Energy Audit Summary Report
Austrian Energy Agency
Audit no. 24 – AUT06

Service/Production
Industrial Laundry

AUSTRIAN ENERGY AGENCY

19.12.2011

Supported by INTELLIGENT ENERGY EUROPE

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AUDIT no. 24 – AUT06

1. Data of the auditor

1.1. Contact data of the auditor

Konstantin Kulterer, Austrian Energy Agency, Austria, Vienna

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

Audit date: 17.10.2011

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

2. Introduction

2.1. Objectives

Main objective was to give an overview of the energy consumption and possible energy savings.

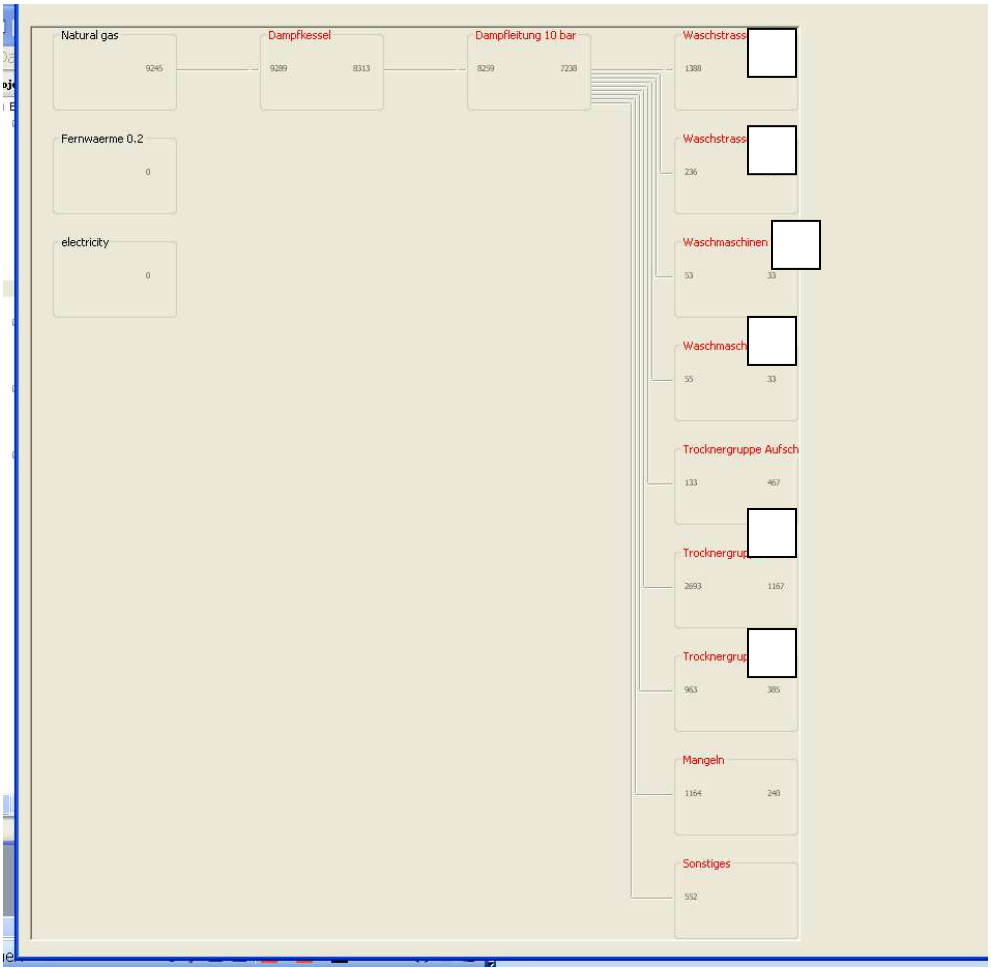
3. Status Quo: processes, distribution, energy supply

3.1. General info of company

Different laundries are washed, towels, bedclothes for hotels and for nursing homes.

Working time: 5 days (one part: 8 h second part: 16 h per day), 250 days a year.

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



3.3. Description of the existing system

- *Energy Supply*

The main heat supply system are two steam boilers 6 and 4 tons. (the second boiler is for peak demand only)

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]
Brennstoffe gesamt	10.157	72,15	10.170	100,00
Strom gesamt	3.921	27,85	0	0,00
Gesamt (Brennstoffe+Strom)	**14.078**	**100,00**	**10.170**	**100,00**

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]
Natural gas	9.234	87,60	9.245	100,00
Fernwaerme 0.2	0	0,00	0	0,00
Strom	1.307	12,40	0	0,00
Total	10.541	100,00	9.245	100,00

Table 2.1.3. Final energy consumption for thermal use (FET) by equipment (present state).

Equipment	Fuel type	FET by equipment	
		[MWh]	[% of Total]
Dampfkessel	Natural gas	9.289	100,00
Total		**9.289**	**100,00**

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

Process	Total	Circulation	Maintenance	Start-up
	[MWh]	[MWh]	[MWh]	[MWh]
Waschstrasse 1	1.388	1.248	140	0
Waschstrasse 2	236	201	35	0
Waschmaschinen 1	53	48	5	0
Waschmaschine 2	55	48	7	0
Trocknergruppe Aufschuetteln	133	133	0	0
Trocknergruppe 1	2.693	2.453	240	0
Trocknergruppe 2	963	880	83	0
Mangeln	1.164	0	1.164	0
Sonstiges	552	0	552	0
Gesamt	**7.237**			

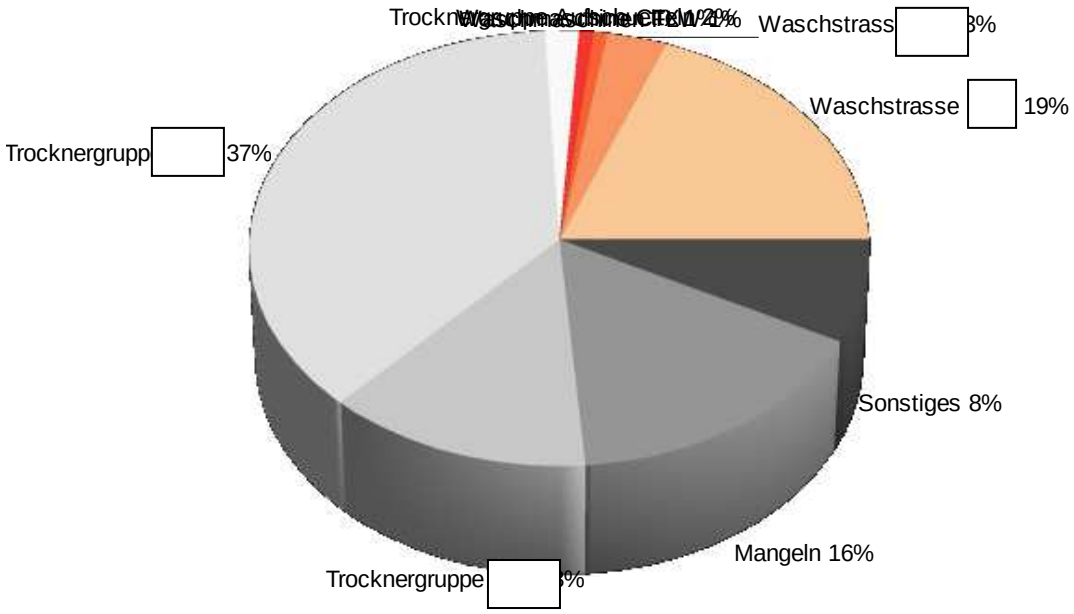


Figure 2.3.1.1 Useful process heat (UPH) by process

- *Distribution system*

The main distribution system is the steam system on different pressure levels (mainly 10 and 5 bars. The condensate of the 10 bars are relieved for energy recovery and sent in the 5 bar net.)
The radiation system and the direct heater for the production hall was not considered for EINSTEIN as no data is available and it is estimated that this consumption is very low.

- *Main energy consuming energy processes and buildings*

The whole production process is split in two main areas: one for flat laundry only. This part is running 8 hours a day, the other 14-16 hours. (two shifts)

Washing
For washingtunnel washers are installed with different capacity. Two of them are equipped with Sanoxy process, which means an average demand of warm water consumption of around 4.5 to 5 liters per kg laundry.

In addition 9 washing machines are installed, one of them with a capacity of 105 kg/h, all the others together around 110 kg/h.

Drying
For drying there are 3 group of dryers installed.

Finishing
For the finishing process three calanders are installed.

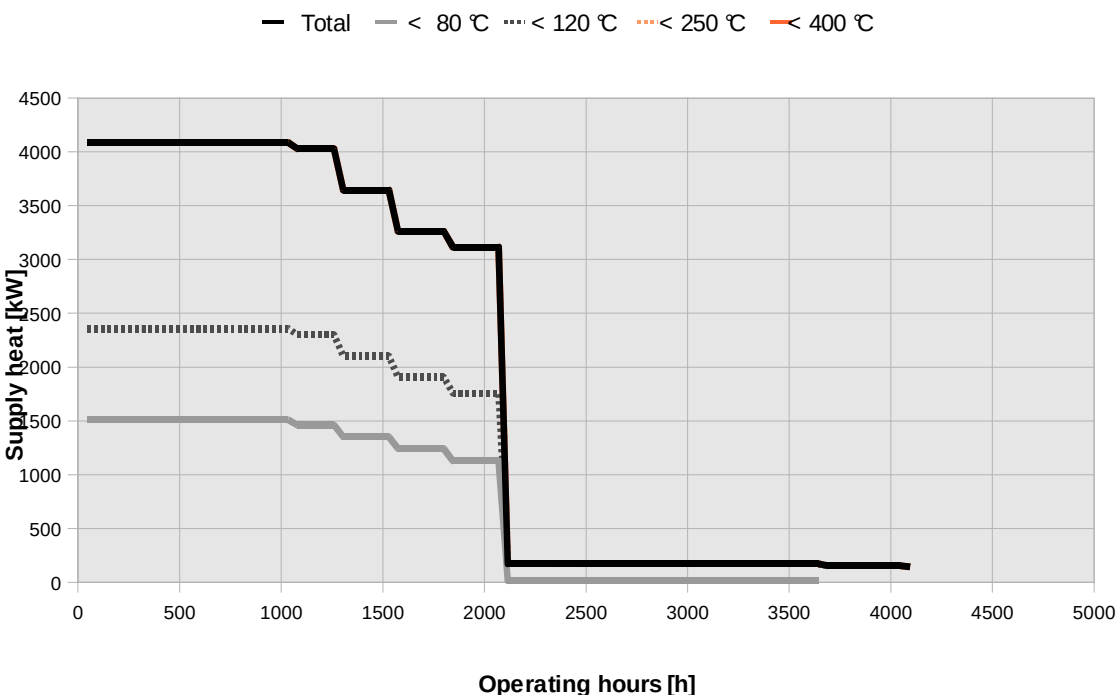


Figure 2.2.2.1 Distribution of supply heat by temperature levels and annual operating hours. Present state.

3.4. General

The laundry is quite complex system as a lot of different machines are installed. The energy consumption is divided on several processes. Therefore several energy saving measures would be needed to reduce the energy consumption considerably.

4. Comparative study

4.1. Proposed alternatives

New Proposal HX EINSTEIN	*This proposal consists of three heat exchangers: Two groups of heat exchangers for the preheating of the air inflow for the dryers by the waste heat of the dryer, and one for the preheating of the washing water by the waste water outflow of two washing tunnels.*
New Proposal CHP	*Significant primary energy and cost saving effects are possible with the installation of a combined heat and power plant.*
New Proposal HX and CHP	*This proposal was selected as it combines the advantages of the alternatives above.*
New Proposal Solarthermal	*This alternative was calculated but not included in the summary as it is not reasonable in this situation(costs, primary energy saving aspect)*

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

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Ist-Zustand (überprüft)	14.078	---	---
Neuer Vorschlag 1 HX	12.311	1.767	12,55
Neuer Vorschlag 3 KWK	11.927	2.151	15,28
Neuer Vorschlag 1 HX(plus KWK)	11.026	3.053	21,68

5. Selected alternative(s) and conclusions

5.1. Selected alternative

This alternative (new proposal HX and CHP) was selected as it has the highest energy saving effect and reasonable costs.

5.1.1. Heat recovery

Three (groups) of heat exchangers are installed: Between in- and outflow of the dryers and the in- and outflow of the washing tunnels.

Heat Exchanger	Power	Heat Source	Heat Sink	Amount of recovered energy	
	[kW]			[MWh]	[%]
WT Waschstrasse 1	141	Waschstrasse 1	Waschstrasse 1	295	23,94
WT Trockner 1	330	Trocknergruppe 1	Trocknergruppe 1	690	55,98
WT Trockner 2	172	Trocknergruppe 2	Trocknergruppe 2	247	20,08
	644			**1232,48**	**100**

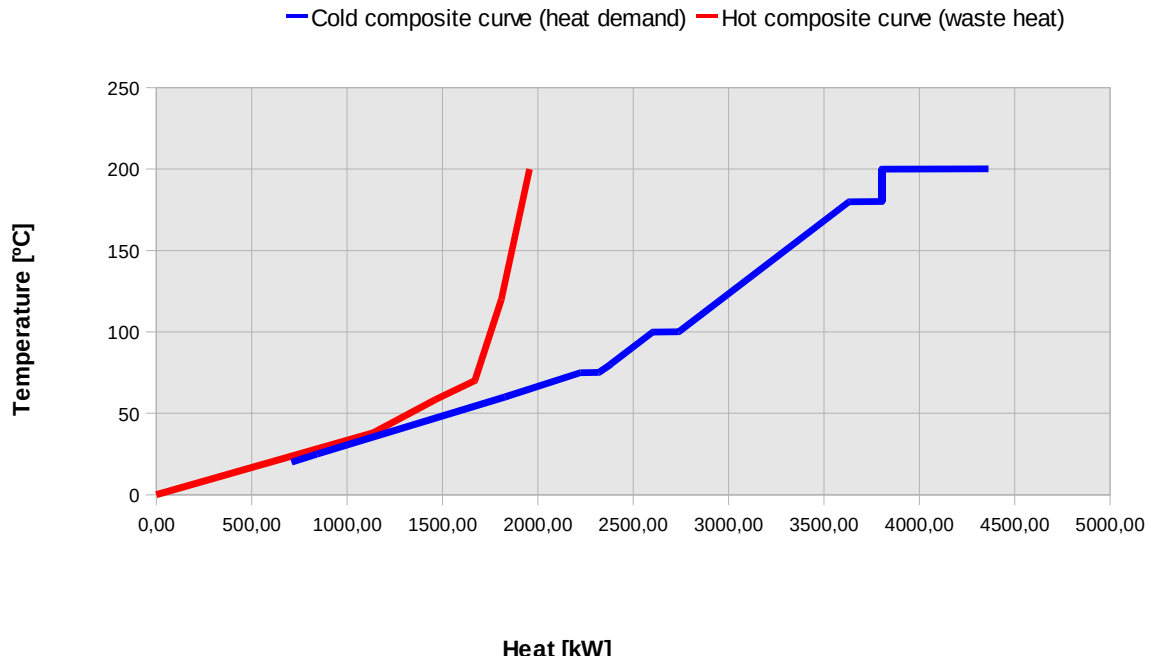


Figure 3.1.2.1. Pinch Analysis - Composite Curves

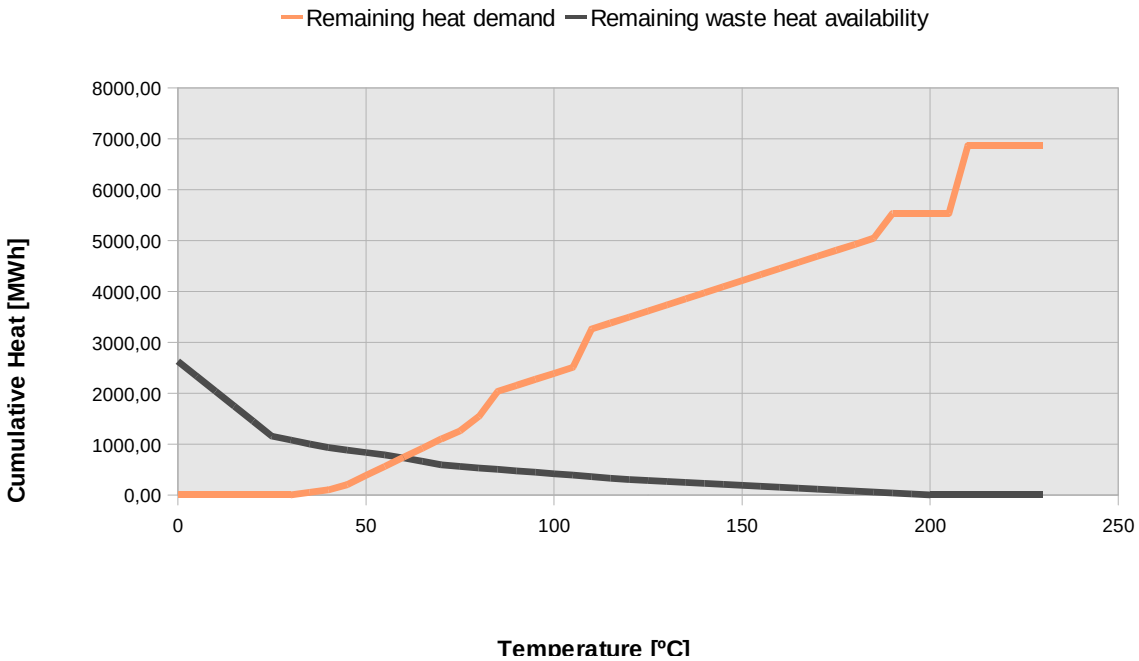


Figure 3.1.2.2. Pinch Analysis – Remaining yearly energy demand and energy availability

5.1.2. Heat and Cold Supply

A new CHP is installed in this alternative which replaces three quarter of the external electricity demand.

Table 3.3.3. Heat and cooling supply equipment and contribution to total heat and cooling supply

Equipment	Type	Heat and cooling supplied to pipe/duct	Nominal capacity	Contribution to total heat and cooling supply	
			[kW]	[MWh]	[%]
New CHP 2	CHP engine	o==Dampfleitung 10 bar==o	469	1.385	20,17
Dampfkessel	steam boiler	o==Dampfleitung 10 bar==o	9.211	5.480	79,83
Gesamt			**9.680**	**6.865**	**200**

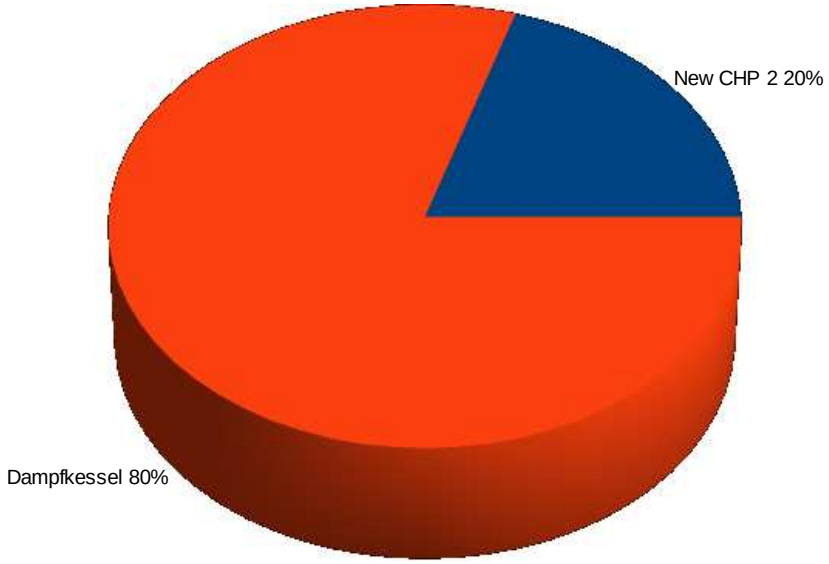


Figure 3.3.3. Contribution of each equipment to the total useful heat and useful cooling supply (USH & USC).

5.2. Comparative study and conclusions

		Present state	**Alternative**	**Saving**
Total primary energy consumption (1)				
- total	[MWh]	14.078	11.026	21%
- gas	[MWh]	10.157	9. 898	3%
- electricity	[MWh]	3.921	1.128	71%
Primary energy saving due to renewable energy	[MWh]	0	0	-
CO_2 emissions	[t/a]	2962,02	2437,50	18%
Annual energy system cost (2)	[EUR]	588.214	501.027	15%
Total investment costs	[EUR]		537.000	
Payback period (3)	[years]		3,5	

(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 21% of funding of total investment (subsidies or equivalent other support mechanisms)

5.2.1. Energy and environmental analysis

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

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Ist-Zustand (überprüft)	14.078	---	---
Neuer Vorschlag 1 HX	12.311	1.767	12,55
Neuer Vorschlag 3 KWK	11.927	2.151	15,28
Neuer Vorschlag 1 HX(plus KWK)	11.026	3.053	21,68

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]
Ist-Zustand (überprüft)	7.237	---	8.338	---
Neuer Vorschlag 1 HX	7.237	0	6.865	1.473
Neuer Vorschlag 3 KWK	7.237	0	8.274	64
Neuer Vorschlag 1 HX(plus KWK)	7.237	0	6.865	1.473

Alternative	Production of CO2	Highly Radioactive Nuclear Waste	Water consumption
	[t]	[kg]	[m3]
Ist-Zustand (überprüft)	2962,02	6,54	0,00
Neuer Vorschlag 1 HX	2560,39	6,54	0,00

Neuer Vorschlag 3 KWK	2738,99	-0,78	0,00
Neuer Vorschlag 1 HX(plus KWK)	2437,50	1,88	0,00

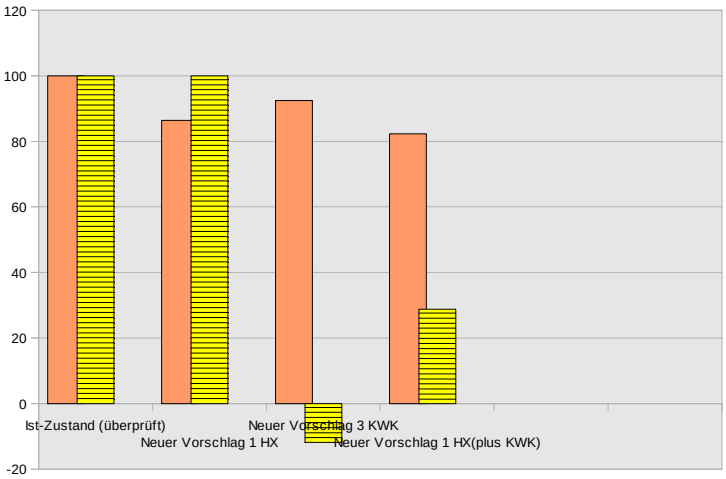


Figure 4.4 Comparison of alternatives: environmental impact

The Useful Supply Heat Demand could be reduced by 21% by installation of the heat exchanger network.

The same is true for the primary energy consumption for the whole package of heat exchangers and CHP. The CO2 Emissions could be reduced by 18% from 2.962 to 2.437 tons of CO2.

5.2.2. Economic analysis

Table 4.5 Investment cost: alternative proposals.

Alternative	Total investment [€]	Own investment [€]	Subsidies [€]
Ist-Zustand (überprüft)	---	---	---
Neuer Vorschlag 1 HX	300.000	210.000	90.000
Neuer Vorschlag 3 KWK	375.000	337.500	37.500
Neuer Vorschlag 1 HX(plus KWK)	537.000	423.300	113.700

Table 4.6 Total annual cost (fuels and electricity, O&M and annuity of investment): present state and alternative proposals.

Alternative	Annuity [€]	Energy Cost [€]	O&M [€]
Ist-Zustand (überprüft)	---	588.214	0
Neuer Vorschlag 1 HX	22.075	517.613	5.000
Neuer Vorschlag 3 KWK	27.593	495.722	12.076
Neuer Vorschlag 1 HX(plus KWK)	39.513	448.274	13.240

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 [years]	Benefit Cost Ratio [-]	Own Investment [€]	Net Present Value (20 years) [€]
Neuer Vorschlag 1 HX	11,9	3,3	---	210.000 €	972.863 €
Neuer Vorschlag 3 KWK	10,4	4,4	---	337.500 €	1.133.866 €
Neuer Vorschlag 1 HX(plus KWK)	11,6	3,5	---	423.300 €	1.865.962 €

The installation of costs of the heat exchanger network is not so high in relation to expected savings. The pay back period is quite quick. In addition a CHP could be very economic for the company. The pay back period for the alternative proposed would be around 3,5 years.

5.2.3. Conclusions and outlook

The company is planning to test the heat exchanger for dryers in one site in March 2012 and will try to use the results of this installation for the other sites.
With the analysis above options for preferential use could be defined.
The CHP is a new option not discussed with the company up to now.