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ORIGINAL RESEARCH PAPER

Impact of Renewable Energy Development on Employment in MENA Member Countries

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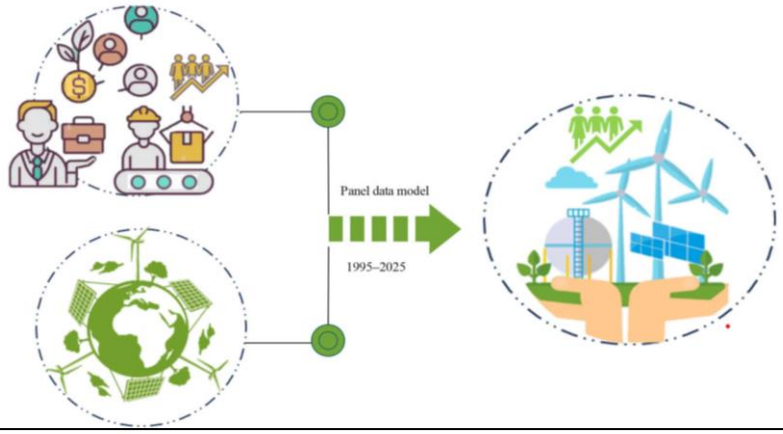
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A B S T R A C T

Countries around the world possess diverse capacities for the production of renewable energy, and due to wider access to these resources, their environmental advantages, and their lower costs compared to conventional fuels, many have taken steps toward expanding renewable energy generation. Energy, as one of the fundamental inputs of production, plays a decisive role in the process of economic development and growth. Therefore, given that macroeconomic indicators are also influenced by the development of renewable energy, this study examines the relationship between renewable energy production and employment rates in MENA member countries over the period 1995–2025. The results of the study indicate that renewable energy production has a positive and statistically significant effect on employment in MENA countries. Specifically, a one percent increase in renewable energy production leads to a 0.12 percent increase in employment in this group of countries. Given the high dependence of MENA economies on extensive fossil fuel resources, the expansion of renewable energy production can generate substantial employment effects by creating new productive capacities and supporting economic diversification.



1. Introduction

Renewable energy sources have attracted increasing attention due to their numerous advantages, including the reduction of negative environmental impacts, enhanced energy security, wider access to energy resources, and fewer global constraints. The development of renewable energy affects national economies through multiple channels, among which its role in job creation and the reduction of unemployment rates is particularly significant. Positive impacts on labor markets are therefore considered one of the main drivers behind the expansion of renewable energy resources.

Investment in renewable energy has so far generated substantial employment opportunities across different regions of the world. In this regard, developed countries—facing high energy demand in their industrial sectors—have increasingly turned toward large-scale investments in renewable energy. According to reports published by the International Renewable Energy Agency (IRENA) on renewable energy and employment, the number of jobs in the renewable energy sector reached 11 million in 2018, compared to 10.34 million in 2017. These figures clearly indicate a growing trend in employment associated with renewable energy development [1].

n this study, the member countries of the MENA organization are examined as the sample. The Middle East and North Africa (MENA) countries possess distinctive economic, demographic, and energy-related characteristics that make them one of the most significant regions globally in terms of energy production and consumption. One of the most prominent features of these countries is the abundance of fossil energy resources—particularly crude oil and natural gas—such that a substantial share of their foreign exchange earnings and gross domestic product (GDP) depends on the export of these resources. While this reliance provides comparative advantages, it also renders their economies vulnerable to fluctuations in global energy prices.

On the other hand, despite their high dependence on fossil fuels, MENA countries possess considerable potential for the development of renewable

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energy, especially solar and wind energy. Favorable climatic conditions, high solar irradiation levels, extensive desert areas, and access to productive wind corridors make large-scale expansion of renewable resources feasible across the region. Consequently, the development of renewable energy has attracted growing attention among policymakers as an effective tool for diversifying the energy portfolio and reducing dependence on fossil resources.

Therefore, the research hypothesis is formulated as follows: the development of renewable energies will have a positive impact on the employment rate in the group of MENA countries, and the aim of this study is to examine the extent of the impact of renewable energy development on the employment rate in the mentioned countries. In this study, the relationship between renewable energy production and employment will be examined using panel data for the years 1995 to 2025. Subsequently, this study will review the literature and previous studies, introduce the model and research variables. Then, by estimating the models and analyzing the data, the results will be examined

2. Theoretical Foundations

In economic literature, the net employment changes resulting from renewable energy development policies are divided into three main components: direct effect, indirect effect (substitution and income effects), and trade effect. The direct or gross effect measures employment changes generated in the renewable energy sector but does not account for potential employment losses in the non-renewable energy sector due to substitution and income effects. For example, reallocating financial resources to the renewable energy sector and increasing the cost of extracting finite resources, such as crude oil from deep wells, can raise the price of non-renewable energy and consequently reduce job opportunities in that sector. This type of substitution effect, primarily driven by changes in investment allocation and energy price fluctuations, is referred to in economic literature as the indirect effect [2, 3]. While the direct effect only reflects the positive aspects of investment in renewable energy, the magnitude of the indirect effect plays a decisive role in estimating the net employment impact. In this regard, Lehr and colleagues show that for most renewable energy technologies, the number of indirect jobs created typically exceeds the number of direct jobs [4].

Furthermore, the pattern of exports and imports of renewable and non-renewable energy can influence the magnitude of net employment changes. The size of the trade effect depends on the supply and demand elasticities in origin and destination countries. For instance, a significant reduction in fossil fuel consumption in oil-importing countries may lead to a decrease in job opportunities in member countries of the Organization of the Petroleum Exporting Countries (OPEC). Conversely, investment by these countries in renewable energy, such as solar and wind power, can create more employment in their domestic markets. Some studies in economic literature offer a different interpretation of these effects. According to research by Mo and colleagues and Stavropoulos and Burger, direct effects represent jobs created as a result of increased Renewable Energy Sources (RES) capacity, while indirect employment effects arise through industries that support the development of the renewable energy sector [5, 6]. These industries can influence net employment through positive spillover effects. However, factors such as reduced investment in fossil fuels, changes in energy prices in the competition for capital, fluctuations in labor wages, and changes in household income may ultimately lead to a net positive or negative effect on employment [7].

3. Literature Review

Ma and Wang surveyed, the interrelationship between renewable energy, employment, and economic growth, Over the period 2000–2023, particularly in BRICS countries. This study examines the role of renewable energy in fostering green job creation and promoting sustainable development within BRICS economies, employing an Autoregressive Distributed Lag (ARDL) framework to capture both short- and long-run dynamics. The empirical findings indicate that renewable energy development plays a significant role in expanding green employment across BRICS countries, exerting a strong positive impact on jobs in environmentally sustainable sectors. Furthermore, the results suggest that investments in renewable energy contribute to sustainable economic growth by lowering carbon emissions and strengthening energy security. In the short run, the adoption of renewable energy generates immediate economic benefits, while in the long run, it supports sustained employment growth and environmental resilience [8].

Rutovitze and colleagues estimate employment factors across different stages of renewable energy projects, compares the results with international benchmarks, and provides detailed occupational breakdowns for five key energy technologies. These indicators are subsequently applied to workforce projections within the Australian 2024 Integrated System Plan for the electricity sector. The findings indicate that employment associated with large-scale renewable energy deployment under least-cost energy transition scenarios is highly volatile. Moreover, substantial overlap is observed in the occupational requirements across different renewable technologies and electricity transmission infrastructure. As countries seek to rapidly scale up renewable energy capacity and expand transmission networks, integrating workforce projections into electricity system planning through robust employment indicators can significantly enhance policy effectiveness [9].

Naeimi and Varahrami the relationship between the production of renewable energy and the employment rate and the comparison of this relationship in selected OECD and OPEC countries have been investigated. For this purpose, using panel data method and data related to 20 OECD member countries and 8 OPEC member countries in the period of 1990-2019, the effect of renewable energy production on employment has been evaluated. According to the results of this study, in both groups of OECD and OPEC countries, acceptable energy production has had a positive effect on the work rate in these countries. In the OPEC group, a one percent change in the production of positive energy has increased energy to 0.27%, which is equal to 0.05 in the OECD countries [10].

Hieu and Mai in an article examined the impact of renewable energy on economic growth in developing countries. Using data from 80 developing countries with different income levels over the period 1990–2020 and estimating Method of Moments Quantile Regression, they state that renewable energy consumption has had a positive impact on economic growth, while the impact of non-renewable energy consumption on economic growth has been negative [11].

Azretbergenova and colleagues examined the impact of renewable energy production on employment in 27 member countries of the European Union. They used data covering the period 2006–2019 and applied the panel ARDL approach. According to the results of this study, renewable energy production has a positive effect on employment in EU member countries in the long run. Specifically, in the long run, 1 percent increase in primary renewable energy production leads to 0.08 percent increase in employment [12].

Arvanitopoulos and Agnolucci examined the long-term effect of renewable electricity development on employment in the United Kingdom, a transparent and replicable econometric method based on a vector error-correction model is used. This model is estimated using annual data from 1990 onward for the electricity-generation sector in the UK and provides evidence that the long-term employment impact of renewable technologies is substantially larger than the impact from deploying nuclear or natural-gas technologies. The model analysis shows that a permanent 1-gigawatt-hour increase in the annual electricity supply generated by renewable technologies creates 3.5 jobs in the long term [13].

4. Model and Estimation

This paper uses annual data for MENA member countries over the period 1995–2025, and the following model is proposed within the framework of the theoretical foundations and based on the study by Azarbergenova and colleagues [12]:

$$emp_{it} = \beta_i + \beta_1 rep_{it} + \beta_2 gdp_{it} + \beta_3 cap_{it} + \beta_4 w + \varepsilon_{it} \quad (1)$$

emp: employment
rep: renewable energy production
gdp: Per capita gross domestic product
*cap***:** gross fixed capital formation
w: wage.

In order for the coefficients of the above model to better capture, the variables in this study are included in the model in logarithmic form. Renewable energy production includes solar energy, biomass and waste energy, geothermal energy, hydropower, wind energy, and marine energy. The unit of primary renewable energy production is measured in ktoe (thousand tons of oil equivalent). These data are obtained from the Renewable Energy Agency database. Data on per capita gross domestic product, gross fixed capital formation, wages, and employment are extracted from the World Bank database. Total labor force is selected as the employment variable and is measured in terms of the number of persons. All variables are used in logarithmic form [14, 15].

To avoid estimating a spurious regression, the variables must be stationary. The Augmented Dickey–Fuller (ADF) unit root test is used to examine the stationarity of the variables. Based on the results reported in Table 1, all variables are stationary.

Table 1. Unit root test (ADF) results.

Variables	Statistic	Prob	Result
lemp	3.25	0.00	I(0)
Lw	4.15	0.00	I(0)
Lrep	3.28	0.02	I(0)
Lgdp	3.19	0.00	I(0)
Lcap	4.02	0.03	I(0)

The results of the F-Limer test for the models used in this study are reported in Table 2. The F-Limer test results indicate that, for the MENA countries model, the null hypothesis of pooled data is rejected, while the alternative hypothesis of panel data is accepted. Therefore, the model employed in this study is of the panel data type.

Table 2. F-Limer test.

Cross-section F	
Statistic	**Prob**
8.26	0.00
10.63	0.00

The results of the Hausman test for the models used in this study are reported in Table 3. The results of this test indicate that the fixed effects method should be employed.

Table 3. Hausman test.

Chi-Sq d.f	Prob
3.48	0.00

The results obtained from estimating the model for the MENA countries over the period 1995-2025, using the panel data method with fixed effects, are presented in Table 4.

Table 4. Estimation results.

Variable	Coefficient	t-static	Prob
C	10.53	6.35	0.00
Lrep	0.12	5.81	0.00
Lgdp	0.24	5.36	0.00
Lcap	0.17	4.66	0.00
Lw	-0.03	3.82	0.00

The estimation results of the model indicate that the impact of the variables renewable energy production, GDP per capita, and fixed capital formation on employment in the MENA group of countries is positive, while the impact of wages is negative. Specifically, a one percent change in renewable energy production leads to a 0.12 percent increase in employment. The GDP per capita variable has the greatest impact on employment in this model. If the fixed capital variable increases by one percent, employment will increase by 0.17 percent.

5. Conclusions

Energy, as one of the factors of production, plays an important role in the development and economic growth of countries. Given that macroeconomic indicators are also influenced by the development of renewable energies, this article examines the relationship between renewable energy production and the employment rate in MENA countries. The reason for selecting the group of MENA countries is their access to inexpensive fossil energy resources and the increasing adoption of renewable energy in recent years.

Countries around the world, due to greater access to renewable energy resources, their environmental benefits, and their lower cost compared to other fuels, have sought to expand the production of this type of energy. Investments made in the renewable energy sector, by creating positive effects such as increased domestic production, job creation, and reduced imports, lead to economic growth and development.

The results of this study indicate a positive effect of renewable energy production on employment in the group of MENA countries and are consistent with the findings of Naeimi and Varahrami [10], Hieu and Mai [11] and Azretbergenova and colleagues [12]. Based on the results obtained from estimating the research models, it can be stated that MENA countries should invest more in renewable energy technologies. In order to achieve desirable outcomes from the development of renewable energy, the use of fossil fuels should be reduced, and appropriate resources and infrastructure should be allocated to renewable energy production. To fully benefit from the advantages of renewable energy development, international cooperation, support programs, and joint projects among countries should be expanded.

From a labor market perspective, many MENA member countries face relatively high unemployment rates, particularly among youth and educated labor forces. This issue has further increased the importance of developing new economic sectors, including the renewable energy industry. Investment in this sector can play a significant role in increasing employment and reducing unemployment by creating direct and indirect job opportunities at various stages such as production, installation, operation, and maintenance.

Moreover, population growth and increasing urbanization in MENA countries have led to a rise in energy demand, reinforcing the necessity of transitioning toward sustainable and clean energy sources. In addition, environmental challenges such as climate change, rising temperatures, and water scarcity have further highlighted the need to reduce greenhouse gas emissions and expand renewable energy development in the region. Therefore, greater utilization of renewable energy resources can be considered a policy tool for improving economic conditions and achieving sustainable growth and development in these countries.

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Credit Authorship Contribution Statement

Vida Varahrami, supervision, project administration, manuscript writing and editing results.

Conflicts of Interest

Author declares that she does not have any personal or financial conflicts of interest.

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