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THE JORDANIAN NUCLEAR CONTROVERSY

A Public Acceptance Analysis of the Nuclear Power Project

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Abstract

Nuclear power has been a controversial subject for the past few decades due to the huge risks it carries with its benefits. Plans to construct nuclear power plants in Jordan have been in place since 2008, with none coming to fruition as of today. As the country is in constant need of securing its energy supply after suffering due to the turmoil surrounding it, discussions regarding the usage of nuclear power in the Kingdom have raged on with no consensus reached amongst the population.

This research has two main aims. First, to identify the different benefits and risks cited by relevant stakeholders in relation to their acceptance or opposition of the nuclear power project (NPP). Second, to evaluate the impact certain individual and contextual characteristics have on the perceived severity of those benefits and risks. A modified framework based on previous literature concerning public acceptance of renewable and nuclear energy is used to explore the different dimensions affecting public opinion of the NPP. This was done by classifying the relevant stakeholders and identifying socio-political conflicts, as well as the benefits and risks of the NPP they perceive. The personal, cultural and socio-psychological drivers that impact perception are then evaluated. Following that, economic risks of the project are evaluated in relation to their effect on market acceptance.

The analyses conclude that goodwill trust and knowledge have affected public acceptance the most by decreasing benefit perception and increasing risk perception. Economic analyses also show that the proposed plans for the NPP can have a negative impact on energy affordability and the country's treasury. Focus on overcoming those challenges will be crucial for the project to gain acceptance of the Jordanian public.

Key words: Nuclear power, stakeholders, Jordan, social acceptance, public opinion, political acceptance, community acceptance, market acceptance.

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List of Acronyms

FES: Friedrich Ebert Stiftung

GW: Gigawatt

JAEC: Jordan Atomic Energy Commission

JD: Jordanian Dinar

JFOE: Jordan Friends of the Environment

JNRC: Jordan Nuclear Regulatory Commission

JRTR: Jordan Research and Training Reactor

JUST: Jordan University of Science and Technology

KW: Kilowatt

KWh: Kilowatt-hour

LNG: Liquified Natural Gas

MEMR: Ministry of Energy and Mineral Resources

MP: Member of Parliament

MW: Megawatt

MWh: Megawatt-hours

NEPCO: National Electric Power Company

NPP: Nuclear Power Project

OECD: Organisation for Economic Co-operation and Development

OIC: Organisation of Islamic Conference

RE: Renewable Energy

Introduction

Overview

The power of the atom has been at the forefront of world news since the Manhattan Project in 1942. For the public, it has appeared in two contrasting faces; one that fast-tracks developments by introducing clean and reliable energy along with scientific advancement, and one that brings destruction and havoc in the form of atomic bombs and nuclear meltdowns. This has also made it a difficult proposal to address and initiate in most countries. While countries such as France, where nuclear power has been seen as a success story, continue to depend heavily on it, others such as Japan have become wary of a technology that has brought them irreversible damage.

The Hashemite Kingdom of Jordan has decided to adopt nuclear power to alleviate issues of energy supply and security. Meanwhile, the country has been an eyewitness to the Arab Spring, the refugee crisis, civil wars, terrorism and foreign invasion, and the Middle East remains rife with conflict and turmoil. The government has had to manage its affairs with great consideration in order to ensure political and economic stability within its borders. Hence, a question appeared: has Jordan – the most stable country in the region – made a grave mistake by attempting to introduce an issue as hotly-debated as nuclear power into this boiling cauldron?

Countries such as Egypt, Syria, Iraq and Libya have struggled through these problematic times, and neighbouring countries felt the shockwaves arising from the conflicts. While mass immigration and terrorist attacks dominate the news, issues of energy supply and security have caused massive strains on all of the region's players. Jordan in particular has felt the impact when its natural gas supply from Egypt was cut off due to terrorist attacks to the pipeline. This prompted Jordan to burn heavy fuel for electricity, incurring around 4 billion USD in annual losses between 2011-2015. Diversifying the energy mix and decreasing dependence on a single foreign source for resources became a priority for the government, and major investments were mobilized into various energy sources such as renewable energy and oil shale. Moreover, serious steps were being taken to advance the Nuclear Power Project (NPP) that was first proposed in 2007, despite global fears around

that time due to the Fukushima disaster. The officials of the Jordan Atomic Energy Commission (JAEC) in charge of the NPP declared that nuclear energy had the potential to provide Jordan with up to 30% of its electricity needs. They also claimed that Jordanian territory was abundant with uranium, enough so that it can cover the Kingdom's usage and also be exported for billions in revenue.

However, nuclear programmes have never been devoid of controversy. Given that the timing of this news coincided with the decision of several countries to phase out nuclear energy, major doubts arose in Jordan regarding the safety of this technology, especially with the Fukushima tragedy making global headlines. Furthermore, concerns circulated regarding the political motives behind this public policy, the country's economic woes, and its capacity to develop a safe and environmentally-friendly nuclear power plant. Members of Parliament, environmental activists and tribal leaders have all militantly opposed the NPP, creating constant fiery arguments within parliament halls, holding public protests and even organizing civil disobedience movements in the proposed construction regions.

This paper aims to examine the drivers affecting public acceptance of the nuclear power project and its political, social and economic implications. The first chapter will provide a timeline for the development of the NPP, and an identification of relevant local and foreign stakeholders, in order to provide a clear overview of the situation for the reader.

The following three chapters will use a modified version of Wüstenhagen et al.'s (2007) framework of social acceptance through "*socio-political acceptance*", "*community acceptance"* and "*market acceptance*", as shown in figure 1, where the community acceptance aspect is expanded upon to include other individual and cultural characteristics due to the nature of nuclear technology and its wide-scale impact.

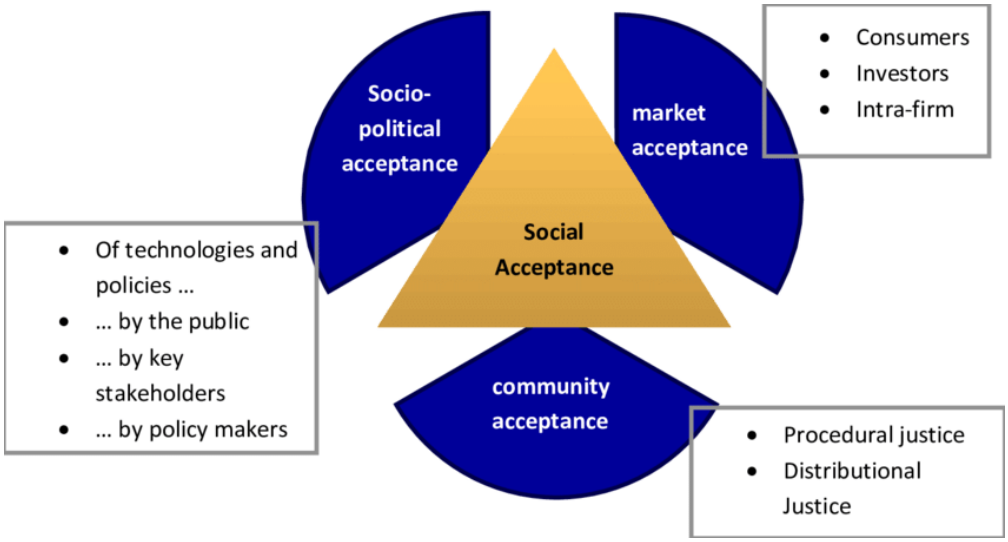

Figure 1- Social Acceptance Triangle (Wüstenhagen et al., 2007)

The second chapter will examine the stance of different socio-political actors, their internal and external conflicts, and some strategies the JAEC and other actors are taking to spread awareness on their position towards this issue. It will also outline the perceived benefits and risks cited by supporters and opposers of the NPP.

The third chapter examines the factors affecting public acceptance on both an individual and collective (community) basis by identifying the drivers, analysing them in the context of Jordanian society and its actors, and evaluating their effect on the overall acceptance of the NPP.

The fourth chapter evaluates the economic impact of the NPP on the country's treasury, energy consumers, and existing and new competitors in the Jordanian energy market in order to evaluate its potential impact on market actors' acceptance of it, and the validity of economic concerns mentioned in previous chapters.

The paper will be concluded with a summary of the previous sections and how they interrelate, and areas of focus will be narrowed down for further research to help evaluate public acceptance of the NPP more concretely.

Research Question: What are the drivers affecting public acceptance of the nuclear power project in Jordan, and to what extent do personal, cultural, psychological characteristics impact them?

Methodology

In this paper, a mixed quantitative and qualitative approach was undertaken. For the basis of the paper, a desktop qualitative research was conducted by reviewing academic journals, books, news articles, and recorded video interviews. This was done in order to find the most appropriate frameworks to be used as the structure of this paper, and to ensure the availability of information at hand.

Furthermore, semi-structured interviews were conducted with five stakeholders to ensure the provision of well-rounded and balanced data, as the stakeholders represented nuclear officials, environmentalists, students, and researchers. These interviews were done with:

- Dr. Ahmad Al-Sabbagh – Fuel Cycle Commissioner of the JAEC.
- Basel Burgan – Chairman of the Jordan Friends of Environment.
- Julien Jreissati – Greenpeace Campaigner.
- Nuclear Engineering students – Jordanian University of Science and Technology.
- Anonymous – Visiting researcher at a Jordanian research institute.

The interviews were tailored to the information and opinion needed from each stakeholder. The meetings were held in their offices, in public spaces, and through phone calls. The data was used in order to support hypotheses inferred from previous literature and news articles.

Questions were prepared prior to the interview in order to ensure the discussion yields the results needed. Deviations in the subject were welcomed, however, and were used to develop and support certain arguments in this paper.

For quantitative data, existing polls and questionnaires were used in order to obtain a quantitative estimation for different aspects regarding public acceptance, environmental awareness, and other issues pertaining to the subject of this paper. This data was used to corroborate hypotheses obtained from interviews and desk research, in order to evaluate the impact of different factors on the public acceptance of the NPP in Jordan.

Current and predicted energy costs and pricing was collected for use in calculations for economic evaluation of the nuclear power project in the final chapter, where existing methodology was used such as the Levelized Cost of Energy (LCOE) to provide the relevant data and the basis for the conclusion of the corresponding sections.

Risks and Limitations

Primary data collection through questionnaires was not done by the author due to time and financial restrictions, as well as the availability of existing relevant surveys.

Fluctuations in economic costs of energy can make predictive modelling of economic scenarios difficult and volatile. The predictive models are based entirely on the author's collected data and may not represent other models or findings.

Literature Review

Social Acceptance of Nuclear and Renewable Energy

As the aim of this paper is to analyse public attitudes towards the nuclear power project in Jordan through a methodology normally used for renewable energy, it is important to examine existing literature on public acceptance in the cases of both renewables and nuclear.

It is increasingly recognized that social acceptance may be a constraining factor in achieving energy targets. As can be seen in the case of wind energy due to its impact on natural landscapes. Wustenhagen, Wolsink and Bürer (2007) introduce three dimensions of social acceptance, namely socio-political, community and market acceptance. Factors influencing socio-political and community acceptance are recognized as being important for understanding the apparent contradictions between general public support for energy development and the difficult completion of specific projects. The third dimension, market acceptance, is mainly focused on the impacts on market players, such as consumers and competitors (Wüstenhagen,, Wolsink, & Bürer, 2007).

Others have attempted to explore public acceptance of renewables through different methods. Devine-Wright (2007) summarizes existing research on the acceptance of

renewable energy, and provides a unique classification of factors that affect public attitudes; personal, psychological and contextual. He concludes by calling for further systematic research on social acceptance that is motivated by psychological and social sciences theoretical frameworks, and the use of innovative methodological tools, along with more emphasis on symbolic and affective aspects.

Individual and Contextual Characteristics

Psychological factors have been discussed in the area of nuclear energy acceptance for decades now. For example, a paper by Stoutenborough, Sturgess and Vedlitz examines public support in the US for nuclear power following the Fukushima catastrophe, and the influence of knowledge and risk perception on public support of nuclear power policy-making (Stoutenborough, Sturgess, Vedlitz, 2013). Kim, Kim and Kim examine the effects of knowledge, trust, risk and benefit perception as determinants of public acceptance of nuclear energy in 19 countries. Without grouping the countries, they found that trust in inspection authorities is essential for the decision between opposition and reluctant acceptance. Additionally, their results show that generation of electricity has the most positive effect on public acceptance of nuclear power (Kim, Kim, & Kim, 2013).

Scholars have examined the effect of personal characteristics on the likelihood of acceptance or opposition of nuclear, such as gender. Solomon, Tomaskovic-Devey and Risman have attributed this "gender gap" to differences in safety concerns and risk perception between males and females, and women's propensity to process negative information regarding nuclear power (Solomon, Tomaskovic-Devey, & Risman, Barbara, 1989). However, others have contested that, with the results of a national survey in 1994 showing that the gap was differentiated by race rather than gender due to socio-political factors such as power, status, alienation and trust (Flynn, Slovic, & Mertz, 1994).

The effect of worldview and inherent psychological biases on nuclear acceptance has also been discussed. Peters and Slovic demonstrate how fatalist, hierarchal and individualist worldviews can increase support for nuclear power usage, while an egalitarian worldview would have the opposite effect (Peters, & Slovic, 1996).

Relevant Case Studies

Country-specific studies have been done using different methodologies in order to gauge public acceptance of nuclear energy and factors affecting it. Song, Kim and Han (2013) demonstrated the effect of perceived efficacy on strong acceptance of the nuclear power plants in South Korea, and the relationship between communication quality, trusted mediated relationships and perceived risks and benefits in the context of nuclear acceptance. Xiao, Liu and Feldman (2017) examined the effect of goodwill and competence trust, showing that improved goodwill trust decreases risk perception, while improved competence trust increases benefit perception; both leading to stronger acceptance of nuclear power plants in Qinshan, China.

A European-wide comparative analysis was done to gauge public attitudes towards nuclear by Wang and Kim (2018), classifying factors affecting acceptance into two categories; individual and contextual. The analysis showed that perceived benefits explained the largest variance of acceptance, followed by trust and perceived risk. At the contextual level, nuclear power share in the overall energy supply, environmental awareness and ideology impacted the acceptance the most. The study argues that individuals' acceptance of nuclear is based on beliefs and perceptions, but is also greatly influenced by the socio-cultural and institutional context of each country.

Chapter 1: Overview and Stakeholder Mapping

1.1: Current Energy Situation

Jordan lies in a tough neighbourhood, with rife political instability all around it. This instability has led to mass immigration into the country, creating a considerable economic and financial load. The population of Jordan has increased from 6.5 million to 10.7 million in 2019, a 40% increase (MEMR, 2018). To put that into perspective, global population only increased by 7% in the same duration (Worldometers). This has placed significant pressure on the electricity grid, as consumption rose from 14.5 TWh to over 18 TWh, according to the Ministry of Energy and Mineral Resources (MEMR, 2018). Meanwhile, Jordan imports over 93% of its energy needs, and produces the rest using its installed wind and solar energy capacities (JT, 2018).

This makes energy security one of the biggest challenges Jordan has faced in the last two decades. The IEA defines energy security as "the uninterrupted availability of energy sources at an affordable price" (IEA). And according to that definition, Jordan has definitely encountered some major obstacles to secure its energy supply. The two major incidents being the stoppage of Iraq's oil sales to Jordan at favourable prices after the fall of Saddam's government in 2003, and the terrorist attacks cutting off the gas supply from Egypt after 2013.

The Jordanian government realized the need to secure its supply, whether through internal or external means. It has done so through several ways. Firstly, it has pushed for the development of renewable energy. As mentioned earlier, wind and solar energy provides around 7% of the country's total energy consumption, following the 2007-2020 Master Strategy of the Energy Sector, which aimed for 10% by 2020 (MEMR, 2007).

Secondly, it has facilitated the import of Liquified Natural Gas (LNG) by building an LNG regasification terminal in Aqaba in 2015 (ALTC).

Thirdly, it pushed for the production of oil shale as a way of decreasing imported energy and possibly exporting oil. This was done by collaborating with Estonian company Enefit, the world's largest oil shale producer, in order to make us of its

reserves. Later on, a $2.1 billion deal to build an oil shale-to-power plant was announced, which was backed by Chinese investors and banks (The National, 2018). The plant is expected to start generating power in late 2019.

Fourthly, NEPCO began importing natural gas from Israel as part of a $10 bn deal signed in 2016. This entailed 15-year long agreement to obtain gas from the Leviathan gas fields in the Mediterranean Sea through pipelines passing from the coast to Al-Mafraq in Jordan (Bloomberg, 2018). This move caused public outrage, as the Jordanian population opposes any form of normalization with the Israeli state (Brookings, 2016).

Lastly, and most importantly in the scope of this paper, Jordan revealed the plans for developing nuclear power plants. The timeline of the development of the nuclear power project is explained in the next section.

1.2: Timeline of the Nuclear Power Project

Jordan's Committee for Nuclear Strategy (JCNS) was established in 2007, with the aim of providing 30% of Jordan's electricity through nuclear energy by 2030. Following that, nuclear law was amended that year in order to establish the Jordan Atomic Energy Commission (JAEC) and the Jordan Nuclear Regulatory Commission (JNRC).

The JAEC was established in 2008 with several missions and objectives in mind. It aimed for the use of nuclear energy for peaceful purposes by exploiting natural local nuclear resources (uranium), developing local capacities to support the nuclear program, strengthening nuclear science and medicine, partnering with the IAEA and other countries with nuclear expertise, and building a nuclear power plant for energy production and water desalination (JAEC).

Several proposals for nuclear power plants seemed to have been reported following the establishment of the JAEC. In 2008, discussions were had with Canadian actors to conduct a feasibility study to build a 740 MW Enhanced Candu-6 reactor (Electricity Forum, 2008). A month later, another report claimed that the government intended to opt for an AREVA reactor, specifically from Atmea, an Areva-Mitsubishi joint venture (ATMEA SAS, 2009). Later in the year, the JAEC

signed an MoU with Korea Electric Power Corp for a feasibility study for a nuclear power and desalination projects near the coast of Aqaba (Abdul-Rahim, & Eid, 2017).

In September 2009, the JAEC contracted the Belgian company Tractabel Engineering for a siting study for a power plant near Aqaba. However, the proposed location for the reactor changed to Qusayr Amra in Al Mafraq province, due to more favourable seismic characteristics. As a substitute for the cooling water that was supposed to come from the Red Sea, the municipal Khirbet Samra Wastewater Treatement Plant was chosen to provide cooling with a model based on the Palo Verde reactor in the arid regions of Arizona, USA.

Figure 2- Location of Qusayr Amra (indicated in red)(Jordan Google Map)

In November 2009, the commission signed an agreement with Australian energy consultancy WorleyParsons worth $11.3 million for the pre-construction phase of a nuclear power plant including technology selection, planning the tender, and assisting in fuel cycle and waste management planning for the reactor (MEED, 2009). The plan was for two 1 GW class-reactors, and WorleyParsons were to assist with establishing a public-private utility company with 75% equity from a strategic partner to own and operate the plant.

The program was moving slowly around that time, until February 2011 when the Energy Minister, who at that time was Dr. Khaled Toukan, announced that the JAEC had shortlisted the Belgian GDF Suez, the Russian Rusatom, the Chinese Datang Power, and the South Korean KEPCO as the potential partners for constructing the 2 GW nuclear power plant. The financing plan was to have a debt-equity ratio of 70-30 with a Power Purchase Agreement (PPA) of 45 years, that included a sovereign government guarantee. An overnight capital cost of 4900$/kW was expected, which would amount to almost $9.8 billion for the plant. Another estimate for the cost was made at $12 billion (World Nuclear, 2019).

Most reports following the announcement seemed to indicate that Jordan plans to proceed with a partnership with Rusatom. In October 2013, the JAEC announced that AtomStroyExport (ASE), Rusatom's reactor export subsidiary, would supply two AES-92 Units for the 2 GW plant, and that Rusatom Overseas would be the strategic partner and operator of the reactors through a joint venture. Some reports mentioned that Rusatom would provide 49.9% of the project's financing, with the government-wned Jordan Nuclear Power Co (JNPC) financing the 50.1%, thus retaining control of the project (IAEA, 2016). Other talks were had with Chinese bodies for different financing mechanisms between Jordan, Russia and China, but no further developments were made.

In 2014, the JAEC invited the International Atomic Energy Agency (IAEA) to perform an integrated nuclear infrastructure review (INIR) to gauge the country's preparations for the NPP, after former reviews in 2009 and 2012. The reports were favourable. However, a second phase of the INIR reported that improvement was needed in infrastructure and governmental regulation (IAEA, 2014).

In 2016, Rusatom announced that a feasibility study for the NPP in Jordan will be ready in 2017 (World Nuclear, 2019). However, the JAEC announced in 2018 the scrapping of the agreement with Rusatom, as financing through commercial loans -as Rusatom requested- was deemed financially unfeasible (GCR, 2018).

This led to the current discussions regarding the usage of Small Module Reactors (SMRs), due to their smaller capacities and relative ease of installation, as well as the advantages regarding saving water due to their gas-cooling capabilities.

Discussions have been held with the American company NuScale (WNN, 2019), the Chinese X-Energy (WNN, 2019), Rosatom (Rosatom, 2017), and others. As of June 2019, a definitive plan regarding the model or strategic partner has not been announced, which leaves room for speculation regarding the future of the NPP in Jordan.

1.3: Stakeholder Mapping

In order to discuss the stance of stakeholders regarding the NPP, their internal and external conflicts, and the drivers behind their acceptance or opposition, it is important to identify clearly both local and foreign actors, and determine their interest and influence over the project.

For local actors, a brief description of the stakeholder will be given along with the key or most relevant actors for the context of the paper.

Table 1: Stakeholder identification

Stakeholder	Description	Key Actor
National Authorities	The Jordanian government is a parliamentary monarchy, where King Abdullah bin Hussein II appoints the non-partisan government, and the parliament is elected. The parliament consists of 130 representative members, 99 being independent, and 65 senators chosen by the king.	Prime Minister Dr. Omar Al-Razzaz
Jordan Atomic Energy Commission (JAEC)	The governmental body that aims to promote and develop peaceful utilization of nuclear atomic energy. The commission manages and develops the nuclear power project, uranium mining, and nuclear research.	Chairman Dr. Khaled Toukan
Jordan Nuclear Regulatory Commission (JNRC)	As part of the Jordanian Energy Regulatory Commission, its aim is to issue licenses for nuclear development and oversee it, screen employees in the sector, and perform inspections and auditing for nuclear facilities.	
Non-Governmental Organizations (NGOs)	Several NGOs are playing an active role in the public discourse of the NPP, such as Greenpeace and Jordan Friends of the Environment (JFoE).	JFoE Chairman Basel Burgan
Ministry of Energy and Mineral Resources (MEMR)	The ministry responsible for energy and resource development and regulation in Jordan. The JEEC and the JNRC fall under its jurisdiction.	Minister Hiba Zawati
Local Energy Companies	Private actors in the energy industry, mainly in the energy generation sector. This includes the recent oil shale power plant owned by a Malaysian-Estonian consortium, and renewable energy developers such as JWPC.	
National Electric Power Corporation (NEPCO)	Government owned energy utility company that s responsible for the activities of the transmission networks and stations and the electrical connection and control.	GM Amjad Rawashdeh

International Atomic Energy Agency (IAEA)	An international organization that seeks to promote the peaceful use of nuclear energy. It reports to both the United Nations General Assembly and the Security Council.	Director-General Yukiya Amano
Jordanian Civil Society	Current population of around 10 million inhabitants, with almost 40% living in the capital city Amman. Literacy rate of over 98%. Majority (97%) Muslim population. Highly educated, with a researcher ratio higher than the EU average.	Major tribes (Bani Hasan, Bani Sakher, Edwan)

Following the identification of local stakeholders involved in the nuclear power project, it is important to identify some foreign stakeholders and their interest in the project. It is important to note that this table is only for the identification of foreign stakeholders, and further explanation regarding countries' interests and influence will be given in the final part of the second chapter.

Table 2: International stakeholder identification.

Stakeholder	Interest
USA	Commercial interest for involvement of US companies in the NPP. Prevention of full fuel cycle ownership by countries in volatile regions.
Israel	Safety concerns due to earthquake potential of the area.
Russia	Commercial interest in selling Russian nuclear technology.
China	Commercial interest in selling Chinese nuclear technology.
South Korea	Commercial interest in selling South Korean nuclear technology. Already provided the JRTR.
Japan	Commercial interest in selling Japanese nuclear technology.

A stakeholder mapping is performed and evaluated according to interest and influence, which is derived through historical evidence of impact on the NPP through news articles, academic research, interviews, and other media. It is shown in figure 3 below.

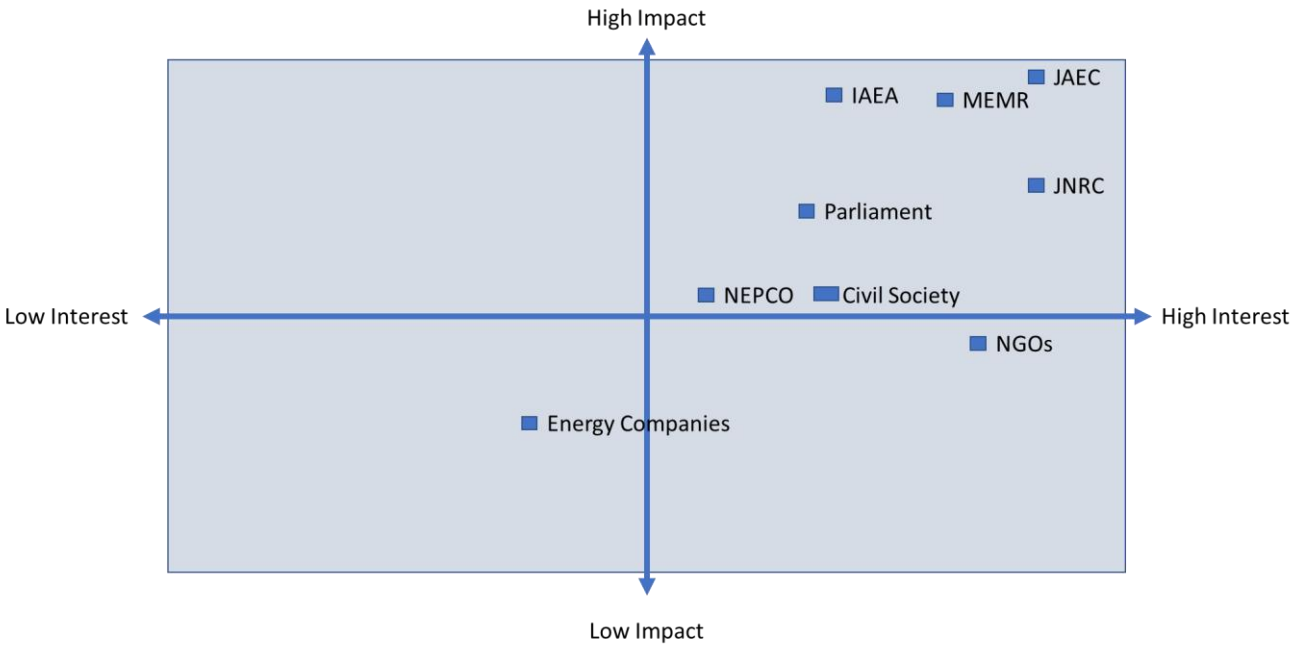

Figure 3- Stakeholder mapping

1.4: Conflicts and Coalitions

It is important to consider possible coalitions and conflicts when outlining stakeholders in the NPP. From the previously mentioned stakeholders, a clear working relationship is seen between the JAEC and the JNRC due their sole focus on nuclear matters. As they both report to the MEMR, their public opinions seem to be along the same line, due to the fear of any discourse discrepancies that might affect the legitimacy of those institutions. Utility companies such as NEPCO are publicly owned, and therefore, follow the same public opinion as government institutions.

The parliament itself has conflicts and coalitions within it, especially with regards to the NPP. Due to the current weak party system in Jordan, there is an absence of a homogenous opinion within large groups of MPs, and therefore, voting patterns maybe be unpredictable. The fair representation of the population can also be doubtful in some cases due to the nepotist nature of those institutions.

Non-governmental organizations have opposed the NPP strongly, and have worked with civil society and tribal leaders in order to influence public opinion.

Internationally, some countries have been willing to work together as described earlier, for example, China and Russia. Potential conflicts could occur between the US and those countries in the case of either being chosen as the financier of the

NPP; this is due to Jordan being a long-term ally of the US, and it may be seen as an attempt to gain influence in the country by the US' main international rivals.

These conflicts, coalitions and ongoing events will be discussed in detail in the following chapter in order to develop a full picture of the situation in Jordan in the context of the NPP.

Chapter 2: Socio-Political Acceptance

In order to understand the factors driving acceptance or opposition of the Jordanian nuclear power project, it is important to have a solid overview of the views of the key stakeholders and their cited reasons for their stance on the NPP. Therefore, it is important to explore some key concepts in this chapter that will provide the reader with a solid understanding of the current situation in order to delve deeper into personal, cultural, psychological, and economic factors affecting public discourse on this project. They key issues in this chapter are the following:

1. Cited reasons for acceptance or opposition.
2. Internal conflicts within a stakeholder's organization.
3. External conflicts with other stakeholders.
4. Strategies taken by stakeholders to influence acceptance or opposition.

Important local stakeholders mentioned in the stakeholder mapping of the previous chapter will be focused on, and the final section of this chapter will be dedicated to giving an overview of the positions of international actors.

As this chapter provides a relatively descriptive analysis of these issues, it is important to note that they will be backed by the author's interviews, journalistic and scientific articles, and relevant surveys.

2.1: Politics of Jordan

The politics of Jordan are based on a parliamentary monarchy system, with the Prime Minister (currently Dr. Omar Al-Razzaz) acting as the head of government with a multi-party system. It has been a constitutional monarchy since 1952, and the king exercises his power through the appointed government which is responsible before the parliament.

The king approves amendments to the constitution according to parliament votes, acts as supreme leader of the arm forces, and is capable of appointing and dismissing judges.

The lower house of parliament is made up of 130 representatives as shown in figure 4. However, Jordan is known for its weak party system, and many choose to run as independents as can be seen in the figure 4.

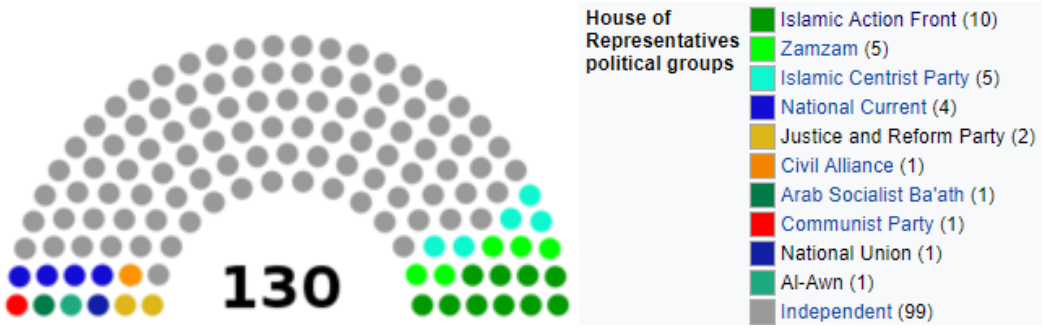

Figure 4- Parliament of Jordan (Wikimedia, 2018)

2.2: Government Bodies (JAEC, JNRC, MEMR)

The strongest support for the NPP comes from government bodies, as the main enablers for this project. However, that does not apply to individuals in those bodies. Therefore, it is important to explore the drivers for the support of those stakeholders for the nuclear programme, the internal and external conflicts they face, and the actions they are taking in order to increase public acceptance of the project.

Why the JAEC wants the NPP.

The JAEC, headed by Dr. Khaled Toukan has the highest influence and control over the NPP. The commission has the biggest incentive to deliver on their project proposal and succeed with the NPP.

In an interview with JAEC Commissioner of the Nuclear Fuel Cycle Dr. Ahmad Al-Sabbagh, he explains his reasoning on why Jordan needs to take advantage of nuclear energy. For Jordan's current situation and energy demand, which is around 3.2 GW, it is impossible to supply the base load using renewable energy due to its intermittency. Moreover, Jordan had severe energy security issues during the period from 2011-2014 due to the cutting off of the supply from Egypt, and heavy oil had to be used at that time which resulted in over 6 billion JD in losses. He says this was a lesson that the country cannot keep relying on foreign sources for energy, and must aim to achieve energy independence in the most cost beneficial way. Hence, expansion of renewable energy should not be encouraged, as they involve "take-or-pay" contracts, where NEPCO will have to either take the energy supplied by

renewables or pay compensation for the unused energy. This, he says, will end up costing the country a lot of money as it pays for energy it doesn't need, as energy from wind or solar cannot be scheduled as is the case with "base-load" sources. This does not mean, however, that renewable energy should be dismissed. On the contrary, he thinks it should definitely be used, but after careful consideration of the type of contract and how it fits within the grid. Sabbagh also stresses the importance of a diversified energy mix in Jordan, one that includes different sources of energy to avoid overdependence on one type, as was the case with imported natural gas from Egypt. He believes nuclear energy is the best solution for Jordan, in an energy mix that also includes oil shale, natural gas, wind and solar.

Dr. Sabbagh also stressed the fact that JAEC does not only exist for the sole purpose of developing the nuclear power plants, but also to run advanced projects and programmes in medicine and physics based on nuclear technology, to make Jordan a frontrunner in this field.

Internal Conflict

This excerpt from the interview reflects the strong belief the JAEC has in the NPP, and its importance as a solution to Jordan's energy security issues, as well as its commitment to use nuclear technology for other functions to add value to the citizens of Jordan. However, not everyone in the JAEC agreed. Former commissioner of the nuclear fuel cycle Dr. Nidal Zoubi was the commission's first outspoken internal critic, when he claimed that the uranium researchers found was less than 7% of what was expected. He also doubted Jordan's ability to provide enough water for uranium mining when it is the fourth poorest country in the world in terms of water (Seeley, 2014). He claims he was sent into retirement by the JAEC after publicly criticizing the programme. Another internal critic was the JAEC's former director of site management, Kamal Khdeir, who objected to the decision to choose the Qusayr Amra site for the reactor instead of Aqaba, and duly resigned (Seeley, 2013). In addition, in 2012, the director-general of the JNRC, Jamal Sharaf, was fired from his post, with the JAEC citing both incompetence and his anti-nuclear position as the reasons for his removal. However, another member of the JNRC board claimed that Sharaf was fired due to his refusal to comply with

Toukan's request for building licenses for the JRTR that were against regulations, and the JAEC's failure to provide necessary site studies and environmental assessments. Furthermore, Sharaf's replacement was Majd Hawwari, the brother of Ayman Hawwari, head of the nuclear program at the University of South Carolina, and the former JAEC commissioner for nuclear reactors (Seeley, 2014).

This intensified claims that the JAEC uses gagging or censorship methods to keep its opposition quiet, as well as nepotism in order to keep both the JAEC and JNRC on the same track. In response to a question about gagging allegations, Dr. Sabbagh says he personally does not agree with any censorship laws, and he does not think any person can be silenced nowadays due to the plethora of media outlets that allow anyone to publish their thoughts to their liking.

Another major conflict that came from the JAEC was an unintended one. In 2012, a leaked audio clip was circulated on news websites and social media in Jordan, in which Dr. Khaled Toukan allegedly appears to insult the people who oppose the NPP, calling them "donkeys" and "garbagemen" (Ammon News, 2012). This stirred up a huge controversy in both the parliament and the general Jordanian public, and led to even stronger opposition to the NPP based on a now-personal issue with the person in charge of the programme.

Stakeholder Engagement Strategy

However, the JAEC understand the need for the public to be on board with the programme for it to succeed. Therefore, they developed a comprehensive stakeholder engagement strategy in order to raise awareness for the benefits of the project, involve stakeholders, and increase public acceptance. This strategy is not public as of yet, but it was discussed in further detail by Dr. Sabbagh during the interview with the author. It covered the following: key players, actions to achieve objectives, target stakeholders, communication tools and key messages to deliver, and a major timeline.

A main focus of the strategy is on schools. As of January 2019, 83 schools had been visited by a team from the JAEC that holds scientific days with lectures about radiation, which includes both theoretical teaching and practical testing of radiation

using detectors for students to understand the nature of radiation. Another method of knowledge dissemination that the JAEC have been using is also through social and conventional media, where they have even shared facts about nuclear energy through popular existing TV shows and cartoons, as well as hold awareness events. They also have plans for a public information centre in the future. And finally, the JAEC "believe that seeing something is more important than just hearing about it," and therefore, allow individuals to register to see the research test reactor in action providing they pass a security screening.

Hence, it is clear to see that the JAEC aim to increase acceptance of the NPP by focusing on raising awareness and knowledge regarding the safety of nuclear power and radiation, and by dispelling myths and pre-existing biases against the technology that could have been influenced by either nuclear accidents or the threat of nuclear weapons. The effect of education and pre-existing biases on public acceptance will be discussed further in the third chapter.

However, it is interesting to note that the strategy does not involve the "cleaning" of the commission's image which some may see as corrupt; an issue that will be touched upon multiple times further on in the text. In response to this, Dr. Sabbagh claims everything is transparent for the public to see; for instance, in the Jordanian Audit Bureau's annual report, it can be seen that the JAEC has had zero negative remarks or comments. Therefore, the reputation of the JAEC should speak for itself.

Ministerial Support and Opposition

As of 2019, the MEMR under Hala Zawati has not shown clear public support for nuclear power generation in Jordan, neither have any key members from the cabinet it criticized it. In December of 2018, Zawati said that the new 2030 strategy for the energy sector in Jordan will not contain nuclear power generation, which is the reason for the closure of the Nuclear Power Company (Alghad, 2018). This is possibly due to the current uncertainty surrounding the NPP and the technologies it may utilize for power generation.

Some former figures in the MEMR have shown their opposition for the project after their stints in the ministry. Ex-Minister of Energy Malik Al-Kabariti stated in an

interview “I still don’t understand how some governments, even in Europe, are still thinking of nuclear power (after Fukushima and Chernobyl). This is madness.” (IPG, 2019). However, government figures and civil servants remain relatively quiet

2.3: Parliamentary Opposition and Acceptance

The picture changes significantly when analysing the perspectives and discourse of the members of parliament. With a lacking party system and a multitude of different ideologies and independent actors, many opinions can be found from within, and coalitions and opposition groups tend to naturally form and change according to the subject at hand, with the NPP being a permanent fixture since 2008 in heated parliamentary sessions.

A significant opposition to the NPP has been apparent in the Jordanian parliament. In the “Global Conference for a Nuclear Free World” in Yokahoma in 2012, just after the Fukushima accident, 2 Jordanian MPs were in attendance, in an effort to lobby their Japanese parliamentary counterparts in order to convince them to renounce the exportation of Japanese nuclear power plants to Jordan. They also stated that 64 out of 120 MPs had signed a petition against the construction of the power plants (Saito, 2012).

In a Lower House session on the 30th of May 2012, 36 out of 63 MPs voted in favour of a recommendation by the Energy and Mineral Resources Committee to halt Jordan’s nuclear programme, stating it “will drive the country into a dark tunnel and will bring about adverse environmental effects that cannot be avoided”, along with several criticisms such as its heavy economic burden, Jordan’s scarcity of water and lack of transparency (Wise Uranium, 2019). Several MPs have repeatedly shown their disapproval of the NPP, including Atif Kawwar, Hind Al-Fayez, and Jamal Gammoh, the head of the Parliamentary Energy Committee. Kawwar once said the government has put all its eggs in the nuclear basket, and claimed that everything (other energy projects) is being delayed, to the benefit of the nuclear programme (Seeley, 2014). For example, he claims that the oil shale deal with the Estonian-Malaysian consortium was being delayed to due opposition from the nuclear lobby. Al-Fayez, a former MP, has denounced the NPP on several

occasions, once stating: “They’ll build that plant over my dead body”. Moreover, despite the aforementioned vote to halt the NPP, the JAEC persisted with it, leading to claims of foul play and conspiracy from the parliament.

However, some argue that the vote to stop the nuclear programme was driven by personal vendettas against Dr. Khaled Toukan, rather than as an impartial objection to the NPP. After the parliamentary session in which the vote occurred, former MP Sameer Urabi, stated that circumstances surrounding the vote signifies that there are personal disputes between the MPs and Toukan. He hinted that he considers it a reaction to the leaked audio recording of Toukan insulting NPP opposers, especially after 45 MPs requested a general discussion regarding the recording (Saraya News, 2012).

In December 2018, MP Wafa’ Bani Mustafa criticized Toukan harshly -not for the first time- in a parliamentary session, saying he had “sold an illusion to the Jordanian public”, that he’s “bigger than the state”, and that he had failed to attend all meetings organized to discuss the NPP (Alghad, 2018). This emphasised the aforementioned dislike some figures have for Toukan’s actions and statements, as criticisms in this case were directed towards his person in the public statement as opposed to strictly the NPP.

Another supporter of the NPP is the Islamic Action Front (IAF), the political wing of the Muslim Brotherhood in Jordan. In the beginning, they opposed the programme, citing the same risks mentioned by other MPs. However, on the 13th of February, 2013, they changed their stance on the subject, accepting the construction of the nuclear power plants as long as they meet 12 conditions they set. The party leader at the time, Sheikh Hamza Mansour, announced those conditions which included ensuring that the NPP provides an affordable energy source, ensuring a remote location far away from residential areas, and not to use untested and uncertified nuclear technologies, among others (Alghad, 2013).

Due to the lack of a cohesive party system in the Jordanian parliament, it is difficult to group supporters and opposers of the NPP based on political affiliation or beliefs. Voting registries are also unavailable for public viewing, which then leaves members’ political stances to be based on published news articles and statements.

As representatives of their communities, opposition of the MPs can reflect the factors behind the opposition of the people they represent. Therefore, the reasons vary among each candidate, and can be environmental, economic, cultural and psychological. Those factors and their drivers will be discussed in further detail in the third and fourth chapters of this paper.

2.4: Tribal

Another hurdle for the NPP in Jordan is the tribal opposition. Jordanian civil society is still based on a tribal structure, with historically and numerically influential tribes and families having a very active role in the country's politics and decision-making. Some of them have been significantly vocal opponents of the NPP, most notably, the Bani Sakher tribe. As a historically Bedouin tribe with many significant social and political figures (including Hind Al-Fayez) in Jordan, they have vehemently protested the plan to construct the plant in Qusayr Amra, which lies within their region in central Jordan. This resulted in a series of civil disobedience campaigns as a part of the "Bani Sakher Awakening" – a government opposition movement- that aimed to disrupt any attempts by civil contractors to start working on the project. A representative of another major tribe and a former MP representing the central Badia district, Shaish Khraisha, declared "We absolutely reject the nuclear power project on our land," (AlJazeera, 2014).

Other significant campaigns opposing the NPP were organized by the Bani Hasan tribe, the largest of Jordan, nicknamed the "tribe of a million". This came as a part of sit-ins and protests when the project was projected to be realized in Al-Mafraq, the district of Bani Hasan's origin. In the interview with Basel Burgan, he claimed that representatives of 21 families belonging to Bani Hasan even took a case against Dr. Khaled Toukan to court, claiming hate speech from the JAEC head commissioner. This was in relation to the leaked audio clip mentioned earlier. He went on to mention that the court ruled in favour of Toukan citing results from an audio expert, incurring anger from the Bani Hasan tribe (Jafra News, 2015) .

In another significant case, during the construction phase of the JRTR, 500 local residents infiltrated and vandalized offices belonging to the nuclear engineering department in the university, causing damages worth over 250,000 JD. They

demanded a complete halt to the project, stating that the Emirati company that bought the land announced that it will be used for the construction of a swimming pool and a mosque. They were also worried about the effect of nuclear radiation from the JRTR on the surrounding residents and environment. Furthermore, they claimed unfair compensation from the government for the acquisition of their lands, and unconstitutional sales of those lands to private actors (Alghad, 2013).

However, tribes also contain different factions within themselves, as well as distinguished and influential individuals that can be considered opinion leaders. Therefore, vocal acceptance of a project coming from an influential person of a certain tribe can serve to positively influence the opinion of tribe members. The directors of the nuclear programme understand that, and have tried to utilize it to their advantage. Burgan confirms this, stating that certain tribe members have been appointment as high-level directors and employees in related companies in order to "bribe" tribes for their silence or acceptance. For instance, current Minister of Interior Salameh Hammad was included as a managing partner of JUMCO, and former Royal Court Chief Faisal al-Fayez was appointed as the CEO of the Nuclear Power Company (AlRai, 2015; Saraha News, 2015) .

That is not to say that only underhanded methods are used in order to promote acceptance of the project. Another method used by the JAEC is by assisting the development of local communities as part of their stakeholder engagement plan. In his interview with the author, Commissioner Dr. Sabbagh described projects that included renovation of schools and involvement of local communities in order to promote the benefits of the project to the local tribal communities.

Tribal protests seem tightly linked to three issues. Firstly, their attachment to the land they deem as their land of origin, as it is seen as a matter of pride and honour, and holds sentimental value. Secondly, the effect of the construction of the nuclear power plants on their livelihoods and lifestyle. And thirdly, a lack of trust of confidence in the government's actions, due to perception of corruption and unjust distribution. These three issues will be discussed in further detail in the third chapter "Community Acceptance". The government recognizes the importance of tribal acceptance, and attempts to promote it by providing additional benefits to local

communities surrounding the project's area, while also engaging in alleged methods of silencing vocal opposition using bribery.

2.5: Environmental Activists and NGOs

Environmental activism has played a huge role in stirring up public opinion regarding the NPP. This has come from NGOs such as Greenpeace, think tanks such as the Friedrich Ebert Stiftung, and individual activists. From organizing protests and sit-ins to writing op-eds and articles in the media, they have definitely managed to raise awareness about the nuclear programme. Several protests were held by Greenpeace in front of the headquarters of the JAEC and the MEMR (Wise International, 2011). They were held in collaboration with the anti-nuclear movement *Irhamouna* ("Spare us"), where they voiced their concerns regarding potential environmental, health and economic risks the NPP may pose for the country. In an interview with Greenpeace campaigner Julien Jreissati, he also mentions the security risk a nuclear power plant might have in such a volatile region. He also references the difficulties that will be had with waste management, the increasing relative cost of nuclear (while citing the financing difficulties the UK's Hinkley Point C plant is facing), Jordan's water scarcity in relation to cooling of the plant, and risk of a catastrophe like Fukushima. Greenpeace's stance on the energy security issue of Jordan is clear: they believe Jordan can transition to 100% renewable energy by 2050.

Friedrich Ebert Stiftung, the German think tank associated with the Social Democrat party of Germany, has shown its opposition towards the NPP as well. This view definitely reflects the strong anti-nuclear view that has been prevalent in Germany since Fukushima. In a report titled "Empowering NGOs on nuclear power socio-economic and environmental hazards versus renewables as energies of peace", written by the prominent anti-nuclear activist, Dr. Ayoub Abu Dayyeh in 2015, a long list of potential risks is given. This included the risks mentioned in the earlier paragraph, alongside some others such as the lack of public consultation, deadlines not being met, feasibility studies not being announced, issues with land ownership (as mentioned in the tribal section), and the lack of a legitimate environmental assessment (FES, 2015). It also mentions a scandal that was uncovered in South Korea that involved bribery and faked quality assurances for

nuclear power plant parts (FoE, 2013). As the JRTR was built by a South Korean consortium, Abu Dayyeh displays his doubts regarding the actual quality of the parts of a technology with such catastrophic consequences in the case of a bad scenario.

Abu Dayyeh's concerns also match up with Basel Burgan's concerns voiced in the interview with the author. However, Burgan's worries also have a major political driver behind them. He speaks of a history of corruption surrounding JAEC chairman Dr. Toukan, along with the current vice-chairman Abdel Halim Wreikat, that goes back to when Toukan was the director of the Balqa' Applied University. He continues to say that the conviction at that time was covered up by some higher-ups.

Another concern for Burgan, and the general public, is potential radiation from the reactor. This greatly concerns the Jordanian population, especially seeing as news articles had been published in the past stating that the number of cases of cancer diagnoses near Al-Karak and Al-Tafila has risen due to radiation leakage from the Shimon Peres Negev Nuclear Research Center in Israel, also known as the Dimona Reactor (Roee, 2010). There are many conspiracies regarding the Dimona Reactor, with a large political implication. However, the main concern over it has been the fact that it has been over 65 years since its commissioning, and that the inaction towards decommissioning it are the cause of its radiation leakages.

Princess Basma, however, has displayed her opposition to the NPP openly, despite the RHC's support. A strong environmental activist, she has aided the Jordanian Royal Marine Conservation Society (JREDS) and other associations in organizing anti-nuclear campaigns. She also stands by the idea that Jordan's renewable energy potential is too good to ignore for the sake of nuclear power (Wise International, 2011).

In general, the NPP has faced a unified and strong opposition coming from the field of environmental activism. NGOs such as Greenpeace and JFOE, as well as anti-nuclear movements and campaigners, have all expressed their full opposition to the nuclear programme. On the surface, risks such as water scarcity, waste management issues, radiation, and cost can be seen as some of the major factors affecting the

acceptance of the NPP from environmentally-concerned actors. However, issues such as perceived corruption, legitimacy, transparency and dishonesty can be seen as some of the underlying drivers which have pushed individuals such as Burgan and Abu Dayyeh to campaign so strongly against the program.

2.6: International Acceptance

Nuclear energy by nature can be considered a globally relevant issue for several reasons. Firstly, the potential of nuclear weapon development is a persistent concern and a cause of tension for all, which is why the Nuclear Non-Proliferation Treaties is considered mandatory. Secondly, aside from some exceptional cases, the supply chain of for nuclear power generation extends across several regions, as there is a need for uranium which is not found in all countries, as well as nuclear technology which is limited to a small number of states. And thirdly, both the benefits and risks of a nuclear power plant can be regional. For example, excess power generated from a nuclear plant can be distributed across borders if needed, and nuclear medicinal research can prove to be beneficial on a global scale. However, an accident occurring in a nuclear power plant can have significant implications on surrounding countries, as was the case in Chernobyl.

This makes the acceptance or opposition of other countries an important subject of examination, due to its potential implications of the development of the NPP and its subsequent success. Jordan is a country that relies heavily on foreign aid and assistance, and strategic partnerships with countries for nuclear power could help Jordan maintain their strategic importance in the region for that purpose.

The United States is a major example. Jordan and the US were due to finalize a bilateral agreement on nuclear cooperation in 2013. One major stipulation of this agreement coming from the US was to ban Jordan from uranium enrichment activities. This is part of an American effort to prevent countries from owning full fuel cycle technologies (including enrichment and reprocessing), to minimize the risk of countries in volatile regions producing nuclear weapons unassisted (Chen, 2013). However, Jordan declined this condition, stating that it unfairly limits their rights under the Nuclear Non-Proliferation Treaty, and prevents them from becoming a major uranium and nuclear fuel supplier (Peel, 2013). In an interview

with a researcher in the field, he mentions how, in a US-Jordanian Security Conference in November of 2018, Dr. Khaled Toukan declared that the agreement is a violation of Jordan's sovereignty, echoing his sentiments from 5 years earlier.

Another conflict lies with Jordan's neighbour, Israel. In 2011, King Abdullah accused Israel of attempting to derail the NPP by warning off potential partners. However, Israel dismissed the King's accusation, as the head of the Israel Atomic Energy Commission said they "supported the use of nuclear power by its neighbours for their energy and water needs" (Peel, 2013). In 2009, Israel had expressed their worries about Jordan acquiring nuclear technology, citing safety issues. They highlighted that the initially proposed location for the power plant was along a major earthquake fault line in the Jordan River Valley. During that meeting, Jordanian officials cited Japan as an example of an earthquake-prone country that has successfully avoided risk to its nuclear reactors. This was only 2 years before the Fukushima disaster (Schenker, 2015).

However, the nuclear programme has been seen as an opportunity by some other international actors. Both the UAE and Saudi Arabia see opportunities for mining uranium in Jordan that can benefit their own nuclear power plans. The US also seems potential for the involvement of US companies in the programme, providing that Jordan signs the bilateral agreement.

Other major nuclear powers also see business opportunities in Jordan. As part of China "1+2+3" investment framework with the Arab states that runs parallel with its Belt Road Initiative, nuclear energy is seen as one of the main investment areas (Tiezzi, 2016). This can be seen in Jordan's case as they look to China to provide SMRs in their latest proposed plan. Russia also offers ready financing at low interest in order to push for the sale of nuclear technology from its biggest nuclear energy company, Rosatom. Japanese officials also lobbied strongly in favour of Japanese nuclear technology during their visit to Jordan in 2010 (JT, 2010). South Korean officials also attempted to sell their own technology in 2009 (Hibbs, 2009), before winning the contract for the JRTR.

It can be seen that the international acceptance of the nuclear power project in Jordan depends on the perceived risks and benefits for each country. While Israel

seem to oppose the NPP due to safety reasons, other countries that are more geographically distant seem to embrace it for the economic potential for their own companies and economies. Even the United States, despite a disagreement with Jordan regarding its proposed bilateral agreement, sees potential economic benefits if the deal were to go through. However, the subject of international acceptance is tied to the broader study of nuclear diplomacy. Hence, it needs in-depth research using theories of international relations in order to clearly quantify the reasons for acceptance and opposition of states to the NPP, as opposed to the local framework used in this paper.

Chapter 3: Community Acceptance

In this chapter, public attitude towards the NPP will be explored in order to determine the personal, cultural and psychological reasons behind the acceptance (or lack thereof) of the proposed nuclear power plants in Jordan. This chapter will use existing literature, the author's interviews, surveys, and extrapolated analysis from studies in other regions in order to offer a comprehensive view of the multidimensional motives lying behind the stakeholders' opinions expressed in the previous chapters.

The chapter will be divided into three sections, according to a modified version of a report from the European Parliament Research Service (EPRS, 2019) (based on Devine-Wright, 2007) categorization of public attitude dimensions for low carbon technologies. The first section will explore the personal aspect, which includes age, gender, class and income. The second section will explore the cultural aspect, which includes trust, environmental awareness and personal responsibility. The third section will explore the social-psychological aspect, which includes knowledge and awareness and place attachment.

The concept of **risk and benefit perception** has to be defined before analysing the upcoming dimensions, as it can serve as the link between the personal, cultural, and psychological aspects and public acceptance. Risk has been often seen as the likelihood that an individual will experience the effect of danger by a specific action, both in terms of probability of its occurrence and its magnitude (Sjöberg, Moen, & Rundmo, 2004). Benefit can be defined positive consequences that are caused by the action, also in terms of probability and magnitude (Leung, 2013). An increased perception of risk of a certain action can decrease its acceptance by an individual, and vice versa. An increased perception of benefit of a certain action can increase its acceptance, and vice versa. It is also important to note that studies have shown that risk and benefit perception are inversely correlated; the greater the perceived benefit, the lower the perceived risk and vice versa (Alhakami, & Slovic, 1994). The following dimensions and characteristics all have an influence on the benefit and risk perception of the NPP that were mentioned in the previous chapter

(environmental, health, economic, political, etc.), and its acceptance, which will be summarized at the end of the section.

3.1: Personal

Various literature exists on the effect different demographic characteristics such as age, gender, class and income level have on a person or group's attitude towards certain types of technology. The "gender gap" in the context of attitude towards nuclear power has been discussed in academic circles for decades now. Some surveys have shown a clear difference in the level of acceptance between male and female participants, with males generally having a significantly higher rate of acceptance (The Times, 2015). Several discussions have arisen about the reason behind this discrepancy. For example, a study in 1989 titled "The Gender Gap and Nuclear Power: Attitudes in a politicized environment" suggests that the reason behind females' aversion towards nuclear power plants is due to them having higher safety concerns in face of negative information about the technology than males (Solomon, Tomaskovic-Devey, & Risman, Barbara, 1989). However, other studies dispute that claim, stating that this discrepancy does not appear with non-white participants, and hence it should be argued that the gap exists between white males versus all other participants, rather than between males and females. This is attributed to the idea that white males stand to see more benefits from environmentally risky projects than other, more vulnerable demographics (Flynn, Slovic, & Mertz, 1994).

Other studies and surveys have shown a positive relationship between income level and acceptance of nuclear power plants in Australia and the United States (Stahlik, 2010; Rankin, Melber, Overcast, & Nealey, 1981). This can be attributed to higher levels of education, or perception of personal accrued benefits of the project. This can be loosely related to the conclusion of the former paragraph, as income levels in these countries are higher for white males (Payscale, 2019). Furthermore, many national polls show increasing support with age, especially for male participants (Canadian Nuclear Association, 2012). These findings -that older white males with above-average income levels tend to support nuclear power plant construction more than others- can lead to different hypotheses regarding the correlation of acceptance with those certain demographic characteristics. The prevailing one is the

aforementioned one, that a more privileged demographic stands to see more benefits from a nuclear power plant as they manage, control and reap the profits off such a project, while being less vulnerable to any health or economic risks that may come out of it (Roberts, 2015). Global surveys from OECD countries support that notion by showing that "In summary, nuclear energy is supported more by males, the better educated, those to the right of the political spectrum and those who are older." (OECD, 2010).

As Jordan is racially homogenous, especially more so when compared to the countries performing the previously mentioned surveys, it can be difficult (or redundant) to emulate the racial element into its own national surveys and studies. Therefore, the former findings can be interpolated for the Jordanian situation by only removing the racial element, which leaves the following statement to be tested for the local context: older males with higher income levels tend to support nuclear power plant construction more than others.

Using the national survey conducted by the Centre for Strategic Studies in 2016, there is a slightly increased acceptance of the NPP by general population participants over 50 years old, as well as a positive correlation between education level and acceptance of the NPP (Center for Strategic Studies, 2016). Within the "opinion leader" segment, there was a higher acceptance of the NPP by statesmen and business leaders than their academic, journalistic and trade union counterparts.

With the assumption that statesmen and business leaders will have a higher average income than others, and that education level is generally higher for demographics with higher income, a correspondence with the earlier statement can be made; older demographics with higher income levels tend to support the NPP more than others. Unfortunately, the survey did not disclose the gender ratio of participants. However, another survey done to evaluate school-age students' perceptions of energy sources showed that male students tended to support building nuclear power plants significantly more than female students (Zyadin, Puhakka, et al., 2014).

In conclusion, a tendency for more privileged demographics in Jordan to support the NPP can be seen, which follows tendencies seen in surveys and studies for other regions. Reasons behind this could be:

1- The perception of accrued economic and quality of life benefits from the NPP.
2- Less vulnerability in the face of economic and health risks in the case of the occurrence of a negative scenario.

However, data on income levels and gender of the national survey is inexistent. Further surveys should be held in order to verify the corroboration of the local tendency with the global one with more certainty.

3.2: Cultural

The cultural dimension of community acceptance is complex as it can include different aspects that are not necessarily linked as they do in the case of the personal dimension. These aspects include trust in the government, trust in others, environmental awareness and religion.

3.2.1: Trust

In this case, trust can be defined in two ways. Goodwill trust, which is *the belief that the other party will produce something beneficial out of a risky proposal*. And competence trust, which is *the belief that the other party has the capacity and expertise to achieve its objective/proposal successfully*. Therefore, it is important to analyse both types extensively in order to determine the drivers that impact the Jordanian public's trust of the developers of the NPP (the government) and their capacity to achieve their promise. In the research done by Xiao et al. (2017) on this issue, it was determined that an increase of trust would increase benefit perception and decrease risk perception, which will increase public acceptance, and a decrease of trust would cause the opposite, as shown in figure 5 below.

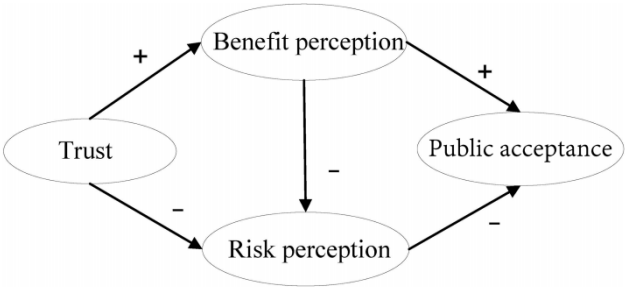

Figure 5- Trust, perception and public acceptance (Xiao et al., 2017)

Hence, **goodwill trust** needs to be contextualized further for the case of Jordan as it can be a more abstract concept than competence trust, and might also be more difficult to quantify through surveys. Goodwill trust can include whether certain figures stand to gain more than the rest of the population (perception of corruption), whether information given by the government about the NPP is reliable, and whether the government is acting for the interest of its own people as opposed to the interest of a foreign entity.

The former aspects of goodwill trust can be gauged to an extent through analysing the public discourse through news articles and relevant literature, the author's interviews with key actors, and relevant surveys regarding the public's trust in the government. The lack of reliable information has been a key element in the NPP issue in Jordan. Over the last decade, since the issuing of the nuclear energy public policy, many changes in the proposed plans for the NPP have occurred. For example, several changes to the proposed locations of the power plants were announced, from Aqaba, to Qusayr Amra. Moreover, the official rhetoric regarding the availability of uranium reserves in the country also incurred some changes. Uranium reserves were said to range from 40,000 tonnes to 70,000 tonnes, while Areva reported only 12,300 tonnes. No significant mining or exports have been made as of now. This was heavily criticized by several actors. In an interview, JUST nuclear engineering students claimed they understand the lack of trust coming from the public towards the information, as it is constantly changing and lowers credibility. Burgan also stated that the lack of credibility of the information given by the JAEC and Toukan is a reason why the project will never gain public acceptance. A report published by Friedrich Ebert Stiftung cited changing deadlines as one of the major examples of bad management of the NPP (FES, 2015).

Moreover, the lack of transparency has been cited as a major roadblock for public acceptance. This includes lack of transparency in published information, holding scoping sessions and public forums, and journalistic freedom. In his interview, Burgan claims he has been unable to publish any articles or editorials in Jordanian media since 2015 due to government censorship towards opposition of the NPP. It is important to note that the biggest Jordanian daily newspapers are all state-owned (Al-Rai, Al-Dustur, etc), and Jordan is ranked 130th out of 180 countries on the

Press Freedom Index (Reporters Without Borders, 2019). Furthermore, Burgan was detained by Jordanian authorities for a week in March, 2019, for allegedly spreading false information regarding a leak in the JRTR on Facebook, under the highly-criticized recent Cyber Crime Law. This sparked intense outrage from the Jordanian public and figures over the credibility of the JAEC and the validity of Burgan's claims (Nuke Resister, 2019).

The NPP has not been spared from claims of corruption. Corruption in Jordan has been known internally to be conducted through nepotism, bribery, *wasta* (middlemen), and cronyism (Ayed, 2019). It is difficult to quantify corruption in Jordan due to the lack of journalistic freedom (a law was passed in 2011 that allows journalists that report corruption without solid facts to be fined (BTI, 2016)) and transparency. However, the perception of the existence of corruption can be the factor that influences public acceptance. Therefore, even rumoured cases of such nature can influence public opinion on a certain matter. For example, nepotism in the nuclear sector was displayed, as mentioned in the second chapter, in the form of the brother of a JAEC official obtaining the director position in the JNRC. Others claim that some employees in the JAEC and the JRTR have been hired due to *wasta* or to appease tribal communities. Moreover, some allege that the JAEC have sent illegal payments to foreign actors for years (AllofJo, 2012). It is difficult to prove the validity of those claims, and some may rightly dismiss them as rumours. However, the very existence of this perception of corruption can weaken the trust of the people towards the government and the JAEC.

Regarding **competence trust**, it can be quantified using some of the questions asked in the 2016 CSS survey. Moreover, it can be supported using news articles, interviews, and other sources. In the aforementioned survey, the following question was asked: "Do you have confidence in the capacity of Jordan to build nuclear power plants?". The results were as following:

Table 3: Capacity confidence (CSS, 2017)

	General Public (%)	Opinion Leaders (%)
Great confidence	36.7	38.3
Moderate confidence	41.8	27.8
Little confidence	10.4	10.5
No confidence	9.1	22.3
Do not know	2.0	1.0

If moderate-to-great confidence is to be classified as a positive response, and according to those numbers, the general public's trust in the state's technical competence (or their ability to provide and acquire technical and engineering resources, locally or not) to can be said to be rather high. In an interview, Jordan nuclear engineering students reiterated this sentiment by saying they also believe that Jordan is capable of building and operating a nuclear power plant successfully, aside from their other doubts regarding the NPP. However, they do agree with the current idea at the JAEC, that SMRs are the right choice for Jordan, as the absence of an infinite heat sink in Jordan will make cooling (and thus operating) the reactor impossible. Moreover, the JRTR has been successfully running for 3 years (Farouki, Hamdan, Jun, & Alkhafaii, 2018), and its success could influence perception of a future large-scale project. Therefore, it can be concluded that technical competence trust is substantially high.

Another aspect within competence trust should be explored in this case, which is expertise trust. It can be defined in this context as the belief whether the experts and local workforce involved in this project have the capabilities to safely and successfully build and operate this project on a long-term basis. Self-doubt in Jordan communities seems like a pervasive issue, and on a surface level, it may seem like foreign entities are seen as more credible when it comes to project development. In the same interview with the students, they mention a strong lack of confidence from the Jordanian society in Jordanian engineers, especially ones who have completed their studies in the kingdom. However, in the CSS survey, "presence of a competent workforce" was cited as the public's lowest worry on

average when compared to “economic cost”, “security”, and other issues. Being the least-worrying out of these options does not mean it is not a significant worry for Jordanians, however, as it is still a present issue in the mind of the community. Therefore, it is a matter than can increase risk perception, and decrease public acceptance of the NPP, and it is important to build the public’s confidence in the nation’s expertise in order to sway public opinion towards the project, however slightly.

3.2.2: Religion

Religion plays a significant part in the Jordanian way of life, and its influence can be seen in its culture, education, traditions and governance. Islam is the religion of the Jordanian state in the constitution, and 97% of the population follows it. Therefore, to gauge factors affecting community acceptance of the Jordan public, it is important to look at the religious dimension of Jordanian culture.

At the moment, there is a lack of literature discussing the view of Islam on the usage of nuclear energy for power generation, or at least a collective consensus from the Islamic world. On one hand, there are examples of opposition coming from Islamic leaders and groups. For instance, in a document provided by the Islamic Foundation for Ecology and Environmental Sciences, based in the UK, it was stated that conventional nuclear power generation has potential for catastrophic risks, and is therefore not preferable as a source of sustainable energy. A wishful preference was also given to nuclear fusion as a great alternative (IFEES, 2016). This sentiment is shared by other imams (mosque leaders) that are especially active environmentally (SAFCEI, 2015)). In another instance, in a world first, a plan for a nuclear power plant in Jepara, Indonesia, was declared *haram* (forbidden) by local Islamic scholars, basing it on their conclusion that the risks faced by having a nuclear power plant in their district outweigh the benefits it presents (Tanter, 2007).

On the other hand, sentiments change when it comes to the Arab world. In the 2009 edition of the annual Islamic Affairs Conference, held in Cairo, the Supreme Council for Islamic Affairs declared that all countries have the right of owning and utilizing nuclear energy for peaceful purposes (Aleqtisadiya, 2009). This was the first instance of such a declaration from an Islamic international body on the matter.

Moreover, as mentioned in the second chapter, the IAF in Jordan stated its support for the NPP in Jordan given 12 conditions are provided; conditions that deal with environmental, economic, and societal concerns of the programme. As the political arm of the religious and conservative Muslim Brotherhood, it can be said that the IAF's support of the nuclear power plants represent the Brotherhood's views on the matter as well. As Muslim Brotherhood-affiliated political parties (IAF and Zamzam) have the largest number of seats in the Parliament of Jordan (15 as of 2019), their views on nuclear power can be said to either represent the views of a significant number of Jordanian citizens, or are able to influence their follower's attitudes towards it.

Hence, it can be said that the religious dimension has not played a significant part in the public acceptance of the NPP, as the examples of the acceptance or opposition it has garnered from certain religiously-affiliated bodies seem to come from the same factors that affect other dimensions (environmental, economic, personal, etc.) rather than from a purely theological basis derived from religious text or studies.

3.2.3: Environmental Awareness and Responsibility

In the second chapter, the lack of a valid environmental assessment for the NPP was one of the cited reasons for opposition for several critics. Other environmental worries were mentioned, such as water scarcity, waste management, and harmful radioactivity. Hence, it can be helpful to examine the level of environmental awareness of the Jordanian public, and how prevalent environmental issues are as factors driving public acceptance of the NPP.

In a 2005 study by Ziadat et al., a questionnaire was conducted in order to seek out the major factors contributing to environmental awareness in Jordan. Ziadat defined awareness as "to imply a level of knowledge gained empirically through one's perceptions, but it can also be considered synonymous with ''cognizance,'' which is the recognition of something sensed or felt." (Ziadat, 2009). Three steps are mentioned for environmental interaction which were defined by Cheremisinoff and Bendavid-val (2001): awareness of what should be done, the knowledge of the method of addressing an environmental concern, and incentive with matching direct rewards for performance to better the environment.

On that basis, Ziadat conducted the questionnaire in order to answer the research question. The results of the questionnaire concluded a relatively high (71.08%) overall awareness in the proposed environmental topics, with 86% of participants responding that the protection of the environment is the responsibility of both the government and the individual. Environmental awareness was higher in Aqaba than other cities, possibly due to its coastal location and hence, a more direct interaction of citizens with a valuable environmental commodity (water). It was also concluded that females in all regions had higher environmental awareness, possibly due to more daily interaction with environmentally-related issues such as water rationing, solid waste disposal, and household chemical usage, due to Middle Eastern culture. Finally, environmental awareness increased with both age and education levels.

Furthermore, in another study by Zyadin (2014), school-age students from both rural and urban areas leaned more towards agreeing to paying additional money to receive clean energy in their homes in the future, which indicates higher concern for environmental issues.

This can be compared with responses from the CSS nuclear power survey, in order to contextualize it for this paper. In a question asking about the biggest reason for opposing the construction of nuclear power plants, 52.6% of the general public cited health concerns, and 15.1% cited environmental concerns. For those who responded with health concerns, it could be attributed to either educational reasons (which will be discussed in the *education and awareness section)* or a genuine environmental concern due to potential radioactivity and waste management.

In another question, participants were asked to evaluate their different concerns for the NPP from 1-5 (1 being not worried, 5 being extremely worried). The results concluded water and cooling being the highest for both opinion leaders and the general public, economic worries being the second highest, and environmental and health concerns scoring equally for the third highest concerns. Environmental issues that encompass water, health, and natural elements seem to be a strong factor in the discourse regarding the NPP, with water being repeatedly mentioned due to its scarcity in Jordan.

Therefore, it can be deduced through both the higher environmental awareness of Aqaba residents and the CSS survey results that water scarcity seems to be the most prominent driver for environmental concerns regarding the NPP. However, it is difficult to evaluate the extent of which other environmental concerns have impacted the acceptance of the NPP as the health concerns cited in the CSS survey could indicate heightened risk perception due to misinformation, as well as due to reasons of environmental awareness.

Nevertheless, studies have shown that the population of Jordan has a high sense of responsibility towards its environment, which correlates to its high level of education compared to other Middle Eastern countries. This highlights the need for environmental challenges to be tackled publicly in order to decrease environmental risk perception of the NPP and increase public acceptance.

3.3: Social-Psychological Dimension

Baron, Byrne & Suls (1989) define social psychology as 'the scientific field that seeks to understand the nature and causes of individual behaviour in social situations'. It is then important to examine how some characteristics that are affected by social interaction and experience, such as education, awareness, and place attachment, can have an effect on perception and acceptance of the NPP.

3.3.1: Education and Awareness

The JAEC believe that increasing the public's knowledge regarding nuclear energy, its benefits and the science behind it will increase acceptance of the nuclear power project, and this belief matches existing academic research regarding the link between awareness of nuclear technology and acceptance. The lack of understanding of nuclear power and technology can lead to misinformation regarding its risks, and therefore increase risk perception and decreased acceptance (Kim, Kim, & Kim, 2014).

On an individual level, it is important to note that individuals do not operate with perfect information (Simon, 1972), and therefore are prone to form opinions based on misinformation. In addition to the general level of education for a population or community, the particular knowledge of nuclear that is communicated to the

individual as well as their willingness to learn about it are crucial in affecting benefit and risk perception.

Many surveys and studies have shown that an increased level of education equates to an increased level of acceptance. In 2010, an EU poll presented by Eurobarometer found that respondents with higher levels of education are more likely to think that the advantages of nuclear outweigh its risks. Similarly, a Globespan poll for the IAEA concluded that respondents with higher levels with education are more likely to think that nuclear power is safe and new plants should be built, and respondents with lower levels of education are more likely to think that nuclear power is dangerous and plants should be closed down (OECD, 2010).

In Jordan, as noted in the "*Personal*" section of this chapter, there is an increased level of acceptance of the NPP correlated with a higher level of education. Jordan also generally has a high level of education, being ranked the first amongst OIC countries (OIC, 2010). However, the relatively high level of education in Jordan did not respond directly to knowledge about nuclear power or its environmental impact. In the CSS survey, the following question was asked: "Do you believe that nuclear energy is environmentally-friendly and produces zero dangerous emissions, when modern technology is used?". 46.9% of respondents answered no, 46% answered yes, and 7.1% said they do not know.

Furthermore, some studies show that knowledge dissemination should not only focus on general knowledge of nuclear or radiation. Perko et al. (2012) show that effective risk communication "not only on knowledge but also on other more heuristic predictors, such as risk perception or attitudes toward communicated risks.". Wang et al. (2018) also shows the importance of communicating direct messages regarding benefit and risk perception, rather than only on general messages regarding nuclear. Therefore, for a beneficial outreach campaign from the JAEC, it is important to directly challenge risk perception of individuals rather than only educating them on the general topic of nuclear and radiation science.

However, an invested interest in learning about the Jordanian nuclear power project, and exposure to information about it, did correlate positively with knowledge of it.

A question was asked to both opinion leaders and the general public about their personal estimation of their knowledge of nuclear energy.

The following was the result:

Table 4: Knowledge estimate of nuclear (CSS, 2017)

Group	Excellent	Good	Weak
Opinion Leaders	17.2%	60.2%	22.6%
General Public	6.2%	34.3%	59.5%

It can be seen that opinion leaders have in general a much better estimation of their own understanding of nuclear energy than the general public.

Another question was asked regarding exposure and awareness of the NPP, asking if the respondent has heard, read, or watched anything regarding the NPP.

The following was the result:

Table 5: Exposure to NPP (CSS, 2017)

Group	Yes	No	Don't know
Opinion Leaders	83.1%	16.4%	0.4%
General Public	43.0%	54.1%	3.0%

This shows that the willingness to inform one's self regarding nuclear and increased exposure does increase knowledge. However, as mentioned earlier, that does not necessarily increase acceptance if other factors are not directly challenged. For example, when stating their top reason for opposing the construction of a nuclear power plant, the general public opposition leaned heavily towards citing health risks, while opinion leaders cited economic unfeasibility and the sufficiency of renewable energy as the top factors for their opposition. It can also be seen from interviews with students in a nuclear engineering program that any opposition to the NPP can be attributed to both goodwill and competency trust as opposed to perceived environmental or safety risks of nuclear. This can be attributed to their advanced acquired knowledge of nuclear technology through their studies Therefore, it can be seen that increased of knowledge of nuclear can decrease perception of risks that can form more easily due to misinformation, such as health

risks, but it does not necessarily decrease opposition if other perceived risks -that are more tangible- still persist.

In conclusion, the link between level of education and acceptance of nuclear does exist. However, for an educational campaign to effectively increase acceptance of the project, it is important to aim to challenge all perceived risks rather than only aim to provide general education on nuclear energy and radiation, as economic, trust and other risks can still persist despite a high level of knowledge regarding the subject.

3.3.2: Place Attachment

An important concept in environmental psychology, place attachment is defined as the bonding that occurs between individuals and their meaningful environments. It also contributes to the understanding of environmental risk perception and place protective attitudes. (Scannell, & Gifford, 2010). Therefore, it can be beneficial to explore this concept to identify why opposition to the NPP on the basis of land attachment and protection is so prevalent in Jordanian civil society, and especially in tribal actors.

Research on place attachment has predominantly focused on the social aspect; the idea that people are attached to places that facilitate social interaction, relationships and group identity. Using Scannell and Gifford's framework, some functions of place attachment can be used to support the sentiments of residents who have used land attachment and protection as their reason for opposing the NPP. One function is that place attachment can exist due to a certain location offering advantages for survival. This may include the ability to extract food, water and other resources, and the familiarity of how to extract them (Turnbull, 1987). As a country with Bedouin heritage, traditional Jordanian life relies heavily on making the best use out of limited agricultural capacity. In an anti-nuclear protest, Khaled Jabour, a herdsman from the proposed plant location of Azraq said: "We have lived all of our lives as herdsmen and growing wheat and barley, who is going to buy our products once these reactors are placed on the land where we herd and grow?". The owner of a nearby farm also claimed: "No one wants to buy produce form Azraq anymore, the reactors are not even built and we are known as a 'nuclear area'" (AlJazeera,

2014). This exemplifies the perspective that place attachment can relate to a person or community's dependence on it for survival and security, and both the environmental and reputational risks can harm its residents' ability to use it for survival.

Another function of place attachment is the provision of continuity; a stable sense of self that links past and future behaviours on an individual level (Hallowell, 1955). This can be in the form of a link to a childhood home, to people that a person might have lost, or through a cultural link with historical stories and myths that enriches the pride of a community of the significance of the place (Low, 1990). Tribal communities identify strongly by their place of origin, even when relocation occurs through generations. This could be supported by the manner in which Fawzi Jabbour, head of the "Bani Sakher Awakening" movement, talks about the nuclear plans in his region: "As Bedouins, we have always defended this country; and we will not allow anyone to dig or construct anything in our land" (AlJazeera, 2014).

Other functions mentioned in the framework include providing individuals with a sense of belongingness (Guiliani, Ferrara, & Barabotti, 2003), and an attachment to places with distinct social or physical qualities (La Guardia, Ryan, Couchman, & Deci, 2000). Tribal communities are based on interdependent relationships amongst themselves, with close social ties and frequent interaction. This could explain how a major nuclear development in their region can lead them to perceive a direct negative impact to their way of life, their belongingness, and their social habits, and therefore lead to an opposition of this development.

Place attachment can be an important concept to explore in relation to risk perception, as it can be seen that risk perception increases when individuals or communities detect negative impacts to the functions of place attachment mentioned. Impact can occur to a community's ability of survival, its cultural and heritage link to the place, or its social ties, which can lead to opposition of the NPP. Further research and surveys need to be done in order to quantify the most relevant risks these communities may perceive in relation to place attachment, as the available data can only support hypotheses but not clearly quantify conclusive

evidence to which functions of place attachment have had the most effect on the acceptance or opposition of the NPP.

3.3.3: Other

Other characteristics of community acceptance exist that need to be explored further in the context of Jordanian society. Political beliefs and worldview have been shown to have an effect on the acceptance of nuclear power according to research by Peters and Slovic (1996). The role of gender in nuclear acceptance in Jordan can also be examined, as multiple studies worldwide have shown a significant difference of acceptance between male and female poll participants. Other factors such as perception of effect on lifestyle, and feelings of personal responsibility, can also be studied.

In conclusion, the effects of these different dimensions on public acceptance can be summarized in the following diagram (figure 6), in accordance with the trust-risk and benefit model proposed by Xiao et al. (2017).

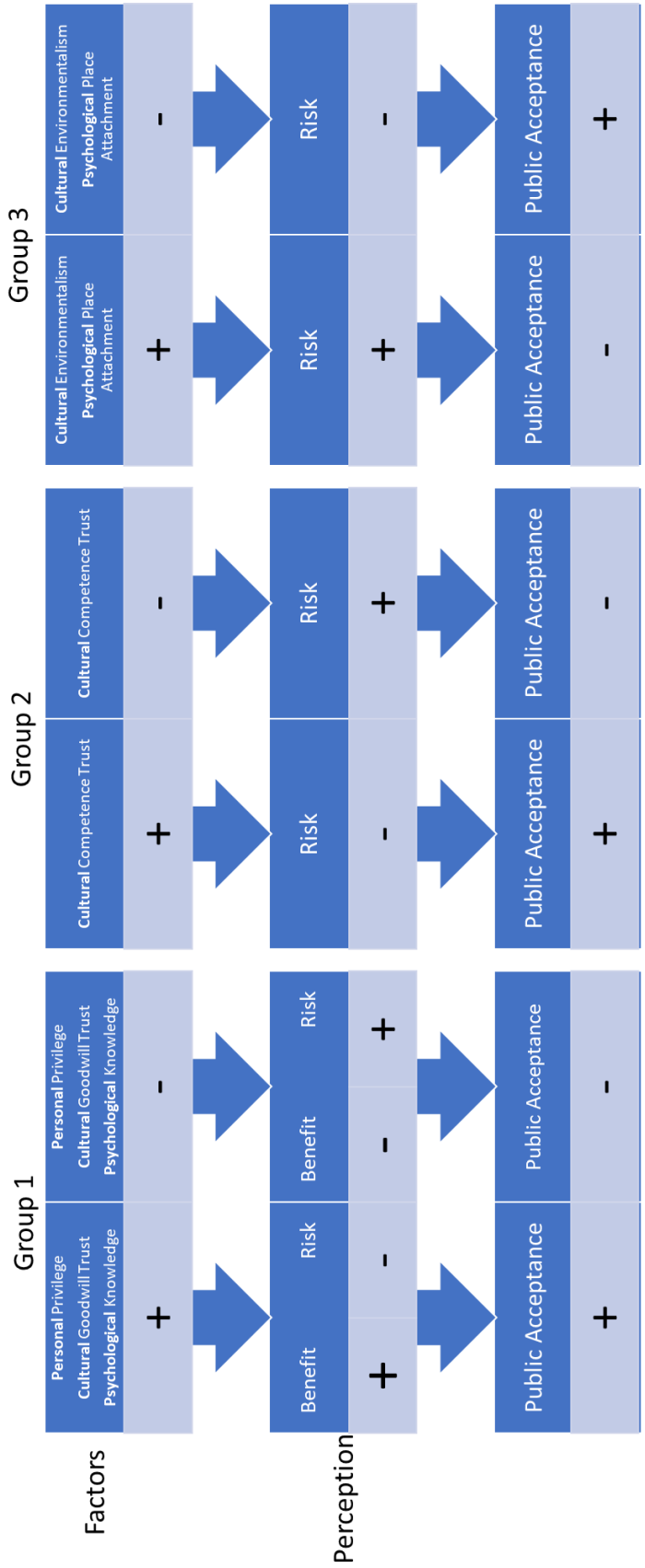

Figure 6- Impact of Community Factors on Perception and Public Acceptance

The previous diagram shows how the aforementioned personal, cultural and socio-psychological factors were seen to affect the risks and benefits perceived in the second chapter (economic, health, environmental, etc.), and hence, how those factors affect overall public acceptance. For example, increased (+) goodwill trust leads to increased benefit perception as well as decreased (-) risk perception, which leads to increased public acceptance, while decreased goodwill trust leads to decreased benefit perception and increased risk perception, therefore decreasing public acceptance. Group 1 had noticeable influence on both perceptions of risk and benefits. Group 2 and 3 were shown to mostly influence risk perception. This does not take into account religion, which has not shown to be highly influential to acceptance or opposition within the context of Jordan.

Chapter 4: Market Acceptance

It is essential to define what market acceptance is before discussing it in the context of this thesis. In Wustenagen et al.'s paper (2007), it is defined as the market adoption of an innovation. However, it is important to expand on the definition for this topic in particular by including the ideas of its affordability, economic benefit, and effect on its competitors. Therefore, market acceptance can be contextualized for the NPP by defining it in the following way: *"the market's adoptability of the nuclear power project with regards to its affordability for the consumer, its economic benefit for the state, and its effect on the rest of the energy sector."*

This section aims to explore the aforementioned three aspects of market acceptance as per its definition in this paper, according to existing literature, interviews, and the author's analysis. This will aim to provide a clearer explanation to the economic risks mentioned in previous chapters in order to determine their validity and their actual severity on the three stakeholders mentioned.

4.1: Affordability

Energy affordability by consumers, whether domestic, commercial, or industrial, is of paramount importance to the acceptance of a new source of energy in Jordan. For individuals and households considered poor -which is over a third of the population in Jordan (WFP, 2018)- financial security is prioritized, presumably on the same level as personal security according to Maslow's hierarchy of needs (Maslow, 1943). In theory, that means the lower the price a consumer pays for their energy relative to their income, the more acceptable the energy source is, as it increases financial security. Therefore, the cost-competitiveness of the proposed nuclear power plants should be examined in comparison with other energy sources.

Electricity tariffs in Jordan adhere to the cost causation principle, where the rate paid by the consumer for a unit of energy are closely related to the cost caused by producing the unit of energy (Hogan, 2019). Hence, comparing the cost of generating energy from the available sources in Jordan with nuclear energy should yield an approximate answer to whether utilizing nuclear energy will positively or negatively affect affordability, and accordingly, acceptance of the technology.

In 2015, a study by Dr. Ali Ahmad was undertaken in order to gauge the economic risk of the NPP using a comparative cost analysis. The analysis was done using the estimated costs of various energy sources' Levelized Cost of Energy (LCOE) at that time, and under the assumption that the reactors built were to be of the same type as the Novovoronezh reactors built in Russia. It was found that nuclear power would only be relatively economical to Concentrated Solar Power (CSP) and Photovoltaics (PV) if their capital costs were to be higher than 2300 and 1800 USD respectively. As for natural gas, it was calculated that nuclear energy would be uneconomical if Jordan could obtain natural gas at 12 USD per mmBTU or lower (Ahmad, 2015).

As the proposed reactors for the NPP in Jordan have changed, along with the prices of natural gas and solar energy, an updated study is needed. The emergence of oil shale as an energy source in Jordan should also be considered.

A cost comparison can be done using previous LCOE analyses from existing literature and studies in order to determine the cost competitiveness of nuclear power (from SMRs) against other energy sources.

Table 6: LCOE of Energy Sources

Source	LCOE ($/MWh)	Source
Nuclear SMR	87	(SMR Roadmap, 2018)
Natural Gas CC	58	(SMR Roadmap, 2018)
Onshore Wind	76	(SMR Roadmap, 2018)
Solar PV	60	(NREL, 2018)
Solar CSP	130	(NREL, 2018)
Oil Shale	134	(Ea Energy Analyses, 2013)

It can be seen from the previous table that electricity produced using SMRs would only be provide cheaper energy than solar CSP and oil shale. Due to the large reserves of oil shale in Jordan, oil shale fired power plants can prove to be even cheaper than nuclear according to the author's calculations if oil were to be used at only production cost (shown in annex B). Therefore, if natural gas were to be sourced at the current prices (or close to it), and renewables continue to be

developed around the country, then nuclear cannot provide more affordable energy than its alternatives, and hence, cannot gain acceptance based on economic benefit.

4.2: Economic Effect on Jordan

Many local actors have stated that one of their main worries -if not their main worry- regarding the NPP is the huge negative implications it may have on a struggling Jordanian economy. In a recent meeting between the parliamentary committee for energy and mineral resources and the Jordan Transparency Centre held on the 22nd of May, 2019, the current head of the committee MP Haitham Zyadin called for a complete suspension of the nuclear programme as they consider it as a waste of public funds, citing costs that could reach up to 10 billion JD (JT, 2019).

Multiple studies have been conducted with the conclusion that the NPP could pose serious economic risks for the country. In Ahmad's paper from 2015, several challenges are mentioned that support that claim. Firstly, the affordability issue mentioned in the previous section is presented.

Secondly, the question of financing agreements is discussed. Originally, the JAEC's plan was for Jordan to cover 50.1% of the 10 billion USD project's cost, with Rosatom covering 49.9%. Jordan's part of the cost was to be financed by prospective uranium exports that were hoped to bring in over 1.25 billion USD annually in revenue by 2012. As uranium mining has not yet proven to be feasible, it is unknown how the JAEC is planning to finance the project. Obtaining money from tax revenues would add gasoline over an already fired-up mood in the Jordanian streets (see 4th circle protests), while seeking loans from financial lenders may prove to be a risky move. Jordan is unable to provide sovereign guarantees due to its weak credit rating, which could force the country to turn to commercial lenders with higher interests and unfavourable conditions. PPA could be used to incentivize lenders. However, that may lead to Jordan being forced to turn to nuclear when other, cheaper alternatives are available in the future.

Thirdly, Ahmad denotes the potential risk of project cancellation. Nuclear power plants are prone to delays and suspensions, as can be seen with the UK's Hinkley Point C (The Guardian, 2017). Cost escalations, for example, could prove to be a

real obstacle for a country with such weak financial capabilities. This could lead to delay or cancellation of the project, and its sunk costs will decrease the public's trust in the government's capacity in handling projects. Another cause for cancellation could be public opposition, especially if it escalates with political and damaging implications.

Finally, Ahmad presents the possibility of an unplanned plant outage placing heavy strain on the grid, due to the early 1-2 GW nuclear plant proposition. However, this issue will be difficult to be taken into account until a firm decision regarding the plants' technology is taken, as several smaller units of SMRs could mitigate outage risks a single 1-2 GW plant might carry.

In a country with increasing public unrest due to unemployment, corruption, and low standards of living, a project with such high economic risks can make the public extremely wary, as people would prefer to see government funds being put into projects with tangible and short-term effects with low risks such as schooling, health and infrastructure, rather than an already controversial project with such an unpredictable outcome. Therefore, the JAEC must be able to present clear and convincing economic feasibility studies to the public in order to prove that this project is not, as MP Zyadin remarked, "a waste of government funds".

4.3: Effect on Competitors

In the idealistic vision of having a diversified and reliable energy mix, as opposed to the current situation of one energy source getting the lion's share of the electricity market in Jordan, it is important to study the effect the NPP might have on the companies operating in other energy sources. In such a prospective study, it is hard difficult to accurately predict market trends as the parameters and their impacts are impossible to forecast. However, several scenarios can be explored based on estimated supply and demand parameters, with estimated cost of energy scenarios for different sources to be used as the variable[1].

In this context, the following parameters have to be defined in order:

[1] This analysis is based on basic assumptions and hypotheses, and solely provides very rough estimates of potential scenarios without taking into account many volatile variables such as market trends, fuel prices and regional political and economic circumstances.

1. Energy demand forecast in Jordan by 2025.
2. Energy supply capacity of the major proposed energy sources (nuclear and fossil fuels).
3. Estimate of the remaining gap to be filled by renewable energy or other sources.

This logical sequence can be too simplistic to provide even a rough estimation, as it does not take into account the competitiveness of the various energy sources. Therefore, the estimated cost of energy for different sources can be used as a variable to generate different scenarios that will allow the identification of the different ways the NPP could impact its competitors.

1. Energy Demand Forecast: in an official document released by the MEMR, maximum energy demand is expected to increase to 4433 MW by 2025, where energy demand growth will equal 3.8% (MEMR, 2018).
2. Energy supply capacity: providing that the current plan of utilizing SMRs instead of large nuclear reactors for the NPP is in order, several SMRs units with ~250 MW capacities will be installed in pairs. An assumption of 4-8 units will be made to create two different scenarios of 1-2 GW of nuclear power generation.
3. Estimate of the remaining gap: The capacity of the Attarat oil shale power plant is 470 MW. The capacity of nuclear energy capacity can be estimated to be around 1-2 GW for now. The combined total is 1.47-2.47 GW. Of the 4,433 MW predicted demand of 2025, that represents 33.3-55.7%. This leaves 44.3-76.7%, or 1,963-2,963 MW to be filled by natural gas and renewable energy[2].

The following graph shows the remaining capacity for other energy sources, mainly renewable energy and natural gas, according to possible NPP scenarios:

[2] According to the MEMR, renewable energy capacity should increase to around 2,400 MW by 2021, from their current 1,130 MW capacity .

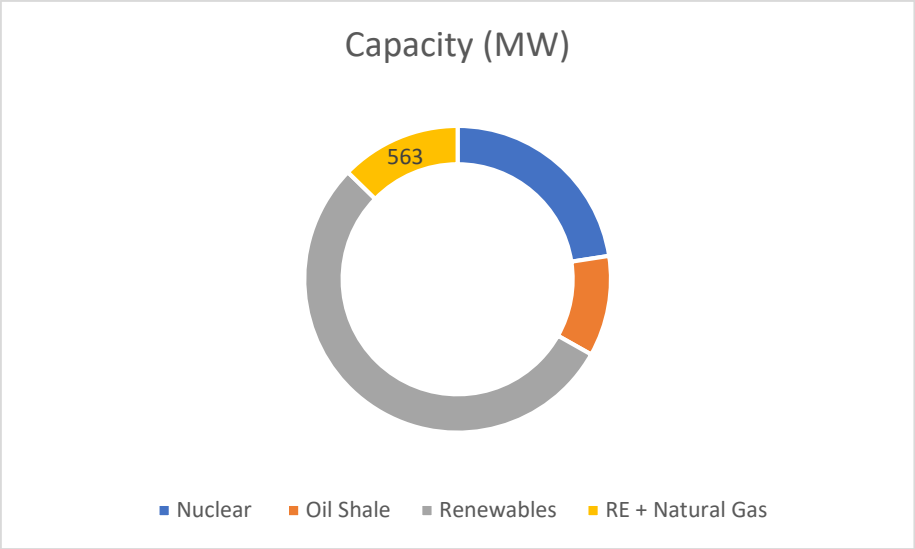

Figure 7- Scenario 1: 1 GW Nuclear

In scenario 1, it can be seen that around 563 MW will be left for further investments in natural gas and renewable energy. The number should be higher, however, as the intermittent nature of renewables will call for a much bigger investment in both RE capacity and storage technology in order to satisfy demand, unless investment is made mostly in the natural gas department.

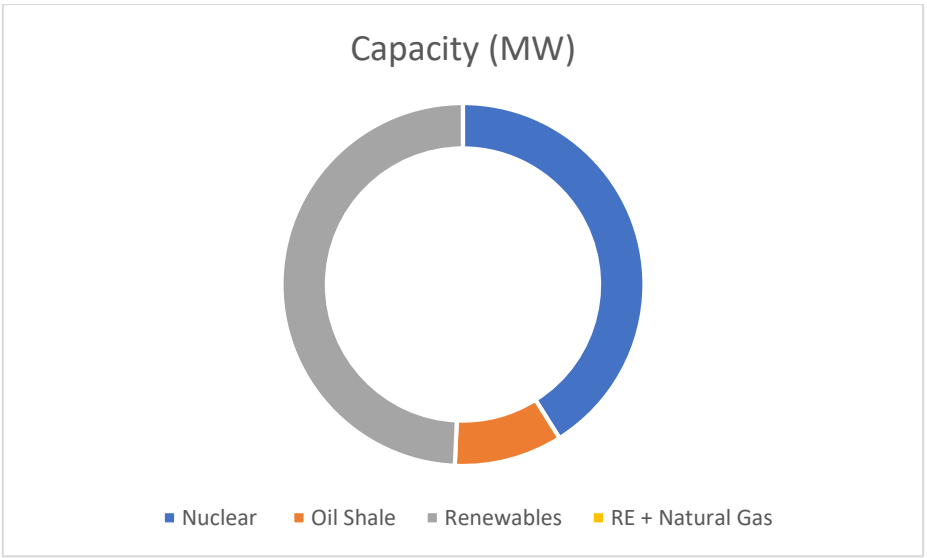

Figure 8 - Scenario 2: 2 GW Nuclear

In scenario 2, it can be seen that there will actually be an excess of 437 MW considering the usage of full capacity. While this is definitely not the case

constantly due to the intermittency of RE, it shows that installing 2 GW of nuclear capacity can be an obstacle for the integration of further RE into the grid in Jordan.

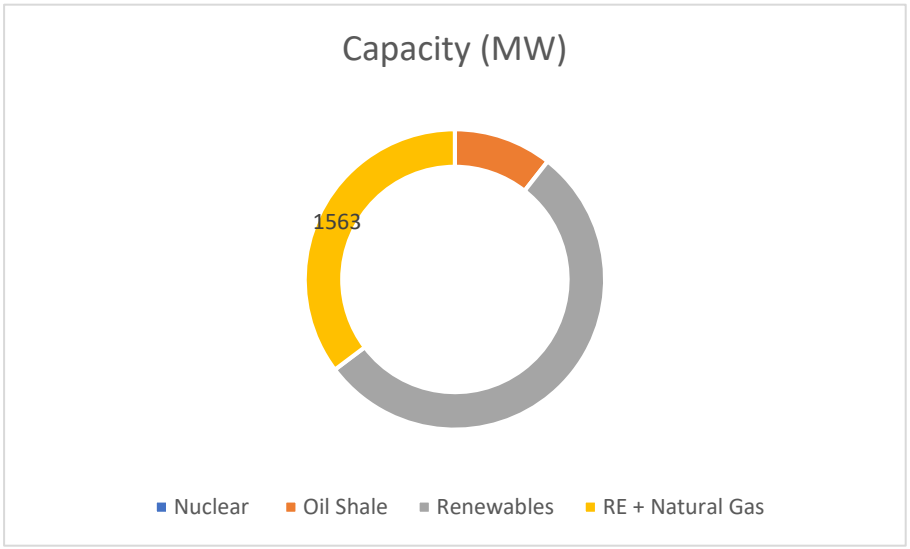

Figure 9- Scenario 3: No Nuclear

In scenario 3, where no nuclear power plants are installed, a lot of room will be available for investment into alternative sources of energy such as RE, natural gas, and oil shale. For RE, it will be very difficult to fill the remaining gap without massive investments into large capacity installations and storage technology.

The former calculations were done based on very basic presumptions and do not take into account worldwide market scenarios that may affect fossil fuel or RE installation costs. For example, natural gas could become too costly to be viable for usage in Jordan which could push for further usage of oil shale or RE. This also does not take into account potential fossil fuel exploration in Jordan which could make fossil fuel-fired power plants more economically viable than RE.

Depending on the capacities and technologies the JAEC decides to proceed with, different scenarios could be unveiled. For competitors in the renewable energy industry, scenarios 3 and 1 will prove to be the most favourable as it leaves room for extensive investment into RE technologies, thus making nuclear a possibly acceptable competitor in the energy industry as not much harm in the RE industry will be felt. This also applies to investors in natural gas power generation plants, with even more acceptability in the first scenario due to the need of covering the demand with a base-load energy source. The second scenario (or a similar one)

could harm the aforementioned industry significantly by leaving no room for further RE and power plant connections to the grid to avoid overloading.

In conclusion, there is a risk of harming competitors in the energy sector if large capacities of nuclear power are installed. To maintain acceptance from the sector, smaller capacities should be pursued that will preserve competitiveness in the energy sector in Jordan while serving as a bridging technology in the pursuit of increased energy security and independence.

4.4: Conclusion

Table 7: Economic effects on market acceptance.

	Affordability	**Economic Effect on Jordan**	**Effect on Competitors**
Stakeholders Affected	Civil Society (tribes, low-income households). Commercial and industrial consumers.	Government institutions. Civil society. Industries.	Energy companies (oil shale, renewable energy, natural gas). Fossil fuel suppliers (Egypt, Israel, Iraq).
Effect on Perception	Decreases economic benefit perception. Increases economic risk perception.	Decreases economic benefit perception. Increases economic risk perception.	Depends on scenario as mentioned in section 4.3.
Acceptance of NPP	Decreases.	Decreases.	Depending on scenario, could decrease or be unaffected

The table above summarizes the economic impact on certain stakeholders in the Jordanian market. It can be seen that effects will mostly be negative if the current proposed scenarios were to unfold. This will decrease accept of the NPP as by decreasing economic benefit perceptions of more affordable electricity tariffs and export profits for the country. It will also increase economic risk perception for

certain stakeholders, for example, more costly energy on the consumer side, worries of indebting the country, and less room for energy competitors to develop capacities in their field.

There is one case that could negate the previous concerns, however. If uranium reserves are concretely shown to be in the same range as the previous ambitious announcements from the JAEC, and successful mining and processing of it is performed, then the country could profit considerably from exports of uranium, and duly subsidize energy for consumers as well as cover commercial loans more easily.

Conclusion

Jordan has been brought to a near-boiling point politically through constant internal and external pressure, caused by scarce resources, governmental mismanagement, and extreme turmoil in neighbouring countries. This has led to the current state of intense scrutiny by a frustrated population over policies with local impact. Therefore, the NPP, with its potential for major economic and environmental risks has been at the forefront of arguments proposed by critics of the government and its policies.

Evaluating the factors that lead to public acceptance or opposition of a major public policy is an arduous task. In a heterogeneous society such as Jordan's, with a multitude of different ideologies, religions, worldviews and life experiences, it is very difficult to pinpoint a single factor that could be used as a blanket reasoning for the opposition or acceptance of a project as impactful as the nuclear power project. Therefore, it is of utmost importance to examine all the different dimensions that affect public opinion in order to develop a strategy to sway opinions to one's side of the spectrum, whether that be anti-nuclear or pro-nuclear.

Supporters of the nuclear programme spearheaded by the JAEC have cited different potential benefits to the deployment of the NPP. First, nuclear power can secure Jordan's energy supply in a region where major disruptions can occur at any time, as was the case with the attack on Egypt's gas pipelines, and the suspension of cheap fossil fuel imports from Saddam Hussein's Iraq before that. A nuclear reactor that is powered by locally-mined uranium can decrease reliance on other states on a commodity as crucial as energy. Second, nuclear power generation is a zero-emission process. This implies that it would decrease net carbon emissions caused by power generation in Jordan and help the country reach global emission targets to fight climate change. Third, the NPP can provide much-needed jobs for Jordanian youth through building and operating the power plants, as well as through uranium mining and export. Fourth, the project could have economic benefit in the future through exporting uranium, as well as excess power to neighbouring countries. Lastly, nuclear could be considered key in diversifying Jordan's energy sources,

alongside oil shale and renewables, in order to eventually reach full sovereignty over energy generation.

On the other hand, opposition of the NPP have concerns over risks that range from economic setbacks to a full-blown nuclear meltdown. Many arguments have been set forth by different stakeholders regarding why nuclear power should not be used for power generation in Jordan. First, fears of a catastrophe similar to the Fukushima disaster have not subsided, especially seeing as Jordan is located in a region with considerable seismic activity. Second, the economic burden such an expensive project could pose would set a significant blow to the country's treasury, more so if an unfavourable financing scheme with a foreign entity were to be used. Third, environmental concerns arose due to the uncertainty of fuel waste management and unsafe uranium mining hazards. Fourth, a power plant with such high capacity (i.e. the proposed 2 GW reactor) could negatively impact the growth of the renewable energy sector on the long run. Fifth, suspicions of a terrorist attack in an unstable region persist, which could lead to catastrophic risk if the proper safety measures were not to be taken. Lastly, fears of radiation leakages creating health and cancerous risks arose, especially due to similar reports being published regarding the neighbouring Israeli Dimona reactor.

A comprehensive analysis of certain factors and characteristics that affect the aforementioned reasons for acceptance and opposition was performed in the third and fourth chapter of this paper. In the third chapter, personal, cultural and social-psychological dimensions were examined in order to evaluate their impact on risk and benefit perception, and consequently, public acceptance. Within the personal dimension, it was shown that privileged demographics, mostly being older males with above-average income and education, were more likely to perceive the benefits of the NPP as opposed to its risks, and thus, are more likely to accept the NPP. This was attributed to their increased capacity to evade any risks posed by a failure of the NPP (whether economic or health related) due to higher access to wealth and resources.

Some culturally-embedded aspects were shown to have a significant effect on the public acceptance of the NPP. Goodwill trust from different stakeholders towards

the government and JAEC seemed to be considerably lacking, which decreases the perception of accrued benefits of the NPP and increases the perception of all risks it may pose. Competence trust was shown to be of less impact in this case, as there is a general belief that the technical resources can be allocated efficiently by the developers of the NPP, despite certain concerns regarding the expertise of the Jordanian labour force in building, maintaining and operating the power plants, which increases risk perception. Religion was found to not pose a significant impact on benefit or risk perception, as there was not a theological reasoning touted behind either the acceptance or opposition of nuclear power. Environmental awareness – that is relatively high in Jordan, as a result of a high level of general education - was also shown as a strong driver behind the opposition to the NPP, especially around coastal areas due to water scarcity.

Following that, it was shown that education and awareness regarding the science and technicalities behind nuclear power generation correlated positively with acceptance of the NPP. However, challenging precepted risks is of stronger importance than general education regarding nuclear science as it can help lower opposition levels. Another social-psychological factor that had a noteworthy impact was place attachment, which was mostly seen within tribal groups. The NPP was cited as a risk to agricultural livelihoods and the traditional way of living, and thus, unwanted in regions where certain groups reside.

The economic impact of the NPP was discussed in the fourth chapter. It was shown that at current and foreseeable fossil fuel prices, as well as capital costs for renewable energy installations, nuclear power will not necessarily provide cheaper energy, which will reduce perception of its benefits and hence reduce acceptance. It was also shown that such a high-risk investment with unfavourable foreign financing schemes will only serve to increase opposition in a country in a dire economic situation, where the population will most likely want to see their taxes being spent on projects with immediate and low-risk results such as infrastructure, health and education. Furthermore, the choice of reactor technology and capacity was seen to have negative effects on competitors in the energy sectors that range from mild to major in the case that nuclear gets the lion’s share of Jordan’s installed energy capacity.

Considering the findings of this paper, it can be seen that certain dimensions seem to have more severe impacts than others with regards to affecting social acceptance of the NPP. Most significantly, perception of corruption has been shown to diminish benefit perception for certain groups and individuals, and the lack of transparency and consistent information increases risk perception. The JAEC must seek to deal with these matters directly if they hope to gain more support for the NPP from the general public, as the current strategy of only identifying and challenging radiation-related misinformation and risks has not been very successful. However, these are sensitive issues that need to be addressed carefully and in an intelligent manner in order to not incite any further opposition from a society that is currently wary of misleading political discourse and developments.

Economic risks must also be taken into account when addressing the general public, as other costly projects such as the Bus Rapid Transit in Amman have received a large amount of criticism due to their continuously rising costs and constant delays. A transparent economic feasibility study with a clear and fair financing scheme with a trusted partner would need to be published to reduce perceptions of economic risk on an individual and governmental level, in order to increase acceptance of the NPP.

Finally, environmental and health risks need to be attended to publicly and in detail, especially with regards to water scarcity. In a country with such scarce water resources, the major challenge of cooling a nuclear reactor is a huge talking point. If there proposed SMRs were to actually use a reasonable amount of cooling water from the wastewater treatment facility, then that information needs to be disseminated clearly and extensively in order to alleviate concerns that affect perceptions of risks of water supply damage.

Nuclear energy has been a controversial issue globally for decades. It has helped countries such as France become a major force in the energy field by securing their energy supply and creating profits by exporting energy to other EU countries. In other cases, such as Japan, it has had catastrophic effects that have damaged whole communities and cities indefinitely. Therefore, while the upsides to its usage for power generation can be tremendous, an extensive analysis of a country's profile, including its social, cultural, economic and political dimensions, needs to be

performed in order to evaluate whether how its deployment will affect the country and its population on both the short and long-term. In the context of a Jordan under pressure, it is clear that issues both related and unrelated to the technology itself must be addressed before development of the NPP commences, as one step in the wrong direction can impact not only individuals, but the country's institutional and economic stability itself.

Annex A: Interview Guidelines

Interviewee: Basel Burgan

Occupation: Burgan Drugstores CEO, JFoE Chairman

Date: 24/12/2018

Duration: 1 hour

Main Questions	Key Findings
• Who is lobbying for nuclear? • Is there proof that nuclear lobby has delayed other projects? • What is the effect of the Dimona reactor on health in Jordan (and proof)? • Which energy sources do you advocate for?	• Naming of certain figures lobbying for nuclear. • Information on censorship tactics used by nuclear lobby. • Big advocate of renewable energy. • Prefers oil shale to nuclear.

Interviewee: Dr. Ahmad AlSabbagh

Occupation: JAEC Nuclear Fuel Cycle Commissioner

Date: 02/01/2019

Duration: 1 hour

Main Questions	Key Findings
• What are the most recent updates on the NPP? • How is media being handled (incl. strategies)? • How will financing be achieved while lowering risk?	• SMRs will be the most appropriate for the situation in Jordan. • Stakeholder engagement strategy explained.

• Thoughts on other energy sources?	• Diversification is key for Jordan in his mind, and that includes nuclear, oil shale, renewables, etc.

Interviewee: Julien Jreissati

Occupation: Greenpeace Campaigner for Middle East

Date: 08/03/2019

Duration: 30 minutes

Main Questions	**Key Findings**
• What was Greenpeace's role in the first protests, and how did they select their partners and participants? • What is Greenpeace's current stance on the NPP in Jordan? • Was there any significant pressure from the opposition?	• Greenpeace organized protests and awareness concerts, etc. • Petitions. • Against nuclear due to economic, health, environmental, waste risks. • Huge support of 100% renewables by 2050.

Interviewee: Anonymous Students

Occupation: JUST Nuclear Engineering Students

Date: 28/12/2018

Duration: 1 hour

Main Questions	**Key Findings**
• Experience with the JRTR?	• JRTR is successful, but with some unqualified figures.

• Any focus on social acceptance in their course? • Their thoughts on success potential of NPP? • Extent of lecturing about nuclear catastrophes?	• No focus on social acceptance. • Jordan has the resources to do it successfully, but water scarcity is an issue. • A lot of lectures about lessons learned from Fukushima, Chernobyl, Three Mile island.

Interviewee: Anonymous Researcher

Occupation: VisitingResearcher, Institute in Jordan

Date: 05/01/2019

Duration: 1 hour

Main Questions	**Key Findings**
• What is the situation of nuclear diplomacy in Jordan? • What are the most valid risks and benefits of nuclear in your experience? • Stance of Israeli acceptance of the NPP?	• Stance of JAEC on foreign bodies. • Lack of public acceptance studies within Jordan as opposed to UAE. • Different financing schemes of MENA countries with regards to nuclear power plants

Annex B: LCOE Calculations

	Nuclear	Natural Gas	Oil Shale	Reference
Unit Capital Cost ($/KW)	5000	1023	1550	(SMR Roadmap, 2018)
O&M cost ratio	1	1	1	(Ahmad, 2015)
Fixed O&M ($/kW-y)	145	15.37	60	(Ahmad, 2015; SMR Roadmap, 2018; Ea Energy Analyses)
Variable O&M ($/KWh)	0.00051	0.00327	0.00327	(SMR Roadmap, 2018; Beattie, 2019)
Heat rate (BTU/kWh)	10450	6430	10000	(Ahmad, 2015; SMR Roadmap, 2018)
Fueling costs ($/mmBTU)	8.4	6.2	8	(SMR Roadmap, 2018; Beattie, 2019)
Economic life (years)	40	40	40	(Ahmad, 2015)
Capacity factor	90%	90%	75%	(Ahmad, 2015)
Auxiliary consumption	8%	8%	8%	(Ahmad, 2015)
Discount rate	10%	10%	10%	(Ahmad, 2015)
LCOE ($/MWh)	87.8	39.9	80.0	

Simplified LCOE equation:

sLCOE = {(overnight capital cost * capital recovery factor + fixed O&M cost)/(8760 * capacity factor)} + (fuel cost * heat rate) + variable O&M cost. (NREL)

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