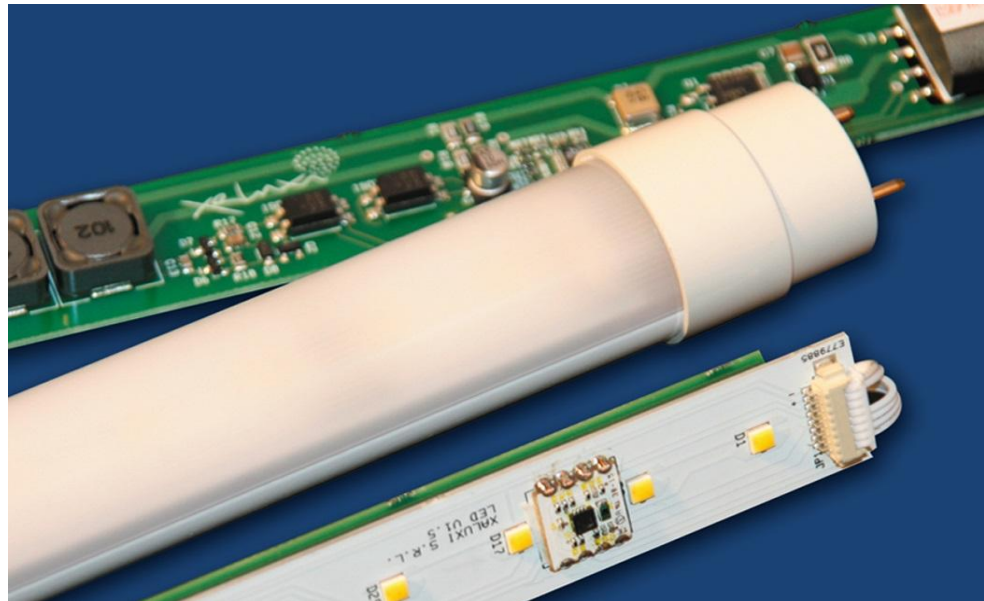


Energy efficient lighting

Self-regulating LED lamps for Turin
Polytechnic



| | |
|-------------------------|---|
| Purchasing body: | Polytechnic of Turin |
| Contract: | Supply of LED lamps Awarded: August 2015 |
| Savings: | <ul style="list-style-type: none"> • 0.9 tons of CO₂ emissions saved per year • Primary Energy saving of 0,138 GWh over 25 yrs • Financial saving of €2 per year per lamp |

SUMMARY

- Pilot installation of 16 self-regulating LED lamps at the the Department of Control and Computer Science (DAUIN) of Polytechnic of Turin
- Tender awarded to Neodelis S.r.l. for the product Ecolumiere. Cost: €560 (excluding VAT)
- 1 year efficiency and cost evaluation demonstrated long-term savings despite high purchase price

Procurement Approach

Turin Polytechnic is engaged in research and development into new technologies. One area of current interest is innovative lighting solutions which can reduce energy consumption and costs, whilst providing as good or better functionality. When a set of obsolete fluorescent lamps needed to be replaced in a passageway it was seen as the perfect opportunity to pilot a new solution, based on a thorough needs analysis, which may then be rolled out to other buildings.

In order to assess applicability for a wider roll out a detailed assessment of both life cycle costs and environmental impacts is also to be undertaken.

The RFT (Request for tender) was published on 3 July by Turin Polytechnic's Central Administration Department on the electronic procurement portal for Italian public administrations (www.acquistinretepa.it).

The request consisted in the supply of one lot of 16 LED T8 10W lamps with G13 bases. The tender was awarded on lowest price.

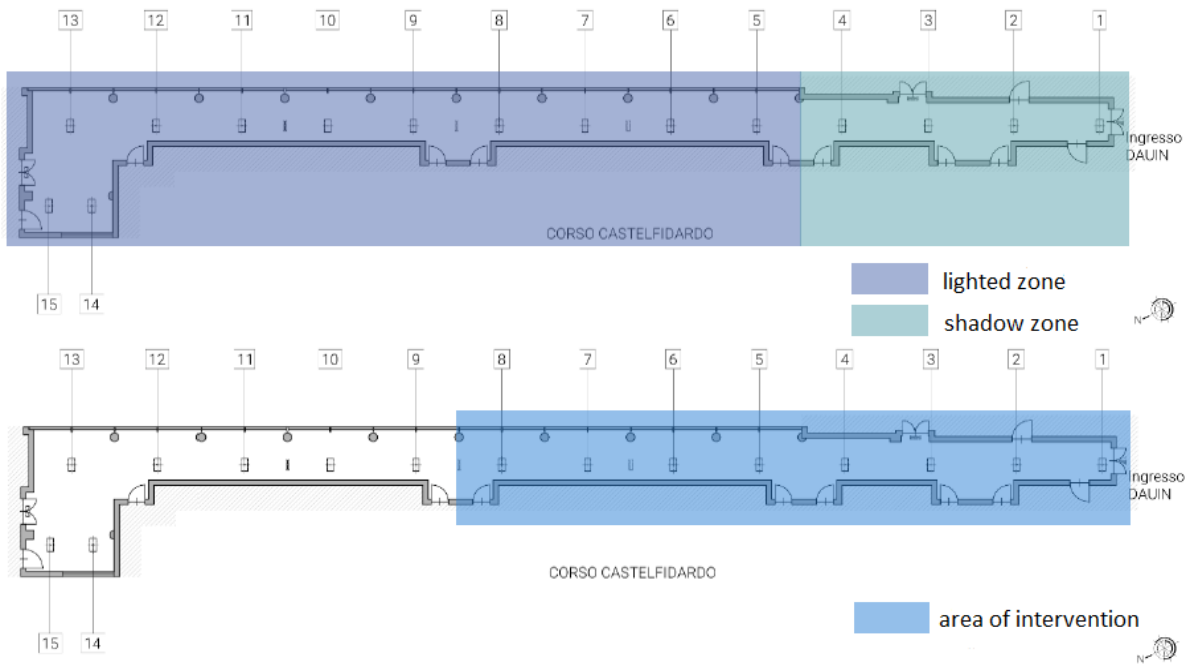
Needs analysis

The lighting requirements of the Polytechnic areas are strongly differentiated according to use: classrooms, offices, corridors etc. The passageway selected for the pilot is characterised by a clear division between lighted zone (both daylight and artificial light) and the shadow zone.

The Polytechnic wished to identify technical solutions available on the market which regulate the light emitted as a system according to the conditions. As this corridor is located in the Department of Control and Computer Engineering (DAUIN) of the Polytechnic of Turin, the project was also the subject of 1-year evaluation assessing energy consumption, lighting efficiency and cost.

INNOVATIVE SOLUTION - ECOLUMIERE

- “Intelligent” LED
- Amount of light emitted automatically adjusted according to daylight and other artificial light, as well as the presence of people
- Tubes communicate with each other to maintain uniform brightness, even when one fails
- Quick to install and low maintenance costs
- No need to install external sensors or change the existing electrical system
- Won the First Italian National Prize for Innovation in 2013



Tender specifications and Verification

TECHNICAL SPECIFICATIONS

- Tube length: 591 mm
- Tube: T8
- Colour temperature: 4000K
- Colour rendering: Ra > 80
- Power factor: min 0.95
- Installed power: max 10 W
- Luminous efficiency: min 1100 W/lumen
- L85/B10 > 50,000 hours
- Automatic dimming depending on the outside brightness and on the required ambient illumination value
- Communication between the elements to achieve lighting uniformity and maintain a specific illumination requirement

VERIFICATION

The supplier is required to submit the product data sheet, which clearly indicates all the minimum and mandatory features.

Results

Environmental impacts

Replacing the current fluorescent lamps with the Ecolumiere LED lamps will lead to a reduction of 0.9 tonnes CO₂ emissions, and 6,000 kWh per year (22.3 tCO₂, and 0.138 GWh over a 25 year planning horizon) – a reduction of 62.79%. In comparison to a conventional fluorescent lamp, a saving of 36% would be achieved.

Table 1: Environmental savings – green tender compared to current solution

| Tender | Consumption (kWh) | CO ₂ emissions (tonnes) | | Primary Energy consumption (GWh) | |
|---|-------------------|------------------------------------|-------------|----------------------------------|--------------|
| | | Year | Lifetime | Year | Lifetime |
| Benchmark (Current fluorescent lamp) | 3,508.8 | 1.4 | 35.5 | 0.009 | 0.219 |
| Green tender (Ecolumiere LED lamp) | 1,305.6 | 0.5 | 13.2 | 0.003 | 0.082 |
| Savings (62.79%) | 2,203.2 | 0.9 | 22.3 | 0.006 | 0.138 |

Table 2: Environmental savings – green tender compared to conventional solution

| Tender | Consumption (kWh) | CO ₂ emissions (tonnes) | | Primary Energy consumption (GWh) | |
|---|-------------------|------------------------------------|------------|----------------------------------|--------------|
| | | Year | Lifetime | Year | Lifetime |
| Conventional solution (efficient fluorescent lamp) | 2,040 | 0.8 | 20.6 | 0.005 | 0.128 |
| Green tender (Ecolumiere LED lamp) | 1,305.6 | 0.5 | 13.2 | 0.003 | 0.082 |
| Savings (36%) | 734.4 | 0.3 | 7.4 | 0.002 | 0.046 |

CALCULATION BASIS

- CO2 emissions for conventional electricity set at 0,404652 g/kWh
- For primary energy consumption a PEF (Primary Energy Factor) of 2.5 was assumed for electricity produced from fossil fuels
- Calculation made using the tool developed within the GPP 2020 project (www.gpp2020.eu), and refined within the SPP Regions project. Available on the SPP Regions website.

Financial impacts

The final tender value was €560 (excluding VAT), equivalent to €35 per lamp. This expenditure is included in the calculation of the first-year costs. In the following table we can see that the increase in total cumulative costs from the second year onwards is mainly due to energy consumption and maintenance, both lower in Ecolumiere lamps. These, having a longer useful life, require fewer replacements and, consequently, less maintenance.

Table 3: Total accumulated costs

| Year | Fluorescent lamp | Led lamp Ecolumiere |
|------|------------------|---------------------|
| 0 | 0.00 | 0.00 |
| 1 | 214.61 | 634.12 |
| 2 | 391.71 | 706.00 |
| 3 | 563.44 | 775.71 |
| 4 | 759.17 | 843.30 |
| 5 | 920.68 | 908.86 |
| 6 | 1077.30 | 972.43 |
| 7 | 1229.19 | 1034.08 |
| 8 | 1402.30 | 1093.87 |
| 9 | 1545.14 | 1151.84 |
| 10 | 1683.67 | 1632.86 |
| 11 | 1841.54 | 1687.39 |
| 12 | 1971.81 | 1740.26 |
| 13 | 2098.15 | 1791.54 |
| 14 | 2220.66 | 1841.27 |
| 15 | 2360.29 | 1889.49 |
| 16 | 2475.50 | 1936.26 |
| 17 | 2587.24 | 1981.61 |
| 18 | 2714.58 | 2025.59 |
| 19 | 2819.66 | 2068.24 |
| 20 | 2921.56 | 2422.08 |
| 21 | 3020.38 | 2462.19 |

| | | |
|-----------|---------|---------|
| 22 | 3133.00 | 2501.09 |
| 23 | 3225.94 | 2538.81 |
| 24 | 3316.06 | 2575.39 |
| 25 | 3418.77 | 2610.87 |

By comparing the two products, we note that by the fifth year, the cumulative costs of the Ecolumiere LED lamp are lower than those of the fluorescent lamp. The net present value of investment in fluorescent lamps is equal to €3,419 over 25 years, compared to €2,611 for the Ecolumiere LED lamps. If energy costs rise, this would lead to an even more advantageous evaluation.

A detailed life cycle costing calculation, including a comparison of more efficient fluorescent lamps and standard LEDs can be found in the annex.

Market response

The RFT was sent to nine suppliers (distributors and/or producers). Five submitted tenders. Of these five: three were immediately excluded for obvious discrepancies in the bidding phase and one later during the technical evaluation. Only one fully compliant tender was therefore received. Given the high technological standards required, a low supply of eco-innovative products was found on the market.

Lessons learned and future challenges

- Low level of competition in eco-innovative sectors of the electric lighting market
- Significant room for improvement in lighting systems
- Reduced costs for new technologies in the medium to long term
- The efficiency of the innovative lighting system depends on the location where it is installed

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Annex 1 – Life cycle calculation

As part of the pilot project a life cycle cost comparison was made following installation and real-time monitoring between the Ecolumiere and three other products. The analysis included environmental costs – with a cost allocated to CO₂ emissions. This analysis was performed using the [SMART SPP LCC-CO₂ Tool](#).¹

The following products were compared:

- Fluorescent lamp (installed before the tender)
- Energy-saving fluorescent lamp (standard model)
- LED lamp (standard model)
- **Ecolumiere LED lamp**

To calculate, the following variables were defined:

- Medium-long planning horizon (25 years)
- Discount rate of 3.018 % and inflation rate -0.10 % (sources: ISTAT and Bank of Italy 2016)
- Lamp power and estimated duration
- Energy costs (assumed constant over time)
- Acquisition cost
- Operation costs (as a function of energy consumption)
- Maintenance and repair costs (average hourly cost of maintenance personnel)
- Environmental costs (using a cost of 0.04 €/kg CO₂²)

| | Power (W) | Average price/unit (€) | Duration (hours) | CO2 Emissions costs (€/unit/year) | Maintenance costs (€/unit/year) | Operative costs* (€/unit/year) |
|---|-----------|------------------------|------------------|-----------------------------------|---------------------------------|--------------------------------|
| Fluorescent lamp (model in Polytechnic) | 43 | 2 | 18000 | 1,04 | 0,78 | 10 |
| Energy-saving fluorescent lamp (standard model) | 25 | 7 | 25000 | 0,67 | 0,76 | 6 |
| LED lamp (standard model) | 18 | 25 | 30000 | 0,43 | 0,74 | 4 |
| LED lamp Ecolumiere | 16 | 35 | 50000 | 0,38 | 0,73 | 4 |

*calculated on 5100 hours per year

Table 4: Features and costs of the lamps being compared

¹ Developed by Ecoinstitut Barcelona and Öko-Institut within the SMART SPP project (www.smart-spp.eu)

² As set in the Clean Vehicles Directive (2009/33/EC)

| | Total costs in NPV (after 25 years) - € | Annual average costs - €/year | Total costs per unit (after 25 years) - €/unit | Annual costs per unit - €/unit/year |
|---|---|-------------------------------|--|-------------------------------------|
| Fluorescent lamp (model in Polytechnic) | 3419 | 137 | 214 | 9 |
| Energy-saving fluorescent lamp (standard model) | 2636 | 105 | 165 | 7 |
| LED lamp (standard model) | 2918 | 117 | 182 | 7 |
| LED lamp Ecolumiere | 2611 | 104 | 163 | 7 |

Table 5: Lifetime/Annual cycle cost comparison (with a planning horizon of 25 years)

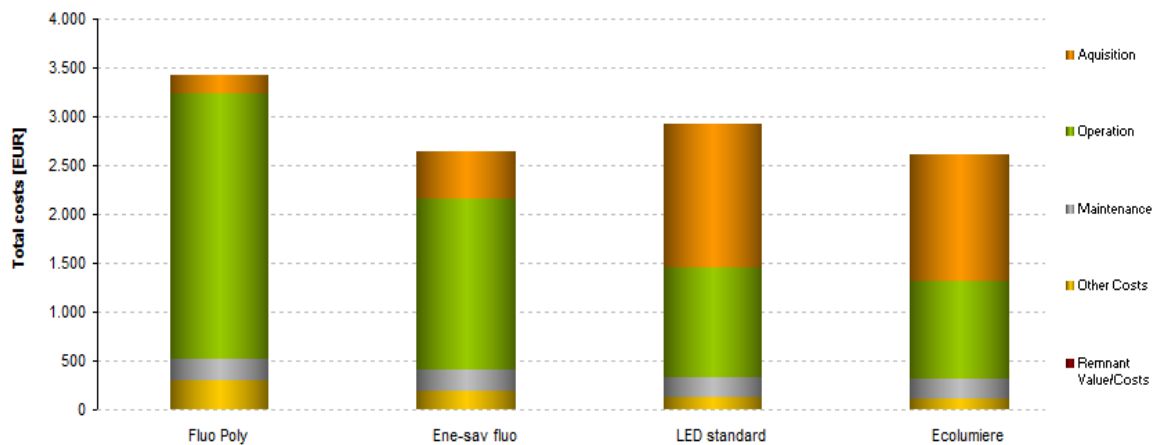


Table 6: Total costs at the end of planning horizon

As the comparison above shows, the Ecolumiere LED lamps have the best technical characteristics and the lowest costs after 25 years. LCC results show that the long lifetime of the Ecolumiere lamp and lower operating and environmental costs (given by the lower energy consumption with the same efficiency lighting) offset the higher procurement costs in the long run.

About SPP Regions

SPP Regions is promoting the creation and expansion of 7 European regional networks of municipalities working together on sustainable public procurement (SPP) and public procurement of innovation (PPI).

The regional networks are collaborating directly on tendering for eco-innovative solutions, whilst building capacities and transferring skills and knowledge through their SPP and PPI activities. The 42 tenders within the project will achieve 54.3 GWh/year primary energy savings and trigger 45 GWh/year renewable energy.

SPP REGIONS PARTNERS



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649718. The sole responsibility for any error or omissions lies with the editor. The content does not necessarily reflect the opinion of the European Commission. The European Commission is also not responsible for any use that may be made of the information contained herein.