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The influence of the European Union, as an economic bloc, on non-governmental energy companies within the bloc.

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Abstract

Since its inception, the European Union (EU) has sought to utilise the collective power and influence of its Member States to improve the lives of both its own citizens and others worldwide. The emerging climate crisis presents a global threat unlike any before. With its combined strength, the EU is uniquely positioned. By formulating policies aimed at reducing reliance on fossil fuels and promoting renewable energy, the EU aims to become a leader in the fight against the impending climate disaster.

However, the EU themselves are largely limited in what they, as an institution can achieve. It is through the drafting and implementation of policies which directly affect the energy consumption habits of its population and more importantly, the companies conducting business within its borders, that the EU can affect large-scale change.

This dissertation examines how companies operating within the EU are affected by its legislation and regulations. Through the use of statistical analysis, it aims to quantify how companies' energy usage is influenced by the political and economic union in which they operate.

Keywords

The EU Energy market; Energy security; National Champions; Renewable energy; EU Climate policies.

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List of Abbreviations, Terms and Definitions

Abbrev.	Term	Definition
	Member States	Member States of the EU (see table 1, page viii).
	Third countries	Countries which are not Member States.
	The ‘National Champions’	Companies which are technically non-governmental but receive either explicit or implicit governmental support in order to but receive either maintain a dominant position in a national economy.
	Vertical Company (in the energy market)	A company in the energy market with operations in the production, transmission and distribution of energy/ or at least two of these functions.
ACER	The ‘Agency for the Cooperation of Energy Regulators’	An Agency of the European Union whose function is to assist national regulatory authorities in performing their regulatory function at European level and, where necessary, coordinates their work.
BE	Belgium	Member State
C&CF	Coal and consumable fuel	Type of company
CO2	Carbon dioxide	Chemical element
COVID-19	(SARS-CoV-2)	An infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
CZ	Czech Republic	Member State
DE	Germany	Member State
DK	Denmark	Member State
DSO	Distribution System Operators	Type of system of operation
DU	Multi-utilities	Type of company

E&P	Oil & gas exploration and production	Type of company
EEC	European Economic Community	EU precursor community
EMEA	Europa, the Middle East and Africa	Geographic location
ES	Spain	Member State
EU	The European Union (the 'EU')	The 27 Member States of the European Union, not including the United Kingdom. However, data sets in which the United Kingdom was included will be referenced in this dissertation.
EU	Electric utilities	Type of company
FI	Finland	Member State
FR	France	Member State
GDP	Gross Domestic Product	Standard measure of the value created through the production of goods and services in a country during a certain period
GHG	Greenhouse Gas	Gas that absorbs and emits radiant energy within the thermal infrared range and can lead to environmental damage.
Gov	Governmental	
GR	Greece	Member State
GU	Gas utilities	Type of company
HU	Hungary	Member State
IOG	Integrated oil & gas	Type of company
IPP	Independent power producers and energy traders	Type of company
IT	Italy	Member State
LNG	Liquefied Natural Gas	
M&A	Mergers and Acquisitions	

Mix	Governmental partake	A mix of governmental non-governmental ownership.
NEGP	Northern Europe Gas Pipeline	Transport route for gas and oil that connects Vyborg-Russia to Greifswald-Germany
NL	Netherlands	Member State
Non-gov	Non-governmental companies	A private company, in which a national government is not a majority shareholder. However, a non-governmental company can still be at least partly owned by a national government, as long as the government owns only a minority of its shares.
PO	Poland	Member State
PT	Portugal	Member State
R&M	Oil & gas refining marketing	Type of company
RES	Renewable Energy Sources	Energy from a source that is not depleted when used, such as wind or solar power.
S&T	Oil & gas storage and transportation	Type of company
SE	Sweden	Member State
TSO	Transmission System Operators	Type of system of transmission of gas or/and oil
UK	The United Kingdom (the 'UK')	A sovereign country comprising England, Scotland, Wales, Northern Ireland and a number of territories and dependencies.
UN	United Nations	A formal organisation comprising 193 Member States whose goal is to promote international peace and cooperation.
WW II	Second World War	World War of 1939-1945

Table 1 - EU States Members (Europa, 2020) - Table altered

Member States	Year of Entry	Member States	Year of Entry	Member States	Year of Entry
Belgium	01/01/1958	Austria	01/01/1995	Latvia	01/05/2004
France	01/01/1958	Finland	01/01/1995	Lithuania	01/05/2004
Germany	01/01/1958	Sweden	01/01/1995	Malta	01/05/2004
Italy	01/01/1958	Portugal	01/01/1986	Poland	01/05/2004
Luxembourg	01/01/1958	Spain	01/01/1986	Slovakia	01/05/2004
Netherlands	01/01/1958	Cyprus	01/05/2004	Slovenia	01/05/2004
Denmark	01/01/1973	Czechia	01/05/2004	Bulgaria	01/01/2007
Ireland	01/01/1973	Estonia	01/05/2004	Romania	01/01/2007
Greece	01/01/1981	Hungary	01/05/2004	Croatia	01/01/2013
United Kingdom (England, Scotland, Wales, and North Ireland) – Entry on 01/01/1973 and withdrawal of the bloc on 31/01/2020					

Table Colour Indication:

- First formation
- First integration members
- Second integration members
- Third integration members
- Fourth integration members
- Fifth integration members
- Sixth integration members
- Seventh integration members

The influence of the European Union, as an economic bloc, on non-governmental energy companies within the bloc.

1 Introduction

The European Union (the 'EU') has its origins based in the energy market. After the Second World War ('WW II'), six countries in Europe came together to create a mutual aid base between themselves to develop the coal and steel market at the time, and aid in the recovery of their economies in the post-war era (Pinder and Usherwood, 2007).

Since the founding of the bloc in 1951, the energy sector has been a particularly important and sensitive issue for the EU. Since its founding, the EU energy market has been influenced in a number of ways by geo-political events. Examples of these influences include the scarcity of energy resources in the 1970s, the total dependence on imports of energy sources to the EU from third countries (Rocco, 2015); and climate change derived from greenhouse gases ('GHG') emitted by sources of energy considered to be 'unclean'.

The energy market in recent years has proven to be attractive for companies that develop energy supply, as a result of the changes that the sector has been experiencing. Due to climate change and the limited amount of fossil resources for energy generation on the planet, a segment of this energy market has undergone major transformation and aims to expand widely. This segment of the energy market is the development of renewable energy sources ('RES'). The EU's energy policies will greatly influence the capabilities of these companies to develop the required energy resources. In recent years, the EU's energy policy has been increasingly focused on low-carbon energy (European Commission, 2012), and as a result, this will form a key issue to be examined in this dissertation.

Many countries, due to their geographical position, already benefit from the use of low-carbon energy sources. Examples include the United States,

Canada, Brazil, China, Paraguay, Venezuela and Bolivia. Much of this low-carbon energy is as a result of renewable energy from hydroelectric plants and photovoltaic power generation. However, it should be noted that some of them are also among the world's largest producers and consumers of energy derived from fossil sources (Reis, 2018). Unfortunately, the EU does not have most of these natural resources in abundance, nor is it geographically constituted to benefit from these highly developed technologies. On the other hand, the developments in RES through wind and photovoltaic energy is very promising for some regions of the European continent (Jones, 2016).

These new RES have the capacity to change the European energy market, which essentially relies on the consumption of gas, oil, and coal. About 75% of all energy consumed within the bloc is generated through combustion, which in turn, generates GHG (Eurostat 1, 2020).

The possibility of expansion in a market automatically generates the potential for economic growth, thereby theoretically increasing the number of companies that seek to enter this market. This should result in increasing competition, which directly benefits the quality of life of the residents in the regions impacted by this development, by broadening their choice of supplier. Despite this, the energy market has unique features that other markets lack. Energy means power and security, that is, the energy market is a national security market. Therefore, governmental energy policies have a direct impact on national security. This is particularly important in an economic bloc, such as the EU, and therefore will be examined in detail.

Historically, the energy market has always been controlled by governments or state-owned companies and its market structure is that of a monopoly (Eikeland, 2004), that is, a lack of competition between companies within this market. These characteristics of the energy market already demonstrate rigidity in the market, and because of this structure, changes, even in diversification in the sector, become difficult to realise.

For there to be an opening of this market, it is necessary to use political agreements that make this process feasible. That is, the governments would have to decrease the exercising of their power to the detriment of non-

governmental companies, especially if these companies are not from the same country. Accordingly, if any country is hesitant to cede control over its energy sources to non-governmental companies, it is likely that they will be even further hesitant to do so to a foreign company. How can this then be managed in an economic bloc, operating under the premise of a fair and open market for all of its Member States? This is the question that the EU must answer.

This study aims to analyse how EU policies can influence non-governmental companies in the energy sector; to increase competition and boost the economy in this area in a free and fair way, through the Directives and Regulations formulated by the EU.

To make this study possible, it is necessary to understand how the EU works. How does this bloc influence the governments of the Member States that comprise it? What powers are allocated to the bloc in relation to governments acting unilaterally and governments acting in unison? How does this affect the current energy market?

Through the use of the qualitative and quantitative methodologies, the dissertation aims to quantify how the EU's energy objectives and policies influence the business practices of energy companies operating within the bloc. A critical analysis of some of the pertinent literature and data, such as studies by M. Papiez and A.B. Rocco and data from Eurostat will also be conducted.

As a part of answering the title question, a number of sub-questions will also need to be addressed, including:

- Why did the EU formulate these policies?
- How does it seek to enforce them?
- Which companies are the largest energy providers within the EU? and
- How effective has the EU been in achieving its objectives?

The results of this study will be based on a quantitative and qualitative analysis of the relevant data, such as gross domestic product (‘GDP’) between 2008 and 2019, percentage of dependence on energy imports from the EU and shareholder structure of European energy companies.

In the following chapters, various issues related to this area of study will be addressed, starting with the Literature Review, where an overview of the EU, its history and its economy will be provided. Also examined will be the characteristics of the energy market, the current energy market in the EU, the most powerful companies operating in that market and the competitiveness within the market. Further substantive issues to be assessed include: Forms of energy that are developed within the EU, Russia's importance in the EU energy market, and the EU's approach to climate change. This will be followed by details of the Methodology used in the study, the resulting Data, the Findings and Discussion, and finally, a Conclusion of the dissertation.

2 Literature Review

2.1 European Union (EU) – The Economic Bloc

The EU is an economic bloc, which has the role of standardising measures to promote the economic and societal development of the bloc. To do this, it is necessary to understand how the EU regulates the energy sector, and what policies and tools it has at its disposal to integrate the Member States, in order to develop growth and maintain the stability of the energy market.

2.1.1 Economic Blocs

The creation of economic blocs is a practice among governments that aims to create equal standards and guidelines among countries that are part of that same economic bloc. They are a collection of different countries with a common interest in economic and social growth (Bezerra, 2020). Several reasons make it appealing to form political pacts between countries. These reasons may be due to the strengthening of national security, because of shared political ideologies or the promotion of economic growth in the countries involved in the political agreement.

Economic blocs can be classified into five different divisions. These are:

- Free Trade Area;
- Customs Union;
- Common Market;
- Economic and Monetary Union; and
- Preferential Trade Area (Mundo Vestibular, 2020).

In all types of economic blocs, the objective is to reduce or eliminate tariffs or taxes between member countries in import and export operations. This creates the desired conditions to grow and to energise the economies, thus minimising or eliminating economic barriers between members (Matias, 2020).

Currently, the EU is considered to be a Common Market economic bloc. This means that it is characterised by the reduction or elimination of trade tariffs between the countries belonging to the bloc; as well as the regulation of trade with other nations outside the bloc, through a common external tariff and the free movement of capital, services and people within the bloc. The EU is in the process of changing the classification of the bloc, from 'Common Market' to 'Economic and Monetary Union', which aims to adopt the same development policy and the same currency for all Member States (Matias, 2020). This process will aim to eliminate exchange rate variations and make the market fairer for all Member States.

2.1.2 EU History

The EU is considered to be the result of a process of more than half a century of development that began with the creation of the European Coal and Steel Community, which started five years after the end of the WW II (Pinder and Usherwood, 2007). This economic bloc was founded in 1951 with six member countries, Belgium, Germany, France, Italy, Luxembourg and the Netherlands, and this group was originally named the European Economic Community (the 'EEC') (Europa, 2020). Thus, it expanded the concept of a common market, beginning to integrate the economies, and creating this system to form a rational and sensible economic interdependence between the EEC Member States (Pinder and Usherwood, 2007).

The EU, in its modern iteration, was formally created on November 1, 1993 (Artis and Nixson, 2007). It is a political and economic agreement derived from other treaties within Europe, such as the Lisbon Treaty, the Treaty of Amsterdam and the Nice Treaty, among others. These treaties have been negotiated for many years between the Member States to ensure that unfair advantages and complications between Member States are minimised, while taking into account the best interests of EU citizens. Under these agreements, Article 3 states that competence for trade policy is an EU competence. EU treaties are of exclusive jurisdiction and only apply within the EU itself (Werquin, 2018).

2.1.3 EU Economy

The EU has constantly sought to become the largest economy in the world. For this reason, the EU has been establishing several objectives and defining guidelines, so that these goals can be monitored and achieved in the future. According to the meeting of the Council of the EU in 2000, held in Lisbon, a strategic objective was established, in which, through a series of structural reforms, indicators related to growth and improvement of employment, innovation and research could be used to create sustainable economic and social cohesion within the economic bloc. The objective was to become the most competitive and dynamic knowledge-based economy in the world in the decade following the meeting (Artis and Nixson, 2007).

However, contrary to the objective stated at the 2000 meeting, a significant drop in productivity has hit Europe's wealthy countries over the past twenty years. Some experts point to this drop in production as a flaw in the method of measuring collected data. On the other hand, most experts in the field point to this event as a real phenomenon, regardless of possible flaws that may have occurred in the measurement method performed for data analysis (Castellani *et al.*, 2018). Despite this disagreement among experts, table 4 (see page 44) shows that the EU's GDP data between 2008 and 2019 has suffered a decline over the years, and that any growth in general has been meagre.

Notwithstanding the methods used to analyse the economic results of the bloc, the EU has shown a fall in its growth in recent decades. The EU’s economic performance has a cause-and-effect relationship with energy companies' decision-making and on their strategies for market development. Energy is linked directly to all markets, as all markets require energy either directly or indirectly to exist. This makes energy indices directly correlated with Member States' GDP.

In the next section, market and security issues will be discussed, the main energy companies, how the EU energy market was structured, and how competitive the market is.

2.2 Energy Market

2.2.1 Energy Market and Security

The main characteristics of the energy market are the issues of security and economic development. But rather than merely having the typical relationship between demand and supply of the market itself, energy sources are a precondition for economic growth and the legitimacy of a nation's power (Rocco, 2015).

Baumann (2008) does an excellent job of explaining that a nation's economic production, political stability, and personal well-being would be hugely impaired if any interruption to a constant flow of energy were to occur, due to total dependence on the provision of energy services from by a third country. He notes well that the destabilisation of the energy supply would damage private homes, the business sector, and the proper functioning of public services. Therefore, all variables related to the energy sector are considered to be a security issue a state of security, that is, energy security. The energy sector can compromise the governance and security of a nation if it is not well structured and established, and the EU must form its policies with this threat in mind.

Energy resources are so important that they have the power to destabilise a nation's economy. Some countries who enjoy a dominant position in obtaining these resources, use them as a tool to promote their geopolitical objectives. An example of this is the case of Russia, who between 2005 and 2007, raised the price of gas for Ukraine, Belarus and Moldova, generating a significant increase in the debts of those countries. The aim of this strategy was to take over their main energy companies and to have control over these countries' gas pipelines and transmission lines, thus gaining more power over them and disrupting their economies (Rocco, 2015).

Another example of concern caused by the power of energy security, according to Luft (2009), was demonstrated during a deposition made on April 5, 2006, before the United States Senate Foreign Relations Committee. The Secretary of State at the time, Condoleezza Rice, referred to the power that

some energy producing countries have over other countries who are dependent on their supply. This dependence goes so far as to create diplomatic distortions in their relations and uses the same power in a way that is not conducive towards good international relations. Rice continued to say that many of these countries would not have this power, if this source of power did not derive from the sources of energy geographically located in their territories, for example in the Middle East.

For many years, issues of energy, politics and power were clearly intertwined as a set that defines the strength of international security (Pascual, 2008). Aiming at the power that energy production capacity gives to supplier countries, the United States and the European Union have repeatedly tried to formulate diplomatic strategies to disrupt and dismantle the Iranian Nuclear Program.

How these energy and security issues affect the EU

It is this type of scenario of dependency that currently concerns the EU, which makes the EU vulnerable to variations in the oil and gas markets in Russia, on which it is most dependent for those resources, in addition to Algeria and Norway. Thus, the EU concludes that the best option to maintain its energy security in the bloc would be the development of technologies in the energy sector, to reduce external energy dependence, together with a diplomatic approach towards its suppliers in this sector (Luft, 2009).

It is because of this conclusion reached by Luft that the market development for new energy companies from within the EU becomes important, and that is why the EU needs to develop protocols that facilitate the growth of this industry internally. It is in the context of having domestic energy security, with a fair market, which makes companies want to invest in that market. An added benefit for the EU in this case, would be that a reduction of energy dependence on third countries will simultaneously result in economic growth via new entrants to the energy market from within the EU.

Currently, problems related to energy security are inextricably linked to environmental damage. This could be either due to the lack of control over the development of nuclear energy with the potential to increase the risk of manufacturing nuclear weapons, or even by nuclear disasters as occurred in Fukushima in Japan in 2017 (BBC, 2017). The worst-case scenario would be the destruction of life on the planet due to the generation of high levels of pollution, causing climate change through the GHG effect, the knock-on effects of which could make life on the planet unfeasible.

Therefore, the EU as an institution alone, is not enough to benefit any type of energy company. It must allocate benefits to companies that generate energy with low carbon emissions. Failure to address this issue will have catastrophic results, and as this is a global issue, governments must work collectively to find solutions that reverse or at least slow, the rates of climate change, due to the previous neglect of world governments on this issue historically (Pascual, 2008).

2.2.2 The EU Energy Market

During what is known as the 'Oil Shock' in the 1970's, the excessive increase in the price of oil put the economic development and well-being of European citizens at risk, since at that time the EU was totally dependent on imported gas and oil (Rocco, 2015). These events caused the European internal energy market to attract the attention of the EU Council in the late 1980s. Accordingly, the Council proposed actions such as removing barriers to trade, the movement of capital between Member States and free competition to improve levels of economic growth and well-being in the European community (Eikeland, 2004).

The Commission found in its 2001 comparative reports that the internal energy market presented several serious problems, due to the non-regulation of the laws previously established for the bloc. There was a lot of asymmetry in the application of the relevant Directives and Regulations between the bloc's Member States. Unfortunately, the results obtained in the 2003 reports,

showed that almost no improvement was made in the performance of the Member States in their adherence to and enforcement of these rules (Eikeland, 2004).

The EU Council's request to open up the energy sector was not initially welcomed by Member States, due to the importance of the energy market in each country. It was observed that national obstacles prevent an integrated market in the EU energy sector. Instances of mergers between energy companies in Europe such as Engie-GDF Suez (France) and Endesa-Enel (Spain), graced the cover page of the Financial Times on numerous occasions, as they created tensions between EU Member States between 2004 and 2006, who feared a consolidation of the monopoly of power in the energy sector (Motta and Ruta, 2007). The perception of energy security in each Member State is different, which is why each country has adopted different strategies according to its own interests, making it difficult to create a coherent energy policy that covers the entire economic bloc (Rocco, 2015). Despite this, the European Commission is achieving positive results, as can be demonstrated in the reduction of the EU's energy dependence on imported energy sources, documented in the 2018 reports (Eurostat 1, 2020).

Years after these measures to be carried out were announced by the European Commission in 2001, the European Statistical Agency made data available from 2018, showing that the EU has a 55% dependence on its energy from third countries, and that energy consumption is divided into 5 different energy sources (Eurostat 1, 2020):

- Petroleum products (including crude oil) - 36 %;
- Natural gas - 21 %;
- Solid fossil fuels - 15 %;
- Renewable energy - 15 %; and
- Nuclear energy -13 %

However, the bloc already has a self-sufficiency of 45% of the total energy supply within the EU produced by the Member States. That 45% is made up of:

- Renewable energy 34.3%;
- Nuclear energy 30.9%;
- Solid fuel 21.6%;
- Natural gas 9.3%; and
- Crude oil 3.9% (Eurostat 1, 2020).

A good example of the bloc's efficiency in the development of increased energy capacity is that, between 2000 and 2010, there was an increase in the number of domestic natural gas supplying countries to the EU, from 14 to 23. This ensured the stability of the gas supply of the bloc during the winter of 2011/2012, without the need to increase imports from third countries (European Commission, 2012).

A downturn in the EU's fortunes

Despite this apparently positive outlook, the EU's energy market has displayed a downward trend in growth over the past decade (Eurostat 2, 2020). Analysing the period between 2008 and 2018, the energy production within the bloc was gradually decreasing, with the exception of 2010, which improved over 2009, the year of the beginning of the global financial crisis when the energy sector experienced an abrupt drop in production. During that period from 2008 to 2018, there was a large reduction in the majority of energy sources produced in the EU, as is shown by the 46.4% drop in natural gas production, -35.3% in crude oil production, 27.9% solid fossil fuel production, and 14.4% of nuclear energy production. The only source of energy that showed growth in production in the same period was the production of renewable energy, which grew by 49.2% (Eurostat 2, 2020).

The dependence on energy imported by the EU is still high, and data from 2018 shows that more than half of the energy needed for consumption by Member States comes from imports. This percentage of dependency has remained almost the same in the last decade. The EU's energy security could be threatened if the bloc's primary energy supply is concentrated in a small number of trading partners, and that is exactly what is happening today. Primary energy imports in 2018 were as follows:

- 70.3% of natural gas imports were of Russian, Norwegian and Algerian origin;
- 74.3% of hard coal imports were of Russian, American and Colombian origin; and
- 45.9% of crude oil imports were of Russian, Iraqi and Arab origin (Eurostat 2, 2020).

These market disparities make it necessary to expand the internal energy production and distribution network, which should encourage the EU to create the means to facilitate the entry and development of energy companies in the region. But what are the problems faced by the economic bloc to encourage growth in this sector? Eikeland (2004) and Rocco (2015) point out problems in the implementation of EU guidelines by Member States for opening the energy market, but they do not offer potentially corrective measures which were or could have been taken by the EU in this regard. Another complicating factor is the power of the large energy companies, known as 'National Champions' in Europe, which try to consolidate a monopoly market according to Motta and Rutta (2007) and Rocco (2015). They argue that through an Oligopoly market, with few companies in the sector, thus decreasing market competition, this shows that the EU's efforts to open the market are not yet sufficient.

2.2.3 EU Energy companies

The energy markets until the 1990s within the EU had exclusive supply in a specific geographic space. They were operated by government-run companies

that were responsible for the entire supply of the sector and control of national transmission lines and pipelines, thus creating thus a monopoly of the energy market (Rocco, 2015).

According to Eikeland (2004), in some EU countries, the privatisation of the energy sector was authorised, but governments continued to keep companies under their control through the use of exclusive rights of exchange and transfer.

To try to break up this monopoly system, the EU focuses its efforts on dividing the energy production chain of generation, production, transmission and distribution. In doing so, they are attempting to reduce the power of state-owned companies in the energy market. These measures focus on reducing the bilateral agreements of the bloc's countries, which weaken the power of the economic bloc as a unit (Eikeland, 2004).

These measures make it possible to break the hegemony of State monopolies, making the market more competitive and easing the entry of new non-governmental companies. This, in turn, brings benefits both in the development of energy-generating technology and reducing the energy dependence on third countries, as well as contributing to economic growth and job creation.

Table 2 - Top 42 EU Energy Company – 2019 (Weber, 2019) – Table altered

Country	Energy Companies
Belgium	Elia System Operator AS
Czech	CEZ a.s.
Denmark	Ørsted A/S
Finland	NESTE Oyj Fortum Oyj
France	Total AS, Electricité de France AS Veolia Environnement AS ENGIE AS
Germany	E.ON SE EnBW Energie Baden - Württemberg AG Uniper SE RWE Aktiengesellschaft
Greece	Hellenic Petroleum AS

Hungary	MOL Hungarian Oil & Gas Co
Italy	Eni S.p.A. Enel SpA Snam S.p.A. Terna SpA A2A S.p.A. Hera S.p.A. Italgas S.p.A. ACEA S.p.A. Iren SpA
Netherlands	Royal Dutch Shell plc
Poland	Polski Koncern Naftowy ORLEN Spólka Akcyjna Polski Górnictwo Naftowe i Gazownictwo AS Grupa LOTOS AS Polska Grupa Energetyczna AS
Portugal	Galp Energia SGPS AS EDP - Energias de Portugal AS
Spain	Iberdrola AS Repsol Red Elétrica Corporación AS Naturgy Energy Group AS Acciona AS Enagás AS
Sweden	Lundin Petroleum AB (publ)
*United Kingdom	BP p.l.c SSE plc National Crid plc Centrica plc

Currently, according to table 6 (see page 48), only 27.58% of the 42 largest energy companies in the EU have some Member State government ownership of their shares. Of these companies, only one company is fully government-owned, Iren in Italy, and in 11 others a government holds a majority of shares. This evidences a major increase in the number of non-governmental companies in the EU energy sector. It also demonstrates that the 1990 scenario outlined by Rocco (2015) of government monopolies no longer exists, and that the majority participation of energy companies by the governments cited by Eikeand (2004), is no longer applicable.

The ‘National Champions’

Among the companies responsible for the energy sector in the EU, there are a handful of companies which some commentators have referred to as ‘National Champions’ (Falck *et al.*, 2011). These companies receive support from their government for political and economic reasons to be the largest companies in the sector in which they operate (Falck *et al.*, 2011). The companies which are classified as 'National Champions' hold considerable power in the market, which may destabilise or frustrate the improvements sought by the EU in the sector. These agreements would have the purpose of facilitating and/or regulating a level playing field among Member States, with the objective of creating fair competition within the market (Rocco, 2015). According to Rocco, examples of these companies include:

- ENGIE (formerly GDF Suez) - France;
- Eni – Italy;
- Eon Hurgas – Germany; and
- Endesa – Spain (a subsidiary of Enel – Italy).

Another ‘National Champion’ is the Russian giant Gazprom, which is not part of the EU, but which is the largest energy exporter to the EU.

The 'National Champions' have a negative impact on the opening of the European energy market. In addition to their dominant market position, they often absorb new entrants to the market through mergers and acquisitions, building a conglomerate or group of companies, which limits the bloc's competitiveness. A good example of an ‘M&A’ deal between two large energy companies was Eon’s acquisition of the renewable energy business Innogy from RWE for €43 billion in 2018 (Massoudi and Buck, 2018). The problems that these ‘National Champions’ present for the opening of the market to new entrants who would minimise the energy dependence of the EU, are well addressed by Motta and Ruta (2007), but disappointingly, they propose no effective measures to control the power that the 'National Campions' have.

2.2.4 Liberalisation of the energy market in the EU

The liberalisation of the energy market in the EU could directly result in the economic growth of the bloc, through free competition between energy companies, thereby causing gains in energy efficiency and well-being indices by presenting more competitive and more equitable prices for consumers within the EU. Such a strategy would also increase industrial competitiveness, which directly influences the economic growth of the bloc through the generation of employment and local development (Eikeland, 2004).

According to Rocco (2015), after the publication of the White Paper in 1985 and the Green Paper in 1988, under the title ‘Internal Energy Market’ the Delors Commission provided a legal basis for the liberalisation of the European energy market. That document references that one of the main obstacles to achieving an integrated energy market within the EU was the existence of monopolies in the supply of gas and electricity. Since then, efforts have been made to create an internal energy market linked to the abolition of monopolies through the restructuring of the energy supply in Europe; which has long-term supply structures in a vertical corporate structure, highlighting the juxtaposition of sovereignty of power by the Member States in opposition to the supranationally of the economic bloc (Eikeland, 2004). That obstacle is being overcome by decreasing the participation of governments in energy companies. Currently, governments represent only 27.58% of companies' participation, on the other hand, this government power has been replaced by the power of 'National Champions', as shown in table 6 (see page 48).

Eikeland (2004) also states that it is essential to separate production, transmission and distribution as much as possible in the energy sector to avoid barriers to market access and anti-competitive practices resulting from cross-subsidisation for those companies. Therefore, the EU are trying to minimise the verticalisation of the energy sector, as the verticality of the sector reduces the number of active market participants and increases the chances of creating monopolies, consequently decreasing competition in the sector and limiting an environment of multilateral economic growth.

The European Commission (2012) emphasises that if the EU fails to make major changes in the energy market, this will place the EU in a critical energy market situation. They will face a scenario of an unreliable and expensive energy system, a decrease in the bloc's wealth and a loss of competitiveness, in addition to creating a series of obstacles to the decarbonisation of the continent. These changes are linked to a modernisation of the energy generation infrastructure, its transmission and distribution, as well as the encouragement of fair competition and empowerment of the consumer to actively exercise their power of choice and rights in this market. The cost of these modernisations is estimated to be one trillion euros (European Commission, 2012).

2.2.5 The Process of liberalisation of the energy market in the EU

Before the 1980s, most public services were administered by national or state monopolies, including energy and gas services, among others (Jones, 2016). In 1988, the energy sector formed part of the agenda of the Delors Commission. At the time, the heavy EU dependency on energy from external sources was already causing concern to the Commission, with energy import costs being 0.5% of the GDP of the entire European community (Rocco, 2015). Due to this concerning energy scenario, the Commission created a legislative package that was divided into three stages of implementation for the release of the European energy market. This package is designed to:

- Provide an implementation term;
- Expanding the competition in retail energy supply;
- Improve access to infrastructure for transport and storage of resources; and
- Increase the sharing of the transport infrastructure for energy generation, production, supply, and electricity generation (Rocco, 2015).

The deadline for the implementation of the third phase of the package was in 2011, which resulted in a disappointment for the committee regarding the

implementation and execution of the pre-defined phases. None of the Member States had advised the Commission that they had completely transposed the legislation (Rocco, 2015). None of the Member States had advised the Commission that they had completely transposed the legislation (Rocco, 2015).

Member States have shown great reluctance to abandon the position of maintaining their monopolies in the gas and energy sector, as this represents a loss of their national power. The Commission, for its part, adopted the use of articles of the Treaty related to competition law, arguing that the practice of monopoly would violate the requirements of the Treaties on the Free Movement of Goods and Establishment that govern the economic bloc, thus putting pressure on Member States to comply with proposed legislation (Jones, 2016).

The proceedings opened against Member States in September 2011, 19 of which were infringement proceedings for non-compliance with Directive 2009/72/EC and 19 cases of non-transposition of Directive 2009/73/EC. This resulted in certain Member States assuming the need to establish new programmes for the implementation of these guidelines, which led to new negotiations on a plan, (Rocco, 2015). The trials led the Commission and the EU Member States to open negotiations, thus establishing a Directive that required a progressive opening of the gas and energy market (Jones, 2016).

On June 26, 2013, the implementation of the second gas and energy guidelines granted the market a complete opening to competition. Covering 25 countries, it gave rise to the largest open gas and energy market in the world. Subsequently, all consumers, regardless of their size, became free to decide who would be their supplier in this sector. This market opening has expanded beyond the EU, and also reached neighbouring countries (Jonas, 2016).

Weaknesses in the Directives and Regulations

Between 2006 and 2007, the Commission identified some deficiencies in the new Directives and in the regulatory framework for the gas and energy sector.

These were presented through an explanatory memorandum, followed by a proposal to remedy the deficiencies identified through a variety of measures. According to Jones (2016), some of these deficiencies were:

- Price regulation (price caps), which makes it difficult for new entrants to join the market;
- Lack of independence between transmission system operators ('TSO') and distribution system operators ('DSO');
- Difficulty accessing the existing distribution networks for new entrants, which prioritises the use of the network by holders of long-term contracts;
- Insufficiently trained regulators;
- Large and vertical companies in comparison have an advantage compared to other companies, due to the supply-chain information available to them, which creates a competitive disadvantage for smaller companies;
- Favouritism shown towards large and vertical companies by the regulators, hindering the opening of the market and competitiveness in the sector; among other problems.

In order to correct the deficiencies presented, the Commission drew up a package, in which four key proposals were included:

I. To separate energy transmission, generation and supply companies more effectively, even if this does not mean separation of ownership in the case of vertical companies;

II. The creation of a new European Agency to coordinate national energy sector regulators, the Agency for the Cooperation of Energy Regulators ('ACER');

III. Creation of new transmission agencies for better integration of the market; and

IV. Creation of a simplified decision-making process, through new ACER codes and rules, developed in conjunction with TSO's (Jones, 2016).

The package of measures was implemented gradually, to provide the Member States with time to fulfil the requirements detailed in the agreement. The deadline for implementation by Member States was March 2011 (Jones, 2016). The EU Commission has also imposed fines on energy companies for failure anti-competitive practices. In 2018, the Commission fined state-owned Bulgarian Energy Holdings €77 million for blocking competitors' access to vital elements of the gas infrastructure between 2010 and 2015 (Reuters, 2019).

2.2.6 EU energy market competition

The energy market differs from other goods and services markets due to the importance and impact that this sector has. This sector directly influences and impacts other sectors of the economy, including public, national, and individual security in the country. Therefore, it is considered a security issue, which is why the issues of energy and security are inextricably linked for opening the market to competition (Rocco, 2015).

In agreement with Rocco regarding the peculiarities of the energy sector, Jones (2016), points out that the energy and gas market is exceptional and has at least three characteristics that make it unique. Firstly, the supply of this product is essential and must be carried out through a continuous, safe, reliable and reasonably priced supply, to guarantee the functionality of other sectors. Secondly, the supply of this sector is carried out through a specific supply infrastructure network. Thirdly, although new infrastructure networks can be built, the construction and operation of this infrastructure naturally lends a competitive advantage to whichever company builds and controls it.

To open this market within an economic bloc such as the EU, according to Jones (2016) it is necessary to follow six basic measures for the integration of new competitors into the existing market. Those six basic measures would be:

- Creating a competitive electricity and gas wholesale market;

- Improving access to new market entrants;
- Unbundling of existing verticalised companies;
- The establishment of an independent energy regulator;
- High public service standards; and
- Effective EU-wide rules on trade-related regulatory issues (Jones, 2016).

The six basic measures mentioned by Jones are exactly the guidelines that the Commission has been implementing over the years in the EU. This can be achieved without compromising the supply of energy and gas, and without generating a negative impact in this sector, which consequently could cause chaos in all of the other markets dependent on it, thus avoiding the damage to the infrastructure and economy of the bloc.

According to Eikeland (2004), since 1988 the EU has sought to implement free and fair competition in the internal energy and gas market. Such regulation would lead Member States to gain in energy efficiency, lower prices and improve competitiveness for energy consumption industries, which means that energy companies must face the same regulatory pressures in the domestic market and have the same rights of access. This would benefit economic growth and increase well-being, as well as the legitimacy of the process. and have the same rights of access. This would benefit economic growth and increase well-being, as well as the legitimacy of the process.

Based on this information, it is possible to confirm that Jones and Eikeland hold similar views on how the energy market should be opened.

Despite this, there is a serious problem in structuring a free and fair market in the EU energy market. A conflict of interest in the energy sector is exposed whenever the issue of opening the energy market to fair competition impacts on the security of supply requirements among Member States at the political level in the EU. To exemplify this discord, the European coal market, because of its importance in ensuring security of supply in the EU, was subsidised by governments for many years. In 2002, when the coal market subsidy contract expired, the Commission could have restructured this market more fairly, with

the aim that this segment of the energy market could have been made more competitive. However, it did not, and they decided that the subsidy to state-owned coal companies would continue to be subsidised. This decision ended up benefiting countries like Germany, Spain and France in comparison to the other Member States of the bloc (Eikeland, 2004). continue to be subsidised. This decision ended up benefiting countries like Germany, Spain and France in comparison to the other Member States of the bloc (Eikeland, 2004).

Although this set of measures is theoretically well structured, it is not yet a reality within the EU. Another example is the participation of Russian companies in the EU energy market. Russia owns a large part of the gas supply market within the bloc, which hinders fair competition. Despite this, due to conflicts in recent years within this market and due to internal impossibilities, Russia has ceased construction of the South Stream pipeline which would supply Russian gas to the countries of southern Europe. This left a gap in the market, and this gap created potential for new companies to develop their businesses in this region, and thus assist the diversification of suppliers in the EU (Stang, 2015).

The EU Commission recognises that the obstacles to the full opening of the energy and gas market, to be carried out in a free and fair manner, are related to the dilemmas arising from the resistance of the Member States and to measures proposed by the Commission to achieve the objectives. These problems are not always linked to liberation, competitiveness in the market and protection of the environment. For these objectives to be achieved, EU policymakers must reconcile broader objectives with effective instruments to make adherence to energy policy within the economic bloc mandatory. A demonstration of the Commission's failures was when the Single European Act and the Maastricht Treaty gave the Commission more political power, when it opened a majority vote on environmental legislation, but, on the other hand, gave Member States the power to implement more stringent laws than that of the Commission themselves, damaging the notion of their supposed superseding power (Eikeland, 2004).

Therefore, to circumvent the EU's perceived lack of political power, the European Commission takes advantage of market failures, as was the case with the political stalemate of the Member States that led to the failure of the Russian South Stream gas pipeline, with which Europe adjusted its energy relations with Russia in its own favour. Although this dependence on Russia did not undergo major changes, it increased the use of Liquefied Natural Gas ('LNG') in the short term within the bloc. This increased the number of suppliers in this market, as this material comes from all over the world, reducing dependency on the primary suppliers. The EU also announced an expansion of energy partnerships in the Mediterranean, further increasing Algeria's market share. These measures aim to transform gas into a more normal commodity, favouring the entry of new participants and reducing the security risk posed by energy supply from a single supplier (Stang, 2015). The EU also announced an expansion of energy partnerships in the Mediterranean, further increasing Algeria's market share. These measures aim to transform gas into a more normal commodity, favouring the entry of new participants and reducing the security risk posed by energy supply from a single supplier (Stang, 2015)

The section below assesses which types of energy are developed in the EU, with a particular focus on renewable and nuclear energy.

2.3 EU – Developing energy sources

There are seven energy sources on the planet today, five of them are RES and two are non-renewable energy sources:

- RES: Wind energy, solar energy, hydropower, biomass, and tidal energy.
- Non-renewable energy sources: Fossil fuels (oil, coal, and natural gas), and nuclear energy (Energy, 2020).

Among the technologically available sources of energy, due the EU's ambitions to become the first decarbonised continent, development of non-renewable

energy options through fossil sources is not considered a viable option. Therefore, the primary options available are renewable energy and nuclear energy, which would be the sources on which the EU would be willing to create guidelines that will boost the growth of companies that develop this type of energy.

2.3.1 EU Renewable energy

Due to the EU Renewable Energy Directive, there has been a profound impact on the energy sector in recent years. In order to achieve their goals, Member States have developed mutual support schemes in the EU. These measures can cause a massive increase in investments in the area of renewable energy, such as wind and photovoltaic energy (solar energy), which has been gaining prominence among some Member States (Jones, 2016). These investments are reflected in the continued increase in renewable energy consumption between the years 2004 and 2018 in the EU, from 9.6% to 18.9% .In that period, the countries that consumed the most energy from renewable sources in the economic bloc were Sweden with 54.6% of its energy consumed in renewable energy, followed by Finland with 42.2% and Latvia with 40.3% of energy consumption from RES (Eurostat 1, 2020).

The development of technologies for the generation of energy from renewable sources has put European countries in a strong position to increase the consumption of energy from renewable sources. To further boost this development, in November 2016, the European Commission published a set of legislative acts, entitled ‘Clean energy for all Europeans’, or also known as the ‘Winter Package’. This package consists of eight proposals which complement the structure that already existed for the years 2020-2030 in relation to energy policies in Europe. In November 2018, adopting a long-term strategic vision, the European Commission, in terms of climate until 2050, projected a competitive, modern, carbon-neutral and prosperous economy (Papiez *et. al*, 2019).

According to Pascual *et al* (2008), climate change is a major driver of the development of new technologies in the energy sector, the need for new investments in the energy sector, and the stricter application of carbon emissions controls in the atmosphere by individual countries. One of the most efficient ways for the market and its Member States to actually start investing in a clean energy policy would be a high carbon taxed price that discourages governments from continuing to use oil and gas as their primary energy source. Such a tax would transform the use of fossil-derived energy into a non-viable market practice, forcing governments to invest in new technologies. To this end, the EU has aimed to implement the 'EU Emissions Trading System', which creates a single pricing for emitted carbon (European Commission, 2012), demonstrating the EU's power to influence the energy market. energy source. Such a tax would transform the use of fossil-derived energy into a non-viable market practice, forcing governments to invest in new technologies. To this end, the EU has aimed to implement the 'EU Emissions Trading System', which creates a single pricing for emitted carbon (European Commission, 2012), demonstrating the EU's power to influence the energy market.

The culmination of this EU drive towards green energy was the European Commission's much-anticipated 'Green Deal', announced in December 2019. The key element of the plan is to make Europe carbon-neutral by 2050, and "reconcile the economy with the planet" its president, Ursula von der Leyen, confidently declared. The estimated cost of the plan was estimated by the Commission to amount to somewhere between 175 and 290 billion euro annually, though the hope is that much of this will be funded by private investors, eager to avail of green energy incentives (The Economist, 2019).

An important weakness in this plan however, is its vulnerability to external shocks. During a marathon summit in July 2020, EU leaders slashed the 'Just Transition Fund', a specific fund to ease the strain of energy transformation on the most polluting regions of Europe, from €40 to €17.5 billion in order to part-fund the bloc's response to the COVID-19 pandemic (Khan and Shotter, 2020).

The development of renewable energy in the energy sector can positively impact the economy. Due to the existing political pressure, this development cannot be neutral. There has been a significant increase in economic activity due to the use of energy from new RES, such as the increase in jobs in services and equipment, innovation, technology and patents, particularly in the case of Germany, which is the leader in consuming renewable energy among the Member States. This transition shows a positive impact on its economy due to the consumption of this type of energy (Papiez *et. al*, 2019). On the other hand, there are studies with empirical evidence in which the relationship between economic growth and consumption of renewable energy cannot be confirmed. Other European countries do not demonstrate clear results in relation to the consumption of renewable energy and the growth of their economy in their markets. This can be explained by the type of renewable energy distribution, which is considered to be inadequate in these countries. However, the replacement of fossil fuel sources by renewable energy can negatively impact the economy, which can cause structural changes in employment, reducing the employability of the energy sector in regions where the main income is derived from fossil fuel energy production fossil (Papiez *et. al*, 2019).

Despite this, one of the policies of the 'European Climate and Energy Package', is to increase the sharing of RES, regardless of the economic impact that this may have on the countries of the bloc (Papiez *et. al*, 2019). For this to happen, since 2013, companies who have shown a significant transition to low-carbon energy have received rewards for their investment from the EU (European Commission, 2012). received rewards for their investment from the EU (European Commission, 2012).

Policies debated to enable a new world-wide pattern of energy consumption face several obstacles. Examples include compensation for governments that contribute proportionally fewer emissions, but are disproportionally negatively affected by a decrease in fossil fuel energy; the fragility of the oil and gas market internationally; nuclear proliferation worldwide; climate change and geopolitical shocks. All of these issues must be addressed to ensure the

prosperity, sustainability, responsibility and security of these countries (Pascual, 2008). and security of these countries (Pascual, 2008).

Hypothetically, despite the ambiguous results on the use of renewable energy versus economic growth, many analysts believe in the effects of growth on the economy based on the consumption of renewable energy (Papiez *et. al*, 2019).

According to Papiez *et al.* (2009), long-term renewable energies generate an increase in energy security. They support the transition to a low-carbon future, reduce the emission of dust and GHG into the atmosphere, and improve the local environment and the business environments as well. the business environments as well.

Studies show that energy production from RES has been growing within the EU. In 2018 the energy produced through renewable sources was 34.3% of the total internal energy production according to Graph 1. The results show consistency with the analyses made by Papiez *et al.* (2009), regarding the economic growth of the bloc (2009), for the economic growth of the bloc.

2.3.2 Nuclear Energy

Nuclear energy, despite its benefits in containing climate change by not emitting carbon dioxide (‘CO2’) into the atmosphere, poses a new problem, although it remains an attractive option for governments that are open-minded to uranium enrichment. The difficulty is that it provides governments with the opportunity to develop the technology used to manufacture nuclear weapons, thereby increasing the military capabilities for the government, in addition to increasing the chances of this technology falling into the hands of terrorist organisations (Pascual, 2008).

The biggest risk of using nuclear power is that, in some way, nuclear technology and materials will be made available to rogue states or terrorist organisations, who could generate levels of destruction seen only in WW II in the cities of Hiroshima and Nagasaki in Japan, to achieve their goals. To ensure that this does not happen, it would be ideal for aspirants to use civilian

nuclear energy to purchase nuclear fuel through international fuel banks and to renounce uranium enrichment programs. These banks would have to follow nuclear programs under the Additional Protocol of the International Atomic Energy Agency (IAEA), to minimise the risk of material leaks that can reach the hands of dangerous governments and terrorist organisations, or cause catastrophic environmental damage, such as what happened at Chernobyl. The banks would also require a guarantee of nuclear non-proliferation, vertical or horizontal, under the NPT treaty and the Comprehensive Nuclear Test Ban Treaty, through enhanced monitoring and surveillance of these bodies, of which Russia is not a part (Pascual, 2008).

However, half of the EU Member States already have nuclear power plants in their territories and in 2016, these plants generated the equivalent of a quarter (25.8%) of all of the internal energy produced in the bloc. The EU Member States with active nuclear plants in 2016 were: Belgium, Bulgaria, Czech Republic, Germany, Spain, France, Hungary, Netherlands, Romania, Slovenia, Slovakia, Finland, Sweden and the United Kingdom, and the other 14 EU Member States do not have active nuclear facilities.

France accounts for half of the electricity generated from nuclear energy in the EU (48%), followed by Germany (10%), the United Kingdom (8.5%), Sweden (7.5%), and Spain (7%). In contrast, Lithuania closed its nuclear facilities in 2009, and between 1990 and 2016 Germany reduced its production by -44.5% and Sweden by -7.6% (Eurostat 3, 2020).

In 2018, the internal production of energy from nuclear sources increased by almost 20% in relation to 2016, contrary to Pascual's (2008) prediction of a decrease in nuclear energy production.

In the next section Russia's participation and importance in the EU energy market will be analysed.

2.4 Russia, the largest energy exporter to the EU

Russia has an extensive role in the global energy market, particularly in the European market, being the largest outside exporter of gas and oil. In addition, Russia is uniquely geographically positioned to supply gas to European countries (Pascual, 2008).

For a long time, Russia believed in this potential for mutual dependence, but after the cut in supply to Ukraine, Europe found itself in an uncomfortable situation with Russia as its main gas supplier (Stang, 2015).

The data reported in 2018 by the European Commission shows that Russia accounts for 30% of crude oil imports, 40% of natural gas imports and 42% of solid fuel imports, primarily coal, to the EU (Eurostat 1, 2020).

Achieving a dramatic change in the supply of oil and gas to the EU is no easy task. Diversifying suppliers in this sector costs time and money. This can be exemplified through the Northern Europe gas pipeline transport route ('NEGP'). This oil and gas transport network connects Vyborg in Russia and Greifswald in Germany. Consisting of two phases, this project started the first phase in 2010 and the second in 2012, aiming to supply 25% of the additional consumption needs of Europe by 2015, and cost approximately US $ 5 billion. The construction of this transmission line further increased the dependence on Russian oil and gas by the EU (Pascual, 2008). These investments in infrastructure and the consolidation of contracts for European gas supply from companies such as Gazprom (Russia), with clauses that guarantee decades of supply, make Russia even more prevalent in gas imports by the EU (Stang, 2015).

In 2014, with gas supplies to Ukraine interrupted by Russia, the EU attempted to diversify its suppliers. However, due to the stagnant market, Russia continued to exercise its power in gas distribution and still threatened supply cuts to other countries who had tried to supply gas to Ukraine, such as Slovakia, Austria, Romania and Poland. This manoeuvre demonstrated once more Europe's power and dependence on Russia (Stang, 2015). Once again, the EU's energy security was weakened, and it demonstrated the need for

Member States within the EU to invest in the development of the internal energy market.

Due to this dependence that Russia also has with the EU to sell its energy sources, could the EU gain any advantage in this market without risking its supply?

The next section will outline some of the measures that the EU has implemented to reduce CO2 emissions in the bloc.

2.5 The geopolitics of climate change and the EU's goals

Policies related to climate change have been widely debated for decades. In order to meaningfully combat and slow climate change, a coordinated response is required to unite the fields of technology, economics and politics. In this sense, the EU has an advantage in that it already has experience in coordinating and formulating policies between a number of countries, often when there are competing interests between them. The biggest cause of GHG emissions in the atmosphere is causally linked to energy consumption and lifestyle. The more dependent on impure energy derived from fossil fuels the people are, like oil and gas, the more GHG are emitted into the atmosphere (Pascual, 2008). The energy sector was responsible for 54.5% of the GHG emissions in 2017 in the EU. Of the total GHG emitted by the energy sector, 29% was emitted through the energy producing industries and 25.5% was issued indirectly, through the combustion of fuels by users. However, total EU GHG emissions fell by 19% compared to 1990, which represents a reduction of 935 million tons of CO2 equivalents in the atmosphere (Eurostat 1, 2020).

The EU, together with The Energy Union in 2015, are considered the main political instrument in the area of energy and environmental impact. Together, they formulated the '*The European Green Deal*', (see 2.3.1 above) an ambitious political strategy objective to be undertaken until 2050, where the goal is to make Europe the first carbon-neutral continent (Eurostat 1, 2020).

However, there remains an imbalance between Member States in their willingness and ability to adapt to the urgency of this issue. According to Wojciech Dabrowski, the head of Poland's largest energy utility, PGE, the proposed 55% reduction in emissions by 2030 would be prohibitively expensive for Poland. He claimed that "this cost would be unacceptable in light of the very high prices for households and industry. This amount is four-times the capital that PGE is planning to spend on low-emission investments by 2030." (Khan and Shotter, 2020).

The most critical changes are through the conservation of existing energy sources, alternative fuels, developments in new building codes and new technologies that are more efficient in minimising energy consumption and unprecedented changes in the current lifestyle of the EU's population (Pascual, 2008). To this end, the EU outlined plans to transform the European energy system which consists of five interconnected dimensions. These dimensions are:

1. Make efficient use of the energy produced by the bloc, and diversify European energy sources, thus ensuring energy security, trust and solidarity;

2. Eliminate technical and regulatory barriers to create a fully integrated internal energy market. This will generate fair competition and will positively impact the price of energy;

3. Reduce energy dependence from third parties, by modernising demand through energy efficiency and reducing consumption;

4. Encourage private investment in new technologies and infrastructure, and put pressure on other governments to form global agreements on climate change, with the objective of decarbonising the world economy;

5. Coordinate research and establish partnerships with the private sector, financing projects focusing on advances in low-carbon technologies, supporting research, innovation and competitiveness (Eurostat 1, 2020 p.4).

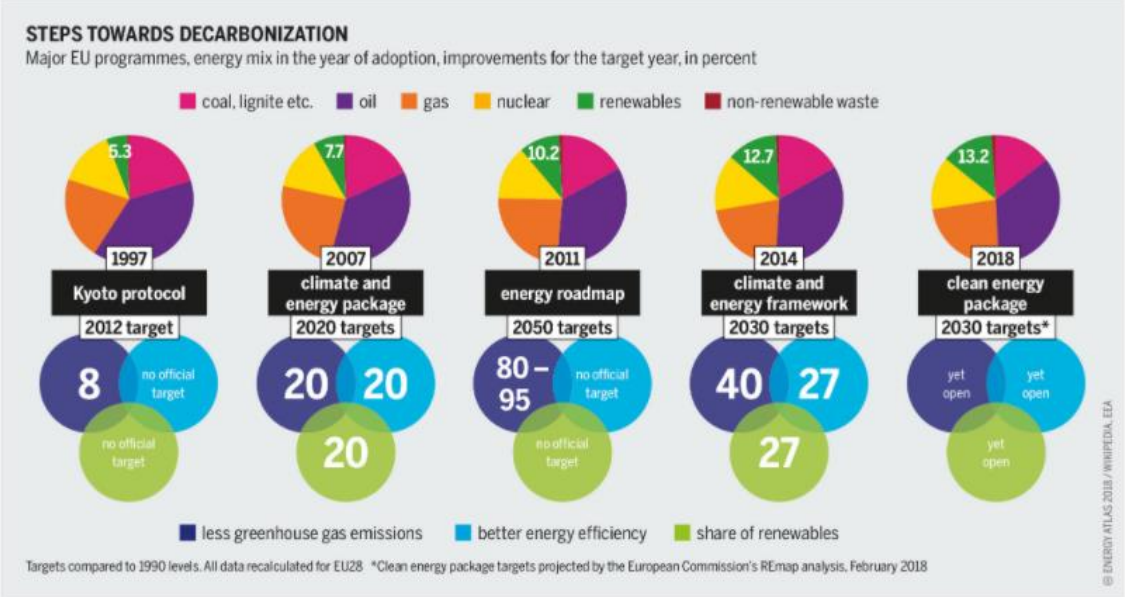
Emerging economies are currently the largest generators of GHG. Many of these economies show that they are willing to share the cost in solving the

problem. However, other countries and economic blocs considered to be economic powerhouses show no real intention of participating in joint-action projects with these emerging economies, preferring to focus on their own emissions targets, as is the case in the United States, Europe and Japan (Pascual, 2008). To show commitment in projects related to climate change, the EU annually monitors the progress of this area and highlights regions that deserve more attention and assistance because of problems that present during their implementation (Eurostat 1, 2020).

Considering that until recently, there was no coordinated policy and technological framework to achieve the goals established by the United Nations ('UN') for the reduction of GHG emissions in the atmosphere, this objective is unprecedented in its scale and ambition. However, as the EU wants to be part of the first continent to become carbon-neutral by 2050, the European Commission has been working hard to develop technologies and agreements that will make Europe's decarbonisation goal feasible (Eurostat 1, 2020).

To demonstrate its commitment to achieving the decarbonisation goal, the EU has been implementing measures towards this end. One of these measures is the creation of a single carbon price in Europe, through the EU Emissions Trading System. An EU-wide market for carbon credits was established in 2005 in order to achieve the EU's commitments under the Kyoto Protocol and is an essential arm of the EU's efforts in combating climate change (Wallace, 2020). Another measure was implementation from the year 2013, of an internal carbon-trading market designed to facilitate the transition to a sustainable, efficient, low-carbon system. This plan rewards investments in the development of low-carbon energy resources compared with carbon-intensive systems (European Commission, 2012).

Chart 1 – Steps towards decarbonisation (Primova, 2018)



However, will Member States follow the guidelines set by the EU to achieve these goals and achieve the status of the world's first decarbonised continent? If Member States fail to comply with the guidelines, how will they be persuaded to do so? How could the investment in new energy companies be realised if the 'National Champions' continue to dominate the market, preventing an expansion of it? These are questions that the EU must ask to make its efforts to release the energy market more effective, to encourage non-governmental energy companies to enter the European market, and to give these companies incentives to develop a low carbon emission energy supply.

One method of enforcement which the EU has already threatened, is the use of fines on Member States who fail to meet their emissions targets. These Member States will face multibillion-euro fines in the event that they do not reduce their CO2 emissions to within their target range. In addition to offering economic incentives to Member States to pivot towards climate-friendly energy sources, the use of fines offers a powerful tool to encourage compliance (O'Sullivan, 2019).

Table 3 - Key EU and EU Energy Market Milestones (Author's own research)

1951	Foundation of the EEC.
1970's	The 'Oil Shock', a sharp spike in the price of oil put the economic development and well-being of European citizens at risk.
1980's (late)	The European internal energy market begins to attract the attention of the EU Council.
1985 and 1988	With the White Paper (1985) and the Green Paper (1988), the Delors Commission provides a legal basis for the Liberalisation of the European energy market.
1990's	The rupture of state-owned companies in the energy market begins.
1993	Formal creation of the modern-day version of the EU.
2000	EU Council meeting in Lisbon is held.
2001	The Commission found in its comparative reports that the internal energy market presented several serious problems, due to the insufficient regulation of the laws previously established for the bloc.
2002	Coal market subsidy contract expires. Member States determined that the subsidy to state-owned coal companies will continue.
Between 2004 and 2006	Engie-GDF Suez (France) and Endesa-Enel (Spain), create tension in the market after their merger.
2004 and 2018	There is a significant increase in renewable energy consumption within the EU.
Between 2005 and 2007	Russa raises the price of gas for Ukraine, Belarus and Moldova.
2006 and 2007	The Commission identifies crucial deficiencies in the new energy-related Directives, and in the regulatory framework for the gas and energy sector.
2008	Global Financial crisis begins.
2009	Lithuania shuts down its nuclear power plant.
2011	The deadline for the implementation of the third phase of the package for the release of the European energy market. Certain Member States do not meet the deadline,

	and are forced to renegotiate with the European Commission.
2012	Work begins on the NEGP, connecting Vyborg in Russia and Greifswald in Germany.
2013	Companies begin to receive awards from the EU for their investment in renewable energy.
2014	Russia interrupts the gas supply to Ukraine.
2015	The EU and The Energy Union formulate 'The European Green Deal'.
2016	The European Commission published the 'Clean energy for all Europeans', an eight-part package to complement the structure already in place for the years 2020-2030.
2018	The European Commission designs a climate programme to create a competitive, modern, carbon-neutral and prosperous economy by the year 2050.
2018	The internal production of energy from nuclear sources increases by almost 20% in comparison to 2016.
2019	The European Commission commences 'The European Green Deal', sooner than its original planned commencement in 2020.

Gaps in the Literature Review

During the course of this research, some inconsistencies, breaches of continuity and disparities have been identified in previous academic studies in this area. For instance, Baumann writes that "energy policy should be securitised, and thus has to be handled as a security matter" (Baumann, 2008, p.12). However, he does not expand on this point at all in his paper. Rocco (2015) notes that Member States are reluctant to transfer their decision-making power (sovereignty) to the supranational level in the context of the 'National Champions', but does not offer any explanation as to why this is, and I thought it to be worthy of investigation.

Motta and Ruta (2007) conclude in their paper by noting that further research is required on certain issues. They write that a question:

“we leave for future research, is to what extent the current regulatory environment is fit to avoid distortions in merger decisions. For instance, do the existing tools of the European Commission suffice to discipline governments of Member States?” (Motta and Ruta, 2007, p. 19). I also believe that this question is deserving of further research, and was one of the motivations behind my research question. These issues are examined elsewhere in this dissertation.

Similarly, Dupont and Oberthür observe that:

“further studies may identify in more detail, constellations of factors that favour (or not) CPI (Climate Policy Integration) in energy policy and beyond. There is also much potential for deriving new insights on the interactions of theories of European integration in the reality of EU policymaking” (Dupont and Oberthür, 2012, p. 243).

These gaps in the research include:

1. Member States are giving up on the governance of State-owned energy companies, but they encourage the development of ‘National Champions’, as the opening of the EU energy market occurs without the disruption of the market monopoly or oligopoly system. The very existence of ‘National Champions’ appears to breach EU rules on State Aid, and there does not appear to be adequate academic commentary on this point.

2. The EU's energy security is compromised by the lack of autonomy in domestic production, as the market has not developed sufficiently (see section 2.2.2 above). Why has the market not been sufficiently developed until now to address this?

3. Because the problem of Russia exercising enormous much power in the EU's energy supply.

4. The EU is developing programs for the decarbonisation of the European continent, but there is no conclusive research about the resistance of energy companies to this effort.

During the course of the research for this dissertation, it became apparent that there has been insufficient academic commentary or analysis on the above issues. Although a small number of the sources referenced elsewhere throughout this paper address them in an indirect way, I believe that further analysis is required.

It is in response to these gaps in previous research that justify the development of this research question. The subject matter piqued my interest to examine how a statistical analysis of how the EU's energy policies affect energy companies, could strengthen the proposition that increased integration of the market through policymaking could be beneficial for the EU's energy and economic policies as a whole.

3 Methodology

The analysis for this study is based on econometric models and the marketing model. Econometrics is a study that uses mathematical and statistical methods to evaluate theories about economics and finance and the marketing model uses methods of measurement by value and documentary descriptive to evaluate the proportions of the market.

The Econometrics Method

Econometrics is a method of statistical and mathematical analysis that draws causal inferences through observational data. The strategies used in this method are the empirical identification and strategy of macroeconomics.

The econometric method can identify the cause and effect relationship through an analysis of the data set if that is sufficiently large (Athey and Imbens, 2017). This methodology is both valid and suitable for this type of research because it will compare the effects of the economic performance of the EU over 12 years (using Eurostat data), in relation to the economic performance of the 42 largest energy companies in the EU during the same period (using data collected from the Consolidated Annual Financial Report from each company's website), that is, a large set of information and variables. Methodological econometrics has proven popular in academic analysis in the last three decades, but it is more efficient when aligned with other methods to define cause and effect, according to Athey and Imbens (2017). Furthermore, the marketing analysis method will also be used in this study to add depth and substance to the methodology.

The Pearson correlation analysis method is used in econometric analysis to define the correlation of the analysed data. Presenting trend data trends can be positive, when it has the same evolutionary trend, or negative, when the evolutionary trend of the data is opposite. The Pearson correlation is based on

a scale of -1 to 1, where 0 corresponds to no relationship. -1 corresponds to an opposite linear trend of perfect equality, and 1 corresponds to a linear trend of perfect equality.

Pearson's correlation coefficient is calculated according to the following formula:

$$\rho = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2} \cdot \sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}} = \frac{\operatorname{cov}(X, Y)}{\sqrt{\operatorname{var}(X) \cdot \operatorname{var}(Y)}}$$

Where $x_1, x_2, \ldots, x_n$ and $y_1, y_2, \ldots, y_n$ are the measured values of both variables.

Furthermore, $\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i$ and $\bar{y} = \frac{1}{n} \cdot \sum_{i=1}^{n} y_i$ are the arithmetic means of both variables.

The Pearson correlation calculation was performed using the Microsoft Excel software as shown in Appendix 1 (see page 67).

The Quantitative Research method will be used in this research, to statistically demonstrate a correlation in performance between real GDP and revenue of energy companies in the EU. This approach to business and management in general is a useful asset to interpret numerical information critically, giving managers a more assertive view of performance (Swift and Piff, 2014). The data panel model will be used, based on data from the 27 EU Member States.

Real GDP was used in this study, excluding the use of nominal GDP, due to the intrinsic characteristics of the distinction between real GDP and nominal GDP. Nominal GDP refers to the value of GDP calculated at the current price, that is, the year the product was conducted or traded. Real GDP is calculated at constant prices where a base year is chosen, eliminating the inflationary effect, which makes the analysis of the data more consistent (Mankiw, 2015). Therefore, real GDP is better for use in analysing the long-term data examined in this study, as changes in values due to inflation in the period does not affect the values of the amounts used.

Marketing Analysis

The marketing analysis methodology is the study and empirical analysis of market data, which includes the analysis of internal production values, imports, market share and other data, which can be obtained through publication of specialised entities such as Eurostat (Raithel *et al.,* 2011). This method is valid and appropriate for this study because reliable data is available which can be utilised in the analysis of the correlation between the EU and the energy companies within the bloc. All data collected for documentary analysis were taken from reports produced by Eurostat. Eurostat is an organisation of statistical studies from the European Commission, which produces statistical data for the EU with the aim of promoting and harmonising statistical methods between Member States. These statistical results are produced through macroeconomic data and regional and classification data, which are utilised to guide the formation of EU economic policies (Eurostat, 2020).

The Qualitative Research method will also be used in this research. The bibliographic and documentary analysis, both of literature, information from financial newspapers and data collection from EU reports, can help to measure the structure of the companies operating in this market and how much the market can develop within the EU.

Period analysed

The data collected for the Qualitative-Quantitative analysis is for a period of 12 years, between 2008 and 2019. This period was selected because all current Member States were in the bloc during that period.

This period was also deemed appropriate, to generate a sufficient database for the econometric analysis of the study, in addition to encompassing some of the most important events that impacted the EU energy sector in recent years. Some examples of these events are:

- The 2008 global financial crisis;

- The implementation of the EU Emissions Trading System in 2013;
- The interruption of energy supply to Ukraine by Russia in 2013; and
- The launch of a new EU climate action package entitled 'Clean energy for all Europeans' package in 2019.

This analysis aims to create a correlation between EU real GDP and the revenues of the 42 largest EU energy companies. This can be done by analysing the growth capacity in this sector for non-governmental energy companies, and examining which EU policies most affect their business. This information can then be used to ascertain the extent of the impact that these policies have on the companies' decision-making processes.

This study is based on 840 data points or variables for analysing the connection between EU real GDP and EU energy company revenue, as well as an analysis of Eurostat reports on the performance of the EU energy market in that same period.

Limitations of this research

This study has limitations that may present inaccurate results. These include:

(a) The balance sheets of some companies examined in this study show consolidated results. This means that it was not possible to extract data only referring to the energy market within the EU, since several of the studied companies have market operations outside the EU and this data is consolidated in their Annual Financial Report.

(b) The data in the reports and documents are total values, which can lead to an inaccuracy in the values resulting from the survey, as they do not have a breakdown of the information which could be reviewed.

(c) The results found in the study will give a perspective of the EU energy market, but not an entirely accurate projection.

4 Data

Table 4 below entitled ‘EU real GDP growth rate 2008 / 2019' (Eurostat, 2020), presents the real GDP of Member States between the years 2008 and 2019. With units of measure for chain-linked volumes and percentage change from previous period, this table is divided into four groups. These groups are:

- Real GDP of the 27 Member States that are currently part of the EU;
- The UK (for comparative purposes);
- Real GDP countries that have applied for membership of the EU; and
- An overview.

Table 4 – EU real GDP growth rate 2008/2019 (Eurostat, 2020)
Table altered

Real GDP growth rate

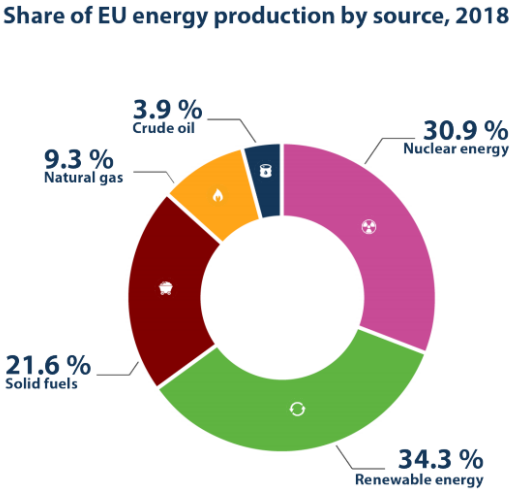
	TIME	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Current EU formation (Countries)	Austria	1.5	-3.8	1.8	2.9	0.7	0	0.7	1	2.1	2.5	2.4	1.6
	Belgium	0.4	-2	2.9	1.7	0.7	0.5	1.6	2	1.5	1.9	1.5	1.4
	Bulgaria	6.1	-3.4	0.6	2.4	0.4	0.3	1.9	4	3.8	3.5	3.1	3.4
	Croatia	1.8	-7.4	-1.5	-0.3	-2.2	-0.5	-0.1	2.4	3.5	3.1	2.7	2.9
	Cyprus	3.6	-2	2	0.4	-3.4	-6.6	-1.9	3.4	6.7	4.4	4.1	3.2
	Czechia	2.7	-4.7	2.4	1.8	-0.8	0	2.3	5.4	2.5	5.2	3.2	2.3
	Denmark	-0.5	-4.9	1.9	1.3	0.2	0.9	1.6	2.3	3.2	2	2.4	2.3
	Estonia	-5.1	-14.4	2.7	7.4	3.1	1.3	3	1.8	2.6	5.7	4.8	4.3
	Finland	0.8	-8.1	3.2	2.5	-1.4	-0.9	-0.4	0.5	2.8	3.3	1.5	1.1
	France	0.3	-2.9	1.9	2.2	0.3	0.6	1	1.1	1.1	2.3	1.8	1.5
	Germany	1	-5.7	4.2	3.9	0.4	0.4	2.2	1.7	2.2	2.5	1.5	0.6
	Greece	-0.3	-4.3	-5.5	-9.1	-7.3	-3.2	0.7	-0.4	-0.2	1.5	1.9	1.9
	Hungary	1.1	-6.7	0.7	1.8	-1.5	2	4.2	3.8	2.2	4.3	5.1	4.9
	Ireland	-4.4	-5.1	1.8	0.6	0.1	1.2	8.6	25.2	2	9.1	8.5	5.6
	Italy	-1	-5.3	1.7	0.7	-3	-1.8	0	0.8	1.3	1.7	0.8	0.3
	Latvia	-3.3	-14.2	-4.5	6.3	4.1	2.3	1.9	3.3	1.8	3.8	4.3	2.2
	Lithuania	2.6	-14.8	1.5	6	3.8	3.6	3.5	2	2.6	4.2	3.6	3.9
	Luxembourg	-1.3	-4.4	4.9	2.5	-0.4	3.7	4.3	4.3	4.6	1.8	3.1	2.3
	Malta	3.3	-2.5	3.5	1.4	2.8	4.9	9	10.9	5.8	6.5	7.3	4.7
	Netherlands	2.2	-3.7	1.3	1.6	-1	-0.1	1.4	2	2.2	2.9	2.4	1.7
	Poland	4.2	2.8	3.6	5	1.6	1.4	3.3	3.8	3.1	4.9	5.3	4.1
	Portugal	0.3	-3.1	1.7	-1.7	-4.1	-0.9	0.8	1.8	2	3.5	2.6	2.2
	Romania	9.3	-5.5	-3.9	2	2.1	3.5	3.4	3.9	4.8	7.1	4.4	4.1
	Slovakia	5.6	-5.5	5.7	2.9	1.9	0.7	2.8	4.8	2.1	3	3.9	2.4
	Slovenia	3.5	-7.5	1.3	0.9	-2.6	-1	2.8	2.2	3.1	4.8	4.1	2.4
	Spain	0.9	-3.8	0.2	-0.8	-3	-1.4	1.4	3.8	3	2.9	2.4	2
	Sweden	-0.5	-4.3	6	3.2	-0.6	1.2	2.7	4.5	2.1	2.6	2	1.2
	United Kingdom	-0.3	-4.2	1.9	1.5	1.5	2.1	2.6	2.4	1.9	1.9	1.3	1.5
Candidate Countries	Albania	:	:	:	:	:	:	:	:	:	:	:	:
	Montenegro	7.2	-5.8	2.7	3.2	-2.7	3.5	1.8	3.4	2.9	4.7	5.1	:
	North Macedonia	5.5	-0.4	3.4	2.3	-0.5	2.9	3.6	3.9	2.8	1.1	2.7	:
	Serbia	5.7	-2.7	0.7	2	-0.7	2.9	-1.6	1.8	3.3	2	4.4	4.2
	Turkey	0.8	-4.7	8.5	11.1	4.8	8.5	5.2	6.1	3.2	7.5	2.8	:
Over view	European Union - 27 countries (from 2020)	0.6	-4.3	2.2	1.8	-0.7	0	1.6	2.4	2	2.8	2.1	1.5
	European Union - 28 countries (2013-2020)	0.5	-4.3	2.1	1.8	-0.4	0.3	1.7	2.4	2	2.6	2	1.5
	Euro area (EA11-1999, EA12-2001, EA13-2007, EA15-2008, EA16-2009, EA17-2011, EA18-2014, EA19-2015)	0.4	-4.4	2.1	1.7	-0.9	-0.3	1.4	2.1	1.9	2.6	1.9	1.3
	Euro area - 19 countries (from 2015)	0.4	-4.5	2.1	1.7	-0.9	-0.2	1.4	2.1	1.9	2.6	1.9	1.3

Special value

: not available

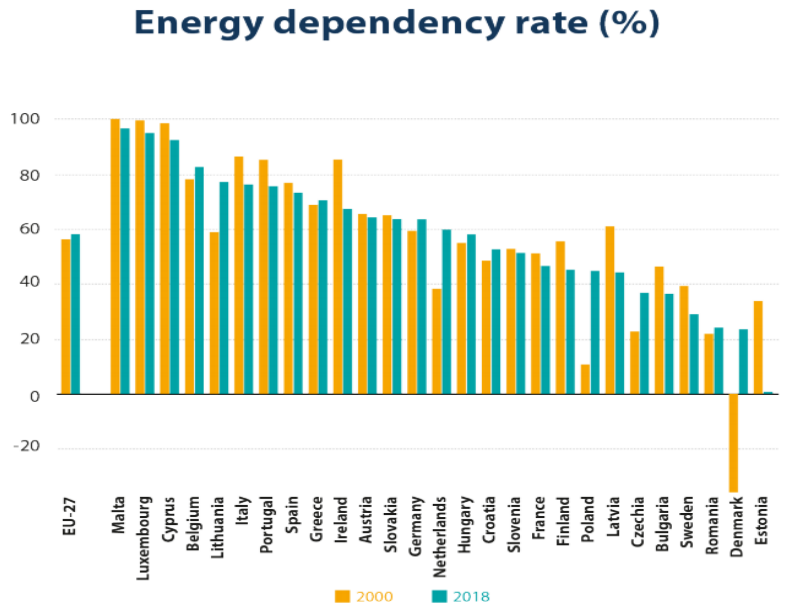
Graph 1, entitled 'Participation in EU energy production by source - 2008' (Eurostat 1, 2020), presents the data in percentages, which shows the performance of energy production within the EU in 2018, divided into five categories of energy sources.

Graph 1 – Share of EU energy production (Eurostat 1, 2020, p. 7)



Graph 2, entitled 'EU Energy dependency rate of importation - 2000 vs 2018' (Eurostat 1, 2020), presents the data in percentages, which shows the EU's energy dependence on third parties through a comparison between the years 2000 and 2018.

Graph 2 – EU Energy importation dependency 2000 vs 2018 rate - % (Eurostat 1, 2020, p.10)



The next three charts, Chart 2, entitled 'EU imports of Crude Oil-2018', Chart 3, entitled 'EU imports of Natural Gas-2018, and Chart 4, entitled ‘EU imports of Solid Fuel-2018' (Eurostat1, 2020), present the data in percentages, which shows which countries are the largest energy exporters to the EU in each of the three main sources of energy imported into the EU in 2018.

Chart 2 – EU imports of crude oil by partner 2018 (Eurostat 1, 2020, p. 9)

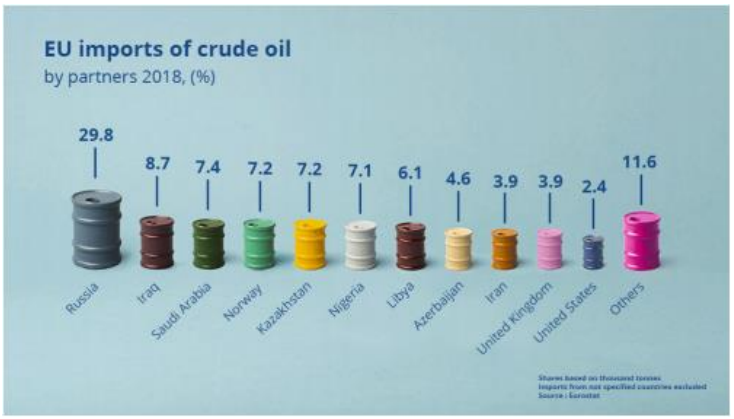


Chart 3 – EU imports of natural gas by partner 2018 (Eurostat 1, 2020, p. 9)

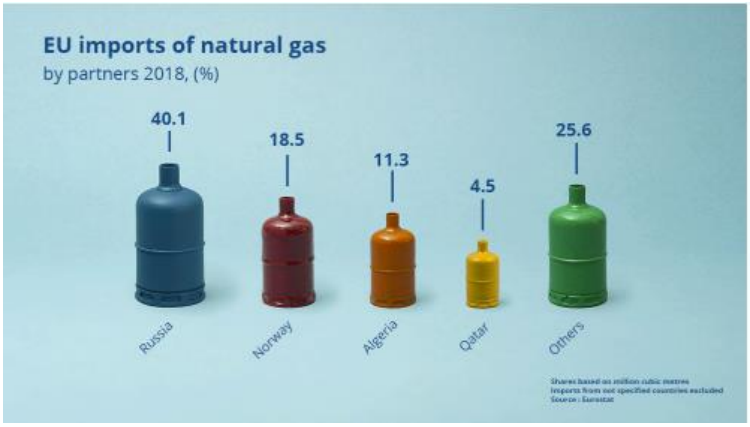


Chart 4 – EU imports of solid fuel by partner 2018 (Eurostat 1, 2020, p.9)

Table 5, entitled 'Ranking of Top 42 EU Energy Companies - 2019 Financial' (Weber, 2019), presents the 42 largest energy companies in the EU in 2019 and the financial performance represented by those companies' assets, revenues and profit.

Table 5 – Top 42 EU Energy Companies 2019 - Financial (Weber, 2019) Table altered

						$ million		
	Pos.	Company	Country	Region	Ind	Assets	Revenues	Profits
1	1	**Royal Dutch Shell plc**	NL	EMEA	IOG	399194	388379	23352
2	8	**Total AS**	FR	EMEA	IOG	256762	184106	12138
3	15	**E.ON SE**	DE	EMEA	DU	61059	33673	3301
4	16	**BP p.l.c**	UK	EMEA	IOG	282176	297220	9382
5	20	**Eni S.p.A.**	IT	EMEA	IOG	133048	85966	4638
6	26	**Enel SpA**	IT	EMEA	EU	185932	82993	5383
7	36	**Iberdrola AS**	ES	EMEA	EU	127052	39424	3445
8	37	**Ørsted A/S**	DK	EMEA	EU	26276	11367	2682
9	42	**Repsol**	ES	EMEA	IOG	68313	48981	2136
10	45	**ORLEN**	PO	EMEA	R&M	16849	28818	1459
11	59	**SSE plc**	UK	EMEA	EU	32126	9294	1751
12	61	**National Crid plc**	UK	EMEA	DU	79816	18930	1900
13	65	**MOL**	HU	EMEA	IOG	16096	18041	1051
14	75	**Electricité de France AS**	FR	EMEA	EU	318275	77527	667
15	83	**Galp Energia SGPS SA**	PT	EMEA	IOG	14260	19382	833
16	84	**NESTE Oyj**	FI	EMEA	R&M	9244	15135	874
17	96	**PGNIG**	PO	EMEA	IOG	13993	10831	844
18	107	**Veolia Environnement**	FR	EMEA	DU	42253	29123	476
19	110	**EDP**	PT	EMEA	EU	46788	17172	584
20	114	**EnBW**	DE	EMEA	EU	44520	23288	376
21	120	**Fortum Oyj**	FI	EMEA	EU	25187	5994	948
22	121	**ENGIE AS**	FR	EMEA	DU	172757	68108	-176
23	125	**Snam S.p.A.**	IT	EMEA	S&T	25382	2907	1079
24	133	**Uniper SE**	DE	EMEA	IPP	56879	87957	-508
25	140	**Centrica plc**	UK	EMEA	DU	26059	37632	232
26	144	**Terna SpA**	IT	EMEA	EU	19254	2578	794
27	149	**Red Elétrica**	ES	EMEA	EU	12658	2260	792
28	154	**CEZ a.s.**	CZ	EMEA	EU	30894	7925	451
29	158	**Grupa LOTOS AS**	PO	EMEA	R&M	5838	7912	417
30	160	**RWE**	DE	EMEA	DU	90030	15098	-890
31	162	**Naturgy Energy Group**	ES	EMEA	GU	45668	27356	-3161
32	184	**Acciona AS**	ES	EMEA	EU	16789	8960	369
33	186	**PGE**	PO	EMEA	EU	19939	6816	393
34	189	**A2A S.p.A.**	IT	EMEA	DU	11614	7080	363
35	199	**Hera S.p.A.**	IT	EMEA	DU	10241	7244	317
36	203	**Enagás AS**	ES	EMEA	S&T	10707	1455	498
37	211	**Hellenic Petroleum AS**	GR	EMEA	R&M	7865	10980	238
38	225	**Italgas S.p.A.**	IT	EMEA	GU	7595	1816	353
39	228	**ACEA S.p.A.**	IT	EMEA	DU	9168	3220	305
40	230	**Lundin Petroleum AB**	SE	EMEA	E&P	5842	2641	222
41	236	**Iren SpA**	IT	EMEA	DU	9630	4231	272
42	245	**Elia System Operator AS**	BE	EMEA	EU	15459	2049	309

Table 6, entitled 'Ranking of the 42 largest energy companies in the EU - 2019 Ownership', shows the 42 largest energy companies in the EU in 2019 and the percentage of government participation in these companies, either as Government, State or Municipal owners.

Table 6 -Top 42 EU Energy Company 2019 – Ownership %
(Author's own research)

	Pos.	Company	Country	Ind	IPO Status	Company	Government Ownership (%)
1	1	**Royal Dutch Shell plc**	NL	IOG	Public	Non-gov	
2	8	**Total AS**	FR	IOG	Public	Non-gov	
3	15	**E.ON SE**	DE	DU	Public	Non-gov	
4	16	**BP p.l.c**	UK	IOG	Public	Non-gov	
5	20	**Eni S.p.A.**	IT	IOG	Public	Mix	30.33
6	26	**Enel SpA**	IT	EU	Public	Mix	31.24
7	36	**Iberdrola AS**	ES	EU	Public	Non-gov	
8	37	**Ørsted A/S**	DK	EU	Public	Mix	50.1
9	42	**Repsol**	ES	IOG	Public	Mix	66
10	45	**ORLEN**	PO	R&M	Public	Non-gov	
11	59	**SSE plc**	UK	EU	Public	Mix	27.59
12	61	**National Crid plc**	UK	DU	Public	Non-gov	
13	65	**MOL**	HU	IOG	Public	Mix	15.24
14	75	**Electricité de France**	FR	EU	Public	Mix	83.6
15	83	**Galp Energia SGPS**	PO	IOG	Public	Mix	7.48
16	84	**NESTE Oyj**	FI	R&M	Public	Mix	35.96
17	96	**PGNIG**	PO	IOG	Public	Mix	71.88
18	107	**Veolia**	FR	DU	Private	Non-gov	
19	110	**EDP**	PT	EU	Private	Non-gov	
20	114	**EnBW**	DE	EU	Private	Mix	46.75
21	120	**Fortum Oyj**	FI	EU	Private	Mix	50.76
22	121	**ENGIE AS**	FR	DU	Public	Mix	23.64
23	125	**Snam S.p.A.**	IT	S&T	Public	Non-gov	
24	133	**Uniper SE**	DE	IPP	Public	Mix	73.4 (Fortum - Finland
25	140	**Centrica plc**	UK	DU	Public	Non-gov	
26	144	**Terna SpA**	IT	EU	Private	Mix	29.85
27	149	**Red Elétrica**	ES	EU	Private	Mix	20
28	154	**CEZ a.s.**	CZ	EU	Public	Mix	70
29	158	**Grupa LOTOS AS**	PO	R&M	Private	Mix	53.19
30	160	**RWE**	DE	DU	Public	Non-gov	
31	162	**Naturgy Energy**	ES	GU	Public	Non-gov	
32	184	**Acciona AS**	ES	EU	Private	Non-gov	
33	186	**PGE**	PO	EU	Private	Mix	57.39
34	189	**A2A S.p.A.**	IT	DU	Public	Mix	50
35	199	**Hera S.p.A.**	IT	DU	Public	Mix	46.4
36	203	**Enagás AS**	ES	S&T	Private	Mix	5
37	211	**Hellenic Petroleum**	GR	R&M	Private	Mix	35.5
38	225	**Italgas S.p.A.**	IT	GU	Public	Mix	26
39	228	**ACEA S.p.A.**	IT	DU	Private	Mix	51
40	230	**Lundin Petroleum A**	SE	E&P	Public	Non-gov	
41	236	**Iren SpA**	IT	DU	Public	Gov	100
42	245	**Elia System**	BE	EU	Public	Non-gov	

Table 7, entitled ‘Ranking of Top 42 EU Energy Companies (2019) - Revenue 2008 - 2019, shows the 42 largest energy companies in the EU in 2019 and their revenues between the years 2008 and 2019. The numbers were standardised for millions and the exchange rate of some companies was changed to euro based on the currency rate on the last day of each year.

Table 7 – Ranking of Top 42 EU Energy Companies (2019)-Revenue 2008/2019 (Author’s own research)

€ million

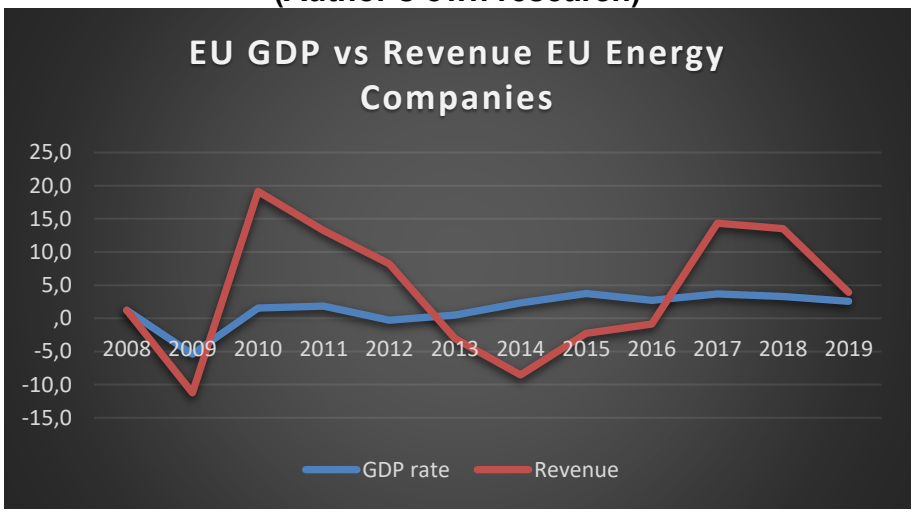
Company		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Shell	NL	329,745	193,647	274,975	363,019	353,915	327,556	347,993	244,012	222,005	254,184	338,266	307,575
Total AS	FR	7,880	6,007	8,074	9,714	10,482	8,363	3,512	4,408	5,898	6,912	10,060	10,201
E.ON SE	DE	2,857	2,858	2,858	1,905	2,097	1,145	966	976	452	1,320	1,053	1,210
BP p.l.c	UK	264,058	171,337	230,800	298,388	294,005	287,618	296,404	208,116	177,350	203,712	264,547	252,048
Eni S.p.A.	IT	108,810	84,345	99,479	108,616	128,766	116,107	109,847	72,286	55,762	70,977	76,938	71,041
Enel SpA	IT	61,184	64,035	73,377	79,514	84,949	80,535	75,791	75,658	70,592	74,639	75,575	80,327
Iberdrola AS	ES	:	25,892	30,431	31,648	34,201	32,808	2,119	1,581	28,759	31,263	35,076	36,438
Ørsted A/S	DK	8,165	6,647	7,327	7,646	9,013	9,800	9,006	9,494	8,232	7,993	10,304	9,081
Repsol	ES	107,748	124,251	145,508	173,567	57,852	56,298	47,292	41,741	34,556	41,242	49,701	49,006
ORLEN	PO	13,184	10,939	15,697	17,740	29,345	27,432	24,958	20,686	18,019	22,843	25,524	26,105
SSE plc	UK	:	:	:	:	:	:	:	:	:	:	30,405	8,590
National Crid	UK	:	:	:	:	:	:	:	:	:	:	:	14,541
MOL	HU	13,367	12,450	15,533	17,167	18,910	18,431	15,526	13,290	11,549	13,404	16,230	16,023
Electricité	FR	63,847	66,336	65,320	65,307	72,178	75,594	73,383	75,006	71,203	69,632	68,546	71,317
Galp Energia	PT	15,188	12,138	14,270	16,987	18,644	19,767	18,126	15,617	13,256	15,308	17,470	17,182
NESTE Oyj	FI	15,043	9,636	11,892	15,420	17,853	17,238	15,011	11,131	11,689	13,217	14,918	15,840
PGNIG	PO	4,475	4,698	5,369	5,163	7,020	7,739	8,188	8,713	7,519	8,589	9,593	5,245
Veolia	FR	35,090	33,952	34,787	22,482	23.238.9	22,315	23,880	24,965	24,187	25,125	25,911	27,189
EDP	PT	350,887	443,117	392,017	440,546	147,896	157,104	16,294	15,517	638,919	575,509	306,609	335,945
EnBW	DE	16,305	15,64.2	17,509	18,756	19,324	20,540	21,003	21,167	19,368	21,974	18,765	20,815
Fortum Oyj	FI	5,636	5,435	6,296	6,161	6,159	6,056	4,751	3,459	3,632	4,520	5,242	5,447
ENGIE AS	FR	67,924	79,908	84,478	90,673	97,038	87,898	74,686	69,883	64,840	65,029	56,967	60,058
Snam S.p.A.	IT	1,902	2,468	3,508	4	3,946	3,848	3,882	3,970	2,501	2,533	2,586	2,665
Uniper SE	DE	:	:	:	:	:	:	:	92,115	67,285	72,238	91,813	65,804
Centrica plc	UK	21,584	24,719	26,168	27,275	29,362	31,894	37,761	38,056	31,576	31,582	25,983	26,675
Terna SpA	IT	1,196	1,295	1,533	1,591	1,733	1,644	1,651	2,012	2,033	2,184	2,273	2,288
Red Elétrica	ES	1,126	1,200	1,397	1,637	1,755	1,758	1,847	1,939	1,932	1,941	1,929	2,007
CEZ a.s.	CZ	6,084	6,569	6,985	7,045	8,563	7,928	7,279	7,774	7,537	7,892	7,172	8,116
Grupa LOTOS	PO	4,218	2,925	4,910	7,067	7,445	6,340	6,803	5,427	4,784	5,698	7,059	6,856
RWE	DE	47,500	46,191	50,722	49,153	50,771	51,393	46,149	46,357	43,590	42,434	13,406	13,125
Naturgy	ES	13,544	14,879	19,630	21,076	24,904	24,969	24,697	26,015	21,908	23,306	24,339	23,035
Acciona AS	ES	:	:	6,263	7,366	7,016	6,607	6,499	6,544	5,977	7,254	7,510	7,191
PGE	PO	5,495	4,982	5,112	6,790	7,303	7,159	6,718	6,820	6,420	5,442	6,081	8,747
A2A S.p.A.	IT	6,094	5,910	6,041	6,198	6,281	5,389	4,984	4,921	4,860	5,796	6,494	7,324
Hera S.p.A.	IT	3,716	4,204	3,669	4,106	4,493	4,457	4,189	4,487	4,460	5,612	6,134	6,913
Enagás AS	ES	813	867	966	1,096	1,180	1,279	566	543	522	515	1,295	1,153
Hellenic	GR	10,131	6,757	8,477	9,308	10,469	9,674	9,478	7,303	6,613	7,995	9,769	8,857
Italgas S.p.A.	IT	:	:	:	:	:	:	:	:	:	:	1,176	1,258
ACEA S.p.A.	IT	:	:	:	:	:	3,289	3,038	2,917	2,832	2,797	3,028	3,186
Lundin	SE	584	55	89	142	156	133	83	62	121	203	258	288
Iren SpA	IT	2,482	2,260	2,828	3,520	4,328	3,448	2,901	3,094	3,283	3,697	4,041	4,275
Elia System	BE	:	:	:	:	:	1,323	786	780	800	829	1,935	2,242

6 Findings and discussion

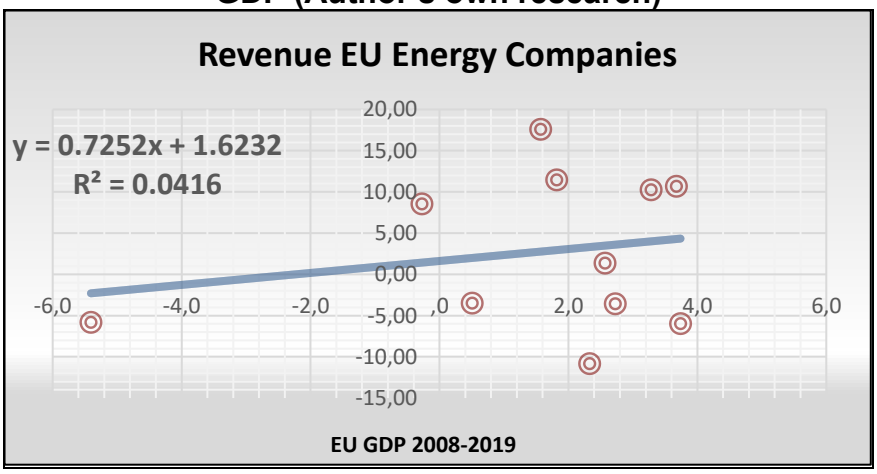
6.1 Findings

Through a statistical analysis between EU GDP real rate and the revenue of the 42 largest energy companies in the EU, it is possible to see the correlation between them is positive, but of a low tendency, as is verified in Pearson's correlation, being a correlation of 0.20, as shown on graphs 3 and 4. This indicates that both follow the same trend, but some variables make the performance of energy companies asymmetric with economic growth. One of these aspects can be explained by an improvement in the energy efficiency of these companies, or mergers with non-EU entities.

Graph 3 – EU GDP rate vs Revenue EU Energy Companies (Author's own research)

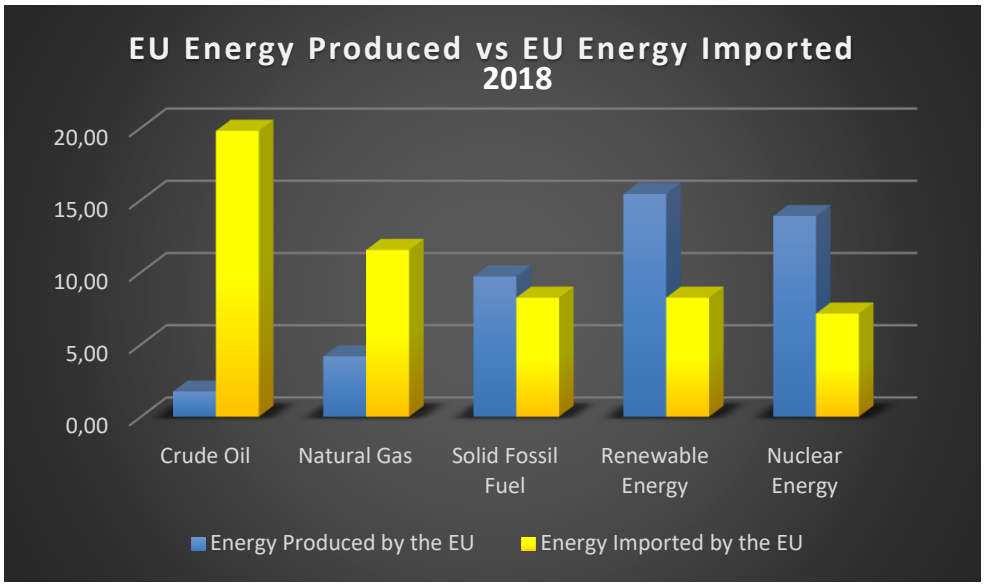


Graph 4 – Correlation between Revenue EU Energy Companies and EU GDP (Author's own research)



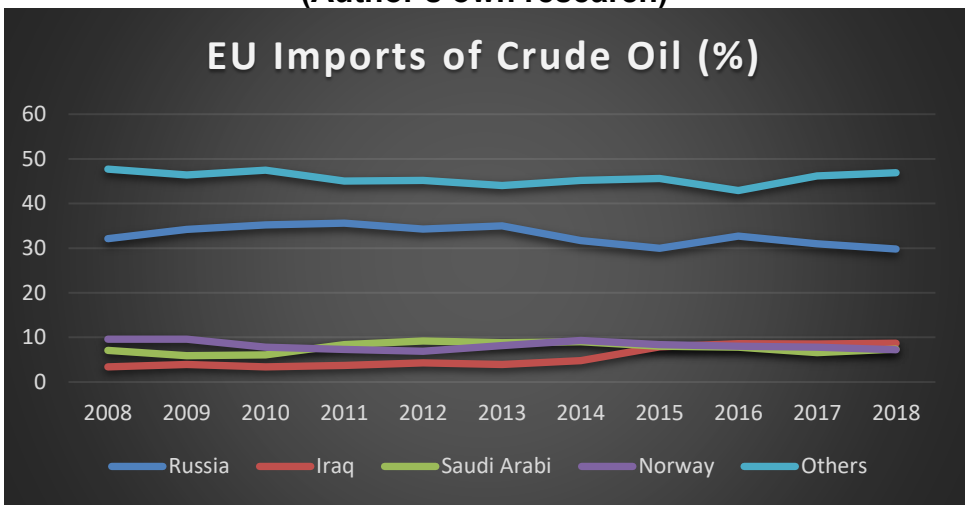
Energy imports to the EU represent 55% of the total energy consumed in the EU. The dependence on energy sources such as crude oil, natural gas and solid fossil fuel from third countries remains substantial. On the other hand, the production of renewable energy and nuclear energy has been growing within the bloc. In 2018, it is apparent that two of the three largest sources of energy in the EU are produced domestically by Member States, as showed on Graph 5.

Graph 5 – EU Energy by Production and Importation – 2018 (Author's own research)

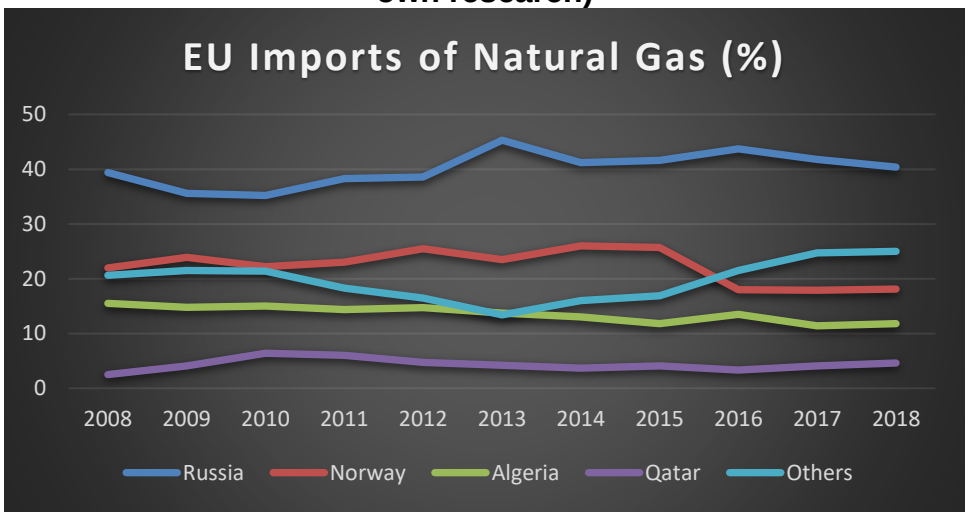


Regarding these energy imports, of the three main sources of energy imported into the EU (these sources being crude oil, natural gas and solid fossil fuel), a significant portion of it comes from Russia. This energy dependence on a small number of partners (particularly one with the military and political history of Russia), could destabilise the EU economy in the event of a shortage among its trading partners, as shown in graphs 6, 7 and 8.

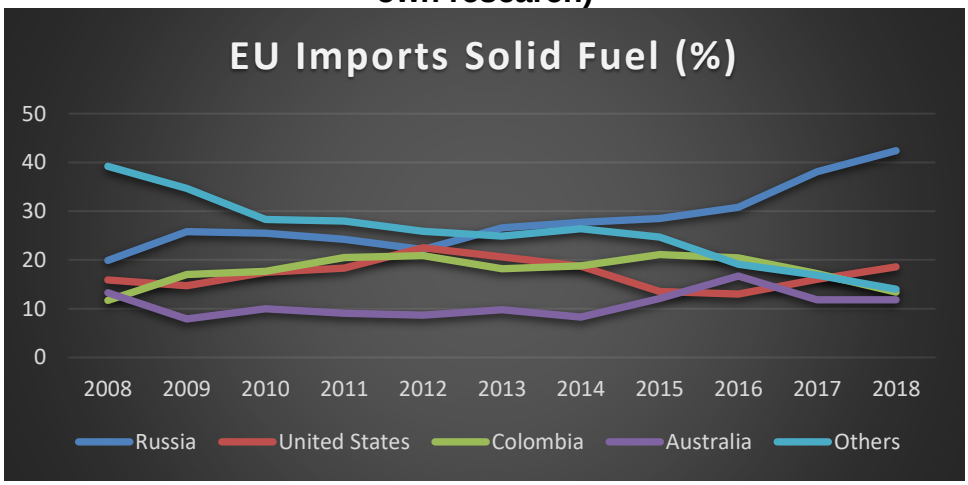
Graph 6 – EU Imports of Crude Oil between 2008 and 2018 (Author's own research)



Graph 7 – EU Imports of Natural Gas between 2008 and 2018 (Author's own research)



Graph 8 – EU Imports of Solid Fuel between 2008 and 2018 (Author's own research)



The findings identify that the most effective available measures that the EU has taken to create a safer energy market, have already been formulated and are either in force or in the process of being implemented by Member States. These measures include:

- De-verticalisation of energy companies. The same company cannot be responsible for the production, transmission and distribution of energy;
- Charging levies on carbon CO2 emissions for companies. The EU Emissions Trading System is the system that controls and charges governments and companies for the emission of CO2 derived from their market operations;
- Rewards for companies that invest in low-carbon energy production;
- A redesign of the Internal energy market to facilitate the transition from the conventional market practices over the previous years, to a sustainable, efficient and low carbon system; and
- Giving rights to the final consumer, whether a residential or industrial consumer, to choose which company they want to supply the energy to them; thereby increasing the competitiveness in the sector.

Apparent barriers to the development of the EU internal energy market include:

- The ‘National Champions’ create an oligopoly; the new companies end up being merged with these companies;
- Historic contracts for transmission lines and pipeline use give exclusivity or preference to some companies in their use, making it difficult for new companies to operate, and/or forcing them to make their products more expensive;
- The stagnation of the growth of the internal energy market in the last ten years; and
- Subsidies that benefit some energy companies or countries in the EU.

6.2 Discussion

The EU is formulating and implementing Directives to make the energy market more efficient, sustainable and independent, with lower CO2 emissions and greater security. These Directives range from how the energy structure should be rebuilt, to the rights given to consumers on the energy market.

The EU energy market could be increased by 122%, based on the current internal market of 45%. This market could increase energy security in the EU by decreasing reliance on energy imports, and broadening the partners from third countries, particularly to reduce reliance on Russia, which dominates most of the EU market in exporting energy into the EU.

Breaking the energy market into sectors increases the number of companies that are part of the market, with the intention of increasing competition within the economic bloc. The unbundling of the energy sector tries to eliminate the monopolistic tendencies of the market, opening space for new entrants. This makes the market more competitive. However, the 'National Champions' continue to exercise their power within the energy sector, acquiring new companies through mergers or acquisitions. Another measure taken to stimulate more competitive prices in the energy market is, end consumers have gained the ability to migrate between energy companies in search of better prices for supply.

The EU has been discouraging energy companies that operate with supply systems that generate CO2 emissions. These companies pay levies on the amount of CO2 emitted. On the other hand, companies gain incentives to develop technologies in energy production with low CO2 emissions. The market redraws its structure for a transition between a market with high CO2 emissions, to a market with low CO2 emissions.

Energy companies are having to make their energy production more efficient in order to remain competitive, with barriers to verticalisation of the market, and the obligation to offer a fair price service to keep their consumers.

Companies are under pressure from both sides to be competitive. They are under pressure from both the EU and its consumers.

Taxation for CO2 emissions causes the price of energy production to increase, making companies less competitive. Carbon taxation discourages companies from maintaining this type of process, thus incentivising investing in low carbon energy production, opting for renewable or nuclear energy sources. Companies that operate energy systems with low CO2 emissions gain incentives, which make them more competitive in the market, improving their end-price for consumers. However, many companies receive subsidies from their governments to continue with their processes unchanged, which lengthens the transition in the type of energy produced.

Despite the guidelines formulated by the EU to develop the internal energy market, this market has been stagnant for the past ten years.

Expectations and Findings

In this study, as had been expected, several pieces of evidence were found which indicate that the EU is committed to developing the internal energy market through Directives and Regulations. The EU monitors and frequently updates the Directives, aiming to make the internal energy market autonomous and secure. Accordingly, it is not surprising that many companies, mainly non-governmental companies, are adapting their facilities, development and research to develop and supply energy with low CO2 emissions.

As expected, the growth in the energy market remains at the same size as it had in the last ten years, following the low economic growth performance of the EU in the same period. Despite the fact that energy companies show a higher annual growth in their revenues, this data is not entirely reliable, since companies operate in other countries outside the EU, and such countries may be performing better in their economic growth, impacting that company's results. energy sources and not necessarily in the EU energy market.

Surprisingly, this study shows that the EU has been giving consumers rights, so that consumers can pressure energy companies to become more competitive, thereby influencing the energy market as well.

Another unexpected fact is that, despite Russia being a threat to energy security, as demonstrated in 2013 when it interrupted the supply of energy to Ukraine, Russia continues to gain market share among imports, standing out as the largest energy exporter to the EU. Given the allegations of Russian involvement in disrupting and influencing the US Presidential Election of 2016 and the Brexit vote, and that they are suspected of involvement in cyberterrorism and numerous assassinations abroad, it is very surprising that the EU maintains such reliance on Russia for energy.

On balance, it is encouraging to see the data trend indicating that EU companies are availing of the incentives to decarbonise their business operations in order to combat climate change. Although it can be difficult to discern whether this process is as a result of altruism, or is merely motivated by balance-sheet concerns, it evidences the proposition that political intervention can result in important real-world consequences. As one of the EU's primary objectives is to improve the quality of life of its citizens, they should feel motivated by their apparent success in this area.

7 Conclusion

The EU has begun to implement several measures to create a fair and free energy market. Among them are disincentivising state-owned companies, banning the vertical structure of companies in the energy market, introducing measures for access to the common energy market between Member States, and redesigning the moulds of energy sources for a transition of energy production with high emissions CO2 for energy production with low CO2 emissions, through incentives and taxes.

These measures resulted in a growth in the domestic energy market, which currently accounts for 45% of the production of energy consumed in the bloc.

On the other hand, governments belonging to the bloc are resistant to transferring national decision-making power to the detriment of the EU's supranational position. The energy market has the peculiarity of being directly related to the security status of each Member State, which means that governments create a way to not lose power over that market.

Governments within the EU decreased their participation in the energy market through state-owned companies, but continued to maintain their power through the 'National Champions', non-governmental companies that receive incentives from their governments to remain giants within the energy market. This makes it difficult to create a fair and free energy market, minimising the chances of new entrants to the market.

Another aspect of this study is the transition from energy sources produced in the EU. Companies whose main production is energy from fossils, which are CO2 generators, have to make massive investments to make this transition to develop other sources of energy and continue in the market. In addition to the impending deadline stipulated by the EU, the companies pay more and more for their CO2 emission rates they produce.

The EU energy market has great potential for expansion, today being considered a market that can grow internally by up to 122%. This would boost the economy of the economic bloc and decrease the dependence on energy imports. This study demonstrates that the EU develops policies to stimulate

the economic growth of the bloc, through policies that guarantee energy security and constantly seeks through its agreements, to reach the goal of decarbonisation by 2050. However, EU energy companies are using their revenues in order to adapt the measures imposed by the EU, and or, investing in other countries outside the bloc to maximize their revenues. This results in the lack of expansion of the domestic energy market in the past ten years. This provides third countries with security in their energy export operations to the EU, mainly to Russia, which has been increasing its share of energy exports to the EU.

It is necessary to pay attention, then, to the amount of effort and investments made by non-governmental companies to comply with the policies imposed by the EU. It is clear how much this impacts on the development of the internal energy market. If required to, they should rethink whether these deadlines imposed by the EU are realistic for the bloc and its energy companies. If the achievement of the goal of being the first decarbonised continent is deprioritised in favour of extending deadlines for compliance and lowering taxes and investment, the EU will suffer in the medium and long term. Instead, they should formulate a programme whereby both their energy security is protected and investment in renewable energy is rewarded.

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Appendix 1

42 Top Energy Companies - Revenue rate performance 2008 to 2019

			2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
			%	%	%	%	%	%	%	%	%	%	%	%
Shell	NL	:		-41.27	42.00	32.02	-2.51	-7.45	6.24	-29.88	-9.02	14.49	33.08	-9.07
Total	FR	:		-23.77	34.42	20.31	7.91	-20.21	-58.01	25.50	33.82	17.19	45.53	1.40
E.ON	DE	:		0.05	0.00	-33.33	10.08	-45.42	-15.58	1.01	-53.70	192.10	-20.25	14.86
BP	UK	:		-35.11	34.71	29.28	-1.47	-2.17	3.05	-29.79	-14.78	14.86	29.86	-4.72
Eni	IT	:		-22.48	17.94	9.18	18.55	-9.83	-5.39	-34.19	-22.86	27.29	8.40	-7.66
Enel	IT	:		4.66	14.59	8.36	6.84	-5.20	-5.89	-0.18	-6.70	5.73	1.25	6.29
Iberdrola	ES	:			17.53	4.00	8.07	-4.07	-93.54	-25.39	1718.89	8.71	12.20	3.88
Ørsted	DK	:		-18.59	10.22	4.36	17.88	8.73	-8.11	5.42	-13.29	-2.91	28.92	-11.87
Repsol	ES	:		15.32	17.11	19.28	-66.67	-2.69	-16.00	-11.74	-17.21	19.35	20.51	-1.40
ORLEN	PO	:		-17.03	43.49	13.01	65.42	-6.52	-9.02	-17.12	-12.89	26.77	11.74	2.28
SSE	UK	:	:	:	:	:	:	:	:	:	:	:	:	-71.75
National	UK	:	:	:	:	:	:	:	:	:	:	:	:	:
MOL	HU	:		-6.86	24.76	10.52	10.15	-2.53	-15.76	-14.40	-13.10	16.06	21.08	-1.28
Electricite	FR	:		3.90	-1.53	-0.02	10.52	4.73	-2.92	2.21	-5.07	-2.21	-1.56	4.04
Galp	PT	:		-20.08	17.56	19.05	9.75	6.02	-8.30	-13.85	-15.12	15.48	14.12	-1.65
NESTE	FI	:		-35.94	23.41	29.67	15.78	-3.44	-12.92	-25.85	5.01	13.07	12.87	6.18
PGNIG	PO	:		4.99	14.28	-3.84	35.96	10.25	5.80	6.41	-13.70	14.23	11.69	-45.32
Veolia	FR	:		-3.24	2.46	-35.37	3.36	-3.98	7.01	4.54	-3.12	3.88	3.13	4.93
EDP	PT	:		26.28	-11.53	12.38	-66.43	6.23	-89.63	-4.77	4017.60	-9.92	-46.72	9.57
EnBW	DE	:		-4.07	11.94	7.12	3.03	6.29	2.25	0.78	-8.50	13.45	-14.60	10.93
Fortum	FI	:		-3.57	15.84	-2.14	-0.03	-1.67	-21.55	-27.19	5.00	24.45	15.97	3.91
ENGIE	FR	:		17.64	5.72	7.33	7.02	-9.42	-15.03	-6.43	-7.22	0.29	-12.40	5.43
Snam	IT	:		29.76	42.14	2.77	9.46	-2.48	0.88	2.27	-37.00	1.28	2.09	3.05
Uniper	DE	:									-26.96	7.36	27.10	-28.33
Centrica	UK	:		14.52	5.86	4.23	7.65	8.62	18.39	0.78	-17.03	0.02	-17.73	2.67
Terna	IT	:		8.29	18.37	3.80	8.89	-5.10	0.38	21.88	1.03	7.45	4.05	0.68
Red	ES	:		6.59	16.43	17.18	7.20	0.17	5.03	4.99	-0.34	0.46	-0.65	4.08
CEZ	CZ	:		7.98	6.32	0.86	21.55	-7.41	-8.19	6.81	-3.06	4.71	-9.12	13.16
LOTOS	PO	:		-30.65	67.86	43.93	5.34	-14.84	7.31	-20.24	-11.85	19.11	23.90	-2.88
RWE	DE	:		-2.76	9.81	-3.09	3.29	1.23	-10.20	0.45	-5.97	-2.65	-68.41	-2.10
Naturgy	ES	:		9.86	31.93	7.37	18.16	0.26	-1.09	5.34	-15.79	6.38	4.43	-5.36
Acciona	ES	:	:	:		17.61	-4.75	-5.83	-1.64	0.69	-8.65	21.36	3.52	-4.25
PGE	PO	:		-9.34	2.62	32.82	7.56	-1.98	-6.15	1.52	-5.87	-15.23	11.74	43.84
A2A	IT	:		-3.02	2.22	2.60	1.34	-14.20	-7.52	-1.26	-1.24	19.26	12.04	12.78
Hera	IT	:		13.13	-12.74	11.92	9.43	-0.80	-6.01	7.11	-0.60	25.83	9.31	12.69
Enagas	ES	:		6.61	11.44	13.49	7.64	8.35	-55.75	-3.96	-3.97	-1.31	151.44	-10.93
Hellenic	GR	:		-33.31	25.46	9.80	12.48	-7.59	-2.02	-22.95	-9.44	20.89	22.20	-9.34
Italgas	IT	:	:	:	:	:	:	:	:	:	:	:	:	6.95
ACEA	IT	:	:	:	:	:	:	:	-7.62	-3.98	-2.91	-1.25	8.28	5.21
Lundin	SE	:		-90.53	60.29	60.04	9.89	-14.57	-37.93	-24.64	94.37	67.45	26.94	11.66
Iren	IT	:		-8.96	25.16	24.47	22.95	-20.33	-15.85	6.65	6.11	12.61	9.29	5.79
Elia	BE	:	:	:	:	:	:		-40.63	-0.69	2.56	3.55	133.53	15.89

EU - Member States Real GDP rate Performance 2008 to 2019

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
%	%	%	%	%	%	%	%	%	%	%	%
-5.1	-14.80	-5.50	-9.10	-7.30	-6.60	-1.90	-0.40	-0.20	0.10	0.80	0.30
-4.4	-14.40	-4.50	-1.70	-4.10	-3.20	-0.40	0.50	1.10	1.50	1.30	0.60
-3.3	-14.20	-3.90	-0.80	-3.40	-1.80	-0.10	0.80	1.30	1.70	1.50	1.10
-1.3	-8.10	-1.50	-0.30	-3.00	-1.40	0.00	1.00	1.50	1.80	1.50	1.20
-1	-7.50	0.20	0.40	-3.00	-1.00	0.70	1.10	1.80	1.90	1.50	1.40
-0.5	-7.40	0.60	0.60	-2.60	-0.90	0.70	1.70	1.90	1.90	1.80	1.50
-0.5	-6.70	0.70	0.70	-2.20	-0.90	0.80	1.80	2.00	2.00	1.90	1.50
-0.3	-5.70	1.30	0.90	-1.50	-0.50	1.00	1.80	2.00	2.30	2.00	1.60
-0.3	-5.50	1.30	1.30	-1.40	-0.10	1.40	2.00	2.10	2.50	2.40	1.70
0.3	-5.50	1.50	1.40	-1.00	0.00	1.40	2.00	2.10	2.50	2.40	1.90
0.3	-5.30	1.70	1.50	-0.80	0.00	1.60	2.00	2.10	2.60	2.40	2.00
0.8	-5.10	1.70	1.60	-0.60	0.30	1.60	2.20	2.20	2.90	2.40	2.20
0.9	-4.90	1.80	1.70	-0.40	0.40	1.90	2.30	2.20	2.90	2.60	2.20
1	-4.70	1.80	1.80	0.10	0.50	1.90	2.40	2.20	3.00	2.70	2.30
1.1	-4.40	1.90	1.80	0.20	0.60	2.20	2.40	2.50	3.10	3.10	2.30
1.5	-4.30	1.90	2.00	0.30	0.70	2.30	3.30	2.60	3.30	3.10	2.30
1.8	-4.30	1.90	2.20	0.40	0.90	2.60	3.40	2.60	3.50	3.20	2.40
2.2	-4.20	2.00	2.40	0.40	1.20	2.70	3.80	2.80	3.50	3.60	2.40
2.6	-3.80	2.40	2.50	0.70	1.20	2.80	3.80	3.00	3.80	3.90	2.90
2.7	-3.80	2.70	2.50	0.70	1.30	2.80	3.80	3.10	4.20	4.10	3.20
3.3	-3.70	2.90	2.90	1.50	1.40	3.00	3.90	3.10	4.30	4.10	3.40
3.5	-3.40	3.20	2.90	1.60	2.00	3.30	4.00	3.20	4.40	4.30	3.90
3.6	-3.10	3.50	3.20	1.90	2.10	3.40	4.30	3.50	4.80	4.40	4.10
4	-2.90	3.60	3.90	2.10	2.30	3.50	4.50	3.80	4.90	4.80	4.10
4.2	-2.50	4.20	5.00	2.80	3.50	4.20	4.80	4.60	5.20	5.10	4.30
5.6	-2.00	4.90	6.00	3.10	3.60	4.30	5.40	4.80	5.70	5.30	4.70
6.1	-2.00	5.70	6.30	3.80	3.70	8.60	10.90	5.80	6.50	7.30	4.90
9.3	2.80	6.00	7.40	4.10	4.90	9.00	25.20	6.70	7.10	8.50	5.60

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
GDP rate	1.36	-5.41	1.57	1.82	-0.27	0.51	2.33	3.74	2.73	3.35	3.29	2.57
Revenue		-7.09	18.52	11.14	6.70	-4.41	-13.73	-5.63	141.47	15.63	13.56	-0.14
ratific. 10% Revenue		-5.83	17.55	11.41	8.50	-3.54	-10.86	-6.00	-3.60	10.65	10.21	1.35

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
GDP rate	1.36	-5.41	1.57	1.82	-0.27	0.51	2.33	3.74	2.73	3.35	3.29	2.57
ratific. 10% Revenue		-5.83	17.55	11.41	8.50	-3.54	-10.86	-6.00	-3.60	10.65	10.21	1.35

=PEARSON(matriz1;matriz2)

Pearson Correlação 0.20