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Using regression analysis to predict the future energy consumption of a supermarket in the UK

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HIGHLIGHTS

- Energy consumption of supermarket depends more on temperature than humidity.
- Multiple regression analysis is a flexible tool to consider for energy use prediction.
- Results show dramatic reduction in gas use and modest increase in electricity use.

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ABSTRACT

The change in climate has led to an interest in how this will affect the energy consumption in buildings. Most of the work in the literature relates to offices and homes. However, this paper investigates a supermarket in northern England by means of a multiple regression analysis based on gas and electricity data for 2012.

The equations obtained in this analysis use the humidity ratio derived from the dry-bulb temperature and the relative humidity in conjunction with the actual dry-bulb temperature. These equations are used to estimate the consumption for the base year period (1961–1990) and for the predicted climate period 2030–2059.

The findings indicate that electricity use will increase by 2.1% whereas gas consumption will drop by about 13% for the central future estimate. The research further suggests that the year 2012 is comparable in temperature to the future climate, but the relative humidity is lower. Further research should include adaptation/mitigation measures and an evaluation of their usefulness.

1. Introduction

With the founding of the IPCC in 1988 [1] the idea of anthropogenic climate change really entered the scientific arena so that, currently, the vast majority of researchers working in this area believe that the climate is changing and that this is fundamentally man-made [2]. That the issue of global warming has also reached politics is evident by the coming into force of the UN framework convention on climate change [3] in 1994 [4]. All of this has added to the interest in assessing the impact of climate change on various aspects of society, including on energy consumption in buildings.

Some of those assessments examine specific countries such as the UK. Jenkins et al. [5], for example, use a software model of a four-story office building to investigate five locations in the UK to see how the change in climate will affect the energy demand for heating and cooling in 2030. These researchers find that the energy demand, although in part location dependent, is primarily heating dominated. Their study also includes the assumption that office equipment and lighting will be more efficient (so producing less waste heat) in the future which will increase the demand for heating. However, they conclude that the temperature increase due to climate change will mitigate this to a degree. Gupta and Gregg [6] evaluate the effect of climate change on four types of dwelling located in Oxford, UK, by means of the simulation software IES. They find that thermal discomfort will rise significantly with climate change, especially in flats.

A number of other studies are summarized by Li et al. [7] who point out the two main approaches: the degree-day method and simulation techniques. Most of the papers in that review study office buildings and homes. The authors find that the predicted warming will result in a reduced heating load and an increased cooling load. This translates into a reduction in energy use for

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