**Annex 2\_Tender tasks, timeline and deliverables**

1. **DESCRIPTION OF THE CURRENT SITUATION**

In the area of the city of Živinice, public lighting serves to illuminats main roads, squares, neighborhoods, pedestrian zones, and key public facilities. The coverage rate is 100% in urban areas and 80% in rural areas. The City of Živinice is responsible for the construction, management and maintenance of public lighting and related equipment. Public lighting in the city can be categorized into three types:

* street lighting (traffic lightning), ensures the safe, fast and comfortable movement of motor vehicles and cyclists as well as the secure passage of pedestrians.
* urban lighting enhances the ambiance of public spaces, such as squares and streets, creating a welcoming and vibrant environment.
* architectural lighting designed to highlight and accentuate the features of architectural landmarks and significant historical monuments.

On average, public lighting operates approximately 4,015 hours annually (slightly below the standardized operating time of 4,100 hours according to European Standards for road lighting, [BAS EN 13201:2015](https://www.en-standard.eu/csn-en-13201-1-4-road-lighting/?srsltid=AfmBOoo8uQdYlaEGEA8nQqtqZZ-P6ff8WwhgoMKfKKFYMJsl3iNfz84q), depending on weather conditions (sensor-based day-night system). The public lighting network in the city is managed by the City and powered by the low-voltage grid through 240 connection points, where electricity consumption is measured. According to the Sustainable Energy Action Plan Živinice (2017) The network is of mixed construction: suburban areas primarily have overhead lines, while the city zone consists of 80% overhead and 20% underground lines.

According to the City Administration, **the public lighting system network comprises an estimated 9,500 streetlights**, which are the focus of this project assignment. These streetlights are predominantly mounted on metal poles and reinforced concrete poles, with a smaller number on wooden poles supported by brackets.

According to data provided by the city services, the City of Živinice does not have specific information on how the public lighting system is controlled (time relays, photocells). In 2023, the public lighting system consumed 3,858 MWh of electricity, resulting in 2,872 tonnes of CO2 equivalent emissions. Maintenance of the public lighting system is carried out by companies selected annually through a public tender process. So far, projects to replace inefficient lighting fixtures with new energy-efficient ones have been funded by the City Administration’s own resources.

Public lighting in Živinice operates seasonally, adjusting to the changing duration of daylight throughout the year. However, many components are outdated and inadequate, leading to frequent breakdowns, further damage due to substandard equipment, and high maintenance costs. Additionally, the system’s significant electricity consumption places a heavy strain on the City’s budget. Inefficient lamps lacking proper reflectors contribute to energy waste by scattering light onto unintended surfaces. The outdated lamp designs and absence of modern technologies exacerbate problems such as environmental light pollution, including excessive illumination of the night sky, which adversely impacts the quality of life in Živinice.

In the coming period, it is essential to upgrade public lighting, especially along major roads, parking areas, pedestrian paths and zones, bus stops, and taxi stands. The existing lighting for roads, parking areas, and pedestrian routes within the regulatory plan needs to be enhanced to meet current energy efficiency standards and the [Commission Internationale de l'Éclairage (CIE)](https://cie.co.at/) recommendations, which provide guidelines for lighting levels, uniformity, and glare reduction to ensure safety and visual comfort. Compared to most other technologies, LEDs reach very high energy efficiency levels (lumen per Watt of power). The efficiency of the system among others is influenced by the spatial light distribution (luminous intensity) and the geometrical arrangement of the road and the lighting system. Currently, much of the existing lightning infrastructure fails to meet these standards due to outdated installations with low energy efficiency and poor photometric performance, resulting in inadequate illumination and higher energy consumption.

Energy audit has the aim to increase the understanding better the state of municipal infrastructure, improve management and maintenance, and reduce long-term costs through energy efficiency measures, a digital registry of the public lighting system, along with an audit, is planned.

The inventory of existing documentation will be provided by representatives of the City of Živinice, including:

1. [Development of New and Upgrade of Existing Feasibility Studies for the Installation of a New Energy-Efficient Public Lighting System](https://www.undp.org/sites/g/files/zskgke326/files/migration/ba/d2171d9183118634618ca25e611eaf5813f9cd113f46d3326f85d47edd20a886.pdf) (2021).
2. Sustainable Energy Action Plan Živinice (2017)
3. **PROJECT ASSIGNMENT DESCRIPTION Digital Public Lighting Management System**

The development of the **Digital Public Lighting Registry** with an energy audit involves establishing an integrated system for managing public lighting by creating a digital register that includes an energy audit of all existing lighting fixtures in the city of Živinice. The objective is to enable efficient management and oversight of public lighting infrastructure, as well as to identify energy-saving potential and cost optimization.

The key phases that the **Contractor** is required to complete are outlined below:

**PHASE 1: Development of a Digital Public Lightning Registry**

This phase focuses on creating a comprehensive inventory of the public lighting infrastructure. It includes:

* Data Collection: Recording details of all existing lighting fixtures, including their location, type, power, age, condition, and other technical characteristics.
* Equipment Documentation: Cataloging the performance and specifications of installed components, such as power circuits, transformer stations, switches, and cables.

The digitization process involves preparing this data for integration into the existing Geographic Information System (GIS). By utilizing GPS technology (without requiring geodetic-level accuracy), the exact locations of lighting fixtures and associated equipment can be mapped for precise spatial representation and management.

**PHASE 2: Conducting an Energy Audit of the Public Lighting System**

The purpose of this phase is to assess the energy efficiency potential in street lighting in the City of Živinice, and to identify potential energy efficiency investments which may cover the rehabilitation and optimization of the lighting system, including lighting equipment replacement, and associated infrastructure to enhance energy efficiency.

The detailed energy audit includes data collection, measurements of the systems, analysis of the historical and measured data, and detailed energy savings as well as financial and economic calculations for suggested street lighting projects. The detailed energy audit not only involves the analyses of the performance of individual equipment, but the evaluation of the complete system. The detailed energy audit includes the following key steps: (i) calculation and establishment of the energy consumption baseline; (ii) assessment of potential energy efficiency options and the identification and costing of recommended measures for reducing energy costs and improve energy efficiency in street lighting; and (iii) the monitoring and verification framework.

The detailed energy audits should cover the following elements: (i) lighting fixtures; (ii) poles; (iii) arms; (iv) electrical wiring; and (v) management and control systems for street lighting. Energy audit covers only electricity consumption systems from points of electricity take over up to the final consumer/lighting fixture.

It is also important that the audits take into account the key features of effective energy-efficient street lighting systems which include (i) proper pole height and spacing; (ii) proper luminaire aesthetics; (iii) high lamp efficacy and luminaire efficiency; (iv) life of the luminaire and other components; (v) cost-effectiveness; (vi) high lumen maintenance; (vii) good color rendering; (viii) short lamp restrike; (ix) proper light distribution; (x) proper cutoff; (xi) minimizing light pollution; (xii) automatic shutoff; (xiii) compliance with national and local norms and standards for street lighting.

**PHASE 3: Training Representatives of the City of Živinice**

Training will be provided to ensure long-term sustainable management of the public lighting system using the digital register and energy audit tools. The Contractor is required to deliver a minimum of 6 hours of training to city representatives.

**The key phases are described in more detail below:**

**PHASE 1: CREATION OF THE DIGITAL REGISTER**

**1.1 Analysis of the existing GIS system**

**Task**: Review the existing GIS system to understand its structure, data formats, and organization.

The City of Živinice currently utilizes the **GAUSS Web City** platform as its licensed GIS system (more details available at <https://gauss.ba/en/solutions/gauss-webcity>). This platform is a modular solution tailored for local administrations, and the city is presently operating its basic model for spatial data presentation.

This foundational model can be further enhanced by incorporating an additional module dedicated to public lighting. Such an upgrade would enable streamlined management of activities related to the construction, rehabilitation, reconstruction, and maintenance of public lighting infrastructure. It would also facilitate the creation of a comprehensive database for public lighting solutions linked to this tender. Moreover, the enhanced module would offer an open user interface for citizens, allowing them to report public lighting issues with precise location details.

The implementation of this module could lead to significant benefits, including reduced labor costs, increased employee efficiency, and improved satisfaction among citizens, local communities, and the general public. However, it is essential to note that adopting this module is optional and not included in the current tender; its deployment will depend on the City of Živinice's future plans and budget considerations.

**Steps**:

a) Review of the existing GIS system.

b) Identify suitable data formats (e.g., shapefiles, geodatabases) that will be used in line with the requirements of this ToR and point 1.3. Preparation of data for GIS integration.

c) Understand the database structure and data relationships.

**1.2 Field survey and assessment of existing conditions**

**Task**: Collect data on the current state of the public lighting system in the field.

**Steps**:

a) Prepare necessary equipment for fieldwork (GPS devices, cameras, notebooks).

b) Visit all public lighting locations and document the position of all elements: pillars of the LV network, poles, luminaires, metering points, distribution cabinet (cables, wires, sockets, fuses, switches and circuit brackets).

c) Photograph each element of the lighting system.

d) Record relevant data (e.g., pole height, type of fixture, equipment condition, installation date).

e) Check the quality of electricity.

f) Perform the measurement of current, voltage, power, cosφ at circuits of the lighting system.

**1.3 Preparation of data for GIS integration**

**Task**: Prepare public lighting data for integration into the GIS system.

**Steps**:

a) Format data to be compatible with the existing GIS system.

b) Ensure all required attributes are included (street lighting pole characteristics & lighting fixture characteristics) and linked to geographic coordinates.

c) Georeference and verify coordinates to align with the existing GIS system.

d) Geographic coordinates should be connected:

* Primarily to the **Street Lighting Pole Characteristics**:
* Pole ID: Unique identifier for each pole.
* Geographic Coordinates: Latitude and longitude of the pole location.
* Pole Height: Height of the pole in meters.
* Material: Type of material (e.g., steel, concrete, wood).
* Condition: Current condition of the pole (e.g., good, fair, poor).
* Installation Date: Date when the pole was installed (if available).
* Connector Details: Information about connectors within the pole.
* Photograph: Image of the pole for visual reference.
* Maintenance History: Records of any maintenance or repairs performed (if available).
* **Lighting Fixture Characteristics** (which could be more than one at one street lighting pole) including data:
* Fixture ID: Unique identifier for each fixture.
* Pole ID: Identifier linking the fixture to its corresponding pole.
* Fixture Type: Type of lighting fixture (e.g., LED, sodium vapor).
* Wattage: Power consumption in watts.
* Mounting Height: Height at which the fixture is mounted on the pole.
* Light Output: Luminous flux in lumens.
* Condition: Current condition of the fixture (e.g., operational, needs repair).
* Installation Date: Date when the fixture was installed (if available).
* Photograph: Image of the fixture for visual reference.
* Maintenance History: Records of any maintenance or repairs performed (if available).

**PHASE 2: ENERGY AUDIT: COLLECTION OF BASIC INFORMATION**

**2.1 Collection of basic information and preparation for field survey**

**Task**: Gather initial data for conducting the field survey.

**Steps**:

a) Identify and collect required data: energy consumption for last 3 years for each measuring point, ownership, technical characteristics of roads and lighting.

b) Collect necessary documents~~,~~:  ~~such as~~ such as:

* Project designs or similar project documentation for the modernization, reconstruction or construction of a public lighting system;
* Existing public lighting baseline data (elements, lighting classification, etc.);
* Existing energy audit (if any)
* Information on implemented and/or planned modernizations through the maintenance of public lighting in the past and/or the next XY months;
* Detailed data on electricity consumption in the last 3 years from billing metering points;
* Last available bill for electricity of public lighting or other source for actual electricity price information;
* Data on the costs and content of maintaining the public lighting system in the last 3 years;
* Data about the public lighting system stakeholders (maintainer, distribution system operator, electricity supplier and other possible stakeholders)

c) Distribute a questionnaire to the designated municipal contact for data collection.

**1.2 Field survey and fixture classification**

**Task**: Conduct a field survey in conjunction with Phase 1.2, assess and classify fixtures and roads.

**1.3 Data analysis and additional measurements**

**Task**: Analyze the collected data and perform additional control measurements if necessary.

**Steps**:

1. Conduct the following analyses based on the collected data, information, and completed measurements:

* Energy consumption and system operating costs over the past 3 years.
* System management methods and regulation of lighting fixtures.
* Maintenance methods and costs over the past three years.
* Photometric and energy parameters of the observed part of the system and their compliance with technical regulations and standards.
* Required final energy and CO2 emissions for the entire system/part of the system based on the provided data. The calculation is performed using a model for the approximate calculation of final energy requirements for public lighting systems, in accordance with applicable BH laws, guidelines, and recommendations (Guidelines for road design, construction, maintenance and supervision/FBiH and RS), European Standard EN 13201-2 to 4, and relevant recommendations from the International Commission on Illumination (CIE) - No. 88/90, No. 115/95, and No. 15/2-10.
* Requirements for additional measurements and information for verification/correction of data in case of significant deviations between analysis results and previously collected data.

**2.4 Defining measures and techno-economic analysis**

**Task: Define energy efficiency measures and conduct a techno-economic analysis**.

**Steps**:

a) Define energy efficiency (EE) measures and estimate their potential impact.

b) Estimate required investments based on market prices.

c) Calculate potential savings in energy and maintenance costs, and CO2 reduction.

d) Perform an economic analysis to assess the viability of EE measures (e.g., simple payback period, net present value, internal rate of return).

**2.5 Preparation of the Energy Audit Report**

**Task**: Prepare a report on the conducted energy audit with supporting documentation (e.g., consumption data, photometric calculations, sketches, and maps of the lighting system).

Energy Audit Report includes an analysis of the public lighting system with a proposal of measures to improve energy efficiency, taking into account road lighting requirements essential for road safety, as well as requirements to reduce light pollution. An energy audit report must recommend measures to improve energy efficiency and to create high-quality base for preparation of project documentation for the implementation of concrete measures.

The main goal of these audits is to identify cost-effective energy saving measures and to promote energy conservation in public street lighting and therefore reduce the rate of expenditures of public money and reduce GHG emissions.

The energy audit report should include:

1. Introduction
2. Methodology and scope
3. System specifications, Location Mapping and Physical Condition Assessment
4. Inventory of Light Sources
5. Measurement-Based Analysis
6. Optical and Technical Review – Photometric Study
7. Surface classification and infrastructure details
8. Energy consumption analysis (over last 3 years, per light source and OMM)
9. Power and regulation systems assessment, Maintenance costs and replacement frequency
10. Recommendations to increase efficiency for each metering point
11. Techno-Economic Analysis for the public lightning system
12. Environmental Analysis of the proposed measured against EU practices and GHG emission reduction
13. Conclusion

The report on the performed energy audit should include appropriate appendicies:

* Measurement results
* Detailed maps and photographic evidence of public lightning system
* Supporting tables and data.

It is advisable to elaborate a summary of the basic parameters of the public lighting system elements in free form. It is necessary to determine the baseline electricity power, lighting regimes and the electricity consumption of the public lighting system. It is necessary to give an overview of possible differences between the actual state and the baseline data. All collected data must be recorded in an electronic tabular presentation, while all textual descriptions and explanations must be recorded in the Report on the conducted detailed energy audit.

**PHASE 3: Training representatives of the City of Živinice**

**Task**: Provide training and procedures for continuous updating and maintenance of the integrated database.

**Steps**:

a) Define procedures for regularly updating lighting data.

b) Train relevant staff on using and maintaining the public lighting database.

**Obligations of the City of Živinice:**

* Collect basic data on the public lighting system, maintenance, and consumption, and provide technical documentation.
* Integrate the prepared public lighting data into the city's GIS system, based on data provided by the Contractor.

1. **PHASES AND TIMELINES**

The total planned period for the development of the digital registry, along with the energy audit and training, is a maximum **of eight (8) months**.

Each phase of the project has clearly defined activities, resources, and deadlines. The detailed project development plan is outlined below:

**Phase 1: Development of the GIS Database for the Public Lighting System (8 months)**

**Activities**:

* Analysis of the existing GIS system in the City of Živinice,
* Review and assessment of the current state in the field,
* Preparation of data for integration.

**Phase 2: Preparation of the Energy Audit for the Public Lighting System (2 months)**

**Activities**:

* Collection of basic information and preparation for field visits,
* Field visits, classification of lighting fixtures, and road segments,
* Analysis of collected data and, if necessary, additional control measurements,
* Defining measures and performing a techno-economic analysis of the proposed measures.

**Note**: Phase 2 – Preparation of the Energy Audit for the Public Lighting System will be conducted in parallel with Phase 1 – Development of the GIS Database for the Public Lighting System, allowing the collected data to be immediately used for the energy audit.

**Phase 3: Training of the City of Živinice Representatives for the Use of the Digital Public Lighting Registry (1 month)**

**Note**: Phase 3 will also be conducted in parallel with Phase 1 and can be realized during the final month of the project. This will ensure that city representatives are introduced to the new system while data is being collected and analyzed. This approach ensures efficient resource use and guarantees that all project participants are familiarized with the new tools and methodologies in a timely manner.

1. **DEADLINES AND DELIVERABLES**

The selected Contractor will be required to provide services according to the deadlines outlined below:

|  |  |
| --- | --- |
| **Task** | **Deadline** |
| **Task 1:**  Collected data on all existing streetlights within the public lighting system, submitted to SEI and representatives of the City of Živinice for review and comments | 1 May 2025 |
| **Task 2:**  The prepared data for integration into the existing GIS system, submitted to SEI and representatives of the City of Živinice for review and comments | 1 September 2025 |
| **Task 3:**  Created the Energy audit (draft version), submitted to SEI and representatives of the City of Živinice for review and comments | 1 April 2025 |
| **Task 4:**  Created the Energy audit (final version), submitted to SEI and representatives of the City of Živinice for review and comments | 1 May 2025 |
| **Task 5:**  Created recommendations for replacing energy-inefficient equipment, submitted to SEI and representatives of the City of Živinice for review and comments | 1 July 2025 |
| **Task 6:**  The training was conducted and the report was created, submitted to SEI and representatives of the City of Živinice | 1 June 2025 |
| **Task 7:**  Report to SEI on the work performed | 30 September 2025 |

The selected Contractor is required to consider comments from representatives of the City of Živinice, SEI and other relevant parties, and to align their work with the provided suggestions.