



Energy Efficiency Assessment

for selected municipal buildings

Final Report

with recommendations for Implementation

June, 2018



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Acronyms

EE - Energy Efficiency
GHG - Green House Gas
SDAP - Sustainable Development and Policy Center
SEAP - Sustainable Energy Action Plan
TRACE - Tool for Rapid Assessment of City Energy

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The Team Composition

The SDAP team comprised of the following experts: Karine Milikadze, Onki Aloian, Besik Jokharidze, Boris Dgebuadze and Giorgi Lekveishvili, all energy efficiency experts.

The SDAP was founded in 2008. The Center is actively engaged in implementing energy efficiency assessments of developments and in design and renewal processes of the existing buildings and new constructions. The center provides expertise in developing the energy passports and expertise of new building designs and carries out energy audits. The Center offers functional and technical training and support, resolving any and all troubleshooting issues, selecting of equipment and building design options.

1. Background

Tbilisi City Administration invited technical support from the World Bank on several of the core pillars of its resilience vision, including: coverage and accessibility of public amenities and green infrastructure, and energy efficiency improvement.

Improving energy efficiency of public assets is one of the near-term strategies for reducing Green House Gas (GHG) emissions, mitigating air pollution, improving quality of services and achieving operational cost savings that could be channeled into other public services. The city first identified energy efficiency as a priority area of intervention in 2011, when the city prepared a Sustainable Energy Action Plan. Public assets account for 10% of total energy consumption in Tbilisi; given that most public assets are old and haven't been renovated, and that the city has policy and management control over those assets, the situation presents an opportunity for efficiency improvements. In 2012, the World Bank conducted a high-level assessment of energy use in Tbilisi, using TRACE (Tool for Rapid Assessment of City Energy), prioritizing sectors with significant energy savings potential; the report identified transport, public lighting, public buildings and solid waste as areas for improvement. A pilot upgrade of 10 municipal buildings to achieve higher energy efficiency has already been funded by the municipality; however, per the Tbilisi Energy Efficiency brief prepared by Copenhagen Centre on Energy Efficiency, further investment will be critical to catalyze a broader uptake of energy efficiency practices. By focusing on energy efficiency of public assets the city can reduce its carbon footprint as well as its operating costs. Energy Efficiency (EE) interventions also can enhance the quality of services (better and brighter street lighting, warmer hospitals etc.), productivity of the public sector (better, safer, warmer workspaces for public employees), and set in motion a broad scope of positive social and economic externalities resulting from mainstreaming of energy efficiency practices in the society.

To help the City Administration with energy efficiency assessment, the World Bank through the SDAP Center assessed the EE potential in the selected public assets in Tbilisi, identified ways to scale up ongoing city efforts to improve energy efficiency, and presented the findings and results at a workshop with municipal officials responsible for asset management and resilience.

2. Methodology and approach

The comprehensive energy assessment was conducted using ENSI EAB and ENSI Economic Profitability software tools. These are well-established tools in the EU countries for proper evaluation of energy consumption profile in a systemic way and identification of energy efficiency profitable measures.

The pilot energy assessment studies aim at contributing to and informing the city administration on the need to scale up EE in municipal buildings.

The energy audit covered inspection of the buildings to evaluate the current state of energy consumption and general conditions of building envelope and technical systems. The reliability of energy consumption data plays decisive role for carrying out energy audit. Prior to inspection stage, the energy audit team received the natural gas and electricity bills from the Tbilisi Municipality. Architectural and engineering layouts were mostly provided by the administrations of the selected facilities. Where absent, all measurements were carried out by the energy audit team. During the site inspection the energy audit team obtained information from administration on details of audited facility and filled in all relevant information in the inspection check list. Preliminary data analysis was performed for broader understanding of particularities of energy consumption profile for each facility. All parameters, describing the conditions of the building envelope and technical building systems, were entered into the software for calibration of a model and development of the energy consumption scenarios for “Actual”, “Baseline” and “After EE Renovation” for analysis of the energy performance of buildings and various measures that could be implemented to reduce the energy consumption, greenhouse emissions and improve the indoor environment. The detailed results for each facility are presented in Energy Audit Reports for each selected facility and describe recommended measures with corresponding investments, savings and profits. For more details, please see the attached energy audit reports.

The City Administration prioritized five municipal buildings as a pilot for assessment. These included:

1. Kindergarten No. 95,
2. Kindergarten No. 191,
3. Art School No. 6;
4. Municipal Fitness / Gymnastic Sports Center, and
5. Gldani Nadzaladevi district Sports Center

3. Findings and Recommendations

The current report summarizes the main findings from the energy audit assessments of the selected municipal buildings, including energy saving potential and evaluation of energy efficiency measures, which will result in reduction of energy consumption and related costs and associated greenhouse emissions, and increase of energy efficiency.

The energy efficiency assessment yield considerable energy efficiency improvements potential in all buildings:

Institution	Savings in delivered energy (kWh/year)	Net savings (GEL/year)	Investments (GEL)	Payback (Year)	CO2 emissions reduction (tons/year)
Kindergarten No. 95	218,230	19,805	199,971	10.1	43.80
Kindergarten No. 191	135,419	12,970	180,111	8.6	25.55
Art School No. 6	54,395	5,436	48,090	8.8	10.01
Municipal Fitness / Gymnastic Sports Center	781,552	60,179	486,948	8.1	157.9
Gldani Nadzaladevi district Sports Center	576,945	48,055	243,000	5.1	114.1

For the five buildings the total savings in delivered energy will constitute amount of: 1,766,541 kWh/year with the associated emissions reduction of: 351.31 tons/year. Implementation of these measures will require the total investment of 1,158,120 GEL.

The studies also showed that in addition to physical interventions to increase the energy efficiency in the municipal buildings, there is also a need to train the staff on how to maintain buildings with respect to proper management and operations.

Georgia is on its way meeting commitments foreseen in the Association Agreement with the EU, in particular the EU/GE/Annex XXV that targets sustainable energy use and energy efficiency of future developments of the Georgian energy sector. Given this circumstance and upcoming legislation changes to support energy efficiency, the team recommends the following:

1. In the past five years, the Tbilisi City Hall rehabilitated large number of kindergartens with respect of energy efficient measures, including installation of modern heating system with efficient boilers, energy-efficient bulbs, double-glazed metal plastic windows and doors. According to energy monitoring report on implementation of the SEAP measures in buildings sector the installation of new heating system with efficient boiler was implemented more than in 40 kindergartens, installation of metal plastic windows was carried out in 107 kindergartens, and with the municipal investment of 57,360 GEL the energy efficient bulbs were installed in the part of kindergartens as well. However it is recommended not to restrict the EE rehabilitation of buildings only

to implementation of the above EE measures. It is known that the energy-efficient measures are ranked according to their energy-saving opportunities. The buildings sector in the SEAP incorporates comprehensive set of energy saving measures that are suggested for implementation. This includes the measures covering insulation of the exterior of the municipal buildings. The above measures have high energy saving potential because buildings built during the Soviet period did require implementation of energy efficiency by building codes of that time. For reduction of high energy consumption in buildings, it is highly desirable to implement the building insulation measures.

2. For insulation of the building envelope, the SEAP suggests insulating building's exterior structure, including the windows and doors, walls and floors. The city largely implemented only one measure – installation of double glazed metal plastic windows, which led to the modest energy savings from 40%-45% to 15%-17 %. It is suggested that full scale interventions are conducted. This also applies to Kindergarten No. 95. The new technical requirements were partly followed. New heating system with gas condensing boiler and heat pump were installed in the boiler room for achieving higher energy efficiency indicators. Ventilation system units with heat recovery were installed in classrooms and photovoltaic panels for onsite generation of electricity were installed on the flat roof. In addition, the solar collectors with area of 23 m² were installed on the flat roof for preparation of DHW supply. The system still does not operate properly as insulation of building envelope components were not implemented. This predetermined significant thermal losses that were not foreseen with development of technical design and resulted in much higher energy consumption demand of heating system for provision of indoor comfortable conditions.
3. All five energy audits reports suggest that there is a significant room for improvements for each selected municipal building. It is important to note that identification of the energy consumption profile, energy savings arising from specified EE measures and investment costs needs to be carried out before comprehensive energy efficient rehabilitation project is implemented. This will lead to elaboration of correct technical solutions for implementation of EE measures that correctly pinpoint EE indicators of energy performance of building. In some sense this presents a road map for further development of technical requirements for development of technical design of the EE rehabilitation project. It is highly recommended to implement all identified EE measures as a one package since measures influence each other.
4. Given the findings from the reports and considering upcoming regulations, the City administration should implement a pilot project with comprehensive rehabilitation of the exterior components. This can be achieved with the technical assistance of the professionals from the sector and a dedicated team of experts from the city administration.

5. Based on the pilot studies, the City Administration can implement the rehabilitation program for the municipal buildings to achieve the following:
 - a. Tbilisi City Hall owns 372 buildings with the total floor area of 453,652 m² among which the total internal/heated area of the kindergarten buildings constitutes area of 209,872.57 m². Based on these two pilots, by investing 22,424,203 GEL, the City will reduce energy consumption by 131.22 kWh/m²/year. For all municipal kindergartens in Tbilisi this will represent 27,311,155.8 kWh/year in savings. This will result in reduction of the associated CO₂ emissions in kindergarten buildings approximately by 5,152.9 t/year.
 - b. The city owns 12 sport facilities with the total heated area of 38,342 m². Energy audits of the sports facilities identified saving in delivered energy per square meter as follows: 214.123 kWh/m²/year in case of the Municipal Gymnastic Sports/Fitness Centre considering insulation of the building envelope's components and improvements with installation of technical systems as well as 153.85 kWh/m²/year for improvement of technical building systems with installation of the solar collectors and automation control system for proper operation of systems at Gldani – Nadzaladevi Sport Complex. Implementation of energy efficiency measures in all 12 Sport Facilities will result in approximate savings in delivered energy of 8,209,904 kWh/year taking into account insulation of building envelope, or in case of improvement of technical building systems savings in delivered energy will constitute amount of 5,898,916.7 kWh/year. This will require investment costs of 133.41 GEL/m² for approximation of results of the Municipal Gymnastic Sports/Fitness Centre and scaling them to all Sports Facilities. Accordingly, this will constitute in investment cost of 4,614,918.7 GEL. Approximation of the GHG reduction from the case of the energy audit findings of the Municipal Gymnastic Sports/ Fitness Centre to all remaining municipal sport facilities will reduce the amount of GHG emissions to 1,497.8 t/year and in case of approximation of results of the Gldani – Nadzaladevi district Sport Complex amount of reduced GHG emissions will constitute to 1,054.64 t/year.
 - c. Total amount of the municipal buildings heated floor area that belong to the Schools of Arts constitute to 18,576 m². The energy audit findings of School of Arts No. 6 identified savings in delivered energy specified as: 73.41 kWh/m²/year that will require investment costs of 64.9 GEL/m²/year for implementation of energy efficiency measures. Scaling up results of the energy audits to remaining total area of all art schools area will provide savings in delivered energy of at least 1,363,664.2 kWh/year with investments costs of 1.205,582.4 GEL and reduction of the associated GHG emissions by 250.94 t/year.
6. Considering the new energy efficiency buildings regulations, Tbilisi City Hall will be required to build a coordinated approach towards implementation of energy efficiency

measures for municipal assets (including management) and large public investments for various regeneration and rehabilitation schemes. This has to result in adjusted municipal policy that will be carried out by a team of motivated local government officials with the improved knowledge of implementation of energy efficiency and experts' technical assistance. Improvement of quality of technical documentation, trainings, proper operation and maintenance of building and equipment as well as energy monitoring activities should be taken into consideration as well. To these end, it is recommended to set up an energy efficiency group or unit, who will be responsible for energy efficiency activities at a municipal level. It is expected that activities will cover coordination on implementation of energy efficiency measures in buildings, development of comprehensive municipal data base, improvement of collection of energy related data, inclusion of energy monitoring procedures, analysis of behavior patterns, as well as strengthening requirements of technical documentation.

7. After rehabilitation, another important element to achieve the maximum effect of energy efficiency is the operation and maintenance of technical systems. To operate and maintain building properly, the staff should be aware their roles and responsibilities, operations arrangements and guidelines, maintenance requirements. These can be achieved through a structured learning events.
8. At a lower (building) level, it is recommended to establish an organized group responsible for energy monitoring. The weekly routines should be done by the operation and maintenance personnel of the building and include the reading of the energy meters in the building and calculate the specific energy consumption, registration of the outdoor mean temperature for the corresponding period; inserting these two data in the ET-diagram, checking deviations from the ET-curve that may indicate some malfunctioning equipment or wrong operation settings. The practice may help to identify the issues and implement the required repair or adjustments to the systems.

The World Bank and SDAP stand ready to provide further assistance in addressing the issues identified above, implement the recommendations at a city or local level and support the City administration in developing a pilot project to upgrade the city facilities with respect to energy efficiency measures.

Attachments:

1. Energy Audit Report - Kindergarten No 95
2. Energy Audit Report - Kindergarten No 191
3. Energy Audit Report - Art School No 6
4. Energy Audit Report - Municipal Fitness / Gymnastic Sports Center
5. Energy Audit Report - Gldani Nadzaladevi district Sports Center