

## Accepted Manuscript

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Authors: Alfonso González González, Justo García-Sanz-Calcedo, David Rodríguez Salgado



PII: S2210-6707(17)31323-9  
DOI: <https://doi.org/10.1016/j.scs.2017.10.029>  
Reference: SCS 821

To appear in:

Received date: 3-6-2017  
Revised date: 18-9-2017  
Accepted date: 25-10-2017

Please cite this article as: González González, Alfonso., García-Sanz-Calcedo, Justo., & Salgado, David Rodríguez., A quantitative analysis of final energy consumption in hospitals in Spain. *Sustainable Cities and Society* <https://doi.org/10.1016/j.scs.2017.10.029>

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# A quantitative analysis of final energy consumption in hospitals in Spain

Alfonso González González<sup>1</sup>, Justo García-Sanz-Calcedo<sup>2\*</sup>, David Rodríguez Salgado<sup>3</sup>

<sup>1</sup>Department of Mechanical, Energy and Materials Engineering, University of Extremadura, Mérida, Spain

<sup>2</sup>Department of Graphical Expression, University of Extremadura, Badajoz, Spain

<sup>3</sup>Department of Mechanical, Energy and Materials Engineering, University of Extremadura, Badajoz, Spain

## ABSTRACT

The accurate identification of the final energy consumption in hospitals is a key task to determine potential savings and therefore to set appropriate design criteria. However, correlations between consumption and functional indicators for Spanish hospitals have not been yet accounted for in detail. A total of 80 Eco-Management and Audit Schemes (EMAS) from 20 hospitals were analysed in the period 2005-2014 in order to seek correlations between energy consumption and climate conditions, gross domestic product (GDP), built surface area, number of available beds and number of staff.

The results set the average annual energy consumption in a Spanish hospital for standard operating conditions as 0.27 MWh/m<sup>2</sup>, 9.99 MWh/worker and 34.61 MWh/bed (standard deviations 0.07 MWh/m<sup>2</sup>, 3.96 MWh/worker and 12.49 MWh/bed, respectively). The geographic location was seen to show a direct influence on those values, as opposed to the specific type of management (TM), the number of available beds, the GDP or the particular climate conditions.

**Keywords:** healthcare centre; hospital; energy consumption; healthcare engineering.

## 1. INTRODUCTION

There is a global commitment on the reduction of CO<sub>2</sub> emissions to stabilize total levels below 450 ppm, or similarly to prevent a global temperature increase of 2°C as compared to the year 1990 [1]. The average annual energy consumption in Spanish hospitals reaches 20% of the total consumption in the tertiary sector in Spain [2]. The energy demand of hospitals is among the highest of non-residential buildings [3].

Several strategies devoted to reduce CO<sub>2</sub> emissions have been developed by governments worldwide since the signing of Kyoto Protocol [4]. In this sense, specific programmes widely have promoted the use of renewable energies at final stages of consumption as well as the reduction of

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