

## Accepted Manuscript

Title: Exergy analysis applied to performance of buildings in Europe.

Author: K Sartor

PII: S0378-7788(17)30377-8

DOI: <http://dx.doi.org/doi:10.1016/j.enbuild.2017.05.026>

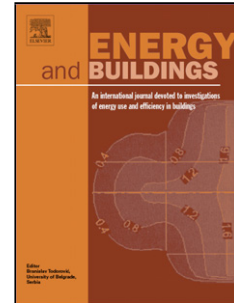
Reference: ENB 7607

To appear in: *ENB*

Received date: 14-2-2017

Revised date: 5-5-2017

Accepted date: 12-5-2017



Please cite this article as: K Sartor<ce:text>P.Dewallef</ce:text>, Exergy analysis applied to performance of buildings in Europe., <![CDATA[Energy & Buildings]]> (2017), <http://dx.doi.org/10.1016/j.enbuild.2017.05.026>

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# 1 Exergy analysis applied to performance of buildings in 2 Europe.

3 K Sartor<sup>a</sup>, P. Dewallef<sup>a</sup>,

4 <sup>a</sup>*Aerospace and Mechanical Engineering Department - Laboratory of Thermodynamic and*  
5 *Energetic, University of Liège, 17 Allée de la découverte, 4000 Liège, Belgium*

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## 6 Abstract

7 Energy performance of buildings generally assesses the energy consumption  
8 of buildings such as heating, domestic heat water, ventilation systems, etc.  
9 However, this approach is based on the first law of thermodynamics and  
10 considers only the quantity of energy used without considering its 'quality'  
11 and leads to a lack of information about the energy conversion processes. This  
12 is particularly true in the new low-energy buildings where sometimes high  
13 temperatures sources are used to meet low-temperature needs. The exergy  
14 analysis of a system, based on first and second thermodynamic laws, can be  
15 used to overcome this. In this work, it is proposed to compare the energy and  
16 the exergy consumption and the related  $CO_2$  emissions of several kinds of  
17 buildings to determine the best systems in terms of energy and exergy needs.  
18 The energy demand calculations are performed using the official software  
19 available in Belgium and some assumptions are implemented to consider  
20 the exergy approach. As exergy calculations require a reference state, some  
21 different climatic conditions are also investigated. Finally, some conclusions  
22 are discussed to rank the sources of energy and their related exergy losses.

23 *Keywords:* exergy analysis, building performance, exergy,  $CO_2$  reduction,  
24 heat sources.

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## 25 1. Introduction

26 About 40% of the Europe energy is dedicated to the buildings [1, 2] and  
27 represents about 36% of the  $CO_2$  emissions. Therefore European Union sets  
28 up the Directive 2002/91/EC, reinforced in 2010 by Directive 2010/31/EU  
29 to try to improve the performance of the buildings and to reduce the energy

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