

A Case Study of Electricity Usage Monitoring for Deterioration and Economic Analysis of Main Equipment in University Laboratory

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Abstract: Our country is aiming at 30% reductions in building energy consumption accounting for 39% of the total energy consumption by 2020[1]. For this purpose, the government is developing and applying the Building Energy Management System (hereinafter, referred to as "BEMS", Smart plug, etc.) while the researches on new renewable energy development. BEMS, which is applied with focus on large buildings, is inducing energy management of the entire building through energy measurement and data management, but considering its economic efficiency, it's very difficult to apply BEMS to small & medium-size buildings. Hereupon, this study intends to implement the case analysis of deterioration and economic efficiency of major equipment in buildings on the basis of electricity consumption which has been measured targeting small & medium-size buildings for a certain period by taking into account that equipment deterioration is a contributor to the increase in energy consumption.

Keywords: Building Energy Saving, Energy Usage Amount, Deterioration Analysis, Economic Analysis

I. INTRODUCTION

A. Background and Purpose of Research

While the interest about the regulation of use on energy and carbon emission is increasing globally, Korea, which commonly consumes energy, also announced measured to reduce energy in 2014. It is aiming at 30% reduction in building energy consumption accounting for 39% of the total energy consumption by 2020[1].

In this regard, large buildings introduced IOT equipment and Building Energy Management System (BEMS) to execute monitoring for energy reduction. When university facility, which is one of the target for management for greenhouse gas/energy, consumes more than 80TJ (15,000COTon) energy, yearly reduction goal execution plan and execution performance are being evaluated.

Therefore, this research analyzes the measurement / monitoring of electricity usage about the main equipment of laboratories within the university facility as a part of deterioration and Economic analysis about the equipment using electricity as energy source in contrast to the goal greenhouse gas/energy goal management of university facility.

B. Scope and Method of Research

The usage of energy was measured with Smart Plug of Korea's L Company (Manufactured by Netherlands P Company). Furthermore, the scope was limited to analyzing deterioration and Economic of the equipment

being used in university laboratory through consumed cost and electricity usage.

II. MONITORING ELECTRICITY USAGE OF UNIVERSITY LABORATORY

A. Monitoring Overview

Monitoring of electricity usage about all equipment using electricity as energy source of M University's general laboratory (excluding test room, research special equipment, and equipment room) that is not a target of greenhouse gas/energy goal management 79 University Facilities (April 2014 Standard) was executed according to the following:

- Target: Laptop, Refrigerator, Cold and Hot water Dispenser, Air Conditioner
- Condition: Actual Size: Around 51m²
- Operating Time: 9 hours on weekdays, days a week
- Period: 226 days (Around 6 months)

B. Result of Electricity Usage Monitoring

The Announced energy consumption amount and energy usage amount that uses electricity as energy source in the university laboratory is shown on Table 1.

The energy usage amount on the 4 equipment were analysed in the order of cold and hot water dispenser, refrigerator, air conditioner, and laptop.

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TABLE I
 ANNOUNCED ENERGY CONSUMPTION AMOUNT
 AND ENERGY USAGE AMOUNT

Classification	Refrigerator	Laptop	Air Conditioner	Cold and Hot Water Dispenser
Announced Energy Consumption Amount	22kw / Month	7.7kw / Month	416kw / Month	37.74kw / Month
H Average (kw/H)	0.052	0.009	0.027	0.073
D Average (kw/D)	1.257	0.221	0.645	1.75
M Average (kw/M)	35.398	6.266	19.73	49.519

However, the air conditioner is a product reflecting seasonal characteristic where the energy usage amount increased in May. Air conditioner did not meet KS standard 7.2 hours(KSC9306 Air Conditioner) where the energy usage amount was low compared to the announced energy consumption amount.

III. DETERIORATION AND ECONOMIC ANALYSIS OF ELECTRONIC EQUIPMENT THROUGH ELECTRICITY USAGE AMOUNT OF UNIVERSITY LABORATORY

A. Deterioration Analysis Assessment

Deterioration refers to items that cannot be perform correctly because it is old and worn-out. Announced energy consumption amount of equipment using electricity energy and the actual energy usage amount were compared to assess deterioration.

$$\frac{\text{Energy Usage Amount}}{\text{Announced Energy Consumption Amount}} \times 100$$

TABLE II

DETERIORATION EVALUATION OF ELECTRIC EQUIPMENT ACCORDING TO THE USE OF ELECTRIC ENERGY USAGE (MONTH)

Classification	Energy Usage Amount	Announced Energy Consumption Amount	Calculation Value
Cold and Hot Water Dispenser	49.519 kw	37.74 kw	131.2 %
Refrigerator	35.398 kw	22.0 kw	160.9 %
Air Conditioner	382.895 kw	416 kw	92.0 %
Laptop	6.266 kw	7.7 kw	81.4 %

B. Economic Analysis Assessment

Economic efficiency is the property where less of fortune, resource, effort, and time are consumed while also being beneficial. Economic was evaluated through the relationship of the following energy cost and actual input energy cost.

$$\frac{\text{Energy Usage Amount Cost}}{\text{Announced Energy Consumption Amount Cost(Year or Month)}} \times 100$$

Instructional power rate cost was applied resulting in the calculation for the cost on electric usage amount as follows.

TABLE III
 ECONOMIC ASSESSMENT OF ELECTRIC EQUIPMENT ACCORDING TO THE ELECTRICITY USAGE (226 days, KRW)

Classification	Actual Energy Usage Amount Cost	Announced Energy Consumption Amount Cost	Calculation Value
Cold and Hot Water Dispenser	28,578.9	20,198.99	141.49 %
Refrigerator	19,818.67	11,791.85	168.07 %
Air Conditioner	198,320.47	215,467.22	92.04 %
Laptop	4,117.0	3,988.2	121.20 %

Table 3 evaluated Economic based on the data during the data collection period (226 days). The result calculated the cost of only the actual energy usage amount excluding the basic cost. For air conditioner, the actual usage time was set to 7.2 hours, but was actually lower than the actual announced energy consumption amount. For laptop, the actual energy usage amount was lower than the announced energy consumption amount, but more cost was consumed due to the cost difference per hourly use.

IV. CONCLUSION

This research while considering future national policies, the usage amount of electricity was monitored based on university facilities that require energy reduction. Especially, some of the equipment using electricity as the main energy source consumed more than the necessary energy due to deterioration of the equipment. Thus, this research judged the deterioration and Economic by comparing the announced standard and electricity usage amount in existing and different perspectives.

Through this, it was identified that considerable energy was being consumed compared to the announced energy consumption amount according to the elapsed year by monitoring usage amount of electricity on the equipment being used in university laboratory. Also, the equipment that showed deterioration of more than certain ratio was judged to have validity in the aspect of Economic and energy reduction by replacing the equipment rather than continuously using the equipment.

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REFERENCES

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