Assessing the Geopolitical Relevance of Oil in the Energy Transition: the Evolution of Saudi Arabia's Decarbonization Policies and Responses to Russia's Invasions of Ukraine

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Abstract

The price of crude oil in global markets has experienced unforeseen volatility in the past decade. Some of these changes occurred during moments of geopolitical tension. In 2014, Russia surprised the world by invading Ukraine to capture and absorb Crimea into its territory. The following year, the Syrian civil war escalated with Russia's military intervention, adding to the existing mix of external involvement, including that of Saudi Arabia's political rival, Iran. During this period, global oil prices tumbled, placing pressure on petroleum exporters. The main driver of this continued price fall was Saudi Arabia, which urged the Organization of the Petroleum Exporting Countries (OPEC) members to maintain production levels to retain the low price. Speculation ensued about the motivation behind Saudi Arabia's export strategy. While some experts viewed the moves as based purely on economic factors, others suggested that such a strategy could have been done for geopolitical purposes with aims to harm the Russian or Iranian economy.

Amidst this tense political environment, the world came together to join the historic Paris Agreement, promising to reduce their carbon emissions to slow global warming to a maximum of 1.5 degrees Celsius above pre-industrial levels. Within this, the emphasis is on phasing out fossil fuels. Saudi Arabia has committed itself to become less dependent on fossil fuel production for its economy in possible response to the decline of oil prices in 2014 (Grand & Wolff, 2020). Crown Prince Mohammed bin Salman and other policymakers have proposed a series of initiatives focused on decarbonization. In an analysis of these and the policies and themes shared at United Nations climate change conferences from 2018 to the present, Saudi Arabia is actively developing its low and zero-carbon hydrogen capabilities while simultaneously continuing the export of its hydrocarbons.

However, the Russian invasion of Ukraine in 2022 and the consequential energy crisis, particularly in Europe, have proven how much the world still relies upon hydrocarbons. Recent news reports of U.S. lobbying in Saudi Arabia appear to show a desire from U.S. policymakers to utilize Saudi Arabia's oil as a geopolitical tool against Russia. Instead of oil prices collapsing as they did in 2014, this period is witnessing prices reaching new heights. As the energy crisis

has led to substantial profitability for Saudi Arabia's fossil fuel exports, these events exhibited a lack of accommodation in the kingdom using its exports for geopolitical aims. While the conflict has devasted Russia's hydrogen export ambitions, it is opening up avenues of opportunity for Saudi Arabia. Ultimately, not only have Saudi Arabia's decarbonization policies survived throughout the war in Ukraine but have been propagating. Perhaps most advantageous for Saudi Arabia, the conflict has brought them closer to potential consumer countries with rising demand for hydrogen imports.

While oil maintains an intimate relationship with geopolitics, Saudi Arabia's energy strategy prioritizes economic gains over geopolitical feats. While the kingdom's aggressive pricing strategy following Russia's invasion of Ukraine in 2014 may have been primarily motivated by the rising competitiveness of U.S. petroleum suppliers, it is also possible that such energy tactics held geopolitical inclinations. Saudi Arabia proved willing and able to utilize oil as an effective geoeconomic instrument as it waged the price war on Russia in 2020. It appears less likely that Saudi Arabia is focused on enacting geopolitical losses on Russia for its invasion of Ukraine in 2022. However, the world's renewed emphasis on energy security is likely promoting Saudi Arabia's two-prong strategy of maintaining its dominance in the oil export market while also preparing itself to lead in future hydrogen production. The ongoing geopolitical situation benefits Saudi Arabia and positions it to become the top hydrogen exporter. While oil has proven its geopolitical and geoeconomic efficacy, it is yet to be seen if hydrogen will be its successor in both facets. However, the geopolitical relevance of oil should be questioned, at least in the case of Saudi Arabia, as the kingdom is seeking to prioritize its geoeconomic positioning through fossil fuel and hydrogen exports rather than risk its economic competitiveness for Western geopolitical imperatives.

Introduction

Saudi Arabia holds global significance as the home of Islam and remains the symbol of Middle Eastern oil in the fossil fuel era. It is also a distinctive nation as an absolute monarchy with a longstanding history of close relations with the United States. In the 21st century, it has proven itself as one of the U.S.'s most trusted security partners in the region, coordinating with regional and foreign actors in counter-terrorism operations to promote stability in the Middle East. Since the discovery of oil in the Middle East, Saudi Arabia has been characterized by its ability to produce and export this resource globally. My personal interest in the country was limited to its cultural heritage until I moved to Saudi Arabia in December 2010, just before the Arab Spring occurred. While living in a Saudi Aramco compound near one of its largest refineries, I understood better the influence of Aramco in the global energy trade. As Saudi Arabia is a leading member of the Gulf Cooperation Council (GCC) and the Organization of the Petroleum Exporting Countries (OPEC), its influence among fellow hydrocarbon export countries is considerable. Its investment power, most notably with its sovereign wealth fund, is among the highest in the world.

In 2013, while walking along the streets of Ukraine's capital, I found myself in a precarious situation as an incidental observer of a stirring revolution that would define global geopolitics in the years to come. As oil prices dropped substantially following Russia's invasion of Crimea in 2014, speculation arose over the motives of one of Russia's leading energy export competitors, Saudi Arabia. While some experts claimed that Saudi Arabia and the United States were colluding to use oil exports for geopolitical purposes, others viewed the kingdom's strategy as purely economic. The Russian invasion of Ukraine in 2022 and U.S. diplomacy seeking Saudi Arabia's help to enact economic reparations against Russia inspired me to assess the willingness of the kingdom to use oil as a geopolitical device.

A critical global moment occurred between the two invasions, however. In 2015, the world joined the Paris Agreement to keep emissions below 2 degrees Celsius, ideally limited to 1.5 Celsius. Attention shifted to how these countries can achieve this goal along with their Nationally Determined Contributions (NDCs). In recent years, media reports have been

circulating about the potential of next-generation, low and zero-carbon energies, with blue and green hydrogen gaining prominence. With the expectation that these fuels can lead the world in its energy transition, much will depend on how the largest hydrocarbon exporters promote this energy transfer, especially as many are poised to become producers. In this clean energy outlook, Saudi Arabia has been announcing its goals to develop its renewable energy sector while improving energy efficiency and potentially seeking nuclear energy production capabilities. Perhaps most visibly, it actively promotes its Circular Carbon Economy (CCE) framework. Through these initiatives, it aims to achieve carbon neutrality by 2060. This moment witnessed nations prioritize decarbonization, apparently forgetting about the guarantees of fossil fuels.

As recent events, namely the Coronavirus pandemic and Russia’s invasion of Ukraine, disrupt supply chains and energy flows, hydrocarbons are gaining prominence as key guarantors of energy security. Understanding how this change of emphasis is affecting Saudi Arabia’s progress in its decarbonization initiatives is vital. Its support of the energy transition is vital for the region and the globe. At the same time, the world is reminded of oil's importance. As part of energy security, are oil-exporting nations using the resource for geopolitical pursuits? How relevant is this dimension of oil in the switch to low and zero-carbon fuels of the energy transition?

An evaluation of Saudi Arabia's responses to Russia's invasions of Ukraine was chosen as the military offensives of Crimea in 2014 and of Central and Eastern Ukraine in 2022 exhibit similar events. However, the two are separated in time by the historic Paris Agreement and Saudi Arabia's central decarbonization policies. This comparison of Saudi Arabia's responses to the two invasions allows for an analysis of policy shifts to determine the continuity of oil exports as a preferred approach in Saudi Arabia's geoeconomic stockpile. It also examines oil's geopolitical relevance as the kingdom progresses on its decarbonization initiatives.

Chapter 1

Decarbonization and War: Understanding Geopolitical Entanglements

Main Research Questions

This thesis endeavors to examine the geopolitical relevance of oil in the case of Saudi Arabia. To understand the country's potential use of oil for geopolitical aims, it was decided to compare Saudi Arabia's responses to the invasion of Ukraine in 2014 with that of 2022. These events were separated by two pivotal moments for Saudi Arabia—the kingdom gained a new leader, Mohammed bin Salman, and virtually the entire world endorsed the Paris Agreement. If these factors impacted the kingdom's overarching trade strategy, it may be that the country's utilization of oil for geopolitics was also affected.

In consideration of other factors that may have determined Saudi Arabia's trade strategy and geopolitical utilization of oil, it is necessary to consider what other developments are impacting the global energy industry. The current energy landscape is largely influenced by three revolutionary factors: technological innovations, the energy transition, and the global energy crisis. Certain technological breakthroughs have led to the Shale Revolution, thereby reorganizing market competitiveness among fossil fuel exporters. Other advancements are accelerating the energy transition, including developments in hydrogen production and carbon capture capabilities. It is necessary to understand how Saudi Arabia has been pursuing decarbonization as part of the energy transition, and whether or not such efforts have been tangible enough to affect its trade strategy. While there appeared to be much international political momentum in the direction of the transition and decarbonization, the world was reminded of the importance of energy security by the invasion of Ukraine in 2022, which resulted in the global energy crisis. Although this has placed pressure on energy import countries, the subsequent high prices have enriched oil exporters. For Saudi Arabia, this may be the greatest test of its commitment to decarbonization as its fossil fuel exports bring in record profits.

This thesis seeks to address these developments by identifying three research questions. Firstly, has Saudi Arabia been using its oil exports as a geopolitical tool in response to the Russian invasions of Ukraine in 2014 and 2022? How have Saudi Arabia's evolving decarbonization policies affected its energy trade strategy? Thirdly, has the recent invasion of Ukraine and the resulting energy crisis affected Saudi Arabia's sustainability policies? By seeking to answer these questions, this thesis finally attempts to enable the reader to understand the relevancy of oil in Saudi Arabia's potential geopolitical endeavors, given its growing interest in decarbonized energy exports.

This research and the approach to the main questions are significant for the public policy academic community as it addresses two of the most pressing global challenges, the war in Ukraine and climate change. Although the global energy industry is being shaped by both long-term and short-term trends, such as the energy transition and the energy crisis, respectively, the current situation is marked by instability. Not only this, but such uncertainty is intensifying. It is hoped that the analysis of the current conditions will allow for certainties to be ascertained in this opaque context, enabling researchers to have more substantial insight into the policy drivers of Saudi Arabia's oil strategy following the invasion of Ukraine in 2014 as well as a better understanding of how top Middle Eastern oil producers are adapting to the dynamic environment. It is expected that readers will then be able to generalize this analysis to comprehend how other major oil exporters are acclimatizing. Additionally, it is anticipated that such writing will aid other scholars in studies on the future relevance of Saudi Arabia's oil for geopolitical pursuits and on the long-term implications of the kingdom’s decarbonization policies and hydrogen aspirations.

Methodology and Limitations of Research

This research is done by performing a documentary analysis of various texts. While this research emphasizes qualitative studies to understand the evolution of the policies in question, it also includes quantitative studies. These quantitative studies primarily consider the size of energy production, hydrocarbon output levels, and investment in clean energy technologies. The data collected comes from government documents, conference notes, media outlets, press releases, think tank publications, energy analyses, market intelligence sources, financial services

firms, and peer-reviewed academic journals. Most of these sources were accessed online. Secondary sources' reputations were considered when selecting data sources, while primary-source data, primarily government documents, were selected based on relevance. While multiple sources may contain overlapping information, they may all be included if the particular insight found in one source was absent in another. In analyzing the data collected, quantitative numbers were often checked in multiple outlets if the information was found in secondary sources. As much of the quantitative data found in primary-source documentation, primarily government documents and announcements, were future expected targets, these were accepted without additional verification. This thesis largely consists of qualitative research, with the analysis being content-based.

Since this thesis provides an analysis of current events, which are continuing to evolve, the main difficulty in researching this topic was including the latest information as relevant news reports and articles were continuing to be published. As this research covers an ongoing issue, there are few pertinent peer-reviewed journal articles on the latest developments. If this thesis's research were performed later, more peer-reviewed publications would likely be available for inclusion in collecting relevant data. If this research were to be done later, this methodology would ideally include future publications to add to the analysis. As many government sources were sought after in the data collection process, it would have been preferable to attend various international forums of relevance. As this thesis was designed to assess the geopolitical relevance of oil and how the ongoing war has affected Saudi Arabia’s decarbonization policies, its focus is not on measuring the viability of Saudi Arabia’s policies and initiatives in reaching its Nationally Determined Contributions (NDCs). Instead, this paper seeks to understand if the policymakers of Saudi Arabia will utilize oil as a geopolitical tool and if it will continue its decarbonization efforts.

Structure of the Thesis

This thesis starts by examining how oil can be understood within the realm of both geopolitics and geoeconomics. It then considers the role of the U.S. shale revolution and subsequent interplay with Saudi Arabia's oil export strategy following the Russian invasion of Ukraine in 2014. It considers economic and political factors in the kingdom's policy calculus and

attempts to answer the question of oil's geopolitical relevance at that time. The paper then covers the background of Saudi Arabia's decarbonization policies, considering the policies and initiatives presented in the country's immediate plans for decarbonization: the Saudi Arabia 2030 Vision, the Circular Carbon Economy framework, Saudi Green Initiative, and Middle East Green Initiative. This paper reviews Saudi Arabia's policies and themes shared at United Nations climate change conferences from 2018 to the present. The thesis then takes readers through how the energy landscape has been fundamentally altered by Russia's invasion of Ukraine in 2022 and the consequential energy crisis. The research explores the status of oil production and profitability since Russia's invasion of Ukraine in 2022, examining Saudi Arabia's export decisions, collaboration with the U.S., and response to European importers. The paper analyses how energy trade relationships have shifted, highlighting impacts on Russia's hydrogen aspirations. It then reviews the progress of Saudi Arabia's decarbonization policies through the conflict and considers the war's implications on the initiatives highlighted. Lastly, the paper seeks to assess Saudi Arabia's energy strategy in consideration of the changing geopolitical situation, covering Saudi Arabia's potential for hydrogen exports and its consideration of geoeconomic and geopolitical maneuvers. The conclusion is written to provide a summary of the analysis while also answering the main research questions to understand the geopolitical relevance of oil in the clean energy transition in the case of Saudi Arabia.

Chapter 2

The Connectivity of Oil and Geopolitics

Framing Oil As a Geopolitical Tool

As one of the most valuable commodities, oil has been a symbol of economic and political strength in the modern era. The fossil fuel era has witnessed oil being utilized for geopolitical purposes since the 20th century. Oil has been a central component of foreign policy as the world's most developed economies and the current permanent members of the U.N. Security Council are either major importers or top exporters of the resource (Hendrix, 2018, p. 5). This dependence on oil has enabled the commodity to retain paramount importance in global trade. While political relations have often dictated the energy trade among nations, fossil fuels, notably oil itself, have been used by countries to pursue geopolitical agendas. It is necessary to consider how the commodity is understood in the lexicon of international relations and refer to historical instances of its integration with geopolitics to verify the applicability of this geopolitical framing of fossil fuels.

Energy has not only established itself within the realm of geopolitics, but some have referred to it as belonging to the categorization of geoeconomics. This term, coined by Edward Luttwak, was used to describe how states find political power through economic rather than military means, with geoeconomics referring to the interaction of international geopolitics, strategy, and economics (Schneider-Petsinger, 2020). Scholars Mikael Wigell and Vihma Antto identify geoeconomics as an economic activity among states characterized by strategic interests beyond those found in commercial rationale, defining it as "the geostrategic use of economic power" (Wigell & Antto, 2016, p. 606). Authors and former civil servants Robert Blackwill and Jennifer Harris specifically identify energy as a central geoeconomic device (Schneider-Petsinger, 2020). However, the connectivity between energy exports and intended geopolitical effects as part of a comprehensive strategy largely depends on whether or not the exports are done in the public or private domain. The geoeconomic definition would apply to state-owned firms that enable nations to have economic power while also entailing political motives in trade strategies (Schneider-Petsinger, 2020). This definition may be more suitable for energy exports

as they are economic, entail a capacity for geopolitical use, and are often considered part of trade strategies. In this paper, we will continue to consider both terms as relevant, with the focus of the analysis being on how the economic actions of Saudi Arabia potentially contained geopolitical intentions. Furthermore, this thesis will focus on the relevance of oil being used for geopolitical purposes, even if it can also be understood as a geoeconomic device.

The integration of politics and energy has a long history. Although it can be challenging to determine which is more affected by the other, we can view their interplay through different periods by observing the following examples of how energy exports were used for geopolitical aims. In August 1941, the U.S. decided to enact a ban on oil exports to Japan to place pressure on the country for its invasion of Indochina, which then resulted in the Japanese military's attack on Pearl Harbor in December, marking the start of the war between both nations ("Oil Dependence," n.d.). During the Six Day War in 1967, the Middle East witnessed the engagement of Israel with Egypt, Jordan, and Syria in military conflict, which led to Arab countries placing oil embargos on nations, including the U.S., that maintained friendly relations with Israel ("Oil Dependence," n.d.). Former Acting Prime Minister of Russia and economist Yegor Gaidar believed that the fall of the Soviet Union was caused by Saudi Arabia's flooding of the oil market in September 1985 to drop prices and capture market share (Brower, 2014). Not only has oil been used as a geopolitical instrument to punish nations for their diplomatic support of other countries, but such use of these exports may have catalyzed some of the most significant political events of the 20th century. It is essential to differentiate between the former examples from the latter as Saudi Arabia’s decision to capture market share in 1985 may have been without political motivations but instead was driven by economic strategies. Wigell and Antto also identify how the Ukraine crisis in 2014 exhibited how President Vladimir Putin's geopolitical endeavors weakened Russia's geoeconomics due to damaged economic relations with Europe (Wigell & Antto, 2016, p. 607). This case illustrates the peculiar interplay between oil and geopolitics, one often affects the other, but an ambiguity of intentions can exist. These historical examples highlight both the geopolitical capability of oil exports and the willingness of some nations to pursue those interests through economic means.

The Shale Revolution

While historically, Russia and Saudi Arabia have held public perception as the leading players in the global energy game, the United States entered the arena with the "Shale Revolution" and lifting of crude oil export restrictions in December 2015. The revolution occurred as U.S. petroleum companies began utilizing technological developments to combine hydraulic fracturing with horizontal drilling. These techniques brought dramatic increases in output and led to the United States becoming the top producer of crude oil in 2018, overtaking Russia and Saudi Arabia (Ward, 2020).

Table 1

The three largest oil producers and share of total world oil production in 2018

Country	Millions of barrels per day	Share of the world's total
United States	17.94	18%
Saudi Arabia	12.42	12%
Russia	11.40	11%

Note. Adapted from *The Saudi Arabia-Russia oil war, explained*, by A. Ward, 2020 (https://www.vox.com/2020/3/9/21171406/coronavirus-saudi-arabia-russia-oil-war-explained).

In a review of the changes in U.S. energy policies, the International Energy Agency heralded the United States as the "world's top oil and gas producer and a leading exporter for the fuels" with exports of LNG and technological advancement in renewable energy and carbon capture technologies assisting nations in pursuing the energy transition ("The US shale revolution," 2019). While some energy experts viewed the lifting of the U.S. ban on oil exports to have largely inconsequential geopolitical impacts, several European nations were keen to diversify their fuel imports with U.S. oil (Levi, 2015). This would have allowed these nations to lower their economic dependence on Russia, improving their political mobility should relations with Russia sour. The success of U.S. petroleum suppliers in the global market may have occurred purely due to economic circumstances, but even without intentions in policymaking, such changes in the global oil market had potential geopolitical implications.

A Potential Response to the Invasion of Crimea in 2014?

As news reports cover the political fallout Saudi Arabia is experiencing with the U.S. due to an announcement that OPEC will be reversing its earlier decision to increase oil output, this may give credit to earlier speculation that the kingdom and the U.S. had moments of collusion to use fuel exports for geopolitical ends. One moment of such suspected U.S. involvement in the export decisions of Saudi Arabia happened following Russia's invasion of Crimea in 2014. While public government statements have not confirmed this, an overview of the political and economic landscape at the time may help to clarify potential policy considerations for Saudi Arabia to maintain high levels of oil output. At the same time, the price significantly declined, leading to economic losses for hydrocarbon producers.

In 2014, crude oil prices plunged from $110 per barrel in June to $75 in November ("Oil Dependence," n.d.). Although OPEC members sought to slow production to curb the falling price, Saudi Arabia urged the cartel to hold production at the current levels ("Oil Dependence," n.d.). A few months later, in early 2015, prices fell further to $50 per barrel, resulting in economic losses for oil-producing states and companies ("Oil Dependence," n.d.). Russia, which had fossil fuels comprising nearly 70% of its exports, needed the price of oil to be around $100 per barrel for the sale of the commodity to retain profitability (Elliott, 2014). These dramatic price shifts caused economic pain for Russia and Saudi Arabia, which urged OPEC members to keep production levels and continue the disadvantageous price for oil suppliers.

Russian and Saudi officials have publicly stated that their decision for production has only been reflective of economics and devoid of geopolitical intentions (Mazzetti et al., 2015). However, they have also expressed musings on how the low oil price could open up diplomatic channels to make progress on some of their foreign policy interests, including influencing Russian involvement in the Syrian civil war (Mazzetti et al., 2015). As this period witnessed both the Russian annexation of Crimea and the ongoing civil war in Syria, it may be that these political musings by Saudi officials were also complemented by U.S. interests to inflict economic damage on Russia as retribution for Ukraine. In 2014, some analysts believed that the lowered price of oil was precisely for this purpose—to punish Putin for the ongoing conflict in

Ukraine (Elliott, 2014). However, this perception of the events continues to be disputed, with experts emphasizing various economic and political factors.

At the same time, the energy chessboard was altered by the emergence of the U.S. as a significant oil and natural gas exporter. Perhaps these changing economic circumstances were more prominent factors in Saudi Arabia's energy strategy than any potential geopolitical incentives. The shale revolution threatened Saudi Arabia's global market share as U.S. suppliers began to produce low-priced natural gas, realize low production costs, and increase the number of hydrocarbon exports (Alhajji, 2015). The kingdom's decision to lower the global oil price was likely to undermine investment prospects for U.S. shale energy production (Alhajji, 2015). Some experts have concluded that the motive of Saudi Arabia to keep prices low was an effort to restore coordination among OPEC member countries (Goldwyn, 2015). This pattern appears to emerge where Saudi Arabia reigns in other oil exporters when they begin seeing themselves disadvantaged as the swing producer. While this may be the prime goal, it brings into question why Saudi Arabia decided to have OPEC members maintain high production levels during the low oil prices in November 2014, especially as those countries appeared to be following Saudi Arabia's lead at the time. It may be that the kingdom wanted to prove how far it was willing to go to guarantee compliance and cooperation among OPEC members. Alternatively, or simultaneously, Saudi Arabia sought to pressure U.S. suppliers as the export ban was lifted to keep them from gaining considerable market share. The low oil price appears to have had that effect, with U.S. oil producers slowing operations (Lindsay & Jaffe, 2020). Concurrently, Saudi Arabia was able to take back global market share from non-OPEC suppliers (Lawler, 2015). It was apparent that Saudi Arabia viewed U.S. suppliers and their capture of global market share as a legitimate threat to its economic interests.

However, the frustration expressed by U.S. officials, including President Biden, saying there will be "consequences for what they have done with Russia" (Baker, 2022) after diplomatic visits to Saudi Arabia appears to showcase how surprised the U.S. about the kingdom not increasing production to both benefit Europe and punish Russia in 2022. This nearly emotional response gives credit to the theory that both countries had an ongoing history of coordination regarding Saudi Arabia's fuel exports.

Some energy experts believe that Saudi Arabia is pursuing a multi-pronged energy strategy. While it is argued that the central motivation was likely to protect its market share and hinder the growth of U.S. petroleum companies, the political gains of disadvantaging other hydrocarbon exporters, notably Russia, Iran, and Venezuelan, were concurrently achievable (Alhajji, 2015). While the policy calculus of Saudi Arabia during these political and economic circumstances is not precisely known, it is noteworthy that the nation's energy production strategy directly resulted in economic losses for itself and other countries dependent on oil exports. What could not be known at the time is how the events of 2014 to 2016 would lend themselves to the dynamic transformation of Saudi Arabia as it gained new leadership and the world promised to protect future generations from the worsening climate crisis.

Chapter 3

Background of Saudi Arabia's Decarbonization Policies

In 2015, the world came together to sign the historic Paris Agreement bringing hope that a decarbonized future was attainable. The same year, Saudi Arabia received a new and ambitious crown prince, Mohammed bin Salman. His dynamic leadership brought societal and economic change, giving the country a path forward in the decarbonization era.

Saudi Arabia 2030 Vision

Through the introduction of the Saudi Arabia 2030 Vision in 2016, the kingdom has been establishing various initiatives to evolve its economy and society. The vision aims to build upon Saudi Arabia's position as the home of Islam, a retainer of immense investment power, and geographic location to achieve three themes: be an ambitious nation by improving efficacy in governance and promoting social responsibility; have a thriving economy through diversification, growth, and increased participation in the workforce; realize a vibrant society by enhancing its national and Islamic identify and enabling citizens to live healthy and satisfying lives ("Vision 2030," n.d.). This vision for the nation was "drawn up" by Crown Prince Mohammed bin Salman who entered into his appointed position in April 2015, just one year prior to the launch of the Saudi Arabia 2030 Vision. Just as the kingdom experienced this change in leadership, it also received this national plan as the foundation for many of the kingdom's subsequent policy initiatives, including those conceived for decarbonization efforts. It remains a hallmark of the crown prince's newfound authority and his steering of the nation.

According to the official government materials, the vision was conceived with sustainability being a core tenet ("A Sustainable Saudi Vision," n.d.). Within this pillar of sustainability, the 2030 Vision seeks to "accelerate the energy transition, achieve sustainability goals, and drive a new wave of investment" ("A Sustainable Saudi Vision," n.d). A key sustainability target identified in the Saudi Vision 2030 Document is establishing a renewable energy market to generate 9.5 gigawatts of renewable energy. In total, the renewable power projects in development are excepted to provide enough electricity to reduce emissions by 8

million tons per year (“A Sustainable Saudi Vision,” 2021). Alongside this push for alternative energy sources, Saudi Arabia has also announced objectives to help make its economy less dependent on fossil fuel exports. The 2030 Vision includes non-oil revenue comprising nearly 59% of the kingdom’s GDP (“Economy & Business,” n.d.). The 2030 Vision is multifaceted in its approach; it aims for sustainability in energy production and economic opportunity for a nation that historically has its economic health directly linked to the price of crude oil. As the Saudi Vision 2030 was released in 2016 and is designed to encourage the pursuit of revenue apart from fossil fuels, it can be seen that this government initiative may have been primarily prompted by the fall of oil prices in 2014 (Grand & Wolff, 2020). As the 2030 Vision may be directly linked with the expectation that oil exports will provide diminishing returns in the future, it can be surmised that the primary purpose of this vision is to protect Saudi Arabia's economy from future market shocks. To protect these interests, Saudi Arabia is building up its capability to expand its energy exports beyond hydrocarbons, namely "green energy" innovations, including blue hydrogen, green hydrogen, and carbon capture, utilization, and storage (CCUS) technology. While blue hydrogen is considered a low-carbon fuel as it is produced with natural gas and carbon capture technology, green hydrogen is recognized as a low or zero-carbon resource produced with electricity from renewable sources. Carbon capture, utilization, and storage (CCUS) technologies are those that capture carbon dioxide, commonly at industrial facilities, to then utilize them for various purposes or store it underground to prevent emissions from either escaping into or remaining in the atmosphere (“About CCUS,” 2021).

The Circular Carbon Economy Framework

In 2020, Saudi hosted the annual G20 summit in Riyadh. It promoted the concept of the Circular Carbon Economy (CCE) framework, which is composed of four pillars centered on carbon dioxide: reduce, reuse, recycle, and remove.

Table 2

Reduce	Reuse	Recycle	Remove
Reducing the amount of carbon entering the system	Reusing carbon without chemical conversion	Recycling carbon with chemical conversion	Removing carbon from the system
• Energy and materials efficiency • Renewable energy, including hybrid use with fossil fuel • Nuclear energy, including hybrid use with fossil fuel • Advanced ultra-super-critical technologies for coal power plants • Hydrogen (blue/green) fuel cells for long-distance heavy-duty vehicles • Ammonia produced from zero-carbon hydrogen (blue/green) for power generation and ships • Direct reduction in steel making by using CO_2 free hydrogen (blue/green)	• Carbon capture and utilization (CCU) • Use CO_2 at carbon utilization facilities, such as at greenhouses for enhancing crops • Bio-jet fuels with reed beds • Algal synthesis	• CCU • Artificial photosynthesis • Bioenergy recycle in the pulp and paper industry • Bioenergy with carbon capture and storage • Carbamide (urea production using CO_2 as feedstock) • Coal ash concrete curing with absorbing CO_2 • Electrochemical reduction of CO_2 • Fine chemicals with innovative manufacturing processes and carbon recycling • Fischer-Tropsch exothermic of carbon dioxide with hydrogen syngas • Hydrogenation to formic acid • Oil sludge pyrolysis • Sabatier synthesis (CO_2 methanation: exothermic of carbon dioxide with blue/green hydrogen) • Thermal pyrolysis	• CCS • Direct air capture (DAC) • Carbon dioxide removal • Fossil fuels-based blue hydrogen

Note. From *A carbon management system of innovation: Towards a circular carbon economy*, by N. Y. Mansouri et al., 2020 (https://www.g20-insights.org/policy_briefs/a-carbon-management-system-of-innovation-towards-a-circular-carbon-economy/).

Saudi Arabia is progressing on each pillar of the framework. Although the country plans to have renewables cover 50% of its domestic energy mix, it has been switching to less carbon-intensive fuels in its domestic electricity generation. Saudi Arabia's Public Investment Fund, Saudi Aramco, and ACWA Power joined together to invest in the $900 million Sudair Solar project, which is expected to produce 1.5 gigawatts of electrical power, fulfilling the majority of domestic renewable energy needs (Lee, 2021). The country is constructing a green hydrogen plant in NEOM capable of producing 1.2 million tons of green ammonia yearly (Shehri et al., 2022). In parallel with the policy ambition announced by Saudi Arabia, the country is committing itself to having the infrastructure and production capacity needed to capture a sizable portion of the green hydrogen market.

The Saudi Green Initiative and the Middle East Green Initiative

Launched in 2021, the Saudi Green Initiative set out additional decarbonization targets for the country to build upon the initial sustainability goals of the Saudi Vision 2030. As part of its inception, the kingdom declared that it would achieve carbon neutrality by 2060. The Saudi Green Initiative also includes the hallmark climate goals for the country to achieve by 2030. Its objectives include reducing carbon dioxide emissions by over 278 million metric tons per annum, having renewable energy comprise 50% of domestic electrical power generation capacity, planting 450 million trees, and contributing to the Global Methane Pledge ("Saudi Green Initiative," n.d.). The country is pursuing five pathways: renewable energy investment; energy efficiency; carbon capture, utilization, and storage; improving waste management; and becoming the top exporter of "clean hydrogen" to reach these decarbonization targets("SGI target," n.d.). While the original Saudi Arabia 2030 Vision emphasized renewable energy as its focal point for non-oil economic transformation, the Saudi Green Initiative reinforces that goal while also introducing alternative methods of decarbonization.

The purpose of the Middle East Green Initiative is to rally political momentum for sustainability in the region. It is endorsed by: Algeria, Bahrain, Brazil, Chad, China, Djibouti, Egypt, France, Greece, India, Iraq, Italy, Jordan, Kuwait, Libya, Morocco, Oman, Pakistan, Palestine, Qatar, the Russian Federation, Saudi Arabia, South Africa, Sweden, Tanzania, Tunisia, the United Arab Emirates, the United Kingdom, the United States, and Yemen ("MGI: powering regional climate," n.d.). The initiative desires to have regional actors collaborate to reduce the emissions of fossil fuel production by 60% by adhering to the CCE framework; developing a regional carbon capture, utilization, and sequestration hub; investing in green technologies; and encouraging the use of cleaner fuels for cooking ("MGI target," n.d.). As Saudi Arabia is leading this initiative to encourage other countries in the region most famous for fossil fuel exports to lower their emissions, it appears that Saudi Arabia's interests lie in transforming the global energy sector. While these policy motives may be economically driven, it must be recognized that investment in such a multilateral partnership is genuine in its efforts to change how fossil fuel exporters pollute the climate.

Saudi Arabia at COP24 to COP27

In recent years, Saudi Arabia has hosted side events at the annual U.N. Climate Change Conference. At the 2018 United Nations Climate Change Conference in Katowice, Saudi Arabia sponsored events on the topics of carbon capture, utilization, and storage (CCUS). Side events covered the kingdom's current CCUS capabilities and how it can be used for enhanced oil recovery (EOR), which allows petroleum producers to extract more oil from reservoirs. CCUS technologies not only can be used to continue fossil fuel production by capturing carbon emissions but also to extend the extraction of fossil fuels themselves. Rather than replacing fossil fuel exports, the side events at this conference highlighted how hydrocarbons could be more efficiently produced with the integration of CCUS technologies.

The 2021 United Nations Climate Change Conference in Glasgow took place alongside key climate initiatives announced by Saudi Arabia. These included the carbon neutrality by 2060 commitment, Saudi Green Initiative, Middle East Green Initiative, and the Circular Carbon Economy framework to spend $187 billion on climate goals to reduce annual carbon dioxide emissions by 278 million tons by 2030 (Al-Atrush et al., 2021). Saudi Arabia also announced plans to produce 4 million tons of green and blue hydrogen and develop a CCUS facility to capture 44 million tons of carbon emissions annually by 2030 ("Saudi Arabia – High-level Segment," n.d.). In matching these ambitions, the kingdom also exhibited how important the ruling family views these annual conferences by having Crown Prince Mohammed bin Salman attend (Holleis, 2021). The conference witnessed Saudi Arabia and the United Arab Emirates (UAE) declaring that there must be a balance of environmental policies, energy security, and economic development (Wang, 2021). Both countries emphasized developing carbon capture capabilities rather than limiting hydrocarbon production to keep fuel prices affordable for less developed economies and streamline the energy transition (Wang, 2021). In line with this, Saudi Arabia committed $10 billion to fund the development and deployment of technology associated with the CCE framework across Africa, the Middle East, and developing countries to "ensure that the kingdom maintains and enhances its leadership role in promoting the security and stability of energy markets" (Wang, 2021). Although Saudi Arabia claims it can produce oil at some of the lowest production costs and emissions levels globally, Saudi Aramco announced it would become carbon neutral by 2050 (Al-Atrush et al., 2021). At the same time, Aramco

announced it would increase crude oil production by an additional one million barrels per day by 2027 (Holleis, 2021). The concluding words of the Saudi speech during the high-level segment at the conference stated, "It is imperative that we recognize the diversity of climate solutions, and the importance of emissions reduction as stipulated in the Paris Agreement, without any bias towards or against any particular source of energy" ("Saudi Arabia – High-level Segment," n.d.) exhibits how its policies are encouraging the development of decarbonization technologies while keeping fossil fuel exports available. At the conference, Crown Prince Mohammed bin Salman announced that the country would maintain its position as a leading producer of fossil fuels (Al-Atrush et al., 2021). It appears the Saudi Arabian position is fixated on developing technology that can complement the export of fossil fuels rather than replace the sector altogether.

Alongside COP27 in November 2022, Saudi Arabia hosted the second Middle East Green Initiative Forum and Saudi Green initiative Forum, which held the tagline "from ambition to action" ("Saudi Green Initiative Forum," n.d.). Crown Prince Mohammed bin Salman announced that the country scaled up its NDCs, pledging that 278 million metric tons per annum would be reduced by 2030 and that the Public Investment Fund would become carbon neutral by 2050 ("HRH the Crown Prince," 2022). It was also stated that the kingdom is on track to achieve its 2030 reduction goal as $9 billion is being used to finance the development of 13 renewable energy projects with a combined capacity of 11.4 gigawatts ("Saudi Arabia accelerates," 2022). The kingdom reiterated its aspiration to become the world's leading low-cost producer of low and zero-carbon hydrogen. Also, it announced that it would launch an emission crediting and offsetting scheme next year to promote investment in reduction and removal efforts.

The diplomatic messaging at this year's conference was noticeably emboldened. Saudi Arabia's Minister of Energy, Prince Abdulaziz bin Salman said, "We want people to match us, and we want to make sure people put their money where their mouths are" (El Safty & Lewis, 2022). Such strong language may reveal that Saudi Arabia is positioning itself to benefit from the global energy transition. It was also announced that Saudi plans to continue to export oil, liquid gases, electricity, and hydrogen while simultaneously endeavoring to capture 44 million tons of carbon dioxide by 2035. As part of this ambition, Saudi Aramco and the kingdom are developing one of the largest carbon capture and storage hubs, which is expected to be able to hold 9 million

tons of captured carbon dioxide annually (El Safty & Lewis, 2022). Suppose global decarbonization entails Saudi Arabian hydrogen exports being part of the global energy mix. In that case, Saudi Arabia may be economically incentivized to promote this global responsibility to decarbonize. These efforts support the hypothesis that Saudi Arabia believes in keeping fossil fuels in the energy mix to support a stable energy transition or to simultaneously export low and zero-carbon hydrogen and fossil fuels as long as demand exists.

Low and Zero-Carbon Hydrogen Aspirations

A theme appears throughout these policy initiatives: Saudi Arabia earnestly seeks to develop its hydrogen production and export capabilities. The CCE framework is impactful as it aligns the interests of fossil fuel exporters with carbon-neutral strategies (Shehri et al., 2022). It allows energy producers like Saudi Arabia to cater to changes in the market with planned development in clean energy, including green and blue hydrogen and ammonia, while concurrently utilizing fossil fuels to produce those next-generation energies with CCUS technology. Saudi Aramco has announced that it expects to hold a large share of the global blue hydrogen market starting in 2030 (Martin et al., 2021). As Saudi Arabia's domestic oil production process emits among the lowest carbon dioxide emissions (Shehri et al., 2022), the country is well positioned to utilize its existing fossil fuel capabilities to produce blue hydrogen, depending on the development of carbon capture technologies. As the production cost of renewable energy and electrolyzers is expected to decrease, Saudi Arabia's production cost of green hydrogen could reach $1.50 per kilogram by 2030 and drop below $1 per kilogram by 2050 (Hasan & Shabaneh, 2022). Depending on domestic natural gas prices, blue hydrogen could be produced at $1.14 per kilogram by 2030 (Hasan & Shabaneh, 2022). Saudi Arabia has substantial potential to generate renewable energy and plans to have solar power supply 27 gigawatts of electricity by 2023 and nearly 58 gigawatts by 2030 (Nakano, 2022). Not only will it increase its capacity for renewable power, but the country is also breaking records as the price of solar generation is among the lowest in the world. In 2021, a solar energy plant in Saudi Arabia sold electricity at a world record low of 1.04 cents per kilowatt (Carpenter, 2021). As Saudi Arabia builds up its renewable energy infrastructure, the framework also enables it to take advantage of its potential as a solar-power producer for uses such as water desalination and green hydrogen production. As of September 2019, Saudi Aramco boasts the world’s lowest crude oil

production costs at $2.80 per barrel (Eaton, 2019). To replace oil with hydrogen and ammonia as key next-generation energy exports, Saudi Arabia must realize sufficient economic incentives to make the switch. Its existing dominance of low-cost and low-emissions fossil fuel production and its potential to generate substantial renewable energy enables the country to be in a suitable position to be a forerunner in the development of both blue hydrogen in the short term leading up to the production of green hydrogen in the future.

Saudi Arabia is preparing to have a substantial production capacity to export blue and green hydrogen. By 2030, it expects to have the ability to produce 2.9 million tons of hydrogen annually before reaching a capacity of 4 million tons by 2035 (Nakano, 2022). The premier $5 billion green hydrogen facility in NEOM is expected to produce 1.2 million tons of green hydrogen annually, which equates to 5 million barrels of oil annually (Nakano, 2022). It is important to note that this annual level of hydrogen production is far below daily crude oil production in Saudi Arabia, which is currently at approximately 12 million barrels (Nakano, 2022). Saudi Arabia is developing partnerships in anticipation of the demand for hydrogen rising. Saudi Aramco signed a memorandum of understanding with South Korea's Hyundai Oilbank Company, which includes plans for South Korea to import liquified petroleum gas before returning carbon dioxide to Aramco after the hydrogen conversion process (Nakano, 2022). Saudi Arabia's Public Investment Fund is also considering investing in Thyssenkrupp AG's hydrogen project (Henning et al., 2022). Saudi Arabia and Japan joined together in the comprehensive Saudi-Japan Vision 2030. The initiative outlined pathways of cooperation on the development and testing of hydrogen; ammonia; and carbon capture, utilization, and storage (CCUS) ("Saudi Japan Vision 2030," 2020). The vision document also included plans for a “supply network demonstration” of blue ammonia(“Saudi Japan Vision 2030,” 2020). This project was achieved in 2020 as a shipment of 40 tons of blue ammonia arrived in Japan from Saudi Arabia (Kumagai, 2021). In addition to cooperation in the public sector, private companies are also establishing trade partnerships based on this next generation of clean energy. Japan's largest refiner, ENEOS, entered into a memorandum of understanding with Saudi Aramco to develop a hydrogen and ammonia supply chain (Kumagai, 2021). If low and zero-carbon hydrogen or ammonia are met with substantial demand, Japan and Saudi Arabia are at the forefront of developing a supply chain from the Middle East to East Asia.

Regional Competition Fostering Decarbonization

While Saudi Arabia is committing itself to regional partnerships to reduce carbon emissions, competition is emerging. The leading competitor is Saudi Arabia's neighboring country, the United Arab Emirates. The UAE is well positioned to lead in the region's decarbonization efforts as it is home to the International Renewable Energy Agency (IRENA) and was the first Arab nation to announce a carbon neutrality target by 2050 (Gibney, 2022). As of November 2021, the UAE committed $163 billion to fund renewable energy-related investments (Saadi, 2021). The UAE is also emphasizing CCUS technologies. Its net-zero strategy includes coal-fired power equipped with CCS capabilities in its energy mix (Gibney, 2022). The UAE has announced its goal to capture 25% of the global hydrogen market by 2030 (Al-Atrush, 2022). At COP26, the country vocalized its ambition to be a leader in hydrogen and described it as the "energy carrier of the future" (Ansari, 2022). Since 2021, the UAE has been operating the Middle East's first green hydrogen plant (Ansari, 2022). Like Saudi Arabia, the UAE collaborates with Japan on low and zero-carbon energies. As of August 2021, the UAE sent its third shipment of blue ammonia to Japan (Di Paola, 2021). In addition, ADNOC, like Saudi Aramco, is pursuing long-term trade contracts with Japan and South Korea (Di Paola, 2021). The UAE also considers India and Germany potential key hydrogen import countries (Saadi, 2021). In addition, the UAE is pursuing nuclear power development. While Saudi Arabia has been making arrangements to construct nuclear power reactors, the UAE has the most advanced nuclear energy plant in the Middle East (Ibraheem, 2022). This capacity may give the UAE a substantial advantage in the regional competition to decarbonize and export carbon-neutral energy. Recently, Saudi Arabia opened the Middle East's first carbon market, and the UAE is quickly following suit by establishing another voluntary carbon market in the region (Tamo & Ratcliffe, 2022). While Saudi Arabia is set to construct the world's largest green hydrogen production facility, the UAE is advantageously positioned with its operational green hydrogen plant and the region's most advanced nuclear power plant.

Just weeks after the Russian invasion of Ukraine in 2022, the UAE made a deal with Aurubis AG to send shipments of blue ammonia to Germany (Ratcliffe, 2022). In 2021, the German-Saudi Energy dialogue was held, and a memorandum of understanding was made

between the two countries to promote the trade of green hydrogen and the integration of German technology in Saudi Arabian hydrogen facilities (Ansari, 2022). While a Germany-Saudi hydrogen diplomacy office was established as part of the dialogue, the UAE set up a joint task force with Germany as a result of similar talks (Ansari, 2022). Beyond import agreements, the UAE entered into the Partnership for Accelerating Clean Energy (PACE) with the U.S. in November 2022 to bring about 100 gigawatts of clean energy via $100 billion in clean energy investments in the respective countries and emerging economies ("FACT SHEET: U.S.-UAE Partnership," 2022). Notably, the investments include CCUS technologies and nuclear power development. The desire for leadership in hydrogen production, especially green hydrogen, may motivate Saudi Arabia and the UAE to compete for market dominance. As the two countries seek agreements with the same potential import partners, namely Japan, South Korea, and Germany, consumer demand may overshadow available supply, allowing both the UAE and Saudi Arabia to sell hydrogen at favorable rates.

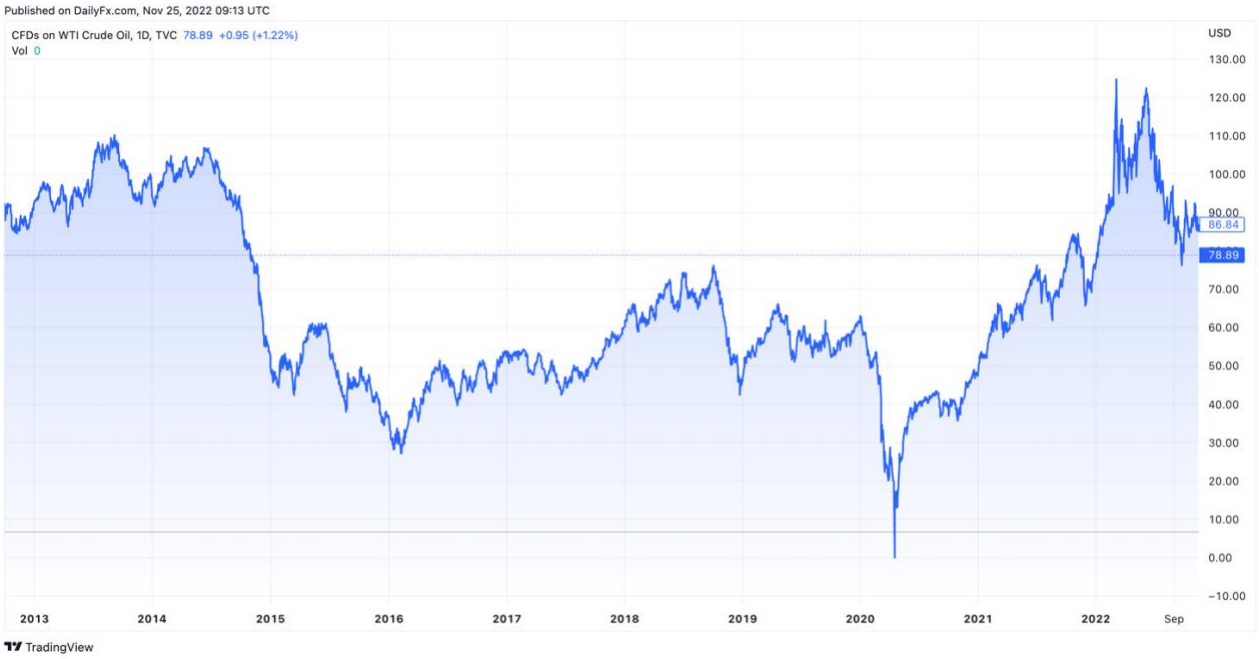
Amidst this regional competition, some plans for cooperation have been pursued. The Emirati company Helios is collaborating on the construction of solar energy infrastructure in the Saudi city of NEOM (Ansari, 2022). Crown Prince Mohammed bin Salman reached several hydrogen development-related agreements with Oman (Ansari, 2022). The Saudi Arabia-based company Alfanar signed a memorandum of understanding to construct a $3.5 billion green hydrogen plant in Egypt (El Safty, 2022). It has yet to be seen if a mutual partnership or competition will become hallmarks of the Middle East hydrogen export industry. With the region becoming home to industry-leading projects and facilities, the incredible potential exists to co-develop hydrogen production plants and cooperate in infrastructure development, enabling exporters to reach consumer countries abroad. As Saudi launched the Middle East Green Initiative, it appears incentivized to encourage collaboration on Circular Carbon Economy-related technologies with regional partners. Whether met with collaboration or competition, either would motivate Saudi Arabia further to develop its hydrogen potential.

Chapter 4

The New Landscape: A Price War and An Energy Crisis

Since 2014, oil prices have experienced severe volatility, especially during the price war and the ongoing energy crisis. The below chart shows the price of West Texas Intermediate crude oil from 2013 up until the present. The collapse of prices in 2014 and 2020 is evident. Since that time, the price has been surging.

Figure 1



Note. Adapted from *Crude Oil Prices Today*. 2022. (https://www.dailyfx.com/crude-oil).

The 2020 Russia-Saudi Arabia Oil Price War

Due to the pandemic, the global oil market experienced dwindling demand in early 2020. As petroleum-exporting countries considered how to respond, divisions ensued, with Russia choosing its output levels independent of the Organization of the Petroleum Exporting Countries Plus (OPEC+), which materialized in 2016 to guide coordination among oil-exporting countries,

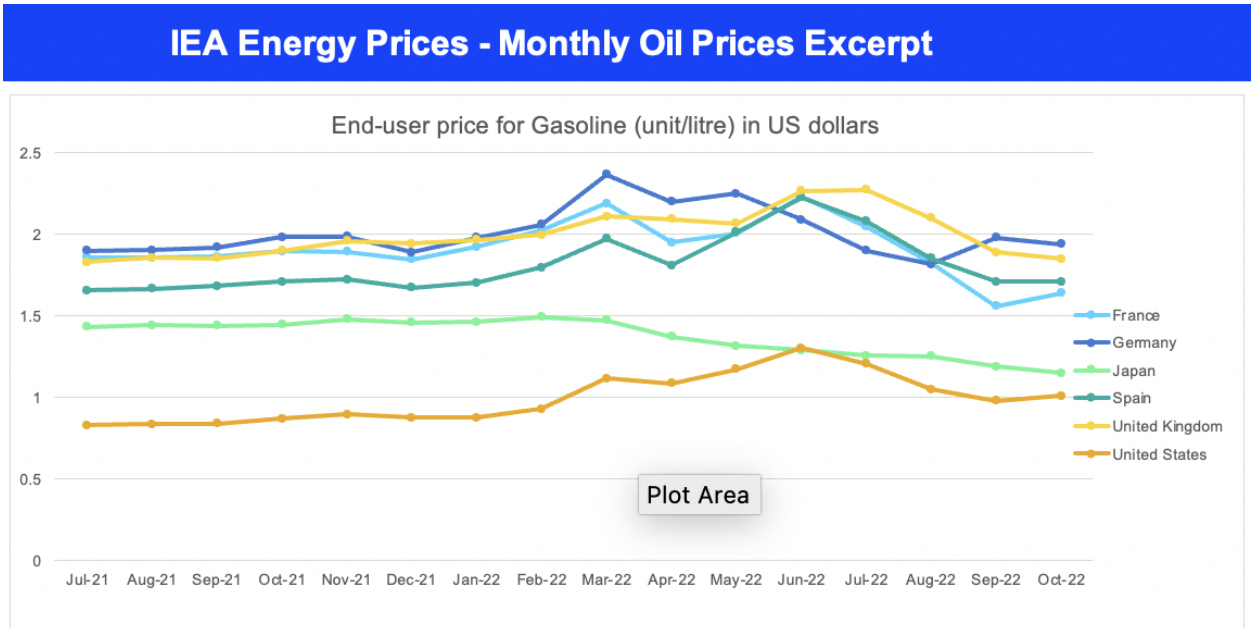
including Russia. Some experts predicted that Russia chose to detach itself from OPEC+ output determinations to gain market share, capturing it from U.S. exporters and selling more to Asian markets (Ward, 2020). In March, a price war erupted, with both nations competing to prove which economy was most resilient to low oil revenues (Blas, 2022). This economic skirmish was waged by Saudi Arabia, which decided to substantially increase output and offer discounts ever on its crude oil in expectation of bringing Russia back into agreement with the output decisions of OPEC+ as member countries individually determined their production levels (Blas, 2022). Within two weeks, Saudi Arabia's actions led to a collapse of the oil price, bringing it down by 40% (Blas, 2022). This effort successfully resulted in Russia signing an agreement with Saudi Arabia and returning to cooperate on OPEC+, exhibiting how the Russian economy is more vulnerable to low fossil fuel prices than Saudi Arabia's (Blas, 2022). As Russia came together with Saudi Arabia and other oil exporters to cut production levels, prices continued to drop (Reed & Krauss, 2020). The West Texas Intermediate crude price fell below $0 for the first time in history to nearly negative $40 (Herron et al., 2022). This episode marked how far Saudi Arabia is willing to go to hold together OPEC+ members in their oil production and output directives. However, the resulting price plunge shows how they may have miscalculated their aggressive price war strategy. Although favorable oil revenue levels have returned recently, the memory of negative oil prices may continue to influence Saudi Arabia's export strategy for the foreseeable future.

The Invasion and Resulting Energy Crisis

Russia's invasion of Ukraine in 2022 radically altered the global fossil fuel market, shifting trade partnerships and boosting profitability for top exporter countries. In 2021, while economic activity was returning following the slowdown caused by the pandemic, Russia began curbing gas exports to Europe, leaving the continent with insufficient quantities of fuel ("Global Energy Crisis," n.d.). As sanctions were enacted and Europe sought to decouple itself from Russian energy import dependence, it looked to other energy exporters. It offered to pay higher prices for liquified natural gas (LNG) sourced from other exporters, including the U.S., Qatar, and Australia, which then disrupted supply chain networks in other parts of the world, notably Asia ("Global Energy Crisis," n.d.). Concurrently, the shift in trade networks due to Western sanctions and countries refusing to buy Russian energy exports led to oil prices escalating

("Global Energy Crisis," n.d.). The chart below shows how the end-user gasoline price was affected in select countries of Europe, Japan, the United Kingdom, and the United States.

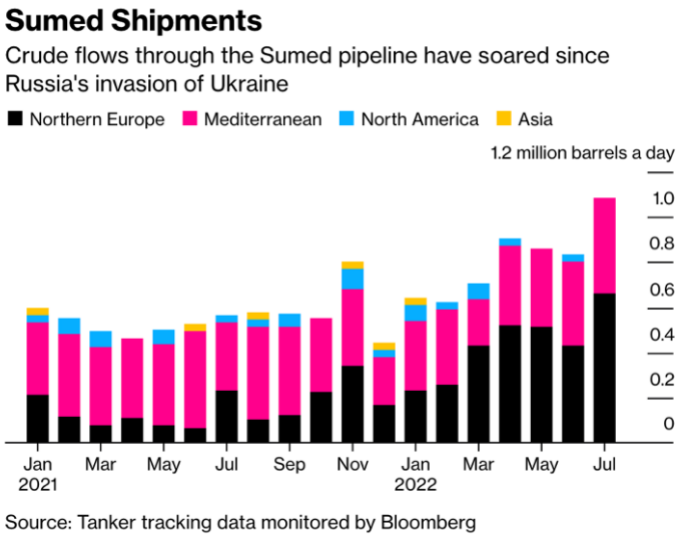
Figure 2



Note. Adapted from *Monthly Oil Price Statistics*. 2022 (https://www.iea.org/data-and-statistics/data-product/monthly-oil-price-statistics-2).

As of June 2022, Middle Eastern oil flows, mainly from Saudi Arabia and Iraq, to Europe have risen by almost 90% since January (Longley & Lee, 2022). In September 2022, Saudi Arabian oil exports to Europe reached 950,000 barrels per day, compared with 190,000 barrels daily in September 2021 (Wilson, 2022). The below graph shows the change in crude oil flows through the Sumed pipeline from the Middle East to Europe.

Figure 3



Note. From *Saudi Arabia and Iraq Come to the Aid of Europe's Oil Refiners* by A. Longley & J. Lee, 2022 (https://www.bloomberg.com/news/articles/2022-07-22/saudi-arabia-and-iraq-come-to-the-aid-of-europe-s-oil-refiners).

In the second quarter of 2022, Aramco experienced record-high revenues of $48.4 billion, which was a 90% increase over the same period in the previous year (Gibney, 2022). Saudi Arabia is also expecting the high profitability of oil to contribute to the projected $298 billion in 2023 government revenue and GDP growth of 8.6% in quarter three of 2022 (El Safty, 2022). This situation is a dramatic change from the status of the oil export market of 2020, whereby the pandemic and lowered fuel demand caused substantial pain for the Saudi Arabian economy (Grand & Wolff, 2020). Likewise, it was predicted that Russia would earn substantially more from oil revenues this year than the previous year (Potter, 2022), even with sanctions and lowered output to longtime energy partners in Europe. The energy crisis is improving Saudi Arabia's and Russia's financial lifelines.

Throughout the war in 2022, Western nations have approached Middle East energy exporters to increase their production output to offset Russian hydrocarbons. President Biden traveled to meet with Crown Prince Mohammed bin Salman to seek assurances from the kingdom regarding oil production levels. It is debatable if the U.S. strategic priority in the lobbying efforts was for lowering oil prices to stabilize markets, bringing additional economic

retaliation against Russia for its actions in Ukraine, or both. Such requests have been met with mixed responses. After the U.S. and other consumer countries made requests during the summer of 2022, Saudi Arabia increased oil production to 11 million barrels a day, leading to a lowering in the price of Brent crude futures from $120 per barrel in June to $95 per barrel by the end of summer (Smith, 2022). As diplomatic efforts were underway to convince OPEC to increase its oil output, OPEC member countries initially agreed to a slight increase (Gibney, 2022). However, they then moved in the opposite course of action to limit the output further in early October (Gibney, 2022). According to a *Wall Street Journal* article, the UAE sent its national security adviser, Sheikh Tahnoun bin Zayed Al Nahyan, to meet with Saudi officials and vocalize concerns that a decline in oil production could have negative, geopolitical consequences (Said & Nissenbaum, 2022). According to the article, the UAE publicly supported the decision to decrease oil output while signaling to the U.S. that it could increase production if necessary. Reportedly, Saudi officials communicated their concerns to the UAE and U.S. that a price collapse was imminent unless production was reduced (Said & Nissenbaum, 2022). Perhaps still traumatized by the price collapse in April 2020, Saudi Arabian policymakers may be more cautious about pricing expectations. However, it must be recognized that a decision to lower oil output economically benefits hydrocarbon-exporting nations, including both Saudi Arabia and Russia (Krauss, 2022). U.S. officials suspect that a critical moment that changed Crown Prince Mohammed's decision was when he met with Energy Minister Prince Abdulaziz, who warned that failing to lower production could lead to oil prices dropping to $50 per barrel, which would undermine the economic diversification projects, including decarbonization initiatives (Mazzetti et al., 2022). They also theorized that Russia could have convinced the kingdom of the value of its cooperative relationship (Mazzetti et al., 2022). The decision to increase output was likely driven by economic considerations and the crown prince's desire to protect the country's decarbonization prospects and the lifeline of oil revenues.

In contrast to the claims of stabilizing markets, the IEA stated that the rising oil prices might serve as "the tipping point for a global economy already on the brink of recession" (Elhamy & Abd-Alaziz, 2022). According to Goldman Sachs research, OPEC had never cut production in the last two decades when reserves in OECD countries were this low. However, OPEC lowered output when the market experienced weakened demand. OPEC, the International

Energy Agency, and the U.S. Energy Department all forecast reduced demand for 2023 (Elhamy & Abd-Alaziz, 2022). By 2023, it is estimated that Russia's oil output could be lowered by 20% to 30% (Kozhanov, 2022). Reportedly, Saudi Arabia may anticipate that additional sanctions will be enacted on Russia, further limiting the output of Russian fossil fuels (Tani & Wilson, 2022). If this happens, Saudi Arabia may position itself to keep some excess oil production capacity in reserve (Tani & Wilson, 2022). Additionally, the Chief Executive of Saudi Aramco, Amin Nasser, cautioned that additional production capacity would be needed if China relaxes its pandemic restrictions, economies improve, or the aviation industry re-awakens (Tani & Wilson, 2022). An additional benefit to not increasing production output is that maintaining a high price would attract investment (Quilliam, 2022). This upstream investment is precisely what Saudi officials have repeatedly said is needed to keep up with future demand. Also, increased production by Saudi Arabia to disadvantage Russia would damage OPEC+ cooperation, which Saudi Arabia sought as it waged a price war on Russia in 2020 to have them return to OPEC+ agreements (Quilliam, 2022). In this economic environment, with demand for fossil fuel expected to decrease next year and with sudden market demands for oil exports appearing, Saudi Arabia appears to have numerous incentives to keep production output limited.

The war in Ukraine and the associated global energy crisis are making virtually every government prioritize energy security among economic efficiency and environmental considerations. While the energy transition and decarbonization were policy priorities before the war, a visible shift of emphasis has taken place, especially among energy import-dependent countries. Fossil fuels have, once again, entered the spotlight to help guarantee energy security. These recent events have bestowed importance on oil and oil-exporting nations. As the world has recognized the significance of these resources in providing energy security, Saudi Arabia has captured international attention and returned to a position of influence.

Underinvestment in Fossil Fuels

With the Russian invasion of Ukraine in 2022 and a reawakening global economy, the world has been met with a worsening energy crisis. Although this crisis may have been avoidable had the invasion not occurred, Middle Eastern officials have vocalized that this crisis has been compounded by underinvestment in fossil fuels. There is also an expectation that energy demand

will increase at a rate that low-carbon fuels cannot keep pace with, keeping fossil fuels as essential components of the global energy mix. Saudi Arabia and other OPEC member countries have urged against slowing fossil fuel investment as the supply of hydrocarbons would fall below market demand (Said & Faucon, 2021). While demand for fossil fuels has nearly returned to pre-pandemic levels, upstream investment in oil and gas fell by 30% from 2019 to 2020 and a further lowering of 23% in 2021 (Diwan et al., 2021). Even as fossil fuel prices have risen since the energy crisis began, researchers and Saudi Arabian officials are expressing concern about a misalignment between investment and prices in the sector (Hickin, 2022). As of November 2022, OPEC's forecasts identified an investment need of $12.1 trillion in the oil sector leading up to 2045, with the expectation that the oil demand will plateau after 2035 (Lawler, 2022). The IEA also predicts that demand for natural gas will plateau by 2030 ("World Energy Outlook," 2022). With this underinvestment in fossil fuel development, the International Energy Forum (IEF) and HIS Markit found that the market will likely be more volatile, and higher prices will be seen in the future (Diwan et al., 2021). Energy expert and author Daniel Yergin has also expressed concern over how the underwhelming level of investment in the hydrocarbon sector and the emphasis on clean energy could lead to future energy crises (Imahashi, 2022). With demand increasing and investment not keeping pace, this misalignment supports the claims of oil producers that more investment is needed.

Alongside Saudi Arabia's efforts to develop its low and zero-carbon hydrogen energy, it has been promoting this dual narrative of investment in clean energy innovations and fossil fuel production capacity for future demand. In order to resolve the current energy crisis and prevent future ones from occurring, Saudi Arabian officials have said that Western countries should invest in fossil fuels to increase oil output (Said & Amon, 2022). Aramco Chief Amin Nasser said that investment in decarbonizing fossil fuels is essential while the development of the renewable energy industry is underway (El Safty & Lewis, 2022). Although investor demand appears to be moving towards clean energy, these findings support this concern expressed by Saudi Arabia. This problem is especially true as demand for fuel continues to rise following the reopening of economies after pandemic-related restrictions have been lifted while upstream investment has been substantially declining. While Saudi Arabia has established targets to decarbonize its economy and switch to low and zero-carbon fuels, this dual narrative of

investment need for hydrocarbon and clean energy development may not be mutually exclusive. Suppose the demand for energy globally is anticipated to increase beyond what supply is expected to be available in the energy transition. In that case, it may be economically valid to continue upstream investment in fossil fuels and clean energies if market volatility and energy shortages are to be avoided.

Trade With India and China

While Saudi Arabia may expect further demand for fuel imports from Europe, Russia's discounted hydrocarbon exports have led to their export dominance to specific Asian markets. In 2021, nearly 50% of Russia's oil and 75% of its natural gas exports were sent to Europe, while Asia purchased 40% of its oil and 13% of its natural gas exports (Hübner, 2022). Due to the ongoing Western sanctions, Russian fossil fuel exports to Europe have diminished, while those to India and China have increased dramatically since the invasion of Ukraine in 2022 (N. Narayanan, 2022). While this change to Russian hydrocarbon exports has led to a decrease in exports from Saudi Arabia, it has had an unsubstantial impact on Saudi Arabia's GDP (N. Narayanan, 2022). Even Saudi Arabia has doubled its Russian oil imports for electricity generation to reserve more domestically produced hydrocarbons for export (Krauss, 2022). Although this may not disadvantage Saudi Arabia at present, these changes in energy partnerships will likely affect future energy flows and the export of low and zero-carbon fuels in the future.

As Russia is positioning itself as a top energy trade partner with China and India, Saudi Arabia must consider which cooperation pathways remain viable to supply those Asian economies with energy exports. Since China is currently the top manufacturer of hydrogen and electrolyzers and is purchasing discounted fuel imports from Russia, it may be difficult for Saudi Arabia to capture a large share of the Chinese energy market. Additionally, suppose China does use these imports to generate hydrogen domestically, as expected by some. In that case, Saudi Arabia's potential as the future leading exporter of low and zero-carbon fuels may be inconsequential for China. On the other hand, India's future decarbonization aspirations would require the country to look for cost-efficient energy imports and those that will keep it on track to hit its carbon reduction goals. With its current net zero target of 2070, discounted Russian natural

gas may comprise a majority percentage of fuel imports for the near future. If Russia's low prices are unsustainable or India's decarbonization ambitions amplify, Saudi Arabia's low and zero-carbon hydrogen or ammonia may be perceived as preferable alternatives. If India's economy continues to expand substantially, this may allow for both Russian and Saudi Arabian carbon-intensive fuels to gain footholds in the Indian market.

Russia's Expectations

As Russian policymakers were assessing the new energy landscape before the invasion of 2022, officials within the country must have assessed the potential geoeconomic consequences of such military intervention. With Western policymakers warning of substantial sanctions and with speculation around U.S.-Saudi collusion on utilizing oil as a geoeconomic device after the invasion of Crimea in 2014, Russia must have considered these for its risk calculus. The recent price war must have also magnified the Russian understanding of Saudi Arabia's potential for geoeconomic contention. Even with the perceived threats of sanctions and its primary source of economic power possibly being curtailed by Saudi Arabian energy exports, Russia was still willing to proceed with the invasion of Ukraine in 2022. It can only be speculated how Russia weighed these considerations in its risk assessment, especially if few officials were involved in the decision process. Perhaps they accepted the importance of the invasion as surpassing all the economic risks. Alternatively, those same officials may have believed that Europe's energy dependence on Russia would not allow substantial sanctions to materialize. Additionally, if sanctions were to appear, it was likely understood that India and China would be viable import countries if Russia could guarantee discounts on energy exports. It could have also been perceived that Saudi Arabia's geoeconomic relationship with the U.S. had changed in the past decade, lowering the chances that another oil price war would be waged in response to political aggravations. This shift may have been even more perceivable given that Saudi Arabia and Russia had begun coordinating their energy production levels through OPEC+.

Saudi-U.S. Relations

This year witnessed increased cooperation and unexpected tensions between the U.S. and Saudi Arabia. Earlier this year, the U.S. sent some of its top government officials, including President Joe Biden, seemingly to convince Saudi Arabia to increase oil production, lower

prices, and open up avenues of cooperation between the two countries on energy security (Crowley, 2022). In June 2022, President Biden met with King Salman bin Abdulaziz Al-Saud and Crown Prince Mohammed bin Salman to commit to the Partnership Framework for Advancing Clean Energy, which includes investment for renewable energy, low and zero-carbon hydrogen, capacity-building and regulatory cooperation for nuclear power development, and CCUS technologies ("The Jeddah Communique," 2022). The partnership also emphasizes climate and energy security investment in low and middle-income economies. While this may be a hallmark of Saudi-U.S. cooperation on decarbonization, it came before OPEC decided to decrease oil output, causing a diplomatic rift between the two nations. Due to Saudi Arabia's change in production levels, President Biden has had to utilize the U.S. Strategic Petroleum Reserve further to maintain supply levels and reduce oil prices in the U.S. (Crowley, 2022). OPEC's decision was especially contentious within the U.S. as it risked raising oil prices before the U.S. midterm elections in November, influencing voter confidence in President Biden's administration. While Saudi officials have said that the decision to lower output was based purely on economic considerations, U.S.-Saudi relations were brought to new lows. Some experts have speculated that such a move also benefits Saudi Arabia by showing it is "independent of American influence" (Krauss, 2022). In response to the political fallout, Saudi Arabia has utilized diplomatic avenues to publicly express support for Ukraine by pledging $400 million in aid to support Ukraine and condemning Russia's annexation of Ukrainian territories (Holland & Mason, 2022). While the U.S. acknowledged these diplomatic overtures made, it is apparent that relations remain bruised. While the change in oil output may continue to sour relations in the near future, additional partnerships for decarbonization were made and are still in effect. These will be especially important for the two countries as they are well-positioned to advance on hydrogen and CCUS technological development.

Decarbonization During the War

As long as Saudi Arabian domestic natural gas and renewable energy are relatively affordable, hydrogen production costs in Saudi Arabia are expected to be among the lowest globally (Abuljadayel, 2022). In March 2022, Saudi Arabia began constructing the $5 billion green hydrogen facility in NEOM, which is predicted to become operational by 2026 ("Saudi Arabia in prime position," 2022). While the cost of European green hydrogen production is

anticipated to be between $3 and $5 per kilogram in 2030, the current cost of producing it in Saudi Arabia is estimated to be $2.16 per kilogram, with after-delivery costs to Europe bringing the price to under $4.50 per kilogram ("Saudi Arabia in prime position," 2022). The war in Ukraine and the consequential high price of oil prompted 25 countries to commit $73 billion to additional investment in green hydrogen development, with Germany, Morocco, and the U.S. pledging the most (Chestney, 2022). The war resulted in both potential producer and consumer countries increasing their efforts to progress in the development of hydrogen. With Europe being an indispensable region of consumer economies and Saudi Arabia realizing price competitiveness for its hydrogen exports, Russia's invasion has given additional credibility to the viability of Saudi Arabia's hydrogen export aspirations.

Saudi Arabia is also pursuing alternative avenues for decarbonization. Recently, Saudi Arabia hosted the Middle East's first carbon offset auction (Tamo & Ratcliffe, 2022). Additionally, Saudi's Public Investment Fund raised $4 billion for its first green bond sale in October 2022 (A. Narayanan, 2022). The fund is tasked with financing 70% of renewable energy projects in Saudi Arabia and is scheduled to place $10 billion in sustainable projects by 2026 (A. Narayanan, 2022). Within the offering circular of the fund's green bond sale, it is written that the fund is contributing to the achievement of the Saudi Vision 2030, specifically supporting the increase of non-oil GDP in the country by approximately 7% per year ("PIF Euro," 2022). Concurrently, Saudi Aramco announced the launch of its $1.5 billion sustainability fund to promote development in energy efficiency, emissions reduction, CCUS technologies, nature-based solutions (afforestation), hydrogen, ammonia, synthetic fuels, and digital sustainability ("Aramco announces $1.5bn," 2022). Through these projects, Aramco plans to produce 11 million metric tons of blue ammonia annually by 2030 ("Aramco announces $1.5bn," 2022). Even though the kingdom has experienced record profits from oil exports during the energy crisis, it is actively developing its low and zero-carbon fuel sector while directly investing in and enabling other investors to promote sustainable projects.

Russia's Hydrogen Development Prospects

Before the invasion in 2022, prospects for cooperation on hydrogen development between Russia and Saudi Arabia were promising. In November 2020, Russian officials spoke

with Japanese companies and officials to discuss hydrogen exports to Asia and Europe (Ishikawa, 2020). In October 2021, Russia's Deputy Prime Minister Alexander Novak spoke with Saudi Arabian and Emirati officials to consider collaboration on hydrogen development (Agnihotri, 2021). A month later, Russia signed a memorandum of understanding with the UAE on hydrogen production, anticipating that Russia would export 2 million metric tons annually by 2035 before increasing capacity to at least 15 million metric tons by 2050 (Saadi, 2021). These expected capacity levels were designed to be pursued with Russia's overarching plan to capture 20% of the global hydrogen market by 2030 (Patonia, 2022). These aspirations may have been feasible as Russia contains much potential for hydrogen production with its reserves of natural gas, a developed nuclear energy sector, and the proper conditions for renewable energy generation and underground storage sites for CCS (Patonia, 2022). In 2021, Russia prepared to offer low-carbon fuel exports by designating 33 energy projects for hydrogen and ammonia development (Patonia, 2022).

Russia's hydrogen export strategy before the invasion in 2022 recognized Europe and Asia, namely Japan and South Korea, as key potential import countries for the hydrogen trade (Patonia, 2022). This plan was auspicious as Russia was well-equipped to develop its hydrogen capabilities and conveniently export to Europe, building upon its longstanding trade relationships in the region (Patonia, 2022). Nord Stream 2, having just been constructed before the invasion began, would have been an ideal conduit for hydrogen transport if the war had not occurred (Patonia, 2022). The European Commission’s REPowerEU plan to remove its dependence on Russian fossil fuels contains EUR 200 million for research in green hydrogen production with an expectation of producing 10 Mt of green hydrogen and importing 10 Mt by 2030 (Patonia, 2022). However, it does not include any plans to import this fuel from Russia (Patonia, 2022). In June 2022, Russia's Minister of Energy realized the lowered potential for its future hydrogen exports, reportedly due to diminishing trade prospects with Germany, Japan, and South Korea, with 2030 and 2050 expectations for exports dropping to 1.4 million and 4.5 million metric tons, respectively (Patonia, 2022). Europe’s plan confirms that Europe will likely not be a potential importer of low-carbon Russian hydrogen.

Not only has this expectation been reversed due to the ongoing war and these nations supporting the sanctions placed on Russia, but those potential consumer nations could have provided technology transfer for Russia to develop its hydrogen infrastructure (Patonia, 2022). Japan would have been an ideal partner on this front as it is leading advancement in equipping marine vessels with storage and delivery systems designed for hydrogen and ammonia (Patonia, 2022). Another aspect of technology hampering hydrogen production in Russia is due to Russia's now limited access to European-manufactured proton exchange membrane (PEM) electrolyzers, which are most appropriate for solar and wind power to produce green hydrogen (Patonia, 2022). While China is a top manufacturer of alkaline electrolyzers, these are designed to operate with stable power sources, such as hydropower or nuclear power (Patonia, 2022). Russia may be able to purchase these electrolyzers from China, but it can be expected that it would only do so if it expected demand for hydrogen exports to exist.

Flows of financing from private investors for Russian energy infrastructure have declined. Investors from developed economies are now hesitant to invest in Russian energy infrastructure due to the ongoing conflict (Patonia, 2022). Saudi Arabia and Russia were cooperating on energy investment. Before the Russian invasion of Ukraine in 2022, Saudi Arabia sought cooperation on the mutual development of energy infrastructure. Saudi Arabia's Public Investment Fund (PIF) and the Russian Direct Investment Fund (RDIF) agreed to invest in joint projects reaching up to $10 billion ("PIF Euro," 2022). Just as the invasion began in early 2022, Saudi Arabia's Kingdom Holding Company invested over $600 million in Russian energy companies Gazprom, Rosneft, and Lukoil as share prices tumbled (Krauss, 2022). As of June 2022, the PIF had invested $2 billion in related projects ("PIF Euro," 2022). However, due to the ongoing conflict, the PIF will not use proceeds from Saudi Arabia's green bond sale to fund projects in Russia or with the RDIF ("PIF Euro," 2022). The ongoing war has halted specific streams of investment that could be used to develop energy infrastructure between the two nations mutually. However, it was not ascertainable if the PIF had entirely halted investment in Russia. Regardless, additional flows of financing are being hampered. For some investors, providing financing for Russia's energy industry is not an option. In March 2022, the U.S. banned investment in Russia's energy industry ("The Russia-Ukraine crisis," 2022). This investment history proves that the geopolitical situation has disrupted Saudi Arabia's investment

interests in Russia. However, the worsening of Russia's hydrogen investment environment may give Saudi Arabia a more advantaged position.

As Europe, South Korea, and Japan are no longer viable long-term consumer countries of Russian energy exports, Russia has found new opportunities to export hydrocarbons to China and India. As these countries are posed to be Russia's energy trade partners in the future, it will have to adjust its hydrogen export strategy. China's status as the world's top manufacturer of electrolyzers and top producer of hydrogen, it is expected that China will prioritize cheaper natural gas imports from Russia to use its domestic hydrogen production rather than become a consumer of Russian hydrogen (Patonia, 2022). Since China is continuing to expand its renewable energy infrastructure and may consider having green hydrogen comprise a more significant portion of its energy mix, Chinese demand for Russian gas imports may subside (Patonia, 2022). While India was procuring most of its oil imports from Saudi Arabia and Iraq, Russia's discounted exports have now led it to become India's top supplier of oil (Cornish et al., 2022). This change in trade partnerships may benefit Russia as India and China have massive energy needs. However, both countries may have less demand for Russian hydrogen exports than other developed economies.

With India's imports of Russian oil ramping up, Russia will presumably continue to foster this trade relationship by prioritizing cheap oil and natural gas exports. As China will likely not import Russian hydrogen, and India may continue to prioritize the import of fossil fuels, it may be that Russian investment in blue and green hydrogen subsides altogether. With a lack of investment in the production, transport, and infrastructure capabilities for low and zero-carbon hydrogen development, Russia may prioritize less costly hydrogen produced without renewable energy or CCUS technologies if India signals its interest in purchasing hydrogen. Although Russian competitiveness on hydrogen may be diminished, China may not be a top consumer of Middle Eastern-produced low or zero-carbon hydrogen. As Chinese-Russian energy trade relations continue alongside Russia's worsened relations with other potential hydrogen importers, Russia may continue to supply countries like China and India with low-priced fossil fuels in the long term. While Saudi Arabia could benefit enormously from Russia not being a key player in the global hydrogen market, it may disconnect Saudi Arabia from one of its most promising

importers of fossil fuels, China. This development may further incentivize Saudi Arabia to switch to low and zero-carbon hydrogen as its trade partners express growing demand.

As relations between the West and Russia are strained, Saudi Arabia has the opportunity to seek long-term export agreements and trade partnerships with Europe, Japan, and South Korea, to accelerate Saudi Arabian hydrocarbon exports and to build up the infrastructure for future hydrogen exports. While Saudi Arabia has been successfully demonstrating the feasibility of transporting blue ammonia to Japan, it will need the transport infrastructure to ship large quantities of the fuel to Europe. The stunting of Russia's hydrogen development enables Saudi Arabia to capture market share in the countries most interested in hydrogen imports. The war in Ukraine has undoubtedly led to advantageous positioning for Saudi Arabia's hydrogen ambitions and will likely enable the country to further this critical component of its decarbonization initiatives.

Saudi Arabian Oil Exports As A Geopolitical Tool in 2022?

In the current political and economic environments, Saudi Arabia has a peculiar relationship with Russia. It is both a partner and a competitor in trade and investment. The kingdom is considerably increasing its imports of Russian hydrocarbons and is actively coordinating with the country through OPEC Plus (OPEC+). Additionally, Saudi Arabia's Public Investment Fund has made commitments to invest in Russian energy projects and infrastructure. If Western sanctions remain in effect, the kingdom may continue importing Russian oil and gas in the short term with long-term projections depending on lowered price offerings. These partnerships may enable Saudi Arabia to have a tangible influence on Russia, exemplified by the price war waged on Russia in 2020.

In recent years, Saudi Arabia was seen to be most aggressive in its oil output strategy in 2020 when it waged a price war on Russia. This stance was reportedly motivated by Saudi Arabia's desire to bring Russia back in line with the production agreements of OPEC+ rather than using the low oil price to pressure Russia for political aims. Instead of lowering oil prices to cause economic retaliation against Russia for its invasion of Ukraine in 2022, Saudi Arabia has allowed crude prices to rise, benefitting both its and Russia's economies. The outcry from the

U.S. regarding Saudi Arabia's lack of cooperation in lowering global oil prices exhibits how collusion between the two countries on the kingdom's oil export strategy may have existed in the past, whether or not such efforts were geopolitically inclined. It also exhibits how the lack of coordination may be a political decision of Saudi Arabia to demonstrate its changing relations with the U.S., exhibiting an independent political position. Furthermore, the kingdom's purchase of Russian oil and increased shipments to Europe give credit to the view that the country is practicing a hedging strategy with Russia and the West, mixing cooperation with resistance to achieve its strategic interests.

As the kingdom draws much of its strategic power from its economic capabilities, it is challenging to differentiate between its political and economic interests. The country is now prioritizing its economic gains above Washington's requests for it to utilize the kingdom's oil exports for its interests. It is not fully ascertainable if the strategic priority of the U.S. diplomatic lobbying was for lowered oil prices to stabilize markets and lessen the burden on consumers or if it was to add pressure economic pressure on President Putin. Coincidentally, both effects could be achieved with a lowered oil price, potentially incentivizing U.S. policymakers further to pursue this course of action. However, such a production increase ran counter to Saudi Arabia's interests. As the kingdom is enjoying record-high revenues due to inflated oil prices, the West's main target for sanctions, Russia, is also benefitting. Even during the energy crisis, the progress and preservation of Saudi Arabia's decarbonization initiatives give credit to the theory that the kingdom finds much geoeconomic potential in its future hydrogen exports. The price war shows that Saudi Arabia is still willing and capable of using oil for its geoeconomic effectiveness. Saudi Arabia appears to prioritize its economic interests and geoeconomic positioning rather than use its oil exports as a purely geopolitical tool against Putin following the invasion in 2022.

Conclusion

As outlined in the introduction, this thesis endeavors to assess the geopolitical relevance of oil in the energy transition by considering the evolution of Saudi Arabia's decarbonization policies and its potential responses to the Russian invasions of Ukraine in 2014 and 2022. The analysis presented in this paper was performed to answer the following main research questions:

1. Has Saudi Arabia been using its oil exports as a geopolitical tool in response to the Russian invasions of Ukraine in 2014 and 2022?
2. How have Saudi Arabia's evolving decarbonization policies affected its energy trade strategy?
3. Has the recent invasion of Ukraine and the resulting energy crisis affected Saudi Arabia's sustainability policies?

By answering these questions, this thesis seeks to enable readers to more clearly assess the relevancy of oil in Saudi Arabia's potential geopolitical endeavors, given its growing interest in decarbonized energy exports.

Has Saudi Arabia been using its oil exports as a geopolitical tool in response to the Russian invasion of Ukraine in 2014 and 2022? In 2014 and 2020, Saudi Arabia spearheaded a low-price strategy, targeting global market share while simultaneously weakening Russia's geoeconomic capabilities. Various factors likely influenced Saudi Arabia's energy strategy in 2014. While many experts believe the motives were purely economic, it cannot be discounted that such action also had geopolitical consequences for Russia. Russia may not have been the sole target in 2014 as U.S. exporters were taking global market share from Saudi Arabia. However, the price war of 2020 exhibits how the kingdom is willing to utilize its oil resources to guarantee Russia's cooperation in adhering to the policies presented at OPEC+. While the global oil markets of 2014 and 2020 were characterized by plummeting prices and economic decline for Russia and Saudi Arabia, the situation following the Russian invasion of Ukraine in 2022 and the resulting energy crisis is in stark contrast. Saudi Arabia and Russia benefit from high oil prices and shifts in demand. While Saudi Arabia may be less involved in potential geopolitical

machinations of the West, it has become apparent that the kingdom is willing and able to utilize its production levels for its geoeconomic advantage. As it is developing its capabilities for hydrogen production and utilizing oil revenues for future investment in such fuels, the kingdom may understand that oil's geoeconomic and geopolitical efficacy may be limited in a global economy that demands low-carbon energy sources.

How have Saudi Arabia's evolving decarbonization policies affected its energy trade strategy? When assessing the previous data presented, a pattern has emerged for Saudi Arabia—it is actively advancing its carbon emission reduction efforts and is showing a substantial interest in becoming the world's leading low and zero-carbon hydrogen exporter. In diplomatic circles and at international fora, it is evident that the country does not view the phase-out of fossil fuel production and the development of clean energy as mutually exclusive pursuits. As the country's hydrocarbon production processes boast some of the world's lowest costs and emissions, it may be positioned to be the final supplier of fossil fuels when global demand eventually drops to zero in favor of carbon-neutral fuels. Saudi Arabia is positioning itself to become one of the world's top exporters of low and zero-carbon hydrogen. By constructing one of the most extensive green hydrogen facilities and realizing its potential for renewables both in availability and cost-efficiency, Saudi Arabia's hydrogen exports appear to potentially be price-competitive even in foreign markets, mainly those in Europe, Japan, and South Korea. As Saudi Arabia partners with other countries to demonstrate the feasibility of transporting hydrogen and ammonia, it is laying the groundwork for supply chains to be developed. Saudi Arabia's leadership has clearly expressed its overall strategy regarding the energy transition—dominating both the fossil fuel and hydrogen markets.

Has the recent invasion of Ukraine and the resulting energy crisis affected Saudi Arabia’s sustainability policies? Russia’s invasion has resulted in Saudi Arabia benefiting from its export of fossil fuels and its endeavors to develop its hydrogen sector. The high oil price enables Saudi Arabia to achieve multiple goals: encouraging upstream investment in the fossil fuel sector and reaping high profits while preparing for the demand for hydrogen imports to rise. However, it is difficult to predict if the demand for Saudi oil exports will rise or fall as global economic or political changes could lead to rapid changes in demand. With Russia's hydrogen prospects

diminishing, Saudi Arabia can capture a large portion of the hydrogen market. It may cooperate or compete with its regional partners in developing the infrastructure needed for the hydrogen trade. The shift in energy trade relations and Russia's hydrocarbon export dominance in China and India has changed prospects for Saudi Arabia's future exports. Once the export of blue and green hydrogen occurs on a large scale, it is yet to be seen how much of the global market will be taken by China. It is well-positioned as the top electrolyzer producer and capable of generating low-priced hydrogen domestically with Russia's discounted natural gas exports. However, new market opportunities have emerged for Saudi Arabia as Europe, South Korea, and Japan no longer consider Russia a reliable energy partner. Saudi Arabia may be further prompted to emphasize its decarbonization policies in an appeal to these countries.

In the short term, Saudi Arabia's hydrocarbon exports to these consumers may continue to rise dramatically. With the expectation that the energy transition continues, these trade partnerships may prove foundational for Saudi Arabia's zero-carbon export ambitions. Saudi Arabia's aspirations for energy dominance in high, low, and zero-carbon fuels are heavily dependent on progress in the construction of renewable energy facilities and the technological advancement of CCUS. The country recognizes this and is actively pursuing collaboration on these. Although the high price of oil may result in Saudi Arabia saving more of its hydrocarbon production for exports, investments in hydrogen appear to be increasing in anticipation of future demand for hydrocarbons eventually plateauing. While the country likely will continue to try to dominate the energy market on both fronts, it may eventually prioritize its hydrogen exports as it develops healthy trade relations with countries most interested in implementing the energy transition. Rather than the war halting Saudi Arabia's decarbonization policies, it underscores how Saudi Arabia has been attempting to maintain its competitiveness as an energy exporter while also preparing itself to further its economic interests during the energy transition.

While oil has a history of geopolitical integration, the export strategies of Saudi Arabia in recent years give credit to the idea that economic interest most likely surpassed those geopolitical motives. However, it cannot be entirely discounted that political considerations were factors in Saudi Arabia's policymaking, even if peripheral. Saudi Arabia may still understand the potential of oil to be used as an effective geopolitical instrument, and its policy focus and investment

priorities appear to be on its ability to capture market share both in the short and long term. Its decarbonization goals reflect this business acumen as it understands that the demand for low and zero-carbon fuels is growing globally. Although Saudi Arabia may not be changing oil output levels for geopolitical effect, its overarching energy strategy is likely modified by the current geopolitical situation, including the consequential energy crisis. While keeping fossil fuel exports active as long as possible, the kingdom is setting its sights on the "energy of the future," hydrogen. Although, it is yet to be seen if this fuel will be a successor of oil in its geoeconomic potential. What can be determined now is that current geopolitics are aiding Saudi Arabia in its dream of becoming the world's top exporter of hydrogen. While Saudi Arabia has proved that oil remains an effective geoeconomic tool, it appears to be elevating its geoeconomic positioning through hydrocarbons and future low and zero-carbon fuels rather than prioritizing Western geopolitical objectives through its exports.

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