# Geopolitics of Renewable Energy in the Middle East and North Africa Region

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**Abstract.** The energy transition from fossil fuels to renewable energy in the Middle East and North Africa (MENA) region is a significant geopolitical challenge, given the economic dependence of these countries on hydrocarbon exports. This study uses a classical realism approach to analyze the impact of the energy transition on regional political dynamics and global alliances and explores the role of MENA countries in renewable energy integration. The methodology used is a systematic literature review of various reports and articles. The results show that despite the great opportunities in the renewable energy sector, political, economic, and infrastructure challenges remain major bottlenecks. This study provides important insights for policymakers and energy actors in understanding geopolitical changes in the MENA region due to the energy transition.

**Keywords:** MENA region, geopolitics, renewable energy transition, energy security

## 1 Introduction

Oil and gas have an important role in shaping the nature of global politics (Mohapatra 2017). Even over the past century, oil has shaped the world's economy and society, and enabled socio-economic development, especially in the Middle East and North Africa (MENA) region. The region has been greatly influenced by its rich hydrocarbon resources and the global increase in oil consumption following World War II, which have fueled socio-economic growth, shaped the political landscape, and strengthened its governance (Hafner et al. 2023).

The important role of oil and gas faces a major challenge in the form of global warming caused by increasingly high CO2 emissions (IEA 2023). This encourages MENA countries as the world's main oil and gas exporters to develop renewable energy as an effort to decarbonize the global energy supply (IRENA 2017) which is also believed to be a panacea for fossil fuel-related diseases that have been faced by countries in the Middle East and North Africa (MENA), such as dependence on imports and transportation congestion (Scholten et al. 2020).

The development of renewable energy, many see it as only having technical obstacles, in fact, this effort is full of complex social and geopolitical issues (Kuzemko et al. 2024). For this reason, this study seeks to analyse this issue using a geopolitical approach. Geopolitics is one of the approaches integrated into the theory of 'realism',


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which has dominated the study of international relations (Kuzemko et al. 2024), especially since the end of the Second World War. We will remember how Germany planned to wage a war for control of the oil fields in Baku, the Japanese aggression at Pearl Harbor in 1941, as well as the American policy in the West Asian region, and the resulting energy crisis after the Second World War. The crisis contributed to the formation of a formal regime in the form of OPEC (Mohapatra 2017). The geopolitical importance of OPEC became evident during the Yom Kippur War, also referred to as the Arab-Israeli War, which broke out in October 1973. In reaction to the support extended by certain nations to Israel, Arab members of OPEC enforced an oil embargo targeting the United States, the Netherlands, Portugal, and South Africa (Hafner and Tagliapietra 2020).

In 1943, Home Secretary Harold Ickes in an article titled '*We Are Running Out of Oil',* gave a strong signal to acquire more energy resources. To quote his statement: *'If there is a World War III then the war must be waged using someone else's oil, because the United States will not have it...*' (Mohapatra 2017). Ickes' statement proved to be true, that energy scarcity, fluctuations in energy prices, and depletion of resources, have created gaps and threatened energy security that we assume will lead us to the same geopolitical epicentre in the next few years (Mohapatra 2017). This gap can be seen from the estimates given by the International Energy Agency (IEA) that gas demand will increase by 50% and will be around 5 trillion cubic meters by 2035 (Mohapatra 2017).

Since World War I, there is no doubt that oil has represented the cornerstone of global energy geopolitics (Hafner and Tagliapietra 2020). Energy geopolitics first emerged as a neo-classical geopolitical genre born out of the OPEC oil crisis in 1973–74 (Kuzemko 2024). The geopolitical implications of renewable energy are increasingly attracting the attention of both scholars and policymakers. Historically, experts in international relations have predominantly concentrated on oil and gas when examining topics such as energy security, energy geopolitics, and the international political economy of energy. Much of their work consists of detailed historical accounts that largely overlook the role of renewable energy sources (Scholten et al. 2020). Currently, they are focused on shale gas, non-conventional oil, and the expanding global LNG market. In contrast, renewable energy experts have largely overlooked the international political implications of renewable energy, concentrating instead on their accomplishments, including the potential of renewable sources, system integration, and the dissemination of new technology in emerging markets (Ellabban et al. 2014). Currently, geopolitics is the best approach to connect spatial and territorial ideas with renewable energy, although the main focus is on climate and environmental politics (Scholten et al. 2020). What drives this research to focus on the MENA Region in this study is the great ambition and commitment of the MENA Region in the application of renewable energy and is a solution to energy security issues. This article aims to explore the comparison between the geopolitics of renewable energy and fossil fuels in the MENA region to ensure that the energy transition policies adopted by various nations can effectively address global energy security.

This article makes an important contribution by discussing the geopolitical impact of the energy transition in the MENA region, including the formation of new alliances between countries such as the UAE and Saudi Arabia with global powers such as China and Europe. In addition, this article examines the strategic role of MENA countries in renewable energy dynamics as well as challenges and opportunities, especially related to investment and political stability. This contribution is beneficial for academics, policymakers, and energy industry players to understand geopolitical changes in The MENA Region energy transition era.

## 2 Methodology

This article is based on a review of publicly available secondary data, including analytical reports by energy organizations, think tanks, and media articles. The report uses a systematic literature review, which is important for identifying and critically assessing relevant research, as well as for collecting and analysing data from such studies (Snyder 2019). To provide an overview of this topic, geopolitics has become the most suitable approach to connect spatial and territorial ideas with renewable energy, although the main focus is on climate and environmental politics (Scholten et al. 2020), this energy geopolitics is closely related to the competition for resources that is the basic assumption in classical realism theory in the field of International Relations (IR) studies.

In this research, I draw on classical realism theory in the field of International Relations (IR) studies to make the argument that states as rational actors operating in an anarchic world, each state aim to maximize gains and minimize losses due to a lack of trust between nations or filled with mutual suspicion of the intentions of other parties because in the realism paradigm no one can guarantee that other countries will behave well to each other (Rosyidin 2022). As a paradigm, realism has three basic assumptions (hard core) (Legro and Moravscik 1999). Realism views that the essence of actors is unitary and rational in an anarchic world. The two key concepts in this first basic assumption are 'rational' and 'anarchic' (Rosyidin 2022).

In addition, realism views that international structures are determined by material capabilities. Realism believes that state behavior is shaped entirely by material structures in the international system (Rosyidin 2022). The material structure here is everything that is visible and tangible power such as the military posture of a country, per capita income, the amount of defense budget, the number of nuclear weapons, the capability of weapons, the size of the territory, the geographical position, the wealth of natural resources, and so on that are the ambitions of a country as mentioned in the statement of Kautilya, a political advisor to King Candragupta of the Mauryan Empire who is quoted as a realist thinker, once mentioned in his classic work Arthasastra that: *'It is the ambition of every country to "gain strength and happiness" for its* people'. This is only possible with the conquest of new resources and territories (Mohaparta 2017). Therefore, the geopolitics of renewable energy, with its competition for new resources, aligns with the realist paradigm in International Relations.

# 3 Discussion and Findings

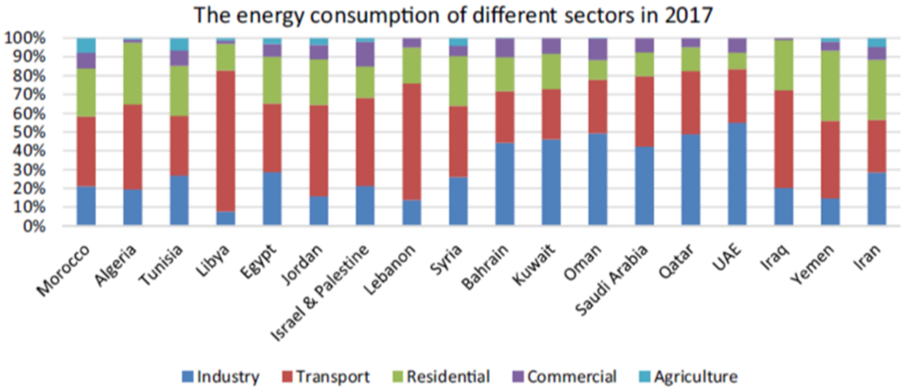
## 3.1 Renewable energy trends in the MENA region

The Middle East and North Africa (MENA) region is called by Hafner (2020) as a challenge for the global energy transition. The region has become a vital global oil and gas export hub. The region has undergone significant population growth, rapid industrialization with high energy demands, and a series of oil-related explosions. Additionally, the availability of subsidized fuels has contributed to its status as one of the world's regions with the highest energy consumption, both on a per capita basis and relative to GDP (Hafner and Tagliapietra 2020).


**Fig. 1.** MENA region countries (M. Kabil et al. 2022)

MENA regions are vulnerable to climate change due to water scarcity, while they have a significant dependence on climate-sensitive agricultural sectors, as well as the concentration of population and economic activities in urban areas that are prone to flooding (Mejbri et al. 2015). Climate change has the potential to intensify existing social, environmental, and economic challenges across various sectors, including water resources, agriculture, infrastructure, aquaculture, health, and tourism. In this context, the Middle East and North Africa (MENA) region places a significant emphasis on the development and implementation of renewable energy sources as a response to these pressing issues (Hatipoglu et al. 2023). By adopting renewable energy technologies, MENA countries can play a vital role in the global effort to combat climate change while also strengthening their energy security. This transition not only addresses environmental concerns but also promotes sustainable development and economic growth in the region (Cirdei 2017).

Although MENA countries have oil wealth, energy security is also a new challenge that encourages the development of alternative energy resources (Hatipoglu et al. 2023). From a sustainable energy standpoint, it is important to remember that oil independence is essential to a country's economy. However, from 2009 to 2020, the MENA region had the second highest growth in primary energy consumption, following the




Asia Pacific region (Hatipoglu et al. 2023), due to the rapid increase in population, increased electrification rates, increased consumption in the private sector (e.g., air conditioning, heating, cooking, communication), and economic growth (Timmerberg et al. 2019), accompanied by the phenomenon of zonal climate change and the water cycle, has become a strong driver for the integration of development and planning for renewable energy and sustainable infrastructure in recent decades (Hassan et al. 2023).

**Fig. 2.** Energy Consumption of Different sectors in 2017, retrieved from Chentouf and Allouch 2022

In welcoming this trend, in fact, MENA countries show heterogeneity in several dimensions such as per capita income and energy consumption levels across the region (Arezki 2023). This region consists of high-income countries (the oil giants), with high levels of energy consumption, namely: Saudi Arabia, Iraq, the United Arab Emirates (UAE), Iran, and Kuwait (almost all of them are in the Gulf Area, except Iran). Moreover, it holds a pivotal position as a major producer of natural gas (Hatipoglu et al 2023), with Iran, Qatar, and the UAE ranking among the world's top ten producers. Meanwhile, Yemen and Syria are in the bottom group of energy income and consumption. The country's credit rating also varies widely. Saudi Arabia, Kuwait, Qatar, and the UAE have high rankings, while Jordan, Oman, and Bahrain are positioned in the middle class. In contrast, Iraq and Lebanon have low ratings (Hassan et al. 2023) (Jabbour 2020). Currently, spending on fossil fuel supplies is significantly greater than on clean energy. For every dollar allocated to fossil fuels, merely 20 cents is channeled into clean energy investments. This figure equates to approximately one-tenth of the global average ratio between clean energy and fossil fuel investments (IEA 2024).

Political considerations and commitments to address climate issues vary across the region. On one hand, countries like the UAE and Morocco are making significant investments to establish themselves as leaders in climate action and clean energy within the region (Hafner et al. 2023). In addition, the level and type of natural resource wealth are also very different. Not to mention the structure of government, the composition of major trading partners, and the portfolio of military alliances are also very varied (Hatipoglu et al. 2023).

Collective initiatives to carry out an energy transition have emerged over the past decade in the region, particularly in the Gulf states as the largest oil producers. Even the Gulf states have placed climate change as an environmental issue that will be managed by a special department in an environmental ministry or agency (Hafner et al. 2023).

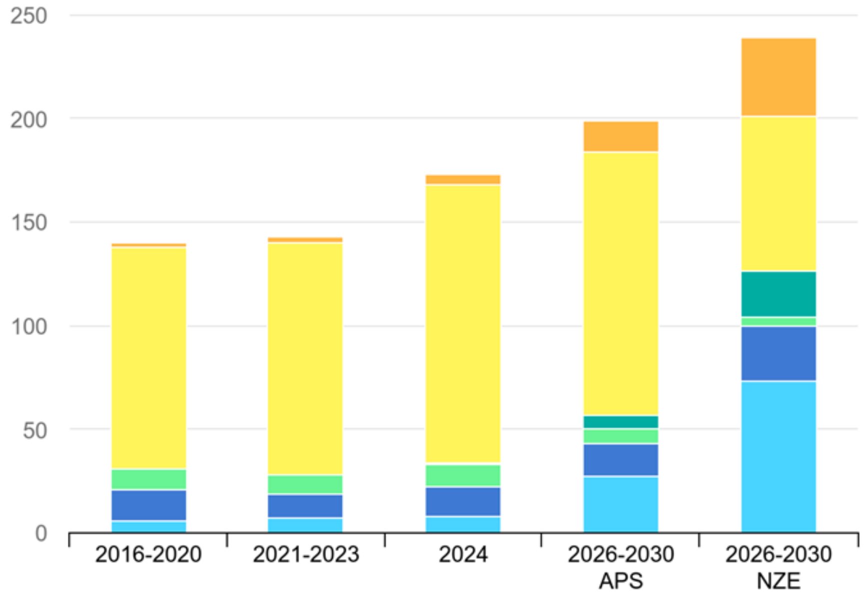



**Fig. 3**. Past and future energy investment in the Middle East in the Announced Pledges Scenario and in the Net Zero Emissions by 2050 Scenario, 2016-2030. Source: IEA 2024, World Energy Investment 2024 Middle East, https://www.iea.org/reports/world-energy-investment-2024/middle-east, License: CC BY 4.0;

Each country in the region has set renewable energy use targets as can be seen in Table 1 (Mahmoud and Habib 2019). It is undeniable that these initiatives and targets are motivated by the region's abundant renewable resource potential which provides great opportunities for countries to diversify their economies, create job opportunities—especially for qualified young people—and encourage the private sector (Hatipoglu et al. 2020). Therefore, economic diversification is a crucial factor in facilitating the initiation of the energy transition across MENA countries (Shaar and Leal Arcas 2023) by maximizing their hydrocarbon exports while utilizing renewable sources for domestic consumption.

**Table 1.** Renewable energy targets in each country in the MENA Region. Source: Chentouf and Allouch 2022

| Country | RE target (capacity) | Share in total power | Year of achievement |
|---|---|---|---|
| Morocco | 10 GW | 52% | 2030 |
| Algeria | 22 GW | 32% | 2030 |
| Tunisia | 3.815 GW | 30% | 2030 |
| Libya | 4.6 GW | 22% | 2030 |
| Egypt | 54 GW | 42% | 2035 |
| Jordan | 3.22 GW | 15% | 2025 |
| Palestine | 0.5 GW | 25% | 2030 |
| Lebanon | 0.75 GW | 30% | 2030 |
| Syria | 4.5 GW | 30% | 2030 |
| Bahrain | 0.71 GW | 10.3% | 2035 |
| Kuwait | 4.266 GW | 15% | 2030 |
| Oman | 3.05 GW | 16% | 2025 |
| Saudi Arabia | 58.7 GW | 30% | 2030 |
| Qatar | 1.8 GW | 20% | 2030 |
| UAE | 6.5 GW | 44% | 2050 |
| Iraq | 6.2 | 10% | 2028 |
| Yemen | 0.715 GW | 15% | 2025 |
| Iran | 20 GW | 18% | 2025 |

The following is an explanation of the trends and achievements of the renewable energy transition in each country in the MENA Region:

**Morocco**

Morocco has become one of the leading countries in renewable energy development in Africa, with 17% of total energy coming from renewable sources in 2021 (Mahmoud and Habib 2020). Solar and wind projects, such as the Noor Ouarzazate Complex, have placed Morocco as a key player in the region (Benbba et al. 2024). Morocco has also signed an agreement with Portugal to develop green hydrogen. However, the need for large investments to continue to expand renewable energy capacity is still the main challenge (IRENA 2024).

**Algeria**

Algeria is still heavily reliant on fossil energy, with renewables accounting for only 0% of total energy in 2021 (IRENA 2024). However, Algeria offers a promising market for renewable energy development due to its large market size and significant resource potential (Mahmoud and Habib 2020). Despite Algeria's significant potential in harnessing solar and wind energy, the country encounters challenges stemming from inadequate investment and underdeveloped infrastructure. Solar and wind projects have been planned, but the growth of the renewable energy sector is still held back (IRENA 2024).

**Tunisia**

Tunisia has made steady progress in renewable energy, contributing 10% of the total energy supply in 2021 (IRENA 2024). Renewable energy projects are primarily focused on solar and wind power, although there is chance for further expansion. Tunisia faces challenges in terms of dependence on energy imports (Ersoy and Terrapon-Pfaff 2021), but the opportunities in the development of renewable energy, especially solar power, are enormous (IRENA 2024).

**Libya**

Libya has increased its renewable energy capacity to 25,797 TJ in 2021, with a significant solar contribution (IRENA 2024). The main renewable energy project is solar power, although its contribution to the total energy mix is still small (4%)(IRENA 2024). The potential for wind power is also there, but Libya's institutional stability is the crucial first step in achieving its long-term renewable energy goals (Mahmoud and Habib 2020).

**Egypt**

Egypt has a considerable renewable energy capacity, with a contribution of 12% of total energy in 2021 (IRENA 2024). Wind and solar power projects dominate the renewable energy sector in the country (Mahmoud and Habib 2020). Egypt has great potential in both sectors, especially in the Red Sea region. However, Egypt's dependence on natural gas is a major challenge in the transition to clean energy (IRENA 2024).

**Jordan**

Jordan is one of the leaders in the Middle East in the transition to renewable energy (Mahmoud and Habib 2020), with a significant increase in installed capacity, reaching 34,401 TJ in 2021, or 10% of the country's total energy (IRENA 2024). Solar and wind projects are major mainstays, with major projects such as solar power plants in the Wadi Rum Desert. Despite its great potential, the main challenges are its still high dependence on energy imports and limited water resources for power generation (IRENA 2024).

**Palestine**

In Palestine, renewable energy is growing significantly, with an increase from 8% in 2016 to 12% in 2021 (IRENA 2024). Solar energy projects dominate the development of renewable energy in the country, accounting for almost all renewable energy capacity (Mahmoud and Habib 2020). However, limited geographical conditions and an unstable political situation are the main obstacles to further development (IRENA 2024).

**Lebanon**

Lebanon has increased the contribution of renewable energy in its energy mix, from 2% in 2016 to 4% in 2021 (IRENA 2024). Major renewable energy projects in Lebanon include solar and hydro power development, with renewable energy installed capacity reaching 10,377 TJ in 2021. The potential of solar power is enormous, but political and economic instability is a major challenge that hinders further investment (IRENA 2024).

**Syria**

Syria faces a difficult situation in developing renewable energy. In 2021, renewable energy accounted for only 1% of the total energy supply, with most of it coming from hydropower (IRENA 2024). The potential for solar power exists, but infrastructure and political instability are the main obstacles in its utilization (Mahmoud and Habib 2020). The opportunity lies in the rehabilitation of the post-conflict energy sector, with solar power being a quick solution in providing energy in hard-to-reach areas (IRENA 2024).

**Bahrain**

In 2021, Bahrain generated only 548 TJ from renewable energy, despite experiencing a growth of 64% since 2016 (IRENA 2024). Renewable energy projects in Bahrain rely heavily on solar power, with the potential of wind power still not optimal. Bahrain has a great opportunity to increase solar energy given its ideal geographical conditions, but the main challenge is the limited land and adequate water resources to support large-scale green energy generation (IRENA 2024).

**Kuwait**

Kuwait showed an increase in renewable energy capacity with a growth of 438% from 2016 to 2021 (IRENA 2024). Despite this, renewable energy only accounts for 1% of the total energy supply. Kuwait has great potential in solar and wind power, but its use is still very limited. Major projects include solar capacity of 179 GWh and wind capacity of 1,722 GWh (IRENA 2024). A major challenge facing Kuwait is its high dependence on fossil fuels and barriers to expanding renewable energy infrastructure.

**Oman**

Oman has made significant progress in renewable energy development, with a contribution of 6,947 TJ in 2021, up nearly 700% since 2016 (IRENA 2024). Oman's renewable energy projects mainly focus on solar power, which accounts for a large portion of renewable energy production. The potential of wind power is also significant, although it has not been utilized to the fullest. The main challenge is the dominance of natural gas in the energy mix, while the opportunity lies in the potential of wind and solar in a large area (IRENA 2024).

**Saudi Arabia**

Saudi Arabia has ambitious targets in renewable energy projects through the Saudi Green Initiative, including the massive Sudair Solar Plant project. In 2021, the installed capacity of renewable energy reached 11,618 TJ, with a rapid growth of 2,005% from 2016 (IRENA 2024). The project is mainly driven by solar and wind power, where Saudi Arabia's wind potential is enormous. However, the challenge faced is the heavy dependence on fossil fuels, which account for 99% of the total energy supply (IRENA 2024). The opportunity for Saudi Arabia lies in the integration of green technologies and the great potential in generating energy from wind and solar sources.

**Qatar**

Qatar is showing slower progress in renewable energy development compared to other neighbors. In 2021, Qatar's renewable energy contribution was only 0%, with most energy still dependent on natural gas (IRENA 2024). Qatar has great potential for solar development, but current initiatives are still limited. The main challenges are slow economic diversification and limited human resources in the renewable energy sector (IRENA 2024).

**Uni Emirat Arab (UEA)**

The UAE is one of the leaders in renewable energy development in the MENA region, with ambitious projects in solar power (Mahmoud and Habib 2020). In 2021, the UAE's renewable energy capacity grew by 67%, driven by a major expansion in solar power (IRENA 2024). Masdar City and various other projects put the UAE at the forefront of renewable energy innovation. However, challenges remain in terms of the sustainability of water resources for cooling in renewable energy plants as well as limited wind capacity (IRENA 2024).

**Iraq**

Iraq is also in a phase of transition towards renewable energy, although currently only 1% of the total energy comes from renewable sources (IRENA 2024). Hydropower projects dominate the sector, while solar and wind development is still very limited. Iraq has great potential in terms of wind and solar, but political and security challenges, as well as inadequate infrastructure (Mahmoud and Habib 2020), are major obstacles (IRENA 2024).

**Yemen**

Yemen is experiencing rapid growth in the adoption of renewable energy, especially solar energy which currently accounts for 17% of the country's total renewable energy (IRENA 2024). With favorable geographical conditions, Yemen has great potential for the development of solar and wind energy (Mahmoud and Habib 2020). However, prolonged conflicts are a major challenge that hampers renewable energy infrastructure. Nonetheless, there are significant opportunities in the use of solar energy for the needs of households and local communities (IRENA 2024).

**Iran**

Iran has great potential in the development of renewable energy, although its contribution to total energy is still limited to 1%. Most renewable energy comes from hydro plants with a small contribution from solar and wind power (IRENA 2024). However, Iran has shown an increase in renewable energy capacity, especially solar power, which grew by more than 108% in the 2018-2023 period (IRENA 2024). The main challenges are the decline in public investment and the still dominant fossil fuel in the country's main energy supply.

## 3.2 Renewable energy resources in the MENA Region

Currently, most energy in the Middle East is produced by steam power plants that utilize natural gas and oil. While the use of renewable energy in the Middle East and North Africa remains low, an increasing number of countries in the region are exploring alternatives to relying exclusively on domestic oil and natural gas for electricity generation (Hassan et al. 2023). They are considering the environmental and economic benefits of diversifying their energy sources.

The Middle East and North Africa region is the only region that has "low hanging fruits", great potential for solar power and wind compared to other regions (Rodriguez et al. 2024). The projected potential of concentrated photovoltaic and solar power in Saudi Arabia over the next two decades is around 28 GW (Hassan et al. 2023). The Energy Information Agency estimates that by 2035, the Middle East could generate between 15 and 25 GW from each of the three main renewable energy sources: wind, photovoltaic, and concentrated solar power (Hassan et al. 2023).

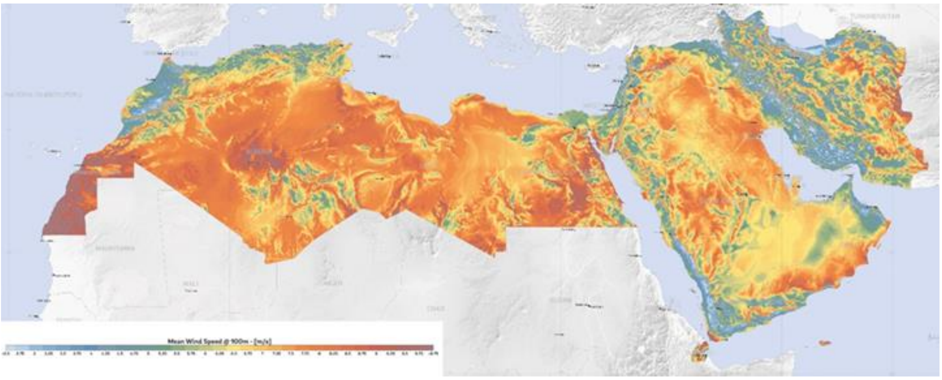


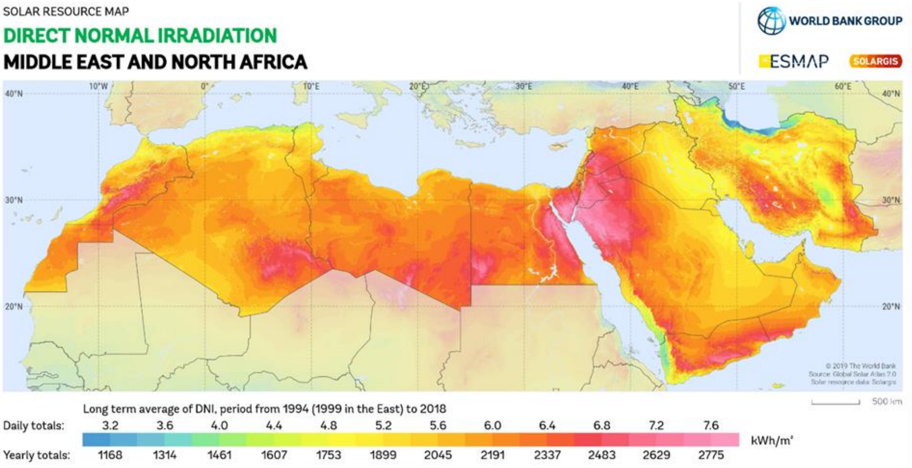
**Fig. 4.** Mean Wind Speed in MENA (Global Wind Atlas, © 2019 THEWORLDBANK)

*Wind energy potential.* Wind energy is one of the most attractive renewable energies (Sayed et al. 2023). Wind energy is a form of potential energy generated by the movement of air. Wind energy systems convert this kinetic energy into usable energy. Additionally, electricity produced from wind power emits less carbon dioxide, resulting in a lower greenhouse effect (Hassan et al. 2023). Some locations in the MENA Region have relatively high average wind speeds, which exceed 8 m/s at an altitude of 100 m as shown in figure 4 (Global Wind Atlas, 2019; Chentouf and Allouch 2022).

Wind energy resources in most MENA countries are relatively modest, with the exception of specific regions primarily located in Algeria, Egypt, Iran, Iraq, Libya, Oman, and Syria (Sayed et al. 2023). The varying intensity of winds means that the average wind levels in different areas of the Middle East do not accurately represent the potential electricity generation of a wind turbine. Typically, the probability density curve is adjusted based on observable data to assess the frequency of wind speeds in a specific location (Hassan et al. 2023). In general, wind near the ground level is used to generate electricity. In recent times, great advances have been made in the technology used to generate energy from the wind at a faster, more stable altitude, and its potential is global. Compared to fossil fuels, the use of wind energy is considered to provide many conveniences and advantages such as more abundant sources, renewable, widely available, clean, does not release greenhouse gases in the manufacturing process, and only requires a small amount of land to manufacture it (Hassan et al. 2023). In addition, the development of wind energy can encourage the creation of vary job opportunities.

*Solar energy potential.* Most MENA countries have abundant solar radiation resources due to their diverse geographical conditions, which can be utilized as primary energy sources (Sayed et al. 2023). The potential of solar energy in MENA per square kilometer is equivalent to the energy generated by 1-2 million barrels of oil annually and can meet at least 50% of global electricity needs, as can be seen in the direct normal irradiation in Figure 5 (World Bank 2022). Solar energy is the direct or indirect conversion of radiation into energy using photovoltaic energy or concentrated solar energy.

Concentrated solar energy systems use mirrors or lenses and tracking systems to condense radiation from a large area into a narrow beam (Hassan et al. 2023). Solar energy




is clean, renewable, and globally accessible.

**Fig. 5.** Concentrating Solar Power Potential in the MENA (© 2020 The World Bank, Source: Global Solar Atlas 2.0, Solar resource data: Solargis, CC BY 4.0)

There are various methods for utilizing solar energy, as outlined by Hassan et al. (2023). The first is the generation of electrical energy through photovoltaic (PV) solar cells, as well as producing hydrogen by combining photovoltaics with water electrolysis (Sayed et al. 2023). The MENA region, particularly Algeria, Egypt, Jordan, Saudi Arabia, the United Arab Emirates, and Yemen, shows significant potential for photovoltaic solar power generation, with these six countries accounting for 90% of the region's PV capacity today (Mahmoud and Habib 2019). By 2026, the MENA region is projected to add approximately 33 GW of renewable energy capacity, with about 26 GW dedicated to solar PV utilities and distribution (Al Ashmawy and Shatila 2022).

The second method is concentrating solar power (CSP), a renewable energy technology that transforms solar radiation into high-temperature heat, which is then converted into electricity (Moser et al. 2013). CSP systems can generate energy to power turbines, heat water, and employ diverse solar collector designs, such as concentrate collectors, flat plates, and evacuated collectors (Sayed et al. 2023). Regions with the highest CSP potential include Algeria, Egypt, Iran, Iraq, and Jordan (Moser et al. 2013).

Alongside the benefits of renewable energy, solar energy offers additional advantages (Hassan et al. 2022); restoration of degraded land; lack of focus on the national power grid; improving water quality throughout the country; and expanding electricity in remote areas. Although MENA has the best solar power conditions in the world, it is not superior enough to generate large leases, if it includes long-distance transmission, so an effective investment model is essential for MENA's renewable energy to compete with neighboring regions, especially due to the intense competition for lower funding costs (Hafner and Tagliapietra 2023).

In addition to having high potential for wind and solar energy, the mineral industry in Middle Eastern and North African countries has become one of the important pillars of diversification of petrochemicals and is a promising investment channel facilitated by sovereign wealth funds, institutional and private investors (Rodriguez et al. 2024). Although the MENA region's production has advanced rapidly than other potential green steel producers like Brazil, Canada, and Australia, it has the potential to emerge as a global leader in green steel exports. This is particularly significant for key regions where demand is steadily increasing, supported by the presence of three major green iron production hubs located in Saudi Arabia, the United Arab Emirates, and Oman (Basirat and Nicholas 2023).

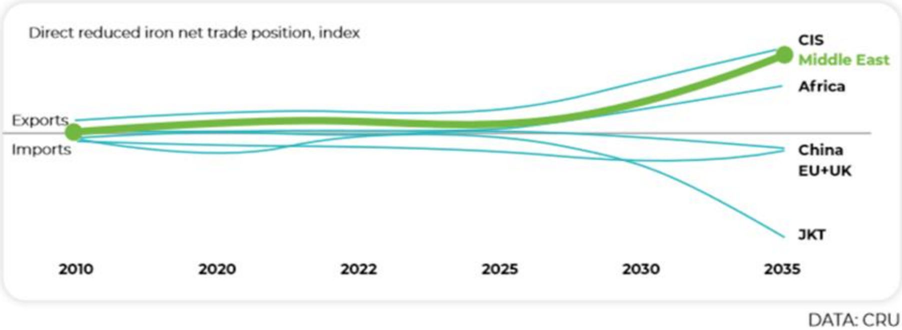



**Fig. 6.** The Middle East and Africa will be the main strategic suppliers of steelmaking raw materials in the global market. Source: Rodriguez et al. 2024

### 3.3 Geopolitics of Renewable Energy in The MENA Region

The MENA Region has experienced ongoing geopolitical instability and conflict since World War II (Hafner and Tagliapietra 2020). The growing shift toward renewable energy does not resolve the geopolitical challenges that continue to stem from oil and gas trade in the region. Instead, large-scale transitions create a new set of opportunities and challenges for relations between countries (Hatipoglu et al. 2023).

The energy transition in today's world involves substituting fossil fuels with renewable energy sources, which is rapidly becoming a significant area of focus in energy geopolitics (Huda 2024). The literature on the geopolitics of the energy transition is still evolving, but several key trends have emerged. As noted by energy expert Indra Overland (2021), existing studies on this topic often draw from significant statements regarding past energy systems, which tend to shape perceptions of geopolitical conflicts surrounding oil and gas. Consequently, this viewpoint often leads to projections for the energy transition that are unbalanced and fail to capture the dynamic and transformative nature of renewable energy (Huda 2024).

Scholten (2020) highlights that renewable energy systems possess geographical and technical characteristics that fundamentally differ from those of coal, oil, and natural gas. The geopolitics of fossil fuels have long been dominated by power imbalances, restricted access to energy resources, and asymmetric interdependence reflected in trade and infrastructure. As renewable energy gains prominence, the focus of energy security is shifting from resource acquisition to energy distribution. Additionally, the power generation sector is anticipated to face emerging challenges that will replace the conventional issues it has historically encountered (Scholten 2020). So overall, International energy relations are likely to become more stable and symmetrical as countries engage in trade out of necessity rather than coercion. Fossil fuel-based energy systems create tensions and divide the world into 'the rich' and 'the poor,' leaving many underprivileged countries struggling to access essential resources. This leads to hegemonic struggles, particularly exemplified by Russia’s influence as a global energy supplier, using its resources to exert power over Europe, China, Iran, and Venezuela (Scholten 2020). Furthermore, fossil fuels underpin the social contract in petrostate countries like Saudi Arabia, where authoritarian regimes significantly impact international politics.

Scholten's view (2020) supports Overland's view that the renewable energy transition will reduce location and resource problems in international energy issues. The presence of abundant and dispersed renewable energy resources in various locations makes the technology for capturing, storing, and transporting these resources increasingly vital. Consequently, international energy competition may evolve from a focus on controlling physical resources and their transportation routes to emphasizing technology and intellectual property rights (Overland 2019). Overland (2019) also emphasized that the growth of renewable energy occurs in tandem with the rise of digitalization. On the one hand, digitalization can certainly help maintain the balance of the power grid, even when the production of a large number of renewable energy producers depends on the weather. There are concerns among academics, security think tanks, intelligence and security organizations, parliamentary committees, and consultants regarding the potential for terrorists or intelligence agencies from hostile nations to infiltrate computer systems that govern utilities and power grids (Overland 2019).

However, Hatipoglu (2023) stated that there are still potential risks in the renewable energy transition with high investment in renewable energy that can trigger territorial conflicts in the MENA Region. Renewable energy plants utilizing wind and solar power require considerable land, and suitable "high-capacity" sites are often limited. If these locations overlap with contested territories, dormant conflicts may arise. Given past territorial tensions over hydrocarbon resources, it is unlikely that renewable energy projects would be exempt from similar disputes, particularly in regions with ambiguous claims or near borders (Hatipoglu et al. 2023). The potential for offshore wind power generation intensifies the risks within exclusive economic zones, particularly in the northern Arabian Gulf. The integration of renewable energy in the MENA region also prompts inquiries about the future orientation of the area—specifically, whether it will gravitate toward China or other suppliers of rare earth metals, minerals, renewable equipment, and technology. It remains to be seen if this trade in renewable energy equipment will lead to foreign policy alignments between non-Western exporters and MENA countries (Hatipoglu et al. 2023).

Su et al. (2021) also emphasize that the process of transitioning to renewable energy (RE) encompasses numerous countries and cross-border regions, making it particularly susceptible to cyber threats and terrorism. Additionally, the growing involvement of non-state actors, combined with escalating competition for rare earth metals, presents substantial challenges for the energy market.

**Result**

Based on the discussion above, it can be found that the renewable energy transition in the MENA region will not eliminate the geopolitical tensions of the hydrocarbon era (or show a trend of continuity), but only shift its shape. Such as Hatipoglu et al. (2023) who stated that there will still be a scramble for new resources. As renewable energy can be produced in more places, large projects still require large areas and strategic locations with access to energy sources, such as desert land for solar projects or coastal areas for offshore wind power. This can create new tensions in the form of regional disputes that have the potential for high-capacity renewable energy. In addition, the issue of energy transit such as in hydrocarbon trading is possible because transit countries will still have an important role in the distribution of renewable energy, for example in the management of cross-border networks that can cause tensions.

There are also opinions that refute the previous opinion that the renewable energy transition will create geopolitical competition that is different from the hydrocarbon era (or show a transformation trend), as stated by Scholten (2020) and Overland (2019). This statement is rooted in several key factors, *first*, the reliance on more decentralized renewable energy. Renewable energy, such as solar and wind, does not require complex global distribution infrastructures such as oil and gas, which have been triggering conflicts related to territorial control and distribution lines. This can reduce energy geopolitical tensions in the region and is even expected to increase energy security and security, especially in post-conflict recovery scenarios (Hatipoglu et al. 2023), *second*, there is a shift in the role of energy producers. Hydrocarbon-producing countries such as Saudi Arabia and the UAE have the potential to maintain their geopolitical relevance through the production of green hydrogen and clean electricity for export, replacing their role as oil and gas exporters (Hatipoglu et al. 2023) (Hafner et al. 2023). *Third*, Abouyoub (2023) stated that there is a possibility of forming new relationships between MENA countries and global players such as China and India, especially related to the trade of renewable energy technologies such as solar and wind panels. For example, China is already a major supplier of solar panels in the Gulf region (Hatipoglu et al. 2023). On the other hand, North African countries such as Morocco are more inclined to strengthen energy ties with Europe, especially through major projects such as Desertec and renewable energy export plans to Europe (Hatipoglu et al. 2023). Fourth, there is a development in the role of non-state actors, including private companies and armed groups in the MENA region. These actors can play an important role in managing energy conflicts, especially in post-conflict areas that require decentralized energy access such as solar energy (Hatipoglu et al. 2023). In Libya, for example, local actors that do not depend on the central government can use renewable energy to restore local economies in conflict-affected areas (Hatipoglu et al. 2023). Fifth, both Hatipoglu et al. (2023) and Hafner et al. (2023) focus on technology competition, innovation, and control over important supply chains for components such as batteries and solar panels, especially related to solar power and hydrogen. It is different from the control of physical resources that characterizes hydrocarbon geopolitics. In the MENA region, green hydrogen is seen as a future technology that can replace the role of oil and gas. Countries such as the UAE and Saudi Arabia have a great opportunity to become key players in the global hydrogen market (Hatipoglu et al., 2023).

In addition to the above description of continuity and transformation, Paltsev (2016) states that the geopolitics of renewable energy is more similar to the post-Cold War world, where we are often faced with uncertainty about what challenges will be faced next, what form of challenges will arise, or where those challenges will arise (Paltsev, 2016).

**Conclusion**

The increasing trend of renewable energy in the MENA Region as an effort to diversify the economy and solutions for energy security encourages studies related to renewable energy geopolitics. The geopolitics of renewable energy in the MENA region maintains several points of continuity with the hydrocarbon-based past, especially in terms of economic interests and potential territorial conflicts. However, it also introduces significant transformations, including greater decentralization (unlike the centralized nature of hydrocarbon energy), shifts in economic and export strategies, new geopolitical alliances, the increasing influence of non-state actors, and a focus on technology and supply chains for components such as batteries and solar panels, different from the control of physical resources that characterize hydrocarbon geopolitics. These changes mark a complex and evolving geopolitical landscape that is very different from the traditional hydrocarbon paradigm. The initiation of the energy transition, especially in the MENA Region, still requires a holistic policy study and requires global cooperation so that the results are not only enjoyed by the MENA Region but also felt by the world community.

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