Western Balkans Investment Framework WBIF

ces CLEAN ENERGY SOLUTIONS

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Energy Audits and Energy Efficiency Design

Mechanical Engineering

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Content

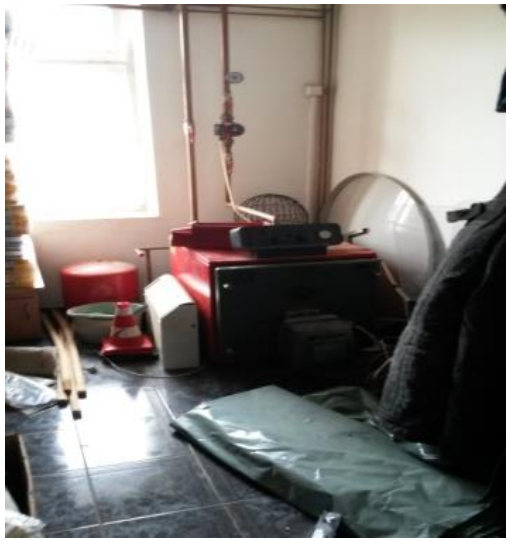
- Heating systems
- Ventilation systems
- Cooling systems
- Sanitary hot water systems
- Water systems

Heating systems

- Typically decentralized systems (outside major cities which have DH)
- Campuses with centralized boiler rooms
- Main fuel used DH/diesel (HFO)
- Very often supplemented with electric heaters
- Generally, very bad situation of boiler rooms/substations
- Maintenance questionable (replacement on need basis)
- Often quick-fixes and improvisations
- Missing insulation of the main pipes and other components
- Fire protection/safety issues
  - Boiler rooms often used as additional storages/equipment disposal
  - Leaks in fuel tanks
  - Mishandling fuel

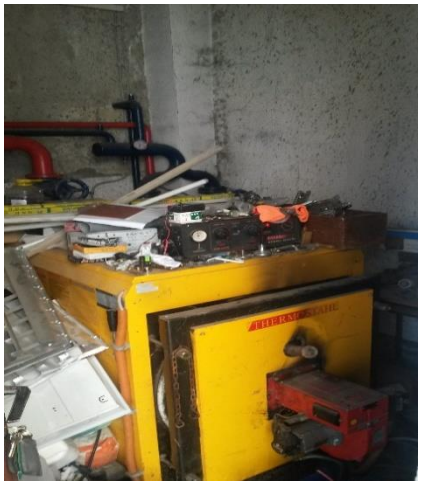
Heating systems

Heating systems



Heating systems

Heating systems



Heating systems

- Missing mechanical design documentation, problems with:
  - Determining whether the system was correctly dimensioned in the first place
  - Determining system parameters
  - Sizing new components
  - Providing enough heating energy
- Missing information related to maintenance, e.g.:
  - How many times was the system actually drained and re-filled?
  - Was it filled with the required medium?
- Lack of thermostatic valves/incorrect installation
- Hydraulic balancing issues
- Heating system regulation
- Improvisations in the heating distribution network (missing pipe segments, removed radiators, etc.)
- Damaged radiators (corrosion, leaks, top covers, etc.)

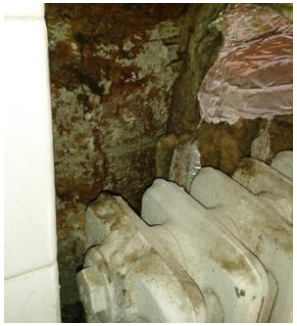
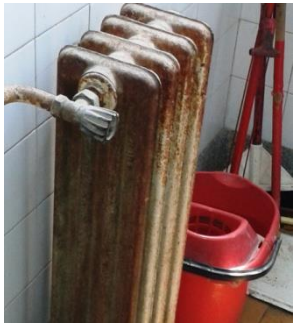
Heating systems









Heating systems






Heating systems

- Missing information/documentation about the system - WHAT TO DO?
  - Partial refurbishment?
  - Complete refurbishment?
- How to reach a conclusion
  - Measurements - room temperature (very good indication)
  - Interview with technical personnel/room/building users
  - Observation
- Findings outside the set task?
  - To report or not?
  - Influence on the task in hand?
  - Consequences?
- Include them in the investment?
  - As a part of EE measures?
  - Separately?

Heating systems

- In the end…
  - Must be properly dimensioned (norms/standards/regulation)
  - Must meet the heat losses due to envelope properties
  - Must be balanced
  - Must be automatically regulated
  - Must be efficient
  - Must ensure room temperature regulation
  - Must ensure comfort
  - Must be regularly maintained
  - Must be monitored

Ventilation systems

- Absolute requirement in low-energy buildings
  - Provide fresh air/extract used air
  - Prevents possibility of mold/high moisture environment
  - Eliminates high heat losses due to window opening
  - Heat recovery
- Present mostly in hospital buildings/laboratories
- Mostly not working/not operating properly
  - Incorrectly dimensioned ducts/system pressure drop
  - Insufficient air (extract/supply) quantities
  - Malfunctioned components
  - Missing heat recovery
  - Fire safety?
- Not present in spaces with special requirements

Cooling systems

- Mostly distributed cooling devices (split AC units)
- Centralized units present in several cases
- Used for cooling but also as auxiliary heating devices
- In general replacement with new split AC units not viable
- Removal or re-installation after envelope renovation?
- Re-installation
  - Should be foreseen in design
  - Notes for construction companies on proper re-installation after refurbishment to prevent damages to envelope

Sanitary hot water systems

- Mostly distributed electrical devices
- Centralized systems present in several cases (larger complexes)
- Solar thermal systems present
  - Broken collectors
  - Improper installation in the roof construction
  - Problematic dimensioning
  - Intermittent demand (e.g. dormitories) - water wasting
- Actual demand - benchmarks, standards, etc.
- Need for a centralized system?
- System efficiency?
- Need for a solar thermal system?

Water systems

- Not considered but…
  - Can cause significant increase in building operation costs
  - Consumption can be easily reduced - low cost-high effect
  - Faucet aerators and two-stage toilet tanks

Source: RC Mannesmann

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Who does what? - Level of detail

- **ENERGY AUDITOR**
- **DESIGNER**

Considered EE & RE measures

- MECHANICAL ENGINEERING MEASURES
  - Improvement of the heating system
    - Installation of TRVs
    - Replacement of pumps
    - Replacement, fixing and cleaning the existing heating distribution system
  - Fuel switch - district heating, biomass, *heat pumps*
  - Sanitary hot water preparation - Solar thermal systems

EXAMPLE

In addition to this, Dormitory for men has installed solar panels with a total of 22 panels (1.2x2 m) and 4 water storage tanks of 1000l each. The tanks are also connected to the electrical system for water preparation when solar panels are not supplying to full requirement, but currently they are turned off due to high energy expenses. SHW substation is located in the basement of the Dormitory and no major deficiencies were noted.

Sanitary hot water consumption is estimated to around 1314 m^3/a, meaning 77 MWh energy (calculated with 10°C average annual cold water temperature and 60°C desired SHW temperature).

Type	Description	Quantity
Solar panels	- Dim. 1.2x2.0 m	22
Hot water tank	- V = 1,000 l each	4
Expansion vessel	- V = 100 l each	2
Pumps	- Wilo, Ips 350/10	1

Table 12 – Installed equipment for Sanitary Hot water production and distribution

Figure 9 – SHW preparation

5.4. SPACE HEATING

Kosovo Academy for Public Safety campus has a centralized heating system with one heating plant serving all buildings within campus. Heating plant runs on diesel boilers. Entire heating system was refurbished during 2000-2002. The water is distributed through an underground pipeline system. Site visit revealed that the underground piping system was recently replaced (in 2014) (Dormitory men, Dormitory women, Administration, New Dormitory, and Range shooting). The old pipes were replaced with new pipes insulated with glass wool and laid into concrete trenches. The interview revealed that second phase of the project is expected to be finalized during 2015 when pipes that supply Sports Hall and School building will be replaced with new. This was already implemented in the second half of 2015 according to information that was received. Every building (besides Steve Benet building, Healthcare building and Building 14) has its own substation, where the hot water enters into the hot water headers and then through the circulating pumps to upper floors.

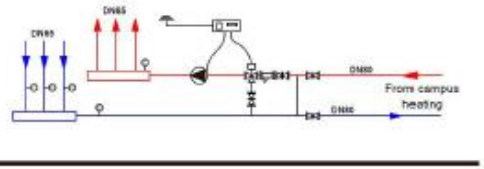

Figure 10 – Technological scheme of heating

5.4.1. Hot Water Preparation and Distribution

Substation is located in the basement covering an area of 18 m^2, which is sufficient for the current heating system and storages around it would allow placement of potential additional equipment.

Heating substation has been renovated in 2000 when new pumps, valves and piping were installed. Heating hot water is circulated with one Wilo pump without VFD. A three way valve is installed and working properly. The distribution pipes within the substation are well insulated with some minor deficiencies caused during some construction works. However, personnel didn't report any leakages in the system.

The installed equipment for heating preparation and distribution is listed below:

Type	Description	Quantity
Pumps	- Ips 340/2, type Wilo	1

Table 13 – Installed equipment for heating preparation and distribution

Figure 11 – Substation

EXAMPLE

Figure 12 – Radiators installed in the building

Radiators

Basic he

TYPE	Dimensions	No.	Capacity	Total
			W	kW
PCP	600x1000	21	2,256	47.4
PCP	600x1200	80	2,256	178.8
PCP	600x1400	20	5,126	62.5
PCP	600x1600	8	5,571	28.6
PCP	600x1800	5	4,017	12.1
PCP	500x1200	2	5,704	7.4
	TOTAL	154	42044	553

Table 14 – Specification of radiators

Internal temperature was measured in different places and the results show 19-22°C in most of the rooms. However there was a higher fluctuation in hallways where the measured temperature range was between 12-18°C.

The calculated system power for the baseline scenario is 422 kW (see Annex 2 for calculation details) which is above the total installed radiator capacity of 336 kW, and the comfort conditions are not met due to low capacity of radiators compared to heat losses.

After introducing EE measures, heat demand will drop significantly (200 kW), which means radiators capacity will be oversized. Therefore, it is recommended to install TRVs on each radiator.

5.5. AIR CONDITIONING

There is no central cooling system in the building.

5.6. SPACE VENTILATION

There is no central ventilation system installed.

5.7. ELECTRICAL SYSTEM

There are no data regarding the internal electricity distribution network. In general, the lighting is in a poor condition in terms of EE and there are no replacement parts

available. Fixtures are T8 linear fluorescent lamps operated by conventional control gear (CCG) which has placed under reflecting grill for soft light distribution and incandescent 100 W lights. Lighting measurements accounted for 150-200lux in most of the rooms and approximately the same in hallways. It is recommended to replace the lighting system with a more efficient one which will also ensure higher lighting levels which will meet the national standards. A lighting simulation of one characteristic room is provided on the figure below.

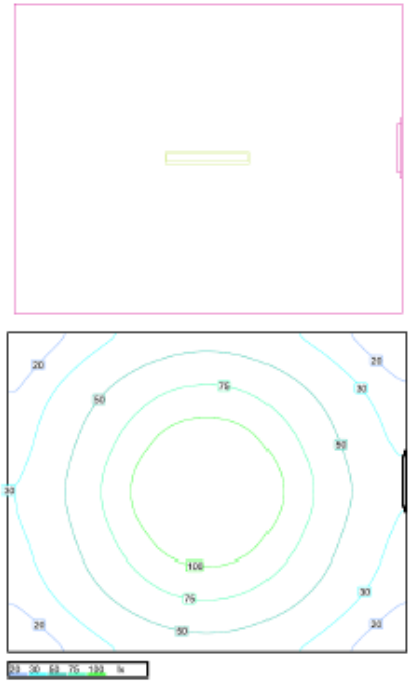

Figure 13 – Lighting simulation of one characteristic room

Since the baseline is calculated for the condition where all the lamps are in place and operating, the new lamps to be installed are only included in the Table of the Investment.

Profile

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Zlatko BAČELIĆ MEDIĆ

- Experience in team management and project coordination in energy efficiency, renewable energy and new technologies implementation
- Team leader in preparation of investment grade energy audits in public, private and industrial sectors
- Experience in capacity building in developing countries
- Extensive experience in technical modeling and preparation of financial analyses for energy efficiency and renewable energy projects
- Expertise in optimization and cost-optimality in energy efficiency projects
- Expertise in analysis and assessment of energy sectors, including energy planning
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to the future.
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Whenever!
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