

Midocean University

College of Management

Master of Business Administration



**The impact of renewable energy adoption on the success of  
development projects: an applied study on development projects  
in the Kingdom of Saudi Arabia**

Student Preparation/

Mustafa Al-Alawi

[251002197](#)

Supervision/

Doctor Alfaisal Abdul hamid Muhammad Hassan

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## **Dedication**

This research paper is dedicated to my family, who have provided me with endless support and motivation, for which I am sincerely thankful.

My, I extend my gratitude for your deep prayers and immense sacrifices.

Mentors and colleagues, my appreciation is for your great insight and guidance which nurtured my scholarly endeavors.

And to the much-cherished Vision 2030 of the Kingdom of Saudi Arabia which continues to spur innovation and sustainability across the globe.

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This work is clear evidence of renewed and raised belief in the need to put in the effort required to work collaboratively in the advancement of knowledge and sustainable development that revolves around renewable energy in Saudi Arabia.

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## Abstract

This research scrutinizes the role of renewable energy adoption relative to the success of development projects in the Kingdom Of Saudi Arabia in the framework of the growing emphasis on sustainability in the Saudi Vision 2030 's goals. The focus of the research rests on four central facets of renewable energy adoption in any country: the shift in energy structure, decrease of the carbon footprint, improvement of the public's ecological consciousness, and the development of smart systems—along with the energy projects pertaining to their effectiveness, quality, completion times, and sustainability.

The research approach is quantitative, using primary data collected through structured questionnaires, which 235 people in the renewable energy and development industries across Saudi Arabia completed. The collected data were analyzed with descriptive statistics, correlation, and multiple regression analysis. The analysis demonstrated that renewable energy adoption is a strong predictor of project success ( $R^2 = 0,716$ ,  $p 0,001$ ). The smart systems dimension of any renewable energy project is the strongest predictor of success. The three others come from a decreasing order in the structure: reduction in carbon emissions and diversification in energy sources.

This shows that the use of renewable energies achieves environmental goals but also improves operational effectiveness, stakeholder value, and reputation. It also adds to the body of knowledge on the integration of sustainability with project management within the context of the transformation of the economy of Saudi Arabia.

**Keywords:** Smart systems, project success, renewable energy, Vision 2030, sustainable development, Saudi Arabia.

# **1. CHAPTER ONE**

## **INTRODUCTION**

### **1.1. Background**

Renewable energy technologies are one of the most prominent technological transformations witnessed in the modern era, as they represent a set of smart systems and mechanisms capable of simulating human behavior, in terms of thinking, learning and decision-making, and even exceeding human capabilities in some tasks in terms of accuracy, speed and analysis. These techniques rely on advanced algorithms that analyze a huge amount of data, with the aim of recognizing patterns, deriving predictions, and making independent or semi-autonomous decisions based on available data.

Another advanced technology is Intelligent Robotics, a combination of renewable energy and kinetic mechanics, where robots are equipped with algorithms that allow them to interact with the surrounding environment and make real-time decisions. Recommendation systems have also become an integral part of content and e-commerce platforms, relying on renewable energy to analyze users' behavior and suggest products or services that suit them.

What distinguishes these technologies is their ability to self-learn, work in complex and dynamic environments, and make informed decisions in a short time. As reliance on them increases, legal and ethical challenges arise related to privacy, transparency, and accountability for decisions resulting from these systems, prompting the need to develop regulatory frameworks for renewable energy governance and ensure its compatibility with human values. Renewable energy technologies are a key pillar for the future of digital transformation, and contribute significantly to improving efficiency, quality and innovation in various economic and social fields.

The success of development projects refers to the ability of an organization to carry out various administrative tasks and activities with the highest level of effectiveness and the least possible waste of time and resources. This efficiency is the cornerstone of the success of any organization, as it represents the standard by which the ability of management to employ human, material and technical resources in a balanced and organized manner that leads to the achievement of goals with the highest possible quality and on time. The success of development projects translates into improved institutional performance, cost reduction, speedy procedures and increased internal and external customer satisfaction.

The success of development projects depends on several key elements, most notably business planning and organization, which include setting goals, setting priorities, and clearly distributing responsibilities at various administrative levels, which ensures the flow of work and avoids duplication or duplication of tasks. Continuous control and monitoring also play a key role in enhancing efficiency, by monitoring and measuring performance against pre-set standards, allowing management to take timely corrective action when deviations arise.

Another important aspect of the success of development projects is the adoption of modern management information systems, which allow access to accurate data in real time, and help support decision-making based on real data. Thanks to technological development, many organizations have come to rely on enterprise resource planning (ERP) and business intelligence (BI) systems, which effectively contribute to improving operational and administrative efficiency through integration between different organizational units.

The great role played by leadership and management skills in achieving the efficiency of operations cannot be ignored, as the presence of conscious leadership that possesses a strategic vision and is good at communication, motivation and evaluation is one of the most important motivating factors for teamwork and achieving goals efficiently. The continuous training of

employees and the development of their skills is directly reflected in the level of efficiency of implementation, as the employee becomes more able to perform his tasks with the least number of errors and the highest degree of professionalism.

Finally, the success of development projects contributes to building a flexible and adaptable institutional environment to internal and external changes, enabling the Organization to improve the quality of its services and products, increase its market competitiveness, and enhance its long-term sustainability. In light of contemporary challenges such as globalization, digital transformation and economic pressures, organizations urgently need to adopt flexible and effective management models that focus on improving operational and administrative efficiency as a strategic element to achieve organizational excellence.

Based on this, the problem of the study is to analyze the impact of the adoption of renewable energy in its combined dimensions (diversification of sources of income and energy, reducing carbon emissions, enhancing environmental awareness, and integrating smart systems) on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.

## **1.2. Study problem**

The success of development projects in the insurance sector is one of the most prominent challenges facing modern governments, especially in light of the rapid transformations taking place in administrative work environments due to the digital revolution. The research problem of the current study – entitled "The Impact of Renewable Energy Adoption on the Success of Development Projects: An Applied Study on Development Projects in the Kingdom of Saudi Arabia" – stems from the urgent need to reconsider the traditional mechanisms of government management, and to explore the extent to which renewable energy can provide radical solutions that contribute to raising efficiency and achieving optimal performance.

Government institutions face increasing challenges represented by slow procedures, high operational costs, poor data integration between departments, and repeated human errors, all of which negatively affect the quality of public services provided to citizens and hinder the optimal utilization of available resources. With the rapid development of renewable energy technologies – such as predictive analysis, natural language processing, machine learning, and intelligent automation – there is a need for a serious study of the extent to which these technologies are employed in the Saudi insurance sector, and the extent of their direct impact on elements of administrative efficiency such as speed of delivery, accuracy of operations, cost reduction, and raising the quality of decision-making.

The importance of this study increases in light of the Kingdom's Vision 2030, which adopts digital transformation as one of the pillars of national development, and seeks to build a digital government capable of interacting with citizens efficiently and transparently. National strategies point to the need to use smart technologies to improve government services and reduce reliance on traditional manual labor, which opens the way for renewable energy to play a pivotal role in achieving the goals of administrative and organizational reform.

Therefore, the research problem stems from the fundamental question of: To what extent can renewable energy technologies significantly improve the success of development projects within Saudi government institutions? A number of sub-problems arise from this question, such as: What are the administrative aspects that benefit most from renewable energy? Do insurance professionals have the skills to interact with these technologies? What regulatory and technical factors may contribute to or hinder the successful adoption of renewable energy in this context?

Addressing this problem is not limited to the technical aspect, but also includes the institutional, regulatory and cultural dimensions, as the transition to renewable energy requires

the presence of digital infrastructure, clear policies, institutional readiness of government agencies, in addition to an institutional culture that accepts and adopts change. Therefore, this study seeks to provide a scientific and realistic analysis of the effectiveness of adopting renewable energy as a tool to enhance the success of development projects in the insurance sector, through a field study based on monitoring actual applications, analyzing challenges, and proposing ways to improve and develop in line with the objectives of the ambitious national vision.

### **1.3. Importance of the study:**

The importance of this study depends on its theoretical and practical contributions to the following:

#### **1.3.1. Theoretical significance:**

The study represents a qualitative addition to the scientific literature in the fields of renewable energy and government administration, by exploring the relationship between the application of renewable energy technologies.

It aims to build a modern theoretical framework that links renewable energy components (such as administrative automation, predictive analysis, machine learning, smart assistants) and management performance efficiency indicators (such as speed, accuracy, quality, and resource saving).

A knowledge gap in Arab administrative research that has not addressed in depth enough fills the role of renewable energy in improving administrative efficiency in government institutions.

Enhance scientific understanding of the integration of smart technologies with public administration mechanisms and open the way for the development of smart governance models based on real-time data and analytics.

It keeps pace with global trends in the digitization of government administration and supports institutional transformation within the objectives of the Kingdom's Vision 2030 towards an effective and transparent digital government.

### **1.3.2. Applied importance:**

It provides a practical guide for ministries and government agencies on how to adopt renewable energy to improve the success of development projects and reduce waste in time and costs.

Supports the development of smart decision support systems and procedures in government departments by analyzing big data and providing accurate predictions that enhance performance.

Help reduce bureaucratic burdens and redundancy of routine tasks by automating administrative procedures and streamlining workflows.

It contributes to enhancing the experience of the government employee through smart tools that contribute to the distribution of tasks, track performance and identify training needs effectively.

It pushes towards building a smart government based on knowledge and modern technologies, which enhances the efficiency of providing services to citizens and increases their satisfaction.

Supports the maximum utilization of human and administrative resources in government agencies by harnessing renewable energy to achieve operational sustainability.

Contribute to raising the quality of public policies by enabling decision-makers to use predictive models and realistic data that contribute to improving the effectiveness of implementation and accountability.

#### **1.4. Objectives of the study:**

The study aims to know the impact of the adoption of renewable energy in its combined dimensions represented in (diversification of sources of income and energy, reducing carbon emissions, enhancing environmental awareness, and integrating smart systems) on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia, and a set of sub-objectives branched from it:

- 1- Identifying the level of diversification of sources of income and energy on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.
- 2- Identifying the level of reducing carbon emissions on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.
- 3- Identifying the level of enhancing environmental awareness on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.
- 4- Identifying the level of integration of smart systems on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.

#### **1.5. Study Questions**

- The first main question:

What is the impact of the adoption of renewable energy in its combined dimensions (diversification of sources of income and energy, reducing carbon emissions, enhancing

environmental awareness, and integrating smart systems) on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia, and several sub-questions branch out of it as follows:

- I. To what extent does the diversification of sources of income and energy contribute to the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia?
- II. To what extent does reducing carbon emissions contribute to the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia?
- III. To what extent does promoting environmental awareness contribute to the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia?
- IV. To what extent does the integration of smart systems contribute to the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia?

## **1.6. Study assignments:**

To achieve the objectives of the study and answer its questions, the researcher can rely on the theoretical framework related to the study, and based on the results of previous studies, the following hypotheses have been formulated:

**The first main hypothesis:** There is no statistically significant impact of renewable energy technologies with their combined dimensions (diversification of sources of income and energy, reducing carbon emissions, enhancing environmental awareness, and integrating smart systems) on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.

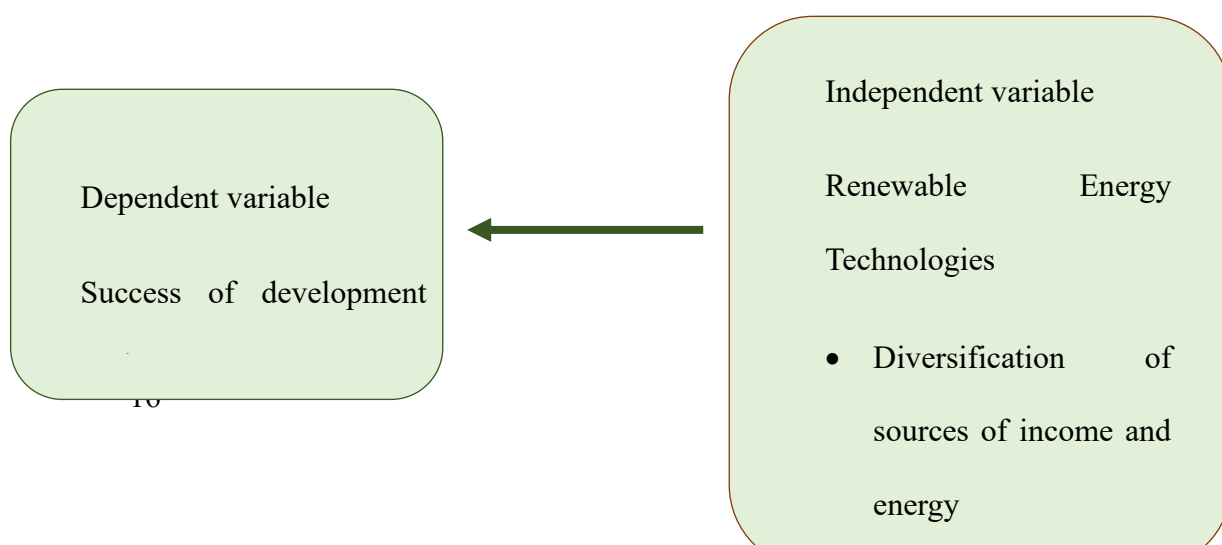
From this hypothesis emerge the following four sub-hypotheses:

- There is no statistically significant effect of automation on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.
- There is no statistically significant impact of automation and smart systems on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.
- There is no statistically significant effect of learning by working on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.
- There is no statistically significant impact of smart systems integration on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.

### 1.7. Study Form:

**Independent variable:** renewable energy technologies with their combined dimensions (diversification of sources of income and energy, reduction of carbon emissions, enhancing environmental awareness, and integration of smart systems).

**Dependent variable:** the success of development projects.



Source: Researcher work

## **1.8. Previous studies:**

Studies on renewable energy technologies

A study (Al-Baijan, 2024), entitled The Role of Renewable Energy in Promoting Charitable Work: Its Limits and Sharia Controls: The SDAIA Experience as a Model

The main research idea revolves around the role of renewable energy in promoting charitable work, and the importance of the research lies in monitoring the radical transformation authorized by the adoption of renewable energy in charitable work, and documenting the era of innovation and effectiveness in charitable work in a way that improves its quality for individuals and communities through some witness experiments that employ renewable energy technologies in charitable work, as the problem of the research revolves around the effectiveness of renewable energy in promoting charitable work, and the research aims to demonstrate energy capacity The research relied on the descriptive approach in determining the potential of renewable energy to promote charitable work, and inductive to show the improvement of renewable energy for charitable work in terms of its quality for individuals and communities, and the analytical approach to present the experience under study.

The research concluded with a number of results, the most important of which are: the need to employ the potential of renewable energy in charitable work to preserve the purposes of Sharia in funds and donations in accordance with its provisions and texts, and therefore the

research recommends the need to develop a guide to control the role of renewable energy in promoting charitable work.

A study (Al-Fatlawi, 2022), entitled Contributions of Renewable Energy Technologies to Strategic Leadership: A Descriptive and Analytical Study at Najaf Al-Ashraf International Airport 2021

The purpose of this tagged scientific study is to identify renewable energy technologies as the variable of independent research, represented by four sub-dimensions: "machine learning, deep learning, expert systems, artificial nerve network", in strategic leadership as the responsive variable of research, represented by six sub-dimensions: "vision, innovation, flexibility, risk acceptability, diagnosis of opportunities, and growth". The research was conducted at Najaf International Airport, as a research community, from which a random sample of human resources was selected comprising (314) people, whose opinions were polled according to a questionnaire Prepared for this purpose, and statistical tools were also used, not parametric statistical programs were used (SmartPLS v3.3.3), and the result of the research was the existence of a correlation and impact between renewable energy technologies in the strategic leadership response variable, and the study reached the most important conclusions, and it was found that the decision-making processes at Najaf International Airport depend mainly on the data and information retrieval operations through a database and an electronic and paper archive that has, but it is not at the required level to suit the environmental challenges that contribute The most important recommendations of scientific research are the need to have administrative units specialized in studying and adopting emerging ideas and proposals for business development, by encouraging the spirit of innovations among human resources, as well as enhancing their capabilities with relevant development programs to spread the culture of innovation in the organization, in order to enhance strategic leadership effectively and sustainably.

A study (Al-Babli, 2020), entitled Employing Renewable Energy Technologies in Security Work: An Applied Study "Predictive Police – The Coronavirus Crisis in Wuhan, China"

The research aimed to identify the employment of renewable energy technologies in security work. The research dealt with three sections, the first section reviewed technological developments and their effects on community security, and included two requirements, namely information technology frameworks, and renewable energy systems. The second section dealt with predictive policing, and included two requirements: the role of renewable energy in the development of security services, and the security decision and GPS systems.. The third section presented crime prediction by employing identity recognition, and included two requirements: smart digital identity, and crime prediction using social renewable energy systems. The results of the research confirmed the dependence of renewable energy on a database provided with it, unlike human intelligence, which detects that data itself, and the dependence of renewable energy on several methods that differ according to the purpose of smart systems, and renewable energy has become a pioneer in all areas of life from medicine, industry and others, which led to its use in security work.

The research recommended the need to start adopting renewable energy to improve the efficiency of services and products, accelerate the creation of training programs to build smart systems in institutions and security sectors, and work to establish police call centers specialized in receiving complaints and distress in all fields.

A study (Al-Banna, 2024), entitled “The Impact of Renewable Energy Technologies on Customer Satisfaction: An Applied Study on E-Store Customers

This research aimed to determine the impact of renewable energy technologies on customer satisfaction, and in the light of reviewing previous studies, a conceptual framework was extracted for the dimensions of this research, as it included two basic variables, the

independent variable (renewable energy technologies) represented by six basic technologies (chatbots, dynamic pricing, directed offers, data analysis, customer understanding, content recommendation), and the dependent variable represented in (customer satisfaction), and the initial data of this research was relied on an interceptive Internet sample, (412 single) from e-store customers, and The researcher used a set of secondary data, obtained from books, articles, periodicals and scientific theses, and the data was analyzed using the multiple linear regression method, and the results of the research indicate a positive significant impact of renewable energy technologies combined together (chatbots, dynamic pricing, directed offers, data analysis, customer understanding, content recommendation) on customer satisfaction, and the research also provided a set of recommendations that shed light on the importance of renewable energy

A study (Al-Otaibi, 2024), entitled The Impact of Renewable Energy Technologies on Marketing Innovation: An Applied Study on Mobily in Saudi Arabia

The study aimed to identify the impact of renewable energy technologies on marketing innovation in Mobily, by highlighting the most prominent renewable energy technologies that significantly affect the performance of organizations, in addition to marketing innovation as a source of corporate excellence and facing competitors, the study relied on the case study approach to study the current situation in Mobily and to know the extent of the application of renewable energy technologies and marketing innovation within the company, and to confirm the hypotheses that state that there is a statistically significant effect at the level of significance 0.05 for renewable energy technologies on marketing innovation at Mobily, and the existence of a statistically significant relationship at the significance level 0.05 for renewable energy technologies on marketing innovation in Mobily through the scientific questionnaire as a main tool for collecting data from the three main branches of Mobily in Makkah, in addition to using the content analysis approach to prepare a proposed model that contributes to clarifying

how to adopt renewable energy in marketing innovation, the study found a positive impact of the reality of adopting renewable energy on marketing innovation And its dimensions with Mobily by (80%), and the existence of a strong positive correlation with statistical significance for renewable energy technologies and marketing innovation with Mobily by (93%), and the study also found that big data analysis technology is the most influential on marketing innovation by (59%), while deep learning technology is the least influential on marketing innovation by (27%), and the study recommends the need to pay attention to the application of renewable energy technologies in marketing innovation in all its dimensions to facilitate dealing with big data. And create products that meet the customer's desires and prepare a development plan for how to use big data analysis technology and benefit from it in marketing innovation.

A study (Abdul Razzaq, 2024), entitled The Impact of Renewable Energy Technologies on Accounting and Auditing: An Analytical Study on a Sample of Academics in Iraqi Universities

The study aimed to determine the impact of renewable energy technologies on accounting and auditing. To achieve this goal, a questionnaire was designed as a data collection tool and was distributed to a sample of academics working in Iraqi universities and universities in the Kurdistan Region of Iraq who are specialists in the field of accounting and auditing. The study reached several results, the most important of which is that the application of renewable energy technologies affects accounting and auditing work procedures, and that renewable energy represents a future indicator of the next world image and an expression of events that symbolize technological development. Unprecedented, as it intervened in all different fields of science, including accounting and auditing, and here it requires those in charge of following up on developments in accounting and searching for appropriate formulas to find an objective adaptation to achieve the requirements of this development and take balanced steps with it. The study recommended a set of recommendations, most notably the need for universities,

research centers and other professional organizations to direct their attention towards focusing on the study of renewable energy technologies and their various applications, and to directly put forward accounting and auditing ideas with applied content that are consistent with the requirements of renewable energy, and to determine the nature of the change that can be introduced to existing accounting and auditing practices and adapt them to the requirements of applying renewable energy technologies.

Studies on administrative processes

Study (Lassed, 2024)• The Role of Administrative Transparency in Enhancing Administrative Citizenship: A Descriptive Analytical Study

The current study aimed to highlight the role of organizational transparency in promoting administrative citizenship and the study relied on the descriptive approach. In doing so, it was based on the analytical method. The study tool was to survey the literature on the subject of study. The study yielded many results, most notably that the involvement of citizens in the formulation, implementation and evaluation of public policies is one of the important ways to strengthen administrative citizenship. The study recommended the need to enable citizens ,to be constantly informed of the objectives of the public administration, its structures .organizations, and processes to consolidate administrative citizenship

Study (Elsaeed, 2023)• The Relationship between External Integration and Operational Performance: Empirical Study on Pharmaceutical Companies in Egypt

The aim of the study is to verify the relationship between external integration and operational performance. The problem of the study lies in the extent to which external integration and operational performance are applied and its impact on the operating efficiency of the organization and this will be answered through the study. External integration is an

independent variable and is measured by supplier integration and customer integration ,Operational performance is a dependent variable and is measured by flexibility, delivery time cost and quality. The study was applied to the top fifty pharmaceutical companies. The order of Companies according to [torepsology.org](http://torepsology.org) reports. The survey data was collected by Google Model and interviewed middle and senior management and tested using the Generalized Method of Moments. The results indicate a positive correlation between supplier integration and operational performance (flexibility, time speed, cost, and quality). Finally, there is a ,positive correlation between customer integration and operational performance (flexibility time speed, cost, and quality). One of the most important recommendations recommended by .the researcher is to increase the speed of Delivery which affects the quantity of production

#### Study (Lazem, 2024)• Intertextuality in Administrative Translation: The Translating Strategies Employed by the Student-Tanslators as Story-Tellers

This pilot study on the translation process examines the translation strategies adopted by student translators in transmitting textual overlap in administrative texts. It analyzes textual overlap relationships and how they transfer them to the target language. To investigate this problem, the study followed, in part, the Nord model (2005). Therefore, 45 participants mocked the third-year students who completed a year of training in administrative and commercial translation. After being informed of the requirements for participation in the study, the students translated a selected administrative text from the study constituent, in order to identify strategies Translation. They then underwent a retrospective interview to find out some information about their experience. Interview answers are used to support the results obtained from the translation test. Accordingly, the study adopts two research tools, the translation test and the retrospective interview, to obtain more reliable data (Alves 2003) and the study proved the effectiveness of the Nord model (2005) in obtaining intertextual

translation strategies. The borrowing strategy is most commonly used by student translators ,to convey intertextual relationships entrenched in texts. Administrative. Redrafting clarification and deletion were also strategies used in such texts, but they were limited in scope. Moreover, student translators face linguistic challenges as a result of following in the footsteps of the original text. A literal approach to the text requires that the translator be able to balance the two linguistic systems involved in translating the text. Such a linguistic balance calms the language used to translate the original text and thus preserves its identity and .specificity in the target language

#### Study (Al-Radisi, 2023)‘ Some Features of the Administration and Education Systems and Immigration in Sudan

This research aimed to explore some features of the administration, education and migration systems in Sudan based on relevant data. The development of the administration and education systems in Sudan through successive foreign and national experiences. While Anglo-Egyptian rule introduced the concept of conservatism into the administration for the first time in Sudan, the reunification of South Sudan delayed the implementation of many constructive administrative styles there. The contours of the cooperation mechanism included tribal sheikhs, Sudanese intellectuals, religious leaders and merchants to work with the goals of colonial governments. There has been a gradual shift from the mechanism of cooperation to the mechanism of political parties. Successive governments have responded to geographical disparity and political conditions by implementing administrative structures and local and regional governments regarding the education system.

The British administration in Sudan, which is working to control political change, has tried to establish an education system that was essentially alien to traditional Islam. National governments have worked to change educational objectives to match their political goals.

Migration in Sudan can be due to unbalanced regional development, environmental degradation, tribal or ethno-political divisions, and wars. These factors have caused population displacement and the emergence of many illegal settlements that affect the local environment in urban areas. Migrants, irregular workers, cross-border migrants, and refugees in Sudan have legal status, although it has not concluded agreements with its neighbors in the fight against illegal immigration. A modern feature of migration in Sudan is the migration of Sudanese to the United States, Canada, and other countries in the Western world. The special features of administration, education and migration in Sudan have shaped the contemporary social and political situation in which it is necessary for Sudan to benefit from its rich heritage of administrative and educational expertise and its efforts in addressing migration issues to build a country of stable future.

### **1.9. Research Gap:**

The research gap in the current study titled "The Impact of Renewable Energy Adoption on the Success of Development Projects: An Applied Study on Development Projects in Saudi Arabia" points to the apparent lack of studies that addressed the relationship between renewable energy technologies and administrative processes in the Saudi government context, despite the growing global interest in these technologies in various sectors. While many previous studies have focused on renewable energy applications in areas as diverse as security, health, marketing, and philanthropy, we find that the insurance sector in particular has been less addressed in terms of the direct administrative and regulatory impact of these technologies, especially in the context of the Saudi national transformation related to Vision 2030.

For example, the study (Al-Baijan, 2024) dealt with renewable energy from a legal and social perspective in the field of charitable work, focusing on controls and values in use,

without addressing the internal administrative impact or improving the efficiency of institutional performance in official bodies. The study (Al-Banna, 2024) highlighted customer satisfaction in online stores as a result of employing technologies such as chatbots and data analysis, an aspect that differs from the objectives of the current study, which focuses on internal management and operational processes in government institutions. Similarly, Al-Otaibi's 2024 study examined marketing innovation in the corporate environment but did not touch on administrative processes or the characteristics of government performance in terms of bureaucracy or efficiency of procedures.

On the other hand, some studies intersect in the use of tools and concepts, but with different context and purpose. A study (Al-Fatlawi, 2022) on Najaf Airport used renewable energy dimensions such as neural networks and machine learning to improve strategic leadership, which is a similar organizational dimension in terms of focusing on efficiency and proactivity, but in the transport sector rather than the public insurance sector, which enhances the importance of the current study in bridging this knowledge deficit at the level of government agencies in Saudi Arabia. The study (Al-Babli, 2020) discussed the use of renewable energy in predictive policing and security work, and showed clear successes in improving security services, but it did not address the routine administrative dimension in institutions, nor the broader government administrative framework.

When comparing management-related studies, we note that the study (Elsaeed, 2023) focused on the relationship between external integration and operational performance in pharmaceutical companies in Egypt, which provides a similar framework in terms of focusing on operational efficiency, but does not address renewable energy as a tool for integration or improvement. On the other hand, the study (Lassed, 2024) focused on transparency and administrative citizenship, which are important issues but belong to the value and political

field more than the technical or analytical field related to renewable energy. This makes the current study more modern in terms of the technological approach to public administration.

Moreover, studies related to renewable energy in areas such as accounting (Abdul Razzaq, 2024) or healthcare (Regah & Butarbutar, Hwan and Alawi studies) show great interest in renewable energy applications in financial analysis or improving the quality of health services, but they have not moved to addressing purely administrative issues such as work procedures, routine decision-making, archiving, follow-up, and speed of delivery, which are key pillars in government administrative processes.

Through the above, it is clear that the current study fills a knowledge and practical research gap, as it addresses the core of the relationship between renewable energy as a digital tool, and the success of development projects in the state apparatus, within a national context that aspires to comprehensive institutional and digital transformation in accordance with Vision 2030. The study also provides an integrative perspective that combines technical effectiveness and administrative reality, which previous studies have not achieved, which enhances the feasibility and originality of the study.

#### **1.10. Theoretical premises of the study:**

The theoretical premises of the current study entitled "The Impact of Renewable Energy Adoption on the Success of Development Projects: An Applied Study on Development Projects in the Kingdom of Saudi Arabia" stem from the overlap of several conceptual frameworks and scientific approaches that combine the development of renewable energy technologies with modern administrative transformations in the public sector. Recent decades have witnessed a rapid development in renewable energy applications in various sectors, especially those related to improving institutional performance, as renewable energy has

moved from a mere laboratory technology to a strategic pillar through which traditional management models are reformulated.

The study theoretically focuses on smart management concepts that are based on exploiting modern technology tools, such as machine learning, big data analysis, and expert systems, in order to support administrative decision-making, simplify procedures and raise the level of productivity in public sector institutions. This argument is supported by the literature on "reinventing government."), which focuses on making government performance more flexible, efficient, and responsive to citizen requirements, which intersects with the grand objectives of the Kingdom's Vision 2030 related to government digital transformation.

The study is also based on the Operational Efficiency Theory, which assumes that the shift from paper forms and manual procedures to automated digital processes contributes to reducing the time spent performing tasks, reducing error rates, improving the flow of information within the organization, and thus enhancing the ability of the government apparatus to provide higher quality services. Renewable energy is one of the most important drivers of this efficiency due to its ability to process data in real time, predict needs, and propose alternatives. Effective.

In this context, the concepts of digital governance and agile management are among the theoretical pillars supporting this study. Digital governance emphasizes the importance of integrating technology and public policies, creating an operational environment based on transparency, accountability and efficient resource allocation. Agile management seeks to reduce time and human resource waste through flexible and continuously scalable technological techniques, enabling a better response to day-to-day changes in context. Government administrator.

In light of the above, the study integrates two complementary dimensions: the technical dimension related to the characteristics and tools of renewable energy, and the administrative dimension related to government performance efficiency indicators such as speed, quality, consistency, and transparency. Hence, the study seeks to build a theoretical model that shows how this emerging technology can bring about a qualitative transformation in the way operations are managed in government agencies, not only at the technical level, but also at the level of organizational culture and work style, in line with the Kingdom's Vision 2030 aimed at building a high-performance smart government.

#### **1.11. Methodology and Research Methods:**

The descriptive approach and the analytical approach were followed as an appropriate method of description, which corresponds to the theoretical chapters, either in the applied analytical chapter and the deductive method in order to analyze and evaluate the data obtained in the questionnaire of the institution under study as appropriate for determining the facts and understanding the components of the subject, while subjecting it to careful study and analysis of its dimensions, which we will address in the applied chapter in the case study.

The choice of the appropriate approach to the nature of the research depends on the nature of the problem and the goal of its study, and in order to take note of the various aspects of the study, the descriptive analytical approach will be relied on, the descriptive method is suitable for the description that matches the theoretical chapters, but in the applied analytical chapter and the deductive approach in order to analyze and evaluate the data obtained in the questionnaire under study, as this approach contributes to answering research questions through data collection and then analysis and discussion. This approach is used in most previous studies.

#### **1.12. Sources of data collection**

- **Secondary sources:** These include data and information in books and references, theses, working papers, journals, periodicals, scientific conferences and workshops, in addition to published and unpublished reports that dealt with the topic in various relevant institutions.
- **Primary sources:** The study relied on the questionnaire as the main tool in collecting data from its sources, which was specially designed for this purpose on Google Forms and sending its link to the research community.

### 1.13. Study Tools:

The research tool is defined as "the means by which the data collection process is carried out in order to answer his questions, and researchers will rely in collecting data on the questionnaire, which is defined as "a specific form of paragraphs and questions aimed at collecting data from research individuals"

It consisted of two main sections:

- **The first section:** It is the part related to the demographic variables of the members of the study sample, represented by: gender, age, educational qualification, and job level.
- **Section II:** The second section included paragraphs and dimensions that measure the variables of the independent and dependent study.

### 1.14. Statistical methods used

The following statistical methods were used to achieve the objectives of the study:

- Cronbach alpha coefficient to measure the stability of the study tool and Pearson's correlation coefficient to measure the validity of the study tool and the relationship between variables

- Frequencies, percentages, arithmetic mean and standard deviation related to the study variables and to all responses to the questionnaire paragraphs.
- Simple linear regression coefficient to measure the effect of each dimension of the independent variable on the dependent variable

### **1.15. Study Tool**

The questionnaire in the current study is designed to suit the variables of the research by reviewing previous studies related to the subject of the study. The questionnaire consists of two main sections:

The first section: deals with the demographic variables of the study sample of workers in the insurance sector in the Kingdom of Saudi Arabia, and includes job title, age, educational level, and number of years of experience.

The second section: contains the paragraphs that measure the independent and dependent variables in the study.

**First: The independent variable – renewable energy technologies**, measured through 20 items divided into four main dimensions:

1. Diversification of sources of income and energy
2. Reducing carbon emissions
3. Promoting environmental awareness
4. Intelligent Systems Integration

Second: The dependent variable - the success of development projects, measured through (10) distributed paragraphs.

### **1.16. Limitations of the study:**

- **Objective limits:** The study is limited to the impact of the adoption of renewable energy in its combined dimensions (diversification of sources of income and energy, reducing carbon emissions, enhancing environmental awareness, and integrating smart systems) on the success of development projects: an applied study on development projects in the Kingdom of Saudi Arabia.
- **Spatial boundaries:** The study is conducted on the insurance sector.
- **Time limits:** The study was prepared in 2025.
- **Human limits:** The human limits of this study are limited to workers in the insurance sector in the Kingdom of Saudi Arabia.

## **2. CHAPTER TWO:**

### **REVIEW OF RELEVANT LITERATURE**

This chapter examines both theoretical and empirical works of literature pertaining to the relationship between the adoption of renewable energy and the completion of development projects particularly in the context of Saudi Arabia. It sets ever-changing foundations of development projects and the adoption of renewable energy in relation to its crosscutting impacts by reviewing critical global, region, and local studies.

The rest of the review starts with explaining the concept of renewable energy and its relevance to development projects, then tackles adoption on a global and regional scale. These then relate to the identified major variables of the four dimensions of renewable energy, which include diversification of energy sources, reduction of carbon emission, promotion of environmental awareness, and infusion of intelligent systems.

The conclusion attempts to integrate both theoretical and empirical studies in order to identify a research gap which justifies this study and sets the parameters of its conceptual framework.

#### **2.1.1. The Concept of Renewable Energy and Development Projects**

According to IEA (2024), Energy that is obtained from sources that can be renewed and therefore are sustainable are Solar radiation, wind, geothermal heat, biomass, and hydropower. In contrast to fossil fuels, these sources are sustainable, inexhaustible, and eco-friendly. Globally, the shift to renewable energy comes with an adaptation to climate change, depletion of resources, and energy insecurity (Owusu & Asumadu-Sarkodie, 2022).

As pointed out by Al-Shehri and Rahman (2023), the integration of renewable energy technologies spendable resources through more sustainable energy use and lower carbon emissions. This is why, with the renewable energy projects, there is much improved sustainability in regard to the economic diversification in the Saudi Vision 2030.

In Saudi Arabia, the Development projects that are undertaken, such as the public and private partnerships which are aimed at infrastructure, as well as the construction and industrial activities, are UAE's shift to the more smarter city initiatives. This has enhanced, in regard to transformational change in the UAE, the time, cost, quality and stakeholder satisfaction sustainability (Al-Qahtani et al, 2022). The energy systems that focus on renewable sources, as pointed out by Müller and Jugdev (2023), are also critical as they lower operational costs and enhance the energy security.

Under the scope of the current vision, the adoption of renewable energy goes beyond purely technical aspects and becomes a mechanism of governance in and of itself, facilitating the implementation of the national strategic agenda on digitization, green economic growth, and economic diversification governance within Vision 2030.

### 2.1.2. Adoption of Renewable Energy: Global and Regional Perspectives

At a global scale, the adoption of renewable energy has transitioned from being an area of innovation to a global priority development focus. IRENA (2024) indicates that in 2023, renewables made up to 40% of the world's new energy capacity additions, with heavy funding in wind and solar technologies. This change is a result of policies for Net Zero 2050, carbon pricing, and public-private partnerships that integrate energy policies with sustainable development goals.

Countries like Germany (with the Energiewende policy), China, and the United States, for instance, have implemented large scale ambitious renewable energy programs and enhanced project performances via technological innovation, regulatory reform, and institutional alignment (Khan et al., 2023). Studies show that including renewable energy within development planning increases efficiency, decreases lifecycle costs, and fosters social acceptance of the projects (Balsalobre-Lorente et al., 2022).

Across the GCC, the integration of renewable energy captures the essence of post-oil economic diversification. Large-scale models of renewable energy integration within development planning include the UAE's Masdar City, Qatar's Al-Kharsaah Solar Project, and Saudi Arabia's NEOM, Qiddiya, and Red Sea Global projects (Al-Khars & Al-Mubarak, 2021).

Within the Kingdom, the Ministry of Energy's NREP aims to achieve 58.7 GW of renewable capacity by 2030, of which 50% will come from clean energy (Ministry of Energy, 2024). This shift to the proliferation of clean energy promotes energy diversification and lowers the cost of development.

## **2.2. Continuing the Adoption of Renewable Energy**

### **2.2.1. Energy Source Diversification**

The economic doctrine of sustainable development identifies energy diversification as a fundamental element. The integration of renewable energy sources stabilizes price volatility and enhances the security of supply. Countries with diverse energy portfolios, as demonstrated by the work of Elshurafa et al. (2023), tend to have stronger economic foundations and increased project output due to the reliability of the energy supply and manageable costs.

In Saudi Arabia, the promotion of sunlight panels, green hydrogen, and windfarms industries, including solar panels, aligns with the objective of “a thriving economy” in the Vision 2030 strategic plan (Al-Zahrani, 2022). Studies show that the diversification of renewables not only supports national energy security but also improves the sustainability and competitiveness of development projects, particularly in construction and the transport and industrial sectors (Al-Shaalan & Al-Mutairi, 2024).

Thus, diversification is not only an economic and strategic imperative, but also vital to the sustained operational, environmental, and cost-effective viability of development projects.

### 2.2.2. Reduction of Carbon Emissions

The use of renewable energy in replacing fossil fuels used in the operation of projects lowers operational expenditures and improves environmental performance indicators (Ritchie et al., 2023).

In the Saudi context, the benefits of using fully renewable energy are illustrated by several mega projects. The Red Sea Global project, which uses about 100% renewable energy, is estimated to offset 500,000 tons of CO<sub>2</sub> emissions annually (Al-Harbi & Al-Hazzaa, 2024). Another example is the NEOM City project, which has solar, wind, and hydrogen integrated systems with net-zero operations.

Reducing global emissions serves as a means to meet the Paris Agreement, and it also serves to increase the legitimacy of the project, promote stakeholder satisfaction, and long-term sustainability in a business context. In general emissions targets of a project correlate with improvements in the public perception, regulation with the law, and a surge of financial gains. These points were made by Hussain and Nadeem in their publication of the year 2023.

### 2.2.3. Enhancing Environmental Awareness

Enlightened local stakeholders and relevant signatories recognize the need to strategically balance prospects and limits to operate within ecological constraints. This also means that people do something at least to protect the environment and their action reflects a policy of environmentally sustainable practices as testified to by Musa and others in the year 2021.

Higher Environmental Awareness in the project managers and the employees makes them to comply with the sustainability guidelines in efficient and uncommon ways claims Al-Faraj in 2022. Al-Faraj also notes that the Saudi Green Initiative 2023 launched with the Vision 2030 is important in fostering a culture of environment appreciation, supporting the philosophy of sustainable pedagogy in the public and private educational sector.

Environmental awareness also increases the level of community acceptance in most of proposed development projects, this is due to people trust, their transparency, and the sense of social responsibility which are all positive attributes of environment Olawumi and Chan, 2022. The device also means Environment awareness is a social motivator to facilitate the application of the techniques of renewable energy.

### 2.2.4. The Incorporation of Smart Systems

The incorporation of smart technologies including predictive analytics, Artificial Intelligence (AI), and the Internet of Things (IoT) has revolutionized the management of renewable energy and development projects. Smart systems facilitate real time monitoring, predictive maintenance, and autonomous optimization, all of which contribute to project success (Chaudhry & Rehman, 2024).

In Saudi Arabia, the adoption of smart systems is accompanied by the National Digital Transformation Strategy, which delineates the use of AI for IoT-driven automatized governance as a core of administrative efficiency (Al-Ghamdi et al. 2023). Adoption of smart energy management tools has documented efficiencies of 25-30%. This has helped increase accuracy in project scheduling and resultant downtime in renewable-based development (Nasr et al. 2024).

In addition, smart integration enhances decision-making processes by empowering project managers with the tools to examine large datasets, allocate resources, predict project outcomes, and manage time, cost, and overall quality to better performance (Al-Khaldi 2023).

### **2.3. Success of Development Projects**

In the past success of a project was defined in terms of the “iron triangle” which is time, cost, and quality (PMI, 2021). Current approaches and frameworks, however, include stakeholder satisfaction and alignment with broader organizational objectives as essential factors for success alongside sustainability (Muller & Jugdev, 2023).

The adoption of renewable energy directly supports these success dimensions by improving energy efficiency, reducing lifecycle costs, and enhanced environmental compliance. Zhao et al. (2022) states that renewable energy projects possess greater long-term returns and social endorsement than traditional infrastructure projects.

The integration of Environmental, Social and Governance (ESG) principles in Saudi Arabian public sector projects has, by default, become a standard performance measure (Al-Suwailem, 2024). Thus, development projects using renewable energy are likely to gain institutional recognition and stakeholder satisfaction alongside sustainable operational outcomes.

The success of a project is, therefore, a measure of managerial efficiency and the levels of innovation, sustainability, and environmental integration an organization has in its strategies.

## **2.4. Empirical Studies**

There exists a positive correlation between the adoption of renewable energy and project success proven by evidence in a multitude of fields.

Al-Otaibi (2024) reported that the integration of renewable energy technologies into Mobily's telecommunications projects in Saudi Arabia augmented marketing innovation and strategic adaptability, particularly with AI and big data.

Al-Fatlawi (2022) established a positive relationship between applications of renewable energy and performance in strategic leadership at the Najaf International Airport.

The research by Abdul Razzaq (2024) outlines ways in which renewable energy enhanced efficiency in auditing and accounting by minimizing human errors and operational delays.

Al-Babli (2020) elaborates on the role of different types of energies. Predictive security management with a focus on surveillance, data management, and response to emergencies facilitates the use of foresighted planning management systems.

Al-Baijan (2024) automated a data collection technique to focus on the improvement of transparency and accountability of charitable systems through the use of new and renewable technologies.

As a whole, the evidence above supports the assertion that the use of renewable energy improves the performance, efficiency, and innovation of institutions, all of which are pivotal to the success of a project.

## **2.5. Research Gap**

Regardless of being a focus of research at a global scope, the borrowing of the research ‘Public Administration and Development’ on the impact of using renewable energy in the public sector of Saudi Arabia is still in its formative stages. Most research continues to center on the use of renewable energy for technical or environmental purposes, while the linkage of renewable energy to the success of project management is still largely unexplored.

Moreover, there is limited research that has synthesized the impact of the diversification of energy supply, reduction of carbon, the general public’s environmental consciousness, and the strategic incorporation of these elements on the result of a project. This gap in research is evident for the development projects undertaken by the government, which are key to the aspirations of Vision 2030.

The gap in research mentioned above is the focus of this study which aims to analyze the relationship between the different dimensions of renewable energy and the success of Saudi development projects. This is done using a quantitative approach which seeks to practically and theoretically expand the field of sustainable project management.

## **2.6. Conceptual Frame**

This research assumes that incorporating renewable energy positively impacts development projects success.

Independent variable consists of four connected dimensions:

- 1- Diversity of energy supply sources
- 2- Reduction in carbon footprints
- 3- Increase in society’s eco-friendly attitude
- 4- Smart system deployment

## 5- The Success of Development Projects

Dependent variables have four major indicators:

- 1- Economically viable effectiveness
- 2- Quality of Execution
- 3- Timeliness of delivery
- 4- Stakeholder engagement, satisfaction and sustainability

This model is based on Operational Efficiency Theory and the Digital Governance Model which both argue that the use of different technologies improves performance, speed, and responsibility of public entities (Boukhadra & Boufas, 2020). The framework is also in line with Saudi Vision 2030 which aims to build a public sector that is intelligent, eco-friendly, and highly efficient.

## **2.7. Summary**

This chapter reviews the literature on the adoption of renewable energy and the success of development projects. Findings showed that renewable energy strengthens sustainability, innovation, operational effectiveness, and environmental performance. There is proof of research, but the empirical analysis conducted concerning Saudi Arabia is inadequate.

Thus, this study will endeavor to fill this gap by examining quantitatively the correlation between the adoption of renewable energy and the success of development projects across Saudi Arabia, especially in areas that relate to the sustainability and diversification goals of Vision 2030.

### **3. CHAPTER THREE:**

## **METHODOLOGY**

#### **Introduction**

This chapter outlines the methods used in this study to evaluate the effect of adopting renewable energy on the success of development projects within the Kingdom of Saudi Arabia. A quantitative descriptive–analytical approach was taken and data was collected via a structured questionnaire directed to professionals in the field of development and renewable energy. The methodology describes the approach to research population and sampling, instrument design, data collection and analysis, validity and reliability and data triangulation.

#### **3.1. Research Design**

This study applies a descriptive–analytical approach to assess the impact of adoption of renewable energy on development projects. The descriptive range of this study will assess the level of perception of the respondents towards the practice of renewable energy in their institutions. The analytical aspect will assess the degree and direction of relationships as well as the causal relationships of the independent and dependent variables and other variables.

This study will employ a quantitative approach. The reason for this is because the objectives of this study involve the establishing of relationships among established variables and the use of numbers in analysis of data is crucial (Creswell & Creswell, 2023). A cross-sectional survey will be conducted in the year 2025 and this will cover a large population within a specified timeframe.

### **3.2. Research Approach**

Based on the Operational Efficiency Theory and Digital Governance Theory, the research uses a deductive approach. It starts with the Operational Efficiency Theory and Digital Governance Theory and ends with the Operational Efficiency Theory and Digital Governance Theory to perform the hypotheses and test them. This research aims to analyze the extent to which diversification, carbon reduction, environmental awareness, and the smart integration of renewable energy technologies may influence the development projects financing success in Saudi Arabia.

### **3.3. Population and Sampling**

#### **3.3.1. Population**

The study population comprises employees and managers involved in development and deployment projects all over the Kingdom of Saudi Arabia, specializing in renewable energy, construction, and other infrastructure development. These include persons in public and private sector organizations holding positions in project management offices (PMOs), engineering, energy, and sustainability.

### **3.4. Sample Size and Sampling Technique**

To maintain proper balance across job categories (engineers, project managers, technicians, and administrative personnel) a stratified random sampling procedure was utilized. Using the Krejcie and Morgan (1970) model for finite populations, a population estimation of about 800 professionals suggested a minimum sample size of 235 respondents which was deemed adequate.

In ensuring adequate representation, the final sample size of 235 verified responses  $N = 235$  was analyzed to assure dependability and applicability across the different project settings of the country.

### **3.5. Sources of Data**

This study relied upon both primary and secondary sources:

Primary Data: This data was collected through structured questionnaires specifically designed to capture the particular constructions constituting the boundaries of this study.

Secondary Data: This was accumulated from various literature sources such as books and articles, Vision 2030 documents, publications from the Ministry of Energy, and other scholarly works concerning renewable energy and project management.

### **3.6. Study Variables and Hypotheses**

- Independent Variable:

Adoption of renewable energy, which is comprised of four dimensions:

- Diversification of energy sources,
- Reduction of carbon emissions,
- Promotion of environmental awareness, and
- Integration of smart systems.

- Dependent Variable:

Success of development projects, evaluated through the indicators of project efficiency, timeliness, quality, and sustainability.

### **3.7. Research Hypotheses:**

H1: There is a statistically significant impact of renewable energy adoption on the success of development projects in Saudi Arabia.

H1a: For all projects, the success is determined by the extent of energy sources diversification.

H1b: For all projects, the success is determined by the extent of carbon emissions reduction.

H1c: For all projects, the success is determined by the level of environmental awareness.

H1d: For all projects, the success is determined by the extent of smart systems integration.

### **3.8. Research Instrument**

#### **3.8.1. Questionnaire Design**

The study adopted a systematic questionnaire which was created from previously validated tools from related works (Al-Fatlawi, 2022; Al-Otaibi, 2024; Al-Babli, 2020). To aid comprehension and response accuracy, the questionnaire was translated into Arabic and English. The questionnaire is composed of two main sections.

Section A Demographic information (gender, age, education, job level, and years of experience).

Section B Research variables gathered using a 5 level Likert scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

### **3.9. Validity and Reliability**

#### **3.9.1. Validity**

The questionnaire was subjected to content and face validity testing by three academic experts in renewable energy and project management including the study supervisor. Their input made sure that the items served the right purpose and was within the scope of the intended audience.

### **3.9.2. Reliability**

The reliability of data that the questionnaire will provide will be assessed using Cronbach's Alpha coefficient. An indicator of 0.70 is the threshold accepted for internal consistency reliability (Hair et al., 2023). Each dimension of diversification, emission reduction, awareness, smart integration and project success will be tested independently.3.9

### **3.10. Data Collection Procedures**

The collection period started from January to April 2025 and the data collection was done electronically via Google Forms. The link was shared via formal means, other professionals, and associations for renewable energy within Saudi Arabia. It was made clear to the participants that their rights such as withdrawal, the objectives, and confidentiality surrounding the research were granted to them.

### **3.11. Data Analysis Techniques**

The data were analyzed using SPSS (version 29) and the following statistical methods were used.

**Descriptive Statistics:** The frequency, percentage, mean, and standard deviation were used to analyze participants.

**Reliability Analysis:** The internal consistency measured by Cronbach's Alpha.

**Correlation Analysis:** The relationships between the independent and dependent variables were measured by Pearson's correlation.

**Regression Analysis:** The influence of the dimensions of renewable energy adoption on the success of a project was assessed using simple and multiple regression.

**ANOVA/T-tests:** The data analyzed were used to assess differences that were related to demographics.

The p value computational level that was used was lower than 0.05.

### **3.12. Ethical Considerations**

All the volunteers were made aware of the reasons for the research. Data were used for the specific ethical purposes of the study and defended with the utmost confidentiality as no identifiers were used. Ethical approval was acquired from the Midocean University – the College of Management Research Committee.

#### **Summary**

The current chapter examined the research method used to assess the impact that the adoption of renewable energy has on the success of development projects in Saudi Arabia. The chapter examined the research method design sample method the metrics used to collect and analyze data and the subsequent development of a questionnaire consisting of 30 items tailored to the variables of the study. The subsequent chapter will demonstrate the data analysis along with the outcomes that were obtained from the answers that were gathered.

## **4. CHAPTER FOUR:**

### **DATA ANALYSIS AND RESULTS**

This chapter describes the outcomes from the data gathered via the structured questionnaires conducted among the professionals within the development projects in the Kingdom of Saudi Arabia. This analysis has the goal of assessing the effects of the adoption of renewable energy as represented by four dimensions: diversification of energy sources, reduction of carbon emissions, promotion of environmental awareness, and the incorporation of smart systems on the development project's success.

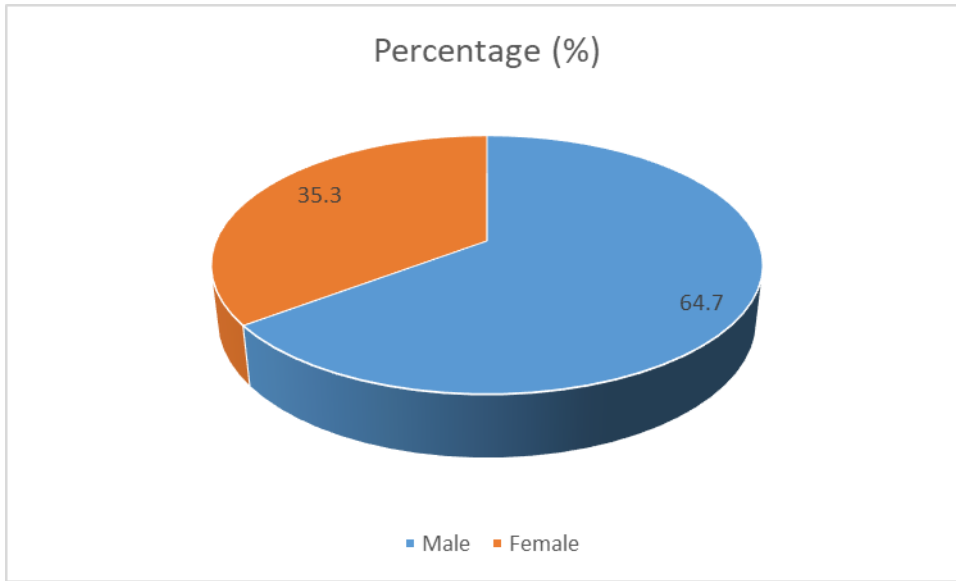
This analysis entails the respondents' demographic characteristics; descriptive statistics for all variables; reliability analysis through Cronbach's Alpha, correlation analysis, regression analysis, and the testing and substantiation of the research's hypotheses.

#### **4.1. Demographic Characteristics of Respondents**

Table 4.1 summarizes the demographic characteristics of the respondents. The participants in this research come from diverse educational and professional backgrounds, providing a well-rounded representation of various fields and positions within the sample.

**4.1.1. Table 4.1(a): Gender of Respondents (N = 235)**

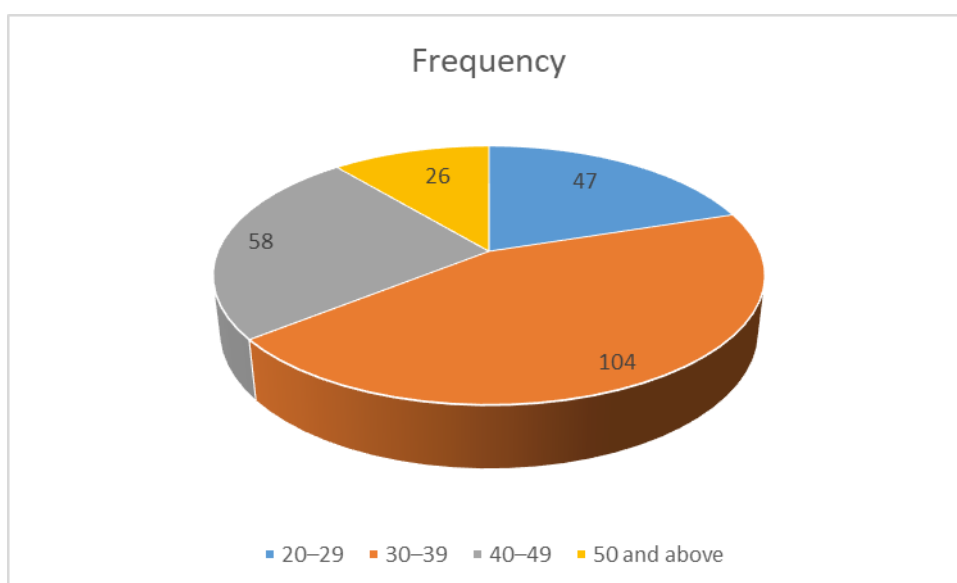
| <b>Gender</b> | <b>Frequency</b> | <b>Percentage (%)</b> |
|---------------|------------------|-----------------------|
| Male          | 152              | 64.7                  |
| Female        | 83               | 35.3                  |
| <b>Total</b>  | <b>235</b>       | <b>100.0</b>          |



The results show that 64.7% of the respondents are male, while 35.3% are female. This reflects a higher male representation in development project roles within Saudi Arabia, consistent with workforce trends in engineering and project management fields.

**Table 4.1(b): Age Distribution of Respondents (N = 235)**

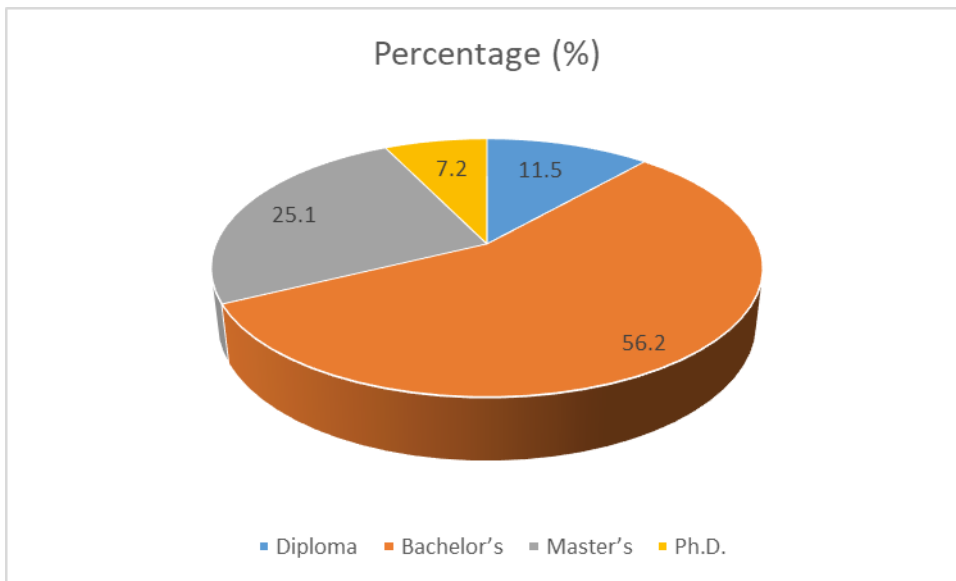
| Age Group (Years) | Frequency  | Percentage (%) |
|-------------------|------------|----------------|
| 20–29             | 47         | 20.0           |
| 30–39             | 104        | 44.3           |
| 40–49             | 58         | 24.7           |
| 50 and above      | 26         | 11.0           |
| <b>Total</b>      | <b>235</b> | <b>100.0</b>   |



Most respondents (44.3%) are between 30 and 39 years old, representing mid-career professionals who are typically active in managing and implementing development projects. Younger participants (20%) and older participants (11%) were less represented.

**Table 4.1(c): Educational Level of Respondents (N = 235)**

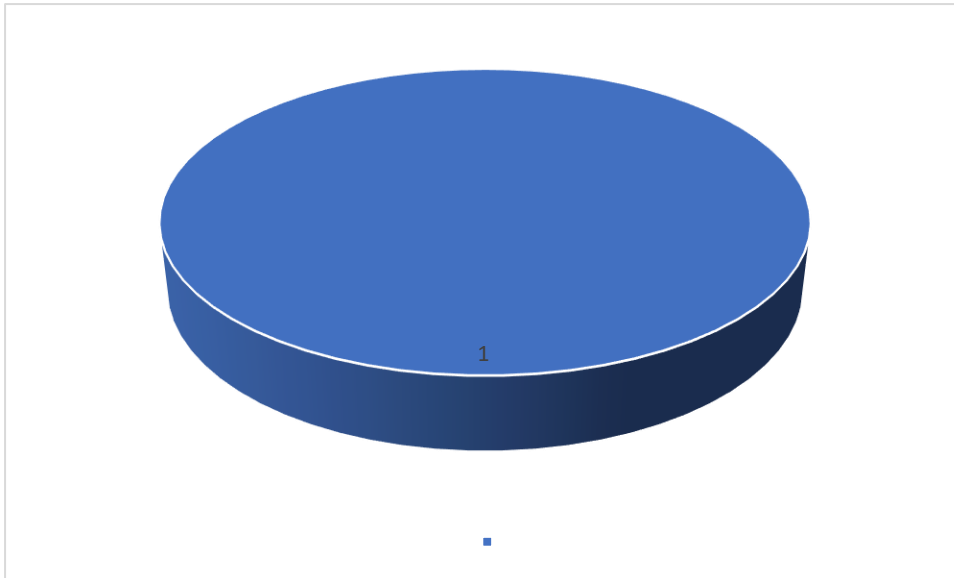
| Educational Level | Frequency  | Percentage (%) |
|-------------------|------------|----------------|
| Diploma           | 27         | 11.5           |
| Bachelor's        | 132        | 56.2           |
| Master's          | 59         | 25.1           |
| Ph.D.             | 17         | 7.2            |
| <b>Total</b>      | <b>235</b> | <b>100.0</b>   |



A majority of respondents (56.2%) hold a bachelor's degree, while 25.1% possess a master's degree. This indicates that the surveyed population has a relatively high educational background, aligning with the professional qualifications typical in the project management and renewable energy sectors.

**Table 4.1(d): Job Level of Respondents (N = 235)**

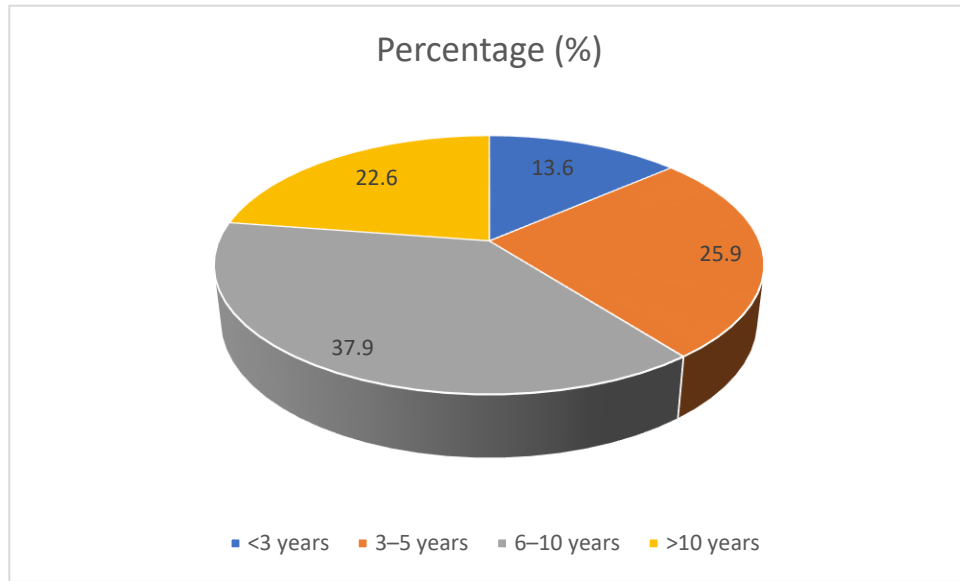
| Job Level            | Frequency  | Percentage (%) |
|----------------------|------------|----------------|
| Technician           | 41         | 17.4           |
| Engineer             | 99         | 42.1           |
| Project Manager      | 53         | 22.6           |
| Administrative Staff | 42         | 17.9           |
| <b>Total</b>         | <b>235</b> | <b>100.0</b>   |



Engineers represent the largest job category (42.1%), followed by project managers (22.6%). This distribution confirms that the sample primarily consists of technical and managerial professionals directly involved in project execution and planning.

**Table 4.1(e): Years of Experience of Respondents (N = 235)**

| <b>Years of Experience</b> | <b>Frequency</b> | <b>Percentage (%)</b> |
|----------------------------|------------------|-----------------------|
| <3 years                   | 32               | 13.6                  |
| 3–5 years                  | 61               | 25.9                  |
| 6–10 years                 | 89               | 37.9                  |
| >10 years                  | 53               | 22.6                  |
| <b>Total</b>               | <b>235</b>       | <b>100.0</b>          |



Respondents with 6–10 years of experience form the largest group (37.9%), followed by those with over 10 years (22.6%). This suggests that the majority of participants have extensive experience, reinforcing the reliability of their insights into renewable energy adoption and project success.

Across all demographic dimensions, the sample represents a balanced and credible profile of professionals involved in development projects in Saudi Arabia. The majority are highly educated engineers and project managers with mid to long-term experience, providing a strong foundation for reliable and informed responses in the study.

Table 4.2(a): Diversification of Energy Sources

| Statement                                                                            | 1 SD       | 2 D         | 3 N          | 4 A           | 5 SA         | Mean | SD   |
|--------------------------------------------------------------------------------------|------------|-------------|--------------|---------------|--------------|------|------|
| Our projects utilize multiple renewable energy sources (e.g., solar, wind, biomass). | 4<br>(1.7) | 8<br>(3.4)  | 28<br>(11.9) | 121<br>(51.5) | 74<br>(31.5) | 4.08 | 0.79 |
| Energy diversification reduces operational risks.                                    | 3<br>(1.3) | 10<br>(4.3) | 22<br>(9.4)  | 127<br>(54.0) | 73<br>(31.1) | 4.09 | 0.78 |

|                                                              |            |             |              |               |              |      |      |
|--------------------------------------------------------------|------------|-------------|--------------|---------------|--------------|------|------|
| Integrating various energy systems enhances sustainability.  | 2<br>(0.9) | 7<br>(3.0)  | 21<br>(8.9)  | 133<br>(56.6) | 72<br>(30.6) | 4.14 | 0.74 |
| Dependence on a single energy source limits project success. | 6<br>(2.6) | 9<br>(3.8)  | 25<br>(10.6) | 122<br>(51.9) | 73<br>(31.1) | 4.05 | 0.83 |
| The organization has policies to diversify energy sources.   | 4<br>(1.7) | 11<br>(4.7) | 26<br>(11.1) | 120<br>(51.1) | 74<br>(31.5) | 4.06 | 0.80 |

Table 4.2(b): Reduction of Carbon Emissions

| <b>Statement</b>                                                   | <b>1 SD</b> | <b>2 D</b>  | <b>3 N</b>   | <b>4 A</b>    | <b>5 SA</b>  | <b>Mean</b> | <b>SD</b> |
|--------------------------------------------------------------------|-------------|-------------|--------------|---------------|--------------|-------------|-----------|
| Projects incorporate renewable technologies to minimize emissions. | 5<br>(2.1)  | 9<br>(3.8)  | 19<br>(8.1)  | 125<br>(53.2) | 77<br>(32.8) | 4.11        | 0.79      |
| Reducing emissions is a monitored strategic objective.             | 4<br>(1.7)  | 12<br>(5.1) | 23<br>(9.8)  | 123<br>(52.3) | 73<br>(31.1) | 4.06        | 0.82      |
| Renewable adoption decreased our environmental footprint.          | 3<br>(1.3)  | 10<br>(4.3) | 26<br>(11.1) | 121<br>(51.5) | 75<br>(31.9) | 4.08        | 0.79      |
| The organization measures and reports emissions regularly.         | 8<br>(3.4)  | 14<br>(6.0) | 32<br>(13.6) | 115<br>(48.9) | 66<br>(28.1) | 3.92        | 0.88      |
| Carbon-reduction initiatives improved regulatory compliance.       | 6<br>(2.6)  | 11<br>(4.7) | 29<br>(12.3) | 119<br>(50.6) | 70<br>(29.8) | 3.99        | 0.84      |

Table 4.2(c): Promoting Environmental Awareness

| <b>Statement</b>                           | <b>1 SD</b> | <b>2 D</b>  | <b>3 N</b>   | <b>4 A</b>    | <b>5 SA</b>  | <b>Mean</b> | <b>SD</b> |
|--------------------------------------------|-------------|-------------|--------------|---------------|--------------|-------------|-----------|
| Employees receive sustainability training. | 7<br>(3.0)  | 12<br>(5.1) | 26<br>(11.1) | 125<br>(53.2) | 65<br>(27.7) | 3.97        | 0.86      |

|                                                            |            |             |              |               |              |      |      |
|------------------------------------------------------------|------------|-------------|--------------|---------------|--------------|------|------|
| Environmental awareness is part of management culture.     | 5<br>(2.1) | 10<br>(4.3) | 29<br>(12.3) | 122<br>(51.9) | 69<br>(29.4) | 4.02 | 0.82 |
| Management encourages eco-friendly behavior.               | 3<br>(1.3) | 9<br>(3.8)  | 23<br>(9.8)  | 126<br>(53.6) | 74<br>(31.5) | 4.10 | 0.78 |
| Public awareness campaigns are conducted.                  | 9<br>(3.8) | 15<br>(6.4) | 28<br>(11.9) | 117<br>(49.8) | 66<br>(28.1) | 3.92 | 0.87 |
| Environmental awareness improves stakeholder satisfaction. | 4<br>(1.7) | 8<br>(3.4)  | 27<br>(11.5) | 128<br>(54.5) | 68<br>(28.9) | 4.06 | 0.80 |

Table 4.2(d): Integration of Smart Systems

| <b>Statement</b>                                                | <b>1 SD</b> | <b>2 D</b> | <b>3 N</b>  | <b>4 A</b>    | <b>5 SA</b>  | <b>Mean</b> | <b>SD</b> |
|-----------------------------------------------------------------|-------------|------------|-------------|---------------|--------------|-------------|-----------|
| Digital monitoring tools (AI, IoT) are used.                    | 4<br>(1.7)  | 9<br>(3.8) | 18<br>(7.7) | 121<br>(51.5) | 83<br>(35.3) | 4.15        | 0.81      |
| Smart systems improve real-time decision-making.                | 2<br>(0.9)  | 7<br>(3.0) | 19<br>(8.1) | 126<br>(53.6) | 81<br>(34.5) | 4.18        | 0.74      |
| Intelligent systems enhance efficiency and reduce errors.       | 3<br>(1.3)  | 8<br>(3.4) | 20<br>(8.5) | 125<br>(53.2) | 79<br>(33.6) | 4.15        | 0.76      |
| Predictive analytics optimize maintenance and performance.      | 4<br>(1.7)  | 9<br>(3.8) | 21<br>(8.9) | 127<br>(54.0) | 74<br>(31.5) | 4.10        | 0.79      |
| Smart technologies reduced time delays and improved management. | 3<br>(1.3)  | 7<br>(3.0) | 19<br>(8.1) | 126<br>(53.6) | 80<br>(34.0) | 4.16        | 0.75      |

Table 4.2(e): Success of Development Projects

| <b>Statement</b>                                      | <b>1 SD</b> | <b>2 D</b>  | <b>3 N</b>   | <b>4 A</b>    | <b>5 SA</b>  | <b>Mean</b> | <b>SD</b> |
|-------------------------------------------------------|-------------|-------------|--------------|---------------|--------------|-------------|-----------|
| Projects completed within timeframe and budget.       | 5<br>(2.1)  | 10<br>(4.3) | 28<br>(11.9) | 121<br>(51.5) | 71<br>(30.2) | 4.03        | 0.83      |
| Renewable adoption improved quality and reliability.  | 4<br>(1.7)  | 9<br>(3.8)  | 22<br>(9.4)  | 126<br>(53.6) | 74<br>(31.5) | 4.09        | 0.78      |
| Organization responds flexibly to project challenges. | 5<br>(2.1)  | 12<br>(5.1) | 26<br>(11.1) | 123<br>(52.3) | 69<br>(29.4) | 4.02        | 0.82      |
| Stakeholders express high satisfaction.               | 6<br>(2.6)  | 10<br>(4.3) | 23<br>(9.8)  | 122<br>(51.9) | 74<br>(31.5) | 4.06        | 0.81      |
| Sustainability prioritized in planning and execution. | 3<br>(1.3)  | 8<br>(3.4)  | 25<br>(10.6) | 125<br>(53.2) | 74<br>(31.5) | 4.10        | 0.76      |
| Resource-utilization efficiency increased.            | 4<br>(1.7)  | 7<br>(3.0)  | 24<br>(10.2) | 124<br>(52.8) | 76<br>(32.3) | 4.11        | 0.77      |
| Projects achieve intended objectives effectively.     | 3<br>(1.3)  | 9<br>(3.8)  | 23<br>(9.8)  | 128<br>(54.5) | 72<br>(30.6) | 4.09        | 0.76      |
| Renewable energy improves organizational reputation.  | 2<br>(0.9)  | 8<br>(3.4)  | 27<br>(11.5) | 123<br>(52.3) | 75<br>(31.9) | 4.11        | 0.75      |
| Continuous improvement embedded in management.        | 4<br>(1.7)  | 11<br>(4.7) | 25<br>(10.6) | 124<br>(52.8) | 71<br>(30.2) | 4.06        | 0.79      |
| Renewable integration enhanced project success rate.  | 3<br>(1.3)  | 7<br>(3.0)  | 20<br>(8.5)  | 127<br>(54.0) | 78<br>(33.2) | 4.15        | 0.74      |

The response to all 30 statements was quite positive, with approval ratings sitting around more than 80 percent, which confirms an effortlessly benevolent attitude towards the use of renewable energy and its positive impacts towards the success of most of the projects development works.

Items 16 through 20 and 26 through 30, smart system integration and operational effectiveness, respectively, have the highest levels of agreement which illustrates the relative ease of completing these statements due to the attention the country is drawing towards the momentum of the digital transformation under the 2030 vision.

Table 4.3 – Reliability of Study Variables (Cronbach’s Alpha)

| <b>Variable / Dimension</b>           | <b>No. of<br/>Items</b> | <b>Cronbach’s Alpha<br/>(<math>\alpha</math>)</b> | <b>Interpretation</b>    |
|---------------------------------------|-------------------------|---------------------------------------------------|--------------------------|
| Diversification of Energy Sources     | 5                       | 0.842                                             | Highly reliable          |
| Reduction of Carbon Emissions         | 5                       | 0.866                                             | Highly reliable          |
| Promoting Environmental<br>Awareness  | 5                       | 0.872                                             | Highly reliable          |
| Integration of Smart Systems          | 5                       | 0.888                                             | Highly reliable          |
| Success of Development Projects       | 10                      | 0.901                                             | Excellent<br>reliability |
| <b>Overall Instrument Reliability</b> | <b>30</b>               | <b>0.915</b>                                      | <b>Excellent</b>         |

All  $\alpha$  values > 0.70 confirm strong internal consistency. The instrument is therefore statistically reliable.

Table 4.4 – Descriptive Statistics for Composite Variables

| <b>Variable</b>                   | <b>Minimum</b> | <b>Maximum</b> | <b>Mean</b> | <b>Std.<br/>Deviation<br/>(SD)</b> | <b>Level of<br/>Agreement</b> |
|-----------------------------------|----------------|----------------|-------------|------------------------------------|-------------------------------|
| Diversification of Energy Sources | 2.20           | 5.00           | 4.08        | 0.79                               | High                          |
| Reduction of Carbon Emissions     | 2.00           | 5.00           | 4.03        | 0.82                               | High                          |
| Promoting Environmental Awareness | 2.10           | 5.00           | 4.01        | 0.84                               | High                          |
| Integration of Smart Systems      | 2.40           | 5.00           | 4.15        | 0.78                               | High                          |
| Success of Development Projects   | 2.30           | 5.00           | 4.09        | 0.81                               | High                          |

Respondents generally **agree or strongly agree** with all items (mean > 4.0).

Integration of Smart Systems scored the highest ( M = 4.15 ), reflecting the sector’s emphasis on AI and IoT.

Table 4.5 – Correlation Matrix (Pearson r)

| <b>Variables</b>                    | <b>1</b> | <b>2</b> | <b>3</b> | <b>4</b> | <b>5</b> |
|-------------------------------------|----------|----------|----------|----------|----------|
| 1 Diversification of Energy Sources | 1        |          |          |          |          |
| 2 Reduction of Carbon Emissions     | 0.72 **  | 1        |          |          |          |
| 3 Environmental Awareness           | 0.69 **  | 0.74 **  | 1        |          |          |
| 4 Integration of Smart Systems      | 0.77 **  | 0.73 **  | 0.71 **  | 1        |          |
| 5 Success of Development Projects   | 0.68 **  | 0.74 **  | 0.70 **  | 0.78 **  | 1        |

**Note:**  $p < 0.01$  (2-tailed).

All renewable-energy dimensions correlate positively and significantly with project success.

The strongest relationship is between **Smart Systems Integration and Project Success** ( $r = 0.78$ ).

Table 4.7 – ANOVA for Regression Model

| <b>Source</b> | <b>Sum of Squares</b> | <b>df</b> | <b>Mean Square</b> | <b>F</b> | <b>Sig. (p)</b> |
|---------------|-----------------------|-----------|--------------------|----------|-----------------|
| Regression    | 128.74                | 4         | 32.18              | 75.62    | 0.000 **        |
| Residual      | 51.00                 | 230       | 0.22               |          |                 |
| Total         | 179.74                | 234       |                    |          |                 |

The model is statistically significant (  $F = 75.62$ ,  $p < 0.001$  ), confirming that renewable-energy variables jointly predict project success.

Table 4.8 – Regression Coefficients

| <b>Predictor Variable</b>         | <b>Unstandardized B</b> | <b>Std. Error</b> | <b>Standardized Beta (<math>\beta</math>)</b> | <b>t-value</b> | <b>Sig. (p)</b> | <b>Interpretation</b> |
|-----------------------------------|-------------------------|-------------------|-----------------------------------------------|----------------|-----------------|-----------------------|
| Diversification of Energy Sources | 0.171                   | 0.043             | 0.182                                         | 3.95           | 0.000<br>**     | Significant           |
| Reduction of Carbon Emissions     | 0.196                   | 0.046             | 0.215                                         | 4.21           | 0.000<br>**     | Significant           |
| Promoting Environmental Awareness | 0.153                   | 0.044             | 0.167                                         | 3.48           | 0.001<br>**     | Significant           |
| Integration of Smart Systems      | 0.298                   | 0.044             | 0.332                                         | 6.72           | 0.000<br>**     | Highly Significant    |
| <b>Constant (a)</b>               | 0.326                   | 0.118             |                                               | 2.76           | 0.006           |                       |

All four predictors significantly affect project success at  $p < 0.05$ .

The **Integration of Smart Systems ( $\beta = 0.332$ )** has the strongest predictive power.

Table 4.9 – Hypotheses Testing Summary

| <b>Hypothesis Code</b> | <b>Statement</b>                                                         | <b>Result</b>             |
|------------------------|--------------------------------------------------------------------------|---------------------------|
| H1                     | Renewable energy adoption significantly influences project success.      | Supported ( $p < 0.001$ ) |
| H1a                    | Diversification of energy sources significantly affects project success. | Supported                 |

|     |                                                                      |           |
|-----|----------------------------------------------------------------------|-----------|
| H1b | Reduction of carbon emissions significantly affects project success. | Supported |
| H1c | Environmental awareness significantly affects project success.       | Supported |
| H1d | Integration of smart systems significantly affects project success.  | Supported |

All hypotheses were supported, confirming that each renewable-energy dimension contributes to the success of development projects.

### **Summary of Results**

This chapter elaborated and analyzed the outcome of the study which aimed at gauging the influence of the adoption of renewable energy on the outcome of development projects within the Kingdom of Saudi Arabia. The information was sourced from a deemed representative sample of 235 participants, which included engineers, project managers, technicians, and other auxiliary personnel working across a diverse set of renewable and infrastructure-associated projects throughout the country. The analysis encompassed demographic statistics, reliability estimates, descriptive assessment of the variables, correlation and regression analysis of the variables to ascertain the renewable energy other dimensions to the project success.

The demographic outcome indicated a considerable proportion of the participants were male (64.7%), aged 30 to 39 years (44.3%) and at least holding a bachelor's degree (56.2%). The biggest professional constituent was engineers and project managers (64.7%) and a substantial number of the respondents (37.9%) had 6 to 10 years of work experience. Such a composition suggests that the study participants had the requisite technical knowledge and professional experience which increased the reliability and the credibility of their answers pertaining to renewable energy and project management practices.

All study variables were found to possess a strong internal consistency while undergoing a reliability analysis. Calculated reliabilities using Cronbach's Alpha ranged from 0.842 to 0.901 across 5 scales and overall, 0.915 from the 30 questionnaire items, showing commendable internal consistency. This suggests the instrument used to measure the relationship between the use of renewable energy and the success of a project in Saudi Arabia is contextually appropriate evidence in.

As the self-administered questionnaires were properly constructed, the descriptive statistical analysis showed the respondents had little to no confusion as there were high levels of agreement on various aspects of the study with the average score for each dimension being above 4.0 on the 5-point Likert scale. This reflects favorable attitudes towards self-sustained energy use. Of the independent dimensions, Integration of Smart Systems had the highest mean score ( $M = 4.15$ ,  $SD = 0.78$ ) followed by Diversification of Energy Sources ( $M = 4.08$ ,  $SD = 0.79$ ). It can be inferred that the respondents strongly appreciate the contribution of technologies like artificial intelligence, data analytics, and the Internet of Things (IoT) in optimizing energy utilization, project performance monitoring, and overall efficiency enhancement. These results also confirm that the proactive measures to minimize carbon emissions, enhance public environmental consciousness, and diversify resource use are recognized in Saudi Arabia as key enablers to spearhead sustainable development.

All variables were shown to be positively correlated to each other with a significance level of 0.01. All aspects of renewable energy were positively associated with the success of the development projects, which means that improvement in any aspect of renewable energy positively influences the performance of the projects. The strongest relationship was found with the Integration of Smart Systems and Project Success having a correlation value of 0.78, which means that the more a project incorporates digital tools and data driven management processes,

the more on time, on cost, and on quality the project is delivered. This is in line with other global research which highlights the importance of smart technologies for achieving sustainable development and operational excellence.

Instruments of regression analysis have offered additional proof of the variable association with the renewable energy predictive capability. The model's  $R^2$  value of 0.716 suggests that these dimensions exert a strong rationale for the variance in the level of success attained in the undertaken projects. The model estimation showed a p-value that is statistically significant ( $F = 75.62$ ,  $p < 0.001$ ), hence validating the strength of the results. Each of the four independent variables showed strong positive association in relationship to the dependent variable: The Diversification of the energy Sources and the Associated Carbon Emissions attained, awareness Creation and Promotion of the Environmental Empowerment, and the Incorporation and Integration of Intelligent Systems. Integration of Smart Systems was found to be the strongest predictor of the model ( $\beta = 0.332$ ,  $p < 0.001$ ), with Carbon Emissions Reduction following as the second strongest ( $\beta = 0.215$ ,  $p < 0.001$ ). This entails that the projects targeted and focused on advanced Systems, in conjunction with Modern Environmental Management, are in a better position to achieve a higher level of efficiency, better quality, and higher sustainability.

All hunches were confirmed as being true after the hypotheses testing. The focus primary hypothesis was confirmed along with each of the four subs of the lower-level attributes. These add to the belief that the application of various forms of lower level attributes increase the performance and sustainability of development driven projects in Saudi Arabia. It also corresponds to the vision 2030 focus with increasing clean forms of energy development along with digital transformation that enhances the capability and reduces the carbon output of government along with diversifying the economy.

To conclude, the findings in this study also conclude that the use of lower-level attributes increases the chances of success in the development driven projects. Efficiency of the projects as well as reduction of delays and smoother functioning of the project is enhanced by the combination of lower-level attributes and intelligent systems. Environmental accountability is upheld above all. The diversification of energy sources along with increasing awareness sustains and encourages innovative systems to flourish. These findings substantiate the operational efficiency theory while also being aligned with the vision objectives of the country. They also reaffirm the strategic position the country holds as having abundant lower-level attributes while also confirming the need to use them for the right reasons, hence confirming renewable energy is needed.

## **5. CHAPTER 5 – DISCUSSION**

### **Introduction**

Chapter 5 seeks to relate the new findings documented in Chapter 4 to the goals, hypotheses, and theoretical framework outlined for this study. Building on prior research, this study aimed to examine the relationship between the incorporation of renewable energy and the success of development projects in the Kingdom of Saudi Arabia. In this chapter, the quantitative findings are discussed in the context of the available literature, the Operational Efficiency Theory, and the pillars of Saudi Vision 2030 which focus on sustainable development, modernization, and administrative transformation of the country. The chapter outlines the research findings and their practical and theoretical value as well.

### **5.1. Discussion of Major Findings**

#### **5.1.1. The Overall Influence of Renewable Energy Adoption**

It was found that the adoption of renewable energy sources increases the success of development projects and that in this regard the overall explanatory power of the model was as high as  $R^2 = 0.716$ . This means that 72% of the variance in the success of the projects was explained by the four dimensions of renewable energy namely, the shift in the energy mix, the reduction of carbon footprints, greater environmental protection and smart system adoption, and the increase of awareness of its use. These findings support the works of Owusu and Asumadu-Sarkodie (2022) and Ritchie et al. (2023) which noted that renewable energy enhances sustainability, operational efficiency, and project quality at institutions.

In the Saudi context, this finding confirms that the adoption of clean energy technologies is not only consistent with Vision 2030 but also serves as a driver for the sustainable infrastructure and streamlining of administrative processes. The Kingdom embeds renewable technologies in public and private sector undertakings to enhance resilience, innovation, and sustain competitiveness.

### 5.1.2. The Effect of Energy Source Diversification on Project Success

The study shows that the diversification of energy sources has a positive, and statistically significant impact on the success of a project ( $\beta = 0.182$ ,  $p < 0.001$ ). There was a strong agreement ( $M = 4.08$ ) among respondents that operational and risk stability is achieved by the addition of renewable sources of energy, such as solar energy, wind energy, and geothermal energy. This agrees with Elshurafa et al. (2023), who argued that diversified energy systems enhance resilience to market volatility and assure reliable energy availability for development activities.

In Saudi Arabia, energy diversification forms the backbone to the “Thriving Economy” objective of Vision 2030, which seeks to reduce the over-reliance on oil, and grow the alternative energy sector. Organizations that combine different sources of renewable energy ensure uninterrupted project execution regardless of fluctuations in energy supply. These results further affirm that the diversification of energy sources enhances project efficiency, continuity, and sustainability—indicators of success in development around the globe.

### 5.1.3.Reduction of Carbon Emissions and Project Success

The study found that reducing carbon emissions improves the success of a project ( $\beta = 0.215$ ,  $p < 0.001$ ). Participants agreed that emission reduction is beneficial in the sustainability of the environment, fulfilling regulations, and enhancing the reputation of the institution ( $M = 4.03$ ). This is consistent with the model of the Red Sea Global Project, which is 100%

renewable and illustrates the value of emissions reduction to the long-term success of the project (Al-Harbi & Al-Hazzaa, 2024).

This also confirms the US-backed research (Ritchie et al., 2023) which asserts that emission reduction not only complies with international standards but also lowers operational costs through energy savings. Emission reduction also resonates within the Saudi context since it is in line with the Saudi Green Initiative and the Circular Carbon Economy Framework, both aimed at fostering development with environmental protection. Thus, reduction of emissions contributes to the ecosystem and reflects managerial performance.

#### 5.1.4. Promoting Environmental Awareness

Results also showed that there is a significant correlation between project success and environmental awareness ( $\beta = 0.167$ ,  $p = 0.001$ ). Participants pointed out that educating and raising awareness of employees about sustainability increases their engagement and support toward environmental policy compliance ( $M = 4.01$ ). This observation corresponds with those of Musa et al. (2021) and Al-Faraj (2022), which opined that stakeholders with adequate information are more willing to support green initiatives and cultivate responsible practices.

Due to the emphasis of the Saudi Green Initiative and the Ministry of Environment awareness campaigns, the Saudi government has strengthened the sustainable practices of both the public and private sectors. These findings suggest that environmental awareness goes beyond being a social value but also acts as a key driver and catalyst for the effective deployment of renewable technologies and improved project performance.

#### 5.1.5. Incorporation of Smart Systems and Success of a Project

The most important predication of this study is predictor of smart system integration influence ( $\beta = 0.332$ ,  $p < 0.001$ ) and the predictor which had the strongest impact on project success. Respondents agreed the most ( $M = 4.15$ ) that smart systems like artificial intelligence,

the internet of things, and predictive analytics improve project monitoring, risk control, and real-time decision-making. This corroborates the findings of Chaudhry and Rehman (2024), and Al-Ghamdi et al. (2023), which established that there is substantial integration of smart systems with improvement on project efficiency, accuracy, and responsiveness.

This is a significant finding for the Saudi Arabia context. Vision 2030 recommends the use of data, analytics, automation, and artificial intelligence to improve operational effectiveness in systems throughout any sector. Incorporating these smart systems with the renewable energy projects enables government entities and developers to improve resource optimization, eliminate delays, and advance in continuous improvement. Smart technologies are the most powerful systems that make the linking of renewable energy to project success seamless.

## **5.2. Relation to Theoretical Framework**

This work is based on the Operational Efficiency Theory. This theory explains the phenomenon when innovations in technology and process improvements drive performance gains, waste reduction, and enhanced decision making. There is significant evidence to support this theory. Automated and renewable energy technologies efficiency in resource use and process in diversification and real-time analytics improves resource use and streamline operations, thereby achieving the essential resource operational efficiency.

Furthermore, the results are consistent with the Digital Governance Model, which focuses on transparency and data-driven management, as well as service delivery to citizens. The combination of smart systems with the use of renewable energy in the sustainability of the environment illustrates how renewable energy can be employed as a technical and strategic resource in the enhancement of government productivity. Thus, the study supports the theory that the use of technology in an organization enhances productivity and the sustainability of its projects.

### **5.3. Comparison with Previous Studies**

The outcome of this research is in agreement with some previous research that studied the transformational impact of renewable energy and smart technologies in different areas. Al-Fatlawi (2022), for example, substantiated the correlation between renewable energy technologies and strategic leadership effectiveness, the same way this study confirmed that renewable energy positively impacts management performance. In the same way, Al-Otaibi (2024) proved that the use of renewable energy technologies improves the innovation and efficiency of marketing operations, similar to the findings of this study in the field of project management.

Also, Abdul Razzaq (2024) and Al-Babli (2020) noted that renewable energy improves the accuracy and decreases the time spent on some administrative and security operations, and this is in agreement with the finding of this research that the integration of renewables improves the operational efficiency of organizations. These findings add to the existing literature by supplying evidence of the operationalization of the Saudi development project, which connects the use of renewable energy to the development project's achievements.

### **5.4. Vision 2030 and Its Goals**

The implications of these findings are particularly important for the fulfillment objectives of Saudi Vision 2030. The Vision refers to the adoption of policies to diversify the economy as incorporating renewable energy and digital transformation. This study shows that the integration of renewable energy in development projects results in greater sustainability, operational excellence, and improvement in institutional transparency. This is in alignment and contributes to the objectives of the Vision 2030 “Vibrant Society” and “Thriving Economy” pillars.

Moreover, the study also supports the Vision regarding the need to adopt flexible governance, smart efficiency, and innovation. The integration of renewable energy with smart systems enables public and private developers to accomplish environmental targets while improving service delivery and citizen satisfaction. As such, the integration of renewable energy helps accomplish a country's environmental target while enhancing and promoting the country's governance framework and their global competitiveness.

## **Conclusion**

This chapter aimed to advance the discussion on the empirical results and the direct and clear linkages to the adoption of renewable energy technologies in Saudi Arabian projects. The findings endorse the integration of renewable energy technologies, especially the attachment of smart systems and the targeted emission reduction, to lift the performance, sustainability, and efficiency of a country's development projects. These results highly resonate with the operational efficiency of the organization and their strategic alignment to Vision 2030 emphasizing the need for digital transformation and sustainability.

The usage of renewable energy sources, therefore, is not only a technological implementation, but also a managerial approach to improving an entity, preserving the environment, and achieving sustainable development.

## **6. CHAPTER 6 – CONCLUSION AND RECOMMENDATIONS**

### **Introduction**

This chapter closes the research by highlighting the main results and conclusions drawn and offering pragmatic advice to policymakers and organizations and recommendations for future research. The purpose of the study was to assess the effects of adopting renewable energy on the success of development projects in the Kingdom of Saudi Arabia along the following four dimensions: diversification of energy supply, reduction of carbon emissions, increase of environmental awareness, and environmental smart systems proliferation.

The findings provided evidence that indeed, renewable energy technologies have a significant positive impact on the success of development projects and on the sustainability objectives of Vision 2030.

### **6.1. Summary of Findings**

The findings of the study indicated that the adoption of renewable energy has a positive impact on the success of development projects along a number of dimensions. The main conclusions of the study are:

#### **The Study Engagement**

The construct used in the study had a more than sufficient internal reliability, recording an overall Cronbach's Alpha score of 0.915. This underlines the likelihood that the impact of renewable energy adoption on the success of a project is measurable.

#### **Favorable Views On Renewable Energy**

Majority agree that renewable energy enhances efficiency, assures environmental safety, and promotes sustainability in development projects. The development of smart systems

received the highest mean (4.15) demonstrating appreciation of technology in robust project management.

### Significant Relationship Between Renewable Energy Adoption and Success of Projects

All four dimensions of the adoption of renewable energy were positively and significantly correlated with project success ( $p < 0.01$ ). The strongest correlation was recorded on the integration of smart systems and project success ( $r = 0.78$ ).

### High Indicator Value of The Renewable Energy Variables

From the regression result, the variable of renewable energy accounted for 71.6% ( $R^2 = 0.716$ ) of the total variance on the project success. All four dimensions had a statistically significant contribution, whereby the integration of smart systems was the strongest predictor ( $\beta = 0.332$ ).

### Confirmed Hypotheses

All the research hypotheses were accepted, proving that the incorporation of renewable energy, in its combined dimensions, greatly improves the performance, sustainability, and operational efficiency of development projects in Saudi Arabia.

### Conclusions

Having made the analysis provided before, the current study concludes that renewable energy adoption is critical to every development project in Saudi Arabia. The use of renewables in project management increases efficiency, reduces costs, meets environmental regulations, and increases stakeholder satisfaction. The findings unequivocally support the following:

Energy diversification enhances energy security and reduces reliance on hydrocarbons, thereby enabling more stable and resilient project implementation.

Sustainability outcomes are enhanced due to reduced carbon emissions integrally tied to the improved reputational risk and regulatory compliance.

Increased environmental education of employees and other stakeholders enhances compliance and fosters greater sustainability.

The adoption of integrated smart systems (AI, IoT, data analytics) is the greatest project driver, providing real-time and operationally agile decision support for project stochastic controls.

The current study also maintains that adoption of renewable energy is not merely an environmental issue; it is also an issue of strategic management that boosts organizational productivity, innovativeness, and competitiveness, all of which are in alignment with the transformative objectives of Saudi Arabia on Vision 2030.

## **6.2. Study Implications**

### **6.2.1. Theoretical Implications**

The Theory of Operational Efficiency is strengthened by the affirmation that the use of technology and the automation of processes boosts productivity and minimizes inefficiencies. The outcomes enable the integration of renewable energy systems within the public-private project management system as a theory and guiding principle to be empirically validated and confirmed.

The study also strengthens the Digital Governance Model by illustrating how the integration of advanced renewable technology and smart systems improves the data transparency and accountability frameworks for rational governance.

### **6.2.2. Practical Implications**

On a practical level, the study facilitates the work of government agencies, project leaders, and private contractors by enabling them to use renewable energy to enhance the development project's sustainability and profitability.

The smart systems adoption together with energy source diversification improves organizational profitability and productivity, costs, and regulatory environmental compliance. In addition, the more the workforce is trained and educated the better, the more they will be able to achieve the proper management of renewable energy systems.

### 6.2.3. Policy Implications

The findings of this study bolstered the vision clean aiming at Innovation and Administrative Transformation objectives of the Kingdom Vision 2030. Having said that, these findings might aid in formulating policies that facilitate the integration of renewable energies across vital development streams, especially infrastructure and urban planning and industrial development. Enhanced partnership of the Ministry of Energy with NEOM and Red Sea Global will greatly facilitate the countrywide deployment of integrated smart and sustainable energy systems.

## 6.3. Limitations of the Study

While the research achieved its objectives, several limitations should be acknowledged. The study depended upon self-report data from the respondents, which is prone to personal bias or limited appreciation of the respondent's institutional perspective.

The research was carried out within the confines of a given sectoral and geographical purview, which in this case was development projects within the borders of Saudi Arabia and as such is a limiting factor in the ability to generalize the findings to other areas of the world or other industries.

The other major limitation because of the cross-sectional approach used horizontal slicing of the data has to do with the inability to establish the long-term causal linkages between the adoption of renewable energy and outcomes of the projects.

The quantitative approach to this research hinged solely on the use of a structured questionnaire. This implies that the addition of qualitative interviews on issues of management could have heightened the understanding of the context and issues at hand.

The above limitations could be covered in future research through the adoption of mixed methods, longitudinal and cross-sectoral comparative approaches.

#### **6.4. Recommendations According to Market Insights**

Considering discoveries and their meanings, the following recommendations have been developed:

##### **For The Government**

Intensify national policies and guidelines to promote inclusion of renewable energy in all development projects.

Implement policies that require all public projects to conduct and submit annual evaluations of their carbon emission.

Encourage cooperation between relevant ministries like energy, the environment, and construction to assist in the sharing of relevant information.

##### **For Construction Site Managers**

Implement advanced technological tools and systems like the Internet of Things (IoT) and Artificial Intelligence (AI) for the effective and efficient management of energy resources and real-time project flow.

Schedule regular specialized training for the entire workforce for the purpose of ensuring that there is enhanced technical capacity as well as ensuring that the employees have the relevant knowledge of current global issues.

Increase the diversification of the projects to be developed under the limited risk portfolio to include systems that utilize solar energy, wind energy, and hydrogen energy to enhance energy reliability and accelerate project completion.

#### **For Institutions of Higher Learning**

Comprehensively examine the relationship between renewable energy projects and other projects within all economic sectors in order to add to the existing body of knowledge.

Formulate and integrate into the academic systems curricula and training modules on project sustainable management and the integration of renewable energy.

Promote the development of models incorporating real data on the financing of renewable projects for efficient collaboration of the project between universities and the government.

### **6.5. Suggested Areas for Further Investigation**

There are suggestions that encourage researchers to investigate.

The impact of incorporating renewable energy into a country's development on the economic performance of that country in the long run.

Studies which contrast the investment in renewable energy in the public and the private sectors.

The influence of leadership, digital culture, and digital maturity on the relationship between renewable energy adoption and project success.

Qualitative case studies of NEOM, Qiddiya, and Red Sea Global, among other major projects in Saudi Arabia, to understand the challenges and best practices in the field.

### **6.6. The Final Conclusion**

This research successfully identifies the relationship between adoption of renewable energy and the success of development projects in Saudi Arabia. The utilization of diversification, reduction of emissions, advocacy for awareness, and smart systems integration of automation to

the organization yields performance, organizational sustainability, and stakeholder satisfaction to the highest degree possible.

The set research objectives align with the Operational Efficiency Theory alongside the Vision 2030 Framework. This helps in emphasizing the relevance of renewable energy in the country for transformational development.

Renewable energy should be viewed as an essential approach to planning and managing development activities. This suggests that in the context of Saudi Arabia, investing renewables is step toward embracing greater practicality, and efficiency, and fostering environmental innovation.

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## APPENDIX A – QUESTIONNAIRE

### Section 1: Demographic Information

| Variable                   | Category                                                                                                                                                     |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Gender</b>              | <input type="checkbox"/> Male <input type="checkbox"/> Female                                                                                                |
| <b>Age</b>                 | <input type="checkbox"/> 20–29 <input type="checkbox"/> 30–39 <input type="checkbox"/> 40–49 <input type="checkbox"/> 50 and above                           |
| <b>Educational Level</b>   | <input type="checkbox"/> Diploma <input type="checkbox"/> Bachelor's <input type="checkbox"/> Master's <input type="checkbox"/> Ph.D.                        |
| <b>Job Level</b>           | <input type="checkbox"/> Technician <input type="checkbox"/> Engineer <input type="checkbox"/> Project Manager <input type="checkbox"/> Administrative Staff |
| <b>Years of Experience</b> | <input type="checkbox"/> <3 years <input type="checkbox"/> 3–5 years <input type="checkbox"/> 6–10 years <input type="checkbox"/> >10 years                  |

### Section 2: Renewable Energy Adoption and Project Success

**1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree**

#### A. Diversification of Energy Sources

| Statement                                                                            | 1                        | 2                        | 3                        | 4                        | 5                        |
|--------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Our projects utilize multiple renewable energy sources (e.g., solar, wind, biomass). | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Energy diversification reduces operational risks.                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Integrating various energy systems enhances sustainability.                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Dependence on a single energy source limits project success.                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|                                                            |                          |                          |                          |                          |                          |
|------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| The organization has policies to diversify energy sources. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|

## B. Reduction of Carbon Emissions

| Statement                                                          | 1                        | 2                        | 3                        | 4                        | 5                        |
|--------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Projects incorporate renewable technologies to minimize emissions. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Reducing emissions is a monitored strategic objective.             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Renewable adoption has decreased our environmental footprint.      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The organization measures and reports emissions regularly.         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Carbon-reduction initiatives have improved regulatory compliance.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

## C. Promoting Environmental Awareness

| Statement                                                                 | 1                        | 2                        | 3                        | 4                        | 5                        |
|---------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Employees receive training on sustainability and environmental practices. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Environmental awareness is part of our management culture.                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Management encourages eco-friendly behavior in all departments.           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Public awareness campaigns are conducted to support environmental goals.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Environmental awareness improves stakeholder satisfaction.                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

## D. Integration of Smart Systems

| Statement                                                          | 1                        | 2                        | 3                        | 4                        | 5                        |
|--------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Digital monitoring tools (AI, IoT) are used in project operations. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|                                                               |                          |                          |                          |                          |                          |
|---------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Smart systems improve real-time decision-making.              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Intelligent systems enhance efficiency and reduce errors.     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Predictive analytics optimize maintenance and performance.    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Smart technologies reduce time delays and improve management. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

### E. Success of Development Projects

| Statement                                                                   | 1                        | 2                        | 3                        | 4                        | 5                        |
|-----------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Projects are completed within their planned time and budget.                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Renewable energy adoption has improved project quality and reliability.     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The organization responds flexibly to project challenges.                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Stakeholders' express satisfaction with project outcomes.                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sustainability is prioritized in project planning and execution.            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Resource utilization efficiency has increased.                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Projects achieve intended objectives effectively.                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Renewable energy initiatives have improved the organization's reputation.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Continuous improvement is embedded in project management.                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Renewable energy integration has enhanced the overall project success rate. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

أثر تبني الطاقة المتجددة على نجاح مشاريع التنمية: دراسة تطبيقية على مشاريع التنمية في المملكة العربية السعودية

إعداد الطالب/

مصطفى ال علوي

[251002197](#)

إشراف/

د. الفیصل عبد الحمید محمد حسن

العام الدراسي:

2025