Energy Audit Summary Report

AEE INTEC

Audit no. 05 – UK01

Data Centre

11th of August 2011

Supported by INTELLIGENT ENERGY EUROPE

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AUDIT no. 05 - UK1

1. Data of the auditor

1.1. Contact data of the auditor

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Number of audits preformed: 1

Date of the audit: 15.04.2011

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 energy savings.

3. Status Quo: processes, distribution, energy supply

The reference data and information are taken from several months in the beginning of the year 2011.

3.1. General information of the company

Data centre

Sector	Data centre
Products	none
No. of employees	n.a. (not available)

Current primary energy consumption 215 [MWh/a]

3.2. Flow sheet of the whole manufacturing side

There is no manufacturing part in the building.

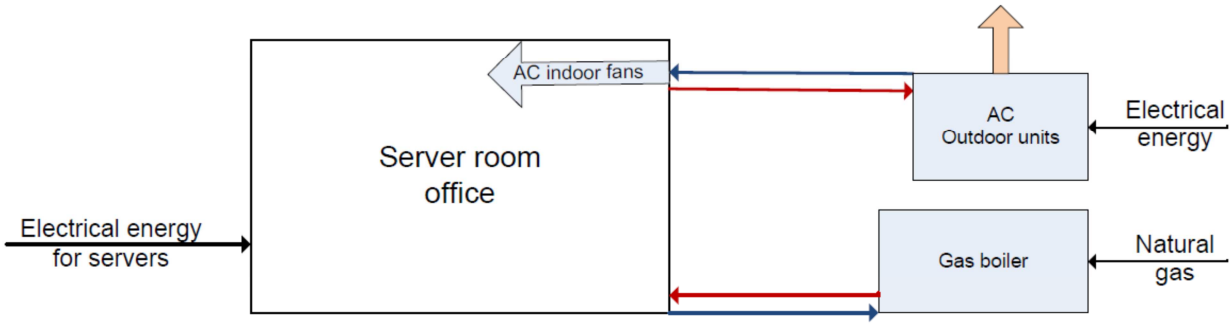

Figure 1: Flow sheet of the data centre
Explanation: AC...Air condition

Picture 1: Server room

3.3. Description of the existing system

- **Energy Supply:**

The company is selling server capacity therefore a lot of electricity is consumed and during the heating period the heating is done by a gas boiler with a capacity of 40 kW. As seen above in Figure 1 during server operation the room temperature

increases and has to be cooled down to a temperature of 22 °C by four air conditioning units. During winter time a gas fired boiler delivers the required heat for heating up the rooms.

Table 1: 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	48	22.52	48	22.52
Total electricity	167	77.48	167	77.48
Total (fuels + electricity)	**215**	**100.00**	**215**	**100.00**

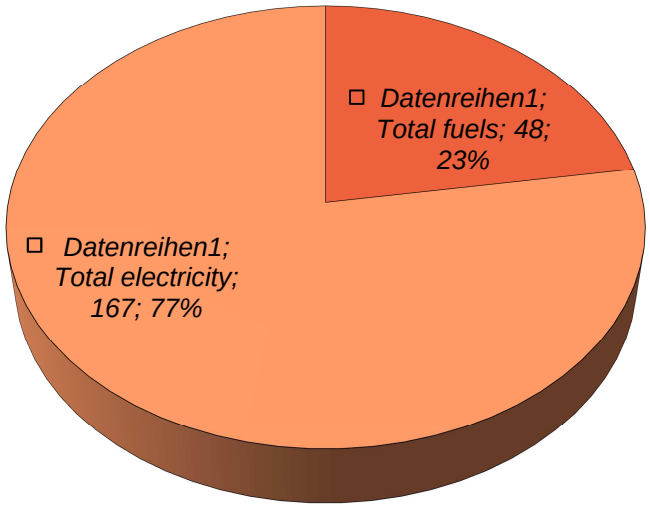

Figure 2: distribution of PEC by fuel type

Table 2: Final energy consumption (FEC) and Final energy consumption for thermal use (FET)

Fuel type	FEC		FET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
Natural gas	44	44.22	44	44.22
Electricity	56	55.78	56	55.78
Total	100	100.00	100	100.00

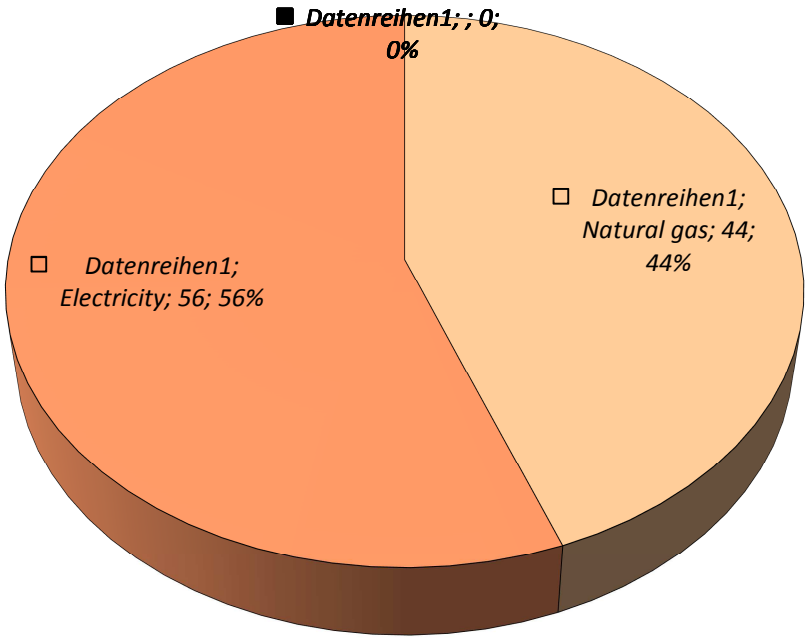

Figure 3: Total final energy consumption for thermal use (FET)

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

		[MWh]	[% of Total]
SERVER	Electricity	39	39.84
Gas boiler	Natural gas	44	44.63
Chiller (cooling)	Electricity	15	15.53
Total		**99**	**100.00**

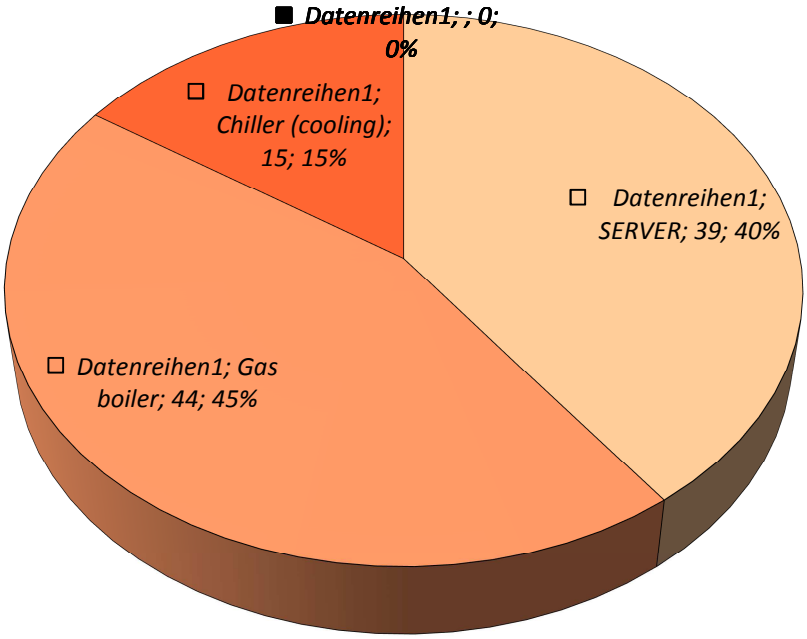

Figure 4: Final energy consumption for thermal use (FET) by equipment

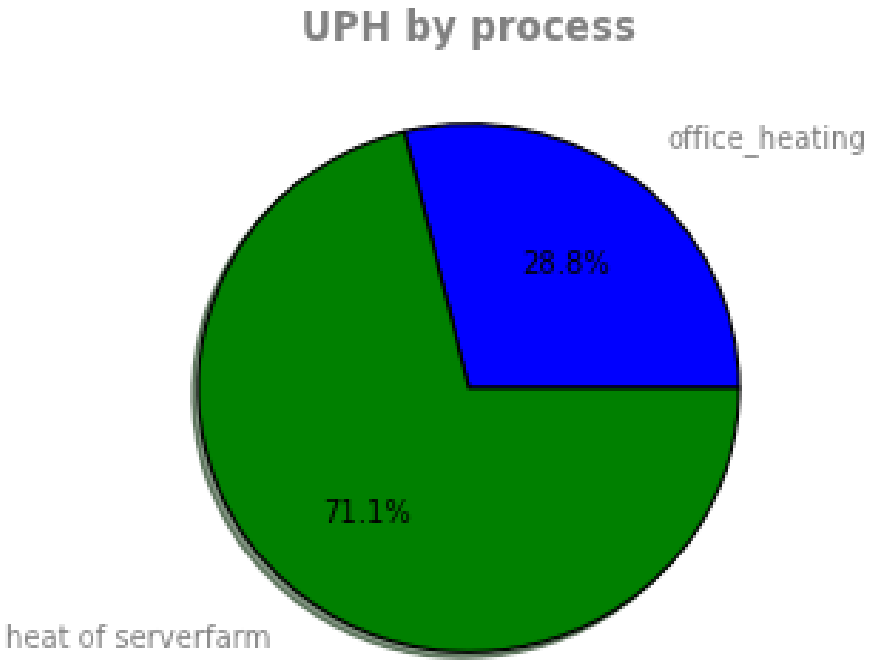

Figure 5: Distribution of process heat demand (UPH total) by processes

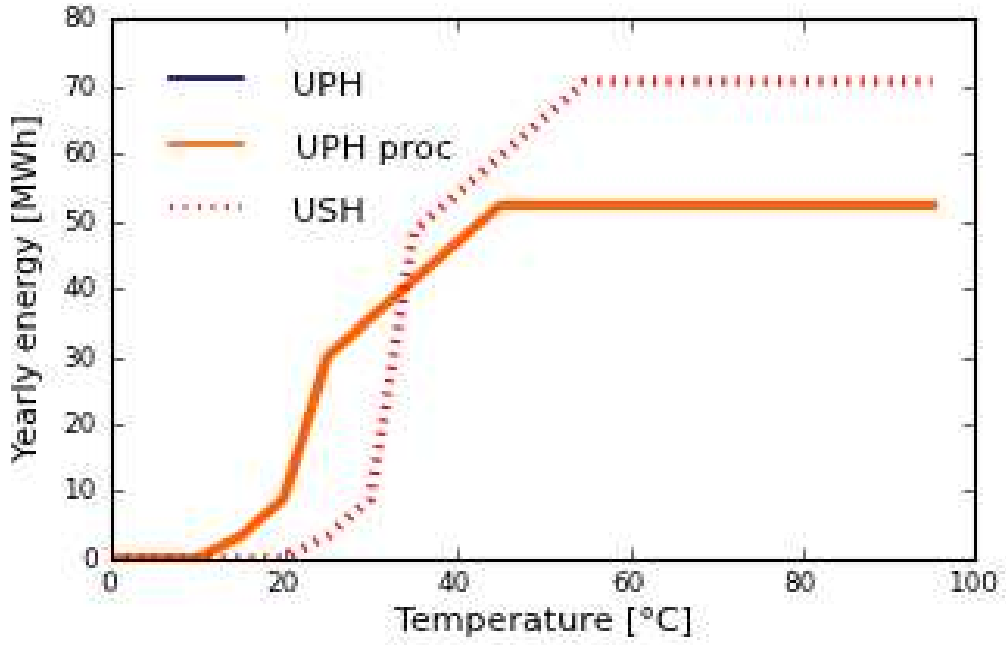

Figure 6: Distribution of heat demand (UPH) and supply (USH) by process temperatures

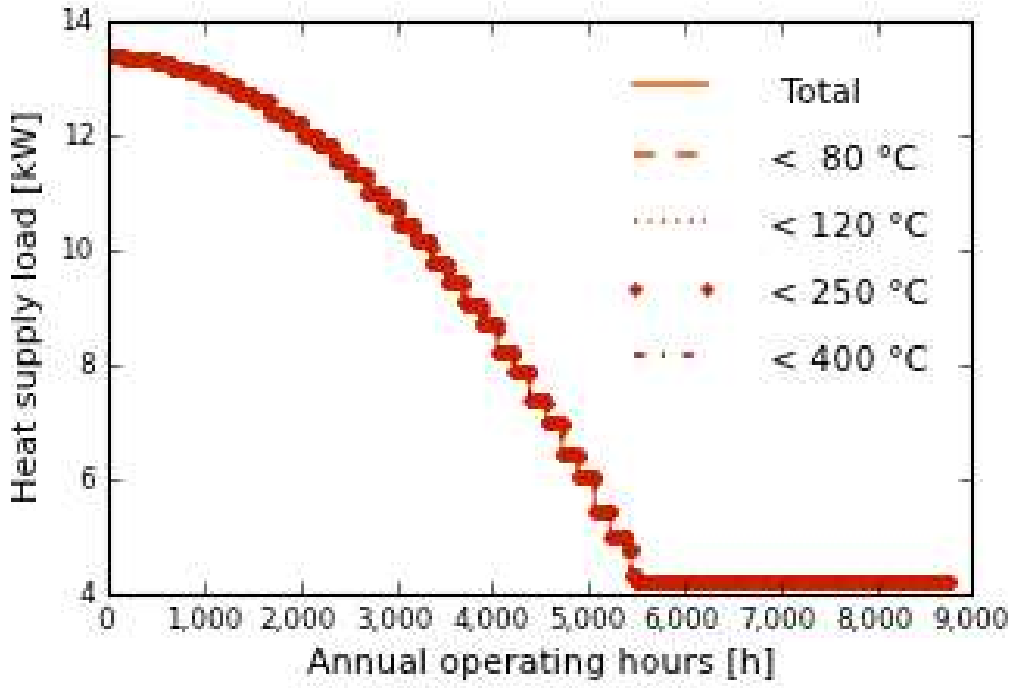

Figure 7: Cumulative heat demand (USH)

- Main energy consuming energy processes and buildings

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

Equipment	**USH by equipment**	
	[MWh]	[% of Total]
SERVER	38	53.05
Gas boiler	34	46.95
Total	**72**	**100.00**

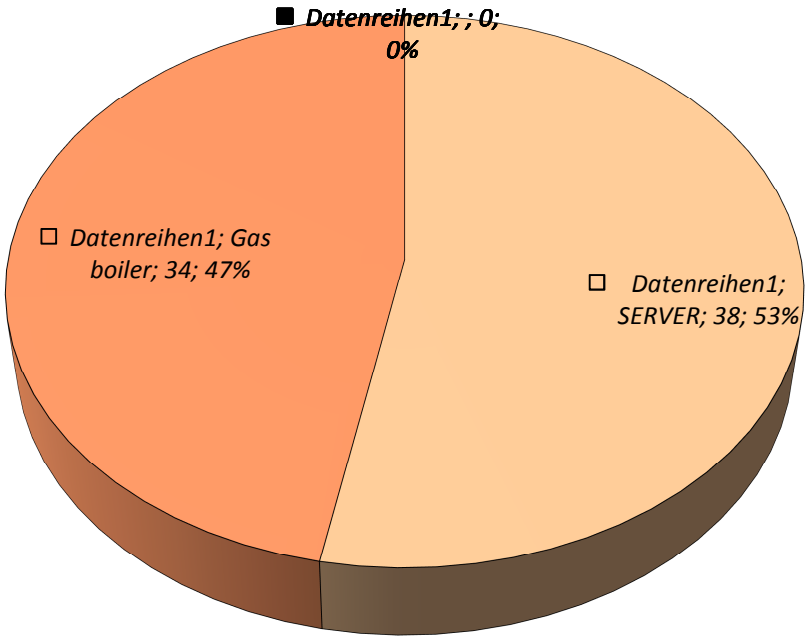

Figure 8: Useful supply heat (USH) by equipment. Present state.

Table 5: Useful supply cold (USC) by equipment. Present state.

Equipment	USC by equipment	
	[MWh]	[% of Total]
Chiller (cooling)	36	100.00
Total	**36**	**100.00**

- Distribution system
  Media: water (90/70 °C)

3.4. General

- The target room temperature for the company is 22 °C and the cooling in the server room is done by four cooling devices.
- The cooling demand was estimated over the heat dissipation of the servers.
- There was only data for several months available, but not for the whole year, so assumptions about the yearly energy consumptions were made.

4. Comparative study

4.1. Proposed alternatives

There are two proposals made in this study. The first study takes the potential energy savings in account by installing a new boiler and the second proposal takes a look at a solar thermal system.

4.1.1. Heat and Cold Supply

- Boiler and Burners: **Boiler Proposal 1**

Type of boiler	gas boiler
Thermal efficiency	0.95
Operating hours	5,496 h

Table 6: Overview of contribution to total heat supply by equipment

Equipment	Nominal capacity	Contribution to total heat supply	
	[kW]	[MWh]	[%]
New boiler	40	34	31.63
Server	40	37	34.42
Gas boiler	41	0	0.00
Chiller	21	36	33.95
Total	**142**	**107**	**100**

- graphic: heat demand covered by boilers

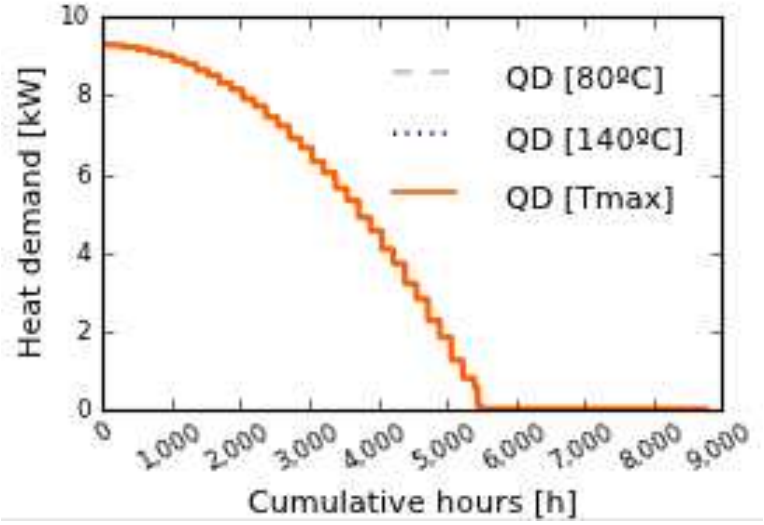

Figure 9: Cumulative heat demand to be covered by boilers

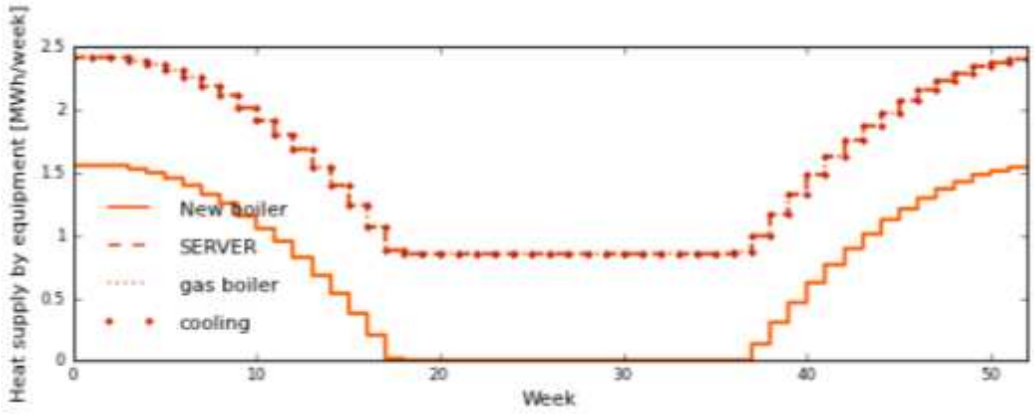

Figure 10: Daily heat supply by equipment

o Solar thermal: **Solar proposal 2**

Table 7: Overview of contribution to total heat supply by equipment

Equipment	Nominal capacity	Contribution to total heat supply	
	[kW]	[MWh]	[%]
Solar thermal system	68	15	14.23
Server	40	37	34.42
Gas boiler	41	19	17.40
Chiller	21	36	33.95
Total	**170**	**107**	**100**

Collector type:	FPC (flat plate collectors)
Installed capacity:	68 kW
Installed collector area:	97 m²
Solar buffer storage volume:	5 m³
Solar fraction:	45.5 %
Annual energy yield:	300 kWh/kWa

- graphic: heat demand covered by solar:

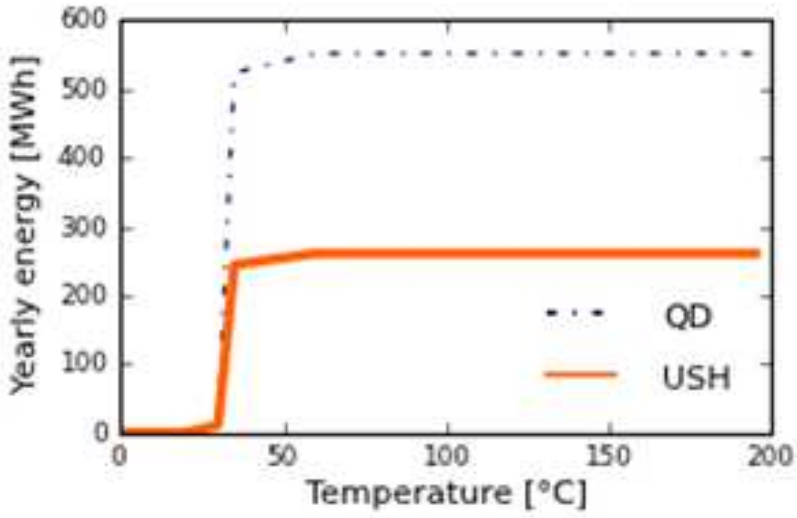

Figure 11: Heat demand and solar contribution

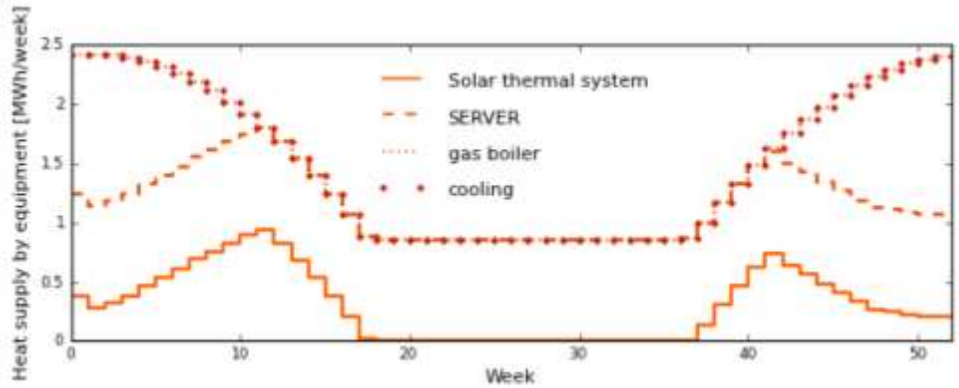

Figure 12: daily heat supply by equipment

- Primary energy consumption (PEC)

Table 8: primary energy consumption and savings

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Present State (checked)	215		
Boiler Proposal 1	190	25	11.49
Solar Proposal 2	182	33	15.51

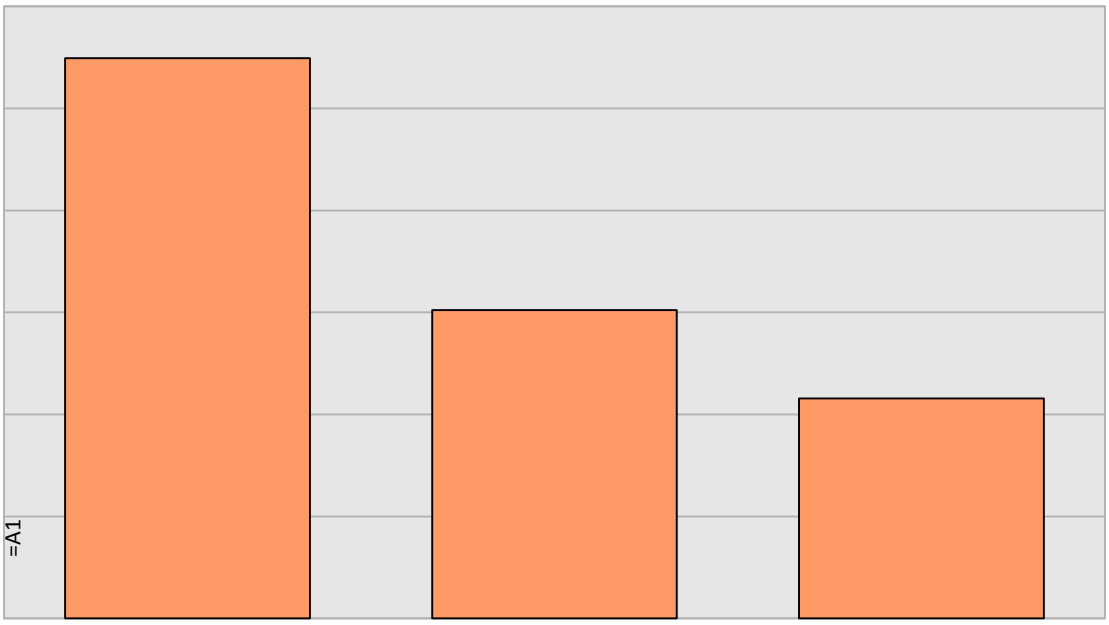

Figure 13: Comparison of alternatives: primary energy consumption

- Useful process and supply heat (UPH and USH)

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

- Environmental impact

Table 9: CO2 Production and CO2 savings per year

Alternative	Production of CO2 [t]	savings of CO2 [t]	% savings [%]
Present state (checked)	38.75		
Boiler Proposal 1	33.76	5.00	12.89
Solar Proposal 2	31.88	6.88	17.75

Table 10: Investment costs and subsidies of the proposals

Alternative	Total investment [€]	Own investment [€]	Subsidies [€]
Boiler Proposal 1	7,000	7,000	0
Solar Proposal 2	58,644	41,051	17,593

5. Selected alternative(s) and conclusions

5.1. Selected alternative

As selected alternative the first proposal was chosen as it is the easiest way to gain primary energy savings by switching from a boiler with an efficiency of 77% to a new boiler with an efficiency of 95 %. No structural optimizations of the building were proposed.

5.1.1. Process optimisation (written proposals)

None

5.1.2. Heat and Cold Supply

Boiler Proposal 1

Type of boiler: gas boiler
Thermal efficiency: 0.95
Operating hours: 5,496 h
Installed capacity: 40 kW

5.2. Comparative study and conclusions

5.2.1. Energy and environmental analysis

In the proposed alternative around 13 % of the CO2 pollution can be saved.

5.2.2. Economic analysis

The payback period of about 9 years has to be checked concerning the investment costs and due to the possible change of these figures the payback period will change in dependency. The calculations are based on costs and subsidies of 30% of the investment costs and have to be revised.

Table 11: Savings of the proposed alternative in comparison to the present state

		Present state	Alternative	Saving	[% savings]
Total primary energy consumption (1)	[MWh]	215	190	25	12%
Total fuels	[MWh]	48	23	25	52%
Total electricity	[MWh]	167	167	-	0%
Share of renewable energy/savings	[%]	-	12%		
CO_2 emissions	[t/a]	39	34	5	13%
Annual energy system cost (2)	[EUR]	7,523	6,685	838	11%
Total investment costs	[EUR]		7,000		
Payback period (3)	[years]		9		

(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.

(3) Supposing 30% of funding of total investment (subsidies or equivalent other support mechanisms)

5.2.3. Conclusions and outlook

- As the calculations are based on data of only a view month and assumptions were made to calculate the yearly overall energy consumptions, these figures and data has to be revised and adapted to the actual figures.

- In order to gain savings as high as calculated, the calculations have to be adapted to the actual thermal efficiency of the new boiler as the computed savings are based on the highest number.
- Additionally it is suggested to change the server cooling in that way that a heat recovery is technically possible. This can be done by having a defined air inlet and outlet for the server racks which makes it possible to use the waste heat of the server farm for preheating the office rooms, as in Figure 14 can be seen.

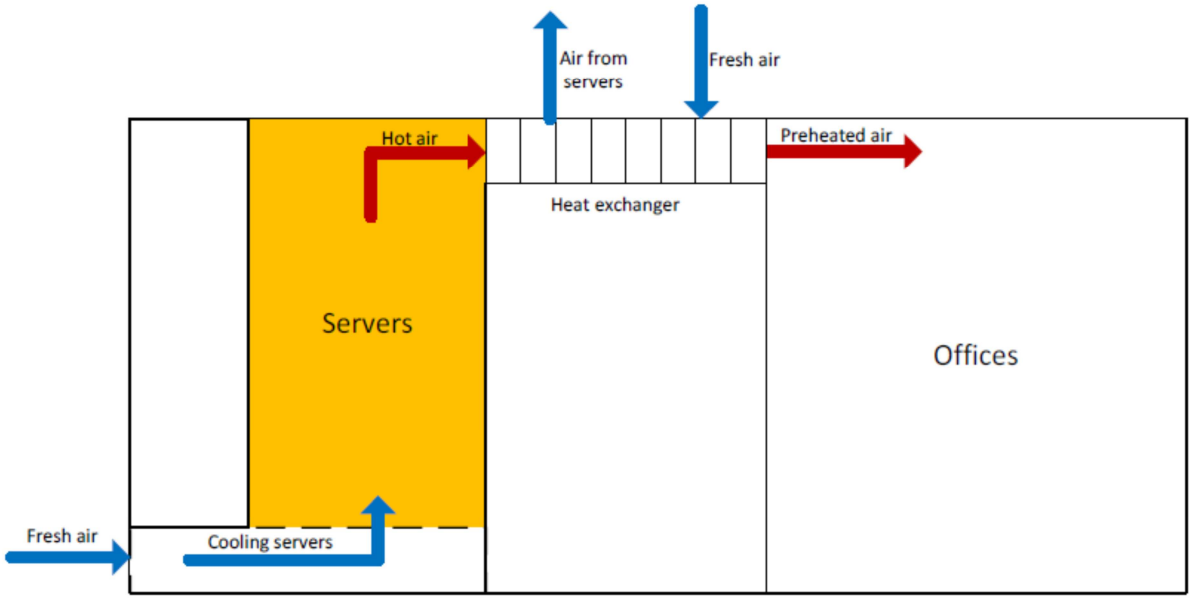

Figure 14: Server cooling and preheating office rooms