Energy Audit Summary Report
Austrian Energy Agency
Audit 67 – *AUT11*

Service/Production
Industrial Laundry

AUSTRIAN ENERGY AGENCY

17.07.2012

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. 67 – AUT11

Industrial Laundry

1. Data of the auditor

1.1. Contact data of the auditor

Konstantin Kulterer, Austrian Energy Agency. The audit was performed on 14. May of 2012.

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

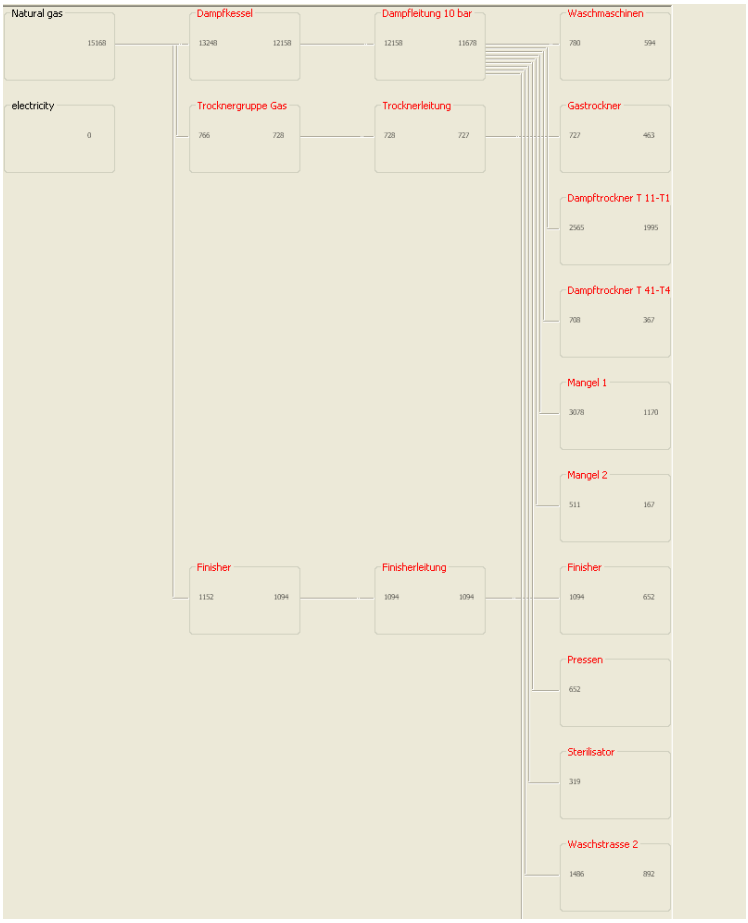
3.1. General info of company

Industrial laundry, (laundry of hotels, professional clothes, hospitals, old peoples home)

Working time: 5-6 days (16 h/day), 285 days a year

3.2. Flow sheet of the whole manufacturing side (processes, distribution, energy supply)

in form of a block diagram



Main processes are:

- **Washing:** washing extractors, 2 tunnel washer
- **Drying:** tumble dryers, presses;
- **Finishing:** 2 Mangles (calanders), tunnel finisher, sterilisators;

3.3. Description of the existing system

The main energy is supplied by a steam boiler (3,25 MW). There is also an small additional boiler (below 300 kW), not considered for this analysis. The flue gas temperature with 120 °C is already quite low. Steam of 10 bar is produced, the feedwater consumption per day is around 20 m^3/day. One group of four dryers and the tunnel finisher are heated directly by gas.

The steam distribution net supplies:

- 9 bar calanders
- 6 bar presses
- 3-4 bar: washing extractors, tunnel washer

Direct gas supplied:

- One group of dryers
- tunnel finisher

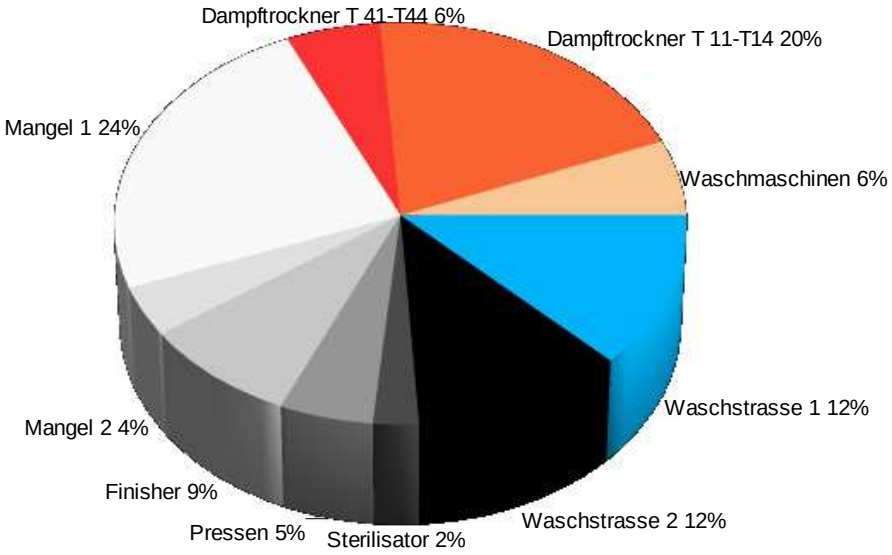


Figure 2.3.1.1: Useful process heat (UPH) by process

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	16.689	70,97	16.685	100,00
Total electricity	6.828	29,03	0	0,00
Total (fuels + electricity)	**23.517**	**100,00**	**16.685**	**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	13.248	87,35
Trocknergruppe Gas	Natural gas	766	5,05

Finisher	Natural gas	1.152	7,60
Total		**15.166**	**100,00**

There are two distribution systems: The main part is a steam distribution system 10/9 bar. The other main heat consumers are directly supplied with gas.

Dryers, Tumble dryer produce heat of 200°C but only at the beginning of the drying process, later on this temperature goes down to 120°C. The calanders (Mangel) are heated with 200°C. The washing processes have a temperature of around 70°C.

The main energy using processes are as mentioned above:
Several dryers, calanders, tunnel washer, washing machines and finisher, presses and sterilisators. For the heating of the building only minor energy consumption was reported and not modelled in EINSTEIN.

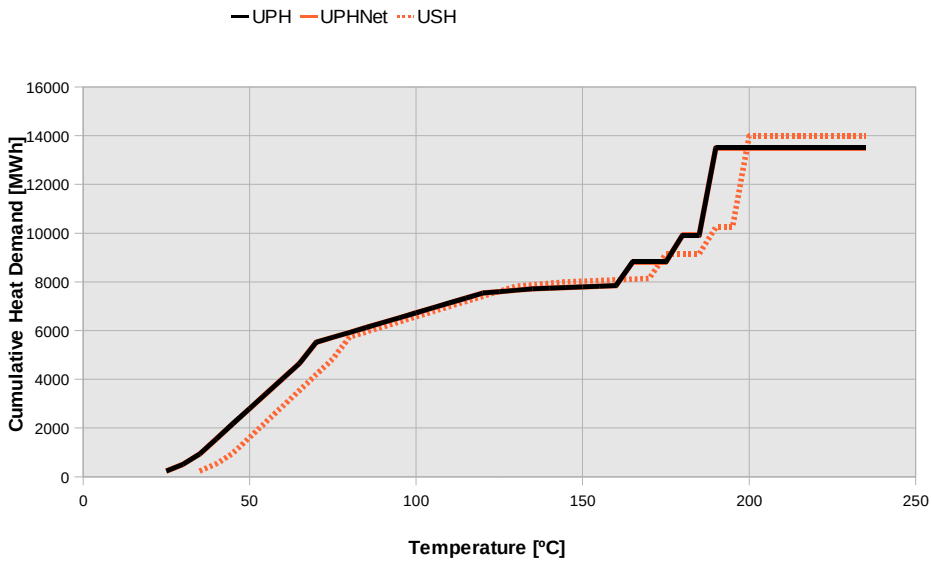


Figure 3: heat and cold demand over the temperature – present state.

3.4. General

No additional measurements were made.

4. Comparative study

4.1. Proposed alternatives

New Proposal WT Trockner	This proposal consists of one heat exchanger: For the preheating of the air inflow for one group of four steam dryers by the waste heat of the same dryers. It has a high saving effect at reasonable costs.
New Proposal WT Calander	Further energy savings are possible with the installation of another heat exchanger between the waste heat of the calander and the inflow of the tunnel washer. This alternative has also excellent pay back time.
New Proposal WT Trockner and KWK	This proposal consists of the heat recovery system in alternative 2 and a CHP.
New Proposal KWK	This proposal consist of an new CHP only.

Solar-thermal was modelled in EINSTEIN but this alternative did not provide economic savings. Heat Pumps were excluded of the analysis.

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

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Present State (checked)	23.517	---	---
New Proposal 1 HX T 11- T 14	22.255	1.262	5,36
New Proposal 2 WT Mangel 1 Waschstr 2	21.128	2.389	10,16
New Proposal WT Netzwerk und KWK	17.785	5.732	24,37
New Proposal 4 KWK	20.121	3.396	14,44

5. Selected alternative(s) and conclusions

5.1. Selected alternative

The selected alternative is the heat exchanger network (two group of heat exchangers) in combination with a gas-turbine (CHP).

5.1.1. Heat Supply System and Heat Recovery Network

Table 5.1.1.1 Heat and cooling supply equipment and contribution to total supply. Final proposed solution.

Equipment	Type	Heat / cooling supplied to pipe/duct	Nominal capacity	Contribution to total heat / cooling supply

			[kW]	[MWh]	[%]
New CHP 1	CHP gas turbine	o==Dampfleitung 10 bar==o o==Trocknerleitung==o o==Finisherleitung==o	938	4.540	37,84
Dampfkessel	steam boiler	o==Dampfleitung 10 bar==o	3.500	6.328	52,73
Trocknergruppe Gas	burner (direct heating)	o==Trocknerleitung==o	750	451	3,76
Finisher	burner (direct heating)	o==Finisherleitung==o	240	681	5,68
Total			**5.428**	**12.000**	**200**

Table 5.1.1.2 Heat exchanger network and amount of recovered energy

Heat Exchanger	Power	Heat Source	Heat Sink	Heat transferred	
	[kW]			[MWh]	[%]
WT T 11 - T 14	269	Dampftrockner T 11-T14	Dampftrockner T 11-T14	997	52,45
WT Mangel WStr. 2	190	Mangel 1	Waschstrasse 2	904	47,55
	459			**1901,85**	**100**

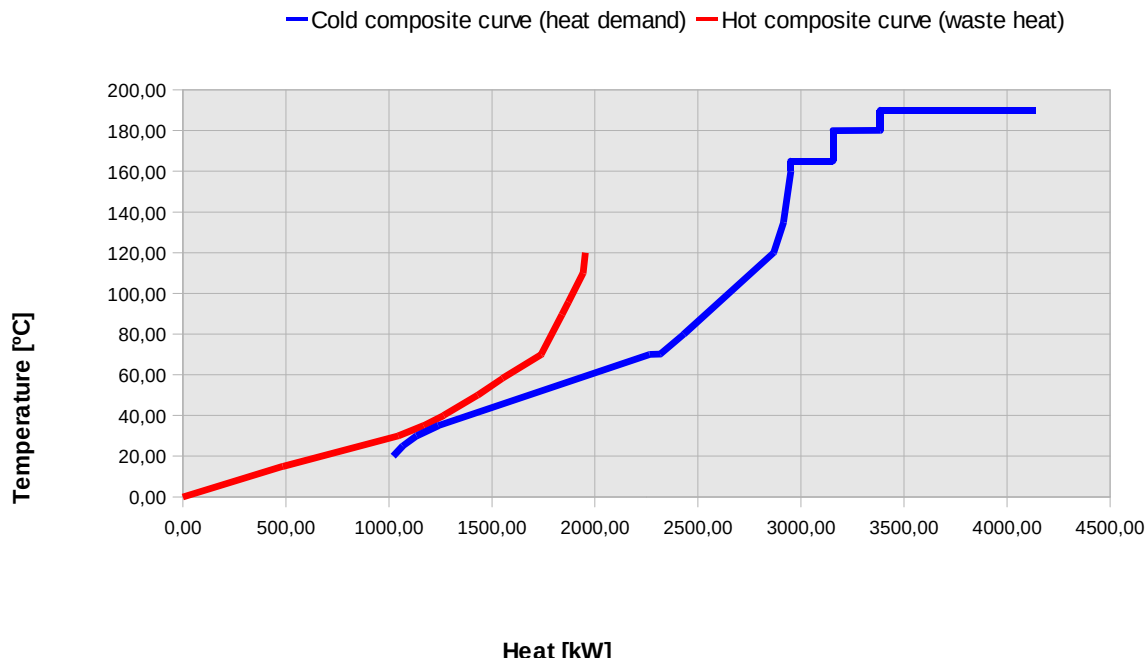


Figure 3.1.2.1. Pinch Analysis - Composite Curves

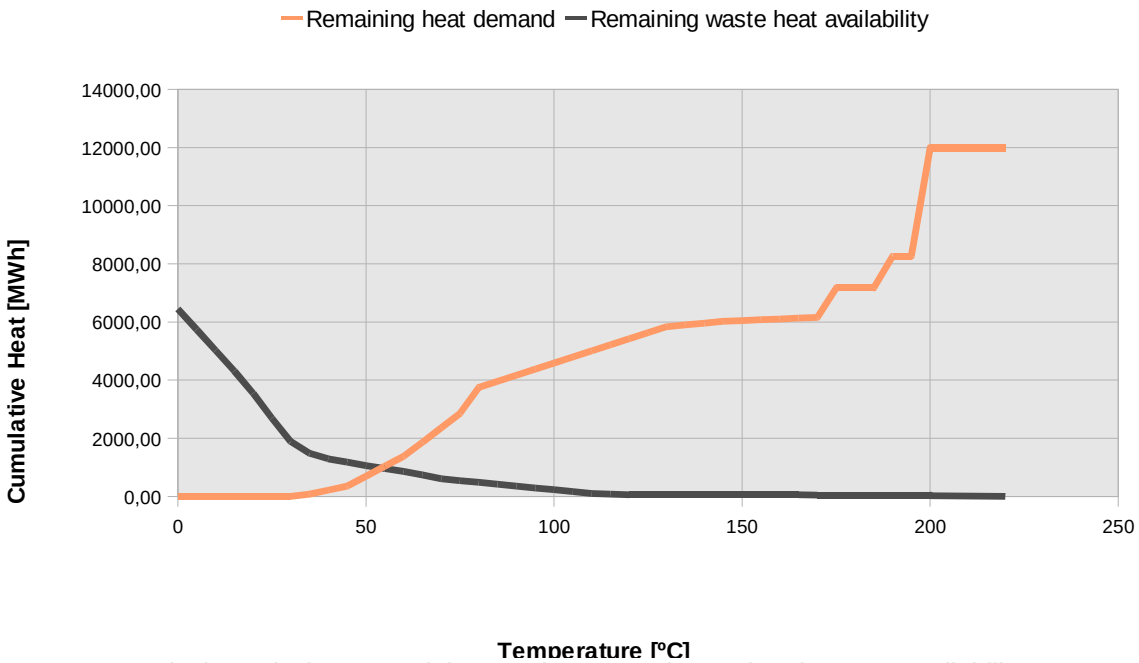


Figure 3.1.2.2. Pinch Analysis – Remaining yearly energy demand and energy availability

		Present state	Alternative	Saving
Primary energy consumption	*[MWh]*	*23.517*	*17.785*	*5732* *24,4%*
- total	*[MWh]*			
- fuels (1)	*[MWh]*	*16.689*	*17.638*	*-949* *-6%*
- electricity	*[MWh]*	*6.828*	*147*	*6.68* *98%1*
Primary energy saving due to renewable energy	*[MWh]*		*0*	*-0*
CO_2 emissions	*[tons/a]*	*4.930,8*	*4033*	*898* *18%*
Annual energy costs	*[EUR]*	*735.827*	605.928	*129.899* *18%*
Investment costs	*[EUR]*		*593.000* *690.000*	
Payback period	*[years]*		*3.2*	

5.1.2. Energy and environmental analysis

The primary energy consumption could be reduced by 10 % by installation of two groups of heat exchangers, another 14% by installation of a CHP (gas-turbine). The CO2 Emissions would be reduced by 18%. The electricity consumption could be provided by the CHP therefore as a total the gas consumption would rise by 6%.

Table 6.1.1 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	17.638	99,17	17.638	160,97
Total electricity	147	0,83	-6.681	-60,97
Total (fuels + electricity)	**17.785**	**100,00**	**10.957**	**100,00**

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)	4930,95	11,38	0,00
New Proposal 1 HX T 11- T 14	4644,21	11,38	0,00
New Proposal 2 WT Mangel 1 Waschstr 2	4387,93	11,38	0,00
New Proposal WT Netzwerk und KWK	4033,15	0,24	0,00
New Proposal 4 KWK	4566,08	0,19	0,00

5.1.3. Economic analysis

The total energy costs could be reduced by approx. 45.000 EUR (for the Heat Exchanger Alternative) and 130.000 EUR for the (CHP and Heat Exchanger Network), which means a reduction by almost 18%. The corresponding investment would be 110.000 EUR for the heat exchanger network and additional 550.000 EUR for the CHP. The pay-pack for the heat exchanger network would be below 2 years, in combination with the CHP the pay-back would be at 3.4 years.

Table 4.5 Investment cost: alternative proposals.

Alternative	Total investment	Own investment	Subsidies
	[€]	[€]	[€]

Present State (checked)	---	---	---
New Proposal 1 HX T 11- T 14	80.000	56.000	24.000
New Proposal 2 WT Mangel 1 Waschstr 2	140.000	98.000	42.000
New Proposal WT Netzwerk und KWK	690.000	593.000	97.000
New Proposal 4 KWK	550.000	495.000	55.000

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 [€]
Present State (checked)	---	735.827	0
New Proposal 1 HX T 11- T 14	5.887	699.115	8.000
New Proposal 2 WT Mangel 1 Waschstr 2	10.301	666.312	14.000
New Proposal WT Netzwerk und KWK	50.771	518.495	36.662
New Proposal 4 KWK	40.470	586.200	22.802

Table 4.7 Total additional cost (w/o subsidies) per saved primary energy (PE): comparison of alternative proposals.

Alternative	Total energy cost (incl. O&M and invest.) [€]	Additional cost [€]	Additional cost per saved PE [€/MWh]
Present State (checked)	735.827	---	---
New Proposal 1 HX T 11- T 14	713.001	-22.825	-18
New Proposal 2 WT Mangel 1 Waschstr 2	690.613	-45.214	-19
New Proposal WT Netzwerk und KWK	605.928	-129.899	-23
New Proposal 4 KWK	649.472	-86.355	-25

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 (20 years)
	[%]	[years]	[-]	[€]	[€]
New Proposal 1 HX T 11- T 14	14,9	2,0	---	56.000 €	478.252 €
New Proposal 2 WT Mangel 1 Waschstr 2	15,4	1,8	---	98.000 €	931.109 €
New Proposal WT Netzwerk und KWK	11,8	3,4	---	593.000 €	2.725.473 €
New Proposal 4 KWK	10,8	4,1	---	495.000 €	1.822.162 €

5.1.4. Conclusions and outlook

Significant energy savings of 10% are possible by the installation of heat exchangers for the main waste heat flows (calander, dryers). In addition a CHP plant (gas turbine) can lead to significant savings of electricity almost of 100%.

As a first step the company should invest in one heat exchanger for one dryer and monitor the energy consumption. The next step would be to install all four dryers with heat exchangers.

The heat exchanger for the calander in combination with the pre-heating for the washing-tunnel needs a little more planning.

The CHP should be the planned in detail.