1.1.6 Street lighting - Kardzhali (BG)

Kardhali is a municipality of Rhodope Mountains located in South East Bulgaria, along Arda River valley at about 700-800 m above the sea level with 70.196 inhabitants. The municipality pursues a policy toward sustainable energy development and is participating in the Green Twinning project as a **twinning municipality of Rubi, Spain**. The municipality is **considering elaboration of a SEAP and joining CoM initiative soon**. The present **action "street lighting"** assessed in the framework of Green-Twinning project, is considered an important part of the municipal RE/EE policy and is expected to significantly contribute to SEAP targets as well as to local socio-economic development.

Technical aspects

Currently the municipal street lighting system consists of **9.000 street luminaries** (of which 6.328 mercury lamps and 2.672 sodium lamps) with a **total installed capacity of 980 kW** (of which mercury lamps: 716.5 kW and sodium lamps: 263,5 kW) and **3.920.000 kWh annual electricity consumption**. The **average annual bills** for street lighting of the municipality **amount to about 320.000 Euro**. The CO_2 emissions associated with this electricity consumption at the current electricity generation mix of Bulgaria amount to **2.176 tonnes CO_2/year**.

The present street lighting system is obsolete and often fails which results in lack of street lighting in some parts of the municipality and additional expenses for repairs and replacement of failed lamps. In addition the existing mercury vapour lamps are inefficient and consume about four times more energy per lumen of lighting flux compared to LED lamps. Given these consideration the municipal authorities decided to implement a sustainable energy action in Kardzhali concerning street lighting which includes:

a) a study which records the existing street lighting in the municipality and categorises roads by their use towards defining the appropriate lighting level,

b) use of LED lamps and control technologies for the reduction of light pollution and for implementation of dimming.

The SEAP action will be implemented in the entire municipality (**total surface of street lighting is 299.357 square meters**) and aims at achieving energy and cost savings, reducing light pollution, reducing criminality rate, improving the living comfort of the city and contributing to the CoM obligations.

The project consists of **replacement of the current mercury and sodium street lamps with the highly efficient LED lamps**. The **new installed capacity of LED lamps will be 324 kW instead of current 980 kW** due to much higher flux values of this technology per installed watt of capacity. Based on the characteristics of LED technology the expected energy savings of replacement of 6328 mercury lamps and 2672 sodium lamps with more efficient LED lamps is **2.672.000 kWh/year at 100 % illumination and about 4.000 operational hour/annum**.

The technology to be employed is well developed, reliable and there are suppliers available in Bulgaria.

Environmental aspects

The action will contribute significantly to the municipal targets for environmental performance by resulting in CO_2 emission reductions of 1.483 tonnes/year.

Financial aspects

The cash flow analysis at current conditions shows that project economic viability depends on the current status and conditions of the street lighting network. If there is a possibility to change only current lamps with the new LED lamps without replacing fixtures and lighting poles, then the project is economically viable with an **NPV of around 1 million Euro** and **discounted payback period of about 5 years**. The **IRR in this case is around 22%.** In case that the lighting fixtures and poles should also be replaced then due to the high costs of the works required and possibly redesign of the whole system, the financial results of the project drop significantly and the project is not financially viable.

Socio-economic aspects

The project is expected to improve the overall socio-economic welfare of the municipality through increase of attractiveness of the municipality for the young people by improving local living conditions, and thus combating the negative demographic trends. Other benefits include improvement effect on the local economy contributing to the local tourism as the project will create better comfort for tourists especially during winter season when significantly higher levels on street illumination are required.

The financial parameters are improved when taking into account socio-economic considerations as per the Guide to Cost Benefit Analysis of investment projects issued by the Directorate General Regional Policy of the European Union in July 2008 but still the variant with a complete replacement of system infrastructure (lighting fixtures and poles) is economically not viable at the current conditions.

Organisational aspects

The working team is cross-departmental and combines different skill (Figure 5).

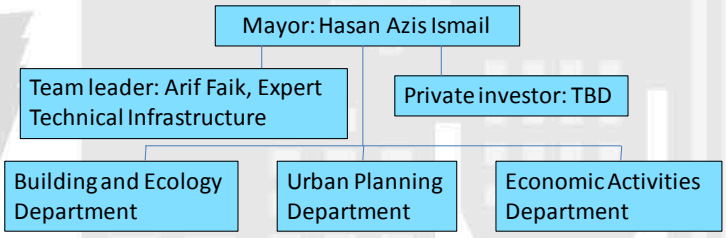

Figure 5 Project Organisational structure in Smolyan

The next steps of the project include decision of the Municipal Council in 2014 and announcement of a public procurement tendering procedure on the municipal web-site. The

project envisages a public-private partnership scheme and the intention of the municipality is a transfer of project construction and operation to a private investor using an ESCO scheme, while the Municipality retains the necessary steps for issuing and monitoring of different permits and regulation related to land usage, ecological and construction issues. This is considered as more risk-free scheme for the municipality. Therefore the monitoring of the construction will be assigned to the private investor and the experience of similar projects (eg. street lighting in L'Alcudia, Spain) shows that the private operator has a continuous real-time automatic control, monitoring and recording of the equipment and system operation parameters which is typical feature of modern street lighting technology.

Table 6 below summarises the results of the technical, financial, socio-economic and organisational analysis of the action entitled "Street lighting in Kardzhali".

Table 5 Summary of the findings of the assessment study of the action "Street lighting in Kardzhali"

Technical/ Environmental Assessment	**Title**	Street lighting in Kardzhali
	Baseline scenario data (kWh, tCO_2, €)	• 3 920 000 kWh/annum • 2 176 tonnes CO2/annum • 320 000 €
	Technology employed	LED lamps
	Technology providers	Various
	Technical specifications	30 W, 50 W, 70 W unit power Average efficacy 120 Lumens/watt, 15D beam angle, 60 000 hours average life
	Annual nergy savings	2.672.000 kWh/annum
	Annual CO_2 savings	1.483 tonnes of CO_2
Financial assessment	**Financing scheme**	EPC/TPF
	Project cost	• I scenario: 9.900.000 € • II scenario: 735.750 €
	Annual maintenance costs	-
	Annual project revenues	213 760 €
	Discount rate	10 %
	NPV (€)	• I scenario: a negative value • II scenario: 1 084 074 €
	Payback period (years)	• I scenario: N/A • II scenario: 5 years €
Socio-economic assessment	**Annual socio-economic benefits**	205.209€
	IRR	24%
	NPV	1.968.722€
Organisational assessment	**Time-schedule**	1/3/2014-1/6/2015