

**Republic of North Macedonia
Ministry of Finance**

**Public Sector Energy Efficiency Project
(P149990)**

MK-MOF-002-2026-CS-CQS

TERMS OF REFERENCE

**DEVELOPING OF FEASIBILITY STUDIES and ESMP FOR IMPROVEMENT OF STREET LIGHTING
LEADING TO ENERGY EFFICIENCY IN TWO 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: (i) energy efficiency investments in the public sector; (ii) technical assistance (TA) and project implementation support; and (iii) Initial capital for the proposed Energy Efficiency Fund. The sub-component 1c of the project includes consultancies to support the investments, including subproject screening, energy audits, detailed designs and technical specifications, and construction supervision for investments. 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 survey. A consultant will be selected in accordance with the Consultant Qualification

(CQS) 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) Sixth edition, February 2025 , 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.
- To ensure safe, comfortable, convenient, and energy-efficient nighttime movement of vehicles and pedestrians through the provision of urban street and pedestrian area lighting systems designed to minimize environmental impact and reduce light pollution.
- 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 Bogovinje and Zelenikovo by preparing feasibility studies for replacement of street lightning

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, environmentally friendly (energy saving and reduction of light pollution) 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 Studies 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 Zelenikovo and Bogovinje.

The Feasibility Study should also provide information on Smart City street lighting control with all hardware and software components needed to efficiently manage the entire lighting system.

III. Scope of services

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

- **Municipality of Zelenikovo**

The locations of replacement of the street lighting will be in the following sites:

Sidewalk from v. Zelenikovo to v. Taor; Korab (village of Zelenikovo); v. Oreshanij; v. Taor; v. Zelenikovo; v. Strahojadica; v. Zelenikovo + Bosansko malo + under the railway until the bridge; sidewalk from Zelenikovo Station until v. Zelenikovo; sidewalk from Zelenikovo Station until v. Zelenikovo; v. Pakosevo and Novo Selo. The approximate number according to the Municipality for replacement is 635.

- **Municipality of Bogovinje**

All settlements in the Bogovinje – The number of the street lights are around 3.000.

The Municipality of Bogovinje has submitted their application within the PSEEP for \ replacement of nearly all 3,000 existing streetlights across its 15 settlements with LED lighting. The new system would include lamps with programmable dimming periods and be supported by a smart software solution for monitoring energy consumption and managing maintenance, particularly along selected traffic routes in certain settlements.

One potential scenario is the phased deployment of a Smart City street lighting system, with implementation priorities aligned to the investment level identified in the Feasibility Study and acceptable to the Municipality of Bogovinje.

The scope of work will include:

TASKS for Feasibility Studies and Cost Benefit Analyses for Zelnikovo and Bogovinje

Task 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 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/m²*
- *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, gateways, software, 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.

Task 2 Cost Benefit Analysis of the Feasibility study (CBA)

Based on the analyses of the baseline information and data collected in Task 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; 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.).

Task 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 Municipalities and User Committees, explaining the investment cycle for the street lighting and energy efficiency improvements.

Following approval of the Draft Feasibility Study and CBA by the PIU, the Consultant will organize a public presentation in each of the two municipalities to present the existing baseline conditions and the proposed improvement measures, including an analysis of the associated financial costs and benefits.

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 Zelenikovo and Bogovinje, 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; once the ESMPs are approved by the PIU, they shall be publicly disposed on the web-sites of the municipalities and Ministry of Finance. Upon 7 days of the public disclosure, the municipalities shall organize a Public Consultation Meeting, when the Consultant should present the ESMPs. The Consultant shall submit Minutes, photos and List of participants from these Public Meeting to PIU.

The PIU shall consider and incorporate the relevant comments from the public consultation regarding the ESMPs.

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

IV. Deliverables/ Tentative Timeline

The deliverables for each task will be submitted to and approved by the PEESP/PIU. The consultant is obliged to deliver the whole documentation per each Municipal sub-project as prescribe in the table given below.

The table below **summarizes the deliverables and indicative timeline for submission of outputs/deliverables by the Consultant** and approvals by the Client. All Documents must be in Macedonian and English language.

Successful completion of this project includes the preparation and submission of the following deliverables/tasks:

Phase	Deliverable/ Milestone	Deadline for submission by the Consultant (weeks after contract signing)	Deadline for approval by the Client (in working days after submission)
Date of Commencement of Services and Kick of meeting		W0	
Phase 1	Complete documentation for the Municipality of Zelenikovo (Draft Final Feasibility study ¹ for energy efficiency street lightning, CBA, Bill of Quantities – Tehnical Specifications with price costs estimates and ESMP)	W0+ 5Weeks	5 days
Phase 2	Complete documentation for the Municipality of Bogovinje (Draft Final Feasibility study ² for energy efficiency street lightning, CBA, Bill of Quantities –	W0+8 Weeks	5 days

¹ Draft Final Feasibility Study” means a near-final version of the Feasibility Study, completed to minimum ninety percent (90%) of the required scope and tasks, in which all core analyses, CBA, conclusions, specifications and recommendations, as well as minimum 3 (three) scenarios that have been prepared, subject only to final comments, clarifications, and minor revisions remains.

² Draft Final Feasibility Study” means a near-final version of the Feasibility Study, completed to minimum ninety percent (90%) of the required scope and tasks, in which all core analyses, conclusions, specifications and recommendations, as well as minimum 3 (three) scenarios have been prepared, subject only to final comments, clarifications, and minor revisions remains.

	Tehnicl Specifications with price costs estimates and ESMP)		
Phase 3	Complete final documentation for the Municipality of Zelenikovo and Bogovinje (Feasibility study, CBA, BoQ and ESMP documents and Minutes of the conducted ESMP Public Consultation Meeting.	W0+13 Weeks	5 days

Indicative Timeline

Below is the timetable presenting the detailed steps and milestones that need to be conducted by the Consultant during the implementation of the scope of services. The Consultant is obliged to submit the same indicative table proposing the indicative timeline for implementation, as part of their proposal.

Phase	Task	Duration	Start Date	End Date
Planning				
	Inception FS Meeting			
Feasibility Study (FS) Drafting				
	Prepare FS Final Draft			
	PIU Review Final Draft FS			
	WB Review and Approve			
	Deliver Final FS			
Approval of the FS				
	Submit Final FS to the Municipality for review			
	Submit FS Acceptance Letter & Scenario by the municipality			
	Prepare BoQ for selected Scenario and approval			
ESMP Development				
	Conduct the 1st User Committee consultation			
	Draft the ESMP documentation			
	Comments, corrections and approval by the PIU			
	Public Disclosure of ESMP Online			
	ESMP Public Presentation Meeting			
Consultations in the Municipality				
	Municipality FS Consultations for acceptance (2nd User Committee consultation)			
	Public Borrowing Presentation Meeting			

V. Main Deliverables and Duration

➤ 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 Zelenikovo, 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 Bogovinje, printed and folded in A4 format and one digital copy.
3. One (1) hard and one digital copy of the FS&CBA Public Presentation for each of the two municipalities, Minutes from the Public Presentation Meeting including photos and List of participants.
4. One digital copy of the final ESMP for each of the two 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.

The Client will approve the documentation within 5 working days if there are no any comments. If there are some comments from the Client, the Consultant must make modification to the documentation according to the remarks in 5 working days and submit for final approval of the monthly report by the Client.

➤ Duration period for compliance of the assignment

The expected duration period of this contract is estimated 95 days. Expected start of services is March 2026. The Consultant is expected to work and travel throughout North Macedonia during assessment. The contract will be lump sum. Payment shall be based on deliverables, acceptable by the Client.

The Consultant shall submit all the documents in a timely manner to complete the services on time without any delay.

VI. Experience and Qualifications of the Consultant

For this assignment a team of experts with relevant experience and qualifications in their subject area as

indicated further below shall be engaged. The Consultant is encouraged to organize more than one team to meet the tight deadlines for this assignment. The Consultant firm may associate with other Consultant firm (s) in the form of a joint venture or of a sub-consultancy to complement their respective areas of expertise, strengthen the technical responsiveness of their proposal, and avail themselves to a broader pool of experts.

The qualification requirements of the Consultant firm are summarized as follows.

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 for street lightning).

1. Consultant Qualifications

Qualification of the consultant company

The Consultant Company should possess the following qualifications:

1.1. Professional capacity of the Consultant

1. License for Design of II category of buildings (License B), issued by the Ministry of Transport 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.
2. At least 15 permanent staff working for the Consultant, confirmed by official institution in RNM.

2. General and Specific experience of the Consultant

2.1. General Experience:

The Consultant company must have at least 5 years of professional experience in preparation of Feasibility studies, relevant for the scope of work references. The Consultant Company shall present in a reference list (the reference list shall include information on contract value, contracting entity/client, project location/country, duration, assignment budget, percentage carried out by consultant in case of association of firms or subcontracting and main activities and client contact information, and accompanied by contracts and certificates of orderly fulfilment of the contracts verified by contracting entity/client).

2.2. Specific Experience:

The Consultant Company shall have a record of minimum 3 Feasibility studies of comparable relevance and scale³. At least 1 (one) of these 3 (three) reference documents must be specifically for street lighting establishment/ improvement. The Consultant Company shall present in a reference list (the reference list shall include information on contract value, contracting entity/client, project location/country, duration, assignment budget, percentage carried out by consultant in case of association of firms or subcontracting and main activities and client contact information), accompanied by

³ A list of these feasibility studies must be submitted with the proposal, including contact details for reference checking purposes (e-mail addresses and/or telephone numbers for contact persons), supported by letter for successful completion.

contracts and certificates of orderly fulfilment of the contracts verified by contracting entity/client).

3. Qualification of the Consultants Team of Key experts and Non-Key experts

The Consultant shall have the organizational capacity (it is expected that the Consultant shall have at least below listed key experts for performing activities under this assignment) and available appropriate skills among staff. The consulting team assembled to implement the project should be composed of experts with strong knowledge as per the below requirements.

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.

3.1. Key Experts

No.	Team of key members and/or areas of expertise	Qualification requirements	Required number
1.	Team Leader – Project Manager	<p>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 actively participate in the preparation of feasibility studies. 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"> • University degree in Electrical Engineering. 	1

		<ul style="list-style-type: none"> • Authorization B for preparation of technical documentation. • 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. • 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). • Proven experience in work with local, governmental or international institutions would be an asset 	
2.	Key-expert: Electrical Engineer	<p>The minimum necessary qualification for the Electrical Engineer:</p> <ul style="list-style-type: none"> • University degree in electrical engineering; • Minimum of 5 years of relevant work experience in street lighting; • Authorization B for preparation of technical documentation in the field of electrical engineering; • Record of at least 3 relevant completed feasibility studies of comparable relevance and scale/similar public projects with comparable nature 	2
3.	Key-expert: Economist	<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"> • University degree in Economy • Minimum of 5 years of relevant work experience on preparing cost benefit analysis to be evidenced by listing of projects titles and contact persons; 	1

		<ul style="list-style-type: none"> • Minimum 3 developed financial analysis, with operational and maintenance costs and pay-back periods for public infrastructure projects; 	
4.	Key-expert: Environmental expert	<p>He/she will be responsible for the preparation of environmental management plans as part of the feasibility studies.</p> <p>The minimum necessary qualification for the Environmental expert:</p> <ul style="list-style-type: none"> • University degree in natural sciences, or environmental engineering • Relevant work experience on preparing of minimum 3 environmental studies/experience on preparing environmental analysis in feasibility studies on public construction / infrastructure projects; 	1
5.	Key-expert: Social expert	<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"> • University degree in social sciences or similar • Relevant work experience in preparation of Social Assessment studies/reports/elaborates for minimum 3 construction projects 	1

NOTES:

- 1) The Consultant company must 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) 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.komoraoai.mk

3.2. Non- key experts

The Consultant company needs to foresee additional technical engineering staff as Non-key experts for successful completion of the assignment, meaning that the consultant must have at least two teams consisted of 5 technical persons for collecting the information and preparing the Feasibility Studies, in order the tight deadlines to be met.

Also, the Consultant is obliged to engage a Non-Key expert electrical engineer with university degree in telecommunications.

They will not be evaluated but the consultant should plan them accordingly.

VI. Implementation arrangement

The Consultant will report directly to the Client Coordinator and the Ministry of finance – PSEEP PIU. If any disagreement occurs between the Consultant and the Client, during the performance of the Consultant Services, the decision from the Client Coordinator and the Ministry of finance – PSEEP PIU will be binding.

Consultants may associate with other firms in the form of a joint venture or a sub-consultancy to enhance their qualifications. The “association” may take the form of a Joint Venture or a sub consultancy. In case of a Joint Venture (JV), all members of the JV will be evaluated jointly for the purpose of short listing and shall be jointly and severally liable for the assignment and shall sign the contract in case of award is made to that JV group. Interested consultants should clearly indicate the structure of their “association” and the duties of the partners and sub consultants in their application. Unclear expression of interests in terms of “in association with” and/or “in affiliation with” and etc. may not be considered for short listing. Keeping one expression of interest per firm as principle, a consultant firm may decide whether it wishes to participate as a sub consultant or as an individual consultant or as a partner in a joint venture. Please note that a firm shall submit only one expression of interest in the same selection process either individually as a consultant or as a partner in a joint venture. No firm can be a sub consultant while submitting an expression of interests individually or as a partner of a joint venture in the same selection process. A firm, if acting in the capacity of sub consultant in any consultant or JV, may participate in more than one consultant, but only in the capacity of a sub consultant.

Note: The Consultant Company may associate with other Consultant Company (s) in the form of a joint venture or of a sub-consultancy to complement their respective areas of expertise, strengthen the technical responsiveness of their proposal.

Annex 1 - Contents of Feasibility Study for Modernization / Replacement 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 replacement 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 replacement
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/m²) 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 requirements);

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 (not limited to two options), all smart lights shall comply with Zhaga or Nema socket or equivalent physical and mechanical standards, with Zhaga-D4i certification.. Investments should be calculated for the replacement of the existing lights with new LED lights according to the light requirements, as well as ensuring the independence of the system by placing the management, control and protection equipment in separate cabinets outside EVN substations if necessary.

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, labeling and information on energy efficiency) and 2019/2020 (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 (protection against electric shock according to IEC/EN 61140);
 - Surge protection: with a surge resistance of at least 10 kV at the luminaire input and 4 kV for the LED module, in order to ensure long-term safety and compliance with electrical installations.;
 - 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. 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

Annex 2: PRELIMINARY ASSESSMENT/ SCREENING OF ENVIRONMENTAL IMPACTS

2.1. Project Description and Technical Baseline

- Macro and micro locations of the Project, provided maps of the coverage areas and list and categorization of the targeted settlements (urban, rural, hilly, or mountainous), inhabitants, etc.
- Infrastructure Inventory: List the number of lights to be replaced and their current technology (e.g., number mercury/sodium lamps).
- Technical Solution Justification: Brief description of the chosen technical solution (e.g., LED with Astro-dimming capabilities) and reasoning as defined in the Feasibility studies.
- Ownership & Access: Clear identification of asset ownership (e.g., Municipality owns lamps, EVN owns poles) and the protocol for coordination with the utility provider.

2.2 Energy and Climate Impact

- Energy Baseline: Calculation of average annual consumption (kWh) and costs (MKD) based on the last 3 years.
- Projected Savings: Calculation of expected energy savings and CO2 emission reductions (expressed in tons/year and clarification of the calculation method used).
- Economic Analysis: Inclusion of the ROI (Return on Investment) and TCO (Total Cost of Ownership) to demonstrate project sustainability.

2.3 Identification of possible environmental impact of the project, especially:

- Local and Seasonal Constraints (e.g. The "Stork Clause"): Identification of poles with stork nests. The report must define a "no-work" period (typically April 1st – August 20th) or prioritize these poles for replacement during the migration period (August–March).
- Flora Impact: Any specific species, and Protocol for tree trimming or removal in accordance with the Law on Urban Greenery and coordination with NP National Forests where applicable.
- Protected Areas: Confirmation of whether the project falls within or near any protected natural zones and brief description, status of proclamation.
- Water Management: confirmation of the nearby Project watercourses and their category status.

2.4. Waste Management (Hazardous & Non-Hazardous)

- Waste Quantities Table: A specific table listing waste types, and national codes (e.g., 20 01 21 for mercury lamps*), and estimated volumes/units as stipulated in the BoQ.
- Dual-Track Handling: Functional Waste: A procedure for handing over usable old lamps to the Municipality for reuse in a secure, dry, and labeled storage facility.
 - o Hazardous Waste: Mandatory requirement for contracts with licensed waste collectors and transporters for final disposal.

2.5. Social Impact and Community Engagement

- Size of population, number of households and trends in the past 5 and 10 years; analysis of the payment affordability and level of payment by the households.

Gender-Disaggregated Benefits: Assessment of the project's impact on the safety and mobility of women, children, and elderly residents.

- Public Information Protocol: Requirements for notifying the public via local media, municipal websites, and social media regarding work schedules and potential power outages.
- Grievance Redress Mechanism (GRM): Setup of a formal process for receiving and resolving complaints from both the local community and the contractor's workers.

2.6. Occupational Health and Safety (OHS)

- OHS Elaborate: Requirement for the contractor to prepare a specific Health and Safety plan for working at heights and with electricity.
- Fire Protection: Requirement for fire extinguishers in all transport and lift vehicles.
- Cultural Heritage: Inclusion of a "Chance Find" procedure for any artifacts discovered during works (under the Law on Cultural Heritage Protection).