Accelerating Adoption of Energy Efficient LED Street Lighting

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Head of Philips Lighting University
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Trends in Street and Road lighting
Trends towards **White light**

**Higher color quality of white light**

- Better visibility in the peripheral field of vision
- Lower reaction time
- Recognition of facial expression

Better feeling of Comfort, Safety and Security for residents and road users

Residential areas

Inner streets

-43% energy
Trends towards **White light**

**Higher Luminous efficacy of the white light**

→ Reduction of the required luminance levels for White light applications

↓ Saving of energy and less CO₂
Trends towards Lower cost of ownership

- Initial purchase costs
- Energy cost
- Maintenance / replacement costs
- Disposal and recycling costs

Quite significant throughout the lifetime of the installation
Evolution of Outdoor conventional white Light sources

- **SON PIA**
  - Lower efficacy
  - Shorter lifetime

- **SON Std**
  - Lower efficacy

- **HPI**
  - Lower efficacy
  - Shorter lifetime

- **CDM/CDO**
  - Higher lumen depreciation
  - Shorter lifetime
  - Lower lumen package

- **CDO Plus**
  - Higher lumen depreciation
  - Shorter lifetime

- **Cosmo White**
  - Higher lumen depreciation
  - Shorter lifetime

- **HPL Com**
  - Lower efficacy
  - Lower lumen package
  - Shorter lifetime

- **MHN**
  - Lower lumen package

- **PL QL**
  - Lower lumen package
# LED

The semi-conductor revolution

<table>
<thead>
<tr>
<th></th>
<th>Cool White</th>
<th>Neutral White</th>
<th>Warm white</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Color temperature (CCT)</strong></td>
<td>4500 – 10 000 K</td>
<td>4500 - 3500 K</td>
<td>2670 - 3500 K</td>
</tr>
<tr>
<td><strong>Color rendering index CRI</strong></td>
<td>70</td>
<td>70</td>
<td>90+</td>
</tr>
<tr>
<td><strong>Efficacy [lm/W]</strong></td>
<td>&gt; 130</td>
<td>&gt;120</td>
<td>&gt;110</td>
</tr>
</tbody>
</table>

**LED**
LED  

The semi-conductor revolution

• **Extended lifetime:** 50,000 hours or more

• **Extended controllability:**
  – Dimmable: 0 – 100%
  – Instant On – Off
  – Use with digital control systems
Energy Savings Opportunity of street Lighting in the M.E.
LED for Street and Road lighting

- Are LED street and road lighting systems suitable for use in AGCC’s environmental conditions?

  And if so

- What are the key criteria to ensure optimum performance and reliability?
Operating principle

55% - 80% heat: absorbed by the junction

20% - 45% visible colored light

Driver

Blue LED Chip

Yellow Phosphor

White light

N-material

JUNCTION

P-material

p-type

junction

n-type

holes

electrons
Driver functions

Constant DC voltage

Step down converter

Converts line voltage into **constant** 24V DC voltage

• Drives LED at **different** constant currents
  (350mA, 530mA, 600mA, 700mA)

• Controls this constant current
  control of LED’s brightness (dimming)

Heat at junction is reduced further than light output

LED : only light sources that increase in efficacy (lm/W) when dimmed

PHILIPS
Operating principle
Extraction efficiency

- Excessive heat will affect performance and lifetime
- Overheat can cause permanent damage to the component

\[ q_c \]

Transferred to ambient by conduction

This is called Heat Management

- Key aspect in developing LED luminaires
High flux Philips LED (Illuminator type LEDs)

Heat is pulled away from the chip by means of built-in heat sink and is transferred to a **thermal management system**.
Thermal path
Thermal path

PCB (Light Engine)

In case temperature of PCB’s set point reaching defined critical levels
Driver automatically dims down and eventually switches off the light
Thermal management
Heat study and Light engine configuration

A Metal Core Printed Circuit Board (MCPCB) is used to efficiently remove heat from the LED’s & transfer it to the housing thereby lowering as much as possible LED’s operating temperature.

The MCPCB is mounted on the housing using a highly efficient Thermal Interface Material.

Optimal thermal dissipation

- Die-cast Aluminium housing (better heat spread)
- Vertical curved surfaces (higher heat dissipation capacity)

Outdoor solutions offered in Middle East must be suitable for ambient temperatures up to +50°C

Tuning the lumen output to match the total lumen package
Philips LED pilot installations in the Region
Philips LED pilot installations in the Region
*Sohar – Oman* (2011) *Equal 250W (SON-T)*
Philips LED pilot installations in the Region

Philips LED pilot installations in the Region
Mina Link - Abu Dhabi

(EARLY 2014) Equal 400W (SON-T)
Philips Installations in the Region
AL Dhajer 5 – Al Ain, UAE

(EARLY 2014) Equal 400W (SON-T)

First installation of Luma in Middle East
Total of 1,000 luminaire installed
Optical system
Optics

Multi-layer optical solutions maintain uniformity.

Multi-layer optical solutions maintains uniformity

Multi spot optical solutions create dark spots in time.

Multi spot optical solutions create dark spots in time

Yes

No
Optics

Different optics:

Covering all classes (ME, CE, S-classes): from pedestrian area’s to major roads

<table>
<thead>
<tr>
<th>PEDESTRIAN AREAS</th>
<th>STREETS</th>
<th>ROADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians streets, paths, cyclepaths</td>
<td>Residential streets</td>
<td>Mixed traffic, commercial streets in urban areas</td>
</tr>
<tr>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
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</table>

Pedestrian streets, paths, cyclepaths

Residential streets

Mixed traffic, commercial streets in urban areas

Rural roads

Motorized traffic roads in urban areas

Motorways, Highways, Express ways, ringroads

- < 45/50 W
- > 45/50 W
- <150W
- < 250 W
- 250 – 400W
LED system reliability
Component vs system reliability

"A chain is as strong as its weakest link"

The entire system lasts as long as the critical component with the shortest lifetime

Example calculation

<table>
<thead>
<tr>
<th>Component</th>
<th>Lifetime [hrs x 1000]</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED</td>
<td>60 @ 70% LM</td>
</tr>
<tr>
<td>Optics</td>
<td>180</td>
</tr>
<tr>
<td>Housing</td>
<td>2 200</td>
</tr>
<tr>
<td>Driver</td>
<td>45</td>
</tr>
<tr>
<td>Controls</td>
<td>48</td>
</tr>
<tr>
<td>SYSTEM</td>
<td>45</td>
</tr>
</tbody>
</table>
Summary

Performance
Reliability
Energy savings

+ Price
Lighting controls

Shadi El Abdallah
Philips Lighting Systems and Services
May 29, 2014
Energy Savings Opportunity of Lighting in the M.E.
Consider your own home....
Why can’t we do the same with our road lighting?
Integrated Communication Module

GPS

IP address

Via Existing mobile network

Remote Central management system

“Cloud”

GPS

Integrated Communication Module
Connected Lighting Platform

CityTouch platform

CityTouch LightPoint
CityTouch LightWave

Data import

Connectivity*

Street lights

AssetLink

3rd party asset management solutions

*only in conjunction with CityTouch LightConnect

Lighting asset data
Bringing Your City to Life

Seamless Outdoor Lighting System Architecture

Functionality → Complexity

Easy Access

Energy Reporting

Dimming Schedules
Connectivity will lead to more innovations