Energy Audit Summary Report
CRP HENRY TUDOR
Audit no. *07* – LUX01

Food & Beverages
brewery

14 August 2011

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AUDIT no. 07 – LUX01

1. Data of the auditor

1.1. Contact data of the auditor

Name: Alex Bertrand

Organisation: Public Research Centre Henri Tudor

Country: Luxembourg

Profession: engineer

Number of audits performed: 1

Date of the audit: 04/08/2011

Duration of the audit: 3 weeks

2. Introduction

2.1. Objectives

The objectives of this audit are twofold:

1. Understand the energy consumption structure of the heating and cooling processes in the brewhouse and
2. Assess heat recovery alternatives considering the recovery of waste water

3. Status Quo: processes, distribution, energy supply

3.1. General info of company

Type: Brewery

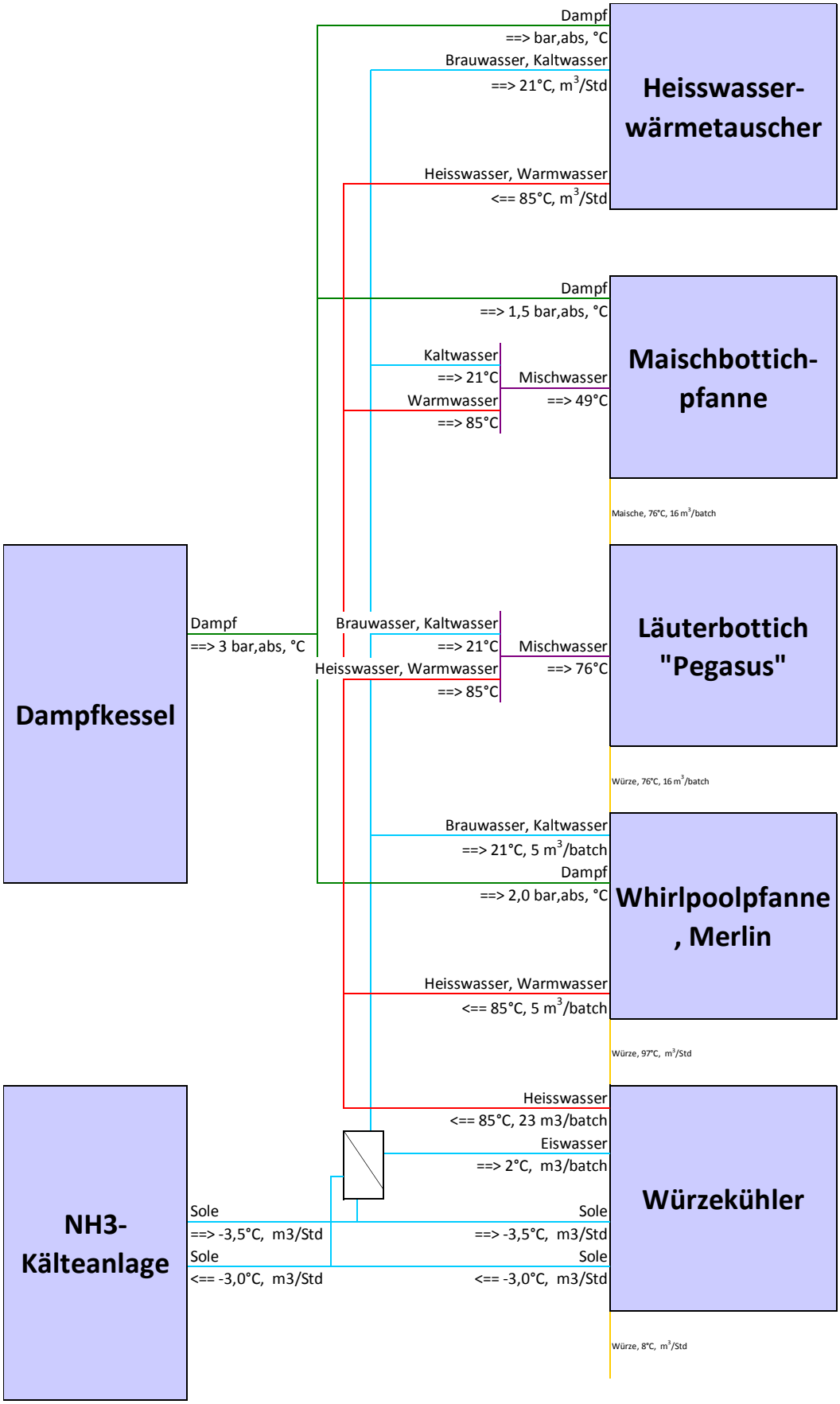
Location: Luxembourg

Sector: food and bewerages

Number of employees: n.a. (non available)

Product: beer

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*

Heat is provided by one vapour boiler using natural gas, and cooling with an ammonia chiller.

Energy type (fuels / electricity)	PEC		PET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
Fuel	2 291	69,56	2 291	69,56
Electricity	1 003	30,44	1 003	30,44
Total (fuel+electricity)	**3 294**	**100**	**3 294**	**100**

Fuel type	FEC		FET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
Natural gas	2 083	86,18	2 083	86,18
Electricity	334	13,82	334	13,82
Total	2 417	100,00	2 417	100,00

Equipment	Fuel type	FET by equipment	
		[MWh]	[% of Total]
Boiler	Natural gas	2 083	86,18
Chiller	Electricity	334	13,82
Total		**2 417**	**100,00**

- *Distribution system*

Media: steam (180°C) and glycol water (-3,5°C). Vapour condensate is recovered partially.

- *Main energy consuming energy processes and buildings*

See list below for the considered heat and cold demand. One process (Maischen) was subdivided in 5 sub-processes in order to improve the model's detail level. 3 processes (Abwasser_WRG) were modelled for the development of heat recovery alternatives. As these processes were not included in the assessment boundaries, their energy consumption was set to 0.

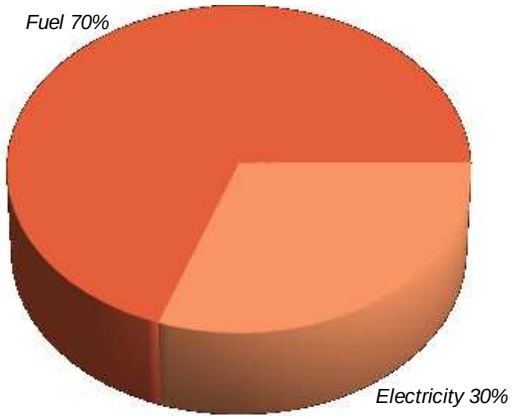
Process	Total	Circulation	Maintenance	Start-up
	[MWh]	[MWh]	[MWh]	[MWh]
Eiswasserproduktion	991	991	0	0
Wuertzekuehlung_mit_Glycol	319	319	0	0
Total	**1 310**			

Process	Total	Circulation	Maintenance	Start-up
	[MWh]	[MWh]	[MWh]	[MWh]
PfaDuKo	775	431	344	0
Heisswasserproduktion_Donnerstag	401	401	0	0
Maischen 1 - 45 Grad	173	172	0	0
Maischen 2 - 62 Grad	227	225	2	0
Maischen 3 - 64 Grad	27	27	1	0
Maischen 4 - 72 Grad	109	106	3	0
Maischen 5 - 76 Grad	53	53	0	0
Heisswasserproduktion_Sonntag	81	81	0	0
Abwasser_WRG_Montag-Dienstag	0	0	0	0
Abwasser_WRG_Mittwoch	0	0	0	0
Abwasser_WRG	0	0	0	0
Total	**1 847**			

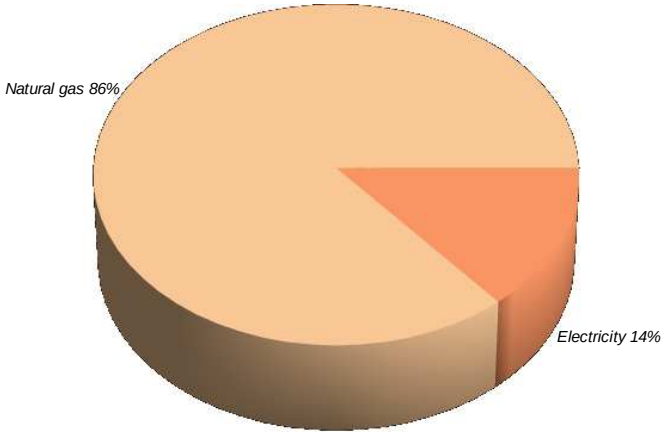
- *Graphics shown – annual data:*

(Brennstoff – fuels, Strom – electricity, Erdgas – natural gas)

Primary energy (PEC):

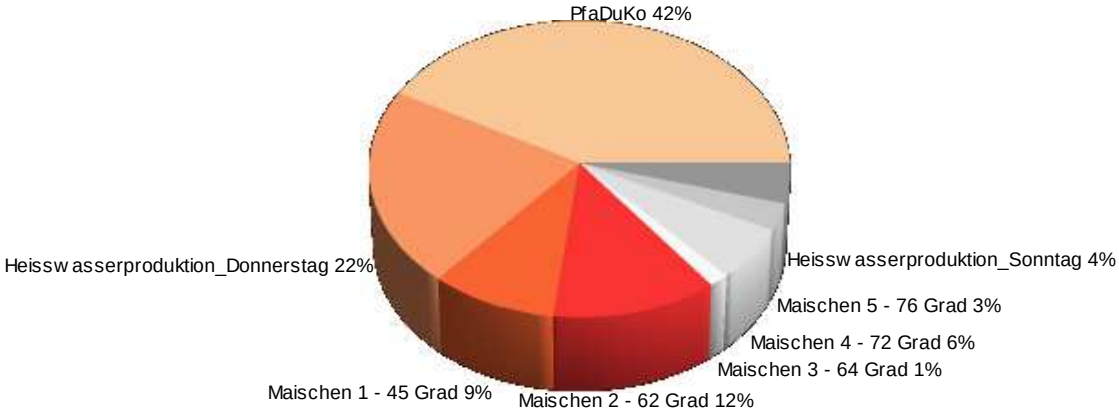


Final energy by equipments (FEC):

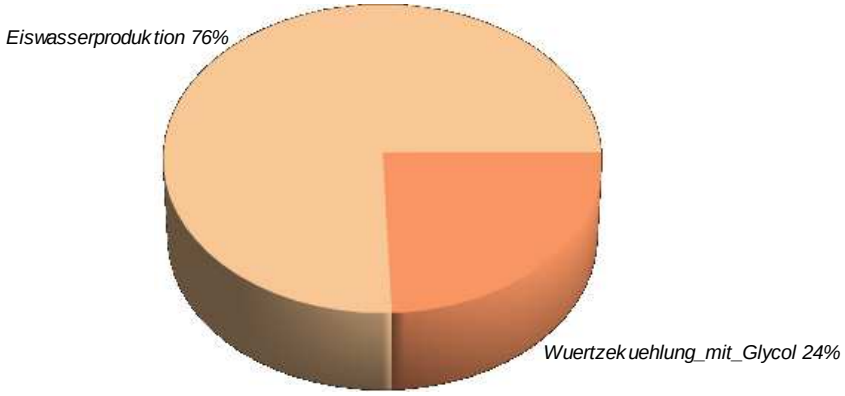


H&C demand (proc):

Heating:

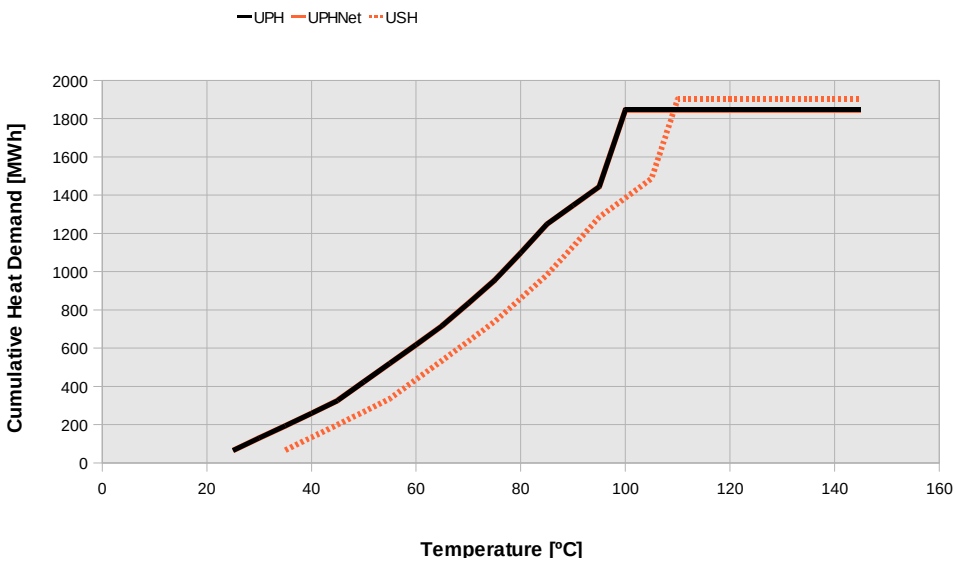


Cooling:

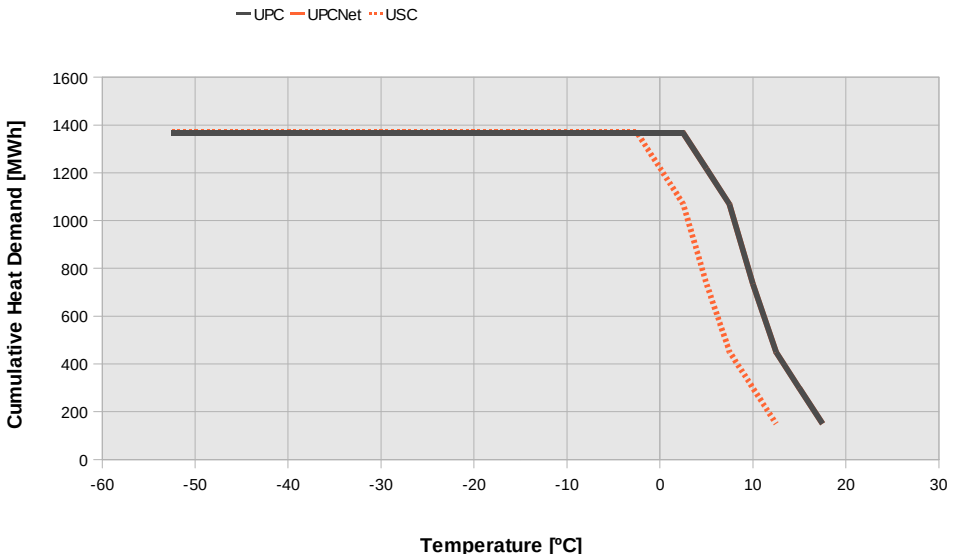


H&C demand (temp):

Heating:



Cooling:



3.4. General

- *Comment briefly specific situation of the company:*

  The company has already implemented a certain number of heat recovery measures, so that their potential for heat reuse optimisation is limited. Typical for the sector, their main interest in energy efficiency lies in heat recovery.
- *Add additional comments and explanations where useful for understanding:*

  n.a.
- *Reports on the assumptions and measurements performed and carried out for missing data both introduced by the auditor and by the consistency check :*

Number of brews per week: 15,

Insulation thickness of conduits and vessels: 0,1m

Average steam conduit diameter: 0,1m

4. Comparative study

4.1. Proposed alternatives

Short Name	Description	Equipment
WRG_Einmaischen	Malt is heated up to 45℃ by heat recovery from wastewater. No changes in equipments	Heat exchanger of 217kW nominal power
WRG_HWprod_Donnerstag	Hot water needed on Thursday is heated up by heat recovery from wastewater on Wednesday. No changes in equipments.	Heat exchanger of 247kW nominal power
WRG_Einmaischen_HWprod_Donnerstag	Malt is heated up to 45℃ by heat recovery from wastewater on Monday and Tuesday. Hot water needed on Thursday is heated up by heat recovery from wastewater on Wednesday. No changes in equipments.	Heat exchangers of 217 and 247kW nominal power

5. Selected alternative(s) and conclusions

5.1. Selected alternative

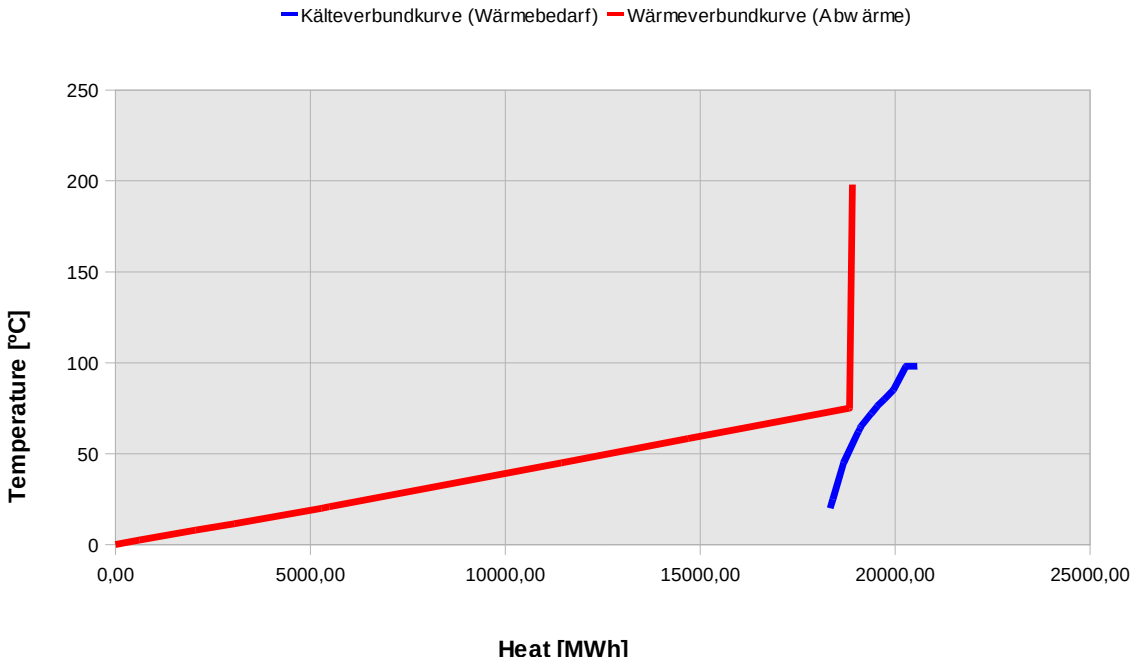
As requested by the company, the optimisation alternatives focused on the recovery of wastewater (Abwasser_WRG) as heat source. Of the 3 alternatives proposed, the last one was used, as it offered a maximal waste heat reuse. No process or equipment optimisations were proposed.

5.1.1. Process optimisation (written proposals):

n.a.

5.1.2. Heat recovery

Heat Exchanger	Power [kW]	Heat source	Heat sink	Heat transferred [MWh]	[%]
WRG_Einmaischen	217	Abwasser_WRG_Montag-Dienstag	Maischen 1 - 45 Grad	45	28,21
WRG_HWprod_Donnerstag	247	Abwasser_WRG_Mittwoch	Heisswasserproduktion_Donnerstag	116	71,79
Total	464			**161,22**	**100**



5.1.3. Heat and Cold Supply

n.a.

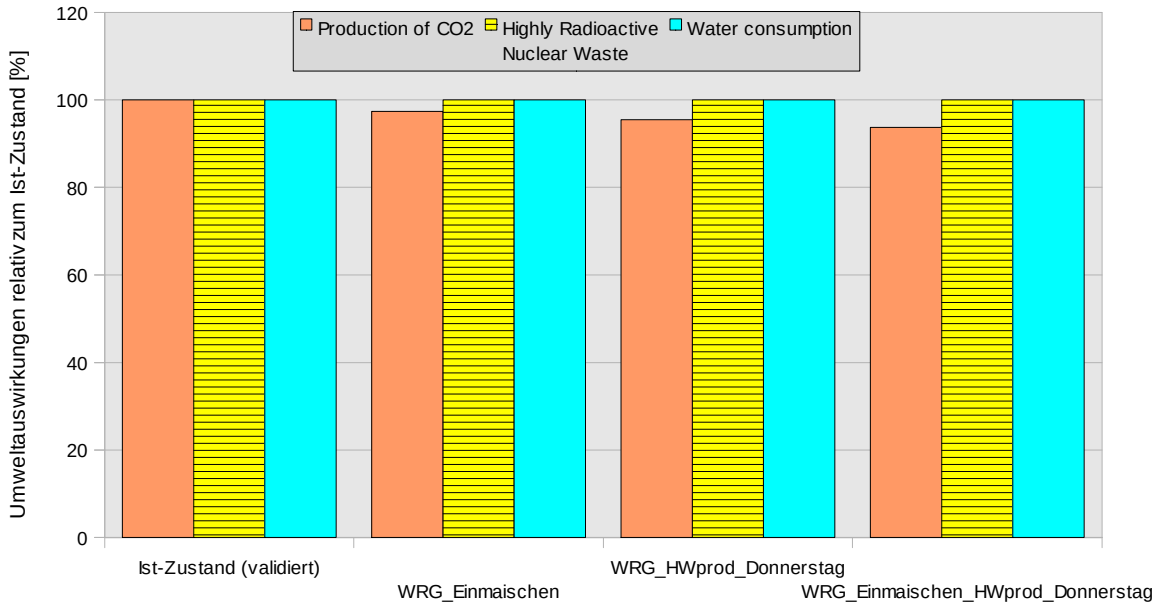
5.2. Comparative study and conclusions

		Present state	Alternative	Saving
Total primary energy consumption (1)	*[MWh]*	*3293*	*3094*	*200*
Allocation of energy consumption	*[-]*	*-*	*-*	*-*
Share of renewable energy	*[%]*	*-*	*-*	*-*
CO_2 emissions	*[tons/a]*	*721*	*676*	*45*
Annual energy system cost (2)	*[MWh]*	*111003*	*119740*	*-8%*
Total investment costs	*[EUR]*	*0*	*227498*	*-*
Payback period (3)	*[years]*	*-*	*11*	

(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

If the considered alternative is implemented by the company, approximately 6,2% of CO_2 emissions would be saved, in regard to the considered process (not the complete site of the company).

5.2.2. Economic analysis

The payback period of 11 is probably too high for the company. But as certain specific economic parameters were not included due to missing data (e.g. financial support by the state), the payback period might still decrease.

5.2.3. Conclusions and outlook

The major assumptions mainly concern the maintenance heat losses. Except for the PfaDuKo process, these losses are, compared to temperature increase energy demand, very small. Therefore, the assumptions should be adapted. As for the PfaDuKo process, no additional data was available to assess the uncertainty of the calculations; the results must be assumed as being adequate.

Upon company's request to focus only on part of the site, the audit conducted did not cover the whole production and buildings. It was agreed with the company that a future support would be available, should e.g. a student continue the modelling under EINSTEIN.

The company is already considering the recovery of heat, and might use the outcomes of this assessment in order to further develop their heat recovery concept. Detailed technical and economic feasibility studies should be conducted before a final decision is taken.