Transitioning to renewable energy in Saudi Arabia

A multi-level perspective analysis of the Saudi renewable energy policies

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MA Thesis in Middle East and North Africa Studies at the Department of Culture and Oriental Languages

(60 credits)

UNIVERSITY OF OSLO

Spring 2017

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2017

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http://www.duo.uio.no/

Print: private/Weberg Printshop.

Abstract

This thesis has assessed the national political context and factors shaping Saudi Arabia's renewable energy policies through a multi-level perspective analysis. Key barriers and drivers to the implementation of renewable energy has been identified an.

Unsustainable domestic energy consumption is eating into oil reserves that could have been exported, thus incurring a huge opportunity cost and economic burden. If left unchecked, domestic energy consumption will outgrow domestic energy generation capacity, and thus force Saudi Arabia to import oil in the near future. Domestic energy consumption is further creating huge GHG emissions, contributing to climate change and environmental damage which is predicted to render Saudi Arabia uninhabitable in few years. The rationale to become more sustainable is apparent and the Saudi government has consequently decided to implement renewable energy into their energy mix, envisioning a green and clean energy future. There are however multiple barriers to the spread of renewables in the country, as seen in the system of double subsidies which locks in the oil-based energy system and locks out renewable energy. Missing legal and regulatory framework deters investors and impedes funding. A weak innovation culture, and lack of a skilled workforce and knowledge base hinders a successful development, manufacturing and implementation process, while the job creation potential is a promising, but under exploited opportunity to reduce the huge unemployment problem in Saudi Arabia. Governmental policy documents and official discourse show an awareness and intent to solve these problems however, with concrete initiatives aimed at increasing feasibility of renewable energy deployment. The political system constitutes a bureaucratic barrier to a wide-spread implementation, but so-called 'islands of efficiency' like the national oil company Saudi Aramco and ambitious senior royal figures can drive the development. The short-term governance effect of implementing renewables might be small, but in the long-term, Saudi Arabia could experience changes in the political balance and the state-society relations as it will be increasingly difficult to reproduce the rentier state through renewable energy.

Acknowledgements

A number of people should be thanked for their contribution to the process of writing this thesis.

First of all I would like to thank my supervisor and professor in several courses during my MA degree, prof. Brynjar Lia. I would like to thank him for introducing me to the very interesting developments of renewable energy in the Middle East, and for inspiring me to choose this subject for my thesis. And also for insightful guidance and feedback on my manuscript. I would also like to thank Berit Thorbjørnsrud for moral support in the darkest of hours, and for interesting courses.

I would also like to thank all my fellow students for contributing to interesting lectures and conversations throughout my time at UiO. A special thanks goes to Shorok for vital moral support, good laughs and for being by my side everyday, and also to Marte and Kjerstin for constructive feedback, pep talks and invaluable help - I would not have made it without you! My friend Erika also deserves a special thanks for being a very supportive friend.

Last, but not least, I'm incredibly grateful to my family for endless support and for believing in me throughout the process. Thank you so much mamma, pappa, mormor and Erik, it means the world to me. I would also like to thank Erik and Iselinn for proof-reading.

All inaccuracies and mistakes in this thesis are entirely my own.

Abbreviations

CSP	Concentrated Solar Power
ECRA	Electricity and Co-Generation Regulatory Authority
EV	Electric Vehicles
FIT	Feed-in-tariff
GCC	The Gulf Cooperation Council
IRENA	The International Renewable Energy Agency
KACARE	King Abdullah City for Atomic and Renewable Energy
KACST	King Abdulaziz City for Science and Technology
KAUST	King Abdullah University of Science and Technology
MEIM	The Ministry of Energy, Industry and Mineral Resources
MLP	The Multi-Level Perspective
MENA	The Middle East and North Africa
NREP	The National Renewable Energy Program
PV	Photovoltaics
REPDO	The Renewable Energy Project Development Office
RES	Renewable energy Sources
RET	Renewable energy Technology
SAREIF	The Saudi Arabia Renewable Energy Investment Forum
SEC	The Saudi Electricity Company
SGBF	Saudi Green Building Forum

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1 Introduction

To many countries in the Middle East and North Africa (MENA) region, and particularly those of the Gulf Cooperation Council (GCC), hydrocarbon revenues derived from exports have been pivotal in development and accruing of wealth, enabling them to "build modern infrastructure, sustain high levels of welfare for their nationals, and exert regional and global influence through sovereign wealth and investments"[1].

This especially holds true for Saudi Arabia, the quintessential oil state with one of the world's largest proven oil reserves and a unique role as the world's most important swing producer of oil, giving the country great power to influence oil prices. Decades of extensive oil production and exports have secured the country astronomical sovereign wealth which has been crucial in shaping its socioeconomic development and political economy. Constituting a foundation of the kingdom's domestic stability and the regime's survival, oil revenues have facilitated the "ruling bargain" - a primarily top-down social contract where the state distributes extensive welfare services and benefits in return for the people's political acquiescence[2].

An important feature of the ruling bargain is heavy subsidies of water, fuel and electricity, which have created "an illusion of abundance", in turn creating extremely wasteful consumer habits and an enormous domestic energy demand. Furthermore, the last decade's industrial and economic growth has also contributed to an increasing domestic energy demand. Domestic consumption is eating away at oil reserves that otherwise could have been exported, thereby creating a huge opportunity cost of oil exports foregone. This is taking a heavy toll on the budget for a country whose "petroleum sector accounts for roughly 87% of budget revenues, 42% of GDP, and 90% of export earnings."[3]

Oil consumption per capita in Saudi Arabia is today one of the highest in the world, with estimates predicting a growth rate of 5,7 percent annually.[4] A Citigroup report predicts that

[1]Mohamed Abdel Raouf and Mari Luomi, eds., *The Green Economy in the Gulf* (New York: Routledge, 2016), 3.
[2] Center for International and Regional Studies, "The Evolving Ruling Bargain in the Middle East: Working Group Summary Report," (Qatar: Georgetown University School of Foreign Service in Qatar, 2013).
[3] Forbes, "Saudi Arabia," Forbes, https://www.forbes.com/places/saudi-arabia/.
[4] Dermot Gately, Nourah Al-Yousef, and Hamad MH Al-Sheikh, "The Rapid Growth of Domestic Oil Consumption in Saudi Arabia and the Opportunity Cost of Oil Exports Foregone," *Energy Policy* 47 (2012). Dramatic slowdown in annual growth rate is also predicted by the International Energy Agency (IEA), US Department of Energy (DOE) and British Petroleum (BP). This will be further discussed later in the thesis.

Saudi Arabia could even become a net importer of oil by 2030.[5] The likelihood of the realization of this gloomy forecast might be low but it points regardless to Saudi Arabia's pressing need to reduce domestic oil consumption and find alternative solutions to meet its domestic energy demand.

Another problem caused by Saudi Arabia's high energy consumption and production of oil is the huge carbon footprints it leaves. Saudi Arabia is one of the top ranking countries when it comes to CO2 emissions and are responsible for 1, 2 percent of global emissions.[6] According to the Climate Action Tracker, Saudi Arabia's contribution to the international climate talks' goal of keeping global warming below two degrees Celsius is inadequate and, certainly not in line with the Paris Agreement's more stringent limit of 1, 5°C. On the contrary, if most countries followed Saudi Arabia's approach, global warming would exceed 3–4°C.[7]

To Saudi Arabia the problem of climate change is twofold: Climate change itself has disastrous consequences for the environment in Saudi Arabia and the greater MENA region, causing increasing sea levels, water scarcity, extreme heat, desertification, causing food insecurity – in many ways making life for the local population exceedingly difficult, if not impossible, potentially leading to mass migration and social unrest. On the other hand climate change and the environmentally harmful effects of CO2 emissions are widely recognized and the unsustainable nature of the oil industry has attracted growing attention from the international community. International climate change mitigation efforts have been increasingly successful, exemplified at the Paris climate conference (COP21), where "195 countries adopted the first-ever universal, legally binding global climate deal" – The Paris agreement.[8] Globally the need for a green shift has been voiced and an energy transition reducing dependence on fossil fuels is underway as witnessed by the huge increases in investments in renewables over the past few years. The successful implementation of measures aiming to reduce the use of fossil fuel and improving energy efficiency will have serious consequences for Saudi Arabia's export revenues, and possibly also for domestic stability if they don't find other significant sources of income.

[5] Maya Shwayder, "Saudi Arabia May Run out of Oil by 2030: Citigroup," *International Business Times* 09.05.2012
[6] Andrea Barolini, "Saudi Arabia Pledges to Reduce Co2 Emissions, Investing in Oil," *Lifegate* 12.11.2015.
[7] Climate Action Tracker, "Saudi Arabia," Climate Action Tracker, http://climateactiontracker.org/countries/saudiarabia.html.
[8] European Commission, "Paris Agreement," European Commission, https://ec.europa.eu/clima/policies/international/negotiations/paris_en.

The status quo of Saudi Arabia's current dependence on oil and oil revenues is not sustainable. If left unchecked, the development will further stress the environment and the climate, as well as the political economy, possibly resulting in social unrest and political instability. Domestic instability in Saudi Arabia could have far-reaching consequences, causing economic, political and energy-related challenges both regionally and globally.

Far from being oblivious to the uncertain future of oil and the need to adjust to the challenges posed by climate change, the Saudi regime has launched the Saudi Vision 2030, a grand plan aiming to reduce the kingdom's dependence on oil and diversify their economy away from oil. In January 2017, Saudi Arabia launched its first competitive global tender for utility-scale solar power projects, and last year a new 'super-ministry', the Energy, Industry & Mineral Resources, was created to streamline decision making. A top-level executive in the renewable energy industry describes the latest efforts as "the highest level commitment to renewable energy ever seen from the Kingdom."[9] Additionally, they have implemented energy efficiency measures, and announcements have been made regarding plans for development of renewable energy projects. On the prospects of renewable energy, and solar energy in particular, the then minister of oil Ali al-Naimi, stated in 2009 that "Saudi Arabia aspires to export as much solar energy in the future as it exports oil now."[10] Furthermore, in 2012 the government announced plans for a $109 billion in renewable energy investments aimed at creating a solar industry that would generate a third of the nation's electricity by 2032.[11] These ambitious plans are yet to be implemented, however. The Saudi Kingdom has also committed to the COP21 and submitted their Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention of Climate Change (UNFCCC). These recent announcements and efforts are signs of a more serious approach from the Saudi government of moving in a sustainable direction.

However, previous ambitious plans to diversify away from oil and deploy renewable energy have been slow to materialize, or have not been executed at all in Saudi Arabia. In 2015, it transpired that the Kingdom was "delaying by eight years its target to complete clean-energy program including $109 billion in solar power", justifying the delays by the need to carefully

[9] Jeremy Luedi, "Under the Radar: Are You Ready for the Middle East's Solar Gold Rush?," *Global Risk Insights* 10.04.2017.
[10] Asma Alsharif, "Kaust Research to Focus on Solar Energy: Al-Naimi," *Arab News* 23.09.2009.
[11] Eco-Business, "Saudi Arabia Plans $109 Billion Boost for Solar Power " *Eco-Business* 11.05.2012.

"assess what technologies it will use" [12] In 2016, Saudi officials again postponed the implementation of renewable energy projects, suggesting instead to increase reliance on natural gas and reduce targets for renewables in the power generation from 50 to 10 percent. [13]

1.1 Research question

Despite Saudi Arabia's goal of becoming less dependent on oil and to diversify their economy away from this commodity, oil is still vital to Saudi Arabia's political economy and plans for the future oil production and exports are being made. There are also multiple drivers and benefits of transitioning to renewable energy in Saudi Arabia, as well as obvious knowledge[14] and intent to exploit these opportunities by the Saudi government. Considering the back-and-forth regarding the renewable energy announcements, the slow or missing action on the ground when it comes to realizing these plans, as well as the current and future plans for oil, this begs the question: Does Saudi Arabia really have a renewable energy policy? Or are their plans just deceptive examples of greenwashing[15] as some claim?

This thesis will seek to answer the following research questions: Does Saudi Arabia have a renewable energy policy, and if yes, how should these policies be understood? What shapes Saudi policies in this vital area?

A transition to renewable energy will be a complex process involving structural changes and a range of Saudi institutions. Past attempt and plans have been made, but were not successfully implemented. In order to answer the broader research question the thesis will aim to answer these sub questions: Why have the deadlines of renewable energy deployment been postponed, the renewable goals changed and planned investments discarded? How does the nature of the Saudi bureaucracy affect the feasibility of such a transition? Can the new deputy crown prince Mohammed bin Salman drive the transition? What are the most important

[12] Bloomberg, "Saudi Arabia Delays $109 Billion Solar Plant by 8 Years," Argaam, http://www.argaam.com/en/article/articledetail/id/368571.
[13] Wael; Nereim Mahdi, Vivian, "Saudi Arabia Scales Back Renewable Energy Goal to Favor Gas," World Oil, http://www.worldoil.com/news/2016/6/7/saudi-arabia-scales-back-renewable-energy-goal-to-favor-gas.
[14] Since the 1970s Saudi Arabia has been a frontrunner in R&D in renewable energy in the region. See: Saleh H Alawaji, "Evaluation of Solar Energy Research and Its Applications in Saudi Arabia—20 Years of Experience," *Renewable and Sustainable Energy Reviews* 5, no. 1 (2001).
[15] "Green washing is when a company, government or other group promotes green-based environmental initiatives or images but actually operates in a way that is damaging to the environment or in an opposite manner to the goal of the announced initiatives." Investopedia, "Greenwashing," http://www.investopedia.com/terms/g/greenwashing.asp.

barriers for implementing renewable energy policies in Saudi Arabia? And what is the institutional and political feasibility of a transition to renewable energy?

A study of the renewable energy policies in Saudi Arabia is highly relevant as their future energy trajectory will have wide-reaching effects, not only within the realms of the Saudi kingdom, but also globally. Saudi oil production has great impact on the global oil market and thus international economy. Furthermore, mitigating climate change is important and Saudi Arabia must reduce their oil consumption and production, and transition to sustainable energy sources. It is therefore important to obtain and understanding of the different aspects that shape Saudi Arabia's renewable energy policies and their ability to implement these policies.

This thesis seeks to explore and analyze empirical material on Saudi renewable energy policies, using an analytical perspective, the Multi-Level Perspective (MLP), as a tool to guide the structure of the analysis and the choice of analytical dimensions, and to conceptualize the discussion of barriers.

The MLP is an analytical framework which suggests that in order to understand technology transitions, (in this case the transition to renewable energy), developments need to be understood on three levels.[16] It is designed to encompass all aspects and relevant factors or variables affecting an energy system and transition and to enable a comprehensive analysis of such a transition. First developed by authors such as Kemp, Loorbach, Geels and others, it was applied to a western context and developed countries. However Dennis Kumetat has further developed the MLP for analysis of resource-rich Arab states in his PhD dissertation, analyzing two cases, Algeria and UAE. The levels and factors which constitute the MLP will be presented in the description of the MLP in the following section.

1.2 Previous literature

Quite a lot of scholarly attention has been devoted to the subject of societal transitions and how they emerge, progress and what constitutes barriers and drivers for such transitions. There exists no consensus, however, on which barriers are best suited to measure what drives and hinders such a transition. The lion's share of this research has focused on energy transitions in a Western context and to my knowledge Dennis Kumetat's study on renewable

[16] Dennis Kumetat, "Managing the Transition: An Analysis of Renewable Energy Policies in Resource-Rich Arab States with a Comparative Focus on the United Arab Emirates and Algeria " (The London School of Economics and Political Science 2012), 23.

energy policies in hydrocarbon-rich Arab states is the most substantial academic effort to study energy transitions in the Middle East. A slightly more limited study on renewable energy in Saudi Arabia has also provided interesting findings that will inform this thesis and will be presented below. Most of the other studies pertaining to renewable energy in Saudi Arabia are of a scientific and technical character, or focus on feasibility perspectives. To my knowledge, there exist no other substantial academic studies on renewable energy policies in Saudi Arabia and my aim is to contribute to fill this gap in the literature.

Rural electrification through solar panels and local empowerment, the focus of one type of studies on energy in the middle east– also the focus for studies of other Asian countries. These studies focus on local communities and the impact of implementing renewable energy into these social configurations. In addition to providing off-grid electricity, the RET has sometimes led to a redistribution of power in traditional Bedouin societies and empowerment of women as seen in the case of The Solar Mamas in Jordan, etc. The results from such studies are highly relevant for the research on development and empowerment, but are not transferable to this study of systemic changes to the national power grid and energy policy.

One of the most relevant studies influencing this thesis is an article from 2011 entitled *An empirical insight into the functionality of emerging sustainable innovation systems: the case of renewable energy in oil-rich Saudi Arabia* by Yasser M. Al-Saleh in which he assesses the potential establishment of a renewable energy industry in Saudi Arabia.[17] His research is based on 15 qualitative interviews and he uses theoretical concepts related to the functions of innovation systems to examine what kind of obstacles were hindering a spread of RE in Saudi Arabia. Drawing on insights from innovation studies, he analyzes his case by looking at seven key processes or 'functions' which could also be described as "the most important factors that arguably could influence the development and widespread diffusion of the technology under consideration."[18] These functions or factors and their main points are:

Function 1. Entrepreneurial activities: This function focuses on the role of entrepreneurial activity, both from new entrepreneurs and incumbent companies, which need to contribute to developments and bring the new system to the market. Referring to Bergek et al. in Al-Saleh,

[17] Yasser M Al-Saleh, "An Empirical Insight into the Functionality of Emerging Sustainable Innovation Systems: The Case of Renewable Energy in Oil-Rich Saudi Arabia," *International Journal of Transitions and Innovation Systems* 1, no. 3 (2011).
[18] Ibid.

the success of a new system is largely dependent on their activities.[19] This function explains that such 'bottom-up' activity is what builds a new system.[20]

Function 2. Knowledge development (learning): As the title suggests, this function focuses on knowledge and learning and referring to Edquist in Al-Saleh, the analysis of the knowledge base and learning aspect connected to a system is important and this entails "systems of formal research and development (R&D), patents, education and training, as well as the processes of learning that are embedded in routine economic activities."[21]

Function 3. Knowledge diffusion through networks: This function points to the importance of widely shared and distributed knowledge, both of renewable energy technologies, but also in the form of awareness on challenges related to energy and the environment.[22]

Function 4. Guidance for the search: Referring to Hekkert et al. in Al-Saleh, this function entails the activities within the system "that can positively affect the visibility and clarity of specific wants among technology users"[23] and is exemplified by targets for renewable energy set by the government. Such targets can influence the other functions and create momentum for diffusion.

Function 5. Market formation: As new technologies can be vulnerable to the competition of incumbent technologies, it can be necessary and helpful to create protected spaces in which the technologies can mature, for instance through temporary advantages or niches like favorable tax regimes or special markets where the technology can be applied.[24]

Function 6. Resource mobilization: Resources that need to be mobilized in order for a successful development of the system is finance, competence capital or human resources and assets like services and network infrastructure.[25] This includes taking advantage of the abundance of solar energy in Saudi Arabia.

Function 7. Creation of legitimacy: It can be difficult for new technologies to become widespread because of the degree of entrenchment in society of the incumbent technology. Parties with vested interest will likely oppose a new technology and it is therefore important

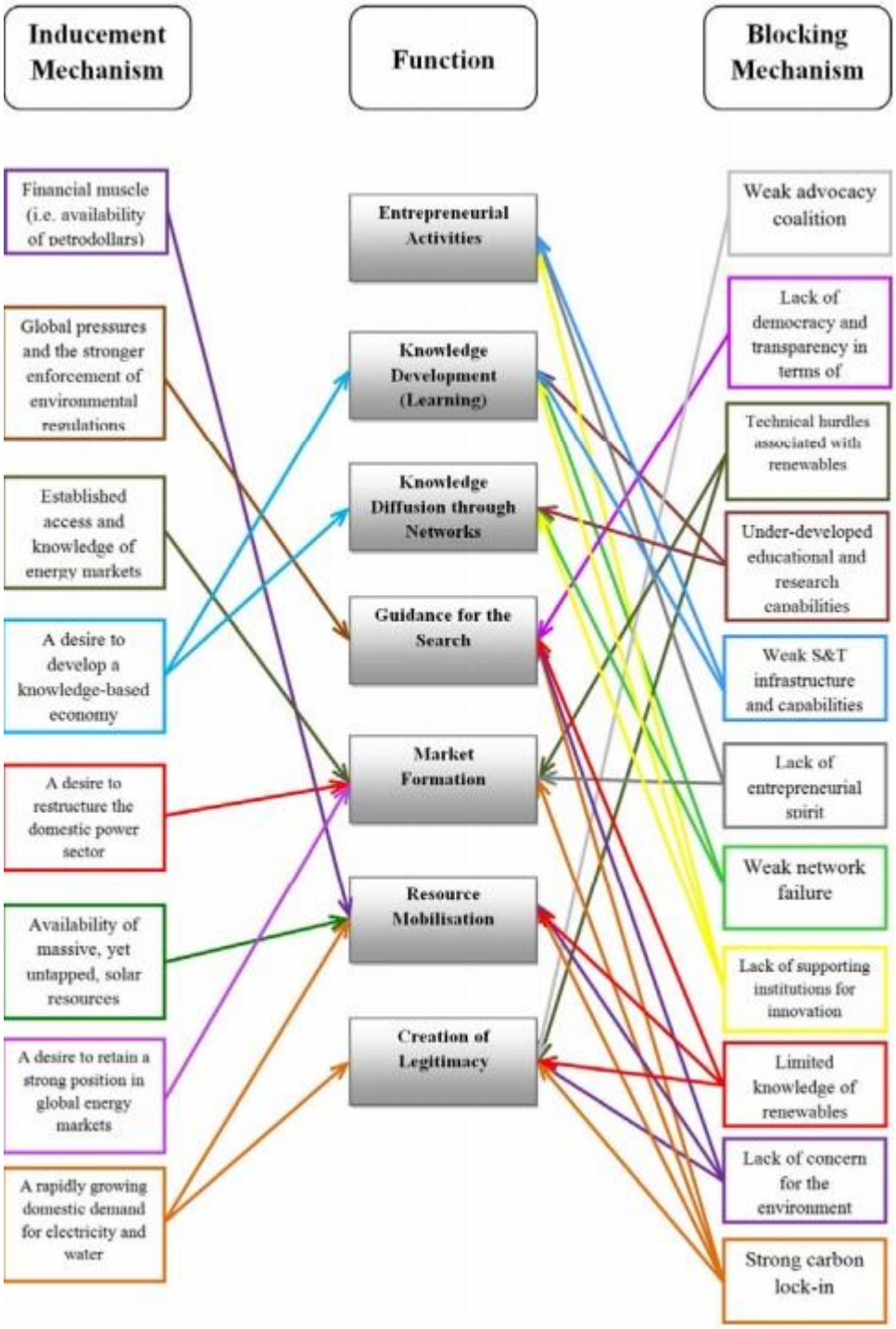
[19] Ibid., 305.
[20] Ibid.
[21] Ibid., 306.
[22] Ibid.
[23] Ibid.
[24] Ibid.
[25] Ibid., 307.

to have interest groups working against these opposing forces to create legitimacy for the new technology. Referring to Sabatier in Al-Saleh, such advocacy coalitions are made up of "actors sharing a specific set of beliefs who seek to influence the political agenda in line with those beliefs, in competition with other coalitions."[26]

The functions described above all influence each other and are not independent, and as they develop and interact they gain momentum and can trigger a diffusion of an emerging technology. In order for an emerging system like a renewable energy system to diffuse and perform well, these factors must be in operation.[27] In his article Al-Saleh analyzes the Saudi Arabian context through these factors and finds several of the factors to be under-developed, or acting as barriers to the spread of renewable energy technology. His main findings are displayed in figure X below, which shows barriers and drivers (inducing mechanisms), as well as the interactions between them and the functions analyzed in the article:

[26] Ibid.
[27] Ibid.

Figure 1: The most important inducement and blocking mechanisms in the case of renewable energy in Saudi Arabia



Source: Al-Saleh[28]

Al-Saleh identifies the following four factors as the most significant barriers: "'strong carbon lock-in', 'lack of concern for the environment', 'limited knowledge of renewables among

[28] Ibid., 315.

Saudi leadership and population' and 'lack of supporting institutions for innovation (e.g., intellectual property rights and standards)'."[29] In connection with the carbon lock-in factor the large subsidies of fossil fuel-based electricity is highlighted. Other barriers identified are, in fifth place, 'weak network failure', and further: "lack of entrepreneurial spirit, weak S&T infrastructure and capabilities, underdeveloped educational and research capabilities, technical hurdles associated with renewables (mainly intermittency and high costs), lack of democracy and transparency in terms of policymaking and weak advocacy coalition."[30]

Based on his findings Al-Saleh suggests these policy-recommendations to counter the barriers and strengthen weak inducement mechanisms:

> political buy-in of renewables; phasing out of subsidies for fossil fuel-based electricity generation; enhancing knowledge of renewables as well as increasing awareness with of energy and environmental concerns; introducing financial incentives to promote sustainable energy applications; allocating sufficient funds to support the development of renewable energy technologies; restructuring the Saudi power market; enhancing a collaborative culture and entrepreneurial activities among various stakeholders within the Saudi energy SI.[31]

The study does provide valuable insights into which drivers and barriers were affecting a transition to renewable energy technologies in Saudi Arabia at the time of his fieldwork in 2008-2009. However, this study is already 8-9 years old and since then, there have been several important developments in the field of renewable energy in Saudi Arabia– especially light of the Saudi Vision 2030. Hence, it seems relevant and interesting to analyze the current state of barriers and drivers. I have benefitted from his findings in my own research, where I assess whether Saudi Arabia has made any effort to implement any of the policies al-Saleh recommended and further to overcome the barriers and strengthen the weak inducement mechanisms, and to what degree they seem to be successful in this endeavor. I will pay special attention to the five most significant barriers identified by al-Saleh.

Further, in his study Al-Saleh writes "information and policies concerning the Saudi energy sector is not readily available in the public domain."[32] This has now changed to a significant

[29] Ibid., 316.
[30] Ibid., 317.
[31] Ibid.
[32] Ibid., 303.

degree, and there is a lot of information available, especially policy and strategic documents like the Saudi Vision 2030, the NTP and other documents and information on energy and particularly renewable energy, which will be analyzed in this thesis. This will be further discussed in the section on methodology.

The factors Al-Saleh has examined in his article are all useful for the analysis in this thesis, however, the scope of the study is somewhat limited, and excludes some factors that are influencing the diffusion of RES in Saudi Arabia. For this reason I will also draw on another study by Dennis Kumetat, who has also studied the inertia in the diffusion of renewable energy; only his study relied on a slightly different analytical framework and focused on the two case studies Algeria and the UAE. In this study, which is influenced by theories on socio-technical transitions, governance and theoretical perspectives from Middle East studies, Kumetat has developed a set of factors that influence the diffusion of RE. This analytical perspective is called the multi-level perspective (MLP) and is used to analyze the different factors' effect on a transition as well as the interaction among them. Kumetat has further developed the MLP by creating factors especially suited for analyses of resource-rich Arab states. As the functions in Al-Saleh's article, factors of the MLP also interact and collectively influence the spread of RE. The factors are divided between three layers; the landscape level, the regime level, and the niche-level, which all have different qualities or ways of affecting the diffusion of renewable energy. The table below shows the three different levels as well as simple definitions of these, and most importantly shows which factors will be analyzed in each level – these can be found in the right column.

Table 1: Analytical dimensions of renewable energy policy in hydrocarbons-rich Arab states structured by the multi-level perspective

Scale	Definition	Analytical focus on
Landscape Level	Long-term macro-drivers that cannot effortlessly be altered by regime-level stakeholders	- Political system - Key regional and transregional energy governance bodies - Climate change - Long-term national economic diversification - Country branding
Regime Level	Entrenched actors and dominant regulatory, financial and political systems	- Technological regime: transmission and power generation infrastructure - User and market regime: structure of national energy markets, pricing and demand issues; legal and institutional frameworks - Socio-cultural regime: consumption patterns, environmental awareness and potential role of religion or environmental ethics - Policy regime: regime-level and transregional governance structures, CSOs
Niche Level	Protected spaces with a potential for radical change in the established regimes	- Science regime: industry structures, R&D strategies - Technological developments

Source: Kumetat[33]

The functions in Al-Saleh's article and their main points for analysis are considered in the analytical factors of the multi-level perspective, only through a different categorization. For instance, the MLP-factor *Social awareness and the role of religion and environmental ethics* enables a discussion of the notions in Al-Saleh's function 3, namely the importance of awareness of renewable energy technologies, and challenges related to energy and the environment. By choosing to use the MLP-factors above instead of the seven functions, it allows for a more distinct analysis, as there are more categories which provides a more precise analysis, while the content and main points of the seven functions are still maintained and assessed. Because of the limited scope of my thesis, which does not allow for an analysis of all the MLP-factors, and because my preliminary research has indicated that not all of the analytical dimensions are equally important, I have chosen to omit and restructure a few of them. My focus will be on the those categories that allow an assessment of the barriers identified in al-Saleh's study, as well as aspects that are discussed as important for large-scale structural change and political reform in literature on the Middle East and Saudi Arabia.

[33] Kumetat, 61.

In-depth analysis of each aspect would most certainly provide better and more precise insight into the aspect in question, than my thesis can and seeks to provide. However such an approach is contingent on extensive, and in this case unrealistic, access to practitioners and policy documents, and is not viable within the framework of a MA-thesis. Furthermore, such an approach would not enable an assessment of the transition as a whole, as an energy transition is multi-scalar in nature and the different aspects all together affect the transition. Understanding the complexity in the transition will not be possible if only one aspect is studied. On studying a system as a whole, instead of focusing on a single aspect, Gregory C. Unruh states that: "However, as is usually the case in complex systems, the whole is frequently greater than the sum of individual parts and, as discussed below, the properties of large technological systems are often different from those of the individual components."[34] Following this reasoning I aim to provide a comprehensive overview of the renewable energy policy and transition, instead of focusing on one aspect. Also, because of the limited amount of research on the renewable energy policy in Saudi Arabia, it seems rewarding to provide an up to date status report and analysis of the current situation.

A brief summary of barriers and drivers to renewable energy

The findings in several other studies of renewable energy in western countries and especially in the MENA and the Gulf Cooperation Council (GCC) region, also identify barriers and drivers to transition to renewable energy. In the following section I will briefly describe and sum up what the literature describes as important barriers and under-developed inducement mechanisms, in order to provide an understanding of which factors are important to and affecting a green energy transition in the region in general and in the MENA and GCC-region.

A comprehensive report on renewable energy and climate change by the Intergovernmental Panel on Climate Change (IPCC) has found a range of barriers to the diffusion of renewable energy: Low social awareness and acceptance of renewable energy technologies; lack of technical expertise and knowledge base and capabilities; lack of information and data on renewable energy; missing infrastructure and regulations for renewable energy and policies favoring the existing energy system.[35] Another study focusing on non-technical barriers to the

[34] Gregory C Unruh, "Understanding Carbon Lock-In," *Energy policy* 28, no. 12 (2000).
[35] Ottmar Edenhofer et al., "Summary for Policymakers," *IPCC special report on renewable energy sources and climate change mitigation - Prepared By Working Group III of the Intergovernmental Panel on Climate Change* (Cambridge, United Kingdom, New York, NY, USA: Cambridge University Press, 2011). 24-25.

spread of renewable energy points to the same barriers but also mentions the general lack of policies supporting renewable energy; high cost of renewables compared to fossil fuels; lack of financing of renewables; failure to internalize all cost and benefits of the different energy choices - which might favor renewables; inadequate workforce and no sufficient education and training.[36] These findings are not pertaining to Saudi Arabia in particular, but have a global scope. They largely support each other's findings as well as the barriers in al-Saleh's study, however. A study on renewables in the GCC countries further adds that vested interests in the oil-based energy system is a barrier in this region.[37]

1.3 Methodology

For this thesis I have chosen to conduct a desk study and have not included a field study or qualitative interviews. Although such a method might have provided more in-depth information and possibly a strengthening of the arguments put forward in the analysis, there are several reasons for my choice of approach as explained in the following paragraphs. The Gulf countries in general, and Saudi Arabia in particular, is a challenging environment for foreign researchers studying government policies and seeking access to influential politicians and practitioners. I will make comparisons to another study on renewable energy policy in the MENA region, to show that even a researcher that is male, more well-connected and more senior than myself faced several obstacles in gaining access to relevant interviewees.

Firstly, the limited scope of my thesis and time frame does not allow for a large amount of in depth interviews that should have been conducted in order to cover all the areas of interest in the thesis. In comparison, a PhD dissertation on renewable energy policy in Algeria and UAE, the researcher Dennis Kumetat carried out 94 in depth interviews. Albeit divided on two cases, even conducting half the number of interviews would be a formidable and unrealistic task in this thesis. It would also be both a very costly and protracted affair to conduct such a large number of interviews. Furthermore, it is difficult to gain access to the most relevant interviewees as many of them are prominent members of the royal family, high-ranking government officials and other elite members of the Saudi society. Access could also become

[36] R Margolis and J Zuboy, "Nontechnical Barriers to Solar Energy Use: Review of Recent Literature National Renewable Energy Laboratory Technical Report," (September, 2006).
[37] Konstantinos D. Patlitzianas and Alexandros Flamos, "Driving Forces for Renewable Development in Gcc Countries," *Energy Sources, Part B: Economics, Planning, and Policy* 11, no. 3 (2016).

difficult because of my gender and position as a master student, which is significantly less prominent than potential interviewees. Kumetat writes that "at worst, the researchers may not be taken seriously because of younger age or the senior position occupied by of the interviewee."[38]

Due to the opaque nature of decision making structures and the degree of secrecy surrounding the inner workings of the Saudi ministries and actors such as Saudi Aramco and other stakeholders in the energy business sector, who are influential in the country's future energy trajectory, it is hard to get access to interviewees from such institutions. Even if access was granted, the data collected might not necessarily provide new information, but simply general observations in line with official government discourse on the subject.

After considering this and other efforts to conduct similar fieldwork in the region and particularly Saudi Arabia, and especially after learning about Kumetat's difficulties with gaining access to relevant interviewees[39], I had little hope of accessing such interviewees myself, since I have virtually no contacts in the right circles and no realistic chance of making such connections in the near future. Furthermore, in order to obtain visa to Saudi Arabia I would have to be invited by a Saudi institution, and as a MA-student I had no way of obtaining such an invitation. Even obtaining a visa to access the country would most likely be very difficult and after reading about and talking to other researchers, (more senior than me), about their experiences with trying to get access to Saudi Arabia for the purpose of fieldwork, I learned that this could be problematic and that visas were usually granted when the researcher had a previous connection to the embassy in Saudi Arabia. Hence, for purposes of research economy, I therefore decided to pursue this MA-thesis without having to relying on data from fieldwork.

More importantly however, are the sources that are actually available without conducting fieldwork, and that I have relied on for information in this thesis and which have made it possible to study the renewable energy policy and context in Saudi Arabia. Energy policy has traditionally been surrounded with considerable secrecy. Recently, however, the Saudi

[38] Kumetat, 137.
[39] Details on Kumetat's travails in obtaining access to elite interviews: "Only a tiny political elite or a top-level manager of a company is Emirati, and is usually unwilling to give interviews to comparatively minor research projects such as PhD theses. During the course of his work the author has attempted to interview a variety of Emirati stakeholders, such as members of the Federal National Council (with an energy profile), clean energy CEOs and ministry officials. In spite of positive introductions by third parties, however, most of these interview requests remained unanswered or were forwarded to less senior European management staff." Ibid., 157.

government has opened up on their policies and are both speaking publicly about their plans and releasing policy documents which have allowed me to study their renewable energy policy in some detail. The recently released Saudi Vision 2030 which is a roadmap for diversifying the economy away from oil, includes information on how they aim to introduce renewable energy. This is further elaborated on in the National Transformation Program (NTP) where more detailed initiatives regarding renewable energy and aspects affecting the spread of RE are described. These documents and other government documents regarding renewable energy, as well as press releases and official statements from the government are the most important empirical sources in this thesis.

Empirical sources on the inner workings of Saudi decision making processes are rare, but I still find it relevant to conduct the study. The lack of transparency in the political sphere is well known (to researchers studying Saudi Arabia), but as this is not the only aspect discussed in this thesis, and some sources are available, I choose to accept this trade-off, at the same time acknowledging the limit this puts on the thesis – my discussion of this aspect must rely on sources that are secondary or of an indicative nature. The discussion on how the political structures affect renewable energy will partly be based on secondary literature like Steffen Hertog's book *Princes, Brokers, and Bureaucrats: Oil and the State in Saudi Arabia*, in which the political structures of Saudi Arabia is explained and discussed, as well as the oil wealth's impact on these structures. Combining these insights with stakeholders' and expert opinions as expressed in reports and news articles on the matter, as well as making comparisons to previous attempts of large scale structural changes, I will discuss how the political system is likely to affect a spread of renewable energy in the country.

It is now possible to find a lot of open sources similar to the ones found in Kumetat's dissertation, as the field of renewable energy in the Middle East and Saudi Arabia has received growing attention in recent years. Important stakeholders from the four categories mentioned above are often and continuously interviewed on the progress and barriers to the development of renewable energy in both the region and Saudi Arabia. Their views as well as other expert opinions are expressed in interviews, news articles, podcasts and reports and will constitute my empirical material. I will use these views to support my arguments.

The empirical data in this thesis will thus consist of primary and secondary sources such as official government documents on energy policy, governmental websites and press releases, news articles, and reports from non-governmental institutions and organizations such as

IRENA, IEA, OPEC, etc. and social media accounts of government institutions and Saudi Aramco. These sources are mostly written in English, but some of them are written in Arabic, like the webpage of the Ministry of Energy, Industry and Minerals. Additionally academic research will provide background information on the different aspects affecting the spread of renewable energy. The sources will provide data for the background information outlined in chapter two, as well as empirical data relevant to the analytical variables in chapter 3. The most important empirical sources are the new strategic documents "the Saudi Vision 2030", which will provide data on the official goals for deployment renewable energy and how the country plans to make it part of the plans for economic diversification, and "The National Transformation Plan" which is a blueprint outlining different initiatives to be undertaken by the ministries in order to implement the stated goals of the Saudi Vision 2030. These and similar sources will provide up to date information on the current renewable energy policy and their content will be analyzed in chapter 3.

2 The rationale for renewable energy in Saudi Arabia

There are several reasons behind Saudi Arabia's plans of becoming less dependent on oil and to implement renewable energy in their energy mix. A country's energy mix refers to the group of primary energy sources that are used for the domestic energy consumption. Such energy sources can be the different types of fossil fuels like natural gas, oil and coal, various renewable energy sources (solar, wind, biomass, geothermal etc.), nuclear energy and energy from waste. Primary energy sources are in turn converted into different types of secondary energy or energy carriers like electricity and transportation fuel that can be used by society. In Saudi Arabia the energy mix currently consist of oil and gas and their use of these fossil fuels are highly unsustainable.

2.1 Domestic energy demand

Despite having abundant energy sources, counting both the unexploited renewable energy sources and also their oil and gas reserves which are among the largest in the world, the country is facing an energy crisis. Saudi Arabia is one of the largest energy consumers in the world and their oil consumption has more than doubled over the last ten years.[40] The increasing domestic energy demand is at the core of this crisis and is caused by wasteful consumer habits and population growth, industrialization and economic development. Perhaps the most important reason is the low energy prices which have led the growing population to consume electricity in an extremely wasteful manner. As the socio-economic conditions and national wealth increases, so will energy consumption.

The domestic electricity demand is increasing with 10 percent each year and Saudi Arabia is burning over 25 percent of their oil production – even more than Germany whose population is three times that of Saudi Arabia and their economy five times as large.[41] Another estimate arrives at slightly different numbers, where the annual growth rate in Saudi electricity demand is 9 percent, while their increase in electricity generation is 7 percent. It is nevertheless

[40] Laura El-Katiri and Bassam Fattouh, "A Brief Political Economy of Energy Subsidies in the Middle East and North Africa," *International Development Policy| Revue internationale de politique de développement*, no. 7.0 (2017).
[41] Jim Krane, "The End of the Saudi Oil Reserve Margin," The Gulf Intelligence, http://www.thegulfintelligence.com/Docs.Viewer/e6f93039-c120-4588-9725-cc38ec4451af/default.aspx.

obvious that the increase in demand will outgrow their capacity to generate electricity if nothing is done to prevent this scenario from happening.[42]

In this case, Saudi Arabia will be forced to import oil to supply domestic demand. This would be catastrophic as they would have no more oil for export and thus no oil revenues, which are vital to Saudi Arabia – the Kingdom relies on oil for 86 percent of its annual revenues.[43] It would also cause energy insecurity, as the country would have to rely on other nations to supply a share of their domestic energy consumption.

Solutions to the crisis can be to try to reduce consumption through energy efficiency measures, increase the energy supply, or both.

Energy efficiency measures are on the agenda in Saudi Arabia, as exemplified by the recently established Saudi Green Building Forum (SGBF), which works to promote sustainable construction, and the country's new green building guidelines.[44] Energy efficiency measures will be important in the Saudi efforts to face the energy-related challenges, but it is not within the scope of my thesis to consider this aspect, and I will focus on renewable energy.

By implementing renewable energy projects, they can supply the domestic energy demand with clean energy that doesn't harm the environment as well as freeing up oil for exports and thereby accruing oil revenues. Furthermore, introducing renewable energy can help to decouple the correlation between economic development, increasing energy consumption and greenhouse gas (GHG) emissions, contributing to sustainable developments (SD).[45]

Hertog and Luciani argue that one should distinguish between consumption of liquid fuels and that of electricity because they see the possibility of alternative resources in only one of the two areas of consumption, namely electricity. They argue that it is very difficult to create a more sustainable consumption of liquid fuels as they see no other option for producing fuels than from oil.[46]

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[42] Export.gov, "Saudi Arabia - Energy," Export.gov, https://www.export.gov/article?id=Saudi-Arabia-Energy.
[43] Adam Lane, "Ksa May Have Only 18 Years Left as Net Exporter," ArabianOilandGas.com, http://www.arabianoilandgas.com/article-10593-ksa-may-have-only-18-years-left-as-net-exporter/.
[44] D. G. McCullough, "Saudi Arabia's Green Decree Brings Hopes of Sustainability," *The Guardian* 12.05.2014.
[45] Ottmar Edenhofer et al., "Ipcc Special Report on Renewable Energy Sources and Climate Change Mitigation," in *Prepared By Working Group III of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK* (2011).
[46] Steffen Hertog and Giacomo Luciani, "Energy and Sustainability Policies in the Gulf States," in *The Transformation of the Gulf: Politics, Economics and the Global Order*, ed. David Held and Kristian Ulrichsen (Oxon and New York: Routledge, 2012), 236-37.

The argument that the consumption of liquid fuels are difficult to make sustainable because there are few viable substitutes for fossil liquid fuel for transportation might be right, but the study making this argument was published in 2012, and they did not considering the effect electric vehicles (EV) could have on this area of consumption as this happened after the study was published. If introduced on a large scale, EVs could strongly decrease the demand for oil in the transportation sector. This is because they run on electricity rather than liquid fuels, and the oil used for fuels could be freed up for exports, thereby relieving some of the economic pressure caused by the consumption in the sector. For now most of the electricity in Saudi Arabia is generated by burning oil, but this could also be made more sustainable if renewable energy were introduced into the national energy mix, thus freeing up even more oil for exports and providing both the transportation sector and the electricity sector as a whole with greener and cleaner energy. Renewable energy and EVs can in this way help to alleviate the environmental and economic pressure from consumption of liquid fuels and ultimately remove the consumption of liquid fuels in the transportation sector all together.

The worldwide proliferation of EVs can however also have negative consequences for Saudi Arabia's economy, if they don't manage to become less dependent on oil revenues before it happens.

A transition to EVs worldwide can cause massive problems for the oil industry and hence for Saudi Arabia's most important source of revenue. In fact, EVs are predicted by some to greatly disrupt the oil industry worldwide, as the demand for oil will decrease substantially with the transition to EVs. A report by the think tank RethinkX, predicts that a rapid transition to EVs will happen within 2030 and that it will have massive economic implications for several sectors including the energy sector and cause the oil prices to collapse because of plummeting demand. In their predicted scenario the global oil demand will drop to 70 million barrels per day by 2030 with the proliferation of EVs.

In comparison the global demand for oil has reached 98 million barrels per day[47] as we are halfway into 2017 and future outlooks (not considering the worldwide transition to EVs) predict a yearly increase in demand. In other words, a worldwide transition to EVs can hurt the Saudi Arabian economy as this would create a significant decrease in oil demand and thus greatly impair their most important source of revenue. The president and CEO of Saudi

[47] The U.S. Energy Information Administration, "Short-Term Energy Outlook " The U.S. Energy Information Administration https://www.eia.gov/outlooks/steo/report/global_oil.cfm.

Aramco, Amin Nasser, has predicted a much lower penetration of EVs however, and does not think EVs will threaten hydrocarbon resources any time soon.[48]The EV-effect cannot be foretold with absolute certainty, but as many sources predicts that this sector will grow and demand for oil consequently will decrease, it can serve as one among several push factors to become less dependent on oil and find other sources of revenue.

2.2 Climate change, water scarcity and desalination as an entry point

Climate change is a huge threat to the living conditions in Saudi Arabia and poses a challenge in many ways. Rising global temperatures will lead to "an above average increase in temperatures and decrease in precipitation"[49] " in the Gulf region. Rising temperatures would increase the need for air conditioning which already demands almost 900 000 barrels of oil per day in the peak season in the summer.[50] Further, water scarcity is already a big problem in the region and with less rain, this would lead to an even bigger need for desalination capacity than what is already in place. Desalination is a process where salt and minerals is removed from saltwater to make it suitable for irrigation and human consumption. This process is very energy intensive and in Saudi Arabia and the desalination plants uses 1,5 million barrels per day[51], which accounts for around 10 percent of the domestic oil consumption.[52] As the need for desalinated water rises with growth in the population and the industrial sector this puts even further strain on the water-stressed country and contributes to the domestic energy demand. The water desalination process is also causing great environmental harm and is thus a cause of both domestic and global environmental concern.[53] Renewable energy could be used in this process, instead of oil, thus making desalination cleaner and more economic as oil could be freed up for export. Saudi Aramco, the national oil

[48] Saudi Aramco, "At Wef 2017, Saudi Aramco Ceo Outlines the Future of Energy," Saudi Aramco, http://www.saudiaramco.com/en/home/news-media/news/wef-2017-saudi-aramco-ceo-outlines-future-of-energy.html.
[49] The International Renewable Energy Agency, "Renewable Energy Market Analysis: The Gcc Region," (Abu Dhabi: IRENA, 2016).
[50] RT, "Saudi Arabia Pushes for Solar Energy Project to Create Thousands of Jobs " *RT* 26.04.2017.
[51] The Energy Technology Systems Analysis Programme, "Water Desalination Using Renewable Energy: Technology Brief," (05.2012).
[52] The International Renewable Energy Agency.
[53] Nisreen Ismail Albanawi, "Saudi Arabian Green Economy Infrastructure: Barriers, Strategies & Opportunity-an Analysis," *International Journal of Business and Economic Development (IJBED)* 3, no. 3 (2015).

company, has already made plans to use renewables for water desalination[54] and what will be the world's first large scale desalination plant powered by solar energy is under construction in the Saudi city Al Khafji.[55] By introducing renewable energy in the desalination process, it could serve as an entry point for renewable energy in Saudi Arabia. [56]

Besides water depletion which reportedly can cause major environmental disasters in Saudi Arabia[57], the country might expect a number of climate changes and environmental damages in the future, with heavy rain fall[58]; rising sea levels that will threaten coastal communities[59]; desertification and scorching heat making life unbearable in an already extremely hot country. In a worst case scenario, Saudi Arabia could become increasingly uninhabitable, rendering parts of the Saudi population climate refugees who could be forced into mass migration. It is vital for Saudi Arabia to make drastic changes to reduce oil consumption and emissions in order to counter these challenges and protect the environment and the climate.

As climate change is threatening the living conditions in their country, this might serve as a driver for sustainable development and deployment of clean energy, although concern for the climate has not been considered in the past.

Looking at Saudi Arabia's track record in international climate change negotiations and mitigation efforts, their actions do not reflect concern for the environment. On the contrary, they have been called obstructionists in climate negotiations and their obstructive behavior has been the focus of a study explaining their role in hindering CC agreements and negotiations[60]. Until recently, they even denied the connection between human activity and climate change, thereby denying that their oil production, consumption and exports has anything to do with climate change, freeing themselves of this responsibility and of the need to make changes in oil-related activities. Luckily, they have changed position and have submitted their Intended Nationally Determined Contribution (INDC) to the United Nations

[54] Saudi Aramco, "Saudi Aramco, Adnoc, and Masdar Sign Mous on Collaboration in Oil & Gas Technology R&D, Sustainable Energy Management," Saudi Aramco, http://www.saudiaramco.com/en/home/news-media/news/ADNOC-Masdar.html.
[55] Water-technology.net, "Al Khafji Solar Saline Water Reverse Osmosis (Solar Swro) Desalination Plant, Saudi Arabia," http://www.water-technology.net/projects/al-khafji-solar-saline-water-reverse-osmosis-solar-swro-desalination-plant/.
[56] Arif Hepbasli and Zeyad Alsuhaibani, "A Key Review on Present Status and Future Directions of Solar Energy Studies and Applications in Saudi Arabia," *Renewable and Sustainable Energy Reviews* 15, no. 9 (2011).
[57] Sputnik, "Dead in the Sand? Saudi Arabia Running out of Water," *Sputnik* 24.02.2016.
[58] Saudi Gazette, "Hottest Summer, Heavy Rains Expected This Year in Kingdom," *Saudi Gazette* 30.05.2016.
[59] The International Renewable Energy Agency.
[60] See: Joanna Depledge, "Striving for No: Saudi Arabia in the Climate Change Regime," *Global Environmental Politics* 8, no. 4 (2008).

Framework Convention on Climate Change (UNFCCC) where they recognize the importance of CC mitigation, stating that: "Being highly vulnerable to climate change and actions and plans to address it, the Kingdom of Saudi Arabia will be engaged in several actions to address climate change and make its development more sustainable."[61] The climate agenda serves as a driver for renewable energy as the Saudi state, in the INDC, commits to diversify their economy away from oil and towards renewable energy.

2.3 Solar and wind

Solar power is an obvious choice for Saudi Arabia, as the country has clear advantages for developing this key renewable energy source. It is perfectly suited and situated for solar parks, with vast stretches of uninhabited land in the desert that can be used for harnessing the energy of the sun[62], as well as some of the world's most intense solar irradiance. Several studies list concentrating solar power (CSP) solar-thermal, as well as photovoltaic (PV) and wind as the most promising renewable energy technologies[63] in the country.[64] Moreover renewable energy technologies like solar and wind have become increasingly cost competitive with conventional fuels.[65] The delivered cost of electricity from solar PVs, CSP and wind are all declining, sometimes rapidly. Renewable technologies are now the most economical solution for new capacity in an increasing number of countries and regions, according to the International Renewable Energy Agency (IRENA).[66] Renewable energy technology is constantly improving and is strongly supported by heavy investments across the world. This development is likely to continue and bring even further improvements and new breakthroughs within the field of renewable energy technology.

[61] The Kingdom of Saudi Arabia, "The Intended Nationally Determined Contribution of the Kingdom of Saudi Arabia under the Unfccc," (Riyadh11.2015), 6.
[62] Steffen Hertog and Giacomo Luciani, "Energy and Sustainability Policies in the Gcc," (2009).
[63] Excessive heat and dust reduce the efficiency of PVs; dust and water scarcity is a challenge for CSP as the current technologies require vast amounts of water to clean the solar mirrors.
[64] Nedhal Al-Tamimi, "A State-of-the-Art Review of the Sustainability and Energy Efficiency of Buildings in Saudi Arabia," *Energy Efficiency* (2017).
[65] Ed Smeloff, "Now That Solar Is Cost Competitive, Utilities Are Taking Aim at This 1978 Energy Law," *Renewable Energy World* 21.10.2016
[66] International Renewable Energy Agency, "Remap 2030: Renewable Power Is Cost-Competitive," in *RENEWABLE POWER GENERATION COSTS IN REMAP 2030* (International Renewable Energy Agency).

Existing studies points to numerous benefits of transitioning to renewable energy including increased economic growth potential, social welfare, job creation and overall trade balances[67], energy access, secure energy supply, climate change mitigation, and the reduction of negative environmental and health impacts.[68] Additionally, "large scale RE utilization may contribute to rural development and electrification, land restoration, fostering energy diversity, and minimizing risk from nuclear weapon proliferation."[69] The positive effects mentioned here are results of studies with a global outlook on the deployment of renewable energy technology, however studies focusing on the GCC and Saudi Arabia in particular also lists several socio-economic benefits from a large scale transition to renewable energy, which has the potential of countering some of the current challenges of the country and region such as rising unemployment, water scarcity, climate change and fossil fuel savings.[70]

2.4 Disadvantages

Although renewable energy has many benefits, there are also some disadvantages worth noting. The high costs have perhaps been one of the biggest obstacles deterring interested parties. The price barrier is rapidly decreasing however, as developments progress. This will be further discussed later. Another challenge is the lack of sufficient and available energy storage capacity to enable a supply when the sun is not shining and the wind is not blowing, and consequently the ability to supply users with electricity is obstructed. Developments are progressing in this area as well, and the research on battery storage possibilities are improving. Funding might also be a problem, as renewable energy technologies are new and constantly in development, and will need massive investments. Additionally, the transportation sector is for the most part reliant on liquid fuels that cannot be replaced by power from renewable energy, at least not until an eventual transition to electrical vehicles have taken place (which actually might happen sooner rather than later and will be discussed below) – and even then there would be means of transportation requiring fuel, like airplanes, ships and heavy goods vehicles, that not yet have viable renewable alternatives.

[67] Rabia; Lopez-Peña Ferroukhi, Alvaro; Kieffer, Ghislaine; Nagpal, Divyam; Hawila, Diala; Khalid, Arslan; El-Katiri, Laura; Vinci, Salvatore; Fernandez, Andres, "Renewable Energy Benefits: Measuring the Economics," (Abu Dhabi, United Arab Emirates: International Renewable Energy Agency, 2016).
[68] Ottmar; Pichs-Madruga Edenhofer, Ramon; Sokona, Youba; Seyboth, Kristin, "Ipcc Special Report on Renewable Energy Sources and Climate Change Mitigation: Summary for Policymakers," in *Working Group III of the IPCC* (Abu Dhabi, United Arab Emirates: IPCC, 08.05.2011).
[69] Anas Zyadin et al., "School Students' Knowledge, Perceptions, and Attitudes toward Renewable Energy in Jordan," *Renewable energy* 45 (2012).
[70] The International Renewable Energy Agency.

2.5 Choosing economy over sustainability?

What used to be a question of choosing economy on the one side *or* the environment, climate and sustainability on the other side, is soon a priority issue of the past as sustainability and renewable energy is gradually turning into a field of great economical potential and growth. Renewable energy is increasingly contributing to a sustainable development, where economic growth goes hand in hand with climate change mitigation efforts. The CC mitigation efforts have for a long time been efforts towards a collective good and with no apparent or short-term economic benefits, and have struggled with this issue as many countries have chosen to prioritize their short- to medium-term economic gains, which have often been driven by high fossil fuel-based energy consumption, and consequently emissions. As other states have worked towards sustainability these states have at the same time benefited from the CC efforts, as the climate is a global phenomenon. This issue which we may dub a 'free rider'-problem, might become less of a problem as the industry now have the ability to combine economic growth and sustainability and climate friendly energy consumption by using renewable energy and energy efficiency measures. In fact, *not* choosing a transition away from fossil fuels and towards sustainability is by many considered to be detrimental for economies heavily dependent on fossil fuels. The question of transitioning is not only a question of if, but also of when. Timing is important and both early movers and late bloomers might pay a high cost.

As the rest of the world seems to be moving in a sustainable direction, deploying renewable energy at rapid speed, initiating sustainable projects, investing in clean energy and working on climate and environmentally friendly initiatives, Saudi Arabia will probably be wise to follow suit in order to position itself in the emerging global renewable energy market.

2.6 Early renewable energy developments in Saudi Arabia

Perhaps surprisingly, considering the importance of oil in Saudi Arabia, they actually began showing an interest in renewable energy as early as the 1960s with the inception of what

could be considered the world's first solar-powered hydrogen-generation plant[71]. The 1970s marked the start of important R&D efforts with the foundation "two major international joint research and development (R&D) programs, in cooperation with the United States of America and the Federal Republic of Germany, aimed at developing renewable energy technology and demonstrating its applications by designing and installing several pilot projects."[72] These programs, SOLERAS and HYSOLAR became important starting points for the R&D on RE in Saudi Arabia.[73] Fast forward to 2009, an article reviewing the progress of renewable energy in the GCC, deemed Saudi Arabia a frontrunner, based on their research and development (R&D) into renewable energy sources (RES) and especially solar energy. By this time they had already started to implement some RES initiatives like pilot, research and real-life projects, supported by institutions and companies like BP Solar Arabia Ltd and the Energy Research Institute – ERI. These efforts were accompanied with governmental initiatives aimed at increasing public awareness on environmental issues and climate change. [74] The following year, in 2010, the government established King Abdullah City for Atomic and Renewable Energy (KACARE) which was given the responsibility to develop the atomic and renewable energy program in the kingdom and which is still working with renewable energy, although not very successfully as will be discussed below.

2.7 The political system in Saudi Arabia

In order to understand how renewable energy policy is shaped and implemented, it is necessary to gain an understanding of the wider political context of Saudi Arabia and also how oil has shaped the political economy. This section will therefore outline the political system and decision-making structures in the country, and briefly explain the impact of oil wealth. When we seek to understand how the political system allows for and shapes a transition away from oil and towards renewable energy, in other words a large scale structural change and reform, we must understand how the political system is built up, and how decisions and policies are made and implemented.

[71] Hepbasli and Alsuhaibani.
[72] Saleh H Alawaji, "Evaluation of Solar Energy Research and Its Applications in Saudi Arabia—20 Years of Experience," ibid.5, no. 1 (2001).
[73] Iskander Tlili, "Renewable Energy in Saudi Arabia: Current Status and Future Potentials," *Environment, Development and Sustainability* 17, no. 4 (2015).
[74] Alexandros Flamos et al., "Exploitation of Renewable Energy Sources in the Gulf Region: Fairy Tale or Challenging Opportunity?," *International Journal of Arab Culture, Management and Sustainable Development* 1, no. 2 (2009).

Saudi Arabia is an absolute monarchy with a strict adherence to Islam. An absolute monarchy is a form of monarchy where the ruler is not restricted by law, but has absolute authority. The absolute monarchy of Saudi Arabia is slightly different however, as the country and consequently the king, must govern in accordance with the constitution-like document or charter, the Basic Law. In the first article of the Basic Law it is declared that the Quran and the Sunnah is the constitution of Saudi Arabia. It reads: "The kingdom of Saudi Arabia is a sovereign Arab Islamic state. Its religion is Islam, and its constitution is the Holy Qur'an and the prophet's (peace be upon him) Sunnah (traditions)."[75] The regime is in this way compelled to follow these Islamic principles and largely legitimizes their rule on their adherence to Islam and their support from the religious establishment, the ulama. Political parties and elections are not allowed and politics are developed and decided on by the royal family in consultation with the ulama. Cooperation and support from the ulama is thus very important to the regime. The extensive royal family, also known as the House of Sauds "is comprised of around 15,000 members, with around 2,000 in the inner circle"[76] and dominates the government. Most ministerial and senior positions are held by one of the many Saudi princes.

Oil and oil income or rent has to a large degree shaped and transformed the Saudi state and its political economy and political system. A widespread and acknowledged strand of theory, namely the 'rentier state theory', has widely been used to explain how oil has created certain features in the relationship between the state and society – the social contract, and in the nature of the political system, often with Saudi Arabia as the primary example. The rentier state theories predict that oil rent is used by the state to buy off the people, so that the state acquire political acquiescence and stability in return for their distribution of oil rents. The state becomes autonomous from the people, "albeit at the cost of weakened regulatory capacity of state institutions and pervasive rent-seeking."[77] This weakened capacity is a result of the underlying distributive mechanism where people are employed in the bureaucracy and thus receives a portion of the oil wealth, however without any incentives to efficiently perform their job, but instead are motivated primarily to seek rent.

[75] Kingdom of Saudi Arabia Ministry of Foreign Affairs, "The Basic Law of Governance," Kingdom of Saudi Arabia Ministry of Foreign Affairs, http://www.mofa.gov.sa/sites/mofaen/ServicesAndInformation/aboutKingDom/SaudiGovernment/Pages/BasicSystemOfGovernance35297.aspx.
[76] House of Saud, "Royal Family Profiles: Key Figures of the Saudi Royal Family," House of Saud, http://houseofsaud.com/saudi-royal-family-profiles/.
[77] Steffen Hertog, *Princes, Brokers, and Bureaucrats - Oil and the State in Saudi Arabia* (Ithaca and London: Cornell University Press, 2011), 2.

The predictions put forward in the traditional rentier state theories are criticized by Steffen Hertog of being to general and of not being able to explain the various outcome of reform in Saudi Arabia.[78] He agrees that the predications are right in some instances, but argues that the system is much more complex than rentier state theories describes and that oil money can be, and is used in many different distributing ways be the ruling elite to shape the state, rather than the view that the shape of the state is predetermined by oil money. He contends that "there is no automatic mechanism that produces corruption, rent-seeking, and a weak bureaucracy"[79], but rather that how and when the elite has decided to distribute the oil wealth through time has been important in shaping the state.

The modern Saudi state structure has grown since the ruling family, the Al-Saud, designed the first formal Saudi state using oil wealth during the 1950s and 1960s. One should note that the Al-Sauds had already formed the state in 1932 and ruled since then, and were largely autonomous from society, with no large social groups constraining their decisions.[80] The discovery and influx of the enormous oil wealth in the 50s and 60s was used to build the state and the state apparatus was divided between members of the huge royal family in order to settle disputes and accommodate diverging views and princes. With no previous experience and tradition for state building, new ministries, agencies, institutions and fiefdoms were created and expanded through the 1950s as a result of "elite whims and scuffles at the moment"[81] in an often unplanned process, which created a fragmented state apparatus growing at a rapid speed.

As time passed and new institutions were created, this system was used to balance power and build patron-client relations, where individuals were coopted into the distributive system – first within the ruling family where princes were given power through important positions or fiefdoms, and over time, this practice of employing people in the state coopted increasingly larger parts of society.[82] No elite groups, like tribes, merchants, ulama or others were ever "vanquished, instead they were all sucked into the orbit of an increasingly rich state"[83], which in the end has created a very heterogeneous state. The ruling family continued the cooptation of society through distributing welfare services like health care and education and state

[78] Ibid.
[79] Ibid., 3.
[80] Ibid., 15.
[81] Ibid., 16.
[82] Ibid., 17.
[83] Ibid., 133.

procurement and licenses directed at merchants, rapidly imposing "a large state on its subjects, thoroughly refashioning social structures."[84] Oil wealth has been, and still is, distributed through employment in the bureaucracy, but also through different social services, contracts and various handouts. This clientelist deal, where material distribution is traded for acceptance of the regime, "served to constrain the state over time"[85] as the system grew and it became almost impossible to retract the various distributions. It has also become a huge fiscal burden as the state and bureaucracy has grown. The state's inability to freely dispose the oil wealth, which is the result of the "large-scale fiscal obligations towards its various clients in society"[86], shows that they are not completely autonomous from the people, but bound by the patron-client relationships and individual interests of the coopted subjects of the state. In fact, Hertog writes that while the state "conquered al larger structures in society, small-scale social interests conquered it in return."[87]

The huge bureaucracy consist of a large number of bureaucrats and institutions who do not operate coherently, but act parallel to each other and work vertically rather than horizontally. Further, the innumerable rentier clients that make up the bureaucracy make reform and even the daily administrative control difficult and slow.[88] The fragmented nature of the state and the clientelist inertia is the main reason for failing policies. Hertog calls the "heterogeneous system of formal and informal, rent-based clientelism in which vertical links dominate" for 'segmented clientelism'.[89] He further explains how this system works on different levels of the bureaucracy and how this affects implementation of policy.

The Al-Sauds did not only create a slow and heavy bureaucracy however. They have also built up certain fractions of the state that has proven to be lean and well-managed, so called 'islands of efficiency'. These efficient domains have been led by Western educated technocratic clients who often have been given scholarships and have been chosen by the regime for their capabilities and performance. The regime also used international expertise to build up these highly efficient administrative bodies.[90] These entities operate under direct royal patronage and have sometimes been helped along by "mandates to bypass the rest of the

[84] Ibid., 17.
[85] Ibid., 18.
[86] Ibid., 3.
[87] Ibid., 134.
[88] Ibid., 4.
[89] Ibid., 5.
[90] Ibid., 11,17.

bureaucracy"[91] and have been very successful in implementing reform and policies. Although these efficient institutions operate efficiently and manage their own business rather well, "their existence has little effect on the bulk of the state apparatus."[92]

Hertog argues that one cannot explain reform outcomes by system-wide explanations of rent-seeking or regulatory failure, but that we must look at the exact attempts of reform in different cases, as the distributions have not been uniform, and thus have had different effects. Hertog argues that two systemic factors determine the feasibility of reform, namely the 'width' and 'depth' of reform. The 'depth' entails "the degree to which it involves gathering information from and changing the behavior of a large numbers of actors, both in bureaucracy and in society"[93], while the 'width' "is the number of organizational players involved in government and in business."[94] The deeper and wider a reform is, the more difficult it is to implement, and more limited reforms have higher feasibility - "the biggest policy successes of the Saudi state have arguably all been individual projects."[95]

Hertog further elaborates on how decisions and policies are affected by and implemented in this hierarchical, vertically fragmented state apparatus, and suggests that three different levels, namely macro- meso- and micro-level, can be distinguished and have certain effects on reform feasibility. On the macro-level we find the royal family who acts as patrons and control the system – no independent interests groups have been allowed. Decisions are made on this level and "only very senior figures can spur the system into action."[96] These decisions are then communicated downwards in the system. And "although the leadership is sensitive to diffuse sentiments of social discontent over issues of equity and service delivery, most actual politics happen within the state."[97] This also makes administration slower, as there are few people on the top to make decision, in comparison to the massive bureaucracy they control. The meso-level of politics consist of the large, fragmented bureaucracy which "tend to communicate upwards with their political patrons"[98] instead of horizontally with each other and they have no "ruling party, no parliament or no pressure groups that could force a

[91] Ibid., 5.
[92] Ibid., 135.
[93] Ibid., 255.
[94] Ibid.
[95] Ibid.
[96] Ibid., 249.
[97] Ibid., 248.
[98] Ibid., 249.

stronger horizontal integration of the system."[99] What is more, the "different parts of the state tend to operate on different rules and report to different principals", resulting in idiosyncratic policy implementation. This level has seen the creation of highly autonomous states within the state, like the powerful "Ministries of Defense and Interior, the National Guard and the religious bureaucracy."[100] The smaller, micro-scale of the bureaucracy is also dominated by vertical communication, but is also further from direct control and the many individual clients can be difficult to control and can subvert policies that are decided by the rulers on the macro-level, "It is the interplay of meso- and micro-politics in the Saudi distributive system that determines policy outcomes."[101] Through the personalized networks between the state and society, individuals can access the resources in the state, but also affect policy outcome as they are relatively free from control and can influence and perform their daily work of policy implementation largely as they please – while still receiving their salary. This notion is supported by Hertog who also explained that they could have a certain level of local control over resources, "mid- or low-level bureaucrats could draw a salary and remain idle or establish their own informal networks of brokerage through which state resources would be locally disputed."[102] Self-interest and bureaucratic sluggishness on the micro-level can even turn into a sort of veto power obstructing the implementation of policies.[103] The oil wealth and its distribution has thus "fragmented society on the meso-level, but empowered it on the micro-level."[104]

The distributive structures outlined above have only grown and become more rigid since the outset of the formal state formation in the 1950s and greatly influence how policies and reform are implemented in Saudi Arabia today, and to what degree they are successful in these endeavors. The state's ability to change has mostly happened by the gradual accumulation of additional state layers, because the existing institutions have been hard to change. The state's ability of administrative change has thus decreases simultaneously with the growth of the bureaucracy, with the notable exception of successful reform and policy implementation within certain islands of efficiency.

[99] Ibid., 13.
[100] Ibid.
[101] Ibid., 11.
[102] Ibid., 19.
[103] Ibid.
[104] Ibid., 12.

3 A multi-level perspective analysis of Saudi Arabia's renewable energy policies

This chapter will provide a multi-level perspective analysis of Saudi renewable energy policies. I will discuss the aspects that shape the renewable energy policy in the Kingdom and also discuss to what degree they seem to have a renewable energy policy.

3.1 Landscape-level factors

3.1.1 Political system

The fragmented nature of the Saudi state has great implications for decision-making and implementation of policies in Saudi Arabia, and thus for the ability of the Saudi state to implement renewable energy policy. As outlined above, the state institutions are mostly parallel entities that do not cooperate with each other on a horizontal level, but report upwards to the ruling elite who make decisions and policies. The fragmented nature of the state and the weak ability of cooperation on a horizontal level, between institutions and agencies, make implementation of policies that require widespread cooperation and coordination between many entities very difficult. The 'veto' power of the individual bureaucrats and their power to subvert the implementation of policies decided on by the elite can further be a barrier. Policies that are limited to fewer entities and institutions are usually more successfully implemented, as are policies and projects delegated to and under the control of the 'islands of efficiency', such as Saudi Aramco.

This system and structures have important implications for the feasibility of implementing renewable energy in Saudi Arabia. As a widespread diffusion of renewable energy in the country involve several other sectors than the energy sector itself, like the educational, the economic, the industry and the labor sectors (which will be discussed in the corresponding sections below), this means that the responsible institutions and ministries will have to be involved and cross-cutting cooperation between various government entities will be required. Looking to the literature and Hertog's description of the Saudi Arabian institutional feasibility of system wide reform, it does not bode well for the required horizontal cooperation needed

for the spread of RE, with all this entails when it comes to managerial capabilities, efficient communication and agreement on how to implement policies. Saudi politics is highly opaque and the exact workings of the ministries and institutions difficult to analyze.

Hertog provides some concrete examples of the outcome of reform and explains that the privatization of the Saudi Telecom in 2003 was conducted in a successful manner, while the regulation of the Saudi labor market was not.[105] He argues that the variation in outcomes cannot be explained through general observations of the Saudi political system, but is a result of the complex system that has grown out the rentier processes that has built the Saudi political system. To figure out why some projects and policies fail, why others succeed, one must trace the distributive rentier processes in detail and understand the exact casual mechanisms that guide the different institutions and entities. While some are highly efficient, others are slow, lack the necessary competency and are held back by rent-seeking individuals who are not able or willing to do what's required to implement policy. The fragmented bureaucracy and fiefdoms created through the historical distribution of rents has led to low institutional capabilities.[106] An extensive fieldwork would be required to assess to what degree the institutions and individual bureaucrats in the system would enable the implementation of renewable energy and perform their related tasks, and as neither I nor anyone else have conducted such a fieldwork, we are left guessing how institutions and individuals will perform their job of implementing the renewable energy policies and if or to what degree they would obstruct these policies, and thus their effect on the implementation of renewable energy policies remain somewhat unclear.

If we look to past attempts of policy implementation however, it is possible to draw tentative conclusions. A highly relevant and recent example can be seen in King Abdullah City for Atomic and Renewable Energy's (KACARE) failure of kick starting the renewable energy transition in Saudi Arabia. This initial renewable program was headed by KACARE, but also involved numerous other entities like the ministries of oil, finance, water and electricity and companies like Saudi Aramco, Saudi Electricity Company (SEC) and the Electricity & Cogeneration Regulatory Authority (ECRA). Additionally, the Saudi Industrial Development Fund (SIDF), the National Cluster Development Program (NICDP), the King Abdullah

[105] Ibid., 2.
[106] Ibid., 2-6.

University of Science and Technology (KAUST) and King Abdulaziz City for Science and Technology (KACST) were responsible for economic and R&D activities. [107]

The share number of involved parties, as well as the missing regulations for cooperation and responsibility that generally have been evident in the Saudi government and between the relevant actors in the political system, was also the principal cause of KACARE's failure. This is confirmed by several sources as they commented on the lack of progress and postponement of KACARE's 41 GW target[108] from 2012 and the first bids for the solar projects. An anonymous Saudi government official pointed to the problem of actually deciding on and implementing policies after goals are set as he stated that "It hasn't been approved yet, we are in a waiting mode … There is a divergence of views. Everybody agrees on the goals, but they have different ideas on how to implement them."[109] Imtiaz Mahtab, the president of the Middle East Solar Industry Association (MESIA), further elaborates on the barrier stemming from unclear relationships between relevant bodies and states that "The key issue is K.A.Care does not belong to any particular ministry leading the initiative and does not have the balance sheet to conclude power purchase agreements directly"[110] a notion corroborated by another industry source who said that "The biggest obstacle, however, is bureaucratic. K.A.Care's relationship with the powerful ministries of electricity and oil was never clearly defined, meaning that no single department was put in charge."[111] Yet another industry source corroborates this notion as he comments on KACARE's failure:

> The Saudi renewables program had long been marred by deep-running dissonances and contradictory claims to power over the program among numerous government entities, with the eventual result that nothing was done at all. The nail in the coffin of the renewables program was that it involved so many departments.[112]

Various sources underline the bureaucratic problems described by Hertog, and KACARE's failure of implementing renewable energy appears to stem from bureaucratic infighting and lack of cooperation between the institutions in the Saudi political system.

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[107] Moritz Borgmann, "Potentially Game-Changing Saudi Arabian Government Restructuring Bolsters 9.5 Gw Renewable Energy Target by 2023," Apricum, https://www.apricum-group.com/saudi-arabia-announces-9-5-gw-renewable-energy-target-new-king-salman-renewable-energy-initiative/.
[108] This target refers to the governments initial goal to install 41 gigawatts of solar electricity by 2032
[109] Reem Shamseddine, "Disagreements over Scope and Ownership Delay Saudi Solar Projects," *Reuters* 2015.
[110] Ibid.
[111] Ibid.
[112] Borgmann.

Overcoming the bureaucratic hurdle?

Has the government learned anything from this and are they attempting to overcome this barrier of bureaucratic sluggishness? It seems so. In order to realize the Saudi Vision 2030, the government is taking steps to reform the bureaucracy and has created a program especially to overcome the bureaucratic barrier to reform and policy implementation. The program for 'Strengthening Public Sector Governance' describes how they will streamline the public offices and decision making, increase their managerial capabilities and increase knowledge based decisions:

> We will work on restructuring our government agencies continuously and with flexibility. We will eliminate redundant roles, unify efforts, streamline procedures and define responsibilities. We shall also enable our agencies to deliver on their mandate, to be accountable, to ensure business continuity and to show adaptability in the face of new challenges.[113]

As these highly ambitious plans are not yet implemented in their entirety; only time can tell if they will succeed and enable a smoother transition to renewable energy. There are signs that they are serious about reform, as can be seen in the government's huge restructuring of its ministries in 2016. The National Transformation Program holds that a total of 21 ministries have been successfully restructured in order to achieve the following objectives from the SV 2030: "achieve the highest levels of transparency and good governance in all sectors and improve performance, productivity and flexibility of public authorities."[114]

The restructuring has its own program, The Government Restructuring program, and the process is done in order "to speed strategy development and decision-making, as well as enhance performance."[115] They have also eliminated supreme councils and established the Council of Political and Security Affairs and the Council of Economic and Development Affairs.[116] Even more relevant for the energy sector, they have created a new energy 'super'-ministry, namely the Ministry of Energy, Industry and Mineral Wealth, combining what was formerly the Ministry of Petroleum and Mineral resources with the industry portfolio of the Ministry of Commerce and Investment and also adding the electricity portfolio from the old

[113] Vision 2030 Kingdom of Saudi Arabia, "Vision," Vision 2030 Kingdom of Saudi Arabia, http://vision2030.gov.sa/en/node/125.
[114] The Kingdom of Saudi Arabia, "The National Transformation Program 2020," (Riyadh2016).
[115] Vision 2030 Kingdom of Saudi Arabia.
[116] Ibid.

Ministry of Water and Electricity. In charge of this new energy ministry is Khalid al-Falih, the former chairman and CEO of Saudi Aramco. He commented on the restructuring saying that "the energy sector is being completely restructured to include an autonomous board of regulators, and with privatized generation capacity."[117] This restructuring can be a very positive step in overcoming the bureaucratic barrier to renewable energy, as the responsibility of the process is now limited to one ministry. Furthermore, they have created a special office in charge of renewable energy, and while this can seem like a case of what Hertog calls layering of the state – adding more entities and thus further bloating the bureaucracy, this office operates directly under the energy ministry and might not be hindered by bureaucratic sluggishness.

The Renewable Energy Project Development Office (REPDO) is working to deploy renewable energy projects through the National Renewable Energy program (NREP)

> and serves to deliver renewable energy across the Kingdom in line with Vision 2030 … The committee brings together heads of the various Kingdom stakeholders involved in energy research, measurement, data acquisition, regulation and predevelopment including, King Abdallah City for Atomic and Renewable Energy (KACARE), Electricity and Cogeneration Regulatory Authority (ECRA), Saudi Aramco and the Saudi Electricity Company (SEC).[118]

The head of the office, Turki al-Shehri, says that after previous delays "the solar program is back on track under the direct management of the energy ministry"[119] and has absorbed authority over the renewable energy program from KACARE. He further states that the establishment of the office and the process of tendering solar projects, (which is already underway), is a "testimony to the fact that we're serious. These tenders have years of pre-development work. Putting out a tender is easy. Putting out a good tender requires work."[120]

Based on Hertog's analysis of reform feasibility, the Saudi state will be most successful with implementation of policies and projects that are limited to one or a few ministries or

[117] Times of Saudia, "Saudi Seeks 10% Renewable Energy in Six Years: Minister – Daily Mail," *Times of Saudia* 17.04.2017.
[118] Industry and Mineral Resources Ministry of Energy, "Renewable Energy Project Development Office " Ministry of Energy, Industry and Mineral Resources https://www.powersaudiarabia.com.sa/web/index.html.
[119] Reed Landberg, "Saudi Arabia Sees 7,000 Jobs Coming from Solar Program by 2020," Bloomberg, https://www.bloomberg.com/news/articles/2017-04-26/saudi-arabia-sees-7-000-jobs-coming-from-solar-program-by-2020.
[120] Ibid.

companies, and especially if they are delegated to 'islands of efficiency'. Therefore the creation of the new energy ministry and the REPDO can be seen as a significant step in overcoming the bureaucratic barrier, and it will be very interesting to see if they can follow through on their ambitious goals. As the pressures to diversify their economy and become more sustainable increases, the Saudi motivations for change must be even bigger than their initial attempt, and their actions do show that they are more serious this time around.

Saudi Aramco, the prime example of a Saudi 'island of efficiency', will also be a leading actor in the renewable energy efforts as well as in the implementation of the Saudi Vision 2030. The company's role in the development of the Saudi state is describes as extremely important: "Saudi Aramco has been a critical agent for the social, economic and infrastructural development of Saudi Arabia; its managerial capacities are unrivalled in the Kingdom – and, indeed, the Gulf region."[121] Saudi Aramco has vast experience with energy projects and has a proven track record of impressive results. A relevant objection to their ability to lead renewable energy projects is that their experiences are within the field of fossil fuels. They are, however, working to diversify their portfolio, and are cooperating with Masdar – one of the largest clean energy projects in the MENA region, as will be further discussed below, to secure the needed skillset and knowledge for the implementation of large-scale renewable energy projects.

The macro-level of the political system

The political system in Saudi Arabia is top down, highly personalized and authoritarian. Power and decision-making "at the very top-level remains the prerogative of a handful of senior princes"[122], and this is also the case for decisions regarding energy policy. The authoritarian character of the state and the limited number of decision-makers could thus enable swift decision-making regarding the future trajectory of the energy-system and policy, without having to go through democratic processes that would protract the process. Without forgetting the meso- and micro-levels' power to subvert and veto policy implementation, it is very important to understand the macro-level of the Saudi political system, as decision are made in this level, and nothing will happen without the involvement of the senior princes in

[121] Steffen Hertog, "Saudi Aramco as a National Development Agent: Recent Shifts," (2013).
[122] Madawi Al-Rasheed, "Circles of Power: Royals and Saudi Society," in *Saudi Arabia in the Balance - Political Economy, Society, Foreign Affairs*, ed. Gerd Nonneman and Paul Aarts (London: C Hurst & Co Publishers Ltd., 2005), 199.

the macro-level. Hertog suggests that an important factor in previous examples of successful policy implementation has been senior figures spurring the system into action."[123]

And this is exactly was is happening in Saudi Arabia today, where the young deputy crown prince Mohammed bin Salman, often referred to as MbS, is spearheading the hugely ambitious reform efforts in the country. MbS recognizes his power, saying that "in pushing for change, Saudi Arabia has the benefit of authoritarian rule. There is an advantage to quickness of decision-making, the kind of fast change that an absolute monarch can do in one step that would take a traditional democracy 10 steps."[124] He is the main architect behind the Saudi Vision 2030 and is driving change full steam ahead and has already implemented drastic austerity measures in an effort to rebalance the Saudi economy in the face of low oil prices.[125] Many see the SV 2030 and MbS' efforts towards reform as a vehicle for personal ambition and a way to enhance his power relative to other senior princes in order to move up in the succession to the throne.

In 2016 MbS moved up the succession line after a reshuffling of the senior princes, making him the country's number three official, right after his father King Salman and his cousin Mohammed bin Nayef, the crown prince. MbS was given some of the most important ministerial positions in the country[126], and travels throughout the world representing Saudi Arabia in the place of his father, effectively strengthening his power.

MbS is a hugely important driving force behind the SV 2030 as well as the renewable energy initiative, however, a relevant question will be if other princes or senior figures would be equally invested in this process, and if the power balance is yet again reshuffled – what would that mean for the progress of renewable energy?

The current energy system is based on oil and many of the most powerful decision makers in the country have vested interests in the fossil fuel industry. The opaqueness and lack of transparency surrounding both the distribution of the oil wealth in the Saudi state, and the decision making structures for new policies, makes it difficult to pinpoint exactly how the state of carbon lock-in works to hinder renewable energy policies aiming to replace the old

[123] Hertog, *Princes, Brokers, and Bureaucrats - Oil and the State in Saudi Arabia*, 249.
[124] David Ignatius, "A 30-Year-Old Saudi Prince Could Jump-Start the Kingdom — or Drive It Off a Cliff," *The Washington Post* 28.06.2016.
[125] Mark; Hubbard Mazzetti, Ben "Rise of Prince Mohammed Bin Salman Rattles Saudi Arabia," *The Times of India* 17.10.2016.
[126] He is minister of defense, chief of the House of Saud royal court, chairman of the Council for Economic and Development Affairs and in charge of Saudi Aramco.

system. However, one must assume that there are top-level actors who are working to protect their interests and oppose renewable energy policies in the Saudi system.

Regime stability vs. democratization: governance effects of renewable energy systems

The effects of renewable energy on regime stability will not be possible to assess until widespread diffusion have actually taken place, but some questions or aspects relating to this issue can still be interesting to consider, as oil is closely connected to regime power and stability in Saudi Arabia and moving away from oil and towards renewable energy and how this effects governance must be on the regime's agenda – if not openly debated.

As mentioned previously, one of the sources of legitimacy for the Saudi regime is the ruling bargain and the distribution of oil wealth, although this social contract might not be as rigid as many studies have predicted - a notion that will be further elaborated on and discussed in the section on double subsidies below.

Several scenarios for transition from oil to renewable energy can be considered, from a full transition to RE to smaller quotas of RE being introduced into the energy mix, where governance effects will be different pertaining to the scenario in question. And although it is not within the scope of the thesis to assess all possible scenarios and their governance effects, and because such discussions would also be hypothetical as Saudi Arabia has not yet transitioned, a brief discussion of how governance and energy is connected can be of relevance to better think about their policy choices and possible outcome of a spread of renewable energy in the country.

If, and rather when, the oil revenues will come to an end or lessen considerably, a very relevant question is how the government will act to preserve the social contract, or alternatively how they will try to change it. The other sources of legitimacy and ways of retaining power – through repression and the alliance with the religious establishment, the ulama, will probably not suffice in the face of diminishing oil revenues and consequently the inability to provide for their citizens. In such a scenario, (with decreasing oil revenues and inability to provide the welfare goods and services the population is used to), the question seems to be *when* and not *if* this will lead to social unrest, increased political protests and instability. Seeking to forestall such effects however, the Saudi government is planning to diversify the economy away from oil and one of their most important initiatives in order to

secure future revenues is the planned public offering, or initial public offering (IPO), of Saudi Aramco, the world's largest oil company. By selling under 5% of the company and raising what Saudi officials (unrealistically) predict to about $2 trillion[127], they want to create an investment fund and secure revenues through investments, and thus secure future welfare distributions. A major challenge to an IPO, however, is the lack of transparency surrounding the company, which might deter foreign investors. In the Saudi Vision 2030, the government is promising to become more transparent; however such transparency might be difficult to implement and could cause opposition if people would be able to trace the exact lines between various distributions, patronage relationships and most importantly the enormous wealth of the rulers accrued from oil revenues.

With the Saudi Vision 2030, it seems like the government is in fact also looking to make certain changes to the social contract, by cutting subsidies (which will be discussed in the section on subsidies) as well as reducing public sector salaries and generally by demanding more of people. [128] This is explicitly stated on the SV 2030 webpage which reads:

> The nation we aspire to build will not be realized without a grand, collective national effort where everyone contributes. We all have roles to fulfill, whether we are working in the public, private or non-profit sectors. We will therefore work continually to achieve our hopes and fulfil our aspirations and responsibilities to our country, our society, our families, and to ourselves.[129]

This is further elaborated and connected to the people's responsibilities to contribute and step up in various spheres like business, society and family. It seems that the question is not whether we will see a change in the relationship between the state and society, but rather when and how this will happen. According to the Saudi government, this process should ideally start now with the implementation of the vision objectives.

The changes stated above are more generally connected to the transition away from old as well as wide-ranging reform of the Saudi state and society. While the demands and changes in, for example, subsidies will create a more even playing field for renewable energy to enter

[127] Some analysts are skeptical of this sum and predict the value to be much lower, about $1 trillion. Fortune, "Saudi Arabia's Latest Move Could Lift the 'World's Biggest Ipo' to $2 Trillion," Fortune, http://fortune.com/2017/03/28/saudi-arabia-aramco-ipo-tax/.
[128] Vision 2030 Kingdom of Saudi Arabia, "National Transformation Program 2020," (Vision 2030 Kingdom of Saudi Arabia), 24.
[129] "An Ambitious Nation Responsibly Enabled," Vision 2030 Kingdom of Saudi Arabia, http://vision2030.gov.sa/en/node/12.

the market (which will be discussed below), and are thus relevant for a broader discussion of the changes needed to implement RE, I will now turn to a discussion of more concrete governance effects of renewable energy.

In Saudi Arabia, the fossil fuels and energy sector is tightly controlled by the regime through a highly centralized government apparatus. A corresponding question regarding the implementation of renewable energy is whether such centralized control can be retained, or if power will become more decentralized and thus lessen the regimes power and control, which may potentially pave the way for a more democratic, or participatory, political system. Kumetat discussed this issue in his study and suggests that "whether an assumed causal nexus from decentralized energy production to a democratic political system can actually be established at all, must remain doubtful" arguing that this appears to be a projection of Western concepts into the MENA region. As Saudi Arabia already is using repressive means to tackle opposition, we probably have reason to believe they would forcefully cling to power, using whatever means necessary to fight opposition. There are numerous examples of use of excessive violence to punish those opposing the regime and intolerance of opposition, as was seen in the regime's crackdown on the uprising in the Eastern province.[130] The authoritarian regime type, and the government's reluctance to make exemptions from or widen political rights in the country, also suggests that if they suspected that renewable energy could challenge their power, then they would not choose to implement it. Most likely they will find a way of centralizing power also over the renewable sector, in order to remain unchallenged. If Saudi Arabia was to subsidize widespread implementation of small-scale decentralized renewable energy systems, like solar roof top and storage systems, or local community-based RE systems, this could perhaps empower the individual owner and consumer to some degree. Such plans has not, yet, been on the agenda in the country. As Kumetat argues, it is more likely that "an industry-scale, state-induced and -controlled spread of renewables"[131] would be pursued by the MENA states resulting in "a Middle Eastern form of environmental authoritarianism and a continuation of a state-controlled, centralized form of power generation" which will not allow for a democratization of the political system. [132]

[130] Toby Matthiesen, "A "Saudi Spring?": The Shi 'a Protest Movement in the Eastern Province 2011–2012," *Middle East Journal* 66, no. 4 (2012).
[131] Kumetat, 81.
[132] Ibid.

It is doubtful that the Saudi state will manage to retain the same degree of centralized control of the power generation in the long-term with a proliferation of renewable energy. In a scenario where the domestic energy demand is supplied with renewable energy in its various forms and prices for renewables drop, the task of control will become daunting and unmanageable – especially as demand rises. It is unlikely that they will ban solar panels and local energy storage for private consumption if these technologies are cheap and readily available. A parallel could be drawn to the proliferation of the internet and the social media, which has democratized the mass media. Despite governmental efforts to censor and control information online, the new platforms and the wide reach and sheer size of the internet has proven to be incontrollable – an effect we might see with a proliferation of renewables. Furthermore, it is unlikely that exports of renewable energy, which is envisioned by the Saudi government, can generate the same amount of revenues as export of oil. It is thus unrealistic that the Saudi government can recreate the rentier state, with control over, and export of, renewable energy. While Kumetat's predictions might be right in the short-term, he might be underestimating how new energy technology can change state-society relations in the long-term.

3.2 Regime-level factors

3.2.1 Technological regime

Challenges for the power sector

Taking into account the rising energy demand in Saudi Arabia, as described in chapter 2, which will require an additional 4 GW generation capacity every year to meet the rising demand, it becomes obvious that the Kingdom will need to increase its energy production substantially. The potential of renewable energy sources of contributing to meet the domestic energy demand is great, and can help alleviate the current strain on the economy and the environment. Both the residential sector and the growth of the local economic sector depend on stable and increasing energy supply. This potential can thus serve as a driver for diversifying the energy mix by installing RES and adding them to the national grid. This notion is recognized by Khalid al-Falih, who is both chairman and former president of Saudi

Aramco, and currently serves as Minister of Energy, Industry and Mineral Resources. In a recent press release he states that their recent efforts towards implementing renewable energy

> "... marks the starting point of a long and sustained program of renewable energy deployment in Saudi Arabia, that will not only diversify our power mix but also catalyze economic development and support long-term prosperity in line with Vision 2030's goals which include creating a new renewable industry and support the buildup of this promising sector."[133]

Although the Saudi Kingdom has been planning to add RE to the energy mix for quite some time, the progress has been slow. In fact the current contribution of RES to the total energy production is very low, with sources disagreeing somewhat about the number, but suggests 17 MW[134] - 23 MW[135]. Comparing this to the current consumption which is X, the need for an additional 4GW a year, it becomes apparent that they are far from realizing the lofty goals stated in official announcements and far from contributing substantially to supply the increasing demand.

There are, however, signs of more serious efforts to speed up this process and actually begin to install more solar energy. The Renewable Energy Project Development Office (REPDO) of Saudi Arabia's Ministry of Energy, Industry and Mineral Resources is in charge of the National Renewable Energy Program (NREP) which is working to substantially increase the share of RE in the energy mix, with the stated goal to increase the share from 0 to 4 percent by 2030[136]. This will mean to realize the goals stated in the National Transformation Plan and Saudi Vision 2030 of namely 3,45 GW by 2020 and 9,5GW by 2023. The NREP will include a total of 30 projects that together will produce the 9,5 GW. These goals will be further described in detail in a section below, *Renewable energy targets and actual performance*, where strategic documents and targets will be described and discussed.

[133] Industry Saudi Arabia's Ministry of Energy, and Mineral Resources, "Saudi Arabia's Ministry of Energy, Industry, and Mineral Resources Issues First Request for Qualifications for Round 1 Projects of the National Renewable Energy Program (Nrep)," news release, 20.02.2017, https://www.powersaudiarabia.com.sa/web/attach/news/RFQ_Press_Release_SaudiArabiaMinistryofEnergy.pdf.
[134] Philippe Chite and Ali Ahmad, "Solar Power in Saudi Arabia: Plans Vs Potential," (2017).
[135] Tsvetomira Tsanova, "Acwa to Bid in S Arabia's Solar Tender - Report," Renewables Now, https://renewablesnow.com/news/acwa-to-bid-in-s-arabias-solar-tender-report-566426/.
[136] Kingdom of Saudi Arabia: National Renewable Energy Program (NREP), "The Nrep Is Now Tendering " https://www.ksa-climate.com/nrep.

The largest project to date is the Sakaka solar project in Al-Jouf in the north of Saudi Arabia, which is part of the King Salman Renewable Energy Initiative.[137]

Initially the Saudi authorities aim to procure respectively 700 megawatts (MW), 1.02GW and 1.73GW through three rounds of tendering, starting in 2017. The first steps have been made and unlike previous RE initiatives, concrete follow-up steps have been taken at the announced timeline. In fact, the first round of choosing developers for the planned projects has already been completed. In the first round, request for qualifications (RFQ) were made, and companies made bids so that the NREP could assess who had the technical and financial capabilities to execute projects of this scale. This process resulted in 27 shortlisted companies who have moved on to round two, where they are now asked for request for proposals (RFP) for a 300MW solar PV and RFP for a "400MW wind project due to be released in weeks".[138]

Saudi Aramco, the national oil company, has also contributed to the process of developing the renewable energy sector and aims to diversify their portfolio to also include renewable energy. The government has given Saudi Aramco a crucial role in the diversifying the country's energy mix. The company is planning to invest 5 billion dollars in renewable energy firms and further to produce 10 GW of power from renewable energy sources by 2023[139]. Saudi Aramco has already installed a small solar plant of 10 MW on top of a parking lot at its headquarter, and has demonstrated the integration of solar PV and solar CPV at their facilities and completed several pilot projects including one of the world's largest solar carport systems. To take advantage of the exceptional wind energy in the country, which is claimed to be "among the best worldwide with wind capacity twice the global minimum in numerous areas in Northern and Northwest regions"[140], the Saudi authorities recently inaugurated the country's first wind turbine capable of supplying the energy needs of "250 homes, and with the potential to displace 19,000 barrels of oil equivalent."[141] In the field of R&D they have

[137] Renewable Energy Project Development Office, "Saudi Energy Minister Announces 'New Phase' in Kingdom's Power Generation as First Round Bids for Renewable Energy Projects Opened," news release, 17.04.2017, https://www.powersaudiarabia.com.sa/web/attach/news/Press-Release-SAREIF-17%20April-EN.pdf.
[138] Ibid.
[139] Matthew Martin, "Saudi Aramco Said to Weigh up to $5 Billion of Renewable Deals," Bloomberg, https://www.bloomberg.com/news/articles/2017-01-29/saudi-aramco-said-to-weigh-up-to-5-billion-of-renewable-deals.
[140] Mohammed Rasooldeen, "Al-Falih Announces Package of Renewable Energy Projects," *Arab News* 17.04.2017.
[141] Ibid.

Not only does this process show that Saudi Arabia is actually starting to implement their strategies in order to reach their stated goals on renewable energy and thus reduce pressure on the domestic conventional power plant park, but this process could also help to provide more jobs and strengthen the private sector if local Saudi Arabian companies are chosen for the 300MW solar and 400MW wind projects. This will be further discussed in the relevant sections. These initial steps taken towards the renewable energy goals set in the Saudi Vision 2030 and the initiatives from the NTP show that there is political will to realize a spread of renewable energy in the country. The steps taken by Saudi Aramco also show that the entrepreneurial function 1 from al-Saleh is enabled and as Saudi Aramco is one of the largest and most important and influential companies in the country, especially in the energy sector, and their activities towards implementing renewable energy is very important. Thus they have started a process of overcoming the barrier of 'lack of entrepreneurial spirit'. As the government is behind the SV 2030, the NTP and the following initiatives, this also shows that they have come far in overcoming the barrier 'limited knowledge of renewables among Saudi leadership'.

Renewable energy and the nuclear alternative

Nuclear energy is another source of energy that can help to counter some of the challenges Saudi Arabia is facing; by adding nuclear energy to the energy mix, they can free up more oil for export and secure the supply for the increasing domestic energy demand. There are several ways in which nuclear energy differ from renewable energy however, and while I will not assess which energy source is the best option for Saudi Arabia, I will briefly outline some of these differences to provide a limited understanding of this source's characteristics.

Nuclear power plants can be governed in a similar centralized, top-down structure as the oil industry in Saudi Arabia, which fits well with the authoritarian system and also with the 'islands of efficiency'.

There are several obstacles and concern with nuclear energy however. Initial costs for construction of the nuclear plants are very high and might be difficult to provide with the Saudi budget being heavily strained by low oil prices and consequently revenues. Such plants also need massive amounts of water for the plants to operate which is a problem in a country already struggling with water scarcity. Further, the lack of sufficient number of competent Saudi nuclear engineers is a challenge, and Saudi authorities would probably have to import

the necessary skills to engineer and operate the plants. As Saudi Arabia is aiming to 'saudize' their workforce, education of Saudi nationals seems like the most likely alternative. Training and educating the needed native workforce is a slower process than importing the necessary skills however and could mean a protracted process for the deployment of nuclear energy.[142] There are also environmental and safety concerns with the nuclear option, as observed in the many discussions on the nuclear endeavors in Iran and North-Korea, and in the wake of the Fukushima Daiichi nuclear disaster in Japan caused by a tsunami in March 2011.

Nuclear energy could be added alongside renewable energy to the energy mix in Saudi Arabia, but it could also be a competitor for RES, and thus hinder the spread of RES. It has been argued that adding nuclear electricity to an energy system prevents a wide-spread deployment of renewable energy.[143]

It is therefore interesting to see if and to what degree the nuclear option is considered in Saudi Arabia. The best indicator of the expected role of nuclear energy in the future energy mix of Saudi Arabia seem to be its role in the energy targets as described in the Saudi Vision 2030, the National Transformation Program and in the webpage of the Ministry of Energy, Industry and Minerals, as well as recent statements made by top decision-makers. Indicatively, there is no mention of nuclear power in SV2013. In comparison, renewable energy is mentioned several times. Moving on to the NTP gives a different result and nuclear energy, or atomic energy is described as a part of the energy future in the country. It follows up on a strategic objective of SV 2030, namely to "Enhance competitiveness of energy sector" by aiming to introduce atomic energy to the national energy mix and to do this in a safe manner, compliant with international and national safety and security standards.[144] Another goal is to localize or saudize the local content contribution, by raising the local workforce in the industrial and service value chains, as well as expertise in technology to 30% by 2020. The number of jobs they aim to create is somewhat unclear, as this number of jobs is provided as a total for the nuclear and renewable energy sector together and it is not discernible how the jobs will be divided between the two sectors. The total number is roughly 7,800 by 2020. To realize these goals, The Council of Economic Development Authority has included them in a five year budget plan with earmarked governmental funding. Under the auspices of KA.CARE, legislation and human capabilities for the atomic sector will be developed, as well as sites and

[142] Brooke Anderson, "Saudis Make Push for Nuclear Energy," *The Wall Street Journal* 15.09.2015.
[143] Kumetat, 99.
[144] Vision 2030 Kingdom of Saudi Arabia, "National Transformation Program 2020," 74.

infrastructure for the nuclear power plants and reactors. This is in line with a statement by the energy minister, Khalid al-Falih, in January 2017 where he confirmed that "significant investment in nuclear energy was on the Saudi agenda saying that they were in the early stages of feasibility studies for two nuclear reactors totaling 2,8 GW."[145]

In all instances, nuclear energy is mentioned not as mutually exclusive to renewable energy, but as complimentary to RE. Saudi authorities aim to incorporate both energy sources into the energy mix, and nuclear energy is not portrayed as a competitor to renewable energy. In fact nuclear energy is presented in a similar fashion as RE when it comes to the environmental gains and its 'clean' character and as part of a sustainable energy future.[146] There seems to be no open disagreement among the top leaders and institutions regarding the choice of new energy sources, and nuclear and RE are often referred to in the same context of diversifying the national energy mix. The possible safety concerns and opposition to nuclear energy among the population is not known, and how the opinion, whether accepting of nuclear energy or not, affects the nuclear options viability is therefore difficult to discuss. KACARE is nevertheless observant of this factor and aims to instill "a comprehensive understanding of the safety culture […], not only into our employees, but also to the population in general in order to overcome whatever concerns they may have."[147]

3.2.2 User and market regime

Market conditions

In order for renewable energy technology to be able to enter the market and become the major source in the energy mix, it needs to be competitive/compete with the existing source of energy. In Saudi Arabia, "virtually all of the [...] domestic power currently comes from crude, refined oil or natural gas".[148] As the current oil-based energy system is heavily locked-in in Saudi Arabia, with many vested interests in the current system, RET need to become cost-competitive to be more attractive and be able to compete with the current energy system. It is not enough that RETs are environmentally sustainable or contributes to a better and greener country image; it needs to be able to provide profit for investors. As discussed in the section

[145] Fortune, "Saudi Arabia Says It's About to Launch a $30-$50 Billion Renewable Energy Program," Fortune, http://fortune.com/2017/01/16/saudi-arabia-renewable-energy-program/.
[146] K.A.CARE, "Atomic," https://www.kacare.gov.sa/en/FutureEnergy/Pages/nucularpower.aspx.
[147] Ibid.
[148] Times of Saudia.

about the seven functions that should be in place for a successful spread of renewable energy technologies, a niche technology such as RET might need to be protected and helped along by the means of a protected space where it can grow and be tested and matured through pilot projects, tests and demonstrations. Further, it needs investments and funding. This notion is reflected in several sources, among them an IRENA report from 2016, which suggests that the GCC states' ability to successfully deploy and exploit the potential of renewable energy depends on both long-term policies and "the creation of a stable and transparent regulatory and investment climate to support early deployment".[149]

Developments and improvements are contributing to lower the prices of RES prices. The price gap between fossil fuels and RETs are becoming smaller by the minute, and renewable energy is expected to outcompete fossil fuels on cost in the near future.[150] In some areas, solar energy has already reached prices competitive with imported gas as could be seen in the remarkably low bid to build a large solar farm in Abu Dhabi in 2016[151]. The development in the cost-competitiveness of RET is expected to grow and before long RE is expected to be the cheapest source of energy. Despite decreasing prices, renewable energies are currently not fully entrenched in the energy mixes around the world, and are not sufficiently cost-competitive and will need to be promoted by policies and measures to help them become competitive.

There is also a need to solve the problem of intermittency, because the renewable energy sources solar and wind cannot produce a steady and secure supply throughout day and night. Electricity from solar depends on the amount of sunshine or solar radiation, and is affected by dust, cloud cover and night time, which will lead to lower amounts of electricity. Energy storage technologies for utilitites are not yet cost competitive, as mentioned initially. Hence, Saudi Arabia will have to secure supply of the energy demand through other energy sources until energy storage solutions become available.

When planning to install and develop a renewable energy sector in Saudi Arabia, they will need substantial funding as initial cost can be high, and vested interests are protecting the oil-based energy system. This funding will need to come from both the private and public

[149] The International Renewable Energy Agency, 22.
[150] Ian Johnston, "India Cancels Plans for Huge Coal Power Stations as Solar Energy Prices Hit Record Low," *Independent* 09.05.2016.
[151] Katie Fehrenbacher, "A Jaw-Dropping World Record Solar Price Was Just Bid in Abu Dhabi," Fortune, http://fortune.com/2016/09/19/world-record-solar-price-abu-dhabi/.

sector.[152] As mentioned, Saudi Arabia has not succeeded in creating an attractive environment for foreign investments until now and need to make changes in their policies in order to attract such investments as well as funding and investments from the private sector. Policies or tools that can help promotion are numerous, including reducing or removing taxes for RE, raising the prices of power, green certificates, subsidization of RE, feed-in-tariff (FIT) and creating a favorable business condition.[153] Various support schemes have been implemented across the world to promote the spread of renewable energy. Al-Saleh recommended several policies suitable for promoting RE in Saudi Arabia in his study and also suggested the need to phase out subsidies for electricity generated from fossil fuels, allocate funding for the development of RE and introduce financial incentives.[154]

A regulatory framework will be very important for Saudi Arabia to move forward with their renewable plans. Laws regulating the sector and providing concrete guidelines for investment and implementation will have to be adopted. Feed-in tariffs (FIT) is a policy tool which can help renewable energy producers by offering cost-based compensation through long-term contracts. FIT has been recommended as the most suitable support mechanism to help spread renewable energy in Saudi Arabia[155] and was on the agenda when KACARE where making their initial renewable energy plans in 2012[156], but FIT was never adopted and is still not implemented.

Discussing the regulatory framework for renewable energy in 2017, a source at the Saudi Electricity Company (SEC) said that Saudi Arabia's future renewable power plants will be based on independent power purchase (IPP) contracts and that SEC will commit to buying all the electricity generated from the renewable energy plants, and further envisioned the involvement of the private sector.[157] But FIT is not yet on the agenda. There are also plans to establish a new company, independent from SEC, that will buy electricity from all suppliers with long-term contracts[158], but also this remains a plan to be realized in the future.

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[152] S. A. Al-Ajlan et al., "Developing Sustainable Energy Policies for Electrical Energy Conservation in Saudi Arabia," *Energy Policy* 34, no. 13 (2006).
[153] Kumetat, 102-03.
[154] Al-Saleh, 317.
[155] Makbul A. M. Ramli and Ssennoga Twaha, "Analysis of Renewable Energy Feed-in Tariffs in Selected Regions of the Globe: Lessons for Saudi Arabia," *Renewable and Sustainable Energy Reviews* 45 (2015).
[156] Paul Gipe, "Saudi Arabia Launches Massive Renewable Program with Hybrid Fits," *Renewable Energy World* 15.05.2012.
[157] Ilias Tsagas, "Wfes 2017: Saudi Arabia Announces New Energy Master Plan," *PV Magazine* (17.01.2017).
[158] Mubasher, "New Saudi Company to Deal with Electricity Suppliers," https://english.mubasher.info/news/3092039/New-Saudi-company-to-deal-with-electricity-suppliers.

The fact that Saudi Arabia does not yet have a legal and regulatory framework in place to promote the renewable energy sector is a considerable barrier. A positive sign is that they are planning to implement such regulations – they will review the laws and regulations to allow private sector investments[159], but it remains to see if this will happen. Their electricity law does currently allow for IPPS but does not say anything specific about renewable energy which is a weakness in their effort to attract investments.

The system of double subsidies

In Saudi Arabia there exists a system of double subsidies which promotes fossil fuels and hinders the emergence of renewable energy. The system works in the following way: The national oil company Saudi Aramco sells fuels at subsidized prices to power plants that generate electricity, which in turn is sold at a subsidized price to the end consumer. Transportation fuels are also subsidized. This means that there are two subsidized transactions which create an opportunity cost. In other words, the fossil fuels and electricity is sold below market prices and both the oil company and the power plant is missing out on revenue they could have made if the oil and electricity were not subsidized but instead sold at market prices. More specifically, the power plants are said to be paying between 5 to 15 dollars per barrel of oil to the national oil company Saudi Aramco[160], a price which is substantially below the market price.[161] This shows the huge opportunity cost of consuming the oil at home at subsidized prices. The calculated 'lost' oil and gas revenues as a result of these subsidies were suggested to be over 80 billion dollars in 2011[162], and had risen to a cost of "$107bn, or 13.2 per cent of gross domestic product in 2015", according to the International Monetary Fund (IMF).[163] At a time of low oil prices and revenues, and consequently a huge deficit in the Saudi national budget, these 'lost' revenues could be of considerable financial help. Not only do the subsidies create an opportunity cost, but they also lock-in the fossil fuel-based energy system and lock-out renewable energy, as the subsidies create structurally favorable conditions for the fossil fuel system.

[159] Vision 2030 Kingdom of Saudi Arabia, "Vision 2030 Kingdom of Saudi Arabia," 49.
[160] Lane.
[161] A barrel of brent crude oil, which is the benchmark for a large part of the world's oil, is traded at $49,68 at the world's second largest stock exchange Nasdaq in June 2017, and has been traded at prices as high as $125 per barrel in 2011. See: Nasdaq, "Crude Oil Brent," http://www.nasdaq.com/markets/crude-oil-brent.aspx?timeframe=7y.
[162] Lane.
[163] Gefira, "Saudi Arabia Looks to Reform Energy Subsidy Programme " https://gefira.org/en/2015/11/13/saudi-arabia-looks-to-reform-energy-subsidy-programme/.

A huge barrier blocking the entry of renewable energy to the Saudi market and energy system is thus the subsidies of the fossil fuels. The subsidies of fossil fuel-based electricity are also highlighted as an important barrier in al-Saleh's study as well as several other studies as mentioned previously. To help overcome this barrier, it is necessary to remove or cut the subsidies for fossil fuels, integrate renewable electricity into the existing subsidy scheme or raise the price of energy, fuel and other welfare goods.

But removing these subsidies might come at a high political cost. The subsidies have been and still are a central part of the ruling bargain between the state and society, and a cut might be interpreted as a breach of the social contract and is a sensitive issue which potentially could lead to political unrest. [164]

A study of energy pricing reforms in the GCC countries finds that there are different risks of reform depending on whether the oil prices are high or low.[165] Regarding the political risk or cost, the authors argues that the highest feasibility of reform occurs when the oil price is low, as the price raise won't have to be too steep in order to adjust to the market price, which means a lower financial burden for the households and potentially lower risk of opposition to the price reform. Currently, the oil prices are low, which might make it slightly easier for Saudi Arabia to decrease the subsidies, than if the oil price was higher. However, in order to consider the political risk, one would have to know what the population feels about any changes being made at all. The authors discuss the relative difference between reforming energy prices at high or low oil prices and which of the two options is most likely to lead to political opposition, or conversely accept. They do not consider the possibility that the people might not accept changes at all, or where their limit is drawn. This will be important for the Saudi regime to consider however, in their efforts and plans to change the subsidies and to overcome the barrier in order to introduce renewable energy.

The subsidy barrier is recognized by the Saudi government, and has prompted the authorities to take action to create a level playing field for the different energy carriers in the country. This is explicitly expressed in the Saudi Vision 2030 and further developed with concrete initiatives in the National Transformation Program. In the Saudi Vision 2030 "We will continue modernizing our social welfare system to make it more efficient, empowering and

[164] Glada Lahn and Paul Stevens, "Burning Oil to Keep Cool - the Hidden Energy Crisis in Saudi Arabia," (London: The Royal Institute of International Affairs, 2011).
[165] Bassam Fattouh, Anupama Sen, and Tom Moerenhout, "Striking the Right Balance? Gcc Energy Reforms in a Low Price Environment," (Oxford: The Oxford Institute for Energy Studies, 2016), 2.

just. Subsidies for fuel, food, water and electricity will be better utilized by redirecting them towards those in need."[166] The NTP follows up on the objective from the SV 2030 to 'enhance competitiveness of energy sector' by aiming to cut subsidies of water and electricity by 200 billion Saudi Arabian Riyals (SAR)[167] which equals approximately $ 54 billion. The government has already started the process of raising subsidies and sharply raised the price of fuel, with petrol going from 0,60 to 0,90 riyals a liter – the price is still however among the lowest in the world.[168] Being mindful of the cost they are creating for the consumers when raising prices, they are trying to find the safe middle ground where they can cut subsidies without hitting the households too hard.

It seems a lesson was learned after a previous attempt at raising water prices caused uproar and public complaint.[169] This resulted in the minister of water and electricity being fired and the deputy crown prince Mohammed bin Salman describing "the ministry's implementation of the new water tariff as 'unsatisfactory'."[170] Consequently, the government aims to adjust their policies so that they can cut the subsidies while still financially support the poorest segments of the population. This is planned to happen through "a cash payments program to support Saudis with lower incomes as part of its effort to ease the pain of economic transformation."[171] Mohammed bin Salman further explains that they will cut subsidies to reach a free energy market, and instead introduce subsidy programs for people with low income.[172] Another Saudi official explains that they will extend existing welfare services like unemployment benefits to help the poorest, and also provide loans for businesses that will be affected by expensive electricity.[173]

The choice to introduce a cash payment program or subsidy program to help offset the negative economic impact on the poorest households will be probably be a smart move in order to avoid opposition, considering the predictions in the literature of possible political unrest as a result of changes in the social contract.

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[166] Vision 2030 Kingdom of Saudi Arabia, "Vision 2030," 29.
[167] The Kingdom of Saudi Arabia, 27.
[168] Anthony McAuley, "Saudi Arabia's 2017 Budget Seen Easing Cuts but Pushing Subsidy Reform," *The National* 21.12.2016.
[169] Bassam Fattouh and Amrita Sen, "Saudi Arabia's Vision 2030, Oil Policy and the Evolution of the Energy Sector," (Oxford: The Oxford Institute for Energy Studies, 2016), 4.
[170] Ibid.
[171] McAuley.
[172] The Economist, "Transcript: Interview with Muhammad Bin Salman," *The Economist* 06.01.2016.
[173] Gefira.

The Saudi government is undoubtedly aware of the potential political risk of changing the social contract and removing welfare goods from the citizens, and has until now been reluctant to make changes to the ruling bargain. It is widely assumed that breaching the social contract will lead to political unrest and the Saudi regime's hesitation to change it, is most likely a sign that they recognize the ruling bargain as essential to their regime's survival. Changes to welfare services have had negative consequences in the past, as described by Gurr in Krane: "declines in state benefits and social welfare are common triggers for political violence and even overthrow of governments."[174] The Arab spring with its revolts and uprisings is a point in case, where socio-economic grievances where among the triggering factors. To prevent the uprising in spreading to Saudi Arabia, they employed different measures, both repressive and financial – the state "began spending $130 billion to pump up civil servant salaries (paying two extra months' salaries), promising to build 500,000 additional units of low income housing, and substantially increasing its financial support for religious organizations."[175] It further prompted the Saudi regime to lay out long-term reform plans in order to gradually improve the living conditions for the Saudi population.

With the current slump in oil prices, the current fiscal situation in the Saudi Kingdom is not sustainable, however, the government is forced to start cut spending and raise prices, instead of increasing handouts. In this endeavor it will however be essential for the government to assess how elastic the social contract really is, and how far they can push the limits in terms of imposing financial burdens on the population.

In their evaluation and planning of how to successfully reform the energy prices, regional experiences with changing subsidies as well as previous experiments in the country might be worth considering. Similar recent attempt of lifting subsides in the region have had different outcomes; In the UAE they "managed to lift subsidies on petrol with no public backlash, but when Kuwait raised the price of kerosene, it had to make exemptions for bakers after they went on strike."[176] Saudi Arabia's own attempt at raising water prices was met with complaints as mentioned above. The reactions on lifting subsidies vary and the government must pay close attention to their population's opinion of this matter.

[174] Jim Krane, "Stability Versus Sustainability: Energy Policy in the Gulf Monarchies," *Energy Journal* 36, no. 4 (2015): 168.
[175] Mehran Kamrava, "The Arab Spring and the Saudi-Led Counterrevolution," *Orbis* 56, no. 1 (2012).
[176] Gefira.

In a study based on a survey of public opinion on subsidies and raising electricity prices in the GCC countries, Jim Krane has suggested that the social contract might be more nuanced than predicted in previous literature on rentierism. The majority of respondents in the survey were native Saudi citizens (not expatriates), and the responses provided some interesting insights about how they perceive changes in the social contract. The study found that "a substantial portion of the public was actually willing to make a personal sacrifice to promote the national interest in a more optimal allocation of exportable resources."[177] However, a portion of the respondents felt entitled to welfare distribution from the oil wealth and would oppose changes to these perceived rights. However, when offered a benefit in exchange for the lost subsidy, the opposition fell considerably in the entitlement group. Thus is seems like an emphasis on national interest or an offer of a replacement benefit would be palatable even to the group most likely to oppose reform.[178]

This shows that Saudi Arabia's strategy of providing replacement benefits like cash payments and extend other welfare services when cutting subsidies, could be a strategy that will be accepted by the Saudi people, in line with Krane's findings. The subsidy cuts planned in the National Transportation Program will probably be more successful if the government frames it as a matter of national interest. It will be interesting to see if the government's demands and expectations will lead to calls for greater political participation and further changes in the social contract.

The matter of framing and raising awareness becomes very important to successfully cutting subsidies, which in turn not only will benefit the economy, but also create a level playing field for all energy carriers and help the spread of renewable energy. Framing, awareness and acceptance of renewable energy and changes in the social contract will be discussed in the next section.

3.2.3 Socio-cultural regime

Social acceptance of renewable energy technology, potential role of religion or environmental ethics

[177] Krane, "Stability Versus Sustainability: Energy Policy in the Gulf Monarchies," 178-79.
[178] Ibid., 187-88.

In order for renewable energy to be spread in a country, it must be supported and accepted. The acceptance by the government, key stakeholders and opinion leaders, as well as the wider population is called socio-political legitimacy and is argued to be particularly significant.[179]

To be able to accept and support renewable energy, one must have a certain level of knowledge and awareness about this type of energy, and preferably also about its financial and environmental effects to appreciate how it can be a rewarding contribution to the energy mix. As al-Saleh assesses the situation in Saudi Arabia in his study in 2008-2011, such knowledge was according to him not widespread, in fact and as previously mentioned, he found that "limited knowledge of renewables among Saudi leadership and population" was one of the most significant barriers to the spread of renewable energy.[180] Others have also argued that in order to exploit renewable energy sources, there is a need to increase public awareness of the use and importance of renewable energy.[181] In the following I will discuss what social acceptance of renewable energy will mean to the spread in Saudi Arabia and discuss to what degree such socio-political legitimacy is obtained in the different groups mentioned above, and thus assess how far they have come in countering this barrier.

The importance of the government's knowledge and acceptance of renewable energy is quite obvious, as they are the responsible party for both creating relevant policies and implementing these policies, including regulatory and legal frameworks. In the lower levels of bureaucracy, awareness of renewable energy and environmental concerns might spur otherwise uninterested bureaucrats to engage more actively with the implementation of new renewable policies.

Not only is the government's acceptance important in order to create and implement relevant policies, but to further raise awareness and reach a broader acceptance in the population at large, it is important that the authorities publicly embrace and support renewable energy. To successfully convey the message to the public and further convince them to change behavior and consumer habits to become more sustainable and efficient, they will have to sufficiently explain the rationale behind. As renewable energy can have several positive effects in Saudi Arabia and be connected to different aspects important in the country, framing could potentially take different forms and lines could be drawn to Islam – as has been the case with

[179] Al-Saleh, 320.
[180] Ibid., 316.
[181] Patlitzianas and Flamos, 249.

their framing and legitimizing of oil; they could appeal to national sentiments; or they can try a secular approach and emphasize the clean nature of renewable energy and its role in countering climate change in the country and further frame it in terms of environmentalism, climate change and sustainability. Combinations of the above could also be an option and perhaps the most viable alternative as they are all relevant and important in Saudi Arabia. If and how they choose to promote renewable energy and raise awareness will be explored below.

Considering the authoritarian nature of the Saudi state, the people's opinion of renewable energy might not seem very relevant at first. It does matter however, and is arguably "a key determinant of success."[182] As introducing renewable energy might entail slight changes to the social contract in terms of raising electricity prices, or changing the subsidy scheme to enhance renewables, it is important that the public support these changes, otherwise political demonstrations, riots, acts of sabotage and other forms of protests might force the government to cancel reforms. Although the rigidity of the social contract is criticized by some and arguments are made that it is more flexible than imagined, there is still broad agreement that considerable breaches of the contract might cause instability. Furthermore, Saudi Arabia has invested massively in the education sector, resulting in a growing group of young, aspirational and educated youth with higher expectations for their future and more impatient with reforms as compared with their parents. Advocacy groups working to mitigate opposition to renewables are often an important driving mechanism. According to Al-Saleh, such organizations are weak in Saudi Arabia and not sufficiently strong to create legitimacy for renewables in the Kingdom. (Also, if the government wants to support small-scale roof top solar panels, this would mean direct involvement by the user, and necessarily accept and support – this domestic use of solar panels does not seem to be something the government is promoting, at least not for the time being.)

Having established the need for social acceptance and support of renewable energy as an important factor for spreading renewable energy, we must look to the current situation in Saudi Arabia, to explore if such acceptance, and also the prerequisite – knowledge, exists.

The best way to gauge the public opinion on these matters would be through surveys or opinion polls, but such polls are almost unknown in the country. In researching for this thesis,

[182] Kumetat, 106.

only a few surveys were found, and these were either old or rather limited in scope, or not focusing directly on the subject of renewable energy.

Another one, that does provide relevant and interesting findings for this thesis, was the study mentioned in the last section, by Jim Krane, assessing public opinion on subsidies. Although the respondents were not asked about renewable energy directly, their answers might still be relevant to gauging how the public will accept renewables. A relevant insight that is of a more general character can be drawn from the study, namely that "the public's understanding of the urgency of reform would […] appear to be an important element in policy acceptance."[183] And further, the finding that the majority would accept personal sacrifices if it promoted national interest shows that framing is important.

These findings do not show how the population perceives renewable energy, and I have found no other available information on this matter, but they do show that the public might accept changes and make the sacrifices needed to implement reform, if it is in the national interest. It also tells us that knowledge of reform is important for acceptance. These general conclusions will probably be relevant to renewable energy and point to the need to raise awareness in the country.

So, how are the Saudi government framing renewable energy, are they promoting this as important to national interest? Or what kind of framing is used to raise awareness about renewable energy?

Changing rentier mentality and creating a new narrative?

Considering the acceptance by the population of the current energy system and the government's control over the oil and gas resources, it seems relevant to understand how this was framed to see if this is also a viable method of framing renewable energy, or if they are choosing a new type of framing. Bernhard Haykel writes that the government's discourse on oil and oil wealth has heavily relied on Islam to legitimize their management and ownership and that they claimed custodianship over the resources in order to "exploit them for general welfare and benefit of the people through the funding of large-scale public infrastructure projects […] and the provision of social services […] of both present and future generations

[183] Krane, "Stability Versus Sustainability: Energy Policy in the Gulf Monarchies," 187.

of Saudis."[184] In their official statements, the government described the discovery of the hydrocarbon reserves as "both a blessing from God and a sign of His favor for the regime."[185] They used Islam to legitimize their ownership over the resources and have framed the oil resources as an affirmation by God of their rule.[186] The Saudi state's ownership over the resources is also written in the Basic Law, article 14, which states:

> "All natural resources that God has deposited underground, above ground, in territorial waters or within the land and sea domains under the authority of the State, together with revenues of these resources, shall be the property of the State, as provided by the Law. The Law shall specify means for exploitation, protection and development of these resources in the best interest of the State, and its security and economy."[187]

As the hydrocarbon-based energy system and wealth is facing several challenges and is becoming increasingly unsustainable, it is interesting to look at how they will explain the need to transition away from oil, as they have portrayed it as God's affirmation of their rule. The renewable resources such as solar and wind, are also part of the earth and thereby God's creation and these resources could therefore fit into a framing using Islam in a similar fashion as the framing of the hydrocarbon resources.

Renewable energy could and should also be framed in terms of environmentalism and national interest, where the long-term interest in transitioning away from oil and towards sustainability is sufficiently explained to the people, in a way that makes them understand that the state's interests and consequently the citizens 'entitlements' are at risk. To convince people of the need to change their consumer habits, use energy more efficiently and allow for certain changes following the adoption of renewable energy, it can be necessary to employ a multifaceted framing strategy aimed at the different groups and sentiment in the Saudi society of people feeling entitled to certain rights and to those willing to sacrifice.

Raising awareness

[184] Bernard Haykel, "Oil in Saudi Arabian Culture and Politics," in *Saudi Arabia in Transition - Insights on Social, Political and Religious Change*, ed. Bernard Haykel, Thomas Hegghammer, and Stéphane Lacroix (Cambridge: Cambridge University Press, 2015), 133.
[185] Ibid.
[186] Ibid.
[187] The Shura Council, "Chapter Four: Economic Principles," The Shura Council, https://www.shura.gov.sa/wps/wcm/connect/ShuraEn/internet/Laws+and+Regulations/The+Basic+Law+Of+Government/Chapter+Four/.

It has been out of the scope of this thesis to go deep into the government's efforts to raise awareness on renewable energy, but briefly researching their promotion of both renewable energy and environmental issues shows that efforts are made to increase the level of knowledge in the population. Promotion of renewable energy specifically has mostly been in the form of official government discourse with press releases, policy documents and statements in the media and social media platforms promoting renewable energy projects and initiatives. Under KACARE, an interactive center, the Mishkat Interactive Center[188], has been established to engage and educate youth on the importance of atomic and renewable energy in their daily lives. The center travels around with their exhibition and hosts a summer school. It is doubtful that this center has a wide reach however, and while it is a positive initiative, more substantial and wide-reaching efforts must be pursued in order to reach the population at large.

Most initiatives have to my knowledge so far been directed at the private and industry sector, with limited attention directed at the general public. The matter of raising awareness in the broader society should, however, be further studied, perhaps as the primary focus of an academic study.

Regarding environmental awareness, there are a number of active groups and initiatives. The Saudi Environment Society (SENS) is an environmental organization founded by the government in order to contribute to sustainable development in the country and to work on environmental issues. SENS aims to engage the wider public and spread knowledge about the environment, so that society as a whole can work towards protection of the environment.[189] The organization frames their mission in Islamic terms writing that the Saudi state's interest in the environment stems from the teachings of Islam[190] and further refers to article 32 in the Basic Law which states that: "The State shall endeavor to preserve, protect, and improve the environment and prevent its pollution."[191]

The Saudi Vision 2030 and the National Transformation Program widely incorporate environmental concerns and issues, and connects it to Islam by saying that it is a an Islamic,

[188] K.A.CARE, "Educational Institutions," https://www.kacare.gov.sa/en/Partners/Pages/EducationalCenters.aspx.
[189] الجمعية السعودية للبيئة [Saudi Environmental Society (SENS)], "عن الجمعية [About the Society]," http://www.sens.org.sa/Page.aspx?name=About_Us.
[190] Ibid.
[191] "Basic Law of Governance," in *A/91*, ed. The Kingdom of Saudi Arabia (Umm al-Qura05.05.1992), 6.

as well as human and moral, duty to preserve the environment and natural resources.[192] Here we have a few examples where environmental obligations are framed in connection with Islam and it will be interesting to see if the promotion of renewable energy also will be framed in Islamic terms. The environmental dimension is also portrayed as a pillar of sustainable development[193] and in line with national interest, which could be a viable form of framing if we look back to the findings in Krane's study of public perceptions on cutting subsidies.

Raising awareness about renewable energy in social media

The Saudi population has been introduced to great changes in technology and communication over the years, and is now among the most active user of online platforms such as twitter and Facebook in the world, in fact they have the highest penetration of twitter users worldwide. Saudi Arabia has over 20 million active internet users which equals 63,7% of the population. [194] These platforms have opened up a new world of information and knowledge to the people. Now they can easily be updated on the happenings in the world and to a certain degree their own country, as far as the censorship allows for news on Saudi Arabian matters. As social awareness on renewable energy and environmental causes is important, the internet and social media can serve as useful platforms for raising awareness on these subjects. The government has realized this and is actively promoting their renewable energy agenda on these platforms. A number of institutions, bodies, agencies and companies that are active in the value chain connected to the deployment of renewable energy have created Facebook pages and are promoting their activities in order to spread awareness on matters relating to renewable energy, climate change and environmentalism. A host of entities involved in the renewable sector are online and are actively promoting their activities to reach out to the people and create awareness.[195] Some of them are also active on twitter, with a large number of followers, and are promoting their renewable energy activity in both Arabic and English reaching out to a broad audience. Saudi Aramco is connecting renewable energy to climate

[192] Vision 2030 Kingdom of Saudi Arabia, "Vibrant Society with Fulfilling Lives," http://vision2030.gov.sa/en/node/10.
[193] The Kingdom of Saudi Arabia, 27.
[194] Gmi_blogger, 25.05.2016, http://www.globalmediainsight.com/blog/saudi-arabia-social-media-statistics/.
[195] These are some of the entities that are active with their own pages on Facebook: The King Abdullah University of Science and Technology (KAUST), KAUST Solar Center, the Biological and Environmental Science and Engineering Division at KAUST, the KAUST Water Desalination and Reuse Center (WDRC), the King Abdulaziz City for Science and Technology (KACST), the Saudi Arabia Solar Industry Association (SASIA.

change mitigation efforts in Saudi Arabia in one tweet[196], and considers renewable energy key to meet future energy demand in another.[197]

Critique of the new narrative?

There are a number of individuals and groups with vested interest in the oil industry which might oppose a new narrative where oil is replaced with renewable energy, and an emphasis is but on green values. We could also imagine disagreement with an environmental discourse as this discourse mostly has been dominated by Western voices. Another critique could be that the Saudi state still is heavily dependent on oil, and that they are planning to continue their oil production into the unforeseeable future, and consequently that their overall contribution to the environment is harmful. Although every step taking in a sustainable direction is positive, they have a long way to go before they can call themselves champions of sustainability, which can be an obstacle in trying to create an image or narrative where the Saudi state is the green and clean protagonist.

Labor markets

Unemployment is one of the big challenges facing Saudi Arabia. They have a large group of young educated people who are expecting to enter the labor market – a group that is growing in size each year.

A large part of the workforce in Saudi Arabia, around 80 percent, consists of expatriate workers who have mostly been employed in the private sector[198] and in manual labor jobs. The bureaucracy has mostly been filled with Saudis benefitting from jobs providing generous distributions and an often limited workload. Now, the government wants to cut jobs in the

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[196] أرامكو [Aramco], [illegible] *[Renewable Energy Helps Reduce Greenhouse Gas Emissions* (18.01.2017).

[197] [Aramco] أرامكو, "[Al-Qadimi: Renewable Energy Contributes to Reducing Carbon Emissions and Environmental Pollution and Is a Key Factor in Meeting the Kingdom's Future Energy Needs] القديمي: تُسهم الطاقة المتجددة في الحد من انبعاثات الكربون والتلوث البيئي وتعتبر كما عاملًا رئيسًا لسد احتياجات المملكة من الطاقة المستقبلية," https://twitter.com/Saudi_Aramco/statuses/853949820406558720.

[198] Peter Waldman, "The $2 Trillion Project to Get Saudi Arabia’s Economy Off Oil," Bloomberg, https://www.bloomberg.com/news/features/2016-04-21/the-2-trillion-project-to-get-saudi-arabia-s-economy-off-oil.

bloated bureaucracy and "eliminate redundant roles"[199], creating more uncertainty for newly educated youth, and putting more pressure on themselves to create alternative employment.

In an effort to secure jobs for the many unemployed Saudis, the government has implemented a national policy called Saudization, which aims to replace the foreign workforce with Saudi nationals. The Saudization process is directly linked to renewable energy in that the government envisions a localization and creation of jobs in the renewable energy value chain. The job market in the renewable energy sector is expected to grow substantially and may help alleviate Saudi Arabia's unemployment problem. It is therefore interesting to see to what degree the government is developing relevant strategies for job creation in the renewable energy sector.

Worldwide 'a renewable job revolution' is taking place with almost 10 million people employed in the renewable energy sector. In the USA "the solar industry is employing people 17 times faster than the rest of the economy."[200] IRENA predicts the growth of renewable jobs to rise with the transition to sustainable energy "with labor force projections reaching 26 million by 2050, a 144% increase."[201]

In comparison with traditional energy industries, IRENA predicts that renewable energy sector will create more new jobs than the traditional fossil fuel industry, where employment is expected to continue to drop after having experienced cuts following the collapse of oil prices in 2014-2015. When comparing the two sectors, IRENA write that "solar PV, for instance, creates more than twice the number of jobs per unit of electricity generation compared with coal or natural gas."[202] This should be a further driver for Saudi Arabia to transition away from fossil fuels and towards renewable energy, at least in terms of job creation.

I have found few sources indicating the current number of available positions in the renewable energy sector, in Saudi Arabia which is admittedly still minuscule compared to the county's massive petroleum sector. The NTP puts the number at merely 500.[203] As the deployment of projects has been slow and most of the progress in the field have been in the areas of planning and R&D, this number is probably still low as indicated.

[199] Arabia, "Vision".
[200] International Renewable Energy Agency, "Renewable Energy and Jobs: Annual Review 2017," (2017), 14.
[201] Ibid., 15.
[202] Ibid., 5-6.
[203] The Kingdom of Saudi Arabia, 74.

The growth potential is recognized by the government however, and the prospect of job creation is both considered and planned, even with concrete numbers, in the Saudi Vision 2030, the NTP and official statements. More generally they aim "to lower the rate of unemployment from 11.6% to 7%"[204], but also to create jobs in the renewable energy sector and further, to saudize the renewable energy sector. The localization of the renewable energy sector is suggested to happen in "research and development, and manufacturing, among other stages."[205] The NTP follows up with more concrete initiatives and aim to raise the localization of jobs in the private sector from 19 to 24 percent, and more specifically to increase the "percent of local content contribution within the renewable energy sector", both in industrial and service value chains, from 25 to 35 percent by 2020.[206] The NTP even suggests a precise number of jobs they want to reach by 2020, which is 7774[207], but it is unclear how many of these are envisaged in the renewable energy sector, as this number is the goal for both the nuclear and RE sector put together. Should the majority of these jobs be in the renewable sector, it is still a rather modest goal.

Saudi minister of Energy al-Falih has corroborated the plans for localization of the value chain and their wish to even develop and produce the technology and equipment themselves, and states that "we are seeking for the kingdom, in the medium term, to become a nation that develops, manufactures and exports the advanced technologies of renewable energy production."[208]

As the government wants to localize the different sectors of the value chain, this means that they need a skilled workforce for all the different stages, from manufacturing, R&D, deployment, maintenance, construction, to the operation of power plants. However, it also means that there will be more jobs for the Saudi population, as they government also want to saudize this sector. The more sectors in the value chain they localize, the more jobs can be expected – and as Saudi Arabia wants to localize most sectors, they will create more jobs. As the Saudi companies develop their skillsets and capabilities over time, the local content rules in renewable energy projects will be increased to ensure localization.[209] The aim of

[204] Arabia, "Vision 2030," 39.
[205] Ibid., 49.
[206] The Kingdom of Saudi Arabia, 74.
[207] Ibid.
[208] Saudia.
[209] Landberg.

localization is also corroborated by KACARE when outlining their plans for their first tendering process, (as mentioned above):

> "This foresees the direct involvement of national and overseas companies not just in the supply of the required equipment and expertise but in local manufacture, the transference of knowledge, the provision of on-the-ground services, and the training of Saudi nationals in all aspects of solar technology from production through construction of the solar fields to their on-going maintenance. Opportunities will also be sought for Saudis to participate with principals in solar energy research and in establishing companies with a focus on exporting energy-sector products and services. Overall it is targeted that a minimum of 80% of inputs to the solar energy sector will be sourced locally."[210]

The expected development of a considerable renewable energy sector could create large number of jobs, if the localization of the sectors in the value chain actually will take place. The government aims to create jobs in these fields, although their goal is somewhat modest. If the development of the renewable energy sector is expanding faster than planned, more jobs could be created, which is what is happening around the world. This could also be the case in Saudi Arabia. They might have to create proper regulation to provide and secure jobs, such as enforcing Saudization through laws and monitoring. Furthermore they might have to impose trade policies to secure local manufacturers, and thus jobs in such businesses, from cheap imports as cost are falling worldwide. [211]

3.2.4 Policy regime: Regime-level and transregional governance structures

Renewable energy targets and actual performance

[210] K.A.CARE, "Corporates," https://www.kacare.gov.sa/en/Partners/Pages/Companies.aspx.
[211] International Renewable Energy Agency, "Renewable Energy and Jobs: Annual Review 2017."

In his study from 2012, Kumetat described the renewable energy targets of the hydrocarbon-rich states as "poor and not yet formalized"[212], and further, that Saudi Arabia had no official targets at the time. Detailed planning, strategies and specific targets are however essential in order to develop and implement such large-scale projects as recently envisioned by Saudi Arabia which entails structural changes and the involvement of several sectors in the Saudi state and society. Detailed policy documents and targets that describe how the government will implement RE-projects will also be important in order to attract investors and engage the private market – in so far as such parties are welcomed into the process. Such signs of political will are important to engage and convince people in all fields and segments of society to support and accept the spread of renewable energy.

From 2012 and until 2017 a lot has happened in Saudi Arabia when it comes to targets, plans and strategies for the development of renewable energy. Although there have been some setbacks and adjustments from the initial ambitious targets from 2012, when KACARE announced "a $109 billion plan to create a solar industry that generates a third of the nation's electricity by 2032"[213], considerable progress has also been made in 2016 and 2017.

A wide-ranging policy vision, the Saudi Vision 2030, was presented in 2016, outlining the highly ambitious plan to diversify the Saudi economy away from oil. Also included in this vision is an intention to deploy renewable energy in the country. More specifically they write that in order to build up the renewable energy sector "we have set ourselves an initial target of generating 9.5 gigawatts of renewable energy", which would make up around five percent of the energy mix. [214] The goal is to reach 9,5 GW by 2023. According to an industry specialist, the annual deployment needed to reach the goal, about 1600 MW, would make the Saudi market "the largest in the MENA region by annual new installations."[215] The energy minister, Khalid al-Falih announced "a target to invest $30 billion to $50 billion"[216] in the renewable energy program.

While the Saudi Vision 2030 is more diffuse and does not include a detailed roadmap, this is not its intention either. As explained on the SV 2030 webpage, they have multiple programs which offer metrics and details on how to implement the different strategies and plans

[212] Kumetat, 111.
[213] Eco-Business.
[214] Saudi Arabia, "Vision 2030," 49.
[215] Borgmann.
[216] Ibid.

outlined in the SV 2030. One of these is the National Transformation Program (NTP), where a total of 543 initiatives and their corresponding metrics, 'key performance indicators' and allocations are listed. These initiatives are aimed at realizing 178 strategic objectives from the SV 2030. In the NTP we find a number of goals for the deployment of renewable energy along with supporting initiatives such as improvements in the educational sector and labor market, and an opening up of the private market, which is meant to provide and develop a capable workforce and funding.

There has also been frequent official statements about 'the King Abdullah Renewable Energy Initiative' and promises of its announcements since 2016. As no documents or webpages with this title has been published yet, it is unclear whether this initiative is just a loose title for the efforts that are actually implemented by the government at the time of writing, or if this initiative will manifest in other ways, for example as a blueprint, strategy or policy document.

To further develop and advance their RE efforts, the Renewable Energy Project Development Office (REPDO) is implementing the National Renewable Energy Program (NREP) which

> is a strategic initiative under Vision 2030 and the National Transformation Program (NTP) that aims to substantially increase the share of renewable energy capacity in the total energy mix within the Kingdom to 9.5 GW by 2023. The program sets out a systematic and targeted road map to rapidly diversify the domestic power supply, catalyze economic development and support long-term prosperity in line with Vision 2030's goals which include creating a new renewable industry and support the buildup of this promising sector.[217]

The national oil company Saudi Aramco is also expected to play an important role in implementing the SV 2030 and in developing the renewable energy sector. Considering their status as an 'island of efficiency' this could be a smart move for the progress of the RE-sector. The government has invited several banks to help Saudi Aramco "identify renewable acquisition targets"[218] as such targets are yet not specified by the company. They have made

[217] Ministry of Energy.
[218] Anna Hirtenstein, "Saudi Aramco's Green Energy Push Seen Widening Appeal of Ipo," Bloomberg, https://www.bloomberg.com/news/articles/2017-03-06/saudi-aramco-s-green-energy-push-seen-widening-appeal-of-ipo.

announcements regarding investments in renewable energy however, and aims to allocate approximately $5 billion to clean energy deals.[219]

On the webpage of the new super-ministry, The Ministry of Energy, Industry and Mineral Resources, they have a section called Vision and Mission in which their raison d'etre is outlined. Here they state that they will focus on oil, gas and minerals, and there is no mention of renewable energy[220]. While an entire section devoted to the policy of Saudi petroleum production can be found under the "About the ministry"-section and oil, gas and minerals are mentioned multiple times as well as detailed descriptions of the ministry's tasks in supporting and facilitating the existence of the petroleum companies, there is no references to renewable energy. The lack of any mentioning of renewable energy in the ministry's Vision and Mission shows that renewable energy is still not a prioritized on the same level as oil, which is no surprise as they are in the initial phase of their renewable energy efforts.

The government's actual performance will be discussed more in detail in the other analytical sections on the various governmental efforts in implementing and facilitating the spread of renewable energy in the country. There are several signs that they are serious about their commitment to their renewable targets and evidence that these are not just empty promises, but that they are in fact putting action behind their words. The establishment of the Renewable Energy Project Development Office and the tendering process for the solar and wind projects are examples of such promising developments.

3.3 Niche-level factors

3.3.1 Science regime: R&D and industry structures, technology transfer strategies

[219] Ibid.
[220] Industry and Mineral Resources] الـ سعوديـ ة الـ عربـ ية الـمملـكة الـمعدنـ ية والـ ثروة والـ صـ ناعة الـ طاقة وزارة [The Ministry of Energy, "الـ رسالة و الـ رؤيـ ة [Vision and Mision]," [The Ministry of Energy, Industry and Mineral Resources] الـ سعوديـ ة الـ عربـ ية الـمملـكة الـمعدنـ ية والـ ثروة والـ صـ ناعة قةالـ طا وزارة http://www.meim.gov.sa/arabic/ministry/Pages/default.aspx.

According to Al-Saleh's study, 'weak S&T infrastructure and capabilities', 'underdeveloped educational and research capabilities' and 'lack of supporting institutions for innovation' are the key barriers to the spread of renewable energy in the Saudi Arabia. Another study highlights that "interaction between regional renewable research centers and local research centers and industries must be promoted" for a successful development of renewable energy.[221] It seems the Saudi government has taken this into consideration as they are currently working to develop their capabilities in education, R&D and knowledge sharing.

Saudi Arabia is now actively working towards the creation of a domestic knowledge base and to enable sharing of information and competency on renewable energy. The most prominent examples are KACARE, KAUST and KACST. The sustainable city in KACARE will host the renewable energy sector and will drive the academic, R&D and economic developments in the renewable energy industry.[222] Besides efforts towards creating a domestic knowledge hub, they are committing to partnerships and agreements with important actors in both the MENA region as well as other international entities.

Education

At KAUST they offer higher education in the field of science and technology (S&T) and aims to educate a workforce that contribute to the research and development of renewable energy in the country. Additionally, they aim to drive innovation in S&T "and to support world-class research in areas such as energy and the environment." [223]

It is a stated goal in both the Saudi Vision 2030 and the NTP that they want to educate the youth and create a skilled workforce that is prepared for the labor market and the post-oil future. A section on education reads: "We will work closely with the private sector to ensure higher education outcomes are in line with the requirements of job market. We will invest in strategic partnerships with apprenticeship providers, new skills councils from industry, and large private companies."[224] Although this is mostly written as a general goal and not in connection with renewable energy, it can still be considered to be relevant for the renewable energy sector, as this is part of the envisioned future in the documents. This goal also describes have they will ensure the that the skillset needed in the labor market is ensured

[221] Patlitzianas and Flamos.
[222] K.A.CARE, "The Sustainable City " https://www.kacare.gov.sa/en/about/pages/city.aspx.
[223] Sunpower, "King Abdullah University, Saudi Arabia," https://global.sunpower.com/solar-case-studies/kaust-saudi-arabia/.
[224] Vision 2030 Kingdom of Saudi Arabia, "Vision 2030," 40.

through cooperation with the private sector and industry, which is in line with the literatures recommendations for the spread of renewable energy.

Research and development, knowledge transfer and industry structures

As mentioned in chapter 2, Saudi Arabia's efforts in R&D into RET started as early as the 1970s and was for many years considered the frontrunner in the GCC in this field. The efforts in R&D was continuously developed and especially bolstered by important institutions like KACARE, KACST and KAUST. A study mentions Saudi Arabia as one of the GCC states that have made significant efforts and points to their status as a frontrunner in the R&D sector, and especially solar energy and explains that "there are a number of RES-implemented activities (pilot, research, and "real life" projects) and major institutes and companies that support these efforts (such as the BP Solar Arabia LTD and the Energy Research Institute – ERI)."[225] Several studies on renewable energy have been published from Saudi researchers, and these are usually of a scientific and technical character.

To further enhance the R&D sector, a new central authority called the National Center for Renewable Energy Data was established in 2017 under the auspices of KACARE. The center is supposed to "provide high-quality data on the renewable energy sector in the Kingdom to investors."[226] The government has also just arranged the Saudi Arabia Renewable Energy Investment Forum (SAREIF), where they gathered a large group of 800 foreign and national delegates, to connect people from the different sectors of academia, finance and development.[227]

In The Saudi Vision 2030, one of the goals connected to the renewable energy development is the localization of research and development[228], but it is only mentioned in a sentence.

Saudi Arabia has traditionally exploited international expertise as well as their own competency in building up certain industries or companies. As they now want to build a renewable energy industry, they are aiming to localize the value chain and workforce, but are also looking to foreign institutions for collaborations and knowledge sharing. Saudi Aramco signed a Memorandum of Understanding (MoU) with Masdar, Abu Dhabi Future Energy Company – the UAE's famous zero-carbon city project, earlier in 2017, and will "collaborate

[225] Patlitzianas and Flamos, 249.
[226] Riyadh Vision, "Al-Falih Announces Package of Renewable Energy Projects," *Riyadh Vision* 19.04.2017.
[227] Ibid.
[228] Vision 2030 Kingdom of Saudi Arabia, "Vision 2030," 49.

on sustainable development and renewable energy, in order to yield advancements in clean electricity generation, and carbon capture for Saudi Arabia, the UAE and the world."[229] The executive director for New Business Development at Saudi Aramco, Yasser Mufti, stated that the MoU "will facilitate cooperation in research and development, education and awareness, on the basis of each company's experience in the development and deployment of sustainability programs."[230] Other officials commented on the cooperation and said that "the tie-up will foster a "culture of knowledge sharing" between the companies."[231] The MoU can prove to be very important and rewarding for Saudi Arabia, as they can gain important insights from the Masdar project which have already shown their ability to implement a large-scale renewable energy project.

Saudi Aramco is looking to diversify into renewable energy and is developing their R&D efforts in this sector. The energy minister al-Falih stated that Saudi Aramco would play a leading role in implementing the Saudi Vision 2030 (in which renewable energy targets figure), and that Saudi Aramco will "do more with renewables" and "create new technologies through its R&D efforts".[232] A female solar engineer at Saudi Aramco explains that they have various renewable energy projects and are focusing on research and development, and that they have special youth teams and collaborates with both national and international teams.[233] As Saudi Aramco has vast experience with energy projects and is known to be an island of efficiency among Saudi institutions, with a highly competent workforce, they might also take the lead in the renewable energy developments.

There are companies with expertise in the renewable energy sector in the country, as some of them have been responsible for, or participating in RE-projects abroad. The Saudi company ACWA POWER, which is "a developer, investor, co-owner and operator of a portfolio of power generation and desalinated water production plants",[234] has substantial experience with renewable projects and their portfolio counts 10 large projects abroad in places like Dubai, Jordan, South-Africa, Bulgaria and Morocco - where they are involved in the development and operation of the Noor projects, which is four large scale solar power projects reported to

[229] Aramco, "Saudi Aramco, Adnoc, and Masdar Sign Mous on Collaboration in Oil & Gas Technology R&D, Sustainable Energy Management".
[230] Ibid.
[231] Ibid.
[232] "Saudi Arabia's Vision for 2030 and Saudi Aramco," https://www.jobsataramco.eu/people-projects/saudi-arabias-vision-2030-and-saudi-aramco.
[233] "Nour - Solar Engineer," http://www.jobsataramco.eu/people-projects/nour-solar-engineer.
[234] Acwa Power, "Introduction," http://www.acwapower.com/en/about-us/introduction/.

become the world's largest solar plant when completed.[235] This expertise can be of help in building a national knowledge hub, if information, knowledge and skills are shared and transferred.

KASCT has also chosen to cooperate with a foreign institution and signed a MoU with the US' Department of Energy, in which a partnership and collaboration was established. The two parties have agreed to cooperate on a broad range of initiatives promoting renewable energy, including: joint pilot projects; exchange of experiences and information; workshops; and student exchange programs. They envisage contributions and participation from several entities such as the government, research centers and universities.[236]

KACARE describes their efforts to ensure collaboration with both local and international partners on their webpage and list a large group of partnering corporates and educational institutions. They have also introduced a 'Dialogue with Professionals Forum' which will enhance cooperation, as part of their development efforts. In their first solar tendering process, (which have been mentioned above), they aim to exploit both national and international expertise and also want to enable transference of knowledge, and furthermore train a workforce of "Saudi nationals in all aspects of solar technology from production through construction of the solar fields to their on-going maintenance. Opportunities will also be sought for Saudis to participate with principals in solar energy research and in establishing companies with a focus on exporting energy-sector products and services." [237]

The Saudi Vision 2030 also describes how the government wants to develop a skilled workforce of nationals and a stated goal is "to localize the industry and produce the necessary skill-sets, we will also encourage public-private partnerships."[238]

Such industry partnerships and collaborations as the ones described above will ensure knowledge and skill sharing vital to developing the RE sector. Furthermore, the already established knowledge hubs KAUST, KACST and KACARE and their traditions for R&D are important contributors. Saudi Aramco also holds the potential to be a leading actor in this field, so does ACWA with their experiences from RE-projects abroad. These institutions and

[235] Arthur Neslen, "Morocco to Switch on First Phase of World's Largest Solar Plant " *The Guardian* 04.02.2016.
[236] الإقـ تـصاديـة [The Economist], "الـطاقـة وتـ كـنولـوجـ يا الـمـ تجددة الـطاقـة مجال فـ ي اتـ فاقـ يةتـ وقـ عان وأمريـ كا الـممـ لكة الـ بديـ لة [the Kingdom and America Sign an Agreement on Renewable Energy and Alternative Energy Technologies]," □□ □□□ □□□□ □ *[The Economist]*
[237] King Abdullah City for Atomic & Renewable K.A.CARE, "Corporates".
[238] Vision 2030 Kingdom of Saudi Arabia, "Vision 2030," 49.

initiatives show that Saudi Arabia is on the way to overcoming the barriers discovered by Al-Saleh regarding weak and underdeveloped educational and research and development sectors and lack of supporting institutions.

However as some of these initiatives are still on the sketch board, and others are planned to be executed in the near future and are only starting now, there will be some time before the actual results appear and we can assess exactly how successful they are in this area.

This is also the case for the training and education of a skilled workforce as they do not yet have the capabilities and educational level needed to develop a higher technology industry, and they will have to complete necessary education and training, which is somewhat time-consuming and the current level of education and knowledge in the technology fields will. Furthermore, this requires that they also manage to build up the educational sector sufficiently.

The Saudi state may find that fostering a vibrant technology and innovation culture from scratch might be challenging in the current lack of an educated workforce, but also because of their authoritarian regime, which is top-down and does not really facilitate bottom-up approaches of innovation. The Saudi political system will likely constrain the type of open inquiry that is necessary for this sector to thrive.[239]

[239] Cullen S. Hendrix, "Wp 17-2 Kicking a Crude Habit: Diversifying Away from Oil and Gas in the 21st Century," (Peterson Institute for International Economics, 02.2017).

4 Concluding remarks

Saudi Arabia's dependency on oil is highly unsustainable. Increasing domestic energy demand is eating away at oil that could have been exported, incurring huge opportunity costs and a huge deficit in the national budget. Left unchecked, Saudi Arabia could be rendered an oil importer in few years, leaving them with few means to uphold their end of the ruling bargain. This situation could have catastrophic consequences for the country which might face opposition and political instability. To alleviate these challenges, Saudi Arabia has announced the introduction of renewable energy into the national energy mix.

This thesis has assessed the Saudi political context and the factors shaping the renewable energy policies through a multi-level perspective analysis. Furthermore, key barriers and drivers to the implementation of renewable energy have been identified. Comparing to the barriers Saudi Arabia was facing a few years ago, as found in al-Saleh's study, this updated analysis show that they have overcome some of the barriers, but that considerable effort in various fields must be made to facilitate a successful transition to renewable energy.

Regarding the political system and the bureaucratic barrier which hindered KACARE's previous attempt to deploy renewable energy - this barrier still exist and the system's inability to effectively cooperate and coordinate between a host of institutions will likely obstruct a wide-reaching implementation of renewable energy. A finding is that the government has taken steps to change this with a restructuring of the government and creation of a new energy ministry and the Renewable Energy Project Development Office (REPDO) to streamline decision-making and implementation. If this will actually increase institutional and managerial feasibility is yet uncertain, but it appears promising and the REPDO is already showing results as exemplified by the tendering process two renewable power plants. As evident by these efforts, the political elite know has increased their knowledge about renewable energy, thus overcoming this barrier. By choosing 'the island of efficiency', Saudi Aramco, which has a proven record of managerial capabilities and experience with large-scale energy projects, to be a leading actor in the development of renewable energy, they are opting to circumvent the bureaucratic hurdle - a strategy that has yielded several reform successes and might also increase their chance of successful implementation of renewable energy.

Furthermore, one of the leading political figures, deputy crown prince Mohammed bin Salman, has a leading role in driving renewable energy development as well as wider reform efforts, showing the existence of political buy-in. This is a factor that was upheld as vital to diffusion of renewable energy in the literature. This buy-in is also seen in the official targets for implementation and in how renewable energy is included in official policy documents and statements. Princely rivalry and reshuffling of the princes in power could have an effect on the future of renewables however, as Saudi politics and decision-making is highly personalized.

The governance effects of transitioning from oil to renewable energy in Saudi Arabia are unknown as this has not yet happened. The discussion in this thesis argues that such a transition can have huge implications for the social contract and political balance however. While the Saudi regime might be able to retain control in the short-term, they might not be able to reproduce the rentier state in the long-term as renewable energy become increasingly cheap and accessible, rendering control over the system impossible. Furthermore, it is unlikely that renewable energy can generate the similar amounts of revenues as oil, and this will affect the state's ability to provide for welfare distributions. it is too early to discern how the government will deal with these implications, and they are unsurprisingly keeping quiet about governance effects.

Although not directly traceable due to the opaque nature of the Saudi state, the thesis argues that vested interests in the oil-based energy system create a barrier to renewable energy.

This paper further finds several other barriers stopping renewables from entering the Saudi energy market. Missing legal and regulatory framework is creating uncertainty for potential investments and must be developed to secure funding and guidelines for implementation. The government has announced that they will review, develop and adopt the necessary regulations, but this has yet to happen. The system of double subsidies is still a one of the most important barriers to renewable energy, as it locks in the oil-based energy system and locks out renewables. The government has made plans to cut in the subsidies to even the playing field and help the renewables to become more cost competitive and to enter the market, but also in these plans has yet to materialize. Only very small cuts have been made and this is not enough to successfully promote renewables. Nuclear power, which could have been a competitor to renewable energy is not a barrier however, as it is perceived as complementary to renewables and the government is planning to deploy both energy sources.

The existence of an industry structure and technology hub that can enable knowledge transfers and secure a high level of expertise and a skilled workforce is imperative. Saudi Arabia does not yet have the innovation culture needed in a higher technology industry and might find that their authoritarian, top-down government structure makes it difficult to create the suitable environment for such endeavors. They are working to create technology transfers and cooperation with institutions abroad and are taking small steps in the right direction. Their effort to provide education and training is yet relatively weak, but they are aiming to improve the educational sector to produce a sufficiently skilled workforce. The potential of job creation in renewable energy is widely predicted to be huge, but the Saudi policy document makes rather modest aims for job creation in their renewable energy sector, thus under exploiting this possibility to alleviate their huge unemployment problem.

To successfully transition from oil to renewable energy, popular acceptance and social awareness about renewable energy is essential in Saudi Arabia. This paper how found no specific data indicating the level of awareness, but the analysis show that the government has started to frame renewables in both national and Islamic terms, which could help to secure social acceptance.

To briefly sum up, we find that Saudi Arabia is still facing substantial barriers to the diffusion of renewable energy, but recent governmental actions have shown increasing intent to overcome the remaining barriers. As the Saudi state is only in the starting phase of implementing renewable energy, we will have to follow the developments closely to further assess their progress.

Suggestions for further research

Saudi Arabia has only just begun the process of implementing renewable energy and, if everything goes according to the Saudi plans, much will happen in the coming years. This process will be incredibly exciting to follow as it can entail great changes for both the state-society relations as well as Saudi Arabia’s and the world’s climate and economy as discussed in the analysis and above.

Rewarding trajectories for future research could be to investigate social awareness through qualitative interviews to assess the level of awareness and acceptance of, or opposition to, renewable energy and environmental concerns. It would also be interesting to see if the religious establishment will be involved in efforts to raise awareness and a type of Islamic environmentalism would transpire, or otherwise in what ways the government will seek to frame renewable energy, environmentalism and sustainability.

Another interesting field to study could be the decision-making structures in the political system and decision-making processes around renewable energy policies. This would only be possible if a researcher managed to get access to the relevant interviewees and this has proven to be extremely difficult.

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