

Energy consumptions in Hospitals: preliminary results of the ICEOs Project

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SUMMARY

The ICEO Project quantifies the thermal and electrical energy consumption in hospitals of an Italian region (Lazio Region). 26 out of the 57 (45,6%) hospitals of the region were selected for a questionnaire in order to acquire information about activities, structural characteristics, technologies and the energetic consumption during the years 2001-2003. Only 61,5% of the selected hospitals supplied the required information. The consumption data show a great variability between hospitals, not always explained by their technological level or by their complexity. In Italy the energy consumption for housing and other civilian uses is increasing and today it represents the third part of the total energetic consumption. To reduce consumption, economic solutions should be adopted such as effective maintenance programs. It could be also useful to increase the adoption of renewable energetic sources and of a strong training program for the hospital staff.

INTRODUCTION

A hospital represents a classic example of a complex system where every structure is different each other and its characteristics are determined by the variety of supplied facilities, the size and the geographic location, sometimes with sophisticated solutions, but where every plant and technical equipment requires attention, in order to supply the service 365 days a year.

Besides, if the leading mission of a hospital is to supply high-grade medical treatments, in a short lapse of time, in optimal general conditions and at the lowest cost, it's also true that the various equipments employed to achieve that goal, and the whole operation, imply a relevant use of both thermal and electric energy.

The major amount of thermal energy consumption in hospitals is generally absorbed by heating and ventilation systems, covering the 50-60% of total consumption [1], whereas the remaining percentage is employed by the so-called "technical service equipments", such as: hot water production, cookery, laundry, sterilization.

The electric energy, instead, covers an average of the 20% of the entire energy consumption, but it could consist up to an average of 30-35% of the total cost [1].

The increase of electric consumption in the last few years is certainly due not only to the operation of a variety of new diagnostic and therapeutic equipments, but, mainly, to the increasing use of television sets in every rooms and in-patient areas, and to a more generalized use of HVAC systems [1].

The study performed by the ENEA (*Ente Nazionale Energia e Ambiente*) in the '90s (1), estimating a thermal energy consumption equal to the 80%, and the remaining 20% of electric energy consumption, already recorded a valuable waste of energy certainly due to a general obsolescence of plants and buildings, but also to an inadequate management. On the whole, the pure cost of energy constituted just a portion of the total consumption.

Referring to the same study in the '90s, it turned out that in Italy the cost of the National Health Service (NHS) amounted to approximately 70,000 billions of Lire in 1991, about the 50% of which was attributable to hospital service. The incidence of energy was estimated, even in other European countries, around the 4-5% of the entire cost of the hospital services and this entails that the energy bill of the Italian hospitals, at that time, was up to 1,500 billions of Lire [1], around 775 millions of Euro, namely 17,445,000 MWh (1.5 Mtep) yearly.

The average energetic cost, for a hospital bed, is 1,700 Euro/year, whereof 1,300 Euro are due to heating cost.

A remarkable amount of energy could be saved reducing the service cost by 10%, improving the energy efficiency, thanks to a better management and rationalization [1]. Therefore, it is important to make aware the hospitals and their staff about the need of a rational use of energy.

OBJECTIVES

Aim of the ICEO Project (translation: investigation on hospital energy consumption) was to quantify the thermal and electrical energy consumption by the hospitals of an Italian Region (Lazio Region), in order to identify the factors associated with the consumption and to define possible strategies of control.

METHODS

The study covered the 45.6% (26 out of 57) of the regional hospitals. By mean of a questionnaire, each hospital has been asked to supply information about activities, structural characteristics, technologies and energetic consumption (thermal and electric) during the years 2001-2003.

Data sheets on energy accounting by ENEL (*Ente Nazionale Energia Elettrica*), data of ENEA researches [1, 2] on the rational use of energy in hospitals, and data used in a previous pilot study [3] were taken into consideration to draw up the questionnaire.

The questionnaire was sent by fax to 26 hospitals selected from the list published in the Ministry of Health website. The acquired data were treated to find out useful energy indicators to compare energy situations in hospitals. Only 2003 energy data, being the others non exhaustive, have been analysed.

RESULTS

16 (61.5%) out of the 26 selected hospitals submitted the questionnaire and just 14 of them provided all the necessary information. It turned out that the majority of them had given the operation of plants in outsourcing.

Table 1 shows hospitals that answered the questionnaire by typology, structure and service.

Considering the relationship with the National and Regional Health services, the complexity level and the financing, the hospitals were divided in four groups: University hospitals, Major General Hospitals, Research Hospitals and Local General Hospitals.

Table. 1 Characteristics of the hospitals involved in the study

	Name	n° of buildings	Volum m ³	n° beds	n° of patients	Average stay (days)
University Hospitals	UH 1	44	1,287,675	154,0	43,985	11.1
	UH 2	1	180,000	450	639	5
	UH 3	1	--	179,0	63,141	8.8
Major General Hospitals (*)	MGH 1	5	415,889.1	105,5	26,972	9
	MGH 2	3	201,387	783	22,428	9
Research hospitals (**)	RH 1	6	66,577	455	24,545	6.8
Local General Hospitals (***)	LGH 1	1	--	99	4,170	6.4
	LGH 2	1	164,500	420	17,102	7.11
	LGH 3	2	31,500	75	3,129	6.73
	LGH 4	1	12,500	41	1,481	4.08
	LGH 5	3	141,703	434	28,000	6.2
	LGH 6	1	85,000	387	11,842	6.8
	LGH 7	1	117,000	369	9,069	9.35
	LGH 8	1	28,000	71	1,839	7.2
	LGH 9	1	57,000	122	3,602	9.5
	LGH 10	1	104,803	324	14,620	6.3

(*) Self administered within the Regional Health Service

(**) Self administered within the National Health Service and financed by the State for research purposes

(***) Administered by the Local Health Units within the Regional Health Service

Figure 1 shows the percentage distribution of Regional and selected hospitals depending on their typology. In the investigated sample the percentage of Research Hospital was lower if compared with the Region, but this defect was acceptable because of the higher percentage of University Hospital.

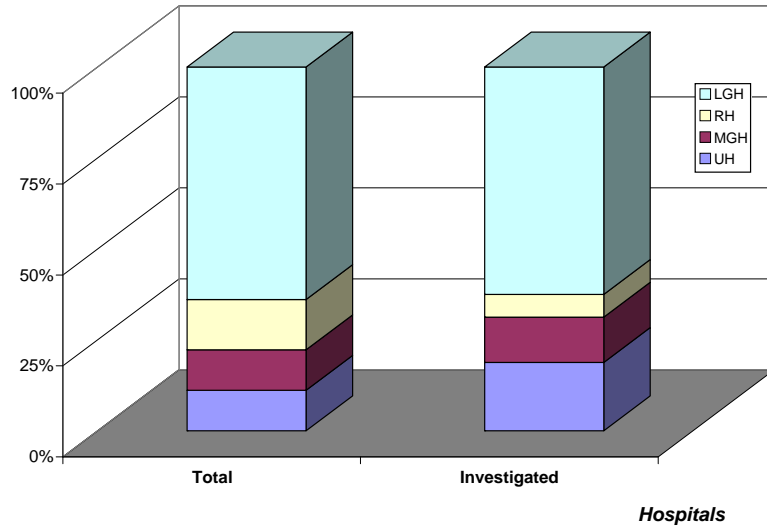


Fig . 1 – Distribution of hospitals by typology: total and investigated hospitals

The largest amount of the hospitals of the Region (73%) use methane as heating fuel (fig. 2), followed by oil (13%), eco-diesel (7%) and Low Sulphur Content (7%).

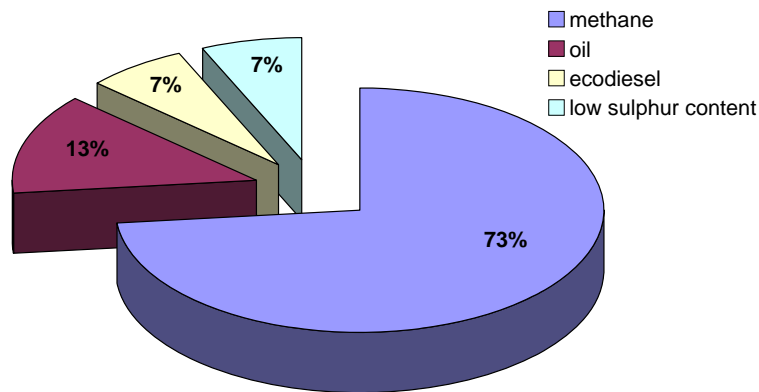


Fig . 2 - Combustible used by hospitals

In regard of electric energy consumption, the yearly average is around 13,500 kWh/bed (min 2,100 kWh/bed - max 23,700 kWh/bed) and the thermal consumption average is around 22,000 kWh (min 9,600 kWh/bed - max 36800 kWh/bed).

Figure 3 illustrates a wide variability among the hospitals, not always explained by their technological level and the level of service supplied. For two hospitals (LGH 6 and LGH 8) data about electric consumptions were not available.

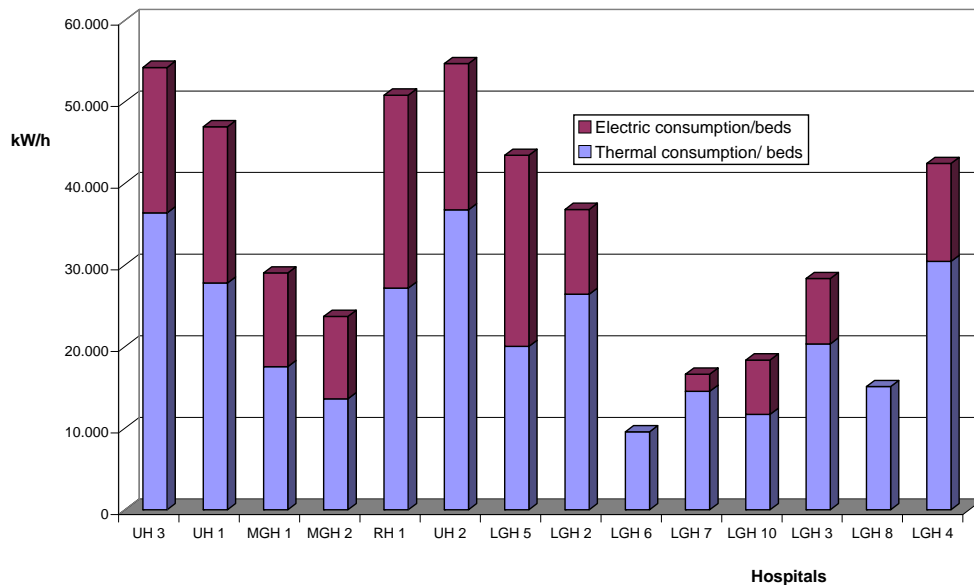


Fig . 3 - Energy consumption (thermal and electric) by hospital

Comparing the average results observed in the study with those obtained by other national and international studies (table 2), we found out that similar proportions of thermal/electric energy requirement are supplied in Italy and in foreign countries.

Table. 2 - Average results observed in the ICEOs study with those obtained in other studies

Study	electric consumption (kWh/bed)	thermal consumption (kWh/bed)
Italy, 1997 (*)	6.000	23.000
Belgium, 1997 (*)	11.000	30.000
Netherlands, 1994 (*)	10.000	36.000
Austria, 1997 (*)	27.000	36.000
Canada, 1997 (*)	23.000	42.000
Milan, 2003 (**)	19.084	69.295
PROST, 2003 (***)	14.600	-
ICEOs, 2003	13.535	21.960

(*) CADDET - Saving Energy with Energy Efficiency in Hospitals, about the average of international consumption [4]

(**) data collected by the "Cà Granda di Riguarda" hospital, Milan, in 2003;

(***) Prost project (Public Procurement of Energy Efficient Technologies), financed by Italian Ministry of Environment and the European program SAVE, that shows the average of thermal consumption in the Italian hospitals [5]

DISCUSSION

The energy consumption for housing and other civilian uses represents the third part of the total energetic consumption in Italy. Besides, the introduction of new technologies implies a strong and continuous increase of consumption. In various hospitals the Energy Manager, although required by Italian law in all structures consuming a quantity of energy >1,000 OET/year, isn't in charge or hasn't a specific competence or is absorbed by other tasks, thus lacking in his reference role for the energetic consumption control program.

The reduction of consumption could be achieved by means of economic solutions such as a greater care by the staff, the use of high-efficiency lamps and heat-saving heating plants, the

adoption of renewable energetic sources and the implementation of strong programs of maintenance.

CONCLUSIONS

Hospitals are supposed to be significantly interested in the adoption of new technologies employing “renewable” natural energetic and, above all, non-pollutant sources.

In accordance with the Italian CIPE directive 57/2002 [6], a solution could be the promotion of the efficiency in the production of energy by means of high-productive technologies to generate electric energy, the spread of plants of co-generation electricity-heat, the use of the energy produced by the plants of thermo-destruction of sewage and the saving of dispersed heat, but also sustaining the use of renewable energetic sources and the promotion of studies and development in the area of less impacting energies.

In this field it's of value the possible planning of a hospital according to the principles of a sustainable development, mainly using sun power by means of systems of active and passive utilization, dampening environmental and economic expenses [7].

The energy consumption in hospital, nowadays, is 3 times greater than the energy consumption for housing, because the whole plant is supposed to assure an extended seasonal heating supply, higher temperatures, more air exchange and particular microclimatic characteristics during the year [7].

As suggested in the literature [1, 7, 8], useful actions to reduce energetic consumption in hospitals could be:

- improving the thermal isolation of both the vertical and horizontal envelope;
- realizing a computerized control of the illumination, HVCA, doors control systems;
- using renewable energetic sources (active and passive sun power systems);
- adopting co generative plants and heat pumps;
- reducing thermal dispersion.

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