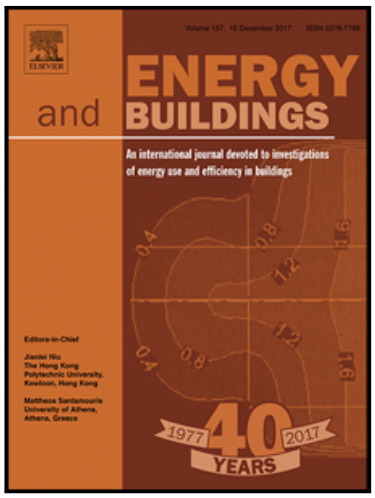

Building Electricity Consumption: Data Analytics of Building Operations with Classical Time Series Decomposition and Case Based Subsetting

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Building Electricity Consumption: Data Analytics of Building Operations with Classical Time Series Decomposition and Case Based Subsetting

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Abstract

The commercial building sector consumes approximately one-fifth of U.S. total energy and exhibits significant operational inefficiencies, leaving a great opportunity to implement various energy-efficiency measures. However, conventional energy audit techniques are expensive, time-consuming, and frequently inaccurate. Conversely, classical time series decomposition of smart meter (i.e. 15-minute interval) building electricity consumption provides quick, inexpensive, and useful insights to building operation and characteristics. Paired with complementary time series datasets such as outdoor temperature and solar irradiation, specific insights into HVAC scheduling, daily operational variation, and the relative impact of temperature and solar radiation were quantitatively assessed. This work analyzes six commercial buildings and identifies various building characteristics, including the potential for savings of over 700 MWh valued at $92,000 per year from building rescheduling alone. With access to only whole building smart meter data, these results are obtained virtually and instantaneously, making the case for a rigorous data analytics approach to unlock the potential of building energy efficiency.

Keywords:

building energy efficiency, classical time series decomposition, data analytics, commercial buildings, virtual energy audit

1. Introduction

Energy is an ever important issue capturing the attention of all major countries, as evident from the 2015 United Nations Climate Change Conference in Paris, France. A massive consumer of energy is the building sector where there is significant opportunity to reduce energy waste[1]. The United States uses approximately 100 quads of energy each year, with about 40% attributed to building uses such as heating, cooling, lighting, and electronics[2, 3]. The U.S. Department of Energy (DOE) has recognized this potential and is committed to reducing commercial building energy use 20% by 2020, as well as citing a long term goal of 50% reduction in overall use[4]. The "Prioritization Tool", developed in the Building Technologies Office (BTO) of the DOE, has calculated the energy savings that could be achieved from currently available and emerging technologies[2, 3]. The analysis revealed that implementation of cost-effective technologies available today could lead to a 30% reduction of energy use in buildings by 2030. Accounting for emerging technologies estimated to become cost-effective within 5 years, the energy savings reaches 55%[2, 3]. This is equivalent to saving up to $300 billion per year if investments in energy efficiency are made strategically.