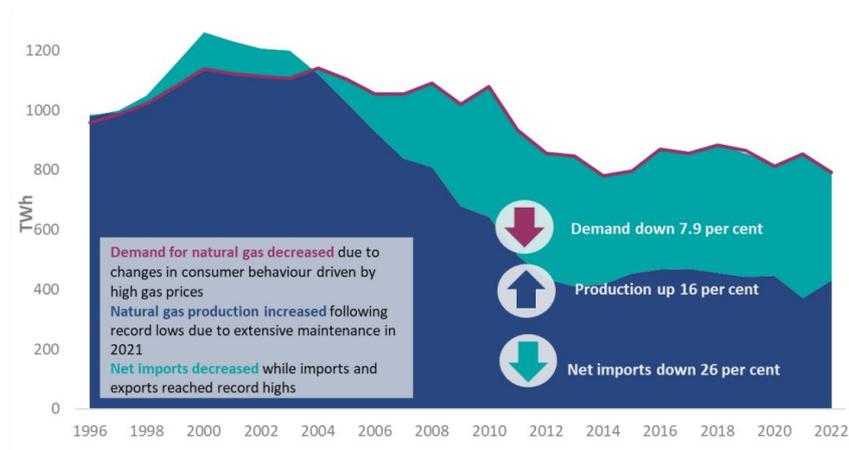


Chart 2.4 Supply and Demand for Natural Gas in the United Kingdom

Source: His Majesty's Government, the Government of the United Kingdom

The industry inside the United Kingdom with or without its consent needs to adapt to the increase in prices of natural gas, therefore the United Kingdom needs to have imports to fulfill the needs sufficiently. In 2022, many disruptions to global gas supply and shifts in the United Kingdom's vital trading partners caused a significant increase in Imports of LNG up to 74% in the same period. The imports are now taken into account by the United States of America as a trading partner and exporter of natural gas to the United Kingdom, it shows 22% of UK LNG imports are from the United States, making its record higher than from Qatar (Heaton, 2023).

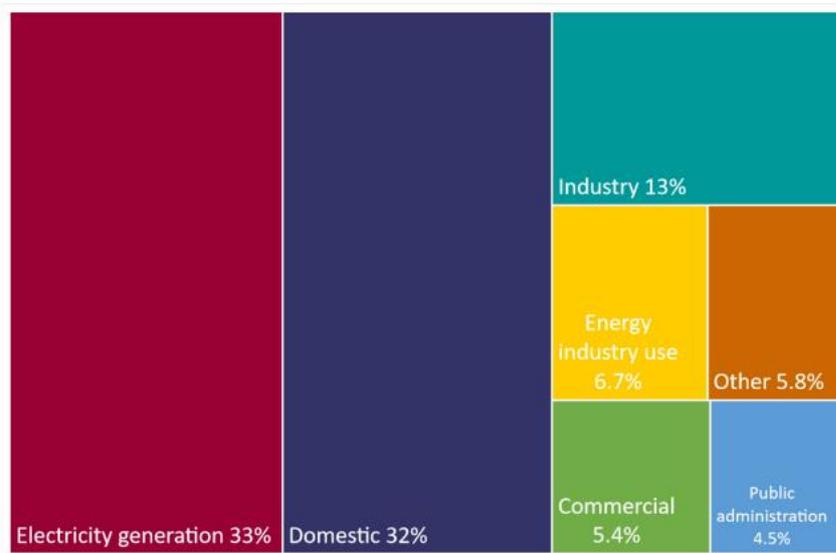


Chart 2.5 Natural Gas consumption in the UK home industry

Source: Energy Security Government of the United Kingdom

2.5 The Nature of Non-Renewable vs Renewable Energy

2.5.1 Non-Renewable Energy Landscape

Nonrenewable energy at its core is mainly energy derived from fossil fuels or mineral fuels. For more than 150 years, the world economy has relied upon such substances, especially carbon-rich fossil fuels from the remains of animals and plants. This source of energy is abundant on earth, but there are some concerning facts and data that show these sources will be depleted sooner than later, not to mention also the fact that it is violating the stability of the environment itself. (Environmental and Energy Study Institute, 2021).

As for the emission standpoint, a substance that has been called Methane remained all-time high near record high last year 2023 which

alarmed several countries, afterwards, there were several summits, efforts, policies, and regulations coming from nations around the world, and notably from the COP28 climate summit in Dubai that have tried to put the emission number into gradual decline (International Energy Agency, 2024). For us to grasp a better understanding of the sources of non-renewable energy and their environmental impact, there is a need to take a closer look at each non-renewable energy source:

- a. Coal: A particular type of widely used non-renewable energy that to harvest the energy from this brownish or rather black rock, must be burned to create energy. This type of non-renewable energy is valued on how much *carbonization* it has undergone. Several type of coal from the lowest rank is Peat which has the least amount of carbonization, this particular type is often relevant and easily can be mined in the United Kingdom territory, especially in the Northern part of the United Kingdom which is Scotland. The highest rank of coal is called Anthracite which has the biggest carbonization value, this type of non-renewable energy can easily be mined in the part of the earth that has a lot of mountain formations, especially in the eastern part of the United States. Obtaining such non-renewable energy requires a very sophisticated process of mining that is divided into two which are surface mining and underground mining. The earlier is used when the coal can be easily located on the surface but it still requires the demolition of the entire habitat of wildlife in

the process of mining. The latter is used when the coal is located deep inside the surface of the earth which can be as deep as 300 meters, it requires a very sophisticated dangerous working machine and gears since the earth gas can also be found. The gas can cause a very big explosion that might destroy any vegetation or even humans (National Geographic Society, 2024).

The trend of the United Kingdom's dependency on Coal as the largest carbon maker among fossil fuels has been decreasing over time. The production trends of Coal have decreased over time from 56.4 Million Tonnes in 1990, 19.6 Million Tonnes in 2000, 11.4 Million tonnes in 2010, 1.2 Million Tonnes in 2020, 0.7 million tonnes in 2021, and ultimately low all-time level of 0.5 in 2022. Final energy consumption has been decreasing over time with the lowest point in 2023 of a total only of 1.6 Million Tonnes from all industries combined (Department for Energy Security & Net Zero, 2023)

- b. Natural Gas is the most widely accepted and also the highest polluting gas on the surface of the earth. This gas mostly consisted of Methane Gas that can be found several hundred meters underground. In order to reach and mine the natural gas, some organizations notably private sectors use the process called *fracking* and/or *hydraulic fracturing* that utilizes HO₂ or water to split apart

the rock underground (National Geographic, 2024; Santander Universidades, 2023).

As for the production in the United Kingdom, Natural gas has been having a slight decrease over time, this also shows that the United Kingdom has been heavily relied upon Natural Gas. The production trends however increased from 45.5 Million Tonnes in 1990 to 108.4 Million tonnes in 2000 as an All-time high, followed by a very slight decrease in 2010 at 55.3 Million Tonnes, 2020 at 37.8 Million tonnes, 2021 at 31.3 Million Tonnes, and 2022 in 36.4 Million Tonnes. The trend shows that there has been only a slight decrease within 10 years from 2010 to 2022 which is roughly only about 5-6 Million Tonnes decrease over the span of 10 years. Final Energy consumption inside the United Kingdom is also still quite high and slightly over its capability of making such substances with over 38.1 Million Tonnes of Gas consumption in 2022 (Department of Energy Security & Net Zero, 2023).

- c. Crude Oil or Liquid Petroleum, this non-renewable energy is extracted from sedimentary rock, inside the sedimentary rock cemented inside there are organic plant and fossil matter that has been accumulated for millions of years. This matters if distilled can be beneficial to become different energy products such as Jet Fuel A1, diesel fuel, heating oil, and gasoline for cars. To mine this crude oil, it can be found hiding under big rocks notably *shale* in which

lies very rich organic materials, organisations that extract these notably private sectors/private own company or state own company use sophisticated drilling mechanisms in which wells are drilled and become oil reservoirs (Santander Universidades, 2023)

As for the United Kingdom, the primary oil production trends have been increasing from 1990 to 2000 and decreasing slightly from 2010 to 2022. Primary oil production in 1990 was 100.1 Million Tonnes increasing to 138.3 Million Tonnes in 2000 and decreasing in 2010 at level 69.0 Million Tonnes. However, since 2010, there has only been a slight decrease from 55.3 Million to 37.8 Million Tonnes in 2020, 44.7 Million Tonnes in 2021, and 41.3 Million Tonnes in 2022. The final energy consumption in 2022 has surpassed its nation's capability to produce oil with the total oil consumption at the level of 56.2 Million Tonnes in 2022 (Department of Energy Security & Net Zero, 2023).

Table 2
Comparison: OPEC and total world, 2018–2019

	OPEC 2018	Total world 2018	OPEC 2019	Total world 2019
Real GDP growth rate (%)	-0.7	3.5	-1.0	2.9
Petroleum export value (\$ bn)	711.2	1,861.8	610.8	1,650.7
Value of non-petroleum exports (\$ bn)	384.6	17,115.2	349.6	16,867.3
Oil exports (as percentage of total exports %)	64.9	9.8	63.6	8.9
Value of imports (\$ bn)	687.6	19,165.9	682.4	18,719.0
Current account balance (\$ bn)	199.5	364.2	88.1	290.5
Crude oil production (mbbl/d)	31.34	75.91	29.33	75.19
Reserves, excluding gold (\$ bn)	915.9	11,796.6	919.9	12,195.9

*2019 data are preliminary estimates.

Note
Figures are partly estimated.

Sources
IMF, EIU, World Bank Development Indicators and OPEC.

Table 2.3 Comparison of OPEC and Total World, 2018-2019

(OPEC, 2019)

- d. Nuclear Fuels, this is particularly dangerous and not exactly applicable to the global south country. Several concerns around nuclear usage are the relative costs of nuclear energy compared to other low-carbon technologies and the flexibility of resources compared to wind or solar. Currently, there are 444 nuclear power reactors which have been providing 394 gigawatts or 10% of world energy (Keppler, 2024)

All of those written above are still more commonly and widely accepted than sustainable sources, there are several problems here that lies. that facilities around the world have been producing and accepting non-renewable energies, the transitions could be something as a pain in the head for state private companies and private sectors to engage with it (Santander Universidad, 2023)

2.6 The Renewable and Sustainable Energy Landscape

Terms of renewable energy nowadays are widely overused, but to set a certain clarity regarding renewable energy, the United Nations defined renewable energy as energy that is obtained or acquired from natural resources that are replenished at a higher rate than they are consumed (United Nations, n.d).

Renewables that are considered nowadays include but are not limited to:

- a. Solar Energy, the energy that comes from solar or sun can be obtained in two ways both passively or actively. The most acceptable method of capturing solar energy are through solar photovoltaic (PV), Solar air heating and cooling, and concentrating solar power (CSP). Since 2006, the solar industry has been growing steadily with 10.000% installation. Another type

of solar technology is passive solar technology which is accepted widely in the form of greenhouses that help plant growth (Prescott, 2021). From an advantageous point of view, solar panels still have a lifespan of roughly 30 years depending on which type and shape the materials are used in the solar energy. However, the drawbacks of using or merely relying on solar power are that it is quite hard to predict when and where the sun can be blocked by clouds and the amount of sunlight received in any location is different depends according to the location and time of the year (National Geographic, 2024).

As for the United Kingdom, the cumulative installed capacity inside Great Britain has been increasing over time for Photovoltaics, the trend shows over the span of 10 years increased 6 times. In 2010 at 77 MW, 2012 at 1,943 MW, 2014 at 2,975 MW, at 2016 at 4,792 MW. However, the increase somewhat reached its peak in 2016 and only increased slightly from 2016 to 2022. In 2020 at 5,684 MW, in 2021 at 5,897 MW, and in 2022 at 6,424 MW (Department of Energy Security & Net Zero, 2023).

- b. Wind Energy, uses the horizontal movement of air which caused by the rotation of the earth and unequal heating of the earth's surface. The common physics of this is wind is flowing from high pressure location to the low pressure, this help to understand the correct placement of wind energy turbines (WindWise Education, 2011). For instance, the topography of turbine energy sites located in the Gabal El-Zayt of Egypt around 350 km from Cairo in the direction of Hurghada, wind blows at an average 10.5

metres per second, faster than the neighbouring city of Zaafarana which located right on the shores of the Red Sea which accounted for 8.5 metres per second wind speed (Chams, 2018)

As for the United Kingdom, Wind power has not yet been installed quite as much as the Photovoltaics, the trends only showed 21 MW in 2010 and increase to 166 MW in 2012 MW. However, there has been quite a surge in installation which in 2014 increased to 447 MW and 2016 in 701 and in 2020 at 776 MW. Within 2020 to 2022, there has no increased in wind power (Department of Energy Security & Net Zero, 2023).

- c. Geothermal energy: This type of renewable energy has the advantage to use and uncover the potential of capturing energy from the heat or Calor that earth core generated overtime. Inside the earth's core lies the potential heat or Calor heat with the estimated temperature of 10,800F or 6000 C. Geothermal resources can be categorized as follows (Waitzman, 2023):
 - i. Shallow Geothermal Systems (GSHP): uses heat pump or GSHP system with has the function to capture temperature from geothermal resource, this technology is very appropriate for modifying temperature of residential and commercial buildings.
 - ii. Deep Geothermal Systems: this system utilize resources with deeper location where the heat is more intense, the heat then can be transfer to generate energy.
 - iii. Mine Water Geothermal Systems: this system utilizes an abandoned mine to be flooded with water for heating and cooling purposes

This type of energy applies to the United Kingdom and the rest of the European countries which have four seasons which include fall and winter, to heat the surface of the earth could potentially use this type of energy. Another way to use geothermal energy is with steam which installed pipes that capture the natural steam of the earth to power generators and electricity. To capture the energy, several reservoirs have been discovered with adequate heat called hydrothermal reservoirs. However, according to the British Parliament, the challenge of using this type of energy is the limitation of the suitable location to access this type of energy source, David MacKay has stated that only several areas can produce enough Calor to support electricity generation (Waitzman, 2023)

- d. Hydroelectric Energy, the name represents the source of this energy pretty well, this renewable energy uses and converts flowing water into kinetic energy with the help of power plants located on large dams to control the flow of a river. This type of energy can generate an exceptional amount of electricity without any time interference, it can be produced constantly 24 hours a day, this type of energy is suitable for the United Kingdom on account of its wet climate and advantageous geographical location which has an extensive amount of fast running water, river, and tidal areas (Burdett-Gardiner & Richardson, 2024). There is plenty of opportunity for the United Kingdom to use Hydro power, however in the past decade this is still underestimated despite its potential significance, the trends show 12 MW in 2010 and increased to 40 MW in 2012 and 2014 at 77 MW.

However, there has been quite a surge in installation in which 2016 increased to 183 MW and 2020 in 236 MW. From 2020 to 2022, there was no increase in hydropower. However, from the Energy Act 2023, this type of energy especially in regards to clean hydrogen has been put at the forefront of energy security strategy nationwide (Department of Energy Security & Net Zero, 2023)

- e. Biomass Energy, is renewable energy that can be depleted over time if the human as the beneficiary can no longer maintain its sustainability and ecosystem. In simple terms, Biomass is any material that comes from microorganisms that have the ability to perform the photosynthesis mechanism when they were alive, this includes the biodegradable fractions of crops, wastes, and other biological residues (Department for Energy Security & Net Zero, 2023). As for the United Kingdom, Micro CHP had no trends up until 2020 only accounted for 1 MW, and for Anaerobic Digestion only accounted 1 MW in 2010 increased to 2 MW in 2012 & 2014, increased to 3 MW in 2016, and constantly 6 MW from 2020 to 2022 (Department for Energy Security & Net Zero, 2023). However, in the new UK government biomass strategy, the priority of this type of energy is to build bioenergy with carbon capture and storage. According to the United Kingdom's Climate Change Minister Graham Stuart:

“Future potential is extraordinary: it is a renewable source that can be used across all three energy sectors (transport; heat; and electricity) as well as non-energy sectors” (Lempriere, 2023)

In conclusion, one should recognize the broader energy landscape of the United Kingdom in which several important British energy private sectors including but not limited to oil and gas, mining, and electricity private companies. However, some companies are notably superior in terms of their valuations, impact, and production capacity, this company leads not only the United Kingdom but also the world in fulfilling their energy both with fossil fuels and/or renewables. INEOS Group has become one of the most influential companies which comprises 36 businesses in 190 countries. Recently the company made a significant 1 billion GBP investment in the United Kingdom's energy assets which help the United Kingdom maintain its energy availability, accessibility, affordability, and acceptability for the public masses.

However, the energy landscape in the United Kingdom is not something that can be proud of. With multiple events occurring notably Brexit which led to the downfall of British energy, the United Kingdom government suffered a significant difficulty in maintaining its positions as the regulator and as the provider of energy to the masses especially when the BREXIT deal was backfiring for them. The 4A's of availability, accessibility, affordability, and acceptability show that the state of energy security becomes more worrying after Brexit. This is due to the consequence of Brexit which led the United Kingdom to restrain itself from accessing the energy

sources and market that was shared with the European Union before Brexit. In simple terms, they can no longer access energy sources and deals which was part of their privilege as the European Union member. This has been leading to the decline of availability, accessibility, and affordability of energy which hindered the ability of His Majesty's government to provide adequate energy.

On a deeper level, the problems are also more than merely Brexit-related. The higher social, economic, and environmental standards that the United Kingdom has ratified are part of the consequences of fossil fuels' impact on humanity. The energy that has been accepted widely is categorized as fossil energy which includes but is not limited to oil & gas, natural gas, coal, and nuclear fuels. However, those types of energy have been depleting over time in a very horrifyingly fast condition. Therefore, to achieve the true state of energy security, the United Kingdom should also rely on the private sector to advance more than mere fossil fuels. Some notable energy sources are categorized as unconventional, sustainable, and renewable, but sooner than later they will become our main sources of energy. Those are solar energy, wind energy, geothermal, hydroelectric, and biomass energy.