UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

Enterprise Energy Efficiency - 3E

PILOT PROJECT PROPOSAL No. B1-1
HIGH SCHOOL IN MOSTAR

SITE VISIT REPORT AND PILOT PROJECT PROPOSAL EVALUATION

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Chief of Party

Sarajevo, April 29, 2011

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1. Pilot Project Proposal Screening Report

I Partners:
City of Mostar

II Proposed EE measures after USAID 3E analysis:	
1. Replacement of windows	250,000 $
2. Installation of a new automatic heating and boiler control system	11,000 $
3. Installation of motorized control valves and thermostatic valves	17,000 $
4. Installation of fan forced hot water unit heaters	6,000 $
5. Monitoring and Verification System	11,000 $
Total cost of proposed EE measures	295,000 **$**

III Co-funding contributions:	
1. Direct co-funding from partner's own funds;	250,000 $
2. Partner co-financing from borrowed funds;	0
3. Other donors` co-funding:	
UNDP	22,500 $
4. Provision of works and services (e.g., decommissioning of old equipment, installation of new equipment, design and supervision services, monitoring and verification (M&V));	0
5. Provision of materials and equipment (e.g., piping, wiring, insulation material, control equipment); and	0
6. Partnership with a private sector partner that might contribute any of above.	0
Total confirmed co-funding by partner/donors:	272,500 **$**

IV Co-funding by USAID 3E:	
Total 3E Project co-funding based on best estimate:	**22,500 $**

V Compliance with criteria for selection:		
1. Replicability potential and relative ease of implementation;	0 - 12	12
2. Readiness and ability to put in place clear M&V procedures for reporting on post-implementation energy savings;	0 - 12	12
3. Appropriate geographic location, building type and types of technologies so that the total portfolio of 10 pilot projects when implemented demonstrates various EE measures, technologies and practices applied to different building types or EE practices and are located across the country;	0 - 24	16
4. Amount of co-financing for the pilot project that the partner is willing to or able to secure, or the amount of assistance the pilot project can obtain from other donors or private sector;	0 - 24	24
5. For the public sector - willingness to introduce energy management practices into other public buildings that are responsibility of the partner;	0 - 12	12
6. For municipalities - readiness to sign the EU Covenant of Mayors on EE;	0 - 4	4
7. For all – a willingness to support the raising of EE awareness of building users and citizens at large.	0 - 12	12
Total:	**100%**	**92%**

VI Environmental Compliance:	
Confirm that the pilot project implementation does not cause any environmental concerns or adverse environmental effects.	Yes

2. Project evaluation summary

2.1 Basic data about the project:

- Project is to reduce thermal losses in the building and improve efficiency of heating system
- The year of construction = 1893, last renovation in early 2009
- The building is not thermally insulated
- Number of floors = 3 + basement
- Heated area = 4,000 m^2
- Heated volume = 15,000 m^3
- Outside wall area = 3000 m^2
- Window area = 400 m^2
- Number of students and staff = 900
- Number of operating days = Official heating season= 150 days
- Heating supplied by two 800 kW oil boilers
- Annual heat energy consumption = 28,000 liters of light fuel oil (300 MWh)
- Annual heating cost for the building = 45,000KM ($32,000)

2.2 Recommended measures:

1. Replacement of windows
2. Installation of a new automatic heating and boiler control system
3. Installation of motorized control valves
4. Installation of thermostatic valves
5. Installation of fan forced hot water unit heaters

2.3 Rationale:

1. The building represents cultural and historical heritage and its facade has been renovated in early 2009. The outside walls are not thermally insulated; and for such historical buildings, insulation must be put on the inside walls in order to preserve the original facade appearance. Like most buildings from the Austro-Hungarian period, this building has thick walls which have a relatively low heat transfer coefficient. However, two identical windows are located in one opening in the façade, separated by 10 cm, which result in higher heat losses and need to be replaced. These windows were made in the same style as the original windows even though they were installed in 1997. The City will replace them with windows that preserve the visual appearance of the original windows but have the heat transfer coefficient according to current regulations. A large number of windows have a unique shape and they need to be made of wood like the original windows. In addition the windows need to be shatterproof for safety reasons, so the cost of replacing them is significantly higher ($625/$m^2$) than the average cost ($200/$m^2$). However, in the calculation for the cost of energy efficiency measures, it is appropriate to use the average cost and the additional cost is attributed to historical heritage preservation. The City of Mostar has already initiated a tender for their replacement.
2. The current heating control system enables manual adjustment of the boiler water outlet temperature. It is manually adjusted by the maintenance personnel on a subjective basis. The control system should be replaced with an automatic system that adjusts the boiler water outlet temperature according to the outdoor temperature.

3. There are two main vertical heating supply pipes running from the boiler room and each supplies one half of the building. From those vertical pipes horizontal supply pipes branch out on each floor. There are no valves that enable reduction of the heat supplied to the part of the building that is not used. This represents a deficiency in the heating system design and results in energy waste, since there are often situations when only a part of the building is used. The recommended motorized control valves can be controlled by the heating automatic control system and indoor temperature sensors that will be installed in the building.
4. Thermostatic valves should be installed on all radiators in the building, and in conjunction with an automatic regulation of water supply temperature significant energy savings and optimal thermal comfort can be achieved. Since this is a high school, it is recommended to install thermostatic valves protected against unauthorized tampering, with temperature settings by students.
5. In the gym, radiators are installed on the ceiling hanging on metal chains. This is a serious flaw in the heating system design, because radiators mounted in this way are ineffective and represent a hazard because of the risk of them falling on students. This is the reason why they have been removed from the part of the gym where football and basketball are played. They should be replaced with fan forced hot water unit heaters that can be enclosed in a metal frame to ensure they would not be damaged or fall down when hit by a ball.
6. These measures can be replicated in many schools, since most of them do not have more advanced control systems installed.
7. The City is financing most of the project costs (90%), which demonstrates its commitment to the project and ensures successful project implementation.

2.4 Benefits:

- A large LCD display can be installed at the entrance of the school, on which students, teachers, parents and visitors can see current and cumulative data related to reduction of fuel oil consumption and CO2 emissions, temperature in different parts of the building, outdoor temperature and such. In addition, short educational films can be shown on the display. This display will serve as an important educational and awareness tool.
- Practical demonstration of energy savings and improved thermal comfort through new windows and a modern heating control system
- Motivate other local governments to financially support such projects in schools by disseminating information about this project. There is a large number of schools in Bosnia and Herzegovina that use fuel oil for heating, and potential financial savings resulting from reduced fuel oil consumption are very significant.
- Stimulate local economy – if more schools followed this example, local companies would improve existing heating systems, install thermal insulation, replace windows, repair roofs
- Reduction of usage of imported fossil fuel
- Reduction of CO2 emissions
- Public health improvement

3. Project Technical Description and Analysis

3.1 Introduction

The city of Mostar is interested in reducing energy consumption and is preparing to sign the Covenant of Mayors. In achieving the targeted reduction in overall energy consumption, reduction in the building sector plays a crucial role. The City proposed the Old high school (Stara gimnazija), built in 1893, which has been partially renovated in 2009 and its original beauty restored (Figure 1).

There is no district heating system or gas pipeline in Mostar, so most buildings are heated using electricity and fuel oil. Both of these energy sources are expensive, so reduction in their consumption has significant financial benefits. Since most electricity is produced from coal, reduction in electricity consumption also has environmental benefits, similar to those resulting from reduced fuel oil consumption.

3.2 Site visit report

The building is built in the typical construction style of the Austro-Hungarian period, with thick walls and high ceilings. Thick walls provide sufficient thermal insulation, but the windows are single glazed and cause high heat loss and cold air infiltration and need to be replaced. Replacement of windows is generally a measure with long payback periods; but in this case, it will be even longer because of the higher cost of manufacturing shatterproof windows of nonstandard form. However, besides energy saving, replacement of windows will reduce noise and dust penetration and improve the comfort of occupants.

The building has its own boiler room in the basement with two 800 kW oil boilers and a light fuel oil storage tank in the backyard. The heating system can be improved, resulting in significant energy savings and improved thermal comfort. The improvements will enable selective heating of different parts of the school, heating according to outside temperature and adequate temperatures in all parts of the building.

Figure 1. Front view of the high school (Gimnazija), Mostar

3.3 Technical and financial analysis

The estimated energy consumptions, before and after measures, for this building are shown in the following table:

Table 1. Energy consumption

Energy carrier	Unit	Present	After measures	Savings
Light fuel oil	MWh	300	180	120

The reduction of CO2 emissions achieved by implementation of the measures is 33 tons per year.

The cost for the measures and the payback period is shown in the following table. It is assumed that the price per kWh remains the same. As mentioned earlier, in the calculation for the cost of energy efficiency measures, it is appropriate to use the average cost ($200/m^2; for 400m^2 the cost is $80,000) and the additional cost is attributed to historical heritage preservation.

Table 2. Preliminary cost and benefit analysis for recommended measures

Measures	Investment [$]	Annual Savings Est [$]	Simple payback period [year]
Windows, automatic heating control system, control and thermostatic valves, fan forced hot water unit heaters; Installation of motion sensors, replacement of incandescent bulbs and magnetic ballasts	125,000	13,000	9.6

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