LED street lighting of Residential Areas
The economical option for Local Authorities

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For some years the LED light source has been the centre of research and development in order to improve its luminous efficacy and at the same time, to reduce its cost.

Technical improvements in LED research have brought improvements, in:

- Increased luminous efficacy of 120lm/W for commercially available LEDs.
- High reliability, which is providing life times of 50,000 hours, at a 20% LED failure rate (L80), provided the maximum junction temperature of the LED is not exceeded.
- Good colour rendering, which is comparable to the best artificial light sources of the HID lamp range, like the Metal Halide Lamps.
- A range of colour temperatures, which makes the LED light source suitable for all applications, like neutral white in public lighting environments and warm white colour temperature in cosy, interior spaces.

All this on top of LED's known advantages, like:

- Vibration resistance
- Dimmable, providing a linear relationship between light generated and energy used.
- Instant switch on

The cost of the generated lumen has been the inhibiting factor for the past years, which prevented the wide-spread adoption of LED light sources in technically and commercially viable applications.

However, the time has come to say goodbye to the known and familiar light sources in the wattage range of 50W to 150W, since LED's have now reached a level where their use is technically and economically justified.

Particularly we should say goodbye to the usage of these light sources in street Lights, as we will elaborate in this paper:

The LED Generation we refer to represents a new era in the field of lighting.

This has been applied in the South African designed and manufactured street light luminaire, which reflects the need to continue "Right Lighting", by offering technological solutions that make this new light source a valid alternative to traditional sources.

To do so, concepts have been developed that will make LEDs the new instrument to offer the lighting solutions of today and tomorrow.

Recent history shows that the Light Emitting Diode has revolutionised our technological understanding and engineering. The conventional lamp technology including all kind of discharge lamps, e.g. fluorescent lamps, metal halide lamps and high pressure sodium lamps, all had more or less the same electrical and thermal characteristics which have been reflected in all the luminaire designs of the past.

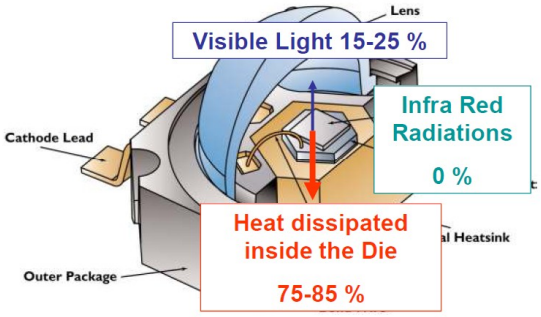
The LED however differentiates itself tremendously from the traditional light source as we refer to them. To understand the requirements of a properly designed LED luminaire we have to understand the new technology.

- The LED is a semiconductor device and thus a fully identified electronic component. Certain aspects need to be pointed out:
  - An LED itself cannot be operated on its own. It needs to be assembled on to a printed circuit board in combination without or preferably with electronic components which protect and ensures the proper functioning of the LED.
  - An LED can only be directly touched or man handled inside an ESD (Electrostatic Discharge) environment. This implicates that it is not advisable that an LED as such can be replaced on site, like we had with our traditional light sources.
- The lifetime of an LED is exceptionally high, ranging between 30,000 to 100,000 hrs, depending on certain operating criteria like chip temperature, light depreciation and level of ingress protection.
  - This implies that an LED luminaire has to be designed to operate for that period

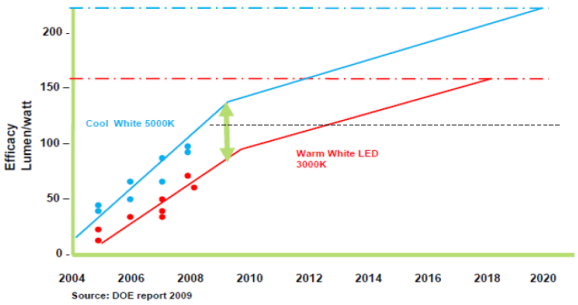
without any or at least very little maintenance.

- Furthermore all the components, e.g. luminaire housing, electronic power supply, type of LED have to be well balanced and designed for these extreme lifetimes.

- LEDs are still converting most of their energy into heat even though much less compared to traditional light sources. LEDs emit no heat via Infrared radiation but only by conduction to its surrounding material.
  - This results in new design features making LED luminaires very shallow with no reflector required but with a well-designed thermal concept.



- The LED is an electronic device, with which we are experiencing the same fast pace of improvement in performance and efficiency as other electronic devices, e.g. computers or mobile phones. Thus the luminaire has to provide the option for upgrading components without having to replace the whole luminaire. This should be done safely and fast with as little cost involved as possible. A gradual operational mind-set shift from maintenance towards upgrading has to follow.



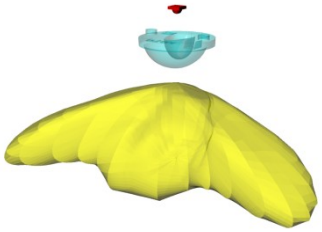
Therefore the design of the LED Street light adheres to the following terms:

POWERFULL PHOTOMETRIC ENGINE

Our company continues to implement its lighting competence by offering a photometric engine which covers every type of South Africa lighting application most efficiently and cost effective .

LensoFlex®. A photometric engine that builds on the flexibility offered by a selection of specially developed lenses with the following goals to offer the best lighting quality:

- ✓ Meeting the SABS lighting criteria in the most efficient and cost effective way.
- ✓ Improve facial recognition for safety and security by providing neutral white light with a high colour rendering (CRI).
- ✓ Smooth distribution providing excellent uniformity.
- ✓ Controlled beam, limiting glare.
- ✓ Dark-sky friendly by using only flat glass protector.



LEDSafe®.

To ensure a long service life by preventing dust and water from getting into the optical compartment, we have implemented the *LEDSafe®* system. This is based on the idea of a completely sealed photometric engine rated to IP66.

Protected by glass or polycarbonate lens, the LEDs and lenses do not come into direct contact with the outside environment. This helps to ensure that performance is preserved over time.

ThermiX®.

To optimise heat extraction to maintain 80% of the nominal luminous flux at 60,000 hours of use up to a maximum ambient temperature of 35°C.

This concept is based on several factors:

- ✓ Thermal compartmentalisation between the LEDs and the control gear.
- ✓ Direct conduction by minimising the path between the heat source and the outside.

- ✓ Optimised design of the external heat exchange surface.
- ✓ A temperature sensor placed next to the LEDs avoids accidental overheating, e.g. luminaire operating during daytime.

UPGRADABLE TECHNOLOGY

In the new LED Street light we have applied the *FutureProof* concept. This will allow on site replacement of the photometric engine or electronic assembly either as a result of technology improvements or at the end of an LED's service life, and thereby allowing users to integrate future innovations. This maximises energy saving by reducing the amount of LEDs over time.

Additional optional features can be provided:

- Electronically integrated daylight switch, which enables the local authorities to keep the supply cables alive at all times.
- Autonomous dimming system which reduces the power consumption and therefore the lighting levels during predetermined periods.
- Incorporation of Tele Management Modules

ENERGY AND ECOLOGICAL FOOTPRINT

The luminaire is designed towards sustainable development. The LED luminaire complies with the following internationally desirable criteria:

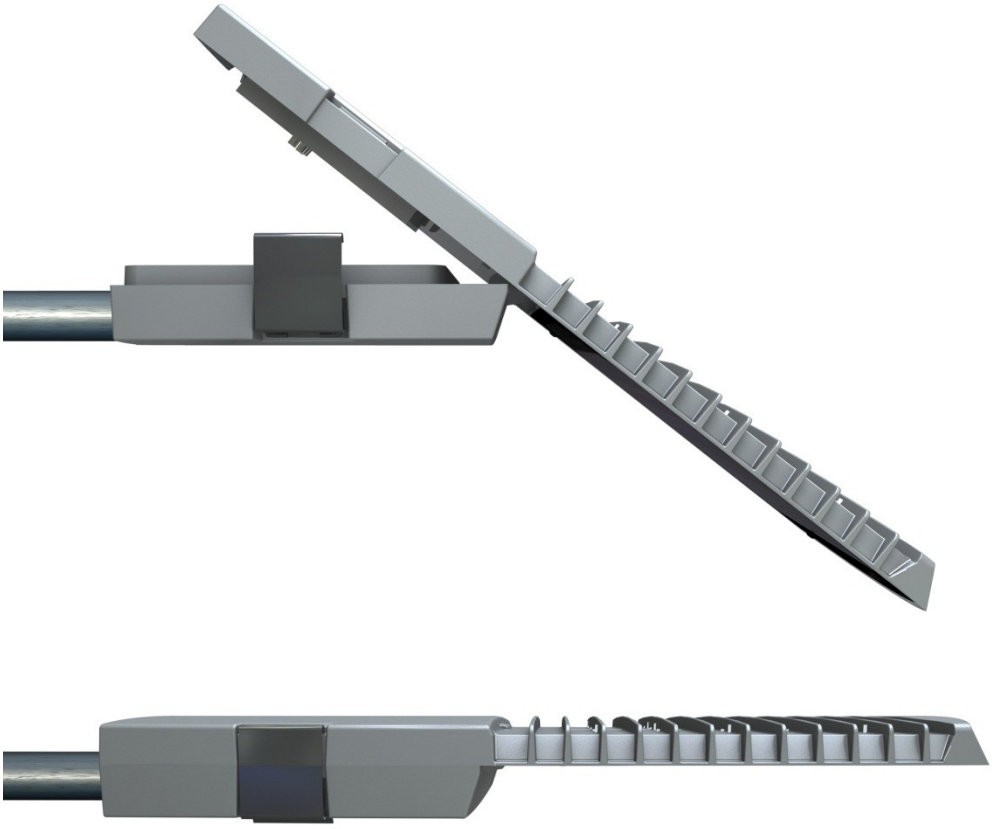
Maximising energy savings

The Product has to be fully recyclable

No or only limited amount of toxic material being utilised

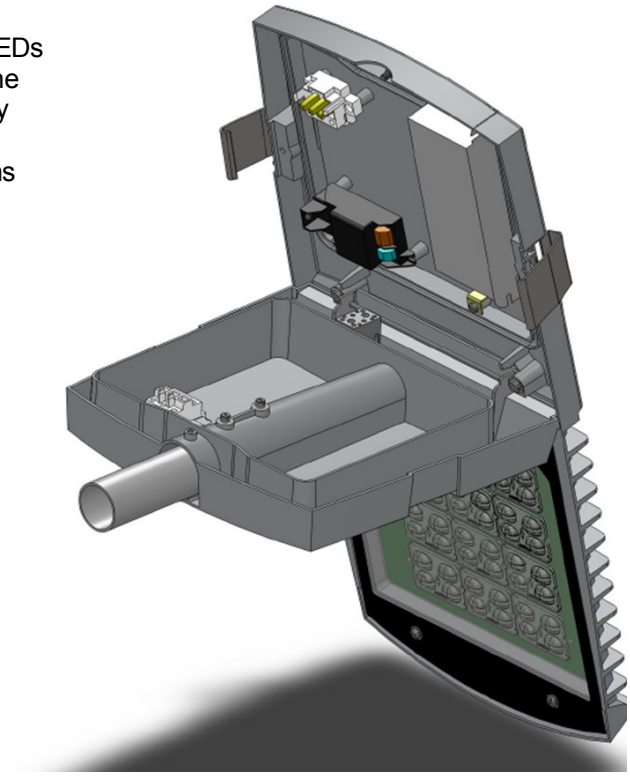
Ensuring local production

No or limited upward lighting



The power supply (as well as the optional dimming or remote management system) is mounted on the removable top cast *(FutureProof).* Highly efficient SELV Power Supply
> 89 % efficiency, >0.95 PF.
Thermal feedback from the LEDs and a thermal shutdown on the Power Supply will prevent any premature LED failures when operated in ambient conditions higher than 35 degrees.

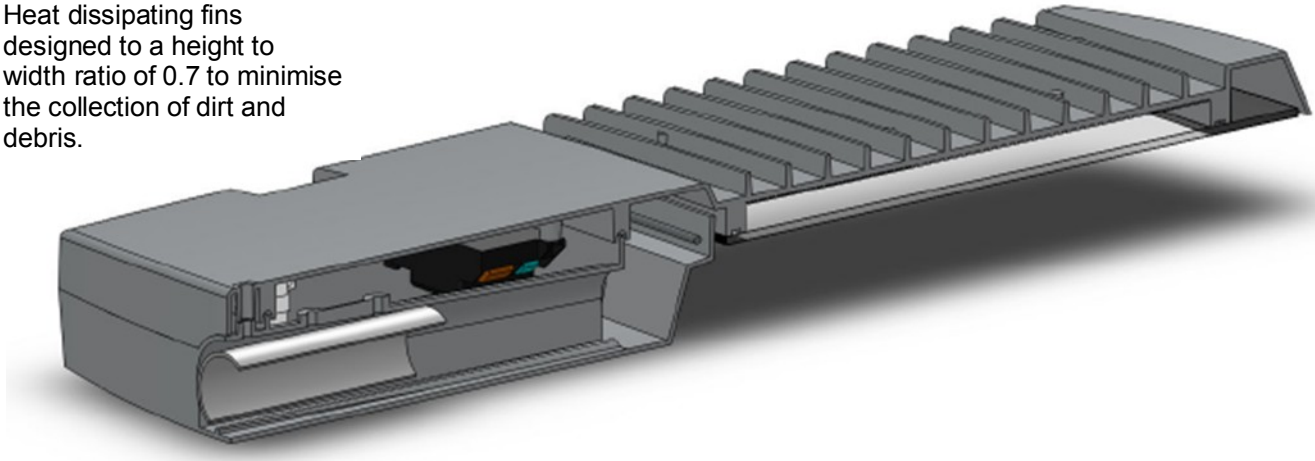
Optical compartment IP66 *LEDSafe*® engine completely sealed by an extra-clear glass or PC protector for an optimal luminous flux and lower lumen depreciation.
The concept of the photometric engine is consistent with the *FutureProof* principle.
It will be able to be replaced on site with no tools required, taking advantage of future technological developments.



The spigot compartment allows for horizontal mounting and securing from the inside. It creates the platform for upgrading and ease of installation with no tools or special skills required.

LensoFlex®: A photometric engine specifically dedicated to street lighting where performance, uniformity and comfort is essential.
LEDs in neutral white 4500K with a CRI >70, equipped with special developed lenses provide this requirement.

Thermix®:
A short and direct thermal path provides for the best possible heat extraction.
Heat dissipating fins designed to a height to width ratio of 0.7 to minimise the collection of dirt and debris.



Conclusion:
The time has come for LED street light luminaires to be used in residential and lower lighting class main road lighting, providing economic benefits for the utility companies. These benefits are not only applying to the lower energy costs, but to the vastly reduced maintenance costs.
Intelligent designs can make LED luminaires particularly suitable for the challenging African environments i.r.o. thermal, mechanical and operational requirements.