Energy Audit Summary Report
Austrian Energy Agency
Audit no. 34 – AUT10

Hospital

AUSTRIAN ENERGY AGENCY

07.01.2012

Supported by INTELLIGENT ENERGY EUROPE

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AUDIT no. 34 – AUT10

1. Data of the auditor

1.1. Contact data of the auditor

Marcus Hofmann, Austrian Energy Agency, Austria, Vienna

Energy Expert (not Energy Auditor), several energy audits performed

Audit date: 19.1.2011 (afternoon)

Duration: Several hours on-site for data acquisition and on-site visit

2. Introduction

2.1. Objectives

Status-Quo analysis on efficiency level of this industrial laundry plan, strategy for energy efficiency improvements.

3. Status Quo: processes, distribution, energy supply

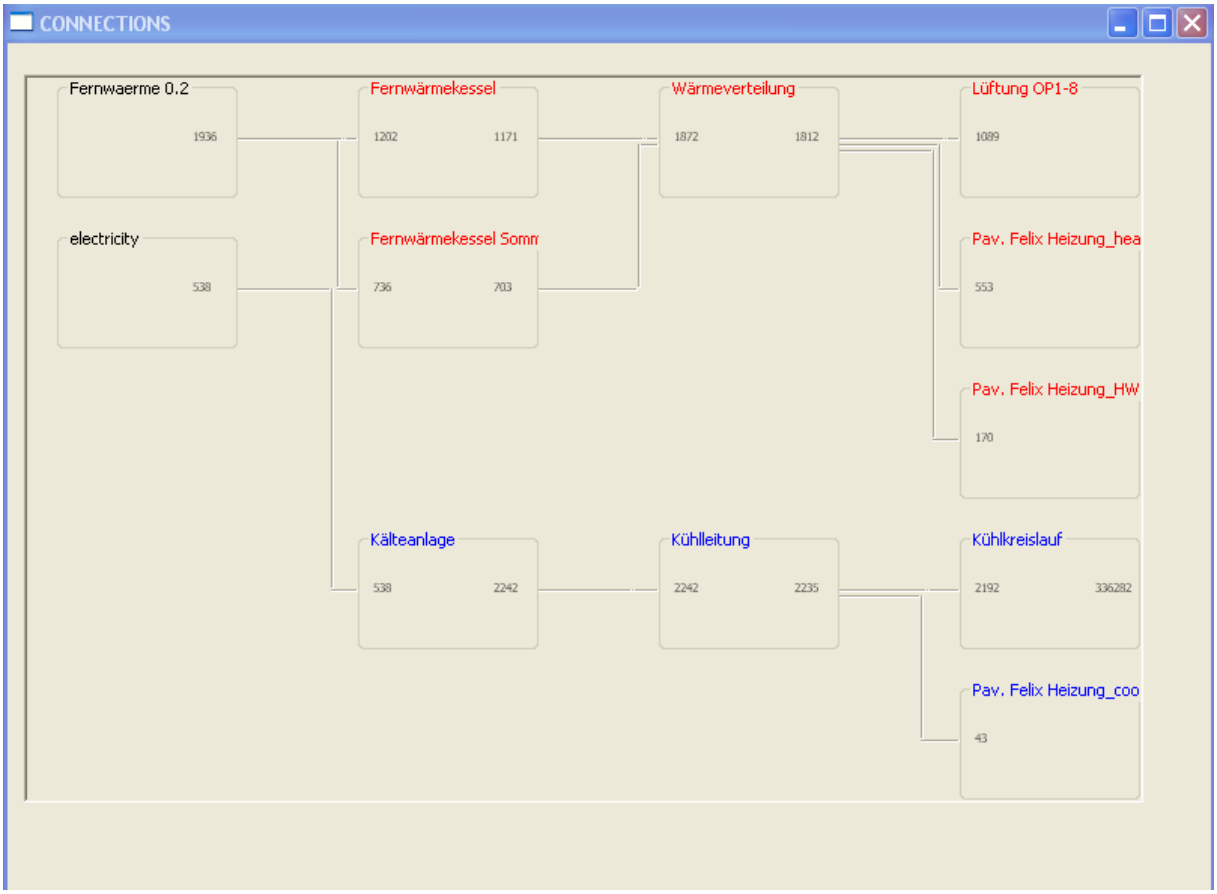
3.1. General info of company

Hospital

Production capacity: Working time: 7 days (24 h/day), 365 days a year

The orthopedic department is divided into 2 pavilions. The gross floor area of pavilion Felix amounts 4214.0 m2, which is distributed to 56 beds. The building is using radiators, floor heating, four OP air conditioning systems, three air conditioners for the areas of surgery, orthopedics and sterilization, one air-conditioning for the plant room, four additional exhaust air fans, two large refrigerators and two split air conditioners. For hot water supply in the building two heat exchanger Systems are installed and combined with two hot water tanks (built 2000), each with a volume of 2500 liters, of which only one is operating, the other is for security of supply.

3.2. Flow sheet of the whole manufacturing side (processes, distribution, energy supply) in form of a block diagram



Main processes are:

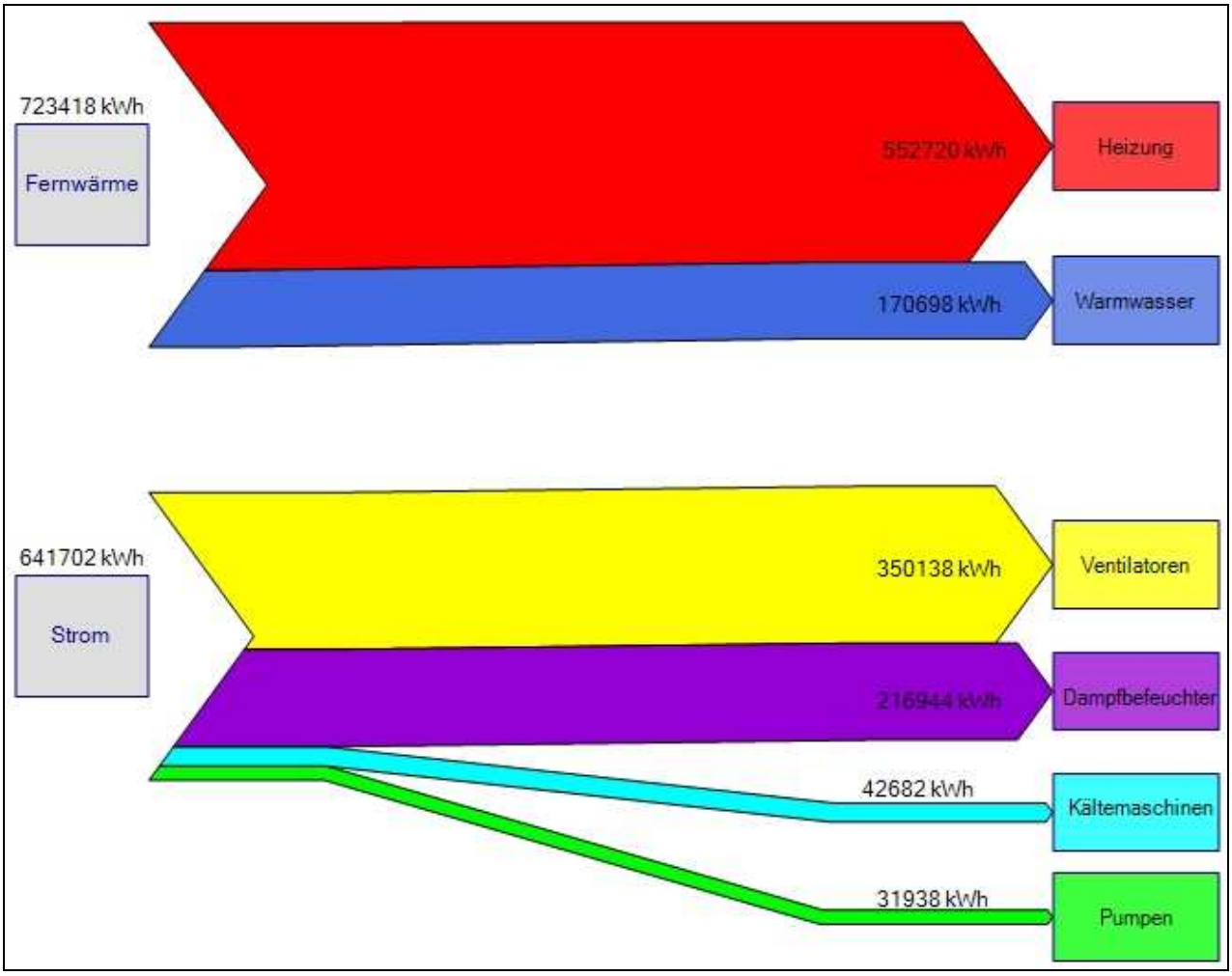
- **Air conditioner systems:** for 4 OP rooms and surgery, orthopedics, sterilization and technology center
- **Heating ad hot water:** For the building (Bed rooms, living rooms, etc.)
- **Cooling:** Two large refrigerator to supply the cooling grills, for each an installed capacity of 134 kW

3.3. Description of the existing system

Short description of the following main areas using pictures or block schemes and also refer to chapter 3.2

- *Energy Supply*

The heating and the production of hot water is provided by district heating. In winter the power input add up to 1020 kW whereas in summer time it is about 320 kW. The current average energy consumption of HLK components in pavilion Felix is covered with 723 418 kWh by district heating and with 641,702.0 kWh by electricity per year. The allocation of energy supplied by district heating, energy on hot water and heating, and the allocation of electricity consumption in pumps, fans, chillers, and steam humidifier is illustrated by the following energy flow diagram.



Result of Excel Calculation for the Energy (Heat&Electricity) Consumption

Table 2.1.1 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	1.872	54,50	1.872	54,39
Total electricity	1.562	45,50	1.569	45,61
Total (fuels + electricity)	**3.434**	**100,00**	**3.441**	**100,00**

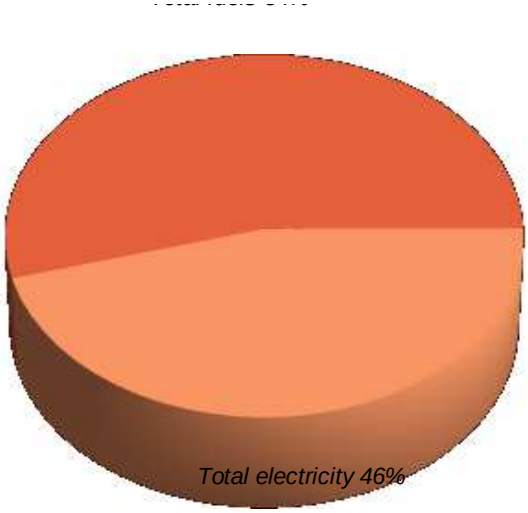


Figure 2.1.1.1 Distribution of PET by fuel type

Table 2.1.2 Total final energy consumption (FEC) and final energy for thermal use (FET); present state.

Fuel type	FEC		FET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
Fernwaerme 0.2	1.872	77,65	1.872	77,57
Electricity	539	22,35	541	22,43

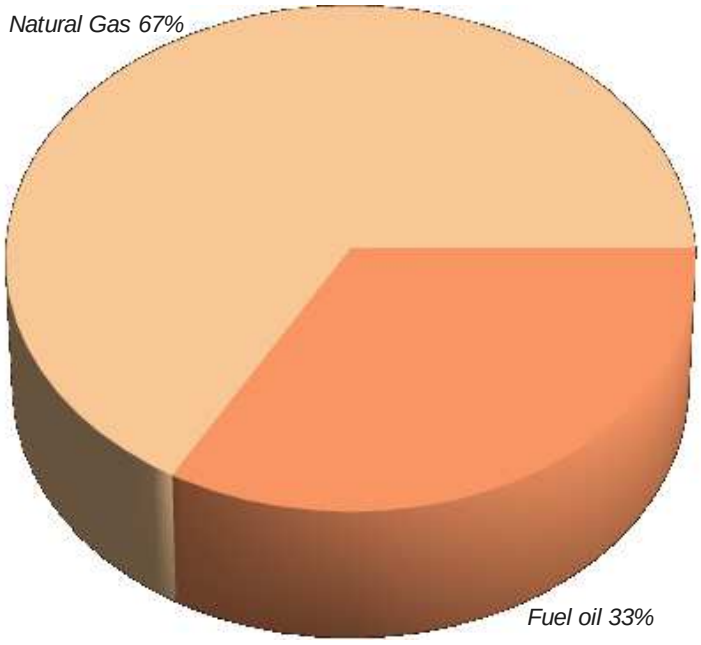


Figure 2.1.2.1 Total final energy consumption for thermal use (FET), present state

Table 2.3.1.1 Useful process heat demand (UPH) by process. Present state.

Process	Total	Circulation	Maintenance	Start-up
	[MWh]	[MWh]	[MWh]	[MWh]
Pav. Felix Heizung_HW	170	170	0	0
Pav. Felix Heizung_heating	553	0	553	0
Lueftung OP1-8	1.089	1.089	0	0
Total	**1.812**			

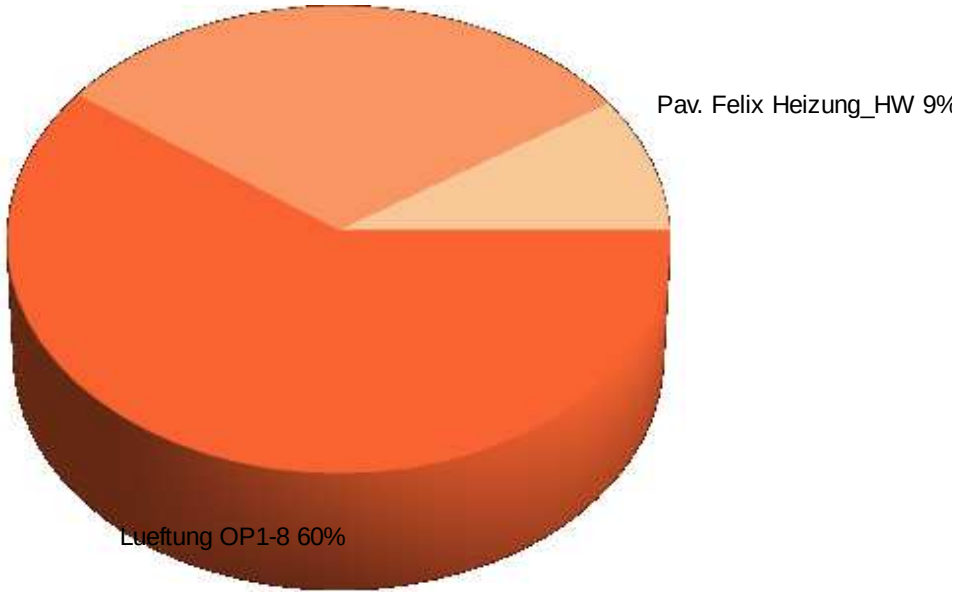


Figure 2.3.1.1 Useful process heat (UPH) by process

Media and temperatures

The district heating supply comes with a temperature of 70 ° C. The temperature for the floor heating is 50 ° C. For the air condition system, the inlet temperature is an averaged of 12°C over the year, and is heated up to 22 ° C.

- *Main energy consuming energy processes and buildings*

The main energy using processes are as mentioned above:

8 Air conditioner systems: 4 OP rooms, surgery, orthopedics, sterilization and technology center. Heating for hot water: For the building (Bed rooms, living rooms, etc.). Cooling: Two large refrigerator to supply the cooling grills, for each an installed capacity of 134 kW

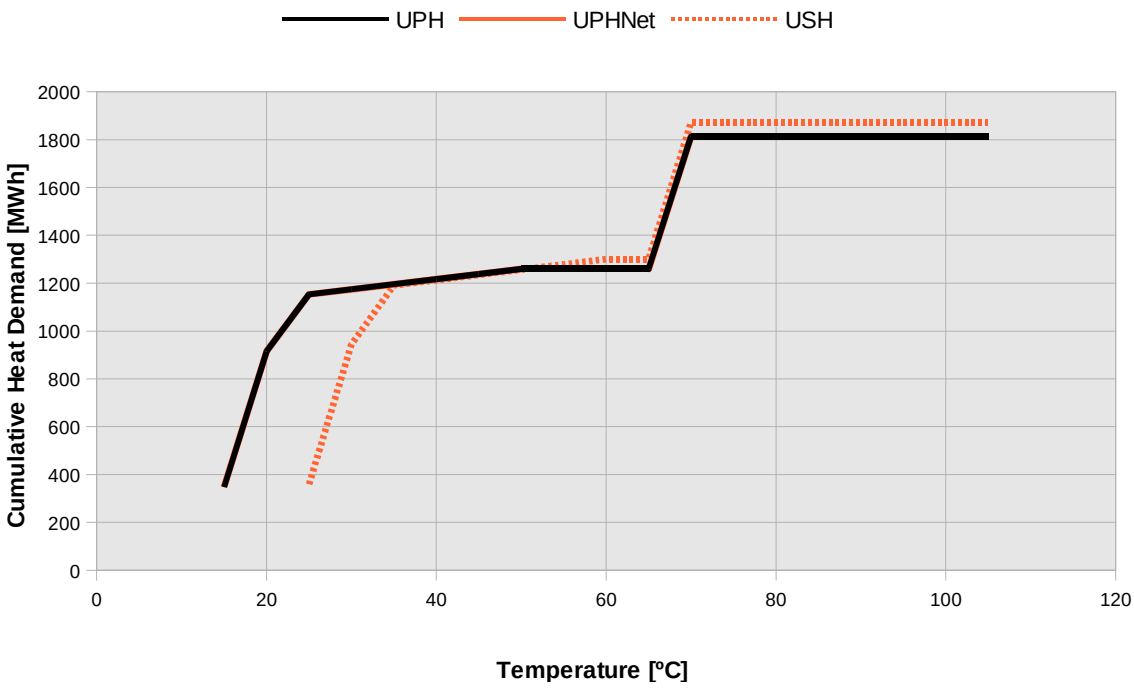


Figure 2.3.2.1 Distribution of heat demand by temperature levels

3.4. General

No additional measurements were made.

4. Comparative study

4.1. Proposed alternatives

Table 4.1. Primary energy consumption: present state and alternative proposals.

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Present State (checked)	3.434	---	---
Solarthermie	3.514	-80	-2,33
KWK	3.273	161	4,69

Table 4.5 Investment cost: alternative proposals.

Alternative	Total investment	Own investment	Subsidies
	[€]	[€]	[€]
Present State (checked)	---	---	---
Solarthermie	197.244	138.071	59.173
KWK	100.000	90.000	10.000

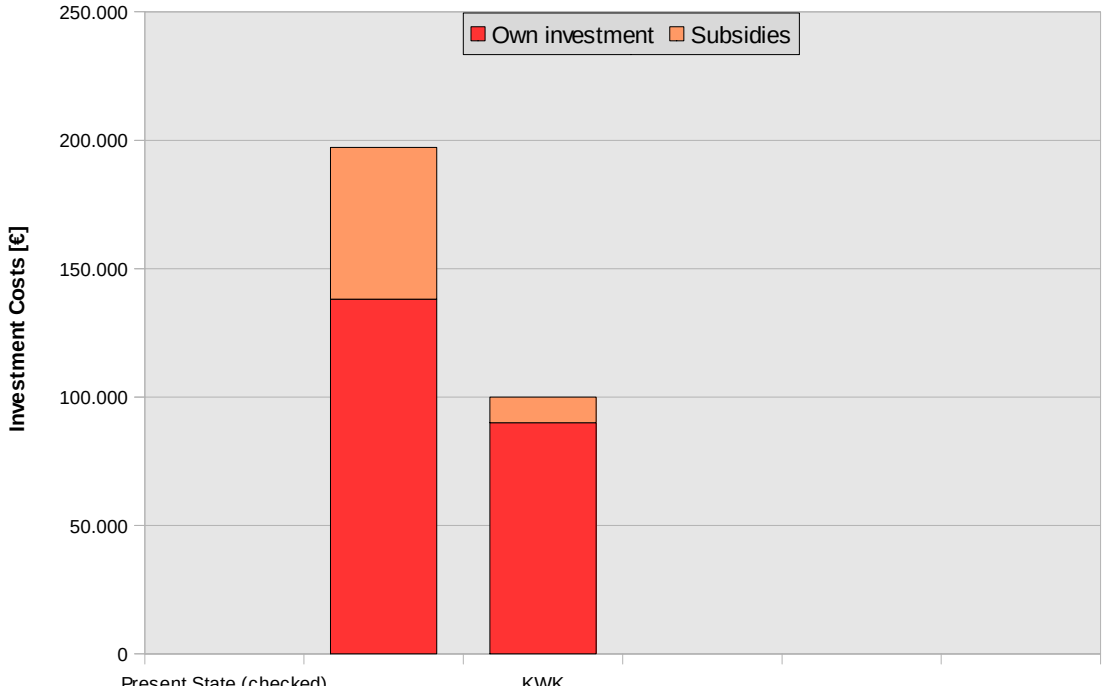


Figure 4.5 Comparison of alternatives: Investment costs

Table 4.8 Internal rate of return (IRR) and net present value (NPV) of investment: alternative proposals.

Alternative	Modified Internal Rate of Return	Pay-Back Period	Benefit Cost Ratio	Own Investment	Net Present Value (10 years)
	[%]	[years]	[-]	[€]	[€]
Solarthermie	-100,0	99,0	---	138.071 €	-400.965 €
KWK	-100,0	99,0	---	90.000 €	-2.560.401 €

5. Selected alternative(s) and conclusions

5.1. Selected alternative

The selected alternative is the CHP plant.

5.2. Comparative study and conclusions

		Present state	Alternative	Saving
Total primary energy consumption (1)	*[MWh]*			
- total	*[MWh]*	3434	3273	-161
- fuels	*[MWh]*	1872	2881	-1009 + 53,89%
- electricity	*[MWh]*	1562	392	1170 - 75 %
Primary energy saving due to renewable energy	*[MWh]*			-
CO_2 emissions	*[tons/a]*	*643,68*	*694,63*	*- 50,95* *+ 7,91%*
Annual energy system cost (2)	*[EUR]*	*63914*	*113657*	*49743 additional costs*
Total investment costs	*[EUR]*		*100.000* *90.000 with subsidies*	
Payback period (3)	*[years]*		*> 99*	

(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 10% of funding of total investment (subsidies or equivalent other support mechanisms)

5.2.1. Energy and environmental analysis

The primary energy consumption could be reduced by 4,69 % by the CHP plant. The corresponding CO2 emissions would increase by 7,91%.

Through the solar thermal plant no energy savings are possible! In contrary the energy consumption increases by 2,33%! The corresponding CO2 emissions would increase by 1,36%.

Table 4.1. Primary energy consumption: present state and alternative proposals.

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Present State (checked)	3.434	---	---
Solarthermie	3.514	-80	-2,33
KWK	3.273	161	4,69

Table 4.2 Useful process and supply heat: present state and alternative proposals.

Alternative	Useful process heat (UPH)	Savings UPH	Useful supply heat (USH)	Savings USH
	[MWh]	[MWh]	[MWh]	[MWh]
Present State (checked)	1.812	---	1.872	---
Solarthermie	1.812	0	1.872	0
KWK	1.812	0	1.872	0

Table 4.4 Environmental impact: present state and alternative proposals.

Alternative	Production of CO2	Highly Radioactive Nuclear Waste	Water consumption
	[t]	[kg]	[m3]
Present State (checked)	643,68	53,87	0,00
Solarthermie	652,49	62,89	0,00
KWK	694,63	13,51	0,00

5.2.2. Economic analysis

In both alternatives the total energy costs could not be reduced.

Table 4.5 Investment cost: alternative proposals.

Alternative	Total investment	Own investment	Subsidies
	[€]	[€]	[€]
Present State (checked)	---	---	---
Solarthermie	197.244	138.071	59.173
KWK	100.000	90.000	10.000

Table 4.8 Internal rate of return (IRR) and net present value (NPV) of investment: alternative proposals.

Alternative	Modified Internal Rate of Return	Pay-Back Period	Benefit Cost Ratio	Own Investment	Net Present Value (10 years)
	[%]	[years]	[-]	[€]	[€]
Solarthermie	-100,0	99,0	---	138.071 €	-400.965 €
KWK	-100,0	99,0	---	90.000 €	-2.560.401 €

5.2.3. Conclusions and outlook

None of the alternatives is economically sensible. The CHP plant is not profitable due to the very low price of district heating.

The solar thermal plant will save 181 MWh of gas but at the same time leads to an increase in electricity consumption by 89 MWh. Due to the high investment costs, this alternative is also not economically.

Appendix:

The reduction of the duration of the air conditioning system to 8h per day leads to UPH of 364 MWh instead of 1089 MWh which equals 66,66 % in energy savings of UPH of the air conditioning system (see table 2.3.1.1)!

Useful heat demand by process (UPH)

heating

	Process	UPH Total [MWh]	Share [%]	Circulation [MWh]	Maintenance [MWh]	Start-Up [MWh]	Process Temp. [°C]	Process Supply Temp. [°C]
1	Pav. Felix Heizung_HW	169.93	15.64	169.93	0.00	0.00	50.00	
2	Pav. Felix Heizung_heating	553.00	50.91	0.00	553.00	0.00	22.00	
3	Lueftung OP1-8	363.39	33.45	363.39	0.00	0.00	22.00	
4	**Total**	**1086.32**	**100.00**					

Distribution of process heat demand (UPH Total) by processes