“Concentrated Solar Power” Station in the Sahara desert

Shems A. Vouwzee
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1. Introduction

Technical advancement is an extremely important factor for the prosperity of our society. It is due to technology that the Western world has reached this level of prosperity. However, there are many problems nowadays that are regarded as a result this technical advancement that has brought us to this level of prosperity. An example is the development of the car. When the first cars were introduced, most people saw it as a dangerous and devilish machines. Gradually, people got used to the concept and over time it became socially excepted. Nowadays, most people own a car and use it on a daily basis. The car had a positive influence on our society and economy. However, a significant percentage of the green house gas in our atmosphere is are the result of this same invention. This is just an example of how people are suspicious at the introduction of new technology and how technology may have long-term and often unexpected side-effects.

Companies depend to a large extent to their investments in innovative new technologies and countries can be considered Third World if their level of technological development is insufficient. Therefore, governments as well as companies should carefully choose the technology in which they invest in order to continue developing. A certain ability to see into the future is required to make such decisions. There are several techniques and models developed to help “technology forecasting”.

In this paper, the introduction of new technology into Egyptian society will be studied. It involves the placement of a “concentrated solar power” station in the Sahara desert, in the vicinity of the Egyptian capital, Cairo. The Egyptian society, economy and government is briefly reviewed to obtain a better picture of the possible impact of such a project. Section 4 deals with the technical aspects and costs of the CSP station.

The relation between culture and technology is a complicated one. Therefore, the Social Construction of Technology (SCOT) model is used to construct a technological forecast for this subject, which is done in section 5. This model is the most suitable of those described in the manual for prediction of the implications the placement of a CSP-station might have and its immediate effect on the people involved. In the final section the conclusions and recommendation will be presented.

2. Egypt – Background Information

Egypt is officially called the Arab Republic of Egypt. As the name implies, Egypt is a republic, lead by president Mohammed Hosni Mubarak. Egypt became partially independent from the United Kingdom in 1922, and acquired full sovereignty following Word War II. The construction of the Aswan High Dam, which was completed in 1971, had a tremendous impact on the agriculture and ecology of Egypt, which has the fastest growing population in the Arab world. However, farmland is limited and agriculture depends to a large extent on the Nile. However, since the “depression” following the economic growth spurt in the 1990’s, the Egyptian government is preparing the country for a new era through economic reform and massive investments in communications and physical infrastructure.

Egypt is located in Northern Africa, bordering the Mediterranean Sea, between Libya, the Gaza Strip and the Red Sea, north of Sudan. The terrain is best described as a vast desert plateau, interrupted by the Nile valley and delta. The climate is a desert climate; very hot with dry summers and moderate winters. Unfortunately, the climate and geographic location give rise to a number of natural hazards that may occur, such as periodic droughts, earthquakes and landslides, flash floods, wind-, dust- and sandstorms.

Currently, a lot of agricultural land is being lost to urbanization and windblown sands. There is an increasing soil salination below the Aswan High Dam, which may have a negative influence on Egypt’s energy supply. In the following section more information will be provided on this issue. Other environmental issues are increasing desertification, oil pollution threatening the coral reefs, beaches and other marine habitats, other water pollution resulting from the use of agricultural pesticides, raw sewage, and industrial effluents. The fresh water resources are very limited away from the Nile, which is the country’s only perennial water source.

As mentioned earlier, Egypt’s economy experienced a “depression” after the 1990’s; the lack of substantial progress on economic reform limited foreign investment. However, Egypt implemented measures to increase foreign investments in 2004 by custom reforms, proposals for income and corporate tax reforms, reduced energy subsides and the privatization of several companies. These measures had a positive influence on Egypt's economy. The natural resources present are petroleum, natural gas, iron ore, phosphates, manganese, gypsum, limestone, talc, lead, and zinc. The development of an export market for natural gas has potential for future growth prospects [1].

3. Egypt's Energy

All energy consumed in Egypt is generated from domestic sources; electricity is generated from oil-powered stations and hydro-powered turbines on the Nile, especially those of the Aswan High Dam. Oil, natural gas and their derivatives supply other types of energy. Solar energy is not yet exploited because currently the technology is insufficiently developed to enable competition with other energy sources.

Exact figures on the energy distribution and prices in Egypt are unavailable online. Therefore, it is impossible to sketch a clear picture of the current situation. Some sources say that the contribution of the Aswan High Dam is approximately 15%, an additional 5% from alternative energy sources, and the rest is generated from fossil fuel.

The company Siemens is strongly involved in realizing Egypt's energy needs with the latest technology in power generation, transmission, and distribution. According to the company's website, Siemens technology supplies almost half of Egypt's thermal power generating capacity. Currently, there are three stations active that are producing electricity using Siemens turbines, at Damietta, Ataka, and Cairo West. In addition, their turbines are being used at textile, paper, sugar, and chemical plants. The website in vague on what type of fuel is used to drive their turbines, but it is probably fossil fuel [2].

3.1. The Aswan High Dam

Throughout history Egypt has depended on the water of the Nile. Even nowadays, 95% of the Egyptian population lives within 20 km from the river. The main tributaries of the Nile are the White Nile and the Blue Nile. The White Nile originates in Lake Victoria and the Blue Nile in the Ethiopean Highlands. The White and Blue converge in the Sudanese capital Khartoum, after which the river is called the Nile. The length of the Nile is 6.695 km from source to sea [3].

The Aswan High Dam, or Saad al Aali in Arabic, can be seen in Figure 1 and was originally designed to control the Nile River. Before installation of the dam, Egypt experienced annual floods that deposited 4 million tons of nutrient-rich sediment each year which enabled agricultural activity. Placement of a dam controls flooding and creates the possibility of water storage for times of droughts. In addition, it may be equipped to provide hydroelectric power. The high dam is the second dam built at Aswan; the first was built in 1889. At the time, Egypt was controlled by the British, who wanted to increase the irrigation capabilities for cash crops, such as cotton. The dam had to be raised on two occasions, in 1912 and 1933, due to the irregular flooding pattern of the Nile and increased water demand. At some point, a debate started about raising the dam a third time, after which it was decided to build a new "super dam".

Figure 1: The Aswan High Dam [4].

However, the possibility of actually building this new dam was not studied properly until after the revolution, in 1952. The new dam, the Aswan High Dam, was to be a technical miracle; 5 kilometers long at its crest, 1 kilometer thick at its base, 40 meters thick at its crest and raised 107 meters above sea level. The material used for the dam (43 million cubic meters) equals 17 times the amount of material used for the Great Pyramid at Giza, one of the Seven Wonders of the Ancient World . The reservoir, Lake Nasser, is 480 km long and 16 km at its widest. The surface area is approximately 6.000 km^2 and holds 150 to 165 km^3 water. No less than 11.000 cubic meters of water can pass through the dam every second. Every cubic meter flowing down the Nile is exploited by equipping the dam with hydroelectric turbines. The dam comprises 12 electric generators each rated at 175 megawatts. At its peak output, the dam provided approximately half of Egypt’s power supply, however, its contribution amounts to 15% nowadays. Another advantage of the dam is that since the installation it has been easier to navigate along the river due to the consistent water flow [4].

Naturally, every technology or advancement has its drawbacks. In the case of the Aswan High Dam several problems arose. Before the dam could be build 90.000 people had to be moved because the land of Nubia was to be flooded. The Egyptian Nubians were located 45 km from their original habitat, but the Sudanese Nubians had to move a distance of 600 km. About 17% of Lake Nasser sits on Sudanese territory, so Sudan and Egypt have an agreement on the distribution of water. Besides that, the government had to relocate the Great Temple of Abu Simbel and dig for artifacts.

Nowadays, farmers have to use artificial fertilizers to compensate for the nutrients which no longer flood their land. This lack of sediment results in other problems as well; the Nile delta is shrinking due to erosion. Without the dam this erosion would be somewhat compensated by the agglomeration of sediment. In addition, it has been proposed that the change in water flow caused by the Aswan High Dam is responsible for the decrease in the shrimp population of the Mediterranean Sea. The sediments that should be flowing downstream have been filling Lake Nasser, which causes the reservoir to loose its storage capacity[5].

Another issue is that poor drainage of the newly irrigated fields caused saturation and increased salinity. Nowadays, almost half of the farmland in Egypt is rated medium to poor soil. The stagnant water in the fields, as well as in Lake Nasser, has been associated with the parasitic disease schistosomiasis. Studies have shown an increase in affected individuals after placement of the dam. The disease is also known as bilharzias and leads to chronic ill health. It is the mayor health risk in the rural parts of Egypt and has been recognized since the time of the pharaohs. People are infected by contact with water used in normal daily activities [6].

4. CSP Technology

The most common way to convert solar radiation into electricity is by use of solar cells or panels. These devices are based on the principle of photo-voltaics (PV), shortly defined as the production of usable electric current by means of energy in the form of photons. Figure 2 is a picture of the well known blue Silicon based solar panels that can be seen on roofs and such, which are based on PV-technology. This technology is suitable for small scale applications. However, this technology has three mayor disadvantages;

- Storage of the generated energy is only possible through the use of expensive batteries,
- The device itself is very expensive,
- It requires a lot of energy to produce the device (even in a sunny country it takes four years to regain the energy it took to produce it).

Figure 2: Solar panel installed on a rooftop (source : www.solartwin.com).

An alternative method to convert solar radiation into energy is Concentrating Solar Power (CSP)-technology. In a CSP-station, the direct sunrays are concentrated by parabolic mirrors. The high temperature in the area in which the sunrays are concentrated, is used to heat tubes with flowing oil to approximately 400ºC. The hot oil is then transported to a steam boiler where water is converted to steam under high pressure. The steam is then transported to a turbine, which impels a generator that produces electricity. Basically, the power station consists of two parts; one that collects solar energy and converts that into heat and another that converts the generated heat into electricity. This principle creates the possibility of energy storage; a part of the daily generated heat is retained so solar energy can be generated at night. Hydrogen can be produced in a CSP-station in two ways; the first is the “old fashioned” way with electricity as the intermediate. The second is by using the high temperatures in the concentration area to decompose water in a closed circuit of chemical reactions. Another mayor advantage of this technology is that the “rest heat” can be used to produce drinking water from sea water [7].

The stations can be sized for village power (approximately 10 kilowatts) or for grid-connected applications (up to 100 megawatts). Aside from thermal storage for continuous power generation, there is the possibility of combining the station with a fossil fuel powered station to create a hybrid power station. These features, together with high solar-to-electric conversion efficiency, makes CSP technology a reliable and attractive renewable energy option in sunny countries. The amount of power that can be generated by a CSP station is determined by the amount of direct sunlight that the station receives. That means that the sunnier the local climate, the more power can be generated daily. Currently, there are four differently configured CSP technologies being used and investigated worldwide. These different technologies are parabolic trough systems (conventional or with application of the Fresnel principle), power tower systems, and parabolic dish systems. In the following sections the difference between these technologies will be explained.

4.1. Parabolic trough system

This configuration is the one used in the original design; the system comprises parabolically curved, trough-shaped reflectors that concentrate the sun rays. A receiver pipe filled with oil runs along the inside of the curved surface, where the solar energy is captured by heating the oil. The heat energy of the oil is then used to generate electricity in a conventional steam generator. This configuration is schematically represented in Figure 3.

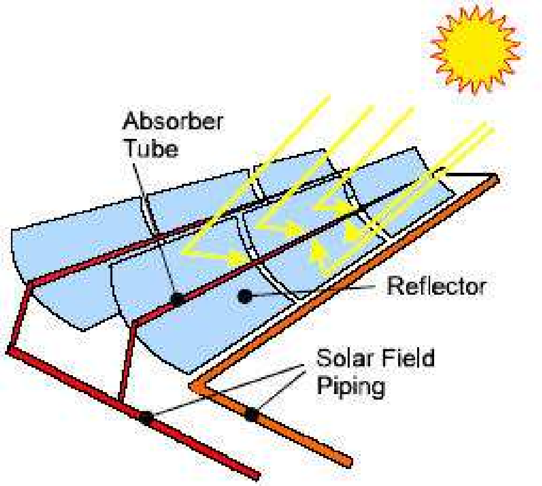

Figure 3: Schematically represented picture of the parabolic trough system (source: www.solarpaces.org).

The collector field of a CSP station using this configuration is made up of many troughs in parallel rows. The troughs are aligned on a north-south axis such that they can track the sun from east to west during the day. This ensures that the sun is continuously focused on the receiver pipes. Nowadays, a individual trough system can generate approximately 80 megawatts of electricity.

This design incorporates thermal storage by isolating the heat transfer fluid in its hot phase. This allows the generation of electricity for several hours into the evening. All parabolic trough CSP stations operating currently are hybrid stations; they use fossil fuels to compensate the station’s output during periods of low solar radiation. Usually, this is realized by use of natural gas-fired heat, gas steam boiler/reheater, or by integration of the station with existing coal-fired plants.

4.2. Parabolic trough system based on the Fresnel principle

This system comprises basically the same configuration as the conventional parabolic trough system; the difference, however, are the troughs. In order to understand how the principle of Fresnel can be applied to a parabolic mirror, the mirror is treated as a Fresnel lens. Viewed from the side a lens can be seen as a parabolic shape; thick in the middle and it tampers down to nothing on the sides. The Fresnel lens reduces the amount of material required for the construction of a conventional lens. This is accomplished by breaking the lens into a set of concentric annular sections, known as the Fresnel zones. The overall thickness is then reduced, effectively chopping the continuous surface of a standard lens into a set of surfaces of the same curvature. The thickness is then reduced substantially, while the image (or light) is magnified just as in the original lens. The first Fresnel lens found its application in lighthouses [8]. This CSP technology comprises the approximation of the parabolic trough by segmented mirrors according to the Fresnel principle, schematically represented in Figure 4. The configuration of the same as the conventional design, only the troughs are replaced by the ones in Figure 4.

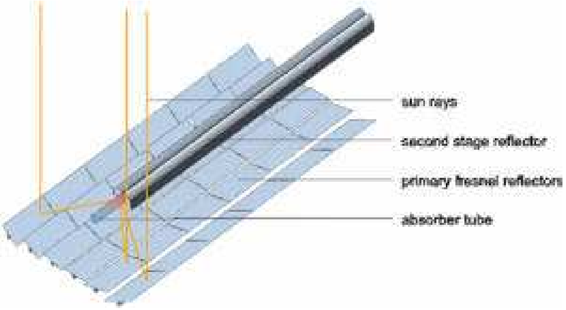

Figure 4: Schematically represented alternative for the parabolic trough based on the Fresnel principal (source: www.solarpaces.org).

4.3. Power tower system

The power tower system utilizes many large, sun-tracking mirrors, which are normally referred to as heliostats. The heliostats focus the sunlight on a receiver which is placed at the top of a tower, as can be seen in Figure 5. The heat transfer fluid is heated in the receiver and then used to generate steam. The heated steam is then used in a conventional turbine-generator for the production of electricity. Conventional power towers utilized steam as the heat transfer fluid. Nowadays, in the U.S. molten nitrate salt is used due to its superior heat transfer properties and energy storage capabilities. In Europe, however, air is used as the heat transfer medium due to its high temperature and its ease of handling. Commercial CSP stations comprising power towers produce between 50 and 200 megawatts of electricity.

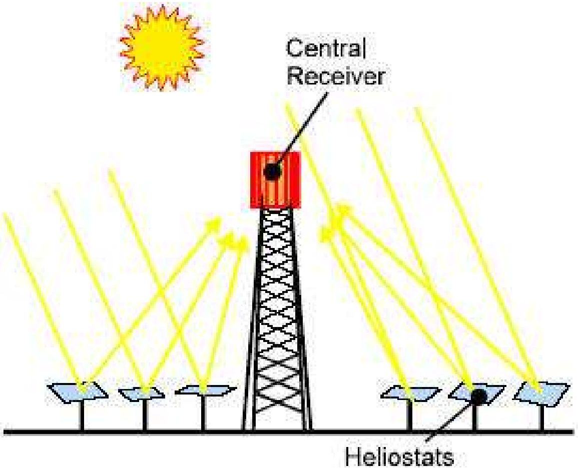

Figure 5: Schematically represented CSP-station comprising a power tower (source: www.solarpaces.org).

4.4. Parabolic dish systems

This design comprises parabolic-shaped point focus concentrators in the form of a dish, which reflect the solar radiation onto a receiver located at the focal point. These dishes are mounted on a structure with a two-axis tracking system to follow the sun. This configuration is schematically depicted in Figure 6. Normally, the collected heat is directly used in a heat engine (either a Stirling or Brayton cycle engine) that is connected to the receiver. Modular systems have been realized with total capacities up to 5 megawatts of electricity. The individual modules have maximum sizes of 50 kilowatts and have achieved peak efficiencies up to 30% [9].

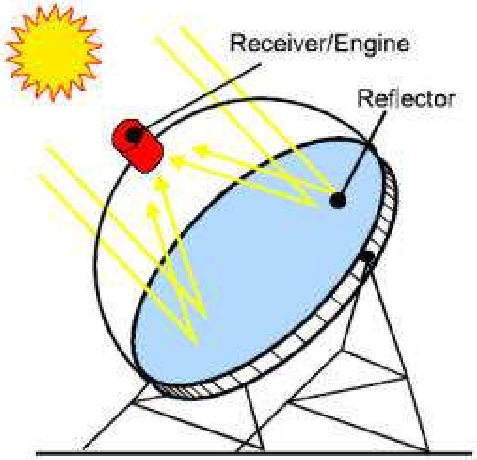

Figure 6: Schematically represented parabolic dish (source: www.solarpaces.org).

The first and only CSP-stations built are located in California. They were opened in the 1980's and they supplied energy to the local energy network. However, they did not survive the liberalization of the energy market in the 1990's. Since then this technology has been more or less forgotten by the general public. Some research is still going on to improve the performance of CSP-stations, mostly in Germany, Spain, and the U.S. [7].

4.5. CSP Costs

The cost of electricity from solar thermal power systems will depend on a multitude of factors related to the technology, such as capital, material and construction costs, and performance. There are, however, external factors that significantly influence the eventual cost of the generated electricity. For example, for troughs and power tower systems, small scale projects are extremely expensive. In order to compete with current fossil technologies the cost of CSP technology has to be reduced. This can be achieved by scale-up projects, such as a solar power park where multiple projects are built at the same site. In addition, this technology in essence replaces conventional fuel with capital equipment, so the cost of capital and taxation issues related to capital intensive technology will have a strong effect on their competitiveness.

Currently, CSP technology offers the cheapest solar electricity for large scale power generation, meaning 10 megawatts and above. Current alternative solar power technologies cost between 7,50 and 10 euros per kWh. The hybrid systems which combine large CSP stations with conventional oil-, natural gas-, or coal-powered stations can reduce the cost even to less than 6,60 euros per kWh. There is, however, no data available on the current prices of electricity in Egypt, so a comparison cannot be made.

Advancement in the technology, as well as the use of low-cost thermal storage, will allow CSP-stations to operate more hours during the day. The solar power generation can then be shifted to the evening hours. It is expected that in the next few decades solar power can be generated for approximately 3,5 euros per kWh [10].

In reality, cost reduction is the key issue that needs tackling in order to popularize CSP technology. This can be realized through the manufacturing of low cost components and higher overall efficiency. Additional research has to be done in the areas of low-cost components for industrial application, low-cost solar reactors for high-temperature chemical processes and low-cost thermal storage.

5. Social Construction Of Technology-model

In order to apply this model to the development of CSP stations in the desert surrounding Cairo, two important concepts in the SCOT-model have to be identified; the artifact and the relevant social group. In this model, the artifact is defined as an object deliberately created by human hands, which in this case would be the CSP station itself. A relevant social group is defined as a group of people that is concerned with a certain technical development and to whom the artifact has the same meaning.

The model is based on the assumption that one can identify a number of relevant social groups around every artifact. People concerned with the development of a certain technology, or the artifact in this context, all have their own opinion regarding this artifact. Especially the negative opinions, or (potential) problems, are important. Relevant social groups are formed when people share an opinion or experience collective recognition of a (possible) problem. In addition, a social group may have multiple problems regarding one artifact. Summarizing; an artifact is linked to a number of relevant social groups, of which each may have a number of problems regarding this artifact. Most problems fortunately have multiple solutions. The social groups around a given artifact influence the development of technologies by directing the solution of a problem towards their own ideals. In other words, technology is embedded in social systems and technological choices are determined in part by social factors.

The original SCOT model has been expanded by Pinch and Bijker to simplify the identification of the relevant social groups [11]. They define four categories of social groups; producers, advocates, users, and bystanders. These social groups can be identified through their interest in the technology, i.e., the group is determined by their direct or indirect relation with the technology. Producers have an organizational and economical interest, advocates political, users personal, and bystanders have a social or moral interest.

Producers

The activities of this social group include engineering, designing, marketing, advertising, investing, and reselling. Therefore, a number of groups can be identified in this category; the first two being the CSP construction company and the Egyptian company that will run the station. The Egyptian government is also a social group in this category due to their organizational interest in the matter. Not only will they have to invest in the project, they are also in charge of the location of the station, since the desert land is property of the government. Another relevant social group in this category are the competing energy companies. They have an economic interest in the project, since they have to compete against the CSP station.

Advocates

Advocates are usually organized groups which do not have a direct influence over the construction of the technology, but they have an indirect influence. Groups in this category are often organizations that influence the general public, usually through mass media. There are environmental groups active in Egypt that will be in favor of placement of a CSP station, since it has potential in reducing the usage of fossil fuels. They also tend to make themselves heard through mass media, which might positively affect other social groups, such as the government and the potential users.

Users

Users have, as well as the producers, a direct relationship with the technology. This social group socially constructs the technology by their potential use. However, users are by definition not formally organized into groups. Their activities that shape the development of the technology include talking about, buying, and using the technology. In this case, this social group is difficult to define due to the fact that it is difficult to say what the generated solar power will be used for. A possibility is that the generated energy is used for the numerous textile, paper, sugar, and chemical industries present in Egypt, or the energy could be used for the energy grid that supplies power to individual homes and offices. Therefore, two potential social groups can be defined in this category; industry and individual households. However, hereafter these groups will be referred to as the potential users, since their interests are very similar.

Capturing the essence of the subject; the question here is the progression from fossil fuel to solar energy. This concept is ready stabilized at the basic level, since for the usage of the artifact, i.e., the generated energy, is exactly the same as before. Switching from fossil fuel to solar energy will not alter the usage of domestic appliances or industrial machinery. In other words, the category of relevant social groups that is defined as the users, will not experience any difference in daily use of the technology. At least, as long as the prices stay the same.

Bystanders

Bystanders have an indirect connection with the technology; this category is defined as individuals whose opinions and language shape the social construction of the technology and they lack direct involvement. It is my opinion that this category can be neglected in this analysis, since the only possible negative effect is an increase in the electricity price, which would affect users rather than bystanders. In addition, it is hard to imagine there would be individuals with strong moral objections against the placement of a CSP station.

Summarizing, the following relevant social groups have been identified around the introduction of CSP technology in Egypt;

- The (probably) European construction company,
- The Egyptian future staff,
- Competing energy companies,
- The Egyptian government,
- Active environmental groups,
- Potential users, which may be individuals or industry.

The social groups around the CSP station are presented in Figure 7. Each of these social groups may have their own opinions and problems regarding the introduction of this technology into Egyptian society. Application of the SCOT-model to this situation requires the identification of all possible problems that each social group may have. This will be attempted in the following sections.

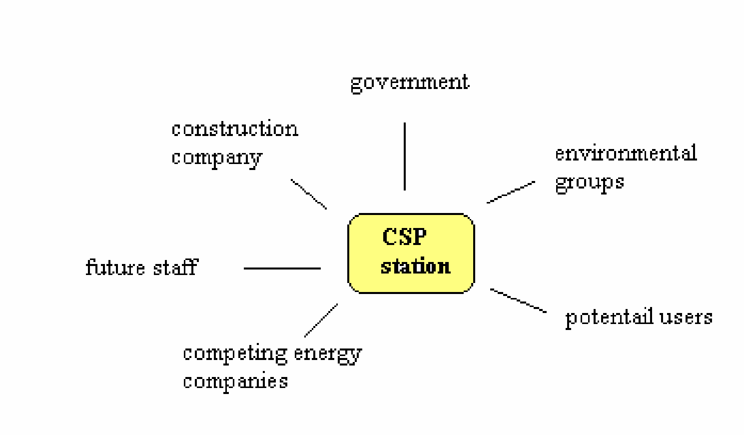

Figure 7: The social groups around the CSP station, schematically represented.

5.1. *The CSP construction company*

The company that will build the CSP station near Cairo is probably located somewhere else. Since the existing CSP stations and research centers are located in Germany, Spain, the U.S., and China, it is assumed that this company will be European. The engineers contracted for the project will have to move their families to Egypt, since the construction of the station probably takes several years. Therefore, the required emigration could be a problem for this social group. Secondly, the engineers will have to work with Egyptian construction workers and will have to educate the Egyptian future staff. These are issues related to language and cultural differences.

The station will be built on desert soil, which is very different than European soil. Desert soil tends to be alkaline, high in salt, and the soil contracts and expands from the wetting and drying cycles. Metals and concrete deteriorate faster due to the salt present. Furthermore, expansion and contraction of the soil could lead to upheaval of the structure, leading to misalignment of the mirrors or cracking of walls, or worse. CSP-stations are normally built on concrete foundations with many metal parts, so maybe other materials should be used in this particular case. These different circumstances could create problems for the engineering team.

5.2. *The Egyptian future staff*

The first issue that comes to mind is the same as that of the company that will build the station. The staff will have to learn how to operate, maintain, and repair the station from the European engineers. Although generally speaking the knowledge of the English language is quite good among Egyptians, the language could create a barrier. In addition, if the company is Spanish, there is a good chance that many of the Spanish engineers do not speak English. Again this can be defined as language and cultural differences.

Secondly, the station would probably be located in a remote area. Possibly, the future staff will also have to move, maybe with their families, to reduce the work-home distance to an acceptable level. In addition, if the location is too far from the city to travel every day, facilities have to be built to accommodate the staff. If this is the case, the staff will experience isolation while working at the location.

5.3. Competing energy companies

The problem or concern of this relevant social group is rather straight forward; if the CSP station provides cheaper electricity the other fossil fuel powered stations will have to lower their prices in order to stay competitive. Probably, this will not be the case in the first years of operation, due to the relatively high investment costs, but eventually the price would lower. After all, the “fuel” that powers the CSP station is free.

5.4. The Egyptian government

Building a CSP station would require huge investments. In the period from 1981 to 2005, the Egyptian government invested approximately 68,5 Egyptian pounds in the electricity sector, which means that they are probably willing to invest in a project such as this. Even if the CSP station is to operate as a commercial company, the government will have to subsidize the project because it is hard to imagine that there would be an Egyptian investor that can finance it alone. Therefore, one of the problems of this social group is financing.

The Egyptian desert land is property of the Egyptian government, which means that the location of the station is a decision for the government. However, there are two aspects to be considered. Firstly, the more remote the location is, the higher the investment costs. If the location is really remote, facilities will have to be built to accommodate the staff. On the other hand, building the station close to Cairo might destroy the landscape. In addition, it is recommended to build the station away from Cairo’s extremely busy highways, due to flying desert dust that might settle on the mirrors and thus intensifying the need for maintenance. Secondly, the government will have to dig for ancient Egyptian artifacts prior to building the station, to protect the pharaonic legacy, as was done before construction of the Aswan High Dam.

5.5. Active environmental groups

Generally speaking, the introduction of new technologies gives rise to many negative opinions due to fear or ignorance. However, in this particular case this is less probable. Possibly, active environmental groups will promote the introduction of CSP technology in Egypt due to its environmental friendly nature. It is likely that the technology will be promoted in the mass media and the people will be encouraged to switch to solar energy, even if the price is higher. This is happening already in Europe and the U.S. The role of this social group is not problematic but rather positive. Actions of this social group through mass media might even stimulate the Egyptian government to participate in the project.

5.6. Potential users

If the CSP station is able to provide energy at the same price as the conventional power stations, there is no problem to be expected from this relevant social group. However, the group remains relevant in the scope of the model, since the technology cannot have a future without this social group. In addition, the opinion of this social group can be influenced by the actions of the advocates, which in this case are the active environmental groups. The most important aspect is financial, especially because it is not a very rich country. Even in the West, many energy consumers are reluctant to pay extra for “green energy”. Therefore, it is imperative to maintain prices equal to the price of energy generated by conventional methods.

5.7. Problems

Now that all relevant social groups and their opinions or problems have been identified, Figure 7 can be expanded, and Figure 8 is obtained. The social groups are represented in the squares and the problems in circles. It becomes obvious from the figure that the problems are shared among some of the social groups and the groups have multiple problems. In the following section each problem will be addressed the possible solutions will be investigated.

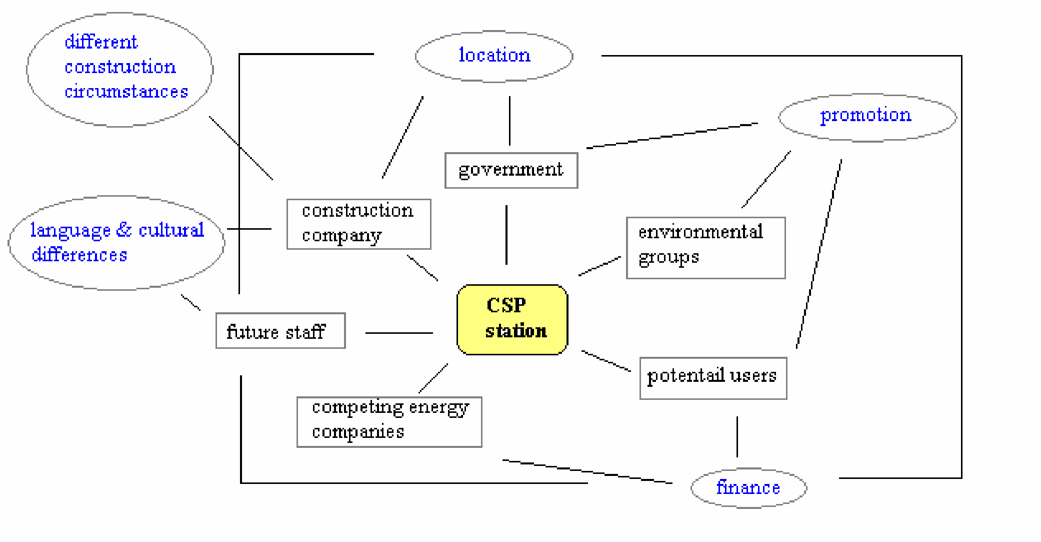

Figure 8: Relevant social groups and identified problems around the CSP station, schematically represented.

5.7.1. Language & Cultural Differences

This is the only problem to which there is no real solution. It is simply a matter of adaptation and tolerance from the involved parties. The CSP construction company should carefully choose the people that will work on this project, select them on language skills and open mindedness. The future Egyptian staff should be selected on the same criteria.

5.7.2. Location

Choice of location influences three of the social groups in different ways. The CSP construction company is affected by the general location, meaning that they will have to move to Egypt to carry out the project. It does not matter much weather it is 10 or 100 km from Cairo. The government, however, should carefully choose the location, as explained in a previous section, the location also influences the required investments. The future staff is influenced by the location of the CSP station for obvious reasons addressed earlier. Therefore, the location should be selected carefully.

5.7.3. Promotion

The promotion of the technology, carried out by active environmental groups, should be defined as an action rather than a problem. The role of this social group is of tremendous importance in the introduction of CSP technology in Egypt. Through advertisement using mass media the government can be influeced to decide in favor of participation in the project and the general public may be persuaded to switch to solar energy.

5.7.4. Different construction circumstances

Carrying out the project on desert soil would present a challenge for the European engineering team. They should team up with Egyptian engineers to determine the best materials and configuration, because the Egyptians are used to the circumstances. This problem can be easily overcome by cooperation.

5.7.5. Finance

The financial concept is also shared among some social groups, although for different reasons. The government will have to invest in the project and the choice of location influences the amount. The potential users will base their decision of using the technology on the price of the product. Finally, the competing energy companies and the CSP station both depend on the price of the product.

6. Conclusions

It is my opinion that the long-term effects of the realization of a project such as this will benefit most of the relevant social groups. In fact, switching to solar energy by application of this technology in countries where the climate permits it would benefit the entire world. There is, however, a lot more research required to reduce the investment costs. Most countries can simply not yet afford it. The investments can now only be reduced by very large-scale projects, such as solar power parks.

However, when the time comes for actual construction of a CSP station in Egypt, the station can be equipped with water purification installation. Clean energy can then be generated and the fresh water problem can be solved simultaneously. Fresh water sources are very limited in areas away from the Nile and, unlike everything else in Egypt, the CSP station need not be close to the Nile.

The CSP station would also provide job opportunities for the local. There will be staff needed for the construction, operation, maintenance, and so on. The energy prices will eventually lower, since solar energy is free.

Sources:

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