Session 3.5. Energy-efficient Lighting Systems

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22 March 2021 | Copenhagen

AGENDA

Objective: in the context of municipalities, share insights on the importance of energy-efficient (EE) lighting systems, as well as potential actions & tools

#	Minutes	Title	Speaker
3.5	**20'**	**EE - Lighting systems**	**Clara Camarasa**
3.51	10'	Fundamentals of EE Lighting Systems	
3.52	10'	Steps in implementing EE lighting systems in Municipalities: including C2E2 EE Street Lighting Tools	

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Block 3.51

Fundamentals of Energy-efficient Lighting Systems

THE ROLE OF LIGHTING IN GLOBAL GHG EMISSIONS

STATUS QUO AND TRENDS IN LIGHTING´S ENERGY CONSUMPTION

- ✓ **Lighting accounts for approximately 19% (i.e. 2900 TWH), of the global electric energy consumption.**
- ✓ If governments only rely on current policies, **global electricity use for lighting will grow to around 4250 TWh by 2030** - an increase of more than 40%, due to:
  - ✓ the world's growing population
  - ✓ increasing demand for electrically driven services in emerging economies

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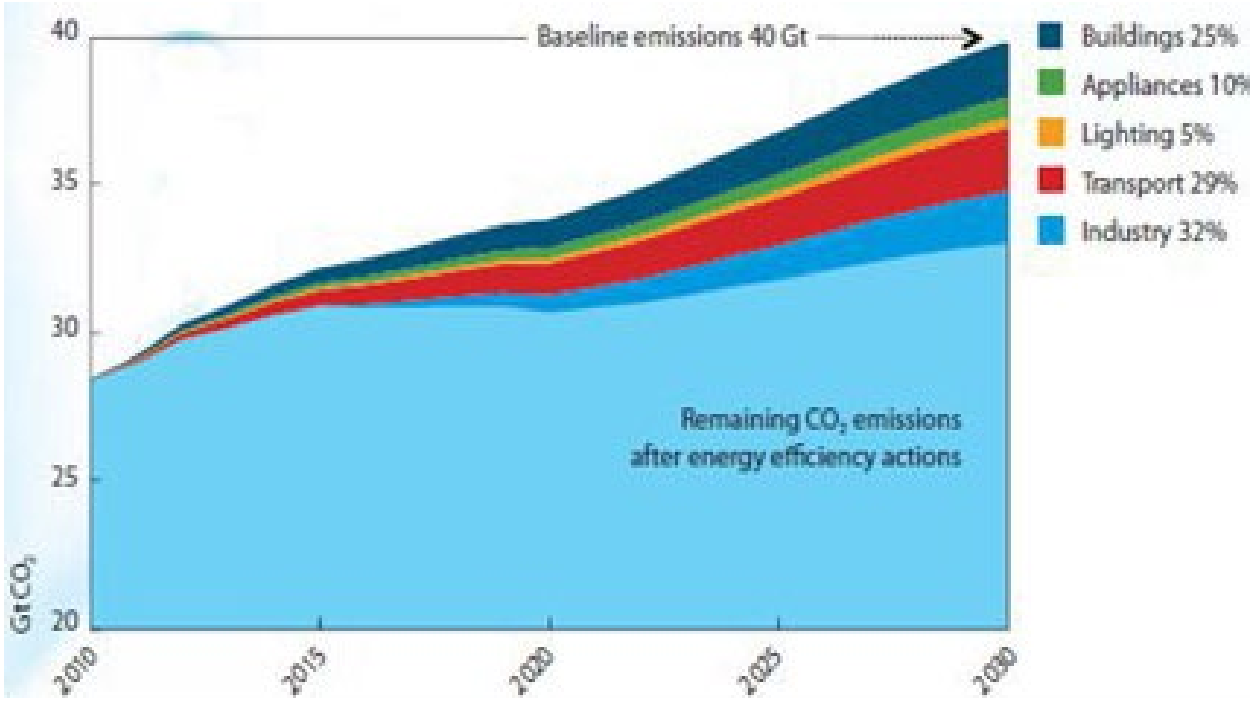
CO2 SAVING POTENTIAL FROM EE MEASURES



Source: Green growth and energy efficiency (IEA, 2019)

"Worldwide, over 90 million lighting poles count for more than 50% of the public energy consumption and about 60% of relative costs". **Source:** (IEA, 2019)

Efficient lighting is one of the **most cost-effective** ways to **reduce energy demand & CO_2 emissions!**

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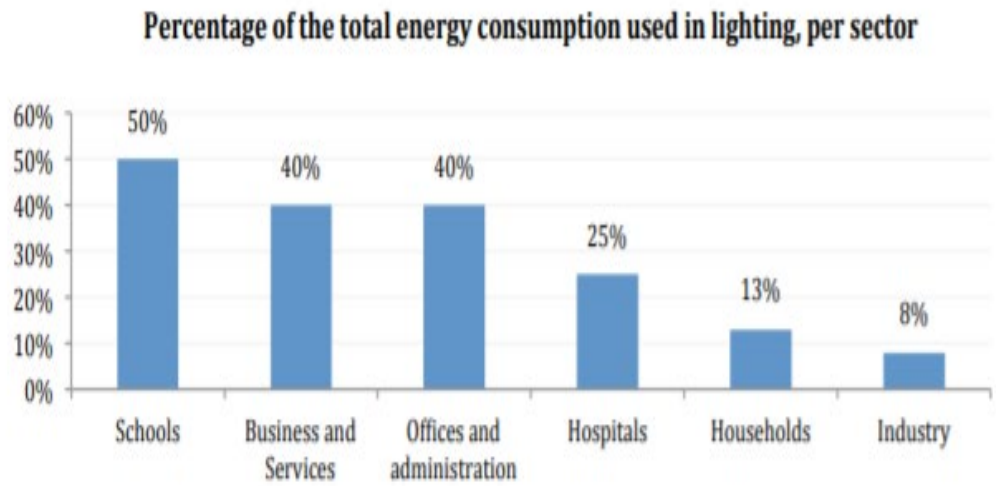
DEFINITION OF EE LIGHTING SYSTEMS

EE in Lighting Systems as a means of maximizing energy usage while minimizing individual carbon footprint for the arrangement or effect of lights.

Lighting in Buildings - *Municipal*



Source: Aalborg University, 2016

Street Lighting – *Public/Municipal*

- Public lighting for public spaces, including traffic light signalling

Objective

- To make the traffic and obstructions clear
- **street** more attractive
- Community value
- Safety and reduce criminality

Source: C2E2

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EE STREET LIGHTING SYSTEMS vs NON-EE

Non-EE systems

Mercury Vapor and Sodium Vapor

Is a gas-discharge lamp that uses sodium in an excited state to produce light at a characteristic wavelength near 589 nm

Metal halide

Electrical lamp that produces light by an electric arc through a gaseous mixture of vaporized mercury and metal halides

Incandescent

An electric light with a wire filament heated until it glows

Compact-fluorescent lamps (CFL)

They are made of a glass tube filled with a low pressure mixture of gases, specifically mercury and noble gases.

Fluorescent tube

A glass tube which radiates light when phosphor inside surface is made to fluoresce by ultraviolet radiation mercury vapour

EE systems

Light emitting diode (LED)

An electric light that produces light using light-emitting diodes (LEDs)

Lighting Smart Control Systems

Control system is a smart network of lighting controls which allow you to control lights in a particular space

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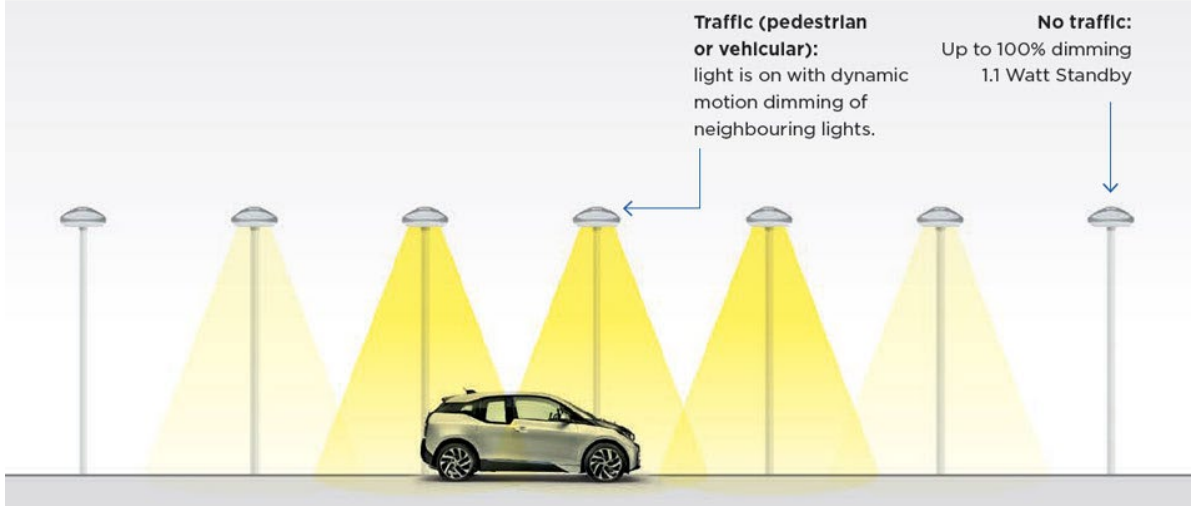
EE MEASURES IN STREET LIGHTING

LED

- ✓ **New >** Lighting with LED lamps
- ✓ **Existing >** Replacement of non-EE lamps in outdoor lighting with LEDs

Lighting control



- ✓ Lighting zoning
- ✓ Install sensors/detectors in areas of sporadic use
- ✓ Adjust the use of hours to capitalize on daylight
- ✓ Centralized > Lighting management systems:

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TECHNICAL SPECIFICATION OF LIGHTING TECHNOLOGIES

Typical Key Data and Figures for Lighting Technologies

	Incandescent	CFL	LED
Life	1,000 hrs+	10,000 hrs+	50,000 hrs+
Efficacy (Lumens per Watt)	~10	~50-60	~70-90
Color Rendering Index	100	80+	80-90+
Color Temperature	2800-3000	2700-6000	2700-6000
Dimming	Easy	Poorly	Varies
RGB	No	No	Yes
Radiated Heat	High (85 btu's/hr)	Medium (30 btu's/hr)	Very Low (3.4btu's/hr)
UV Radiation	Minimal	Yes	None
Power Converted to Visible Light	~8%	~20%	~20-50%
Contains Mercury	No	Yes	No
Instant On	Yes	No	Yes
Operates at Low Temperatures	Yes	No	Yes
Durability	Fragile	Fragile	Durable
Size	Medium	Large	Small
Directional	No	No	Yes

Source: WAC Lighting

LED BULBS VS NON-LED BULBS

Advantages of LED lighting

- Highest efficacy light
- Lowest running costs
- Long operating life – typically more than 20,000 hours
- High flux in a small package, good for optical control
- Offering excellent colour rendering
- Contains no mercury

In comparison with non-LED Systems

- LEDs bulbs use 70-90% less energy compared to Incandescent, Mercury Vapor or CFL luminaires
- LEDs bulbs use Up to 40-50% with respect to Metal Halides, Sodium Vapor or Halogens
- LEDs last triple than any other regular bulb
- A total of 40-60% of annual energy demand reduction and subsequent CO_2 emissions

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STREET LIGHTING CONTROL SYSTEMS

Street Lighting control strategies

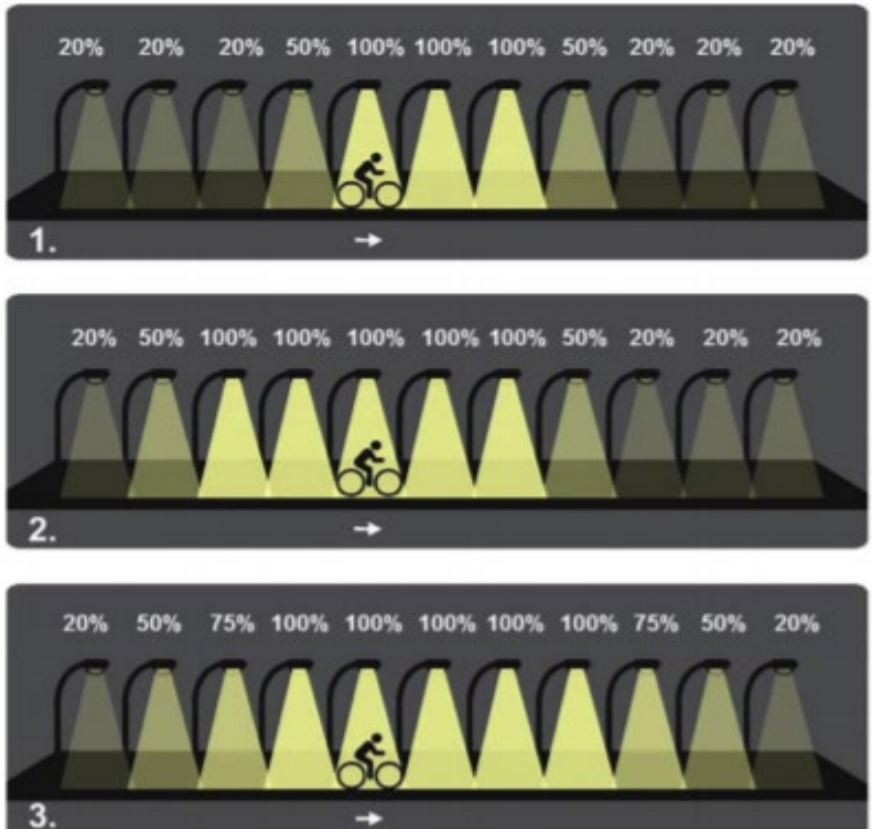
- Daylight harvesting
- Dimming
- Use optimization

Degrees of controls

- Autonomous
- Centralized
- Dynamic

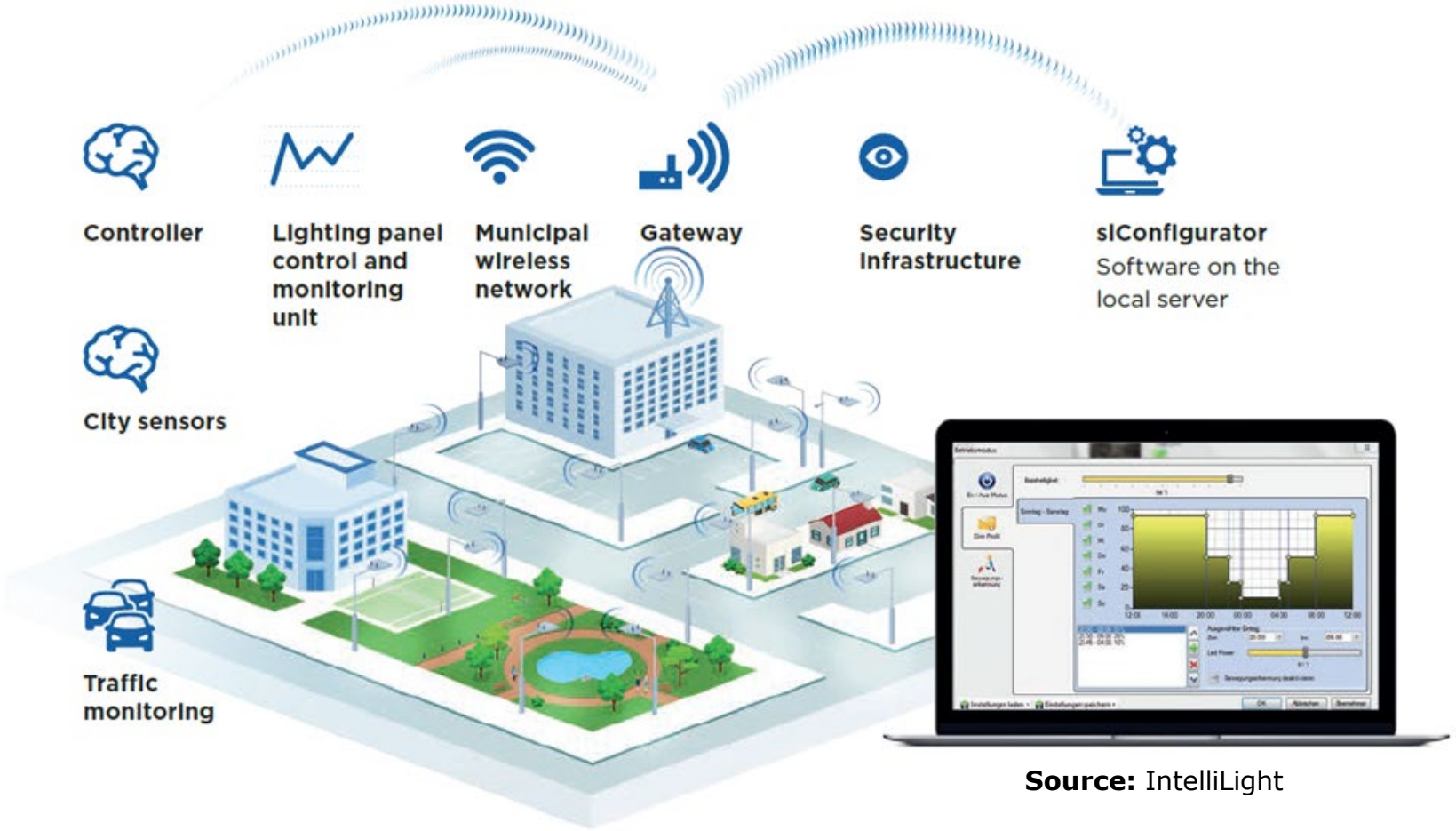
Types of sensors

- Motion sensors
- Time control sensors
- Light sensors



Source: IntelliLight

Lighting management systems



Source: IntelliLight

They offer the potential of connected "intelligent" lighting as an additional EE and a smart city tool

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MULTIPLE BENEFITS OF EE LIGHTING TO MUNICIPALITIES

Cutting Costs While Improving Safety and Service

Lighting Quality	Energy Savings	Less Maintenance	Intelligent Networks
• Significant improvement over the yellow glow of sodium	• Save on average between 40% and 80% of energy (and OPEX costs)	• Significant longer operating life, fewer lamp changes, for old and inefficient systems	• Controls and intelligent networks further augments their benefits of LEDs

Source: LED Street Lighting, C2E2

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Implementing EE Street Lighting Systems in Municipalities

CASE STUDY EE STREET LIGHTING – BUENOS AIRES, ARGENTINA

Image: DigitalistMag

Project

- Project start year: 2013
- Project end: 2020
- Replacement of inefficient luminaires

Results

- First Latin American city with 100% LED lights
- Energy savings: 50% (85,000 kWh / year)
- Equivalent to the consumption of 25,000 homes
- Reduction of 44,000 tons of CO2 / year
- Centralized management system (40% reduction in maintenance time and 30% costs)

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CASE STUDY EE STREET LIGHTING – MUNICIPALITY OF CASCAIS, PORTUGAL

Project

- Objective: Replacement of inefficient luminaires to reduce electricity bill

Results

- More than **307** luminaries
- Around **160k€** invested – 3 year RoI
- Reduction **88%** kWh/year energy consumption
- CO_2 reduction **292,000 kg/year**

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STEP-BY-STEP IN IMPLEMENTING EE LIGHTING SYSTEMS

HOW CAN WE SUPPORT YOU?

1. Create a team	2. Conduct a rapid assessment	3. Define project	4. Secure Budget	5. Implement Project
• put together the necessary team of experts	• Technical, economic and environmental key indicators	• Design key steps and resources in the project	• Ensure the investment and finance, e.g. Project Bundling	• Undertake the necessary EE Lighting works, including MRV

C2E2 Street Lighting EE Calculator Tool

CE2E Street Lighting Financing Tool (SLFT)

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C2E2 - Street Lighting Energy Efficiency Calculator

Click here to access the tool !

Goal

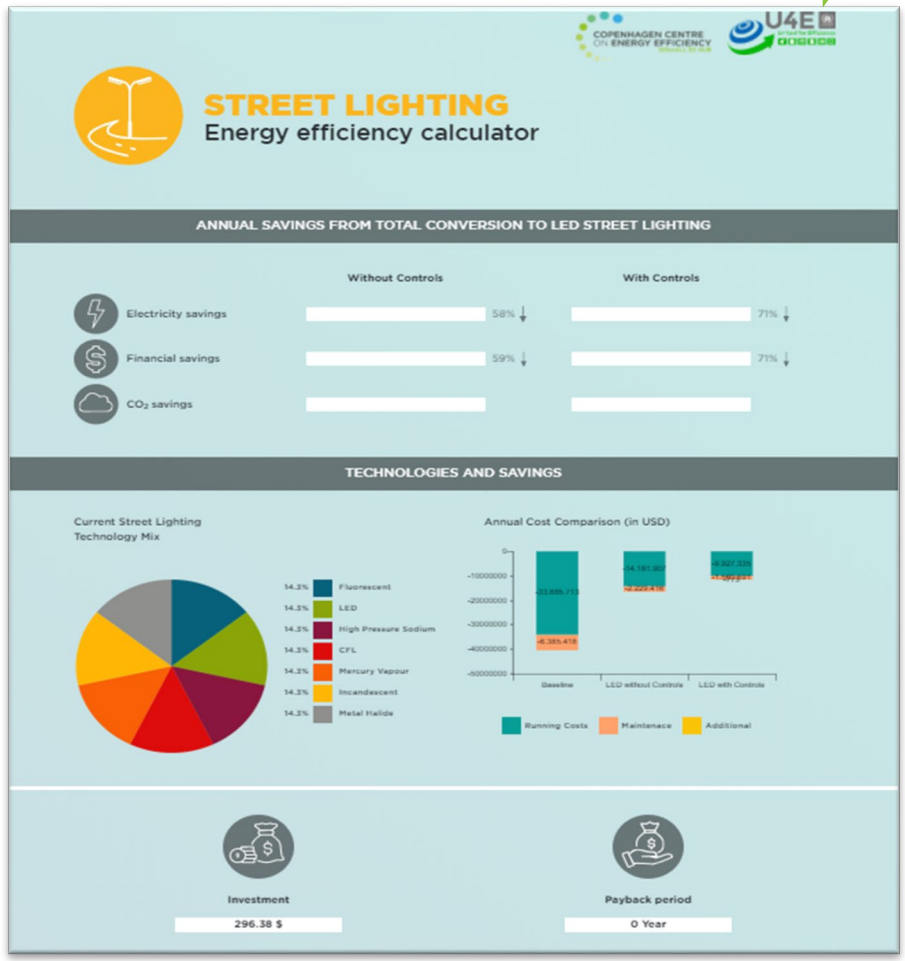
asses the potential savings from the switch to LED lighting from the Street Lighting system of the city or municipality.

Data required

- General data of the municipality; Country, Annual light hours, Electricity price, Emission intensity
- Current lamps in the municipality; Types, Power (w), Quantity (stock), Price ($ / lamp)

Output

- Results with and without light intensity control
- Savings compared to the current system:
  - Electricity consumption
  - Financial: investment required, Return on Investment (RoI)
  - CO_2 emissions



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❖ **USER FRIENDLY :** QUICK & EASY TO NAVIGATE

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C2E2 - Street Lighting Financing Tool (SLFT)

Goal

Guide you into which are the optimal financing mechanisms/instrument to implement the EE lighting systems in your municipality, based on the projects and countries conditions

Data required

- No prior data required
- Only knowledge on policy framework

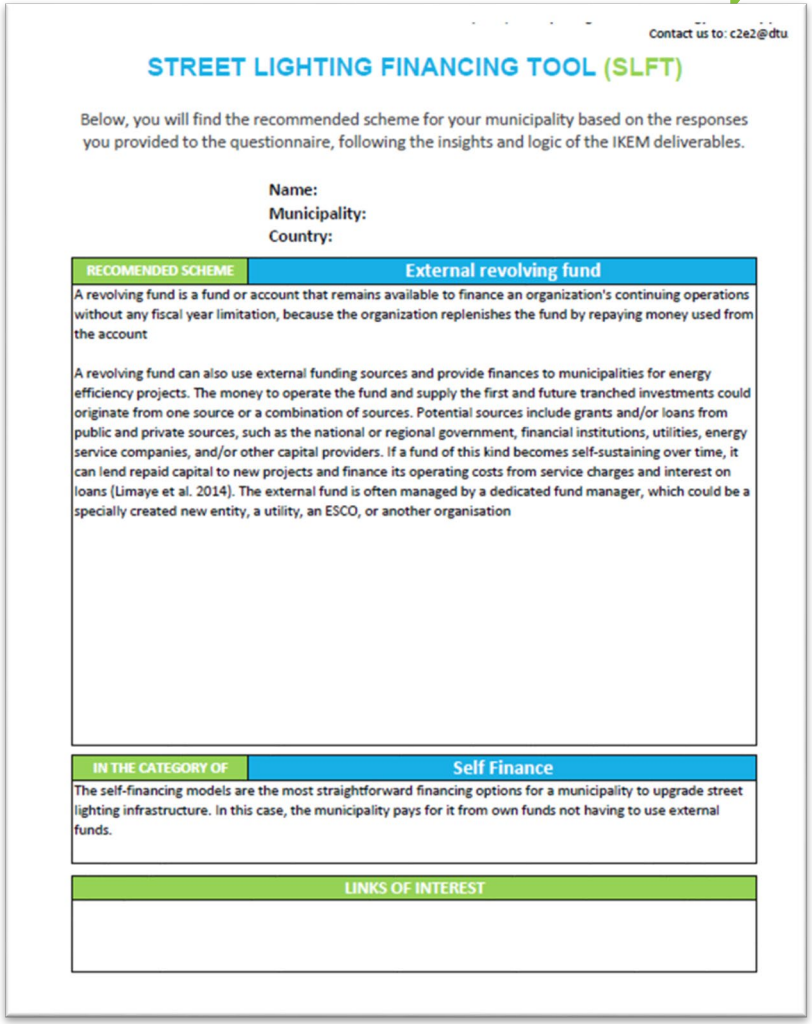
Output

- Report where you will have access to the best financial scheme (PDF)

❖ **FREE**

❖ **USER FRIENDLY :** QUICK & EASY TO NAVIGATE

Click here to access the tool



Contact us to: c2e2@dtu

STREET LIGHTING FINANCING TOOL (SLFT)

Below, you will find the recommended scheme for your municipality based on the responses you provided to the questionnaire, following the insights and logic of the IKEM deliverables.

Name:
Municipality:
Country:

RECOMENDED SCHEME	External revolving fund

A revolving fund is a fund or account that remains available to finance an organization's continuing operations without any fiscal year limitation, because the organization replenishes the fund by repaying money used from the account

A revolving fund can also use external funding sources and provide finances to municipalities for energy efficiency projects. The money to operate the fund and supply the first and future tranched investments could originate from one source or a combination of sources. Potential sources include grants and/or loans from public and private sources, such as the national or regional government, financial institutions, utilities, energy service companies, and/or other capital providers. If a fund of this kind becomes self-sustaining over time, it can lend repaid capital to new projects and finance its operating costs from service charges and interest on loans (Limaye et al. 2014). The external fund is often managed by a dedicated fund manager, which could be a specially created new entity, a utility, an ESCO, or another organisation

IN THE CATEGORY OF	Self Finance

The self-financing models are the most straightforward financing options for a municipality to upgrade street lighting infrastructure. In this case, the municipality pays for it from own funds not having to use external funds.

LINKS OF INTEREST

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Thank you for your attention

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