Opportunities, Challenges and Risks of Transition into Renewable Energy: The Case of the Arab Gulf Cooperation Council

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Abstract *– Gulf Cooperation Council (GCC) member states have abounded underground fossil fuel resources and high potentials for renewable energy (RE). However, given the Peak Oil Theory and the international climate change regulations and protocols, investments in RE became a first-class candidate. The current conceptualized study investigates barriers, risk, and opportunities associated with the transition to RE generation in member states of GCC. The study deploys secondary data extracted from published statistics and related literature. Via an interpretive, exploratory and explanatory approach, we conclude that there is a long-term need to expand uptake of RE technologies in order to meet the possible medium to long-terms energy and economic securities. Bureaucratic inefficiency and fuel subsidies along with absence of both suitable investment framework and supporting energy policies for investments in RE were found to be significant barriers to RE deployment in the GCC states. The current paper argues that the GCC has a specific climate advantage for RE. Therefore, if RE options are utilised ideally by the GCC member states they can play a significant role in substituting conventional energy sources and in sustaining energy and economic securities of the GCC member states*

Keywords – Energy efficiency, Gulf Cooperation Council, renewable energy, renewable energy investment, renewable energy policy, transition to renewable energy

1. INTRODUCTION

Gulf Cooperation Council (GCC), a name given to a trading block, created in 1981, constitutes of six Arab countries including: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE) [1]. Remarkable growth has been experienced by the GCC economies in respect of socio-economic indicators in the past few decades. Oil and gas revenue along with the growth-oriented policies have fuelled this socio-economic growth. The result of this enhanced socio-economic growth is obvious from the improved living standards and urbanization rate of GCC economies, which was recorded among the world leading economies in 2013 [2]. The macroeconomic factors evidently show that GCC member states have historically been dependent, both politically and economically on the fossil fuels exploitation. However, it has been observed in the past decade that GCC economies have begun to adopt RE technologies [3]. This deployment of RE options has not been remarkably significant and is progressing somewhat slowly. The adoption of RE technologies by the GCC states can be justified and related to a number of international factors. These factors are connected with the 'Peak Oil' theory, the climate change laws and regulations and the tendency of the developed industrial countries to depend more on greener and sustainable RE [4]. These factors play key roles in the demand of energy and economic securities of the GCC states. Therefore, persuade investments in RE as an ideal solution for any possible energy and economic insecurities that the GCC states may be subject to in the future [5]. This paper, via literature review and statistical data extracted from secondary sources, aims to explore and explain barriers, risks, and opportunities of investments in RE options in GCC states. The study builds on the existing literature and contributes to the debate on the suitability, significance and opportunities of RE uptake. Furthermore, the study contributes to the debate on energy and economic securities of the GCC member States and the significance of RE to ease off any concerns.

1.1 The Current Trend

GCC member economies depend exceedingly on selling oil and gas. For example, in 2013 GCC economies have exported approximately 13 million barrels per day, which has generated around 80% of the total revenue for the countries in that region, in the same year [6]. See table 1 and figure 1 below.

Table 1: GCC Crude Oil Exports in Thousands Barrel per day

Year	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
2012	245.9	2070	768.4	588.3	7556.8	2445.2
2013	247.5	2058.5	838.2	598.7	7570	2761.4
2014	248.3	1994.8	804.3	595.5	7153.5	2496.7
2015	249.3	1963.8	788	490.2	7163.3	2441.5
2016	230.3	2128.2	887.5	503.4	7463.4	2407.8

Source: [7]

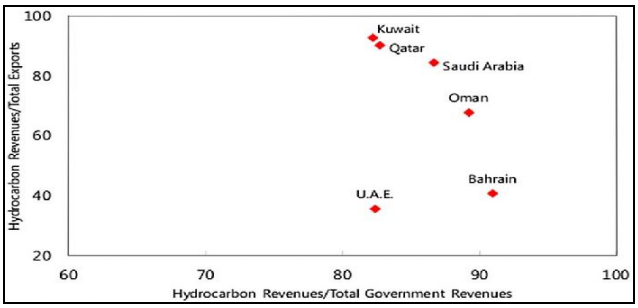

Figure 1: Hydrocarbon revenue as a share of total government revenue

Source: Adapted from [3]

However, since most of the industrial countries are deploying RE and persuading strict climate change regulations fossil fuel-based energy may lose significant parts of its market share in future. This scenario suggests that oil may still exist in future, but demand for oil may diminish. This would put energy and economic securities of GCC countries at stake; therefore, investments in RE options seem to be the most appropriate option for these countries at this particular time [8].

Jointly, the six GCC member states are ranked globally as the leading producers of fossil fuels. The region's share of world oil production increased from 21.3 per cent in 2009 to just less than 25 per cent in 2016; similarly, the GCC gas production as a percentage to the world gas production increased from 9 per cent in 2009 to 12 per cent in 2016 (see tables 2 and 3). These statistics not only show the importance of the region in the world in terms of oil and gas production, they also show the significance of oil and gas commodities to the region's economies. Therefore, it is vital for the GCC member states to have a suitable, efficient and sustainable substitute for fossil fuels. Such substitutes should sustain energy security of these states at both the demand *and* supply sides and ensure economic security of the region. In addition to their energy and revenue potentials, RE options do not contribute to the climate change, therefore their market share is expected to expand rapidly when generation costs continue to decline to levels that match those of fossil fuels.

Table 2: GCC oil Production in Thousands barrels per day

Year	Bahrain*	Kuwait	Oman	Qatar	Saudi Arabia	UAE	**GCC share of the world production
2009	182	2498	813	1421	9663	2725	21.3%
2010	181.8	2560	865	1638	10075	2895	21.9%
2011	190.3	2913	885	1834	11144	3320	24.1%
2012	173	3169	918	1931	11635	3401	24.6%
2013	197.6	3129	942	1906	11393	3627	24.5%
2014	202.5	3101	943	1886	11505	3679	24.0%
2015	202.6	3068	981	1890	11986	3928	24.1%
2016	205	3151	1004	1899	12349	4073	24.6%

Sources: [9]. *: Data is from [7]. **: Own Authors' Calculations

Table 3: GCC Natural gas Production in Billion cubic meters

Year	Bahrain*	Kuwait	Oman	Qatar	Saudi Arabia	UAE	**GCC share of the world production
2009	12.58	11.5	27	89.3	78.5	48.8	9.0%
2010	12.91	11.7	29.3	131.2	87.7	51.3	10.2%
2011	12.62	13.5	30.9	145.3	92.3	52.3	10.5%
2012	13.74	15.5	32.2	157	99.3	54.3	11.1%
2013	17.22	16.3	34.8	177	100	54.6	11.7%
2014	20.62	15	33.3	174.1	102.9	54.2	11.5%
2015	21.28	16.9	34.7	178.5	104.5	60.2	11.8%
2016	22.35	17.1	35.4	181.2	109.4	61.9	12.0%

Source: [9]. *: Data is from [7]. **: Own Authors' Calculations.

Of the world's proven reserves of oil and natural gas, GCC member states hold 30% and 23% respectively [10]. It is worth noting that reserve to production ratio (R/P) in most of the GCC member states exceeds 30 years. This quota is more than half of century in big producer's states: for example, Saudi Arabia and Qatar's oil and natural gas reserves to production quota are 88 and 155 years respectively [11].

Being the lead region for crude oil export, Saudi Arabia has contributed almost 19% of the total world crude oil exports in 2013. Qatar dominates the market for the production and export of natural gas, which has separately contributed almost 12% of total world export for natural gas in 2013 [6]. This clearly depicts the significant role of these two countries in the international energy market and indicates the significant roles of oil and natural gas production and exports to these countries' economies.

1.2 Changes to the Current Trend

The presumption that fossil fuels is a low-cost source of energy, along with perceived abundance of this low-cost energy, has certainly amplified the GCC energy demand growth, and alternatively stimulated broad energy-intensive industrialization and has enhanced living standards of GCC member economies. The international economic growth increased the demand for oil and gas in order to fuel the industrial advancements, this increase in demand coupled with increase in production, processing and transportation costs. This led to significant increase in

oil and natural gas prices. Such increases in oil and gas prices since 2000 has significantly increased the cost of importing oil in world market in general; and in particular for the net energy importing countries (NICs), Japan and China for example. On the other hand, net oil and gas exporting countries such as Saudi Arabia and Russia, have diverted the ample shares of energy to local energy demands at highest implicit and explicit cost, rather selling oil in the international market for higher prices,. This action, whilst reducing the quantity of oil available for export, highlights aspects of energy and economic insecurities for these countries.

The increasing trends of globalisation and modernisation have further intensified the demand for energy sources: both renewable and non-renewable. However, the shift of the international energy demand from fossil-based into cleaner, greener RE is clear due to climate change regulations. This has forced all of those concerned policymaking and production of energy sector to invest more in the RE sector to fill the demand gap.

To meet the challenges faced by the sector, a practical and remarkable step has been taken by the GCC States in the form of adaptation of "Pan-Arab Strategy for Development of Renewable Energy 2010-2030." The plan has been adopted under the umbrella of LAS the third Arab Economic and Social Development summit held in 2013, the long-term goals and targets were set for the electricity generation from renewable sources. In order to achieve the set targets, it was agreed that GCC States must work to eventually upgrade RE uptake and production significantly. Along with the generation of electricity, the strategy has also focused on upgrading RE options for other purposes including: heating, cooling, transportation, and desalination.

This study highlights the current energy position of GCC States and amendments that have been made to this position. The study aims to explore challenges, risks and opportunities that come with investments in RE options. It addresses the role of RE investments in the energy and economic securities of GCC States. In order to meet these objectives, the study raises the following empirical questions:

1. What barriers, risk and opportunities are associated with investments and transition to RE in the GCC member states?
2. To what extent are the GCC states immune from energy and economic insecurities on the medium to longer terms?

The remaining of this paper is organised as follows: the next section discusses the methodology and methods, section three presents the analysis and discussion, and the conclusion is presented in section four.

2. METHODOLOGY AND METHODS

Given its exploratory and explanatory nature, this study utilises an interpretive methodological approach. According to this approach, reality is constructed and conveyed by the researchers via their own understanding to the meaning of the existing knowledge on energy positions of the GCC States and the factors that necessities deploying RE options. This knowledge exists outside the realisation of the researchers in the literature, however acquired by a relatively extensive review of the existing literature; interpreted and developed by the researchers based on their discursive resources and own knowledge. Our approach depends on discussing the current trends in energy production and export of the GCC States, and the changes to these trends. Critical discussion of changes to the current energy production and demand trends, coupled with the climate change regulations steered the discussion towards the necessity and role of RE. Via the use of secondary data and literature it discusses the potentials, risks and barriers for deploying RE technologies in the GCC member states. Secondary data was collected from different sources, these include OPEC, IMF and BP Statistical Review. Dependents of these sources for data collection was down to the lack of one single source that offers the required data for this study on one hand, and the credibility of these sources on the other hand. Our approach followed a systematic reasoning by using three different, but related, measures for each GCC member state : share of RE to total energy mix, total RE installed capacity and installed RE capacity per capita. These measures allowed us to highlight the position of each member state in terms of its RE deployment. Thereafter, we discussed barriers to utilisation of RE options in GCC member states and highlighted risks associated with deploying RE technologies. This approach allowed us to summarise and conclude the paper in section 4.

3. ANALYSIS AND DISCUSSION

3. 1. Energy consumption and potentials of RE

Gulf Cooperation Council (GCC) economies have occupied a pivotal place in the international energy market particularly in the oil and gas sector. The upward sustainable economic growth of GCC, observed over the past decade has placed them among worldwide, rapidly growing markets. A 5 percent per annum growth in energy consumption has been recorded during 2000s, which was higher than the energy consumption growth of a number of other countries during the same period, including India, Brazil, and China to name a few [6]. The growth of the GCC economies has been associated with an increase in domestic energy consumption (see table 4).

Table 4: GCC Primary energy consumption Million Tones oil equivalent

Year	Kuwait	Qatar	Saudi Arabia	UAE
2009	**31.6**	**24.8**	**196.5**	**82.6**
2010	**34**	**33.3**	**216.1**	**86.2**
2011	**35.4**	**25.7**	**222.2**	**91.5**
2012	**41**	**29.3**	**235.7**	**95.8**
2013	**39.5**	**43.4**	**237.4**	**97.2**
2014	**37.6**	**42.5**	**252.1**	**99.5**
2015	**41.5**	**50.2**	**260.8**	**108.6**
2016	**41.7**	**49.2**	**266.5**	**113.8**

Source: [9]

With the increase in domestic demand for energy, oil and gas production did not cover domestic demand in

some cases. For example, United Arab Emirates (UAE) imports natural gas to cover the gap in this commodity production and local consumption.

Given the above scenario, GCC counties had to devise strategies for natural resource conservation, diversification towards alternative energy mix and improvement in energy efficiency. In fact, some GCC member states have already begun devising policies for their gradual transition for more of an affirm energy future, for example Saudi Arabia and United Arab Emirates (UAE), [8]. Given the geographical location of the GCC states on what is known as 'Global Sunbelt', their wind resources and their daily exposure to the sun have significant RE potentials for these states [4, 8]. Saudi Arabia has been described as being the 'Kingdom of Oil'. Using oil revenues to deploy RE investments may led to Saudi Arabia being nominated as 'Kingdom of Sustainable Energy'. Further research is needed to accurately highlight capacity of RE sources available in Saudi Arabia and the other GCC states.

3. 2. Opportunities for deployment of Renewable energy at GCC member sates

Gulf Countries Cooperation (GCC) states, being the leader in the world energy market, significantly relies on non-renewable sources for energy generation. At the same time, the ground reality suggests that the deserts of Arab Peninsula have a significant potential for renewable energy generation, specifically solar energy.

An ample body of research asserts that there are four main stimuli for expansion of energy production through renewable sources in the GCC [1, 4, 8, 12 -14]. These are:

a. The growth of both population and economic activities in GCC have raised the demand for electricity along with the increasing need for water desalination. However, deploying RE technologies will help to fill the gap between supply and demand in GCC member states.
b. Investment in RE options will lead to the diversification of energy mix and dependence on RE based electricity, therefore will release significant amount of fuel extracted from fossils, which will be exported on relatively profitable terms.
c. The RE sector, though currently passing through its initial stages, is highly promising in GCC states. Especially CSP is an option that will diversify GCC region. In addition, the surplus production might provide an innovative energy exportable commodity.
d. Finally expending RE will decrease the environmental impression of the GCC member states and promote their efforts towards tackling climate change.

The potential opportunities of RE options, if optimally utilized, may fulfil the future regional demand for energy. To this extent, excluding wind power, PV module along with other RE alternative, can produce 150,000 TWh/year [14, 15].

In terms of cost-competitiveness and resource availability, solar energy has gained popularity worldwide. The main factors contributing to the attractiveness of solar energy include; Production potential of solar energy in GCC region, abundances of solar resource along with the decrease in per unit cost of solar electricity and photovoltaic (PV) modules. Being located on the Global Sunbelt, which has some of the world's highest solar irradiances, GCC states have significant potentials of solar energy. Of the total Geographical position covered by Gulf Cooperation Council, about 60% of the surface area is technically suitable for Photovoltaic (PV) module installation and decreasing solar installation by just 1% will add 470 Gigawatts (GW) to the electricity supply capacity of the region [14].

Approximately, this quantity is equal to the preliminary global consumption of energy in 2012 [10], where the studies suggest that the GCC member states had the potential electricity production of 470 TWh/year and their preliminary demand for energy is 4400 TWh/year (BP: Statistical Review of World Energy, 2013; International Energy Agency, 2014). This potential reality has led to many energy sector experts to suggest: extension of renewable energy at larger scale in the GCC states may be useful to meet Middle East energy demand, and in the long term, they will also be in the position of exporting renewable energy to other regions [16, 17].

The transition from non-renewable will usually take time and is confronted by barriers. There exists some variation in the deployment policies regarding renewable energy in GCC six-member states, which are explicitly categorised as "leaders" and "laggards" regarding renewable energy adoption. GCC member economies have higher prospective for different types of renewable energy generation, with particular advantage in solar energy. In order to meet total demand of the country, Saudi Arabia has to utilize less than 0.2 % of its total land area for the installation of photovoltaic module [18]. Oman has a high potential for producing energy from installation of wind turbines, especially during the period from April to September, but unfortunately, yet no large-scale turbine has been connected to the grid [19]. It was only in 2014 when Masdar Initiative of Abu Dhabi announced that they would build first wind farm of utility-scale, which will have a potential capacity of 50 Megawatts energy generation ability in Oman [3].

Despite the fact that they have significantly similar political and economic systems, and have great potential for generating energy form renewable sources, in terms of renewable energy generation, GCC states are subject to remarkable differences in technologies deployment. Three indicators are utilized in the current work to distinguish "leaders" from "laggards".

3. 3. Share of RE of total energy mix

In order to illustrate the share of RE to the total energy mix in the GCC states and to provide an indicator of the importance of RE to the member state the authors used a ratio of RE to total energy mix a first indicator in this study [4, 5]. In doing so, total renewable installed energy capacity was divided by total energy capacity. Total renewable installed energy capacity is the sum of energy produced by photovoltaic module, biomass, energy

produce from waste, and energy produced through wind turbines in. unit of measurements is Megawatts (MW).

GCC states have different RE installed capacity and different shares of RE options in the total energy mix [15]. Table 5 shows that none of the GCC states has a significant level of RE utilisation yet. Using the RE to total energy mix indicator it can be seen that currently two countries (UAE and Qatar) termed as leaders' concentrations are approximately equal to 1% and an average value of 0.55%, where Bahrain, who has the highest share of 0.14%, is marked as a laggards.

Table 5: Variation based on adopted renewable technologies

	Leaders		Laggards			
Year	2013	2012	2013	2012	2013	2012
	UAE	Qatar	SA	Bahrain	Kuwait	Oman
% Share of RE	0.57	0.52	0.01	0.14	0.12	0.01
Installed RE capacity (MW)	134	41.2	19	5.5	1.8	0.7
Installed RE per capita (Watts/Person)	14.41	18.73	0.63	5	0.15	0.18

Source: adopted from [3]

It is important to explain here that leaders understand fully the need to innovate and advance their work, therefore they prioritize innovation and enhancement to fit the stage of business development necessitates. However, the laggards refers to the institutions and/or individuals that do not recognise the stage of business development and its necessities therefore are do not know why they should innovate. Laggards cannot see changes happening and have a classical view of business management.

3. 4. Installed RE capacity (MW)

The total volume of installed RE capacities of GCC states has been utilized as second indicator for the purpose of comparison between the States [5]. This indicator reflects the future vision of the member state of the importance of RE. Furthermore, it indicates the vision of the member state in terms of the current business changes and the necessary requirements to implement innovative mechanisms and prioritize these in accordance to the stage of business development.

The volume of total RE installed capacity is a reasonable indicator of a given state's willingness to extend the contribution of RE to the total energy mix of that particular state. In terms of the first indicator, the related RE to total energy mix figures in Table 5 suggest that, at present, the share of energy produced by means of renewable sources is at a negligible level. With regard to the second indicator, the installed RE capacity indicator, UAE has been ranked as the leader, as can produce about 134 Megawatts (MW) through renewable sources. Qatar has the second position on this indicator with a total installed capacity of 41.2 MW. The remaining four GCC states are considered as laggards on this indicator, this is because their installed capacity is not high enough to classify them as leaders and do not reflect the importance of RE for the current and future stages of business development locally and international. In terms of absolute deployed RE, Saudi Arabia seems to be closer to becoming a leader. However, due to the relatively low RE production per capita, Saudi Arabia falls significantly behind and has thus not been placed in the leaders [3]. Similarly, Oman is not generating a significant amount of RE either. Both percentage of RE to total energy mix and installed RE capacity are very low: 0.01 and 0.7 respectively. This suggests that Oman has to learn from other countries' and to enhance its RE deployments.

Whilst the differences in installed capacities and share of RE to total energy mix seem proportionate given the size and populations differences among the GCC states , the overall installed RE capacity seems relatively small in comparison to domestic energy demands. In order to meet both domestic energy demands and the revenue share, that might be lost due to decrease in future oil and gas exports, of the GCC states installed RE capacities need to be significantly expanded.

3. 5. Installed RE per capita (Watts/Person)

Both first and second indicators are important, but equally important is to see how much each individual person at GCC member states benefit from the total installed capacity. Therefore, installed RE capacity per capita is the third indicator used in this study [8]. At many dimensions, GCC member states share common characteristics, but demographically differ significantly. In accordance with this indicator, Qatar and UAE, as shown in Table 5 above, are the two leaders in the region as they have 18.73 and 14.41 Watts/person respectively. Despite the fact that Saudi Arabia has a significantly high potential for solar energy, in terms of the third indicator, it still falls behind Qatar and UAE. Total solar radian per year in Saudi Arabia is estimated as more than 2.0 MWH/m2 [20], and has 19 MW generation capacity through solar photovoltaic module, thus further progression must be made before it completely exploits its prospective [3].

The above discussion allows us to argue that consequent to the larger size of the desert, opportunity for generating energy through deploying RE options is significant in GCC member states [14, 21]. Furthermore, given that electricity demand in GCC states reaches its peak in summer, due to the extensive use of air-conditioners, solar energy seems a best candidate to meet this increase in electricity demand. This suggests that GCC states have potential and opportunities of utilising solar, and other alternative energy options. However, there are a number of challenges that face deploying RE in GCC states; these are discussed next.

3. 6. Barriers of deploying RE options

Transition to RE in the GCC member states faces a number of barriers. Barriers differ among the region for a number of reasons: 1- the type of non-renewable source used for electricity generation, 2- whether solar energy is well utilised and preferred over other RE options, 3- whether RE is decentralised in the GCC member state, and 4- the cost effectiveness of the RE technologies.

- The prominent factor in determining any deployment of a modern and new technology is its cost compared to existing technologies. Decision about the deployment of RE technology

has continuously confronted more problems than most of the other existing technologies. This is mainly because of the long lifecycles of RE technologies on one hand and the relatively long payback period that is needed to recover the deployment high initial installation cost on the other. Previous studies suggest that for GCC states the lifecycle cost could be lower than those of other regions [22 – 26]. But to date, the GCC states have not utilized the available RE sources efficiently. The reason for which is the GCC member states energy market structure, specifically the way energy is priced domestically and subsidized. The below factors characterise the political economy of energy prices in the GCC member states. Availability of conventional sources of energy in the form of oil and gas on a large scale;

- The significant role that has been played in the economic development of the GCC region by the wealth generated through hydrocarbon in most of the GCC member states since 1960s; and finally
- The implicit social contract in the GCC member states. This refers to where it has been considered that it is the government's responsibility to provide electricity to the public for no charge or at a reduced price, which constitutes only a small fraction of the generation cost.

These factors collectively are hindering utilization of RE technologies in the GCC states. However, awareness of energy security and climate change issues seems to be low in GCC states [8]. This is an additional factor in fact does not allow conservation of energy in GCC, states, thus contributes towards increased energy consumption and wastes.

Consequently, prices of energy in GCC states differ across various fuel options. In general, these prices are relatively low and this is a problem facing uptake of renewable energy investments. This problem extends to involve the implicit and explicit government payments to subsidise fossil fuels products provided directly to the consumers [27]. It is recognized that governments of GCC states implemented high energy subsidy rates for a number of reasons. 1- Being oil and gas rich nations, expanding access to energy by local citizens, particularly those who are financially less able, is one of the main welfare-driven reasons for such subsidies. 2- In order to foster industrial growth GCC states implemented special energy subsidies to the industrial sectors. 3- Political and social justice reasons where parts of the oil and gas revenues incurred to the government can be shared with the citizens.

As a practical example, in 2012, in one of the leading GCC economy i.e. Saudi Arabia's the domestic selling price for electricity calculated on the basis of its assumed input costs, taking place at $0.013/Kilowatt/hour for the housing, while for the commercial users it was $0.036/kilowatt [27]. The Saudi Electricity and Co-generation Regularity Authority (ECRA) confirms that none of the prices reflect the actual production cost [28]. Therefore, despite the fact that cost of deploying RE sources has fallen significantly over the previous years, still it is hard to propose a commercially eye-catching opportunity.

It is widely accepted that with globalisation and international/regional integration, energy generation through renewable sources have increasingly become less costly and have gained competitive advantage, but many of these technologies have not yet passed through the stage of full commercialisation in GCC states.

Lilliestam and Patt [10] suggested that a significant barrier in utilizing RE technologies in GCC states is the deficiency of proper support framework for renewables, and if pooled with fossil oil and energy utility subsidisations, can results in gainful business today. This barrier has been mentioned as "super-barrier" in the way of preventing profitable RE related investments in GCC states [10]. Therefore, there is a prompt need for devising policies to create incentives in the GCC for RE sources and to overcome the potential commercial risks faced by investors and lenders.

Inefficiencies in bureaucracy and red tape culture are both barrier and risk, which are hindering potentially profitable and attractive investment opportunities. Furthermore, lack of awareness among potential investors regarding existing opportunities has been identified amongst thoughtful but easy-to-solve obstacles [10]. Finally, corruption has not been mentioned as a major barrier in the way of deploying renewable energy in GCC member states in the literature about the topic is under-consideration.

In summary, five proximate barriers have been identified.

1. Due the present structure of the market for energy in the GCC member states, where fossil fuel is heavily subsidized, along with imperfect market structure which makes entry difficult to the energy market. The market for RE does not function well [1, 13, 21].
2. Lack of a suitable investment framework and support policies and mechanisms for RE production; grid connectivity and financial support are also worth mentioning [21].
3. Significant resistance being exercised by authorities working in fossil fuel industry [21, 29, 30].
4. Lack of technical know-how of renewables [1, 30].
5. Lack of awareness of key issues such as energy security, energy conservation, green energy, economic securities and climate change.

3. 7. Risks involve in deploying RE

Project management literature offers a variety of definitions for risk and barriers and differentiates between these two concepts. Risk reflects a situation where a damage or loss may occur and which is caused by internal or external exposures, and which may be avoided via pre-emptive actions. Risk is different from barriers as this last represent obstacles and difficulties that may face certain projects. Contrary to risk, these barriers do not necessarily lead to loss and damage occurrence as these can be prevented. Risk and barriers can be industry, company or location specific and there may not be a one-size-fits all

policy to deal with risk and barriers. However, earlier risk analysis and barriers identification coupled with response-planning techniques should eliminate, or at least minimised, the negative impact of risk and barriers. Whilst identifying risks and barriers and policies and techniques to tackle these is an important subject, this falls beyond the merit of this article.

A number of risk factors impact the utilisation of RE options in the GCC states. These are: political risk, financial risk, technological risk, institutional risk, operational risk, construction risk, and human capacity risk. Unfortunately, the non-availability of desired data for GCC member states makes it difficult to analyse all of the factors.

Lilliestam and Patt [10], in a meta-analysis conducted for GCC states highlighted two major risks to the deployment of RE technologies. They argue that those who are concerned with the deployment of RE see neither political nor public opinion risks towards the deployment of renewables [10]. Accounting for these risks allows monitoring and minimizing them in one way or another thus investments in RE options becomes viable. Lilliestam, and Patt [10] concluded that RE deployment faces a number of risks, these are depicted in Figure 2.

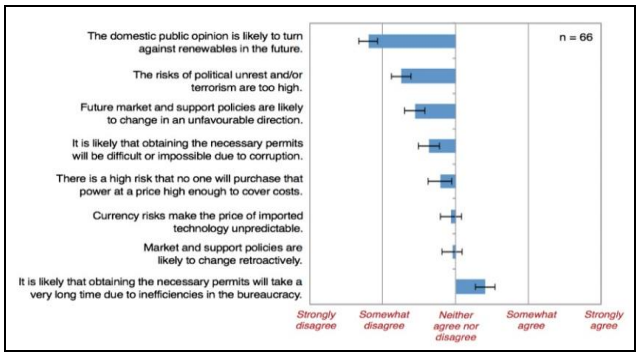

Figure 2: GCC Potential Business Risks to RE Technologies
Source: Adapted from [10]

Figure 2 reveals that, the perception of the general public in GCC region is that; politicians are not serious about the future change for development. With regard to off-take risk, in the absence of follow-up schemes, there is less disagreement among experienced individuals on facing this risk as it is considered as a common sense.

The one significant risk Lilliestam and Patt [10] is one that emerged from the meta-analysis of GCC states is the risk related to bureaucratic processing and delays. The same hold true in case of North Africa: culture of red tapes is simultaneously a severe risk and a significant obstacle for business and investment opportunities. In case of GCC states, political uncertainty and instability is not as significant a risk to investment in renewables, contrary to the case of GCC states these were found as serious risk in North Africa to investments in RE options. Lilliestam and Patt [10] analysis suggests that unpredictable policies are problematic in some GCC member economies, however generally speaking investment environment is rather stable.

4. CONCLUSION

The current work is carried out to analyse the current situation of RE investments in the GCC member states. This necessities identifying barriers, risk, and opportunities for the expansion of RE sources in GCC member states s. Dependence on the interpretive approach and utilisation of secondary data facilitated the conduct of this research study.

We found that two short-term barriers face the successful deployment of RE options up-to their potential level: the GCC member states subsidisation system of fossil fuel and electricity along with the absence of investment framework and a follow-up schemes, make it hard to invest in RE technologies in GCC member states. If these subsides are removed the domestic price of fossil fuel energy will be priced on its full cost, this will make investment in RE options comparatively more viable. This in turn will lead to further economic development of GCC member states. Secondly, bureaucracy is a real obstacle in GCC member states. Bureaucracy leads to delays and cost overrunning and may further lead to stopping the whole project. Bureaucracy will not help potential and prospective investors to obtain the necessary investment permissions in time.

Based on the three indicators (discussed in sections 3.4, 3.5 and 3.5) it is observed that in the GCC member states, United Arab Emirates and Qatar are the two leaders, where Saudi Arabia, Bahrain, Oman, and Kuwait are still trying to push their efforts towards meeting future challenges in RE. However, we find some indicators that these countries are trying to invest in RE options.

Given the assumptions of the 'Peak Oil Theory', the association between oil and gas revenues and economic security of the GCC states and the importance of RE in tackling climate change it is concluded that: GCC member states may face energy and economic insecurities in the medium to longer terms. This is because when oil and gas resources physically expire from these states, or when demand on these resources slow down by importing nations, due to climate change, GCC states will face an energy security problem on the demand side and this will result in severe economic insecurities for these countries. Therefore, it is strongly advisable that these states use oil and gas revenues for investing heavily in RE options. Suitable and encouraging investment framework and supporting energy policies all need to be in place so that private and foreign direct investments in RE options continues on a faster speed. Given the financial resources available to the GCC states and their geographical location, it is expected that an ideal utilisation of RE options will market these states as the empire of sustainable and green energy.

This study highlights the current energy position of GCC states and changes to this position. The study explores challenges, risks and opportunities that come with investments in RE options in GCC member states Further research is required to quantify the opportunities of investments of RE options in the GCC states and to identify the opportunity cost of delaying such investments. This requires a multi-disciplinary study that utilizes engineering and business-related research experience.

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