Energy Audit Summary Report
CRP HENRI TUDOR
Audit no. 56 – LU02

Hospital

tudor
Centre de Ressources des Technologies pour l'Environnement

May 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 n°56

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: 5

Date of the audit: -

Duration of the audit: 3 weeks

2. Introduction

2.1. Objectives

The objectives of this audit are to assess the energy consumption of the trigeneration plant under ideal conditions, as well as to analyse the impact of replacing the absorption chillers with mechanical chillers.

3. Status Quo: processes, distribution, energy supply

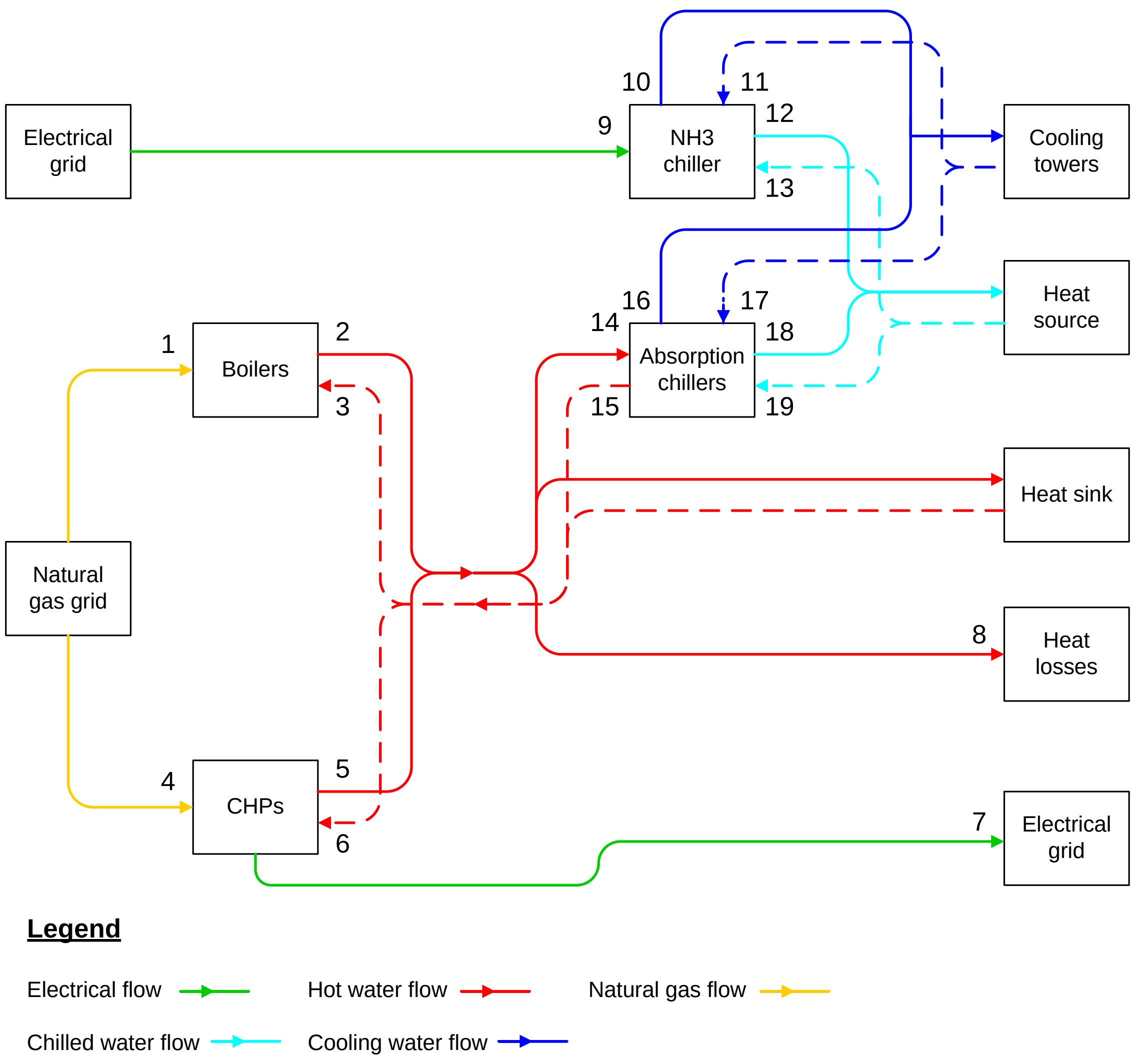
3.1. General info of company

Type: Hospital

Location: Luxembourg

Number of employees: n.a.

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

The system considered in this audit is composed of 3 CHP modules, 3 boilers, 2 absorption chillers and one NH3 chiller. Identical equipment are regrouped into one for modelling purposes.

- *Primary energy consumption: 30 517 MWh*

- *Final energy consumption*

	[MWh]
Natural gas	27 743
Electricity	-7 379
Total	**20 364**

- *Final energy demand thermal (FET) by equipment*

Equipment	Type de combustible	FET by equipment	
		[MWh]	[% du total]
Chiller_NH3	Electricity	205	1,02
Chaudière (Boiler)	Natural gas	7 255	36,09
Cogénération (CHP)	Natural gas (- gen.elect.)	12 629	62,82
Chiller_absorption	Electricity	13	0,07
Total		**20 103**	**100,00**

- *Useful supply heat (USH)*

Equipment	USH by equipment	
	[MWh]	[% du total]
Chaudière (Boiler)	6 792	40,36
Cogénération (CHP)	10 039	59,64
Total	**16 831**	**100,00**

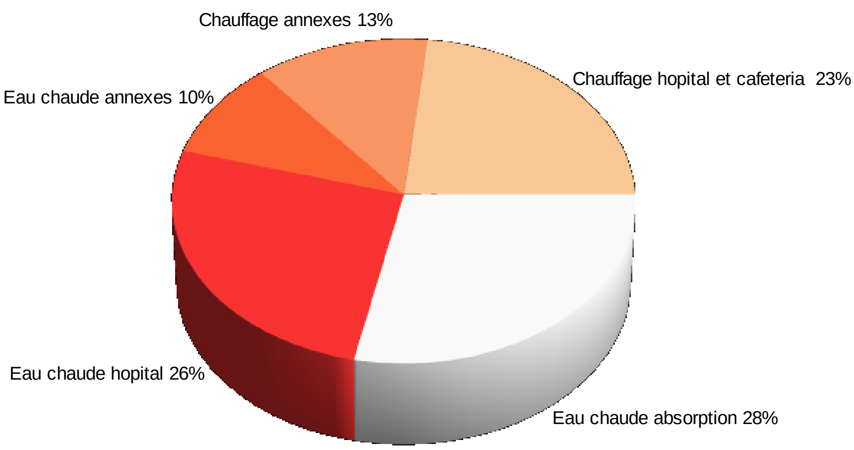
- *Useful supply cool (USC)*

Equipment	USC by equipment	
	[MWh]	[% du total]
Chiller_NH3	995	35,74
Chiller_absorption	1 789	64,26
Total	**2 784**	**100,00**

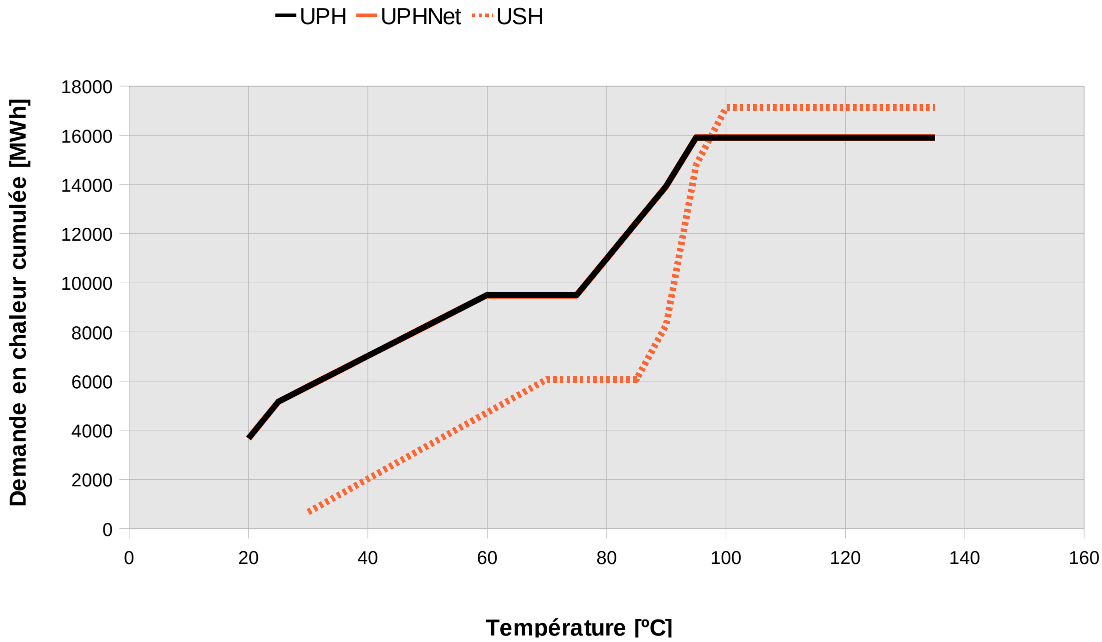
- *Main energy consuming energy processes (UPH)*

Process	Total [MWh]	Circulation [MWh]	Maintenance [MWh]
Chauffage hopital et cafeteria	3 643	3 418	225
Chauffage annexes	1 977	0	1 977
Eau chaude annexes	1 508	1 508	0
Eau chaude hopital	4 077	4 077	0
Eau chaude absorption	4 431	4 431	0
Total	**15 636**	**13434**	**2202**

- *Heat demand (proc),*



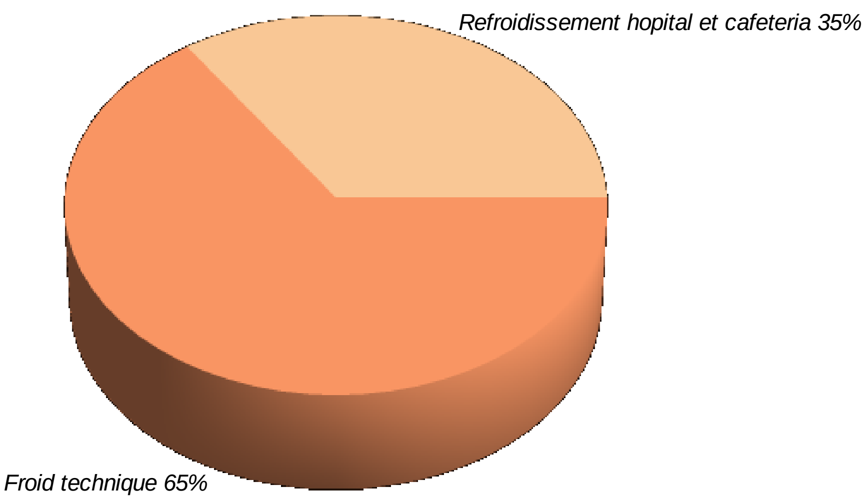
- *Heat demand (temp),*



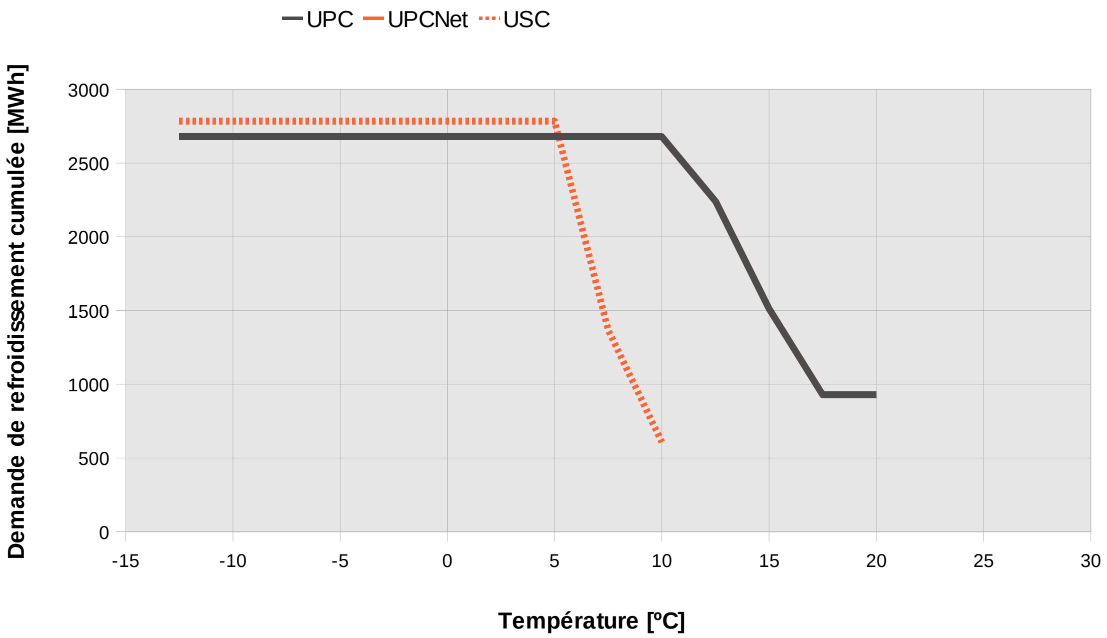
- *Main energy consuming energy processes (UPC)*

Processus	Total [MWh]	Circulation [MWh]	Entretien [MWh]
Refroidissement hopital et cafeteria	927	432	495
Froid technique	1 752	1 752	0
Total	**2 679**	**2184**	**495**

- *Cold demand (proc),*



- *Cold demand (temp),*



3.4. General

For this specific audit, the objective was not to understand how much heat is being used (measured data is available), but, instead, to better understand how heating and cooling are produced, and what the impacts of various effects on the energy consumption are.

For this reason, the modelling in EINSTEIN was approached in a different way than usual. The present state was defined as alternative (which is then simulated in hourly steps, therefore providing more precise results). A boiler was defined as base-load, followed in the heat cascade by the CHP unit and a second boiler. This modelling was necessary in order to split the energy consumption of the various equipment according to real conditions, as EINSTEIN does not take into account specific working conditions (interruptions for maintenance reason, limited number of working hours during the day, etc.).

The main assumptions made concerned the length of heating and cooling distribution, as well as the distribution between technical and comfort cooling (determined by assuming that the cooling needs in the winter are purely used for technical purposes).

4. Comparative study

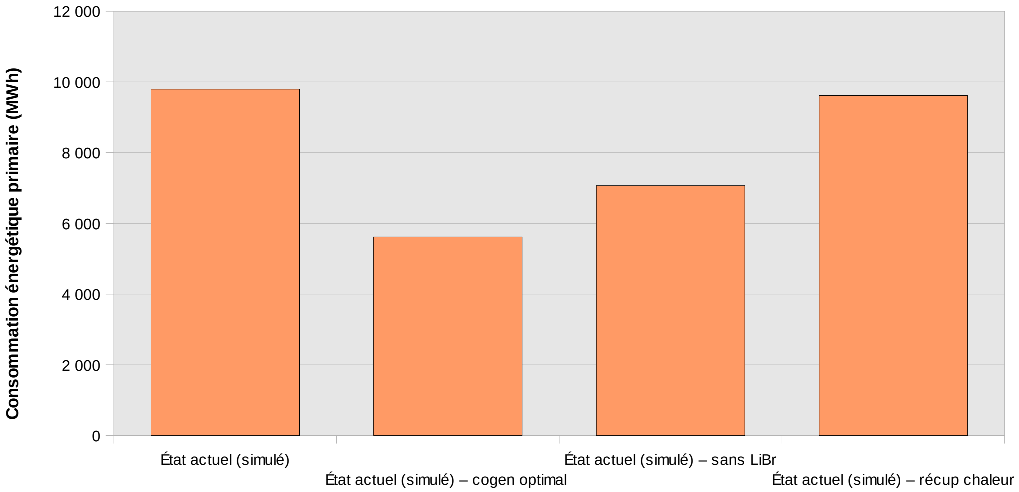
4.1. Proposed alternatives

The present state was defined as alternative ("Etat actuel (simulé)") to serve as reference for the other alternatives.

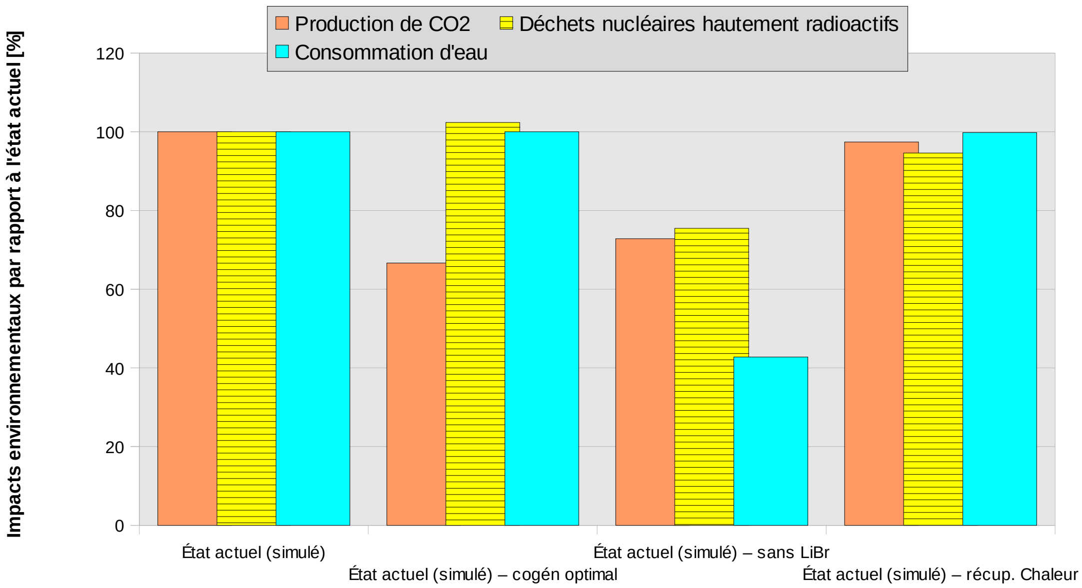
3 scenarios were considered:

1. Optimisation of the CHP unit: the CHP is really used for base-load, while the boilers are used for peak-load. No interruptions are taken into account.
2. Cooling production without the absorption chillers
3. Heat recovery on the boilers to preheat sanitary water.

- *Primary energy demands*



- *Environmental assessment*



5. Selected alternative(s) and conclusions

5.1. Selected alternative

The alternative where the CHP is running under ideal conditions was retained as final scenario, as it reflects the negative impact of real working conditions.

5.1.1. Process optimisation (written proposals)

No process optimisation was proposed.

5.1.2. Heat recovery

No heat recovery concept was proposed.

5.1.3. Heat and Cold Supply

In this specific case, the equipment was not changed, only the way of working of the equipment.

Equipment	Type	Heat and cooling supplied to pipe/duct	Nominal capacity	Contribution to total heat and cooling supply	
			[kW]	[MWh]	[%]
Chiller_absorption	thermal chiller (water cooled)	o==Distribution_eau_froide_hôpital==o	1 054	1 366	49,05
Chiller_NH3	compression chiller (water cooled)	o==Distribution_eau_froide_hôpital==o	636	1 419	50,95
Cogénération	CHP engine	o==Distribution_eau_chaude_hôpital==o o==Distribution_eau_chaude_annexes==o	2 865	14 322	82,52
Chaudière	Hot water boiler	o==Distribution_eau_chaude_hôpital==o o==Distribution_eau_chaude_annexes==o	10 350	3 034	17,48
Total			**14 905**	**20 140**	**200**

5.2. Comparative study and conclusions

		Present state (simulated)	Alternative	Saving
Total primary energy consumption (1)				
- total	[MWh]	30 517	27 519	10%
- fuels	[MWh]	-	-	-
- electricity	[MWh]	-	-	-
Primary energy saving due to renewable energy	[MWh]			
CO_2 emissions	[t/a]	*2 810.27*	*1 873.48*	*33.33%*
Annual energy system cost (2)	[EUR]	*991 584*	*989 465*	*0.21%*
Total investment costs	[EUR]	*0*	*0*	*0*
Payback period	[years]	-	-	-

(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

By increasing the CHP's use, primary energy savings of 10% and CO_2 emission reduction of 33% could be obtained.

5.2.2. Economic analysis

No investment costs are necessary for this alternative. Nevertheless, increasing the CHP's working would probably imply increasing prevention work on the units.

5.2.3. Conclusions and outlook

The difficulty of this alternative is that it is a theoretical assessment. Currently, the technical team on site is already at the maximum of its capacity, so that further prevention work is difficult to implement. In addition, limits imposed by the authorisation of the plant, influencing its way of working, cannot easily be changed. Nevertheless, the outcomes of this audit should be presented to the concerned actors to show the available potential for optimisation and their influence on these.