RENEWABLE ENERGY MARKET IN NAMIBIA

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ABSTRACT

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ABSTRACT

This thesis was conducted for the Connect-project that kicked off in February of this year. The project got together students together who were interested in doing market research for Finnish companies in the field of renewable energy. The target countries were from Asia and Africa and the project itself seemed interesting enough to get into. Originally the idea was just to write a country report but after getting deeper into the topic, the idea of turning this into a thesis was proposed. The topic was accepted and the author started working on it soon after.

The objective of this thesis was to shed light onto the energy sector of Namibia and the possibilities its market offers. In this thesis there is a market analysis on the current energy situation and the current renewable energy sector situation. The thesis is concluded with recommendations for Finnish SMEs in the country. Most of the information is reliable secondary data, collected from various sources, including the Ministry of Mines and Energy of Namibia. Both qualitative and quantitative methods are applied in the study.

The study revealed that Namibia has established a renewable energy sector and the government is serious about green energy. The country has a great amount of green resources ranging from solar power to biomass and hydropower. While the industry is fairly young and the markets are not oversaturated yet, the number of renewable energy suppliers is growing and the competition is growing. The author was able to find a couple of market areas where Finnish SME's and professionals might find success in.

Keywords Renewable energy, solar power, Namibia

Pages 34 pp. + List of sources

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1 INTRODUCTION

This thesis aims to shed light onto the energy sector of the Southwest African country of Namibia, and the possibilities this market offers for Finnish companies, specifically in the renewable energy sector. The research includes a market analysis of the current energy situation and the current renewable energy situation in the country. The paper is concluded with recommendations for Finnish SMEs that are looking for new markets.

1.1 Energy

Energy is a fundamental part of our universe and one of the basic requirements in order for us to exist. We use energy to move, play and work. Work is energy. Energy powers our vehicles and means of transportation, lights our cities, heats our homes, plays our music and powers machinery in our production facilities. Everything we do is connected to energy in one way or another. We have used the energy from the sun since we came to existence. Energy is found in a number of different forms. It can be electrical energy, heat (thermal) energy, mechanical energy, nuclear energy and chemical energy. It is a key component to everything that works around us and within us, as well as the foundation of the society we live in. (Energyquest 2012.)

Humans convert energy from less desirable forms to more useful forms (for example from wood to heat, from fossil fuels to electricity etc.). Over the years, humans have developed ways to expand their ability to harvest energy. The East African man from a million years ago only had access to the food he ate, so his daily consumption has been estimated have been about 2000 Kcal. An average person living in the USA today is responsible for consuming more than 250 000 Kcal daily, of which more than 30% comes from electrical energy alone. Of that electrical energy, more than half is wasted energy on inefficiencies in energy generation and transmission. Energy consumption is often wasteful, or at least inefficient. More and more emphasis is put on efficient and clean energy usage i.e. the implementation of new technologies and forms of producing and harnessing energy. While global warming or climate change is debatable, it is clear that South Americans, Asians and Africans should not follow the path of Europeans in energy production; a path that is detrimental to the environment. Figure 1 displays the percentages of world energy consumption by region from 1980 to 2002. (Western Oregon University, 2012.)

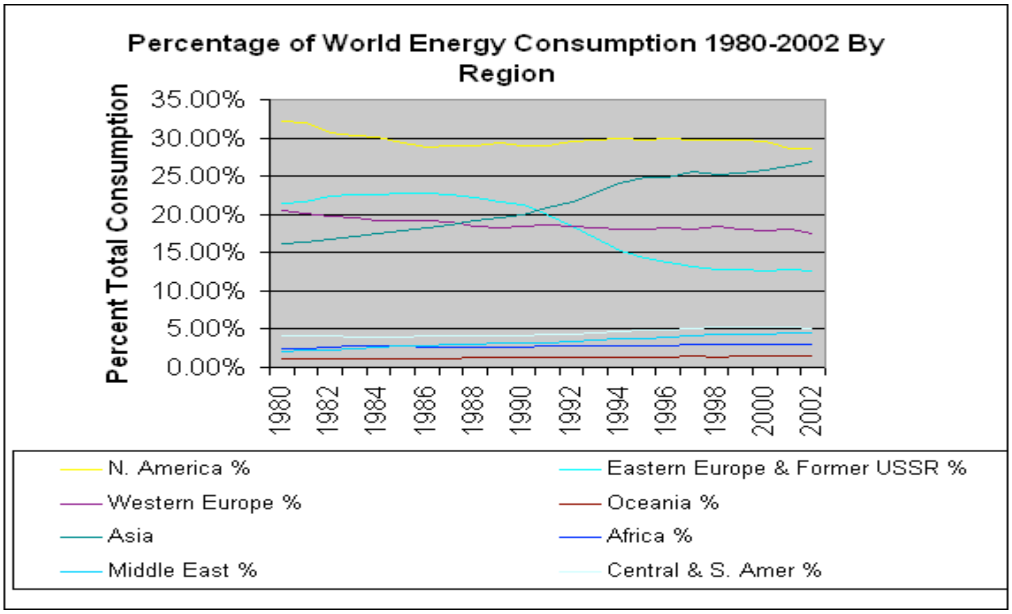

Figure 1. Percentage of World Energy Consumption Regionally from 1980 to 2002 (Western Oregon University, 2012).

1.2 Renewable energy

The global renewable energy sector received the largest amount of investment in its history in 2011 (increased by 17% to 257 billion US dollars) and extended enormously. By the end of the year, the global power capacity from renewable energies was over 1350 gigawatts, and it supplied more than 20 percent of global electricity. Still, the industry will face years of growing pains before it can legitimately compete with fossil fuels. (NewScientist 2012.) Renewable energies will have to overcome financial, political, as well as social barriers. In the African markets, these barriers include a low level of understanding among stakeholders, a lack of transparency from the governments and lack of investment finance. The desire and resources are almost always present, but the proper stimuli are often missing from the mix. (Renewable Energy World 2012.)

In Namibia, solar energy technologies have been in use since the 1970s and solar energy continues to be the most widely implemented renewable energy. While many forms of renewables and their benefits remain unexplored in the country, the milieu seems to be right for exploring new opportunities in the field. Namibia is facing problems in meeting the rapidly growing energy demand in the country, not to mention that about half of the country's energy is already imported. In recent years, the Namibian government has established renewable energy programs (most notably the Namibian Renewable Energy Programme, NAMREP) as well as several renewable energy directives (one requires all new public buildings to use solar water heaters instead of electrical water heaters) to encourage the use of renewable forms of energy in the country.

1.3 Introduction to Namibia

Namibia is a country located on the coast of the Atlantic Ocean in Southeast Africa. Its neighboring countries are South Africa in the South, Angola and Zambia in the North, and Botswana in the East. Its total land area is 824 269sqkm (more than twice the size of Finland) and it has a population of 2.1 million. Namibia is a former German colony that was under South African rule during apartheid, before gaining independence in 1990. The country's capital city is Windhoek. There is a detailed breakdown of the business environment in Namibia in Chapter 3.

2 RESEARCH METHODS

The research conducted for this report was exclusively based on secondary data for several reasons. Firstly, secondary research was a good alternative as it gave access to more information that might not have been available through primary research. As a student, lack of experience, credibility and knowledge in the field would have hindered the research process and the desired research results would not have been achieved.

Furthermore, collecting primary data in Namibia was not an option due to resource constraints. However, guidance on where to find relevant data was given by a Namibian renewable energy specialist. While collecting primary data is often considered to be the best way for collecting information to analyze (Vartanian, 2011, 3), this option might not always be the most economically or practically feasible. Data was available at no cost in the Internet and from previously written publications related to the topic of this report. The data collected from the local market can be considered reliable as the key sources included official reports from Namibian Ministry of Mines and Energy (MME) and Electricity Control Board (ECB).

From the above mentioned sources both qualitative and quantitative data was collected. Qualitative data is data that focuses on behavioral factors and answers questions related to "why" and "how"(Flyvbjerg, 2006). Quantitative data supports the qualitative data and contains mathematical and statistical techniques in research (Given, 2008). The core data used in the research was qualitative in nature and quantitative data added a deeper, more detailed insight to the topic.

3 BUSINESS ENVIRONMENT IN NAMIBIA

3.1 History of Namibia

The Namibian history can be divided into four periods; the pre-colonial times, the German period, the Apartheid period and the independent period. Little is known of the pre-colonial times since the Europeans were the first to write about what was happening in the area. Parts of the events of the time can however still be found in the oral traditions that circulate in the local communities. Several stories from this time recount a time reminiscent of the "Wild West" with cattle raiding, ambushes, drinking and riding horses through open landscapes. A lot of people claim that the Germans founded Windhoek but it has always been a popular place to stay. The city was originally called /Ai Gams. (The Cardboard Box 2012.)

Europeans named Namibia German South West Africa when they came ashore in the territory in the 1880's. At the Berlin conference in 1883, Africa was divided between European countries (to the surprise of Africans). As a result of the conference, Germans ended up with this desert land that most Europeans saw little use in claiming. The German Colonial Administration was never fully in control of Namibia. The period was full of conflicts and rebellions against the colonizers by the pre-colonial Namibian population. Almost 100 000 Hereros, Damaras and Namas, and about a 1000 German troops died because of these wars and the resulting concentration camps that were used to intern the "rebels". There was an outcry in Germany to stop these wars and specifically to stop the first genocide of the 20th century; the genocide of the Hereros. Of the 80 000 Herero population, about 60 000 were killed during this time. In 1915, after defeat to the Union Troops of South Africa, Germany surrendered administration of the land to the South African Prime Minister Louis Botha. Reminders of the German period can still be seen in Namibia today; there are many German style buildings and monuments that were built during the era. Namibia is also the only African country that publishes a German daily newspaper as the German language coexists alongside the many languages that are spoken in the country.

In 1948, the Afrikaner led National Party gained power in South Africa. The leaders of the Republic of South Africa (RSA) saw Namibia as a potential fifth province of their country. The existing system of segregation was heightened during the Apartheid period ('Apartheid' means "living separately"). In the 1950's and 60's, the living quarters of black and coloured (not to be confused with the derogatory American term) Namibians were torn down in towns. According to the Apartheid principle, these people had to be moved out of Windhoek, a city that was reserved for whites only at the time. Ultimately, most coloured Namibians were transferred to Khomasdal, five kilometers outside of Windhoek and the black Namibians were transferred to Katutura (which literally means "a place where we don't want to stay"). These areas now form parts of Windhoek. The signs of the Apartheid period are still evident, as the predominantly low-income black Namibians still inhabit Katutura and low-income coloureds live in Khomasdal.

In 1978, the UN Security Council drafted UN Resolution 435, a resolution whose objective was "the withdrawal of South Africa's illegal administration from Namibia and the transfer of power to the people of Namibia with the assistance of the UN". (Encyclopedia of the Nations 2012.) After numerous failed attempts by the UN to apply the resolution, transition to Namibian independence finally started in 1988 under the tripartite diplomatic agreement between South Africa, Angola and Cuba, with USSR and USA as observers. RSA agreed to withdraw its forces from Namibia, and Cuba (with troops in Southern Angola supporting the Namibian liberation movement) agreed to pull back its troops. A UN civilian and peacekeeping force under the Finn Martti Ahtisaari supervised the military withdrawals and the holding of Namibia's first election in 1989. Namibia became officially independent on 21st of March 1990 when Sam Nujoma was elected as the president of the country. Martti Ahtisaari was appointed an honorary Namibian citizen in 1989, after the independence elections. (The Cardboard Box 2012.)

3.2 Language & religion

The official language of Namibia is English. Before 1990, German and Afrikaans were also official languages, until SWAPO, the ruling political party and former liberation movement in Namibia, decided that the country should become officially monolingual. The majority of Northern Namibians speak Oshiwambo as their first and often only language, while Afrikaans remains the most widely spoken and understood language (especially among the white Namibians). Other notable indigenous languages include Oshiherero and Nama. (Encyclopedia of the Nations 2012.)

The first missionaries in Namibia were British Congregationalists and Methodists; German and Finnish Lutherans and German-speaking Roman Catholics followed soon after. As a result of this, a large majority of Namibians (80-90%) belong to the Christian religion of which at least 50% are Lutheran. About 10% of the population practices indigenous religions, mostly among the ethnic tribes. There are also small numbers of Jews, Buddhists, Baha'is and Muslims in Namibia. (Encyclopedia of the Nations 2012.)

3.3 Political factors

3.3.1 Government

Namibia is a republic and has a government in which the president acts as both the chief of state and the head of government. The president is selected by popular vote every five years (and is eligible for a second term). The president appoints the cabinet members from the National Assembly.

As it states in the Namibian constitution: “The legislative power of Namibia is vested in the National Assembly, with the power to pass laws with the assent of the President as provided in this Constitution subject, where applicable, to the powers and functions of the National Council as set out in this Constitution”. (The Namibian 2011.) The legislative branch is made up of the National Council (an advisory body), that holds 26 seats (two members are chosen from each of the 13 regions of the country to serve six-year terms), and the National Assembly that holds 72 seats (the president appoints six members, the rest are appointed by popular vote to serve five-year terms). (The Supreme Courts Namibia 2007.)

SWAPO (South West Africa People’s Organization) has been the ruling party since independence and was formerly the liberation movement that fought for independent Namibia. In the 2009 general elections, SWAPO candidate Hifikepunye Pohamba received 75% of the votes. The main opposition to the ruling party is currently RDP (Rally for Democracy and Progress). In the election it gained eight seats in the National Assembly and became the official opposition. (Institute for Security Services 2012.)

Namibia is relatively stable politically. While so many nations around it have had issues with civil unrest, Namibia has been able to maintain domestic peace. Still, the legacy of racism and ethnic politics continues to play a role in the politics of the country. The neighboring Zimbabwe is an example of land redistribution gone terribly wrong and Namibia has been dealing with some of the same issues during its young independence. The land is very unevenly distributed between the minority whites (who own 30.5m hectares of the land) and the majority blacks (own 2.2m hectares) (2002). Recently, president Pohamba stated that the country might be in for a civil war if the land reform issue is not addressed urgently. (Institute for Security Services 2012) (All Africa 2012)

3.3.2 Corruption

Corruption is an issue bigger than any other form of organized crime or fraud in Namibia, according to the World Bank. The latest Corruption Perceptions Index (CPI) also finds Namibia “highly corrupt”. Corruption comes in the form of illegal issuing of licenses, bribery, kickbacks, investment schemes, financing of lifestyles and paying for luxury items like cars and apartments for highly ranked members of the country. The World Bank conducted research in Namibia from November 2011 to February 2012, interviewing the government, the private sector, academic sector and civil society on the issue. After the research, the World Bank stated that corruption and alleged corruption cases vary from a few million Namibian dollars to N$30 million through a Social Security Commission/Avid Scandal, N$100 million through an Offshore Development Corporation (ODC) and about N$ 1.8 billion through the Government Institutions Pension Fund’s (GIPF) Development Capital Portfolio (DCP). (All Africa 2012.)

Even though Namibia's legal and institutional framework for fighting corruption has generally received a "thumbs up", there are insufficient controls and many loopholes in the system, as stated by the World Bank. The research report states that: "Namibia is considered to be highly vulnerable to the inflow of proceeds of crime and corruption from other countries". Those "other countries" refer to the neighboring countries of Angola and South Africa, two countries that are regarded as largely thriving criminally. Angolans, according to the report, spend large sums of money in the Namibian economy doing business, driving up real estate prices and outbidding Namibian entrepreneurs. (All Africa 2012.)

3.3.3 Private/Public ownership

"We can privatize, there is nothing wrong with that. But the insecurity created for the people who will not be able to find other jobs could lead to total chaos. Each country should try to solve its own unique problems in its own way." – Senior SWAPO MP, Ben Amadhila. May 2003

Many countries around the world have been forced to liberalize their economies in order to qualify for a loan from The World Bank and the IMF. Borrowing countries in Africa often have loans tied to a program of economic reform, a so-called structural adjustment program. That privatization has been adopted at such a great pace in sub-Saharan Africa and is largely due to the pressure applied by the World Bank and the IMF. In many cases, this form of neo-liberalism has not helped the country borrowing the money at all. Instead, it has allowed foreign investors to reap the benefits, while leaving the country in debt. Many countries also self-impose a neo-liberal framework based on the assumption that individual countries cannot resist globalization on their own. Privatization is also driven by a deliberate government policy to make State-owned enterprises profitable and also as a means to downsize the public sector. (Bank of Namibia, 2009.)

The so-called hallmarks of Namibia's brand of privatization are the PPPs (Public-Private Partnerships). In PPPs, the emphasis has been shifting from the privatization of enterprises to the privatization of public services. This arrangement allows the state to retain the ownership of utilities and to regulate the performance of the private company providing the service. This form is the dominating form of Namibian privatization.

PPPs may take place in the following forms:

1. Service contracts – the government or municipality signs a service contract with a private company to render an operation and/or maintenance function. This is the most simple form of contract and usually short-term.
2. Management contracts – In this form, the company takes on the responsibility for the management and operation of a specific government or municipal work or service (for example, the running of a plant). The private company gets paid a certain amount by the government/municipality for

the management. Management contracts are usually medium term contracts (5-10years).

3. Lease contracts – Here the private company takes the responsibility for managing and operating a government or a municipality work and service but also leases the relevant assets from the government/municipality. In this case, the company assumes responsibility for billing and tariff collection, as this would be the main source of income for the company. Lease contracts are usually long term contracts (10-20years).
4. Concessions – The fourth and final form of PPP is concessions. Here the private company takes on the responsibility for managing and operating the government/municipality work or service, as well as for financing and facilitating further infrastructure development. The private company receives its income directly from the end-users through tariffs and connection fees. These contracts are long-term contracts (15 years and above). (Bank of Namibia 2009.)

The biggest argument against the PPPs is that they are seen as a way for the Namibian elite to apportion national assets among themselves without offering any noticeable benefits to the majority of the country's citizens.

While Namibian companies are open to foreign investment for the most part, the government owned enterprises have been closed to all investors (Namibian and foreign). Foreign investors have mostly participated in joint ventures with parastatals in certain sectors like telecommunications. Parastatals provide most of the essential services such as telecommunications, transport, water and electricity. Even though the Namibian government underscores its commitment to privatization, the process remains slow and many parastatals remain under the control of the government. This hints that the government is not yet fully prepared to privatize. This could be because of equity consideration and not wanting to sell off the national assets to the elite and foreigners. (Bank of Namibia 2009.)

3.3.4 Company taxation

The value-added tax (VAT) in Namibia is 15%. Companies subject to taxing in Namibia include not only the companies registered in Namibia, but also branches in Namibia of foreign companies deriving some kind of income from the country. Companies other than those that have manufacturing status are subject to a normal tax rate of 35%. (Ministry of Trade and Industry 2008) No environmental tax has yet been introduced in the country, although it has been said that the legislation is in the process of being finalized. (Deloitte 2011.)

3.4 Economic factors

Namibia's economy is open and quite dependent on the extraction and processing of minerals for export. Mining accounts for 8% of the GDP, but at the same time provides more than 50% of the foreign exchange earnings. Namibia is a major source for gem-quality diamonds and the fourth-largest producer of uranium in the world. Other notable natural resources in the country are zinc, lithium, cadmium, tungsten, salt, iron ore, copper, silver and gold. Even though the mining industry is crucial to the Namibian economy, it employs only 3% of the population. Apart from mining, the most significant economic sectors in Namibia are agriculture, tourism and manufacturing. A particularly high per capita GDP in relation to the region hides one of the world's more unequal income distributions (70.7 GINI coefficient). (C.I.A. World Factbook 2012.) (Ministry of Mines and Energy, 2005.)

The country's economy has close ties with the South African economy because of their shared history. The Namibian dollar was introduced in 1993 but it remains at par and fully convertible to the South African Rand. Until 2010, Namibia drew 40% of its budget revenues from the South African Customs Union (SACU). Increased payments from SACU put the country's budget into surplus in 2007 (the first time since independence in 1990), and the share kept increasing until the global recession in 2010-11. Increases in fish production as well as mining income spurred growth in between 2003 and 2008 but the growth has been undercut by poor fish catches, lowered demand for diamonds, higher costs of producing metals and the aforementioned global recession in recent years. (C.I.A. World Factbook 2012.)

Namibia has a high official unemployment rate of about 50%; around half the country's population lives under the international poverty line of 1.25 US dollars/day. However, there is a significant sector of workers that are not accounted for in the official numbers. In 2010, the Government tender board announced that, "henceforth 100% of all unskilled and semi-skilled labor must be sourced from within Namibia". (Economy Watch 2012.) Table 1 illustrates the economical statistics of Namibia.

Table 1. Economic Statistics of Namibia. (C.I.A. Worldfactbook 2012)

Total GDP	15.9 billion USD
GDP per capita	7,500 USD
GDP growth rate	3.6%
Public debt	26.8% of total GDP
Exports	4.39 billion USD
Imports	5.35 billion USD
Inflation	5% (consumer price change)

All figures are 2011 estimates

3.5 Social factors

Namibia has a population of 2.1 million people with an estimated average population density of just under 3 persons per square kilometer in 2000, making it one of the least densely populated countries in the world. The country is divided into 13 regions - in four of them the population density is less than one person/sqkm. Only about 28% of the entire population was counted as "urban population" in 2001 but it grew to 38% by 2011. The average household size stood at 5.1 persons in 2001 and the median age was 21.7 years in 2011. 34.2% of the total population belongs to the age group from 0 to 14, 61.7% belongs to the group from 15 to 64 and only 4.1% belong to the group of 65 years or older. (C.I.A World Factbook 2012.) (Ministry of Mines and Energy, 2005.) Table 2 exhibits the basic information of the 13 regions, including the capital city, population, population density and the land area of each region. The table is followed by Figure 1, where the regions are placed on the Namibian map.

Table 2. Namibia's 13 Regions (Ministry of Mines and Energy 2005.)

Region	**Capital**	**Population (2011)**	**Area (km2)**	**Population density (persons/km2)**
Caprivi	Katima Mulilo	79,826 (2001)	14,528	5.5
Erongo	Swakopmund	100,663 (2001)	63,579	1.6
Hardap	Mariental	68,249 (2001)	109,651	0.6
Karas	Keetmanshoop	76,000	161,215	0.5
Kavango	Rundu	222,500	48,463	4.6
Khomas	Windhoek	340,900	37,007	9.2
Kunene	Outjo	68,735 (2001)	115,293	0.6
Ohangwena	Eenhana	245,100	10,703	22.9
Omaheke	Gobabis	70,800	84,612	0.8
Omusati	Outapi	242,900	26,573	9.1
Oshana	Oshakati	161,916 (2001)	8,653	19.0
Oshikoto	Omuthiya	181,600	38,653	4.7
Otjozondjupa	Otjiwarongo	135,384 (2001)	105,185	1.3

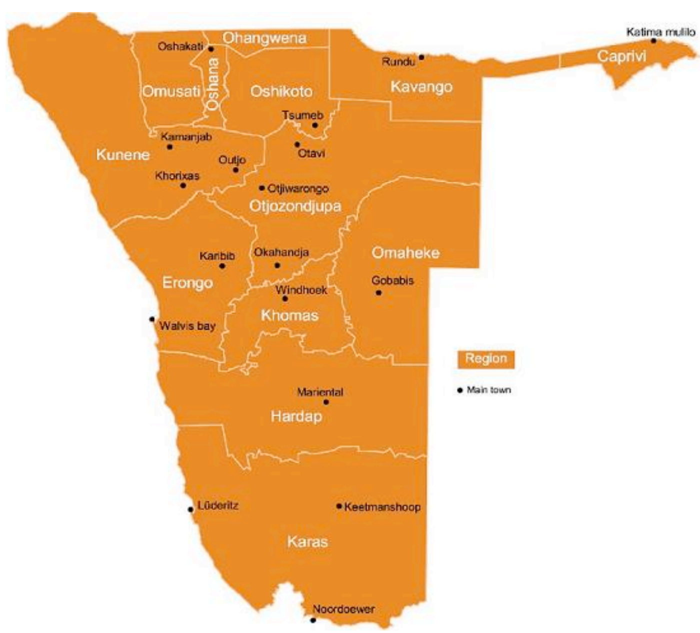

Figure 2. Map of the 13 regions of Namibia (Life's Work 2008).

3.6 Technological factors

Solar energy technologies have been used in Namibia since the 1970's. The first larger scale solar photovoltaic pumps were installed in the 80's in remote areas. That was also the time when the first attempts at solar water heating were made using a collector and a hot water tank. (Ministry of Mines and Energy, 2006.)

In the 1990's, when Neste Oil tried to set up solar energy systems in Namibia, the solar panels were so expensive that they kept going missing (most of them stolen). Today, the solar panels coming in from China are relatively cheap and less of a barrier-to-entry financially. Most of these panels are not as high quality as the ones made in Europe and North America, and some of them end up breaking after a year or two of use. However, the overall cost of solar panels has gone down for the past three years due to a switch to large-scale manufacturing, which means the higher quality panels might become very affordable in Namibia in the near future. Solar power technologies available in Namibia are considered to be comparatively advanced in general. (New Scientist, 2012.)

3.7 Geographical & environmental factors

As mentioned in the introduction, Namibia is located in Southwest Africa by the Atlantic Ocean. Its neighboring countries include South Africa in the South, Angola and Zambia in the North, and Botswana in the East. The country covers an area of 824 269km2, more than twice the size of Finland. The capital city is Windhoek, with a population of 350,000, located in the middle of the country.

Namibia is the driest country in sub-Saharan Africa. There are very limited fresh water resources, as well as continuous problems with desertification. The country experiences more than 300 days of sunshine per year for up to 10 hours/day. Additionally, sunshine in the country can produce a daily radiation rate of 5 to 6 kwH/m2. The key features of Namibia's climate are the scarcity and unpredictability of rainfall. What makes the situation even more aggravating is the fact that the country has a very high rate of evaporation; some estimate that 83% of all rainfall is evaporated and an additional 14% is lost through transpiration of plants. This sometimes adds up to prolonged periods of drought. (Ministry of Mines and Energy, 2005.)

The central, southern and coastal areas of Namibia constitute some of the driest landscapes in sub-Saharan Africa. The hottest months are January and February, with an average day temperature of above 30-Celsius degrees. During the winter months (May to September), minimum temperatures vary from -6 degrees Celsius to 10 degrees Celsius at night to above 20-Celsius degrees during the day. Frost occurs over large areas of the country during winter, but in general the winter days are clear, cloudless, and sunny. (Namibia Weather Network, 2012.)

As mentioned above, only 38% of Namibia's population is considered "urban". The rural populations are spread over large parts of the country, which often makes grid extensions unviable. Large majorities of the rural population have not yet experienced the handiness and usefulness of modern energy services; most of the rural households rely on fuel-wood for cooking and heating and paraffin is used by nearly half of the rural households as lighting fuel. Because paraffin, candles etc. deliver light of inferior quality at a high cost per unit of light, the evening activities are limited to a minimum. This in turn reduces opportunities for income generation and improvement in the quality of education and health. (Ministry of Mines and Energy, 2005.)

Namibia is the first country in the world to incorporate the protection of the environment into its constitution. Around 14% of the total land is under protection, including nearly the entire Namib Desert coastal strip. (C.I.A. World Factbook 2012.)

Namibia has eight airports (one international), two harbors (one deep-sea harbor), a railway network in the south and a road network that covers nearly the entire country. (Government of Namibia 2012.)

3.8 Legal factors

3.8.1 The Judiciary

The Administration of justice in Namibia comprises of the Supreme Court, the High Court and the Lower Courts. The Administration is an independent department from the other organs of the state. Namibia has a system of *stare decisis,* which means that all decisions emanating from the Supreme Court are binding on all the lower level courts as well. The Supreme Court is the highest forum of appeal in the country. The Lower Courts include; the Magistrate courts, which deal with the most cases in the entire legal system; the Labor courts, which deal with labor disputes; and the Community courts, which apply customary law. (New York University School of Law 2010.)

3.8.2 The White Paper On Energy Policy

The White Paper on Energy Policy presented by the government in 1998 is the most important energy policy in Namibia. It sets out the most essential energy policy goals and acts as the strategy paper for liberalizing and privatizing the electricity sector. The main ideas of the paper are ; a) effective governance systems are in place to provide stable policy, legislative and regulatory frameworks for the energy sector, b) Namibia achieves security of energy supply through an appropriate diversity of economically competitive and reliable sources, with an emphasis on the development of Namibian resources, c) social upliftment takes place through households and communities having access to appropriate and affordable energy supplies, d) the Namibian energy sector expands through local and foreign fixed investment, resulting in economic benefits for the country, e) the energy sector is economically efficient and contributes to Namibia's economic competitiveness and f) the Namibian energy sector moves towards the sustainable use of natural resources for energy production and consumption. (Electricity Control Board 2006.)

4 CURRENT ENERGY SITUATION IN NAMIBIA

4.1 Introduction

In 2007, Namibians consumed the equivalent of up to 10 TWh of liquid fuels, which made up 63% of the country's total energy consumption during that year. Transport fuels were by far the single largest factor in the country's entire energy mix. That 63% is the equivalent of 4,800KWh per person in a year. In comparison, the total electrical energy consumption equated to 1,800KWh per person during the same year. In 2002, 34.7% of the population was connected to the national electricity grid. (Electricity Control Board 2009.)

4.2 Installed capacity

Namibia produces no coal, oil or natural gas (although some sources claim that oil has been found recently). All of the country's petroleum is imported and used mainly for transportation and industry. This is problematic because, as mentioned above, 63% of Namibia's total energy consumption is constituted of liquid fuels. Namibia's main sources of electricity generation are Ruacana Hydroelectric Power Station (with about 240-250MW yearly until 2012, reports from July 2012 claim that the capacity has been raised to 330MW), Van Eck Coal Power Plant in Windhoek (120-125MW) and Walvis Bay's Paratus Diesel Power Station (20-25MW). (Renewable Energy World, 2012) (Developing Renewables 2006) (Division Environment and Infrastructure 2007.)

Originally, the Van Eck Coal Power Plant and the Paratus Diesel Power Station were installed only as a temporary solutions because the Ruacana plant was not completed in time. It was anticipated that the Ruacana plant would be able to provide a sufficient amount of electricity for the entire country. Due to increased demand for electricity since the completion of the plant, not only are all the plants still in operation, but also about 50% of Namibia's electricity is imported from neighboring countries. The energy imported from South Africa (more than 300MW yearly) is actually less expensive than the energy generated by Namibia's own thermal power plants. The plants are therefore only used during the periods of high peak load. Cost of electricity generated by the Ruacana plant is, however, relatively cheap, yet dependent on the daily water flow from Angola. In the absence of sufficient water flows the plant is unable to feed electricity into the national grid on demand. (Developing Renewable, 2006) (Electricity Control Board 2009)

4.3 Power transmission and distribution

The power transmission network in Namibia is well developed and emanates from Windhoek. The main transmission line goes through the country from

North to South because the Ruacana Power Stations is located in the North on the Angolan border and the point where the Namibian grid connects with the South African grid is at the Southern border. Because of greater transmission efficiency, Namibia has managed to reduce its transmission losses from 9.1% to 5.1% between 2001 and 2005. An efficient power transmission network is and continues to be key in harnessing the power of solar technologies in Namibia. (GTZ, 2007)

The transmission and distribution of power in the country is managed by NamPower (a state-owned electricity supply utility). NamPower has stated that the biggest challenges they face in the transmission are the electricity market restructuring in the SADC Power Pool, security of supply concerns (due to a shortage of generation capacity in Namibia) and the resulting effects it has on Namibia and the integration of newer technologies like those related to renewable energy. (Developing Renewables 2006.)

4.4 Rural electrification

The Namibian government launched a rural electrification program in 1990 at independence. Approximately 10,000 rural households were connected to the electricity grid. Around 400 rural towns, villages and settlements have been grid electrified and an estimated 8,330 households had benefited from the program by the early 2000's. The Rural Electricity Distribution Master Plan from the year 2000 covers all future electricity customers in the country that have not yet gained access to electricity (of the 2,855 villages found in Namibia, around 2,400 still have no link to the national power grid). 131 villages are located in officially declared off-grid areas but the Ministry of Mines and Energy (MME) plans to get the remaining villages connected to the power grid within 20 years. (Ministry of Mines and Energy, 2005)

A fee-for-service model was tested in the Ovitoto village in 2002. 100 households were equipped with solar systems and only the electricity consumed was paid for using a pre-payment system. The test proved uneconomical due to the area being thinly populated. The systems were later transformed into solar home systems and the users now pay a monthly fixed rate until their respective system is paid for and they assume the ownership of it. (Ministry of Mines and Energy, 2005)

4.5 Need for energy

A medium-income Namibian household uses between 5 and 15kWh of electrical energy on average per day. The Rössing uranium mine (one of the largest open pit uranium mines in the world) located in the Namib Desert used more than 425,000 MWh of energy in 2007. The entire electrical energy consumption of Namibia was 3.6 TWh in 2007. The total energy consumption of the same year was more than 15 TWh (including the consumption of all liquid fuels, electricity, biomass, solar and other renewable energies). The country also produces, exports and imports several goods that all require energy for manufacturing and transporting. (Electricity Control Board, 2009)

4.6 Electricity Market Participants

4.6.1 NamPower

NamPower is a corporation owned completely by the government of Namibia. It operates the country's three power plants and the national power grid. NamPower supplies electricity directly to customers who are situated beyond the reach of local power providers. The company buys and sells electricity regionally through its energy trading division (GTZ, 2007). NamPower will experience an estimated 40 million euro shortfall on its balance sheet for the 2012/13 financial year. This caused the managing director of the company Paulinus Shilamba to announce that: "prices of electricity will gradually increase to ensure that cost reflective tariffs are maintained". No plans to privatize the company or split off any of the division have been made public so far. (All Africa, 2012)

4.6.2 Regional electricity distributors

In the past, Namibia's municipalities organized the local supply of electricity to end-users and local authorities set the tariffs. The restructuring of the Namibian energy sector meant that the municipal power suppliers of the past were grouped into five utility companies called Regional Electricity Distributors. The utilities have the status of independent enterprises in their respective regions, They are managed according to market-economy principles and are regulated by the Electricity Control Board (ECB).

4.6.3 Electricity Control Board (ECB)

ECB regulates the electricity sector and ensures that the market develops in a way that reflects the interests of all stakeholders. The board is responsible for issuing licenses to market participants engaged in anything related to the electricity sector in Namibia. ECB's independence is greatly limited due to the MME being responsible for authorizing the granting of all licenses. The board mostly makes recommendations the ministry after examining and evaluating the incoming license applications. (GTZ, 2007)

4.7 Power shortages

Unlike many other African countries, there have been no issues with power shortages in Namibia so far. This has a lot to do with the small population and comparatively developed energy industry. According to The Namibian - a major local newspaper, this may become an issue in the near future. Namibia could face power shortages due to growing demand driven by increased mining activities in the country and an over-reliance on South Africa to supply power. NamPower's managing director Paulinus Shilamba has stated that, "the next three to four years will remain critical for Namibia", until NamPower can commission its base load power station in 2016. However, The recent expansion of the Ruacana Hydropower Plant's capacity to 330MW offers immediate relief to the energy burden. Shilamba has estimated that the country might face a shortage of about 80MW of electricity as soon as next year. (The Namibian, 2012) (The Economist, 2012)

4.8 Energy efficiency In Namibia

According to the Green Energy in Namibia report (2009), most Namibian households can save up to 20% of their normal electric energy consumption without a loss in service levels of comfort. This could be achieved by applying a combination of different consumption behaviours and using energy efficient appliances. For example, washing clothes with cold-water detergents instead of hot water detergents, using a washing line instead of a tumble dryer or simply enabling the power saving options on electric and electronic devices would all help in saving electricity.

According to the same report, most Namibian businesses and industries offer significant energy saving potentials. For example, using heat-reflective paint on roofs and insulating materials, closing windows while using air conditioners, and investing in energy efficient technologies all make a difference in saving energy. An experienced energy auditor could not only help save energy, but could easily shave off 10 to 25% of a business' electricity bill. (Electricity Control Board, 2009)

Even though the demand for energy is growing in Namibia, the production and consumption levels are relatively low, as can be seen from Table 3, where Namibia's energy statistics are compared with those of Finland. Still, as mentioned before, only about half of the country's demand can be met with domestic electricity production as of now.

Table 3. Comparison of Energy Statistics between Finland and Namibia.

	Finland	Namibia
Electricity production (million MWh)	77.44	1.49
Electricity consumption (million MWh)	87.25	2.85
Electricity consumption/capita (MWh)	16.22	1.35
Ecological footprint (ha/capita, 2008)	2.7	0.7
CO2 emissions (tonnes/capita, 2007)	12.1	1.5
CO2 emissions ranking (2007)	23	136

(CIA World Factbook, 2012)

5 RENEWABLE ENERGY MARKET IN NAMIBIA

5.1 Introduction

Renewable energy refers to all energy that is generated from natural resources such as sun or wind, at sustainable levels. Solar energy is derived from the sun, wind energy from air movement that is a result of low and high atmospheric pressure of hot and cold temperatures produced by the sun, wave energy (power) comes from wind and temperature shifts over water, tidal power is the result of the gravitational pull and wind etc. The ability of these sources to replenish their energy means that the use of them can be sustainable as long as the right means are used. Sustainability and green values are the main causes of interest in the field of renewable energy. Scientific evidence argues that all of todays mainstream sources of energy are more or less harmful to the environment. Many scientists claim that the issue of global climate will be the most important issue for this and the coming generations. Failing to address this issue now might lead to catastrophic environmental changes later. This topic remains debated, as many more scientists claim that there is no clear evidence of humans affecting the global climate in any way, and that Al Gore's critically acclaimed documentary 'The Inconvenient Truth' is based on insufficient evidence and fabricated lies (Petition Project, 2012).

The application of a renewable energy is dependent on the environment and the surroundings. Due to relative economic costs, resources that may be viable in one country may not be viable in another. The incentive behind sustainable resources is that they endure and provide economic as well as environmental benefits over longer periods of time.

5.2 Biomass

A significant portion of Namibia (about 25 million hectares) is covered by invader bush. This phenomena is something called "bush encroachment", where indigenous thorny bush and shrub species found in natural lands grow in such abundance that the so-called invader bush suppresses the growth of grasses and reduces the penetration of rainwater into the soil and therefore makes it difficult for the underground water resources to recharge. It also reduces biodiversity. This bush is a significant but underutilized source of energy. It is underutilized mostly because of attitudes that see it as a nuisance only since it is a growing problem for farmers. Still, biomass covered as much as 13% of Namibia's total energy consumption in 2007. (Electricity Control Board, 2009)

Invader bush is also a potential fuel source for the country's power plants and the wood gathered from it may be used to fuel the boilers of conventional power stations. In theory, biomass-to-electricity power plants could contribute more than 100MW to the national capacity, while providing 0.5 TWh to the national energy mix at the same time. All of this remains on the theoretic level, however, at least for now. The financial viability of these small-scale bush-to-biomass-to-electricity plants remains minimal, but small plants (5-20MW) may turn out to be economically viable in the near future. (Electricity Control Board, 2009) (All Africa, 2011)

5.3 Biofuels

Liquid fuels derived from plants or crops are considered biofuels. The development of carbon-neutral biofuels is largely considered to be the key to the future of our means of transportation. Ethanol is one example of a biofuel that can be blended into petroleum or even be used in specially equipped ethanol engines. Biodiesel is another example and is derived from oil-bearing fruits or nuts such as soybean, canola, sunflower seeds etc. It can also be manufactured from organic-, vegetable- or recycled cooking oils. All biofuels are not necessarily a true source of so-called green energy.
(Electricity Control Board, 2009)

LL Bio-Fuels Namibia, a foreign-initiated billion-dollar-venture, secured 300,000 hectares of land in the Northeastern region of Caprivi to plant jatropha in 2010. The project had a 100-strong multi-ethnic work force when it was initiated but the number was expected to multiply to thousands if it attains commercial production. LL Biofuels' agronomist Alon Vered stated that the firm has planted 400 different species of jatropha on a small portion of the farm to determine which varieties of the nut offer the highest diesel yield. The project is on-going. (BioDiesel Magazine, 2010)

Utilization of biofuels is still in its first stages in the country. There are several other projects that are being started at the time of writing but no real success stories have been reported as of yet.

5.4 Geothermal energy

Geothermal energy stations use hot water that is found close to the Earth's surface to generate electricity that is carbon-neutral. Another source that may be used for geothermal energy are geological formations underground that trap heat in them.

The potential of geothermal energy remains unknown in Namibia. While some hot springs exist in Windhoek, Rehoboth and in the Kunene Region, the evidence to conclude that viable geological formations can be in found in the country is insufficient. Research about this renewable energy source is costly, and therefore probably the biggest barrier in finding out the true potential of it. (NamPower, 2008)

5.5 Waste to energy

Waste dumps offer opportunities for the generation of energy. This can be done by incineration to generate heat and electricity, or by harnessing methane gas that can power piston engines and drive electric generators.

Industrial as well as household waste is placed in landfills across Namibia. Excluding the collection of materials for recycling purposes, these continuous waste streams have little to no value. Counting the fact that the bigger Namibian cities dispose of tens of thousands of tons of biodegradable waste each year, there are a variety of opportunities in the waste to energy-field. However, only a detailed assessment of the matter can reveal the real costs and benefits of using waste for power generation in the country. (Electricity Control Board, 2009)

5.6 Wind energy

The energy resources derived from wind along the Namibian coast are considerable (the country has 1600km of coastline by the Atlantic Ocean). Various on-shore wind farms with an installed capacity of somewhere between 20 and 50 MW (each) could be built along the coast. For example a 50 MW wind farm positioned on the southern end of the coast could yield up to 0.12 TWh annually. As of today, unfortunately, there are very limited site-specific wind measurements available. This type of data is essential in order to build farms that are optimal in size and design in given locations. The absence of the data keeps potential investors and future wind farms operators from understanding how viable such investments could be. The connection of these farms to the national grid would be demanding as well. (Electricity Control Board, 2009) Despite the obstacles, United Africa Group (UAG) recently signed an agreement to build a wind farm near the German colonial town of Luderitz. If everything goes according to plan, the farm will be completed and connected to the national grid by the end of 2013. (Energy Boom, 2010)

5.7 Hydropower

In 1992, Namibia’s gross theoretical hydropower potential was estimated at approximately 9000GWh per year. The real potential of hydropower in Namibia remains unknown. (Developing Renewables, 2006)

The country is currently considering a 500MW Baynes Hydropower project that would be located by the Angolan border at Epupa Falls. In addition, according to the Ministry of Mines and Energy, the downstream area of Ruacana still has hydropower potential of up to 2,000MW. Minister Isak Kitali has stated that it would be an absolute waste of resources to not utilize this opportunity. (Renewable Energy World, 2012)

5.8 Solar power

As mentioned before, Namibia experiences more than 300 days of sunshine per year and up to 10 hours of sunshine/day. A daily radiation rate of 5 to 7 kwH/m2 is reached on majority of those 300 days. These conditions make Namibia one of the most suitable countries for solar power in the world and the situation ideal for solar energy use. Nonetheless, there are many barriers for implementing larger solar installations. Few of the reasons include poor social acceptance, lack of capacity for service and maintenance, lack of information and high cost of installations. Small-scale installations have proved to be less problematic, as shown in the study later on in this chapter.

In 2003, the government established the Namibian Renewable Energy Programme (NAMREP) to deal with these issues. The first phase of the programme had the objective to "remove barriers to the delivery of commercially, institutionally, and technically sustainable Renewable Energy Systems (RES) including electricity production (for off-grid lighting, radio, TV, water pumping, and refrigeration), and water heating to the household, institutional, commercial, and agro-industrial sectors and to demonstrate the enabled environment through affirming demonstrations of the application of the technologies". Some of the intended results of the phase were to build capacity in the Renewable Energy Technology (RET) industry; to implement new policies, laws, regulations and actions in support of RETs in place; to increase public awareness and social acceptability; and to increase accessibility to RETs as a result of more affordable financing schemes and strategies to reduce costs. Overall the first phase was deemed a success. One indication of this was that the number of annually installed solar water heaters had increased from 135 in 2003 to 400 systems in 2006. Still, the potential for renewable solar energy was seen as higher. (United Nations Development Programme, 2005)

Phase II took place from June 2007 to December 2010 and had the main objectives of; removing barriers to the delivery of Renewable Energy Systems (RES) and water heating systems to all sectors, as well as showing the benefits of RES for the environment through affirming demonstrations of the application of the renewable energy technologies. (United Nations Development Programme, 2008)

The most used solar technologies in Namibia are currently solar water heaters (SWH), photovoltaic pumps (PVP), solar home systems (SHS) and solar cookers (SC). Many electric water heaters have been replaced by solar water heater-installations already. Other, less common, solar technologies include solar street lighting and solar-hybrid mini-grid installations. The many open and flat spaces in the country and good connection possibilities to the national grid make solar power the renewable energy that is likely to be the most widely utilized in the future. Nonetheless, harnessing and transporting the solar energy has proven to be a difficult task. (Ministry of Mines and Energy, 2005)

5.8.1 Photovoltaic pumping and power

The generation potential of photovoltaic plants in the country is not limited by the availability of the resource itself, but matching the supply from this type of power plant to the current demand and dealing with the supply peculiarities in the national grid are key issues. Large-scale photovoltaic power generation is still very expensive and requires storing capabilities if the output power is to be available continuously. (Renewable Energy & Energy Efficiency Institute, 2008)

The main types of photovoltaic water pumps commercially available are AC Submersibles, DC Submersibles and DC Hammerheads. The Submersibles are attached to a water pipe, a power cable and a rope and then lowered into a well or a borehole. The DC Hammerheads are above ground installations that utilize more conventional piston-type cylinders, steel pipes and pump rods because they are used by wind water pumps and diesel pumps. Hammerheads are more mechanical in nature than the Submersibles, while the Submersibles are more electronic. The AC Submersibles require a DC/AC inverter and are designed for larger water supplies (from 40,000 liters up/day), while the DC Submersibles are coupled to the solar panels and supply much smaller amounts of water (from 4,000 to 10,000 liters/day). The Hammerheads are designed most specifically for deep-well pumping and their supply ranges from 7,000 to 25,000 liters daily. All the supply numbers rely heavily on the environmental- and situation specific conditions. The AC Submersibles are delivered mostly from Europe and the USA, DC Submersibles from Europe and South Africa and the Hammerheads are manufactured in Namibia.

The costs for pumps in 2004 were as follows (VAT-excluded):
DC Submersible 24,000 N$ (7,000-liters daily)
DC Hammerhead 55,000 N$ (15,000-liters daily)
AC Submersible 110,000 N$ (50,000-liters daily)

5.8.2 Solar water heating

Solar water heaters (SWH) absorb the sun’s electromagnetic radiation in the form of heat. A SWH can reduce a household’s electricity expenditure by up to 50%. This solar technology has great potential in Namibia on both macro- and micro-economic levels and is already used extensively in off-grid areas by rural clinics, hostels and commercial farms. Probably the most appropriate solar water heating technology for Namibian conditions is the indirect (dual-cycle) system. This system transfers its heat through a heat exchange mechanism and then returns to be heated again without ever being in contact with the tap water. This prevents fresh water from passing through the system continuously and hence depositing lime into pipes and tubes, which would in turn clog up the water heater. The “heat exchange” happens in the water storage tank, which is often located above the “solar collector”. The solar collector is black for heat absorption and has rows of copper pipes that the water flows through. The hot water from the collector transfers its heat to the household’s water. (Ministry of Mines and Energy, 2005) In Graph 2 the indirect solar water heater can be seen on the left, and a drainback SWH on the right.

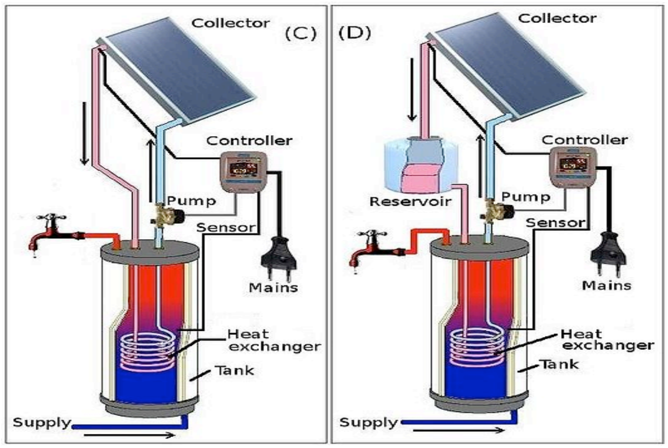

Figure 3. Indirect- and Drainback Solar Water Heaters (Wikipedia 2012)

The indirect solar water heaters have very low maintenance requirements, little to no operating requirements, up to ten-year warranties and a lifetime of 10 to 15-20 years.

In 2004, there were four solar water heater brands commercially available in Namibia. At the time the brands had excellent reputation and extensive local expertise. SWH makes up the highest portion of electricity generated from renewable energy in the country. Due to a government directive in August 2007 through the MME for the use of SWH technology in all government buildings, solar water heaters will continue to be an important source of energy in the future.

The costs for solar water heaters in 2004 were as follows (VAT-included):

- 100-liter solar water heater 7,000 N$
- 150-liter solar water heater 10,000 N$
- 300-liter solar water heater 14,000 N$

5.8.3 Solar home systems

Solar home systems are designed to provide households with a basic electricity service using the sun as a power source. A SHS can be used to supply electricity for lights, radio, television, hi-fi equipment, refrigerators etc. but can’t be used for any equipment that produces heat (i.e. stoves or irons). A typical system is made up of solar panels, batteries, a controller, cables, sockets and lights. A photovoltaic module converts irradiation of the sun into an electric current. Currently, there are six PV module technologies; the mono crystalline, poly crystalline, string ribbon silicon and thin-film technologies, copper-indium-diselenide (CIS), amorphous silicon (a-Si), and cadmium-telluride (CdTe). The PV module is the largest cost contributor to the initial cost of

SHS' in almost all the cases. (Ministry of Mines and Energy, 2005) (Ministry of Mines and Energy, 2006.)

There is extensive experience and expertise in the configuration, supply and installation of solar home systems in Namibia.

The costs for solar home systems in 2004 were as follows (VAT-included):

- 50W DC 6,764 N$
- 150W AC 18,913 N$
- 350W AC 26,159 N$

(Ministry of Mines and Energy, 2005.)

5.8.4 Solar cookers

A solar cooker uses the heat created by the sun for cooking, boiling and baking. The most common types of solar cookers include box type solar cookers, flat plate collector systems and parabolic concentrators. In 2004, there was only one solar cooker manufacturer in Namibia, while other dealers periodically supplied the other solar cookers.

The costs for solar cookers in 2004 were as follows (VAT-excluded):

- Box Cooker (Chicken size) 500 N$
- Parabolic Concentrator (normal size) 800 N$

(Ministry of Mines and Energy, 2005)

5.8.5 Suppliers of solar renewable energy

According to a renewable energy supplier survey conducted in 2004 by the MME, suppliers sell their products mainly to local clients at a market-related price. Most of the suppliers are based in the capital city Windhoek. Only a few suppliers operated from Eastern, Southern or Northern Namibia (for example from Tsumeb and Oshakati in the North).

Also found in the survey was that different suppliers interacted and networked very infrequently and when they did, the communication was mainly focused on product related inquiries. The communication was dedicated to purchasing products, troubleshooting and assessing product warranties in order to sustain their own businesses. Because of the limited interaction between companies and suppliers and the resulted lack of coordination and cooperation, the renewable energy suppliers were a poor lobbying entity with extremely restricted and narrow influence on national policies and initiatives. The suppliers were aware that better communication and cooperation would be beneficial to them individually and as an entity (85% of suppliers would support an association of RE suppliers).

The biggest concern of the suppliers (according to the same survey) was making sure that sufficient technical standards and quality control of the technologies related to renewable energy were maintained and maybe even enforced.

Another concern was that without identifying an independent and objective (not subjective) driver to lead the association, the competition between the suppliers would discourage everyone to assume any responsibilities.

Product marketing was also very uneven and no clear marketing strategies were in place. Most suppliers had only one or two methods of marketing their products. The most popular media for marketing were newspapers, schools, trade fairs and radio. The most effective medium for marketing renewable energy (in this case, solar) had not been identified yet. The biggest reasons for the lack of comprehensive marketing planning were financial constraints but the lack of the suppliers' marketing skills has most likely played a big role as well. It should be noted that only one of those interviewed has a strong market presence in Northern Namibia, where the market for RE technologies is extensive and concentrated. (Ministry of Mines and Energy, 2005.)

5.8.6 Solar energy product registration

In 2006, NAMREP appointed a consultancy for the establishment of a Register of Recommended Products and for the adoption of Codes of Practice. They address the three solar technologies of Solar Home Systems, Solar Water Heaters and Solar PV Water Pumping Systems. The program has established that the solar energy products on Namibian markets must meet minimum quality levels to increase the reliability of solar energy technologies. The key components that are evaluated in the Register of Products are; PV modules, batteries, charge controllers, lamps and inverters for solar home systems; PV modules, electronic controllers and motor subsets for PV Water Pumps; and collector and storage tanks for solar water heaters. The criteria for the evaluation takes account the Namibian climatic conditions, quality and reliability aspects as well as life expectancy. (Ministry of Mines and Energy, 2006) The product approval procedure is shown in Figure 2:

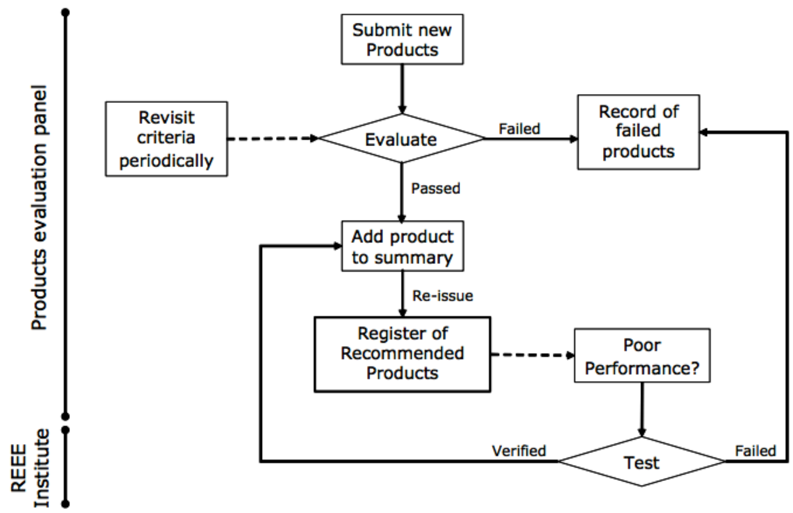

Figure 2. Solar Energy Product Approval Procedure. (Ministry of Mines and Energy, 2006)

5.8.7 Assessment of Replacement of Electrical Water Heaters Study

In 2005, the Ministry of Mines and Energy conducted a comparative cost analysis comparing the costs of basic indirect solar water heaters to electrical water heaters taking into account all cost items, electricity consumption and tariffs for several Namibian towns. The reference case used in the study was comparing a 200-liter indirect solar water heater with a back-up element connected to a 150-liter electric water heater. Since the per census data for an average Namibian household stood at 5.3 people, the study was conducted on a 5 person household.

For the purpose of comparing the SWH option with the electric water heater (EWH) option, a lifecycle costing approach was used. The method allowed systems that offer similar quality of service to be compared on an equal basis by reducing future costs that occur at different time periods of the systems lifetime, to one value, referred to as LCC (Life Cycle Cost) of a system. Future costs included operating costs, maintenance costs, and replacement costs. The life cycle costing performed in this study makes use of the so-called constant dollar approach which therefore excluded inflation. The discount rate, the loan rate and the escalation rates used in the analysis were therefore real rates, exclusive of inflation. (Ministry of Mines and Energy, 2005) Table 4 displays all parameters taken into consideration in the study:

Table 4. Input Parameters for LCC (1$ = 10.2 N$, 18.7.2012)

Parameters	Value	Unit
Project life	15	Years
Inflation rate	3.5	%
Real loan rate	6	%
Carbon credits	65	N$ / ton
Indirect solar water heater: 100 liter	9,660	N$
ISWH: 150 liter	11,960	N$
ISWH: 180 liter	12,535	N$
ISWH: 200 liter	13,570	N$
ISWH: 250 liter	17,250	N$
Electrical water heater: 100 litre	3,350	N$
EWH: 150 liter	3,500	N$
EWH: 200 liter	4,650	N$
EWH: 250 liter	6,750	N$
Shipping to towns	Range	Per kg
Maintenance: anode replacement	500	N$/ 3 years
Maintenance: element replacement	500	N$ / 5 years
Maintenance: pressure valve replacement	750	N$ / 5 years
Hot water consumption (middle income house)	30	Liters/person/day
Water temperature differential: Inland	38	Celsius
Water temperature differential: Coast	44	Celsius
Daily average solar irradiation: Inland	6.5	kWh/sqm/day
Daily average solar irradiation: Coast	6.0	kWh/sqm/day
Solar collector efficiency	65	%
Electrical heating efficiency	95	%
SWH: Thermal storage losses: Inland	60	W/h at 150 liter
EWH: Thermal storage losses: Inland	60	W/h at liter
Thermal energy losses: Coast	Add 10	%

(Ministry of Mines and Energy 2005)

The inflation rates for the last years were; 3.9% (2004), 7.3% (2003), 11.3% (2002), 9.3% (2001), and 9.2% (2000).

It is assumed that the main water consumption in a domestic household is for showering or for bathing. Hot water consumption is estimated at 30-liters/person/day for a middle-income household (20 liters for a low income and 40 liters for a high income/person/day). This estimation relies on assumptions and experience data. The model used also differentiated between inland and coastal towns through levels of irradiance and through cold-water inlet temperature. (Ministry of Mines and Energy, 2005)

Tables 5 and 6 show the electricity tariffs of Namibian towns from 2004/05 and the anticipated tariff escalation throughout the 15-year life cycle of the solar water heater systems.

Table 5. Electricity Tariffs for some of Namibia's Towns (2004/05)

Town	**Energy charge (c/kWh)**	**Fixed charge: 25A (N$/month)**
Gobabis	71.15	40.65
Katima Mulilo	50.00	56.25
Keetmanshoop	61.00	50.00
Khorixas	31.00	24.25
Luderitz	50.82	60.45
Mariental	39.40	29.93
Okahandja	35.00	86.00
Ondangwa	61.00	50.00
Oshakati	54.71	65.00
Otjiwarongo	41.25	104.45
Outjo	56.00	61.75
Rehoboth	43.28	45.38
Rundu	61.00	50.00
Swakopmund	44.00	97.20
Tsumeb	63.66	73.45
Walvis Bay	45.16	64.79
Windhoek	30.95	125.85

(Ministry of Mines and Energy 2005)

Table 6. Scenario of Anticipated Real Electricity Tariff Escalation

Year	Tariff escalation (%)	Compounded tariff escalation (%)
1	2.0	2.0
2	5.0	7.1
3	5.0	12.5
4	5.0	18.1
5	4.0	22.8
6	3.0	26.5
7	2.0	29.0
8	2.0	31.6
9	2.0	34.2
10	2.0	36.9
11	2.0	39.6
12	2.0	42.4
13	2.0	45.3
14	2.0	48.2
15	2.0	51.2

(Ministry of Mines and Energy 2005)

Results:
The LCC breakdown is shown here for two SWH systems as well as for a normal EWH system:

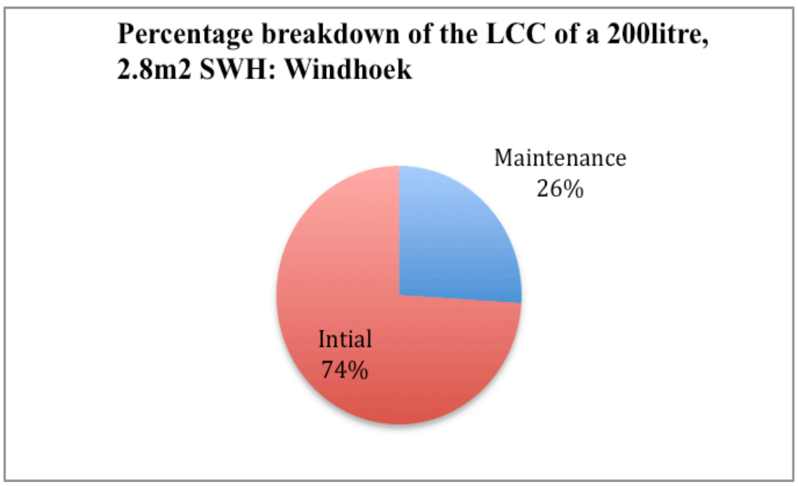

Figure 3. Percentage Breakdown of the LCC of a 200-liter, 2.8m2 SWH: Windhoek (Ministry of Mines and Energy, 2005)

The back-up element will not consume any significant electricity in this scenario and therefore has zero operating costs since the collector area is sufficient for the water consumption requirements. In case a smaller SWH is selected for the same operating conditions, the electrical back-up element will start consuming electricity, especially during winter. This is shown for a 180 liter SWH with a 2m2 collector in the following graph. In this scenario, the operating costs make up 16% of the total LCC of the system. (Ministry of Mines and Energy, 2005)

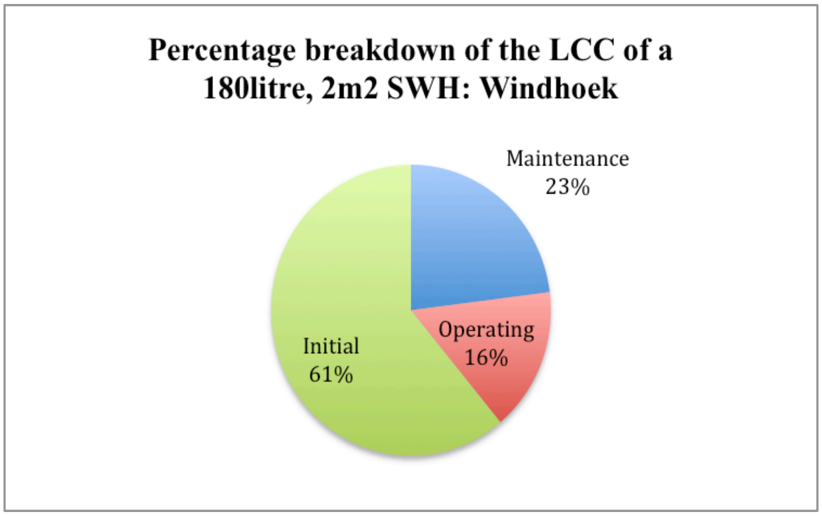

Figure 4. Percentage breakdown of the LCC of a 180-liter. 2m2 SHW: Windhoek (Ministry of Mines and Energy 2005)

In both scenarios, the initial cost makes up the bulk of the cost of the SWH system: 74% in scenario 1, and 61% in scenario 2.

In case of the EWH, the operating cost represents the bulk of the service costs, while the initial capital cost is small compared to the SWH systems.

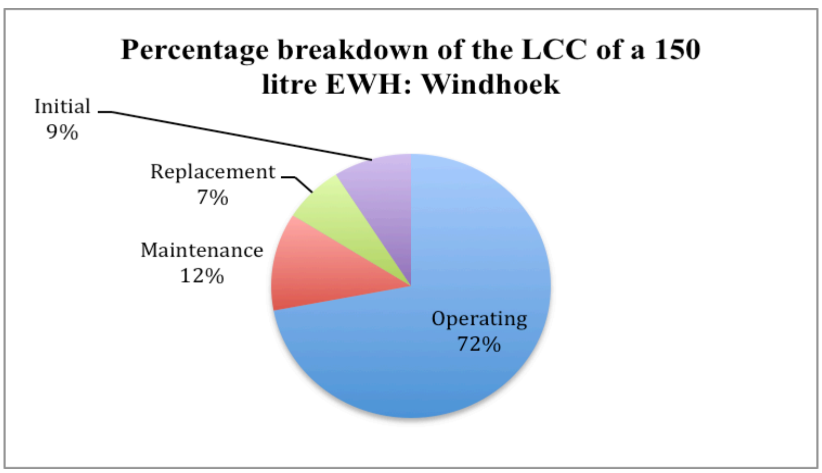

Figure 5. Percentage breakdown of the LCC of a 150-liter EWH: Windhoek (Ministry of Mines and Energy 2005)

Almost three quarters of this systems cost comes from the operating costs in this scenario. Hence, the LCC of the EWH is particularly sensitive to the tariff. (Ministry of Mines and Energy, 2005)

Table 7. Life cycle cost for SWH and EWH on pre-payment tariff for a 5 Person middle-income household (years to the breakeven point included)

Town	Pre-payment tariff	LCC of SWH (N$)	LCC of EWH (N$)	Breakeven year
Gobabis	87.06	18,497	54,203	3.5
Tsumeb	82.83	18,557	52,148	3.7
Outjo	77.00	18,510	49,220	4.0
Swakopmund	65.00	18,510	47,976	4.1
Luderitz	63.25	18,603	47,051	4.3
Oshakati	65.69	18,603	43,676	4.7
Rehoboth	65.15	18,497	43,328	4.7
Walvis Bay	55.00	18,510	42,287	4.8
Windhoek	61.18	18,312	41,217	4.9
Ondangwa	62.00	18,603	41,845	4.9
Rundu	62.00	18,603	41,845	4.9
Katima Mulilo	62.00	18,620	41,858	5.0
Keetmanshoop	61.00	18,557	41,313	5.0
Mariental	47.10	18,510	34,379	6.4
Khorixas	37.00	18,557	29,401	8.2

(Ministry of Mines and Energy 2005)

Based on these numbers it can be concluded that even though the initial costs of setting up a SWH are much higher than those of Electric Water Heaters, the users that opt for SWH systems stand to save significant amounts of money in the long run (Ministry of Mines and Energy, 2005). In Gobabis and Tsumeb the breakeven point would be reached after about 3 and half years. However, it would take more than six years for systems installed in Mariental and Khorixas to reach theirs. The overall cost savings over the 15-year life cycle of the SWH systems can be seen in Graph 6. Systems installed in Gobabis, Tsumbe, Outjo and Swakopmund would end up saving the end-user as much as 30,000 N$ or more.

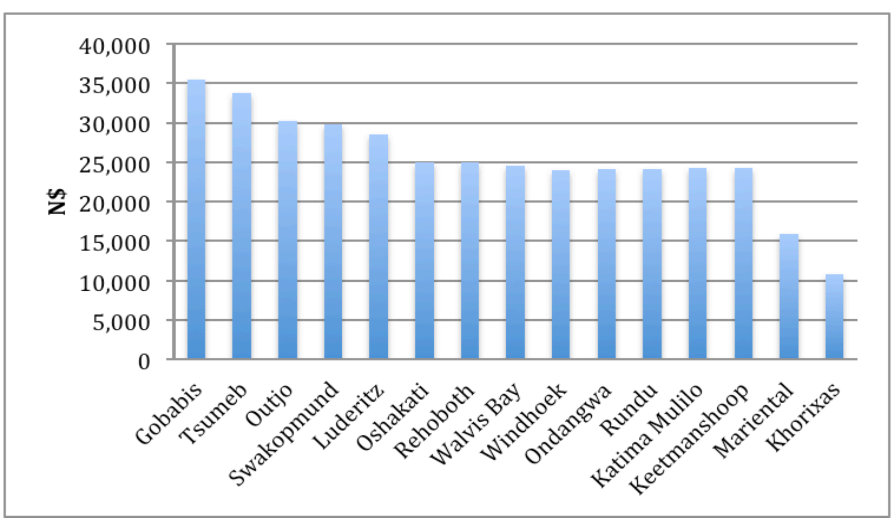

Figure 6. Savings of SWH-users per household after 15 years (Ministry of Mines and Energy 2005)

5.8.8 Conclusion of solar power

The use of solar power has been established and solidified in Namibia and has the potential to be the most significant energy resource in the future. It has already provided energy to thousands of people who couldn't be reached with any other method of energy generation. As the study done on the feasibility to replace electric water heaters with solar water heaters demonstrates, small-scale installations have already cut costs of energy consumption and improved the environmental effects. Large-scale solar power generation technologies have had difficulties in the transportation and grid-connections but should be a feasible option as soon as a few technical adjustments are made. Suppliers of solar energy need to improve their communication-, marketing- and advertising skills in order to provide a better, more understandable package for the customers and hence improve their position in the energy sector.

5.9 Conclusion of renewable energy

This chapter discussed the different types of renewable energies and their current status as well as future possibilities in Namibia. What seemed to be an occurring theme with most types is that the ultimate potential of them remains unknown until on-going and further studies are completed on their feasibility in the country. Still, Namibians seem to be serious about using renewable energies and working towards cutting out the most harmful ways of generating energy (environmentally). This is evident in the directives and policies the government has set in recent years and the overall growth of the field. In addition, all additional sources of energy are welcomed in a country that imports half of its energy and might face power shortages as soon as 2013.

6 CONCLUSION

This paper examined Namibia as a business environment, the current energy situation in the country, as well as the future possibilities and potential for renewable forms of energy. While the reader most likely has a good idea of the market and its possibilities after having studied the previous chapters, the author will conclude the report with a few recommendations. These recommendations are targeted to Finnish SMEs looking to expand their businesses by penetrating into new markets.

6.1 Recommendations

Finland and Namibia signed an Agreement for Promotion and Protection of Investments in 2005 and Finnish companies now have a possibility to utilize international trade agreements. The Ministry for Foreign Affairs of Finland describes competition in the Namibian market as minimal, although increasing (Ministry for Foreign Affairs of Finland 2012). There are currently very few Finnish companies and/or investments in Namibia. Finns have had a presence in the country for decades. The first Finnish missionaries actually arrived in Namibia more than 140 years ago and from my own experience Finns are found to be likeable and trustworthy by the locals. Finnish/Namibian history and current relations are an opportunity that Finnish SMEs should take advantage of if they want to penetrate the renewable energy market in Namibia.

As discussed in chapter 5, biomass is a form of renewable energy that has a huge potential in Namibia. Invader bush is a very promising resource that can be turned into an energy source in heavy manufacturing plants. Multi-million dollar investments have already been made in the field by Schwenk Group, a German construction company (All Africa 2011). Based on this research, the market is not oversaturated yet and professionals in the field should be able to find an opening in it.

Namibia is a very arid country with limited water resources. While an old water reserve was found recently that experts speculate might meet the country's water demand for the next four centuries, nothing is certain. In an extremely dry area where water is scarce, several parties are going to be interested in exploiting the newly found resource and it can be almost guaranteed that the water will not be utilized with the citizens' best interests in mind (Daily Mail, 2012). Companies that provide services such as turning solar power into water will find a great demand in Namibia. With the right business model and local connections, Finnish SMEs could be very successful here. Companies that provide technology and products for the aforementioned purpose will most likely find a good market share as well. While the solar energy market is the most saturated and competitive, there is still a lot of room for companies with innovative systems that range from small units to grid-connected installations in size. Being able to provide high-quality solar panels at an affordable price to replace of low-quality models manufactured in China might be reason enough to test the market.

The key for success lies in understanding the local market and finding the right people to do business with. The business culture in Namibia is quite different from the one in Finland, yet much closer to the European culture compared to several other African countries. This will make the transformation a bit easier but there is no doubt that having a trustworthy representative or a consultant in the country would help there to a great deal. There are solid opportunities in the renewable energy market in Namibia, and with the right tools and further research Finnish SMEs may find great success in it.

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