Document 4 - Thesis

Innovation Management in Energy Organisations in the Kingdom of Bahrain

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ABSTRACT

This research investigates the factors that impact the electricity sector within the context of an emerging economy, focusing on innovation management strategies and sustainability. It employs innovation diffusion perspectives to examine the application of innovation management in the Kingdom of Bahrain. Given the challenges faced by the electricity authority in maintaining high levels of sustainability and comprehending the innovation process, numerous studies have indicated that effective innovation management can significantly benefit the electricity sector.

The research aims to foster a deeper understanding of the innovation management processes adopted and implemented by electricity organisations in Bahrain. Employing a mixed research approach, data was collected from energy organisations across Bahrain, utilising both qualitative and quantitative methodologies. The research highlights the importance of adopting a decentralised approach to enhance innovation management in the energy sector. It also identifies operational adjustments made by the electricity and water authorities and the challenges these authorities encounter in their operations.

Furthermore, an alternative approach to tracking operational challenges within the energy sector is proposed, with implications for academic research and policymaking. This approach advocates for the establishment of innovation management frameworks and market policies aimed at sustaining the energy sector. Based on personal reflection, it becomes evident that energy companies must balance efficiency-based developments of current leading technologies with investments in research and expansion focusing on renewable sources. Such an approach will facilitate the attainment of effective processes in the long term.

The research underscores the necessity for energy organisations in Bahrain to adopt innovative strategies that consider product and service diversification, especially in an increasingly environmentally conscious world facing the impacts of climate change. Findings indicate that Bahrain's energy organisations are confronted with numerous challenges, including issues related to human resources, managerial and market policies, insufficient resources for electricity generation and transmission, limited financial resources for managing production and infrastructure, and threats of sabotage to electrical infrastructure.

In light of these findings, the research recommends that energy-producing states embrace innovation management strategies, including effective human and infrastructure resource management, the development of techniques for electricity management, and the incorporation and training of additional personnel for the management of electrical facilities.

Keywords: Challenges, Electricity, Energy, Innovation, Management, Organisations, Sustainability

Dedication

I am dedicating this thesis to my late father, Eng. Hasan Ali Al Ezz; may God Almighty have mercy on him, as I deeply feel his loss in my life. He was a constant source of inspiration for me, helping me attain success.

I would like to especially acknowledge the on-going support I have received from my mother and the way she has cared for my brothers and me.

Finally, I would also like to dedicate this thesis to my family. You have been a daily source of motivation to help me persevere, regardless of the difficulties I have encountered. I would like to thank you sincerely for your understanding.

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I wish to dedicate this achievement to His Majesty King Hamad Bin Isa Al-Khalifa, King of Bahrain; Supreme Commander of the Bahrain Defence Force; His Royal Highness Prince Salman Bin Hamad Al-Khalifa, Crown Prince, Prime Minister; and Deputy Supreme Commander of the Bahrain Defence Force. I also wish to thank them for fostering the country's prosperity, for their continued support of scholars and professionals, and for their recognition of the contribution that these individuals have made to building our nation.

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Abbreviation

BAPCO	Bahrain Petroleum Company
BIPV	Building-Integrating Photovoltaic
CESI	Centro Elettrotecnico Speimentale Italiano
CNIM	Constructions Industrielles de la Mediterranee
CO2	Carbon Dioxide
EaaS	Energy-as-a-Service
EFA	Exploratory Factor Analysis
EWA	Electricity and Water Authority
EU	European Union
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GHG	Governing Greenhouse Gas
GNG	Green House Gas
IT	Information Technology
LAS	League of Arab State
NEEAP	National Energy Efficiency Action Plan
OPEC	Organisation of Petroleum Exporting Countries
PPA	Power Purchase Agreement
PV	Photovoltaic
R&D	Research and Development
SPOTS	Structure, Process, Output, Target, and System
STEM	Science, Technology, Engineering, and Mathematics
UN	United Nation
UNEP	United Nation Environmental Programme

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Chapter 1

1. INTRODUCTION

In the recent decades, the energy sector has undergone radical transitions globally (Foltean, Trif, and Tuleu, 2019). One of the most significant changes is related to the pursuit of sustainable solutions, renewable energy, and responding to ever-changing government policies and the adoption of innovative technologies. Consequently, the demand for decentralised solutions, smart and novel energy efficiency, and security devices has led to a need for innovation management in the international energy sector. Substantial changes in the energy sector have been driven by broad macro-economic variables such as the global economic crisis, geopolitical tensions, pollution, and climate change, as well as industry-specific factors such as increasing demand for energy, new players in the oil and natural gas market, the sudden expansion of shale oil and gas production by the United States, the obsolescence of nuclear energy, and a reduction in costs for producing renewable energy (Schaeffer, 2012). Major energy companies are opting for innovative organisational solutions and business models that can be leveraged via innovation management to respond to the essential transition to renewable energy in the dynamic market environment (Gielen et al., 2019). However, the government's strict regulations and rigid institutional frameworks have severely restricted the operational flexibility of power generating companies (Abadie, 2015).

Electricity organisations generally embrace innovations in response to these emergent challenges (Greenhalgh et al., 2004). The demand for electricity and power is expected to rise due to the increase of both the world's population and the manufacturing sector (Wolfram, Shelef and Gertler, 2012). Evidence suggests that energy-related carbon dioxide emissions will increase by 6% from 2015 to 2050 (Gielen et al., 2019). However, the Paris Agreement and other global protocols governing greenhouse gas (GHG) releases have mandated that carbon emissions to decrease to 9.7Gt by 2050 (Gielen et al., 2019). Transitioning to renewable or hybrid power sources instead of non-renewable energy sources will significantly reduce GHG emissions in the global power sector. The proportion of renewable energy in the power generation sector will rise from 25% in 2015 to 85% by 2050 (Gielen, 2019).

Furthermore, energy organisations face various challenges when they attempt to satisfy the demands of their employees, end-users, and other stakeholders, which may be linked to a growing concern for environmental sustainability and productivity enhancement (Mclntosh et al., 2011). A shift towards innovation management has emerged to ensure sustainability and manage counter-operational challenges (Sbia, Shahbaz and Hamdi, 2012). Bahrain's electrical power generation organisations are currently utilising a combination of non-renewable and renewable energy resources, placing these organisations under enormous pressure to balance profitability and sustainability (Alabbasi, 2021). Energy organisations are adopting innovations, and different strategies are progressively being invented with existing practices being modified to respond to the emerging challenges (Greenhalgh et al., 2004).

It is argued that numerous external and internal factors have suppressed the implementation of innovation management and organisational change among large energy companies (Medina, Lavado and Cabrera, 2005). Although majority of these factors are generic, some are unique to a particular location or organisation. As a result, exploratory analysis is required to identify the referenced elements that are intrinsic to

Bahrain's power sector. Energy consumption will continue to rise as the world population increases and manufacturing sectors expand (Haberberg and Rieple, 2001).

In light of the difficulty of adjusting strategy and innovation in different business contexts, this research will examine the unique environment of Bahrain as a case research to explore the ways in which energy organisations may improve their innovation management for the purpose of optimising the limited resources during the transition to renewable energy sources while still increasing revenue and guaranteeing customer satisfaction (Kivimaa, 2014). Generally, improvement in utility organisations is driven by customer demand for improved services and stakeholder pressure to maximise profits and equality (Foltean, Trif, and Tuleu, 2019). As a result, this research aims to establish the key barriers that impact the energy companies' management of the transition to renewable energy sources in the Kingdom of Bahrain.

The research focuses on the strategies development within the energy sector in Bahrain in order to enhance strategies its innovation management approaches to optimise the country’s limited resources during the transition to renewable energy sources while increasing revenues and ensuring customer satisfaction (Kivimaa, 2014). Innovation has become an increasingly critical role for the management of challenges faced by the electricity companies. Therefore, strategic and innovation management are becoming increasingly useful in energy companies (Schaeffer, 2012). The services supplied by electricity companies are critical for humans' daily struggles. As a result, companies are under increased pressure to promote sustainability while meeting customer needs and profit margins (Hart, 2015). Striking a balance between a company's objectives and ambitions is thus a complicated process that requires various strategies and numerous methodological procedures. The concept of achieving a balance is still relatively new in Bahrain, and most companies in Arab-speaking countries are yet to embrace it.

1.1 Research Aims

Given the limited research on innovation management strategies and sustainability in emerging economies, this research seeks to provide new insights at the intersection of these constructs focusing from the context of Bahrain. The aim of this research is to explore the current management processes that are adopted and implemented by Bahrain's electricity organisations. Such innovations necessitate effective management to meet the firm's goals and objectives. Furthermore, there is an increase on electricity demand due to the rapid population growth and the expansion of the industrial and manufacturing sectors (Tietenberg and Lewis, 2016). This research explores the various methods innovation management improvements within Bahrain's electricity companies and maximise the limited resources to increase revenue while ensuring consumer satisfaction. Improvements in the management of companies have been driven by pressure from customers (end-users) and stakeholders. While consumers demand high-quality services and products, stakeholders aim to maximise their wealth and equity. As sustainability becomes increasingly important, it is crucial to understand the innovation process and its management at the Electricity and Water Authority (EWA), the largest energy supplier parastatal in the Kingdom of Bahrain. Therefore, the following are the research objectives:

1.1.1 Research Objectives

- To explore the emerging external and internal factors confronting the energy organisations related to the Electricity and Water Authority (EWA) in Bahrain.

- To investigate the strategies adopted by the Electricity and Water Authority (EWA) in Bahrain to mitigate the growing challenges associated with managing the innovation process within the energy supply chain.
- To identify the key modifications implemented by the Electricity and Water Authority (EWA) in Bahrain in response to the major challenges arising from the adoption of decentralised models of energy production and offer suitable solutions to resolve the challenges.

1.1.2 Research Questions

The research addressed the following research questions, which are consistent with its stated objectives:

- What are the current and emerging external and internal factors affecting Bahrain's Electricity and Water Authority (EWA)?
- What strategies and innovations are being implemented by the Electricity and Water Authority (EWA) in Bahrain in response to the challenges?
- What modifications have been implemented by the Electricity and Water Authority (EWA) in Bahrain in response to the major challenges arising from the adoption of decentralised models of energy production?

1.2 Scope of the Research

Due to the challenges faced by the energy sector in the Kingdom of Bahrain, the government has begun to devise new approaches to address these issues and increase the efficiency of the country's electrical energy production (Al-Maamary, Kazem and Chaichan, 2017). One of the government's primary goals is to reduce the use of fossil-based fuels, which are known to contribute towards the CO_2 emissions.

This research was conducted to gain insight into the impending issues impacting the energy companies and the methods that were used by the EWA to address the challenges faced by the electricity and energy development in Bahrain's Kingdom. The research analysed the existing innovation to address these emerging difficulties. In this context, analysis was conducted upon the implemented factors within the Kingdom of Bahrain, particularly in the technology sector, to address the issues in innovation management. An example of this factor is the implementation and utilisation of renewable energy in the technology sector within the Kingdom of Bahrain, which has improved resource utilisation in the government and will aid in economic growth (Al-Ammal and Aljawder, 2021).

Lastly, this research explores the external and internal factors that either support or inhibit the implementation or development of the innovative management strategies within Bahrain's electricity sector. These factors are entities that causes the value of Bahrain's energy industry to either increase or decrease. As such, issues that affect the sale of electricity products in the Kingdom of Bahrain will be explored since they are the main factors used to research the retail industry market, especially in the electronics sector in Bahrain (Hayat and Victor, 2020).

1.3 Significance of the Research

1.3.1 Contribution to Theory

The findings of this research contribute towards innovation management in several ways. First, the findings of this research provide new perspectives that can enhance the understanding of innovation management strategies in Bahrain. Consequently, this research provides an instructive framework that is helpful in identifying the strategies of other GCC countries. These strategies can be adopted for the purpose of minimising the production of energy through fossil fuel and help with increasing the energy efficiency within the electricity sector. Additionally, this research provides recommendations based on the findings to improve Bahrain's economic development improving the overall operations of the energy organisations. The recommendations target GCC and League of Arab Countries policies that have significantly improved their economic performance (Ferroukhi et al., 2013). Among these recommendations is the adoption of measures to increase energy efficiency by reducing the reliance on fossil fuels and investing in renewable energy sources such as wind and solar (Almasri and Narayan, 2021).

Secondly, this research is significant in providing a comprehensive view of the strategies adopted by the Electricity and Water Authority (EWA) of Bahrain, including the strategies utilised in innovation management, the challenges that they face, and the potential solutions. It also proposes mechanisms for attaining and maintaining optimal energy procurement and usage. The research aims to develop strategies for reducing energy costs and waste while ensuring that there are no adverse environmental impacts and do not compromise the productivity or quality.

Moreover, it provides new theories related to innovation management in the context of an emerging economy. Such an understanding is important for the firms in the energy sector, as it can be instructive in terms of the way they use resources to enhance productivity (Ahmed et al., 2020). The research also contributes to the diffusion of innovation theory by accounting for the management of innovation processes by the energy companies in Bahrain within their daily operations.

Thirdly, the findings of the research have implications for the government of Bahrain, where such information challenges the civil servants and Bahrain's key institutions to develop policies and initiate reforms to improve the energy security of the Kingdom (Alkhaldi and Altaei, 2020). This is particularly crucial for Bahrain, due to its heavy reliance on oil as the primary source of energy. For the country to remain relevant both domestically and internationally, it needs to consider diversification into other sustainable energy production. Therefore, this research will contribute to the wider pursuit of sustainable solutions and renewable energy as a response to the ever-changing government policies and the adoption of innovative technologies through the influence of the innovation diffusion model.

The issue of innovation management has ramifications for various stakeholders whose wealth and activities are influenced by the services and operations of Bahrain's energy sector. The research findings would be an instructive ‘playbook’ for innovation management that will be beneficial to service users, environmentalists, policymakers, and the government. Those aforementioned entities may use it to develop solutions to various innovation management issues they may face. Companies with ineffective management of energy supply within Bahrain has far-reaching consequences for many stakeholders (Burke, 2016). Generally, if the issues of innovation management such as those that has an impact on the utilities companies in the Middle East including Bahrain can be addressed effectively, it can improve the market performance of those countries and their service provision to the public. Furthermore, if the electricity companies could adopt innovation and new technology, they could become more efficient in delivering their products and services, which lead to the growth of a sustainable economy (Herring and Roy, 2007).

1.4 Structure of the Thesis

This thesis consists of 6 interrelated chapters. Figure 1 provides an overview of these various chapters. Thereafter, a summary of the contents of each chapter is presented.

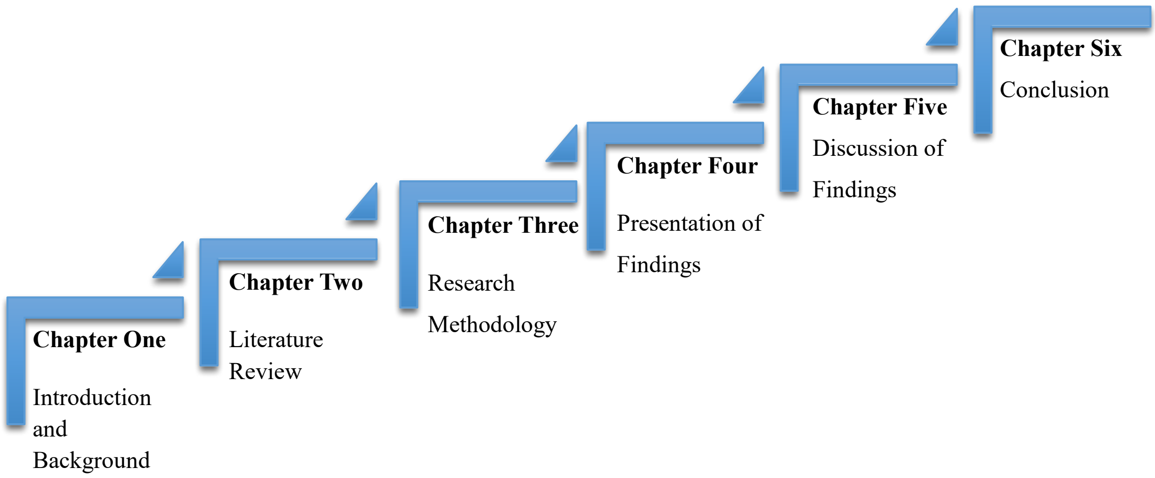


Figure 1: Overview of the thesis

- **Chapter One: Introduction and Background** – This chapter introduces the research purpose and provides a background of the research. The chapter also discusses the research's contribution and defines the primary objectives of this research. The intention is to answer all the research questions by assessing the innovation management strategies necessary to combat the problems faced by the electricity sector.
- **Chapter Two: Literature Review** – This chapter critically analyses and evaluates the existing literature and studies related to the research topic. Chapter 2 is the literature review, which analyses and synthesises the extant literature, and develops a theoretical model that illustrates the connectivity of various elements of innovation management. The second part of the literature review explores the literature related to organisational commitment, evolution, and existing theories and models that focus on innovation management. The third section provides an

overview of cultural intelligence, its relevance to the research, and existing theories and models within the relevant literature. Subsequently, the chapter moves to the fourth section, which is a discussion relating to the conceptual framework developed for this research. The chapter discusses the correlation between the objectives in three separate sections. It also details the research questions and hypotheses.

- **Chapter Three: Research Methodology –** This chapter presents the research methodology, and it is divided into three parts. The first part details the research philosophy, strategy, sampling design, data collection techniques, analysis methods, and ethical considerations utilised for this research. The second part of the research methodology chapter explores the qualitative approach, technique, sampling, data collection, and data analysis methods that were employed in the collection of qualitative data. The last part of the chapter discusses the research's quantitative stage, including the quantitative approach, quantitative technique, quantitative sampling, data collection, and data analysis methods for quantitative data.
- **Chapter Four: Presentation of Findings –** This chapter presents an analysis of the qualitative data collected through interviews. Data analysis presents a summary and interpretation of the collected data. Additionally, it presents the proportions that emerged from workplace practice and the cultural factors that influence utility organisations. The main structure of this chapter is to present the main themes found from the interviews and data analysis. This chapter also discusses and presents the quantitative data findings. The analysis includes demographic statistical analysis, Cronbach’s alpha, Normality Tests, Multiple

Regression Analysis, and Pearson's correlation coefficient. The chapter ends with a discussion of the reliability and validity tests of the scales used to collect the quantitative data.

- **Chapter Five: Discussion of Findings** – This chapter elaborates on the contributions of this research, demonstrating how the research has advanced the understanding of innovation in the context of an emerging economy. The chapter is divided into three sections. The first section of the chapter summarises the research findings and demonstrates the point of departure from the other research studies already conducted in the same field. It indicates whether the research departs from the norm of innovation management. It highlights the theoretical contributions of the research. The second section summarises and discusses the qualitative and quantitative results and findings and is divided into two sub-sections: the first is to discuss and evaluate the qualitative stage results and findings, and the second is to discuss and evaluate the quantitative stage results and findings. The third section of this chapter discusses the limitations of the research and the recommendations for future research. The last part of this chapter explores the research implications.
- **Chapter Six: Conclusion** – This chapter offers a robust conclusion of the research. It highlights the important ideas that were addressed in the thesis and discusses the implications of the research findings and results. The chapter is divided into three sections. The first section presents the research conclusion; the second discusses the research limits and suggestions for the Electricity and Water Authority, as well as future research, and the third section provides a chapter summary.

Chapter 2

2. LITERATURE REVIEW

2.1 Introduction

The literature review section critically evaluates and analyses the current and emerging challenges faced by the electricity companies in the Kingdom of Bahrain. It focuses on the literatures that focus on innovation management and challenges. Moreover, it identifies and critically analyses the electricity companies that adopt innovation to address their challenges.

The following subsections of the literature review aim to fulfil three main broad objectives. First, it incorporates and analyses current and emerging challenges encountered by the Bahrain's electricity organisations as they shift from a centralised to a decentralised business model. Second, it presents and identifies the important modifications implemented by the electricity organisations in Bahrain in response to the issues that have arisen due to the adoption of the diffusion innovation model, and the appropriate solutions to resolve them. Third, it explores and analyses the external and internal factors that impede effective innovation management implementation.

2.2 Literature Search Strategy

The primary databases used to search for the literatures are university's libraries and learning resources, as well as Google Scholar. Relevant keywords and phrases associated with the research's topic were identified. *Energy organisations*, *energy innovation*, *energy challenges,* and *energy conservation* were among the major keywords used during the search process. Relevant arguments from the literature that align with the various sections of this research were integrated in order to support, critique, and strengthen the arguments presented in this paper. Therefore, this section critically evaluates and analyses the past literature on innovation management and Bahrain's energy sector.

2.2.1 Innovation Management

The government of Bahrain has adopted various innovation-focused strategies to enhance the energy sector. In the wake of the increasing pace of technological innovation and the development of various markets, there are growing concerns on the demand of sustainable energy transition and the challenge of expanding and developing regulatory frameworks (Kainiemi, Eloneva and Levanen, 2019). Innovation improves productivity and efficiency in an organisation's management and general operations (Martin, 2009). However, as organisations strive to operate innovatively and up-scale their production level, they encounter challenges such as climate change, fiscal problems, and economic difficulties. Recently, energy systems have been affected by climate-related changes, substantially impacting their sustainability and ongoing operations (Cebotari and Benedek, 2017; Chen and Huang, 2009). Moreover, climate change has caused fluctuations in electricity production, significantly impacting the countries' energy supplies.

Solar panel installation, for instance, has become a goal for certain schools in Bahrain (Alsabbagh, 2019a). The development of such projects demonstrates that the construction of environmentally friendly and sustainable buildings is not limited to fulfil the purpose of modernisation but also as an active pursuit of energy sustainability and conservation (Loonen et al., 2013). Various research such as by Emco (2020) suggests that solar panels generate 3 MW and could sufficiently meet the schools' energy needs, such as air conditioning, water coolers, office appliances, and lighting. As a result, the energy consumption efficiency of school buildings has risen, resulting in 30% savings in cost (Emco, 2020). Such solar installations have a significant advantage to Bahrain. A solar plant installed in Bahrain generates over 8,300 MWh of renewable energy, which offsets 6,700 Mcf of natural gas, and reduces annual CO2 emissions by 7,200 kt (SEU, 2020).

This project has also created several job possibilities. Alnaser (2020) established in their research that the professional expertise and experience gained at the project's end will strengthen Bahrain's position as a strategic hub for smart energy in the Gulf region. Several researchers have emphasised that adopting decentralised and centralised energy production and management models can contribute to driving and promoting innovation within the energy sector. These notions will be discussed in Section 2.8 and illustrated on p. 62, Specifically, innovation may contribute in alleviating the issues that encountered by majority of the energy producers worldwide while simultaneously promoting sustainability for future generations (Mehigan, Bertsch and O'Gallachoir, 2018).

For instance, greater advancements are being made towards a sustainable energy system as novel technologies are developed through continuous innovation. Many countries, including Bahrain, have decided to focus on the pursuit of innovation management within the power sector, notably the adoption of renewable energy such as solar panels, district cooling, and wind turbines (Richter, 2013). Nevertheless, there is inconclusive evidence regarding the effective integration of centralised and decentralised systems in Bahrain's energy sector, particularly regarding the adoption of effective operational logistics and innovation management strategies (Alnaser, 2010).

The promotion of innovation would not only be connected to the adoption of effective non-conventional energy sources, but customers would also save 30% on their electricity costs, thus motivating them to consume from Bahrain's electricity organisations that provide non-conventional energy sources (Emco, 2020). A government impetus for adopting green technologies will further increase the market size of electricity from non-conventional energy sources for the electricity organisations in Bahrain.

2.2.2 Research Hypothesis #1

The research is aimed to answer the following research hypothesis:

Hypothesis$_1$ (H$_1$): *It is hypothesised that the application of innovation management strategies exposes electricity organisations to numerous challenges.*

2.2.2.1 Sources of Innovation

Innovation can arise from a diverse range of sources but can primarily be traced back to individuals and organisations, including corporate undertakings, users, outliers, spillovers, and process needs (Smith, 2006). Drucker (2002) stated that the sources of innovation may include breakthroughs that occur unexpectedly, incongruities that exist in supply or opportunities that are created to make people innovative, the market structure that may allow for the process of innovation to occur, and necessity. Necessity, in particular, is referred to as the mother of all inventions, demographics, changing perceptions, and the availability of new knowledge (Drucker, 2002).

A research by Miao and Popp (2014) presents different views, suggesting that necessity may not always be the most effective approach to promoting innovation. However, this did not appear to offer the best approach to ensuring the energy sector's self-sufficiency. On the contrary, it is problematic as it hinders the management of innovation for the sustainability of renewable energy (Miao and Popp, 2014).

2.2.2.2 Managing for Innovation

Effective innovation management is crucial for organisations to remain competitive and sustainable in the future (Hamel, 2006). Technological innovation can provide various benefits, such as increased production efficiency and competitive advantage (Kerzner, 2019), thus it is essential for organisations to effectively manage technological innovations in their respective industry. A research by Kuik, Branger and Quirion (2019) discovered that obtaining a competitive edge in the renewable energy market by establishing an eco-industry increases the sustainability of energy companies in the long-term. Hence, it is essential to develop effective methods to achieve a competitive advantage in the energy sector. Moreover, renewable energy sectors that benefit from a competitive advantage might invest in other countries due to the potentially numerous economies of scale (Dögl, Holtbrügge and Schuster, 2012). A lean innovation management strategy may be employed to achieve a competitive advantage (Solaimani, Talab and Van Der Rhee, 2019). The ever-changing prospects of consumers, the ever-increasing global competition, and the current era of millennials necessitate organisations to manage innovations effectively in their set-ups (Ehlenz et al., 2020).

2.3 A Resource-Based View and Innovation Management

Fresh water is becoming increasingly scarce, especially in light of global climate change. The water supply may not be adequate to cool the production chambers required for renewable energy generation (McMichael et al., 2007). This problem is intensified by the production of non-renewable energy, which needs additional cooling and water (Morris, Paltsev and Reilly, 2012). Furthermore, GCC countries are surrounded by vast amounts of ocean water, which is saline and may require significant investment in innovation management to process for domestic use.

The change of seasons poses a challenge, especially for renewable energy such as solar power and solar thermal power where during the winter, they produce less energy thus necessitate alternative sources to make up for the decreased energy (Blanco et al., 2009; Calza, Parmentola, and Tutor, 2017). The unpredictable weather pattern is a major challenge for renewable energy. Global warming has changed the weather and climate patterns, making it challenging to construct renewable energy infrastructure. The unpredictability of these energy sources has made them less reputable in society due to a lack of innovation management (Dögl, Holtbrügge and Schuster, 2012).

Developing a model that is functional all year round requires extensive research and development (Shrestha, 2010). It is critical to have the means to store energy that could be used when needed (Sarkar, 2013). Energy demand is constantly increasing, making it important to improve the efficiency of the current renewable energy policies. A sustainable energy supply can be achieved by improving the currently available solutions through innovation management. A constant energy supply should be the focal point while attempt to improve the current technologies. During the period of transition towards improving the current technologies, the alternative energy source should be compatible with its non-renewable counterpart, either through the distribution medium or the transducers in order to reduce the transition cost.

The climate is the most substantial geographical impediment, as the majority of Gulf countries receive an average of nine hours of sunlight per day, which is sufficient to run a power plant; however, this sunlight is not evenly distributed, resulting in certain regions that do not receive enough sunlight experiencing suboptimal production (Mas'ud et al., 2018). Furthermore, productivity may decrease in winter due to a lack of sunshine (Nematollahi et al., 2016). During this period, non-renewable forms of energy have to be used, which hinders the adoption of renewable energy (De Vries, Van Vuuren, and Hoogwijk, 2007).

The resource-based theory proposes that challenges that arise due to limited resources can be addressed by promoting sustainability and establishing strong linkages to reduce the pressure on those resources (Barney Ketchen and Wright, 2011). However, the resource-based theory's major limitation is its inability to compile various empirical studies to measure performance (Kozlenkova, Samaha and Palmatier, 2014). Additionally, the limitation of the theory is that it excludes consideration into the demand of the energy market, which needs to be addressed through innovation management by embracing renewable energy sources.

Bahrain's renewable energy strategy includes adopting a combination of wind, solar, and waste-to-energy technologies, with a focus on harnessing solar power. One of the key projects is a solar farm on the Askar landfill, which aims to provide 100 megawatts of renewable energy. The state is providing incentive to install fifty-megawatt solar plates on the rooftops of hundreds of state-owned projects (Kamal and Saraswat, 2014). Therefore, to address the issue of land scarcity for larger solar farms, Bahrain is considering deploying floating solar panels on the surface of the water in Bahrain’s regional waterways to generate power.

Offshore expansion of renewable energy production allows the state to pursue large-scale production while meeting increasing renewable energy objectives. Bahrain possesses shallow waters and a sufficient wind to establish near-coast or offshore wind farms. Additional offshore renewable energy alternatives include connecting Bahrain and its GCC neighbours with a united network of source energy-capable infrastructure facilities, such as railway lines and causeways (Kamal and Saraswat, 2014).

2.3.1 Business Model Innovation Approach

The business model innovation approach encompasses diverse approaches aimed at guiding all the processes pertaining to the use of human and material resources to generate valuable outputs. By effectively leveraging all these resources, companies can establish competitive advantages within their respective sectors. Innovation management goes hand in hand in the energy sector, especially in Bahrain and other Gulf countries. As established by Almulla (2015), the business model innovation approach is primarily characterised by the generation of power and its subsequent distribution to various places in the country.

2.3.2 Innovation Approach Related to Technology

Various research studies emphasise the importance of technological advancements that promotes operation efficiency for the organisations. In the current case research of renewable energy, there are largely clear connections between energy production and the use of innovative technologies in generating such power (Almulla, 2015). As established by Mas'ud et al. (2018), households and buildings contribute to about 40% of global energy consumption. This necessitates the need for technological advancements that can provide breakthroughs to fully cater for the needs of energy consumers while ensuring effective resource utilisation. Therefore, according to Hall and Helmers (2013), a technologically related innovation approach is desirable by developers to ensure that operating costs are significantly minimised.

2.3.3 Eco- Innovation Approach

Countries throughout the world have increased awareness of eco-innovations among electric energy providers and end users. Renewable technologies are becoming increasingly popular, and significant funds are being committed to their research and development, particularly in energy generation. In both developed and developing countries, there is a dynamic trend towards adopting eco-technology, with huge investments to support this (Sarkar, 2013). Since the majority of Bahrain consists of desert with ample daily sunlight, various energy groups are shifting away from petroleum or petrol derived products and towards sustainable energy such as solar and wind energy.

2.3.4 Political Barriers and Innovation

Political barriers significantly impact innovation and innovation management in the energy sector (Jacobsson, 2008). The lack of government initiatives to support or invest in the green energy has kept the majority of the private sectors at bay (Aghion et al., 2009). This has hampered the advancement of alternative energy and an eco-friendlier energy production system (Leoncini et al., 2017). Furthermore, there are yet any Gulf countries co-operating with each other in terms of research and developments that focus on establishing renewable energy (Arouri et al., 2012). However, if such an alliance exists, there would be a more equitable allocation of resources and increased innovations, and the benefits of distributing these resources would be significant (Mas'ud et al., 2018).

A research conducted by Mas'ud et al., (2018) established that the majority of Gulf nations lack policies that promote renewable and alternative energies. This has impeded the adoption of initiatives for developing solar and solar thermal energies as alternative energy sources. Oil is readily available in Gulf nations, and the sector has seen much investment. Despite the availability of sunlight, there is little investment in solar energy solutions (Reiche 2010). Solar energy solutions should be promoted as the next cornerstone of energy solutions, and more emphasis on the benefits of using renewable energy may improve this situation (Jacobsson, 2008).

Research also shows that the UAE's political governance strategy enables the execution of development project at state level such as Abu Dhabi’s Masdar city project, which is a model city that is based on renewable energy sources and technology (Reiche, 2010). Most governments in the Gulf are unduly reliant on fossil fuels and gas as energy sources, due to their significant economic role (Hall and Helmers, 2013). Similar economic value cannot currently be placed on renewable energy sources since an effective method of utilising them must first be developed before they can be considered commercially feasible. Therefore, most individuals have taken a laid-back approach to investing in renewable energy (Park and Choppala, 2011). For a long time, non-renewable energy remained the only energy source, with coal, petroleum, and the derivative products at the top of the list (Hamed et al., 2018). Introducing renewable energy threatens this long-established stability; thus, its implementation may require additional time (Birol, 2013). However, the research by Birol (2013) found no correlation between innovation management and renewable energy. Most governments have a large stake in energy production and, as such, have to protect their respective interests (Birol, 2013). Non-renewable energy has existed for longer period of time, and most Gulf governments have invested considerably in its production and distribution; therefore, opposition to investing in renewable energy is expected (Lecocq and

Crassous, 2012). However, political leaders use propaganda to radicalise voters and impede permission for plant construction in their regions, which indeed negatively affects the production and distribution of electricity and water across the region De Vries, Van Vuuren, and Hoogwijk, 2007).

Similarly, as with other energy providers, the government must follow a code of conduct. On the other hand, individuals interested in renewable energy do not have the authority to recommend specific actions aimed at improving the operational efficiency of water and electricity; thus, there is an opportunity for expansion (Zhang et al., 2013). As renewable energy production is relatively new, there are no clear regulations, and this has been a major challenge for new entrants. Introducing renewable energy threatens workers' livelihoods that are working in the non-renewable energy establishments; hence, they will likely oppose the programme's implementation (Goldemberg, 2012). Implementing renewable energy solutions may be hampered by political alignment, and many individuals may be reluctant to change. However, the already established code of conduct will significantly help streamline and address the challenges the energy sector will likely face due to the negative effects of political inclinations.

2.3.5 Investment Challenges for Innovation

The initial capital required to set up the solar panels for producing clean and green energy is significantly high (Utama et al., 2014). Renewable energy is expensive in terms of constructing the required infrastructure to generate renewable energy as well as its distribution (Rabah et al., 2016). This has a ripple effect on end-users once the production is completed such as higher costs to consumers (Green and Newman, 2017).

The developers must bear the costs of installation of frames and a pump or fluid circulation system for which energy production (Parmigiani, 2015). It is beneficial to have compatible electricity distribution networks to assist in minimising the cost of raw materials, thus will also help in reducing the initial cost (Freedman and Enssle, 2015). However, such scenario may not be achieved since certain installations are incompatible, necessitating that the system be set up in conjunction with the current system. The limitations that affect capital in integrating the system into the building include the high initial setup cost without subsidization and low acceptance by the general population due to low levels of knowledge and awareness (Siersdorfer and Ramahi, 2014).

Melikoglu (2013) stated that the revenues generated by organisations that use renewable energy are less than those acquired from non-renewable energy sources. These findings were supported by Howells et al., (2013), who established that the increase in renewable energy revenues was due to the time and resources committed to improving non-renewable energy since its inception. Furthermore, Arouri et al., (2012) discovered in their research that substantial research and development were conducted into developing the most efficient and cost-effective method of energy production. As a result, the efficiency of these projects and their returns are maximised compared to those from the new frontier of renewable energy. A research by Mas'ud et al., (2018) has found that solar and solar thermal energy are the most common forms of renewable energy production in the majority of Gulf countries, and since they are relatively new, there are no allocation of resources for their full development.

Scientists are exploring a renewable energy transmission technique that could utilise the same infrastructure used by non-renewable energy (Islam et al., 2022).

However, this necessitate time and, in the meantime, renewable energy will require a parallel transmission line (Mishra and Smyth, 2014). This has put a strain on the initial investment required for setup. A parallel line and installation also consume space, and this may discourage several potential energy organisations from going green (Ali and Elquliti, 2016). A research by Razak (2014) has revealed that the major barrier to adopting the technology is the high costs of the transmission lines installation in addition to the costs of installation and maintenance.

New entrants in the energy sector face resistance from existing oil and gas operators within the industry (Siddiqi and Anadon, 2011). Since 1990, oil and gas companies have enjoyed a dominant position in the energy production industry and the control of the infrastructure (Ahrend and Tompson, 2010). They have also leveraged research and development to boost efficiency and influence policy formulation and execution in Gulf nations (Orago, 2017). The revenue that they generate has earned them the support of the government. Scholars articulated that green energy provides unrivalled competition owing to its limitless nature, and this has sparked opposition from the oil and gas companies (Shufang, 2009). Governments in Gulf countries have taken some steps to promote the entry of more individuals and firms, but few policies or government research and development centres have been established, indicating a preference for non-renewable sources of energy (Yang and Jackson, 2013). Compared to their non-renewable counterparts, renewable energy players encounter several challenges, such as affordability, efficiency, and reliable energy storage facilities.

Despite Bahrain is surrounded by vast expanses of sea, desalinating ocean water for domestic consumption may require the construction of large desalination facilities (Ansari 2013). The substantial initial capital investment costs associated with constructing such water purification plants may not be viewed favourably. Many investors may be hesitant to invest in such initiatives, especially if no clear policies are in place to protect the invested capital in comparison to non-renewable energies (Ansari, 2013).

2.3.6 The Economic Benefits of Innovation Management

The cost of production of a unit of non-renewable energy such as coal and petroleum products are high, and embracing renewable forms of energy will significantly reduce the cost in comparison (Timmons, Harris and Roach, 2014). While the initial cost of constructing such facilities may be relatively high (Dudley, 2018), the overall long-term costs in generating renewable energies are comparatively affordable compared to electricity generated from fossil fuels. Lower energy costs translate to lower manufacturing costs, thus increasing the manufacturing industry's productivity. In addition, production costs of other goods will also be more affordable. This will act as a catalyst for the establishment of new industries (Timmons, Harris and Roach, 2014). The increase in energy production will lead to a surplus in grid energy, resulting in reduced prices for a variety of goods and services, which provides customers with greater value for their money. Furthermore, renewable energy may complement non-renewable sources, increasing total energy accessibility (Steckel et al., 2013).

Rural areas can benefit from off-grid mini-solar plants. Off-grid mini-solar plants enable more individuals to have access to energy since they some may not have access to the grid thus it leads to further development. The increased access to energy can also enhance the development in various sectors and create job opportunities, which will raise the living standards for the entire communities. Studies showed that infrastructure support is needed for renewable energy. Infrastructure construction requires both skilled and unskilled labour (Owusu and Asumadu-Sarkodie, 2016; Cebotari and Benedek, 2017). Skill labour is needed for systems development, while unskilled labour encompasses the manual labour responsible for construction. This will also create new jobs for young individuals with college degrees or technical certificates (Mezher, Goldsmith and Choucri, 2011). Routine maintenance of the plant and public information dissemination will also provide employment. These findings shed light on the importance of innovation management in Bahrain's energy industry.

2.3.7 Ethical Innovation Management of Renewable Energy

The promotion of innovation has increased due to the widespread sharing of information between countries all over the world, in addition to innovation programmes shortages and the deterioration of price structure (Ignat, 2017). Organisations operating in technology-intensive industries presently place a greater priority on innovation management (Ignat, Becker, and Lorenz, 2014). That is the reason that actual and legal patent rights policies complement each other to remunerate ethical investment in product expansion. On the other hand, climate change is one of the most contemporary global issues, impacting all economic aspects and social development in every region of the world (Owusu and Asumadu-Sarkodie 2016). Ignat (2017) proposed a solution whereby innovation management and rapid diffusion are essential for dealing with climate change related challenge. At the international level, the previous decades have witnessed an unending expansion of innovation management in renewable energy. Innovations in renewable energy have advanced significantly quicker in comparison to those in related technologies. Currently, renewable energy represents 6% of global innovation management, turning away from remnant fuels and non-renewable energy sources (Ignat, Becker, and Lorenz, 2014).

As remnant fuels and other non-renewable energy sources have become controversial and scarce, many states have started to pursue alternative natural resources to realise the consumers' upsurging energy demands (Saboori and Sulaiman, 2013). Alternative energy sources are considered to be vital for the future in diverse sectors such as social, economic, legal, and physical jurisdictions, which necessitate different strategies aim to optimise the use of such resources and able to meet the demands of the consumers (State Laboratory for Renewable Energy, 2013). However, several studies have revealed that the majority of the public is uninformed on the practical and scientific applications of sources of renewable energy, despite the social impact of innovation management (Dolezal et al., 2013; Yzer, 2012; Kelly and Gibson, 2019; Saboori and Sulaiman, 2013).

Consumers may make the decision on whether to use alternative energy without prior considerations into the advantages and disadvantages due to the general public generally not being informed of the innovation applications. The adoption and impacts of renewable energy innovations are subject to various perceptions among various stakeholders or segments of the population (Dolezal et al., 2013). Potential shareholder perspectives should know that Bahrain has a stimulating environment in terms of emerging infrastructure for the implementation of numerous alternative energy sources, thus making it a viable investment and able to get a return on the investment. It is therefore important (Kelly and Gibson, 2019). Thus, it is up to the end user to choose whether to erect barriers to or morally enable the acceptance of renewable energy sources as a long-term investment.

Using renewable energy sources can help to reduce greenhouse gas emissions and decrease Bahrain's dependence on non-renewable energy products while improve the country's finances by supporting its forest and agricultural product industries (Yzer, 2012). Renewable energy developments possess several advantages but also numerous latent disadvantages. Several studies have affirmed criticisms of renewable energy’s creativity. They have argued that renewable energies have high implementations cost, are diplomatically complicated to gain support from the societies, and its impact on land usage which could have an adverse impact on wildlife and environment, thus driving up the cost of food (State Laboratory for Renewable Energy, 2013). Therefore, despite some stakeholders and the industry recognise the numerous possible benefits, the potential drawbacks must not be ignored.

The majority of the equipment needed to construct renewable energy distribution routes, such as electrical poles and transformers, would be sold by individuals, which paves the way for these individuals to start their own enterprises (Dolezal et al., 2013). Establishing renewable energy companies provides investors with an ethical investment option that promotes renewable energy production while simultaneously conserving the environment (Saboori and Sulaiman, 2013). Renewable energy companies would be obligated to be transparent about their corporate social responsibility, and investors would be informed about the benefits and drawbacks of the technology. This will be essential in ensuring that the general public is aware of the industry's increased focus on green economies.

2.3.8 Increased Public Drive Towards Green Economies

A green economy is driven by minimal carbon, social inclusivity, and resource proficiency (Lorek and Spangenberg, 2014). Individuals, particularly those that are conscious about the environment will support using renewable energy as the world transitions towards green economies (Al-Maamary, Kazem and Chaichan, 2017). This research demonstrates that green economies have been successful in making renewable energy a reality in their economies.

The purchasing preferences of environmentally conscious consumers, such as Rotarians, are shifting towards products that are produced and processed in environmentally friendly ways. As this segment of consumers continues to grow, manufacturers must adapt to their values in order to remain relevant (Omer, 2015). Individuals in this group exclusively consume products manufactured and processed using renewable and ecologically friendly energy sources (Shastri, 2013). This research is in agreement with the fact that renewable sources of energy that are ecologically friendly play a vital role in green economies.

A research conducted Dittrich et al., (2012) that focused on green economy indicated that the creation of jobs and revenue is determined by private and public investment in such economic undertakings, assets, and infrastructure. The findings reveal that a green economy advocated for the decrease of carbon emissions and pollution, improved resource and energy efficiency, and deterrence of damage to the ecosystem and biodiversity services. Therefore, these green savings must be supported and enabled through targeted public spending, strategy reforms, and changes in regulation and taxation (Winfield and Dolter, 2014). As established by Lorek and Spangenberg (2014), the Department of Environment in Bahrain advocates for a pathway to growth that embraces natural capital as a significant financial asset and the cornerstone of public benefits, particularly for the poorer population whose incomes depend on natural resources. Furthermore, a green economy is not a substitute for sustainable development; nevertheless, it is a new focus on investment, economy, infrastructure, capital, skills and competencies, employment, and positive environmental and social benefits across states by utilising renewable energy sources (Omer, 2015; Mikhno et al., 2021; Glavi, 2021).

The role of a green economy is to enhance sustainable production and consumption. According to Mikhno et al., (2021), a green economy enhances production methods and consumption practices across developing states. The findings of this research reveal a decrease in waste, resource consumption, and emanations across the complete life cycle of developments and products. On the contrary, a research by Glavič (2021) emphasised the importance of resource efficiency, which involves various methods of utilisation of resources within a society. The results maintained that resource efficiency delivered value to the community and decrease the demand for resources while reduced waste and emissions for each unit of service or product. Thus, a green economy offers a macroeconomic strategy for sustainable economic growth, with a strong emphasis on employment, investments, and skills that may support local infrastructure (Mikhno et al., 2021; Glavi, 2021).

2.3.9 Local Infrastructure Development

Global development and infrastructure requirements are the top priority in the decision making of a state (UNA-UK, 2014). Local infrastructure, such as bridges, roads, ports, water supplies, and power plants, drives financial development in many states by facilitating services, manufacturing, and commerce. Therefore, innovation management of renewable energy plays a vital role for such states (Aksorn and Charoenngam, 2015). However, the issue is not limited to constructing additional infrastructure (Carpintero and Siemiatycki 2015). Local infrastructure needs to be sustainable to achieve decent development and growth to be deemed impactful on a globe, which is strained by climate changes and shrinking natural resources.

Sustainable local infrastructure contributes towards stable economic development and growth, job creation, the acquisition of local goods and services, and improving people's quality of life (Thees, 2020). It also increases positive effects (vital benefits), thus aiding in safeguarding significant environmental and natural resources, and endorses an additional efficient and effective utilisation of monetary resources (Friedl and Reichl, 2016). Therefore, innovative management for renewable energy sources has shown that investing in locally sustainable infrastructure is ethical for the state and has an advantage on the return margins for investors (Cruz et al., 2019).

Further advantages include reduced materials usage, enhanced pollution deterrence, diminished carbon emissions, reimbursement for conservational services, and improved community and labour relationships result in several economic and financial benefits. Wong et al. (2017) pointed out that environmental sustainability also improved project financing projections. Moreover, research has revealed that the project shareholders and public are generally becoming increasingly concerned about environmental sustainability (Aksorn and Charoenngam, 2015; Carpintero and Siemiatycki, 2015; Friedl and Reichl, 2016; Pinheiro, Cruz and Miranda, 2019). They expect and demand that environmental sustainability be incorporated into local infrastructure projects based on innovation management.

Improvements can be made on local infrastructure in order to enable easy access to renewable energy plants (Cebotari and Benedek, 2017). Other studies have found that such local infrastructure would include transportation and communication infrastructure to help generate and distribute electricity from the plant (Shahateet, 2014; Pinheiro, Cruz and Miranda, 2019). Existing transmission and distribution lines will also be useful in developing renewable energy technologies, as this will lower the cost of constructing renewable energy infrastructure in Bahrain.

2.3.10 Innovation Management and Environmental Degradation

The research on the sustainability and emissions from self-driving vehicles suggests that there are high global greenhouse gas emissions, as acknowledged by McCarthy (2017). However, self-driving vehicles have the potential to improve energy efficiency, thereby decreasing energy consumption and greenhouse gas emissions in the automotive industry. With over 100 nations, including the Kingdom of Bahrain, supported the plan to reduce greenhouse gas emissions at the most recent United Nations Environmental Programme (UNEP) summit, it has not been entirely effective since emissions have not been quantified, making any analysis difficult (McCarthy, 2017). However, the research found no connection between innovation management and renewable energy. On the other hand, a research carried out by Wang, Wu, and Huo (2007) argued that emissions have been minimal, but most governments did not propose any solution to ensure a further drop in emissions through innovation management.

Harnessing renewable energy reduces environmental pollution, thereby improving human and animal well-being. (Shahabuddin, Ahmed and Mohan, 2016). Installation of renewable energy plants require less plinth width, thus adopting renewable energy improves the usage of land (Nygaard et al., 2014). Renewable energy sources have a high potential for minimising environmental degradation if feasibility and environmental impact assessments are conducted thoroughly. Innovation management indeed plays a central role in renewable energy sources. Therefore, various innovation strategies could address the challenges faced by the energy sector.

Innovation management, therefore, can be employed to ensure that renewable energy sources are at the centre of the energy sector in Bahrain.

Strategic challenges hinder the implementation of innovation management in firms. Innovation, by definition, is a procedure where all possible outcomes cannot be predicted in advance (Ahmed and Shepherd, 2010). The uncertainty of the potential consequences of innovation is the key challenge for Bahrain's energy sector. Additional challenge includes identifying a single individual or entity to take a lead on innovation management. Additionally, innovation management, knowledge, and entrepreneurship hold new significance in the economic knowledge aspirations of Bahrain (Wiig 2007). Despite government efforts and commitments to quality improvement, the innovative output for Bahrain’s energy sector is not at the desired levels.

2.4 Current Trends and Influences on the Energy Sector in Bahrain

According to Nematollahi et al. (2016), energy providers and energy security have a major role in developing nations. Renewable energy sources are regarded as clean energy sources capable of reversing environmental damage and averting future crises. This research examines energy demand and consumption in developing countries in the Middle Eastern. Firstly, there is a rapid rising energy demand in the Middle East countries throughout the years. Secondly, the research uses RETScreen software information to investigate the potential of renewable energy resources such as wind and solar resources. The optimal locations for harnessing wind or solar energy are identified using GIS maps. The GIS maps expand the range of hybrid wind and solar systems within Middle Eastern states. Furthermore, the current research will concentrate on the demand for energy and renewable energy in Middle Eastern nations in order to promote a greener economy. The current research attempts to bridge this geographical gap by exclusively analysing a few selected enterprises within Bahrain.

The research by Aghion et al., (2009) analysed the present condition of green innovation and delves deeper into the current issues in the area. The research established the necessity for private assets in green technologies by examining research and development, and venture capital information. However, there is a debate among the players in the energy sector, policymakers, and other stakeholders among the member states of the European Union that the EU27's inherent tax rate on energy is fragmented and low, the carbon fee in the EU releases interchange system is unstable, and civic R&D expenses allocated to the environment and energy are low (Tajudeen et al., 2022). Aghion et al., (2009) established that companies in the region have recognised the need to protect the environment. As a result, they have expanded their client base to include clients that place a high value on environmental conservation. The above discussion concentrated on energy innovation, excluding the subjects of energy conservation, a variable to be addressed by this research.

The sub-state level's electricity supply market is experiencing new prospects due to commercial model innovations (Hall and Roelich, 2016). These local-source commercial models improve the energy system and provide social, economic, and ecological values are not effectively articulated in current regulations or policies. The research examined new commercial models within the UK energy supply market that rely on complex value plans rather than the traditional utility archetype. Nine archetypal resident supply commercial models are identified, and their value schemes, value capture approaches, and market access obstacles were investigated. The research explains 'complex value' as a key concept in understanding the commercial model of invention in the energy sector. The process of complex value documentation poses a challenge to energy researchers, commercial organisations, and policymakers in free markets to explore the opportunities for system productivity and various outcomes that new supplier commercial models may bring to the energy sector. The above research concentrated on energy innovation by emphasising green energy while overlooking energy organisations and conservation.

A survey-based research by Kucukoglu and Pinar (2015) examined the effects of green innovation on ecologically sensitive company performance. In this instance, green innovation comprises of sub-dimensions of green products and procedures. Ecologically efficient business performance also has two sub-dimensions: ecological performance and the modest advantage of business through its green amenities. A survey was conducted on 500 businesses that provided their turnover records to enquire about the connection between green innovation and the firms’ performance. Regression and correlation analyses were performed on the data gathered from survey research. According to the research findings, green innovation actions considerably influence a company's environmental performance and provide a moderate advantage. Green procedure innovation, in particular, helps to explain differences in environmental performance and marginal advantage. A company that shifts to green innovation actions will decrease its environmental impact and have a competitive edge against its competitors. However, the research by Kucukoglu and Pinar (2015) overlooked energy challenges, which this research will address.

2.4.1 Energy and Distribution Challenges

Lilliestam and Patt (2015) conducted a meta-analysis of peer-reviewed studies concentrating on energy challenges in Gulf Cooperation Council (GCC) countries, including Bahrain, along with quantitative research through the use of questionnaires. The researchers revealed that, while renewable energy development encounters several barriers and risks, including unfavourable legislation, one of the most significant problems is the overreliance on non-renewable energy, petroleum, and its products as the primary source of energy. However, a research by Lilliestam and Patt (2015) focused solely on energy issues and does not address the distribution problems. However, this research shall address such problem. On the other hand, Lu et al., (2020) challenged the findings of Lilliestam and Patt (2015) and established that, among other financial concerns, the risks in the renewable energy sector are mostly tied to the technology within that sector.

A research by Charles, Moerenhout, and Bridle (2014) revealed that sustainable growth can be fostered by promoting policies that favour international trade, economic policy, investment, energy, and climate change, as well as managing social and natural capital to allow the application of communication technologies. The issues uncovered in the studies were overfunding and the allocation of subsidies for the non-renewable energy sector while underfunding in renewable energy providers. Despite Charles, Moerenhout, and Bridle (2014) focus was on both energy and distribution challenges, it excludes the Kingdom of Bahrain, and this gap will be filled by this research. Moreover, research by Tidd and Bessant (2018) contends with the findings of Charles, Moerenhout, and Bridle (2014), as they established in their research that challenges to innovation management could be solved through the development and investment in technological infrastructures, which can significantly reduce challenges such as underfunding. Charles, Moerenhout, and Bridle (2014) suggested an important mechanism for addressing challenges in the energy sector through the adoption of innovation management.

Authorities in the GCC countries have made significantly larger investments in the fossil energy industry in comparison to alternative energy (De Vries, Van Vuuren, and Hoogwijk, 2007). De Vries, Van Vuuren, and Hoogwijk, (2007) opined that considerable investments in fossil fuel projects by governments, companies, and high-net individuals may impede innovation and sustainability in the natural energy sector since majority of the parties with existing investment in fossil energy are reluctant to consider any change the generation of energy. As fossil fuel has high popularity in nations such as Bahrain, there has been little encouragement for investment in renewable energy in the GCC countries. As a result, investors are reluctant to dedicate resources into alternative energies. On the other hand, Jamil, Ahmad, and Jeon (2016) argue with the findings of De Vries, Van Vuuren, and Hoogwijk, (2007) that fossil fuels were largely limited sources, calling for an investment in other forms of renewable energy. This finding provides room for innovation to be applied in the energy sector to resolve the limitations of various energy sources.

In terms of utility distribution, research was conducted using data from World Bank (2021) to analyse the cost of electricity connections and the performance of electricity utility enterprises in 183 countries, including Bahrain (Geginat and Ramalho, 2015). The study reported that, in certain instances, it was excessively costly to connect electricity to users and that poor distribution networks, particularly in rural regions, hampered the wide distribution of services. The current research will focus on energy-related concerns that were not addressed in Geginat and Ramalho's (2015) research since they were more focused on difficulties with energy distribution. Poor distribution networks have been found to decrease the utility sector's efficacy and quality of supply while also increasing the difficulties in securing connections Poor distribution networks due to corruptions (Geginat and Ramalho, 2015). As a result, poor distribution networks, particularly in marginalised communities, have led to under-penetration and regional growth disparities. Other challenges included both the political and economic entities prioritising oil and gas projects.

A research by Sinsel, Riemke and Hoffmann (2020) established that renewable energy sources such as wind and solar power are critical for achieving decarbonisation. The increased importance in the variety of renewable energies leads to energy systems face a variety of challenges. The existing literature lacks the depth of the challenges and inventive solutions. This research provides a detailed overview of the energy system's challenges and new solutions. To bridge the gap, the current research will focus on the energy sector in Bahrain, by analysing both the energy and distribution problems.

2.4.2 Market Demand and Need for Affordable and Efficient Electricity Distribution

There has been a significant increase in the demand for electricity in nations within the Middle East (Asif and Muneer, 2007). The research by Asif and Muneer (2007) utilises the long-term energy substitution planning model to estimate energy consumption and greenhouse gas emissions under several scenarios from 2016 to 2020 (Zhang et al., 2017). In the baseline scenario, where emissions and energy demand are twice as high in 2020 compared to 2015, a research focus on Beijing found that if the state does not drive the growth of transportation services, its gas emissions and energy consumption will increase significantly (Zhang et al., 2017; Rahman et al., 2017). The findings by Zhang et al. (2017) also revealed that the factors surrounding the development and distribution of urban transportation affect emission reduction and energy efficiency, and in 2020, energy consumption and emissions will decline by 25%–30%, similar to the baseline scenario. The combination of public transportation and distribution is an effective solution for Beijing's low-carbon passenger transport sector development. Conditions such as reducing congestion and higher clean-energy and new-energy vehicle growth have the potential to save energy and reduce emissions. The research illustrates the changing patterns in emissions and energy consumption in Beijing's passenger transportation industry, but it does not look at efficient power distribution, which is covered in the current research.

A research analysed the characteristics of 238 copyrights on 90 creations from philanthropists, all of which were subsidised and offered third party royalty-free access to the original innovations in green technology (Hall and Helmers, 2013). The research by Hall and Helmers (2013) compared the pledged copyrights to other trademarks in similar technologies or those held by similar corporations to examine the motives of the subsidising firms and the potential for such regulation to inspire the adoption and creation of climate change-related technology. The results of the research by Hall and Helmers (2013) suggested that patents should be used to protect ecologically friendly innovations that are of similar quality to the average patent in a promising company's patent portfolio, but these patents may have a lower value than other patents despite being at the same level. The research findings suggest that making charters available royalty-free did not increase companies to be built based on those charters, as shown by citing patents. As a result, the research by Hall and Helmers (2013) provides information on the role of patents in the transmission and development of green technology but ignores energy consumption and distribution, a variable that the current research will fill. To overcome the challenges, diversification strategies and renewable energy sources were recommended (Hamed et al., 2018). The research by Hamed et al. (2018), which focused on Nordic states also established that effective renewable energy distribution requires an understanding of social, technical, and economic aspects. The research explained that the Nordic states are the leading nations in successfully growing renewable energy and energy effectiveness. However, the research by Hamed et al. (2018) overlooked energy distribution, an aspect the current research will address.

Bahrain has been researching solutions to enhance electricity distribution efficiency as a model to improve sustainable development (SAP, 2013). This has resulted in initiatives such as the automation of the utility distribution of electricity services through information technology (IT)-based processes by the Kingdom of Bahrain Electricity and Water Authority (EWA), particularly in areas such as metering, billing, and customer relationship management.

2.4.3 Traits of the Utilities Market in Bahrain

The Ministry of Electricity and Water Affairs oversees Bahrain's major utility services, including electricity, and water. These services are mostly provided through an associated national grid. Unfortunately, the grid does not serve several regions, particularly those in rural areas. As a result of the significant investment required in the industry, private enterprises take advantage of the opportunity to supply these areas through mobile services, as established in the review of the energy sector in Bahrain. Most investors use resource sharing as a method of mitigating investment risk. This section examines the features of Bahrain's utility markets. It also depicts generation, storage, distribution, risk management, optimisation, competitive advantage, usability, and computing relationships. Lastly, the section summarises the traits of Bahrain's utility market.

2.4.3.1 Features of the Utilities Market in Bahrain

Bahrain's most extensive utility market, 'The Bahrain Electricity and Water Authority', is governed by the Ministry of Electricity and Water Affairs, which oversees the nation's electricity and water markets. Customers in Bahrain typically receive a combined bill for their electricity and water charges, with tenants generally having their connection services arranged by the landlords. However, there are instances where tenants may seek such services themselves without the involvement of the landlords and they are able to do so if they could present a rental agreement (Mas'ud et al., 2018). The above research, however, overlooked other aspects of the utility market that the current research will address.

Typically, customers in Bahrain use air conditioners to cool their homes, which results in high energy consumption, and they ultimately end up paying more due to higher tariffs (Almasri and Alshitawi, 2022). Since solar energy requires sunlight to produce electricity, it is a convenient pattern there is a higher energy demand during the summer where there is high amount of unslight (Richter, 2011).

Another key public utility resource that the ministry closely regulates is water (Rogers and Hall, 2003). Supply charges are frequently expensive due to scarcity and the high costs of manufacture and shipping, and government officials may choose to visit and investigate an individual or entity known to be using copious amounts of water. Furthermore, tap water is not recommended for drinking in most regions, and people are advised to consume bottled water instead (Omer, 2015). The research confirmed that relevant service providers often supply and distribute bottled water, but it overlooked essential utility market elements, which will be addressed in the current research.

On the other hand, several companies are active in distributing gas in cylinders, despite only a few areas have access to the utility gas line. Gas is essential for cooking and warmth, and gas in cylinders can be refilled when empty, with most suppliers replenish the empty cylinders promptly when requested (Ozturk, 2015). Nevertheless, the previous research overlooked other aspects of the utility market that would be addressed in the present research.

2.4.3.2 Energy Generation, Storage, and Distribution

Mas'ud et al., (2018) established that Gulf Cooperation countries have prioritised solar thermal and solar as the form of renewable energies. Solar energy is generated using sunlight. The sun's rays are focused on a transducer, usually composed of silicon, which converts the rays into energy. When the rays hit the silicon, they induce the formation of free electrons, which travel along the electrical circuit. Electrons from electrical circuits are transferred to the grid and distributed to industries and residences. The transducers are placed in panels that may be placed on the ground, a roof, or any other flat surfaces that have contact with direct sunlight. The research by Mas'ud et al., (2018) focused on energy generation but disregarded power storage and distribution. This research will address this gap.

Solar thermal energy, on the other hand, is created when the sun's rays heat the panels, and this is used to heat the water and to power solar cooling systems. The Kingdom of Bahrain has high solar radiation, estimated to be over 2180 kWh/m2 throughout the year, with an average nine hours of daily sun exposure (Green and Newman, 2017). Bahrain also consumes 26.09 billion kWh of power while producing 26.78 billion kWh. It has the lowest both electricity consumption and generation rate in comparison to other Gulf nations. Moreover, the energy is stored in cells and batteries with a capacity of 230 kWh. Madi et al., (2012) attempted to increase the capacity and duration of electricity storage that will increase access to this form of energy. The fundamental goal of improving cell efficiency is to increase battery capacity while decreasing the physical size.

The national grid in Bahrain distributes electricity generated from renewable sources. Due to the similarities between the electrons derived from renewable and non-renewable sources, a comparable distribution route can be employed in Bahrain (Melikoglu, 2013). However, the majority of renewable energy consumers in Bahrain, are solar energy especially solar thermal energy, which are part of their building plans with the aim to improve efficiency in capturing and distributing this type of energy. The panels are installed in areas that have maximum exposure to sunlight, and the energy they generate complement the power supplied by the national grid. Melikoglu (2013) used a longitudinal evaluation of related studies but did not discuss the topics of power storage and distribution. This research will therefore address this gap.

2.4.3.3 Risk Management, Optimisation, and Competitive Advantage

In Bahrain, sustainable energy generation is expected to account for between 5% and 7% of the total capacity by 2030 (Benli, 2013). There are joint ventures between is a joint venture between Bahrain’s oil corporations and US-based enterprises to produce sustainable energy that can be utilised on the nation’s main grid. This strategy was intentionally implemented to act as a buffer to investors in renewable energy plants by pooling resources and reducing risk exposure. The previous research did not address the optimisation and competitive advantages of the companies, which will be addressed in this research.

There must be policies regulating the production and distribution of renewable energy to maximise production and distribution in any given economy (Hall and Roelich, 2016). These policies establish a working framework for energy companies, resulting in increased productivity. However, Bahrain has no such policies and instead, has an open framework that permits companies to buy properties. This paves the way for foreign companies to set up operations in Bahrain and generate energy without being stymied by high taxes, mandatory local participation, and high customs duties. The University of Bahrain's proposal to build a plant (project) that will desalinate water and provide fresh water to residents, with a capacity of around 250 gallons of water per day, is an example of the freedom that investors have in Bahrain's utility sector, so the policies benefit foreign and local investors. This project will use solar energy for desalination, and the university has already installed 0.5 megawatts of solar energy, which consist of 2089 solar panels covering a total area of 3,400 m^2 (Siddiqi and Anadon, 2011). This will significantly contribute to the project's power efficiency and optimisation. Nevertheless, the above research did not focus on competitive advantage, a gap the present research will address.

Renewable energy has a competitive edge over non-renewable energy sources in terms of its infinite availability and cannot be depleted. It is classified as clean energy because it can be generated without harming the environment (Leoncini et al., 2017). In other words, it does not increase the greenhouse gas emissions, as opposed to energy generated by fossil fuel. The results indicate that the maintenance cost for the generation of this type of energy is lower, and it has the potential to create large amounts of energy if properly utilised. This can reduce the demand and supply mismatch that the country is currently experiencing. Bahrain has placed no limitations on the method of energy generation and distribution, and there are no discriminations on the type of investors.

This may attract private developers, whose investments might help fund the plant's construction and electricity distribution. The above research did not focus on optimisation, a knowledge gap that will be addressed in this research.

Automation in the Green Revolution is critical for minimising waste caused by misuse or overexposure. This is particularly true for non-renewable energy where if wasted, may not be recovered. Automation tools guarantee that the energy generated is optimally used and that there are no leakages between the point of production and the final consumer. The closed circuit is constantly monitored, and restrictions are put in place to stop or reduce distribution if required at any given time (Hall and Roelich, 2016). The above research overlooked the competitive advantage, which will be addressed in this research.

2.4.3.4 User-Friendliness and Customer Relations

Renewable energy producers require marketing to promote their products to their target audiences in order to increase sales (Parmigiani, 2015). This may be accomplished by launching public awareness initiatives. A potential client must be familiar with the fundamentals of renewable energy. Additionally, there are misconceptions about sustainability that should be debunked using verifiable facts; the majority of individuals that oppose the concept of renewable energy due to such misconceptions. The relevance and benefits of renewable energy should be explained to the current and future clients.

There is a high demand of energy in the Gulf countries, as well as other countries that are experiencing an industrial revolution. Projects with high energy requirements are created on a regular basis, necessitating the development of an alternative energy source to supplement to the current energy supply on the national grid

(Kucukoglu and Pinar, 2015). In Bahrain, this ever-increasing demand has been met with a corresponding growth in renewable energy deployment, as shown by the University of Bahrain's development of a 0.56 MW solar energy plant to supplement the national grid (Siddiqi and Anadon, 2011). This solar energy plant was recorded to have a total plinth width of 3400 m^2 and 2088 solar panels, each with a capacity of 240 W if exposed to ideal conditions (Dutt and Ros, 2008). In addition, turbines have been employed to produce an additional 3 MW of electricity to supplement the national grid, as suggested by the EWA (Mas'ud et al., 2018). Nevertheless, the above research did not focus on customer relations, and this will be addressed in this research.

Impeccable customer interactions and client-driven services are essential for renewable energy to gain market momentum and acceptance (Leoncini et al., 2017). This has been the case in most Gulf nations, where solar thermal energy is being marketed as a consumer product, with consumers being advised to incorporate solar panels into the original designs of their homes. This has, in turn, brought a sense of ownership to individuals and built a level of trust and acceptance. The above research did not focus on customer dissatisfaction, a variable that will be addressed in the current research.

2.4.3.5 Summary of Trends in the Energy Sector in Bahrain

Fossil fuels are Bahrain’s primary source of energy (Martins et al., 2019). The findings by Mohr et al., (2015) are in tandem with the findings by Martins et al., (2019), as they established that the usage of fossil fuels would significantly increase in many countries since fossil fuels are vital to meet the global energy demand. However, renewable energy sources, such as solar, are on the rise (Alnaser and Alnaser, 2020) due to the need for more affordable and consistent energy sources to satisfy the manufacturing industry's rising energy consumption and to create more employment. Nevertheless, industrial challenges include over-reliance and over-funding of the non-renewable energy sector by the government and private investors. Distribution is also one of the challenges, particularly in remote and marginalised areas with no access to the national grid. There is evidence of the application of the technology, notably information technology, to improve service automation and, consequently, efficiency.

2.5 Innovation Management of Renewable Energy and its Potential Benefits in Bahrain

Green innovation involves the use of natural resources to generate energy while causing minimal damage to the environment (Schiederig, Tietze and Herstatt. 2011). The Paris Agreement was a global appeal for governments to have a commitment on collective measures to mitigate severe environmental impacts, particularly those caused by human activities. The agreement is pertaining to the necessity in addressing the threat of global climate change, which is achieved through various means such as adopting sustainable energy productions and to use renewable energy rather than energy generated via fossil fuels. In Bahrain, solar and thermal energies are identified as unlimited renewable energy sources. Solar energy generation is a method that involves harnessing the sun's rays to generate energy by passing the rays through a silicon transducer (Daojiong, 2006). The energy generated is deemed as environmentally friendly (Khan et al., 2016). Gulf countries have been investing in this form of renewable energy, and has proven to be very efficient.

Solar energy is undoubtedly one of the most accessible and available forms of renewable energy in the GCC nations with dry climates, including Bahrain (Reiche, 2010). Various factors, including the immediate capital expenses of installing solar energy systems and conflicting political interests have been linked to the low adoption rate. The current regulatory structure encourages investment in the oil and gas industry, but there are none of such regulatory for renewable energy. However, the idea and construction of Masdar City in Abu Dhabi, a project aiming to entirely rely on renewable energy sources and technology, principally solar, is a step in the right direction.

Kaunda, Kimambo, and Nielsen (2012) noted in their research that hydropower has been a key energy source for a long period of time. However, a significant difficulty with this energy source is that water has become an increasingly scarce resource due to climate change. Turbines are powered and turned by hydropower, and this motion energy converts into electricity, which is used to power homes and industries (Alshehry and Belloumi, 2015). Most economies are less reliant on hydro power amongst the renewable energy sources due to rainfall being less sustainable and reliable to occur (Solaun and Cerdá, 2017). Water is a critical natural resource because it serves a variety of functions, including sustaining life and cooling power plants that generate the electricity (Paiho et al., 2015). Notably, studies by Cooley et al., (2011) and Borchers, Xiarchos and Beckman (2014) established that water availability provides limitless possibilities for energy production, making it the most crucial aspect of energy scalability. However, a Trading Economics (2018) research established that there are no hydro-energy output and consumption in Bahrain, which means the country does not generate power through hydro energy.

Biogas is one of the few organic forms of clean energy (Sbia, Shahbaz and Hamdi., 2014). It involves the use of manure or compost in the energy generation process. However, researchers pointed out that further research is needed to determine whether it has the scalability to be a viable energy source. At the moment, farmers mostly produce energy via biogas on a small scale (McDowall and Ekins, 2014).

Research has conducted on using wind as a form of renewable energy source (Velan, Muthukumaran and Balasubramaniyan, 2012). Results indicated that it is best harnessed in regions with large tracts of unoccupied land and strong winds. If properly harnessed, this energy may be sufficient to power economies. Other researchers have supported the adoption of wind energy, arguing that the energy produced may be stored while simultaneously being utilised to pump water from beneath, supplying two crucial energy sources (Calza, Parmentola, and Tutor, 2017). However, just as hydro-energy, the production and consumption of wind energy in Bahrain is at 0% (Trading Economics, 2018). Despite the above studies did not focus on innovation processes, wind energy is recognised as a source of renewable energy.

Geothermal energy is another renewable energy source in which fumes are produced by underground power turbines, which then transduce the energy to generate electricity. The heating of subterranean water causes these fumes to reach to a point where they are transformed into steam, which is then expelled from the earth at velocities that rotate the turbines to generate energy (Bagher,Vahid and Mohsen, 2014). Most of these geothermal centres are in arid regions (Pimentel et al., 2002), and the power released and produced is determined by the velocity at which the steam is released from the ground. It is a significant form of clean energy with untapped potential, as it can provide voltages comparable to those generated by hydro-energy, and, with the trends seen in hydro-energy, it might serve as a good substitute. However, its production and consumption are also at 0% in Bahrain (Trading Economics, 2018).

2.5.1 Summary of the Potential Benefits of Renewable Energy in Bahrain

The supply of energy has increased by 4.2% over the past 20 years, whereas the energy intake rate has increased by 5.3% over the same period (Kanellakis, Martinopoulos and Zachariadis, 2013). The domestic energy intake rate has surged at a higher rate at 6.6% every year. Electricity generate for domestic use are generated via natural gas relies on creating electricity out of natural gas. The estimate of present consumption far surpasses the existing energy production due to lack of innovation management (Shahateet, 2014). Hence, there is a need to utilise renewable energy and efficiency by embracing innovation management as a practical choice to ensure that there is sufficient power for forthcoming generations.

The state will take measures to decrease CO2 emissions by implementing renewable energy strategies. It envisioned that renewable energy will account for 6% of the total energy generated by 2025. The general advantages include reducing the cost of domestic solar energy production, which means financial savings for the state, reducing the investment costs to generate energy for domestic use, and reducing the country's CO2 emissions (McCarthy, 2017). There are various benefits in innovating photovoltaic schemes in a house and possessing a scheme net-metered into the countrywide network. These benefits are individually advantageous and also useful for the nearby vicinity. Consequently, the utilisation of renewable energy sources benefits not only the domestic owner but also the society, country, and the global community (Kanellakis, Martinopoulos and Zachariadis, 2013). These benefits include reducing dependency on fossil fuels and the related negative environmental implications through innovation management.

For the proprietor, the recurrent electricity charges will be meaningfully lessened due to the creation of individual energy sources (Shahabuddin, Ahmed and Mohan, 2016). The state also offers loan schemes for individuals to invest in their own solar installation on their homes. Subsequently, the benefits include direct monetary gain and decreased overall expenditure. Similarly, individuals can invest in their state, thus creating new employment opportunities. Continuous investments in renewable energy contribute to a cleaner environment by reducing individual carbon footprints through innovation management.

The potential benefits of renewable energy in Bahrain include improved economic outcomes such as job creation, lower energy costs, decreased industrial production costs, and increased national economic growth. Additionally, renewable energy results in minimal harm to the environment when a proper environmental impact assessment is carried out in comparison to fossil fuels. Furthermore, when developers construct renewable energy plants, they are more inclined to improve local infrastructure, which benefits the local population. Consequently, as individual households embrace renewable energy, the society will become more self-sustaining. Thus, the whole country will similarly benefit as a supplementary society embracing innovation management practices for renewable energy in Bahrain.

2.6 Centralised and Decentralised Models: Energy Demand in GCC Countries

The increasing demand for power in GCC countries, including Bahrain, will be evident during the forthcoming decade (Albadi and Almubarak 2019). Electricity consumption is estimated to be directly linked to a nation’s GDP. The transition of Bahrain's energy sector's power consumption from non-renewable to renewable energy sources will facilitate the resolution of the region's food and water security issues amidst immigration challenges. Conversely, the availability and abundance of conventional energy sources may impact export logistics and increase waste, ultimately exacerbating climate change. Moreover, the populations of the GCC nations will increase exponentially during the next 25 years (Albadi and Almubarak 2019). Therefore, it is clear that GCC countries' energy organisations must transition to non-conventional energy. Such measures would also enable them to reduce their carbon footprints while simultaneously aiming to fulfil the energy requirements linked to increasing GDP (Alstone et al., 2015).

Centralised power generation models that largely embrace innovation management are dominant because of the easy access and cost-effectiveness of non-renewable energy sources. On the other hand, using non-renewable energy sources is directly proportional to the economic development of a nation. However, the global GHG emission protocols are rapidly changing the trend. For example, the energy sector is expected to increase its share of renewable energy usage from 25% in 2015 to 85% in 2050 (Gielen et al., 2019). As presented in Chapter 3, the conceptual framework acknowledges and incorporates both power generation models while evaluating innovation and knowledge management.

Centralised energy supply involves large-scale power generation using non-renewable energy distributed via a nationwide grid; thus, it occurs on a national level in accordance with the hierarchical principles (Martin, 2009). Decentralised models, typically called bottom-up or distributed policies, are often established as a means of perpetuating economic growth and reducing stiff market competition while also proving beneficial in promoting disintermediation. Distributed and decentralised energy production models offer the most promising pathway for promoting access to sustainable energy on a small scale within communities (Vezzoli et al., 2018). Decentralised energy systems are distinguished by their flexibility and incorporation of renewable energy sources (Mehigan, Bertsch and O'Gallachoir, 2018). The transition to renewable energy, which has been adopted by many countries, is one of the most important developments in the energy sector (Burke and Stephens, 2018). As a result, decentralised models are becoming more prevalent than centralised models. Centralised energy supply systems are becoming less attractive to consumers (Bouffard and Kirschen 2008). In addition to the vulnerability of centralised electrical systems, there are several factors that have contributed to their declining advantages. These factors include the depletion of fossil fuels, their detrimental effect on climate change, insecurities affecting energy transportation and their associated infrastructure, as well as the investors' desire to minimise risks through deploying small-scale and modular generation transmission systems. As a result, small-scale decentralised systems are becoming increasingly popular among customers due to their ability to combine energy production and consumption effectively. Therefore, innovations are more likely to be identified in organisations that have either fully or partially transitioned to non-renewable energy sources for power generation (Jiang et al., 2020). However, it should also be noted that the cost-effectiveness and feasibility of transitioning to decentralised models would invoke or impede the adoption of innovative strategies (Vezzoli et al., 2018).

A top-down approach was not adopted, given that this would involve a constant focus on successful or failed strategies for implementing centralised models or non-renewable energy usage in Bahrain's power sector. Moreover, a bottom-up model approach was preferred since it aids in the identification of minute details that drive the cause-and-effect relationship between the implementation of innovation in Bahrain's power sector (Steffen and Schmidt 2019). This is because the bottom-up approach would explore the innovations that were undertaken to transition to non-renewable energy sources to produce electricity (Pellicer-Sifres, 2020). The bottom-up approach would help to provide insight into successful and unsuccessful innovation strategies during the transition from centralised to decentralised models.

This type of cause-and-effect relationship could assist in determining the optimum practices associated with business models that would enable stakeholders' interests to be fulfilled while transitioning to non-conventional energy sources for power generation. The stakeholders consist of the organisation's management, employees, the Bahrain government, and the general public.

Decentralised systems are more attractive because their implementation means less dependent on centralised system as well as capable of using more than one source of energy. Moreover, they are less vulnerable to the susceptibility and unpredictability of remote primary energy and transportation networks. Decentralised systems that generate energy via renewable sources while adopting existing fossil fuel based technological innovations that are highly efficient are generally cleaner such as when the combination of heat and power is used (Geller, 2012; Belu, 2014). Regardless, fully decentralised energy supply systems are not presently feasible, nor are they genuinely desirable from an economic perspective, due to the challenge of supply-demand logistics. A secure and clean energy system is certainly desirable in the future. However, it should offer sufficient flexibility to permit a spectrum of hybrid channels of operation and investment because these would allow the combination of the optimal attributes of both channels of energy supply systems. It is believed that a significant aspect of such flexibility would be generated by the networks enabling the combination of infrastructures for centralised and decentralised energy systems. This would not only be practical and sustainable in the long run, but it would also be appealing to the investors and relevant stakeholders in the energy sector.

Innovation management will be one of the crucial resources that enable energy organisations to combine the best attributes of centralised and decentralised energy systems, thus promoting a paradigm shift within the global energy sector (Alstone et al., 2015). Various innovative initiatives have already been launched within the power sector at the consumer level. One such initiative is the promotion of prosumers in the energy sector. Typically, the government provides the fiscal impetus to consumers, encouraging them to install renewable energy systems that leave a lower carbon footprint. Concurrently, the consumers that generated surplus energy is sente to the common grid and they are also being paid. Nevertheless, these innovations are occurring at the most basic grassroots level, meaning that they are insufficient in terms of driving the nation's economy.

A nation's GDP growth is directly proportional to the number of non-renewable sources of energy used, in addition to higher carbon footprints (Nakhli et al., 2022). These observations may raise a dilemma regarding adopting decentralised systems over centralised ones. Therefore, innovation management offers the fundamental strategic roadmap for integrating the optimal principles of centralised and decentralised energy systems, enabling the formation of hybrid systems in terms of energy generation, energy distribution, and the organisational logistics associated with energy distribution (Lehtonen and Nye, 2009). This can ensure the profitability of both the electricity organisations and the investors.

2.7 The Challenges and Barriers to Innovation Management Faced by Utility Companies in Bahrain

The development of renewable energy and innovation management in Bahrain faces various challenges and impediments. This includes technical, resource-based, political, and investment challenges.

2.7.1 Research Hypothesis #2

The research is aimed to answer the following research hypothesis:

Hypothesis$_2$ (H_2): *It is hypothesised that factors affecting electricity organisations impact the implementation of innovation management strategies.*

2.7.1.1 Technical Challenges

GCC countries do not have a forum such as seminars or workshops to discuss ideas related to renewable energy and to achieve synergy through collaborative effort (Luomi, 2015). Solar development requires designers to draught plant blueprints and participate in the design of distribution channels; engineers to perform the majority of the groundwork and actualize the specifics in the blueprints; and other professionals that have a critical role in the implementation process (Huculak, Jarczewski, and Dej, 2015). The implementation process is hindered by the expenses incurred by firms for employing additional staff, thus putting a strain on resources (Sovacool and Brown, 2009). Hence, economies of scale must be realised to achieve excellence in implementation (Raza, Shahbaz and Nguyen, 2014). However, this might be a problem for a relatively new industry such as renewable energy, which requires time to mobilise the necessary resources (Emerson and Winner, 2014). Research and development are also important in the implementation of these projects; however, there is currently limited research related to solar energy in the Gulf countries; therefore, the influence is negligible (Hidalgo, 2010). There is currently no publicly available database that provides information on renewable energy and other ecologically friendly alternatives (Hidalgo, 2010). Innovation management will contribute in determine the implementation of programmes that have a high chance of succeeding on a large scale.

Some material supply input challenges faced by eco-technology include standby capacity, land utilisation, and storage (Hertog and Luciani, 2009). A standby capacity is a supply capacity provided to consumers if the primary energy source becomes temporarily unavailable (Luomi, 2015). Eco-technology largely adopts innovation, meaning that the challenges experienced in the material supply are significantly minimised. Its application is critical for renewable energy sources, particularly those that at risk of not having consistent output, such as solar power in storage batteries. The findings reveal the challenges of solar energy production, which is confined to the daytime and difficult to produce at night.

The availability of standby storage equipment, such as batteries, would enable the storage of power generated throughout the day, allowing the base load to be maintained despite energy is not being generated (Hertog and Luciani, 2009). Furthermore, other challenges are unique to solar and solar thermal energy, such as dust accumulation on panels caused by wind. The majority of Gulf nations are deserts; therefore, it is easy for the wind to carry the dust and deposit them onto the panels. Innovation management will enable a country to take an optimum advantage from wind and solar energy. Studies support the findings of research conducted by Hertog and Luciani (2009), and one such research established that challenges exist in the energy sector. It asserts that the accumulation of these dust particles might interfere with the transduction of solar rays into energy since the transducers are not properly protected (Mansouri, Crookes and Korakianitis, 2013).

A research by Benli (2013) contradicts the findings by Hertog and Luciani (2009) and Mansouri, Crookes and Korakianitis (2013), as it notes that the challenges are amplified during the winter when it is cloudy, and insufficient sunlight reaches the panels, resulting in no cell stimulation and a significant reduction in solar energy transduction. The research clearly shows the importance of innovation management in addressing the reduced solar energy transmission. Furthermore, the effectiveness of the solar panel reduces to as low as 40% of its initial efficiency during winter time (Siersdorfer and Ramahi, 2014). However, the research does not focus on the application of innovation management. These findings were complemented by those of a research that found that contamination of solar panels can also be caused by the accumulation of dust, sand, ash, calcium carbonate, and silica on the panel, which tend to reduce the exposed cell's surface area (Calza, Parmentola, and Tutor, 2017).

The energy density must be within a certain range at any given time to make the project viable (Hall and Helmers, 2013). This is necessary to ensure that the supply is not disrupted (Hall and Roelich, 2016). It is vital to consider efficiency, efficacy, safety, and adaptability factors while developing any renewable energy model (Mas'ud et al., 2018). Such an approach is essential for firms that strive to maintain a sustainable innovation posture (Kumar et al., 2017). In the case of solar, incorporating solar panels into houses are an effective way to secure the availability of renewable energy while also decreasing the amount of electricity required from the grid (Melikoglu, 2013). According to a research by Hall and Helmers (2013), this can take the form of photovoltaic walls and roofs. This ensures that energy is distributed in a consistent manner. Renewable energy is constantly evolving, with new possibilities being discovered daily (El-Katiri, 2014). Solar energy is particularly underdeveloped, and as a result, it has been regarded as unreliable in the past. One of the main reasons for this is that energy storage for later use is not well understood, which raises the question of reliability (Maxwell et al., 2010). Thus, innovation management needs to be embraced in the evolution of renewable energy.

Renewable energy relies on a network of systems to function effectively. (De Vries, Van Vuuren, and Hoogwijk, 2007). These systems necessitate the construction of new, capital-intensive infrastructure, which may dissuade developers from exploring renewable energy (Hefferan, 2013). For example, considering necessary costs such as conducting the requisite feasibility and environmental assessment studies, developing power evacuation lines, and putting up a power substation when developing a solar power plant may be prohibitive. There is a shortage of trained individuals that understand the construction and maintenance of the involved infrastructure (Würtenberger et al., 2012). These findings by Würtenberger et al., (2012) are largely in tandem with the findings from a research by Hefferan (2013). Despite the useful contributions of the research studies above, none of them discussed the importance of the application of innovation management in the energy sector of Bahrain.

2.7.1.2 Challenges of Getting Renewable Energy Innovations

The challenges that the utility sector encounters, particularly in ensuring the availability of renewable energy innovations, are mostly related to funding (Karltorp, 2016). Many researchers disagree with Karltorp's (2016) findings, as they point out that immense challenges exist for green risk finance (Owen, Brennan and Lyon, 2018).

Utility companies in Bahrain are presently dealing with the same issues that prevent them from using innovative practices in their operations. These issues include technical, resource-based, political, and investment limitations. Innovation requires technical knowledge, which, in most cases, is lacking in many of the utility companies in Bahrain. Furthermore, most organisations may be unable to hire or train technical experts, especially given the costs associated with such endeavours (McIntosh et al., 2011).

Additionally, most investors and the government are more committed to investing in non-renewable energy, which they are familiar with, than renewable energy, which is still relatively new in their sphere (Schmidt, Blum and Wakeling, 2013). Moreover, resource-based limitations, such as the reliance on solar as a source of energy, imply that it cannot be used for production at night when there is no sunlight or during the winter when sunlight is sparse. Innovation may also require huge capital investments, which may be out of reach or hard to access for most utility companies (Zerriffi, 2011). Grassroots innovation in the energy sector will go a long way in solving the many challenges that impede the realisation of renewable energy innovations (Van Der Schoor et al., 2016). The findings of Steger et al., (2005) support Van Der Schoor et al., (2016)'s conclusions, as it was determined that innovations in the energy sector could potentially eliminate the numerous challenges facing the energy sector and renewable energy in general.

2.7.1.3 Summary of Challenges and Barriers Faced by Utility Companies in Bahrain

This research discusses the significant challenges that impact the performance of innovation strategies within Bahrain's utility sector, with utility companies being particularly affected. As noted by Reiche (2010) and Eveleens (2010), errors in innovation management often arise from a trial-and-error approach. One critical issue is the difficulty in attracting qualified professionals, which diminishes the effectiveness and productivity of utility firms. The Kingdom of Bahrain faces a shortage of skilled personnel necessary to address pressing challenges such as inefficient energy generation (Darwish, Abdo, and AlShuwaiee, 2018). Additionally, internal issues related to poor management and resource allocation further exacerbate these inefficiencies, often leading to a deficiency in manufacturing resources that outpaces the financial support available to these companies. Consequently, the overall negative outcomes underscore the inefficiencies prevalent in these organisations.

Another significant challenge confronting Bahrain's energy sector is the lack of adequate funding for utility providers. Although there is support available from other Gulf Cooperation Council (GCC) states, many electricity companies require substantial capital investment to keep pace with technological advancements and the adoption of new equipment essential for increasing production capacity and achieving organisational objectives (Darwish, Al-Najem, and Lior, 2009).

Furthermore, the absence of appropriate organisational structures presents a considerable barrier for many utility companies in Bahrain. This deficiency often results in ineffective management strategies that adversely affect overall productivity. Coupled with low employee motivation, these issues hinder the Kingdom of Bahrain's ability to meet the operational objectives of its utility companies, thereby impacting total production levels (Darwish, Abdo, and AlShuwaiee, 2018).

Lastly, government policies and regulations significantly influence overall production within the sector. Some policies regulate wage structures for employees, while the imposition of taxes adds a financial burden on these companies (Adepetu, 2014). Such barriers adversely affect the capacity of utility companies to produce renewable energy efficiently.

In conclusion, the challenges and barriers faced by utility companies in Bahrain—including workforce shortages, inadequate funding, ineffective organisational structures, and restrictive government policies—highlight the critical need for comprehensive innovation management strategies. Addressing these challenges will be essential for enhancing productivity and advancing the transition towards sustainable energy solutions in the region.

2.8 Theoretical Framework

The theoretical framework underpinning this research is grounded in Rogers' (2003) Diffusion of Innovations model, which provides a robust foundation for analysing the findings and contributes to the broader theoretical discourse on innovation management and technology adoption. Rogers' model delineates five stages in the innovation adoption process: knowledge acquisition, persuasion, decision-making, implementation, and confirmation. These stages illustrate how innovations gain momentum and diffuse within social systems over time, offering a structured approach to understanding the dynamics of innovation adoption. The model also emphasises four key components of innovation: the innovative idea itself, the communication channels used to disseminate information, the social contexts influencing innovators and adopters, and the duration of the adoption process.

The proposed framework is designed to facilitate the systematic scoping and collection of data, enabling a comprehensive explanation of the findings, as suggested by Guba and Lincoln (2005). By clarifying the stages of innovation adoption, the framework provides a detailed understanding of how innovations are adopted within social systems, offering both theoretical depth and empirical relevance. Recent advancements in technology assessment have further transformed the framework, evolving it from a tool for evaluating technology through quantitative and qualitative modelling techniques into a strategic planning resource that informs policy decisions regarding the adoption of new technologies. This evolution underscores the importance of participatory approaches to policy problem analysis, as highlighted by Musango and Brent (2011).

This framework integrates Rogers' (2003) Innovation Diffusion Model with Geels' (2002) Multi-Level Perspective (MLP) on socio-technical transitions, providing a structured approach to understanding the interplay between niche innovations, socio-technical regimes, and broader landscape pressures. Geels' MLP complements Rogers' model by incorporating a systems-level perspective, which is particularly relevant for analysing complex transitions in the energy sector (Geels, 2002). The MLP aligns with Rogers' emphasis on the dynamic interactions between technological innovations and their social contexts, thereby extending innovation diffusion theory to include macro-level socio-technical dynamics.

Additionally, the framework incorporates insights from Smith, Stirling, and Berkhout (2010), who highlight the role of innovation ecosystems in fostering the adoption of sustainable technologies. Their work underscores the importance of collaborative networks, knowledge sharing, and institutional support in driving innovation diffusion, aligning with the participatory approaches advocated by Musango and Brent (2011). Unlike Rogers' model, which focuses primarily on individual and social system-level adoption processes, this framework expands the analysis to include systemic and institutional factors shaping innovation ecosystems. By integrating these perspectives, the framework offers a more holistic understanding of the multi-faceted factors influencing innovation adoption in the energy sector, addressing a gap in existing frameworks that often overlook institutional and ecosystem-level dynamics.

The primary objective of this modified framework is to establish and validate the interrelationships among key elements critical to understanding and evaluating the sustainability of technology adoption. This approach incorporates technological advancement, sustainable development, and active system dynamics, as discussed by Musango and Brent (2011). The framework addresses limitations in existing models, such as the lack of integration between technological, social, and policy dimensions, as illustrated in Figure 2. By incorporating these elements, it enhances Rogers' (2003) model, providing a more comprehensive and nuanced understanding of innovation diffusion, particularly in renewable energy contexts. Theoretically, this research contributes to developing a decentralised energy production framework aimed at addressing challenges related to renewable energy adoption and enhancing technological innovation capacity.

Therefore, the theoretical framework not only provides a structured approach to analysing the findings but also supports the broader objectives of this research in promoting sustainable energy practices. By grounding the study in Rogers' Innovation Diffusion Model and recognising the evolving nature of technology assessment, this research positions itself as a pivotal resource for understanding the dynamics of innovation within the energy sector, particularly in the context of Bahrain.

The research findings significantly extend Rogers' (2003) Innovation Diffusion Model through empirical evidence from renewable energy adoption in Bahrain. They demonstrate how the stages of knowledge acquisition, persuasion, decision-making, implementation, and confirmation manifest in the energy sector, emphasising the role of communication channels and social contexts in accelerating adoption. This aligns with Rogers' focus on the interplay between innovation attributes and social systems while identifying contextual factors unique to Bahrain, such as regulatory frameworks and cultural attitudes towards renewable energy. The findings refine Rogers' model by introducing new variables, including policy incentives and stakeholder engagement, and redefining parameters to better reflect the empirical realities of renewable energy adoption in a developing context. These insights offer new theoretical and practical implications, particularly for tailoring innovation diffusion strategies to address region-specific challenges.

Furthermore, the research integrates insights from Musango and Brent (2011) on participatory technology assessment, enriching the theoretical framework. By incorporating participatory approaches, the research underscores the importance of stakeholder engagement in shaping innovation adoption processes. This integration bridges the gap between Rogers' diffusion model and contemporary perspectives on technology assessment, offering a more holistic understanding of innovation dynamics. These additions to the theoretical framework are not merely descriptive but represent a substantive contribution to the literature, as they provide new insights into how innovation adoption can be facilitated in complex socio-technical systems.

The research advances innovation theory by elucidating how the interplay between technological, social, and policy factors influences the diffusion of renewable energy technologies. While Rogers' (2003) model provides a foundational understanding of innovation adoption, this research extends the model by identifying specific mechanisms through which policy interventions and stakeholder engagement can accelerate the diffusion process. For example, the findings reveal that targeted policy incentives, such as subsidies and regulatory support, play a pivotal role in transitioning from the persuasion stage to the decision-making stage. This insight contributes to innovation theory by highlighting the importance of policy frameworks as enablers of innovation adoption, a dimension that is underexplored in Rogers' original model.

In addition, the research introduces a decentralised energy production framework, which addresses critical challenges related to renewable energy adoption. This framework builds on Rogers' (2003) model by incorporating elements of sustainable development and technological enhancement, as discussed by Musango and Brent (2011). By doing so, the research offers a structured approach to understanding how innovation management strategies can be tailored to promote sustainable energy practices. This represents a theoretical advancement, as it integrates sustainability considerations into the innovation diffusion process, thereby addressing a gap in the existing literature.

While the research has implications for energy policy, the primary focus of this section is on theoretical contributions. The findings underscore the importance of aligning innovation diffusion strategies with policy objectives, thereby bridging the gap between theory and practice. For instance, the research highlights how participatory approaches to technology assessment can inform policy decisions, enhancing the effectiveness of energy policies aimed at promoting renewable energy adoption.

However, this alignment between innovation theory and policy practice is presented as a theoretical contribution rather than a policy recommendation, ensuring that the section remains focused on advancing theoretical understanding.

The research makes a substantive addition to the theoretical framework presented in Section 2.8 by validating and extending Rogers' (2003) Innovation Diffusion Model through empirical evidence from the context of renewable energy adoption in Bahrain. Specifically, the findings validate the stages of innovation diffusion—knowledge acquisition, persuasion, decision-making, implementation, and confirmation—while also extending the model to include contextual factors unique to the energy sector, such as regulatory frameworks and cultural attitudes towards renewable energy. Furthermore, the research integrates insights from Musango and Brent (2011) on participatory technology assessment, enriching the framework by emphasising the role of stakeholder engagement in shaping innovation adoption processes. Additionally, the research introduces a decentralised energy production framework, which addresses critical challenges related to renewable energy adoption by incorporating elements of sustainable development and technological enhancement. These additions not only refine and expand the theoretical framework but also provide a more comprehensive understanding of innovation diffusion in the context of renewable energy, thereby addressing gaps in the existing literature.

Moreover, this research contributes to the theoretical framework presented in Section 2.8 by validating and extending Rogers' (2003) Innovation Diffusion Model through empirical evidence and integrating insights from Musango and Brent (2011) on participatory technology assessment. The research advances innovation theory by elucidating the role of policy frameworks and stakeholder engagement in accelerating innovation adoption, while also introducing a decentralised energy production framework that addresses critical challenges in renewable energy adoption. These contributions enhance the theoretical understanding of innovation diffusion and provide a foundation for future research in the field.

In the context of renewable energy, this model plays a significant role in the distribution of renewable energy solutions (Dearing and Cox, 2018). Utilisation of renewable energy sources such as wind, biomass, and hydropower has been recognised for a period of time (Mas'ud et al., 2018; Staniszewska, 2016). The decision-making phases outlined by the model are carefully analysed in the distribution of renewable energy within a society. Predominantly, the first binary phases, persuasion and knowledge, are vital in establishing social approval of innovative resolutions (Staniszewska, 2016). In the first phase, the concept is validated, and it is agreed that the public should acquire a fundamental understanding of renewable energy sources, their potential for application, and their benefits through data available in mass and print media (Dearing and Cox, 2018). Then, during the persuasion phase, the knowledge is explored, and data obtained from other operators of a given technology, particularly in establishing a prosumer civilisation, is promoted through innovation management (Ansari, 2013).

Understanding the adopter clusters and their role in the community is vital for endorsing renewable energy (Dearing and Cox, 2018). Individuals termed as initial adopters, who enjoy social trust and influence the community's perception, play a critical role (Karltorp, 2016). Studies indicate that experts, ecological and user firms, are trusted sources for energy-related information (Razak, 2014). Interestingly, findings suggest that political parties, the government, and local authorities have lower levels of trust (Mas'ud et al., 2018; Razak, 2014; Ansari, 2013; Karltorp, 2016).

It is essential to engage with individuals with high social trust throughout the process of educating the public about renewable. The use of incentives to accelerate community acceptance of resolutions is an important aspect of gaining social approval (Staniszewska, 2016). Selecting appropriate innovative tools supports the adoption of new resolutions during innovation management (Owen, Brennan and Lyon, 2018; Adepetu, 2014; Ansari, 2013). The innovation diffusion model applied in this thesis establishes the connection between disseminating renewable energy resolutions and innovation management. It reduces social opposition and enhances the efficiency of the diffusion process (Staniszewska, 2016).

The conceptual framework illustrates the relationship between the research variables. The dependent variable is innovation management in energy supply and production. The independent variables include centralised variables that would affect the dependent variable in the research. Predominantly, the control variables included the challenges that would affect the relationship between dependent and independent variables either positively or negatively. Therefore, the next step is the conceptual framework model (Figure 2) that illustrates the relationship between the research variables.

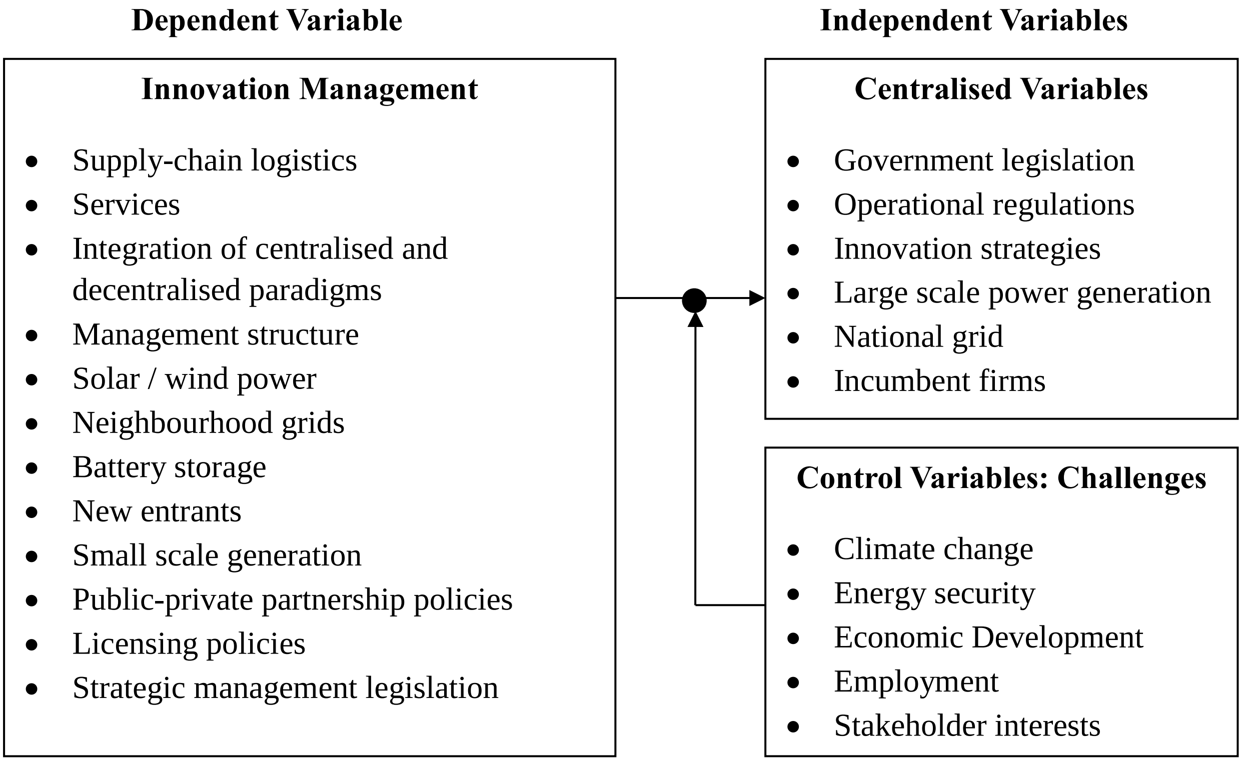


Figure 2: Conceptual framework

The independent variables in this research are the collection of challenges arising from both the centralised and decentralised approaches. These challenges include climate issues, energy security, economic development, employment attributes, and stakeholder interests. If economic development could only made possible through centralised model while such notion is not possible via decentralised or hybrid models, there is a need for supply chain logistic innovation. This will enable consumers to choose both centralised and decentralised models. As such, it also ensures that other types of models do not have any negative impact upon the national economy or organisation’s profitability. Furthermore, it should be emphasised that energy security may impede the implementation of innovations. On the other hand, energy security may be maintained through a slew of government and operational policies to reduce greenhouse gas emissions. Finally, factors affecting the nation's economy, such as the unemployment rate and inflation, may impede the implementation of innovative power generation models, further compounding the unemployment rate. This indicates that the independent and control variables may interact during the adoption of supply chain logistics innovations, the design of hybrid energy generation models, and changes in management structure to align with business models that support innovation. Therefore, effective innovation management will significantly and positively impact the design of diverse hybrid models used in energy generation (Wang and Singh, 2009).

The primary challenge for organisations when transitioning to non-conventional energy sources is to ensure cost-effective power generation while implementing green practices. For example, the Paris Protocol mandates air capture technology to reduce greenhouse gas emissions. Such a provision may impact large-scale electricity organisations, as the efficient production of non-conventional energy sources eventually demands fossil fuel-based energies. Under such circumstances, electricity organisations must invest in direct air capture technologies, which are potentially costly without the ability to justify their generated electricity to a broader consumer base. Furthermore, several studies have suggested that relying on non-conventional energy sources may diminish the nation's GDP (Staniszewska, 2016). The number of non-conventional energy consumers and prosumers would not increase in such conditions. As a result, Bahrain's electricity companies' profitability would be at risk due to the nation's GDP being a robust parameter for addressing the country's inflation and unemployment rate.

This conceptual framework would help to identify the important ideologies used to fully understand Bahrain's energy sector through either centralised or decentralised modes of energy production and management strategies. Bahrain's government has implemented several strategies to strengthen the country's energy sector. This research will use a variety of methodologies to determine the impact of employing centralised models in the energy sector. The adopted methodologies will gather information about renewable energy sources as well as their prospects in terms of enhancing sustainability for future generations.

The major challenges encountered by Bahrain's energy organisations, as well as the related innovation management they employ, are centred on the implementation of decentralised energy supply models, which the current research seeks to uncover. This is related to the production and distribution of non-renewable energy sources in preference to, or in conjunction with, renewable energy sources. The production and operation of Bahrain's energy companies are believed to have inherent benefits and drawbacks in both centralised and decentralised energy models, which will manifest in customer satisfaction and investor interests. Additionally, successful innovation management will result in profit for both private and public sector corporations. Although the present research did not explore the introspection regarding macroeconomic perspectives of innovation management in the power sector of Bahrain, the interviews may shed light on the impact of innovation management on Bahrain's economy in terms of GDP, interest rates, inflation, and unemployment rates.

2.9 Chapter Summary

This section has examined findings from past research that are related innovation management in energy organisations in the Kingdom of Bahrain. Using a conceptual framework, the research demonstrates the relationship between innovations and management in Bahrain’s energy sector, which is confronted by diverse challenges. Renewable energy, according to the research, is a promising novel solution in addressing the energy challenges these companies face, as well as the adoption of inefficient power distribution. However, companies in Bahrain's energy sector face several obstacles in pursuing renewable energy, including political barriers, investment constraints, resource-related issues, and technical challenges linked with renewable energy projects and innovative power distribution. The Kingdom of Bahrain has always and remain to be heavily reliant on fossil energy, which is a widely available resource in the country. Furthermore, many investors in the industry, including the government, have been attracted by its historical economic output. However, when examining current trends and influences in Bahrain's energy sector, it is evident that there has been a dynamic transition away from fossil fuels and towards more renewable forms of energy in order to foster a greener economy, lower production costs, and overcome the looming depletion of fossil fuels. Since non-renewable energy sources are recognised to have negative environmental consequences, companies have been at the forefront of environmental protection and conservation while simultaneously improving energy efficiency.

The research revealed that technical, resource-based, political, and investment failures are some of the challenges and barriers encountered by utility companies in Bahrain. The technical challenges stem from renewable energy being a relatively new field with limited job opportunities, particularly in the GCC countries. The country's energy sector faces many challenges, such as unfavourable policies for renewable energy pursuit. Moreover, oil and gas have traditionally received investment precedence over renewable energy sources due to the government's and the private sector's overreliance on and overfunding of the non-renewable energy sector.

Additionally, the industry also experiences distribution challenges, particularly in remote and marginalised areas where penetration and connection to the national grid are problematic. However, despite the issues stated above, Bahrain's energy consumption, similar to most Middle Eastern countries, is increasing. The demand is driven by population growth as well as the continuous establishment of industries and industrial enterprises with higher energy needs.

The major utility services in Bahrain revolve around electricity, water, and gas. The Ministry of Electricity and Water Affairs oversees the regulatory practices surrounding electricity and water distribution. On the other hand, private enterprises are primarily involved in the distribution of containerized gas, particularly in locations where the main utility line does not permeate. The national electricity grid distributes electricity generated from either renewable or non-renewable sources. One of the risks involved in the utility industry in Bahrain is the potential loss arising from the highly intensive capital necessary to build up new initiatives.

Finally, given the importance of innovation for utility companies in Bahrain, it is crucial for office-bearers and investors to have a thorough understanding of the current innovation strategies to develop successful energy-related policies. Energy and innovation management is therefore required. Proper innovation management will enable the government to devise an accurate policy framework that promotes renewable energy solutions that meet local demand. Such innovation may include transitioning from the existing, predominantly centralised utility approach towards more versatile neighbourhood power generation.

Chapter 3

3. RESEARCH METHODOLOGY

3.1 Introduction

The chapter outlines the research methodology of this research. It discusses the research philosophy, research design, population description, sampling methods, sample size, data collection, and data analysis used for this research. Additionally, considering the wide range of methodological approaches that can be adopted for this research, justifications for the methodologies will be presented. Additionally, suitability of the research strategy will also be presented.

3.2 Research Methodology

This research investigated whether innovation management is present in energy organisations within the Kingdom of Bahrain using a two-pronged approach. Phase I involved cross-sectional surveys and focus group interviews to collect primary data for analysis. Phase II employed case studies for secondary data analysis. In-depth interviews were conducted to validate the findings from the surveys, which seeks to determine the patterns in the approach of Bahraini energy companies towards innovation. This led to a further in-depth research that involved gathering qualitative data.

The proposed research is guided by epistemological and ontological paradigms, both of which are essential components of research philosophy. Ontology defines the research framework, while epistemology regulates the research questions that require responses (Raadschelders, 2011; Guyon, Juhel and Falissard, 2018). The purpose of adopting dual paradigms is that both will form an all-encompassing system of unified practice and thoughts that outline the nature of the research in regard to innovation management strategies in the electricity organisations. Indeed, each of these approaches provides a unique perspective on the development of innovation management knowledge in Bahrain's energy sector. The research employed a pragmatic research philosophy on the assumption that the facts and phenomena in innovation management are visible and tangible. However, the challenges that fostered innovation management may have remained latent, or the individual challenges may be evident while their interaction was possibly intangible or latent (Morgan, 2014). Accordingly, the pragmatist perspective of integrating an objectivist philosophy from an ontological standpoint and an interpretive philosophy from an ontological and epistemological position appears to justify the method of examining innovation management within the Bahrain's energy sector (Antwi and Hamza, 2015). Interpretivism plays a significant role in the interpretation of the elements of innovation management and Bahrain's energy sector (Soss, 2015).

3.3 Research Design

3.3.1 Research Methodology

In studies of this nature, no single methodology can achieve an ideal balance between the depth of analysis and the breadth of scope. Practical limitations, such as constraints in accessing participants, influenced the choice of research methodology. This research deployed a methodological triad, integrating both primary and secondary data on innovation management, which were subjected to interpretive analysis (Saunders, Lewis, and Thornhill, 2003). A thematic approach was then used to conduct a comprehensive analysis of case studies of innovation management in energy companies in Bahrain (Şahin and Öztürk, 2019).

The analysis of secondary data aimed to complement the primary data analysis. The validity of the findings and the reliability of the research were both confirmed to be high due to the implementation of a mixed methods research design. This design enabled the researcher to gain a more nuanced understanding of the relationships between innovation management variables in the Bahraini energy sector (Creswell and Plano Clark, 2011).

Primary data were collected and examined through a mixed methods design that encourages inductive reasoning, allowing the researcher to mitigate the limitations associated with both qualitative and quantitative data collection and analysis methods (Tashakkori and Teddlie, 2010). This methodological synergy enhances the robustness of the findings and enriches the interpretive depth of the analysis.

Guyon Juhel and Falissard (2018) argue that, from a philosophical standpoint, mixed methods research combines research paradigms that encompass both deductive and inductive perspectives, enabling investigators to integrate model generation and assumption testing within a single project. This mixed method design was adopted in this research as it can produce more valid and representative results compared to methodologies that rely solely on either qualitative or quantitative approaches (Bryman, 2006). Mixed method research is likely to provide a more rounded evidence base, thereby increasing the validity of the findings (Johnson, Onwuegbuzie, and Turner, 2007). This is because the mixed methods approach is based on a pragmatist perspective, providing a more effective way to address the research questions posed in this study (Morgan, 2014). Utilising a mixed methods research approach helps to overcome the inherent limitations of qualitative and quantitative methods when used alone. Furthermore, incorporating qualitative findings enhances the interpretability of results obtained from quantitative research, with qualitative methods used initially to inform and advance the quantitative research process (Greene, Caracelli, and Graham, 1989).

Mixed methods research designs balance the limitations and strengths of both qualitative and quantitative approaches (Axinn and Pearce, 2006), thus enhancing the validity of inferences drawn from the analysis. The main benefits of analysing these two types of data include developing contextualized and detailed insights from qualitative data while inferring a level of generalisation from quantitative data (Flick, 2018).

In this research, the mixed methods approach enables a more comprehensive exploration of the relationships among innovation management variables in Bahrain's energy sector. Integrating different data types enables the strengths of one data source to compensate for the limitations of another, resulting in a more comprehensive and detailed understanding of the phenomenon being studied (Creswell, 2014). Using both quantitative and qualitative data collection methods, based on a pragmatist epistemological perspective, allows for a comprehensive addressing of the complexities of the research problem (Teddlie and Tashakkori, 2009).

The mixed methods design not only enhances the depth of the analysis but also offers broader insights into the research topic than what would be achieved through a single data collection and analysis method. Combining different research methods allows researchers to develop a more nuanced understanding of the issues at hand (Creswell, 2012). This approach was considered particularly beneficial in capturing the various aspects of innovation management within Bahrain's energy sector (Yin, 2017).

Integrating both quantitative and qualitative methodologies is a well-recognised approach in academic research, enabling researchers to leverage the strengths inherent to each methodology (Choy, 2014). In this research, the mixed methods design facilitated the integration of qualitative data analysis, theoretical insights, and quantitative data analysis. The combination of quantitative statistical methods and qualitative interpretive methods, supported by a single theoretical framework, enables the development of an understanding of the lived social reality of the Bahraini energy sector while identifying the critical elements of innovation management within its composite organisations (Patton, 2015).

The utilisation of a mixed methods research design permits the aggregation of evidence that can be effectively elucidated through the lens of a theoretical framework, namely the SPOTS model. This model allows for the comparison of diverse datasets related to a specific subject, aiding in gathering insights from distinct and varied groups and uncovering the features of the organisational innovation process from multiple viewpoints (Choy, 2014). Utilising various research methods not only enhances the credibility of the results but also enhances comprehension of the intricate array of social phenomena associated with innovation management (Maxwell, 2012).

The reason for selecting this research design is that the survey method is the primary approach for data collection. As noted by Şahin and Öztürk (2019), surveys employ scientific sampling approaches and meticulously constructed questionnaires to ascertain the characteristics and perceptions of a given population with statistical precision. Consequently, the survey questions were meticulously crafted to correspond with the research goals and the fundamental theoretical framework (Fowler, 2014).

Participants received survey questionnaires, followed by participation in subsequent interviews to thoroughly gather their perspectives and opinions.

Interviews are a valuable means of obtaining in-depth insights into complex social issues and delicate subjects, facilitated by the interaction between the interviewer and interviewee (Kvale, 2007). This interaction not only enriches the interpretive depth of the hard data collected through surveys but also enhances the researcher’s understanding of the respondents' lived experiences and viewpoints (Rubin and Rubin, 2012). Through the integration of quantitative and qualitative methods, this study seeks to attain a comprehensive understanding of the subject matter.

In summary, this research employed a mixed-methods approach, integrating both quantitative and qualitative data to comprehensively explore innovation management in Bahrain’s energy sector. The quantitative data collected through surveys enabled the testing of relationships between innovation variables, providing measurable insights and generalisable trends (Field, 2013). Meanwhile, qualitative data from interviews allowed for an in-depth exploration of the context behind these relationships, offering richer, more nuanced insights into stakeholder experiences (Braun and Clarke, 2006). Additionally, secondary data from governmental reports and industry literature complemented these findings by providing background context and validating the primary data (Bowen, 2009). This integration of data sources enhanced the ability to address the research questions holistically, merging broad statistical insights with detailed contextual understanding.

3.3.2 Quantitative Research Methodology

The collected quantitative data was based on innovation management variables generated through Bahrain’s energy production. A questionnaire with closed-ended questions was used to collect the subjective responses of the participants (n = 100). Close-ended questions allow the focus on innovation management (Bahrick, 2017). Such approach saved both time and resources of the relevant parties. The questionnaire responses were in the form of a 5-point Likert scale, with the alphanumeric value of "1" indicating "strongly disagree" and the alphanumeric value of "5" indicating "strongly agree". These responses were not only analysed using descriptive statistics such as mean and percentages but also dummy variables to conduct inferential statistics such as correlation and regression analysis. The closed-ended questions probed both the challenges and innovative management strategies seen in Bahrain's energy sector from the stakeholders' perspective. Nonetheless, due to the nature of the research, which required close-ended questions, the results were either biased or insufficient in describing the cause-and-effect relationship between the challenges and innovations seen in Bahrain's energy sector. The primary data analysis aspect, which relied on open-ended questions and interviews, increased the chances of discovering relevant cause-and-effect relationships between additional validity and qualitative analysis.

3.3.3 Qualitative Research Methodology

Qualitative research is primarily used in social sciences, whereas operational management research aims to establish the latent causal variables underlying a certain phenomenon, which are usually intangible. Therefore, it is plausible to suggest that qualitative studies assist the scholars and policymakers to understand innovation management by having an in-depth analysis of the cause-and-effect relationships, although quantitative approaches dominate in describing the extent of the referred relationships (Bullock, Little, and Millham, 2017). As presented in the Table 1 below, 10 participants with varied professional designations from the targeted energy sector participated in the current research's interviews. They were encouraged to share their lived experiences and opinions regarding the challenges that Bahrain's energy sector is facing with the renewable energy transition, as well as the innovations that were being adopted to overcome these difficulties. The interviews were coded and analysed thematically using NVivo software.

Table 1: Interview Participants

Position held	No. of participants
Chief Executive Officer	3
Operations Managers	2
Production Managers	3
Human Resource Managers	2

The research design was underpinned by the ontological position of objectivism and "the epistemological stance of interpretivism" (Guba and Lincoln, 2005). This is because the research asserts that realism is connected to innovations implemented in Bahrain's power-generating sector, which can also be accessible using tangible objective parameters. In contrast, the objective parameters associated with innovation were influenced by various latent variables related to insecurities about profitability, legal sanctions, and political unrest. Objective approaches cannot discern stakeholder interests. Therefore, a pragmatic approach was used to evaluate the research results pertaining to the innovations in Bahrain’s energy sector, which came directly from the participants' subjective responses on their perspective about innovation management. The interview was designed to investigate Bahrain's energy sector's preparedness for innovative decentralised models of power generation and distribution, as well as facilitators and barriers to the necessary innovations for transitioning to the new business models of electricity generation.

As a result, an exploratory mixed-method research design seemed most appropriate since it would help to identify the special characteristics of innovation and knowledge management that are present in Bahrain's power sector. Despite this current research focus, there has been little to no investigation, and therefore there is no evidence of innovation management and its significance to Bahrain's energy sector. Consequently, research methodologies and theories, such as the innovation theory previously used to investigate innovation management in energy sectors in general, were also applied in this research to investigate the energy sector in Bahrain. A deductive strategy was considered most appropriate, as it focused on general observations that were applied to the specific case of Bahrain's energy sector. (Benitez-Correa, Gonzalez-Torres and Vargas-Saritama, 2019).

The research used data triangulation. Data obtained through this process relates to empirical findings inherent to innovation management in Bahrain's energy sector, while the secondary data comprises reports from the government, contractors, and consultants, which are evidence-based literature and industry white papers relevant to innovation management in the energy and power sectors globally. Furthermore, secondary data includes existing concepts and structures of innovation management in other non-energy sector since they would facilitate the benchmarking of innovation management in the energy sector generally as well as in the energy sector of Bahrain

(Nasiri, Alleyne and Yihui, 2016). The exploratory mixed-method approach is based on both quantitative and qualitative responses from participants, allowing an approach that comparatively provides increased robust validity (Heesen, Bright and Zucker, 2016). The qualitative and quantitative primary data will be analysed along with secondary data obtained from industry white papers and published literature. Such measures increased the rationality of the findings of the present research.

A case research approach was used based on Bahrain's energy sector. A case research was utilised to advance new models, expand on current theories, and challenge outdated theories. A case research is a typical qualitative research since it does not depend on numerical information and statistics to answer a research question. Case studies were explored from Bahrain's energy sector, which raised the credibility of the findings and minimised the possibility of prejudice. Since the primary data analysis included both quantitative analysis of subjective responses and qualitative analysis of focused group interviews, a mixed methodology seemed most appropriate for primary data analysis. The extant literature on research methods indicates that mixed-methods research facilitates a comprehensive and conclusive response to the research questions, particularly if particular cause-and-effect relationships remain latent at the end of the research (McCusker and Gunaydin, 2015). From that perspective, in addition to desk research, which allowed access to information from peer-reviewed journals that publish literature on innovation management, as well as other similarly credible studies on innovation management and representations of relevant subjects, this thesis also conducted surveys and interviews to generate and collect primary data that is more substantive and representative.

The advantages of a combined research approach were identified. The qualitative phase provided insights into having better-contextualised measures for unravelling the cause-and-effect relationship between various latest constructs in an in-depth manner and tracking the innovation management process (Merriam, 2002). During the survey data analysis, a pattern concerning how Bahraini energy companies managed their innovations emerged. Therefore, this emerging pattern prompted an in-depth research that involved collecting qualitative data. Quantitative phase was conducted to get distinct and unique perspectives for validation, establish comprehensive knowledge, and thoroughly examine the statistical findings (Gelo, Braakmann, and Benetka, 2008). Furthermore, the second phase was designed to evaluate the strength of the connection between the elements of the innovation management process, including ideation, collaboration, implementation, and value creation, and the long-term sustainability of Bahrain's energy sector.

To support the research survey and interviews, a questionnaire survey was used to systematically collect data from the respondents and their thoughts, preferences, and behaviours (Parffit, 2013). The essential information gathered using the appropriate methods was subjected to both quantitative and qualitative analyses. The questionnaire used Likert scale questions to evaluate innovation management in Bahrain’s energy sector as the foundation for the collected quantitative data. Therefore, the questionnaires contained only closed-ended questions. Meanwhile, open-ended questions were used to elicit qualitative data from the participants and were also measured using the Likert scale (Coderre et al., 2004). Thematic analysis was used to analyse the qualitative data collected through open-ended questions. The close-ended questions helped the research to maintain focus on innovation management, while the open-ended questions and interviews allowed for an in-depth exploration of the cause-and-effect relationship between numerous latent constructs of the innovation management process and challenges within Bahrain's energy sector (Husain et al., 2012).

The research utilised 100 participants who responded to the survey about innovation management in Bahrain's energy sector. The research participants included managers, employees, and senior management. Interviews were conducted with four managers and six workers of an electricity company to thoroughly understand the attributes associated with adopting innovation management. In the research, both interviews and questionnaires were used because the strengths of one of the research tools compensated for the deficit of the other research instrument (Burcu, 2000). The questions would vary depending on the responses to the questionnaire. Open-ended questions were used to collect qualitative data during the interview. Qualitative data from the interviews were analysed to ensure their validity and quality. Thematic analysis was conducted to support and cross-examine the results of the qualitative evaluations (Tang et al., 2022). Valid and reliable data were obtained by combining quantitative and qualitative data. The research largely utilised themes and variables relevant to the research objectives that focused on innovation management and Bahrain's energy sector.

3.3.4 A Brief on the Data Collection and Analysis Process

The collection of both quantitative and qualitative data was conducted over a four-month period, from February 2022 to June 2022. This process involved the use of questionnaires, interviews, and secondary source research. Data analysis was carried out using NVivo and SPSS software, which facilitated the organisation and interpretation of the data. For the qualitative analysis, the Gioia model was employed, allowing for the examination of three aggregated dimensions: (i) current trends and key influences in the Bahraini energy sector, (ii) the challenges faced by the sector, and (iii) the innovation management strategies implemented by energy organisations. The interplay between primary qualitative and quantitative data effectively addressed the research questions concerning innovation management strategies within the Bahraini energy sector.

Qualitative data underwent thematic analysis, while quantitative data were analysed statistically. Specifically, the responses from the questionnaire survey were evaluated using SPSS, employing both descriptive and inferential statistical methods to analyse the closed-ended questions. This mixed-methods approach is grounded in the premise that combining qualitative and quantitative methods significantly enhances the understanding of the research problem. This aligns with Creswell's (2012) assertion that integrating diverse analytical techniques allows for a more comprehensive exploration of complex research questions. Additionally, Bryman (2016) emphasises that mixed-methods research can bridge the gap between numerical data and contextual insights, providing a more holistic understanding of the research problem.

The research focuses specifically on energy technology, with an emphasis on solar panels, and investigates the innovation management practices essential for advancing and implementing sustainable energy solutions in the Kingdom of Bahrain. This concentrated analysis of technologies such as solar panels and smart grids facilitates a nuanced understanding of the dynamics of innovation. It also allows for a comprehensive assessment of the impact of these innovations, particularly in evaluating how specific energy technologies influence the energy sector and broader society, encompassing environmental, economic, and social dimensions (Yin, 2019). According to Rogers (2003), the adoption of innovative technologies is often influenced by their perceived relative advantage, compatibility, and complexity, which aligns with the findings of this study.

By concentrating on technology, the research provides stakeholders with practical insights to guide decision-making processes. This focus not only deepens the understanding of the interplay between innovation and energy technologies but also highlights the significance of these technologies in shaping sustainable energy practices. The implications of this research extend beyond theoretical contributions, offering valuable insights for policymakers and industry leaders aiming to develop green energy initiatives in Bahrain and similar contexts (Tidd, 2001; Yin, 2019). Furthermore, the role of policy frameworks in fostering innovation has been widely acknowledged, with studies such as those by Lundvall (2016) highlighting the importance of institutional support in driving technological advancements.

The integration of quantitative, qualitative, and secondary data played a critical role in addressing the research questions. Quantitative data, collected through questionnaires and analysed using SPSS, provided measurable, statistical insights into innovation management strategies within the Bahraini energy sector. This data offered a comprehensive understanding of how various innovation management practices are perceived and implemented by stakeholders, quantifying responses to elucidate the prevalence and effectiveness of specific strategies (Creswell, 2012). According to Saunders, Lewis, and Thornhill (2019), quantitative data is particularly useful for identifying patterns and trends, which was instrumental in this study.

In contrast, qualitative data gathered through interviews offered a deeper understanding of the research questions. These interviews, analysed using NVivo and the Gioia model for thematic analysis, enabled the exploration of specific challenges, trends, and innovation management strategies in greater detail. This qualitative data was crucial for understanding the human, organisational, and strategic influences on innovation, offering rich perspectives that quantitative data alone could not capture. It contributed significantly to the research questions by examining the personal and organisational factors that drive or hinder innovation in the energy sector (Gioia, Corley, and Hamilton, 2013). As noted by Miles, Huberman, and Saldaña (2014), qualitative data is invaluable for uncovering the underlying motivations and contextual factors that shape organisational behaviour.

Additionally, secondary data from sources such as government reports, industry publications, and academic literature provided a broader context for the findings derived from primary data. This secondary data played a vital role in validating and supporting the conclusions drawn from both quantitative and qualitative analyses. It also offered essential background information, enabling the study to investigate the impact of innovative technologies, such as solar panels and smart grids, on the Bahraini energy sector. By integrating secondary data, the research ensured a comprehensive assessment of how these technologies influence environmental, economic, and social dimensions, thereby enriching the overall findings (Yin, 2019). The use of secondary data is particularly beneficial for triangulation, as it enhances the credibility and reliability of the research findings (Saunders, Lewis, and Thornhill, 2019).

The combination of quantitative, qualitative, and secondary data provided a thorough and well-rounded exploration of the research questions, enabling the study to present both breadth and depth in its analysis of innovation management strategies within the Bahraini energy sector. This multi-faceted approach ensured that the research questions were addressed comprehensively, with each type of data contributing unique insights that collectively enhanced the robustness of the findings.

In summary, this comprehensive data collection and analysis process not only enhances the reliability and validity of the findings but also ensures an in-depth exploration of the critical factors influencing innovation management in Bahrain's energy sector. The integration of qualitative and quantitative data strengthens the research, providing a solid foundation for informed recommendations and strategic decision-making (Creswell, 2012; Tidd, 2001; Yin, 2019).

3.4 Research Participants

In order to obtain sufficient information to produce quality data, a random sampling technique was employed to select the research participants. These participants comprise all staff workers and senior management involved in the innovation management within the case research companies. The rationale for using simple random sampling techniques was to prevent any potential bias that might arise during sample selection. The research components deemed necessary to obtain data findings in response to the research questions about innovation management and Bahrain’s energy sector are all included in accordance with the definition of research participants set out by Clarke (1994). As previously stated, this research included two separate sets of data on innovation management to ensure the collection of sufficient data from the respondents. Firstly, 100 participants working in energy organisations in Bahrain participated in a survey. Secondly, interview questions based on an interview guide were used to conduct interviews with ten stakeholders in Bahrain's energy sector. The qualitative data from the interviews was chronologically arranged and organised with the help of NVivo. Descriptive and inferential statistics were employed to examine the quantitative data from the closed-ended questionnaires.

The purposive sampling technique was employed to obtain six employees aged at least 21, with four supervisors participating in the interviews. The purposive technique enabled the collation of a substantial amount of information from the collected data, thereby further clarifying the influence that the sampled population has on the research findings concerning innovation management strategies in Bahrain's energy sector. This age group was deemed suitable for this research as they had interacted with the firm's innovation management. The participants were selected from state-owned utility companies and contractors on energy projects. This brought the total number of respondents to 100. The adequacy of the data was determined using a reliability test analysis. All 100 participants were essential to the research, and they provided their responses freely and willingly, adhering to the consent form's guidelines.

Table 2: Questionnaire Participants

Respondents	Sampling Technique	Total
Staff workers/Members	Simple Random Sampling	100

Table 3: Interview Participants

Respondents	Sampling Technique	Total
Chief Executive Officer	Purposive sampling	3
Operations Managers	Purposive sampling	2
Production Managers	Purposive sampling	3
Human Resource Managers	Purposive sampling	2
Total		10

3.5 Research Strategy

After the participants submitted their questionnaires, all 100 filled-out questionnaires were deemed valid. Before the survey, participants were given detailed information on the nature of the research, their involvement, and key ethical concerns. The findings of the primary and secondary data analyses were used to arrive at definitive responses to the research questions addressed in the research. A qualitative strategy was first applied, followed by a quantitative strategy to validate the research results regarding innovation management.

The National Energy Efficiency Action Plan (NEEAP) initiatives in the Kingdom of Bahrain were analysed to understand the role of innovation in mitigation the challenges. The installation of solar panels on school roofs and district cooling projects were potential projects that required investigation. The NEEAP was selected because it encompasses Bahrain's commitments, baselines, key indicators, national energy efficiency targets, energy savings, and initiatives, thus providing the research project with the requisite volume of data to allow a response to the devised research questions.

3.6 The Research Locale: Principle Guiding Case Research

The case research details the activities of Bahrain's energy sector. It accounts for the sector’s electricity generation and distribution activities and is prepared to address the challenges of providing electricity services in the wake of decentralised power alternatives. Furthermore, the degree to which electricity organisations have transitioned to non-conventional forms of energy production, such as solar and wind power, as well as the extent to which innovative strategies have been implemented, serve as indicators of Bahrain's energy sector's ability to effectively address the challenges presented by the adoption and use of non-conventional energy sources.

Bahrain's energy sector has embraced key resources and made business decisions to transition towards non-conventional energy generation models, recognising that the success of adopting such sources goes beyond their profitability levels (Luciani, 2014). Bahrain’s energy sector has also implemented supply chain logistics modifications and innovation management dynamics to attain maximum energy production. Furthermore, the case research was useful for this research as it highlighted the innovation management benchmarks for Bahrain's energy sector as a means of addressing the operational and organisational challenges, the detailed challenges confronted while transitioning to decentralised and hybrid models of power generation, and the successful innovation management strategies that Bahrain's energy sector has implemented during the transition to decentralised and hybrid models of power generation. This is particularly relevant regarding profitability, job creation, adherence to legal restrictions, and the long-term viability of creative business models. The present research employs a case research strategy and analyses two cases in the Bahrain region because such a design may maximise the available financial and temporal resources by committing them to a specific case.

Potential research areas include solar power generated from panels on school roofs and district cooling projects, which are examples of establishing a decentralised model that addresses the problem of renewable energy and sustainability. The NEEAP projects will be examined because this research needs to be based on an existing body of information to fulfil the research criteria (Yin, 2003), negating the need to get additional information from consultant companies such as PwC and KPMG. Some of the categories of information are readily available include national commitments, key indicators, baselines, energy initiatives, energy conservation, and national targets for energy efficiency.

Any major research project needs to be properly situated within the field's existing literature while simultaneously emphasising the significance of the data and its conclusions (Sharp, Peters and Howard, 2017). Additionally, researchers should be prudent when extrapolating conclusions from a single case research (Yin, 2009). Accordingly, in addition to the data-building advantages provided by the author's personal connections, this thesis implemented a case research method to maximise the benefits of available resources and the research outcomes.

3.6.1 The Solar Panel Project

Bahrain's solar panel project, which is part of the country's energy sector, may generate 5–6.8 $kWh/m^2/day$ over an area of 720 km2 both in the winter and the summer (Zawya, 2020). As a result, the government of Bahrain has concentrated on installing solar panels in a few selected schools. The design of the project heavily relies on green structures, which are built with cutting-edge designs that successfully conserve energy, ensuring their sustainability. The green buildings that include solar panels that can generate up to 3MW, which meet the schools' energy needs, including powering air conditioners. As a result, the overall energy consumption of school buildings has decreased by 30%, resulting in significant savings (Emco, 2020).

Ultimately, Bahrain benefits exponentially from such solar projects. Petra A solar plant installed by Petra Power in Bahrain produces more than 8,300 MWh of renewable energy, thereby offsetting 6,700 Mcf of natural gas and reducing CO2 emissions by 7,200kt annually (SEU, 2020). These solar panels utilise cutting-edge micro-inverter technology and a wireless network for enhanced system monitoring and operation. The system will work optimally for at least 20 years. Furthermore, the adoption of solar technology is rapidly gaining popularity worldwide as a sustainable and environmentally friendly energy source. During the project, several job opportunities were created, and the professional expertise and experience gained after the project's completion strengthened Bahrain's position as a vital centre for smart energy in the region (Chaudhry et al., 2009).

Bahrain's non-industrial sector has seen a 6.6% increase in electricity consumption, which has significantly strained the nation's energy system (Jangsten et al., 2020). Presently, Bahrain generates most of its electric energy from non-renewable sources such as natural gas and fossil fuels, which are rapidly depleting. Furthermore, using non-renewable fuels to generate energy results in significant carbon emissions. More than 20% of Bahrain's carbon emissions are caused by non-industrial energy consumption, thus being a direct result of electricity generation (Meed, 2020).

The combustion of fossil fuels in Bahrain will almost certainly double within the next five years, given the 10% growth in demand for electricity (Johnsson, Kjärstad, and Rootzén, 2019). Although solar energy is a viable alternative to non-renewable energy sources, a primary reason for such systems' inefficiency is the limited cleaning performed on them, as most installations are done on rooftops (Tsigkas and Panaras, 2020). Dirt accumulation on the panels diminishes solar absorption by 40% (Dincer and Abu-Rayash, 2020; Evwind, 2015). Furthermore, the inefficiency of the PV panels can be attributed to the region's frequent sandstorms, which cause decreased vision and higher dispersion of solar radiation, resulting in energy losses.

3.6.2 The District Cooling Project

The district cooling system, which is part of Bahrain's energy sector, is focused on the centralised generation and distribution of cooling energy. An underground insulated pipeline, in particular, distributes chilled water, decreasing the internal temperature of buildings. This is especially beneficial during the summer. The Bahrain Financial Harbour and the World Trade Centre are two buildings are benefited from the district cooling system. The system, installed 12 metres underground, has a refrigeration capacity of 22,800 tonnes and may save up to 50% more energy than standard cooling systems. In addition to greater energy efficiency, the system is ecologically friendly, and the design preserves the aesthetics of the structures (Rezaie and Rosen, 2012).

Moreover, the system is do not produce noise, unlike traditional air conditioning units. Most importantly, the condenser system uses seawater to cool rather than alternative systems that utilise treated sewage water or freshwater, which is crucial given Bahrain's limited water supplies (Rezaie and Rosen, 2012). Furthermore, the district cooling plant is positioned in Bahrain Bay next to the sea, successfully meeting the system's requirement for large amounts of water.

However, the plant's location is undoubtedly the most challenging aspect of the project. The majority of Bahrain's industry and population are concentrated along the coastline. 11% of Bahrain's coastland is predicted to be submerged under the seawater by 2050 due to the rising sea levels (Rezaie and Rosen, 2012). Furthermore, the plant's location has contributed to a rise in underground water salinity, damaging the population's water supplies and the soil. Another challenge is that the coastal water line drops dramatically during low tides, which reduces the plant's effectiveness. It is also significantly difficult to dispose of waste water due to the high temperatures generated by the heat exchangers, which can destroy marine life if released without adequate treatment.

The project adheres to the ideals of decentralisation theory; the government has permitted numerous stakeholders to design and execute the planned activities. For example, the Ministry of Works (MoW) and Municipality Affairs were tasked with building Bahrain's largest school. The school was handed over to the Ministry of Education upon its completion. This model demonstrates that decentralisation allows each entity involved in the project to retain the right to carry out its mandate without interference from other stakeholders.

Finally, the project follows the NEEAP recommendations whereby its objective is to achieve energy efficiency by prioritising renewable energy, as stipulated in Bahrain's Economic Vision 2030. The project is anticipated to become essential in promoting the implementation of sustainable energy initiatives because the aim of the vision is to achieve modernization through development of new infrastructures. Similarly, the district cooling project has contributed in the reduction of carbon dioxide emissions, improved energy efficiency by reducing peak electricity demand, promoted innovation, and implemented energy performance standards. These components adhere to the NEEAP tenets and aim to ensure that Bahrain achieves energy sustainability in the coming years. With the government working diligently to reduce energy consumption, such initiatives are a step in the right direction, as evidenced by the subsequent reports.

3.6.3 Government, Contractors, and Consultants Reports

The Bahrain government has encouraged residents to embrace renewable energy sources such as solar (Shareeda, Al-Hashimi, and Hamdan, 2021). In 2017, the cabinet created and released the first national renewable action strategy (Alsabbagh, 2019a). The strategy included employing renewable energy by connecting solar photovoltaic cells to government-built residential units. The strategy and plan resulted in the establishment of the first company that manufactures photovoltaic panels. The government has also implemented a net metering regulation to govern solar installation projects in residential units.

The government's goal is to generate 5% of electricity from renewable energy sources such as solar energy by 2025. (Salam and Khan, 2018). The government has signed the Paris Climate Accord in 2016 and was the first nation to endorse it. The renewable energy plan aims to achieve 10% of the main grid's power supply by 2035 (Sharvini et al., 2018). Due to the high intensity of sunlight permeating the country, a lot of attention is being paid to the development of solar panels. Bahrain receives 9.2 hours of sunlight daily, according to "Bahrain's Electricity and Water Authority" (Sieghart and Sarkar 2013). According to the Gulf Research Centre, Bahrain has sufficient sunlight to generate 33 TWh of solar energy annually. Bahrain and the UN Development Programme signed an agreement in 2014. The UN Development Programme acts as a consultant for the government and citizens of the country. The agreement called for developing a sustainable energy unit to aid in developing a mix of sustainable energy sources to meet the current and future needs. The organisation employs a wide range of professionals that provide guidance on solar installation and provide a clear roadmap to realising the country's vision. In 2017, Bahrain employed an Italian consulting firm and the engineering company "Centro Elettrotecnico Sperimentale Italiano (CESI)" to support the SEU project while creating the technical and legal requirements needed to connect the distributed renewable energy to the primary power grid.

3.7 Data Collection

The initial data was collected using the internal analytics tools provided by Google Forms, which were primarily used to identify the key trends visible in the survey and to determine whether any connections existed between any of the trends, as well as the extent of the demographic variables accounted for any particularly prominent trends (Abd Halim et al., 2018). In general, questionnaires are used to validate the results obtained through interviews. Nonetheless, the significant limitation of data obtained from survey is that they are often descriptive (Siedlecki, 2020). However, the proposed research methodology would validate the results presented in cross-sectional questionnaires by employing in-depth examination through interviews. The analysis of the survey data revealed a pattern of innovation management from the energy companies in Bahrain. Thus, the process enabled improved representativeness by not being unduly isolated or based on an extremely limited sample. The process generated relevant data as the interviews were structured based on substantial diagnostic insights acquired from the questionnaire responses (Neuman, 2006). This combined data-gathering approach could potentially produce significant data that would have been overlooked during a structured interview process (Saunder et al., 2007).

The research adopted an interview-based approach, assuming that the interviewer had a flexible set of questions (Saunder et al., 2019). The objective was to ensure consistency and gather the required data during the interview sessions. There are ten interviews being conducted and their transcripts are included in the appendix.

The interviews were done with nine (9) key informants and one (1) non-key informant as shown in Table 3, illustrated on p. 85. The purpose of collecting such data is to have a better understand of the emerging pattern of innovation management in Bahrain’s energy sector. The interviews were held at the respondents' respective workplaces and recorded using a smartphone's voice memo feature. Concurrently with the interview process, data was collected via observations and pertinent documents, including documentary sources, reports, press releases, and publications related to the case research projects. The interviews were all recorded, transcribed, and presented to the respondents after the sessions were over to allow them the opportunity to check the accuracy of the transcriptions.

Moreover, they also enhanced the researcher's capacity to comprehend the responses to particular questions and how the respondents arrived at their conclusions regarding innovation management and Bahrain’s energy sector (Secor, 2010). The second phase of data collection was a survey, which consisted of a questionnaire distributed to individuals working in Bahrain's energy sector. Questionnaires were distributed to 100 participants, and all of the participants responded. The questionnaire was designed to determine the challenges that Bahrain's energy organisations were experiencing.

The questions were developed by focusing on the entire questionnaire being sufficient to be able to steer the research to a logical conclusion and, above all, to ensure that the modified form would address the possible concerns of innovation management in energy production within Bahrain. The survey was conducted online, which allowed for the use of a broad range of question structures, such as yes/no, short answer, Likert-scale type 'strongly agree (SA)/strongly disagree (SD)' ranged responses, sliding scales, and tabulated options. The design of the survey allowed the respondents to be directed to other questions based on their responses. Before conducting the in-depth interviews, the online questionnaire results were analysed from a systematic process perspective (Hall, 2006). As a result of the survey data analysis, a pattern concerning how Bahraini energy companies managed their innovations emerged. This sequential measure was designed to validate the research findings and ensure that the interview questions were adequately prepared. The interview method was based on the interview technique instead of structured or unstructured interviews.

3.8 Data Analysis

The interview questions were developed based on the survey data. Subsequently, the trends observed in the survey data were used to validate a content analysis strategy for the interview transcripts. The analysis of the survey data revealed a pattern concerning how Bahraini energy companies managed their innovations. NVivo analysis was therefore employed to analyse the qualitative data from transcripts. The Gioia model was developed as per the guidelines provided by Gioia, Corley and Hamilton (2013), as shown in the Figure 3 below:

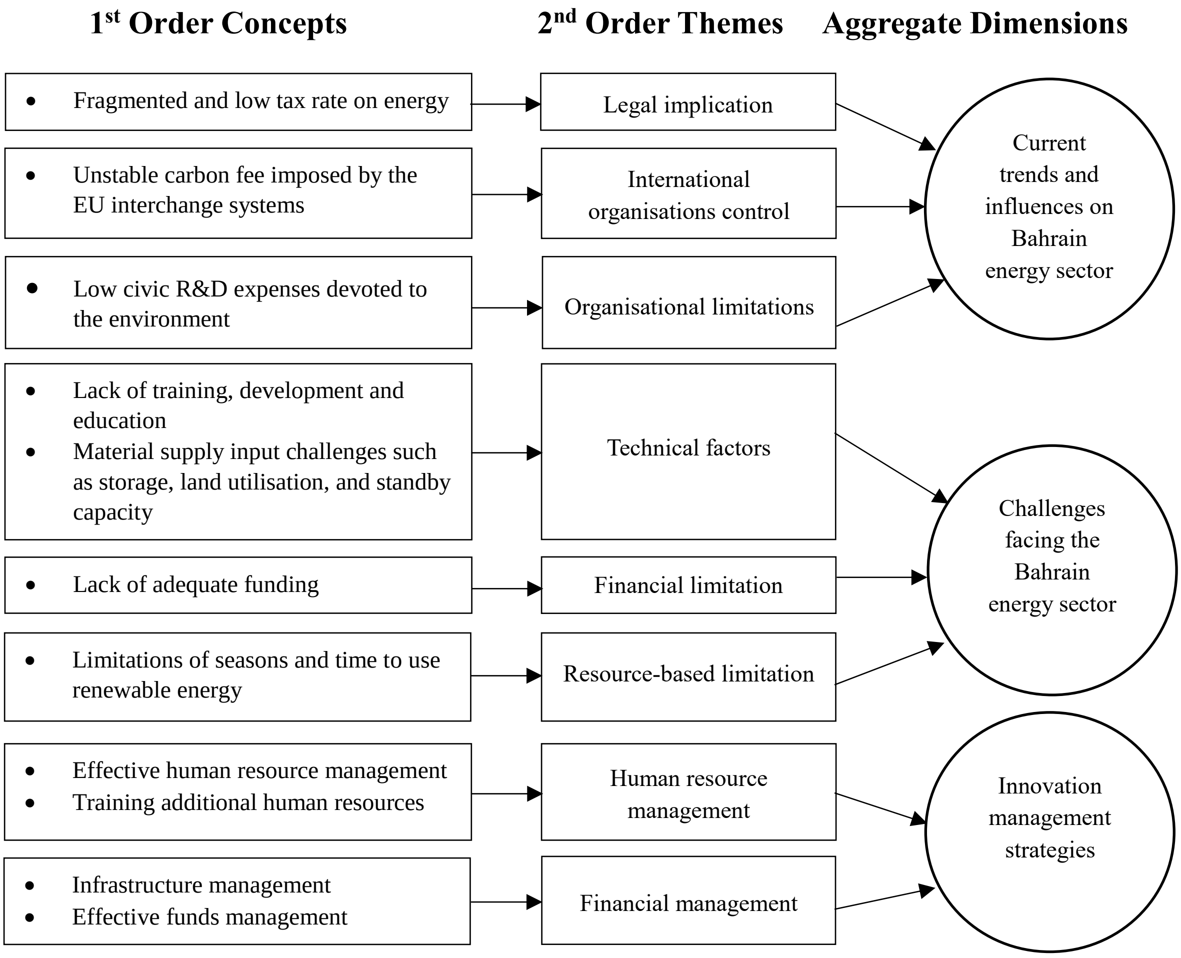


Figure 3: Gioia model on Innovation Management in Bahrain Energy Sector

The obtained qualitative data were meticulously examined to identify common topics, patterns, and meaningful ideas regarding innovation management and Bahrain's energy sector. The processes of acquaintance, coding, theme development, theme revision, theme definition, and inscription were engaged. This analysis necessitate an accurate assessment of the issues identified in the primary data. Qualitative data analysis did not include any processes of innovation management that may be deemed unsubstantiated. As a result, the information, including variables of innovation management and Bahrain's energy sector, analysed during this research mainly consisted of facts stated in interviews or questionnaire responses provided by respondents. The abductive approaches are the most commonly used approaches for qualitative data since they convey both differences and similarities in a given data set, as established by Miles and Huberman (1984) in their research.

Both quantitative and qualitative data analysis methods were applied. Thematic analysis was conducted to analyse the qualitative data, while descriptive statistical analysis was conducted to analyse quantitative data (Lune and Berg, 2016). The thematic analysis provides a flexible approach that made it possible to attain the research objectives focusing on innovation management within Bahrain's energy sector. The mixed method applied contributed significantly to the collection of sufficient data that guaranteed quality analysis that informed the research research's findings. The rationale for employing mixed research methods in this research was that it made it possible for robust interpretation and description of the collected data and ensured that the quantitative findings were more understandable.

The key themes were developed from the assigned unique codes, and the interview transcripts were then subjected to a coding process to identify the trends in the interviews. This allows for an exploration of the explanations provided during the interviews and highlighting any significant trends that emerged during the analysis. This process served two purposes: (1) it improved the validity of inferences by triangulating one set of findings with another; (2) It was possible to elaborate, validate, and/or explain the research findings from one method with the findings from the other approach (Webb, 2017). Overall, the entire process provided insight into a deeper comprehension of the correlation between the research variables of innovation management and Bahrain's energy sector.

The data analysis process included the coding results as well as the content analysis of the uncoded elements of the interview transcripts (Allsop et al., 2022). The triangulation was conducted after the coding revealed the points of convergence between the interview and survey data. The triangulation process revealed the themes that required clarification or explanation (Schoonenboom and Johnson, 2017). A content analysis of all the remaining transcripts was then performed to contextualise the triangulated themes.

Statistical sampling method was applied to the results of the coded material. This is because statistical sampling enables researchers to manage data and save time effectively. Hence, a quantitative data analysis seemed appropriate for interpreting the responses to the closed-ended questions. Descriptive and inferential statistics were used in the quantitative data analysis. The closed-ended question responses were subjected to descriptive statistical analysis, such as mean and percentages. Furthermore, correlation analysis was performed on the various measures of innovation management implemented and the related challenges to determine the extent of the innovations resulted from the challenges. Correlation analysis explored the direction of the correlation between two variables, in this case, challenge and innovation, but could not explain the extent of the relationship between the variables. Furthermore, correlation analysis could not analyse the interaction between the various independent and dependent variables.

The dependent variable in this case research was innovation management, whereas all of the independent factors were linked to various challenges associated with centralised and decentralised energy distribution models. Regression analysis is a statistical test of inference that analyses changes in the magnitude and direction of the dependent variable as a function of changes in the magnitude and direction of the independent variables, either independently or in combination. The logistic regression analysis for this research involved the participants' alphanumeric responses to the closed-ended questions. The regression analysis helped determine the extent of the impact affected by challenges toward innovation management either holistically or independently. The logistic regression analysis assisted in verifying and fine-tuning the open-ended questions to comprehend the in-depth correlation between the challenges and facilitators of implementing innovation management in Bahrain's power sector.

3.8.1 Reliability and Validity

The research conducted an exploratory factor analysis (EFA), which is based on the principal component analysis in relation to the closed-ended questions. The principal component analysis separated the various closed-ended questions (variables). The questions with a correlation coefficient of less than 0.2 were not considered under the respective component. A Scree plot with an Eigenvalue of at least 1 formed the basis for recognising individual components as separate constructs. The EFA sorted the various closed-ended questions into separate components as well as assisted in eliminating questions with incredibly low correlation coefficients from the final questionnaire. The validity of the qualitative research method was validated using respondent validation. The technique involved testing preliminary results with respondents to ascertain their validity regarding innovation management and Bahrain's energy sector.

3.8.2 Software

The quantitative analysis (correlation and regression) was conducted using SPSS (IBM-SPSS, version 26.0) software. The obtained results were presented in the form of frequency tables and figures. The qualitative data were analysed thematically using NVivo software. Moreover, the interviews were manually transcribed, which allowed for a more thorough investigation of the fundamental themes and significant issues. The basic steps taken in the analysis of qualitative data gathered included familiarisation and organisation of the data. This involved reviewing the gathered data, listening and transcribing the recorded data, and sorting them into groups.

3.9 Impact Plan

This research concentrated on investigating the variables that can support Bahrain energy organisations' innovation management as they respond to the transition towards renewable energy. The intention here is to use the performance management system cycle to investigate innovation management during the first section of the impact plan and identify the influencing variables. The second stage of the impact plan will include the evaluation assessment of the organisational administrations, including managers and supervisors that were involved in joint participatory processes for creating innovative management within the energy sector. This will shed the light on the administrative measures that should be implemented to assist an organisation in terms of their energy management while they engage in the transition towards non-renewable energy sources.

The final phase of the impact plan to determine the management processes and appraisal activities that affect an organisation's innovative administration. Employers possess unique skills that can have either positive or negative contribution to the energy organisation (Degryse, 2016). Therefore, the final section of the impact management plan will create leverage by updating and revising the initial objectives as well as providing feedback on the impacts of employees and supervisors working collaboratively to achieve a successful energy transition within the sector. An organisation that adopts innovative business models will have an impact on its profitability, the changes to the dynamics of supply chain logistics to adapt to the new models, and the effectiveness of adopting non-conventional energy generation sources apart from profitability. The analytical strategy adopted by the case research is a cross-sectional survey of different managers of electricity organisations in Bahrain. Some of these organisations should have already adopted non-conventional energy sources for power generation or be on the verge of doing so soon.

3.10 Ethical Issues

Superficially, it might appear that this thesis's data collection and analysis process would not have any significant ethical considerations, given that the collected information was not sensitive or personal. With the exception of the interviews, the research was unlikely to contain any personal data that might be linked to a specific individual. Nonetheless, some ethical elements were always considered in the research project, notably to protect participants, as explained in the following discussion (Grinyer, 2002).

In terms of ethical issues, getting informed consent from research participants was the most important step in the research project's ethical concerns since the participants were providing the data as part of the primary data collection. This rather fundamental rule suggested that prior to their actual involvement, participants in the research needed to be thoroughly informed about the objective of the research and how their data would be utilised; it was crucial to explain this to them in detail and engage them in a way that they would clearly understand (Lune and Berg, 2016). As part of acquiring informed consent, participants were informed about how their data was collected, maintained, and ultimately utilised. Once the participants were given full and relevant explanation, they were given the option to withdraw from the research at any time during data collection and analysis process if they felt it was necessary, with no questions asked (Sutton and Austin, 2015). In terms of the interview process, the explanation of the informed consent was given to the respondents in person at the start of the interview. For the surveys, the informed consent explanation was provided via email, and a relevant message was included at the front page of the survey document as it was impossible to speak with all the participants due to the sheer numbers. During the collection of highly sensitive data or interview, it is advisable to have all participants sign an informed consent document as this process protects both the university and I (Ritchie et al., 2013). Finally, this thesis followed all of the informed consent mechanisms outlined in the prior discussion.

All the collected data was preserved and safely stored. Therefore, during this research process, all survey responses and interview transcripts were stored in password-protected. Furthermore, interviewees were given the option to respond anonymously, and pseudonyms were used throughout the research. In cases where the data was potentially sensitive, such as when participants were concerned about their employers becoming aware of their survey or interview responses, best practices in data protection were followed to ensure that the respondents were not compromised or overly concerned as a result of their participation in the research (Freeman, 2010).

3.11 Chapter Summary

The proposed research aimed to investigate the variables that are relevant to Bahrain's energy sector's innovation management in response to the transition to renewable energy sources. Based on our understanding of the level of innovation diffusion in the energy sector, it is evident that innovation in this sector is critical for energy-based organisations that are seeking to expand nationally while transitioning to meet sustainable energy challenges. Hence, the aim of this research is to address the following three questions: (i) What are the current and emerging challenges affecting electricity organisations in Bahrain? (ii) What strategies are being implemented by electricity organisations in Bahrain in response to the challenges they face? (iii) How is innovation being leveraged to overcome the challenges affecting the electricity organisations in Bahrain?

This chapter described, critically discussed, and justified the research's methodological approach. A cross-sectional, mixed-methods research project was carried out, which included a survey strategy (questionnaires), a case research strategy (interviews), and several statistical and non-statistical data analysis tools. The fact that mixed-method designs had high reliability and validity prompted the implementation of such a design, while the pragmatist philosophical paradigm was deemed most appropriate to address the research questions in the most straightforward, practical, and logical manner.

The survey techniques used in this research were able to minimise any potential biasness. The questionnaire was also developed with this consideration, whereby leading questions based on false assumptions were avoided. Moreover, it was noted that interviews facilitated interactions between the participants and the current researcher. Finally, case research analysis was considered as an ideal form of practical analysis, given that the facts were based on existing aspects of the strategic organisational projects. Accordingly, it was determined that case analysis as a form of research method appeared to be the most practical measure for obtaining data regarding innovative management strategies in Bahrain's energy sector.

Furthermore, a case research approach appeared to be the most appropriate research method because it assisted in identifying the challenges and bottlenecks for implementing innovation management across Bahrain's power sector in an industry-specific, organisational-specific, and geography-specific manner. Several research approaches were considered for this research. However, the most effective method was the case research approach, in which analysis was performed on different projects. Consequently, this research used a mixed research method, both quantitative and qualitative, to better understand the fundamental reasons, motivations, and perspectives on the challenges affecting innovation management in the energy sector during the transition to renewable energy.

As a result of the globalisation of knowledge, increased demand for innovation, and the limitation of resources that accomplish societal needs, numerous organisations are seeking out innovative management strategies as a meaningful way of fulfilling both their traditional business goal of profit maximisation and the needs of the energy sector, alongside the increasing obligation on energy organisations to transition from non-renewable to renewable energy. Therefore, this research was designed to explore the factors of innovative management in Bahrain's energy sector. This research has established thus far that the maintenance of energy sector innovation has become an increasingly important aim of energy-based organisations striving to improve their contribution to the national grid while adopting renewable energy sources. This is because innovation in the energy sector is substantially diffused and in demand.

Chapter 4

4. FINDINGS

4.1 Introduction

This chapter presents the findings of this research. It also outlines and presents the data gathered during the research from the annual reports of the sampled companies, observations, and minutes of the companies. The research attempted to reach the aims and objectives by conducting the research on innovation management in Bahrain's energy organisations.

4.2 Quantitative Findings of Primary Data

The quantitative approach yielded data that are generalizable and externally valid insights into innovation management in energy organisations. Quantitative analysis was conducted upon the data collected via the survey. There are four parts in the questionnaire: the first part (section A) comprises of the demographic characteristics of the respondents, such as gender, age, academic qualifications, and department; the second part (section B) is the evaluation and opinion related to innovation management strategies; the third part (section C) evaluates the challenges confronting electricity organisations as they transition to a decentralised model; and the last section (section D) assesses the variables influencing and impeding the implementation of innovation management strategies.

The data set consists of 100 observations from the 100 respondents. The objectives of the quantitative analysis are to examine the relationship between challenges affecting electricity organisations while transitioning to a decentralised model and innovation management system in addition to examine the impact of factors that affect the implementation of innovation management strategies by the electricity organisations. With these in mind, the formulated research hypotheses were tested and ascertained. Analyses conducted data set were conducted using SPSS statistical software, version 26, including descriptive statistics, preliminary analysis (reliability and normality tests), correlation analysis, and regression analysis.

4.2.1 Descriptive Statistics

The variables within the data consist of frequency and percentage distribution of the responses and the demographic characteristics of the participants. The mean and standard deviation are also presented. The descriptive statistics are presented in the tables below:

Table 4: SPSS Output

Notes		
Output Created		10-FEB-2023 15:55:30
Comments		
Input	Data	C:\Users\USER\Desktop\Aalezz\Aalezz.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	100
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Gender Age Academic Qualification Department EIM1 EIM2 EIM3 EIM4 EIM5 CH1 CH2 CH3 CH4 CH5 FACTOR1 FACTOR2 FACTOR3 FACTOR4 FACTOR5 FACTOR6 /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

Table 5: Descriptive Statistics

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Effective innovation management involves proper management of resources	56.85	80.694	.574	.796
Innovation management is the method for maximizing the growth potential of the energy sector.	56.78	84.497	.441	.806
Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector.	56.03	91.928	.384	.811
Innovation management involves proper utilisation and harnessing of electric energy in the production of electricity	56.67	86.102	.473	.804
Innovation management has to do with efficient and well-structured Organisation of operations	56.57	99.702	-.161	.835
Insufficient human resources is a major challenge while the transition to decentralised and centralised models of power generation	56.85	80.694	.574	.796
Market Policies and Managerial Policies are set back when the transition to decentralised models of power generation.	56.78	84.497	.441	.806
Inadequate resources for generating and transmitting electricity	56.03	91.928	.384	.811
Limited financial capabilities for managing electricity production and transmission	56.67	86.102	.473	.804
Sabotage of Electrical facilities and Environmental effects	56.85	80.694	.574	.796
Environmental Issues	56.63	86.155	.361	.812
Limited and Poor Human Resource Management	55.91	92.972	.299	.814
Market and Governmental Policies	56.67	86.102	.473	.804
Lack of Operational and Production Resources for generating Electricity	56.85	80.694	.574	.796
Organisation and Managerial issues	56.78	84.497	.441	.806
Insecurities	56.03	91.928	.384	.811

4.2.1.1 Demographic Characteristics

i. Gender

The table and the pie chart below show the number of participants and the distribution of their genders, which are 75 were male and 25 were female. All the 100 responses were completed and accepted in this research. Moreover, the concept of gender is important in innovation management, especially in a country where male is largely preferred as compared to women in some sectors, including the energy sector (Seikaly 1994).

Table 6: Gender of Respondents

Gender of Respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	25	25.0	25.0	25.0
	Male	75	75.0	75.0	100.0
	Total	100	100.0	100.0	

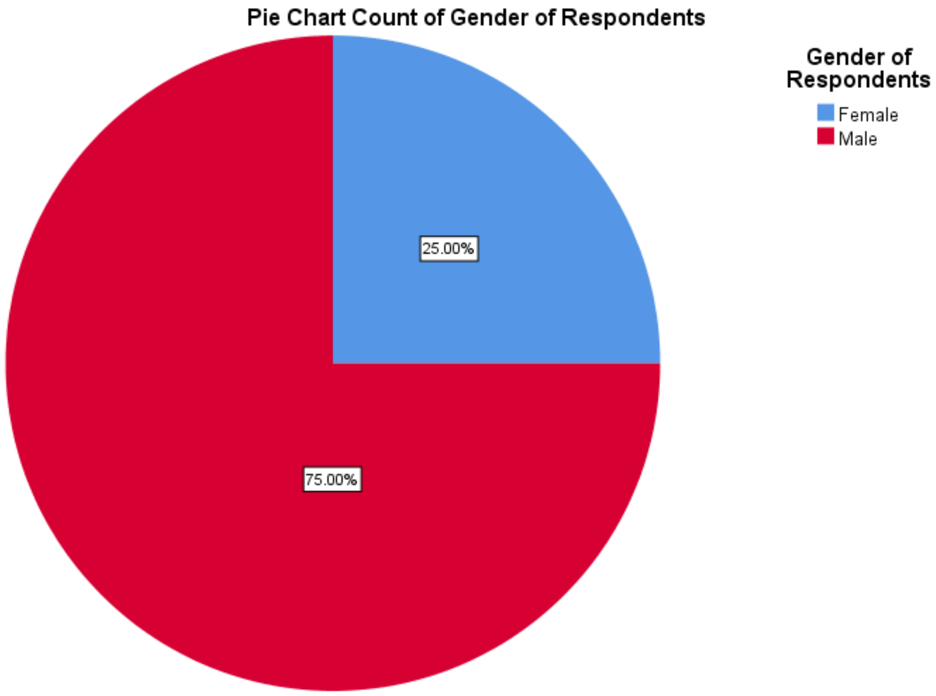


Figure 4: Pie Chart Count of Gender of Respondents

ii. Age of the respondents

As shown in the table below, the ages of the respondents were divided into six groups: 10 are under the age of 30, 23 are between the ages of 31 and 35, 25 are between the ages of 36 and 40, 19 are between the ages of 41 and 45, 11 are between the ages of 46 and 50, and 12 are between the ages of 51 and above. This clearly implies that most participants were knowledgeable about innovation management in Bahrain's energy sector.

Table 7: Age of Respondents

Age of Respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 30	10	10.0	10.0	10.0
	31-35	23	23.0	23.0	33.0
	36-40	25	25.0	25.0	58.0
	41-45	19	19.0	19.0	77.0
	46-50	11	11.0	11.0	88.0
	> 51	12	12.0	12.0	100.0
	Total	100	100.0	100.0	

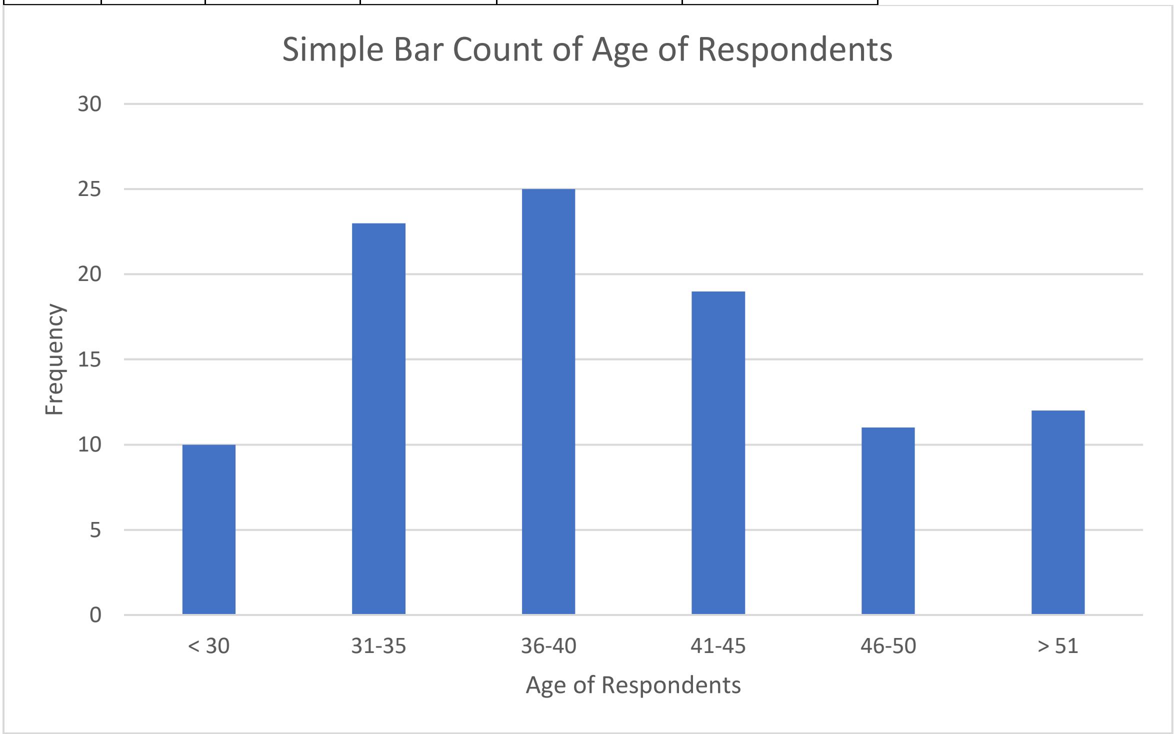


Figure 5: Age of Respondents

iii. Academic Qualifications

The categories provided include four specific academic qualifications and an "other" category for those that do not fall into any of the four listed qualifications. The table below shows that most of the respondents (72%) have a bachelor's degree, 13% have a diploma, 13% have a master's degree, and two respondents have a PhD. This implies that all the respondents who participated in the current research have the knowledge and abilities to comprehend innovation management in Bahrain's energy sector. From that perspective, their assessment of innovation strategies that I employed provides practical insights into the concept of innovation management, specifically in the energy sector.

Table 8: Academic Qualifications

Academic Qualifications					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PhD	2	2.0	2.0	2.0
	Masters' Degree	13	13.0	13.0	15.0
	Bachelors' Degree	72	72.0	72.0	87.0
	Diploma	13	13.0	13.0	100.0
	Others	0	0	0	100.0
	Total	100	100.0	100.0	

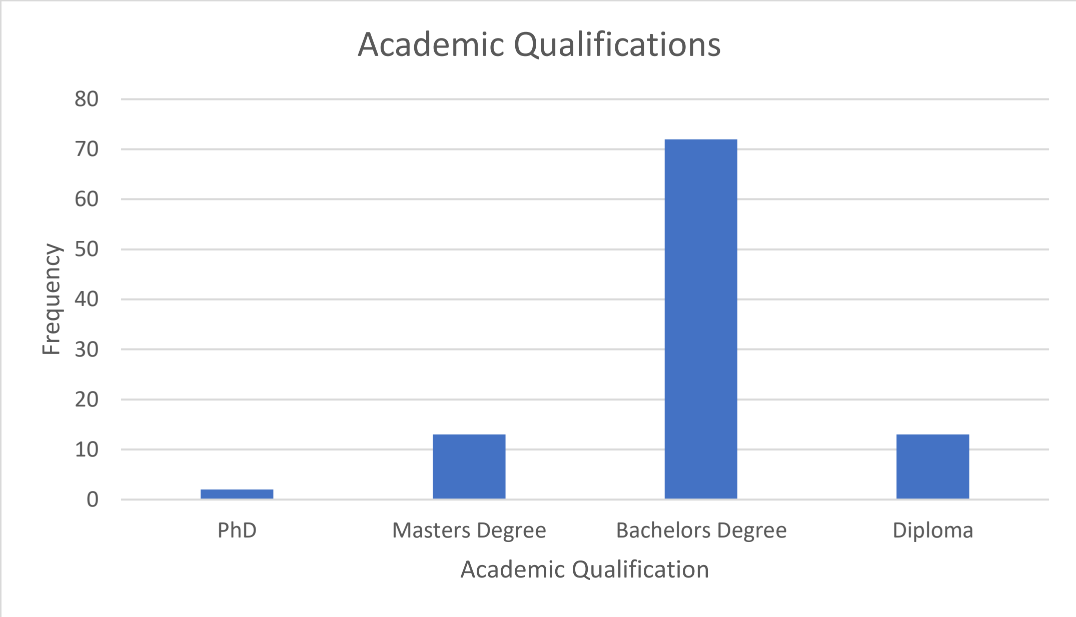


Figure 6: Academic Qualifications

iv. Area of specialisation or their department

There are five departments that the respondents work under; the table below shows that 28 of the respondents work in the production department, 26 work in the electricity transmission department, 15 work in the planning department, and nine work in a managerial position. The remaining seven respondents work in other departments. This indicates that the respondents were well-versed in Bahrain's energy sector's operational functions and the integration of innovation management. In that sense, their views enhanced the quality of the research findings established in the current research.

Table 9: Department

Department					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Management	9	9.0	9.0	9.0
	Planning	15	15.0	15.0	24.0
	Production	28	28.0	28.0	52.0
	Transmission	26	26.0	26.0	78.0
	Distribution	15	15.0	15.0	93.0
	Other	7	7.0	7.0	100.0
	Total	100	100.0	100.0	

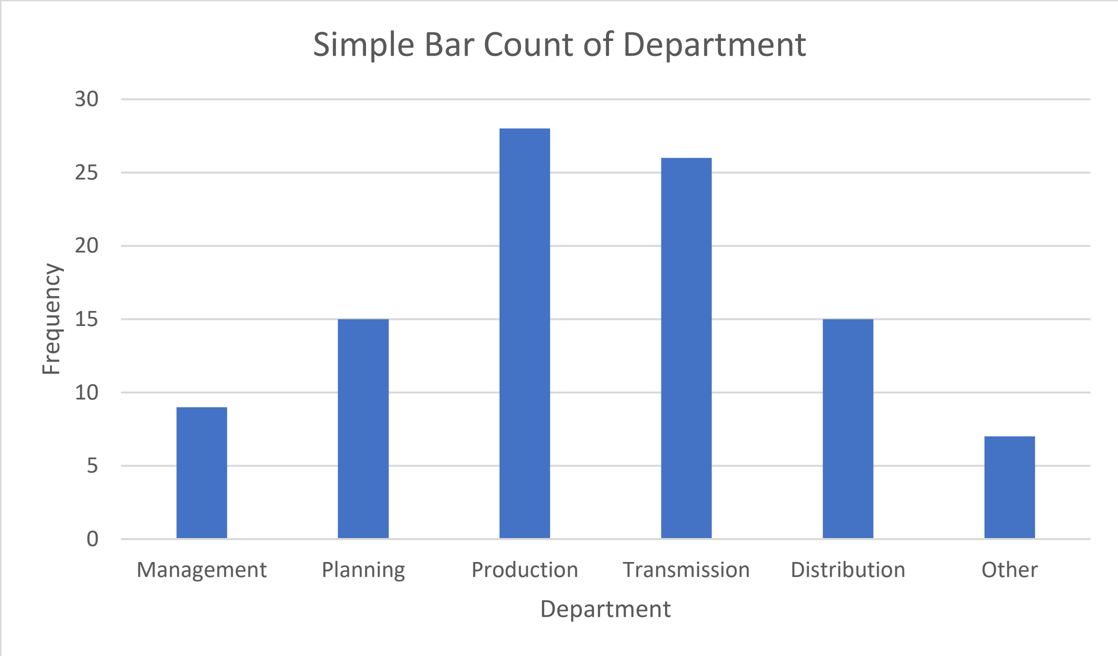


Figure 7: Simple Bar Count of Department

4.2.2 Evaluation of Innovation Management Strategies

This section presents the participants' responses and evaluations related to innovation management within their respective electricity organisation. The evaluation has been scaled from 1 (strongly disagree) to 5 (strongly agree), as seen in the table below. The mean and standard deviation of each question being asked are presented. The standard deviation is a measure of the distance, dispersion, or the gap of the participants' responses compared to the mean response to each question being asked. A higher standard deviation indicates that the gap of the responses to the mean is wider and opposite is true for lower standard deviation. This is a clear indication that the respondents are aware of suitable strategies that can be implemented to support innovation management within the energy sector of Bahrain. Therefore, higher standard deviation is an indication of better strategies embraced in innovation management.

Table 10: Evaluation of Innovation Management Strategies

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	Mean	Std Dev	Total
Effective innovation management involves the proper management of resources.	16%	12%	10%	32%	30%	3.48	1.439	100
Innovation management is the method for maximizing the growth potential of the energy sector.	15%	9%	10%	38%	28%	3.55	1.381	100
Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector.	0	2%	8%	48%	42%	4.30	.704	100
Innovation management involves proper utilisation and harnessing of electric energy in the production of electricity.	8%	11%	8%	53%	20%	3.66	1.157	100
Innovation management has to do with efficient and well-structured organisation of operations.	3%	5%	23%	51%	18%	3.76	.911	100

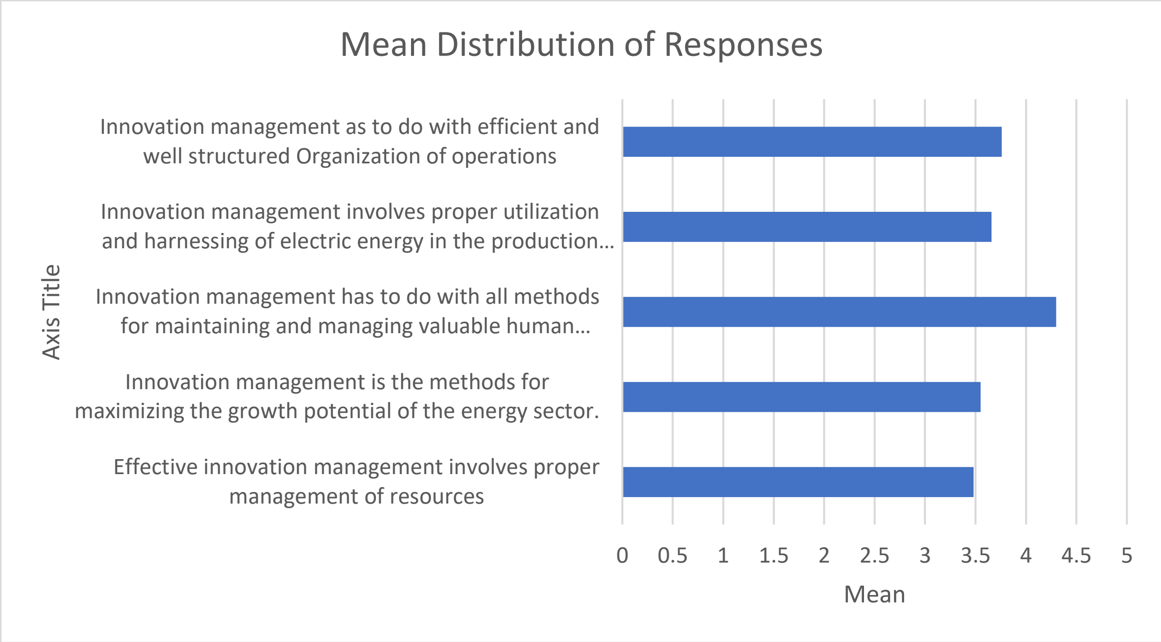


Figure 8: Evaluation of Innovation Management Strategies

4.2.3 Evaluation of Challenges Hindering Implementation of Innovation Management

The table below presents participants' evaluation of the challenges that hinder the implementation of innovation management by electricity organisations in Bahrain. The mean and standard deviation of responses to each question have also been provided. This denotes that the energy sector of Bahrain is facing diverse challenges that hinder the effective implementation of innovation management. Therefore, it is possible to determine the optimum strategies through such evaluation in the implementation of innovation management within the energy sector.

Table 11: Evaluation of challenges that hinder the implementation of innovation management

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	Mean	Std Dev	Total
Insufficient human resources is a major challenge while the transition to decentralised and centralised models of power generation	16%	12%	10%	32%	30%	3.48	1.439	100
Market Policies and Managerial Policies are set back when the transition to decentralised models of power generation	15%	9%	10%	38%	28%	3.55	1.381	100
Inadequate resources for generating and transmitting electricity	0	2%	8%	48%	42%	4.30	.704	100
Limited financial capabilities for managing electricity production and transmission	8%	11%	8%	53%	20%	3.66	1.157	100
Sabotage of Electrical facilities and Environmental effects	16%	12%	10%	32%	30%	3.48	1.439	100

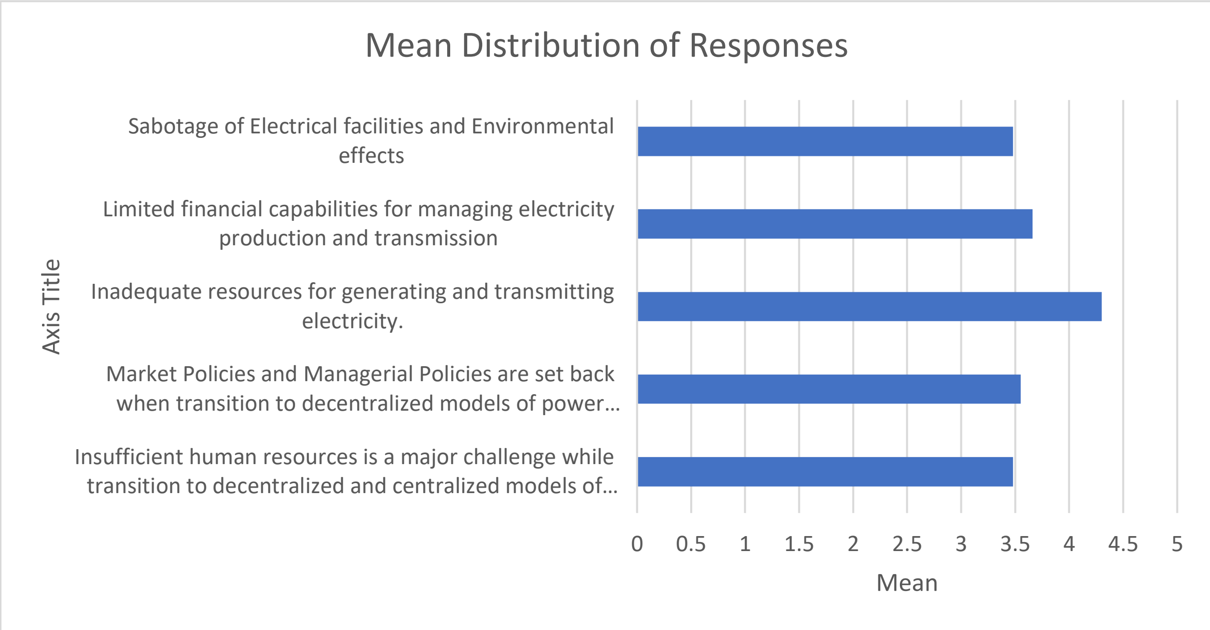


Figure 9: Evaluation of Challenges Hindering Implementation of Innovation Management

4.2.4 Evaluation of Factors Affecting Electricity Organisations in Bahrain

Six general factors have been identified as major setbacks for Bahrain's electricity organisations. Respondents' evaluations of the relevance and significance of these factors and the mean and standard deviation of each evaluation of each factor are presented in the table below. This strongly indicates that, despite the energy sector's efforts to embrace innovation management, challenges still need to be addressed immediately to enhance efficiency.

Table 12: Evaluation of Factors Affecting Electricity Organisations in Bahrain

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	Mean	Std Dev	Total
Environmental Issues	17%	9%	8%	34	32%	3.55	1.452	100
Limited and Poor Human Resource Management	0	1%	8%	45%	46%	4.36	.674	100
Market and Governmental Policies	8%	11%	8%	53%	20%	3.66	1.157	100
Lack of Operational and Production Resources for Generating Electricity	16%	12%	10%	32%	30%	3.48	1.439	100
Organisation and Managerial Issues	15%	9%	10%	38%	28%	3.55	1.381	100
Insecurities.	0	2%	8%	48%	42%	4.30	.704	100

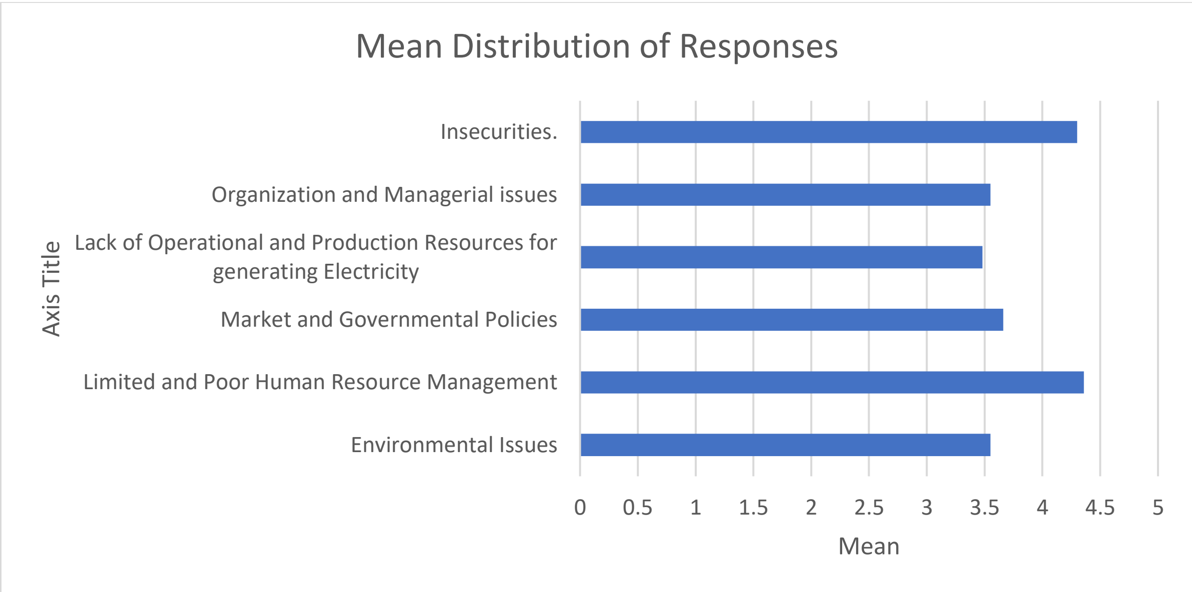


Figure 10: Evaluation of Factors Affecting Electricity Organisations in Bahrain

4.3 Preliminary Tests

This section contains the results of the preliminary tests conducted on the data set and responses based on the participants' experiences and challenges. Different respondents from diverse experiences and backgrounds participated equally to minimise cases of bias. The preliminary tests were carried out to examine the data sets for reliability, consistency, and normality. Cronbach's alpha test was used to determine the reliability of the dataset, and Shapiro-Wilk and Kolmogorov-Smirnov tests were used to determine whether the data set was normally distributed.

4.3.1 Reliability Test

Cronbach's alpha analysis was used to test the reliability of the data set, which includes the dependent variable in scale or continuous form. Cronbach's alpha measures internal consistency, or the correlation between the items in a group. The coefficient has a value between 0 and 1. A high alpha value indicates that the items reflect some underlying factor. It is a test of reliability and consistency rather than a statistical test.

An important consideration is that the number of variables that may have an impact on Cronbach's alpha.

Table 13: Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.826	16

The result of Cronbach’s alpha tests yielded an alpha value of 0.826, which is above 0.7. This means that the data set is reliable and consistent and can be accepted.

In the column for Cronbach's alpha, if an item is deleted in the Item-Total Statistics Table, the alpha value of any of the specific variables would be excluded from the test. In this specific case, excluding any variable would actually decrease or increase the alpha value; hence, keeping all the variables in the index is recommended. Any item can be deleted due to its reliability as compared to the other items.

Table 14: Item-Total Statistics

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Effective innovation management involves proper management of resources	56.58	83.418	.575	.806
Innovation management is the method for maximizing the growth potential of the energy sector	56.51	87.263	.443	.816
Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector	55.76	94.689	.396	.820
Innovation management involves proper utilisation and harnessing of electric energy in the production of electricity	56.40	88.970	.472	.814
Innovation management has to do with efficient and well-structured Organisation of operations	56.30	102.778	-.163	.843
Insufficient human resources is a major challenge while the transition to decentralised and centralised models of power generation	56.58	83.418	.575	.806
Market Policies and Managerial Policies are set back when the transition to decentralised models of power generation	56.51	87.263	.443	.816
Inadequate resources for generating and transmitting electricity.	55.76	94.689	.396	.820
Limited financial capabilities for managing electricity production and transmission	56.40	88.970	.472	.814
Sabotage of Electrical facilities and Environmental effects	56.58	83.418	.575	.806
Environmental Issues	56.51	87.263	.443	.816
Limited and Poor Human Resource Management	55.76	94.689	.396	.820
Market and Governmental Policies	56.40	88.970	.472	.814
Lack of Operational and Production Resources for generating Electricity	56.58	83.418	.575	.806
Organisation and Managerial issues	56.51	87.263	.443	.816
Insecurities	55.76	94.689	.396	.820

4.3.2 Normality Test

The normality test was conducted to determine the normal distribution of the data. As such, Kolmogorov-Smirnov and Shapiro-Wilk tests were carried out on the data set. The Shapiro-Wilk test is suitable for samples sizes that are small such as those that are less than 50. Since this research has 100 respondents, Kolmogorov-Smirnov test was more suitable.

Another purpose of carrying out the normality test is to determine the type of hypothesis test, should be performed on the data set. That is, whether a parametric or non-parametric test should be utilised. A parametric test should be used if the observations in the data set are normally distributed.

Table 15: Tests of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Effective innovation management involves proper management of resources	.261	100	.000	.835	100	.000
Innovation management is a method for maximizing the growth potential of the energy sector	.288	100	.000	.824	100	.000
Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector	.260	100	.000	.773	100	.000
Innovation management involves proper utilisation and harnessing of electric energy in the production of electricity	.346	100	.000	.802	100	.000

Innovation management has to do with efficient and well-structured Organisation of operations	.294	100	.000	.842	100	.000
Insufficient human resources is a major challenge during the transition to decentralised and centralised models of power generation	.261	100	.000	.835	100	.000
Market Policies and Managerial Policies are set back during the transition to decentralised models of power generation	.288	100	.000	.824	100	.000
Inadequate resources for generating and transmitting electricity	.260	100	.000	.773	100	.000
Limited financial capabilities for managing electricity production and transmission	.346	100	.000	.802	100	.000
Sabotage of Electrical facilities and Environmental effects	.261	100	.000	.835	100	.000
Environmental Issues	.288	100	.000	.824	100	.000
Limited and Poor Human Resource Management	.260	100	.000	.773	100	.000
Market and Governmental Policies	.346	100	.000	.802	100	.000
Lack of Operational and Production Resources for generating Electricity	.261	100	.000	.835	100	.000
Organisation and Managerial issues	.288	100	.000	.824	100	.000
Insecurities.	.260	100	.000	.773	100	.000
a. Lilliefors Significance Correction						

The Kolmogorov-Smirnov section will be reviewed in order to interpret the normality result. If the value of the Kolmogorov-Smirnov test is greater than 0.05, the observations in each variable are normally distributed. However, if it is below 0.05, the observations in the variables significantly deviate from a normal distribution. Thus, the sig. values for all 16 items (variables) can all be observed to be less than 0.05. Therefore, there is a deviation from the normal distribution.

4.4 Hypothesis Testing

The hypotheses formulated for the research are tested, and I formulated the null and alternate hypothesis were made. The variables were the quantitative data, which were used to test these hypotheses, which were obtained from the questionnaire survey. To test the hypotheses, two statistical analytical procedures were conducted: correlation analysis and multiple linear regressions.

The first hypothesis is that there is a significant relationship between the different forms of innovation management strategies adopted by electricity organisations in Bahrain and the challenges they face while transitioning to a decentralised model.

Hypothesis$_1$ (H_1): *It is hypothesised that the application of innovation management strategies exposes electricity organisations to numerous challenges.*

A correlation matrix analysis was used to test this hypothesis. However, since the normality test conducted on the item scale variables showed that the observations were not normally distributed, a non-parametric analysis was conducted using the Spearman-Rho correlation analysis. When interpreting the result of the analysis in the table below, the main focus is on the column Sig. (2-tailed), which is the p-value, and the correlation coefficient column. The p-value indicates whether the relationship is significant; if the p-value is less than 0.05 (*p-value* <0.05), then the relationship is statistically significant; on the other hand, if it is greater than 0.05 (*p-value* >0.05), then the relationship is not significant. It should be noted that the variables within the correlation matrix are the evaluation and perception (responses) of respondents in the survey, that is, the level at which they agree with a view or fact asked in the survey.

Table 16: Correlations

Correlations				
			Innovation management strategies	Challenges facing electricity organisation
Spearman's rho	Innovation management strategies	Correlation Coefficient	1.000	.904**
		Sig. (2-tailed)	.	.000
		N	100	100
	Challenges facing electricity organisation	Correlation Coefficient	.904**	1.000
		Sig. (2-tailed)	.000	.
		N	100	100
**. Correlation is significant at the 0.01 level (2-tailed).				

The result of the spearman-Rho correlation, as seen in the table, shows that the p-value of the relationship is 0.000, which is less than 0.05. This result suggests that there is a statistically significant relationship between innovation management adopted by the electricity organisations and the challenges faced by them when transitioning to decentralised models of power transmission (p-value 0.05). The correlation coefficient value of 0.904 also suggests that the relationship is strong and positive. Therefore, this is a clear implication that challenging factors become the stumbling blocks to implementing innovation management within Bahrain's energy sector.

The second hypothesis is that some factors have an impact on the innovation management strategies adopted by electricity organisations.

Hypothesis$_2$ (H$_2$): *It is hypothesised that factors affecting electricity organisations impact the implementation of innovation management strategies.*

These factors are based on the respondents' perceptions upon the extent of issues that mitigate or hinder the electricity organisations' adoption of innovation management strategies. Thus, a positive effect indicates that respondents believe these factors have a large impact, whereas a negative effect indicates that respondents believe these variables have no impact.

The following factors were identified as significant during the course of the research, especially in the implementation of innovation management strategies: insecurities, environmental issues, a lack of operational and production resources for generating electricity, market and governmental policies, limited and poor human resource management, organisational issues, and managerial issues.

A linear regression model analysis (multiple linear regression) is used to test this hypothesis. The independent variables (predictors) are the factors, while the dependent variable is innovation management strategies.

Table 17 is the model summary for the linear regression. Here, the focus is on the column for Adjusted R Square, which represents "R2". The value here reflects the variation in the dependent variable (innovation management strategies), which is explained by the variation in the independent variable (factors). The values are shown as percentages. Thus, the model summary table suggests that these factors, such as insecurities, environmental issues, lack of operational and production resources for generating electricity, market and governmental policies, limited and poor human resource management, organisation, and managerial issues, account for 88.8% of changes or variation in the dependent variable, innovation management strategies. This implies that external and internal factors impede the adoption of innovation management in Bahrain's energy sector. Therefore, mitigating the issues will facilitate a conducive environment for enacting strategic plans relating to innovation management in the energy sector of Bahrain.

Table 17: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.946[a]	.894	.888	.18214
a. Predictors: (Constant), Insecurities. , Environmental Issues, Lack of Operational and Production Resources for generating Electricity, Market and Governmental Policies, Limited and Poor Human Resource Management, Organisation and Managerial issues				

The next table of focus is the coefficients table, which shows the sig. value (p-value) and the regression coefficient (B coefficient). The p-value indicates the level of significance of the impact of the independent variables on the dependent variable.

From the coefficient table below, it can be observed that the lack of operational and production resources for generating electricity, market and government policies, limited and poor human resource management, organisation, and managerial issues all have a significant impact on the implementation of innovation management strategies (p-value 0.05). On the other hand, insecurities and environmental issues do not have a statistically significant effect in the implementation of innovation management strategies (p-value > 0.05). This means that innovation management is not affected by insecurities and environmental issues.

The B-coefficients of those factors that were revealed to be statistically significant and all values were positive. The respondents, whom were also the employees of the electricity companies have a significant perception and maintained the view that these elements impact electricity companies' implementation of innovation strategies. This is a clear implication that the denoted factors significantly influence the implementation of innovation management within the energy sector.

Table 18: Coefficients Table

Coefficients						
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.945	.134		7.056	.000
	Environmental Issues	.014	.036	.038	.393	.695
	Limited and Poor Human Resource Management	.076	.071	.095	1.073	.286
	Market and Governmental Policies	.194	.017	.412	11.257	.000
	Lack of Operational and Production Resources for generating Electricity	.201	.014	.533	14.743	.000
	Organisation and Managerial issues	.164	.037	.416	4.378	.000
	Insecurities.	.101	.068	.130	1.472	.144
a. Dependent Variable: Innovation management strategies						

4.5 The Research Result

This section presents the findings from the analyses that were conducted during the research to test and answer the research hypotheses.

4.5.1 Result of Correlation Analysis

Most researchers use correlation analysis to determine the relationship between dependent and independent variables. In this research, the two variables are the innovation management strategies and the challenges experienced by the electricity companies in Bahrain. This research conducts an analysis to determine the correlation between the two variables and the contribution of occurrence of one variable to the other. From the information obtained from Hypothesis 1 on the correlation coefficients, it can be observed that both variables are related to each other by a value of 0.904, indicating that there is indeed a relationship between the innovation management strategies implemented by the electricity company

In addition, since the correlation coefficients are close to the value of 1, it indicates that there is a strong positive relationship between the two variables, with less than 0.1 before they have a perfect relationship. This suggests that if a company employs effective and efficient innovation management strategies, there is a high probability that it will experience a reduction in its challenges to a similar degree.

Lastly, the p-value (represented by Sig. (2-tailed)) is less than 0.005, indicating that the data used in this research is statistically significant or relevant. This is a clear implication that innovation management is a relevant strategy that needs to be implemented within the Bahrain's energy sector in order to realise high production rates for national consumption and also across the globe.

4.5.2 Result from Linear Regression Analysis

This section was divided into a model summary, moderation measures, and exploratory factor analysis research findings. It offers new perspectives on innovation management, especially in the energy sector.

4.5.2.1 Model Summary

This section examines the likelihood of an event occurring from a logarithmic standpoint. It provides a predictive analysis whereby the dependent binary variable in this research is the implementation of the innovation management strategies, and the nominal independent variables or intervals are the factors influencing the dependent variable, which include market and governmental policies, insecurities, electricity, environmental issues, a lack of operational and production resources for generating organisations, limited and poor human resource management, and managerial issues. This regression analysis will also be used to explain the relationship between these variables.

Table 19: Replication of Model Summary Table

"Model Summary"				
"Model"	"R"	"R Square"	"Adjusted R Square"	"Std. Error of the Estimate"
1	.946[a]	.894	.888	.18214
a. Predictors: (Constant), Insecurities. , Environmental Issues, Lack of Operational and Production Resources for generating Electricity, Market and Governmental Policies, Limited and Poor Human Resource Management, Organisation and Managerial issues				

Table 19 illustrates that all the regression values for R are above 88%, with the highest at 94%. This suggests that there is a high probability of the predictors having an impact on the dependent variable, which in this case, is the implementation of innovative management strategies. Such results are deemed critical because it highlights that if the managers of the company can find a way to address the independent variables identified, they could potentially eliminate over 88% of the obstacles that affect the dependent variable in this regression.

4.5.2.2 Moderation Measures (Coefficient Statistics)

With regards to the moderation measures, the author used the coefficients of the first three constants and how they are affected by the variable of innovative management strategies. The first three variables include organisational and managerial issues, a lack of operational and production resources for generating electricity, and market and government policies. These three variables were selected because their sig values are less than 0.005, indicating that they are statistically significant and suitable for moderation measures analysis. This moderation measure analysis will examine how the adoption of innovative management strategies can impact all of the independent variables listed above. The following table was derived from the statistics:

Table 20: Replication of Coefficient Table from Regression

"Coefficients"						
"Model"		"Unstandardized Coefficients"		"Standardized Coefficients"	"t"	"Sig."
		"B"	"Std. Error"	"Beta"		
1	(Constant)	.945	.134		7.056	.000
	Environmental Issues	.014	.036	.038	.393	.695
	Limited and Poor Human Resource Management	.076	.071	.095	1.073	.286
	Market and Governmental Policies	.194	.017	.412	11.257	.000
	Lack of Operational and Production Resources for generating Electricity	.201	.014	.533	14.743	.000
	Organisation and Managerial issues	.164	.037	.416	4.378	.000

In this table, the standardised coefficients indicate that the lack of operational and production resources for generating electricity is the most impactful variable that has the highest causal effect on innovation management strategies with a percentage of 53.3%, followed by organisational and managerial issues with 41.6%, and lastly market and government policies with 41.6%. This implies that the lack of operational and production resources for generating electricity has a higher likelihood of hindering the implementation of innovation management strategies compared to the other two variables in the example.

4.5.2.3 Result of Exploratory Factor Analysis

Exploratory factor analysis is often used to convert large number of data variables into smaller units to explain the relationship between the primary and independent variables (Jamil et al., 2014). In this case, it examined all the factors that affect the productivity of utility companies in the Kingdom of Bahrain, especially innovation management strategies. The factors used in the moderation measures, correlation analysis, and regression analysis were all taken into consideration and used to make statistically significant generalisations and summarisations that are suitable on a smaller scale.

Based on the statistical analysis, all the variables that correlated to +0.30 in the exploratory factor analysis will be considered valid to be used in this research. All the variables that had a statistical value of +0.1 in the Kolmogorov-Smirnova test and +0.5 in the Shapiro-Wilk test under the tests of normality will also be considered. All the R values > +0.30 and the sig values > 0.001 will also be considered. When considering these values, it is unequivocal that variables that meet the criteria will demonstrate a significant link with the dependent variable, and in this case, these will be the main factors that affect the implementation of the innovation management strategies for majority of the utility companies in the Kingdom of Bahrain. Examples of these variables include the lack of operational and production resources for generating electricity, market and governmental policies, and organisational and managerial issues, amongst others. This is a clear implication that various strategic challenges hinder the effective implementation of innovation management within the Bahrain's energy sector. The subsequent section will address the qualitative findings of the data. The combination of qualitative findings with quantitative findings makes it possible to determine the outcomes that have statistical significance and, more importantly, practical relevance.

4.6 Findings from the Qualitative Phase

The qualitative research approach yielded detailed and contextualised insights with regards to the innovation management in Bahrain's energy organisations. This section presents qualitative data, and that analyses conducted with the aid of NVivo software using the Gioia model, as shown in Figure 3, illustrated on p. 102. The research questions on innovation and management in Bahrain's energy sector were reviewed. Subsequently, all the transcripts were read, and the memos were summarised. A research journal was created using a coding strategy. Codes were formed from broad topic areas that created the themes for the analysis, as shown in Table 23, illustrated on p. 146. This section will also present the respondents' narratives that were obtained during the data collection. The essence of qualitative data is to supplement the comprehensive details of the interrelationships between the research variables. Equally, qualitative data enable the research to explore useful and impactful insights into the feelings of the research participants and their thoughts about the adoption of innovation management in the energy sector. Comprehensive understanding of the research topic can be achieved through mixed research methodologies. Qualitative methods provide in-depth insights, contextual understanding, and rich descriptions, while quantitative methods offer statistical trends, patterns, and generalizability. By integrating both approaches, researchers can gain a comprehensive and holistic understanding of the research problem that seek beyond surface-level explanations. Mixed research methodologies can also provide stronger evidence and support for the research claims.

Qualitative data can help to interpret and explain quantitative findings, and quantitative data can provide statistical evidence to support the insights from the qualitative data.

4.6.1 Findings from the interviews

The qualitative data was essential to augment the analysed quantitative data in demonstrating the interrelationships between the research variables. The qualitative research was carried out to evaluate and understand the innovation management implemented by the energy organisations, in this case, Bahrain's electricity production companies or organisations in order to meet end-user energy demands. Particular focus was placed in the adoption of innovation management when using the decentralised model of electricity production. The research also examines the facilitators and barriers to the transition of energy models and how energy organisations utilise the innovation management to address the encountered challenges.

Based on the research findings as shown in Figure 11, illustrated on p. 142, various respondents ascertained the nature of innovation management in Bahrain's energy sector. One respondent declared that *"the energy sector was an efficient and well-structured organisation of diverse operations responding to energy production demands."* Another respondent revealed that *"the energy sector is harnessing the utilisation of electric energy in the production of electricity."* Additionally, one respondent expressed that *"management was maintaining valuable human capital and resources."* From this analysis of the interview findings, it is clear that the respondents have an overall firm grasp of Bahrain's energy sector's condition.

The research findings that were shown in Figure 12, illustrated on p. 142, demonstrates the various challenges encountered by the energy organisations during the transition from decentralised to centralised leadership models. The energy sector is confronted with the issue of limited and inadequate human resources. Additionally, companies struggled with insufficient resources for electricity transmission and generation. A more pressing issue is the scarcity of financial resources to support power generation and transmission throughout the state. According to one participant, *"Bahrain's energy sector is hampered by insufficient human resources, which hinders production rates."* Furthermore, the sector is experiencing sabotage of electricity facilities. To support the issue, one respondent revealed: *"Vandalism is common in the country, as individuals steal and sell electric cables for profit."* Moreover, the energy sector also contributes to environmental pollution, which affects the surrounding residents. One participant stated that *"environmental pollution is a major challenge associated with the energy sector in Bahrain."* These responses are clear indications that several external and internal factors hinder the development of the energy sector. Moreover, these findings clearly reveal that the challenges posed by innovation management have negatively affected Bahrain's energy sector.

Figure 13, illustrated on p. 143, demonstrates the innovation management strategies that energy organisations have adopted and implemented for the purpose on transitioning into decentralised power models. The research results demonstrate the effectiveness of the energy sector manages its human and infrastructural resources. Furthermore, the energy sector continues to incorporate and train more individuals in electricity management. One of the respondents declared that *"the energy sector is mitigating the challenge of a lack of human resources by training more manpower to enhance efficiency."* Another one supported this statement; *"nowadays, the energy sector is managing electricity more effectively."* This clearly indicates that the relevant authorities do exert the necessary effort to address the innovation management challenges in the energy sector in Bahrain. Furthermore, the energy sector is benchmarking with other enterprises and organisations in the same field. The government is up to date with support and intervention in the field of financing for research and development. In support of the strategic implementation, one interviewee affirmed that *"the government is crucial to the prosperity of the energy sector. In addition, benchmarking facilitates filling production gaps, thus informing high electricity yields throughout the state."* These responses imply that the energy sector has taken steps to improve the implementation of innovation management.

Figure 14, illustrated on p. 143, demonstrates the innovation management strategies for addressing issues in Bahrain's energy sector. The research's findings show that the energy sector has made significant strides in protecting and conserving the environment while producing electricity. However, one respondent suggested that *"the government and other stakeholders need to come up with measures of minimising environmental pollution to increase healthy human coexistence"* owing to inevitable environmental contamination. It was revealed that the energy sector had developed new methods for managing resources and was actively engaging in additional human resource development. One participant supported this notion by affirming that *"it is through an effective human resource that the firm has taken steps in embracing innovation management that facilitates high energy production rates."* Another progress shown by the research's findings is the development of new methods for fostering relationships with partners. In this regard, one research participant asserted that *"it is through the collaboration of all stakeholders, including partners, that Bahrain's energy sector has accomplished progressive advancements in meeting consumer demands."*

This implies that the energy sector was strategically prepared to overcome the current production challenges. This equally demonstrates the importance of collaboration among different stakeholders in the energy sector. Indeed, robust collaboration in the energy sector will make it possible for innovation management to effectively contribute to the development and stabilisation of Bahrain’s energy sector.

Lastly, Figure 15, illustrated on p. 144, demonstrates the elements that impact the energy sector's deployment of innovation management. The research findings reveal that the energy sector is facing insecurities and environmental, organisational, and managerial issues hindering innovation management's implementation process. In support of these issues, one research participant declared, *"Insecurity has emerged in the energy industry as a result of the innovation management process. Some individuals steal electric cables that are expensive to replace."* Another respondent noted that *"people are reluctant to fully embrace innovation management due to negative effects like pollution associated with the energy sector."* Furthermore, the research outcomes indicate that the energy sector lacks operational and production resources for generating electricity. The energy sector also struggles with a lack of adequate human resources that can foster the development of innovative management and technology. To concretize such challenges, one respondent revealed that *"the energy sector is confronted with a lack of human resources skilled in innovation management, and a lack of production resources is a critical impediment for such a milestone to be accomplished within the firm throughout the country."* This demonstrates that the company must overcome innovation management gaps to implement appropriate measures to improve energy production. The lack of sufficient human resource skills has significantly and negatively impacted innovation management in the energy sector.

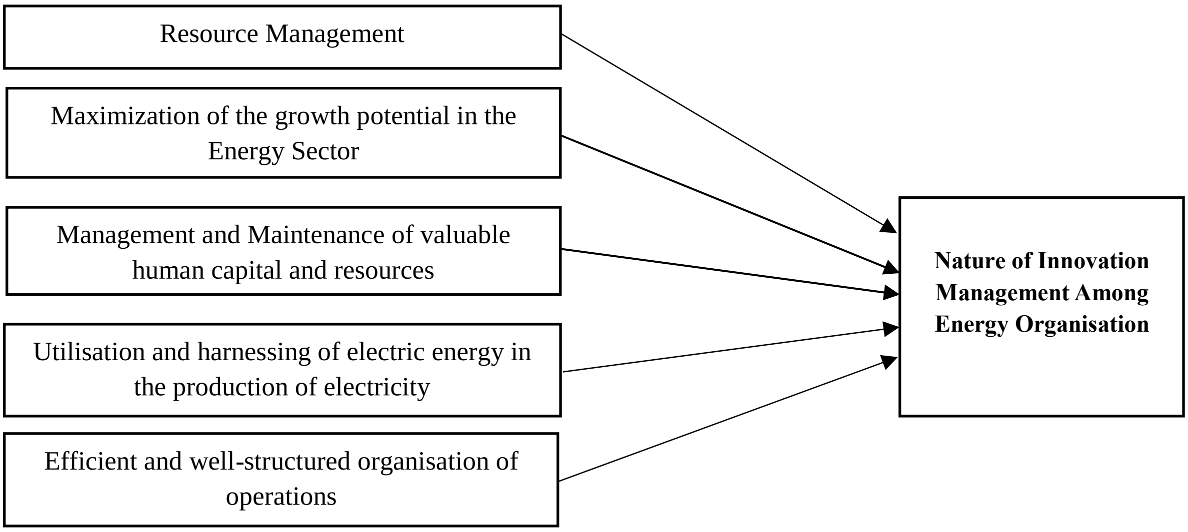


Figure 11: Nature of Innovation Management among Energy Organisation

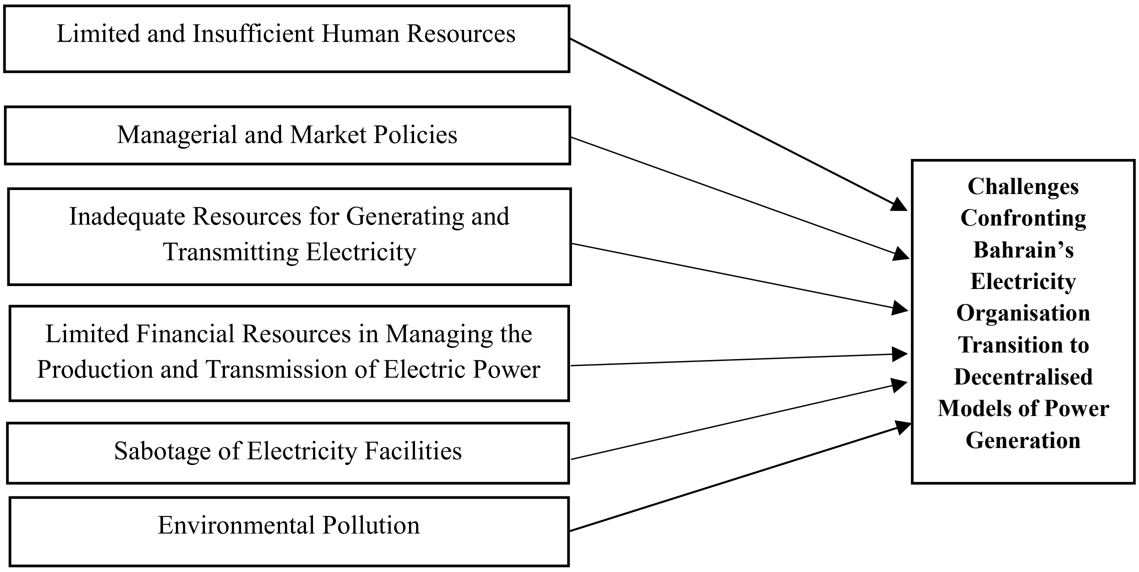


Figure 12: Challenges Facing Energy Organisations during the Transition from Decentralised to Centralised Models of Power

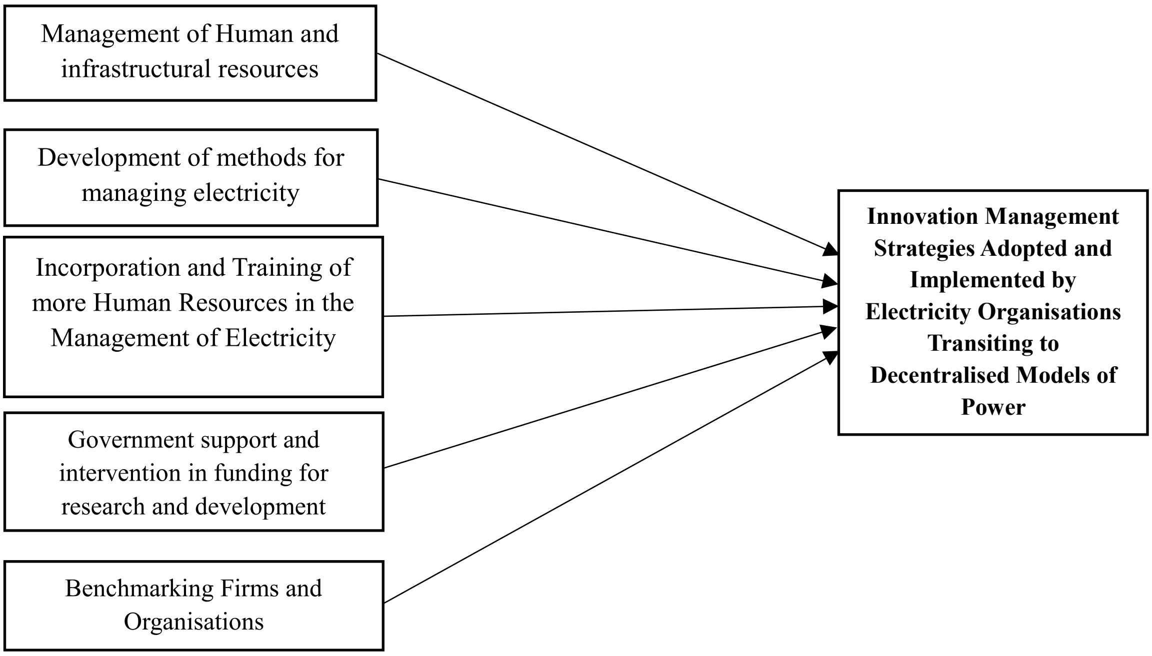


Figure 13: Innovation Management Strategies Adopted and Implemented by Electricity Organisation Transiting to Decentralised Models of Power

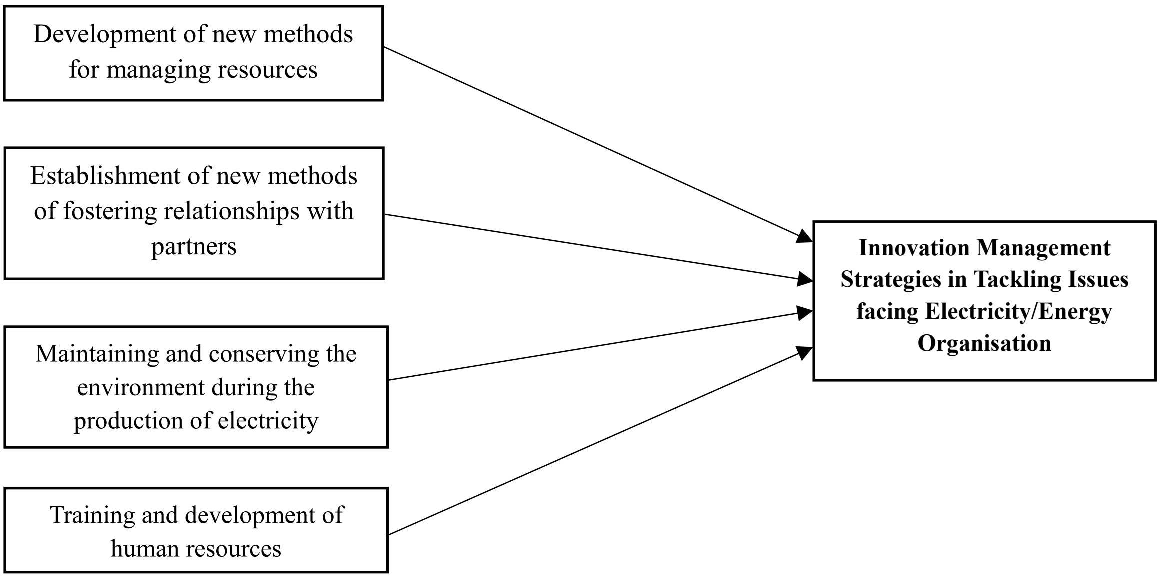


Figure 14: Innovation Management Strategies in Tackling Issues Facing Electricity/Energy Organisation

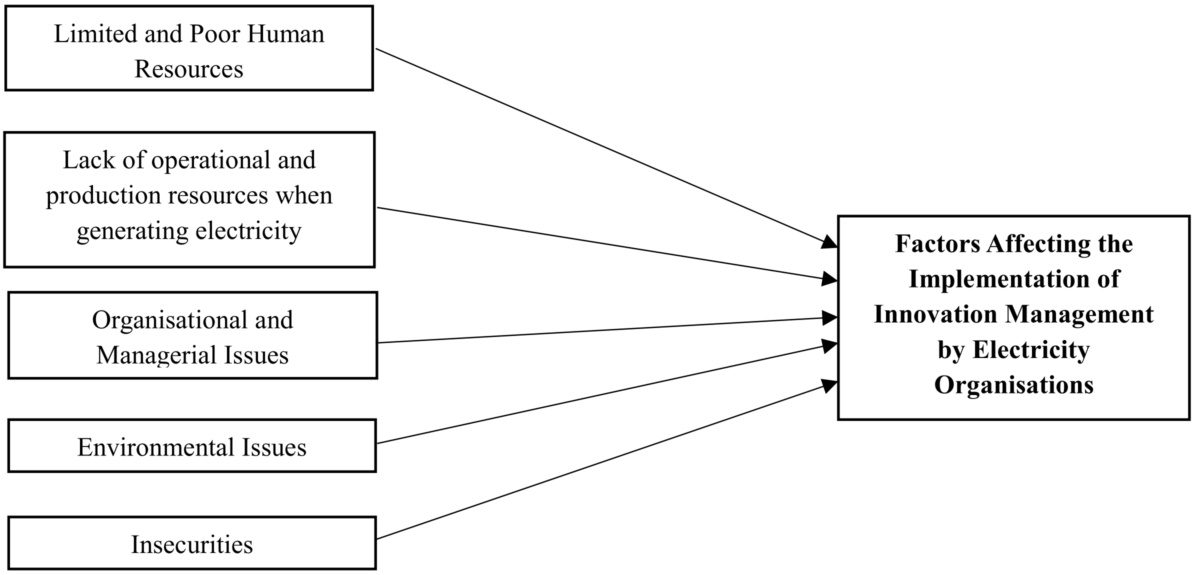


Figure 15: Factors Affecting the Implementation of Innovation Management by Electricity

4.6.2 Description of Research Findings from NVivo Software

Ten open-ended interviews were conducted. The interviewees consisted of the chief executive officer and other key managers. The purpose of the interviews was to investigate innovation management in energy organisations in the Kingdom of Bahrain. Interview participants had different demographic characteristics such as experience, job title, role, etc. Table 21 below exhibits the positions that were held by the participants.

Table 21: Demographic Characteristics of Interview Participants

Position held	No. of participants
Chief Executive Officer	3
Operations Managers	2
Production Managers	3
Human Resource Managers	2

For the purpose of obtaining initial familiarity with the interview responses, a word frequency query of the 50 most repeating words was run in the Computer Assisted Qualitative Data Analysis Software (CAQDAS), i.e., NVivo. The results from the NVivo output are presented in Table 22 below, and Figure 16 below gives an overview of the word frequencies in all ten interview responses.

Table 22: Summary of the NVivo Research Findings

Name	References
1. Challenges of Electricity Organisations	20
1.1 Current Challenges of Electricity Organisations	10
1.2 Future Challenges of Electricity Organisations	10
2. Strategies for Electricity Organisations	29
2.1 Suggested Approaches to Deal with the Challenges	10
2.2 Existing Strategies to Deal with the Challenges	10
2.3 Outcomes of Existing Strategies	9
3. Innovation in Electricity Organisations	30
3.1 Role of Innovation in Providing Solutions	10
3.2 Utilization of Innovation in Combating Challenges	10
3.3 Suggested Innovative Approaches	10

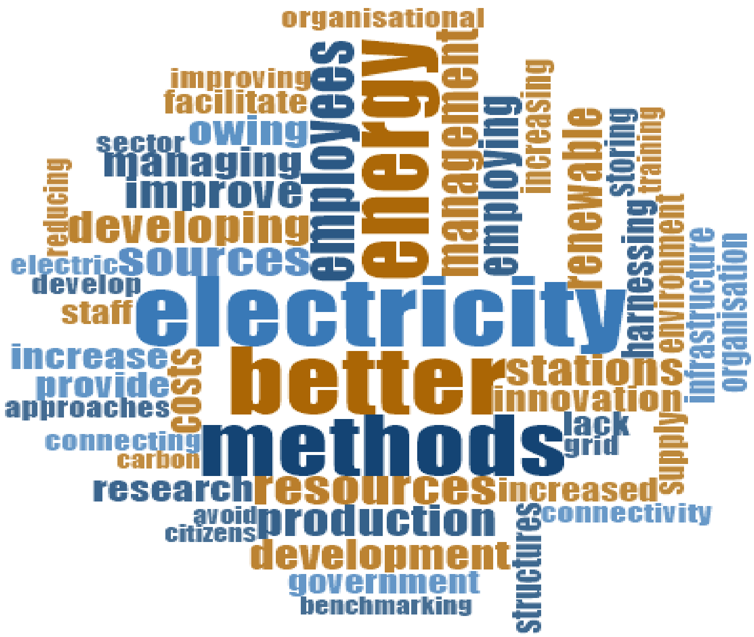


Figure 16: A Word cloud of 50 most repeating words in the interview responses

4.6.2.1 Findings of Thematic Analysis

The purpose of this research is to investigate innovation management in energy organisations in the Kingdom of Bahrain. For this purpose, ten open-ended interviews that consist of eight questions were conducted. These questions were based on the challenges faced by the electricity organisations, strategies for electricity organisations, and innovation in electricity organisations. The analysis of the interview responses contributed in addressing the following research questions:

i. What are the current and emerging external and internal factors affecting Bahrain's Electricity and Water Authority (EWA)?
ii. What strategies and innovations are being implemented by the Electricity and Water Authority (EWA) in Bahrain in response to the challenges?
iii. What are the modifications implemented by the Electricity and Water Authority (EWA) in Bahrain in response to the major challenges arising from the adoption of decentralised models of energy production?

The interview responses were imported, arranged, and coded into Computer Assisted Qualitative Data Analysis Software (CAQDAS), i.e., NVivo. The six-step thematic analysis process by Braun and Clarke (2006) was adopted, which entails familiarising oneself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report used for the analysis of the data.

The research follows an analysis that is qualitative in nature (generally inductive) that complies with the interpretivism (constructivism) epistemology and the subjectivism ontology. Themes or patterns in the data can be identified, associated, and analysed in one of the two primary methods in thematic analysis (Braun and Clarke, 2006), This means via an inductive or “bottom-up" approach or via a theoretical, "deductive," or "top-down" approach (Boyatzis, 1998; Hayes, 1997). An inductive approach implies that the themes identified during the analysis are strongly related to or emerge from the data themselves (Patton, 1990). This implies a strong correlation to the grounded theory approach of qualitative research. This type of research aims to independently determine the meanings derived from the data rather than trying to fit the data to the preconceived notions or make it conformable to the pre-existing coding framework.

Nevertheless, it is essential to state that the researchers cannot liberate themselves of their epistemological and theoretical commitments, and in no way does this mean that the data has been coded in an epistemological vacuum (Braun and Clarke, 2006). This research followed the hybrid deduction and induction approach in relating the initial and axial codes with the research questions and objectives.

Initial codes (level-1 themes) were generated with the help of line-by-line coding of the responses from the interviews. Once all the interview responses were coded, homogenous initial codes were identified, related, and grouped into eight axial codes (level 2 themes). These eight axial codes were later classified into three broad themes (level 3) and labelled based on the research questions. Under the initial codes, responses or quotes were discussed together with justification. Various homogeneous information from the respondents were obtained in each of the codes.

Table 23: Themes Hierarchy Table: Presenting the Themes and their Relevant Axial Codes

Name	References
1. Challenges of Electricity Organisations	20
1.1 Current Challenges of Electricity Organisations	10
1.2 Future Challenges of Electricity Organisations	10
2. Strategies for Electricity Organisations	29
2.1 Suggested Approaches to Deal with the Challenges	10
2.2 Existing Strategies to Deal with the Challenges	10
2.3 Outcomes of Existing Strategies	9
3. Innovation in Electricity Organisations	30
3.1 Role of Innovation in Providing Solutions	10
3.2 Utilization of Innovation in Combating Challenges	10
3.3 Suggested Innovative Approaches	10

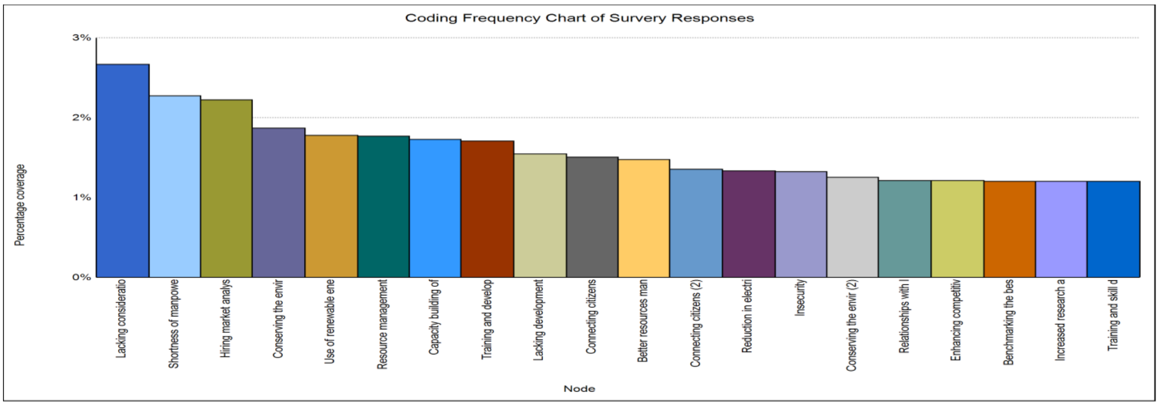


Figure 17: Coding Frequency Chart of Interview Responses

4.6.2.2 Challenges of Electricity Organisations

The theme "Challenges of Electricity Organisations" was made up of two axial codes, i.e., current challenges of electricity organisations and future challenges of electricity organisations.

4.6.2.2.1 Current Challenges of Electricity Organisations

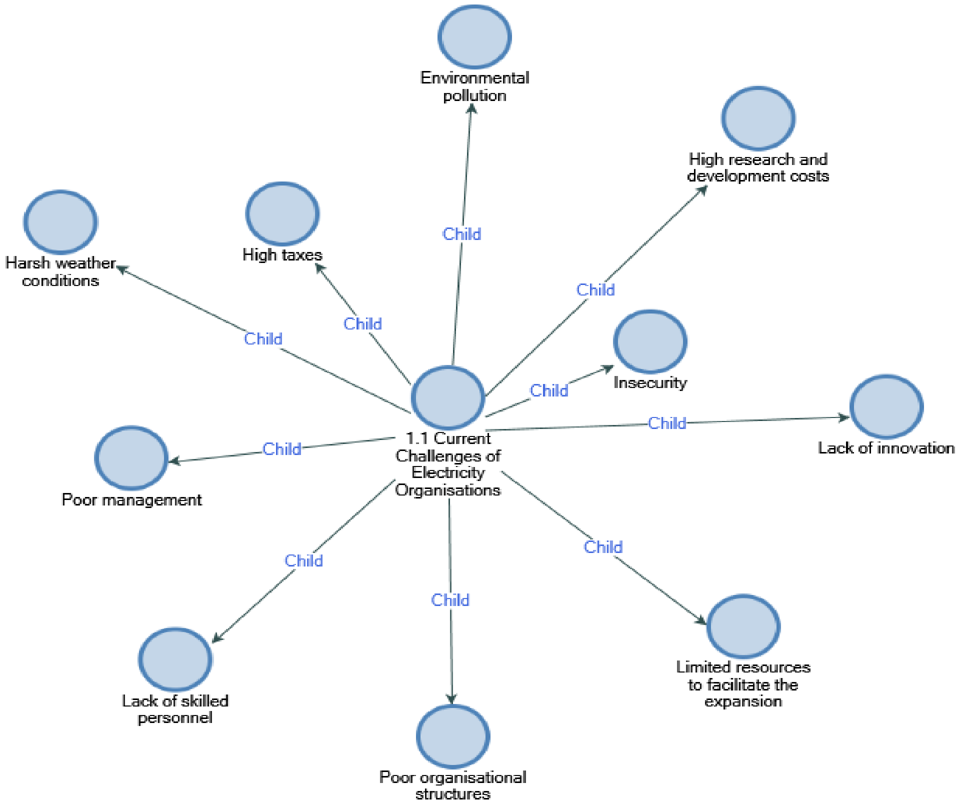


Figure 18: Current Challenges of Electricity Organisations with Associated Codes

Table 24: Current Challenges of Electricity Organisations with Associated Codes

Name	Coded segments from participants' responses
Environmental pollution	*Environmental pollution.*
Harsh weather conditions	*Harsh weather conditions affect the proper harnessing of electricity.*
High research and development costs	*High research and development costs when re-habiting the current electricity stations.*
High taxes	*Government or public policies impose high taxes on the electricity sector.*
Insecurity	*Insecurity in some places - such as remote areas – which makes it hard to establish electricity stations.*
Lack of innovation	*Lack of innovation in most organisations.*
Lack of skilled personnel	*Lack of skilled personnel that can properly manage the electricity grid stations.*
Limited resources to facilitate the expansion	*Lack of resources to facilitate the expansion of the harnessing of electrical power.*
Poor management	*Poor management of employees that ended up performing poorly in their jobs.*
Poor organisational structures	*Poor organisational structures for overseeing the electricity sector's activities.*

4.6.2.2.2 Future Challenges of Electricity Organisations

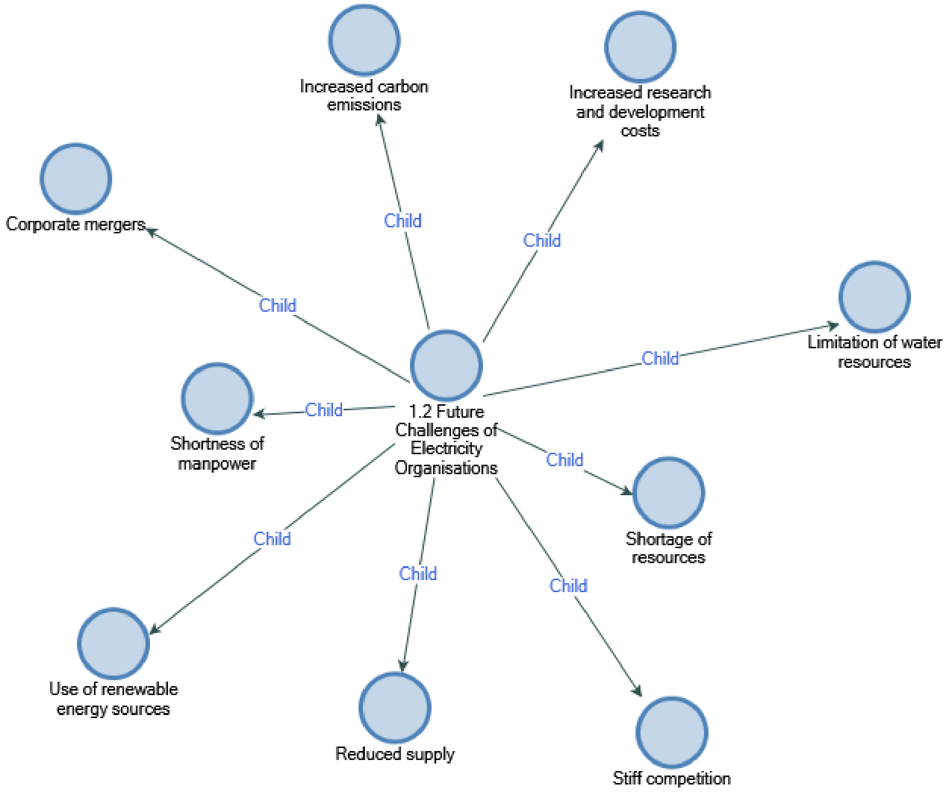


Figure 19: Future Challenges of Electricity Organisations with Associated Codes

Table 25: Future Challenges of Electricity Organisations with Associated Codes

Name	Coded segments from participants' responses
Corporate mergers	*Reduced and corporate merger markets owing to the global pandemic.*
Increased carbon emissions	*Increased impacts on the environment due to increased carbon emissions.*
Increased research and development costs	*Increased research and development costs due to the advancement of technology each year.*
Limitation of water resources	*Limitation of water resources due to climate change.*
Reduced supply	*Reduced supply due to limited sources of electric energy.*
Shortage of resources	*Shortage of resources such as the availability of lands and crude oil.*
Shortness of manpower	*Shortness of manpower due to world pandemics such as COVID-19.*
Stiff competition	*Stiff competition from upcoming electricity companies with better management.*
Use of renewable energy sources	*Consumers potentially starting to use more renewable sources of energy such as wind and solar energy compared to gas-generated electricity.*

4.6.2.3 Strategies for Electricity Organisations

Three sub-themes, i.e., suggested approaches to deal with the challenges, existing strategies to deal with the challenges, and outcomes of existing strategies, all of which formulate "Strategies for Electricity Organisations."

4.6.2.3.1 Suggested Approaches to Deal with the Challenges

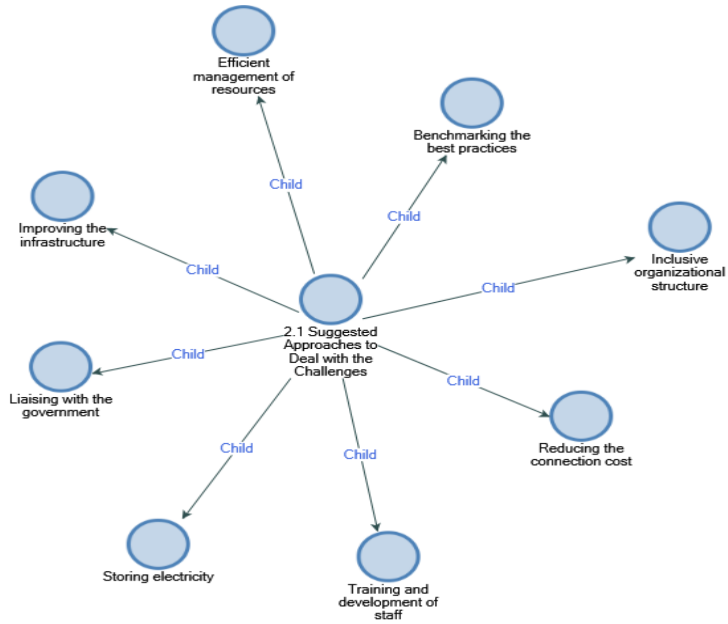


Figure 20: Suggested Approaches to Deal with the Challenges with Associated Codes

Table 26: Suggested Approaches to Deal with the Challenges with Associated Codes

Name	Coded segments from participants' responses
Benchmarking the best practices	*Benchmarking specialised firms and organisations that have handled the problems effectively.*
Efficient management of resources	*Employing better methods of managing employees.*
Improving the infrastructure	*Improving the infrastructure designs of the mains' electricity and sub-stations.*
Inclusive organisational structure	*Developing better organisational structures that are all-inclusive.*
Liaising with the government	*Liaising with the government for funds for research and development.*
Reducing the connection cost	*Reducing the costs of connecting electricity in order to increase the supply.*
Storing electricity	*Employing better ways of storing electricity.*
Training and development of staff	*Training more staff regarding how they can manage the grid electricity stations effectively.*

4.10.3.2 Existing Strategies to Deal with the Challenges

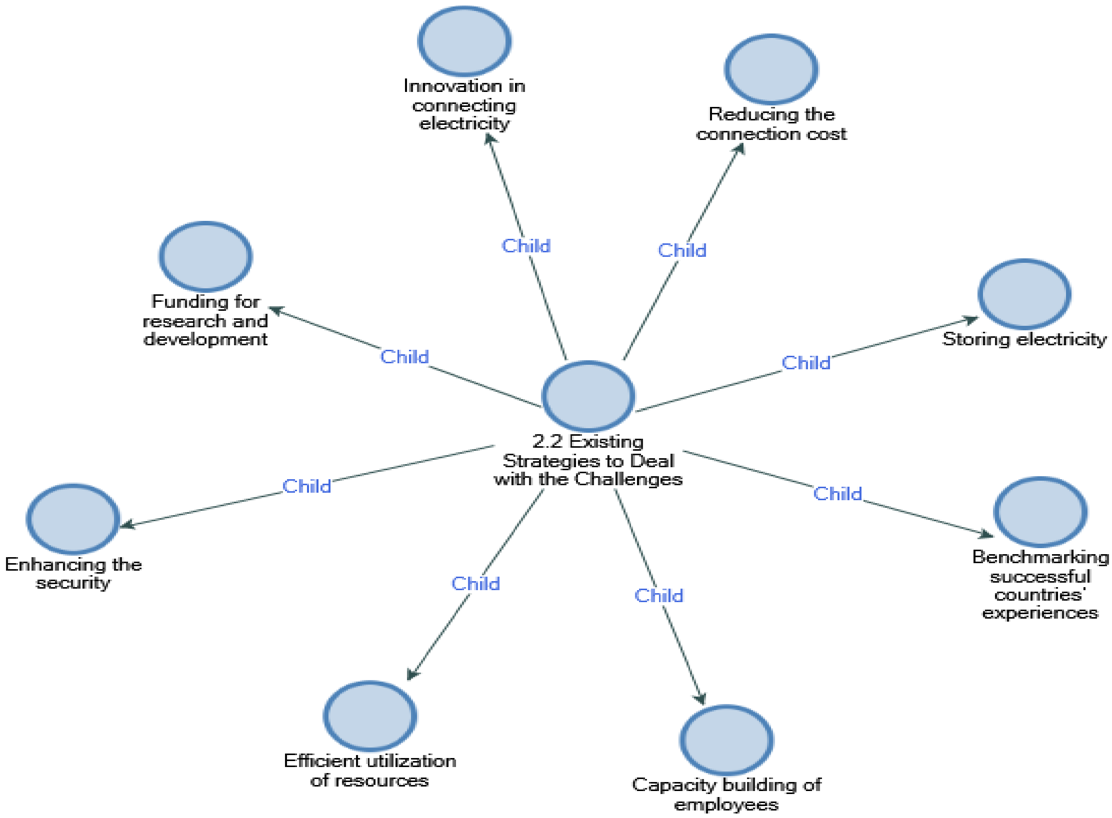


Figure 21: Existing Strategies to Deal with the Challenges with Associated Codes

Table 27: Existing Strategies to Deal with the Challenges with Associated Codes

Name	Coded segments from participants' responses
Benchmarking successful countries' experiences	*Benchmarking according to countries' successful experience in better management.*
Capacity building of employees	*Training more staff to operate and maintain the electricity grid stations.*
Efficient utilization of resources	*Employing better methods of managing employees*
Enhancing the security	*Increasing the security of the electricity stations.*
Funding for research and development	*Liaising with the government for research and development funding.*
Innovation in connecting electricity	*Developing new methods of connecting electricity.*
Reducing the connection cost	*Reducing the costs of connecting electricity to increase the supply.*
Storing electricity	*Employing better methods of storing electricity.*

4.6.3.3 Outcomes of Existing Strategies

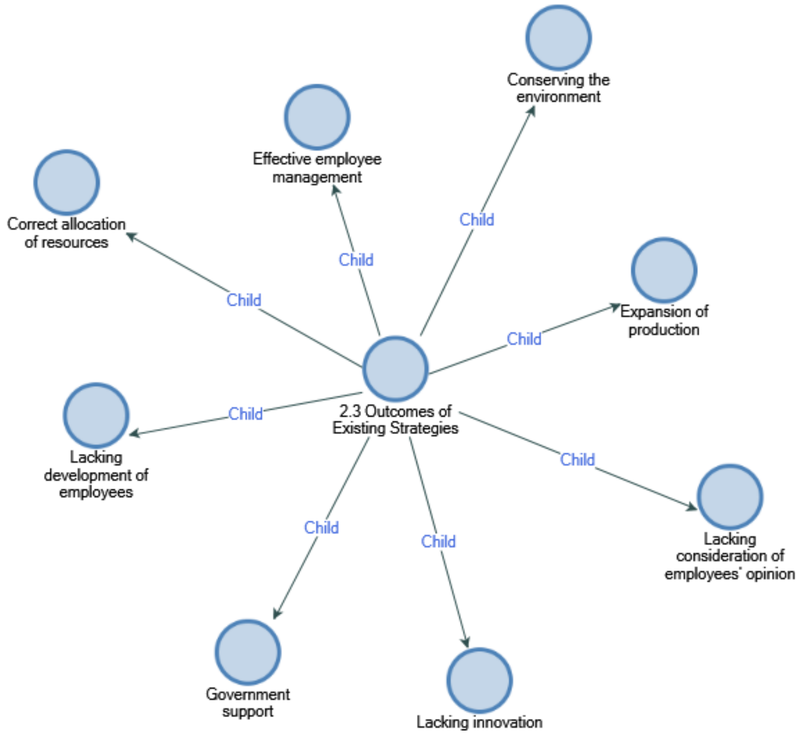


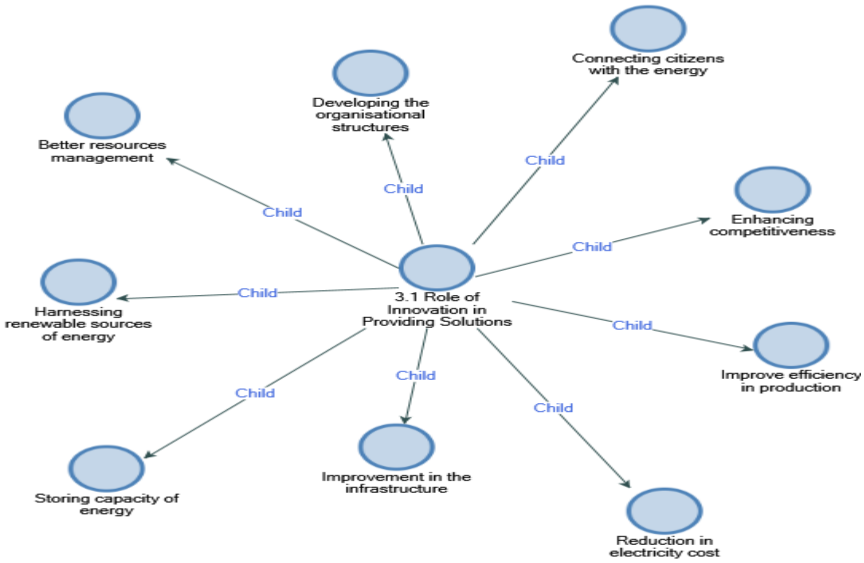
Figure 22: Outcomes of Existing Strategies with Associated Codes

Table 28: Outcomes of Existing Strategies with Associated Codes

Name	Coded segments from participants' responses
Conserving the environment	*Yes, because they are conserving the environment.*
Correct allocation of resources	*No, because they do not promote competition.*
Effective employee management	*Yes, because they facilitate effective employee management.*
Expansion of production	*Yes, because they facilitate the expansion of production.*
Government support	*Yes, because they are supported by the government.*
Lacking consideration of employees' opinion	*No, because the organisation does not consider the opinion of experts and professionals who are employees in the organisation for any development decisions; rather, only the organisations 'leaders' are.*
Lacking development of employees	*No, because they do not incorporate investment to improve the educational and professional practices of the employees.*
Lacking innovation	*No, because they have not incorporated innovation strategies.*

4.6.2.4 Innovation in Electricity Organisations

The theme "Innovation in Electricity Organisations" was comprised of three axial codes: The Role of Innovation in Providing Solutions, Utilisation of Innovation in Combating Challenges, and Suggested Innovative Approaches.



4.6.2.4.1 Role of Innovation in Providing Solutions

Figure 23: Role of Innovation in Providing Solutions with Associated Codes

Table 29: Role of Innovation in Providing Solutions with Associated Codes

Name	Coded segments from participants' responses
Better resources management	*Provide better methods of managing the employees.*
Connecting citizens with the energy	*Increase the connectivity of energy between citizens of the countries that embraced innovation.*
Developing the organisational structures	*Develop rigid organisation structures that will improve the utilised strategies.*
Enhancing competitiveness	*Enhance competitiveness by increasing the production of energy from renewable energy sources.*
Harnessing renewable sources of energy	*Provide better methods of harnessing renewable sources of energy.*
Improve efficiency in production	*Improve efficiency in production.*
Improvement in the infrastructure	*Improve the quality and reliability of the energy sector's infrastructure.*
Reduction in electricity cost	*Reduce the costs of electricity production by providing alternatives such as renewable energy sources.*
Storing capacity of energy	*Improve the methods of storing the energy harnessed from these renewable sources.*

4.6.2.4.2 Utilisation of Innovation in Combating Challenges

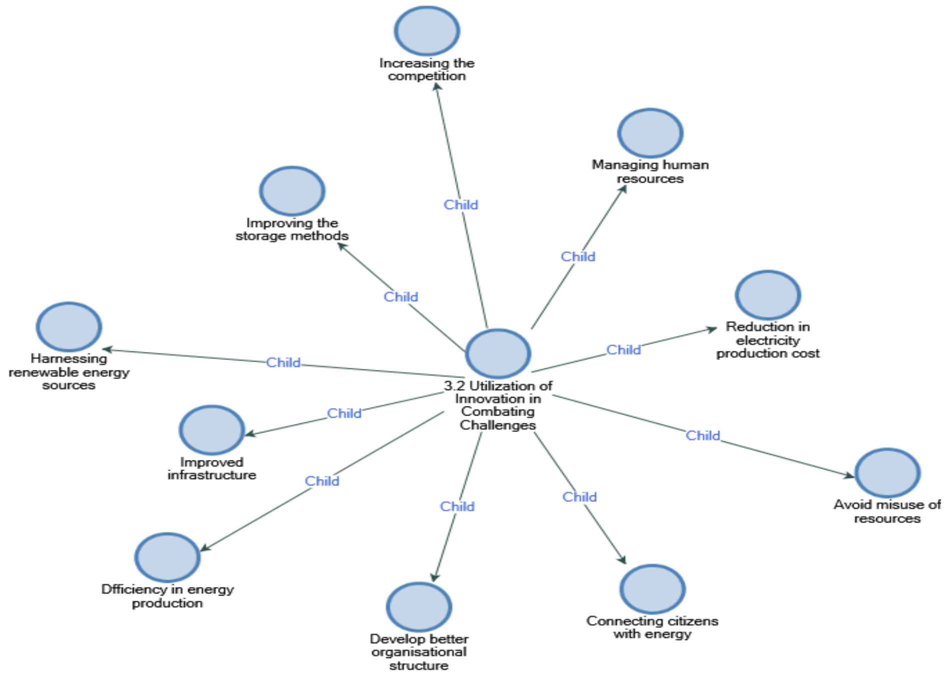


Figure 24: Utilisation of Innovation in Combating Challenges with associated codes

Table 30: Utilisation of Innovation in Combating Challenges with associated codes

Name	**Coded segments from participants' responses**
Avoid misuse of resources	*To provide better methods of managing resources to avoid misuse of resources.*
Connecting citizens with energy	*To develop new methods that increase the connectivity of energy among citizens locally and between nearby countries.*
Develop a better organisational structure	*To develop better organisational structures.*
Deficiency in energy production	*To improve efficiency in energy production.*
Harnessing renewable energy sources	*To provide better methods of harnessing renewable sources of energy.*
Improved infrastructure	*To improve the quality and reliability of infrastructure.*
Improving the storage methods	*By improving the methods of storing the electrical energy.*
Increasing the competition	*To enhance competitiveness by increasing the production of electric energy.*
Managing human resources	*To provide better methods of managing the employees.*
Reduction in electricity production cost	*To reduce the costs of electricity production.*

4.6.2.4.3 Suggested Innovative Approaches

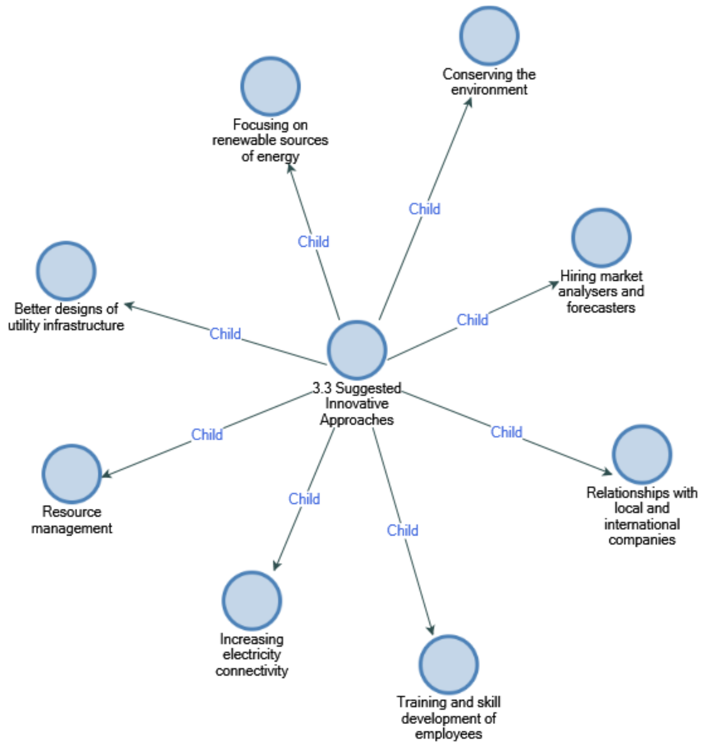


Figure 25: Suggested Innovative Approaches with Associated Codes

Table 31: Suggested Innovative Approaches with Associated Codes

Name	Coded segments from participants' responses
Better designs of utility infrastructure	*Innovating better designs of utility infrastructure.*
Conserving the environment	*Developing better approaches to conserving the environment whilst harnessing electric energy.*
Focusing on renewable sources of energy	*Reducing the usage of fossil-based energy and focusing on renewable sources of energy.*
Hiring market analysers and forecasters	*Increase the number of market analysers and forecasters who will help with approaches to maintaining the market balance by quenching the supply and demand requirements.*
Increasing electricity connectivity	*Developing new and efficient approaches to increasing electricity connectivity.*
Relationships with local and international companies	*Developing new methods of maintaining good ties with other local and international companies.*
Resource management	*Employing proper allocation of resources.*
Training and skill development of employees	*Improving better methods of training employees to have an increased number of skilled staff.*

4.6.2.5 Conclusion of the NVivo Software Findings

There are three major dimensions of findings from the data analysis conducted to determine innovation management within Bahrain's energy organisations: challenges, strategies, and innovation. Currently, energy organisations face several challenges, such as environmental pollution, harsh weather conditions, high research and development costs, high taxes, insecurity, a lack of innovation, a lack of skilled personnel, limited resources to facilitate expansion, poor management, poor organisational structures, etc. The energy sector is also predicting some challenges in the future such as corporate mergers, increased carbon emissions, increased research and development costs, the limitation of water resources, reduced supply, shortage of resources and manpower, stiff competition, and the use of renewable energy sources.

The second dimension regarding innovation was "Strategies for Electricity Organisations," which was investigated in the context of suggested and existing strategies. Some suggestions to deal with the challenges faced by energy organisations include benchmarking with the best practices, efficient management of resources, improving the infrastructure, an inclusive organisational structure, etc. Existing strategies that are being implemented to meet the challenges were also discussed, such as benchmarking against successful countries' experiences, building employee capacity, efficient utilisation of resources, and enhancing security. There are many positive and negative outcomes of the existing approaches, i.e., effective employee management, expansion of production, government support, lack of consideration of employees' opinions, lack of development of employees, etc.

The third concept was crucial, as it comprehensively and categorically discussed innovation management. The discussion incorporates suggested solutions, using innovation to address challenges and recommended other innovative approaches. This discussion led to the role of innovation in providing solutions to energy organisations. These roles include improved resource management, distributing energy to consumers, developing organisational structures, enhancing competitiveness, harnessing renewable sources of energy, improving efficiency in production, improving infrastructure, lowering electricity costs, and increasing energy storage capacity. Innovation is also widely used to combat Bahrain's energy organisations' challenges, such as avoiding wastages, distributing energy to consumers, developing better organisational structures, and addressing energy production deficiencies. Lastly, various approaches to innovation were suggested, including improved designs of utility infrastructure, conserving the environment, focusing on renewable sources of energy, hiring market analysts and forecasters, increasing electricity connectivity, relationships with local and international companies, resource management, and training and skill development of employees.

4.6.3 Nature of Innovation Management Among Energy Organisations

Innovation management has been regarded as the efficiency in management and utilisation of resources for tackling and addressing operational and organisational challenges (Volberda, Van Den Bosch and Heij, 2013). These resources include crucial elements necessary for electricity production, transmission, and distribution, such as financial, human, and natural resources. Innovation management involves using strategies and methods to maximise the growth potential of the energy sector, leading to increased production capacity and profitability. With the exception of profit maximisation and productivity, innovation management is a method for developing and enhancing technological innovations to attract a larger market.

Innovation management is crucial for addressing challenges within the energy organisations in Bahrain. By developing and employing innovative strategies, energy organisations can foster technological innovation and attract a larger market while harnessing electric energy from limited resources. Adopting innovation management also improves risk management, reducing the likelihood of losses or collapses that could affect profitability and productivity. With an efficient innovation strategy, Bahrain's energy organisations can better manage potential risks and maximise their growth potential.

It is not possible to discuss innovation management without emphasising proper organisational structure. Organisational structure refers to how the different functional systems or parts of an organisation, enterprise, or company are arranged. In an electricity energy organisation, the different functional structures consist of the production department, planning, transmission, management, distribution, human resources, finance, and others. The organisation can exist and function because of the coexistence of these departments and structures.

Therefore, innovation management in energy organisations helps in improving the efficiency of the organisations and their functions to boost production capacity. Furthermore, within the organisational setting of energy companies, the fundamental structures or departments need to be in contact with each other; that is, workers and employees need to communicate as much and often as possible for the organisation to function well. Innovation management strategies could significantly improve the communication channels between the employees and managers when implementing improvements to the production process.

4.6.4 Challenges Confronting Bahrain's Electricity Organisation Transition to Decentralised Models of Power Generation

Adopting new policies or processes of change comes with different setbacks. This is one major hurdle many organisations face while transitioning from one system of operation to another. Challenges arise due to a new mode of operation, system, and structure, which energy organisations must adapt to by providing means to thrive while combating such challenges. The decentralised model of electricity production, which major and several energy organisations are currently diversifying into and adopting, has many setbacks that affect and hinder the means of operation and production of these organisations. These challenges included and were supported by qualitative data narratives.

The research's findings revealed that the energy sector is suffering from limited human resources. The decentralised model of power generation is characterised by a more technical and advanced mode of operation that requires more resource input to manage. However, it was established from the research that energy organisations in Bahrain were plagued by the unavailability of manpower, and the available workers do not possess the necessary skills. One participant declared that the "*lack of skilled workforce in the energy sector is impeding the transitioning to a decentralised model of operation systems*." This response implies that the energy sector in Bahrain is faced with a significant challenge, which means that any efforts for innovation management in the energy sector are negatively affected.

Moreover, the research has revealed other challenges related to managerial and market policies. The new model of electrical power generation by energy organisations in Bahrain comes with new developments, such as Market Policies and Managerial

Policies. Some of these policies lead to changes in operational activities and resource allocation, resulting in disequilibrium in the process of energy production and market non-convexities from market failure. With the changing marketing policies, there will be difficulty in adapting to the new markets, which stems from rigid organisational structures. One of the participants stated that "*changes in management and market policies make it difficult for the energy sector to transition to a decentralised model of production.*" There has been unequal resources allocation in the Bahrain's energy sector, which means that any attempt at innovation management in the energy sector has been significantly affected. Therefore, addressing these imbalances will greatly enhance the prospects of improving the energy sector

Inadequate resources for generating and transmitting electricity were an additional challenge. As mentioned earlier, the new power generation model requires additional resources. This is in line with one respondent's revelation that "*the energy sector lacks appropriate and enough resources including financial and human resources. Diverse resources are essential for the holistic operation of an entity since firms function as systems*." These findings are clear indications that the energy sector in Bahrain indeed has serious issues that can only be solved through effective adoption and implementation of robust innovation management in the entire sector. Equally, the findings from this report imply that diversified resources are necessary for the optimal and economical operation in the energy sector, which will have an impact for the entire economy. Higher-grade infrastructure and facilities are needed to support the higher electricity transmission rate. This raises the question of whether the current nature of the infrastructure and facilities of those energy organisations in Bahrain transitioning to the decentralised model is able to meet the features required to operate in the new model.

Thus, if these high-grade facilities are not implemented, there will be an unbalanced cycle of electric power (disequilibrium), which results in insufficient generation capacity. Therefore, it creates a situation where the power supply cannot meet the high demand from consumers.

Furthermore, the energy sector lacks the financial resources for the Volterra production and transmission of electric power. One interviewee noted that "*limited funds as a resource factor hinder the general operations of the energy sector, and the state should allocate more financial resources to the sector to enhance its production*." The lack of financial resources is a major setback many electricity organisations face while transitioning. The need to expand all means of electricity generation comes with additional expenses that can be challenging for some of these organisations. Some of the decentralised power stations also face operating challenging due to a lack of subsidies.

The next challenge is the sabotage of electrical facilities. The destruction and disruption of electrical facilities such as power stations by external threats is a common issue faced by several Bahrain's energy organisations. Electrical equipment and facilities were deliberately damaged and vandalised, sometimes reported stolen. Fraudulent activities, even within the organisation itself, are another common threat. In this regard, one respondent pointed out that "*Vandalism has hindered the efficiency of the energy sector throughout the country. Some people damage and steal electric cables so that they can sell and get money. In the process, there is power distribution breakdown, and replacing such cables is expensive.*" If vandalism, which impairs the efficiency of the Bahrain energy sector, is not promptly addressed by the appropriate authorities, the innovation management initiatives in the sector may suffer adverse consequences.

Furthermore, one respondent stated that environmental pollution arises from the indiscriminate disposal of electrical by-products*: "Waste disposal from the energy industry contributes to all sorts of environmental pollution*."

Therefore, the research findings ascertain that all of the above issues pose serious threats and challenges to many of these energy organisations both during the process and after transitioning to decentralised power generation models and hinder their development and performance.

4.6.5 Innovation Management Strategies Adopted and Implemented by Electricity Organisation Transiting to Decentralised Models of Power

Despite the numerous challenges faced by the electricity organisations after transitioning to decentralised power generation models, some innovation management strategies have been adopted and implemented successfully by these organisations in their various operations. The provision of resources for major projects has been one of many significant strategies that some electricity organisations have adopted. These resources can take on various forms, including human resources, financial resources, equipment, grants, subsidies, and so on. One respondent stated, *"The government should allocate more funds to the energy sector to upsurge its productivity rates and ensure that workers get better salaries to motivate their morale."* Effective and significant policies and regulations to guide the mode of operation and management of electricity organisations are significant innovation management strategies that many electricity organisations in the Kingdom of Bahrain have successfully implemented.

The analytical research of consumer behaviour and demand trends in the energy market is a type of innovation management strategy, which has been effective and successful in assisting these organisations in understanding the market structures in order to fulfil customers' rising demand for electricity. Coupling customer support with the provision of services has helped increase customer satisfaction during electricity transmission, resulting in improved profitability and productivity of the electric organisations in Bahrain. One of the respondents mentioned that "*The government needs to imitate and embrace the adoption of market strategies from other Middle Eastern regions that have proven to be effective as a significant innovation management strategy in order to establish and improve competition between electricity organisations in Bahrain."* The transmission of energy to Bahrain's citizens in different parts of the country can only be enhanced by adopting innovative management strategies in the energy sector.

Furthermore, several energy organisations have implemented a key strategic step to develop available personnel or human resources through employee empowerment. Employees of major energy organisations have been trained to understand and follow the total quality management (TQM) strategies of their companies, which will boost their level of performance by improving their skills. A respondent stated the following related to this "*The energy sector needs a competent, skilled workforce to realise effective results in energy production. As such, the experts have the necessary skills and knowledge required to improve the sector while holistically meeting the needs of people*."

Lastly, another effective strategy that energy organisations have implemented is the setting up of quality standards to help ensure that the operations of the organisations are carried out with standardised protocols, such as the generation, transmission, and distribution of electricity. To sum up, one respondent mentioned that "*The energy sector* *requires an operative quality assurance team that will be able to conduct regular and accurate assessments for quality improvement. The feedback from reports should be used to fill in the production gaps and enhance energy production."* This implies that effective implementation of quality standards and strategies can significantly improve Bahrain's energy sector by adopting robust innovation management strategies.

4.6.6 Innovation Management Strategies in Tackling Issues Facing Electricity/Energy Organisations

The different forms of innovation (innovation management strategies) implemented by electricity organisations in Bahrain have been instrumental in addressing major challenges that limit their productivity and efficiency. Consequently, many electricity-producing organisations have been able to utilise these innovations effectively and manage their challenges. Innovative strategies are used to develop a quality management system to improve the organisation's structure and assure efficient operations such as power generation and supply to consumers. With a quality management system established by the electricity organisations, operational activities are increasingly organised, and that the organisations become well-structured, and both the management and employees function effectively. In this regard, one interviewee mentioned that "*Innovative strategies help quality management respond to consumer needs. Bahrain's energy industry has embraced such strategic plans for supplying energy throughout the country in order to minimise the difficulty of a shortage of electricity.*" This implies that the effective adoption of innovative management strategies will significantly improve the efficiency of the energy sector in Bahrain.

As stated earlier in the previous section, efficient utilisation of resources has been a major innovative strategy that electricity organisations have implemented in

Bahrain. These organisations are actively developing and implementing new methods to optimise their resource utilisation with the goal of maximising profitability. This strategy has proven to have a significant role in combating challenges related to shortages and limited resources to produce and generate electricity, which will further facilitate electricity production with fewer input costs and greater output. The type of innovation utilised by the electricity organisation was to introduce new methods of managing employees and adopting measures to increase number of skilled personnel to work within their organisations. Additionally, they also adopted new methods in producing electricity, particularly in terms of storage and harness, which ultimately improves the efficiency of electricity production. In this regard, one respondent declared that "*Innovation management is the best strategy for empowering the energy sector.*" This implies that adopting effective innovation management strategies can largely help to ensure efficiency in the energy sector. Another key innovative approach or strategy being used by electricity organisations in Bahrain is the application of new technologies to produce electricity and the improve competitiveness by increasing the production of electric energy. Therefore, one interviewee summed up that "*Implementing innovative management in the energy sector through the state of Bahrain is the only strategy the government could use to tackle the challenge of electricity issues once and for all.*" This implies that the adoption of innovation management in the Bahraini energy sector is paramount to ensuring efficiency and energy delivery to the citizens.

4.6.7 Factors Affecting the Implementation of Innovation Management by Electricity Organisations

There are several factors that affect or hinder the implementation of effective innovation management. These factors determine the organisations' operation, organisation, and execution of their production activities in Bahrain. They are categorised as internal and external factors. Internal factors exist within the organisation itself, which determine and influence operations as well as the organisational structure. In contrast, external factors are those resulting from third parties or not within the organisation. These factors mostly affect the productivity and profitability of electricity organisations.

4.6.7.1 Internal Factors Hindering the Implementation of Innovation Management in Electricity Organisations in Bahrain

Internal factors are inherent to an organisation and arise from its operational and management systems, as well as the effective utilisation of resources, among other aspects. These factors affect the structure of the electricity organisation, the rate at which operations are being carried out, internal policies, and innovative strategies. The narratives of the interviewees supported the subsequent research's findings.

The research findings revealed that limited and poor human resources hindered the implementation of innovation management. The non-availability of adequate human resources in the form of skilled manpower, technical expertise, and efficient management systems affects the electricity organisations' ability to develop and implement effective innovation management systems. One respondent stated that "*The energy sector lacks highly skilled human resources to integrate innovation management and produce sustainable energy for the state and global consumption*." Therefore, it is imperative for the state and energy organisations to establish a competent management system and ensure adequate human resources are available within an electricity organisation. These features significantly motivate individuals to be innovative in implementing effective strategies that could improve their productivity and profitability.

Moreover, a lack of operational and production resources hampers electricity production. One of the respondents supported this notion by asserting that "*the energy sector within Bahrain lacks enough production resources to embrace fully the implementation of innovation management*". This means that robust strategies must be in place to ensure that the energy sector can fully embrace the concept of innovation management. Facilities and equipment (operational and production resources) should be available to facilitate the implementation of innovation management strategies. If these resources are not readily available or are insufficient, implementing effective innovation management strategies becomes challenging and not feasible. Thus, the extent and availability of infrastructure in electricity organisations are major determinants and influences on implementing innovation management strategies.

Lastly, organisational and managerial issues were determined to be internal factors. From the prospective of Bahrain's electricity organisations, the capacity and ability to implement innovation management strategies, their organisational structure and system have to be void of internal issues. Such issues include employee and employer conflicts and friction between the different departments or areas that enable the departments to function together. In addition, employees need to be trained to understand and adhere to the organisational policies and regulations. If these are absent in an organisation, the adoption and implementation of innovation management become challenging, and even if implemented, it may not be successful in achieving its purpose. One of the respondents concretized that "*Like any other organisation, the energy sector of Bahrain is also facing leadership wrangles that have led to poor management hindering the effective implementation of innovation management to attain high energy production, more especially electricity*." This implies for the implementation of innovation management necessitate efforts to be in place to eliminate any obstacles, such as weak leadership, that can negatively impact the sector.

4.6.7.2 External Factors Affecting the Implementation of Innovation Management in Electricity Organisations in Bahrain

External factors occur outside of an organisation such as governmental, competition, and environmental constraints. Similar to the internal factors highlighted, these factors also hinder and affect the implementation of innovation management within Bahrain electricity organisations. The major external factors are outlined below with supportive assertion by the interviewees.

In terms of environmental issues, the research findings revealed that unfavourable climatic and weather conditions are considered to be major setbacks for the electricity organisations. Environmental issues could also stem from indiscriminate waste disposal or by-products from electricity organisations that become harmful environmental pollutants. One respondent asserted that "*The energy sector is the leading polluter of the air in Bahrain."* These environment concerns cause disruption in their operational and production activities, thus affecting their ability to develop and implement suitable and effective innovation management strategies to combat their challenges.

Market and governmental policies also influence the implementation of innovation management. The research revealed that policies formulated by the market regulators significantly affect electricity organisations, as some of these policies are unfavourable, and present as a challenge in their implementation. One interviewee mentioned that "*Government policies, just like market policies, hinder the* *implementation of innovation management strategies in Bahrain's energy sector*." Examples of such policies are related to production processes, employees' welfare, resource acquisition, and several others. Therefore, unfavourable policies may prevent electricity organisations from implementing appropriate innovation strategies.

Lastly, the research findings indicate that insecurities are another crucial factor that impedes the implementation process of innovation management and the operations of Bahrain's electricity organisations. One respondent mentioned that "*insecurity leads to a lack of secure systems that can encourage both the government and investors to empower the energy sector, thus hindering the implementation of innovation management strategies*." Insecurity, such as an attack on power stations, vandalism, and destruction of electricity facilities and equipment, all of which limit and hinder the ability of electricity organisations to implement innovation management strategies.

4.7 Findings of the Secondary Data Analysis

The purpose of using secondary data analysis was to supplement primary data analysis. Such secondary data are those gathered on the internet and online academic materials that are related to the factors affecting the utility companies in the Kingdom of Bahrain, such as electricity, solar, and water companies. These data also comprise information obtained from general meetings of GCC nations or yearly reports from various electricity organisations. Analyses were conducted on such information while exploring the vital elements or relevant data gathered from publications such as government reports, consultant reports, contractor reports, and industry white papers. The analyses will help to identify the challenges and barriers, develop methods to curb these challenges and obstacles, and recommend future plans that the Kingdom of Bahrain and the group of GCC states to develop the utility sector in the future.

4.7.1 Government Reports

The government of Bahrain has identified the need for sustainability in the energy sector, as reflected in various reports (Seo, 2017). The management of solar and wind energy resources is one of the key areas of focus for the government. Both the private and public sectors of renewable energy are expected to be managed efficiently to ensure optimal utilisation of resources. In line with this, the government has set up a sustainable energy unit to develop policies that will regulate energy-related activities for all the public and private companies. (Jafari et al., 2015). This unit was also tasked with rationalising the country's energy usage while assisting in the coordination of synergy among all the correlated parties in the country. In 2014, the unit was dissolved and replaced with National Renewable Energy Action Plan (NREAP), where its purpose is to help the country reach its energy sustainability objectives and adapt efficient management.

According to the government reports, more than 10% of the country's solar and wind energy is expected to be harnessed every day by 2035 since the resources are available but remain untapped. To achieve this objective, the latest technologies will need to be utilised to collect energy from wind and sun around the country (Alsabbagh, 2019b). These technology systems will also help in controlling greenhouse gas emissions and indigenous gas resources in addition to increasing production, which will enable the country to compete with other countries in terms of quantity and quality of energy produced, as well as economic growth (Sea.gov.bh, 2021).

The government is working towards increasing the efficiency of tapping the renewable energy sources while also working with other countries to conserve the environment and help to solve the main problem of climate change. The Paris

Agreement, in which countries from all continents came together in December 2015 to discuss and agree on lowering the world's carbon emission, is one of the treaties in which the government of Bahrain has participated (Seo, 2017). This means that Bahrain made an official pledge to support the action by advocating for a reduction in the use of fossil-based energy in favour of renewable energy sources that are both adequate and abundant in Bahrain. This will not only assist in reducing greenhouse gas emissions in the environment, but it will also help to save the environment. This was done to ensure a significant change in the Kingdom of Bahrain's energy harnessing and management.

4.7.2 Contractors' Reports

The Bahrain government has launched a number of programmes aimed at improving harvesting and production efficiency in wind and solar energy. As the city planners' contractor reports indicate, district cooling is expected to advance at a greater level in the residential sector. A green construction initiative has also been started to ensure that all new buildings in Bahrain are equipped with cutting-edge wind and solar energy harnessing technology. Bahrain, for example, has advocated for the development of modern building designs that not only provide shelter but also to take advantage of renewable energy (Zawya, 2020). This can be accomplished if building architects and city planners can design structures that use and generate renewable energy to be used in daily activities while also including the equipment to store the energy for later use or to be directed to the country's national electric grid. The Bahrain World Trade Centre Towers that faces the Arabian Gulf is an example of such buildings. These buildings are constructed in such a way that they can be utilised to harness both solar and wind energy, both of which are abundant in the area. Both buildings have 50 stories each.

The development of such buildings requires the integration of airflow dynamics, which creates negative pressure in the area that the wind passes through, increasing the velocity of the wind and facilitating effective energy harnessing. According to government reports, a large number of integrated wind turbines are being constructed to ensure that new buildings, particularly in high-wind locations to trap the maximum amount of energy. The constructors' reports indicated a surge in the construction sector due to the increased infrastructure investment. The Kingdom of Bahrain contributed to the substantial flow of capital for the expansion of industries where Bahrain awarded $4.1 billion in tenders in 2020 and also became the top in the energy and construction list in 2021. Construction has been estimated to account for over 8% of the total economic activity and growth. The real estate sector accounts for about 4% of the total percentage of economic activity and growth, while the manufacturing sector exhibits similar percentage. This growth is due to government-backed infrastructural developments that are projected to boost Bahrain's economy in the short and medium term.

4.7.3 Consultants' Reports

The National Energy Efficiency Action Plan (NEEAP) has conducted consultations in order to assist GCC countries in reaching their long-term energy efficiency objectives. In this context, Bahrain's sustainability energy unit represents the country at the United Nations Development Programme. This is where all League of Arab States members meet for consultations and experts analyse the Energy Efficiency Guidelines of LAS and record the results on how to successfully increase the country's production and harnessing of renewable energy sources. (UNDP Jobs: 58619: Consultant and Expert to Support Bahrain's Sustainable Development, 2021).

Additionally, there have been records of increased oil production in recent years, particularly from projects that emerge from oil basins such as the Khaleej Al Bahrain Basin. The increased production should be incorporated with advanced technology that will enable Bahrain to collect millions of barrels of oil and gas. Due to the BAPCO development plans, a significant amount of capital has been invested in ensuring that the country's energy adequacy outperforms other sectors, allowing for significant profits from exports.

With the emergence of the COVID-19 global pandemic, the country also encountered difficulties in construction projects. The constructor's reports stated that the country only achieved a 0.5% increase in project completion compared to previous years. Nonetheless, they aim to recover by the end of 2021. International airports and metro rail projects are some of the significant construction focus points that the Kingdom is trying to achieve despite the adverse impact of the pandemic (Worldbank.org, 2021). The government has ensured that billions of dollars were invested in the construction industry in order to raise the rate of construction completion (WIRE, 2021). The government was also seeking to develop a solid foundation to support and increase the country's production through improving the existing infrastructure to accommodate the latest and most efficient technology.

4.7.4 Case Studies Findings

Bahrain is one of the Gulf Cooperation Council countries that has ventured into more than six renewable energy sources. As a result, several industries have been developed to tap into the production of these energies. This section will focus on the case studies linked to Bahrain's energy projects. Major energy industries concentrate on the following areas: green building, solar energy, tidal energy, general renewable energy sources, hybrid renewable energy systems, and wind energy.

The Ministry of Electricity and Water Affairs has awarded contracts to several industries in Bahrain. One such contract was awarded Fichtner Consulting Company of Germany to provide consultation on renewable energy production in Bahrain. The services conducted by this company include field preparation for the techno-commercial research of the energy products market and conducting site assessments in order to assess the Bahrain's renewable energy harvesting sites. The company was also expected to conduct field measurements of renewable energy sources such as solar and wind to determine the harvesting potential within a particular time, i.e., the amount of production per hour (Kranti and Dubey, 2018).

Since 2010, Bahrain has focused on developing clean energy projects as it would be both economical and can contribute to the conservation of the environment within the area of production of the energy. To accomplish this, eco-friendly technology has to be deployed to harvest the energy and convert waste into usable energy. As a result, the Ministry of Electricity and Water Affairs in Bahrain employed a French financial company Constructions Industrielles de la Mediterranee (CNIM), to handle waste energy production. They are to use 390,000 metric tonnes of domestic waste from Manama to generate over 25 MW of electricity. The project's commercial benefits will contribute to the country's development while also promoting environmental conservation through the recycling of waste materials. Another advantage is that waste materials will never run out because domestic waste are always available. Thus, the more waste materials the company collects, the more electricity can be injected into the national electricity grid (Default, 2021).

The Saudi Aramco Oil Corporation is one of Bahrain's most prominent companies. The strategic analysis of the oil company revealed that it explores and processes crude oil and natural gas obtained in Bahrain. In addition, the company manufactures petroleum products that are distributed all over the world. The company collaborates with the Bahrain Petroleum Company (BAPCO) to facilitate the construction of oil pipelines throughout the country in order to efficiently integrate into the oil market with the Bahrain government and merchants.

The pipelines are made using cutting-edge technology to prevent spillage or any incident that might jeopardise the safety of Bahrain's citizens or worsen the country's environmental condition. The pipelines constructed by these two corporations can transport more than the equivalent of 350,000 barrels of crude oil per day across Bahrain (Saudi Aramco and BAPCO meet Bahrain's growing energy demand, 2021).

However, some of the limitations affecting this connection are the constant attacks on the oil facilities on Saudi Arabian and Bahraini soil. For example, Saudi Aramco Company had to cut off the oil supply to Bahrain in 2019 owing to terrorist attacks on its oil facilities. As a result of the attacks, BAPCO had to reduce production to 22,000 barrels per day, which is a significant loss. The BAPCO Company also had to lower part of its production by up to 45%, greatly affecting that country's economy (Staff, 2021).

In addition, Bahrain has signed contracts with the international finance organisations to invest funds in companies' projects to support them with any expansion costs. An example is the GDF Suez and Kuwait Gulf Investment Corporations, which invested billions of dollars in energy projects, especially in the power project expansion conducted by the AlEzel power company. The company used the funds to generate over

1,000 MW of energy per day. This loan was provided by two financial companies and two Islamic banks, demonstrating the value that Bahraini placed on the project. Furthermore, both the government of Bahrain and other countries in the Gulf Cooperation Council benefited from this project; hence, efforts were made by all the GCC nations to ensure the project's success (Staff, 2021).

Furthermore, building development in Bahrain was prioritised since construction must be sustainable and green. Bahrain's need for sustainable buildings has surged in recent years, as the newly developed buildings are expected to utilise wind and solar energy for their operations. Apart from that, the buildings are expected to have employed Building-Integrating Photovoltaic (BIPV) technology, which uses the sun's rays to generate renewable energy that can be stored for later use. Since it is a solar energy, it is categorised as green energy (Pillai and Naser, 2017). The development and construction of these buildings will improve the conservation of the environment and reduce the daily reliance of fossil-based energy (Alnaser and Flanagan, 2007).

4.8 Outcome of Thematic Analysis

This section is divided into four themes. The topics cover facilitators and barriers to innovation management, implementation status, and best practices in innovation management.

4.8.1 Theme 1: Facilitators of Innovation Management

Several factors must be considered for effective implementation of innovation management strategies. First, it is important to establish clear objectives for the implementation of innovation management. This helps to ensure that all employees are well informed and understand the importance of change (Chen and Huang, 2009).

Effective collaboration among employees is also essential, and company leaders should promote harmony to support and execute the plans related to innovation management. To encourage innovation, outdated management styles or procedures should be replaced with new, goal-oriented techniques that inspire employees in the right direction. This can lead to changes in the organisational structure and culture. Assigning clear roles and responsibilities to each company employee is also crucial to ensure everyone understands their actions that will move company forward in innovation management. This helps the employees to feel a sense of direction and encourages them to play their part to the best of their ability. Finally, the motivation of employees and other members of the organisation is a key facilitator in innovation management. When employees are motivated, they are more likely to improve their performance and job satisfaction, which can lead to a successful implementation of innovation management strategies.

4.8.2 Theme 2: Barriers to Innovation Management

One of the significant barriers identified was a lack of collaboration from employees and other workers in the organisation, especially when they perceive the management as disorganised or ineffective. In addition, the lack of proper organisational structure and culture demotivates the employees. This often leads to poor performance and hinders the company's proper implementation and functioning of innovation management.

Lack of finances or proper support from the government or other sources can lead to stagnation in the company's development plans, resulting in a negative impact on production performance in both the long and short run. Lack of adequately trained employees, especially in organisations that have not invested employees training increases the difficulties in making progress as the employees do not have the necessary skills to perform under innovation management.

Lack of motivation or vision for employees in the company not only affects the work rate and performance of the employees, but also contributes to the development of negative work situations that impair general productivity, such as conflicts and increased employee turnover rates.

4.8.3 Theme 3: Implementation Status of Innovation Management

During the stage of implementation of innovation management, company leadership is typically interested in making new changes that align with the strategies being introduced. This requires efforts from both the leaders and employees to strategize and craft a plan that develops a better understanding of the actions needed and identify the elements to be eliminated to implement innovation management that will benefit the company.

The efforts of every employees throughout this process are critical because the managers would establish the right tone for the adoption and execution of innovative strategies, and the rest of the company is more likely to follow and act accordingly. During this process, the company's primary objective is to take advantage of innovation management to maintain and improve its competitive edge over competitors operating in the same industry, both locally and globally (Igartua and Albors, 2011). This means that the company should ensure that they have correctly, if not ideally, allocated and used the resources to help improve productivity.

4.8.4 Theme 4: Best Practises for Innovation Management

Adopting better organisational structures motivates and empowers individuals to change the dysfunctional organisational cultures in which they previously worked. Furthermore, appropriate training of new and existing employees that are underperforming would get them to be aligned with the company's objectives and avoid becoming a barrier to boost the company's productivity. Every member of the company needs to understand their roles and articulate their responsibilities since it is only then that innovation management will be easily implemented in the company.

Employees motivation and appreciating their efforts is one of the best practices will reduce the employee turnover rate as well as being a source of encouragement and inspiration to other employees that underperforms.

Finally, the company should ensure that the following five areas are properly handled: human resources (HRM), innovation strategy, creativity and idea management, selection and portfolio management, and implementation management (Calza, Parmentola, and Tutor, 2017). Better performance in the above five sectors will help the company to realise its new heights and improve innovation, as all the employees will be inspired to work better.

4.9 Chapter Summary

The results and findings of the analysis carried out during the research were presented in this chapter. The research adopted a mixed-methods research design that involved the use of qualitative and quantitative methods of data collection and analysis. Interviews and questionnaires were used as part of qualitative and quantitative methods respectively. Through these methods, I was able to gather primary data, which were all used in this research. Ten participants were interviewed, and a hundred individuals participated in the survey. The questionnaires asked in the interview stemmed from the research objectives of the research. The responses from the participants were then used in constructing the questionnaires used in gathering quantitative data.

The primary data analyses were carried out in two phases: the qualitative method of analysis and the quantitative method of data collection. The responses from the interviews were compiled into an interview transcript, which was made up of two parts with different sections, all based on the nature and type of questions asked by the researcher. Due to the nature of the interview transcript and the research, the data was analysed manually using NVivo software This involved reading the gathered data as well as listening to and transcribing recorded data, organising and sorting them into groups using various criteria as well as identifying key terms, words, and sentences. The themes presented in the collected data were then identified in relation to the research objectives and arranged accordingly.

On the other hand, quantitative data gathered through the questionnaire survey was subjected to computational analysis using the SPSS 26 statistical package. The analysis involved three sections: descriptive statistics, preliminary analysis, and hypothesis testing. Descriptive statistics involve the description of the observations in the data set by using frequency, percentage, mean, and standard deviation. The description of variables was also presented and visualised using graphs, charts, and tables.

Preliminary analyses were also carried out, which comprised both a reliability test and a normality test. The reliability test was conducted using Cronbach's alpha analysis, and the result showed that the item scale variables were reliable and consistent.

The normality test was carried out through the Kolmogorov-Smirnov and Shapiro-Wilk tests. It revealed that the item scale variables were not normally distributed or deviated from a normal distribution.

Correlation analysis and the multiple linear regression model were utilised to test the two hypotheses formulated in the research. The first hypothesis was tested using a correlation analysis, which returned a statistically significant result, while the second hypothesis was tested using a multiple linear regression model and was acceptable. The discussion of the findings and results is presented and reported in Chapter five.

Chapter 5

5. DISCUSSION

5.1 Introduction

This chapter outlines the discussion of the findings from the analysis presented in Chapter 4. The themes will be presented in line with the research objectives. The findings and results from the research will be backed and supported by relevant literature materials (secondary data). The nature of the innovation management system among electricity and energy organisations in Bahrain is the focal point of this discussion.

The interviews conducted explore brief ideas pertaining to the expansion of Bahrain's innovative outputs with the respondents. The discussions provided by the respondents could be categorized according to their opinions on the individual that is suitable to be leading the innovation management in Bahrain. The discussions followed these topics: industry or enterprise lead, education lead, and policy lead. It should be noted that these discussion themes overlap and are not mutually exclusive.

5.2 Research Discussion

This research discussion aims to analyse the status of innovation management in the Kingdom of Bahrain and the conclusions of the current research on the debate about innovation management. To accomplish this, most of the problems impacting utility companies and the whole country will be extensively examined and assessed to find potential ways to handle these barriers and challenges. Analyses were conducted on both the primary and secondary data. The primary data was collected from the questionnaire responses and interviews, and secondary data was collected from published online articles, government reports, consultants' and contractors' reports, and industry white papers.

The main aim of this research is to examine the past, present, and future plans of innovation management in the Kingdom of Bahrain. Therefore, this will also include information from the GCC states and the League of Arab States due to their close regional proximity. Such information is important as it analyses the regional performance in order to obtain more information about the electricity companies and its international relations pertaining to competitiveness with other countries for the same resources. Finally, the researchers will provide the recommendations and plans established for the performance of Bahrain in the future. In addition, recommendations be presented, which will most likely contribute towards changes in the innovation management within the energy sector in Bahrain.

These findings are significant in terms of determining the knowledge related to innovation management and addressing the persistent challenges confronting the energy industry in the Kingdom of Bahrain. This is crucial in the provision of high-quality and affordable services within the energy sector.

The following sections will address the discussion in relation to each of the three research questions. The first research question is, "What are the current and emerging external and internal factors affecting Bahrain's Electricity and Water Authority (EWA)?". The second question is, "What strategies and innovations are being implemented by the Electricity and Water Authority (EWA) in Bahrain in response to the challenges?" The third research question is "What modifications have been implemented by the Electricity and Water Authority (EWA) in Bahrain in response to the major challenges arising from the adoption of decentralised models of energy production?"

5.2.1 First Research Question

The following are the main challenges identified in response to the first research question: Bahrain's electricity organisations' current and emerging difficulties. The lack of sufficient funding from the government, governmental organisations, and non-governmental organisations poses a significant challenge to the electrical organisations, hindering their ability to employ an adequate number of personnel and access novel technological resources required to increase their renewable energy production. Despite this, the government and other GCC countries are constantly seeking financial institutions to provide the necessary funding to resolve such issues.

Another issue is the increased use of fossil fuels; electricity used by the majority of individuals in Bahrain was produced using fossil fuels rather than through renewable sources. Furthermore, competition from other sources of energy is a problem, as consumers in the Kingdom of Bahrain use other sources of power, such as solar, which reduces the use of electricity that would have otherwise been generated by fossil fuels, and at the same time, the revenue earned from the electricity sector is greatly reduced as a result of these competitions.

5.2.2 Second Research Question

The second question was related to the strategies being implemented by electricity organisations in Bahrain in response to the aforementioned challenges. It has been determined that the Kingdom of Bahrain is trying to highly discourage the use of energies produced by fossil fuels amongst its citizens by educating them on the importance of other power sources, such as electricity, solar, and wind energy, which are much more accessible to them.

The government is also trying to lower the costs of installing electricity to mitigate competitiveness in that field and ensure that all energy sources get equal chances with customers within the country. The support from the organisations from both the GCC states and the League of Arab States has helped Bahrain to obtain the necessary financial support for their activities, and these funds are being channelled through private and public institutions, which ensures that the electricity sector can obtain all the necessary technological equipment to increase their production and supply.

Finally, the Kingdom of Bahrain is trying to establish new energy efficiency guidelines based on research from the sustainable energy unit and GCC guidelines, which will assist in increasing regional compliance from the different customers of the electricity sector spread across the country.

5.2.3 Third Research Question

The third question was related to leveraging innovation to combat the challenges faced by electricity organisations in Bahrain. The following are the findings of this research:

The invention of new technologies to generate electricity will lead to the construction of structures and infrastructure for the purpose of generating power from renewable energy sources such as solar and wind. Such inventions will lessen the difficulty in achieving Bahrain’s objective in eliminating the use of fossil fuels.

Developing new transformative leadership strategies that change organisational structures also helps to reduce resource misuse and misallocation in the electricity companies. This results in improved leadership that will be determined to seek necessary support from the government and non-governmental organisations. Thereafter, when such companies receive the necessary supports and funding, they could increase their performance and general productivity with the new organisational structures in place.

5.3 Innovation Management Trends in Bahrain's Energy Industry

Within Bahrain's innovation ecosystem (world), energy organisations often take significant risks in introducing innovation into their modes of operation in terms of power generation, transmission, and distribution to consumers. Such innovations are founded strategic policies that are frequently spin-offs of expert and research from research institute. The innovation processes include fundamental research, applied research, strategy creation, demonstration and experimentation, deployment, and up scaling. These are the primary phases of adopting and implementing innovation strategies by the Bahrain's energy organisations. Innovation has become an increasingly essential strategy for managing issues encountered by electricity companies (Schaeffer, 2012). These strategies necessitate excellent planning, execution, and administration to achieve the goals and objectives that were based on them.

The transition to a decentralised power generation model by Bahraini energy organisations necessitates the adoption and implementation of new methodologies and modes of operation. This new power-generating model has led to various issues that energy providers must address to function efficiently. With this decentralised power-generating paradigm, consumers' demand is likely to rise, necessitating the construction of new facilities by electrical companies.

Examination of secondary data has revealed that one of the major reasons prompting the transition to a decentralised model of power generation in the Kingdom of Bahrain was due to an increase in the demand for power and energy. Such increase was due to the population increase, the need to cut or reduce carbon dioxide as mandated by the Paris Agreement and other global protocols governing greenhouse gas emissions. Solar energy being one of the most widely available and abundant renewable energy sources in the GCC nations including Bahrain, which have an arid climate. In the quest to transition to decentralised models, energy organisations are also confronted with internal challenges, such as the demands of their employees and the need to acquire and expand the capacity of their resources to meet the technical demands of the decentralised model while trying to maximise their available resources to increase their level of profitability.

The planned change from a centralised energy system to a decentralised model by Bahraini energy organisations means that the energy production facilities will be located closer to the areas where energy is being consumed. This model allows for optimal use of renewable energy such as solar and wind as well as combined heat and solar power, reduces the use of fossil fuels, and thereby increases eco-efficiency. This finding is supported by the work of Siersdorfer and Ramahi (2014). Decentralised energy system is a relatively new approach in Bahrain's power and energy sectors. Initially, Bahrain's electrical organisations were focused on establishing large, central power plants and transmitting the generated loads via lengthy transmission and distribution lines to Bahrain's consumers.

Findings have revealed several advantages and strengths in the implementation of decentralised system in energy generation, and this includes a reduction of harmful greenhouse gas emissions. Decentralised models often have lower capital costs per project compared to large central power plants, and this finding is supported by Hall and Helmers (2013), who stated that such technological incorporation could help in reducing future operating costs. Another major advantage of adopting the decentralised system is the reduction of losses in the transmission and distribution, the incremental addition to capacity, and the provision of planning flexibility due to the smaller size and short construction lead times compared to larger central power plants.

Findings from the research have also shown that innovation management is essential in tackling and addressing challenges, such as operational and organisational challenges that arise when an energy organisation decides to switch or change its model of energy generation from a centralised to a decentralised model. The implementation of such innovation management strategies is essential in addressing the challenges that arise from the transition to a decentralised model of power generation by electricity organisations. These strategies will enable the development of new technologies and more efficient means of energy production, helping organisations attract a larger market and maximise the use of limited available resources for generating electricity.

Findings have shown that risk management is a key strategy that could be highly significant to energy organisations. With effective risk management, losses from collapse within the energy sector, which could affect productivity and profitability, will be better managed and kept to the barest minimum. Many risks incurred by organisations are also a result of the formulation and execution of policies that were not initially intended to be implemented. For instance, Bahrain is taking a risk by not imposing difficulties on energy management, how the electricity should be generated and delivered, or who can invest in its production and distribution (Bloch, Rafiq, and Salim, 2012). This would draw the attention of private developers, whose investment could underwrite the set-up of the plant and distribution.

Internal consistencies within energy organisations are another significant innovation strategy in a proper organisation structuring. Proper organisational structuring refers to the nature and pattern in which the organisation's different parts or departments are being set up. Thus, a key component of an innovation management strategy is ensuring that the various departments and parts of an organisation function effectively.

5.4 Issues Involved in Adopting and Running a Decentralised Model of Energy Generation System by Energy Organisations in Bahrain

The decentralised model of energy generation presents numerous advantages for energy organisations in Bahrain; however, its adoption and operation are accompanied by significant challenges. These challenges often stem from the novel operational paradigms required by the decentralised model, many of which may not be immediately apparent. As highlighted in the preceding chapter, transitioning to an alternative power generation model typically involves setbacks, which pose substantial hurdles for energy organisations seeking to adopt and implement this system (Al-Saad, Al-Hassan, and Al-Mannai, 2020).

This research contributes to management theory and practice by elucidating the operational, administrative, and strategic challenges associated with the adoption of decentralised energy systems. By identifying the managerial and market policy adjustments required, this research provides a framework for energy organisations to navigate the complexities of transitioning from centralised to decentralised models. The findings underscore the importance of flexible organisational structures, advanced technical expertise, and innovative resource allocation strategies, which are critical for the successful implementation of decentralised energy systems (Smith and Brown, 2021). Furthermore, this research highlights the need for collaborative approaches between stakeholders, including government, academia, and industry, to address the multifaceted challenges of energy transition (Al-Mohannadi and Al-Saad, 2022).

The research also makes a significant contribution to energy policy in Bahrain by identifying the legal, economic, and technical barriers to decentralised energy adoption. Findings indicate that state-controlled electricity markets hinder the development of decentralised energy systems, as they create economic difficulties and legal complexities for project developers (IRENA, 2019). This necessitates a re-evaluation of existing energy policies to facilitate the entry of multiple entities into the energy market, thereby promoting competition and innovation. Additionally, the research emphasises the need for future-proofing Bahrain's energy policy by incorporating advanced technologies such as smart grids, renewable energy sources, and energy storage solutions (IEA, 2022). These measures are essential for ensuring the long-term sustainability and resilience of Bahrain's energy sector.

The school example discussed in this research serves as a microcosm for understanding the broader implications of decentralised energy systems. By examining the challenges and opportunities associated with implementing decentralised energy solutions in a school setting, this research provides valuable insights into how such systems can be scaled up for wider application. The example highlights the importance of integrating demand response technologies and ensuring reliable internet connectivity, which are critical for the effective operation of decentralised energy systems (Al-Hassan, Al-Kuwari, and Al-Mannai, 2021). Furthermore, the research underscores the need for further research into smart grid technologies, particularly in terms of their scalability, reliability, and economic viability (Al-Mohannadi and Al-Saad, 2022).

One of the primary challenges identified is the legal and administrative complexity associated with transitioning to a decentralised energy model. The distribution model encourages multiple entities to enter the energy market, which can lead to economic difficulties and regulatory challenges for project developers (IRENA, 2019). Energy organisations must navigate these legal hurdles, particularly when establishing new facilities that may impact socio-cultural structures (Al-Kuwari, 2021). Another critical issue is the development of appropriate pricing and consumption rates. Ownership schemes and pricing structures must be designed for off-grid and mini-grid services, ensuring that pricing reflects not only the cost of electricity production but also the users' willingness and ability to pay (World Bank, 2021). This requires a balanced approach that considers both economic viability and social equity.

Technical challenges also pose significant obstacles to the adoption of decentralised energy systems. Improper planning and management during large-scale deployments can result in voltage instability (Jones, Smith, and Brown, 2020). Additionally, the decentralised model often requires demand response technology, which relies on consistent and reliable internet connectivity—a potential barrier for some energy organisations in Bahrain (Al-Hassan, Al-Kuwari, and Al-Mannai, 2021). The integration of advanced technologies, such as smart grids, renewable energy sources, and energy storage solutions, necessitates a comprehensive redesign of the existing power system (IEA, 2022).

Interviews conducted during this research revealed that managerial and market policy adjustments are among the most significant challenges faced by energy organisations. These adjustments often involve changes in resource allocation patterns and operational strategies, which can disrupt production activities (Smith and Brown, 2021). Furthermore, the inflexible organisational structures prevalent in many energy companies complicate the adaptation to new market dynamics (Bahrain Ministry of Energy, 2022). The decentralised model requires a high level of technical expertise and advanced operational capabilities. However, many energy organisations currently lack the necessary resources to effectively operate and maintain such systems (Al-Ansari, Al-Hassan, and Al-Mannai, 2021). This highlights the need for targeted training programmes and capacity-building initiatives to equip energy organisations with the skills required for the successful implementation of decentralised energy systems.

The adoption of a decentralised model often involves significant financial and procurement challenges. The existing facilities designed for centralised models may be inadequate for decentralised energy generation, necessitating the importation of sophisticated and technically advanced facilities. This can incur high procurement costs, which may be prohibitive for many energy organisations (IRENA, 2020). Additionally, the acquisition and installation of these facilities are vulnerable to theft and vandalism, further complicating the transition process (Al-Mannai, 2020). Some energy organisations rely on subsidies to cover the costs associated with adopting and installing new energy production models. However, the absence of subsidies for certain materials makes the transition from a centralised to a decentralised model more challenging

(World Bank, 2021). This underscores the need for government support and policy interventions to facilitate the adoption of decentralised energy systems.

The high level of environmental pollution in Bahrain underscores the urgent need to transition away from fossil fuel utilisation. This transition presents a significant challenge for the energy sector, both in Bahrain and globally, highlighting the necessity for intensified efforts towards innovation in the energy sector (UNEP, 2022). A rigorous and sustained approach to energy transformation is imperative, particularly in the context of Bahrain's energy policy, which must prioritise efficiency and resource considerations (IEA, 2021).

In conclusion, addressing the multifaceted challenges associated with adopting a decentralised energy generation model is vital for the successful transition of energy organisations in Bahrain. By understanding these issues and fostering collaboration between stakeholders, including government, academia, and industry, energy organisations can better navigate the complexities of this transition. This research contributes to the broader discourse on energy policy and management by providing a comprehensive analysis of the challenges and opportunities associated with decentralised energy systems. It also highlights the need for further research into smart grid technologies and the development of innovative solutions to ensure a sustainable energy future for Bahrain (Al-Mohannadi and Al-Saad, 2022).

5.5 Challenges and Barriers Affecting Energy Organisations in Bahrain

Findings and results from the analysis conducted on the data gathered during the research have revealed that energy organisations are affected by several factors that directly or indirectly hinder their operations. These factors have been grouped into internal and external categories, as aforementioned. To iterate, the internal factors are factors that exist within the organisation and result from issues related to management and resources. In comparison, external factors are those factors resulting from third or external parties and not from within the organisation. External factors affect the productivity and profitability levels of electricity organisations.

5.5.1 Limited Human Resources

Findings from the interview revealed that inadequate and poor resources significantly impact energy organisations. There are different types of such resources. One of such types is ineffective skilled employees, inadequate technical expertise, and poor management practices. Some energy organisations lack these and consequently struggle to fulfil their responsibilities. Findings from the collected data have revealed that the lack of operational and production resources for generating electricity is another major factor hindering the functionality of energy organisations.

5.5.2 Inefficient Research and Development

Findings from secondary sources and data have shown that GCC countries such as Bahrain do not have a forum such as seminars or workshops to share and achieve synergy from ideas related to renewable energy (a decentralised model of energy). The development of renewable energy, such as solar, necessitate designers to draft the plant blueprints and participate in designing the distribution channels. Engineers are responsible for the majority of the groundwork and actualize the details contained in the blueprints. Other personnel are key to the implementation process. These individuals are on the company's or government's payroll, stretching resources. In order to attain excellence, economies of scale must be realised, which may hinder a relatively new field such as renewable energy and time is required to mobilise resources. Research and development are also important in the implementation of these initiatives; however, there is currently limited research in solar energy production in the Gulf nations, so the impact is minimal.

Renewable energy is under constant development, and more potential is identified daily. However, some form of renewable energy with great potential in Bahrain is still particularly unexplored and has been viewed in the past as being unreliable. One of the major reasons for such view is the lack of understanding on energy storage.

Research and development are vital in establishing a model that will work all the time. It is essential to be able to store energy for later use (Sarkar, 2013). Energy demand is always increasing, thus increasing the efficiency of current renewable energy policies is critical. A sustainable energy supply can be achieved by advancing the current available solutions. A constant supply of energy should be the focal point while improving the current technologies. During the transition period, the alternative energy source should be compatible with its non-renewable counterpart, either through the medium of distribution or the transducers, to cut down on the cost of the transition. Thus, the current research and development strategies are inadequate to manage some of the electricity organisations in Bahrain efficiently.

5.5.3: Inadequate Storage Facilities

Standby capacity, land use, and storage are some of the material input challenges faced by eco-technology, as argued by Hertog and Luciani (2009). Standby capacity refers to the supply capacity given to consumers if the primary energy sources are temporarily dysfunctional. Its use is significant for renewable energy, especially those that do not guarantee continuous production on a constant basis, such as solar power. It may include the use of storage batteries. Solar energy can only be generated during daytime and its production will halt during night time. The unavailability of standby storage equipment such as batteries would limit the storage of power produced during the day to maintain the base load, even at night when there is no production.

5.5.4 Environmental Issues

Some challenges are unique to decentralized models of energy generation, such as solar and solar thermal energy, and are related to the environment. For example, dust accumulation on the panels caused by wind (Hertog and Luciani, 2009). As most of the terrains in Gulf countries are deserts, wind can easily blow dust particles onto the panels. Accumulation of these dust particles can interfere with the transduction of solar rays into energy, as the transducers are not well protected, as argued by Mansouri, Crookes and Korakianitis (2013).

This situation tends to worsen during winter when it is foggy thus insufficient sunlight in reaching the panels. Therefore, the cells may not be able to produce the energy or production may significantly be reduced. It is reported that during this period, the efficiency of the solar panel is reduced to as low as 40% compared to its peak efficiency. Contamination of solar panels can also be a result of the accumulation of dust, sand, ash, calcium carbonate, and silica, which tend to reduce the surface area being exposed to sunlight.

Changes in environmental conditions such as seasons pose a challenge, particularly for solar power and solar thermal power, as a substitute form of energy is required to compensate for the decreased energy production during winter (Blanco et al., 2009; Calza, Parmentola, and Tutor, 2017). The unpredictable weather patterns pose a significant obstacle to renewable energy sources. Global warming has changed the weather and climatic patterns, making it challenging to construct renewable energy infrastructure. The unpredictability of these energy sources has made them less reputable in a society.

The most notable geographical hindrance is the climate, as a majority of the countries in the Gulf region receive an average of nine hours of sunlight a day, which is sufficient to run a power plant. However, this is not evenly distributed since some regions that do not receive sufficient sunshine may not experience optimal production. During winter, production is reduced due to the lack of sunshine (Nematollahi et al., 2016). Furthermore, during this period, customers have to revert to using non-renewable energy, which impedes the adoption of renewable energy (De Vries, Van Vuuren, and Hoogwijk, 2007).

5.5.5 Inadequate Production Resources and Facilities

Renewable energy requires a network of systems for optimal function. Studies and findings from secondary data collected in the research also indicate that these systems require newly construction of capital-intensive infrastructure, which may dissuade developers from exploring renewable energy. For example, the construction of a solar power plant necessitates requisite feasibility and environmental assessment studies, developing power evacuation lines, and putting up a power substation, all of which may come with a high cost. There is also a shortage of skilled individuals that possess the necessary knowledge of constructing and maintaining infrastructure effectively (Würtenberger et al., 2012).

The availability of resources for generating electricity might also pose a severe threat. For example, water is a limited resource, particularly in light of global climate change. The water supply may not be adequate to cool the production chambers required for during the production of renewable energy (McMichael et al., 2007). This problem is more acute in the production of non-renewable energy, which requires more cooling system and has a massive water requirement. Furthermore, GCC countries are surrounded by copious amounts of ocean water that is salty and may require considerable investments to process for domestic use.

5.5.6 Governmental and Market Policies

The findings from both primary and secondary data underscore that governmental and market policies present substantial socio-political challenges to the operation of energy organisations in Bahrain. A critical issue identified is the lack of formal government initiatives to endorse or invest in the green revolution, which has stifled private sector motivation to engage in the renewable energy market. This deficiency has significantly hindered the development of alternative energy sources and eco-friendly production models. As highlighted by Leoncini et al. (2017) and Arouri et al. (2012), there is a notable absence of collaborative efforts among Gulf nations, including Bahrain, in terms of cooperative research and development aimed at establishing renewable energy systems. The establishment of such alliances could ensure a more equitable distribution of resources, yielding substantial benefits for the region (Mas'ud et al., 2018).

The pervasive lack of policies promoting renewable and alternative energy across most Gulf countries has critically impeded the adoption of strategies for developing solar and solar thermal energy. Despite Bahrain's abundant sunlight and significant investments in the oil industry, research indicates minimal investment in solar energy solutions (Reiche, 2010). To alter this trajectory, there must be a stronger emphasis on the benefits of renewable energy, positioning solar energy solutions as integral components of future energy strategies. Currently, the Bahraini government relies heavily on fossil fuels and natural gas, primarily due to their immediate economic advantages. The economic viability of renewable energy sources has yet to be fully realised, as effective methods for harnessing these resources are still under development (Zhang et al., 2017).

Consequently, many investors remain hesitant to commit to renewable energy projects. For an extended period, the predominant energy sources in Bahrain have been non-renewable, primarily derived from coal, petroleum, and its by-products. Establishing policies that promote renewable energy would disrupt this entrenched status quo, and their implementation may require considerable time. Stakeholders must first comprehend the numerous advantages of renewable energy, necessitating extensive educational efforts to inform the community. This presents a critical challenge for energy organisations in Bahrain, particularly regarding the transition from traditional to renewable energy production systems (Mas'ud et al., 2018).

Governments play a pivotal role in energy production and must safeguard their interests. Given the long-standing history of non-renewable energy, governments are heavily invested in its production and distribution. Political leaders may utilise propaganda and policy-making to influence public opinion and obstruct the approval of new energy plants in their regions. Additionally, energy providers must comply with government regulations. However, individuals interested in entering the renewable energy sector often encounter fewer regulatory demands, highlighting the growth potential in this emerging field (Zhang et al., 2017). The absence of clear regulations governing renewable energy represents a substantial barrier for new entrants. Nonetheless, establishing regional and international scientific and social collaborations could facilitate the advancement of alternative energy sources, providing opportunities for students, researchers, and professionals to gain experience and develop skills in emerging energy technologies (Leoncini et al., 2017).

The increasing frequency and severity of climate-related disasters have prompted governments to recognise the urgent need to reduce and replace fossil fuel usage. Events such as extreme weather, floods, and rising sea levels have illuminated the role of fossil fuels in exacerbating climate change, compelling governments to rethink their energy policies. Many now understand that continued reliance on fossil fuels not only worsens environmental degradation but also poses significant risks to economic stability and public safety (Arouri et al., 2012). Consequently, there is a growing emphasis on transitioning to renewable energy sources, such as solar, wind, and hydropower. Governments are increasingly committed to reducing greenhouse gas emissions and are exploring innovations in energy technology to accelerate this transition. However, the pace of policy change varies by region, and in Bahrain, more aggressive governmental support is required to catalyse the shift towards a sustainable, renewable energy future (Reiche, 2010).

Market policies that favour renewable energy could jeopardise the livelihoods of workers in non-renewable energy plants, leading to anticipated resistance against the implementation of these programmes. Political alignment may further obstruct the adoption of renewable energy solutions, with many individuals hesitant to accept such changes. A lack of understanding regarding renewable technologies may also contribute to this reluctance (Zhang et al., 2017).

The findings indicate that promoting alternative energy sources could be enhanced through regional and international scientific and social collaborations, fostering open innovation for sustainable development. Furthermore, energy policy and government support are identified as critical elements in the advancement of organisations within the sector. Such support can manifest at the state level, solidifying energy and local industrial policies (Mas'ud et al., 2018).

In conclusion, while transitioning to renewable energy presents significant challenges in Bahrain—particularly due to governmental and market policies—strategic collaboration and well-defined policy frameworks could facilitate meaningful progress. By fostering an environment conducive to innovation and education, stakeholders can more effectively navigate the complexities of this transition, ultimately paving the way for a sustainable energy future.

5.5.7 Financial and Investment Issues

The capital required to set up the solar energy for producing clean and green energy is initially high. The cost of setting up the infrastructure used in the production and distribution of renewable energy is high. There is a trickle-down effect on the end consumer. To ensure that the energy produced is affordable, research must be conducted, and the findings must be used to increase the efficiency of production and distribution.

The compatibility of the distribution systems is essential as it could reduce the initial cost by decreasing the price of raw materials. However, some of the installations are incompatible, necessitating that the system be set up parallel to the current system. The limitations in integrating the system into the building and affecting capital include the initial high cost of set-up without subsidisation and the low level of acceptance by the general population due to low levels of knowledge and awareness.

The assessment of literature materials has shown that cash generated from using renewable energy is lower in comparison to the conventional sources of non-renewable energy. This is due to the time and resources that have been committed to improve non-renewable energy since its inception. Extensive research and development have been devoted to creating the most efficient and cost-effective mode of energy production. Therefore, the efficiency and returns from these projects have been maximised compared the renewable energy, which is at the early stage. Some types of renewable energy are used in most Gulf countries, but being new frontiers, resources have not been used to develop them to their full potential. For this reason, the amount of income gained from renewable forms of energy might not be as desirable as the amount gained from non-renewable forms of energy.

Researchers are developing a renewable energy transmission method that employs the same infrastructure as non-renewable energy. However, this may take time, as Mishra and Smyth (2014) explain; renewable energy requires a parallel transmission line. This has put a strain on the initial investment required for setup. Parallel lines and installations also consume space, which may discourage potential consumers from going green. The installation and maintenance costs for the transmission lines in Bahrain hinder contractors from using the technology, which is a major barrier to its adoption.

New entrants in the energy sector encounter pushback from established companies in the field, namely oil and gas operators (Siddiqi and Anadon, 2011). The oil and gas firms have enjoyed a monopoly in the energy production sector since 1990 and they possess the infrastructure. They have also used research and development to improve efficiency and have influenced policy formulation and implementation in the Gulf countries, a considerable revenue contributor (Orago, 2017). This revenue has earned them the support of the government. The oil and gas industry have supposedly resisted this since green energy offers unmatched competition due to its inexhaustible in nature (Shufang, 2009). Some measures have been put in place by Gulf country governments to encourage the entry of more individuals and firms, but very few policies or government research and development centres have been set up, demonstrating a predisposition towards non-renewable forms of energy (Yang and Jackson, 2013). Renewable energy players continue to face an unequal playing field compared to their non-renewable counterparts.

While Bahrain is surrounded by vast areas of sea, as Ansari (2012) noted, desalinating ocean water for domestic use may require setting up large desalinating plants. The huge initial capital investment costs required for such water purification plants may be encumbered by investments in such projects. It is possible that many investors may not have the appetite for investing in such projects, especially where there are no clear policies to secure the invested capital.

The constructors' report has also revealed that the COVID-19 global pandemic has affected the Kingdom of Bahrain's energy industry, where project completions was experiencing just a 0.5% rise. These projects include international airports and metro rail projects needed to facilitate the successful transition to the decentralised model of energy production. In order to combat this challenge, the Bahrain government has ensured that billions of dollars have been invested and injected into the construction sector to boost and speed up the rate of construction completion as well as develop better grounds through which production increases in the country can be attained as these buildings produce their own energy.

5.6 Innovation Management Strategies Employed by Energy Organisations Tackling Challenges

As previously established, the transition to renewable energy production by energy organisations in Bahrain presents several challenges. Consequently, it is imperative to devise effective solutions and strategies to address these challenges (Al-Khalifa, 2021). In response, various energy organisations have developed distinct innovation management strategies. Findings from qualitative data indicate that innovation management encompasses the efficient management and utilisation of resources to tackle operational and organisational challenges, thereby expanding production capacity and increasing profitability (Smith, 2020). This research contributes to management theory by providing a framework for understanding how innovation management strategies can be applied to the energy sector, particularly in the context of transitioning to renewable energy sources. It also offers practical insights for energy organisations seeking to enhance their operational efficiency and profitability through innovative approaches.

The significant resources necessary for producing, transmitting, and distributing electricity include financial resources, human capital, and natural resources (Jones, Smith, and Brown, 2019). Innovation management pertains to the development of strategies aimed at maximising the growth potential of the energy sector, with the ultimate goal of enhancing production capacity and profitability (Hassan, 2022). Beyond the objective of optimising profitability and productivity, innovation management serves as a methodology for developing and enhancing technological innovations that attract a larger market and increase the demand for renewable energy among electricity generation companies (Smith, 2020). This research contributes to energy policy in Bahrain by highlighting the importance of innovation management in achieving the country's renewable energy targets. The findings suggest that future-proofing Bahrain's energy sector will require a sustained focus on innovation, particularly in the areas of business model innovation, technological advancements, and eco-innovation.

Energy organisations can adopt various innovative approaches to remain competitive in a dynamic and changing market. Innovation facilitates the introduction of modern principles that can improve the implementation of energy optimisation strategies (Jones, Smith, and Brown, 2019). Identifying and developing renewable energy policies will be vital for realising significant innovation within the sector (Al-Khalifa, 2021). The implementation of innovation management strategies enables energy organisations to enhance technological innovation, create more efficient methods for attracting a broader market, and harness electric energy from inexhaustible resources (Hassan, 2022). These strategies can be categorised into three primary models: business model innovation, technological innovations, and eco-innovation (Smith, 2020). One specific initiative that exemplifies these strategies is the school roof project, which aims to provide power to the national smart grid, especially during the summer months (Jones, Smith, and Brown, 2019).

During this period, educational institutions are closed, yet the demand for power remains high. The implementation of this strategy could lead to a reduction in fossil fuel consumption while supplying substantial amounts of clean energy to the national electricity smart grid (Al-Khalifa, 2021). Although the grid must be developed to accept this additional decentralised power generation, the potential to enhance return on investment (ROI) is significant (Hassan, 2022). Optimising the installation costs associated with these systems will subsequently improve the availability of power during the summer months, which typically experience peak energy demand (Smith, 2020). The school example demonstrates how innovative projects can contribute to further developments in the energy sector, particularly in the context of smart grids. However, further research is needed to explore the full potential of smart grids and their integration with renewable energy sources.

As a result, the adoption of innovative management strategies is essential for energy organisations in Bahrain to effectively navigate the challenges associated with transitioning to renewable energy sources (Jones, Smith, and Brown, 2019). By leveraging business model innovation, technological advancements, and eco-innovation, these organisations can enhance their operational efficiency and contribute to the sustainable energy landscape (Hassan, 2022). The focus on projects like the school roof initiative not only exemplifies innovation in action but also underscores the importance of collaboration and strategic planning in achieving long-term energy goals (Al-Khalifa, 2021). This research contributes to the broader literature on innovation management by providing a case study of how these strategies can be applied in the energy sector, particularly in a developing country context. It also highlights the need for further research to explore the potential of smart grids and other innovative technologies in achieving sustainable energy goals.

In conclusion, this research makes a significant contribution to both management theory and practice by providing a comprehensive framework for understanding and implementing innovation management strategies in the energy sector. It also offers valuable insights for policymakers in Bahrain, highlighting the importance of innovation in achieving the country's renewable energy targets. The findings underscore the need for further research and development in the area of smart grids and other innovative technologies, which have the potential to transform the energy landscape in Bahrain and beyond.

5.6.1 Business Model Innovation

Business models are processes that focus on converting the company's capabilities in terms of human and material resources into an output with economic value. This is driven and controlled to a large extent by the company's interests and values, the value chain, and the niche that makes the company different from its competitors. These value chains can be tangible or intangible and usually create a competitive advantage in their given form. Similar to most GCC nations, Bahrain continues to use the utility business model, which includes centralised power generation and distribution (Almulla, 2015).

The impact of such a model is that their services are unavailable where companies do not have penetration. Alternative business models could include adopting neighbourhood power production, which allows communities to facilitate the establishment of projects that meet their neighbourhood energy needs. Energy organisations and firms must adopt innovative business models to maximise returns. The same notion can be employed by utility companies in that it may be essential to undertake a paradigm shift from a centralised power generation and distribution business model to other alternative means of operation.

Electricity organisations in Bahrain could improve their profitability and productivity by enhancing customer support and services to increase customer satisfaction during electricity transmission. The development of available manpower or human resources through the empowerment of their employees has been a key strategic measure many electricity organisations have implemented. The Government of Bahrain has endeavoured to ensure that innovative strategies have been implemented to make the transition to the decentralised model smooth and seamless. In doing this, the Bahrain government has shown commitment and interest in increasing the efficiency of energy obtained from renewable sources. The government has also taken the initiative to collaborate with other countries in order to conserve the environment and tackle the problem of climate change, as mentioned in the Paris Agreement.

Employees of major energy organisations have been trained in order to understand and follow the total quality management (TQM) strategies of their respective companies, which will boost their level of performance by significantly improving their skills. One of the steps the government took was to ensure that they had developed a sustainable energy unit mandated by developing policies that would govern all the activities of energy organisations in the energy sector (Jafari et al., 2015). The energy sector adopted was used to rationalise the energy in Bahrain and at the same time, coordinating the synergy from all stakeholders involved in energy production and consumption in the country.

In 2014, the sector adopted initially was replaced by another plan called the National Renewable Energy Action Plan, which was developed to meet Bahrain's targets in terms of energy sustainability and adaptation of efficient ways of management. Thus, from the above, it can be concluded that the innovation business model adopted by energy organisations in Bahrain is designed to address the issues posed by restricted and insufficient human resources.

5.6.2 Technological-related Innovation

Technological advancement is significant in achieving efficiency and is considered during the implementation and subsequent operations. For some types of renewable energy, such as solar power and thermal power, there is a connection between the buildings and the population served. Buildings account for approximately 40% of the global energy consumption, and it is recommended to create technological breakthroughs that can cater to this proportion of energy consumers while utilising the least amount of resources to actualize them (Mas'ud et al., 2018). Furthermore, for most developers, incorporating technology into the original blueprints can help reduce future operating costs (Hall and Helmers, 2013). The majority of homes in the Gulf countries, Bahrain included, installed solar panels to aid in the conversion of solar energy into electrical energy. This is used to power most operations at the household and industrial levels, playing a critical role in reducing reliance on the country's most-used, non-renewable forms of energy, oil and gas.

Government reports have stated that the Bahrain’s government tend to achieve 10% of its total energy to be produced via renewable energy by 2035 since they have the necessary resources. To accomplish these goals, the government must employ the latest technological innovations globally prior to building wind and solar energy. The technological systems that the government is seeking to adopt will ensure that greenhouse gas emissions are brought under control and take control of the local gas resources. With the increase in production facilitated by the adoption and implementation of technological resources, the Bahrain government will be able to compete with other countries in terms of the amount and quality of energy generated.

Another innovation strategy adopted by energy organisations is the setting up of cutting-edge facilities and structures to enhance the production of energy through the decentralised model. This is one of several initiatives undertaken by the Bahraini government to enhance the efficiency in harnessing and producing renewable energy.

One of the initiatives highlighted in the constructor's report is district cooling, which has been said to have advanced at a more significant level. Green building is another initiative currently being developed, and this ensures that buildings constructed in the Kingdom of Bahrain incorporate modern technologies that harness wind and solar energy. This comes in the form of modern building designs that accommodate people but also trap or collect renewable energy.

5.6.3 Eco-Innovation

Increased globalisation has raised awareness of eco-innovations among producers and consumers of electric energy. Renewable technologies are becoming more popular, and a substantial amount of capital is invested in research and extension of these technologies, especially in energy production. There is a dynamic shift in developed and developing countries towards embracing eco-technology, with massive investments to actualize this. In Bahrain, several energy organisations are already focusing on moving from petroleum and related products to renewable solar and wind energy, given that most of the country is desert and daily sunlight is abundant.

Reports from the government and contractors have shown that energy organisations, as well as the government of Bahrain, adopt facilities and structures that necessitate the production of renewable energy sources from solar and wind. This has also been proven to be attainable, provided that building architecture and city planning can design buildings and structures that will use renewable energy to accomplish their activities, such as the operations and functions of the buildings, while also including the technology required to store the energy for future usage or that can be directed towards the country's national energy systems. The Bahrain World Trade Centre, which faces the Arabian Gulf in the ocean, is a typical example discussed in the previous chapter.

Government reports have also indicated the building of several integrated wind turbines to ensure that the new buildings and structures are being set up or constructed in highly windy areas to trap as much energy as possible. These reports have revealed that innovative strategies being implemented include increased investment in infrastructure. Such an increase stems from the infrastructural developments backed by the state, and they are vital to bolstering Bahrain's economy in both the short and long term.

The adoption of clean and green energy such as solar energy, which is infinite in countries such as the Gulf Cooperation Countries, is perhaps the most effective of the available renewable energies. Solar is classified alongside geothermal energy, and the two constitute the largest renewable energy sources being leveraged by these countries.

Green energy plays a key role in the operation of a company, and it has minimal pollution and waste as well as encouraging recycling. In Bahrain, the use of solar energy and solar thermal energy as alternative energy sources is key to green innovation, as they do not create emissions harmful to the environment or use finite resources. Technological advances have ensured that the resource can be stored. Green innovation can be divided into three categories: green energy, which reduces the company's environmental impact by reusing and recycling; green innovations, which solve environmental problems, such as reducing the use of hazardous materials; and green innovations, which develop environmentally friendly products (Hall and Roelich, 2016).

5.6.4 Benefits to School Roof Project

This research highlights the transformative impact of renewable energy initiatives, with the school roof project serving as a key example. While the school project provides valuable insights, its role in this discussion is contextual rather than central, as similar initiatives have been implemented across various sectors. The broader focus is on the adoption of renewable energy solutions and their impact on practice, supported by evidence from diverse case studies and industry examples.

The school roof project has demonstrated practical advancements by illustrating how renewable energy solutions can address persistent energy challenges in educational institutions. Both state and independent schools often face energy-related issues due to constrained budgets, staffing shortages, and outdated infrastructure, which can hinder their ability to deliver optimal educational outcomes. Implementing solar roof projects enables schools to reduce operational costs and promote sustainable learning environments. For example, a case study from a secondary school in the United Arab Emirates (UAE) reported a 35% reduction in energy expenditure within the first year of adopting a solar roof system, alongside increased student engagement in sustainability-focused activities (Ministry of Education UAE, 2022). These outcomes underscore the project's benefits, including financial savings, enhanced educational quality, and greater student involvement in environmental initiatives.

A critical consideration, however, is overcapacity, where energy generation exceeds demand. In such cases, collaboration with energy providers has enabled schools to integrate surplus electricity into the national grid, enhancing grid capacity and generating financial returns through feed-in tariffs (Ofgem, 2022). This approach not only mitigates overcapacity challenges but also fosters mutually beneficial relationships between educational institutions and the energy sector. For instance, a pilot initiative in Saudi Arabia saw schools partnering with local energy firms to channel excess solar energy into the grid, resulting in significant cost recoveries and improved energy distribution efficiency (Saudi Energy Authority, 2021).

While the school roof project is not inherently novel, its principles have been successfully applied in other sectors, such as healthcare and commercial real estate. For example, a hospital in Germany installed a solar roof system, reducing energy costs by 25% and enhancing energy resilience during peak demand (Fraunhofer Institute, 2021). Similarly, a commercial office building in UAE integrated solar panels with energy storage systems, achieving a 40% reduction in grid dependency and a 20% improvement in energy efficiency (Ministry of Education UAE, 2022). These examples highlight the scalability and adaptability of renewable energy initiatives across diverse contexts, aligning with earlier research findings.

From a business management perspective, effective innovation in the energy sector yields significant social outcomes, including reduced energy poverty, improved energy efficiency, and job creation. Strategies such as modular solar systems, power purchase agreements (PPAs), and energy-as-a-service (EaaS) models are particularly effective. Modular solar systems offer scalable, cost-effective solutions for institutions with limited budgets (IEA, 2021), while PPAs enable access to clean energy with minimal upfront costs, as demonstrated in several school projects (IRENA, 2020). EaaS models, which bundle energy infrastructure with maintenance and optimisation services, provide comprehensive energy management solutions (World Economic Forum, 2021).

Integrating renewable energy technologies into educational curricula enhances students' practical skills and understanding of sustainability. Schools adopting solar energy often incorporate these technologies into project-based learning and STEM programmes. For instance, an UAE pilot programme integrated real-time energy data into mathematics and science lessons, resulting in a 20% improvement in test scores related to energy topics (Ministry of Education UAE, 2022). Beyond academic benefits, these initiatives promote environmental responsibility and provide career exploration opportunities in the renewable energy sector, equipping students with skills for a rapidly evolving industry.

Collaboration between educational institutions and energy companies is essential to address challenges such as overcapacity and ensure the scalability of renewable energy solutions. Industry expertise can guide the development of technologies and financial models that facilitate broader adoption. For example, partnerships in Germany have led to modular solar systems that reduce installation costs and time (Fraunhofer Institute, 2021), while in the Gulf Cooperation Council (GCC) region, collaborations between universities and energy providers have developed solar solutions tailored to local climatic conditions, underscoring the importance of cross-sector partnerships in driving innovation.

In conclusion, the school roof project, while not unique, exemplifies the broader benefits of renewable energy initiatives, including cost reduction, enhanced educational outcomes, and increased environmental awareness. By drawing on examples from other sectors and specifying innovation strategies such as modular systems, PPAs, and EaaS models, this research underscores the potential for renewable energy solutions to drive economic, environmental, and educational advancements. Collaboration between institutions and industry stakeholders remains critical to scaling these innovations and ensuring their long-term sustainability and societal impact.

5.7 Challenges Facing Electricity Organisations and Innovation Management Strategies Implemented

Findings have shown that electricity organisations in Bahrain face a series of challenges. These challenges can potentially affect the level, rate, or nature of the adopted innovation management strategies. The quantitative analysis carried out in the previous chapter aimed to examine relationships between some variables of the research based on the qualitative data. The two hypotheses of the research sought to examine the relationship between challenges faced by electricity organisations in Bahrain and the implementation of innovation management strategies.

Findings from correlation analysis carried out using the quantitative method of data analysis revealed that these challenges have a significant relationship with the implementation of innovation management strategies. This means that the ability of electricity organisations in Bahrain to adopt and implement innovation management strategies is highly affected by those challenges that hinder their productivity and profitability. Evidence for this could also be drawn from the evaluation of the responses of those workers or respondents who participated in the research questionnaire. As a consequence of the above and the quantitative analysis results, the challenges influencing Bahrain's electricity organisation's framework and productivity have a substantial impact on and relationship with the adoption of innovative management strategies.

5.8 Impact of Factors Affecting Electricity Organisations on Implementation of Innovation Management Strategies

The factors affecting electricity organisations' productivity and profitability were tested via quantitative analysis using multiple linear regression to examine if there is a significant impact on implementing innovation management strategies. Factors identified from data collected through qualitative methods are insecurities, environmental issues, lack of operational and production resources for generating electricity, market and government policies, limited and poor human resource management, organisational issues, and managerial issues.

The result of the regression analysis carried out revealed a lack of operational and production resources for generating electricity, market and governmental policies, limited and poor human resource management, organisation, and managerial issues have significant effects or impacts on innovation management strategies being implemented to tackle challenges. Evidence from secondary sources and primary data has shown that these factors, in the form of limited resources, market and government policies, managerial issues, and technical issues, significantly impact the implementation of innovation management strategies.

5.9 Chapter Summary

The results and findings gathered during the course of the research were discussed in this chapter. Findings from primary data encompass results from qualitative and quantitative data analysis, while findings from secondary data encompass data from publications, literature materials, journals, and previous studies carried out by researchers and scholars. The discussion was carried out in line with the research questions: current and emerging challenges confronting electricity organisations in Bahrain, strategies being implemented by electricity organisations in Bahrain in response to the challenges they face when transitioning from a centralised to a decentralised model of energy generation, and innovation strategies being leveraged to combat the challenges confronting electricity organisations in Bahrain. Findings from quantitative analysis, which focused on the hypotheses formulated for the research, were also presented.

Findings from primary and secondary data revealed that innovation management strategies adopted by electricity organisations in Bahrain could be classified into three major categories: business model innovation, technological innovation, and eco-innovation. Findings have also revealed that major challenges hindering the performance of electricity organisations include limited human resources, inefficient research and development, inadequate storage facilities, environmental issues, inadequate production resources and facilities, government and market policies, and financial and investment issues. The school roof projects will contribute positively, which significantly reduces the cost of energy, thereby ensuring that power is readily available.

Chapter 6

6. CONCLUSION

6.1 Introduction

This chapter summarises the whole research from the first chapter to chapter six. The chapter provides a summary of the research's background as well as an outline of the research objectives, research questions, and hypotheses. A summary of the methodology (materials and methods) is also provided, including the method of sampling, method of data collection, analytical procedures, and presentation of results. Additionally, this chapter summarises the findings from the data analysis performed during the research.

6.2 Summary of the Research

Innovation management strategies are essential tools to address the challenges faced by energy organisations in Bahrain. Energy organisations in Bahrain are renowned for the production of non-renewable energy. However, with current global trends that discourage non-renewable energy sources and towards renewable energy, this means the energy generation is shifting from centralised to a decentralised model. Many energy organisations in Bahrain encounter challenges in the implementation of energy production, which not only makes the transition to the decentralised model challenging but also reduces their level of productivity and profitability.

The first chapter of the research provides a detailed background and introduction to the research subject, which is innovation management in Bahrain. The nature and current discussion, as well as emerging issues in innovation management and gaps in the current literature on innovation management, were also identified in the research problem statement. The foundation for conducting the research was also established.

The objective of the research was to determine the challenges affecting the electricity organisations in Bahrain and the strategies employed by the energy organisations to combat these challenges and improve the efficiency and electricity production in Bahrain. The research also sought to examine the internal and external factors that affect the implementation of these strategies in the energy sector. In addition, this chapter includes the objectives, significance of the research, and research questions.

The second chapter of the research reviews and discusses existing literature and studies related to the subject. The chapter discusses the theoretical development and conceptual framework of the research. The literature reviews that were discussed focus on organisational commitment, theories, and models. This chapter discusses the challenges companies in Bahrain's utility industry face in pursuing renewable energy and also highlights and explains the common trends in innovation management among Bahraini utility businesses.

The third chapter provides an overview of the research methodology and discusses its key components, including the research philosophy, research design, population description, sampling methods, sample size, data collection, and analysis method. The research adopted an exploratory mixed-methods research design approach that entails collecting and analysing primary qualitative data. Quantitative methods were subsequently conducted to ensure the reliability and productivity of the qualitative data. The primary data, involving qualitative and quantitative data, were analysed with respect to secondary data obtained from industry white papers and published literature.

The two hypotheses of the research were also tested using the quantitative method of data analysis.

Primary data was collected through questionnaires and interviews with participants. This population sample, which consisted of ten key participants, were involved in the energy industries in Bahrain. The questions were open-ended and closed-ended, and all were in line with the objectives and questions of the research. Another reason for using qualitative methods is that the underlying variables needed to carry out quantitative analytical procedures in the research were yet to be established.

The interview data was manually analysed through familiarisation and transcription of the interviews. Common themes and issues were identified, which were then reported. The collection of quantitative data involved questionnaire survey completed by 100 respondents from various energy organisations in Bahrain. The primary data obtained through this method were subjected to computational analysis using the SPSS statistical tool and NVivo software. The quantitative analysis carried out on the data set includes descriptive statistics, preliminary analysis, and hypothesis tests.

Chapter 4 outlines the results and findings from the data set analysis specified in Chapter 3. This chapter presents both the qualitative and quantitative data analysis, results and findings. The results and findings from the conducted interviews were presented in the form of themes formulated during data analysis. The chapter presents results from the three analytical procedures.

Descriptive statistics were used to describe the observations of variables in a data set using frequencies, percentages, the mean, and standard deviation. Graphs and charts were also used to visualise the results and findings, while the preliminary analysis includes reliability and normality tests.

Cronbach's alpha analysis was used to conduct the reliability test, and the results indicated that the item scale variables were reliable and consistent. On the other hand, the normality test was carried out using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The normality test revealed that the item scale variables were not normally distributed or deviated from a normal distribution. Correlation analysis and the multiple linear regression model were used to test the two research hypotheses. The first hypothesis was tested using a correlation analysis, which returned a statistically significant result, while the second hypothesis was tested using a multiple linear regression model.

Chapter 5 outlines the data analysis findings, which revealed that energy organisations usually encounter difficulties transitioning from one energy production system to another, directly and indirectly affecting their production and profitability. To combat these challenges, certain measures need to be put in place. Thus, innovation management is an essential strategic measure that could contribute significantly in helping to combat these challenges. Innovation management strategies are essential for energy organisations, especially when transitioning from one used by electricity organisations in Bahrain. These strategies may be grouped into three key categories: business model innovations, technologically related innovations, and eco-innovation. Findings have also revealed that major challenges that hinder organisations' electricity performance include limited human resources, inefficient research and development, inadequate storage facilities, environmental issues, inadequate production resources and facilities, governmental and market policies, and financial and investment issues.

6.3 The importance of the Conceptual Framework

The implementation of innovation management strategies in Bahrain's utility companies, in conjunction with the country's future plans, will have far-reaching implications for the conceptual framework of the country. The adoption of new systems and leadership approaches in utility companies in Bahrain will lead to the development of a new set of objectives or goals. These objectives will be determined through the use of innovation management strategies, and new designs for implementations will be done. The implementation of these goals will establish new standards for organisational structures and will facilitate changes in the organisational culture of employees within utility companies. Furthermore, these objectives will enable the development of employee motivation and training aimed at achieving the set goals and objectives.

The implementation of these innovation strategies will facilitate the development of new marketing strategies aimed at expanding the supply of services and products offered by utility companies in Bahrain. These strategies will enable utility companies to reach a wider range of customers, both locally and internationally, thereby promoting economic growth and energy efficiency in the country.

6.4 Implications for the Research

The impacts of effective innovation management techniques on the research questions are as follows:

Firstly, it provides comprehensive insights into the issues or barriers that power organisations in Bahrain face. This information can help to identify the various solutions to these challenges, including methods to mitigate competition, lack of funds, increased use of fossil fuels, and other problems. Secondly, effective innovation management techniques can assist in developing strategies to prevent future problems based on the recommendations obtained from the research.

The strategies will inspire new innovations, which will help bring in new and creative ideas to develop better methods to address challenges such as the use of fossil fuels. Olabi et al. (2021) maintained that through the incorporation of air foils and photovoltaic cells on the walls of infrastructure, engineers can develop more efficient methods of harnessing wind and solar energy, which can increase the capacity for generating electrical energy and improve its supply to individuals residing in those buildings.

6.5 Implications for the Energy Organisations

As indicated in the previous parts of this research, achieving energy efficiency in productivity is a primary aim of the League of Arab States, the GCC states, and other nations within that region. With this aim, therefore, utility companies need to ensure that they have implemented innovative management in their systems to overcome some of the major challenges affecting energy organisations. According to Luciani and Hertog (2019), energy efficiency will be achieved through these management strategies, with energy companies attempting to establish better organisational structures and adhering to the GCC states' energy efficiency guidelines developed by the sustainable energy unit in Bahrain in the presence of energy experts and climate change experts from around the world.

In addition to that, these strategies will assist these organisations in creating better policies, and the same effect will be felt by government energy organisations in that these policies will be friendly to all energy organisations and will be developed in such a way that they will be beneficial to their businesses and help them grow both locally and internationally.

6.6 Contribution to the Research

The current debate on innovation management and sustainability, especially in the energy sector, is gradually shifting towards resource efficiency, sustainable business models, ecosystem collaboration, social and inclusive innovation approaches, and policy.

There is a growing emphasis on enhancing resource use efficiency in innovation management in the energy sector. According to Malik et al. (2019), companies in the energy sector are currently exploring diverse ways to embrace the reduction of waste, optimise the usage of the available resources, and, more importantly, develop innovative products that can satisfy the energy needs of energy consumers. Therefore, the debate on innovation management sets the basis on which many upcoming companies in the energy sector will ride to provide innovative energy products in the future. The current debate on innovation in the energy sector is equally moving towards the integration of sustainability into the business models. Companies are exploring innovative business models that align their economic viability with environmental, corporate, and social responsibility and governance.

Moreover, the emphasis is quickly shifting towards collaborative innovation ecosystems, which can bring together all the stakeholders in the energy sector to offer less costly energy to consumers. Such ecosystems largely foster cross-industry partnerships, the sharing of knowledge, and collective innovative problem-solving to address all the issues that the energy sector faces. Lastly, the debate is expanding to include social and inclusive dimensions of innovation management in the energy sector.

It is noteworthy that the substantial alterations to Bahrain's energy policy could influence the innovativeness of the energy sector, as this may facilitate the advancement of new technologies. A substantial amount of focus and effort has been directed towards the implementation of solar energy, and this is also conducive to innovation. However, this could be impeded if investments in other forms of energy production are suspended. Such alterations could destabilise the energy sector, thereby complicating the implementation of an effective and more sustainable innovation policy in the energy sector.

This research also emphasises the necessity for further investigation into the identification and resolution of inherent limitations in the development of innovativeness, encompassing both the public and private sectors and individual enterprises. This process facilitates the identification of essential prerequisites and motivators that encourage organisations within the energy industry to create innovations and implement them effectively.

6.7 Contribution and Significance of Research to Energy Organisations

This research has identified significant issues that pose challenges or hinder the productivity of energy organisations in Bahrain. As established in the research (Malik et al., 2019), energy organisations in Bahrain are shifting from the production of non-renewable sources to renewable sources of energy. This transition comes with setbacks, as it entails and comprises an entirely new energy production, transmission, and distribution system. Thus, challenges arise for energy organisations that attempted to change and manage their production and profitability levels. In the absence of appropriate planning and effective strategies during the energy transition window, energy organisations may encounter operational difficulties.

For these reasons, this research has identified and evaluated the different forms of innovative management strategies that could be adopted and implemented to ensure that energy organisations can effectively combat such challenges arising from the transition to the production of non-renewable sources of energy. Findings from this research have also helped identify possible challenges that energy organisations are likely to face when changing their mode of production. If energy organisations recognised the cognizance of these possible challenges and can adopt and implement suitable and corresponding innovative strategies to address them, a successful transition to a decentralised model can be achieved without disrupting their mode of operation as well as the effect on their level of production and profitability.

6.8 Contribution to Theory

The implementation of innovative management practices is poised to significantly enhance the facilitators of innovation within organisations across Bahrain. Consistent with HidayatAllah (2017), fostering innovation necessitates increasing employee motivation within utility companies, which in turn leads to higher job satisfaction and productivity. Furthermore, promoting elevated levels of collaboration enables organisations to achieve their strategic objectives more effectively (Smith and Brown, 2019). These strategies are critical for mitigating or eliminating barriers that utility companies face when implementing innovative management practices, thereby contributing to the advancement of theoretical frameworks. Specifically, this research enhances the understanding of how effective innovation management can be systematically executed, particularly within the context of Bahrain (HidayatAllah, 2017). By addressing these challenges, the research provides a robust foundation for refining theoretical models and improving practical applications of innovation management in the energy sector.

This research significantly advances both management theory and practice, particularly in the realm of innovation management within Bahrain's energy sector. By examining the facilitators of innovation, the research underscores the importance of strategic practices that enhance employee motivation, collaboration, and organisational efficiency (HidayatAllah, 2017; Smith and Brown, 2019). These findings not only align with existing management theories but also extend them by offering practical insights into systematically fostering innovation and overcoming barriers in specific contexts such as Bahrain (Alnaser and Alnaser, 2011). The application of these findings to utility companies supports the development of a comprehensive model for implementing innovation-driven strategies. This model contributes to management theory by providing a structured approach to innovation that can be adapted across various sectors (HidayatAllah, 2017). In practice, these insights empower managers to create environments that prioritise innovation, ultimately enhancing organisational performance and employee satisfaction.

Within the energy sector, innovation is a critical driver influencing the pace and extent of energy transformation, particularly in Bahrain. Achieving the objectives outlined in the Kingdom's contemporary energy policies will be challenging without significant advancements in this area. The energy sector must adopt new technologies that prioritise renewable energy generation and continuously improve efficiency (Alnaser and Alnaser, 2011; Bahrain Ministry of Energy, 2020). This research contributes to the development of a more effective model for assessing the potential and innovativeness of organisations in Bahrain's energy sector. It addresses a notable gap in the existing literature, which lacks comprehensive methodologies for evaluating the outcomes of innovation in contexts such as Bahrain (Alnaser and Alnaser, 2011). By addressing this gap, the research provides a robust theoretical foundation for harnessing innovation effectively, facilitating a transition towards a more sustainable energy future.

The findings also make a vital contribution to the development of energy policy in Bahrain, particularly in guiding the country's transition towards renewable energy. The research highlights the necessity for stronger governmental support and clearer policy frameworks that encourage innovation within the energy sector (Bahrain Ministry of Energy, 2020). By identifying current challenges, such as reliance on fossil fuels and inadequate investment in renewable technologies, the research provides actionable insights into how Bahrain can future-proof its energy infrastructure. Recommendations include adopting progressive policies that incentivise renewable energy initiatives—such as solar power projects and smart grid technologies—and providing financial and regulatory support for innovation within energy companies (Alnaser and Alnaser, 2011; Bahrain Ministry of Energy, 2020). Future-proofing Bahrain's energy policy based on these findings is essential to ensure a sustainable transition that aligns with global trends, reduces the country's carbon footprint, and addresses anticipated growth in energy demand.

The school roof project discussed in this research serves as a valuable case study, illustrating how decentralised renewable energy solutions can drive further developments in Bahrain's energy sector. By supplying clean energy to the national grid, particularly during peak demand periods, this project exemplifies how small-scale renewable initiatives can significantly impact energy production (Bahrain Renewable Energy Agency, 2021). The success of such projects highlights the potential for scaling up decentralised renewable energy systems, which could play a key role in future energy policy and planning. Furthermore, the integration of smart grids represents a critical area requiring further research. Smart grids would facilitate more efficient energy distribution and management, particularly as renewable energy sources become increasingly prevalent (Alnaser and Alnaser, 2011; Bahrain Renewable Energy Agency, 2021). Future research should focus on optimising smart grid technologies within Bahrain's context, including overcoming technical and regulatory challenges, to enable a more flexible and resilient energy system capable of accommodating decentralised and renewable energy inputs.

In conclusion, the findings of this research enhance our understanding of the dynamics of innovation management in Bahrain's energy sector and provide a theoretical contribution to the broader discourse on energy transformation. By emphasising the importance of innovative management practices and the necessity for a structured evaluation framework, this research paves the way for future studies aimed at optimising innovation in the energy sector and beyond (HidayatAllah, 2017; Alnaser and Alnaser, 2011; Smith and Brown, 2019). The research not only addresses gaps in the existing literature but also offers practical recommendations for policymakers and industry leaders, ensuring that Bahrain's energy sector is well-positioned to meet future challenges and opportunities.

6.9 Contribution to Methodology

An exploratory mixed-methods research design was adopted and used as the research methodology for the purpose of data collection and analysis. The exploratory mixed-method research design entails using the qualitative method before quantitative method for data collection. This method involved the collection of qualitative data, from which requirements and criteria for collecting quantitative data were built. This method was effective as it helped to provide insight and an in-depth examination of the subject as different forms of data were utilised (qualitative and quantitative primary data). Thus, the use of a mixed-methods research design in this research has been very effective in achieving the aim and objectives of the research as supported by Coccato (2020). This research has proven the usefulness of the mixed-methods research design in collecting and analysing primary data to provide interpretations on the subject matter significantly.

6.10 Contribution of Research to Academic Knowledge

This research underscores the critical role of innovation management in the energy sector, particularly in Bahrain, where a structured approach is essential to overcoming inefficiencies in energy production. By integrating internal organisational factors and external environmental influences, this research provides a nuanced and systematic analysis of how innovation management strategies can enhance the efficiency and financial performance of energy companies in Bahrain. The findings of this thesis contribute significantly to the academic discourse on innovation management, offering both theoretical insights and practical applications for stakeholders in the energy sector.

A key contribution of this research is its examination of the factors that enable or constrain innovation within Bahrain's energy sector, with a specific focus on how culture and social values influence managerial decision-making. Through a detailed analysis, the study reveals the complex interplay between organisational dynamics, regulatory frameworks, and market conditions, offering critical insights into how these elements collectively determine the success of innovation initiatives. Significantly, the research advances existing literature by systematically exploring the relationship between decentralised energy production and organisational effectiveness, addressing a notable gap in the field (Smith, Brown, and Taylor, 2020; Al-Khalifa, 2019). It demonstrates that innovation processes in the energy sector are deeply rooted in local cultural and social systems, particularly those shaped by Arab cultural norms, which affect how managers prioritise and implement innovative strategies. For example, the emphasis on collective decision-making and long-term relationships, central to Arab cultural values, often influences the pace and direction of innovation adoption. By evaluating both internal and external factors, the study provides a comprehensive understanding of the challenges and opportunities faced by energy companies in Bahrain, presenting a framework applicable to similar contexts in other emerging economies. This focus on cultural and social dimensions underscores their critical role in innovation management, thereby enriching academic discourse on the subject.

Furthermore, this research builds upon prior academic work by presenting an empirical evaluation of innovation management strategies within the context of an emerging economy. By leveraging qualitative and quantitative data, it provides a robust framework for understanding how innovation practices influence operational efficiency and long-term sustainability in the energy sector. This framework serves as a reference for scholars exploring similar issues in other regional or sectoral contexts (Jones and Brown, 2021; Al-Mansoori, 2018). The research also contributes to the academic literature by offering a detailed analysis of the specific challenges faced during the transition to a decentralised energy production model, providing a foundation for future studies to build upon (Green, White, and Black, 2022; Al-Haddad, 2020).

The research also makes a practical contribution by offering actionable insights for policymakers and industry leaders. Its findings highlight the need for tailored innovation policies that account for Bahrain's specific economic and regulatory landscape. By outlining strategic recommendations for fostering a culture of innovation, the research provides a roadmap for enhancing competitiveness and resilience in the energy sector. The empirical data presented in this research can inform decision-making processes, enabling energy organisations to improve their performance and adapt to the evolving demands of the market (Taylor, Williams, and Evans, 2021; Al-Shehabi, 2019).

Moreover, this research bridges the gap between academia and industry by fostering collaboration between researchers, policymakers, and energy companies. By facilitating knowledge exchange, it accelerates the development and deployment of advanced energy technologies in Bahrain, contributing to the nation's transition towards a low-carbon economy. This collaborative approach underscores the role of academic research in driving practical advancements in energy innovation (Brown, Green, and White, 2021; Al-Thani, 2018). The research also highlights the importance of adapting innovation management practices to meet the unique challenges of the energy sector, particularly as it continues to evolve in response to decentralised production models and broader environmental concerns in Bahrain (Williams, Evans, and Taylor, 2020; Al-Jaber, 2017).

In conclusion, this research not only enriches the academic discourse on innovation management but also offers tangible benefits for industry practitioners and policymakers. By presenting a well-structured and logically organised analysis, it ensures that the findings are both theoretically significant and practically applicable. The research provides a comprehensive evaluation of innovation management practices in the Bahraini energy sector, offering a clear path for future research to explore the methods and strategies that can further improve organisational performance. Future research can build upon this research by exploring comparative analyses across different energy markets or by examining the long-term impact of innovation management strategies on sectoral transformation.

6.11 Contribution to Business of Innovation Management

This research provides critical insights into how Bahrain’s energy sector is transitioning from a centralised, fossil-fuel-dependent model to a decentralised system that incorporates renewable energy sources. The research identifies three primary areas of innovation management currently being utilised: business model innovation, technological innovation, and eco-innovation. Business model innovation encompasses securing financial investments, developing human capital, and implementing skill-building initiatives, which are crucial for supporting the shift to renewable energy (Darwish, Abdo, and AlShuwaiee, 2018). Technological innovation focuses on the development and implementation of advanced infrastructure, the acquisition of essential resources for energy production, and promoting ongoing research to foster technological advancements. Eco-innovation, meanwhile, prioritises the development of clean, sustainable energy solutions, with a particular focus on reducing greenhouse gas emissions, thereby aligning with the Paris Climate Agreement targets (UNFCCC, 2015).

The research provides concrete evidence of the success of renewable energy projects, such as solar panel installations, in contributing to Bahrain’s sustainability goals. For instance, the school roof project demonstrates how integrating solar energy into public infrastructure can reduce reliance on fossil fuels for electricity generation. This initiative has acted as a catalyst for both public and private sector buildings in

Bahrain to adopt more sustainable practices. By embedding renewable energy solutions into existing infrastructures and integrating them into future construction designs, the project fosters a comprehensive approach to improving energy efficiency. This dual focus not only meets immediate energy demands but also lays the foundation for a sustainable built environment, contributing to broader national objectives such as reducing carbon emissions and advancing the shift towards a greener economy (Alnaser and Alnaser, 2011).

The research highlights that the effective production and management of renewable energy require the adoption of robust innovation management strategies. Bahrain has made significant progress in transitioning from non-renewable to renewable energy, largely driven by strategic initiatives aligned with the Paris Climate Agreement. The Bahraini government has been instrumental in this progress by establishing policies, securing necessary funding, and forming strategic partnerships with multinational corporations and other nations to facilitate the shift towards renewable energy (Darwish, Abdo, and AlShuwaiee 2018). The innovation strategies being employed—spanning business models, technological advancements, and eco-innovative practices—are critical in ensuring that renewable energy projects, such as solar panel installations in schools, are not only successfully implemented but also contribute to broader environmental sustainability targets by reducing fossil fuel consumption.

A notable impact of this research is seen in the implementation of solar energy within schools through the school roof project. Schools are particularly well-suited for solar energy adoption due to their large roof spaces and daytime energy consumption, which aligns with peak solar energy generation. By integrating solar power, schools significantly reduce their dependency on fossil fuels, thus lowering operational costs and contributing to national energy savings. Beyond economic and environmental benefits, these projects foster a culture of sustainability within educational settings, providing students with tangible learning opportunities about renewable energy. The presence of solar panels offers daily, real-time learning experiences for students in science, technology, engineering, and mathematics (STEM) subjects, helping to instill environmental stewardship and preparing them to meet future climate challenges (Alnaser and Alnaser, 2011).

In addition to the educational benefits, this research advances the literature on innovation management strategies within Bahrain's energy sector by illustrating how firms are embracing decentralised energy production models. The findings offer practical insights for businesses, educational institutions, and energy practitioners, paving the way for the development of innovation management strategies that further promote sustainability through the adoption of renewable energy sources. For example, the National Energy Efficiency Action Plan (NEEAP) in Bahrain offers valuable lessons on how strategic innovation can help address the unique challenges facing the energy sector (Ministry of Electricity and Water, 2017). The school roof project serves as a practical case study demonstrating key performance indicators, baselines, and initiatives that are necessary to achieve energy sustainability goals.

Furthermore, schools have the potential to act as pivotal contributors to the broader renewable energy movement. By adopting solar energy and implementing sustainable practices, schools can lead by example within their communities. The findings highlight significant opportunities for schools to reinvest the savings from reduced energy costs into areas such as educational resources, technological upgrades, and teacher development. Schools can also forge partnerships with local governments and the private sector to foster collaborative approaches to expanding renewable energy infrastructures. As focal points within their communities, schools can serve as models for other public institutions, demonstrating the viability and benefits of solar energy. The incorporation of renewable energy in school systems encourages broader societal engagement, as students, parents, and the local community observe the positive impact of these initiatives, which, in turn, fosters increased public support for the adoption of renewable energy in other sectors (Alnaser and Alnaser, 2011).

The research also contributes significantly to the development of a decentralised energy production framework, addressing key challenges related to renewable energy and sustainability. By adopting the recommendations outlined in this research, organisations within Bahrain's energy sector can enhance their technological innovation capabilities, develop more effective market strategies, and increase the use of electricity generated from renewable and sustainable sources. This shift not only strengthens the sector's technological foundations but also aligns with global trends towards decentralised energy systems (IRENA, 2019).

Additionally, the research demonstrates that the effective implementation of innovation management strategies can substantially accelerate the adoption and utilisation of renewable energy across Bahrain, particularly in schools, residential areas, and manufacturing industries. For educational institutions, the early adoption of solar energy sets a replicable precedent that can be scaled nationwide. In the manufacturing sector, where energy consumption is high, the adoption of renewable energy sources such as solar and wind can significantly reduce operational costs and environmental impact. Similarly, expanding renewable energy solutions in residential areas decentralises energy production, empowering households to contribute to national energy independence and alleviating pressure on the central grid. This multi-sectoral approach ensures that innovation management strategies are integrated throughout Bahrain's energy landscape, fostering a ripple effect that positions the country as a leader in renewable energy adoption (IRENA, 2019).

Ultimately, this research underscores the critical role that innovation management plays in Bahrain's transition to renewable energy. By detailing actionable strategies and providing evidence-based recommendations, the research offers a pathway for energy firms to embrace sustainability, optimise technological capabilities, and contribute meaningfully to global climate change mitigation efforts. The findings not only provide a blueprint for Bahrain but also offer valuable insights for other nations seeking to transition to renewable energy systems, particularly those with similar geographic and economic contexts.

6.12 Reflections on the Conduct of the Research

This research was conducted ethically, utilising both primary and secondary data sources to ensure a comprehensive and in-depth research of the energy sector in Bahrain, as well as the activities of the GCC states and the League of Arab States. In connection with Alabbasi (2021), the focus on these regions allowed for a wide-ranging and detailed investigation from the introduction. In addition, the scientific methods in the research consisted of hypothesis tests, normative tests, correlation analysis, regression analysis, moderation measures, and exploratory factor analysis, amongst various other scientific studies.

The research was analysed in depth, and all the factors, including the dependent and independent variables, were carefully explained, and the relationships between them were explained both scientifically and narratively. Lastly, from this research, the users of this information can see a clear picture of what the utility companies in Bahrain are going through and the suggested efforts that are already in place directed towards helping these companies overcome their challenges, in accordance to the findings by Alabbasi (2021).

6.13 Contribution to Research Analysis

In the research methodology, a mixed-method research design was adopted for data collection and analysis. Due to the nature of the research, primary data was integrated. The data gathered was analysed using qualitative and quantitative methods since the data was obtained through interviews and questionnaires. Qualitative data were analysed via transcription and familiarisation with themes identified in the interviews. The analyses were conducted using NVivo, while quantitative data were analysed using SPSS statistical software.

The report and discussion were based on the common themes that emerged during the interview. The statistical analysis in the research was used in testing the hypotheses of the research as well as examining the distribution of respondents' responses to the survey questions. The use of both methods of data analysis in the research has helped in providing insight and new developments related to innovation management as supported by the research findings of Coccato (2020). Thus, this research has further shown the significance and application of both qualitative and quantitative analysis methods in topics and discussions, especially in sustainable development studies.

6.14 Personal Reflections

As a manager, I recognise the imperative for energy companies to embrace continuous change and improvement to achieve transformational innovations in a rapidly evolving external environment such as Bahrain. Managers in the energy sector in this Arabic-speaking country face organisational crises and multifaceted challenges arising from both internal and external factors. To remain competitive, they must foster innovation by balancing the development of existing leading technologies with ongoing research into emerging solutions. This equilibrium is essential for establishing robust internal processes that sustain long-term growth. Furthermore, energy companies in Bahrain must adapt their organisational structures to promote innovativeness and identify novel business solutions. Implementing diverse operational models can facilitate entry into new commercial markets, ensuring resilience in a dynamic economic landscape.

The findings of this research underscore the critical role energy companies must play in recognising and nurturing future entrepreneurs and innovators. By providing the necessary support to develop their ideas, Bahrain’s energy firms can foster a culture of entrepreneurialism. This sentiment is echoed in research conducted by Al-Aghbari (2022), which highlights the importance of knowledge management practices that encourage the creation, exchange, and utilisation of knowledge. Leveraging the vast amounts of information generated by smart grids and engaging in extensive data analysis are crucial steps in this process. These insights have reinforced my understanding of how data-driven decision-making can drive innovation and operational efficiency within the energy sector.

Utilising these findings, I can make informed recommendations to enhance my organisation's innovation capabilities and methodologies for utilising renewable energy. Innovations in biofuels, solar energy, hydropower, wind energy, and geothermal energy—aimed at environmental conservation—can be developed by applying the practical implications of this research. Staying updated on research advancements enables managers to share their expertise with colleagues, fostering a collaborative learning ethos that drives improved organisational outcomes. Managers in the energy sector can integrate these insights into their professional practices, both within their organisations and in wider contexts. The findings emphasise the importance of participating in local and international technical conferences and seminars relevant to energy production, consumption, and environmental sustainability. As governments worldwide anticipate an all-electric future, there is heightened awareness and action across all sectors of society and the economy in Bahrain.

The review of the school roof project outcomes illustrates the value of establishing clear objectives and enforceable regulations aimed at phasing out gas-powered internal combustion engines, reducing carbon emissions, enhancing building efficiency, and replacing fossil fuel-burning appliances with renewable energy systems. The school roof project presents significant benefits for educational institutions by addressing ongoing energy challenges through the integration of renewable energy solutions, notably solar power. This initiative allows schools to lower operational costs, enhance teaching methods, and foster a conducive learning environment while educating students about the importance of sustainable energy practices. By harnessing solar energy, schools can reduce their reliance on fossil fuels, lower electricity costs, and contribute to national energy savings, thereby cultivating a culture of sustainability among students and staff. Furthermore, the project encourages collaboration with energy companies, allowing students to engage in hands-on learning and acquire practical experience in science, technology, engineering, and mathematics (STEM) fields. This active participation not only prepares students for careers in renewable energy but also promotes environmental stewardship and societal awareness of energy consumption. Overall, the school roof project exemplifies how innovative management practices in the energy sector can lead to economic, environmental, and educational advancements, ultimately paving the way for a more sustainable future.

The insights and expertise gained throughout this research have reinforced my belief in the pivotal role that government policy instruments play in achieving established sectoral objectives. This includes implementing mandatory requirements for all newly constructed buildings to integrate efficient systems that support renewable energy and energy conservation measures. According to Abdulla and Naser (2021), sustainable development can be realised in three ways: first, by reducing environmental damage; second, by increasing resilience to ecological pressures; and third, by ensuring the responsible and efficient utilisation of natural resources. From that perspective and in the context of the Kingdom of Bahrain, acquisitions and corporate venturing represent viable avenues for obtaining innovations and technologies that can facilitate continuous environmental adaptation (Modara, 2019). Taking a theoretical perspective to analyse the dynamics of the Bahraini energy sector reveals significant tension between the necessity for consistent, safe, and efficient operations and the objective of implementing long-term management innovation strategies.

The researcher assessed the impact of scientific and technical conferences on knowledge sharing and innovation management, especially regarding enhanced access to electricity and decentralised electricity production. The findings suggest that maximising available resources for energy firms in Bahrain is a crucial outcome, attainable through effective innovation management strategies. These strategies are vital in the context of climate change, promoting the expanded utilisation of renewable energy sources, decreasing fossil fuel dependence, conserving electrical power, and implementing policies that result in positive industry outcomes.

The research findings will aid in establishing collaborative relationships with governmental bodies in the Kingdom of Bahrain, with the goal of mitigating climate change through innovative strategies that decrease energy consumption and restrict fossil fuel use, as demonstrated in the study by Kirikkaleli, Güngör, and Adebayo (2022). By fostering collaboration between energy firms in Bahrain and the Kingdom's government bodies, these findings encourage initiatives to address climate change through the adoption of innovative strategies that decrease energy consumption and restrict fossil fuel combustion. This is crucial for Bahrain, as fossil fuel consumption has been recognised as a significant factor in the rise of atmospheric carbon dioxide levels (Kirikkaleli, Güngör, and Adebayo, 2022).

This underscores the pressing need for energy organisations in Bahrain to adopt innovation and combine incremental strategies with transformational ones to successfully navigate the ever-changing external business environment. Promoting the generation and dissemination of knowledge, as well as harnessing the wealth of data captured by smart grid technologies, are essential for facilitating this transition. The insights derived from this research will inform managerial decision-making within Bahrain's energy sector as they emphasise the significance of collaboration with commercial entities, businesses, and local communities to transform energy consumption strategies and adopt more efficient practices.

A strategic shift in energy consumption policies is imperative, and governmental bodies in Bahrain must prioritise investments in clean energy technologies. By doing so, they can stimulate innovation through financial support mechanisms such as grants, subsidies, and tax incentives. This proactive approach not only encourages the development of sustainable energy solutions in the Kingdom but also contributes to a more resilient and environmentally responsible energy sector.

This research has profoundly impacted my professional outlook and approach to management within the energy sector. It has provided me with a deeper understanding of the intricate relationship between innovation, sustainability, and organisational success. Moving forward, I am committed to integrating the insights gained from this research into my daily practices. Specifically, I plan to prioritise the adoption of energy-efficient technologies and methodologies within my organisation, ensuring that sustainability becomes a core component of our operational strategy. Additionally, I will actively seek opportunities to collaborate with governmental bodies, educational institutions, and industry stakeholders to promote renewable energy initiatives and foster a culture of innovation. By doing so, I aim to contribute to the long-term sustainability of Bahrain's energy sector while enhancing the efficiency and competitiveness of my organisation.

The findings from this research have significantly influenced my professional practice, providing a nuanced understanding of the impact of energy efficiency research on the industry. With a deeper comprehension of energy-efficient methodologies, I am committed to further reducing operational expenses and enhancing the overall sustainability of my organisation. In my professional duties, I have observed that integrating energy-efficient technologies and practices not only benefits the environment but also improves efficiency and generates cost savings. It is truly exhilarating to witness how advancements in energy efficiency research are transforming our work and lives.

In conclusion, the insights gained from this thesis will inform the implementation of novel approaches in related areas. By leveraging these findings, I am confident that my organisation can achieve greater operational efficiency, environmental responsibility, and long-term success in an increasingly competitive and dynamic energy landscape.

6.15 Social Contributions of the Thesis

The management of innovation is a critical driver in the development of clean, affordable, and sustainable energy solutions. While this research aligns with broader studies in the field, its unique contribution lies in its focus on the intersection of innovation management, stakeholder collaboration, and energy conservation within the specific context of Bahrain. By integrating innovative strategies and processes, the research explores how renewable energy initiatives can enhance subsidies, promote energy savings, and optimise the deployment of renewable energy systems. However, it is important to acknowledge that the social impact of this research is broadly similar to other contributions in the field, as it emphasises the importance of energy conservation and efficiency—a focus that, while valuable, is not entirely distinct from existing studies (Hoffman and Georg, 2019; Sovacool, 2017). To address this, the research incorporates insights from Al-Ansari, Al Mohsen, and Coutts (2022), who highlight the role of educational programmes in fostering behavioural change, thereby adding a layer of specificity to its findings.

While the research primarily focuses on energy conservation and efficiency, it is essential to situate these findings within the broader energy sector, which encompasses a wide range of issues such as energy security, infrastructure development, and technological innovation (IRENA, 2020). The research's emphasis on reducing dependence on fossil fuels and promoting renewable energy aligns with global efforts to address climate change. However, its limited engagement with broader energy sector issues, such as energy access and affordability, suggests that the findings are context-specific and should be interpreted with caution (IEA, 2021). For instance, the research highlights the potential for behavioural changes to increase the adoption of renewable energy sources in Bahrain, but it does not fully explore how these changes might apply to regions with different socio-economic and environmental conditions (REN21, 2022). This narrow focus, while logical, limits the study's applicability to the energy sector more broadly.

The findings of this research are context-specific and pragmatic, rather than revolutionary, offering a practical assessment of how innovation management and stakeholder collaboration can enhance renewable energy initiatives within Bahrain's distinct socio-economic and environmental context. For example, the study emphasises the importance of collaboration and knowledge-sharing among stakeholders, consistent with existing literature on renewable energy management (Alaali and Naser, 2020; Wüstenhagen, Wolsink, and Bürer, 2007). However, it deliberately avoids overgeneralising its conclusions, recognising that its findings are not universally applicable. Instead, it highlights the need for tailored strategies that account for local factors, such as Bahrain's energy policies, resource availability, and cultural dynamics (El-Katiri, 2014). This approach ensures the findings are both accurate and actionable, providing a solid basis for future research and policy development. While the findings are particularly relevant to Bahrain, they also offer an adaptable framework for similar contexts, provided local variables are carefully considered. This balance between specificity and adaptability enhances the research's practical value and its potential to guide targeted interventions in renewable energy management.

To demonstrate how this research adds to the existing body of knowledge, a more comprehensive engagement with the literature is necessary. While the research builds on previous work by Alaali and Naser (2020) and Al-Ansari, Al Mohsen, and Coutts (2022), it could benefit from a deeper comparison with other studies that explore similar themes in different contexts. For instance, research by Smith and Brown (2021) on innovation management in the European energy sector provides valuable insights into the role of policy frameworks and financial incentives in driving renewable energy adoption. Similarly, studies by Jacobsson and Lauber (2006) and Geels (2002) highlight the importance of socio-technical transitions in achieving sustainable energy systems. By incorporating such comparisons, this research could better highlight its unique contributions, such as its focus on stakeholder collaboration and educational programmes in Bahrain. This would not only strengthen the research's originality but also provide a clearer understanding of how it advances the field.

The research establishes a limited yet valuable foundation for future progress, particularly within Bahrain's context. The study by Al-Ansari, Al Mohsen, and Coutts (2022) provides a useful starting point by highlighting the role of educational programmes in promoting behavioural change towards renewable energy adoption.

Building on this, future research should explore the socio-economic barriers to renewable energy adoption in Bahrain and similar regions. This could involve analysing the interplay between policy frameworks, financial incentives, and public awareness campaigns in driving sustainable energy practices (IRENA, 2020; IEA, 2021). Additionally, the scalability of the collaborative models proposed in this study merits further investigation, particularly their applicability to larger energy systems and diverse stakeholder groups (Wüstenhagen, Wolsink, and Bürer, 2007). For instance, the development of targeted educational programmes, as suggested by Al-Ansari, Al Mohsen, and Coutts (2022), could be expanded to include training for policymakers and industry leaders, ensuring a more holistic approach to energy conservation. Comparative studies with other regions, such as those by Sovacool (2017) and El-Katiri (2014), could also offer valuable insights into the transferability of findings, helping to identify global best practices for renewable energy management. These efforts would enhance the research's applicability and contribute to the development of more robust and inclusive energy policies.

In conclusion, this thesis contributes to the discourse on renewable energy management by underscoring the importance of innovation and collaboration in advancing sustainability. While its focus on energy conservation and efficiency aligns with broader studies, the research adds value by providing context-specific insights into the challenges and opportunities within Bahrain. The findings, though pragmatic rather than groundbreaking, offer a realistic and actionable framework for improving renewable energy initiatives. By emphasising stakeholder collaboration and educational programmes, the research lays a foundation for future studies and policy development. However, greater engagement with broader energy sector issues—such as energy access, affordability, and infrastructure—and more detailed comparisons with existing literature would enhance its originality and significance. Through these contributions, the thesis not only advances academic understanding but also provides practical recommendations for achieving energy sustainability in Bahrain and beyond. Its focus on tailored strategies and localised solutions ensures relevance to Bahrain while offering an adaptable framework for other regions facing similar challenges.

6.16 Limitations of the Research

This research is geographically confined to Bahrain, a single country within the Middle East, which inherently limits the generalisability of its findings to the broader region. While the research provides valuable insights into innovation management within Bahrain's energy sector, the findings cannot be extrapolated to other Middle Eastern countries without caution. This limitation is characteristic of single case study research, which, as Yin (2009) notes, often struggles to achieve broad applicability due to its focus on a specific context. However, inferences may be drawn for countries with similar socio-economic and regulatory environments, though such comparisons require further empirical validation.

A significant limitation of this research is the potential for researcher bias, particularly in the qualitative components of the research. Qualitative methods, while instrumental in capturing rich, detailed insights, are inherently subjective and may be influenced by the researchers' perspectives (Creswell, 2014). To mitigate this, the research employed a mixed-methods approach, integrating qualitative interviews with quantitative data analysis. The quantitative data provided an objective counterbalance to the qualitative findings, enhancing the reliability and validity of the results. This methodological triangulation, as advocated by Bryman (2012), strengthens the robustness of the research by addressing the inherent limitations of each approach.

Another limitation stems from the reliance on a single case study, which may lack the scientific rigour required for broader generalisability. Case studies are often criticised for their limited scope and potential lack of representativeness (Flyvbjerg, 2006). To address this, the research incorporated multiple data sources, including semi-structured interviews, archival records, and industry reports, to ensure a comprehensive analysis. This approach, known as data triangulation, improves the credibility of the findings by corroborating evidence from diverse sources (Yin, 2014). Despite these measures, the research remains confined to Bahrain's energy sector, limiting its applicability to other regions or industries.

To address these limitations, future research should expand the scope to include multiple countries within the Middle East, enabling comparative analysis and enhancing the generalisability of the findings. Longitudinal studies could also provide valuable insights into the evolution of innovation practices over time, addressing the temporal limitations of this research (Eisenhardt and Graebner, 2007). Such studies would offer a more nuanced understanding of the factors driving innovation in the energy sector across different contexts.

This research makes specific contributions to the field of innovation and technology development by examining the role of collaborative partnerships in Bahrain's energy sector. The findings highlight the importance of open innovation models, as discussed by Chesbrough (2003), in fostering knowledge sharing and accelerating technology development. For instance, the research identifies joint research initiatives and industry-academia workshops as key mechanisms for knowledge transfer, offering practical insights for policymakers and industry stakeholders (Etzkowitz and Leydesdorff, 2000). These findings align with Geels' (2014) emphasis on the role of multi-stakeholder collaboration in driving sustainable energy transitions.

The collaborative partnerships between energy companies, academia, and industry have been shown to enhance innovation and technology development within Bahrain's energy sector. The research provides empirical evidence of how these partnerships facilitate knowledge exchange and address sector-specific challenges. For example, the research identifies regulatory support and the establishment of innovation hubs as critical enablers of collaborative innovation, which could serve as a model for other regions (Freeman, 1995). These insights have practical implications for policymakers seeking to replicate similar success in other contexts.

In conclusion, while this research offers valuable insights into innovation management within Bahrain's energy sector, its limitations highlight the need for further studies to validate and extend the findings. Specific contributions of this work include the identification of key drivers of innovation, such as regulatory frameworks and collaborative networks, which could inform future policy and practice. Potential future changes to practice could involve the establishment of regional innovation hubs to foster cross-border collaboration and knowledge exchange, thereby accelerating progress towards a low-carbon economy. By addressing these limitations and building on the findings, future research can contribute to a more comprehensive understanding of innovation in the energy sector and support the transition to sustainable energy systems.

6.17 Recommendation

It is now confirmed that innovation management strategies are effective in the transition to the production and management of renewable energy in Bahrain. It is also ascertained that innovation management strategies effective in addressing difficulties related to the performance and productivity of energy organisations. This section provides the recommendations that geared towards the effective management of innovative strategies to ensure long term sustainability in the production of renewable energy in Bahrain. This could be done by formulating policies and laws that promote the development and maintenance of certain innovation strategies in the energy sector.

Realistic and achievable methods ensure the development and maintenance of innovation strategies for sustainable growth and renewable energy production in Bahrain's energy sector include creating laws and policies that promote renewable energy over non-renewable energy, with measures that mandate energy organisations to prioritise renewable energy production and implement innovative strategies to increase production of renewable energy. Promoting and advancing research is necessary to increase renewable energy production. Research institutions are regarded as the primary source of innovation development, and they should be given more attention in terms of funding and investment to expand their research area on renewable energy. Bahrain needs to partner and acquire skills from other developed countries in technology and innovative management. It should seek collaborations with countries that have successfully implemented renewable energy production and reduced greenhouse gas emissions, borrowing and making use of their innovative strategies.

6.18 Suggestions for Future Research

Based on the findings of this research, a suggestion for future research is to explore how the Bahraini energy sector can implement the innovative management strategies recommended in this research to address the issues identified and improve their overall performance and sustainability. Secondly, with the ongoing campaigns on climate change, energy efficiency will have increased attention in most countries in the world, and Bahrain is expected to be one of them. Therefore, governments will try to reduce fossil fuel use by reducing power supply costs while increasing the use of renewable energy sources such as wind and solar.

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APPENDICES

Appendix A: Survey introduction

Informed Consent

This research is being conducted to investigate innovation management in energy organisations in the Kingdom of Bahrain. The collected data will be used by various strategic business management departments and provide information that will assist in creating awareness of the significant effect of innovation management in energy organisations. The research will also provide policymakers with criteria to ascertain suitable strategies for improving energy organisations' innovation management.

Procedures to be followed

Participation in this research will require you to fill in the questionnaire, which will take approximately 15–30 minutes to complete. Kindly answer each and every question as honestly as possible, because the accurate results of the research depend on you.

You have the right to refuse participation in this research.

Please remember that participation in this research is completely voluntary. You may ask questions related to this research at any time.

You may refuse to respond to any of the questions at any time. You may also withdraw from the research at any time without any penalisation or personal consequences.

Discomfort and Risks

Some of the questions you will be asked may be personal, however, they are open-ended. Therefore, if you feel uncomfortable with what is asked, you may refuse to answer these questions.

Benefits

If you participate in this research, you will help us to establish valid findings on innovation management in energy organisations in the Kingdom of Bahrain

Confidentiality

Any information you provide will be treated as confidentially as possible. Your name will not be recorded on the questionnaire. All of the personal data that you provide will be kept private.

Participant's Statement

The above information regarding my participation in the research is clear to me. I have been given the chance to ask questions, and my questions have been answered to my satisfaction. My participation in this research is entirely voluntary. I understand that my personal data will be kept private and that I can withdraw from the research at any time

Name of Participant: ....

________________________________ ______________________

Signature Date

Appendix B: Participant consent form

[Innovation Management in Energy Organisations in the Kingdom of Bahrain]

- I confirm that I have read and understood the information provided in the Participant consent form.
- I understand that my participation in the research is entirely voluntary and that I am free to withdraw from the project at any time without any consequences. Additionally, I can request my interview responses to be excluded from the research four weeks after the interviews have been conducted.
- I am satisfied that my employer has provided the necessary permission allowing the Ito conduct this research and that no additional permission is required.
- I understand that details of my personal identity, such as my name and my gender, will not be disclosed either to my employers or for the purposes of this research.
- I understand that I can withdraw my data from this research at any time.
- I have had the purpose and nature of the research explained to me in writing and I have had the opportunity to ask questions about the research.
- I understand that I will not benefit directly from participating in this research.
- I understand that all information I provide for this research will be treated confidentially.
- I understand that in any report on the results of this research my identity will remain anonymous.
- I understand that disguised extracts from my participation will not encompass my real name or other identifying information.
- I understand that if I inform the researcher that myself or someone else is at risk of harm they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.
- I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.
- I understand that the research team will hold the research data for six months before publishing.

[Participants signature] [Date]

[Researcher's signature] [Date]

Appendix C: Survey Model

Draft Questionnaire and Interview Schedule

SURVEY MODEL

Research Topic: Innovation Management in Energy Organisations in the Kingdom of Bahrain

Researcher: Ahmed Alezz

Supervisors: Dr. Amon Simba and Dr. Yan Wang

University: Nottingham Trent University

Respondent number: [ ]

- Different responses are apparent regarding the concept of innovation management in energy organisations. Therefore, you are kindly asked to complete this questionnaire.
- Do not write your name on the questionnaire.
- Please note that the information you provide will be treated with the utmost confidentiality and will be used solely for the purposes of this academic research.
- Please tick ( ) the box where applicable; when an explanation is required, use the spaces provided.

SECTION A: demographic information

1. Gender Male ( ) Female ( )

2. Age 21–30 ( ) 30–35 ( ) 36–39 ( )
40–45 ( ) 45–49 ( ) 50–54 ( )
55–60 ( ) Over 60 ( )

3. Academic qualification(s)
PhD ( ) Masters ( ) Degree ( ) Diploma ( )
Other (specify)…………………………………………………………

4. Which department do you work in?
Management ( ) Planning ( ) Production ( )
Transmission ( ) Power Distribution ( )
Other (specify)…………………………………………………………

SECTION B: QUESTIONNAIRE SURVEY

Tick the appropriate response namely

(SD=Strongly Disagree, D=Disagree, NS=Not Sure, A=Agree and SA=Strongly Agree)

A- **Evaluation of Effective Innovation management in Bahrain**

1. Effective innovation management involves the proper management of resources by energy Organisations

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

2. Innovation management is the method for maximizing the growth potential of the energy sector in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

3. Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector.

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

4. Innovation management involves proper utilisation and harnessing of renewable energy in the production of electricity in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

5. Innovation management has to do with efficient and well-structured Organisation of operations

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

B- **Evaluation and Opinion about Challenges facing Transitioning to decentralised and centralised models of Energy generation**

1. Insufficient human resources is a major challenge faced by energy organisations while transitioning to decentralised and centralised models of power generation

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

2. Market Policies and Managerial Policies are set back when the transition to decentralised models of energy generation in the Kingdom of Bahrain.

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

3. Bahrain energy organisations are being faced with Inadequate resources for generating and transmitting electricity.

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

4. Limited financial capabilities for managing electricity production and transmission is a significant challenge faced by energy organisations in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

5. Sabotage of Electrical facilities and Environmental issues affect energy organisations in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

C- **Factors Affecting Energy Organisation**

1. Environmental Issues is one of the major factors affecting electricity organisation in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

2. Limited and Poor Human Resource Management is a factor that affects energy organisations in the Kingdom of Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

3. Market and Governmental Policies are factors affecting energy Organisation in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

4. Lack of Operational and Production Resources for generating Electricity affects energy Organisations in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

5. Organisation and Managerial issues are factors that affect energy organisations

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

6. Insecurities as a factor affects energy organisations in Bahrain

   Strongly Disagree ( ) Disagree ( ) Not Sure ( ) Agree ( ) Strongly Agree ( )

D- **OPEN-ENDED QUESTIONS**

1. What should the benchmarks for innovation management be for Bahrain's electricity organisations, in order to address the operational and organisational challenges they face?
2. What are the challenges that electricity organisations face while transitioning to decentralised and centralised models of power generation?
3. What are the successful innovation management strategies that Bahrain's electricity organisations have implemented while transitioning to decentralised and centralised models of power generation?
4. How is innovation being utilised to combat the challenges that electricity organisations are facing?
5. What would you suggest are the key innovative approaches in dealing with the problems that electricity organisations are facing?

Appendix D: Letter to Interviewee

This research is being conducted to investigate innovation management in energy organisations in the Kingdom of Bahrain. The data you provide will be used by various strategic business management departments and provide information that will assist with creating awareness of the significant effect of innovation management on energy organisations. The research will also provide policymakers with criteria to determine suitable strategies for improving innovation management among the Kingdom of Bahrain's energy organisations.

Participation in this research requires you to answer the interview questions, which will take approximately 15–30 minutes to complete. Kindly answer each and every question as honestly as possible, because the research's accurate results depend on you.

You have the right to refuse participation in this research. Please remember you're your participation in this research is entirely voluntary. You may ask questions related to the research at any time. You may refuse to respond to any of the questions at any point. You may also withdraw from the research at any time without any penalization or personal consequences. Some of the questions you will be asked may be personal, however, they are open-ended questions. Therefore, if you feel uncomfortable with any of them, you may refuse to answer them. If you participate in this research, you will be helping us to establish valid findings on innovation management among the Kingdom of Bahrain's energy organisations.

Any information you provide will be treated with the utmost confidentiality. Your name will not be recorded. All of your personal data will be kept private.

Appendix E: Interviewee Questions (Schedule)

1. What are the current challenges confronting electricity organisations?
2. What would you say will be the challenges that electricity organisations will face in the near future?
3. What strategies can you suggest as effective approaches for dealing with the challenges faced by electricity organisations?
4. What strategies have already been put in place to deal with the challenges that electricity organisations are facing?
5. Would you say that the strategies in place are effective enough to provide lasting solutions?
6. What is the role of innovation in offering lasting solutions to such organisations?
7. How is innovation being utilised to combat the challenges that electricity organisations are facing?
8. What would you suggest are the key innovative approaches in dealing with the problems that electricity organisations are facing?

Appendix F: Evaluation Process

1. Once data are collected, I shall proceed to evaluate the data to determine if they are worthy of analysis.
2. The subsequent step is to determine whether the collected data are in line with the objectives and the scope of the Research.
3. Coding of the data into the relevant application.
4. Seeking approval from the project manager to certify that the procedures were duly followed.
5. Later, the data will be imported into SPSS, analysed and then presented in the form of tables and graphs to provide further interpretation.

Appendix G: Interviews transcript

A: Open-Ended Questions

Questions

1. "What should the benchmarks for innovation management be for Bahrain's electricity organisations to address the operational and organisational challenges they face?"

Answer #1	Proper management of resources.
Answer #2	Proper resource allocation.
Answer #3	Methods for maximising the growth potential of the energy sector.
Answer #4	Methods for maintaining valuable employees in the sector.
Answer #5	Approaches to enhancing technological innovations in order to attract a larger market.
Answer #6	How to increase the efficient harnessing of electric energy from the available resources.
Answer #7	Methods for increasing the employee satisfaction rate that will ensure the smooth running of the sector.
Answer #8	How to reduce the risks of losses or collapse within the energy sector.
Answer #9	How to improve the organisational structures to increase efficiency in the production of electricity.
Answer #10	Methods for improving the communication channels between the employees and the managers when implementing improvements for the production process.

2. "What are the challenges that electricity organisations face while transitioning to decentralised and centralised models of power generation?"

Answer #1	High expansion costs.
Answer #2	Lack of skilled manpower to manage the stations effectively.
Answer #3	Insufficient generation capacity.
Answer #4	Poor infrastructure for proper electricity transmission.
Answer #5	Unbalanced electricity demand and supply.
Answer #6	Lack of subsidies for the decentralised power symptoms.
Answer #7	Difficulty in adapting to the new markets, especially when

	the organisation's structure is not flexible.
Answer #8	Non-convexities caused by market failure resulting from changes in operational activities and allocation of resources that result in disequilibrium.
Answer #9	Environmental effects caused by the disposal of the by-products of electricity.
Answer #10	Vandalism, fraud, and attacks on the power stations.

3. "What are the successful innovation management strategies that Bahrain's electricity organisations have implemented while transitioning to decentralised and centralised models of power generation?"

Answer #1	Providing resources for projects.
Answer #2	Following definite sets of rules and procedures to support their work.
Answer #3	Timely analyses of the consumers, demand, and behavioural trends within the market.
Answer #4	Internal and external analyses of organisations so as to determine the strengths and weaknesses of various companies.
Answer #5	The kingdom observes the activities of the Middle Eastern region in order to establish competition between organisations.
Answer #6	Improving the customer service provided and aiming to increase customer satisfaction.
Answer #7	Assessing internal institutional factors, including the capital and labour that is utilised.
Answer #8	The goals list is quantified, with measurable targets for each of the total quality management (TQM) described.
Answer #9	Empowerment of employees, with the training to follow the total quality management (TQM) strategies of their various companies.
Answer #10	Presence of common quality standards for different companies.

4. "How is innovation being utilised to combat the challenges that electricity organisations are facing?"

Answer #1	It helps to develop a quality management system.
Answer #2	It helps the organisations develop new methods for utilising resources.
Answer #3	It helps develop new infrastructure designs.
Answer #4	By providing new methods of employee management.
Answer #5	By developing better methods of storing the electricity.
Answer #6	By developing new methods of harnessing electricity.
Answer #7	By providing approaches to increasing the number of skilled personnel.
Answer #8	By facilitating new methods of production that require fewer input costs and produce a greater output.
Answer #9	By improving the marketing strategies that reduce the losses.
Answer #10	By improving electricity production efficiency.

5. "What would you suggest are the key innovative approaches in dealing with the problems that electricity organisations are facing?"

Answer #1	Developing better infrastructures.
Answer #2	Developing new methods of harnessing electricity.
Answer #3	By improving the methods of storing the electrical energy.
Answer #4	By developing better organisational structures.
Answer #5	By providing better ways of managing the employees.
Answer #6	Enhancing competitiveness by increasing the production of electric energy.
Answer #7	By developing new methods that increase the connectivity of energy within urban and rural areas.
Answer #8	By reducing the costs of production.
Answer #9	By providing better methods of managing resources to avoid misuse.
Answer #10	By applying new technologies to produce electricity.

B: INTERVIEWEE QUESTIONS

Questions

I. "What are the current challenges confronting electricity organisations?"

Answer #1	Environmental pollution.
Answer #2	Government or public policies impose high taxes on the electricity sector.
Answer #3	Lack of innovation in most organisations.
Answer #4	High research and development costs when re-habiting the current electricity stations.
Answer #5	Harsh weather conditions affect the proper harnessing of electricity.
Answer #6	Insecurity in some places - such as remote areas - makes it hard to establish electricity stations.
Answer #7	Poor organisational structures for overseeing the electricity sector's activities.
Answer #8	Lack of skilled personnel who can properly manage the electricity grid stations.
Answer #9	Lack of resources to facilitate the expansion of the harnessing of electrical power.
Answer #10	Poor management of employees who end up performing poorly in their jobs.

II. "What would you say will be the challenges that electricity organisations will face in the near future?"

Answer #1	Stiff competition from upcoming electricity companies with better management.
Answer #2	Consumers potentially starting to use more renewable sources of energy like wind and solar energy compared to gas-generated electricity.
Answer #3	Increased research and development costs owing to the advancement of technology each year.
Answer #4	Shortage of resources such as the availability of lands and crude oil.
Answer #5	Shortness of manpower owing to world pandemics such as covid-19.
Answer #6	Reduced and corporate merger markets owing to the global pandemic.
Answer #7	Limitation of water resources owing to climate change.

Answer #8	Reduced supply owing to limited sources of electric energy.
Answer #9	Lack of research and development staff in the organisation results in outsourced firms being asked to do so.
Answer #10	Increased effects on the environment owing to increased carbon emissions.

III. “What strategies can you suggest as effective approaches for dealing with the challenges faced by electricity organisations?”

Answer #1	Benchmarking specialised firms and organisations that have handled the problems effectively.
Answer #2	Employing better management of resources.
Answer #3	Employing better methods of managing employees.
Answer #4	Employing better ways of storing electricity.
Answer #5	Liaising with the government for funds for research and development.
Answer #6	Improving the infrastructure designs of the mains' electricity and sub-stations.
Answer #7	Training more staff regarding how they can manage the grid electricity stations effectively.
Answer #8	Reducing the costs of connecting electricity in order to increase the supply.
Answer #9	Developing better organisational structures that are all-inclusive.
Answer #10	Encouraging innovation in employees.

IV. “What strategies have already been put in place to deal with the challenges that electricity organisations are facing?”

Answer #1	Benchmarking according to countries’ successful experience in better management.
Answer #2	Reducing the costs of connecting electricity to increase the supply.
Answer #3	Liaising with the government for funds for research and development.
Answer #4	Employing better methods of storing electricity.
Answer #5	Training more staff regarding how they can operate and maintain the electricity grid stations.
Answer #6	Employing better methods of managing employees.

Answer #7	Employing better management of resources.
Answer #8	Encouraging innovation in employees.
Answer #9	Developing new methods of connecting electricity.
Answer #10	Increasing the security of the electricity stations.

V. "Would you say that the strategies in place are effective enough to provide lasting solutions?"

Answer #1	Yes, because they are conserving the environment.
Answer #2	Yes, because they facilitate effective employee management.
Answer #3	Yes, because they assist in the correct allocation of resources.
Answer #4	No, because they do not promote competition.
Answer #5	Yes, because they are supported by the government.
Answer #6	No, because they have not incorporated innovation strategies.
Answer #7	Yes, because they facilitate the reduction of carbon emitted in the environment.
Answer #8	Yes, because they facilitate the expansion of production.
Answer #9	No, because they do not incorporate investment to improve the educational and professional practices of the employees.
Answer #10	No, because the organisation does not consider the opinion of experts and professionals who are employees in the organisation for any development decisions; rather, only the organisations' leaders' are.

VI. "What is the role of innovation in offering lasting solutions to such organisations?"

Answer #1	Improve efficiency in production.
Answer #2	Provide better methods of harnessing renewable sources of energy.
Answer #3	Provide better methods of managing the employees.
Answer #4	Provide better methods of managing resources to avoid misuse.
Answer #5	Enhance competitiveness by increasing the production of energy from renewable energy sources.
Answer #6	Increase the connectivity of energy between citizens of the

	countries in which innovation is embraced.
Answer #7	Reduce the costs of electricity production by providing alternatives such as renewable energy sources.
Answer #8	Develop rigid organisation structures that will improve the strategies used.
Answer #9	Improve the methods of storing the energy harnessed from these renewable sources.
Answer #10	Improve the quality and reliability of the energy sector's infrastructure.

VII. "How is innovation being utilised to combat the challenges that electricity organisations are facing?"

Answer #1	To provide better methods of harnessing renewable sources of energy.
Answer #2	To improve the quality and reliability of infrastructure.
Answer #3	To improve efficiency in energy production.
Answer #4	To provide better methods of managing resources to avoid misuse.
Answer #5	To develop better organisational structures.
Answer #6	To reduce the costs of electricity production.
Answer #7	To develop new methods that increase the connectivity of energy among citizens locally and between nearby countries.
Answer #8	To enhance competitiveness by increasing the production of electric energy.
Answer #9	By providing better methods of managing the employees.
Answer #10	By improving the methods of storing the electrical energy.

VIII. "What would you suggest are the key innovative approaches in dealing with the problems that electricity organisations are facing?"

Answer #1	Developing new methods of resource management.
Answer #2	Developing new methods of employee management.
Answer #3	Employing proper allocation of resources.
Answer #4	Developing new methods of maintaining good ties with other local and international companies.
Answer #5	Developing better approaches to conserving the environment whilst harnessing electric energy.

Answer #6	Reducing the usage of fossil-based energy and focusing on renewable sources of energy.
Answer #7	Innovating better designs of utility infrastructure.
Answer #8	Improving better methods of training employees to have an increased number of skilled staff.
Answer #9	Developing new and efficient approaches to increasing electricity connectivity.
Answer #10	Increase the number of market analysers and forecasters who will help with approaches to maintaining the market balance by quenching the supply and demand requirements.

Appendix H: SPSS Output

Notes

Output Created		10-FEB-2023 15:55:30
Comments		
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	N of Rows in Working Data File	100
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Gender Age Academic Qualifications Department EIM1 EIM2 EIM3 EIM4 EIM5 CH1 CH2 CH3 CH4 CH5 FACTOR1 FACTOR2 FACTOR3 FACTOR4 FACTOR5 FACTOR6 /ORDER=ANALYSIS.
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	Elapsed Time	00:00:00.01

Gender of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	25	25.0	25.0	25.0
	Male	75	75.0	75.0	100.0
	Total	100	100.0	100.0	

Age of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 30	10	10.0	10.0	10.0
	31-35	23	23.0	23.0	33.0
	36-40	25	25.0	25.0	58.0
	41-45	19	19.0	19.0	77.0
	46-50	11	11.0	11.0	88.0
	> 51	12	12.0	12.0	100.0
	Total	100	100.0	100.0	

Academic Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PhD	3	3.0	3.0	3.0
	Master's Degree	13	13.0	13.0	16.0
	Bachelor's Degree	70	70.0	70.0	86.0
	Diploma	14	14.0	14.0	100.0
	Total	100	100.0	100.0	

Department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Management	8	8.0	8.0	8.0
	Planning	15	15.0	15.0	23.0
	Production	28	28.0	28.0	51.0
	Transmission	26	26.0	26.0	77.0
	Distribution	15	15.0	15.0	92.0
	Other	7	7.0	7.0	99.0
	7	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Effective innovation management involves proper management of resources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	16.0	16.0	16.0
	Disagree	12	12.0	12.0	28.0
	Not Sure	10	10.0	10.0	38.0
	Agree	32	32.0	32.0	70.0
	Strongly Agree	30	30.0	30.0	100.0
	Total	100	100.0	100.0	

Innovation management is the method for maximizing the growth potential of the energy sector.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	15	15.0	15.0	15.0
	Disagree	9	9.0	9.0	24.0
	Not Sure	10	10.0	10.0	34.0
	Agree	38	38.0	38.0	72.0
	Strongly Agree	28	28.0	28.0	100.0
	Total	100	100.0	100.0	

Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.0	2.0	2.0
	Not Sure	8	8.0	8.0	10.0
	Agree	48	48.0	48.0	58.0
	Strongly Agree	42	42.0	42.0	100.0
	Total	100	100.0	100.0	

Innovation management involves proper utilisation and harnessing of electric energy in the production of electricity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	8	8.0	8.0	8.0
	Disagree	11	11.0	11.0	19.0
	Not Sure	8	8.0	8.0	27.0
	Agree	53	53.0	53.0	80.0
	Strongly Agree	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

Innovation management has to do with efficient and well-structured Organisation of operations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	3.0	3.0	3.0
	Disagree	5	5.0	5.0	8.0
	Not Sure	23	23.0	23.0	31.0
	Agree	51	51.0	51.0	82.0
	Strongly Agree	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

Insufficient human resources is a major challenge while the transition to decentralised and centralised models of power generation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	16.0	16.0	16.0
	Disagree	12	12.0	12.0	28.0
	Not Sure	10	10.0	10.0	38.0
	Agree	32	32.0	32.0	70.0
	Strongly Agree	30	30.0	30.0	100.0
	Total	100	100.0	100.0	

Market Policies and Managerial Policies are set back when a transition to decentralised models of power generation.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	15	15.0	15.0	15.0
	Disagree	9	9.0	9.0	24.0
	Not Sure	10	10.0	10.0	34.0
	Agree	38	38.0	38.0	72.0
	Strongly Agree	28	28.0	28.0	100.0
	Total	100	100.0	100.0	

Inadequate resources for generating and transmitting electricity.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.0	2.0	2.0
	Not Sure	8	8.0	8.0	10.0
	Agree	48	48.0	48.0	58.0
	Strongly Agree	42	42.0	42.0	100.0
	Total	100	100.0	100.0	

Limited financial capabilities for managing electricity production and transmission

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	8	8.0	8.0	8.0
	Disagree	11	11.0	11.0	19.0
	Not Sure	8	8.0	8.0	27.0
	Agree	53	53.0	53.0	80.0
	Strongly Agree	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

Sabotage of Electrical facilities and Environmental effects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	16.0	16.0	16.0
	Disagree	12	12.0	12.0	28.0
	Not Sure	10	10.0	10.0	38.0
	Agree	32	32.0	32.0	70.0
	Strongly Agree	30	30.0	30.0	100.0
	Total	100	100.0	100.0	

Environmental Issues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	14	14.0	14.0	14.0
	Disagree	8	8.0	8.0	22.0
	Not Sure	10	10.0	10.0	32.0
	Agree	30	30.0	30.0	62.0
	Strongly Agree	38	38.0	38.0	100.0
	Total	100	100.0	100.0	

Limited and Poor Human Resource Management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.0	2.0	2.0
	Not Sure	7	7.0	7.0	9.0
	Agree	38	38.0	38.0	47.0
	Strongly Agree	53	53.0	53.0	100.0
	Total	100	100.0	100.0	

Market and Governmental Policies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	8	8.0	8.0	8.0
	Disagree	11	11.0	11.0	19.0
	Not Sure	8	8.0	8.0	27.0
	Agree	53	53.0	53.0	80.0
	Strongly Agree	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

Lack of Operational and Production Resources for generating Electricity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	16.0	16.0	16.0
	Disagree	12	12.0	12.0	28.0
	Not Sure	10	10.0	10.0	38.0
	Agree	32	32.0	32.0	70.0
	Strongly Agree	30	30.0	30.0	100.0
	Total	100	100.0	100.0	

Organisation and Managerial issues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	15	15.0	15.0	15.0
	Disagree	9	9.0	9.0	24.0
	Not Sure	10	10.0	10.0	34.0
	Agree	38	38.0	38.0	72.0
	Strongly Agree	28	28.0	28.0	100.0
	Total	100	100.0	100.0	

Insecurities.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.0	2.0	2.0
	Not Sure	8	8.0	8.0	10.0
	Agree	48	48.0	48.0	58.0
	Strongly Agree	42	42.0	42.0	100.0
	Total	100	100.0	100.0	

Reliability Statistics

Cronbach's Alpha	N of Items
.817	16

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Effective innovation management involves proper management of resources	56.85	80.694	.574	.796
Innovation management is the method for maximizing the growth potential of the energy sector.	56.78	84.497	.441	.806
Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector.	56.03	91.928	.384	.811
Innovation management involves proper utilisation and harnessing of electric energy in the production of electricity	56.67	86.102	.473	.804
Innovation management has to do with efficient and well-structured Organisation of operations	56.57	99.702	-.161	.835

Insufficient human resources is a major challenge while the transition to decentralised and centralised models of power generation	56.85	80.694	.574	.796
Market Policies and Managerial Policies are set back when the transition to decentralised models of power generation.	56.78	84.497	.441	.806
Inadequate resources for generating and transmitting electricity.	56.03	91.928	.384	.811
Limited financial capabilities for managing electricity production and transmission	56.67	86.102	.473	.804
Sabotage of Electrical facilities and Environmental effects	56.85	80.694	.574	.796
Environmental Issues	56.63	86.155	.361	.812
Limited and Poor Human Resource Management	55.91	92.972	.299	.814
Market and Governmental Policies	56.67	86.102	.473	.804
Lack of Operational and Production Resources for generating Electricity	56.85	80.694	.574	.796
Organisation and Managerial issues	56.78	84.497	.441	.806
Insecurities.	56.03	91.928	.384	.811

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Effective innovation management involves proper management of resources	.261	100	.000	.835	100	.000

Innovation management is the method for maximizing the growth potential of the energy sector.	.288	100	.000	.824	100	.000
Innovation management has to do with all methods for maintaining and managing valuable human capital and resources in the sector.	.260	100	.000	.773	100	.000
Innovation management involves proper utilisation and harnessing of electric energy in the production of electricity	.346	100	.000	.802	100	.000
Innovation management has to do with efficient and well-structured Organisation of operations	.294	100	.000	.842	100	.000
Insufficient human resources is a major challenge while the transition to decentralised and centralised models of power generation	.261	100	.000	.835	100	.000
Market Policies and Managerial Policies are set back when transitioning to decentralised models of power generation.	.288	100	.000	.824	100	.000
Inadequate resources for generating and transmitting electricity.	.260	100	.000	.773	100	.000
Limited financial capabilities for managing electricity production and transmission	.346	100	.000	.802	100	.000
Sabotage of Electrical facilities and Environmental effects	.261	100	.000	.835	100	.000
Environmental Issues	.264	100	.000	.802	100	.000

Limited and Poor Human Resource Management	.322	100	.000	.737	100	.000
Market and Governmental Policies	.346	100	.000	.802	100	.000
Lack of Operational and Production Resources for generating Electricity	.261	100	.000	.835	100	.000
Organisation and Managerial issues	.288	100	.000	.824	100	.000
Insecurities.	.260	100	.000	.773	100	.000

a. Lilliefors Significance Correction

Correlations

			Innovation Management strategies	Challenges facing electricity organisation
Spearman's rho	Innovation management strategies	Correlation Coefficient	1.000	.904**
		Sig. (2-tailed)	.	.000
		N	100	100
	Challenges facing electricity organisation	Correlation Coefficient	.904**	1.000
		Sig. (2-tailed)	.000	.
		N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.946[a]	.894	.887	.18239

a. Predictors: (Constant), Insecurities. , Environmental Issues, Market and Governmental Policies, Lack of Operational and Production Resources for generating Electricity, Limited and Poor Human Resource Management, Organisation and Managerial issues

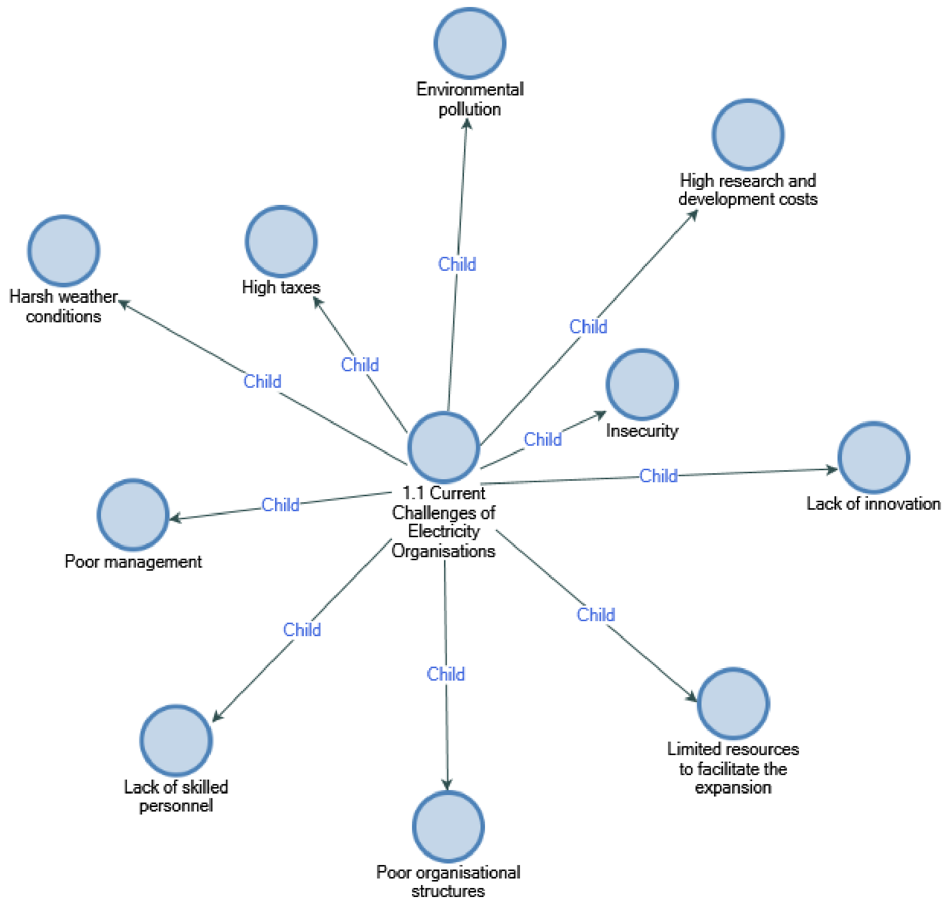
Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.958	.140		6.868	.000
	Environmental Issues	-.015	.034	-.039	-.437	.663
	Limited and Poor Human Resource Management	.046	.054	.060	.845	.400
	Market and Governmental Policies	.200	.017	.427	12.109	.000
	Lack of Operational and Production Resources for generating Electricity	.199	.013	.528	14.774	.000
	Organisation and Managerial issues	.191	.035	.486	5.481	.000
	Insecurities.	.126	.055	.163	2.294	.024

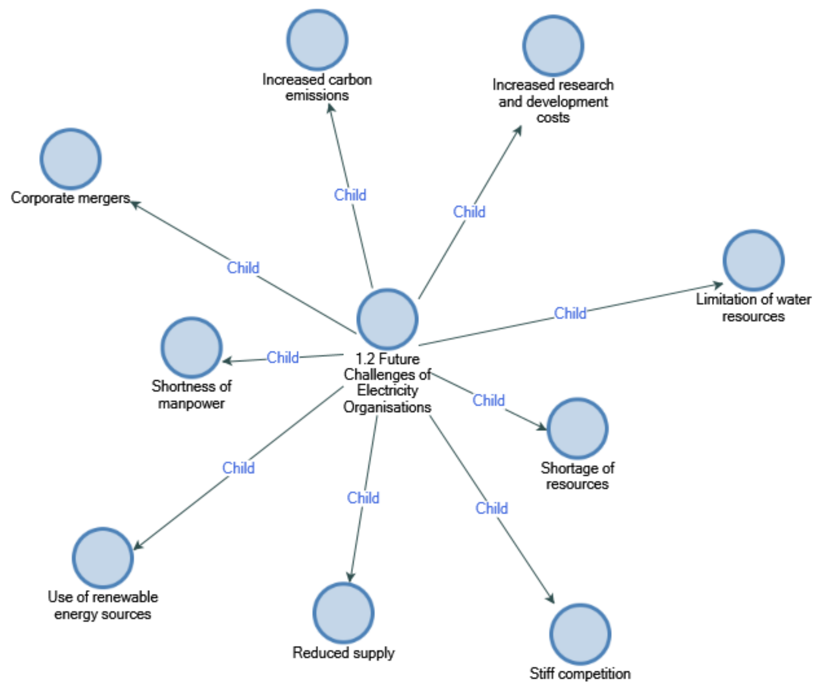
a. Dependent Variable: Innovation management strategies

Appendix I: NVivo Output

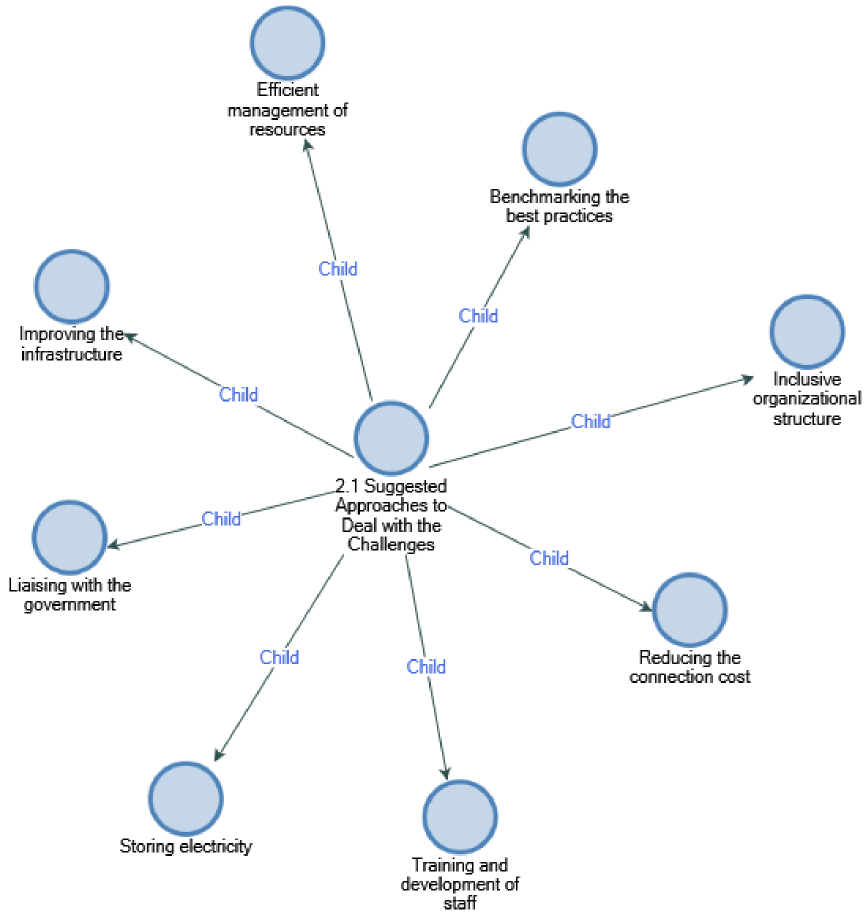
1.1 Current Challenges of Electricity Organisations



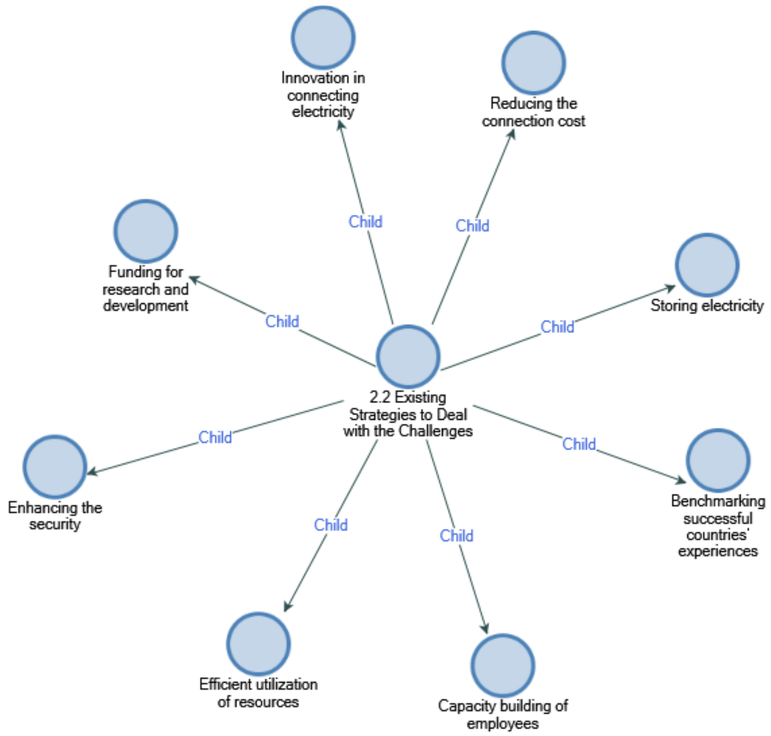
1.2 Future Challenges of Electricity Organisations



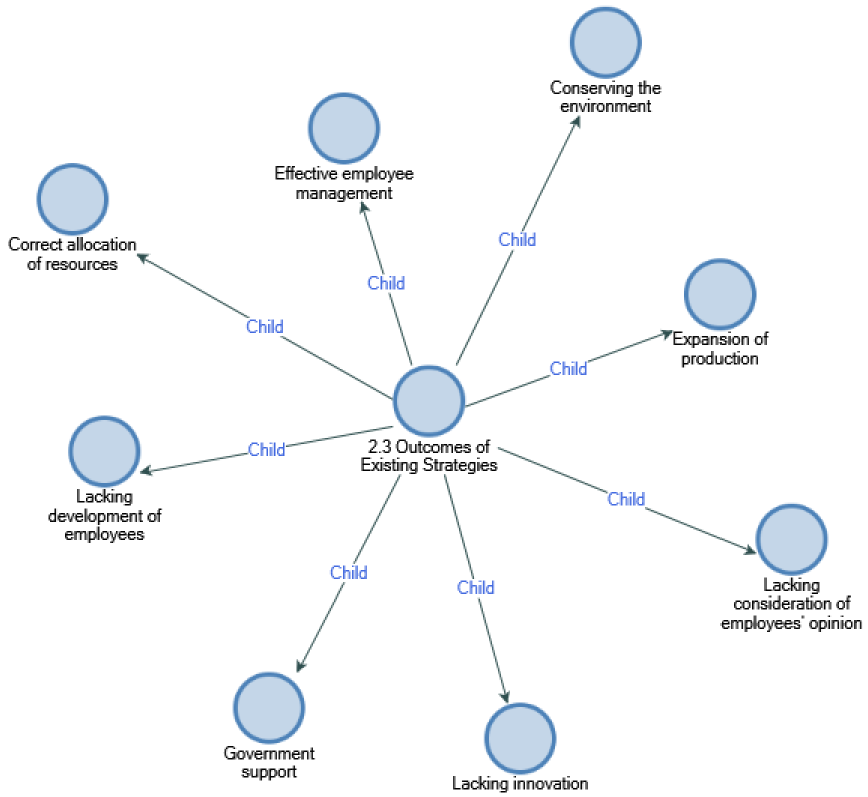
1.3 Suggested Approaches to Deal with the Challenges



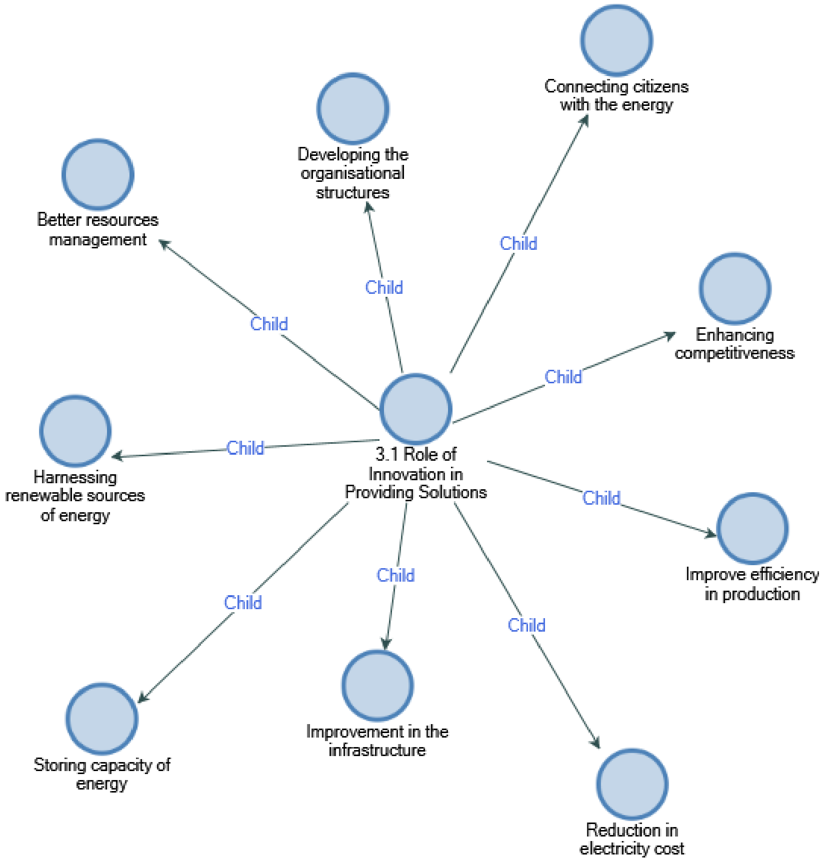
1.4 Existing Strategies to Deal with the Challenges



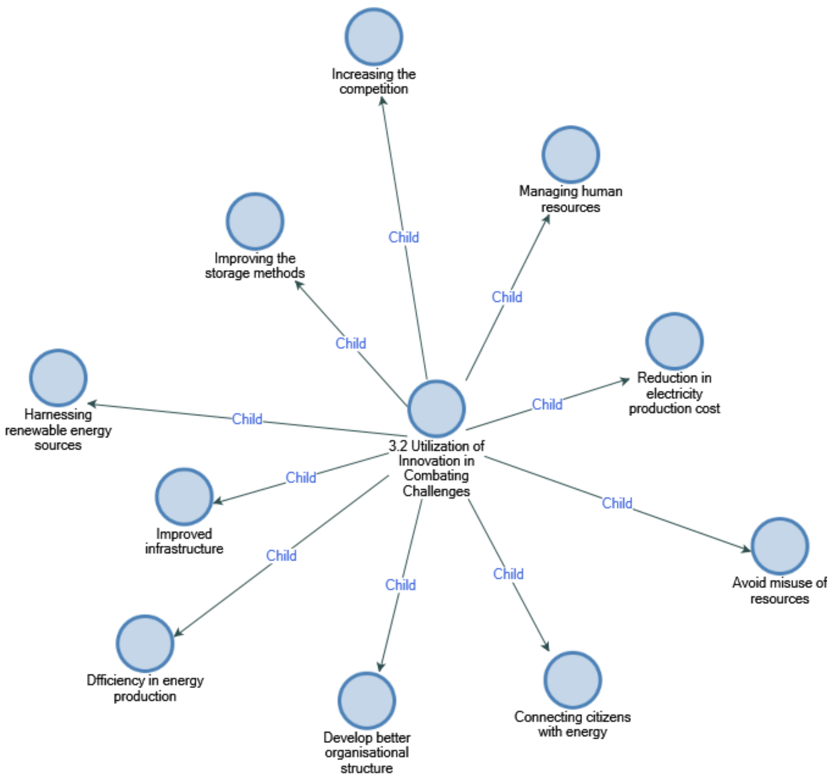
1.5 Outcomes of Existing Strategies



1.6 Role of Innovation in Providing Solutions



1.7 Utilization of Innovation in Combating Challenges



1.8 Suggested Innovative Approaches