The Ukraine war: A Catalyst or a Barrier to Big Oil's Green Energy Transition Progress?

A qualitative analysis based on insights from leading industry experts

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Abstract

Title: The Ukraine war: A Catalyst or a Barrier to Big Oil's Green Energy Transition Progress?

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24th of February 2022. Russia invades Ukraine and marks the beginning of a cruel war. As a result, the energy system got disrupted, and an energy crisis was triggered with multiple consequences for companies, governments, and society. Simultaneously, the consequences of the climate crisis are getting ever closer, and it is uncertain how the progress in the energy transition will behave in the current energy crisis and what consequences the war will have on it. This study aims to provide insights into how the Ukraine war influenced the green energy transition. While there is existing research on the subject from a policymaker's perspective, there is a lack of evidence from the company's point of view (which plays a significant role in the transition) that this paper aims to deliver.

The overarching question that this paper answers is whether the Ukraine war led to an acceleration or deceleration of the green energy transition. To answer this question, interviews with leading industry experts from big energy companies and consultancies have been conducted along with an external view from scientist and IPCC lead author Bart van den Hurk.

The key findings from these interviews provide a deep understanding of the perspective of energy companies on the influence of the war in both the short- and long term. These insights will allow companies and policymakers to enrich their strategic decision-making and strengthen their understanding of this dynamic and complex challenge.

Keywords: Green energy transition, Sustainability, Crisis management, Business, Energy crisis, Climate change, Energy trilemma, Management, Ukraine war

Resumo

Título: A guerra na Ucrânia: Um catalisador ou um obstáculo ao progresso da transição para a energia verde das grandes petrolíferas?

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24 de Fevereiro de 2022. A Rússia invade a Ucrânia e marca o início de uma guerra cruel. Como resultado, o sistema energético foi perturbado e foi desencadeada uma crise energética com múltiplas consequências para as empresas, os governos e a sociedade. Simultaneamente, as consequências da crise climática estão cada vez mais próximas e não se sabe ao certo como se comportará o progresso da transição energética na actual crise energética e que consequências terá a guerra. O presente estudo tem por objectivo analisar a forma como a guerra na Ucrânia influenciou a transição para a energia verde. Embora exista investigação sobre o assunto do ponto de vista dos decisores políticos, faltam provas do ponto de vista das empresas (que desempenham um papel significativo na transição), o que o presente documento pretende fornecer.

A questão fundamental a que este documento responde é se a guerra na Ucrânia levou a uma aceleração ou desaceleração da transição para a energia verde. Para responder a esta questão, foram realizadas entrevistas com os principais especialistas do sector de grandes empresas de energia e consultores, juntamente com uma visão externa do cientista e principal autor do IPCC, van den Hurk.

As principais conclusões destas entrevistas proporcionam uma compreensão profunda da perspectiva das empresas do sector da energia sobre a influência da guerra, tanto a curto como a longo prazo. Estes conhecimentos permitirão às empresas e aos decisores políticos enriquecer a sua tomada de decisões estratégicas e reforçar a sua compreensão deste desafio dinâmico e complexo.

Palavras-chave: Transição energética verde, Sustentabilidade, Gestão de crises, Empresas, Crise energética, Alterações climáticas, Trilema energético, Gestão, Guerra da Ucrânia

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List of Abbreviations

APERC	Asia Pacific Energy Research Centre
BECCS	Bioenergy with Carbon Capture and storage
C	Celsius
CCS	Carbon Capture and Storage
CO2	Carbon Dioxide
Covid-19	Coronavirus Disease 2019
e.g.	exempli gratia
ECEEE	European Council for an Energy Efficient Economy
etc.	et cetera
EU	European Union
i.e.	id est
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
LNG	Liquefied Natural Gas
PhD	Doctor of Philosophy
WCED	World Commission on Environment and Development
WEC	World Energy Council

1. Introduction

With the invasion of Russia in Ukraine on the 24th of February 2022, the energy market got disrupted as the EU distanced itself from Russian gas. However, being dependent on the Russian gas supply, an energy crisis arose with peaking prices and uncertainty about how to fill up the energy storage for the upcoming winter (Nerlinger & Utz, 2022). Soon after the invasion, energy security was the main focus for big energy companies and governments. Securing Europe's energy supply while preceding gas from one of its largest suppliers quickly led to discussions about dependencies and possible alternatives to Russian gas. Consequently, solutions were quickly associated with expanding renewable energy sources to become independent from global structures while having a positive climate impact.

The conflict between Russia and Ukraine caused difficulties for clean and fossil energy in various ways leading to high-level inflation, disruptions in the financial markets, and recession. For instance, the prices for energy between December 2021 and June 2022 increased by 58,3% with a high degree of volatility and concerns about energy security, challenges in the supply chain, and general concerns about the security of the world order (Mohammed et al., 2023). Working closely with big energy companies, the EU has been forced to adjust rapidly to develop new energy policies that secure the short-term energy need while pushing the green energy transition to reach net-zero targets in the long term. On top, it is critical to promote renewable energy sources because they can stabilize the economic situation (Aydin, 2022). Therefore, research on how the Russian invasion has influenced green energy transition progress has become crucial to improve strategic decision-making in times of uncertainty and crisis.

This paper investigates the perspective of big energy companies on how the Ukraine war influenced the green energy transition progress. This paper underlies the following structure: In the first chapter, the literature will be presented from two directions. First, a general understanding of what a green energy transition is considered and what an energy trilemma is will be provided before diving into energy security and its role in a green energy transition. The next chapter elaborates on the research intention and the topic's relevance. Following the methodology and the study procedure will be discussed in Chapter 4. Then, in Chapter 5, the findings from the research will be presented, allowing us to answer the research questions. Finally, the key takeaways of the research will be concluded in Chapter 6, followed by a discussion of further research opportunities based on an outlook given by industry experts.

2. Literature Review

The first chapter of this literature review explores the significance of the green energy transition in addressing the energy trilemma. In addition, it examines the effects of both concepts on the Ukraine conflict, highlighting the interplay between energy dynamics and geopolitical conflicts. Moving forward, Chapter 2 concentrates on the impact of crisis management on strategic management, delving into how organizations respond to and navigate crises, thereby shaping their long-term strategies. Finally, this chapter explores the critical role of crisis management in assuring the resilience and adaptability of organizations.

2.1. Green energy transition and the energy trilemma

2.1.1 What is the green energy transition?

This section provides a more comprehensive understanding of the green energy transition. A renewable energy transition is the process of eliminating carbon-based fuels from the energy sector. From 2015 on, all signatory nations are obligated to advance the shared goal of the Paris Agreement, one of the earliest multilateral agreements on modern climate change and green energy transitions, which is to limit global temperature rises to 1.5 °C above pre-industrial levels. Renewable energy sources, increased energy efficiency, electrification of end uses, hydrogen and its derivatives, carbon capture and storage (CCS) in industries, bioenergy with carbon capture and storage (BECCS), and removal strategies are a few ways to speed up the transition to green energy (International Renewable Energy Agency, 2022). According to studies, implementing these instruments and resources would reduce emissions by approximately one-third by 2030. The graph below illustrates the necessary transition to renewable energy sources by 2030.

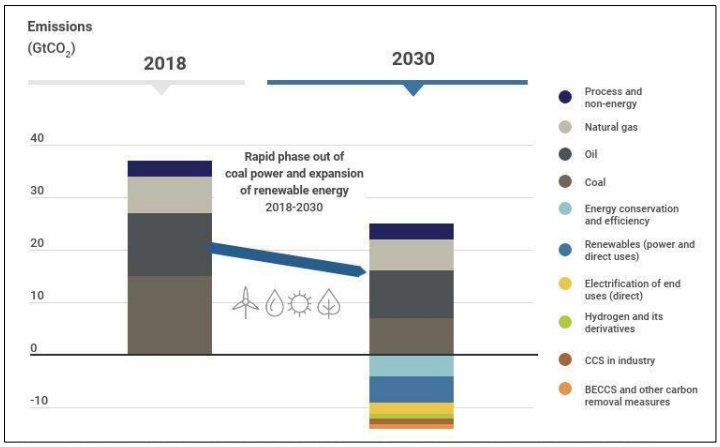

Figure 1: *Energy transition impact on total emissions (IRENA, 2022).*

Whether an energy source is renewable is determined by its characteristics: whether it has an infinite supply and cannot be depleted (International Renewable Energy Agency, 2022). The majority of renewable energy sources are derived from soil, biomass, water, wind, and the sun. In 2019, they accounted for 11,2 percent of the world's energy consumption and are the "fastest-growing energy sources globally." (Selectra Climate, 2022). The most significant obstacles to the rapid development of renewable energy are expense and logistics.

In contrast, conventional non-renewable energy sources are comprised of fossil fuels such as coal, oil, and natural gas. There are varying degrees of environmental impact associated with these fossil fuels. The most polluting source, coal, is responsible for 0.3C of the average global temperature increase of 1C (Client Earth, 2022). The combustion of hydrocarbons causes one-third of the world's carbon emissions. One-fifth of the world's carbon emissions are caused by natural gas, which is seen as less environmental harmful as coal and oil.

Additionally, liquefied natural gas (LNG) is gaining popularity. When LNG is cooled to temperatures below minus 160 degrees Celsius, it transforms into a liquid and is compressed by a factor of 60. Because it less storage space than gas-fired natural gas is needed, it can be transported in specialized tankers (IEA, 2020).

Nuclear energy is a decarbonized, low-polluting, and greenhouse gas-emitting energy source. Although uranium, the energy source used in nuclear reactors, is considered green energy, it is not renewable because it is a finite resource using data from Selectra Climate 2022. Nevertheless, it still has value for nations striving to achieve net-zero energy because it is not weather-dependent like solar energy. However, countries may hesitate to use nuclear energy because it produces radioactive waste that is harmful to the environment and must be stored.

2.1.2 The energy trilemma

The concept of the energy transition traces back to the theory of sustainable development, first introduced by the Brundtland report, published by the World Commission on Environment and Development (WCED). It has three interdependent pillars: environmental protection, social and economic development. In short, sustainable development entails attempting to satisfy the needs of current generations without compromising those of future generations (WCED, 1987).

We can derive the energy trilemma by applying this concept to the energy sector and the readily available energy sources. The energy trilemma is the interdependence of three crucial dimensions that help energy policymaking and classifying specific energy sources: Energy

security, environmental sustainability, and energy equity (i.e., the price of an energy source). Progress in one dimension frequently presents obstacles in another, resulting in a complex trilemma. Initially proposed by the World Energy Council (WEC), the trilemma framework is a valuable instrument for analyzing the trade-offs and synergies between different energy sources (World Energy Council, 2021). The following example illustrates the trilemma in the energy sector: Traditional fossil energy sources were seen as both secure and relatively affordable to the broad society, which made them the primary source of energy for the past decades. However, fossil energy sources do not fulfill environmental sustainability criteria because they produce vast emissions while depleting resources. On the other hand, renewable energy sources such as photovoltaic energy were considered sustainable, but in the past, both availability and price needed to be marketable enough for these energy sources to be used predominantly (van den Hurk, 2023). A more detailed description can be given below for a better understanding of the three pillars on which the energy trilemma is based.

Energy security: Having a secure supply of energy is fundamental for a country to function and for an economy to work and prosper. As indicated in Chapter 2.1.1, the energy demand is constantly increasing, making the security of energy supply a task of utmost importance (ASIF & MUNEER, 2007). Therefore, Energy security can be described as the capacity to meet current and future energy demand, considering management efficiency, dependability, and resistance to shocks that cause supply disruptions (Marti & Puertas, 2022).

Environmental Sustainability: In an endeavor to combat climate change, environmental sustainability refers to the transition of the energy infrastructure to low- or zero-carbon by reducing carbon dioxide (CO2) emissions to acceptable levels (Khan et al., 2021). This dimension focuses on the productivity and efficiency of generation, transmission, and distribution, decarbonization, and air quality. The most popular sustainable energy sources are solar, wind, geothermal, hydro, and bioenergy (World Energy Council, 2019).

Energy equity: The last pillar of the energy trilemma evaluates the capacity of a nation or an energy source to provide reliable, affordable, and abundant energy for residential and commercial use. The dimension encompasses fundamental access to electricity and clean cooking fuels and technologies, access to prosperity-enabling energy consumption levels, and the affordability of electricity, gas, and fuel – the price per unit is the most important key figure here (World Energy Council, 2019).

2.1.3 Implication on the Ukraine war

The Ukraine war undoubtedly impacts the energy trilemma and, in turn, the green energy transition. The current literature and short-term media coverage highlight two possible scenarios in which the war might affect energy trilemma and energy transition. First, the conflict and accompanying geopolitical unpredictability could impede the energy transition's development. This is predominantly due to diverting vital resources, such as financial capital and human expertise, to conflict resolution. As a result, there may be delays in allocating these resources to renewable energy programs and decarbonization initiatives. Moreover, prevalent concerns regarding energy security can motivate nations to prioritize the development of conventional energy sources, particularly natural gas, in order to reduce their reliance on volatile regions (Economist, 2022).

On the other hand, the Ukrainian conflict could also serve as an impetus to speed up the energy transition. The conflict has heightened awareness of the vulnerabilities inherent in fossil fuel-dependent energy systems, emphasizing the necessity of diversification and a faster transition. As a result, energy policies have been reevaluated in several nations, leading to a renewed emphasis on pursuing alternative energy sources and enhancing energy independence. This paradigm shift has the potential to stimulate increased investments in renewable energy technologies, the implementation of energy efficiency measures, and the growth of decentralized energy systems (McKinsey, 2022).

Looking at the numerous ramifications resulting from the influence of the Ukrainian conflict on the energy transition, it is necessary to conduct a thorough analysis of the factors that have contributed to the emergence of obstacles and opportunities by conducting interviews with industry leaders.

2.2. The relevance of energy security for green energy transition

2.2.1. Energy security and its relevance during crisis

Although the concept of energy security has likely existed for centuries, the term “energy security” was introduced in 1975 (Valentine, 2011). However, the fast-growing economy in an increasingly globalized world increased the importance and complexity of securing energy supply since energy prices increased (Vivoda, 2010) and the economy got more reliant on industrial industries (Azzuni, 2018). The multifaceted literature around energy security research the concept from various perspectives reaching from a policymaking and political perspective (Jonsson, 2015) to a national security point of view, highlighting different aspects of the concept

such as regional or historical aspects (KIRCHNER & BERK, 2010).

According to the IEA, energy security can be described as "the uninterrupted availability of energy sources at an affordable price. Energy security has many aspects: Long-term energy security mainly deals with timely investments to supply energy in line with economic developments and environmental needs. On the other hand, short-term energy security focuses on the ability of the energy system to react promptly to sudden changes in the supply-demand balance" (IEA, 2022). However, the Asia Pacific Energy Research Centre (APERC) builds the concept on four dimensions, making it more measurable and exhaustive. Accessibility, Affordability, Availability, and Acceptability are the dimensions (APERC, 2007). Measures like this can be introduced to analyze the degree of security different energy sources have, and it allows companies and governments to compare the performance of their energy system. Although this sounds trivial in theory, the complexity of the (global) energy system presents challenges for decision-makers (Axon & Darton, 2021).

As mentioned, securing energy is a task of tremendous importance for both energy companies and governments. Due to the difficult international economic relations, crises such as the Ukraine war or Covid-19 can put energy security at risk and shift the market equilibrium, which is why securing energy supply is a decisive factor (World Energy Council, 2022).

2.2.2. The role of green energy transition during crisis

In times of crisis, the global energy system, which in the past was mainly based on energy from fossil fuels, gets disrupted because it is heavily dependent on international dependencies and complex supply chains. For example, in one of the most recent crises, the Covid-19 crisis, it can be observed that the crisis changed the market mix in favor of renewable energy options (Kuzemko et al., 2020). As a result, according to the IEA, the demand for coal energy dropped by 8%, while the demand for renewable energy increased slightly by 1% (IEA, 2020).

There is a reciprocal connection between energy security and sustainability, which Axon and Darton describe point out different things the two have in common such as the regional scope (national and international) and that they address a wide range of stakeholders. However, there is a trade-off between energy security and sustainability because some of their goals are conflicting. Energy security aims to secure the energy supply now as well as in the near future. As long as the energy source fulfills the four dimensions (see above), considerations regarding sustainability are put aside. Hence, the concept of energy security is short-term focused.

On the other hand, sustainable energy sources (e.g., solar, wind, hydropower) might be less available than energy sources from fossil fuels. However, they are long-term oriented in nature since renewable energy sources do not pollute the environment and deplete resources (Axon & Darton, 2021). On top of that, the short-term perspective (use of fossil energy) usually has been more profitable in the past incentivizing Big Oil to focus on traditional business instead of fossil energy sources have been more profitable in the past instead of prioritizing way to secure long-term benefits. Keppler explains this phenomenon with the underrepresentation of the economic benefit of sustainability (Keppler, 2007).

2.2.3. Current state of research

After Russia invaded Ukraine, media, academic journals, and other reports started to investigate the potential impact of the war on the energy sector and whether the war would facilitate the green energy transition or if the war is yet another roadblock on the way to carbon-free energy (Steffen & Patt, 2022). Predominantly, the long-term positive effects of the crisis on renewable energy transitions were suggested. In the short term, however, energy prices will increase significantly, and other nations replace Russia's position as a supplier of fossil fuels since the short-term energy supply needs to be secured (Tollefson, 2022). Again, long- and short-term differentiation is crucial when discussing the effects of the Ukraine war, and yet there is literature that supports both sides. The predominant arguments found in the literature are the following.

Increased political motivation: Especially countries within the EU that are heavily dependent on Russian Gas gain a strong interest in becoming independent by reorganizing their energy supply and ensuring energy security in the long term. The vital need for independence and the shift to long-term supply security could accelerate the green energy transition as it would allow companies and countries to be independent and sustainable (International Renewable Energy Agency, 2022). Proof of this is the REPower EU Plan, which was the immediate response of the EU to the energy crisis resulting from the Ukraine war. The REPower EU, introduced by the European Council for an Energy-Efficient Economy (ECEEE), has the goal of accelerating the use of renewable energy faster than initially planned by introducing different measures: „The measures in the REPowerEU Plan include energy savings, diversification of energy supplies, and accelerated roll-out of renewable energy to replace fossil fuels in homes, industry, and power generation. The Commission has proposed to more than double the EU renewables rate, from 20% to at least 45% by 2030" (European Council for an energy efficient economy [ECEEE], 2022).

Economic price development: As an immediate result of the Ukraine war, prices for oil and gas skyrocketed because Russian gas was cut out of the supply side. In turn, renewable energy sources became a more profitable and attractive investment opportunity over fossil energy sources (International Renewable Energy Agency, 2022). As of July 2022, renewable energy sources gained a price advantage according to IRENA's report on the 24th of July 2022:

> *"The benefits of renewables in 2022 will be unprecedented given the fossil fuel price crisis: The lifetime cost per kWh of new solar and wind capacity added in Europe in 2021 will be, on average, at least four to six times lower than the marginal cost of fossil fuels in 2022" (IRENA, 2021)."*

On the flip side, however, researchers point out factors that speak against accelerating the transition due to the war.

Energy security over sustainability: The omission of Russian gas in the energy market led to concerns regarding the security of supply for the upcoming winter (2022) and the winter in 2023. The high focus on securing energy supply and keeping households warm could eventually move sustainability considerations in the background leading to a slow-down in the green energy transition (van Helden, 2023). Additionally, the literature suggests that the acceleration of the green energy transition in Europe could lead to a slow-down of the transition in other parts of the world because as soon as the prices for fossil energy decreases, poorer countries will be the ones to consume the fossil energy resulting in a reverse effect on the green energy transition (Tollefson, 2022).

3. Research intention and relevance

Since the Ukraine war and its effects is a timely and dynamic concern, there is currently not enough evidence on the impact of this black swan event, especially lacking insights from a company's perspective. This master's thesis aims to close this gap of evidence by providing insights into the influence of the Ukraine conflict on the green energy transition progress of major oil companies. By analyzing short- and long-term impacts, this study provides a deep understanding of the significance of the Ukraine war for the green energy transition. The research aims to conduct practical evidence for businesses and governments to prosper from as they navigate the energy transition during the current energy crisis. This study contributes to the literature on the intersection of geopolitics, energy, and sustainability by providing policymakers, industry professionals, and academics with valuable insights. Furthermore, as

the collected data is gathered from different players in the energy market, the insights from this paper can be used by other energy companies to help with their market anticipation and decision-making.

3.1. Research questions

In an effort to provide high-level industry insights for businesses, policymakers, and academics, this study will investigate how the Ukraine war affected the green energy transition progress at Big Oil companies. The study also delivers insights on a topic that has not been deeply explored in the existing literature from a company's perspective which can lead to a biased and insufficient view on the topic.

Has the Ukraine conflict accelerated or slowed the transition to renewable energy? The research will examine three aspects of the transition to answer this overarching question. First, we must provide a broad, high-level perspective on the Ukraine war's short- and long-term effects on Big Oil's green energy transition. Next, since the security of supply is a fundamental objective of Big Oil, we must determine to what extent the war affected energy security and whether considerations regarding renewable energy sources have grown or diminished. Finally, we seek a perspective on the energy sources used to bridge the transition and whether the war has positively or negatively impacted the energy mix regarding renewable energy sources. After collecting and evaluating the data, we will then be able to make a profound statement regarding our overarching question. From this, the following research questions can be derived and will be investigated further:

- **RQ1:** How will the Ukraine war influence the green energy transition progress at "Big Oil" in short and long term?
- **RQ2:** What strategic thoughts do energy companies have on ensuring supply security in regard to the green energy transition?
- **RQ3:** Have the considerations regarding the transition energy (energy mix) changed as a result of the war in favor or against renewable energy?

4. Methodology

In this chapter, the applied methodology will be explained and presented. In the following, the paper elaborates on different structural parts of the research process, including the applied research method, the nature of the sample, and the research procedure leading us to our findings. This chapter helps to understand the approach to gathering the data, which will lead to the findings discussed in Chapter 5. The raw data (interview transcripts) gathered from the data collection can be consulted on request.

4.1. Applied research method

The invasion of Russia in Ukraine has happened very timely from an academic perspective, with many things happening simultaneously. Since this field lacks robust quantitative data, qualitative research is necessary to understand the key drivers influencing the green energy transition at Big Oil and the effect of an unprecedented event, the Ukraine war. Collecting first-hand insights from leading industry experts will allow us to draw profound conclusions on our research questions (Patton, 2015). To get a holistic view of this thesis's topic, internal and external experts are being interviewed (the detailed sample is described in 4.2). To generate practical insights, the current study combines a comprehensive academic literature review and insights gathered from practice. Interviews have been selected as a standard and widely accepted data collection technique for qualitative research to obtain insights from practical experience (Patton, 2015). Semi-structured interviews are preferred as they provide a framework for the interview while allowing to be flexible and to adapt to individual circumstances. Also, there is the possibility to ask additional questions (Sayrs, 1998). The interview protocol developed for this study ensured consistency across all interviews (Patton, 2015).

4.2. Selected Sample

A holistic perspective is preferable to a micro-level perspective when investigating complex topics like war and its effect on an energy crisis to understand the big picture. According to section 4.1, this research study included both internal and external experts in its sample. The internal experts comprised top-level executives from the energy industry's most prominent players, such as BP, Shell, and E.ON. The external experts were chosen from various professions, including science, consulting firms, and renewable energy companies, to provide an outsider's perspective that complements the industry experts' insights. The external perspective aims to deliver a more robust topic picture and eliminate biases. The table below

provides a comprehensive list of all the industry experts, each of whom has extensive work experience over many years in the field of energy transition and a proven track record of accomplishments in the industry, establishing them as credible and reliable sources.

#	Name	Institution	Industry	Position
1	**Audney van Helden** (AvH)	Shell	Energy	Vice President Decarbonization
2	**Jens Mueller-Belau** (JMB)	Shell	Energy	Managing Director Energy Transition
3	**Simon Worthington** (SW)	BP	Energy	Senior advisor Energy Markets
4	**Marie-Louise Risoud** (MR)	BP	Energy	Advisor Energy Markets
5	**Leonie Giessing** (LG)	E. ON	Energy	Senior Manager Corporate Strategy
6	**Pavel Balada** (PB)	Vraend	Renewable Energy	Managing Director Renewable Energy
7	**Bart van den Hurk** (BvdH)	IPCC	Science	Senior Researcher and IPCC Author
8	**Moritz Heinemann** (MH)	SMP	Consulting	Senior Consultant Energy Transition

***Table 1**: List of interview partners*

4.3. Study procedure

First, industry experts were contacted through social networks such as LinkedIn, personal networks, and Nuno Moreira da Cruz's academic network. The industry experts were selected based on the following criteria:

1. **Seniority:** When looking for experts, it is crucial to find industry experts with many years of practice and a proven track record within the industry to meet the academic standards of the research.
2. **Area of expertise:** As stated above, a complex topic like this needs to have multiple perspectives and a holistic approach. This is why experts with different focus within the energy sector have been chosen. This helps to eliminate biases and further strengthen the quality of findings of the study.

In the second phase, an introduction email with a brief description of the research and a link to schedule a meeting was sent to all interview prospects. After agreeing to the interview and confirming to be a credible source, the respondents were given the questionnaire in advance to prepare (see Table 2) adequately. Before being transcribed, the interviews were conducted using standard technological tools, such as Microsoft Teams and Zoom. The transcription process was completed with the help of artificial intelligence using *Amberscript* to generate a first draft, which was then edited manually based on the audio file for a precise and thorough transcription.

Research question	Interview question	Optional sub-questions
Introduction question	When did you start your current role and what are you currently working on?	1. Do you agree that the session will be recorded?
RQ1: How will the Ukraine war influence the green energy transition progress at "Big Oil" in short and long term?	The Ukraine war has a tremendous effect on (energy) supply chains in the world. What effect does the Russian invasion and the resulting energy crisis have on the green energy transition progress for your company in short and long term?	1. What was the first reaction of energy companies to the Ukraine war, what short-term adjustments were made? 2. Looking to the future, how will the war and the associated energy crisis affect the energy transition, what strategic changes do you see in your company? 3. In summary, how would you assess the impact of the war on the green energy transition progress in your company and in the energy sector?
RQ2: What strategic thoughts do energy companies have on ensuring supply security in regard to the green energy transition?	The security of energy supply is a much-discussed topic these days. What were the strategic considerations of the companies for securing the energy supply at the beginning of the war and in the future?	1. Which energy sources were initially the most attractive to ensure energy security? 2. How important did the question of sustainability and green energy seem in the context of security of supply in the short and long term? 3. Can you see a shift of energy sources to ensure long term security of supply?
RQ3: Have the considerations regarding the transition energy (energy mix) changed as a result of the war in favor or against renewable energy?	What energy source/mix is being used to bridge the transition, and have these considerations changed because of the war?	1. Are there scenarios (best to worst) for the energy transition and what factors influence them? What effect did the war have on this? 2. In which time frame do you want to switch to green energy? 3. Will you focus exclusively on green energy in the long term, or will you keep energy from fossil fuels as a reserve?

***Table 2**: Interview questionnaire*

5. Findings

After the data collection through expert interviews, the experts provide significant qualitative insights and findings regarding the effect of the Ukraine war on Big Oil's green energy transition strategy. To answer whether the war has accelerated the transition or slowed it down, it is necessary to examine in depth the various aspects that may influence the pace of the transition. Section 5.1 examines the Ukraine conflict's short- and long-term effects on Big Oil's strategy and the overall advancement of the green energy transition. Subsequently, Section 5.2 examines how the war has affected the role of renewable energy in securing energy supply in the future and provides insights into the significance of energy supply security. Finally, section 5.3 sheds light on the transitioning process and the extent to which the conflict has highlighted renewable energy as a component of the energy mix required to bridge the transition. By addressing these research questions, we can gain a comprehensive understanding of the impact of the conflict on Big Oil's transition to green energy.

5.1. Effect of Ukraine war on green energy transition strategy

The findings for research question 1: “How will the Ukraine war influence the green energy transition strategy at "Big Oil" in short and long term?” will be discussed in section 5.1.1 and 5.1.2 highlighting different aspects of the research question.

5.1.1. Short-term

As discussed, the war has been both a disrupting and surprising black-swan event, which came out of the blue for most companies. After Russia invaded Ukraine, the supply chains were disrupted, and an energy shortage arose, leading to a shift of the focus of Big Oil as well as politicians to secure energy supply for the upcoming winter.

> *“Without enough gas, coal and nuclear energy were used to very high prices. Everyone was so worried about freezing during the winter, that sustainability considerations were put aside in the short-term.” (AvH)*

The urgency and uncertainty of the event let the considerations regarding the green energy transition move to the background. However, the following short-term effects have been discovered by industry experts.

Back to coal: Coal emerged as the primary alternative to Russian gas in the short term, as it was readily accessible and a reliable energy source. This finding demonstrates that large oil companies were more concerned with finding immediate solutions to meet energy demand than

investing in long-term, sustainable alternatives.

> *"What we've seen in the market is that there has been a strong demand for gas and other fossil energy sources, especially energy from coal because of it's immediate availability and reliability" (MH)*

Supply-chain disruption: The issues and disruption in the supply chain made it difficult to source raw materials and other supplies (e.g., electrons for solar panels). As Big Oil companies struggled to surmount the logistical obstacles, these issues slowed the transition towards sustainable energy alternatives.

> *"The war has had an enormous effect on the supply chains, which slows the transition down because a lot of resources are needed to create the transition." (AvH)*

General market uncertainty: On top of it, Pavel Balada explains that due to the credit risk associated with the war and the state of the economy, it was difficult for renewable energy companies to secure funding for new projects. This suggests that the conflict harmed the funding aspect of the green energy transition strategy and slowed it down in the short-term. Furthermore, the uncertainty influenced investors' risk appetite, further amplifying the effect.

> *"In the beginning, the crisis brought difficulties to the renewable energy companies as well because of the credit risk, it was hard to fulfil the financing needs to fund new projects." (PB)*

Early indications for an accelerated shift: However, two other factors indicate an acceleration of the green energy transition going forward. First, Leonie Giessing (Ph.D.) from E. ON can see a market trend towards renewables based on customer demand early after the Russian invasion.

> *"We experienced an increased demand in renewable energy products shortly after the invasion since the renewable energy sources were promoted as, so-called, freedom energies." (LG)*

This can eventually be explained by the second factor, a change in the energy trilemma. With Russian gas becoming insecure, customers prefer more local energy solutions, which gives renewables an advantage. In total, the short-term effects were mainly driven by securing the energy supply (discussed in 5.2), but we can identify signs indicating a shift in the long-term.

5.1.2. Long-term

Despite the roadblocks towards an accelerated green energy transition in the short-term, the long-term perspective looks promising primarily, according to industry experts. This is incentivized by different aspects, which will be presented in the following.

Wake-up call: With Russia's invasion of Ukraine and the associated energy crisis, the solid dependencies and inconsistencies in the energy system became drastically visible for companies, governments, and society. According to the experts, the shock of the start of the war was a wake-up call to act quickly.

> *"The focus and urgency of a transition was already one of the absolute Group strategies before the onset of the war to remain a relevant energy company. Nevertheless, we expect that the increased urgency will lead to the war accelerating the energy transition." (JMB)*

Marie-Louise Risoud confirms that this wake-up call was heard within BP and explains that the Ukraine war had an intrinsic effect on pushing towards a green energy transition.

> *"The current situation gives us more enthusiasm and motivation to push for the green energy transition faster and to become independent from Russian gas as soon as possible. It puts more pressure on us from all sides, including the society." (MR)*

Green energy equals "Freedom Energy": Another big reason for an accelerated green energy transition due to the war is that in addition to sustainability and reaching net-zero goals, there is now a strong demand for independence from Russia (and similar regimes). Renewable energy sources, which neither has been considered affordable nor very reliable in the past, have now gained a decisive advantage since they are sustainable, locally available, and not attached to dependencies with other countries, explains Leonie Giessing (Ph.D.).

> *"The energy trilemma has shifted in favor of renewable energy. Reliable, affordable, and sustainable. Previously, green power was not considered particularly reliable, but this has been altered by the war, which now calls into question the reliability of global dependencies. Green energies are now considered reliable, therefore freedom energies, because they can fulfill the whole energy trilemma." (LG)*

Change in consumer preference: The effect of the Ukraine war also changed society's view on energy consumption. As both prices for energy and the frustration about the Russian regime in, the demand side change for more locally sourced and sustainable solutions, which can be which is already noticeable at E.ON very early on.

> *"We see a big effect as the war has influenced consumer attitudes toward sustainable energy, which we can clearly see in the increased demand." (LG)*

Partnerships increase pace: Lastly, Moritz Heinemann points out another effect the Ukraine war has in the long-term development of the green energy transition – the building of partnerships between traditional energy companies, renewable energy companies, and regional energy suppliers. According to Heinemann, this will accelerate the green energy transition and indicates how seriously energy companies take the matter.

> *"To accelerate the process, partnerships have been formed, for instance between traditional energy companies and renewable energy companies. This will lead to an acceleration of the energy transition." (MH)*

Many arguments speak for an accelerated green energy transition due to the Ukraine war in the long term. However, Simon Worthington points out that despite the increased urge to push for a faster transition, the internal and external (net-zero) targets still need to be adjusted as they were already ambitious. He explains, "At BP, the targets have not changed compared to the past. The reason is that we set ourselves strategic goals and strategic ambitions, which we presented to investors. So these targets were already ambitious."

5.2. Effect of Ukraine war on security of supply

As discussed in Chapter 2.2, securing the energy supply is fundamental to energy companies and governments. Several key insights have emerged through expert interviews, shedding light on the complex dynamics between the war, energy security, and the transition to renewable energy sources. A detailed look at the energy security considerations is needed to understand how the Ukraine war influenced the transition at and its pace Big Oil. After the Russian invasion, are the renewable energy sources already sufficiently reliable that they can be used to secure the energy supply? Did the war change those considerations for the better or worse?

Energy security at all costs: "Energy security is becoming increasingly a priority for the governments," mentions Simon Worthington. Especially in the short term, Big Oil companies were trying to fill the gas storage at all costs, putting sustainability considerations aside.

Consequently, it did not lead to a greener way of approaching energy security in the short term due to the urgency with which companies had to look for options to gather enough energy as needed. As a result, traditional energy sources like coal, gas, and, in some countries, nuclear power were the primary energy source to secure the supply.

> *"Shell sold an extensive amount of Liquefied Natural Gas (LNG) when everyone was searching for gas to fill their storage tanks at a very high cost. What could not have been filled with gas was filled with coal and, in some locations (such as France), nuclear power. Everyone was so concerned about freezing during the winter that short-term sustainability concerns were set aside." (AvH)*

The shift of perceptions towards independence: Briefly after the Russian invasion, global energy dependencies, especially with Russia, were exposed, making stakeholders realize how counter-beneficial such dependencies are and that a reorganization of the energy system is overdue. Being more reliable, less dependent, and self-sufficient, recognition of renewable energy increased. Consequently, companies are more eager to shift towards more sustainable energy security.

> *"BP pushes hard to make renewable projects in a lot of different countries to achieve a Europe-wide possibility to let green energy play a role in the supply security in the future." (MR)*

Bottleneck infrastructure: The war led to a more robust recognition of renewables. However, regarding energy security, several infrastructural issues make it challenging to consider renewables when it comes to energy security, neither in the short-term nor in the upcoming years, according to the interview experts.

> *"The fact that energy security is and will be based on fossil fuels is because the infrastructure development for renewables is moving forward too slow, so the energy sources considered for the supply security are likely to remain fossil energies in the next years." (JMB)*

In addition, Pavel Balada has a critical view on renewable energy as the main source to secure energy supply:

> *"Renewables will play a role, but energy sources that are more reliable and*

sustainable, such as nuclear, could and should play a greater role. For security of supply, renewables will not be the focus, at least not in the next ten years, because they do not always provide demand flexibility." (PB)

Reassessment of nuclear power: Since renewables are not yet sufficiently available to secure the energy supply, the war led companies and governments to explore other energy sources which are not subject to dependency and have a lower carbon impact than coal and gas, such as nuclear power. Although nuclear power is reassessed within the EU, different roadblocks make it difficult to reconsider.

"There have been decisions in the past regarding which affect the energy transition today (like shutting down nuclear plants). Not having these restrictions could help us now to accelerate the transition even more." (AvH)

Jens Mueller-Belau, Managing Director for Energy Transition at Shell, also has a critical view on past decision regarding nuclear power.

"Due to the nuclear phase-out in some countries, we now have fewer non-renewable energy options that can help us with energy security, which is unfortunate and could become a problem once the coal-fired power plants are shut down." (JMB)

Despite the eagerness of Big Oil to consider renewable energy sources for supply security, different factors hinder the prioritization of renewables now and in the following years. Nevertheless, the war had a marginal positive impact because of the perceptional shift in renewables and global dependencies. On top of that, in some EU countries, nuclear power has been facilitated and, in consequence, emitted less emissions.

5.3. Effect of Ukraine war on the bridging energy

In this section, the findings regarding the effect of the Ukraine war on the energy mix which is being used to bridge the transition. The section aims to shed light on the question of to what extent the war has changed the considerations in favor or against the transition giving. The following insights were gained from the expert interviews.

Persistence of Gas and Coal: Similar to the effects in Chapter 5.2, energy from fossil fuels persisted in the short term due to a lack of renewable infrastructure. Big Oil was trying to

explore other gas sources rather than preferring renewables. Consequently, the war had no short-term effects on the energy mix used to bridge the transition, explains Mueller-Belau.

> *"The main energy source remains gas and coal-fired power plants (which will eventually be phased out), here the focus is to explore new sources of gas rather than particularly considering renewable energy." (JMB)*

Momentum for renewables: However, in a long-term view, the experts revealed that renewables gained further momentum regarding the energy mix. Pavel Balada reasons this with the enormously increasing investments in renewables despite the reliance on fossil fuels in the short-term. Further, he expects the war to trigger increased commitment, leading to a higher share of renewables in the energy mix sooner.

> *"I think it [the war] will speed up the renewable investments within. This way, we will have an increasing portion of renewables in the energy mix. As I mentioned earlier, we need more renewables, we need more flexibility, production assets. I believe we will see the decrease of the coal fired power plants and the total mixture." (PB)*

Exploration of other Sustainable Energy Sources: While discussing the change in the energy mix, the industry experts pointed out that the Ukraine war has accelerated the research and the use of other renewable energy sources among the well-known renewable energy sources. As more renewable energy sources enter the market, this could lead to a quicker transition.

> *"There are new solutions, which will enter the energy mix to bridge the transition, for instance in the steel sector its hydrogen and in mobility sector biofuels can play a role." (AvH)*

The research findings indicate mainly two things. On the one hand, the energy mix has stayed the same due to the war and will keep relying on fossil fuels until slowly being replaced by renewables, which means there was no significant effect of the war. On the other hand, as we observed in other research questions, the urgency that the war has created changed the pace of the transition and put a stronger emphasis on the exploration of innovative renewable energy sources.

5.4. External view of the effects on the green energy transition

While the company's perspective is the main focus of this study, this section aims to provide an external perspective from a scientific standpoint and contributes to a holistic view on the researched subject: Did the Ukraine war accelerate the green energy transition at Big Oil or slow it down?

The insights in this chapter were gained from an expert interview with Bart van den Hurk. Van den Hurk has been a scientist in climate information for 20+ years. His main area of research was conducted in climate scenarios, land-atmosphere interaction, and climate modeling. Remarkably, van den Hurk was one of the lead authors of the sixth assessment report of the IPCC. Interestingly, his insights were mostly aligned with those from the industry leader and are presented in the following.

Short-term impact: Here, van den Hurk observed that short-term needs and long-term goals are conflicting, which led to the prioritization of fossil energy, which in turn led to a disadvantageous effect on the transition.

> *"In the short-term, we see that the companies are unable to accommodate short-term responses to long-term needs. If there is a short-term crisis there is an immediate response, regardless of the climate effect, in this case it was the stronger use of fossil energies." (BvdH)*

Before the war, the EU had been subsidizing fossil energy consumption, which was the opposite of what the IPCC recommended and was because the EU and the companies could not afford a rapid phase-out of fossil fuels. This realization has been emphasized with the outbreak of the war (van den Hurk, 2022).

Long-term impact: Nevertheless, van den Hurk confirms that the Ukraine war has been a significant wake-up call for companies, governments, and society. He mentions that this is the most significant driver for an accelerated energy transition because the need for independence has been promoted strongly, aiming for the same output as sustainability considerations. He observed that independence became a more potent driver to push the green energy transition than sustainability.

> *"It's more about being independent from Russia as reaching the climate goals, but if this helps to go into the right direction, it is a positive thing." (BvdH)*

Positive side effects: Additionally, the war has promoted side effects, which also help to speed up the transition. As energy prices began sparking, companies considered promoting energy efficiency to save costs. While this is mainly driven by economic motivation, it positively affected the transition. The same goes for households. Since governments publicly promoted energy-saving measures for society, less energy has been consumed, decreasing the CO2 impact (van den Hurk, 2022).

6. Conclusion

Within the scope of this research paper, the effects of the Ukraine conflict on Big Oil's green energy transition development have been examined. To summarize the findings, section 6.1 will provide the main conclusions from the conducted research. In addition to the scope of this paper, section 6.2 will give an outlook on the subject based on insights from the expert interviews. These insights will give indications of further research opportunities in the research field of green energy transition. The limitations of this study are discussed in section 6.3.

6.1. Key-take aways

In addition to the existing insights and research presented in section 2, the critical insights from this paper's research (concluded from chapter 5) can be added. The conclusions we can draw on the impact of the Ukraine war on the green energy transition progress at Big Oil are presented in the following. The significant impact on the research output came from the short- and long-term differentiation, which is why the key arguments will be grouped as such. On top, additional vital insights are presented at the end of the section.

Short-term:

- The Ukraine war has encouraged a stronger focus on coal and other fossil fuels since energy security became the top priority and must be secured at all costs. Considerations regarding sustainability had to be put aside to achieve energy security within the EU, negatively impacting the transition process.
- Furthermore, the high market uncertainty due to the war significantly increased the credit risk, making it very challenging to secure funding for new projects and investments in renewable energy, especially for renewable energy companies. This led to a short-term slowdown of the transition process.
- For both energy security and the energy mix to bridge the transition, the Ukraine war has not had a strong impact in the short term, leading to companies focusing mainly on

fossil fuels in the short term. This is because of the need for more infrastructure and the high volatility of renewables.

- However, the spike in prices for coal and gas in the short-term and the perceptional shift of companies, society, and policymakers, suggest a acceleration of the transition due to the war and can already be seen in short-term demand increases for renewables.

Long-term:

- The war has been a massive wake-up call for long-term changes in the global energy system. This wake-up call has led to a significant increase in motivation and pressure to speed up the green energy transition, leading to various factors that help to accelerate the transition, including:
- There is a shift in the energy trilemma since renewables are sustainable and will become more affordable and less dependent than fossil energy sources. The strong dependence on Russian gas mainly influenced this shift and will positively influence the green energy transition.
- Investments in renewable energy projects are being pushed harder and faster than before the occurrence of the war, impacting the green energy transition positively.
- Traditional energy companies are building partnerships with companies focusing on renewable energy, helping them achieve results faster and get funding for their projects and investments. These cooperations increased due to the war and will lead to a faster transition.
- Consumer awareness and changes in consumer preferences are other long-term results of the Ukraine war. With spiking prices and the awareness of independence and sustainability, consumers will prefer renewable energy sources even more. This will also help speed up the transition.
- The key insights of this paper show that the Ukraine war had both positive and negative impacts on the transition at Big Oil. However, most of the arguments against an accelerated transition due to the war occurred in the short-term period. In contrast, arguments in favor were found in the long-term perspective, i.e., the positive impact of the Ukraine war on the transition outweighs the negative. The study results allow us to conclude with the research questions and the title: "The Ukraine War: A Catalyst or a Barrier to Big Oil's Green Energy Transition?": Short-term barrier but long-term catalyst.

6.2. Expert outlook and future research opportunities

Additionally, in answering the research questions, the industry experts were asked to give an outlook on how the green energy transition can succeed after the knowledge generated months after the Russian invasion. The result is various factors needed to accelerate the green energy transition and reach net-zero targets. Furthermore, these insights derive future research opportunities in this area. The expert outlook can be comprised of the following.

- Infrastructure expansion: A fast infrastructure expansion for renewable energy sources is crucial to speed the transition by scaling renewables and replacing fossil energies (MH, 2022). The infrastructural bottlenecks and ways to rapid expansion could be a topic for further investigation.
- Overcome skill shortage: A successful and fast implementation of renewable energy sources (such as installing solar panels) needs skilled workers, which we currently need (LG, 2023). An assessment of the required labor skills to analyze the current gap in the labor shortage could be an excellent area to study.
- Streamlining authorization processes: To accelerate the transition, approval processes need to be accelerated and the immense bureaucracy reduced. This will encourage investors and companies to transition faster (PB, 2022). An analysis of complex processes with recommendations for making them more efficient could be helpful.
- Promoting circular economy: Leonie Giessing (Ph.D.) explains that a circular economy is needed to overcome the potential shortage in supply in the following decades, such as recycling raw materials and reusing or repurposing old production parts (LG, 2023).

  "I believe that our next crisis will be a resource crisis. Therefore, we need to make our economy more circular today" (LG)

  Exploring ways to make the energy industry more circular presents another research opportunity.
- Research in new technologies and other renewable energy sources: Innovations and technology are essential to speed up the transition (e.g., carbon capture technologies and hydrogen) (PB, 2022) and present various further research opportunities.

6.3. Limitations

As this study aims to serve as an appropriate starting point for future research, this section discusses the main limitations of the paper. To begin with, a bigger sample size is needed to

achieve empirical validity, i.e., quantifiable results. The methodology applied in this paper gives detailed qualitative insights into the research questions from credible experts. However, without empirical evidence, answers could contain inherent biases.

Secondly, since the Ukraine war has been a recent and timely event with dynamic news development, it is essential to provide a cut-off date that limits the paper's work. Therefore, the present paper contains information until the day of the last interview, which has been 31.03.2023. Therefore, this research paper has yet to consider new information, policy changes, and company statement after this date.

Lastly, this paper adds evidence by providing a company-based view on the topic (with an additional external view of Bart van den Hurk) and therefore limited to this view. For an entirely holistic view of the subject, all stakeholders, including policymakers, and society, must be included in the study.

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