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Analyzing the Role of Conventional Energy Sources in Economic Expansion within the Middle East

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ABSTRACT

The purpose of this study is to analyze the concept of "developed man" and determine the The Middle East is a crucial area for global energy dynamics, housing five major oil-producing nations: Saudi Arabia, Iraq, the United Arab Emirates, Iran, and Kuwait. Together ,these nations make up more than 40% of the world's oil exports as of 2022. Despite having vast fossil fuel resources, which contribute almost 95% of the electricity produced in the region, the Middle East confronts substantial challenges, including climate change and increasing domestic energy demands.This research investigates the correlation between the adoption of renewable energy and economic growth in countries within this region, emphasizing the urgency of shifting towards sustainable energy solutions to diversify economies in light of unpredictable fossil fuel markets. Analyzing panel data spanning from 1990 to 2022, the study employs Dynamic Ordinary Least Squares (DOLS) and Fully Modified Ordinary Least Squares (FMOLS) methodologies to evaluate these impacts.Findings reveal that while the consumption of non-renewable energy significantly influences GDP growth, its effect is much less pronounced than that of renewable energy. For instance, a 1% rise in gross fixed capital formation is associated with a 0.0328% increase in GDP. In comparison, greater trade openness and workforce expansion relate to GDP increases of 0.378% and 0.448%, respectively. Interestingly a 1% rise in fuel usage results in a 0.611% increase in GDP, while the effect of increased consumption of non-renewable energy is restrained to a slight 0.127% growth.This study highlights the critical need for Middle Eastern economies to prioritize investments in renewable energy to foster sustainable development and ensure environmental health. With the region's abundant solar energy potential, enhancing the role of renewable sources is essential to reduce CO2 emissions and strengthen economic stability amid changing global energy landscapes.

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1- Introduction and problem description

The environmental impacts of global warming and the rise in greenhouse gas emissions have heightened concerns regarding fossil fuel consumption. As a result, renewable energy sources have become a crucial element in the global energy landscape. A key advantage of renewable energy is its potential to significantly reducing carbon dioxide emissions and helping to protect the environment. While fossil fuels are theoretically renewable over extended time frames, they are at risk of depletion in the near future(Jeevanandam, & Danquah, 2022).

According to World Bioenergy Association(World Bioenergy Association,2022) fossil fuels plays a major role in the world's energy landscape, accounting for approximately 80 percent of all primary energy, including coal, crude oil, and natural gas. In 2020, renewable energy sources such as solar, wind, hydroelectricity, biomass and geothermal contributed about 15% to the primary energy mix, representing a modest increase of 0.9% compared to the prior year.

In 2019, as shown in Table 1, Asia's electricity generation was heavily reliant on coal, producing 7,434 terawatt-hours (TWh), which represented 75% of the world’s total coal-generated electricity. In contrast, both the Americas and Europe primarily depended in natural gas, 32% and 27%of their electricity generation, respectively. Europe boasted a significant proportion of renewables in its energy mix, with renewables making up 33.7% of its electricity, while the Americas followed closely behind with 32.5%. On a global scale, renewable energy production reached 7,311 TWh in 2019.

Table 1. Overall primary energy supply by continent in 2019
Source: World Bioenergy Association

	oal	il	as	uclear	Renewables	otal	Renewables(%)
frica	97	.28	.66	14	8	5.9	47%
mericas	3.9	1.7	47	0.7	2	40	14%
sia	25	3.7	99	.06	9	61	13%

Europe	16.2	1.6	0.7	12.5	13.6	115	12%
Oceania	1.81	2.09	0.6	0.00	0.75	6.25	12%
EU - 28	7.56	217	6.8	18.97	10.6	65.9	16%

Figure 1 shows the contribution of each of the mentioned fuels for each continent separately. In Asia, we have the highest amount of renewable energy potential, and therefore, focusing on the development of these energy sources is very important to improve energy consumption and utilization.

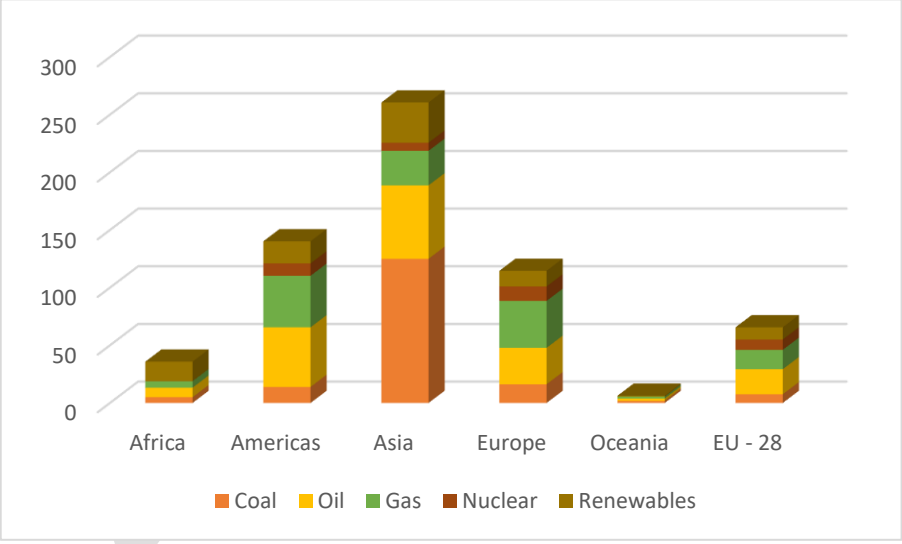


Figure 1. Overall primary energy supply by continent in the year 2019.
Source: World Bioenergy Association

The Middle East plays a vital role in the worldwide energy structure**,** hosting ۵ of the world's largest oil producers: Iran, Saudi Arabia, the United Arab Emirates, Iraq, and Kuwait. Additionally, the region ranks among the top contributors to natural gas production, with three countries in the top twenty globally. In 2022, more than 40% of the world's oil exports originated from the Middle East[1].

[1] International Energy Agency. (n.d.). Middle East. Retrieved December 21, 2024, from https://www.iea.org/regions/middle-east

However, countries in this region face considerable challenges linked to energy demands and climate change. As their economies develop and populations grow, there is an anticipated surge in domestic consumption of oil and gas. Moreover, the impacts of climate change, which include an increase in extreme weather conditions like heatwaves and droughts, are expected to escalate the need for cooling technologies and desalinated water. Currently, about 95% of electricity in the Middle East is produced from oil and natural gas, making it the highest dependence on fossil fuels globally, despite the region's significant solar energy potential.As the global shift towards clean energy diminishes dependency on fossil fuels, Middle Eastern economies reliant on oil production are encouraged to investigate alternative income sources. Consequently, several producers are actively developing strategies to establish low-carbon energy sectors, capitalizing on their existing energy knowledge to diversify their economic and energy portfolios.

Table 2 outlines the Total Energy Supply (TES) data for 2022 across various Middle Eastern nations, indicating that Iran leads in TES figures, while Yemen has the lowest in the region.

Table 2. Total primary energy availability across continents in 2022
Source: World Energy Balances

Rank	Country	Total
1	IRN[2]	12242084
2	SAU	10143218
3	ARE	3516204
4	IRQ	2604587
5	QAT	1856178
6	KWT	1754336

[2] **Note:** IRN: Iran , SAU: Saudi Arabia ,ARE: United Arab Emirates,IRQ: Iraq,QAT: Qatar,KWT: Kuwait,OMN: Oman,SYR: Syria,JOR: Jordan,LBN: Lebanon,YEM: Yemen

7	OMN	1161994
8	SYR	427463
9	JOR	355487
10	LBN	148511
11	YEM	110341

Taking into account unique geopolitical and economic context of Middle Eastern countries, the data on the supply of renewable and non-renewable fuels in2022 indicates that most of the energy supply is achieved from natural gas and oil, while the contribution of renewable fuels remains marginal.(As Figure 2 is shown).

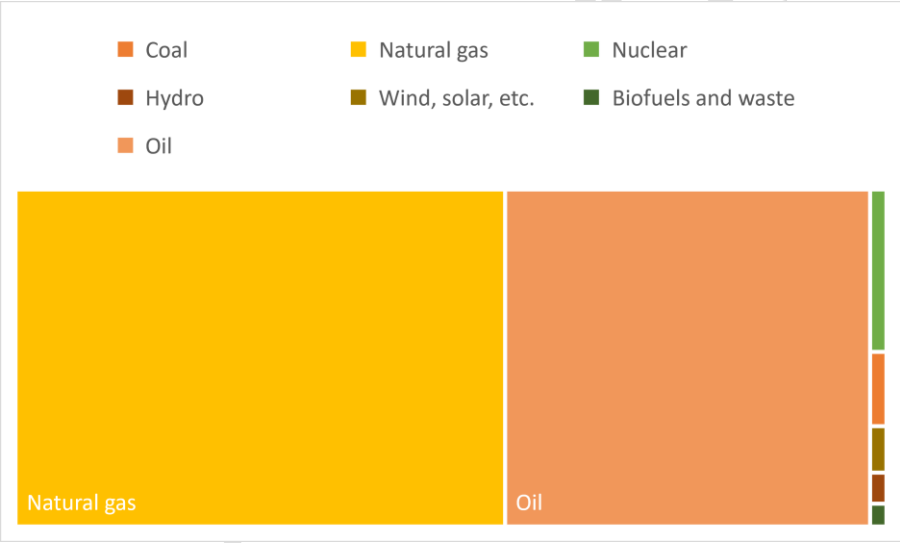


Figure 2. Total energy supply by source, Middle East, 2022
Source: International Energy Agency

A similar trend is evident in the energy consumption patterns of the countries in question. Figure3 illustrates the energy consumption of Middle Eastern nations since the year2000. A significant rise is observed in the use of petroleum and natural gas. Although the uptake of other gases shows a slow upward trend, the growth of petroleum and natural gas consumption greatly exceeds that of renewable alternatives, emphasizing their central position in the energy landscape. This difference highlights the much larger reliance on these non-renewable

resources when compared to sustainable energy options, which is the central theme of this research.

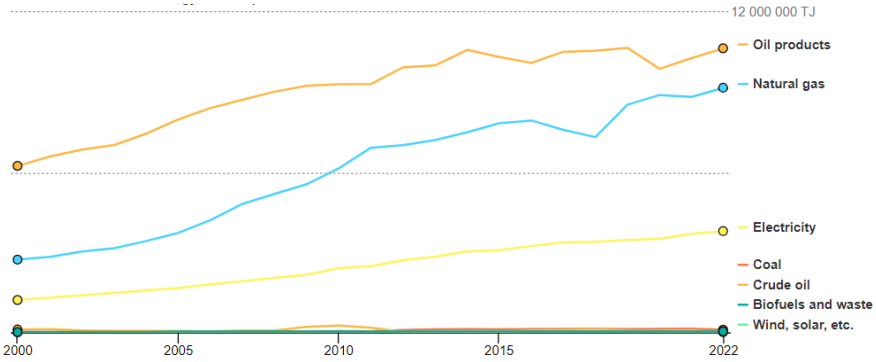


Figure 3. Evolution of total final energy consumption in Middle East since 2000
Source: International Energy Agency

renewable energy generation and usage 's significance is increasingly acknowledged as crucial not only for economic growth but also for achieving environmental sustainability. Within this context, the present study investigates the effects of renewable energy consumption on the economic development of Middle Eastern countries. This research aims to clarify the connection between economic progress and the use of sustainable energy alternatives, evaluating the extent to which embracing these energy alternatives promotes economic growth compared to fossil fuels, which are well-known for their significant CO2 emissions. Furthermore, the study examines the potential for enhancing the contribution of sustainable energy to supporting a sustainable ecological future. The analysis is based on panel data from 1990 to 2022 across different nations in the Middle East.

This article is structured into five key sections. The first section provides an introduction that emphasizes the significance of the topic

under exploration. The second section delves into the literature review, outlining previous studies and research conducted in this domain.

In the third section, the methodology is discussed, the models used, the data analysis and the results are presented and the subsequent interpretation is explained. The fourth section presents the conclusions drawn from the study, coupled with recommendations for future research and practical applications. Finally, the article concludes with a comprehensive list of references and sources consulted throughout the research process.

2- literature Interview

The relationship between renewable energy adoption and economic growth is a crucial area of study, with several key research contributions illuminating this interaction. For instance,

Further exploring this theme, Morteza Gorban Sarisht and Hamid Sephardoust examined the effects of economic growth and information and communication technology (ICT) on electricity consumption in Iran during the years 2005 to 2015. They tested Wagner's theory of income-expenditure, which posits that as per capita income increases, the public sector’s expenditure relative to economic infrastructure also increases. Their study employed an Autoregressive Distributed Lag (ARDL) approach to demonstrate long-term relationships, an Error Correction Model (ECM) for short-term dynamics, and Granger causality tests to establish causal relationships. The results indicated that both long-term economic growth and ICT significantly stimulate electricity consumption in Iran, with specific values indicating that a 1% increase in economic growth and ICT results in a 1.87% and 1.27% increase in electricity consumption, respectively. Additionally, the error correction coefficient revealed that 3.8% of the imbalance in per capita electricity consumption is corrected towards its long-term trend in each period, thereby supporting Wagner's theory and suggesting a clear relationship between income growth and the demand for public goods like affordable energy.

The study by Morteza Gorban Sarisht and Hamid Sephardoust investigates the effects of economic growth and information and communication technology (ICT) on electricity consumption in Iran from 2005 to 2015, testing Wagner's theory of income-expenditure. Wagner's theory posits that as per capita income increases, the relative size of public sector expenditure rises to support economic infrastructure. The researchers utilized an Autoregressive Distributed Lag (ARDL) approach to demonstrate long-term relationships, Error Correction Model (ECM) for short-term relationships, and Granger causality tests to establish cause-and-effect relations. The findings indicate that long-term economic growth and ICT both stimulate electricity consumption in Iran. Specifically, a 1% increase in economic growth and ICT leads to a 1.87% and 1.27% increase in electricity consumption, respectively. Furthermore, the error correction coefficient suggests that 3.8% of the imbalance in per capita electricity consumption is corrected toward its long-term trend in each period. The results support Wagner's theory, indicating a relationship between income growth and increased demand for public goods such as affordable energy.

The literature on renewable energy, particularly in the context of developing countries like Iran, emphasizes the multifaceted benefits of transitioning to sustainable energy sources. Zare and Sabzevari (2019) highlight how renewable energy can drive economic growth, enhance energy security, and mitigate environmental challenges. The theoretical framework surrounding this issue often draws upon principles of sustainable development, where the use of renewable resources aligns with the goals of reducing carbon emissions and fostering economic resilience. In the case of Iran, significant attention has been directed towards assessing the country’s vast potential for solar, wind, and hydropower, as noted by Zare and Sabzevari (2019), which could play a crucial role in diversifying its energy portfolio and stimulating rural development. The narratives within this body of research suggest that investment in renewable energy not only addresses immediate energy demands but also promotes job creation

and improves living standards in underserved regions. Overall, the combination of theoretical insights and empirical data, as discussed by Zare and Sabzevari (2019), underscores the critical role of renewable energy in achieving comprehensive economic and social development, particularly in areas that have been historically marginalized.

The theoretical framework and literature surrounding the relationship between renewable energy utilization and economic growth have garnered significant attention in recent years. In their 2021 study, Nasiri, Mohammadi, and Farzanegan explore this interplay within the context of Iran, highlighting how a strategic shift towards renewable energy sources can substantially enhance the country's GDP. Their findings contribute to the broader discourse on sustainable development, suggesting that investment in renewable energy not only addresses environmental concerns but also acts as a catalyst for economic advancement. This alignment of ecological sustainability with economic performance underscores the importance of integrating renewable energy into national development strategies, particularly for countries like Iran, which possess untapped renewable resources.

In this study, we review the theoretical foundations and literature surrounding the relationship between renewable energy utilization and economic development, with a focus on South Africa. Recent research, including Odhiambo (2016), underscores the positive correlation between increased adoption of renewable energy sources and economic growth. The analytical framework employed in this study combines econometric models to assess the impact of renewable energy policies on a diversified energy portfolio. By analyzing various economic indicators, we aim to provide an in-depth understanding of how strategic investments in renewable energy can drive sustainable economic progress, highlighting the necessity for targeted policy interventions to foster a resilient energy sector.

In a study by Kumar and Singh (2019), The study explores the intricate relationship between energy consumption, economic growth, and carbon emissions, establishing a theoretical basis that emphasizes the role of energy as a critical input for economic activities. It highlights that energy consumption is a prime determinant of carbon emissions, particularly in the context of industrial activities that rely heavily on fossil fuels, which negatively impact the environment . The

research employs various models to analyze these relationships, including the Artificial Neural Network (ANN), which is utilized to explain the dependency of carbon emissions on energy consumption and GDP . Additionally, the study incorporates the STIRPAT model and causality tests to examine the influence of different factors on carbon emissions, providing a comprehensive view of the dynamics at play . The findings indicate that while renewable energy adoption can help mitigate emissions in developed countries, developing nations may not experience the same benefits, underscoring the need for tailored approaches in energy policy . The Granger causality tests further confirm the existence of both short and long-run associations among economic growth, energy consumption, and carbon emissions, suggesting a bidirectional causality that emphasizes the complexity of these interactions . Overall, the study contributes to the literature by demonstrating that the transition from fossil fuels to clean energy sources is essential for achieving sustainable economic growth while addressing environmental concerns .

Research reveals a meaningful relationship between the utilization of renewable energy and economic advancement in diverse areas. It highlights the critical role of effective policy frameworks and investment approaches that can support the shift toward renewable energy sources, thereby bolstering both economic progress and environmental sustainability.

A number of recent investigations have focused on the connection between the use of renewable energy and economic development through the application of panel methods, for example Xie, P., Zhu, Z., Hu, G., & Huang, J. (2023). In recent years, the trend toward environmental sustainability has accelerated through the adoption of renewable energy resources. A key question, however, is whether the consumption of renewable energy contributes to economic growth. This study investigates the renewable energy-led economic growth hypothesis in the Next-11 economies from 1990 to 2020. It also examines the impact of industry value added, gross national

expenditure, and trade openness on the economic growth of these nations. Utilizing a second-generation panel unit root test and a non-parametric panel data approach, specifically the quantile method of moments regression, the findings indicate heterogeneous slope coefficients and cross-sectional dependency within the panel. The non-parametric analysis supports the validity of the renewable energy-led growth hypothesis. Additionally, industry value added, gross national expenditure, and trade openness are shown to positively influence the economic growth of these economies. Results from the panel causality test indicate a bidirectional causal relationship among the variables. The study concludes with policy implications for policymakers and researchers.

The article "Sustainable economic growth via human capital and cleaner energy: evidence from non-parametric panel methods" is authored by Boya Sun, and et al.This study explores the intricate relationship between natural resource volatility (NRV) and economic performance (EP) in the context of the G-7 countries from 1990 to 2020. It highlights the significant negative impact of NRV on EP, supporting the resource curse hypothesis, which suggests that countries rich in natural resources may experience slower economic growth due to volatility and mismanagement . The authors also emphasize the importance of human capital investment (HCI) and technological innovation (TI) as critical factors influencing economic performance, indicating that enhancing education and fostering innovation can mitigate the adverse effects of NRV .Moreover, the study discusses the role of cleaner energy investments in promoting sustainable economic growth, although it notes that their impact may be insignificant in higher quantiles of economic performance . The methodological approach employed in the research, utilizing non-parametric panel quantile methods, allows for a nuanced analysis of the relationships between these variables across different contexts, enhancing the rigor of the findings .In summary, the authors provide valuable insights into how effective management of natural resources, alongside investments in human capital and technology, can lead to sustainable economic growth, particularly in developed economies.

The article "Renewable Energy Consumption and Economic Growth: Evidence from a Panel of OECD Countries" by Apergis and

Payne (2016) investigates the relationship between renewable energy consumption and economic growth in developed nations. The study finds a positive correlation, suggesting that renewable energy is not only a sustainable resource but also a key driver of economic development and job creation.Grounded in theories of sustainable development, the research highlights the necessity of achieving economic growth without harming the environment. The authors emphasize that utilizing renewable energy can reduce environmental impacts while facilitating economic progress.Additionally, the article discusses the critical role of government policies in promoting renewable energy. By providing incentives and supporting investments in renewable projects, governments can foster new markets and boost production capacities.Overall, the study underscores the importance of integrating renewable energy consumption into economic models to support sustainable growth and improve quality of life.

In the context of the theoretical framework for the study of the impact of renewable energy consumption on social development, it is crucial to integrate various models that elucidate the relationship between energy usage, economic indicators, and social outcomes. The research of Khajasteh Rahimi, K., Faraji Dizaji, S., & Asari Arani, A. (2018) draws on the Sustainable Development Goals (SDGs) and the Human Development Index (HDI) as foundational frameworks. It posits that while renewable energy consumption can reduce environmental degradation, it also plays a significant role in shaping socio-economic dynamics. The study utilizes an econometric model to analyze data from OECD countries, focusing on how increased investments in renewable energy influence government spending on education and healthcare, thereby affecting social development parameters such as life expectancy and inequality. By addressing both the positive and negative impacts of renewable energy, this framework aims to provide a comprehensive understanding of its role in fostering social progress.

Qinghua Fu,& et al. (2021) explore the relationship between economic development and CO2 emissions. They employed panel

spatial SEM and GS2SLS methodologies to analyze EU countries, concluding that there is a positive correlation between economic growth and CO2 emissions. Importantly, the study also highlights that the use of renewable energy sources can significantly reduce overall CO2 emissions, emphasizing the need for a transition towards cleaner energy to mitigate environmental degradation. This source is particularly relevant as it provides empirical evidence supporting the argument that renewable energy can play a crucial role in achieving sustainable economic growth while addressing environmental concerns .Additionally, the research by Fang (2021) is noteworthy, as it utilized a regression-based model to ascertain the impact of renewable energy on China's GDP growth. Fang found that a 1% increase in renewable energy consumption led to a 0.162% growth in GDP, indicating a positive relationship between renewable energy usage and economic performance. This study contributes to the understanding of how renewable energy can serve as a catalyst for economic growth, particularly in developing countries like those in the BRICS group .These sources collectively underscore the importance of integrating renewable energy into economic strategies to foster growth while minimizing environmental impacts.

Together, these investigations deepen our insight into the connection between renewable energy usage and economic development as examined through panel data methods. They consistently show that a rise in renewable energy consumption tends to correlate with economic growth across various nations and situations. This underscores the vital role of energy strategies and investments in sustainable energy initiatives.

3- Information, approach, and practical findings

The sample course of this study spans from 1990 to 2022 , utilizing annual data from 11 countries in the Middle East including: namely Iran, Saudi Arabia, United Arab Emirates, Iraq, Qatar , Kuwait, Oman, Syria, Jordan, Lebanon, Yemen.To construct a GDP growth model for these nations, four primary variables are incorporated based on

Sadorsky's GDP growth framework[3]. The key determinants selected are openness to trade, the overall workforce, and investment in fixed capital. Additionally, the analysis includes energy consumption (EC) to assess its influence on GDP growth in these nations.

In this study, the dependent variable is the Gross Domestic Product (GDP)[4]. This analysis employs four independent variables: gross fixed capital formation (GFC)[5] ,aggregate trade in goods an, services (TD)[6]; total labor force (L)[7]; and energy consumption (EC), which has been differentiated into two distinct segments.: non-renewable (NREC) and renewable energy consumption(REC)[8].

GDP, TD, GFC, L ,NREC and REC are sourced from World Bank and our world in data. A panel model is adopted for this research due to its numerous advantages, including the ability to manage serial correlation and account for individual heterogeneity. This approach enhances the degrees of freedom and offers greater reliability and efficiency compared to traditional individual time series analyses. The following outlines the model for GDP growth:

(1)
$$GDP_{it} = f(GFC_{it}, L_{it}, TD_{it}, REC_{it}, NREC_{it})$$

Each variable is represented in its natural logarithmic form. Additionally, an error term is incorporated into the GDP growth model. The model can be expressed as follows:

(2)
$$GDP_{it} = \beta_{1i} GFC_{it} + \beta_{2i} L_{it} + \beta_{3i} TD_{it} + \beta_{4i} REC_{it} + \beta_{5i} NREC_{it} + \varepsilon_{it}$$

[3] Sadorsky, P.(2012).

[4] expressed in millions of 2015 dollars

[5] quantified in millions of 2015 dollar

[6] which signifies trade openness, measured in constant 2015 US dollars

[7] measured across thousands of workers

[8] involving fossil fuel comprises coal, oil, petroleum, and natural gas products

The coefficients for the slope are represented by the variables β_{1i}, β_{2i}, β_{3i}, β_{4i}, and β_{5i} while the index *i* denotes the cross-section of 11 Middle Eastern countries, and t*t* indicates the time period from 1990 to 2021. The error term is represented by ϵ.

In the initial stage of the analysis, we will evaluate the stationarity of the variables by employing two unit root tests: the FADF [9]test and the Fisher-PP test[10]. These methods utilize a combination of individual assessments of unit roots to generate panel results. Both the PP and ADF tests operate under a framework characterized by specified null and alternative hypotheses.

The analysis suggests the presence of panel unit root among the analyzed factors, indicating their non-stationarity. In contrast, an alternative examination reveals that these variables are stationary, thus rejecting the existence of a panel unit root. Generally, panel unit root tests have become increasingly favored among researchers due to their enhanced power in comparison to traditional time series unit root tests.

Table 3 provides a detailed summary of the consequence from the unit root tests. It is noted that all factors fail to exhibit significance in their level forms, leading to the conclusion that the null hypothesis indicating the existence of a panel unit root cannot be dismissed. Conversely, when the first difference of the variables is considered, they demonstrate statistical significance, which allows for rejecting the null hypothesis concerning the unit root. Consequently, it should be concluded that these variables attain stationarity after first differencing.

Table 3. Results of the unit root tests
Source: Research findings

Panel I: ADF-Fisher Chi-square				
	Level		First difference	
Variables	Intercept	Intercept and trend	Intercept	Intercept and trend
GDP	11.53	18.75	95.13***[11]	73.08***
L	6.38	24.32	57.75***	41.24***

[9] Fisher-Augmented Dickey-Fuller (Fisher-ADF)

[10] Fisher-Phillips-Perron

[11] **Note**:Unit root tests were executed incorporating trends and intercepts for every variable. The optimal lag length for the analysis was determined automatically utilizing the Schwarz Information Criterion (SIC).

***Indicates statistical significance at the 1% levels ; * Indicates statistical significance at the 10% levels

TD	14.12	19.81	58.10***	45.28***
GFC	7.16	11.5	87.15***	66.92***
REC	40.72*	60.29*	75.89***	96.73***
NREC	35.84	42.58	87.73***	74.99***
Panel II: PP-Fisher Chi-square				
	Level		First difference	
Variables	Intercept	Intercept and trend	Intercept	Intercept and trend
GDP				
L	3.45	6.52	56.98***	39.76***
TD	13.85	6.53	103.08***	89.93***
GFC	17.55	59.22	120.11***	343.32***
REC	16.12	15.02	397.01***	123.88***
NREC	22.66	15.67	160.54***	152.098***

In this study, the cointegration test is employed due to finding that all variables are stationary at their first differences. The Pedroni cointegration test(Pedroni, 1999,2004) is specifically examine the long-run relationships among the factors under consideration. Pedroni introduces a variety of cointegration tests that account for the presence of heterogeneous intercepts and trend coefficients in different time periods. This analysis is grounded in the following regression:

$$y_{it} = \alpha_i + \delta_{it} + \beta_1 x_{1,it} + \beta_2 x_{2,it} + ... + \beta_k x_{k,it} + \varepsilon_{it} \quad (3)$$

Let t=1,…,T; i=1,…,N; where both y and x are assumed that they are integrated from the first order, denoted as I(1). α_i and δ_{it} represent individual entity effects and time effects, respectively, and may be constrained to zero if necessary. Based on the null hypothesis of non-collinearity, the residuals ε_{it} are also I(1). Pedroni formulates a variety of statistics to test the null hypothesis of non-collinearity, including the panel υ-statistic, panel ρ-statistic, panel ADF-statistic, panel PP-statistic, group ρ-statistic, group PP-statistic, and group ADF-statistic. The initial four statistics are classified as within-dimension or panel statistics, whereas the subsequent tests are identified as between-dimension statistics.

The DOLS methodology, as recommended by Pedroni(Pedroni, 2004), entails augmenting the cointegration regression by incorporating both lags and leads of ΔX_{it}. This method ensures that the error term of the

resulting cointegration equation is orthogonal to the comprehensive history of random innovations in the regressions.

$$y_{it} = X'_{it}\beta + D'_{1it}\gamma_1 + \sum_{j=-q}^{r} \Delta X_{it+j}\delta + \nu_{1it} \quad (4)$$

By including multiple lags(q) and leads (r) of the different predictors, we can successfully remove long-term correlations between the error terms. To investigate the enduring cointegration relationship between the response and explanatory variables, an analysis will be conducted utilizing combined panel data, applying the pooled FMOLS(PFMOLS) method. This approach, introduced by Phillips and Moon(Phillips& Moon,1999), is particularly adept at mitigating issues of spurious regression that may arise from the inclusion of I(1) variables, which could otherwise lead to misleading inferences. The formulation of the PFMOLS estimator is articulated as follows:

$$\tilde{\boldsymbol{\beta}}_{\boldsymbol{PFM}} = (\sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{\boldsymbol{Y}}_{\boldsymbol{it}}\tilde{\boldsymbol{X}}_{\boldsymbol{it}}{}' - \boldsymbol{nT}\tilde{\boldsymbol{\Lambda}}_{\boldsymbol{ex}}^{+})(\sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{\boldsymbol{X}}_{\boldsymbol{it}}\tilde{\boldsymbol{X}}_{\boldsymbol{it}}{}')^{-1} \quad (5)$$

In this context, $\tilde{Y}_{it}$ and $\tilde{X}_{it}$ denote the corresponding datasets that have had their individual deterministic trends removed, while $\tilde{\Lambda}$ signifies the regressors of cointegration. It is crucial to acknowledge that the PFMOLS operates by separately summing across cross-sections in both the numerator and the denominator.

3-1- *Interpretation of Results*

Table 4 presents the results of the Pedroni cointegration test, indicating that four of the statistics attained statistical significance. As a result, we reject the null hypothesis of no cointegration. Furthermore, the findings suggest that GDP growth, CFG, TD, the L, NREC and REC are cointegrated.

Table 4. The findings derived from Pedroni's cointegration tests
Source: Research results

Test	Statistics	P-values
panel υ -statistic	-1.544	.2407
panel ρ -statistic	-.660	.176
panel PP-statistic	-2.872	.0020[***12]
panel ADF-statistic	-1.187	.0304[**]

[12] **Note:**[***] Indicates statistical significance at the 1% levels ; [**] Indicates statistical significance at the 5% levels

Test	Statistics	P-values
Group ρ -statistic	2.170	.379
Group PP-statistic	-1.992	.002***
Group ADF-statistic	-1.408	.0495**

The statistical results show that they are significant at the 1% and 5% levels and indicate that there is a stable relationship between the explanatory variables.

This study employs panel data methodology for its analysis, allowing for policy implications to be derived from the panel results. The findings indicate that GFC, TD, L, NREC and EC exert a positive long-term impact on GDP growth in studied countries.

Table ۵ presents findings from the DOLS and FMOLS test.

Table 5. The findings from the Panel group mean DOLS and FMOLS analyses.
Source: Research results

Dependent variable: GDP	DOLS	FMOLS
GFC	.0328*(33.082)[13]	.128***(2.751)
TD	.376**(59.08)	.429***(3.904)
L	.448** (42.243)	.483***(2.751)
NREC	.611***(45.149)	.866***(3.042)
REC	.0821** (20.573)	.127**(2.345)

Table 5 presents the results of DOLS and FMOLS analyses, with GDP as the dependent variable. The table includes estimates for various independent variables, along with their respective t-statistics in parentheses.

For DOLS Model, a 1% rise in GFC correlates with a 0.0328% rise in GDP growth. This suggests that an increase in GFC is associated with a substantial increase in GDP. Similarly, a 1% increase TD and L

[13] **Note:**[***] Indicates statistical significance at the 1% levels ; [**] Indicates statistical significance at the 5% levels ; [*] Indicates statistical significance at the 10% levels

are associated with a significant GDP growth increase of 0.378% and .448%, respectively. Notably, the results derived from the DOLS approach highlight that non-renewable energy consumption plays a critical role in enhancing GDP growth, with a 1% rise in natural gas consumption leading to a 0.611% increase in GDP across the studied countries. However, the contribution of energy consumption to economic growth, when compared to fossil fuels, is notably minimal. Specifically, a 1% increase in the REC results in a mere 0.0۸۲% enhancement in economic growth.

Moreover, the results derived from the FMOLS analysis indicate that GFC, TD, , L , REC and NREC significantly enhance GDP growth in the studied countries. Specifically, a 1% increase in GFC corresponds to an uplift of .128% in GDP growth, while TD and L contribute increases of .429% and .483%,respectively. The NREC results in a rise of 0.866%. However, the effect of REC on economic growth is notably minimal. Research indicates that a 1% rise in NREC leads to only a modest increase of 0.127% in economic growth, underscoring its relatively minor influence when compared to fossil fuels.

4- Conclusion and Recommendation

The analysis highlights both the immense potential and the inherent challenges associated with the transition to a renewable energy-dominated future in the Middle East. While the region possesses abundant renewable resources, overcoming the inertia of fossil fuel dependence and addressing the complexities of integrating variable renewable energy sources into the grid will be crucial for realizing the full potential of this transition.Renewable energy is driving economic growth in the Middle East more than fossil fuels. Despite the region's vast fossil fuel reserves, renewable energy sources contribute significantly more to economic development. This highlights the importance of investing in renewable energy to secure future economic growth and sustainability.

Renewable energy can significantly contribute to economic diversification and reduce dependency on oil and gas. The renewable

energy sector presents new employment opportunities. As countries invest in the construction of solar farms, wind turbines, and other renewable energy infrastructures, numerous jobs will emerge in technical, engineering, and management fields. Utilizing renewable energy sources contributes to lower greenhouse gas emissions and mitigates environmental challenges. With the ongoing climate crisis, shifting to cleaner energy can lead to improved air quality and a reduction in harmful pollution levels. This is particularly important for Middle Eastern countries, many of which face severe environmental degradation as a result of fossil fuel extraction and consumption. By investing in renewable energy and advancing relevant technologies, Middle Eastern countries can decrease their energy production costs over time. As renewable technologies like solar panels and wind turbines become more affordable and efficient, they provide a competitive alternative to traditional fossil fuels. This shift can lead to greater energy independence and economic stability.

The analysis of DOLS and FMOLS models, with GDP as the dependent variable, reveals a significant positive correlation between both renewable and non-renewable energy consumption and economic growth. However, the results indicate that the impact of non-renewable energy consumption on GDP growth is more pronounced in the context of the specific models and data used. While renewable energy consumption also contributes positively to economic growth, its effect is relatively smaller in this particular analysis. These findings suggest that, based on the data and models employed, non-renewable energy sources have had a more substantial influence on economic growth in the regions or countries under examination. It's important to note that these results are subject to limitations related to data quality, model specifications, and the specific context of the analysis. Further research is needed to fully understand the complex relationship between renewable and non-renewable energy consumption and economic growth, particularly as the global energy landscape continues to evolve

The Middle East possesses significant potential for renewable energy consumption, necessitating a strategic shift in energy policy. While fossil fuels have historically driven economic growth, the region must prioritize a gradual transition towards a more sustainable energy mix. Diversifying energy investments beyond non-renewable sources is crucial. Investing in renewable energy projects not only aligns with environmental sustainability goals but also presents a unique opportunity for economic diversification, job creation, and long-term economic growth. Enhancing energy efficiency across all sectors is paramount to reduce reliance on non-renewable resources while maintaining economic progress. Furthermore, investing in research and development of both renewable and non-renewable energy technologies is essential to unlock innovative solutions that enhance energy efficiency, minimize environmental impact, and maximize economic benefits.

Establishing a supportive policy framework and providing regulatory support are essential to stimulate growth. A robust legal structure that incentivizes investments in both renewable and non-renewable sectors will attract both domestic and foreign investment.

Finally, increasing public awareness and education about the benefits of renewable energy and energy conservation can shift consumer behavior. This cultural change will encourage the adoption of greener energy choices and reduce reliance on non-renewable resources, paving the way for a more sustainable future.

While the ongoing dependence on non-renewable energy sources is economically beneficial for Middle Eastern countries, a strategic shift towards a more balanced and sustainable energy approach is vital for long-term economic growth and environmental sustainability. By implementing these recommendations, countries in the region can not only bolster their economies but also ensure a more sustainable future.

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