Energy Audit Summary Report
AEE INTEC
Audit no. *14* – UK04
Metal Treatment
Aluminum Casting

10th of November 2011

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 n. 14 – UK04

1. Data of the auditor

1.1. Contact data of the auditor

Name: Matthäus Hubmann
Organisation: AEE INTEC
Country: Austria
Profession: engineer
Number of audits performed: 1
Date of the audit: 10/11/2011
Duration of the audit: 4 weeks

2. Introduction

2.1. Objectives

The objectives of the audit are the modelling of the present state, the calculation of the energy consumption (total and process split) and furthermore the recognition of heat recovery potentials and possible changes in the energy supply.

3. Status Quo: processes, distribution, energy supply

3.1. General info of company

Sector: metal treatment, aluminium casting
Number of employees: n.a.
Product: aluminium parts

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

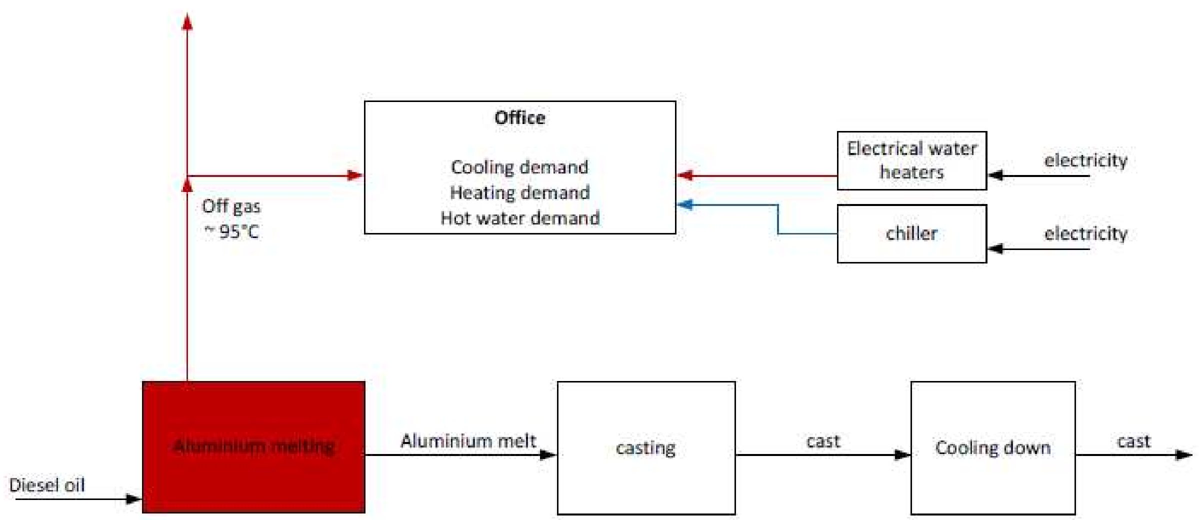

Figure 1: Flow sheet

3.3. Description of the existing system

The furnaces for melting the aluminium spent around 65,000 litres of diesel-oil per year with approximately 2,000 litres per week. The cooling in the offices of the company is done by four air conditioning (AC) units with a cooling capacity of 3.6 kW and a coefficient of performance (COP) of 3. Hot water (HW) is generated by electrical heaters.

- **Energy Supply:**

  Primary energy consumption:

Table 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	926	75.90	926	96.18
Total electricity	294	24.10	37	3.82
Total (fuels + electricity)	**1,220**	**100.00**	**962**	**100.00**

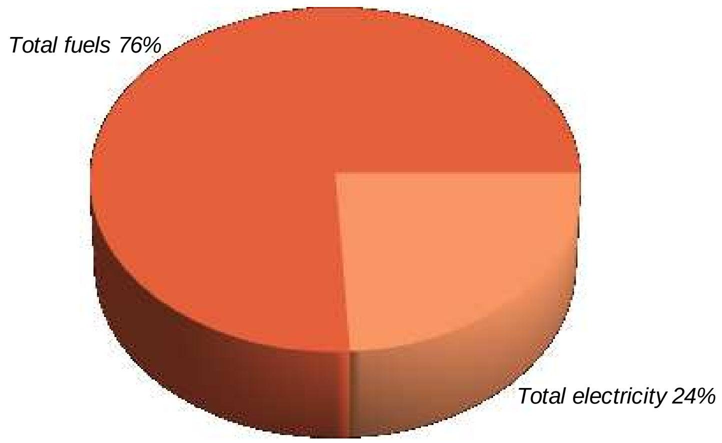

Figure 2: **Distribution of PEC by fuel type**

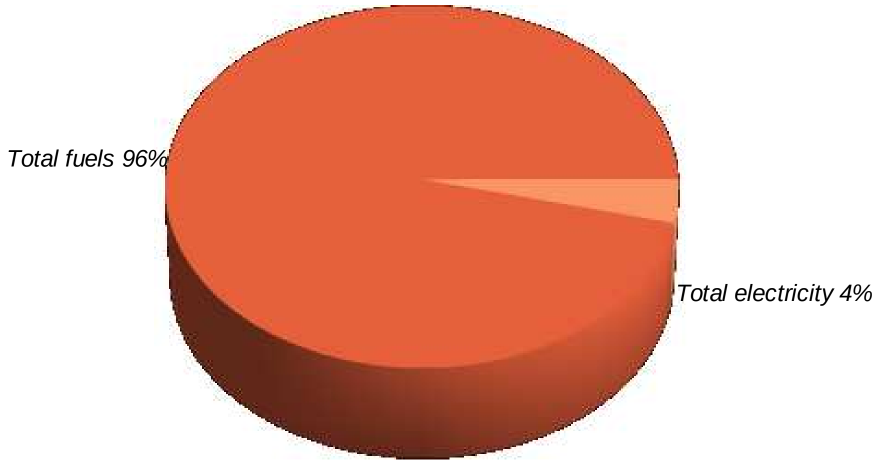

Figure 3: Distribution of PET by fuel type

Final energy consumption (FEC) per fuel, final energy demand thermal (FET):

Table 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]
Gas oil	842	89.57	842	98.56
Electricity	98	10.43	12	1.44
Total	939	100.00	854	100.00

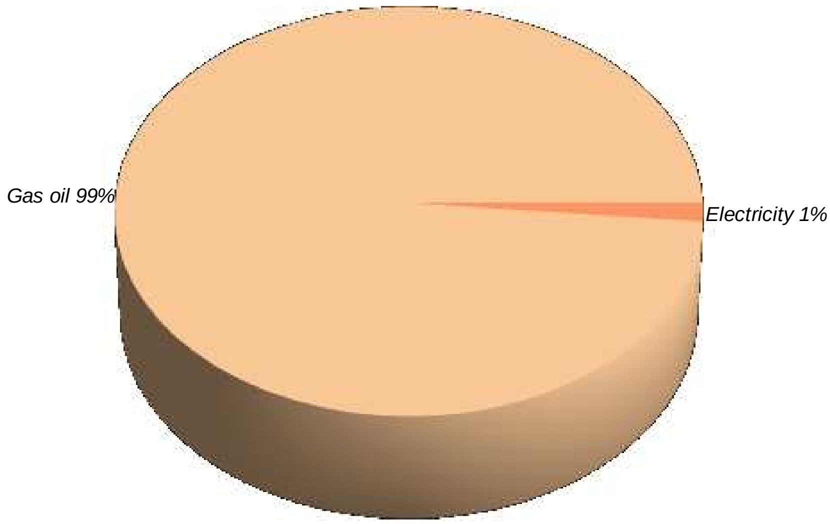

Figure 4: Total final energy consumption for thermal use (FET); present state.

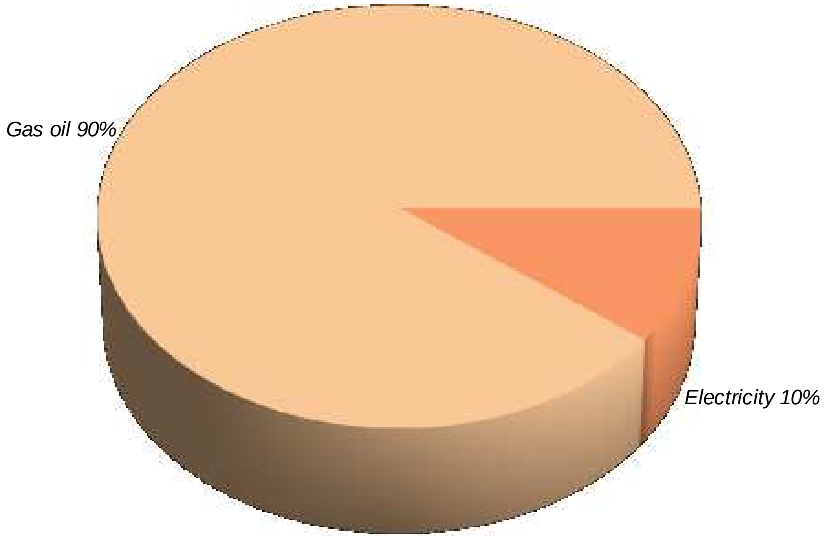

Figure 5: Total final energy consumption (FEC); present state.

Table 3: **Final energy consumption for thermal use (FET) by equipment (present state).**

Equipment	Fuel type	FET by equipment	
		[MWh]	[% of Total]
AC chiller	Electricity	4	0.43
melting plant	Gas oil	842	98.56
water heaters	Electricity	9	1.01
Total		**854**	**100.00**

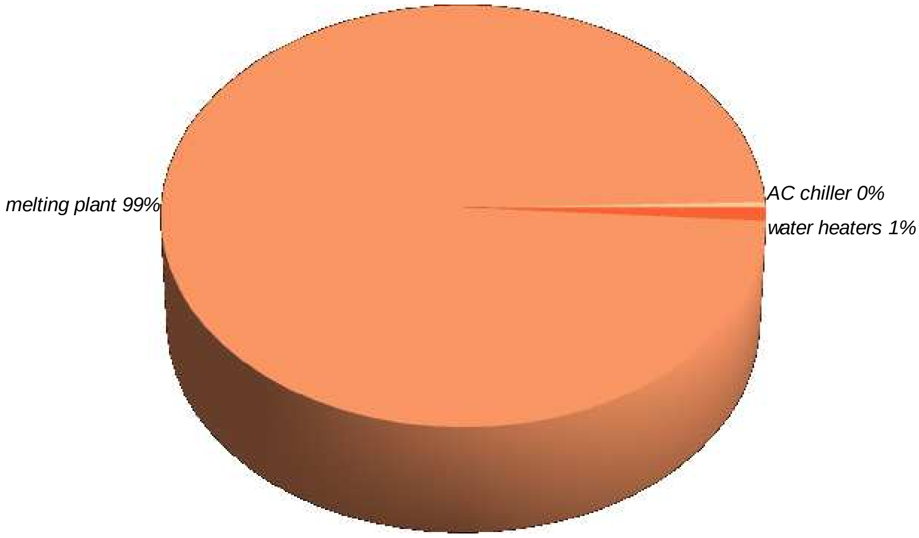

Figure 6: Final energy consumption for thermal use (FET) by equipment

Useful supply heat (USH), Fuel and electricity demand:

Table 4: **Useful supply heat (USH) by equipment; present state**

Equipment	USH by equipment	
	[MWh]	[% of Total]
melting plant	739	98.86
water heaters	8	1.14
Total	**747**	**100.00**

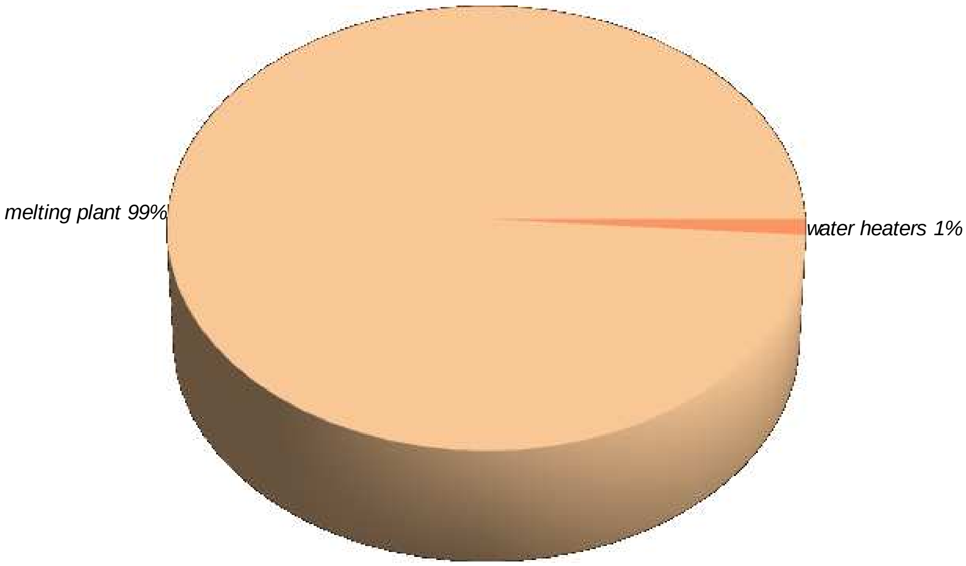

Figure 7: Useful supply heat (USH) by equipment. Present state.

Table 5: **Useful supply cooling (USC) by equipment; present state**

Equipment	USC by equipment	
	[MWh]	[% of Total]
AC chiller	10	100.00
Total	**10**	**100.00**

- **Distribution system:**

  Media and temperatures

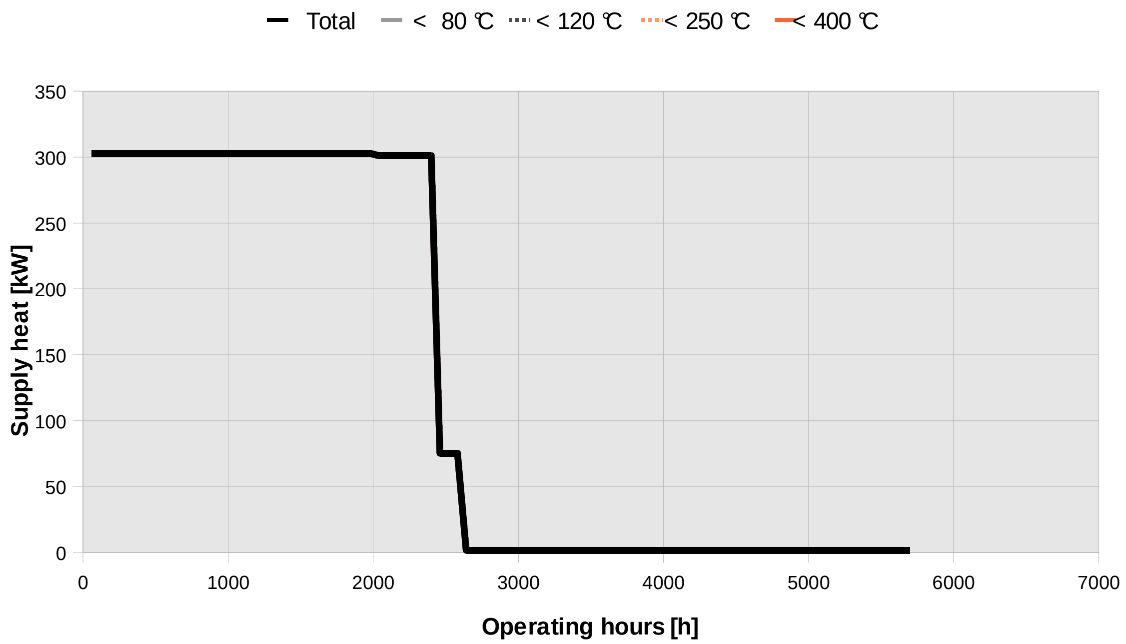

Figure 8: Distribution of supply heat by temperature levels and annual operating hours. Present state.

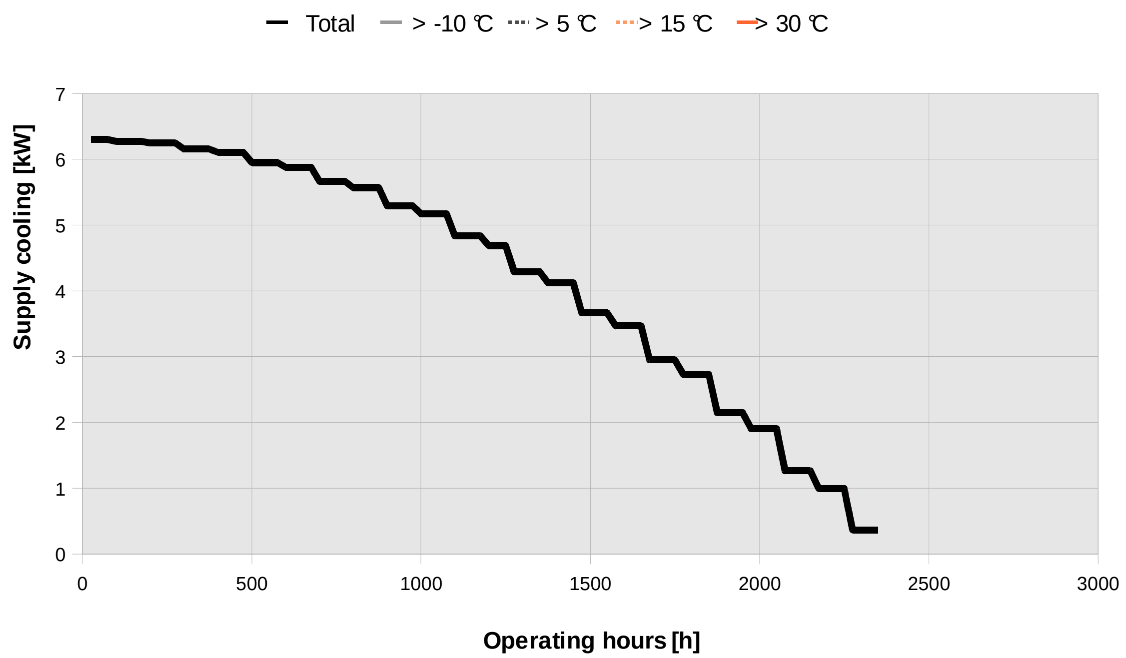

Figure 9: Distribution of supply cooling by temperature levels and annual operating hours. Present state.

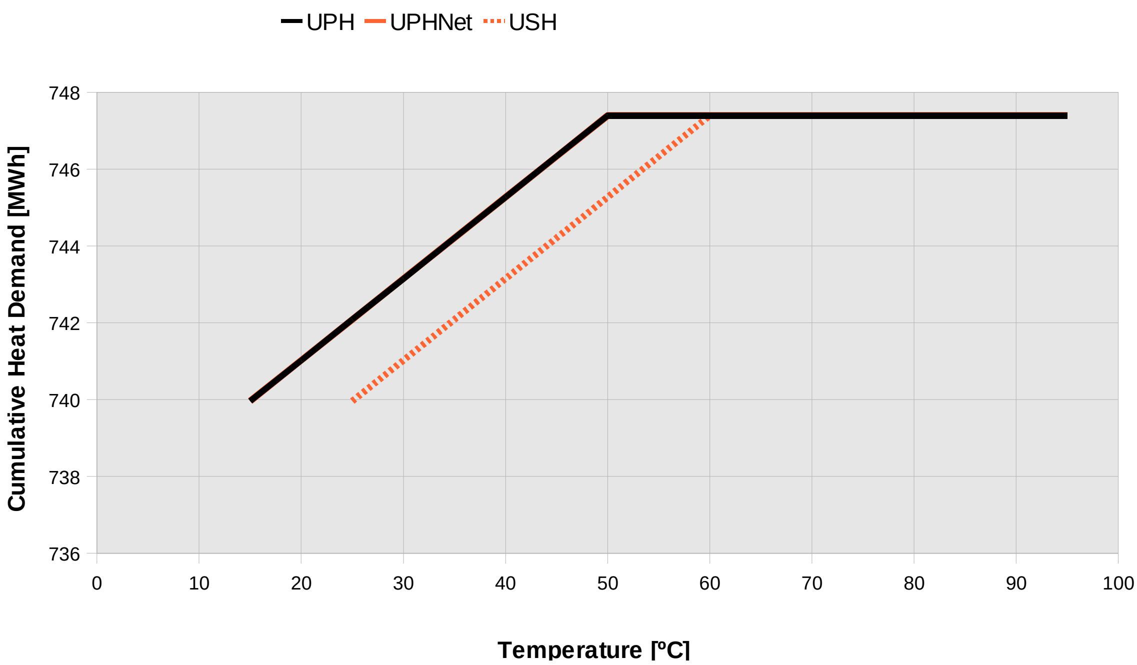

Figure 10: Distribution of the heat demand by temperature levels

- Main energy consuming energy processes and buildings
  External energy delivered to process (UPHproc), Total energy demand (UPH) per process

Table 6: **Useful process heat demand (UPH) by process. Present state**

Process	Total [MWh]	Circulation [MWh]	Maintenance [MWh]	Start-up [MWh]
office_HW	8	8	0	0
melting aluminium	739	0	739	0
Total	**747**			

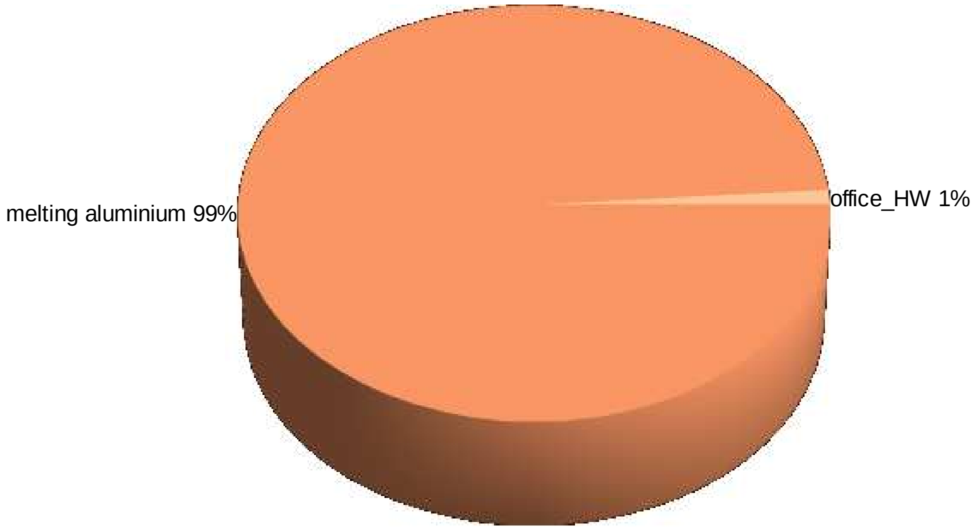

Figure 11: Useful process heat (UPH) by process

Table 7: Useful process cooling demand (UPC) by process. Present state

Process	Total [MWh]	Circulation [MWh]	Maintenance [MWh]	Start-up [MWh]
office_cooling	10	0	10	0
Total	**10**			

3.4. General

- An assumption to define the cooling demand of the offices had to be made because the calculations done, taking the change of the electricity demand in account couldn't be used. So the cooling demand was defined to be 10 MWh per year.
- Additionally the hot water consumption was assumed to be 0,5 m^3/day as no data was available. This assumption is based on an average water consumption of 22 litres per occupant and day.
- Due to the lack of data concerning the air compressors they were ignored in the following comparative studies.

4. Comparative study

Table 8: **Overview of the alternative proposals studied**

Short Name	Description
HR manual	based on present state + HR heat recovery
HR manual + no cooling	based on present state + HR manual + no cooling demand

4.1. Proposed alternative: **HR manual**

- HR manual

  The waste heat of the aluminium melting furnaces is used to heat up the hot water which is currently provided by electrical heaters.

Table 9: **Heat exchangers and amount of recovered energy**

Heat Exchanger	Power	Heat Source	Heat Sink	Amount of recovered energy	
	[kW]			[MWh]	[%]
HR burner - HW	2	melting furnance	office_HW	8	100.00
	2			**8.5**	**100**

Table 10: **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]	[%]
AC chiller	compression chiller (air cooled)	o==cooling offices==o	20	10	1.34
melting furnance	burner (direct heating)	o==melting aluminium==o	386	739	98.66
water heaters	hot water boiler	o==hot water pipe==o	5	0	0.00
Total			**411**	**749**	**100**

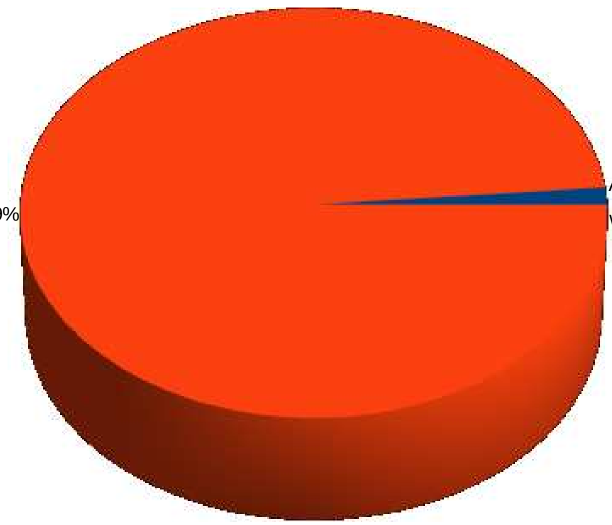

Figure 12: Contribution of each equipment to the total useful heat and useful cooling supply (USH & USC).

4.2. Proposed alternative: **HR manual + no cooling**

- HR manual + no cooling

  The waste heat of the aluminium melting furnaces is used to heat up the hot water which is currently provided by electrical heaters. Additionally the rest of the waste heat is ducted to the top of the roof to prevent overheating of the production hall and leads to reduction of the cooling demand.

Table 11: **Heat exchangers and amount of recovered energy**

Heat Exchanger	Power	Heat Source	Heat Sink	Amount of recovered energy	
	[kW]			[MWh]	[%]
HR burner - HW	2	melting furnance	office_HW	8	100.00
Total	2			**8.5**	**100**

Table 12: **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]	[%]
AC chiller	compression chiller (air cooled)	o==cooling offices==o	20	0	0.00
melting furnance	burner (direct heating)	o==melting aluminium==o	386	739	100.00
water heaters	hot water boiler	o==hot water pipe==o	5	0	0.00
Total			**411**	**739**	**100**

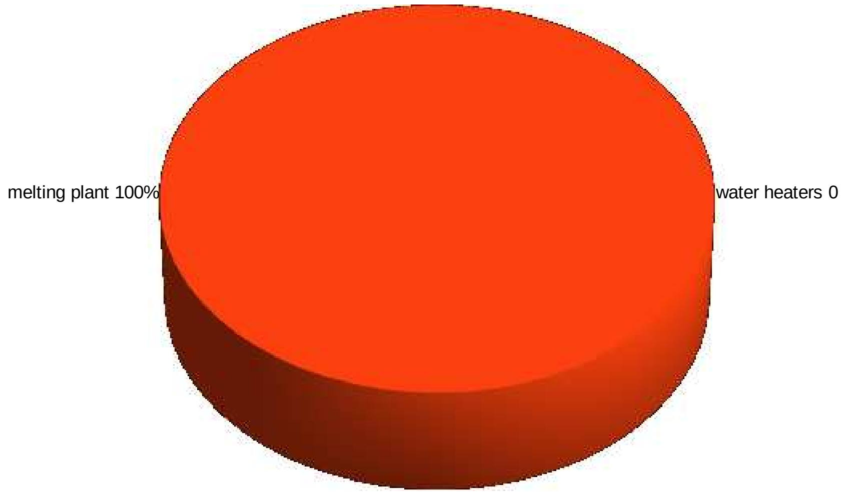

Figure 13: Contribution of each equipment to the total useful heat and useful cooling supply (USH & USC).

5. Selected alternative(s) and conclusions

5.1. Selected alternative: **HR manual + no cooling**

Table 13: Primary energy consumption: present state and alternative proposals

Alternative	Primary energy consumption	Savings	
	[MWh]	[MWh]	[%]
Present State (checked)	1,220	---	---
HR manual	1,197	23	1.88
HR manual + no cooling	1,191	29	2.38

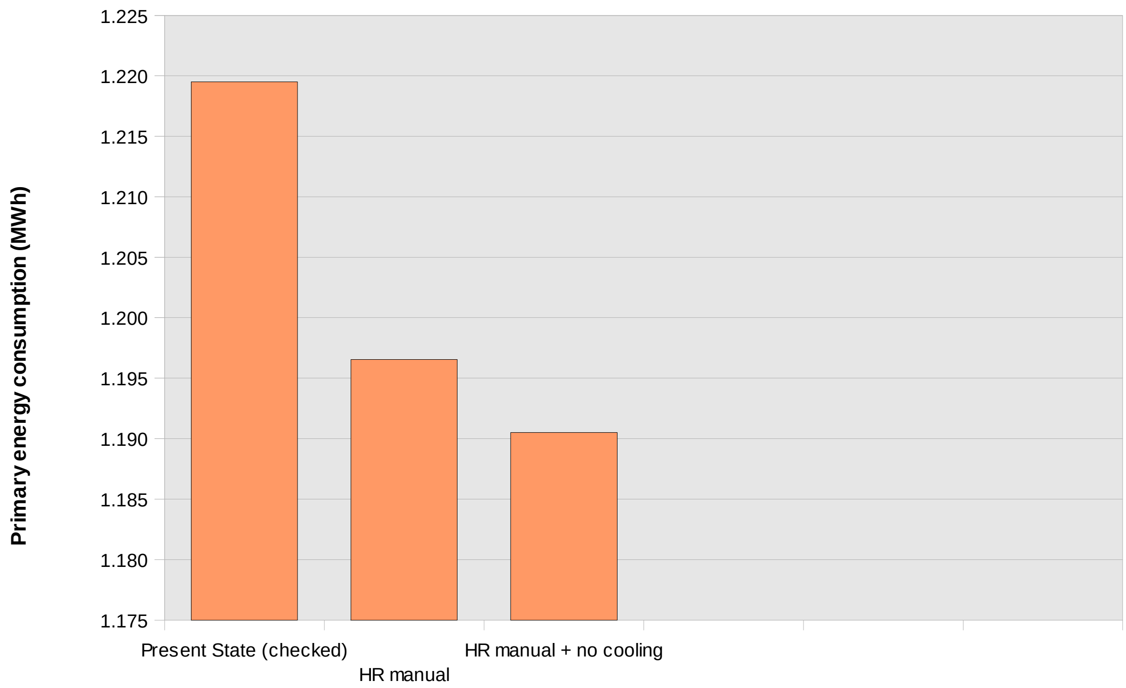

Figure 14: Comparison of alternatives: primary energy consumption

5.1.1. Process optimisation (written proposals)

Based on the available data no process optimisation was proposed.

5.1.2. Heat recovery

Table 14: Heat exchangers and amount of recovered energy

Heat Exchanger	Power	Heat Source	Heat Sink	Amount of recovered energy	
	[kW]			[MWh]	[%]
HR burner - HW	2	melting furnance	office_HW	8	100.00
Total	2			**8.5**	**100**

5.1.3. Heat and Cold Supply

No new equipment is proposed.

5.2. Comparative study and conclusions

Table 15: comparative study

		Present state	**Alternative**	**Saving**
Total primary energy consumption (1)		1,220	1,191	29
- total	[MWh]			
- fuels	[MWh]	926	926	-
- electricity	[MWh]	294	265	29
Primary energy saving due to renewable energy	[MWh]		-	
CO_2 emissions	[t/a]	259	255	5
Annual energy system cost (2)	[EUR]	74,009	73,121	888
Total investment costs	[EUR]		8,000	
Payback period (3)	[years]		10	

(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)

- CO_2-emission savings chart:

Table 16: Environmental impact: present state and alternative proposals

Alternative	Production of CO2	Water consumption
	[t]	[m3]
Present State (checked)	259,35	0,00
HR manual	255,52	0,00
HR manual + no cooling	254,52	0,00

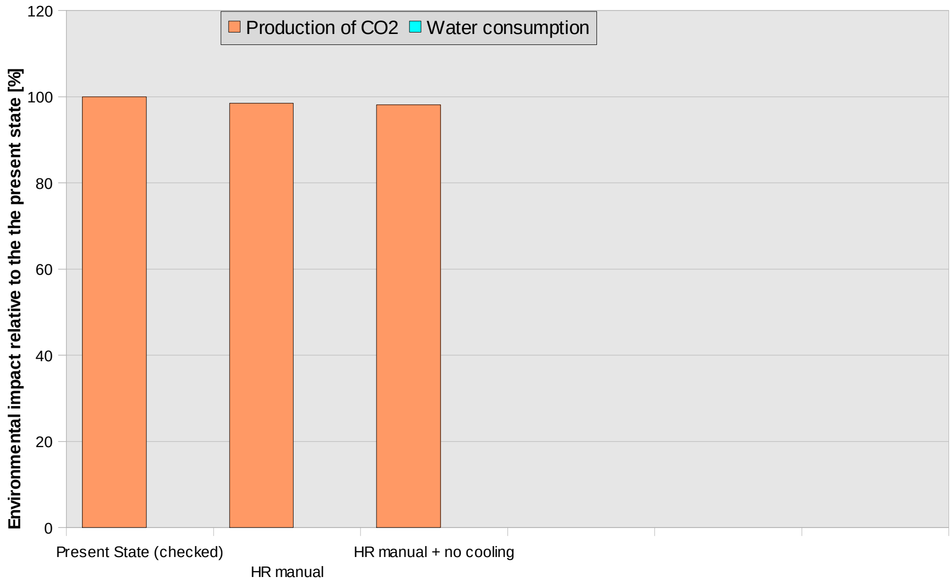

Figure 15: Comparison of alternatives: environmental impact

5.2.1. Energy and environmental analysis

By installing the heat exchanger the final energy demand for thermal use can be reduced by 12 MWh and the additional reduction of the cooling demand implements a reduction of 29 MWh of primary energy and saves 5 tons of CO2 per year compared to the present state.

5.2.2. Economic analysis

The investment costs for the heat exchanger network are assumed by € 2,000 and investment costs of the modification and installation of exhaust gas tubes and the supply system for the hot water are assumed by € 6,000. The calculated payback period is therefore 10 years.

5.2.3. Conclusions and outlook

Based on the available data and measurements performed the energy consumption split to the processes and equipments could have been calculated by EINSTEN and the results are well comparable to the present state of the company. For the economic aspects some further calculations will be necessary as the funding rate and the final investment costs are based on first estimations.