

ENERGY CONSUMPTION FOR  
76 HOSPITALS IN BELGIUM

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1. Introduction

We were commissioned by the Belgian Science Policy Office (S.P.P.S.) to do an enquiry on energy consumption in Belgian hospitals.

Belgium is a country with 10 millions inhabitants and has 240 hospitals totalizing around 92 500 beds in which psychiatrics hospitals represents around 22 800 beds (1).

A form, easily to be filled, was sent to each for these 240 hospitals and we received 76 answers relating to 21 280 beds.

The results can thus be considered significant and allow us :

- to have a better knowledge on energy consumption
- to appreciate energy management as well as energy conservation opportunities for hospitals in Belgium.

Belgium is a moderate climate country with 2076 degree-days 15/15 and basis outside temperature for thermal losses calculations varying from -7 °C (at coast) to -12 °C (Eastern part).

2. Enquiry form

The informations asked to the hospitals were :

- Heated area, shared between hospitalization area and other heated areas.
- Heated volume.
- Number of beds, of hospitalizations nights, of working people.
- Number and power of boilers, nature of fuel.
- Heated areas of buildings (other than the hospital) heated by the same plant.

- Is there electric heating ?
- Is domestic hot water (DHW) prepared by the central heating plant ?
- Number and power of electric transformers or low-voltage connections to utility network.
- Consumption and cost of fuels and electricity (shared, for the later, between night and day).
- cos phi and peak power.

These basic data were to be completed by informations on :

- Ventilation and/or air-conditionning
- Number and power of frigorific compressors
- Incinerators
- Hydrotherapy pool
- Kitchen
- Laundry
- Energy Management System
- Special heat recovery unit

3. Presentation of results

3.1. Preliminary note

In the tables and figures here beneath are reported the mean yearly consumptions per bed for "heating" and of electricity.

In "heating" consumptions are comprised all energy uses others than electricity if these uses are assumed by natural gas or heating(s) plant(s) :

- heating, ventilating and air conditioning
- laundry
- kitchen
- sterilization
- hydrotherapy swimming-pool
- etc...

The broad scattering of the results are to be underlined ; thus the specific values given here beneath must be considered more indicative than absolute references and that prevent us to make strong correlations (2).

### 3.2. Hospitalization and heated area

Sometimes other(s) building(s) is (are) heated by the same heating plant than the hospital itself :

- office building for administration,
- nurse's school or dormitory
- etc...

Otherwise, we suspected than large hospitals had more annex departements as laboratories, sterilization, food preparation etc... than the smaller ones.

It is the reason why we asked, through the enquiry form, to distinguish between the total heated area, which relates to the building(s) heated by the plant(s) for which the fuel consumption is given, and the hospitalization area which relates only to the rooms, their corridors and night nurse's office.

Table 1 shows the values of the ratio of hospitalization area (A hosp.) on heated area (A heat.) for hospitals of different sizes.

Table 1 - Hospitalization area versus heated area

Size of hospital (beds)	0/100	101/250	251/400	401/600	601/1 400
Number of hosp. :	9	36	6	7	8
Number of beds considered :	606	6 136	1 896	3 606	6 244
<u>A hosp/A heat.</u> (%) :					
Mean value	62	50	49	52	51
Range	43 to 69	13 to 79	28/75	42/63	28/65

As expected, smaller hospitals are more concerned by pure hospitalization than the bigger ones. We can also notice the large scattering of A hosp/A heat, which varies from 13 % to 79 %.

### 3.3. Energy consumption for heating

In table 2 and figures 1 and 2 are reported the mean yearly consumptions per bed for "heating".

These energy consumptions were calculated from fuel consumption (in l, kg or m<sup>3</sup>) and the following lower heat contents :

Light fuel oil	:	10.19 kWh/l
Heavy fuel oil	:	11.39 kWh/kg
Extra heavy fuel oil	:	11.17 kWh/kg
Natural gas	:	9 kWh/m <sup>3</sup>

(1 kWh = 3,6 MJ)

Table 2 - Energy consumption for "heating"

Size of hosp. (beds)	Heat consumption (MWh/y x bed)	
	Mean	Range
0/ 100	22.6	6.3 to 36.5
101/ 250	22.1	5.8 to 51
251/ 400	21.9	16.3 to 31.3
401/ 600	21.2	12.1 to 33.1
600/1400	25.3	16 to 36.7

We cannot explain how, with a higher ration A hosp/ A heat, hospital ranging from 0 to 100 beds have a slightly higher mean heat consumption than hospitals ranging from 401 to 600 beds.

On the other hand, the higher specific heat consumption for the largest hospital can be easily explained by their auxiliary services and because they are more often partially or totally mechanically ventilated or air-conditionned.

In table 3 are reported the auxiliary services and occurrence of ventilation, as answered through the inquiry.

Table 3 Ventilation and auxiliary services

Size of hosp. (beds)	Number	Ventil(*)	Hydroth(*)	Laundry(*)	Kitchen(*)
0/ 100	9	3	-	-	4
101/ 250	36	11	4	5	35
251/ 400	6	4	2	1	6
401/ 600	7	4	2	3	7
601/1400	8	8	7	2	8

(\*) Number of hospitals of the corresponding size having the said equipment.

The scattering of the specific heat consumption, from 6.3 to 51 MWh/y x bed is also seen in figures 1 and 2.

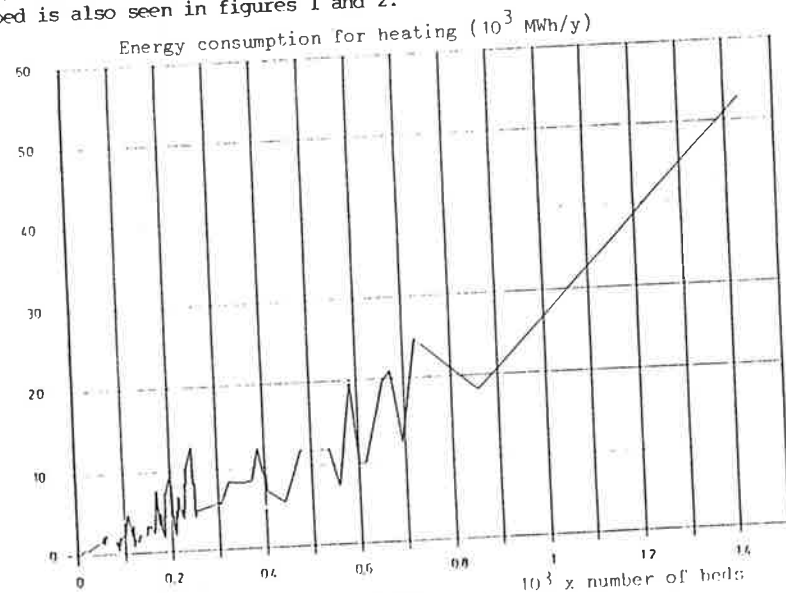


Fig. 1. Energy consumption for heating

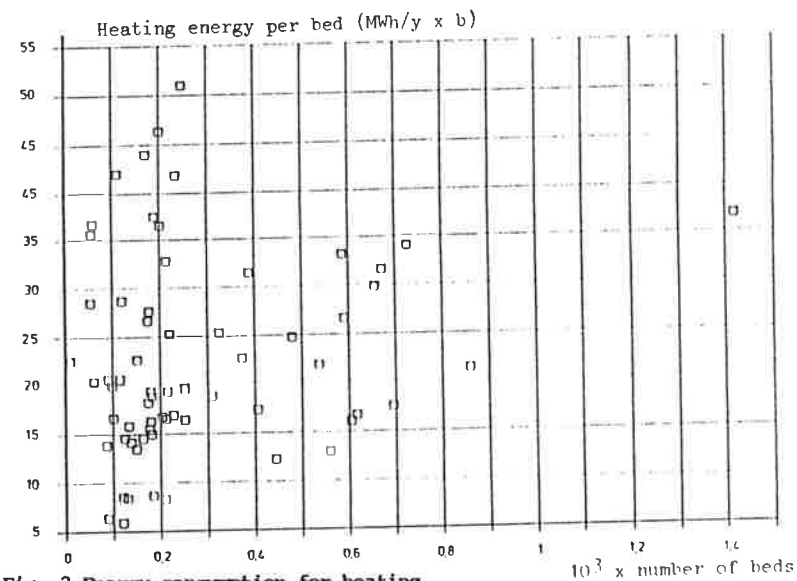


Fig. 2 Energy consumption for heating

#### 3.4. Electricity consumption

The mean electricity consumption per year and bed is 3.6 MWh/y x b, but also with a big scattering ranging from 1 to 12 MWh/y x b.

Table 4 and figures 3 and 4 report these results.

Table 4 - Electricity consumption

Hospital size (bed)	Electricity use (MWh/y x b)	
	Mean	Range
0/ 100	2.52	0.09 to 4.66
101/ 250	3.35	1.05 to 6.85
251/ 400	3.14	2.5 to 4.36
401/ 600	3.59	1.87 to 7.6
601/1400	6.14	1.28 to 11.7

We note here an increase of the mean value of electricity consumption with the number of bed, due to a higher sophistication of medical equipment, ventilation and other services.

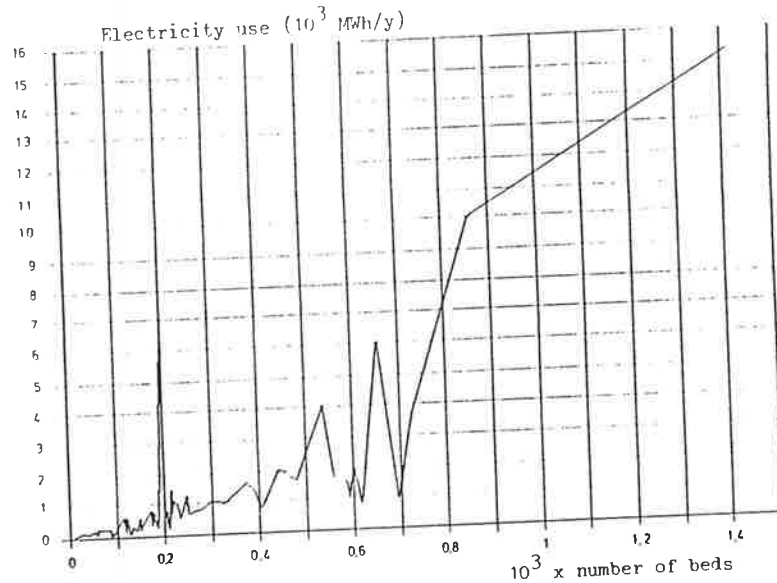


Fig. 3 Electricity use

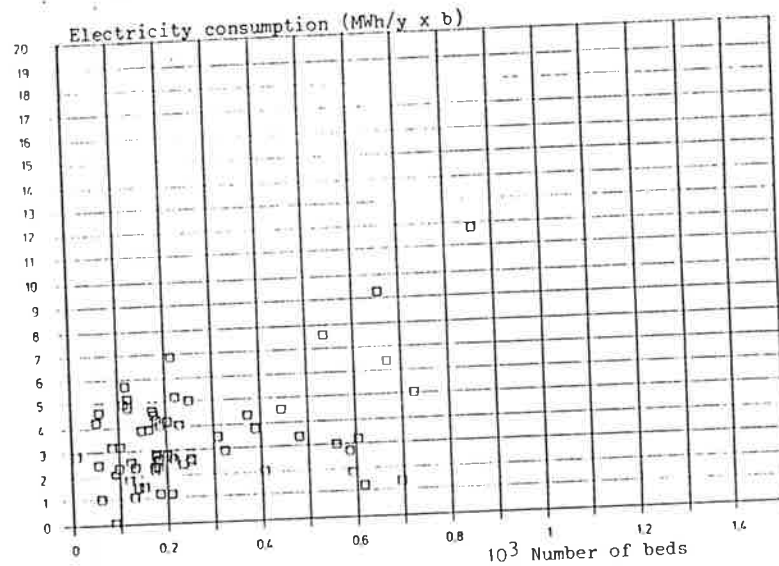


Fig. 4 Electricity use

4. Comments of results

Tough we received 76 inquiry forms, we report here the results for only 66 hospitals.

Two were left because they relates to electric heated hospitals and we had no data on the sharing of electricity consumption between heating and other uses. So the corresponding values could distort the mean values calculations.

But the others were left because some essential informations were missing, as fuel consumption, electricity consumption, area or costs.

Eng. J. de VRIES has conducted in the Netherlands in 1984 a survey on 40 hospitals ranging from 190 to 785 beds (3).

The mean values of energy consumption per year and bed were (excluding 4 hospitals with total energy plants) :

- for gas : 35.8 MWh/y x b (ranging from 22.2 to 64.6)
- for electricity : 8.62 MWh/y x b (ranging from 3.12 to 18.3)

It must be noted that 22 of these hospitals were equipped with mechanical ventilation or air-conditionning, which can explain, as well as differences in climatic conditions and comfort level, the higher values in the survey of de Vries.

The scattering of the values reported by de Vries is also very important, but not as in our survey.

The scattering of the values can also result from misunderstanding when filling the inquiry form, or bad data :

- What is for instance the number of bed of partially occupied hospitals ?
- Are the electric or fuel consumptions correctly measured and reported ?

We suspect that sort of errors when looking at others data in the form and correlating them.

For example, a totally electric hospital of 200 beds reports a gas consumption (for heating a small workshop) which is twice higher than the mean.

Another seems to pay its electricity three times the mean price.