# COMPREHENSIVE EVALUATION OF RESTAURANT

# EQUIPPED WITH ENERGY SAVING SYSTEMS

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## 1. PURPOSE AND BACKGROUND OF THE STUDY

The amount of carbon dioxide emissions in Japan is still increasing and that from operations sector in 2001 increased by 30.4% compared with 1990. In order to achieve the goals mentioned in "Kyoto protocol", which will be enforced in February 2005, that is, to reduce the CO2 emissions by 6% in 2010 compared with 1990, it is important to carry out effective energy-saving measures considering actual energy consumption. The purpose of this study is to evaluate the introduction of the energy saving systems (electricity only, Co-generation system (CGS), Photo Voltaic system (PVS) and present system) from the view points of not only economics and environment, but also resources.

## 2. FACILITY FOR INTRODUCTION AND EVALUATION METHOD

**(1) Object facilities**

A restaurant in Osaka is selected and the annual load data were measured.

**(2) Energy systems**

In present system, gas-fired boiler for hot-water supply and gas stove for kitchen are used. In the case of electricity only, electric heat pump and IH stove are used instead. In the case of CGS and PVS, no facility changes but boiler is used as support.

**(3) Evaluation method**

Evaluations are carried out from the view point of annual cost, lifecycle $CO_2$ emission and consumption of resources.

## 3. RESULT OF THE EVALUATION AND DISCUSSION

**(1) Effect of introduction of electricity only system**

Both annual cost and index of energy resources decreased compared with current facilities, while $CO_2$ emission increased because $CO_2$ emission from gas is less than that from increased electricity. Both indices of material and waste treatment site slightly increased since power plant is constructed from highly recycled and abundant materials.

**(2) Effect of introduction of CGS**

Annual cost increased, while $CO_2$ emission decreased in some floor area. Although all indices increased, they decreased with increasing floor area and waste heat recovery. It is important to introduce the facility which can use waste heat effectively.

**(3) Effect of introduction of PVS**

Annual cost is the most expensive compared with other systems because of facility's high cost. Although $CO_2$ emission and energy resource consumption index decrease, both indices of material and waste treatment site show large values. In order to improve this problem, recycling PV or using alternative abundant resources are necessary.

## 4. CONCLUSION

It is found that, there is no energy saving system which can simultaneously decrease all items evaluated in this study. When the reduction of $CO_2$ emission is first priority, both CGS and PV system should be chosen despite they have some economical and resources problems. Therefore, the countermeasure such as reconsideration of energy and material resources and construction of recycle system should be implemented.