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Energy consumption, CO_2 emissions and costs related to baths water consumption depending on the temperature and the use of flow reducing valves

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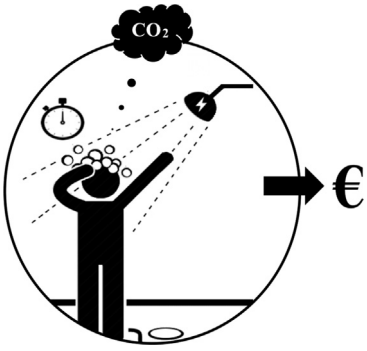
HIGHLIGHTS

- Bath temperature influences energy consumption and water consumption
- The presence of a flow reducing valve is not a guarantee of water saving.
- Flow reducer can lead to a bath duration increase.
- Higher values of CO_2 emissions are obtained for baths with higher temperatures.
- The presence of a flow reducer with higher temperature baths increase the costs.

GRAPHICAL ABSTRACT



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ABSTRACT

In the domestic segment, various appliances and processes consume great amount of water and, consequently, energy. In this context, the main aim of this study is to analyse the impact of water temperature, flow and bath duration in water and energy consumptions. The impact on CO_2 emissions and a simple costs analysis were also carried out. It included a monitoring plan of 197 baths taken under different scenarios of water temperature and flow. It was concluded that increasing water consumption leads to an increase on energy consumption and that both resources consumptions increase with bath duration. Bath temperature had influence not only on energy consumption, as expected, but also in water consumption, what may be explained by the user's satisfaction during baths with higher temperatures. The use of a flow reducing valve is not a guarantee of water saving which can also be related to the user's satisfaction patterns, given that the introduction of a flow reducing valve can lead to a bath duration increase. In what concerns to the CO_2 emissions, it was concluded, as expected, that higher values are obtained for baths with higher temperatures given their relation with higher energy consumptions patterns. A simple costs analysis revealed that having flow reducing valves, with a bath temperature of 75 °C, increased the costs with electricity and water in 119% and 32%, respectively, when compared with a temperature of 60 °C.

1. Introduction

Worldwide, the domestic water and energy consumption has increased along the last two decades. The residential sector reaches

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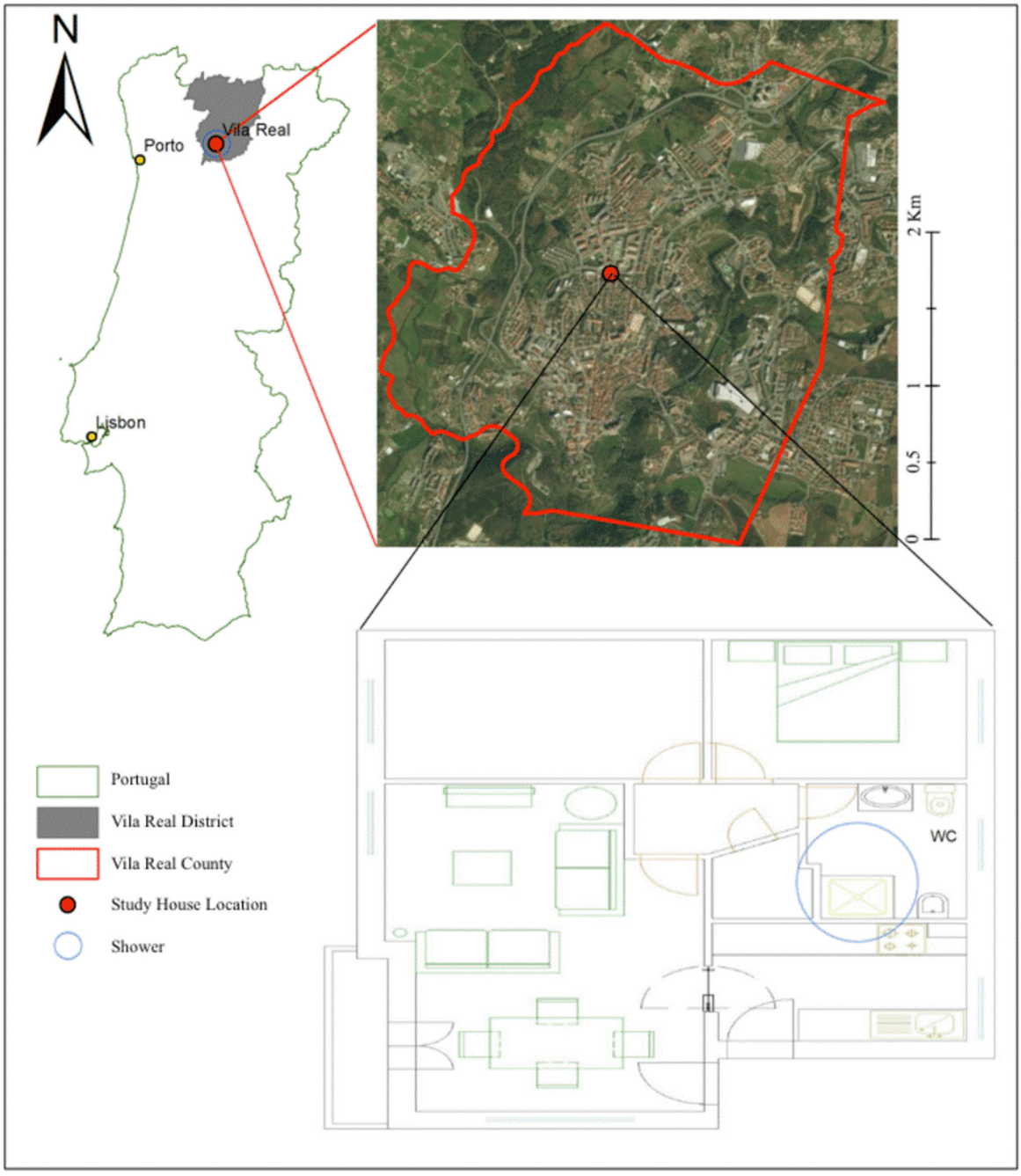

Fig. 1. Case study location.

about 40% of the total energy consumption. Most of this energy is used for lighting, water heating, cooking and air-conditioning (Duarte et al., 2010). Pérez-Lombard et al. (2008) concluded that, in the European Union, 14% of the total energy consumption in residential buildings is spent in water heating. It is also referred values of 17% in the United States, 22% in the United Kingdom and 26% in Spain. Other studies reported that water heating corresponds to 18% of the total energy consumption in standard residential buildings in the United Kingdom and the United States (Boait et al. (2012); Liu et al. (2014)). A higher value of energy consumption spent in water heating was identified in France, corresponding to more than 40% of the total energy consumption in energy efficient residential buildings (Thiers and Peuportier, 2012). In Australia, Aye et al. (2002) and Kenway (2013) described

Table 1
Description of the scenarios monitored.

Designation	n	Description
Scenario 1 (C1RT60)	49	With flow reducer valve Bath temperature of 60 °C
Scenario 2 (C2RT75)	51	With flow reducer valve Bath temperature of 75 °C
Scenario 3 (C3T75)	50	Without flow reducer valve Bath temperature of 75 °C
Scenario 4 (C4T60)	47	Without flow reducer valve Bath temperature of 60 °C

n - number of observations.