CERT Thematic Discussions: The role of ‘behavioural aspects’ for reaching net zero emissions by 2050

Impact of “Setsuden”
- data survey on the potential for Japan’s electricity savings by behavioural change

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The Institute of Energy Economics, Japan
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What is “Setsuden”?

• “Setsuden” is electricity savings resulting from technical/operational efficiency improvement – including behavioral change.

• To cope with the rolling blackout after the Great Eastern Japan Earthquake in 2011, Ministry requested industry, commercial and residential consumers to facilitate electricity peak savings.

• The behavioral change for electricity peak savings and electricity consumption savings – prompted by the emergency situation – continues to be implemented.

Weather-adjusted Peak Electricity Savings Rate July-September (compared with July-September in 2010)


Actions for Residential Electricity Savings

The Outline of METI Commissioned Study: “Electricity Demand and Potential for Peak Demand Savings”

(1) Survey/measure: 10,000 households and and 10,000 building owners/occupants for 3 different seasons (summer, middle, winter) in 10 regions in Japan

(2) Estimate load curve: for 3 different seasons (summer, middle, winter) by technology in 10 regions in Japan

(3) List up menus of peak demand savings: for 3 seasons by technology for 10 regions

(4) Estimate potential for electricity savings: for 3 seasons in 10 regions

(5) Consider method for information diffusion: for 3 seasons in 10 regions

For emergency preparedness and load leveling, the IEEJ implemented METI (Ministry of Economy, Trade and Industry, Japan) commissioned study in FY 2019 on the impact of “Setsuden”. The study was conducted along with the Energy Conservation Center, Japan, Jyukankyo Research Institute, and Dentsu Corp.

This presentation covers the results on residential sector – although the METI’s study included the analyses of the commercial sector.

Note: A 899-page report on detailed analysis for 10 regions in Japan

10 Regions in Japan

Source: FEPC
Residential electricity load curve is estimated using 1) surveyed data, 2) statistical data, 3) measured data to compare with the regional hourly load curve data from electric utilities. This estimation is implemented for summer, middle, winter in 10 regions.
Regional Differences, and Seasonal Differences

Contributions to Peak Demand

- **Kanto, Summer (14:00)**
  - Air Conditioner: 44.7%
  - Refrigerator: 17.8%
  - Lighting: 6.3%
  - TV: 4.3%
  - Other: 13.0%
  - Electric water heater: 2.8%
  - Electric water boiler: 1.0%
  - Electric toilet seat: 0.8%
  - Vacuum cleaner: 1.7%
  - PC: 0.8%
  - Stand-by power: 6.2%
  - Dryer: 0.6%
  - Washing machine: 0.4%
  - Rice Cooker: 2.5%

- **Hokkaido, Summer (16:00)**
  - Air Conditioner: 24.7%
  - Refrigerator: 18.4%
  - Lighting: 10.8%
  - TV: 3.3%
  - Other: 19.6%
  - Electric water heater: 4.3%
  - Electric water boiler: 1.7%
  - Electric toilet seat: 0.6%
  - Vacuum cleaner: 1.7%
  - PC: 0.8%
  - Stand-by power: 7.6%
  - Dryer: 1.0%
  - Washing machine: 0.6%
  - Rice Cooker: 7.0%

- **Kanto, Winter (17:00)**
  - Air Conditioner: 23.0%
  - Refrigerator: 16.0%
  - Lighting: 8.2%
  - TV: 3.3%
  - Other: 13.3%
  - Electric stove: 4.4%
  - Electric water heater: 2.8%
  - Electric water boiler: 1.8%
  - Electric toilet seat: 0.5%
  - Vacuum cleaner: 2.0%
  - PC: 0.5%
  - Stand-by power: 6.1%
  - Dryer: 0.6%
  - Washing machine: 0.3%
  - Rice Cooker: 8.7%

- **Hokkaido, Winter (9:00)**
  - Air Conditioner: 18.4%
  - Refrigerator: 12.0%
  - Road heating: 12.0%
  - Dryer: 5.2%
  - Washing machine: 0.6%
  - Electric toilet seat: 0.9%
  - Vacuum cleaner: 2.0%
  - PC: 0.5%
  - TV: 3.2%
  - Lighting: 7.5%
  - Rice Cooker: 6.1%
  - Electric water heater: 1.5%
  - Electric water boiler: 1.8%
  - Electric carpet: 2.1%
  - Kotatsu: 0.6%

Hours of Peak Demand by Season, and by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Summer</th>
<th>Middle</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>16:00</td>
<td>18:00</td>
<td>9:00</td>
</tr>
<tr>
<td>Tohoku</td>
<td>14:00</td>
<td>14:00</td>
<td>17:00</td>
</tr>
<tr>
<td>Kanto</td>
<td>14:00</td>
<td>14:00</td>
<td>17:00</td>
</tr>
<tr>
<td>Chubu</td>
<td>14:00</td>
<td>14:00</td>
<td>9:00</td>
</tr>
<tr>
<td>Hokuriku</td>
<td>14:00</td>
<td>14:00</td>
<td>9:00</td>
</tr>
<tr>
<td>Kinki</td>
<td>14:00</td>
<td>16:00</td>
<td>17:00</td>
</tr>
<tr>
<td>Chugoku</td>
<td>14:00</td>
<td>14:00</td>
<td>9:00</td>
</tr>
<tr>
<td>Shikoku</td>
<td>15:00</td>
<td>14:00</td>
<td>18:00</td>
</tr>
<tr>
<td>Kyushu</td>
<td>14:00</td>
<td>19:00</td>
<td>18:00</td>
</tr>
<tr>
<td>Okinawa</td>
<td>16:00</td>
<td>19:00</td>
<td>19:00</td>
</tr>
</tbody>
</table>

Source: The Institute of Energy Economics, Japan (2020)

- Effective electricity savings options at peak load should consider operational characteristics by region.
### Menu List of Electricity Savings (Basic List) and the Impact

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
<th>Electricity savings rate</th>
<th>Peak demand savings rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Maintain room temperature at 28°C</td>
<td>14%</td>
<td>6.3%</td>
</tr>
<tr>
<td>AC</td>
<td>Use of blind at window</td>
<td>10%</td>
<td>4.5%</td>
</tr>
<tr>
<td>AC</td>
<td>Use of fan to minimize the use of AC</td>
<td>100%</td>
<td>44.0%</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>Set temperature at middle level, minimize the frequency of opening door, and do not put too much stuff inside</td>
<td>10%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Lighting</td>
<td>Switch off unnecessary light</td>
<td>50%</td>
<td>3.1%</td>
</tr>
<tr>
<td>TV</td>
<td>Set at energy efficient mode, lower luminance level, and switch off when it is not necessary</td>
<td>25%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Electric Toilette</td>
<td>Switch off hot water supply function, and use energy efficient mode</td>
<td>100%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Rice Cooker</td>
<td>Avoid use during the peak hours, and keep those that are ready in refrigerator or freezer.</td>
<td>100%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Stand-by</td>
<td>Plug off when appliances (TV, PC and Printer) are not in use</td>
<td>100%</td>
<td>0.8%</td>
</tr>
<tr>
<td>AC</td>
<td>Maintain room temperature at 20°C</td>
<td>16%</td>
<td>3.7%</td>
</tr>
<tr>
<td>AC</td>
<td>Draw curtain at the window</td>
<td>5%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>Set temperature at middle level, minimize the frequency of opening door, and do not put too much stuff inside</td>
<td>10%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Lighting</td>
<td>Switch off unnecessary light</td>
<td>50%</td>
<td>4.1%</td>
</tr>
<tr>
<td>TV</td>
<td>Set at energy efficient mode, lower luminance level, and switch off when it is not necessary</td>
<td>25%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Electric Toilette</td>
<td>Use energy efficient mode. Lower temperature setting for seat and hot water, and close the lid when it is not in use.</td>
<td>27%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Rice Cooker</td>
<td>Avoid use during the peak hours, and keep those that are ready in refrigerator or freezer.</td>
<td>100%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Stand-by</td>
<td>Plug off when appliances (TV, PC and Printer) are not in use</td>
<td>100%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

**Source:** The Institute of Energy Economics, Japan (2020)

- Electricity savings rate represents potential electricity savings from behavior change. The list is prepared reflecting 1) manufactures input, 2) discussions with experts and 3) literature study. Respective menu option has different impact by region.
Impact of Behavioral Change for Electricity Peak Saving

Impact of Behavioral Change by the Residential Consumers

### Questionnaire results: Electricity savings activities (Winter)

**Hokkaido**
- **Summer**
  - Peak Hours: 16:00
  - Total Peak Demand (MW): 4,340
  - Maximum Peak Savings: 5.7% (246 MW)
  - Possible Peak Savings: 3.3% (144 MW)
  - Emergency Peak Savings: 0.5% (5 MW)

- **Middle**
  - Peak Hours: 18:00
  - Total Peak Demand (MW): 3,710
  - Maximum Peak Savings: 9.8% (365 MW)
  - Possible Peak Savings: 5.7% (210 MW)
  - Emergency Peak Savings: 0.7% (7 MW)

- **Winter**
  - Peak Hours: 9:00
  - Total Peak Demand (MW): 5,230
  - Maximum Peak Savings: 5.1% (266 MW)
  - Possible Peak Savings: 3.1% (162 MW)
  - Emergency Peak Savings: 0.2% (11 MW)

**Kanto**
- **Summer**
  - Peak Hours: 14:00
  - Total Peak Demand (MW): 54,480
  - Maximum Peak Savings: 3.7% (2,042 MW)
  - Possible Peak Savings: 2.2% (1,194 MW)
  - Emergency Peak Savings: 0.4% (228 MW)

- **Middle**
  - Peak Hours: 14:00
  - Total Peak Demand (MW): 35,170
  - Maximum Peak Savings: 4.8% (1,680 MW)
  - Possible Peak Savings: 3.0% (1,055 MW)
  - Emergency Peak Savings: 0.5% (172 MW)

- **Winter**
  - Peak Hours: 17:00
  - Total Peak Demand (MW): 49,450
  - Maximum Peak Savings: 6.1% (3,000 MW)
  - Possible Peak Savings: 4.0% (1,966 MW)
  - Emergency Peak Savings: 0.5% (255 MW)

### Questionnaire results: Willingness to cope with the emergency requests (Winter)

**Question list**

1. AC - filter clean up
2. AC - temperature setting
3. AC - with blind use
4. AC - shorter operation
5. Electric carpet - smaller floor space
7. Electric carpet - shorter operation
8. Electric carpet - lower frequency
10. Kotatsu - shorter operation
11. Kotatsu - lower frequency
12. Dishwasher - lower temp.
13. Shower - economize hot water use
14. Bath - sequential use
15. TV - EE mode
16. TV - switch off when not use
17. TV - plug off when not use
18. Refrigerator - minimize open/close
20. Refrigerator - not put too much stuff
21. Light - switch off unnecessary ones
22. Light - lower luminance
23. Toilet - EE mode
24. Toilet - close the lid when not in use
25. Toilet - lower temp setting
26. PC - eco mode operation
27. PC - turn off when not use
28. Modem/Router - turn off when not use
29. Washing machine - implement at once
30. Dryer - shorter time
31. Rice cooker - not use keep warm mode
32. Electric water boiler - plug off when not use
33. Dishwasher - implement at once
34. Dishwasher - shorter time
35. Vacuum cleaner - EE mode

Source: The Institute of Energy Economics, Japan (2020)
Information Diffusion/Consumers’ Awareness

Contents Shown at Digital Signage

Digital Signage

Response: Behavioral Impact of Digital Signage

- Digital signage on facilitating EE behavior change – should be located at places that consumers can see on everyday basis. In addition, information should be combined with other essential information such as weather or earthquake. Use of SNS and push notifications will facilitate consumers’ behavioral change.

Source: Dentsu Corp. (2020)
Key Messages

• A list of options for “Setsuden” - behavioral change for electricity peak savings - should be prepared based on local characteristics and good understanding over how appliances/technologies are utilized.

• Appropriate method of information provision should be tailored to meet regional characteristics.

• Estimation of potential for “Setsuden” – electricity savings at the demand side - can benefit the supply side as it can avoid unnecessary investment at generation, transmission, and distribution.

• The purposes of listing-up options for behavioral change involve 1) emergency preparedness, and 2) load leveling for economic purpose – both offer significant impacts on CO₂ emissions reduction.