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How Does a Digital Government Impact Energy Transition in Gulf Economies?

Jihen Bousrih[1]

Abstract

In the global economy, the oil and gas sector has been crucial. It supplies the energy needed for global production, transportation, and heating systems. Natural gas and crude oil have been essential for advancing economic development. However, there are financial and environmental costs associated with our reliance on fossil fuels. The transition towards a sustainable environment with low-carbon energy makes clean energy solutions more and more popular among businesses, consumers, and nations. It reduces dependence on gas and oil and diversifies energy portfolios. This paper applies a panel approach to Gulf Cooperation Council countries from 2005 to 2022 to investigate the effect of digitalizing government on the energy transition process in the Middle East. On the one hand, the results show that online services, human development, and infrastructure have a positive and significant impact on renewable energies for the GCC countries. On the other hand, the findings focus on the importance of a digital government in resource management.

Keywords: *Energy Transition, Sustainability, GCC countries, E-government Development Index, Renewable energy, Panel Approach.*

Introduction

Sustainable development is the highest priority for the United Nations and the international community. Sustainable development is defined as social and economic advancement that respects planetary boundaries, preventing irreversible environmental effects, and intergenerational equity. The current development shouldn't compromise the prospects of future generations. In this context, three challenges have emerged as critical: pollution, the use of fossil fuels and its impact on climate change, and the exploitation of natural resources. Failure in these three areas will have a high price to pay in terms of sustainability and the planet Earth's long-term health.

A thorough examination of the impact of the digital economy's rapid expansion on equitable and sustainable development may be found in recent editions of the Digital Economy Report (2024)[2]. The growing importance of new digital technologies and digital data was specifically discussed. The findings emphasized the rapid acceleration of digitalization, which has resulted in a constantly evolving digital economy with significant environmental and digital implications. To ensure equitable and sustainable development outcomes, it is imperative to bridge these gaps and build balanced frameworks for global governance of data and digital platforms. The rapid evolution of digitalization has presented both new environmental challenges and opportunities, including constraints to sustainability. Policy discussions are beginning to pay more attention to the relationship between digitalization and environmental sustainability in all its dimensions to maximize the potential benefits of digitalization while minimizing environmental harm and promoting sustainability.

The GCC's governments have created ambitious plans and strategies in response to the recognition of the potential social and economic advantages of digital transformation. Vision 2030 in Saudi Arabia, Smart Dubai, Qatar's Connect Vision 2030 ICT Policy, and Oman's digital strategy (e-Oman) are a few examples. The UAE Ministry of Economy's Global Manufacturing and Industrialization Summit is proof of several sectors' perceptions of the significance of digital technology. As a means of promoting economic diversity

[1] Department of Economics, College of Business and Administration, Princess Nourah bint Abdulrahman University, P.O. Box 84428, Riyadh 11671, Saudi Arabia, Email: jsbousrih@pnu.edu.sa, (Corresponding Author)

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and growth, the GCC nations aggressively adopt cloud computing, big data analytics, artificial intelligence (AI), and the Internet of Things (3T). Smart city initiatives and e-government platforms are among the digital agenda items that each country has set forth. But technological advancements alone won't be enough; knowledge, expertise, and affordable solutions are all needed for a successful transition, Westerman (2014). Organizational culture, leadership, and the capacity to adjust to shifting digital environments are all included in the concept of digital transformation, Omol (2023). To stay competitive, adaptable to market changes, and customer-focused, it reflects a comprehensive and calculated strategy for employing digital capabilities. It highlights the necessity for businesses to prioritize innovation-driven culture and promote agility and adaptability to successfully manage the challenges presented by the digital age. Laursen (2016).

Significant challenges have been faced by oil industries globally because of the COVID-19 outbreak and an unexpected drop in oil prices. But the GCC's notoriety for the energy and electricity sectors might make it tough to think of a moment in the future when the region isn't supplying the world with oil. But as sustainability and digitalization acquire greater recognition and more nations commit to becoming net-zero and reducing their dependency on fossil fuels, the GCC needs to look at alternative options to ensure that their economies can prosper even without their profitable hydrocarbon industry. Nonetheless, oil will continue to play a significant role in the energy mix for the time being, despite the current energy transition process. The GCC's low production costs put national oil companies in a favorable position. To maintain their competitive edge, increase productivity, and be resistant to changes in the market and prices, they must also change the way they do business. From this perspective, digital transformation is crucial.

The United Nations E-Government Survey reports can be used to track the worldwide progress of digital transformation in governance. Since 2001, the United Nations Department of Economics and Social Policy has conducted surveys to assess the state of e-government service development in each of the 193 member nations. The report provides data that countries can use to evaluate the advantages and disadvantages of their e-government and, in turn, develop relevant regulations and strategies to digitalize their governments.

E-government, also known as digital government or electronic governance, is a term commonly used to describe how to improve government efficiency and the supply of services to individuals around the world. The use of information and communication technology (ICT) in the public sector to improve transparency, simplify administrative processes, and encourage citizen participation in governance is known as e-government. In the last few decades, several countries have experienced a significant digital shift, with varying degrees of severity and manifestations. The E-Government Development Index (EGDI) is a crucial metric for assessing a nation's readiness and efficiency in executing e-government projects to improve the digitalization status of each country. Programs for e-government have been implemented throughout the Middle East region, which includes Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE), Meniado (2021). These nations have made significant investments in ICT infrastructure and e-government programs to support economic diversification, improve public services, encourage innovation, and foster energy transition by 20240. They are well-known for their strong economic growth and ambitious objectives. There is still a scarcity of research on the impact of digital government on several sectors in the Middle East region. Therefore, this paper represents an innovative investigation of the impact of digitalization, through the EGDI, on the energy sector to ensure an efficient transition toward more sustainable development.

For oil exporter countries like the Gulf Cooperation Council (GCC), the energy transition necessitates anticipating and planning future developments. With nearly one-fifth of the world's oil supply produced by its members, the GCC region is home to the highest concentration of oil exporters. Oil continues to be essential for the GDP. Furthermore, even though the importance of non-oil industries has grown in recent years, many of them are dependent on the oil demand, whether it is through public or private spending of oil income or wealth gained from it. This dependence was sharply brought home by the oil price shock of 2014–2015, which significantly reduced non-oil growth throughout the region. Several studies, including Alqublan (2024), Asem et al. (2024), Saeed et al. (2023), and Khan et al. (2017), looked at how digitalization might change the GCC countries' reliance on energy and their options for switching to clean energy sources. This is because this is an important area and technologies are changing quickly.

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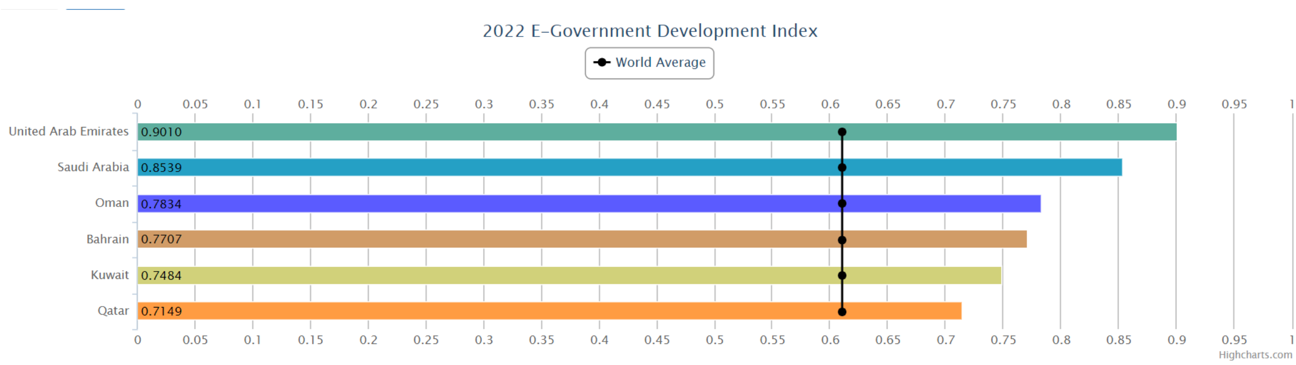
Three key factors make the deployment of renewable energy potentially advantageous in the case of high oil prices for GCC countries. In these economies, where fossil fuels are the main source of electricity, rising oil prices first drive up the cost of electricity. Renewable energy sources are more competitive for producing power when electricity rates are high. Second, the large budget surplus that governments receive from high oil prices provides plenty of money to support R&D and renewable energy initiatives. Finally, producer economies are more inclined to sell oil rather than utilize it internally when prices are high, as this raises the opportunity cost of oil. To replace the fossil fuels burned domestically, renewable energy is vital.

Figure 1 below shows the ranking of GCC countries according to the EGDI index for 2022. The E-Government Development Index evaluates a nation's digital development practices, like its infrastructure and level of education, to show how it uses information technologies to support its citizens' inclusion and accessibility. Three essential components of e-government are measured by the EGDI, which is a composite of three factors: human capacity (HCI), telecommunication connectivity (TII), and online service availability (OSI). The Cooperation Council for the Arab States of the Gulf (GCC) has similar e-government developments. Four of the six GCC nations are in the extremely high EGDI group; the top three are Saudi Arabia, Oman, and the United Arab Emirates. Within the high EGDI group, Kuwait and Qatar have the highest rating class. These countries all have extremely advanced telecommunications infrastructure, with an average TII of 0.8246. Additionally, most of them have relatively high OSI and HCI values; nevertheless, increasing investment in the supply of online services could enable Kuwait and Qatar to move up into the very high EGDI group. Bahrain would probably benefit from more infrastructure investment, and Qatar should consider making greater investments in human capital development.

Figure 1: E-Government Development Index (EGDI) For GCC Countries In 2022



Source: E-Government Survey, United Nations Website (2024)

In addition to the research on digitalization and energy transition, the current research includes three recommendations. Firstly, we believe that this paper examines the possible impact of digitalization on the shift to renewable energy for GCC countries. This serves as a helpful framework for GCC governments as they develop energy-related policies from a new digital economy perspective. This research not only evaluates the immediate effects of digitalization on the energy transition, but also explores the possible involvement of digital governance in this relationship. Third, this paper holds significant practical implications for GCC governments looking to widen the digital government's development pathways and accelerate the energy transition.

The rest of our paper is organized as follows. The review of the literature is in Section 2. While Sections 4 and 5 discuss the empirical findings, Section 3 presents the methodology and data. The study is concluded in Section 6.

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Literature Review

Danish et al. (2020) and Palvia et al. (2018) have extensively discussed the importance of digitalization in ecology. Berkhout (2001) states that technologies may have one of three possible consequences on the environment: first-order effects, second-order effects, or third-order effects. The negative effects of digitalization on the environment are thought to be the first-order or direct consequences. For instance, CO2 emissions rise when technologies are widely used, Alatas (2021). These negative consequences are mostly linked to the many phases of the life cycle of digital goods, which include the creation, application, and eventual disposal of these technologies. The need for energy will grow during these phases, and so will the gas emissions that cause pollution. The positive environmental benefits of digitalization represent the second-order or indirect effects. Adopting digitalization can lower greenhouse gas emissions, according to numerous research studies, including those by references Sahoo et al. (2023) and Tsimisaraka (2023). The benefits of digitalization for the environment could be explained by a few different factors. Using videoconferences and online communication, for example, may reduce the need for travel and the associated greenhouse gas emissions. Systemic effects, also known as rebound effects, are third-order effects. Gains in energy efficiency may, in theory, result in lower energy-related expenses and higher total energy consumption, according to Greening (2000). Stated differently, growth in the demand for digital information storage could offset the environmental benefits of enhanced energy efficiency (second-order effects).

At the same time, digitalization affects energy consumption in a variety of ways. Energy consumption decreases because of industry developments brought about by digitization and the expansion of ICT services, which enhance energy efficiency. Conversely, ICT production, usage, and disposal along with rising productivity, are likely to drive up energy consumption, Ike (2020). While the growth of the digital economy lowers carbon emissions intensity dramatically, it also raises carbon emissions per person. The findings are supported by studies conducted by Feng et al. (2022), Adha et al. (2022), and Wang et al. (2022). According to Bianchini et al. (2023), achieving climate neutrality in GCC countries and facilitating the energy transition through increased investment in digital technologies is a long-term goal that promotes sustainable development. Using digital public services to reduce resource depletion, sustainability advances. Numerous studies have examined the importance of a digital government for the attainment of sustainable development (Arslan et al., 2022; Khan et al., 2023). Renewable energy sources such as solar, wind, hydropower, and biofuels are replacing conventional hydrocarbon and nuclear energy in the current energy shift. Global energy demand, which includes fossil fuel consumption, CO2 emissions, urban population growth, and the effectiveness of government, all have an impact on the speed at which the energy transition occurs. Many scholars believe that maintaining political stability and good governance are crucial for ensuring sustainable development and reducing reliance on non-renewable energy sources. According to Adebayo (2022), Bourcet (2020), and Uzar (2020), consumption of renewable energy is increased in regions with higher institutional quality, lower political risk, and per capita income. The digital economy has significantly accelerated the energy shift. Digital technology development has opened a world of opportunities for innovation, expansion, and employment creation across all sectors. Data from the European Union (EU) in 2014, for instance, demonstrated that information and communications technologies (ICT) greatly lower energy usage and improve energy efficiency, Wang et al. (2022). Government initiatives for integrating renewable energy sources and ICT must be implemented, according to a study by Zheng et al. (2021), which indicated a substantial positive macro-level association. Some researchers, including Ahmed et al., (2017), and Stallo et al., (2010), who investigated the relationship between IT and renewable energies, concluded that although ICT may help other sectors become "smart," or energy efficient, the ICT sector, which uses a lot of energy, cannot function without renewable energy. Future greener and more sustainable systems will heavily rely on the transformative role that ICTs and renewable energies play in producing, consuming, and using energy.

As stated by Estevez and Janowski (2013), "e-government for sustainable development" refers to the use of ICT to enhance public administration, public essential services, and citizen-government interactions. The objectives are to protect the environment, advance social justice, enable citizen participation in governmental decision-making, and improve socioeconomic growth for coming generations. Research has

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indicated a significant correlation between the variables of digitization, specifically e-government and sustainable development (Goli & Golmohammadi, 2022; Abadi et al. 2024). UN member states are therefore required to have strong e-government competencies. A study conducted by Bohnsack (2021) examined the elements impacting the digitization of sustainable development in 157 countries with varying socioeconomic development levels and found that e-government was essential for improving global sustainability. Acknowledging its significance, governments globally have launched multiple programs aimed at reducing digital disparities, maintaining citizen confidence, and increasing transparency and openness in governance services to attain sustainable development. An excellent platform for putting these findings into practice is electronic government or e-government. The e-governance is a crucial instrument for achieving the SDGs, Alhassan (2020). Therefore, for developing nations to fully benefit from the SDGs by 2030, e-government and sustainable development must be pursued concurrently. Kostoska et al (2019) point out that the presence of related factors is an essential condition for the implementation of ICTs' significant contributions to SDGs. First, it is necessary to set up the necessary ICT infrastructure. According to Sharfat et al. (2017), this requires a broad availability of broadband infrastructure at a reasonable cost that is widely accepted. To use ICT infrastructure efficiently, citizens also need to possess the necessary skills.

Human development (HD) is one important component of e-governance. A nation's degree of social and economic development is indicated by its human development index (HDI), Mubarik et al., (2021); Marabet el al (2021) and Opoku et al (2022). Increased use of natural resources is frequently associated with higher HDI, which raises energy consumption. However, empirical research on e-governance's contribution to human development is still lacking. Human resources with digital skills contribute to technological advancement and ensure greater social growth, as demonstrated by Burlacu et al. (2019). Alvarado et al. (2023) showed that high-quality infrastructure in 63 different nations supported the growth of human capital between 1996 and 2004. Human development enhances society's sustainability, ensuring that people have access to the resources and opportunities they need to prosper. Fostering a more inclusive society produces sustainable business and governance, thereby increasing investment returns, Castro and Lopez (2022).

In many respects, this study contributes to the body of knowledge. Although numerous aspects, including urbanization and economic openness, have been studied in the empirical literature regarding environmental sustainability in GCC countries, there is a lack of research on the environmental effects of digitalization and e-governance. As a result, by examining the effects of digitalization on the environment, current research seeks to close this gap. Second, economic digitalization was measured using the e-government development index (EGDI). Since the EGDI includes three indicators about online services, infrastructure, and human development, it is recommended over conventional measurements like ICT and research and development.

Methodology

After presenting a review of the literature, the following section defines the data and methodology used in this research.

Data and Methodology

Data

In this section, we present the details of the selected variables. We attempt to explore the effect of digital governance on the energy transition process in the GCC countries. The variables were chosen based on the literature. According to Adams (2023), we use the E-Government Development Index as an indicator of digitalization for 54 African countries from 2010 to 2020. The EGDI (E-Government Development Index), created by the UN, is used to measure the progress of e-government or digitalization in governance. This index is intended to evaluate the progress of e-government at the federal level. It is a weighted average of three standardized measures that form the basis of the composite index.

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The Telecommunications Infrastructure Index (TII), which is derived from information supplied by the International Telecommunication Union (ITU), accounts for one-third of the EGDI. The Human Capital Index (HCI), which is derived from information supplied by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), accounts for an additional one-third of the EGDI. The Online Services Index (OSI) determines how the remaining one-third of the index is calculated. The OSI is based on data collected via an independent online services questionnaire (OSQ) administered by UNDESA, the United Nations Department of Economic and Social Affairs. The OSQ evaluates each of the 193 UN member nations' national online presence. The focus of OSI is on how governments use Internet services to conduct electronic consultations, disseminate electronic information, and make electronic decisions. Matallah et al. (2023) state that we use the variable oil rent to measure the consumption of renewable energy. The definitions of the variables are detailed in Table 1.

The sample includes 6 countries of the Gulf Cooperation Countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. We collect the data from the World Development Indicators database and the United Nations database, covering the period from 2005 to 2022. The estimation is performed using EVIEWS 12.

Table 1: Variables: Definitions and Codes

Name	Code	Definition	Sources
Dependent variable			
Oil rents	Oil Rent	The value of crude oil production value minus production costs (%, as a percentage of GDP) is termed oil rents.	World Development Indicators
Independent variables			
Online Services index	OSI	The ability and willingness of a government to engage electronically and offer services is gauged by the online service index.	United Nations Database (UN Data)
Human Capital Index	HCI	An overview of average performance in three key areas of human development—living a healthy and long life, having knowledge, and enjoying a fair standard of living—is given by the Human Development Index (HDI).	United Nations Database (UN Data)
Telecommunication Infrastructure Index	TII	Five indicators are combined and averaged arithmetically to create the Telecommunication Infrastructure Index (TII): anticipated internet users per 100 people, primary fixed phone line counts per 100 people, mobile subscriber counts per 100 people, wireless broadband subscription counts per 100 people, and fixed broadband subscription counts per 100 people.	United Nations Database (UN Data)
E-Government Index	E-Gov	A country's use of information technologies to support access and inclusion of its citizens is reflected in the E-Government Development Index, which takes into account access characteristics including	United Nations Database (UN Data)

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		infrastructure and educational attainment. E-Gov = 1/3 (OSI+HCI+TTI)	
Control variables			
CO2 emissions	CO2	Climate Watch Historical GHG Emissions (metric tons per capita) is the source of the emissions data.	World Development Indicators

Sources: United Nations and World Development Indicators databases (2024)

Methodology

Panel data analysis is a commonly employed method in economics to examine the behavior of several micro and macroeconomic variables. Several categories of analytical models are applied to panel data. These include models with constant coefficients, fixed effects, and random effects. It uses cross-sectional time series data with numerous observations for each individual, as opposed to aggregate data. (Greene, 2012). The model is shown below:

$$\text{OiL Rent}_{it} = \alpha + \delta_1 \text{Oil Rent}_{it-1} + \delta_2 W_{it} + \varepsilon_{it} \qquad (1)$$

Where Oil Rent_{it} represents the Rents from the oil sector for the country i in period t ;W_{it} represents the vector of the independent variables (e-Gov; TII; HCI; OSI; Co2) for the country i in period t and ε_{it} is the associated error.

Empirical Results

The empirical results are summarized in the following tables. The descriptive statistics provide quantitative insights into the selected data series. The standard deviation and central measures are shown in Table 2 below. For the sample that was chosen, there are 98 observations because the six GCC countries' data spans the years 2005 through 2022. The findings indicate that, during the study period, the means of all the variables chosen were positive. However, when compared to the other model variables, oil rent has a higher standard deviation. This fluctuation is a result of the global oil price volatility that began with the 2015 crisis.

Table 2: Descriptives Statistics

	Oil-Rent	E-Gov	TII	HCI	OSI	Co2 emissions
Mean	**28.2981**	**0.6354**	**0.5118**	**0.7710**	**0.6309**	**0.3654**
Median	**25.6208**	**0.6393**	**0.5306**	**0.7739**	**0.6702**	**0.3613**
Maximum	**58.3689**	**0.8555**	**0.9344**	**0.8932**	**0.9444**	**0.4574**
Minimum	**6.6955**	**0.3405**	**0.1384**	**0.6624**	**0.1730**	**0.2636**
St Dev	**13.6461**	**0.1207**	**0.2092**	**0.0644**	**0.1986**	**0.0535**
Jarque-Bera	**6.1541**	**3.5270**	**4.2431**	**5.1073**	**6.2600**	**7.8887**
Probability	**0.0460**	**0.1714**	**0.1198**	**0.0777**	**0.0437**	**0.0193**
Sum	**2773.220**	**62.2732**	**50.1647**	**75.5658**	**61.8282**	**35.8152**
Observations	**98**	**98**	**98**	**98**	**98**	**98**

Authors' calculations based on the UN database and World Development Indicators (2024)

Table 3 shows the correlation matrix to assist in investigating any potential link between the variables of interest. The findings indicate that the variables don't demonstrate a significant association for GCC

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countries. With a correlation coefficient of 0.7963, the Online Service Index (OSI) and Telecommunication, Infrastructure Index (TII) have a strong and favorable relationship.

Table 3: Correlation Matrix

	Oil-Rent	TII	HCI	OSI	CO2
Oil-Rent	1				
TII	-0.5828	1			
HCI	0.1494	-0.3467	1		
OSI	-0.5427	0.7963	-0.4333	1	
CO2	0.1042	0.0142	0.2692	0.0133	1

Authors' calculations based on the UN database and World Development Indicators (2024)

Table 4 presents the results of the panel estimation. We present the OLS regression in the first column, details for the fixed effect model are in column two, and finally, the random effects model is presented in column three.

Table 4: Panel Results

	OLS Model	Fixed Effects Model	Random effects Model	
C	68.9478*** (15.4881)	60.0437*** (12.5702)	68.9478*** (7.9704)	
E-gov	-335.7818*** (74.7210)	-253.9377*** (45.3463)	-335.7818*** (41.7333)	
TII	79.7791*** (25.0593)	45.2728*** (15.0854)	79.7791*** (13.9961)	
HCI	71.2567** (29.6318)	60.3957*** (19.8215)	71.2567*** (16.5500)	
OSI	94.2228*** (26.7897)	16.5852*** (19.9623)	94.2228*** (14.9626)	
Co2-emissions	47.8637** (19.8403)	16.5852 (19.9623)	47.8637*** (11.0812)	
	Effects Specification		**SD**	**Rho**
Cross Section random			0.0000	0.0000
Idiosyncratic random			5.5434	1.0000
R^2	0.4982	0.8519	0.4982	
F-statistics (P-value)	18.2728 0.0000	50.0805 (0.0000)	18.2728 (0.0000)	
Durbin Watson	0.4295	1.1516	0.4295	
Observations	98	98	98	

Notes: Robust standard errors are provided in parenthesis. Statistical significance levels are ***p < 0.01, **p < 0.05, and *p < 0.1.

For the three models, all the variables are significant at different levels. For the variable OSI, the results show a positive and significant effect on oil rent for the OLS, fixed effects, and random effects models. Online service accessibility can motivate people and enterprises to shift their production orientation toward carbon reduction, even though it can't force them to cut back on energy use. According to Ngô et al. (2022), the digitization of services will improve green consumption and production by reducing the cost of renewable energy while also making it easier to access natural resources. With the rise of "online services," digitization is now better able to track the optimal distribution of energy supply and demand, which lowers costs associated with production and consumption while also increasing productivity.

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Regarding the Human Development Index (HDI), the results show a positive and significant effect at 1% on the oil rent variable. Looking for higher human development rankings is frequently linked to higher economic development, which usually means higher levels of industrialization and energy consumption. According to Fomba et al. (2023), due to their heavy reliance on fossil fuels, like in GCC countries, both factors are important producers of carbon emissions. Higher levels of human development are positively correlated with higher levels of oil consumption in GCC countries, but it's important to remember that this correlation does not represent a positive outcome, Radmehr (2021). Therefore, on a global scale, decoupling economic growth and human development from energy consumption is essential. Sustainable behaviors, technological advancement, and international agreements such as the Paris Agreement—which attempts to reduce fossil consumption while encouraging human development—are how this purpose will be accomplished. According to Wang et al. (2020), to reduce the ongoing global warming due to oil consumption and ensure an efficient energy transition, progress must be made in many sectors.

The Telecommunications Infrastructure Index (TII) significantly and positively affects oil rent at the 1% level of significance. ICT is crucial to reaching energy efficiency targets. Grid optimization systems and artificial intelligence are two related ICT applications in the energy sector. The corresponding opinion is supported by a few examples. According to Tsimisaraka (2023), connecting microgrids to distant terminals can significantly lower the amount of electricity resources used, particularly in isolated locations. By optimizing the system using cloud servers and the Internet of Things, power energy efficiency can be effectively increased, and the power grid may be modified in real time. ICT can guarantee the sustainable development of energy by utilizing an efficient energy management system, according to Zheng (2021).

Regarding the E-Government Development Index (EGDI), the results show that e-governance has a negative and significant impact on oil rent for the three models. These findings can be explained by the policies adopted by the GCC countries during the last decade toward a shift in the energy sector to a cleaner energy resource to achieve their environmental sustainability goals by 2030. Bahrain has made significant progress toward e-government development, focusing on growing online services and digital infrastructure. Initiatives like the National Portal and the e-Government Authority have helped the country speed up its digital transition. To improve public services and digital accessibility, and to simplify online services, Qatar has launched programs like the e-Government Portal and Qatar Digital Government in addition to large investments in e-government projects. Saudi Arabia has been working to improve its e-government services and digital infrastructure through the implementation of projects like the National Transformation Program and the Saudi e-Government Program. The goal of these initiatives is to improve service delivery and digital accessibility. Kuwait is improving its digital infrastructure and e-government services by implementing initiatives like the Kuwait e-Government Portal.

All these GCC nations have recently been actively enhancing their digital governance to improve their capacity for renewable energy, Asem et al. (2024). As the world moves more and more toward renewable energy sources to fight climate change, this is part of a calculated strategy to diversify energy sources beyond hydrocarbons using new technologies. The GCC countries are utilizing the region's abundant solar and wind resources at different rates to incorporate renewable energy sources into their energy mixes and meet their ambitious targets, Castro et al (2022).

Robustness Tests

The Hausman test and likelihood ratio test need to be run to assess the panel model's robustness. Tables 5 and 6 present the findings.

Hausman Test

The Hausman test can be used in panel data analysis to select between a fixed effects model and a random effects model. The selected model has fixed effects, according to the alternative hypothesis, while the null hypothesis claims that the preferred model has random effects. According to Table 5's description, the results indicate that the fixed effects model is the most effective.

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Table 5: Hausmann test-Random Effects

Test cross Section Random effects			
	Statistic	df	Prob.
Cross-Section Chi-square	207.9222	5	0.0000

Likelihood Ratio Test

Now, we use the likelihood ratio test to look at the error terms' heteroskedasticity. The alternative hypothesis of the test is that the variance of the error term is heteroscedastic, whereas the null hypothesis is that all of the error terms have the same variance or are homoscedastic. Based on Table 6's likelihood of the F-statistic, the null hypothesis states that the error components have the same variance and that there is no evidence of heteroscedasticity.

Table 6: The Likelihood Ratio Test

Test cross Section fixed effects			
	Statistic	**df**	**Prob.**
Cross-Section F	41.5844	5.87	0.0000
Cross-Section Chi-square	119.6387	5	0.0000

Conclusion and Recommendations

The GCC countries rank among the world's top producers and exporters of fossil fuels, as well as those with the highest CO2 emissions per person. The GCC region's electrical mix still includes very little renewable energy, but the deployment of renewable energy is expanding throughout the area. The region's deployment of renewable energy is still very concentrated, with the UAE holding nearly 70% of investments in renewable energy and more than 60% of the region's total capacity. However, as the GCC states carry out their renewable energy plans, it is anticipated that these investments and deployments will pick up speed. The region has prospects for energy diversification and adaptation to climate change because of the energy transition, which includes the use of renewable energy. Due to the region's high level of climatic vulnerability, immediate action must be taken to mitigate the effects of climate change and adapt to them, with a focus on renewable energy sources. The GCC has a strong energy infrastructure that can be expanded further to accommodate higher proportions of renewable energy. In the era of renewable energy, the oil and gas business will go through significant transformations. This dynamic landscape is full of opportunities and uncertainties. Brave leadership is needed to facilitate the shift to a resilient and sustainable energy future. Additionally, it necessitates that all parties concerned act jointly and with vision. The oil and gas sector may perform a vital role by adopting innovation, teamwork, and ecological responsibility. It has the potential to impact the energy transition process positively. It can also help future generations create a more economic and ecologically sustainable society. This paper is an attempt to investigate the impact of a digital government on the energy transition process for the GCC countries. The results show that for the online services variable, the OLS, fixed effects, and random effects models all demonstrate a positive and significant impact on oil rent. Although it cannot make people or businesses consume less energy, the availability of online services can encourage them to change the direction of their production toward reducing carbon emissions and reducing the cost of production. The findings also indicate that the Human Development Index (HDI) has a positive and significant impact on the oil rent variable. Higher economic development, which typically translates into higher levels of industrialization and energy consumption, is generally associated with better human development rankings. For the ICT component (TII), the results present a positive impact of infrastructure on the energy transition process. A good ICT infrastructure will facilitate the production and consumption of energy with fewer costs. Finally, to increase their ability to produce renewable energy, all of these GCC countries have recently been actively strengthening their digital governance. This is all part of a planned effort to diversify energy sources beyond hydrocarbons utilizing new technology, as more investments are made in renewable energy rather than non-renewable energy to battle climate change.

Although these are positive initiatives, the region needs to move more aggressively to accelerate its digital transformation and promptly diversify its businesses. The GCC nations are still unable to keep up with developed economies because they lack enough innovation, digital talent, and locally generated digital goods and services.

References

Abadi, A., and Ebrahimi-Moghadam,A., (2024), "An innovative sustainable multi-generation energy system (electricity, heat, cold, and potable water) based on green hydrogen-fueled engine and dryer", Applied Energy, Volume 376, Part B, 124184, https://doi.org/10.1016/j.apenergy.2024.124184.

Adams, S. O., & Paul, C. (2023). E-government development indices and the attainment of United Nations sustainable development goals in Africa: A cross-sectional data analysis. European Journal of Sustainable Development Research, 7(4), em0234. https://doi.org/10.29333/ejosdr/13576

Adebayo, T.S.(2022). " Renewable Energy Consumption and Environmental Sustainability in Canada: Does Political Stability Make a Difference?" Environ Sci Pollut Res 29, 61307–61322. https://doi.org/10.1007/s11356-022-20008-4.

Adha, R., Hong, C.-Y., Agrawal, S., and Li, L.-H. (2022), " ICT, carbon emissions, climate change, and energy demand nexus: The potential benefit of digitalization in Taiwan", Energy & Environment, 0(0). https://doi.org/10.1177/0958305X221093458

Ahmed, Ahmed H., Elmaghrabi, Mohamed E., Dunne, Theresa, & Hussainey, Khaled. (2021). Gaining momentum: toward integrated reporting practices in Gulf Cooperation Council countries. Business Strategy and Development, 4(2), 78–93. https://doi.org/10.1002/bsd2.130

Ahmed, F., Naeem, M., and Iqbal, M.(2017), " ICT and renewable energy: a way forward to the next generation telecom base stations", Telecommun. Syst. 64 (2017) 43-56, https://doi.org/10.1007/s11235-016-0156-4

Alataş, S.(2021), " The role of information and communication technologies for environmental sustainability: Evidence from a large panel data analysis." J. Environ. Manag., 293, 112889.

Alhassan, G. (2020).E-governance for sustainable development in Ghana: Issues and prospects. [Master's Thesis, the American University in Cairo]. AUC Knowledge Fountain.

https://fount.aucegypt.edu/etds/814 Sharafat, A. R., & Lehr, W. (Eds.). (2017). ICT-centric economic growth, innovation and job creation 2017. ITU. https://www.itu.int/en/ITU-D/Pages/IMPACT-STUDY. aspx

Alqublan, L. (2024), The Adoption of Technologies in the Kingdom of Saudi Arabia's Sovereign Wealth Fund in Propelling Its Attainment of Vision 2030 Goals. SSRN Electron. J.

Alvarado,R., & Murshed, M., & Cifuentes-Faura, J., & Işık, C., & Razib H.,(2023), "Nexuses between rent of natural resources, economic complexity, and technological innovation: The roles of GDP, human capital and civil liberties," Resources Policy, Elsevier, vol. 85(PA).

Arief, A., Ayub, W., Iis., & Muhammad, M.,(2021). Barriers and challenges of e-government services: A systematic literature review and meta-analyses. IOP Conference Series: Materials Science and Engineering, 1125(1), 012027. https://doi.org/10.1088/1757-899x/1125/1/012027

Arslan, H.M., Khan, I., Latif, M.I. et al. (2022), "Understanding the dynamics of natural resources rents, environmental sustainability, and sustainable economic growth: new insights from China." Environ Sci Pollut Res 29, 58746–5876, https://doi.org/10.1007/s11356-022-19952-y

Asem, A.; Yousif R Al Ghofaili, A.; Mohammad, A.; Alzaidan, Z. (2024), Navigating Digital Transformation in Alignment with Vision 2030: A Review of Organizational Strategies, Innovations, and Implications in Saudi Arabia. J. Knowl. Learn. Sci. Technol. (Online) , 3, 21–29.

Berkhout, F.; Hertin, J. (2001), "Impacts of Information and Communication Technologies on Environmental Sustainability: Speculations and Evidence;", Report to the OECD; OECD: Paris, France.

Bianchini, S., Damioli, G. & Ghisetti, C. (2023), "The environmental effects of the "twin" green and digital transition in European regions". Environ Resource Econ 84, 877–918. https://doi.org/10.1007/s10640-022-00741-7.

Bohnsack, R., & Bidmon, C., & Pinkse, J.,(2021). Sustainability in the digital age: intended and unintended consequences of digital technologies for sustainable development. Business Strategy and the Environment. 31. 10.1002/bse.2938.

Bourcet, C.(2020), " Empirical determinants of renewable energy deployment: A systematic literature review", Energy Economics vol. 85, https://doi.org/10.1016/j.eneco.2019.104563

Burlacu, S., Alpopi, C., Mitrită, M., & Popescu, M.-L. (2019). Sustainable e-Governance and Human Resource Development. European Journal of Sustainable Development, 8(5), 16. https://doi.org/10.14207/ejsd.2019.v8n5p16.

Castro, C,. and Lopez, C., (2022) Digital Government and Sustainable Development", Journal of Knowledge Economy, (13), 880-903.

Danish; U.,, R.; Khan, S.U.-D, (2020), "Determinants of the ecological footprint: Role of renewable energy, natural resources, and urbanization". Sustain. Cities Soc., 54, 101996.

Estevez, E., & Janowski, T. (2013). "Electronic governance for sustainable development conceptual framework and state of research". Government Information Quarterly, 30, S94- S109. https://doi.org/10.1016/j.giq.2012.11.001

Feng D.,, Mengyue H., Yujin G.,, Yajie L., Jiao Z.,, and Yuling P.,(2022), " How does the digital economy affect carbon emissions? Evidence from global 60 countries", , Science of The Total Environment, vol. 852, 15 158401. https://doi.org/10.1016/j.scitotenv.2022.158401

Fomba, B.K.; Talla, D.N.D.F.; Ningaye, P. (2023), "Institutional Quality and Education Quality in Developing Countries: Effects and Transmission Channels". J. Knowl. Econ., 14, 86–115

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DOI: https://doi.org/10.62754/joe.v3i6.4103

Goli, A., & Golmohammadi, A. M. (2022). Multi-objective optimization of location and distribution in a closed-loop supply chain by considering market share in competitive conditions. International Journal of Supply and Operations Management, 9(4), 483-495.

Greening, L.A.; Greene, D.L.; Difiglio, C. (2000), " Energy efficiency and consumption—The rebound effect—A survey."Energy Policy, 28, 389–401

Ike, G. N., Usman, O., Alola, A. A., and Sarkodie, S. A.,(2020), " Environmental quality effects of income, energy prices and trade: The role of renewable energy consumption in G-7 countries," Science of the Total Environment, vol. 721, 137813. doi.org/10.1016/j.scitotenv.2020.137813

Khan, M.S.; Woo, M.; Nam, K.; Chathoth, P.(2017), Smart City and Smart Tourism: A Case of Dubai. Sustainability , 9, 2279.

Khan, Y., & Liu, F., & Hassan, T., (2023). "Natural resources and sustainable development: Evaluating the role of remittances and energy resources efficiency," Resources Policy, Elsevier, vol. 80(C).

Kostoska, O., and Ljupco,K., (2019). "A Novel ICT Framework for Sustainable Development Goals" Sustainability 11, no. 7: 1961. https://doi.org/10.3390/su11071961

Lange, S., Pohl, J., and Santarius, T. (2020), "Digitalization and energy consumption. Does ICT reduce energy demand?" Ecological Economics, vol. 176, 106760. (2020). DOI: 10.1016/j.ecolecon.2020.106760.

Laursen, G.H.; Thorlund, J.(2016), " Business Analytics for Managers: Taking Business Intelligence Beyond Reporting"; John Wiley & Sons: New York, NY, USA.

Matallah,S., Matallah,A., Benlahcene,L., Djelil, Z, (2023), "The lure of oil rents and the lack of innovation: Barriers to the roll-out of renewable energy in oil-rich MENA countries", Fuel, Volume 341, https://doi.org/10.1016/j.fuel.2023.127651.

Meniado, Joel C. (2021). Extensive reading practices in the Arabian Gulf region. Eurasian Journal of Applied Linguistics, 7(1), 222–239. https://doi.org/10.32601/ejal.911262

Mrabet, Z.; Alsamara, M.; Mimouni, K.; Mnasri, A. (2021), "Can human development and political stability improve environmental quality? New evidence from the MENA region. Econ. Model, 94, 28–44.

Mrabet, Z.; Alsamara, M.; Mimouni, K.; Mnasri, A. (2021), "Can human development and political stability improve environmental quality? New evidence from the MENA region. Econ. Model, 94, 28–44.

Mubarak, M., Hasnain Alam Kazmi, S., and Zaman, I., (2021), "Application of gray DEMATEL-ANP in green-strategic sourcing", Technology in Society, Volume 64, https://doi.org/10.1016/j.techsoc.2020.101524.

Musfikar, R., (2018). Kendala dalam implementasi E-government pada pemerintah kabupaten pidie. Cyberspace: Jurnal Pendidikan Teknologi Informasi, 2(1), 48. https://doi.org/10.22373/cs.v2i1.2746

Ngô, T., et. al. (2022). "Effects of digitalization on natural resource use in European countries : does economic complexity matter?" In: International Journal of Energy Economics and Policy 12 (3), S. 77-92.

Omol, E.J, (2023), "Organizational digital transformation: From evolution to future trends."Digit. Transform. Soc. 2023, 3, 240–256.

Opoku, E.E.O.; Dogah, K.E.; Aluko, O.A. (2022), "The contribution of human development towards environmental sustainability", Energy Econ., 106, 105782

Opoku, E.E.O.; Dogah, K.E.; Aluko, O.A. (2022), "The contribution of human development towards environmental sustainability", Energy Econ., 106, 105782

Palvia, P.; Baqir, N.; Nemati, H.(2018), "ICT for socio-economic development: A citizens' perspective." Inf. Manag., 55, 160–176.

Radmehr, R.; Henneberry, S.R.; Shayanmehr, S. (2021), "Renewable Energy Consumption, CO2 Emissions, and Economic Growth Nexus: A Simultaneity Spatial Modeling Analysis of EU Countries." Struct. Chang. Econ. Dyn., 57, 13–2

Saeed, S.; Altamimi, S.A.; Alkayyal, N.A.; Alshehri, E.; Alabbad, D.A. (2023), Digital Transformation and Cybersecurity Challenges for Businesses Resilience: Issues and Recommendations. Sensors, 23, 6666.

Sahoo, M.; Sethi, N.; Padilla, M.A.E.(2023), "Unpacking the dynamics of information and communication technology, control of corruption and sustainability in green development in developing economies: New evidence." Renew. Energy, 216, 119088.

Savoldelli, A., Codagnone, C., & Misuraca, G.; (2014). Understanding the e-government paradox: Learning from literature and practice on barriers to adoption. Government Information Quarterly, 31(Suppl. 1), S63–S71. https://doi.org/10.1016/j.giq.2014.01.008

Stallo, C., De Sanctis, M., Ruggieri, M., Bisio, I., and Marchese, M.(2010), " ICT applications in green and renewable energy sector", in: Proc. Work. Enabling Technol. Infrastruct. Collab. Enterp. WETICE, pp. 175-179. https://doi.org/10.1109/WETICE.2010.33.

Tsimisaraka, R.S.M.; Xiang, L.; Andrianarivo, A.R.N.A.; Josoa, E.Z.; Khan, N.; Hanif, M.S.; Limongi, R. (2023), "Impact of financial inclusion, globalization, renewable energy, ICT, and economic growth on CO2 emission in OBOR countries." Sustainability, 15, 6534

Uzar, U.(2020), " Political economy of renewable energy: Does institutional quality make a difference in renewable energy consumption? "Renewable Energy, Volume 155, pp. 591-603. https://doi.org/10.1016/j.renene.2020.03.172.

Wang, J.D., Dong, X.C., and Dong, K.Y., (2022), "How does ICT agglomeration affect carbon emissions? The case of Yangtze River Delta urban agglomeration in China". DOI: 10.1016/j.eneco.2022.106107.

Wang, R.; Mirza, N.; Vasbieva, D.G.; Abbas, Q.; Xiong, D. (2020), "The nexus of carbon emissions, financial development, renewable energy consumption, and technological innovation: What should be the priorities in light of COP 21 Agreements?" J. Environ. Manag., 271, 111027.

Westerman, G.; Bonnet, D.; McAfee, A. Leading Digital: Turning Technology into Business Transformation; Harvard Business Press: Boston, MA, USA, 2014

Zheng, J. and Wang, X. (2021), "Can mobile information communication technologies (ICTs) promote the development of renewables? - evidence from seven countries", Energy Pol. 149, 112041, https://doi.org/10.1016/j.enpol.2020.112041.