SUMMARY OF Ph.D. DISSERTATION

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Title

Study on Optimum Introduction of Cogeneration Systems on University Campuses Aiming for Energy Conservation

Abstract

Primary energy consumption on a public sector, including universities or office buildings, is still increasing. About 60 percent of that is consumed for thermal demand, such as cooling, heating, and hot-water. Effective introduction of the cogeneration systems (CGS) is expected to reduce the primary energy because exhaust heat of the CGS can be reutilized for the thermal demand. On the other hand, under the condition that the environmental system to efficiently operate the CGS is not constructed, the CGS cannot exercise its maximum performance due to mismatch between energy demand and supply systems, and quantitative difference between power and thermal demand. In this study, I consider the environmental system to optimally operate the CGS, by taking Keio University Shonan Fujisawa Campus (SFC) as an example, and indicate an effective way to achieve energy conservation on the public sector.

In the Chapter 1, the background and objective of this study are described.

In the Chapter 2, past studies about public energy demand and energy utilization systems on Universities are introduced, and what we will clear by this study is described.

In the Chapter 3, how to establish the energy demand model on a final use state is shown, by applying coefficient of performance (COP) of air conditioning equipments to energy consumption of them, based on the actual data on SFC.

In the Chapter 4, the actual CGS on SFC is evaluated, in terms of energy conservation and environmental load, based on the actual operation data, and the improvements of the systems are considered, focusing on the seasonal variation of the CGS exhaust heat reutilization.

Based on the above researches, optimum energy utilization systems with CGS are considered by a computational simulation. In the Chapter 5, the contents of the simulation are described.

In the Chapter 6, the air conditioning system on SFC is examined, where the CGS exhaust heat is maximally reutilized. As a result, the possibility was shown of reducing the primary energy consumption by 14 percent (18 TJ/year), and the carbon dioxide emissions by 9 percent (450 t-CO_2/year) for the average commercial grid power or 36 percent (1,900 t-CO_2/year) for the petroleum power plants, compared to the actual value on SFC. In addition, the effect of the CGS exhaust heat utilization on the curtailment of the peak power demand, was quantitatively cleared.

In the Chapter 7, the CGS power transmission system from SFC to Keio University Yagami Campus whose power demand is high, is examined. By employing the system combined with the expansion of the exhaust heat reutilization, the CGS can be efficiently operated due to the improvement of the operation flexibility. As a result, the possibility was shown of reducing the primary energy consumption by 8 percent (27 TJ/year), and the carbon dioxide emissions by 0 percent for the average commercial grid power or 30 percent (4,100 t-CO_2/year) for the petroleum power plants, compared to the actual value on SFC and Yagami Campus.

In the Chapter 8, conclusions of this study are stated.