Energy Audit Summary Report
CRP HENRY TUDOR
Audit no. *18* – FR02

Food & Beverages
Cooking factory

14 December 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. 18 – FR02

1. Data of the auditor

1.1. Contact data of the auditor

Name: Jonathan Hervieu

Organisation: Public Research Centre Henri Tudor

Country: Luxembourg

Profession: Engineer

Number of audits performed: 1

Date of the audit: 10/24/2011

Duration of the audit: 3 weeks

2. Introduction

2.1. Objectives

The objectives of this audit are twofold:

1. Understand and analyse the energy consumption structure of the heating and cooling processes in the cooking factory and
2. Explore options to reduce the waste heat, mainly focussed on the recovery of heat and solar possibilities.

3. Status Quo: processes, distribution, energy supply

3.1. General info of company

Type: Cooking factory

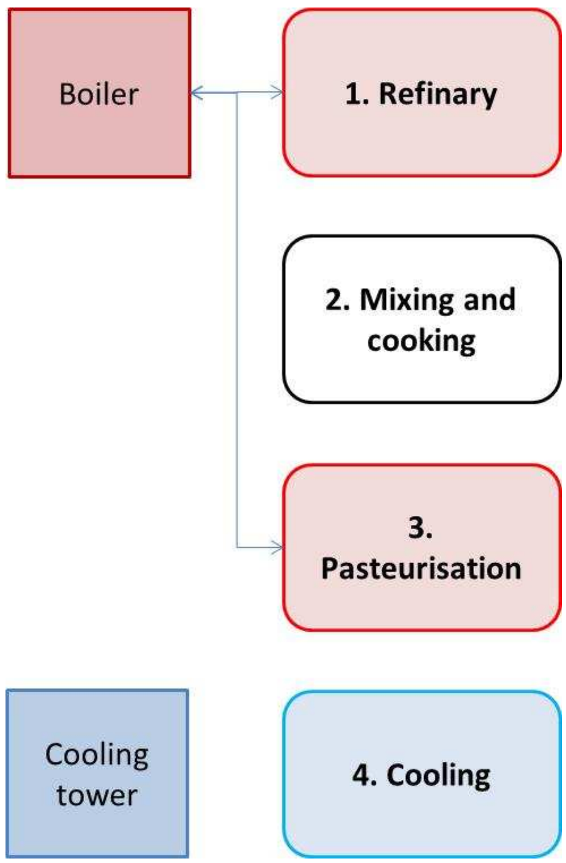
Location: France

Sector: food and beverages

Number of employees: 220

Product: Apple-based product

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 steam boiler using natural gas, and cooling by a cooling tower.

Type d'énergie (combustible/électricité)	PEC		PET	
	[MWh]	[% du total]	[MWh]	[% du total]
Combustible total	6,352	98.89	6,352	98.89
Électricité total	71	1.11	71	1.11
Total (combustible + électricité)	**6,423**	**100.00**	**6,423**	**100.00**

Type de combustible	FEC		FET	
	[MWh]	[% de total]	[MWh]	[% de total]
Gaz naturel	5,774	99.63	5,774	99.63
Électricité	22	0.37	22	0.37
Total	5,796	100.00	5,796	100.00

Équipement	Type de combustible	FET par équipement	
		[MWh]	[% du total]
Chaudière	Gaz naturel	5,774	99.63
Tour de refroidissement	Électricité	22	0.37
Total		**5,796**	**100.00**

- ***Distribution system***

  Media: steam (172°C) and water (25°C). Steam condensate and cooling water is totally recovered.

- ***Main energy consuming energy processes and buildings***

  See the list below for the considered heat and cold demand

Cooling:

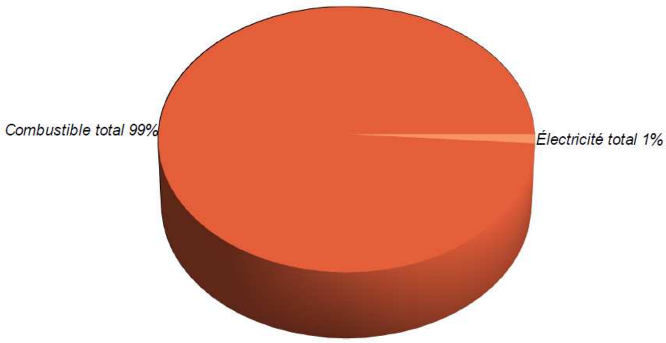
Processus	Total	Circulation	Entretien	Démarrage
	[MWh]	[MWh]	[MWh]	[MWh]
Refroidissement_coupelles_alu	398	398	0	0
Refroidissement_boites_conserve	347	347	0	0
Total	**745**	**745**		

Heating:

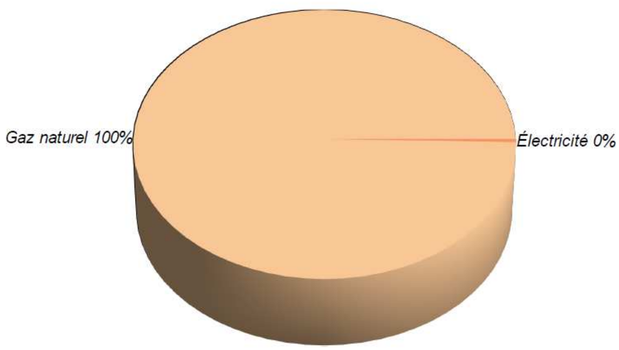
Processus	Total [MWh]	Circulation [MWh]	Maintenance [MWh]	Démarrage [MWh]
Bertocchi 1	834	834	0	0
Bertocchi 2	556	556	0	0
Bertocchi 3	1,390	1,390	0	0
Caustier	475	475	0	0
5 piste 1	157	157	0	0
5 piste 2	157	157	0	0
Gualapack 1	67	67	0	0
Gualapack 2	125	125	0	0
Gualapack 3	133	133	0	0
Arcil	647	647	0	0
5_kg	274	274	0	0
Bocaux	333	333	0	0
CIP_production_annuelle	41	41	0	0
CIP_production_saisonniere	3	3	0	0
Total	**5,193**	**5,193**		

Figures:

Primary energy (PEC)

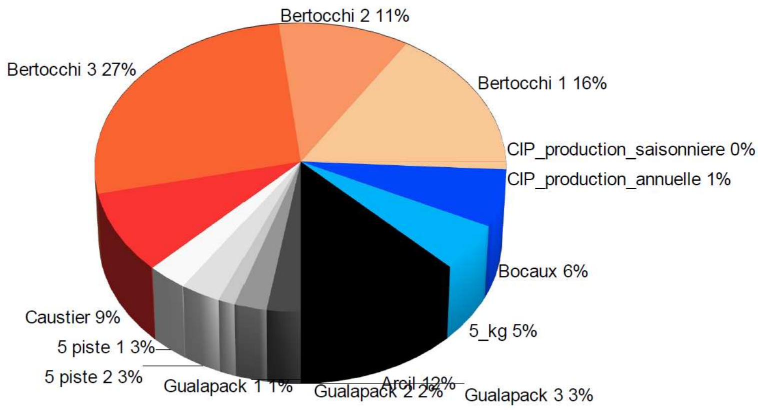


Final energy by equipment (FEC)

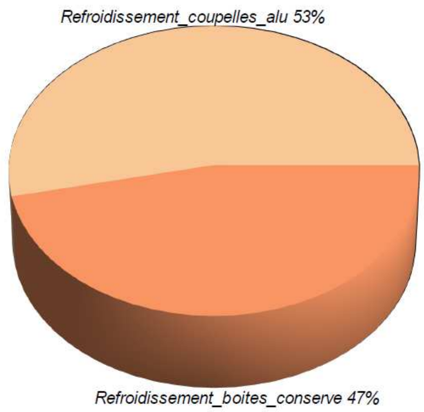


- ***H&C demand (proc)***

Heating:

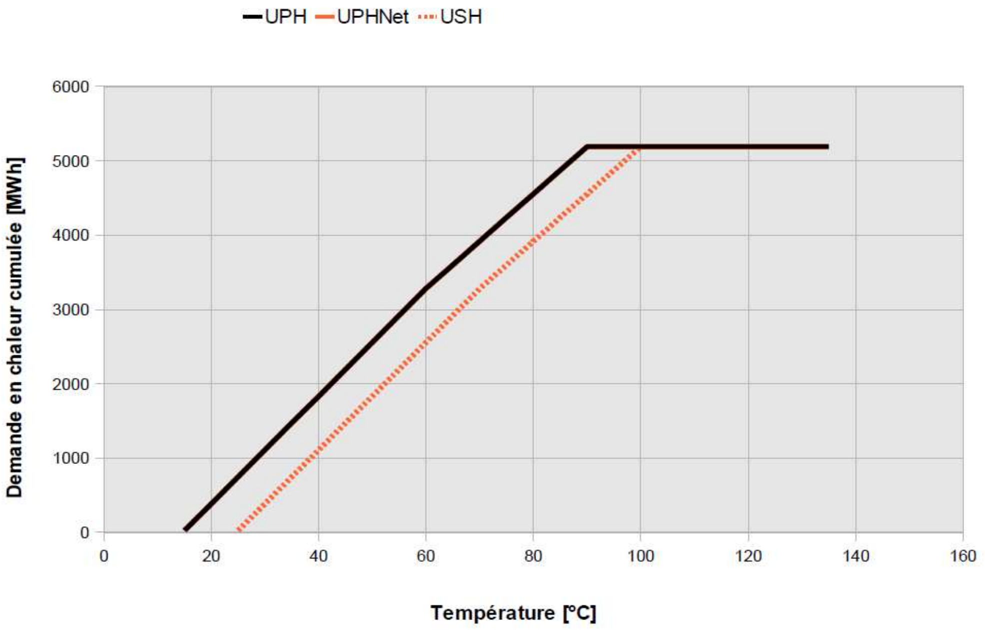


Cooling:

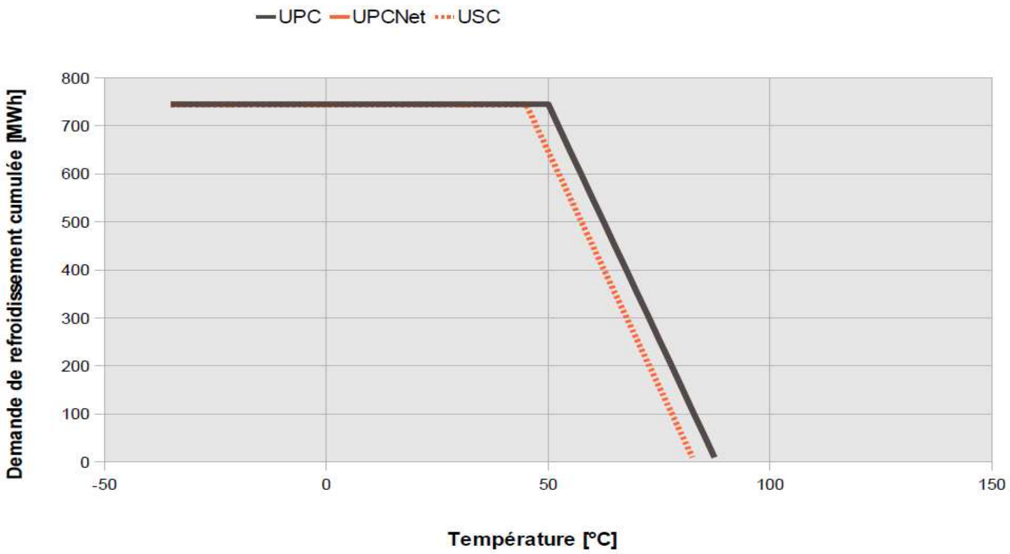


- ***H&C demand (temp)***

Heating:



Cooling:



3.4. General

- Assumptions:
    - The flow of apples is considered like a flow of 83% of water.
    - The inflow temperature of apple is constant during the year.
    - Consumption of Domestic Hot Water is considered null.
    - No temperature drop assumed on the pipes.
- The company doesn't have any heat recovery measures installed.

4. Comparative study

4.1. Proposed alternatives

Short Name	Description	Equipment
Récupération de chaleur	Consideration of the "theoretical" potential for heat recovery. After the pasteurization the waste heat can be used to heat the previews processes of the chain.	4 heat exchangers (of 277/385/151/141 kW nominal power)
Récup. Chaleur + Sol. Therm	This alternative is the combination of the previous scenario and a solar installation to produce hot water and pre-heat processes.	4 heat exchangers + a solar thermal installation (nominal power of 966kW)

5. Selected alternative(s) and conclusions

5.1. Selected alternative

The selected alternative is the one with combined heat recovery and solar thermal system. A solar solution is a very interesting perspective because of the company location in the South of France (high solar irradiation).

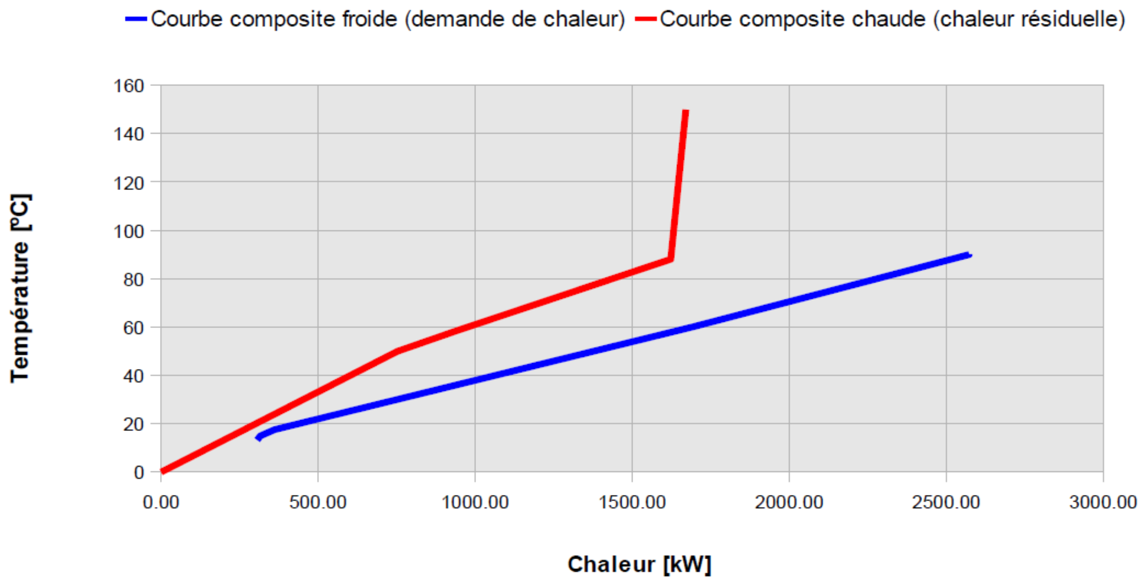
During the production a large amount of heat is lost after the pasteurization due to the cooling process. This waste heat could be theoretically recovered, but this solution is hard to implement in reality, as it would imply using a stream of solid material for heat recovery.

5.1.1. Process optimisation (written proposals)

n.a.

5.1.2. Heat recovery

Échangeur de chaleur	Puissance	Source de chaleur	Dissipateur de chaleur	Quantité d'énergie récupérée	
	[kW]			[MWh]	[%]
HX_1	277	Arcil	Bertocchi 3	1,394	47.70
HX_2	385	Refroidissement_boites_ Conserve	Caustier	359	12.28
HX_3	151	Bocaux	Bertocchi 1	758	25.93
HX_4	142	Refroidissement_coupelles _alu	Bertocchi 2	412	14.08
Total	**955**			**2922.46**	**100**



5.1.3. Heat and Cold Supply

Équipement	Type	Chaleur et refroidissement fournis dans le tuyau/conduit	Capacité nominale	Contribution à la fourniture de chaleur et de refroidissement totale	
			[kW]	[MWh]	[%]
Système solaire thermique	Capteur solaire (tube sous vide)	o==Circuit_vapeur==o	966	742	30.08
Chaudière	Chaudière à vapeur	o==Circuit_vapeur==o	6,960	1,716	69.52
Tour de refroidissement	Tour de refroidissement (humide)	o==Eau_de_refroidissement==o	3,489	10	0.40
Total			**11,415**	**2,468**	**100**

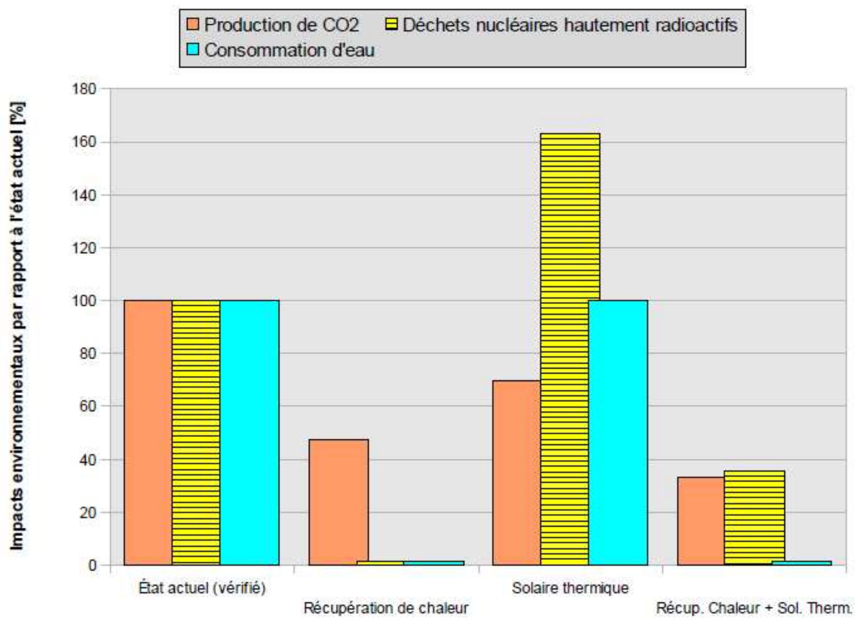
5.2. Comparative study and conclusions

		Present state	Alternative	Saving
Total primary energy consumption (1)				
- total	[MWh]	*6423*	*2124*	*67%*
- fuels	[MWh]	*6352*	*2098*	*67%*
- electricity	[MWh]	*71*	*25*	*65%*
Primary energy saving due to renewable energy	[MWh]	-	*886*	-
CO_2 emissions	[t/a]	*1445.75*	*477.67*	*67%*
Annual energy system cost (2)	[EUR]	*172404.77*	*97320.00*	*43%*
Total investment costs	[EUR]	*0*	*617265*	-
Payback period (3)	[years]	-	*4*	-

(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 more than 60% of CO_2 emissions and nuclear waste would be saved, in regard to the existing processes (not the complete site of the company).

5.2.2. Economic analysis

The payback time is around 4 years. But as certain specific economic parameters were not included due to missing data, the real payback period will be longer.

5.2.3. Conclusions and outlook

Due to the cooling step following the pasteurisation, the assessed chain of processes yields an important potential for heat recovery. Unfortunately, this potential is difficult to use to its full extend as it would imply important restructuring of the processes to allow heat recovery on solid flows. Nevertheless, the company should keep in mind the heat recovery potential provided by their chain of production.

As the company is located in Southern France, the use of thermal solar collectors could also be an interesting solution to reduce their natural gas consumption. A difficulty here is that all heating processes use steam, which implies more specific (and therefore more costly) solar thermal collector types. The change of the heat distribution from steam to hot water would simplify the application of this type of solution.