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# The impact of the Russian invasion of Ukraine on the European Union's Energy Transition

Energy Independence as both a Catalyst and Consequence

Tiago Morais Dias

Dissertation submitted as partial requirement for the conferral of Master in Economy and Public Policies

Supervisor:
PhD Cristina Sousa, Associate Professor, Department of Political Economy
Iscte - University Institute of Lisboa

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CIÊNCIAS SOCIAIS
E HUMANAS

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## Dedication

This work is dedicated to the brave and resilient people of Ukraine, who continue to endure unimaginable hardships in the face of conflict, and whose sacrifice keeps all of Europe safer, stronger, and freer.

## Acknowledgements

Completing this thesis has been not only an academic challenge but also a profound journey of personal growth.

First and foremost, I would like to express my deepest gratitude to my mother, her unwavering support and belief in me has been the foundation of all that I have achieved in my academic path. Thank you for your presence, patience, and love, during these past 24 years.

To my partner, Sara, thank you for your endless love, care, and understanding throughout this process. You been my constant source of strength during the most demanding nights and days, and I am forever grateful.

To my grandmother and Bruno, a heartfelt thanks for always being there for me, offering words of wisdom and motivation when I needed them most. I am also grateful to the rest of my family for their support and belief in my academic choices and success.

To my hommies, Afonso, Bernardo, Daniel, Guilherme, Luís, Lin e Ricardo, thank you for providing welcome distractions when I needed them most, and for your encouragement and academic help whenever I encountered new challenges. Your presence was vital in helping me navigate the complexities of my research.

Lastly, I am immensely grateful to my supervisor, Cristina Sousa, for encouraging me to explore complex ideas and for her guidance and support throughout this project. I would also like to thank the university for providing the environment and resources that enabled me to complete this thesis.

## Abstract

The invasion of Ukraine in 2022 has significantly reshaped the energy landscape in Europe, prompting the European Union (EU) to reassess its energy policies and accelerate the energy transition, leaving behind fossil fuels of which it was mostly dependent on Russia and rolling-out renewables as a path to energy independence and security. This thesis aims to provide a comprehensive analysis of energy policy changes and the impact those policies have had since February 24, 2022.

This research begins with a literature review focused on clarifying concepts related to energy and the risks of climate change for European citizens. This is, followed by a review of past energy crisis and geopolitical events that have affected energy policy, and an overview of the EU's energy landscape prior to the Ukraine invasion. The subsequent sections provide a detailed analyses of the energy data from before and after the beginning of the invasion, as well as recent policies aimed at fighting climate change, starting with the European Green Deal, and examining how the war, through the REPower EU program, has reshaped European energy policies to accelerate the energy transition. By accelerating renewable energies integration, the EU not only distances itself from Russia, but also positions itself as a global leader in the fight against climate change.



**Keywords:**

Energy Transition; European Union; Russia-Ukraine War; European Energy Policy; Renewable Energy

**JEL Classification**

F51 - International Conflicts; Negotiations; Sanctions

Q40 – Energy

# Resumo

A invasão da Ucrânia em 2022 transformou significativamente o panorama energético na Europa, levando a União Europeia (UE) a reavaliar as suas políticas energéticas e a acelerar a transição energética, deixando para trás os combustíveis fósseis de que dependia maioritariamente da Rússia e lançando as energias renováveis como via para a independência e segurança energética. Esta dissertação tem como objetivo fornecer uma análise abrangente das mudanças na política energética e do impacto que essas políticas tiveram desde 24 de fevereiro de 2022.

A presente investigação começa com uma revisão da literatura centrada na clarificação dos conceitos em torno da energia e dos riscos das alterações climáticas para os cidadãos europeus, seguida de uma análise das crises energéticas passadas e dos acontecimentos geopolíticos que afetaram a política energética, seguindo-se depois uma visão geral do mercado energético da UE antes da invasão da Ucrânia. As secções seguintes analisam em pormenor os dados energéticos de antes e depois do início da invasão e as recentes políticas adotadas para combater as alterações climáticas, começando pelo Pacto Ecológico Europeu e pela forma como a guerra, e a resposta à mesma através do programa REPower EU, alterou as políticas energéticas europeias para acelerar a transição. Ao acelerar a integração das energias renováveis, a UE não só se distancia da Rússia, como se posiciona como líder mundial na luta contra as alterações climáticas.



**Palavras-chave:**

Transição Energética; União Europeia; Guerra Russo-Ucraniana; Política Energética Europeia; Energias Renováveis

**Classificação JEL**

F51 – Conflitos Internacionais; Negociações; Sanções

Q40 – Energia

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## Glossary

CCUS - Carbon Capture, Utilisation And Storage

ECC - European Economic Community

EEA – European Environment Agency

EU – European Union

EU ETS - European Union Emission Trading System

G7+ - Group of Seven Plus

GHG – Greenhouse Gases

IEA - International Energy Agency

LNG - Liquified Natural Gas

NATO – North Atlantic Treaty Organisation

NGO – Non-governmental Organisation

OECD - Organisation for Economic Co-operation and Development

OPEAC – Organisation of Arab Petroleum Exporting Countries

OPEC - Organisation of the Petroleum Exporting Countries

RES – Renewable Energy Sources

UN – United Nations

U.S. – United States of America

GJ - Gigajoules

GW – Gigawatt

TW – Terawatt

*"Electric power is everywhere present in unlimited quantities and can drive the world's machinery without the need of coal, oil, gas or any other of the common fuels"*

Based on *The Problem of Increasing Human Energy* (1900) by Nicolas Tesla

# 1. Introduction

Energy is in everything. Our societies are fully dependent on it in all sectors, be it to power all our lights and machines, to drive our cars, or to heat our homes, virtually every aspect of modern society is shaped by energy. Fossil fuels have been the basis of all energy systems since the Industrial Revolution, and while Europe started its industrialisation with more than enough energy resources to meet its needs, as demand grew, and especially as oil became the main energy source, Europe had to find partners to satisfy its needs and grow its economy. For decades Russia has been this partner. Most of the necessary pipeline infrastructure had been set during the Cold War in Soviet countries, and other alternative partners were distant and thus more expensive (Goldthau, 2008; Mitrova, 2014). As a result, although Russia and the European nations have been distancing themselves politicly, their energy relations have only grown closer (Goldthau & Sitter, 2014).

The first bells rang in 2014 with the annexation of Crimea. At the time light sanctions were imposed, relations tightened with Ukraine and deteriorated with Russia. It had become apparent, in Ukraine and other nations, that Russia was willing to use its energy power as a geopolitical weapon (Pirani et al., 2009). Despite warnings from some politicians regarding the cost of the EU's extensive integration of Russia in its energy sector (Huuhtanen, 2016; U.S. Department of State, 2019), the dependence remained and, in some places, even deepened, as is the case with the construction of the Nord Stream 2 pipeline, which, fortunately, never became operational and had no gas flow through it (Sziklai et al., 2020; Wettengel, 2023).

Although some countries had already taken steps in this direction, it was only after the 2015 Paris Climate Agreement that more global and concrete goals were set to limit Greenhouse Gas (GHG) Emissions and fight Climate Change. Countries in the EU took the lead, being some of the first to set its net zero-emission goals in 2050 (Fominova, 2022). A target which would later become a banner of the European Green Deal.

Following the 2019 European election, the energy transition became a centre piece of the European Council and European Commission's agendas for the 2019-2024 legislature (European Council, 2019; von der Leyen, 2019). The European Green Deal presented by the Commission set the roadmap for a series of reforms and targets to be implemented over the coming years, with the ultimate goal of reaching net-zero by 2050. Changing our electricity production to 100% renewable energy sources (RES) is a vital but insufficient step. For the transition to be successful, we must electrify carbon intensive sectors such as transportation and manufacturing, increase energy efficiency, and improve both national and transnational energy grids (Zappa, 2019).

A net-zero Europe will also be a freer, safer, and more stable Europe. Reducing the fossil dependency on foreign powers will stabilise energy prices by decoupling them from international price fluctuations and geopolitical crises. This is vital for our industries which depend on abundant, cheap, and stable energy supplies. It will ensure Europe's energy security in all sectors is dependent only on its production and electrical grids, meaning it will be energy independent.

The 2022 Russian invasion of Ukraine turned theorical fears about Russian energy dependence into an immediate and clear danger for energy and heat security in the EU. The purpose of this work is not to investigate whether or not there was an impact in the energy sector, as it is abundantly clear there was, but to understand if such changes led to a push forward or a setback in the EU's ongoing energy transition.

In this optic, this thesis strives to address the following question: *Has the impact of the war in Ukraine on the European energy sector accelerated or delayed the energy transition, in line with the objectives set by the European Union?*

The war in Ukraine has created both opportunities and challenges for the EU's energy transition. On the one hand, the disruption of Russian gas imports has encouraged the EU to accelerate its investments in renewable energy and diversify its energy sources. On the other hand, the immediate need to ensure its energy security for the coming winters (2023 and 2024) has led to a temporary resurgence in fossil fuel consumption, especially natural gas from non-Russian suppliers and coal for electricity generation.

Based on this complex scenario, the hypothesis of this research is that the war in Ukraine has had a mixed impact on the European energy transition, simultaneously accelerating certain aspects of the energy transition while delaying others due to short-term energy security concerns. This research will analyse these contrasting effects, considering both the acceleration driven by geopolitical shifts and the delays caused by the immediate necessity for traditional energy resources. Nonetheless, taking all factors into account, we believe that the benefits will outweigh the delays and that, in the long run, Europe's energy transition has been accelerated by the sudden need to wean itself off Russia's fossil resources.

To study how the war has affected the EU's energy sector, this work will start by conducting an extensive literature review with the goal of understanding the importance of energy in our society, defending the relevance of the energy transition, and analysing how energy resources are commonly used as 'weapons' in geopolitics and war. We will also seek to explore the progress made in the academic field in linking the war in Ukraine and the European energy sector.

Secondly, with more than two years passed, we analyse the immediate impact of the war and the subsequent sanctions against Russia on the European energy market's composition by looking into the data from the past months, quarters and semesters between February 2022 until December 2023 or June 2024, depending on the available data. To better understand previous trends and determine whether they have persisted, the data before the war is analysed since January 2017. This retrospective is particularly important given the influence of the COVID-19 pandemic and associated preventive measures on the period between the first quarter of 2020 and the third quarter of 2023, when the EU's economy returned to pre-pandemic levels.

Finally, we examine the major energy transition policies and goals already in motion before the start of the war, most of which are under the European Green Deal, and we compare these to the new proposals made after February 24, 2022, mainly the REPower EU program. We also look into the main measures, part of the thirteen sanction packages, which affect the energy sector.

This thesis employs a mixed-methods approach, combining quantitative data analysis with qualitative insights from energy sector reports, policy documents and policymaker statements. The quantitative analysis examines changes in the overall energy mix in the EU, the electricity production mix, the volume of imports of certain fossil fuels and the origin of such imports, the GHG emissions and the fluctuations in gas and electricity prices. The qualitative analysis explores reports from Think Tanks, International Organisations and European Institutions, sanctions and policy documents from European legislatures and policymakers, mainly from the EU Commission, European Parliament and Press-notes and statements from EU Council meetings, as well as direct statements from policymakers and European Institutions leaders.

We consider this issue to be of paramount importance given that the war in Ukraine has dominated European foreign and energy policies during the years. Likewise, energy transition has increasingly become a priority on the political agenda of European institutions, with targets set for the decarbonisation of the continent.

Therefore, due to Europe's dependence on Russia for its energy supply, in particular natural gas, which was being used by several Member States as a transitional energy source (as it is less polluting than coal or oil) (Metaxas, 2023), these two issues come together, with the energy transition currently dependent on the policies adopted in response to the energy crisis caused by the war and the consequent sanctions against Russia. Similarly, the response to Russia depends on the interests and needs of European citizens, which has several times delayed more severe sanctions on the Russian energy sector.

The EU's support for Ukraine is manifested not only in the supply of arms and ammunition but also in the economic sacrifices that Member States are prepared to make (through the application of sanctions) to weaken the Russian state. Nevertheless, it is up to the European Commission and the Member States to honour their commitments to their citizens and to achieve their energy transition goals.

Therefore, it is in the academic interest, but also in the civic and democratic interest, to analyse the real (and not just the desired) impact of the EU's and Member States' energy policies, and to see how the war, in its immediate aftermath and its continuing impact, has allowed policymakers to keep or accelerate their promises, or whether it will force a delay in achieving the set goals.

# 2. Energy and Energy Transition

This literature review aims to (1) clarify the concepts around Energy, Energy Security, Energy Securitisation, Energy Independence, and Energy Transition, given that they are frequently used interchangeably. (2) analyse the impact of Climate Change in the EU, its causes and how we should take action and (3) what steps have been made until this day.

Literature around these topics is relatively recent. As climate change and energy transition policies, actions, and investments have grown in recent years, the academic literature has followed suit (Figure 2.1). A 2023 review article revealed that of the 875 articles published on the topic of Energy Transition in the last 2 decades (2002-2022), 70% had been published after 2016 (Genc & Kosempel, 2023).

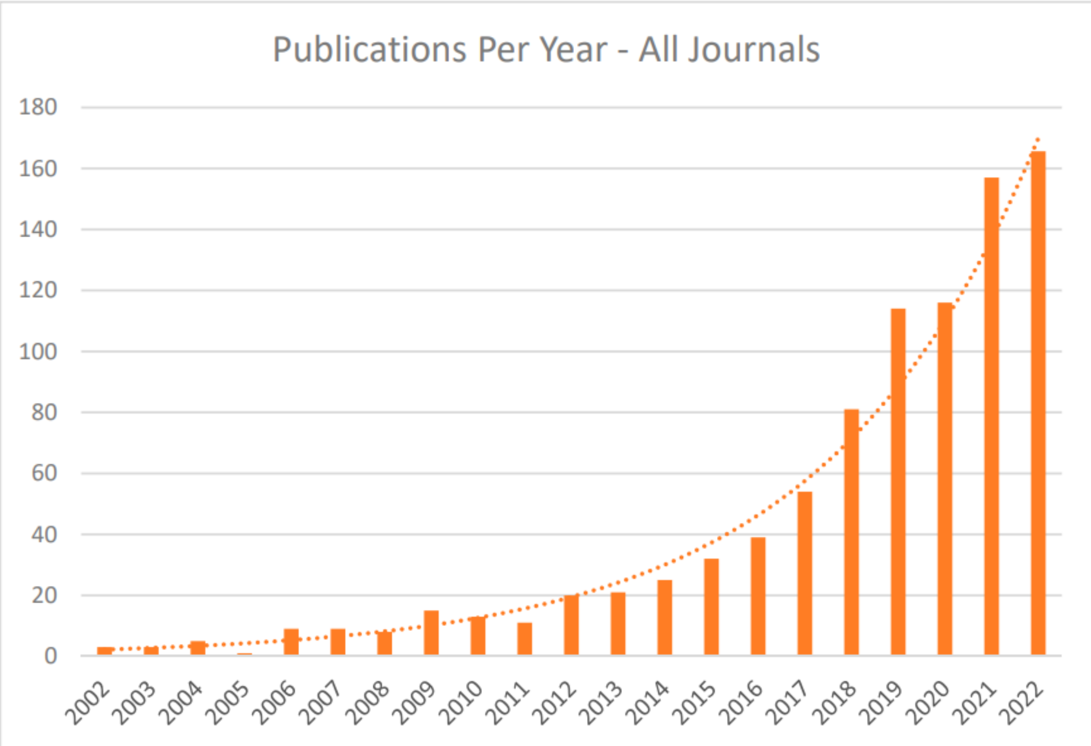


*Figure 2.1: Publications per year, all journals. (Genc & Kosempel, 2023)*

## 2.1. About Energy

Energy is a complex and multifaceted concept. The origin of the word Energy comes from Aristotle in Greek, *Energeia*, which can be loosely translated to "being at work" or "activity" (Snurr & Freude, 2019). To this day in physics, energy is described as the capacity to do work or to produce change. It can be kinetic, potential, thermal, chemical, electrical, nuclear, or radiant (U.S. Energy Information Administration, 2023). However, we often, in our daily lives, use the concept of energy intertwined with that of electricity, but energy is a much broader concept.

Energy is present everywhere, in the forces that constitute our universe and bind atoms together, in the gravity that keeps Earth orbiting the Sun and in particular in the energy we receive from the Sun in the form of radiation which is the main source of energy on earth. The Law of Conservation of Energy states that energy cannot be created or destroyed, it can only be transformed, meaning energy can only change between its diverse types but the total balance of energy in the universe always remains the same (Snurr & Freude, 2019).

The energy in our planet comes mainly from the Sun, it is the nuclear fusion that takes place in the sun's core that transforms nuclear energy into radiant energy which heats our planet and is transformed into chemical energy through photosynthesis making up the base of our ecosystem. The energy and life of all living organisms comes from the sun. Under certain conditions of temperature and pressure, the accumulation of dead organic matter is transformed into fossil fuels, which are highly concentrated sources of chemical energy, stored in carbon molecules (Geological Survey Ireland, 2019).

In our society, the main uses of energy are to create electricity, to heat our homes, to power our engines and for industrial processes (International Energy Agency (IEA), 2023).

Electricity is a practical use or representation of energy. It is created by using one or more of these types of energy to create a current, a flow of electrons (Kashy et al., 2024). Whether it is using the kinetic energy of water flowing in a river to turn a turbine to create that current, or inducing the fission of uranium atoms to create a chain reaction and convert their nuclear energy into thermal energy that heats water, resulting in high-pressure steam, which then converts its thermal energy into kinetic energy and turns a turbine that transforms that kinetic energy into electrical energy to power our cities and homes.

A similar process is used to power combustion engines, chemical energy stored in carbon molecules (such as those found in high concentrations in oil, gas, or coal) is used to create thermal energy which can cause air to expand, thus creating kinetic energy and powering the engines (Office of Energy Efficiency & Renewable Energy, 2013). This kinetic movement directly makes our vehicles work. This same process of using carbon-dense fossil fuels to create thermal energy is also what is used to power homes in several countries, mainly with natural gas.

The purpose of these examples is to distinguish between the concepts of energy as a whole and of electricity, as well as to have a better understanding of how energy is present in our daily lives and society in a much broader way than just electricity. And, through this, to better understand the challenge of decarbonisation, which aims to remove these carbon sources (which when chemical energy is converted into thermal energy, not only creates heat but also $CO_2$ molecules) from all uses of energy.

The energy cycle, represented in the Energy balance flow diagram in Annex A, starts in our economies with the harness or production of primary energy resources, such as fossil fuels, renewable resources, or nuclear heat. Those produced within the EU are part of our indigenous (i.e., domestic) production, some of which are exported. The difference between our needs and what is left of our production after taking into account the exports is what we need to import from third countries, and that imbalance is our energy dependence.

These resources are then transformed, either processed into other fuels (for example, crude oil is processed into petrol) or used to generate electricity. Some of these transformed energy resources are also exported to third countries and not all of the resources are transformed, some are used directly in their primary state. After distribution, the energy consumed in the various sectors, mainly households, manufacturing, and transportation, is the final energy consumption. This is not only the electricity consumed, but also the fuel for the cars, the coal for the fireplaces, or the gas for heating households.

The carbon emissions from electricity production only represent around 17.59% (first quarter of 2024) of the EU's total emissions (Eurostat, 2024b). Although it accounts for a significant share of emissions, it shows that decarbonising our energy production is not enough to decarbonise our society. Transportation, industrial processes, agriculture, building heating and waste management are all significant sources of greenhouse gas emissions (Eurostat, 2024b). For the green transition to be successful in lowering emissions and fighting climate change, all these sectors require alternatives. Some of the problems can be solved by promoting the electrification of processes (Morte et al., 2023). For example, the growing sector of electric vehicles, not only for personal use but also in public transportation. Also, there are electric heating alternatives to central gas heating. The main issue with widespread electrification is that we are in a phase of energy transition and electrification will increase the stress in power grids, so to be successful in decarbonisation we do not only need to decarbonise the energy sources, but we also need to increase energy production and make it more efficient so that there is less energy lost in the system (Zappa, 2019).

This goal must be met while always ensuring the energy security of EU's citizens, i.e., the guarantee of uninterrupted access to energy, that is affordable and accessible to the population (Sovacool et al., 2013). If a country's energy market can meet its energy demands but at such prices that part of its population have to ration their use or are restricted from using it for financial reasons, then those people are not energy secure.

Given recent and past geopolitical turmoil, no country that is not 100% independent, that is, able to secure its energy needs without relying on foreign energy imports, is immune from energy security risk. Whether through exposure to global energy price fluctuations or by the global impact of geopolitical crises, all sectors of society are affected by the lack of reliable energy prices, from the competitiveness of industries to the average household energy bills (Sovacool et al., 2013).

Therefore, energy security is one of the main priorities of modern states. When it is put at risk due to ongoing crises that lead to energy supply disruptions, the need to ensure the states' energy security will supplant other energy-related policy imperatives. As Kuzemko et al. (2022) put it, energy tends to be securitised during acute geopolitical crises, resulting in energy security obfuscating other energy policy goals, such as the energy transition goals, making it harder for policymakers to pursue long-term transition strategies in an increasingly unpredictable geopolitical landscape.

Energy, an issue usually reserved for public or private companies, becomes part of a widespread debate during moments of crisis. This process is defined as securitisation. It occurs when an issue usually not associated with security, unlike defence or individual physical security is brought into the public debate as a security issue because it affects our collective security, be it economic, cultural, or political (Wæver, 1995). In the case of energy securitisation, it is "[…] especially likely after a period where questions of safety and security had slipped down political agendas, leading to associations of shock with recognition of insecurity." (Kuzemko et al., 2022, p. 2), resulting from fears of high oil prices, the possible lack of gas for central heating during the winter or even the lack of means to produce electricity leading to blackouts.

Securitisation has the positive effect of bringing these issues into the public debate, drawing attention to them and making the public aware of the negative consequences that may be associated with the decisions needed to increase energy security. It can also have the opposite effect, public opinion can deviate from what competent actors consider the necessary course. This can be exploited by the state's enemies by spreading disinformation and creating a debate around an issue, securitising it, in order to weaken the state's decisions, and, or, to create a sense of fear and confusion among the public. Securitisation most often arises from feelings of vulnerability and worry, not strength (Markiewicz, 2023). Either way, even if it is not truly a security issue, if it is handled in such a way by public figures, in their speeches, actions, and legislation, it will enable actors to achieve different results than if it was handled as a non-securitised issue (Wæver, 1995).

Climate change might also be viewed under these terms as a securitised issue in the public debate since it has been growingly put under an emergency frame. Speeches by civil actors and politicians have stressed the need to treat climate as a serious and impending emergency (Climate Emergency Declaration, 2024; UN Environment Programme, 2022). This frame has the purpose of generating engagement of the public, increasing political activism, and building up support for action (Patterson et al., 2021). However, when compared to the new energy security dilemmas, the need for action regarding the energy transition is sidelined, for it is not seen as such an immediate threat and it is hard to maintain high levels of support for emergencies over time without it leading to fatigue and even becoming a more polarised issue in civil society (Patterson et al., 2021), effectively resulting in the emergency frame being counterproductive to its original purpose and easily sidelined by other, more present emergencies.

In the context of Russia's invasion of Ukraine, there are examples of regressing tendencies within the EU in climate policy to ensure energy security, but also cases of energy security and energy transition objectives complementing each other (Kuzemko et al., 2022). Although in some countries there may be an extension or revitalisation of the use of more carbon-intensive energy solutions, this is a temporary setback. In the long term, the energy transition goals were never put into question and there will be a complete transition to renewable sources (Zuk & Zuk, 2022).

Reframing the Climate issue as a transnational crisis has also allowed the EU to gradually take more action in more energy-related areas, as was the case with energy efficiency policies, which were being developed at an EU level since the 1970s but were consistently put aside by the Member States, as the EU did not yet have this authority. Only by framing energy efficiency and other energy transition policies as climate-related issues requiring transnational action were EU policymakers able to gradually negotiate and adopt measures, even before they were granted legal authority under the 2009 Lisbon Treaty (Dupont, 2020).

### 2.2. Why should Europe be worried about Climate Change?

How clear is the impact of anthropogenic GHG emissions in climate? And what effects is the change in global temperature having in our world? As we can see in Table 2.1, based on the Climate Change 2023 report by the Intergovernmental Panel on Climate Change (IPCC), global GHG emissions are at their highest in the past two million years. This dramatic increase has occurred primarily in the past few centuries since the industrial revolution, with emissions continuing to increase during the past decade. This increase in the concentration of GHG is responsible for the increase in global mean temperature, which leads to global sea level rise, among other effects.

| **Observed Warming and its Causes** | **Observed Changes and Impacts** |
|---|---|
| The global surface temperature was 1.09 [0.95-1.20] ºC higher in 2011-2020 when compared to 1850-1900 | Global mean sea level increased by 0.20 [0.15 to 0.25]m between 1901 and 2018. Human influence has very likely been the main driver since at least 1971. |
| GHGs contributed between 1 to 2ºC of the warming with other human drivers (mainly aerosols) contributing with a cooling of 0.0 to 0.8ºC | 3.3 to 3.6 billion people live in the context of high vulnerability to climate change. Increasing weather and climate extremes events expose millions to food insecurity and water scarcity. |
| 2019 concentration of $CO_2$ was higher than at time in at least two million years (high confidence) and those of methane and nitrous oxide in at least 800,000 (very high confidence) | Climate change has caused damage or even irreversible losses in ecosystems. |
| Net anthropogenic GHG emissions were 12% higher in 2019 compared to 2010 and 54% up from 1990. Average annual emissions were higher in the last decade than any time before. | The increase in extreme heat events, climate-related food-borne and water-borne diseases and vector-borne diseases have increased human mortality and morbidity. |

| | |
|---|---|
| Historic contributions of $CO_2$ vary significantly around the world, with the 10% richest households contributing 34-45% of global consumption-based GHG emissions, while the bottom 50% only contribute 13-15%. | Climate-exposed sectors such as agriculture, forestry, fishery, energy, and tourism have had negative economic impacts because of climate change. The intensified extreme heat events in cities have also led to disruption of services resulting in economic losses. |

*Table 2.1: Observed Warming and its Causes and Observed Changes and Impacts, based on data from IPCC (2023). Table created by the author.*

Climate change poses a significant threat to various regions around the world, as we can see in Table 2.1 with the European Union not being immune to such effects. Recent academic literature reveals that climate change already exacerbates the frequency and intensity of extreme weather events in the EU, including heatwaves, floods, and storms (Pradhan et al., 2022). These events disrupt all aspects of ecosystems, not only human activity. Climate change and biodiversity crisis are intertwined, with gradual changes in climate and extreme weather events accelerating the degradation of natural habitats and biodiversity loss already caused by human land, freshwater, and ocean exploitation, which remains its main driver (Arneth et al., 2020).

Vector-borne diseases such as Lyme disease, West Nile virus and Malaria, also expand to new territories and threaten further human populations. These vectors are cold-blooded animals that thrive in warmer areas and have seen their habitats expand due to the increase in temperature (Rocklöv & Dubrow, 2020). The transmission potential for dengue by *Aedes aegypti* and *Aedes albopictus* increased by 28.6% and 27.7%, respectively, and 12.7% more of the coastline is now suitable for *Vibrio* transmission in 2022 than in 1982-2010, putting a record 1.4 billion people at risk (Romanello et al., 2023).

More frequent heatwaves also pose a threat contributing to heat-related illnesses and exacerbating chronic conditions, such as cardiovascular and respiratory diseases. Even if temperature increase is limited to 2 degrees Celsius above pre-industrial levels, by mid-century, heat-related deaths are projected to increase by 370%, heat-related labour losses are projected to increase by 50%, and 524.9 million additional people are projected to experience moderate to severe food insecurity (Romanello et al., 2023).

While there is certainly a pattern of more severe and extended droughts, correlation does not imply causality, and climate patterns are difficult for scientists to study, involving large degrees of uncertainty. It is also a phenomenon that does not affect the whole world equally, for when a region is affected by drought, the extra water evaporated from the soil may well lead to above average precipitation in other zones of the globe, as is the case in North America where there has been a megadrought in the western United States and northern Mexico, which has been linked to anthropogenic climate change (Williams et al., 2020), but with the overall trend being of a wetter U.S. (U.S. EPA, 2016).

Nevertheless, some points are clear, some regions have been suffering from soil aridification, with average higher temperatures removing the humidity from the soil. And several mountain ranges in the western U.S. and Europe have seen lower-than-average snow accumulation (Huning & AghaKouchak, 2020) and a worrisome pace of glacier melting (Mannerfelt et al., 2022), which is one of the main sources of water storage during the winter for the summer months. Furthermore, according to the 2021 Working Group I contribution to the Sixth IPCC Assessment Report, there is a high-level consensus among scientists that with every 0.5ºC increase in atmospheric temperature, there are significant increases in the intensity and frequency of droughts in some regions, and that extreme events have become more likely than before human-induced climate change began (IPCC, 2023).

When compared with 1981–2010, the higher frequency of heatwave days and drought months was associated with 127 million more people experiencing moderate or severe food insecurity in 2021 and heat exposure-related loss in labour capacity resulted in average potential income losses equivalent to $863 billion in 2022. With agricultural workers being the most affected (Romanello et al., 2023). According to the Eurostat and the European Environmental Agency, extreme weather and climate-related events have cost the EU €145 billion over the past decade, with a clear upward trend of 2% per year over the 30-year average (Eurostat, 2022).

To make matters worse, vulnerable communities, such as the elderly, children, those in poor health, and groups of lower socio-economic status (unemployed, low income or lower levels of education), are disproportionately affected by pollution and extreme weather events leading to increased social inequality (EEA & Kaźmierczak, 2018).

Although climate change has become an increasingly politicised issue (Fisher et al., 2022), it remains the consensus of the vast majority of European citizens (European Commission & Directorate-General for Climate Action, 2023), as well as, scientific literature, intergovernmental organisations and NGOs report that we are living in a time of anthropogenic climate change (Cook et al., 2013), meaning the changes in our atmosphere and climate are the result of human activity in the present and past centuries.

## 2.3. How to Energy Transition

Given that human-induced global warming is caused by an increase in greenhouse gases in the atmosphere, if we are to limit the atmosphere temperature increase, we must decrease the total emissions in our societies.

Fundamentally, the energy transition is the transition of energy systems from high carbon intensity to clean energy. This transition should not only limit our environmental impact but should also ensure energy security, reliability, access, affordability, and sustainability (Genc & Kosempel, 2023). There are examples of energy transitions throughout history, but most of them occurred over significant periods and were stimulated by local technological innovations, resources scarcity or high labour costs. One example of a modern energy transition, which occurred in the context of the 1973 OPEC oil embargo, is France's mass deployment of nuclear energy (Solomon & Krishna, 2011), which to this day remains the country's main electricity source (IEA, 2024).

However, this is a transition in a specific sector on a countrywide scale. For an endeavour similar to the one we now face, where we need to succeed in an economywide energy transition, on a global scale, in different economic systems and on a tight schedule, there are no past historical examples and the little literature available is not particularly optimistic about our chances in succeeding to significantly reduce greenhouse gas emissions in the next few decades (Solomon & Krishna, 2011; International Renewable Energy Agency (IRENA), 2024)

The main focus of the energy transition has been the substitution of fossil to renewable energy sources (RES) in electricity production and the electrification of other carbon-intensive sectors of society (ex: transport, industry, heating). However, in 2020, fossil fuels still accounted for 83% of the global energy needs (Holechek et al., 2022).

RES are wind, solar, hydro, geothermal and bioenergy, and they are called renewable for they derive from natural resources that replenish faster than they are consumed (United Nations, 2023). Therefore, they are resources that cannot be exported or imported, one country cannot export sunlight to another or import wind on rainy days. These are resources that vary throughout the year, months, and days, depending on rain levels, sunshine intensity and hours or wind speed (geothermal is the most consistent one). Not only are these energy sources clean of greenhouse gases but a power grid that can be 100% functional with only renewable energy will be completely independent of foreign resources for energy production and will have a considerably cheaper running cost than carbon-intensive alternatives (IRENA, 2024).

According to Zappa (2019), it is possible for the EU to achieve 100% renewable electricity production by 2050. The study analyses eight possible scenarios, emphasising that such a goal is achievable but would entail costs and significant restructuring of the European electrical grids, particularly the interconnection between countries. This restructuring is necessary so that throughout the year the various energy peaks can be balanced between countries. For instance, in the summer, there may be an excess of solar production in southern countries, which can be redistributed to the north, and in the winter, excess hydroelectric and wind production from the north can be sent to the south. Consequently, it is estimated that cross-border transmission capacity would need to increase by 240%.

Also, considering the greater instability of renewable energies with current technologies and to support the growing electrification, it is necessary to create an excess production capacity, so electricity generation would need to increase by 90% to 1.9TW to ensure energy security. Therefore, as important as the mere deployment of renewable energy production technologies is the adaptation and modernisation of the continent's electrical infrastructure. The Union’s current infrastructure is inadequate for future challenges and requires investment in new systems and technologies to improve the efficiency and security of the system (Zappa, 2019).

To reach this capacity, EU countries would have to mobilise massive resources. Even then, for the electric system to be 100% renewable, without including nuclear power or carbon capture and storage technology to offset certain low-carbon sectors, it would cost around 30% more than the mixed system (Zappa, 2019).

Nevertheless, there are some challenges to these goals, as stated in Zappa (2019) and in the latest “Net Zero Roadmap” report by the International Energy Agency (2023), to reach zero emissions by 2050, the world depends on new technologies, mainly in carbon capture, utilisation and storage (CCUS), to offset sectors not yet ready for decarbonisation or electrification, and the investment in and deployment of these technologies has been slow and insufficient.

Considering that the main goal must be to reduce emissions as soon as possible, some authors consider that the focus in making a full transition to renewables is taking investment out of other policies which could have a more significant immediate impact and for which the technology already exists (Solomon & Krishna, 2011). They are not against the fast deployment of RES, just a diversification of strategies since a faster reduction in emissions would mean less accumulated GHG in the atmosphere even if we do not phase out all fossil fuels as fast.

Most of the proposed policies focus on increasing the efficiency of already operating electricity power technologies, such as waste heat recycling in industries or the use of ultra-supercritical coal-fired power plants, which are significantly more effective than current power plants, thus using fewer fossil fuels. It is estimated these policies alone could offset around 30% of the electricity produced by fossil fuel combustion (Solomon & Krishna, 2011). Furthermore, CCUS technology leads to a significant reduction in the efficiency of these power plants, wiping out the advantage of ultra-supercritical or advanced ultra-supercritical plants compared to normal subcritical coal-fired power plants (Tillman, 2018). Meaning this technology cannot be paired with CCUS for further emission decreases and will not be viable in countries where CCUS is or might become mandatory for coal-fired power plants.

This position is not in line with most authors and institutions, with the majority pointing out that this would mean further investment in fossil fuel technologies, which would go against the public stance of politicians and the notion of an emergency in the decarbonisation process, and in the medium to long term delay a full decarbonisation of the economy, which must be the ultimate goal (Holechek et al., 2022).

Regardless of the path chosen in electricity production, another topic that is addressed by most academics and policymakers is the need to make the energy grid more efficient and increase the interconnectivity capacity between European countries and regions (Zappa et al., 2019).

The path to increased efficiency is through the adaptation of our old electrical grid into a Smart Grid. This is the digitalisation of the electrical grid system, allowing for two-way communication between customers and producers, with smart meters along the line allowing for automation in response to changing energy supply and demand. Smart Grids allow for more efficient transmission, reduced operation costs (and thus reduced electricity costs for consumers), increased integration of RES and better integration of customer-owned power generation systems (U.S. Department of Energy, 2022). As energy efficiency expert and leading advocate, Amory Lovins, put it when interviewed about the role of energy efficiency, "Putin's war is being financed by those who buy Russian fossil fuels. In the first two weeks the west has paid €8bn to Russia. We have a new energy crisis, and efficiency is the largest, cheapest, safest, cleanest and fastest way to address it" (Vidal, 2022). When used to complement the increase in

RES, energy efficiency will allow for a better distribution of energy, with fewer losses, and a reduction in overall energy consumption and demand, allowing the faster reduction in fossil fuel consumption, be it in electricity production or in household uses such as heating.

Public policies play a crucial role in driving the energy transition, as they create the necessary frameworks and incentives to shift from fossil fuels to renewable energy. Governments and financial institutions can implement policies such as carbon pricing, stricter emissions regulations, subsidies for renewable energy projects, and green bonds or loans (Resources for the Future, 2021; Sartzetakis, 2021), which help accelerate the adoption of clean energy technologies. Without such measures, the market may continue to favour fossil fuels due to their entrenched infrastructure and lower immediate costs. For example, carbon pricing incentivises companies to reduce emissions by making it more costly to rely on carbon-intensive energy sources, and green bonds give more favourable than average conditions to fund projects with a positive climate impact, making it more financially viable to invest in them (Sartzetakis, 2021).

Moreover, public policy is essential in ensuring that the energy transition is socially equitable and inclusive. Policies supporting job retraining, infrastructure investments, and social safety nets are needed to help workers and communities currently dependent on fossil fuel industries (Piggot et al., 2019). Policies and energy prices must also be accessible and support those in the fringes of the energy system (Piggot et al., 2019), be it because of financial difficulties or outdated household or neighbourhood infrastructure, some people have limited access to the energy, and many are more subjected to extreme cold or heats conditions which may endanger their health. The energy transition must benefit all.

## 3. Impact of Energy Policy on Geopolitics

*"He who controls the spice controls the universe"*

From the 1984 David Lynch movie adaptation
of Frank Herbert's novel *Dune*

These words may be from a fictional universe, but hydrocarbons, just like spice, have an immense impact on our world. "He", the countries who have access to these resources, control not the universe but the global economy.

As we have seen, fossil fuels have been, in the last few centuries, a cornerstone of the global economy, driving industrialisation and economic growth. The significance of fossil fuels is evident in their role as the primary energy source for various industries, including manufacturing (e.g. steel and cement), transportation, and electricity generation. In 2023, oil consumption exceeded one hundred million barrels per day for the first time ever, with oil accounting for approximately 31.7% of the world's primary energy supply, making it the most consumed energy source globally (Energy Institute, 2024).

The Organisation of the Petroleum Exporting Countries (OPEC), which is an intergovernmental organisation of twelve major oil-exporting countries that coordinates oil production goals, reports that oil exports accounted for 55.35% of total export revenues of its members in 2022 (OPEC, 2023), meaning that oil price fluctuations continue to significantly influence their economic stability and growth prospects. This organisation includes countries such as Saudi Arabia, Iran, Iraq, and Venezuela. The United States is not a part of the organisation but was, however, the world's largest producer of oil in 2023, with its production targets and exports having a significant impact on the oil price globally, alongside those of the OPEC members.

Oil prices are influenced by numerous factors including supply and demand dynamics, geopolitical events, OPEC decisions, market speculation, and exchange rates. Supply-demand balance is fundamental and global demand chocks have a direct impact on the price of oil all around the world and indirectly in all other sectors of the economy, ultimately affecting the price of goods and services, resulting in higher inflation (Kilian, 2009). Furthermore, given that the USD is the most used currency for commodities trading, fluctuations in the U.S. dollar influence oil prices, as a stronger dollar makes oil more expensive for foreign buyers (Akram, 2009).

So, it is not surprising that major countries throughout recent decades have fought wars and conquered territories to secure these resources. And, once in control of such resources, global actors have used them to influence other countries, either by providing cheap access to them or by denying such access. In this way, actors have been able to influence policies and alignment without fighting wars, thus increasing their economic and political power (Sonmez & Cobanoglu, 2016).

On October 06, 1973, a coalition of Arab countries, led by Egypt and Syria, launched a surprise attack on Israel triggering the Yom Kippur war (after the name of the Jewish holiday on which the attack happened). The focus of the attacks was the Sinai Peninsula and the Golan Heights, which had been occupied by Israel since the 1967 war from Egypt and Syria, respectively.

In response to the support to Israel by the U.S. and several Western European and aligned African nations, the OAPEC (Organisation of Arab Petroleum Exporting Countries) members imposed a total oil embargo on these countries. The embargo lasted 6 months until March 1974. By that time, oil prices had risen to $11.65 per barrel, an increase of around 300% (Yergin, 2023). The embargo only ended after (1) the withdrawal of Israeli troops from the west side of the Suez Canal (Quandt, 2005), (2) growing international pressure on OPEC countries due to the significant impact of high oil prices, and (3) OPEC's realisation that a prolonged embargo would lead to a permanent diversification of energy sources by western nations, ultimately harming OPEC countries in the long term (Licklider, 1988).

At the time, the U.S. had significant potential for domestic oil production and only imported 36% of its oil needs, 47% of which came from OPEC nations (U.S. Energy Information Administration, 2021). Meanwhile, European Economic Community (ECC) Member States were 95% dependent on oil imports, of which two-thirds came from Arab countries (Schramm, 2023). This led western European nations to distance themselves from U.S. policies in the Middle East and adopt more pro-Arab and Palestinian policies in comparison with the U.S. resolute pro-Israel policies, with several NATO countries even refusing to allow the U.S. to use their Mediterranean bases for military deliveries to Israel (Licklider, 1988).

### 3.1. Previous crises with Russia

Russia employed these tactics twice in the 2000s against Ukraine. The first time was in 2006 when Russia dramatically reduced the gas flow through Ukraine's pipelines for three days due to an ongoing dispute over gas prices and payments. Hungary, Austria, and Romania lost about a third of their expected gas supply during this period, while Russia insisted that it was delivering all the promised gas and accused Ukraine of diverting the gas supply. In the end, Russia gained some concessions, but it was unable to enforce its main objective of imposing European gas prices on Ukraine, as Ukraine also reminded Russia that it had a near-monopoly on Russia's gas transit to Europe (Pirani et al., 2009). This was the first incident to raise doubts on the security of having Russia as Europe's main energy supplier.

By 2009 Ukraine transited 65% of Russia's gas into the EU, with contracts with Russia being in place not only for the sale of gas but also for its transit. In January 2009, Russia once again cut gas supply to Ukraine but resumed the flow to Europe, on the basis of the contract with Ukraine expiring and wanting to renegotiate prices. In the first days of the crisis, Ukraine diverted the gas on the argument it needed the gas to maintain the systems and later that the transit payment contract had also expired. On January 7, Russia cut off gas supply completely. Negotiations lasted for a few weeks with European Union representatives and later European Energy companies applying increasing pressure to Russia. New contracts were negotiated on January 19 and the flow of gas resumed on the morning of the 20. Ultimately Russia succeeded in forcing Ukraine into the 'European price' from 2010 onwards (Pirani et al., 2009).

### 3.2. Lead up to the Invasion of Ukraine

EU's-Russia relationship is described by Forsberg and Haukkala (2016) as 'the partnership that failed'. They argued that the accumulation of differences and conflicts in the economic, political and, most notably, security arenas made a deep crisis the most likely outcome. Energy in particular has been the long-term economic cornerstone of the relationship, as well as arguably its most strategic component (Belyi, 2015).

Throughout the past decade, official foreign policy documents from Russia indicated an increasing defence of a multipolar world where Russia would try to maintain its global power status. Simultaneously, Putin became increasingly nationalistic in his public notes, shifting Russia's position in the international order from a status quo to a revisionist power and deteriorating its relations with Europe to levels not seen since the fall of the USSR (Light, 2015).

At the same time, Europe's energy dependency continued to grow, further feeding into the Kremlin's war readiness and increasing the size of its geoeconomic weapon. There were many warnings by academics and politicians from Europe and abroad, mainly from the U.S. administrations (Huuhtanen, 2016; U.S. Department of State, 2019; Sabadus, 2021). The signs were clear, Putin tried his "weapon" several times against smaller bordering nations to try to persuade them to follow his desired course of action, but European nations, and mostly Germany under Angela Merkel's administration further integrated its energy systems with Russia with the approval of Nord Stream 2 (Sziklai et al., 2020), a Baltic Sea pipeline, that would enable Russia to circumvent other nations in delivering gas to Germany. This would not only increase Germany's independence, but also sideline other transit nations like Ukraine, further endangering them to Russia's blackmail and influence (Sziklai et al., 2020). Although there was a conscience that Europe was acting against its interest, any energy cut off from Russia was ultimately unlikely to happen if not for the current emergency frame (Kuzemko et al., 2022).

Siddi (2022) reviews several books regarding the EU-Russia relations leading up the invasion of Ukraine, arguing that from the point of view of external actors (one of which Russia) "the EU is seen as a considerable power in the economic and normative sphere, but as an inefficient mediator, as weak in public diplomacy and as non-existent in the security realm" (p. 896).

Moreover, as per Siddi (2022) review on several books regarding the EU-Russia relations leading up the invasion of Ukraine, from the point of view of several external actors (one of which Russia) "the EU is seen as a considerable power in the economic and normative sphere, but as an inefficient mediator, as weak in public diplomacy and as non-existent in the security realm" (p. 896), mainly due to a lack of a common external policy (Siddi, 2022).

In 2023, even after the beginning of the invasion, most EU Member States had its military budgets below NATO's 2% of GDP goal. Only 10 of the 30 NATO countries, not including Sweden and Finland, were above the goal. In 2024, after the entrance into the defensive alliance of Finland in April 2023 and Sweden in March 2024, the number has grown to 23 out of 32 (Henry-Laur Allik, 2024).

### 3.3. Invasion of Ukraine

When Russia invaded Ukraine, its 'weapon' against Europe was 'activated'. Europe would be left with the option to either continue to import energy resources from Russia, thus indirectly funding Russia's brutal invasion of Ukraine against its own geopolitical objectives, or, to cut ties with Russia through a series of sanctions, while risking rough winters for the European population and its energy security. Although Europe stood by its rhetoric and followed the second option, it was and continues to be slow and ineffective at completely cutting off Russia's energy sector. Since the beginning of the invasion, each EU citizen has, on average, paid more than €400 for Russian fossil fuels (Raghunandan, Levi, et al., 2024). Sanctions were used to gradually reduce Russia's energy imports while ensuring European reserves were full and ready for the winter of 2023. However, more than two and a half years into the war, Russia Liquefied Natural Gas (LNG) tankers continue to dock and unload in European ports, during the first semester of 2024 there was a 11% increase in Russian LNG imports (Humpert, 2024), meaning that euros continue to flow into Russia's reserves and fuel its war machine. The difficulty in cutting off Russia even after the start of the invasion highlights how, despite the ongoing energy transition into sustainable energy, fossil fuels still play a huge part in Europe's energy needs (Kuzemko et al., 2022).

As part of its strategy to reduce dependence on Russian gas, the EU, in order to ensure its energy security, has made short-term commitments to fossil fuels. These decisions risk a lock-in effect in which these investments will delay the phased out some non-renewable energy sources (Eyl-Mazzega & Mathieu, 2022). Furthermore, Kuzemko et al. (2022) raise concerns about the global implications of the EU's rapid need for energy source diversification. To replace Russia's gas, the EU increased its LNG imports, competing with developing nations and destabilising the global energy market, with negative impacts on the global South. This is noteworthy since non-OECD countries are expected to represent 64% of energy demand by 2040 (Ahmad & Zhang, 2020).

The competition between global North and South for the necessary resources for the energy transition will probably result in the delay of such transition in the developing nations, which lack the economic resources to compete with developed nations. Moreover, developing resource-rich countries, which continue to receive investment to develop their fossil fuels industries, have their economies trapped in assets that are bound to devalue in the coming decades, while being under pressure to pursue policies that may increase their exposure to this risk (Manley et al., 2016). Leaving such a lock-in requires vast amounts of investments in established infrastructures, markets, and institutions. Investments which low-income nations do not have the economic power, or, in some cases, even the political stability to pursue (Manley et al., 2016).

Most of the fossil fuels infrastructures will be rendered obsolete before the end of their economic cycle, meaning companies, investors and countries will be left with stranded assets worth several billion dollars. One article which considered a 3.5ºC median warming in the 21st century, aligned with the IEA's 2019 World Energy Outlook analysis of current policies, estimates losses at $1.4 Trillion (Semieniuk et al., 2022). Another study, which considers a more aggressive climate policy that keeps warming between 1.5-1.8ºC - a target that is aligned with Paris Agreement objectives but unlikely, as the latest report by the World Meteorological Organisation (WMO, 2024) predicts an 80% chance of annual average temperatures exceeding the 1.5ºC limit within the next 5 years - estimates losses between $13 to $17 trillion in fossil fuels devaluation (Hansen, 2022).

Thus, the already poorest and least stable countries in the world are most at risk of not making the transition, which would further separate them from the modern developed world and exacerbate their problems. Such uneven transition is bound to result in new geopolitical complications (Eicke et al. 2019).

# 4. The history of European Energy Policy

Throughout history, energy uses were mostly local, decentralised and based on biomass (e.g., wood or charcoal) (Bashmakov, 2007), with oil obtained from surface seeps playing a very limited role during the classical and medieval eras (Craig et al., 2018). Since the Industrial Revolution, the use of energy expanded to factories and businesses which started using large amounts of coal. With the introduction of new production and refining technologies in the 1860s, the need for oil and gas grew exponentially. During this time, the first commercial oil wells in Europe were dug in Poland, Romania, Germany, and Italy, with some fields in the northern Carpathian Mountains still active as of 2018 (Craig et al., 2018). Curiously, Romania was the first country to officially register crude oil output in national statistics in 1857 and also its capital, Bucharest, was the first in the world to have refined oil used for street lighting (Craig et al., 2018).

At the time, these resources were enough to fulfil Europe’s modest needs. However, it was not long before major wars erupted at the turn of the century which made countries struggle to maintain the necessary supply of hydrocarbons. During this time, allied countries depended on overseas oil, mainly from the U.S. and Iran. Oil fields, refineries and supplies became high value targets to both the Allies and the Axis to try to hinder each other war efforts (Craig et al., 2018).

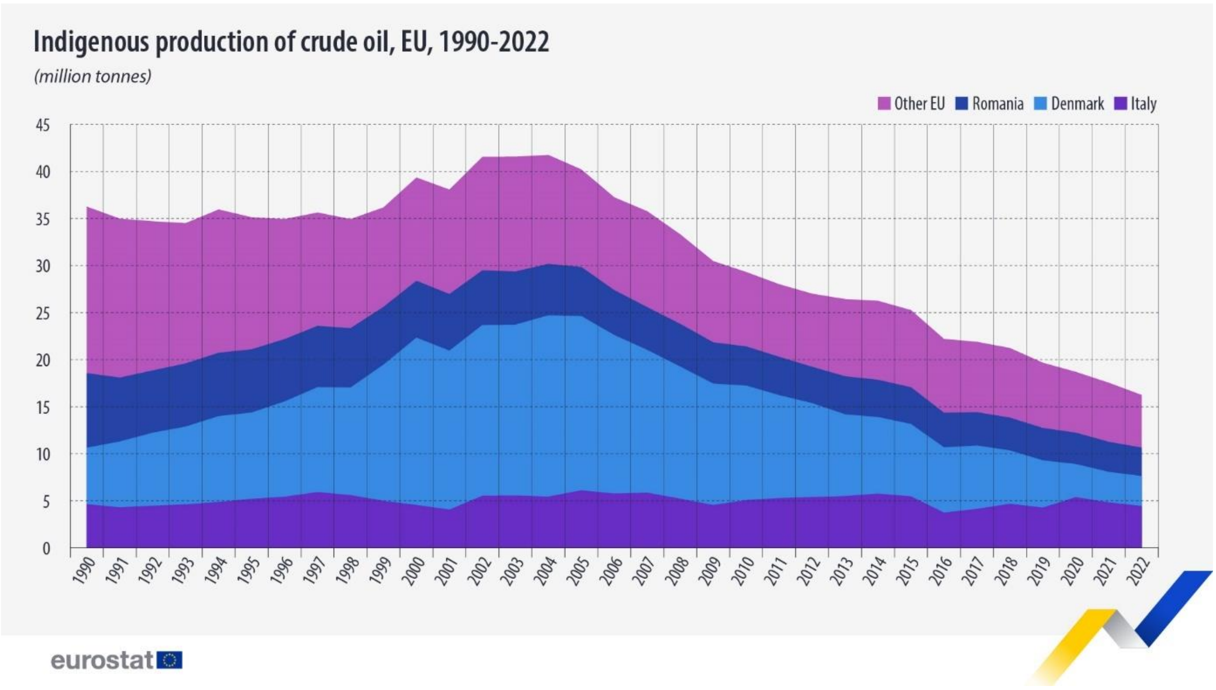


*Figure 4.1: Indigenous production of crude oil, EU, 1990-2022 from Eurostat*

With the aim of mitigating these effects, government funded explorations led to the eventual discovery of major fields in England, around the North Sea, in the Netherlands and northern Italy. Some of these fields were sufficient to fuel local and regional needs for decades and enable countries to be self-sufficient and build back after the second World War (Craig et al., 2018). However, they were not meaningful at a global scale and at a time in which oil became the most important source of energy, fuelling not only our power plants but all economic sectors, from industry to our daily lives, it was the oil fields in Eastern Europe, Russia, the U.S., and later the Middle East that ensured global oil supplies (Craig et al., 2018).

Even the most resource-rich European nations have seen their production start to decline rapidly in the early 2000s (Figure 4.1) and more than halving in the past 2 decades, except Norway, which has maintained its production and exports levels, even significantly increasing the exports since 2021 (Norwegian Petroleum, 2024).

### 4.1. From the 1990s to 2014 – growing European Dependency

The 1990s marked a period of significant transformation in the EU energy market. Following the end of the Cold War, the European Union started a liberalisation process as part of broader efforts for the formation of a European Internal Energy Market, for which the legal basis had been set in the Treaty on the Functioning of the European Union (Pepermans, 2019). The oil crisis in the 1970s set the first push in energy-related initiatives but stronger gains and cooperation only came in the 80s and 90s. Then, climate change was starting to take the centre stage in EU policy and thus coordinated policies on energy production and consumption were necessary (Pepermans, 2019).

This period marked a significant shift from heavily regulated, state-controlled energy sectors to a more market-oriented approach aimed at increasing competition, efficiency, and consumer choice. In a state-owned energy market, the energy sector is monopolistic and vertical, meaning that it is the same actor (the state-owned utilities) which is involved in all processes from imports, to production, distribution, grid management and retail sales. The liberalisation process involves not only the sale of state-owned companies, but also the separation into competitive segments of the different stages of energy supply, with more than one company being able to compete in the same stage (Vasilica Rotaru, 2013).

Wildly different energy prices among European countries affect the competitiveness of the single market, so in the late 1990s, the first steps were taken towards liberalisation.

Noticeably, the Electricity Directive 96/92/EC (European Parliament and Council) and the Gas Directive 98/30/EC (European Parliament and Council) laid the groundwork for opening up the electricity and gas markets, respectively. In 2007, the Energy Action Plan, which set sustainability, security of supply and competitiveness as the three major challenges of European Energy Policy, was established. Two years after, the Third Energy Package completed the integration of the European electricity and gas markets, making EU Member States establish a National Regulatory Authority, and created an EU level forum for regulators, the Agency for the Cooperation of Energy Regulators (ACER) (Pepermans, 2019).

During the 1990s and early 2000s, the energy relationship between Russia and Europe deepened significantly, driven by mutual economic interests and Europe's growing need for secure energy supplies. Infrastructure projects such as the Yamal-Europe pipeline (from the Yamal region in Russia to central Europe through Belarus) and the first Nord Stream pipeline (directly from Russia to Germany through the Baltic Sea), further entrenched Russia's role as Europe's primary energy supplier (Goldthau, 2016). Despite political disagreements on issues like NATO expansion and Russia's internal policies, energy cooperation remained strong, with economic pragmatism overriding geopolitical tensions (Goldthau & Sitter, 2014). The EU-Russia Energy Dialogue, established in 2000, aimed to deepen cooperation, ensuring stable energy flows to Europe while providing Russia with much-needed revenues to support its post-Soviet recovery (European Commission, 2002).

### 4.2. From 2014 to 2020 – sealing Europe's fate

Following the annexation of Crimea in 2014, the EU faced a significant dilemma regarding its energy policy and relations with Russia. The annexation prompted an initial wave of economic sanctions against Russia, including restrictions on certain energy-related exports and measures against key energy companies such as Rosneft and Gazprom (Hanousek & Bělín, 2019). Despite these sanctions, Europe's dependency on Russian energy supplies, particularly natural gas, remained largely unchanged. This dependency was deeply embedded in the EU's energy infrastructure and market, with Russia still representing close to 45% of the EU's total natural gas imports by 2021 (European Council, 2024).

One of the most controversial developments during this period was the introduction of the Nord Stream 2 pipeline project. Like its predecessor Nord Stream 1, it was designed to transport natural gas directly from Russia to Germany via the Baltic Sea (Goldthau, 2016).

Despite fierce opposition from several EU Member States, particularly Poland and the Baltic nations, as well as the United States, construction on Nord Stream 2 progressed with strong backing from Germany and Austria (Wettengel, 2023).

Concerns about energy security led the EU to launch initiatives such as the European Energy Union in 2015 (European Commission, 2015). These initiatives aimed to diversify energy sources, improve infrastructure, and reduce reliance on Russia through projects like the Southern Gas Corridor (Koranyi, 2014) and increased liquefied natural gas (LNG) imports from countries such as Qatar and the United States. During this period, Europe pushed forward with its clean energy transition, spurred by commitments such as the Paris Agreement in 2015 and the European Green Deal in 2019. However, despite the progress in renewable energy development, reliance on Russian gas persisted, particularly in Central and Eastern Europe, where the infrastructure for alternative energy sources remained limited (Mitrova, 2014).

This reliance on Russian energy ultimately sealed Europe’s fate, locking the EU into a dependency that would later prove difficult to resolve, especially when geopolitical tensions escalated further with the full-scale invasion of Ukraine in 2022. In hindsight, this period shows the EU’s failure to prioritise long-term energy security over short-term economic gains, which undermined its strategic autonomy in the energy sector.

## 5. Methodology

This study employs a mixed-methods approach, integrating both quantitative (Chapter 6) and qualitative (Chapter 7) analysis, with the objective of providing a comprehensive examination of the impact of the war in Ukraine on the EU's energy transition. This approach is justified by the complexity of the subject, which encompasses both quantifiable economic and energy trends and the more nuanced geopolitical, political and policy dynamics. The combination of these two methods allows us to gain a more comprehensive understanding of the evolution of the EU's energy landscape in response to the conflict, ensuring that the research is not limited to raw data but also includes an understanding of the policy environment, public discourse, and geopolitical events that have played a significant role in shaping the EU's energy transition.

For the quantitative analysis of this research, the data utilised are sourced from Eurostat, the European Statistical Office, a Directorate-General of the European Commission responsible for providing and harmonising statistical information for the European institutions and European public, making it a reliable data source for the topics at hand. Most of the analysed data were collected monthly, with the exception of the air emissions accounts for greenhouse gases by NACE Rev. 2 activity, which were collected quarterly, and gas prices for household and non-household consumers, which were collected bi-annually.

In our analyses, we have decided to aggregate the monthly data into quarters, by summing the three corresponding months. The first quarter (Q1) is from January to March, the second quarter (Q2) from April to June, the third quarter (Q3) from July to September and the fourth quarter (Q4) from October to December. Monthly data are more subject to short-term fluctuations, which in the case of energy data can be strongly influenced by one-off weather events. Quarterly data maintains the fluctuation related to seasonality but smooths out these short-term variations, reducing the noise in the analysis. This quarterly approach also provides a better long-term perspective, as monthly variations are less indicative of overall changes in trends.

In addition, due to seasonal variations in climate, the quarterly comparison in this analysis is mostly year-on-year rather than quarter-on-quarter, meaning that quarters are compared with the same quarter of the previous year (e.g. Q1 2023 is compared to Q1 2022). It is also common for reports and objectives made by EU institutions to be set in quarters, this approach facilitates the comparison between the observed results and the established goals.

The analysed time period includes data between Q1 2017 and Q4 2023, with some datasets extending to Q2 2024, where available. When comparing changes between before and after the start of the war, the reference period for the pre-war comparison includes all quarters of 2019, as well as Q3 and Q4 of 2021. Some of the data from 2020 and the first half of 2021 are heavily influenced by the COVID-19 pandemic and the impact of the worldwide lockdown policies on global trade, supply chains and the overall economy. Consequentially, 2019 was the last year of full economic activity in the EU before the war, and it was not until late 2021 that the EU's economy finally recovered and surpassed pre-pandemic levels.

To ensure a reliable direct comparison between different fossil fuels, thousands of tonnes of oil equivalent (toe) was chosen as a common unit of measurement. Natural gas and coal (with coal separated in the raw data into hard coal and brown coal) were converted using the following approximate conversion factors from the BP Statistical Review of World Energy:

- Natural gas was converted using a factor of 1 million cubic meters of natural gas equalling 0.860 thousand tonnes of oil equivalent (BP, 2021).

- Hard coal and brown coal were converted using factors of 40 and 95 million tonnes per exajoule, respectively, with one exajoule being approximately equivalent to 23,884.59 thousand tonnes of oil equivalent. This results in direct conversion factor of 0.5971147 for hard coal and 0.2514167 for brown coal (BP, 2021).

The qualitative analysis in this research was designed to complement and contextualise the quantitative findings by providing a deeper insight into the policy-making processes, political discourse, and strategic responses to the energy crisis triggered by the war in Ukraine, highlighting how EU policies and external pressures have influenced the pace and direction of the energy transition.

The analysis is based on an in-depth examination of secondary sources. The examined sources were key policy documents, official communications, and reports from a range of European institutions, including the European Commission, the European Parliament, and the European Council. Examples of these documents include Council Decisions regarding imposed sanctions and official policy papers such as the REPower EU programme. These documents provide a first-hand account of how the EU institution framed and responded to the evolving energy crisis, illustrating the shifts in narrative and priorities that have occurred over the recent years. Furthermore, new goals and measures were introduced, which were then subjected to analysis in comparison with previously approved legislation.

Moreover, reports from international organisations and energy or climate-focused think tanks were integrated into the analysis to offer an impartial and informed evaluation of the European Union's policy responses. These sources were selected to offer insights into the potential economic, social, and geopolitical impacts of the EU’s strategies, helping to assess whether the policies are likely to achieve their intended goals. By including these expert perspectives, the analysis offers a balanced view of the EU’s energy transition, highlighting both its achievements and its shortcomings.

By using both methods, combining a significant variety of statistical data and a wide assessment of secondary sources, we hope to reach more comprehensive conclusions about the energy transition. With the quantitative analysis revealing what has changed in the energy landscape, while the qualitative analysis provides insights into why these changes have occurred.

# 6. Energy Data Analysis and Interpretation

## 6.1. Natural Gas

To allow for a clearer analysis, the graph in Figure 6.1 uses the 2019 consumption and import data as the baseline (100) and compares each quarter to the corresponding quarter in 2019 to give us a perception on overall trends without the ups and downs related to seasonality.

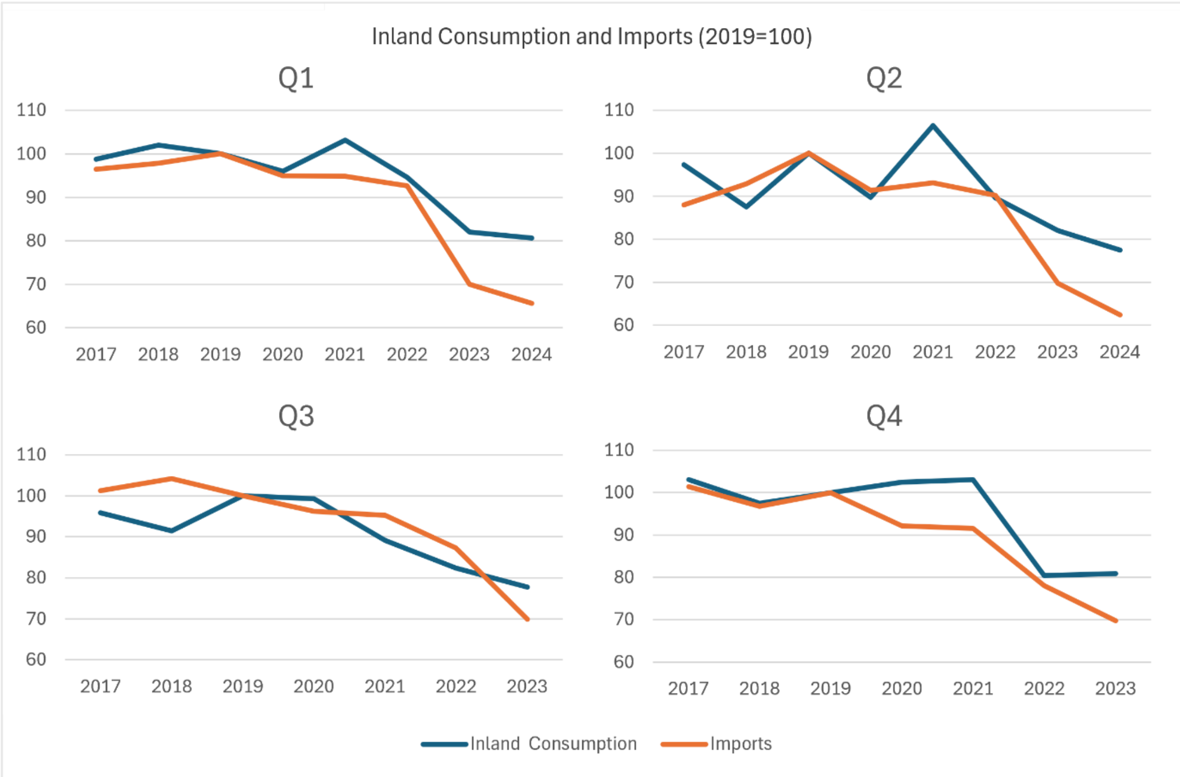


*Figure 6.1: Inland Consumption and Imports of Natural Gas in the EU27 (2019=100), data from Eurostat (2024i)*

Analysing the available data, we observe a downward shift in natural gas consumption starting from the Q3 2022. The last two quarters (Q3 and Q4) of 2022 show decreases of 13.47% and 20.55%, respectively, when compared to the average consumption for the same quarter between 2017 and 2021, representing the lowest values in the analysed data. This trend continues in 2023, with values on average 17.75% lower than previous years' averages. Overall, from 2021 to 2023, there was a decrease of 20.07% in total annual inland natural gas consumption. As already explained above, these interpretations were reached by comparing quarterly and annual consumption data across the specified periods, highlighting the significant impact of external factors on energy demand.

According to the EU Council Regulation on coordinated demand-reduction measures for gas (Regulation 2022/1369), which sets coordinated reduction targets for the demand and consumption of natural gas, the EU Member States should reduce their gas consumption by

15% in the period between August 01, 2022, and March 31, 2023, compared to the average gas consumption for the same period (August to March) in the years 2017-2021. The average inland gas consumption in the baseline period was 37,999.45 and the average consumption for the same period in 2022/23 was 30,910.69, meaning there was a reduction of 18.65%, above the set 15% reduction target.

Natural gas import data from the years 2019 and 2020, from January 2021, and from January 2022 to April 2022 are unavailable or incomplete for some partner countries, but the total sum is available. There is a significant decrease in imported natural gas from the Q2 2022 onwards, as sanctions started to be applied. Given that natural gas consumption varies significantly throughout the year, mainly due to the use of gas for household heating and in electricity generation, its peak consumption is during the winter season, i.e., the first and fourth quarters.

In the analysed period, 2019 was the year with the highest inland consumption of natural gas, and if we use this year as the baseline for a pre-COVID and pre-war European economy, we see that during the COVID-19 years (2020-2021) the consumption was lower but relatively stable, representing around 93.70% of 2019 consumption levels. As we can observe in Figure 6.1, during 2022 there is a clear and significant decrease in the consumption levels which have not recovered ever since. By the end of 2022, consumption had fallen to 78.03% of the baseline, it was down 30.16% during 2023 and 35.97% during the first half of 2024. When we look at a direct year-on-year analysis, there was a decrease in annual consumption of 7.02% from 2022 to 2023 and of 19.81% from 2022 to 2023. The first semester of 2024 is 31.92% lower than the corresponding semester in 2021 and 36.01% lower than 2019.

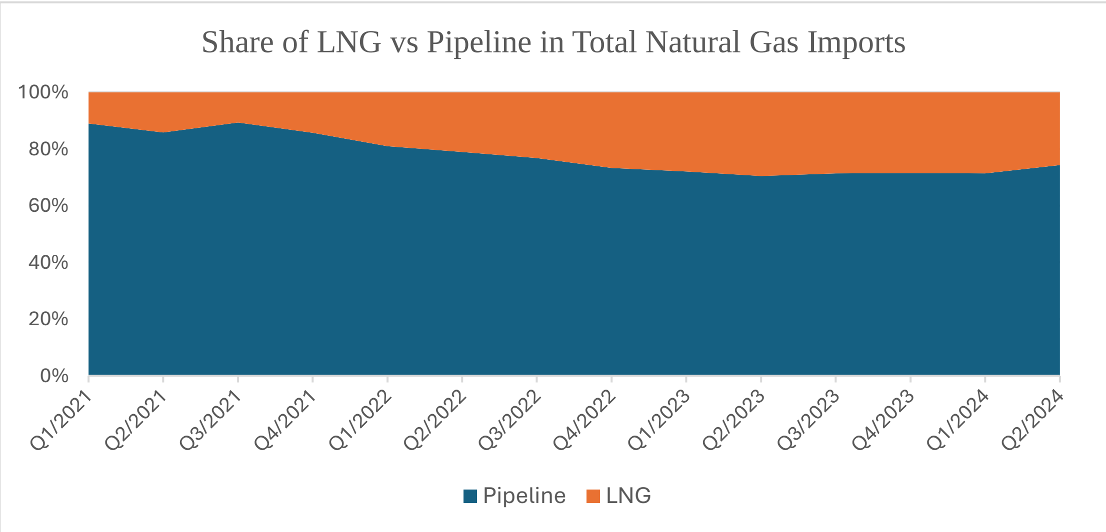


*Figure 6.2: Share of LNG vs Pipeline in Total EU natural gas Imports (Q1 2021 - Q2 2024), data from Eurostat (2024e)*

On the other hand, there is an extremely significant increase in LNG imports. The percentage of LNG imports, as part of the total natural gas imports, had already been increasing slightly. In 2017 only 6.79% of all gas imports were LNG, by 2021 the number had grown to 12.52%. In Figure 6.2, which compares the proportions of LNG and pipeline gas in the total natural gas imports from Q1 2021 to Q2 2024, we observe that from the beginning of 2022, the share of LNG increased significantly, reaching 26.71% by the end of 2022 and peaking and stabilising during 2023 at a yearly average of 28.62%. In absolute numbers, 2023 was 170.10% higher than 2021 and 305.84% higher than the 2017 average. The sharp decline in natural gas imports, mainly by pipeline, simultaneous with significant increases in LNG imports, led to a substantial growth in the share of LNG in total natural gas imports.

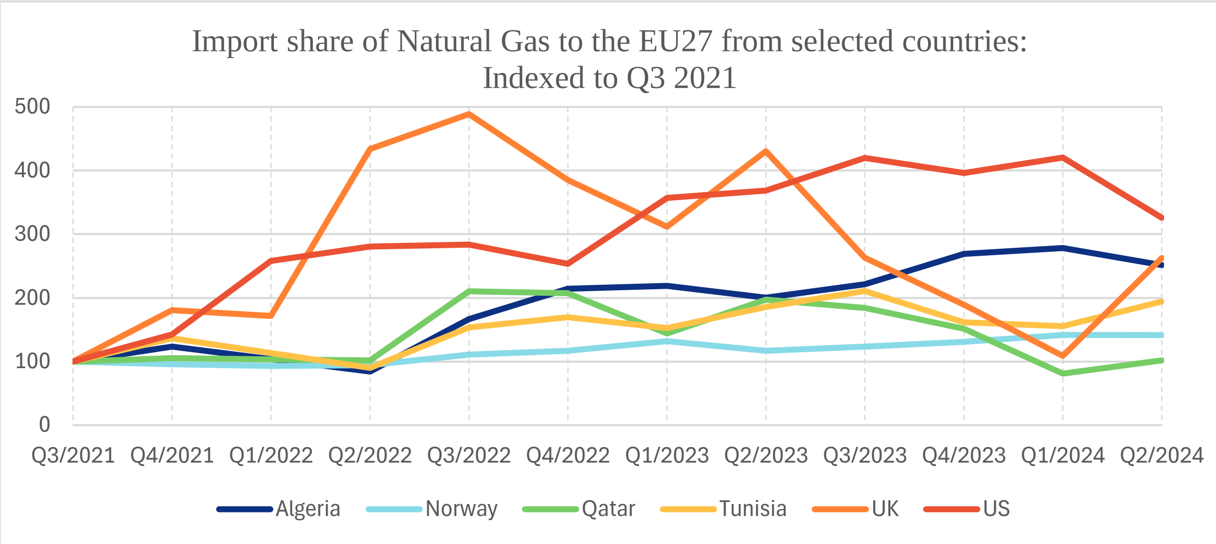


*Figure 6.3: Indexed trends of Natural Gas imports shares to the EU27 from selected countries, using the share from Q3 2021 of each country as a baseline (index value = 100), data from Eurostat (2024e)*

This is largely due to the diversification of import sources and the increase in imports from the United States. Figure 6.3 visualises the indexed trends in the share of each respective country in the EU's total natural gas imports using the third quarter of 2021 as a baseline. The data for the first quarter of 2022 regarding Algeria, Qatar and Tunisia was missing. To ensure a continuous and consistent dataset and visualisation, we used the linear interpolation method to estimate the values between known data points by assuming a continuous trend between these. While these values are not accurate, we believe this method maintains the integrity of the data without introducing any bias (Kong et al., 2020). The formula used for the linear interpolation is:

$$y = y1 + (x - x1)\frac{(y2 - y1)}{(x2 - x1)}$$

where $y$ is the interpolated value, x is the corresponding value on the x-axis and, $x_1$, $y_1$ and $x_2$, $y_2$ are the know data points.

Algeria, Norway, Qatar, Tunisia, the United Kingdom, and the United States were the six major EU partners that helped the EU diversify its natural gas sources away from Russia. All these countries, except Norway, which already accounted for a significant share of EU natural gas imports (15.23% as of Q3 2021), at some point more than doubled their imports to the EU during 2022 and 2023 compared to third quarter of 2021. Some countries, such as Qatar and the United Kingdom (UK), played a significant role in securing the EU's gas needs in 2022 and 2023 and have since returned to a lower level. On the other hand, other countries, like Algeria, Tunisia and, mostly notably the U.S., have seen their shares continue to grow to become important partners, while before 2022 they only accounted for a very small share of EU natural gas imports. The U.S. in particular, through LNG imports, has grown from a share of 2.33% in the third quarter of 2021, to an average of 8.98% in 2023 and 8.69% in the first half of 2024.

Since the data provided by Eurostat on imports from partner countries includes transit countries as importing partners, it is more challenging to obtain accurate data on Russia's natural gas imports to the EU. However, according to European Council publications based on data from ENTSO-G (European Network of Transmission System Operators for Gas) and Refinitiv (now renamed LSEG), Russia accounted for 44.93% of all natural gas imports to the EU (pipeline and LNG combined) in 2021, dropping to 14.80% in 2023, representing an overall decrease of 71.44% of imported gas from Russia in two years (European Council, 2024).

The EU's indigenous production of natural gas continued its tendency of decrease and is now at an all-time low (considering monthly data from 2014 onwards), imports are also at their lowest level, with more than half of Russia's gas supplies being phased out. In line with the decrease in production and taking into account the need for greater diversification of sources, EU exports are also at its lowest level. The decrease in exports means that the net trade of natural gas has remained fairly stable, with only a slight decrease since mid-2022.

Finally, in Figure 6.4 (with S1 representing the first semester of the year and S2 the second), we use typical average household and non-household consumption levels, which range from 20 to 199 GJ and from 10,000 to 99,999 GJ per semester, respectively. We observe that gas prices skyrocketed during 2022. In the second semester of 2022, gas prices were up by 79.49% compared to the same period in 2021 and by 96.79% compared to 2019. As shown in Figure 6.4, we can observe that gas prices for both household and non-household consumers have a similar behaviour, with the key difference being that higher consumption levels lead to reductions in the price.

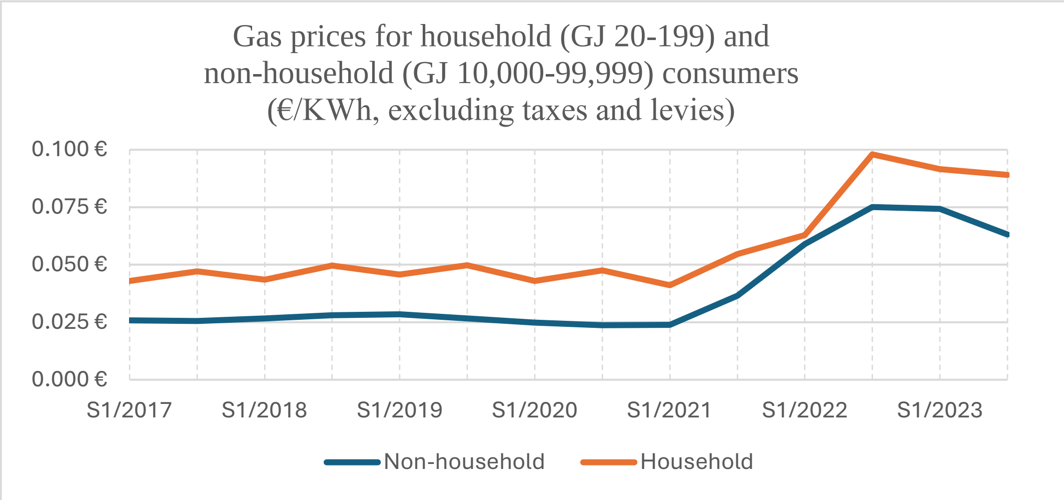


*Figure 6.4: Gas prices for household (GJ 20-199) and non-household (GJ 10,000-99,999) consumers in the EU27, excluding taxes and levies (€/KWh, S1 2017 – S2 2023), data from Eurostat (2024c ,2024d)*

### 6.2. Oil and Petroleum

According to a 2024 news article published by Eurostat, the EU reached its highest oil dependency level in 2022, with a dependency on imports of 97.7% of all oil and petroleum products (Eurostat, 2024a). Net imports increased by 9.5% due a 4.9% rise in imports and a 1.7% fall in exports. At the same time, the EU's indigenous production continues to decline (Figure 3.1).

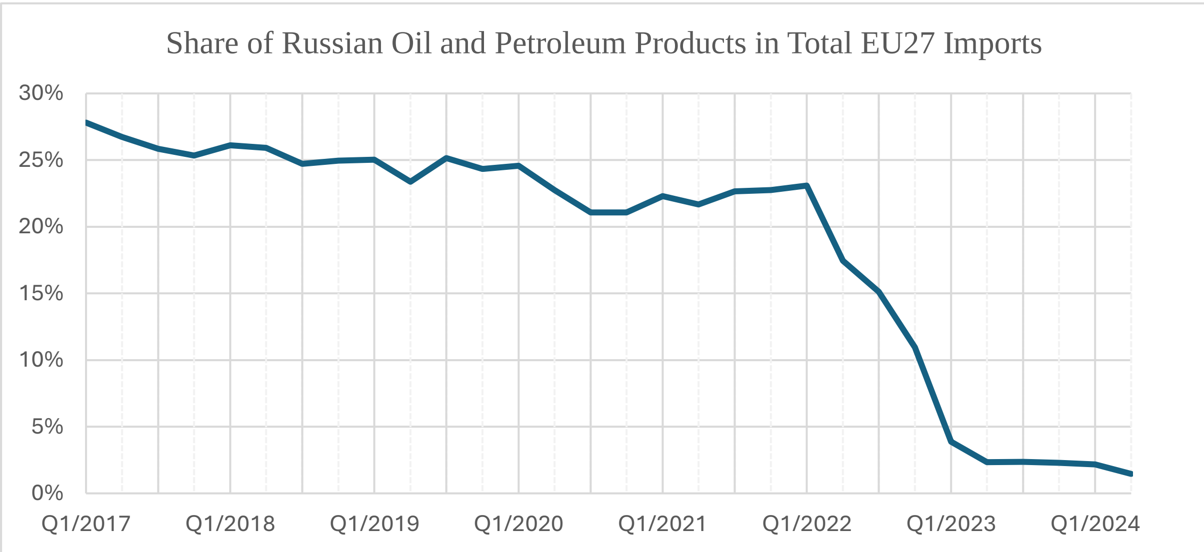


*Figure 6.5: Share of Russian oil and petroleum products in Total EU27 imports – quarterly (Q1 2017 – Q1 2024), data from Eurostat (2024f)*

Figure 6.5 illustrates the share of Russian oil and petroleum products in the total oil and petroleum products imports in the EU between Q1 2017 and Q1 2024. Analysing the graph, we can observe that there are significant changes in oil and petroleum products import sources after Q1 2022, most notably, Russia's contribution to European imports has greatly decreased. It had been decreasing slowly in the past years, from an average of 26.4% of imports in 2017 to around 22.3% in 2020 and 2021. However, from the Q2 2022 onwards the decrease accelerates. At the start of 2023, Russia's imports were down to 3.87% and by most recent data (Q2 2024) they are down to 1.46%. In two years, Russia's oil imports to the EU decreased 96.11%, going from the EU's biggest provider of oil and petroleum products to no longer being one of the top ten partners.

Russia has thus been replaced by a diversification of partners. While some countries solidified their position as top partners such as Norway, the United States, Saudi Arabia, Kazakhstan, Libya, Nigeria, and the UK. Other nations such as Angola, the UAE, Brazil, India, and Turkey, saw their imports close to double.

The EU has thus been successful in diverting from its dependency on Russian oil in a short period, while maintaining its post-COVID levels of imports. There was notable reduction in Gross Inland Deliveries from 2019 to 2020 and 2021, and although levels have risen with the post-pandemic economic recovery and somewhat stagnated, overall oil use is on average 7.63% lower in the last analysed quarters (Q2 2023 to Q1 2024) when compared the same quarters in 2019.

### 6.3. Coal and Solid Fossil Fuels

Solid fossil fuels are divided into 3 main categories: hard coal, brown coal, and coal products. Coal products are mainly subproducts of coal which can be used in specific industries. To simplify our analysis, we summed the two main types of coal used in electricity generation and manufacturing and present the data as “Coal”. The share of each of the types of coal in the total consumption has remained stable in the past years at an average of 36.05% of hard coal and 63.95% of brown coal.

Most countries have made the phase-out of coal from electricity production their first objective, as coal is the most polluting of fossil fuels. Austria, Belgium, Sweden, and Portugal have already phased-out coal. Beyond Fossil Fuels, an aggregation of over sixty climate-related organisations across Europe, has an overview of the EU Member States plans for coal phase-out. According to them, eleven countries have made commitments to be coal free by 2030 and another seven after 2030. However, during 2022 and 2023, France, Greece, Italy, Hungary, and Romania announced they would delay their coal exit plans (Beyond Fossil Fuels, 2024).

Austria, which had closed its coal power plants in 2020, had to restart one of its coal power plants during 2022 and 2023, but in 2024 it was decommissioned once again. Germany also had to reopen several coal power plants between October 2023 and March 2024 to ensure its energy security in face of the drop in natural gas imports from Russia (Reuters, 2023). Poland remains the EU's most coal dependent country with close to 85% of its energy needs and 70% of its electricity production coming from coal in 2023 (Abnett, 2024; Kardaś, 2023). It is yet to set an end date for the complete phase-out of coal, with the only goal set being the very late phase out of hard coal by 2049 (Beyond Fossil Fuels, 2024).

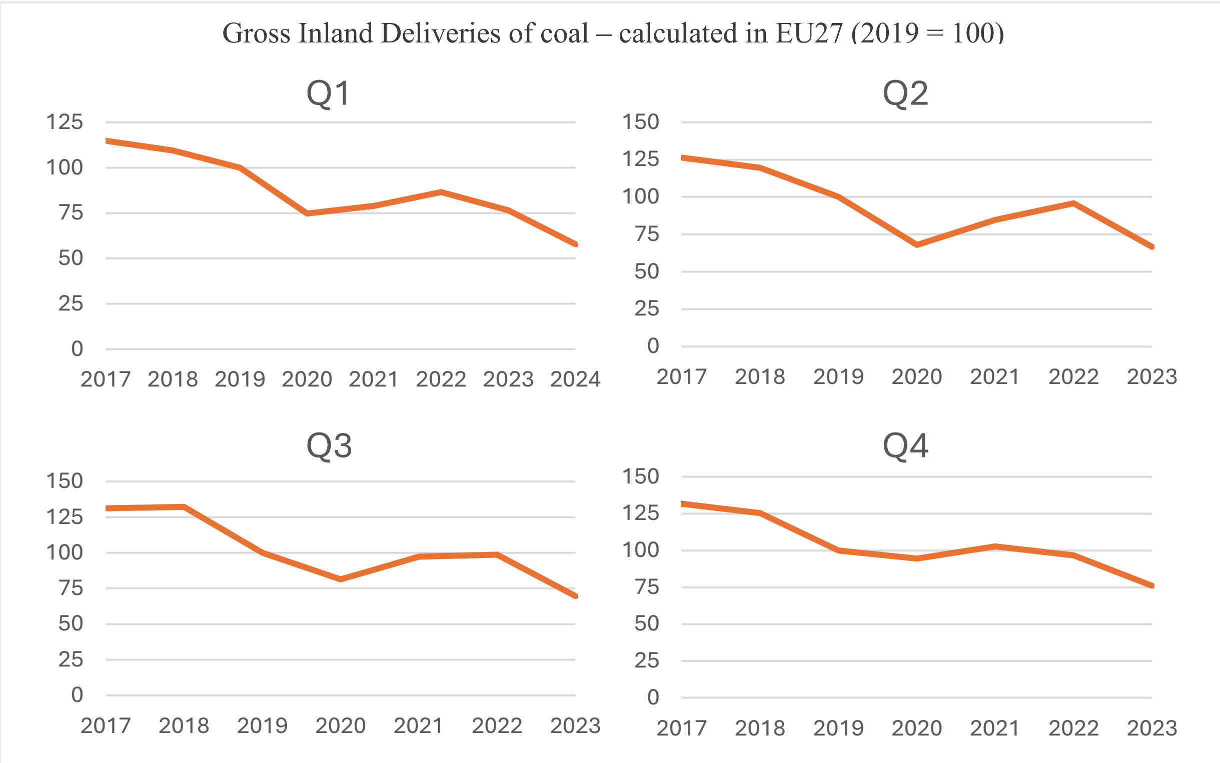


*Figure 6.6: Gross Inland Deliveries of coal (calculated) in EU27 (2019=100), data from Eurostat (2024k)*

As shown in Figure 6.6, which illustrates the trends in coal consumption across the EU using 2019 as the reference year, coal consumption has been following a downtrend that accelerated during the COVID-19 pandemic in 2020. During 2021, in line with the economic recovery in the EU, coal consumption increased but remained below 2019 levels. In the first (Q1) and second (Q2) quarters of 2022, consumption increased 9.48% and 13.09%, respectively, compared to the same quarters in 2021.

During the third quarter (Q3), coal consumption almost stabilises, with an increase of only 1.39% compared to the previous year, followed by a decrease of 5.85% in the fourth quarter (Q4). In 2023, the EU as a whole return to its downward tendency, decreasing on average by 23.16% over the four quarters compared to 2022 and by 19.69% compared to 2021, reaching its lowest level in the analysed data. This makes it clear that the increases in 2021 and 2022 were outliers due to exceptional conditions, while the level in 2023 decreased significantly more than the increases seen in 2021 and 2022.

### 6.4. Electricity

The discrepancy between electricity generation and demand in the EU is close to inexistent, meaning EU countries, as a whole, are able to produce almost all the electricity needed for consumption. This production may itself be dependent in the import of energy resources from countries outside the EU, but if these needs are imported from allied countries and, or, if an increasing share of electricity production comes from renewable sources, then EU countries are always able to securely meet their electricity needs.

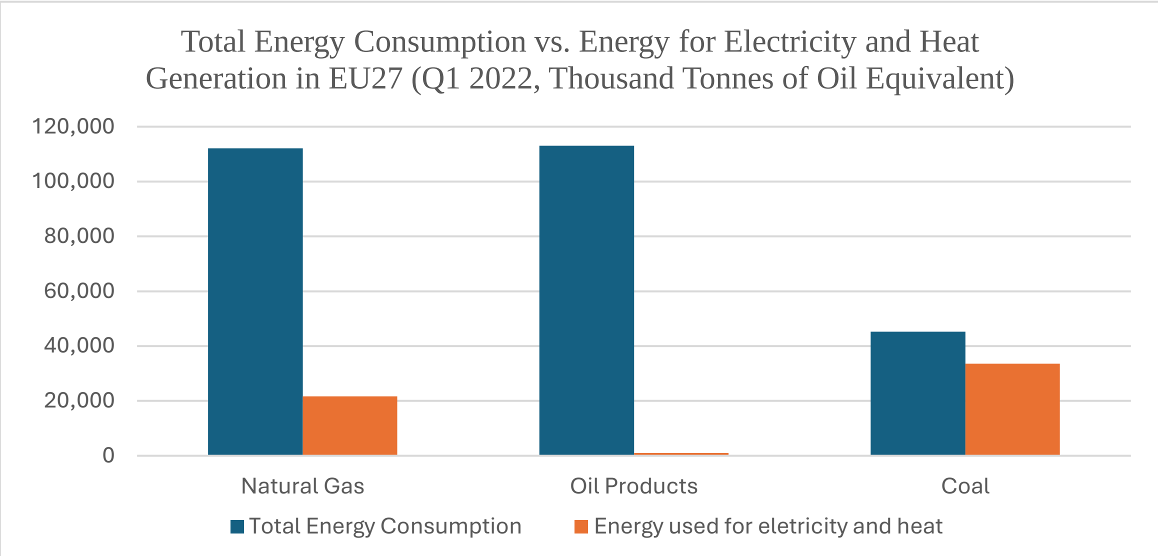


*Figure 6.7: Total energy consumption vs. Energy for electricity and heat generation in EU27 (Q1 2022, thousand tonnes of oil equivalent), data from Eurostat (2024i, 2024j, 2024k)*

Furthermore, only a part of the total energy consumption is used for electricity generation. The graph in Figure 6.7 uses Q1 2022 as it is the last quarter for which consumption and transformation data for gas, oil and coal products were fully available in the analysed dataset. In this quarter only 0.88% of oil and petroleum products were used for electricity and heat generation (the vast majority being refined into other fuels), 74.16% of coal and 19.34% of natural gas. The natural gas value is interesting as it deviates from the expected value, however, in this dataset, electricity and heat generation do not account for household consumption which constitutes the largest of natural gas used for heating.

The graphs in Figure 6.8 present the same data in three different ways. The top graph has the main sources of electricity generation: renewables (mainly hydro, wind, and solar), coal, oil and petroleum products, natural gas, and nuclear heat. The bottom left graph aggregates the fossil fuels (coal, oil, and gas) into a single category (Fossil Fuels) and compares it to the nuclear and renewables share. Finaly, the bottom right graph is based on the definition (according to the EU "Taxonomy" rulebook from 2023) of gas and nuclear power plants as green (Abnett, 2022). It aggregates renewables, natural gas, and nuclear as green sources and oil and coal as carbon intensive sources.

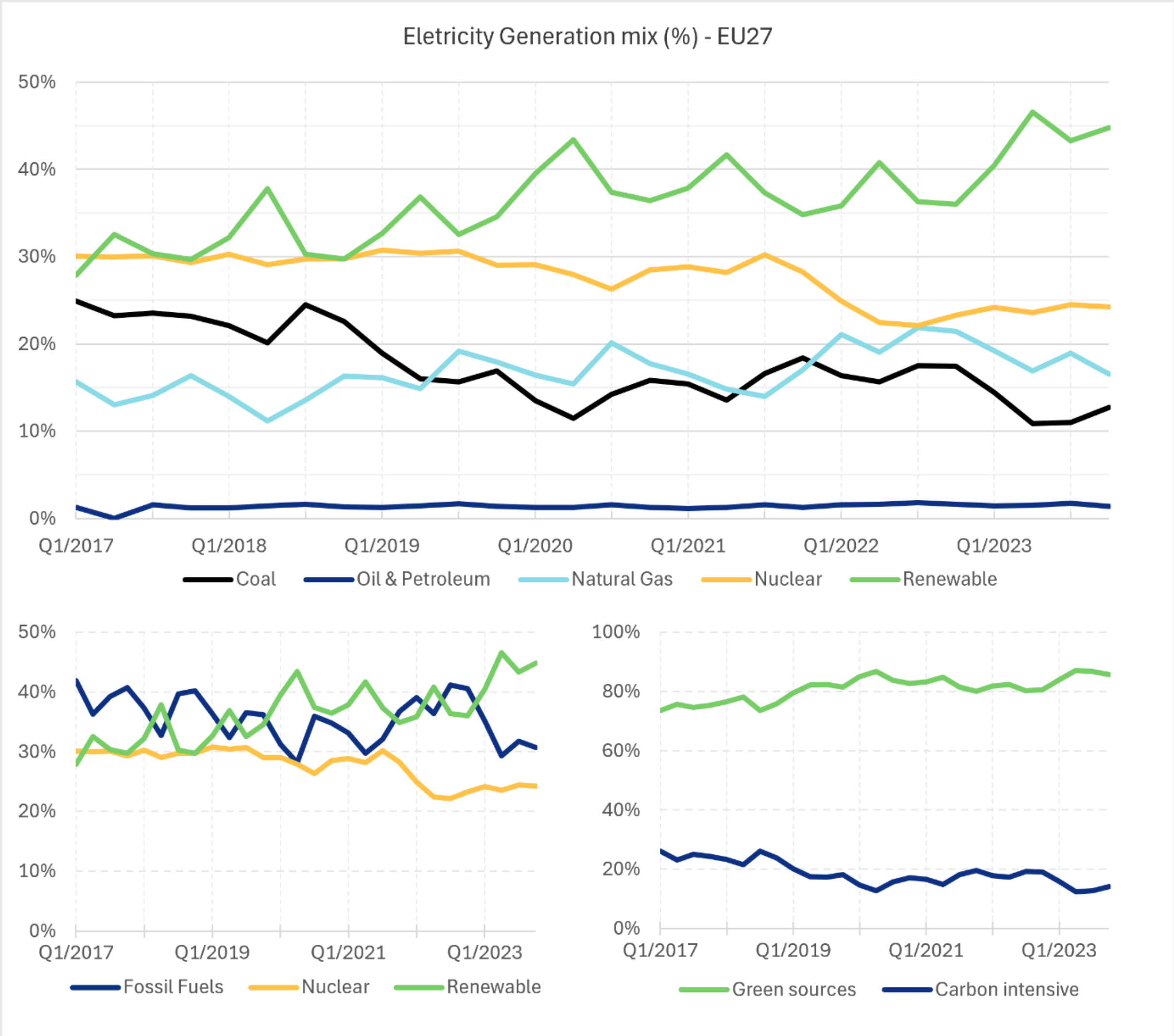


*Figure 6.8: Energy generation mix in EU27 (%, Q1 2017 – Q4 2023), data from Eurostat (2024g)*

Traditionally, fossil fuel sources constituted the bulk of electricity production, representing an average of 39.52% of the EU's electricity production in each quarter of 2017, while nuclear and renewables only accounted for around 30% each. Before the pandemic, the tendency in electricity generation showed significant reduction in coal usage, decreasing from

23.71% in 2017 to 16.87% in 2019, alongside an increase in the use of natural gas, which rose from 14.8% in 2017 to 17.04% in 2019, and also an increase in renewable energies.

In 2020, coal usage reached its lowest share ever during the second quarter, representing only 10.21% of the EU's electricity generation. Starting in the third quarter of 2021, there was an increase in the share of coal, reaching 18.4% in the final quarter of 2021 and maintaining on average 16.76% quarterly during 2022. During this period, fossil fuel usage increased significantly with its share reaching 41.16% in the third quarter of 2022, levels not seen since the first quarter of 2017. In 2022 its share was on average 111.13% above 2019 averages, compared to 92.03% in 2020, 93.08% in 2021 and 89.74% in 2023.

Natural gas share also reached its all-time value with a quarterly average of 20.85% during 2022. At the same time, nuclear generation decreased significantly from 30.2% in the third quarter of 2021 to 22.43% in the second quarter of 2022, a 25.7% decrease in its share. As we can see in the upper graph in Figure 6.8, the share of nuclear and natural gas electricity generation almost equalled during the second half of 2022.

Although the renewable energy share of electricity generation has been above 2019 levels in all quarters, except for the fourth quarter of 2021, for most of 2022, fossil fuel electricity production was, on average, higher than renewables across the EU. As we can see in the bottom left graph in Figure 6.8, in 2023 there were significant increases in the renewable share of electric generation, with it being above 40% in all quarters with an average of 43.77%, which is 38.04% above the fossil fuels share of electricity generation in the same period.

The use of oil and petroleum products in electricity generation, although it has been increasing, remains almost residual. Nevertheless, during 2022 and 2023, it was above all previously analysed years, with an average of 1.66% and 1.54%, respectively. Above the share of 1.31% it had in 2021 and of 1.43% in 2019.

Looking into the bottom right graph in Figure 6.8, it is clear that the green sources represent the astronomical majority of electricity generation and that the gap between green and carbon intensive sources has been widening. It first widened in the pre-pandemic and pandemic years, with green sources reaching a high of 86.76% in the second quarter of 2020, when the heaviest lockdown measures were being applied across Europe. It then started decreasing during the second half of 2021, and 2022, with its quarterly share at an average of 80.77% and 81.26% in the respective periods. In 2023, it recovered to a high quarterly average of 85.79% and a respective quarterly average share of 13.81% for carbon intensive sources.

Overall electricity generation has been down from 2019 quarterly levels except for the third and fourth quarters of 2021. From the second half of 2021 to the second half of 2023, total electricity generation has decreased 6.25%.

To summarise, 2022 saw an increase in fossil fuel usage for electricity generation, while nuclear generation reached its lowest level of share in at least the previous 5 years. In 2023 the trend inverted, with coal and gas usage diminishing and renewable sources reaching all time high shares in electricity generation.

### 6.5. Greenhouse Gases Emissions

The graph in Figure 6.9 uses a four-quarter moving average to smooth out short term fluctuations and show the long-term trend without being affected by seasonality. The grey area represents the period most heavily impacted by the COVID-19 pandemic (Q1 2020 to Q3 2021), which has been excluded from the linear regression (orange dashed line) as it could have introduced irregularities due to extraordinary circumstances that do not reflect the long-term changes in emissions. As per the regression equation in Figure 6.9, we see that the slope of the regression and the high $R^2$ value of 0.9744 indicate a strong and consistent downtrend, with the data for 2022 and 2023 not deviating significantly from the pre-pandemic reduction trend.

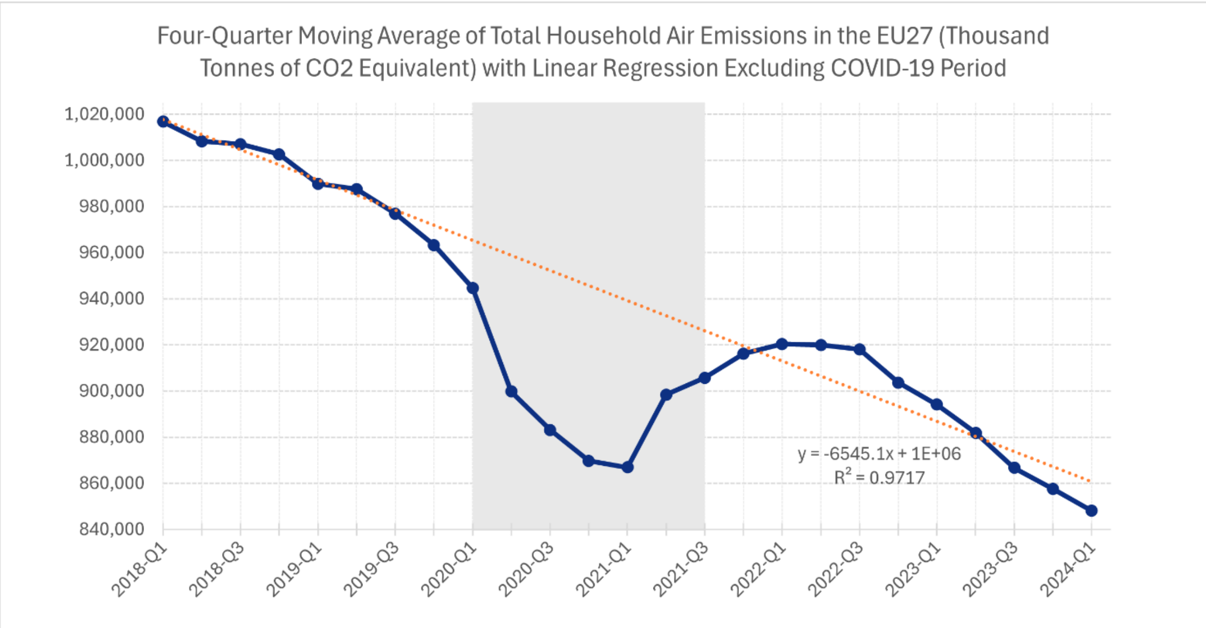


*Figure 6.9: Four-quarter moving average of total household air emissions in the EU27 (Q1 2018-Q1 2024, thousand tonnes of $CO_2$ equivalent) with linear regression excluding COVID-19 period (Q1 2020-Q2 2021), data from Eurostat (2024b)*

Regarding the air emissions per NACE v.2 activities (i.e., the second revision of the EU Commission statistical classification rulebook for economic activities), most sectors share of total emissions have remained somewhat stable, only increasing about 1-2% in share the past 7 years, except for the Electricity, gas, steam, and air conditioning supply sector. This sector was the main polluter until mid-2019 when it was overtaken by manufacturing. During the COVID pandemic its share decreased significantly to below 19.5% of total emissions. During 2022 its share increased again, almost equalling that of the manufacturing sector at a quarterly average share of 20.49%. Since the beginning of 2023, its share dropped significantly, now being the third most polluting sector of economic activity, representing 17.23% of total air emissions as of the first quarter of 2024.

## 7. Energy Policies and Objectives

The establishment of EU wide long-term objectives in what has been called the European Green Deal started in 2019 with the endorsement of three mains goals: to reach net zero GHG emissions by 2050, to decouple economic growth from intensive resource use, and to ensure the green transition is fair to all EU citizens, with the promise to establish new goals and concrete actions in this direction during the 2019-2024 legislature. Effectively, the European Green Deal is a roadmap of commitments and objectives to ensure a just and inclusive transition by 2050.

The European Green Deal gained new purpose following the economic downturn associated with the COVID-19 emergency measures and the resulting worldwide trade and economic disruptions. It was the conviction of EU leaders and legislators that the investment in green technologies, such as smart grids, hydrogen, and renewables energies, was necessary to boost Europe's economic recovery, with such investment having the potential to create new high-value jobs, increase technological competitiveness and accelerate the decarbonisation of European society. As Tomislav Ćorić, Croatia's Minister of Environment and Energy from 2020 to 2022, remarked during the Croatian presidency of the Council of the European Union at a conference of environment ministers: "The recovery plan […] can help kick-start Europe's economy after the COVID-19 crisis, and at the same time boost Europe's sustainability and climate action" (Ćorić, 2020, 11:46:31).

Prior to 2020, the 2030 GHG emission reduction target was set at a 40% reduction when compared to 1990 levels. In January 2020, the EU Commission released a communication in titled "Stepping up Europe's 2030 ambition", which would later be discussed by the European Council in October and endorsed in the December meeting of the same year. In this new proposal, the Commission wanted to increase the target to a reduction of 55% when compared to 1990 levels, taking into account the impact of new legislative work and investments associated with the European Green Deal.

The objectives of the European Green Deal are set into law, thus making them mandatory, through the approval of the European Climate Law. Its main goals were the 2050 climate neutrality, and the intermediary objective of a 55% reduction in GHG emissions by 2030. It established the policies and funds needed to reach those targets, thus providing clear expectation and stability for investors and economic actors, creating a progression monitoring system and ensuring the transition is fulfilled across Member States and is irreversible.

The Council and the EU Parliament had discussed and reached an agreement regarding the European Climate Law before putting it to vote. By April 2021, a provisional agreement was reached, establishing three new additions to the law: to give priority to emission reduction over emission removal to reach the 2030 target, to establish a European Scientific Advisory Board on Climate Change to periodically report on the progress being made and potential necessary adjustment to policies, budgets, or targets, and set an intermediary target for 2040, to be defined by the Commission. The law entered into force on July 29, 2021 (European Commission, 2023).

### 7.1. Fit for 55

On July 14, 2021, the EU Commission presented the Fit for 55 package, which updates EU legislation and creates new initiatives to ensure the EU meets the 55% reduction climate goal by 2030. The Fit for 55 proposals would grow to incorporate reforms in almost all sectors of economic activity, as shown in Table 7.1. The final vote and approval of the package was only after the beginning of the war, meaning some of the policies were scaled up as a response, most notably the increase in emissions reduction target in sectors not covered by the EU ETS from 29% to 40% compared to 2005 levels. Nevertheless, the main goal, the overall 55% reduction by 2030, was not changed from before to after the start of the invasion. A provisional agreement was reached between the Council and the Parliament in November 2022, and it entered into force in March 2023.

| **Reforms/Objectives** | **Description** |
|---|---|
| Main goal | Reduction of GHG by at least 55% by 2030 |
| EU Emission Trading System (EU ETS) | Extend the system to cover more sectors, phase-out free allowances for some sectors and faster reduction of emissions allowances. |
| Reduction of GHG in sectors not covered by EU ETS | Increases GHG reduction target for 2030 from 29% to 40% compared to 2005 levels, in some sectors not covered by the EU ETS. |
| Carbon Border Adjustment Mechanism (CBAM) | Aims to replace existing mechanism to reduce the risk of carbon leakage. |

| | |
|---|---|
| Land use, land-use change and forestry (LULUCF) regulation | Sets a goal of 310 MT of $CO_2$ equivalent net removal of GHG by 2030. With binding national targets for each Member State. |
| $CO_2$ emission standards for cars and vans | Promote electric vehicles and sustainable fuels, with a goal of zero emissions from new cars by 2035. |
| Renewable Energy | Increase the share of renewable energy from the previous goal of 32% to 40% of the EU's total energy mix by 2030. |
| Energy Efficiency | Reduce final energy consumption by 11.7% by 2030, compared to 2020 projections of energy usage. |
| Energy performance of buildings | All new buildings be zero-emissions from 2030 onwards, and all existing buildings be transformed to zero-emission by 2050. |

*Table 7.1: Main reforms and objectives of the Fit for 55 package, based on data from European Council (2024b). Table created by the author.*

### 7.2. Sanctions

Before 2022, the EU already had sanctions in place in response to Russia’s illegal annexation of Crimea in 2014, its continued support for separatist movements in Ukraine and its violations of International Law in cases such as the poisoning of Alexei Navalny in 2020. In the energy sector, these sanctions included embargos on certain equipment and technologies, particularly to impact new Russian exploration and drilling in the Arctic, a ban on Russia state-owned energy companies from participating in European capital markets, and a ban on any investment by European companies in the energy sector in Crimea (Hanousek & Bělín, 2019).

Although not officially sanctioned, the Nord Stream project was under intense scrutiny and pressure by European policymakers and allies such as the U.S., which warned of the risks of further integrating Russia in the European energy sector. By September 2021, the pipeline was complete, but it never entered into service, with its certification being suspended on February 22, 2024, due to Russia’s recognition of the self-entitled Donetsk and Luhansk People’s Republic.

Furthermore, in response to this first move by Putin, the EU Council approved on February 23, 2024, the first of what would be, at the time of writing, fourteen sanction packages by EU leaders against Russia (Table 7.2). The table below lists in chronological order those sanctions which had measures impacting the energy sector. It is evident that there is a gradual increase in scope of the sanctions, with the first sanctions only tackling equipment and investment bans, and later sanctions making way for the decoupling of the EU from Russia's energy resources with the prohibition on imports of crude oil, petroleum products, liquified methane, and coal and other solid fossil fuels. While, at the same time, also trying to impact Russia's ability to maintain its funding by diversifying its source to third countries by making restriction to the use of EU ports and maritime companies.

At the time of writing, and as evidenced by the data in the previous chapter, the EU has not banned imports of natural gas from Russia. Although imports have fallen significantly (mainly by pipeline), the levels still remain significant and it is frequent for EU ports to receive Russian shipments of LNG.

| **Sanction Package** | **Energy Policies** |
|---|---|
| Second package – February 25, 2022 | Prohibits the export of specific goods and technologies in oil refining (Council Decision 2022/327). |
| Fourth package – March 15, 2022 | Prohibits new investments in the Russian energy sector and expands the export restriction on equipment, technology and services in the energy sector (Council Decision 2022/430). |
| Sixth package – June 03, 2022 | Prohibits the imports of crude oil and other petroleum products (phase out taking between 6 and 8 months). Except crude oil by pipeline for certain EU countries (Council of the EU, 2022). |
| Eight package – October 06, 2022 | Prohibition of EU vessels to provide maritime transport of crude oil and petroleum products purchased above a pre-established price cap (Council Decision 2022/1909). |
| Tenth package – February 25, 2023 | Prohibition to provide gas storage capacity (with the exclusion of the part of LNG facilities) to Russian nationals (Council Decision 2023/434). |
| Thirteenth package – February 23, 2024 | Import ban on liquefied propane (12 months phase out), strengthening of oil price cap mechanism (Council Decision 2023/2874). |

| | |
|---|---|
| Fourteenth package – June 24, 2024 | Bans reloading services of Russian LNG in EU territory for the purpose of transshipment operations to third countries. Prohibition of investment in LNG projects in construction in Russia (Council Decision 2024/1745). |

*Table 7.2: Sanction measures impacting the European energy sector, based on data from European Council (2024c). Table created by the author.*

### 7.3. REPower EU

On March 8, twelve days after the start of the full-scale invasion of Ukraine, the EU Commission proposed a plan to make the EU 100% independent of Russian fossil fuels by 2030. This plan also prepared Europe for the rise in energy prices and to ensure adequate natural gas stocks for the winter of 2022/2023, for which a reduction in Russian gas pipeline imports was expected. The plan, dubbed REPower EU, aimed to reduce Russian gas demand by two-thirds in one year, a target which, according to the data analysed in the previous chapter, was successfully met, with imports of Russian natural gas decreasing 67.82% from March 2022 to March 2023.

The plan was endorsed by EU leaders at the informal meeting of EU's heads of state and government in Versailles during March 10 to 11, 2022. In the Versailles Declaration, EU leaders prioritise the need to reduce energy dependency and invite the Commission to propose a roadmap (European Council, 2022). Shortly after the Versailles meeting, on the March 25, 2022, the EU and the United States established a joint Task Force on Energy Security, with the U.S. committing to significantly increase, alongside other internation partners, LNG trade with the EU to help fulfil the EU's natural gas needs (Commission Statement No 22/2041).

The proposed REPower EU plan works side by side with the Fit for 55 package and the European Climate Law, aiming to reduce overall dependence on fossil fuels (not only Russian) faster and to accelerate the implementation of renewable energies, thus increasing European autonomy in the energy sector. In the short term, the EU's energy security will be ensured through three main objectives: reducing energy consumption, diversifying energy sources away from Russia to allied countries, mainly through investment in LNG infrastructure, and accelerating the investment in renewables.

As previously discussed in Chapter 2 and corroborated by the data analysed in Chapter 6, the roll-out of renewables by itself is insufficient to ensure the energy transition, since renewables mainly impact electricity generation, which only accounts for 17.23% of total GHG air emissions. The REPower EU program therefore also focused on the decarbonisation and electrification of industries, the energy efficiency of buildings, reducing the consumption and demand, prioritising investment in zero-emission transport, such as rail, and increasing electricity storage capacity.

The initial Fit for 55 reforms of the Energy Efficiency Directive set the reduction target at 9% of final energy consumption by 2030, compared to 2020 levels. In the REPower EU proposal, the EU Commission sought to increase the reduction to 13%, but ended settling on a 11.7% reduction later in the legislative process. The program also increased the target in the Renewable Energy Directive from 40% to 45% renewables in the overall energy mix by 2030, and sets a target of 320GW of newly installed solar photovoltaic by 2025 and 600GW by 2030.

Hydrogen plays a key role in the REPower EU program, being seen as an alternative fuel for hard to electrify sectors. It sets a target of producing, importing, and transporting 20 million tonnes of hydrogen by 2030, with a focus on developing new hydrogen infrastructure.

The Commission estimates that an investment of €210 billion will be needed by 2027 to implement the REPower EU plan. Unlike the Fit for 55 and the European Climate Law, which are mainly funded through the EU budget, the REPower will be funded by the Recovery and Resiliency Facility, which is part of the NextGenerationEU program, consisting of a mix of Grants and Loans. Furthermore, according to the Commission estimates, the move away from fossil will save the EU economy around €93.7 billion per year by 2030.

## 8. Conclusion

This work comes from a standpoint, backed by previous research and even by the everyday life of every European citizen, that Russia's invasion of Ukraine has changed both the energy uses in the EU and the mindsets of our policymakers. The data analysed in chapters 6 and 7 confirms this. The war has undeniably reshaped the European energy market substantially and, in some sectors, irreversibly.

The most disrupted of all energy resources was natural gas, which saw its prices soar due to low supply from Russia, causing a short-term energy security crisis in Europe. Nevertheless, the EU succeeded in its objective to reduce its natural gas consumption and managed to diversify its imports sources by more than doubling LNG imports, mainly from the U.S. and Qatar, and by increasing pipeline imports from Norway, Algeria, and Tunisia. The heavy dependence on Russian imports, mostly due to pre-existing pipeline infrastructure and lower prices than the alternatives, was finally overturned. And even though some of these structural shifts were already happening before 2022, they all accelerated significantly with Russia's aggression, leading the EU to now aim to be full energy independent from Russia by 2027.

Overall levels for all the major fossil fuels - natural gas, oil and petroleum, and coal and other solid fossil fuels - are lower than before the invasion began and before the pandemic. This means that although there were some instances, out of necessity, where fossil fuel usage increased - mainly due to the restart of some previously decommissioned coal fuelled power plants and the delay of coal phase out plans in some countries - such actions have been temporary, aimed at compensating for the decrease in natural gas imports from Russia, and have not impacted the overall decarbonisation objectives and trend in the EU.

This was further corroborated by the GHG emissions data. Although there was a slight above trend increase in total household air emissions seen in Figure 6.9, which coincides with the increase in fossil fuels share of electricity generation seen in Figure 6.8, mainly during 2022, the total emissions quickly fell to below the expected behaviour since 2018 (not including COVID-19 period data). For the most part, total emissions data regarding GHG emissions shows there is a reduction, but that such reduction is in line with the reductions being made in the pre- and post-pandemic periods. There is no noticeable increase or decrease in overall emissions trend seen post-February 2022. Ultimately, this means that the accelerations and decelerations seen throughout the data cancel each other with the overall trend remaining the same.

However, given the consensus found in the literature that the path to net zero in the EU will be through a combination of net zero in electricity generation and the electrification of carbon-intensive sectors such as transportation and manufacturing, the fact that the EU has accelerated its electricity production transition to renewable energies due to a reduction and depart from fossil fuels of which it was heavily dependent on Russia is a good outlook for the future of the energy transition in Europe. In other words, if the accelerated transition in the electricity sector had been followed by an accelerated electrification in carbon-intensive sectors (which have been growing), there would have been a more significant impact in the reduction of emissions.

Additionally, there has been positive progress in the policies and targets set. Even with the fact that the REPower EU program does not change the European Green Deal objective of a 55% reduction in emissions by 2030, it increases the renewable energy goals from 40% to 45% of total energy consumption by 2030, expands the role of green hydrogen as a transition fuel in manufacturing and transport, which, if successful, would be vital to decarbonise hard to electrify sectors, and improves energy efficiency targets. All these factors combined would lead to an acceleration in GHG emissions reduction when compared to the previously set goals.

There is thus a positive impact to be taken out of something as horrible as the invasion of Ukraine. It might be unclear and debatable what led Vladimir Putin to invade Ukraine in 2022, nonetheless, with or without the invasion of Ukraine, the EU was poised to transition to a society less reliant on fossil fuels and thus less dependable and ‘afraid’ of Russia. If Putin intended to strike and try to use his energy weapon to keep Europe in check, it had to be sooner rather than later. We know, from his texts (including academic works) and speeches, that Putin sees the world through the eyes of geopolitical realism, making reflections like these necessary to comprehend Russia’s moves. Europe did not bow to Russia, and has instead taken a confrontational stance. This forced need to break away from Russia’s dependence has accelerated the EU’s transition to a clean future, enlarging the already significant green targets previously set by the EU and resulting in a triple positive effect, reinforcing the EU’s energy security, energy independence and energy transition.

Another vital aspect, which has been backed by Mario Draghi’s recent report (Draghi, 2024), is the need for better synergies between each Member States’ energy infrastructure and investment plans. Competition between Member States might lead to an installation of excessive capacities, reducing the overall benefits of each one. For the transition to be successful, there must be a joint plan for decarbonisation and competitiveness.

For example, the pivot from Russia's gas to LNG imports requires the investment in new port infrastructure. Mediterranean European nations are pouring billions of euros competing among themselves to become the next major gas hub (MIBGAS, 2024; Euronews, 2024). These investments have been criticised for using taxpayers' money to fund large fossil fuel infrastructure when the rhetoric is focused on the need to transition away from fossil fuels. As Escribano & Lázaro, (2020) put it: "Such fossil mega-projects, while typical of the past, are rapidly becoming strategically obsolete. They threaten to impose a fossil lock-in, making EU finance a stranded asset that is not consistent with the mid-century carbon neutrality goal" (p. 9). These projects, while serving a short-term goal, will delay long-term objectives by diverting investment and by keeping fossils flowing for several years or decades while countries must use and justify such large-scale investments.

Nevertheless, it is important for Europe to keep its energy grid stable and affordable, to ensure that the energy transition works with and not undermines Europe's industrial competitiveness. Continued investment in renewables and in the circular economy should continue to bring down electricity prices (Draghi, 2024).

As repeated through the literature analysed in this work (e.g., Zappa, 2019), the EU must continue to increase interconnectivity between Member States to allow excess capacity to be efficiently distributed throughout the continent, thus making the best use of different types of renewable energy sources during different seasons and weather conditions. Simultaneously, it must advance significantly in the electrification of combustion vehicles-dependent sectors such as transportation. Electricity accounts for only 17.23% of emissions, so without a substantial focus on energy electrification and energy efficiency, even with 100% electricity generation from RES, we would still maintain 82.77% of current GHG emissions. Energy efficiency measures can include stricter building and electronic manufacturing codes with high energy standards, adoption of smart meters and other technologies to educate the citizens on their wastes and help consumers reduce their consumption, shift demand peaks to align with renewable peaks, and further reduce total consumption.

Also, considering the heavy impact that decoupling from Russia's energy influence has had on Europe in recent years, it is important for Europe to choose its new partners carefully, taking into account the instability in some regions and how the EU's energy supply may be affected by ongoing or escalating conflicts, mainly in the Middle East, with occasional tensions and threats in both the strait of Hormuz and Bab-el-Mandeb strait.

It is also important for the EU to ensure it is not maintaining its dependency on Russia through third countries. EU imports of refined oil products from Turkey have increased while simultaneously Turkey's dependence on Russian seaborne oil imports rose from 34% in 2023 to 70% in the first half of 2024 (Raghunandan et al., 2024). This means almost all of EU's oil and petroleum products imports from Turkey are in fact from Russia, with the Centre for Research on Energy and Clean Air estimating the G7+ have imported €1.8 billion in oil products derived from Russian crude oil from only three refineries in Turkey in the first half of 2024 (Raghunandan et al., 2024). This money will undoubtedly be used for Russia to fund its ongoing invasion in Ukraine, which not only is against Europe's geopolitical and security interests but also against its financial interests, given that the EU and most of its Member States are also transferring significant amounts to help Ukraine defence. Cases such as this imply Europe continues to fund both sides of the war, thus perpetuating Ukraine's suffering.

In retrospect, although this work strives to provide an adequate analysis of available energy data and relevant energy policy changes, we recognise the limitations and shortcomings of the study that need to be addressed.

Firstly, the data used for the post-war analysis is insufficient to infer long-term trend changes. Especially given that the consumption of most energy resources exhibits a high degree of seasonality, and that its analysis had to be conducted by comparing the same quarters in different years, there were only two data points - one for each quarter from 2022 and 2023 – available to analyse the changes. This is clearly insufficient, although we can observe some deviations from previous trends or levels, it is not adequate for a comprehensive trend analysis. Furthermore, given that most of the policy changes associated with the imposed sanctions and the REPower EU were only approved throughout 2022, 2023 and even 2024, we cannot assess their long-term impact in the available data. With the exception of when clear short-term goals were established, as was the case with the reduction in natural gas consumption and the target set for natural gas storage levels.

Moreover, the disturbance caused by the COVID-19 impact on energy data made the analysis especially hard and complex. Despite the fact that the EU economy had mostly recovered by the third quarter of 2023, this is not a homogenous fact, given that the recovery has not been the same in all Member States or in all economic sectors. While 2019 can be considered the last full 'normal' year of economic activity before the war, the COVID-19 pandemic, while causing massive disruption, did not lead to a full standstill on the energy transition progress, with the installation of new RES continuing to grow. So, while on the one side we could not fully consider 2021 because of the impact of COVID in energy demand, it is also somewhat incorrect to consider 2019, since it is three years apart from the start of the war.

We tried to mitigate these shortcomings by comparing recent data to both 2019 and late 2021, but we recognise the limitations of this analysis.

Secondly, while the need for progress in energy efficiency and the integration of energy grids is significantly discussed in this work, the analyses lack data on how the EU is progressing on both these issues, relying only on the academic research available on these subjects. This also highlights the shortcomings of Eurostat as a source. Although it is one of the most complete databanks on European statistics, it often had several datapoints missing or clearly incorrect, which posed a challenge for the analysis.

Finally, this dissertation is exclusively focused on the impacts in the EU's transition, however, the invasion of Ukraine had repercussions all over the world and fossil fuel supplies tend to be a zero-sum game. Some authors raise concerns that the diversification of sources by the EU has negatively affected the energy security of developing countries and impacted their energy transitions (Kuzemko et al., 2022).

It is our belief that future research should continue to analyse this topic periodically to better understand how the impact of the war in the European energy transition continues to progress, becoming more or less apparent in a positive or negative way. Future studies on this subject would benefit from a series of interviews with policymakers and experts from the private energy sector to gain an insight on the empirical challenges presented by the war, the change in mindsets and the expectations. It is also important to analyse more data on energy efficiency across various sectors of society, as well as on the progress and speed at which carbon-intense economic sectors are being electrified.

A more interdisciplinary approach, integrating political, technological, and economic perspectives would provide a deeper understanding of the energy transition. It would also be of utmost relevance to broaden the analysis to understand how the changes in the EU's energy transition as a result of the war in Ukraine have affected the rest of the world, whether negatively, by sidelining other countries in the international energy market, or positively, by acceleration our transition targets and influencing other countries to do so.

Despite its limitations, we believe this thesis has explored the multifaceted impacts of the war in Ukraine on the European energy sector and its transition. The conflict, while creating significant challenges for EU policymakers and citizens, has ultimately been a catalyst for the acceleration of the shift towards renewable energy sources. Policies such as the multiple sanctions on Russian energy imports and the REPower EU have pushed the EU to diversify its energy partners, invest in renewables, set bolder transition targets, and prioritise energy efficiency measures.

In conclusion, the EU’s response to the energy crisis demonstrated resilience and adaptability. Most likely this will not be Europe’s last energy crisis during its transition, its long-term success will depend on overcoming the necessary short-term trade-offs and remaining ever committed to decarbonisation. Ultimately, even with the energy transition far from complete, the events triggered by the war in Ukraine have accelerated Europe’s path towards a more sustainable, independent, and secure energy future.

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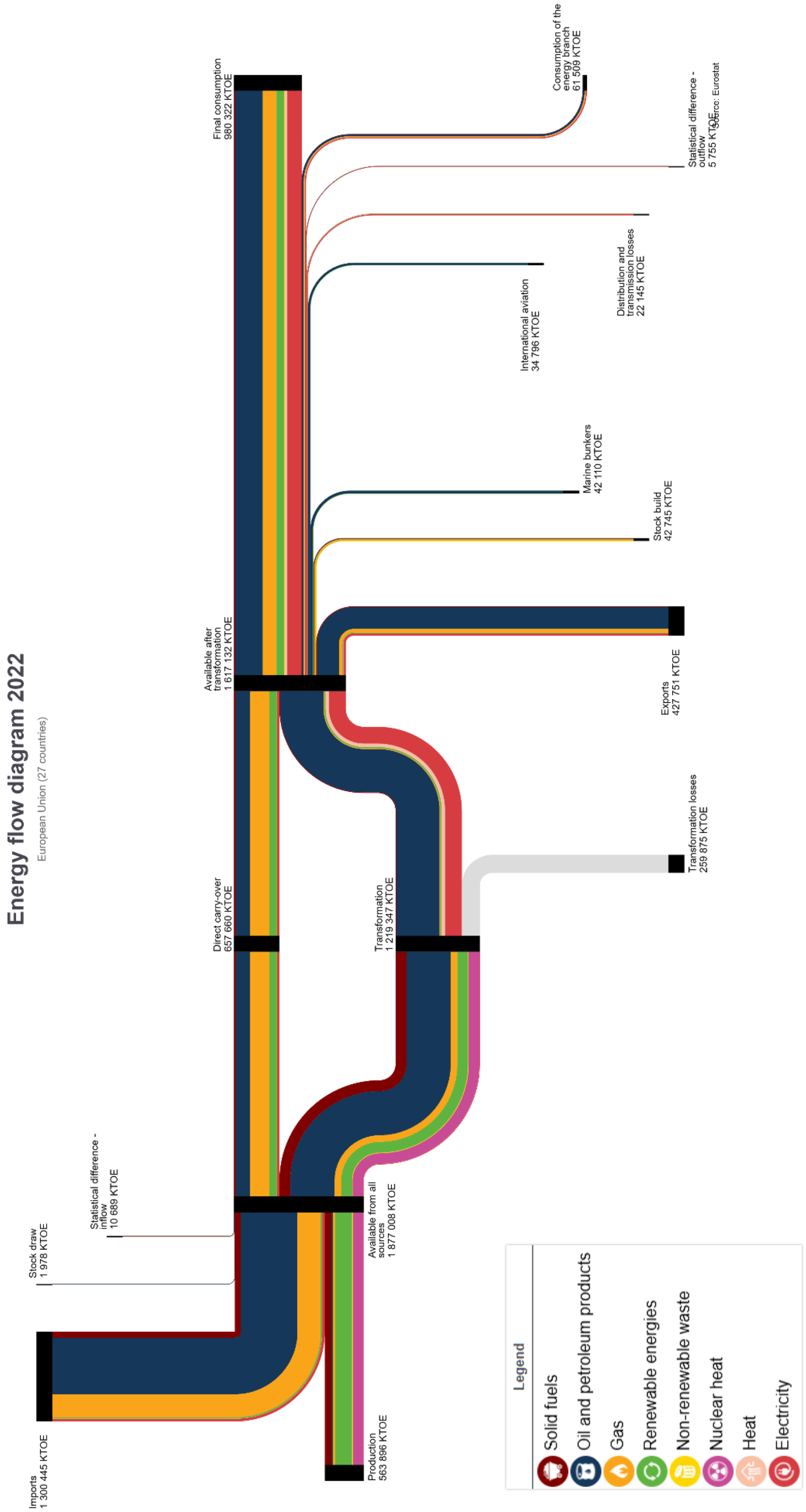
# Annex A



Energy flow diagram 2022
European Union (27 countries)
Imports
1 300 445 KTOE
Stock draw
1 978 KTOE
Statistical difference - inflow
10 689 KTOE
Production
563 896 KTOE
Available from all sources
1 877 008 KTOE
Direct carry-over
657 660 KTOE
Transformation
1 219 347 KTOE
Transformation losses
259 875 KTOE
Available after transformation
1 617 132 KTOE
Exports
427 751 KTOE
Stock build
42 745 KTOE
Marine bunkers
42 110 KTOE
International aviation
34 796 KTOE
Distribution and transmission losses
22 145 KTOE
Statistical difference - outflow
5 755 KTOE
Consumption of the energy branch
61 509 KTOE
Final consumption
980 322 KTOE
Source: Eurostat
Legend
Solid fuels
Oil and petroleum products
Gas
Renewable energies
Non-renewable waste
Nuclear heat
Heat
Electricity