

# Effectiveness of displaying energy consumption data in residential houses

## Analysis on how the residents respond

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### Keywords

energy information, energy consumption, energy savings, monitoring, residential house

### Abstract

Providing the residents with information on their energy use has become a feasible option to promote energy savings in residential sector. The authors have constructed an interactive "energy consumption information system" that displays energy consumption of the whole house and domestic appliances. The display system were set up into 10 residential houses and the effects on energy consumption have been analyzed in detail based on the monitored energy data before and after the installation of the system and also on the log of how the residents responded through the keyboard.

In this paper, the amount of energy savings actually achieved by setting up the display system and how these savings were achieved by the residents will be described. Some of the observed facts to be shown are the following:

1. The responses of residents to the questionnaire were received for more than nine months and provided us with useful information. The participants became especially interested in the daily load curve.
2. Total energy consumption was reduced by 12% after the installation of the system.
3. 60% of the houses recognized and reduced standby power consumption.
4. 70% of the houses paid attention to the energy consumption for space heating and they have taken actions such as switching to other appliances and reducing the length

of space heating. Some of the houses were successful to cut down their heating demand by 20–45%.

### Introduction

In Japan, the number of residential houses and the floor space per house are increasing, and the diffusion of various appliances causes the increasing energy demand in residential sector. In order to meet the Kyoto Protocol, it has become clear that reducing energy demand and consequently CO<sub>2</sub> emission in this sector is vitally important.

This study focused on the awareness of residents to energy conservation and on the potential of reducing energy demand through energy saving activities. The method introduced here is to induce energy saving by providing household members with information on actual domestic energy consumption. A number of researches have been conducted with regards to this; for example, C.Egan investigated the relationship between different display formats and the reaction to each from informants [Egan, 1999]. M.Newborough analyzed the effectiveness of an appliance-specific display showing the energy consumption for cooking [Mnsouri, 1999][Wood, 2003a], and classified the features necessary for displaying energy information [Wood, 2003b]. Brandon analyzed the most effective energy saving technique among several feedback methods using, for example, computer, leaflet, etc [Brandon, 1997] [Brandon, 1999]. In Japan, the "Shoene-navi (energy saving navigator)" developed by the Energy Conservation Center of Japan displays the power consumption of an entire household [EC-CJ]. Osaka Gas developed an energy consumption information service in an experimental apartment house

called "NEXT21". This service not only measures electric power and heated-water supply, but also displays graphs of consumption charges on a web browser [NEXT21, 2002]. In these researches, however, the energy awareness behaviors of the consumers induced by these energy information systems were not discussed in detail.

The authors have developed an on-line Energy Consumption Information System (hereafter referred to as ECOIS I) that provided residents with information on end-use electric power consumption, and installed the system into 10 residential houses. It was confirmed that power consumption of the whole house was reduced on average by about 9% across eight households [Ueno, 2003]. However, the experiment showed that it was necessary to provide residents with information not only on electric power consumption but also on other energy sources consumed in each household in order to reduce total energy consumption.

In this context, the authors constructed a new on-line Energy Consumption Information System (hereafter referred to as ECOIS II) that provided residents with information on city gas consumption and room temperature in addition to electric power consumption. The ECOIS II was installed in 10 residential houses in a city near Osaka.

The main purposes of the study were to analyze 1) how consumers are interested in their household energy consumption, 2) how consumers changed their behaviors toward energy conservation and how power consumption changed after installation of ECOIS II, and 3) whether there are any energy saving effects of ECOIS II. In this paper, the amount of energy savings actually achieved by setting up the display system and how the residents achieved these savings are described.

## Construction and Experiment of an Energy Consumption Information System

### THE MONITORING AND INFORMATION SYSTEM

Figure 1 shows the configuration of ECOIS II, which consists of monitoring and distribution components. The monitoring component includes Load Survey Meter (LSM) that measures electric power consumption and city gas consumption for the entire house, and a type of End-Use Meter

(EUM) that measures electric power consumption for each home appliance and another type of EUM that measures room temperature. Power consumption and city gas consumption, room temperature are measured for intervals of 30 minutes. The measured power and temperature data by EUM were sent to the LSM through distribution lines in a house, and the city gas data were sent to the LSM through an exclusive line. Data were then collected through PHS network every night by a computer in the author's laboratory at Osaka University.

The distribution component includes a laboratory-based computer which distributes data to the information terminal in each house by E-mail. The logs of operation of the information terminal and responses of the consumers to the energy tips were sent to the distribution server every morning. Here, operation of the information terminal means pressing of buttons on the screen of a terminal, namely, a B5-sized laptop computer, by the customer.

### DESIGN OF THE INFORMATION TERMINAL

Figure 2 shows the composition of the display on the information terminal with an example of the graphs that can be drawn on the screen. Although various display methods can be considered effective for providing energy consumption information, conciseness has a big influence on the overall effectiveness of the display methods. Hence, the composition of the display needs to be designed carefully. The following were taken into consideration during the design stage of the ECOIS display:

1. Simple access to the detailed data.

A number of buttons are properly located on a single display picture, and only a mouse is required in order to access various functions and more detailed data. The main graph area is located at the center of the display picture, while windows displaying energy saving tips and information on electricity charge are located below and to the right of the main graph area, respectively. Table 1 shows the various graphs that can be displayed. Note that the measured power consumption and city gas consumption data are displayed in terms of Japanese Yen so that residents can understand it easily.

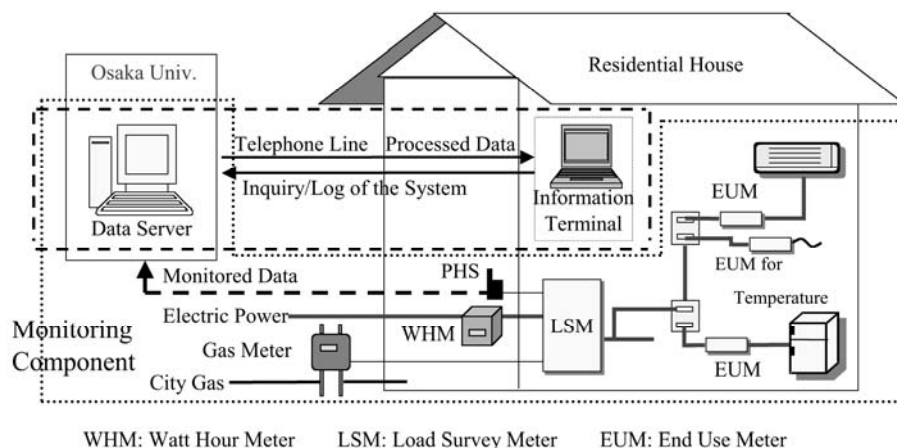


Figure 1. Configuration of ECOIS II.

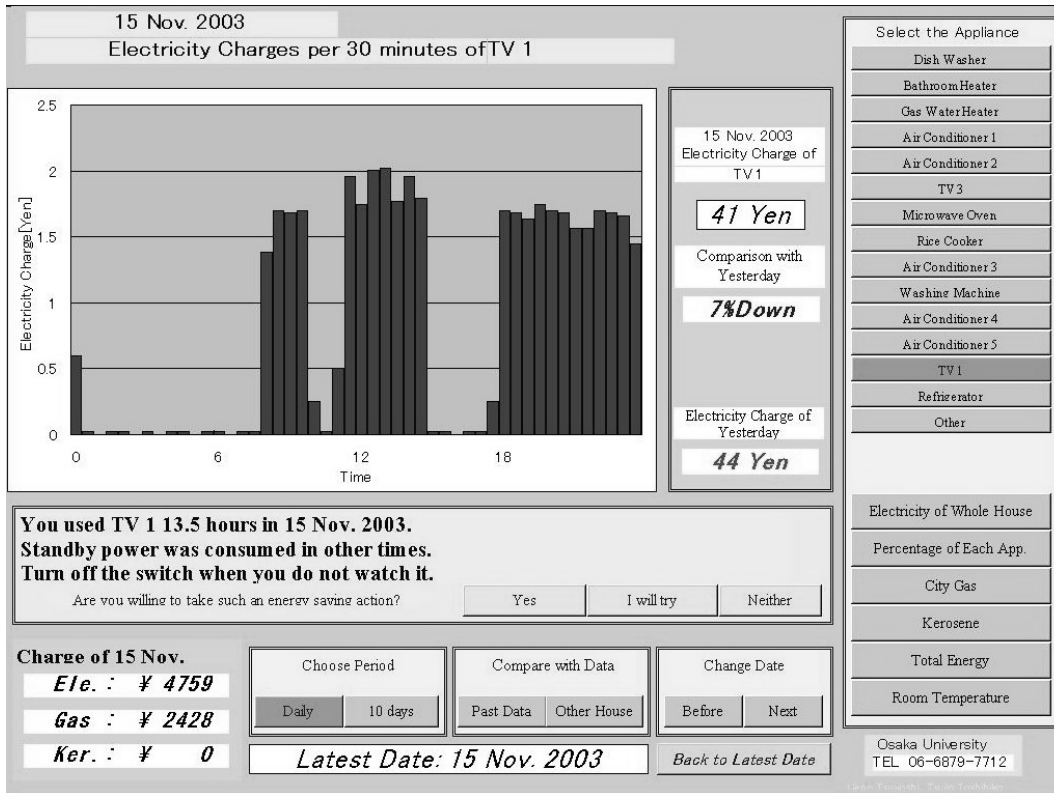


Figure 2. Display picture on the information terminal (translated into English).

Table 1. The buttons and corresponding graphs.

		Buttons below the main graph area			
		Daily	10 days	Comparison with past data*	Comparison with other houses
Buttons on the right-hand side of the main graph area	Electricity charge of the appliances**	Hourly electricity charge over a day	Daily electricity charge over a 10-day period	Daily electricity charge, present and past	Own house and other house
	Electricity charge of whole house	Hourly electricity charge over a day	Daily electricity charge over a 10-day period	Daily electricity charge, present and past	Own house and other house
	Percentage of the electricity consumption charge	Percentage of power expense of each appliance	Daily percentage of power expense over a 10-day period	---	---
	City gas charge of whole house	Hourly city gas charge over a day	Daily city gas charge over a 10-day period	Daily city gas charge, present and past	Own house and other house
	Kerosene charge of whole house	Hourly kerosene charge over a day	Daily kerosene charge over a 10-day period	Daily kerosene charge, present and past	Own house and other house
	Total energy charge of whole house	Hourly total energy charge over a day	Daily total energy charge over a 10-day period	Daily total energy charge, present and past	Own house and other house
	Temperature at living room	Hourly room temperature over a day	Daily average room temperature over a 10-day period	present and past	Own house and other house

\* Past data means the daily data averaged over the current month, previous month and previous year.

\*\* There are many buttons in this section as shown in fig.2.

2. Provision of useful information for residents to save energy.

3. Capability of recording operation of the information terminal.

While displaying a graph of each appliance, energy saving tips are displayed on the message window. Each piece of advice urges the customer press one of following three response buttons: [Yes], [I will try] and [Neither].

When analyzing the awareness of consumers on energy consumption and on energy saving potential, information on how each consumer is interested in the energy consumption of each appliance and how these interests change over time

are very important. Hence, operation of all buttons and the responses to each tip were recorded.

Here, there is a button on the screen to show kerosene consumption of the appliances, however, no monitored household use kerosene in this experiment. Therefore, kerosene consumption is not shown on the screen.

### ECOIS II EXPERIMENT

Monitoring was commenced in Dec. 2002 at 19 detached houses in a newly developed town in the suburb of Osaka and information terminals were installed on 2-8 Feb. 2003 into 10 houses among them. Energy consumption in other nine houses was measured in order to identify the effect of ECOIS II. Hereafter, group A means the household with information terminal, and group B means the household without information terminal. Each household included a married couple with 1-3 children (and one house included an aged woman) and the averaged floor space of group A and group B are 141 m<sup>2</sup> and 139 m<sup>2</sup>, respectively. Although the information about levels of education, incomes, and occupations are not investigated, it can be speculated that there are no clear difference between group A and group B in its socio-economic profile. Experiment continued until 13 Nov. 2003.

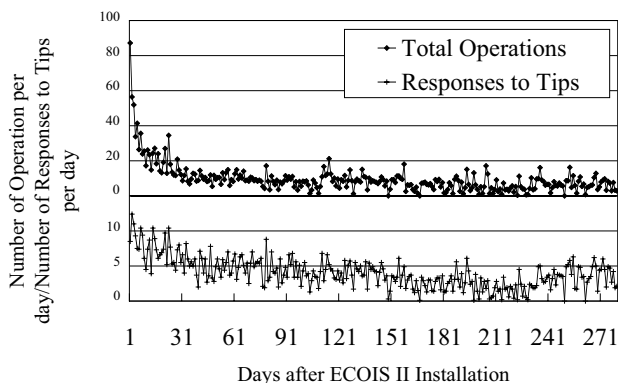


Figure 3. Number of operations by the residents.

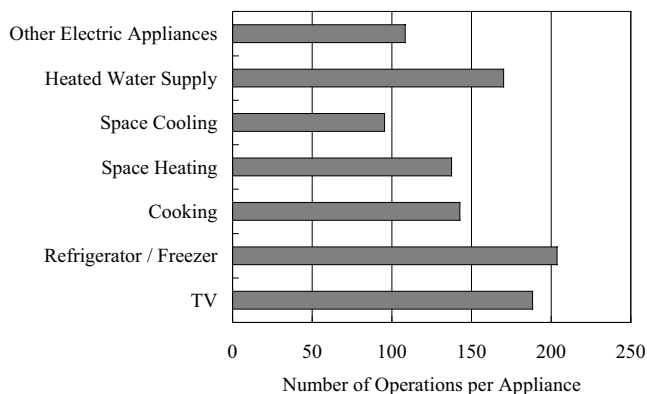


Figure 4. Number of operations for each appliance averaged over 10 houses during ECOIS II experiment (280 days).

### Energy Awareness of Residents

Figure 3 shows the number of total operations (button pressing) and responses to energy saving tips per day averaged over the ten households during ECOIS II experiment (280 days). It is clear that the number of total operations was very large immediately after installation after that it decreased gradually. However, the residents kept pressing buttons on the screen of the information terminal long after the installation.

Table 2 shows the number of operations of buttons for selecting graphs over the experimental period. The number of [each appliance], [electricity charge of whole house] and [city gas charge of whole house] operations were large among the right-hand side buttons. The number of [daily] operations were the largest, then comes [10 days], [comparison with other house], and [comparison with past data] in the buttons below the main graph area. The most residents told in a questionnaire survey that they were interested in the graphs of [comparison with other house] because these graphs induced competitive spirit of the residents.

Figure 4 shows the number of operations of buttons for each appliance averaged over each end-use purpose. The number of refrigerator/freezer was the largest, then comes TV and heated water supply. The numbers of space heating and space cooling were smaller than other end-use purposes because these appliances were used only several months, whereas others were used throughout the year.

### Change in Energy Consumption

#### EVALUATION PERIOD

Since the change of ambient temperature or the numbers of household individuals influence energy consumption of the whole house, it is difficult to evaluate the effect of ECOIS II installation quantitatively in case they change. Therefore ECOIS II experiment was scheduled to start at the middle of winter when the ambient temperature would not change very much for several weeks. To evaluate the effect of ECOIS II installation on energy consumption, consumption in two periods referred to as "period I" and "period II" was compared. Here, 28 weekdays before installation of ECOIS II was defined as "period I", and 28 weekdays after installation was defined as "period II"; here, weekdays means any day except Saturday, Sunday, national holidays, the end and beginning of the year. To evaluate energy consumption before and after installation impartially, the evaluation periods were limited to weekdays only. A questionnaire survey was used to check that no changes in the number of household individuals, for example, as a result of a business trip or hospitalization, or changes in the rooms used occurred. Also, energy consumption of houses in group A and group B was compared for each period.

Figure 5 shows the evaluation period of ECOIS II experiment. The average ambient temperatures at Period I and Period II were 5.1 and 6.8°C, respectively.

#### CASE STUDY ON ENERGY SAVING ACTIVITIES

In this section, actual examples of energy saving activities of consumers induced by the energy information system are

**Table 2. Number of operations (pressing buttons) averaged over 10 houses during ECOIS II experiment (280 days).**

		Buttons below the main graph area				Total
		Daily	10 days	Comparison with past data	Comparison with other houses	
Buttons on the right-hand side of the main graph area	Electricity charge of the appliances	1 184.3	776.7	40.6	81.5	2 083.1
	Electricity charge of whole house	69	62	10.1	36.5	177.6
	Percentage of the electricity consumption charge	55.1	30.1	---	---	85.2
	City gas charge of whole house	52.9	38.8	2.7	29	123.4
	Kerosene charge of whole house	---	---	---	---	---
	Total energy charge of whole house	39.8	39.4	7.2	21	107.4
	Temperature at living room	38.4	37.6	5.4	11.3	92.7

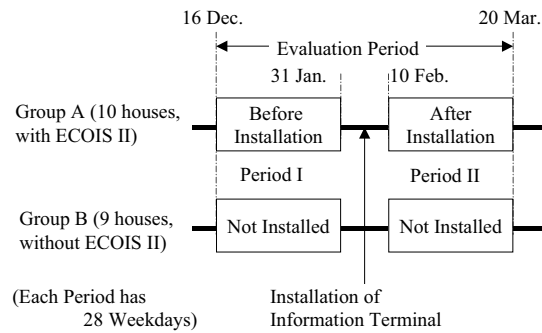
described first, by using the data of household no.1 in Group A. Table 3 shows the energy consumption of each appliance. There are three sets of air-conditioners in this house. Only the power consumption of electronic fan heater and TV2 increased among 14 appliances whose information was displayed. Especially, reduction in space heating consumption was large. City gas is consumed only for cooking and heated water supply, not for space heating.

Figure 6 shows the daily load curves for space heating appliances during period A and period B. It can clearly be seen from Figure 6 that consumption of the electric fan heater 1 increased and that of other space heating appliances decreased. Living room and dining room are connected in this house and two electric fan heaters were used in these rooms. The residents stopped using one of the two heaters after the installation of ECOIS II. Moreover, they almost stopped turning on the hot carpet, because they noticed that the carpet itself has enough insulation effect.

Figure 7 shows the load duration curves<sup>1</sup> of several appliances in household no.1. Figure 7 (a) and (b) show the load duration curves of TV1 and TV2, respectively. TV1, a 36-inch television in the living room consumes 36W during standby. TV2, a 14-inch television in the dining room did not consume standby power. Although the load duration curves of TV2 (Fig. 7(b)) did not change much after ECOIS II installation, the power consumption of TV1 was reduced dramatically as shown in Fig. 7(a). It shows also that the reduction occurred mainly in standby power. It turns out that the induced energy saving activity for this case was disconnecting TV1 from the outlet when it is not being watched, not reducing the period of watching.

Figure 7(c) and (d) shows the load duration curves of electric pot and heated toilet, respectively. For the electric pot, the hours of boiling water was not changed, on the other hand the hours of keeping warmth was reduced after ECOIS II installation. For the heated toilet, consumed electric power became smaller by adjusting its temperature setting.

Total energy savings were 25% in electric power and 14% in city gas.



**Figure 5. Evaluation period of ECOIS II experiment.**

**Table 3. Energy consumption of each appliance in household no.1\***

\*Energy consumption of each appliance in each household in group A is shown in the appendix.

Appliance		Period I [Wh/day]	Period II [Wh/day]	Reduction [Wh/day]	Rate of reduction [%]
Power consumption	TV 1	789	335	454	58
	TV 2	347	355	-8	-2
	Refrigerator	2 259	2 187	72	3
	Electric pot	1 299	883	416	32
	Set of air con. 1	6 992	4 930	2 062	29
	Set of air con. 2	4 105	1 848	2 257	55
	Set of air con. 3	3 778	1 569	2 209	58
	Ele. fan heater 1	7 827	9 255	-1 428	-18
	Ele. fan heater 2	5 664	1 478	4 186	74
	Hot carpet 1	515	0	515	100
	Hot carpet 2	260	9	251	97
	Gas water heater	302	260	42	14
	Heated toilet	780	588	192	25
	Extractor fan	1 601	1 004	597	37
	Total of Not displayed	20 047	17 662	2 385	12
Total	56 562	42 365	14 197	25	
City Gas Consumption		46 379	40 100	6 279	14

1. In this paper, the load duration curve means that the data converted from the measured power consumption [Wh] in every 30 minutes to electric power [W] and rearranged into descending order. By analyzing the load duration curve of an appliance, useful information such as the amount of standby power, the operating hours and standby hours, can be acquired.

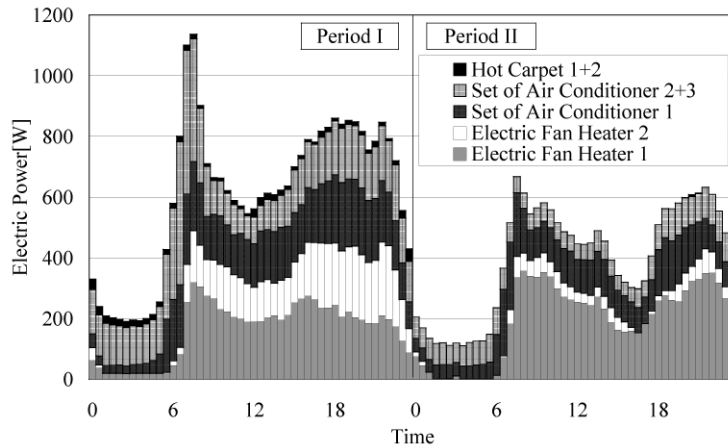


Figure 6. Daily load curves for space heating appliances in household no. 1.

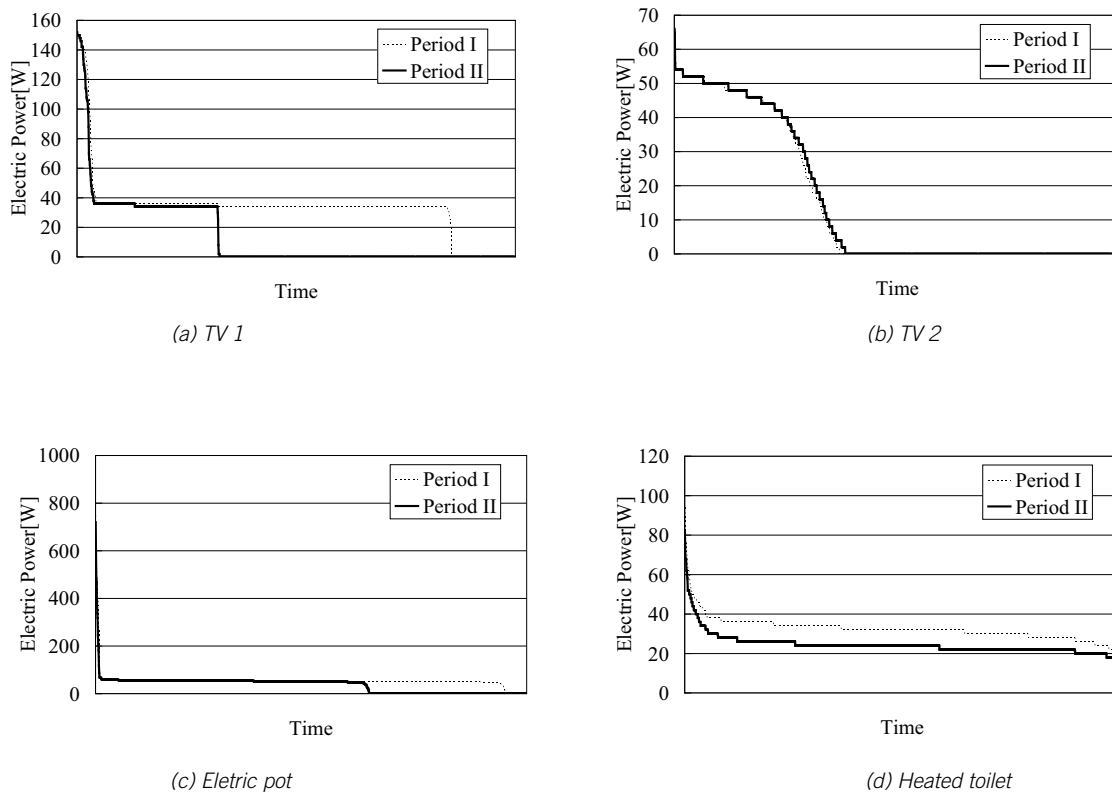


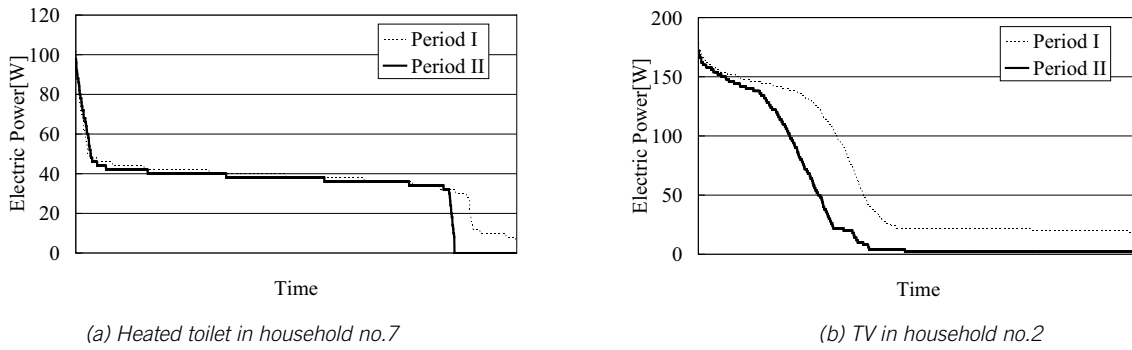
Figure 7. Load duration curves of each appliance in household no. 1.

**CHANGES IN THE POWER CONSUMPTION DURING STANDBY**

The so-called “standby power” of an electric appliance is the power consumption during the period when it is not in use by any of the household members, and it is defined, for example, by the International Energy Agency [Huenges-Wajer, 1999]. Standby power has received much attention in the last ten years since it represents an apparent potential for energy saving through improved control circuits or appliance usage [IEA, 2001] [Ueno, 2001]. Power consumption for appliances with the function of keeping warmth, for example, an electric pot or a rice cooker, is not included in the

“standby power”. However, these appliances consume power when they are in the mode of keeping warmth, and once a consumer becomes aware of the power consumption, the consumer tends to treat these appliances as if these had standby power. This section describes the changes in power consumption when the appliances are in the mode of keeping warmth.

Standby power consumption was identified for 63 appliances, and power consumption for keeping warmth was identified for 12 appliances among 114 electric appliances which were monitored in both period I and period II. Table 4 shows the number of appliances that consume



**Figure 8.** Load duration curves showing the reductions in standby power after ECOIS II installation for (a) a heated toilet in household no.7 and (b) a television in household no.2.

standby power, and the number of appliance whose standby power was reduced. Standby power of 11 appliances among 63 was reduced. The number of the households that reduced standby power of at least one appliance was 6 (60%).

Figure 8 shows the load duration curves of a heated toilet in household no.7 and of a television in household no.2. As shown in Figure 7(d), temperature setting was adjusted for the heated toilet in household no.1. Unlike the appliance in household no.1, the heated toilet in household no.8 was disconnected from outlet when not in use. On the other hand, the residents changed the mode of the TV in household no.2 during standby to a mode of lower power consumption.

Table 5 shows the number of appliances that consume electric power to keep warmth and the number of those which the hours for keeping warmth were reduced. Hours for keeping warmth of four electric pots among six were reduced. Figure 9 shows the load duration curves and daily load curves of the electric pot in household no.6. Although it kept warmth all day long in period I, it became to be disconnected from the outlet at night and boil water in the morning after ECOIS II installation, in period II. The energy saving effect of this activity was approximately 10%.

**ENERGY SAVING ACTIVITIES FOR SPACE HEATING**

Table 6 shows the energy consumption and the rate of reduction of energy consumption for each end-use purpose averaged over ten houses in group A, and the maximum and minimum value of each end-use purpose of group A. It turns out from table 6 that the rate of power consumption for space heating to the whole house is very large (45%). In addition, the rate of reduction of power consumption for space heating is about 30%, which is second largest, after “other appliances”. These data show that the energy consumption for space heating is very large and the energy saving potential is also large in winter. In the following, the change in energy consumption for space heating is investigated in detail.

As mentioned above, only the city gas consumption of whole house was monitored and the consumption of each end-use purpose such as cooking, heated water supply and space heating was not measured. In order to estimate the energy consumption for space heating, the city gas consumption of gas fan heaters was estimated using their power consumption and the city gas consumption of whole house. By estimating the city gas consumption by gas fan heaters,

**Table 4. Appliances consuming standby power.**

Appliance	Number of appliances that consume standby power	Number of appliances whose standby power reduced
TV	7	3
Electric pot	1	0
Electric rice cooker	3	0
Dish dryer	2	0
Microwave oven	1	0
Microwave oven with city gas	1	0
Air conditioner	27	4
Gas fan heater	4	2
Hot carpet	2	1
Kotatsu*	1	0
Electric fan heater	2	0
Electric stove	1	1
Bathroom heater	1	0
Gas water heater	10	0

\* Japanese foot warmer with a quilt over it

**Table 5. Appliances with a function of keeping warmth.**

Appliance	Number of appliances that consume electric power to keep warmth	Number of appliances for which the hours of keeping warmth were reduced
Electric pot	6	4
Electric rice cooker	2	0
Heated toilet	4	2

total energy consumption for space heating can be calculated. Figure 10 shows the energy consumption for space heating in the period I and II for each household in group A. The average reduction was about 20%. It should be noted, however, that the average temperature in period II was 0.9 degree C higher than that in period I, therefore the actual effect of ECOIS II installation may be less than 20%.

**CHANGES IN ENERGY CONSUMPTION OF WHOLE HOUSE**

In this section, the changes in energy consumption of whole houses are described as a result of energy saving activities of

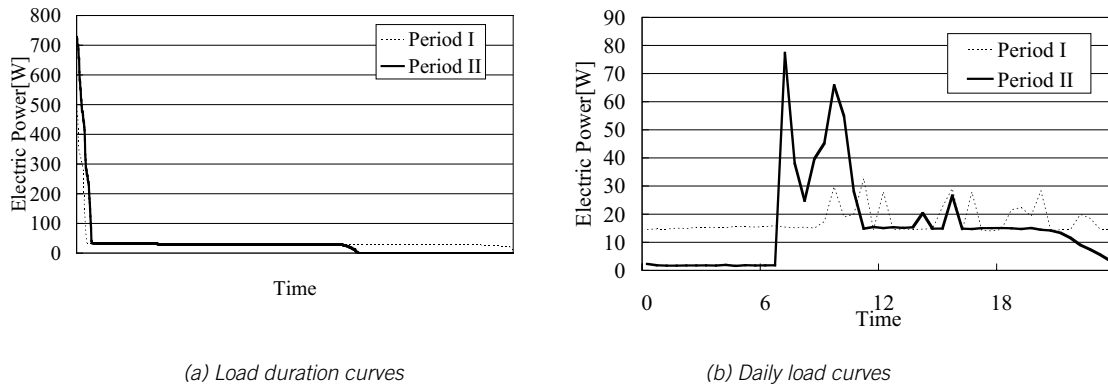


Figure 9. Changes in the power consumption of the electric pot in household no.6 at period I and II.

Table 6. Energy consumption and ratio of reduction for each end-use purpose.

End-use purpose	Period I [Wh/day]	Period II [Wh/day]	Reduction [Wh/day]	Rate of reduction [%]	Number of app.	Maximum value [Wh/day]		Minimum value [Wh/day]	
						Period I	Period II	Period I	Period II
TV	1 017	948	69	6.8	11	1 900	1 911	50	38
Refrigerator	1 447	1 404	43	3.0	9	2 283	2 187	1 172	1 171
Cooking	896	836	60	6.6	13	2 001	1 957	151	217
Space heating	13 045	9 147	3 898	29.9	63	29 139	19 090	2 910	723
Heated water supply	783	659	124	15.9	10	1 722	1 696	245	130
Other appliances	460	319	141	30.7	6	2 380	1 592	6	4
Not displayed app.*	11 283	10 468	814	7.2	-	20 047	17 302	5 082	5 064
<b>Total</b>	<b>28 930</b>	<b>23 780</b>	<b>5 150</b>	<b>17.8</b>	<b>10</b>	<b>56 562</b>	<b>42 005</b>	<b>12 622</b>	<b>11 432</b>
City Gas Consumption	55 274	50 399	4 875	8.8	10	105 467	109 622	24 055	25 381

\* Not displayed app. means the difference of the power consumption of entire house (measured by LSM) and the total of each displayed appliance (measured by EUM). 7.2% of reduction may indicate the possible spread of energy saving activities for those appliances that are not displayed.

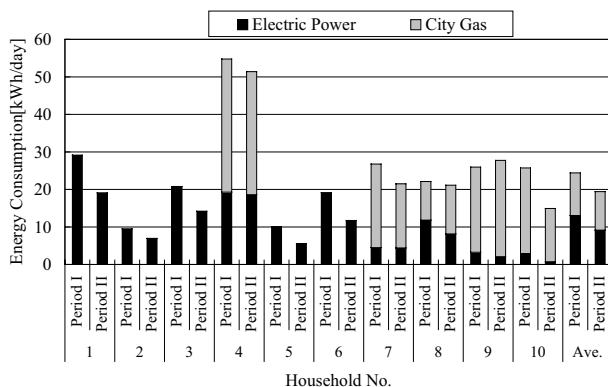
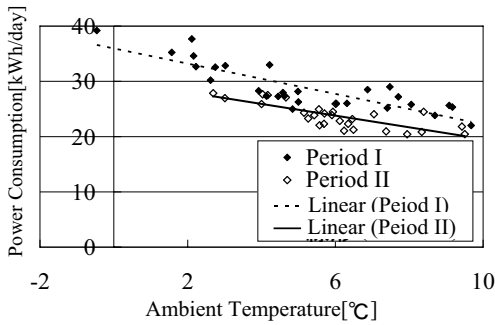


Figure 10. Energy consumption of space heating at period I and II (secondary energy).

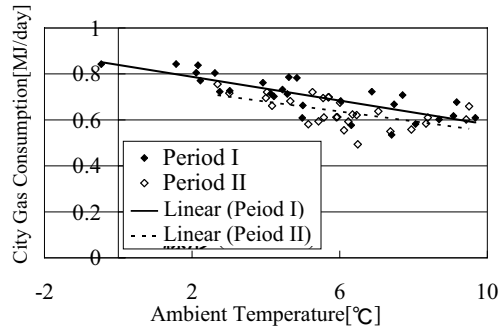
residents shown in the previous sections. Figure 11 and 12 show the relationship between the ambient temperature and the daily power and city gas consumption of whole house averaged over households in group A and B, respectively. Energy consumption in period II of group A is lower if these plots are compared with each other for the similar temperature. On the other hand, energy consumption in period II of group B remains in the same range as in Period I.

Figure 13 shows the energy consumption per day of the households in group A. The power consumption of whole house averaged over ten households in group A was reduced by 5 150 Wh/day (17.8%) and the city gas consumption of that was reduced 4 875 Wh/day (8.8%). Figure 14 is for group B. The power consumption of whole house averaged over nine households in group B was reduced by 891 Wh/day (4.7%) and the city gas consumption increased 179 Wh/day (0.4%).

From these observations, it is considered that installation of ECOIS II did have considerable effect on energy saving. The reduction rate of energy consumption averaged over the ten houses in group A was 12%. It should be noted here also that the energy consumption in winter depends heavily

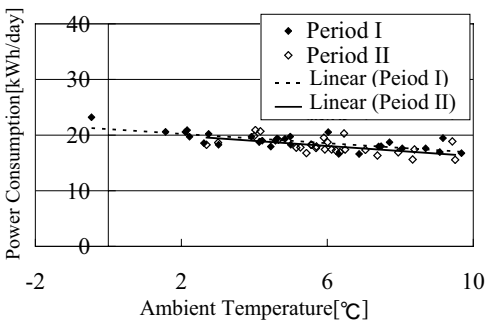


(a) Electric power consumption of whole house

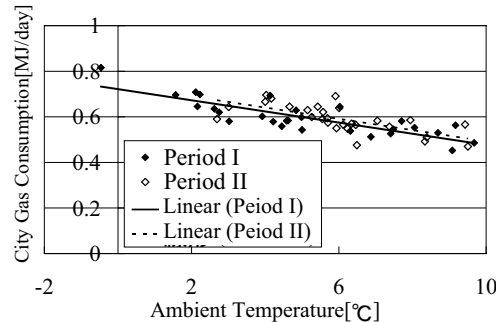


(b) City gas consumption of whole house

Figure 11. Relationship between the ambient temperature and daily energy consumption averaged over the households in group A.



(a) Electric power consumption of whole house



(b) City gas consumption of whole house

Figure 12. Relationship between the ambient temperature and daily energy consumption averaged over the households in group B.

on ambient temperature and hence the actual effect would be less than 12%.

The energy consumptions of the two groups A and B differ each other significantly as it can be seen from Figures 11 and 12. It was difficult to distinguish these differences at the time of selection of households for ECOIS II installation and the authors believe that this difference would not obscure the evidence on the effectiveness of installing ECOIS II.

**Conclusion**

In this study, an on-line energy consumption information system for motivating energy saving activities was constructed, and the energy saving activities induced by this system were analysed based on the monitored data.

Major findings can be summarized as follows:

1. The responses of residents to the questionnaire generated by the system were received for more than nine months and provided us with useful information. The residents were interested in the information on TV, power consumption of whole house, and space heating.
2. The load duration curves and daily load curves of appliances in a household revealed that the residents saved energy for various appliances such as TV, electric pot, space heating appliance. Approximately 20% of energy consumption of whole house was reduced in the household no.1.

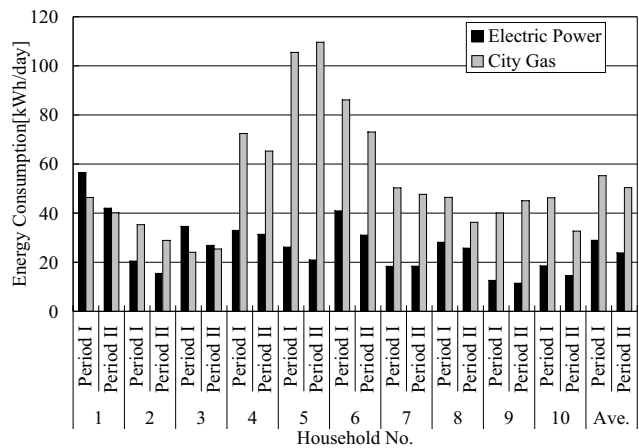
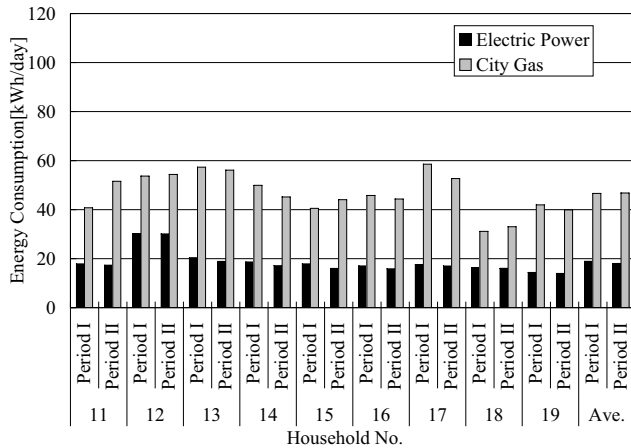


Figure 13. Changes in energy consumption of whole house (group A, secondary energy).

3. Reduction of space heating was the largest among end-use purposes. 70% of the houses paid attention to the energy consumption for space heating and they have taken actions such as switching to other appliances and reducing the length of space heating. Some of the houses were successful to cut down their heating demand by 20-45%.



**Figure 14.** Changes in energy consumption of whole house (group B, secondary energy).

- Standby power was reduced for 11 appliances among 63 appliances by changing the operation mode at standby or disconnecting the plug, and 60% of the houses took some actions to reduce standby power consumption. Power consumption to retain warmth was reduced for 6 appliances among 12 appliances.
- The total power consumption decreased about 18% and the total city gas consumption decreased about 9% averaged over ten houses with ECOIS II. On the other hand, the total power consumption decreased about 5% and the total city gas consumption increased 0.4% averaged over nine houses without ECOIS II. Thus it can be conceived that installation of ECOIS II had certain influence on the energy saving awareness of the customers. Total energy consumption was reduced by 12% after the installation of the system.

It should be noted that the average ambient temperature in period II (after installation) is 0.9 deg. C higher than that in period I (before installation). Generally, the energy consumption of the whole household increases with the fall in ambient temperature in winter. Hence, it is thought that the actual reduction rates were somewhat less than those values shown in the conclusion number 2., 3. and 5. above.

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### Appendix

**Table A1 Energy consumption of each appliance in household no.1-5.**

End-use purpose	Household No.	No.1		No.2		No.3		No.4		No.5		
	Period	I	II	I	II	I	II	I	II	I	II	
Power consumption	TV	TV	1 136	690	1 515	907	890	909	469	539	662	593
	Ref.	Refrigerator	2 259	2 187	1 278	1 279	1 817	1 803			1 546	1 578
	Cooking	Electric rice cooker					905	964			166	217
		Microwave oven (with city gas)					249	228				
		Electric pot	1 299	883	979	704			804	853		
		Dish dryer					413	765				
	Space heating	Air conditioner	14 875	8 347	9 446	6 949	16 533	11 399	93	127	10 057	5 564
		Oil radiator					2 821	1 690				
		Gas fan heater							417	392		
		Hot carpet + Kotatsu	775	9	43	0	1 442	1 093	178	309	50	19
		Electric fan heater	13 490	10 734					18 596	17 701		
		Electric stove			21	0						
	Heated water supply	Bathroom heater										
		Gas water heater	302	260	505	431	543	324	1 226	961	1 722	1 696
	Other appliances	Heated toilet	780	588	505	431	543	324	1 226	961	1 722	1 696
		Others	1 601	1 004	560	108	6	4				
	Entire house [kWh/day]		56.6	42.0	20.4	15.4	34.6	26.9	33.0	31.4	26.2	20.9
City gas consumption [MJ/day]		167	144	127	104	87	91	261	235	380	395	

**Table A2 Energy consumption of each appliance in household no.6-10.**

End-use purpose	Household No.	No.6		No.7		No.8		No.9		No.10		
	Period	I	II	I	II	I	II	I	II	I	II	
Power consumption	TV	TV	1 900	1 911	1 223	1 321	50	38	532	732	1 796	1 838
	Ref.	Refrigerator	2 283	1 937	1 205	1 243	1 282	1 171	1 172	1 233	1 622	1 603
	Cooking	Electric rice cooker							669	638		
		Microwave oven (with city gas)										
		Electric pot	847	765	1 144	1 050			1 012	916		
		Dish dryer							319	125	151	254
	Space heating	Air conditioner	16 723	9 295	1 159	443	4 730	2 625	379	421	2 091	495
		Oil radiator					4 455	4 027	1 355	416		
		Gas fan heater			147	111	224	240	200	226	159	106
		Hot carpet + Kotatsu			1 725	1 933	2 407	1 245	1 319	1 011	32	0
		Electric fan heater	2 422	2 422	1 459	1 918						
		Electric stove									445	2
	Heated water supply	Bathroom heater									182	120
		Gas water heater	1 670	1 409	658	597	245	130	435	354	525	423
	Other appliances	Heated toilet			885	810			149	80		
		Others										
	Entire house [kWh/day]		40.9	31.0	18.3	18.4	28.1	25.7	12.6	11.4	18.5	14.6
City gas consumption [MJ/day]		310	263	181	172	167	131	144	162	166	118	