Energy Audit Summary Report

AEE INTEC

Audit no. 06 – BUL01

English School

10th of June 2011

Supported by INTELLIGENT ENERGY EUROPE

This energy audit has been carried out with cofunding of the European Commission (EACI) in the Framework of the EU funded project EINSTEIN-II (ProjectNo. IEE/09/702/SI2

AUDIT no. 06 – BUL01

1. Data of the auditor

1.1. Contact data of the auditor

Name of the auditor: Matthaeus Hubmann

Number of audits preformed: 3

date of the audit: 10.06.2011

duration of the audit: 4 weeks

AEE-Intec, Gleisdorf, Austria

2. Introduction

2.1. Objectives

The main objectives of this audit were to verify and check the potential of solar thermal power.

3. Status Quo: processes, distribution, energy supply

The reference data and information are taken from the year 2010.

3.1. General information of the company

English School, Ruse (Bulgaria)

Sector	School, Public Building
Products	none
No. of employees	55 staff, ~610 students

Current final energy consumption [MWh/a]

District heating	510

3.2. Flow sheet of the whole manufacturing side

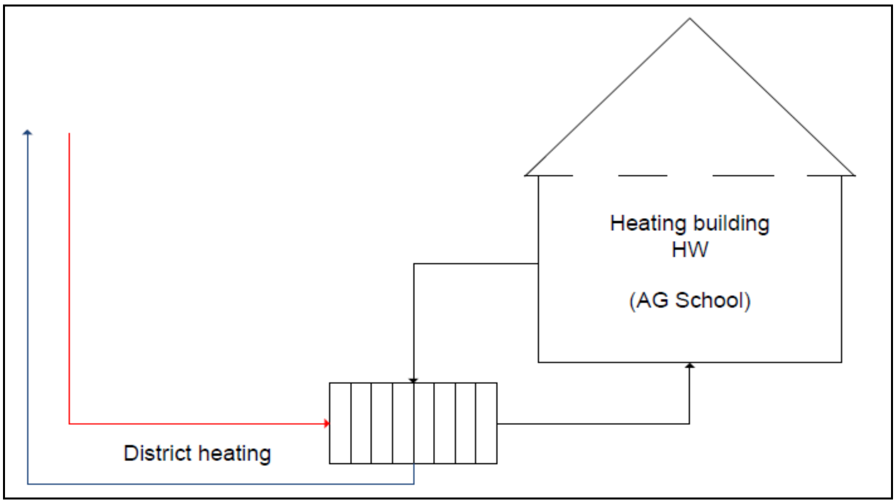

Figure 1: Flow sheet of the School
Explanation: HW... Hot water, There is no manufacturing part in the building.

3.3. Description of the existing system

Figure 2: Heat supply installations in the basement

The building is connected to a public heat supply system. The spent amount of heat is measured by a thermal energy meter. Two pumps circulate the heating media (water) in the building at a temperature of 90°C which is delivered by the public district heating.

Table 1: Total primary energy consumption (PEC) and primary energy consumption for thermal use (PET)

Energy type (fuels / electricity)	PEC		PET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
Total fuels	561	89,90	561	100,00
Total electricity	63	10,10	0	0,00
Total	**624**	**100,00**	**561**	**100,00**

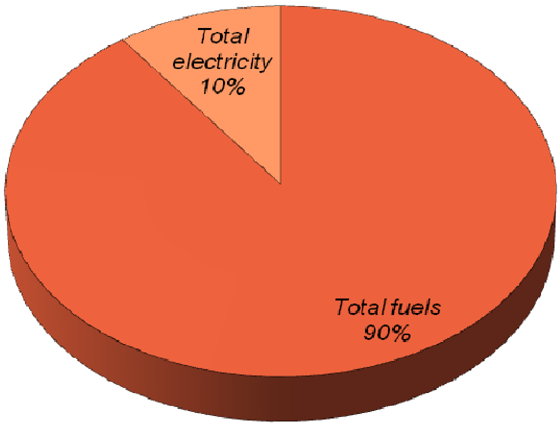

Figure 3: Distribution of PEC by fuel type

Table 2: Total final energy consumption (FEC) and final energy for thermal use (FET); present state.

Fuel type	FEC		FET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
District heating	510	96,05	510	100,00
Electricity	21	3,95	0	0,00
Total	531	100,00	510	100,00

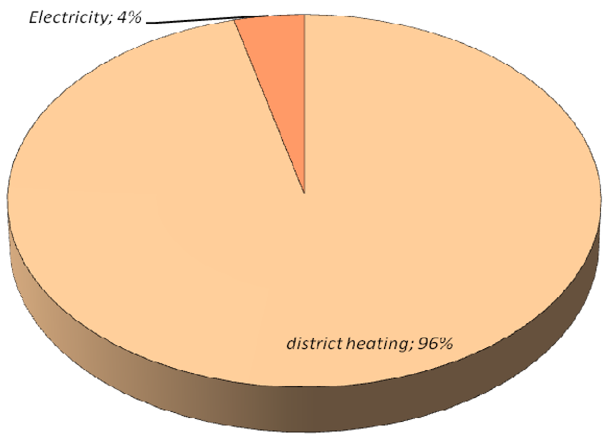

Figure 4: Total final energy consumption (FEC); present state.

Table 3: Final energy consumption for thermal use (FET) by equipment (present state)

Equipment	Fuel type	FET by equipment	
		[MWh]	[% of Total]
district heating	district heating	510	100,00
Total		**510**	**100,00**

Table 4: Useful supply heat (USH) by equipment; present state.

Equipment	USH by equipment	
	[MWh]	[% of Total]
district heating	505	100,00
Total	**505**	**100,00**

- Distribution system

  Media: water (90/70 °C)

Table 5: Useful heat demand (UPH) by processes
Explanation: HW...hot water

	[MWh]	[% of total]
HW school	44	9%
heating school	460	91%
total	505	100%

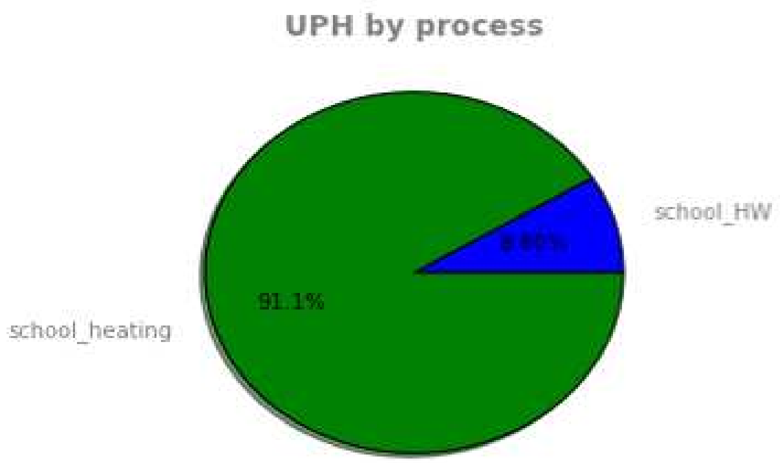

Figure 5: Distribution of process heat demand (UPH Total) by processes

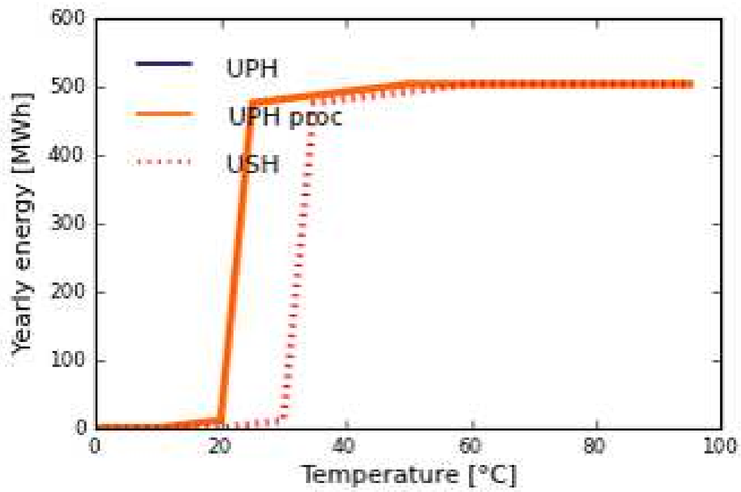

Figure 6: Distribution of heat demand (UPH) and supply (USH) by process temperature

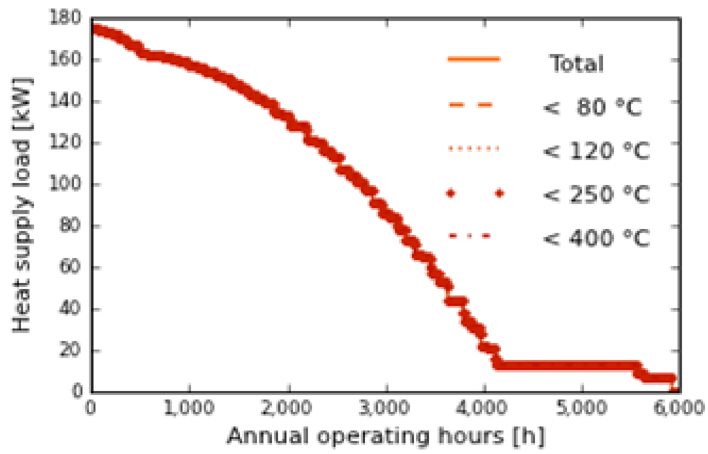

Figure 7: Cumulative heat demand (USH)

3.4. General

- The company is already connected to the public heat supply system nevertheless a potential of renewable energy supply has been considered in this study.
- In the following study the improvement of the building (100kWh/m²a) itself is not considered. This is due to the fact that EINSTEIN is not a tool for optimization of a building but considers only the heating and hot water demand of a building.
- Because there was no information about the approximate use of hot water at the school an assumption was made that there is a use of 3 m³ of hot water per day.
- The summer holiday period of the school was set to first of July until end of August and a winter break of 2 weeks in the end of December and beginning of January was defined.

4. Comparative study

4.1. Proposed alternatives

There are two proposals made in this study. Both of them substitute a part of the necessary heat delivered by the district heating through solar thermal power. The first proposal (solar proposal 1) shows the potential of a flat plate collectors and the second proposal (solar proposal 2) takes the use of evacuated tube collectors into account.

4.1.1. Heat and Cold Supply

- Solar thermal: **Solar proposal 1**

collector type:	flat plate collectors
installed capacity:	279 kW
needed area:	440 m²
solar puffer storage volume:	19,95 m³
solar fraction:	16,6 %
annual energy yield:	300 kWh/kWa

Table 6: Heat and cooling supply equipment and contribution to total heat and cooling supply

Equipment	Nominal capacity	Contribution to total heat and cooling supply	
	[kW]	[MWh]	[%]
Solar Proposal 1	279	84	16,60
District heating	200	421	83,40
Total	**479**	**505**	**100**

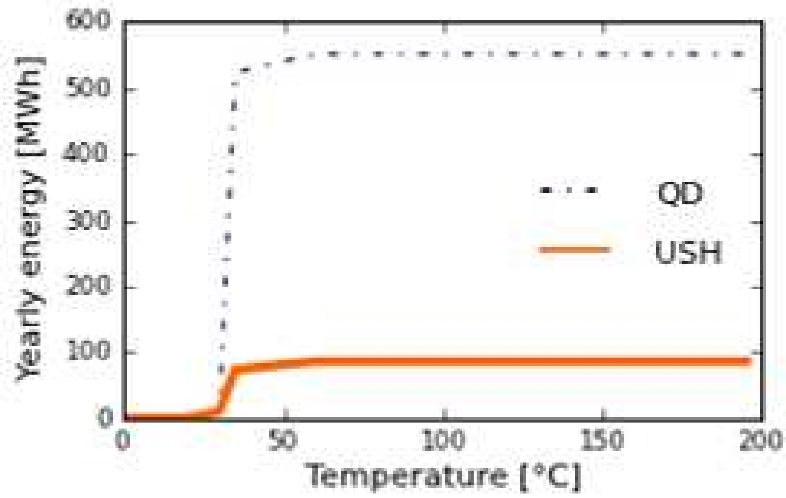

Figure 8: Heat demand and solar contribution

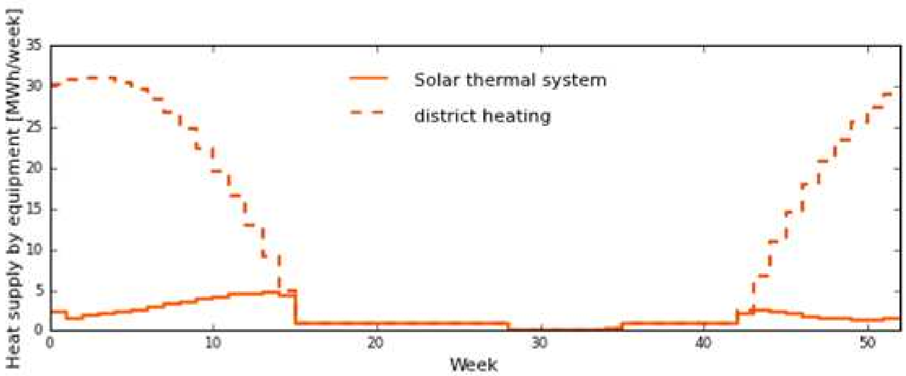

Figure 9: Daily heat supply by equipment

- Solar thermal: **Solar proposal 2**

collector type:	evacuated tube collector
installed capacity:	811,3 kW
needed area:	1.270 m²
solar buffer storage volume:	57 m³
solar fraction:	48,24 %
annual energy yield:	300 kWh/kWa

Table 7: Heat and cooling supply equipment and contribution to total heat and cooling supply

Equipment	Nominal capacity	Contribution to total heat and cooling supply	
	[kW]	[MWh]	[%]
Solar thermal system	811	243	48,24
District heating	200	261	51,76
Total	**1.011**	**505**	**100**

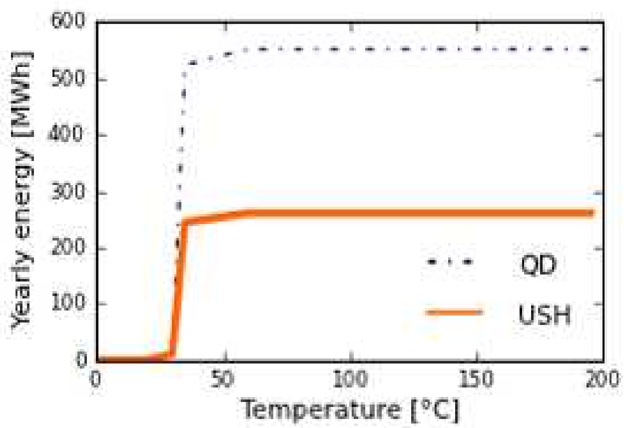

Figure 10: Heat demand and solar contribution

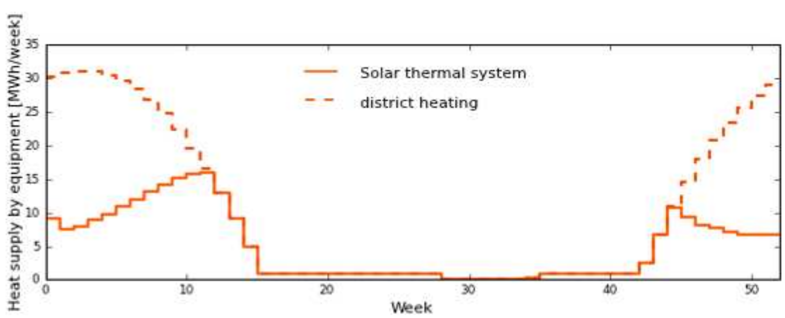

Figure 11: Daily heat supply by equipment

Table 8: Primary energy consumption: present state and alternative proposals.

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Present State (checked)	624		
Solar Proposal 1	528	96	15,32
Solar Proposal 2	358	266	42,70

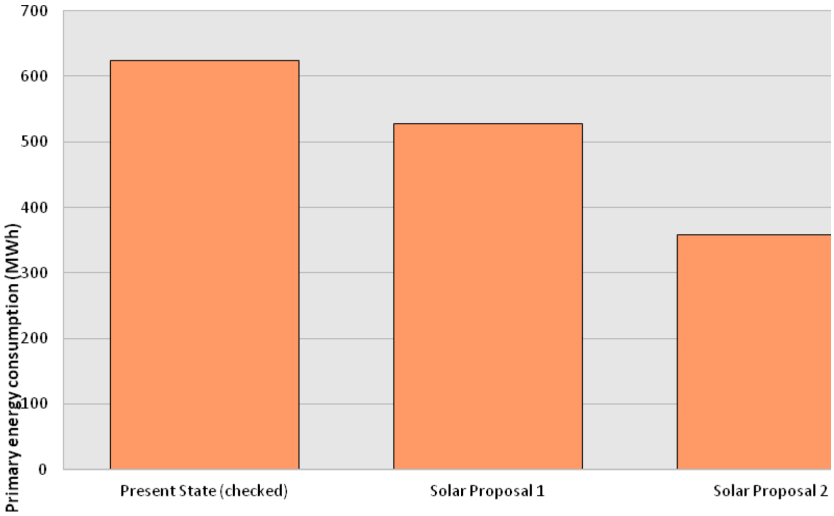

Table 9: Comparison of alternatives: primary energy consumption

Due to the fact that the processes were not changed, the useful process heat and the supply heat stayed the same.

Table 10: Environmental impact: present state and alternative proposals.

Alternative	Production of CO2	CO2 savings	% savings
	[t]	[t]	[%]
Present state	138,00		
Solar Proposal 1	116,12	21,88	15,86
Solar Proposal 2	77,00	61,00	44,20

5. Selected alternative(s) and conclusions

5.1. Selected alternative

As selected alternative the second proposal was chosen as it promises best primary energy savings. No structural optimizations of the building were proposed.

5.1.1. Process optimisation (written proposals)

None

5.1.2. Heat and Cold Supply

Solar thermal:	**Solar proposal 2**
collector type:	ETC (evacuated tube collector)
installed capacity:	811,3 kW
needed area:	1.270 m²
solar buffer storage volume:	57 m³
solar fraction:	48,24 %
annual energy yield:	300 kWh/kWa

5.2. Comparative study and conclusions

		Present state	Alternative	Saving
Total primary energy consumption (1)	[MWh]	624	358	266
Allocation of energy consumption	[-]			
Total fuels	[MWh]	561	295	266
Total electricity	[MWh]	63	63	-
Share of renewable energy	[%]	-	43%	
CO_2 emissions	[tons/a]	138	77	
Annual energy system cost (2)	[EUR]	17.910	10.438	4.790
Total investment costs	[EUR]		303.613	

(1) including primary energy consumption for non-thermal uses

(2) including energy cost (fuel and electricity bills), operation and maintenance costs and annuity of total investment.

5.2.1. Energy and environmental analysis

In the proposed alternative more than 40% of the initial CO_2 pollution can be saved by switching to solar thermal equipment.

5.2.2. Economic analysis

The payback period of more than 20 years is probably too high for the public building. There is a big potential that this figure can be lowered because the calculations are based on subsidies of 30% and the investment costs have to be revised.

5.2.3. Conclusions and outlook

In order to consider the installation of the solar thermal equipment the roof construction, inclination, orientation and possible shading problems of the surrounding trees have to be checked.

As told before the exact calculation of the payback period could not be done and have to be revised because they are based on subsidies of 30 % and have to be changed to the correct data.