1.1.13 Public lighting (inner lighting in schools) - Giurgiu (RO)

The lighting of a building (school), should be considered early in the design stage, because it is at this stage that the major decisions affecting day-lighting are made. It is possible to make changes to the electric lighting system during the life of the building relatively easily, but significant changes to the day-lighting are much more difficult and costly, although they may be cost effective. The energy efficiency of a lighting installation depends on:

- The efficiency of the various components of the system: lamps, ballasts, luminaires.
- The way they are used, often strongly influenced by the control system and daylight availability.
- Maintenance regime.

All these aspects should be considered, toghether with features of the lighting design such as the balance between general and localised lighting and any special needs. Available meassures range from low cost initiatives, such as the use of stickers to encourage occupants to switch off the lighting as they vacate the space, to more expensive options such as the complete replacement of existing luminaires. The maintenance can be usually improved with relatively little cost. Reductions in lighting use (till comfort levels) can often be made by improving the control system at moderate cost.

Daylighting has a major effect on the appearance of the space and can have considerable energy efficiency implications. So the major factors affecting the daylight of an interior are the depth of the room, the size and location of windows and rooflights, the glazing system and any external obstructions.

Technical aspects

The energy audits and diagnosis results of technical parameters for the inner lighting system in schools showed inadequate interior lighting conditions for schools in Giurgiu. Therefore, a sustainable energy action assessment study was developed in order to identify technologies, equipment, solutions and systems. Following objectives are to be achieved:

- Optimization of technical parameters and functional interior lighting system components of the public educational institutions;
- Managing and reducing electricity consumption;
- Managing and reducing operational costs, maintenance and operation of the lighting system.
- Monitoring and measurement of energy consumption parameters.

The study analyzed 28 institutions: 10 kinder gardens, 10 schools and 8 high schools with a total of 438 classrooms and 5508 lamps (12 of 250 W; 32 of 160 W; 51 of 75 W; the rest with powers between 18 and 36 W). The aspects in Table 15 were taken into account:

Table 14 Aspects considered in the sustainable energy action assessment study for the indoor lighting in Giurgiu

Visual technical and economic performances	*Scope of installation*	*Parameters*
role of the room (space)	ensuring timely and correct perception of the visual task	average luminance
categories of visual work		uniformity of luminance
work places'distribution	balance of luminance in the room and at work	reflexion coefficients
quality specific conditions		color rendering index
quality of lighting conditions	accurate color reproduction	light direction
energy consumptions, investment and maintenance costs	good utilization coefficient for saving capital expenditure and operating	aspect of working surfaces
beneficiary's requests	users' safety	lighting factors' depreciation

The above aspects enable pupils to see easily and in comfort allowing them to perform their work efficiently without strain or fatigue. Calculations were performed for:

- The daily operation of lighting: Interior lamps: 4 - 9 h/day; Exterior lamps: 11 h/day;
- Annual lighting operation duration: 185 days /y;
- Electricity tariff (without VAT): 104,2 €/MWh;
- CO_2 electricity generation emission factor in Romania: 0,701 tCO_2/MWh

The results of the audit for the existing lighting sources are illustrated in Table 16 together with the proposed solution (replacing existing lamps with LED technology)

Table 15 Results of the audit of the existing lighting sources and proposed solution

	Present	*Proposed solution (replacement of old lamps with LED)*
Number of lamps (pcs)	5508	
Installed power (kWh)	305,3	142,2
Annual energy consumption (MWh/y)	325,1	147,9
Emissions CO_2 (tCO_2/y)	227,9	103,6
Annual costs (€/y)	40839	10793
Energy savings (MWh/y)		124,3
CO_2 emissions' reduction (tCO_2/y)		87,1
Costs' savings (€/y)		30.040
Investments (€)		400.066

Several options and scenarios were studied in the assessment study. The optimum solution is:

- installation of luminaires using LED technology, more efficient than the existing ones and the lighting performance meet the lighting regulations and standards in force;
- Installation of supporting luminaires;

Financial aspects

The financial indicators, taking into account a discount rate of 5% and an analysis period of 15 years are mentioned below:

- Payback period: 13,3 years;
- NPV: -150.541 (thd €);
- IRR: -3.1%

The financial indicators are not favorable; nevertheless the top management and the mayoralty have to decide whether they will be able to implement the project, taking into account the social and environmental aspects.

Socio-economic aspects

„Good lighting in a building provides sufficient light in the right place at the right time." From socio-economic point of view, the proposed solution has the following benefits:

- raising the quality of learning conditions in schools, in order to decrease the gap with developed countries;
- In addition, good lighting enhances the appearance of a space to provide a pleasant internal environment and can contribute to the creation of different atmospheres appropriate to different activities;
- supporting and fostering economic and social development of the City
- increasing civilization, comfort and quality of life;
- increasing individual and collective security in the schools;
- energy efficient and safe operation;
- achievement of a municipal infrastructure as a base for a socio-economic development.

Table 17 below summarises the results of the technical, financial, socio-economic and organisational analysis of the action entitled "Improvement the energy efficiency for inner lighting in schools - Giurgiu Municipality".

Table 16 Summary of the findings of the assessment study of "Improvement the energy efficiency for inner lighting in schools - Giurgiu Municipality"

Technical/ Environmental Assessment	**Title**	Improvement the energy efficiency for inner lighting in schools - Giurgiu Municipality
	Baseline scenario data (kWh, tCO_2, €)	325,1 MWh 227 tCO_2 40.839 €
	Technology employed	LED lamps
	Technology	Various (determined on bid demand)

	providers	
	Technical specifications	LED Lamps with installed power 10 - 100 W
	Energy savings	124,3 MWh/y
	CO_2 savings	87,1 tCO_2/y
Financial assessment	**Financing scheme**	• Variant 1 - Local budget (25% investments costs) & National/ European funds (75% investments costs) • Variant 2 - Possible financing through Norwegian funds
	Project cost	400.066 €
	Annual maintenance costs	12.202 €
	Annual project revenues	30.040 €
	Discount rate	5 %
	IRR (%)	-3,1 %
	NPV (€)	-150.541 €
	Payback period (years)	13,3 years
Organisational assessment	**Time-schedule**	6 months - the start of the action has not been established yet.