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ENHANCING CAPACITY FOR LOW EMISSION DEVELOPMENT  
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## Project Proposal

# Utilization of Solar Energy through Centralized Solar Farm in Bolnisi



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# 1. PROJECT PREREQUISITES

## 1.1. Problem Description

Since 2010 the process of undertaking voluntary commitments has been launched in Georgia under the Covenant of Mayors which means that the cities joined this initiative aim to reduce the GHG emissions for their territories by 20% till 2020. Main sectors considered by the EU cities within the frames of this initiative are transport and buildings; however, the cities may include some other sectors as well (street lighting, waste management, landscaping, etc.).

Following Tbilisi, other self-governing cities of Georgia enthusiastically embraced this initiative and started to join it gradually. 13 self-governments have already joined this initiative, including 9 self-governing cities and 4 municipalities.

There have already been developed Sustainable Energy Action Plans (SEAP) for eight self-governing cities and a monitoring report - for Tbilisi. Main sectors considered by the cities of Georgia include transport, buildings, street lighting, waste management and landscaping.

Bolnisi Municipality is an administrative unit located in central part of Kvemo Kartli region. It is bordered by Marneuli, Dmanisi and Tetrtskaro municipalities and Republic of Armenia.

Area of municipality is 80 692 ha mostly represented with plain terrace with dry subtropical steppe climate, moderately cold winter and hot summer. Average annual temperature in Bolnisi is 12 °C. Average temperature of the coldest month – January is 0.3°C, while an average for the warmest month – August is 23.3°C. Annual precipitation amounts to 572 mm, maximal precipitation is observed in May (86 mm) and minimum in December (21mm).

According to the municipal board information from 2012 population of municipality is 78 700.

Bolnisi municipality has signed the Covenant of Mayors (CoM) on March 16, 2015 and thus has undertaken an obligation to prepare and implement within its administrative borders the SEAP aimed at the reduction of GHG emissions.

The SEAP for the city of Bolnisi is currently being prepared and is to include Transportation, Buildings, Street lightning as well as Greening sectors.

Below project addresses Buildings and Street Lightning sectors.

The municipality of Bolnisi has neither an appropriate experience, nor skills, or enough technical staff to plan or manage sustainable development process of municipality; Particularly, one of strategic sectors of Bolnisi, under the short-term strategy of sustainable energy development process, is building sector but in order to move smoothly to clean/low emission buildings, carrying out of serious steps and planning awareness raising activities for the population, highlighting advantages of energy savings and utilization of local renewable energy resources.

One of the projects to be implemented by Bolnisi Municipality in 2016 involves:

- Rehabilitation of kindergarten

- Complete renovation of Kostava and Tsminda Nino streets with LED lighting.

Activities aimed at reduction of GHG emissions and energy consumption and increase in sustainability of the city infrastructure include installation of PV windows in the kindergarten, and installation of LED lighting on 2 streets. To increase the effect of these activities and aid efforts of municipality to meet obligations after signature to the Covenant of Mayors as well as decrease of operational costs related to energy consumption it is necessary for the municipality to strengthen its project and demonstrate even more climate friendly approach and reduction of municipality's carbon footprint.

## **1.2. Project Goal**

Due to the municipalities obligations given in SEAP after signature to the Covenant of Mayors as well as a goal to decrease operational costs related it is necessary for the municipality to implement a project that demonstrates climate friendly approach and reduction of municipality's carbon footprint.

To achieve this goal it is planned to establish solar energy farm that would provide electrical energy to for municipal needs: supply of electricity to Kindergarten, Administration building of municipality and Bolnisi Culture house, and lighting on Kostava and Tsminda Nino streets. Project monitoring and statistics-based recommendations will provide Bolnisi Municipality with significant findings to ensure long-term planning of renovation activities for municipal buildings, support preparation and implementation of new projects and remove knowledge and awareness raising barriers.

While specific objectives of the project are showcasing generation of energy from renewable sources, providing energy to municipal consumer and reduction of energy consumption and GHG emissions.

To accomplish these specific objectives of the project it is planned to:

- Design and install an so called solar energy farm to power energy efficiency lightning on the street and supply electricity to municipal building
- Showcase to residents and guests of the town system of renewable energy generation and energy-efficient utilization to gain support of wider public and backing replicability in other areas of the Bolnisi well as other municipalities of Georgia

To accomplish reduction of energy consumption and GHG emissions it is planned to:

- Replace consumption of electricity from grid with renewable energy
- Reduce consumption of electricity for lighting purposes

### 1.3. Partners and Beneficiaries

#### 1.3.1. Partners:

- **Bolnisi Municipality Government** – the major partner, largest beneficiary and main implementer of the project. Bolnisi Municipal government is ready to allocate funds to conduct EE measures in kindergarten building;
- **Bolnisi Municipality/Community** – Community leaders will support the project in attracting qualified local staff, raising awareness and spreading obtained results on other buildings;
- **Ministry of Environment and Natural Resources Protection of Georgia ( As a coordinator of the Covenant of Mayors in Georgia)** – the Ministry is responsible for implementing Climate Change Convention Principles throughout Georgia. Moreover, it coordinates the Covenant of Mayors initiative, supporting the participating cities and municipalities through methodologies and available data. Therefore, it may play significant role in attracting additional funding for such Agencies.
- **Ministry of Energy ( As a coordinator of the Covenant of Mayors in Georgia)** – the Ministry of Energy also coordinates the Covenant of Mayors initiative for the country in cooperation with the Ministry of Environment and Natural Resources Protection of Georgia. Processes, strategies or action plans of the country, scheduled by the Ministry, are directly reflected in the SEAPs of the Covenant of Mayors signatory cities and municipalities. Plans are particularly important for sustainability of heat supply and energy efficiency improvements. The Ministry actively cooperates with municipalities and cities throughout the plans preparation processes, supplying them with parameters, preliminary evaluated at national level. (GDP, Population growth, elasticity coefficients of various sectors, etc.);
- **Ministry of Regional Development and Infrastructure of Georgia** – The Ministry is directly linked to the implementation of the SEAPs and large part of real activities are being planned in cooperation with them as well as partially funded by them;
- **NALA (National Association of Local Authorities)** – NALA can make special contribution to local staff training initiatives. Along with additional investments, awareness raising programs on climate change, sustainable development etc. prepared by them for municipalities are able to significantly contribute to these processes.

#### 1.3.2. Beneficiaries

- **Bolnisi Municipal Government** – will benefit from reduced expenses and energy efficient, low emission building;
- **Bolnisi Municipality/Community** – it will receive a benefit in terms of workplaces causing by spreading the innovation to other buildings.
- **Local population of Bolnisi municipality and its Community** – as they acquire certain skills increasing their chances of employment;

- **Ministry of Environment and Natural Resources of Georgia** – as a body directly responsible for implementing the GHG emission-reduction measures across the country and developing appropriate strategies and action plans;
- **Government of Georgia** – aiming at regional decentralization and strength due to its key importance, in terms of the country's security and independence. Strong regions would be useful while fulfilling their obligations under the Climate Change Convention.

#### **1.4. Contributing Factors to Project Implementation**

- International obligations taken by the Country and self-governing units (the EU Association Agreement; the Covenant of Mayors, future commitments under the Climate Change Agreement);
- Relevance of the issue and an opportunity to show quick results;
- Abundance and availability of grant resources.

## **2. PROJECT IMPLEMENTATION BARRIERS**

- Procurement gaps. Procurement law is currently based only on the principle of the lowest price that has seriously damaged the quality of a number of implemented projects. This problem should be solved and the law should be improved through joint efforts of the municipalities and cooperation with the central government; a bidding document shall contain material and equipment specifications and necessity of submission certificates of origin and quality assurance to avoid delivery of low-quality products.
- Lack of awareness of decision makers in preparing bidding/project document for such type of activities.
- Insufficient budgetary resources and local staff to prepare grant application. Closer cooperation with private sector seeking support from them;
- Lack/absence of well qualified staff. Capacity building measures (donors' support required);
- Keeping trained employees – building motivation (including financial) (donors' partial support).

## **3. PROJECT IMPLEMENTATION STAGES AND METHODOLOGY**

Stage one. Study of existing project. Projects of street lighting and kindergarten building renovation were studied, analyzed and examined for energy requirements.

Stage two. Preparation of recommendations on activities to be implemented – Determination of specific tasks and activities to be conducted to achieve project goals.

Stage three. Environmental and economic analysis of the drawn up project cost estimates – economic and environmental report has been prepared on basis of project and cost estimating documents; savings on utility bills and the degree of emission reduction have been evaluated.

#### **4. RECOMMENDATIONS ON ACTIVITIES TO BE IMPLEMENTED**

Based on the study and analysis of projects of municipality and economic, social, resource related circumstances in Bolnisi municipality it is recommended to design, engineer and install a solar energy farm: establishment solar energy farm that consists of 20X5 m metal framed structure covered with photovoltaic panels

Project will showcase the use of the solar energy sources for various purposes.

The energy will be produced and stored with the following equipment

- Photovoltaic panels with total capacity of 16.6 kW
- Invertors
- Controllers

As for sufficiency of solar energy resources in project area justification is given below:

- Sun: According to Technical Regulations “Building Climatology” of Georgia ([http://gov.ge/files/382\\_40062\\_363410\\_71-5.pdf](http://gov.ge/files/382_40062_363410_71-5.pdf)) direct and constant radiation in Bolnisi is following:

Constant: January – 55 kWh/m<sup>2</sup>, April – 138 kWh/m<sup>2</sup>, July – 197 kWh/m<sup>2</sup>, October - 98 kWh/m<sup>2</sup>

Direct: January – 32 kWh/m<sup>2</sup>, April – 68 kWh/m<sup>2</sup>, July – 128 kWh/m<sup>2</sup>, October - 58 kWh/m<sup>2</sup>

These amounts of radiation will provide sufficient energy for operation of PV.

Establishment of energy farm will result in generation of electric power estimated at 9196kWh (16.575kWX8hX365daysX19%\*)

#### **5. EXPENDITURE ESTIMATES FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY MEASURES**

Major cost of the project is covered by Bolnisi Municipality to finance the following tasks:

- Rehabilitation of Kindergarten building (840 sq. m.)
- Renovation of Kostava and Tsminda Nino streets
- Connection of Energy farm to consumers (street lighting, municipal buildings)
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Expected budget for activities assigned by Bolnisi Municipality in the boundaries of project amount to GEL 930,000. Assuming exchange rate of GEL 2.15 to 1 USD the budget equals to USD 432,558.

EE and RE Measures to be implemented by project include:

- Installation of so called solar farm including its infrastructure (20x5 m metal frame structure, inverters and controllers, fixings, cables etc). which consists of shredder for biomass, small size biomass chips’ storage, biomass boiler, hot water storage and buffer tank, control and monitoring system and photovoltaics that will supply system with required electricity

- Presentation, discussion and approval of project details (design, solutions, work-plan) with stakeholders (municipality authorities, grant provider) and interested parties
- Execution of equipment purchase, production and assembly of components and installation works
- Monitoring and control of execution of works up to date of completion
- Handing over executed works to Bolnisi Municipality
- Providing training of local human resource allocated by municipality on maintenance and operation of the equipment installed in the boundaries of the project.
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Total cost of the above is estimated at USD 50,000.

Project considers the following budget items:

### **I. Salaries:**

**A. Project Director-** is responsible for successful and smooth implementation of all tasks of project, timely fulfillment of the project and supervises the project throughout the timeframe.

Salary/Day- \$300, Total (15 days) - \$4500

**B. Project Manager** - is managing the implementation of the project, financial and economic aspects and coordination of tasks with different parties.

Salary/Day- \$100, Total (18 days) - \$1800

**C. Architect** – is responsible for design of heating module

Salary/Day - \$50, Total (18 days) - \$900

**D. MEP Engineer** – is responsible for Mechanical, Electrical and Plumbing engineering of infrastructure.

Salary/Day - \$50, Total (15 days) - \$750

**E. Mechanical Engineer** – is responsible for mechanical design and engineering of infrastructural solutions.

Salary/Day - \$50, Total (15 days) - \$750

### **II. Travel and Per Diem**

A. Travel of project staff will be required for site visits for pre-installation phase, meetings with municipality representatives, supervision, etc. Total number of visits 25 (2-4 managers per visit). Cost per visit \$30. Total travel costs - \$750.

### **III. Procurement**

**A. Execution** of equipment purchase, construction, production and assembly of components and installation works.

| # | Item               | Unit  | Quantity | Unit Price (usd) incl. installation (USD) | Total Price incl. installation (USD) |
|---|--------------------|-------|----------|---|--------------------------------------|
| 1 | Photovoltaic panel | PC    | 65       | 256                                       | 16640                                |
| 2 | Inverter           | PC    | 3        | 2365                                      | 7095                                 |
| 3 | Controller         | PC    | 2        | 600                                       | 1200                                 |
| 4 | Foundation pins    | PC    | 8        | 575                                       | 4600                                 |
| 5 | Metal poles        | PC    | 8        | 500                                       | 4000                                 |
| 6 | 20x5m metal frame  | sq.m. | 100      | 50  | 5000                                 |
|   | Fixings and cables | set   | 1        | 500                                       | 500                                  |
|   | Transportation     |       |          |   | 1000                                 |
|   | Total              |       |          |   | 40035                                |

Total budget – \$40,035

#### IV. Other Direct Costs

**A. Office/Communication expenses** - will cover costs of office supplies needed to complete the project such as printer paper cartridge, telephone bills, bid announcements etc

Price/month- \$172 Total (3 months) - \$515

## 6. SUSTAINABILITY, ENVIRONMENTAL AND ECONOMIC ANALYSIS

The sustainability of the project is a direct outcome of obligations of municipality's joining to the Covenant of Mayors. Another important factor that backs the project fulfillment and guarantees its growth beyond the phase is reduction of operation costs due to reduced consumption and therefore economy of the budget for municipal utility bills. Therefore it is in the municipal authority's interest to sustain project and take on maintenance and operation of the project after it is handed-over.



In addition to achieve high level of sustainability New Technology Center will provide training of local human resource allocated by municipal authority on maintenance and operation of the equipment installed in the boundaries of the project.

It is also important to note that sustainability is aided by Georgia-EU association agreement, which included Georgia’s responsibility to adapt the environmentally friendly and energy efficient technologies.

As for the replicability of the project its’ feasibility is based on the demonstrational qualities of the project. Use of solar energy in the region makes it possible to replicate these technologies and approaches not only in municipal buildings like kindergartens and administrative units but a number of other municipal, state and residential buildings.

It is also noteworthy that there are 13 Covenant of Mayor signatory cities in Georgia that have taken similar commitments to reduce their Carbon footprint and thus this project is likely to be exported throughout these 13 municipalities. The technology used in this project can be fully or selectively transferred to various GHG reduction projects nationwide.

As for GHG’s reduction and energy savings these will be obtained from installation of PV windows that will provide reduction of building consumption on heating from 150 W/sq.m. to 100 W/sq.m. As a result this will decrease energy consumption on heating by 51,340 kWh (840sq.m.X(0.15-0.1)X8X151). To acquire the mentioned above amount of energy (51,340 kWh/yr) by burning the natural gas, it’s demanded volume will be  $51,340 / 9.4 = 5,462 \text{ m}^3$  costing  $5,462 \times 0.84 = 4,588 \text{ GEL}$ .

This reduction is providing in decrease of 10.4 tons/annually GHG emissions (0.202kg/kWh).

Replacing street lighting with LED will provide further economy and reduction of GHG emissions. This activity will result in the following reduction:

|                                    | Amount of lamps | Capacity (W) | Daily operation hours | Daily consumption in kWh | Annual consumption in kWh | Emission factor kg CO2/kWh |
|------------------------------------|-----------------|--------------|-----------------------|--------------------------|---------------------------|----------------------------|
| Base Lighting                      | 28              | 360          | 12                    | 120.96                   | 44150                     | 0.104                      |
| After installation of LED lighting | 28              | 100          | 12                    | 33.6                     | 12264                     | 0.104                      |

Annual reduction of consumption – 31886 kWh,

Annual reduction of GHG emissions - 3,3 t

Thus total reduction of GHG emissions from activities already planned by municipality are estimated at 13.7 tons.

Grant funded activities will provide additional reductions is obtained from electricity generation from solar energy. Annual production of electric power is estimated at 9196 kWh which with a conversion rate of 0.104 t CO<sub>2</sub>/MWh amounts to 0.96 tons/year.

Total emission reduction from all project activities is 14.66 tons per year.