

ARAB WORLD ENERGY TRANSITION CHALLENGES: OBSTACLES AND FEASIBLE SOLUTIONS IN LIGHT OF REMAP'2030



Imane Azzouz ¹

Laboratory for research and studies in international relations, University of Algiers 3,
(Algeria)

azzouz.imane@univ-alger3.dz

Ammar Moussi ²

Department of Electrical Engineering, University of Biskra, Biskra, Algeria

ammam.moussi@univ-biskra.dz

Djamila Ziguem ³

Faculty of Political Science and International Relations, University of Algiers 3, Algeria

Ziguem.djamila@univ-alg3.dz

Submission date: 29/02/2024 Acceptance date: 09/05/2024 Publication date: 15/06/2024

Abstract:

Several studies indicate that most countries have reached the limits of fossil energy use, especially in major industrialized countries. With the growing devastating environmental effects, calls have emerged calling for the need to turn to the exploitation of renewable energies to protect the environment and achieve energy security. In this context, this paper comes to study this problem in the Arab region. The most important challenges facing renewable energies exploitation where highlighted, and in return we presented solutions according to the 2030 renewable energies roadmap. The study concluded that a smooth energy transition can be achieved if effective policies are adopted to efficiently exploit human potential and natural renewable energies resources.

Keywords: energy transition, energy policies, Arab world, Renewable energy, REmap 2030,

ملخص: تشير العديد من الدراسات إلى أن معظم الدول وصلت إلى حدود استخدام الطاقة الأحفورية خاصة في الدول الصناعية الكبرى. ومع تزايد الآثار البيئية المدمرة، ظهرت دعوات تطالب بضرورة التوجه إلى استغلال الطاقات المتجددة لحماية البيئة وتحقيق الأمن الطاقوي المستدام. وفي هذا السياق تأتي هذه الورقة لدراسة هذه المشكلة في المنطقة العربية. حيث تم تسليط الضوء على مجمل الموارد الطاقوية المتجددة بمنطقة شمال إفريقيا والشرق الأوسط وأهم التحديات التي تواجه استغلال الطاقات المتجددة، وفي المقابل قدمنا حلولاً وفق خارطة طريق الطاقات المتجددة لسنة 2030. وخلصت الدراسة إلى أنه يمكن تحقيق تحول طاقوي سلس إذا تم اعتماد سياسات فعالة ومستدامة لاستغلال الإمكانيات البشرية الكفاءة وموارد الطاقات المتجددة المتوفرة.

الكلمات المفتاحية: الانتقال الطاقوي، سياسات الطاقة، المنطقة العربية، الطاقة المتجددة، خارطة طريق REmap 2030.

Introduction:

The world is witnessing a rapid expansion and remarkable growth in the field of renewable energies, thanks to technological progress and government support. Most Arab countries abound with huge fossil energy capacities of oil and gas, in addition to having an important balance of renewable energies mainly solar energy, wind energy, and others. However, security or institutional stability issues, which is now suffering from severe local development problems that led to the exacerbation of the living situation with a high rate of poverty and unemployment, which prevented succeeding governments to think thoroughly of relying on renewable energies as a strategic alternative. This is because of the competing socioeconomics priorities and weak investment resources, not to mention the need for a strong political will and government's commitment to implement their programs on the ground.

Decision makers and policies in the Arab countries have a decisive role in advancing the renewable energies sector. Markets provide affordable and diversified solutions and are open for competition. However, ensuring a sustainable future requires good governance policy, political guidance and effective strategies. Therefore, investments must be strengthened and transition stimulated by adopting attractive regulations and effective policies to modernize the renewable energies sector; besides all that, accelerating financing for the energy transition plans for long-term gains.

In this context the question to rise is about the main challenges facing the Arab countries in implementing the energy transition policies, and is the road map for renewable energies REmap'2030 capable of forming a path for the Arab countries to achieve progress in the field of developing renewable energies. This main problem invokes the following sub-questions:

- Are the Arab region potentials for renewable energies sufficient and worthy for exploitation and investment?
- Do Arab countries have the necessary funds to advance renewable energy projects and ensure their completion within the stipulated deadlines?
- What are the main challenges that impede the implementation of energy transition policies in the region, and what is the way to confront them?

And since energy transition concept have become one of the most important issues raised in the twenty-first century for economic and environmental reasons, the Arab countries, with their enormous potential; deserve to contribute to the global energy mix by exploiting their renewable energy sources.

Accordingly, this study aims to analyze those challenges that stand behind the implementation of energy transition policies in the Arab region, despite the availability of various sources of renewable energies, and thus provides solutions represented in the renewable energies road map REmap'2030 as one of

the international jurisprudence for energy transition. The analytical descriptive approach is adopted in this study, as well as the statistical method to serve the subject and its objectives.

The conceptual framework of the energy transition

The notion of 'Energy Transitions' concept sits at the heart of polemical definitions. Starting with those who claim that the concept of energy transition emerged within Germanic circles under the name *Energiewende* as a set of scientific expectations developed by the German "oeko Institute" in 1980. The aim was to find an alternative to oil (Yassaa N And Khelif M., 2022, p. 67). Another opinion claims that this concept was first pronounced by US President Jimmy Carter in one of his speeches whilst one opinion says that the humanity has experienced several transitions over the past three centuries in contrast to those saying that humans have not had energy transitions but rather 'energy additions'. Different points of view were well detailed by Benjamin K. Sovacool in the book *The Political Economy of Clean Energy Transitions* (Benjamin K. Sovacool, 2017, pp. 16-36).

Aside from these diverse points of view, one can return to the definition adopted by The International Renewable Energy Agency (IRENA) defining it as "transforming the global energy sector based on fossil energy into a zero-carbon energy sector in the second half of this century. It implies to the transition from the current energy system based on the use of traditional resources to the energy mix that is mainly based on renewable resources, which dictate the development of alternatives to depleted fossil fuels and gradually replacing them with renewable energy sources, in order to preserve the environment and the needs of future generations (Bouakrif *et al.* 2021, pp. 370-371, Barry D and Karthik K., 2011, pp. 7422-7431)

In order to achieve these promising goals, the International Renewable Energy Agency (IRENA) published a full report outlining what can be done to double the share of energy in the global energy mix by 2030. The report, titled: '2030 Roadmap for Renewable Energies' was launched at the 'First Sustainable Energy for All' Forum 4-6 June 2014 at the UN Headquarters in New York.

The Arab region's potential for renewable energies

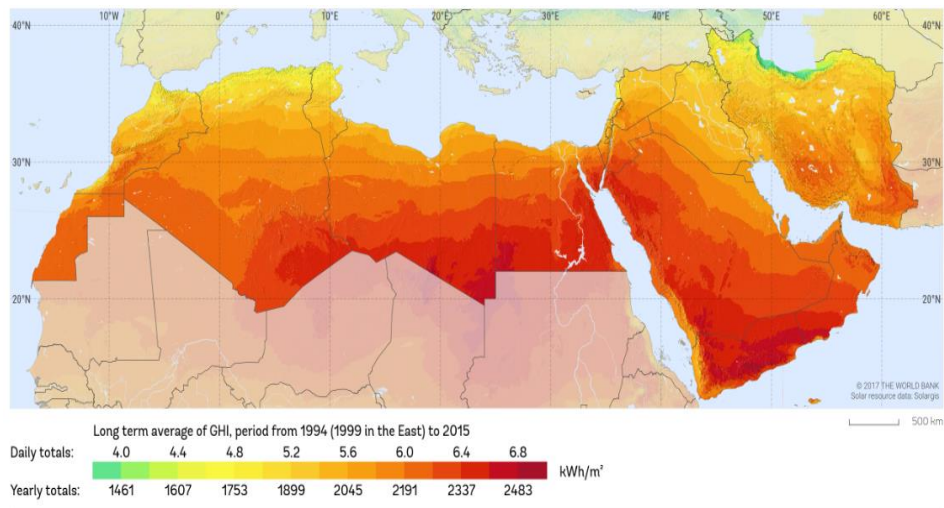
Arab countries have most of the elements of renewable energy, especially solar and wind energy, which makes the region distinct from a global geoenergy standpoint. Below are presented main Arab region potentials regarding these resources.

Solar energy

The Arab region is characterized by an important solar radiation level throughout the year, as the direct annual radiation of solar energy is more than 1700 kWh/m²/year, and it also receives sunlight for more than 3000 hours annually, as the amount of solar radiation varies from one region to another in the Arab world, as Most of them range between 6-7 kWh/m² (Bin Saghir F. and Boujanah R., 2019, p. 632), *Figure 1*.

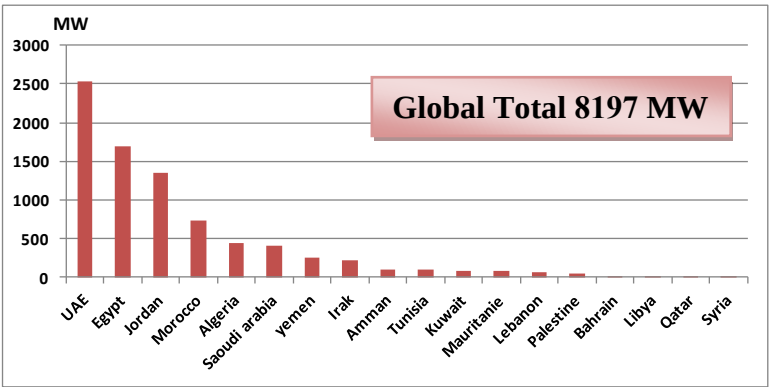
Photovoltaic stations are widespread in the Arab region, whether on the scale of major projects linked to the network, or as small and medium-capacity central systems or systems on building's rooftops. Solar station systems based on solar thermal concentration have gained importance in: Saudi Arabia, Algeria, Morocco, Egypt and the United Arab Emirates. The Global Total does not exceed 8197MW, (Majid K. *et all*, 2020, p. 20).

Figure 1. Arab world Solar radiation map



Source: Global Solar Atlas 2.0, Solar resource data: Solargis.

Graph 1: Installed capacities of solar energy in the Arab countries - 2020



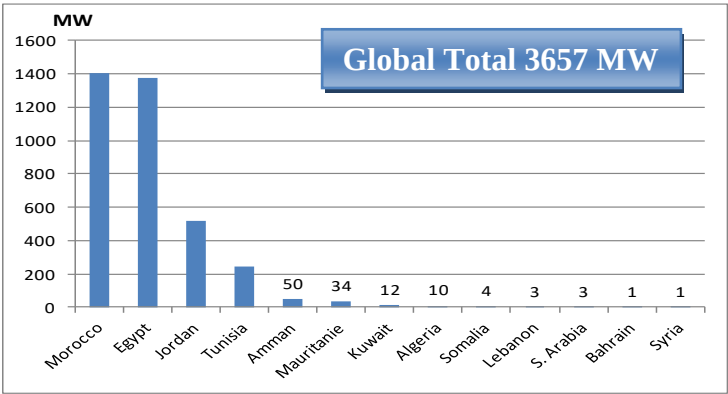
Source: IRENA, Renewable capacity statistics ; 2020

As depicted in *Graph 1*, It is shown that the United Arab Emirates is the most interested Arab country in the field of solar energy development. It is shown that the installed capacities amounted to about 2539 MW, followed by Egypt with 1694 MW, and Syria ranks last with only 2 MW.

Wind Energy

The strategic location of the Arab world and its geographical nature characterised by a distinguished view on the oceans and the Mediterranean Sea, made it enjoy acceptable wind speed in most of its lands, as the wind speed increases in the areas overlooking the coasts (Majid *et al*, 2020, p. 21), where the wind strength ranges between 2.8 m/s to 5 m/s, and wind energy is available In several locations in the Arab countries, including Jordan: the Gulf of Aqaba, Wadi Araba, Ras al-Naqb, Ibrahimiya, Tunisia and Algeria on the Mediterranean coast and in the plateaus and the Great Algerian Desert, Sudan on the Red Sea coast, Oman on the Indian Ocean coast, Egypt on the Gulf of Suez coast, Morocco and Mauritania on the Atlantic coast (Odeh Al Jayyousi, 2015, p. 75).

Graph 2: Installed capacities of wind energy in the Arab countries - 2020



Source: IRENA, Renewable capacity statistics; 2020

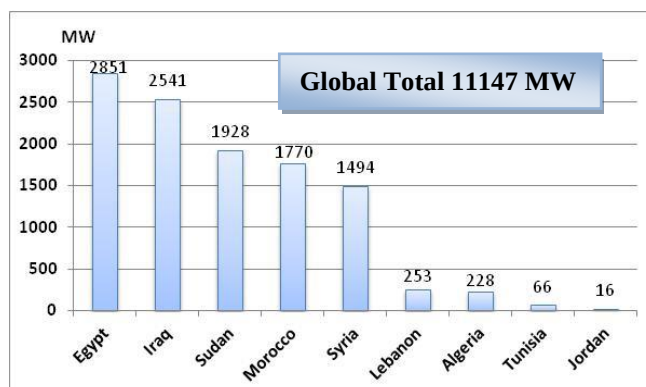
Through *Graph 2*, it is clear that the percentage of wind energy exploitation in the Arab region is very small, with a total of 0.3% of the total installed energies in the world. One can notice from the above *Graph* that Morocco ranks first in the Arab world with a total of 40%, followed by Egypt with a total of 37%.

Hydropower

Water energy is one of the oldest sources of energy used to produce mechanical and electrical energy. Hydro turbines appeared in the middle of the eighteenth century and their development was associated, late nineteenth century, with the use of hydropower to generate electricity, both for industrial and civil activities (Pierre-Louis Viollet, 2017). Hydroelectric projects include

dam projects with reservoirs, natural flow projects for rivers, and internal flow. This diversity gives hydroelectric power the ability to meet the needs of huge central urban as well as unfocused rural needs. (Hassan Y. S. A., 2020, p. 252). Due to their geographical location and climatologic characteristics, most Arab countries don't rely on this valuable source. Furthermore, due to climate changes, even existing hydro projects are at risk and need adaptation and revision of the operation rules (Saeed Jamali *et all*, 2013).

Graph 3: Installed capacities of hydroelectric power in the Arab region -2020



Source: IRENA, Renewable capacity statistics; 2020

It is noted from *Graph 3* that the installed capacities of hydroelectric power in the Arab countries did not exceed 11120 megawatts out of the global total estimated at 1307994 megawatts, or 0.8%, which is a very small percentage due to the lack of dams and waterways in the region, and Egypt occupied the lead with 2851 megawatts. Recent years, revealed a new way to use *Hydro* where it is looked to be very useful for Solar PV energy storage especially at seasonal rainfall (Julian David Hunt *et all*, 2021). This procedure can also be used for energy storage or mains supply regulation mainly at pick power production moments (Shaima A. S. *et all* 2022).

Biomass and geothermal energy

Wood, animal and plant wastes are considered one of the most important sources of energy that were common before the oil era. Nowadays, there are some Arab countries such as the United Arab Emirates, Qatar, Jordan and Sudan that exploit biomass and are interested in developing it. As for thermal energy, we find it in Palestine, which is the only Arab country that has a thermal power station in the Arab world. Algeria, Djibouti, Saudi Arabia, Sudan and Yemen aspire to invest in this field and exploit their thermal and biomass resources (Bin Saghir F. and Boujanah R., 2019, p. 635).

The challenges of the energy transition in the Arab region

Arab countries face a wide range of challenges, including rapid population growth, slow economic growth, and severe environmental pressures that make them fragile in keeping pace with recent developments in renewable energies technologies in order to ensure their energy security. This is in addition to the instability of political systems and institutions and the absence of serious strategies that serve the goal of the energy transition. In light of these challenges, many Arab countries stand unable to raise the challenge to support policies for energy transfer.

Political, organizational and institutional obstacles

Energy legislation is the basis on which energy markets in general, and Renewables in particular, are built. Therefore, the application of solutions offered by renewable sources is dependent on legislation, institutional frameworks, incentive policies, financing, implementation, monitoring and evaluation mechanisms approved by the state (ESCWA, 2019). The adoption of renewable energies as a strategic alternative to traditional energies needs political will and the extent of government commitment in order to shift towards low-carbon energy systems.

However, the poor design of policies, uncertainty and hesitation especially in light of the international changes taking place, prevents setting a clear vision about the path of developing renewable energies and the wise formula for its implementation. This is due mainly to the lack of awareness of the importance of the energy transition on one hand (Bakhda K. 2021, p. 604) and the oil dependence to external parties that work to obstruct any effort to adopt alternative energy as a resource on the other hand (Nizar Awni Al-Labadi, 2015, p.247) in addition to the political and institutional instability in most Arab countries. This is reflected in the failure of many Arab countries to attract local and foreign investors and their inability to conclude agreements to promote renewable energies and stimulate investment in projects related to the sector.

The challenges of securing renewable energy facilities in conflict situations and the problem of identifying sources of danger

The Arab region is currently witnessing prolonged conflicts and disputes in: Sudan, Palestine, Yemen, Libya and Syria, which have caused the deaths of thousands and the displacement of millions. Therefore, the use of energy of both types in this case represents a major obstacle to the state, which has led to a disruption of the economic, developmental and environmental system, and as a result has pushed Millions of Arab peoples to unemployment, poverty and the spread of diseases (Raguia Zahia, 2021, p. 247). Therefore, investment solutions

in Arab countries that are witnessing security disturbances constitute a risk, in addition to this lack of proactive mechanisms to identify risks, whether related to natural disasters or terrorist threats, and sabotage operations of infrastructure. Terrorist operations have become focused on striking energy sources and the supply network of pipelines and ships. As well as the state of war that occurs in the production areas, as the weakness of stability and security affects global energy security (Ahmed Abdel-Ghani Aliwi Al-Luwaizi, 2021, p. 145).

Economic challenges and the inability to finance renewable energy projects

The various programs related to the development and development of renewable energies require their implementation to provide and allocate large financial envelopes and credits, and what is observed in most Arab countries, especially non-energy ones, is the inability of the local banking sector and its inability to guarantee the financing process. This negatively affects the process of developing the renewable energies sector, and with the reluctance, the local investor refrained from entering this field due to its unattractiveness. These difficulties require the state to explore ways of external partnership and conclude international cooperation agreements to ensure appropriate funding and financial support.

What hinders the energy transition process is the large government support for the oil and gas industry in the energy Arab countries such as Iraq and Algeria, which makes it difficult to achieve high rates of deployment of renewable energies in the energy market (Ben Haj Djilali and Maghraoua Fatiha, 2013, p. 234) This subsidy also affects and prevents the creation of private and public investments in the field of solar electricity generation due to its high cost and its inability to compete at present. Supporting small and medium enterprises and startups in crisis areas would increase competition in the markets and create good job opportunities unless the current support policies are reviewed (Raguia Zahia, 2021, p. 250).

Knowledge Challenge: Education and training in this field to qualify professionals (universities, vocational training, etc..)

The burden of the energy transition in the future will fall on the shoulders of today's students, and they must therefore participate in the culture and behavior of wanting to create a cleaner future in order to achieve our carbon reduction goals for the years 2030 and 2050; Thus, Academic institutions have a fundamental role in delivering the message about the urgency of combating climate change and speeding up the energy transition. They are the key stakeholder in the societal commitment to combating climate change and a resource pool for new talent capable of exploring the next technological breakthroughs in energy. For this sake, great national and regional efforts must

be deployed for promoting this technology in the Arab world. Unfortunately, according to the 2023 Arab region SDG index and dashboard report (Zakzak Lama *et all*, 2023) and with respect to the ninth goal concerning Industry innovation and infrastructure, most Arab countries are far from the projected goals for the time being. In this context, *Table 01* reflects the unpleasant current situation for some Arab countries for the ninth goal “Industry innovation and infrastructure” which is solely related to Energy transition perspectives.

Table 1. The 2022 Arab Region SDG Index and Dashboard Report

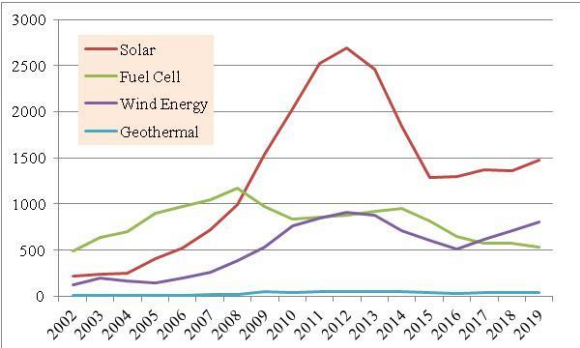
	Saudi A.	Qatar	UAE	Egypt	Jordan	Algeria	Oman	Morocco	Tunisia	Kuwait
R & D Expenditure (% GDP)	0.8	0.5	1.3	0.7	0.7	0.5	0.2	0.7	0.6	0.1
Number Of Scientific And Technical Journal Articles (1000 Population)	0.3	0.5	0.3	0.1	0.3	0.1	0.2	0.1	0.5	0.2
<i>The Times Higher Education Universities Ranking: Average Score of Top Universities</i>	47.8	46.8	41.5	40.5	34.2	27.8	27.6	21.0	17.7	17.7

This uncomfortable situation is a direct result of low expenditure on research and development projects in addition to improvised and immature policies which has a direct impact on the status of scientific research and the ranking of universities internationally as shown

The technological challenge and the absence of Arab countries' contributions to scientific production and patents

The share of renewables in the energy mix is on a continuous rise. As innovation in the sector increases, this will help to reduce the cost of renewable energy sources and decrease the role that fossil fuels play in the energy industry. Looking at trends in technological development and patent publications can give us an insight into which technology areas are leading the way and where this innovation is happening (WIPO, 2019). As shown in *Graph 4*, Innovation in the solar sector is obviously leading the way between years 2010 and 2019. *Graph 5* shows the top countries publishing International patent applications relating to solar power while *Figure 2* illustrates graphically PCT's applications distribution by origin for the year 2018. On can notice that the contribution of the MENA countries is insignificant if not totally absent for some countries despite the fact that they leads all countries in solar energy stocks It is shown that they are highly concentrated only among a few origins. Some MENA countries are focusing instead on commercially exploiting affordable technology.

Graph 4: Technology areas leading Innovation in Renewable Energy



Graph 5: Top countries publishing solar power International patent applications 2010-2019

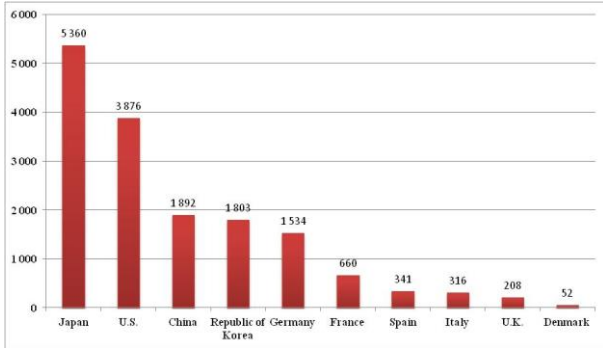
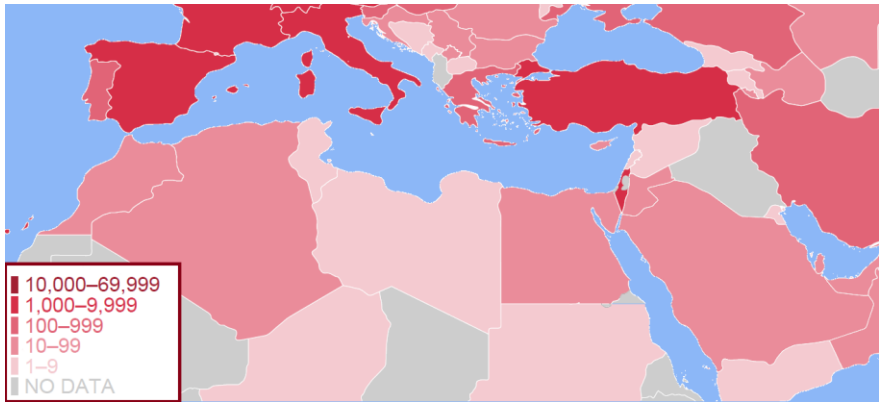


Figure 2: PCT applications distribution around the MENA region.



Source: WIPO Statistics Database, March 2019

As the MENA countries depend exclusively on foreign experience and expertise in building their energy projects, and this is what costs them exorbitant prices, and the development of renewable energy technology is associated with the extent of the state's ability to absorb knowledge and its generation and application. Perhaps the most important challenge facing the Arab countries is the technical gap, which combines all forms of social, economic and cultural inequality in its aspects (Maya Gradini, 2017). Nevertheless, most Arab countries witness a great weakness in renewable energy technologies in terms of industrialization, and in terms of developing research, innovation and patents.

Environmental challenge

Calculating the environmental cost of developing renewable energies in Arab countries is usually overlooked. The geographical nature of the Arab region requires the availability of high-precision technological techniques. For example, solar panels that are used in desert areas must be highly efficient to

face the risk of breakage and withstand high temperatures, which may increase the cost of Construction, without forgetting the negative environmental repercussions of such projects, which may require waste of water or excessive exploitation of significant agricultural areas.

In addition to this, the Arab region has recently witnessed the risk of drought due to the low rates of rainfall, which is reflected in the international investment environment in the region (Saeed Jamali *et all*, 2013).

The societal challenge

The Arab region is witnessing an unprecedented increase in the population, which reached 456 million in 2021 (The world bank, 2021), of which 56% live in cities, and the percentage is expected to rise to more than 68% by 2050 (ESCWA, 2019). Population and economic growth and industrial expansion require growth in daily energy consumption rates. Therefore, the demand for electric energy in the countries of the Middle East reached 1064 terawatts/hour in 2022 out of the total global demand 247000 terawatts / hour, after it was counted in 2010 at about 7154 terawatts/hour (IEA, 2022).

The problem of overconsumption by individuals and the problem of wastage (losses in the electrical network) are among the most important challenges to rationalize consumption. Where some specialists indicate that the Algerian citizen consumes 10 times more than the global percentage and double what the Maghreb citizen consumes. And that the old and weak electricity transmission networks may cause a loss of about 20-30%, as is the case in Syria.

Steps to achieve the energy transition requires, at the outset, work to rationalize energy consumption so that it is possible to move to the consumption of more permanent energies, and this is done by changing the lifestyles within society in coordination between the public and private sectors and the efforts of civil society to perpetuate the culture of energy conservation.

The challenge of providing scarce resources in global markets

The manufacture of semiconductor additives, electric energy storage devices, or batteries of all kinds, especially those dedicated to electric vehicles, requires the provision of rare metals such as lithium and nickel. The biggest challenge for developing energy transition policies is the provision of these resources, which are witnessing intense competition and high prices in global markets, not to mention their scarcity, the reluctance of some countries to market them, and the monopoly of manufacturing processes by some countries. This makes the options for developing renewable energy systems and technologies linked to the extent of the availability of more rare, non-renewable resources in global markets.

Proposed solutions for the energy transition in the Arab region according to the 2030 renewable energies road map

The roadmap for Renewable Energies full report outlines what can be done to double the share of energy in the global energy mix by 2030 and aims to double the share of renewable energy in the global energy mix between 2010 and 2030. The report identifies realistic possibilities and practical mechanisms for the gradual integration of sources. Renewable resources available within the consumed energy basket, while working to devote the concept of energy efficiency at all levels in order to ensure a sustainable energy transition.

The highlights of the report are as follows:

- The shift to renewable energies would lead to savings of up to 700 billion US dollars annually by 2030 (IRENA 2014).
- Strengthening the economic motive for the energy transition when considering the socio-economic benefits, providing jobs and improving health by reducing CO2 emissions from fuel burning, as emissions can be avoided by about 8.6 megatons by 2030.
- Increasing electricity from renewable sources by bringing about the growth of renewable energies in the four energy-consuming sectors: buildings, transportation, industry, and electricity. If we rely on REmap'2030 options, the share of renewable energy in the energy mix in 2030 could reach 44% in the electricity sector, 38% in buildings, 26% in industry, and 17% in the transportation sector (AFED 2014).
- Benefit from synergies between energy efficiency and renewable energy, nurture system-wide innovation, and ensure equitable distribution of transition costs and benefits (IRENA 2018).

Thus, some solutions can be presented to embody the energy transition process in the Arab region and can be summarised as follow:

- a. Providing financial incentives and grants: This includes support in the form of fiscal and customs incentives provided to entities that contribute to the development of renewable energies. This is done through a national fund whose mission is to finance renewable energy development projects, grant soft loans and provide guarantees to obtain them from banks and financial institutions, and reduce customs and tax fees. On the added value with regard to the import of components, raw materials and primary products that are used in the production of components of renewable energies equipment (Hassan Y. S. A, 2020, pp. 282-283).
- b. Transferring knowledge and consolidating the culture of renewable energies in the Arab world as a must. There is a need to promote the culture

of renewable energies and raise public awareness of the importance of a smooth and orderly energy transition in which everyone, including bodies, institutions and civil society, is integrated. Without forgetting the conditions and levels of governance within which the most important pillar falls, which is energy pricing and public-private sector partnership, in addition to the involvement of civil society to establish collective action to control consumption and raise awareness (Odeh Al Jayyousi, 2015, p. 75)

- c. Regional and international partnership: which will contributes also to develop joint research programs and exchanging experiences to create a knowledge shift in the field of renewable energies. From this standpoint, it is possible to establish multiparty educational and training programs between North African countries and the Gulf Cooperation Council countries GCC, for example in view of societal rapprochement and similar energy transition requirements. This may allow in the future exchanging experiences and competencies or creating joint projects.
- d. Promoting Arab-Arab cooperation: The decision of the Arab Economic and Social Development Summit was issued at its third session in Riyadh on January 22, 2013 regarding the adoption of the Arab strategy for the development of renewable energy uses (2010-2030) as a framework for joint Arab action in the field of renewable energies (Hassan Y. S. A, 2020, p. 252). Advancing regional trade in the field of energy and virtual energy through electrical interconnection networks and solving development problems, especially since many Arab countries such as the United Arab Emirates, Saudi Arabia, Morocco and Jordan have made tangible progress in the field of energy diversification, and bilateral cooperation has also formed An important role in promoting alternative energies.
- e. On the sidelines of all of this, it is necessary for the MENA countries to be convinced of the necessity of coordination and joint action, not as an option, but as an inevitable necessity, given the close, if not unified, societal, cultural, and economic dimensions. This will allow reducing burdens on individual countries, saving efforts, and ensuring integration in several economic fields which will ensure success and sustainability.

Recommendations:

By extrapolating reality, knowing the capabilities and qualifications of the region, reviewing the policies followed in several countries, and based on the above study, the following recommendations can be presented, which may help to implement a flexible and safe energy transition in the Arab region.

- Increasing technological and financial support for the development of research projects in the field of renewable energies, especially solar PV and wind energy, and rehabilitating educational and training programs to keep pace with the energy transition development.
- Enhancing the participation of the private sector by providing a climate for investment in commercial projects for the development of sustainable energy sources, and protecting the possibility of obtaining low-cost capital from private and international financial institutions whose goals revolve around development;
- Drawing up a medium and long-term vision to diversify the energy mix in the areas that consume the most energy especially buildings and transport and ensure the issues for its implementation (legislations) and, in return, reduce the exploitation of hydrocarbons;
- Work to form a unified Arab regional system by activating the role of bodies and organizations specialized in the field of renewable energies, such an Arab Authority for Renewable Energies proposed by Qatar during the Fourth meeting of the Arab Union of Electricity; and the Regional Center for Renewable Energy and Energy Efficiency (RCREEE) which aims to enable and increase the adoption of renewable energy and energy efficiency practices across pan-Arab countries or the Arab Renewable Energy Commission AREC.

Conclusion

Through our analysis of this topic, we concluded that the Arab countries have enormous capabilities in renewable energy resources, especially solar energy and wind energy, not to mention the presence of great knowledge competencies capable of achieving a qualitative leap in this field. However, the reality shows that many of these countries suffer from major obstacles and challenges that prevent the implementation of energy transition policies, and the most important of these challenges is the absence of mature policies and mature studies that allow the implementation of actual and rational projects. Then comes the financial challenge, such that it is unable to support the energy economy outside the hydrocarbon sector as a result of dependency. In addition to this, the technological challenge stands up, most investment actions are limited to transferring primary equipment without the expertise and knowhow to develop the use and exploitation of local energies. These two factors are the backbone of the energy transition and a basic pillar for getting rid of technological dependency and freedom from the burden of fossil energy financing.

Nowadays, anyone who follows the course of events realizes the determination of the MENA countries on seriousness in achieving the goals of sustainable development, and the best evidence is the holding of the COP27

conferences in Egypt and the COP28 conferences in the Emirates. the latter resulted in taking very important decisions to embody the aspirations and challenges of the energy transition as we stand on the verge of the first threshold in the year 2030. For this reason some clear, practical, precise and thoughtful decisions were taken to move forward to achieve the success of the sustainable development goals globally and locally with steady steps.

References

- Ahmed Abdel-Ghani Aliwi Al-Luwaizi (2021), Energy Security Stakes in the Middle East (Geostrategic Study). *Dar Al-Academies Publishing and Distribution Company*, Jordan.
- Arab Forum for Environment and Development AFED (2014), Who works in renewable energy? Environment and Development, Environment and Development Magazine. issue 192-193 Mars-April 2014, at the following link:
<http://www.afedmag.com/web/ala3dadAlSabia-details.aspx?id=178>
- Bakhda Kheda (2021), Alternative Energies to Address the Trilemma (Energy Access, Energy Security and Climate Change) in Africa. *Journal of Legal and Political Research*. Volume 6, No. 2.
- Barry D. Solomon , Karthik Krishna (2011), The coming sustainable energy transition: History, strategies, and outlook. *Energy Policy*. Volume 39, Issue 11.
<https://doi.org/10.1016/j.enpol.2011.09.009>
- Ben Haj Djilali and Maghraoua Fatiha (2013), The bets of renewable energies and the challenges of the Arab strategy for developing their uses 2010-2030. *Maarif Magazine*. No. 15, Year 8
- Benjamin K. Sovacool (2017), The History and Politics of Energy Transitions: Comparing Contested Views and Finding Common Ground. *The Political Economy of Clean Energy Transitions*, Oxford University Press.
<https://doi.org/10.1093/oso/9780198802242.003.0002>
- Bin Saghir F. Al-Zahra and Boujanah Hamza (2019), The Arab world's tendency to exploit renewable energy as a strategic option and an energy alternative to achieve sustainable development, an analytical study, *Al-Bashaer Economic Journal*, Vol. 5, Issue 2.
- Bouakrif Zuhair, Zinad Suhaila and Quraishi Al-Eid (2021), Energy Transition: Towards the inevitability of exploiting renewable energies to achieve sustainable development in Algeria. *Journal of Finance and Markets*. Volume 8, Issue 1.
- Eliaana Lopez, Eliaana Lopez, Barbara Schlomann, Matthias Reuter, Wolfgang Eichhammer (2018). Energy Efficiency Trends and Policies in Germany – An Analysis Based on the ODYSSEE and MURE Databases, , *Fraunhofer Institute for Systems and Innovation Research ISI*, Karlsruhe, Germany. <http://www.isi.fraunhofer.de>
- ESCWA (2019). Energy Vulnerability in the Arab region, *Economic and Social Commission for Western Asia, United Nation press*. E/ESCWA/SDPD/2019/1, Available at https://www.unescwa.org/sites/default/files/pubs/pdf/energy-vulnerability-arab-region-english_0.pdf
- ESCWA (2019). Renewable Energy legislation and Policies in the Arab Region. *Economic and Social Commission for Western Asia, United Nation, Fact Sheet*, E/ESCWA/SDPD/2019/INF.1. Available at https://archive.unescwa.org/sites/www.unescwa.org/files/publications/files/renewable-energy-legislations-policies-arab-region-arabic_1.pdf
- IEA International Energy Agency (2022). World Energy Outlook 2022, Revised version, November 2022.

- IRENA 2014. IRENA's Global Renewable Energy Roadmap, REmap 2030. *IRENA Report*. Available at : https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_REmap_summary_findings_2014.pdf
- IRENA, 2018. Global Energy Transformation; a Roadmap to 2050. *IRENA Report*. Available at: <https://www.irena.org/publications/2019/Apr/Global-energy-transformation-The-REmap-transition-pathway>
- Julian David Hunt, Giacomo Falchetta, Simon Parkinson, Adriano Vinca and others (2021). Hydropower and seasonal pumped hydropower storage in the Indus basin:pros and cons. *Journal of Energy Storage*, Volume 41. <https://doi.org/10.1016/j.est.2021.102916>
- Majid Karam El-Din, Ali Habib, Yasmine Al-Masry (2020). Arab Renewable Energy Index, interactions of Arab renewable energy markets. *Arab Electricity Magazine, Regional Center for Renewable Energy and Energy Efficiency*, 2020, Issue 139.
- Maya Gradini (2019). what are the most important challenges facing the renewable energy sector? Article published on 09/09/2019: <https://www.alarabiya.net/aswaq/oil-and-gas>
- Nizar Awni Al-Labadi (2015). Sustainable Development, Exploitation of Natural Resources and Renewable Energy. *Dardijlah Publishing and Distribution House*, Jordan, 1st edition 2015. <https://books4arabs.com/BORE02-2/BORE02-2235.pdf>
- Odeh Al Jayyousi (2015). Renewable Energy in the Arab World: Transfer of Knowledge and Prospects of Arab Cooperation, *Friedrich Ebert publications*; Jordan.
- Pierre-Louis Viollet (2017). From the water wheel to turbines and hydroelectricity, Technological evolution and revolutions. *Comptes Rendus Mecanique*, Volume 345, Issue 8.
- Raguia Zahia (2021). The strategic and security dimension of energy in the policies of the Arab world, an analytical study 2000/2020. *doctoral thesis, University of Algiers 03*.
- IRENA (2014). Roadmap for Renewable Energies REmap 2030 Full Report. Available at : <https://www.irena.org/publications/2014/jun/REmap-2030-Full-Report>
- Saeed Jamali, Ahmad Abrishamchi, Kaveh Madani (2017). Climate Change and Hydropower Planning in the Middle East: Implications for Iran's Karkheh Hydropower Systems. *Journal of Energy Engineering*, Volume 139, Issue 3, Available at [https://doi.org/10.1061/\(ASCE\)EY.1943-7897.0000115](https://doi.org/10.1061/(ASCE)EY.1943-7897.0000115)
- Hassan Youssef Sahar Ahmed (2020). Renewable Energy between Reality and Aspirations, Remap Roadmap (IRENA analysis), *Scientific Journal of Economics and Trade*.
- Alnaqbi S.A., Alasad S., Aljaghoub H., Alami A.H., Abdelkareem M.A., Olabi A.G., Applicability of Hydropower Generation and Pumped Hydro Energy Storage in the Middle East and North Africa. *Energies* **2022**, 15. <https://doi.org/10.3390/en15072412>
- The world bank. total Arab Population. Available at: <https://data.worldbank.org/indicator/SP.POP.TOTL?locations=1A>
- World Intellectual Property Organization WIPO (2019). Patent Cooperation Treaty, Yearly Review 2019, 29. Available at: Patent Cooperation Treaty (PCT)
- Yassaa N, Khelif M. (2022). Energy Transition in Algeria: Lessons, Current Status and Improvements for Accelerated Development of Renewable Energies”, *CEREFEE press*. [https://www.cerefe.gov.dz/wp-content/uploads/2022/02/Rapport CEREFEE TE-2020-4.pdf](https://www.cerefe.gov.dz/wp-content/uploads/2022/02/Rapport_CEREFEE_TE-2020-4.pdf)
- Zakzak Lama et all (2023). Arab Region SDG Index and Dashboards Report 2023, Special Edition for the COP28, *Mohammed bin Rashid School of Government (MBRSG) and the UN Sustainable Development Solutions Network (SDSN)*. Available at <https://sdgtransformationcenter.org/reports/arab-region-sdg-index-and-dashboards-report-2023>