Energy Audit Summary Report
CRP HENRI TUDOR
Audit no. *41* – France *06*

Food & Beverages
Cookies manufacturing

Centre de Ressources des Technologies pour l'Environnement

17th of February 2012

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AUDIT n 41 – FR06

1. Data of the auditor

1.1. Contact data of the auditor

Name: Alex Bertrand and Jonathan Hervieu

Organisation: Public Research Centre Henri Tudor

Country: Luxembourg

Profession: Engineer

Number of audits performed: 4

Date of the audit: 08/04/2011

Duration of the audit: 2 weeks

2. Introduction

2.1. Objectives

Due to the very limited number of available data, this audit only focused on the electrical ovens and hot water production of the company. The objectives of this audit are twofold:

1. Understand and analyse the energy consumption structure of the cooking ovens and
2. Explore alternatives aiming at minimising the primary energy consumption, environmental impacts and costs.

3. Status Quo: processes, distribution, energy supply

3.1. General info of company

Type: Cookie manufacturing company

Location: France

Sector: food and beverages

Number of employees: n.a.

Product: Cookies

3.2. Description of the existing system

The system considered in this audit is composed of 6 electrical cooking ovens and one electrical hot water tank used for cleaning. Therefore process, distribution and equipment are all one single unit.

- *Primary energy consumption*

Energy type (fuels / electricity)	PEC		PET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
Total fuels	0	0,00	0	0,00
Total electricity	1 201	100,00	1 201	100,00
Total (fuels + electricity)	**1 201**	**100,00**	**1 201**	**100,00**

(Fuels consumption is zero, as only electrical equipment are used).

- *Final energy consumption (FEC) per fuel and final energy demand thermal (FET),*

Fuel type	FEC		FET	
	[MWh]	[% of Total]	[MWh]	[% of Total]
Natural gas	0	0,00	0	0,00
Electricity	364	100,00	364	100,00
Total	**364**	**100,00**	**364**	**100,00**

- *Useful supply heat (USH)*

Equipment	Fuel type	USH by equipment	
		[MWh]	[% of Total]
Four 1.1	Electricity	36	10,11
Four 1.2	Electricity	44	12,50
Four 2.1	Electricity	36	10,11
Four 2.2	Electricity	44	12,50
Four 3	Electricity	22	6,12
Four 4	Electricity	33	9,17
Four 5	Electricity	27	7,55
Four 6 :	Electricity	54	15,17
Chauffe-eau :	Electricity	60	16,77
Total		**356**	**100,00**

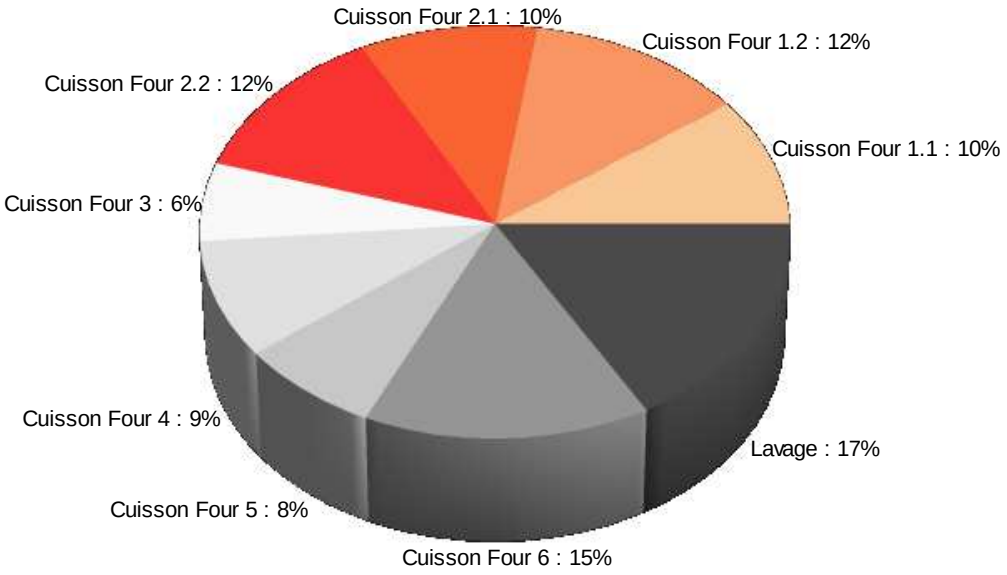
- *Distribution system*

n.a

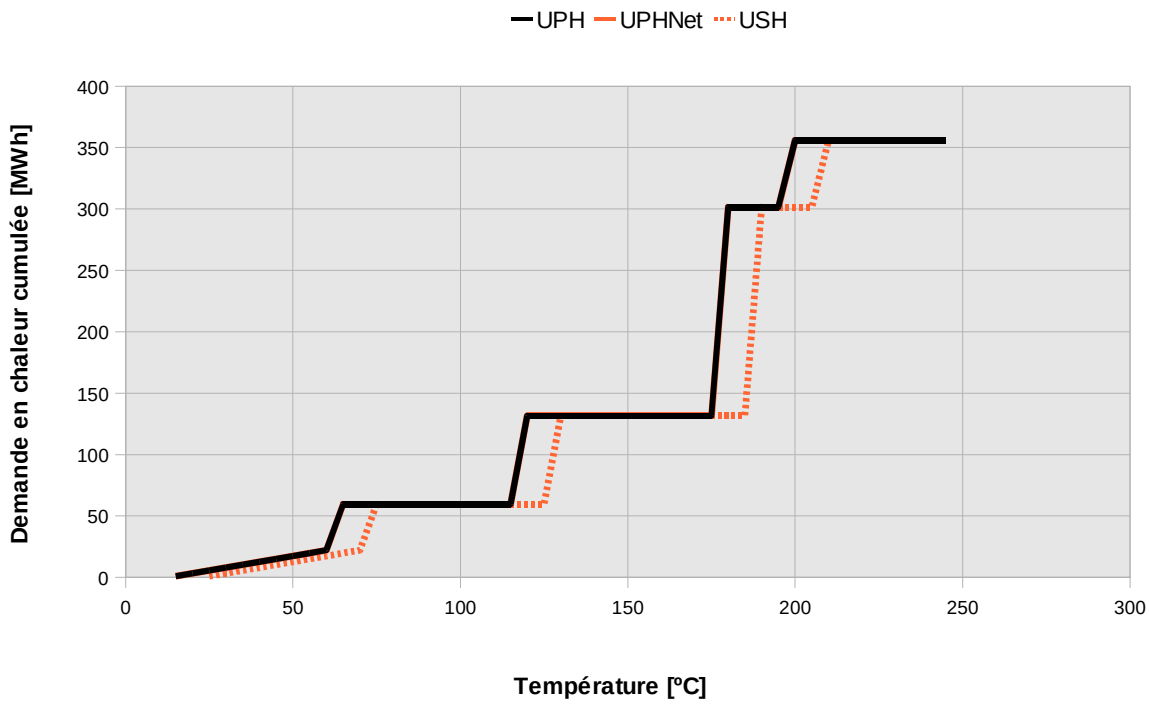
- *Main energy consuming energy processes*

Process	Total	Circulation	Maintenance
	[MWh]	[MWh]	[MWh]
Cuisson Four 1.1	36	0	36
Cuisson Four 1.2	45	0	44
Cuisson Four 2.1	36	0	36
Cuisson Four 2.2	44	0	44
Cuisson Four 3	22	0	22
Cuisson Four 4	33	0	33
Cuisson Four 5	27	0	27
Cuisson Four 6	54	0	54
Lavage	60	24	35
Total	**356**	**24**	**332**

- *H&C demand (proc),*



- *H&C demand (temp),*



3.3. General

The major thermal processes of this company are 6 electrical ovens used for backing and a hot water tank used for process and room cleaning. As only limited data were available, numerous hypotheses had to be taken, among others:

- The ovens are working continuously, no losses due to breaks are considered (which implies an overestimation of the electrical consumption),
- The electrical power of the ovens were considered as constant maintenance power,
- For the calculation of alternatives, the existence of a natural gas grid was assumed.

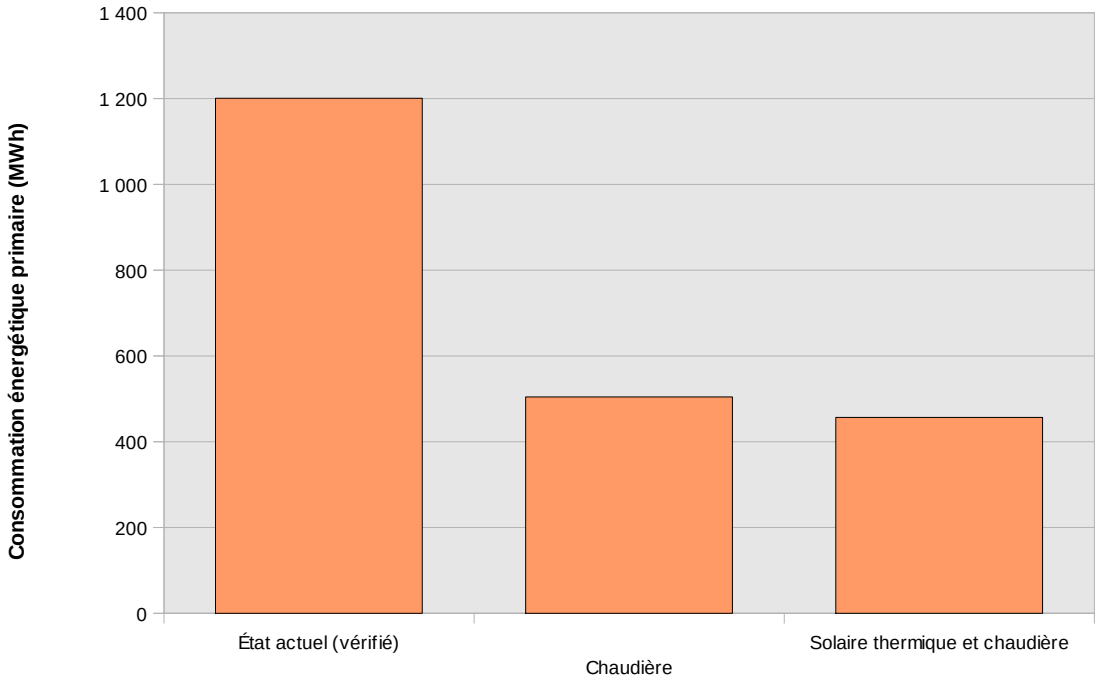
4. Comparative study

4.1. Proposed alternatives

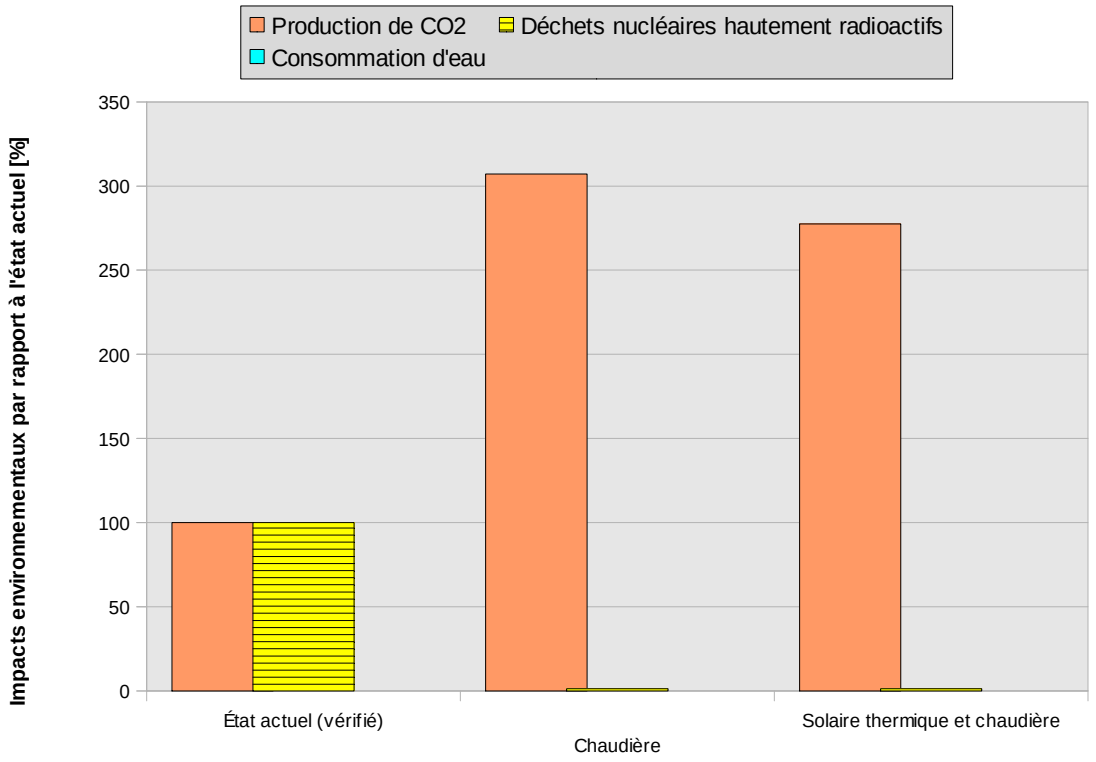
Two alternatives were assessed in detail: the use of a steam boiler for heat production, as well as the combination of solar thermal with steam boiler.

In the early stages of the audit, heat recovery as well as the use of a cogeneration unit were also considered as alternatives. Unfortunately, waste heat is only available in small quantities (according to the company), and the thermal base load was too small for a cogeneration unit. Therefore these two solutions were not further assessed.

- *Primary energy demands*



- *Environmental assessment*



5. Selected alternative(s) and conclusions

5.1. Selected alternative

Due to high investment costs and small primary energy saving potential of the solar thermal alternative, the scenario considering a steam boiler was selected as the most relevant one.

5.1.1. Process optimisation (written proposals)

n.a.

5.1.2. Heat recovery

n.a.

5.1.3. Heat and Cold Supply

Equipment	Type	Heat and cooling supplied to pipe/duct	Nominal capacity	Contribution to total heat and cooling supply	
			[kW]	[MWh]	[%]
Boiler	Steam boiler	o==pipe four 1.1==o o==pipe four 1.2==o o==pipe four 2.1==o o==pipe four 2.2==o o==pipe four 3==o o==pipe four 4==o o==pipe four 5==o o==pipe four 6==o o==Pipe chauffe-eau==o	600	356	100,00
Total			**600**	**356**	**200**

5.2. Comparative study and conclusions

		Present state	Alternative	Saving
Total primary energy consumption (1)				
- total	[MWh]	*1 201*	*504*	*58%*
- fuels	[MWh]	*0*	*490*	-
- electricity	[MWh]	*1 201*	*15*	*99%*
Primary energy saving due to renewable energy	[MWh]	-	-	-
CO_2 emissions	[t/a]	*36*	*112*	*-311%*
Annual energy system cost (2)	[EUR]	*31 723*	*18 795*	*41%*

(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.

5.2.1. Energy and environmental analysis

As can be seen from the figures and table above, the first alternative presents a very high primary energy saving potential compared to the present state, which is due to the replacement of electricity with natural gas as energy carrier. As the considered site is located in France, this alternative also leads to a reduction in nuclear waste production. Unfortunately, this also implies about 3 times more CO_2 emissions as fossil fuel is used.

5.2.2. Economic analysis

When comparing energy costs, the selected alternative (as well as the other one) leads to important savings. Unfortunately, the implementation of this alternative would not only imply the acquisition of a boiler, but also of a new distribution system as well as the modification of the cooking ovens. As these costs were not assessed, the further detail of the investment costs as calculated by EINSTEIN are not given here.

5.2.3. Conclusions and outlook

The lack of data was a major issue for this audit. As numerous hypotheses needed to be taken, the audit's results are not very precise. Concerning the outcomes of the audit, the decision-taking process remains difficult, as the considered parameters lead to contradictory conclusions. The chosen alternative might imply reduced primary energy use as well as reduced nuclear waste production, but it also implies higher CO_2 emissions due to the use of natural gas. The audit should therefore be further detailed using real company data. Based on this new assessment, improved alternatives should be developed and assessed.