

Saudi Arabia's Energy Transition To Renewables - The Role Of Saudi Aramco

[Name of Student]

[Name of Institution]

UKDISSERTATIONWRITING.CO.UK

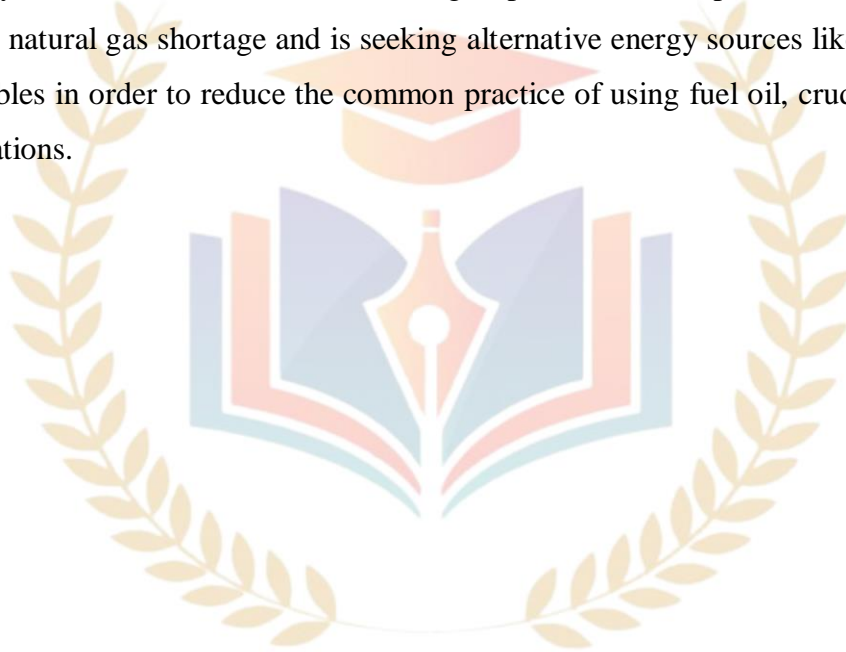
[Date of Submission]



+44-789-562-8894

ABSTRACT

Energy transition is an important structural alteration in energy systems. The aim of this study was to assess Saudi Arabia's energy transition to renewables - the role of Saudi Aramco. The objectives of the research was to evaluate the status of the current energy system of Saudi Arabia, to identify the surrounding challenges faced by Saudi Arabia. In addition to identify potential opportunities in natural gas and renewables for Saudi Arabia and to recognise the role of Saudi Aramco in Saudi Arabia's Energy Transition to Renewables. The research method of the study was secondary qualitative data and it was analysed with the help of content analysis. In the current study which is on Saudi Arabia's energy transition to renewables and the role of Saudi Aramco, inductive research approach was adopted. The energy sector of the Kingdom is considered to be as the backbone for the Saudi economy. It has been due to the reason that the Kingdom possess a quarter of the world's proven oil reserves which consequently make the sector as one of the largest producer and exporter of oil. Saudi Arabia now faces a natural gas shortage and is seeking alternative energy sources like nuclear power and renewables in order to reduce the common practice of using fuel oil, crude oil and diesel in power stations.



+44-789-562-8894

TABLE OF CONTENT

CHAPTER ONE: INTRODUCTION.....	6
1.1 Contextual Background.....	6
1.2 Problem of the study.....	7
1.3 Research aim and objectives.....	7
1.4 Research Questions.....	8
1.5 Rationale of the Study.....	8
1.6 Significance of the Research.....	8
1.7 Research Structure.....	9
CHAPTER TWO: LITERATURE REVIEW.....	10
2.0 Introduction.....	10
2.1 Concept of Energy transition.....	10
2.2 Importance of Renewable for developing countries.....	11
2.3 Current status energy system of Saudi Arabia.....	12
2.3.1 Heavy oil dependency.....	12
2.3.2 Blue hydrogen.....	12
2.3.3 Natural gas.....	13
2.4 Challenges faced by Saudi Arabia in energy transition to renewables.....	13
2.5 Potential opportunities in oil, natural gas and renewables for Saudi Arabia.....	14
2.5.1 Renewable's growth rate projections.....	14
2.5.2 Impact on Saudi employment rate and GDP.....	15
2.6 Role of Saudi Aramco in Saudi Arabia's energy transition to renewables.....	15
2.7 Participation of Saudi Arabia in the energy transition to renewable.....	16
2.8 Theoretical Framework.....	17
2.9 Conclusion.....	18
CHAPTER THREE: METHODOLOGY.....	18
3.1. Introduction.....	18

3.2. Research Philosophy	18
3.3. Research Approach.....	19
3.4. Research Design.....	19
3.5. Data Collection Method.....	20
3.6. Data Analysis	20
3.7. Ethical Consideration	21
3.8. Research Limitation.....	21
3.9. Chapter Summary.....	22
CHAPTER FOUR: ANALYSIS AND DISCUSSION.....	23
4.1. Introduction.....	23
4.2 Content Analysis	23
4.2.1 Scrutinising the Status of the Current Energy System of KSA.....	23
4.2.2 Critical Evaluation of the Challenges faced by KSA in the Current Energy System	25
4.2.3 Undertaking Feasibility Study for natural gas and renewables of KSA	26
4.2.4 Investigating the Role of Saudi Aramco in KSA's Energy Transition to Renewables.....	27
4.3. Discussion.....	28
4.3.1 Objective 1: To evaluate the status of the current energy system of Saudi Arabia by focusing on heavy oil dependency, blue hydrogen and natural gas.....	28
4.3.2 Objective 2: To identify the surrounding challenges faced by Saudi Arabia in the current energy system.....	29
4.3.3 Objective 3: To identify potential opportunities in natural gas and renewables for Saudi Arabia.....	30
4.3.4 Objective 4: To recognise the role of Saudi Aramco in Saudi Arabia's Energy Transition to Renewables.....	30
4.4. Chapter Summary.....	31
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS	32

5.1. Introduction..... 32

5.2. Summarised Findings 32

5.3. Recommendations 33

5.4. Future Implications..... 33

5.5. Conclusion 34

REFERENCES 35

UKDISSERTATIONWRITING.CO.UK



+44-789-562-8894

CHAPTER ONE: INTRODUCTION

1.1 Contextual Background

The energy transition is an important structural alteration in energy systems. Generally, this type of changes are being driven by the availability and demand for different fuels (Markard, 2018). The energy transition is a process or a way toward the transformation of the global energy industry by changing from fossil-based to zero-carbon resources of energy to achieve sustainable energy resources (Diji, 2019). Energy efficiency and renewable energy measures can probably attain a 90% decrease in carbon than the required one (IRENA, 2021). This can be fulfilled with a major objective of limiting climate change and decreasing carbon dioxide emission to a satisfactory level. Renewables are a natural resource used for energy and not depleted with the usage like water, solar power or wind. In comparison to other energy resources, the production cost and related expenses of renewables are higher specifically for oil, gas, and coal. Mainly, renewable energy referred to as clean energy produced from the procedures that are constantly replenished or natural resource (Shinn, 2018).

Specifically, with respect to Saudi Arabia and its usage of renewable energy, the country is investing more in renewables to reduce the burning of oil while power generation for export and decreases the carbon dioxide emissions. It has been addressed by Prince Abdul-Aziz, an energy minister of Saudi Arabia that the country plans to create 70% of power by using gases and the remaining 30% from renewables (Saadi, 2020). In the year 2018, the clean energy goals were revised by Saudi Arabia, enhancing its target of 2023 from 9.5GW to 27.3 comprising 7GW of wind and 20GW of solar thereby moving its target of 2030 which is 58.7GW related to renewable energy (Collins, 2021). The transition of energy will be attained through Information Technology (IT), policy framework, smart technology and market instruments. The Gulf Cooperation Council (GCC) member economies are relied mainly on selling gas and oil. Since a majority of the industrial countries are looking for the production of renewable energy and urging effective regulations of climate change. In those conditions, there is a chance that energy based on fossil fuel-based may lose part of the market share in future. It has been noted that for Saudi Arabia sufficient amount of oil still exists for future. Considering the crude oil production of Saudi Arabia, the production existing level is at 9.064M which is unchanged from 0.064M last month. This is changed in comparison to down stats which is 9.951M one year ago (Y Charts, 2021). But this arises a concern that due to increasing technology and renewable energy the oil demand would be decreased (Darwish et al., 2019).

1.2 Problem of the study

The important natural resources of Saudi Arabia are petroleum, gold, iron ore, copper and gas. The economy of the country is mainly based on oil and is also considered as the largest exporter of petroleum across the world (Thomas, 2012). Darwish, Abdo and Shuwaiee(2018) suggested that there are chances for increased demand for renewable energy which decreased the demand for oil and gas. The reason for this is that both developed and developing countries are shifting and focusing on the energy transition to renewables. For Saudi Arabia, it is most important to focus on renewable energy and its related investment seems like a lucrative option for the country. Nonetheless, this arises a concern for Saudi Arabia pertaining to how the kingdom can form the balance between the consumption and production of high risk oil reserves against the emerging theme of renewable energy which is more becoming of the need for the nations at the present time.

To fulfil the basic requirements of renewable is a key solution to achieve the zero-carbon solutions that direct to a sustainable country. The major problem of the study is related to this evaluation concerning Saudi Arabia where this energy transition to renewables is assessed and evaluated. For renewables, countries like Saudi Arabia also faces certain challenges in terms of utilisation of resources like oil, natural gas and renewables. The reason for these issues is because Saudi Arabia is one of the developing countries and has a lower economic performance as per the International Monetary Fund (IMF) statistics (World Data, 2020). All these related issues are covered with the comparison of the current status of the energy system and potential opportunities in renewables and natural gas of Saudi Arabia. Renewable energy is most important for any country because it supports conserving the natural resources of the nation. It provides fuel diversification and reliable supplies of power, which increase security of energy and lower risk of fuel spills while decreasing the requirement for imported fuels (Clean Energy, 2021). Considering the same, the state-owned Oil Company has revealed its plan and initiatives of launching plans of \$500m fund for the promotion of energy efficiency and renewable technologies (NS Energy, 2021). Therefore, the following study has been conducted in order to highlight and investigate the urge of state-owned companies towards renewable energy transitions in order to reflect the kingdom own initiatives towards energy transition.

1.3 Research aim and objectives

This research is aimed to examine the energy transition to renewables of Saudi Arabia in consideration of the important role of Saudi Aramco. To accomplish this aim the objectives are designed which are given as under:

- To evaluate the status of the current energy system of Saudi Arabia by focusing on heavy oil dependency, blue hydrogen and natural gas.
- To identify the surrounding challenges faced by Saudi Arabia in the current energy system.
- To identify potential opportunities in natural gas and renewables for Saudi Arabia.
- To recognise the role of Saudi Aramco in Saudi Arabia's Energy Transition to Renewables.
- To recommend the strategies for the future energy transition to renewables and help Saudi to tackle Oil, natural gas and renewables.

1.4 Research Questions

- What is the status of the current energy system of Saudi Arabia by focusing on heavy oil dependency, blue hydrogen and natural gas?
- What are the surrounding challenges faced by Saudi Arabia in the current energy system?
- What are the potential opportunities in natural gas and renewables for Saudi Arabia?
- What is the role of Saudi Aramco in Saudi Arabia's energy transition to renewables?

1.5 Rationale of the Study

In literature, numerous studies are related to renewables and energy with the relationship of various other sources and measures. Like, the study was given by Caldera and Breyer (2018) has been depicted the water storage and battery in Saudi Arabia's transition to integrated renewable energy. The other study proposed by Kalair et al. (2021) has been highlighted the role of energy storage systems in conversion from fossil fuel to renewables. The other related study is addressed by Barhoumi et al. (2019) it has been evaluated that transition of renewable energy with respect to Saudi Arabia which is a different country with respect to the current study. In consideration of the aforementioned study, the current study is entirely different and distinctly defined with a unique purpose that justifies the existence of research. Reflecting the studies current study is specifically about Saudi Arabia and evaluate the role of Saudi Aramco in the energy transition to renewables. Thus, the set of objectives, designed problems and structure of this study is different in comparison to other previous studies.

1.6 Significance of the Research

In this modern era where the focus of every country on sustainability and zero-carbon emissions increases the significance of the current study in both perspective i-e. Theoretical

or practical significance. While considering the practical significance the findings of this study are crucial for the Gulf countries and related developing countries of Saudi Arabia in order to make country more renewable and polluted free. On the other side, the role of companies like Saudi Aramco in the energy transition to renewables is also highlighted in this study therefore the companies same as Saudi Aramco can also take benefits from the findings related to the role of Saudi Aramco and can utilise similar character to derive the renewables for the country. Comparatively, the theoretical significance of the study is that the findings of this study are important for the future researcher who want to undertake study on a similar topic and can derive the problem or gap of the study from the recommendations and future implications of the study.

1.7 Research Structure

Chapter One: Introduction

This chapter involves crucial things like the problem statement and contextual background is discussed in this study. Whereas, the aim and objectives along with the significance of the study are also highlighted in this chapter.

Chapter Two: Literature Review

This chapter demonstrates an in-depth comprehension of the state of knowledge on the selected phenomenon comprising the gaps and boundaries of current knowledge and its potential outcomes. This chapter discusses the related concepts and theoretical framework related to the study.

Chapter Three: Research Methodology

This chapter discusses the entire process of the study from selecting the topic to how the data is analysed to attain the results of the study. This comprises data collection technique, research philosophy, research approach and data analysis technique.

Chapter Four: Results and Discussion

The results are included in this chapter which is followed by a detailed and critical discussion of the results with the help of existing literature.

Chapter Five: Conclusion and Recommendations

A final chapter of the dissertation contains the conclusion of the entire study followed by the summarised findings. Moreover, the title of chapter comprises the recommendation and future implications of the study related to Saudi Arabia's energy transition to renewables.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The purpose of this chapter is to provide a comprehensive review of the literature associated with the topic of this investigation. It is divided into section and subsections explaining key theories and the past researches on the topic. The first section includes concept of energy transition followed by importance of renewable for developing countries, current status energy system of Saudi Arabia, challenges faced by Saudi Arabia in energy transition to renewables, potential opportunities in oil, natural gas and renewables for Saudi Arabia, role of Saudi Aramco in Saudi Arabia's energy transition to renewables and participation of Saudi Arabia in the energy transition to renewable. The chapter also covers the theoretical framework associated with the study.

2.1 Concept of Energy transition

In today's crucial part of the global socio-economic system - approx. 80% - based on fossil fuels, and energy demand is constantly increasing (Gielen et al., 2019). In order to achieve climate neutrality, it is important to reverse this process by switching to continuously renewable energy sources so that one can minimize greenhouse gas emissions and offset the remaining emissions, for example by improving the carbon sink capacity of forests and soils, so that human activity has a neutral effect on climate change (Ogle et al., 2019). The process required for this, called the energy transition, is extremely complex, as it also affects individual industrial processes, from the building stock through the transport sector (Ogle et al., 2019). The history of human civilization is also a history of energy transitions - a series of disruptive technologies that have indelibly marked distinct stages of economic, social, cultural development, etc. (Rick et al., 2020). In principle, humanity has experienced three major energy transitions and is now struggling to start the fourth.

The first was the control of fire, which allowed people to release energy received from the sun by burning biomass, the amount of which was limited by photosynthesis (Dhillon and von Wuehlisch, 2013). With the help of fire, people began to eat better, live more comfortably and appear more efficiently than animals. Mastery of fire was one of the most impressive achievements of the species, permanently separating humans from other mammals (Grade and Götz, 2017). The second transition took place 10,000 -12,000 years ago, with the invention of agriculture, which transformed and concentrated solar energy into food (chemical energy). The transition from the itinerant search for food to its sedentary production, coupled with the domestication of animals, freed people for activities other than subsistence and led to the birth of great cultures, organized societies and historical

consciousness (Stremke, 2015). In this second period, which ended only a few centuries ago, animals in households and larger human populations also provided energy in the form of muscle power.

The third energy transition, from biofuels and animal power to fossil fuels, created today's modern world and the first true global civilization (Schlögl, 2017). The industrial revolution - the major emblem of this transition - was the revolution of coal, oil, natural gas and cars that used these fuels to produce electricity, heat or kinetic energy (Laes, Gorissen and Nevens, 2014). Today, the world is facing its fourth energy transition: a sudden abandonment, in just a few decades, of fossil fuels, and their replacement with non-carbon dioxide energy sources (Laes, Gorissen and Nevens, 2014). Basically, a return to pre- industrial times is claimed through a return to the current energy flows of the sun, instead of the historical ones, which, millions of years ago, materialized in deposits of coal, oil and natural gas.

2.2 Importance of Renewable for developing countries

In developing countries, the energy transition is slower than in developed countries, it is enough to look at the 2030 targets for renewable energy and energy efficiency (Gielen et al., 2019). The reason for this is not only to be found in the differences in economic development, but at the same time it would be a mistake to transfer all responsibilities to decision-makers: a successful energy transition and the ambitious goals and political decisions required for it require broad support from society (Aliyu, Modu and Tan, 2018). For the first time in industrial history (since 2010), more money has been invested in renewable energies worldwide than in conventional ones. The industry has received an investment of about \$ 155 billion, which is growing year by year thanks to the Kyoto Convention and UN regulations (Newell, Pizer and Raimi, 2013). Fortunately, there are more and more environmentally conscious people in the private sector who value the importance and future benefits of using solar energy with solar panels or wind energy with a wind turbine (Nazir et al., 2020). Wind and Solar Energy is an inexhaustible source of energy and is completely free. At present, developing countries do not use this kind of clean energy to the extent that it has great potential.

Energy prices are rising at a rapid rate in the developing countries, and harnessing wind and solar energy with solar-powered solar power plants with wind turbine parks is a possible solution for developing countries (Shahsavari and Akbari, 2018). The world's energy demand is growing rapidly. One of the most important questions for the future is whether developing countries can produce electricity, heat or fuel without using up our reserves, with

no harmful by-products or waste that does not degrade over millennia (Ahmed, Hashaikeh and Hilal, 2019). Because anyone can access it at any time, the energy source itself has no price - unlike crude oil, for example, which requires work: drilling to find, bringing it up, and then delivering it to the end user through international pipelines or tankers (Ahmed, Hashaikeh and Hilal, 2019). They are also commonly referred to as clean energy, as they are not believed to emit harmful by-products, as opposed to fossil fuels.

2.3 Current status energy system of Saudi Arabia

Energy in Saudi Arabia incorporates petroleum and the producers of natural gas, consumer, exporters and the production of electricity. The entire energy sector is the backbone of Saudi economy. It is one of the largest producers and exporter of oil in the world. However, it has been observed that Saudi Arabia is also developing its additional energy resources including natural gas. The current status of the energy system in Saudi Arabia is that the generation of electricity is 40% from oil which is 52% and from natural gas and 8% from steam (Saudi Embassy, 2021). The generation capacity in Saudi Arabia is estimated as 55 GW which requires to be increased up to 120 GW till 2032. In addition, it determines that the economy of Saudi Arabia is petroleum-based where oil accounts for 90% of the total country's exports and around 75% of the government revenue.

2.3.1 Heavy oil dependency

Saudi Arabia's economy is heavily dependent on oil which possesses around 17% of the world's proven petroleum reserves. It determines that the oil and gas sector of the Saudi Arab finances about 50% of the gross domestic product along with 70% of the export earnings (OPEC, 2021). Other than that, oil is considered as the pillar of the Saudi Arabia's economy where oil is accounted for around 85% of exports and 90% of the fiscal revenue, whereas, the overall oil industry encompasses of 40% of the overall GDP (AL- TAMIMI, 2016).

2.3.2 Blue hydrogen

Saudi Arabia is one of the pioneers of blue hydrogen (Noussan, *et al.*, 2021). In this regard, it is determined that the 50% of the power sector fuel of Saudi Arabia will be transformed into gas and the rest will be attained from renewables. The current status shows that Saudi Arabia is showing great appetite towards the production of blue hydrogen capacity and technologies, where blue hydrogen will be developed from natural gas through steam (Gulzar, *et al.*, 2020). Later in years, blue hydrogen can be utilised for domestic energy usage which will then be exported in ammonia form globally as a source of income.

2.3.3 *Natural gas*

Saudi Arabia encompasses of 303 trillion cubic feet of the proven gas reserves in 2017, which is the 5th rank globally which is accounted for 4% of the world's total natural gas which determines that Saudi Arabia has 79 years of the gas left (Worldometer, 2021). Currently, natural gas is being used in manufacturing wide variety of products.

2.4 *Challenges faced by Saudi Arabia in energy transition to renewables*

The energy sector in Saudi Arabia is in the process of transitioning to green, clean energy, reaching a crossroads in 2020 (BBC, 2020). On the one hand it faces the challenge of decarbonizing energy systems, to reduce greenhouse gas emissions and promote renewable sources, and on the other hand it must ensure the security of electricity supply at an affordable cost to the final consumer (Ansari, 2017). The role that Saudi Arabia has been assumed in addressing the energy transition will determine whether the country will be able to benefit from this change or whether it will rather bear its costs (Ansari, 2017). But these benefits cannot materialize without a well-defined strategy at national. Basically, Saudi Arabia wants a sustainable transformation of the economy, by removing fossil fuels, promoting clean energy from renewable sources, and developing a circular economy (Kalair et al., 2021). However, achieving these changes requires a huge need for investment. Lockwood (2015) stated that in order to truly feel the benefits of such a change and to put the Saudi Arabia's ambitions into practice, it will be necessary for a significant part of the investment to go towards the creation of a strong and independent industry that can deliver solutions that meet the challenges, generating added value in the economy.

Saudi Arabia is facing an unprecedented climate crisis whereas the balance of the environment in which people live is increasingly precarious (Kumar, 2019). It needs to change the way people think, act and engage in shaping their future to avoid a climate catastrophe. Saudi Arabia must be firm in calling on politicians and companies to act in the interests of humanity and, implicitly, of the climate. However, it will be very important in the next period for Saudi Arabia decision-makers to make sustained efforts to ensure the achievement of the objectives and for the successful management of the energy transition (Alsharif, Peters and Dixon, 2020). The social impact of these changes at national level should not be neglected, especially in carbon-dependent mono-industrial areas. Saudi Arabia will face many challenges in the energy sector in the next ten years, but we are still at the moment when we can prepare (Renukappa et al., 2020). It will be up to KSA to make the necessary commitments for a successful energy transition. The use of energy from renewable sources has a number of potential benefits, including reduced greenhouse gas emissions,

diversification of energy supply and less dependence on fossil fuel markets (especially oil and gas markets) (Al Garni et al., 2016). The expansion of renewable energy sources can also stimulate employment in Saudi Arabia by creating new green technology jobs.

First of all, the simple growth of Saudi Arabia needed to meet current energy needs is difficult to conceive. Increasing the share of renewables from a few percent to over 50% is not a simple operation of additional investments (Lehtveer, Mattsson and Hedenus, 2017). The entire energy infrastructure and the current structure of the mining and hydrocarbon workforce will have to be massively modified even if only to try to implement the new transition in the torments of making. Secondly, one cannot forget a large and constant headache of renewables: due to their intermittent nature, they are unable to provide permanent power, so they need fossil fuels on standby (Salam and Khan, 2018). The new measures can significantly strengthen the rights of consumers, who become an active part of the energy market and important players in the energy transition process (Tlili, 2015). Saudi Arabia ensures a rebalancing of the areas in which decision-making power is allocated at national and local level, respectively, so as to allow an autonomous energy policy (Tlili, 2015). It also includes from the perspective of the energy mix, but taking into account the need to increase energy efficiency and promote renewable energy sources, as well as the need to coordinate decisions at the regional level.

2.5 Potential opportunities in oil, natural gas and renewables for Saudi Arabia

Saudi Arabia comprises of the sustainable capacity for the production of oil more than 10.5m b/d. In accordance to it, the program of Saudi Aramco's provides number of opportunities to the organisations that are functioning in energy services and construction sectors. The main focus was towards bringing back the shut-in facilities, rapid construction of additional GOSPs and the massive water-injection facilities by maintaining reservoir pressures. The potential opportunities in oil, natural gas and renewables for Saudi Arabia are as follows;

2.5.1 Renewable's growth rate projections

It has been observed that the renewable energy is expected to meet nearly 13% of the total energy demand which is projected to grow around 5% of CAGR during the forecasting period. Moreover, the investments in wind power sector is rise by 3% in 2018 as compared to previous years that can reach up to USD 129 (Ahmad, Zhang, and Yan, 2020). The opportunity in this regard, is that with the passing years the growth is expected to be increased where solar PV growth is probable to remain stable as the faster expansion of

renewables. There is a huge opportunity of adopting renewable energy for Saudi Arabia that is required to be increased and transformed in the upcoming years (Xu, *et al.*, 2019).

2.5.2 *Impact on Saudi employment rate and GDP*

There is a massive opportunity within oil, natural gas and renewables for Saudi Arabia which determines that the transformation towards renewable energy have a significant impact on Saudi employment rate and GDP. Real non-oil growth is expected to empower up to 2.9% in 2019 as of the government spending and the increase in confidence therefore, in this regard, the growth of GDP is expected to be slow down to 1.9% (Naseem, 2020). Thus, even the real oil growth slows to 0.7% with the integration of OPEC agreement. Hence, the unemployment rate in Saudi nationals has moved down still it remains high to 12.5%. Though, there is an opportunity to increase the employment rate in Saudi Arabia (Albassam, 2019).

2.6 *Role of Saudi Aramco in Saudi Arabia's energy transition to renewables*

One of the primarily owned Saudi-Aramco is officially known as Saudi Arabian Oil Company which is one of the largest producers in the world. Saudi Arabia tends towards deriving a significant portion in the wealth of Saudi Arabia. Saudi Aramco, the oil company, which pays a hefty tax rate of 50% too the government of Saudi Arabia (Lau, *et al.*, 2021). In 2017, the tax rate was 85%. Saudi Aramco and BP officials plays a significant role which determines that there are certain technologies that could help in reducing the missions of oil industry which entails electrification and carbon capture. As electrification is one of the most potential force in the energy transition (Noussan, *et al.*, 2020).

It has been observed that there is a requirement of hydrogen as an energy vector that the company Saudi Aramco, is aiming to undertake 10% of its market share by 2030 (Asmelash, and Gorini, 2021). The transformation taking place in Saudi Arabia, so will the Saudi Aramco will as it is both bold and visionary that steps into the changing world that emphasis on the evolution of global economy, emerging technologies, geopolitical trends and other. The role of Saudi Aramco is in the transformation of energy to renewables with the help of transformation program with a vision of 2030 (Khan, 2016). The organisation focuses on making the world more agile that seeks towards moving, changing and expanding areas in order to lead the industry towards a better and bright future. In this regard, the aim of Saudi Aramco is to develop stronger downstream business, double refining capacity, growth in chemicals along with doing more with renewables and technologies that can create new business lines through investments and acquisitions that has a significant impact on the Saudi Arabia's economy (Ramady, 2018).

2.7 Participation of Saudi Arabia in the energy transition to renewable

Saudi Arabia has the opportunity to develop new industries, especially in the field of renewable resources, to create new jobs and to generate added value in the economy (Khan, 2016). However, the potential benefits are not limited to energy production; according to the same study, the energy transition can have positive effects in construction, transport, energy services, industrial production and the automotive industry (Al Garni et al., 2016). Saudi Arabia has also undertaken the liberalization of the electricity and natural gas markets in the period 2020–2021, this being absolutely necessary to support the development of new capacities and for integration with other energy markets in the region (Al Garni et al., 2016). A fully integrated and functioning internal energy market ensures affordable energy prices, provides the necessary price signals for green energy investments, ensures energy supply and paves the least expensive path to climate neutrality (Abdmouleh, Alammari and Gastli, 2015). Internal energy market legislation was first introduced in the third energy package. Saudi Arabia has always expressed its strong support for a common energy policy that addresses issues such as decarbonisation, competitiveness, security and sustainability (Pflugmann and De Blasio, 2020). Saudi Arabia has repeatedly called for coherence, determination, cooperation and solidarity between states in resolving current and future attempts in the internal market

Given Saudi Arabia's growing dependence on fossil fuels, the government welcomed the plan, believing that it will make a key contribution to sustainability and security of supply and that it will be necessary to meet the Saudi Arabia's 2030 energy and climate goals and 2050 (Khan, 2016). Emphasizing the important role of research in ensuring a sustainable energy supply, the government emphasized the need to make joint efforts in the field of new energy technologies. It is both in terms of both renewable energy sources and sustainable fossil fuel technologies, as well as to provide additional public and private funds to ensure the successful implementation of the plan (Malik et al., 2019). Saudi Arabia's latest energy resolutions have increased the relevance of all climate and environmental objectives underlying energy policy. For this, 40–45% of the electricity in Saudi Arabia will come by 2025 from renewable energy sources, by 2035 this percentage will reach 55-60%, and by 2050 to 80% (Kalair et al., 2021). Progress can already be seen in this regard. In 2016, about a third of Saudi Arabia's electricity consumption was covered by renewable energy sources (Al Garni et al., 2016). The production of plants for the use of renewable energy sources, as well as their design; construction, maintenance and operation have evolved into an important economic factor.

In order to assess the progress made in achieving the proposed objectives, the Saudi Arabian Government publishes an annual monitoring report which details topics such as energy efficiency, renewable energy, power plants, power grids, greenhouse gas emissions and energy prices (Bhattachara et al., 2016). Saudi Arabia is campaigning for an energy revolution that eliminates the use of fossil fuels (coal, oil, natural gas) from energy production to limit the disastrous effects of climate change. Saudi Arabia supports an accelerated transition from these dirty energy sources to clean and sustainable ones from renewable sources (sun, wind) (Ramli, Hiendro and Al-Turki, 2016). Saudi Arabia is running a national campaign for the protection and sustainable management of forests, because we are convinced that without healthy and prosperous forests, the earth cannot sustain life (Magdoff, 2013). For the future of forests in Saudi Arabia, the government proposes the creation of an extensive network of protected areas, sustainable management, as well as the capitalization and responsible consumption of forest products.

2.8 Theoretical Framework

There are number of theories and literatures, that could help in supporting the study and provide evidences with regards to the theory. In this regard, the Technology Acceptance Model (TAM) model is one of the information systems theory that determines that how the users come to accept and adopt the use of technology (Marangunić, and Granić, 2015). In this theory, behavioural intention is an aspect that encourage people to make use of technology as it helps in effective working along with better resulting. TAM theory proposes the perceived ease of use and the usefulness of the technological tool that leads towards the consumer acceptance extent. This theory helps the organisation to help people admit and utilise new technologies in their working that could be an effective approach for Saudi Arabia (Kalayou, Endehabtu, and Tilahun, 2020). This model determines about the emerging technologies and comprehending the user's adoption.

The other theory that can be integrated are the theories of Innovation Adoption includes Diffusion of Innovation (DOI) Theory, which is based on four major components in Roger's diffusion theory which encompasses of innovation, or the channels of communication that can be used to broadcast information regarding innovation (Al-Jabri, and Sohail, 2012). The adoption of social system around the innovation adopters along with the time it takes for the individuals to move along with the adoption process. This Roger's Diffusion theory is essential for the adoption of the innovation in the country along with improving the organisational structure (Dingfelder, and Mandell, 2011).

2.9 Conclusion

This chapter sheds light on reviewing the literatures that is obtained from secondary sources. It concludes that Saudi Arabia is one of the largest oil producers in the world where the economy of Saudi Arabia is highly relied on oil. In addition, the study determines that Saudi Arabia is one of the pioneers of blue hydrogen and it comprises of 303 trillion cubic feet of the proven gas reserves. Furthermore, the study highlights the challenges that are faced by Saudi Arabia in energy transition to renewables which possess towards power quality issues, power availability or resource location. Conclusively, the study focuses on the role of Saudi Aramco in Saudi Arabia's energy transition to renewables. The theories that have been incorporated in the study are the Technology Acceptance Model (TAM) and Diffusion of Innovation (DOI) Theory.

UKDISSERTATIONWRITING.CO.UK

CHAPTER THREE: METHODOLOGY

3.1. Introduction

In research methodology, theoretical model, paradigm, qualitative or quantitative techniques are required. For all these techniques there is a need of expertise for the research process, which involves defining problems, formulating objective and research questions, gathering and analysing data, and drawing genuine conclusions (Rahi, 2017). The aim of the study is to evaluate the tools of reasoning and experience through the use of authentic sources of data. The chapter covers research philosophy, research approach, data collection method, data analysis, and ethical consideration and research limitations. In the last, the chapter summary was discussed in which key points of the research had discussed.

3.2. Research Philosophy

Research philosophy is one of the essential aspect of the research methodology. As per the research conducted by Matta (2015), research philosophy is mainly categorised into three division such as pragmatism, interpretivism and realism. Moreover, research philosophy emphasis on the need for gathering the information that is important for the study (Zangirolami-Raimundo, Echeimberg and Leone, 2018). Another researcher proposes that with the help of adopting research philosophy, the research is able to execute researchstrategy, originate a problem and attain ways to effectively collect data for the study (Žukauskas et al., 2018). In order to carry out study on Saudi Arabia's Energy Transition to Renewables interpretivism philosophy has been acquired. Interpretivist philosophy focuses

on the understanding of multiple elements based on human interest and that relates with the study (Gravetter, Frederick and Lori-Ann, 2018). As the study was based on qualitative data that is why interpretivism philosophy was most appropriate. Moreover, the research was designed to examine the Role of Saudi Aramco in Energy Transition to Renewables. Through this research philosophy data was assessed in a subjective manner. Thereby, interpretivism contributed in the research by interpreting different studies to evaluate the Role of Saudi Aramco. Moreover, it also enabled to gather in depth data for the research.

3.3. Research Approach

According to Bazeley (2017), research approaches are defined as the plans and methods of the research which extent the stages of data collection, analysis, and interpretation, from general assumptions to comprehensive methods of data collection, analysis, and interpretation. There were several decisions which needs to be made by the researcher in the plans according to the nature of the study. Research approaches comprises into three main types which are inductive, deductive and abductive (Okoli, 2021). In the current study which is on Saudi Arabia's energy transition to renewables and the role of Saudi Aramco, inductive research approach was adopted. Inductive approach entails to look for trends in observations and developing reasons theories for certain patterns through a sequence of hypotheses. The research intends to adopt this approach because it helps in developing the relation between the objectives and findings of the research which was carried out after analysing the data (Tong and Zuo, 2021). Moreover, inductive approach intended to provide various options to the researcher in which they have to work upon and also create reliable findings. The inductive approach helps in developing new ideas that were used to create trends in order to build a theory (Gioia, Corley and Hamilton, 2013).

3.4. Research Design +44-789-562-8894

In the words of Mitchell and Jolley (2012), research design is classified in three forms including mixed, qualitative and quantitative research design methods. Research design emphasis on the different practices and approaches by which the researcher can gather and analyse the data. In addition, it is an overall approach in which multiple components of the study can be integrated in a logical flow. Furthermore, research design methods are very crucial for the research as it sheds light on the delivery of the results. According to Sekaran, Uma, and Roger (2016), through research design choice is provided to the researcher in regards to adopt different methods to collect information and conduct data analysis. It is also

stated by these researchers that helps in acquiring and finding out clear results from the study. Taking in consideration this study was based on qualitative research design. The reason to choose this design method was that it most suitable for interpretivism philosophy. Furthermore, it provided flexibility to carry out research by the researcher on Saudi Arabia's Energy Transition to Renewables. Moreover, this type of research design contains relevant information based on past researches and carry no rigidity.

3.5. Data Collection Method

It has been stated by Palinkas et al (2015), data for research can be extracted from methods of primary data collection and secondary data collection. Methods adopted to obtain data for the study carry a significant value. Furthermore, it is not possible for the researcher to gather data without using appropriate collection methods. For conducting this research data was collected with the help of different secondary sources. According to Johnston (2017), in secondary method of collecting data, no new piece of information is collected and data is extracted by taking help of secondary sources. It has been stated by Cyr (2016), first-hand information is used in primary method that has been never gathered before. The justification for implementing method of secondary data collection is that it helped the researcher in conducting effective research. Moreover, it helped in gathering deeper insights through previous researches based on the research topic. Furthermore, secondary method of collecting data compared to primary method is inexpensive and consumes less time. Thereby, for gathering data on Energy Transition to Renewables of Saudi Arabia was mainly from different articles, annual reports, journals, websites and news.

3.6. Data Analysis

The researcher needs to adopt a technique according to the nature of the study for the analysis of data. Qualitative and quantitative data analysis are the two main important techniques for the analysis of data (Queirós, Faria and Almeida, 2017). Quantitative analysis entails gathering and evaluating numerical data objectively in order to explain, predict, or monitor variables of interest. It also helps in establishing a relationship between the variables (Patel, Shah and Shah, 2020). SPSS tools helps to determine the relation between variable to obtain regression analysis. In qualitative data, non-numeric data is collected analysed, and interpreted and the data is collected from in-depth interviews (Newcomer, Hatry and Wholey, 2015). Content analysis, grounded theory, and thematic analysis are some of the approaches that can be used for the analysis of data in qualitative interpretations (Vaismoradi and

Snelgrove, 2019). The research was adopted content analysis for the analysis of secondary-qualitative data. Themes were established in this form of research, and secondary source results are critically analysed. Therefore, with the help of content analysis, the researcher was able to establish that the information about Saudi Arabia's energy transition to renewables and Saudi Aramco's role was accurate.

3.7. Ethical Consideration

Ethical considerations is one of the crucial part of the researcher's study and should be taken into the attention while conducting a particular research. In addition to the previous statement, ethical consideration ensures whether the researcher has acquired ethical norms, beliefs and values. In the words of Quinlan et al (2019), when conducting secondary qualitative research certain ethical norms should be considered by the researcher to guarantee reliability. Similarly, in order to carry out research on the role of Saudi Aramco certain ethical values were considered and strictly obeyed. The researcher utilised other researches data with proper referencing in order to praise and give recognition to the real author. Moreover, any kind of biasness was avoided in conducting this research. Furthermore, in the light of this study the researcher ensured to respect intellectual property rights of other researchers. The data collected for this research was entirely free from duplication and misrepresentation.

3.8. Research Limitation

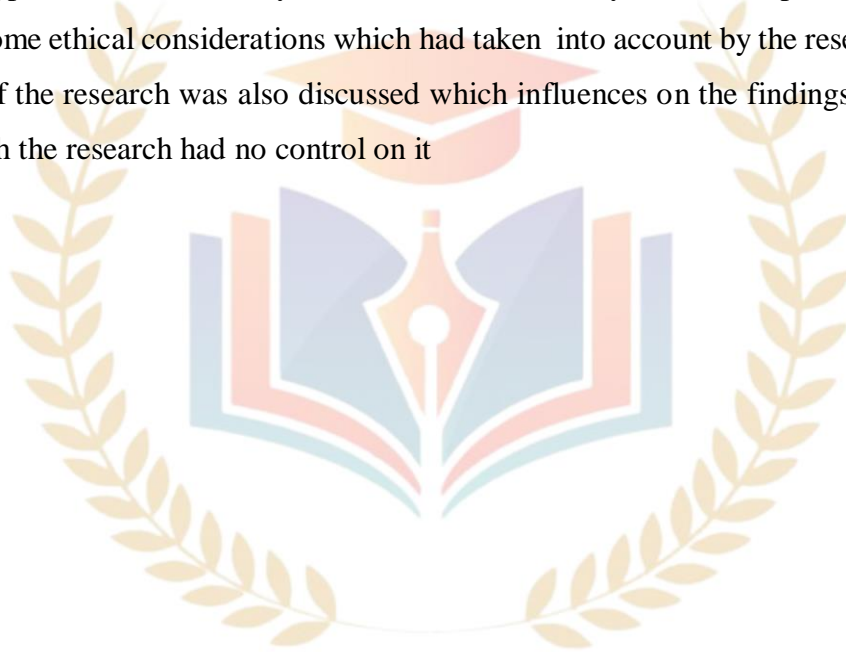
There are some research limitations which are discussed below:

1. One of the research limitation is that as the research is based on the secondary-qualitative data and it involves cost and time elements. Therefore, it is difficult to draw the samples from large scale data sets.
2. While conducting the research, time is another limitation which researcher was faced because they have to complete the research within the given time framework.
3. The availability of the data regarding Saudi Arabia's energy transition to renewables was very limited and this is the major limitation of the research. As the researcher finds it difficult to analyse the data due to the availability of the limited data.

4. The statistics which is extracted from the secondary source are measured on the basis of the previous studies and things are getting changed with the span of time
5. There is one more limitation that there are some secondary data that is unpublished literature, it cannot always be checked because it has not been peer reviewed.

3.9. Chapter Summary

The concluding remarks of the chapter is that the purpose of conducting this chapter is to understand that what methods and approaches are suitable for the current research. The research philosophy which was adopted in the research was interpretivist philosophy. Likewise, the research design was secondary qualitative therefore the research approach was inductive approach. For the analysis of data, content analysis was adopted in the research. There are some ethical considerations which had taken into account by the researchers. Lastly, limitation of the research was also discussed which influences on the findings of the research and at which the research had no control on it



+44-789-562-8894

CHAPTER FOUR: ANALYSIS AND DISCUSSION

4.1. Introduction

This chapter of research is centred towards the presentation of data and analysis of the research which has been utilised to establish understanding on the Saudi Arabia's Energy Transition to Renewables - The Role of Saudi Aramco. In regards to the research topic, data has been collected from multiple secondary sources and has been analysed by using content analysis. Furthermore, in order to carry out content analysis, multiple themes have been formed on the basis of objective that are designed in the light of this research. The first theme is to scrutinise the status of the present energy systems of Saudi Arabia. Furthermore, the second theme is to critically evaluate the challenges which are associated in current energy systems of KSA's. The third theme focuses on undertaking feasibility study on renewables and natural gas. The last theme emphasis on investigating the role of Saudi Aramco in KSA's Energy Transition. Furthermore, discussion has also been carried out on the objectives which triangulates present study findings with established study's findings.

4.2 Content Analysis

4.2.1 Scrutinising the Status of the Current Energy System of KSA

The energy sector of the Kingdom is considered to be as the backbone for the Saudi economy. It has been due to the reason that the Kingdom possess a quarter of the world's proven oil reserves which consequently make the sector as one of the largest producer and exporter of oil. The abundance of oil reserves not merely enable the Kingdom to be the leading oil exporter however, at the same time it also contributes significantly in fulfilling its domestic energy needs. As per the statistics of Saudi Embassy (2021), it is estimated that onequarter of the world's known reserves that makes to 260 billion barrels make the economy heavily dependent on its oil reserves. More specifically, it has also been discussed that Saudi refineries produces around 8 million barrels of oil per day meanwhile, it has plans to increase the production to around 12 million barrels per day. Being the world's largest producer and exporter of oil, the Kingdom plays a dominating role in the global energy industry. As per the statistics of 2017 provided by British Petroleum 2018, the Kingdom total crude oil reserves comprises 266.2 billion barrels. Moreover, in terms of natural gas, 8.04 trillion cubic meters reserve of natural gas is hold by the Kingdom. Also, in terms of electricity production, the production is recorded as 375.6 terawatt-hours.

Crude oil reserves	266.2 billion barrels
Natural gas reserves	8.04 trillion cubic meters
Oil production	11.95 million barrels/day*
Oil consumption	3.92 million barrels/day*
Natural gas production	111.4 billion cubic meters
Natural gas consumption	111.4 billion cubic meters
Coal consumption	0.09 million tonnes of oil equivalent
Electricity production	375.6 terrawatt-hours

Figure 1: Saudi Arabia's basic energy indicators for 2017, Source: BP 2018

The aforementioned numbers suggests that Saudi Arabia's electricity production is greatly dependent on the oil and gas reserves. Also, in terms of the blue hydrogen, the report of Arab News (2021) suggests that 50 percent of Saudi Arabia power sector is to be converted into gas meanwhile, the rest will be converted to renewable energy. It has been due to the government 2030 vision under which the government has planned to focus on sustainability program under hydrocarbon sustainability program. Also by considering the report of Natural Gas Intelligence (2021), the state owned Oil Company, Saudi Aramco is planning to expand its natural gas operations over traditional export route and is preferring to capture the competitiveness in blue hydrogen. The executives of the company confirms the export of gas for the company is growing twice at the rate in comparison to the crude at the global scale. The report further states that one of the key reason behind this shift is because of the low carbon footprint which has become crucial while maintaining its strategic position.

Further, the report of Saudi Embassy (2021), also suggested that Saudi Arabia is actively promoting foreign direct investment in its natural gas production. In this regard, one of the renowned agreement was of 2003 agreement which the company signed with the Royal Dutch/ Shell and France's total in order to upstream the gas operations. Here it becomes essential to mention the major industrial sector of the Kingdom is also dependent on the gas use. As per the report of EIA (2021), despite its sizeable reserves, the natural gas production in Saudi Arabia remains limited. Nonetheless, the government has been planning to monetise its vast natural gas as it is expanding to its petrochemical sector along with the natural gas- fired electric power generation. Besides lowering the dependency on its oil reserves, the country at the same time plans to increase electricity generating capacity to 120 gigawatts by the end of 2032 in order to meet the increasing capacity of its electricity.

4.2.2 Critical Evaluation of the Challenges faced by KSA in the Current Energy System

With reference to the findings of Woertz (2013), Saudi Arabia's domestic energy consumption is exponentially rising. Specifically, the growth of electricity demand is high however, at the same time, this demand is subject to high degree of seasonality. Moreover, the findings of the aforementioned researcher has further stated that the demand drivers in the form of population growth, subsidy regime which gives rise to the wasteful consumption. Though the high reserves of oil is still considered as one of the major contributor for the oil production in the country however, it becomes essential to mention that this high consumption of crude oil and its consumption has raised considerable environmental sustainability for the country. In realisation of this, the government has strong initiatives towards making the energy system as sustainable and environmental friendly.

Further, with respect to the findings of Nchet (2015), the Kingdom's role on the global energy is threatened by several domestic aspects. Some of the aspects are in the form of fast-growing population which is consequently increasing the gap in its demand and supply. The exponential rise in the demand of electricity is urging analysts to predict the country will soon facing a situation in which the country will be forced to import electric power. Further, it is also notable that the energy sector of KSA is heavily dependent on hydrocarbons and the two third of its total consumption of crude oil is consumed by electricity sector. Nonetheless, with the increasing environmental concerns and carbon footprints, the government has realised that there is a dire need for an organisation to review its domestic energy policy. Moreover, the findings of Nchet (2015) also infers that Saudi Arabia because of the high transition from crude oil consumption to the natural gas has started facing one of the other concerning issue of natural gas shortage. Also, by referring to the findings of Arab News (2021), 50 percent of Saudi Arabia power sector is going to be converted into gas while, the rest will be dependent on renewable energy. Nonetheless, while referring to the findings of Nathaniel (2019), it can be assumed that the shift of non-renewable energy to the renewable energy is not considered as the smooth process instead, it requires mind-set and adequate time to show complete dependency on the non-renewable energy. Also, the findings

of Nachet (2015), has asserted that there is a need to bring considerable reforms to the energy sector to successfully transit to the non-renewable sources of energy. However, these reforms are subject to political sensitivity. It has been due to the reason that citizens consider subsidies as the right meanwhile, government is always found reluctant to touch subsidies so as to avoid the political unrest that has been a threat for the Kingdom.

4.2.3 Undertaking Feasibility Study for natural gas and renewables of KSA

With regards to the findings of Ahmad (2017), Saudi Arabia is one of the rarest countries that directly burns crude oil for power generation. It is estimated that around 60 % of electricity is generated through oil while the remaining is fulfilled by the natural gas. Apart from this high domestic consumption of oil, the country is also recognised as the leading oil exporter and has been selling high amount of oil in the international markets at a considerably lower price. This maintains the demand of its oil at the international market. However, this high consumption and production of oil has also raised considerable challenges for the country especially in terms of environmental concerns and the carbon footprint which the country has been producing. Since Saudi Arabia is also selling the oil excessively therefore, it is also expected that country may face oil reserves depletion in coming decades. Here it becomes essential to mention that Saudi Arabia has a lot of capacity in the renewable energy especially in solar, wind and geothermal. As per the report of S&P Global Platts (2020), Saudi Arabia is way inclined towards renewable in the current decade. It has been under the initiative of the country's vision to reduce the oil burned in power generation. As per its 2025 vision, the kingdom is aiming to generate 30 GW from renewables by 2025 while as per its vision 2030, it has a target to reach 60 GW. As per the report, private sector including multi-national companies have pre-qualified to bid. The Ministry of Energy has pre-developed and tendered 2.17 GW of renewable energy capacity among which 700 MW was awarded in 2019 while 1.47 GW was awarded in 2020. The Kingdom plans to produce 70 % of its power from gas and while 30 % from renewable energy in the first phase.

4.2.4 Investigating the Role of Saudi Aramco in KSA's Energy Transition to Renewables.

As per the Report of Bloomberg (2021), Saudi Arabia is well- inclined towards showing greater dependency on renewable energy. The country is currently considered to be pioneer in hydrogen production because of its vision of making its economy diversified. Different reforms have been initiated with the purpose to escalate the prevalence of green energy production in the country. In realisation of this, the state-owned energy giant Saudi Aramco is leading the nation's efforts with its blue hydrogen initiative. Apart from blue hydrogen, it also becomes essential to mention that Pennsylvania-based Air Products & Chemicals Inc. and local firm ACWA Power International are developing some of such biggest plants at Neom on the Red Sea Coast. The role of Saudi Aramco is crucial in fostering the generation and consumption of renewable energy in a manner that its entire business model was developed in accordance with the non-renewable energy i.e. oil and gas production. However, in realisation of the initiatives taken from the government, the company is way forward to making investment in the non-renewable energy production and consumption and is leaving the generation of crude oil and its production of electricity generation. With regards to the findings of Natural Gas Intelligence (2021) is expanding its natural gas business by reducing the traditional export and is focusing on blue hydrogen. The company which is recognised as the largest oil exporter also possess abundance of natural gas reserves. The prime purpose behind this initiative is to reduce the carbon footprint which has threatened the economy because of its greatest production of oil. Since gas has considerably low carbon footprints in comparison to the crude, therefore, the interest and focus of the company has been shifted towards the natural gas including the liquefied natural gas which has great opportunity. One of the significant advantage the Aramco has even because of its transition is that it possess conventional and unconventional oil and gas stores. The company also has competitive edge because of the economy of scale, its geological position and operational platforms. Nonetheless, it becomes essential to mention that the Aramco is also looking beyond beside the consumption, generation and exportation of LNG. The company is

focused towards the generation of blue hydrogen and is planning to export on the large thereby earning significant profits.

4.3. Discussion

4.3.1 Objective 1: To evaluate the status of the current energy system of Saudi Arabia by focusing on heavy oil dependency, blue hydrogen and natural gas.

This objective of the research was designed in order to evaluate the current status of energy systems of Saudi Arabia by emphasising on blue hydrogen, natural gas and heavy oil dependency. As discussed in the literature that energy sector of Saudi Arabia acts as to be the backbone of their economy. In addition to the previous statement, energy system in Saudi Arabia integrates petroleum and production of electricity. It also comprises of producers, consumer and exporters of natural gas. Moreover, Saudi Arabia is amongst world's proven oil reserves that contribute them in making their energy system largest oil exporter and producer. Besides, Saudi Arabia is continuously making efforts in developing their energy resources. As per the research conducted by Saudi Embassy (2021), states that present energy system of Saudi Arabia generates electricity by 40% from oil reserves, 8% from steam and 52% from natural gas reserves. Thereby, it is true that the economy of Saudi Arabia's dependent on oil reserves that is considered to be 17% of the petroleum reserves of the world. It has been found through taking help from British Petroleum (2018), which states that in terms of electricity production, the production has been recorded as 375.6 terawatt-hours. However, it has been stated in other studies that Saudi Arabia holds capacity of producing 55 GW electricity which is estimated to increase till 2032 up to 120 GW.

Furthermore, as it was stated in the literature that in the year 2017 Saudi Arabia had recorded around of 303 trillion cubic feet of gas reserves (Worldometer, 2021). However, we found by extracting data from British Petroleum (2018), that it has been recorded 8.4 trillion of natural gas reserves in Saudi Arabia. Taking into the consideration blue hydrogen, Saudi Arabia is known for being leader in blue hydrogen. It was discussed in literature that energy system of Saudi Arabia will be soon transformed into gas and will be obtained from renewables. In addition to the previous statement, we also discussed that Saudi Arabia is planning for moving towards producing of blue hydrogen technologies and capacities, and that with the help natural gas blue hydrogen will be developed. We found by the help Arab News (2021) that the power sector of Saudi Arabia to 50 percent will be converted into gas and the rest will be converted into renewable energy. We also discovered through our findings that government of Saudi Arabia is planning for sustainability program for fulfilling

their vision of 2030 under hydrocarbon sustainability program. Lastly, through our findings based on the report by Saudi Embassy (2021), we discovered that Saudi Arabia in regards to natural gas production is actively promoting foreign direct investment.

4.3.2 Objective 2: To identify the surrounding challenges faced by Saudi Arabia in the current energy system

This objective acquire to identify the surrounding challenges which is faced by Saudi Arabia in the current energy system. It can be observed with one of the findings of Woertz (2013), the consumption of domestic energy in Saudi Arabia is explicitly rising due to the increasing demand of electricity. As it varies on the high degree of seasonality because the need for air conditioners increases in summer season. It can be observed from the finding of the research that Saudi Arabia faces a huge shortage of natural gas and the country has already started think to shift towards alternative energy sources such as nuclear power and renewables. The reason to adopt alternative energy sources is to eliminate the common practice of using crude oil, fuel oil and diesel in power station. While reviewing the findings of the literature such as BBC (2020), the energy sector of Saudi Arabia is facing major challenges in the energy sector due to the decarbonising energy system and emission of greenhouse gases. This is the reason that Saudi Arabia has transformed to sustainable strategies such as green and clean energy in order to reach a crossroads in 2020. By reviewing one of the literature findings of Kumar (2019), variations in the climate of Saudi Arabia leads the energy sector in crisis because the country in which people live is becoming increasingly dangerous.

The aforementioned information proves that there are serious challenges which are faced by the Saudi Arabia in the energy sector and in order to fight against these challenges there is a need of huge investment. Therefore, Saudi Arabia is moving towards the precautionary measure to fight against the challenges in the energy sector. While reviewing the findings of the literature such as Kalair et al. (2017), it proves that Saudi Arabia wants a stabilize economy with the help of sustainable transformation. They want to completely remove the consumption of fossil fuels and also promotes to use the renewable sources for clean energy in order to enhance circular economy. Moreover, the country also wants to change the perception of people in terms of their actions and engagement in determining their future in order to prevent a climate disaster. Saudi Arabia must be consistent in its demands that politicians and corporations behave in the best interests of humanity and, indirectly, the environment.

4.3.3 Objective 3: To identify potential opportunities in natural gas and renewables for Saudi Arabia

Saudi Arabia is renowned as the major producer of oil as the country has the sustainable capacity which is more than 10.5 b/d. in. Therefore, Saudi Aramco's provides number of opportunities to the institutions which function under the energy and construction sector. It can be observed that Renewable energy is expected to meet approximately 13% of total energy demand, which is expected to rise at a CAGR of about 5% over the forecasting period. Furthermore, investments in the wind power sector are expected to increase by 3% in 2018 compared to previous years, reaching USD 129 billion. By reviewing the findings of the literature such as Xu et al. (2019), the opportunity in this regard is that as time passes, growth is expected to increase, with solar PV growth likely to remain steady as renewables expand at a faster rate. Saudi Arabia has a tremendous opportunity to embrace renewable energy, which will need to be increased and transformed in the coming years. It can be observed that Saudi Arabia has a huge potential in oil, natural gas, and renewable energy, which means that the shift to renewable energy would have a direct effect on Saudi jobs and GDP.

While referring to the literature findings of the Naseem (2020), it can be observed that as a result of government spending and increased optimism, real non-oil growth is expected to accelerate to 2.9 percent in 2019. As a result, GDP growth is expected to slow to 1.9 percent in 2019. It can be observed with the integration of the OPEC deal, even real oil growth slows to 0.7 percent. As a result, although the unemployment rate among Saudi nationals has decreased, it remains high at 12.5 percent. However, Saudi Arabia has the potential to raise its job rate.

4.3.4 Objective 4: To recognise the role of Saudi Aramco in Saudi Arabia's Energy Transition to Renewables.

This objective of the research was designed in order to recognise the role Saudi Aramco in Saudi Arabia's Energy Transition to Renewables. Taking into the consideration Saudi Aramco, owns Saudi Arabian Oil Company which is considered as to be among the largest producers of the world. In addition to the previous statement, Saudi Aramco contributes in providing large portion of wealth to Saudi Arabia. In the words of Lau, et al., (2021), Saudi Aramco pays heavy rate of tax which is estimated to be of 50% to the Saudi Arabia government. Through conducting the research, we found that Saudi Aramco plays a vital role Saudi Arabia's energy transition and it is the largest hydrocarbon network across the globe known as Master Gas System (Hertog, 2013). Furthermore, we also found out that Saudi Aramco leading producer of chemical and energy which drives globally in order to

improve the lives of people living around the world. Additionally, Saudi Aramco believes in hydrogen as to be an energy vector and aims to achieve 10% of the market share by the year 2030 (Ramady, 2018).

We developed in literature that BP and Saudi Aramco plays an essential role in determining the technologies which could significantly contribute in reducing oil industry missions of involving carbon capture and electrification. However, we found out that Saudi Aramco believes in making impact in the environment by adopting technologies and knowledge in order to deliver innovative and creative solutions (Aramco.com, 2021). Furthermore, they also believe in enhancing efficiency and productivity with minimization of environmental impacts. It was also found through conducting research, that Saudi Aramco examines environmental performance vital to business performance sustainable.

4.4. Chapter Summary

To be summarise, it was concluded that themes were established in the research, and secondary source results are critically analysed. There were four themes which was created in the research which are undertaking feasibility study for natural gas and renewables of KSA. Second theme is investigating the role of Saudi Aramco in KSA's energy transition to renewables. Third theme is critical evaluation of the Challenges faced by KSA in the current energy system. Scrutinising the Status of the Current Energy System of KSA. The chapter carried out discussion on different research objectives in which objective one discusses the evaluation status of the current energy system of Saudi Arabia by focusing on heavy oil dependency, blue hydrogen and natural gas. The second objective discusses the surrounding challenges faced by Saudi Arabia in the current energy system. The third objective discusses the potential opportunities in natural gas and renewables for Saudi Arabia. The fourth objective discusses the role of Saudi Aramco in Saudi Arabia's Energy Transition to Renewables with the help of findings and findings of the literature of the different sources.

+44-789-562-8894

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

The conclusion and recommendations section has emphasis over the summary of above findings in this study which has been carried out to determine Saudi Arabia's energy transition to renewables that is the role of Saudi ARAMCO. In this manner, the fifth section involves summarised findings that provide a summary of the content analysis from the prior section. Additionally, this section also includes recommendations that have been provided based on the results and discussion carried out in prior sections. On the other hand, the future implications have also been included which highlights the limitations of this study and how these limitations can be captured by future researchers for the purpose of presenting more significant findings in similar research areas. Lastly, the conclusion has been provided in this chapter which has summarised the entire study.

5.2. Summarised Findings

This study has been carried out to determine Saudi Arabia's energy transition to renewables is the role of Saudi ARAMCO. In this manner, the analysis determined that due to the fact Kingdom possess a quarter of the world's proven oil reserves which consequently make the sector as one of the largest producer and exporter of oil, the energy sector of the Kingdom is considered to be as the backbone for the Saudi economy. In addition to this, it is also determined that the abundance of oil reserves contributes significantly to fulfilling its domestic energy needs despite just enabling Kingdom to be the leading oil exporter. Moreover, it is identified that the total crude oil reserves in Saudi Arabia comprise 266.2 billion barrels while there is an 8.04 trillion cubic meters reserve of natural gas. On the other hand, it is determined that the demand drivers in the form of population growth, subsidy regime increase wasteful consumption in Saudi Arabia. However, high reserves of oil are still considered as one of the major contributors to oil production in the country.

It is also determined from the analysis that due to the high transition from crude oil consumption to natural gas has started facing one of the other concerning issues of natural gas shortage in Saudi Arabia. Moreover, with respect to the feasibility study for natural gas and renewables of KSA, it is identified that Saudi Arabia is among the rarest countries that directly burn crude oil for power generation. Furthermore, it is estimated that around 60% of electricity is generated through oil while the remaining is fulfilled by natural gas. Conversely, this increased consumption and production of oil has also raised substantial challenges for the country with respect to environmental concerns and carbon footprint. Therefore, it becomes

essential to mention that Saudi Arabia has a huge capacity for renewable energy especially solar, wind and geothermal. It is due to the reason that as per its 2025 vision, KSA is directing to produce 30 GW from renewables by 2025 while as per its vision 2030, it has a target to reach 60 GW. Lastly, Aramco is also looking beyond the consumption, generation and exportation of LNG. The company is dedicated to the generation of blue hydrogen and is planning to export on the large which will help the company to earn significant profits.

5.3. Recommendations

Based on the discussion and analysis carried out in a prior section of the study, there are numerous recommendations for Saudi Arabia in order to emphasise more on the renewable sources of energy while minimising the environmental concerns. These recommendations are provided below:

- It is suggested for Saudi Arabia to be consistent in its demands that politicians and corporations behave in the best interests of humanity and, indirectly, the environment. It is due to the reason that consistent demand will avoid the urgent need to fulfil more energy needs while most of the energy demands can be catered with the help of renewable energy sources.
- It is also recommended for energy sector of Saudi Arabia to must ensure the security of electricity supply at an affordable cost to the final consumer. It is due to the reason that provision of cheap electricity that will help the government to encourage consumers to use renewable sources of energy in order to cater for their increased energy demands.
- Lastly, it is also suggested for Aramco towards the generation of blue hydrogen. It is due to the reason that the use of blue hydrogen will help a company to cater to increased demand for energy while exporting. In this manner, the company would be able to earn huge profits while reducing the operational cost of energy generation.

+44-789-562-8894

5.4. Future Implications

This study has been carried out to determine Saudi Arabia's energy transition to renewables is the role of Saudi ARAMCO. Therefore, the findings of this study are restricted to energy sector of Saudi Arabia. In this manner, it is suggested for future researchers to emphasise also on other companies in Saudi energy sector along with energy sector of other

countries in the region. This will help future researchers in order to increase the scope of this study.

5.5. Conclusion

The energy transition is a process or a way toward the transformation of the global energy industry by changing from fossil-based to zero-carbon resources of energy to achieve sustainable energy resources. In terms of Saudi Arabia, it is significant to focus on renewable energy as its related investment seems like a lucrative option. However, this arises a concern for Saudi Arabia pertaining to how the kingdom can form the balance between the consumption and production of high rick oil reserves against the emerging theme of renewable energy which is highly demanded by different nations all over the world. In this manner, the researcher has adopted a qualitative research design while the inductive approach has been adopted. On the other hand, the researcher has adopted interpretivism research philosophy as the study has focused on content and quality rather than numerical evidence. The data in this study has been collected with the help of secondary sources and is analysed through content analysis.

Through the analysis, it is determined that the energy sector of the Kingdom is regarded as the backbone of the Saudi economy. It is due to the reason that the Kingdom possess a quarter of the world's proven oil reserves which consequently make the sector as one of the largest producer and exporter of oil. The country however has faced a shortage of natural gas and is pursuing renewable or alternative energy sources like nuclear power for the purpose of reducing the common practice of using crude oil, fuel oil and diesel in power stations. Based on this, it is suggested for Saudi Arabia to be consistent in its demands that politicians and corporations behave in the best interests of humanity and, indirectly, the environment. In addition, it is also recommended for energy sector of Saudi Arabia to must ensure the security of electricity supply at an affordable cost to the final consumer.

+44-789-562-8894

REFERENCES

- Abdmouleh, Z., Alammari, R.A. and Gastli, A., 2015. Recommendations on renewable energy policies for the GCC countries. *Renewable and Sustainable Energy Reviews*, 50, pp.1181-1191.
- Ahmad, T., Zhang, H. and Yan, B., 2020. A review on renewable energy and electricity requirement forecasting models for smart grid and buildings. *Sustainable Cities and of Saudi Arabia: Opportunities and Prospects*. In 2017 9th IEEE-GCC Conference and Exhibition (GCCCE) (pp. 1-9). IEEE.
- Ahmed, F.E., Hashaikeh, R. and Hilal, N., 2019. Solar powered desalination—Technology, energy and future outlook. *Desalination*, 453, pp.54-76.
- Al Garni, H., Kassem, A., Awasthi, A., Komljenovic, D. and Al-Haddad, K., 2016. A multicriteria decision making approach for evaluating renewable power generation sources in Saudi Arabia. *Sustainable energy technologies and assessments*, 16, pp.137-150.
- Al Garni, H., Kassem, A., Awasthi, A., Komljenovic, D. and Al-Haddad, K., 2016. A multicriteria decision making approach for evaluating renewable power generation sources in Saudi Arabia. *Sustainable energy technologies and assessments*, 16, pp.137-150.
- Albassam, B.A., 2019. The public financial system in Saudi Arabia: the need for reform. *International Journal on Governmental Financial Management*, 19(2), pp.38-53.
- Aliyu, A.K., Modu, B. and Tan, C.W., 2018. A review of renewable energy development in Africa: A focus in South Africa, Egypt and Nigeria. *Renewable and Sustainable Energy Reviews*, 81, pp.2502-2518.
- Al-Jabri, I.M. and Sohail, M.S., 2012. Mobile banking adoption: Application of diffusion of innovation theory. *Journal of Electronic Commerce Research*, 13(4), pp.379-391.
- Alsharif, M.A., Peters, M.D. and Dixon, T.J., 2020. Designing and implementing effective campus sustainability in Saudi Arabian universities: An assessment of drivers and barriers in a rational choice theoretical context. *Sustainability*, 12(12), p.5096.
- AL-TAMIMI, N., 2016. Saudi's Arabia Oil Dependence: Challenges Ahead. *Italian Institute for International Political Studies (ISPI)*. Retrieved from <https://www.ispionline.it/en/pubblicazione/saudi-arabias-oil-dependence-challenges-ahead-14997>.

- Ansari, D., 2017. OPEC, Saudi Arabia, and the shale revolution: Insights from equilibrium modelling and oil politics. *Energy Policy*, 111, pp.166-178.
- Arab News 2021. Saudi Arabia to pioneer producers of green, blue hydrogen: Energy minister. Available at: <https://www.arabnews.com/node/1799451/business-economy>(Accessed: 6 May 2021).
- Arab News 2021. Saudi Arabia to pioneer producers of green, blue hydrogen: Energy Aramco.com. 2021. *Environmental performance*. [online] Available at: <<https://www.aramco.com/en/creating-value/sustainable-business-operations/environmental-performance>> [Accessed 6 May 2021].
- Asmelash, E. and Gorini, R., 2021. International oil companies and the energy transition, International Renewable Energy Agency, Abu Dhabi About IRENA The International Renewable Energy Agency (IRENA) serves as the principal platform for international co-operation, a centre of excellence, a repository of policy, technology, resource and financial knowledge, and a driver of action on the ground to advance the transformation of the global energy system. An intergovernmental organisation established in 2011, IRENA promotes the widespread
- Barhoumi, E.M., Okonkwo, P.C., Zghaibeh, M., Belgacem, I.B., Alkanhal, T.A., Abo-Khalil, A.G. and Tlili, I., 2019. Renewable energy resources and workforce case study Saudi Arabia: review and recommendations. *Journal of Thermal Analysis and Calorimetry*, pp.1-10.
- Bazeley, P., 2017. *Integrating analyses in mixed methods research*. Sage.
- BBC, 2020. The new fuel to come from Saudi Arabia. Online Available at: <https://www.bbc.com/future/article/20201112-the-green-hydrogen-revolution-in-renewable-energy> [Accessed 23 Apr. 21]
- Bhattacharya, M., Paramati, S.R., Ozturk, I. and Bhattacharya, S., 2016. The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy*, 162, pp.733-741.
- Bloomberg - Saudi Arabia Aims to Become Next Germany of Renewable Energy (2021). Available at: <https://www.bloomberg.com/news/articles/2021-01-27/saudi-arabia-aims-to-become-the-germany-of-renewable-energy> (Accessed: 7 May 2021).

- Caldera, U. and Breyer, C., 2018. The role that battery and water storage play in Saudi Arabia's transition to an integrated 100% renewable energy power system. *Journal of Energy Storage*, 17, pp.299-310.
- Clean Energy., 2021. Why Clean Energy is Important. [Online] Available at: <https://buycleanenergy.org/why#:~:text=Renewable%20energy%20also%20helps%20conserve%20the%20nation's%20natural%20resources.&text=Energy%20Security-.Renewable%20energy%20provides%20reliable%20power%20supplies%20and%20fuel%20diversification%2C%20which.conserve%20the%20nation's%20natural%20resources>. [Accessed on: March 18, 2021]
- Collins, L., 2021. 'We will be pioneering': Saudi Arabia reveals 50% renewables goal by 2030, but is that realistic? [Online] <https://www.rechargenews.com/energy-transition/we-will-be-pioneering-saudi-arabia-reveals-50-renewables-goal-by-2030-but-is-that-realistic-/2-1-954094>
- Cyr, J., 2016. The pitfalls and promise of focus groups as a data collection method. *Sociological methods & research*, 45(2), pp.231-259.
- Darwish, S., Abdo, H. and Alsabuwaiee, W., 2019. Opportunities, challenges and risks of transition into renewable energy: The case study of arab gulf cooperation council. *International Energy Journal*, 18(4).
- Darwish, S., Abdo, H. and Alsabuwaiee, W., 2019. Opportunities, challenges and risks of transition into renewable energy: The case study of arab gulf cooperation council. *International Energy Journal*, 18(4).
- Darwish, S., Abdo, H. and AlShuwaiee, W.M., 2018. Opportunities, challenges and risks of transition into renewable energy: the case of the Arab Gulf Cooperation Council. *International Energy Journal*, 18(4).
- Dhillon, R.S. and von Wuehlisch, G., 2013. Mitigation of global warming through renewable biomass. *Biomass and bioenergy*, 48, pp.75-89.
- Diji, C.J., 2019. Energy Transition Process and Sustainable Development. *Encyclopedia of Sustainability in Higher Education*, pp.516-523.
- Dingfelder, H.E. and Mandell, D.S., 2011. Bridging the research-to-practice gap in autism intervention: An application of diffusion of innovation theory. *Journal of autism and developmental disorders*, 41(5), pp.597-609.
- EIA, 2021. International - U.S. Energy Information Administration. Available at: <https://www.eia.gov/international/overview/country/SAU> (Accessed: 6 May 2021).

- EIA, 2021. International - U.S. Energy Information Administration. Available at: <https://www.eia.gov/international/overview/country/SAU> (Accessed: 6 May 2021).
- Gielen, D., Boshell, F., Saygin, D., Bazilian, M.D., Wagner, N. and Gorini, R., 2019. The role of renewable energy in the global energy transformation. *Energy Strategy Reviews*, 24, pp.38-50.
- Gielen, D., Boshell, F., Saygin, D., Bazilian, M.D., Wagner, N. and Gorini, R., 2019. The Gioia, D.A., Corley, K.G. and Hamilton, A.L., 2013. Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational research methods*, 16(1), pp.15-31.
- Grade, S. and Götz, M., 2017. Neuronal replacement therapy: previous achievements and challenges ahead. *NPJ Regenerative medicine*, 2(1), pp.1-11.
- Gravetter, F.J. and Forzano, L.A.B., 2018. Research methods for the behavioral sciences. Cengage Learning.
- Gulzar, A., Gulzar, A., Ansari, M.B., He, F., Gai, S. and Yang, P., 2020. Carbon dioxide utilization: A paradigm shift with CO2 economy. *Chemical Engineering Journal Advances*, p.100013.
- Hertog, S., 2013. Saudi Aramco as a national development agent: recent shifts.
- IRENA, 2021. *Energy Transition*. [Online] Available at: <https://www.irena.org/energytransition#:~:text=The%20energy%20transition%20is%20a,second%20half%20of%20this%20century.&text=Renewable%20energy%20and%20energy%20efficiency,of%20the%20required%20carbon%20reductions>. (Accessed: 18 March 2021).
- Johnston, M.P., 2017. Secondary data analysis: A method of which the time has come. *Qualitative and quantitative methods in libraries*, 3(3), pp.619-626.
- Kalair, A., Abas, N., Saleem, M.S., Kalair, A.R. and Khan, N., 2021. Role of energy storage systems in energy transition from fossil fuels to renewables. *Energy Storage*, 3(1), p.e135.
- Kalair, A., Abas, N., Saleem, M.S., Kalair, A.R. and Khan, N., 2021. Role of energy storage systems in energy transition from fossil fuels to renewables. *Energy Storage*, 3(1), p.e135.

- Kalair, A., Abas, N., Saleem, M.S., Kalair, A.R. and Khan, N., 2021. Role of energy storage systems in energy transition from fossil fuels to renewables. *Energy Storage*, 3(1), p.e135.
- Kalayou, M.H., Endehabtu, B.F. and Tilahun, B., 2020. The Applicability of the Modified Technology Acceptance Model (TAM) on the Sustainable Adoption of eHealth Systems in Resource-Limited Settings. *Journal of Multidisciplinary Healthcare*, 13, p.1827.
- Khan, M., 2016. Saudi Arabia's vision 2030. *Defence Journal*, 19(11), pp.36-42.
- Khan, M., 2016. Saudi Arabia's vision 2030. *Defence Journal*, 19(11), pp.36-42.
- Kumar, R., 2019. Sustainable Development and Environmental Problems: Coping with Green House and Climate Change. *International Journal of Applied Social Science*, 6(3), pp.572-591.
- Laes, E., Gorissen, L. and Nevens, F., 2014. A comparison of energy transition governance in Germany, the Netherlands and the United Kingdom. *Sustainability*, 6(3), pp.1129-1152.
- Lau, H.C., Ramakrishna, S., Zhang, K. and Radhamani, A.V., 2021. The Role of Carbon Capture and Storage in the Energy Transition. *Energy & Fuels*.
- Lehtveer, M., Mattsson, N. and Hedenus, F., 2017. Using resource based slicing to capture the intermittency of variable renewables in energy system models. *Energy strategy reviews*, 18, pp.73-84.
- Lockwood, M., 2015. Fossil fuel subsidy reform, rent management and political fragmentation in developing countries. *New Political Economy*, 20(4), pp.475-494.
- Magdoff, F., 2013. Global resource depletion. *Monthly Review*, 64(8), pp.13-28.
- Malik, K., Rahman, S.M., Khondaker, A.N., Abubakar, I.R., Aina, Y.A. and Hasan, M.A., 2019. Renewable energy utilization to promote sustainability in GCC countries: policies, drivers, and barriers. *Environmental Science and Pollution Research*, 26(20), pp.20798-20814.
- Marangunić, N. and Granić, A., 2015. Technology acceptance model: a literature review from 1986 to 2013. *Universal access in the information society*, 14(1), pp.81-95.
- Markard, J. (2018). The next phase of the energy transition and its implications for research and policy. *Nature Energy*, 3(8), 628-633.
- Matta, C., 2015. Interpretivism and Causal Explanations: A Case from Educational Research. *Philosophy of the social sciences*, 45(6), pp.543-567.

- Nachet, S. and Aoun, M.C., 2015. The Saudi electricity sector: pressing issues and challenges. IFRI Security Studies Center.
- Naseem, S., 2020. Performance of fiscal measures in rectifying fiscal imbalances in Saudi Arabia. *Financial Studies*, 24(4 (90)), pp.60-67.
- Nathaniel, S.P. and Iheonu, C.O., 2019. Carbon dioxide abatement in Africa: the role of renewable and non-renewable energy consumption. *Science of the Total Environment*, 688, pp.145-155.
- Natural Gas Intelligence, 2021. Aramco Looking to Skip LNG Exports, Focus on Blue Hydrogen Transport -. Available at: <https://www.naturalgasintel.com/aramco-looking-to-skip-lng-exports-focus-on-blue-hydrogen-transport/> (Accessed: 6 May 2021).
- Natural Gas Intelligence, 2021. Aramco Looking to Skip LNG Exports, Focus on Blue Hydrogen Transport -. Available at: <https://www.naturalgasintel.com/aramco-looking-to-skip-lng-exports-focus-on-blue-hydrogen-transport/> (Accessed: 6 May 2021).
- Nazir, M.S., Wang, Y., Muhammad, B., Hafiz M, S., Kadhem, A.A., Nazir, H.M., Abdalla, A.N. and Ma, Y., 2020. Comparison of small-scale wind energy conversion systems: economic indexes. *Clean Technologies*, 2(2), pp.144-155.
- Newcomer, K.E., Hatry, H.P. and Wholey, J.S., 2015. Qualitative data analysis. *Handb. Pract. Program Eval*, pp.429-453.
- Newell, R.G., Pizer, W.A. and Raimi, D., 2013. Carbon markets 15 years after Kyoto: Lessons learned, new challenges. *Journal of Economic Perspectives*, 27(1), pp.123- 46.
- Noussan, M., Raimondi, P.P., Scita, R. and Hafner, M., 2020. The Role of Green and Blue Hydrogen in the Energy Transition: A Technological and Geopolitical Perspective. *Sustainability* 2021, 13, 298.
- Noussan, M., Raimondi, P.P., Scita, R. and Hafner, M., 2021. The Role of Green and Blue Hydrogen in the Energy Transition—A Technological and Geopolitical Perspective. *Sustainability*, 13(1), p.298.
- NS Energy., 2021. Analysis Archives. Retrieved 22 March 2021, from <https://www.nsenergybusiness.com/features/saudi-aramco-renewable-energy/>
- Ogle, S.M., Alsaker, C., Baldock, J., Bernoux, M., Breidt, F.J., McConkey, B., Regina, K. and Vazquez-Amabile, G.G., 2019. Climate and soil characteristics determine where no-till management can store carbon in soils and mitigate greenhouse gas emissions. *Scientific reports*, 9(1), pp.1-8.

- Okoli, C., 2021. Inductive, Abductive and Deductive Theorizing. Available at SSRN 3774317.
- OPEC, 2021. *OPEC : Saudi Arabia*. [online] Opec.org. Available at: <https://www.opec.org/opec_web/en/about_us/169.htm> [Accessed 22 April 2021].
- Patel, D., Shah, D. and Shah, M., 2020. The intertwine of brain and body: a quantitative analysis on how big data influences the system of sports. *Annals of Data Science*, Carbon Energy Markets. *Geopolitics, History, and International Relations*, 12(1), pp.9-44.
- Queirós, A., Faria, D. and Almeida, F., 2017. Strengths and limitations of qualitative and quantitative research methods. *European Journal of Education Studies*.
- Quinlan, C., Babin, B., Carr, J. and Griffin, M., 2019. *Business research methods*. South Western Cengage.
- Rahi, S., 2017. Research design and methods: A systematic review of research paradigms, sampling issues and instruments development. *International Journal of Economics & Management Sciences*, 6(2), pp.1-5.
- Ramady, M.A., 2018. *Saudi Aramco 2030*. Springer.
- Ramady, M.A., 2018. *Saudi Aramco 2030*. Springer.
- Ramli, M.A., Hiendro, A. and Al-Turki, Y.A., 2016. Techno-economic energy analysis of wind/solar hybrid system: Case study for western coastal area of Saudi Arabia. *Renewable energy*, 91, pp.374-385.
- Renukappa, S., Suresh, S., Al Nabt, S., Sarrakh, R. and Algahtani, K., 2020. An ISM approach to evaluate critical success factors for knowledge management in the Kingdom of Saudi Arabia. *Harnessing Knowledge, Innovation and Competence in Engineering of Mission Critical Systems*, p.65.
- Rick, T., Ontiveros, M.Á.C., Jerardino, A., Mariotti, A., Méndez, C. and Williams, A.N., 2020. Human-environmental interactions in Mediterranean climate regions from the Pleistocene to the Anthropocene. *Anthropocene*, p.100253.
- S&P Global Platts, 2020. Saudi Arabia expects more than \$20 bil investment in renewables over a decade: official. Available at: <https://www.spglobal.com/platts/en/market-insights/latest-news/coal/101920-saudi-arabia-expects-more-than-20-bil-investment-in-renewables-over-a-decade-official> (Accessed: 7 May 2021).

- Saadi, D., 2020. *Saudi Arabia expects more than \$20 bil investment in renewables over a decade: official | S&P Global Platts*. [Online] Available at: <https://www.spglobal.com/platts/en/market-insights/latest-news/coal/101920-saudi-arabia-expects-more-than-20-bil-investment-in-renewables-over-a-decade-official> (Accessed: 18 March 2021).
- Salam, M.A. and Khan, S.A., 2018. Transition towards sustainable energy production—A Saudi Embassy, 2021. *Energy | The Embassy of The Kingdom of Saudi Arabia*. Available at: <https://www.saudiembassy.net/energy> (Accessed: 6 May 2021).
- Saudi Embassy, 2021. *Energy | The Embassy of The Kingdom of Saudi Arabia*. Available at: <https://www.saudiembassy.net/energy> (Accessed: 6 May 2021).
- Saudi Embassy, 2021. *Energy | The Embassy of The Kingdom of Saudi Arabia*. [online] Saudiembassy.net. Available at: <https://www.saudiembassy.net/energy> [Accessed 22 April 2021].
- Schlögl, R., 2017. E-Mobility and the Energy Transition. *Angewandte Chemie International Edition*, 56(37), pp.11019-11022.
- Shahsavari, A. and Akbari, M., 2018. Potential of solar energy in developing countries for reducing energy-related emissions. *Renewable and Sustainable Energy Reviews*, 90, pp.275-291.
- Shinn, L., 2018. *Renewable Energy: The Clean Facts*. [Online] Available at: <https://www.nrdc.org/stories/renewable-energy-clean-facts> (Accessed: 18 March 2021).
- Stremke, S., 2015. Sustainable energy landscape: Implementing energy transition in the physical realm. In *Encyclopedia of environmental management*. CRC Press.
- Thomas, G., 2012. Saudi Arabia: Mining, Minerals and Fuel Resources. [Online] Available at: <https://www.azominig.com/Article.aspx?ArticleID=102#:~:text=Saudi%20Arabia's%20key%20natural%20resources,of%20petroleum%20in%20the%20world.> [Accessed on: March 18, 2020].
- Tlili, I., 2015. Renewable energy in Saudi Arabia: current status and future potentials. *Environment, development and sustainability*, 17(4), pp.859-886.

- Tong, J. and Zuo, L., 2021. Dialoguing with data and data reduction: An observational, narrowing-down approach to social media network analysis. *Journalism and Media*, 2(1), pp.14-29.
- Vaismoradi, M. and Snelgrove, S., 2019, September. Theme in qualitative content analysis and thematic analysis. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 20, No. 3).
- Woertz, E., 2013. The domestic challenges in the Saudi energy market and their regional and geopolitical implications. Norwegian Peacebuilding Resource Centre Policy Brief.
- World Data., 2020. Saudi Arabia. [Online] Available at:<https://www.worlddata.info/asia/saudi-arabia/index.php#:~:text=According%20to%20the%20definition%20of,developed%20economies%20by%20UN%2Ddefinition.> [Accessed on: March 18, 2021]
- Worldometer, 2021. *Saudi Arabia Natural Gas Reserves, Production and Consumption Statistics* - Worldometer. [online] Worldometers.info. Available at: [https://www.worldometers.info/gas/saudi-arabia-natural-gas/#:~:text=Saudi%20Arabia%20holds%20303%20trillion,gas%20reserves%20of%206%2C923%20Tcf.&text=This%20means%20it%20has%20about,levels%20and%20excluding%20unproven%20reserves\).](https://www.worldometers.info/gas/saudi-arabia-natural-gas/#:~:text=Saudi%20Arabia%20holds%20303%20trillion,gas%20reserves%20of%206%2C923%20Tcf.&text=This%20means%20it%20has%20about,levels%20and%20excluding%20unproven%20reserves).>) [Accessed 22 April 2021].
- Xu, X., Wei, Z., Ji, Q., Wang, C. and Gao, G., 2019. Global renewable energy development: Influencing factors, trend predictions and countermeasures. *Resources Policy*, 63, p.101470.
- Y Charts ., 2021. Saudi Arabia Crude Oil Production. [Online] Available at: <https://ycharts.com/indicators/saudi-arabia-crude-oil-production#:~:text=Saudi%20Arabia%20Crude%20Oil%20Production%20is%20at%20a%20current%20level,8.91%25%20from%20one%20year%20ago.>
- Zangirolami-Raimundo, J., Echeimberg, J.D.O. and Leone, C., 2018. Research methodology topics: Cross-sectional studies. *Journal of Human Growth and Development*, 28(3), pp.356-360.
- Žukauskas, P., Vveinhardt, J. and Andriukaitienė, R., 2018. Philosophy and paradigm of scientific research. *Management Culture and Corporate Social Responsibility*, 121.. Philosophy and paradigm of scientific research. *Management Culture and Corporate Social Responsibility*, 121.