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Measurement and normalization methods to provide detailed information on energy consumption by usage in apartment buildings

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Abstract

To reduce greenhouse gas emissions nationwide, the Korean government has announced a target of reducing greenhouse gases by 37% relative to the business-as-usual (BAU) level by 2030. Because the building sector is important for the reduction of greenhouse gas emissions, various policies are being strengthened to reduce building energy. For these policies to have a substantial effect, it is necessary to ensure technological and economic feasibility in the marketplace and to provide energy information that can be easily understood and evaluated by building owners and engineers. Providing information that accounts for the status of energy consumption by end use (heating, cooling, domestic hot water, lighting, etc.) is a very important part of establishing a concrete action plan for energy conservation in separate equipment systems. In response, a national research project is being conducted regarding the installation of systems for the continuous measurement of energy consumption by end use in sample buildings and the creation of a reference energy-use intensity (EUI) database and benchmarking system for comparative analysis. As a basis for this national project, this study defined energy consumption by end use for both apartment units and public areas in an apartment complex. The study also found ways to measure such consumption and convert the results into EUI data. Forty complexes, including a total of 200 units, were selected as samples. The installation for the sample buildings is scheduled to be completed in phases over 4 years starting in 2015, and systems have thus far been installed in 10 complexes and 50 units. A reference EUI database for apartment buildings and a benchmarking tool based on this database will be made available after 2020, and similar systems for office buildings are now being established.

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Keywords: Measurement; Normalization; Detailed Information; Energy Consumption by Usage; Apartment Buildings

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1. Introduction

1.1. Purpose

At COP 21 (21st Conference of the Parties to the United Nations Framework Convention on Climate Change 2015), which was held in Paris for the adoption of the final agreement to establish a post-2020 climate regime, the Korean government announced a national emissions target of reducing greenhouse gases by 37% relative to the business-as-usual (BAU) level by 2030. As policy measures to reduce emissions, the building sector suggested expanding the use of light-emitting diodes (LEDs), increasing the efficiency of home appliances and office electronics, tightening design standards to save energy in buildings, introducing Building Energy Management Systems (BEMSs) and strengthening insulation regulations for buildings. To make these policies effective in practice, it is necessary to ensure their technological and economic feasibility in the marketplace and to provide energy information that can be easily understood and evaluated by building owners and officials. Providing detailed information that conveys the performance levels and statuses of energy consumption by end use (heating, cooling, domestic hot water, lighting, ventilation, etc.) is a very important part of establishing a concrete action plan for energy conservation in separate equipment systems, and it can encourage building officials to actively improve energy performance.

Many countries are currently operating database systems for managing energy-use intensity (EUI) data on each building type, energy source and end use based on calculations, measurements, and surveys. In the US, for instance, there are the California End Use Survey (CEUS) [1] and the Commercial Buildings Energy Consumption Survey (CBECS) [2]. These countries make it possible to gain a detailed understanding of the status and performance of energy consumption in a building classified by end use. Building energy benchmarking tools based on such database systems (the Cal-Arch building energy research tool for California, Energy IQ for the US, etc.) have been established to provide access to the details of the energy performance of a building and to enable performance comparisons between buildings. Such tools also provide information on how to improve the shortcomings of a building relative to other buildings.

To provide information on energy consumption in the building sector, the Korean government accumulated various types of information about energy consumption, established the Building Energy Integrated Management System (Green Together), and now offers services that offer information on the energy consumption of a building depending on the energy source and facilitate the comparison of similar buildings in a group for the purposes of issuing an energy evaluation report for an Energy Efficiency Rating System. Information on energy consumption by end use (heating, cooling, domestic hot water, lighting, ventilation), however, is completely unavailable. Moreover, it could be equally important to provide information based on aspects of actual energy consumption such as priorities among end uses, vulnerable sectors and their levels of vulnerability, and energy-use patterns by end use to establish sophisticated and effective building energy policies and lay the foundations for developing energy-efficient designs and technologies in the architectural, mechanical and electrical sectors as well as to encourage relevant building stakeholders to voluntarily enhance energy performance. However, these efforts also fall short.

To provide detailed information on current building energy consumption by end use for each energy source, a national research project is being conducted regarding the installation of systems for the continuous measurement of energy consumption by end use in sample buildings and the creation of a reference EUI database and benchmarking system for comparative analysis. The goal of this research is to develop a service to be provided through the Building Energy Integrated Management System (Green Together). The purpose of this study was to define the energy consumption of an apartment building classified by end use and find ways to measure and create EUI data for various end uses. In addition, this report provides a brief outline of the designs of the sample apartment buildings selected to measure the end-use energy consumption and the status of measurement system installation in these buildings. The method of measuring end-use consumption in an apartment building suggested in this study could not only contribute to the ultimate goal of establishing a database for reference EUI data by end use but also provide guidance regarding the effective implementation of a BEMS, which has been proposed by the Korean government as a policy instrument for reducing greenhouse gas emissions in the building sector.