

**TERMS OF REFERENCE**  
**DEVELOPING OF FEASIBILITY STUDIES AND DETAILED DESIGNS FOR**  
**IMPROVEMENT OF STREET LIGHTING LEADING TO ENERGY EFFICIENCY IN FOUR**  
**MUNICIPALITIES IN NORTH MACEDONIA**

**I. Background**

The global commitment to environmental protection and to reduction of greenhouse gas emissions, North Macedonia's dependence on energy imports, as well as the need to secure greater variety and thereby reliability of energy supply undoubtedly impose increased share of renewable energy sources in the final energy consumption. However, in parallel with activities and measures targeting increased share of renewable energy sources, measures and activities to increase energy efficiency of final energy consumption should be pursued. Thus, the target share of renewable energy sources in final consumption will be achieved much easily and faster, but the economy's competitiveness will also be improved due to reduced energy costs.

In partnership with the World Bank, Republic of North Macedonia intends to implement the Public Sector Energy Efficiency Project. The project development objectives are: (i) reduce energy consumption in the municipal sector; and (ii) support the establishment and operationalization of a sustainable financing mechanism for the public sector. The project will be supported by a €25 million equivalent IBRD loan, to support energy efficiency investments in public buildings and policy/TA to help set-up and operationalize an energy efficiency revolving fund. Physical investments will be needed to help develop the market for energy efficiency materials and services, while a transition plan is developed to move from the proposed Project Implementation Unit (PIU) structure to a more sustainable and permanent, independent fund.

The Project would include three components: (1) energy efficiency investments in the municipal sector; (2) technical assistance (TA) and project implementation support and (3) establishing of Energy Efficiency Fund.

The sub-component 1c (Technical studies to support investments) of the project would include consultancies to support the investment component, including development of detailed energy audit reports and detailed designs and technical specifications, as well as supervision over the works. It would also include technical assessments needed for adequate disposal of any hazardous materials from the renovations as well as their actual disposal and a pre-and post-renovation building occupant satisfaction surveys. Consultants will be selected in accordance with the Consultant Qualification Specification (CQS) which will be conducted according to the World Bank's Procurement Regulations for Investment Project Financing (IPF) Borrowers 'Procurement in IPF, Goods, Works, Non-Consulting, and Consulting Services' (Procurement Regulations) dated July 2016, revised November 2017 and August 2018, under the 'New Procurement Framework (NPF)'; the 'Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants', dated October 15, 2006 and revised on July 1, 2016; and other provisions stipulated in the Financing Agreements.

## II. Objectives

- To provide lighting to the streets such that minimum possible power is consumed during night and at the same time observing all the lighting and technical characteristics for that type of street.
- Provide safer, comfortable, more convenient, efficient movement of vehicles and pedestrians at night time, urban street lighting as well as pedestrian's areas.
- Replacement of the conventional head with head with LEDs lamps
- Provide possibility to install Zhaga or Nema socket or equivalent, to provide an electrical and mechanical connection between the control cell and the luminaire for intelligent street lighting
- Achieve best energy savings in street lighting

The main objectives of this assignment are:

- (a) improving the street lighting with energy efficient measures in the municipalities of Demir Kapija, Rankovce, Debrca and Lozovo by preparing feasibility studies for street lightning
- (b) enlarging the street lightning network needed in the municipality of Demir Kapija, by preparing a detailed electrical design and feasibility study for enlarging the existing electrical street lightning network.

The feasibility studies shall be based on the critical need for improving the existing street lightning network in a way that minimum possible power is consumed during nights in order to have safer, comfortable, more convenient, efficient movement of vehicles and pedestrians at night time by implementing energy efficient measures leading to lowest financial costs. The consultant is obliged to check the existing inventory in cooperation with the municipality. The same in the Feasibility Study should determine the reference value and consumption of electricity which is the basis for calculating energy savings. It should be adopted by the Municipal Council.

The Feasibility studies should also provide information for replacing conventional lamps with power LEDs in the lightning system that will work independent from the electricity network by own PV panel (off-grid) in the Municipalities of Lozovo, Rankovce, Debrca and Demir Kapija.

For municipality of Demir Kapija, the Feasibility study should also provide information for the type of street lightning poles and lights, which will be base for preparing the detailed electrical design.

The Consultant is obliged to provide technical revision of the detailed electrical design, which will be done by independent legal entity that poses valid license for revision of technical documentation according to the Macedonian law on construction and other Macedonian legislation (all relevant laws and by-laws).

## III. Scope of work

The Consultant will be responsible for preparing Feasibility Studies, Energy Saving and Cost Benefit Analyses and Detailed Designs in the following areas:

- **Municipality of Lozovo**

Village Lozovo (st. Avnoy, st. Asnom, st. Bratsvo- Edinstvo, st. Vasil Glaviniv, st Vladimir Ili4 Lenin, st. Zeleznicka, st. Ivo lola Ribar, st. Ilindenska, st. Jane Sandanski, Koraza, st. Kole Nedelkovski, st. Kocho Racin,

st. Marko Cepenkov, st. Marshal Tito, st. Oktomvriska Revolucija, st. Pitu guli); Village Milino; Village Dorfulija; Village Karatmanovo; Village Adzimatovo; Village Saramzalino; Village Guzemelci; and Village Koseleri.

- **Municipality of Demir Kapija**

Ring road; New Bridge and Street 3; City Park; st. [October 11](#); st. Prvomajska (boulevard of wine); and st. Ilindenska.

- **Municipality of Debrca**

All settlements in the Municipality – Arbinovo; Belchishta; Botun; Brezhani; Velmej; Volino; Vrbjani; Godivje; Gorenci; Gorno Sredorecie; Grko Pole; Dolno Sredorecie; Zlesti; Izdeglavje; Klimestani; Laktinje; Lesani; Meseista; Mramorec; Novo Selo; Ozdoleni; Orovnik; Pesocani; Slatino; Slatinski Ciflik; Slivovo; Sosani; Trebenista; Turje; and Crvena Voda.

- **Municipality of Rankovce**

All settlements in the Municipality – Baratlija; Vetunica; Vrzogrnici; German; Ginovci; Gulinci; Krivi Kamen; Ljubinci; Milutinice; Odreno; Opila; Otosnica; Pkliste; Petralica; Psaca; Radibus; Rankovce and Stanca.

The scope of work will include:

### **TASK 1 Feasibility Studies and Cost Benefit Analyses for Lozovo, Demir Kapija, Debrca and Rankovce**

#### **Sub-task 1.1 Feasibility Studies (FS)**

The Consultant shall review existing background information and obtain relevant guidance from municipalities, in order to start the preparation of the Feasibility studies. This background information should be complemented by field visits to assess current infrastructure and operating conditions, map out the existing street lighting system and confirm the list of inventories for street lighting provided by the municipalities. The Consultant will closely work with the Municipalities and PIU to coordinate with relevant department(s) to facilitate the field visits.

The consultant shall also clarify the current (without project) context of the street lighting system, including the energy balance of the system (for each type of technology), electricity and O&M costs, inventory and quality of lighting equipment, as well issues related to current service levels (e.g. quality of light; consistency of light, lamp failures, coverage) and as compared to relevant national norms.

The Consultant shall review invoices and bills of electricity consumption for street lighting for the past 3 years. Additional information on existing service levels, past upgrades, should be considered. In this line, the Consultant shall calculate the CO2 emissions trend in the past 3 years.

The Consultant shall propose options to establish electricity consumption baselines for energy efficiency street lighting system.

The current baseline against which the performance of the energy efficient project will be assessed, as well as key parameters, should include (not limited to, more detailed list of key parameters is presented in Annex 1 to the ToR):

- *Inventory of different types of lamps to be replaced, including their rated capacities, efficacy (lumens/Watt), lifetime (hours), lamp and fixture types, ballast capacity/type, etc.*
- *Description of the type of road as well as dimensions.*
- *Street light power consumption (kWh per year)*

- *Average power consumption per light point*
- *Street light operation (hours per day/year)*
- *Energy and O&M costs per year; electricity use should be based on actual bills for the past 3 years*
- *Average illumination levels in each street of the municipality (in lux) according to the classified types of streets*
- *Density of electric power for lighting (DPEA) W/m<sup>2</sup>*
- *A drawing for installing solar powered LED lamps (off-grid), for integrated and split-type, adaptive lighting options (remote control and monitoring systems, dusk to dawn, dimming, light and motion sensors, control accessories, etc.)*
- *Lighting design drawings with photometric plan;*
- *Compliance with street lighting national and local norms*

The Consultant shall also evaluate the current users' satisfaction level from the existing street lighting system, by proposing specific questionnaire and methodology. While taking into account the voltage and pre-voltage protection when proposing the new solution.

### **Sub-task 1.2 Cost Benefit Analysis of the Feasibility study (CBA)**

Based on the analyses of the baseline information and data collected in Sub-task 1.1 and assessment of current infrastructure and operations' conditions from the field visit, the Consultant will consider and identify technically viable EE measures/options and, for each one, calculate the investment needed, annual energy consumption, life-time maintenance costs and energy/O&M cost savings. Simple payback period shall be calculated also considering the number of households, projected electricity price and projected tariff levels.

For the assessment of EE potential, the Consultant should consider all likely EE measures including: lamp replacement (with higher energy efficiency technology, such as LED and metal halide); replacement of fixtures (including replacement of ballasts, reflectors, etc.); redesign of system (including number, height and spacing of poles); control systems (e.g., dimmers), and other options as appropriate. The assessment should include list of options considered, relevant costs and financial information for each, indicate which options were not considered for technical reasons, and include a separate summary table of options. The financial analyses should also specify all assumptions used (electricity costs, electricity tariff, technology costs, equipment lifetime, hours of operation, grid emissions factor, inflation rate, etc.).

### **Sub task 1.3 Public presentation of the FS & CBA and selection of measures**

The Consultant shall be responsible for presenting the outputs of the FS&CBA to the Municipal Councils and User Committees, explaining the investment cycle for the street lighting and energy efficiency improvements.

Upon approval of the Draft Feasibility Study and CBA by the PIU, the Consultant shall conduct a public presentation in each of the four municipalities, explaining the current baseline conditions and list of possible measures for improvement, analyzing the financial costs and benefits including any corrections to the current tariffs for the households.

The Consultant shall provide any additional feed-back and response to the raised questions and carry out certain amendments to the FS&CBA, if required. Final Minutes from this public presentation of the FS&CBA shall be submitted to the PIU.

Based on the selection of the measures for improvement of street lighting in the Municipalities of Lozovo, Rankovce and Debrca, the Consultant shall prepare a final Conclusion with Bill of Quantities and price cost estimates, to be delivered to the municipalities for their preparation of the tender documentation for implementation of the investment measures.

During preparation of the final Conclusion, the Consultant shall also prepare an Environmental and Social Management Plans (ESMPs) for the implementation of the investment projects. The Consultant shall support the municipalities in their public consultation process, if needed.

The ESMPs shall be available for a 30 days period for public consultation, ending up with a Public Meeting. The Consultant shall submit Minutes, photos and List of participants from these Public Meetings to PIU. The Consultant shall consider and incorporate the relevant comments from the public regarding the ESMPs.

The outline and content of the ESMP for improvement of street lighting is presented in Annex 2 of this ToR.

### **Outputs of task 1**

<b>Task 1</b>	<b>Deliverables</b>
Lozovo	Feasibility Studies and CBA Bill of Quantities with price cost estimates ESMP
Demir Kapija	Feasibility Studies and CBA
Debrca	Feasibility Studies and CBA Bill of Quantities with price cost estimates ESMP
Rankovce	Feasibility Studies and CBA Bill of Quantities with price cost estimates ESMP

### **TASK 2 Detailed Design for Municipality of Demir Kapija**

The Consultant shall prepare revised Detailed Design of the selected options and measures from Task 1. This Detailed Design must include but no limited to:

- lighting design drawings with photometric plan;
  - electrical system design drawings;
  - electrical control system design drawings;
  - street lighting control system design drawings (remote control and monitoring systems, control unit and feeder pillars, control accessories, etc.);
  - a design drawing for installing lamp poles in the ground and digging trenches for installing electrical cables for the lighting systems - on-grid;
  - a design drawing for installing solar powered LED lamps (off-grid), for integrated and split-type, adaptive lighting options (remote control and monitoring systems, dusk to dawn, dimming, light and motion sensors, control accessories, etc.)
  - a design justification; and
  - a concise report on the estimated cost.
- Electrical power supply:
  - Electrical power supply for the lighting systems to be designed for the alley and street lines

(source, phases, overhead lines or underground lines etc.);

- Survey of ground structures to plan for civil works needed for fixing lamp poles in the ground and for drawing underground electrical cables for lighting systems;
- Voltage and pre-voltage protection are to be provided on the appropriate lines and measuring points or on the lamps themselves

All necessary details in textual and graphical part in accordance with the national laws and by laws.

The locations are presented below in the table.

#### Locations for Municipality of Demir Kapija

#	Location	Length/ meters
1	Ring road	1,891
2	New Bridge and Street 3	410
3	City Park	950
4	St. October 11	438
5	St. Prvomajska (boulevard of wine)	968
6	St. Ilindenska	136
7	St. Goce Delchev	63

During preparation of the Detailed Design, the Consultant shall also prepare an Environmental and Social Management Plan (ESMP) for the implementation of the investment project and support the municipality in its public consultation process, if needed. The ESMP shall be available for a 30 days period for public consultation, ending up with a Public Meeting. The Consultant shall submit Minutes, photos and List of participants from this Public Meeting to PIU. The Consultant shall consider and incorporate the relevant comments from the public regarding the ESMP.

The outline and content of the ESMP for improvement of street lighting is presented in Annex 2 of this ToR.

#### Outputs of task 2

Task 2	Deliverables
Demir Kapija	Detail Electrical Design
Demir Kapija	Technical review of the Detailed Electrical Design
Demir Kapija	ESMP

## IV. Main Deliverables, Duration and payment method

### ➤ *For compliance of the assignment the main deliverables are:*

1. Three (3) copies in A4 format of the feasibility study for improving of existing street lightning network with energy efficiency street lightning network in the municipality of Lozovo, printed and folded in A4 format and one digital copy.
2. Three (3) copies of the feasibility study for improving of existing street lightning network with energy efficiency street lightning network in the municipality of Rankovce, printed and folded in A4 format and one digital copy.

3. Three (3) copies of the feasibility study for improving of existing street lightning network with energy efficiency street lightning network in the municipality of Debrca, printed and folded in A4 format and one digital copy.
4. Three (3) copies of the feasibility study for improving of existing street lightning network with energy efficiency street lightning network in the municipality of Demir Kapija, printed and folded in A4 format and one digital copy.
5. Three (3) hard copies of the detailed electrical design for extending the existing street lightning network in the municipality of Demir Kapija, printed and folded in A4 format and one digital copy.
6. Three (3) hard copies of the technical review of the detailed electrical design for extending the existing street lightning network in the municipality of Demir Kapija, printed and folded in A4 format and one digital copy.
7. One (1) hard and one digital copy of the FS&CBA Public Presentation for each of the four municipalities, Minutes from the Public Presentation Meeting including photos and List of participants.
8. One (1) hard and one digital copy of the final ESMP for each of the four municipalities, Minutes from the ESMP Public Consultation Meeting including photos and List of participants.

All digital copies should be signed and stamped according to the national laws and by-laws.

➤ ***Duration period for compliance of the assignment and payment method***

The Duration period of the assignment is estimated 90 days and the payment's method is presented in table below:

Complete documentation for the Municipality of Lozovo (Feasibility study for energy efficiency street lightning )	<b>20%</b>
Complete documentation for the Municipality of Debrca (Feasibility study for energy efficiency street lightning )	<b>20%</b>
Complete documentation for the Municipality of Rankovce (Feasibility study for energy efficiency street lightning )	<b>20%</b>
Complete documentation for the Municipality of Demir Kapija (Feasibility study for energy efficiency street lightning, detailed electrical design for extending the street lightning network, technical review of the detailed electrical design for extending the street lightning network)	<b>40%</b>

## Experience and Qualifications of the Consultant

### **Consultant company qualifications and relevant experience**

The Consultant should be a consulting firm with relevant experience according to the requirements of this Terms of Reference. Interested consultant companies should provide detailed information, demonstrating that they have the required qualifications and relevant experience to perform the services. The Consultant has to deliver detailed portfolio of his past and completed experience in relevance of the scope of the services (Preparation of Feasibility studies and \_Preparation of detailed electrical designs for

street lightning)

**General Experience:**

- 1.** The Consultant company must have at least 5 years of professional experience in preparation of Feasibility studies , as well as experience in preparation od detailed electrical designs for street lightning, relevant for the scope of work references.

**Financial Situation and Performance:**

- 1.** The average annual turnover of the Consultant must exceed 200.000 EUR for the last 3 financial years each (2019, 2020 and 2021)

**Specific Experience:**

- 1.** The Consultant Company shall have a record of minimum 3 Feasibility studies of comparable relevance and scale<sup>1</sup>. At least one of these three reference documents must be specifically for street lighting establishment/ improvement.
- 2.** License for Design of I category of buildings (License A), issued by the Ministry of Transport and Communications of RNM or ability to obtain verification of foreign Licenses for design as per Construction Law of RNM. In case of JV - at least one of the members in the JV must obtain valid company license.
- 3.** At least 10 permanent staff working for the Consultant.

**Staff requirements and relevant experience**

The scope of work for this assignment requires a team of skilled professionals with previous experience in similar projects.

It is expected that the Consultant company will provide a team of experts with experience in similar activities and work under similar conditions and constraints, with specific professional certifications and authorizations for the services provided in the project, required by the legal framework in the Republic of North Macedonia. The core team will consist of key-experts supported by a subsidiary team of non-key experts, which the Consultant company can draw upon when needed.

No.	Team of key members and/or areas of expertise	Qualification requirements
1.	Team Leader – Project Manager	The Team Leader will be tasked with the overall coordination of the assignment, provision of technical documentation and delivery of activities within the budget and time limits contracted, and will also

<sup>1</sup> A list of these feasibility studies and detailed electrical designs for street lightning must be submitted with the proposal, including contact details for reference checking purposes (e-mail addresses and/or telephone numbers for contact persons – see Annex 2), supported by letter for successful completion



		<p>actively participate in the preparation of feasibility studies/detailed designs. He/she will be the main contact person of the Consultant company and interface with the Client Coordinator. He/she will develop the work plan, manage deliverables, identify required expertise and allocate tasks.</p> <ul style="list-style-type: none"> <li>• University degree in <b>Architecture or Electrical Engineering (MSc/Phd degree is an asset)</b></li> <li>• Authorization A for preparation of technical documentation.</li> <li>• At least 5 years of experience in preparation of feasibility studies of comparable relevance and scale/similar public projects with comparable nature with the assignment.</li> <li>• Record of at least 3 relevant completed feasibility studies of comparable relevance and scale/similar public projects with comparable nature with the assignment. (please indicate the e-mail addresses or telephone numbers of contact persons).</li> <li>• Proven experience in work with local, governmental or international institutions would be an asset</li> </ul>
2.	<b>Key-expert 1: Architect</b>	<p>He/she will be responsible for preparation of the feasibility studies, , will be nominated as responsible designer and, hence, will be also in charge of bill of quantities and cost estimates.</p> <p>The minimum necessary qualification for the Architect:</p> <ul style="list-style-type: none"> <li>• University degree in <b>Architecture</b></li> <li>• Minimum of 5 years of relevant work experience in the area of expertise;</li> <li>• Authorization A for preparation of technical documentation in the field of Architecture;</li> <li>• Record of at least 3 relevant completed feasibility studies. (please indicate the e-mail addresses or telephone numbers of contact persons).</li> </ul>
3.	<b>Key-expert 2: Electrical Engineer</b>	<p>He/she will be responsible for the preparation of the detailed electrical design for street lightning, will be nominated as responsible designer and, hence, will be also in charge of bill of quantities and cost estimates.</p> <p>The minimum necessary qualification for the Electrical Engineer:</p> <ul style="list-style-type: none"> <li>• University degree in <b>electrical engineering;</b></li> <li>• Minimum of 5 years of relevant work experience in preparation detailed electrical designs for street lightning;</li> <li>• Authorization A for preparation of technical documentation in the field of electrical engineering;</li> <li>• Record of at least 3 relevant completed detailed electrical designs for street lightning with comparable nature with the assignment. (please indicate the e-mail addresses or telephone numbers of contact persons).</li> </ul>
4.	<b>Key-expert 3: Economist</b>	<p>He/she will be responsible for the preparation of economic and cost benefit analysis for the feasibility studies.</p> <p>The minimum necessary qualification for the Economist</p> <ul style="list-style-type: none"> <li>• University degree in <b>Economy</b></li> <li>• Minimum of 5 years of relevant work experience on preparing cost benefit analysis to be evidenced by listing of projects titles and contact persons;</li> </ul>

		<ul style="list-style-type: none"> <li>• Minimum 3 developed financial analysis, with operational and maintenance costs and pay-back periods for public infrastructure projects;</li> </ul>
5.	<b>Key-expert 3: Environmental expert</b>	<p>He/she will be responsible for the preparation of environmental management plans in the feasibility studies.</p> <p>The minimum necessary qualification for the Environmental expert:</p> <ul style="list-style-type: none"> <li>• University degree in natural sciences, electro/mechanical engineering, architecture/construction or environmental engineering</li> <li>• Relevant work experience on preparing of minimum 3 environmental studies/experience on preparing environmental analysis in feasibility studies on public infrastructure projects;</li> <li>• Certificate for environmental impact assessment issued by the Ministry of Environment and Physical Planning;</li> </ul>
6.	<b>Key-expert 6 Social expert</b>	<p>He/she will be responsible for the preparation of the social management plans in the feasibility studies and organizing of the public consultation.</p> <ul style="list-style-type: none"> <li>• University degree in social sciences or similar</li> <li>• Relevant work experience in preparation of Social Assessment studies/reports/elaborates for minimum 3 construction projects</li> </ul>

**NOTES:**

- 1) The Consultant company can submit CVs of all key-experts in order to confirm the availability of the key experts. Note : the CV's of the key experts shall not be evaluated at the current stage of the process.
- 2) The Consultant company needs to foresee additional technical engineering staff as Non-key experts for successful completion of the assignment. They will not be evaluated but the consultant should plan them accordingly.
- 3) Authorizations for preparing the technical documentation must be issued by the Chamber of Authorized Architects and Authorized Engineers of the Republic of Macedonia, according to Art. 33 of the Law on construction (O.G. of RNM, No. 130/09) and must be members of the Chamber of Authorized Architects and Authorized Engineers of the Republic of Macedonia. All relevant information concerning membership, authorization etc., can be found on [www.komoraoui.mk](http://www.komoraoui.mk)

## Annex 1 - Contents of Feasibility Study for Modernization / Reconstruction of Public Street Lighting

I.2. Analysis of possible models of financing, construction, maintenance and development of public lighting  
I.3. Determining the subject and scope of the reconstruction of public lighting  
I.4. Identification of project weaknesses and their elimination and reduction  
I.5. Social, political and other issues related to the project  
I.6. Issues related to supervision and control in the investment and operational period

### I. GENERAL PART

I.1. Legal basis for awarding of contract for public lighting reconstruction  
I.2. Analysis of possible models of financing, construction, maintenance and development of public lighting  
I.3. Determining the subject and scope of public lighting reconstruction  
I.4. Identification of project weaknesses and their elimination and reduction  
I.5. Social, political and other issues related to the project  
I.6. Issues related to supervision and control in the investment and operational period

### II. TECHNICAL ANALYSIS

II.1. Description of the existing public lighting (PL) system

II.1.1. Technical description of the equipment and system for PL

Exact number of lights, poles and cabinets

- Cabinets for power supply, management and measurement of energy consumption, their position in relation to the physical location (inside or outside the substation);
- Street lights by type and power;
- Lights for school yards lighting, and
- Lights for playground lighting etc.

Outside the scope of the feasibility study:

- Power supply cables for lights (from switch cabinets to lights);
- Poles, their distance from each other, as well as determining the voltage conditions of end poles from the street lighting network. (is voltage drop within permitted limits).

II.1.2. Photometry of the existing system

To compare the existing light level or illuminance with EN 13201-2: 2015 standard. The EN 13201-2: 2015 standard is a European standard that defines lighting classes according to street types (main intersections and streets, side streets and most remote streets in peripheral parts of the municipality), in rural areas as well as.

For each class, the public lighting system must provide a minimum illumination in candela (cd/m<sup>2</sup>) or lumen (lm) according to standard and minimum lamp life.

II.2.1. Economic and financial parameters of the existing public lighting (PL) system.

Determining the current state of energy consumption for street lighting based on electricity bills

II.3.1. Determining the need for introduction of energy efficiency, and proposals for modernization of the public lighting system

II.4.1. Description of measures and assumptions

The main goal of the reconstruction of the street lighting system is:

- Providing a quality street lighting system according to the standards for quality of lighting of streets and

other public areas;

- Maximum energy efficiency and minimization of other maintenance costs.

The energy efficiency of the system is achieved with:

- Selection of lights with higher efficiency, i.e. lower power, and the quality of the offered lights and light levels should meet EN 13201 -1, 2,3,4,5 standards

- Selection of smart lights that will have the ability for automatic dimming in periods of reduced frequency of traffic and pedestrians aligned with the needs of the municipality;

- Precise control of turning on and off of the lights (with smart controllers with built-in astronomical time calendar and / or photo-relays in the control cabinets);

- Measuring the consumption at cabinet level and preventing unauthorized use of electricity by illegal connections;

- Planning of dislocation of all switch cabinets outside EVN substations.

II.4.1.1. Option 1 - investment and maintenance with components in the scope of: lights, cabinets, management and control, (basic automation in the management of astronomical time-relay and / or photo-relay. The new LED lights should be equipped with a connector for the "Smart city" network in accordance with the DALI 2.0 management protocol in compliance with standard IEC 62386- version 2, replacement of existing lights with new LED lights according to a light for a light principle);

II.4.1.1. Option 2 - investment and maintenance with components of the scope of lights, cabinets, monitoring system, management and control with installation of Smart Analyzer and Smart IoT controller in each cabinet, call center operation and establishing of a 48 hours system. The new LED lights should be equipped with a connector for the "Smart city" network in accordance with the DALI 2.0 management protocol in compliance with standard IEC 62386- version 2, replacement of existing lights with new LED lights according to a light for a light principle). Integrated software solution for monitoring and remote control and control of the street lighting system on the territory of the whole municipality located on a cloud, which would include a communication protocol between each individual cabinet/light and the monitoring center.

For each of the envisaged options, investments should be calculated for the replacement of the existing lights with new LED lights according to the light for a light principle, as well as ensuring the independence of the system by placing the management, control and protection equipment in separate cabinets outside EVN substations.

II.5. Defining technical requirements for modernization and measures for development of the public lighting system

II.5.1. During the preparation of the feasibility study, apart from determining the light level for each street in accordance with the light-technical requirements, the minimum power of the light that meets those requirements should be determined as well.

II.5.1.2. The proposed light type should meet the following standards:

- The light source should meet the European regulations 874/2012 (for energy marking of the light source) and 1194/2012 (for eco design, direction of light and connecting equipment);

- Lights testing standard: IEC 60598-2-3;

- ENEC standard which confirms that the tests and certificates are performed according to the EU standards.

II.5.2.1. Analysis of characteristics for light selection and specific indicators, factors and parameters (definitions)

○ Quality standards and criteria (ENEC, EN 13201-1,2,3,4,5);

○ Energy efficiency of LED lights: minimum 120 lm/W at color temperature  $T = 4000\text{K}$ ;

○ Power factor:  $\cos \varphi \geq 0.9$  at full light power,  $\cos \varphi \geq 0.8$ , at 50% light dimming;

○ Color temperature: 4000K;

- Color rendering index: Minimum CRI (Ra) ≥ 80;
  - Light pollution: ULOR = 0%;
  - Intensity class, glare: Class G4 or higher;
  - Protection degree IP 65 or higher, degree of mechanical protection IK 08 or higher;
  - Degree of electrical protection: Class II;
  - Surge protection: 10 KV for the installation and 4 KV for on the light source (LED chip);
  - Lifespan: minimum 100 000 working hours at 25° C for the light source (Luminaire lifetime) and for the driver (control gear lifetime) meeting standard L80/B10 (light flux after 100 000 working hours should not fall below 80%, and the number of defective lights prior to the expiration of the warranty period should not exceed 10%);
- When preparing the Feasibility Study, the procedure for determining the light level should be explained in detail, i.e. each abbreviation or designation for physical measurements, as well as the definitions on used physical measurements should be explained.

### II.5.3. Environmental Impact Analysis

II.5.3.1. Analysis of adverse effects on the environment;

II.5.3.2. Measures to reduce the environmental impact of the project;

II.5.3.3. Plan regarding the manner and procedure for removal and storage of existing lights and electrical equipment.

## III. FINANCIAL AND ECONOMIC ANALYSIS

### III.1. Cost-benefit analysis

III.1.1. Analysis of annual cost projections for each of the Options and return on investment time and period of operation

III.1.2. The economic analysis for replacement of lights needs to define

III.1.2.1. Technical parameters

- Existing bulbs with (power- [W]; consumption - [kWh/ann.]; and service life - Hours)
- Replacement light ((power- [W]; consumption - [kWh / ann.]; and service life - Hour)

III.1.2.2. Economic parameters

- Existing bulbs (electricity consumed ([EUR (MKD)/ann.); maintenance costs [EUR (MKD)])
- Replacement light (initial investment [EUR (MKD)]; amount of energy consumed [EUR (MKD)/ann.]; and maintenance costs [EUR (MKD)])

III.1.3. Annual revenue projection analysis

III.1.3.1. Profitability analysis for each of the options

- Initial investment [EUR (MKD)]
- Differences in assets during operation [EUR (MKD)]
- Return on Investment [EUR (MKD)] (through savings from each of the above Options)

III.1.3.2. Feasibility analysis of revenue and cash flow projections

III.2. Comparative analysis of alternatives in relation to the zero scenario (municipality with its own funds), in relation to (i) a favorable loan or (ii) a private financial initiative

III.3. Calculation of value for money

III.4. Eligibility assessment and efficiency analysis based on NPV and IRR with conclusions

## IV. LEGAL ANALYSIS

IV.1. Analysis of the legal framework for project implementation

IV.2. Review of documentation for implementation of the procedure for project realization

- IV.3. Procedure steps for implementation of the procedure for realization of the project
- IV.4. Analysis and recommendations regarding the content of the Contract for Reconstruction of Public Lighting
- IV.5. Type and amount of guarantee for possible non-fulfillment of Contract obligations
- IV.6. Manner and conditions under which transfer of facilities, equipment and right to public service will be performed
- IV.7 Manner of resolving possible disputes
- IV.8 Manner of monitoring and verification of achieved results

## **V. RISK ANALYSIS**

- V.1. Risk identification, management, distribution, evaluation and mitigation
- V.2. Risk Matrix

## **VI. PRELIMINARY ASSESSMENT OF ENVIRONMENTAL IMPACT**

- VI.1. Relevant national legislation
- VI.2. Relevant EU Directives
- VI.3. Procedure for assessment of environmental impact of the project
- VI.4. Identification of possible environmental impact of the project
- VI.5. Proposed measures to mitigate the adverse project impact on the environment
- VI. 3.6. Monitoring and mitigation plan for adverse project impact on the environment

## **VII. CONCLUSIONS AND RECOMMENDATIONS**

### **ATTACHMENTS**

- Attachment 1. Bill of quantities with cost estimates
- Attachment 2. Financial analysis (excel)
- Attachment 3. Technical specifications
- Attachment 4. List of projects/locations