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UMR 5213

Light beyond Lighting, frontiers in Lighting Technologies:

The human-centric intelligent lighting challenge

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Today, artificial Lighting is everywhere

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Multiples Usages...

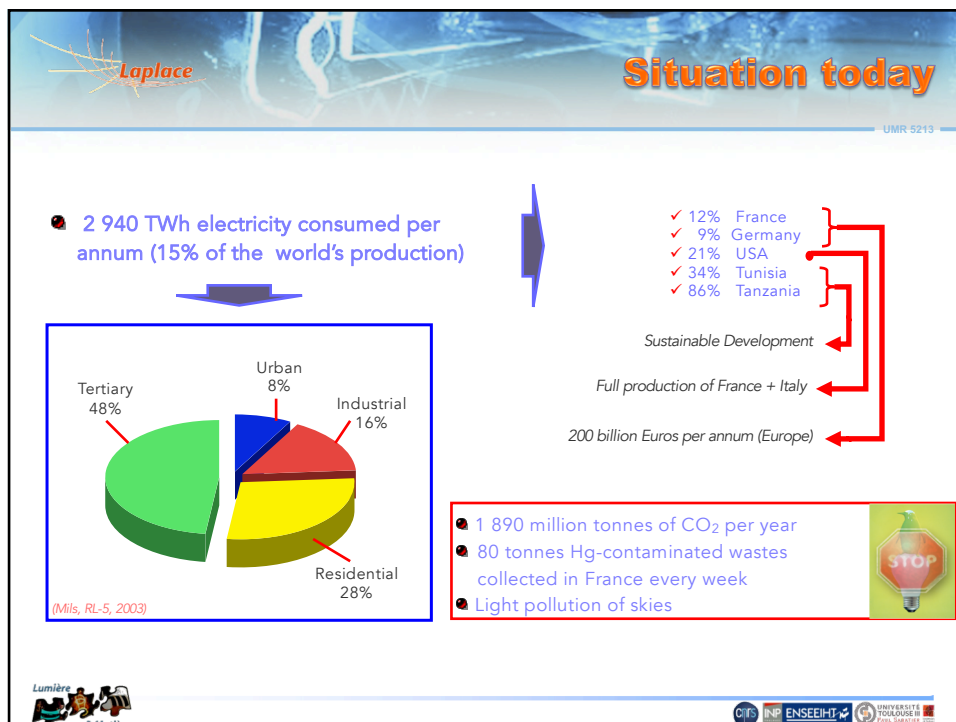
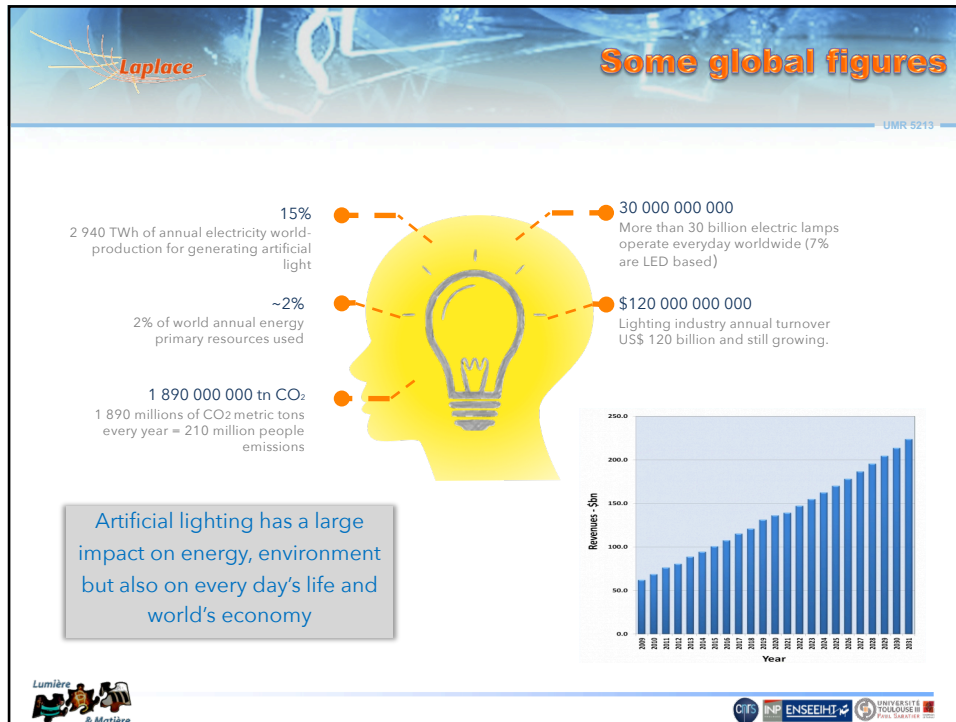
- Monument Lighting
- Street Lighting
- Indoor Lighting
- Signage & displays
- Vehicles & transport
- Industrial Applications



Toulouse by night

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Laplace **And what about 2030?**

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- 7,3 billion people live on earth (2015) → 1,14% growth/annum → 8,8 billion (2030)
- 1,0 billion without connection to electricity grid (2015) → 0,8 billion (2030)

6,3 billion people use 2 940 TWh par year
Energy used for lighting: 465 kWh/person/annum

We need more efficient technologies

- 10,2 k\$ average annual GDP/person (2015)
- 3,6% annual average GDP growth (2015)

Average 750 kWh/person/annum for 8 billion people in 2030

60% OR 2 times more energy requested...

Energy (kWh/person/annum)
GDP/person (k\$/an)

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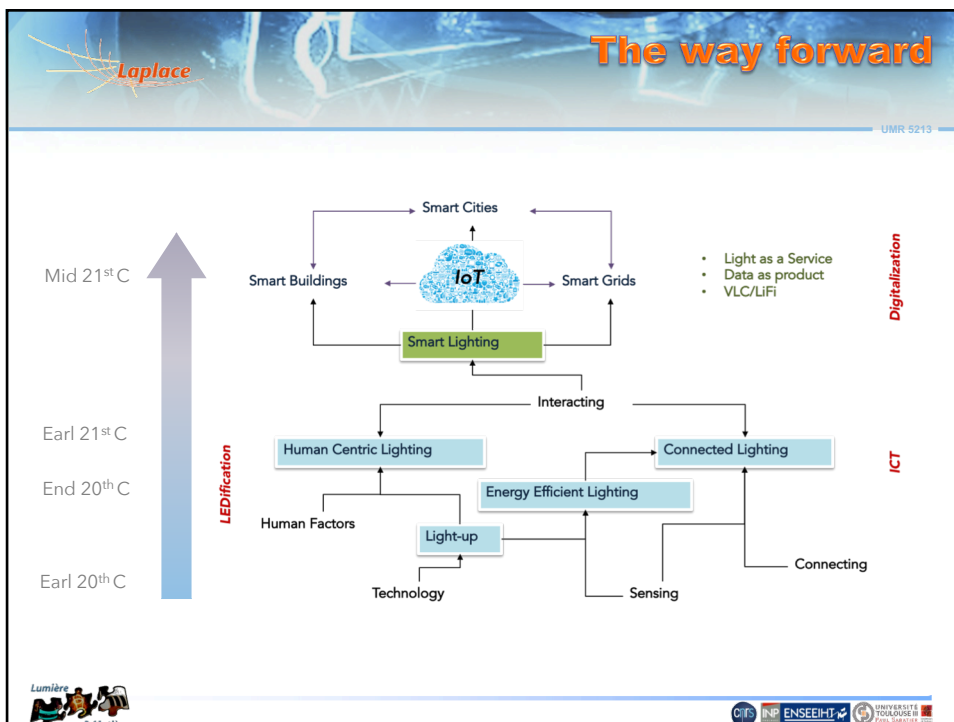
Laplace **Evolutions & revolutions...**

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Incandescence Luminescence

Solid State Lighting (SSL)
Connected lighting

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Laplace **Toulouse's projects: The "cognitive lighting"**

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Cognitive/adaptive lighting with embedded form recognition

The diagram illustrates the components of the cognitive lighting system. On the left, it shows an 'Armoire de distribution électrique équipée d'un Controller Lighting' connected to 'Moving Sensor Lighting avec détection panoramique 360° (alimentation photovoltaïque)'. A 'SITE DÉCHARGÉ' box highlights 'Driver Lighting' and 'LED'. On the right, a cross-section of a street lamp shows 'KAWANTECH' lighting with '20°-30°' and '45°-60°' beam angles, 'Red Height' and 'Blue Height' indicators, and a 'Typical residential street 10-12m' layout with zones for 'Shoulder 2.2m', 'Shared driving lane 3.8m', 'Parking lane 2.2m', and 'Shoulder 2.2m'.

toulouse métropole **ASIA INDUSTRIE** **MAIRIE DE TOULOUSE** **KAWANTECH**

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Laplace **What next? Smart lighting systems**

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SMART URBAN COMMUNICATION NETWORK

The diagram shows a 'SMART URBAN COMMUNICATION NETWORK' with wireless signals for 'WiFi', 'LIFI', 'Bluetooth', and 'ZigBee' connecting street lamps to vehicles and pedestrians. Below, a red car is shown with 'Traffic Information Access', 'Vehicle-to-Vehicle Communication', 'City Information Network Access', and 'In-Car Entertainment'. A cartoon character is shown interacting with a smart lamp. On the right, an aerial view of a city street shows a network of smart lighting poles with blue signal waves.

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We can do also: Smarter, brighter, better

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T'AS VU NOTRE NOUVEL ÉCLAIRAGE PUBLIC «ANTIGASPI»? ÉCONOMIQUE, ÉCOLOGIQUE....

ET PUIS ÇA CRÉE DES EMPLOIS!

DID YOU NOTICE THE NEW GREEN STREET LIGHTING? ECONOMIC, ECOLOGIC...

AND IT CREATES NEW JOBS!

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The ultimate solution: "right human-centric lighting" concept

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"illuminate" does not mean "flood" objects, people or buildings with light!

Technology

Impacts

Human & Social needs

Light-up smart, where it is needed and when it is necessary!

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Evaluate the real environmental impact

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- ✓ **Life Cycle analysis (LCA)** is primarily a method to measure the environmental impacts of various economic activities and, throughout the life cycle of the product or process.
- ✓ LCA can identify the points on which a product can be improved and designed to prevent impacts from human activities.
- ✓ LCA does not include economic aspects.

Take into account the full life of the product
"From cradle to the grave"

ISO 14040 & 14044

Inputs (Energy, Materials, Water, Land-use)

Wastes (Solid, liquid, gaseous, heat, radioactivity...)

Component Recovering

Material Recovering

Energy recovering

Conception, R&D, Industrialization, Marketing

Production Packing

Distribution Sales

Installation Use

Repairing

End-of-life
• Collection
• Transport
• Treatment

Raw material acquisition
• Refining
• Transport

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Take into account skies pollution

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Artificial Night Sky Brightness due to Light Pollution in North America
A preliminary picture of the growth from 1950 to 2025

Need to evaluate the impacts on fauna and flora

Artificial night sky brightness due to light pollution is increasing rapidly. The map shows the growth of artificial night sky brightness from 1950 to 2025. The color scale indicates the magnitude of the increase.


© 2001 Cinzano, P., Falchi, F., Elvidge, C.D.

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Laplace **Take into account impacts to human health and well-being** UMR 5213

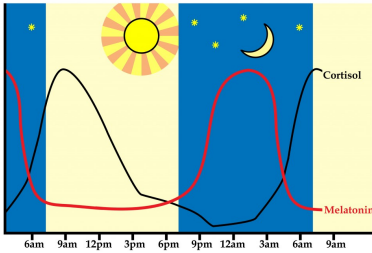
Light quantity and colour change during daytime



A lot of light
High colour temperature
Uniform light

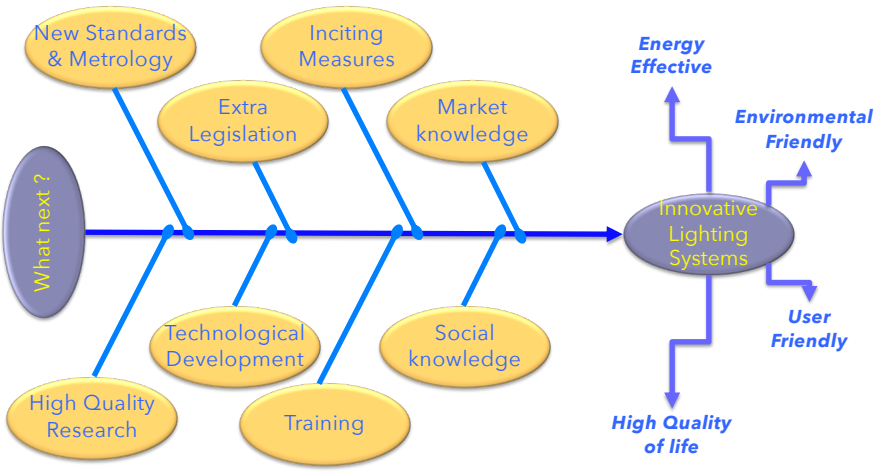
Less light
Low colour temperature
Non-uniform distribution

The concentration of melatonin and cortisol depend on the variation of light



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Laplace **Other issues are also crucial...** UMR 5213



What next?

- New Standards & Metrology
- Extra Legislation
- Inciting Measures
- Market knowledge
- Technological Development
- Social knowledge
- High Quality Research
- Training

Innovative Lighting Systems

- Energy Effective
- Environmental Friendly
- User Friendly
- High Quality of life

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