Towards a New Culture of Lighting

Wolfgang Gregor
CSO, OSRAM GmbH
OSRAM: The Lighting Company

A successful future built on 100 years of innovation

- OSRAM: one of the world's two leading lighting manufacturers (headquarters: Munich)
- Trademark registration: on April 17, 1906 at the then Imperial Patent Office in Berlin
- 100% subsidiary of the SIEMENS AG
- Represented in the US by OSRAM SYLVANIA

Employees: More than 43,500
Production: 46 factories in 17 countries
Turnover: EUR 4.6 billion
Group profit: EUR 401 million
R&D: 6% of sales

Long-term business strategy:
Innovation, global presence, cost leadership

Figures for FY 2008
OSRAM: The Lighting Company

Shaping the future of light - today

Opera in Oslo, Norway
Chandelier illuminated with LED

German President’s Prize for Technology and Innovation

High intensity discharge lamp with ceramic arc tube Ideal for shoplighting

World Premiere: Table luminaire with organic LEDs (OLEDs)

German Sustainability Award 2008
OSRAM products have proven quality

Honors for quality and innovation

2008 ENERGY STAR® Award for Sustained Excellence by the US Environmental Protection Agency (EPA) and the US Department of Energy (DOE).

80% of the OSRAM energy-saving lamps tested were rated "good" in the latest test by a German consumer association. This is a result that no other manufacturer has achieved.

German President's Prize for Technology and Innovation: Thinfilm chips are revolutionizing LED technology

OSRAM was awarded the German Sustainability Prize 2008 for its large product portfolio of energy efficient products and its exceptional research and development performance in this field.
“Global Care” represents our commitment to social and environmental responsibility worldwide. As a leader in innovative lighting solutions, we are dedicated to products and processes that contribute to solve global sustainability challenges, address economic needs and protect the environment for today and for the future.
Agenda

1. The Impact of Lighting on a Global Scale
2. Phasing Out Inefficient Lamps
3. Products for a New Culture of Lighting
4. Taking Responsibility Along the Life Cycle (Mercury & Recycling)
5. Sustainable Lighting - Going Beyond
The Impact of Lighting on a Global Scale

Lighting consumes a significant amount of energy

- Lighting accounts for 19% of the global electricity consumption → 2.4% of the world’s entire primary energy consumption
- 2,651 TWh were used globally for lighting in 2005 ~ 2/3 of the electricity consumption of the United States
- Nearly 70% of electricity is used by lamps for which a better alternative is available (Orange: e.g. T12 fluorescent, standard incandescent, mercury vapor lamps)
The Impact of Lighting on a Global Scale

The savings potential of efficient lighting is enormous

• It would be technically feasible to save ~ 50% of the electricity used for lighting

• Over 1/3 of the electricity for lighting could realistically be saved – nearly 900 billion kWh

• As a result, 450 million tons of CO₂ would not be emitted into the atmosphere* – an effect similar to planting a new forest the area of ten of the first thirteen US states

* At average Energy-Mix: 0.5 kg CO₂/kWh
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**General Service Incandescent (GSI) Phase-Out**

OSRAM is proactively working to phase out inefficient lighting worldwide

- Strong cooperation with the European Commission to define the future Ecodesign requirements for Lighting in Europe (Street, Office & Industry and General Lighting)
- Development of quality charters and of further requirements on lighting products regarding hazardous substances (RoHS)
- Support of Experts of Governments worldwide in their efforts to develop legislation for phasing-out inefficient light sources (e.g. Argentina, Brazil, Australia, Russia)
- The phase-out of lamps with the lowest efficiency level (mostly GSI) will cause an increased demand for alternative technologies
- Quality of light and consumer choice must also be considered, so compact fluorescents can not be the only option
- Adjustment to the changing demand of production capacities accordingly, through acquisition and partnerships with suppliers worldwide, adaptation of existing production sites and installation of new production lines for sustainable products in various countries
## GSI products

### Consequences of EUP DIM

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**Ban of all clear GLS**

- Non clear GLS lamps to be replaced by CFLi (A)
- Implementation measure on directional light sources to be decided by end of 2009
- Special purpose lamps

*All Lamps with Energy Class F&G banned starting Sept. 2009*
Phase-out of GSI in the US

Energy Independence & Security Act aims to phase-out inefficient GSI

Energy Independence and Security Act – 2007
- Covers incandescent or halogen medium screw base lamps for general service applications
- Does not cover special types like appliance lamps, bug lamps, reflector lamps, etc.
- Maximum wattages for 4 specific lumen ranges and minimum rated life (1000 hours) for standard GSI
- Phases out standard wattages, beginning January 2012
- Caps wattage of two decorative types

<table>
<thead>
<tr>
<th>US Lumen Range &amp; Wattage Cap Standards</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<tbody>
<tr>
<td>100W standards (max 72W)</td>
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<td>75W standards (max 53W)</td>
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<td>60W standards (max 43W)</td>
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<td>40W standards (max 29W)</td>
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Outcomes:
- Standard bulbs of 40W – 100W will disappear from U.S. store shelves (5 years from now)
- Compact Fluorescent Lamp (CFL) sales will continue to grow

Predicted Annual Savings:
- $13 billion for electricity
- 100 million tons of CO₂
EU Legislation: Office, Industry and Street Lighting

Office & Industry Lighting (OIL) and Street Lighting Implementing Measure (SLIM)

EU-Members states are putting OIL into force

In 2009/2010*:
Phasing-out inefficient fluorescent lamp systems through minimum performance requirements for all fluorescent lamps

EU-Members states are putting SLIM into force

1st Step 2010/2011*:
Phasing-out inefficient mercury vapor lamps by minimum efficacy levels for all street lighting lamps

2nd Step 2013/2014*:
Phasing-out less efficient high pressure sodium and metal halide lamps with minimum performance levels

* Date depending on speed of European and national implementation

Mercury Vapor System

Halo-phosphate system T12/T10/T8 conventional magnetic ballast

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Disruptive technologies are changing the lighting market

End user / Market awareness / Maturity

High

Low

Time

Latent awareness

Emerging awareness

Increasing awareness

High awareness

Decreasing awareness

Products for a New Culture of Lighting

New technologies require a systems approach in conjunction with drivers

OLED

LED

Compact Fluorescent (CFL)

High Intensity Discharge (HID) Standard

Halogen

Incandescent

Fluorescent (FL)

High Performance HID

Incandescent

OLED

LED

New technologies require a systems approach in conjunction with drivers.
## Energy Savings in Different Lighting Applications

<table>
<thead>
<tr>
<th>Application in general lighting</th>
<th>Energy saving through innovative lamp technologies</th>
<th>~savings / lamp / year*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street lighting</td>
<td>Mercury vapor ~40% High-pressure sodium lamp</td>
<td>220 kWh / 110 kg CO₂</td>
</tr>
<tr>
<td>Office &amp; Industry Lighting</td>
<td>Fluorescent lp. w. halophosphate phosphor ~65%</td>
<td>180 kWh / 90 kg CO₂</td>
</tr>
<tr>
<td>Shop lighting</td>
<td>3 Standard Halogen lamps ~80% New Ceramic metal halide lamps</td>
<td>500 kWh / 250 kg CO₂</td>
</tr>
<tr>
<td>Hospitality Spotlighting</td>
<td>Low voltage halogen reflector ~30% Dichroic Halogen lamp with infrared coat technology</td>
<td>60 kWh / 30 kg CO₂</td>
</tr>
<tr>
<td>Household lighting (private)</td>
<td>Standard Incandescent ~80% Compact fluorescent</td>
<td>50 kWh / 25 kg CO₂</td>
</tr>
<tr>
<td>Lighting design</td>
<td>Low voltage halogen reflector ~50% White LED Module COINlight OSTAR</td>
<td>45 kWh / 22 kg CO₂</td>
</tr>
</tbody>
</table>

* For typical usage / Energy-Mix 0.5 kg CO₂/kWh

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Energy Saving Potential with Light Management

Efficient light sources are not the only concept for saving energy

- 100% power consumption with T5 & ECG
- Savings with daylight harvesting
- Additional savings with presence detection
- Savings up to 70% with DALI multi 3
Additional savings by intelligent control technologies
Savings with energy efficient lighting technologies

- 60% by intelligent controls
Case Study: Domestic Lighting

Lighting an apartment with 100 m² and saving 32,40 $ / year

Additional benefits:
- Longer lifetime

<table>
<thead>
<tr>
<th></th>
<th>kWh consumed</th>
<th>Electricity Cost*</th>
<th>CO₂ Emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 x 60 W incandescent lamps</td>
<td>600 kWh</td>
<td>54.00 $</td>
<td>300 kg CO₂</td>
</tr>
<tr>
<td>4 x 42 W Halogen ES lamps</td>
<td>240 kWh</td>
<td>21.60 $</td>
<td>120 kg CO₂</td>
</tr>
</tbody>
</table>

* Electricity 0.10 $/kWh, energy-Mix 0.5 kg CO₂/kWh

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Case Study: Street Lighting

Lighting 1km street section with 33 lamp poles and saving 636 $ / year

Additional benefits:
- Longer lifetime = less maintenance
- Better light distribution would allow reducing the number of lamp poles to 29 to achieve the same lighting level

<table>
<thead>
<tr>
<th>Installed Power per pole</th>
<th>kWh consumed 4 000 h/yr</th>
<th>Electricity Cost*</th>
<th>CO₂ Emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>HQL 125W de Luxe mercury vapor lamps</td>
<td>137 W</td>
<td>18 084 kWh</td>
<td>1 620 $</td>
</tr>
<tr>
<td>NAV-T 70W Super 4Y High Pressure Sodium lamps</td>
<td>83 W</td>
<td>10 984 kWh</td>
<td>984 $</td>
</tr>
</tbody>
</table>

* Electricity 0.10 $/kWh, energy-Mix 0.5 kg CO₂/kWh

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## Case Study: Shop Lighting

Lighting a showroom with an area of 1000m² and saving 21 960 $ / year

### Additional benefits:
- Longer lifetime = less maintenance
- Lower air conditioning costs

<table>
<thead>
<tr>
<th>Lamps required</th>
<th>Installed Power</th>
<th>kWh consumed 3 600 h/yr</th>
<th>Electricity Cost*</th>
<th>CO₂ Emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 W Standard Halogen lamps, magnetic ballast</td>
<td>1 460</td>
<td>87.6 kW</td>
<td>315 000 kWh</td>
<td>28 350 $</td>
</tr>
<tr>
<td>HCI-T POWERBALL 35 W with electronic ballast</td>
<td>460</td>
<td>19.78 kW</td>
<td>71 000 kWh</td>
<td>6 390 $</td>
</tr>
</tbody>
</table>

* Electricity 0.10 $/kWh, energy-Mix 0.5 kg CO₂/kWh

78% savings
## Other Case Studies

<table>
<thead>
<tr>
<th>Location</th>
<th>Savings</th>
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<tbody>
<tr>
<td>Open Plan Office</td>
<td>57% savings</td>
</tr>
<tr>
<td>Warehouse</td>
<td>20% savings</td>
</tr>
<tr>
<td>Production Hall</td>
<td>35% savings</td>
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</table>
Providing solution-oriented tools

OSRAM offers tools to help customers optimize their lighting

- Facility Management for Lighting
- Provides cost transparency
- Calculates savings potential
- Automatically improves lights

### Savings US $ / CO₂

<table>
<thead>
<tr>
<th>Year</th>
<th>Savings US $</th>
<th>CO₂ / year</th>
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OSRAM light@FM
Shaping the future of light - LED

LED illuminated historical Stone Bridge Regensburg, 2004
Light source efficiency
Lumen/Watt

Year of invention

Solid state lighting vs. classical technologies

1938 Incandescent
1940 Halogen
1961 Metal halide
1981 Fluorescent
1990 CFL
1996 Solid State Lighting

Potentials

2002 LED
2005 OLED
2010

Solid State Lighting

Lighting Technologies:
- Incandescent
- Halogen
- Mercury
- Metal halide
- Fluorescent
- CFL
- Solid State Lighting

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Innovative OLED lighting products and solutions will have the potential for attractive and unique features:

- Thin, flat and light weight
- Pleasant diffused light source (complementary to LED point light source)
- Transparent or mirror-like substrates
- Electronic color control
- High design flexibility: variable shape, bendable
- Instant-on feature
- Environmentally friendly (free of Hg)
Cell design Ingo Maurer

- Object & task light
- High quality white (high CRI & light output)
- Dimmable

Mood light

- 10 OLEDs
- Dimmable

Transparent technology

- 90 cm², transparent
- Dimmable

Accessoire „Light drop“

- 50 cm², 1 OLED
OLED – Roadmap to the Light of the Future

- **2008**
  - Self illuminating traffic signs
  - Emergency and other signs

- **2016**
  - Flexible OLED Lighting wallpaper and light curtains
  - Automotive interior lighting
  - Advertisement
  - General lighting
  - Transparent room separators
  - Decorative illumination
  - Diffuse ceiling lighting

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Our Responsibility: Reducing Mercury - Increasing Recycling

OSRAM is continuously reducing the mercury content of its products

- We have constantly reduced the mercury content of our innovative lamps
- Today, the OSRAM DULUX® Longlife lamp contains less than 3 mg of mercury. With its long lifetime, it has an impressive ratio of hours of light per mg of mercury (Hg mileage)
- SYLVANIA markets the micro-mini, the lowest mercury CFL in US
- Our short-term goal for linear fluorescent lamps is 1.8 mg, for compact fluorescents it is 1.3 mg of mercury per lamp
Our Responsibility: Reducing Mercury - Increasing Recycling

Although CFLs contain mercury, they help keep it out of the environment

Mercury-paradoxon:

- Burning coal to generate the electricity releases mercury into the environment
- Generating additional electricity for powering an incandescent lamp for five years releases more mercury into the atmosphere than is contained in the CFL
- Mercury emitted by coal power plants is never recycled

Source: EPA
Our Responsibility:
Reducing Mercury - Increasing Recycling

Recycling lamps reinforces their benefit for the environment

OSRAM supports the setup of industry systems that manage the environmental friendly and efficient retraction of lamps and initiates the dialogue with authorities to shape legislation facilitating this effort.

- OSRAM is the driving force in the lighting industry activities to develop, establish and continuously improve the sustainable and efficient producer retraction schemes in the European Union according to the WEEE* regulation
- OSRAM will proactively support authorities all over the world to define proper legislation for WEEE

Situation in the United States:
- The SYLVANIA recycling program was the first from a US manufacturer
- 35-40 recycling facilities nationwide
- Capacity exists to support recycling for the remaining 70% of commercial lamp recycling

*WEEE: Waste Electrical and Electronic Equipment
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CDM: A New Business Model Based on Sustainability

The Kyoto Protocol offers OSRAM new ways to business

Following the Clean Development Mechanism (CDM) set forth by the Kyoto protocol, OSRAM distributes CFLi lamps to replace standard incandescents in exchange for Certified Emission Reduction certificates (CERs).

- The partner country and its population profit from affordable quality lighting and reduced energy consumption (less stress on the grid)
- The global environment benefits from reduced CO₂ Emissions

The first project is under way in India, aiming to replace two million incandescent lamps.

Product Requirement:
DULUX EL Longlife (15,000 hrs)

\[ \Delta \text{ in kWh} \cdot (\text{Grid Emission Factor in g CO}_2/\text{kWh}) \cdot 10 \text{ years} = \text{CERs (\$\$)} \]
Details: The Project Area

- Geographical boundary of project area has to be clearly defined
- No other CDM project is registered in the project area
- All participating households must be registered customers of the utility company
Every household will reduce their electricity bill every month from the start.

**Sample Calculation India:**

\[
80\text{W} \times 4\text{h/day} \times 365\text{days} \Rightarrow 116,800 \text{KWh} \times 4 \text{INR (KWh)} \Rightarrow 467 \text{INR per year !}
\]
Details: Training

Detailed training of distribution team is mandatory
Lamp exchange simulations and Training material provide a practical and easy learning process
Bilingual Training ensures that contains have been fully understood.
Details: Distribution of Lamps

The correct distribution & exchange of lamps is the key issue for a successful project:

- The distribution of the lamps will be done by the local utility company in collaboration with Self-Help-Groups in the urban as well as the rural areas.
- OSRAM will intensively train all section leaders of the local utility as well as the NGOs.
- OSRAM will temporarily hire additional staff to assure a qualified training & distribution.
Details: Distribution of Lamps
Off Grid Lighting – The Lake Victoria Project
OSRAM is addressing 1.6 bn people dependant on “fuel-based lighting”

### Off Grid Lighting

1/4 of the world’s population relies on kerosene or candle light for illumination

- **24%** 1.6 billion people
- **76%** 5.0 billion people

These people account for a large share of kerosene consumption and CO₂ emission.

- Annual fuel consumption for lighting: **About 20 billion gallons of kerosene**
- Annual emission of carbon dioxide: **About 190 million tons of CO₂**
- The present price for 20 billion gallons of kerosene amounts to: **>50 billion $**

For its users, kerosene is dangerous, expensive and unhealthy while offering low quality light

BUT: it can be bought in small portions, and thus allows for low and irregular incomes

OSRAM has developed an innovative off-grid concept “beyond the product” where light can be bought in small portions, providing an inexpensive solution.
Off Grid Lighting – The Lake Victoria Project

A pilot project with "Energy Hubs" on Lake Victoria has been started

The concept is simple – Lanterns and batteries are charged at a solar-powered "Energy Hub". An innovative financing ensures energy and lighting at affordable costs for the BoP

The first four energy hubs have been built on the shores on Lake Victoria. Providing Light without kerosene is especially important here:

• The fishermen spend up to 70% of their income for kerosene – they profit from the lower price of light, with the OSRAM solution up to 40%
• Kerosene spills are avoided, and much less CO₂ is emitted
• The pilot projects (OSRAM invests approx. 2Mio €) serve to test the viability of an exciting new business model.
Off Grid Lighting – The Lake Victoria Project
Off Grid Project - Mbita
Off Grid Lighting – The Lake Victoria Project
Off Grid Project – Technical Details
Off Grid Lighting – The Lake Victoria Project
Market Transformation in Less Developed Countries

Initiative to create a PPP for efficient lighting in LDC with GEF and UNEP
Further Saving Potential

There is further saving potential even with the most efficient lighting

When the music's over –

turn out the lights.