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Energy transitions in the European Union in times of crisis

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AUTHOR'S DECLARATION

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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The European Union (EU) is the global leader in low-carbon energy transitions and at the same time strongly depends on energy imports from Russia. With Russia's invasion of Ukraine in February 2022, the EU faced an unprecedented challenge of simultaneously tackling energy security and climate emergency. This thesis examines whether and how the current crisis affects the speed and direction of the EU's energy transition. It analyses official documents, statistical data, and media publications to show that in the short-term (1-2 years) the EU's energy transitions are not likely to be accelerated. The longer-term (5-10 years) goals to significantly expand renewables and low-carbon fuels and to reduce energy demand aim to somewhat accelerate the transition as compared to the pre-crisis plans, but the feasibility of achieving these goals is so far unclear. On the other hand, the envisioned extension of natural gas infrastructure and the unavoidable turn to coal in power generation will likely lock in fossil fuel use. More generally, the thesis argues that while energy security crises can motivate ambitious energy policies, not all of them aim to accelerate low-carbon transitions and some may even backpedal decarbonisation. Furthermore, the implementation of most ambitious decarbonisation targets is likely constrained by factors other than pure policy motivation. This thesis contributes to the scholarly debate on feasible speeds and drivers of transitions and provides a basis for future research on the medium- and long-term effects of the 2022 energy and security crisis.

Keywords: energy transition, energy security, energy policy, EU energy dependency, deployment of renewables, decarbonisation, natural gas, fossil fuel lock-in

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Full text
Bcm	Billion cubic metres
CEPS	Centre for European Policy Studies
COP	Conference of the Parties
EC	European Commission
EEB	European Environmental Bureau
EU	European Union
EV	Electric vehicle
GEA	Global Energy Assessment
GHG	Greenhouse gases
GW	Gigawatt
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
Kb/d	Thousand barrels per day
Kg	Kilogram
KWh	Kilowatt-hour
LHV	Lower heating value
LNG	Liquified natural gas
Mj	Megajoule
MS	Member States
Mt	Million tonnes
Mtoe	Million tonnes of oil equivalent
MW	Megawatt
NECP	National Energy and Climate Plans
NSP	Nord Stream Pipeline
NSP2	Nord Stream Pipeline 2
OPEC	Organization of the Petroleum Exporting Countries
Pj	Petajoule
SDGs	Sustainable Development Goals
SEE Focus Group	South-East-European Focus Group
SCF	Social Climate Fund
TWh	Terawatt-hour
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US	United States
WWF	World Wide Fund for Nature

1 INTRODUCTION

1.1 Background

Climate change – "long-term shifts in temperatures and weather patterns" (UN 2022) – is one of the major threats that humankind is facing (UN Environment 2019). Climate change is primarily driven by human activities, particularly by emissions of CO2 and other greenhouse gases (GHG) during fossil fuel combustion. According to the latest Intergovernmental Panel on Climate Change (IPCC) Report, human-caused GHG emissions are responsible for about 1.1°C of warming since 1850-1900 (IPCC 2021b). In order to prevent a catastrophic climate change, the use of fossil fuels must be stopped.

On the other hand, burning of fossil fuels is essential for the functioning of modern societies. As of 2019, approximately 84% of global primary energy came from fossil fuels: coal, oil, and gas (Ritchie, Roser, and Rosado 2020). Energy use – divided between electricity, heating, and transport – accounts for almost 74% of total emissions (ibid.). To reduce emissions, it is necessary to rapidly and radically substitute fossil fuels by low-carbon energy sources in the process known as low-carbon energy transition (IRENA 2022).

Profound energy transitions have occurred in the past, but in many cases, the process was slow and uneven (Smil 2016, 195). Energy transitions depend on technological innovations, economy, policies, and strong governance capacities (Vinichenko, Cherp, and Jewell 2021, 1485–86), as well as on wider social processes (Fouquet and Pearson 2012, 2). Starting from the 20th century, energy transitions have often been politically motivated. For example, expansion of nuclear energy and natural gas in the 1970s was stirred by state interests to mitigate energy security concerns stimulated by oil crisis (Cherp and Jewell 2011, 2). Contemporary low-carbon energy transitions are primarily driven by the climate goals. In contrast, with Russia's invasion of Ukraine in February 2022, both energy insecurity and climate goals have become relevant to energy transitions in Europe. This situation created a uniquely complex challenge for the energy policy of the European Union (EU).

1.2 Research questions

The interplay between climate change and security in energy transitions has been discussed in recent literature (see e.g., Jewell, Cherp, and Riahi 2014), but there have been limited opportunities to observe it empirically in situations where both challenges are as serious as in EU in 2022.

Though the EU is a global leader in climate change policies, it has not been similarly successful in ensuring the security of its energy system. Having limited and declining levels of domestic production of oil, gas, and coal, the EU needs to import a large share of its energy. In 2021, Russia was the main supplier of fossil fuels for the EU and provided approximately 40% of the EU's total gas imports, 27% of oil imports and 46% of coal imports (EC 2022m). As Russia's economy heavily relies on fossil fuel revenues, the EU and Russia mutually depend on energy trade with each other.

Russia's invasion of Ukraine triggered calls in the EU to cut Russian energy imports. This aimed to reducing Russia's revenues facilitating thereby the sooner end of the invasion (The European Council 2022). From March to mid-July 2022, the EU had adopted two packages of sanctions imposing a ban on Russian coal, crude oil and petroleum products imports (EC 2022r). In response to the security crisis, the European Commission (EC), national governments, and the International Energy Agency (IEA) have released numerous proposals to reduce dependency on Russian fossil fuels through diversification of energy suppliers, accelerating deployment of renewables, and energy savings.

This situation provides a unique opportunity to answer several questions that have dominated the energy transitions debate:

- The first question is whether the security crisis will accelerate or slow down the ongoing transition to low-carbon sources. Some of the proposed measures (e.g., faster deployment of renewables or energy efficiency) would facilitate decarbonisation whereas some other (e.g., re-starting coal power plants and expanding infrastructure to import non-Russian energy sources) may both increase emissions and exacerbate long-term carbon lock-in. Answering this question also implies determining whether ambitious political targets in response to such existential crises as the invasion of Ukraine are realistic and are likely to remain priorities in the long term
- The second more general question is to what extent energy transitions (low-carbon or otherwise) can be accelerated by the application of strong policies in times of crises. If to conceptualize climate change in terms of an existential threat to energy system, it is crucial to know how fast political decisions can be taken to eliminate the risks. Some authors (see e.g., Sovacool 2016; Kern and Rogge 2016; Sovacool and Geels 2016) argue that strong political motivations are not only necessary but also sufficient for rapid transitions while others (see, e.g. Smil 2010; Fouquet and Pearson 2012; Grübler and Wilson 2013) are more sceptical in this regard.

1.3 Research aims and objectives

The aims of this paper are (1) to evaluate the effect of the crisis on the speed and direction of energy transition in the EU and (2) to establish to what extent energy transitions can be accelerated by crises.

To achieve the aims stated above, the research objectives are:

- To review the EU dependency on Russian fossil fuels;
- To review past energy crises affected the EU;
- To analyse, using official policy documents, the EU energy transition strategies (The 'Fit for 55' package (EC 2021a) and REPowerEU Plan (EC 2022i)) as well as strategies of EU Member States adopted in response to the crisis;
- To analyse media coverage of the EU's and its Member States responses to the crisis.
- To identify changes in the EU energy transition strategy due to the crisis (The 'Fit for 55' package (EC 2021a) and REPowerEU Plan (EC 2022i)).

This thesis aims to be of both academic and practical relevance. First, the established database of publications and policies proposed and enacted within the first five months of the 2022 crisis provides a basis for the future research on the medium- and long-term effects of the crisis. Second, by analysing the EU's policy responses in a highly securitized environment, this thesis contributes evidence concerning the extent to which existential crises can accelerate energy transitions. Third, it evaluates potential short- and longer-term effects of the EU's policies and therefore contributes to the scholarly debate on feasible speeds of transitions. Finally, it enables to better understand vulnerabilities of the EU's energy system and, thus, to inform energy policies beneficial to society and the environment.

1.4 Thesis structure

This thesis consists of six chapters. Chapter 1 provides background information, presents research questions as well as aims and objectives of this thesis and its contribution to energy transition and energy security studies. Chapter 2 is a literature review introducing the concept of energy transition, historical energy transitions, scholarly debate on feasible speeds of transitions, and European context. Chapter 3 explains the theoretical framework of this research, methods, and their limitations. Chapter 4 presents the results of the study divided into four sections covering the objectives of the thesis. Chapter 5 discusses the results of the research in the broader context and conceptualizes potential short- and longer-term effects of the EU policies on low-carbon transitions. Finally, Chapter 6 concludes with providing a summary of the research findings and identifies possibilities for future research.

2 LITERATURE REVIEW

The following literature review consists of three sections. The first section opens with the definition of energy transition, elaborates on interconnectivity of environmental and energy problems, outlines drivers and barriers for energy transitions, presents interplay between climate change and security considerations, and portrays speed of transition debate in the current literature. The second section provides an overview of the global climate targets, the EU climate-aligned actions and highlights barriers for energy transition in the EU. The third section summarizes this chapter, stressing the complexity of energy transitions and recaps obstacles that energy transitions face in the EU.

2.1 What is energy transition?

Energy plays a crucial role in economies and societies, yet, still nowadays, access to energy varies across the countries (IEA et al. 2022). At the same time, energy production is responsible for approximately three-quarters of total GHG emissions (Ritchie, Roser, and Rosado 2020). Consequently, the global energy challenges that are widely discussed in the literature and reflected in the policies include a need to provide affordable, clean and reliable energy for all, to guarantee energy security, and to decrease environmental impact of energy. Solving this requires unprecedent transformation of energy systems aligned with social, energy, and climate goals (Cherp, Jewell, and Goldthau 2011). However, due to the complexity of energy challenges, steering energy transitions is not a trivial task.

2.1.1 Definition

One of the difficulties related to understanding and explaining energy transition as a phenomenon is the diversity of scholarly approaches to studying it (Cherp et al. 2018, 175). This could probably be a logical consequence of intersection of this topic with several research areas and, thus, research methods. Economics, political science, geography, geology, history, social sciences, etc. contribute to understanding of the past transitions and provide with insights of how future transformations of energy systems might evolve. Due to interdisciplinary of this research field, definitions of ‘energy transitions’ in the scholarly literature vary. Table 1 presents several approaches to define ‘energy transition’.

Table 1. Definitions of 'energy transition'.

Definition	Source
“Change from one state of an energy system to another one, for example, from comparatively low levels of energy use relying on noncommercial, traditional, renewable fuels to high levels of energy use relying on commercial, modern, fossil-based fuels”	Grübler (2004, 163)
“The change in the composition (structure) of primary energy supply, the gradual shift from a specific pattern of energy provision to a new state of an energy system”	Smil (2010, vii)
“A particularly significant set of changes to the patterns of energy use in a society, potentially affecting resources, carriers, converters, and services”	O’Connor (2010, 2) cited in Sovacool (2016, 203)
“Switch from an economic system dependent on one or a series of energy sources and technologies to another”	Fouquet and Pearson (2012, 1)
“A change in the state of an energy system as opposed to a change in an individual energy technology or fuel source”	Grübler, Wilson, and Nemet (2016, 18)
“A pathway toward transformation of the global energy sector from fossil-based to zero-carbon”	IRENA (2022)

As Sovacool (2016, 203) emphasizes it, though there is no a standard definition of ‘energy transition’, there is still a common pattern within the existing definitions, namely, that they conceptualize ‘energy transition’ through “a change in an energy system, usually to a particular fuel source, technology, or prime mover”.

What is also important to bear in mind in transition studies is that sometimes ‘energy transitions’, ‘low-carbon transitions’ and ‘sustainability transitions’ are used as synonyms. However, as Cherp et al. (2018, 175) notice, these concepts are not identical. Energy transitions can be both ‘low-carbon’ and ‘sustainable’, but ‘low-carbon’ and ‘sustainability’ transitions do not necessarily occur in the energy sector. For instance, industry, agriculture, and forestry systems may also undergo ‘low-carbon’ transitions (Geels et al. 2017, 1242), while ‘sustainability’ transitions may happen in the sphere of human rights, distribution of wealth or governance (Cherp et al. 2018, 176) as well as in production and consumption modes (Markard, Raven, and Truffer 2012, 955) being driven by sustainable goals. In this paper, low-carbon energy transitions occurring today in the EU are referred to as energy transitions.

Finally, as the given definitions of energy transitions demonstrate (Table 1) the process of transformation in energy system involve changes in energy sources, technologies, social practices, and institutions that govern energy system. Thus, a multi-perspective approach (Geels 2002; Verbong and Geels 2010; Cherp et al. 2018) is a preferable one to analyse energy transitions.

Consideration of the addressed nuances is crucial for understanding of the myriad of research areas and theories presented in the literature on energy transitions.

2.1.2 Lessons from historical energy transitions

Transformations in energy sector, i.e., in conversion and use of energy by people, occurred in the past, happen now and, obviously, will be observed in the future. Though modern energy transitions have some features that differ them from those that happened earlier in time (Sovacool 2016, 207; Kern and Rogge 2016, 13), many researchers (see, e.g. Smil 2016; Hirsh and Jones 2014; Fouquet 2016a; Vinichenko, Cherp, and Jewell 2021) argue that history of past transitions can still provide scientists and policy makers with valuable insights about the relations between energy, culture, and society, relevant for prospective low carbon transitions.

Probably, the best example of past transition is the switch from biomass and muscle power to the use of coal and steam power which facilitated a shift from a pre-industrial system to an industrial one (Grübler, Wilson, and Nemet 2016, 18). The second big transformation that occurred in the beginning of the last century led to the raise of oil (Sovacool 2016, 203). More recent transitions involve increased use of gas and nuclear power due to the oil crisis in the 1970s (Figure 1). In all these cases, changes in fuels and technologies resulted in dramatic transformations of society and economy.

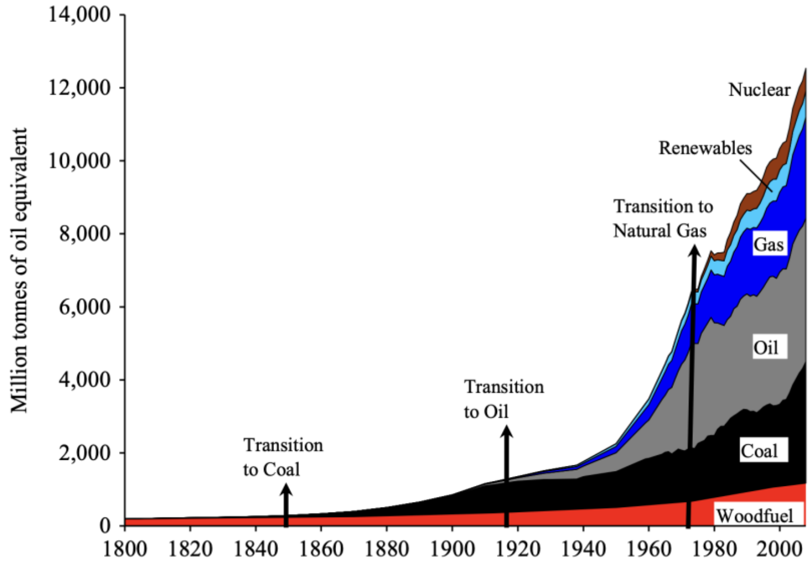

Figure 1. Global energy consumption and transitions, 1800–2010. Source: Fouquet (2009) cited in Fouquet and Pearson (2012).

Several features of past transitions relevant for this research and outlined in the literature should be mentioned. First, historical transitions took decades and were not smooth (see, e.g. Smil 2010; Grübler, Wilson, and Nemet 2016; Fouquet and Pearson 2012). For example, it took coal 60 years to reach 50% of the global primary energy supply in 1900, and about the same time (1915-1970) until oil started to provide 40% of the total supply (Smil 2016, 195). Second, past transitions led to increased energy use (Figure 1) and displayed coupling between economic and energy growth (Figure 2). Indeed, a timespan between 1800 and 2000 reveals 20-fold increase in energy use (Grübler 2004, 164) and demonstrates an overall positive correlation between economic development and energy growth (ibid., 165). However, the latter should not be understood as a universal 'law' defining relationship between growth in GDP and energy use across countries (ibid., 167).

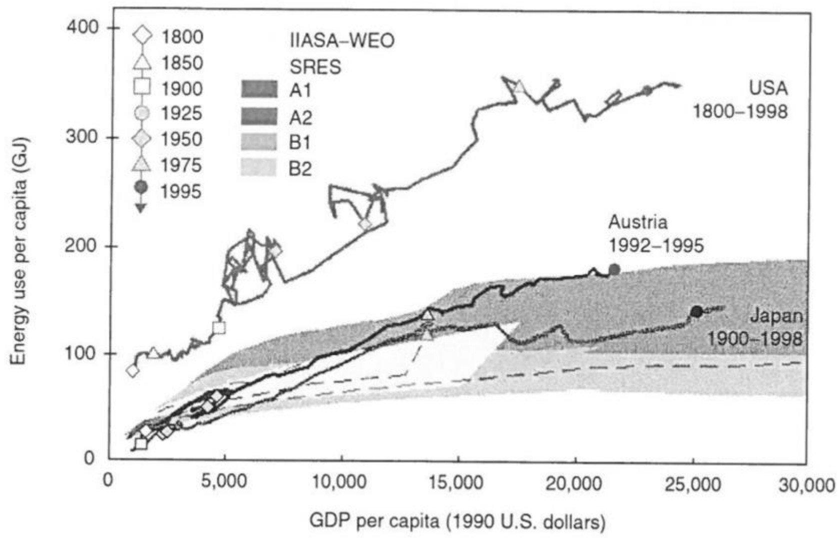

Figure 2. Growth in GDP per capita versus growth in per capita energy use in selected countries, selected years.
Source: Grübler 2004, 167.

Finally, energy transitions depend on economic development, technological innovation, political systems and policies they introduce (Cherp et al. 2018) as well as on the timing and wider social processes (Fouquet and Pearson 2012, 2; Markard 2018). Since the 20th century, political goals were often a driver for energy transitions which also applies to a new phase of energy transition observed nowadays. This modern transition, unlike historical ones, does not mean a simple switching from one set of primary energy sources to another as it has climate concerns as its raison d'être (Smil 2016, 195). The next sub-section explains how energy and environmental problems are connected and why a new transition is an unprecedented challenge.

2.1.3 Climate change and energy transition

A turning point in the addressing of the global environmental problems was marked with the United Nations Conference on the Human Environment, also known as the Stockholm Conference (1972) (InforMEA 2022). Today, sustainability challenges being driven by a combination of environmental, social, and economic problems are well-known and stalk several domains of modern societies. Climate change, population growth, urbanization, poverty, food and water security, energy demand growth and necessity to decarbonize energy systems, hazardous waste, and gender inequality stand among the fundamental problems of nowadays (UN Environment 2019). Due to the complexity and co-dependency of these issues, their negative impacts tend to overlap formulating an unprecedently difficult task for humanity.

However, climate change and global warming stand out from other problems as they impose an existential threat both to humankind and biodiversity of the planet. Once a theory that combustion of fossil fuels for electricity, heat and transportation is the largest source of GHG emissions driving climate change, now it is an established fact proved by five cycles of IPCC assessment cycles (IPCC 2021a, 43–44). The history of human-driven climate change is rooted in the Industrial Revolution and the followed transformation of the energy system (Fouquet 2016b, 79). Yet, the role of energy in mitigating development problems and environmental issues is explicitly acknowledged only since the early 2000s (UNDP 2000).

The major problem that is well recognized today is that economic development typically results in increased resource use which accelerates environmental degradation (UN Environment 2019, 22). A key question both for scientists and policy makers hence is decoupling economic growth from resource consumption and aligning economic development with sustainable consumption and production (UN Environment 2019, 39). Since 2000s, studies of innovations and technologies facilitating green transitions started to increasingly receive attention (Markard, Raven, and Truffer 2012, 955). Nowadays, international energy strategies envisaging pathways for solving climate change issues (see, e.g. IEA 2021a; IPCC 2022) and policies aimed at decoupling economic development from energy growth (see, e.g. Hennicke and Khosla 2014; Sharma, Smeets, and Tryggestad 2019; IRP 2019; UN Environment 2019) are well established. Both in scientific and policy discourses, decarbonisation of global energy system, i.e., switching from 'hard carbon' and non-renewable resources to 'low carbon' and renewable ones, is seen as the only way to limit rise in global temperatures and attain sustainable goals.

In this respect, 2015 was a particularly remarkable year for energy researchers and policy makers. First, energy was placed at the centre of many of the 17 Sustainable Development Goals (SDGs) adopted in 2015 as part of the 2030 Agenda for Sustainable Development with the aim to eliminate poverty, protect environment, and guarantee prosperity (Birol 2018). In particular, SDG 7 calls on nations to provide access to affordable, reliable and clean energy to the population, to increase the share of renewable energy sources, and to improve energy efficiency (UNDESA 2015).

Second, the Paris Agreement adopted in 2015 by 196 Parties at the UN Climate Change Conference (COP21) in Paris aims to limit increase in the global average temperature to well below 2 °C (preferably to 1.5 °C) above pre-industrial levels (UNFCCC 2015). The latest UN Climate Change Conference (COP26), held in Glasgow from 31 October to 13 November 2021, reaffirmed the goal of the Paris Agreement and stressed the urgent need to reduce global emissions (UNFCCC 2022, 4). One of the key outcomes of the COP26 was a call upon Parties to accelerate phasing down of unabated coal and subsidies for fossil fuels (UNFCCC 2022, 5).

However, there are several challenges related to current energy transitions. First, global energy systems continue to heavily rely on fossil fuels. Introduced only in the 1980s, modern renewables – wind and solar – are still far from dominating global energy mix. Back in 2020, fossil fuels accounted for more than 80% of energy consumption (Our World in Data 2021) (Figure 3). While it is relatively easy to generate clean electricity, switching to low-carbon sources in heating or transport is far more demanding.

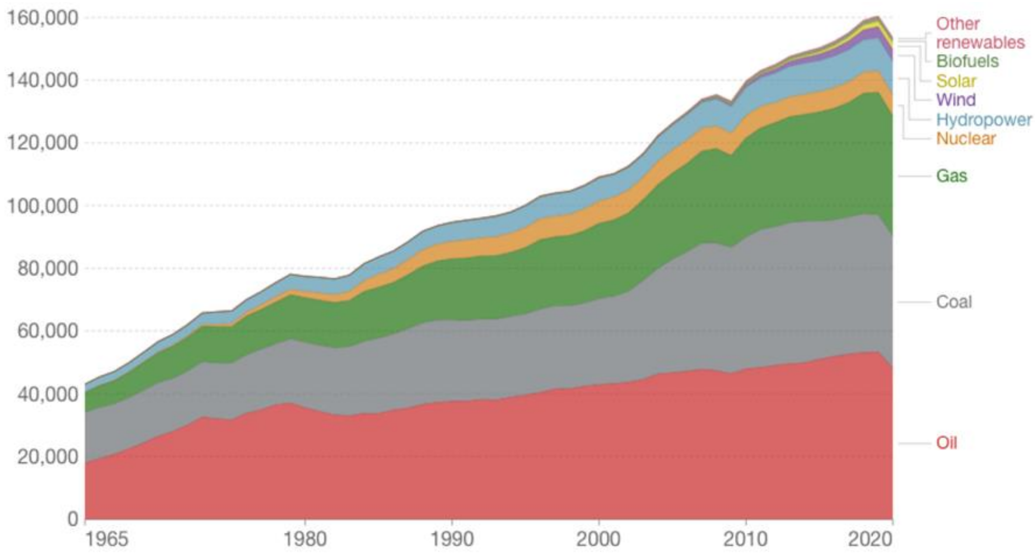

Figure 3. Primary energy consumption by source, World, 1965-2020, TWh. Note: 'Other renewables' includes geothermal, biomass and waste energy. Source: Our World in Data 2021.

Second, the role of energy consumers in energy transitions should not be underestimated. Prices for clean modern energy remain higher than for less efficient and polluting one, but as research reveals, as soon as their incomes allow users switch to better options (Grübler 2004, 174). This proves that providing access to clean and inexpensive energy is crucial for achieving climate targets. At the same time, although energy poverty is presented both in developed and developing countries (see, e.g. Brunner, Spitzer, and Christanell 2012; Stojilovska, Yoon, and Robert 2021; Euractiv 2021), this problem remains poorly addressed. Success of modern energy transition depends, among other factors, on whether energy poverty issues will be adequately recognized and resolved.

Finally, global energy systems face several interconnected challenges, namely, how to provide reliable and clean energy to all, how to guarantee energy security on a national level and how to combat climate change (Cherp, Jewell, and Goldthau 2011). Therefore, modern phase of energy transition has to urgently and simultaneously solve these problems which requires not only research, technologies, and innovations, but also a strong socio-political involvement and support (GEA 2012, 1174). On the other hand, a ‘one-size-fits-all’ approach for steering energy transitions and their speed does not exist (Geels et al. 2017, 1242). Moreover, there is no consensus in the literature whether modern transitions can be accelerated by any means (e.g., through application of the deliberate energy policies). The next subchapter of this literature review sheds a light on this debate.

2.2 Speed of transition debate

Since the end of the 1970s, researchers of energy technologies aimed to understand the process of technological substitution occurring in energy supply. In 1979, Marchetti and Nakicenovic (1979) successfully used logistic function (i.e. S-shaped curve) to analyse changes in energy technologies, which marked a turning point in conceptualizing technology diffusion and decline in energy systems. Within the last 50 years, researchers discovered certain patterns in historical shifts in energy supply, particularly, that in the past it took large-scale technological changes decades to happen (see, e.g. Smil 2016). However, mitigating climate change requires faster transformation of modern energy systems compared to historical precedents (see, e.g. Vinichenko, Cherp, and Jewell 2021). Therefore, questions how long low-carbon energy transitions may take and whether they can be accelerated are crucial both for scientists and policy makers. This subchapter summarizes two current views on this matter.

2.2.1 The speed of transition is determined by technological and economic factors

The first group of scholars argues that significant shifts in energy systems typically take decades as they heavily depend on economic factors, technological innovations, and infrastructure (see, e.g. Smil 2010; Fouquet and Pearson 2012; Grübler and Wilson 2013). For example, Fouquet (2010) considers quality and affordability of the energy services as the major drivers that facilitated adoption of technologies in the past. Bento (2013) analysed historical scaling dynamics of various technologies and concluded that at the early stage of technology diffusion (formative phase) large scale technologies (e.g., steam machines) require more time than small end-use ones (e.g. e-bikes). That is so due to the challenges that larger scale technologies face when trying to enter the market as experimentation, vital for their development and upscaling, is expensive and technologically complicated (Bento 2013, 28). Through analysis of 37 national, five regional, and one global episode of fossil fuel decline in electricity generation Vinichenko, Cherp, and Jewell (2021) detected three main reasons for historical decline, namely fuel switching (i.e. substituting one fossil fuel with another), technology substitution, or demand decline. They have shown that the speed of such decline has rarely exceeded 30% of the national electricity supply per decade.

As every full energy transition (e.g. from coal to oil, from oil to gas) required a change in several sectors and energy services, it had also be aligned with technological and institutional solutions, thoughtfully designed for each sector and service (Fouquet 2016a, 8). Moreover, the greater infrastructural changes a new technology involves, the longer it will take this technology to diffuse. Grübler et al. claim that "[a]doption of technologies using existing infrastructures happens fast (a decade), upgrading existing infrastructures takes longer (up to three decades), and building entire new infrastructures (technological systems) involves transition times of four to 5 decades" (2016, 20). As a consequence of their own complexity, transitions in the past were very slow and rare events (Fouquet and Pearson 2012).

Considering the lessons from previous transitions, the first group of researchers concludes that the speed of adoption of non-carbon technologies will be in line with the pace of the historical transitions (Smil 2016, 196). In 2020, renewables (solar, wind, and biofuels) contributed to less than 5% of global energy consumption (Ritchie, Roser, and Rosado 2020). Unruh claims that a 'carbon lock-in' of the modern economies is backed by technological systems and governing institutions that create barriers for carbon-saving technologies and prevent them from upscaling (2000, 828). Thus, a modern phase of energy transitions aimed at mitigation of environmental change still requires a large-scale transformation of the global energy system to switch from carbon-intensive economy to a low-carbon one. According to Smil, this will be “a prolonged, multidecadal process” (Smil 2016, 194).

2.2.2 Transition can be accelerated by deliberate policies

However, not all the researchers share this assumption. The second group of scholars (Sovacool 2016; Kern and Rogge 2016; Sovacool and Geels 2016) believes that proper policies and governance can accelerate modern, low-carbon, energy transitions as they occur in another time with greater technologies and policy tools. Moreover, as there were historical precedents of comparatively rapid adoption of new energy technologies, it is possible to suggest that current energy transitions may happen faster than historical ones. For example, Bento and Wilson (2016) analysed the formative phase duration for 16 technologies using ‘first sequential commercialization’ and ‘user adoption’ (year when 2.5% of maximum potential users have adopted a new technology) indicators as the start and the end points of the formative phase. In the considered sample, it took three technologies – nuclear power, jet aircraft and fluid catalytic cracking – the least time to reach 2.5% share of the market potential. Table 1 presents key results of their analysis.

Table 2. Formative phase durations in years.
Source: Bento and Wilson 2016.

Energy technology	Central estimate	Longest estimate
1. Stationary Steam Engines	85	168
2. Steamships	19	114
3. Steam Locomotives	21	96
4. Bicycles	25	83
5. Coal Power	9	79
6. Natural Gas Power	25	71
7. Cars	23	82
8. Washing Machines	15	58
9. Motorcycles	21	71

10. Wind Power	15	115
11. E-Bikes	35	114
12. Jet Aircraft	7	40
13. FCC, Fluid Catalytic Cracking (refineries)	4	5
14. Nuclear Power	13	22
15. Mobile Phones	14	55
16. CFLs, Compact Fluorescent Lamps	20	27

Sovacool (2016) provides several examples when rapid energy transitions in energy supply took place. Among other cases, he names nuclear growth in France in the 1980s and expansion of natural gas in the Netherlands in the 1970s (Sovacool 2016, 209). A striking feature of these three transitions is that they benefited from the well-coordinated public policies and institutions (Grübler, Wilson, and Nemet 2016, 19). Positive effects of policies were also identified by Rogge and Johnstone (2017) in their analysis of the renewables expansion in Germany as well by Johnstone and Stirling (2020) in their study on the German nuclear phase-out.

These and some other cases led to an assumption that implementation of the deliberate policies can facilitate faster transition processes. Moreover, some researchers, for example, Kern and Rogge (2016), believe that modern transitions are different from the historical ones and, thus, may have another pace. First, unlike previous transitions, switching to the low-carbon sources is being governed by a wide range of actors (Kern and Rogge 2016, 14). Second, globalized world creates favourable conditions for steering energy transitions worldwide as national developments have an impact on the global economy (ibid., 15). Finally, recognition of the environmental problems at the international conferences over the last decades led to the initiation of the international agreements (e.g., Paris Agreement of 2015) and setting of the national targets for emission reduction, which can fast-track decarbonisation (ibid., 16).

However, in order for policies to accelerate energy transitions, there should be strong motivations for policy actors. One of the strongest drivers to change energy systems has been energy security (Helm 2002). Indeed, some of the fastest cases of energy systems transformations in modern times have occurred as a result of energy security crises (see, e.g. Ikenberry 1986; Vinichenko, Cherp, and Jewell 2021). After World War II, developed economies became heavily dependent on oil as it was commonly used in industry, transport, food production, heating, and electricity generation (Cherp and Jewell 2011). On the other hand, domestic oil production in the industrialized countries was not sufficient to meet the national needs, so that they relied on oil imports from developing countries (ibid.). Due to this, the 1973 oil embargo triggered an economic crisis and highlighted vulnerabilities of the global energy system. Relatively rapid oil substitution – first with coal and then with natural gas and nuclear power – in the 1970s and 1980s was triggered by concerns over oil imports or exhausting capacities of domestic fossil fuel production (Vinichenko, Cherp, and Jewell 2021, 1481). In another example, a relatively rapid formative phase for nuclear power, jet aircraft and fluid catalytic cracking was a consequence of the 'unique institutional environment around World War II' (Delina and Diesendorf 2013, cited in Bento and Wilson 2016, 106).

These examples illustrate how technological transformations can be hastened by strong policies triggered by somewhat extreme circumstances perceived as security of existential threats. 'Regular' climate, environmental and sustainability policies rarely have a comparable element of urgency and strength. Therefore, it is of great interest whether and to what extent security-motivated policies can accelerate transitions to low-carbon energy systems. Observed empirically, this effect of stronger policies may subsequently serve as a benchmark or a frontier for the feasible acceleration of transitions by 'regular' climate policies.

The next subchapter of this literature review provides European energy context important for understanding energy transitions in the EU.

2.3 Energy context and energy transitions in the EU

The European context is characterized by both its strong dependence on energy imports and its leadership in low-carbon energy transitions (Carley et al. 2017; Vinichenko, Cherp, and Jewell 2021). On the one hand, the vulnerabilities of its energy system push the EU to seek solutions that would diversify energy supply (Directorate-General for Energy (EC) 2019) and decrease its reliance on fossil fuels (EEA et al. 2018). On the other hand, natural, social, and economic constraints of low-carbon energy such as geophysical limitations, social opposition to nuclear and sometimes wind power, intermittency of wind and solar generation, soaring prices for raw materials, create barriers for a rapid energy transition (Cherp et al. 2021). It is the balance of these drivers and barriers that define the eventual pace of the transition.

Moreover, though certain energy trends can be identified for the entire EU, energy profiles of the EU MS are different as their energy systems were initially shaped according to the combination of physical, economic, and political factors (e.g., availability of energy sources, strong connections with certain energy exporters). For example, in Western European countries gas supply is diversified whereas Eastern Europe's gas infrastructure is strongly connected to Russia (Jewell 2014). Section 4.1 describes energy supply challenges and energy security concerns of the EU.

2.4 Summary of literature review

This literature review explained why energy transitions are necessary for limiting climate change, it summarized the existing approaches to defining and explaining energy transitions and provided examples of historical transitions. This chapter has also outlined the scholarly debate on whether modern energy transitions can be accelerated by deliberate policy interventions. Finally, this chapter pointed out the studies characterizing the interplay between energy security and low-carbon transitions in the EU.

With rare exceptions, historical energy transitions were slow and took several decades or centuries to happen. In contrast, limiting climate change requires faster transformations that should unfold in 1-2 decades. One group of researchers believes that due to the differences between historical and ongoing transitions low-carbon transitions can take much less time if the deliberate policies are applied. Another group of scholars insists that energy transitions are always long and complex processes that cannot be substantially accelerated by policies. Both scholars recognize that the cases of relatively rapid energy transitions in the past usually were the results of national responses to the existential threats to national energy security (e.g., the 1973 oil embargo).

Security of energy supply continues to be a concern for many modern states. At the same time, in comparison to the 1970s, when secure oil supply was the major concern for the states, nowadays dependency on gas supply increases worries of energy consumers. Understanding vulnerabilities of its energy system related to the overdependence on imported energy, the EU aims to improve its energy services through reducing reliance on fossil fuels, deploying renewables, increasing energy efficiency, and decreasing total energy consumption.

However, despite variety of policies and established climate action mechanisms, the speed of energy transitions in the EU is still insufficient to achieve targets crucial for limiting rise in global temperature. Moreover, Russia's invasion of Ukraine intensified energy security concerns and created additional challenges to the EU's climate policy. This raises a question of whether the current security crisis in Europe can accelerate its transition to low-carbon sources as similar crises accelerated energy transitions in the past.

3 THEORY AND METHODS

The following chapter outlines theories and methods used in this thesis. First, it describes a meta-theoretical framework for analysis of the national energy transitions that is a selected approach to conceptualize complexity of energy transitions in this thesis. Next, it presents a 'sovereignty perspective' on energy security claiming that one of the most important energy goals for a state is energy security of the vital energy systems. Then, it explains why energy transitions are complex events dependent on many interrelated and interlocked factors. After that, it outlines methods used in this thesis. Finally, it identifies limitations of this research.

3.1 Theory

3.1.1 Three perspectives on national energy transitions

Energy transitions occur in economic, technological, and political spheres. Accordingly, the factors and mechanisms shaping energy transitions can be grouped into what Cherp et al. (2018) call 'the three perspectives on energy transitions' (Table 3). The techno-economic perspective considers energy systems as physical energy flows and corresponding economic markets. The socio-technical perspective focuses on the flows of knowledge and practices. The political perspective incorporates policy action systems where political actors interact to determine the socially acceptable direction of energy systems evolution. The three perspectives strongly interact, e.g., economic interests and considerations may affect policies whereas policies may favour certain technologies etc.

The crisis caused by Russia's invasion of Ukraine affects all three perspectives, but probably the most immediate effect is on the political perspective. One of the top-level variables in the political perspective are state interests (Cherp et al. 2018) and among those interest a key imperative is energy security (Helm 2002). It is thus important to understand how the current crisis affects energy security and therefore shapes policy actions which in turn affect energy transitions.

Table 3. Perspectives on energy transitions: systemic focus, drivers for change and relevance for the current thesis.
Characteristics of the perspectives adopted from Cherp et al. 2018.

Perspective	Systemic focus	A typical driver for change	Focus in this thesis
Techno-economic	Energy flows associated with energy extraction, conversion and use processes involved in energy production and consumption as coordinated by energy markets	Growth	To what extent politically driven changes correlate with the state's goal to balance national supply-demand
Socio-technical	Knowledge, practices and networks associated with energy technologies	Innovation	To what extent new technologies and building of the new infrastructure driven by policies correlate with climate goals
Political	Political actions and energy policies	Policies	To what extent developed policies consider techno-economic constraints

3.1.2 A 'sovereignty perspective' on energy security

Cherp and Jewell (2011; 2014) identify three perspectives on energy security: sovereignty, robustness and resilience. The most relevant of these three perspectives is sovereignty which presumes minimizing control of foreign, especially hostile, actors over the vital energy systems. The latter are defined as "energy systems [combinations of energy infrastructures, resources, and services – *AP*] that support critical social functions" (Cherp and Jewell 2014, 418).

From this perspective, there are two vital energy systems in Europe that are of concern: supply of oil and its products and supply of natural gas. Both systems are vital because without oil it is impossible to organize such functions of modern society as transport of people and goods, agriculture, defence, and health care, to name a few. At the moment, oil lacks immediate substitutes and constitute the most serious energy concern in the world (Cherp et al. 2012).

Natural gas is used in power production, heating and in industry and although it can be in some sectors replaced more easily than oil, in others (e.g., industry, heating in large cities in cold climates) replacements are not possible. Heating and electricity production are also vital functions of modern societies that should be protected by the state.

Europe is *dependent on Russia in both oil and gas.* With Russia's invasion of Ukraine, Russian control over vital energy systems becomes unacceptable, triggering a range of policy responses in the EU.

3.1.3 Combined effects

The state imperative to enhance energy security is never directly translated into policy action, even less into concrete outcomes. As I explained in section 3.1.1, transition is shaped by a combination of factors which include for example, diverse political interests, institutional capacities, learning, innovation and diffusion of new technologies and inertia and lock-in of the existing socio-technical systems as well as availability of energy resources, costs of infrastructure and numerous techno-engineering considerations. It is the combined effects of all these factors that could either accelerate or slow down energy transitions.

3.2 Methods

The research methods of this study were selected to achieve its two main goals: (a) evaluation of the effect of Russia's invasion of Ukraine on the speed and direction of energy transition in the EU and (b) understanding to what extent energy transitions can be hastened by crises. Since reaching the research goals requires a broader understanding of the energy transition process in the EU (e.g., how low-carbon energy transitions unfolded before Russia's invasion of Ukraine), this thesis involves analysis of the additional information beyond a case-study of the 2022 crisis. Figure 4 presents a simplified research workflow and key elements for analysis.

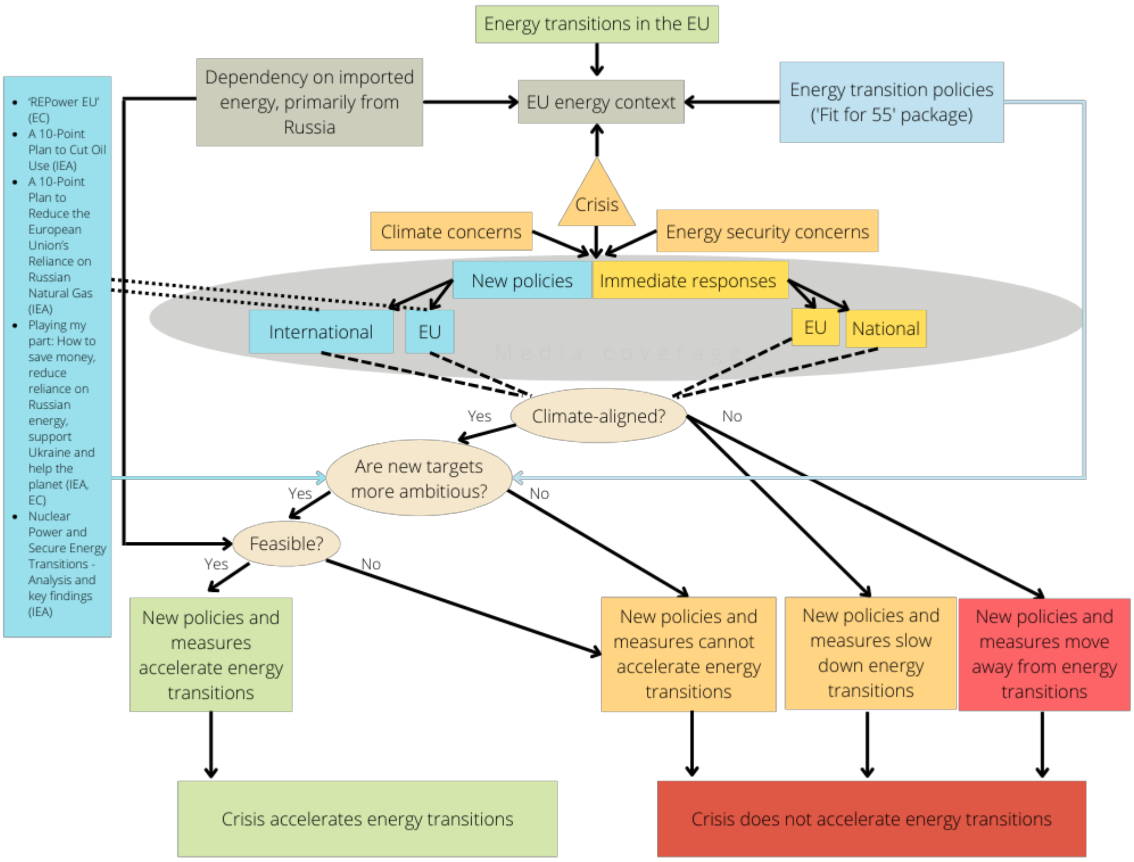

Figure 4. A simplified research workflow and key elements for analysis.
Source: Author.

Energy crisis occurred after Russia's invasion of Ukraine in February 2022 grants a unique opportunity to analyse how energy security issues were resolved and whether the decisions taken in a highly securitized environment accelerate or slow down energy transitions in the EU. In this respect, this research is both basic and applied. On the one hand, it is driven by intellectual interest to extend the knowledge about feasible speeds of energy transitions, and, on the other hand, it aims to provide researchers and policymakers with insights valuable for understanding the effects of the crises on energy policies in the EU.

In light of these considerations, this thesis incorporates the following methods and steps:

- Review of the EU dependency on Russian fossil fuels;
- Review of the past energy crises affected the EU;

- Analysis of the EU energy transition strategies (The ‘Fit for 55’ package (EC 2021a) and REPowerEU Plan (EC 2022i)) as well as strategies of EU Member States adopted in response to the crisis;
- Analysis of the media coverage of the EU’s and its Member States responses to the crisis.
- Identification of the changes in the EU energy transition strategy due to the crisis (The ‘Fit for 55’ package (EC 2021a) and REPowerEU Plan (EC 2022i)).

3.2.1 Review of the EU dependency on energy imports

In order to understand why energy security concerns were intensified during the current crisis, overall dependency of the EU energy system on fossil fuels should be considered. Moreover, since Russia was the largest global fossil fuel exporter in 2021 (IEA 2022e), the country’s invasion of Ukraine had a significant impact on the energy markets worldwide. For a comprehensive analysis of the EU energy transitions, it is therefore essential to know how dependent the EU is on Russian fossil fuels. At the same time, as the EU is not homogenous in its energy use, understanding the differences in energy patterns between EU MS is important for identifying vulnerabilities and challenges of the national energy systems of the EU MS. Thus, this step is divided into three:

- Analysis of the overall dependency of the EU on energy imports;
- Analysis of the EU dependency on Russian fossil fuels;
- Analysis of the trends in energy use of different EU MS.

The major sources for this step were data from the statistical office of the EU Eurostat, the statistics portal Statista, the IEA, and a scientific online publication Our World in Data. All these data sources are accessible online. The results of this analysis are reported in the section 4.1.

3.2.2 Review of the 2009 and 2014 energy security crises

Over the second step, impacts of the two gas crises (2009 and 2014) on the EU's energy strategies are analysed. This provides a broader understanding of how previous crises influenced energy policies in the EU and how the EU responded to these crises. The main sources were the Commission's assessments and proposals (EC 2009; 2010; 2014a; 2014b; 2014c), publications of the Oxford Institute for Energy Studies and the Centre for European Policy Studies (CEPS). The respective results are presented in section 4.2.

3.2.3 Review of the recent EU energy transition policies

The third step is a documentary analysis. This method requires a criterion-based selection of the documents where the quality of the source is the major criterion for including a document in the analysis (Merriam and Tisdell 2015, 94). Since this thesis considers energy transitions in the EU, analysis of the EC's proposals related to energy policies is both essential and beneficial for the quality of this research. The next step is defining the appropriate period for sources selection. As evaluation of the effects of the current crisis on speed and direction of energy transitions requires understanding of the past and present contexts, two EC's proposals, issued in 2021 and in 2022 respectively, were selected: The 'Fit for 55' package (EC 2021a) and REPowerEU Plan (EC 2022i). This choice enables to identify changes in the targets and thus to establish how heavily EU energy targets were affected by the crisis. The results of this review are communicated in sections 4.3.

The second step is divided into two smaller ones:

- Review of the measures in 'Fit for 55' package and 'REPower EU' plan;

- Identification of the changes in the EU energy transition strategy due to the crisis.

3.2.4 Identification of the EU Member States' energy strategies mitigating the crisis. Analysis of the media coverage of the EU's responses to the crisis

Introductory notes on media sources

To accomplish this step of the research, a database of responses of the EU MS to the crisis was created. Since the events started only in February 2022 and were still unfolding when the work on this thesis took place, it was decided to base the analysis on media and government sources (as opposed to scholarly literature).

Since the pioneering work of McLuhan (1964, reprint 1994) on media, scholars continue to analyse the influence of the media sources on political life and civic participation, especially in the digital age (see, e.g. Gil de Zúñiga and Chen 2019; Boulianne 2020). With media playing an important role in modern societies, its impact on economy, culture, and politics is a topic of growing interest (see, e.g. Castells 2004; Ghani et al. 2019; Perloff 2021). Moreover, media coverage can influence energy transitions through affecting diffusion and adoption of new technologies and public acceptance of energy policies. (see, e.g. Sengers, Raven, and Van Venrooij 2010; Lyytimäki et al. 2018; Cox 2010). Analysis of how and which EU's responses to the current crisis were reflected in the media is therefore beneficial to the broader understanding of the European energy transition context. Researching media in this thesis was also practical due to their widespread online availabilities, which provide the researcher with what Marotzki, Holze, and Verständig (2014) call "infinite research possibilities".

Selection of the online media sources included both purposeful and random sampling. The purposeful sampling was used to establish a diverse range of credible media sources (12 main and 79 additional), with understanding that quantity of the sources does not necessarily guarantee comprehensiveness of the research (Merriam and Tisdell 2015, 185). Subsequently a random sampling was applied to the selected media sources to minimize biasness and increase validity (ibid., 100) in collecting publication items.

Finally, paraphrasing Ratcliffe, data cannot speak without an interpreter (1983, 149). At the same time, this means that a certain scientific theory or a perspective guiding a researcher has its impact on data interpretation. Therefore, to enhance credibility of the conducted research additional steps should be taken. For example, triangulation is a well-recognized technique to increase objectivity of the findings and validity of the research (see, e.g. Seale 1999; Patton 2015; Denzin 2017). In this research I applied triangulation through using a variety of sources and methods (Table 4).

Table 4. Sources and methods used.
Source: Author.

Sources			Methods		
Official documents (the EC proposals, the IEA plans, policy briefs of NGOs, discussion papers, etc.)	Statistical data (Eurostat, Statista, IEA, IRENA, Our World in Data)	News, political statements, published interviews (variety of sources)	Policy analysis (the EC proposals, the IEA plans, policy briefs of NGOs, discussion papers, etc.)	Data analysis (Eurostat, Statista, IEA, IRENA, Our World in Data)	Content analysis of the interviews, statements and opinions of the European politicians and energy transition experts

Data selection, collection, and classification

First, credible media sources were defined. Annex A to this thesis contains a full list of media and governmental sources used. Then, the first database for collecting publication items (i.e., news articles on measures mitigating energy crisis in the EU, interviews and comments of the European politicians, analysis and opinions of the energy experts, NGOs, think tanks, etc.) on a Notion knowledge management platform (www.notion.so) was established (Figure 5). The data gathering continued from April 2022 to July 2022. After the first 50 items had been added to the database, the data classification started. Initially the publication items were coded against the country's name (e.g., 'Austria') and the measure it described (e.g., 'substituting Russian gas').

Publication date · Tags · Tags for measures · Measures · + Add filter · Reset

Name	Summary	Tags	Type	Tags for measures	Measures	URL	Publication date	Added on
Indonesia trade surplus beats forecast after palm oil exports resumption | Reuters	Coal shipments to Europe from Indonesia jumped	EU ban on Russian coal	news	coal: sanctions	Coal embargo Alternative suppliers for Russian coal	https://www.reuters.com/markets/commodities/indonesia-trade-surplus-beats-forecast-after-palm-oil-exports-resumption-2022-07-15/	July 15, 2022	July 17, 2022 7:07 PM
Freeport LNG Blast Created 450-Feet-High Fireball, Report Shows - Bloomberg	Freeport LNG still plans a partial restart of the plant in October, it said in an emailed statement. The accident slashed the volume of liquefied natural gas exported from the US at a critical time for consumers in Europe, who face a historic squeeze as Russia reduces supplies. The shutdown of the plant has also pushed domestic natural gas prices lower in recent weeks.	EU US Substituting Russian g LNG	news	gas: alternative suppliers	Alternative suppliers for Russian gas	https://www.bloomberg.com/news/articles/2022-07-12/freeport-lng-blast-created-450-feet-high-fireball-report-shows	July 13, 2022	July 15, 2022 6:22 PM
US, allies aim to cap Russian oil prices to hinder invasion | AP News	With thousands of sanctions already imposed on Russia to flatten its economy, the U.S. and its allies are working on new measures to starve the Russian war machine while also stopping the price of oil and gasoline from soaring to levels that could crush the global economy.	EU US tariffs on Russian oil	news	oil: tariffs	Oil sanctions	https://apnews.com/article/russia-ukraine-global-trade-prices-76b1b9a40a1b8de40b8d14ada4102a92	July 13, 2022	July 13, 2022 1:09 PM
The EU Is Prepping Another Round Of Sanctions Against Russia | OilPrice.com	The European Union is already working on the seventh package of sanctions against Russia as it continues to try to punish Moscow for its invasion of Ukraine.	EU Russian energy embai	news	coal: sanctions oil: sanctions oil&gas: tariffs	Oil sanctions Coal embargo	https://oilprice.com/Latest-Energy-News/World-News/The-EU-Is-Prepping-Another-Round-Of-Sanctions-Against-Russia.html	July 12, 2022	July 13, 2022 12:55 PM

Figure 5. Selected publication items in the first database. Screenshot from a Notion knowledge management platform.

Second, after documentary analysis of the Commission's and the IEA's proposals was completed (subsection 3.2.2), the second database was established (Figure 6). It summarizes specific measures from the REPowerEU Plan (EC 2022o), the IEA's plans to reduce oil use (IEA 2022a) and Russian natural gas imports (IEA 2022b), and the joint plan of the EC and the IEA to save energy (IEA 2022g). In addition, the new UK energy strategy (The UK Government 2022) was analysed and included into the database. The measures were later classified according to the energy source which it targets (e.g., coal, oil, gas, nuclear). Cross-cutting measures were included into one group (e.g., support on energy bills). Publication items in the first database were coded against the measure's group (e.g., 'gas: alternative suppliers').

Measure	Group	Source	Media and policy sources
Increasing domestic oil extraction 1	oil: domestic extractior	British	Croatia moves to boost own energy production, s
Alternative suppliers for Russian nuclear fue	nuclear: alternative sur	REPowerEU British	Europe's Other Energy Problem: Relying on Russi
Oil sanctions 1	oil: sanctions	REPowerEU 6th sanctions package	EU could combine tariffs on Russian oil with emba
Alternative suppliers for Russian oil 1	oil: alternative supplier	REPowerEU British	Germany to Stop Russian Oil Imports Regardless
Alternative suppliers for Russian coal	coal: alternative suppli	REPowerEU	How heavily does Germany rely on Russian energ
Coal embargo 1	coal: sanctions	5th sanctions package	EU mulls coal embargo on Russia, but still spares
Boosting biomethane 1	gas: boosting biometha	REPowerEU IEA 10-point gas plan	Russia's weaponization of natural gas could back
Switching to coal 3	gas: switching to coal	IEA 10-point gas plan REPowerEU	Nuclear, coal, LNG: 'no taboos' in Germany's ener
Increasing domestic gas production	gas: domestic producti	British REPowerEU	EU Security of Supply – The energy Europe needs
Introduce minimum gas storage obligations	gas: storage	IEA 10-point gas plan REPowerEU	LEAK: EU countries urged to prepare for Russian
Accelerate the deployment of renewables (v	gas: boosting renewabl	IEA 10-point gas plan British REPowerEU	Shut down fossil fuel production sites early to avc
Improving the connecting network infrast	gas: infrastructure imp	IEA 10-point gas plan REPowerEU British	Bulgaria and Greece plan joint gas deliveries for s
Accelerate hydrogen production 2	gas: boosting hydroger	British REPowerEU IEA 10-point gas plan	Iberdrola inaugurates green hydrogen plant in Pue
Boosting nuclear energy 1	gas: boosting nuclear	British IEA 10-point gas plan	Record number of Finns now favour nuclear to go
Alternative suppliers for Russian gas 2	gas: alternative supplie	British REPowerEU IEA 10-point gas plan	Bulgaria and Albania set ground for new gas corri
Encourage a temporary thermostat adjustm	gas: behavioral change	IEA 10-point gas plan IEA+EC REPowerEU	EU readies €195 billion plan to quit Russian fossil
Adjusting boiler's settings	gas: behavioral change	IEA+EC	The end of energy resource imports from Russia?

Figure 6. Selected measures in the second database. Note: the last column contains publication items from the first database. Screenshot from a Notion knowledge management platform.

Finally, the first database was connected with the second one using the capacity of Notion to create and manage relational databases, so that publication items could be directly linked with the measures from the documents. Statements that could be not classified as measures or if they represented measures not reflected in the documents of the EC, the IEA, UK were classified as 'not a measure' (for example, discussion about legal payments for Russian gas) or 'other measures' (e.g., gas sanctions that were discussed in the media but not included in the Commission's proposals or a sanction package). Additionally, such publication items as critical reviews, concerns of the environmental organizations, and analytical articles collected in the first database were coded not only against the measure they reflected on but also as 'criticism/concerns/analysis/proposals' and constitute an independent group in the second database to ease the navigation.

Eventually, the first database contains 352 publication items which is sufficient to provide an overview of the media framing of the crisis. This database contains nine columns representing a headline of the item, its summary, tags for countries and measures, type of the publication (news/ document/ statement/ proposal/ analysis/ opinion), tags for measures from the second database, URL address, publication date, and the date when the information was added to the database. The second database includes 40 rows representing (a) measures from the documents, (b) measures that were discussed in the media but not presented in the documents, (c) information relevant for understanding the crisis but not formulating a particular measure, and (d) critical reviews and analysis. The four columns stand for a measure's title, group to which it relates, source (document), and media sources that reflect on the particular measure in the first database. The results of the data analysis are reported in section 4.4. Due to their size, both databases are uploaded to a file hosting service Dropbox and can be accessed via the link below: *https://www.dropbox.com/sh/bofe976fdjl96jr/AACChvksn7Eppc1fygzxv8ZUa?dl=0*.

Analysis of the general trends in media

In order to understand general trends in the media regarding the crisis (e.g., sanctions) and topics relevant for energy transitions (e.g., renewables) and how they correlated, two tasks were completed. First, tendencies in the user web search and news search were analysed. This was done via Google trends, a service that allows to compare users' interest for different topics and demonstrates how users' search interest changes over time. While sanctions were among the most discussed topic in the media according to the collected publication items (see section 3.2.4 for database description and section 4.4 for results of the analysis), the first set of search terms that were compared included 'sanctions', 'Russian gas', 'renewable energy', 'nuclear energy', and 'Russian oil'. The second set of search terms contained 'Russian gas', 'renewable energy', 'nuclear energy', and 'Russian oil'. Both times worldwide interest for different search terms was checked for a time range between 01.02.2022 and 01.07.2022.

Second, statistics about publications on two topics in the media – sanctions and renewables – was gathered. While the first step allows to establish, which topics were of particular interest among the Internet users, the second step provides with insights about media coverage of the two topics. Since Reuters publishes news on a daily basis that are read by more than a billion people each day and stands for high journalistic standards (Reuters 2022a), Reuters' publication database was selected for this analysis. The search was conducted using online search tool on the Reuters's website and based on the keyword phrases 'sanctions on Russia' and 'renewable energy' within two time ranges (past month and past year). The results of both analyses are reported in section 4.4.

Table 5 presents all steps as well as their data sources, goals and relevance to research questions included in the research method in this study.

Table 5. Identification of steps, goals, sources, and their relevance for research questions.
Source: Author.

Step	Goals	Sources	Relevance for the research questions
Review of the EU dependency on energy imports	To understand how dependent the EU is in its energy consumption	Eurostat Our World in Data	Enables to understand diversity within EU MS Provides information about main energy partners of the EU Enables to understand global interconnections between the countries
Review of the MS' reliance on Russian fossil fuels	To understand dependency on Russian fossil fuels in different EU MS To understand vulnerabilities of energy systems in EU MS	Eurostat Statista IEA	Enables to understand energy security concerns in the EU Enables to understand which EU MS are likelier to immediately seek for new energy partners Enables to understand complexity of reducing Russian fossil fuel imports
Review of the trends in energy mix and electricity generation in MS	To understand electricity mix in EU MS To understand to what extent electricity generation in MS depends on fossil fuels	Eurostat IEA Our World in Data	Enables to understand diversity within EU MS Provides insights about feasibility and ambitiousness of further decarbonisation of electricity in different EU MS
Review of the past energy crises (2009 and 2014)	To understand how past crises affected the EU energy policies	Energy 2020 – A strategy for competitive, sustainable and	Enables to understand which measures were taken in the past to mitigate energy crunch

Step	Goals	Sources	Relevance for the research questions
		secure energy (EC 2010) The January 2009 gas supply disruption to the EU: an assessment (EC 2009) Report on the findings of the South-East-European Focus Group (EC 2014a) European Energy Security Strategy (EC 2014b) Energy security: Commission puts forward comprehensive strategy to strengthen security of supply (EC 2014c) Publication of the Oxford Institute for Energy Studies and CEPS	
Review of the measures in the ‘Fit for 55’ package and REPowerEU plan	To detect difference in energy policies and targets before and after the Russian invasion To identify whether the new EU energy targets are aligned with low-carbon transition	The ‘Fit for 55’ package (EC 2021a) REPowerEU Plan (draft and the final proposal) including accompanying documents (EC 2022o)	Enables to understand how the crisis affected energy policy in the EU Enables to understand whether security of energy supply was prioritized over climate concerns Enables to understand how fast the EU can develop proposals aimed at mitigation of the crisis Provides a base to answer a question whether the security crisis will accelerate or slow down the ongoing transition to low-carbon sources
Review of the measures in the IEA proposals	To identify recommendations of the IEA aimed at cutting the EU dependency on Russian fossil fuels	A 10-Point Plan to Cut Oil Use (IEA 2022a) A 10-Point Plan to Reduce the European Union’s	Enables to understand how fast international organizations can develop proposals aimed at mitigation of the crisis Enables to draw conclusions about effects of the crisis on speed of the ongoing transition to low-carbon sources

Step	Goals	Sources	Relevance for the research questions
		Reliance on Russian Natural Gas (IEA 2022b) Playing my part: How to save money, reduce reliance on Russian energy, support Ukraine and help the planet (IEA 2022g) Nuclear Power and Secure Energy Transitions – Analysis (IEA 2022f)	
Identification of the EU MS' energy strategies mitigating the crisis	To understand immediate responses of EU MS to the Russian invasion related to their energy policy	Media sources primarily presented but not limited to Reuters, Bloomberg, The Economist, Financial Times, The Independent, Politico, The Washington Post, the Guardian, Euractiv, Energy Monitor, Oilprice.com, CNBC, The Times, Deutsche Welle, Der Spiegel, Die Welt, Tagesschau	Enables to understand how the crisis affected energy policy in EU MS Enables to understand whether national security of energy supply was prioritized over climate concerns Enables to understand how fast EU MS response to the crisis Highlights the major energy problems that different EU MS face during the crisis Enables to draw conclusions about speed and direction of the ongoing transition to low-carbon sources Provides a base to answer a question to what extent energy transitions (low-carbon or otherwise) can be facilitated by the application of strong policies Provides a base to answer a question whether the security crisis will accelerate or slow down the ongoing transition to low-carbon sources Provides insights about the development of future energy markets
Analysis of the media coverage of the EU's responses to the crisis	To identify how the REPowerEU proposals were reflected in the media	Media sources primarily presented but not limited to Reuters, Bloomberg, The Economist, Financial Times,	Highlights the most discussed mitigation pathways and topics relevant for the EU energy transitions and current energy security crisis

Step	Goals	Sources	Relevance for the research questions
		The Independent, Politico, The Washington Post, the Guardian, Euractiv, Energy Monitor, Oilprice.com, CNBC, The Times, Deutsche Welle, Der Spiegel, Die Welt, Tagesschau	

3.3 Limitations

This thesis was completed when the European energy crisis triggered by Russia's invasion of Ukraine was still unfolding. The thesis is based on the first five months that followed the Russian invasion and, therefore, it considers and analyses emergency responses to the crisis as well as proposals and energy policies that appeared in this timespan, i.e., only contains information available up to 20 July 2022. Therefore, the thesis could not provide a complete account of the long-term effect of the crisis. Theorizing about future geopolitical context and the prospective EU-Russia relations, though having significant implications for energy trade and global energy market, are beyond the scope of this thesis.

Second, the analysis of the media coverage did not involve all media sources, articles, opinions, statements, etc. issued between March 2022 and July 2022. Instead, a purposeful followed by random sampling were chosen with an intention not to overrepresent particular media sources and certain topics over other and to follow the unfolding crisis from the perspectives of different media and different actors (e.g., the leaders of the European states, the heads of the ministries, the EU representatives, energy experts, international organizations, think tanks, etc.). It is conceivable that another sampling strategy would produce different results, possibly also answering a slightly different question (e.g., investigating the *perception* of the crisis and the response by a particular social group that uses a particular segment of the media).

Finally, there is a difference between ‘setting targets’ and ‘reaching targets’. Indeed, analysis of the EU proposals emerged due to Russia’s invasion of Ukraine is limited to the envisioned measures and immediate responses of the EU MS. However, it is still important to consider emerging measures and policies as, paraphrasing Ikenberry, it enables to understand *how* problems were defined at governmental level and *which* policy responses were considered as possible (Ikenberry 1986, 105).

4 RESULTS

This chapter presents the results of the study. The first subsection covers the EU's dependency on imported energy. The second subsection outlines historical precedents of energy threats related to Russia-Ukraine conflicts and their effects on the EU. The third subsection examines the EU energy transition policies released in 2021 and 2022. The fourth subsection portrays the EU's responses to the current crisis, demonstrates how they were covered in the media, and reflects on feasibility of the new energy targets and their alignment with low-carbon transitions.

4.1 Dependency of the EU on energy imports

The European continent has been increasingly dependent on imported energy resources as energy demand significantly exceeds its domestic production. Moreover, due to the depletion of the domestic reserves (e.g., in the North sea) and environmental policies, focused on transition to low-carbon sources, both oil and gas production in the EU have considerably declined within the last twenty years (Sönnichsen 2022). Compared to 2020, EU domestic production in 2020 dropped by 89% for oil (Statista 2021b) and by 80% for gas (Statista 2021a). Overall dependency on fossil fuel imports in the EU was as high as 60% in the recent years, with a slight decline due to the decreased energy consumption caused by the COVID-19 pandemic (Figure 7). In 2020, the EU relied on net imports for 97 % of the crude oil and petroleum products (Eurostat 2022f), for 84% of natural gas (Statista 2022b), and for 35.8 % of solid fossil fuels (Eurostat 2022a) it consumed.

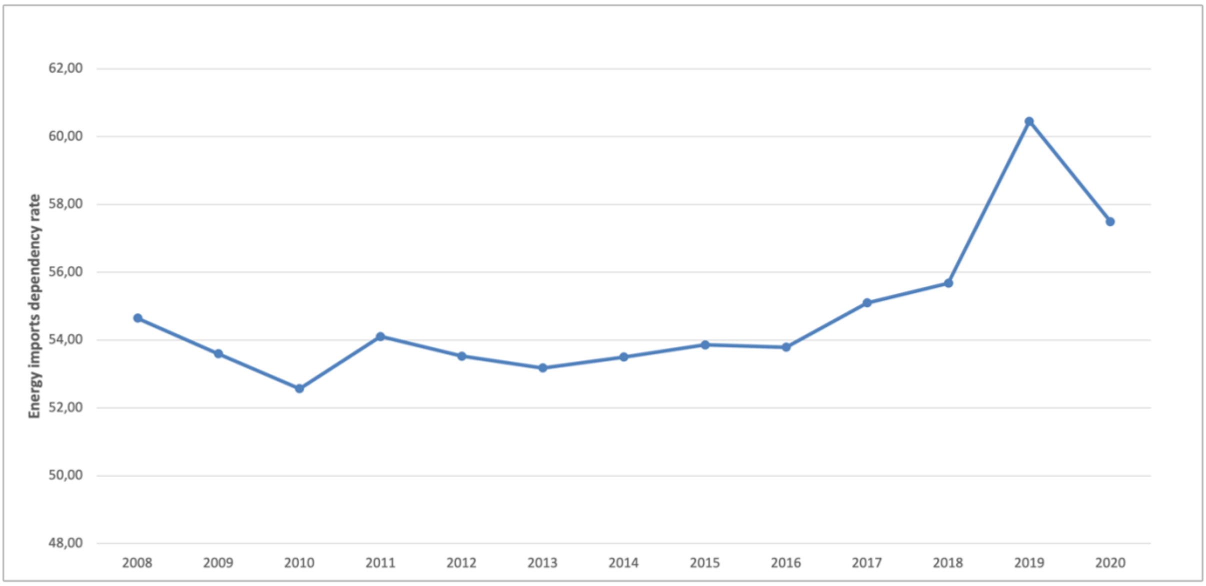

Figure 7. Dependency rate on energy imports in the European Union (EU-28) from 2008 to 2020.
Data source: Statista 2022b.

Another trend observed in the EU over time is a prevalent dependency on Russian fossil fuels. For example, in 2020, Russia alone met 24.4% of all EU energy needs (Eurostat 2022c). That year, Russia was the main supplier of fossil fuels and accounted for more than 40% of the EU's total gas imports, for 29% of its oil imports and for 54% of its coal imports (Eurostat 2022g). Table 6 presents the key EU suppliers of crude oil, natural gas and solid fossil fuels.

Table 6. The main EU suppliers of crude oil, natural gas and solid fossil fuels, 2020. Data source: Eurostat 2022.

Supplier	Crude oil, % of total imports	Natural gas, % of total imports	Solid fossil fuels, % of total imports
Russia	29	43	54
The United States	9	-	16
Norway	8	21	-
Saudi Arabia	7	-	-
The United Kingdom	7	-	-
Kazakhstan	6	-	-
Nigeria	6	-	-

Supplier	Crude oil, % of total imports	Natural gas, % of total imports	Solid fossil fuels, % of total imports
Algeria	-	8	-
Qatar	-	5	-
Australia	-	-	14

In order to understand the EU context, it is important to consider that there are different patterns in energy use among the EU MS and, therefore, energy dependency on Russia varies across the EU. While some European countries have multiple energy partners and the share of Russian fossil fuels is not high, for others, Russia is the main oil (e.g., Hungary) or gas (e.g., Latvia) supplier. Table 7 identifies reliance of the EU MS on Russian energy imports as of 2020.

Table 7. Share of fossil fuels supplied by Russia in total energy imports in the EU MS, %, 2020.
Data source: Eurostat 2022f; IEA 2022c*[1].

Country	Crude oil	Natural gas	Solid fossil fuels
Austria	10.3 (36.6 Kazakhstan)	0*	9.5 (58.9 Poland)
Belgium	28.5	6.7 (41 Norway)	32
Bulgaria	99 (as of 2018)*	75.2	85.4
Croatia	14.7 (66.8 Azerbaijan)	0 (69.6 Hungary)	70.4
Cyprus	2.8 (as of 2019)*	0*	100
Czech Republic	48.8	100	8 (76.2 Poland)
Denmark	12.2 (34 USA)	0 (99.9 Germany)	95.7
Estonia	NA[2]	93	100
Finland	80.9	97.6	50.4
France	8.7 (16.1 Kazakhstan)	16.9 (36.3 Norway)	31.8
Germany	34	66.1	45.9

[1] The IEA data were used where Eurostat data were not available. It should be noted that the IEA and Eurostat use slightly different methodologies resulting in data discrepancies in cases where data are provided by both sources.
[2] IEA note on Estonia: "Estonia shows negative values for 2019 and 2020 as a result of the statistical processing of oil shale liquefaction processes" (IEA 2022h). For more information about Estonia's oil shale see IEA 2022c.

Country	Crude oil	Natural gas	Solid fossil fuels
Greece	28.2 (30 Iraq)	38.4	87
Hungary	58.8	95	20 (44.9 USA)
Ireland	0 (74.3 USA)	0 (100 UK)	20.7 (24.5 South Africa)
Italy	13.5 (Azerbaijan 18.8)	43.3	52.7
Latvia	0 (100 Estonia)	100	97
Lithuania	72.3	41.8	90.6
Luxembourg	0*	27.2 (32.9 Norway)	6.2 (81.5 South Africa)
Malta	37.4 (as of 2019)*	0 (81.2 Trinidad and Tobago)	0*
The Netherlands	24.3	30.3 (36.5 Norway)	53.3
Poland	71.5	54.8	72.1
Portugal	4.9 (24.3 Brazil)	9.7 (53.8 Nigeria)	66.3
Romania	37.2 (Kazakhstan 44.5)	44.8 (52.8 Hungary)	55.7
Slovakia	100*	85.4	30.4
Slovenia	27.9*	8.7 (91 Austria)	4.5 (85.9 Indonesia)
Spain	5.9 (18.5 Nigeria)	10.5 (29.2 Algeria)	46
Sweden	10.3 (61.8 Norway)	13.8 (49.1 Denmark)	22.7 (52.6 Australia)

Note: Crude oil data include crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons. Solid fossil fuels include coal and coal products. When Russia is not the main supplier, the biggest supplier is given in the brackets.

On the other hand, fossil fuels play different role in the EU MS' energy and electricity mix. For example, though both Finland and Latvia relied on Russia for more than 90% of natural gas in 2020, the importance of this source is not the same for these two countries. In Finland, the share of natural gas was as low as 6.53% in primary energy consumption per capita and 5.81% in electricity consumption per capita as of 2020 (Our World in Data 2022c; 2022b). For Latvia, dependency on Russia is stronger as natural gas accounted for 27% in primary energy consumption per capita and for 36% in electricity consumption per capita as of 2020 (ibid.). Figure 8 and Figure 9 provide an overview of energy and electricity consumption by source in the EU MS.

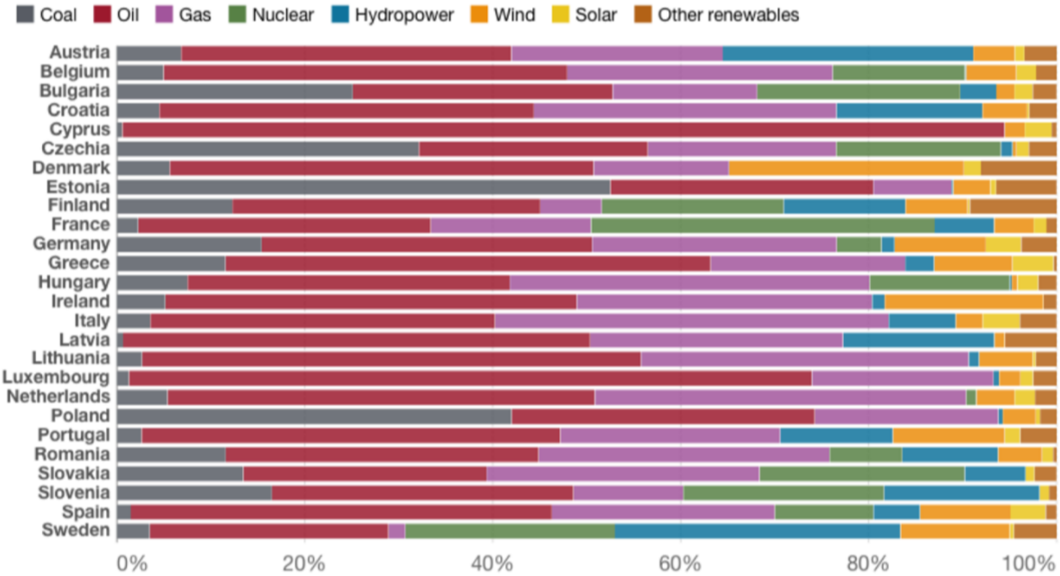

Figure 8. Per capita primary energy consumption by source, EU26 (no data for Malta), 2020.
Source: Our World in Data 2022b.

Note: Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.

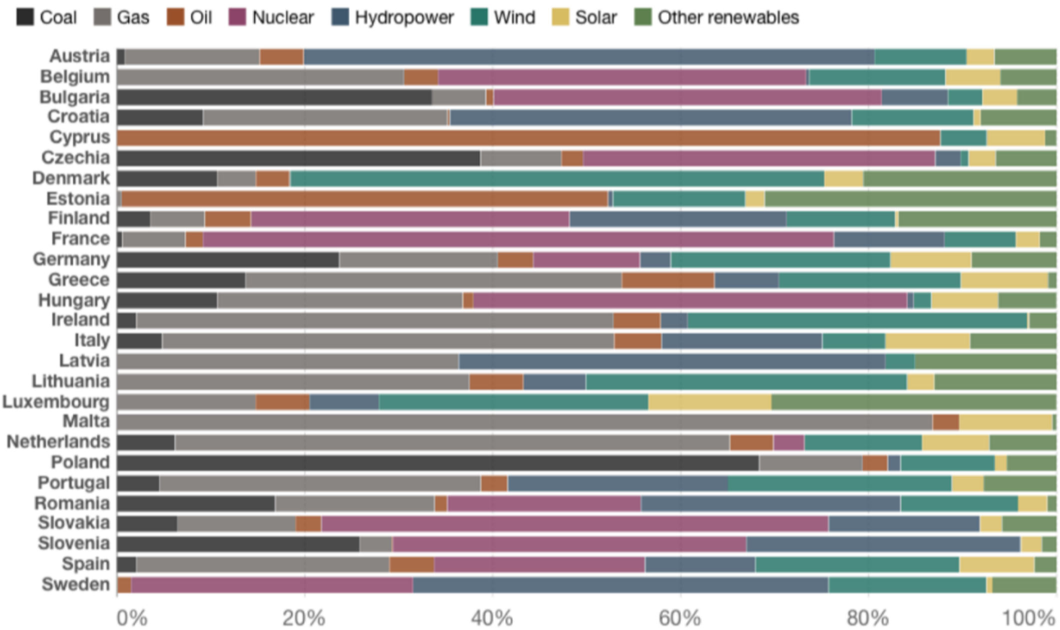

Figure 9. Per capita electricity consumption by source, EU-27, 2020.
Source: Our World in Data 2022a.

To understand why energy security concerns in the EU are on the top of the European political agendas, it is therefore necessary to look deeper not only into the EU energy imports, but also into the ways how energy is used in different EU MS, on which energy sources their economies run, whether states have multiple energy suppliers or just a few, and how dependent on energy imports and certain suppliers they are. Due to the overall considerable reliance on Russian fossil fuels in the EU (Table 6) and the EU-Russia relations becoming particularly strained after Russia's invasion of Ukraine, it is important to know which countries are especially reliant on Russian energy imports. Table 8 provides an overview of the European countries dependent on Russian oil, gas and coal in electricity use.

Table 8. The EU MS dependent on Russian fossil fuels in electricity use.
Source: Eurostat 2022f; Our World in Data 2022a.

	Russia is the main/second main supplier for the respective fossil fuel
Significant share of oil in electricity (over 15%)	Estonia
Significant share of gas in electricity (over 15%)	Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Portugal, Romania, Spain
Significant share of coal in electricity (over 15%)	Bulgaria, Germany, Poland, Romania

4.2 Past energy security crises (2009 and 2014)

During the last decades, energy security concerns were triggered in the EU several times. In winter 2008/2009, a dispute over gas prices between Russian Gazprom and Ukrainian Naftogaz resulted in cutting gas supplies to Ukraine which led to the interruption of gas transit to 18 European countries from Russia pass via Ukraine in the middle of winter (Reuters 2009). For Europe, it became "a landmark gas and energy security event" with far-reaching economic consequences (Pirani et al. 2009, 60). The EU had to rapidly facilitate an agreement between Russia and Ukraine to ensure gas supplies to EU MS as back then "[t]here was no contingency plan at national or EU level as to how to react to an unforeseen major disruption, which industry representatives had thought 'impossible'" (EC 2009, 5). Vulnerabilities of the EU energy system to gas disruption caused significant economic repercussions in several EU MS. Russia's reputation of a reliable gas supplier and Ukrain's reputation as a secure transit country were considerably damaged (Pirani et al. 2009, 61).

Understanding the need to improve EU response mechanisms to crises (including early monitoring, prediction and mitigation strategies), the EC assessed the 2009 gas crisis in detail and proposed improvements to the existing regulations in the energy security realm (EC 2009). The main lesson learnt from the January 2009 gas crisis was that interruption of gas supply on this scale might happen again due to any unforeseen events (e.g., political disagreements, technical problems or accidents on the major gas pipelines transiting gas to Europe) (EC 2009, 6). The initiated discussion resulted in the development of the renewed energy strategy ('Energy 2020') with the following definition of the EU's energy security objective:

> [T]o ensure the uninterrupted physical availability of energy products and services on the market, at a price which is affordable for all consumers (private and industrial), while contributing to the EU's wider social and climate goals (EC 2010).

The biggest difficulties that the EU energy system faced when attempted to mitigate the 2009 gas crisis related to the lack of sufficient infrastructure (e.g., interconnections between MS) and very limited diversification options both for route change and fuel source switching (EC 2009, 14). The results of the EC's assessment revealed that the countries that had fuel switching options as well as access to gas storages and alternative routes were the most successful in tackling a sudden interruption of gas supply (ibid., 8). For example, in Austria, Slovakia, Greece, Poland, Bulgaria, and Romania temporary switching from gas to oil for heating and coal for power generation took place (ibid.). Increased natural gas imports from Norway and Libya, switching to the pipeline route via Belarus and Turkey to receive Russian gas, collaboration between MS to use gas from storage, and additional LNG supply assisted in mitigating the impacts of the energy crisis. In this respect, south-eastern Europe (e.g., Bulgaria, Moldova, and Serbia) lacking a pipeline network and interconnections that would transport gas from other European regions was particularly vulnerable to the suspension of Russian gas. Due to this, both the EC and external experts (see e.g., Macintosh 2010; Pirani et al. 2009) recommended diversification of the EU suppliers and fuel options (e.g., LNG and respective infrastructure) to reduce reliance on a single energy provider and fuel routes, making, therefore, the EU energy system more resilient and independent from the geopolitical context and technical issues.

Though Russia's responsibility in cutting back deliveries to the EU was recognized, it was considered that Russia's decision targeted Ukraine and not the European customers as the EU and Russia mutually depended on the gas trade and a sudden suspension of gas supplies meant lost revenues and penalties for Gazprom (Pirani et al. 2009, 33). Understanding that the Russia-Ukraine relationships could worsen again leading to a new cut off, a new gas pipeline route away from Ukraine, the Nord Stream twin pipeline system (NSP), connecting Russian Vyborg and German Lubmin via the Baltic Sea was completed in 2012 (Nord Stream AG 2022). Construction of another pipeline that would connect Russia and south-eastern Europe through the Black Sea bypassing Ukraine, South Stream, started in the same year.

The next crisis was not long in coming. In 2014, following the escalation of the conflict between Russia and Ukraine, a new dispute over gas prices and payments for gas supplies started and eventually led to suspension of gas supplies to Ukraine in June 2014 (POLITICO 2014). This raised concerns about disruption of gas transit to the EU as it happened in 2009. At the same time, as NSP was already in operation and the mild weather conditions in the EU in summer 2014 resulted in a relatively low gas demand, an immediate interruption of gas supplies via Ukraine in 2014 could not be same disruptive for the EU energy system as it was in 2009 (Pirani et al. 2014). Nevertheless, understanding potential risks, the Commission proposed a new European Energy Security Strategy (EC 2014b). Presenting the Strategy, European Commission President (2004-2014) José Manuel Barroso said:

> The EU has done a lot in the aftermath of the gas crisis 2009 to increase its energy security. Yet, it remains vulnerable. The tensions over Ukraine again drove home this message. In the light of an overall energy import dependency of more than 50% we have to make further steps. (EC 2014c)

To reduce energy insecurity, the Commission suggested eight steps, including diversification of energy supplies, moderation of energy demand, and increase in energy production in the EU (EC 2014b, 3). Development of new gas routes, expansion of the infrastructure, stronger interconnectivity between Member States as well as broadening of gas suppliers aimed to decrease the EU's dependency on 'particular suppliers' (EC 2014b, 20). At the same time, the Strategy emphasized that shifting of the European economy to a low-carbon one should be a priority for 2014-2020 (ibid.). Ahead of winter 2014, the South-East European (SEE) Focus Group, consisting of Bulgaria, Croatia, Greece, Hungary, and Romania, released recommendations to mitigate potential interruption of gas supply from Russia (EC 2014a). Being the most exposed Member States to this disruption due to their mutual dependency and reliance on Russian natural gas, the SEE Focus Group concluded that for them fuel switching is a key measure in case of Russian gas cut-off (EC 2014a, 8).

Throughout 2014, Russian remained the EU's main gas supplier (Directorate-General for Energy (EC) 2014, 8). At the same time, the escalation of military conflict in Ukraine increased tension between the EU and Russia. The construction of South Stream pipeline project bypassing Ukraine was cancelled in December 2014 (Reuters 2014), but later replaced with the TurkStream project that transports Russian gas to Turkey, South and Southeast Europe (TurkStream 2022).

Both crises, though having different direct impacts on the EU economic situation, demonstrated that heavy dependency on Russian supplies – whether through Ukraine or away from it – may be dangerous for European energy system. These shock events raised energy security concerns and deepened an understanding that diversification of supply sources, suppliers, transit routes and fuel form (e.g., LNG) is required to guarantee security of energy supplies. At the same time, due to the attractive price for Russian gas and existing pipeline network connecting

Russia with Europe, moving away from Russian gas remained problematic. The construction of the next pipeline route connecting Russia and Germany, Nord Stream 2 (NSP2), started in 2018 and was finished in the end of 2021. However, with the new escalation of the Russia-Ukrainian conflict resulted in Russia's invasion of Ukraine in February 2022, NSP2 project was frozen (Marsh and Chambers 2022).

4.3 Recent EU energy transition policies

4.3.1 European Green Deal and the 'Fit for 55' package

Due to the EU heavily reliance on Russia for its energy imports and energy security concerns associated with that, switching to indigenous sources of energy and diversification of energy sources and suppliers is an important step towards lower energy dependence of the EU. At the same time, as climate change creates additional threats to the world, mitigation of energy security concerns should be aligned with climate targets.

Today, the EU is considered as a global leader in climate change policies, planning to achieve net-zero emissions target by 2050 (EC 2022a) and to meet 55% emission reduction by 2030 (EC 2022j). The Union has led the introduction and expansion of such low-carbon technologies as nuclear (Brutschin, Cherp, and Jewell 2021; Jewell 2011) and renewables (Cherp et al. 2021) as well as the phase-out of coal power (Jewell et al. 2019; Vinichenko, Cherp, and Jewell 2021).

At the heart of the EU energy transition policies is the European Green Deal (EC 2019), which was labelled as "Europe's man on the moon moment" (Simon 2019). It should be noticed that the Green Deal is far more than one document containing all possible measures. Instead, it is a set of various policies united under one goal: fighting climate change. By the time this thesis was completed, the Green Deal included several climate action initiatives, namely, European Climate Law (binding legislation of the 2050 climate-neutrality objective of the EU), European

Climate Pact (aims to engage society in climate action), 2030 Climate Target Plan (sets a target of emission reduction by 55% by 2030), and EU Strategy on Climate Adaptation (aims to improve adaptation of the EU and increase resilience to impacts of climate change by 2050) (EC 2022a). Each of these documents is responsible for a particular action and altogether they guarantee that the Green Deal targets will be achieved. Moreover, development and implementation of the policies and discussion of the Green Deal proposals (e.g., achieving climate neutrality by 2050) took several years. Key steps in delivering the European Green Deal presented in the Figure 10.

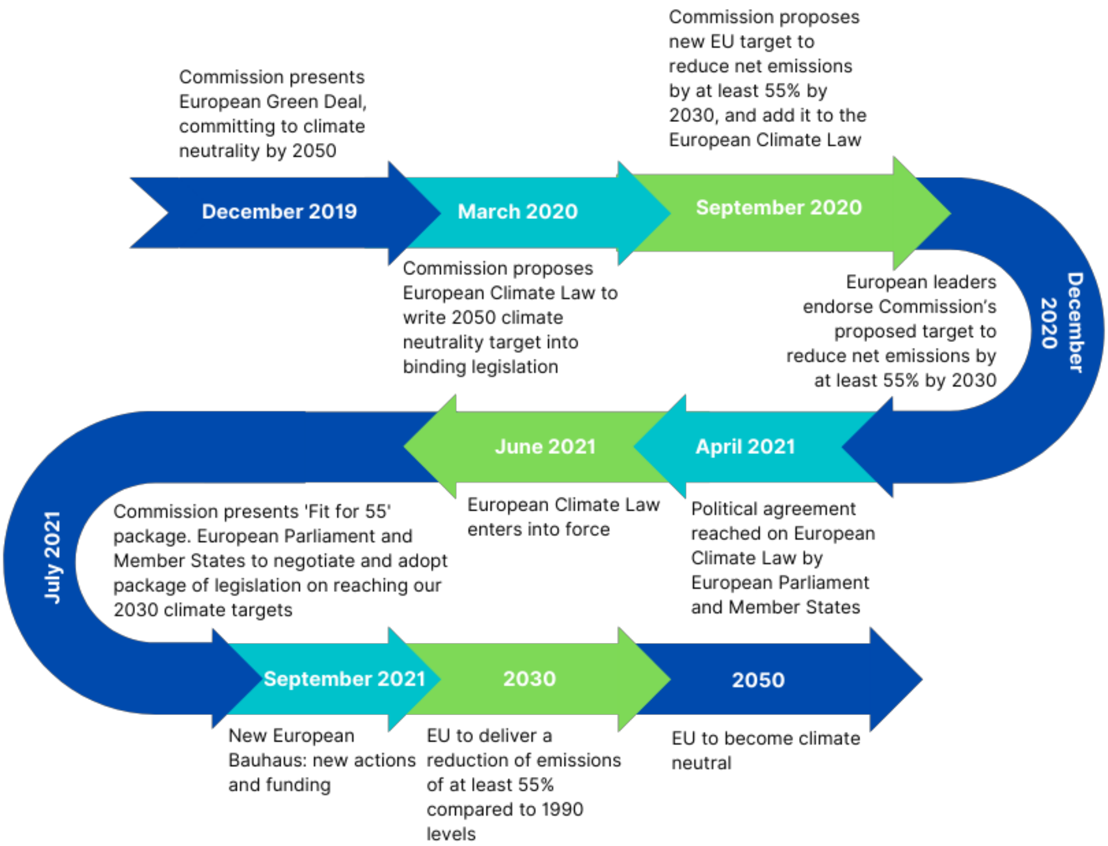

Figure 10. Delivering the European Green Deal: Key steps.
Data source: EC 2022g. Own design.

The aim of the European Green Deal is to simultaneously ensure emission reduction making Europe the first climate neutral continent in the world, to decouple economic growth from increase in energy use, and to guarantee just transitions for regions traditionally dependent on fossil fuel production and energy intensive industries (EC 2019). The Green Deal initiatives involve transformations in the EU economy, transport, energy, buildings, and nature protection and aims to boost global climate action (Figure 11). They outline mechanisms aimed at reducing GHG emissions from electricity generation, industry, transport, and flights within the EU, increasing energy efficiency, accelerating deployment of renewables, funding climate-aligned changes, etc.

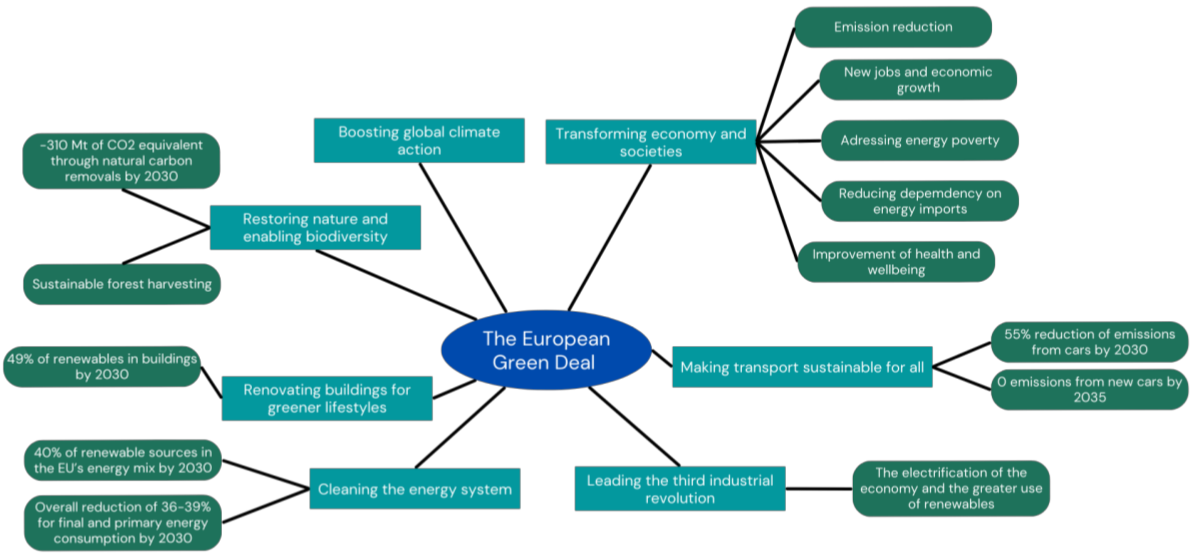

Figure 11. Mind map of the European Green Deal.
Data source: EC 2022i. Own design.

Presented in July 2021, the EU 'Fit for 55' package is part of the European Green Deal legislation and envisages a pathway to "a fair, competitive and green transition by 2030 and beyond" through a set of proposals (EC 2021a, 3). It balances between various policy mechanisms (e.g., pricing, support measures, introduction of the standards, etc.) and contains new initiatives for climate, energy, buildings, land use and forestry (ibid.). Particularly, the 'Fit for 55' package suggested to extend Emissions Trading System (ETS) to road transport and buildings from 2026, proposed a Carbon Border Adjustment Mechanism (CBAM) that would set a price on imports of high-polluting goods, and presented a new Social Climate Fund (SCF) aimed at supporting energy vulnerable households. Table 9 provides a full list of updates and proposals included in the ‘Fit for 55’ package.

Table 9. The 'Fit for 55' package proposals.
Source: EC 2021a.

Pricing	Targets	Rules
•Stronger Emissions Trading System including in aviation •Extending Emissions Trading to maritime, road transport, and buildings •Updated Energy taxation Directive •New Carbon Border Adjustment Mechanism	•Updated Effort Sharing Regulation •Updated Land Use Land Use Change and Forestry Regulation •Updated Renewable Energy Directive •Updated Energy Efficiency Directive	•Stricter CO2 performance for cars & vans •New infrastructure for alternative fuels •ReFuelEU: More sustainable aviation fuels •FuelEU: Cleaner maritime fuels
Support measures		
Using revenues and regulations to promote innovation, build solidarity and mitigate impacts for the vulnerable, notably through the new Social Climate Fund and enhanced Modernisation and Innovation Funds		

Considering that both the European Green Deal and the ‘Fit for 55’ package were introduced only several years ago (in 2019 and 2021 respectively), and development and implementation of the concrete policies under the Green Deal legislation does not happen fast, it is too early to evaluate the results of the latest EU climate actions. On the other hand, while between 1990 and 2018, GHG emissions in the EU were reduced by 23% (EC 2019, 4), achieving the Green Deal target means greater emission reduction within much shorter period of time. Though the EU is a world leader in taking action against the climate crisis, the speed of energy transitions in the EU is still considered insufficient to reach ambitious climate targets (Cherp et al. 2021).

4.3.2 REPowerEU Plan

Russia’s invasion of Ukraine became “a stark reminder of the implications that Europe’s strategic dependence on fossil fuels (gas, oil and coal) imports from third countries can have on the Union’s energy markets and security of supply” (EC 2022g). Under intensified energy security concerns, in March 2022, the Commission proposed the first outline of the REPowerEU Plan to phase out Russian fossil fuels well before 2030 (EC 2022h). Initially, the document that has been drafted since the beginning of 2022 was planned as a response to soaring energy prices, but after the Russian invasion it was redesigned to respond to the energy crisis (Keating 2022). Presenting the Plan, Commission President Ursula von der Leyen said:

> We must become independent from Russian oil, coal and gas. We simply cannot rely on a supplier who explicitly threatens US. We need to act now to mitigate the impact of rising energy prices, diversify our gas supply for next winter and accelerate the clean energy transition. The quicker we switch to renewables and hydrogen, combined with more energy efficiency, the quicker we will be truly independent and master our energy system. (EC 2022q)

The final version of the REPowerEU Plan released in May 2022 (EC 2022i) was accompanied with five documents targeting particular areas of the Plan (EC 2022o). Table 10 provides an overview of the key documents under the REPowerEU Plan.

Table 10. REPowerEU: Key documents and their scope.
Source: EC 2022m.

Document	Scope
Commission Staff Working Document Implementing the Repower EU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets Accompanying the Document Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions REPowerEU Plan (EC 2022c)	Acceleration of the hydrogen projects and bio-methane production
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU 'Save Energy' (EC 2022d)	Energy savings and energy efficiency
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Short-Term Energy Market Interventions and Long-Term Improvements to the Electricity Market Design – a course for action (EC 2022g)	Security of supply and affordable energy prices
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU Solar Energy Strategy (EC 2022e)	Scaling-up and speeding-up of solar power capacities
Joint Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU external energy engagement in a changing world (EC 2022n)	Diversification of energy supplies and building long-term partnerships with energy suppliers

The REPowerEU Plan includes proposals on energy saving measures, diversification of energy supplies, and acceleration of renewable energy deployment. According to the Commission, combination of these measures should assist EU in moving away from Russian fossil fuels. Simultaneously, the Commission aims to stay under the Green Deal legislation and mitigate climate change when scaling-up solar power capacities and speeding-up hydrogen and bio-methane production.

As it was demonstrated in subsection 4.1, before the crisis Russia was the leading supplier of oil, natural gas, and coal to the EU. Cutting dependence on Russian imports is therefore a complicated task for the Union. Moreover, as MS have uneven share of the fossil fuels in energy mix and electricity generation (Figure 5 and Figure 6) and as their reliance on Russian imports differs (Table 7), implications of the Commission's proposals also vary across the EU. Acknowledging the challenges that the EU faces, the IEA released two proposals how to reduce fossil fuel use and decrease dependency on Russian energy imports: "A 10-Point Plan to Cut Oil Use" (IEA 2022a) and "A 10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas" (IEA 2022b). Together with the Commission, IEA also suggested a set of energy saving measures: "Playing my part: How to save money, reduce reliance on Russian energy, support Ukraine and help the planet" (IEA 2022g).

As analysis of the proposals shows, the major difference between the EC's and the IEA' positions is their opinion on nuclear power. In the REPowerEU Plan, the Commission envisaged extending lifetime of two nuclear power plants in Belgium and maintaining nuclear capacity in France (EC 2022c, 12). In contrast, IEA suggests not only extension of the operation of the plants scheduled for closure (five in total), but also returning reactors that were set offline in 2021 back to operations (IEA 2022b). Moreover, in the latest report on potential of nuclear power to mitigate both the current energy and climate crises, IEA encourages new investments in the nuclear technologies (particularly in small modular reactors) to reach net zero targets by 2050 (IEA 2022f). Challenges that nuclear energy faces in the EU are presented in detail in section 4.4.3. Table 11 presents overview of the short-, mid-, and long-term measures reducing dependence Russian fossil fuels from the Commission's and the IEA's proposals. Additionally, implications of the two packages of sanctions adopted by the Council of the European Union and imposed on Russian energy imports (EC 2022r) are indicated.

Table 11. Measures proposed by the Commission and IEA.

Measure	**Short- / mid- / long-term**	**Particular action in the EU27 (if applies)**	**Source**
		Russian oil	
Alternative suppliers	Short-term	Work with G7, G20, OPEC, IEA, and other international fora as well as bilaterally with relevant countries to ensure well supplied and well-functioning oil markets (EC 2022n)	REPowerEU Plan
Sanctions	Short-term	Crude and refined oil embargo (immediate effect) For seaborne crude oil, spot market transactions and execution of existing contracts will be permitted for six months after entry into force, while for petroleum products, these will be permitted for eight months after entry into force. Member States who have a particular pipeline dependency on Russia can benefit from a temporary exemption and continue to receive crude oil delivered by pipeline (without permission to resell), until the Council decides otherwise. After a wind down period of 6 months, EU operators will be prohibited from insuring and financing the transport, in particular through maritime routes, of oil to third countries.	Sixth package adopted by the Council of the European Union on 3 June 2022 (EC 2022r)
Demand-side behavioural measures to reduce consumption	Short-term	Reduce speed limits on highways by at least 10 km/h Work from home up to 3 days Car-free Sundays in cities A shift to public transport, cycling, walking Alternate car access to roads in cities Increase car sharing and reduce fuel use Promote efficient driving for trucks Use existing HSR and night trains Reduce business flights EVs and more efficient vehicles (EC 2022c; 2022d)	IEA 10-Point Oil Plan REPowerEU Plan

Measure	Short- / mid- / long-term	Particular action in the EU27 (if applies)	Source
		Russian gas	
Alternative suppliers	Short-term (using existing LNG infrastructure and pipeline corridors) Mid-/Long-term (until 2027) (new LNG infrastructure and pipeline corridors)	Scope of (potential) partners for LNG: US, Canada, Qatar, Australia, Egypt, Israel, Nigeria, Senegal, Angola Scope of partners for pipeline gas: Norway, Algeria, Azerbaijan (EC 2022n)	IEA 10-Point Gas Plan REPowerEU*
Demand-side behavioural measures to reduce consumption	Short-term	Reduction of thermostats by 1º C (EC 2022d)	IEA 10-Point Gas Plan REPowerEU
Increasing energy efficiency	Mid-term (until 2027)	Speed up the replacement of gas boilers with heat pumps Accelerate energy efficiency improvements in buildings and industry (EC 2022d)	IEA 10-Point Gas Plan REPowerEU
Delayed phase-out of coal power plants	Short-term	More operating hours and delayed phase out of coal power plants in response to high gas prices (EC 2022c)	IEA 10-Point Gas Plan REPowerEU
Abandoned/ delayed phase-out of nuclear plants	Short-term	Envisaged operation of two Belgian nuclear units beyond 2025 and maintained nuclear capacity in France (EC 2022c)	IEA 10-Point Gas Plan REPowerEU
Boosting nuclear energy development	Long-term		Nuclear Power and Secure Energy Transitions – Analysis (IEA 2022f)
Accelerating deployment of renewables	Mid-term (until 2027)	The renewables reach a 45% share in 2030 (EC 2022e)	IEA 10-Point Gas Plan REPowerEU
Accelerating bio-methane production	Mid-term (until 2027)	Bio-methane production reaches 35 bcm in 2030 (EC 2022c)	IEA 10-Point Gas Plan REPowerEU
Accelerating renewable hydrogen production and imports	Long-term (by 2030 and beyond)	Envisioned cooperation between Europe, Africa and the Gulf, potentially with Ukraine (EC 2022n) Renewable hydrogen use reaches 20 million tonnes (mt) by 2030 (EC 2022c)	IEA 10-Point Gas Plan REPowerEU

Measure	Short- / mid- / long-term	Particular action in the EU27 (if applies)	Source
		Russian coal	
Sanctions	Short-term	The purchase, import or transport into the Union of coal and other solid fossil fuels from August 2022 (EC 2022r)	Fifth package adopted by the Council of the European Union on 8 April 2022
Alternative suppliers	Short-term (coal phase-out by 2030)	Replacing 44 to 56 million tonnes of coal annually, largely by importing (EC 2022n)	REPowerEU
		Cross-cutting	
Protecting vulnerable groups	Short-term	Support on energy bills	IEA 10-Point Gas Plan REPowerEU

**Note: The REPowerEU includes documents listed in the Table 10. References to the respective documents are provided in the brackets.*

While the Commission did not cancel the proposals outlined in the 'Fit for 55' package, it reconsidered several energy targets set up earlier and added new measures to the REPowerEU Plan due to the unfolding crisis (Table 12). Concretely, it raised a target for renewables' share in the overall EU energy mix from 40% to 45% by 2030, envisaged greater hydrogen production and hydrogen imports, set a new target for domestic production of bio-methane, and adjusted target for reduction of energy use from 9% to 13% for 2030 compared to the 2020 Reference Scenario (EC 2022i). Understanding energy security threats to the vital energy systems in the EU, on the one hand, and willing to stop financing Russia's invasion, on the other, the Commission has also proposed measures to diversify energy supply and to reduce energy use in the EU through implementation of the behavioural measures, which should cut demand for Russian gas in the EU by two-thirds by the end of 2022 (EC 2022q).

Table 12. Comparison of selected energy targets in the 'Fit for 55' package and the REPowerEU Plan.
Source: EC 2021a; 2022i; 2022c; 2022n.

Criterion for comparison	The 'Fit for 55' Package	The REPowerEU Plan
Release date	July 14, 2021	March 8, 2022 (first outline), May 18, 2022 (final)
Purpose	"Fit for 55 refers to the EU's target of reducing net greenhouse gas emissions by at least 55% by 2030. The proposed package aims to bring EU legislation in line with the 2030 goal. The 'Fit for	"REPowerEU is a response to the hardships and global energy market disruption caused by Russia's invasion of Ukraine. There is a double urgency to transform Europe's energy system: **ending the EU's**

	55' package is a **set of proposals to revise and update EU legislation**" (EC 2021a)	**dependence on Russian fossil fuels**, which are used as an economic and political weapon and cost European taxpayers nearly €100 billion per year and **tackling the climate crisis.** The measures in the REPowerEU Plan can respond to this ambition, through **energy savings, diversification of energy supplies, and accelerated roll-out of renewable energy** to replace fossil fuels in homes, industry and power generation"
Emission reduction target	At least -55% GHG by 2030 compared with 1990 levels	At least -55% GHG by 2030 compared with 1990 levels
Renewables target in the overall energy mix	40% by 2030	45% by 2030
Renewable hydrogen (domestic production and import) target	5.6 mt by 2030 (production)	Up to ~20 mt (~10 mt production + 10 mt imported) by 2030, reflected in the 'Implementing the Repower EU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets' (EC 2022c)
Bio-methane domestic production target	17 bcm by 2030	35 bcm by 2030, reflected in the 'Implementing the Repower EU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets' (EC 2022c)
Reduction of final energy consumption	By 9% in 2030 compared to the level of efforts under the 2020 Reference Scenario[3]	By 13% in 2030 compared to the level of efforts under the 2020 Reference Scenario[4]
Measures aimed at diversifying of natural gas supply	–	LNG diversification (equivalent to 50 bcm, by the end of 2022) and pipeline gas import diversification (10 bcm by the end of 2022) Potential suppliers reflected in the 'EU external energy engagement in a changing world' (EC 2022n)
Natural gas and oil saving measures (through demand-side behavioural measures)	–	Reflected in the 'EU Save Energy' (EC 2022d) and 'Implementing the Repower EU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets' (EC 2022c), illustrative potential: ~ 13 bcm of natural gas, ~16 mtoe of oil
Natural gas saving measures (through longer operation of coal and nuclear power plants)	–	Reflected in the 'Implementing the Repower EU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets' (EC 2022c), potentially saves 31 bcm of gas
Impact of the measures on gas consumption	Reduction by 30%, equivalent to 116 bcm, by 2030 compared to 2020	Reduction by ~80%, equivalent to 310 bcm, by 2030 compared to 2020

[3] For more information about the 2020 Reference Scenario please see Directorate-General for Climate Action (EC) et al. 2021; EC 2021b.
[4] For more information about the 2020 Reference Scenario please see Directorate-General for Climate Action (EC) et al. 2021; EC 2021b.

4.4 EU energy strategies emerged in response to the crisis

The section starts with an overview of the media coverage of the Commission's proposals to gain an insight about the most discussed topics regarding the current energy crisis. Then, this section describes measures outlined in the REPowerEU Plan and these immediate responses to the crisis that have already emerged in Member States. Following the Commissions' logic, both proposals and responses are classified into the five categories: (1) diversification of suppliers, (2) shift in the mix of energy sources, (3) acceleration of renewable energy deployment, (4) energy savings, and (5) support on energy bills. Each of these categories constitutes a subsection with occasional breaking into smaller clusters when it was required.

4.4.1 Overview of the media coverage of the EU's responses to the crisis

This subsection reports the results of the analysis of the media coverage of the EU's responses to the current crisis. While some of the measures are aligned with low-carbon transitions (e.g., deployment of renewable energy, switching nuclear power, increase in energy efficiency), others are not aligned (e.g., switching to coal power generation) or aligned with constraints (e.g., a shift to EVs). Since media can potentially influence energy transitions through delivering information to energy consumers and providing policymakers with feedback, consideration of the media coverage of renewable energy is beneficial for analysis of energy transitions. Moreover, as there is a strong interaction between what Cherp et al. (2018) call 'the three perspectives on energy transitions' and the socio-technical perspective incorporates flows of knowledge and practices, media framing of energy topics can lead to easier adoption of the new technologies or result in stronger resilience towards them.

The share of publication items focusing on sanctions and their implications as well as on finding alternative suppliers for Russian gas (including LNG) was the highest and accounted for more than 20% of the collected items for each of these two topics (*n* = 352). Alternative suppliers for Russian oil, renewables, switching to coal and nuclear power, energy efficiency measures and support to households and industries hit by the crisis were covered considerably less (5-15%). A shift to electric vehicles (EVs) and reduction of gas consumption were even less represented in the collected publication items (1-5%). The coverage of bio-methane production was below 1%. Table 13summarizes results of the media analysis and classifies the covered measures according to their alignment with low-carbon transitions.

Table 13. Media coverage of the EU's responses to the crisis.
Source: Author.

Media coverage	Aligned with transition	
	Yes	**No**
High (>20% of the total statements)		Sanctions (new infrastructure, new routes, increased domestic production, switching to the more affordable and emitting fuels) Alternative suppliers for Russian gas (building new pipelines and LNG import terminals)
Medium (>5% of the total statements)	Acceleration of the renewable energy deployment Delayed nuclear phase-out and boosting nuclear energy development Increasing energy efficiency	Delayed coal phase-out and restarting coal plants Supporting households and industries (fossil fuel subsidies, energy price cap) Alternative suppliers for Russian oil (new infrastructure, new routes, new contracts, increased domestic production)
Low (1-5% of the total statements)	Acceleration of the shift to EVs (with constraints) Reduced gas consumption (with constraints) Acceleration of hydrogen production (with constraints)	

Analysis of the users' web and news search via Google trends demonstrated similar patterns. In comparison to Russian gas, renewable energy, nuclear energy, and Russian oil, a term ‘sanctions’ was the most searched, though a considerable decline in interest over time for this topic is observed (Figure 12 and Figure 13).

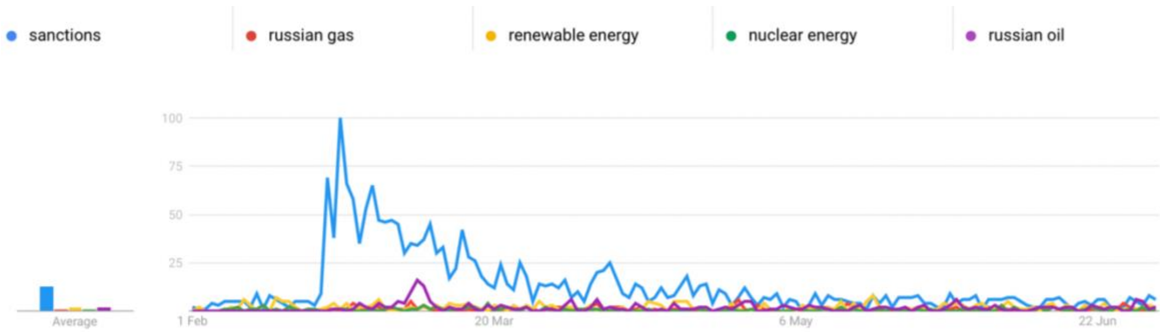

Figure 12. Comparison of interest over time for selected terms, World, News search, 01.02.2022-01.07.2022.
Source: Google trends.

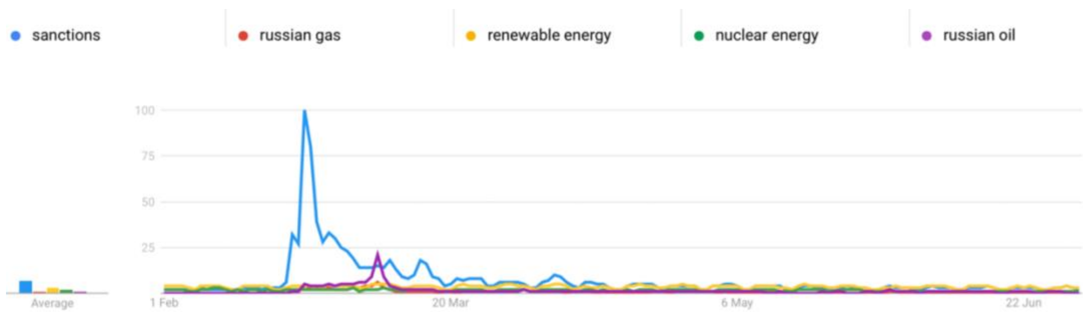

Figure 13. Comparison of interest over time for selected terms, World, Web search, 01.02.2022-01.07.2022.
Source: Google trends.

On the other hand, between Russian gas, renewable energy, nuclear energy, and Russian oil the latter reached the maximum of interest among the users in the news search, whereas renewable energy was the second popular term for news search (Figure 14) and the most popular term for the web search (Figure 15).

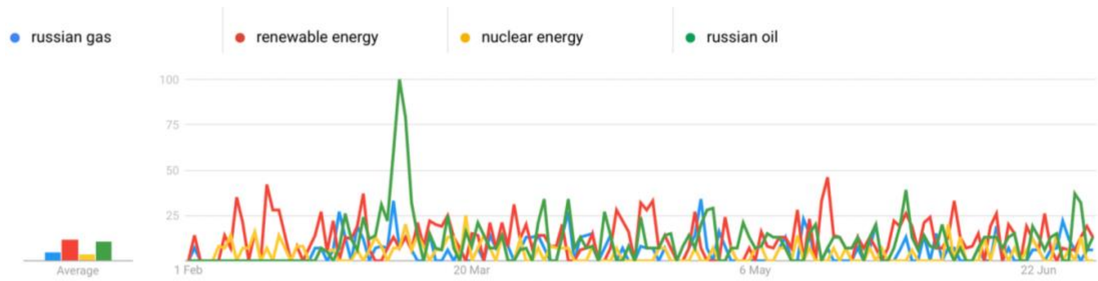

Figure 14. Comparison of interest over time for selected terms, World, News search, 01.02.2022-01.07.2022.
Source: Google trends.

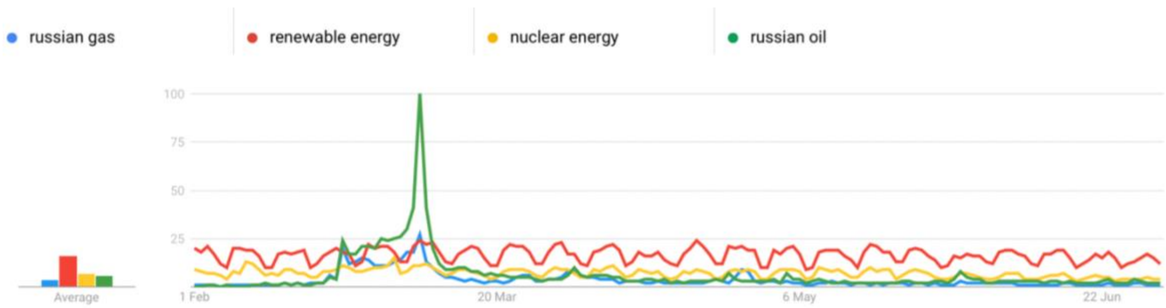

Figure 15. Comparison of interest over time for selected terms, World, Web search, 01.02.2022-01.07.2022.
Source: Google trends.

Finally, analysis of the publications on the Reuters's website supports the results reported earlier in this section. The conducted search revealed that the number of items between May 2021 and May 2022 containing the keyword phrase 'renewable energy' (RE) was more than two times lower (2045) than the ones containing the keyword phrase 'sanctions on Russia' (SoR) (5173). At the same time, in May 2022 there were 154 articles covering RE and 647 covering SoR which stands for 4.2 times difference. Moreover, average monthly number of publications on RE between May 2021 and May 2022 was 170, which means that in May 2022 there were less coverage of this topic than averagely. In contrast, average monthly number of publications on SoR during the same time range was equal to 471. The coverage of SoR in May 2022 was therefore almost 40% higher compared to the average number of articles on this issue. Figure 16 depicts the obtained results.

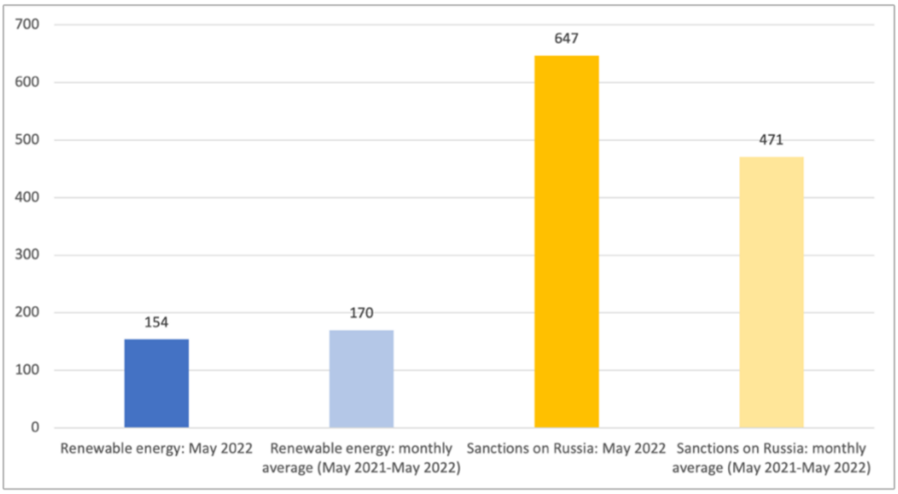

Figure 16. Number of publications on 'renewable energy' and 'sanctions on Russia' in Reuters: May 2022 and monthly average.
Source: Author.

4.4.2 Diversification of energy suppliers

Sanctions

As it was outlined in section 4.1, before 24 February 2022 Russia was the leading exporter of fossil fuels to Europe. Russian invasion of Ukraine evoked memories about the past energy crises and intensified energy security concerns in the Union. To replace Russian energy sources and to hinder Russian invasion, the EU started to seek for alternative suppliers.

Though sanctions as such are not included in the REPowerEU Plan, the Commission considered already imposed and upcoming sanctions when released its proposals (EC 2022n, 5). From March to mid-July 2022, two packages of sanctions (the fifth and the sixth) were adopted by the Council of the European Union (EC 2022r), and as of 13 July 2022, capping the price on Russian oil imports is being discussed between the US and the EU (Hussein 2022). One of the two packages of sanctions adopted on 8 April 2022 imposed an import ban on Russian coal (EC 2022r). The next package adopted almost two months later (ibid.), incorporated embargo on Russian crude and refined oil with immediate effect, while permitting seaborn crude oil imports, spot market transactions and execution of concluded contracts until the end of the year. Unlike coal sanctions, oil sanctions took more time to negotiate due to heavy reliance of several MS on Russian oil imports (e.g., Bulgaria and Hungary). After all, particularly dependent MS were temporarily exempted from oil sanctions. For example, Bulgaria can import crude oil and petroleum products via maritime transport until the end of 2024 (EC 2022r).

While the long-term economic effects of sanctions against Russia are yet to observe, in the short-term the EU needs to replace 44 to 56 million tonnes of coal annually (EC 2022n, 7) and secure oil supply when energy crisis continues to unfold and production capacities remain tight (Sergei Vakulenko 2022). In the context of the coal phase-out scheduled in advanced economies by 2030 and globally by 2040 (UNFCCC 2021), it might seem that the EU is less sensitive to coal sanctions than to the oil ones. Yet, with several European countries considering switching to coal due to the soaring gas prices, including the largest economy in Europe – Germany (see section 4.4.3 for details), finding alternative suppliers for Russian coal as well restarting domestic production and closed coal plants may be not easy too. Moreover, though Russian gas was not targeted in sanctions, the Commission's aim to cut demand for Russian gas imports by two-thirds by the end of 2022 (EC 2022q) means that significant efforts to diversify gas supplies and to reduce overall gas consumption are required. The next subsection reviews potential suppliers to replace Russian fossil fuels.

New suppliers

While earlier EU energy policies incorporated in the 'Fit for 55' package focused on environmental agenda, an important part of the REPowerEU Plan is reducing EU dependency on Russian energy imports.

Natural gas

As it is particularly difficult to eliminate the EU's reliance on Russian natural gas due to the gas infrastructure and pipeline routes, seeking for alternatives to replace Russian supplies became of immediate importance for the EU. This also explains extremely high coverage of this topic in the media in comparison to many others (Table 13).

One of the first actions taken to diversify gas supplies was establishment of a joint Task Force on Energy Security between the US and the EU in March 2022 (EC 2022s). According to the agreement, the US will delivery LNG to the Union, starting with 15 bcm in 2022 and, then, 50 bcm annually until 2030 with possibility of extension (EC 2022n, 3). By the end of the March, Germany, France, Italy announced that they would rent or acquire LNG terminals to increase LNG import capacity (Kurmayer 2022b). Latvia, Estonia and Greece also seek to develop import terminals for LNG, while Denmark suggested to increase its natural gas output to reduce Europe's reliance on Russian gas (Wienberg 2022). Bulgaria and Greece agreed to joint LNG purchases to provide south-eastern Europe with gas (Euractiv 2022a). Italian energy company Eni signed a deal with QatarEnergy for the largest LNG project of nowadays (Mills 2022). Along with the US and Nigeria that already deliver LNG to Europe, other potential EU partners for LNG trade listed by the Commission include Canada, Israel, Egypt, Senegal, and Angola (EC 2022n, 3).

Russian President Vladimir Putin's decree that imposed a new payments system for gas supplies (Follain 2022) pushed some of the MS to seek for replacement of Russian gas even faster. Particularly, the decree demanded that EU companies were obliged to pay for gas via Russian Gazprombank, opening accounts in roubles. The MS that did not accept the new system could not receive Russian gas any longer. By mid-July 2022, gas supply to Poland, Bulgaria, Finland, Denmark, and the Netherlands was suspended (Liboreiro 2022). In response to this, Poland turned to Germany to source gas via its links, and Bulgaria will receive Azeri gas partly covering its demand once a new pipeline connecting Bulgaria with Greece will be operational (Chestney 2022). A plan for building a new offshore pipeline between Spain and Italy is being explored (Reuters 2022c), while a pipeline route connecting Poland and Norway will be finished in October 2022 (Chestney 2022).

Trying to secure gas supply, the Netherlands and Germany have decided to jointly exploit a new gas field in the North sea with production starting in 2024 (Reuters 2022d). In the meantime, the Dutch officials said that in the worst-case scenario – if Russia halts gas – they would increase output from the Groningen field (Koc and Baazil 2022) where they planned to end gas production already this year due to seismic risks (Reuters 2021). On July 18, 2022 President of the EU Commission Ursula von der Leyen announced that Azeri gas supplies via the Southern Gas Corridor to the EU will be doubled (von der Leyen 2022). On the other hand, any large-scale transformations in the European gas infrastructure will not be completed by the end of the year.

Significant advantage of LNG is that natural gas in a liquid state can be transported between the countries not connected with pipeline routes. At the same time, operations with LNG require a special infrastructure. First, to become LNG natural gas should be liquified at the LNG facilities, then, only special tankers can ship it, and, finally, to be used at power plants or by industries LNG should be regasified at the LNG terminals. According to IEA chief Dr Fatih Birol, building one LNG terminal a year requires $25 billion which is equal to the annual investments needed to provide all African people with energy access by 2030 (IEA 2022d).

Besides from the enormous costs, both environmental organizations and energy experts criticized the EU's plan to replace Russian gas through increased LNG imports for several reasons. For example, NGO Global Witness warned that construction of new LNG terminals and supplementary infrastructure will encourage further gas imports to Europe instead of fossil fuel phase-out (Taylor 2022). Furthermore, if to consider the overall emissions related to shipping and regasification of LNG, then this fuel is even more carbon-intensive than pipeline gas (EEB 2022a). It was also argued that soaring gas prices demonstrated that natural gas is not a reliable transition fuel and, therefore, investing in any new gas infrastructure is wasteful (Rangelova and Vladimirov 2022).

Energy experts, on the other hand, considered the Commission's target to reduce demand for Russian natural gas by two-thirds by the end of 2022 (which is approximately 100 bcm) to be unachievable (see e.g., Sergey Vakulenko 2022; Roberts and Bowden 2022). First, the process of construction of LNG capacities and new pipeline routes that could deliver enough gas to Europe to replace Russian imports goes beyond 2022. For example, Floating Storage Regasification Units (FSRUs) in Germany could be operational only in 2023 (LNG Industry 2022). Second, none of the existing suppliers of gas to Europe (e.g. Norway, Algeria and Libya) can significantly increase supplies to ease the energy crisis (Roberts and Bowden 2022). Also, global LNG demand is expected to outpace the available supply, which destabilizes the entire LNG market (Rystad Energy 2022). Moreover, a recent accident at the Freeport LNG terminal in the US that planned to be restarted only in October 2022 (Chapa 2022) and the unplanned outages in the Norwegian gas production (Mazneva 2022) became a reminder that gas supplies are fragile and can rapidly increase gas prices.

Oil

Finding alternative suppliers to replace Russian oil imports is not less challenging. First, some European countries heavily rely on the Druzhba pipeline network – the longest in the world – which carries oil from the eastern part of Russia to several EU countries (e.g., Poland, Hungary, Slovakia, the Czech Republic, and Germany). Similarly to natural gas deliveries by pipeline, oil supply via Druzhba is difficult to be rapidly substituted. Landlocked European countries are particularly sensitive to the Russian oil embargo as they cannot import oil via maritime transport from other countries. Another problem for the countries that were traditionally dependent on Russia is that their refineries were designed to be run on Russian oil (e.g., the only Slovakia's refinery, the Schwedt refinery in Germany that also partly supplies Poland). These two factors resulted in temporary exemption of Bulgaria, Hungary, Slovakia, and Czech Republic from the ban on Russian oil deliveries (Abnett, Strupczewski, and Melander 2022).

The EU partners for oil trade already include Saudi Arabia, the US and Norway (Table 6). On the other hand, a share of oil supply from these countries in the total EU oil imports was much more modest in comparison to the volumes imported from Russia. The Organization of the Petroleum Exporting Countries (OPEC) that coordinates global oil policies and includes 13 oil producers warned that sanctions on Russian oil could lead to one of the worst oil supply shocks in history, claiming that it would be impossible to replace Russian volumes (Abnett and Lawler 2022). A discussion about Russian oil embargo, initiated by the US on the second week of March 2022, resulted in oil jumping to more than $120 a barrel at the open, though short after Russia's invasion of Ukraine the closing price of Brent was still about $100 (Statista 2022a). In July 2022, Saudi Arabia, the world's largest oil exporter, did not agree to ramp up oil production which raise oil prices again after a slight decline (Kearney 2022). Figure 17 reflects the changes in closing price of Brent crude oil from March 2020 to July 2022.

Energy experts, in line with OPEC warnings, expressed their concerns regarding EU plans to impose sanctions on Russian energy. For example, energy analyst Vakulenko (2022b) argued that Russian energy embargo would lead to a severe global crisis due to the 'cascading effects' of this action and criticized a publication of ECONtribute (Bachmann et al. 2022) for underestimating negative impacts of embargo on the global energy market.

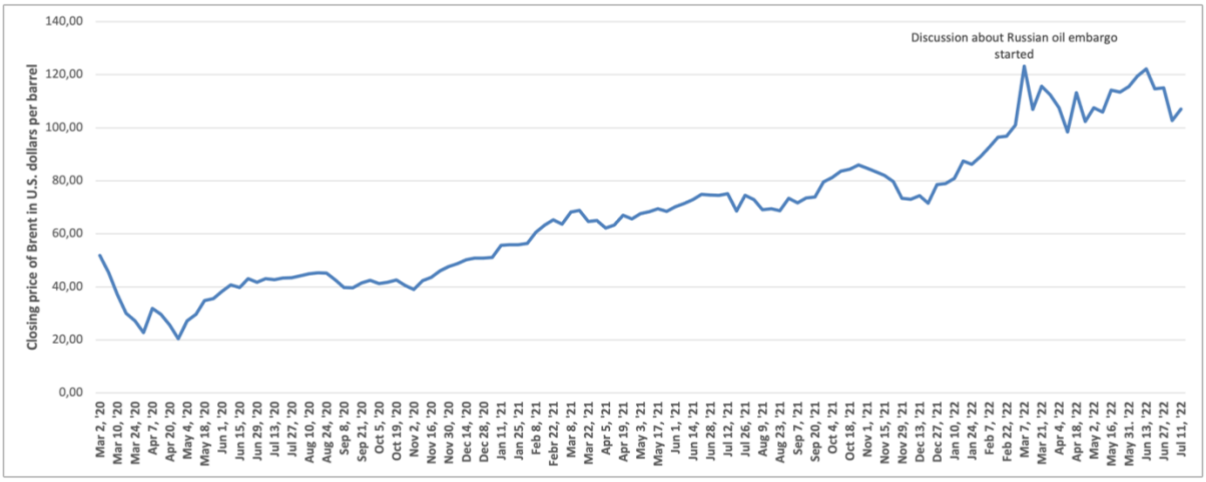

Figure 17. Closing price of Brent crude oil from March 2020 to July 2022 (in US dollars per barrel).
Source: Statista 2022a.

Understanding potential risks for the EU economy, German Chancellor Olaf Scholz for several months opposed Russian energy embargo (see, e.g. Donahue 2022; Paraskova 2022; The Economist 2022b), arguing that "there is currently no other way of securing Europe's supply of energy for heating, transport and electricity and for industry" (Donahue 2022). Yet, trying to hinder Russia's invasion of Ukraine, Germany together with other MS supported sanctions targeting both Russian oil and coal. On the other hand, so far not all the countries announced plans to refuse Russian fossil fuels. For example, China (Aizhu 2022) and India (Verma 2022) are as of July 2022 the biggest buyers of cheap Russian oil. Saudi Arabia more than doubled imports of Russian fuel oil for power generation to free Saudi oil for exports due to the discounted prices set by Russia (Reuters 2022f). How the situation will develop and whether OPEC will change its position regarding oil production when the European import restrictions for Russian seaborne oil and petroleum products will come into force, is still to be observed.

Coal

In the long-term, scheduled coal phase-out (UNFCCC 2021) should decrease reliance on coal-fired power in the Union. At the same time, the world's richest countries, Group of Seven (G7), failed to set a target to quit coal-fuelled power during their latest meeting in the end of May 2022 (Euractiv 2022c). Moreover, according to the Commission's projections in the REPowerEU Plan, utilization of the coal plants in the short-term will exceed the last year estimations given in the 'Fit for 55' package due to the soaring prices for natural gas (EC 2022c, 12). In several European countries, including Germany, Poland, Romania and Bulgaria, coal continues to play a vital role in electricity generation (Figure 9), whereas these four countries are also the biggest importers of Russian coal (Table 8). This means that rapid replacing Russian coal imports, banned in the EU from August 2022, could be challenging and would require both growth in domestic extraction and in imports of non-Russian coal. At the same time, not all European countries have a large supply of domestic coal. Increased deliveries from the US and Australia could theoretically replace up to 70% of Russian coal imports to the EU, though being about 20 billion euros more expensive (Mathis, Rathi, and Ainger 2022). Coal exports from Indonesia to the EU has already jumped amid upcoming ban of Russian coal (Suroyo and Christina 2022). Due to the coal embargo, Russia could lose about 4 billion euros in revenues (Guarascio 2022), though increased exports to China (Bloomberg 2022), India (Tan 2022), and Turkey (Russell 2022) may potentially substitute trade with the Union.

4.4.3 Shift in the mix of energy sources

As it was outlined in section 4.2, fuel-switching already took place during the previous energy security crises. This subsection reviews two strategies discussed both by the Commission and Member States' governments in the context of current energy crisis: switching from gas to coal and from gas to nuclear power.

Switching from gas to coal

Natural gas, being a relatively clean source for power generation, is used as a 'transition fuel' that balances intermittent renewables and facilitates transition from a carbon-intensive economy to a low-carbon one. Over the last decade, a share of coal in electricity generation in the EU27 was decreasing – from 25% in 2012 to 15% in 2021 (Our World in Data 2022a). By 2022, most of the EU countries set their national targets to end use of unabated coal in line with the Paris Agreement (Table 14).

Table 14. Coal phase-out plans in the EU27 as of July 2022.
Source: The Europe Beyond Coal 2022.

Country	Announced date of coal phase-out
Austria	2023
Belgium	No coal in electricity mix
Bulgaria	2038 or 2040
Croatia	2033
Cyprus	No coal in electricity mix
Czech Republic	2033
Denmark	2028
Estonia	No coal in electricity mix
Finland	2029
France	2023
Germany	2038
Greece	2028
Hungary	2025
Ireland	2025
Italy	2025
Latvia	No coal in electricity mix
Lithuania	No coal in electricity mix
Luxembourg	No coal in electricity mix
Malta	No coal in electricity mix
The Netherlands	2029
Poland	No coal phase-out plan
Portugal	No coal in electricity mix
Romania	2030
Slovakia	2030
Slovenia	2033
Spain	2030

Country	Announced date of coal phase-out
Sweden	No coal in electricity mix

Issued in 2021, the ‘Fit for 55’ package (EC 2021a) did not envisage a renaissance of coal in the Union. In contrast, REPowerEU Plan expects higher gross electricity generation from coal in 2030 than it was projected earlier (EC 2022c, 12). Indeed, soaring gas prices and potential disruption of Russian gas supply made natural gas less affordable and less reliable energy source and already turned several EU countries to coal for power generation. For example, Austria transformed its last coal-fired plant into a gas facility in 2020, but due to energy security concerns the Austrian government could switch to coal to ensure electricity generation in the country as well as use oil instead of gas for district heating in the Austrian capital (Strobl 2022). In the end of February, the German officials said they would consider extension of the life-spans of coal plants (Steitz, Alkousaa, and Sheahan 2022a) and in July 2022 they ordered to use more coal instead of gas for power generation amidst gas crisis (FAZ 2022). This move, according to Bloomberg’s estimation, could reduce up to 52% of gas used in electricity production in Germany within next 12 months (Wilkes, Delfs, and Dezem 2022). Italy and the Netherlands announced their plans to use coal too, having concerns about gas supply in the upcoming winter (Morris, Westfall, and Thebault 2022).

Fears that Russia may halt gas became strong after series of gas cut-offs to the countries that disagreed to pay for Russian gas in roubles (see section 4.4.2) and then were hastened due to the maintenance on the Nord Stream pipeline – the main route for Russian gas to Europe (Wilkes, Delfs, and Dezem 2022). While Europe uses nearly all Russian gas for electricity production (Jewell 2022), significant reduction of gas imports from Russia threatens scheduled coal phase-out in the EU. Countries that have large supply of domestic coal, on the one hand, and depend on Russian gas for power generation, on the other, are most at risk of coal lock-in

(Nacke and Jewell 2022). Concretely, this refers to Bulgaria, Czechia, Greece, Germany, Romania and Poland where either discussion of a potential coal phase-out delay or a turn to coal use took place (ibid.).

Switching from gas to nuclear power

In 2020, nuclear energy remained one of the largest sources for low-carbon electricity in the EU and accounted for about 25% of its total electricity generation (Eurostat 2022e). Out of 27 EU Member States, 13 countries use nuclear energy for electricity generation with106 operable nuclear reactors (ENSREG 2022). As of 2020, the leaders of nuclear power generation were France (67%), Slovakia (54%), Hungary (46%), and Bulgaria (41%).

Despite the importance of nuclear power, the EU does not have a common position in this area because some of its member states pursue expansion of nuclear power while some others purse its phase-out. For instance, Lithuania shut down its nuclear facilities in 2009, Germany and Sweden significantly decreased nuclear electricity production, while Romania, Hungary and Slovenia increased electricity generation from nuclear (Table 15). The lack of unity in the EU regarding the future of nuclear energy could explain why earlier energy proposals, for instance, 'Fit for 55' package (EC 2021a), did not make this technology part of the EU decarbonisation plan.

Table 15. Gross nuclear electricity production from 1990 to 2020 in the EU Member States, GWh.
Data source: Eurostat 2022e.

	1990	1995	2000	2005	2010	2015	2020
EU	729 114	791 857	859 930	916 081	854 470	786 676	683 512
Belgium	42 722	41 356	48 157	47 595	47 944	26 103	34 435
Bulgaria	14 665	17 261	18 178	18 653	15 249	15 383	16 626
Czechia	12 585	12 230	13 590	24 728	27 998	26 841	30 043

	1990	1995	2000	2005	2010	2015	2020
Germany	152 468	153 091	169 606	163 055	140 556	91 786	64 382
Spain	54 268	55 455	62 206	57 539	61 990	57 196	58 299
France	314 081	377 231	415 162	451 529	428 521	437 428	353 833
Lithuania	17 033	11 822	8 419	10 337	0	0	0
Hungary	13 731	14 026	14 180	13 834	15 761	15 834	16 055
The Netherlands	3 502	4 018	3 926	3 997	3 969	4 078	4 087
Romania	0	0	5 456	5 555	11 623	11 640	11 466
Slovenia	4 622	4 779	4 761	5 884	5 657	5 648	6 353
Slovakia	12 036	11 437	16 494	17 727	14 574	15 146	15 444
Finland	19 216	19 216	22 479	23 271	22 800	23 245	23 291
Sweden	68 185	69 935	57 316	72 377	57 828	53 348	49 198

As Russia was a main exporter of natural gas to Europe, Russia's invasion of Ukraine made Europe to look for alternatives that would reduce dependency on the Russian imports. Possible increase in nuclear electricity generation or delayed phase-out of nuclear power plants could ease the dependence on Russian gas. According to the IEA analysis, maximization of generation from such low-emissions sources as bioenergy and nuclear could potentially reduce EU gas use for electricity by 13 bcm per year (IEA 2022b).

Nevertheless, measures, outlined in the first draft of REPowerEU Plan (EC 2022h) and in its later version, issued on May 18, 2022 (EC 2022p), do not contain any information on potential contribution of nuclear power to electricity security of the EU. The only document where the Commission considers the possibility of abandoning phase-out of nuclear plants is "Implementing the REPowerEU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets" that accompanies the main text of the Plan (EC 2022c). According to the Commission's estimation, this measure could save up to 7 bcm of natural gas by 2030 (EC 2022c, 6). The difference between the IEA plan aimed at reducing dependency on Russian gas and the Commission's proposal was reflected in the media (see, e.g. Clifford 2022; Maizland 2022). IAEA director-general Rafael Mariano Grossi criticized the lack of attention to nuclear from the Commission's side and said that "[i]gnoring the EU's main source of highly dispatchable, low-carbon and non-weather dependent energy raises questions about whether the proposed measures are realistic" (Keating 2022).

At the same time, back in 2021, the European Commission's Executive Vice President in charge of the Green Deal Frans Timmermans said that "the choice to use nuclear power, or not, is solely up to the member states, and the Commission will support, sustain and assist those member states that make this choice" (Moussu 2021). Answering the questions regarding the lack of explicit reference to nuclear energy in the first draft of REPowerEU plan, he only repeated his earlier statement given above (Clifford 2022). The fact that the EU did not mention nuclear energy in its Plan was also noticed by some Instagram users when the Commission presented the final version of REPowerEU plan in the social media. The comments under the respective post included questions about the prospects of nuclear energy in the EU and reasons why the Commission does not say a lot about it in the REPowerEU plan. The answer of the EC is in line with the Timmermans' earlier comments on this issue:

> We didn't forget nuclear energy. It is up to the EU countries to decide if they want to use nuclear as long as it is combined with accelerating our clean energy transition. We will support them in the choices they make. We hope this clarifies! (EC 2022l)

The countries make, indeed, different choices. Though in the beginning of the Russian invasion the German economy minister and a member of the Greens Robert Habeck said that Germany thought about extending the life-span of its last nuclear power plants (Steitz, Alkousaa, and Sheahan 2022b), soon afterwards the minister stated that this measure would not help the country in "foreign policy situation" (Kurmayer 2022a). Currently, Germany still sticks to the closure of its three remaining nuclear facilities at the end of 2022 (Weise 2022). In July 2022, the Dutch Minister for Climate and Energy Policy Rob Jetten asked German Economy Minister Robert Habeck to delay a nuclear phase-out due to the unfolding energy crisis, admitting though that there are slim chances that Germany will change its opinion on this matter (Koc and Baazil 2022).

At the same time, Belgium reconsidered its nuclear power phase-out planned by 2025, due to the disruption of energy markets in Europe (Guillot 2022). When the conflict between Russia and Ukraine was still escalating, on February 10 2022, the French president Emmanuel Macron announced construction of new six reactors by 2050 – in addition to 56 reactors that it has – and launching a study regarding the construction of eight more with total estimated costs €50bn-€60bn (Gerretsen 2022). The UK that left the EU in 2020 has even more ambitious plans to boost nuclear energy in the country. As it is outlined in the British energy strategy, the UK aims to produce 25 % of its electricity from nuclear energy by 2050 in contrast to the current 15 % (The UK Government 2022). For that, the country would need to construct up to eight new reactors, including small modular ones. The plan was criticized for being not only too expensive but also for the state's ambitions that go too far to the future while the current energy crisis requires quick responses and less costly measures (The Economist 2022a).

Additional tension between the European countries in nuclear technologies is related to the EU Regulation on climate change mitigation (European Parliament and Council of the European Union 2020). After redrafting document for more than a year, in July 2022 the European Parliament voted to label investments both in natural gas and nuclear power as 'green' (European Parliament 2022). While some countries greeted inclusion of gas and nuclear into the EU Taxonomy, other EU MS believe it contradicts principles of sustainability (Simon 2022). For example, Austria that in 1999 adopted the Constitutional Law on a Nuclear-free

Austria (The Government of Austria 1999) together with Luxembourg plan to challenge the decision in court (Abnett 2022) The Regulation is part of the Commission action plan on financing sustainable growth (EC 2020b) that aims to increase EU-wide funding of low-carbon technologies.

Nevertheless, further development and expansion of nuclear technology in the EU has several obstacles. Being potentially a reliable source for clean electricity that decreases a country's use of Russian fossil fuels, nuclear energy also creates new international dependences. First, mining of uranium that is essential for nuclear technology is concentrated in five countries: Kazakhstan, Canada, Australia, Namibia, and Niger (Brutschin and Jewell 2018, 324). At the same time, Kazakhstan, Canada, Australia, Russia, and Niger have the biggest share of estimated uranium resources (ibid.). Second, uranium processing enrichment requires technologies that a limited number of countries possesses with only China, France, Russia, US and UK having the full nuclear fuel cycle capacity (Brutschin and Jewell 2018, 327). Russia is the biggest supplier of enriched uranium followed by the US and France (Brutschin and Jewell 2018, 329). Third, construction of nuclear power plants is concentrated in eight countries (Cherp et al. 2012, 346), among which the US and Russia dominate international technological nuclear cooperation (Jewell, Vetier, and Garcia-Cabrera 2019).

In the EU, Russian nuclear fuel is used in reactors in Bulgaria, Czech Republic, Finland, Hungary, Slovenia, Slovakia (Tirone, Pohjanpalo, and Starn 2022). Moreover, nuclear power plants in Bulgaria, Czech Republic, Hungary and Slovakia are serviced through the Russian GazpromBank owned company (Vetier 2022). As of beginning of June 2022, Russia was also behind two nuclear projects in Slovakia and Hungary (Vetier 2022). Consequently, Russia's invasion of Ukraine and the sanctions imposed on Russia in response to it intensified energy security concerns for the countries dependent on Russia's nuclear technology and nuclear fuel.

Though replacing service companies and alternative suppliers of nuclear fuel could decrease reliance of some EU MS on Russia, this is not a trivial task. As Russian-built nuclear power plants designed to be run on Russian fuel, it takes a long time to license non-Russian sources and receive 'tailor-made' nuclear fuel for such plants. According to the deputy director general for energy at Finland's Economy Ministry Liisa Heikinheimo, replacing of Russian nuclear fuel will require three to four years (Tirone, Pohjanpalo, and Starn 2022). For old reactors, the costs of switching to non-Russian fuel might be too high.

However, countries seek for alternatives. Poland, trying to transform its energy sector reliant on coal and gas and reach climate targets, cooperates with the US on the development of the national nuclear program and plans to build six nuclear units by 2043 (World Nuclear News 2021). In April 2022, Czechia declined bidding of Russia's TVEL and signed a long-term contract with the US and France for the supply of nuclear fuel assemblies to the Temelín nuclear power plant (World Nuclear News 2022). In May 2022, Finland ditched the Russian-backed construction of the Hanhikivi 1 nuclear power plant, approved in 2014 (Kauranen 2022).

Considering all stated above, the dependence of the EU on Russia is not limited to fossil fuels. Despite the great potential to contribute to achieving a net-zero target and solving (at least partly) some of the energy security issues, the future of nuclear power in the EU remains uncertain. The lack of unity on this technology will limit the investments on the EU scale, leaving the final decision up to the MS. Yet, for many, the costs, the time required to complete nuclear projects, nuclear safety concerns, limited nuclear fuel suppliers and a handful of manufacturing companies decrease the attractiveness and competitiveness of nuclear energy.

4.4.4 Accelerating deployment of renewables and 'green' fuels

In the REPowerEU Plan the Commission set more ambitious targets concerning development of renewables and 'green' fuels (e.g., bio-methane and hydrogen) in comparison to the earlier proposals outlined in the 'Fit for 55' package (Table 12). By 2030, a share of renewables[5] in the EU energy mix envisioned to reach 45%, bio-methane production to be equal to 35 bcm, and use of green hydrogen should achieve 20 mt (EC 2022i, 7), which would correspond to about 6.5% of EU's total energy supply[6].

In 2020, a share of energy from renewable sources accounted for a bit more than 22 % (Table 16). The Commission's target for 2030 means that between 2020 and 2030 renewables' share should increase by ca 23 %. At the same time, between 2011 and 2020, renewables' share in gross final energy consumption grew from 14.5 % to 22.1 %, which is equal to 7.6 % difference. This means that in 2020-2030 renewables should grow about 3 times faster than in the previous decade.

Table 16. Share of energy from renewable sources, 2011-2020 (% of gross final energy consumption).
Source: Eurostat 2022g.

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
14.5	16	16.7	17.4	17.8	18	18.4	19.1	19.9	22.1

[5] Renewable energy sources in the EU energy statistics include non-combustible renewables (hydropower, tide, wave, ocean energy, geothermal energy, wind energy, solar energy, ambient heat (heat pumps)) and combustible renewables (biofuels (i.e. fuels from biomass, including solid biofuels, biogas and liquid biofuels) and renewable municipal waste) (Eurostat 2022d).

[6] In the envisioned target, 10 mt of hydrogen are produced in the EU and 10 mt are imported from other countries (EC 2022i, 7). To calculate the share of hydrogen in the EU energy consumption, the following steps were taken. Energy content of hydrogen is 120Mj/kg. The EU plans to use 20 mt of hydrogen, which is equal to 2×10^{10} kg. A total energy content of hydrogen is therefore 2.4×10^{12} Mj (i.e., 120 Mj/kg × (2×10^{10} kg)). Energy consumption of the EU as of 2020 amounted to 37 086 Pj (Eurostat 2022b). A share of hydrogen in the EU energy consumption by 2030 is calculated as ((2.4×10^{12} Mj) ÷ 37 086 Pj) × 100 which corresponds to about 6.5 %.

The Solar Strategy that accompanies the REPowerEU Plan envisions that to reach the 2030 renewables' target, the EU needs to install on the average 45 GW of solar PV per year (EC 2022e, 2). At the same time, in 2020 the EU added approximately 18 GW of solar capacity (ibid.). This means that the EU would need to significantly accelerate and install solar PV 2.5 times faster. The document, accompanying the Plan "Implementing the REPowerEU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets", also presumes doubling of installed wind power capacity, from 236 GW in 2021 to 510 GW in 2030 (EC 2022c, 16). In order to reach this target, the EU would need to add ca 30 GW of wind capacity per year in 2022-2030. In comparison, in 2021 the EU27 installed 11 GW of new wind capacity (WindEurope 2022). The 2030 target requires therefore to deploy wind capacity 2-3 times faster than it happened in 2021.

Compared to the 'Fit for 55' package, the REPowerEU Plan also doubles the previous EU renewable hydrogen target to 10 mt of annual domestic production and envisions 10 mt of renewable hydrogen imports by 2030 (EC 2022i, 7). To produce such amounts, an installed electrolyser capacity of ca 100 GW_{LHV} is required (EC 2022k). In contrast, the European Hydrogen Strategy, published in 2020, envisioned 40 GW of renewable hydrogen electrolysers by 2030 (EC 2020a). This is therefore even more ambitious in comparison to the EU renewable target due to the current state of hydrogen development in the EU. According to Odenweller et al. (2022), within a decade or two electrolysis capacity is unlikely to significantly grow and until 2030 green hydrogen would supply less than 1% of final energy in the EU (which is much less than 6.5% targeted). Moreover, a large-scale deployment of green hydrogen requires significant investments and clearer regulation mechanisms to compete with fossil fuels (Szabo 2020). The Commission recognizes existing bottlenecks in boosting hydrogen (e.g., production capacity and lack of dedicated transport infrastructure) and suggests that renewable hydrogen may contribute to fossil fuel phase-out only after 2027 (EC 2022c, 11).

To reduce Russian natural gas imports, bio-methane production should be more than doubled in comparison to target in the 'Fit for 55' package and reach 35 bcm by 2030 (EC 2022i, 8). To boost bio-methane production, the Commission outlines several measures. For example, it suggests to upgrade and expand existing infrastructure to transport bio-methane through the EU gas grid, to promote biogases in the EU, to increase research on biogases, and to potentially include bio-methane production targets in the National Energy and Climate Plans (NECPs) (EC 2022c, 34–46). At the same time, the Commission emphasizes that bio-methane should be produced exclusively from organic waste and forest and agricultural residues (EC 2022i, 8).

Deployment of renewables in the EU faces multiple challenges. For example, the European Environmental Bureau (EEB 2022b) considers a lack of robust spatial planning and skilled professionals, bureaucratic hurdles, supply chain bottlenecks, subsidies for fossil heating, and grid constraints among the barriers for renewables in the Union. The Commission in turn names "slow and complex permitting process" as a key constraint for renewables' expansion (EC 2022i, 11). To overcome this obstacle, the Commission proposes to reduce the duration and complexity of administrative procedures related to renewables' installations, increase amount of employees responsible for permit-granting and environmental assessments and improve their skills, and ease grid connection permits through digitalization (EC 2022b). As a measure to boost solar power, the EC suggests to limit permitting for rooftop solar installations to three months (EC 2022e, 3). Among MS, the German government has already taken some measures to accelerate the expansion of renewables. For example, the German Easter package proposed to ease permitting procedures and to consider deployment of renewables as 'overriding public interests' in order to triple the expansion of onshore and off-shore renewables' additions (The Federal Ministry for Economic Affairs and Climate Action 2022). Yet, this measure was criticized both by a local Green party in Germany (see e.g. WELT 2022a) as well as by the

EEB due to possible negative impacts of the eased permitting procedures on the environment (EEB 2022a).

Remarkably, most media attention from February to July 2022 was to the measures which are either neutral or negative with respect to low-carbon transitions. Considering that media can potentially promote adoption of renewable technologies and shape public attitude towards them, it does not seem likely that current media coverage can accelerate expansion of renewables in the EU.

4.4.5 Energy-saving measures and increase in energy efficiency

Having an ambitious target to move away from Russian energy well before 2030 and to reduce Russian gas imports by two-thirds by the end of 2022, the Commission sets binding energy reduction target at 13% – 4% higher compared to the 'Fit for 55' package (EC 2022i, 3). To reach this goal, the EC proposes demand-side energy savings and measures to increase energy efficiency. Energy savings, being technically easy, are seen in the REPowerEU Plan as "the quickest and cheapest way to address the current energy crisis" (EC 2022i, 3). Moreover, lower energy use potentially could simultaneously reduce households' expenditures on energy and mitigate climate change. Already in March 2022, the IEA released two 10-point plans aimed at cutting oil and gas use in the EU (IEA 2022a; 2022b). Later, in April, the IEA and the EC presented a joint proposal "Playing my part: How to save money, reduce reliance on Russian energy, support Ukraine and help the planet" (IEA 2022g), outlining demand-side behavioural measures for European citizens to reduce energy use. Table 17 presents measures considered by the Commission in the documents accompanying the REPowerEU Plan.

Table 17. Energy-saving measures to reduce oil and gas demand in the EU. Source: EC 2022c; 2022d.

Measure	Comment
Saving oil	
Reduce speed limits on highways by at least 10 km/h Work from home up to 3 days Car-free Sundays in cities A shift to public transport, cycling, walking Alternate car access to roads in cities Increase car sharing and reduce fuel use Promote efficient driving for trucks Use existing HSR and night trains Reduce business flights EVs and more efficient vehicles (EC 2022c; 2022d)	Potentially saves 850 kb/d
Saving gas	
Adjusting the thermostat (reducing heating by 1 °C) (EC 2022c; 2022d)	Potentially saves 10 bcm of natural gas per year

Increase in energy efficiency is envisioned to be reached through reduced VAT rates for high-efficient heating systems, better insulation in buildings, replacement of oil and gas boilers with heat pumps, and use of more efficient appliances (EC 2022i, 3). Particularly, the Commission proposes to double the current speed of heat pumps' deployment in the EU to reach 10 million units by 2027 (ibid., 6).

Other institutions and organizations (see, e.g. ZOE Institute 2022; Holz et al. 2022; WWF 2022) have also released their proposals with the aim of stimulating energy demand reduction. In some Member States, national governments have already taken steps – or announced plans to do so soon – to decrease energy consumption. For example, in Munich water in the public pools is less heated and authorities in Hamburg consider to limit warm water supply (Wilkes, Delfs, and Dezem 2022). Government of the Netherlands (2022) advised to insulate homes, turn down heating by 1ºC, and choose energy-saving appliances. Italian officials mandated in May to lower use of air conditioning in public buildings (Jucca 2022). However, the overall media coverage of demand-side energy savings was low (Table 13).

Due to the uncertainty about further natural gas supply via NSP, in July 2022, the Commission presented its new plan "Save Gas for a Safe Winter" (EC 2022f), proposing Member States to voluntarily reduce gas use by 15% until spring 2023, which in case of imbalance between gas supply and demand may become a binding reduction target. Prior to curtailments, the EC recommends MS to try all other available options, e.g., fuel switching and turn to alternative energy sources, preferably, to renewables (EC 2022f, 4). At the same time, the Commission acknowledges that the use of coal and oil to replace gas is unavoidable in the short-term, and warns that these measures should not threat 'decarbonisation objectives' (EC 2022f, 14). However, possible shortages of coal and oil supply due to imposed sanctions on Russian imports should be considered by Member States when they make their choices (ibid., 13). MS are requested to update national emergency plans and identify selected measures by the end of September (ibid., 16). To date (27 July), there is no clarity how and whether European governments will follow the Commission's proposals. The reduction plan has already faced criticism from MS and industries (Financial Times 2022).

4.4.6 Providing support to vulnerable groups

Already the 'Fit for 55' package included support measures for vulnerable groups, affected by energy transition policies (e.g. by the extension of the Emission Trading System to road transport and buildings that would significantly increase fuel prices), through establishment of the Social Climate Fund (SCF) (EC 2021a, 4). The Fund would provide financial assistance to Member States which would use it "to support vulnerable low and middle-income households, transport users, and micro-enterprises affected by the impact of the extension of emission trading to building and transport" (ibid.). Additional mechanisms of support envisioned by the Commission include investments in renewables, renovations of buildings, clean cooling and heating, zero- and low-emission mobility (ibid.). Understanding that phasing out Russian fossil fuels will increase energy prices, the REPowerEU Plan stressed the significance of the SCF and called upon the European Parliament and the Council to adopt it (EC 2022i, 12).

In the meantime, Member States started to seek for solutions facing higher energy bills. For example, energy minister of Greece Kostas Skrekas said that recently the "financial and social burden has become unbearable" and prolonged subsidies to power bills of households and businesses in July 2022, even though the country has already spent almost 7 billion euros on support measures since September 2021 (Reuters 2022e). Before, in May 2022, Italy has approved a 14 billion-euro aid package to mitigate high energy prices for citizens and set 25% windfall tax on energy industry profits (Albanese 2022). Hungary's government introduced price caps on fuels, basic food and mortgages and suggested to impose windfall taxes on banks and parge private companies (Euractiv 2022b). The German government suggested a 16 billion-euro relief package to support energy bills of the population (Reuters 2022b), while the UK will extend imposed in 2019 price cap on energy bills beyond 2023 to mitigate soaring energy prices for households (Morison 2022). Spain and Portugal capped electricity prices in their local market, while other Member States believe that this measure will only exacerbate the situation (Baczynska, Abnett, and Melander 2022). On the EU level, In July 2022, the Commission proposed to rise the cap of state aid by 25% to 500.000 to the European companies affected by the imposed sanctions on Russia (Fonte and Strauss 2022). At the next EU summit in October 2022, the Commission plans to present its proposals and discuss options to stabilize European energy market (Baczynska, Abnett, and Melander 2022).

5 DISCUSSION

The REPowerEU Plan is focused on phasing-out Russian fossil fuels well before 2030 through diversification of energy supply, acceleration of renewable energy deployment and introduction of energy-saving measures. This section summarizes short- and longer-term effects of the Plan on the EU energy transitions and the related uncertainties.

Short-term effects (1-2 years)

Part of the EU strategy to cut Russian fossil fuels imports well before 2030 is finding alternative suppliers. As the Commission aims to reduce Russian gas imports by two-thirds already by the end of 2022 (EC 2022q), replacing Russian gas and reducing gas use in power generation is particularly important for the Union. Entering into new trade agreements, for example, with Azerbaijan for pipeline gas supply (von der Leyen 2022) or with the US for LNG imports (EC 2022s), is already taking place. While using the already-existing infrastructure for these new imports will have no impact on the energy transition, construction of the LNG facilities and increased LNG imports will, in the short-term, result in higher emissions due to shipping and regasification (EEB 2022a).

Energy prices hikes can have both positive and negative short-term effects on energy transitions. On the one hand, higher prices can reduce energy demand and trigger more energy-efficient practices as well as investment in non-fossil technologies. Energy savings led by the states, for example, reduction of air conditioning usage in public buildings in Italy (Jucca 2022) or potential limits on warm water supply in Hamburg (WELT 2022b) can contribute to reduced energy demand.

On the other hand, the planned state aid to vulnerable households may dampen energy saving efforts. Moreover, as the COVID-19 pandemic demonstrated, decline in electricity demand tends to go back to 'normal' once the situation stabilizes (IEA 2021). Furthermore, additional expenditures of governments and households on energy can limit their abilities to invest in energy transitions. A recent survey of McKinsey & Company revealed that rising prices significantly dominate over other concerns of European consumers (e.g., invasion of Ukraine, COVID-19 pandemic, or extreme weather events) in Germany, Italy, France, UK and Spain (McKinsey & Company 2022). However, this is not necessary a blessing: many energy-saving measures, e.g., turning down a thermostat by 1º C, remain poorly covered by the media (Table 13), probably due to their unpopularity among citizens. In addition, concerns over high prices may trigger populist and anti-transition energy policies.

Soaring gas prices have already influenced national politics undermining previous efforts to phase-out coal. Though increase in coal use in electricity generation was considered in the REPowerEU Plan (EC 2022c, 12), the real outcomes of the coal renaissance – even a temporary one – are to be assessed in the future. Due to the spare capacity and a large supply of domestic coal in some Member States (e.g., in Germany, Poland, and Czechia), conversion of gas facilities into coal ones as well as reopening or extending lifespan of the coal-fired power plants to generate electricity is not difficult in technical terms and was already announced by several states (see, e.g. Morris, Westfall, and Thebault 2022; Strobl 2022; Wilkes, Delfs, and Dezem 2022). Coal phase-out and therefore overall decarbonisation in the Union will be likely delayed – at least in the short-term. For example, the decision of Germany to extend lifespan of coal and oil power plants could increase carbon emissions by 20% in 2023 in its power sector (Peck 2022).

According to the Commission's plans, increase in coal use will be balanced with greater share of renewables in the overall energy mix. The REPowerEU Plan sets a more ambitious target for this in comparison to the 2021 'Fit for 55' package: In 2030, renewables should account for 45% in the EU energy mix, up from 40% target in the last year's proposal (EC 2022i, 6). Due to many obstacles that renewables face in the EU, for instance, bureaucratic hurdles, shortages of materials and technologies, lack of skilled workers (EEB 2022b), it is unlikely that speeding up of low-carbon technologies will occur in the short-term.

Although the IEA proposed to develop nuclear technologies as they could facilitate to phase out Russian gas and ensure low-carbon transitions (IEA 2022b; 2022f), in the short-term significant changes in nuclear power infrastructure or output are not expected. This is due to both social unacceptance of nuclear power in some European countries (e.g., in Germany and Austria) and the time needed to build new or re-start stopped reactors. Moreover, as the MS have not recently constructed new nuclear power facilities, even if motivation to develop nuclear energy appears, it could take from five to ten years to accelerate nuclear build out in Europe (Jewell 2022).

Longer-term (5-10 years)

In contrast to the use of existing infrastructure, building of the new LNG facilities or pipeline routes to replace Russian gas supply and roll-out of renewables cannot happen fast and therefore the effects of these measure are to be observed in horizon of 5-10 years.

Expanding of the LNG infrastructure (both across the EU and in other countries) as well as exploiting of the new gas fields (see, e.g., Reuters 2022d) will likely lead to a long-term carbon lock-in (Unruh 2000; Seto et al. 2016). At the same time, lack of attention towards nuclear and challenges that it faces in the EU enable to conclude that this low-carbon technology will unlikely be boosted even in the longer term. Though public opposition may be theoretically reversed, the speeds of construction of nuclear power plants will not possibly exceed historical speeds. Nuclear expansion reached the maximum speed between 1980 and 1985 in response to the 1970s oil crisis, which was equal to 2 % increase in total electricity supply per year (Suzuki 2022). Considering the current state of nuclear energy in the Union, achieving this again is problematic.

On the other hand, the REPowerEU Plan sets ambitious targets for renewables and hydrogen. For example, in order to reach 45 % of renewables in the EU energy mix by 2030, the share of renewables should be increased by ca 23 % in 2020-2030. In comparison, in 2011-2020, renewables' share in gross final energy consumption grew by 7.6 %. The EU 2030 target therefore presumes tripling of the speed of renewable energy expansion. The 2030 target for solar capacity means in turn that the EU would need to yearly install additional solar capacity 2.5 times faster compared to the speed of installation in 2021. The Commission also presumes doubling of wind power capacity by 2030, which would require to install new wind power capacity 2-3 times faster than in 2021. It should also be noted that the deployment of the renewables depends on many factors (e.g., land capital availability and public acceptance) that cannot be easily managed by the simple application of policies. For example, the Commission acknowledges that the access to critical raw materials, supply chain bottlenecks, and the EU's manufacturing capacities are the obstacles that need to be overcome to reach the targets of the REPowerEU Plan (EC 2022i, 9–10).

Hydrogen in contrast is an emerging technology with highly uncertain future where strong government support may trigger exponential growth. Reaching the EU 2030 target to produce 10 mt and import 10 mt of renewable hydrogen would require bridging the EU aspirations with significant efforts and far more ambitious actions from the Member States. According to Odenweller (Odenweller et al. 2022), feasibility of realisation of the EU's hydrogen plans is problematic due to electrolysis capacity that hardly will significantly grow within a decade or two.

At the same time, as Vinichenko, Cherp, and Jewell argue, emission reduction depends rather on the fossil fuel phase-out than on expansion of renewables and low-carbon sources (2021, 1478). While envisioning a higher share of renewables in the EU energy mix, the REPowerEU Plan does not raise the 2030 GHG emission reduction target. It is thus not inconceivable that increases in the use of renewables will not translate into equal decreases of fossil fuel use.

Related uncertainties

Discussing impacts of technologies on environmental change in GEO-6, UNEP notes that "in times of crisis, incentives strongly favour adoption of riskier options and elimination or minimization of safeguards" (UN Environment 2019, 24). The current crisis partly confirms this statement. The Commission's proposals have already faced criticism – both from the environmental organizations and energy experts. For example, WWF (2022), the Sierra Club (Cunningham 2022), and Ember (Brown 2022) oppose the Commission's plans to build new infrastructure for LNG and pipeline gas imports as it promotes further use of fossil fuels. Though LNG facilities could be theoretically used for green hydrogen, its pace of growth remains too slow to replace fossil fuels in the short-term (Odenweller et al. 2022). The EEB (2022) has also argued that easing the procedure of renewables' deployment due to the 'overriding public interest' undermines environmental legislation and creates dangerous precedents for other developments. Energy experts, in turn, criticized the REPowerEU Plan for disregarding nuclear power as a reliable and low-carbon energy (Mazzucchi 2022; Keating 2022) and expressed concerns about the feasibility of replacing natural gas supply from Russia with LNG imports as fast as the REPowerEU Plan envisaged it (Rystad Energy 2022).

The long-term impacts of the unfolding energy crisis are still to be observed. Yet, in mid-July IEA Executive Director Fatih Birol warned that "[t]he world has never witnessed such a major energy crisis in terms of its depth and its complexity" and "[w]e might not have seen the worst of it yet – this is affecting the entire world" (Stringer 2022). Regarding this, it cannot be excluded that coping with high energy prices and supply shortages will be of immediate importance for the Union. The Czech officials, whose EU presidency started in July and will last for the next six months, already stated that they will focus rather on securing energy supply for the EU than on decarbonisation (Bayer 2022). At the same time, underinvestment in renewable energy or renovation of energy insufficient buildings will clearly have long-term effects on the European energy system, resulting in a carbon lock-in.

Some authors (e.g., Grübler, Nakićenović, and Victor 1999) argue that decarbonisation is a continuous trend of historical energy transitions as every next fossil fuel has always been lighter in carbon per unit of energy released when combusted (e.g., oil compared to coal or gas compared to oil). At the same time, under existential threat to vital energy systems, for example, when facing massive disruption of natural gas supply, states can turn to the available energy source (e.g., to coal), even if it is more carbon-intensive. Decarbonisation is therefore not necessarily determined.

The examples of historical rapid transitions demonstrate that they were motivated by energy security concerns (e.g., fast-tracked nuclear deployment in response to the 1970s oil crisis) and not by the climate ones. Moreover, these examples are context-related and, therefore, cannot be adequetly compared to the 'regular' ones (Grübler, Wilson, and Nemet 2016, 22). In order to establish the same speed of technology diffusion as in the past rapid transitions, a combination of extreme demand environments, market factors, political efforts, and low sensitivity of a new technology to risks is required (ibid.).

Thus, it is a question whether (a) environmental goals could be as influential in accelerating transitions as the state concerns over security of fuel supply and (b) whether the current crisis created adequate conditions for large-scale deployment of low-carbon solutions. For example, Suzuki argues that climate change concerns increased from the 1990s have not fostered the growth of low-carbon electricity sources to the levels of nuclear power expansion in 1970-1985 in response to the 1970s oil crisis (Suzuki 2022). During the current crisis, both the Commission and the Member States suggest to partly substitute Russian natural gas with coal, which is against decarbonisation trend of the previous years. This means that energy insecurity still has a greater impact on political actions than environmental concerns.

6 CONCLUSION

Russia's invasion of Ukraine on 24 February 2022 triggered an energy security crisis by causing significant price hikes and supply shortages and demonstrated vulnerabilities of the fossil-based economy. For Europe, that is on the one hand heavily dependent on Russian fossil fuels, and on the other hand plans to significantly reduce emissions, the current crisis created a uniquely complex challenge when both energy insecurity and climate change have to be simultaneously tackled in an energy transition.

This thesis analyses the effects of the unfolding crisis on speed and direction of energy transitions in the EU and establishes to what extent energy transitions can be accelerated by crises. By doing so, it contributes to the scholarly debate on feasible speeds of transitions and the opportunities for their political acceleration.

The study uses a meta-theoretical framework to conceptualize national energy transitions and demonstrate that they depend on many interrelated and interlocked factors in economic, technological, and political spheres. A defining feature of the present EU energy transition is that state interests – one of the top-level variables in the political perspective – are primarily focused on securing energy supply from geopolitically reliable sources.

To achieve its aims, the thesis provides a comprehensive analysis of the European energy context, EU energy transition policies of the recent years, and media coverage of the EU policy responses to the current crisis. It also outlines the impacts of past gas crises on the European energy strategies. Through using a variety of sources (official documents, statistical data, media publications) and methods (data, policy, and content analyses), this thesis demonstrates how the current crisis affects energy security in the EU and therefore shapes policy responses which in turn have an impact on energy transitions.

Analysis of the energy trade flows shows that Europe is heavily reliant on Russian oil and natural gas which supply EU's two vital energy systems. After the invasion of Ukraine, Russia could not be considered as a trustworthy partner. In addition, reduction of fossil fuel imports from Russia also aims to hinder the invasion since the Russian state budget heavily depends on revenues from the energy trade with the EU. The European Commission's proposals, incorporated in the REPowerEU Plan, aim to eliminate Russia's control over the EU vital energy systems. The Plan envisages Russian fossil fuel phase-out through diversification of energy imports, acceleration of renewable energy deployment and energy savings. While the Commission suggests that overall dependency on Russian fossil fuels could be ended well before 2030, it also envisions that demand for Russian gas can be reduced by two-thirds already by the end of 2022.

In comparison to the earlier Commission's proposals for energy transitions in the 'Fit for 55' package, the REPowerEU Plan aims to address both climate change and energy security concerns. As a result, several of the earlier targets are updated. Renewables' share in the EU energy mix should reach 45% (instead of 40% set in the 'Fit for 55' package), hydrogen production – 10 mt (instead of 5.6 mt), bio-methane production – 35 bcm (instead of 17 bcm), and energy use should be reduced by 13% (instead of 9%). In addition, the REPowerEU Plan and accompanying it documents contain demand-side measures (e.g., shifting to EVs and lower heating temperatures) to reduce oil and gas consumption. Developed in the highly securitized environment, not all of the Commission's proposals are climate-aligned. For example, re-starting coal power plants and expanding LNG facilities increase emissions, delay fossil fuel phase-out, and therefore put at risk EU decarbonisation targets. Remarkably, however, the Commission does not attempt to foster nuclear technologies which may signal that they remain unacceptable even in this environment.

As media can promote or hinder new technologies or policies by influencing public attitudes and concerns, it is important to know which energy topics media covers and how. My analysis of the media coverage of the EU's responses to the crisis shows that most media attention from February to July 2022 was to the measures which are either neutral or negative with respect to low-carbon transitions. For example, seeking alternative suppliers for Russian gas (including LNG shipments) and sanctions were the most covered topics, accounting for more than 20% of 352 collected publication items.

To understand the eventual effects of the current proposals, I also take a look into historical analogies. The immediate responses of the EU are in general in line with previous mitigation strategies used by the Union to tackle past energy security crises. For example, during the massive gas disruption in 2009, fuel-switching took place in many Member States, and building of the new infrastructure to diversify gas supply accelerated both after the 2009 and 2014 crises. At the same time, unlike earlier crises that were also triggered by Russia-Ukraine conflicts, in 2022 the EU took leadership in hindering Russia's invasion and to do so imposed ban on Russian coal, crude oil and petroleum products imports. Yet, this crisis is different in several aspects. Most importantly, the current strategy sets a very ambitious aim to replace the entire Russian supply in a medium-term and has to operate in a complicated environment of sanctioned energy trade flows and high energy prices fuelling public concerns.

The effects of some of the proposed measures are already witnessed (e.g., trade agreements with new partners), whereas effects of some other (e.g., hydrogen production) are yet to materialize. All in all, my analysis demonstrates that in the short-term (1-2 years) acceleration of energy transitions in the EU is not likely. First, this is because the deployment of renewables faces several obstacles that cannot be eliminated fast. Second, reduced energy and electricity consumption due to high prices will rebound once the situation stabilizes or if households and businesses across EU receive state aid (which already happens). Moreover, a turn to coal for electricity generation, announced by several Member States, will increase emissions and thus backpedal decarbonisation efforts.

In the longer term (5-10 years), if the EU implements all the announced projects concerning new natural gas and LNG infrastructure, it will likely lock in fossil fuel use in the Union. Higher emission rates are expected from LNG construction and operation in comparison to usage of natural gas delivered via existing pipeline routes. The proposed policies aim to speed up the expansion of renewables to unprecedented levels, presuming threefold acceleration of the renewables' deployment in 2022-2030. Such speeds may or may not be realistic because there are too many factors that can constrain the development of renewables in Europe (e.g., land availability, public and local authorities' acceptance, manufacturing and material constraints, technological challenges of load balancing) which cannot be easily affected by government policies. Nuclear energy, on the other hand, despite IEA proposals, is not a priority in the EU whereas to be ramped up it needs significant state and public support.

At the same time, several uncertainties should be considered when anticipating EU energy transitions. The first one is that national energy transitions are complex events that depend on interaction between economic, technological, and political spheres. Currently, in light of potential disruption of natural gas supply to the EU, sanctions restricting energy trade, and high energy prices, ensuring energy supply and therefore smooth functioning of the vital energy systems is prioritized in the Union. Indeed, proposals aimed at diversification of energy supply are translated into action (e.g., a recent agreement between the EU and Azerbaijan for pipeline gas imports or the one between the US and the EU for LNG deliveries) and switching from natural gas to coal to generate electricity in case of insufficient gas supply was announced. Though this is overall in line with the EU's responses to the past security crises, the situation still rapidly evolves. It should not be therefore excluded that the application of 'emergency-like policy measures', for example, to green hydrogen production may result in considerable acceleration of energy transitions.

While this thesis provides insights about the vulnerabilities of the EU's energy system, the EU's responses and their potential efficiency, its findings should be treated with caution because the crisis, triggered by Russia's invasion of Ukraine, is still unfolding and its long-term implications remain uncertain. I show that energy security crises can indeed trigger a wide-ranged and ambitious political response, especially in jurisdictions where energy transitions were already important priorities before the crises. Some, but not all of these responses clearly intend to significantly accelerate energy transitions, whereas others may lock in fossil fuels. It is simply too early to tell which factors will prevail. In addition to the 'snapshot' of insights from this thesis, the database of publications and policies which I created can become a starting point for the future research on the medium- and long-term effects 2022 energy security crisis. These studies should be able to not only inform transition policies in Europe and beyond but also answer a fundamental question of whether it is in our power to make transitions significantly faster.

BIBLIOGRAPHY

Abnett, Kate. 2022. 'EU Parliament Backs Labelling Gas and Nuclear Investments as Green'. Reuters, 6 July 2022, sec. Sustainable Business. URL: https://www.reuters.com/business/sustainable-business/eu-parliament-vote-green-gas-nuclear-rules-2022-07-06/.

Abnett, Kate, and Alex Lawler. 2022. 'OPEC Tells EU It's Not Possible to Replace Potential Russian Oil Supply Loss'. Reuters, 11 April 2022, sec. Energy. URL: https://www.reuters.com/business/energy/eu-meets-opec-amid-calls-oil-output-increase-2022-04-11/.

Abnett, Kate, Jan Strupczewski, and Ingrid Melander. 2022. 'EU Agrees Russia Oil Embargo, Gives Hungary Exemptions; Zelenskiy Vows More Sanctions'. Reuters, 31 May 2022, sec. Europe. URL: https://www.reuters.com/world/europe/best-we-could-get-eu-bows-hungarian-demands-agree-russian-oil-ban-2022-05-31/.

Aizhu, Chen. 2022. 'China May Oil Imports from Russia Soar to a Record, Surpass Top Supplier Saudi'. Reuters, 6 July 2022, sec. Commodities. URL: https://www.reuters.com/markets/commodities/chinas-may-oil-imports-russia-soar-55-record-surpass-saudi-supply-2022-06-20/.

Albanese, Chiara. 2022. 'Italy Passes $15 Billion Aid Package Focused on Energy Relief', 2 May 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-05-02/italy-passes-15-billion-aid-package-focused-on-energy-relief.

Bachmann, Rüdiger, David Baqaee, Christian Bayer, Moritz Kuhn, Andreas Löschel, Benjamin Moll, Andreas Peichl, Karen Pittel, and Moritz Schularick. 2022. 'What If? The Economic Effects for Germany of a Stop of Energy Imports from Russia', EconPol Policy Report 36. URL: https://www.cesifo.org/en/publikationen/2022/working-paper/what-if-economic-effects-germany-stop-energy-imports-russia

Baczynska, Gabriela, Kate Abnett, and Ingrid Melander. 2022. 'EU Plans for Life without Russian Gas amid Inflation Spike'. Reuters, 24 June 2022, sec. Europe. URL: https://www.reuters.com/world/europe/eu-leaders-debate-economy-woes-russia-squeezes-gas-supplies-2022-06-24/.

Bayer, Lili. 2022. 'Czech Republic Braces for Rocky EU Presidency amid Ukraine War, High Inflation'. POLITICO. 23 June 2022. URL: https://www.politico.eu/article/czech-presidency-council-of-the-eu-ukraine-inflation-energy/.

Bento, Nuno. 2013. 'New Evidence in Technology Scaling Dynamics and the Role of the Formative Phase'. IIASA Interim Report. IIASA, Laxenburg, Austria: IR-13-004.

Bento, Nuno, and Charlie Wilson. 2016. 'Measuring the Duration of Formative Phases for Energy Technologies'. Environmental Innovation and Societal Transitions 21 (January): 95–112. https://doi.org/10.1016/j.eist.2016.04.004.

Birol, Fatih. 2018. 'Energy Is at the Heart of the Sustainable Development Agenda to 2030'.

IEA. 2018. URL: https://www.iea.org/commentaries/energy-is-at-the-heart-of-the-sustainable-development-agenda-to-2030.

Bloomberg. 2022. 'China Buys Cheap Russian Coal as World Shuns Moscow (Correct)', 20 April 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-04-20/china-buys-cheap-coking-coal-from-russia-as-world-shuns-moscow.

Boulianne, Shelley. 2020. 'Twenty Years of Digital Media Effects on Civic and Political Participation'. Communication Research 47 (7): 947–66. https://doi.org/10.1177/0093650218808186.

Brown, Sarah. 2022. 'EU Can Stop Russian Gas Imports by 2025'. Ember. 23 March 2022. URL: https://ember-climate.org/insights/research/eu-can-stop-russian-gas-imports-by-2025/.

Brunner, Karl-Michael, Markus Spitzer, and Anja Christanell. 2012. 'Experiencing Fuel Poverty. Coping Strategies of Low-Income Households in Vienna/Austria'. Energy Policy, Special Section: Fuel Poverty Comes of Age: Commemorating 21 Years of Research and Policy, 49 (October): 53–59. https://doi.org/10.1016/j.enpol.2011.11.076.

Brutschin, Elina, Aleh Cherp, and Jessica Jewell. 2021. 'Failing the Formative Phase: The Global Diffusion of Nuclear Power Is Limited by National Markets'. Energy Research & Social Science 80: 102221. https://doi.org/10.1016/j.erss.2021.102221.

Brutschin, Elina, and Jessica Jewell. 2018. 'International Political Economy of Nuclear Energy'. In Handbook of the International Political Economy of Energy and Natural Resources, by Andreas Goldthau, Michael Keating, and Caroline Kuzemko, 322–41. Edward Elgar Publishing. https://doi.org/10.4337/9781783475636.00033.

Carley, Sanya, Elizabeth Baldwin, Lauren M. MacLean, and Jennifer N. Brass. 2017. 'Global Expansion of Renewable Energy Generation: An Analysis of Policy Instruments'. Environmental and Resource Economics 68 (2): 397–440. https://doi.org/10.1007/s10640-016-0025-3.

Castells, Manuel. 2004. The Network Society: A Cross-Cultural Perspective. Cheltenham: E. Elgar.

Chapa, Sergio. 2022. 'Freeport LNG Blast Created 450-Feet-High Fireball, Report Shows', 12 July 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-07-12/freeport-lng-blast-created-450-feet-high-fireball-report-shows.

Cherp, Aleh, Adeola Adenikinju, Andreas Goldthau, Francisco Hernandez, Larry Hughes, Jessica Jewell, Marina Olshanskaya, Jaap Jansen, Ricardo Soares, and Sergey Vakulenko. 2012. 'Energy and Security'. In Global Energy Assessment: Toward a Sustainable Future, edited by Thomas B. Johansson, Nebosja Nakicenovic, and Anand Patwardan, 325–83. Cambridge University Press.

Cherp, Aleh, and Jessica Jewell. 2011. 'The Three Perspectives on Energy Security: Intellectual History, Disciplinary Roots and the Potential for Integration'. Current Opinion in Environmental Sustainability 3 (4): 202–12. https://doi.org/10.1016/j.cosust.2011.07.001.

———. 2014. ‘The Concept of Energy Security: Beyond the Four As’. Energy Policy 75 (December): 415–21. https://doi.org/10.1016/j.enpol.2014.09.005.

Cherp, Aleh, Jessica Jewell, and Andreas Goldthau. 2011. ‘Governing Global Energy: Systems, Transitions, Complexity: Governing Global Energy’. Global Policy 2 (1): 75–88. https://doi.org/10.1111/j.1758-5899.2010.00059.x.

Cherp, Aleh, Vadim Vinichenko, Jessica Jewell, Elina Brutschin, and Benjamin Sovacool. 2018. ‘Integrating Techno-Economic, Socio-Technical and Political Perspectives on National Energy Transitions: A Meta-Theoretical Framework’. Energy Research & Social Science 37 (March): 175–90. https://doi.org/10.1016/j.erss.2017.09.015.

Cherp, Aleh, Vadim Vinichenko, Jale Tosun, Joel A. Gordon, and Jessica Jewell. 2021. ‘National Growth Dynamics of Wind and Solar Power Compared to the Growth Required for Global Climate Targets’. Nature Energy 6 (7): 742–54. https://doi.org/10.1038/s41560-021-00863-0.

Chestney, Nina. 2022. ‘Factbox: How Can Europe Get Gas If Russia’s Supply Is Disrupted?’ Reuters, 11 May 2022, sec. Energy. URL: https://www.reuters.com/business/energy/how-can-europe-get-gas-if-russias-supply-is-disrupted-2022-05-11/.

Clifford, Catherine. 2022. ‘Why the EU Didn’t Include Nuclear Energy in Its Plan to Get off Russian Gas’. CNBC. 9 March 2022. URL: https://www.cnbc.com/2022/03/09/why-eu-didnt-include-nuclear-energy-in-plan-to-get-off-russian-gas.html.

Cox, J. Robert. 2010. Environmental Communication and the Public Sphere. 2nd ed. Thousand Oaks, Calif: Sage Publications.

Cunningham, Nick. 2022. ‘Biden’s LNG Plan for Europe: Ineffectual and a Climate Disaster’. Sierra Club. 12 April 2022. URL: https://www.sierraclub.org/sierra/biden-s-lng-plan-for-europe-ineffectual-and-climate-disaster.

Denzin, Norman K. 2017. ‘Strategies of Multiple Triangulation’. In The Research Act: A Theoretical Introduction to Sociological Methods, 1st ed. Routledge. https://doi.org/10.4324/9781315134543.

Directorate-General for Climate Action (EC), Directorate-General for Energy (EC), Directorate-General for Mobility and Transport (EC), A. De Vita, P. Capros, L. Paroussos, K. Fragkiadakis, et al. 2021. EU Reference Scenario 2020: Energy, Transport and GHG Emissions: Trends to 2050. LU: Publications Office of the European Union. https://data.europa.eu/doi/10.2833/35750.

Directorate-General for Energy (EC). 2014. ‘Quarterly Report on European Gas Markets’. 7, issue 4. Brussels, Belgium. https://circabc.europa.eu/ui/group/3ef9355f-1ffe-4c82-ba19-f60a3ed2f652/library/fbf064b1-46b6-4664-a71b-bbd902243ef0/details.

Directorate-General for Energy (EC). 2019. Impact of PCIs on Gas Security of Supply in Europe: Study S05. LU: Publications Office of the European Union. URL: https://data.europa.eu/doi/10.2833/491078.

Donahue, Patrick. 2022. ‘Germany Signals Opposition to Ban on Russian Energy Imports’.

Bloomberg.Com, 7 March 2022. URL: https://www.bloomberg.com/news/articles/2022-03-07/germany-signals-opposition-to-cutting-essential-russian-energy.

EC. 2009. Commission Staff Working Document - Accompanying Document to the Proposal for a Regulation of the European Parliament and of the Council Concerning Measures to Safeguard Security of Gas Supply and Repealing Directive 2004/67/EC - The January 2009 Gas Supply Disruption to the EU: An Assessment. SEC(2009) 977 Final. URL: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=celex%3A52009SC0977.

———. 2010. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Energy 2020 – A Strategy for Competitive, Sustainable and Secure Energy. COM(2010) 639 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52010DC0639.

———. 2014a. Commission Staff Working Document Report on the Findings of the South-East-European Focus Group Accompanying the Document Communication from the Commission to the European Parliament and the Council, on the Short Term Resilience of the European Gas System Preparedness for a Possible Disruption of Supplies from the East during the Fall and Winter of 2014/2015. SWD(2014) 326 Final. URL: https://ec.europa.eu/energy/sites/ener/files/documents/2014_energystresstests_southeasteuropeanfocusgroup.pdf.

———. 2014b. Communication from the Commission to the European Parliament and the Council European Energy Security Strategy. COM(2014) 330 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0330&from=DE

———. 2014c. 'Energy Security: Commission Puts Forward Comprehensive Strategy to Strengthen Security of Supply'. European Commission. URL: https://ec.europa.eu/commission/presscorner/detail/en/IP_14_606.

———. 2019. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions The European Green Deal. COM(2019) 640 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN.

———. 2020a. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A Hydrogen Strategy for a Climate-Neutral Europe. COM(2020) 301 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0301.

———. 2020b. 'Renewed Sustainable Finance Strategy and Implementation of the Action Plan on Financing Sustainable Growth'. European Commission. 2020. URL: https://ec.europa.eu/info/publications/sustainable-finance-renewed-strategy_en.

———. 2021a. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Fit for 55': Delivering the EU's 2030 Climate Target on the Way to Climate Neutrality. COM (2021) 550 Final. URL: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2021:550:FIN

———. 2021b. Proposal For a Directive of the European Parliament and of the Council on Energy Efficiency (Recast). COM/(2021) 558 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0558.

———. 2022a. 'A European Green Deal'. European Commission. URL: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

———. 2022b. Commission Staff Working Document Guidance to Member States on Good Practices to Speed up Permit-Granting Procedures for Renewable Energy Projects and on Facilitating Power Purchase Agreements Accompanying the Document Commission Recommendation on Speeding up Permit-Granting Procedures for Renewable Energy Projects and Facilitating Power Purchase Agreements. SWD(2022) 149 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022SC0149&qid=1658485186254.

———. 2022c. Commission Staff Working Document Implementing the Repower EU Action Plan: Investment Needs, Hydrogen Accelerator and Achieving the Bio-Methane Targets Accompanying the Document Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions REPowerEU Plan. SWD(2022) 230 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=SWD%3A2022%3A230%3AFIN.

———. 2022d. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU 'Save Energy'. COM(2022) 240 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A240%3AFIN&qid=1653033053936.

———. 2022e. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU Solar Energy Strategy. COM(2022) 221 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A221%3AFIN&qid=1653034500503.

———. 2022f. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Save Gas for a Safe Winter'. COM(2022) 360 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0360&qid=1658479881117.

———. 2022g. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Short-Term Energy Market Interventions and Long-Term Improvements to the Electricity Market Design – a Course for Action. COM(2022) 236 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A236%3AFIN&qid=1653032581730.

———. 2022h. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions REPowerEU: Joint European Action for More Affordable, Secure and Sustainable Energy. COM(2022) 108 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A108%3AFIN.

———. 2022i. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions REPowerEU Plan. COM(2022) 230 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483.

———. 2022j. 'Delivering the European Green Deal'. European Commission. URL: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en.

———. 2022k. 'Electrolyser Summit Joint Declaration'. DocsRoom - European Commission. 2022. URL: https://ec.europa.eu/docsroom/documents/50014.

———. 2022l. 'European Commission EU in Instagram: «👏 🚗 🔜 🚲 Taking simple steps can help you reduce your energy use and save money according to the @internationalenergyagency "Playing my…»'. Instagram (blog). 2022. URL: https://www.instagram.com/reel/Cd5Elw_AYJQ/.

———. 2022m. 'In Focus: Reducing the EU's Dependence on Imported Fossil Fuels'. European Commission. 2022. URL: https://ec.europa.eu/info/news/focus-reducing-eus-dependence-imported-fossil-fuels-2022-apr-20_en.

———. 2022n. Joint Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU External Energy Engagement in a Changing World. JOIN(2022) 23 Final. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=JOIN%3A2022%3A23%3AFIN&qid=1653033264976.

———. 2022o. 'Key Documents: REPowerEU'. European Commission. 2022. URL: https://ec.europa.eu/info/publications/key-documents-repowereu_en.

———. 2022p. 'REPowerEU: A Plan to Rapidly Reduce Dependence on Russian Fossil Fuels and Fast Forward the Green Transition'. European Commission. 2022. URL: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3131.

———. 2022q. 'REPowerEU: Joint European Action for More Affordable, Secure and Sustainable Energy'. European Commission. 2022. URL: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511.

———. 2022r. 'Sanctions Adopted Following Russia's Military Aggression against Ukraine'. Text. European Commission. 2022. URL: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/international-relations/restrictive-measures-sanctions/sanctions-adopted-following-russias-military-aggression-against-ukraine_en.

———. 2022s. 'Statement between the Commission and the US on Energy'. European Commission. 2022. URL: https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_22_2041.

EEA, Christian Nissen, Frank Meinke-Hubeny, Lukas Emele, Mihai Tomescu, Anjana Das, and Ils Moorkens. 2018. Renewable Energy in Europe 2018: Recent Growth and Knock on Effects. LU: Publications Office of the European Union. https://data.europa.eu/doi/10.2800/03040.

EEB. 2022a. 'REPowerEU Paves the Way for Renewables but Also Undermines Environmental Legislation'. European Environmental Bureau. 2022. URL: https://eeb.org/repowereu-paves-the-way-for-renewables-but-also-undermines-environmental-legislation/.

———. 2022b. 'The Top Ten Problems for Renewable Energy in Europe Are Not Linked with Nature Protection'. 2022. URL: https://eeb.org/library/the-top-ten-problems-for-renewable-energy-in-europe-are-not-linked-with-nature-protection/.

ENSREG. 2022. 'Nuclear Energy in the EU'. 2022. URL: https://www.ensreg.eu/members-glance/nuclear-eu.

Euractiv. 2021. 'Energy Poverty. Special Report.' URL: https://eurac.tv/9UON.

———. 2022a. 'Bulgaria and Greece Plan Joint Gas Deliveries for Southeast Europe'. Euractiv. 6 May 2022. URL: https://www.euractiv.com/section/energy/news/bulgaria-and-greece-plan-joint-gas-deliveries-for-southeast-europe/.

———. 2022b. 'Hungary's Orban Turns Again to Windfall Taxes on Banks, Companies to Plug Budget'. Euractiv. 25 May 2022. URL: https://www.euractiv.com/section/politics/news/hungarys-orban-turns-again-to-windfall-taxes-on-banks-companies-to-plug-budget/.

———. 2022c. 'G7 Pledges to Phase out Coal Power but without Fixing Date'. Euractiv. 27 May 2022. URL: https://www.euractiv.com/section/energy/news/g7-pledges-to-phase-out-coal-power-but-without-fixing-date/.

European Parliament. 2022. 'Taxonomy: MEPs Do Not Object to Inclusion of Gas and Nuclear Activities'. 6 July 2022. URL: https://www.europarl.europa.eu/news/en/press-room/20220701IPR34365/taxonomy-meps-do-not-object-to-inclusion-of-gas-and-nuclear-activities.

European Parliament, and Council of the European Union. 2020. Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the Establishment of a Framework to Facilitate Sustainable Investment, and Amending Regulation (EU) 2019/2088 (Text with EEA Relevance). OJ L. Vol. 198. URL: http://data.europa.eu/eli/reg/2020/852/oj/eng.

Eurostat. 2022a. 'Coal Production and Consumption Statistics'. 2022. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Coal_production_and_consumption_statistics.

———. 2022b. 'Energy Statistics - an Overview'. Eurostat. 2022. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_statistics_-_an_overview.

———. 2022c. 'EU Energy Mix and Import Dependency'. Eurostat. 2022. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_energy_mix_and_import_dependency.

———. 2022d. ‘Glossary: Renewable Energy Sources’. Eurostat. 2022. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Renewable_energy_sources.

———. 2022e. ‘Nuclear Energy Statistics’. 2022. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Nuclear_energy_statistics.

———. 2022f. ‘Oil and Petroleum Products - a Statistical Overview’. 2022. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Oil_and_petroleum_products_-_a_statistical_overview.

———. 2022g. ‘Renewable Energy Statistics’. Eurostat. 2022. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics.

———. 2022h. ‘Shedding Light on Energy in the EU: From Where Do We Import Energy ?’ Shedding Light on Energy in the EU. 2022. URL: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2c.html.

Eurostat, Eurostat. 2022i. ‘Energy Trade Flows’. Energy Trade. 2022. URL: https://ec.europa.eu/eurostat/cache/infographs/energy_trade/entrade.html.

FAZ. 2022. ‘Green light for coal as a gas replacement (In German 'Bundestagsbeschluss: Grünes Licht für Kohle als Gas-Ersatz')’, 2022, Die Frankfurter Allgemeine Zeitung edition. URL: https://www.faz.net/aktuell/wirtschaft/klima-nachhaltigkeit/kohlekraftwerke-bundestag-gibt-gruenes-licht-fuer-gas-ersatz-18157912.html.

Follain, John. 2022. ‘Why Putin’s Demand for Rubles Has Europe Scrambling’. Bloomberg, 29 April 2022. URL: https://www.bloomberg.com/news/articles/2022-04-29/why-putin-s-demand-for-rubles-has-europe-scrambling-quicktake.

Fonte, Giuseppe, and Marine Strauss. 2022. ‘Sanctions-Hit Firms May Get 500,000 Euros State Aid under EU Plans’. Reuters, 11 July 2022, sec. Europe. URL: https://www.reuters.com/world/europe/sanctions-hit-firms-may-get-500000-euros-state-aid-under-eu-plans-2022-07-11/.

Fouquet, Roger. 2009. ‘A Brief History of Energy’. In International Handbook on the Economics of Energy, by Joanne Evans and Lester Hunt, 12764. Edward Elgar Publishing. https://doi.org/10.4337/9781849801997.00006.

———. 2010. ‘The Slow Search for Solutions: Lessons from Historical Energy Transitions by Sector and Service’. Energy Policy, Energy Efficiency Policies and Strategies with regular papers., 38 (11): 6586–96. https://doi.org/10.1016/j.enpol.2010.06.029.

———. 2016a. ‘Historical Energy Transitions: Speed, Prices and System Transformation’. Energy Research & Social Science 22 (December): 7–12. https://doi.org/10.1016/j.erss.2016.08.014.

———. 2016b. ‘Lessons from Energy History for Climate Policy: Technological Change, Demand and Economic Development’. Energy Research & Social Science 22 (December): 79–93. https://doi.org/10.1016/j.erss.2016.09.001.

Fouquet, Roger, and Peter J. G. Pearson. 2012. ‘Past and Prospective Energy Transitions: Insights from History’. Energy Policy, Special Section: Past and Prospective Energy Transitions - Insights from History, 50 (November): 1–7. https://doi.org/10.1016/j.enpol.2012.08.014.

GEA. 2012. ‘Transitions in Energy Systems’. In Global Energy Assessment (GEA), edited by Thomas B. Johansson, Anand Patwardhan, Nebojša Nakićenović, Luis Gomez-Echeverri, and International Institute for Applied Systems Analysis, 1174–1201. Cambridge : Laxenburg, Austria: Cambridge University Press ; International Institute for Applied Systems Analysis.

Geels, Frank W. 2002. ‘Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study’. Research Policy 31 (8–9): 1257–74. https://doi.org/10.1016/S0048-7333(02)00062-8.

Geels, Frank W., Benjamin K. Sovacool, Tim Schwanen, and Steve Sorrell. 2017. ‘Sociotechnical Transitions for Deep Decarbonisation’. Science 357 (6357): 1242–44. https://doi.org/10.1126/science.aao3760.

Gerretsen, Isabelle. 2022. ‘Macron Promises to Abandon Gas, Oil and Coal, but Will He Deliver?’ Climate Home News. 26 April 2022. URL: https://www.climatechangenews.com/2022/04/26/macron-promises-to-abandon-gas-oil-and-coal-but-will-he-deliver/.

Ghani, Norjihan Abdul, Suraya Hamid, Ibrahim Abaker Targio Hashem, and Ejaz Ahmed. 2019. ‘Social Media Big Data Analytics: A Survey’. Computers in Human Behavior 101 (December): 417–28. https://doi.org/10.1016/j.chb.2018.08.039.

Gil de Zúñiga, Homero, and Hsuan-Ting Chen. 2019. ‘Digital Media and Politics: Effects of the Great Information and Communication Divides’. Journal of Broadcasting & Electronic Media 63 (3): 365–73. https://doi.org/10.1080/08838151.2019.1662019.

Government of the Netherlands. 2022. ‘What Can Households and Businesses Do to Reduce Their Energy Use?’ Government.Nl. Ministerie van Algemene Zaken. 12 April 2022. URL: https://www.government.nl/topics/gas/what-can-households-and-businesses-do-to-reduce-their-energy-use.

Grübler, Arnulf. 2004. ‘Transitions in Energy Use’. Monograph. Encyclopedia of Energy. IIASA, Laxenburg, Austria: RP-04-005. Reprinted from Encyclopedia of Energy, 6:163-177 [2004]. 2004. URL: https://iiasa.dev.local/.

Grübler, Arnulf, Nebojša Nakićenović, and David G. Victor. 1999. ‘Dynamics of Energy Technologies and Global Change’. Energy Policy 27 (5): 247–80. https://doi.org/10.1016/s0301-4215(98)00067-6.

Grübler, Arnulf, and Charlie Wilson. 2013. Energy Technology Innovation: Learning from Historical Successes and Failures. Cambridge Core. Cambridge: Cambridge University Press. https://doi.org/10.1017/cbo9781139150880.

Grübler, Arnulf, Charlie Wilson, and Gregory Nemet. 2016. ‘Apples, Oranges, and Consistent Comparisons of the Temporal Dynamics of Energy Transitions’. Energy Research & Social Science 22 (December): 18–25. https://doi.org/10.1016/j.erss.2016.08.015.

Guarascio, Francesco. 2022. ‘EU’s Full Ban on Russian Coal to Be Pushed Back to Mid-August -Sources’, 7 April 2022, Reuters edition, sec. Energy. URL: https://www.reuters.com/business/energy/eus-full-ban-russian-coal-be-pushed-back-mid-august-source-2022-04-07/.

Guillot, Louise. 2022. ‘Belgium Delays Nuclear Phaseout amid War Worries’. POLITICO. 19 March 2022. URL: https://www.politico.eu/article/belgium-delays-nuclear-phase-out-amid-war-worries/.

Helm, Dieter. 2002. ‘Energy Policy: Security of Supply, Sustainability and Competition’. Energy Policy 30 (3): 173–84. https://doi.org/10.1016/s0301-4215(01)00141-0.

Hennicke, Peter, and Ashok Khosla. 2014. ‘Decoupling Economic Growth from Resource Consumption. A Transformation Strategy with Manifold Socio-Economic Benefits for India And Germany’. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Environmental Policy Programme Nov. 2014. URL: https://www.giz.de/de/downloads/giz2014-en-IGEG_2_decoupling-econimic-growth.pdf

Hirsh, Richard F., and Christopher F. Jones. 2014. ‘History’s Contributions to Energy Research and Policy’. Energy Research & Social Science 1 (March): 106–11. https://doi.org/10.1016/j.erss.2014.02.010.

Holz, Franziska, Robin Sogalla, Christian von Hirschhausen, and Claudia Kemfert. ‘Energy supply in Germany secured even without natural gas from Russia’ (In German ‘Energieversorgung in Deutschland auch ohne Erdgas aus Russland gesichert’). DIW aktuell, no. 83. DIW-Berlin. URL: https://www.diw.de/de/diw_01.c.838843.de/publikationen/diw_aktuell/2022_0083/energieversorgung_in_deutschland_auch_ohne_erdgas_aus_russland_gesichert.html

Hussein, Fatima. 2022. ‘US, Allies Aim to Cap Russian Oil Prices to Hinder Invasion’. AP NEWS. 13 July 2022. URL: https://apnews.com/article/russia-ukraine-global-trade-prices-76b1b9a40a1b8de40b8d14ada4102a92.

IEA. 2021. ‘Covid-19 Impact on Electricity’. IEA. 2021. URL: https://www.iea.org/reports/covid-19-impact-on-electricity.

———. 2022a. ‘A 10-Point Plan to Cut Oil Use’. 2022. URL: https://www.iea.org/reports/a-10-point-plan-to-cut-oil-use.

———. 2022b. ‘A 10-Point Plan to Reduce the European Union’s Reliance on Russian Natural Gas’. 2022. URL: https://www.iea.org/reports/a-10-point-plan-to-reduce-the-european-unions-reliance-on-russian-natural-gas.

———. 2022c. ‘Estonia - Countries & Regions’. IEA. 2022. URL: https://www.iea.org/countries/estonia.

———. 2022d. ‘Global Energy Crisis Shows Urgency of Accelerating Investment in Cheaper and Cleaner Energy in Africa’. IEA. 2022. URL: https://www.iea.org/news/global-energy-crisis-shows-urgency-of-accelerating-investment-in-cheaper-and-cleaner-energy-in-africa.

———. 2022e. ‘National Reliance on Russian Fossil Fuel Imports – Analysis’. IEA. 2022. URL: https://www.iea.org/reports/national-reliance-on-russian-fossil-fuel-imports.

———. 2022f. ‘Nuclear Power and Secure Energy Transitions – Analysis’. IEA. 2022. URL: https://www.iea.org/reports/nuclear-power-and-secure-energy-transitions.

———. 2022g. ‘Playing My Part: How to Save Money, Reduce Reliance on Russian Energy, Support Ukraine and Help the Planet’. URL: IEA. 2022. https://www.iea.org/reports/playing-my-part.

———. 2022h. ‘Reliance on Russian Fossil Fuels in OECD and EU Countries - Data Product’. IEA. 2022. URL: https://www.iea.org/data-and-statistics/data-product/reliance-on-russian-fossil-fuels-in-oecd-and-eu-countries.

———. 2021a. ‘Net Zero by 2050 - A Roadmap for the Global Energy Sector’. URL: https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

IEA, IRENA, UN, World Bank, and WHO. 2022. ‘Tracking SDG7 Progress across Targets: Indicators and Data’. URL: https://trackingsdg7.esmap.org/results.

Ikenberry, G. John. 1986. ‘The Irony of State Strength: Comparative Responses to the Oil Shocks in the 1970s’. International Organization 40 (1): 105–37. https://doi.org/10.1017/S0020818300004495.

InforMEA. 2022. ‘United Nations Conference on the Human Environment (Stockholm Declaration)’. The United Nations Information Portal on Multilateral Environmental Agreements. 2022. URL: https://www.informea.org/en/united-nations-conference-human-environment-stockholm-declaration.

IPCC. 2021a. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Edited by Valérie Masson-Delmotte, Panmao Zhai, Anna Pirani, Sarah L. Connors, C. Péan, Sophie Berger, Nada Caud, et al. Cambridge University Press.

———. 2021b. ‘Climate Change Widespread, Rapid, and Intensifying’. IPCC Press Release. URL: https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/

———. 2022. ‘Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change’. URL: https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/.

IRENA. 2022. ‘Energy Transition’. URL: https://www.irena.org/energytransition.

IRP. 2019. Global Resources Outlook 2019: Natural Resources for the Future We Want. A Report of the International Resource Panel. Nairobi, Kenya: United Nations Environment Programme.

Jewell, Jessica. 2011. 'Ready for Nuclear Energy?: An Assessment of Capacities and Motivations for Launching New National Nuclear Power Programs'. Energy Policy 39 (3): 1041–55. https://doi.org/10.1016/j.enpol.2010.10.041.

———. 2014. 'EU Energy Security Is Only as Strong as Its Weakest Link: The Former Eastern Bloc'. The Conversation. 2014. URL: http://theconversation.com/eu-energy-security-is-only-as-strong-as-its-weakest-link-the-former-eastern-bloc-25670.

———. 2022. 'How Fast Can Europe Get off Russian Gas?' POLET (blog). 2022. URL: https://www.polet.network/blog/how-fast-can-europe-get-off-russian-gas.

Jewell, Jessica, Aleh Cherp, and Keywan Riahi. 2014. 'Energy Security under De-Carbonization Scenarios: An Assessment Framework and Evaluation under Different Technology and Policy Choices'. Energy Policy 65 (February): 743–60. https://doi.org/10.1016/j.enpol.2013.10.051.

Jewell, Jessica, Marta Vetier, and Daniel Garcia-Cabrera. 2019. 'The International Technological Nuclear Cooperation Landscape: A New Dataset and Network Analysis'. Energy Policy 128 (May): 838–52. https://doi.org/10.1016/j.enpol.2018.12.024.

Jewell, Jessica, Vadim Vinichenko, Lola Nacke, and Aleh Cherp. 2019. 'Prospects for Powering Past Coal'. Nature Climate Change 9 (8): 592–97. https://doi.org/10.1038/s41558-019-0509-6.

Jucca, Lisa. 2022. 'Breakingviews - Saving Energy Now Is an EU No-Brainer'. Reuters, 29 June 2022, sec. Breakingviews. URL: https://www.reuters.com/breakingviews/saving-energy-now-is-an-eu-no-brainer-2022-06-29/.

Kauranen, Anne. 2022. 'Finnish Group Ditches Russian-Built Nuclear Plant Plan'. Reuters, 2 May 2022, sec. Europe. URL: https://www.reuters.com/world/europe/finnish-group-ditches-russian-built-nuclear-plant-plan-2022-05-02/.

Kearney, Laila. 2022. 'Oil Rises 2% as No Immediate Saudi Output Boost Expected'. Reuters, 15 July 2022, sec. Energy. URL: https://www.reuters.com/business/energy/oil-prices-climb-amid-questions-over-scale-us-rate-hike-2022-07-15/.

Keating, Dave. 2022. 'Will the Ukraine War Change Europe's Thinking on Nuclear?' Energy Monitor. 2022. URL: https://www.energymonitor.ai/sectors/power/will-the-ukraine-war-change-europes-thinking-on-nuclear.

Kern, Florian, and Karoline S. Rogge. 2016. 'The Pace of Governed Energy Transitions: Agency, International Dynamics and the Global Paris Agreement Accelerating Decarbonisation Processes?' Energy Research & Social Science 22 (December): 13–17. https://doi.org/10.1016/j.erss.2016.08.016.

Koc, Kagan, and Diederik Baazil. 2022. 'Dutch Ask If German Nuclear Plants May Stay Open Amid Gas Crisis'. Bloomberg.Com, 7 July 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-07-07/dutch-ask-germany-to-keep-nuclear-plants-open-to-ease-gas-crisis.

Kurmayer, Nikolaus J. 2022a. 'Germany Rules out Prolonging Its Nuclear Power Plants'. Www.Euractiv.Com. 8 March 2022.

URL: https://www.euractiv.com/section/energy/news/germany-rules-out-prolonging-its-nuclear-power-plants/.

———. 2022b. ‘EU Countries Bet on Floating LNG Terminals to Raise Import Capacity’. Euractiv. 31 March 2022. URL: https://www.euractiv.com/section/energy/news/eu-countries-bet-on-floating-lng-terminals-to-raise-import-capacity/.

Leyen, Ursula von der. 2022. ‘Ursula von der Leyen in Twitter’. Twitter. 2022. URL: https://twitter.com/vonderleyen/status/1549008925806268416?s=20&t=E43puf M7YnKynwg2lDkvvQ.

Liboreiro, Jorge. 2022. ‘Which EU Countries Have Been Cut off from Russian Gas?’ Euronews. 7 July 2022. URL: https://www.euronews.com/my-europe/2022/07/07/which-eu-countries-have-been-totally-or-partially-cut-off-from-russian-gas.

LNG Industry. 2022. ‘Uniper and Dynagas Ltd Facilitate the Charter of Two FSRUs’. LNG Industry. 5 May 2022. URL: https://www.lngindustry.com/liquid-natural-gas/05052022/uniper-and-dynagas-ltd-facilitate-the-charter-of-two-fsrus/.

Lyytimäki, Jari, Nina A. Nygrén, Anna Pulkka, and Salla Rantala. 2018. ‘Energy Transition Looming behind the Headlines? Newspaper Coverage of Biogas Production in Finland’. Energy, Sustainability and Society 8 (1): 15. https://doi.org/10.1186/s13705-018-0158-z.

Macintosh, Andrew. 2010. ‘Security of Europe’s Gas Supply: EU Vulnerability’, CEPS Policy Brief, no. 222, November 2010.URL: https://www.ceps.eu/ceps-publications/security-europes-gas-supply-eu-vulnerability/

Maizland, Lindsay. 2022. ‘Could Nuclear Power Cut Europe’s Dependence on Russian Energy?’ Council on Foreign Relations. 2022. URL: https://www.cfr.org/in-brief/could-nuclear-power-cut-europes-dependence-russian-energy.

Marchetti, C., and N. Nakicenovic. 1979. ‘The Dynamics of Energy Systems and the Logistic Substitution Model’. Monograph. IIASA, Laxenburg, Austria: RR-79-013. December 1979. URL: https://iiasa.dev.local/.

Markard, Jochen. 2018. ‘The next Phase of the Energy Transition and Its Implications for Research and Policy’. Nature Energy 3 (8): 628–33. https://doi.org/10.1038/s41560-018-0171-7.

Markard, Jochen, Rob Raven, and Bernhard Truffer. 2012. ‘Sustainability Transitions: An Emerging Field of Research and Its Prospects’. Research Policy 41 (6): 955–67. https://doi.org/10.1016/j.respol.2012.02.013.

Marotzki, Winfried, Jens Holze, and Dan Verständig. 2014. ‘Analysing Virtual Data’. In The Sage Handbook of Qualitative Data Analysis, edited by Uwe Flick, 450–65. Los Angeles, Calif.: Sage.

Marsh, Sarah, and Madeline Chambers. 2022. ‘Germany Freezes Nord Stream 2 Gas Project as Ukraine Crisis Deepens’. Reuters. 2022. URL: https://www.reuters.com/business/energy/germanys-scholz-halts-nord-stream-2-

certification-2022-02-22/.

Mathis, Will, Akshat Rathi, and John Ainger. 2022. 'Europe Is on a Wartime Mission to Ditch Russian Oil and Gas', 8 March 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/features/2022-03-08/can-europe-weaken-putin-s-power-over-global-energy.

Mazneva, Elena. 2022. 'UK Gets Reminder From Norway of How Fragile Gas Supplies Are', 12 July 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-07-12/uk-gets-reminder-from-norway-of-how-fragile-gas-supplies-are.

Mazzucchi, Nicolas. 2022. 'Nuclear Power Can Help the Democratic World Achieve Energy Independence'. Nature 606 (7916): 841–841. https://doi.org/10.1038/d41586-022-01733-9.

McKinsey & Company. 2022. 'European Consumers Increasingly React to the Stress of Rising Prices – Survey'. URL: https://www.mckinsey.com/business-functions/growth-marketing-and-sales/our-insights/survey-european-consumer-sentiment-during-the-coronavirus-crisis.

Merriam, Sharan B., and Elizabeth J. Tisdell. 2015. Qualitative Research: A Guide to Design and Implementation. Fourth edition. The Jossey-Bass Higher and Adult Education Series. San Francisco, CA: John Wiley & Sons.

Mills, Andrew. 2022. 'Qatar Energy Partners with Eni for North Field East LNG Project'. Reuters, 19 June 2022, sec. Energy. URL: https://www.reuters.com/business/energy/qatar-energy-joins-eni-north-field-east-lng-project-2022-06-19/.

Morison, Rachel. 2022. 'UK to Extend Cap for Energy Bills to Protect Households', 10 May 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-05-10/u-k-to-extend-cap-for-energy-bills-to-protect-households.

Morris, Loveday, Sammy Westfall, and Reis Thebault. 2022. 'Russia's Chokehold over Gas Could Send Europe Back to Coal', 2022. URL: https://www.washingtonpost.com/world/2022/06/22/coal-plant-europe-germany-austria-netherlands-russia-gas/.

Moussu, Nelly. 2021. 'EU's Timmermans: Brussels "will Support" Member States That Choose Nuclear'. Www.Euractiv.Com. 10 December 2021. URL: https://www.euractiv.com/section/energy-environment/news/eus-timmermans-commission-will-support-member-states-that-choose-nuclear/.

Nacke, Lola, and Jessica Jewell. 2022. 'Effects of Russia's War on European Coal Phase-Out'. POLET (blog). 2022. URL: https://www.polet.network/blog/russia-eu-coal-phase-out.

Nord Stream AG. 2022. 'Nord Stream AG'. Nord Stream AG. 2022. URL: https://www.nord-stream.com/.

O'Connor, Peter A. 2010. 'Energy Transitions', The Pardee Papers, no. 12. URL: https://www.bu.edu/pardee/pardee-paper-012-energy/.

Odenweller, Adrian, Falko Ueckerdt, Gregory Nemet, and Miha Jensterle. 2022. 'Probabilistic Feasibility Space of Scaling up Green Hydrogen Supply' PREPRINT (Version 1). https://doi.org/10.21203/rs.3.rs-1318076/v1.

Our World in Data. 2021. 'Energy Consumption by Source'. Our World in Data. 2021. URL: https://ourworldindata.org/grapher/energy-consumption-by-source-and-region.

———. 2022a. 'Electricity Production by Source'. Our World in Data. 2022. URL: https://ourworldindata.org/grapher/electricity-prod-source-stacked.

———. 2022b. 'Per Capita Electricity Consumption by Source'. Our World in Data. 2022. URL: https://ourworldindata.org/grapher/per-capita-electricity-source-stacked.

———. 2022c. 'Per Capita Primary Energy Consumption by Source'. Our World in Data. 2022. URL: https://ourworldindata.org/grapher/per-capita-energy-stacked.

Paraskova, Tsvetana. 2022. 'EU-OPEC Meet As Europe Discusses Russian Oil Embargo'. OilPrice.Com. 2022. URL: https://oilprice.com/Energy/Crude-Oil/EU-OPEC-Meet-As-Europe-Discusses-Russian-Oil-Embargo.html.

Patton, Michael Quinn. 2015. 'Enhancing the Quality and Credibility of Qualitative Studies'. In Qualitative Research & Evaluation Methods: Integrating Theory and Practice, 4. ed, 652–744. Thousand Oaks, Calif.: Sage.

Peck, William. 2022. 'Germany to Activate Supply Reserve "as Soon as Possible" – Power Mix and Emissions Impact'. ICIS Explore (blog). 2022. URL: https://www.icis.com/explore/resources/news/2022/06/22/10777583/germany-to-activate-supply-reserve-as-soon-as-possible-power-mix-and-emissions-impact.

Perloff, Richard M. 2021. The Dynamics of Political Communication: Media and Politics in a Digital Age. 3rd ed. New York: Routledge. https://doi.org/10.4324/9780429298851.

Pirani, Simon, James Henderson, Anouk Honoré, Rogers Howard, and Katja Yafimava. 2014. 'What the Ukrainian Crisis Means for Gas Markets'. Oxford Energy Comment. The Oxford Institute for Energy Studies. URL: https://www.oxfordenergy.org/publications/what-the-ukrainian-crisis-means-for-gas-markets/.

Pirani, Simon, Jonathan P Stern, Katja Yafimava, and Oxford Institute for Energy Studies. 2009. The Russo-Ukrainian Gas Dispute of January 2009: A Comprehensive Assessment. Oxford: Oxford Institute for Energy Studies. URL: https://www.oxfordenergy.org/publications/the-russo-ukrainian-gas-dispute-of-january-2009-a-comprehensive-assessment/

POLITICO. 2014. 'Russia Cuts Gas to Ukraine'. POLITICO. 2014. URL: https://www.politico.eu/article/russia-cuts-gas-to-ukraine/.

Rangelova, Kostantsa, and Martin Vladimirov. 2022. 'Europe Should Dream Big and Start the Gas Exit Now'. Euractiv. 5 May 2022. URL: https://www.euractiv.com/section/energy-environment/opinion/europe-should-dream-big-and-start-the-gas-exit-now/.

Ratcliffe, John W. 1983. 'Notions of Validity in Qualitative Research Methodology'.

Knowledge 5 (2): 147–67. https://doi.org/10.1177/107554708300500201.

Reuters. 2009. ‘TIMELINE: Gas Crises between Russia and Ukraine’. Reuters, 11 January 2009, sec. Earnings. URL: https://www.reuters.com/article/us-russia-ukraine-gas-timeline-sb-idUSTRE50A1A720090111.

———. 2014. ‘Putin Drops South Stream Gas Pipeline to EU, Courts Turkey’. Reuters, 1 December 2014, sec. Economic News. URL: https://www.reuters.com/article/us-russia-gas-gazprom-pipeline-idUSKCN0JF30A20141201.

———. 2021. ‘Dutch Confirm Plan to End Gas Production at Groningen next Year’. Reuters, 24 September 2021, sec. Energy. URL: https://www.reuters.com/business/energy/dutch-confirm-plan-end-gas-production-groningen-next-year-2021-09-24/.

———. 2022a. ‘About Reuters Fact Check’. 2022. URL: https://www.reuters.com/fact-check/about.

———. 2022b. ‘Rising Energy Prices Push Almost Half German Companies to Cut New Investments - Survey’. Reuters, 25 April 2022, sec. Business. URL: https://www.reuters.com/business/rising-energy-prices-push-almost-half-german-companies-cut-new-investments-2022-04-25/.

———. 2022c. ‘Snam Signs Deal to Study Spain-Italy Gas Pipeline’. Reuters, 12 May 2022, sec. Energy. URL: https://www.reuters.com/business/energy/snam-signs-deal-with-enagas-study-spain-italy-gas-pipeline-2022-05-12/.

———. 2022d. ‘Netherlands, Germany to Jointly Develop New Gas Field in North Sea’. Reuters, 1 June 2022, sec. Energy. URL: https://www.reuters.com/article/netherlands-gas-north-sea-idUSA5N2W501G.

———. 2022e. ‘Greece Launches More Energy Subsidies to Curb “unbearable” Power Costs’. Reuters, 5 July 2022, sec. Energy. URL: https://www.reuters.com/business/energy/greece-launches-more-energy-subsidies-curb-unbearable-power-costs-minister-2022-07-05/.

———. 2022f. ‘Exclusive: Saudi Arabia Doubles Second-Quarter Russian Fuel Oil Imports for Power Generation’. Reuters, 15 July 2022, sec. Energy. URL: https://www.reuters.com/business/energy/exclusive-saudi-arabia-doubles-q2-russian-fuel-oil-imports-power-generation-2022-07-14/.

Ritchie, Hannah, Max Roser, and Pablo Rosado. 2020. ‘Energy’. Our World in Data, November. URL: https://ourworldindata.org/fossil-fuels.

Roberts, John, and Julian Bowden. 2022. ‘The EU’s Plans to Replace Russian Gas: Aspiration and Reality’. Atlantic Council (blog). 25 April 2022. URL: https://www.atlanticcouncil.org/blogs/energysource/the-eus-plans-to-replace-russian-gas/.

Russell, Clyde. 2022. ‘Column: Russia Boosts Coal Exports as Western Sanctions yet to Bite’. Reuters, 5 July 2022, sec. Commodities. URL: https://www.reuters.com/markets/commodities/russia-boosts-coal-exports-western-sanctions-yet-bite-russell-2022-07-05/.

Rystad Energy. 2022. ‘A Perfect and Unavoidable Storm: LNG Supply Crisis Will Make Landfall in Winter 2022’. Rystad Energy. 2022. URL: https://www.rystadenergy.com/newsevents/news/press-releases/a-perfect-and-unavoidable-storm-LNG-supply-crisis-will-make-landfall-in-winter-2022/.

Seale, Clive. 1999. ‘Quality in Qualitative Research’. Qualitative Inquiry 5 (4): 465–78. https://doi.org/10.1177/107780049900500402.

Sengers, F., R.P.J.M. Raven, and A. Van Venrooij. 2010. ‘From Riches to Rags: Biofuels, Media Discourses, and Resistance to Sustainable Energy Technologies’. Energy Policy 38 (9): 5013–27. https://doi.org/10.1016/j.enpol.2010.04.030.

Seto, Karen C., Steven J. Davis, Ronald B. Mitchell, Eleanor C. Stokes, Gregory Unruh, and Diana Ürge-Vorsatz. 2016. ‘Carbon Lock-In: Types, Causes, and Policy Implications’. Annual Review of Environment and Resources 41 (1): 425–52. https://doi.org/10.1146/annurev-environ-110615-085934.

Sharma, Namit, Bram Smeets, and Christler Tryggestad. 2019. ‘Energy and GDP Growth’. McKinsey. 2019. URL: https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/the-decoupling-of-gdp-and-energy-growth-a-ceo-guide.

Simon, Frédéric. 2019. ‘EU Commission Unveils “European Green Deal”: The Key Points’. Euractiv. 11 December 2019. URL: https://www.euractiv.com/section/energy-environment/news/eu-commission-unveils-european-green-deal-the-key-points/.

———. 2022. ‘“Moment of Truth”: EU’s “green” Gas and Nuclear Investment Rules Head for Final Vote’. Euractiv. 6 July 2022. URL: https://www.euractiv.com/section/energy-environment/news/moment-of-truth-eus-green-gas-and-nuclear-investment-rules-head-for-final-vote/.

Smil, Vaclav. 2010. Energy Transitions: History, Requirements, Prospects. Santa Barbara, Calif.: Praeger.

———. 2016. ‘Examining Energy Transitions: A Dozen Insights Based on Performance’. Energy Research & Social Science 22 (December): 194–97. https://doi.org/10.1016/j.erss.2016.08.017.

Sönnichsen, N. 2022. ‘Topic: Energy Import Dependency in Europe’. Statista. 2022. URL: https://www.statista.com/topics/9165/energy-import-dependency-in-europe/.

Sovacool, Benjamin K. 2016. ‘How Long Will It Take? Conceptualizing the Temporal Dynamics of Energy Transitions’. Energy Research & Social Science 13 (March): 202–15. https://doi.org/10.1016/j.erss.2015.12.020.

Sovacool, Benjamin K., and Frank W. Geels. 2016. ‘Further Reflections on the Temporality of Energy Transitions: A Response to Critics’. Energy Research & Social Science 22 (December): 232–37. https://doi.org/10.1016/j.erss.2016.08.013.

Statista. 2021a. ‘EU: Natural Gas Production 2020’. Statista. 2021. URL: https://www.statista.com/statistics/265345/natural-gas-production-in-the-european-union/.

———. 2021b. ‘Oil Production in the EU 2020’. Statista. 2021. URL: https://www.statista.com/statistics/265206/oil-production-in-the-european-union-in-barrels-per-day/.

———. 2022a. ‘Crude Oil Price Chart 2022’. Statista. 2022. URL: https://www.statista.com/statistics/326017/weekly-crude-oil-prices/.

———. 2022b. ‘EU: Dependency on Natural Gas Imports 2020’. Statista. 2022. URL: https://www.statista.com/statistics/1293942/natural-gas-import-dependency-in-the-european-union/.

———. 2022c. ‘EU-28: Energy Dependency Rate 2008-2020’. Statista. 2022. URL: https://www.statista.com/statistics/267588/dependency-on-energy-imports-in-the-eu/.

Steitz, Christoph, Riham Alkousaa, and Maria Sheahan. 2022a. ‘Nuclear, Coal, LNG: “no Taboos” in Germany’s Energy about-Face’. Reuters, 27 February 2022, sec. Energy. URL: https://www.reuters.com/business/energy/germany-step-up-plans-cut-dependence-russia-gas-2022-02-27/.

———. 2022b. ‘Nuclear, Coal, LNG: “no Taboos” in Germany’s Energy about-Face’. Reuters, 27 February 2022, sec. Energy. URL: https://www.reuters.com/business/energy/germany-step-up-plans-cut-dependence-russia-gas-2022-02-27/.

Stojilovska, Ana, Hyerim Yoon, and Coralie Robert. 2021. ‘Out of the Margins, into the Light: Exploring Energy Poverty and Household Coping Strategies in Austria, North Macedonia, France, and Spain’. Energy Research & Social Science 82 (December): 102279. https://doi.org/10.1016/j.erss.2021.102279.

Stringer, David. 2022. ‘Worst of Global Energy Crisis May Still Be Ahead, IEA Says’, 12 July 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-07-12/worst-of-global-energy-crisis-may-be-ahead-iea-s-birol-warns.

Strobl, Günther. 2022. ‘District heating in Vienna currently works entirely without gas’ (In German ‘Fernwärme kommt derzeit in Wien ganz ohne Gas aus’). Der STANDARD. 2022. URL: https://www.derstandard.at/story/2000136760173/fernwaerme-kommt-derzeit-in-wien-ganz-ohne-gas-aus.

Suroyo, Gayatri, and Bernadette Christina. 2022. ‘Indonesia Trade Surplus Beats Forecast after Palm Oil Exports Resumption’. Reuters, 15 July 2022, sec. Commodities. URL: https://www.reuters.com/markets/commodities/indonesia-trade-surplus-beats-forecast-after-palm-oil-exports-resumption-2022-07-15/.

Suzuki, Masahiro. 2022. ‘Feasibility of Decarbonising Electricity in G7 by 2035’. POLET (blog). 2022. URL: https://www.polet.network/blog/feasibility-of-decarbonising-electricity-in-g7-by-2035.

Szabo, John. 2020. ‘Hydrogen…yet Again’. Energy Transition. 23 July 2020. URL: https://energytransition.org/2020/07/hydrogenyet-again/.

Tan, Weizhen. 2022. ‘After Buying Cheap Russian Oil, India Is Now Setting Sights on Its

Coal'. CNBC. 14 April 2022. URL: https://www.cnbc.com/2022/04/14/after-buying-russias-discounted-oil-india-looks-to-buy-its-coal.html.

Taylor, Kira. 2022. 'EU, US Strike LNG Deal as Europe Seeks to Ditch Russian Gas'. Euractiv. 25 March 2022. URL: https://www.euractiv.com/section/energy/news/eu-us-strike-lng-deal-as-europe-seeks-to-ditch-russian-gas/.

The Economist. 2022a. 'Britain's Energy Strategy Is Both Timid and Unrealistic'. The Economist, 2022. URL: https://www.economist.com/britain/britains-energy-strategy-is-both-timid-and-unrealistic/21808702.

———. 2022b. 'How Heavily Does Germany Rely on Russian Energy?', 2022. URL: https://www.economist.com/the-economist-explains/2022/05/04/how-heavily-does-germany-rely-on-russian-energy.

The Europe Beyond Coal. 2022. 'Europe's Coal Exit'. Europe Beyond Coal (blog). 2022. URL: https://beyond-coal.eu/europes-coal-exit/.

The European Council. 2022. 'EU Response to Russia's Invasion of Ukraine'. The Council of the EU and the European Council. 2022. URL: https://www.consilium.europa.eu/en/policies/eu-response-ukraine-invasion/.

The Federal Ministry for Economic Affairs and Climate Action. 2022. 'Federal Minister Robert Habeck Says Easter Package Is Accelerator for Renewable Energy as the Federal Cabinet Adopts Key Amendment to Accelerate the Expansion of Renewables'. Bundesministerium Für Wirtschaft Und Klimaschutz. 2022. URL: https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2022/04/20220406-federal-minister-robert-habeck-says-easter-package-is-accelerator-for-renewable-energy.html.

The Government of Austria. 1999. Federal Constitutional Law on a Nuclear-Free Austria (In German: Bundesverfassungsgesetz Für Ein Atomfreies Österreich). BGBl. I Nr. 149/1999. URL: https://www.ris.bka.gv.at/Ergebnis.wxe?Abfrage=Bundesnormen&Gesetzesnummer=&VonParagraf=0&FassungVom=02.02.2222&Titel=&Kundmachungsorgan=BGBl.+I+Nr.&Kundmachungsnummer=149/1999.

The UK Government. 2022. 'British Energy Security Strategy'. GOV.UK. 2022. URL: https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy.

Tirone, Jonathan, Kati Pohjanpalo, and Jesper Starn. 2022. 'Europe's Other Energy Problem: Relying on Russian Nuclear Fuel', 7 April 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-04-07/europe-s-other-energy-problem-relying-on-russian-nuclear-fuel.

TurkStream. 2022. 'The TurkStream Pipeline Project'. 2022. URL: https://www.turkstream.info/project/.

UN. 2022. 'What Is Climate Change?' United Nations. United Nations. 2022. URL: https://www.un.org/en/climatechange/what-is-climate-change.

UN Environment, ed. 2019. Global Environment Outlook – GEO-6: Healthy Planet, Healthy People. 1st ed. Cambridge University Press. https://doi.org/10.1017/9781108627146.

UNDESA. 2015. 'Transforming Our World: The 2030 Agenda for Sustainable Development'. 2015. URL: https://sdgs.un.org/2030agenda.

UNDP. 2000. World Energy Assessment: Energy and the Challenge of Sustainability. New York: United Nations Publications. URL: https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=2423&menu=35.

UNFCCC. 2015. 'The Paris Agreement'. URL: https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

———. 2021. 'End of Coal in Sight at COP26'. United Nations Climate Change. 2021. URL: https://unfccc.int/news/end-of-coal-in-sight-at-cop26.

———. 2022. 'Decisions Adopted by the Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement'. In Glasgow, UK. URL: https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf.

Unruh, Gregory C. 2000. 'Understanding Carbon Lock-In'. Energy Policy 28 (12): 817–30. https://doi.org/10.1016/S0301-4215(00)00070-7.

Vakulenko, Sergei. 2022. 'A Big Bang? Anticipating the Impact of Europe's Sanctions on Russian Energy'. Carnegie Endowment for International Peace. 2022. URL: https://carnegieendowment.org/eurasiainsight/87318.

Vakulenko, Sergey. 2022a. 'Russian Energy Embargo 2/6'. On Energy, Cabbages and Kings (blog). 28 April 2022. URL: https://svakulenko.substack.com/p/russian-energy-embargo-707.

———. 2022b. 'Russian Energy Embargo 3/6'. On Energy, Cabbages and Kings (blog). 29 April 2022. URL: https://svakulenko.substack.com/p/russian-energy-embargo-3.

Verbong, G.P.J., and F.W. Geels. 2010. 'Exploring Sustainability Transitions in the Electricity Sector with Socio-Technical Pathways'. Technological Forecasting and Social Change 77 (8): 1214–21. https://doi.org/10.1016/j.techfore.2010.04.008.

Verma, Nidhi. 2022. 'Russia's Share of India's June Oil Imports Surges to Record'. Reuters, 11 July 2022, sec. Energy. URL: https://www.reuters.com/business/energy/russias-share-indias-june-oil-imports-surges-record-2022-07-11/.

Vetier, Marta. 2022. 'Nuclear Power Worldwide Is Also Affected by Russia's War in Ukraine'. POLET (blog). 2022. URL: https://www.polet.network/blog/nuclear-power-worldwide-is-also-affected-by-russias-war-in-ukraine.

Vinichenko, Vadim, Aleh Cherp, and Jessica Jewell. 2021. 'Historical Precedents and Feasibility of Rapid Coal and Gas Decline Required for the 1.5°C Target'. One Earth 4 (10): 1477–90. https://doi.org/10.1016/j.oneear.2021.09.012.

Weise, Zia. 2022. 'Why Germany Won't Give up on Giving up Nuclear'. POLITICO. 28 April

2022. URL: https://www.politico.eu/article/politics-behind-germany-refusal-reconsider-nuclear-phaseout/.

WELT. 2022a. 'Rainer Borcherding: Grünen-Chef in Habecks Wahlkreis Tritt Aus Protest Zurück'. WELT. 2022. URL: https://www.welt.de/politik/deutschland/article239799641/Rainer-Borcherding-Gruenen-Chef-in-Habecks-Wahlkreis-tritt-aus-Protest-zurueck.html.

———. 2022b. 'Zeitung: Hamburg könnte bei Gasmangel Warmwasser begrenzen', 2 July 2022. WELT. URL: https://www.welt.de/regionales/hamburg/article239694259/Zeitung-Hamburg-koennte-bei-Gasmangel-Warmwasser-begrenzen.html.

Wienberg, Christian. 2022. 'Denmark Green Energy Transition Plan to Phase Out Natural Gas Entirely by 2030'. Bloomberg. 2022. URL: https://www.bloomberg.com/news/articles/2022-04-19/denmark-wants-to-phase-out-natural-gas-entirely-by-2030?utm_source=twitter&utm_content=business&utm_campaign=socialflow-organic&utm_medium=social&cmpid=socialflow-twitter-business.

Wilkes, William, Arne Delfs, and Vanessa Dezem. 2022. 'Putin Is Set to Halt Gas and Germany Fears It's Not Coming Back', 9 July 2022, Bloomberg edition. URL: https://www.bloomberg.com/news/articles/2022-07-09/germany-fears-putin-will-make-his-biggest-move-yet-to-squeeze-gas-supplies.

WindEurope. 2022. 'Wind Energy in Europe: 2021 Statistics and the Outlook for 2022-2026'. WindEurope. 2022. URL: https://windeurope.org/data-and-analysis/product/wind-energy-in-europe-2021-statistics-and-the-outlook-for-2022-2026.

World Nuclear News. 2021. 'Polish-US Civil Nuclear Agreement Enters into Force : Nuclear Policies'. 2021. URL: https://world-nuclear-news.org/Articles/Polish-US-civil-nuclear-agreement-enters-into-forc.

———. 2022. 'Framatome and Westinghouse to Supply Fuel to Temelín : Uranium & Fuel - World Nuclear News'. 2022. URL: https://www.world-nuclear-news.org/Articles/Framatome-and-Westinghouse-to-supply-fuel-to-Temel.

WWF. 2022. 'Boosting EU Resilience and Independence through the European Green Deal'. 2022. URL: https://www.wwf.eu/?6583966/Boosting-EU-resilience-and-independence-through-the-European-Green-Deal.

ZOE Institute. 2022. 'Demand-side solutions to address energy shortages'. 2022. URL: https://zoe-institut.de/en/publication/demand-side-solutions-to-address-energy-shortages/.

ANNEX A

List of the media and governmental sources used in the database

Media source	Web address
AP News	https://apnews.com
Atlantic Council	https://www.atlanticcouncil.org
Balkan Green Energy News	https://balkangreenenergynews.com
Balkan Insight (the flagship of the Balkan Investigative Reporting Network)	https://balkaninsight.com
BBC	https://www.bbc.com
Bloomberg Tax (part of Bloomberg Industry Group)	https://news.bloombergtax.com
Bloomberg	https://www.bloomberg.com
BQ Prime	https://www.bqprime.com
Buenos Aires Times	https://www.batimes.com.ar
Business Insider	https://www.businessinsider.com
Cable News Network (CNN)	https://edition.cnn.com
Carnegie Endowment for International Peace	https://carnegieendowment.org
Centre for Research on Energy and Clean Air (CREA)	https://energyandcleanair.org
Clean Energy Wire (CLEW)	https://www.cleanenergywire.org
Climate Home News	https://www.climatechangenews.com
CNBC	https://www.cnbc.com
Der Spiegel	https://www.spiegel.de
Deutsche Welle	https://www.dw.com
ECONtribute: Markets & Public Policy	https://www.econtribute.de
Ember	https://ember-climate.org
Energy Monitor	https://www.energymonitor.ai
Energy Post	https://energypost.eu
Energy Storage News	https://www.energy-storage.news
ERR News	https://rus.err.ee

EUobserver	https://euobserver.com
EUR-Lex	https://eur-lex.europa.eu
Euractiv	https://www.euractiv.com
Euronews	https://www.euronews.com
European Commission website	https://ec.europa.eu
European Council on Foreign Relations	https://ecfr.eu
European Environmental Bureau (EEB)	https://eeb.org
Financial Times	https://www.ft.com
Fitch Ratings	https://www.fitchratings.com
Forum Energii	https://www.forum-energii.eu
Frankfurter Allgemeine Zeitung	https://www.faz.net
German Institute for Economic Research (DIW Berlin)	https://www.diw.de
Global Witness	https://www.globalwitness.org
Government of the Netherlands	https://www.government.nl
Handelsblatt	https://www.handelsblatt.com
IEA	https://www.iea.org/articles/
InsideEVs	https://insideevs.com
LNG Industry	https://www.lngindustry.com
McKinsey & Company	https://www.mckinsey.com
Mining Technology	https://www.mining-technology.com
Montel	https://www.montelnews.com
National Geographic	https://www.nationalgeographic.com
Natural Resources Defense Council (NRDC)	https://www.nrdc.org
Nature	https://www.nature.com
Offshore Energy	https://www.offshore-energy.biz
OilPrice.com	https://oilprice.com
Politico	https://www.politico.eu
PV Tech	https://www.pv-tech.org
Recharge	https://www.rechargenews.com

Renewables Now	https://renewablesnow.com
Reuters	https://www.reuters.com
Riddle	https://ridl.io/en
Rystad Energy	https://www.rystadenergy.com
Der STANDARD	https://www.derstandard.at
Substack	https://svakulenko.substack.com
T-online	https://www.t-online.de
Tagesschau	https://www.tagesschau.de
The Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology	https://www.bmk.gv.at
The Connexion	https://www.connexionfrance.com
The Conversation	https://theconversation.com
The Council of the EU and the European Council	https://www.consilium.europa.eu
The Council on Foreign Relations (CFR)	https://www.cfr.org
The Economist	https://www.economist.com
The European Centre for Development Policy Management (ECDPM)	https://ecdpm.org
The German Federal Government	https://www.bundesregierung.de
The German Federal Ministry for Economic Affairs and Climate Action	https://www.bmwk.de
The Guardian	https://www.theguardian.com
The Independent	https://www.independent.co.uk
The Institute for Future-Fit Economies (ZOE)	https://zoe-institut.de
The Magazine of the Sierra Club	https://www.sierraclub.org
The Peninsula	https://thepeninsulaqatar.com
The Philadelphia Inquirer	https://www.inquirer.com
The Times	https://www.thetimes.co.uk
The UK government	https://www.gov.uk
The Wall Street Journal	https://www.wsj.com
The Washington Post	https://www.washingtonpost.com

The Week	https://www.theweek.co.uk
Twitter of the president of the European Commission Ursula von der Leyen	https://mobile.twitter.com/vonderleyen
UnHerd	https://unherd.com
VoxEU.org (policy portal of the Centre for Economic Policy Research (CEPR))	https://voxeu.org
We Mean Business Coalition	https://www.wemeanbusinesscoalition.org
Welt	https://www.welt.de
World Economic Forum	https://www.weforum.org
World Nuclear News	https://www.world-nuclear-news.org
World Wide Fund For Nature	https://www.wwf.eu
Wuppertal Institute for Climate, Environment and Energy	https://wupperinst.org
Zeit Online	https://www.zeit.de