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Environmental Sustainability Prospects and Challenges Amidst Energy Transition in the Arabian Gulf: A Saudi Arabian Case Study

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Abstract

The Arab Gulf region and Saudi Arabia are focusing on energy transformation to address environmental challenges and climate change. The 2030 Gulf Cooperation Council and Saudi Vision 2030 aim to deepen the specificity of environmental sustainability, highlighting its reality in the region. The study identifies challenges and opportunities for operationalizing sustainability in energy transformation projects. Proposals and recommendations are being proposed to develop strategic policies that support environmental sustainability and energy transformation, building on the Kingdom's Vision 2030 leadership, and achieving a green economy.

Keywords: Environmental Sustainability, Energy Transformation, Vision 2030 for Sustainable Development, Gulf Cooperation Council.

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Résumé

La transition vers une économie verte est devenue une nécessité mondiale urgente, d'autant plus que les défis environnementaux s'aggravent et que le changement climatique s'accélère. Malgré les efforts accrus de la région et des États arabes du Golfe en particulier, les défis environnementaux croissants et la rareté de l'eau ont fait de la transformation énergétique un axe central de la vision du Conseil de coopération du Golfe pour 2030, qui s'inscrit dans la ligne de la Vision 2030 pour le développement durable de l'Arabie saoudite. À la lumière de ces développements, il est crucial d'approfondir la spécificité de la durabilité environnementale, dans le but de mettre en évidence sa réalité dans la région du Golfe arabe et le Royaume de l'Arabie saoudite, l'adoption du Conseil de coopération du Golfe et de la Vision 2030 saoudienne pour les projets de développement dans les domaines de la durabilité et de la transformation énergétique. Cela a permis à l'étude de recenser les défis majeurs qui se posent à la durabilité environnementale dans la région, au fur et à mesure que les contraintes environnementales augmentent. Sans parler de l'identification des perspectives et des possibilités d'opérationnaliser la durabilité à mesure que les projets de transformation énergétique se développent. Une série de propositions et de recommandations ont été proposées pour élaborer des politiques stratégiques qui soutiennent la durabilité environnementale et la transformation énergétique dans la région, en s'appuyant sur le leadership du Royaume dans la Vision 2030, pour réaliser une économie verte.

Mots-clés: Durabilité environnementale, Transformation énergétique, Vision 2030 pour le développement durable, Conseil de coopération du Golfe.

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آفاق وتحديّات الإستدامة البيئيّة في ظلّ التّحوّل الطّاقيّ في الخليج العربيّ – السّعوديّة نموذجاً

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الملخص

أصبح التّحوّل نحو الإقتصاد الأخضر ضرورة عالميّة مُلحّة، لا سيّما في ظلّ تفاقُم التّحديّات البيئيّة وتسارع وتيرة التّغيّر المُناخيّ. ورغم الجهود المُتزايدة التي تبذلها دول المنطقة، ودول الخليج العربيّ على وجه الخصوص، فإنّ التّحديّات البيئيّة المتفاقمة وندرة المياه جعلت التّحوّل الطّاقيّ محورًا أساسيًّا في رؤى مجلس التّعاون الخليجيّ 2030، والتي تتماشى مع رؤية المملكة العربيّة السّعوديّة 2030 للتنمية المستدامة. في ضوء هذه المُستجدّات، يكتسب التّعمّق في خصوصيّة الإستدامة البيئيّة أهميّة بالغة، بهدف تسليط الضّوء على واقعها في منطقة الخليج العربيّ والمملكة العربيّة السّعوديّة، خاصةً مع تبنّي دول مجلس التّعاون الخليجيّ ورؤية المملكة العربيّة السّعوديّة 2030 لمشاريع تنمويّة رائدة في مجالي الإستدامة والتّحوّل الطّاقيّ. إنّ هذا مكّن الدّراسة من تعيين التّحديّات البارزة التي تقف أمام تحقيق الإستدامة البيئيّة في المنطقة مع تزايد المعوّقات البيئيّة. ناهيك عن تحديد آفاق وفرص تفعيل الإستدامة مع تنامي مشاريع التّحوّل الطّاقيّ فيها. إذ تم إقتراح مجموعة من المقترحات والتّوصيّات تهدف إلى تطوير سياسات إستراتيجيّة تدعم الإستدامة البيئيّة والتّحوّل الطّاقيّ في المنطقة، مستفيدةً من ريادة رؤية المملكة 2030، لتحقيق الرّيادة الخليجيّة في الإقتصاد الأخضر.

الكَلِماتُ المِفْتاحيَّةُ: الإستدامة البيئيّة، التّحوّل الطّاقيّ، رؤية المملكة 2030 للتنمية المُستدامة، مجلس التّعاون الخليجيّ.

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INTRODUCTION

Climate change is no longer just an environmental issue but a global development challenge that threatens the stability of societies and the prosperity of economies. It's devastating effects transcend nature's boundaries, affecting various aspects of human life, from food and water security to public health, infrastructure, and political stability. As a result, there is an increasingly urgent need to integrate climate change issues while preserving biodiversity and combating desertification, where these issues interact, requiring an integrated approach to address global and regional environmental challenges that directly affect the economy, society, and government performance.

The Middle East and North Africa region faces daunting climate challenges, prompting its countries to develop climate crisis strategies. Owing to rapid economic and population growth, the Arabian Gulf is moving towards energy transformation, as it relies on fossil fuels and increasing water scarcity. Energy transformation in its concept refers to moving from relying on traditional energy sources contaminated by the environment, including fossil fuels, to renewable energy sources and functions, such as solar power and wind energy.(1) This transformation has become imperative to address the challenges of climate change and stimulate sustainability in the environment globally and in the Arab Gulf region. Therefore, it been a central part of the Gulf Cooperation Council's Vision 2030, which is integrated with its development objectives with the goals of the Saudi Arabian Vision 2030 for Sustainable Development. The goals of this transition are complementary to the principles of environmental sustainability, whose strategies mean preserving natural resources and biodiversity, reducing negative impacts on the environment, and ensuring a sustainable future for next generations.

In this context, Saudi Crown Prince and Prime Minister Mohammed bin Salman bin Abdul-Aziz Al Saud emphasized that "environmental protection is an integral part of our vision for sustainable development. The Kingdom is determined to make a lasting regional

(1) Vaclav Smil, The Energy Transition: History, Requirements, Strategies ,MIT Press, Cambridge, 2023, p. 45.

and global impact. As part of its leadership role, work on the Middle East Green Initiative will begin with the countries of the Gulf Cooperation Council and the Middle East, and in partnership with the Middle East countries, will seek to cultivate 40 billion to achieve energy transformation and environmental sustainability."(1)

Energy transformation is based on protecting the environment, promoting energy independence, providing new jobs, and improving quality of life. Led by Saudi Arabia, the Arab Gulf region seeks to be self-sufficient and reduce power costs by investing in renewable power. Furthermore, the Kingdom is pushing for energy transformation through initiatives such as "Green Saudi Arabia" and "National Renewable Energy Program." In this context, Vision 2030 leads international partnerships to address environmental challenges. The Gulf Cooperation Council has reaffirmed its commitment to increasing investment in renewable power projects, developing green hydrogen, diversifying energy sources, modernizing functional technologies, and increasing energy efficiency.(2)

Thus, in light of growing development projects and initiatives to achieve a green economy in the Arab Gulf, the region faces many challenges despite broad prospects for energy transformation and strengthening its environmental sustainability. As the Arab Gulf States and the Kingdom of Saudi Arabia's Vision 2030 for Sustainable Development continue their efforts towards energy transformation, vital questions arise about the opportunities and constraints to achieving environmental sustainability on this path and how to maximize the opportunities available to operationalize the goals of cell visions towards a more sustainable and prosperous society. To achieve this goal, we must draw recommendations and proposals that will accelerate the region's energy transition in line with the Gulf's aspirations to strengthen environmental sustainability.

(1) Mohammed bin Salman provokes an interaction with a statement described as "the strongest statement by an Arab leader", Arabic. CNN, 10/12/2022, article website, https://arabic.cnn.com/entertainment/article/2024/08/31/saudi-mohammad-bin-salman-crown-prince-birthday-social.

(2) His Excellency the Secretary-General of the GCC: The organization of the COP28 World Climate Action Summit in the United Arab Emirates is a reflection of its global standing and leadership role towards finding solutions to climate challenges, GCC Secretariat 1/12/2023, report website, https://gcc-sg/ar/MediaCenter/News/Pages/news2023-12-1-1.aspx

I-**The Importance of Study**

1. Emphasize the importance of energy transformation as a key tool to address challenges and achieve environmental sustainability.
2. Highlighting GCC and Saudi Arabia's efforts in environmental sustainability and energy transformation as a leading regional and global model.
3. Provide a comprehensive analysis of the challenges facing the Gulf region in its energy transformation pursuit, as well as the promising opportunities that can be exploited to achieve environmental sustainability goals.
4. Enrich the scientific library with research studies on environmental sustainability and Emphasize Vision 2030's objectives in activating energy transformation and achieving a green economy in the Arabian Gulf.
5. Enhancing community awareness of the importance of energy transformation and encouraging community participation in achieving environmental sustainability.
6. Proposes strategic recommendations and proposals to support Gulf visions and the Kingdom's Vision 2030 for sustainable development, focusing on accelerating energy transformation and achieving environmental sustainability in the Gulf Arab region.

II- **Study Objectives**

1. Analyze the environmental sustainability in the Arab Gulf by identifying current efforts and government initiatives in the field of environmental sustainability and energy transformation.
2. Identify the challenges facing the region in achieving environmental sustainability and explore opportunities to accelerate energy transformation.
3. Assessing environmental sustainability by analyzing the environmental, economic, social, and institutional dimensions of sustainability in the region.
4. Demonstrate environmental sustainability applications by providing concrete examples of their applications in various sectors in the Arab Gulf States.
5. Formulating strategic policies that align with the Kingdom's Vision 2030, aiming to promote environmental sustainability and energy transformation in the region.

III- **Study Problem**

Environmental sustainability is a core strategic objective of the GCC Vision 2030, particularly as member states pursue their development goals by implementing a green economy through energy transition to ensure the well-being and sustainability of their populations. Further, the 2030 Saudi Development Plan has included several initiatives and projects that support energy transformation to address environmental challenges and climate change by strengthening strategic partnerships and activating scientific innovation in this regard. Hence, this study focuses on the effectiveness of energy transformation in achieving environmental sustainability in the Gulf region and Saudi Arabia in particular. The study's problem has several questions:

1. What are the characteristics of environmental sustainability, and how do they manifest themselves in the Gulf context in general and Saudi Arabia in particular?
2. What are the integrated dimensions of sustainability in the Arab Gulf region?
3. How are environmental sustainability applications reflected in projects and initiatives implemented in the region?
4. What are the main challenges and opportunities for enabling environmental sustainability under energy transformation?
5. What are the recommendations and proposals for promoting environmental sustainability in conjunction with achieving a green economy through energy transformation in the Arab Gulf region?

IV- Study Methodology

The following scientific curricula have been adopted to address the topic of the study on the analysis of opportunities and constraints of environmental sustainability as environmental and climate challenges grow, with a focus on Gulf and Saudi endeavors to promote energy transformation as a model, in order to reach the desired outcomes:

1. Extrapolation approach: in order to focus on the extrapolation of environmental sustainability applications, specifically within the context of Saudi Arabia's Vision 2030, to

analyze its role in fostering a green economy. The objective is to evaluate the region's current sustainability and energy transition landscapes through the lens of these extrapolated concepts.

2. Analytical approach: The study uses an analytical approach to analyze environmental sustainability in the Gulf region and Saudi Arabia, focusing on energy transformation projects and the relationship between these transformations and sustainability under the Council's Vision 2030 and Vision 2030. It aims to identify challenges and opportunities for enhancing energy transformation and supporting sustainability. The study draws on the policy of openness and economic diversification supported by Vision 2030 and the Gulf aspirations to provide scientific recommendations for targeted development strategies and a more sustainable and prosperous regional environment.

Therefore, this study will address the dimensions of environmental sustainability in the Arabian Gulf region, with a primary focus on Saudi Arabia, through the following key areas. Furthermore, it will examine the challenges and opportunities related to sustainability and energy transition in both the Gulf and Saudi Arabia. Ultimately, the aim is to develop effective proposals and recommendations that will inform strategic policies, driving environmental sustainability and accelerating energy transition to establish the Gulf region as a global leader in the green economy.

I. **Environmental sustainability in the Arab Gulf: Saudi Arabia is at the forefront of the application**

Environmental sustainability is a key pillar for sustainable development, going beyond the mere preservation of natural resources to include a promising and sustainable future for the next generations. The importance of environmental sustainability is reflected in its ability to balance economic, social, and environmental dimensions, ensuring long-term growth and prosperity. The world, and the Arab Gulf region in particular, is moving towards adopting strategies and initiatives aimed at achieving environmental sustainability through sustainable practices across sectors. In this context, Crown Prince and Prime Minister, Mohammed bin Salman bin Abdul-Aziz Al Saud, highlighted at the Climate Sum-

mit the Kingdom's tireless efforts to preserve the environment and climate and strive to achieve zero neutrality by 2060 through government initiatives and projects that represent a clear road map for the Kingdom to reduce carbon emissions. (1)

a. **Environmental Sustainability: Definition and Scope**

Sustainability, in its broader concept, refers to the viability of a process or its support over time, enabling it to remain available over a longer period, and its goal is to prevent the continued depletion of natural or material resources. At its core, sustainability is the ability to meet today's needs without compromising the ability of successive generations to meet their own needs. It is a comprehensive and integrated vision that takes into account the economic, social, and environmental dimensions and seeks to balance them.

Furthermore, international organizations are making intensive efforts to achieve environmental sustainability goals through diverse initiatives and programs. The United Nations stands out as a leader in this area through the 17 interrelated sustainable development goals and programs such as the United Nations Environment Program and the United Nations Development Program. In this context, the Gulf Cooperation Council focuses on protecting biodiversity and achieving the region's green economy. Additionally, the Global Fund for Nature aims to preserve the natural environment, while the Organization for Economic Cooperation and Development promotes policies supportive of sustained economic growth and environmental protection and makes recommendations to member states for balancing economic and environmental objectives. (2)

Sustainability is reflected in three key interrelated axes, including economic, environmental, and social, enabling enterprises to achieve sustainable goals focused on reducing environmental impact and promoting resource conservation. Some Gulf companies have embraced "green investments" to better match the environment, including ADNOC in the United Arab Emirates, GPIC Bahrain, and others.

Sustainability is an ethical commitment and shared responsibility to conserve natural re-

(1) Badr al-Otaibi, the crown prince's speech at the climate summit... Road Map Drawn by Saudi Arabia for Environmental Conservation, Sabaq E-Newspaper, 8/11/2022, Article Website, https://sabq.org/saudi/fe1tkgtu9h.

(2) J. Smith, Sustainable Futures: Balancing Economy, Society, and Environment, Greenleaf Publishing, New York, 2020, p. 45

sources and biodiversity, and to combat pollution and climate change. This is achieved through sustainable practices such as renewable power use and waste management. Sustainability in the Gulf region is reflected in companies' shift to solar power, and governments adopt policies that reduce carbon emissions. Sustainability has become a competitive advantage for companies in the Arab Gulf. Its principles include reducing environmental impact, improving resource efficiency, enhancing social responsibility, and achieving transparency.(1)

Thus, sustainability is not just a theoretical concept, but a practical need to ensure a prosperous future for people, and requires concerted efforts by governments, companies, civil society and individuals to conserve natural resources, reduce climate change and pollution, achieve sustainable economic growth, and promote social justice.

b. **Environmental Sustainability Dimensions in the Arabian Gulf**

The diversity of ecosystems in GCC countries, from deserts to maritime systems, is the key to the region's environmental and economic sustainability. Recognizing and protecting this diversity is no longer selective for companies but rather a strategic goal that converges with global sustainability goals and the Gulf Cooperation Council's Vision 2030 to achieve a green economy. In this context, H.E. Mr. Jassim Mohammed Al-Badaywi, Secretary General of the Gulf Cooperation Council, stressed that the future vision of the GCC countries is based on a strong and diversified economy that ensures sustainable growth and job creation for young people. So, to achieve this ambitious vision for a green economy, close cooperation among GCC states in achieving economic integration and sharing experiences and knowledge are key pillars. (2)

The Kingdom of Saudi Arabia embraces a comprehensive vision of environmental sustainability, believing that it is not just a goal but an imperative to achieve a more sustainable and prosperous society. Further, Crown Prince Mohammed bin Salman bin Abdul-Aziz Al

(1) Grayson, David, and Chris Coulter, Sustainable Business Strategies: Creating Value Through Social, Environmental, and Economic Performance, Routledge, London, 2023, pp. 78-85.

(2) H.E. the Secretary-General of the GCC: The GCC States were a reliable partner in the light of their wise and moderate policies at all levels regionally and internationally, GCC General Secretariat, 13/11/2024, website of the report, https://gcc-sg.org/ar/MediaCenter/News/Pages/news2024-11-12-1.aspx .

Saud, Deputy Prime Minister, announced the launch of the "Green Saudi Initiative" and the "Green Middle East Initiative," emphasizing that these initiatives will set a clear and ambitious path for the region in protecting land and nature and will contribute effectively to the achievement of global development goals.(1) This highlights the Gulf's endeavors to strike a balance between economic development and environmental conservation by adopting integrated dimensions of sustainability.

The Gulf's interest in the environmental dimension focuses on the preservation of ecosystems, biodiversity, pollution control, and rational management of natural resources. Additionally, Arab Gulf States are taking concrete steps, such as increasing investment in renewable power projects, including solar and wind energy, that contribute to reducing reliance on fossil fuels, reducing carbon emissions, and creating natural reserves to protect their unique ecosystems. It also adopts sustainable agricultural practices, applies modern waste management and recycling techniques, and promotes scientific research into the environment.

With respect to the economic dimension of sustainability, the Arab Gulf States are keen to achieve sustainable, environmentally sensitive growth by encouraging investment in functional technologies and developing circular economic models. The Kingdom of Saudi Arabia and the Gulf Cooperation Council countries are working in this regard to provide incentives to companies that adopt sustainable practices and develop the ecotourism sector, creating new economic opportunities and contributing to the conservation of natural resources.

Gulf governments at the social level seek to provide equal employment opportunities and promote human development. In this regard, its states invest in education and training to qualify young people for renewable energy, improving health care and social services. In the institutional dimension, policies and legislation are being developed that ensure environmental sustainability and promote cooperation between governments, the private sector, and civil society through strict environmental standards, accountability and transparency mechanisms, and partnerships with international organizations.

(1) The contents of the royal speech... A prosperous economy and a successful vision in a leading kingdom, Riyadh, 28/12/2023, article website, https://www.alriyadh.com/2050850 .

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The countries of the Arabian Gulf region are also fully aware that achieving environmental sustainability is not an easy task but requires the concerted efforts of all sectors and society as a whole.(1) Therefore, Gulf governments are promoting awareness of the importance of environmental sustainability, encouraging community participation in environmental conservation, and developing educational and training programs to raise environmental awareness among future generations. The development initiatives launched by the Kingdom and the Arab Gulf region in general, notably the Neom City Project, the Mohammed bin Rashid Al Maktoum Solar Power Project, the Noor Abu Dhabi Project, and others, reflect its firm commitment to achieving environmental sustainability goals and striving to be a leading global model in this area.

c. **Diverse Environmental Sustainability Applications in the Arabian Gulf**

The Arabian Gulf region, which produces hydrocarbons, is keeping pace with a global shift towards low-carbon energy. Leveraging its abundant natural resources and its strategic policies, the Gulf Cooperation Council has become a leading model in balancing energy sustainability and promoting sustained economic growth.

Led by the Kingdom of Saudi Arabia, the Arab Gulf region is moving towards eco-sustainability and functional energy, embracing innovative development strategies.(2) In Saudi Arabia, the nuclear power program, investing $33 billion, is the cornerstone of energy, in parallel with the world's largest solar power plant in Mecca. In this context, Saudi Arabia's comprehensive Vision 2030 for environmental sustainability is embodied in a variety of applications covering various sectors and initiatives, with the aim of striking a careful balance between economic development and environmental conservation to ensure a sustainable future for the next generations. The Green Saudi Initiative is a vivid example of this trend, aiming to reduce carbon emissions by 278 million tons per year by 2030 by planting 10 billion trees across the Kingdom, protecting land and marine areas, and increasing reliance on energy sources.

(1) Omar Al-Shahabi and Hamad Al-Rayis, Sustainability in the Gulf, Center for Arab Unity Studies, Beirut, 2021 p. 55-60.

(2) Robin Mills, The Future of Energy in the Gulf: Policies, Projects, and Prospects, Oxford University Press, Oxford, 2023, pp. 120-135.

At the regional level, Emirati "Masdar" leads globally renewed energy projects, and green transformation stimulates investments in Gulf industries to adopt sustainable practices. The United Arab Emirates' efforts to build a clean industrial base, green financial instruments, and initiatives such as "green aluminum" are evident. Qatar also stands out in solar energy investment and green construction, organizing environmentally friendly events. Therefore, the Arab Gulf States are joining forces to achieve environmental sustainability, crystallized in Oman through renewable energy projects and commitment to carbon neutrality, and Kuwait and Bahrain seek to increase reliance on renewable energy. The Arab Gulf region is committed to achieving environmental sustainability and energy diversification. Saudi Arabia seeks to generate 50% of electricity from renewable sources by 2030 and encourages private investment. Gulf governments also attach importance to water management, adopt smart cities, safeguard biodiversity, and adopt a circular carbon economy. These efforts reflect Gulf States' endeavors to diversify energy sources and adopt sustainable practices as a global model of sustainability.

II. **Sustainability and Energy Transition in the Saudi Arabia Kingdom: Challenges and Opportunities**

The world is witnessing an accelerated shift towards sustainable practices. At the core of this transformation, the Arabian Gulf region and Saudi Arabia stand out as a driving force towards a sustainable future. Further, Saudi Minister of Energy Prince Abdul-Aziz bin Salman asked at the "Future Investment Initiative" conference, "Which country has historically achieved this amount of transformation in the last 6 to 7 years as Saudi?" Saudi Arabia has shifted from its core reliance on oil to a leader in clean power projects, including green hydrogen and carbon capture projects, supported by massive investments to achieve carbon neutrality by 2060.(1) In this regard, the Arab Gulf region is making strides towards achieving the transition while deeply recognizing the opportunities and challenges that accompany this critical phase.

a. **Environmental Sustainability Challenges in the Energy Transition**

The twenty-first century has seen unprecedented environmental challenges threatening

(1) Mohammed Ateef, Saudi Arabia and Environmental Transformation.. Global Model Leader in Clean Energy Pathway, Sabq Newspaper, 31/10/2024, Article Website, https://sabq.org/saudi/5d548rie3g .

the planet's future survival, and as the pace of climate change accelerates, the international community is keen to cooperate to address the climate crisis and reduce its negative impacts. In this context, the Arab Gulf countries stand out as key players in the global energy landscape and strive to address these challenges by adopting ambitious strategies for a robust transition and environmental sustainability. However, these challenges are as follows:(1)

1. Fossil fuel dependence: The historical dependence of Gulf States on fossil fuels, especially oil and gas, is one of the most significant challenges facing their endeavors towards sustainable energy transformation. This sector continues to be the cornerstone of its economy, making the transition to renewable energy sources more complex. Achieving energy transformation goals requires massive investments in new infrastructure, the development of advanced technologies, and radical changes in existing policies and regulations. In addition, careful management of current resources is required, ensuring the stability of supplies during the transition period, taking into account potential economic and social impacts.

2. Technical and economic challenges: The development of renewable energy projects requires massive investments in technology and infrastructure, which imposes significant short-term financial burdens, despite expected long-term economic and environmental returns. On the other hand, some renewable energy technologies, including solar power and wind energy, continue to face efficiency and cost challenges, especially under local climatic conditions that may affect their performance. The integration of renewable power sources and the existing electrical grid is also a complex technical challenge, requiring the development of smart grids and sophisticated energy storage systems.

3. Environmental challenges: At the environmental level, issues of water resource scarcity, desertification, and high temperatures are exacerbated, requiring sustainable management of natural resources and reducing environmental impacts from renewable power projects. For instance, solar power projects require large areas of land, which may degrade local ecosystems, while wind energy projects may affect wildlife, especially migratory birds.

(1) David L. Goldwyn, Energy Transition in the Gulf: Challenges and Opportunities, Atlantic Council, Washington, 2023, pp.30-45.

Therefore, adopting innovative solutions and using environmentally friendly technologies is essential to ensure that energy transformation goals are achieved without harming the environment.

Not only are there the difficulties of that scope, but the region's energy transformation also faces the social challenges of raising community awareness of the importance of sustainability and providing new jobs in the renewable energy sector. Despite these constraints, the Arab Gulf States have tremendous potential for sustainable energy transformation and can play a leading role in this area at the regional and global levels.

b. **Gulf Energy Transformation: A Sustainable Vision for the Environment**

The Gulf region is at a significant strategic juncture in the energy sector, embracing an integrated path to environmental sustainability based on innovation, partnership, and shared responsibility. This reflects Gulf ambitions to develop functional technologies, diversify the economy, and enhance environmental awareness by supporting the Gulf Cooperation Council to launch the Kingdom's Vision for Sustainable Development 2030 that encourages investment in renewable energy projects. It seeks to overcome obstacles and provide an investment-attractive environment with the following opportunities: (1)

1. The enormous potential of renewable energy: the countries of the region have tremendous potential in the field of renewable energy. Their natural resources are abundant in solar power and wind energy, qualifying them to be leaders in the production of functional energy. This reality opens up broad prospects for investment in renewable power projects, which in turn will greatly contribute to diversifying energy sources and reducing reliance on fossil fuels, which embodies a strategic goal within the framework of GCC Vision 2030.

2. Economic diversification: The renewable energy sector is a promising economic driver. It offers promising investment opportunities and diversified business, ranging from the manufacture of renewed power components such as solar panels and relief turbines, through the development of power storage technologies, which guarantee the decision to

(1) IBID, pp. 46-56.

provide engineering services. This diversification contributes to the creation of new jobs in multiple areas, supporting economic growth and reducing dependence on oil as a major source of income, thus diversifying national sources of income and promoting economic sustainability.

3. Regional and Global Leadership: The Arab Gulf States seek to consolidate their position as a leading power in energy transformation at the regional and global levels by sharing advanced experiences and technologies with other countries. In this context, their governments are investing heavily in state of the art technologies, such as waste hydrogen and carbon capture and storage, with a view to reducing reliance on fossil fuels and reducing carbon emissions. Through these efforts, the region's nations seek to be a regional and global model for adopting sustainable and innovative energy solutions, enhancing their role as an influential global power in the energy sector, and accelerating the transition towards a sustainable energy future.

CONCLUSION

Arab Gulf countries place environmental sustainability at the core of their Vision 2030 for Sustainable Development, seeking to promote the energy transition towards a greener and more developed future. As global challenges grow as climate changes grow, developing the performance of Gulf Productive Sector Institutions becomes urgent, especially in light of digital progress towards a more pioneering and innovative society. This allows enterprises to meet the intertwined challenges and take advantage of opportunities for a sustainable green Gulf economy. In view of this fact, it is important to make various proposals that we wish the Gulf governments and their public departments from strategic policy experts and engineers and research centers to adopt in order to maximize energy transformation to support environmental sustainability in the Gulf economy by enabling investment in renewable energy. Also, developing national green energy competencies and enhancing community awareness about environmental sustainability and energy transformation in the Saudi Arabia Kingdom.

As a result, we are raising the following recommendations:

a. **At the Legislative and Regulatory level:**

1. Developing legal frameworks through the enactment of laws and legislation supportive of renewable power projects, setting clear standards for environmental sustainability. This includes updating existing environmental and energy laws in line with Vision 2030 and the Sustainable Development Goals and streamlining regulatory procedures to encourage investment in this vital sector.

2. Enact laws encouraging investment in renewable power projects and functional technologies by providing tax and customs incentives to companies working in this field and establishing more support and funding funds dedicated to these projects. In addition, strengthen public-private partnerships to accelerate the implementation of renewable power projects and achieve environmental sustainability goals.

3. Develop a legal framework that promotes transparency and accountability in order to achieve environmental sustainability and energy transformation in the Kingdom. This includes legislating more laws that establish clear accountability and transparency mech-

anisms in the implementation of renewable power projects, and carefully monitoring the environmental impact. Periodic reports should also be published on the Kingdom's achievements in achieving the goals of environmental sustainability and energy transformation, to ensure that the public and stakeholders are informed of the efforts made and the results achieved.

b. **At the Equipment's level**

1. Expand renewable power projects by increasing investments in solar and wind power projects, developing power storage technologies, and creating sophisticated smart networks to manage energy flow efficiently. In addition, it is recommended that green hydrogen and carbon capture and storage projects be supported.

2. Develop an integrated infrastructure, starting with green building standards in urban projects, promoting sustainable public transport networks, and encouraging electric vehicles to reduce carbon emissions and traffic congestion. Additionally, improve waste management and recycling to create healthy, sustainable cities for future generations.

3. Apply rigorous standards of power efficiency in the industry, buildings, and electrical appliances while encouraging the use of modern technologies to rationalize consumption and develop the necessary infrastructure to support the shift towards functional power sources.

c. **At the Economic level**

1. Encourage investment in green industries and support small and medium enterprises to diversify income sources and promote environmental sustainability. This approach not only contributes to building a diverse and sustainable economy but also creates new jobs and promotes innovation in functional technologies.

2. Develop energy-efficient desalination technologies, implement modern irrigation systems in the agricultural sector, and strengthen effective strategies for highly efficient water management in order to ensure sustainable management of water resources.

3. Create more nature reserves to protect endangered plants and animals through programs to rehabilitate degraded ecosystems in order to enhance community awareness of the importance of biodiversity and the need to safeguard it for future generations.

d. **At the level of Human Resources**

1. Develop specialized educational and training programs in universities and technical institutes, focusing on renewable energy and environmental sustainability, and offering courses and workshops to qualify national cadres in functional technologies and environmental project management, while encouraging scientific research in this field and providing financial support to researchers and innovators.

2. Raise the level of community awareness by organizing awareness and media campaigns that highlight the importance of environmental sustainability and energy mobility, incorporate environmental sustainability concepts into curricula at all educational stages, encourage community participation in environmental initiatives, and provide support to non-governmental organizations working in this area.

3. Provide new jobs for Gulf youth by encouraging investment in renewable energy projects and green industries. In addition, specialized training programs can be provided to qualify young people to work in this promising sector, supporting entrepreneurship in functional technologies and environmental projects. These combined steps contribute to building a qualified workforce capable of driving energy transformation and achieving the region's environmental sustainability goals.

4. Promote innovation and scientific research by supporting scientific research in the field of renewable energy technologies and energy efficiency. Additionally, partnerships between Gulf universities, research centers and the private sector to develop innovative solutions. New energy innovation centers have also been established to encourage entrepreneurs and startups**.**

5. Adopt an integrated strategy aimed at developing national green energy competencies. Its items include support for the establishment of specialized training and rehabilitation programs in green power, as well as the promotion of the exchange of experience and knowledge with the countries in question. This enables Arab Gulf countries to achieve their energy transformation goals.

e. **At the level of Activating Gulf Strategic Partnerships**

1. Promote cooperation in research and development among GCC countries through the

establishment of joint research centers to exchange expertise and develop modern technologies in the field of renewable energy and energy efficiency, and launch joint initiatives to finance research and development in the areas of environmental sustainability.

2. Development of shared infrastructure through the establishment of regional energy networks for renewable energy exchange among GCC countries and development of joint green infrastructure projects, including sustainable transport and waste management projects.

3. Adopt unified policies and legislation to promote environmental sustainability in Gulf Cooperation Council States by standardizing environmental standards and regulations among Member States and developing common policies to encourage investment in renewable energy and energy efficiency.

4. Enhancing cooperation in the field of education and awareness by launching joint educational programs to train human cadres in the fields of environmental sustainability, as well as conducting joint awareness campaigns to raise awareness of the importance of environmental sustainability.

5. Activate the role of joint economic institutions by activating the role of the Gulf Cooperation Council in supporting cooperation in the area of environmental sustainability. Also, encourage collaboration among Gulf companies in the area of sustainable practices.

6. Benefit from international experiences and activate cooperation with international organizations in the areas of environment and energy by exchanging experiences with traders in sustainability and energy transformation.

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