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An Analysis of Energy Consumption and Greenhouse Gas Emissions in University Buildings

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Abstract. This study analyzed the energy consumption and greenhouse gas emission patterns of 'S' University in Korea to develop an energy consumption & CO_2 emission reduction plan for university buildings. According to the analysis, a total of 7,698 tCO_2 were produced. Among them, nearly 60% was consumed for electricity. Therefore, it is quite urgent to develop a decent energy consumption & CO_2 emission reduction plan.

Keywords: University Building, Energy Consumption, Greenhouse Gas

1 Introduction

Among Korea's total energy consumption in building in 2013, 'educational facilities' accounted for the biggest portion with 17% (415,000 TOE). In particular, most college buildings in Korea don't have any regulations on energy consumption. Recently, in addition, they have been recognized as the primary reason for increase in Greenhouse Gas (CO_2) emissions. Therefore, it is urgent to come up with an alternative for the systematic management and reduction of energy consumption. For this, this study attempted to analyze the current direct and indirect energy consumption of college buildings in Korea, estimate their CO_2 emissions and establish basic data to develop a plan to reduce energy consumption and CO_2 emissions in college.

2 Scope and methods

After selecting 'S' University in Gyeonggi-do as a target, the amount of energy consumed and CO_2 produced by all its buildings were estimated. Both electricity and gas were consumed by these buildings for the following purposes: lighting, power, heating, cooling, cooking and hot water. The energy consumption was analyzed based on the measurements on electricity and gas consumption, and the CO_2 emissions were estimated based on the factor suggested by IPCC (2006).

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3 Analysis results

3. 1 Analysis of energy consumption

The figure below reveals total electricity and gas consumption by 'S' University during 2013:

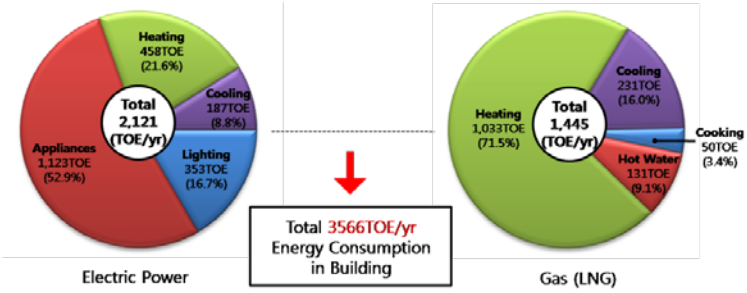

Fig 1. Total Energy Consumption by Usage

According to the analysis, 2,121TOE (9,863,349kwh) of electricity was consumed. When classified by the purpose of the consumption, 'lighting' and 'power' accounted for 69.6%. In fact, they were evaluated as basic energy which is evenly consumed throughout the year. In addition to the basic energy, 'heating' and 'cooling' were 21.6% and 8.8% respectively.

In case of gas, a total of 1,449TOE (59,660,111MJ) was consumed. When classified by the purpose, 'heating' accounted for the greatest portion with 71.3%. Some buildings still have a centralized heating system so that energy consumption was high. When gas consumption was examined by purpose, 'heating and 'cooling' was evenly consumed throughout the year, accounting for 12.9% while 'cooling' was 15.9%.

3. 2 Analysis of CO_2 production

Figure 2 below shows monthly CO_2 emissions produced by energy consumption.

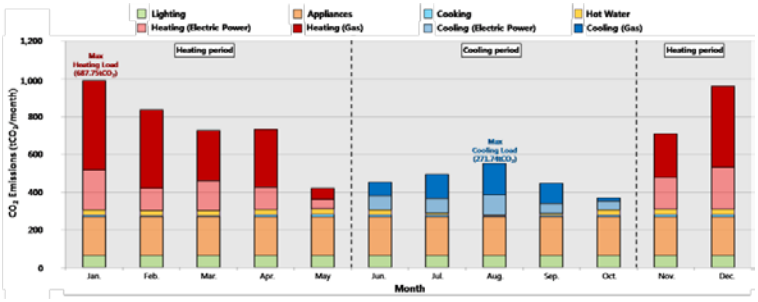

Fig 2. CO_2 Production Patterns by Energy Source

According to the analysis, total CO_2 emissions reached to 7,698t. When classified by purpose, energy was evenly consumed for 'lighting', 'power', 'cooking' and 'hot water' throughout the year. in summer and winter, CO_2 emissions increased for 'cooling' and 'heating' respectively.

In terms of CO_2 emissions by energy source, 'electricity' accounted for 60.3% (4,641tCO_2) while gas was 39.7% (3,057tCO_2). When electricity consumption was classified by purpose, 'power' was the highest with 31.9%, followed by 'heating (13.0%)', 'lighting (10.0%)' and 'cooling (5.3%)'. In terms of gas consumption by purpose, 'heating (28.3%)' was the highest, followed by 'cooling (6.3%)', 'hot water (3.6%)' and 'cooking (1.5%)'.

According to analysis on CO_2 emissions per student as of 2013, 730.7kgCO_2 was observed.

4 Conclusion

This study attempted to establish basic data for the reduction of energy consumption and CO_2 emissions in college buildings in Korea and found the followings

According to analysis, 60% of CO_2 emissions in college originated from the consumption of electricity. In particular, 'lighting' and 'power' accounted for over 40% of total energy consumption. Therefore, it would be effective to reduce CO_2 emissions through the reduction of power energy consumption and introduction of PV-based alternative energy source.

In addition, most old college buildings (30 years or older) still have a centralized heating/cooling system so that energy consumption has been high. Hence, it is recommended to carry out a study on the reduction of energy consumption through the adoption of individual energy control systems and energy-efficiency equipment.

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