Challenges and traps of assessing Life Cycle Cost analysis (LCC)

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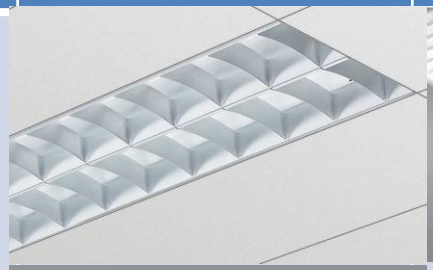
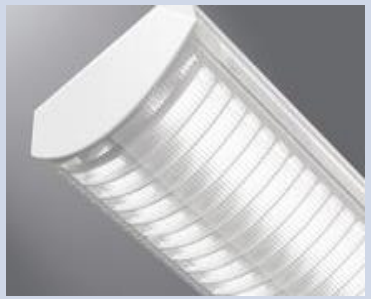
« Lighting retrofit issue is mainly a decision process cocerning possible benefits to change, *before their end of life*, the lighting installations »

Tasks:

1) to identify the « low hanging fruits »
2) To identify the winning schemes

What are are the Life Cycle Costs (LCC) of major lighting schemes?

Looking for « low hanging fruits » and best solutions

	Industrial buillding	Office building	School	Store
OLD (15 – 30 yrs)	 	 	 	 
New (2014-2015)	 	 	 	 

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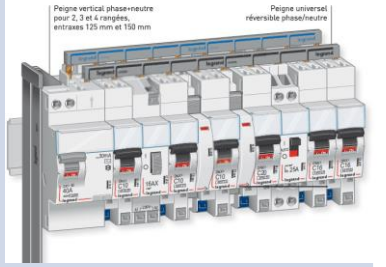
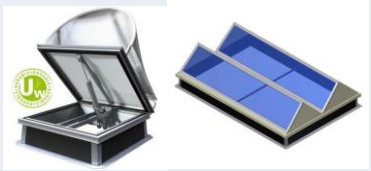
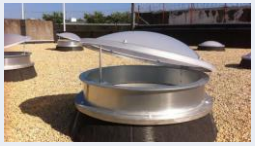
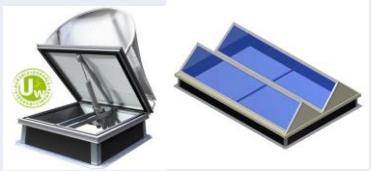
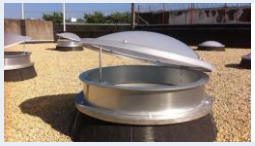
Looking for « low hanging fruits » and best solutions / Daylighting and controls

	Industrial buillding	Office building	School	Store
OLD (15 – 30 yrs)	 Insufficient daylight, aging roof monitors, steady electrical lighting	   Individual shadings, on-off and clock controls	  Manually controlled shading and lamps.	  Manual switches, or clock driven
New (2014-2015)	   Roof monitors with improved performance and sunlight control. Daylight responsive sensors	 Daylight sensor  Occupancy sensor  Sensors and intelligent managemen tof sunbeams.	 Daylight sensor  Automatic controls of shading, override, clocks	   Roof monitors with improved performance and sunlight control. Daylight responsive sensors

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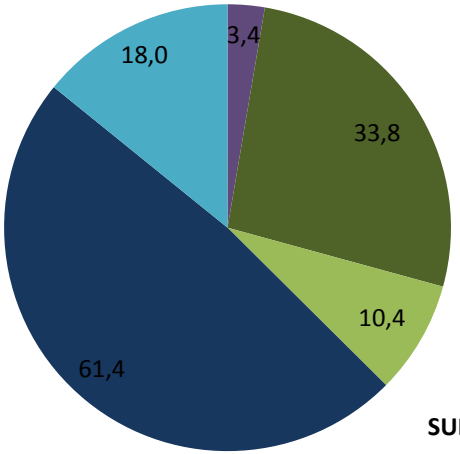
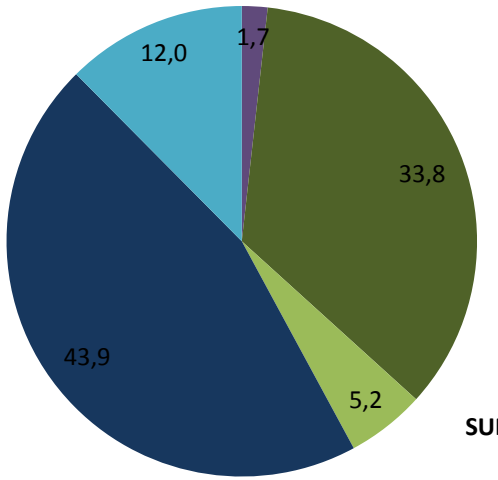
Cumulated costs for good fluorescent lights

Garage 5600 hr/yr 1.5 W/m2



SUM – 127 Euro/m2

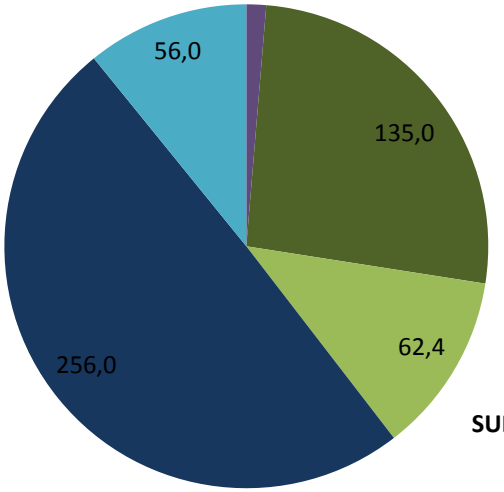
Office hallways 2400 hr/yr 2.5 W/m2



SUM – 96.6 Euro/m2

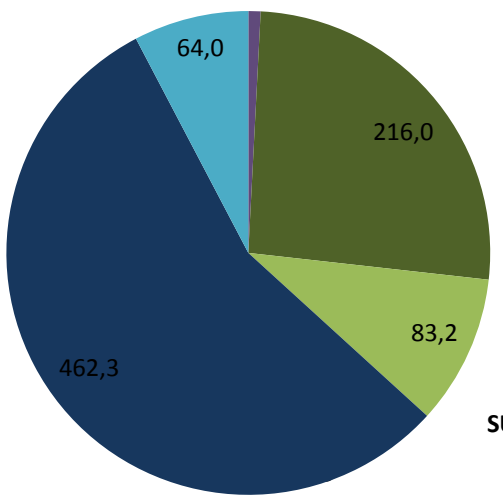
Change of electronic ballast
Investment with all components
Change of lighttubes
Electricity Price
Installation price

Office 3500 hr/yr 10 W/m2



SUM – 516.2 Euro/m2

Commercial 4000 hr/yr 16 W/m2



SUM – 832 Euro/m2

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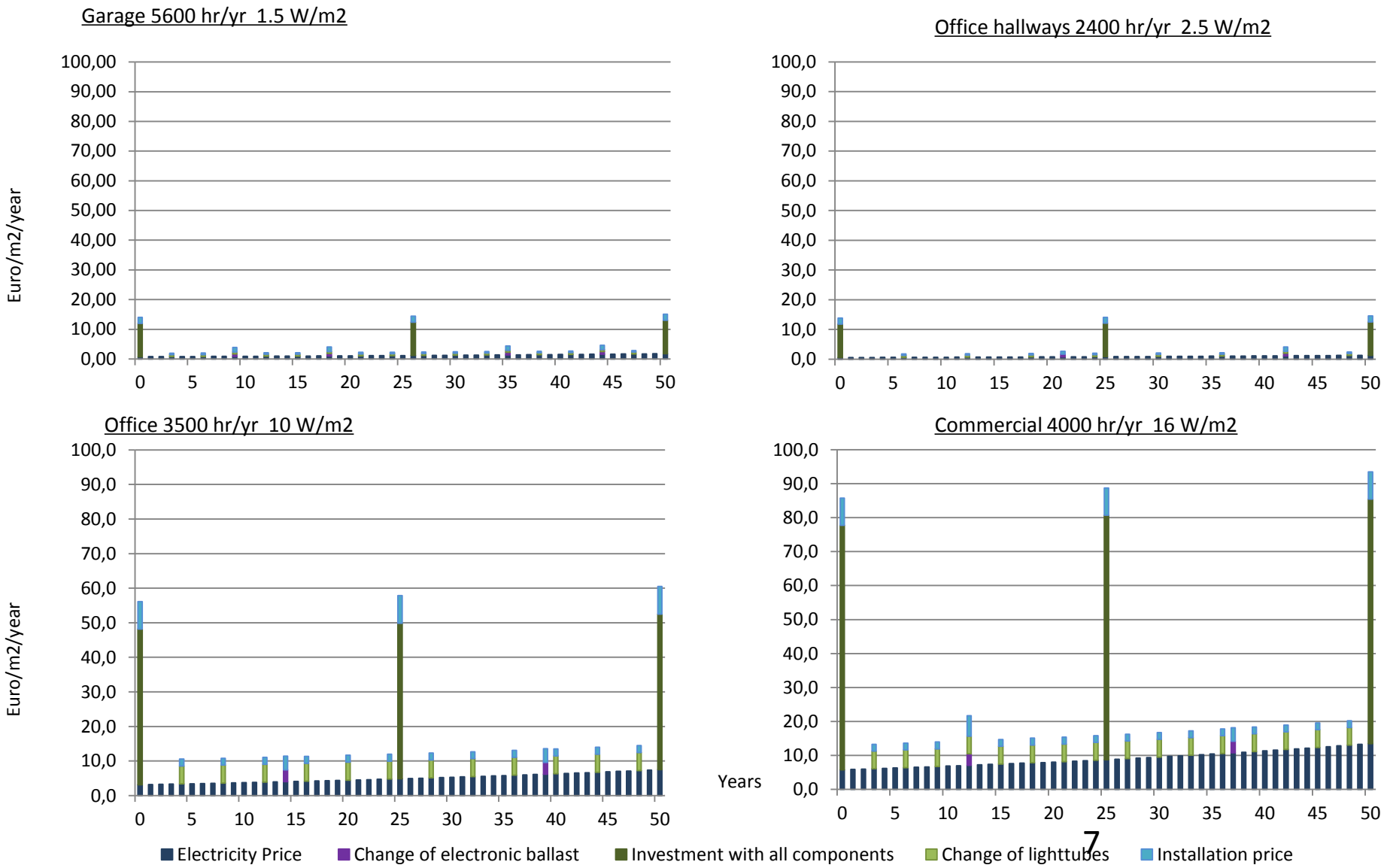
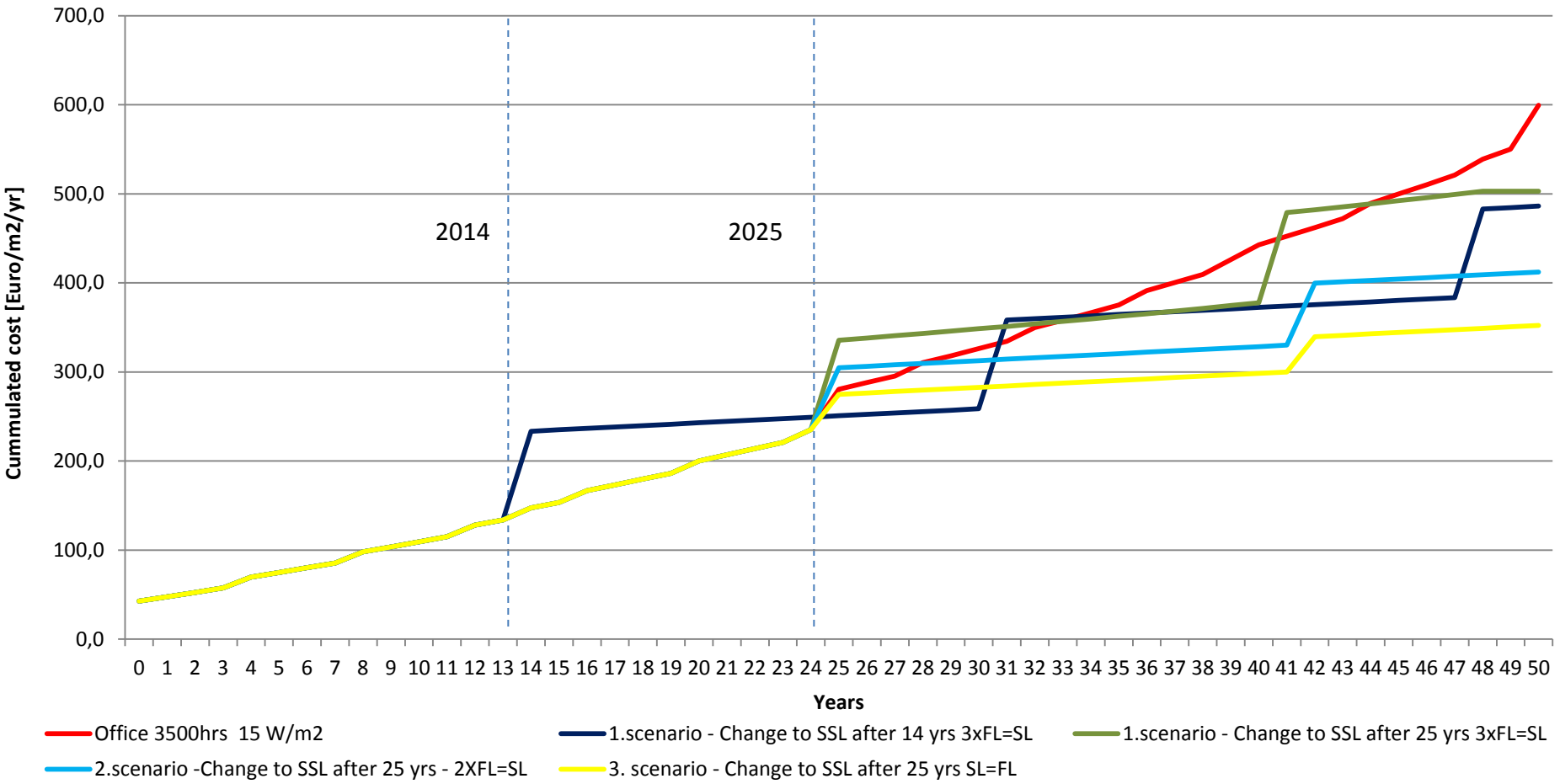
Lighting cost storyboard for ”good” fluorescent lights



Change from fluorescent 15 W/m2 to SSL



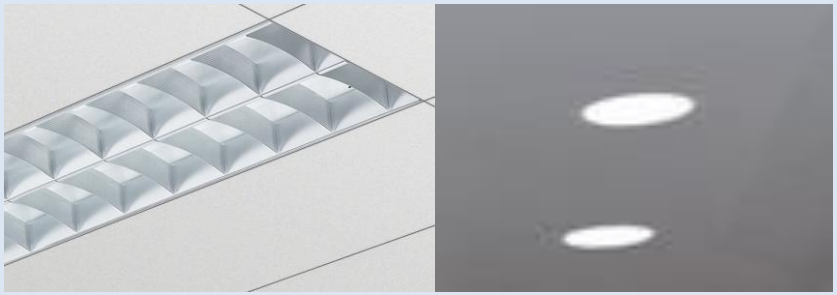
Benefit in all cases, but one can wait until 2025 until performing change to SSL: it may be useful to wait until prices of SSL drops significantly after 2020 or 2025)

Investor _ Industrial building (Processing)

Typical installation to replace Approx 15 to 30 years old	Typical new generation installation
	
Double fluorescent with cheap reflector Suspended HP sodium Suspended HID Typical illuminance_500 lux Typical power density_30 W/m2	Linear LED tubes Suspended LED Typical illuminance_ 750 lux Typical power density_15 W/m2
	<u>Investment cost (incl. Installation)</u> - LED (15 W/m2) _21 €/m2

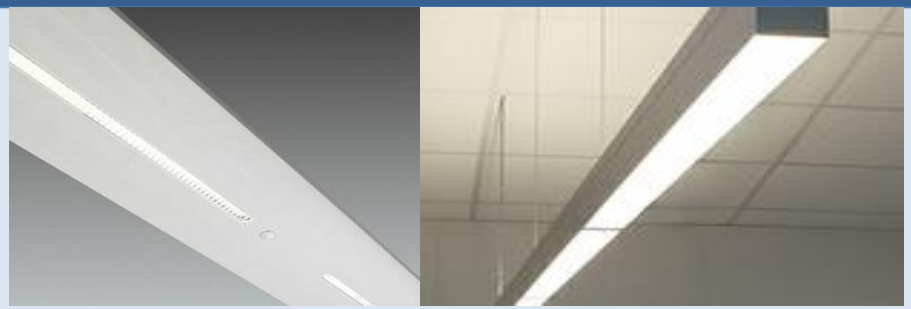
Based on:
Typical operating hours_ 4000 hours/yr
Typical lifespan of products (LED/SSL)_60000 hrs/yr
For industrial building 10 m2 is thought for every luminaire
Installation_ 60 min_ 40 E/hr_ 10m2/luminaire
LED /SSL 5W/m2_ the same price as a 6 W/m2 fluorescent lamp.
Price for LED (15 W/m2) defined based on this and taking the difference in power density into consideration.

Investor _ Office building

Typical installation to replace Approx 15 to 30 years old	Typical new generation installation
	
60 X 60 recessed luminaire Circular compact fluorescent downlighters Typical illuminance_500 lux (designed) 350 lux (service) Typical power density_15W/m2 and 10 W/m2	Single T5 luminaires, prismatic Rails with LED spots (Suspended direct indirect) Stand alone luiminaires Typical illuminance_500 lux (desk space) 350 lux(floor space) Typical power density_5 W/m2
	<u>Investment cost (incl. Installation)</u> - Fluorescent (6 W/m2) _ 57 €/m2 - LED/SSL (5 W/m2) _57 €/m2

Based on:
Typical operating hours_ 3500 hours/yr
Typical lifespan of products (fluorescent)_ 15000 hrs/yr for fluorescent tubes, 50000 hrs/yr for ballast and 25 yrs for fixtures.
Typical lifespan of products (LED/SSL)_60000 hrs/yr
For office 6 m2 is thought for every luminaire
Installation_ 60 min_ 40 E/hr_ 6m2/luminaire
LED /SSL 5W/m2_ the same price as a 6 W/m2 fluorescent lamp.

Investor _ Schools

Typical installation to replace Approx 15 to 30 years old	Typical new generation installation
 2 x 1,20 T8 low price ptics Typical illuminance _ 300 lux Typical power density_ 10 W/m2	 Single T5 luminaires, continuous Suspended direct indirect (3 tubes) Typical illuminance_500 lux Typical power density_ 6 W/m2
	<u>Investment cost (incl. Installation)</u> - Fluorescent (6W/m2)_ 68 €/m2

Based on:
Typical operating hours_ 1500 hours/yr
Typical lifespan of products (fluorescent)_ 15000 hrs/yr for fluorescent tubes, 50000 hrs/yr for ballast and 25 yrs for fixtures.
For schools 5 m2 is thought for every luminaire
Installation_ 60 min_ 40 E/hr_ 5m2/luminaire

Investor _Store

Typical installation to replace Approx 15 to 30 years old	Typical new generation installation
  Double fluorescent Suspended HID Typical illuminance_ 750 lux Typical power density_20 W/m2	  Linear LED tubes Suspended LED Typical illuminance_ 750 lux Typical power density_12 W/m2
	<u>Investment cost (incl. Installation)</u> - LED (12 W/m2) _28 €/m2

Based on:
Typical operating hours_ 4000 hours/yr
Typical lifespan of products (LED/SSL)_60000 hrs/yr
For commercial 6 m2 is thought for every luminaire
Installation_ 60 min_ 40 E/hr_ 6m2/luminaire
LED /SSL 5W/m2_ the same price as a 6 W/m2 fluorescent lamp.
Price for LED (12 W/m2) defined based on this and taking the difference in power density into consideration.

Retrofit: roof openings

Typical installation to replace Approx 15 to 30 years old	Typical new generation installation
 No daylighting or poor daylighting Typical illuminance 0 – 100 lx	 1.40 m x 1.40 m Roof apertures 10% of roof area , DF = 2 to 2.5 % Diffuse horizontal illuminance of 16 000 lx exceeded 50 % of daylight hours with 10% of roof area.
	<u>Investment/installation and maintenance cost</u> Retrofit: 2200 € to install a 1.4 x 1.4 m ($2m^2$) roof monitor in an existing building (less than 1500€ if new) . Investment is 110€/m2.

Based on:

Roof top area = 10% of floor area for DF average 2%, and > 50% electricity savings during daylight hours.
Investment cost 110€$/m2 for retrofit

Retrofit: lighting controls

Installation with manual / clock control	Fluorescent with Daylight sensors On –off or dimming (HF ballast or LEDs)
   Operation 2000 to 8000 hrs /yr.	 Daylight sensor  Occupancy sensor Savings can reach 50% of lighting electricity
	<u>Investment/installation and maintenance cost on top of an industrial luminaire single tube</u> <u>120€ extra</u>

Based on:

1.5 m , 35 W Single T5 no diimming 130 € , with dimming (0-10 v, DALI) : 250€
Typical savings per year 1500 hrs x 6 W/m2 = 9 Kwh/m2.yr →value 1,35€/m^2
Investment, per m2 : one luminaire per 10 m^2: 12 €/m^2

Retrofit: improved shading / redirecting shading devices

Textile shading	Louvre system, with controllable angles
	
Operation when daylight is glary, leading to possible unnecessary us of electricity 200 to 800 hrs /yr.	Possibility to adjust teh right level of daylight indoor, and, with specifiv louver design, tio bring daylight deeper into interiors.
	Benefit: some extra saving in lighting electricity (above 200 hrs per year in area located between 3 an6 meter from facade) and reduction of glare
Based on: Investment : 200 € /m2 of facade, 40€/m2 of floor Savings: maximum 0.5 cts / m^2 per year	

Concerns by actors : how to promote lighting retrofit? Where are the benefits

Actor	Investment Costs Life	Installation costs Installation simplicity	Maintenance costs Cleaning simplicity Failures	Energy consumption Controls to reduce consumption	Lighting quality Comfort Flexibility
Investor /owner	***	**			***
Installer		**			
User Maintenance			**	***	***

Early finding statements

1. There are many “low hanging fruits” in lighting leading to return on investments below 3 years), and often increasing lighting quality

2. These low hanging fruits are found mainly in industrial buildings and stores where lighting is independent from ceiling systems

3. In office buildings and schools, it is essential to estimate possible schedule of ceiling refurbishment, to conduct lighting retrofit at the same time.

1. **Anticipating retrofitting** a lighting installation can be justified if cost of new (high efficiency) luminaires remains low: for example if SSL costs are close from fluorescent luminaires

Early finding statements (Cont'd)

5. In offices, hybrid task ambient strategies, with electric power densities around 4W/m2 are the most energy efficient solutions, and can be easily implemented

6. Other benefits should dominate: added rental value, lighting quality, lower maintenance

7. Market seems to move to disposable luminaires (life below 60 000 hrs) with maintenance limited to simple cleaning

8. Evolution of ceiling systems may also lead to reduction of life of ceiling components.

9. Daylighting measures can dimish electric lighting by 50%, bur without possibbilities of return on investment related to these savings only

Questions to lighting industry and professionals

Is the energy saving model the dominant argument for investing in new lighting, or is it a secondary one?

Is there a growing interest , in Japan, for retrofitting lighting before the end of life

Will a technological gap modify