JUNGLE POWER ENGINEERING PLC

BUSINESS PLAN AUTOMATIC ELECTRICAL POWER REGULATION DEVICES

BUSINESS PLAN FOR THE ESTABLISHMENT OF A NEW INNOVATION TECHNOLOGY AUTOMATIC ELECTRIC POWER REGULATION DEVICE MANUFACTURING PLANT IN ETHIOPIA

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By 1): Fikadu Diriba (Dr.)

2) Robal Bamelak (Young Innovator)

Phone no. 0915588306

Email: fikadu.drb@gmail.com

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1. Executive Summary

Energy is one of the basic human needs. The Ethiopian government works extensively on hydropower generation. More than 35% of the generated energy is wasted due to a lack of technology in delivering it to the consumer. Most industries in Ethiopia have problems with proper energy use. There is a lack of awareness on the part of the customer that they will be charged for reactive power and pay a penalty for the low power factor. This technology reduces wasted reactive power and provides voltage balancing and harmonic filtering. Automatic Electric Power Regulation Devices is an innovative technology that improves energy use efficiency through technological innovation by using the software design printing circuit board (PCB) and the programming language in C language for machine controlling the devices.

This technology is registered with the Ethiopian Intellectual Property Authority under patent number ETUM1109B1 for industrially applicable Automatic Electric Power Regulation Devices (AEPRD).

Innovative technology will contribute to creating new ideas, creating and developing technology, making and developing technology, creating job opportunities, and saving Energy in the country. The Technology will benefit both the supplier and the consumer.
The profile shows the establishments of an Automatic Electrical Power Regulation Device Industry with a production capacity for the first year in the capacity of 2.2% product are of 30 units of various KVAR ratings

The project's total investment cost including working capital and machinery is **30,000,003.81 Birr** of which **12,620,340 Birr** is required for machinery. When the project is fully operational, it will create employment opportunities for over 30 people. The Innovative Finance covers the financing through a Finance loan. Operating expenses, projected income statements, loan repayment plans, and project cash flow tables are prepared to determine the project's financial viability.

Based on this projection, the project will have a healthy liquidity position and will not face cash shortages throughout its life. The project shows a simple rate of return of 21% and a payback period of about 4.2 years. Generally, these financial indicators indicate that the project is viable and worth investing in.

The data is given from Ethiopian Electric Utility (EEU) the demand of customers is **30,993** from this data the power factor (PF) < 0.75 power factor Customers are **17,236**, and the power factor (PF) < 0.9 customers are **26,620**. From the customer **17,236** Must be installed AEPRD highly mandatory for the customer (high power loss in the systems) and also mandatory to install the power factor below 0.9 as EEU Recommended the customer 26,620 mandatory to installed AEPRD there is a large market in the country.

As Jungle Power Engineering Industry Automatic Electric Power Regulation Devices Manufacturing Company is the first new technology in the innovative technological industry in Ethiopia, will be a profitable technology in the country.

Keywords: AEPRD, PF, EEU

2. Introduction

Electrical energy is essentially required for the industrial as well as all-round development of any country. Growing Energy Consumption, Driven by World Population and Income Growth, will be a Challenging Future for the World in General and Africa in Particular. The growing demand for power for a variety of human activities, and technological industrial innovation, cannot be answered without continuous efforts of exploring better options and application of sustainable energy sources.

In Ethiopia, energy consumption has increased very rapidly in the past few years due to the economic development of the country and the increasing population. To meet the ever-increasing demand for electric energy, the government of Ethiopia is constructing huge hydroelectric power plants and alternative energy sources; however, part of the energy generated is lost not only in the transmission and distribution systems but also at the utilization level. More than 35% of the generated energy is wasted due to a lack of technology in delivering it to the consumer.

Most industries in Ethiopia have problems with proper energy use. There is a lack of awareness on the part of the customer that they will be charged for reactive power and pay a penalty for the low power factor. This technology reduces wasted reactive power and provides voltage balancing and harmonic filtering.

Ethiopia does not have laws or mandates to encourage utilities or government agencies to invest in energy efficiency. However, the Ethiopian Electricity Service to increase energy efficiency among consumers in its demand-side management program, EEE/industries to increase their energy score to 0.9 so as not to be penalized. approximately 80% of customer outages are due to problems in the distribution networks.

The Automatic electric power regulation devices (AEPRD) close the market gap the low-voltage and medium-voltage in customer-side applications. This technology reduces wasted reactive power and provides voltage balancing and harmonic filtering. Automatic Electric Power Regulation Devices is an innovative technology that improves energy use efficiency through technological innovation by using the software design printing circuit board (PCB) and the programming language in C language for machine controlling the devices.

It saves the customer from electric penalties and saves the utility from loss of power so when we think about it the advantage is for both the **customer** and the **provider/supply**. The supply company (EEA and Energy Authority) believes that the tariff will reduce the overall cost of electricity generation and also ensure a return on capital investment. Our country Ethiopia is committed to investing in innovation Idea financing and development by investing in innovative technology. These new technological processes and services, achieve high results for the country's growth and prosperity and increase competitiveness in the African and world markets.

The Jungle Power Engineering PLC works to compete in a highly competitive globalized market by supporting young researchers, innovating and developing technology to bring about rapid technological change.

3. Vision, Mission, Objectives, and Values of the company

3.1. Vision

The vision of Jungle Power Engineering PLC is - To see Ethiopia undertaking coherent technological industry initiatives which eventually lead the country to begin exporting its technologies by the year 2030.

Vision: Be a leading technology innovation industry that stimulates and supports technological innovation to improve the quality of life for all Ethiopians.

"Our vision is the country is no power interruption and no power loss"

3.2. Mission

The mission of Jungle Power Engineering PLC in the industry is to create an innovative and technology industry foundation and to coordinate the national technological capability-building, enhance the competitiveness of the economy, and reduce the technological dependence of the country.

3.3. Objectives

The main objective of the proposed Automatic Electrical Regulation Equipment is to reduce energy loss, reduce energy costs, and improve energy efficiency. As energy represents the largest cost of production in the industrial sector, reducing energy waste is critical to a company's success in building capacity and increasing production and productivity.

The electric power customer pays the utility for the power it provides to the company for carrying excess reactive power; the customer pays a penalty for a low power factor. This customer's use of automatic electrical Power equipment will reduce costs and thus increase profitability.

3.4. Values:

- ✓ Teamwork,
- ✓ Professionalism:
- ✓ Excellence:
- ✓ Integrity:
- ✓ Transparency
- ✓ Innovation.

4. Scope

The scope of the study will be to conduct feasibility studies on technological innovation opportunities in industry and investment and business areas in the country. Based on this business plan, the investor decides to invest in the project and request financial support from lending banks.

This feasibility study includes the improvement of energy efficiency, in terms of cost savings, providing several benefits; It should also involve increasing productivity competitiveness and investment in many areas.

The compliance generates income (profit) for the owner, to transfer technological knowledge, and produce and provide quality products to the customers. This innovative automatic power management system addresses energy demand, supply gaps, and energy loss problems in industries in general, with a particular focus on energy efficiency

5. Background of the Promoter

The Jungle Power Engineering PLC is a new technological innovation industry. The company which will supply new technology automatic electric power regulation devices is located in Addis Ababa.

Innovation is a key driver of economic growth and prosperity. In the future, the creation of the Jungle Power Engineering PLC is the Industry must fulfill various key tasks: investing in innovation, increasing our country's economy, accelerating our country's technological competitiveness, increasing our country's innovation, and developing a broad technology industry, creating a wide range of employment opportunities, and making Ethiopia a high-paying job.

5.1. Staff

Jungle Power Engineering Industry is manufacturing AEPRD and has planned to have 30 employees including 18 engineering technicians (5 Electrical engineers, 2 Software Engineers, 2 computer engineers 5 Mechanical engineers, 2 material engineers), and 5 innovators. All the employees work with certificates after strict training assessment and have independent production operation capacity. All the engineering technicians have accepted senior professional education, had abundant working experience, and made prominent contributions to our products' development, design, production, marketing, and other aspects. With efforts and cooperation of front-line staff and R&D personnel, our company constantly develops user-satisfied qualified products through increasingly strong technical force, winning good praise from users.

5.2. Scale

The Jungle Engineering Industry covers an area of 30,000 M2 hectares and a plant area of 12,300 m2.

The Jungle Power Engineering Industry produces technology that benefits the country. Technology is the foundation of our country's development and job opportunities. Next, our country will have its technology brand. The industry produces innovative technologies. It will export the latest technological products to Africa and other countries.

5.3. Name and Legal Status:

The new company's proposed name will be "Jungle Power Engineering PLC" Automatic Electric Power Regulation Equipment Manufacturing Industrial". Ethiopian inventors will find a company with extensive experience in the industrial sector and research. The forest engineering industry is an organization established by new technology innovators, owners, and researchers, and it enables the supply of products to the local market and neighboring African countries.

5.4. Profile of the Company

Table 5.1- profile of the company

Name of entity	JUNGLE POWER ENGINEERING PLC
Office Address	Addis Ababa, Ethiopia
Project site	Addis Ababa, Ethiopia
Managing director	FIKADU DIRIBA (Dr.)
Nationality	ETHIOPIA
Contact person	FIKADU DIRIBA (DR) and ROBEL BAMELAK (YOUNG INNOVATOR)
Designation	General manager
Type of Economic Activity/Project	Setting up a manufacturing plant for the production of automatic electric power regulation devices
Legal form of business	New
Status of the business	New project
Registering Agency	
Licensing Agency	
Permit No. & Date	

5.5. Analysis of the Business Environment

Electrical power is the most common and widely used in industries energy accounts for the highest share of production cost.

a) Some Macro Economic Indicators and The Policy Environment

One of the determinants for private investment in one particular country is the macroeconomic stability of the economy. Socio-economic development makes energy an indispensable resource. Measures to reduce energy economic growth in one country. Green energy should be the policy of the environment in one country.

b) Country Profile

Ethiopia is the second largest populated country in Africa after Nigeria with a population of over 120 million people. About 84 percent of the population lives in the rural areas driving its livelihoods from subsistence agriculture, and 16 percent live in urban areas. We indicate the effective family plan campaign conducted in the country.

c) Macro-Economic Performance of the Ethiopian Economy

There has been a major departure in the exchange rate against the dollar. At different times, the government devalued the domestic currency (Birr) against foreign currency. Macroeconomic stabilization measures implemented by the Government in the past years have generally yielded improved performance in the economy.

d. Economic Importance of Power Factors and its Power regulating to Electricity Consumers/ Utility Companies

Power factors and hence, Automatic electric power regulation devices (AEPRD) are important because they attempt to adjust the reactive power to control the system voltage in a transmission network. It is applied by power utilities to improve the stability and efficiency of the transmission network or could be installed by individual customers to reduce the costs charged to them by electricity suppliers. efficiency is not only good for the environment but also profitable for industries.

6. Market study

6.1. Overview

In the present technological revolution, power is very precious. So, we need to find out the causes of power loss and improve the power system. The electricity service provider offers its own energy prices to different users and customers. The tariff which considers the current market conditions, electricity service charges for demand, power, service charge, and power factor penalty.

According to Ethiopian Energy Authority Tariff Guideline and Methodology, December 2018 For Grid Power supply

According to the Article 42. Power Factor Penalty

The current end-user tariff structure includes a power factor payment for high and low-voltage consumers (for the interconnected and self-contained system) and is denominated in Birr/month. Since industrial consumers are on three-part tariff charges, (i.e. Energy, Demand, and Service Charges), the lagging power factor costs should be recovered through the Demand Portion of the tariff. In order for the large power users to be incentivized to operate close to the system benchmark value of 0.9 lagging, a power factor penalty payment should be introduced, by using a transparent formula to compute the power factor payment. This approach is presented below.

Article formula from EEU and Ethiopian energy utility

Article 43. Power Factor Payment Formula

The Power Factor penalty payment can be calculated using the following equation:

Power Factor Penalty Payment =

Power factor penalty payment = KVA * $MD_{REC} * [\mathbf{0.95/PF_{AVG}}] \mathbf{-KVA}$

Power factor penalty payment = KVA *[$MD_{REC} *[[\mathbf{0.95/PF_{AVG}}]$ -1]]

where:

KVA = Demand Charge (Birr/KVA/month), as set by EEA as part of the tariff;

MDREC = Recorded Maximum Demand over the billing period (KVA)

PFAVG = Consumer's average power factor during a billing period (i.e. month)

Industrial, LV, MV, HV

Energy tariff: Birr/KWH,

1) Energy Tariff: Birr/KWh: Non-TOU customers

2) Demand Charge: Birr/KVA (IBT Tariff Structure)

3) Fixed service Charge: Birr/Customer

4) Power Factor Payment (as a function of KVA)

6.2. Demand analysis

The process demand analysis of using technology takes a serious look at energy use. By evaluating the customer's energy consumption from total energy cost, reactive power charge, demand charge, and low power factor penalty it shows current energy efficiency and status. The national benefits of using the technology are numerous as it increases the profitability, efficiency, and productivity of your customer's energy use. The document presents a feasibility study of energy management and audit effectiveness for various customers using this technology.

6.2.1. Demand analysis of customer Walia Steel Industry

ELECTRICAL ENERGY AUDIT OF WALIA STEEL INDUSTRY: By Getachew Adane, Advisor Dr. Yilma Tadesse, November 2020 Addis Ababa, Ethiopia,

As the energy demands rise, it becomes imperative to save energy in all fields in which it is used therefore the subject of energy conservation is a big concern for industries in general and steel industries in particular where energy is intensively used but not properly managed. When it comes to the energy usage of Walia Steel Industry the inefficient energy usage of the factory can be seen from the average power factor value of 0.48, its poor monthly average load factor of 31.80%, high specific energy consumptions as compared with international benchmarks, under-loaded motors, transformer, and cable losses, oversized installed capacities of distribution transformers and from the monthly average penalties power factor and maximum demand which is of **81,564.67ETB.**

From the detailed audit replacing the under loaded motors with the proper sizes of motors can save **705,210.25ETB** annually, and by correcting the power factor of the system and reconfiguring the network the energy loss has decreased by 69.1% and the annual cost saving of **167,690.43ETB** can be gained from the avoided loss from avoided demand charge is of 84,253.80ETB and from the avoided power factor penalty is **2,835,000.00ETB**. Finally, to

mitigate the energy inefficiency of the factory resizing the motors and installing power factor correctors in the power system of the factory has been recommended.

Table 6-1 Electrical Energy and Penalty Costs Break Down (April 2018-February 2020)

Month (Billing Period)	Monthly Energy Cost (ETB)	PF Charge (ETB)	Maximum Demand Cost (ETB)	Total Electrical Energy Cost and penalty
Dec 2019	65,307.60	47,089.31	49,794.75	162,191.66
Janu 2020	82,956.60	86,330.41	91,290.38	260,577.39
Feb. 2020	108,108.00	120,288.93	132,786.00	361,182.9
Total	1,400,629.40	996,075.05	829,912.51	3,276,616.93
Average	60,896.93	43,307.61	36,083.15	142,461.61
Percental (%)	Real Energy Cost (ETB) 43%	PF Charge (ETB) 32%	maximum Demand Cost (ETB) 25%	100 %

From Table 6-1, it is observed that the monthly average electrical energy cost was 142,461.61ETB; of which 60,896.93ETB was the monthly average real energy cost, 45,481.52 ETB was the power factor penalty cost and 36,083.15ETB was the maximum demand penalty cost thus the factory was paying 81,564.67ETB monthly on average for penalty of inefficient energy usage which is 57% of the monthly average electrical energy cost and annually paying **978,776.04ETB** for penalty only.

Table 6-2 Monthly Energy Consumption from EEU Grid Data

Month (Billing Period)	KWh	KVARh	Maximum Demand (KW)	Power Factor	Cost per KWh	Monthly Energy Cost	PF Charge	Maximum Demand Cost	Total Electrical Energy Cost
Dec 2019	108,000.00	207,000.00	1350	0.46	0.6047	65,307.60	47,089.31	49,794.75	162,191.66

Jan 2020	108,000.00	207,000.00	1350	0.46	0.6047	82,956.60	86,330.41	91,290.38	260,577.39
Feb 2020	135,000.00	252,000.00	1800	0.47	0.8008	108,108.0 0	120,288.9 3	132,786.00	361,182.93

The poor energy performance can be evidenced by the PF (power factor) and the loading factor values and that is why the PF (power factor) charge (reactive energy cost) and maximum demand charge costs are greatly affecting the monthly electrical energy cost of the factory almost in all the months.

Conclusion: The Walia Steel Industry's customers need an analysis of the benefits of using technology.

Using this technology in the steel industry will increase productivity, efficiency, and cost-effectiveness.

- For as EEU decided the bills of energy from this billing of the medium voltage industry tariff as of Dec. 21 onward birr/kwh

  1) flat rate 1.1930birr/ kWh and

  2) demand charge rate 147.54 birr/kwh

We take that the industry works for 24 days per month, and 10 hours per day and an Average of

- Active power (kWh)=135,000
- Reactive power (KVARh)=252,000
- And apparent power (KVAh)= 285,882.84
- Power factor =0.47
- Active power in KW = (135,000/ (24*10)) = 562.5
- Reactive power kVAR = (252,000/ (24*10)) =1050
- Apparent power KVA = (285,882.84/ (24*10)) =1191.1785

Power factor penalty payment = KVA *[MD_{REC} *[[0.9/PF_{AVG}] -1]]

When improve power factor to 0.95

- ✓ Before power factor correction

- Late P_1 = 562.5KW

Q_1 = 1050KVAr

S_1 = 1191.1785KVA

$\text{Cos}\,\Phi_1$ = 0.47 from this Φ_1 = 61.965°

- ✓ After power factor correction

$P_2 = P_1$ = 562.5KW

$\text{Cos}\,\Phi_2$ = 0.95 from this Φ_2 = 18.194°

$S_2 = \frac{P2}{\text{Cos}\,\Phi_2} = \frac{562.5KW}{0.95}$ = 865.384KVA

$Q_2 = \sqrt{{S_2}^2 - {P_2}^2} = \sqrt{865.384^2 - 562.5^2}$ = 657.634KVAr

The difference power consumption after power factor correction and saving

Reactive power (ΔQ) = $Q_1 - Q_2$ = 1050KVAr - 657.634KVAr = 392.366KVAr

Apparent power (ΔS) = $S_1 - S_2$ = 1191.1785KVA -865.384KVA = 325.794KVA

The total Active power saved = ΔS *($\text{Cos}\,\Phi_2$ - $\text{Cos}\,\Phi_1$)= 325.794KVA * (0.95 - 0.47) = 156.381KW/month

- ❖ LET the installation of the reactive power compensation Automatic electric power regulation devices in this factor from Jungle Engineering Industry 400KVAR the price of 400kvar from the AEPRD in jungle engineering industry **1,110,481.34 birr**

This factor monthly penalized and cost saving 241,670.52 and 265,572.00 total of **507,242.52 birr**

Annually the saving the energy 507,242.52*12= 6,086,910.24 birr

From power factor penalized 241,670.52 birr *12 =2,900,046.24 birr

- ➢ Payback= overall costs capacitor banks

Saving per year

= 1.110,481.34/2,900,046.24 = 0.3828*12= 5 month only form power factor penalized

= from over all saving payback 2.5 months

6.3. Real Power and Apparent Power and Power Factor

Active power (also known as "working power") is used in all electrical equipment to perform the task. It is expressed in kilowatts (kW). Apart from working power, inductive loads such as motor, transformer and chokes also requires reactive power to produce a magnetic field to operate. This power which does the not performs any work is called as kilovolt-amperes-reactive (kVAR). Every industry requires both active and reactive power in order to sustain. These two powers together result as apparent power, which is expressed in kilovolt-amperes (kVA). Inductive loads require two kinds of current: Working power and reactive power together make up apparent power. Apparent power is measured in kilovolt-amperes (kVA)

Power factor is the ratio of working power to apparent power. It measures how effectively electrical power is being used. In order to have an efficient system the power factor shall be corrected using power factor correctors of capacitor banks and the value shall be brought a little in excess of 0.9 but shall not be too close to unity, to avoid the leading current in the electrical system.

6.4. Technology of Automatic Electrical Power Regulation Device (AEPRD)

The technology of automatic electric power regulation devices in the system reduces the reactive component of the power drawn by the electrical power, thereby improving the distribution line losses, transformer losses, and motor losses of the industry. As an electric service provider, it removes the penalty due to a lagging power factor. The energy-conserving measures to be implemented in the industry will increase the overall energy efficiency of the industry. To improve the power factor value of the industry by incorporating power factor Use of an automatic electrical power regulation device (AEPRD) to correct power factors could result in significant cost savings for a mid- or large-size primary-metered service customer.

This technology is registered with the Ethiopian Intellectual Property Authority under patent number ETUM1109B1 for industrially applicable automatic electric power.

6.5. Energy efficiency benefits for the customer and the country

Using technology to improve energy efficiency at the plant is a key and rewarding task. The efficiency of most industrial equipment and processing is lower than expected. The electrical industries are highly energy intensive judicious use of energy becomes imperative for developing countries like Ethiopia where power generation requires a huge sum of money for project implementation of generating power plants. Energy efficiency is important for the customer and for the country.

1) Customer: Increased energy efficiency for the customer generally means improved profitability.

2) Country: Energy efficiency provides many benefits to countries; these include improved utilization of national resources, reduced energy supply, improved balance of trade, foreign exchange protection, reduced capital requirements for new energy production facilities, and reduced environmental pollution from energy use and production.

6.6. Technological Benefits of the Customer and Supply

Benefits of installing automatic electric power regulation devices (AEPRD) the customer and supplier

The benefits for installing automatic electric power regulation devices for the customer, for the provider and for over all the country. The benefits that can be achieved by applying the automatic electrical power regulation devices are:

- Environmental benefit.
- Reduction of electricity bills
- Reduction of power consumption due to improved energy efficiency.
- Extra kVA available from the existing supply
- Increased system capacity
- Reduction of (I^2 R) losses in transformers and distribution equipment
- Reduction of voltage drop in long cables.
- Provide of the capacity of electrical power

- Extended equipment life – Reduced electrical burden on cables and electrical components. Reduced heating in equipment, Increased equipment life,
- Reduction in energy losses and operating costs
- Freeing up available energy

6.6.1. Environmental benefit:

Reduced power consumption means less greenhouse gas emissions and fossil fuel depletion by power stations.

- **Reduced Carbon Footprint:** By enhancing energy efficiency, APFC units contribute to lower carbon emissions, supporting environmental sustainability initiatives.
- **Resource Conservation:** Efficient power usage reduces the need for additional energy generation, conserving natural resources.

6.6.2. Reduced electrical utility bills

The benefits that can be gained through improving the power factor of a system:

- ✓ Lower utility fees by reducing peak KW billing demand and eliminating the power factor penalty.
- ✓ Increased system capacity and reduced system losses in the electrical system
- ✓ Increased voltage level in your electrical system and cooler, more efficient motors.

- ✓ **Reduced Energy Bills:** By improving the power factor, APFC units reduce reactive power and thus lower the demand charges on electricity bills. Customers can save significantly on their energy expenses.
- ✓ **Penalty Avoidance:** Many utility companies impose penalties for poor power factor. Using APFC units helps customers avoid these additional costs.

6.6.3. Reduction of power consumption due to improved energy efficiency.

- **Improved Equipment Performance:** A better power factor reduces the burden on electrical equipment, leading to more efficient operation.
- **Extended Equipment Life:** Reduced electrical losses and heat generation prolong the lifespan of machinery and electrical components.

6.6.4. Extra kVA available from the existing supply

Automatic power regulation devices applied at the origin of the installation consist of a controller monitoring the VAR and this controller switches capacitors in or out to maintain the power factor better than a preset limit (typically 0.9). Where 'bulk' power factor correction is installed, other loads can in theory be connected anywhere on the network.

Automatic electric power regulation device corrects power factor in terms of engaging and disengaged the capacitor controlling reactive power and active power.

6.6.5. Increased system capacity

The automatic electric power regulation devices increase system current-carrying capacity. Raising the power factor on a kW load reduces kVA. Therefore, by adding capacitors, you can add additional kW load to your system without altering the kVA.

- **Optimized Capacity Utilization:** By correcting the power factor, APFC unit's free up capacity in the electrical system, allowing customers to add more loads without upgrading their infrastructure.
- **Deferred Infrastructure Investments:** Customers can postpone expensive upgrades to transformers, generators, and distribution systems.

6.6.6. Reduction of (I^2 R) losses in transformers and distribution equipment

Reduced losses: -Losses caused by poor power factor are due to reactive current flowing in the system. These are watt-related charges and can be eliminated through power factor correction. Power loss (watts) in a distribution system is calculated by squaring the current and multiplying it by the circuit resistance (1^2R). To calculate loss reduction % reduction losses = 100 – 100 × (original power factor/new power factor)^2

6.6.7. Reduction of voltage drop in long cables

- **Reduced Voltage Drops:** Enhanced power factor improves voltage stability, leading to fewer voltage drops and fluctuations, which can damage sensitive equipment.
- **Harmonic Mitigation:** APFC units with harmonic filtering capabilities reduce harmonic distortion, improving overall power quality.

6.6.8. Improved voltage conditions

- **Adherence to Standards:** Many regions have regulations requiring a minimum power factor. APFC units help customers comply with these standards and avoid legal issues.
- **Sustainability Goals:** Improving energy efficiency aligns with global sustainability goals and helps customers meet corporate social responsibility (CSR) targets.

6.6.9. Increasing power capacitors in new construction and expansion plans

- **Improved Equipment Performance:** A better power factor reduces the burden on electrical equipment, leading to more efficient operation.
- **Extended Equipment Life:** Reduced electrical losses and heat generation prolong the lifespan of machinery and electrical components.

6.7. Industrial Sectors

Ethiopia's industrial sectors are classified into four basic groups: agriculture, food processing, construction, resources and energy, and tourism. Agriculture constitutes over 50% of the economic sector in Ethiopia, and the largest dependable economic activity. It includes the production of livestock products (milk, egg, meat), beverages, leather, and textiles industry.

6.8. Ethiopia Energy Sector Overview

Under its latest Growth and Transformation Plan (GTP), the Government of Ethiopia envisions transitioning from a developing country to a middle-income country by 2025.

Ethiopian Electric Utility (EEU) announced its plans to increase its customers to 7.5 million in 2030. The company's Chief Executive Officer stated that EEU was also working to expand its supply coverage and provide electric supply across the entire country by 2030. To achieve this plan, EEU aims to modernize its infrastructure, provide customer-oriented services, and build a reliable financial capacity.

Source: Addis Zemen and EEU Customers' Satisfaction Survey 2022

6.9. Demand Estimation

The automatic electrical power regulation devices are a device the automatic power factor correction device is a very useful device for improving efficient transmission and distribution of

active power. Power Regulation The term power factor correction, usually in the form of capacitors, is added to neutralize as much of the magnetizing current as possible. Typically, the corrected power factor will be 0.9 to 0.99. Some power distributors offer incentives for operating with a power factor of better than 0.99

According to the data is given by Ethiopian electric utility the demand of customers is **30,993** According to the data obtained by EEU, among the **30,993** customers in Ethiopia, the number of customers whose power factor (PF) is less than 0.75 is **17,236** and the number of customers whose power factor is less than 0.9 is **23,828**

From the customer 14,884 Must be installed AEPRD highly mandator for customer (high power loss in the systems) and also mandatory to installed the power factor below 0.9 as EEU Recommended the customer 23,828 mandatory to installed AEPRD

The Ethiopian electric authority it mandator to installed the power factor less than 0.9, restrictor not give the power less than the power factor 0.75

Table the customer demand power factor (PF) < 0.75

The Table of demand customers the power factor (PF) if less than 0.75 is **17,236** customers

Power factor	Demand	Remark
<0.7	14884	Must be installed AEPRD highly mandator for customer (high power loss in the systems)
0.7- 0.75	2352	Must be installed AEPRD highly mandatory for customer (high power loss in the systems) **17,236**
0.75-0.8	2368	
0.8-0.85	2280	
0.85-0.9	1944	
0.9-0.95	1775	
0.95-1.0	5195	
>1	195	
Total	30,993	

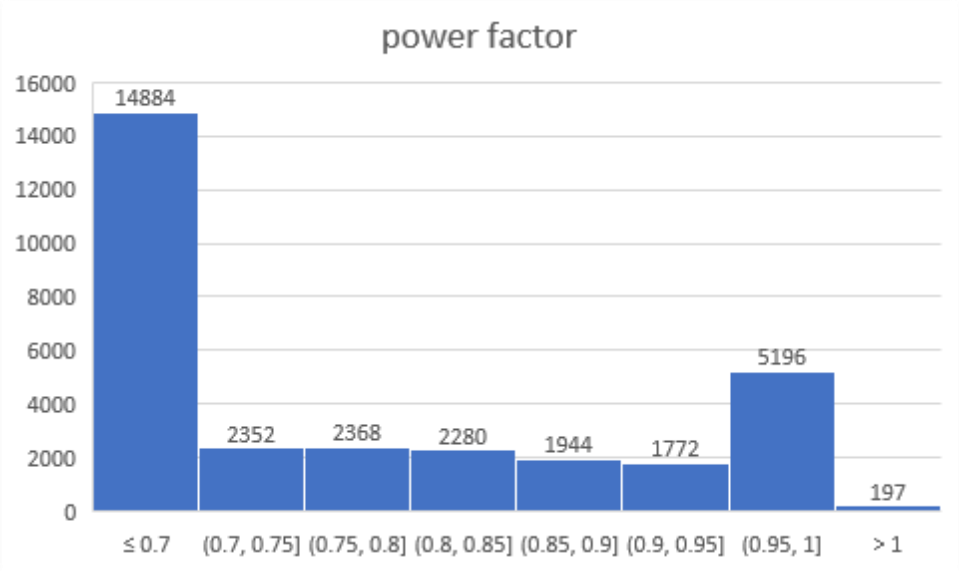
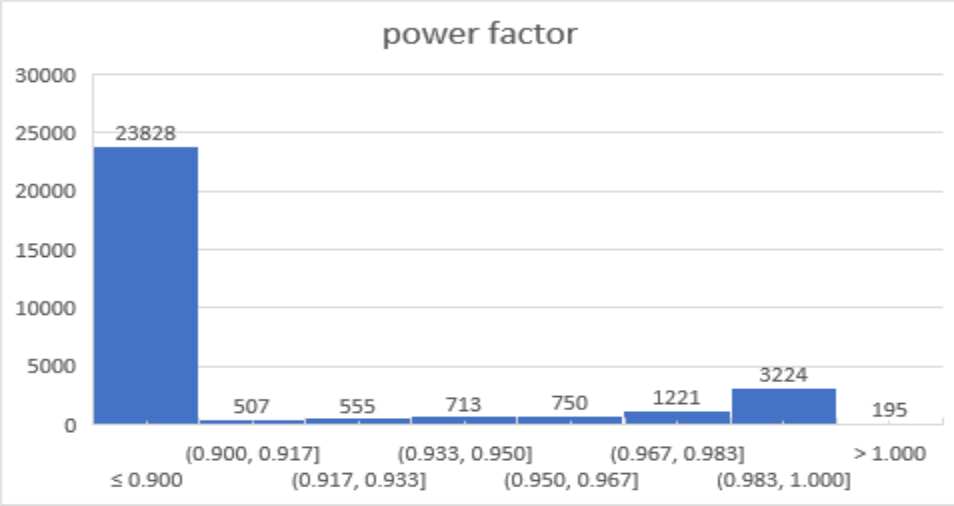


Table of demand customers the power factor (PF) if less than 0.9 is **23,828** customers

Power factor	Demand	Remark
<0.9	23,828	Mandatory Installed AEPRD
0.9- 0.917	507	
0.917-0.933	555	
0.933-0.95	713	
0.95-0.967	750	
0.967-0.983	1221	
0.983-1.00	3224	
>1	195	
Total	30,993	



The Jungle Power Engineering Industry, with the help of innovative methods and upgrades in technology, will have to manufacture power regulation that offers maximum functional efficiency and is at the same time less costly and economically viable.

In our country, the customer is fined for the low power factor, and even if he buys and uses this Automatic Electric Power Regulation Device, it will pay back the customer in less than a year. Indeed, this automatic power regulation machine ensures high productivity when the customer uses it.

Our country's technology is growing and changing and the demand for energy is increasing. It is plausible to use technological results to reduce energy waste and power quality. It is to provide products to hospitals, factories, industries, universities, shared housing and other large institutions as needed to reduce power outages. Producing a quality product and selling it at a reasonable price are strong facts that support success.

7. SWOT

7.1. SWOT Analysis

This is to analyze whether the company faces good fortune or not from the point of view of the external and internal environment of the project. Strengths and weaknesses refer to the internal factors of the enterprise that affect the production and marketing of the proposed commodity.

Opportunity and threat refer to external factors that are beyond the company's control. Analyzing these factors is important to know very well the negative aspects that the promoter faces from the external environment.

Strengths

- The project owners have good experience of working in a large manufacturing plant. The fact that she has experience working with the same technology.
- The fact that it has a strong network of owners who have provided training in various technology areas.
- The project has an integrated management system and is well organized to produce the intended product.
- Most of the owners are creative and technology professionals and owners.
- Having a clear understanding of hiring and adapting professionals with relevant experience

Opportunities

- Existent of abundant man power to be trained in the project area.
- The repetitive power interruption in the country for different reasons which demands quality items badly.
- Existence of excess demand for the product in the domestic market specifically and in foreign market generally.
- There are stable political and economic environment at present.
- Following the industrialization process in the country, this demands the product at large.
- Medium- and long-term loans provided from financial institutions for the investors with competitive rates.
- There is stable and conductive investment environment in the project area specifically and at the national level in general. There are different incentive schemes the government availed to attract investment.
- The Energy Policy mandates the company to improve energy productivity within the organization and provides the Energy Manager with sufficient power of authority to be able to realize the energy efficiency targets.

- Describe mandate and involvement from top management

❖ EEU and energy authority an awareness creation needs to be organized in the to make all the community aware of the potential energy loss behavior and practices. To make different mechanisms of awareness creation.

❖ EEU mandatory to installed is automatic electric power regulation devices for low power factor.

❖ The Ethiopian Development Bank invests in idea financing under the approved policy to support the innovation and technology.

Threats

• Non-availability of most of the input components in the country.

• Fluctuations in international prices due to changes in the output of the projects.

• Lack of awareness of energy efficiency and lack of awareness of penalty due to low energy.

• Awareness creation Although most people are aware of the benefits of (electrical) energy, only a few are aware of energy wastage and its impact on economy and energy supply.

Lack of funding for the study done by Development Bank.

Weakness

Weakness is not yet seen

8. Marketing plan and strategies

8.1. Marketing Mix Assessment

The marketing mix referred as 4P's, product, price, place and promotion, involves creating a unique blend of the right product, selling at the right price, in the right place, using the most suitable methods of promotion. For a successful marketing effort all the 4P's should be maintained rightly and balanced

8.2. Product Description

The company manufactures automatic electrical power control equipment based on market opportunities. The technical and financial analysis takes these products into account and prepares them.

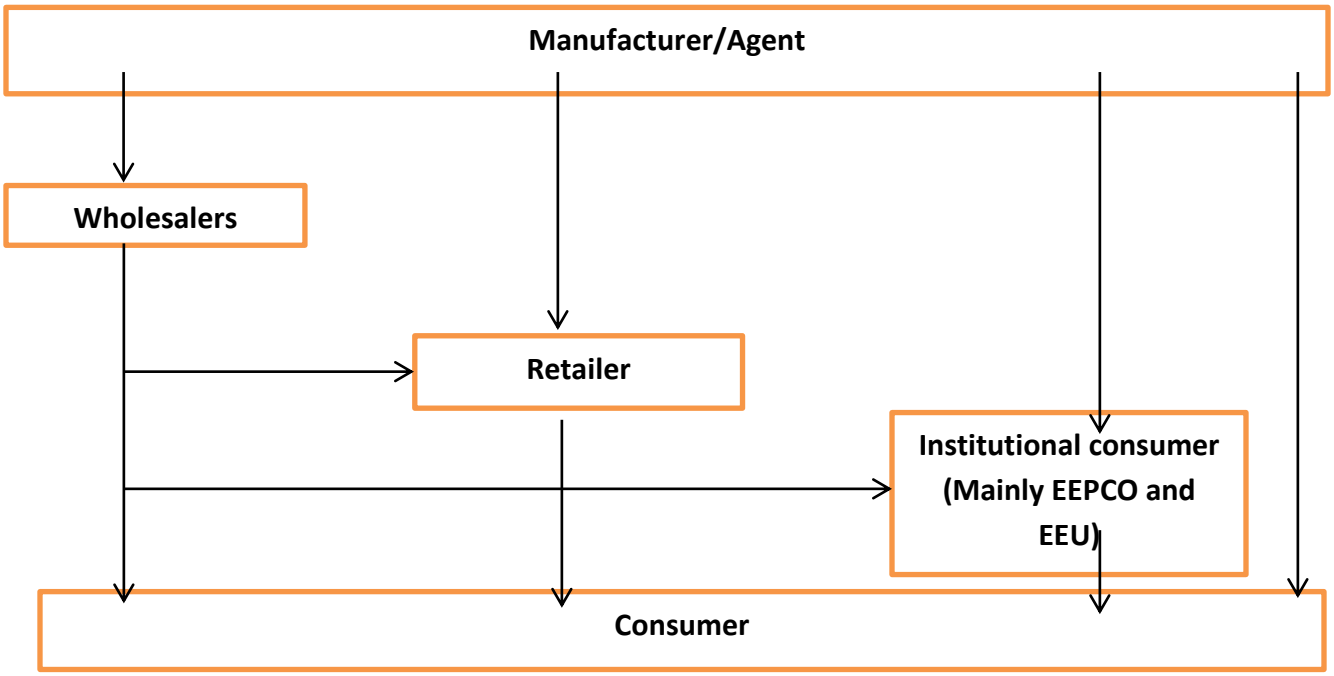
At present, energy waste is widely seen, and there is a need to use the technology widely, so to satisfy the needs of the country's customers, it produces the product in the required quantity from a local manufacturing company and manufactures the product in a wide range and with the required quality from local manufacturers.

This project requires many customers and many products, and it has a vast, untapped market.

8.3. Pricing and Distribution

Pricing a product is a critical activity since it is the major factor in determining revenue. If a lower price is fixed, it will affect the profitability of the company, and if a higher price is fixed, the product will not be able to stand in market competition and may be forced out of the market. Therefore, the right price has to be fixed.

Hence, the objective of the envisaged project pricing policy should be to gain a foothold in the market, gain a sizable market share, and sustain a reasonable profit. At the initial stage, this is only achieved through charging lower prices, which is called influencing consumers



Product Distribution Chart

8.4. Promotion

Promotion is about effectively communicating with customers so that they are encouraged to buy a product. As a key marketing element, promotion comprises communications tactics used to educate consumers, increase demand, and differentiate brands.

The new project is recommended to participate in major national and regional exhibitions and trade fairs as well as sponsoring public events in particular those related with environment for public awareness and image building to meet consumers from the country and abroad.

8.5. Quality

Quality can be defined as fulfilling a specification or customer requirement without any defects. A product is said to be of high quality if it is functioning as expected and is reliable. Quality controls refer to activities to ensure that produced items are of the highest possible quality.

Product quality has two dimensions, i.e., level and consistency. Level means the producer must first choose a quality level that will be acceptable in the market and that complies with the quality of competing products. Consistency refers to the consistent delivery of established quality through strict quality control measures.

9 Plant Capacity and Production Program

9.1. Plant Capacity

While selecting the feasible plant capacity for the envisaged power regulation manufacturing plant different technical and financial factors including demand for the product, raw material availability for the project life, and technology and availability of machinery and equipment in the world market with the proposed capacity.

Considering all the above factors, the capacity of the plant is selected to be 30 pcs/annum for the first year in 2.3% production capacity. This capacity is proposed to be achieved generally based on 250 working days per annum and one shift of 8 hours per day.

9.2. Production Program

The production program is formulated in the context of the projected demand share to be captured by the selected plant capacity and it will serve as a basis for projecting and quantifying the direct and indirect raw materials, inputs, supplies, and consumables of the project's annual operation.

The manufacturing technology of AEPRD is not so complicated. Since the business is not well distributed in the country; it may take a long time to develop the specific skills and know-how of the workers to manage the manufacturing activities of the product and for this, it is assumed that the employees of the Jungle Engineering Industry will take extensive training with the expert of the respective supplier. Hence, the employees will develop the specific skills and know-how to operate the plant in the specified period.

The envisaged plant will operate at different average capacity utilization rate from the first year namely from 2.5 %, 75% in the second year, and followed by rich 100% experience of technical, financial, marketing and sales factors of the environment, the envisaged plant will operate at full capacity utilization then after.

Table 9.1-Production Programmer

Products specification	Units	Year of production			
		1st Year Planned Capacity utilization percentage (2.3%)	2nd Year Planned Capacity utilization percentage (75%)	3rd Year Planned Capacity utilization percentage (100%)	Designed capacity (100%)
Automatic electric power regulation devices with different KVAR ratings	Pcs	30	1500	2000	2000
Total	Pcs	30	1500	2000	

- Capacity utilization percentage = Actual production X 100%

Designed capacity

Note: - We can take as sample 30 units of Automatic Electric Power Regulation Devices and present the returning on investment and profit details below.

Table:9.2 manufacturing cost per rating

No.	Rating	direct material (birr)	direct labor	machine hour cost	factor overhead cost	Total cost (birrs)
1	50kvar	181,489.10	1,391.30	773.59	26,397.76	210,051.76
2	75kvar	213,759.39	1,398.65	773.46	26,585.76	242,517.26
3	100kvar	256,016.62	1,410.94	773.59	26,679.76	284,880.91
4	150kvar	340,305.81	1,663.35	839.42	27,039.76	369,848.33
5	200kvar	395,088.11	1,667.46	839.42	27,039.76	424,634.74
6	250kvar	502,420.44	1,724.04	839.42	27,039.76	532,023.65
7	300kvar	544,443.07	2,307.54	955.8	27,039.76	574,746.16
8	400kvar	676,844.72	2,527.31	963.35	27,879.76	708,215.14
9	500kvar	873,376.08	2,805.09	963.35	31,189.92	908,334.43
	Total	3,983,743.34	16,895.66	7,721.39	246,891.99	4,255,252.38

Table 9.3 manufacturing cost of for total of three years AEPRD

no.	rating in KVAR	Each Manf, Cost in Birr	first 6 months	Total	2^{nd} 6 months	Total	Manufacturing.	mfc*total in birr
1	50kvar	210,051.76	2.00	420,103.52	23.00	4,831,190.48	25	5,251,293.92
2	75kvar	242,517.26	2.00	485,034.52	23.00	5,577,896.98	25	6,062,931.39
3	100kvar	284,880.91	5.00	1,424,404.55	20.00	5,697,618.20	25	7,122,022.81
4	150kvar	369,848.33	5.00	1,849,241.65	45.00	16,643,174.85	50	18,492,416.44
5	200kvar	424,634.74	12.00	5,095,616.88	88.00	37,367,857.12	100	42,463,474.27
6	250kvar	532,023.65	2.00	1,064,047.30	98.00	52,138,317.70	100	53,202,364.83
7	300kvar	574,746.16	2.00	1,149,492.32	98.00	56,325,123.68	100	57,474,616.30
8	400kvar	708,215.14	0.00	0.00	50.00	35,410,757.00	50	35,410,756.87
9	500kvar	908,334.43	0.00	0.00	25.00	22,708,360.75	25	22,708,360.77
	TOTAL	**4,255,252.38**	**30.00**	**11,487,940.74**	**470.00**	**236,700,296.76**	**500**	**248,188,237.60**

9.3. Technical Study

9.3.1. Raw Materials and Inputs

The raw materials and inputs required for the manufacturing plant mainly for the production of automatic power regulation devices can be preliminarily categorized as direct and indirect raw materials, auxiliary materials and inputs and utilities. The direct raw materials of the envisaged plant are electronics equipment, electrical and sheet metals.

In addition to direct raw material, some auxiliary inputs and factory supplies are required which are to be consumed and used during intermediate operation of the production process. Moreover, over auxiliary raw materials are also required for the operation of the envisaged plant namely bus bar and printing plate.

Different types of hand tools, and some drilling cutting, and grinding machines will be required.

Table:9.4 Electrical Raw Material

				Qty /1	**total**		
No	**Item description**	**Rating**	**Specification**	**UMO**		**Unit Price**	**Total Price**
1	extra-large size panel(500kvar)		Metal sheet or GRP	pcs	1	100,000.00	100,000.00
2	large size panel(400kvar)				3	80,000.00	240,000.00
3	medium size panel				2	50,920.00	101,840.00
4	small size panel				3	33,224.00	99,672.00
5	Circuit breaker	1000A	3P,50HZ, I=36KA	pcs	1	85,000.00	85,000.00
6	Circuit breaker	800A	3P,50HZ, I=36KA		1	43,193.23	43,193.23
7	Circuit breaker	630A	3P,50HZ, I=36KA		1	40,000.00	40,000.00
8	Circuit breaker	500A	3P,50HZ, I=36KA		1	39,400.00	39,400.00
9	Circuit breaker	400A	3P,50HZ, I=36KA		1	29,408.00	29,408.00
10	Circuit breaker	315A	3P,50HZ, I=36KA		1	29,408.00	29,408.00
11	Circuit breaker	250A	3P,50HZ, I=36KA		1	25,885.00	25,885.00
12	Circuit breaker	160A	3P,50HZ, I=36KA		1	6,200.00	6,200.00

13	Circuit breaker	100A	3P,50HZ, I=36KA		1	5,500.00	5,500.00
14	Current transformer	2000/5A	class 0.5 molded case	pcs	6	15,000.00	90,000.00
		1300/5A	class 0.5 moulded case		3	12,000.00	36,000.00
		1000/5A	class 0.5 moulded case		6	11,000.00	66,000.00
		700/5 A	class 0.5 moulded case		3	8,000.00	24,000.00
		500/5 A	class 0.5 moulded case		3	8,000.00	24,000.00
		400/5A	class 0.5 moulded case		3	8,000.00	24,000.00
		300/5A	class 0.5 mounded case		3	5,000.00	15,000.00
15	Power Capacitor with Discharge resistor	25Kvar	3x154 u f, Cylindrical, dry type, Self-healing with over pressure Disconnector"	pcs	81	16,000.00	1,296,000.00
16	Special purpose capacitor duty contactor	25Kvar	With damping resistors, Coil Voltage 380-415V 50Hz	pcs	81	3,815.53	309,057.93
17	Cable and wire	$16mm^2$	stranded wire	m	406.2	294.58	119,658.40
			Copper stranded fully flexible	m	144	294.58	42,419.52
		$2.5mm^2$	Copper Stranded fully flexible blue	m	144	32.00	4,608.00
		$2.5mm^2$	Copper stranded fully flexible red	m	144	32.00	4,608.00
		$2.5mm^2$	Copper Stranded fully flexible yellow	m	144	32.00	4,608.00
		1.5	Copper stranded fully flexible	m	181	25.00	4,525.00
18	Bus bar 500kvar	60x12 mm^2	Copper stranded fully flexible	m	9	6,500.00	58,500.00
		$60x6mm^2$	copper purity 99.9%, red color	m	0.4	6,000.00	2,400.00
19	bus bar 400kvar	40*10mm2	copper purity 99.9%, red color	m	7.6	4,175.00	31,730.00
		40*5mm	copper purity 99.9%,	m	0.4	2,100.00	840.00

			red colour				
20	bus bar 300kvar	50*5mm^2	copper purity 99.9%, red colour	m	3.5	2,600.00	9,100.00
		20*3mm^2	copper purity 99.9%, red colour	m	0.5	800.00	400.00
	bus bar 250kvar	40*5mm2	copper purity 99.9%, red colour	M	7.6	2,100.00	15,960.00
		20*3mm	copper purity 99.9%, red colour	M	0.4	800.00	320.00
	bus bar 200kvar	25*5mm2	copper purity 99.9%, red colour	M	3.7	891.31	3,297.83
		20*3mm2	copper purity 99.9%, red colour	M	0.8	800.00	640.00
	bus bar 150kvar	25*3mm	copper purity 99.9%, red colour	M	3.7	825.00	3,052.50
		15*2mm	copper purity 99.9%, red colour	M	0.8	700.00	560.00
	bus bar 100kvar	20*2mm2	copper purity 99.9%, red colour	m	3.7	800.00	2,960.00
		15*2mm	copper purity 99.9%, red colour	m	0.8	700.00	560.00
	bus bar 75kvar	15*2mm2	copper purity 99.9%, red colour	m	3.5	700.00	2,450.00
		15*2mm	copper purity 99.9%, red colour	m	0.5	700.00	350.00
	bus bar 50kvar	15*2mm^2	Copper purity 99.9%, red colour	m	3.5	700.00	2,450.00
		15*2mm	copper purity 99.9%, red colour	m	0.5	700.00	350.00
21	Cooling Fan with cover	0.23A	65w 220-240VAC,50Hz	pcs	15	3,925.55	58,883.25
22	Cable lug	70-95mm2	Aluminum	pcs	57	617.00	35,169.00
23		50-75mm2	Aluminum	pcs	20	320.17	6,403.40
24	Insulator cap		5000V	pcs	106	3,736.69	396,089.14
25	Miniature circuit	63A	3p, MCB Icu =6Ka	pcs	81	925.55	74,969.55

	breaker	16A	16A,1Phase, MCB, Icu=6KA	pcs	21	275.96	5,795.16
26	Thermostat with sensor	230V	230 V AC, range from -50 0C to +150 0C, panel mounting	pcs	9	5,200.00	46,800.00
27	Painting powder		230 V AC, range from -50 0C to +150 0C, panel mounting	kg	27	1,206.00	32,562.00
28	Bolt and nut		M10	pcs	222	27.00	5,994.00
			M12	pcs	102	44.00	4,488.00
29	Rail iron	2mmThickness	T=1mm, DIN rail 35*7.5mm	m	45	487.00	21,915.00
30	breaker supporter	2mm Thickness	6cm*184cm	pcs	38	249.60	9,484.80
			5cm*130cm		24	190.97	4,583.28
31	Conduit spiral			m	390	23.00	8,970.00
32	self-screw		M4x20mm	pcs	40	10.30	412.00
33	Flat screw with nut		M4,40mm	pcs	62	11.00	682.00
			M4,50mm	pcs	44	11.50	506.00
34	PQ Master			pcs	9	11,120.81	100,087.29
35	switching module			pcs	22	5,946.86	130,830.83
36	Connector		6mm2	pcs	35	47.82	1,673.70
			$2.5mm^2$	pcs	23	20.00	460.00
37	Bus bar insulation		Ø60	m	49.8	300.00	14,940.00
			Ø60	m	4.4	300.00	1,320.00
38	bottom cover		1.5*660*660mm	pcs	9	487.35	4,386.15
39	cable tie			pcs	315	1.50	472.50
40	ground copper wire	$1*10mm^2$	Copper Stranded fully flexible	m	9	46.24	416.16
41	Lifting lug		$19mm^2$	pcs	36	215	7,740.00
TOTAL from (50,75,100,150,200,250,300,400,500 kVAR) per pic = 4,021,944.62							

In addition to direct raw material some auxiliary inputs and factory supplies are required which are to be consumed and used during intermediate operation of the production process.

9.4. Production facility

Table 9.9 Tools used for Soldering Material for Software loading

Item	Materials	Quantity
1	AVR programmer	2
2	Computer with full accessory	4

Table 9.10 Material for Testing

Item	Materials	Quantity
1	Calibration machine	2
2	Humidity tasting machine	1
3	Vibration testing machine	1
4	Temperature testing machine	1
5	Contactor Kit	4

Table 9.11 - Accessories

NO	Accessories	Application area
1	Gloves wrist band	For anti-static safety
2	Tool box(kit)	Used to maintenance.
3	Owner's manual, maintenance manual	For the guidance of the assembler and the customer
4	Spares	For spare

10. Machinery & Equipment

10.1. List of Machinery

The list of machinery and equipment required for providing the envisaged products within the scope defined in the previous chapter of this study is given in the table 10.1,10.2,10.3.

10.1.1. Machinery for electrical and mechanical

Table10.1-List of plant machinery and equipment required with quantity

No.	Machine name	Specification	Unit	Price	total price	Remark
	For electrical and mechanical part			Birr	Birr	
1	bus bar machine		1	228,000.00	228,000.00	
2	fighting machine		1	74,000.00	74,000.00	
3	drill machine		1	50,000.00	50,000.00	
4	painting machine		1	100,000.00	100,000.00	
5	welding machine		1	150,000.00	150,000.00	
6	Fork lift 5 ton		2	350,000.00	700,000.00	
7	Pi cap (car)		3	3,000,000.00	9,000,000.00	
8	Isuzu (car)		1	3,000,000.00	3,000,000.00	
9	cutting machine		1	60,000.00	60,000.00	
10	Hot gun		1	6,000.00	6,000.00	
11	tools (wrench, wire clamper...)		1	28,200.00	28,200.00	
12	grinding machine		1	10,000.00	10,000.00	
	TOTAL				**13,406,200**	

10.1.2. machine for electronics

Table 10.2 -List of plant machinery and tools for Electronics

Machine and tools for Electronics							
No.	**Electronics and software part**	**Specification**	**unit**	**quantity**	**Price**	**Price**	**Remark**
	For electronics part				**Birr**	**Birr**	
1	Software and software kit		Pcs	1	400,000	400,000	
2	Soldering tip and accessories		Pcs	1	200,000	200,000	
3	Testing Instrument and Calibrating Machines		Pcs	1	500,000	500,000	
4	Three Phase Calibrator	KS833	Pcs	1	3,000,000	3,000,000	
5	3D printing machine with accessory	3D printing machine	Pcs	1	500,000	500,000	
6	PCB board printing machine with accessory		Pcs	1	3,000,000	3,000,000	
	TOTAL electronics PRICES				**7,600,000**	**7,600,000**	

10.1.3. machinery testing equipment

Table 10.3 -List of plant machinery testing equipment required with quantity

Sr. no.	Item	Qty	Unit Price	Total	Remark
1	Power Frequency Tester	1	60,000	60,000	
2	Characteristic Tester	1	80,000	80,000	
3	Temperature Recorder	1	4,000	4,000	
4	dummy load Tester	1	80,000	80,000	
5	3Phase Circuit Tester	1	6,000	6,000	
6	Clamp Tester	2	700	1,400	

7	Voltage Regulator	1	15,000	15,000	
8	Mellit meter	2	2500	5,000	
9	CT	2	5,000	10,000	
10	PT	1	4,000	4,000	
11	Painting Thickness Measuring	1	2,500	2,500	
12	Other Devices	1	32,100	32,100	
	Total equipment test			**300,000**	

10.2. Annual Utility Consumption Estimated Jungle Engineering Industry

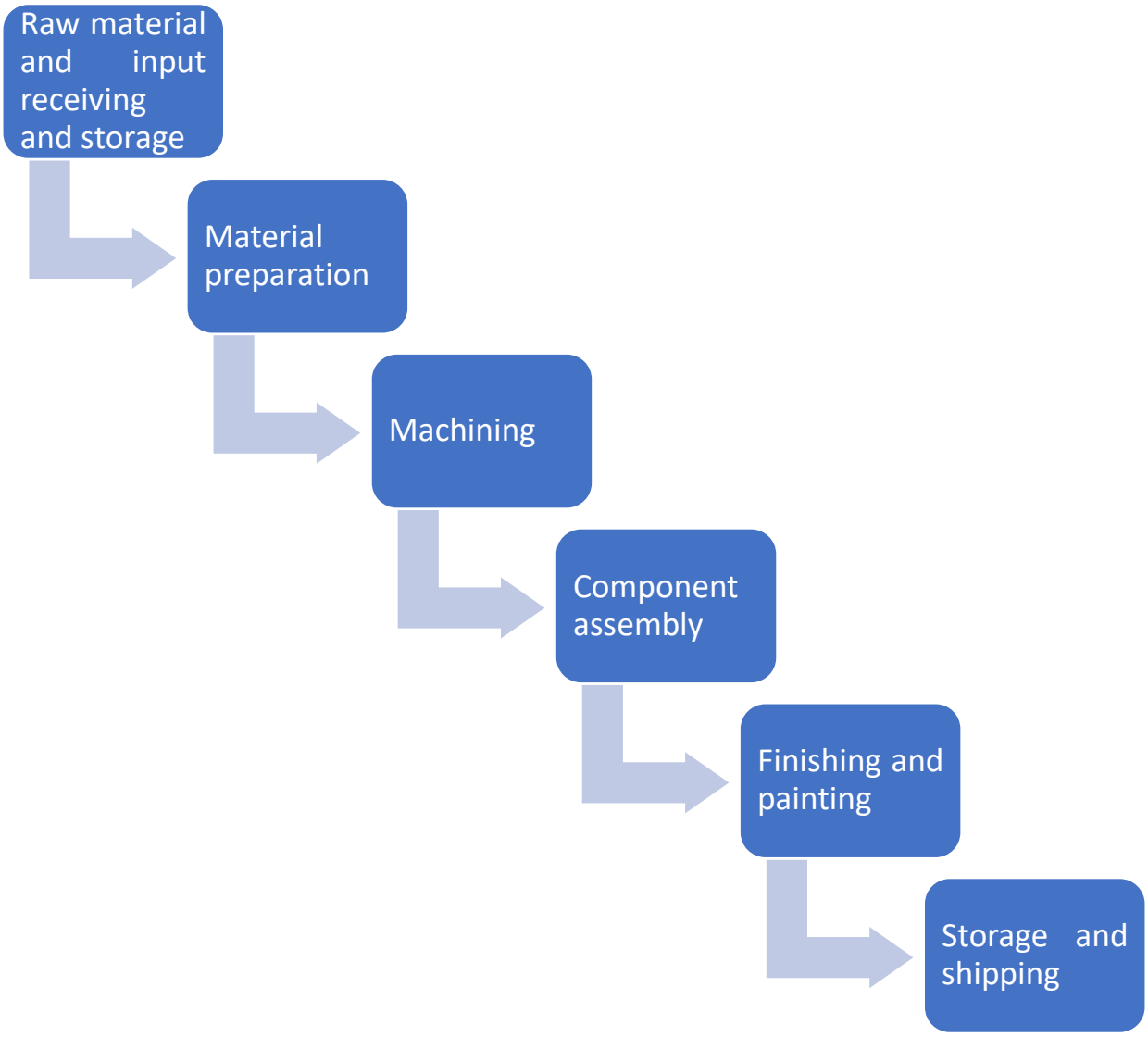
Jungle Engineering Industry Manufacturing Automatic Electric Power Regulation Devices manufacturing plant will use electrical energy and water as main utilities. Estimated annual utility consumption along with corresponding cost is indicated in Table-10.4.

Table10.4- utility consumption of the plant and cost at full capacity (cost in birr)

Utility	Unit	Consumption	Unit Cost	Total Cost
Electrical Energy	KWh	10,000	2.481	24,810.00
Water	M^3	4	1.67	7.01
Telephone	Hrs.	489	21	10,269.4
Grand Total				**35,086.41**

10.3. Process Flow Chart

The production process is summarized in flow chart as follows:



11. Location, Site and Environment

Location: Based on availability of land building, utility and market outlet, our future location is proposed to be in Addis Ababa city or around**.**

Site: Site is a plot of land within the selected location sufficient and suitable for installation and operation of the plant. In our case, Addis Ababa is selected as the location of the project. The

characteristics of the plant site strongly influence the technical and economic feasibility of the project and the site itself has to be selected with up most care using certain site selection criteria considering the following major points: -

- Lower land cost
- Sufficient space for future expansion of the plant
- Availability of water and electricity
- Proximity to market access & raw material source
- Adequate road access

11.1. Working Place

In total company plans to lease 30,000sqm land from the government and build a shade in three phases. In each phase two identical shades were built with every 5000sqm identical size but with different designs according to the use and production designs. After building the whole three phase the plant can produce the products with the full capacity.

Note: **-** We can take phase one as an example and the shade fee not included and calculated under the financial details of this study because land lease information gap. If land leased is issued the owners' equity increased as well as the project feasibility also increased proportionally.

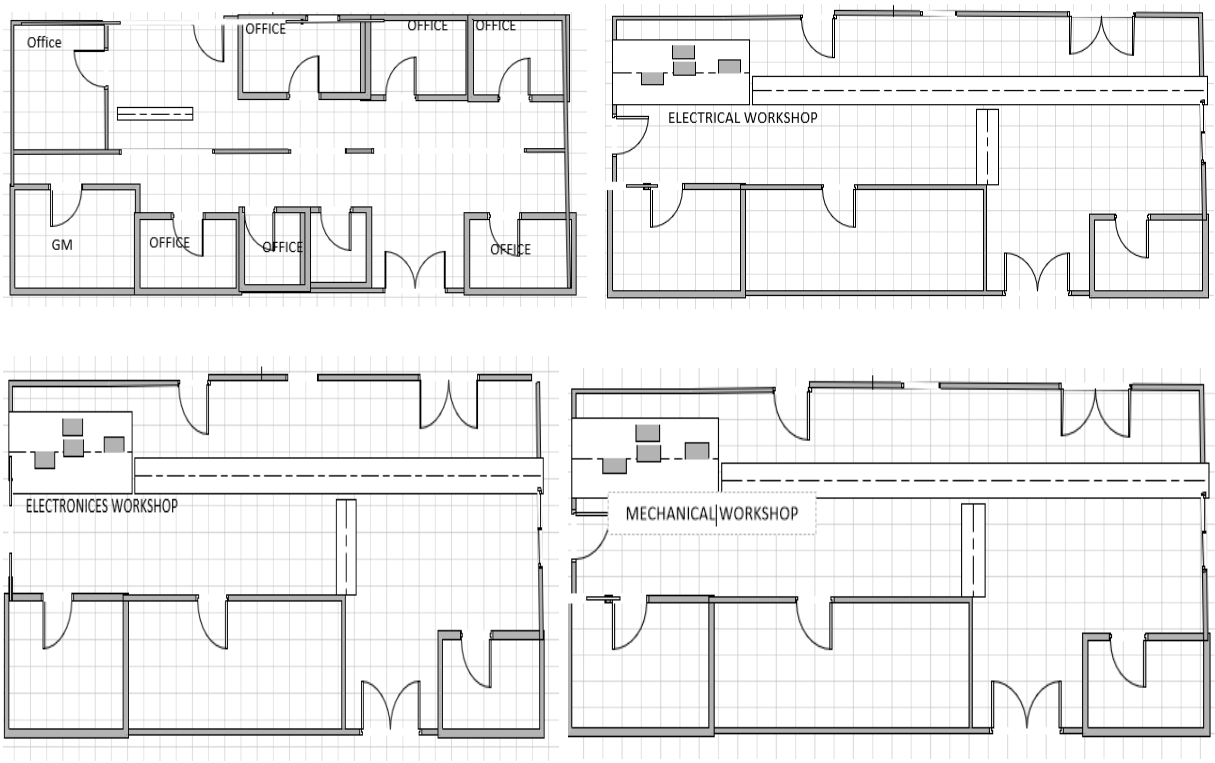
Phase one:

Jungle Engineering Industry build three will be standard houses each 5000sqm as phase one in Addis Ababa for the manufacturing process for which costs about birr 5,179,250 birr. For how many years intend to land lease and it costs; it is depending on the government policy.

11.2. Working Place Layout

Layout diagram of factory, It has three production workshops (electric manufacturing production workshop, mechanical manufacturing production workshop, electronics manufacturing production workshop), one test hall, seven storehouses (material storehouse, electrical storehouse, electronic storehouse, component storehouse, semi-finished product storehouse, finished product storehouse, packaging storehouse), as well as seven departments (GM Room, Office, Production Department, Supply and Marketing Department, Technology and Innovation

Department, QC Department, Financial Department). Our company has complete tool production equipment, including a testing facility.



12.Organization and Human Resource Requirement

12.1. Organizational Structures

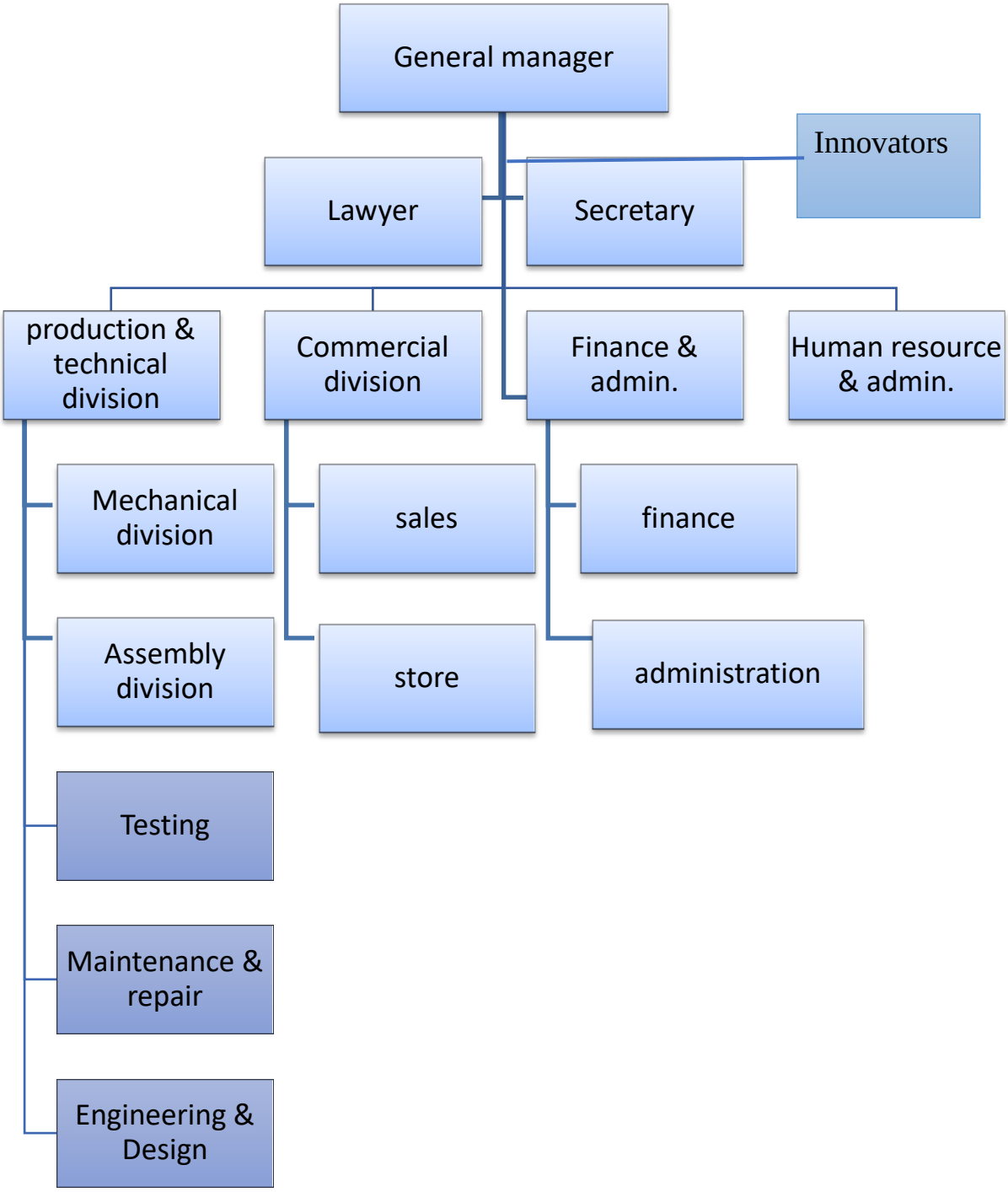
The envisaged plant operations and activities will be assigned to organizational units represented by managerial staff, supervisors and workforce to attain the objectives of the factory. The activities include planning, directing, coordinating and controlling of the factory operations at the required level of quality and specified time. As such the structure makes possible the application of management and its principles also to crate frame work of order and command through which the activities of the company can be planned, organized, directed and controlled. The organization structure will be staffed with eligible personnel with the corresponding authority and responsibility for the achievement of the goals and objectives of the firm.

12.1.1. Factors to Be Considered for Selecting Appropriate Organizational Structure

Structural dimension consists of formulation (the amount of written documentation in the organization-including procedure, job description, regulation and policy manual), specialization (degree of tasks sub divided in to separate job-the division of labor), hierarchy of authority description (describing who report to whom and the span of control).

12.1.2. Proposed Organizational Structure

Jungle Engineering Industry is a newly established company regulate power, control power loss, mitigate power fluctuation at different rating as the customers need and design factory, in this industry special innovators



12.1. Human Resource Planning and Staffing

The human resource planning is conducted considering job complexity the size and flow of work for the envisaged plant volume of work to be conducted by each

employee depending on the type of work and working environment it involves the number of shifts per day and proposed organizational structure.

12.2.1 Job Specification

Job specification is an outline of the qualification necessary for a particular job expressed in term of educational specification and experience. The educational specification has been determined based on the minimum formal education required by each job in line with the existing educational and trailing policy of the county. In addition, appropriate and relevant work experience requirements have been set considering the complexity and scarcity in the labor market etc. similar industries are assessed to be used as input to the development of specification for all position indicated in the organization structure. The job specification of the envisaged plant is given in table 12.1-12.3.

Table12.1-Job specification GM office

Sr. No.	Job title	Qty	Education qualification	Year of experience
1	General manager	1	BSC/MBA/MSC in mechanical/electrical /industrial engineering/electromechanical	10/8year experience relevant experience
2	Executive secretary	1	Secretarial science/office management	8-year experience relevant experience
3	Lawyer	1	BA/MA in law	7-year experience relevant experience
4	Driver 1	2	10+3	6-year experience relevant experience
Total		**5**		

Table 12.2 job specification of technological innovator's

Sr. No.	Job title	Qty	Education qualification	Year of experience
1	Technological innovators	3	innovators	Non
Total		**3**		

Table12.3 - Job specification for commercial division

Sr. No	Job title	Qty	Education qualification	Year of experience
1	Marketing department manager	1	BA In marketing/relevant qualification	11year experience relevant experience
2	Procurement and supply division head	1	BA in supply/economics/mgt	11year experience relevant experience
3	Senior purchaser		BA in marketing/mgt/economics/accounting	8year experience relevant experience
4	Senior marketing office	1	BA in purchasing/mgt/economics/accounting	8year experience relevant experience
5	Senior store keeper	1	diploma in supply purchasing /mgt	6year experience relevant experience
6	Driver		10+3	6-year experience relevant experience
Total		**5**		

Table12.4 - Job Specification Finance& Administration

Sr. No.	Job title	Qty	Educational qualification	Year of experience
1	Manager	1	BA in management /accounting	9year experience relevant experience
2	Senior accountant	1	BA in accounting	8-year experience relevant experience
3	Accountant	1	BA in accounting	2year experience relevant experience
4	Driver	1	10+3	6-year experience relevant experience
5	Liaison		10+3	4-year experience relevant experience
6	Telephone operator		10+1/10/9 academic	No need of experience
7	Get pass controller		10+1/10/9 academic	No need of experience
8	Guard shift coordinator		10/9 academic	No need of experience
9	Photocopy operator		10/10 academic	No need of experience
10	Messenger	1	10/10academic	No need of experience
Total		5		

Table12. 5- Job Specification for production & technical division

Sr. No .	Job title	Qty	Education qualification	Years of experienced
1	Production	1	MSC/BSC in	8/9year experience

	Manager		mechanical/electrical/industrial engineering	relevant experience
2	Engineering & design department	1	MSC/BSC in mechanical/electrical/industrial engineering	8/9year experience relevant experience
3	Mechanical division manager	1	MSC/BSC in mechanical/electrical/industrial engineering	8/9year experience relevant experience
4	Quality supervisor	1	BSC in mechanical/industrial/ electrical engineering	7 years' experience relevant experience
5	Assembly division manager	1	BSC in mechanical/industrial/engineering/manufacturing	7 years' experience relevant experience
6	Planning and monitoring department manager	1	BA/BSC in economics/mechanical/industrial engineering	11-year experience relevant experience
7	Technical division head	1	BSC in mechanical/industrial technology/electrical engineering	7 years' experience relevant experience
8	Equipment maintenance & repair supervisor	1	BSC in mechanical/electrical engineering	5-year experience relevant experience
9	Electrical engineer	3	BSC in electrical engineering	6year experience relevant experience
10	Mechanical engineer	3	BSC in Mechanical engineering	6year experience relevant experience

11	Software engineer	2	BSC in software engineering	6year experience relevant experience
12	Computer engineer	2	BSC in computer engineering	6year experience relevant experience
11	Senior safety officer		BSC in mechanical/industrial/electrical /management	6year experience relevant experience
12	Senior welder		10+3 collage/TVET diploma in electric city	6year experience relevant experience
13	Welder	2	10+3 collage/TVET diploma in electric city	4year experience relevant experience
14	Senior painter		10+3 Collage/TVET diploma in painting	6-year experience relevant experience
15	Painter	1	10+3 Collage/TVET diploma in painting	4-year experience relevant experience
16	Technician level 3	1	10+3 collage/TVET diploma in electricity	2year experience relevant experience
1	Technician level 4	1	10+3 collage/TVET diploma in electricity	3year experience relevant experience
17	Technician level 5	1	10+3 collage/TVET diploma in electricity	4year experience relevant experience
18	Forklift operator	1	Diploma in automotive	8-year experience relevant experience
19	Driver		10+3	6-year experience relevant experience
Total		**25**		

12.3 Office Furniture and Equipment

The project needs to procure office furniture and equipment to furnish its office for administrative and production staffs. The total cost of office furniture and equipment is estimated to be birr 686,900.00. Table 12.6: list office furniture and equipment requirement

Table12-6 List of office Furniture and equipment

S. No	Item	No	Unit Price	Total Price
1	Managerial table for GM office	1	17,000	17,000
2	Managerial swivel chair for GM office	1	11,500	11,500
3	Conference table with 8 standard chairs, set	1	66,000	66,000
4	Guest chair	2	1,200	2,400
5	Secretarial swivel chair &Table	1	8,000	8,000
6	Office Table & chair	6	8,000	45,000
7	Division managerial chair and table	4	12,000	48,000
8	Guest chair	8	1,200	96,000
9	File Cabinet	6	3,500	21,000
10	Computers with Accessory	6	14,000	84,000
11	Printer with scanner	6	8,000	48,000
12	Copy machine	6	40,000	240,000
	Grand Total			686,900.00

13 Manpower and Training Requirement

The project is machine-oriented but skilled labor is important for the success of the business. A skilled machine man is required to operate the machine efficiently and effectively. The skill of machine-man will result in lower wastage of materials and time, lower maintenance cost of machines and also longer life of machines. This will enhance the quality of the product and timely delivery of orders and hence, help in creating a good image among customers.

13.1. Manpower Requirement

Manpower planning is the process of estimating the optimum number of people required for completing a project task or a goal with in time. Manpower planning includes parameters like several personal different types of skills, time, period

13.2. Training Requirement

The factory management should arrange for on-job training with the machinery suppliers before and during the installation & commissioning of the pieces of machinery at the premises of the supplier for a scheduled period. Similarly, maintenance and quality assurance personnel should be given practical training in their respective fields of engagement. Training should also be given to machine operators & visual quality control workers on the various types of product defects and their remedies in the production process. Training should be given software and PCB Printing board; the duration of such training shall be scheduled. As a result, all key production personnel will have the opportunity for being familiar with the operation of machineries and the technology.

13.3. Required Man Power Estimated Cost

13.3.1. Required Man Power Estimated Cost

The factory required total 30 skilled and supported staff man power with estimated cost Birr **1,434,000.00**

Table13.1: required manpower estimated cost

	Department	Position	**Req.**	**Gross**	**Salary for**	**salary for**	**Salary for**

			Number	Salary	Month	3 months	Year
1	**General**	General Manager	1	45,000.00	45,000.00	135,000.00	540,000.00
2	**manager Office**	Executive Secretor	1	7,000.00	7,000.00	21,000.00	84,000.00
4		Drivers	1	7,000.00	7,000.00	21,000.00	84,000.00
5	**Commercial**	Marketing Manager	1	25,000.00	25,000.00	75,000.00	300,000.00
8		Senior marketing office	1	10,000.00	10,000.00	30,000.00	120,000.00
10		Drivers	1	7,000.00	7,000.00	21,000.00	84,000.00
11	**Finance**	Finance Manager	1	25,000.00	25,000.00	75,000.00	300,000.00
12	**and Admin**	Senior Accountant	1	12,000.00	12,000.00	36,000.00	144,000.00
21	Technological innovated	Innovators	3	14,000.00	42,000.00	126,000.00	168,000.00
22	Production, innovator's and manufacturing	Production Manager	1	30,000.00	30,000.00	90,000.00	360,000.00
23		Engineering & Design Manager	1	25,000.00	25,000.00	75,000.00	300,000.00
24		Mechanical division manager	1	25,000.00	25,000.00	75,000.00	300,000.00
25		software engineer division manager	1	25,000.00	25,000.00	75,000.00	300,000.00
26		Quality	1	8,000.00	8,000.00	24,000.00	96,000.00

		supervisor					
27		Assembly division manager	1	20,000.00	20,000.00	60,000.00	240,000.00
29		Technical division head	1	20,000.00	20,000.00	60,000.00	240,000.00
31		Electrical engineer	3	14,000.00	42,000.00	126,000.00	168,000.00
32		computer engineer	1	14,000.00	14,000.00	42,000.00	168,000.00
33		software engineer	1	14,000.00	14,000.00	42,000.00	168,000.00
34		Mechanical engineer	3	14,000.00	42,000.00	126,000.00	168,000.00
36		Senior welder	1	8,000.00	8,000.00	24,000.00	96,000.00
40		Technician level 3	1	7,000.00	7,000.00	21,000.00	84,000.00
41		technical level 4	1	8,000.00	8,000.00	24,000.00	96,000.00
42		Technician level 5	1	10,000.00	10,000.00	30,000.00	120,000.00
			30		**478,000.00**	**1,434,000.00**	**4,728,000.00**

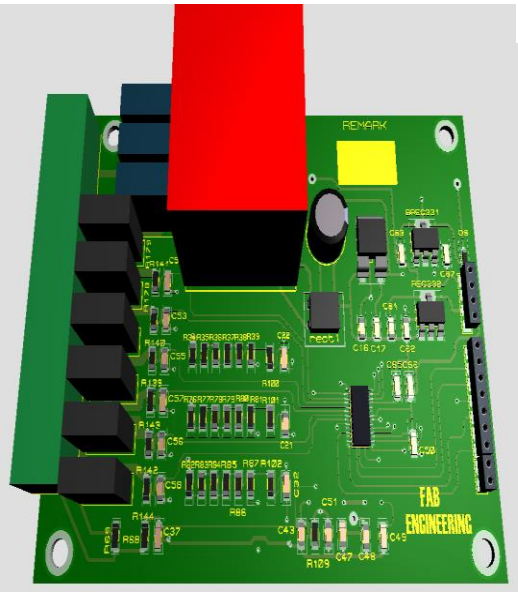
13.4. Products to be manufactured:

The major technology and machinery required for the envisaged plant will focus on the production of automatic electric power regulation Devices with different KVAR ratings (50kvar,75kvar,100kvar, 150kvar, 200kvar, 250kvar, 300kvar, 400kvar, 500kvar, 600kvar, 700kvar,800kvar, 900kavr, 1000kvar). It creates-

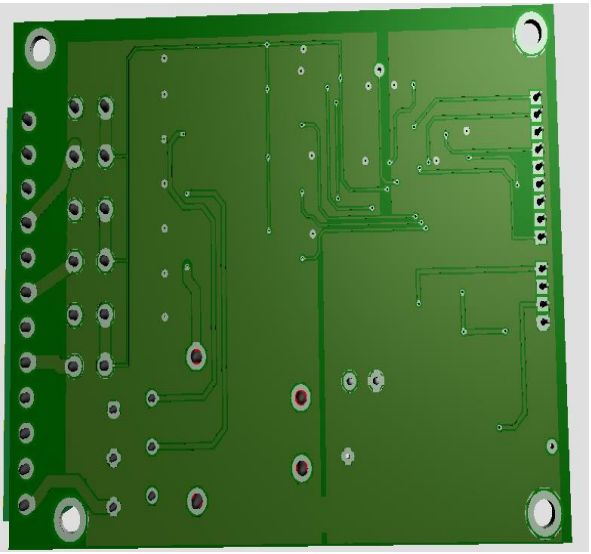
- Higher profit through the local manufacturing AEPRD in Ethiopia.

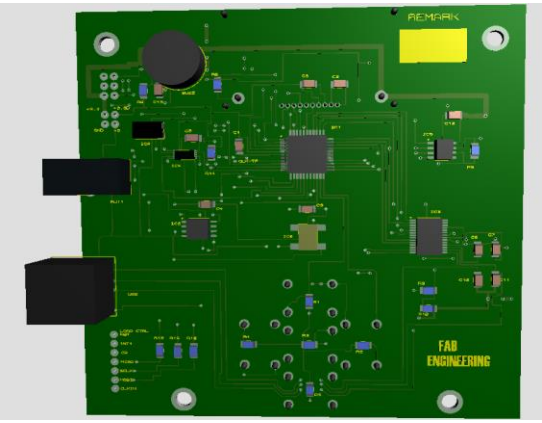
- National Competitiveness
- Innovative technology in our country
- Import replacement power regulated devices effect

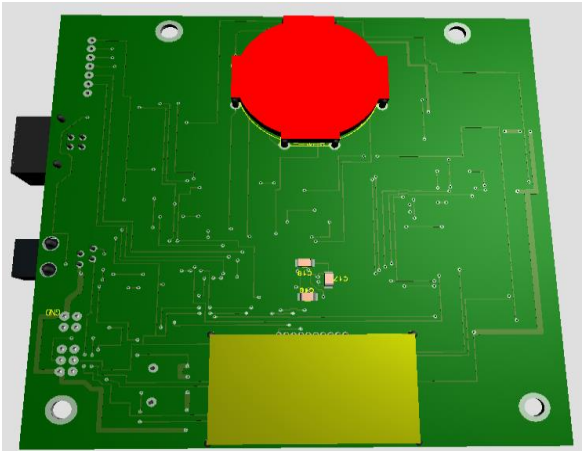
2.1.2 sensing board front side

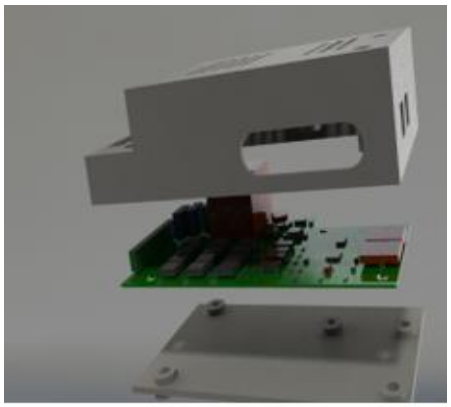


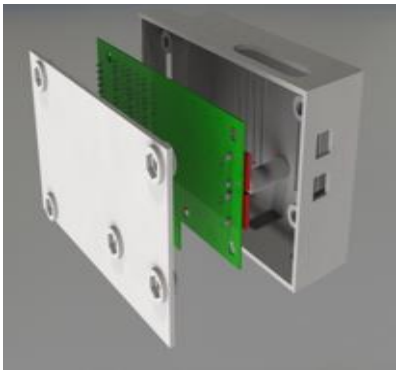
2.1.3 sensing board rare side

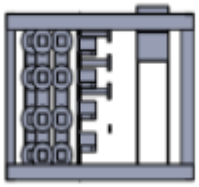


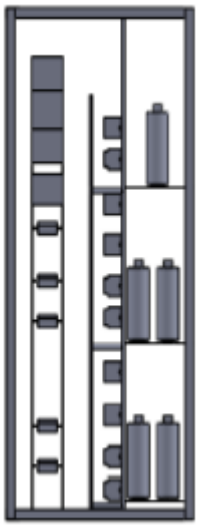


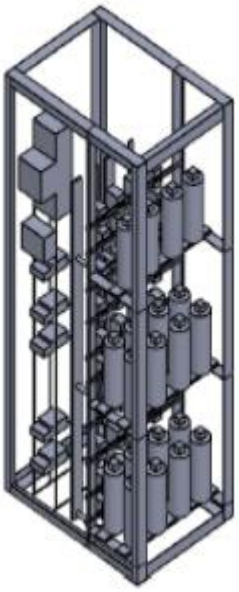












14. Financial Analysis

The financial analysis of the Project bases on the data presented in the previous chapters: -

14.1. Manufacturing cost for different rating per rating

Table 14.1 manufacturing cost for different rating per rating

No.	Rating	direct material (birr)	direct labor	machine hour cost	factor overhead cost	Total cost(birrs)
1	50kvar	181,489.10	1,391.30	773.59	26,397.76	210,051.76
2	75kvar	213,759.39	1,398.65	773.46	26,585.76	242,517.26
3	100kvar	256,016.62	1,410.94	773.59	26,679.76	284,880.91
4	150kvar	340,305.81	1,663.35	839.42	27,039.76	369,848.33
5	200kvar	395,088.11	1,667.46	839.42	27,039.76	424,634.74
6	250kvar	502,420.44	1,724.04	839.42	27,039.76	532,023.65
7	300kvar	544,443.07	2,307.54	955.80	27,039.76	574,746.16
8	400kvar	676,844.72	2,527.31	963.35	27,879.76	708,215.14
9	500kvar	873,376.08	2,805.09	963.35	31,189.92	908,334.43
	Total	3,983,743.34	16,895.66	7,721.39	246,891.99	4,255,252.38

14.2. Manufacturing cost for different rating total of 500 production

Table 13.2 Manufacturing cost for 500units

no.	rating in KVAR	Each Manf, Cost in Birr	Manufacturing.	mfc*total in birr
1	50kvar	210,051.76	25	5,251,293.92
2	75kvar	242,517.26	25	6,062,931.39
3	100kvar	284,880.91	25	7,122,022.81
4	150kvar	369,848.33	50	18,492,416.44
5	200kvar	424,634.74	100	42,463,474.27
6	250kvar	532,023.65	100	53,202,364.83
7	300kvar	574,746.16	100	57,474,616.30
8	400kvar	708,215.14	50	35,410,756.87
9	500kvar	908,334.43	25	22,708,360.77
	TOTAL	**4,255,252.38**	**500**	**248,188,237.60**

no.	rating in KVAR	Each Manf, Cost in Birr	first 6 months	total	next 6nd months	total	Manu facturing.	mfc*total in birr
1	50kvar	210,051.76	2.00	420,103.52	23.00	4,831,190.48	25	5,251,293.92
2	75kvar	242,517.26	2.00	485,034.52	23.00	5,577,896.98	25	6,062,931.39
3	100kvar	284,880.91	5.00	1,424,404.55	20.00	5,697,618.20	25	7,122,022.81
4	150kvar	369,848.33	5.00	1,849,241.65	45.00	16,643,174.85	50	18,492,416.44
5	200kvar	424,634.74	12.00	5,095,616.88	88.00	37,367,857.12	100	42,463,474.27
6	250kvar	532,023.65	2.00	1,064,047.30	98.00	52,138,317.70	100	53,202,364.83
7	300kvar	574,746.16	2.00	1,149,492.32	98.00	56,325,123.68	100	57,474,616.30
8	400kvar	708,215.14	0.00	0.00	50.00	35,410,757.00	50	35,410,756.87
9	500kvar	908,334.43	0.00	0.00	25.00	22,708,360.75	25	22,708,360.77
	TOTAL	**4,255,252.38**	**30.00**	**11,487,940.74**	**470.00**	**236,700,296.76**	**500**	**248,188,237.60**

Table 2.1 selling price per unit

no.	rating in KVAR	selling price	first 6 months	total
1	50kvar	336,082.82	2	672,165.63
2	75kvar	388,027.62	2	776,055.23
3	100kvar	470,053.50	5	2,350,267.51
4	150kvar	665,726.99	5	3,328,634.97
5	200kvar	806,806.01	12	9,681,672.07
6	250kvar	1,010,844.94	2	2,021,689.87
7	300kvar	1,120,755.01	2	2,241,510.02
	TOTAL		**30**	**21,071,995.31**

14.3. Total Initial Investment Cost

The total initial investment cost of the project including working capital is estimated at Birr **30,000,003.81** of which some of it will be required in foreign currency. Details are indicated in Table 14.3.

Table-14.3: Initial Investments

No	**Description**	**Amount in Birr**
1	Land Lease	580,000.00
2	Plant Machinery and Equipment	12,620,340
3	Office Furniture and Equipment and other cost	343,450.00

4	Man power	2,151,000.00
5	Average Production cost per unit (382931*30)	11,487,940.74
6	Training manpower	90,000.00
	Sub total	**27,272,730.74**
8	Initial Working Capital (10%)	2,727,273.07
	Grand Total	**30,000,003.81**

14.4. Source of Finance

As discussed earlier in the introduction, the project is planned to be Loan financed by commercial bank of Ethiopia (CBE) 100%. The loan is planned to be paid back in five consecutive years. Tables showing the source of finance & its schedule of payment are listed below.

Table-14.4: Source of finance & schedule

No	Source of finance	Amount in birr	Share %
1	Loan Financing Bank of Ethiopia	**30,000,003.81**	100

14.5. Loan Repayment Schedule

Repayment of principle is assumed to be an equal installment of the outstanding amount of each year ending & according to Bank of Ethiopia (2024) interest rate would be assumed i%. Therefore, the loan repayment schedule & interest payable is 5 years.

14.6. The Initial Working Capital

The initial working capital is estimated at **birr 2,727,273.07** it is the initial operation cost and cash on hand for the startup of the project. It is computed as one-month consumption of imported

and local inputs, one-month salaries & utilities etc. A detail of the initial working capital is as tabulated above.

14.7. Financial Evaluation

14.7.1. Profitability

According to the projected income statement, the project will start generating profit in the first year of operation. Important ratios such as the percentage of net profit to total sales, net profit to equity (return on equity) and net profit plus interest to total investment (return on total investment) will show an increasing trend throughout the production life of the project. The income statement and other profitability indicators show that the project is viable.

Table14.1 - Profit/loss statement for the coming three year.

No	Description	6 months	next 6 months	Year two	Year three
			(birr)	(birr)	(birr)
1	Production Capacity Per year	30	470	1,500	2,000
	Average Selling Price per unit				
2	Revenue	21,071,995.31	347,463,532.50	1,051,447,540.50	1,434,923,154.00
	Average Production cost per unit				
3	Production cost	11,487,940.74	248,188,237.50	751,033,957.50	1,024,945,110.00
4	**Gross Profit**	**9,584,054.57**	**99,275,295.00**	**300,413,583.00**	**409,978,044.00**
5	Administration expense	1,150,086.55	11,913,035.40	36,049,629.96	49,197,365.28
6	Profit Before tax	8,433,968.02	87,362,259.60	264,363,953.04	360,780,678.72
7	Business tax (30%)	2,530,190.41	26,208,677.88	79,309,185.91	108,234,203.62
8	**Net profit**	**5,903,777.61**	**61,153,581.72**	**185,054,767.13**	**252,546,475.10**

14.7.2. Simple Rate of Return (SRR)

The ratio of the sum of the above annual net profit and bank interest to the total investment cost of the project gives us the simple rate of return (SRR) as shown in the following computation. Thus, SRR of the project is about 21% which is positive.

27,272,730.74 and net profit 5,903,777.61

SSR= (net profit/investment cost) X100%

SRR=$\frac{\mathbf{5,903,777.61}}{\mathbf{27,272,730.74}} X$ 100% = **SRR=21%**

14.7.3. Payback Period (PBP)

PBP is the ratio of the total investment cost to the sum of the net profit and total depreciation. Thus, as shown below, the project is expected to pay back itself in about 4.2 years.

PBP=$\frac{Total\ investment\ cost}{Net\ profit+Total\ depreciation}$

PBP = $\frac{\mathbf{27,2730.74}}{(\mathbf{5,903,777.61} + 161,676.00)}$ =

=4.2 years

Total depreciation is assumed to be = 20% of cost of vehicles + 10% cost of furniture + 20% cost of machineries & equipment) = birr 161,676.00

15. Conclusion

Ethiopia is one of the developing countries in the world. There is huge power waste and outages in our country. If I use this technology, it will help control the energy waste in our country. Energy-saving measures implemented in the industry will increase overall energy efficiency. Automatic electrical power control equipment has many advantages: it is economically viable, technology creates employment opportunities for many people, and it is technology for our country's problems. In the industrial use of high-energy production processes, it is important to improve energy efficiency.

This technology has been registered by the Ethiopian Intellectual Property Authority under patent number ETUM1109B1 for industrial automatic electricity.

Based on this projection, the project will have a healthy liquidity position and will not face cash shortages throughout its life. The project requires a total investment of **30,000,003.81 BIRR.,** including **12,620,340 Birr** for machinery and 2,727,273.07 **Birr** for initial working capital. The Simple Rate of Return (SRR) is approximately 21%, and the Payback Period (PBP) is about 4.2 years. These financial indicators suggest the project is viable and a good investment, with a loan repayment period of under 5 years.

The data is given from Ethiopian Electric utility the demand of customers is **30,993** from this data the power factor (PF) < 0.75 power factor Customers are **17,236**, and the power factor (PF) < 0.9 customers are **26,620**.From the customer 14,884 Must be installed AEPRD highly mandator for customer (high power loss in the systems) and also mandatory to install the power factor below 0.9 as EEU Recommended the customer 26,620 mandatory to install AEPRD there is a large market in the country.

16 Recommendation

The results of the market research show that there is a wide market for AEPRD products. At present, extensive work has to be done to ensure that the product demand is fully met, so the project should be done with the attention and cooperation of the stakeholders. Since the project is of great importance for job opportunities and technology transfer, the problem of energy wastage in our country cannot be solved by this research and research alone, so the Energy Authority, Ethiopian Electricity Service, government stakeholders and investors should help and support the project.

Innovation is a key driver of economic growth and prosperity. Investing in innovation and supporting technology will bring about social and economic changes in our country. Our country, Ethiopia, should be supported in order to be technologically competitive. The government's support and assistance should be more than this with the changes and development our country is achieving. As there is energy wastage in both generation and distribution, the technology should be supported and further developed.

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