



# Smart Lighting for Smarter Sustainable Cities

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# Smart Lighting for Smarter Sustainable Cities

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## Today, artificial light is everywhere

### Multiples Usages:

- Monument Lighting
- Street Lighting
- Indoor Lighting
- Signage & displays
- Vehicles & transport
- Non-lighting Applications



### Multiples Functions:

- |                 |                    |                   |
|-----------------|--------------------|-------------------|
| ▶ See & be seen | ▶ Make secure      | ▶ Appreciate      |
| ▶ Locate        | ▶ Make feel secure | ▶ Enhance & fancy |
| ▶ Identify      | ▶ Communicate      | ▶ Create ambiance |



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## Some global figures

13-14%  
2 900 TWh of annual electricity world-production for generating artificial light

~2%  
2% of world annual energy primary resources used

1 150 000 000 metric tons CO<sub>2</sub>  
5% of the world CO<sub>2</sub> annual emissions =  
230 million people CO<sub>2</sub> emissions

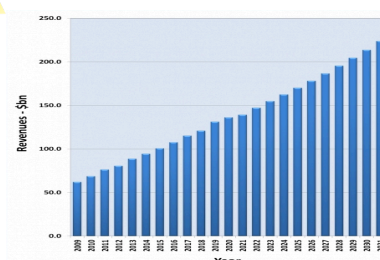


30 000 000 000  
More than 30 billion electric lamps operate everyday worldwide

40-45%  
LED market revenue share

\$120 000 000 000  
Lighting industry annual turnover US\$ 120 billion and still growing.

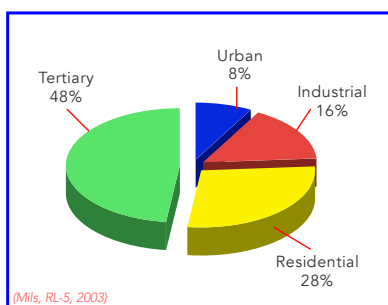
Artificial lighting has a large impact on energy, environment but also on every day's life and world's economy



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## Situation today

▶ 2 900 TWh electricity consumed per annum (16.5% of the world's production)



✓ 12% France  
✓ 9% Germany  
✓ 21% USA  
✓ 34% Tunisia  
✓ 86% Tanzania

Sustainable Development

Full production of France + Italy

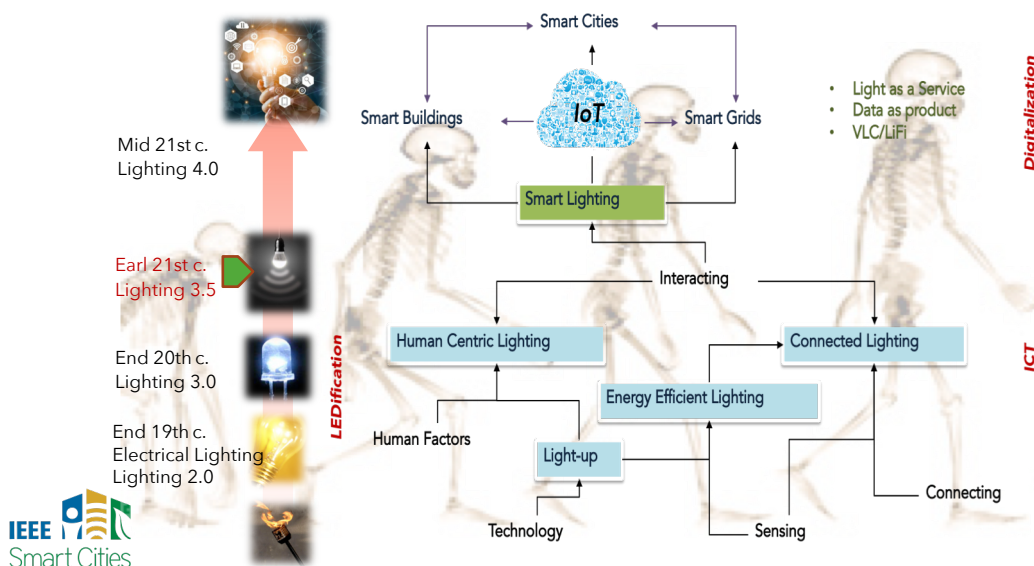
200 billion Euros per annum (Europe)

▶ 1 150 million tonnes of CO<sub>2</sub> per year  
▶ 80 tonnes Hg-contaminated wastes collected in France every week  
▶ Light pollution of skies



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## The way forward to Lighting 4.0 era



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## What is a smart lighting system?

A **smart lighting system** principal function is to **produce, at any moment, the right light**: where it is needed and when it is necessary. It should **adapt the quantity and quality of light to enhance visual performance** in agreement with the type of executed tasks. It must **guarantee well-being, health and safety of the end-users**. It should **not squander passively the resources of our planet and limit actively the effects of light pollution on the biotope**, or, any other impacts on the environment. Ideally, the system could **offer additional services** (geo-localisation, data connectivity...) to the end-users through Visual Light Communication protocols.

### Smart Lighting Functions

- Adapt dynamically the light quantity, light distribution in space and light quality (CCT, IRC, spectrum...) to optimise visual performance and respect any normative requirements
- Avoiding any visual disturbance (glare, light flicker, strobe effects, shadows...) that can compromise end-user's security and well-being at any moment.
- Always reduce energy consumption of the installation without compromising the above conditions
- Actively limit the effects of light pollution on the ecosystem and biotope, respecting that new sky-protection legislations/standards.
- If necessary, relay information via VLC methods (eg. provide geolocalization reference).

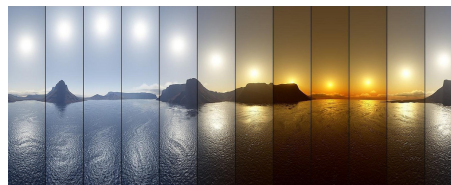


"I installed an awesome smart light. It turns off when my parents enter my room so they can't see the mess."

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## Human Centric Lighting

- ▶ **Human Centric Lighting (HCL)** is becoming the next big step in lighting. Biologically effective lighting represents lighting systems that are appropriate to stimulate the biological organism, thus improving cognitive performance.
- ▶ **Emotionally effective lighting** systems are designed to create emotionally stimulating environments and appealing atmospheres. Visual cues in design of a space aid us in our interactions with our surroundings. Using natural and electric lighting to illuminate objects in a space while minimizing negative effects such as glare and low contrast is beneficial.
- ▶ **HCL Enhances Elder's & disable's life.** Smart Lighting systems can provide the best lighting conditions to elder or/and visually impaired persons in order to facilitate the every-days actions and life offering them the feeling of larger autonomy and security.



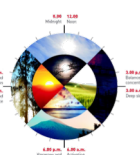
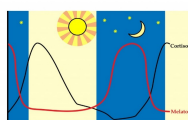
**Sun at zenith:**

A lot of light  
High colour temperature  
Uniform light

**Sunset:**

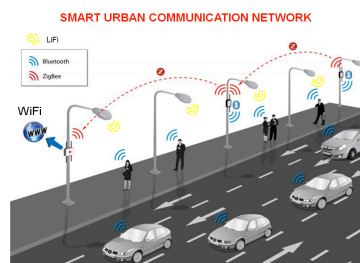
Less light  
Low colour temperature  
Shadows

Light quantity and colour change during daytime



## Smart Lighting for Smart Cities

- ▶ In smart cities, so-called **smart urban objects** can be used in public areas to **increase the sense of security of people**. Safety in everyday life is improved by overcoming barriers such as dark areas at night without being in obligation to squander energy for illuminating empty spaces. For instance elder people, which can enhance their participation in public life.

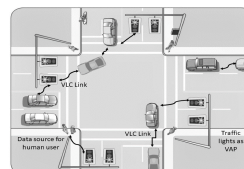
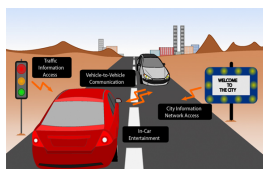


- ▶ **Connected smart lighting can reduce vulnerabilities** as it can recognize social alarms, hazardous citations, accidents and broadcast information to vulnerable public space users (i.e. elder or disable people).

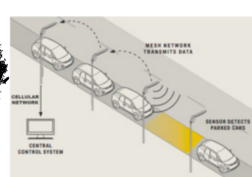
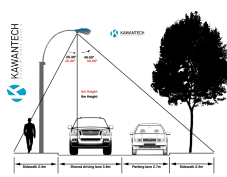


## Additional services

- ▶ A communicating lighting system can be used to regulate traffic. VLC/LiFi can be used for communicating from car to car or/and from city to car. Information can be used to adjust trajectories, reduce speed, prevent collisions. Transfer signals information to cars (traffic lights, speed limits...).

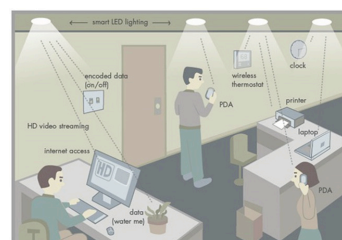
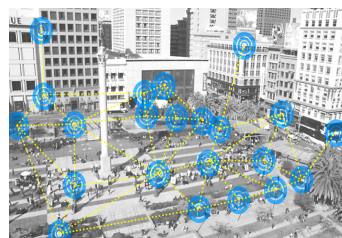


- ▶ A communicating lighting system can reduce car roaming for parking. Locate a parking spot in a city is time consuming and polluting action. Smart lighting poles can locate available parking spots and broadcast information to driver's mobile phones or direct to smart cars.

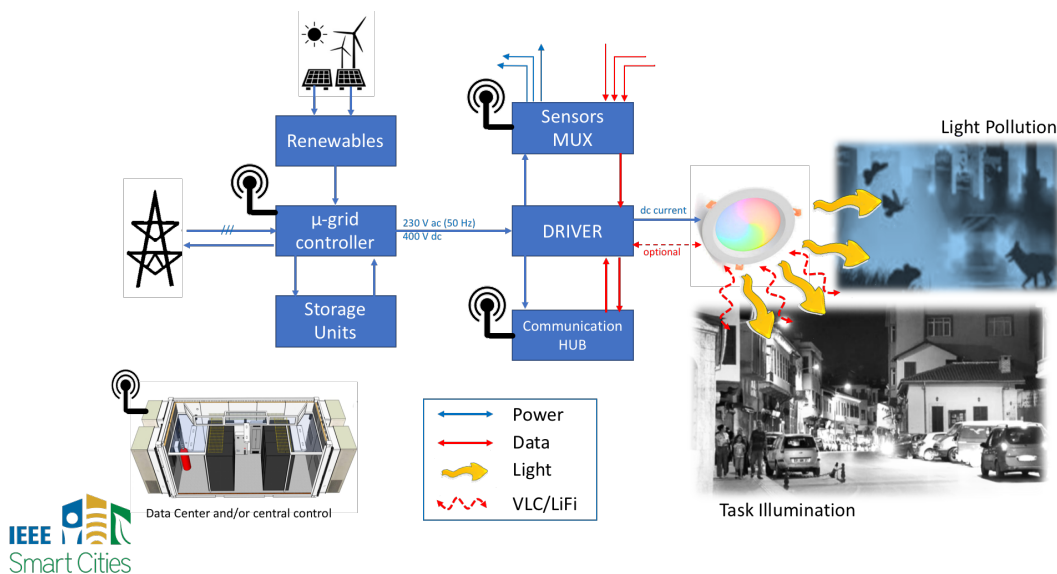


## Lighting, an IoT system's component...

- ▶ A connected lighting system can be used as basis for connecting communicating objects thanks to visual light communication (VLC) and LiFi functionalities. Objects can communicate between them or/and a central system. VLC/LiFi offer a large band-pass to allow large data flows. A lighting network forms a dense mesh that can be used for various applications & services
- ▶ Illumination will become a sub-function of a more complex ICT (Information Communication Technology) system, which will be a sub-system in the Internet-of-Things (IoT) global system. Light will be the vector of new services and carrier of dataflows that will spawn additional products
- ▶ According to market research, Li-Fi and in general VLC are expected to garner US\$ 115 billion by 2022, registering a CAGR of 116,8% during the forecast period 2016 – 2022. US host important national lighting and ICT related industries that smart lighting technologies development will contribute in consolidating world leader position in that segments

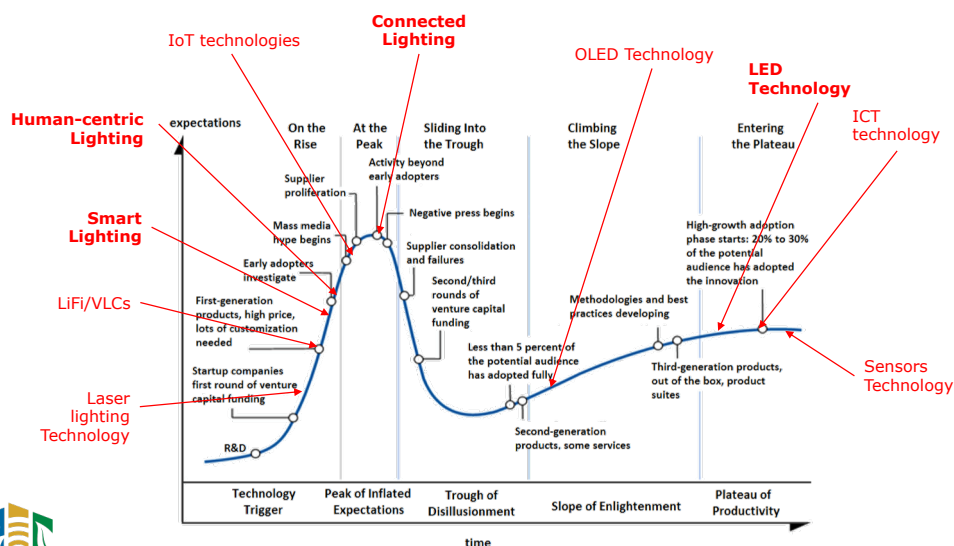


## The ideal Configuration



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## Smart Lighting Technology status - the Hype Cycle



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## The ultimate solution: the "right human-centric smart lighting" concept



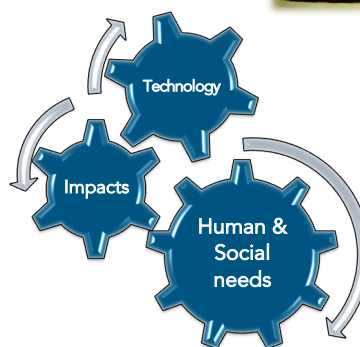
*Illuminate doesn't mean "flood" objects, people or buildings with light!*



- ▶ Light-up smart, where it is needed, when it is necessary and as best as possible!

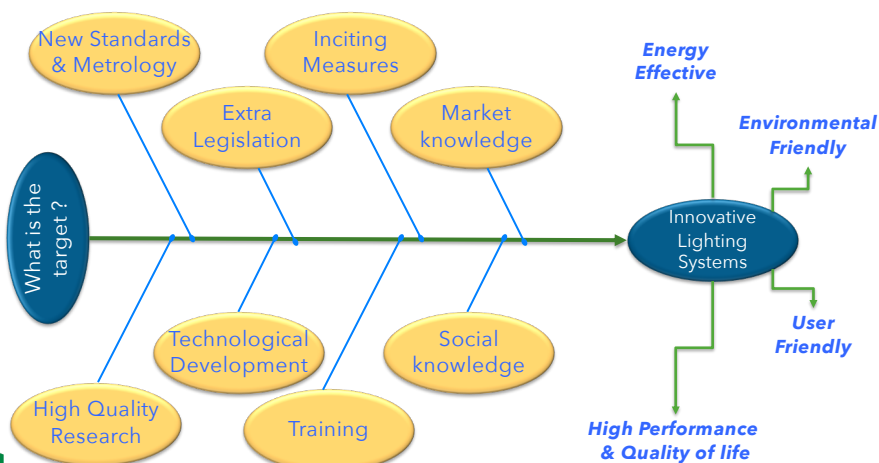
*Smart Lighting development contributes to several world's grand challenges*

- ▶ Contribute to Energy savings
- ▶ Contribute to Healthy working environments and high task performance
- ▶ Contribute to Silver Economy
- ▶ Contribute to Lighting and IT industry rise



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## To achieve that objective cross-discipline efforts are required



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**Thank you!**

