Efficient public lighting guide

In support of Municipal Energy Efficiency and Demand Side Management

reeep renewable energy & energy efficiency partnership

CITY ENERGY SUPPORT UNIT

SEA Sustainable Energy Africa NPC (RF)

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SALGA South African Local Government Association

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Introduction

A range of more energy efficient lighting technologies are coming into the market. Programmes, such as the DOE's Municipal EEDSM and Eskom's IDM Programme, to support the retrofit existing public lighting with more energy efficient alternatives are underway. In addition to power and electricity saving, retrofit programmes usually also result in cost savings (both operational and demand charge reductions) and reduced negative environmental impacts.

This brochure offers a very introductory overview of a range of public lighting options. It offers an overview of different lighting technologies; looks at traffic, street and public building lighting and provides some comparison of technologies, capital and operating costs, and electricity savings. The information is designed to support Municipal EEDSM strategy and business planning processes.

Lighting is a complex issue, however, and local municipal officials are best equipped to make final decisions about what type of lighting best suits local needs and conditions. It is also a rapidly evolving space and, while this brochure can provide some initial direction, it is important that greater detail is obtained from independent research studies, suppliers and professional colleagues during the business planning phase of any retrofit initiative. It should also be noted that while the focus of this brochure is on luminaires, there are a range of lighting related technologies, relating to reflectors, ballasts and power switch technology that are also available and can significantly improve the energy efficiency of street and building lighting.

Contents

Lighting technology overview

		OVERVIEW, PROS AND CONS
Incandescent		Introduced more than 125 years ago, these lamps produce light by heating up a metal filament enclosed within the lamp's glass. More than 90% of the energy used by an incandescent light bulb escapes as heat, with less than 10% producing light. Possible use in areas prone to frequent theft or vandalism, where high rate of replacement may make a case for use. **PROS**: Lowest initial cost (purchase price). Good colour rendering. No mercury. **CONS**: Very inefficient, short life time.
Mercury Vapour		Developed in the late 1940s, these are much brighter than incandescent, and last much longer. However, it is worth noting that sale of new MV fittings (ballast and bulb) has been banned in the US since 2008 (bulbs to replace old lamps in existing fittings do continue). **PROS**: Inexpensive, medium length life. **CONS**: Very inefficient, contains mercury (10 – 100mg), ultraviolet radiation. Depreciate – get dimmer over time while using same amount of energy.
Metal Halide		MH are similar to MV lamps, but with the addition of metal halides. The lamps operate at high temperatures and pressures, emit UV light and need special fixtures to minimize risk of injury or accidental fire in event of so called 'non passive' failure. Newer and less efficient than sodium counterparts. **PROS**: good colour rendering and lumen maintenance, consider for visually demanding applications such as city centres, shopping areas, pedestrian walk ways **CONS**: high cost, low life hours and rapid depreciation, high maintenance, UV radiation, contains mercury (10 – 1000mg) and lead, risk of bursting at the end of life
High pressure sodium		Introduced around 1970, and one of more popular street lighting options. Internal arc tube of translucent ceramic enclosed in an outer glass envelope. Arc tube contains mercury, metallic sodium and Xenon gas or neon-argon gas. Ionised by electric current. **PROS**: medium length life, good lumen maintenance, more energy efficient than MV and MH counterparts **CONS**: low colour rendering with yellow light, contains mercury (10-50mg) and lead * Although officially longish life, experience of some municipalities is that the larger HPS lamps – 250W – may last only 8-9months.
Compact fluorescent		Used more frequently as time has improved the quality. Phosphor coated glass tube with mercury and inert gas. Ionising by electric current. UV light converted to visible by phosphor coating. **PROS**: Efficiency high and colour rendering is excellent. **CONS**: Some issues include: limited lumen output, high heat build up in self contained ballast, low life/burnout due to frequent cycling (on/off) of lamp, become dimmer/fail to start in cold weather and/or moist environments. Contains mercury (3-50mg). Expensive.
Induction		Induction based fixtures are relatively new to the market. These use radio frequency or microwaves to create induced electrical fields, which in turn excite gases to produce light. Have rapid start up, work at peak, with minimal warm up. Although efficient and long life cycle, high initial costs and competition from LED evolution have led to limited adoption. **PROS**: Rapid start up, long life, energy efficient, good colour rendering, **CONS**: Higher initial cost. Contains mercury (0.25-3mg, solid state thus safer) and may contain lead. Negatively affected by heat.
LED		Rapidly evolving and latest high performance LED technologies are exceeding other technologies in all technical parameters. **PROS**: High energy efficiency and low maintenance/long life. Free of harmful substances. Low light pollution due to high directional light. Low rates of lumen depreciation and can handle cold temperatures and on/off switching. **CONS**: Relatively higher initial cost. Some poor manufacture/low quality on market.

*(**Information sources**: Independent agencies: Energy Star; Lighting Wizards; Suppliers/manufactures: Lumino; Grah lighting, SA Induction Lighting)*

COLOUR OF LIGHT	LIFE TIME (HOURS)	LUMENS/ WATT	CRI
White	1000-5000	11-20	40
Bluish-white	12000-24000	13-48	15-55
White	10000-20000	60-100	70-105
Golden yellow	12000-24000	45-130	25
Soft white	12000-20000	50-80	85
White	60000-70000	70-90	80
White	50000-70000	70-150	85-100

- **Colour Rendering Index (CRI)** is a comparison of a light source's ability to accurately render the colour of an object. The CRI scale is from 0 to 100, with a value of 100 indicating excellent colour rendering. Only compare colour rendering with lamps of roughly equivalent colour temperatures.
- **Efficacy (or energy efficiency)** is a measure of light output (lumens) per watt of electrical power needed by the lamp. Lumens measure how much light is emitted. Watts indicate how much electrical power is consumed.

What is a ballast?

The ballast is a device that serves to control the flow of power to a fluorescent lamp. These devices also draw on power so that the whole system power consumption of any lamp is higher than simply the lamp wattage. Electronic ballasts are being used to replace magnetic ballasts of the past. These improve the efficiencies of HPS and fluorescent technologies. Induction and LED technologies do not use ballast technology and draw even less system power than in the case of electronic control gear (ECG) ballasts.

Traffic lighting efficiency

LED lighting has become the standard efficient retrofit technology. Where incandescent and halogen light bulbs require replacement every four months, LED traffic light fittings last 5 – 8 years, substantially reducing maintenance costs. Operating costs are also massively reduced due to the same level of lumination available with LED lighting, at a much lower wattage. The LED technology is easy to retrofit as it fits the existing aspects.

COST AND ENERGY COMPARISON			
	75W Incandescent	**55W Halogen**	**LED 8-10W**
Purchase price for a single traffic signal bulb (R)	14	8	400
Electricity usage (W)	75	55	10
Lumens (lm)	1100	1500	1300
Lumens/watt	15	27	130-160
Lifespan (hours) for single bulb @ 8hours/day	960	960	14400
Bulb cost over 10 years @ 8 hours/day	420	240	800
Energy consumption over 10 years for single bulb (KWh)	2160	1584	288
Energy cost over 10 years @ ave electricity rate of R0.81/KWh (at est 10% increase p.a) (Rands)	1749.6	1283.04	233.28
TOTAL Cost over 10 years for single bulb	2169.6	1523.04	1033.28
TOTAL Cost over 10 years for single aspect (3 lights)	6508.8	4569.12	3099.84
Cost saving with LED retrofit of Incandescent traffic signal (single aspect, 3 lamps) over 10 years			**R 3 408.96**
Energy consumption over 10 years for single bulb	2160	1584	288
Energy consumption over 10 years for single aspect (3 lights)	6480	4752	864
Energy saving with LED retrofit of Incandescent traffic signal (single aspect, 3 lamps) over 10 years (KWh)			**5616 KWh**
Carbon emissions reduction (t CO_2e)			**5.8 t CO_2e**

Method notes:

life span of incandescent and halogen bulbs based on 4 months; LED based on a conservative estimate of 5 years;

1. *Average electricity cost of R0.81 is worked off a base line average cost of R0.52/KWh, and based on a 10% increase per annum;*
2. *The savings calculation is for operational costs alone, and would be greater for LEDs if it also included savings in maintenance costs and load reduction charges.*

Real experience from South African municipal implementation

Since 2009, the Department of Energy has managed a Municipal EEDSM Programme, with funds from a National Treasury (DORA) allocation. The following detail some of the technology choices and implementation outcomes achieved through this fund (note: these are indicative projections, based on communications with the municipalities, rather than verified results, which should shortly be available).

Municipality	No of units	Old technology	New technology	Energy saving per lamp (W)	Projected energy saving per year (KWh)
Cape Town	42333 lamps	75W/55W Halogen	8W LED	67 and 45	6,238,028
Ekurhuleni	288 signals	75W/50W Halogen	8-5W LED	67 and 45	129,157
eThekwini	455 intersections	75W Halogen	10W LED	65	813,103
Polokwane	1150 aspects	75-95W Halogen	2,9W - 4,9W LED	72-90W per aspect	721,960

Across these four municipalities, the funding towards the retrofits has been around R60 million in total. This funding will have 'generated' a total of 39,511,241 KWh of electricity savings over the 5 year lifespan of the technology. This translates, roughly, to an average cost of R1.50 per KWh saved over the lifespan of the efficient technology. However, the range of costs amongst the municipalities differ quite widely, largely as some reported costs are inclusive of labour, others not, and so these figures represent a very general bench mark only at this stage.

Street lighting efficiency

There are many technologies (lamp, reflector, ballast and power switch) that can greatly improve street lighting efficiency. It is important to get all of this right in order to achieve maximum efficiencies. This includes making sure you align your choice of lamp correctly in terms of the road lighting category (technical specifications set in terms of SANS 10098-1 and are provided for ease of reference at the end of this section). The right reflector can increase lighting levels substantially without increasing the energy consumption (or reduce energy consumptions substantially without reducing the lighting level). A well installed fitting, where lamp and gear compartments are tightly sealed, prevents corrosion and dirt and depreciation of the lamp or ignition devices.

It is increasingly considered good practice for municipalities and Road Agencies to change their specifications to make the cost of a Lighting Scheme and not the unit price of a luminaire, the tender criteria.

The tables below provide an overview of technologies for Group A and B roads (it is by no means comprehensive). Due to technology advances lamps with lower lumen outputs can replace conventional lamps with a higher output (for example, replacing a 400W MV with a 250W HPS). However, in each instance it is vital that all the SANS 10098-1 conditions are met for each road type.

These figures are designed to provide an indicative sense of the relative costs only. They don't take into account different lamp styles or the labour costs involved in the implementation. Stated life spans for lamp technology vary quite widely: for example, while HPS are given a fairly long life cycle, the on-the-ground experience of some municipalities is that the life span is far shorter. The case studies below also show some real examples of technology replacements and some comparison can be made as to which type of replacements may offer the best energy and cost savings over time.

Group A Roads (SANS 10098-1) Freeways and Major Roads

Technology	Wattage (W)	Cost of luminaire (including lamp)	lamp cost	Lifespan of lamp (hrs)	Lamp changes over 10 years	Energy consumption over 10 years (KWh)	Energy cost over 10 years	Luminaire and replacement lamp costs over 10 years	TOTAL cost over 10 years
400 MV	400	R 1,819	R 86	12045	3.3	16060	R 13,651	R 2,103	R 15,754
400 HPS	400	R 2,052	R 105	12000	3.3	16060	R 13,651	R 2,399	R 16,050
MH 400	400	R 2,052	R 221	10000	4	16060	R 13,651	R 2,936	R 16,587
250 HPS*	250	R 1,280	R 38	16060	2.5	10038	R 8,532	R 1,375	R 9,907
MV 250	250	R 1,733	R 86	12045	3.3	10038	R 8,532	R 2,017	R 10,549
MH 250	250	R 1,504	R 221	10000	4	10038	R 8,532	R 2,388	R 10,920
Induction 250*	250	R 3,600	R 0	70000	0	10038	R 8,532	R 3,600	R 12,132
Induction 200*	200	R 3,450	R 0	70000	0	8030	R 6,826	R 3,450	R 10,276
HPS 150	150	R 1,452	R 101	16060	2.5	6023	R 5,119	R 1,705	R 6,824
Induction 150**	150	R 2,950	R 0	70000	0	6023	R 5,119	R 2,950	R 8,069
MV 125	125	R 900	R 250	12000	3.3	5019	R 4,266	R 1,725	R 5,991
Induction 120**	120	R 2,650	R 0	70000	0	4818	R 4,095	R 2,650	R 6,745
LED 90W*	90	R 4,783	R 0	60000	0	3614	R 3,071	R 4,783	R 7,854
LED 77W**	77	R 4,783	R 0	60000	0	3092	R 2,628	R 4,783	R 7,411
CFL 57***	57	R 2,791	R 102	32120	1	2289	R 1,945	R 2,919	R 4,864
HPS 50***	50	R 629	R 241	12000	3	2008	R 1,706	R 1,424	R 3,131

** due to higher levels of lumen output can replace up to 400W MV depending on road application*

*** due to higher levels of lumen output can replace up to 250W MV depending on road application*

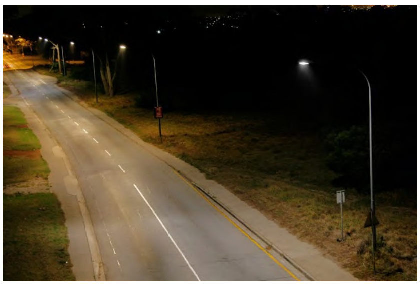
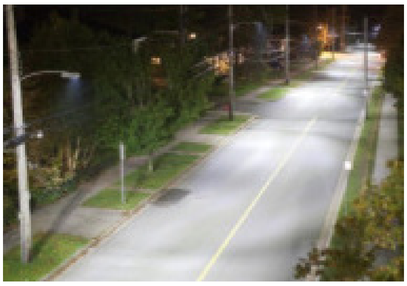
**** due to higher levels of lumen output can replace up to 125W MV depending on road application*

Group B Roads (SANS 10098-1) Streets

Technology	wattage (W)	Cost of luminaire (including lamp)	lamp cost	Lifespan of lamp (hrs)	Lamp changes over 10 years	Energy consump-tion over 10 years (KWh)	Energy cost over 10 years	Luminaire and lamp costs over 10 years	TOTAL cost over 10 years	Total cost over 20 years
80W MV	80	R 656	R 27	12000	3.3	3212	R 2,730	R 745	R 3,475	R 10,417
HPS 70	70	R 900	R 67	12000	3.345833333	2811	R 2,389	R 1,124	R 3,513	R 9,610
Induction 70	70	R 1,845	R 0	70000	0	2811	R 2,389	R 1,845	R 4,234	R 10,220
Induction 55	55	R 1,538	R 0	70000	0	2208	R 1,877	R 1,538	R 3,415	R 8,119
MH 50	50	R 900	R 250	20000	2	2008	R 1,706	R 1,402	R 3,108	R 7,882
LED 41 W	41	R 2,680	R 0	60000	0	1646	R 1,399	R 2,680	R 4,079	R 7,586
CFL	57	R 2,791	R 102	30000	1.3	2289	R 1,945	R 2,928	R 4,873	R 9,884
HPS 50	50	R 629	R 241	12000	3.3	2008	R 1,706	R 1,435	R 3,142	R 7,262
LED 33W	33	R 3,596	R 0	60000	0	1325	R 1,126	R 3,596	R 4,722	R 7,544
LED 23 W	23	R 3,592	R 0	60000	0	923	R 785	R 3,592	R 4,377	R 6,344

Method notes:

1. *The annual operation period is set at 11 hours/day for 365 days/year for each technology (based on information from municipalities).*
2. *The average electricity rate (R/KWh) against which the energy cost over ten years is assessed is set at R0,85 (and R1.49 over 20 years) based on a simple 10% tariff increase p.a.*
3. *While costs and technical assessments have been checked as much as possible, these obviously change rapidly over time and are subject to specific supplier rates. Figures presented here are designed to provide indicative results only.*
4. *The energy and cost calculations are based on operational costs alone; cost savings would be greater for the longer life technologies (LED, Induction) if maintenance costs were also included.*
5. *Efficiency comparisons are often done by KWh/km. This would make sense in a green field development, rather than a retrofit where the existing poles spacing may well be retained.*

HPS with electro-magnetic ballast


CFL


Light Emitting Diode

Real experience from South African municipal implementation

The DoE's Municipal EEDSM fund has also contributed substantially towards street lighting retrofit projects. The following table provides insight into the kind of technology choices made by municipalities, and the savings achieved.

Municipality	Old technology	New technology	Energy saving per lamp	est energy saving per year (KWh)	Life span of new technology (years)	KWh saved over retrofit lifespan
Buffalo City	125 W MV	50 W HPS	75W	2526740	4	10,106,960
Ekurhuleni	Mercury Vapour (MV) to High Pressure Sodium (HPS) retrofit * 400W to 250 W * 250W to 150W * 150W to 100W * 125W to 70W		Range: 150W - 50W	10147000	4	40,588,000
Cape Town	Mercury Vapour (MV) to High Pressure Sodium (HPS) retrofit: 400W to 250 W; 250W to 150W; 250W to 70W; 150W to 100W; 125W to 70W; 80W to 70W		Range: 150W - 10W	5030000	4	20,120,000
eThekwini	80W	60W	20W	950210	15	14,253,150
Nelson Mandela Bay	125W	57W	68W	1342364	4	5,369,456

Across these municipalities, the indications are that a total achievement of 70,814,959KWh savings will be realised over the life span of the retrofit. This has been achieved at an average cost of R1.52/KWh (ranging from around R0.99 – R2.42/KWh).

A breakdown of the various retrofits undertaken by the City of Cape Town is provided below as a helpful guide to savings across different size lighting retrofits. The results show the different levels of savings achieved with each retrofit. Larger wattage savings provide greater efficiency, but of course lower wattage lamps must still meet the SANS standards for the road type in question.

Number of Units	Old technology (MV)	New technology (HPS)	Unit saving	KWh saving per year	Life span new tech	KWh saving/life span	KWh/lamp over the lamp lifespan
575	400W	250W	150W	346293.75	1.75	606014.0625	1054
1977	250W	150W	100W	793765.5	1.75	1389089.625	703
100	250W	100W	150W	60225	1.75	105393.75	1054
17	250W	70W	180W	12285.9	1.75	21500.325	1265
1395	125W	70W	55W	1008166.5	1.75	1764291.375	1265
3701	80W	70W	10W	148595.15	1.75	260041.5125	70

SANS 10098-1 Lighting values for all road types: a quick reference

Table 1: Recommended Lighting Values for Group A Roads (SANS 10098-1)

Lighting category: Types of Road	**Road Cross Section**																							
	Without Median												**With Median**											
	Maximum traffic volume during darkness (motor vehicles per hour per lane)																							
	> 600				**300**				**100**				**>900**				**600**				**200**			
	Ln	**U_o**	**U_L**	**TI**	**Ln**	**U_o**	**U_L**	**TI**	**Ln**	**U_o**	**U_L**	**TI**	**Ln**	**U_o**	**U_L**	**TI**	**Ln**	**U_o**	**U_L**	**TI**	**Ln**	**U_o**	**U_L**	**TI**
A1: Freeway and expressway with median, free of level crossings; for speed limits exceeding 90km/h	2	0,4	0,7	15	1,5	0,4	0,7	20	1	0,4	0,6	20	2	0,4	0,7	15	1,5	0,4	0,7	20	1	0,4	0,6	20
A2: Major roads, for speed limits not exceeding 90km/h	1.5	0,4	0,7	20	1	0,4	0,6	20	0,8	0,4	0,5	20	1.5	0,4	0,7	20	1	0,4	0,6	20	0,8	0,4	0,5	20
A3: Important urban traffic routes for speed limits not exceeding 60 km/h	1	0,4	0,6	20	0,6	0,4	0,5	20	0,5	0,4	0,5	20	1	0,4	0,6	20	0,8	0,4	0,5	20	0,5	0,4	0,5	20
A4: Connecting roads; local distributor roads; residential major roads	0,75	0,4	0,5	20	0,5	0,4	0,5	20	0,3	0,3	0,5	25	0,75	0,4	0,5	20	0,5	0,4	0,5	20	0,3	0,3	0,5	25

Notes

a) The values apply to straight sections of the roads, and to curves and intersections.

b) The luminance values apply to a dry roadsurface of any material.

c) Ln = Minimum luminance cd/m2

Uo = Overall luminance uniformity

UL = Longitudinal luminance uniformity; and

TI = Threshold increment, %

Source: SANS 10098-1 (SABS 098-1), Public lighting – Part 1: The lighting of public thoroughfares.

Table 2: Recommended Lighting Values for Group B and Group C Streets and Footways (SANS 10098-1)

Lighting Category	**Type of Street**	**Minimal Average Horizontal Illuminance ($E_{H\,av}$)**	**Minimal Horizontal Illuminance ($E_{H\,min}$)**	**Minimum semi cylindrical illuminance ($E_{ac\,min}$)**
B1	Residential streets with medium to high volume traffic	5 lux	1 lux	2 lux
B2	Residential streets with medium volume traffic	3 lux	0.6 ux	1 lux
B3	Residential streets with low volume traffic	2 lux	0.4 lux	0.6 lux
C1	Wholly pedestrian in city centre	10 lux	3 lux	7.5 lux
C2	Wholly pedestrian in local shopping malls	7.5 lux	1.5 lux	3 lux

Notes

a) Horizontal illuminance values apply across the carriageway on footways up to 2m from the edge of the carriageway.

b) For areas requiring higher security, semi-cylindrical illuminance values as stated can be used as a supplementary criterion. They apply on the footways parallel to the kerbs in both directions.

Source: SANS 10098-1 (SABS 098-1), Public lighting – Part 1: The lighting of public thoroughfares.

Building lighting efficiency

Retrofitting public buildings with energy efficient lighting technologies can result in substantial savings both in operational and maintenance costs. This exercise can be a fairly complex undertaking. It is usually done by an ESCO (an energy services company) who will do an initial audit and provide the 'customer' with an overview of current energy costs and anticipated savings. Esco's are usually paid through a shared savings business model, i.e. the Esco puts up the initial capital and then a portion of the electricity savings is paid back to the Esco over the following months. This can be a difficult model to do in the public sector, though versions of this approach have been successfully implemented. DOE EEDSM funding can be used for audit and direct payment for the capital costs of the retrofit; the IDM Programme of Eskom will also pay for building lighting retrofit programmes through the Standard Product payment model (See Eskom's IDM website: www.eskomidm.co.za for details).

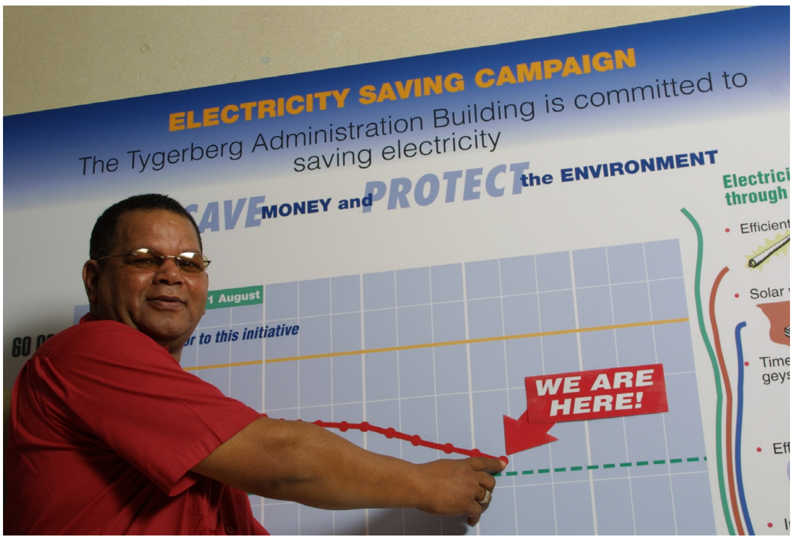
The following table provides an overview of the kinds of energy efficient lighting technology options available for building lighting. The life span of the technology has not been included here. This must be factored in when comparing costs (see Cost and energy comparison for T8-T5 and T8-10W LED below).

Conventional Light Fitting sets	**Power (W) with CCG**	**Cost of lamp**	**Energy Efficient Fluorescent Fitting**	**Approx power saved (W) per fitting with FLlamp and ECG**	**Cost of Lamp**	**Approx Cost of entire new fitting for T5 lamps (T5 don't fit into T8 fitting)**	**Energy Efficient LED fitting (NB fits into T8 fitting, bypassing ballast, not T5)**	**Approx power saved (W)**	**Cost of lamp**
2 x 18W Fluorescent tube (T8)	44	R 16.00	2 x 14W (T5)	14.52	R 32.00	R 700.00	2x 10W LED Tube	20	R 584.00
3 x 18W Fluorescent tube (T8)	66	R 16.00	3 x 14W (T5)	21.78	R 32.00	R 1,200.00	3 x 10W LED Tube	32	R 584.00
4 x 18W Fluorescent tube (T8)	88	R 16.00	3 x 24W (T5)	12.24	R 38.00	R 1,400.00	4 x 10W LED Tube	44	R 584.00
1 x36W Fluorescent tube (T8)	44	R 18.00	28W (T5)	14.52	R 42.00	R 850.00	1 x 18W LED Tube	16	R 802.00
2 x 36W Fluorescent tube (T8) - with CCG and ECG	88	R 18.00	2 x 28W (T5)	29.04	R 42.00	R 1,300.00	2 x 18W LED Tube	48	R 802.00
	76	R 18.00	2 x 28W (T5)	16.8	R 42.00	R 1,300.00	2 x 18W LED Tube	36	R 802.00
3 x 36W Fluorescent tube (T8)	132	R 18.00	3 x 28W (T5)	43.56	R 42.00	R 1,400.00	3 x 18W LED Tube	75	R 802.00
4 x36W Fluorescent tube (T8)	173	R 18.00	2 x 54W (T5)	59.4	R 48.00	R 1,550.00	4 x 18W LED Tube	98	R 802.00
1 x 40W Fluorescent tube (T9 circular)	54	R 35.00	ECG	49.33			1 x 18W LED Tube	34	R 802.00
1 x 58W Fluorescent tube (T8)	71	R 21.00	35W (T5)	70.40	R 35.00	700	1 x 25W LED TUBE	46	R 1,166.00
2 x 58W Fluorescent tube (T8) - with CCG and ECG	142	R 21.00	2 x 35W (T5)	68.02	R 35.00	R 950.00	2 x 25W LED TUBE	84	R 1,166.00
	122	R 21.00	2 x 35W (T5)	48.30	R 35.00	R 1,250.00	2 x 25W LED TUBE	65	R 1,166.00
2 x 65W	159	R 35.00	2 x 49W (T5)	55.70	R 72.00	1400	2 x 25W LED TUBE	100	R 1,166.00

Conventional Light Fitting sets	Power (W) with CCG	Cost of lamp	Energy Efficient Fluorescent Fitting	Approx power saved (W) per fitting with FLlamp and ECG	Cost of Lamp	Approx Cost of entire new fitting for T5 lamps (T5 don't fit into T8 fitting)	Energy Efficient LED fitting (NB fits into T8 fitting, bypassing ballast, not T5)	Approx power saved (W)	Cost of lamp
1 x 75W	92	discontinued	49W (T5)	40.05	R 72.00	R 950.00	1 x 25W LED TUBE	60	R 1,166.00
1 x PL13	16	R 25.00	ECG	2.35	R 34.00				
2D 16W Fluorescent	20	R 32.00	ECG	2.72	R 28.00				
2D 22W Fluorescent	27	R 32.00	ECG	3.74	R 36.00				
100W incandescent	100	R 12.00	23W CFL	77	R 38.00		NOTE: the lamp prices below are for whole new fitting; each of these lamps can be replaced with a 9.5W LED lamp at a cost of R365.00 each. However, note that lamp life of each LED lamp is 35000 - 50000 year		
1 x 18W CFL Downlight	22	R 25.00					1 x 12W LED lamp	5	R 609
2 x 13W CFL Downlight	32	R 25.00					1 x 12W LED lamp	14	R 609
2 x 18W CFL Downlight	44	R 25.00					1 x 12W LED lamp	27	R 609
2 x 26W CFL Downlight	63	R 32.00					1 x 19W LED lamp	36	R 1,048
35W Halogen Downlight	42	R 30.00					1 x 6W LED lamp	33	R 495
50 Halogen Downlight	60	R 21.00					1 x 12W LED lamp	43	R 695

Method notes:

1. *All energy efficiency fittings are assumed to be running off the more efficient Electronic Control Gear (ECG) and LED drivers, while all 'old' fittings are assumed to be running off the less efficient Conventional Control Gear (CCG).*
2. *Costs are approximate and are VAT exclusive.*
3. *T5 fluorescents require a new fitting – increasing the upfront retrofit cost of this technology; Led lamps can be fitted into the T8 fitting, where they must be fitted to bypass the ballast.*



Real experience from South African municipalities

Ekurhuleni Metro Municipality replaced 120 000 lighting units in its municipal buildings using funds from the DOE's Municipal EEDSM programme. The retrofit included T8 – T5 fluorescent retrofits and T8 – LED retrofits. In addition, 15 000 occupancy sensors (motion sensitive light switches) have been installed which will reduce the power consumption of the buildings even more substantially. A number of other municipalities have engaged in building retrofits, most extensively replacing T8 with T5 fluorescent luminaires. At this stage there are no clear results on broad costs per KWh saved over the lifespan of the retrofit technology, but these should soon be available.

COST AND ENERGY COMPARISON OF T8; T5 AND LED EQUIVALENT			
	2 x 18W Fluorescent tube (T8)	**2 x 14W Fluorescent tube (T5)**	**2 x 10 W LED tube**
Purchase price for the lamp (R)	32	64	1168
Purchase price for the fitting (R)	0	700	0
Electricity usage (W)	44	30	24
Lifespan (hours) for single bulb @ 8hours/day	15000	15000	40000
Bulb cost over 10 years @ 8 hours/day	64	128	1168
Energy consumption over 10 years for single bulb (KWh)	1267	864	691
Energy cost over 10 years @ ave electricity rate of R0.81/KWh (at est 10% increase p.a) (Rands)	R 1 026.43	R 699.84	R 559.87
TOTAL Cost over 10 years for single bulb (Rands)	**R 1 090.43**	**R 1 527.84**	**R 1 727.87**




Conclusion and further sources of information

Initial experience emerging from South African municipalities points to the strong potential within public lighting for achieving energy efficiencies, as well as cost savings. Traffic and street lighting retrofits appear to be fairly comparable in terms of the cost per KWh saving achieved. However, within street lighting there are clearly some greater 'wins' than others and this might be worth considering when deciding on which luminaire changes to prioritise. Building retrofits, particularly where these are coupled with behaviour change campaigns and technologies such as occupancy sensors, offer substantial potential, although they may require greater levels of capacity to manage.

Although a number of technologies offer savings, it is worth noting that experts indicate that LED technology is changing fast and does appear to be the way of the future. This technology should be kept clearly in municipal sights. LED technology also has the advantage of not containing hazardous materials (notably mercury).

Useful sources of information

Eskom's Integrated Demand Management Programme information can be found on: www.eskomidm.co.za

An initiative called the Super-efficient Equipment and Appliance Deployment (SEAD) Initiative has been set up by the UNFCCC to support energy efficiency in response to climate change (South Africa is a member country). This site has a Street lighting fact sheet and offers a tool for municipalities seeking to upgrade or retrofit street lights: www.superefficient.org

Additional information on municipal EEDSM in South African municipalities may be found on Sustainable Energy Africa's City Energy Support Unit site: www.cityenergy.org.za