THESIS PROPOSAL

Stakeholders' perspective of environmental and social effects of a combined cycle power plant

(A case study in Zahedan city)

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Abstract

Through this research, opinions of key stakeholders regarding the environmental and social impacts of constructing a new power plant in Zahedan were examined with the purpose to identify risks and barriers that can hinder its construction. Additionally, positive and negative implications of constructing it were also identified. Zahedan city is located in the province of Sistan and Baluchistan and this province shares borders with Afghanistan and Pakistan. Hence, Zahedan city has an important strategic location that makes the implementation of any project more complex than less strategic locations because social and national security potential threats should be taken into account from the planning phase. In order to identify the key stakeholders to be involved in this work, the theory of stakeholders by Mitchell [Mitchell et al., 1997] was used as the theoretical model. The method used to conduct this research is a case study type with qualitative research methods. Once key stakeholders were selected, a questionnaire containing 14 questions was used to gather their opinions. In order to increase the reliability of this research, two methods of peer debriefing and member checking have been used. To use the peer debriefing method, the researcher used the experiences of experts who have already had experience working in the field of power plants. Having conversations with them and studying similar projects that have already been done by them helped the researcher to increase the reliability of this research. Also, by using the member checking method, after conducting the interviews and collecting the required information and answers, the researcher provided the results of the interviews to various governmental stakeholders (environmental organization of the province, regional water organization of the province) who could be part of this research as reviewers. From the analysis of the interviews, it was possible to observe optimistic and positive opinions about the construction of a new power plant. However, there were also serious concerns about the provision of financial resources required for the project, the destructive effects that the power plant may have on the environment, the provision of required skilled work force, the level of interest of the local residents to cooperate, and the positive and negative implications of constructing and operating the power plant. On the other hand, the scenario of not having the power plant in the region was also studied. This work showed that without the new power plant, Zahedan city would continue to face problems, such as frequent blackouts and power outages, which would cause more problems for residents and owners of industries and businesses with negative financial consequences. Finally, recommendations are formulated regarding mitigating some disadvantages and issues in case the new power plant will be constructed in the future.

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1. Introduction

In this chapter, there are background information about Sistan and Baloochestan province, also the description of some problems of that province, and some evidence showing the necessity of increasing the local supply of electricity. The background information was built to explain what the specific problem that motivated this research work is. Related research questions and main objectives driving this work are also presented, as well as the structure of the rest of this thesis.

1.1 Background

Sistan and Baloochestan province is the most southeastern province of Iran, which is in the neighborhood of Pakistan and Afghanistan. Sistan and Baloochestan has many problems such as poverty, high rate of unemployment, low education level compared to the national average [Iran statistical center, 2019], bad weather and sand storms, lack of energy resources, multiple droughts, lack of safe drinking water, and insecurity in neighboring countries. However, this province has rich gold and copper mines, the exploitation of which can be a suitable alternative for Iran's oil revenues. Also, the presence of Chabahar port, which is close to the border of Pakistan, plays a key role in the development of trade relations with other countries such as India. Zahedan is the farthest province center from Tehran (capital of Iran). For this reason, for many governmental organizations and private companies, investing in this province is a big risk for them [Afrakhteh, 2006]. Unfortunately, the government of Iran has a weak performance in relation to the deprived provinces. For example, the province is severely facing a problem of drinking water supply. However, the government's efforts to obtain Iran's rights to the Hirmand river, which originates in Afghanistan, have not been sufficient in any way. Also, due to the severe and intermittent sandstorms that occur in the province, the necessity of planting trees resistant to the desert climate is of great importance, but unfortunately, the government has not performed well in this regard [komeili, 2011]. However, in recent years, the Iranian government has tried to pay more attention to the development of these areas of the country [Arabshahi, 2022]. For this purpose, some provinces like Sistan and Baloochistan have been prioritized for planning and development. In order to supply the electricity needed by Zahedan city, the capital of Sistan and Baloochestan province, the construction of a block of combined cycle power plant within the boundaries of this county is on the agenda of the Ministry of Energy in Iran. "Some representatives from Mitsubishi Heavy Industries have stated that in combined-cycle technology of power plant both a gas turbine and a steam turbine are used to generate electricity by burning the natural gas which is beneficial for lower environmental impact than other fossil fuels. The exhaust heat from the gas turbine is used to generate steam, leading to more electricity generation, less waste and lower fuel costs". Therefore, combined-cycle power plants can be considered as very efficient industries in the country, which represent cost-effective and environmentally solutions because their low greenhouse gases emissions Electricity supply in

this area can greatly help to improve both social and economic situations of the local residents. As one of the infrastructure industries, the electricity industry has improved the lives of local people and has a significant impact on other industrial, agricultural and service sectors, so that the economic improvement of countries strongly depends on electricity, and as one of the main and important economic infrastructures, it has a key role in economic growth and welfare of the society. The advantages of electricity energy, such as cleanliness, ease of consumption, and the possibility of conversion to other types of energy, increase its importance [El-Sharkawi, 2008]. However, there are some negative effects of electricity generation that can be mentioned:

Environmental pollution is the first effect of electricity generation. Fossil fuels like oil, coal, and natural gas are used to burn in traditional electricity generation ways, and produce harmful greenhouse gases and other pollutants. This is the reason of air and water pollution, climate change, and other environmental problems [Markandya et al., 2007]. Another effect is health risks. Electrical devices and power lines can produce electromagnetic fields which cause lots of health problems such as cancer, physical disabilities, and neurological disorders [Alabi et al., 2021]. Electronic waste is the third effect that is mentioned. The use of electronic devices and the disposal of them have led to an increase in electronic waste. This is one of the main reasons for environmental pollution and concerns about the impact on human health. It is suspected that toxic substances inter the food chain and ecosystems [Alabi et al., 2021]. The last one is dependency on electricity. The reliance of industry and people's live on the use of electricity can cause vulnerability during power outages and other disruptions. In emergency situations such as natural disasters, where access to electricity is critical for society, transportation, and other essential services, a disruption in the electrical system can cause many problems [Dugan et al., 2023].

On the other hand, power plants can also have some benefits for local ecosystem, such as providing habitat for certain species or serving as a carbon reservoir in case of using biomass energy [Von Sperling, 2012].

It can be said that the impacts of power plants on the local ecosystem is dependent on a variety of factors. These factors can be based on the type of fuel which is used for electricity generation, the size and location of the power plant, and the management methods employed by the power plant operators.

1.2 Problem statement

In recent years, many villages around Zahedan have been deserted, and large populations of the villages have migrated to Zahedan. Some reasons for this issue are unfavorable weather, lack of drinking water, droughts, and difficulties in finding suitable job [Ibrahimzadeh et al., 2004]. On the other hand, the existing industries in Zahedan city, which have been established in recent years, meet the local needs of this province to a considerable extent. Most of the industries in this

city are food industries (flour and bread making), ice making, clothing production, mosaic making, wood products production, metal products, stone cutting, brick making, lime making, silo factories, textile, metalworking workshops, foundry and tanker manufacturing. Therefore, due to the increasing consumption of electricity in Zahedan city caused by the population growth and the existence of important industries, the construction of a power plant to supply the electricity of the region has been prioritized and a plan to build Zahedan combined cycle power plant has been proposed. The aim of this thesis is to assess what is the role of the electricity industry in the economic and social improvement of the region and optimum production and consumption of energy by observing environmental considerations and standards like 50th article of the Constitution of Iran. The 50th article of the Constitution says: In the Islamic Republic of Iran, protecting the environment, in which today's generation and future generations may have a growing social life, is considered a public duty. Therefore, economic activities and any other type of activity that is associated with environmental contamination or irreparable destruction are prohibited. The government as one of the main stakeholders has obliged the Ministry of Energy to create a suitable plan for providing a solution to the problem of electricity shortage in the region and improving the quality of life in this city. The construction of a power plant in this area, along with solving the electricity problem, will in principle, bring economic prosperity, but there are other questions around the social acceptance and effects to the local ecosystem during the power plant construction and its operation phase. Those can represent important risks for ecosystems and people living and working around the area where the power plant is planned to be constructed. Hence the main objective of this project is to investigate the environmental and social effects of a new power plant from the perspective of key stakeholders. Power plants can have significant effects on the local ecosystem. Some of the potential impacts are mentioned here:

Water pollution is one of the important impacts of power plants. Power plants usually require large amounts of water to generate electricity, which discharges hot water and chemicals into nearby waterways and rivers. This problem is one of the reasons that causes changes in water temperature and chemicals, and can harm the life of fish and other aquatic animals [Singh et al., 2016]. Air pollution is another impact as power plants can cause a lot of pollution, including the emission of sulfur dioxide, nitrogen oxides, and certain substances in the air. These pollutants can cause respiratory problems and other health problems for humans and animals. Also these chemicals are one of the reasons for acid rain and climate change [Barron et al., 2016]. Habitat destruction is the third impact that is necessary to be noticed. Power plants usually require large areas of land for construction and operation. Land use changes can lead to the loss of agricultural lands. A power plant which uses fossil fuels to produce electricity can lead to the destruction of natural habitats and loss of biodiversity [Turney et al., 2011]. Noise pollution is the last one but not least. Power plants based on their operational nature, produce a high level of noise, which can disrupt the behavior and communication of the surrounding wildlife [Sarmadi et al., 2021].

Another important issue is social acceptance. The social acceptance of a new power plant can be influenced by some factors.

Environmental issues: Environmental impact is the first one. One of the most significant factors affecting social acceptance is acknowledge of potential environmental impacts of the power plant. Local residents may be worried about air and water pollution, habitat destruction, and other negative effects on the local ecosystem [Yuan et al., 2017].

Economic restrictions: As power plants can have significant economic benefits, this factor plays a key role in social acceptance. For example, create new jobs, tax revenue, and other economic development opportunities for the local community. These benefits can make a new power plant more socially acceptable, especially if the society has economic problems [Yuan et al., 2017].

Stakeholders' pressure and education: Community involvement is the third factor. Participation of the local community in the decision-making process for the power plant can also be an important factor for social acceptance. Community members will be more likely to accept the new power plant if the community can express their opinions during participatory activities [Jang et al., 2020]. Public education is another factor. Providing accurate and clear information about the power plant, its operation, and the effects it can have on society, as well as ways to reduce those effects can also increase social acceptance. Public education along with providing the right information and training can build trust within members of the local community [Palleto et al., 2019].

Regulations: Government regulations are the last factor that can be noticed. Strong government regulations can also increase social acceptance by ensuring that the power plant has high levels of environmental and safety standards [Emodi et al., 2021].

Table 1: Factors of social acceptance

	Category	Example	Reference
Factors of social acceptance	Environmental issues	Air pollution, Water pollution, Habitat destruction	[Yuan et al., 2017]
	Economic restrictions	New jobs, Tax revenue	[Yuan et al., 2017]
	Stakeholders' pressure and education	Participation in decision-making process, Provide accurate information, Training	[Jang et al., 2020], [Palleto et al., 2019]
	Regulations	Government regulations	[Emodi et al., 2021]

Considering all the arguments here above mentioned, the lack of electricity generation sources, the importance of supplying electricity to the region, the importance of developing deprived areas and reducing the problems of the residents' life, the necessity of implementing a power plant in Zahedan seems to be part of the solution. As mentioned, constructing a combined cycle power plant has been considered for the city of Zahedan, because these kinds of power plants are the best types of power plants and they are very efficient, cost-effective, and the most environmentally friendly solution for electricity generation. These power plants cause less emission of pollutants like CO2, SO2, NOx, and particulate matter (PM) than other power plants [de Castro Villela et al., 2007] due to their high thermal efficiency [Polyzakis et al., 2008] and complete combustion [Mohammed et al., 2017], and as a result, energy loss is reduced [Pattanayak et al., 2017]. Therefore, they can be considered as the most suitable type of power plant. However, what is necessary here is to highlight the importance of analyzing those positive effects versus potential threats against the local population, and environmental impacts of implementation the plan. It is noticeable that conducting such research, especially in developing countries such as Iran, can help society in achieving sustainable development. Even further, by having stakeholders' involvement, additional possibilities of improving the living standards of people can be considered in the plan of the electricity supply plant.

1.3 Research question and main objective

The objective of the study is to investigate the stakeholders' acceptance of environmental and social effects of the construction of a new combined cycle power plant block. These stakeholders are each related to the electricity industry in some way, such as the government, investors, environmental organizations, and energy companies, or are affected by the construction of a new power plant, such as local residents. "Various elements can influence the enhancement of social acceptance such as awareness of climate changes and technological knowledge, the fairness of decision-making process, costs and risks and benefits of the technology, local context characteristics, and trust in decision-makers and other relevant stakeholders [Fytili et al., 2017]." "However, fears caused by lack of information, knowledge, and environmental concerns on the emissions, often lead to conflicts, resistance, and low acceptance of projects [Fytili et al., 2017]."

The leading research question that reflects the research objective is: To what extent, can the construction of a new power plant, taking into account environmental and social aspects, affect the lives of the residents and meet the main objectives of stakeholders?

To examine and answer the main question as accurately as possible, it has been divided in the following sub-questions:

1- What organizations or people can be considered the key stakeholders?
2- Is the construction of a new power plant in Zahedan environmentally and socially acceptable?

3- What implications can the power plant have for the key stakeholders?
4- What risks and implementation barriers are important for the key stakeholders?

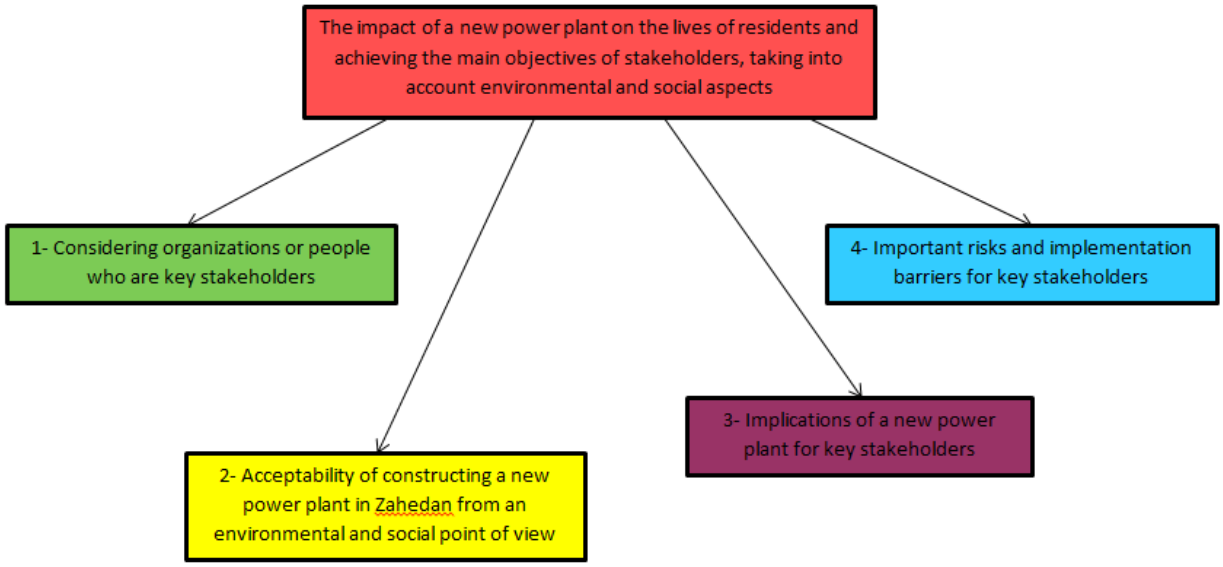

Figure 1: Schematic view of research questions and sub questions.

1.4 Organization of the report

This thesis includes the following chapters: The first chapter is an introduction and it is about the background of the research, the problem statement and importance of conducting this research, the main objective of the research, main question and sub-questions. The second chapter of the thesis is about the literature reviews and examines the Iranian and foreign literatures about the case. It includes concepts about the stakeholder typology, identification of the main stakeholders, importance of environmental and social effects of electricity sector, barriers and risks to construct a new power plant, implications of power plant construction, and research history and present situation of Zahedan city. The third chapter is the research methodology. This chapter contains several parts including research framework, key definitions, research material, data gathering, data analyzing, research limitations, and ethical procedure. The forth chapter is about the findings obtained from conducting 10 interviews with the main stakeholders who expressed their point of views on the environmental and social effects of the construction of the power plant. The chapter five corresponds to the discussion, in which we examine two options: (i) not implementing the construction plan of the energy plant and, (ii) the implementing of the plan. Finally, the last chapter is the conclusions and some recommendations from this research to mitigate some of the disadvantages and issues.

2. Literature review

In this chapter, we have carried out research about the stakeholders' categorization models/theories that can serve as theoretical foundation of this work. Then a more precise definition of stakeholders is provided. After that, all the main stakeholders involved in this project were identified. Even further, as part of the revision of literature, some sections of this chapter are dedicated to compile environmental and social effects of electricity sector, barriers and risks to construct a new power plant, implications of power plant construction. As last component, some historical details of Zahedan city that help to connect with the present situation of the city are discussed here.

2.1 Stakeholder typology

After the revision of some of the stakeholder categorization theories (Mitchell et al., 1997; Mannetti et al., 2019; Podnar et al., 2006; Slabá, 2015), due to the features to categorize stakeholders used by Mitchell in 1997, for this research, the main theory that is used is the Stakeholder theory by Mitchell (1997). According to the Stakeholder theory [Mitchell et al., 1997], real stakeholders have one or more of the three characteristics of the relationship. He calls these three characteristics "power, legitimacy, and urgency". By combining these three features, we identify several groups of stakeholders and decide which categories are the most important to company managers. Here, the importance of stakeholders is determined based on some parameters: "primary or secondary stakeholders", "owners and non-owners of the company", "owners of capital or owners of less valuable assets", "as actors or those who are acted upon", "as those who are in a voluntary or involuntary relationship with the company", "as right holders or contractors or moral claimants", "as suppliers of resources or dependents of the company", "as a risk takers or influencers", and finally "as legal managers to whom agent managers have a fiduciary duty" [Mitchell et al., 1997]. Primary stakeholders such as government, investors, and local community, are those who are directly affected by project outcomes or whose actions can have an important impact on the project, but secondary stakeholders are those who are not directly involved in the project or organization. However, they may be indirectly affected by the project activities. NGOs and competitors are examples of secondary stakeholders [Benn et al., 2016]. Voluntary stakeholders can bear risk of having invested of capital, human, and financial, but involuntary stakeholders are placed at risk as a result of a firm's activities [Mitchell et al., 1997]. In the stakeholder literature, almost everyone about an organization's actions, can affect or be affected by the organization's activities. It is needed to separate stakeholders from non-stakeholders reliably by using some theoretical support. For this research, the theory of stakeholder identification was applied. Here, in order to adopt the Mitchell model, firstly a definition of the stakeholders is reported, in this case from Freeman (1984) who stated that: Any

group or individual who can affect or is affected by the achievement of the organization's objectives. In general, stakeholders can be internal or can include groups or people outside the organization. In relation to any company and according to Mitchell (1997), Stakeholders are identified based on having one or more of the following characteristics: The **power** of stakeholder for influencing the company, the **legitimacy** of the relationship that stakeholder has with the company and the **urgency** of the stakeholder's claim about the company. These three characteristics are observed in figure 2.

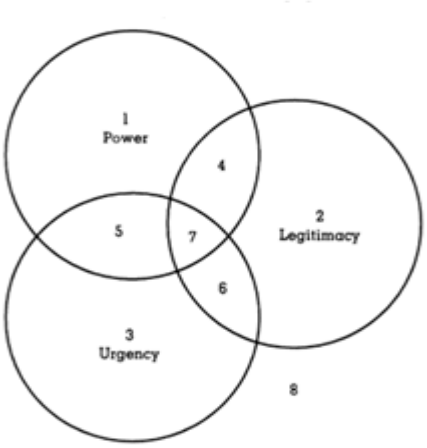

Figure 2: Qualitative Classes of stakeholders' theory [Mitchell et al., 1997].

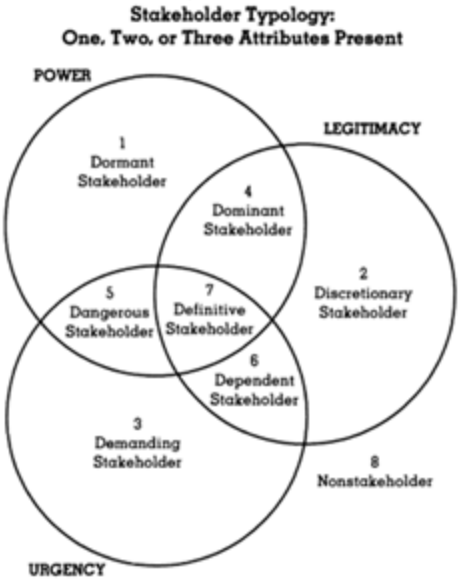

Figure 3: Stakeholder typology [Mitchell et al., 1997].

What can be inferred from figure 3 is that different categories can be considered for stakeholders from the combination of different characteristics. For example, stakeholder number 4, which is called the Dominant stakeholder, has a combination of characteristics of power and legitimacy, or as another example, stakeholder number 7, which is called the Definitive stakeholder, has all three characteristics of power, legitimacy, and urgency. Here are the 7 different categories considered in Mitchell's theory (1997), for stakeholders, which can be considered in any company:

"Dormant stakeholders": The characteristic of this stakeholder is having power. For example, this stakeholder can be someone who has lots of financial sources or someone that has ability to attract the attention of the media. "This stakeholder has limited or no interaction with company, but they have the potential to acquire a second characteristic, and then become more salient to managers if their gain legitimacy or urgency [Mitchell et al., 1997]".

"Discretionary stakeholders": "They have legitimacy, but they do not have power to influence the company, and also they do not have power for urgent claim". "The important thing about these stakeholders is that because this kind of stakeholder has no power and urgency, there is no obligation for directors to actively communicate with this stakeholder although directors can do so [Mitchell et al., 1997]".

"Demanding stakeholders": "When the only characteristic of the stakeholder's relationship with the manager is urgency, the stakeholder is described as desirable". In a situation when stakeholders cannot or do not want to obtain power or legitimacy, "urgency is not enough to project the stakeholder claim beyond latency [Mitchell et al., 1997]".

"Dominant stakeholder": When stakeholders have both power and legitimacy, their authority in the company is guaranteed because they form a dominant coalition. "We describe them as dominant in terms of the legitimate claims they have on the company and their capability to act on those claims. Dominant stakeholders are actually those stakeholders that many researchers identify as the only stakeholders of the company [Mitchell et al., 1997]".

"Dangerous stakeholders": "In a situation where the urgency and power of the stakeholder is not accompanied by legitimacy, that stakeholder is likely to be violent, and its existence is literally not only unhelpful but also dangerous to the company". "The performance of these stakeholders is not legitimate and is even dangerous, both for the relationship between stakeholder and manager, and for the individuals and institutions involved [Mitchell et al., 1997]".

"Dependent stakeholder": "These stakeholders are described as dependent, because they do not have power but they have urgent legitimate claims". "These stakeholders have dependency on other stakeholders or directors for executing their will [Mitchell et al., 1997]".

"Definitive stakeholders": "The prominence of the stakeholders will be high where they have all three mentioned characteristics". A stakeholder that demonstrates both power and legitimacy can

enter a company's dominant coalition, and if the demands of such a stakeholder are urgent, managers have an urgent mandate to address and prioritize that stakeholder's claim. When the stakeholders feel that their legitimate interests are not provided by the company's directors, and this issue will cause a sharp decrease in the values of their stock, they can easily remove the company's managers [Mitchell et al., 1997]. Therefore, the significance of a correct understanding of power, legitimacy, and urgency is shown. It should be noted that these classifications are proposed here so that we can later include each of the key stakeholders involved in the project in one of these categories based on having one or more of these three key characteristics.

2.2 Identification of the main stakeholders

The identification of main and effective stakeholders has a crucial dimension in the development of this research and mentioned in the prior section. In the case of businesses, businesses have the obligation to consider the interests of all stakeholders such as shareholders, employees, customers, and community [Shrader-Frechette, 2011]. Even further, applying Mitchell theory (1997) to the research object of this work (power plant construction) can include considerations around having the perspectives of all key stakeholders during the making decision processes. Hence, keeping the focus on the purpose of this research, stakeholders can be the government, investors, environmental organizations, energy companies, and local community; their roles are here below further described. The role of stakeholders in the project, their interests, preferences, concerns, conflict of interests, and interactions between each other should also be considered [Andreasen et al., 2014]. From such angle, in the following paragraphs, stakeholders in the scope of this research are briefly described.

Government is one of the main stakeholders to construct the power plant, because it is responsible for policies, regulations, incentives, and fund allocations to the projects [Hafezalkotob et al., 2017]. According to Mitchell (1997), the government can be classified as a definitive stakeholder.

Another main stakeholder is the group of **investors**. Investors are responsible for bringing money to the power plant projects, and it is clear that they expect a return on their investments in the shortest period of time. Potential risks and uncertain situations can determine whether stakeholders tend to invest on a project [Groot et al., 2013]. These stakeholders can be considered as definitive stakeholders as well. Investors in Iran are usually employer companies that invest in various projects using the budget provided by the government. It is clear that most of these companies are under the government authority. However, in some projects, the private sector will also be allowed to invest. As mentioned before, the special conditions of the city of Zahedan have caused investors to have little desire to invest in the city, and this issue should be taken into consideration by the government [Afrakhteh, 2006], [Komeili, 2011].

Environmental organizations are the next stakeholders involved. They will always be involved in every industrial development project, because they have concerns about the environmental impacts on their direct health condition and indirectly through the ecosystems. Some of those risks associated to the environment pollution are greenhouse gas emissions and air pollution. When negative effects are well-known, governments try to control and prevent them by environmental regulations [Fraser et al., 2021]. Environmental organizations can be classified as dominant stakeholders**.**

Energy companies are also considered in the list of key stakeholders who are responsible for designing, constructing, and operating the power plants. They can also invest in a project and allocate their financial resources to the work [Kattirtzi et al., 2021]. This kind of stakeholder can be definitive stakeholders. In Iran these stakeholders are mainly contractor companies. It is worth noting that usually these companies do not invest in projects unless they have special equipment, machines, and instruments that they can use in the implementation of the project.

Local community and residents of the area are considered as a key stakeholder because, as mentioned before, power plant construction can cause air pollution, water contamination, noise, and traffic, and also it can affect the value of assets and quality of life [Guerin 2017]. They can be categorized as discretionary stakeholders.

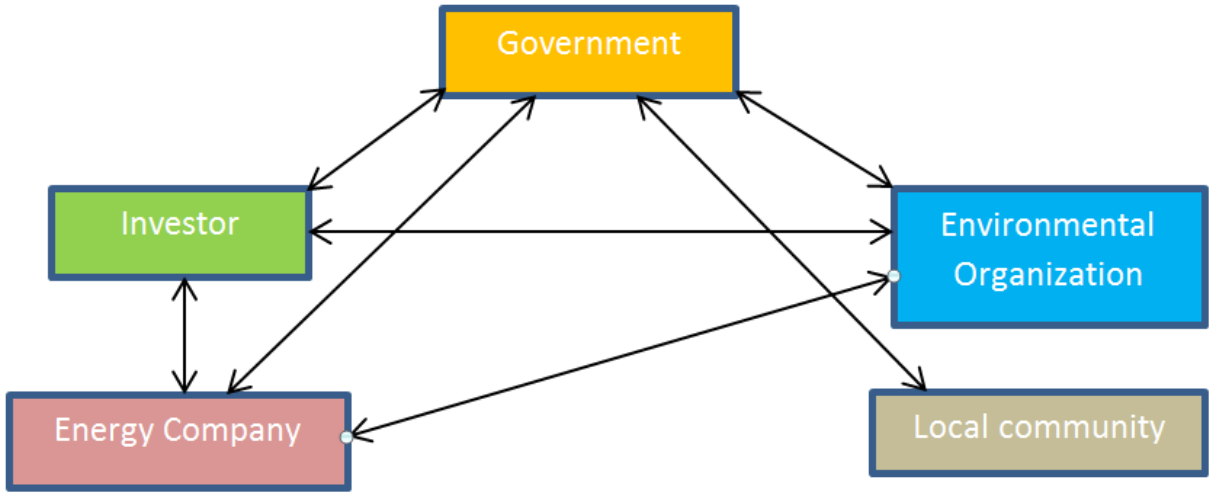

Figure 4: Interactions between stakeholders.

2.3 Environmental and social effects of electricity sector

Energy plays a very decisive role in creating economic growth. Countries with a stronger economy demand more intensive energy supply [Shaari et al., 2017]. All kinds of energy sources like oil, gas, and electricity are consumed in production, industry, transportation, and service

sectors, but electricity is consumed in all sectors and this is the most important advantage of electricity over other sources [Shaari et al., 2017]. The generation and consumption of electricity can be harmful to the environment, because different sources like coal, oil and gas are used to produce the electricity, and all of them can result in greenhouse gases emission. Greenhouse gases are the main reason for climate change. Therefore, electricity and economic development have positive and significant effects on the degradation of environment [Ferguson et al., 2000]. Also, many environmentalists believe that globalization helps to increase demand for goods and services, which leads to increased economic activities and production. This issue leads to environmental destruction and overusing of limited natural resources [Shahbaz et al., 2017].

The effects of electricity generation on the environment and human health can be easily assessed from a bottom-up approach [Markandya et al., 2007]. This means that the hazards and emissions that each stage of the electricity generation cycle can produce, from the beginning to the end consumers, are to a large extent measured. In fact, for a certain power plant, different sources of fuel supply are assessed separately and its ecological and social footprint is analyzed [Markandya et al., 2007]. In order to prevent damage to the environment and human health, the use of renewable energies that produce less carbon such as sun, water, wind, wave, biofuel, and geothermal are important to be prioritized. Defining and correct performing of energy sector policies and environmental regulations and rules are important in all over the world for having healthier and better quality of environment [Rahman, 2020]. Government has a duty to set an average level of greenhouse gas emissions as a standard and companies that cause more pollution by ignoring these standards should be required to pay taxes or fines. Also increasing public awareness has influence on polluting companies to have more social responsibility in maintaining customer relationships [Rahman, 2020].

A relevant additional aspect is to learn and dig into the **social effects** and costs of electricity generation projects, especially the activities related to the construction of the power plants. The generation of electricity has both positive and negative social effects. Some of the negative social effects of electricity generation are as follows:

Air pollution caused by burning fossil fuels can cause health problems for those who live in the neighborhood of power plants. Also, for the construction of the new power plant and its operation and use, some issues such as noise and traffic are considerable [Markandya et al., 2007]. The next negative effect is climate change. Climate change caused by fossil fuels has negative social effects such as extreme weather events or difficulties about food security [Brown et al., 2015].

Apart from negative social effects, electricity generation has positive implications:

Electricity can increase energy access in order to use essential services like heating and lighting especially in deprived areas [Zaeri et al., 2022]. Also, electricity generation can cause employment and job creation with construction, operation, and maintenance of power plants

[Dvořák et al., 2017]. Finally, electricity generation has a key role for national security, because electricity for essential services such as hospitals will be provided [Mara et al., 2022].

After knowing positive and negative aspects of electricity generation, in the next part, we discuss the barriers and risks that can be effective in the process of constructing a power plant as a facility of electricity generation on a large scale.

2.4 Barriers and risks to construct a new power plant

Any project such as constructing a new power plant can face significant risks and barriers from the beginning to the end of the project. It is important to be able to prove its justification by considering the benefits and costs of each stage of the project. In this section, studies about potential risks and important barriers that can be created and perceived by main stakeholders in the construction phase of the project are described. As mentioned before, for this project, the main stakeholders can be the government, investors, environmental organizations, energy companies, and local community and residents [Ahmed et al., 2020]. When a decision is made to construct a new power plant, the first things that would be identified are what barriers can there be in the way of a new project and what are the risks of constructing this new project. These are usually done as part of a feasibility study, which is done to determine if the project is technically and economically viable. A feasibility study usually involves comprehensive risk assessment to identify potential barriers and risks that could affect the success of the project [Sazal et al., 2022]. Generally, risk and barrier are related concepts, but they refer to different things. Risk refers to the possibility of something bad happening. In other words, it is the chance that an event or situation will have a negative outcome. Risk can be quantified usually in terms of probability, and it is often expressed as a percentage or ratio. On the other hand, barriers are obstacles that prevent progress or action. Barriers can be physical or they can be conceptual, such as a lack of knowledge. Barriers can be overcome, but they require effort and resources. About project or activity, risk and barriers are both potential challenges that should be addressed in order to achieve success. Identifying and assessing risks can help to reduce them, while identifying and overcoming barriers can help to move a project forward [Sengar et al., 2020]. Here we will mention some barriers reported in literature in order to build a new power plant:

Regulatory barriers are the first group of barriers. The construction of a new power plant needs the application of certain regulations and rules and obtaining some permission. Usually, it is a time-consuming process, and failure to comply with them can cause delays and fines for companies [Emodi et al., 2021].

Other important barriers are **financial ones**. Building a new power plant requires significant capital including initial investment. Funding a project can be difficult in principle, but when we know that the project is high risk or has uncertainty conditions, it can become even more challenging [Yuan et al., 2017]. For a city like Zahedan, as mentioned before, due to the

proximity to Afghanistan and Pakistan and the insecurity of the province, as well as the distance from the capital, there is a little desire to invest [Komeili, 2011].

The third one is **technical barriers**. The construction of new power plants requires relevant knowledge and expertise. It includes knowledge of technology, engineering expertise, and skilled workers [Sovacool et al., 2011].

Environmental barriers are one of the noticeable categories of barriers. As mentioned before, power plants can have considerable environmental effects, like air and water pollution, habitat destruction, and greenhouse gas emissions. These effects, in turn, can have negative effects on social acceptance. Therefore, constructing a new power plant can be controversial, especially if it is perceived as a threat to public health or the environment. Opposition from local people, environmental organizations, and other stakeholders can be a significant barrier to construction [Alabi et al., 2021].

Finally, **access to resources** can be mentioned. The construction of a power plant needs some resources such as land, water, and fuel to be accessible. Depending on the location of the power plant, these resources may be limited and difficult to provide [Denholm et al., 2009].

Table 2: Barriers to construct a new power plant

	Category	Example	Reference
Barriers to construct a new power plant	**Regulatory barriers**	certain regulations and rules, and obtaining some permission	[Emodi et al., 2021]
	Financial barriers	initial investment	[Yuan et al., 2017], [Komeili, 2011]
	Technical barriers	technology, engineering expertise, and skilled workers	[Sovacool et al., 2011]
	Environmental barriers	air and water pollution, habitat destruction, and greenhouse gas emissions	[Alabi et al., 2021]
	Access to resources	land, water, and fuel	[Denholm et al., 2009]

There are also **some risks associated** with constructing a new power plant. They are as follows:

Environmental and safety hazards are the most important one. Power plants can have considerable effects on the environment and public safety. There is always the risk of accidents or emissions that could harm people or the environment. This can lead to regulatory fines as well as damage to the company's name [Lindell 1994]. **Political risks** are another category. Power plants are under several laws and regulations at the local, provincial, and national levels. Changes in regulations or political priorities can affect project possibility or profitability. In some cases regulatory and political risks can lead to project cancellations and delays [Belikova et al., 2019]. **Construction delay** is another risk. Constructing a new power plant is a complex process in which many factors are involved. Delays caused by unforeseen problems, weather conditions, or legal approvals, etc., can lead to increased costs and delays in revenue and delays in the return of investors' capital [Diniz et al., 2023]. **Unanticipated costs** are the next one. It is not easy to calculate the costs of constructing a new power plant in advance, and unexpected cost can come up during the construction process. For example, in countries like Iran that are facing increasing inflation, the cost of material and labor may increase, or unexpected problems may arise on site that need to be addressed. These costs can reduce the profitability of the project and can even make it uneconomical [Maronati et al., 2019]. Finally, we can mention **technical issues**. Power plants rely on complex machines and systems that require suitable design, construction, and maintenance. Technical issues may arise during construction, such as equipment failure, design flaws, or safety concerns which can lead to costly repairs or even project failure [Sovacool et al., 2011].

Table 3: Risks to construct a new power plant

	Category	Example	Reference
Risks to construct a new power plant	**Environmental and safety hazards**	accidents or emissions	[Lindell 1994]
	Political risks	changes in regulations or political priorities	[Belikova et al., 2019]
	Construction delay	unforeseen problems, weather conditions, or legal approvals	[Diniz et al., 2023]
	Unanticipated costs	inflation	[Maronati et al., 2019]
	Technical issues	equipment failure, design flaws, or safety concerns	[Sovacool et al., 2011]

2.5 Implications of power plant construction

The construction of a power plant can have significant implications, which we can call them as problems and opportunities, for stakeholders involved. Here are some of them:

Governments may support the construction of power plants to meet growing energy demand, promote economic development of the country, and increase access to electricity, but they may face some problems related to environmental regulation, financing and allocating money, and community participation [Hafezalkotob et al., 2017]. Also, **investors** may consider the power plant construction project as a potentially profitable investment [Groot et al., 2013], but the risks related to compliance with the regulations, delays in construction and additional costs of the project can be considered for them [Yuan et al., 2019]. **Environmentalists** and environmental organizations may oppose the construction of a new power plant because of its potential negative effects, like air pollution and water contamination, habitat loss, and climate change. They may recommend other energy sources and promote renewable energy and energy conservation [Fraser et al., 2021]. Then, **energy companies** may benefit from the construction of power plants by increasing their energy production and meeting energy demand, but they may face new challenges related to regulatory compliance, stakeholders' involvement and participation, and extra costs [Kattirtzi et al., 2021]. Finally**, local people** living near power plants may experience both positive and negative effects. Increasing job opportunities, infrastructure development, and access to electricity are examples of positive consequences, and land use change, displacement, health effects caused by pollution, noise [Sarmadi et al., 2021], and economic effects are examples of negative consequences [Alabi et al., 2021].

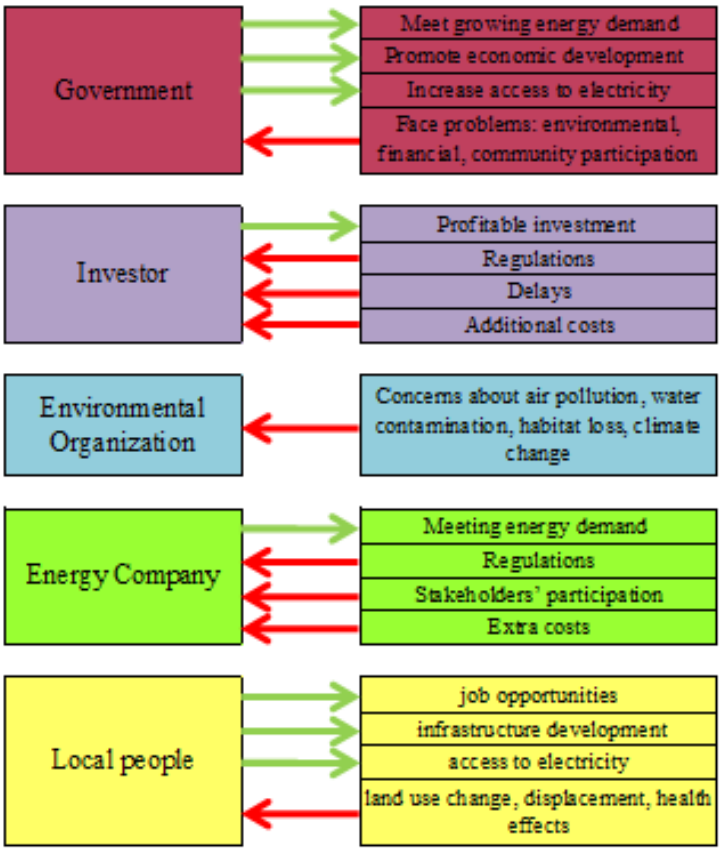

Figure 5: Implications of a new power plant for stakeholders.

2.6 Research history and present situation of Zahedan

So far, no combined cycle power plant has been built in Zahedan city, and no academic and scientific research has been done about it. However, in recent years, there have been discussions regarding the construction of another combined cycle power plant in Chabahar, another city of Sistan and Baloochestan, so that the living conditions of the local residents can be improved as much as possible by using this power plant. If this new project of Zahedan city can get the necessary approvals from all points of view, including legal, environmental, social, technical, and financial issues, a big step will be taken in the direction of providing electricity to the residents of the city. As mentioned earlier, due to the migration to Zahedan and presence of workshops and industrial factories, the need of region for electricity generation is increasing day by day. Therefore, it is necessary to adopt and implement the best and most suitable method of electricity generation by considering all aspects, especially social and environmental issues.

3. Methodology

In this chapter, the research methodological approach to identify the key stakeholders and the barriers and risks that could exist regarding the construction of the power plant is presented. Implications associated to new power plants made part of this chapter.

In fact, every research begins with a problem. The research problem creates some questions in the researcher's mind [Ashjaei, 2015]. For answering every research question and draw conclusions the data collected about the research is the input and the basis of the research, and finally the researcher should take action regarding the answers to the research question according to the collected data. Achieving scientific goals or scientific knowledge will not be possible unless it is done with proper methodology. In this chapter, we have some parts like research framework, key definitions, research material, data gathering, data analyzing, research limitations, and ethical procedure. In the following section, a brief description of the research framework is elaborated.

3.1 Research framework

To build a research framework it is necessary to state the purpose of the research. As mentioned before, the main intention of the research is investigating the environmental and social effects of the construction of a new combined cycle power plant block from key stakeholders' perspective. All of these stakeholders are somehow related to the electricity industry and power plant construction or are affected by it. For this purpose, the main theory that is used in this research is stakeholder theory, and for investigating all the environmental and social effects of the construction of this power plant, all benefits, costs, conflict of interests of stakeholders, positive and negative implications, and risks and barriers that can exist are considered. The focus of the social and environmental effects of this research comes from diverse academic sources. The first step is to accurately and completely identify the situation of the region in order to political, environmental, economic, social, local and regional relations, and the cultural conditions governing the region. Then the main stakeholders of the project are identified from the beginning to the end of the project process. These stakeholders can benefit from the new power plant or this project will cause significant losses for them. By using the theory of stakeholder identification and salience by Mitchell (1997) as the main frame of our work, we can completely analyze the project based on the profit and loss of stakeholders.

Here, the analytical framework will be explained. For this kind of framework, I used the idea of Verschuren [Verschuren et al., 2010] about designing a research project. As mentioned in that document, the analytical framework has seven steps:

1- Defining the objective of the research: The main objective of this thesis is to investigate the stakeholders' acceptance of environmental and social effects of the new combined cycle power plant block construction. For this purpose, it is necessary to identify the key stakeholders involved in the project. After that, it is required to determine the risks and barriers of implementation the project, and also implications that the new power plant can have for main stakeholders. As mentioned earlier, no such power plant has been built in Zahedan city. Therefore, the successful completion of this research can help to improve the current conditions of Zahedan.
2- Determining the research objects: The research object in this research is to investigate the possibility of constructing a new combined cycle power plant based on stakeholders' acceptance of environmental and social effect.
3- Establishing the nature of the research: While examining the positive and negative environmental and social effects of a new power plant, this research will provide methods to reduce the negative environmental effects and also increase the social acceptance among stakeholders.
4- Determining the sources of the research: Theoretical framework for this research is developed by reviewing scientific literatures and other sources of data such as books, reports, and scientific magazines. The main foundation of our research is based on stakeholder theory.
5- Making the schematic presentation of the research framework: The framework of this research can be seen in figure 4.

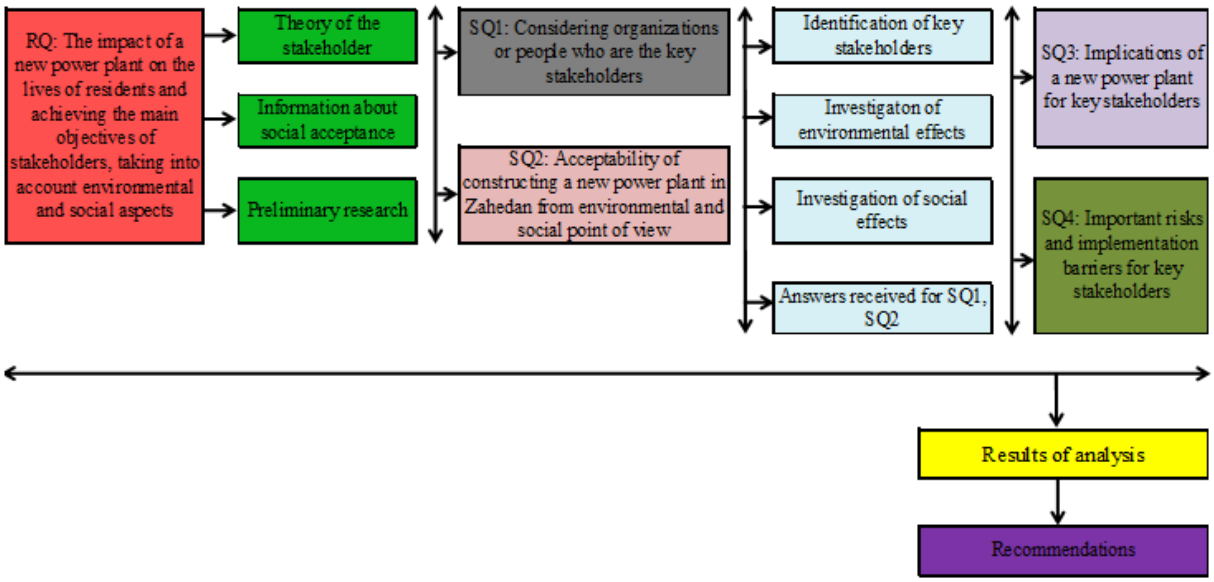

Figure 6: Analytical framework of the research

6- Formulating the research framework:
(a) Literature review and preliminary research about stakeholders, environmental aspects, and social aspects for the research.
(b) By which the research objects will be assessed.
(c) Results of analysis.
(d) Recommendations to solve the problems.
7- Check the model to know whether it requires any changes.

3.2 Key definitions

A combined cycle power plant usually includes the following equipment and systems: gas turbine, steam turbine, main cooling system, recovery boiler, secondary cooling system, condensation system, chimney, safety and fire alarm system, fuel transfer and storage system, water transfer and purification and storage system, wastewater collection and treatment system, electricity generation system and connection to the network, and finally evaporation pond. Depending on the case, a definition of the function of each part may be provided to familiarize the reader with these concepts. The definitions considered in this section will include technical definitions about the structure and operation of the power plant, and of course definitions related to environmental concepts, which are the main foundation of this research. Also, each combined cycle power plant has side facilities that are part of the project and provide the needs of the power generation units. These facilities are related to the:

Gas pressure reduction station, construction of gas pipelines and gas or diesel storage and transmission facilities, water supply of the power plant through the construction of the water pipeline to the site, sewage and water treatment plants, firefighting system and heating, cooling and air conditioning systems, control room facilities, installation of air compressors to produce compressed air, diesel fuel and water tanks, administrative buildings and offices and amenities, warehouses, side workshops such as turning- casting- mechanical and electrical, guard posts, electricity distribution facilities, laboratory facilities for fuel quality diagnosis.

Apart from the topics related to the power plant, other important definitions may be presented in relation to this research, which are environmental effects, social effects, key stakeholders, implications, risks, and barriers.

In relation to all the above-mentioned key items, we discuss about relevant definitions and details later.

3.3 Research material

The research material for the purpose of this research is first and secondary sources of information. Based on the sub-questions of the research, the required data can be identified. The methods and tools of information gathering in this research are library and field study methods. The required information are collected from scientific literature review, as well as books, scientific magazines, internal magazines of companies and organizations. Also the information of other projects that have been carried out by employer companies, consultants, and contractors in Zahedan city, such as geological and hydrological projects and dam construction, are used to get to know the city of Zahedan in general and to know its climatic and geographical characteristics and most importantly the environmental conditions and considerations of the region. Also, plans are made to conduct targeted interviews and field research. By means of these resources, the research objects are assessed. The table below shows sources which are required for gathering data, methods of gathering information, and analyzing method.

Table 4: Research matrix for sources of data gathering and methods of analyzing

Research sub-questions	Source of data	Gathering method	Analyzing method
1-What organizations or people can be considered the key stakeholders?	Literature review, Books, Scientific magazines, reports, Iranian governmental websites, Knowledge of Previous projects' employees, Iran environmental organization	interviews, Content analysis	Qualitative analysis of information from the sources
2-Is the construction of a new power plant in Zahedan environmentally and socially acceptable?	Literature review, Books, Scientific magazines, reports, Iranian governmental websites, Knowledge of Previous projects' employees, Iran environmental organization, and Interviews	interviews, Content analysis	Qualitative analysis of information from the sources
3-What implications can the power plant have for the key stakeholders?	Literature review, Books, Scientific magazines, reports, Iranian governmental websites, Knowledge of Previous projects' employees, Iran environmental organization, Interviews, Answers received for SQ1, SQ2	interviews, Content analysis	Qualitative analysis of information from the sources

4-What risks and implementation barriers are important for the key stakeholders?	Literature review, Books, Scientific magazines, reports, Iranian governmental websites, Knowledge of Previous projects' employees, Iran environmental organization, Interviews, Answers received for SQ1, SQ2	interviews, Content analysis	Qualitative analysis of information from the sources

3.4 Data gathering

There are various methods for gathering data that depend on the variety of data and information and the objective of this research. In this research for gathering data, we used some methods such as open-ended questionnaire for the interviews to communicate with relevant employees and experts for obtaining necessary information from them based on their experiences and work they have done in different projects. Interviews with the key stakeholders, whose brief description was given earlier, are the main priority of the work. The interviews are designed based on the stakeholder theory that is mentioned in chapter 2, literature review. Here, factors are considered to select the people who participate in the interview according to "three characteristics of power, legitimacy, and urgency". Therefore, stakeholder authorities and responsibilities, their level of involvement in the project, benefits and advantages that this project has for them, losses and also opportunities that this project creates for stakeholders are considered for designing interviews. Basically, interviews are conversations between interviewer and interviewee and "can be in person, on the phone or by using some applications like Google Meet or Microsoft Teams." The other method of gathering data for this research is content analysis. "Content analysis is a helpful method, for studying trends and patterns in documents". In any content analysis some questions are raised such as which data is analyzed, or how this data is defined [Krippendorff, 2018].

3.5 Data analyzing

For analyzing the information, qualitative analysis method is used for data that we gathered from literature review, and some other sources such as governmental websites, relevant organizations, previous projects, and questionnaires and interviews. There are some steps for analyzing literature review data. Before starting to analyze the data, having clear research question is important, because it helps researcher identify relevant literature. After that, searching the relevant literature is necessary. This can include academic databases such as Google scholar, and other sources like books, reports, and scientific magazines. "After finding the appropriate literature, and ensuring the quality of that, the information obtained from them can be combined and the key findings can be summarized" [Müller-Bloch et al., 2015]. The next step in analyzing literature review is data analysis, which may include statistical data analysis or qualitative

analysis. “It is also possible to compare the findings of different sources to identify similarities and differences.” It can be mentioned that the quality of each source is really important according to method of using research or credibility [Onwuegbuzie et al., 2012]. In some cases, for comparison between different possibilities, we may have to use the comparative analysis as another method of analyzing to identify similarities and differences or advantages and disadvantages. For example, to determine a suitable location for the construction of a power plant, various proposals are usually presented, which are done by comparing all the advantages and disadvantages of each location in order to determine the suitable and final location. Analyzing the information led to results that can be used to provide recommendations for continuous improvement.

Also, it is noticeable that in order to increase the reliability of the research, two methods of peer debriefing and member checking have been used. For the first method, the experiences of experts who had experience working in the field of power plants, conversations with them and the study of similar projects that have already been done by them were considered. By using the member checking method, after conducting interviews and collecting the required information, the results of interviews have been provided to some stakeholders such as environmental organization of the province and regional water organization of the province to check the results as reviewers.

3.6 Research limitations

Here it is necessary to explain that in relation to conducting this research, the distance of Zahedan from Tehran was one of the limitations for gathering data, because for a stay of several days, there was a discussion of accommodation and suitable place and related costs. Also, some organizations and institutions did not fully cooperate with the researcher in providing sufficient and transparent information. For example, in some cases, the researcher had to ask other people instead of interviewing the main expert involved in the project, for instance, ask her/his senior manager. Unfortunately, sometimes, senior managers are not as knowledgeable about all the details as project experts. In some cases, companies and organizations, while introducing their colleagues through official letters, ask other organizations to help them in providing the necessary information, but many governmental organizations usually go through long and time-consuming procedures in issuing permits to people outside the organization.

3.7 Ethical procedure

According to the guidelines of Twente University, all the participants in the interviews should be aware of the student’s intention and decision and know that the student uses their opinions in her/his thesis and for what reason. In fact, according to the ethical principles, the participants in the interviews will participate consciously and have sufficient information about the topic of the

research, the purpose of the research, the consequences of their answers in the interview, and the student's use of their answers. Therefore, before conducting any interview, the consent form should be provided to the participants and the form should be signed up by the informants. There is also no requirement to include the names of the people and sometimes their age, but the position and responsibility of the people involved in the project, especially the key stakeholders may be important, but that information can be disclaimed only if the informant gave his/her written consent. Here it is pointed out that fortunately the researcher was able to get the approval of the ethical committee to conduct the research. Consent letter text is provided in the appendix 2.

4. Findings

In this section, I give an overview of the findings in relation to the methods used to gather them. This is with the purpose of explaining how the information was collected. In chapter 3, I indicated that most of the information to be used in this research will come from interviews and literature review. After that the findings were analyzed, then I compiled them in a way that information was applied to answer each of the four sub-research questions that conform this research.

4.1 Methods used to collect findings

To conduct the research, I chose to use the mixed-research method implied in the case -study approach of this research. This was done by combining literature review and interview methods. According to the research plan, 10 persons were interviewed after agreement on the ethical conditions of carrying out this research. They were mainly asked about their opinions about the environmental and social effects of the construction of the power plant. The 10 persons were selected from the main stakeholders, this based on Mitchel's theory of stakeholders (key stakeholders is presented in table 2). In relation to investor company, energy company, and environmental organization, the criteria for selecting persons for interviews was based on choosing those who are supposed to be involved and work in this project, but about the local community, those who had jobs that were somehow related to the power plant concept were chosen such as one of the mechanical engineering professors in the university and one of the electrical engineers working in the cement factory. The interview includes 14 questions about environmental and social aspects, as well as questions about people's gender, their age, and their level of education. This demographic data allow researchers to disaggregate results and analyze

responses by different population groups and can also help identify inequalities in different aspects of society, such as education or employment opportunities. Interview questions are provided in the appendix 3. On the other hand, by reviewing the literature and studying the available scientific articles and sources, the researcher has tried to come to the conclusion that the importance of constructing a power plant or the need to build it in Zahedan, to what extent it corresponds to reality.

4.2 Findings presented per sub-research question

Before presenting the answers to the sub-questions, few specific details about stakeholders are elaborated in this section with the intention to justify their involvement as respondents of this research. After reviewing similar projects, various articles and literature review, the researcher came to the conclusion that investor companies [Ahmed et al., 2020], energy companies [Ahmed et al., 2020], environmental organization, and the general public [Ahmed et al., 2020] can be part of the key stakeholders for this project. In order to categorize their influential relevance, three characteristics (power, legitimacy, and urgency), of each of the stakeholders were analyzed to classify them in a comprehensive approach. This analysis was based on the importance and effect that the stakeholders would have for the company by showing one or more above-mentioned characteristics. The key stakeholders selected for this research are enlisted and described according to the labels used in Mitchel model (see table 2). For the purpose of this research, as mentioned in previous section, experts from the investor company (which is the employer company and representative of the government in decision-making process and project implementation), experts from the environmental organization of Sistan and Baluchistan province, experts from the energy company (which are usually contractor companies in Iran), and a number of local residents who live in Zahedan were also involved in the interviews.

Table 5: Type of stakeholders chosen for the interviews

Type of stakeholder	category	characteristics
Investor (representative of the government)	Definitive stakeholder	Power- Legitimacy- Urgency
Energy company	Definitive stakeholder	Power- Legitimacy- Urgency
Environmental Organization	Dominant stakeholder	Power- Legitimacy
Local residents	Discretionary stakeholder	Legitimacy

Below, the answers to the sub-questions obtained from the interviews are presented, and as much as possible, secondary sources were added to validate some of the informants' answers.

First sub-question: What organizations or people can be considered the key stakeholders? As mentioned above, the key stakeholders involved in this research are one of the investor companies in Iran, one of the energy companies, Environmental Organization of the province, and local residents. Investor Company for this project will be the Regional Water Organization of Sistan and Baluchistan province. This organization will be the employer of the project and the representative of the government for implementing this plan. This organization in this project is a definitive stakeholder which has 3 characteristics of power, legitimacy, and urgency. In Iran, usually for projects regarding water, such as dam or power plant projects, Regional Water Organizations of the provinces are chosen by the Iranian Ministry of Energy as project employers. After that, the required funds are provided to them through the government, and they obtain the legitimacy to involve in projects from the government. Also, they have the power to influence many aspects, and the commands they have for other organizations may be carried out as soon as possible, because the employer has the right to cease the projects in case of dissatisfaction. Another key stakeholder corresponds to the energy companies. These companies are usually of the type of contractor companies, and their responsibility is to provide skilled workers, tools, equipment, and machinery for the project. This stakeholder is a definitive stakeholder as well, and also has 3 characteristics of power, legitimacy, and urgency. These companies have significant financial power, because if they cannot or do not want to provide their equipment and machinery to the project, the continuation of the project can easily face problems. These companies also have legitimacy because for the implementation of projects, employers usually invite those contractors companies to work that have a better record than competitors. Also, the more the contractor companies act transparently about the use of the budget provided by the employer, and complete the projects in the shortest possible time with the lowest cost and the highest quality, the more legitimacy they will have. These companies also have the characteristic of urgency because their demands must be met by the employer in the shortest possible time, so that they do not face any problems to continue working. The third stakeholder is Environmental Organization of Sistan and Baluchistan province and it is considered as a dominant stakeholder with two characteristics of power and legitimacy. If environmental organizations realize that environmental issues have arisen or will arise in the process of project implementation, they have the power to cease the project in any phase of the work, but unfortunately, environmental organizations do not have the urgency to implement their commands for in many cases. On the other hand, these organizations have definitely legitimacy, because environmental assessment is an undeniable part of the implementation of any project, and after the companies have done their evaluations, the results of them must be approved by the Environmental Organization to start the implementation of each project. The last stakeholder is local residents of Zahedan and according to the theory of stakeholder by Mitchell (1997) it is categorized as a discretionary stakeholder with the characteristic of legitimacy, but in many cases local people do not have the power to implement projects, because they do not have financial

resources, they are not involved in decisions, many construction projects may be planned and implemented without the consent of local residents. Also, if they are critical of an issue, in many cases, people's requests are addressed after long delays and spending a lot of time. However, it seems that each country involves different organizations as the key stakeholders in the construction of power plant projects based on its requirements or its political and social structure. For example, "in Indonesia, the Ministry of Finance, Ministry of agriculture, and National Energy Board are of the key stakeholders [Widya et al., 2019]." "It is assumed that the Ministry of Finance can allocate the appropriate budget to the project or the Ministry of Agriculture can manage the palm oil plantations because these can be used as raw materials of biofuels [Widya et al., 2019]."

Second sub-question: Is the construction of a new power plant in Zahedan environmentally and socially acceptable? Based on the answers, almost all of the employees of the organizations involved in the project and many residents of the Zahedan agree with the construction of the power plant. Considering the new power plant is going to be built somewhere outside of Zahedan, it seems that it will not affect much the air quality of the city (Shahraki, A. (2023, May 29) (personal interview)). However, the environment around the construction site of the power plant will definitely have air pollution and negative impacts that mostly affect the employees who work there and experts involved in the project when they go to the construction site of the project to get information and track work progress and evaluate progress of the project (Asgharian, M. (2023, May 29) (personal interview)). During the construction phase of the power plant, there will be other pollutions, such as soil, water, and noise pollution, but they will have temporary effects. Moreover, since the construction work of the power plant is happening out of the city, it will not have a negative impact on the quality of life of the residents of Zahedan. On the other hand, a new power plant will boost the economic growth of Zahedan and the province. As mentioned before, one of the main achievements of providing electricity in any region is increasing economic growth and improving the quality of life of residents [Rahman, 2020]. It may definitely have permanent benefits for the people of the region. It seems that it does not have much effect on value of properties in the region, but in terms of employment rate and income level, it definitely has positive influence (Kord, B. (2023, May 30) (personal interview)). In other words, for the employees of the Regional Water Organization as an employer, the more projects defined by the government for this province and this organization, the more people will be employed and salaries, benefits, and rewards will increase obviously (Naderi, H. (2023, May 29) (personal interview)). Also, by employing local people, the employment rate in Zahedan city will improve, because the project requires skilled workers, engineers, experts, technicians, managers, and labors. On the other hand, residents and experts believe that the construction of the power plant can reduce the electricity blackouts and frequent power outages especially in the summer, when demands for the electricity significantly increase in the region, and power outages will cause serious damages to household electrical appliances (Dehdar, H. (2023, May 31) (personal interview)). It is clear that, power outages, whether happen due to natural disasters, or due to electrical overload and excessive electricity

consumption as a result of using too much energy by people, or due to the inability of governments to supply the electricity, can have irreparable consequences in many areas. For example, in 2021 in Texas, America, a storm caused a power outage and the death of hundreds of people due to carbon monoxide poisoning, and the exacerbation of their previous illnesses [Dugan et al., 2023]. The important point is that some residents believe that the rate of unemployment in Zahedan and the entire province is so high that a power plant cannot be very effective, but maybe building a power plant is better than nothing (Teymoori, P. (2023, May 31) (personal interview)). Every industry will create more job opportunities, but unfortunately in some projects, it can be seen that instead of employing local people, employers prefer to employ experts they need from other provinces, especially from Tehran (the capital). Therefore, if the local work force of the province is employed, it can create suitable job opportunities for the region, and the economic growth and development will be achieved. It is worth noting that creating new jobs in the region can partially prevent the migration of native people who migrate to other cities in order to find job [Komeili, 2011]. In the construction phase, due to the employment of labors in some of the project activities, there will certainly be suitable training opportunities for unskilled or semi-skilled labors in this phase to improve their knowledge, skills, and scientific level. The implementation of the project will create an opportunity to transform the unskilled workforce into skilled or skilled to highly skilled workforce (Hosseinpour, F. (2023, May 29) (personal interview)), and it will increase the level of social acceptance of the project.

Third sub-question: What implications can the power plant have for the key stakeholders?
Those who work for an investor company, an energy company, and an environmental organization mentioned that based on the type of activities they have regarding the power plant projects, they have been exposed to various pollutants many times (Saljoughi, F. (2023, May 30) (personal interview)). The implications of new power plant construction can be divided into some categories [Hafezalkotob et al., 2017]. The first category is **environmental implications**. When there is a lack of suitable space for the construction of a power plant, it is inevitable to change the land use [Fraser et al., 2021] for the construction of workshops, camps for workers, and creation of suitable roads. The change of land use will cause destruction of slopes and natural heights during the construction stages in order to flatten the land (Jaafari, N. (2023, May 30) (personal interview)). These factors may lead to disrupt ecological processes or reduce biodiversity. However, for this project the place of the new power plant does not have the effect on the province wildlife. Also, air, water, and soil pollution are unavoidable during the construction stage. Soil pollution caused by the waste of construction materials, leakage of fuel storage tanks, human waste and production waste in temporary settlement camps of workers, and soil erosion in the traffic area of heavy vehicles are very likely to happen (Bolouki, A. (2023, May 31) (personal interview)). On the other hand, power plants usually need water for cooling. The intake of water and discharge of heated water back into water can impact aquatic life and other organisms [Singh et al., 2016], but residents mentioned that there is no protected area around Zahedan and there is little plant and animal diversity. Therefore, it does not seem to have much effect. Power plant can affect the quantity and quality of underground water due to

disposal of wastes incompatible with the environment. Furthermore, the exhaust gases coming out of the power plant chimney can cause air pollution. The power plant construction definitely produces noise pollution as well [Sarmadi et al., 2021]. However, for this power plant which is supposed to be built out of the city, it seems that it will not cause many health problems for residents, but at the construction site of the power plant, there will be air pollution, water pollution, noise pollution, and vibration, which if not controlled, can have a negative impact on the health of workers and people involved in the project [Barron et al., 2016]. Another implication is socio-economic implications. As mentioned in the second sub-question, every new power plant can create job opportunities, because of the requirement of skilled staff and experts. Therefore, if employers employ local residents in Zahedan, more job positions will be created and filled, which can greatly contribute to the **economic growth** of the region and increase the income of residents [Rahman, 2020]. Also, the construction of a power plant around Zahedan may lead to increase the migration from villages or other cities of the province to Zahedan (Dehdar, H. (2023, May 31) (personal interview)). As a result, it can increase housing prices and rental fees in Zahedan over the years. It does not work in the short run, but the increase in economic prosperity and development in any city will have a direct impact on the housing prices. It is worth noting that the values of properties around every power plant may be reduced due to the noise, pollutant gas emissions, or health problems near the power plants [Guerin 2017]. Regarding the construction of power plants, there will definitely be **traffic** due to the carrying the construction materials and the traffic of heavy machinery, but about the Zahedan power plant, it seems that there is no effect on city traffic (Asgharian, M. (2023, May 29) (personal interview)). It is mentioned that power plant construction activities can cause noise or dust. These factors may be inconveniencing for the residents around the power plants, especially the workers involved in the project. On the other hand, in some cases, power plant construction activities cause the direction of roads or streets to be changed for certain reasons. This issue can be annoying for residents (Kord, B. (2023, May 30) (personal interview)). As a result for this sub-question, certainly the construction of the power plant will have both positive and negative effects. Every power plant brings negative implications along with its positive ones and benefits it creates for the society [Alabi et al., 2021], but if this plan is implemented, due to its distance from Zahedan, it does not pose many environmental dangers for the people. Also, it does not seem to have negative social implications.

Forth sub-question: What risks and implementation barriers are important for the key stakeholders? Risks are divided into some categories. One of the most important and noticeable categories is **environmental and safety risks**. The experts of the investor company, energy company, and environmental organization also mentioned that some of the existing risks include dangerous and toxic chemicals, magnetic and electric fields (Shahraki, A. (2023, May 29) (personal interview)), hearing loss, non-compliance with the standards of the Environmental Protection Organization (Bolouki, A. (2023, May 31) (personal interview)), regarding the industrial effluent from the power plant, and non-compliance with safety issues, which can be monitored to some extent by providing control measures. Also, residents said that their

knowledge about environmental risks is not very much, but every industry will definitely have disadvantages along with its advantages, and especially it can cause air pollution unless it is built far enough out of the city. Another important category is financial risks [Maronati et al., 2019]. The biggest problem that can arise for employer organization, both at the beginning of the work or with the progress of the project, is that the government cannot act properly in fulfilling its obligations. Many projects have remained half-finished due to budget deficit or issues such as inflation and uncertain situation in Iran. Many employers demand large sums of money from the government, which can have a negative impact on other matters such as not paying employees' salaries on time (Naderi, H. (2023, May 29) (personal interview)). Another category of risks is related to **political considerations** [Belikova et al., 2019], and geographical situation of the province. It is noticeable that due to the proximity of this province to Afghanistan and Pakistan, the opinion of the security authorities and political officials of the province is considered for the implementation of any plan (Hosseinpour, F. (2023, May 29) (personal interview)).

On the other hand, one of the most important categories of barriers is **financial ones**. The lack of adequate and timely provision of financial resources especially initial investment costs, or incorrect cost estimation at the beginning of the work can have a negative effect [Yuan et al., 2017]. Another category of barriers is **technical** barriers. In order to properly and fully implement the project, it is necessary to prevent the lack of technical facilities, required tools, equipment and machinery, and required workforce such as skilled workers [Sovacool et al., 2011]. The next important category of barriers is **regulatory** barriers [Emodi et al., 2021]. Any regulations related to environmental, security, and social requirements can cause a problem if not properly follow the instructions. For example, in Iran regarding the power plant projects, considering the environmental impact of these projects on air quality in the region, a 13-kilometers radius of the power plant site [Iran Environmental Organization, law on how to prevent air pollution, chapter 3, approved 23 April 1995], which may be affected by air pollution, is considered for examining the environmental characteristics of the project (Kord, B. (2023, May 30) (personal interview)). Also, it is worth noting that the socio-economic scope for power plant projects is equal to the effects of the project on the economic, social and cultural parameters, which are usually chosen according to the political divisions. The best socio-economic area in most projects is equal to the borders of the city unless the project has a wide range of effects and national dimensions. In this project, according to its purpose, the connection to the national electricity network and strengthen the network and improve its quality, Zahedan city is considered as a socio-economic area, because the purpose of this power plant is to supply electricity needed in Zahedan city and connect the electricity grid of the city to the country's electricity network and all the effects that this project will have from the social, economic, or cultural point of view are limited to the boundaries of Zahedan city. "Also, the time-consuming process of obtaining some permissions or the existence of some current regulations or even changing in them can be a big barrier in the construction of a new power plant (Jaafari, N. (2023, May 30) (personal interview))." Environmental Organization's opposition to the implementation of the plan due to the potential negative impacts on the environment, or the level of interest and

willingness of the government to implement the projects in deprived provinces far from the capital are determinant factors as well.

5. Discussion

In this chapter, after the interviews conducted, as well as studying academic and grey literature sources such as previous projects in the literature review, two options of building and not building a new power plant are here discussed and compared with each other.

5.1 The option of not implementing the plan

If Zahedan combined cycle power plant project is not implemented, there will be many issues related to the electricity supply in the short and long term in the region. The population growth in this city on the one hand and the region weather condition on the other hand, lead to an expansion in demand for electric energy. Therefore, electricity supply is one of the most important infrastructure needs in this region, indicating the need of implementing this power plant.

Here, the effects of not implementing the power plant on the physical environment are mentioned as follows:

If the power plant is not built, some of the negative effects caused by the implementation of the project, such as noise pollution or heavy traffic, will not be created. Accordingly, the non-implementation of the power plant compared to the implementation of the plan has positive effects on creating less noise pollution in the region. Also, some negative consequences such as disposal of waste water on surface water resources will not be created, and therefore, the non-implementation of the project will have positive effects on the surface water quality of the region. Another point is about surface water quantity. Due to the dry and semi-arid climate of the studied area, water resources are vital. Considering the problems of extreme water shortage in the region, the treated effluent from the power plant can be used for other purposes such as irrigating green spaces and agricultural lands. Therefore, not implementing the project and not providing this possibility can leave negative effects. About underground water, if the project is not implemented, the withdrawal of underground water sources will not be done to meet the water needs of the power plant, but considering that the underground water level in the area has been decreasing and the area is situated on a prohibited aquifer, therefore, the non-implementation of the plan cane be considered a way to maintain the water level.

If the plan is not implemented, people's quality of life will be truly affected over the time and it may result in many negative impacts, because as mentioned above, the region is facing a shortage of electricity, and this issue is far more important in some places such as hospitals (Dehdar, H. (2023, May 31) (personal interview)). Also, there is no effect on the participation of the people in the plan, land acquisition, population displacement, the value of land, and the employment rate of the area. If the plan is not implemented, the development and improvement of infrastructure, facilities and industries in the region will face problems and will have a negative effect on the economic growth of the region.

5.2 The option of implementing the plan

The most important outcomes of the construction of the power plant include the creation of electric energy as one of the important infrastructure needs in the region, the expansion and development of infrastructure, the improvement of the quality of life, the creation of new job opportunities, and the increase in the income of the residents. Due to the industrial development in the region, the increase in population and demand for electricity consumption, if the plan is not implemented and the existing conditions continue, in addition to frequent blackouts, the region will confront irreparable consequences in economic, political and social fields. Therefore, the need to construct a power plant in the region is evident, and the option of implementing the project would be a good choice. The construction of the power plant will be the important project, so any disruption in its operation can threaten people's health and create disastrous consequences since many important places such as hospitals will be affected by frequent electricity blackouts and power outages. Meanwhile, identifying the risks during the implementation of the project is necessary. The most important activities that can lead to the destruction of the region's environment during the construction phase are changing the use of land, soil destruction caused by the transportation and traffic of heavy vehicles, and also harmful effects caused by the emission and discharge of pollutants during the operation phase of the power plant such as pollutants caused by fuel burning. To reduce possible risks, the HSE department has a significant responsibility regarding any project. To prevent air pollution, suitable ventilation systems and emission control systems such as filters can be effective [Masoudnejad et al., 2022]. Also, using renewable energy is one of the most effective ways to prevent air pollution [Zarzavilla et al., 2022]. About water pollution, using an effective water treatment system can reduce the pollutants in the power plant effluent and prevent water contamination [Saravanan et al., 2021]. The use of ear protection equipment can prevent hearing damage to a large extent and deal with the high level of noise and sound pollution [Amir-Heidari et al., 2016],

The operation of power plants is considered as one of the most important sources of environmental pollution due to gaseous pollutants and production wastewater. In addition to this, their global effects are also quite obvious. Output pollutants can be considered as a factor in the

creation of acid rain, and combustion of fossil fuels as fuel for power plants can lead to greenhouse gases. This is a risk to be controlled during the operation phase of the plant.

The most important pollutions that are produced from the construction of the project are as follows:

Air pollution can be caused by gases like sulfur dioxide (SO2), nitrogen oxides (NOX), carbon dioxide (CO2), and carbon monoxide (CO) coming out of the chimney, and also by dust and particulate matter (PM), mercury (Hg), and other pollutants, movement of machinery, and transportation of materials and equipment. The amount of gaseous pollutants and suspended particles resulting from the combustion of gas depends on the technology used for energy creation and fuel quality. Air pollution mainly affects the labors, but due to the adequate distance of the power plant from residential areas, it does not affect the residents of Zahedan city. As another point, power plants burning fossil fuels can cause greenhouse gas emissions which lead to global warming and climate change. Another issue is water pollution that can be caused by the entry of pollutants from temporary accommodation camps. In the construction phase, the activities resulting from the construction of the power plant, the transportation of materials, the activity of machinery, human sewage and production waste are among the reasons of water pollution. During construction, the main resource required by this power plant is water, so there is the possibility of water contamination with different kinds of pollutant (industrial and sanitary effluent). Effluents contain different pollutants that can cause physical, chemical, and thermal changes in water. The wastewater from cooling systems and boilers also has a high temperature, which can lead to an increase in temperature and disturbance of the ecological balance when released into water. With the increase in water temperature, the activity of microorganisms increases, and with the rapid growth of algae in water and the reduction of dissolved oxygen, it leads to harm aquatic ecosystem or the death of marine organism. Therefore, the treated effluent from the power plant should be filtered and used in other parts (cooling, green space irrigation). Also, disposal of sewage by workers of temporary accommodation camps, discharge of water due to the washing of devices, the leakage of petroleum and chemical compounds from storage tanks, can indirectly affect the quality of soil and underground water resources, but these effects are temporary and short-term. Soil erosion can be caused by some factors like crushing of the soil in the traffic area of heavy vehicles, construction activities, and movement of machinery. However, due to the short duration of the construction period, the negative effect is not important.

In the construction phase, during peak hours of the work, the sound level also increases. The sound level of heavy vehicles (tractors, loaders, trucks) is around 89 to 133 decibels, which is higher than the standard limit of sound in the open environment for residential areas (73 decibels), and even higher than the standard limit for industrial areas (79 decibels). Due to the distance of the power plant from residential areas, the increase in sound level only will influence the employees. Therefore, it is important to use protective equipment for labors.

About terrestrial habitat (destruction and pollution), due to the climate conditions of the area, little and irregular precipitation, high temperature changes, high rate of evaporation, and low degree of underground water, the area has no significant wildlife, but in this hot and dry area around the power plant, birds and reptiles are the main creatures, which are not rich in number and variety of species. The activities during the construction phase can have negative effects, but it is temporary, and the considered effects are not noticeable.

The most important incidents that may occur during the construction phase are accidents caused by working with devices and equipment, dangers regarding moving materials and equipment, possibility of fire and explosion in chemical storage places, toxic gas leakage, and dangers caused by falling from the height.

The scope of studies about pollution will be in the radius of 13-kilometers from the construction site from all directions [Iran Environmental Organization, law on how to prevent air pollution, chapter 3, approved 23 April 1995], and the most important environmental pollutants will also be studied in this area.

6. Conclusion and recommendations

This section depicts some of the most important findings collected to first identify the main stakeholders to decide on the construction of the electricity plant in Zahedan and afterwards to identify their perceptions regarding environmental and social problems related to the construction. From this analysis, some conclusions were elaborated whilst noticing some opportunities for further research and for practitioners. This latter is discussed in the recommendation section.

6.1 Conclusions

All the research sub-questions are firstly here independently addressed and at the end of the section, it is discussed how their findings can enable the researcher to respond the overarching research question of this work. The main research question is: To what extent, can the construction of a new power plant, taking into account environmental and social aspects, affect the lives of the residents and meet the main objectives of stakeholders?

First sub-question: What organizations or people can be considered the key stakeholders?

The stakeholders of the potential construction of a electricity plant in Zahedan city were identified and classified by using the stakeholders theory of Mitchel (1997). This resulted on a list of relevant stakeholders to participate in the interviews to give answers to questions that relate directly to sub-questions 2, 3 and 4.

Among the key stakeholders classified as definitive stakeholders, the investor company, and energy company can be here mentioned. However, the environmental protection agency at province level, is a dominant stakeholder in this work, and representatives of local communities as a discretionary stakeholder are also among the key stakeholders. More descriptive information on their roles and responsibilities are here below presented.

The key stakeholders involved in this research are one of the investor companies in Iran, Regional Water Organization of Sistan and Baluchistan province, and that is the employer of the project and the representative of the government in this plan. This organization is the owner of the project and responsible for funding. In Iran, usually large projects of dam construction, power plant, irrigation and drainage are assigned by the government to the Regional Water Organizations of the provinces and these companies are of the state type and are the arm of the government in the implementation of the projects. The other stakeholder is one of the energy companies which is a contractor company and has a responsibility for providing skilled workers, tools, equipment, and machinery for the project. Contractor companies in Iran are both public and private, and in most cases, employers choose contractors company through bid. Environmental Organization of the province is the third stakeholder. According to Iranian rules, all projects should be reviewed from an environmental point of view and a detailed report on environmental impacts, implications, risks, and limitations is necessary to be prepared. If the project is environmentally acceptable, it can be implemented. Environmental organization is a responsible for the approval of all projects. The last stakeholder group is local residents. People are the main group that can benefit from the construction of a project, because each project is definitely made to enhance the quality of life of the people and meet their needs, or in contrast they can suffer from implementation of the project because of environmental and social effects. This will be further elaborated in the following section.

Second sub-question: Is the construction of a new power plant in Zahedan environmentally and socially acceptable?

From the environmental point of view, the construction of any power plant can cause pollution such as air, water, soil, and noise pollution [Markandya et al., 2007]. Moreover, According to United States Environmental Protection Agency (2018), burning fossil fuels at power plants creates emissions of sulfur dioxide (SO2), nitrogen oxides (NOX), dust and particulate matter (PM), carbon dioxide (CO2), carbon monoxide (CO), mercury (Hg), and other pollutants. NOX and SO2 emissions can cause formation of ground-level ozone and fine PM, which can lead to respiratory and cardiovascular problems, and exposure to mercury can increase the possibility of health issues ranging from cancer to immune system damage (United States Environmental

Protection Agency 2018). However, combined cycle power plants produce the least pollution compared to other types of power plants and are more compatible with the environment and also have higher efficiency than other types of power plants. Combined cycle power plants are environmentally friendly due to using natural gas instead of coal which means low level of carbon dioxide (CO2), carbon monoxide (CO), nitrogen oxide (NOX), sulfur dioxide (SO2), mercury (Hg), and dust emissions released into the air and low volume of hot wastewater released into the oceans [Mitsubishi Heavy Industries 2023]. If renewable energy is used instead of fossil fuels, a combined cycle power plant can produce 49% less CO2 than a simple power plant [Anvari et al., 2019]. The power plant new facility is going to be built out of the city. As a result, those pollutions will not affect the quality of the city's environment. It can be concluded that stakeholders have a positive opinion about environmental implications because its construction out of the city does not cause disruption in the lives of the residents. However, the impact of the negative implications on the workers shows the need to take protective measures.

From the social point of view, by this new power plant, economic growth of the city will be boosted [Rahman, 2020] by employing local workforce and improving in the employment rate. New job opportunities can prevent the migration of local people who migrate to other cities in order to find a job [Komeili, 2011]. "Also, by employing local residents, there will be training opportunities for labors to improve their knowledge, skills, and scientific level." Residents and experts who involved in the interviews believe that "power plant can reduce the electricity blackouts and frequent power outages" [Amin et al., 2007] especially in the summer, when demands for the electricity significantly increase in the region, and power outages will cause damages to household electrical appliances, industrial facilities, hospitals, and education centers.

Below, two main aspects that are affected by constructing the power plant are briefly discussed in the first table, and in the second table their importance from the point of view of each group of stakeholders is presented.

Table 6: Factors affected by power plant implementation

1- Environmental aspects	2- Social, economic and cultural aspects
1-1 Effect on air quality Effect of air pollutants in construction phase on the surrounding environment of the project, taking into account the volume of construction operations, activity of machines and distance between settlements and environmentally sensitive areas	2-1 Effect on social, economic and cultural indicators The degree of effectiveness of indicators such as unemployment rate, population growth rate, and migration rate due to construction and operation of the power plant

1-2 Effect on surface and underground water Effects of the project on the quality and quantity of water in the state of withdrawal and discharge of water or wastewater on surface and underground water resources	2-2 Effect on other rural and urban development plans Synergy or functional and dysfunctional conflicts with other development plans and related consequences
1-3 Effect on soil morphology and quality Effects of the project implementation in both construction and operation stages on the shape of the land, erosion, soil quality and the effects caused by the discharge of sewage and waste to the environment	2-3 Effect on land use Direct and indirect land use changes in the power plant development and avoidable and unavoidable cases for the range of impacts on land use and the importance of land use changes
1-4 Effect on sound quality Effects of noise pollution from construction activities and operation (machines, generators, turbine activity, cooling systems, etc.) [To study this effect, calculation of the ambient noise level on the surrounding settlements and residence areas, industrial centers and business districts around the project site is required]	2-4 Effect on cultural and historical heritage Effects of power plant projects on historical and cultural monuments (directly and indirectly) in terms of conflict with construction operations, building and facilities of the power plant (roads, pipelines, etc.)
1-5 Effect of the project on the important and virgin natural landscapes, habitat conditions of plants, animals and aquatic species	2-5 Effect on infrastructures Effect of the project on the quantity and quality of urban/industrial development, transportation, communication and energy infrastructures
1-6 Effect on global warming The amount of carbon dioxide emitted during the operation period as tons per megawatt hour for generated electricity	

Below the second table is presented. For each group of stakeholders different feedbacks are shown from their point of view.

Table 7: Stakeholder's point of view about the project

Group of stakeholders	Positive (green), neutral (blue), negative (red)
Investor company	1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 2-1, 2-2, 2-3, 2-4, 2-5
Energy company	1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 2-1, 2-2, 2-3, 2-4, 2-5
Environmental organization	1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 2-1, 2-2, 2-3, 2-4, 2-5
Local residents	1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 2-1, 2-2, 2-3, 2-4, 2-5

The numbers above briefly show how important each factor is to each stakeholder. For example, about the energy company, because this company is responsible for supplying the human resources involved in the project, air pollution in the construction site of the power plant can negatively affect the health of the employees of this company. However, water and soil pollution during the construction phase is temporary, and as mentioned before, they do not have much impact, so these two factors are considered neutral for the personnel of the energy company. Also, for the employees of energy company, the high sound level in the construction site and noise pollution are considered as a negative factor, but on the other hand, the social, economic, and cultural advantages of the power plant, such as the development of urban and rural plans or the development of infrastructures are considered as a positive factor for those employees. Also, due to the fact that this power plant will not have a negative impact on the land use or the cultural and historical heritage of the region, these factors are also considered to have positive effects.

To summarize, since Zahedan City power plant project has been planned to be implemented in a vast area of the barren lands far enough from the city in which due to the meteorological and geographical conditions, no wildlife, no significant natural water resource, no cultural and historical heritage and no other urban facilities and infrastructures exist, for whole groups of stakeholders this project is completely acceptable. Hence, it can be here concluded that according to the key stakeholders' opinions, the construction of new power plant can be acceptable both environmentally and socially. The third sub-question has a different perspective because in the third sub-question, the intention is to let stakeholders explain what potential implications the construction of the power plant might have on their roles. Some of the main findings is summarized here below.

Third sub-question: What implications can the power plant have for the key stakeholders?

Here, there are some positive and negative implications which this power plant can cause.

The first category is environmental implications. The change in the land use for the construction of workshops, camps for workers, and creation of suitable roads will cause destruction of slopes and natural heights during the construction stages in order to flatten the land. These factors may lead to disrupt ecological existence or reduce biodiversity [Turney et al., 2011]. However, for this project the place where the new power plant will be built does not have the effect on the province wildlife. Also, air, water, and soil pollution are unavoidable both during the power plant construction stage and after that (power plant operation). However, there is no protected area around Zahedan and there is little plant and animal diversity. At the construction site of the power plant, there will be air pollution, water pollution, noise pollution, and vibration, which if not controlled, can have a negative impact on the health of workers and people involved in the project [Barron et al., 2016].

Another category is socio-economic implications. If employers employ local residents in Zahedan, more job positions will be created and filled, which can greatly contribute to the economic growth of the region and increase the income of residents [Rahman, 2020]. Also, the construction of a power plant around Zahedan may lead to increase the migration from villages or other cities of the province to Zahedan. As a result, it can increase housing prices and rental fees in Zahedan over the years. Moreover, the power plant construction activities can cause noise or dust [Sarmadi et al., 29021]. These factors may be annoying for the residents around the power plants, especially the workers involved in the project. In some cases, power plant construction activities cause the direction of roads or streets to be changed for certain reasons.

Power plants construction cannot be considered without risks and implementation barriers, and therefore, the forth sub-question tried to cover such aspects.

Forth sub-question: What risks and implementation barriers are important for the key stakeholders?

The first category of risks is environmental and safety issues. Some of the existing risks include dangerous and toxic chemicals, magnetic and electric fields [Lindell 1994], hearing loss, non-compliance with the standards of the Environmental Protection Organization, risks regarding the industrial effluent from the power plant [Lindell 1994], and non-compliance with safety issues, which can be monitored to some extent by providing control measures. Another category of risks is financial risks. The biggest problem that can arise for employer organization, both at the beginning of the work or with the progress of the project, is that the government cannot act properly in fulfilling its obligations. The next category is about political considerations and geographical situation of the city [Belikova et al., 2019]. Due to the proximity of this province to Afghanistan and Pakistan, the implementation of any project has political risks.

On the other hand, barriers are categorized into different groups. First of all are financial ones. "The lack of adequate and timely provision of financial resources especially initial investment costs, or incorrect cost estimation at the beginning of the work can have a negative effect [Yuan et al., 2017]." Another category is technical barriers. "It is necessary to provide technical facilities, required tools, equipment and machinery, and required workforce such as skilled workers [Sovacool et al., 2011]." The next important category is regulatory barriers. "Any regulations related to environmental, security, and social requirements can cause a problem if not properly follow the instructions [Emodi et al., 2021]." "The time-consuming process of obtaining some permissions or the existence of some current regulations or even changing in them [Emodi et al., 2021] can be a big barrier in the construction of a new power plant." Environmental Organization's opposition to the implementation of the plan due to the potential negative impacts on the environment, or the level of interest and willingness of the government to implement the projects in deprived provinces are determinant factors as well.

As mentioned before, deciding who can be considered as the main stakeholders in different projects depends on the environmental, social, political and economic conditions of each country. The preferences of each country can be fundamentally different from another part of the world. Even in one country, it may not be possible to consider the same evaluation criteria for two different cities. For example, "in Indonesia, the Ministry of Finance, Ministry of agriculture, and National Energy Board are of the key stakeholders [Widya et al., 2019]." According to the research conducted by the researcher, if other organizations such as the Ministry of Economy and Finance, The Cultural Heritage Organization, the University of Sistan and Baluchistan are also introduced as the main stakeholders in such projects, it can be very effective and provide a more comprehensive view of the nature of the project. Unfortunately these organizations in this research due to researcher's time limitation and lack of familiarity with the role of these organizations in power plant projects have been neglected.

From all the answers given to the interview questions, and studying the scientific sources and reviewing the literature, it is concluded that considering the special conditions of the province and Zahedan city and the increasing need to supply electricity to the residential areas and industries, it seems that the construction of a new power plant has more benefits than disadvantages.

6.2 Recommendations

6.2.1 Recommendations for further research

The researcher believes that many other organizations and people could have been introduced and involved as the key stakeholders in doing this research. However, unfortunately, the

researcher was not very familiar with the duties of those organizations and their role in power plant projects. Moreover, the researcher did not know much about the details of the work of those organizations and the role that these details can play in the process of different projects. These factors caused few stakeholders to be considered in doing this research. For example, it is better to involve some other organizations such as the Ministry of Economy and Finance, The Cultural Heritage Organization, and the University of Sistan and Baluchistan in such projects. Although the Regional Water Organizations receive their budget from the Ministry of Energy, the Ministry of Economy and Finance is responsible for monitoring the spent budgets, monitoring the taxation of companies and organizations, checking the profit and loss balances of companies and many other financial issues. Also, in some provinces the implementation of projects such as power plants can cause damage to ancient and historical monuments of the cities and surrounding areas. On the other hand, in many projects there is a lack of scientific resources and the lack of experts who have sufficient knowledge in some special fields. Therefore, it seems that these three organizations can also be considered as key stakeholders in power plant projects. After reviewing literature, it can also be mentioned that "trade unions, local contractors, operational staff, responsible waste management, local entrepreneurs, Non-Governmental Organizations (NGOs), different ministries, neighboring countries, scientists, educators and students, universities, archaeologists, and historians" [Ahmed et al., 2020] can be the key stakeholders for future research.

The level of involvement of the local residents in decision-making processes about the construction of the new power plant is really important and depends on many factors such as the country. In Iran local people do not have much role in big decisions, because decisions like constructing a power plant are made at the macro level, and local people do not have much of a role in the decision-making process. It is worth noting that in many environmental projects, Environmental Impact Assessment (EIA) is done for evaluating the environmental impacts of the project. "Environmental Impact Assessment (EIA) is the process of examining the anticipated environmental impacts of a proposed project. By considering the environmental impacts at the design stage and preparing an Environmental Impact Assessment Report (EIAR), it is decided whether the project can be implemented or not [Environmental Protection Agency 2023]." This evaluation can increase the possibility of public participation, and local residents may be able to express their opinions to the officials involved in the project. "The five success factors for increasing public participation using the EIA method are authority acceptance of the value of participation, integration of all participation activities under the umbrella of EIA, carrying out participation activities before final strategies are adopted, keeping the decision-making process transparent, and providing sufficient information to the public to facilitate participation [Bond et al., 2004]." Furthermore, to increase people's participation in projects, the survey method can be used, but in addition to the main stakeholders, the opinions of local community can also be considered in collecting information. By informing about the nature and goals of the project and the problems arising from it, positive mindset can be created for public participation.

All methods of electricity production have environmental effects. Environmental effects occur in all stages of electricity production, including resource extraction, equipment construction, material transportation, electricity use and waste disposal [Iranian Energy Journal, 2010]. Some of the major environmental effects of electricity production include air pollution (emission of sulfur dioxide (SO2), nitrogen oxides (NOX), dust and particulate matter (PM), carbon dioxide (CO2), carbon monoxide (CO), mercury (Hg), and other pollutants), emission of greenhouse gases and the effect on human health. Using the Life Cycle Assessment (LCA) method can well determine the environmental effects in all stages of the life cycle of electricity production. Also, by using LCA, it is possible to compare different methods of electricity production from environmental point of view [Gagnon et al., 2002].

6.2.2 Recommendations for practitioners

In relation to projects such as the construction of a power plant, the HSE department is directly responsible for ensuring the health and safety of employees. By using the protective equipment that HSE department provides to the employees or the training courses that HSE organizes for personnel, it can largely prevent the occurrence of dangers [Masoudnejad et al., 2022]. For example, for avoiding air pollution, it is necessary to follow the instructions of the HSE department to protect the health of the employees [Masoudnejad et al., 2022]. Having emission control system such as filters is necessary to prevent particulate matter. Also, it is necessary to use protective equipment for personnel to prevent possible damage to the hearing ability caused by noise. Regarding the performance of the HSE department, it is worth considering that these departments unfortunately do not perform very well in large projects such as power plants, which can be due to two reasons. First Iran has a low rank in providing safety [Amir-Heidari et al., 2016] in the workplaces compared to many countries, and some important departments like HSE do not have effective performance due to limited powers [Masoudnejad et al., 2022]. The second reason is due to the sanctions that Iran is facing [Amir-Heidari et al., 2016], which unfortunately has made it difficult for Iran to import high quality protective products, for example, special protective glasses, special gloves for work with toxic and corrosive substances, and high quality work clothes. However, “since management, human, and hardware are respectively the most important influencing factors in causing accidents” [Amir-Heidari et al., 2016], it is possible to overcome the limitations caused by the lack of high quality equipment in Iran’s working environments to a very significant extent by improving management practices and proper training of human resources [Amir-Heidari et al., 2016].

About water Pollution, it can be said that effective water treatment system can reduce pollutants in the wastewater from the power plant. Also, the importance of preventing materials from leakage into water routes and resources should be considered [Saravanan et al., 2021].

Using renewable energy is another recommendation for future projects of power plants. “Due to the threats posed by global climate change, which is mainly anthropogenic, there is increasing pressure on traditional energy sources to increase global energy demand. Renewable energy sources are proposed as a solution to overcome this concern [Zarzavilla et al., 2022]”. The efforts of countries in the past years regarding climate change have not been enough to prevent the increase in the earth’s temperature [Zarzavilla et al., 2022]. By the end of this century, “growth is estimated at 3.20 °C, well above the targets set in the Paris Agreement (limited to 1.50°C or 2°C). Margins of 2°C can be maintained if countries commit to reducing their greenhouse gas emissions [Zarzavilla et al., 2022]”. “Renewable energies are noticeable solution in providing security of fuel supply, reducing the import of fossil fuels, and creating less environmental pollution due to their capacity in diversifying the energy resources and its gradual decarbonization [Zarzavilla et al., 2022]”.

In relation to deprived provinces such as Sistan and Baluchistan, the role of the government is far more important and it has more responsibility towards the people. Implementation of Zahedan city power plant may create some issues, for example, rising expectation of people in other deprived cities from the government to implement similar projects in their cities. The solution can be the proportionate and equal distribution of facilities as much as possible. Another point is higher costs as a result of prolongation of the power plant construction process. Some solutions can be avoiding using outdated technology, make a task list of all required tasks to complete the project and assign them to the right people, pay special attention to project planning and project control, invest a considerable amount of time in understanding the requirements to ensure zero gaps in knowledge, allocate budget correctly and realistically, identify and mitigate potential bottlenecks and resolve them before they cause delays in the project.

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Appendix:

Appendix 1: Consent letter

"Consent Letter:

- I, ……, voluntarily agree to participate in this research study interview.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that I can withdraw permission to use data from my interview after it, in which case the material will be deleted.
- I have had the purpose and nature of the study explained to me and I have had the opportunity to ask questions about the study.
- I agree to my interview being audio-recorded.
- I understand that all information I provide for this study will be treated confidentially.

- I understand that in any report on the results of this research my identity will remain anonymous if preferred to be so. This will be done by not explicitly mentioning my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.

- I understand that I am entitled to access the information I have provided after the interview.

- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

Here follow the names of the people involved in this research who guarantee the agreed use of this consent and the answers provided during the interview".

Researchers:
Project Supervisor:
Participant:

Signature of participant:

Date:

Appendix 2: Interview questions

Environmental effects:

1- On a scale of 1 to 4, how much do you think the construction of a new power plant will affect your quality of life in terms of income, employment, value of asset, air pollution?

2- Have you been affected by the environmental effects of a power plant construction such as water pollution, air pollution, and noise in the past?

3- On a scale of 1 to 4, what is your knowledge level of environmental effects (water pollution, air pollution, and noise) of constructing a new power plant?

4- On a scale of 1 to 4, how much do you think a new power plant affect the local environment such as wildlife and natural habitat?

5- On a scale of 1 to 4, how much do you know about the health effects from a new power plant construction?

6- Do you know about any measures that should be taken to minimize the environmental effects (water pollution, air pollution, and noise) of a new power plant? If yes, please specify.

7- On a scale of 1 to 4, how important is it to you that the new power plant is built in a location that is not closer than 10 kilometers to residential areas, schools, hospitals or your place of work?

Social effect:

1- On a scale of 1 to 4, how much do you think about job opportunities that a new power plant could bring to the area?

2- On a scale of 1 to 4, how much do you think the construction of a new power plant could impact property values and housing affordability in the area?

3- On a scale of 1 to 4, how much are you worried about the traffic, or other disturbances that could be caused by the construction of a new power plant?

4- On a scale of 1 to 4, how much do you think the local community can be involved in the decision-making process regarding the construction of a new power plant?

5- On a scale of 1 to 4, considering the concept of social responsibility, how important do you consider the government role in constructing a new power plant?

6- Do you know what type of difficulties might stop initiatives as the one of the construction of a new power plant in this locality?

7- On a scale of 1 to 4, how much do you know about the implications can the power plant bring (air and water pollution, climate change, land use change, health effect?

Personal data:

1- Gender: □Female □Male

2- Age group: □25-34 □35-44 □45-54 □+55

3- Education level: □High school □Bachelor Degree □Master Degree □PhD