

**UNITED STATES AGENCY FOR INTERNATIONAL
DEVELOPMENT**

Enterprise Energy Efficiency (3E)

MECHANICAL ENGINEERING FACULTY (MEF)

SARAJEVO

PILOT PROJECT PROPOSAL

July 16, 2010

Zoran Morvaj
Chief of Party

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**UNITED STATES AGENCY FOR INTERNATIONAL
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Enterprise Energy Efficiency (3E)

***ATTACHMENT A:
PILOT PROJECT PROPOSAL SCREENING REPORT***

July 16, 2010

Zoran Morvaj
Chief of Party

Pilot Project Proposal Screening Report

I Partner

Faculty of Mechanical Engineering, Sarajevo

II Proposed EE measures

| | |
|---|--------------------------|
| 1. Insulation of the building | \$68,500 |
| 2. Boiler house reconstruction | \$73,000-83,000 |
| Total cost of proposed EE measures | \$141,500-151,500 |

III Co-funding by partner/donors:

| | |
|---|-----------------|
| 1. Direct co-funding from partner's own funds; | \$30,000 |
| 2. Partner co-financing from borrowed funds; | NO |
| 3. Other donors' co-funding: | |
| Norwegian Ministry of Foreign Affairs | \$6,500 |
| UNDP | TBC |
| 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)); | TBC |
| 5. Provision of materials and equipment (e.g., piping, wiring, insulation material, control equipment); and | NO |
| 6. Partnership with a private sector partner that might contribute any of above. | TBC |
| Total confirmed co-funding by partner/donors: | \$36,500 |

IV Co-funding by USAID 3E:

| | |
|--|--------------------------|
| Total 3E Project co-funding based on best estimate: | \$105,000-115,000 |
|--|--------------------------|

V Compliance with criteria for selection:

| | |
|--|-----|
| 1. Replicability potential and relative ease of implementation; | YES |
| 2. Readiness and ability to put in place clear M&V procedures for reporting on post-implementation energy savings; | YES |
| 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; | YES |
| 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; | YES |
| 5. For the public sector - willingness to introduce energy management practices into other public buildings that are responsibility of the partner; | N/A |
| 6. For municipalities - readiness to sign the EU Covenant of Mayors on EE; and | N/A |
| 7. For all – a willingness to support the raising of EE awareness of building users and citizens at large. | YES |

| <i>VI Indicative project implementation schedule:</i> | |
|--|-----|
| Letter of Commitment signed by | TBC |
| Conceptual Engineering Design completed by | TBC |
| Tender for Detail Design published by | TBC |
| Contract for Detail Design awarded by | TBC |
| Detail Design completed by | TBC |
| Equipment ordered by | TBC |
| Tender for Implementation published by | TBC |
| Contract for Implementation awarded by | TBC |
| Implementation completed by | TBC |

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Enterprise Energy Efficiency (3E)

***ATTACHMENT B:
LETTER FROM THE DEAN***

July 16, 2010

Zoran Morvaj
Chief of Party

Prof. Dr. Ejub Džaferović
Dean
Faculty of Mechanical Engineering
Vilsonovo Šetalište 9
Sarajevo

Dr. Zoran Morvaj
Chief of Party
USAID Enterprise Energy Efficiency (3E) Project

PROPOSAL FOR USAID 3E PILOT PROJECT

Dear Dr. Morvaj,

I was very pleased to hear about the new **USAID Enterprise Energy Efficiency (3E) Project** that encompasses implementation of energy efficiency (EE) pilot projects. This initiative is very welcome since in BiH the EE market is undeveloped and awareness in the society of the importance of EE is at a very low level. My understanding is that the 3E Project is looking for pilot projects and I would like to propose the Mechanical Engineering Faculty building to be considered as a Pilot Project.

The building housing the Mechanical Engineering Faculty (MEF) represents an excellent opportunity for a pilot project for the following reasons:

1. MEF has already started an energy efficiency project through the following activities:
 - A preliminary energy audit was completed by a group of trainees including two employees of the MEF during their training to become energy auditors (the training was conducted by the Norwegian consulting company Energy Saving International - ENSI). The energy audit showed that the heating demand can be reduced 30 to 50% through implementation of energy efficiency measures.
 - The Faculty will invest this summer in the following measures:
 - replacement and relocation of heating pipes that run in the basement to prevent future leakages since one occurred last winter;
 - replacement of the pumps for heating;
 - renovation of one part of the facade funded by the Government of Sarajevo Canton in the amount of €25,000
 - The Norwegian consulting company ENSI has granted €5,500 for co-financing of the listed measures with the condition that the works must be completed by the beginning of October, 2010.
 - Funding for an EE project that would include other EE measures (adding insulation on outside walls, replacement of boiler, installation of

thermostatic valves) is being sought from the Municipality of Novo Sarajevo, Canton of Sarajevo and Federation ministry of education in the amount of €60,000.

- The Faculty has a large maintenance staff and a machine shop and can help in decommissioning of old equipment and production and modification of parts if necessary.
 - The Faculty employs two lecturers who are Heating, Ventilation and Air-Conditioning (HVAC) specialists with extensive practical experience who can help in supervision of project implementation and in monitoring and verification procedures that follow the implementation. One of them is preparing his PhD thesis on EE efficiency and the other successfully completed the training for energy auditors and received a commercial license for ENSI software used in analysis of EE measures in buildings (EAB Software).
2. The Faculty offers an opportunity for a strong public and professional awareness campaign because:
- The faculty has 1200 students, faculty and staff and annual enrolment of 250 students.
 - The Faculty signed a contract with ENSI for 10 academic EAB Software licenses to train students in advanced HVAC courses on identification and evaluation of EE measures.
 - HVAC designers are exclusively educated by Faculties of Mechanical Engineering, and the one in Sarajevo is the largest in BiH.

I am looking forward to an opportunity to discuss this further with you.

Sincerely,

Prof. Dr. Ejub Džaferović



**UNITED STATES AGENCY FOR INTERNATIONAL
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Enterprise Energy Efficiency (3E)

***ATTACHMENT C:
PRELIMINARY ENERGY AUDIT SUMMARY***

July 16, 2010

Zoran Morvaj
Chief of Party

Introduction

The the Dean of Mechanical Engineering Faculty of the University of Sarajevo contacted 3E and proposed the building of the Mechanical Engineering Faculty (MEF) as a pilot project. The MEF is funded by the Canton of Sarajevo through the Ministry of Education and Science and also has own income through projects and graduate courses. MEF owns 2 buildings, one built in 1960 and one built in the late 1980s. For the old building MEF already completed a Preliminary Energy Audit which contains a lot of valuable information, which will serve as a basis for a final energy audit.

Through this project 3E could demonstrate energy efficiency measures for buildings with large heated area that use gas boilers of the old design type and obsolete technology, and little or no automatic control which is very common in Bosnia and Herzegovina. This measure was not suggested in the Preliminary Energy Audit since the expected cost would exceed the budget available to MEF at the time.

The 3E team visited the proposed building and performed a walk-thru audit and collected relevant information:

Building information

- The building is generally in acceptable condition, but maintenance needs improvement (regular painting of windows for example)
- The building has ground floor, 5 floors and basement.
- The building area is 5220 m².
- The building entrance is facing south.



Figure 1. View of the building from the entrance (left) and from the north-west side (right)

Occupants

- Average number of persons in the building on a week day is 250.
- There are 100 employees.

Energy consumption

- Data has been supplied for the years 2007 and 2008.

Table 1. Energy consumption

| Year 2007 | District heating | Electricity | Gas | Total |
|----------------------|-------------------------|--------------------|------------|--------------------------|
| Energy costs | 0 | 36.143 | 46.880 | 83.023 € |
| Energy consumption | 0 | 403.851 | 708.437 | 1.112.288 kWh |
| Specific consumption | 0 | 76,9 | 134,9 | 211,9 kWh/m ² |
| Water consumption | m ³ | | | € |
| Year 2008 | District heating | Electricity | Gas | Total |
| Energy costs | 0 | 36.812 | 42.593 | 79.405 € |
| Energy consumption | 0 | 407.840 | 643.644 | 1.051.484 kWh |
| Specific consumption | 0 | 77,7 | 122,6 | 200,3 kWh/m ² |
| Water consumption | 6.232 m ³ | | | 3.724 € |

Heating and hot water supply system

- MEF owns a boiler room with 3 boilers (814kW boiler built in 1980 and two 1510 kW boilers built in 1986) which heat both buildings. They have all exceeded their technical lifetime and need to be replaced. The fuel is natural gas and heating oil as backup.
- The hot water for heating is supplied to the heating substation where it is divided in 3 heating loops: 1 for the old building, and 2 for the new building.
- Hot water is supplied by individual electric water heaters.
- Total gas consumption is measured.

Lighting

Data for lighting is available but not relevant since none of the proposed EE measures is related to lighting.

Proposed energy efficiency measures

The energy savings potential identified in the Preliminary Energy Audit as energy efficiency and renovation measures is summarised in the following table, with ranking of measures according their profitability (NPVQ). Presently, the heating system is not automatically controlled and introduction of automatic control will ensure proper operation of the system, thermal comfort in

the building and energy savings. The pumps for heating are oversized and inefficient and run 24/7 to prevent freezing and need to be replaced by smaller, more efficient pumps. The building is not thermally insulated and the windows are in poor condition. There is no Technical Building Management which would establish procedures for maintenance, training of the maintenance personnel, heating regime and energy monitoring (EM) and introduction of TBM/EM results in energy savings.

Table 2. EE measures cost and benefits from the Preliminary Energy Audit

| EE Potential - Energy Audit | | | | | |
|-------------------------------------|-------------------|----------------|--|-------------------|-----------|
| <i>Mašinski Fakultet Sarajevo</i> | | | Conditioned area: 5 220 m² | | |
| EE measures | Investment [€] | Net savings | | Payback [year] | NPVQ * |
| | | [kWh/yr] | [€/yr] | | |
| Profitable EE measures | | | | | |
| 1. Heating: Automatic control | 4.200 | 59.350 | 3.767 | 1,1 | 5,97 |
| 2. Fans and pumps: Pumps heating-FR | 2.400 | 12.217 | 823 | 2,9 | 3,33 |
| 3. WALL INSULATION | 30.000 | 134.028 | 8.845 | 3,4 | 3,22 |
| 4. Heating: TBM/EM | 6.500 | 54.971 | 3.228 | 2,0 | 2,86 |
| 5. Fans and pumps: TBM/EM | 1.200 | 3.150 | 187 | 6,4 | 0,97 |
| 6. WINDOWS | 162.000 | 245.461 | 16.200 | 10,0 | 0,26 |
| Total all measures | 206.300 | 509.177 | 33.050 | 6,2 | |

* Based on 4,9 % real interest rate

For the investment and savings to be valid, all measures should be implemented as one project.

The presented savings in delivered energy divided into savings per energy carrier:

| Energy carrier | Unit | Present | After measures | Savings |
|----------------|----------------|---------|----------------|---------------|
| Electricity | kWh | 407.840 | 392.473 | 15.367 |
| Gas | m ³ | 69.209 | 15.882 | 53.327 |

The reduction of CO₂ emissions achieved by implementation of all measures is 171,5 tons/year.



Figure 2. MEF boiler house and 814 kW gas boiler

As mentioned earlier, replacement of the 814kW boiler and separating the heating system for the old and new building should be considered. Modern, efficient, technologically advanced, locally available and locally servicable equipment should be installed. The increase in efficiency of the boiler would result in reduced gas consumption and thus financial savings. It is estimated that the gas consumption will be reduced by 15% which, based on consumptions in 2007 and 2008, is 101,406 kWh which based on gas price in July 2010 (0.0592 €/kWh) is 6000 €. This measure should not be viewed on savings basis alone but also that the boiler exceeded its technical lifetime and must be replaced.

Table 3. Preliminary cost and benefit analysis of boiler replacement

| EE Measure | Investment [€] | Annual Savings Est [€] | Simple payback period [year] |
|---|----------------|------------------------|------------------------------|
| Replacement of 814kW boiler and connection to existing piping | 55,000-65,000 | 6,000 | 9.2 – 10.8 |

Next steps

- Request approval for USAID to proceed with the project, if granted then
 - Sign commitment document with the beneficiary/partner
 - Perform a detailed energy audit
 - Complete Conceptual Engineering Design (CED)
 - Write Project definition and scope