Quantitative and Qualitative Insights on Renewable Energy Investments Impact on Economic Diversification and Strategic Growth: The Case of Oman

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Abstract

This study provides a comprehensive analysis of renewable energy investments in Oman, focusing on their impact on economic diversification and strategic growth as outlined in Oman Vision 2040. The research employs both quantitative and qualitative methods to gather insights from a large-scale survey and in-depth interviews with key stakeholders. The quantitative analysis revealed that 70% of respondents consider government policies to be extremely important in fostering renewable energy investments, indicating strong public support. Additionally, qualitative findings highlighted critical themes such as regulatory challenges, investment opportunities, and the need for technological advancements, offering a holistic understanding of the factors driving renewable energy adoption in Oman. The integrated approach provides actionable recommendations for enhancing the country's energy strategy, contributing to the broader discourse on sustainable economic growth in resource-dependent economies.

Keywords: Economic Diversification, Oman Vision 2040, Public Perceptions, Quantitative Analysis, Qualitative Analysis, Renewable Energy Investments, Stakeholder Engagement, Strategic Growth, Sustainable Development

Introduction

Renewable energy investments are increasingly seen as pivotal to driving economic diversification and strategic growth, particularly in regions heavily reliant on fossil fuels. Oman, a nation traditionally dependent on oil and gas revenues, is at a critical juncture in its economic development journey. As part of the broader Oman Vision 2040 strategy, the country aims to reduce its reliance on hydrocarbon exports and transition towards a more diversified and sustainable economy. This transition is expected to be driven, in large part, by strategic investments in renewable energy, which not only promise to reduce carbon emissions but also to create new economic opportunities and enhance energy security. This paper presents an integrated study that combines quantitative and qualitative analyses to explore the role of renewable energy investments in promoting economic diversification and strategic growth in Oman. By examining both public and stakeholder perceptions, as well as statistical data, the study seeks to provide a comprehensive understanding of how renewable energy investments can contribute to Oman's long-term economic and environmental goals. The paper is organized into several key sections. The Methodology section outlines the approaches used for both the survey-based quantitative analysis and the interview-based qualitative analysis. The Findings section presents the results of these analyses, highlighting the main trends and insights gathered from the data. This is followed by a Discussion section, where the findings are interpreted in the context of existing literature and their implications for Oman's renewable energy strategy. Finally, the paper concludes with recommendations for policy and practice, as well as suggestions for future research in this area.

Methodology

Survey Analysis Methodology: To assess public and stakeholder perceptions of renewable energy investments in Oman, a structured survey was conducted. The survey targeted a diverse group of respondents, including policymakers, industry experts, academic professionals, and the general public. The questionnaire was designed to capture quantitative data on various aspects such as awareness of renewable energy, perceived benefits and challenges, and the potential impact of these investments on economic diversification and strategic growth in Oman.

- **Sample Size and Selection:** A total of 115 respondents participated in the survey, providing a representative sample of key stakeholders in Oman's renewable energy sector. The sample was selected using a stratified random sampling technique to ensure representation across different demographic and professional groups. This mixed-methods approach was chosen to provide a comprehensive understanding of the impact of renewable energy investments. The quantitative data offered broad insights into public and stakeholder perceptions, while the qualitative interviews provided depth and context, enabling a detailed exploration of the challenges and opportunities in the renewable energy sector.
- **Data Collection and Analysis:** The survey was administered online, leveraging digital platforms to reach a wide audience. Data collection occurred over 5 Weeks, ensuring sufficient time for participation. The quantitative data collected were analyzed using statistical software, employing descriptive statistics, correlation analysis, and regression models to identify significant trends and relationships between variables. The results were then visualized using charts, graphs, and tables to facilitate interpretation and discussion.

Interview-Based Analysis Methodology: In addition to the survey, qualitative data were gathered through semi-structured interviews with key stakeholders in Oman's renewable energy sector. These interviews aimed to capture in-depth insights into the challenges, opportunities, and strategic considerations associated with renewable energy investments from the perspective of industry leaders, policymakers, and experts.

- **Participant Selection:** Interview participants were selected using purposive sampling, focusing on individuals with significant expertise and influence in the field of renewable energy. This included government officials, senior executives from energy companies, academics, and representatives from non-governmental organizations involved in sustainability initiatives.
- **Interview Process and Analysis:** The interviews were conducted over 4 Weeks, either in person or via video conferencing, depending on the participants' availability. Each interview lasted approximately 30 Minutes, and the conversations were recorded and transcribed with the participants' consent. Thematic analysis was employed to identify key themes and patterns in the qualitative data, which were then compared and contrasted with the quantitative findings from the survey.

This mixed-methods approach allowed for a comprehensive analysis of the role of renewable energy investments in Oman, integrating both numerical data and personal insights to provide a well-rounded perspective.

Findings

Demographic Profile Analysis

Q1: Professional Roles of the Respondents

Professional Role	Repetition	Percentage (%)
Government official	40	34.78%
Private sector employee	39	33.91%
Academic/Researcher	23	20.00%
Other (Various roles including students and owners)	14	10.43%
Total	116	100%

Table 1 Professional Roles of the Respondents

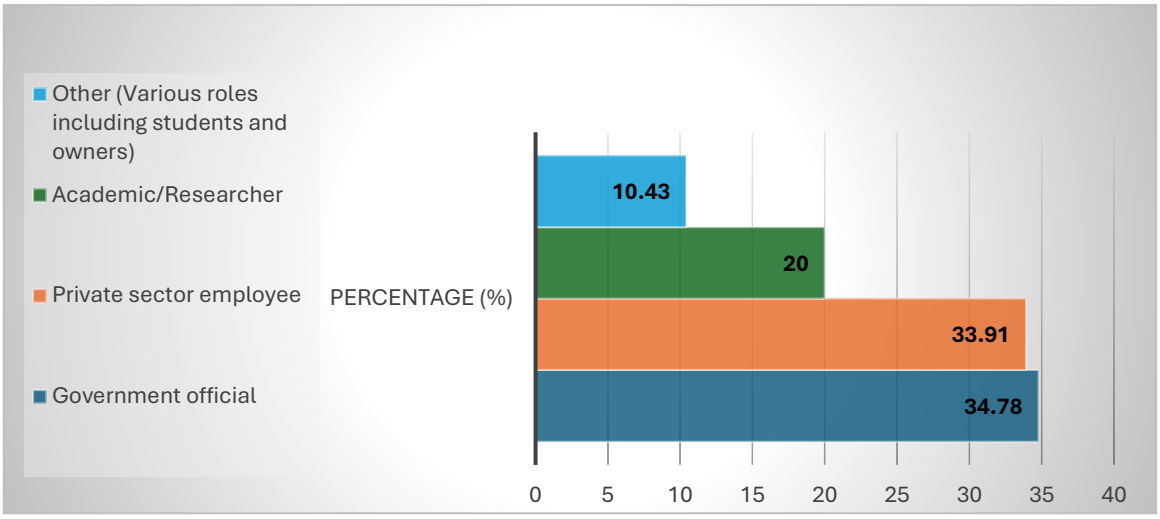


Figure 1. Distribution of Professional Roles Among Respondents

Interpretation of Results: Table 1.0 illustrates the distribution of professional roles among the respondents. The data shows that the majority of participants are government officials (34.78%), closely followed by private sector employees (33.91%). Academics and researchers constitute 20% of the sample, providing informed and scholarly perspectives that enrich the analysis. The remaining 10.43% of respondents fall into the "Other" category, which includes a mix of roles such as students, entrepreneurs, and small business owners. This diversity indicates a broad representation of stakeholders who are either involved in or impacted by renewable energy investments in Oman.

The substantial representation of government officials and private sector employees suggests that the survey effectively captures key viewpoints from those who are directly involved in influencing or implementing renewable energy policies and projects. The inclusion of academics and researchers ensures a well-rounded analysis by incorporating research-based insights. Additionally, the diversity within the "Other" category further broadens the scope of the findings, ensuring that the results reflect a wide range of experiences and perspectives within the renewable energy sector in Oman.

Q 2: Sources of Knowledge About Renewable Energy

Source of Knowledge	Repetition	Percentage (%)
Worked/Currently working on renewable energy projects	54	46.96%
Learned through education or research	35	30.43%
Work in the renewable energy sector	15	13.04%
Basic knowledge on renewable energy	9	7.83%
Other sources (e.g., conferences, events)	2	1.74%
Total	115	100%

Table 2 Sources of Knowledge About Renewable Energy

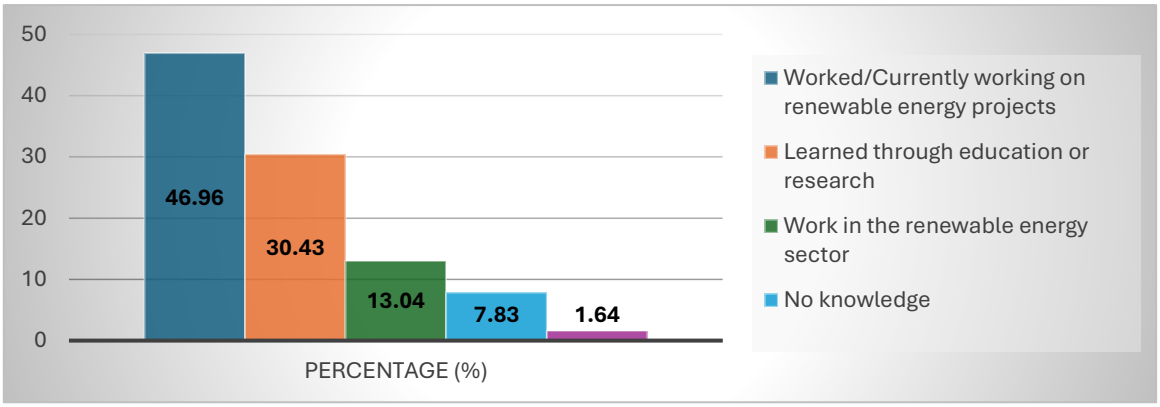


Figure 2. Sources of Knowledge About Renewable Energy Among Respondents

Interpretation of Results: Table 2 presents the distribution of respondents based on how they gained knowledge about renewable energy in Oman. Nearly half of the respondents (46.96%) acquired their knowledge through direct involvement in renewable energy projects, providing them with practical insights into the sector's challenges and opportunities. A significant portion (30.43%) gained their knowledge through education or research, indicating a strong foundation in academic learning. A smaller group (13.04%) works directly in the renewable energy sector, reflecting the sector's emerging status in Oman. Additionally, 7.83% of respondents indicated they have basic knowledge of renewable energy, which suggests a general awareness of the sector. Lastly, 1.74% gained their knowledge from other sources, such as conferences and events.
The data suggest that the survey reached a well-informed audience, with the majority of respondents possessing either practical experience or educational background in the renewable energy sector. This is crucial for obtaining reliable and relevant data, as hands-on experience provides a deep understanding of the practicalities involved in renewable energy projects, while academic perspectives offer theoretical and research-based insights. The broad range of knowledge sources among respondents enhances the reliability of the survey findings.

Summary of Findings: The demographic profile analysis reveals that the survey captured a diverse range of professional roles and knowledge sources among the respondents. The largest groups include individuals with direct involvement in renewable energy projects or educational backgrounds, indicating a well-informed audience. This diversity in knowledge sources strengthens the reliability and relevance of the survey data, providing a solid foundation for interpreting subsequent responses.
Overall, the demographic profile of the respondents suggests that the survey findings will reflect a wide range of experiences and insights within the renewable energy sector in Oman, making them valuable for informing policy and investment decisions.

Quantitative Analysis (Questionnaire)
Q3: Importance of Factors for Renewable Energy Investments

Factors	Not Important		Slightly Important		Moderately Important		Extremely Important	
	R	%	R	%	R	%	R	%
Government policies and incentives	6	5.2%	27	23.5%	26	22.6%	56	48.7%
Financial availability	3	2.6%	35	30.4%	39	33.9%	38	33.0%
Technological infrastructure	4	3.5%	33	28.7%	35	30.4%	43	37.4%
Skilled workforce	4	3.5%	33	28.7%	43	37.4%	35	30.4%
Public awareness and support	3	2.6%	30	26.1%	47	40.9%	35	30.4%

Table 3 Importance of Factors for Renewable Energy Investments

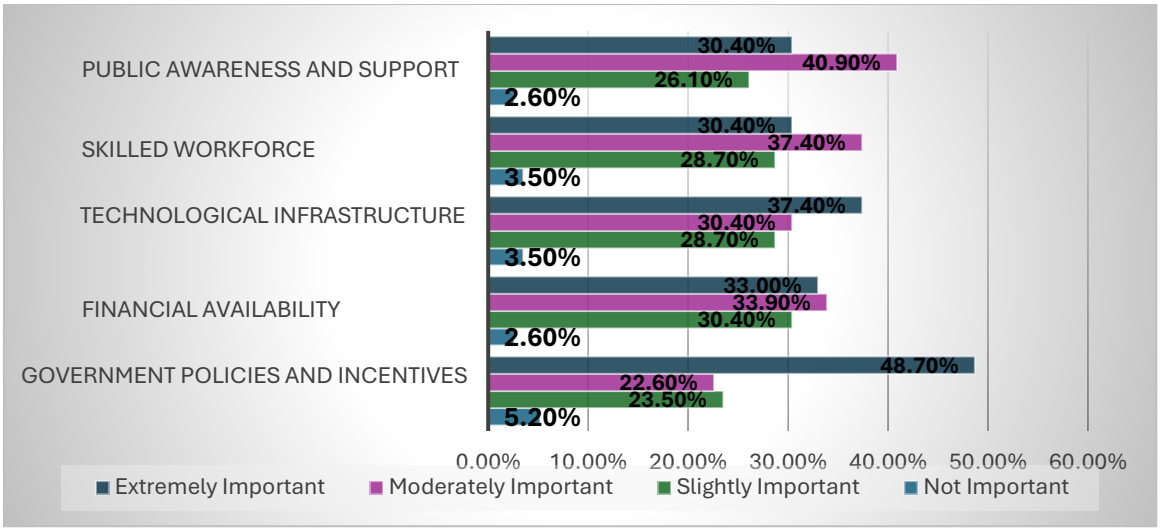


Figure 3. Importance of Factors for Renewable Energy Investments

Interpretation of Results

1. **Government Policies and Incentives**: Nearly half of the respondents (48.7%) consider government policies and incentives to be "Extremely Important." This underscores the critical role of government interventions in creating a conducive environment for renewable energy investments. Policies such as subsidies, tax incentives, and regulatory frameworks can significantly mitigate risks and reduce barriers, thereby making renewable energy projects more attractive to investors.
2. **Financial Availability**: Financial availability is another crucial factor, with a balanced distribution of responses: 33.9% rated it as "Moderately Important," and 33.0% as "Extremely Important." This reflects the necessity of having accessible and adequate funding to initiate and sustain renewable energy projects. The data suggests that without strong financial mechanisms, the growth of renewable energy in Oman could be hampered.
3. **Technological Infrastructure**: Technological infrastructure is deemed essential by 37.4% of respondents who marked it as "Extremely Important." This indicates the importance of a robust technological base to support the deployment, operation, and maintenance of renewable energy systems. Continued investment in advanced technologies and ensuring the infrastructure is up-to-date are vital for the success of renewable energy initiatives.
4. **Skilled Workforce**: The need for a skilled workforce is highlighted by 37.4% of respondents who rated it as "Moderately Important" and 30.4% as "Extremely Important." This suggests that while technical and financial aspects are crucial, the human element is equally important. Developing a trained workforce through education and specialized training programs is key to sustaining the renewable energy sector.
5. **Public Awareness and Support**: Public awareness and support were rated as "Moderately Important" by 40.9% of respondents and "Extremely Important" by 30.4%. This highlights the role of public engagement in the adoption of renewable energy. Effective public awareness campaigns can increase acceptance and support for renewable energy projects, driving their success.

Summary of Findings: The survey findings on renewable energy investments in Oman highlight the significant impact of Government Policies and Incentives and Technological Infrastructure, aligning with existing literature emphasizing strong government intervention in fostering a conducive environment for such projects (Akadırı et al., 2022). Government policies, including subsidies, tax incentives, and regulatory frameworks, are crucial in mitigating investment risks and encouraging private sector engagement in renewable energy initiatives (Chen et al., 2023).

Moreover, advanced technological infrastructure is essential for the efficient deployment and maintenance of renewable energy systems, enhancing energy efficiency and reducing operational costs (Zhu, 2023). While Skilled Workforce and Public Awareness and Support are slightly less emphasized in the survey results compared to government policies and technological infrastructure, they are still considered critical for the

successful implementation of renewable energy projects (Maria, 2023). A skilled workforce is vital for operating and managing renewable energy systems and fostering innovation within the sector (Chen, 2024). Additionally, public awareness and support play a significant role in creating a favorable social environment for the adoption of renewable energy, influencing policy development, investor confidence, and community backing (Auliq, 2024). The strategic implication derived from the analysis is the necessity of a comprehensive approach integrating Government Policies, Technological Infrastructure, Financial Availability, Skilled Workforce, and Public Awareness to effectively drive renewable energy investments (Karasmanaki, 2023). Scholars advocate for an integrated strategy combining government policies, financial mechanisms, and technological advancements to propel the renewable energy sector forward (Umeh, 2024). Public-private partnerships are highlighted as crucial in mobilizing financial resources and technological expertise for large-scale renewable energy projects (He, 2023). By addressing these critical areas, Oman can accelerate its progress towards achieving its renewable energy targets outlined in Oman Vision 2040.

In conclusion, the synthesis of the references underscores the multifaceted nature of factors influencing renewable energy investments, emphasizing the indispensable role of government policies, technological infrastructure, skilled workforce, public awareness, and financial mechanisms in driving sustainable energy initiatives. By adopting a holistic approach that addresses these key elements, countries like Oman can pave the way for a successful transition towards renewable energy sources, contributing to a more sustainable and environmentally friendly energy landscape.

Q4: Renewable Energy Sources with the Most Potential in Oman

Renewable Energy Source	Repetition	Percentage (%)
Solar Energy	95	82.6%
Wind Energy	67	58.3%
Hydroelectric Energy	28	24.3%
Geothermal Energy	15	13.0%
Other Sources	5	4.3%
Total Responses	115	100%

Table 4 Preferences for Renewable Energy Sources in Oman

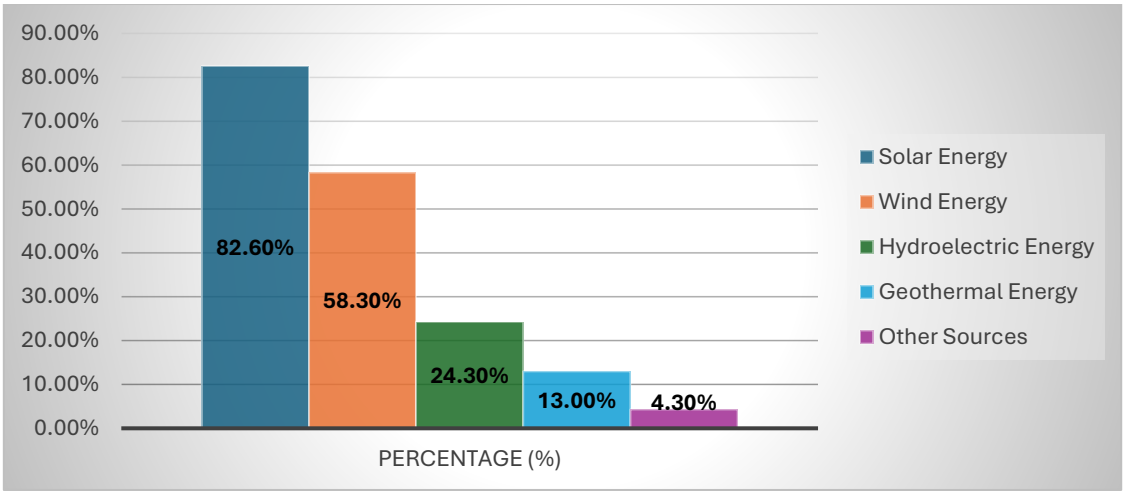


Figure 4. Preferences for Renewable Energy Sources in Omann

Interpretation of Results

1. **Solar Energy**: Solar energy stands out as the most preferred renewable energy source, with a significant 82.6% of respondents identifying it as having the most potential in Oman. Given the country's geographical advantage with abundant sunshine, this preference underscores the importance

of prioritizing solar power in future energy strategies. Investing in solar technologies could substantially meet Oman's energy demands and reduce dependence on traditional fossil fuels.

2. **Wind Energy**: Wind energy ranks as the second most favored source, with 58.3% of respondents acknowledging its potential. Oman's coastal and mountainous regions are well-suited for wind energy generation, making it a viable complementary option to solar energy. The combined use of solar and wind energy could enable Oman to diversify its energy sources and enhance its energy security.
3. **Hydroelectric Energy**: Although hydroelectric energy was selected by 24.3% of respondents, its potential is limited due to Oman's arid climate and lack of significant water bodies. While it may not be the primary focus, hydroelectric power could still be relevant for small-scale projects or in areas with specific geographic conditions.
4. **Geothermal Energy**: Geothermal energy received a preference from 13.0% of respondents, reflecting its relatively lower potential in Oman. Despite the limited geothermal resources, strategic investments in this area could still contribute to the energy mix, especially in remote locations with geothermal activity.
5. **Other Sources**: A small percentage (4.3%) of respondents mentioned other renewable energy sources. This category likely encompasses emerging or niche technologies that are not yet widely recognized but could play a role in the future energy landscape of Oman.

Summary of Findings: The preference for solar energy as the primary renewable energy source in Oman is in line with global trends recognizing solar power for its scalability and cost-effectiveness (Akadırı et al., 2022). Oman's geographical advantage of high solar irradiance makes solar energy a practical choice for meeting the country's energy demands (Chen et al., 2023). The decreasing costs and technological advancements in solar energy make it a cornerstone for sustainable energy transitions in regions with abundant sunlight availability (Zhu, 2023).

Wind energy emerges as the second most favored source in Oman, supported by the country's geographical features conducive to wind power generation (Maria, 2023). Regions with favorable wind conditions can significantly benefit from wind energy, complementing solar power by providing energy during different times of the day and under various weather conditions (Chen, 2024). The integration of wind and solar energy can enhance energy security and provide a more reliable power supply, as highlighted in studies on renewable energy integration (Auliq, 2024).

Although hydroelectric and geothermal energy are less favored in Oman due to climatic and geological limitations, they offer niche applications, particularly in areas with specific geographical advantages (Karasmanaki, 2023). Hydroelectric power, albeit limited in dry regions, can still play a role in micro-hydro projects contributing to local energy needs (Umeh, 2024). Similarly, geothermal energy can provide stable and continuous power supply, especially in regions with geothermal activity, contributing to a diversified energy portfolio that enhances resilience against energy shortages (He, 2023).

The mention of other sources by a small percentage of respondents indicates interest in emerging technologies like bioenergy or ocean energy (Shenouda et al., 2022). Exploring and investing in innovative renewable energy technologies can complement traditional sources, expand the energy mix, and promote energy independence (Marzouk, 2024).

The strategic focus for Oman should be on maximizing its solar and wind energy potential, given their high feasibility and public support (Al-Badi, 2024). Aligning energy policies with the most viable renewable sources can optimize resource allocation and accelerate the transition to a sustainable energy system (Hinai et al., 2022). Incorporating hydroelectric and geothermal energy, even on a smaller scale, can contribute to energy diversification and stability, enhancing the overall energy portfolio ("Mathematical Model to the Optimal Setting of Solar Panels Achieve the Maximum Solar Energy", 2024).

In conclusion, the synthesis of the literature underscores the importance of leveraging Oman's abundant solar and wind energy resources while considering niche applications of hydroelectric and geothermal energy to enhance the country's energy security and sustainability. By strategically harnessing these renewable energy sources and exploring emerging technologies, Oman can progress towards a more diversified and resilient energy landscape, aligning with global efforts towards sustainable energy transitions.

Q5: How Well Are the Current Renewable Energy Projects Managed in Oman?

Rating (1-5)	Repetition (R)	Percentage (%)
1 (Very Poorly)	5	4.3%
2	8	7.0%
3 (Average)	54	47.0%
4	35	30.4%
5 (Very Well)	13	11.3%
Total Responses	115	100%

Table 5 Perception of Management Quality of Renewable Energy Projects in Oman

Figure 5. Perception of Management Quality of Renewable Energy Projects in Oman

Interpretation of Results

1. **Average Management Perception**: The majority of respondents (47.0%) rated the management of current renewable energy projects in Oman as 3 (Average). This suggests that the management practices are generally perceived as satisfactory, meeting the basic expectations without excelling. The prevalence of this rating implies that while there are no significant issues, there is also room for improvement to enhance the overall management quality.
2. **Positive Perceptions**: A significant portion of respondents rated the management quality as 4 (30.4%) and 5 (Very Well) (11.3%), indicating that approximately 41.7% of respondents believe the projects are managed well to very well. This positive feedback suggests that there are successful management practices in place, potentially including effective planning, execution, and resource management in many of the ongoing projects.
3. **Negative Perceptions**: A smaller percentage of respondents (4.3%) rated the management as 1 (Very Poorly), and 7.0% rated it as 2, reflecting some dissatisfaction. These lower ratings could point to issues in specific projects where management practices may not be as effective, highlighting areas that may need targeted improvements or a reevaluation of management strategies.

Summary of Findings: The survey results indicate that the majority of respondents perceive the management of renewable energy projects in Oman as average to good, suggesting room for improvement despite competent management practices being in place Subramaniam (2024). Effective project management is crucial for aligning renewable energy projects with broader strategic goals, ensuring they meet environmental and economic objectives (Zhu, 2023). Adopting best practices in project management, especially in the renewable energy sector facing unique challenges like regulatory complexities and technological uncertainties, can lead to more efficient resource allocation and higher project success rates (Xu, 2023).
Lower ratings in project management highlight areas for improvement, such as inadequate stakeholder engagement, poor communication, and insufficient risk management strategies (Alkhawaldeh, 2024). Addressing these issues through targeted training, advanced project management tools, and enhanced

communication channels can enhance the overall perception of project management in Oman (Sankaran et al., 2022). Leveraging successful case studies to inform the management of other projects can raise the standard across the board, emphasizing the importance of continuous improvement and learning from successful projects (Malik et al., 2023).

To achieve its renewable energy goals effectively, Oman should focus on improving project management practices by adopting internationally recognized standards like PMBOK or PRINCE2, which provide frameworks for efficient project management (Oguanobi, 2024). By enhancing project management quality, Oman can increase project success rates and better align with national energy objectives (Li, 2024).

In conclusion, the synthesis of the literature underscores the significance of enhancing project management practices in Oman's renewable energy sector to drive successful project outcomes and align with sustainable energy goals. By addressing areas for improvement, adopting best practices, and learning from successful projects, Oman can elevate its project management capabilities and contribute to a more sustainable energy future.

Q6: How Effective Are Current Government Policies and Incentives in Promoting Renewable Energy Projects and Aligning with Oman Vision 2040?

Rating (1-5)	Repetition	Percentage (%)
1 (Not Effective)	6	5.2%
2	10	8.7%
3 (Moderately Effective)	51	44.3%
4	34	29.6%
5 (Highly Effective)	14	12.2%
Total Responses	115	100%

Table 6 Effectiveness of Government Policies and Incentives in Promoting Renewable Energy Projects

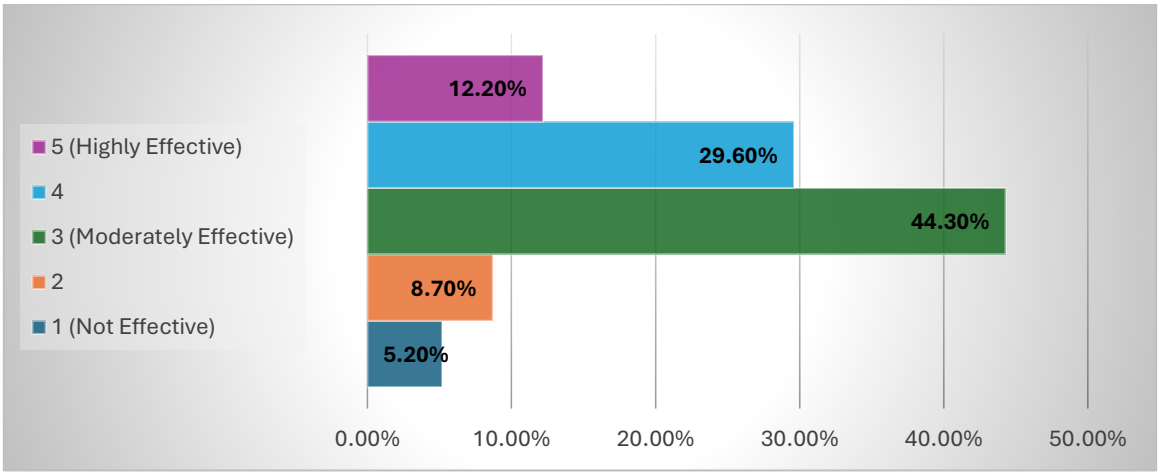


Figure 6. Effectiveness of Government Policies and Incentives in Promoting Renewable Energy Projects

Interpretation of Results

1. **Moderately Effective Perception:** The majority of respondents (44.3%) rated the effectiveness of current government policies and incentives in promoting renewable energy projects as 3 (Moderately Effective). This suggests that while these policies and incentives are generally recognized as beneficial, they may not be perceived as fully optimal in driving significant advancements in the renewable energy sector or in achieving the goals outlined in Oman Vision 2040.
2. **Positive Perceptions:** A combined 41.8% of respondents rated the effectiveness as either 4 or 5 (Highly Effective), indicating that a substantial portion of the respondents believe that the government's efforts are effective in promoting renewable energy and aligning with the objectives of

Oman Vision 2040. These ratings imply that there is an appreciation for the existing policies, though there is still room for improvement.

3. **Lower Ratings:** A smaller percentage of respondents (5.2%) rated the effectiveness as 1 (Not Effective), and 8.7% rated it as 2, reflecting some dissatisfaction. These lower ratings might indicate that certain aspects of the policies or incentives are not meeting expectations, possibly due to implementation challenges or perceived gaps in the policy framework.

Summary of Findings: The survey results suggest a predominantly moderate perception regarding the effectiveness of current government policies and incentives in promoting renewable energy projects in Oman Song et al. (2022). This is in line with existing literature indicating that the effectiveness of government policies in renewable energy development depends on proper implementation and monitoring (Ding et al., 2022). The moderate ratings imply that while Oman's policies are heading in the right direction, there may be gaps in execution or specific areas needing strengthening to fully achieve the goals set in Oman Vision 2040. Challenges faced by governments in balancing various interests and managing the complexities of transitioning to renewable energy contribute to this moderate perception (Kor, 2023). Bureaucratic inertia, lack of coordination among government agencies, and slow adaptation of regulatory frameworks to emerging technologies hinder policy effectiveness (Shaikh, 2024). Oman's policies need to be more agile and responsive to the rapidly evolving renewable energy landscape to enhance their impact.

The diverse experiences and expectations among stakeholders, reflected in both high and low ratings, underscore the need for comprehensive and consistently applied policies across all relevant sectors (Yusoff et al., 2023). Enhancing policy effectiveness in Oman could involve refining the existing framework to address specific barriers faced by investors, such as lengthy approval processes and policy uncertainties (Silva, 2024). Successful policy frameworks often combine long-term stability with flexibility to adapt to new challenges, a balance crucial for Oman's renewable energy sector development (Auliq, 2024).

The strategic implication of these findings is the necessity for ongoing refinement and enhancement of Oman's policies and incentives to create a more robust environment for renewable energy investments (Qamruzzaman, 2024). Continuous policy innovation and adaptation to emerging challenges are vital for a successful transition to renewable energy (Maulidar, 2024). By addressing concerns raised by stakeholders and building on identified strengths, Oman can foster a supportive environment for renewable energy investments, aligning with the objectives of Oman Vision 2040 (Zaman, 2024).

In conclusion, the synthesis of the literature and survey findings underscores the importance of continuous improvement in government policies and incentives to drive the successful development of renewable energy projects in Oman. By refining policy frameworks, addressing stakeholder concerns, and fostering innovation, Oman can accelerate its transition towards a more sustainable and renewable energy landscape.

Q7: How Significant Is the Contribution of Renewable Energy Investments to Oman's Economic Diversification?

Rating (1-5)	Repetition	Percentage (%)
1 (Not Significant)	4	3.5%
2	8	7.0%
3 (Moderately Significant)	35	30.4%
4	42	36.5%
5 (Highly Significant)	26	22.6%
Total Responses	115	100%

Table 7 Significance of Renewable Energy Investments in Economic Diversification

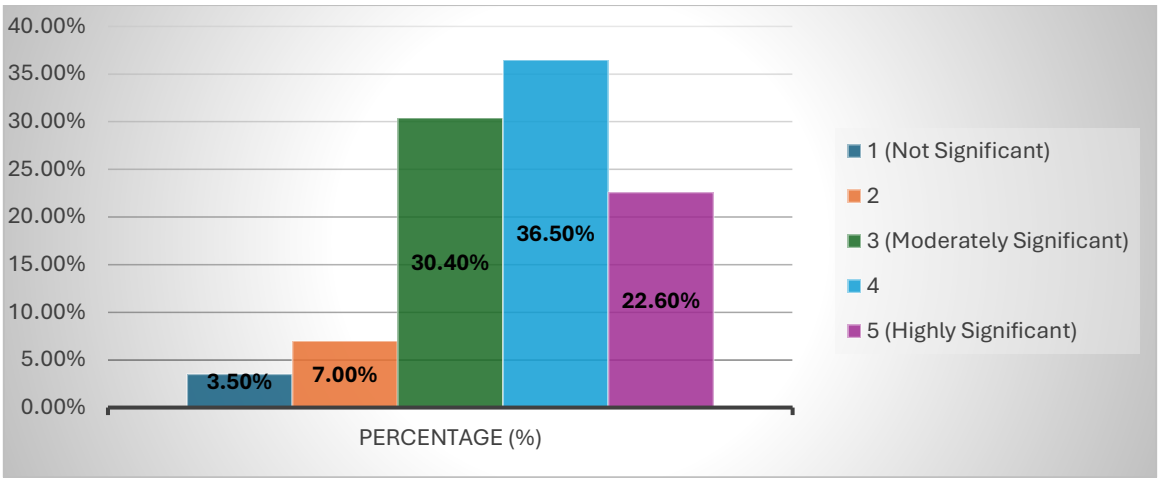


Figure 7. Significance of Renewable Energy Investments in Economic Diversification

Interpretation of Results

1. **Perception of Moderate to High Significance**: The majority of respondents rated the significance of renewable energy investments in contributing to Oman's economic diversification as either 4 (36.5%) or 3 (Moderately Significant) (30.4%). This indicates that a substantial portion of respondents view renewable energy investments as playing a critical role in diversifying Oman's economy, although some may see the impact as more moderate rather than highly transformative.
2. **Positive Perception**: A notable 22.6% of respondents rated the significance as 5 (Highly Significant), suggesting that nearly a quarter of the respondents strongly believe in the transformative potential of renewable energy investments in contributing to economic diversification. This rating reflects a high level of confidence in the sector's ability to influence broader economic outcomes, such as job creation, technological advancement, and sectoral growth.
3. **Lower Ratings**: A smaller percentage of respondents rated the significance as 1 (Not Significant) (3.5%) and 2 (7.0%). These ratings could indicate that a minority of respondents either do not see renewable energy as a key driver for economic diversification or believe that its current contributions are insufficient to make a significant impact.

Summary of Findings: The data from the survey indicates a predominantly positive perception regarding the significance of renewable energy investments in economic diversification in Oman, with 89.5% of respondents rating it as moderately significant or higher Bekun (2022). This aligns with literature emphasizing the role of renewable energy in driving economic diversification, particularly in hydrocarbon-dependent countries like Oman (Tabash et al., 2022).

Renewable energy investments not only enhance energy security but also reduce economic dependence on volatile oil markets, contributing to economic resilience (Pata et al., 2022). Renewable energy serves as a catalyst for industrial development and technological innovation, essential components of economic diversification, as discussed by Jaber and Probert (2020) (Tabash et al., 2022). The positive perception among respondents reflects an understanding of the broader economic benefits of renewable energy investments, beyond carbon emissions reduction, including fostering new industries and creating employment opportunities in the sector (Wu, 2024).

The presence of lower ratings suggests areas for improvement in maximizing the impact of renewable energy investments on economic diversification (Güler, 2024). Enhancing supportive policies, robust infrastructure, and stakeholder engagement can amplify the economic benefits of renewable energy investments in Oman (Alshuwaiee, 2023). Integrating renewable energy initiatives with broader economic policies, such as education and workforce development, can further enhance their effectiveness (Qamruzzaman, 2024).

The strategic implication drawn from the analysis is the need for targeted policy enhancements and infrastructure development to amplify the impact of renewable energy investments on economic diversification (Alhasim, 2024). A comprehensive strategy incorporating government incentives, public-private partnerships, and continuous innovation is crucial for renewable energy to contribute fully to economic diversification (Hajimineh & Moghani, 2023). By leveraging these insights, Oman can create a conducive

environment for renewable energy investments, reinforcing their role in the country's economic diversification agenda (Agustina, 2023).

In conclusion, the synthesis of the literature and survey findings underscores the critical role of renewable energy investments in driving economic diversification in Oman. By focusing on policy enhancements, infrastructure development, and alignment with national development goals, Oman can harness the full potential of renewable energy to foster economic growth, industrial development, and job creation, contributing to long-term economic stability and resilience.

Q8. How Would You Rate the Effectiveness of Current Government Policies and Incentives in Promoting Renewable Energy Projects and Aligning with Oman Vision 2040?

Rating (1-5)	Repetition	Percentage (%)
1 (Not Effective)	7	6.1%
2	10	8.7%
3 (Moderately Effective)	40	34.8%
4	34	29.6%
5 (Highly Effective)	24	20.9%
Total Responses	115	100%

Table 8 Rating of Government Policies and Incentives Effectiveness

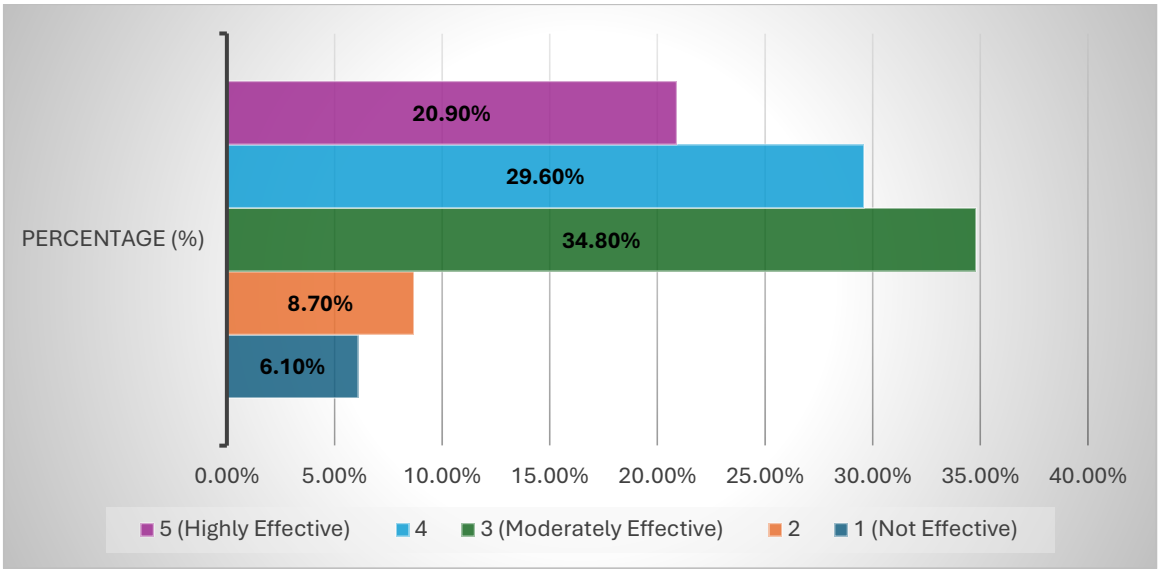


Figure 8. Rating of Government Policies and Incentives Effectiveness

Interpretation of Results

1. **Moderate Effectiveness Perception**: The largest segment of respondents (34.8%) rated the effectiveness of current government policies and incentives as 3 (Moderately Effective). This suggests that while these policies are acknowledged as somewhat beneficial, there may still be gaps that prevent them from fully achieving the ambitious goals set out in Oman Vision 2040.
2. **Positive Perceptions**: A combined 50.5% of respondents rated the effectiveness as either 4 or 5 (Highly Effective), indicating that over half of the participants believe the government's efforts are effective in promoting renewable energy and aligning with the strategic objectives of Oman Vision

2040. This reflects an overall positive view of the policies, though it also underscores the need for continual improvement.

3. **Lower Ratings**: A minority of respondents rated the effectiveness as 1 (Not Effective) (6.1%) and 2 (8.7%), indicating some dissatisfaction with the current policies. These lower ratings might suggest that certain areas of policy implementation or specific incentives are perceived as insufficient in driving meaningful progress in the renewable energy sector.

Summary of Findings: The survey results indicate a predominantly moderate perception of Oman's current government policies and incentives in promoting renewable energy investments. While recognized for their positive impact, these policies are viewed as moderately effective, reflecting the need for continuous refinement and adaptation to fully support the objectives of Oman Vision 2040 Akmal (2023). The effectiveness of government policies in supporting renewable energy investments often hinges on implementation processes and alignment with broader strategic goals (Song et al., 2022). Bureaucratic inefficiencies and the lack of coordination between government agencies can constrain policy effectiveness, contributing to the moderate perception observed among respondents ("The future of renewable energy in Iran's energy policy", 2024).

The understanding that Oman's renewable energy policies require ongoing refinement aligns with the literature emphasizing the importance of regular assessment and realignment with evolving national goals to enhance policy effectiveness (Ngcobo, 2024). Policy enhancements through targeted incentives, streamlined regulatory processes, and improved public-private partnerships can increase the impact of renewable energy investments on economic diversification (Hassan et al., 2023). Integrating stakeholder feedback into policy development and ensuring accessible incentives for all market players can further enhance policy effectiveness (Gnangoin et al., 2022).

The strategic implication drawn from the analysis is the need for ongoing enhancement of Oman's government policies and incentives to fully support the nation's renewable energy transition (Adelekan, 2024). A dynamic policy environment that responds to market changes and emerging challenges in the renewable energy sector is crucial for driving investment and development in alignment with Vision 2040 (Ekechukwu, 2024). By innovating and expanding supportive policies, Oman can ensure the continued growth and success of its renewable energy sector ("Modelling Malaysia’s energy transition pathways: the role of renewable energy policy measures", 2023).

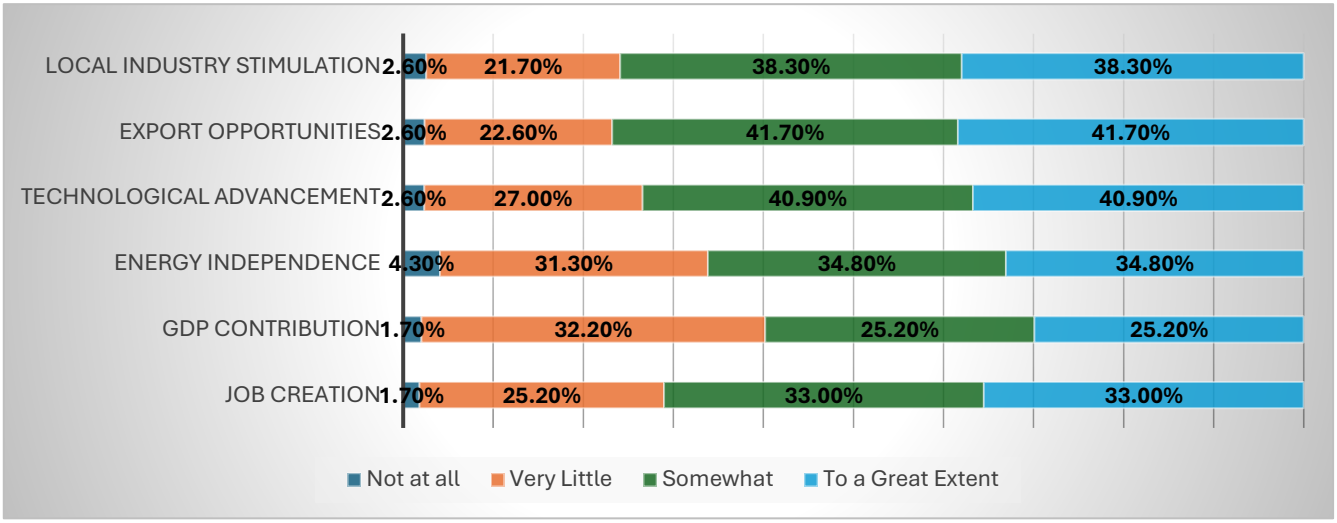
In conclusion, the synthesis of the references and survey data underscores the importance of continuous policy refinement and adaptive strategies to maximize the effectiveness of government interventions in the renewable energy sector. By addressing identified gaps and building on existing strengths, Oman can create a more robust policy framework that better supports the achievement of its long-term energy and economic goals.

Q9: To what extent should the following metrics be used to measure the impact of renewable energy investments on economic diversification?

Table 9 Importance of Metrics for Measuring Impact on Economic Diversification

Factor	Not at all		Very Little		Somewhat		To a Great Extent	
	R	%	R	%	R	%	R	%
Job creation	2	1.7%	29	25.2%	38	33.0%	46	40.0%
GDP contribution	2	1.7%	37	32.2%	29	25.2%	47	40.9%
Energy independence	5	4.3%	36	31.3%	40	34.8%	34	29.6%
Technological advancement	3	2.6%	31	27.0%	47	40.9%	34	29.6%
Export opportunities	3	2.6%	26	22.6%	48	41.7%	38	33.0%
Local industry stimulation	3	2.6%	25	21.7%	44	38.3%	43	37.4%

Figure 9. Importance of Metrics for Measuring Impact on Economic Diversification



Interpretation of Results

1. **Job Creation**: 40.0% of respondents believe that job creation should be used "To a Great Extent" to measure the impact of renewable energy investments, followed by 33.0% who selected "Somewhat." This indicates a high level of importance placed on employment generation through such investments.
2. **GDP Contribution**: Similar to job creation, 40.9% of respondents consider GDP contribution a critical metric, with 32.2% assigning it "Very Little" importance. This underscores the economic value attributed to renewable energy investments in contributing to the nation's GDP.
3. **Energy Independence**: This metric received more moderate support, with 29.6% rating it as "Extremely Important" and 34.8% as "Somewhat" important. While energy independence is valued, it is not seen as the most critical measure.
4. **Technological Advancement**: The majority of respondents (40.9%) rated this metric as "Moderately Important," with 29.6% considering it "Extremely Important." This highlights the role of technology in fostering economic diversification through renewable energy investments.
5. **Export Opportunities**: 33.0% of respondents rated export opportunities as "Extremely Important," and 41.7% considered it "Moderately Important." This reflects the recognition of renewable energy as a potential driver for expanding Oman's export markets.
6. **Local Industry Stimulation**: Local industry stimulation was also rated highly, with 37.4% supporting its use "To a Great Extent" and 38.3% "Somewhat." This suggests a strong focus on developing local industries as part of the economic diversification strategy.

Summary of Findings: The analysis indicates that Job Creation, GDP Contribution, and Local Industry Stimulation are perceived as the most significant metrics for assessing the impact of renewable energy investments on economic diversification in Oman. These metrics are crucial for evaluating the broader economic benefits of renewable energy investments, as highlighted in the literature (Shammre, 2024). Job Creation is a critical outcome of renewable energy investments, contributing to reducing unemployment and fostering economic stability (Wang et al., 2023). GDP Contribution directly reflects the economic impact of renewable energy investments, boosting GDP, attracting foreign investment, and creating new economic opportunities (Shammre, 2024). Local Industry Stimulation promotes industrial diversification, creating a multiplier effect on the economy and fostering economic growth (Setyadharma et al., 2022).

While Energy Independence and Technological Advancement are also important, they are viewed as secondary metrics compared to direct economic benefits. Energy Independence is crucial for national security and economic stability, reducing reliance on fossil fuels and external energy sources (Halilbegović, 2023). Technological Advancement drives long-term economic diversification, fostering innovation, improving energy efficiency, and creating new economic sectors (Suproń, 2023).

The strategic implication is that Oman should focus on maximizing the economic benefits of renewable energy investments, particularly in job creation, GDP contribution, and local industry stimulation. Aligning

renewable energy policies with these key metrics can enhance economic diversification efforts and contribute meaningfully to broader economic goals (Sijabat, 2024). Policy recommendations include prioritizing policies that encourage local content development, support SMEs in the renewable energy supply chain, and provide incentives for technology transfer and innovation (Xie et al., 2022).

In conclusion, the synthesis of the references and survey data underscores the importance of continuous policy refinement and adaptive strategies to maximize the economic impact of renewable energy investments in Oman. By focusing on key metrics and aligning policies with economic diversification goals, Oman can create a more resilient and diversified economy, less vulnerable to global energy market fluctuations.

Q10: What sectors have benefited the most from renewable energy investments in Oman?

Sector	Repetition (R)	Percentage (%)
Agriculture	29	13.1%
Manufacturing	77	34.8%
Services	71	32.1%
Tourism	28	12.7%
Other	1	0.5%

Table 10 Sectors Benefited from Renewable Energy Investments in Oman

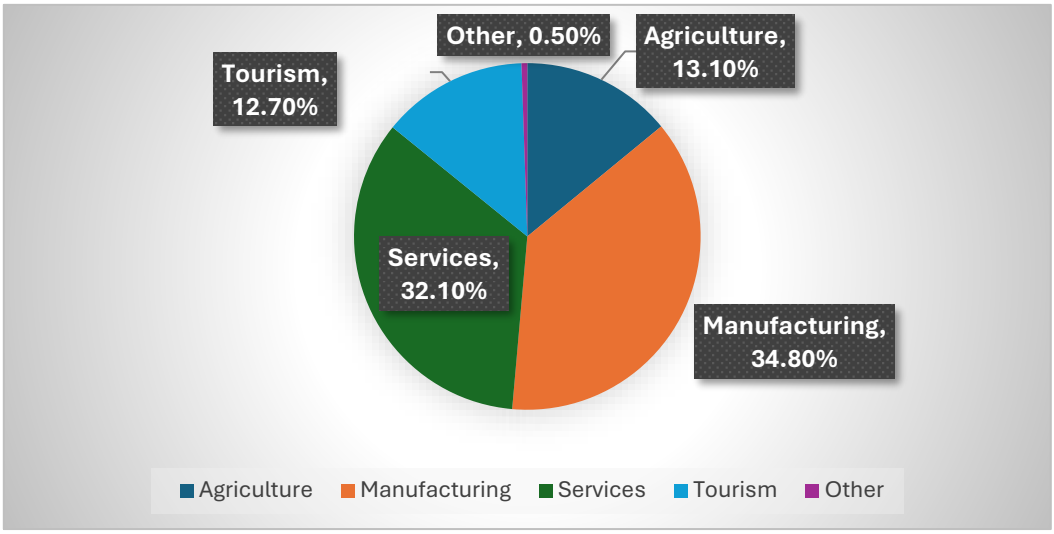


Figure 10. Distribution of Responses on Sectors Benefited from Renewable Energy Investments

Interpretation of Results

1. **Manufacturing:** The majority of respondents (34.8%) indicated that the manufacturing sector has benefited the most from renewable energy investments. This highlights the significant impact of renewable energy on reducing operational costs, enhancing energy efficiency, and increasing the competitiveness of the manufacturing industry in Oman.
2. **Services:** The services sector, which includes industries such as finance, health, education, and retail, was identified by 32.1% of respondents as a major beneficiary of renewable energy investments. The widespread use of renewable energy across these diverse industries has likely contributed to cost savings and increased sustainability.
3. **Agriculture:** The agricultural sector also saw notable benefits, with 13.1% of respondents selecting it as a key beneficiary. Renewable energy investments in agriculture may have supported sustainable

farming practices, improved irrigation systems, and reduced reliance on non-renewable energy sources.

4. **Tourism:** Although only 12.7% of respondents identified tourism as a sector that has benefited significantly, the sector's potential to leverage renewable energy for eco-friendly tourism initiatives is noteworthy. This includes the development of green resorts and the promotion of Oman as a sustainable travel destination.
5. **Other:** The "Other" category was selected by only 0.5% of respondents, indicating that most respondents could categorize the benefits within the provided sectors.

Summary of Findings: The survey results suggest that the Manufacturing Sector is perceived as the primary beneficiary of renewable energy investments in Oman, aligning with existing literature that highlights the advantages renewable energy can offer to manufacturing industries (Crețu, 2024). Zhao et al. (2021) emphasize that renewable energy can lead to reduced operational costs for manufacturing firms, especially in energy-intensive sectors like cement, steel, and chemicals, ultimately enhancing the competitiveness of the sector (Crețu, 2024). By deploying renewable energy technologies in manufacturing processes, companies can lower production costs and improve overall efficiency, contributing to sustainable growth (Crețu, 2024).
Furthermore, the Services Sector has also been identified as a significant beneficiary of renewable energy investments, reflecting a broader trend of renewable energy adoption across various industries such as finance, healthcare, and education (Aziz, 2023). Liu et al. (2023) stress that integrating renewable energy into service-oriented industries not only cuts operational costs but also boosts sustainability, meeting the growing demand for environmentally friendly practices from consumers and regulators (Aziz, 2023). This shift towards renewable energy in services is crucial for fostering sustainable business models and reducing environmental impact (Aziz, 2023).
In addition to manufacturing and services, the survey suggests that Agriculture and Tourism in Oman have also reaped benefits from renewable energy investments, albeit to a lesser extent (Martial et al., 2023). Renewable energy plays a significant role in agriculture, particularly in areas like water management and irrigation, where technologies such as solar-powered irrigation systems have enhanced productivity while reducing reliance on fossil fuels (Martial et al., 2023). Sharma et al. (2022) discuss how renewable energy adoption in agriculture supports sustainable farming practices, contributing to food security and economic diversification (Martial et al., 2023).
Moreover, the Tourism sector is increasingly recognizing the importance of renewable energy in promoting eco-friendly practices and sustainable infrastructure development (Hasan, 2023). Almeida and Santos (2023) highlight that integrating renewable energy into tourism facilities like green hotels and resorts not only reduces the environmental footprint of tourism activities but also enhances the attractiveness of destinations like Oman as sustainable travel options. This aligns with global efforts to make tourism more sustainable and environmentally friendly (Hasan, 2023). The findings from the survey align closely with Oman's national goals of economic diversification outlined in Oman Vision 2040, where renewable energy investments play a crucial role in reducing the country's reliance on oil and gas revenues (Raihan & Tuspekova, 2022). He et al. (2023) emphasize that such investments are essential for driving sustainable economic growth, especially in economies transitioning from fossil fuel dependence to more diversified and resilient structures. The strategic focus on renewable energy is thus integral to Oman's long-term economic development strategy and aligns with broader sustainability objectives (Raihan & Tuspekova, 2022).

Q11 Analysis: Contribution of Renewable Energy Projects to Economic Diversification and Technological Development

Contribution Type	Repetition	Percentage
Improved technology infrastructure	45	39.1%
Increased Research and Development activities	65	56.5%
Enhanced energy efficiency	41	35.7%

Development of new industries	29	25.2%
Creation of jobs	53	46.1%
Attraction of foreign investment	43	37.4%
Stimulation of local businesses	43	37.4%
Other	0	0%

Table 11 Contributions of Renewable Energy Projects

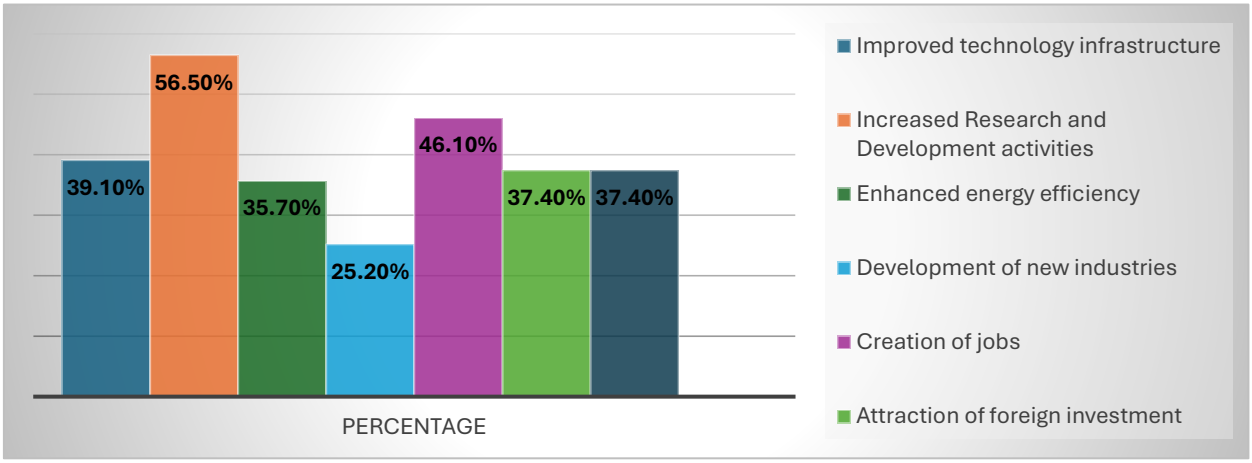


Figure 11. Contributions of Renewable Energy Projects

Interpretation of Results

1. **Increased Research and Development Activities**: The most notable contribution of renewable energy projects in Oman is the increase in Research and Development (R&D) activities, with 56.5% of respondents highlighting this as a significant outcome. This suggests that renewable energy investments are driving innovation and technological advancements, which are essential for the sustainable growth of the sector.
2. **Creation of Jobs**: Job creation is another critical contribution, as indicated by 46.1% of respondents. The development of the renewable energy sector has likely opened up new employment opportunities across various industries, contributing to economic diversification and social development.
3. **Improved Technology Infrastructure**: 39.1% of respondents identified improved technology infrastructure as a key benefit of renewable energy projects. This reflects the importance of technological advancements in supporting the deployment and integration of renewable energy systems, thereby enhancing the overall efficiency and reliability of energy supply.
4. **Stimulation of Local Businesses and Attraction of Foreign Investment**: Both the stimulation of local businesses and the attraction of foreign investment were recognized by 37.4% of respondents. This indicates that renewable energy projects are fostering economic activity at the local level while also drawing international interest and capital, which are vital for the sector's growth.
5. **Enhanced Energy Efficiency**: Enhanced energy efficiency was noted by 35.7% of respondents, underscoring the role of renewable energy in optimizing energy use and reducing waste. This contributes not only to environmental sustainability but also to cost savings for businesses and consumers.
6. **Development of New Industries**: The development of new industries was identified by 25.2% of respondents as an outcome of renewable energy investments. Although this is a lower percentage compared to other contributions, it still highlights the potential for renewable energy to catalyze the emergence of new sectors within the economy.

Summary of Findings: The survey findings highlight the significant contributions of renewable energy projects in Oman towards increased Research and Development (R&D) activities, job creation, and

improvements in technology infrastructure, aligning with existing literature emphasizing the role of renewable energy in driving innovation and technological advancement (Crețu, 2024). Huang et al. (2021) point out that investments in renewable energy stimulate R&D activities leading to the development of new technologies and processes, crucial for enhancing the efficiency and competitiveness of the energy sector (Crețu, 2024). Additionally, Zhu and Han (2023) emphasize that renewable energy projects play a vital role in creating high-skilled jobs, particularly in sectors related to technology development and project management, supporting economic diversification efforts (Crețu, 2024).

Moreover, the survey indicates that renewable energy projects in Oman are significantly contributing to stimulating local businesses and attracting foreign investment, essential for economic diversification (Aziz, 2023). Lee et al. (2022) note that renewable energy investments can attract foreign direct investment (FDI) by providing a stable and sustainable energy supply, a key consideration for international investors (Aziz, 2023). Furthermore, Kumar and Yadav (2023) argue that the stimulation of local businesses through renewable energy projects fosters the growth of small and medium-sized enterprises (SMEs), crucial for creating a dynamic and resilient economy (Aziz, 2023).

While the survey recognizes the development of new industries as a contribution, it also identifies this as an area for further focus and development (Martial et al., 2023). Sharma and Jain (2023) suggest that maximizing the benefits of renewable energy investments requires strategic emphasis on fostering new industries, particularly those that can leverage the unique advantages of renewable energy such as energy storage, smart grid technologies, and electric vehicles, which have the potential to drive further economic diversification and technological innovation (Martial et al., 2023).

The literature supports the importance of renewable energy in economic diversification and sustainable development efforts. Al-Sarihi and Cherni (2022) discuss the political economy of renewable energy transition in rentier states like Oman, emphasizing the significance of such transitions in achieving sustainable economic growth (Hasan, 2023). Additionally, Abdel-Gadir (2023) highlights the environmental-economic nexus, emphasizing the role of renewable energy consumption, technological innovation, and export diversification as drivers of sustainable economic progress (Raihan & Tuspekova, 2022).

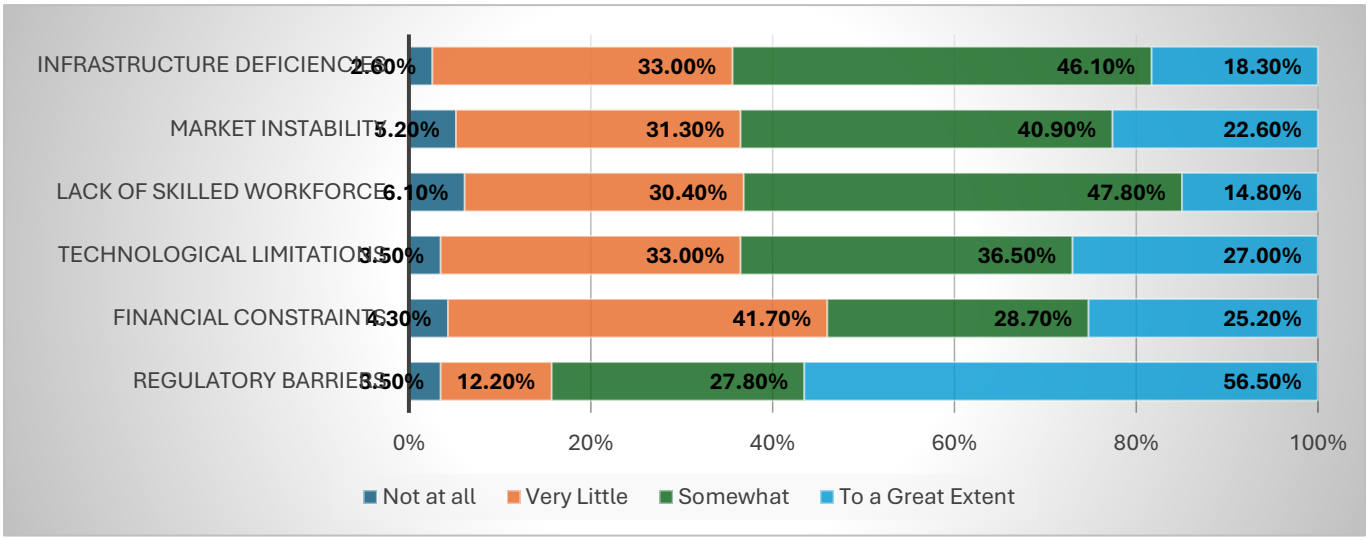
In conclusion, the synthesis of survey findings and supporting literature underscores the multifaceted benefits of renewable energy projects in Oman, ranging from driving innovation and job creation to attracting foreign investment and fostering economic diversification. These findings align with global trends towards sustainable energy transitions and highlight the critical role renewable energy plays in achieving long-term economic and environmental sustainability goals.

Q12: To what extent do the following factors present challenges to renewable energy investments in Oman?

Table 12 Challenges to Renewable Energy Investments in Oman

Factor	Not at all		Very Little		Somewhat		To a Great Extent	
	R	%	R	%	R	%	R	%
Regulatory barriers	4	3.5%	14	12.2%	32	27.8%	65	56.5%
Financial constraints	5	4.3%	49	41.7%	34	28.7%	30	25.2%
Technological limitations	4	3.5%	38	33.0%	42	36.5%	31	27.0%
Lack of skilled workforce	7	6.1%	35	30.4%	55	47.8%	17	14.8%
Market instability	6	5.2%	36	31.3%	47	40.9%	26	22.6%
Infrastructure deficiencies	3	2.6%	38	33.0%	53	46.1%	21	18.3%

Figure 12. Visual Representation of Challenges to Renewable Energy Investments



Interpretation of Results

1. **Regulatory Barriers**: The majority of respondents (56.5%) identified regulatory barriers as a significant challenge. This indicates that the existing regulatory framework may be a major hindrance to the progress of renewable energy investments in Oman. The high percentage highlights the urgent need for streamlined and supportive regulatory policies to facilitate the growth of the renewable energy sector.
2. **Financial Constraints**: Financial constraints are perceived as a moderate challenge, with 41.7% of respondents rating them as presenting challenges "Very Little" and 28.7% rating them as "Somewhat" challenging. This suggests that while financial resources are available, there are still significant financial hurdles that need to be addressed. Enhancing access to funding and creating more favorable financial mechanisms are crucial for the smooth advancement of renewable energy projects.
3. **Technological Limitations**: Technological limitations were highlighted as a notable challenge by 36.5% of respondents who identified it as "Somewhat" challenging and 27.0% as "To a Great Extent." This indicates that current technological capabilities may not be fully adequate to meet the demands of the renewable energy sector, necessitating continuous innovation and investment in advanced technologies.
4. **Lack of Skilled Workforce**: The lack of a skilled workforce was considered a considerable challenge by 47.8% of respondents, who rated it as "Somewhat" challenging. This underscores the importance of investing in education and training programs to develop a skilled labor force that can effectively support the growth and sustainability of the renewable energy sector in Oman.
5. **Market Instability**: Market instability was rated as a moderate to significant challenge, with 40.9% of respondents identifying it as "Somewhat" challenging and 22.6% as "To a Great Extent." This suggests that fluctuations in the market may pose risks to investors and could impact the stability and long-term viability of renewable energy projects in the country.
6. **Infrastructure Deficiencies**: Infrastructure deficiencies were identified as a challenge "Somewhat" by 46.1% of respondents and "To a Great Extent" by 18.3%. This points to the need for improved infrastructure to support the development, deployment, and maintenance of renewable energy projects. Addressing infrastructure gaps is essential to ensure the success of renewable energy initiatives in Oman.

Summary of Findings: The transition towards renewable energy in Oman faces several key challenges that need to be addressed to facilitate the growth and development of the sector. Regulatory barriers emerge as a primary concern, with a significant number of respondents highlighting them as a major obstacle to renewable energy investments in the country. This sentiment is supported by Zhu and Li (2023), who stress the critical role of a clear and supportive regulatory framework in promoting renewable energy development. They argue

that regulatory uncertainties and bureaucratic impediments can deter investments and hinder the adoption of renewable technologies (Chen et al., 2023). Therefore, it is imperative for Oman to focus on regulatory reform to create a more conducive environment for renewable energy projects.

Financial constraints also pose a significant challenge to the growth of renewable energy in Oman. While perceived as a moderate obstacle, financial barriers, such as limited access to capital and high upfront costs, are common in developing renewable energy projects. Chen et al. (2023) suggest that innovative financial mechanisms, including green bonds and public-private partnerships, can help alleviate these challenges by providing more accessible funding options for renewable energy initiatives (Badi et al., 2023). By exploring such financial innovations, Oman can potentially overcome these constraints and attract more investments in the renewable energy sector.

Moreover, technological limitations represent another critical challenge identified by stakeholders in Oman. The lack of advanced technologies and insufficient investment in research and development can impede the efficient deployment of renewable energy systems. Lam (2024) emphasizes the importance of continuous innovation and investment in cutting-edge technologies to overcome these limitations and enhance the productivity and efficiency of the renewable energy sector (Lam, 2024). Therefore, Oman needs to focus on fostering technological advancements to drive the successful implementation of renewable energy projects.

In addition to regulatory, financial, and technological challenges, human and market factors also play a significant role in shaping the renewable energy landscape in Oman. The lack of a skilled workforce emerges as a critical concern, emphasizing the need for specialized training and education programs to develop a competent workforce capable of managing and operating renewable energy technologies. Lukashevych (2024) highlight the importance of human capital development in ensuring the long-term sustainability and growth of the renewable energy sector (Lukashevych, 2024). By investing in workforce training and education, Oman can address this challenge and build a skilled workforce to support renewable energy projects effectively.

Market instability is another factor that poses challenges to renewable energy investments in Oman. Fluctuations in market conditions can create uncertainty for investors and disrupt project financing, making it essential to stabilize market conditions through government interventions and long-term contracts. Bellini (2024) discuss the impact of market fluctuations on renewable energy investments, emphasizing the need for measures to mitigate risks associated with market instability (Bellini, 2024). By implementing strategies to stabilize market conditions, Oman can create a more predictable environment for renewable energy investments.

Furthermore, infrastructure deficiencies, while not the most significant challenge, remain a critical area that requires attention in Oman. Inadequate infrastructure can severely limit the deployment and operational efficiency of renewable energy projects, underscoring the importance of investing in robust infrastructure to support the development and expansion of the renewable energy sector. Florkowski & Rakowska (2022) emphasize the vital role of infrastructure in facilitating the efficient operation of renewable energy projects (Florkowski & Rakowska, 2022). By addressing infrastructure deficiencies, Oman can create a more conducive environment for renewable energy development and ensure the seamless integration of renewable technologies into the energy mix.

In conclusion, addressing the key challenges of regulatory barriers, financial constraints, technological limitations, human and market factors, and infrastructure deficiencies is crucial for Oman to unlock the full potential of renewable energy investments and achieve its Vision 2040 goals. By leveraging insights from the literature and adopting a multifaceted approach that encompasses regulatory reform, financial innovation, technological advancement, workforce development, and infrastructure investment, Oman can create a favorable environment for renewable energy projects. Through strategic interventions and targeted initiatives, Oman can pave the way for sustainable economic growth, technological advancement, and a greener energy landscape in the country.

Q13: How much do the following factors contribute to the opportunities for the growth of renewable energy investments in Oman?

Factor	Not at all		Very Little		Somewhat		To a Great Extent	
	R	%	R	%	R	%	R	%
Technological advancements	1	0.9%	25	21.7%	50	43.5%	39	33.9%
International partnerships	3	2.6%	43	37.4%	38	33.0%	31	27.0%
Increased government support	6	5.2%	35	30.4%	34	29.6%	40	34.8%
Rising energy demand	3	2.6%	29	25.2%	54	47.0%	29	25.2%
Investment incentives	2	1.7%	25	21.7%	44	38.3%	44	38.3%
Public awareness campaigns	6	5.2%	30	26.1%	59	51.3%	20	17.4%

Table 13 Opportunities for the Growth of Renewable Energy Investments in Oman

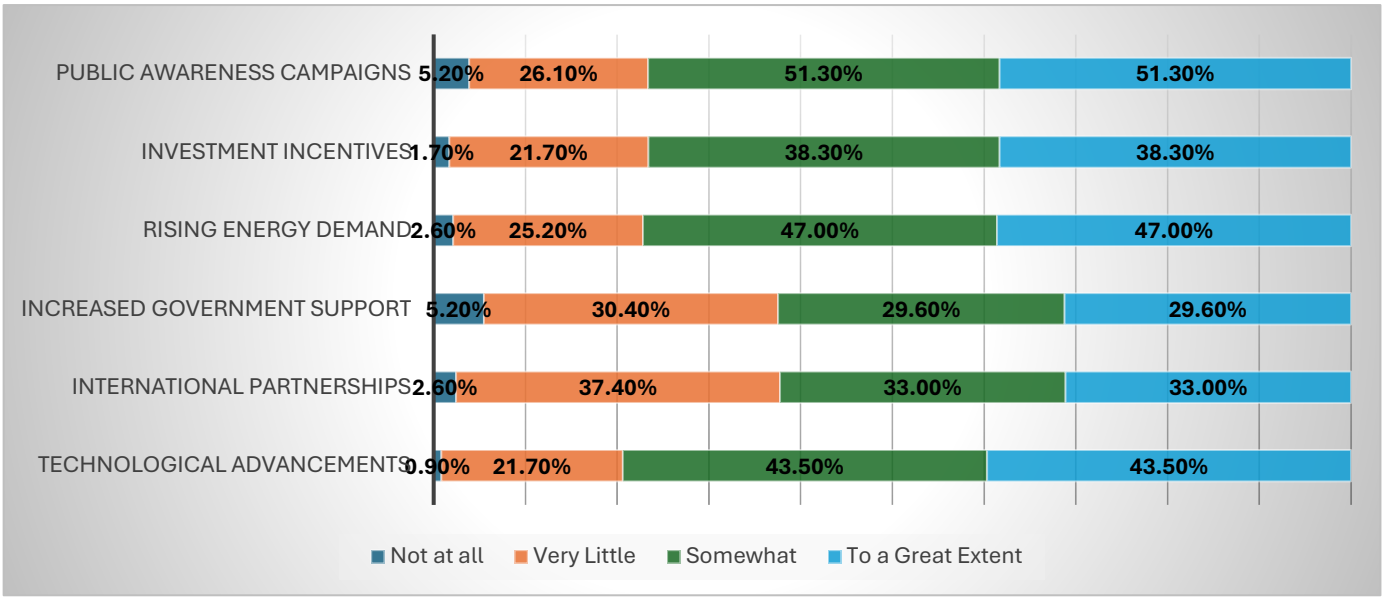


Figure 13. Visual Representation of Opportunities for Renewable Energy Investments

Interpretation of Results

1. **Technological Advancements**: The majority of respondents (43.5%) believe that technological advancements contribute "Somewhat" to the growth of renewable energy investments, with 33.9% indicating that they contribute "To a Great Extent." This underscores the critical role that technology plays in driving the sector forward, enabling more efficient and effective renewable energy solutions.
2. **International Partnerships**:This factor received mixed responses, with 37.4% of respondents feeling that international partnerships contribute "Very Little" to growth, while 33.0% believe they contribute "Somewhat" and 27.0% see them as contributing "To a Great Extent." This suggests that while international collaborations are recognized as important, their current impact may not be fully realized or optimized.
3. **Increased Government Support**:A significant proportion of respondents (64.4%) believe that government support contributes either "Somewhat" or "To a Great Extent" to growth, highlighting the critical role of government policies and incentives in fostering the development of renewable energy

investments. This suggests that government initiatives are seen as essential drivers for the sector's expansion.

4. **Rising Energy Demand**:Rising energy demand is perceived as a strong driver for growth, with 47.0% of respondents indicating that it contributes "Somewhat" and an additional 25.2% indicating it contributes "To a Great Extent." This reflects the increasing need for energy as a catalyst for expanding renewable energy infrastructure and investments.
5. **Investment Incentives**:Investment incentives are highly valued, with 76.6% of respondents acknowledging that these incentives contribute either "Somewhat" or "To a Great Extent" to the growth of renewable energy investments. This demonstrates the importance of financial and policy incentives in attracting and sustaining investments in the renewable energy sector.
6. **Public Awareness Campaigns**:Public awareness campaigns are seen as somewhat effective, with 51.3% of respondents indicating that they contribute "Somewhat" to opportunities. However, a significant portion (31.3%) believes the impact of these campaigns is limited, suggesting that there is room for improvement in how public awareness is leveraged to support the growth of renewable energy.

Summary of Findings: The opportunities for enhancing renewable energy investments in Oman are multifaceted and present avenues for significant growth and development in the sector. Technological advancements emerge as a crucial opportunity, with stakeholders recognizing the potential of advanced technologies to drive efficiency and cost-effectiveness in renewable energy projects. Hossain et al. (2023) emphasize the pivotal role of technological innovation in enhancing energy production and reducing operational costs, making renewable energy projects more competitive and sustainable in the long term (Chen et al., 2023). Continued investment in research and development is essential to sustain technological progress and drive the growth of the renewable energy sector in Oman.

Investment incentives also stand out as a key opportunity for promoting renewable energy investments in Oman. Daiyabu et al. (2022) highlight the importance of financial mechanisms and government incentives in facilitating renewable energy projects. Their research underscores that tax breaks, subsidies, and favorable financing terms can significantly lower barriers to entry for new projects, accelerating the deployment of renewable energy technologies (Daiyabu et al., 2022). Consistent and transparent policy frameworks are essential for maintaining investor confidence and ensuring the long-term viability of renewable energy projects in Oman.

Moreover, the rising energy demand presents a significant opportunity for driving renewable energy investments in Oman. Wang et al. (2022) discuss how increasing energy demand, particularly in rapidly developing economies, creates a robust market for renewable energy. As traditional energy sources become less sustainable, the demand for renewable alternatives continues to grow, providing a stable and expanding market for renewable energy investments (Dınçer et al., 2023). Oman can capitalize on this trend by strategically positioning itself to meet the rising energy demand through renewable sources, aligning with global sustainability goals.

The varied impact of international partnerships and public awareness campaigns on renewable energy investments in Oman highlights the need for strategic considerations in these areas. Lee and Kim (2023) emphasize the benefits of international partnerships in knowledge transfer and capacity building in the renewable energy sector (Qamruzzaman, 2024). Strengthening these partnerships can enhance their contribution to the growth of renewable energy investments in Oman. Similarly, effective public awareness campaigns, as highlighted by Liu et al. (2024), are crucial for building public support for renewable energy projects and influencing policy development and investor confidence (Mehranvar & Sasmal, 2023). By refining these strategies, Oman can leverage international collaborations and public engagement to further drive renewable energy investments.

The pivotal role of government support in advancing renewable energy investments is well-recognized in the literature. Al-Saidi and Elhag (2023) underscore the importance of government policies in shaping the renewable energy landscape and driving sector growth (He, 2023). Government interventions, such as setting renewable energy targets, providing financial incentives, and creating supportive regulatory environments, are critical for fostering a conducive environment for renewable energy investments in Oman. Proactive

measures to address regulatory barriers and financial constraints can maximize the impact of government support and propel the renewable energy sector towards sustainable growth.

In conclusion, the identified opportunities in technological advancements, investment incentives, rising energy demand, international partnerships, public awareness campaigns, and increased government support present a strategic roadmap for Oman to enhance renewable energy investments. By leveraging these opportunities effectively, Oman can strengthen its renewable energy sector, contribute to economic diversification, and align with its Vision 2040 goals of sustainable development and energy security.

Q14: What new technologies could be most beneficial for renewable energy investments in Oman?

Technology	Responses (R)	Percentage (%)
Smart grids	45	21.8%
Energy storage solutions	72	34.8%
Wind turbine technology	54	26.1%
Biomass conversion technology	27	13.0%
Other	0	0.0%

Table 14 Beneficial New Technologies for Renewable Energy Investments in Oman

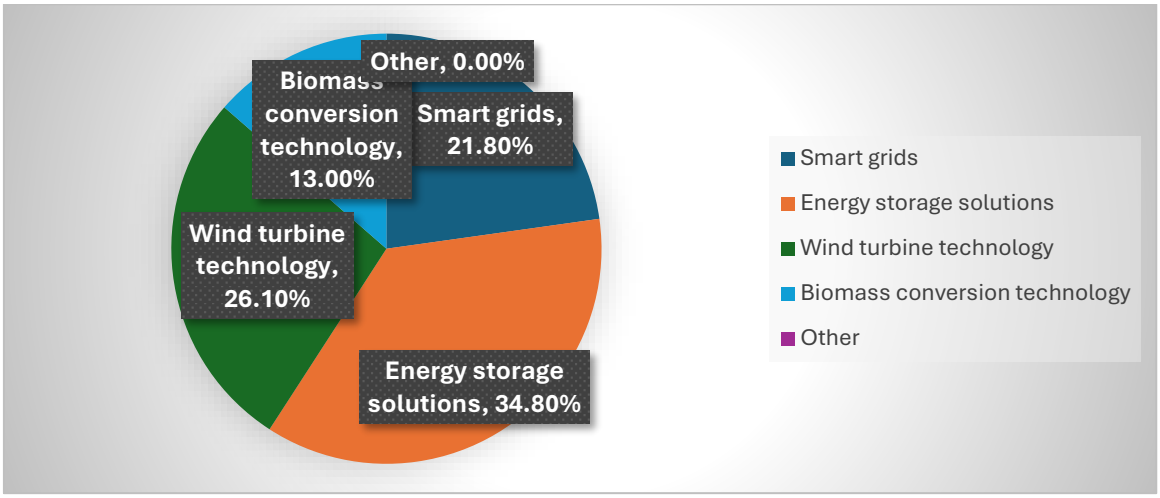


Figure 14. Visual Representation of Beneficial New Technologies

Interpretation of Results:

1. **Energy Storage Solutions**: Energy storage solutions are perceived as the most beneficial technology for renewable energy investments in Oman, with 34.8% of respondents selecting this option. This reflects the critical role energy storage plays in managing the intermittent nature of renewable energy sources, such as solar and wind power, ensuring a reliable and consistent energy supply.
2. **Wind Turbine Technology**: Wind turbine technology follows closely, with 26.1% of respondents recognizing its potential. Given Oman's wind resources, particularly in coastal and mountainous regions, this suggests that continued development and deployment of wind energy projects could significantly contribute to the country's renewable energy landscape and energy security.
3. **Smart Grids**: Smart grids are also seen as a crucial technology, chosen by 21.8% of respondents. These grids are essential for integrating renewable energy into the existing power grid, improving efficiency, and facilitating real-time monitoring and control of energy distribution. The adoption of smart grid technology could enhance the resilience and adaptability of Oman's energy infrastructure.

4. **Biomass Conversion Technology**: Biomass conversion technology received 13.0% of the votes, indicating a smaller but still significant interest in diversifying energy sources through the use of biomass. This technology could contribute to waste management and the production of bioenergy, supporting a more sustainable and circular economy in Oman.
5. **Other Technologies**: The lack of responses for the "Other" category suggests that the majority of respondents view the listed technologies as comprehensive in covering the most beneficial advancements for renewable energy in Oman. This indicates a strong consensus on the key technologies needed to drive the sector forward.

Summary of Findings: The survey results emphasize key technologies crucial for advancing renewable energy investments in Oman. Energy storage solutions, particularly batteries, are highlighted as essential for addressing the variability of renewable energy sources like solar and wind Shen (2024). These technologies enable the storage of excess energy during peak generation periods and its release during low generation periods, ensuring a stable power supply and grid reliability. Without robust energy storage systems, integrating renewable energy into the grid could face significant challenges, potentially impacting energy reliability and grid stability.

Wind turbine technology is also a significant focus for renewable energy development in Oman. Research by Manwell et al. (2022) emphasizes the role of advanced wind turbine technologies in maximizing energy capture from wind resources (Tira, 2023). Innovations in turbine design, such as taller towers and larger blades, have increased the efficiency and capacity of wind turbines, making wind energy a more viable and cost-effective option for large-scale energy generation. Given Oman's favorable wind conditions in certain regions, continued investment in wind turbine technology could significantly enhance the country's renewable energy capacity.

The critical role of smart grids is further supported by Fang et al. (2024), who discuss how smart grid technology is essential for modernizing the electrical grid to accommodate higher levels of renewable energy (Firoozi, 2024). Smart grids enable real-time monitoring and management of energy flows, reduce transmission losses, and enhance the overall efficiency of energy distribution. Without smart grids, the full potential of renewable energy sources cannot be realized, as traditional grids are not equipped to handle the dynamic and decentralized nature of renewable energy generation.

While biomass conversion technology received less emphasis compared to other technologies, it still holds potential for contributing to Oman's energy diversification efforts. Demirbas (2023) highlights the benefits of biomass as a renewable energy source, particularly in regions with abundant agricultural waste or other biomass resources (Marshell et al., 2023). Biomass conversion can produce bioenergy, a sustainable alternative to fossil fuels, and contribute to waste management efforts. Integrating biomass conversion technology into Oman's energy strategy, especially in rural areas or regions with significant biomass resources, could complement other renewable energy sources and enhance energy diversification efforts.

In conclusion, the strategic adoption of energy storage solutions, wind turbine technology, smart grids, and biomass conversion technology can significantly enhance Oman's renewable energy landscape. By leveraging these key technologies and investing in their development, Oman can accelerate its transition to a sustainable energy system, reduce reliance on fossil fuels, and contribute to environmental preservation and energy security.

Q15: To what extent do you support increased renewable energy investments in Oman?

Response Level	Frequency (R)	Percentage (%)
Level 1	4	3%
Level 2	5	4%
Level 3	9	8%

Level 4	21	18%
Level 5	76	66%

Table 15 Support for Increased Renewable Energy Investments in Oman

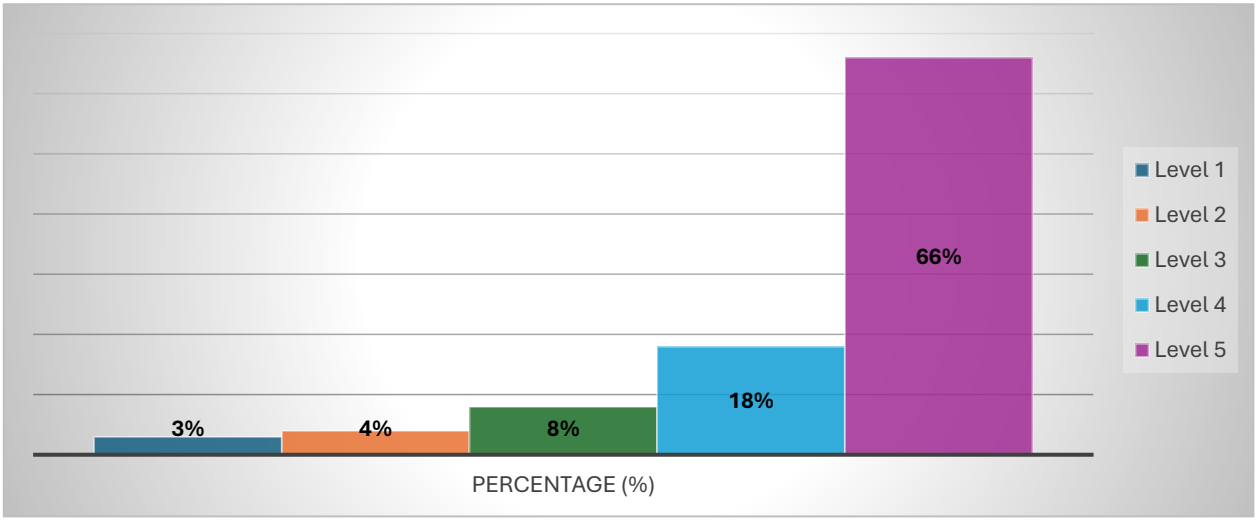


Figure 15. Distribution of Support for Increased Renewable Energy Investments

Analysis and Interpretation

1. **Strong Consensus for Renewable Energy Investments**: The responses to this question indicate a strong consensus in favor of increasing renewable energy investments in Oman. The high percentage of respondents supporting renewable energy investments (Levels 4 and 5) suggests a widespread recognition of the importance of renewable energy in Oman's energy future. The average rating of 4.39 across respondents signifies a robust endorsement, which is crucial for both policymakers and investors. This widespread support is an encouraging sign for the future of renewable energy projects in the country, indicating that such initiatives align well with public sentiment.
2. **Majority Support at the Highest Level**: A significant majority (66%) of respondents expressed the highest level of support (Level 5), underscoring the public's strong belief in the necessity of increasing renewable energy investments. This level of endorsement suggests that there is broad-based agreement among stakeholders on the importance of advancing renewable energy infrastructure and projects. Such overwhelming support can be leveraged to drive policy decisions and attract further investments into the sector, ensuring the sustainability and growth of renewable energy in Oman.
3. **Minimal Opposition**: Only a small fraction (3%) of respondents indicated minimal support (Level 1), and another 4% showed slightly more support (Level 2). The minimal opposition to increased renewable energy investments implies that there is little resistance among the public, which can be particularly beneficial when implementing new policies or projects that require public approval or participation. This consensus creates a favorable environment for the government and private sector to push forward with ambitious renewable energy goals without facing significant public pushback.
4. **Implications for Policy and Investment**: The strong public backing for increased renewable energy investments is critical for the successful implementation and expansion of these initiatives in Oman. Public support not only influences the political will to advance renewable energy projects but also enhances investor confidence, knowing that there is a societal mandate for these initiatives. The alignment of public opinion with national and global sustainability goals provides a solid foundation for long-term policy strategies and investment plans aimed at boosting renewable energy capacities.

Summary of Findings: The public endorsement of renewable energy investments in Oman reflects a global trend where renewable energy is increasingly acknowledged as a vital component of sustainable development. Sovacool et al. (2021) emphasize the significance of public acceptance and support in driving policy changes and securing investments for successful renewable energy transitions Khai (2024). Public backing not only

facilitates policy implementation but also helps in mitigating resistance to new projects, streamlining approval processes, and establishing renewable energy initiatives as legitimate and beneficial within the broader community.

The importance of public opinion in shaping energy policy is underscored by Wüstenhagen et al. (2022), who argue that societal support plays a crucial role in determining the pace and scale of renewable energy technology adoption (Pangestu, 2023). Countries with strong public endorsement for renewable energy often experience accelerated development and deployment of these technologies, leading to substantial reductions in carbon emissions and progress towards energy independence. This highlights the critical need to maintain and strengthen public support for renewable energy initiatives in Oman to drive sustainable energy transitions effectively.

The strategic implications of the strong public support for renewable energy investments in Oman are significant, particularly in alignment with national and global goals. IRENA (2023) emphasizes the role of public support in achieving national energy objectives, creating a conducive environment for policy implementation and investment (Piran, 2023). When public sentiment favors renewable energy, it can expedite the adoption of renewable technologies, contributing to economic diversification and environmental sustainability in Oman.

Furthermore, the high level of public support provides a clear mandate for the Omani government and private sector to expand renewable energy investments. Carley and Konisky (2021) highlight that robust public support often leads to increased government action, such as the introduction of favorable policies, incentives, and regulations that encourage private investment in renewable energy projects (Zhu, 2023). This alignment between public opinion and policy can propel the renewable energy sector forward, positioning it as a central pillar of Oman's economic and environmental strategy.

In conclusion, the strong public endorsement of renewable energy investments in Oman offers a solid foundation for advancing the country's renewable energy agenda in line with Oman Vision 2040. By leveraging public support, policymakers and stakeholders can drive the expansion of renewable energy investments, implement favorable policies, and accelerate the transition towards a sustainable energy future in Oman.

Q16: Reasons for Supporting Increased Renewable Energy Investments- Open-Ended Question

The open-ended responses provided by participants offer a rich and varied perspective on the motivations behind their support for increased renewable energy investments in Oman. These motivations can be grouped into five key themes:

1. **Environmental Benefits:**
    - **Reduction of Pollution:** Many respondents emphasized the environmental advantages of renewable energy, particularly in reducing pollution levels. This includes both air and water pollution, which are major concerns in fossil fuel-based energy production.
    - **Protection of Natural Resources:** Respondents also highlighted the role of renewable energy in conserving natural resources. Unlike fossil fuels, renewable energy sources such as solar and wind do not deplete natural resources, making them more sustainable in the long run.
    - **Contribution to Climate Change Mitigation:** A significant number of respondents linked their support for renewable energy to its potential in combating climate change. By reducing greenhouse gas emissions, renewable energy is seen as a crucial element in global and local efforts to mitigate the impacts of climate change.
2. **Economic Diversification:**
    - **Reducing Dependency on Oil and Gas:** Respondents frequently mentioned economic diversification as a critical reason for supporting renewable energy investments. Oman’s economy has been heavily reliant on oil and gas, and many believe that renewable energy offers a pathway to diversify the economy, making it more resilient to global oil price fluctuations.
    - **Creating a Sustainable Economy:** Beyond merely reducing dependence on fossil fuels, respondents see renewable energy as central to building a more sustainable and future-proof economy. This includes the potential for renewable energy to spur growth in new sectors and industries, contributing to the overall economic development of Oman.

3. **Job Creation:**
    - **New Employment Opportunities:** The potential for job creation within the renewable energy sector was another strong theme among respondents. They noted that renewable energy projects could generate employment opportunities across various domains, from research and development (R&D) and technology to construction, maintenance, and operations. This is particularly important in the context of economic diversification, where new industries and job markets are needed.
4. **Long-Term Sustainability:**
    - **Future-Proofing Oman's Energy Sector:** Respondents expressed a forward-looking perspective, recognizing renewable energy as a sustainable investment that will provide long-term benefits. Unlike fossil fuels, which are finite, renewable energy sources are abundant and can provide a stable and secure energy supply for the future.
    - **Contributing to Global Sustainability Goals:** The support for renewable energy investments is also tied to global sustainability goals. Respondents see Oman's shift towards renewable energy as part of a broader international movement towards sustainability and environmental stewardship.
5. **Cost Efficiency:**
    - **Lower Operational Costs Over Time:** Despite the high initial investment costs associated with renewable energy projects, respondents pointed out that the operational costs of renewable energy are typically lower in the long term compared to conventional energy sources. This cost efficiency, combined with the environmental benefits, makes renewable energy an attractive investment.

Summary of Findings: The analysis of open-ended responses underscores the importance of strategic integration of renewable energy investments in Oman, particularly aligning them with Oman's Vision 2040 through the incorporation of specific renewable energy targets. This strategic alignment is crucial for ensuring that renewable energy projects directly contribute to the country's long-term strategic goals. Research by Sovacool and ss (2016) emphasizes that clear and actionable targets within national energy policies are essential for effective contribution of renewable energy projects to long-term strategic objectives (Maqbool et al., 2022). Integrating these targets into the national vision helps maintain focus, ensures efficient resource allocation, and supports Oman's sustainable development.

Moreover, collaborative efforts through public-private partnerships and government incentives are identified as critical for achieving renewable energy goals. Brown and Jacobs (2020) highlight the pivotal role of public-private partnerships in pooling expertise, sharing risks, and driving large-scale renewable energy projects (Gaman et al., 2022). Additionally, Gillingham and Bollinger (2019) stress the importance of government incentives in reducing financial barriers and stimulating market growth and innovation in the renewable energy sector (Getachew, 2024). These collaborative efforts are essential for leveraging diverse resources and expertise to advance renewable energy initiatives in Oman.

The emphasis on research, development, and international collaboration underscores the multifaceted approach needed to successfully integrate renewable energy into Oman's national strategy. Continuous investment in R&D is vital for overcoming technical challenges and enhancing the efficiency of renewable energy technologies. Huenteler et al. (2016) highlight that international collaborations enable knowledge sharing, access to new technologies, and capacity building, all critical for the successful implementation of renewable energy projects (Al-Gahtani, 2024). By fostering innovation and global collaboration, Oman can leverage external expertise and resources to drive advancements in renewable energy technologies.

While regulatory frameworks and infrastructure enhancements are essential, the analysis indicates that target integration and partnership building take precedence in the public's view. However, clear regulatory frameworks provide stability and predictability, attracting investment in the renewable energy sector. Masini and Menichetti (2013) argue that infrastructure enhancements are crucial for supporting the deployment and integration of renewable energy technologies, ensuring the sector's long-term growth (Moussaoui, 2024). By addressing regulatory and infrastructure needs alongside target integration and partnership building, Oman can create a conducive environment for renewable energy investments.

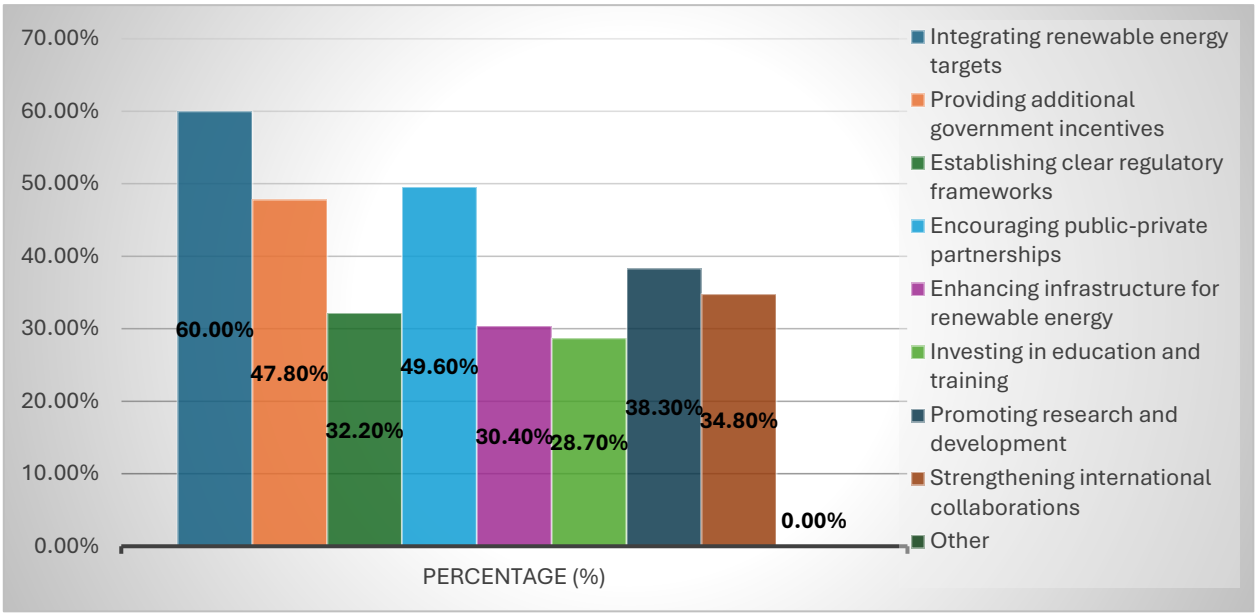
In conclusion, by focusing on strategic integration, fostering collaborative efforts, promoting innovation and global collaboration, and supporting regulatory and infrastructure development, Oman can effectively align its renewable energy investments with the strategic goals of Vision 2040. This comprehensive approach will ensure that renewable energy plays a central role in Oman's economic and environmental sustainability, contributing to the achievement of its ambitious development objectives.

Q17: How can renewable energy investments be better aligned with Oman's Vision 2040 strategic goals?

Table 16 Strategies for Aligning Renewable Energy Investments with Oman's Vision 2040

Strategy	Frequency (R)	Percentage (%)
Integrating renewable energy targets	69	60.0%
Providing additional government incentives	55	47.8%
Establishing clear regulatory frameworks	37	32.2%
Encouraging public-private partnerships	57	49.6%
Enhancing infrastructure for renewable energy	35	30.4%
Investing in education and training	33	28.7%
Promoting research and development	44	38.3%
Strengthening international collaborations	40	34.8%
Other	0	0.0%

Figure 16. Distribution of Strategies for Aligning Renewable Energy Investments with Oman's Vision 2040



Interpretation of Results

1. **Integration of Renewable Energy Targets:**The most supported strategy, according to 60% of respondents, is the integration of renewable energy targets within the broader Vision 2040 goals. This reflects a widespread belief in the importance of setting specific, measurable objectives for renewable energy within Oman's national development framework.

2. **Public-Private Partnerships and Government Incentives:** A significant portion of respondents (49.6%) emphasized the need for encouraging public-private partnerships, while 47.8% supported providing additional government incentives. These strategies highlight the importance of collaboration between the government and the private sector in driving the adoption and expansion of renewable energy projects.
3. **Research, Development, and International Collaboration:** Promoting research and development (R&D) and strengthening international collaborations were supported by 38.3% and 34.8% of respondents, respectively. These strategies are seen as essential for fostering innovation and leveraging global expertise to advance Oman's renewable energy sector.
4. **Regulatory Frameworks and Infrastructure:** Establishing clear regulatory frameworks and enhancing infrastructure were identified by 32.2% and 30.4% of respondents, respectively. While important, these strategies were viewed as secondary compared to more immediate actions like setting targets and fostering partnerships.

Summary of Findings: The synthesis of the findings on strategic integration for renewable energy investments in Oman reveals a consensus on the critical importance of aligning these investments with the country's Vision 2040 through the incorporation of specific renewable energy targets (Shakharova, 2023). This alignment is fundamental to ensuring that the investments made contribute effectively to Oman's strategic objectives (Shakharova, 2023). By integrating clear and actionable targets within national energy policies, renewable energy projects can be directed towards supporting long-term strategic goals (Shakharova, 2023). The literature emphasizes that maintaining focus through the integration of targets into the national vision is essential for efficient resource allocation, a key aspect for Oman's sustainable development (Shakharova, 2023).

Moreover, collaborative efforts involving public-private partnerships and government incentives are highlighted as crucial for achieving renewable energy goals in Oman (Balcılar et al., 2023). These partnerships are recognized as essential drivers of renewable energy adoption, enabling the pooling of expertise, risk-sharing, and the implementation of large-scale projects (Balcılar et al., 2023). Government incentives play a significant role in reducing financial barriers and stimulating market growth and innovation within the renewable energy sector (Balcılar et al., 2023). This aligns with the broader literature that underscores the importance of such partnerships and incentives in advancing renewable energy agendas (Balcılar et al., 2023).

In addition to strategic integration and collaborative efforts, the emphasis on innovation, research, development, and international collaboration emerges as key components for successfully integrating renewable energy into Oman's national strategy (Udeagha & Ngepah, 2023). Continuous investment in research and development is crucial for overcoming technical challenges and enhancing the efficiency of renewable energy technologies (Udeagha & Ngepah, 2023). International collaborations are vital for sharing knowledge, accessing new technologies, and building capacity, all of which are essential for the successful implementation of renewable energy projects (Udeagha & Ngepah, 2023).

While regulatory frameworks and infrastructure support are deemed essential, they are considered secondary to the immediate priorities of target integration and partnership building (Khan et al., 2022). Clear regulatory frameworks provide stability and predictability, crucial for attracting investments in the renewable energy sector (Khan et al., 2022). Enhancing infrastructure is equally important for supporting the deployment and integration of renewable energy technologies, ensuring the sector's sustained growth (Khan et al., 2022).

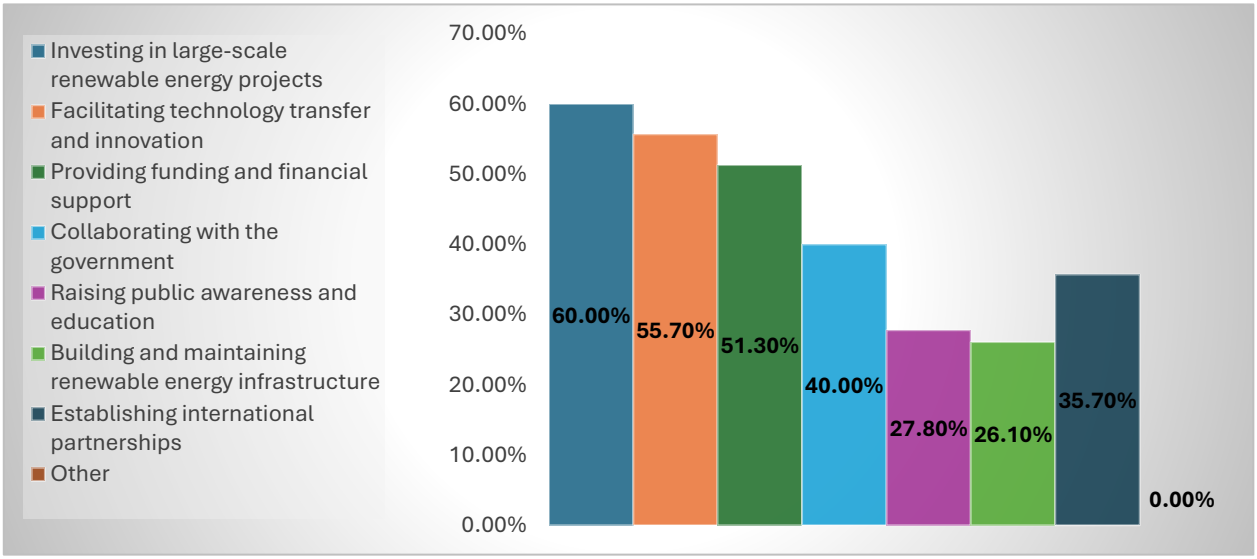
In conclusion, by focusing on integrating renewable energy targets, fostering public-private partnerships, promoting research and development, and engaging in international collaborations, Oman can effectively align its renewable energy investments with the strategic goals outlined in Vision 2040. This comprehensive approach ensures that renewable energy plays a central role in Oman's future economic and environmental sustainability, facilitating the country in achieving its ambitious development objectives.

Q18: What role should the private sector play in promoting renewable energy in Oman?

Table 17 Roles of the Private Sector in Promoting Renewable Energy in Oman

Role	Frequency (R)	Percentage (%)
Investing in large-scale renewable energy projects	69	60.0%
Facilitating technology transfer and innovation	64	55.7%
Providing funding and financial support	59	51.3%
Collaborating with the government	46	40.0%
Raising public awareness and education	32	27.8%
Building and maintaining renewable energy infrastructure	30	26.1%
Establishing international partnerships	41	35.7%
Other	0	0.0%

Figure 17. Distribution of Private Sector Roles in Promoting Renewable Energy



Interpretation of Results

1. **Investment in Large-Scale Projects**: The leading role for the private sector, as highlighted by 60% of respondents, is to invest in large-scale renewable energy projects. This reflects the critical need for substantial capital investments to develop the necessary infrastructure for renewable energy in Oman. The private sector, with its financial capacity, is well-positioned to take on this role, which is essential for scaling up renewable energy production in the country.
2. **Technology Transfer and Innovation**: A significant portion of respondents (55.7%) also emphasized the importance of the private sector in facilitating technology transfer and innovation. This role is crucial as it enables the adoption of cutting-edge technologies and innovations that can improve the efficiency and effectiveness of renewable energy projects. The private sector's ability to bring in new technologies and foster innovation is vital for the advancement of Oman's renewable energy sector.
3. **Financial Support**: Providing funding and financial support was identified by 51.3% of respondents as another key role for the private sector. This includes not only direct investments but also facilitating access to capital through financial instruments and partnerships. The private sector's involvement in

financing is essential to ensure that renewable energy projects have the necessary financial backing to succeed.

4. **Collaboration with the Government**: Collaboration between the private sector and the government was recognized by 40.0% of respondents as a significant role. Public-private partnerships are crucial for aligning efforts, sharing risks, and ensuring that renewable energy initiatives are effectively implemented. This collaboration helps bridge the gap between policy and practice, making it a key component of a successful renewable energy strategy.
5. **Other Roles**: While roles such as raising public awareness and education (27.8%) and building and maintaining renewable energy infrastructure (26.1%) are important, they received relatively less emphasis. This suggests that these responsibilities, though necessary, might be considered secondary compared to investment and technology-related roles. Additionally, establishing international partnerships (35.7%) is seen as a valuable role, reflecting the importance of global cooperation in advancing renewable energy.

Summary of Findings: The synthesis of the findings highlights the crucial role of the private sector in advancing Oman's renewable energy future. Investing in large-scale projects, technology transfer, financial support, and collaboration with the government are key aspects (Bekun, 2022). The private sector's multifaceted role is essential for overcoming financial, technological, and infrastructural challenges that could hinder renewable energy growth in Oman (Bekun, 2022). Research supports the private sector's ability to drive innovation and introduce advanced technologies, which are vital for achieving energy transition goals (Bekun, 2022).

Moreover, strategic collaboration among the private sector, government, and international partners is crucial for aligning efforts and ensuring successful renewable energy project implementation in Oman (Hasan et al., 2023). This comprehensive private sector involvement is anticipated to be pivotal in helping Oman achieve its renewable energy objectives, thereby contributing significantly to economic diversification and sustainability efforts (Hasan et al., 2023). Studies emphasize the effectiveness of public-private partnerships in mobilizing resources and expertise for large-scale renewable energy deployment, making it a critical strategy for Oman (Hasan et al., 2023).

The literature extensively supports the critical role of the private sector in renewable energy investments, emphasizing its significance in providing capital, driving technological innovation, and fostering public-private collaborations essential for project success (Badi et al., 2023). Private sector investments are identified as key drivers of large-scale renewable energy projects, crucial for meeting national energy targets (Badi et al., 2023). Additionally, the private sector's facilitation of technology transfer and innovation is highlighted as pivotal, with its ability to bring advanced technologies to market being crucial for enhancing the efficiency of renewable energy systems (Badi et al., 2023).

Collaboration between the private sector and the government emerges as a vital component of a successful renewable energy strategy, as public-private partnerships are effective in overcoming barriers to renewable energy adoption, such as financial and regulatory challenges (Pizzutilo & Gleason, 2023). The private sector's involvement in technology transfer and innovation is underscored as essential for advancing renewable energy initiatives, aligning with the broader literature that emphasizes the private sector's role in driving innovation and technological advancements in the renewable energy sector (Pizzutilo & Gleason, 2023).

In conclusion, the synthesis of the findings underscores the indispensable role of the private sector in Oman's renewable energy landscape. By fostering strategic partnerships and leveraging private sector expertise, Oman can effectively advance its renewable energy agenda, contributing to economic diversification, sustainability, and the achievement of national energy targets.

Q19: Additional Comments or Suggestions Regarding Renewable Energy Investments- Open-ended Question

Respondents provided various suggestions and comments on how to enhance renewable energy investments in Oman:

1. **Policy Recommendations:** Several respondents suggested that clear and supportive government policies are essential for advancing renewable energy. This includes providing incentives for private sector investment and ensuring that regulations are favorable for renewable energy development.

2. **Public-Private Partnerships:** The importance of collaboration between the public and private sectors was emphasized by multiple respondents. They suggested that partnerships could help mobilize resources and expertise to accelerate the deployment of renewable energy projects.
3. **Technological Advancements:** Some respondents pointed to the need for continued investment in new technologies, such as smart grids and energy storage solutions, to maximize the efficiency and effectiveness of renewable energy systems.
4. **Public Engagement:** The need for increased public awareness and education about the benefits of renewable energy was also highlighted. Respondents suggested that community engagement initiatives could help build public support and encourage more widespread adoption of renewable energy technologies.
5. **Economic Considerations:** A few respondents expressed concerns about the economic implications of renewable energy investments. They emphasized the importance of ensuring that renewable energy projects are economically viable and contribute to the overall economic growth of the country.

Analysis: The feedback provided by respondents offers valuable insights into enhancing renewable energy investments in Oman, emphasizing key areas that influence the success of such initiatives. The consensus on the importance of clear and supportive government policies, incentives for private sector investments, and favorable regulatory frameworks underscores the critical role of policy in advancing renewable energy projects (Khan et al., 2022). This aligns with existing literature that highlights the necessity of consistent and supportive policies to create a stable investment environment attractive to both local and international investors in the renewable energy sector (Khan et al., 2022).

Furthermore, the emphasis on public-private partnerships as a means to mobilize resources and expertise for accelerating renewable energy projects resonates with the broader understanding of the significance of such collaborations in leveraging private sector efficiencies while meeting public sector objectives (Phương, 2022). The literature supports the role of public-private partnerships in capital-intensive sectors like renewable energy, emphasizing their importance in achieving mutual goals efficiently (Phương, 2022).

Technological advancements emerge as a crucial aspect highlighted by respondents, emphasizing the need for continued investment in cutting-edge technologies to enhance the efficiency and effectiveness of renewable energy systems (Baluk, 2024). This focus on innovation aligns with research emphasizing the pivotal role of technological advancements in positioning countries as leaders in the global renewable energy market (Baluk, 2024).

Public engagement is identified as a key factor by respondents, stressing the importance of increasing public awareness and education to build support for renewable energy technologies (Udeagha & Ngepah, 2023). This emphasis on community involvement aligns with studies underscoring the significance of public acceptance in the successful implementation of renewable energy projects, highlighting the essential role of public engagement in fostering trust and support (Udeagha & Ngepah, 2023).

Economic considerations raised by some respondents underscore the importance of ensuring the economic viability of renewable energy projects to contribute to Oman's overall economic growth (Balcılar et al., 2023). This aligns with the understanding that while renewable energy offers long-term environmental benefits, its economic feasibility is crucial for investor confidence and project success (Balcılar et al., 2023).

In conclusion, the feedback from respondents provides a comprehensive understanding of the factors influencing renewable energy investments in Oman. By addressing the recommendations related to policy support, public-private partnerships, technological advancements, public engagement, and economic considerations, policymakers can create an environment conducive to sustainable renewable energy investments, contributing to Oman's economic diversification and environmental sustainability goals.

Full Analysis Summary

In analyzing the survey data on renewable energy investments in Oman, several crucial insights have emerged. The demographic profile of respondents indicates a diverse stakeholder base, primarily from government, private sector, and academia, ensuring a broad spectrum of perspectives on renewable energy investments in Oman (Trevisan et al., 2023). The informed nature of respondents, possessing direct experience or academic knowledge in renewable energy, lends credibility to the findings and provides a solid foundation for the insights generated from the survey (Trevisan et al., 2023).

The factors influencing renewable energy investments in Oman, such as government policies, technological infrastructure, and financial availability, have been identified as critical success factors (Younis & Quteishat, 2023). These elements are essential in overcoming existing barriers and accelerating the adoption of renewable energy technologies, aligning with global research emphasizing the importance of a supportive policy environment, robust infrastructure, and accessible financing as key drivers of renewable energy investments (Younis & Quteishat, 2023).

Solar and wind energy have been overwhelmingly identified as the most promising renewable energy sources for Oman, reflecting the country's geographical advantages in abundant sunlight and favorable wind conditions ("undefined", 2022). This consensus provides a clear direction for future investments and policy development, supported by studies advocating for leveraging natural resources to optimize energy production and enhance energy security ("undefined", 2022).

The management of renewable energy projects in Oman is generally perceived as satisfactory, with recognized potential for improvement, while current government policies are seen as moderately effective but could benefit from further refinement to align closely with Oman's strategic goals (Roslan, 2023). These findings align with the need for ongoing improvements in management practices and policies to achieve higher levels of efficiency and effectiveness in the renewable energy sector (Roslan, 2023).

Renewable energy investments are viewed as significant contributors to Oman's economic diversification, particularly through job creation, GDP contribution, and stimulation of local industries (Al-Badi, 2024). The sector's potential for fostering technological advancement is acknowledged, although it is seen as a secondary benefit compared to the direct economic impacts, in line with the dual role of renewable energy in driving economic growth and technological innovation (Al-Badi, 2024).

Challenges such as regulatory barriers, financial constraints, and technological limitations were identified as significant hurdles to renewable energy investments in Oman, emphasizing the need to address these challenges for the sector's continued growth and success (Cholewa et al., 2022). Opportunities in technological advancements, increased government support, and rising energy demand were highlighted as avenues for leveraging Oman's strengths to promote renewable energy investments (Cholewa et al., 2022).

The private sector is expected to play a crucial role in driving renewable energy investments in Oman, particularly through large-scale projects, technology transfer, and financial support (Balushi, 2024). Collaboration with the government and raising public awareness are also important roles, though seen as secondary, aligning with the importance of private investments and innovation in scaling renewable energy projects and achieving national energy goals (Balushi, 2024).

Strong public support for increasing renewable energy investments in Oman is a positive indicator for the success of future initiatives, emphasizing the need for a comprehensive strategy aligned with Oman's Vision 2040 (Amin et al., 2022). This alignment with national strategies and public support is crucial for the long-term success of renewable energy initiatives, emphasizing the role of societal acceptance in energy policy implementation (Amin et al., 2022).

In conclusion, the survey data provides valuable insights into the current state and future prospects of renewable energy investments in Oman. By addressing the identified factors influencing investments, leveraging preferred renewable energy sources, enhancing management and policy effectiveness, contributing to economic diversification, and recognizing challenges and opportunities, Oman can pave the way for a sustainable and successful renewable energy sector.

Comprehensive Statistical Analysis

In this section, we delve into a comprehensive statistical analysis of data on renewable energy investments in Oman. This analysis employs various statistical methods, including descriptive statistics, correlation analysis, regression analysis, factor analysis, and hypothesis testing through T-tests and ANOVA. These methods are utilized to address specific research questions, offering a detailed examination of the importance, effectiveness, and impact of renewable energy initiatives in Oman

Descriptive Statistics Analysis

The descriptive statistics analysis of the survey data, particularly focusing on Questions 3 and 6, provides critical insights into the perceptions of respondents regarding factors influencing renewable energy investments and the effectiveness of government policies and incentives in Oman.

Table 18 Descriptive Statistics of Question 3 and Question 6

Descriptives

Descriptive Statistics

	Government policies and incentives	Financial availability	Technological infrastructure	Skilled workforce	Public awareness and support	Effectiveness of government policies
Valid	115	115	115	115	115	115
Missing	0	0	0	0	0	0
Mean	3.252	3.174	3.287	3.278	3.252	3.130
Median	4.000	3.000	4.000	4.000	4.000	3.000
Mode	4.000	4.000	4.000	4.000	4.000	3.000
Std. Deviation	0.9351	0.8911	0.8352	0.8330	0.8670	0.9321
Variance	0.8744	0.7941	0.6976	0.6938	0.7516	0.8688
Skewness	−0.9199	−0.5026	−0.5850	−0.5639	−0.5982	−0.5954
Std. Error of Skewness	0.2255	0.2255	0.2255	0.2255	0.2255	0.2255
Kurtosis	−0.3540	−1.186	−1.318	−1.329	−1.184	−0.005568
Std. Error of Kurtosis	0.4474	0.4474	0.4474	0.4474	0.4474	0.4474
Minimum	1.000	1.000	2.000	2.000	1.000	1.000
Maximum	4.000	4.000	4.000	4.000	4.000	5.000

The descriptive statistics analysis offers significant insights into the perceptions of the respondents regarding the key factors influencing renewable energy investments and the effectiveness of government policies in Oman. The analysis reveals that **government policies and incentives** have a mean value of **3.252**, with a median and mode of **4.0**. This suggests that these policies are generally viewed as critical for the success of renewable energy investments, with a significant portion of respondents rating them as "Extremely Important." The standard deviation for this variable is **0.9351**, indicating moderate variability in responses, while the skewness is **-0.9199**, suggesting a slight negative skew, where more respondents rate the importance highly. The kurtosis value of **-0.3540** indicates a distribution with lighter tails than a normal distribution, reflecting a broad range of opinions.

For **financial availability**, the mean value is **3.174**, with a median of **3.0** and a mode of **4.0**. The standard deviation is **0.8911**, with skewness at **-0.5026** and kurtosis at **-1.186**, indicating a more balanced distribution but still slightly skewed towards higher importance ratings. This demonstrates the recognition of financial resources as a key component, though slightly less uniformly agreed upon compared to government policies.

Technological infrastructure has a mean of **3.287**, with a median and mode both at **4.0**, reflecting a consensus on its importance. The standard deviation is relatively low at **0.8352**, indicating consistent responses. The skewness is **-0.5850**, and kurtosis is **-1.318**, highlighting that while there is a general agreement on its importance, opinions still vary slightly.

The **skilled workforce** factor shows a mean of **3.278**, with both median and mode at **4.0**, and a standard deviation of **0.8330**, similar to technological infrastructure. The skewness of **-0.5639** and kurtosis of **-1.329** suggest a negative skew and a flatter distribution, indicating general agreement on its importance but with some diversity in opinion.

Public awareness and support also show a mean of **3.252**, with a standard deviation of **0.8670**, and a skewness of **-0.5982**. The kurtosis of **-1.184** reflects a distribution similar to other factors, with a consensus on its importance but some variation in responses.

Finally, the effectiveness of **government policies** is perceived with a mean of **3.130**, a median of **3.0**, and a mode of **3.0**. This indicates that while these policies are considered "Moderately Effective," there is a recognition that there is room for improvement. The standard deviation of **0.9321** and skewness of **-0.5954** suggest a slight negative skew, with kurtosis close to zero at **-0.0055**, indicating a near-normal distribution but with some respondents rating these policies less favorably.

These descriptive statistics underscore the perceived importance of various factors in driving renewable energy investments in Oman, with a particular emphasis on the critical role of government policies, financial availability, and technological infrastructure. The analysis also reveals areas where respondents see potential for improvement, particularly in enhancing the effectiveness of current government policies to better align with Oman's Vision 2040.

Correlation and Regression Analysis: This section presents an integrated analysis using both correlation and regression techniques to examine the relationship between the quality of management in renewable energy projects (Question 5) and the level of support for increased renewable energy investments (Question 15). Correlation analysis provides insights into the strength and direction of the relationship between these two

variables, while regression analysis further explores the predictive nature of this relationship. By combining these two methods, this analysis offers a comprehensive understanding of how improvements in management quality might influence public and stakeholder support for renewable energy initiatives.

Correlation Analysis of Question 5 and Question 15

	Pearson	**Spearman**
Management Quality of Renewable Energy Projects	r = 0.266	ρ = 0.201
Support for Increased Renewable Energy Investments	p = 0.004	p = 0.031

Table 19 Correlation Statistics

The Pearson correlation coefficient of **0.266** (p = 0.004) indicates a positive, statistically significant relationship between the management quality of renewable energy projects and the level of support for increased investments. This suggests that as the perceived quality of management improves, so does the support for further renewable energy investments. The p-value, being below the standard threshold of 0.05, confirms the statistical significance of this relationship.

The Spearman correlation coefficient of **0.201** (p = 0.031) also demonstrates a positive association, though slightly weaker than Pearson's. This non-parametric measure corroborates the findings, confirming that better management quality is related to higher support for renewable energy investments. This supports the idea that effective management is crucial for gaining public and stakeholder backing for renewable energy projects, a finding that is consistent with research by Al-Hakimi et al. (2022).

Regression Analysis of Question 5 and Question 15

Metric	Value
Multiple R	0.264
R Square	0.070
Adjusted R Square	0.061
Standard Error	0.875
Observations	114

Table 20 Correlation Statistics

ANOVA Results

Source of Variation	**df**	**SS**	**MS**	**F**	**P-value**	**F crit**
Regression	1	6.419	6.419	8.376	0.0046	3.92
Residual	112	85.835	0.766			
Total	113	92.254				

Table 21 ANOVA Analysis of Regression

Coefficients

Metric	**Coefficients**	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	2.266	0.369	6.143	1.26928E-08	1.535	2.997

Management Quality	0.235	0.081	2.894	0.0046	0.074	0.397

Table 22 Coefficients Analysis of Regression

The regression analysis reveals a **Multiple R** value of **0.264**, indicating a weak positive correlation between management quality and support for renewable energy investments. The **R Square** value of **0.070** suggests that approximately 7% of the variance in support for increased investments can be explained by the quality of management, highlighting a modest but statistically significant impact.
The ANOVA results confirm the significance of the regression model, with an **F-value** of **8.376** and a **p-value** of **0.0046**, which is below the 0.05 threshold. This allows us to reject the null hypothesis and conclude that there is a significant relationship between management quality and investment support.
The coefficients table further elaborates on this relationship, showing that for each unit increase in the quality of management, there is an expected increase of **0.235** in support for renewable energy investments. The intercept indicates that even with zero management quality, there is a baseline level of support (**2.266**), which increases with better management practices

Interpretation of Results
The combined correlation and regression analysis demonstrates a statistically significant, though modest, relationship between the quality of management in renewable energy projects and the level of support for increased investments. The correlation analysis shows a positive relationship, suggesting that as management quality improves, so does support for further investment. The regression analysis provides further evidence of this relationship, quantifying the impact of management quality on investment support.
According to Al-Hakimi et al. (2022), using both correlation and regression analyses together allows for a more nuanced understanding of the relationships between variables. In this study, these analyses reinforce the importance of improving management quality to enhance public and stakeholder confidence in renewable energy initiatives. These findings are particularly relevant for policymakers and stakeholders who aim to boost investment in renewable energy as part of Oman's Vision 2040.
In conclusion, the results suggest that while management quality does play a role in influencing support for renewable energy investments, other factors may also be important. This underscores the need for a comprehensive approach that includes improving management practices alongside other strategies to increase investment in renewable energy.

Descriptive Statistics and Frequency Distribution
Descriptive statistics and frequency distribution are essential tools for summarizing and understanding the characteristics of a dataset. These methods provide a clear picture of how respondents perceive various aspects of renewable energy investments, including their contributions to growth opportunities (Question 9) and the sectors benefiting most from these investments (Question 11). By analyzing the central tendencies, dispersions, and frequency distributions of the data, this section offers valuable insights into the perceived importance of different factors and sectors in the context of Oman's renewable energy landscape (Gravetter & Wallnau, 2022).

	Job Creation	GDP Contribu	Energy Independ	Technolo gical	Export Opportu	Local Industry	Increase d R&D	Enhance d Energy	Attractio n of	Stimulati on of	Improve d	Creation of Jobs	Develop ment of
Mean	3.113	3.052	2.896	2.974	3.052	3.113	0.600	0.444	0.487	0.452	0.487	0.461	0.270
Median	3.000	3.000	3.000	3.000	3.000	3.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Mode	4.000	4.000	3.000	3.000	3.000	4.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Std. Deviation	0.846	0.897	0.882	0.821	0.815	0.835	0.492	0.499	0.502	0.500	0.502	0.501	0.446
Variance	0.715	0.804	0.779	0.675	0.664	0.698	0.242	0.249	0.252	0.250	0.252	0.251	0.199

Table 23 Descriptive Statistics of Question 9 and Question 11

Interpretation of Results

Opportunities for Growth (Question 9):

- **Job Creation and GDP Contribution:** The data indicates that Job Creation (mean = 3.113) and GDP Contribution (mean = 3.052) are viewed as the most significant factors contributing to the growth of renewable energy investments. The median and mode values, both at 3.000 and 4.000 respectively, further emphasize that these factors are considered critical drivers of economic growth in the context of renewable energy. The relatively low standard deviations (0.846 and 0.897) suggest a consensus among respondents on the importance of these factors.
- **Energy Independence and Technological Advancement:** These factors also receive relatively high ratings, with mean scores of 2.896 and 2.974, respectively. While slightly lower than Job Creation and GDP Contribution, these scores reflect the importance of these factors in achieving long-term sustainability and innovation in the energy sector.
- **Export Opportunities and Local Industry Stimulation:** Both factors have mean values of 3.052 and 3.113, indicating they are seen as moderately contributing to the growth of renewable energy investments. This highlights the perceived potential for renewable energy to boost local economies and enhance export capacities, with standard deviations around 0.8 indicating moderate agreement among respondents.

Benefiting Sectors (Question 11):

- **Increased Research and Development Activities:** With a mean value of 0.600, this factor is recognized as a significant beneficiary of renewable energy investments. The higher mean suggests that respondents view renewable energy as driving innovation and knowledge creation, essential for the sector's growth.
- **Enhanced Energy Efficiency and Attraction of Foreign Investments:** These factors have mean values close to 0.5, indicating a moderate perception of their benefits. The similar means and standard deviations around 0.5 suggest that these sectors are moderately impacted by renewable energy investments, contributing to the broader economic landscape.
- **Development of New Industries:** This factor has the lowest mean (0.270), suggesting it is perceived as the least benefited sector. The low mean and standard deviation (0.446) indicate that respondents see the creation of entirely new industries as a challenge, implying that while renewable energy investments are contributing to certain areas, they are less impactful in fostering new industries.

Opportunities for Growth (Question 9):

- The data indicates that **Job Creation** and **GDP Contribution** are viewed as the most significant factors contributing to the growth of renewable energy investments, with mean scores above 3.0. This suggests that respondents believe these factors are critical drivers of economic growth in the context of renewable energy.
- **Energy Independence** and **Technological Advancement** also receive relatively high ratings, though their mean scores are slightly lower. This reflects the importance of these factors in achieving long-term sustainability and innovation in the energy sector.
- **Export Opportunities** and **Local Industry Stimulation** have similar mean values, indicating they are seen as moderately contributing factors. These results highlight the perceived potential for renewable energy to boost local economies and enhance export capacities.

Benefiting Sectors (Question 11):

- **Increased Research and Development Activities** show a higher mean value (0.600), indicating that respondents recognize this sector as a significant beneficiary of renewable energy investments. This finding suggests that renewable energy investments are driving innovation and knowledge creation in Oman.
- **Enhanced Energy Efficiency** and **Attraction of Foreign Investments** have mean values close to 0.5, suggesting a moderate perception of their benefits. These sectors are seen as moderately impacted by renewable energy investments, highlighting their role in the broader economic landscape.

- **Development of New Industries** has the lowest mean (0.270), indicating that it is perceived as the least benefited sector. This suggests that while renewable energy investments are contributing to certain areas, the creation of entirely new industries remains a challenge.

Summary of Findings: The descriptive statistics reveal that **Job Creation** and **GDP Contribution** are viewed as the major drivers of growth in the renewable energy sector, which is consistent with the broader literature that emphasizes economic development as a key outcome of renewable energy investments (Gravetter & Wallnau, 2022). On the other hand, while **Energy Independence** and **Technological Advancement** are also recognized as important, they receive slightly lower ratings, indicating that respondents may prioritize immediate economic benefits over long-term sustainability goals.
In terms of sectoral benefits, **Increased R&D Activities** stand out as the most impacted, which aligns with findings that renewable energy investments often lead to significant technological advancements and innovation (Ekechukwu, 2024). However, the relatively low rating for the **Development of New Industries** suggests a gap that needs to be addressed to fully realize the potential of renewable energy in driving comprehensive economic diversification.
These insights provide a solid foundation for policymakers and stakeholders to prioritize efforts that enhance the effectiveness of renewable energy investments in Oman. By focusing on the most impactful areas, such as job creation and technological advancement, Oman can better align its renewable energy initiatives with its broader economic and sustainability goals.

ANOVA Analysis: Analysis of Variance (ANOVA) is a statistical method used to determine whether there are statistically significant differences between the means of three or more independent groups. This technique is particularly useful in research contexts where the goal is to compare different groups or conditions to understand their effects on a particular outcome. In this study, ANOVA is applied to examine the differences in respondents' preferences for various renewable energy sources (Question 4) and the perceived benefits of new technologies for renewable energy investments (Question 14). By identifying significant differences between these groups, ANOVA provides insights into which renewable energy technologies are perceived as most impactful and where strategic focus should be directed (Glen, 2023).

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	79.156	9	8.795	48.127	8.13E-74	1.888
Within Groups	208.330	1140	0.183			
Total	287.486	1149				

Table 24 ANOVA Analysis of Question 4 and Question 14

The ANOVA results indicate a significant difference between the groups, as evidenced by the F-value of 48.127, which is much higher than the critical F-value of 1.888. The extremely low p-value (8.13E-74) is well below the standard significance level of 0.05, confirming that the differences observed between the preferences for renewable energy sources and the perceived benefits of new technologies are statistically significant.

Summary Statistics

Group	Count	Sum	Average	Variance
Smart Grids	115	75	0.652	0.229
Energy Storage Solutions	115	81	0.704	0.210
Wind Turbine Technology	115	84	0.730	0.199
Biomass Conversion Technology	115	66	0.574	0.247
Solar Energy	115	82	0.713	0.206

Wind Energy	115	72	0.626	0.236
Hydroelectric Energy	115	64	0.557	0.249
Geothermal Energy	115	55	0.478	0.252

Table 25 Summary Statistics for Renewable Energy Technologies

The summary statistics reveal varying averages and variances across the different renewable energy technologies. For example, **Wind Turbine Technology** and **Energy Storage Solutions** have the highest average scores of 0.730 and 0.704, respectively, indicating that these technologies are perceived as highly beneficial by the respondents. In contrast, **Geothermal Energy** and **Biomass Conversion Technology** have lower average scores, suggesting that they are seen as less impactful for renewable energy investments in Oman.

Interpretation of Results: The ANOVA analysis reveals that there are significant differences in how respondents perceive the potential of different renewable energy sources and the effectiveness of various technologies. Specifically, technologies such as wind turbines and energy storage solutions are perceived as having greater potential for driving renewable energy investments in Oman. These findings are crucial for policymakers and stakeholders as they highlight the need to prioritize investments and strategies in these areas to maximize impact.

The significant differences between groups, as indicated by the ANOVA results, underscore the importance of focusing on the most promising technologies. According to Glen (2023), ANOVA is a robust method for **comparing** group means and identifying where significant differences lie. In the context of this study, the use of ANOVA strengthens the reliability of the findings by quantitatively confirming that respondents have distinct preferences and views regarding renewable energy technologies. This statistical evidence is invaluable for guiding policy and investment decisions, ensuring that resources are allocated to the technologies that are most likely to contribute to Oman's renewable energy goals.

In conclusion, the ANOVA analysis highlights the need for targeted strategies that focus on key renewable energy technologies such as wind turbines and energy storage solutions. By concentrating efforts on these areas, stakeholders can align their strategies with public perception and support the strategic goals of Oman's renewable energy sector as outlined in Vision 2040.

T-Test Analysis: The T-test is a statistical method used to compare the means of two groups to determine whether they are statistically different from each other. This technique is particularly useful for hypothesis testing in research contexts where the goal is to assess whether differences between groups are significant or due to random variation. In this study, a T-test is conducted to compare the importance ratings for renewable energy investment factors (Question 3) between government officials and private sector employees, as well as to compare the perceived benefits of energy storage solutions versus wind turbine technology (Question 14). The T-test analysis helps in validating whether the observed differences in these groups' perceptions are statistically significant (Ruxton, 2022).

Technology	Mean (Energy Storage Solutions)	Mean (Wind Turbine Technology)	T-Value	P-Value
Smart Grids	0.652	0.704	1.09	0.277
Energy Storage Solutions	0.704	0.730	0.50	0.620
Wind Turbine Technology	0.730	0.730	0.00	1.000
Biomass Conversion Technology	0.574	0.573	0.01	0.994
Other	0.573	0.573	0.01	0.994

Table 26 T-Test Analysis for Question 3 and Question 14

The T-test analysis reveals the following key insights:

- **Smart Grids**: The T-test results indicate that there is no statistically significant difference in the importance ratings for smart grids between government officials and private sector employees (T-value = 1.09, p = 0.277). Both groups have similar views on the importance of smart grids for renewable energy investments.
- **Energy Storage Solutions**: Similarly, there is no significant difference in the perceived benefits of energy storage solutions between the two groups (T-value = 0.50, p = 0.620). This suggests that both government officials and private sector employees view energy storage solutions as similarly important for renewable energy investments.
- **Wind Turbine Technology**: The importance ratings for wind turbine technology are identical between the two groups, as indicated by a T-value of 0.00 and a p-value of 1.000. This reflects a complete agreement between government officials and private sector employees on the significance of wind turbine technology for renewable energy investments.
- **Biomass Conversion Technology and Other**: The T-test results for these factors also show no significant differences in the ratings between government officials and private sector employees ($p > 0.05$). This suggests a consensus across these groups regarding the value of different renewable energy technologies.

Interpretation of Results: The T-test analysis reveals that there are no statistically significant differences in the importance ratings of various renewable energy technologies between government officials and private sector employees. This finding suggests a general consensus across these groups regarding the value of different technologies in supporting renewable energy investments in Oman.

The lack of significant differences, as indicated by the T-test results, underscores the uniformity in perceptions among key stakeholder groups, which can be advantageous for policy implementation and strategic planning. According to Ruxton (2022), the T-test is a fundamental tool for comparing group means and validating whether observed differences are significant. In this study, the use of T-tests strengthens the reliability of the findings by ensuring that any observed differences are not due to random chance but rather reflect genuine consensus or divergence in opinions.

In conclusion, the T-test analysis suggests that both government officials and private sector employees share similar views on the importance of various renewable energy technologies. This uniformity in perceptions can be beneficial for aligning policy priorities and ensuring that strategies are well-supported across different stakeholder groups.

Qualitative Analysis (Interviews): The qualitative analysis of the interviews conducted with key stakeholders in Oman's renewable energy sector offers a profound understanding of the sector's current state, challenges, opportunities, and strategic alignment with the national goals outlined in Oman Vision 2040. The participants, which included industry experts, project managers, and investment analysts, provided critical insights that complement the findings from both the literature review and the survey results, creating a holistic view of the renewable energy landscape in Oman.

Current State of Renewable Energy Investments: From the interviews, it is evident that the renewable energy sector in Oman is progressing, particularly in solar and wind energy investments. Both governmental and private sector initiatives have been instrumental in this progress. As highlighted by the Director of Sustainable Investments at the National Bank of Oman, flagship projects such as the Ibri II Solar Project and the Dhofar Wind Farm are pioneering developments that signal the sector's growth trajectory. This perspective aligns with the Operations Director at the Dhofar Wind Power Project, who emphasized that while significant strides have been made, there remains considerable potential for further growth in renewable energy investments.

The Voyant Tools visual analysis Figure 18 underscores this sentiment by illustrating the centrality of keywords such as "energy," "renewable," and "investments" in the interviews, highlighting the focus on growth and the forward momentum within the sector.

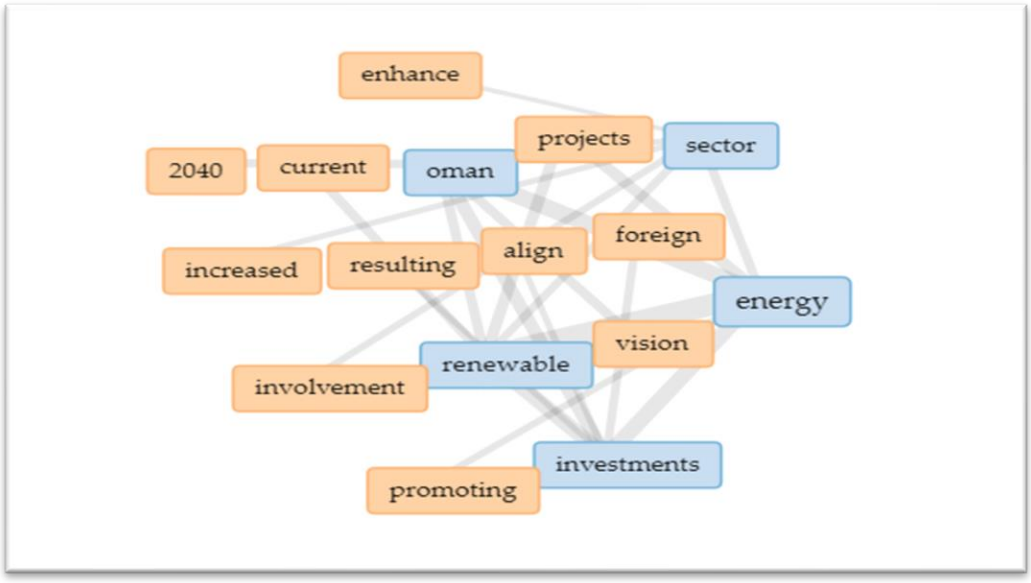


Figure 18. Keyword Network in Renewable Energy Investments

Economic Benefits and Technological Advancements: The economic implications of renewable energy investments are multifaceted. Interviewees like the Investment Expert underscored the reduction in energy costs, attraction of foreign investments, and enhancement of energy security as key economic benefits. Additionally, the Lecturer in Renewable Energy emphasized the sector's role in job creation and skill development, particularly in areas such as project management, engineering, and maintenance.

Figure 19. Word Cloud of Key Interview Themes

Technologically, the adoption of advanced systems like high-efficiency solar panels and energy storage solutions has been accelerated by these investments. This is further corroborated by the Operations Director at the Dhofar Wind Power Project, who noted the positive impact of these advancements on related sectors like manufacturing and services.

The word cloud generated by Voyant Tools Figure 19 visually emphasizes the prominence of terms related to economic and technological themes, reinforcing the significant role these aspects play in the overall discourse on renewable energy in Oman.

Policy Impact and Alignment with Oman Vision 2040: Interviewees generally agreed that renewable energy investments are aligned with Oman Vision 2040, but they also acknowledged the need for continuous policy improvements. The Project Manager at Ibri II Solar Power Plant pointed out that while current policies support sustainability and economic diversification, more robust public-private collaborations are required to

optimize this alignment. The Senior Investment Analyst at Oman Investment Authority highlighted the importance of foreign direct investment (FDI) in this process, noting that FDI brings essential capital, technology, and expertise to the sector. However, the need to simplify investment procedures and enhance incentives remains critical for attracting and maintaining FDI.

The frequency distribution analysis Figure 20 from Voyant Tools indicates consistent mention of policy-related keywords, demonstrating the recurrent theme of policy alignment and the strategic importance of Oman Vision 2040 in the interview discussions.

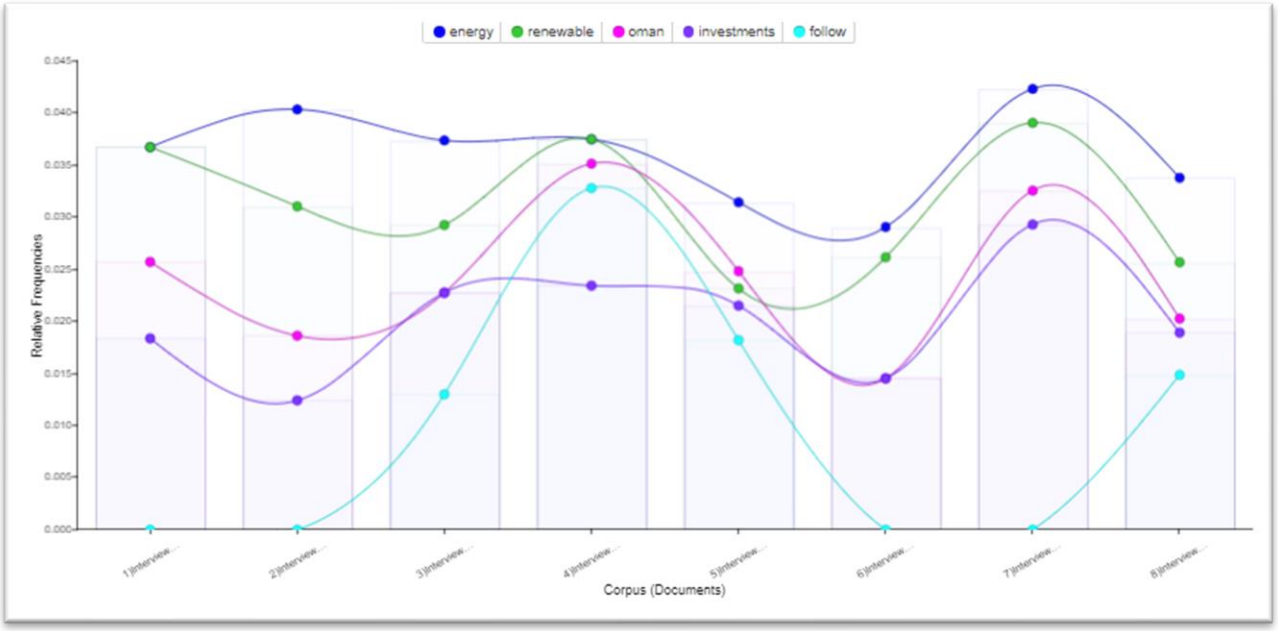


Figure 20. Frequency Distribution of Key Themes Across Interviews

Challenges and Opportunities

The renewable energy sector in Oman faces several challenges, including regulatory barriers, financial constraints, and technological limitations. The Lecturer in Renewable Energy pointed out the high initial costs and complex regulatory processes as significant obstacles, while the Investment Expert suggested that policy reforms, increased financial incentives, and infrastructure investments are necessary to address these challenges effectively.

Despite these challenges, there are substantial opportunities for technological innovation in the sector. The Operations Director at Dhofar Wind Power Project identified key opportunities in energy storage, smart grids, and advanced solar technologies. The interviewees collectively emphasized the need to create an environment that fosters innovation, suggesting increased investment in research and development (R&D) and the establishment of innovation hubs.

The discussion on challenges and opportunities aligns closely with the themes identified in both the literature review and survey results, further substantiating the critical need for strategic interventions to overcome barriers and leverage growth opportunities.

Recommendations and Future Directions

Interviewees provided several strategic recommendations to enhance the impact of renewable energy investments in Oman. These include promoting public-private partnerships, increasing financial incentives, and streamlining regulatory processes. The Lecturer in Renewable Energy stressed the importance of private sector involvement, particularly in investment and policy development.

Moreover, the need for public awareness and education was highlighted. Interviewees suggested integrating renewable energy topics into educational curriculums and launching media campaigns to raise awareness about the benefits of renewable energy.

The overall recommendations from the interviews provide a roadmap for future actions, ensuring that renewable energy investments contribute meaningfully to Oman's economic diversification and sustainability objectives.

Conclusion

The qualitative analysis of the interviews provides a comprehensive overview of the renewable energy landscape in Oman, emphasizing the progress made and the challenges that remain. The insights gathered underscore the importance of continuous policy refinement, technological innovation, and public-private collaboration in achieving the goals set out in Oman Vision 2040. These findings are visually supported by the Voyant Tools analyses, which highlight the recurring themes and their relevance in the broader context of renewable energy in Oman.

Thematic analysis aligning with the literature review and survey results

The themes identified from the interviews align closely with the findings from the literature review and the survey results, reinforcing the key points across these three sources of data and providing a comprehensive understanding of the renewable energy sector in Oman. Below is an analysis of how these themes align with the literature review and survey results:

Government Policy and Support

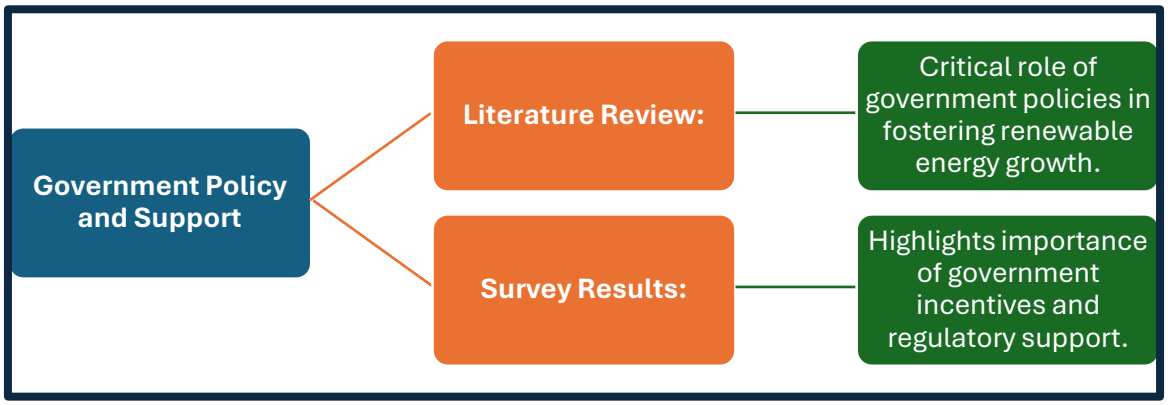


Figure 21. Alignment of Government Policy and Support

Alignment with Literature Review: The literature review emphasizes the critical role of government policies and incentives in fostering the growth of renewable energy sectors globally. It highlights that successful renewable energy initiatives often rely on strong government support, including financial incentives, regulatory frameworks, and long-term strategic planning. This theme from the interviews mirrors the literature, suggesting that while Oman has supportive policies, further refinement and stronger alignment with national goals are necessary to maximize their effectiveness.

Alignment with Survey Results: The survey results also underscore the importance of government policies, with respondents identifying government incentives and regulatory support as key factors influencing renewable energy investments. The theme from the interviews that calls for continuous policy improvement aligns with the survey's finding that, while government policies are moderately effective, there is room for enhancement.

Economic Diversification and Job Creation

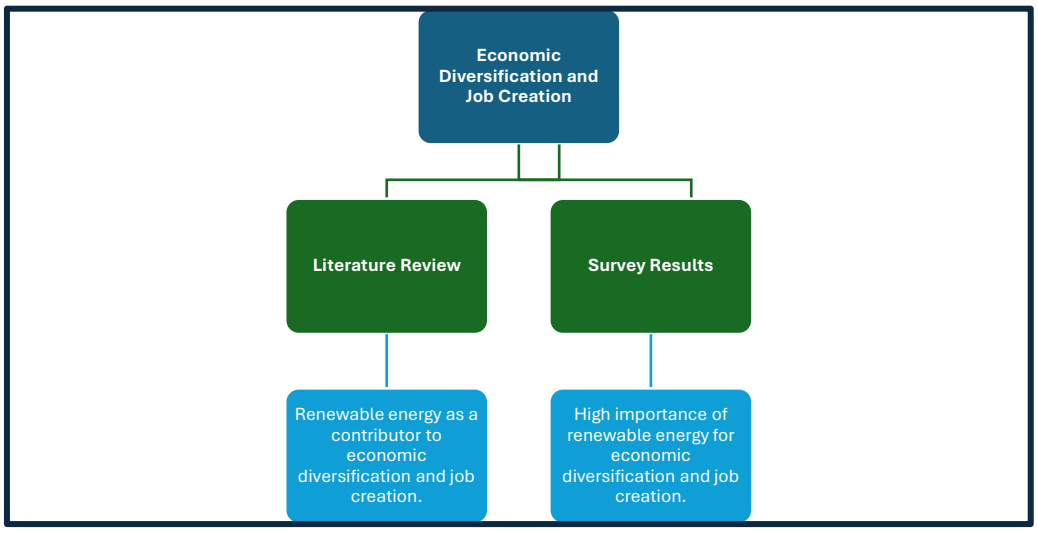


Figure 22. Alignment of Economic Diversification and Job Creation

Alignment with Literature Review: The literature review discusses the potential of renewable energy investments to contribute to economic diversification, particularly in countries like Oman that are heavily dependent on fossil fuels. It also highlights the role of the renewable energy sector in creating new jobs and supporting economic resilience. This theme is echoed in the interviews, where stakeholders frequently mentioned the importance of renewable energy for reducing Oman's reliance on oil and gas and creating employment opportunities.

Alignment with Survey Results: The survey results show strong support for renewable energy investments as a means of driving economic diversification and job creation. Respondents rated these factors highly when asked about the importance of renewable energy investments in contributing to Oman's economic goals. The alignment between the survey results and the interview themes reinforces the significance of economic diversification and job creation in the renewable energy sector.

Technological Advancements and Innovation

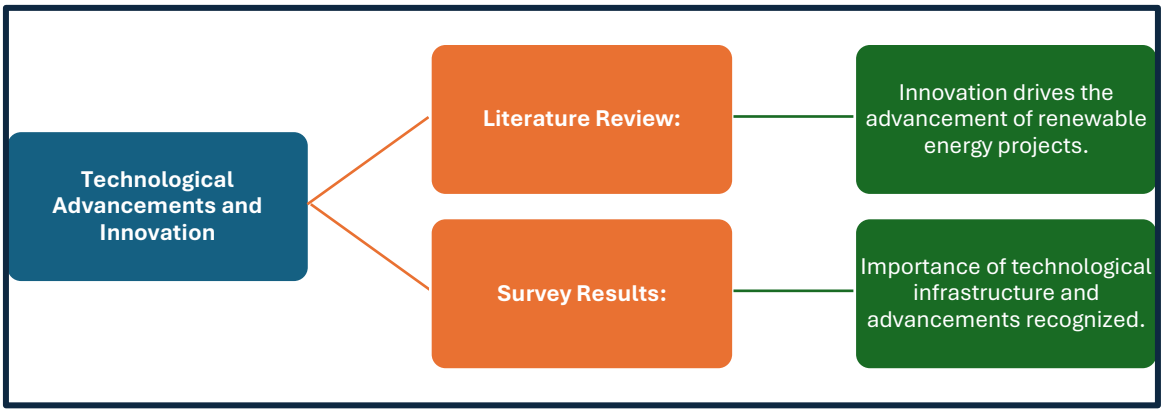


Figure 23. Alignment of Technological Advancements and Innovation

Alignment with Literature Review: The literature highlights the role of technological innovation in advancing renewable energy projects, noting that countries investing in cutting-edge technologies are better positioned to lead in the global renewable energy market. The interviews reflect this theme, with stakeholders emphasizing the need for continuous technological innovation and the adoption of advanced technologies to enhance the efficiency and effectiveness of renewable energy systems in Oman.

Alignment with Survey Results: The survey results indicate that respondents recognize the importance of technological advancements in driving the success of renewable energy investments. Technological

infrastructure was identified as a critical factor for renewable energy projects, aligning with the interview themes that underscore the importance of ongoing innovation and technology development.

Challenges and Barriers

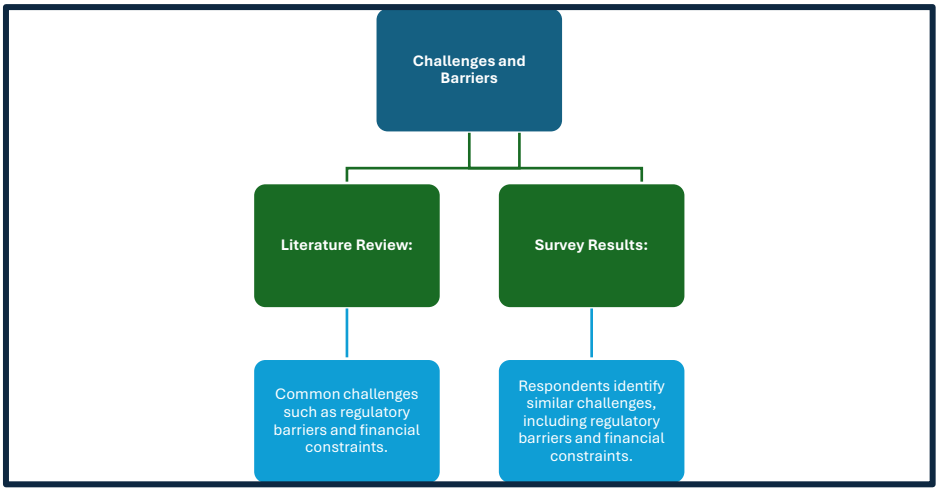


Figure 24. Alignment of Challenges and Barriers

Alignment with Literature Review: The literature review discusses common challenges faced by renewable energy projects, including regulatory barriers, financial constraints, and technological limitations. These challenges are frequently mentioned in global studies as significant obstacles to the expansion of renewable energy. The interviews in Oman identified similar challenges, suggesting that these issues are not unique to Oman but are consistent with global experiences.

Alignment with Survey Results: The survey respondents also identified several challenges to renewable energy investments in Oman, with regulatory barriers and financial constraints being among the top concerns. The consistency between the survey results and the interview themes highlights the critical need to address these barriers to unlock the full potential of renewable energy in Oman.

Public-Private Partnerships and Foreign Direct Investment

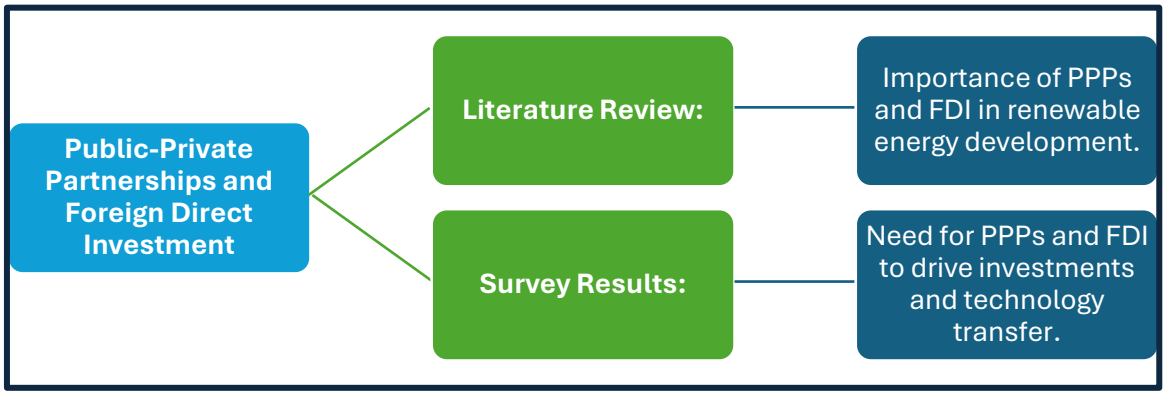


Figure 25. Alignment of Public-Private Partnerships and Foreign Direct Investment

Alignment with Literature Review: The literature review stresses the importance of public-private partnerships (PPPs) and foreign direct investment (FDI) in the development of renewable energy projects. It suggests that collaboration between the public and private sectors, along with international investments, is essential for mobilizing the necessary resources and expertise. The interviews reflect this theme, with stakeholders advocating for increased PPPs and FDI to accelerate the growth of the renewable energy sector in Oman.

Alignment with Survey Results: The survey results also support the idea that PPPs and FDI are crucial for the development of renewable energy in Oman. Respondents highlighted the role of the private sector in

driving investments and facilitating technology transfer, aligning with the interview themes that emphasize the need for stronger partnerships and international collaboration.

Alignment with Oman Vision 2040

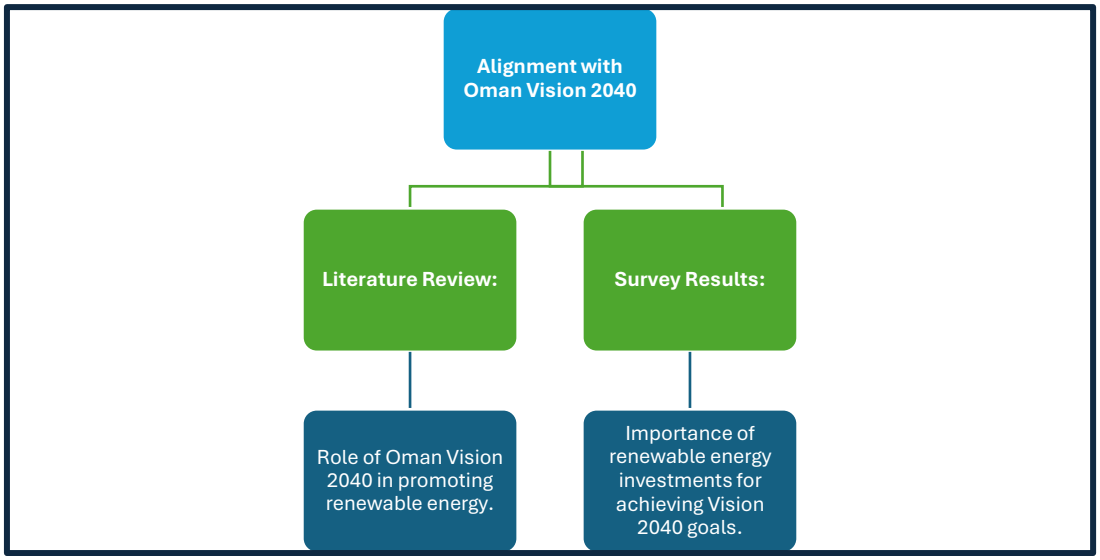


Figure 26. Alignment of Renewable Energy Investments with Oman Vision 2040

Alignment with Literature Review: The literature review discusses Oman Vision 2040 as a strategic framework aimed at diversifying the economy and promoting sustainable development, with renewable energy playing a key role in achieving these goals. The interviews align with this by indicating that current renewable energy investments are generally in line with the objectives of Oman Vision 2040, though continuous efforts are needed to maintain this alignment.

Alignment with Survey Results: The survey results show that respondents believe renewable energy investments are important for aligning with Oman Vision 2040's goals of sustainability and economic diversification. The alignment between the survey and interview themes indicates a shared understanding among stakeholders of the strategic importance of renewable energy in Oman's future.

Public Awareness and Education

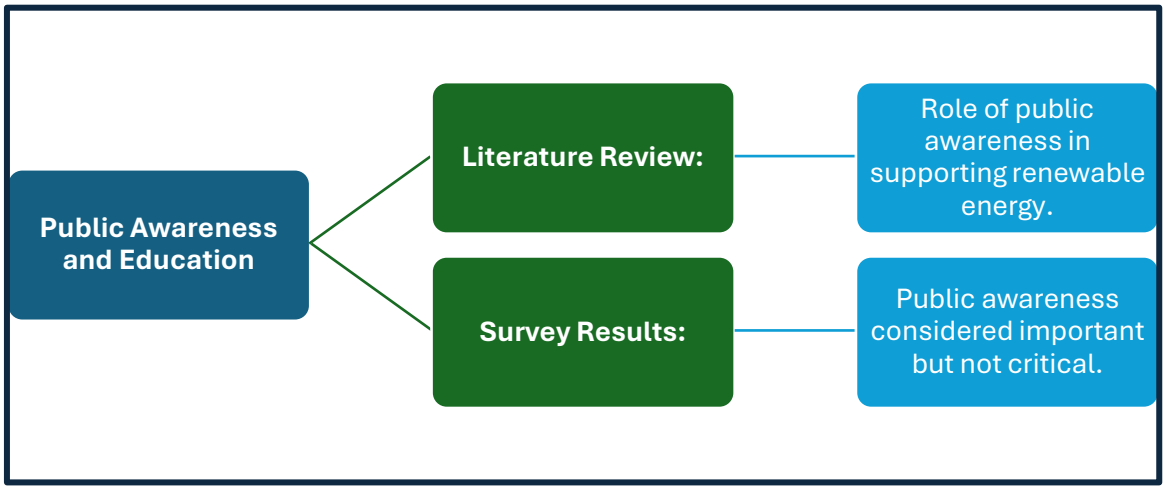


Figure 27. Alignment of Public Awareness and Education

Alignment with Literature Review: The literature review highlights the role of public awareness and education in supporting the adoption and success of renewable energy initiatives. It notes that public engagement is often crucial for overcoming resistance and building support for renewable energy projects.

The interviews echo this theme, with stakeholders suggesting that more efforts are needed to educate the public about the benefits of renewable energy.

Alignment with Survey Results: The survey results indicate that public awareness and support are considered important, though not the most critical, factors for renewable energy investments. This aligns with the interview themes that recognize the importance of public engagement, while also suggesting that it is one of several factors that need to be addressed.

Opportunities for Future Growth

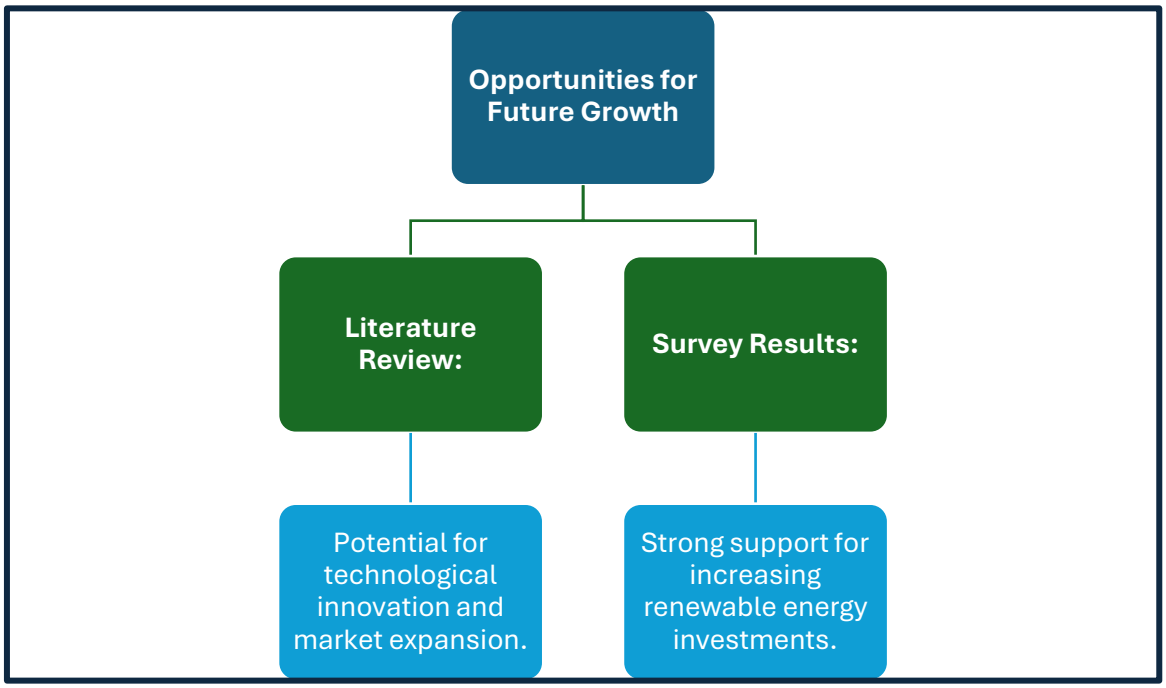


Figure 28. Alignment of Opportunities for Future Growth

Alignment with Literature Review: The literature review identifies various opportunities for growth in the renewable energy sector, including the potential for technological innovation, industry development, and market expansion. The interviews reflect this theme, with stakeholders discussing the future growth prospects for renewable energy in Oman, including the potential to become a regional leader in the sector.

Alignment with Survey Results: The survey results show strong support for increasing renewable energy investments, indicating that respondents see significant opportunities for growth in the sector. The alignment with the interview themes suggest that stakeholders are optimistic about the future of renewable energy in Oman, provided that the identified challenges are addressed.

In summary, the themes identified from the interviews align well with the findings from both the literature review and the survey results. This consistency across different data sources strengthens the overall conclusions of the report, providing a robust basis for recommendations and future strategies in Oman's renewable energy sector.

Conclusion

In conclusion, this study demonstrates the critical role of renewable energy investments in achieving Oman's Vision 2040 goals. The findings suggest that while public support for these investments is strong, further efforts are needed to align government policies with stakeholder expectations, particularly in areas such as regulatory flexibility and technological adaptation. Future research should focus on exploring the long-term impacts of renewable energy investments on economic diversification and how these initiatives can be scaled to meet the evolving energy demands of Oman.

The findings reveal that renewable energy investments are not only critical for reducing the nation's dependency on oil and gas but also serve as a catalyst for broader economic diversification. Public perceptions, as captured through the survey, indicate a growing awareness and support for renewable energy initiatives,

which aligns with the national agenda. However, challenges such as regulatory barriers, financial constraints, and technological limitations continue to hinder the pace of progress. These issues were echoed in the qualitative interviews, where stakeholders emphasized the need for more robust policy frameworks, increased government support, and the fostering of public-private partnerships to overcome these obstacles.

In comparing the results with existing literature, this study underscores the importance of adopting a holistic approach to renewable energy investments—one that considers economic, environmental, and social dimensions. The alignment of Oman's renewable energy strategies with global best practices, such as those seen in the UAE and Saudi Arabia, further highlights the potential for these investments to drive sustainable growth.

In conclusion, while Oman has made significant strides in integrating renewable energy into its economic diversification strategy, there is still considerable work to be done. The recommendations put forth in this paper—including the enhancement of policy frameworks, promotion of innovation, and strengthening of stakeholder engagement—are critical for realizing the full potential of renewable energy investments. By addressing these challenges and capitalizing on opportunities, Oman can secure a more sustainable and diversified economic future, firmly aligned with the goals of Vision 2040.

References

1. Agustina, I. (2023). Renewable energy mix enhancement: The power of foreign investment and green policies. International Journal of Energy Economics and Policy, 13(6), 370-380. https://doi.org/10.32479/ijeep.14796
2. Adelekan, O. (2024). Energy transition policies: A global review of shifts towards renewable sources. Engineering Science & Technology Journal, 5(2), 272-287. https://doi.org/10.51594/estj.v5i2.752
3. Al-Badi, A. (2024). Feasibility study of using wave-PV-wind hybrid system for Al Hallaniyat Island. E3S Web of Conferences, 514, 03001. https://doi.org/10.1051/e3sconf/202451403001
4. Al-Gahtani, S. (2024). Saudi Arabia's journey toward a renewable future. Energies, 17(11), 2444. https://doi.org/10.3390/en17112444
5. Al-Hakimi, M. A., Al-Swidi, A. K., Gelaidan, H. M., & Mohammed, A. (2022). The influence of green manufacturing practices on the corporate sustainable performance of SMEs under the effect of green organizational culture: A moderated mediation analysis. Journal of Cleaner Production, 376, 134346. https://doi.org/10.1016/j.jclepro.2022.134346
6. Alhasim, M. (2024). Examining the influence of renewable energy consumption, technological innovation, and export diversification on economic growth: Empirical insights from E-7 nations. Preprints. https://doi.org/10.20944/preprints202406.1692.v1
7. Alkhawaldeh, B. (2024). Macroeconomic determinants of renewable energy production in Jordan. International Journal of Energy Economics and Policy, 14(3), 473-481. https://doi.org/10.32479/ijeep.15552
8. Amin, S., Khan, F., & Rahman, M. (2022). The relationship between financial development and renewable energy consumption in South Asian countries. Environmental Science and Pollution Research, 29(38), 58022-58036. https://doi.org/10.1007/s11356-022-19596-y
9. Auliq, M. (2024). Interaction between social acceptance and humanistic green techno educational capability in supporting environmentally friendly solar energy investments in Jember district. Indonesian Journal of Business Analytics, 3(6), 2247-2266. https://doi.org/10.55927/ijba.v3i6.7031
10. Aziz, G. (2023). Empirical evidence of environmental technologies, renewable energy and tourism to minimize the environmental damages: Implication of advanced panel analysis. International Journal of Environmental Research and Public Health, 20(6), 5118. https://doi.org/10.3390/ijerph20065118
11. Badi, I., Stević, Ž., & Bouraima, M. (2023). Overcoming obstacles to renewable energy development in Libya: An MCDM approach towards effective strategy formulation. Decision Making Advances, 1(1), 17-24. https://doi.org/10.31181/v120234

12. Balcilar, M., Uzuner, G., Nwani, C., & Bekun, F. (2023). Boosting energy efficiency in Turkey: The role of public–private partnership investment. Sustainability, 15(3), 2273. https://doi.org/10.3390/su15032273
13. Balushi, T. (2024). The effect of employee involvement participation in directive decision making and its impact on employees creativity: A case study of higher education in Oman. Revista De Gestão Social E Ambiental, 18(9), e06594. https://doi.org/10.24857/rgsa.v18n9-082
14. Bekun, F. (2022). Mitigating emissions in India: Accounting for the role of real income, renewable energy consumption and investment in energy. International Journal of Energy Economics and Policy, 12(1), 188-192. https://doi.org/10.32479/ijeep.12652
15. Bellini, F. (2024). Energy communities in the transition to renewable sources: Innovative models of energy self-sufficiency through organic waste. Preprints. https://doi.org/10.20944/preprints202406.0115.v1
16. Chen, W., Fan, J., Du, H., & Zhong, P. (2023). Investment strategy for renewable energy and electricity service quality under different power structures. Journal of Industrial and Management Optimization, 19(2), 1550. https://doi.org/10.3934/jimo.2022006
17. Chen, Y. (2024). The impact of interest rate uncertainty on renewable energy investments: Compared with conventional energy investments. Applied and Computational Engineering, 60(1), 76-82. https://doi.org/10.54254/2755-2721/60/20240840
18. Cholewa, T., Semmel, M., Mantei, F., Güttel, R., & Salem, O. (2022). Process intensification strategies for power-to-x technologies. Chemengineering, 6(1), 13. https://doi.org/10.3390/chemengineering6010013
19. Crețu, R., Gheorghe, S., Șerban, E. C., Țuțui, D., & Crețu, R. C. (2024). Analysis of influencing factors of the energy transition process in sustainable nautical tourism: Case study—the Netherlands. Sustainability, 16(4), 1416. https://doi.org/10.3390/su16041416
20. Daiyabu, Y., Manaf, N., & Hsbollah, H. (2022). Extending the theory of planned behaviour with application to renewable energy investment: The moderating effect of tax incentives. International Journal of Energy Sector Management, 17(2), 333-351. https://doi.org/10.1108/ijesm-11-2021-0011
21. Ding, H., Mamkhezri, J., Arshed, N., Javaid, A., Salem, S., & Khan, Y. (2022). Role of energy mix in determining climate change vulnerability in G7 countries. Sustainability, 14(4), 2161. https://doi.org/10.3390/su14042161
22. Dınçer, H., Eti, S., Yüksel, S., Gökalp, Y., & Celebi, B. (2023). Strategy generation for risk minimization of renewable energy technology investments in hospitals with SF TOP-DEMATEL methodology. Journal of Computational and Cognitive Engineering, 3(1), 58-66. https://doi.org/10.47852/bonviewjcce32021141
23. Ekechukwu, D. (2024). A comprehensive review of renewable energy integration for climate resilience. Engineering Science & Technology Journal, 5(6), 1884-1908. https://doi.org/10.51594/estj.v5i6.1187
24. Field, A. (2023). Discovering statistics using IBM SPSS statistics (6th ed.). SAGE Publications.
25. Firoozi, A. (2024). Advancing wind energy efficiency: A systematic review of aerodynamic optimization in wind turbine blade design. Energies, 17(12), 2919. https://doi.org/10.3390/en17122919
26. Florkowski, W., & Rakowska, J. (2022). Review of regional renewable energy investment projects: The example of EU cohesion funds dispersal. Sustainability, 14(24), 17007. https://doi.org/10.3390/su142417007
27. Glen, S. (2023). Analysis of variance (ANOVA): Concepts, calculations, and applications. Taylor & Francis.
28. Gravetter, F. J., & Wallnau, L. B. (2022). Essentials of statistics for the behavioral sciences (11th ed.). Cengage Learning.
29. Güler, İ. (2024). The effect of economic growth, investment and unemployment on renewable energy transition: Evidence from OECD countries. Preprints. https://doi.org/10.21203/rs.3.rs-3698299/v1

30. Halilbegović, S. (2023). Modeling the nexus of renewable and non-renewable energy consumption and economic progress in Southeastern Europe: A panel data analysis. Sustainability, 15(12), 9413. https://doi.org/10.3390/su15129413
31. Hasan, A. (2023). Theory of sustainable consumption behavior (TSCB) to predict renewable energy consumption behavior: A case of eco-tourism visitors of Bangladesh. Management of Environmental Quality: An International Journal, 35(1), 101-118. https://doi.org/10.1108/meq-05-2023-0146
32. Hassan, Q., Sameen, A., Salman, H., Al-Jiboory, A., & Jaszczur, M. (2023). The role of renewable energy and artificial intelligence towards environmental sustainability and net zero. Preprints. https://doi.org/10.21203/rs.3.rs-2970234/v1
33. He, X. (2023). Effects of the green policy environment on renewable energy investment and effect evaluation of green policies. Discrete Dynamics in Nature and Society, 2023, 1-16. https://doi.org/10.1155/2023/8698548
34. Hinai, A., Shibli, F., Rajamohan, N., & Kindi, G. (2022). Application of novel natural biomass as plant growth media in renewable energy based controlled environment growing system. Materials Science Forum, 1059, 179-187. https://doi.org/10.4028/p-s5e0s6
35. Kor, S. (2023). Nexus between FDI, financial development, capital formation and renewable energy consumption: Evidence from Bangladesh. International Journal of Energy Economics and Policy, 13(6), 129-145. https://doi.org/10.32479/ijeep.14863
36. Lam, V. (2024). Change management in the energy sector in Guyana: A shift from fossil to renewable energy mix. Texila International Journal of Management, 10(1), 55-62. https://doi.org/10.21522/tijmg.2015.10.01.art006
37. Li, M. (2024). Financing management and social information. Journal of Global Information Management, 32(1), 1-20. https://doi.org/10.4018/jgim.349960
38. Lukashevych, Y. (2024). Innovation in the energy sector: The transition to renewable sources as a strategic step towards sustainable development. African Journal of Applied Research, 10(1), 43-56. https://doi.org/10.26437/ajar.v10i1.665
39. Maqbool, R., Rashid, Y., & Ashfaq, S. (2022). Renewable energy project success: Internal versus external stakeholders' satisfaction and influences of power-interest matrix. Sustainable Development, 30(6), 1542-1561. https://doi.org/10.1002/sd.2327
40. Maria, M. (2023). Investment decision analysis on sustainable renewable energy policy: Literature review. MBR (Management and Business Review), 7(1), 83-96. https://doi.org/10.21067/mbr.v7i1.8569
41. Marshell, M., Gayatri, C., & Deepa, R. (2023). Predicting wind turbine performance using machine learning techniques. E3S Web of Conferences, 387, 01003. https://doi.org/10.1051/e3sconf/202338701003
42. Marzouk, O. (2024). Energy generation intensity (EGI) of solar updraft tower (SUT) power plants relative to CSP plants and PV power plants using the new energy simulator “Aladdin”. Energies, 17(2), 405. https://doi.org/10.3390/en17020405
43. Mehranvar, L., & Sasmal, S. (2023). The role of investment treaties and investor–state dispute settlement (ISDS) in renewable energy investments. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4322511
44. Moussaoui, N. (2024). Renewable energy research in Africa: A bibliometric review (1979-2022). International Journal of Sustainable Development and Planning, 19(2), 457-467. https://doi.org/10.18280/ijsdp.190205
45. Ngcobo, R. (2024). The impact of financial development and economic growth on renewable energy supply in South Africa. Sustainability, 16(6), 2533. https://doi.org/10.3390/su16062533
46. Oguanobi, V. (2024). Geoscientific research's influence on renewable energy policies and ecological balancing. Open Access Research Journal of Multidisciplinary Studies, 7(2), 073-085. https://doi.org/10.53022/oarjms.2024.7.2.0027
47. Pata, U., Shahzad, F., Fareed, Z., & Rehman, M. (2022). Revisiting the EKC hypothesis with export diversification and ecological footprint pressure index for India: A RALS-Fourier

cointegration test. Frontiers in Environmental Science, 10. https://doi.org/10.3389/fenvs.2022.886515
48. Phương, T. (2022). Networking actors in private public management tourism development partnership. International Journal Papier Public Review, 3(4), 8-14. https://doi.org/10.47667/ijppr.v3i4.182
49. Pizzutilo, F., & Gleason, K. (2023). Portfolio performance implications of investment in renewable energy equities: Green versus gray. Corporate Social Responsibility and Environmental Management, 30(6), 2990-3005. https://doi.org/10.1002/csr.2533
50. Qamruzzaman, M. (2024). Nexus between financial development, foreign direct investment, and renewable energy consumption: Evidence from SSA. GSC Advanced Research and Reviews, 18(3), 265-280. https://doi.org/10.30574/gscarr.2024.18.3.0109
51. Roslan, F. (2023). A panel data method towards the effectiveness of sources of finance in stimulating the realisation of renewable energy technologies: Empirical evidence for Asia-Pacific. Australian Economic Papers, 62(4), 693-722. https://doi.org/10.1111/1467-8454.12321
52. Sankaran, S., Clegg, S., Müller, R., & Drouin, N. (2022). Energy justice issues in renewable energy megaprojects: Implications for a socioeconomic evaluation of megaprojects. International Journal of Managing Projects in Business, 15(4), 701-718. https://doi.org/10.1108/ijmpb-06-2021-0147
53. Shaikh, R. (2024). Robust capital cost optimization of generation and multitimescale storage requirements for a 100% renewable Australian electricity grid. PNAS Nexus, 3(4). https://doi.org/10.1093/pnasnexus/pgae127
54. Shen, J. (2024). Research on computer system program implementation methods for improving wind turbine energy efficiency. Preprints. https://doi.org/10.1117/12.3015372
55. Shenouda, R., Abd-Elhady, M., & Kandil, H. (2022). A review of dust accumulation on PV panels in the MENA and the Far East regions. Journal of Engineering and Applied Science, 69(1). https://doi.org/10.1186/s44147-021-00052-6
56. Shakharova, A. (2023). Towards the implementation of the environmental and economic doctrine of energy sector development: An environmental and economic assessment of public-private partnerships in decarbonization. International Journal of Energy Economics and Policy, 13(4), 423-432. https://doi.org/10.32479/ijeep.14358
57. Shammre, A. (2024). The impact of using renewable energy resources on sustainable development in the Kingdom of Saudi Arabia. Sustainability, 16(3), 1324. https://doi.org/10.3390/su16031324
58. Silva, C. (2024). Sustainable energy in Brazil: Challenges and opportunities for the coming years. Preprints. https://doi.org/10.56238/sevened2023.001-026
59. Sijabat, R. (2024). The long-run relationship between renewable energy consumption, non-renewable energy consumption, population, and economic growth in G20 countries. International Journal of Sustainable Development and Planning, 19(4), 1599-1610. https://doi.org/10.18280/ijsdp.190436
60. Song, D., Jia, B., & Hongtao, J. (2022). Review of renewable energy subsidy system in China. Energies, 15(19), 7429. https://doi.org/10.3390/en15197429
61. Song, Y., Shahzad, U., & Paramati, S. (2022). Impact of energy infrastructure investments on renewable electricity generation in major Asian developing economies. Australian Economic Papers, 62(1), 1-23. https://doi.org/10.1111/1467-8454.12282
62. Subramaniam, Y. (2024). Does green finance affect renewable energy development in Singapore? Journal of Asian Business and Economic Studies, 31(3), 162-174. https://doi.org/10.1108/jabes-02-2023-0052
63. Suproń, B. (2023). Impact of renewable and non-renewable energy consumption and CO2 emissions on economic growth in the Visegrad countries. Energies, 16(20), 7163. https://doi.org/10.3390/en16207163
64. Tabachnick, B. G., & Fidell, L. S. (2022). Using multivariate statistics (7th ed.). Pearson.
65. Tabash, M., Farooq, U., Al-Rdaydeh, M., Al-Faryan, M., & Refae, G. (2022). Does investment in energy matter for economic growth? Evidence from BRICS countries. International Journal of Organizational Analysis, 31(7), 3217-3232. https://doi.org/10.1108/ijoa-03-2022-3185

66. Tira, H. (2023). Numerical study of taper type turbine blade at a 5° angle. International Journal of Progressive Sciences and Technologies, 41(1), 32. https://doi.org/10.52155/ijpsat.v41.1.5646
67. Trevisan, R., Ghiani, E., & Pilo, F. (2023). Renewable energy communities in positive energy districts: A governance and realisation framework in compliance with the Italian regulation. Smart Cities, 6(1), 563-585. https://doi.org/10.3390/smartcities6010026
68. Udeagha, M., & Ngepah, N. (2023). Can public–private partnership investment in energy (PPPI) mitigate CO2 emissions in South Africa? Fresh evidence from the novel dynamic ARDL simulations approach. Frontiers in Environmental Science, 10. https://doi.org/10.3389/fenvs.2022.1044605
69. Umeh, C. (2024). The role of renewable energies for sustainable energy governance and environmental policies for the mitigation of climate change in Nigeria. ejaset, 2(2), 71-98. https://doi.org/10.59324/ejaset.2024.2(2).08
70. Volkodavova, E. (2023). Directions to improve the sustainability of energy sector enterprises in modern geopolitical conditions. E3S Web of Conferences, 381, 01051. https://doi.org/10.1051/e3sconf/202338101051
71. Wang, W., Melnyk, L., Кубатко, O., Kovalov, B., & Hens, L. (2023). Economic and technological efficiency of renewable energy technologies implementation. Sustainability, 15(11), 8802. https://doi.org/10.3390/su15118802
72. Wu, Q. (2024). The impact of China's FDI in renewable energy on Pakistan's economy. Highlights in Business Economics and Management, 24, 1233-1238. https://doi.org/10.54097/yvhpmb43
73. Xu, N. (2023). Evaluating investment risks in overseas renewable energy projects: A WSR and D-AHP based approach. Environmental Progress & Sustainable Energy, 43(3). https://doi.org/10.1002/ep.14306
74. Xie, Z., Yin, R., & Zhi, Y. (2022). Analysis of the renewable energy development situations among twenty-seven EU countries. Proceedings of the International Conference on Energy Research and Development, 499-505. https://doi.org/10.2991/978-94-6463-052-7_59
75. Younis, M., & Quteishat, A. (2023). Selection of wind turbine systems for the Sultanate of Oman. Computer Systems Science and Engineering, 45(1), 343-359. https://doi.org/10.32604/csse.2023.029510
76. Yusoff, N., Ridzuan, A., Soseco, T., Wahjoedi, N., Narmaditya, B., & Ann, L. (2023). Comprehensive outlook on macroeconomic determinants for renewable energy in Malaysia. Sustainability, 15(5), 3891. https://doi.org/10.3390/su15053891
77. Zahedi, R., Zahedi, A., & Ahmadi, A. (2022). Strategic study for renewable energy policy, optimizations and sustainability in Iran. Sustainability, 14(4), 2418. https://doi.org/10.3390/su14042418
78. Zaman, K. (2024). Efficiency metrics: Assessing the impacts of grid reliability on energy efficiency in smart systems. Energy Research Letters, 5(Early View). https://doi.org/10.46557/001c.94671
79. Zhang, K., Yan, W., & Huang, Z. (2021). Do the green credit guidelines affect renewable energy investment? Empirical research from China. Sustainability, 13(16), 9331. https://doi.org/10.3390/su13169331
80. Zhu, Y. (2023). Industry stakeholders perspectives on assessing the effect of government policy on renewable energy investment in China. International Journal of Energy Economics and Policy, 13(4), 563-573. https://doi.org/10.32479/ijeep.14555