



Energy transitions era: geopolitical characteristics and connotations in the Arab Gulf States[☆]

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ARTICLE INFO

JEL Classification:

Q28
Q41
Q48
N75
O13
F5

Keywords:

Energy transition
Energy geopolitics
Energy policies
Gulf Cooperation Council (GCC)
Renewable energy
Climate change

ABSTRACT

The Middle East's energy landscape is experiencing significant changes due to internal socio-economic issues, shifting global energy demands, and evolving geopolitical circumstances. This study explores the geopolitical trends influencing the energy transitions in the Arab Gulf States. The research examines how these countries navigate the complexities of transitioning from fossil fuels to renewable energy sources amidst fluctuating oil prices, geopolitical tensions, and stringent international climate commitments. Using a mixed-methods approach combining policy analysis, qualitative review, and cross-country comparison, the paper analyzes key national plans and regional dynamics across Saudi Arabia, UAE, Qatar, Kuwait, Oman, and Bahrain. Research findings revealed that the Gulf Arab States face many challenges, including fluctuating oil prices, geopolitical tensions, and balancing economic stability with environmental sustainability. Additionally, adopting renewable energy brings various social and political advantages and enables the Gulf to meet its regional climate governance obligations.

The study highlights strategic approaches such as energy diplomacy, economic diversification under national visions, and emerging investments in green technologies and critical minerals. It further identified the risks associated with insufficient integration into global renewable supply chains. The paper concluded with policy implications for regional sustainability, the balance of geopolitical power, and the imperative for institutional reform. This contribution added to the literature by contextualizing GCC responses within broader international patterns of energy transition and geopolitical realignment.

1. Introduction

Climate Change has become a priority for many countries due to its likely devastating socio-economic impacts on the world. These substantial challenges have prompted the global community to support the adoption of clean energy and environmental policies. Moreover, mitigating the challenges posed by climate change necessitates transitioning away from fossil fuels and adopting cleaner energy sources. In this regard, the United Nations Framework Convention on Climate Change

UNFCCC report warns that, under current national mitigation commitments, global temperatures are projected to increase by over 2 °C by the end of the century [1].

In the meantime, technological advancements in renewable energy, coupled with stringent climate policies, especially those targeting fossil fuels, may induce significant geopolitical implications, underscoring the need for formidable transformation in oil-based economies [2]. The global energy transition is reshaping geopolitical dynamics by altering traditional alliances and rivalries, shifting the focus from oil and gas to

Abbreviations: AE, Austrian Economics; CCUS, Carbon Capture, Utilization, and Storage; CO₂, Carbon Dioxide; COP, Conference of the Parties; EDI, Economic Diversification Index; GCC, Gulf Cooperation Council; GDP, Gross Domestic Product; IEA, International Energy Agency; IPCC, Intergovernmental Panel on Climate Change; IRENA, International Renewable Energy Agency; KSA, Kingdom of Saudi Arabia; LNG, Liquefied Natural Gas; NDCs, Nationally Determined Contributions; UNFCCC, United Nations Framework Convention on Climate Change; NIE, New Institutional Economics; NPE, New Political Economy; OPEC, Organization of the Petroleum Exporting Countries; SDGs, Sustainable Development Goals; UAE, United Arab Emirates.

^{*} Note: All figures and tables in this manuscript are based on data retrieved from publicly available sources such as the IEA, IRENA, BP Statistical Review of World Energy (2023), and national GCC policy documents. Full citations are provided in the References section.

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<https://doi.org/10.1016/j.sfr.2025.100808>

Received 19 October 2024; Received in revised form 7 June 2025; Accepted 7 June 2025

Available online 7 June 2025

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securing supply chains for critical materials like lithium and cobalt [3]. Amid this global shift, countries rich in renewable resources or key materials are gaining prominence, while advances in renewable technologies and energy cybersecurity are becoming crucial aspects of national security [4,5]. This transition creates a complex geopolitical landscape where traditional power structures are challenged, and new alliances emerge into the political scene.

Overcoming the blurring vision associated with predicting a precise fossil fuel future imposes significant challenges on oil-based economies. These challenges are expected to have far-reaching consequences for these countries, not only in terms of geopolitics but also in terms of reforming their decision-making processes [5]. The potential deceleration of oil demand by 2030, as predicted by the peak oil theory, is adding further burdens to these challenges [6].

For Arab Gulf States, the unpredictable nature of energy transition will significantly influence their energy transition pathways. Moreover, the region's heavy reliance on hydrocarbon necessitates a carefully navigated energy transition trajectory [7]. Fortunately, these states leverage significant opportunities to expand their renewable energy sectors while concurrently keeping leverage of their geopolitical significance to the world. In attempts to ascertain these opportunities, some scholars highlight that pursuing robust multilateral climate diplomacy would enable Gulf states to maintain their positions on the global stage while navigating the phase-out of oil and gas [8]. However, implementing strategies that facilitate a rapid energy transition in a world marked by unique challenges in energy markets and the ongoing global transformation of political alliances and power structures remains a formidable task.

This study highlights the critical role that Gulf states or the Gulf Cooperation Council (GCC) countries-Saudi Arabia, United Arab Emirates-UAE-, Kuwait, Qatar, Oman and Bahrain- play in global energy markets and the unique challenges and opportunities they encounter amid an accelerating energy transition. With this significance in mind, the paper aims to analyze how geopolitical trends, local and international energy demands, and internal economic strategies shape the Gulf's approach to diversifying its energy portfolio and achieving sustainable development.

To reach these objectives, the study addresses two key questions: What strategies do Gulf states use to navigate the energy transition? What role do hydrocarbons play in this process? Additionally, the study examines the tailored strategies that Gulf nations adopt as they navigate this complex environment. It incorporates scholarly research, policy analysis, and empirical evidence to offer thorough insights into the multifaceted approaches shaping the region's energy transition trajectory.

The study employed a qualitative, comparative case study approach supported by descriptive empirical data and secondary analysis. The rationale for this approach is rooted in the need to understand the complex, multi-dimensional nature of energy transitions in rentier states such as those in the GCC. The empirical basis of the research included official policy documents (e.g., Saudi Vision 2030, Qatar National Vision 2030), reports from international energy organizations (e.g., IEA, IRENA), and macroeconomic datasets related to energy consumption, emissions, and diversification metrics. Figures and tables were derived from reliable open-access sources and are cited accordingly. Analytical techniques included thematic content analysis of policy frameworks, descriptive trend analysis of economic diversification and renewable energy data, and cross-sectional comparisons among GCC states. The case study of Saudi Arabia was selected due to its dual role as a hydrocarbon powerhouse and an ambitious reformer under Vision 2030. This mixed-methods design supports triangulation and contextual depth, allowing a nuanced understanding of how energy policy and geopolitics intersect in the Gulf region.

This paper contributes to the emerging literature on the geopolitics of energy transition by offering a regionally grounded analysis of how Arab Gulf States maintain geopolitical relevance while selectively

adapting to clean energy imperatives. Unlike econometric studies that focus solely on emissions or renewable uptake, this study synthesizes policy, institutional, and geopolitical dynamics to explain the persistence of hybrid energy strategies. It also integrates overlooked dimensions such as critical mineral dependence, regional policy fragmentation, and state branding in the energy diplomacy of rentier regimes.

The research is organized into nine key sections. [Section 2](#) presents the literature review, exploring the historical and ongoing geopolitical implications of the global energy transition. [Section 3](#) introduces the theoretical framework that guides the analysis and situates the study within relevant scholarly debates. [Section 4](#) investigates how local energy consumption patterns and international market demands influence the energy transition efforts of the Gulf countries individually. [Section 5](#) outlines the distinct path to energy transition for the Gulf. [Section 6](#) identifies the Gulf energy transition's economic, social, and political opportunities and challenges. [Section 7](#) presents a case study of Saudi Arabia, highlighting its efforts to balance its oil legacy, address climate change implications, and navigate the evolving geopolitical energy landscape. Based on the analyses, [Section 8](#) answers the research questions, and [Section 9](#) presents the conclusion.

2. Literature review

The literature on the geopolitics of energy transition has expanded considerably, reflecting the deep transformations underway in global energy systems. Scholars have examined the dynamic interactions between energy security, environmental policy, and geopolitical risk, particularly in contexts where political fragility and resource dependency prevail. For instance, Pata et al. [9] employed a quantile-based load capacity factor approach to assess how geopolitical and energy-related risks deteriorate environmental quality in fragile states, highlighting the role of institutional instability in shaping energy-environment outcomes.

The geopolitical complexity of primary resource markets is further elaborated by Muğaloğlu et al. [10], who investigated regime-dependent behaviors of natural resource markets in response to geopolitical risks and economic policy uncertainty. Their findings point to structural differences across regions, suggesting that GCC economies must strategically differentiate their responses to external shocks to maintain energy and fiscal resilience. Alyamani and Solangi [11] evaluated the driving forces and transition performance of OPEC members, revealing substantial disparities in renewable energy readiness and climate policy execution. These variations are particularly relevant for GCC countries as they attempt to align national visions with international mitigation mandates.

In an Asian context, Kuşkaya et al. [12] explored how gender inequality indirectly affects the energy transition process, emphasizing the spatial spillover effects of socio-political structures on environmental sustainability. Although focused on Asia, their insights into institutional inclusivity offer comparative value for rentier economies in the Gulf. From a Gulf-specific lens, Matar et al. [13] employed wavelet coherence analysis to examine co-movements between electricity use and carbon emissions in the GCC. Their results indicated persistent dependency on fossil-generated electricity, reinforcing the urgency for strategic decoupling through low-carbon technologies.

These contributions underscore a central challenge in the literature: while many studies capture macroeconomic and policy dimensions of the energy transition, fewer integrate the geopolitical, institutional, and environmental complexities that uniquely shape Gulf states. This study contributes by bridging this gap, positioning the GCC's transition strategies within the broader global debate on environmental risk governance, energy diversification, and geopolitical adaptation.

Building on this foundation, it is equally important to examine how these geopolitical and institutional dynamics interact with domestic political economy structures and vision-driven reforms, particularly

within the unique governance frameworks of the Gulf states. Over the past decade, there has been a global shift towards clean energy, highlighting the potential shift away from fossil fuel use due to its significant greenhouse gas emissions. International bodies like International Renewable Energy Agency (IRENA) and the International Energy Agency (IEA) advocate for a fossil-free future by 2050 to meet net-zero emissions targets [14,15]. However, achieving this universal goal by 2030 or 2050 is still challenging, requiring extensive clean technology and infrastructure scale-up. As the energy transition progresses, it promises substantial economic, social, and political shifts, redefining global relations and power dynamics. Thus, this shift could foster global peace as dependencies on volatile fossil fuel sources decrease, decentralizing power structures and potentially challenging economies reliant on these fuels. Goldthau et al. [16] highlighted a scenario of collaborative global adoption of green energy to fragmented nationalistic approaches, each carrying distinct geopolitical implications.

Geopolitical dynamics heavily influence energy politics, with historical events like the 1970s oil shock emphasizing the strategic importance of fossil fuels. The current energy transition could reshape global relationships, diminishing the geopolitical leverage of fossil fuel-dependent economies while enhancing nations' roles that pivot towards renewable energy. This transition, offering both challenges and opportunities, requires robust global governance to effectively align national and international environmental efforts.

In this evolving landscape, countries heavily dependent on fossil fuel exports must navigate this shift cautiously to mitigate potential geopolitical and economic disruptions. This is particularly pertinent for the GCC countries, where large urban populations are likely disproportionately affected, potentially leading to significant socioeconomic disruptions [17]. Effective global governance and cohesive environmental policies are essential to align national interests with global sustainability goals [18]. It is apparent from historical records that the production of fossil fuels in the GCC region has exerted a significant influence on the shaping of both the political and economic landscapes [19]. For several decades, fluctuations in power perceptions regarding the importance of Gulf economies have long influenced regional politics [20].

The unique geographical locations and extraordinary energy potential in the Gulf region have significantly contributed to the rise of global prominence for countries such as Saudi Arabia, Qatar, and the UAE. Realizing this potential has bolstered the region's geopolitical role in the international policy landscape, with massive U.S. bases scattered across their territories, fostering warm bilateral relationships with Western elites, and expanding sovereign wealth funds [20]. With their significant influence in the global energy scene, both politically and financially, the Gulf states play an indispensable role in steering international climate change governance and accelerating energy transition [21].

Considering the paramount importance of fossil fuels in the region, maintaining hydrocarbon production in the coming years represents a top economic priority intricately linked to every aspect of development [22]. Gulf states possess 36 % of the world's proven oil reserves and 20 % of the total proven gas reserves. They serve as major producers and exporters of fossil fuels [22,23]. Revenue from these energy resources has consistently contributed to the volume of imported products and served as a key driver of economic growth in the region. Hydrocarbon resources have significantly transformed the Gulf states' social, political, and economic landscape [24]. Therefore, the priority for the Gulf States is to ensure that the increasing expenditure on energy demands does not negatively affect their GDP [25]. However, over the past decade, growing global attention to climate change governance and environmental protection has raised doubts and concerns about the Gulf region's ability to sustain its reliance on hydrocarbon exploitation [20].

Contrary to common belief, achieving net-zero emissions will not mean the end of oil and gas. An IEA report in 2021 supports this view, projecting that even with a net-zero target by 2050, the world will still consume 50 % of gas and 25 % of oil compared to current levels [26]. Although these reductions are substantial, hydrocarbon-producing

countries will still leverage their fossil fuel reserves for several decades [27]. Despite ranking among the top nations with ecological footprints, it is unlikely that decarbonization and climate change endeavors will diminish their geopolitical significance. Other factors, such as global connections, renewable potentials, and financial reserves, could contribute to the emergence of alternative economic models and prevent lessening their prominence on the international stage [20].

3. Theoretical framework

This paper adopts the Geopolitical of energy to examine the impact of the energy transition and emphasizes the interplay between geopolitical factors and energy systems [28]. Recent empirical contributions have enhanced this geopolitical lens by incorporating environmental vulnerability and structural fragility into the analysis. In this regard, Pata et al. [9] provided an empirical framework for understanding how energy and geopolitical risks interact with environmental capacity, utilizing load factor thresholds to reflect structural fragility. Their methodological innovations underline the need for Gulf-specific indicators that account for vulnerability to shocks and environmental degradation. Their methodological innovations underline the need for Gulf-specific indicators that account for vulnerability to shocks and environmental degradation. Building on this, recent research has explored how primary resource markets behave under geopolitical uncertainty, reinforcing the need for adaptive strategies. For instance, Muğaloğlu et al. [10] proposed a dynamic regime approach to assess how primary resource markets react under differing geopolitical and policy uncertainty conditions. Their findings support this study's argument that Gulf transition strategies must be adaptive to global volatility and not solely anchored in historical oil market stability.

The Geopolitical energy framework reveals how geopolitical risks, environmental regulations, and technological innovations shape energy transitions across different contexts [29,30]. Geopolitical risks significantly influence energy transitions, with more vigorous risks correlating with accelerated shifts towards renewable energy. The study used the framework to analyze how these countries continue centralizing hydrocarbons in their energy transition strategies while maintaining their geopolitical. Moreover, it offers a conceptual foundation for understanding the shift from a hydrocarbon-based energy system to one incorporating renewable energy [31]. In this context, the present study reconceptualizes the Gulf's energy trajectory to reflect the region's dual commitment to hydrocarbons and renewables. This paper conceptualizes the Gulf energy transition as a non-linear socio-political process. Rather than viewing renewables as a replacement for hydrocarbons, the framework acknowledges the coexistence and strategic layering of both systems. This dual-path strategy is best understood through the lens of geopolitical adaptation, as Gulf states aim to preserve strategic autonomy while gradually aligning with global decarbonization trends. Such an approach resonates with the broader literature on the geopolitics of renewable energy, which explores how transitions in energy systems are redefining international power structures and security dynamics. It also reflects ongoing theoretical efforts to conceptualize the geopolitical implications of a renewable energy future and its potential to reshape global influence.

Vakulchuk et al. [32] define the geopolitics of renewable energy as the interaction between and consequences of the growing exploitation of renewable energy on international conflict, state power, and energy security. The literature on the geopolitical implications of energy transitions suggests that undergoing a full-scale transition will bring both potential gains and losses. Historically, after the Second World War, the geopolitics of energy revolved around competition over hydrocarbon resources [32]. Recently, with the growing importance of energy transitions, the discussion has increasingly focused on the geopolitical benefits and challenges associated with renewable energy adoption [31]. Amid this uncertainty, the literature on the geopolitical consequences of energy transitions raises a wide range of questions about the

emerging landscape of renewable energy. These questions include the potential of large-scale renewable energy adoption to enhance global security, the possibility of weaponizing electricity transmission in foreign policy affairs, and how traditional petrostates react to the prospect of declining geopolitical influence. Ignoring the ongoing international changes that the energy transition will have on geopolitics would put the economic, domestic politics, and social institutions of hydrocarbon-based states at risk. In contrast, traditional petrostates that successfully leverage clean energy technologies are more likely to secure geopolitical advantages [32].

This paper draws on the political economy school of thought, incorporating heterodox approaches to examine the ongoing energy transition in the Gulf region. Precisely, it aligns with critical and comparative perspectives within the New Political Economy (NPE) and integrates elements from Austrian Economics (AE) and New Institutional Economics (NIE). These approaches provide a comprehensive framework for analyzing the socio-technical and geopolitical dynamics influencing the Gulf's energy transition [32]. By examining the intricate interplay of social, political, and economic forces, this perspective enables a deeper understanding of the challenges and opportunities inherent in the transition. Rather than employing econometric models, the study utilizes a qualitative approach to critically analyze social change, focusing on resistance to transitions. This is exemplified by the Gulf's sustained investment in hydrocarbon infrastructure, even as global priorities increasingly emphasize renewable energy adoption.

Integrating NIA within the NPE framework provides valuable insights into the institutional dynamics shaping energy governance and policy decisions in the Gulf states. The paper incorporates elements of public choice theory, constitutional economics, and sociological institutionalism to explore how entrenched institutional and economic interests influence the pace and direction of the region's energy transition [32].

The Gulf's energy transition paradox, characterized by the coexistence of hydrocarbon and renewable energy investments, reflects challenges analogous to those observed in Austrian Economics during energy transitions. While striving to achieve sustainable energy goals, the region must balance economic growth, energy diversification, and the risk of socio-economic disruptions. Both regions face trade-offs between immediate well-being and long-term sustainability, alongside economic setbacks, inflation, and societal inequality [33].

In the Gulf context, this transition is nonlinear but reflects a socio-technical system in which fossil fuels and renewables coexist. The transition model emphasizes the concept of path dependency, which explains the continued reliance of Gulf economies on hydrocarbons due to their substantial contributions to government revenue and economic growth. While investments in solar, wind, and green hydrogen projects are increasing, hydrocarbons continue to play a role in the energy mix for the near future [31,33]. To frame the theoretical logic guiding this study, the following conceptual model (Fig. 1) illustrates the cyclical relationship between external geopolitical forces, internal institutional arrangements, strategic responses, and resulting energy transition outcomes in the GCC states. Understanding the interplay between internal path dependencies and evolving external demand dynamics is essential to explain the pace, direction, and contradictions of energy transition trajectories in the region. The following section examines how both local consumption patterns and international market expectations influence strategic decision-making, and investment flows in the GCC's evolving energy landscape.

4. The impact of local and international demand on the Gulf Energy Transition

On the local demand side, oil and gas dominate energy consumption across GCC. Despite the relatively small population of GCC, their annual oil and gas consumption exceeds that of Japan and Indonesia and surpasses the total primary energy consumption across Africa [25]. In the GCC region, residential demands, industry, water desalination, commerce, and oil production operations are the main drivers of energy consumption. Historically, low energy prices have encouraged over-consumption, increased local energy demand and contributed significantly to GDP reduction [34]. The rapid growth in consumption in the region can be attributed to several factors. These factors include a rapidly growing population, higher standards of living, and the rapid expansion of the electricity market. Heavy fuel subsidies and limited energy efficiency regulations have also fueled rising consumption rates [23].

Adopting renewable alternatives, such as solar and wind energy, has become increasingly crucial for GCC states to reduce dependency on hydrocarbon production and decouple energy consumption from economic growth [35]. Continuous consumption, combined with prevailing

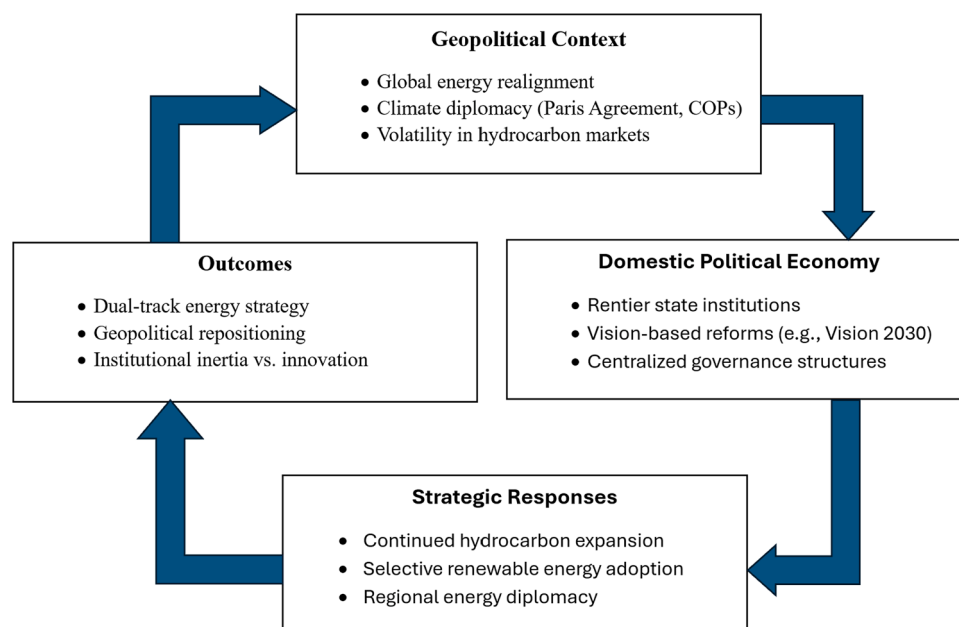


Fig. 1. Conceptual framework of energy transition dynamics in the GCC.

declines in oil prices and budget deficits, exacerbates the difficulty for GCC states in sustaining the provision of highly subsidized energy [25]. Moreover, climate-friendly options such as solar and wind offer reliable substitutes for fossil fuel-based energy generation while enabling surplus oil quotas to be redirected to Europe [34].

On the international demand side, following warnings from the Intergovernmental Panel on Climate Change (IPCC) regarding the ineffectiveness of global energy governance in meeting the mitigation targets of the Paris Agreement and the necessity for increased global societal engagement, popular demonstrations proliferated across Europe, urging governments to embrace decisive actions in addressing the consequences of climate change. In response, in 2019, the European Commission declared a Green Deal, reflecting the ambitious endeavors of the European Union's new strategies to achieve climate neutrality and shift towards renewable energy sources [36]. This deal has prompted the Organization for Economic Co-operation and Development (OECD) to further its pursuit of compliance with global climate governance and mitigating environmental risks. Currently, 34 member countries of the OECD are diligently working towards achieving complete decarbonization of their energy sectors by the year 2050 [25].

The global demand for critical minerals is rising rapidly due to the transition toward cleaner energy systems. According to the IEA, demand for lithium, nickel, cobalt, and other minerals used in batteries is expected to grow by 30 times by 2040 under current climate policies. The IEA further highlights that without sufficient investment in mining and refining, the shortages of these materials could bottleneck global clean energy transitions and potentially increase costs and slow progress [14].

Meanwhile, the worldwide energy markets' contemporary landscape is experiencing an extraordinary convergence of circumstances that are thrusting energy security to the forefront and favoring increased fossil fuel production. For instance, the impact of the COVID-19 pandemic has contributed to a surge in gas prices, prompting a prioritization of energy security over climate protection [37]. Furthermore, the invasion of Ukraine by Russia has underscored the continuity of fossil fuels within the energy market. In this regard, the merits of familiarity, efficient performance, extensive installed infrastructure, and cost-effectiveness emphasize the preference for fossil fuels in addressing urgent fuel needs and mitigating energy crises [38].

The invasion of Ukraine by Russia led the EU to enforce a series of sanction measures against Russian petroleum and natural gas. As a result, European countries accelerated their efforts to diversify their imports, increase renewable adoption for energy security, and advance their net-zero emission targets [39]. Furthermore, these measures have stimulated heightened efforts to diversify energy suppliers within the EU and decreased dependence on Russian fossil fuel allocations. The EU aims to boost imports from clean energies, offering substantial opportunities for Gulf countries to enhance their clean energy production, such as hydrogen and ammonia, to meet the EU's long-term demand objectives [40]. Despite the increase in gas prices and challenges in maintaining living costs at acceptable levels, the introduced corrective measures, along with additional quotas of oil and gas from other producer states such as Gulf economies, assisted in boosting EU energy security [41].

As numerous countries scramble to secure electricity at any cost, oil prices have surged beyond \$80 a barrel. The urgent imperative for energy security and preventing hydrocarbon prices from soaring has prompted the United States to appeal to major GCC producers, such as Saudi Arabia, to increase their production. This new stance redirects geopolitical attention to the GCC countries and strengthens their political dominance on the international scene through continuing oil production [27].

In the future, international energy dependency might be affected, prompting exporters to compete for smaller market shares. The geopolitical importance of the GCC will depend on the type of fossil fuel they export. Hydrocarbon forecasts indicate that oil demand will decrease faster than gas demand [42]. Consequently, Qatar, as the primary

exporter of natural gas, will enjoy greater geopolitical significance than those reliant on oil production. This significance is further accentuated for Qatar as it exports its gas quota as Liquefied Natural Gas (LNG), unlike other gas exporters who rely on pipelines. Exporting gas in the form of LNG enables Qatar to diversify its export portfolio and promptly respond to variations in demand when specific regions experience declines. Regarding GCC oil producers such as Saudi Arabia and the UAE, their geopolitical relevance could thrive in a world of low carbon intensity. The low carbon intensity of their oil and low hydrocarbon production costs would help extend their geopolitical relevance [43].

5. The Gulf's distinct path to energy transition

In response to the evolving geopolitical energy landscape, Gulf Arab states have begun to adopt different strategies to mitigate the risks associated with energy transition uncertainties, mainly through investments in non-oil sectors such as tourism, real estate, and infrastructure, as well as a focus on digital economy initiatives. These include (i) integrating climate policies into their economic development plans, (ii) economic diversification, (iii) maintaining stability in oil and gas markets while investing in renewable energy sources to promote energy security, sustainability, and economic prosperity, (iv) advocating for a gradual transition from conventional energy sources to clean energy systems supported by infrastructure, technology, and financing; and (v) integrating clean technologies, such as renewables, nuclear power, hydrogen, and carbon capture, into their existing energy systems to diversify their energy mix and mitigate carbon emissions [20]; and energy policy reforms.

In terms of integrating climate policies into their economic development plans and recognizing the adverse environmental impact, through their Nationally Determined Contributions (NDCs), they have pledged to reduce their emissions in line with the mandates of the Paris Agreement [24]. These policies aim to achieve climate resilience and mitigate potential economic shocks caused by the transition to renewable energy and the abrupt abandonment of fossil fuels [44]. However, enforcing energy transition policies without addressing associated adverse consequences can generate significant structural challenges. Austrian Economic theory suggests that such transitions may exacerbate socioeconomic vulnerabilities and increase impoverishment [34].

Most recently, the Gulf states have formulated economic diversification strategies to enhance their economic resilience. Notable among these are Saudi Arabia's Vision 2030, Qatar's National Vision 2030, Bahrain's Vision 2030, and UAE's Vision 2031 [45]. These strategies promise to yield numerous benefits, including bolstering long-term growth, amplifying the role of the private sector, and fostering competitiveness in an open economy [46].

Since the beginning of the third millennium, GCC countries have made significant strides in economic diversification. Thus, the Economic Diversification Index (EDI) for the Gulf countries reveals varying levels of progress in diversifying their economies away from oil and gas dependence. The index assesses the diversification efforts of 112 countries across three dimensions: government policy reforms, the degree of private sector involvement, and investment diversification. According to the scores of 2022, the United States, China, and Germany dominate the EDI rankings with scores of 153.2, 146.9, and 139.2, respectively [47].

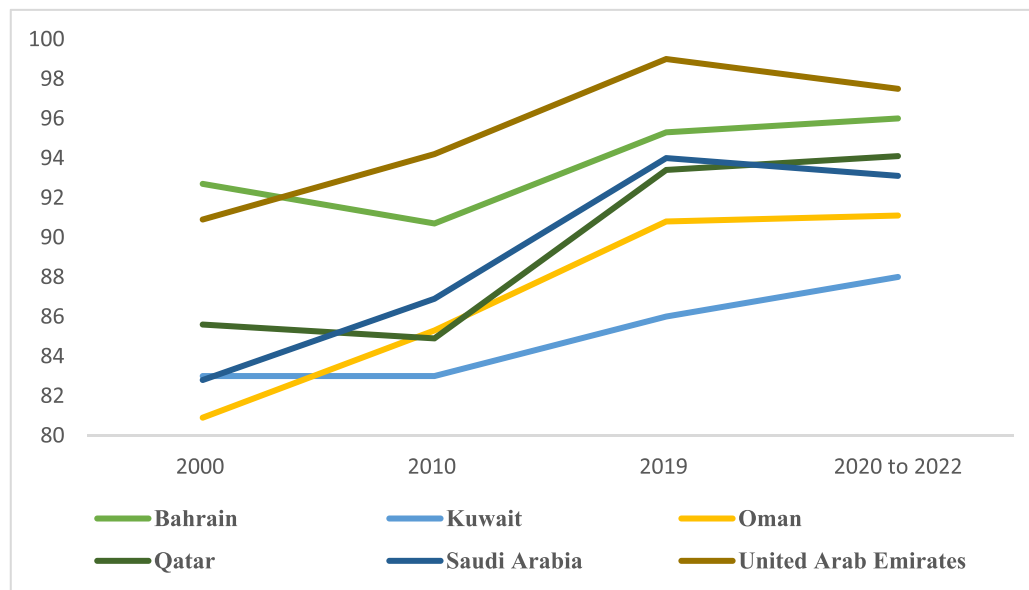


Fig. 2. EDI scores in GCC between 2000 and 2022.
Source: Saidi, [43].

The EDI scores of the UAE and Bahrain in 2022 were relatively higher than those of their GCC counterparts. Meanwhile, Saudi Arabia and Oman have significantly bolstered their scores since 2000, while Kuwait ranked lowest among the GCC states with an EDI score of 88.1 [48]. The following Fig. 2 illustrates the progression of EDI scores² in GCC countries from 2000 to 2022:

Despite efforts to achieve economic diversification, hydrocarbon revenues continue to finance significant expenditures in the Gulf region, covering sectors such as healthcare, employment, education, and subsidies for water and energy. These revenues reduce economic volatility, maintain social peace, eliminate various forms of taxation, address citizen demands for political representation, and stabilize political systems in the region [49]. Ensuring continuous service delivery while pursuing a low-carbon transition presents an arduous task.

Additionally, decarbonization pathways necessitate undergoing social, political, and economic infrastructure changes to ensure economic growth. Furthermore, these states still heavily rely on public investment, adhere to rentier economic policies, and face significant challenges in boosting economic diversification. A rentier state economy refers to a national economic system primarily relying on substantial external rent payments, such as revenues from natural resource exports like oil and gas, rather than domestic production and innovation. These states often derive a sizable portion of their national income from renting indigenous resources to external clients, leading to unique economic and political dynamics [50]. Rentier state economies face difficulties in attracting private investments in manufacturing and non-oil-based services [51].

Aligned with the indispensability of fossil fuels and the necessity of addressing climate change while meeting their international climate governance obligations, Arab Gulf economies advocate for a distinct approach in the global transition towards net-zero emissions. The

strategies GCC countries adopt to embrace the energy transition will vary due to significant production costs and reserve quantities disparities between Gulf states and other producers [52]. For instance, Saudi Arabia benefits from low production costs, while other states like Oman face higher costs [53]. According to the GCC, energy transition visions do not favor a complete phase-out of oil [21]. These visions necessitate maintaining hydrocarbon production to uphold national security, economic stability, and international political influence.

Meanwhile, other factors such as fluctuations in demand, the severity of public pressure, and low production costs would support the Gulf stances in increasing fossil fuel production. In this regard, continuous pressure towards a swift transition to clean energy could raise concerns about the demand for fossil fuels, potentially leading to periodic and abrupt supply contractions. These fluctuations in demand could result in volatile oil prices. In such instances, as traditional petrostate suppliers, GCC countries would benefit from price volatility, strengthening their geopolitical power and augmenting their revenues, mainly as they dominate fossil fuel cartel organizations such as OPEC and GCEF [27].

In contrast, Western oil-producing countries such as the United Kingdom, Norway, and the United States, which aspire to lead future climate advocacy efforts, may reduce fossil fuel production to accelerate the energy transition and respond to increasing public pressure. Furthermore, these countries are making substantial investments in renewable energy. Conversely, the Gulf states that benefit from low-carbon and cost-effective oil production and demonstrate lower dependence on financial climate institutions experience relatively less pressure to diminish their market share of fossil fuels [27].

GCC has proposed various energy reforms to promote renewable energy adoption and enable their pursuit of an energy transition pathway [25]. Prominent examples of these initiatives include Saudi Arabia's Circular Carbon Economy National Program and the UAE's National Adaptation Plan 2017-2050 [24]. These two countries are leading global efforts in renewable energy projects among the Gulf states. Qatar, Oman, and Kuwait have also demonstrated progress in meeting their commitments to expand renewable energy initiatives [25]. Although there has been an increase in the share of renewable energy in electricity capacity over the past five years [49], the utilization of renewable energy remains minimal. Its contribution to electricity generation across the Gulf does not exceed 1 % of primary energy consumption [55]. Fig. 3 illustrates the increasing contribution of renewable energy to electricity capacity in the GCC since 2014.

² The UAE leads with the highest EDI score of 94.8 in 2021, ranking as the 8th largest exporter of commercial services globally in 2022. Bahrain follows closely with an EDI score of 96.0 for the 2020-2022 period, demonstrating strong performance in diversification efforts. Saudi Arabia has also made significant strides, ranking as the 24th largest exporter of commercial services globally in 2022, with a notable improvement in its EDI score since 2000. Oman shows a solid EDI score of 91.1 for the same period, reflecting substantial progress relative to its past performance. Kuwait, while lagging slightly behind, has an EDI score of 88.0 for 2020-2022.

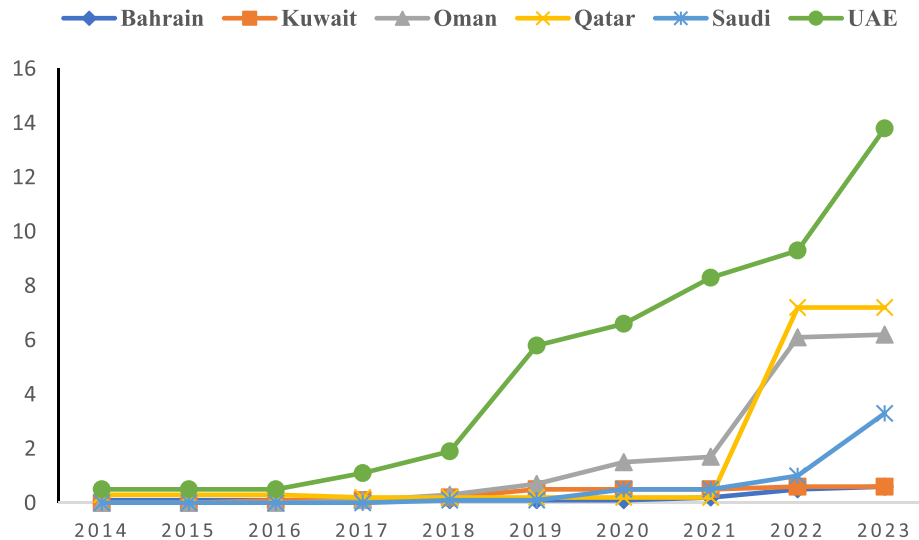


Fig. 3. Renewable energy share of electricity capacity.
Source: IRENA, [49].

6. Gulf energy transition: opportunities and challenges

The increased adoption of renewable energy in the Gulf yields various economic benefits such as subsidy savings, cost efficiency, and social advantages. In this regard, social benefits could be observed in enhancing rural electrification and development. Recognizing this consequence, Oman launched its inaugural policy in 2013 to incentivize and exploit renewable energy in rural areas. Several pilot projects, such as the Mazyonah Solar Project and the Masirah Wind-Based Project, each with a capacity of 303 kW, have been initiated to facilitate electricity generation in remote areas [55].

The broader utilization of renewable energy could bring many political advantages to GCC countries. These advantages primarily encompass promoting equitable energy access, balancing the interests of various stakeholders, and generating employment opportunities. Many countries have succeeded in promoting renewable energy technologies by implementing pro-renewable energy policies, encouraging incentives, and applying specific economic instruments such as feed-in tariffs and carbon taxes [56].

The energy transition in the GCC is explained through political-economic approaches, with less attention given to non-economic factors [56]. However, studies suggest that factors such as geopolitics and the pursuit of megaprojects for modernization play a role in promoting alternative energies in the region. Despite the dominance of economic arguments, there is a growing recognition of the importance of considering non-economic factors such as showcasing prestige, geopolitical posturing, and maintaining the rentier state model in driving the energy transition in GCC. This perspective underscores the need to incorporate intangible benefits into analyzing energy transition in the GCC context [56]. Further, the prospective deployment of renewable energy in the Gulf is projected to fortify the resilience of monarchical regimes. This aim will be achieved by expanding intricate patron-client networks, diversifying sources of revenue through the utilization of green hydrogen and non-hydrocarbon industrial methods and aligning with worldwide low-carbon energy standards [49].

Considering the region's abundance of solar and wind resources [54], exploiting renewable energy potential could yield various economic benefits. An analysis of the GCC's renewable potential by the International Renewable Energy Agency has demonstrated significant promise for the region in fostering a thriving renewable energy market. They could reap numerous benefits from exploiting these resources,

including conserving 400 billion barrels of oil in the energy industry, generating 2000 direct employment opportunities, reducing water usage by 11 trillion liters (equivalent to 16 %), and decreasing the region's per capita carbon emissions to 8 % by 2030 [57].

The GCC have exhibited varying degrees of progress in increasing the share of renewable energy in their electricity capacity over the past decade. While some states have emerged as leaders in the transition to cleaner energy, others remain in the initial stages of development (see Fig. 4). This trend highlights the diverse approaches and levels of commitment to renewable energy integration across the region [58].

The UAE, for instance, has significantly expanded its renewable energy share in electricity capacity, driven by substantial investments in large-scale solar projects. By 2023, the UAE had more than doubled its renewable energy share compared to previous years, underscoring its strategic focus on sustainability and its ambition to lead the region in clean energy adoption. This growth aligns with the UAE's national energy strategy and establishes the country as a regional leader in renewable energy. Conversely, although starting from a lower baseline, Saudi Arabia has made notable strides, particularly in recent years. The increase in the renewable energy share of its electricity capacity reflects the country's efforts to diversify its energy sources under the Vision 2030 framework, which aims to reduce dependency on oil and promote renewable energy, particularly solar power, as part of a broader economic transformation plan [58].

Oman has also shown significant advancements, especially from 2021 onwards, with a rapid increase in the share of renewables in its electricity capacity. This surge indicates Oman's growing commitment to renewable energy, supported by solar and wind energy investments. While demonstrating slower initial progress, Qatar experienced a significant increase in its renewable energy share in 2022. On the other hand, Bahrain has taken a more gradual approach, showing steady but slower growth in the renewable energy share of its electricity capacity.

Kuwait has seen the slowest growth in the renewable energy share of its electricity capacity among the GCC countries. Despite some increases over the past decade, Kuwait's overall share remains relatively low, indicating that more aggressive policies and investments may be required to accelerate renewable energy adoption [54; 58].

On the other hand, several factors propel Gulf states towards developing alternative clean energy sources. These factors include energy security challenges, a projected average demand increase of 5 % annually, and rising greenhouse gas emissions. Furthermore, the

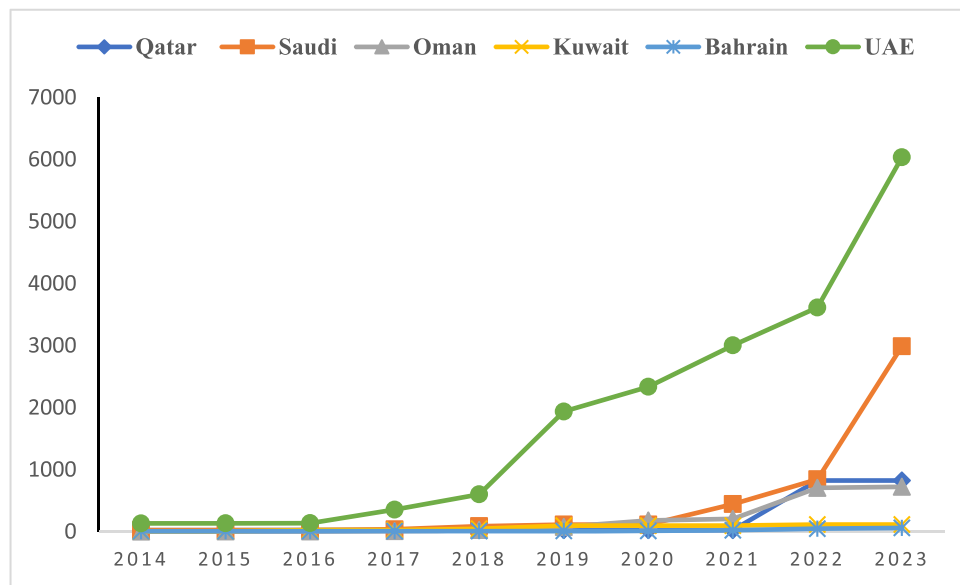


Fig. 4. Total installed renewable energy in the GCC (MW).

Source: IRENA, [49,53].

reliance on oil and gas resources to meet almost 99 % of local energy demands exacerbates the impact of climate change on the region [59]. Additionally, these factors comprise the region's international climate governance obligations, peak oil expectations, and the widespread accessibility of renewable energy technologies [18].

Several studies have investigated the adverse impact of the global energy transition on GCC economies. Their conclusions raise significant concerns about diversifying economic activities, reducing dependence on fossil resources, and reforming energy subsidies. Without addressing these challenges, the global energy transition could lead to unwelcome economic transformations in the region [60,61]. A particular study traced global renewable energy expansion from 2001 to 2019 and found a negative relationship between GCC economic growth and global renewables consumption [21].

The abundance of renewable energy resources in most countries, contrasted with the concentration of fossil fuel resources in specific

geographic areas, is diminishing the geopolitical importance of historically traditional energy chokepoints such as the GCC [62]. Further, a successful transition toward green energy in the GCC requires a paradigm shift, high commitment, and widespread adoption of green energy technologies and carbon dioxide reduction strategies [24]. Embarking on a post-oil development pathway poses political and economic challenges to oil-producing states and undermines the social contract of these resource-rich nations [16]. Considering the substantial susceptibility of GCC countries to climate change occurrences and their high dependence on fossil fuels, addressing these challenges remains a daunting task [63]. From a consumption perspective, the low-carbon transition trajectory may also reshape producer-consumer relations, redirecting attention to oil importers [16].

The total primary energy consumption per capita in the GCC countries presents a complex picture of energy use in a region heavily reliant on fossil fuels (see Fig. 5, excluding Bahrain). Despite ongoing efforts to

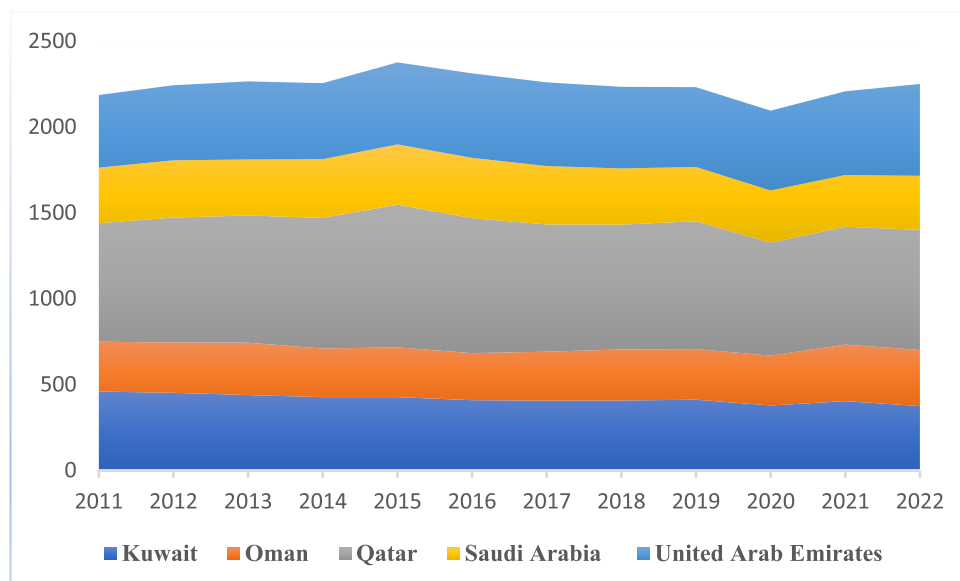


Fig. 5. Primary energy consumption per capita in the GCC.

Sources: BP, [59].

diversify energy sources, reform subsidies, and enhance efficiency, the GCC states continue ranking among the highest global per capita energy consumption [64]. While most GCC states maintained or even increased their energy consumption per capita, countries like Saudi Arabia and the UAE have implemented energy reform and efficiency programs and more renewable energy projects, resulting in slight decreases in per capita energy consumption [65]. These variations point to the differing stages of energy transition and policy implementation across the GCC.

Moreover, the transition to renewable energy in the region is still in its nascent stages, with the UAE leading the region as 4 % of its power generation came from renewables in 2020 [44]. Despite the potential benefits, concerns persist regarding the negative relationship between GCC economic growth and global renewables consumption, underscoring the necessity for GCC policymakers to reduce reliance on hydrocarbons and diversify economies [21]. As the world shifts towards cleaner energy sources, Gulf countries must actively strive to shield themselves from dwindling revenues and a shrinking share of the oil market [47].

Despite being classified among the top per capita greenhouse gas (GHG) emitters globally, the GCC countries have shown a mixed trajectory in reducing emissions (see Fig. 6). For instance, while some states have successfully curtailed their emissions, others, such as Kuwait, have continued to see increases in per capita emissions. This divergence underscores the varied pace and commitment to climate goals across the GCC.

7. The case study of Saudi Arabia

In the early 20th century, the development of the hydrocarbon industry established Saudi Arabia as a key player in the global energy market. As one of the largest oil producers, holding 17 % of the world's proven crude oil reserves, Saudi Arabia exports most of its oil despite increasing domestic consumption (Fig. 7). The low production costs provide a competitive advantage, yielding significant economic returns and allowing Saudi Arabia to exert substantial geopolitical influence by meeting global fossil fuel demands.

Oil and gas revenues have profoundly influenced the Saudi economy, transforming it from an agrarian society into a global economic powerhouse [66]. The influx of oil wealth has enabled Saudi Arabia to fund extensive infrastructure projects, social welfare programs, and modernization efforts, dramatically improving the standard of living.

On the other hand, this heavy reliance on oil has also made the economy vulnerable to global oil price fluctuations. This dependency

poses a risk in the future as global oil demand is expected to decline. The decline will be driven by the accelerating shift towards decarbonization and adopting climate policies to reduce greenhouse gas emissions globally [67]. The country's economic model, deeply rooted in the Rentier state framework, faces challenges as oil revenues diminish. To mitigate these risks, Saudi Arabia must diversify its economy by investing in non-oil sectors and enhancing its financial and industry resilience.

In the coming years, the oil industry is still expected to remain a cornerstone of Saudi Arabia's economy due to its lucrative returns. However, it faces challenges like oil price volatility and diminishing demand patterns. Despite oil revenues remaining pivotal in the economy, the kingdom's shift towards diversification aims to secure long-term economic stability and position itself in the future energy landscape. The dual approach to energy transition reflects the challenge of balancing economic imperatives with global climate policies. However, the continued investment in oil and gas is less resistant to ambitious climate policies and more of a cautious approach to maintaining economic stability and geopolitical influence.

Scholars such as Hafner et al. [43] argued that the evolution of the oil industry has been marked by many critical geopolitical events that have significantly caused a decline in oil prices and reduced revenues (Fig. 8). The most prominent was the 2008 financial crisis, which profoundly affected global oil demand. The rise of U.S. shale oil and gas in the 2010s dramatically allowed the U.S. to significantly increase domestic oil and gas production, reducing its dependence on Middle Eastern oil. In 2015, a landmark agreement emerged from the Paris Climate Conference (COP21), where global leaders committed to significant reductions in greenhouse gas emissions.

The oil price war between OPEC members in 2014–2015, led by Saudi Arabia, aimed to pressure high-cost producers. Saudi Arabia and Russia led a coalition to reduce oil production in 2016 to stabilize prices. The COVID-19 pandemic caused a sharp drop in global oil demand, leading to plummeting prices and economic challenges for Saudi Arabia. Mid-2021, global energy prices surged due to increased demand, limited capacity, and geopolitical tensions. These events emphasized the fragile balance of global energy markets and the need for flexible energy policies and investment in renewable energy.

Meanwhile, the landscape of energy geopolitics is set to undergo significant changes as the world accelerates its transition to cleaner energy sources. Projections indicate that global oil demand will decrease in the coming years as part of efforts to meet climate targets. With its significant reserves and low production costs, Saudi Arabia may keep its

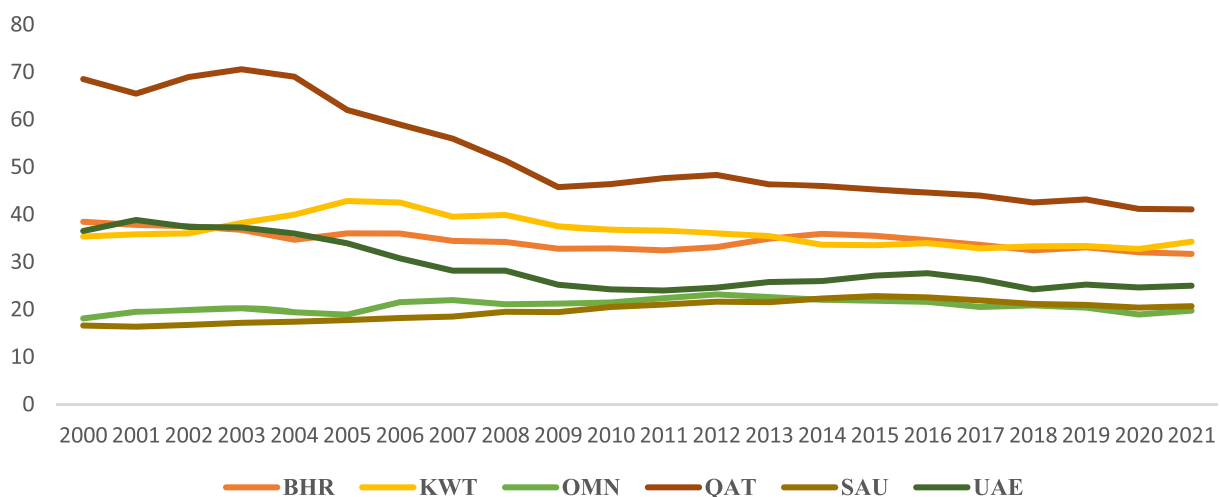


Fig. 6. Gulf Arab States emissions per capita (ton co2).
Source: Climate watch data, & CEIC data, [60].

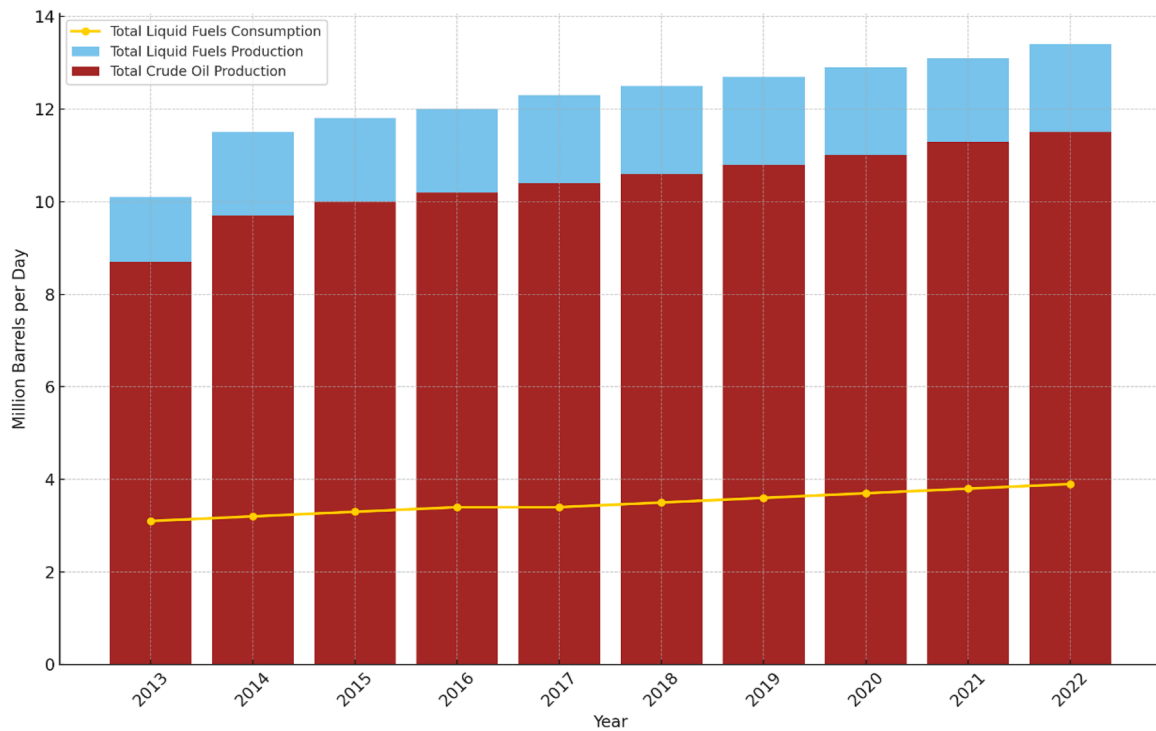


Fig. 7. . Saudi Arabia's annual liquid fuels production and consumption (2013–2022).

Source: EIA, [62].

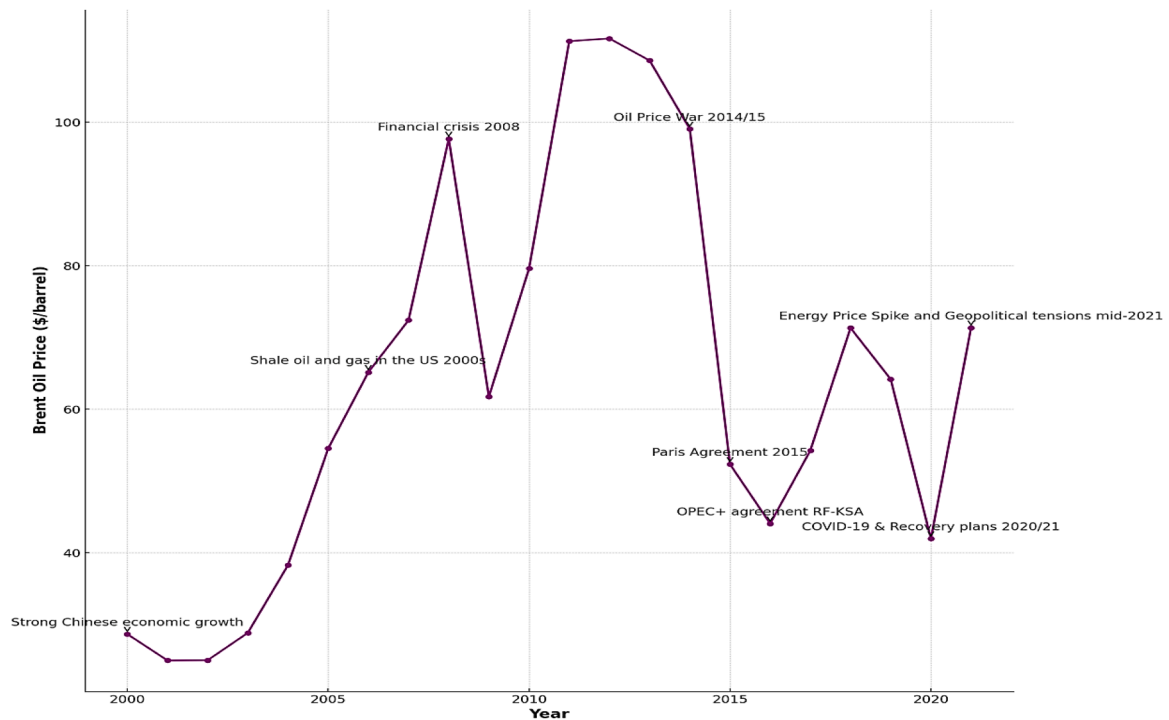


Fig. 8. Key geopolitical events and Brent oil prices(\$/barrel) 2000–2021.

Source: Hafner et al. [38].

market share in Asia (>60 %). See Fig. 9), where decarbonization commitments are less stringent, unlike in the European Union [43], this uneven pace in demand reduction poses challenges for Saudi Arabia in maintaining its geopolitical position in the energy sector. Diversifying export portfolios in new and existing markets and leveraging more revenue from their current production are becoming more crucial during

the energy transition [17].

While reducing oil dependency could weaken relationships with significant powers and oil-importing nations [69], it also opens opportunities for Saudi to capitalize on its renewable energy potential, especially in solar and wind energy. Exploiting these renewable resources could position the kingdom as a leader in clean energy exports and

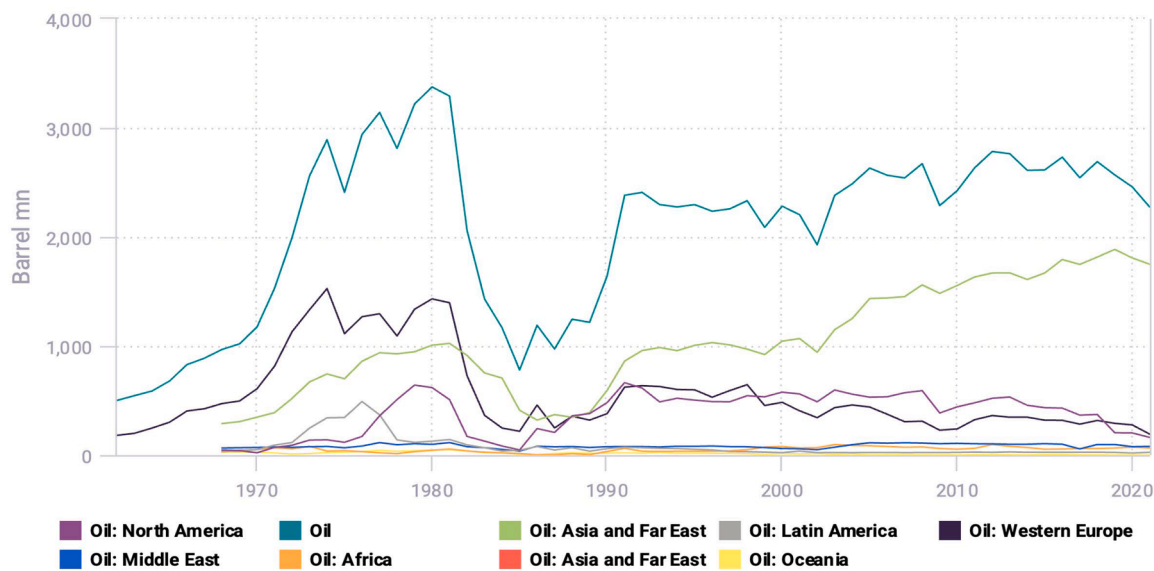


Fig. 9. Saudi energy exports: crude (1962–2021).
Source: CEIC data, [63].

enable it to navigate the challenges of declining oil prices and potential domestic instability due to shifts in traditional energy markets [35,43,68]. Renewable energy is being incorporated into Saudi's energy mix. However, it does not influence the government budgets significantly, as it does not provide high returns like the hydrocarbon sector. To mitigate risks associated with the energy transition, Saudi Arabia is focused on enhancing the competitiveness and resilience of its energy sector. Saudi Arabia advocates a Circular Carbon Economy approach, emphasizing reducing, reusing, recycling, and removing carbon emissions [70]. The strategy aims to achieve net-zero emissions while acknowledging the ongoing role of fossil fuels in the energy mix.

In 2016, Mohammed bin Salman unveiled a new initiative to diversify Saudi Arabia's revenue streams and economy, known as Saudi Vision 2030 [71]. The vision entails measures focused on enhancing structural reforms, promoting transparency, and implementing various economic and social policies. However, the successful implementation of these initiatives relies heavily on the financial resources generated from oil exports. This inherent paradox raises critical questions about the initiative's capacity to improve Saudi Arabia's carbon footprint and its ability to reposition the nation within the evolving global energy landscape.

A key initiative under the 2030 vision is NEOM, a megacity project that promises to be powered entirely by renewable energy, as announced. On the other hand, the Saudi and Middle East Green Initiatives, spearheaded by Saudi Arabia, aim to combat climate change, reduce emissions by 670 million tons of carbon dioxide, and increase the share of renewable energy in electricity generation [72]. Similarly, in pursuit of the 2030 vision, the kingdom implemented energy pricing reforms for residential and commercial users to encourage more prudent usage in 2018 [73]. These reforms aimed to promote more responsible energy use by adjusting the prices of electricity, gasoline, and diesel to reflect the actual costs. Due to these policies, residential electricity consumption dropped by 13 terawatt hours in 2018 compared to the previous year.

Saudi Arabia's current economic structure is deeply entrenched in the hydrocarbon sector, which provides substantial revenue and employment. Shifting away from this requires huge economic adjustments and socio-political changes to manage the impacts on employment and social welfare provided by oil revenues. In the long term, transitioning to a sustainable and climate-resilient economy could provide Saudi Arabia multiple benefits, including enhanced energy security,

technological innovation, and a more robust global competitive position in a low-carbon world.

Indeed, the state depends on national resources to address climate challenges, and it uses rent revenues to strike a balance between economic growth and environmental stewardship. The issue is connecting the distance between relying on fossil fuels and adopting clean energy. This transition requires overcoming national barriers and effectively utilizing indigenous natural resources while establishing a reliable supply chain for renewable energy sources. The kingdom's proposed initiatives aim to achieve this delicate balance, demonstrating a commitment to adapting and adjusting the economy to the new energy era without compromising its status as a leading oil producer.

While Vision 2030 acknowledges the urgency of addressing climate change, integrating climate objectives into policy frameworks faces challenges due to the dominance of the oil sector and political-economic dynamics. Nonetheless, Vision 2030 sets ambitious targets for renewable energy deployment, environmental conservation, and sustainable development, signaling a commitment to transitioning towards a low-carbon economy. The plan includes initiatives to develop other sectors, such as tourism, entertainment, and renewable energy, indicating an explicit acknowledgment by the government of the need to transition [74,75]. By investing in renewable energy projects, Saudi Arabia can reduce its carbon footprint and enhance its geopolitical relevance in the global clean energy market.

8. Discussion

The findings of this study underscore a complex and dualistic trajectory characterizing the energy transitions of GCC states. While these states have taken tangible steps toward diversifying their energy mix, hydrocarbons continue to dominate as the foundation of economic and geopolitical relevance. As illustrated in Fig. 1, these dynamics are embedded within a cyclical framework, where global geopolitical shifts influence domestic institutional responses, which in turn shape strategic choices and reinforce dual-track energy transition outcomes across the Gulf. This paradox reflects the region's rentier structure and its strategic response to global climate imperatives, where renewable adoption complements rather than substitutes fossil fuel dominance. This paradox reflects the region's rentier structure and its strategic response to global climate imperatives, where renewable adoption complements rather than substitutes fossil fuel dominance. The GCC's transition path

diverges significantly from the linear decarbonization models proposed in international frameworks. In contrast to countries that pursue swift fossil fuel divestment, GCC states engage in a gradualist transformation anchored in state-led vision strategies, selective adoption of renewables, and preservation of geopolitical leverage through oil and gas diplomacy. This supports the theoretical argument that energy transitions in rentier systems are deeply shaped by institutional resilience, elite continuity, and global bargaining strategies. The analysis of Saudi Arabia's national vision further illustrates how rentier dynamics intersect with modernization agendas, supporting the persistence of hydrocarbon-led growth despite green rhetoric.

These findings resonate with Pata et al. [9], who demonstrated that geopolitical risks in fragile states shape environmental quality and energy outcomes through institutional channels. However, in contrast to the GCC, where centralized authority enables rapid policy response, their study reflects institutional fragmentation. Similarly, while Alyamani and Solangi [11] documented a general shift toward renewables across OPEC members, the present study underscores the uneven pace and rentier resilience in the GCC, particularly in Kuwait and Bahrain.

In this context, the GCC's strategy involves maximizing hydrocarbon revenues to fund the expansion of renewable energy infrastructure and diversify the economy. This approach is evident in national initiatives such as Saudi Vision and the UAE Energy Strategy, which aim to balance economic diversification with sustained hydrocarbon production. Moreover, technological advancements in carbon capture and storage and circular carbon economy models are being utilized to reduce the environmental footprint of hydrocarbon production, allowing the GCC to remain competitive in a decarbonizing world without abandoning its oil and gas resources.

While the GCC has demonstrated a commitment to advancing renewable energy projects, there has been relatively limited investment in critical mineral supply chains, unlike countries such as China and Australia, which have strategically invested in mining and refining capacities for key minerals globally.

A 2021 report from the IEA highlights the risks associated with the GCC's limited involvement in critical mineral markets, noting that the region could face increased costs for renewable technologies due to reliance on external suppliers [76]. Furthermore, the United Nations Conference on Trade and Development (UNCTAD) emphasizes that global competition for these minerals is intensifying, with supply constraints already causing delays in clean energy projects globally [77]. For developing countries, especially the Gulf States, this could hinder their ability to meet their renewable energy targets, delay the adoption of electric vehicles, and slow progress in energy storage technologies.

The GCC must explore new investment strategies to address these risks and secure access to critical mineral supply chains. Achieving this aim could involve direct investments in mining operations in resource-rich regions such as Africa, Latin America, and Australia. For instance, GCC sovereign wealth funds could invest in joint ventures with companies specializing in extracting and processing critical minerals. Additionally, engaging in strategic partnerships with mineral-producing countries could help secure long-term access to these resources. Developing refining and processing capacities within the Gulf, supported by foreign investment and expertise, could also reduce the region's reliance on external suppliers. Moreover, partnerships with technology leaders in Europe, China, and the United States could provide the necessary expertise to develop domestic capabilities in battery production, mineral refining, and clean technology manufacturing. By doing so, the GCC would enhance its energy security and position itself as a key player in the global supply chain for renewable energy technologies.

The geopolitical implications of the GCC's energy transition are multifaceted and reflect the changing dynamics of global energy markets. As global oil demand is projected to decline, especially in Western markets, the GCC is strategically pivoting toward Asian economies, which are expected to maintain strong hydrocarbon demand in the coming decades. This shift is essential for the GCC states to preserve

their geopolitical influence in a world where decarbonization policies are unevenly applied across regions. As a result, the GCC's energy diplomacy is increasingly focused on securing long-term energy partnerships with Asia-Pacific nations while diversifying into renewable energy to enhance future energy security.

However, the energy transition poses significant challenges for the GCC's geopolitical position. The concentration of renewable energy resources in most countries outside the Middle East reduces the geopolitical importance of traditional energy chokepoints, such as the Strait of Hormuz. Moreover, the transition away from hydrocarbons could weaken the political leverage of oil-dependent GCC states in international relations, particularly as global consumers increasingly turn to alternative energy sources. Mitigating these risks necessitates GCC states to diversify their export portfolios, enhance the value derived from existing hydrocarbon resources, and expand their role as clean energy leaders in solar and wind production.

Given the Gulf's strategic position in global energy governance, policy must evolve beyond transitional rhetoric. National policies should prioritize regulatory certainty and invest in domestic value chains for critical minerals and clean tech manufacturing to avoid external dependencies. Regionally, a GCC-level renewable energy coordination mechanism would harmonize fragmented initiatives and reduce intra-bloc asymmetries. At the international level, the Gulf must reposition itself as a clean energy exporter while enhancing its contribution to global carbon pricing and green finance framework.

This study has several limitations. First, it relies primarily on qualitative analysis and publicly available policy documents, which may not fully reflect internal decision-making dynamics or the political complexities underlying national strategies. Second, although the conceptual framework offers a comprehensive structure, it has not been empirically validated through modeling or field-based research. Future studies could address this by employing quantitative methods or conducting in-depth case studies to test and refine the framework across broader comparative settings.

Further research is also needed to examine the role of non-state actors, such as private sector stakeholders and civil society in shaping energy transition pathways in the Gulf. Methodologically, future work could benefit from econometric modeling or mixed-methods approaches that integrate stakeholder interviews with longitudinal panel data across GCC countries. In addition, investigating the effects of global financial trends, carbon market dynamics, and regional geopolitical tensions could provide a more nuanced understanding of national-level implementation challenges. Finally, exploring policy divergence among GCC states and identifying gaps in public sector execution could offer valuable insights into governance constraints affecting the energy transition.

9. Conclusion

This paper examined how Arab Gulf States navigate the global energy transition while maintaining hydrocarbon centrality and pursuing selective renewable integration. The study revealed that Gulf energy strategies are shaped by a combination of geopolitical calculations, institutional path dependence, and economic diversification imperatives. Despite widespread acknowledgment of climate challenges, hydrocarbons remain essential to state revenue, foreign policy leverage, and social stability in the Gulf. Renewable energy is promoted not as a replacement but as a complement a strategic buffer in an evolving global energy order.

GCC states exhibit differentiated trajectories. The research shows that GCC states, particularly Saudi Arabia, the UAE, and Qatar are adopting divergent but converging strategies to remain geopolitically relevant. These include regional energy diplomacy, domestic economic diversification, and investments in hydrogen and carbon capture technologies. Other states, such as Kuwait and Bahrain advance more cautiously. Regional disparities reflect both structural capacities and political priorities. Nonetheless, the transition strategies converge

around three pillars: preserving oil rents, maintaining geopolitical relevance, and hedging against external shocks.

Policy implications suggest the need for regional coordination in energy planning, enhanced integration with global clean energy supply chains, and structural reforms to mitigate rentier dependencies. Gulf states must also expand investments in critical minerals and green industrial infrastructure to avoid future vulnerabilities in a decarbonizing world.

Limitations and Future Research: This study relies primarily on secondary data and qualitative interpretation, which may constrain generalizability. Future research should incorporate econometric modeling, stakeholder interviews, and comparative implementation analysis to better understand the internal dynamics of policy execution across GCC states.

CRediT authorship contribution statement

Abdaltah Hamed Ali: Conceptualization, Methodology, Data curation, Formal analysis, Visualization, Validation, Supervision, Writing – original draft, Writing – review & editing. **Monged Abdalla:** Conceptualization, Methodology, Data curation, Formal analysis, Visualization, Validation, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript. No financial, personal, or professional affiliations have influenced the research, analysis, or conclusions presented in this paper. The authors have independently conducted this work without any external influence.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.sfr.2025.100808](https://doi.org/10.1016/j.sfr.2025.100808).

Data availability

The data that has been used is confidential.

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