Baseline report

Street lighting in Gabrovo town

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1. Introduction

The main objective of this report is to analyze the potential for energy and O & M costs savings after implementation of a street lighting project.

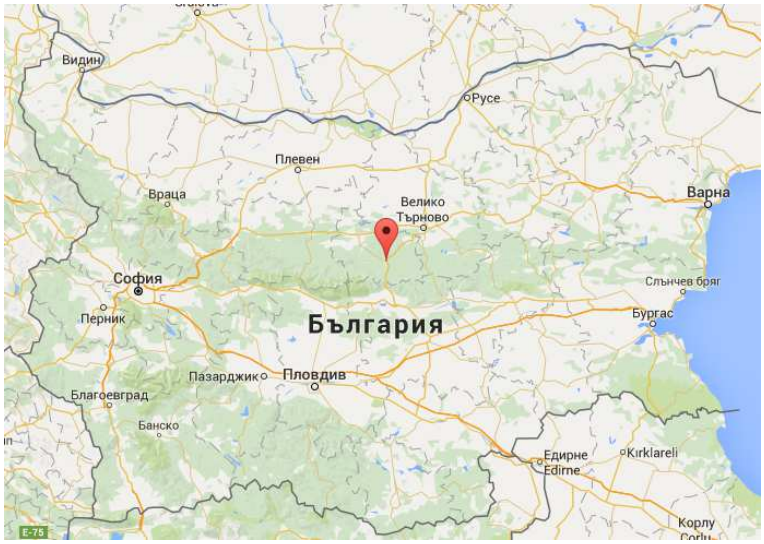
Team of experts visited the municipality and received initial information about the condition of the street lighting system, the current energy consumption and the O & M costs. Based on the provided data analyses and normalization of the current expenses were made. Pessimistic approach was used for the calculation of investments, savings and payback period.

During the submission of this report a detailed energy audit of the street lighting system including technical data for all lighting points, distribution boards and other components is under development. More detailed information about the existing condition, the needed investments and the expected savings will be presented in the audit.

2. Baseline

2.1. Gabrovo municipality

Gabrovo municipality is situated in the central part of Bulgaria. The strategic location of the town and its proximity to the geographic centre of the country define its significance as a transport junction. One of the most important road links passes through Gabrovo and it crosses Bulgaria from north to south. It is a part of trans-European transport corridor № 9 (Helsinki - St. Petersburg - Kiev - Bucharest - Ruse - Veliko Tarnovo - Gabrovo - Stara Zagora - Dimitrovgrad with diversions to Greece and Turkey).



The total population of the municipality is 65,268 inhabitants, whit 58,950 of them living in the town of Gabrovo. This report and the forthcoming energy audit will focus only on the street lighting system of Gabrovo town, and will not include the villages in the municipality.

2.2. Existing street lighting system

The municipality of Gabrovo was a leader in Bulgaria in the field of energy efficient street lighting. The project for implementation of the existing system was implemented in the period 1999 - 2003 with the first in Bulgaria centralized control system, managing a whole town based on FM radio signal. Currently the transmitters and receivers are worn out and some receivers in the existing distribution boards are decommissioned and automatic timers or light-sensible relays are installed. Although this type of control system is comparatively cheap solution it doesn't allow transmitting information from the distribution boards to the centralized control station.

The categorization of the street network and the photometric requirements for different streets were designed in accordance with *БДС 5504-82 Lighting of streets and pedestrian zones. Technical requirements.* However, in 2005 was issued a new standard *БДС EN 13201 Part 1: Selection of lighting classes and БДС EN 13201 Part 2: Street lighting. Technical requirements.* According to the requirements of the new standard streets and parks are classified with different types of lighting situations and depending on additional criteria various classes of lighting exist. These classes differ from the requirements of *БДС 5504-82*.

Currently the street, park and architectural lighting in the town is based mostly on high-pressure sodium lamps (HPSL) with a capacity of 50, 70, 100 and 150W. A significant part of the architectural lighting is based on halogen lamps, characterized with low energy efficiency and short life. Due to the long exploitation period the lighting fixtures operate with deformed light distribution curves

respectively low efficiency. At some points the regulated EU norms cannot be achieved. In general the existing lighting system uses out-of-date technology and is not in satisfactory condition.

Only small part of the lighting fixtures use LED technology.

Most of the distribution boards for the street lighting system are situated in the power substations. According to the Energy Law these substations are owned by the electricity supplier ENERGO-PRO. Thus the street lighting distribution boards should be removed and placed outside the ENERGO-PRO property.

The cable network is not in satisfactory condition. About 30% of the underground cable network is amortized and with problems in some phases of the 3-phase cables. At some places the underground cable is replaced with new overhead twisted insulated wires (pole mounted). On the other hand most of the cables are 3-phase and only one phase is in use. This enables in case of failure to easily replace with another phase from the same cable. The overhead cable network is based on non insulated cables. Only about 20 % of the overhead cables are replaced with more reliable twisted insulated cables.

The main parameters of the existing system, provided by the municipal experts are presented in Table 1. Currently this data is collected on site and may differ in the detailed energy audit.

TABLE 1. GENERAL DATA ABOUT THE EXISTING STREET LIGHTING SYSTEM IN THE TOWN OF GABROVO[1]

Parameter	Value	Unit
Installed capacity (incl. ballast)	501	kW
Operating hours	4100	h/yr
Electricity consumption	2,325,363	kWh/yr
% non functioning	5	%
Total number of luminaries	**6008**	pcs
- *street lighting*	***4333***	*pcs*
- *park lighting*	***1106***	*pcs*
- *architectural lighting*	***569***	*pcs*
Total number of poles	**5246**	pcs
Total number of distribution boards	**250**	pcs
Cable network	**104**	km
- *underground*	***54***	*km*
- *air*	***50***	*km*

2.3. Current energy consumption and expenses

Table 2 presents the annual energy consumption as well as the O & M costs for the lighting system in Gabrovo town for 2015.

[1] The presented data is based on interviews with the municipal experts. Exact number will be determined during the onsite data collection.

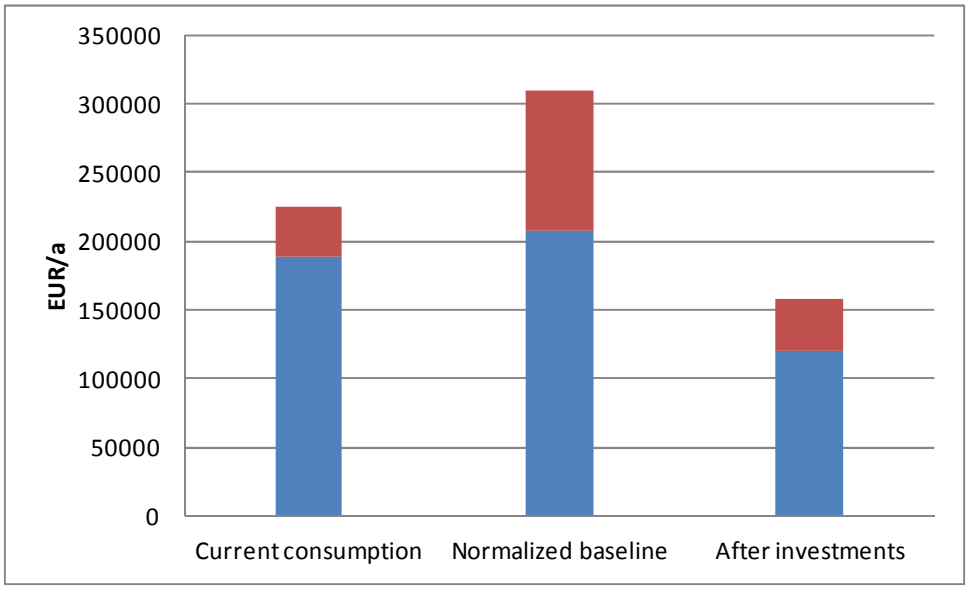
TABLE 2. ANNUAL ENERGY CONSUMPTION AND EXPENSES

Year	Electricity		O&M	Total
	kWh/yr	EUR/yr	EUR/yr	EUR/yr
2015	2,202,909	188,649	36,097	**224,746**

2.4. Baseline of the energy consumption

The results from the preliminary analyses of the actual and normalized energy consumption as well as the expected energy consumption and O&M costs after project implementation are presented in Figure 1.

FIGURE 1. COMPARISON BETWEEN THE ACTUAL CONSUMPTION, THE NORMALIZED CONSUMPTION AND EXPECTED CONSUMPTION AFTER PROJECT IMPLEMENTATION



The normalized baseline is estimated in accordance with the Bulgarian legislation. EnEffect calculated the energy needs and the O&M costs needed to maintain the required lighting parameters with the existing system in the whole town. In case new lighting points in new neighborhoods must be installed and this is determined during the detailed energy audit, the normalized baseline, respectively the consumption after the investments will increase.

3. Project description

3.1. Recommendations

3.1.1. Replacement of the existing lamps with new LED ones.

The following advantages of the LED luminaries are taken into consideration:

- Reliability and extremely long service life over a wide temperature range - the average life of LED luminaries is over 50,000 hours;
- High light output - 100 ÷ 150 lm/W;

- Unlimited possibilities for dynamic dimming;
- Reach their nominal luminous flux immediately;
- The life of the LEDs is not affected by the number of ON and OFF switching;
- Low O&M Costs during the whole life of the luminaries;
- Resistant to vibrations and shocks;
- A small reduction of the luminous flux over time;
- Emitting in a wide range of the visible spectrum of light and good color rendering index;
- Compact size;
- Environmentally friendly, does not contain toxic chemicals such as mercury or other harmful emissions.

The new LED lamps will be with capacity of 25, 35, 45, 80 and 140 W.

3.1.2. Replacement of the existing distribution boards and implementation of a new control system

The new distribution boards will be situated outside the power substations. All boards will be equipped with new energy meters, controllers with standard interface and GPRS transmitters.

The new control system (based on the above mentioned equipment) will send information to the control station in real time. In case of irregularities during operation, alarm signals can also be transmitted. These functions will allow real time monitoring of the current consumption and in case of failure, theft or other critical circumstances the operator will be able to react immediately.

3.1.3. Replacement of arms and poles

Although only one illuminator is needed at some poles, the old double arms are still existing. At such poles new single arms will be installed. During the detailed energy audit the places where arms and poles need replacement will be described in details.

3.1.4. Cable network repairs

For the purposes of this report it is envisaged to replace about 80% of the existing overhead pole mounted network and about 30% of the existing underground network.

3.2. Project costs

Breakdown of the needed investments for the project implementation is presented in Table 3.

TABLE 3. BREAKDOWN OF INVESTMENTS

Parameter	Value, EUR
Replacement of lamps	1,525,000
Distribution boards and control system	766,938
Replacement of arms and poles	15,339
Cables network reconstruction	139,626
Total investments	**2,691,593**

3.3. Expected results

The expected results based on the preliminary assessments of possible energy efficiency measures are presented in Table 4. Values may vary after development of the detailed Energy Audit. For the

calculation of the payback period the needed investments are divided by all monetary savings coming from the reduction of energy consumption and O & M costs.

TABLE 4. EXPECTED RESULTS

Parameter	Value	Unit
Electricity savings	1,026	MWh/yr
Electricity savings	87,820	EUR/yr
O&M costs savings	64,238	EUR/yr
Total savings	**152,058**	**EUR/yr**
CO_2 emission reduction	840	tCO_2/yr
CAPEX	**2,691,593**	**EUR**
Payback period	**17.7**	**year**

4. Conclusions

Pessimistic approach was used during the calculation of the potential energy savings. Based on the more detailed analyses of the existing situation and project parameters, more accurate data will be presented in the detailed energy audit.

Currently the O&M costs includes only urgent repairs done with minimum investments, which reflects on the poor condition of the cable network, the poles and arms and the control system.

After the project implementation the obligation of the municipality (Energy law dated 05.03.2004) to remove the street lighting distribution boards from the power substations owned by the electricity suppliers will be fulfilled.

Other indirect benefit after project implementation will be the improved view of some poles and arms that will be replaced or repaired.

The municipality has intention to install new decorative poles in the central part of the town. These investments are currently not included in the analyses.

The investments in cable network repairs may not be acceptable by a potential private investor and the municipality may need funding to co-finance this activity.