Energy Audit Summary Report
Austrian Energy Agency
Audit no. 23 – AUT05

Service/Production
Industrial Laundry

AUSTRIAN ENERGY AGENCY

7.12.2011

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/SI2.558239)

AUDIT no. 23 – AUT05

1. Data of the auditor

1.1. Contact data of the auditor

Konstantin Kulterer, Austrian Energy Agency, Austria, Vienna

Energy Expert, several energy audits performed

Audit date: 3.10.2011

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.

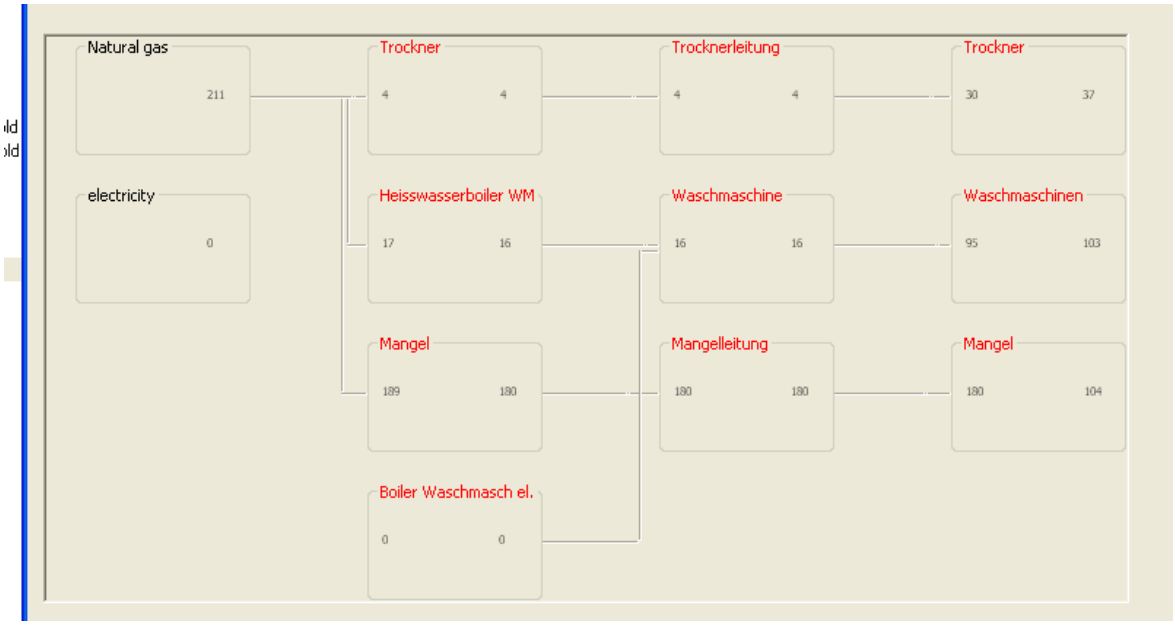
3. Status Quo: processes, distribution, energy supply

3.1. General info of company

The laundry washes laundry for hotels and professional clothes.

Production capacity: 66 kg/h, around 1.000 kg/day, Working time: 5 days (16 h/day for washing machines), 250 days a year.

3.2. Flow sheet of the whole manufacturing side



3.3. Description of the existing system

- *Energy Supply*

For EINSTEIN the energy consumption was modelled that the daily consumption of gas is around 1 MWh. In addition electricity for the washing machines for thermal uses is consumed (around: 93 kWh/day, 23 MWh/a).

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	329	59,01	329	83,83
Total electricity	228	40,99	63	16,17
Total (fuels + electricity)	**557**	**100,00**	**392**	**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	299	79,70	299	93,40
Electricity	76	20,30	21	6,60
Total	375	100,00	320	100,00

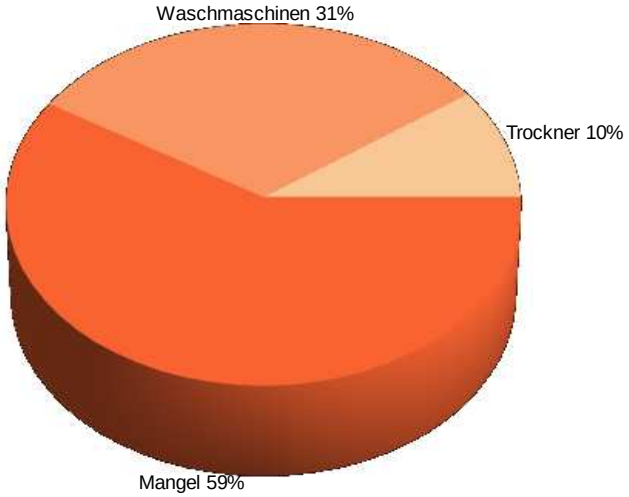
Table 2.1.3. Final energy consumption for thermal use (FET) by equipment (present state).

Equipment	Fuel type	FET by equipment	
		[MWh]	[% of Total]
Trockner	Natural gas	31	9,79
Heisswasserboiler WM	Natural gas	78	24,42
Mangel	Natural gas	189	59,19
Boiler Waschmasch el.	Electricity	21	6,60
Total		**320**	**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]
Trockner	30	26	4	0
Waschmaschinen	95	87	8	0
Mangel	180	0	180	0
Total	**306**			

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



- *Distribution system*

There is no heat distribution system. For EINSTEIN the processes (calander, washing extractors and dryers) are connected to a distribution system; the hot water for the washing machines is supplied by two gas boilers (18 kW total) (two hot water tanks, 180 l each one) and electricity.

- *Main energy consuming energy processes and buildings*

For the heating of the building (one floor within a bigger building) no information is available as the heat consumption is paid within the rent for the rooms.

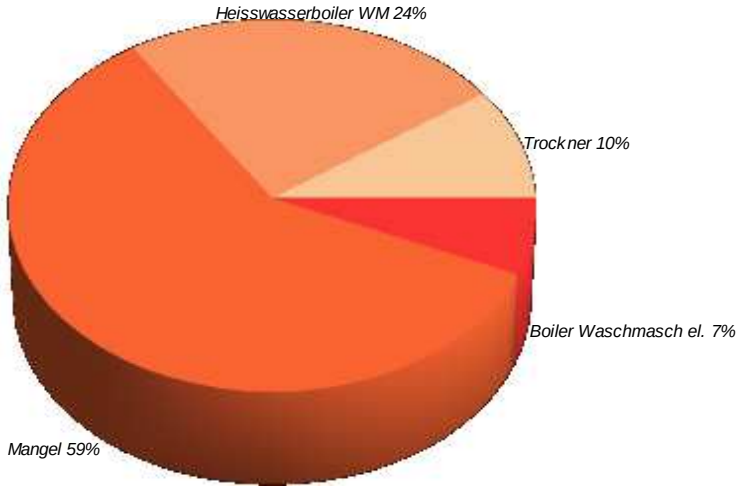
The main energy consuming energy processes are:

- Washing (3 washing extractors, each 22 kW) (gas boiler and electricity)
- Drying (3 tumble dryers, each 12 kW) (direct heating gas)
- Calander (180 kW) (direct heating gas)

The **washing processes** have a temperature of around 65°C. The incoming water has a temperature of around 10°C. The water is heated up with the two gas boilers to around 60°C. Electricity is used to heat it up to final process temperature (at least for one washing machine), as the 2 gas boilers are too small (18 kW) to deliver the whole hot water supply and the peak hot water consumption (needed for the washing process).

For the **dryers** the temperature for the drying programme for tumble dryers is set to only 45°C. Therefore the installed capacity is not fully used.

The **calander** (Mangel) is heated with 200°C (direct gas) and has a capacity of 360 kg/h laundry capacity.



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Final energy consumption for thermal use (FET) by equipment

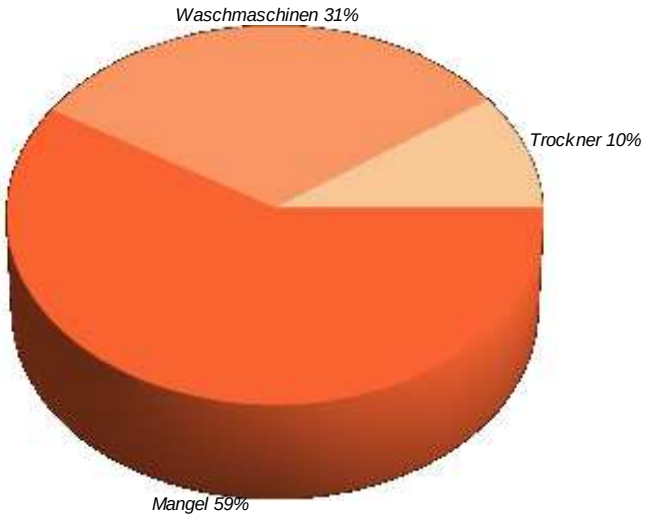

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Figure 2.3.1 Useful supply heat (USH) by equipment

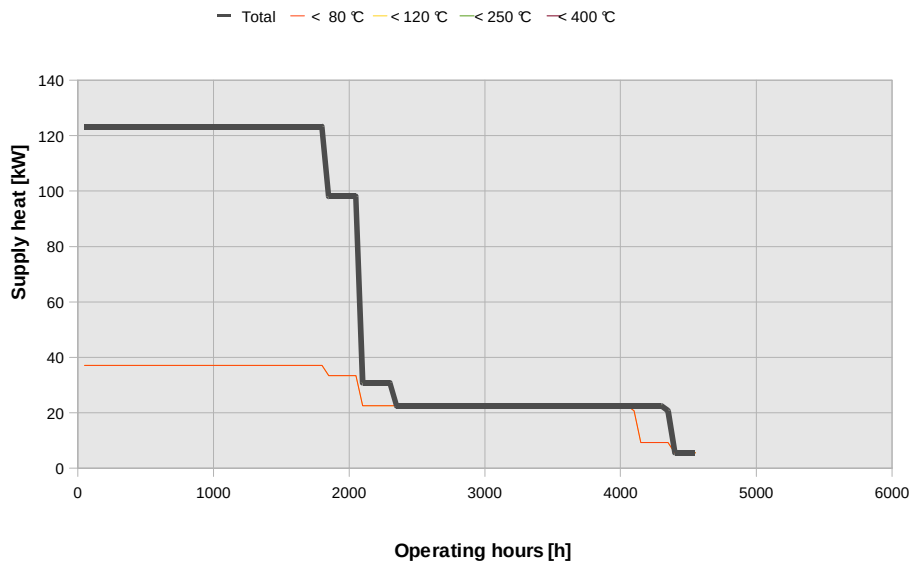

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Figure 2.2.2 Distribution of supply heat by temperature levels and annual operating hours. Present state.

3.4. General

For the size of the company the company has a very big calander, which has negative consequences for the energy demand, as a calander (Mangel) consumes almost 50% of the installed capacity, even unloaded. On the other hand all equipment (dryers and calander) is heated directly via gas which has a positive effect on the energy demand (-20% against steam).

There were not measurements taken, but a consultant made recently measurements for the company on the electric side. This was especially helpful for the estimation of the electric heat demand of the washing machines.

4. Comparative study

4.1. Proposed alternatives

New Proposal HX	This proposal consists of two heat exchangers: One for the preheating of the air inflow for the dryers by the waste heat of the calander, and one for the preheating of the washing water by the waste water outflow of the washing machines. It has a very high energy saving effect but is more expensive the the WM only proposal.
New Proposal Solarthermal	This alternative consists of a solar thermal plant only, it has very high costs the energy saving effect is not so high (as 25% of solar thermal rate was considered)
New Proposal HX WM only	This proposal consists of one heat exchanger for the preheating of the washing water by the washing machines ouflow only. This alternative is very cost efficient and has a high energy savings effect.
New Proposal HX and Solar	This proposal combines Proposal HX and proposal solar thermal. The solar thermal input would be very low (around 1% of total heat demand)

Summary Table. Comparison of possible alternatives

Alternative proposal	Total investment	Total energy system cost	Primary energy consumption
	[€]	[€]	[€/MWh]
Present State (checked)	---	28626,24	557
New Proposal HX	18513,50	23249,02	397
Other possible alternatives studied			
New Proposal Solarthermal	38755,60	28411,90	496
New Proposal HX WM only	6581,80	22896,93	427
New Proposal HX and Solar	30188,30	24051,76	395

5. Selected alternative(s) and conclusions

5.1. Selected alternative

This alternative was selected as it has the highest energy saving effect and reasonable costs.

5.1.1. Heat recovery

Table 3.1.2. Heat supply equipment and contribution to total heat supply

Heat Exchanger	Power	Heat Source	Heat Sink	Contribution to total heat supply	
	[kW]			[MWh]	[%]
WT Mangel Trockner	13	Mangel	Trockner	26	24,89
WT WM Intern	19	Waschmaschinen	Waschmaschinen	79	75,11
Total	31			**105,46**	**100**

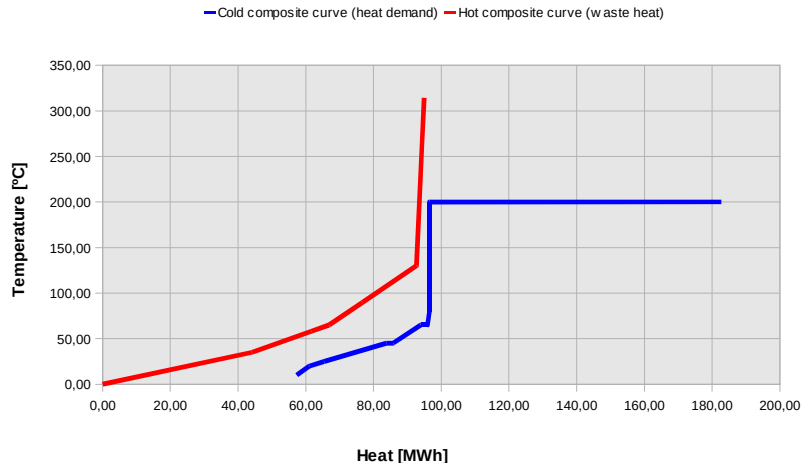

Figure 3.1.2.1. Pinch Analysis - Composite Curves

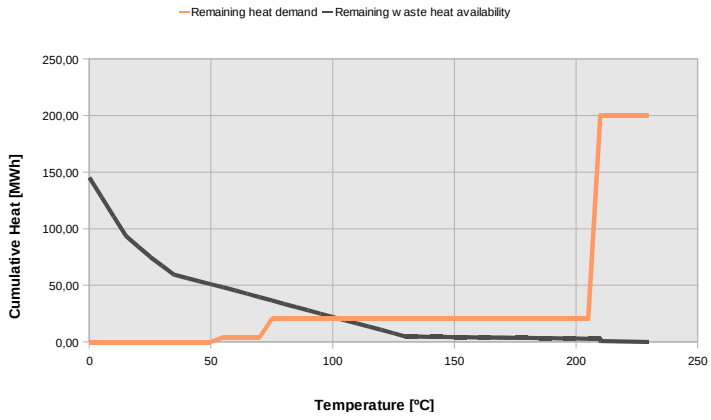

Figure 3.1.2.1. Pinch Analysis – Remaining yearly energy demand and energy availability

5.1.2. Heat and Cold Supply

No additional equipment is needed, but the electricity demand for the hot water for the heating of the water for the washing machines is not needed any more.

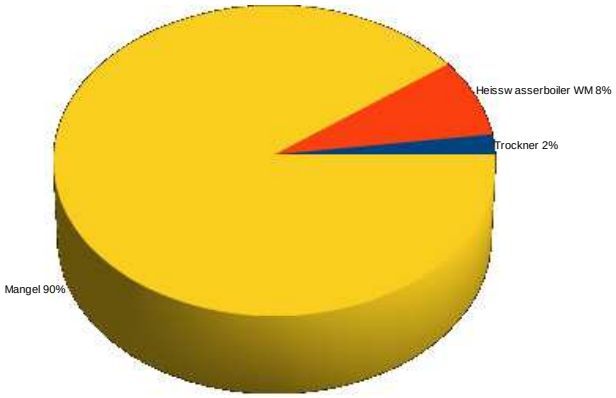

Figure 3.1.3. Contribution of each equipment to the total useful heat supply (USH).

5.2. Comparative study and conclusions

		Present state	**Alternative**	**Saving**
Total primary energy consumption (1)		557	397	29%
- total	[MWh]	557	397	29%
- fuels (gas)	[MWh]	329	232	29%
- electricity	[MWh]	228	165	28%
Primary energy saving due to renewable energy	[MWh]	0	0	
CO_2 emissions	[t/a]	112	80	29%
Annual energy system cost (2)	[EUR]	28.626	24.094	16%
Total investment costs	[EUR]		30.000	
Payback period (3)	[years]		3,25	

(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)

5.2.1. Energy and environmental analysis

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

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Present State (checked)	557	---	---
New Proposal HX	397	160	28,79
New Proposal Solarthermal	496	62	11,07
New Proposal HX WM only	427	131	23,45
New Proposal HX and Solar	395	163	29,18

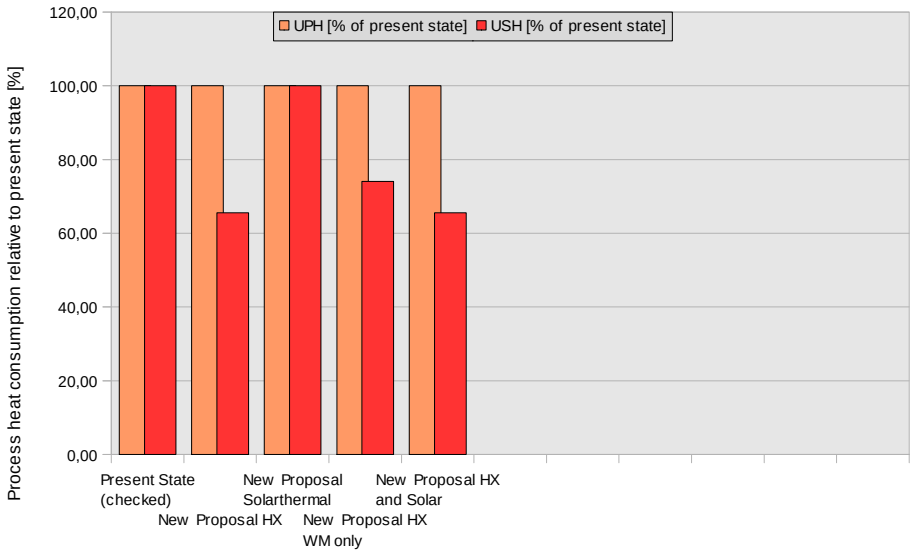

Figure 4.2. Comparison of alternatives: useful process and supply heat

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)	306	---	306	---
New Proposal HX	306	0	200	105
New Proposal Solarthermal	306	0	306	0
New Proposal HX WM only	306	0	227	79
New Proposal HX and Solar	306	0	200	105

Table 4.3 Environmental impact: present state and alternative proposals.

Alternative	Production of CO2	Highly Radioactive Nuclear Waste	Water consumption
	[t]	[kg]	[m3]
Present State (checked)	112,81	0,38	0,00
New Proposal HX	80,20	0,28	0,00
New Proposal Solarthermal	101,29	0,31	0,00
New Proposal HX WM only	86,96	0,28	0,00
New Proposal HX and Solar	79,70	0,28	0,00

The suggested heat exchangers would lead to a CO2 emissions reduction by 32 tons, which means a reduction of 29%. The primary energy demand would be reduced by 200 MWh corresponding to a reduction by 29%. Both consumption of gas and electricity would be reduced by 29%.

5.2.2. Economic analysis

Table 4.4 Investment cost: alternative proposals.

Alternative	Total investment [€]	Own investment [€]	Subsidies [€]
Present State (checked)	---	---	---
New Proposal HX	30.000	21.000	9.000
New Proposal Solarthermal	38.756	27.129	11.627
New Proposal HX WM only	6.582	4.607	1.975
New Proposal HX and Solar	41.675	29172	12.503

Table 4.5 Total annual cost (fuels and electricity, O&M and annuity of investment): present state and alternative proposals.

Alternative	Annuity [€]	Energy Cost [€]	O&M [€]
Present State (checked)	---	28.626	0
New Proposal HX	2207	20.393	1.493
New Proposal Solarthermal	2.852	25.405	155
New Proposal HX WM only	484	21.882	531
New Proposal HX and Solar	3065	20.287	1.543

Alternative	Pay-Back Period [years]	Modified Internal Rate of Return [%]
New Proposal HX	3,25	12,2
New Proposal Solarthermal	9,5	6
New Proposal HX WM only	0,8	20
New Proposal HX and Solar	4,5	10,4

The installation of two heat exchangers would cost around 30.000 EUR (21.000 EUR after subsidy) but would lead to a reduction of the energy costs by more than 8.000 EUR which means a pay back time of 3,25 years.

5.2.3. Conclusions and outlook

The main assumption is the technical possibility to heat up the dryer inflow by an heat exchanger from the calander outflow.
But even with an heat exchanger for the outflow of the washing machines significant savings are possible. For the washing machines storage tanks would be necessary.
Unfortunately at the moment the air inflow of the dryers is only done from the environment and not via a pipe.