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Solving the energy challenges in Adado, Somalia

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Electricity remains one of the fundamental factors that facilitates the economic growth and development of any nation. This thesis, *Solving the Energy Challenges in Adado, Somalia* is written to identify the cause(s) of unreliable and unaffordable electricity in Adado, a suburb in Somalia, and to suggest a functional solution to the problem that has been affecting individuals, firms and the environment of the Adado community. It is almost impossible to write about solving electricity problem in Adado without relating it to Somalia because solving the electricity problem in Somalia is tantamount to solving the electricity problem in Adado and other communities in Somalia.

The project is an on-going project of Solved- Cleantech Company. Professor Jaffar Jimale and Adado Electrical Company both based in Somalia provided all the needed information about the Adado community, and its electricity situation. Personnal research was also done to complement the provided information.

The first three chapters of the thesis focus on the present conditions (electricity players, grid, consumption etc.) of electricity in Somalia in general and identifies the main challenges of electricity in the country.

The fourth chapter of the thesis focuses on the electricity situation in Adado and highlights the challenges of electricity in the Community.

In conclusion, the thesis suggests that a system that can combine more than one type of renewable energy source would be ideal for the situation in Adado.

Keywords	energy, renewable energy, energy production, Adado, Somalia, solar energy, stand-alone grid connection, nocart power system

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1 INTRODUCTION

The role of energy cannot be underemphasized in the economic development of a nation. The continuous access to energy provides numerous benefits to a nation: transportation, home appliances and illumination, suitability of indoor temperature, and health facilities. Commercial and industrial activities require a certain amount of energy to function properly. In a nutshell, undisruptive access to energy (electricity) makes life worthy of living to everybody. [2]

Over the years, the demand for energy has increased due to growth in population as well as in industrial and human activities, and in some geographical locations due to weather. Fossil fuels account for almost 80% of the total energy generation [2]. The generation and consumption of fossil fuel has raised serious concern on the sustainability nature of fossil fuel, as well on the emissions that are associated with the consumption of fossil fuels. Meeting the energy requirement of the populace, sustainability of energy and environmental protection are interconnected challenges that require urgent actions from both the producer of energy and its consumer.

The issue of energy challenge can be said to mean access to affordable energy (electricity) supply, which has little or no negative impact on the environment at large [3]. Just like most cities in the world, the city of Adado (Somalia) is also confronted with the challenges of energy security. As it is today, it is really challenging both to the government and to private organizations to provide a sufficient amount of energy to meet the needs of the continuous growing population and sophisticated ways of living, and to reduce greenhouse gas emissions at the same time.

The aim of the thesis was to identify problems confronted by the energy sector in Somalia and to suggest a viable, functional and affordable renewable energy system for the city of Adado and the entire Somalia.

These objectives were achieved by consulting with Adado Electrical Company, which is responsible for energy production or generation in Adado community. Energy professionals within and outside Somalia were also consulted, a personal research was done.

2 BASIC INFORMATION ABOUT ADADO

Adado is one of the districts or subregions in the Federal Republic of Somalia. Adado, also called Cadaado is located in the Galguduud region, south central of Somalia. Adado Town used to be the capital of Himan and Hebb (an autonomous region in the Federal Republic of Somalia), for economic and security reasons [4].

Himan and Hebb region amalgamated with Galmudug region to form the new Galmudug region in 2014 [4].

Adado is bordered by Galcayko in the north, Red Sea in the East, Dusambareb in the South and Abudwak in the West [5]. The geographical coordinates of Adado are 6°08'25"N and 46°37'32"E [6]. Figure 1 (Map of Adado) demonstrates the geographical and topographical structure in Adado.

A larger percentage of the landscape of Adado is sandy, while about twenty percent of the landscape is rocky. Adado experiences four seasons in a year: drought season (January- March), long rainy season (April- May), winter season (June – July) and short rainy season (November- December) [5].

There are 140 villages within the Adado district; with a total population of 395,051. The main economic activities in Adado district are pastoral farming, fish farming, petty trading, transportation and crop farming [5].

The roads networks in Adado are generally bad. The first main road is within Adado town, and it covers 70km. The second road runs between Da-heer to El nuur and it covers 380 kms. There are four hospitals in Adado town, three of the hospitals are privately owned, while one hospital is government owned [5].

The people in Adado are not really literate, which can be attributed to the fact that the whole Adado has only seven elementary schools, with only a few qualified teachers. The schools are always empty due to the poverty level and lifestyles in the town [5].

Adado town has been confronted with numerous challenges among them are electricity, water sanitation, poor health condition, security etc. Despite all the challenges confronting Adado, the town is still blessed with natural resources: salt in Hinlebi, stones in Godinlabe and forest resources forests in Kahando and lidole clusters [5].

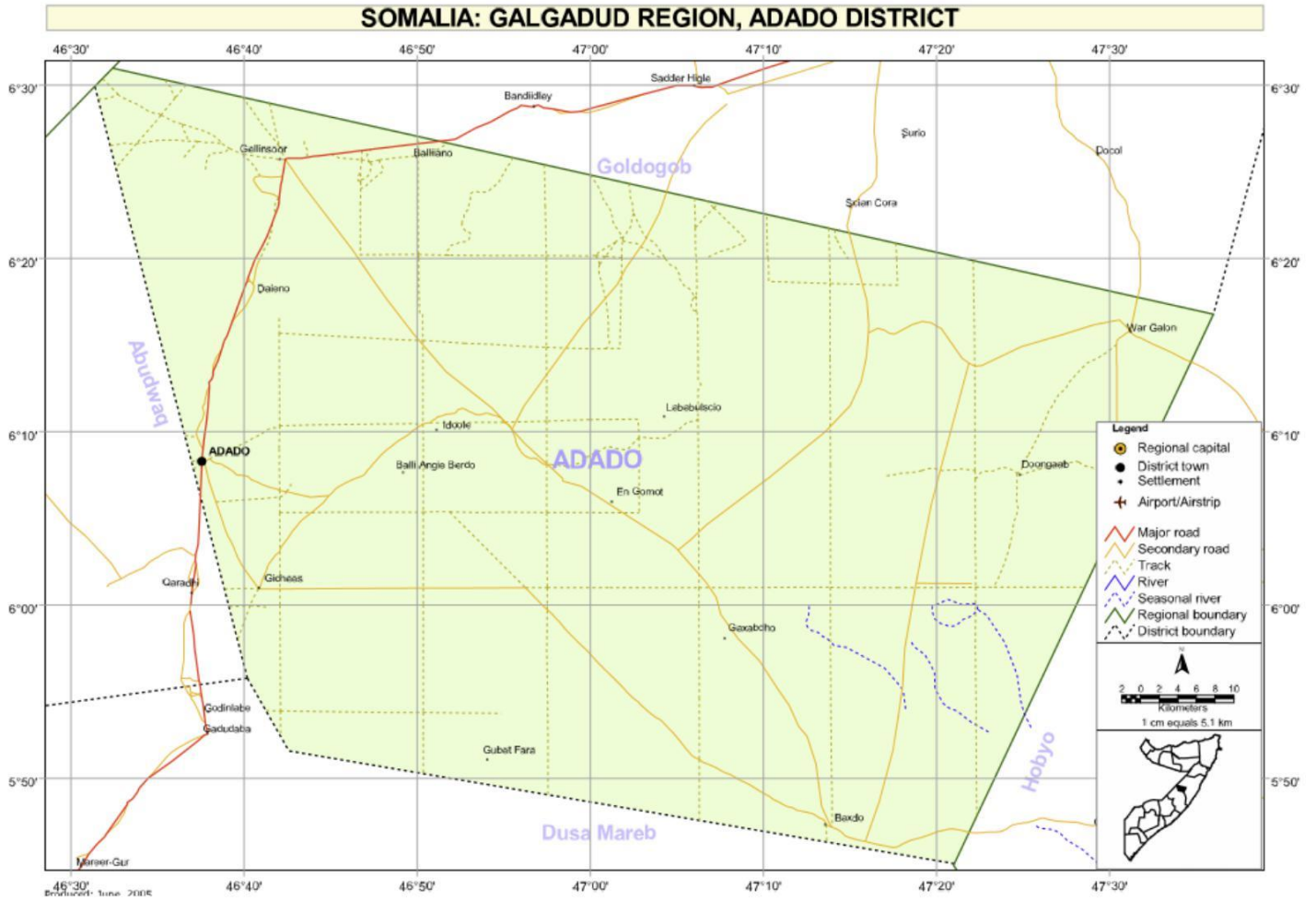


Figure 1 Detailed Map of Adado town [7]

3 INTRODUCTION TO SOMALIA

The Federal Republic of Somalia is a country located in the eastern part of Africa (Figure 2). Until 1960, Somalia was under the British and an Italian protectorate. In 1886 the British reached a protectorate agreement with northern Somalia, while the Italian became protectorate with the eastern Somalia in 1889. [8, 9]

Mogadishu is the capital of Somalia and its largest city. The country is sparsely populated with an average population of 10, 616, 380, and a total area of 637,657 square kilometre, with a geographical coordinates of 10 00 N, 49 00 E .The country is boarded by Ethiopia in West, Kenya in the southwest and Djibouti in the northwest. River Shabelle and river Juba are the main rivers in Somalia. [8, 9]

The economy of Somalia centres around livestock production, which accounts for 40% of the country's GDP. Telecommunication and money transfers are other economic activities in Somalia. In 2014, the GDP (purchasing power parity) of Somalia was estimated to be \$4.431 billion. Electricity production and consumption in Somalia was estimated to be 315 million kWh and 293 million kWh (2012) respectively [8, 9].

Every country has its challenges, Somalia is not an exception, the country has been facing civil war for some time [9] and it is also experiencing energy challenges.



Figure 2 Detailed Map of Somalia [10]

3.1 Somalia Energy Sector

Somalia is a country that is not blessed with abundant or reasonable energy resources, when compared to some countries. Although, the country has an amount of solar energy, hydropower, geothermal, biomass, and forest cover, but some of these resources (geothermal and to some extent hydropower) cannot be harnessed for economic value because they are too small and or remotely located [11].

The civil war in Somalia has a damaging effect on general governance in the country, which also transcends to the energy sector of the country [12]. Before the civil war, there was a structure that regulated the generation and distribution of electricity, though

not really functional, but the civil war destroyed all structures that would have facilitated the distribution of electricity to the grid [1].

The present energy sector in Somalia can be said to be a decentralized and a private sector supply of electricity. The private sector or the independent power providers took over the generation and supply of electricity when it was obvious the central government lacked the capacity to generate and distribute electricity to the public and businesses [1].

The operations of the private provider or independent power provider is that they use installed generator (mainly second from Dubai), which is powered with imported fuel to provide electricity for businesses and the public. The private energy provider might not be ideal, but they offer a short term solution in a country in or coming out of war like Somalia. Their advantages include their ability to easily identify and minimize risks associated with business in their immediate environment. They also have the ability to attract foreign investors. The downside of such a practice is that they are usually ineffective and expensive [1].

3.2 Electricity Players or Providers in Somalia

Somalia is presently divided into three main regions- Puntland, Somaliland, and South and Central Somalia. Each of these regions has its own electricity providers and networks, i.e. the responsibility of electricity supply has been decentralized, and transferred to the private sector [11].

Ente Nazionale Energia Electrical (ENEE) is saddled with the responsibility of electricity generation, distribution and supply in the entire Somalia [11].

The Nugal Electrical Company (NEC), formally known as Nugal Electrical power Agency (NEPA) is one of the major players in Somalia. Established in 1971, the company is based in Garowe, Puntland Somalia. The company is saddled with the responsibilities of generating, transmitting and distributing of electricity within a geographical area of Somalia [11].

The National Electric Power Co-operation (NEPCO) was established on the 1st of May 2009. Its responsibility to generate, transmit, and distribute electricity to the City of

Galkaio, Somalia [13]. Other notable electricity providers are the Ethiopian Electric Power Corporation (EEPSCO), which supplies electricity to over twelve towns in Somalia [24]. The Trans-National Industrial Electricity and Gas Company, an amalgamation of five companies, supplies electricity to towns in Mogadishu. [11]

There is also Banadir Electricity Company (BECO), and other numerous electricity providers in sub-regions of Somalia, which generate, transmit and distribute electricity to their immediate environment [14].

3.3 Electricity Challenges in Somalia

Electricity remains one of the factors that shapes the growth and stability of any economy. Affordable and reliable electricity improves the quality of lives of the people, boost local markets, reduces unemployment rate and above all attract foreign investor [15].

According to a report, only 10% of Somali population has access to electricity, most of those who have access to electricity lives in the urban areas of the country. The cost of electricity in Somalia is one of the highest in the world. In a lay man's language, the cost of electricity can be said to be "one euro per light per night", as expensive as the cost is, it is not even reliable [15].

Due to the expensive and unreliable nature of electricity in Somalia, the people have resorted into other sources of energy to meet their daily needs. It was reported that biomass type fuels (charcoal and or firewood) account for almost 87% of Somalia's energy consumption, while petroleum product and electric power account for the rest, 13% .[15].The use of firewood and or charcoal as an energy source has a damaging effect on the environment, as well as the health of the people.

The challenges of electricity in Somalia centres on three main factors [1];

- I. Civil war and its aftermath.
- II. Collapse of the central government, which lead to Independent power provider (IPP) to take over the responsibilities of generation, distribution and supply electricity in Somalia.
- III. Lack of Regulations that controls the activities of the Independent power provider.

Somalia can be said to be a country emerging from almost a decade; long civil war. The civil war had devastating effects on lives and properties in the country. During the civil war, government owned generators and the national grid were destroyed. Although, there have been efforts to replace and or repair the damaged facilities, but the insecurities surrounding the country has been crippling such efforts. [1]

Since the collapse of the Centre government in Somalia, independent power providers (IPP) took over the generation and supply of electricity using their own created grids. Most of the independent power providers(IPP) venture into the business of power generation and supply mainly because their own private companies need electricity to run; after satisfying their own needs, they supply electricity to households[1] .

The energy or electricity sector is presently not regulated by the government; as a result; the sector is lacking the maximum capacity and the wherewithal to control the activities of the Independent Power Providers (IPP).The Independent Power Providers (IPP) take advantage of this gap, and operate in any ways that will favour their businesses, without considering the effects (pricing) on the people, as well as the environment [1].

3.4 Electricity Generation and Consumption in Somalia

In Somalia, biomass accounts for almost 95% of the energy source. This is due to expensive and unreliable nature of electricity in the country. Imported petroleum accounts for almost 3.98% of energy source in Somalia [1].

In an average house in Somalia, the use of electricity for house lighting and entertainment (television and or radio) are the most reason(s) for consuming electricity. A day electricity profile of a sample of some houses shows that a lot of electricity is consumed between the hours of 10:00 and 12:00, and 18:00 and 22:00 hours. [16]

As at 2015, the capacity of the installed electricity generator in Somalia is 80 megawatts (MW) [24]. The net electricity produced as at 2014 is 0.31 Billion Kilo-Watt hours. The consumption of electricity as at 2014 is 0.29 Billion Kilo-watt hours [17].

The production and consumption of electricity in Somalia have been increasing in the recent years; this trend can be attributed to an increase in population and to the quest for enjoyment [16].

The main source of electricity production is through imported petroleum products from abroad. Due to expensive and unreliable nature of electricity in Somalia, people have resorted to the cheapest and reliable source of energy which is firewood and or charcoal.

Table 1 Installed Generators and Capacities from IPPs [18]

LOCATION	OWNERSHIP	NO.* SIZE(KW) OF UNITS INSTALLED
Garowe,Nugal	Nugal Electricity Cooperative	2x280 1x250 1x100
Bosasso,Bari	Somali Tech	3x600
Hargeisa,Woqooyi,Galbeed	Somaliland Electricity Agency	1x1250 3x1500
Gardho,Bari	Somali Tech	2x140

It can be concluded from Table 1 above shows the sizes or capacities of installed generators for different independent power providers (known) and their quantities. From table 1 above it can be concluded that of the known Independent power providers with known data, Somaliland Electricity Agency has the highest generating capacity with 5750KW, while Somali Tech has the lowest with 280KW.

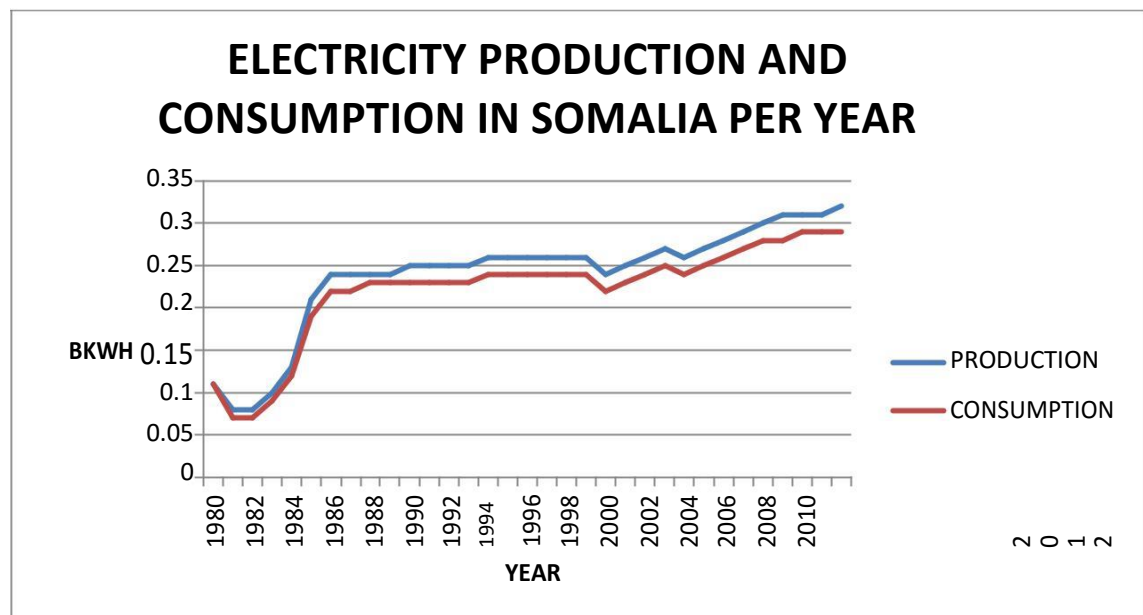
**Figure 3 Electricity production and consumption in Somalia**

Figure 3 above, compares the electricity consumption and production in Somalia. It can be deduced that production slightly outweighs consumption. Electricity is mainly produced through the burning of fossils fuel.

Table 2 Average daily electricity consumption of a household in Somalia [16]

Load Usage	Power Consumption	Time(Hours)	Kwh(Consumption)
TV And Multimedia	250	12	3
Lighting	200	12	2.4
Refrigerator	80	24	1.92
Washing Machine	450	2	0.9
Electronics	150	12	1.8
Iron	1000	1	1
Other Electronics	1500	10	15
Daily consumption of a single house			26.02

Table 2 above shows how electricity is consumed in a typical Somalia house. An average Somali uses electricity mainly for entertainment and for illumination or lightening. A Somali is likely to watch TV and Multimedia for twelve hours in a day, which is equivalent to 3KWH electricity consumption. Electricity is consumed for twelve hours for lightening.

Figure 4 below shows the daily energy profile in Somalia. The highest amount of electricity is consumed between the hours of ten and twelve (10:00-12:00) during the day time and between the hours of twenty and twenty two (20:00-22:00) in the night.



Figure 4 Daily energy profile in Somalia[16]

3.5 Electrical Grid in Somalia

An electrical grid is an interconnected network that connects the supplier or producer of electricity to its consumers. A grid consists of three main components; the generating stations, high-voltage transmission lines and distribution lines. [19]

In the present day Somalia, the national grid barely exists. The existed national grid was destroyed during the civil war in the country. Nevertheless, in some major regional centres, there are 15KV feeders that transfer electricity to load areas via a step down transformer. Electricity is mainly supplied through low voltage distribution lines [18].

The 15KV feeder lines were constructed with either copper or aluminium conductors, attached on poles or wood. The feeders also have insulators and discs for support. A radial distribution system is currently used in the country, a system in which the feeder is used to connect the distributor to the substation at only one end. This distribution system has led to the underutilization of the generators, and loads cannot be shared at peak times [18].

4 PRESENT STATUS OF ELECTRICITY IN ADADO TOWN

Like other districts and towns in Somalia, a private company (Adado electrical company) is responsible for the generation, distribution and supply of electricity in Adado town. There are close to 100,000 people living in Adado. There are 4000 houses in Adado; of the 4000 houses in Adado, only 1700 houses are connected to the grid, i.e. almost 83% are not connected to the grid.[5, 20].



Figure 5 Location of Adado electrical company[20]

Figure 5 above shows the present location of Adado electrical company. The company also have abundant piece of land for expansion.

4.1 Operations of Adado Electrical Company

The company is located at the centre of the town. Like every other Independent Power Providers in the country, the company imports used generators from abroad as well as fuel to generate and supply electricity to the people and companies in the town. The company has three different generating sets with a total capacity of 704KW [20].

The company has eleven members of staff in total; four of them are designated for billing and administration, three of them maintain and service the generators, and the remaining four are responsible for installation and repairs. The others are the operational manager and the CEO [20].

For the distribution and supply system, the company uses six 3-phase feeder lines. Three of the feeder lines are meant to supply power to specific customers including the state house and communication companies. The other three feeders supply the rest of the connected customers and carries different capacity to different loads as follows. [20]

- I. Lighting Feeder line: This particular line is designed to supply power for lighting loads only, and it is activated for use (or switched on) from 18:00 from the generating station. The line is switched off during the day. This means some of the customers have two power lines coming into their premises directly from the power station, and with changeover, they switch from a lighting line to a refrigerator line.
- II. Refrigerator Feeder line: Unlike the lighting feeder line that is switched on in the evening, this feeder line is powered during the day for connected customers to use for their refrigeration needs .
- III. Commercial or Business Feeder line: Most of commercial customers like hotels and restaurants and some well of households are connected to this feeder line which is powered 24 hours each day every day.

However, it should be noted that some customers combine both the lighting feeder and refrigerator feeder into their apartments or premises, and with the aid of an installed changeover they switch from the lighting line to the refrigerator line, or vice versa.

There is also a voltage drop on the feeder line, which increases with the distance from the generating station to the various customers. The table 3 below shows the percentage of voltage drop on these lines. [20]

Table 3 Voltage drop in Adado[20].

Name of Feeders	Length(km)	Voltage drop(%)
Madaxtooyo	2.5	30
Hogol	3	45
Haralay	1.5	25
Kafaalo	3	40
Somtel	1.5	15
Nation	0.5	10

Table 3 above shows the percentage of voltage drop across different feeders in Adado. The rate of voltage drop across different feeders is attributed to many factors.



Figure 7 Changeover box

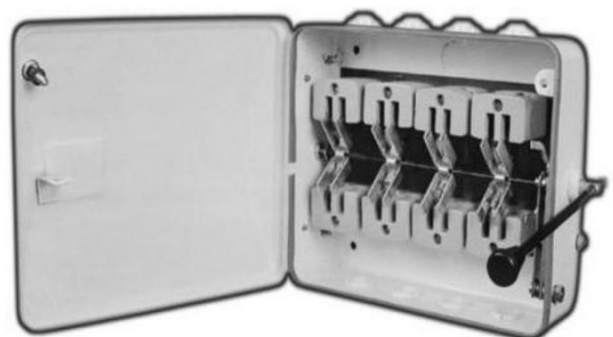


Figure 6 Internal structure of Changeover box

Figures 6 and 7 above show the changeover switch box. The box is used to change from one feeder to another.

Figure 8 below shows the bus bar arrangement of Adado Electrical Company. It is the set up used by company to transfer current to a short distance.



Figure 8 Bus bar arrangement in Adado Electrical Company[20]

4.2 Load Analysis

The electricity supplied by the Adado electrical company to its customers over a day (24 hours) is defined by the type of the feeder (lighting, refrigerating or commercial) that is connected to the customer.

The peak energy consumed is around 93KW, which is consumed during the day, for refrigerating purposes.[20] Electricity is least consumed between the hours of 23:00 and 01:00. At those hours, almost all the private customers are not connected to the

grid. The load analysis helps the company to plan and monitor the distribution and consumption of electricity in the district.

The table and energy profile below shows the electricity data and load curve for a typical consumer in the Adado district.

Table 4 Daily Electricity Consumption in Adado

Hours	Power(KW)
0	40.9501
1	53.99634
2	66.22314
3	57.3172
4	60.63806
5	25.31617
6	53.00439
7	93.91136
8	85.39357
9	93.09193
10	89.01633
11	87.31277
12	88.86538
13	92.31562
14	80.15351
15	87.37746
16	88.04594
17	80.17507
18	56.34682
19	76.16416
20	79.76536
21	76.78952
22	60.3146
23	48.06623

Table 4 above, shows a typical load profile of a household in Adado. It can be seen from the table that electricity is mainly consumed between the hours of 09:00 to 13:00. The consumption of electricity within this period is mainly for business and to a small extent, for private purposes.

Figure 9 shows a graphical illustration of a typical load profile in Adado. It can be deduced that electricity is mainly consumed between the hours 07:00-13:00.

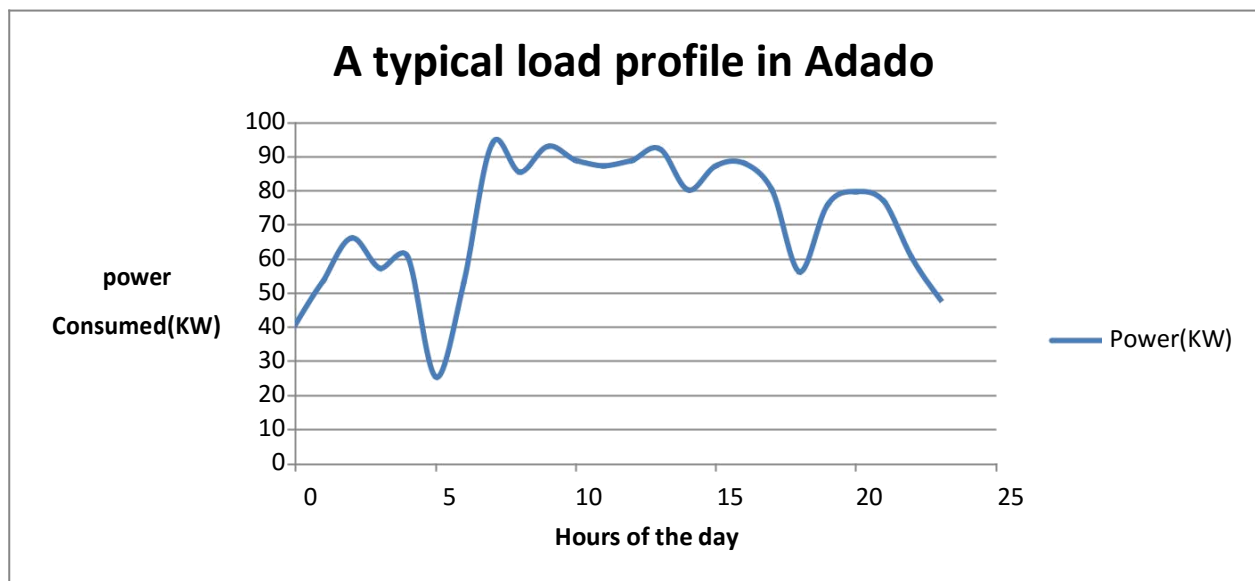


Figure 9 Typical load profile in Adado

4.3 Challenges of Electricity in Adado

After an extensive consultative meeting with the stakeholders of electricity in the Adado town, the following were highlighted as the challenges of electricity in the districts [20]:

- I. A larger percentage of Adado residents does not have access to reliable electricity supply, which is due to the expensive cost of electricity in the

town. The fortunate few in the town that have access to electricity pay as high as one dollar per kWh of electricity (1USD/kWh), which is one of the highest costs of electricity in the world.

- II. The location of some houses or residents make it extremely hard for those houses or residents to have access to electricity, due to a voltage drop that occurs during the distribution system. There is an urgent need to find a way or to design a solution for those residents to have access to electricity.

At the end of the meeting, it was concluded that if the two highlighted challenges can be solved, at least 90% of the residents in Adado town will have access to reliable and affordable electricity.

5 SUGGESTED SOLUTION TO THE ELECTRICITY CHALLENGES IN ADADO

Finding solution(s) to an energy or electricity problem is a herculean task, as a number of parameters need to be considered. A meeting was arranged with Adado Electrical Company to enquire the reason(s) for the high price of electricity in the town. At the end of the meeting, it was discovered that the high cost of generating electricity (mainly cost of imported fuel from abroad) account for the reason for the skyrocketing price.

Since the main cause, of the high price of electricity is due to the overall cost of imported fuel from abroad, and the power to influence (decrease) the price does not lie in our hands for now, it was concluded that an alternative source of energy or electricity should be considered.

5.1 Renewable Energy Resources in Somalia

Somalia is a country that is naturally endowed with abundant renewable energy resources. Renewable energy is not even a new concept in the history of the country. In 1940, the UN Trusteeship Administration introduced the water pump which is powered by wind. There is also the Fanoole Dam which cost almost US \$ 50 million. The country has many untapped or underutilized alternative energy resources. [21]

The country has almost 39 million hectares of wooded areas (as at 1985). With the large quantity of waste generated in farm crops, animal waste and marine biomass, this factor makes solid and liquid biomass a very viable renewable energy option. Sustainable production of charcoal is another option that should be considered [21].

The neglected Fanoole Dam in Somalia had the capacity of generating about 4,600KW of electricity, and irrigates 13,000 ha. There were plans to build the Bardheere Dam which has the potential of generating 493 MW [21].

The country is also endowed with enormous amount of wind and solar energy. In a year, the country is blessed with over 3000 continuous amount of high sunlight. The average insolation is 5-7 kWh/ m²/day [1]. The statistics about wind energy indicates that Somalia has a condition that favours the production of energy through wind. The

large area along the coastal line makes wind farm more feasible. The average wind speed of many territories in Somalia is 6m/s [1], which is ideal for electricity generation.

Harnessing alternative source of energy will not only solve the challenges of energy or electricity in Somalia but will have multiple effects both on the economy as well as the environment at large.

5.2 Solar Energy: Stand-Alone Grid Connection (Nocart Power System)

The following factors were considered before finding a suitable solution for Adado;

- I. The system or cost of production of electricity is the main reason for the high price of electricity in Adado
- II. The grid in Adado is not really functional.
- III. Some areas do not have access to electricity due their distances to the grid.
- IV. There is renewable energy potential in Adado and in Somalia in general.

It was concluded that a system that can combine more than one type of energy source, will be ideal for the situation in Adado. Also, due to the unreliability of the grid in Adado and civil disorder in Somalia, the stand-alone grid connection system seems a perfect fit for such a situation. With a stand-alone connection, the functionability of the system does not depend on the functionability of the grid. It only uses the national grid when it is available.

The solution to the present challenges should not be limited to the present problem, and there should also be considerations for the future. It is for the future reason that the suggested solution (solar energy: stand-alone grid connection) has given room or space for other sources of energy.

At the moment, the diesel generator is used to generate electricity in Adado, Solar energy (stand –alone grid connection) has been suggested as an immediate solution. The solar energy can serve two purposes; it can power the whole Adado town on its own or augment the present energy generation method (diesel generator).

In the future, wind energy, biomass and or other source of energy can be also be incorporated into the system.

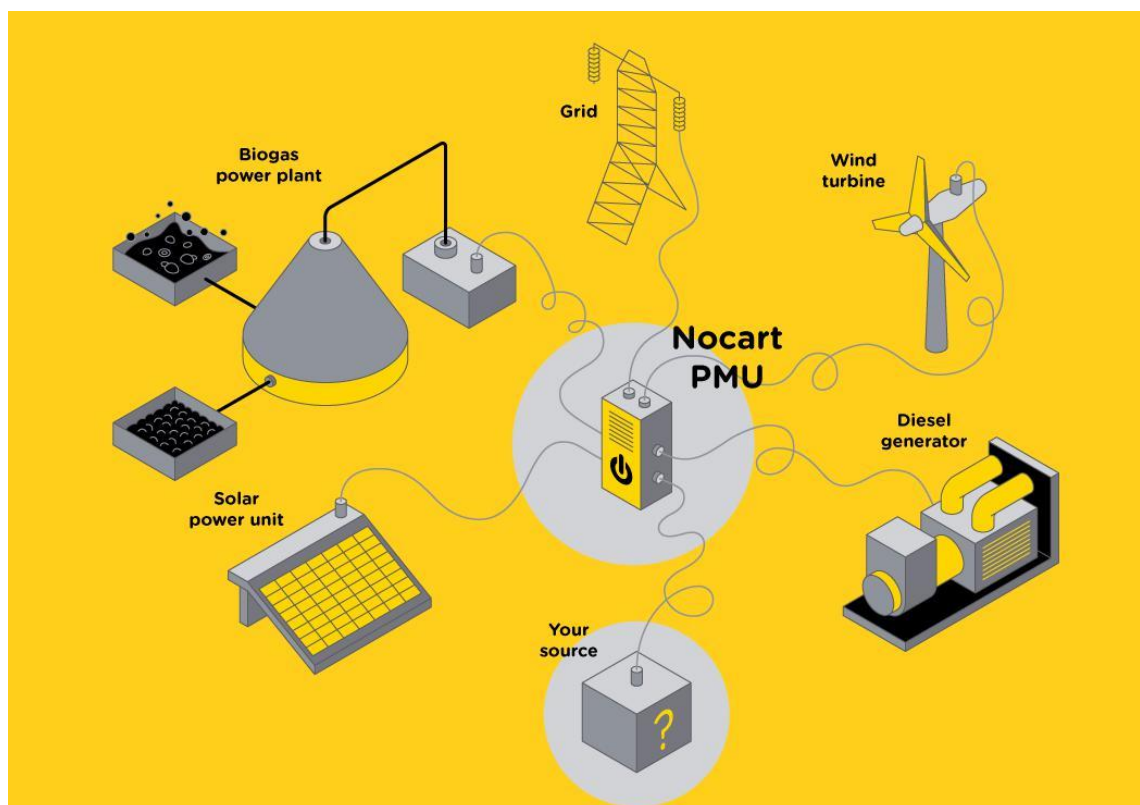


Figure 10 Nocart power system [21]

The Nocart power system is a system that can combine one or more forms of energy or electricity production. In the Nocart power set up, there is an important machine or device called the Power Management Unit (PMU) .The Power Management Unit (PMU) has the ability to work with any renewable energy production and convert it into meaningful electricity for consumption. The device can work continuously for hour, even in harsh or unfavourable conditions [21].

6 CONCLUSION AND RECOMMENDATION

Access to reliable and affordable electricity is one of the fundamental factors that can help in the economic development of any nation. Access to electricity opens and increases productivity, creates more employment and improves the quality of life of people.

This thesis identifies the main challenges of electricity in Adado, and the entire Somalia. It also suggests functional solution to the identified challenges. The independent power providers in Somalia are making efforts to solve the challenges of electricity, but their solution solves little or no problem. Renewable energy was suggested as a viable solution for three reasons: there are traces of underutilize or abandoned renewable energy projects in the country, the country has abundant sources of wind and solar energy and renewable energy also solves the environmental threat caused by the diesel generator which is used by the independent power providers [1, 18].

However, initial investment in renewable energy is huge, and difficult to obtain, most especially in a violent environment like Somalia. This has been the main impediment to implementing renewable energy and the area where the government needs to provide an enabling environment and assure local and international investors of their return.

The energy or electricity sector needs a policy framework or regulations that will guide the operations of the government, the international operators and local operators. There should also be incentive policies that will encourage different investors in renewable energy [1, 18].

Ending the prolonged civil war or civil unrest in Somalia is the first condition and the first problem that must be addressed and solved to achieve any meaningful progress with challenges of electricity in Adado and the entire Somalia.

Before the civil war there were traces of investments in renewable energy in the country; also there were electricity infrastructures provided by the government before the civil war, but all these investments were targeted and destroyed during the civil war.

No matter how functional and feasible a suggested solution is, it will never work in an insecure or violent environment. It is the responsibility of the citizens of Somalia, all stakeholders in the Somalia project, the government, the private bodies and everybody

that is related with the country called Somalia, must come together with one mission, which is ending the age long civil war or civil unrest in the country.

The central government needs to reinvest or attract investors to restore, reconnect, enlarge various electricity infrastructures, and expand the generating capacity as well as investing in renewable energy. This will ensure effective generation and distribution electricity; most especially in the supply of electricity to the remote areas, the problem of voltage drop will be minimized, and the needed electricity consumption can be met [18].

There is a high dearth of skilled renewable energy technicians in the country. It is imperative for both the government and private bodies to organize trainings for interested people in various areas of renewable energy. The people of Somalia should also be sensitized on the benefits of renewable energy.

The government should encourage the independent power providers with incentives such as the feed-in tariff and guarantee loans.

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