Business Plan:
LED Light Enterprise

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EXECUTIVE SUMMARY

Lighting accounts for 19% of the world's electricity consumption. Significant savings of about 40% can be achieved by simply converting to energy-efficient lighting technologies such as Light Emitting Diodes (LEDs). South African energy constraints have contributed to a policy framework intent on converting from old technology and implementing energy-efficient lighting systems. South Africa's LED lighting market is expected to grow by a compound rate of 20% each year until at least 2016, to reach market penetration in general lighting of well over 60% by 2020. The consumer market is filled with offerings from established suppliers that compete mainly on price. Street lighting is a high value, comparatively smaller market. While price is also important quality and value added features are key discriminators in this segment.

The Department of Economy and Enterprise Development (EED) has identified the electronic value addition industry as a catalyst to stimulate economic development, growth and diversification in the North West. The CSIR's Enterprise Creation for Development (ECD) was commissioned to undertake a prefeasibility study in this sector and four value opportunities were identified, namely

- Printed circuit board assembly (PCB): Production of electronic modules.
- Electronic timers: Selected geyser and lighting timers
- LED street lighting: A range of replacement and new installation products
- Prepaid electricity meters: Selected domestic meters

This business plan proposes the establishment of a LED streetlight production enterprise in Mahikeng. It would form part of an electronics cluster envisaged within the province. The LED enterprise will assemble LED streetlight luminaires (the complete lighting unit, excluding street poles) for:

- National/SANRAL and major provincial roads (150 W),
- Urban municipal roads (80 W)
- Rural municipal roads (50 W)

The results from the market, technical and financial analysis indicated that the business could be viable if:

- The enterprise is able to secure sufficient market access through partnerships in the supply chain that serves municipal and SANRAL tenders for new and retrofitted streetlight implementation;
- The PCB enterprise and component manufacturers are able to reliably supply it with quality and affordable components; and
- Funding could be secure for both the establishment year and two additional years of production

As product design is a very costly and time consuming activity, the business plan is based on preliminary conceptual product designs for illustrative purposes. A detailed product development phase leading to fully developed and tested products will be required once the opportunity is pursued further. In turn, this will assist in determining the details of production requirements before committing to the establishment of the related production facilities.

The biggest potential for growth in the lighting industry is in the retrofit market (i.e. upgrading of existing installations), and includes the commercial and public sector.

Although old lighting technologies have a lower initial investment fee, the LED lighting market is growing rapidly based on its energy efficiency and extended lifespan, which translates into savings.

At full capacity the enterprise will produce the various LED streetlight luminaires at the following sales volumes:

- 50 W – 1 200 units (R 5 021)
- 80 W – 1 800 units (R 5 697)
- 150 W – 5 600 units (R 7 744)

The primary market is contractors supplying government tenders for installing and replacing street lamps. Based on the size of the various local market segments, South African municipalities constitute the biggest local demand, followed by SANRAL. The main target market during year one and two will be the North West province, while the national share will need to grow significantly in year three to five. African markets will be targeted for additional sales from the sixth year onwards.

The location for the enterprise is the Special Economic Zone (SEZ), situated next to the Mahikeng International airport. A modern purpose built facility of approximately 1 000 square meters will house:

- Administration
- Semi-automatic assembly facilities
- Testing facilities
- Storage

The business will assemble components such as the control unit, assembled LED array and aluminium casing into complete street lights or luminaires. Control modules and LED arrays will be supplied by the PCB enterprise. All products will be tested prior to dispatch.

The LED enterprise will be managed by a cooperative led by an already identified entrepreneur who is active in the industry. It will have a multi stakeholder management board representing the interests of the funder.

Financial modelling was undertaken using the United Nations Industrial Development Organisation's Computer Model for Feasibility Analysis and Reporting tool. The model is based on the assumption that all investment funds required will be made available as a grant. It was found that if a discount rate of 6% is used:

- The net present value (NPV) is R 44 463 490;
- The internal rate of return (IRR) is 26.81%; and
- The payback period is 7 years.

Because the NPV is positive and the IRR is greater than the discount rate, the business could be deemed financially feasible.

A total investment of R 15 571 000 grant funding will be needed for the establishment of the enterprise as follows:

- Establishment (Year 1): R 3 514 709
- Establishment (Year 2): R 10 094 568
- Production (Year 1): R 1 566 000
- Production (Year 2): R 495 000

Based on the above assumption, the business will have a positive cash flow from the outset. Therefore, it is critical that the involved stakeholders make a long term commitment to fund the establishment and operations of the business.

The socio-economic benefits of the enterprise will include an average Gross Value Addition of R10 513 387 per annum and the creation of new 10 direct jobs.

The establishment of the LED enterprise will be undertaken in a phased manner as outlined below:

- **Phase 1 – Regulatory approvals and engineering design (15 months)**
  - Basic environmental impact assessment and waste management licence.
  - Product engineering design
    - Detailed engineering design
    - Design communication/Design for manufacture
  - Qualification and certification

- **Phase 2 – Facility setup (15 months)**
  - Construction of the LED assembly plant building
  - Procurement of all machinery and equipment, including furniture and office equipment.
  - Registration of the legal entity
  - Recruitment of key staff members
  - Technical and business training

- **Phase 3 – Pilot production (two years)**
  - Pilot production, starting at 19% of capacity Phased increase of production volumes

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GLOSSARY OF TERMS

DTI	-	Department of Trade and Industry
EED	-	NW Department of Economy and Enterprise Development
EPC	-	Energy Performance Contract
LED	-	Light-emitting Diode
MIG	-	Municipal Infrastructure Grant
NAMEC	-	National Association of Manufacturers in Electronic Components
NWU	-	North West University
SADC	-	Southern African Development Community
SAEEC	-	South African Electro-technical Export Council
SAIEE	-	South African Institute of Electrical Engineers
SALGA	-	South African Local Government Association
SANRAL	-	South African National Road Agency
TIA	-	Technology Innovation Agency
NW	-	North West
SEZ	-	Special Economic Zones
IDP	-	Integrated Development Plan
MLM	-	Mahikeng Local Municipality
ECF	-	Employment Creation Fund (ECF)
DST	-	Department of Science and Technology
IPAP	-	Industrial Policy Action Plan
NDP	-	National Development Plan
SADC	-	Southern African Development Community (SADC)
SOE	-	State Owned Enterprise
IDC	-	Industrial Development Corporation
DOE	-	Department of Education
NEF	-	National Empowerment Fund
SMME	-	Small, Medium and Micro Enterprises
ICT	-	Electronics and Information and Communication Technology (ICT)
NMMD	-	Dr Ngaka Modiri Molema District (NMMD)
FET	-	Further Education and Training
SET	-	Science, Engineering and Technology
CHE	-	Council on Higher Education
NWDC	-	North West Development Corporation
REDS	-	Regional Electricity Distributors System (REDS)
OEM	-	Original Equipment Manufactures
IESSA	-	Illumination Engineering Society of South Africa (IESSA)
NLM	-	The Naledi Local Municipality (NLM)
QMS	-	Quality Management System

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1 INTRODUCTION

The Department of Economy and Enterprise Development (EED) identified the electronic value addition industry as a catalyst to stimulate economic development, growth and diversification in the North West. The Council for Scientific and Industrial Research's (CSIR's) Enterprise Creation for Development (ECD) unit was appointed to undertake feasibility studies into the viability of establishing electronic value addition ventures in the North West. If found viable these enterprises could form the basis of an electronics cluster within the province. A Light Emitting Diode (LED) streetlight assembly enterprise was identified as one of the key opportunities with potential to contribute towards the development of this sector. This business plan is based on the viability assessment of the LED streetlight assembly enterprise.

The LED street light luminaire is an integrated light unit consisting of a light fixture and light emitting diodes as its light source. LED is a fairly new option in the lighting sector. In recent times it has been deployed extensively across the world and in South Africa. LED technology has superior attributes compared to traditional incandescent and fluorescent lights in terms of a longer lifespan and higher energy conversion efficiencies.

1.1 Rationale / Intent

The rationale for this project is centred on the following:

- South Africa's LED lighting market is growing significantly and is set on a 60% penetration of the general lighting market by 2020.
- LED lights are being extensively deployed globally and locally due to their energy efficiency and longevity which translates into financial savings when compared to the traditional light technologies. LED street lighting has the potential for electricity savings of up to 70% across all street lighting (The Climate Group, 2014)
- South African energy constraints have contributed to a policy framework intent on converting from old technology and implementing energy-efficient lighting systems.
- The establishment of the LED enterprises could result in the creation of sustainable job opportunities and lead to economic growth and diversification in the North West.
- A local entrepreneur who is already active in the electronics sector has approached EED for support in the establishment of this venture.

1.2 Opportunity description

The enterprise will provide LED streetlight luminaires (i.e. the complete lighting unit excluding poles) to contractors who have been awarded government tenders for installing and replacing street lamps. Based on the size of the various local market segments, South African municipalities constitute the biggest local demand, followed by SANRAL.

At full capacity the LED enterprise will produce a total of 8 600 LED streetlight luminaires annually, comprising of the following product types:

- 150 Watt (W) for national (SANRAL equivalent) and major provincial roads
- 80 W for urban roads
- 50 W for rural roads

The enterprise will be established in Mahikeng and approximately 10 job opportunities will be created.

1.3 Feasibility results

Some of the key results from the feasibility study are included below:

- **Situational analysis (APPENDIX A)**
  The local situation is conducive to the establishment of a LED streetlight assembly enterprise, and such a venture has potential to make much needed local socio-economic impact:
  - The North West's manufacturing sector contributes a mere 4.4% to the provincial economy (2011 figures). Moreover the province has minimal electronic manufacturing activity – most players are installation, service, repair and maintenance enterprises.
  - Unemployment in the province stood at 31.5% in 2011. The human resources required to implement the LED streetlight assembly enterprise would be available in the Mahikeng Local Municipality (MLM), specialised skills could be attracted from outside the municipality or province, if required.
  - The provision of essential services, such as electricity and water is reliable
  - There is an adequate network of road infrastructure that could connect the enterprise to its customers as well as components suppliers.

- **Market study (APPENDIX B)**
  - South Africa's LED lighting market is expected to grow by a compound rate of 20% each year until at least 2016, to reach market penetration in general lighting of well over 60% by 2020. The consumer market is filled with offerings from established suppliers that compete mainly on price. Street lighting is a high value, comparatively smaller market. While price is also important quality and value added features are key discriminators in this segment.
  - LED streetlights are being deployed globally and locally to replace conventional streetlights, in order to reduce electricity costs. This is due to LED technology's energy efficiency and longevity which translates into financial savings when compared to the traditional light technologies. LED street lighting has the potential for electricity savings of up to 70% across all street lighting (The Climate Group, 2014)
  - Significant markets for LED streetlights that have been identified are South African municipalities (especially those in the North West), followed by SANRAL and later expanding to Africa.
  - The biggest potential for growth in the lighting industry is in the retrofit market (i.e. upgrading of existing installations), and includes the commercial and public sector.

- **Technical study (APPENDIX C)**
  - The enterprise will produce 8 600 streetlight luminaires (retrofits and new installations of luminaires).
  - The PCB enterprise will supply control modules and LED arrays to the enterprise and other components will be sourced from other suppliers.
  - The luminaires will be designed and produced according to customers specifications.

- The luminaires will be certified as required by compulsory specifications of electrical products.

- **Financial Analysis (APPENDIX D)**
  - The enterprise could have a positive cash flow from its inception, if a total grant of R15 571 000 is invested into the enterprise over a period its two years of establishment and two subsequent production years.
  - At a discount rate of 6%, the net present value (NPV) is R44 463 490 and the IRR is 26.81%, indicating that the enterprise could be sustainable.
  - The gross value added (GVA) generated by this enterprise is expected to average at around R10 513 387 per annum.

Based on the results of the feasibility study, the LED enterprise could be viable if sufficient market is secured.

1.4 Overall implementation plan

The overall implementation plan for the establishment of the business is illustrated in Figure 1.

Phase		Activities	Duration											
			Establishment Year 1				Establishment Year 2				Production Year 1			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Regulatory Approvals & Engineering Design	Basic environmental assessment	■	■	■									
		Detailed engineering design												
		Detailed circuit design	■	■	■									
		Detailed hardware design	■	■	■									
		Tooling design		■	■	■								
		Prototypes		■	■	■								
		Software design		■	■	■								
		Design for manufacture												
		Product testing				■								
		Final equipment selection				■								
		Qualification & certification												
		Qualification & certification				■	■							
2	Facility set-up	Construction				■	■	■	■					
		Company formation			■	■	■							
		Procurement of equipment							■	■				
		Installation of equipment								■				
		Procurement of office furniture and supplies								■				
		Marketing	■	■	■	■	■	■	■	■				
		Recruitment							■	■				
		Commissioning of machinery								■	■			
		Installation of fittings								■				
		Workforce training									■			
3	Pilot production	Pilot production									■	■	■	■

Figure 1: Phased approach

Table 1 contains the breakdown of the investment costs during the setup phase.

Table 1: Investment cost split at setup phase

Phase		Activities	Establishment Year 1	Establishment Year 2
1	Regulatory Approvals & Engineering services	Basic environmental assessment	R 100 000	
		Engineering design	R 1 990 000	
		Engineering services	R 1 260 000	
2	Facility set-up	Construction		R 7 000 000
		Company formation	R 37 620	
		Procurement of equipment		R 1 093 225
		Installation of equipment		
		Procurement of office furniture and supplies		
		Preproduction expenditure		R 450 000
		Commissioning of machinery		
		Installation of fittings		R 100 000
		Workforce training		R 250 000
3	Pilot production	Pilot production		
Contingencies			R 127 089	R 1 101 343
Total investment (Rand)			R 3 514 709	R 10 094 568

2 BUSINESS AND PRODUCTS

2.1 Description of Products

An LED street light is an integrated light that uses light emitting diodes (LED) as its light source.

The lamp design incorporates two printed circuit boards (PCBs). The first is the control module made up of the LED driver, PCBs, and sensors. The second is an LED Array, which integrates LED chips with a heat sink. Figure 2 illustrates how components integrate to form an integrated lighting fixture. Both PCBs will be sourced from the PCB enterprise, which also forms part of the electronic opportunity analysis.

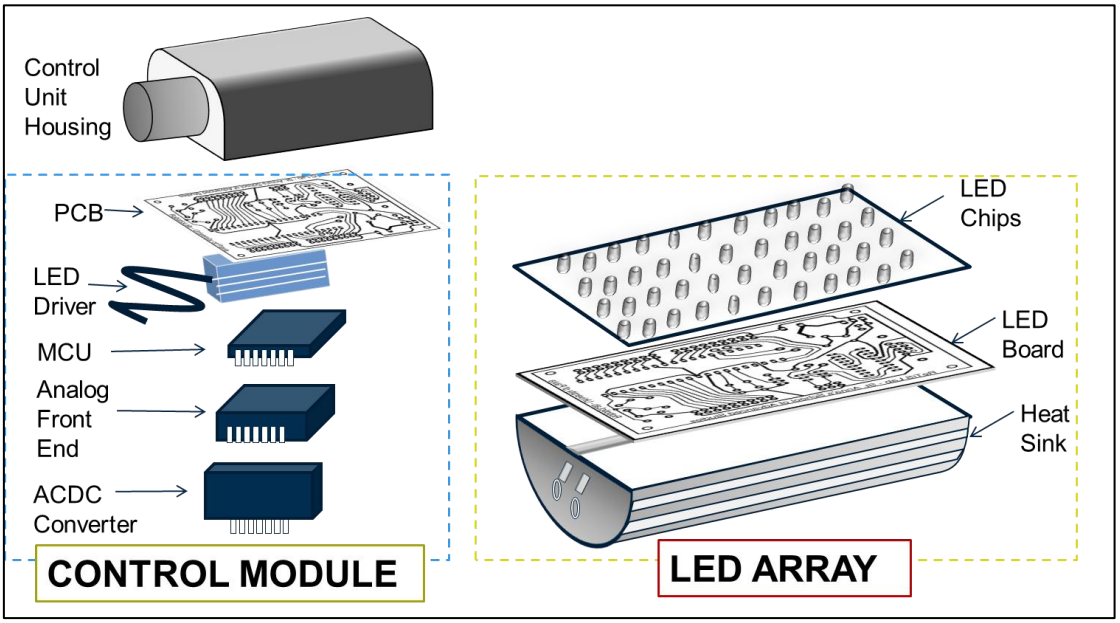

Figure 2: A typical model integrated LED street lamp

Table 2, shows the three LED luminaires that the LED enterprise will assemble.

Table 2: LED products targeted for production

Type	Luminaire 1	Luminaire 2	Luminaire 3
Circuit Power	**150 Watt**	**80 Watt**	**50 Watt**
Application	Replacement for 150 W and 250 W High Pressure Sodium (HPS) lamps on major residential streets and highways.	Replacement for 80 W High Pressure Mercury Vapour (HPMV) lights on residential streets.	Used for residential areas especially in rural areas narrow streets, residential streets and to light private parking lots in residential, and office parks

2.2 Business concept

The biggest potential for growth in the lighting industry is in the retrofit market (i.e. upgrading of existing installations), and includes the public and commercial sector. It is estimated that retrofitting with LED could save energy costs by up to 70% (The Climate Group, 2014).

The market for LED streetlight luminaires (i.e. light source and light fitting) was gauged as follows:

- South African municipalities – an estimated annual requirement of 419 616 units and 3 418 for North West municipalities
- SANRAL – an estimated annual requirement of 16 924 units
- Africa – an estimated annual requirement of 9 000 000 units.

At full capacity the enterprise will assemble the following product volumes for sale:

- 150 W – 5 600 units at R 7 744 each, for national (SANRAL equivalent) and major provincial roads
- 80 W – 1 800 units at R 5 697 each, for urban roads;

- 50 W – 1 200 units at R 5 021 each, for rural roads.

The LED venture will be a mechanical and electrical assembly operation rather than an electronics manufacturer. It will assemble components such as the control module, assembled LED array and aluminium casing – sourced from component suppliers – into complete street lights or luminaires. In order to maximize usage of specialized equipment the PCB assembly enterprise will produce the control modules and LED arrays on order for the LED streetlight enterprise based on supplied design and engineering information. All products will be tested before being packaged and dispatched. This business model is illustrated in Figure 3.

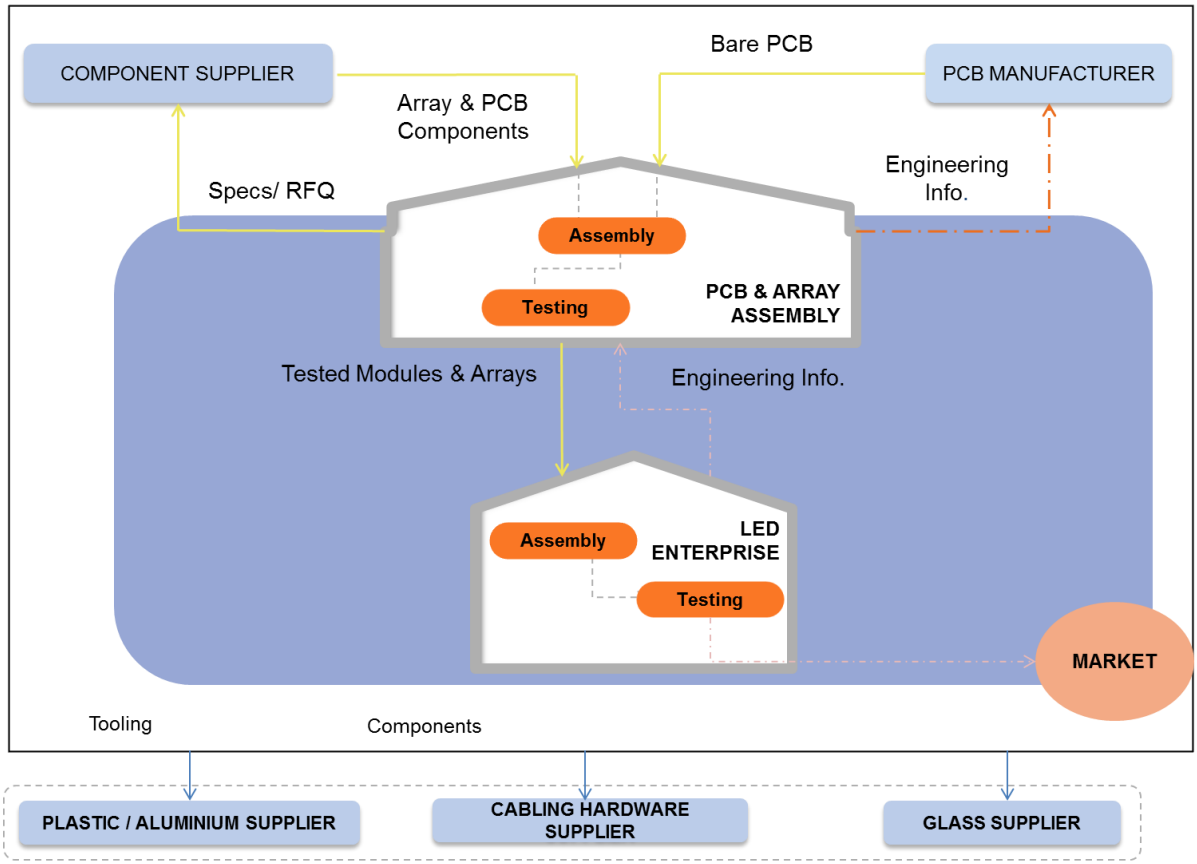

Figure 3 Interrelationship between the LED enterprise and its suppliers

In year 10 the total sales across all product types will amount to R 109.66 million. The enterprise could potentially provide jobs to 10 employees.

2.3 Institutional arrangements

The LED enterprise will be managed by a cooperative led by an already identified entrepreneur who is active in the industry. It will have a multi stakeholder management board representing the interests of the funder. The model is illustrated in Figure 4

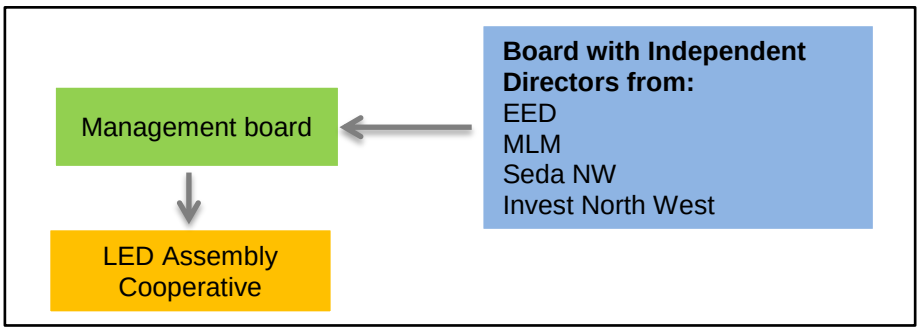

Figure 4: Enterprise model

3 LOCAL ECONOMIC CONTEXT

3.1 Policy and strategy alignment

The enterprise forms part of the electronics sector. The electronics sector in South Africa has been identified as a growth industry that can spark economic activity and create jobs in many national strategic documents. The Industrial Policy Action Plan (IPAP) 2013-2016 identified micro and macro electronics as enabling technologies that can enhance local innovation in various industries (the dti, 2012). The Department of Science and Technology's Technology Localisation Report through the National Industrial Policy Framework identified electronic components that can be manufactured locally leveraging on state owned enterprises procurement programmes (DST, 2008). In 2010 the Department of Trade and Industry published the "Study to identify electronic assemblies, sub-assemblies and components that may be manufactured in South Africa". This report identified sub-sectors in the electronics sector that had the potential to provide scope for local manufacture of electronic products.

3.2 Provincial and local economic context

In 2010 the electronics industry contributed R377 billion to the South African Gross Domestic Product (GDP), and comprised 6.2% of the manufacturing sector (BrandSouthAfrica, 2014). The three main electronics clusters in South Africa are Gauteng, Western Cape and Kwa-Zulu Natal who together house 60% of the electronics manufacturing enterprises. Approximately 60% of the players in the country are classified as small and micro and medium enterprises (SMMEs) and are responsible for the minimal export activity mostly into African countries (the dti, 2010).

Some of the challenges that the industry is experiencing in South Africa are (the dti, 2010):

- Lack of innovation;
- High cost structure of the industry;
- Lack of finance to unlock new markets;
- Availability and application of quality skilled engineers; and
- Barriers to international market access (quality certification and licencing)

The North West's manufacturing sector (of which the electronics industry forms a part) contributed 4.4% to the Gross Regional Product in 2010. The province has minimal

electronic manufacturing activity – most players are installation, service, repair and maintenance enterprises.

The human resource required to implement the LED streetlight luminaire assembly plant is readily available in the MLM.

3.3 Location / Site

The LED streetlight luminaires assembly plant will be established in Mahikeng, within the site earmarked for Special Economic Zone (SEZ), next to the decommissioned Mahikeng airport. It is assumed that sufficient access to municipal water and electricity, as well as bulk infrastructure will be available at the time of establishment.

4 MARKET RESEARCH, ANALYSIS AND PLAN

This chapter summarises the most important aspects relating to the market. Detailed market information is provided in APPENDIX B of this document.

4.1 Customers

The direct customers will be contractors who have been awarded government tenders for installing and replacing street lamps.

The enterprise will target the following market segments:

- Municipalities (urban and rural roads) – initially in the North West and adjacent provinces, expanding to the rest of South Africa from year three onwards;
- National markets (such as SANRAL, and major provincial roads); and
- African markets (national and major provincial roads) from year six onwards.

4.2 Market demand and sales forecast

Various NW municipalities' Integrated Development Plans (IDPs) were referenced to ascertain their street lighting plans and estimated units required. It was estimated that the annual municipal demand for LED streetlights in the province was at least 3 418.

Similarly, the IDPs of SA's ten big metropolitan municipalities were probed and together with the Municipal Infrastructure Grant (MIG), which also provides funding for streetlights, the South African municipalities' annual demand for LED streetlights was estimated at approximately 419 616.

SANRAL's demand for LED street lights was estimated at 16 924 units per annum – taking into account the percentage of its roads that are lit, the lifespan of current older technology streetlights that are due for replacement, and other factors.

The African market for LED street lights was added at 9 million units per annum, based on market research by the International Finance Corporation (IFC).

Based on the above, the main target market during year one and two will be municipalities in the North West and adjacent provinces – to be supplied with a total of 1 600 LED streetlight luminaires annually. The national share will need to grow significantly in year three to five, and a total of 4 100 units will be supplied each year. African markets will be targeted for additional sales from the sixth year onwards resulting in a total of 8 600 units per annum at full capacity.

APPENDIX B contains further information relating to market demand.

4.3 Market prices

Table 3 presents the selling prices for the enterprise's various products, which compares favourably with the average prices listed for comparable products in the market.

Table 3: Market prices

	150 W LED streetlight	80 W LED street light	50 W LED streetlight
Selling price	R 7 744	R 5 697	R 5 021
Average market prices	R7 037 - R11 382	R7 284	R5 160

The average market prices were obtained from various suppliers of LED streetlight luminaires.

4.4 Competition and competitive edge

A number of Gauteng-based national competitors were identified based on a SANRAL tender applicants list, all. The enterprise would likely compete at a provincial and national level with these competitors who have established links to the market.

The enterprise is expected to have a competitive advantage within the NW province as it would be the only company producing LED streetlight luminaires in the province. Price competitiveness and innovative product design will offer additional competitive advantages in the local, national and African markets.

4.5 Marketing and distribution

Since the end customers are various levels of government and related institutions, the enterprise will develop and align its marketing and distribution to government procurement requirements. The venture will partner with installation agents to bid for tenders to supply streetlights to the public sector. In North West it is hoped that the enterprise will be given preference based on regional localisation principles.

The following channels will be utilised for the enterprise's marketing and publication:

- Public private partnerships;
- Business contacts (with the construction sector in particular);

- Exhibitions;
- New media such as websites and social media; and
- Traditional media – where applicable – such as: newspapers, radio and television.

A total budget of R50 000 per annum is allocated to marketing and publication.

4.6 Market implementation plan

The implementation plan for addressing all market related implementation is illustrated in Figure 5:

Activities	Establishment Year 1				Establishment Year 2				Accountability
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
1. Market development									Implementing Agent and General Manager
2. Branding & logo development									Implementing Agent and General Manager
3. Develop & print marketing material									Implementing Agent and General Manager
4. Website development									Implementing Agent and General Manager

Figure 5: Market implementation approach

5 MANUFACTURING AND OPERATIONS PLAN

5.1 Product engineering design

The enterprise will design its own LED streetlight luminaire. This design will become the enterprise's intellectual property (IP). A total budget of R1 990 000 is allocated to the luminaire conceptual design, including product testing and qualification.

More information on engineering design is set out in APPENDIX C

5.2 Production inputs

The primary production inputs for the enterprise will include the following:

- Components (control module, assembled LED array, aluminium housing/casing)
- Utilities (electricity and water);
- Labour
- Logistics costs and
- Packaging materials

APPENDIX C contains further information relating to production inputs.

5.3 Facility

5.3.1 Process flow and facility layout

Figure 6 shows the process flow for the assembly of the LED streetlight luminaires

The process starts with the receiving of various components such as control modules and assembled LED arrays (from the PCB enterprise), as well as aluminium housing (from other suppliers). All components will be inspected and prepared for assembly. A qualified person will perform quality checks on finished products.

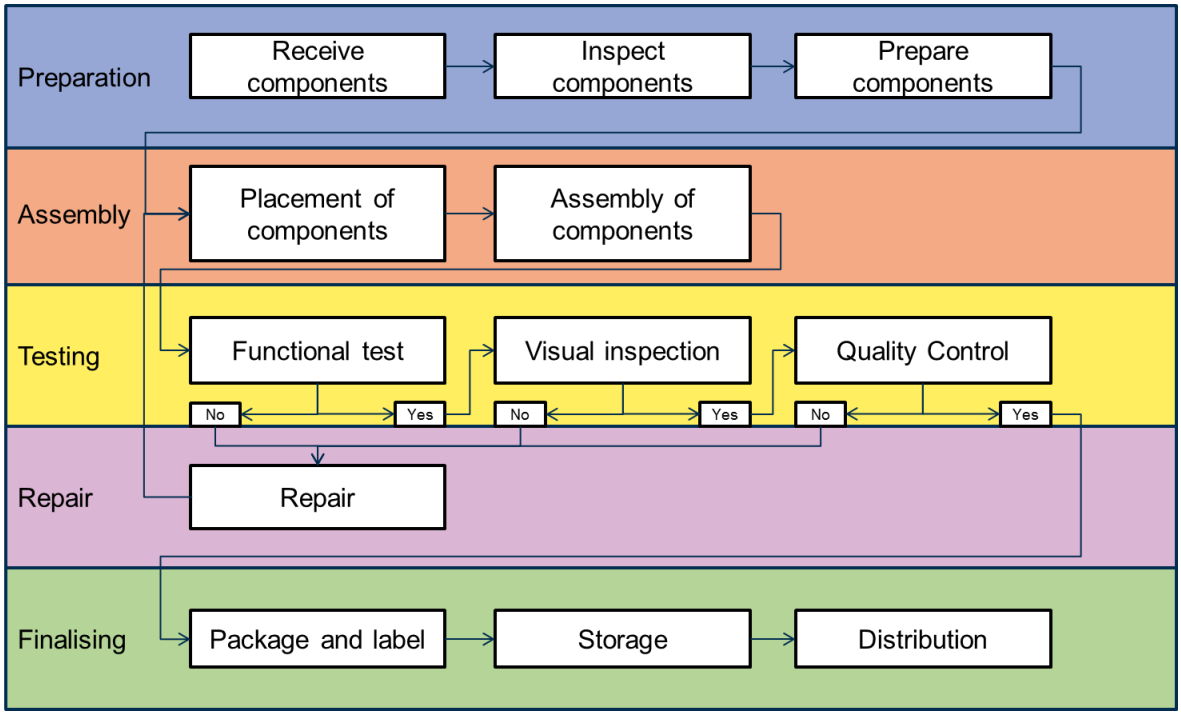

Figure 6: LED streetlight assembly process flow

5.3.2 Space occupied by facility

The LED assembly plant will require a modern purpose built facility of approximately 1 000 m² to be established in Mahikeng. The facility will house the following areas:

- Production area (assembly lines, packing line, testing line and repairs line, area for potential expansion);
- Input components, work in progress (WIP) and finished goods storage areas;
- Offices and boardroom;
- Kitchen area
- Toilets and showers.

It is estimated that the design and construction of the building would cost about R8.26 million.

5.3.3 Utilities

The utilities required for the enterprise are as follows:

- The electricity for equipment will be supplied by ESKOM at an estimated cost of R90 400 per annum.

- Water will be supplied by MLM at an estimated cost of R64 800 per annum.
- Diesel will be purchased from various fuel stations at an approximate cost of R98 460 per annum.

More information pertaining to utilities is set out in APPENDIX C .

5.4 Equipment

The following equipment will be required for the assembly of the LED streetlight luminaires:

- Wire bonder;
- Welding wire machine;
- Sealing / packaging machine;
- Spectrometer;
- Braiding/taping machine;
- Drying cabinet;
- Lamps photoelectric testing instrument
- LED optoelectronic devices;
- High low temperature test box
- Plug line
- Assembly line

A total amount of R805 000 is budgeted for the machinery and equipment above.

5.5 Regulatory and legal issues

In accordance with the National Environmental Management Act (Act No. 107 of 1998) all environmental regulatory requirements need to be addressed before an enterprise can be established. Based on a high level assessment it was determined that a basic environmental assessment accompanied by a waste management licence will be necessary, at an estimated cost of R100 000 (including VAT) and time frame of six to nine months.

APPENDIX C contains more information on regulatory issues and quality standards.

5.5.1 Manuals and operating instructions

Operating manuals for all machinery and equipment will be obtained from respective suppliers. The operating manuals will be incorporated into the standard operating procedures (SOPs), which will be developed to ensure consistency and quality in the production processes.

These operating manuals will also be utilised to train relevant staff members. All operational staff will have access to the copies. Summarised instructions clearly indicating key operations of the machinery will be set out on wall charts close to the relevant machinery and equipment. The main purpose is to maintain quality in the production system.

5.5.2 Material handling systems

On arrival, components will be inspected, neatly sorted and packed in the storeroom. It is important that the enterprise receives components without defect as they would determine the quality of finished products.

Components, WIP and finished products will be moved around the factory by staff members.

5.5.3 Process yield and throughput

The enterprise will produce 8 600 streetlight luminaires per year at full capacity. It will operate from Monday to Friday (i.e. 20 days per month), and eight hours per day. This translates to 39 units per day.

Minimal waste will be produced as the enterprise will only be assembling streetlights luminaires.

5.5.4 Spares lists, consumables and maintenance

The following are the required spare parts (amongst others):
- Valves;
- Sealer;
- Welding Torch; and
- Coils.

It is crucial that the machines are well maintained, because faults or breakage of machinery could adversely affect the production outputs. The maintenance of all the machinery will be done by the supplier of the machinery at least on quarterly basis. The machinery and equipment will however be purchased new, with warranties as part of the package deal.

A total of R14 050 is budgeted for spare parts and general maintenance.

5.5.5 Quality management

The enterprise will develop, integrate and implement the following quality management systems as Integrated Management System (IMS):
- The IPC-A-610D standard for “Acceptability of Electronic Assemblies” focuses on two main principles of standardisation namely: design for manufacture (DFM) and design for the environment (DFE) and will be at the core of the quality management of the enterprise. This document gives guidance on the PCB orientation; inspection methodology; handling of electrical overstress / electrostatic discharge and installation of hardware.
- ISO 9001:2008 - to assist the enterprise with the identification of gaps, to measure, control and improve various core business processes that will ultimately lead to the overall improved business performance
- OHSAS 18001 - all the required measures relating to occupational health and safety, including safety signage; floor demarcations; training and protective clothing

LED streetlights luminaires fall under compulsory specification; therefore, the luminaires will be certified according to the relevant SANS and other standards as applicable to the manufacture or assembly of LED streetlights and as required by the customers or identified markets.

A total budget of R500 000 is allocated to the development of the quality management systems.

More information on quality management is set out in APPENDIX C .

5.6 Supply chain management

Both the inbound and outbound logistics rely heavily on collecting from suppliers and delivering to clients. As such, a Nissan NV 200 panel van will be purchased at R250 000. The control module and assembled LED array will be sourced from the PCB enterprise and luminaire casing (housing) will be sourced from other suppliers. With proper logistics management the one vehicle can service both the supply of input components/materials and the delivery of finished products. It is estimated that approximately R98 460 per annum will be spent on the overall logistics.

5.7 Operations implementation plan

The implementation plan for addressing all operations related implementation is illustrated in

	Establishment Year 1				Establishment Year 2				Production Year 1				
Tasks	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Accountability**
1. Building construction incl. architectural services, civil works, land survey, geotechnical studies													Implementing agent
2. Regulatory issues (e.g. EIA)													Implementing agent
3. Acquisition, installation and commissioning of machinery and equipment													Implementing agent
4. Acquisition of delivery vehicle and trolleys													Implementing agent
5. Acquisition and installation of furniture and IT hardware and software													Implementing agent
6. Product engineering design and product testing													Implementing agent
7. Development of IPC-A-610D													Implementing agent and General Manager
8. Develop ISO 9001:2008 (QMS)													Implementin

												g agent and General Manager
9. Development of OHSAS 18001												Implementing agent and General Manager
10. QMS approval/Product certification												Implementing agent and General Manager
11. Development of wall charts (operating manual)												Implementing agent and General Manager

Figure 7:

	Establishment Year 1				Establishment Year 2				Production Year 1				
Tasks	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Accountability**
12. Building construction incl. architectural services, civil works, land survey, geotechnical studies													Implementing agent
13. Regulatory issues (e.g. EIA)													Implementing agent
14. Acquisition, installation and commissioning of machinery and equipment													Implementing agent
15. Acquisition of delivery vehicle and trolleys													Implementing agent
16. Acquisition and installation of furniture and IT hardware and software													Implementing agent
17. Product engineering design and product testing													Implementing agent
18. Development of IPC-A-610D													Implementing agent and General Manager
19. Develop ISO 9001:2008 (QMS)													Implementing agent and General Manager
20. Development of OHSAS 18001													Implementing agent and General Manager
21. QMS approval/Product certification													Implementing agent and General Manager
22. Development of wall charts (operating manual)													Implementing agent and General Manager

Figure 7: Operations implementation approach

6 HUMAN RESOURCES AND GOVERNANCE

The success of the enterprise will rely on the skills and determination of its human resources. In order to ensure success, it is important to select a full complement of well skilled managers, administrators and production staff.

6.1 Key management personnel

The key management personnel will be the General Manager and the Senior Engineer. The General Manager will oversee the overall operations of the business and business development. The Senior Engineer's key responsibility will be to ensure that correct products are produced efficiently at the right cost and quality level.

More information on human resource requirement is set out in APPENDIX C .

6.2 Industry role players

Key role players include industry associations, the competition (various manufacturers of LED luminaires), street light installation companies, municipalities (district and local) and government (national and provincial), SANRAL, ESKOM and other government agencies and parastatals, as well as universities.

APPENDIX B contains more information on industry role players.

6.3 Supporting professional advisors and services

The LED streetlight assembly operation is both an electronic and mechanical operation. Entities such as the Technology Innovation Agency (TIA)'s Electronic Technology Station and Product Development Technology Station will be consulted for technical advice as and when required.

6.4 Human resource requirements

A total of 10 people will be employed by the enterprise. Figure 8 shows the enterprise's organogram.

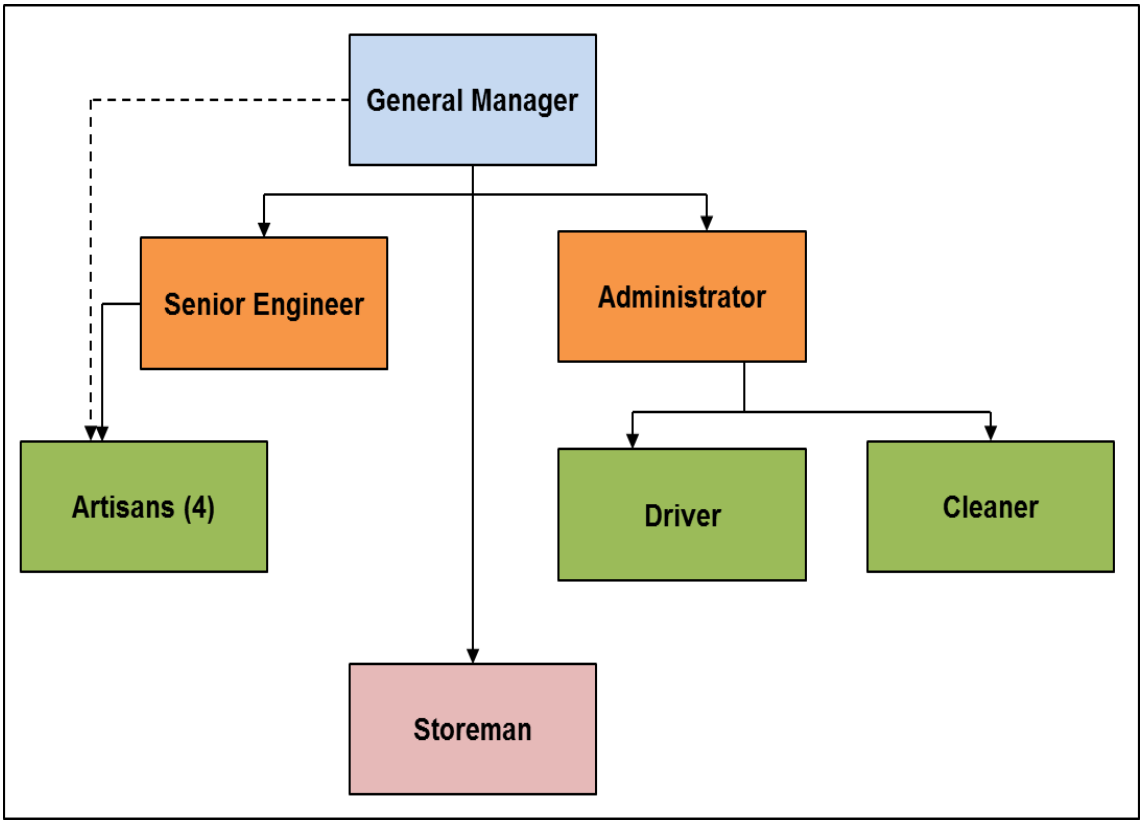

Figure 8: Organogram

The total manpower cost will be R1 490 000 per annum.

Relevant staff members will undergo technical and business training to facilitate efficient operations. A total amount of R250 000 is budgeted for these training activities.

More information on human resource requirements is set out in APPENDIX C .

6.5 Governance

The enterprise will be registered as a cooperative. It will be transparent and accountable, and will be managed according to good corporate governance using the King III principles as a guideline. The management board, which will comprise representatives of stakeholder organisations and beneficiaries, has to oversee the efficient use of resources and require accountability from the manager and employees.

Policies and procedures need to be developed during the business establishment process, and implemented to ensure compliance with legislation, good governance and effective operations. The following aspects need to be covered:

- Governance;
- Procurement;
- Financial management;
- Human resources management;
- General operations; and
- Safety, health and environmental protection

6.6 Human resource and governance implementation plan

The implementation plan for addressing all human resource and governance related implementation is illustrated in

		Establishment Year 1				Establishment Year 2			Accountability
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	
1	Recruitment of staff								EDD and implementing agent
2	Staff training								Implementing agent
3	Identify and engage technical advisors								General Manager and implementing agent
4	Procurement policies								General Manager and implementing agent
4	Human resource policy								General Manager and implementing agent
5	Financial management policy								General Manager and implementing agent
6	Procurement policy								General Manager and implementing agent

Figure 9:

		Establishment Year 1				Establishment Year 2			Accountability
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	
1	Recruitment of staff								EDD and implementing agent
2	Staff training								Implementing agent
3	Identify and engage technical advisors								General Manager and implementing agent
4	Procurement policies								General Manager and implementing agent
4	Human resource policy								General Manager and implementing agent
5	Financial management policy								General Manager and implementing agent
6	Procurement policy								General Manager and implementing agent

Figure 9: Human resource and governance implementation approach

7 RISK MANAGEMENT

The potential risks to the enterprise have been identified and ways to mitigate these. The high risks are listed in Table 4:

Table 4: Risks and mitigation

Risk factor	Risk rating	Mitigation
1. Failure due to inter-dependency between	High	• Incorporate the two enterprises into one.

Risk factor	Risk rating	Mitigation
the LED enterprise and the PCB and LED array enterprise		
2. Unavailability of raw material	High	• Contingency plan to establish a network of suppliers • Identification of alternative or backup suppliers
3. Increase of raw material cost	High	• Sensitivity analysis of cost prices • Negotiating favourable contracts with suppliers
4. Disruption to utility supply	High	• Maintain good relations with the local authorities • Consider own backup power supply
5. Crime (potential theft and robbery)	High	• Employ security company to safeguard assets
6. Conflict and misalignment of expectations from community members	High	• Clarification of expectations before implementation and establishment of the business • Documented roles and responsibilities of all stakeholders
7. Inability to achieve income targets	High	• Build a strong distribution channel and understand the tendering process

8 FINANCIAL PLAN AND ECONOMICS OF THE BUSINESS

This section evaluates the financial outlook of the LED streetlights enterprise. The COMFAR financial modelling software developed by the United Nations Industrial Development Organisation (UNIDO) was used to develop a financial model. Whilst the model is based on information gathered during the feasibility study, it includes a number of key assumptions.

APPENDIX D sets out the full details of the financial analysis, while APPENDIX E lists all of the assumptions and information that was used to develop the financial model.

8.1 Costs

For any operation there are three types of cost that need to be taken into account, namely investment costs, direct operation costs and indirect operation costs. Investment costs are usually once-off costs incurred during the production facility setup or establishment phase for capital expenditure, pre-production expenses and working capital. Both direct and indirect operation costs are incurred only once production starts. Direct operation costs are linked to the number of products produced and sold, while indirect operation costs are incurred irrespective of the number of products produced and sold.

8.1.1 Investment costs

A total investment of R15 571 000 grant funding will be required for the establishment of the enterprise over the following periods:

- Establishment: R 13 510 000
- Production (Year 1): R 1 566 000
- Production (Year 2): R 495 000

The initial investment includes the following items (amongst others):

- The construction of the assembly plant;
- Plant machinery and equipment;
- Working capital
- Product design; and
- Contingencies.

8.1.2 Indirect operation costs

The total indirect cost for the first year of operation amounts to R 2 345 887 and will include the following:

- Electricity – 2%;
- Water – 8%;
- Labour – 60%;
- Factory Overheads – 3%;
- Stationary – 0.51%;
- Audit fees – 1%;
- Bank fees -0.26%;
- Telephone – 1%;
- Internet – 0.38%;
- Insurance -4%;
- Security – 10%; and
- Depreciation – 19%.

8.1.3 Direct product (product related) operation costs

Direct production costs will include raw material, packaging and outbound transportation. Figure 10 to Figure 12 show the cost breakdown for assembling 50W, 80W and 150W LED streetlight luminaire.

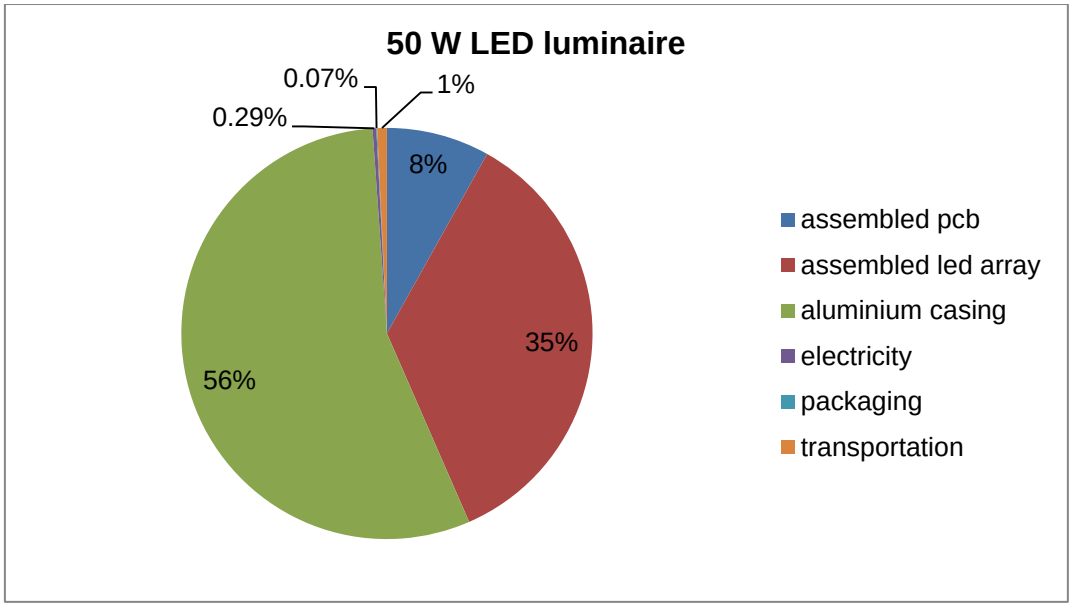

Figure 10: 50 W luminaire production costs

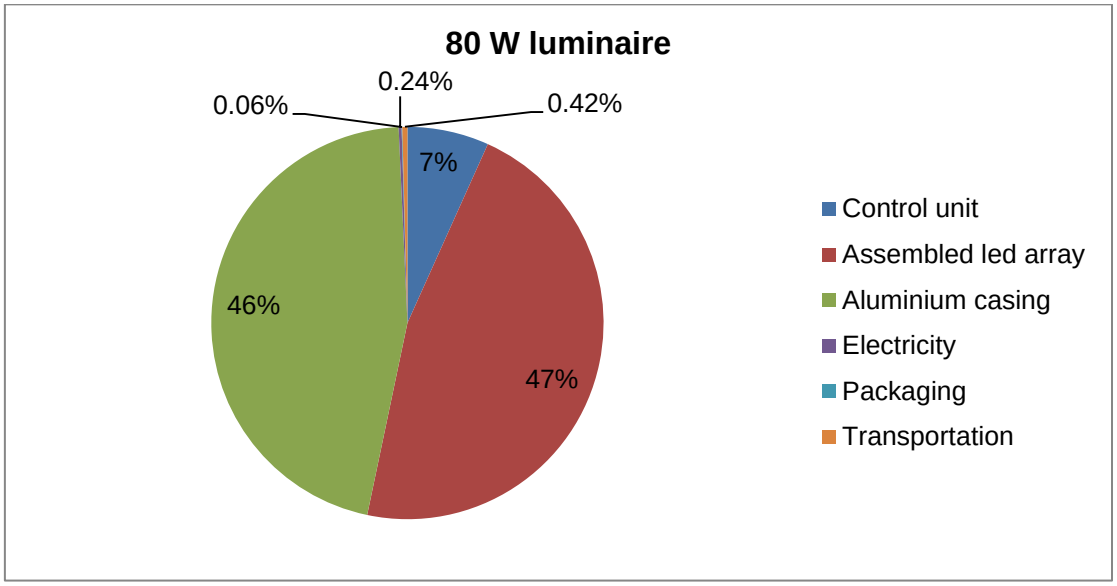

Figure 11: 80 W luminaire production costs

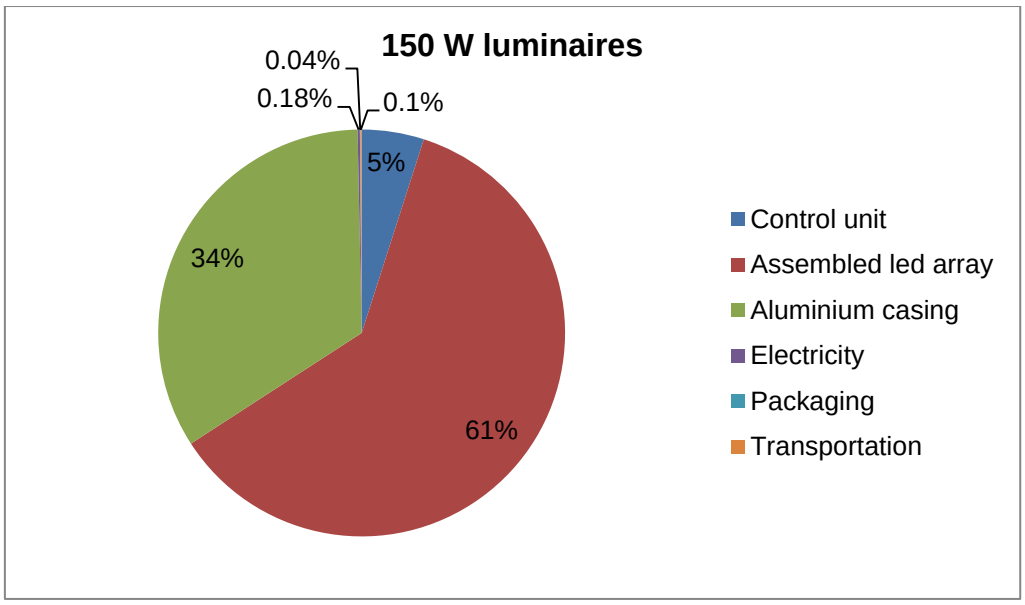

Figure 12: 150 W luminaire production costs

8.2 Predicted ten year financial statements

Based on the cost and sales assumptions, projected ten-year income statement, balance sheet and cash flow forecasts were prepared. Summaries of these statements are included in Table 5, Table 6 and Table 7 respectively.

Table 5: Income statement

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sales revenue	9 609 520	10 282 186	28 391 459	30 378 861	32 505 382	83 656 881	89 512 863	95 778 763	102 483 277	R 109 657 106
Less variable costs	7 227 288	7 733 198	21 363 090	22 858 506	24 458 601	63 479 713	67 923 293	72 677 923	77 765 378	R 83 208 954
VARIABLE MARGIN	**2 382 232**	**2 548 988**	**7 028 370**	**7 520 355**	**8 046 780**	**20 177 168**	**21 589 570**	**23 100 840**	**24 717 899**	**R 26 448 151**
Less fixed costs	2 345 887	2 479 310	2 622 073	2 778 046	2 941 496	3 067 070	3 263 790	3 464 023	3 678 272	R 3 914 525
Material	42 472	45 445	48 626	52 030	55 672	59 569	63 739	68 201	72 975	R 78 083
Personnel	1 414 980	1 514 029	1 620 011	1 733 411	1 854 750	1 984 583	2 123 503	2 272 149	2 431 199	R 2 601 383
Depreciation	439 837	439 837	439 837	443 053	443 053	393 737	403 323	403 323	403 323	R 410 330
Other fixed costs	448 598	480 000	513 600	549 552	588 020	629 182	673 225	720 350	770 775	R 824 729
GROSS PROFIT	**36 345**	**69 678**	**4 406 296**	**4 742 309**	**5 105 284**	**17 110 098**	**18 325 780**	**19 636 817**	**21 039 627**	**R 22 533 627**
TAXABLE PROFIT	**36 345**	**69 678**	**4 406 296**	**4 742 309**	**5 105 284**	**17 110 098**	**18 325 780**	**19 636 817**	**21 039 627**	**R 22 533 627**
Income (corporate) tax	10 177	19 510	1 233 763	1 327 847	1 429 480	4 790 827	5 131 218	5 498 309	5 891 095	R 6 309 415
NET PROFIT	**26 168**	**50 168**	**3 172 533**	**3 414 463**	**3 675 805**	**12 319 270**	**13 194 561**	**14 138 508**	**15 148 531**	**R 16 224 211**

Table 6: Balance sheet

	Establishment year 1 & 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
TOTAL ASSETS	**13 510 000**	**15 812 182**	**16 338 718**	**20 765 348**	**24 192 264**	**28 007 147**	**43 906 875**	**57 146 165**	**71 690 995**	**87 268 522**	**103 951 760**
Total current assets	722	2 742 741	3 709 114	8 499 335	12 369 304	16 612 830	32 732 053	46 374 666	61 322 819	77 189 246	94 282 813
Inventory on materials & supplies	0	614 103	644 559	1 801 601	1 905 020	2 038 371	5 350 596	5 660 451	6 056 683	6 480 651	6 934 296
Work in progress	0	24 682	25 992	64 875	68 660	73 467	184 260	195 002	208 653	223 258	238 886
Finished product	0	177 593	190 024	457 826	489 874	524 165	1 286 309	1 376 351	1 472 695	1 575 784	1 686 089
Accounts receivable	0	1 522 223	1 628 779	3 924 221	4 198 917	4 492 841	11 025 508	11 797 293	12 623 104	13 506 721	14 452 192
Cash-in-hand	0	36 236	38 773	41 487	44 391	47 498	50 823	54 381	58 187	62 261	66 619
Cash surplus, finance available	722	367 904	1 180 987	2 209 325	5 662 442	9 436 488	14 834 556	27 291 187	40 903 496	55 340 571	70 904 730
Total fixed assets, net of depreciation	13 509 278	13 069 441	12 629 604	12 266 013	11 822 960	11 394 317	11 174 822	10 771 499	10 368 176	10 079 277	9 668 947
Fixed investments	0	10 681 658	10 681 658	10 681 658	10 757 903	10 757 903	10 772 314	10 946 555	10 946 555	10 946 555	11 060 978
Construction in progress	10 681 658	0	0	76 245	0	14 411	174 241	0	0	114 424	0
Total pre-production expenditures	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620
Less accumulated depreciation	0	439 837	879 673	1 319 510	1 762 563	2 205 616	2 599 353	3 002 676	3 405 999	3 809 322	4 219 652
TOTAL LIABILITIES	**13 510 000**	**15 812 182**	**16 338 718**	**20 765 348**	**24 192 264**	**28 007 147**	**43 906 875**	**57 146 165**	**71 690 995**	**87 268 522**	**103 951 760**
Total current liabilities	0	710 013	691 382	1 945 478	1 957 931	2 097 010	5 677 467	5 722 196	6 128 518	6 557 514	7 016 540
Total equity capital	13 510 000	15 076 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000
Reserves, retained profit brought forward	0	0	26 168	76 336	3 248 870	6 663 332	10 339 137	22 658 407	35 852 969	49 991 477	65 140 008
Retained profit	0	26 168	50 168	3 172 533	3 414 463	3 675 805	12 319 270	13 194 561	14 138 508	15 148 531	16 224 211
Net worth	13 510 000	15 102 168	15 647 336	18 819 870	22 234 332	25 910 137	38 229 407	51 423 969	65 562 477	80 711 008	96 935 220

Table 7: Cash flow statement

	Establishment Year 1 and 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
TOTAL CASH INFLOW	**13 510 000**	**11 885 533**	**10 777 186**	**29 645 556**	**30 391 314**	**32 644 460**	**87 237 338**	**89 557 591**	**96 185 085**	**102 912 273**	**110 116 132**
Inflow funds	13 510 000	2 276 013	495 000	1 254 096	12 453	139 079	3 580 457	44 729	406 322	428 996	459 026
Total equity capital	13 510 000	1 566 000	495 000	0	0	0	0	0	0	0	0
Total short-term finance	0	710 013	0	1 254 096	12 453	139 079	3 580 457	44 729	406 322	428 996	459 026
Inflow operation - Sales	0	9 609 520	10 282 186	28 391 459	30 378 861	32 505 382	83 656 881	89 512 863	95 778 763	102 483 277	109 657 106
TOTAL CASH OUTFLOW	**13 509 278**	**11 518 352**	**9 964 103**	**28 617 218**	**26 938 197**	**28 870 415**	**81 839 270**	**77 100 961**	**82 572 775**	**88 475 198**	**94 551 972**
Increase in fixed assets	13 509 278	0	0	76 245	0	14 411	174 241	0	0	114 424	0
Fixed investments	10 681 658	0	0	76 245	0	14 411	174 241	0	0	114 424	0
Pre-production expenditures (net of interest)	2 827 620	0	0	0	0	0	0	0	0	0	0
Increase in current assets	0	2 374 837	153 290	3 761 883	416 851	469 480	10 721 155	1 185 982	1 335 844	1 429 353	1 529 407
Operating costs	0	9 133 338	9 772 672	23 545 326	25 193 499	26 957 044	66 153 047	70 783 760	75 738 623	81 040 327	86 713 150
Income (corporate) tax	0	10 177	19 510	1 233 763	1 327 847	1 429 480	4 790 827	5 131 218	5 498 309	5 891 095	6 309 415
Loan repayment	0	0	18 631	0	0	0	0	0	0	0	0
SURPLUS (DEFICIT)	**722**	**367 181**	**813 083**	**1 028 338**	**3 453 117**	**3 774 046**	**5 398 068**	**12 456 631**	**13 612 309**	**14 437 074**	**15 564 160**
CUMULATIVE CASH BALANCE	**722**	**367 904**	**1 180 987**	**2 209 325**	**5 662 442**	**9 436 488**	**14 834 556**	**27 291 187**	**40 903 496**	**55 340 571**	**70 904 730**

As depicted in Table 5, profits are realised from Year 1. The income statement shows a financially viable operation and profit grows from R26 168 in the first year to R16 224 211 in the tenth year. The income statement is also based on the assumption that there will be no dividends throughout the operation of the business.

Table 6 shows the enterprise's balance sheet. At Year 10 the business would have retained cash reserves of just over R65 million.

Table 7 shows the enterprise's cash flow statement. The business will have a positive cash flow from Year 1 onwards. Grant funding of R13 510 000 is required for the establishment of the LED streetlight enterprise. The cash balance at Year 10 is R70 904 730.

If the required funding could be secured for the establishment and the first two years, the business will have a positive cash flow from the beginning. Therefore it is critical that the involved stakeholders make a long term commitment to fund the establishment and operations of the business.

It will be the responsibility of the business (or the implementing agent) to motivate on an annual basis to the applicable government departments the amount of funding required for the continued operation of the business.

8.3 Financial analysis

8.3.1 Financial ratios

If a discount rate of 6% is used:

- The net present value (NPV) is R44 463 490.
- The internal rate of return (IRR) is 26.81%
- The payback period is seven years

Because the NPV is positive and the IRR is greater than the discount rate, the business could be financially feasible.

8.3.2 Sensitivity analysis

The sensitivity analysis was performed on the component costs (for assembling luminaries), labour costs and the products selling price. Table 8 shows the outcome of the sensitivity analysis.

Table 8: Sensitivity analysis results

		Likely	Increase by 10%	Decrease by 10%
Components	NPV	R 44 463 490	R 22 640 133	R 65 932 807
	IRR	26.81%	17.51%	34.62%
	Payback period	7	8.64	5.94
Labour Costs	NPV	R 44 463 490	R 43 397 865	R 45 480 972
	IRR	26.81%	26.24%	27.34%
	Payback period	7	7	7
Product Selling Prices	NPV	R 44 463 490	R 72 608 140	R 15 835 736
	IRR	26.81%	36.42%	14.5%
	Payback period	7	5.7	9.4

The sensitivity analysis indicated that the NPV and IRR will remain positive if the variable costs (components, labour and selling price) are increased by 10%. However, the following additional grant funding will be required:

- R1.8 million in year 1 – if the selling price decreases by 10%; and
- R471 000 and R 746 00 in year 1 and year 2 respectively – if components cost increase by 10%.

8.4 Economic benefits of the business

The establishment of government funded ventures mainly aims at sparking economic activity in a chosen specific area. Job creation also remains high on the government agenda. It is therefore important to analyse the potential of this venture to create jobs and livelihoods in Mahikeng.

8.4.1 GVA

Gross Value Added (GVA), also known as the localised gross domestic product (GDP) is a measure of the value of goods and services produced and delivered in an area, industry or sector of the economy. It takes into account revenues, final sales and net subsidies, which are incomes into the business, as well as salaries, wages and dividends. The GVA is an indication of the economic activity that can take place in a certain geographical area, brought about by the establishment or operation of a venture. GVA is calculated by adding the average net profit, the average annual depreciation and the salary spend.

The GVA for this venture is expected to average at R10 513 387 per annum.

8.4.2 Jobs

Based on the number of people needed to operate the operations, management and auxiliary staff, the venture could yield 10 direct job opportunities. The job opportunities would include the following:

- Qualified staff: General Manager, Senior Engineer, Artisans (X2) and Administrator;
- Grade 12 level jobs: Operators (X2), Store-man; and
- Low skill jobs: Truck Driver and Cleaner

These jobs could be filled from the Mahikeng population.

APPENDIX A SITUATIONAL ANALYSIS

A.1. INTRODUCTION

The National Infrastructure Plan published by the South African government in 2012 identified the North West (NW) province as an area for investment. Based on output and average annual growth, the NW province offers excellent opportunities and prospects in various industries, particularly within the fabricated metal and food industries. The NW EED strives to create market opportunities and a supportive environment to attract business and investment into the North West.

The dti's electronics report released in June 2010 identified nine electronics sub-sectors that could yield potential manufacturing opportunities in South Africa (the dti, 2010).

EED has the intention of stimulating local economic development, diversifying the provincial economy and assisting business to capitalise on the results of the dti sector study. The department thus contracted CSIR's Enterprise Creation for Development (ECD) to investigate the feasibility of establishing an electronics industrial park either within Tlokwe Municipal area or within the Rustenburg Municipal area. At the project's kick-off meeting EED decided – based on the past experience with similar initiatives – that in the short term it would be more beneficial to identify specific electronic manufacturing opportunities that could be investigated for potential enterprise establishment in Mahikeng. The development of such electronic manufacturing enterprises could have a catalytic effect that will attract further electronic opportunities. This would thereby give impetus towards eventual establishment of the industrial park while contributing to local economic growth, diversification and job creation.

This initiative aligns well with some of the national, provincial and local government policies and strategies.

- The dti electronics report has identified nine sub-sectors in the electronic sector.
- The Industrial Policy Action Plan (IPAP) 2013-2016 has identified the micro and macro electronics as technology enablers for local innovation enhancement in various industries in South Africa.
- The National Development Plan (NDP) has prioritised the promotion of export and competitiveness of supplier industries.
- The DST 2010 Technology Localisation Plan addresses the capital expansion programmes of both Eskom and Transnet. In an effort to reduce imports these programmes have earmarked products and technologies for local manufacture – among them electronic components and instrumentation are identified as items for local procurement.
- The Renewable Energy Strategy of the NW province. This strategy highlights the plans of the province for electrification of rural houses, the adoption of renewable energy especially solar power. These provide context for the development of the electronics sector in the province.

The following incentive is available to the industry:

- The Employment Creation Fund (ECF) from the dti. The ECF provides gap and risk funding to national government departments and agencies, provincial government departments and agencies, local government departments and agencies, private sector enterprises, non-governmental organisations (NGOs,) community-based organisations, industry associations, co-operatives, and non-profit organisations

within the borders of South Africa. This fund could assist in the establishment of the LED enterprise.

A.2. METHODOLOGY

ECD's methodology for conducting the project is structured according to project phases as follows:

- Phase 1: Pre-Feasibility Study
- Phase 2: Feasibility Study
- Phase 3: Business Plan or Report

A.2.1. Pre-feasibility study

The purpose of the prefeasibility study (phase one) was to define and qualify four potential electronics manufacturing opportunities for further investigation. All nine sub-sectors identified in the dti report (the dti, 2010) were profiled. From these profiles, a list of opportunities was identified based on three potential indicators:

- A modest component list;
- High demand prospects; and
- Limited technology requirements.

In order to filter down to four opportunities as per the mandate received from EED, a prioritisation matrix was used.

The prioritisation matrix used the following criteria:

- **Relevance** – The opportunity's relevance was evaluated with regards to national priorities and strategies. Points were allocated for the applicability of the opportunity to:
  - DST's Technology Localisation Plan (2010);
  - District and local municipality Integrated Development Plans (IDP) in the NW province;
  - The NDP 2030;
  - The IPAP 2013-2016;
  - Any other national strategy found to be relevant to the particular opportunity
- **Demand** – The extent to which the perceived total demand for each opportunity provides justification for it to be further investigated. Scores were allocated based on low, medium or high potential demand within the following regions:
- The NW province;
- South Africa;
- The Southern African Development Community (SADC);
- Africa; and
- The world
- **Capacity** – Evaluation of the opportunity based on the *national capacity utilisation* of the sub-sector within which it falls. This refers to the extent (percentage) to which the available production capacity is utilised nationally (e.g. a 60% national utilisation capacity would mean that the country only produces 60% of what it has capacity to

produce in a particular sub-sector). Allocation was based on utilisation brackets (e.g. greater than 60% allocates one point whereas utilisation above 91% allocates four points) and the reasons for said utilisation were also taken into consideration. Another assumption made was that the more production capacity is utilised the more opportunities for supply of sub-assemblies would be available for the enterprise.

- **Existing research and development (R&D) / Intellectual property (IP)** – The availability of local (SA) R&D and IP for the development of the opportunity's products. The rating was based on the following sub-criteria:
  - Existing research;
  - Local IP; and
  - Open IP from international sources
- **Infrastructure development programme** – The extent to which each opportunity could leverage from infrastructure development programmes of different state-owned enterprises (SOE's). Procurement programmes from the following SOE's were studied for potential alignment:
  - Prasa
  - Eskom
  - Transnet
  - Telkom; and
  - Any other SOE found to be relevant to an opportunity

Each criterion was then weighted to reach a final score based on importance. Figure 13 depicts the prioritisation matrix used to shortlist opportunities.

Relevance	Demand	Capacity	R&D part of current Scope/ Available IP	Infrastructure Development Programme
10%	20%	20%	20%	30%
DST Localisation = 1	Immediate Local demand=1	<60% = 1	Current Research = 1	Prasa = 1
Alignment with relevant IDP = 1	RSA=1	61% -70% = 2	Indigenous = 1	Eskom =1
Alignment NDP = 1	SADC=1	71% -90% =3	International Demand = 1	Transnet =1
IPAP = 1	Africa=1	>91% = 4		Telkom =1
Alignment to national priorities = 1	International = 1			Other SOE=1

Figure 13: Prioritisation matrix used to shortlist opportunities

The outcome of phase one identified the following four opportunities for further investigation towards enterprise development:

- Electronic timers;
- Prepaid electricity meters;
- Light emitting diode (LED) technology - mainly street lights and traffic lights; and
- Printed circuit boards, as a feeder opportunity to the other three and possible contract manufacturing

A.2.2. Feasibility Study

For each of the four electronics manufacturing enterprises, primary and secondary data was used as inputs to analyse the situation, market and technical aspects during the feasibility phase.

Primary data was gathered through personal interviews, site visits, telephonic interviews and e-mails. Secondary data was gathered through internet searches and reviewing various documents on the product, market, industry, the local context and policies.

Key stakeholders consulted include the following:
- North West University (NWU);
- EED;
- Dti and DOE;
- LED component distributors, and
- CSIR
- Industrial Development Corporation (IDC)
- National Empowerment Fund (NEF)
- Eskom

The data sources consulted are listed in the bibliography.

The results of the analysis were used to develop a financial model using the United Nations Industrial Development Organisation's (UNIDO) Computer Model for Feasibility Analysis and Reporting (COMFAR) tool. Conclusions and recommendations were made after the results of the financial model were analysed. Based on the overall results of the study and the client's desires, a business plan (in case of positive prospects), or a feasibility project report (in case of negative prospects) is compiled.

A.3. OPPORTUNITY

Based on the pre-feasibility study, the EED commissioned the investigation of a potential opportunity for the establishment of an LED assembly enterprise in the Mahikeng, North West province. This enterprise will assemble LED street light luminaires. The LED street light luminaire is an integrated light unit consisting of a light fixture and light emitting diodes (LED) as its light source.

A.3.1. Intent and rationale

LED is a fairly new energy efficient option in the lighting sector that has in recent times been deployed extensively across the world and in South Africa. The technology promises superior attributes that include a longer lifespan and higher energy conversion efficiencies, when compared to the traditional incandescents and fluorescents.

A.3.2. Opportunity Description

The LED enterprise has an opportunity to deliver LED street light luminaires to the market.

The following products will be assembled:

- 50 W street light luminaires predominantly for rural road settings
- 80 W street light luminaires predominantly for urban road settings
- 150 W street light luminaires predominantly for national and major provincial road (SANRAL equivalents) settings

The main target market will be the government (municipal, provincial and national) via tender opportunities – approached in cooperation with related service providers.

Figure 14 depicts the summary of this opportunity.

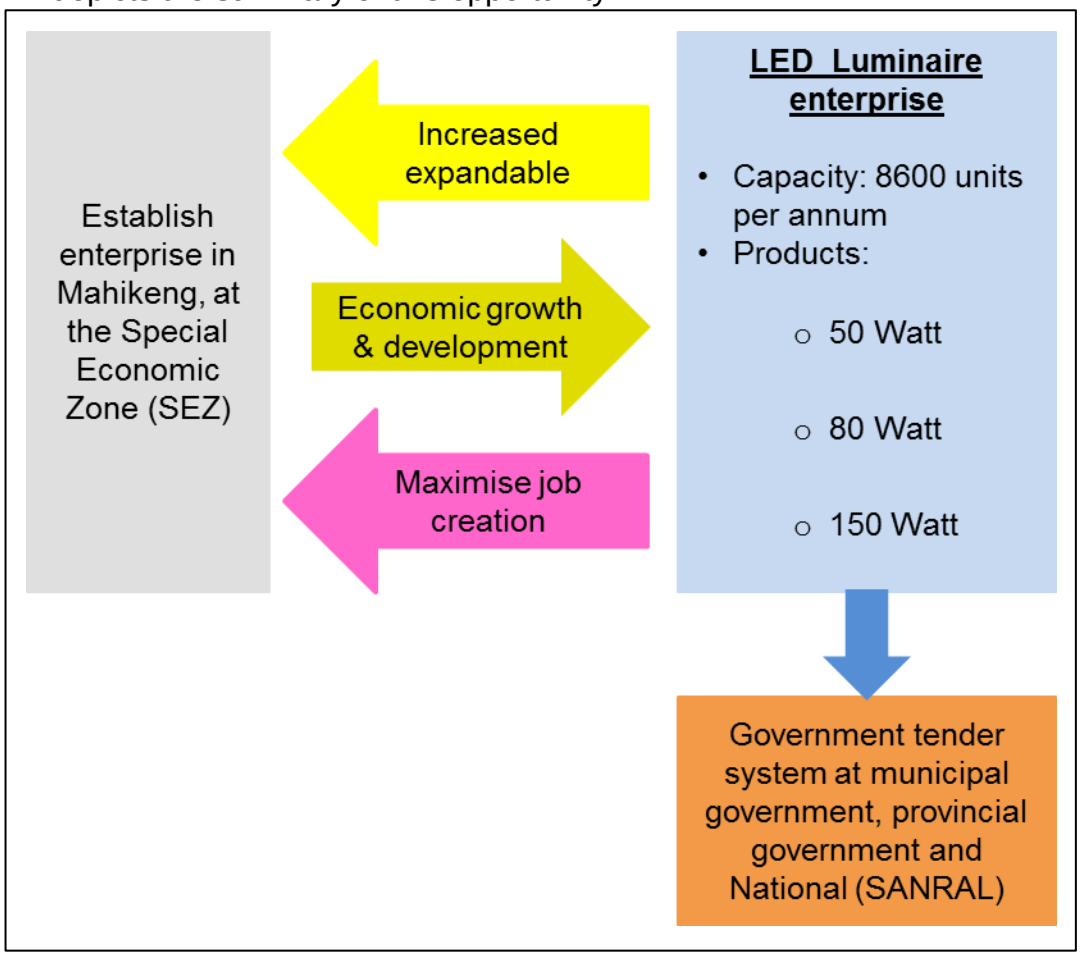

Figure 14: Opportunity description

A.4. LOCAL CONTEXT

All over the world the electronics industry enables the growth of a country's overall economy, and it is no coincidence that the most developed countries all over the world have a thriving electronics industry (ADEC, 2014). Electronics and Information and Communication Technology (ICT) sectors are amongst the sectors that are targeted by the dti for development. These sectors have important roles to play in the South African economy, because of their direct contribution to advanced manufacturing, high value production and the knowledge base of their highly skilled employees (SAVANT, 2011).

In 2006, the electronics sector contributed 60% to the South African GDP. The highest contributing sub-sectors were defence, mining, medical and security. South Africa however possesses minimal IP as compared to its developing counterparts in Asia who command 47% of the electronics market (the dti, 2010).

Approximately 60% of the players in the country are classified as small and micro and medium enterprises (SMMEs) and are clustered in the Western Cape, Gauteng and Kwa-Zulu Natal. These SMMEs are responsible for the minimal export activity mostly into African countrie (the dti, 2010) s. The South African Electrotechnical Export Council (SAEEC) housed within the dti is responsible for the facilitation and enhancement of export activities within the country.

Some of the challenges that the industry is experiencing in South Africa are (the dti, 2010):

- Lack of innovation;
- High cost structure of the industry;
- Lack of finance to unlock new markets;
- Availability and application of quality skilled engineers; and
- Barriers to international market access (quality certification and licencing)

A.4.1. Provincial and Local Economic Context

The NW province has a total land area of 104 882 square kilometres and borders the Limpopo Province to the north, Gauteng to the east, the Free State to the south east, the Northern Cape to the south and Botswana to the North West (wikipedia, 2015).

The province is demarcated into four district municipalities, of which Dr Ngaka Modiri Molema District (NMMD) is one. It is in the Mahikeng Local Municipality (MLM) of this district that the LED lighting manufacturing enterprise will be established.

MLM is large compared to the other four local municipalities located within NMMD. The total area covered by MLM is approximately 2 457 square kilometres (wikipedia, 2015). It is divided into 28 wards consisting of 102 villages and suburbs.

The major economic sectors in the North West Province are shown in Table 9. Eighty three percent of the total economic activity resides in Tlokwe, Klerksdorp and

Rustenburg. Manufacturing is strongly based in Rustenburg, Klerksdorp and Brits (StatsSA, 2012).

Table 9: Major economic sectors in the North West Province

Sector	Contribution to NW RGDP
Mining	33.6%
Agriculture	2.1%
Government Services	12.1%
Finance and Business Services	11.1%
Manufacturing	4.4%

(StatsSA, 2012)

There are a few actors in the electronics industry within the province however; most players are installation, service, repair and maintenance enterprises. There are three power electronics manufacturing plants in Rustenburg namely RusMo1, ABB Manufacturing plants and CBI electric – an industrial timer manufacturer situated in Brits. Figure 15 depicts the players of the different sub-sectors of electronics within the province.

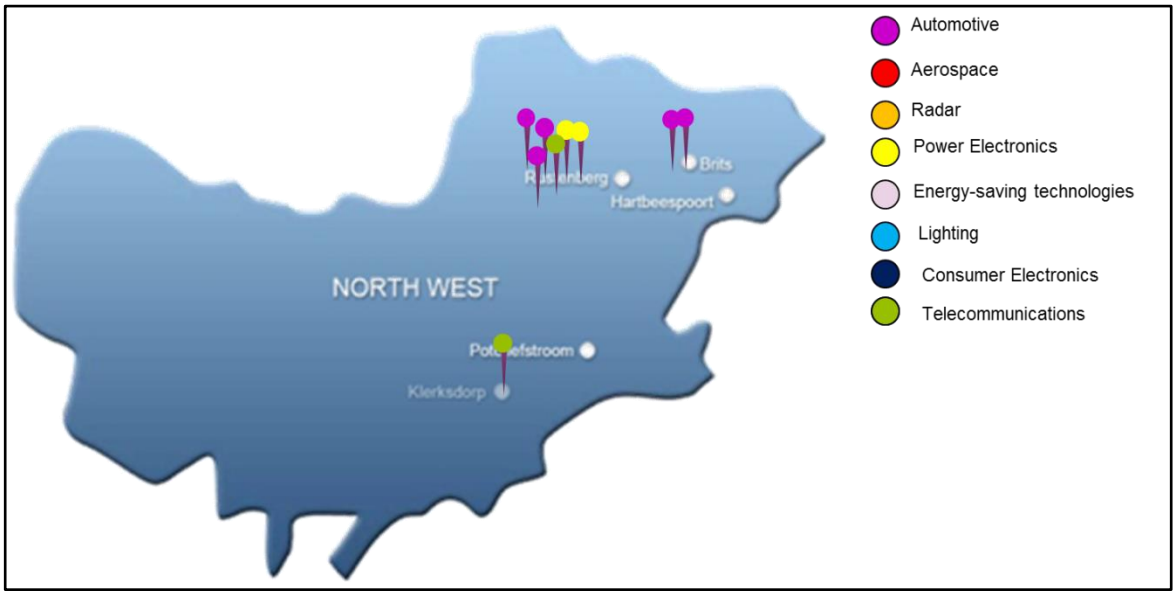

Figure 15: Electronics players in the North West

A.4.1.1. Human Capital

The unemployment rate for the province was 31.5% in 2011, compared to the national rate of 29.8%. However, in line with the national trend, the rate has improved from the 2007 figure of 42.7% (StatsSA, 2011).

Labour is one of the key resources towards the production of goods and services. Moreover, the availability of workers with the right kind of skills is required. Skills could include experience from previous jobs, as well as academic and vocational qualifications. The level of education in an area gives an indication of the skills level and trainability of the available local labour supply.

Figure 16 illustrates the level of education in NW. An estimated 23% of the population in Mahikeng have completed grade 12, compared to the provincial rate of 18%.

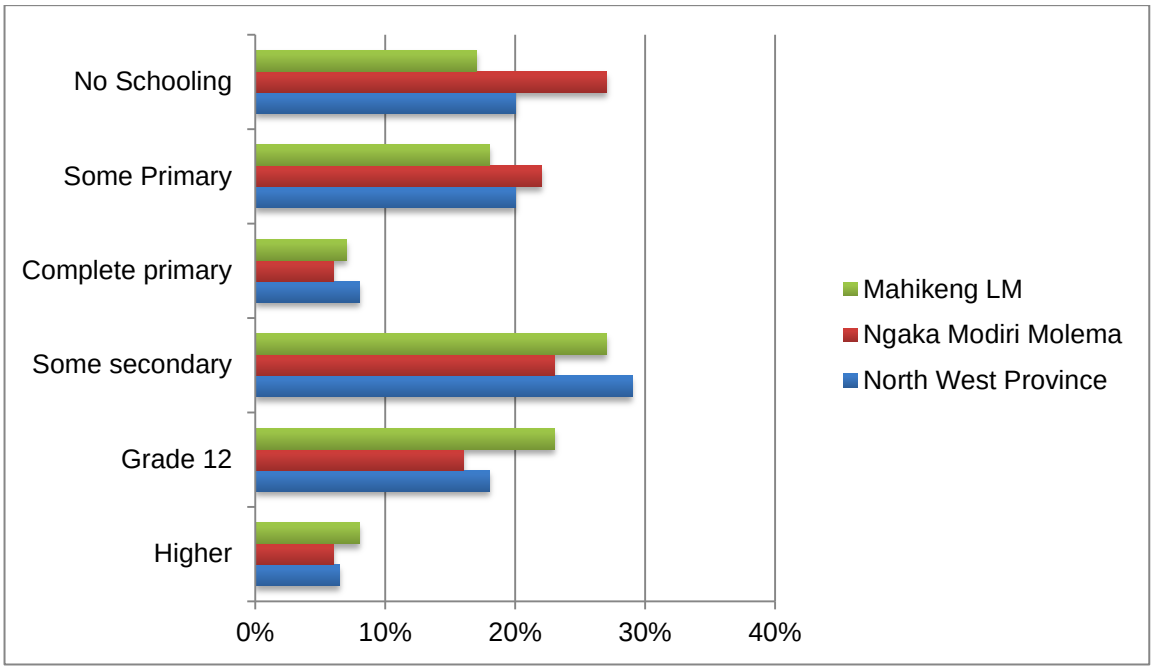

Figure 16: Level of education in the North West province, 2011
(IRR, 2014)

According the 2010 North West University annual report, the average enrolment to the institution is around 56 000 students, scattered around their three campuses in Mahikeng, Potchefstroom and Vaal Triangle. The Science, Engineering and Technology (SET) enrolment is estimated around 10 000 students, with 83.5% of them expected to graduate after a minimum of period of three years. This provides a healthy potential pool of SET graduates to work in the enterprise (NWU, 2010).

According to the FET Colleges 2012 report, there are three Further Education and training (FET) colleges in North West. These colleges are Vuselela FET (Klersdorp), Taletso FET (Mahikeng) and Orbit FET (Rustenburg, Mankwe and Brits). Combined, these colleges have an average enrolment of 160 000 students, of which approximately 6 000 are engineering learners, with a 63% graduation rate (CHE, 2012).

A.4.1.2. Infrastructure

Industrial infrastructure
Industrial activity is concentrated in the larger towns of the province. The development of industrial parks as a major driver for economic development is a priority to the province, in line with the national IPAP.

The North West Development Corporation (NWDC) is currently driving and administering a number of light industrial parks in the North West province. The corporation also aims to expand its developmental impact across parts of the province, where it does not yet have a footprint, by erecting more light industries.

There are industrial areas in all the main towns of the province. These include Rustenburg, City of Matlosana, Tlokwe (Potchefstroom), Vryburg, Wolmaransstad Zeerust, Mahikeng and Brits.

Transport infrastructure

The NW province relies primarily on road infrastructure to transport its goods to the mainstream market nodes. Rail plays a secondary role and is also used for passenger transportation. Figure 17 illustrates the provincial road infrastructure which connects it to other provinces and the neighbouring SADC countries.

Figure 17: North West province road infrastructure

MLM is well connected to the rest of NW and its bordering provinces, via the N4, R45 and the R503.

The two commercial airports closest to the town are OR Tambo International airport and Kimberley.

Telecommunication

Fixed line telecommunications are mostly managed by Telkom, the public utility. South Africa's second landline operator, Neotel, is now also offering its services to both commercial and individual users. There are four cellular networks for voice and data communication.

Electricity

Eskom is currently responsible for all aspects of electrical power supply in MLM's area of jurisdiction. This arrangement may be altered once the proposed Regional Electricity Distributors System (REDS) is introduced, but it is not yet clear exactly when and how this will be implemented.

A.4.2. Location / Site

The identified location for this initiative is Mahikeng next to the Mahikeng International airport. The site was previously earmarked to be an IDZ, but was subsequently revised to become a special economic zone (SEZ). The Airport is currently decommissioned, but with improved SEZ activities the airport should become active again.

Figure 18 presents an aerial picture of the SEZ, adjacent to the airport.

Figure 18: Site location

The site is off the N4 highway interchange, the road to the airport is of an acceptable condition and it allows for connectivity to transport interchanges. There is sufficient transport infrastructure to support raw materials and post production logistics.

APPENDIX B MARKET ANALYSIS

B.1. INTRODUCTION

A thorough market analysis is required as part of the feasibility study of an enterprise in order to determine the factors, conditions and characteristics of the market. This assists in defining the target market and the potential it has to sustain the enterprise.

This LED market assessment analysed the following aspects relating to the enterprise:

- Industry context (key role players, the value chain, etc.) and industry trends (local, national and international)
- Market size / demand for the product, market share and market prices
- Competition and barriers to entry
- Distribution, and
- Promotion

B.2. LIGHT EMITTING DIODE (LED) PRODUCTS

The LED lighting sector is divided into two product categories (Bhandarker, February 2011):

- **LED lamps market**: A **lamp/light bulb** is a replaceable component designed to produce light from i.e. electricity. In addition to its light producing mechanism (which could be halogen-based, tungsten-based, fluorescent-based, diode-based, etc.) it consists of a transparent /translucent glass housing and a base (of ceramic, metal, glass or plastic), which makes an electrical connection in the socket of a light fixture. LED lamps have a lifespan and electrical efficiency that is several times better than incandescent lamps, and significantly better than most fluorescent lamps, with some chips able to emit more than 100 lumens per watt. The LED lamp market is forecasted to grow 21% to $12.2 billion in 2018 globally. This sector is still experiencing pressure from competing traditional technologies but favourable growth forecasts present opportunities (Strategies Unlimited, 2014).
- **LED luminaire market**: A luminaire is a complete lighting unit consisting of a lamp(/s) together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply. The LED luminary sector is forecasted to grow 12% globally to $21.3 billion in 2018. This segment of the industry is driven by commercial, industrial, outdoor and architectural demands for LED products (Strategies Unlimited, 2014).

The LED sector has diverse products and applications crossing both industrial and household demand. Figure 19 shows the two classifications for LED products: **lamps** (various types of bulbs produced with LED) and the **luminaires** (and their applications).

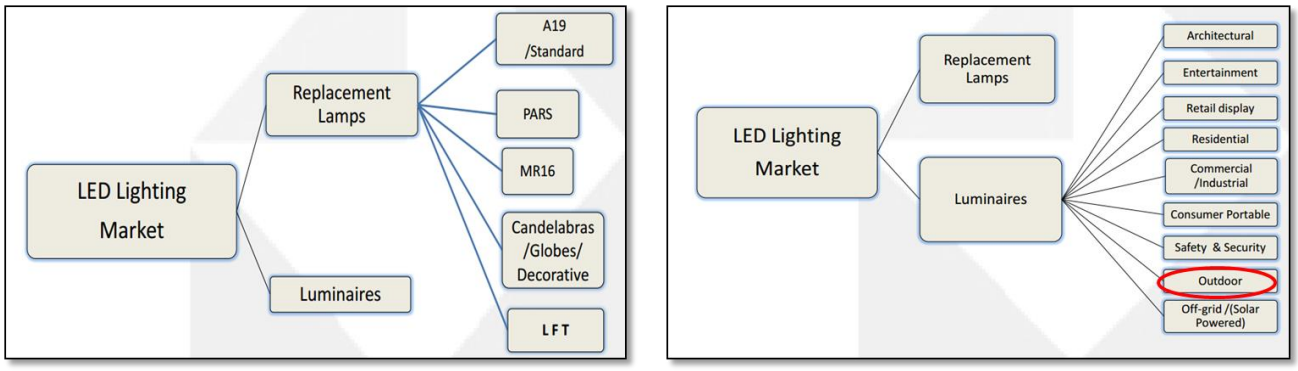

Figure 19: LED product classification

According to LED lighting global market trends, LED luminaires represent 60% of the global market of LED products (Strategies Unlimited, 2014).

The LED enterprise will focus on the development of outdoor LED luminaires, which covers street lights, traffic lights and a variety of lit traffic signals.

The three LED street lights targeted for production at the LED enterprise are the 150 watt, 80 watt and the 50 watt. Table 10 shows the market application for the targeted products.

Table 10: LED products targeted for production

Type	Luminaires 1	Luminaires 2	Luminaires 3
Circuit Power	**150 Watt**	**80 Watt**	**50 Watt**
Application	It replaces the 150 W and 250 W High Pressure Sodium (HPS) lights on major residential streets and highways and it produces a distinct clear, brilliant white light.	It is generally used to replace 80 W High Pressure Mercury Vapour (HPMV) lights on residential streets. It produces a distinct clear, brilliant white light, creating a safer environment for residents.	It is used for residential areas especially in rural areas and to light private parking lots in residential and office parks
Fit	**National and major provincial roads**	**Urban municipal roads**	**Rural municipal roads**

B.3. INDUSTRY CONTEXT

B.3.1. Industry role players

Table 11 lists some of the stakeholders identified as key to the LED enterprise.

Table 11: Industry role players

Industry Role Player	Role	Websites
Eskom	The primary electricity producer in South Africa	www.eskom.co.za
South African Local Government Association (SALGA)	The collective advocacy group for South African municipalities	www.salga.org.za
Association of Municipal Electricity Utilities of South Africa (AMEU)	Manages technology quality standards for municipalities	www.ameu.co.za
National Association of Manufacturers in Electronic Components (NAMEC)	Industry body: black owned electronics manufacturers	www.namec-africa.org.za
South African Electro-technical Export Council (SAEEC)	Collective bargain forum of manufacturers in the export market	www.saeec.org.za
The Association of Distributors and Manufacturers of Electronic Components (ADEC)	Industry body: promotion of growth of industry	www.adec.co.za
Department of Trade and Industry (the dti)	Industrial development custodian in South Africa	www.thedti.gov.za
Economic and Enterprise Development (EED)	Industrial development custodian in the North West Province	www.nwpg.gov.za/economic%20dev.%20&%20tourism/default.asp
North West University (NWU)	Lead producer of Electronic Engineers from within the Province	www.nwu.ac.za
Technology Innovation Agency (TIA)	An Agency within dti responsible technology innovation and transfer	www.tia.org.za
South African Institute of Electrical Engineers (SAiEE)	The advocacy forum for Electronic and Electrical engineers	www.saiee.org.za

B.3.2. Value chain

Figure 20 depicts the electronic value chain, from design and research to component manufacturing, then sub-assembly manufacturing, followed by final assembly manufacturing and lastly packaging and distribution.

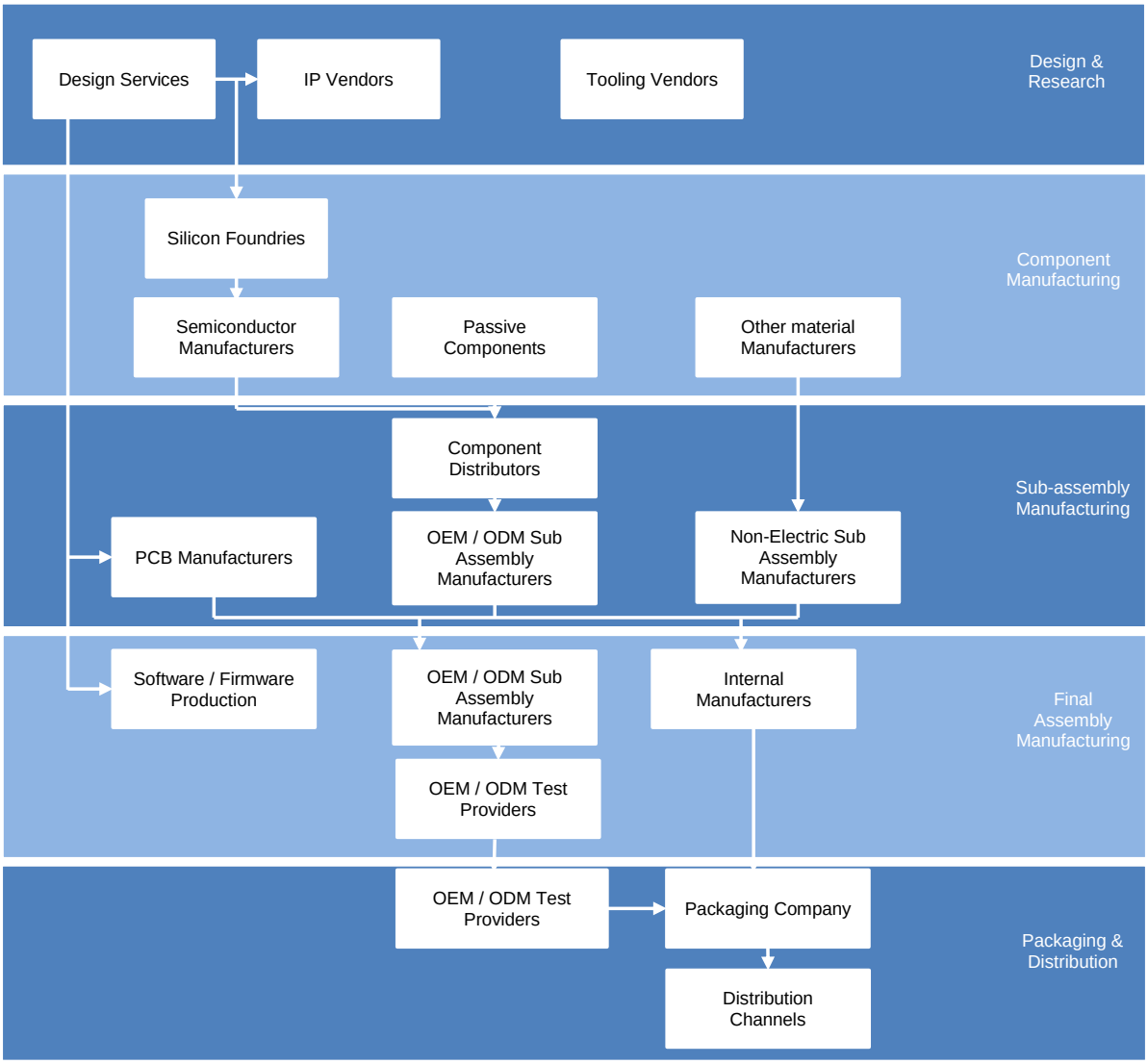

Figure 20: Electronics value chain
(the dti, 2010)

The electronics value chain begins with the **design and research** of the anticipated products through collaboration between a) tooling designers and manufacturers; b) internal design capacity of product manufacturers and c) vendors of intellectual property cores. The tooling designers and manufacturers are responsible for designing the tools used to manufacture new products. An intellectual property core is a reusable unit of logic, cell, or chip layout design that is the intellectual property of one party. The design outputs are then sent as inputs towards the manufacture of the desired components. The design outputs also feed into the production of software and firmware for final products.

During **component design and manufacture**, vertically integrated companies could design the integrated circuit and manufacture the semiconductors, or the designs could be provided to foundry component manufacturers who could manufacture both the integrated circuit and the semiconductors. Passive electronic components include resistors, capacitors, inductive devices etc. and are supplied separately and directly to sub-assembly manufacturers. Furthermore, manufacturers of plastic enclosures also design and manufacture according to design to supply assemblers.

During **sub-assembly manufacture**, printed circuit boards (PCBs) are manufactured either in-house or outsourced to an assembly house. Original design manufacturers (ODM) and original equipment manufacturers (OEM) receive inputs from printed circuit boards (PCB) and enclosure manufacturers for outputs into their respective final assemblers.

Final assemblers are responsible for the **final assembly** of the product. It is then **packaged and distributed**.

The LED venture is intended to be a mechanical and electrical assembly operation rather than an electronics manufacturer. It will be an assembly point for the following components to produce a street light:

- Assembled PCB;
- Assembled LED array; and
- Aluminium housing (casing).

B.4. MARKET TRENDS

Standard lighting approaches are being challenged by new possibilities enabled by LEDs, such as design flexibility, the ability to dynamically change the colour temperature of light, intelligent lighting systems (enabled by the controllability of LED-generated light), etc.

The LED enterprise will be able to link into a globally growing sector, and supply to local South African and adjacent Southern African Development Community (SADC) demands for products.

B.4.1. World trends

Lighting accounts for 19% of the world's electricity consumption. Significant savings are possible – on average 40% – simply by switching to energy-efficient lighting technologies such as LED. On a global level, these savings amount to R1.721 billion in reduced electricity cost and 670 million tons of carbon dioxide (CO_2). Moreover it constitutes the equivalent of 642 power plants which represent a R17 510 billion saving in reduced need for power infrastructure. These facts virtually make LED an economic necessity (The Climate Group, June 2012).

Worldwide, the lighting market is expected to expand to R1 858 billion by 2020, largely driven by growth in demand for LEDs as their prices decline. LEDs are expected to fall in price by more than 80% and reach a global penetration of around 60% across all lighting applications by 2020. The economic benefits will come primarily to nations that invest in LED research and manufacturing today (The Climate Group, June 2012).

Figure 21 shows how global volumes of LED luminaires produced are expected to grow from 600 million units in 2012 to over 1.6 billion units in 2018. China manufacturers produce 50% of the LED products of the world. Europe and North America each has a 10% share, Japan 5%, with the rest of the world accounting for 25% share of the market.

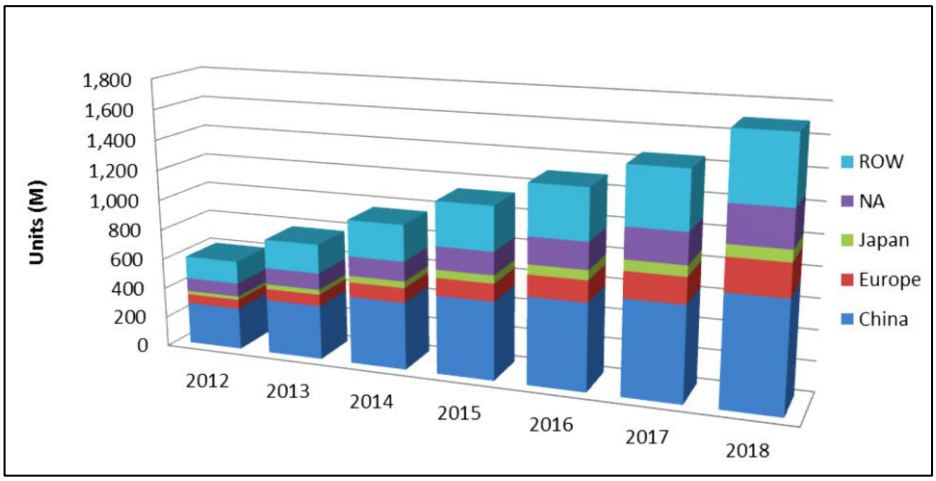

Figure 21: Global LED luminaires market outlook
(Strategies Unlimited, 2014)

Already, nations across the world including Canada, China, India, Italy, Japan, Korea, Malaysia, the Netherlands, Spain and the United States are racing to develop leading-edge LED industries. The product range is expected to reach as much as R1 045 billion in LED product sales by 2020, the industry will support hundreds of thousands of high-value jobs in supply chains that span the globe (The Climate Group, June 2012).

The adoption of innovations and new technologies typically follows an 'S-curve' over time (see Figure 22). A 'tipping point' is expected when adoption reaches 15% to 25% of the market, at which point market penetration accelerates and becomes self-sufficient — and the slope of the curve steepens. The general lighting market is highly fragmented into niche product categories (Mckensy and Company, June 2012).

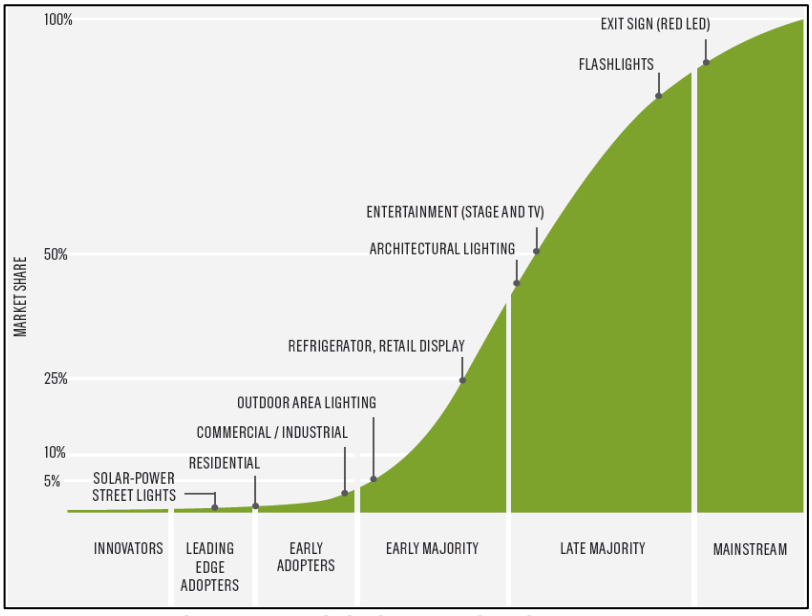

Figure 22: Global LED adoption curve
(Bhandarker, February 2011)

As shown in Figure 22, LEDs have already made significant headway in niche applications such as exit signs, stage and TV entertainment, and architectural illumination. These product categories have reached or will soon reach the late majority

or main stream stages of the 'S-curve', because they involve applications that benefit from LEDs' precise control of colour and illumination levels, as well as their small size. As demand in these niches have grown and provided economies of scale in LED manufacturing, prices have rapidly declined (Bhandarker, February 2011).

White light LEDs, the most important type of LED for outdoor lighting, are just beginning to enter the early stage of the S-curve. In these niches, their high up-front cost and uncertainty about lumen maintenance and lifespan are less important than their outstanding performance benefits. In other major general lighting market segments, such as commercial, industrial, and outdoor lighting, LEDs were below 10% market penetration in 2010. Overall, white light LEDs have begun to be adopted in market segments where the technology's advantages – optical performance, energy efficiency, low maintenance costs, and aesthetic quality – have outweighed its additional up-front costs (Bhandarker, February 2011).

B.4.2. South African trends

The South African lighting industry is currently experiencing an infrastructure-development-driven boom. South African energy constraints have led to a substantial move towards the use of more energy-efficient lighting systems (Gabru, 2009).

Illumination Engineering Society of South Africa (IESSA) estimates that the value of the South African lighting industry is around R5-billion a year. This include all types of light fittings such as street lighting, floodlighting, industrial and commercial lighting, control gear, lamps, the domestic and decorative ranges and other specialised lighting. Lamps and commercial lighting each contribute about R1-billion to the industry, while industrial lighting is estimated to be worth less than R500 000 a year (Gabru, 2009).

The South African market is small; the economies of scale do not support local research and development. Giants in the local lighting market include multinational lighting companies such as Phillips and Osram. Innovation, research and development occur internationally with South Africa following these trends. The biggest potential for growth in the lighting industry is in the retrofit market. The retrofit market includes the commercial and public sector markets, such as schools, office buildings and hospitals, and entails the upgrading of existing installations. South Africa's policy framework is driven towards converting old technology into energy-efficient products (Gabru, 2009).

The LED lighting market is expected to grow by a compound rate of 20% each year until at least 2016, to reach market penetration in general lighting of well over 60% in South Africa by 2020 (Beka (Pty) Ltd , 2012).

B.4.3. Provincial trends

The North West (NW) is rated as the fourth largest electricity consuming province in South Africa and consumes approximately 12% of the available electricity. This is mainly due to the high electricity demand of the energy-intensive mining and related industrial sector. Approximately 63% of the electricity supplied to the NW province is consumed in its mining sector.

Sixty-five percent of the population in the NW province live in rural areas. The majority of households in rural areas use candles for lighting; and wood, charcoal or paraffin for cooking purposes. The NW province has the delicate challenge of balancing the numerous national and provincial mandates towards diversification of energy supply, -security, climate change mitigation and job creation. The quickest impact is likely to lie in addressing the urban and industrial sector, together with the need for rural electrification and development.

The Naledi Local Municipality (NLM) led the installation of LED lights in the NW by piloting the replacement of street lights in the town main road. Rustenburg also has some LED street lights however both these projects are on a very small scale.

B.5. Market Demand and Size

B.5.1. Factors driving the adoption of LED within the identified segments

The following factors are driving potential adoption of LED luminaires in the identified segments above (The Climate Group, June 2012):

- **Cost reduction through retrofitting**: LED retrofitting is the quickest path to the greatest energy saving solution available today. While ordinary lighting fixtures are known to consume a lot of energy, by retrofitting with LED, one can save energy costs by more than 40%. LED retrofitting in the United States has reportedly brought about a 75% saving in energy bills.
- **Growth in developing markets:** Growth is occurring in markets that have been less affected by the recession. In recession-prone nations, the fall in LED prices is likely to drive billions of dollars of retrofits in the short to medium term. The financial case for LED lighting is more compelling in new construction where lighting systems are designed and built from scratch, and lighting components are a small part of a much larger infrastructure investment.
- **Product lifespan:** LED lights have a minimum 50 000 hours lifespan compared incandescent lights, which have a maximum 3 000 hours lifespan. This translates into incandescent lights being replaced 16 times more often than the LED lights. Table 12 shows how LED's lifespan also compares favourably with other lighting technologies. Replacement cost savings is a significant driver for LED market penetration.

Table 12: LED's lifespan compared to other light technologies

Light Technology	Lifespan (hours)	Lumens per Watt
Incandescent Light	1 000 –5 000	11 – 15
Mercury Vapour Light	12 000 – 24 000	13 – 48
Metal Halide Light	10 000 – 15 000	60 – 100
High Pressure Sodium Light	12 000 – 24 000	45 – 130
Low Pressure Sodium Light	10 000 – 18 000	80 – 180
Fluorescent Light	10 000 – 20 000	60 – 100
Compact Fluorescent Light	12 000 – 20 000	50 – 72
Induction Light	60 000 – 100 000	70 – 90
LED light	50 000 – 100 000	70 – 150

(GRH, 2015)

- **Policies and standards:** The local lighting industry, consumer representatives and other key players have founded a working group to address policies and compose a local LED luminaire performance standard which will be available for public comment and then published thereafter (Beka (Pty) Ltd , 2012). This will encourage the market acceptance of the technology and support LED growth.

B.5.2. Demand horizons

To understand the relevant market for LED luminaires in South Africa and Africa, a three horizon analysis was adopted as illustrated in Figure 23. The first horizon is focused on immediate opportunities for LED luminaires within the NW province. The second horizon focused on market opportunities presenting themselves with the country but outside the province. The final horizon is focused on export opportunities within the continent.

Figure 23: Three horizon approach for market analysis

The horizon 1 and 2 markets for street lights are segmented into tiers of government that own the roads/streets. These are:

- SANRAL for national roads
- The various provincial government for provincial roads
- The various municipalities for municipal roads/streets

B.5.2.1. Horizon 1: North West Province

A scan through Integrated Development Plans (IDP) from the NW province's local municipalities was done to ascertain their need for outdoor lighting products. Municipalities have stated their street lighting objectives and plans with estimates of units that may be required in the execution of the plans. Table 13 summarises the stated demand for outdoor lighting from various districts in the NW province. (It should be noted that this is not a reflection of NW street lighting market size but rather the currently identified demand in the province.) A conservative 40% LED market penetration was applied based on the prediction of a 60% LED market penetration in SA by 2020 ((Beka (Pty) Ltd , 2012) – see section B.4.2). Employing an average local product price of R5 000 for a new LED street light luminaire (50 W) (see Table 17) culminates in a total annual demand of 3 418 LED street light units.

Table 13: North West provincial demand for outdoor lighting

District	Local Municipality	IDP Streetlight Budget	Period	IDP Annual Budget	LED Portion (40%)	Annual Demand (2016/17)
Bojanala Platinum District	Moretele	R 1 000 000	2012-2017	R 200 000	R 80 000	16
	Rustenburg	R 4 974 900	Annual	R 4 974 900	R 1 989 960	398
	Kletlengrivier	R 870 000	2012 - 2017	R 174 000	R 69 600	14
	Moses Kotane	R 20 000 000	Annual	R 20 000 000	R 8 000 000	1 600
Ngaka Modiri Molema	Ratlou	R 630 000	2015-2017	R 210 000	R 84 000	17
	Tswaing	R 25 000	Annual	R 25 000	R 10 000	2
	Mahikeng	R 27 000 000	2015-2017	R 9 000 000	R 3 600 000	720
	Ditsobotla	R 2 400 000	2015-2017	R 800 000	R 320 000	64
	Ramotshere Moilwa	R 350 000	Annual	R 350 000	R 140 000	28
Dr Ruth S. Mompati	Naledi	R 2 500 000	2012 - 2017	R 500 000	R 200 000	40
	Mamusa	R 5 489 000	Annual	R 5 489 000	R 2 195 600	439
	Lekwa-Teemane	R 2 500 000	2012 - 2017	R 500 000	R 200 000	40
Dr Kenneth Kaunda	Matlosana	R 2 500 000	2012-2017	R 500 000	R 200 000	40
NW Total				**R 42 722 900**	**R 17 089 160**	**3 418**

NW Municipal IDPs

B.5.2.2. Horizon 2: South Africa

The second horizon is also focused on the potential public sector market for the product.

Metropolitan Municipal demand

To quantify the municipal appetite for streetlights the IDPs of SA's ten big metropolitan cities were probed. Table 14 shows that the ten metros have an annual streetlight budget of approximately R570 million. Again, employing a LED market penetration rate of 40%, results in a LED streetlight budget of almost R 228 million. This converts to 32 562 LED street light units when applying an average market price of R7 000 for a new LED luminaire (80 W) – see Table 17.

Table 14: SA's ten metropolitan cities' budgets

Major City	Annual IDP Streetlight Budget	LED Portion (40%)	Annual Units
Buffalo City	R 3 500 000	R 1 400 000	200
City of Cape Town	R 6 780 000	R 2 712 000	387
City of Johannesburg	R 112 000 000	R 44 800 000	6 400
City of Tshwane	R 90 000 000	R 36 000 000	5 143
Ekurhuleni	R 34 000 000	R 13 600 000	1 943
eThekwini	R 239 480 000	R 95 792 000	13 685
Mangaung	R 20 183 000	R 8 073 200	1 153
Nelson Mandela Bay	R 2 888 750	R 1 155 500	165
Pietermaritzburg	R 55 000 000	R 22 000 000	3 143
Polokwane	R 6 000 000	R 2 400 000	343
Total	**R 569 831 750**	**R 227 932 700**	**32 562**

Individual IDPS

Additionally, the Municipal Infrastructure Grant (MIG) also provides funding for streetlights. The MIG quarterly report ending June 2014, indicated that in the second quarter of 2014, MIG funded the erection of almost 242 000 new street lights (COGTA, 2014). Extrapolating this figure for annual demand, leads to an additional requirement for 967 636 street light units, of which it is again assumed that 40%, i.e. **387 504**, is allocated for LED luminaires. Adding the MIG figure to the IDP figure leads to a total annual metropolitan municipal demand for **419 616** LED street light units.

SA roads

SANRAL is responsible for all declared national roads, which currently stand at 19 704 km out of a total road network of 746 000 km (NRA, 2014). 16% of SANRAL roads are toll/concession roads and according to a SANRAL source, 40% of these roads are lit. The remaining 84% of the non-toll roads are 20% lit. SANRAL's total distance of lit roads thus amounts to 4 701 kilometres (19 704 * 16% * 40% lit toll roads + 19704 * 84% * 20% lit non-toll roads) which presents a demand for 94 020 street lights at a standard application of 50 meters per street light.

According to BEKA in 2010 SANRAL completed an order of 6 500 LED luminaires for approximately R25 million – the biggest order of streetlight luminaires ever awarded in Southern Africa (Engineering News, February 2010). LED lamps have a lifespan of 50 000 to 100 000 hours (see Table 12) which converts to approximately 20 years on average. Based on this 20 year replacement period, the replacement of SANRAL's recent LED luminaire installations are excluded from the immediate market.

New street light installations (for new SANRAL roads being built and the incorporation of unlit provincial roads into the SANRAL network) also need to be considered. According to SANRAL's FAQ web page, in future, SANRAL is expected to manage 35 000 km of SA's roads. No clear timeline is provided for the incorporation of the additional 16 000 km of roads, and thus it is excluded from the market calculations.

SANRAL is considering a luminaire retrofit for their stretch of roads, which since 2010 has been delayed with the controversy around e-tolls (NRA, 2014) The market for both

the installation of new LED streetlights on unlit roads and the replacement of current LED streetlamps is expected to be dwarfed by the retrofitting of old lamp types with LED lamps. Since LED lights are relatively new lighting products, the lion share of current street lights would be older technology lamp types such as sodium or mercury vapour lights with a lifespan of approximately five years (i.e. a quarter of the lifespan of LED lamps - see Table 12). The SANRAL retrofitting market can thus be estimated at 20% per year if a linear LED lamp replacement approach is adopted over the five year lifespan of the existing older street lamp installations. Based on BEKA's reporting on SANRAL's implementation of new LED street lights (mentioned above), it is conservatively assumed that approximately 90% of SANRAL lit roads are furnished with old lamp technology. Thus the SANRAL retrofit market for consideration is estimated at **16 924** per annum (94 020 * 90% / 5 years).

B.5.2.3. Horizon 3: Africa

The third horizon is a potential export market into the continent. Projections indicate that between 2010 and 2025, some African cities will account for up to 85% of the population within the continent of Africa. In 2010, the share of the African urban population was about 36% and is projected to increase to 50% and 60% by 2030 and 2050 respectively (IFC, 2011). This rapid urban growth/migration has changed the continent's demographic landscape and led to slum proliferation in Africa. Thus Africa could benefit from the power of universal access to lighting.

According to Lighting Africa Market Trends, a survey by International Finance Corporation, the intermediate case for LED luminaires will see the market grow at 70-75% annually over 2012-15. This scenario projects cumulative sales to increase to almost 23 million units by 2015 – approximately three million units of which could be attributed to repeat sales – with annual sales of approximately **9-9.5 million** units in 2015 (IFC, 2011).

B.5.3. Market Size

Table 15, shows how the three horizons translate into market for the LED enterprise.

Table 15: Market size

	Horizon 1	Horizon 2		Horizon 3
	North West Province	Rest of South Africa		Africa
	Municipal	Municipal	SANRAL	Exports
Annual LED demand	3 418	419 616	16 924	9 000 000

B.6. MARKET SHARE ESTIMATION

Table 16, shows a phasing in approach to achieving market share. The model assumes the following:

- **Municipal Roads**:
  - The North West province's municipal demand for LED street lights: a 10% market share is assumed, given that the enterprise will be a sole provider from the province and is expected to receive some preference from the NW authorities.

- SA's metropolitan municipal demand for LED street lights: a 0.72% market share is assumed for the enterprise.
- It is further assumed that 40% of the target market will be rural lighting and 60% urban lighting.

- **SANRAL roads**:
  - A ballpark 10% of the SA figure is allotted to the North West (i.e. 1 692 units per year), based on a rough allocation of national roads to the nine provinces.
  - Again a 12% market share is assumed for the province, whereas a 6.5% market share is assumed across the country.
- **Phase One** covers year one and two and will focus on the immediate NW provincial market, as well as 10% of the South African market, for which a 2% municipal market penetration and a 12% SANRAL market penetration is applied.
- **Phase Two** comprises year three to five and includes the rest of the country.
- **Phase Three** involves year six onwards and includes the rest of the continent, where a 0005% market share is assumed.

Table 16: Market share estimation

Phases	Year		Municipal Roads Demand		National (SANRAL) Roads Demand	African Exports
			Rural (40%)	Urban (60%)		
Phase One: NW province & 10% of SA	1 – 2	NW	1 367	2 051	1 692	
		10% SA	6 714	10 071	1 692	
	%Share	NW	10%	10%	12%	
		10% SA	2%	2%	12%	
	Units / yr	NW	137	504	169	
		10% SA	336	205	169	
	Total Units / yr		**±480**	**±720**	**±400**	
Phase Two The whole country	3 – 5		167 846	251 770	16 924	
	%Share		0.72%	0.72%	6.5%	
	Units / yr		**±1 200**	**±1 800**	**±1 100**	
Phase Three The Continent	6 –		167 846	251 770	16 924	9 000 000
	%Share		0.72%	0.72%	6.5%	0005%
	Units / yr		**±1 200**	**±1 800**	**±1 100**	**4 500**

B.7. MARKET PRICES

Table 17 shows the current market prices for LED luminaires.

Table 17: LED streetlight luminaires market prices

	150 W LED streetlight	80 W LED streetlight	50 W LED streetlight
Average market prices	R7 037 – R 11 382	R7 284	R 5 160
Average China prices	R 5 266	R 3 267	R 1 717
LED enterprise selling price	R 7 744	R 5 697	R 5 021

Exports, including logistics costs are not included in the selling price.

B.7.1. Pricing policy

The dynamics of the industry determine the pricing strategy that an enterprise could develop to position itself well in the market, while at the same time ensuring that it generates profits. One of the determining factors is the level of competition in the industry.

Government may buy from the cheapest provider or perhaps from the one which offers the best quality standard or customer service. The determination of selling prices is thus influenced by current industry prices, as well as the competitive advantage of the products. The LED venture will price its products at average local market prices, as presented in Table 17.The selling price was determined by adding 31% mark-up on all products.

Table 18 shows luminaire prices and the projected sales volumes per annum.

Table 18: Prices and project sales for the different phases

	Type	**Luminaires 1**	**Luminaires 2**	**Luminaires 3**	
		(150 W)	**(80 W)**	**(50 W)**	
Phase one (Year 1 & 2)	Product Price	R 7 744	R 5 697	R 5 021	
	Sales Volumes per Annum				**Grand total**
	Rural Municipal Light			480	
	Urban Municipal Light		720		
	SANRAL	400			
	Ave. revenue / yr.	**R 3 097 516.33**	**R 4 101 659.26**	**R 2 410 052.06**	**R 9 609 228**
Phase two (Year 3 to 5)	Rural Municipal Light			1 200	
	Urban Municipal Light		1 800		
	SANRAL	1 100			
	Ave. revenue / yr.	**R 8 518 169.92**	**R 10 254 148.14**	**R 6 025 130.16**	**R 24 797 448**
Phase three From Year 6	Rural Municipal Light			1 200	
	Urban Municipal Light		1 800		
	SANRAL and Africa	5 600			
	Ave. revenue / yr.	**R 43 365 228.68**	**R 10 254 148.14**	**R 6 025 130.16**	**R 59 644 507**

B.8. COMPETITION

Table 19 shows the various competing lamp technologies that can be used for street lighting.

Table 19: Standard lighting technology used in urban streets

Technology	Wattage (W)	Cost of luminaire (incl. lamp)	Lamp cost	Lifespan of lamp (hrs.)	Lamp changes (over 10 yrs)	Energy consumption over 10 yrs (KWh)	Energy cost (over 10 yrs)	Luminaire & replacement lamp costs (over 10 yrs)	Total cost (over 10 yrs)
400 Mercury Vapour (MV)	400	R 1 819	R 86	12 045	3.3	16 060	R 13 651	R 2 103	R 15 754
400 High Pressure Sodium (HPS)	400	R 2 052	R 105	12 000	3.3	16 060	R 13 651	R 2 399	R 16 050
Metal Halide (MH) 400	400	R 2 052	R 221	10 000	4	16 060	R 13 651	R 2 936	R 16 587
250 HPS	250	R 1 280	R 38	16 060	2.5	10 038	R 8 532	R 1 375	R 9 907
MV 250	250	R 1 733	R 86	12 045	3.3	10 038	R 8 532	R 2 017	R 10 549
MH 250	250	R 1 504	R 221	10 000	4	10 038	R 8 532	R 2 388	R 10 920
Induction 250	250	R 3 600	R 0	70 000	0	10 038	R 8 532	R 3 600	R 12 132
Induction 200	200	R 3 450	R 0	70 000	0	8 030	R 6 826	R 3 450	R 10 276
HPS 150	150	R 1 452	R 101	16 060	2.5	6 023	R 5 119	R 1 705	R 6 824
Induction 150	150	R 2 950	R 0	70 000	0	6 023	R 5 119	R 2 950	R 8 069
MV 125	125	R 900	R 250	12 000	3.3	5 019	R 4 266	R 1 725	R 5 991
Induction 120	120	R 2 650	R 0	70 000	0	4 818	R 4 095	R 2 650	R 6 745
LED 80W	80	R 4 783	R 0	60 000	0	3 614	R 3 071	R 4 783	R 7 854

(Sustainable Energy Africa, 2012)

Technologies such as the 400 Watt Mercury Vapour have a lower initial investment fee than the LED luminaire. This makes substitute products attractive in the street lighting space. LED has a competitive edge in the long term, when its prolonged lifespan and energy efficiency translate into savings and overall affordability. This is part of the reason that LED is expected to achieve 60% market penetration in South Africa by 2020 (refer to section B.4.2.)

B.8.1. Competitors

Table 20 lists companies that applied for a SANRAL street light tender in 2009 and are viewed as major competitors in the streetlight space.

Table 20: Competitors

Company	About
Light Be Lighting www.lightbe.co.za	Established in February 2005 to facilitate the local assembly and distribution of the Philips outdoor lighting range in Southern Africa. The product ranges include street lighting, flood lighting, urban lighting, commercial lighting and industrial lighting. These ranges of high quality lighting products use the latest lighting technologies available at the most affordable prices to provide creative and cost-effective lighting solutions to the market.
Gen Lux Lighting www.genlux.co.za	Genlux Lighting, now a division of ACTOM (Pty) LTD, was formed in 1991 when it took over the manufacturing and marketing of the Street, Industrial and Flood Lights, produced at that time by GEC Alsthom - South Africa (now renamed ACTOM (Pty) Limited). Since 1991 all products have been improved and a number of new products added, these include the Apollo street lights, the Olympia, Achilles and Athena flood lights, the Titan and Vulcan Aluminium Industrial bulkheads and a complete range of Commercial decorative aluminium Bulkheads, the Venus and the Vesta.
Beka www.beka-schreder.co.za	BEKA Schréder (Pty) Ltd is Africa's leading manufacturer of luminaires and glass fibre reinforced polyester (GRP) poles. Their objective is to provide the right lighting solutions by optimising the optical and mechanical design of luminaires. Using contemporary technologies, their goal is to offer intelligent and sustainable lighting solutions in order to reduce energy consumption, as well as the overall cost of ownership.
Voltex www.voltex.co.za	Voltex is a leading stockist and reseller of a vast and comprehensive range of electrical and lighting products, including local and international suppliers and their brands. Voltex is a wholly-owned subsidiary of the Bidvest Group Ltd. (listed on the SA stock exchange) and forms part of Bidvest Electrical. It has a level 2 BBBEE rating. The group is divided into specialised supply and distribution business units. Their six supplier divisions namely Atlas Cable Suppliers/Voltex T&D, Versalec Cables, Cabstrut, Voltex LSis, Voltex Lighting and Waco Industries ensure a well-balanced and comprehensive product range. Their supply divisions' facilities design and produce specialised products such as industrial plugs and sockets, aviation warning beacons and energy efficiency solutions.
Bvelela www.bvelelaengineering.co.za	Bvelela Engineering is an electrical engineering company They offer services such as electrical contractors, project management and labour hiring to different clients in the engineering industry. Bvelela Engineering's core business is electrification; installation,

Company	About
	commissioning, and project management. All projects are carried out under strict supervision of qualified professionals. Bvelela Engineering is 100% black owned. Bvelela Engineering's head office is in Glen Austin, Midrand (Gauteng); with a satellite office at Sibasa in Limpopo.

B.8.2. Barriers to entry

The LED manufacturing sector in South Africa is at its inception with room for product differentiation and market establishment.

The following aspects can be regarded as barriers to enter this market:
- The magnitude of capital investment and funding requirements
- Skills availability – with the required technogical proficiency
- Technology – the ability to leverage it to benefit the organisation and its affordability
- Established competition with existing relationships to the market
- High distribution costs (relating to the enterprise's distance from SA's main economic hubs and the
- Quality, standards and regulatory requirements
- High component costs

B.9. DISTRIBUTION AND PROMOTION

The LED enterprise is viewed as an empowerment project designed to stimulate employment creation and social development. With various levels government and related institutions as the end customer, the enterprise will need to develop and align its distribution and promotion efforts to suit government's procurement approach and requirements.

The following should be considered:
- **Regional localisation**: Municipalities and provincial governments are predisposed to local development and investment, and could therefore give preference to local service providers when sourcing products or services.
- **Competitive tender process**: Streetlight supply to government takes place in an industrial marketing space where the mobility of goods from manufacturing to user includes a competitive tender process – an open bid inviting service providers to apply through a tender to supply streetlights. This process involves a purchasing organisation undertaking to procure goods and services from suitable suppliers. Due to the high value of some purchases and the complexity of such purchases, government will seek to obtain a number of bids from competing suppliers and choose the best offering

In addition to tender applications the following communication channels are identified that could contribute to the success of the LED enterprise:
- Public private partnerships
- Personal contacts with the construction sector in particular
- Business Profiles

- Exhibitions
- New media such as websites and social media
- Traditional media – where applicable – such as: newspapers, radio and television

APPENDIX C TECHNICAL ANALYSIS

C.1. INTRODUCTION

The main focus of this technical study is on the products, infrastructure, equipment and the production facility for the LED streetlight assembly enterprise. The results of the study were used in the development of the financial model for the enterprise. This technical study is based on conceptual designs only, and the intended venture should still proceed through further detailed design phases prior to setting up.

The LED enterprise will purchase populated printed circuit boards (PCBs) from a PCB assembly enterprise that has been identified as part of this project. It will receive additional components, assemble the final product and supply it to identified markets. Figure 24 depicts the supply relationship between the LED enterprise and the PCB assembly facility as well as other suppliers.

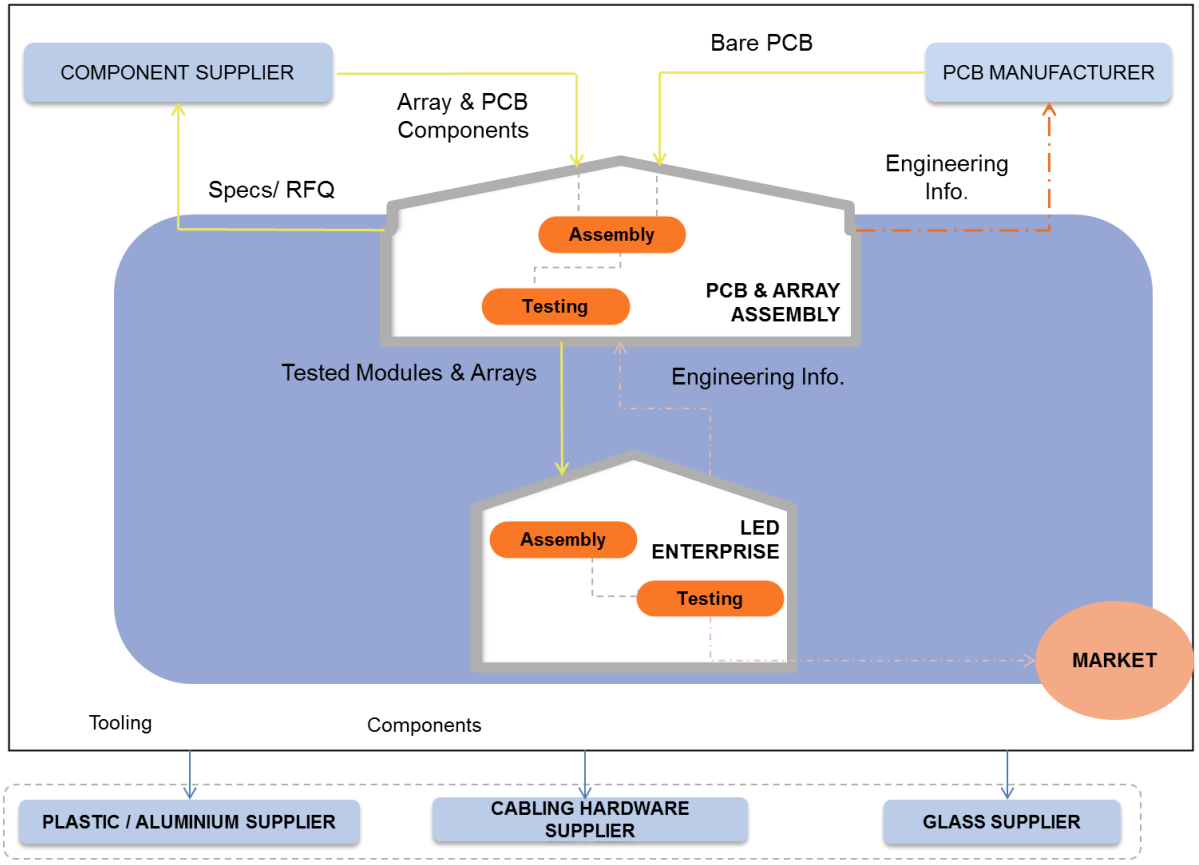

Figure 24: Interrelationship between the LED enterprise and its suppliers

For this enterprise to be successful, it is important that it produces products of a high quality standard. The enterprise could meet these standards by addressing a number of technical requirements and having the following clearly defined:

- Products specifications and standards
- Production processes
- Supply chain
- Regulatory – including quality control and statutory and regulatory compliance
- Organisational – including human resource management
- Identification and management of business risks

C.2. PRODUCTS

An LED street light is an integrated light that uses light emitting diodes (LED) as its light source. It is considered an integrated light because, in most cases, the luminaire and the control module are not separate parts. There are different designs that incorporate various types of LEDs into light fixtures. The current trend is to use high power 1 Watt LEDs. However, some companies use low power LEDs in their products, using several low power LEDs packed together to give a similar light output as a single high power LED. The shape of the LED street light depends on several factors, including LED configuration, the heat sink used with the LEDs and aesthetic design preference.

Heat sinks for LED street lights are similar in design to heat sinks used to cool other electronics such as computers. Heat sinks tend to have as many fins and grooves as possible to facilitate the flow of hot air away from the LEDs. The efficiency of the heat exchange directly affects the lifespan of the LED street light.

The lifespan of an LED street light is determined by comparing its light output with the original design specification. Once its brightness has decreased by 30 percent, an LED street light is considered to be at the end of its life (typical lifespan estimated as eight years).

Most LED street lights have a lens on the LED panel. It is designed to cast light in a rectangular pattern, an advantage compared to traditional street lights, which typically have a reflector on the back side of a high-pressure sodium lamp. In the case of traditional street lights, much of the luminance of the light is lost and produces light pollution in the air and surrounding environment. Such street lights can also cause glare for drivers and pedestrians.

Table 21, shows the three LED luminaires that the LED enterprise will assemble.

Table 21: LED products targeted for production

Type	Luminaire 1	Luminaire 2	Luminaire 3
Circuit Power	**150 Watt**	**80 Watt**	**50 Watt**
Application	Replacement for 150 W and 250 W High Pressure Sodium (HPS) lamps on major residential streets and highways. It produces a distinct clear, brilliant white light.	Replacement for 80 W High Pressure Mercury Vapour (HPMV) lights on residential streets. It produces a distinct clear, brilliant white light, which creates a safer environment for residents.	Used for residential areas especially in rural areas narrow streets, residential streets and to light Private parking lots in residential, and office parks

C.2.1. Product specification

The lamp design incorporates two PCBs. The first is an LED Array, which integrates LED chips with a heat sink. The second is the control module made up of the LED driver, printed circuit board (PCB), and sensors Figure 25 illustrates how components integrate to

form an integrated lighting fixture. Both PCBs will be sourced from the PCB enterprise, which also forms part of the electronic opportunity analysis.

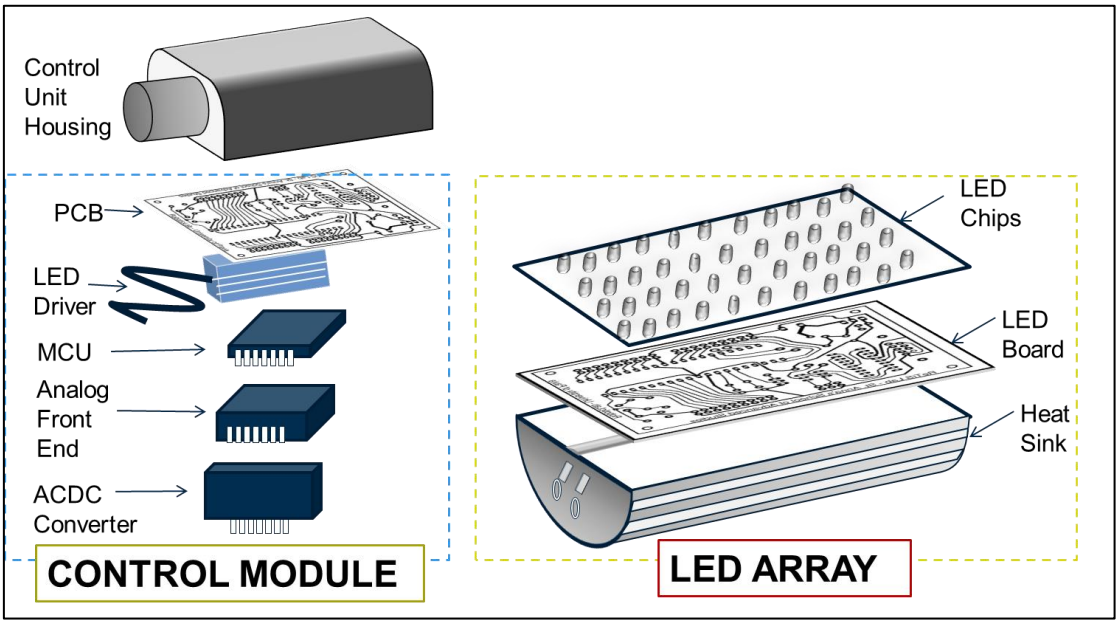

Figure 25: Typical model Integrated LED Street Lamp

The luminaire is designed for LED light sources between 50 W and 150 W of power. Figure 26 shows how the product range will have application from narrow rural roads to wide freeways. Depending on the number of LED chips and power, the luminaire will be able to light narrow roads, residential streets, urban roads, highways, as well as medium and large area high ways.

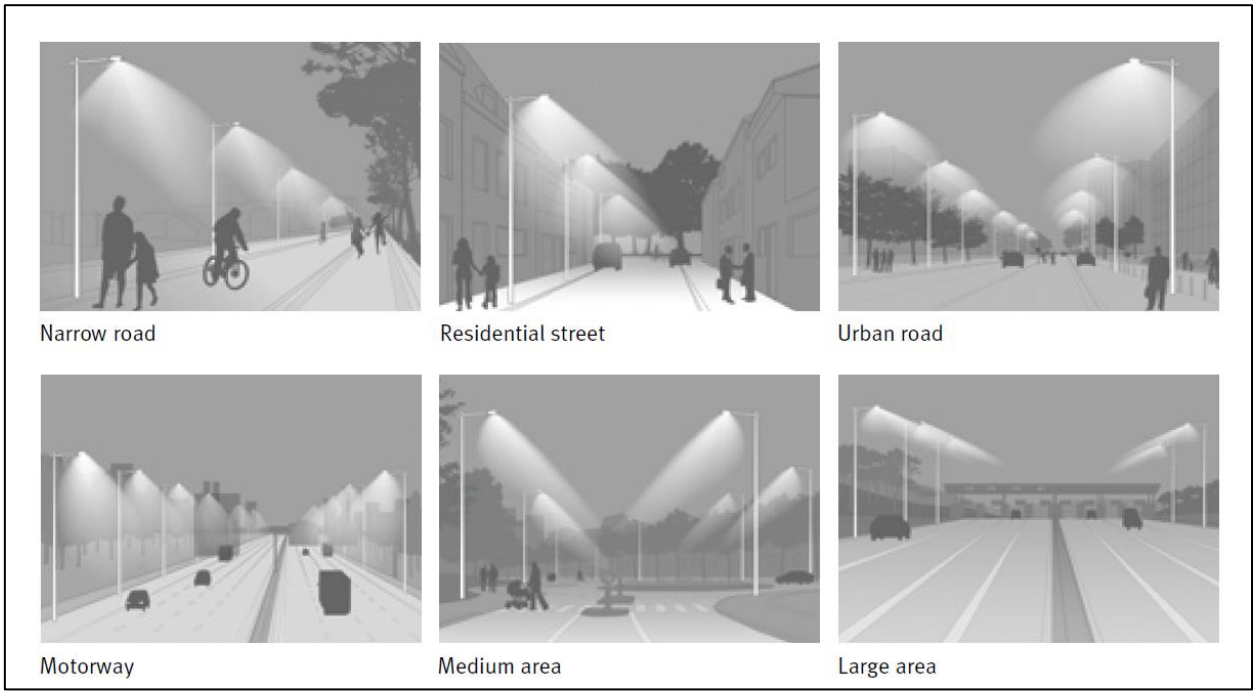

Figure 26: Application of the LED luminaire
(Beka Shreder)

C.2.2. Engineering Design

The engineering design process is a methodical series of steps that engineers use in creating functional products and processes. The steps are usually articulated, subdivided, and/or illustrated in a variety of different ways, but regardless, they generally reflect certain core principles regarding the underlying concepts and their respective sequence and interrelationship. Also, the process is highly iterative - i.e. parts of the process often need to be repeated many times before production of a product can begin. The parts of the process that are repeated, and the number of cycles in any product development is highly variable.

The main aim of the process is the conversion of the requirements of the end user into practical, useable final products. In the design and manufacture of electronic products, the process consists of the following phases:

- Conceptual design;
- Detailed design;
- Design communication / Design for manufacture;
- Qualification and Certification; and
- Mass manufacture

Table 22 shows all costs related to the engineering of LED streetlights (SABERTEK, 2015).

Table 22: Engineering cost into the project

Hardware	
Task	**Total**
Pre Design Documentation	R 102 000
Hardware Development	R 240 000
Harness and Mechanical Design	R 288 000
Post Design Documentation	R 120 000
Software and Hardware integration	R 192 000
Testing	R 156 000
Sub-Total	**R 2 498 000**
Software	
Task	**Total**
Firmware Requirement Specification (SRS)	R 42 000
Firmware Design Document (SDD)	R 60 000
Coding and Testing	R 144 000
Design Reviews	R 48 000
Register Documents and Software Items	R 24 000
Sub Total	R 318 000
Qualification and Certification	
Product Qualification	R 500 000
	R 500 000
Project Management Fees	
	R 72 000
Total	**R 1 990 000**

C.2.2.1. LED conceptual design

A conceptual electronic or circuit design of an LED street light is shown in Figure 27. An alternating current-to-direct current (AC/DC) converter is employed to convert the line AC voltage to a DC voltage. A processor produces pulse-width modulation (PWM) signals that are used in the control of the DC/DC driver which in turn drives the array of LEDs. Sensors are utilised to capture information about the condition of the LEDs such as temperature. A photo-sensor system is used to control light intensity. This allows for multiple light distribution to ensure that the specific requirements of each application are met. It also helps in the efficient operation of the LED street light.

The analogue front end is used for communication purposes. This enables the remote setting of the light intensity. The number of LEDs installed provides the facility to produce variants of different nominal power and light outputs. The multipoint control module (MCU) creates the capacity to connect more LED chip arrays (Gule, 2015).

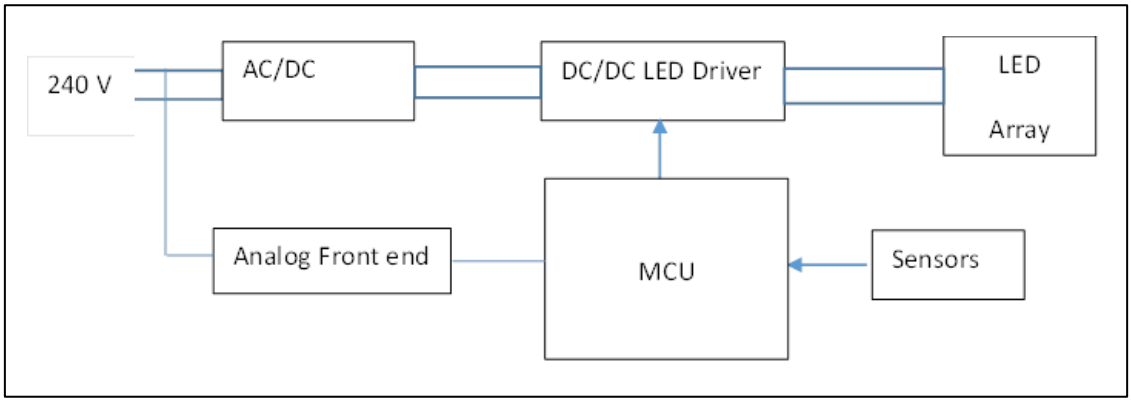

Figure 27: General conceptual design block diagram of an LED street light

C.2.2.2. Industrial design

The LED luminaire is designed for contemporary decorative lighting for all roads where performance, aesthetic, power-saving, low maintenance and precise light control considerations are important factors.

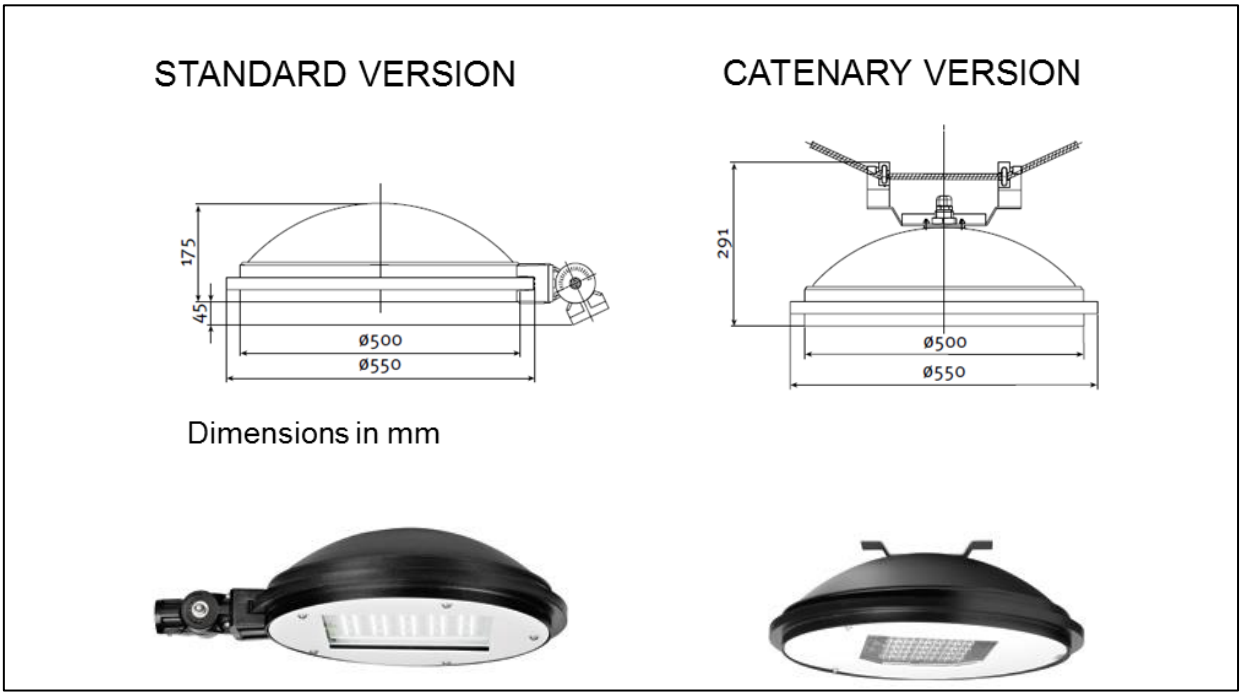

Figure 28: Standard street light designs
(Beka Shreder)

C.2.2.3. Street light housing specification

The casing is made of aluminium and the light protector is a high-impact clear flat glass. The light can be installed at a height range from 4 m to 10 m. All casings will be developed and designed in accordance with:

- SANS 10225 – the standard on the design and construction of lighting masts
- All tubing to SANS 657-1 Grade GW355J HT – covers standards for welded or seamless steel for structural and general engineering purpose
- Manufacturing to SANS 10214-1987-1 – standard for manufacturing poles and streetlight housing
- All galvanizing done to ISO 1461 and SANS 121-2000-1 – covering the process of applying a protective coating to protect the poles from corrosion.
- All welding done by coded welders to SANS 10044 Part 1-4. – covers the standards for welding
- Weld on reducers or swaging depending on clients specifications.

The cost of the aluminium luminaire casing is estimated at R2 000. The design will be done in-house with the manufacturing outsourced to Engineering Drawing and Design.

C.2.2.4. LED street light circuit

A typical reference design circuit for an LED street light from Texas Instruments is shown in Figure 29. This has been used to determine the typical component count of various types as well as the projected PCB type and surface area.

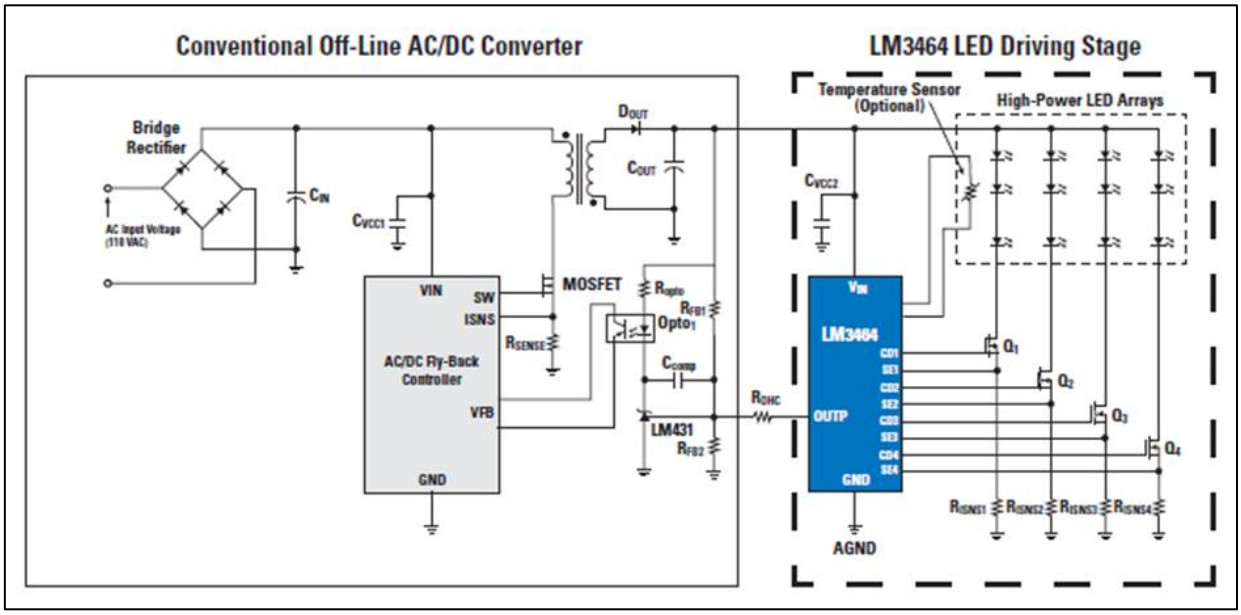

Figure 29: LED lighting system
(Texas Instrument, 2012)

C.2.2.5. Total componentry cost

Table 23 shows the total cost of components involved in the assembly of LED street lights

Table 23: Component costs

	Luminaire 1 150 Watt	Luminaire 2 80 Watt	Luminaire 3 50Watt
Control module	R 292.50	R 292.50	R 292.50
Assembled LED Array	R 3 600	R 2 025	R 1 275
Aluminium Housing - Casing	R 200	R 200	R 200
Total	**R 4 092.50**	**R 2 517.50**	**R 1 767.50**

C.2.3. Customer requirements

The following requirements are stated as customer terms and conditions from the (South African National Road Agency Limited (SANRAL) LED luminaire tender from 2010:

- Luminaires shall be Class 1 as per SANS 60598-1 and shall be of the totally enclosed type.
- Luminaires shall be designed for use under conditions of heavy atmospheric pollution and exposure to high levels of solar (including ultraviolet) radiation which is suitable for operation at an ambient temperature of +35°C. The luminaire may also be exposed to wind, rain, hail and sleet in service.
- Luminaires shall have a lamp, control gear and spigot compartment and shall have a degree of protection rating of a minimum of IP65 rating on the lamp compartment and a minimum of IP54 on the control gear compartment. These are minimum ratings, and preference may be given to luminaires offered with IP ratings exceeding the minimum requirements, particularly on the control gear compartment.
- All ratings must be certified by a test report confirming compliance with SANS 60598-1. The test reports shall be issued by an SANS or IEC accredited test authority.

- Luminaires offered under this contract shall bear the “SABS certification mark for approved performance shown by an “ ’A’ enclosed by a diamond” and shall be tested to the SANS 475 standard.
- Luminaires shall be delivered completely assembled with control gear, lamp holder, reflectors, diffuser (bowl) and housing.

C.3. PRODUCTION

LED street lights will be produced from a midsized factory with automatic and semi-automatic equipment. The objective is to build an efficient facility, which is able to save on production time. Quality management is also a key deliverable with the production of LED luminaires.

C.3.1. Production processes

The LED enterprise will produce LED luminaires from assembly to package through a one-stop production scheme. The production process flow for the LED street light manufacturing is detailed in Figure 30.

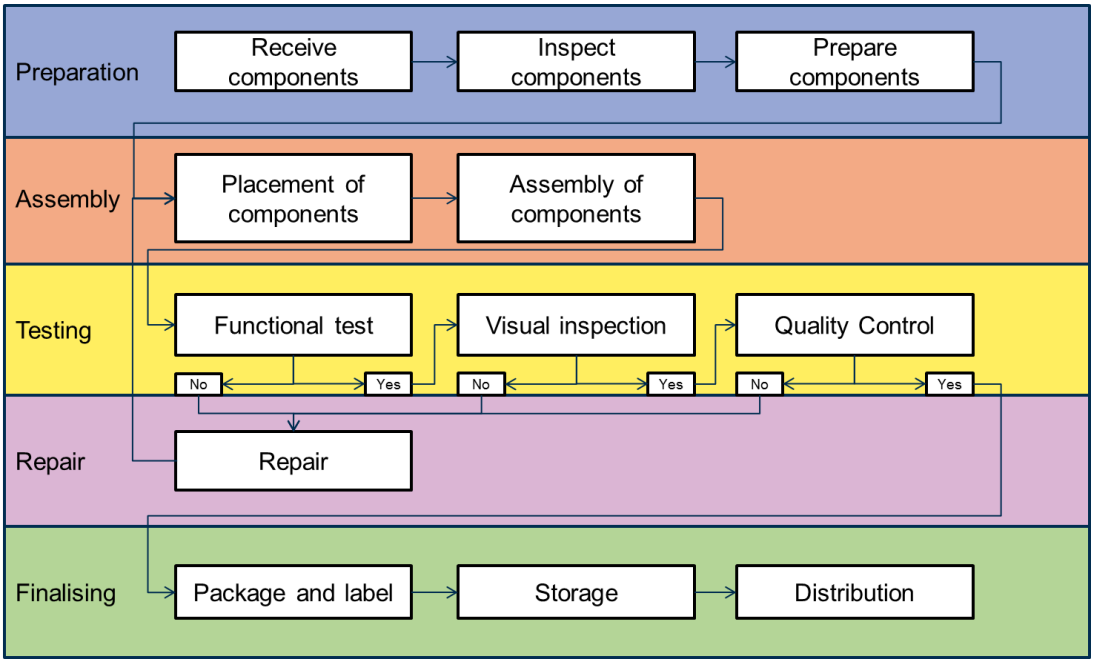

Figure 30: Production process flow

A more detailed explanation of the production process actions in Figure 30 is provided in Table 24.

Table 24: Detailed production process

Action	Details
Receive components	All different components and raw materials are received from respective suppliers
Inspect components	Materials received are inspected for defects before using and assembling as part of the product
Prepare components	From this point, the preparation will differ for the different end-products. From this, the wiring, PCB's, etc. will also have different specifications Copper for wiring – cut to correct length Aluminium housing – cut, drilled and cleaned PCB's – cut, drilled and cleaned
Placement of components	Components are placed and spaced according to detailed drawings and electrical assembly specifications
Assembly of components	Components are glued or drilled in place as specified
Functional test	The test confirms that the LED Luminaire functions as intended – if not, it is returned to the repair-room
Visual inspection	The test confirms that the LED conforms to visual specifications with no visual defects – if not, it is returned to the repair room
Quality control	Quality standard tests are carried out – if the product does not conform to standards, it is returned to the repair room
Repair	Repair line returns product to placement and assembly of components to rectify issues identified during testing or reuse fit-for-use components of an unfit product
Package and label	Product is packaged and labelled
Storage	Product is moved to storage area for distribution
Distribution	Luminaires are distributed to clients

C.3.2. Production inputs

The production input for the LED luminaires includes:

- Components :
- Utilities (electricity);
- Labour;
- Transport and
- Packaging materials

C.3.2.1. Components

Components for the production process include the following:

- Control module (assembled PCB)
- Assembled LED array
- Aluminium housing(casing)

C.3.2.2. Utilities

Electricity will be used for assembly and testing purposes. Table 25 summarises annual utility cost to the enterprise.

Table 25: Utility costs

Utility	Annual consumption	Unit of measure	Rate	Annual costs
Electricity (general use)	36 000	kWh	R 1.13	R 40 680
Electricity(equipment)	80 000	kWh	R 1.13	R 90 400
Water	112	Kl	R16	R 64 800

C.3.2.3. Production cycles and outputs

The enterprise will operate weekly from Monday to Friday (i.e. 20 days per month), and eight hours per day. The enterprise will able to produce 100 units a month in the first two years of operation. This capacity will be quadrupled from year 4 to 6 and the final phase will produce 8 600 units per annum.

Table 26 shows how the production capacity will increase in three phases. The first phase will be two years, the second phase three years, and from year six the facility will operate at nominal capacity.

Table 26: Production phases

Phases	Year	Municipal Roads Demand		National Roads Demand	African Exports
		Rural	Urban		
One	1-2	480	720	400	
Two	3-5	1 200	1 800	1 100	
Three	6 on wards	1 200	1 800	1 100	4 500

C.3.3. Equipment

Table 27, highlights the cost of equipment required by the business.

Table 27: Cost of equipment

Equipment	Power Consumption	Units	Cost	Price (FOB)
Production line				
Wire bonder	10 kW	1	R 140 000	R 140 000
Welding wire machine	10 kW	5	R 5 000	R 25 000
Sealing / packaging machine	10 kW	1	R 120 000	R 120 000
Spectrometer	0.75 kW	2	R 40 000	R 80 000
Braiding / taping machine	0.75 kW	2	R 20 000	R 40 000
Drying cabinet	n/a	1	R 10 000	R 10 000
Lamps photoelectric testing instrument	0.75 kW	1	R 60 000	R 60 000
LED optoelectronic devices	0.75 kW	4	R 20 000	R 80 000
High low temperature test box		2	R 30 000	R 60 000
Assembly line				
Plug line	10 kW	1	R 20 000	R 20 000
Assembly line (automatic belt line)	n/a	1	R 170 000	R 170 000
Total				**R 805 000**

C.3.4. Handling and storage

IPC prescribes the following guidelines relevant to the LED enterprise. Care must be taken during assembly and acceptability inspections to ensure product integrity at all times. Moisture sensitive components (as classified by IPC/JEDEC J-STD-020 or equivalent documented procedure) must be handled in a manner consistent with IPC/JEDEC J-STD-033 or an equivalent documented procedure.

The guidelines in handling electronic assemblies are as follows:

- Keep workstations clean and neat. There must not be any eating, drinking, or use of tobacco products in the work area.
- Minimise the handling of electronic assemblies and components to prevent damage.
- When gloves are used, they need to be changed as frequently as necessary to prevent contamination from dirty gloves.
- Solderable surfaces are not to be handled with bare hands or fingers. Body oils and salts reduce solderability, promote corrosion and dendritic growth. They can also cause poor adhesion of subsequent coatings or encapsulates.
- Do not use hand creams or lotions containing silicone since they can cause solderability and conformal coating adhesion problems.
- Never stack electronic assemblies or physical damage may occur. Special racks need to be provided in assembly areas for temporary storage.
- Always assume the items are electrostatic-sensitive device (ESDs) even if they are not marked.
- Personnel must be trained and follow appropriate ESD practices and procedures.
- Never transport ESDs unless proper packaging is applied.

C.3.5. Space requirements

Approximately 1 000 m² is required to for adequate product assembly and testing facilities.

C.3.6. Factory layout

Figure 31 shows the factory layout modelled on the standard electronic assembly line (Allington, 2006).

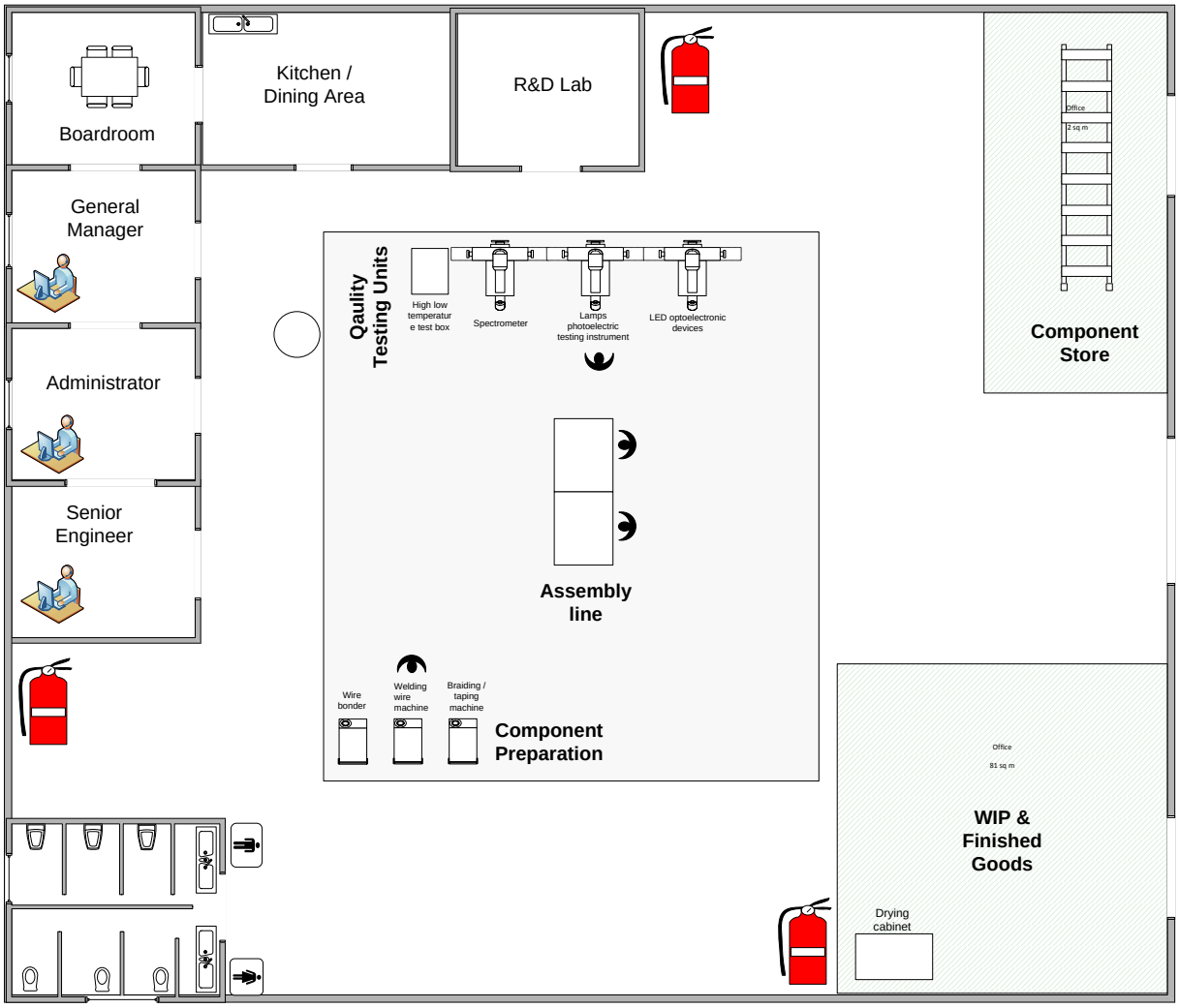

Figure 31: Factory layout

The 1 000 m^2 facility will be constructed within the Mahikeng industrial area zoned for the IDZ. The cost of construction, including professional fees is estimated at R8.26 million. Table 28 shows space allocation for the facility.

Table 28: Construction cost

Structures	Area (m^2)
Boardroom	25
Offices (total)	75
Kitchen / dining area	50
Component Store	115
Finished goods storage	115
Test Bay	50
R&D Lab	30
Ablutions	40
Assembly area	100 (to be occupied) 400 (Expansion)
Total	**1 000**

C.4. SUPPLY CHAIN LOGISTICS

Both the inbound and outbound logistics rely heavily on collecting from suppliers and delivering to clients. This is detailed in Table 29.

Table 29: Inbound logistical information

Item	Collect / Deliver	Receiving logistics
Copper wiring	Collect	The closest copper suppliers are situated in Gauteng (Flexicor, Copalcor and Transwire are all based in Johannesburg)
Aluminium Poles and Housing	Delivered	A Johannesburg based enterprise by Engineering Drawing and Design has been identified as a supplier of street lights aluminium housing and poles
LED light components (driver, AC/DC convertors/chips	Collected	Communica
PCB's	Delivered	Receive from within complex
Packaging	Delivered	Order packaging in bulk

The market for the first phase of LEDs is focussed on the North-West province within which the enterprise will be situated. The furthest point of the province from the anticipated location in Mafikeng is approximately 300 km. The furthest edge of Gauteng also falls within a 350 km radius making it very viable to include the Gauteng province in the supply chain reach. The second phase of distribution is national and the anticipated delivery radius will include other provinces.

The delivery of the retrofit units, which is only the lamp feature, will be delivered with an entry-level van. This van will be purchased by the enterprise at a cost of about R250 000. The supplier of poles for new street lights units will deliver to the client's site and it will not require an additional vehicle. It is anticipated that with proper logistics management, the one vehicle can service both the supply and delivery.

C.5. REGULATORY COMPLIANCE

Table 30 tabulates all relevant quality standards, applicable to the manufacture or assembly of LED Streetlights.

Table 30: Table of quality standards relevant to LED luminaires

Standard	Details
SANS 475:2006	Luminaires for interior lighting, street lighting and floodlighting - performance requirements
ARP 035: 2005	Guidelines for the installation and maintenance of street lighting.
SANS 1088: 2004	Luminaire entries and spigots
SANS 1250: 1991	Capacitors for use with fluorescent and other discharge lamp ballasts
SANS 1266: 2002	Ballasts for discharge lamps (excluding tubular fluorescent lamps)
SANS 1574: 2004	Electrical cables – flexible cords and flexible cables
SABS IEC 922:1989	Ballasts for discharge lamps (excluding tubular fluorescent lamps)
SABS IEC 60923:2001	Ballasts for discharge lamps (excluding tubular fluorescent lamps) – performance requirements
SABS IEC 926:1995	Auxiliaries for lamps – starting devices: general and safety requirements
SABS IEC 60927:2005	Starting devices (other than glow starters) – performance requirements
SABS IEC 61048:2006	Capacitors for use in tubular fluorescent and other discharge lamp circuits: general and safety requirements
SABS IEC 61049:1991	Capacitors for use in tubular fluorescent and other discharge lamp circuits - performance requirements
SANS 529: 2001	Heat-resisting wiring cables
SANS 1507: 2002	Electric cables with extruded solid dielectric insulation for fixed installations
VC 8011:1999	Lamp holders
SANS 1777:2004	Photoelectric control modules for lighting (PECUs)
SABS ISO 1461:2000	Hot dip galvanised coatings on fabricated iron and steel articles - Specifications and test methods
SANS 556-1:2004	Low-voltage switchgear Part 1: circuit-breakers
BS 1490: 1988	Specification for aluminium and aluminium ingots and castings for general engineering purposes.

C.5.1. Quality management

The IPC has released the IPC-A-610D standard which mainly focuses on the “Acceptability of Electronic Assemblies”. The standard focuses on two main principles of standardisation which are design for manufacture (DFM) and design for the environment (DFE). The standard gives guidance into the acceptability of electronic assemblies internationally, mainly focussing on:

- **PCB Orientation**: This guides the typical acceptance criteria and checking points on all PCBs. These checking points are applied to the primary side, secondary side, solder source side, solder destination side etc.
- **Inspection methodology**: This specifies that accept or reject decisions must be based on documentation such as contracts or specifications. It further specifies how inspection should be handled if automated inspection technology (AIT) is used.
- **Prevention of Electrical Overstress (EOS) / Electrostatic Discharge (ESD)**: ESD is the rapid transfer of a static electric charge from one object to another of a different potential that was created from electrostatic sources. When an electrostatic charge is allowed to come in contact with or close to a sensitive component it can cause damage to the component. EOS is the internal result of an unwanted application of electrical energy that results in damaged components. This damage can be from many

different sources, such as electrically powered process equipment or ESD occurring during handling or processing. The IPC-A-610D guides on the prevention of both the EOS and ESD by suggesting different packaging materials (e.g. static shielding materials) and handling methodologies (e.g. use of finger cots)

- **Installation of hardware**: The standard further provides guidelines on the installation of hardware. These guidelines include specification around electrical clearance, interference, threaded fasteners, torque and wiring.

This standard should be at the core of the enterprise's efforts to maintain superior quality. It is further advised that the enterprise affiliates with the IPC in order to unlock access to international progression in the quality improvement of electronic products.

C.5.2. Environmental requirements

C.5.2.1. Environmental impact

An assessment was carried out to determine if there would be any environmental regulations to comply with. Based on a high level assessment, a basic assessment accompanied by a waste management licence will be necessary. This could take between six and nine months. It is estimated to cost R100 000 (including VAT)

C.5.2.2. Air emissions

The manufacture of electronic components is associated with various waste characteristics. For instance, manufacture of PCBs releases air emissions as it includes use of acids such as sulphuric, phosphoric, hydrochloric, nitric and acetic among others. This leads to the emissions of ozone depleting substances. However, the manufacture of electronic LED is less prone to release such atmospheric emissions and as such is low risk.

C.5.2.3. Solid and hazardous wastes

Solid and hazardous wastes from semiconductor manufacture may include: heavy metals, solder dross (solder pot skimmings), arsenic, spent epoxy and waste organic solvents (which represents the largest waste). In PCB operations, solid wastes may include scrap board materials, plating and hydroxide sludges, and inks. The manufacture of printed wiring assemblies solid wastes, however, may include solder dross, scrap boards, components, organic solvents and metals. These are all components of electronic LED. It is therefore anticipated that during rework and repair these solid wastes may be released.

C.5.3. Land tenure

The enterprise will be housed in a newly built facility in the envisaged Mahikeng Special Economic Zone.

C.6. ORGANISATIONAL DESIGN

The enterprise will aim to create sustainable employment and at the same time supply a reliable end-product. The organisation's success therefore greatly depends on the employees and implementation of company structure.

C.6.1. Human resource requirements

It is anticipated that electronic production will require eight employees in total, as detailed per job title in Table 31.

Table 31: Human resource requirements

Human resources	Roles and responsibilities	No. of staff	Monthly cost per employee	Total annual cost
General Manager	• Management of the enterprise and its staff • Marketing of the products • Stakeholder interaction and management • Reporting (to all stakeholders) • Coordination of interest forums • Compliance with applicable policies, legislative and regulatory frameworks • Ultimate responsibility for financial management	1	R 37 500	R 450 000
Senior engineer	• Planning, coordination and control of manufacturing processes • Ensuring that products are produced efficiently and that the correct quantities are produced at the right cost and quality level	1	R 25 915	R 310 980
Administrator	• Setup and operation of the printer machine to print syringe barrels	1	R 7 500	R 90 000
Operators	• They will work as product assemblers.	2	R 4 000	R 96 000
Artisan	• Provide the technical skills into each part of the assembly machines.	2	R 8 000	R 192 000
Driver	• Packing and delivering the LEDs	1	R 4 500	R 54 000
Storeman	• Stock and supplies controls	1	R 4 000	R 48 000
Cleaner	• Ensuring that areas are cleaned to the highest standards at all times • Maintaining health and safety standards at all times • Ensuring that equipment is cleaned, maintained and stored correctly	1	R 2 505	R 30 060
TOTAL		**10**		**R 1 271 040**

C.6.2. Organogram

The enterprise will operate according to the operational organogram in Figure 32.

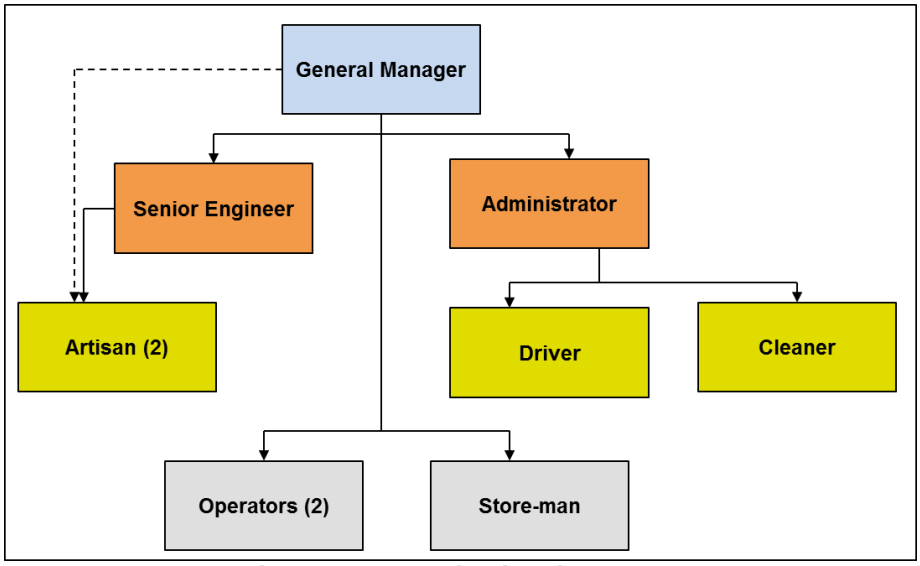

Figure 32: Organisational structure

C.6.3. Institutional Arrangements

It is recommended that the legal entity to be used in the LED enterprise should be a co-operative. This recommendation considered the type of ownership and management structure of a business entity that can attract grant funding. A co-operative is a distinct form of enterprise that provides services and/or products to the market and with its members forming part of its operational value chain. Profits, known as surpluses in a co-operative, are divided among members in relation to the amount of the business each member did with the co-operative. There must be at least five founding members (people) in order to form a primary co-operative.

For governance purposes, it is recommended that the Board include independent directors representing relevant stakeholders, to protect the interests of all parties. The Board will give governance and strategic direction to the cooperative through its management board which will consist of cooperative management members. Figure 33 represents the model

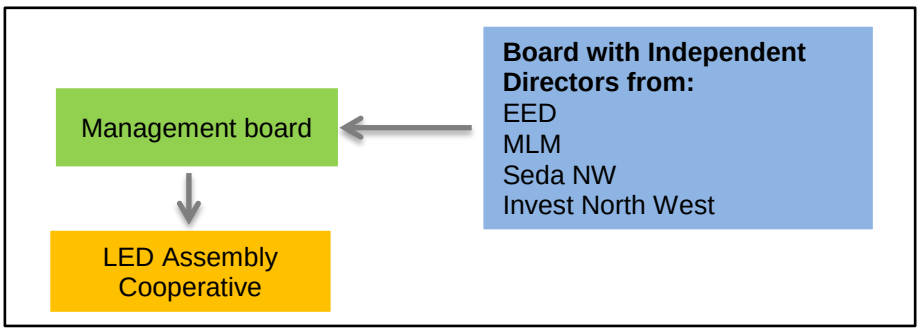

Figure 33: Enterprise model

C.7. RISK MANAGEMENT

Every investment is exposed to some level of risk. It is therefore important to identify and analyse those risks, and implement mitigation measures to manage its impact.

A number of risks are foreseen and possible ways to mitigate these risks are listed in Table 32.

Table 32: Risk factors, impact and mitigation

Risk factor	Likelihood	Impact	Overall risk rating	Mitigation
1. Unavailability of components	High	High	High	• Contingency plan to establish a network of suppliers • Identification of alternative or backup suppliers
2. Supply low quality products	Medium	High	Medium	• Conducting a due diligence on suppliers • Investing heavily on the engineering and quality assurance
3. Increase of components cost	High	High	High	• Sensitivity analysis of cost prices • Negotiating favourable contracts with suppliers
4. Increase of labour costs	Medium	High	Medium	• Adherence to budgeted salary costs • Maintain good labour relations
5. Disruption to utility supply	High	High	High	• Maintain good relations with the local authorities • Consider own backup power supply
6. Crime (potential theft and robbery)	High	High	High	• Employ security company to safeguard assets
7. Inferior equipment	Low	Medium	Low	• Only use knowledgeable and recommended equipment suppliers
8. Improper handling of equipment by operators	Medium	Medium	Medium	• Employ suitable personnel • Provide adequate training on the operation of equipment
9. Inability to attract suitably qualified personnel	Low	Medium	Low	• Offer remuneration in line with industry trends • Comply with all applicable labour legislation
10. Conflict and misalignment of expectations from community members	High	Medium	High	• Clarification of expectations before implementation and establishment of the business • Documented roles and responsibilities of all stakeholders
11. Labour unrest	High	Low	Medium	• Ensure the inclusion of clauses mitigating against this into supplier contracts • Identification of alternative or

Risk factor	Likelihood	Impact	Overall risk rating	Mitigation
				backup suppliers
12. Political change due to government change	Medium	Low	Low	• Establish a good relationship with both government and political stakeholders
13. Major breakdown of equipment	Low	Medium	Low	• Ensure proper usage and maintenance of equipment
14. Inability to achieve income targets	High	High	High	• Build a strong distribution channel and understand the Tendering process

APPENDIX D FINANCIAL ANALYSIS

D.1. INTRODUCTION

Based on a comprehensive list of assumptions (refer to APPENDIX E), a financial model was prepared for the LED Enterprise. The main assumptions that underpin the model are as follows:

- The enterprise will phase products as follows:
  - Year one and two – 50 W luminaire (480), 80 W luminaire (720) and 150 W luminaire (400).
  - Year three to year five – 50 W luminaire (1 200), 80 W luminaire (1 800) and 150 W luminaire (1 100).
  - From Year 6 onwards – 50 W luminaire (1 200), 80 W luminaire (1 800) and 150 W luminaire (5 600).
- At full capacity, the enterprise will produce a total of 8 600 luminaires combined.
- The selling price for the products are benchmarked with other competitive prices for products in the same categories
- Inflation is assumed to be 7% for the next ten years; hence costs and sales prices are escalated at 7% per annum.
- Depreciation rates for infrastructure and equipment are set at the standard South African Revenue Service (SARS) wear and tear rates.

D.2. COSTS

For any operation there are three types of costs that need to be taken into account. These are investment costs, direct operating costs and indirect operating costs.

Investment costs are typically once-off costs incurred during the set-up of the production facility or establishment phase for items such as:

- Capital expenditure;
- Pre-production expenses; and
- Working capital.

Both direct and indirect operating costs are incurred once operations start. Direct operating costs are directly linked to the number of products produced and sold (such as raw material costs). Indirect costs are incurred irrespective of the number of products produced and cold (for example salaries).

D.2.1. Investment costs

The investment costs for this enterprise are summarised in Table 33.

Table 33: Investment costs

	Items for purchase	Establishment Year 1 & 2	Year 1 (Operations)	Year 2 (Operations)
Civil works	Building construction	R 8 260 000		
Plant machinery and equipment	Assembly Line	R 1 055 000		
	Packaging Line			
	Equipment Testing			
	Accessories			
	Bakkie			
Auxiliary and service plant equipment	Telephone connections	R 3 000		
Incorporated fixed assets	Basic canteen furniture	R 135 225.50		
	Office furniture			
	Boardroom furniture			
	Computers			
	Laptop computer			
	Software(MS office)			
	Software(Pastel)			
	Desktop Printers			
	Printer			
	Telephone hand sets			
Engineering design cost	Product design	R 1 990 000		
Pre-production expenditure	Company formation	R 837 620		
	Training			
	Marketing			
	Recruitment			
	Consultants (Environmental compliance)			
Contingencies		R 1 228 432.05		
Working capital			R 1 566 000	R 495 000
TOTAL		**R 13 509 277.55**	**R 1 566 000**	**R 495 000**

A breakdown of establishment costs is shown in Figure 34**.**

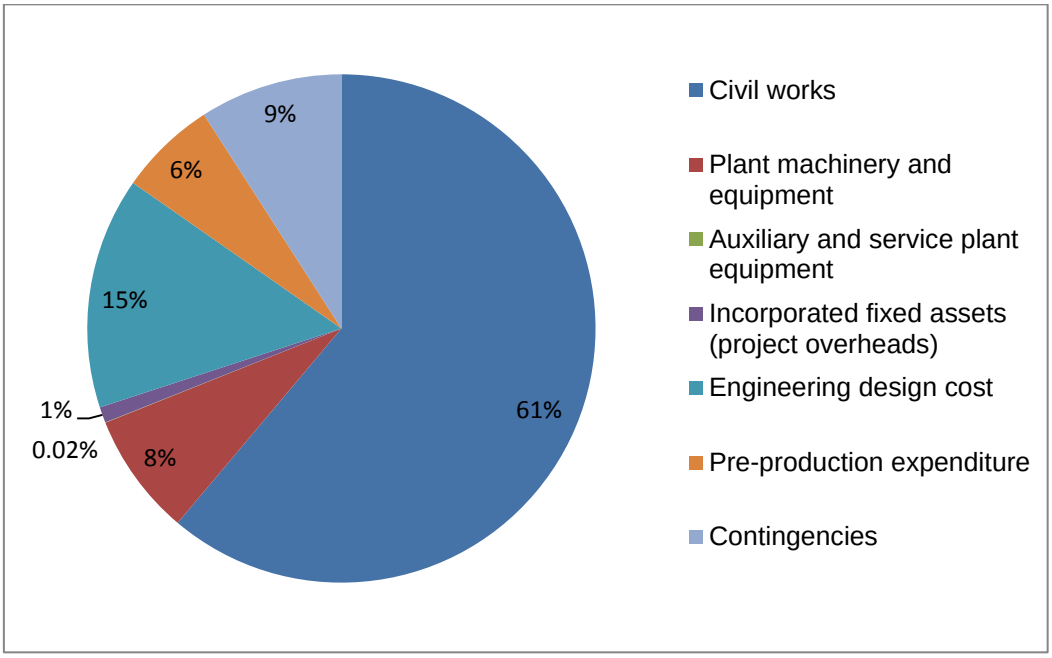

Figure 34: Investment cost breakdown

About 61% of the total investment costs will be for plant building and civil works. Some of the equipment such as computers, the bakkie and furniture will be replaced in the third, fifth and sixth years respectively.

D.2.2. Direct costs

The direct or product related costs of the operation are incurred only when products are produced to be sold. These costs include the following:

- Components;
- Packaging; and
- Outbound logistics.

The cost breakdown of assembling 50 W, 80 W and 150 W luminaires was analysed. The summaries are depicted in Figure 35, Figure 36 and Figure 37 respectively.

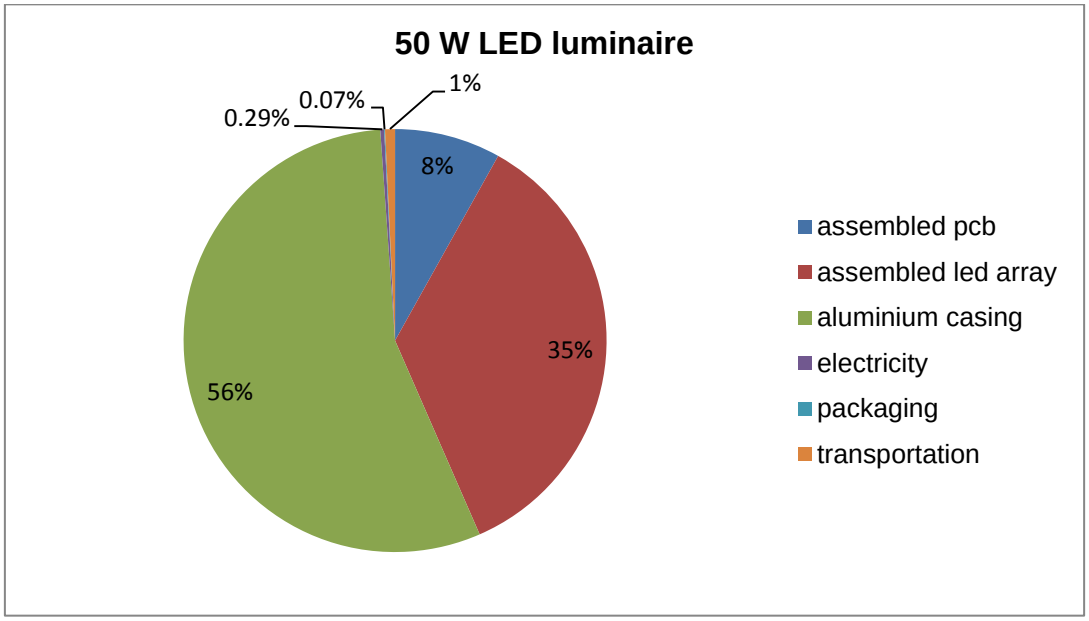

Figure 35: Cost breakdown for 50 W LED streetlight luminaire

About R1 765 407.01 will be spent on the production of 50 W LED streetlight luminaire in the first year of operation.

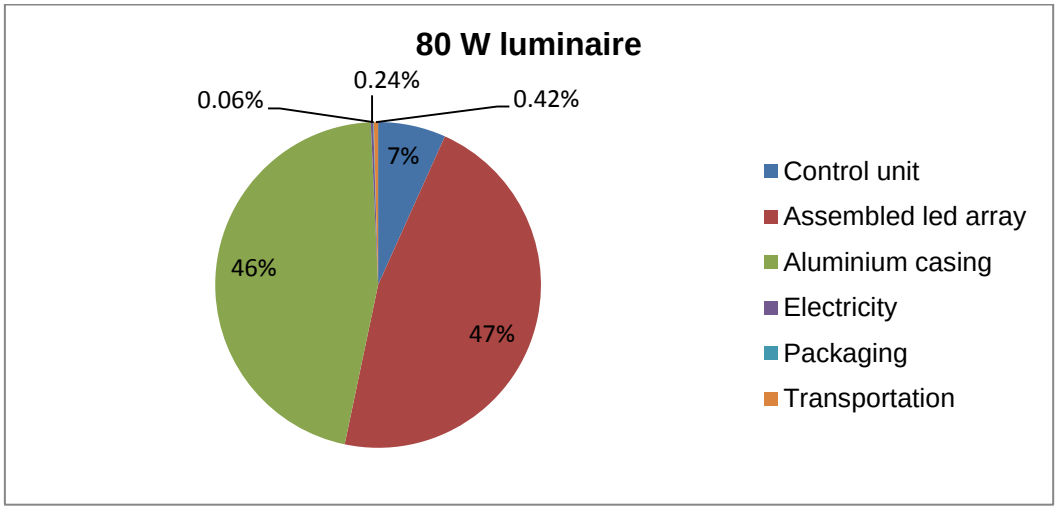

Figure 36: Cost breakdown for 80 W LED streetlight luminaire

About R3 191 918.89 will be spent on the production of 80 W LED street light luminaires in the first year of operation.

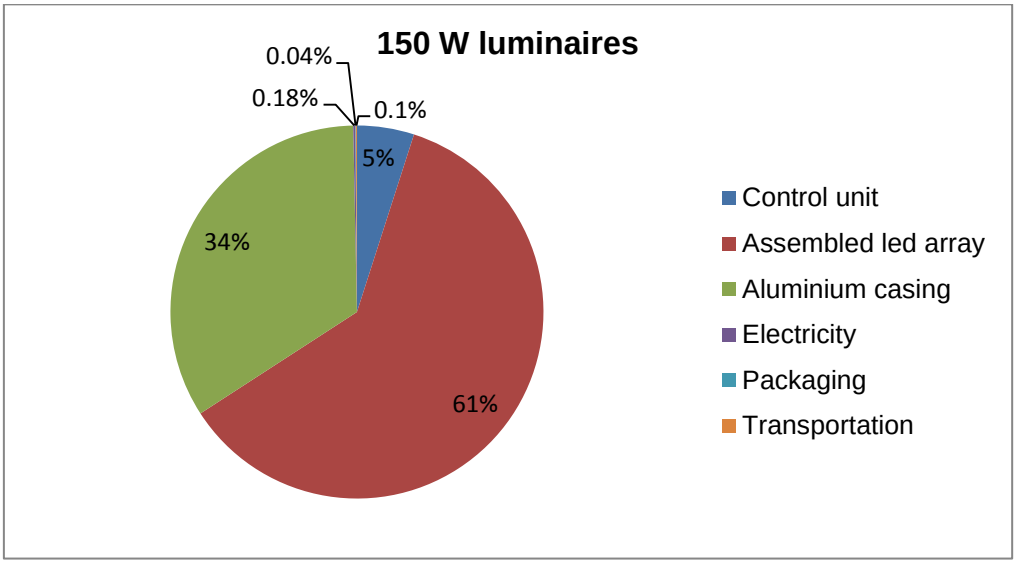

Figure 37: Cost breakdown for 150 W LED streetlight luminaire

About R2 410 492.99 will be spent on the production of 150 W LED street light luminaires in the first year of operation.

D.2.3. Indirect costs

Indirect costs in an enterprise are incurred irrespective of whether products are manufactured and sales are made. The total indirect costs for the first year of production will be R2 345 887 excluding depreciation.

Figure 38 shows the distribution of indirect costs.

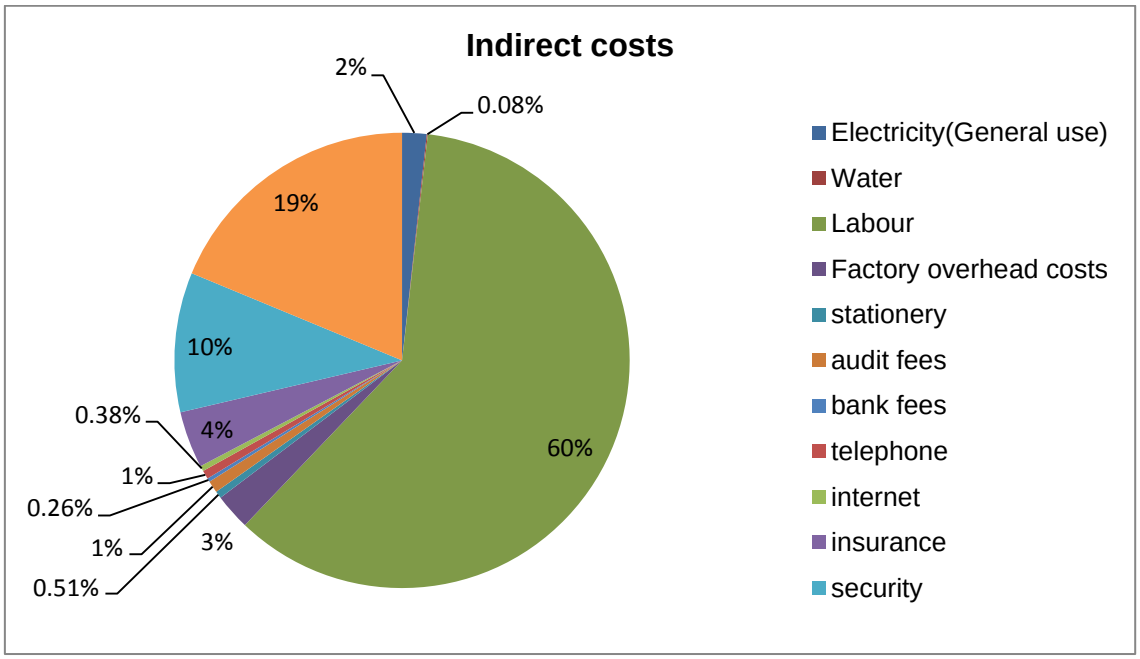

Figure 38: Indirect costs

The highest indirect cost contributor is labour at 60%, followed by depreciation at 31%.

The enterprise would not have direct control over utility prices, but needs to save electricity wherever possible. In addition, the labour costs need to be managed well to ensure that these costs do not escalate to unacceptable level.

D.3. SALES

Table 34 shows the sales forecast quantities and revenue during different stages of production

Table 34: Sales forecast

	Type	Luminaires 1	Luminaires 2	Luminaires 3	
		(150 W)	(80 W)	(50 W)	
Phase one (Year 1 & 2)	Product Price	R 7 744	R 5 697	R 5 021	
	Sales Volumes per Annum				Grand total
	Rural Municipal Light			480	
	Urban Municipal Light		720		
	SANRAL	400			
	Ave. revenue / yr.	**R 3 097 516.33**	**R 4 101 659.26**	**R 2 410 052.06**	**R 9 609 228**
Phase two (Year 3 to 5)	Rural Municipal Light			1 200	
	Urban Municipal Light		1 800		
	SANRAL	1 100			
	Ave. revenue / yr.	**R 8 518 169.92**	**R 10 254 148.14**	**R 6 025 130.16**	**R 24 797 448**
Phase three From Year 6	Rural Municipal Light			1 200	
	Urban Municipal Light		1 800		
	SANRAL and Africa	5 600			
	Ave. revenue / yr.	**R 43 365 228.68**	**R 10 254 148.14**	**R 6 025 130.16**	**R 59 644 507**

D.4. PREDICTED TEN YEAR FINANCIAL STATEMENTS

Based on the cost and sales assumptions, projected ten year cash flow statements, income statements and balance sheet were prepared.

D.4.1. Income Statement

The primary purpose of the income statement is to report the enterprise's earnings to interested and affected parties such as investors, shareholders, employees and creditors over a specific period of time. It matches the corresponding expenses to the revenue. The income statement, sometimes referred to as the statement of earnings or statement of

operations, presents a picture of enterprise's profitability over the entire period of time covered. The predicted income statement of this enterprise is shown in Table 35.

Table 35: Income statement

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sales revenue	9 609 520	10 282 186	28 391 459	30 378 861	32 505 382	83 656 881	89 512 863	95 778 763	102 483 277	R 109 657 106
Less variable costs	7 227 288	7 733 198	21 363 090	22 858 506	24 458 601	63 479 713	67 923 293	72 677 923	77 765 378	R 83 208 954
VARIABLE MARGIN	**2 382 232**	**2 548 988**	**7 028 370**	**7 520 355**	**8 046 780**	**20 177 168**	**21 589 570**	**23 100 840**	**24 717 899**	**R 26 448 151**
Less fixed costs	2 345 887	2 479 310	2 622 073	2 778 046	2 941 496	3 067 070	3 263 790	3 464 023	3 678 272	R 3 914 525
Material	42 472	45 445	48 626	52 030	55 672	59 569	63 739	68 201	72 975	R 78 083
Personnel	1 414 980	1 514 029	1 620 011	1 733 411	1 854 750	1 984 583	2 123 503	2 272 149	2 431 199	R 2 601 383
Depreciation	439 837	439 837	439 837	443 053	443 053	393 737	403 323	403 323	403 323	R 410 330
Other fixed costs	448 598	480 000	513 600	549 552	588 020	629 182	673 225	720 350	770 775	R 824 729
GROSS PROFIT	**36 345**	**69 678**	**4 406 296**	**4 742 309**	**5 105 284**	**17 110 098**	**18 325 780**	**19 636 817**	**21 039 627**	**R 22 533 627**
TAXABLE PROFIT	**36 345**	**69 678**	**4 406 296**	**4 742 309**	**5 105 284**	**17 110 098**	**18 325 780**	**19 636 817**	**21 039 627**	**R 22 533 627**
Income (corporate) tax	10 177	19 510	1 233 763	1 327 847	1 429 480	4 790 827	5 131 218	5 498 309	5 891 095	R 6 309 415
NET PROFIT	**26 168**	**50 168**	**3 172 533**	**3 414 463**	**3 675 805**	**12 319 270**	**13 194 561**	**14 138 508**	**15 148 531**	**R 16 224 211**

Table 35 shows that the enterprise would be profitable from its first year of operation. These results indicate the potential for this opportunity to be turned into a sustainable enterprise.

D.4.2. Balance Sheet

The balance sheet, also known as a "statement of financial position", reveals the enterprise's assets, liabilities and owners' equity (net-worth). The purpose of the balance sheet provides an idea of the enterprise's financial position, along with displaying what it owns and owes.

The projected balance sheet of the enterprise is illustrated in Table 36.

Table 36: Balance sheet

	Establish-ment year 1 & 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
TOTAL ASSETS	**13 510 000**	**15 812 182**	**16 338 718**	**20 765 348**	**24 192 264**	**28 007 147**	**43 906 875**	**57 146 165**	**71 690 995**	**87 268 522**	**103 951 760**
Total current assets	722	2 742 741	3 709 114	8 499 335	12 369 304	16 612 830	32 732 053	46 374 666	61 322 819	77 189 246	94 282 813
Inventory on materials & supplies	0	614 103	644 559	1 801 601	1 905 020	2 038 371	5 350 596	5 660 451	6 056 683	6 480 651	6 934 296
Work in progress	0	24 682	25 992	64 875	68 660	73 467	184 260	195 002	208 653	223 258	238 886
Finished product	0	177 593	190 024	457 826	489 874	524 165	1 286 309	1 376 351	1 472 695	1 575 784	1 686 089
Accounts receivable	0	1 522 223	1 628 779	3 924 221	4 198 917	4 492 841	11 025 508	11 797 293	12 623 104	13 506 721	14 452 192
Cash-in-hand	0	36 236	38 773	41 487	44 391	47 498	50 823	54 381	58 187	62 261	66 619
Cash surplus, finance available	722	367 904	1 180 987	2 209 325	5 662 442	9 436 488	14 834 556	27 291 187	40 903 496	55 340 571	70 904 730
Total fixed assets, net of depreciation	13 509 278	13 069 441	12 629 604	12 266 013	11 822 960	11 394 317	11 174 822	10 771 499	10 368 176	10 079 277	9 668 947
Fixed investments	0	10 681 658	10 681 658	10 681 658	10 757 903	10 757 903	10 772 314	10 946 555	10 946 555	10 946 555	11 060 978
Construction in progress	10 681 658	0	0	76 245	0	14 411	174 241	0	0	114 424	0
Total pre-production expenditures	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620	2 827 620
Less accumulated depreciation	0	439 837	879 673	1 319 510	1 762 563	2 205 616	2 599 353	3 002 676	3 405 999	3 809 322	4 219 652
TOTAL LIABILITIES	**13 510 000**	**15 812 182**	**16 338 718**	**20 765 348**	**24 192 264**	**28 007 147**	**43 906 875**	**57 146 165**	**71 690 995**	**87 268 522**	**103 951 760**
Total current liabilities	0	710 013	691 382	1 945 478	1 957 931	2 097 010	5 677 467	5 722 196	6 128 518	6 557 514	7 016 540
Total equity capital	13 510 000	15 076 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000	15 571 000
Reserves, retained profit brought forward	0	0	26 168	76 336	3 248 870	6 663 332	10 339 137	22 658 407	35 852 969	49 991 477	65 140 008
Retained profit	0	26 168	50 168	3 172 533	3 414 463	3 675 805	12 319 270	13 194 561	14 138 508	15 148 531	16 224 211
Net worth	13 510 000	15 102 168	15 647 336	18 819 870	22 234 332	25 910 137	38 229 407	51 423 969	65 562 477	80 711 008	96 935 220

The balance sheet shows a positive net worth, which is an indication that the enterprise would have sufficient assets to meet its liabilities, both in the short and long-term.

D.4.3. Cash Flow Statement

The cash flow statement discloses how the enterprise raises money and how it spends those funds during a given period. It also measures its ability to cover its expenses in the short term. Generally speaking, a business that is consistently earning more cash than it spends is considered to be of good value.

Table 37 shows the projected cash flow of the enterprise.

Table 37: Cash flow statement

	Establishment Year 1 & 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
TOTAL CASH INFLOW	**13 510 000**	**11 885 533**	**10 777 186**	**29 645 556**	**30 391 314**	**32 644 460**	**87 237 338**	**89 557 591**	**96 185 085**	**102 912 273**	**110 116 132**
Inflow funds	13 510 000	2 276 013	495 000	1 254 096	12 453	139 079	3 580 457	44 729	406 322	428 996	459 026
Total equity capital	13 510 000	1 566 000	495 000	0	0	0	0	0	0	0	0
Total short-term finance	0	710 013	0	1 254 096	12 453	139 079	3 580 457	44 729	406 322	428 996	459 026
Inflow operation - Sales	0	9 609 520	10 282 186	28 391 459	30 378 861	32 505 382	83 656 881	89 512 863	95 778 763	102 483 277	109 657 106
TOTAL CASH OUTFLOW	**13 509 278**	**11 518 352**	**9 964 103**	**28 617 218**	**26 938 197**	**28 870 415**	**81 839 270**	**77 100 961**	**82 572 775**	**88 475 198**	**94 551 972**
Increase in fixed assets	13 509 278	0	0	76 245	0	14 411	174 241	0	0	114 424	0
Fixed investments	10 681 658	0	0	76 245	0	14 411	174 241	0	0	114 424	0
Pre-production expenditures (net of interest)	2 827 620	0	0	0	0	0	0	0	0	0	0
Increase in current assets	0	2 374 837	153 290	3 761 883	416 851	469 480	10 721 155	1 185 982	1 335 844	1 429 353	1 529 407
Operating costs	0	9 133 338	9 772 672	23 545 326	25 193 499	26 957 044	66 153 047	70 783 760	75 738 623	81 040 327	86 713 150
Income (corporate) tax	0	10 177	19 510	1 233 763	1 327 847	1 429 480	4 790 827	5 131 218	5 498 309	5 891 095	6 309 415
Loan repayment	0	0	18 631	0	0	0	0	0	0	0	0
SURPLUS (DEFICIT)	**722**	**367 181**	**813 083**	**1 028 338**	**3 453 117**	**3 774 046**	**5 398 068**	**12 456 631**	**13 612 309**	**14 437 074**	**15 564 160**
CUMULATIVE CASH BALANCE	**722**	**367 904**	**1 180 987**	**2 209 325**	**5 662 442**	**9 436 488**	**14 834 556**	**27 291 187**	**40 903 496**	**55 340 571**	**70 904 730**

The cash flow statement shows a positive net worth, which is an indication that the enterprise would have sufficient assets to meet its liabilities, both in the short and long-term.

A total investment of R15 571 000 grant funding will be needed as follows:

- Establishment: R13 510 000
- Production (Year 1): R 1 566 000
- Production (Year 2): R 495 000

If the required grant funding could be secured, the business will have a positive cash flow from the beginning. Therefore, it is critical that the involved stakeholders make a long term commitment to fund the establishment and operations of the business.

D.5. FINANCIAL ANALYSIS

D.5.1. Net Present Value(NPV)

The NPV compares the value of money today to the value of that same money in the future, taking into account inflation and returns.

If a discount rate of 6% is used, the NPV for this venture is R44 463 490, which indicates a positive return for the business.

D.5.2. Internal Rate of Return (IRR)

The IRR measures and compares the profitability of investments to each other. It is also called the discounted cash flow rate of return.

The IRR for this venture is 26.81%, which is above the discount rate of 6%. Therefore, the business has a strong chance to be financially viable.

D.5.3. Payback period

The payback period gives an indication of how long the business would have to operate to generate profits, and before it will be able to repay the initial investment.

The payback period for this venture is seven years.

D.5.4. Sensitivity Analysis

Sensitivity analysis was conducted on different variables of the financial model, to determine which changes would either negatively or positively affect the financial viability of the enterprise. Table 38 shows the results of the sensitivity analysis.

Table 38: Sensitivity analysis

		Likely	Increase by 10%	Decrease by 10%
Components	NPV	R 44 463 490	R 22 640 133	R 65 932 807
	IRR	26.81%	17.51%	34.62%
	Payback period	7	8.64	5.94
Labour Costs	NPV	R 44 463 490	R 43 397 865	R 45 480 972
	IRR	26.81%	26.24%	27.34%
	Payback period	7	7	7
Product Selling Prices	NPV	R 44 463 490	R 72 608 140	R 15 835 736
	IRR	26.81%	36.42%	14.5%
	Payback period	7	5.7	9.4

When components, labour costs and selling prices are increased or decreased by 10%, the NPV remains positive and the IRR is still above the discount rate of 6%.

An additional R1.8 million (in year 1) in grant funding will be required if the costs of components are increased by 10%, whilst an additional amount of R1.2 million (year 1 and 3 combined) will be required if the selling price is decreased by 10%.

D.6. ECONOMIC BENEFITS OF THE BUSINESS

The establishment of government funded ventures mainly aim at sparking economic activity in a chosen specific area. Job creation also remains high on the government agenda. It is therefore important to analyse the potential for this venture to create jobs and livelihoods in Mahikeng.

D.6.1. Gross Value Added (GVA)

The GVA, also known as the localised gross domestic product (GDP) is a measure of the value of goods and services produced in an area, industry or sector of the economy. It takes into account revenues, final sales and net subsidies, which are incomes to the business, as well as salaries, wages and dividends. The GVA is an indication of the economic activity that can take place in a certain geographical area, brought about by establishment or operation of a venture. GVA in this study has been calculated by adding the average net profit, the average annual depreciation and the salary spend.

The GVA for this venture is expected to average at R10 513 387 per annum.

D.6.2. Jobs

Based on the number of people needed to operate machinery, management and auxiliary staff, the venture could yield 10 direct job opportunities. The job opportunities would include the following:

- Qualified staff: General Manager, Senior Engineer, Artisans (X2) and Administrator;
- Grade 12 level jobs: Operators (X2), Store-man; and

- Low skill jobs: Truck Driver and Cleaner

APPENDIX E FINANCIAL ASSUMPTIONS

Assumptions for the financial model								
Description	**Value**							**Sources/Notes**
1.Project ID								
Project Type:	Industrial							
level of Analysis:	Feasibility Study							
Project Title	NW Electronic LED Project							
Project Classification:	• New project							
Depth of Analysis:	Financial							
Special Features:	• Inflation							
	• Escalate first year= **0** times							
	• Stock model=By total							
2.Planning Horizon								
Month of Balance	(month in which annual reporting needs to be done) 12							
Construction phase	• Beginning month & year=01**/2016**							
	• length=12 **months**							
Production phase	• length= **10 years**							
	• length of start-up phase=months(included in **above years**)							
	• Reference year=10 (no of years after start by which payback will happen)							
3.Products	**Name**	**Start of Production**	**End of Production**	**Nominal Capacity**				
Products:	50 W LED streetlight luminaires	2016	2026	1 200				
	80 W LED streetlight luminaires	2016	2026	1 800				
	150 W LED streetlight luminaires	2016	2026	5 600				
4.Currencies	**8 600**						**units**	
Currency	• Type=Local							
	• Name=South African Rand							
	• Abbreviation=ZAR							
	• Exchange Rate=N/A							
5.Inflation								
Inflation Rate:	**7**% for each year, except for first year (All costs and sales prices will be increased annually by this percentage)							
6.Joint Venture Partner								
Joint Venture Partner	Not applicable							

7.Discounting								
Total investment:	• Rate (%) = **6%**							
	• Length= **11 years**							
Total equity capital:	• Rate (%) = **6%**							
	• Length= **11 years**							
For all Joint Venture Partners:	• Rate (%) = **6%**							
	• Length= **11 years**							
8.Fixed Investments:								
	Description	**Supplier**	**Depreciation Years (Use SARS Wear&Tear Rates)**	**Years of Purchase**	**Quantity**	**Cost(ZAR)**	**Total**	
	Building Construction and Civil Works							Brighton estimatess divide by 4
	Building works		30	Y0	1	R 7 000 000	R 7 000 000	
	Professional fees		30	Y0	1	R 1 260 000	R 1 260 000	
							R 8 260 000	
Fixed Investments:	**Plant machinery & equipment:**							
	Production line							
	Wire bonder		10	Y0	1	R 140 000	R 140 000	
	Welding wire machine		10	Y0	5	R 5 000	R 25 000	
	Sealing / packaging machine		10	Y0	1	R 120 000	R 120 000	
	Spectrometer		10	Y0	2	R 40 000	R 80 000	
	Braiding / taping machine		10	Y0	2	R 20 000	R 40 000	
	Drying cabinet		10	Y0	1	R 10 000	R 10 000	
	Lamps photoelectric testing instrument		10	Y0	1	R 60 000	R 60 000	
	LED optoelectronic devices		10	Y0	4	R 20 000	R 80 000	
	High low temperature test box	Various Organisation	10	Y0	2	R 30 000	R 60 000	Reference to catalogue
	Assembly line						**R 615 000**	
	Plug line		10		1	R 20 000	R 20 000	
	Assembly line (automatic belt line)		10		1	R 170 000	R 170 000	
							R 190 000	
	One large bakkie - NV 200 Panel		5	Y0	1	R250 000	**R 250 000**	

	Van							
	Auxiliary & service plant equipment:							
	•Telephone connections	Telkom		Y0	4	R 750	R 3 000	
	Incorporated fixed assets(project overheads):							
	•Basic canteen furniture	Retail shops	6	Y0, Y6	1	R 12 540	R 12 540	
	Office furniture		6	Y0, Y6	3	R 7 524	R 22 572	
	•Boardroom furniture		6	Y0, Y6	1	R 15 000	R 15 000	
	•Computers	Incredible connection	3	Y0, Y3,Y6,Y9	3	R 13 999	R 41 997	
	•Laptop computer	Incredible connection	3	Y0, Y3,Y6,Y9	1	R 8 999	R 8 999	
	•Software(MS office)	Incredible connection	3	Y0, Y3,Y6,Y9	4	R 3 900	R 15 600	
	•Software(Pastel)	Incredible connection	5	Y0, Y5	1	R 2 600	R 2 600	
	•Desktop Printers	Incredible connection	5	Y0, Y5	1	R 1 999	R 1 999	
	•Laser all-in-one	Incredible connection	5	Y0, Y5	1	R 3 999	R 3 999	
	•Telephone hand sets	Incredible connection	5	Y0, Y5	4	R 599	R 2 396	
							R 127 701.50	
	Preproduction Expenditure							
	Research and Development (Engineering Design)	SABATEK		Y0	1	R 1 990 000	R 1 990 000	
	Company Formation			Y0	1	R 37 620	R 37 620	
	•Training			Y0	1	R 250 000	R 250 000	
	•Marketing			Y0	1	R 300 000	R 300 000	
	•Recruitment			Y0	1	R 150 000	R 150 000	
	•Consultants (Environmental Compliance)			Y0	1	R 100 000	R 100 000	
							R 2 827 620	
	Contingencies			Y0			**R 1 227 032.15**	10% of Total investment costs
9.Production Costs								
Indirect	**Description**			**Years**	**Quantit**	**Cost(ZAR)**		

Costs:					**y**			
	Utilities:							
	Electricity(general Use)			Y1-Y10	1	R 40 680	R 40 680	
	Water(general use)			Y1-Y10	112	R 16	R 1 792	(Per capita 50l/day*#ppl*224days/1000)* R16
							R 42 472	
	Labour:							
	General Manager			Y1 - Y10	1	R 450 000	R 450 000	Industry and location based
	Administrator			Y1 - Y10	1	R 90 000	R 90 000	Industry and location based
	Senior Engineer			Y1 - Y10	1	R 310 980	R 310 980	Industry and location based
	Artisan			Y1 - Y10	4	R 96 000	R 384 000	Industry and location based
	Storeman			Y1 - Y10	1	R 48 000	R 48 000	Industry and location based
	Driver			Y1 - Y10	1	R 54 000	R 54 000	Industry and location based
	Cleaner			Y1 - Y10	1	R 30 060	R 30 060	Industry and location based
							R 1 367 040	
	Factory overhead costs:							
	•Safety clothing			Y1 - Y10	9	R 700	R 6 300	Makro
	•Finger cots			Y1 - Y10	60	R 42	R 2 530	300pc/bag, based on each person using 4 pairs a day
	•General maintenance			Y1 - Y10	12	R 500	R 6 000	
	•Consumables			Y1 - Y10	1	R 8 050	R 8 050	
	•Cleaning materials			Y1 - Y10	12	R 1 500	R 18 000	
	SDL			Y1-Y10	1	R 13 670	R 13 670	
	UIF			Y1-Y10	1	R 13 670	R 13 670	
							R 68 221	
	Administrative overhead costs							
	•Stationary			Y1 - Y10	12	R 1 000	R 12 000	

	•Audit fees			Y1 - Y10	1	R 20 000	R 20 000	
	•Bank fees	FNB		Y1 - Y10	12	R 500	R 6 000	
	•Telephone monthly costs	Telkom		Y1 - Y10	12	R 1 200	R 14 400	
	•Internet monthly costs	Afrihost		Y1 - Y10	12	R 750	R 9 000	
	•Insurance			Y1 - Y10	1	R 94 427	R 94 427	1% of assets costs
	•Security	Retail security services		Y1 - Y10	12	R 19 380	R 232 560	
							R 388 387.02	
150 Watt Retrofit	**Description**			**Years**	**Quantity**	**Cost(ZAR)**		
	Raw Materials							
	Assembled PCB			Y1 - Y10	5600	R 293	R 1 638 000	purchased from PCB enterprise
	Assembled LED Array			Y1 - Y10	5600	R 3 600	R 20 160 000	purchased from PCB enterprise
	Aluminium Housing - Casing			Y1 - Y10	5600	R 2 000	R 11 200 000	
	Electricity			Y1 - Y10	5600	R 11	R 58 856	
	Packaging (bubble wrapping) - Factory supplies			Y1 - Y10	112	R 121	R 13 552	Mackro 1sqm per Lamp
	Transportation (Factory o/h)			Y1 - Y10	24	R 1 368	R 32 820	
							R 33 103 228	**R5 911.29**
80 Watt Retrofit	**Description**			**Years**	**Quantity**	**Cost(ZAR)**		
	Raw Materials							
	Assembled PCB			Y1 - Y10	1800	R 293	R 526 500	purchased from PCB enterprise
	Assembled LED Array			Y1 - Y10	1800	R 2 025	R 3 645 000	purchased from PCB enterprise
	Aluminium Housing - Casing			Y1 - Y10	1800	R 2 000	R 3 600 000	Engineering Drawing and Design Estimate
	Electricity			Y1 - Y10	1800	R 11	R 18 918	
	Packaging (bubble wrapping) - Factory supplies			Y1 - Y10	36	R 121	R 4 356	Mackro 1sqm per Lamp
	Transportation (Factory o/h)			Y1 - Y10	24	R 1 368	R 32 820	
							R 7 827 594	**R4 348.66**
50 Watt	**Description**			**Years**	**Quantity**	**Cost(ZAR)**		

Retrofit	*Raw Materials*						
	Assembled PCB		Y1 - Y10	1200	R 293	R 351 000	purchased from PCB enterprise
	Assembled LED Array		Y1 - Y10	1200	R 1 275	R 1 800 000	purchased from PCB enterprise
	Aluminium Housing - Casing		Y1 - Y10	1200	R 2 000	R 2 400 000	Engineering Drawing and Design Estimate
	Electricity		Y1 - Y10	1200	R 11	R 12 612	
	Packaging (bubble wrapping) - Factory supplies		Y1 - Y10	24	R 121	R 2 904	Mackro 1sqm per Lamp
	Transportation (Factory o/h)		Y1 - Y10	24	R 1 368	R 32 820	
						R 4 599 336	**R3 832.78**
10.Sales Programme	**Description**						
Product Sales:			**Years**	**Quantity**	**Price(ZAR)**	**Total sales**	
	150 Watt Retrofit		Y1	400	R 7 744	R 3 097 516	31% markup
			Y2	400	R 7 744	R 3 097 516	
			Y3	1 100	R 7 744	R 8 518 170	
			Y4	1 100	R 7 744	R 8 518 170	
			Y5	1 100	R 7 744	R 8 518 170	
			Y6	5 600	R 7 744	R 43 365 229	
			Y7	5 600	R 7 744	R 43 365 229	
			Y8	5 600	R 7 744	R 43 365 229	
			Y9	5 600	R 7 744	R 43 365 229	
			Y10	5 600	R 7 744	R 43 365 229	
	80 Watt Retrofit		Y1	720	R 5 697	R 4 101 659	31% markup
			Y2	720	R 5 697	R 4 101 659	
			Y3	1 800	R 5 697	R 10 254 148	
			Y4	1 800	R 5 697	R 10 254 148	
			Y5	1 800	R 5 697	R 10 254 148	
			Y6	1 800	R 5 697	R 10 254 148	
			Y7	1 800	R 5 697	R 10 254 148	
			Y8	1 800	R 5 697	R 10 254 148	
			Y9	1 800	R 5 697	R 10 254 148	
			Y10	1 800	R 5 697	R 10 254 148	
	50 Watt Retrofit		Y1	480	R 5 021	R 2 410 052	31% markup
			Y2	480	R 5 021	R 2 410 052	
			Y3	1 200	R 5 021	R 6 025 130	

		Y4	1 200	R 5 021	R 6 025 130	
		Y5	1 200	R 5 021	R 6 025 130	
		Y6	1 200	R 5 021	R 6 025 130	
		Y7	1 200	R 5 021	R 6 025 130	
		Y8	1 200	R 5 021	R 6 025 130	
		Y9	1 200	R 5 021	R 6 025 130	
		Y10	1 200	R 5 021	R 6 025 130	
11.Working Capital						
Inventory	•Raw Materials=30 days					
	•Work in Progress =1 day					
	•Finished Goods 7 days				48%	
	•Utilities=1 day					
	•Energy= 1 day					
Description	**Value**					
Account Receivable	• 60 days					
Cash-in-hand:	• Cash-in-hand-local=7 days					
Account Payable:	•Raw Materials=30 days					
	•Utilities=30 days					
	•Energy= 30 days					
	•Repair, maintenance, materials= 30 days					
	•Labour= 1day					
	•Labour Overheads = 1 day					
	•Factory Overheads= 30 days					
	•Administrative Costs = 30 days					
	•Direct Marketing Costs = 30 days					
12. Sources of Finance	**(Default for most ECD Projects = Grant Funding, Loans could be included in Scenarios)**					
Equity,Risk Capital	Joint Venture Partner	Year	Amount paid in	Total % of profits distrubited	% of dividends Received(split between partners	
		Y0	R 13 509 277.55			
		Y1	R 1 200 000			
		Y2	R 495 000			
13.Tax Allowances						
Income	•Tax rate=28 % (or use SARS rates for small business)					
Description	**Value**					

(corporate)tax:	•Losses carried forward =3 years		

APPENDIX F REFERENCES

The Climate Group. (2014, December 02). *Accelerating adoption of LED street lighting: event in Tustin, Texas shows there's "no need to wait"*. Retrieved March 01, 2015, from The Climate Group: http://www.theclimategroup.org/

ADEC. (2014). *ADEC Profile and objectives.*

Allington, M. (2006, December). Factory Layout Principles. *UK-RF Closed Nuclear Cities Partnership*.

Beka (Pty) Ltd . (2012). *LED Street Lighting- Current and Future Trends, South African.*

Beka Shreder. (n.d.). *Olifantsfontein.* Olifantsfontein: Olifantsfontein.

Bhandarker, V. (February 2011). *LED Lighting Market Trends .* SANTA MONICA.

BrandSouthAfrica. (2014, November). *SouthAfrica.info*. Retrieved November 2014, from South African Information: http://www.southafrica.info/business/economy/sectors/icte-overview.htm#.VS-rPGeJheV

CHE. (2012). *Fet Colleges Report.*

COGTA. (2014). *Municipal Infrastructure Grant Report.* Department of Cooperative Governance.

DST. (2008). *Technology Localisation Report.*

Engineering News. (February 2010). *Suppply of Street Lights*. Retrieved from http://www.engineeringnews.co.za/article/supply-of-street-lights-for-gfip-80-completed-2010-02-19

Gabru, F. (2009, February 20). *Lighting industry boom despite constraints*. Retrieved Jan 2015, from Enginnering News: Lighting industry boom despite constraints

GRH. (2015, January 10). *Street lighting technology comparison)*. Retrieved March 03, 2015, from GRH LED lighting: http://www.grhlighting.eu/learning-centre/street-lighting-technology-comparison

Gule, D. N. (2015). *LED.*

IFC. (2011). *Lighting Africa, Market Trends.*

IRR. (2014, December). Mirror Mirror on the Wall. *Fast Facts (No 12, Issue 240)*. South African Institute of Race Relations.

Mckensy and Company. (June 2012). *Lighting the Way: Perspective on the global lighting market.*

NRA. (2014). *SANRAL Q&A Report on e-tolls.*

NWU. (2010). *NWU Annual Report.*

SABERTEK. (2015). LED Engineering Cost.

SAVANT. (2011). *Status of South African electronics, ICT sector.*

StatsSA. (2011). *Census 2011.* Statistics South Africa.

StatsSA. (2012). *Regional Economic Growth.* StatsSA.

Strategies Unlimited. (2014). *LED Lighting Global Market Trends.* San Diego.

Sustainable Energy Africa. (2012). *Efficient public lighting guide.* Cape Town.

Texas Instrument. (2012). *LED Circuit Desings.*

The Climate Group. (June 2012). *LED.*

the dti. (2010). *Study to identify electronic assemblies, sub-assemblies and components that may be manufactured in South Africa.* Department of Trade and Industry.

the dti. (2012). *IPAP.* Department of Trade and Industry.

wikipedia. (2015, January 4). *North West (South African Province)*. Retrieved January 15, 2015, from Wikipedia: http://en.wikipedia.org/wiki/North_West_(South_African_Province)