

# Generation Method of Sharable Demand Data for Evaluation of Energy Equipments

## Background

To evaluate the performance of energy equipments objectively, some commonly usable set of demand data reflecting various usages of individual customers should be available among evaluators. However, measured original demand data of individual customers cannot be shared in many cases because of concerns over privacy issues. Methods to utilize such measured demand data are desired.

## Objectives

The purpose of this study is to develop a method to generate sharable virtual demand data which are usable for the evaluation of energy equipments instead of the original demand data.

## Principal Results

### 1. Development of Generation Method of Virtual Demand Data

#### (1) Development of Virtual Demand Data preserving the Demand Characteristics of Original Data

The developed method first extracts the demand characteristics such as (a) values, (b) variations, (c) integrated values of original demand at several time points according to some rules and then generates demand data at each time point by calculating a demand curve which has the extracted demand characteristics using constrained least squares method (Figure 1). Because the demand characteristics of generated virtual demand data are those of the original demand data, the evaluation results of energy equipments are comparable between original and generated virtual demand data.

#### (2) Comparison with Usual Data Generation Methods

While the usual data generation method which adds random noise to original data generates the demand data with unnatural shapes or with largely displaced peaks which influence the performance of energy equipments in many cases (Figure 2(b)), the virtual demand data generated by the developed method have natural shapes even for experts and the peaks almost the same as those of the original data (Figure. 2(a)).

### 2. Evaluation of Validity of the Developed Method

#### (1) Difficulty of the Recovery of the Original Demand Data

We applied our data generation methods to real data measured at 30 min each for one year at one customer. The virtual demand data have the comparable annual mean at each time point but the difference with the original demand data is large at each time point and so the recovery of the original demand is difficult. Therefore, it has high confidentiality of privacy.

#### (2) Interchangeability in Evaluation of Energy Equipments

Using the above original and virtual demand data, we compared the performance of heat pump hot water heater with respect to the electricity expense. When using the virtual data by our method, the difference of electric expense is 0.5 percent but when using the usual data generation method adding random noise, it is about 7.5 percent.

From the above, we confirmed that the developed method can generate virtual demand data which are different from the original demand but are interchangeable with the original demand data in evaluation of energy equipments. This virtual demand data can be used as sharable energy demand data.

## Future Developments

We will enhance the developed method further and apply the developed method to measured real energy demand data to develop a prototype of the sharable energy demand database.

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### Reference

N. Sano, Y. Sinohara., 2009, "Development of Privacy Preserving Data Gathering and Sharing Method for Energy –Demand (Part2)– Generation of sharable demand data", CRIEPI Report R08006 (in Japanese)

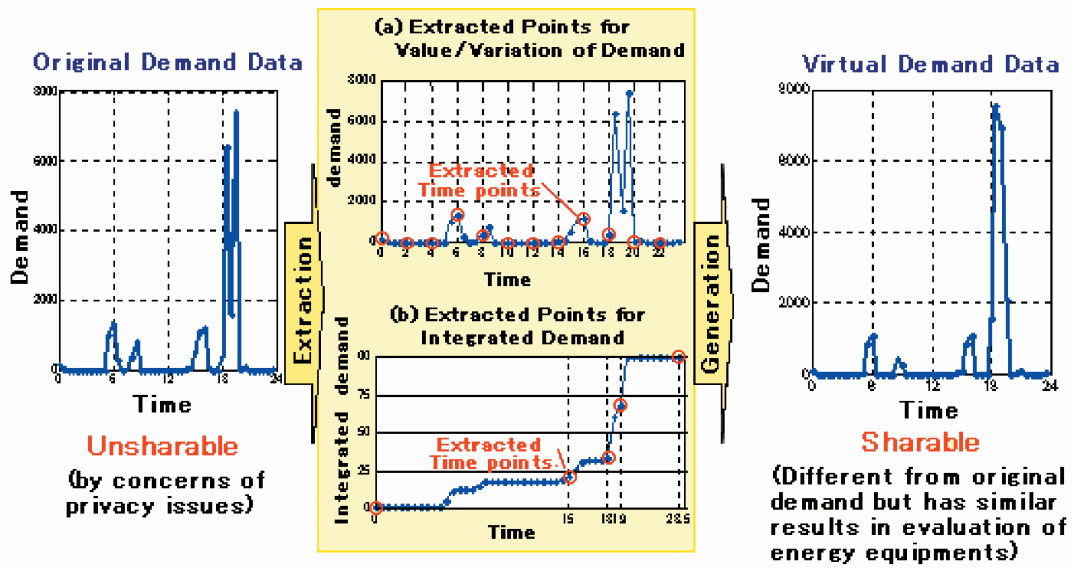
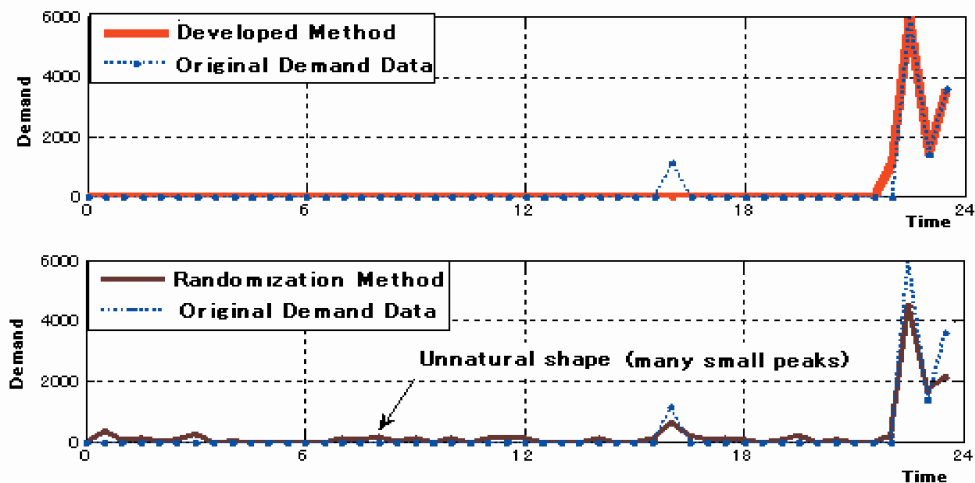


Fig.1 Flow of the Developed Virtual Demand Generation Method



\* Randomized method adds random noise with the half of the standard deviation of original demand data and cuts off negative demands and also normalizes data whose daily total is same as the original demand data.

Fig.2 Characteristics and Difference of Virtual Demand by Developed and Randomization Methods

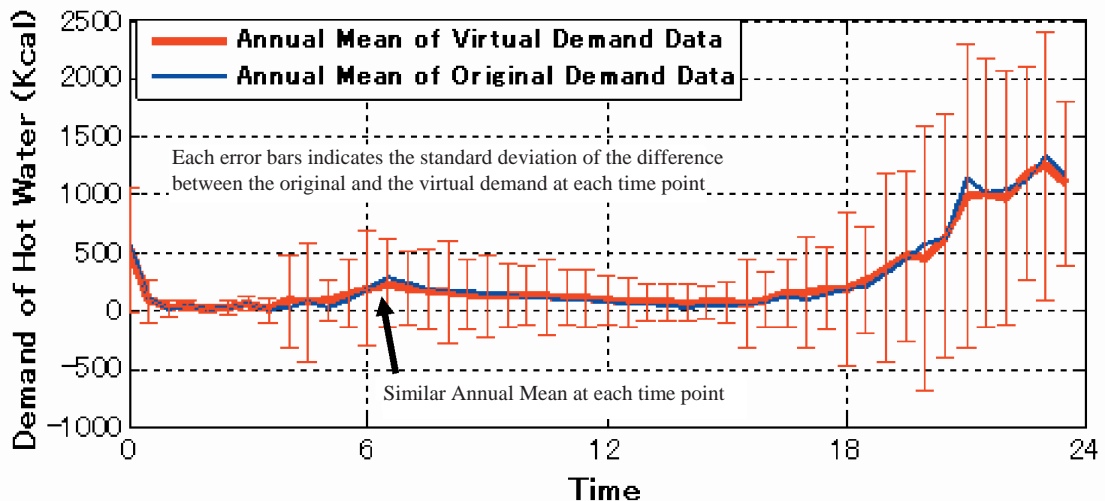


Fig.3 Comparative Result of Evaluation of Heat-pump Water Heater by Original and Virtual Demand Data