KEPCO's approach to energy saving and carbon reduction

Kenji Morimoto

The KANSAI Electric Power Co., Inc.

[KEPCO]
Contents

1. Actions taken on the demand side

2. Summary
Long-Term Growth Strategy 2030

Best partner for energy and life

Main player in the low carbon society

Pioneer in the stable supply of next-generation energy

Expand service lineup and global contribution

Pursuit best solutions

Rock-solid business base

Firm values
Strategy Toward the Realization of a Low Carbon Society

Promoting energy saving and carbon reduction through both:

a) carbon reduction on the supply side by promoting nuclear power generation and streamlining power plants.

b) enhancement of energy efficiency on the demand side by disseminating highly efficient devices and promoting electrification.

Kansai e-Eco strategy

- generating
  - accelerating carbon reduction
  - utilizing nuclear power generation
  - streamlining thermal power plants
  - maintaining and expanding hydro power generation
  - proactive purchasing new energies

- transmitting
  - constructing Kepco’s smart grid
  - sophistication distribution system
  - solar power generation output forecast technology
  - development of supply-demand control technology using rechargeable batteries
  - visualization of energy

- using
  - contribute to energy saving, cost reduction and carbon reduction for our customers and society
  - promoting dissemination of heat pump and other highly efficient devices
  - advancing energy saving and carbon reduction activities in our corporate activities
  - expanding spread of electric vehicles
  - advancing energy saving and carbon reduction activities in our corporate activities
Deployment of actions on both supply and demand sides toward the realization of a low carbon society

**Supply side**
- Ever more efficient and lower carbon grid power
  (Expansion of use of renewable energy, etc.)

**Demand side**
- Energy saving through dissemination of highly efficient devices and electrification
  (heat pump, electric vehicle, etc.)

making combined efforts of the government and the private sector

**Toward the realization of a low carbon society**
While power demand has been consistently expanding, we have steadily developed power sources.

Trend in power demand and development of power sources [Kepco (1)]

Supply capacity (unit: 10 MW)

Trend of the maximum power and supply capacity

- Others (To purchase from other companies, etc.)
- Thermal power
- Nuclear power
- Hydro power
- Max. power
Power resource development has been carried out keeping in mind well-balanced power resource composition.

Trend of electric energy generation

- Others (To purchase from other companies and new energy)
- Thermal power
- Nuclear power
- Hydro power
Aiming at non-fossil fuel power generation that accounts for 60% of all, however, the situation remains opaque due to the Great East Japan Earthquake.

Trend of power resource composition ratio (on the basis of power generation amount)

Non-fossil fuel power ratio, aiming at 60% in 2020

Best mix based primarily on nuclear power
Outline of measures to reduce CO$_2$ emission

Electric power supply side
- Expansion of use of non-fossil fuel energy
- Enhancement of electric power equipment

Electric power demand side
- Energy saving
- Equalization of electric load

International action
- Greenhouse effect gas reduction project

Research and development
- Development of greenhouse effect gas reduction technology

- Expansion of introduction of nuclear power generation, and enhancement of utilization ratio of nuclear power generation
- Development and dissemination of renewable energy
- Enhancement of efficiency of thermal power generation
- Development and dissemination of highly efficient and energy saving devices
- PR activities for provision of information on energy saving
- Use of renewable energy and unused energy
- Promotion of the use of a heat storage system
- Utilization of Kyoto mechanism
- Expansion of CO$_2$ sinks
- Development of heat pump technology, etc.
1. Actions taken on the demand side
Performing energy saving PR activities toward customers in the household through various tools and opportunities

Customers in the household

<table>
<thead>
<tr>
<th>Summer energy saving PR on the back of a meter reading slip</th>
</tr>
</thead>
<tbody>
<tr>
<td>❖ Running summer energy saving PR on the back of a meter reading slip every July</td>
</tr>
</tbody>
</table>

*<Back of a meter reading slip>*

Posting our URL to guide customers to our energy saving homepage

<table>
<thead>
<tr>
<th>“Guidance for electricity”</th>
</tr>
</thead>
<tbody>
<tr>
<td>❖ Sent on the occasion of change of the contract</td>
</tr>
<tr>
<td>❖ Utilized as a consulting tool</td>
</tr>
</tbody>
</table>

*<Guidance for electricity>*

• In addition, cooperation is performed with the Energy Conservation Center through participating in their activities such as energy conservation events, and women and consumer groups, etc. through running summer energy saving advertisements in their newspapers and booklets.
**Major actions taken for the energy saving campaign 2**

**Performing energy saving PR in addition to everyday individual consulting activities**

**Corporate customers**

<table>
<thead>
<tr>
<th>e-Solution, energy saving information (on Website)</th>
</tr>
</thead>
<tbody>
<tr>
<td>❖ Posting energy saving information in the e-solution site</td>
</tr>
<tr>
<td>❖ Sending a mail magazine to e-solution site members</td>
</tr>
<tr>
<td>Posting a variety of useful information on energy conservation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PR for efficient use of electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributing leaflets to enhance awareness and effect of efficient use of electricity</td>
</tr>
<tr>
<td>Posting how to use air conditioners, lighting, OA devices, etc. with less energy</td>
</tr>
</tbody>
</table>
Major actions taken for the enhancement of efficiency (Home use)

Providing household customers with a higher added value through proposal of adding such merchandise and service as environment-friendly **solar power generation and electric vehicles** to our **Ecocute**, a home-use **heat pump device**

Utilizing “**air heat**”, which is renewable energy, for hot-water supply

(Both solar power generation and Ecocute utilize solar energy and friendly to environment, therefore the combination of the two is the best mix.)
Major actions taken for the enhancement of efficiency
(Commercial and industrial use)

For corporate customers, recommending highly efficient heat pump devices for commercial-use air-conditioners and water heaters as well as promoting the development and dissemination of highly efficient devices in the industrial area.

[Activity for corporate customers]

<table>
<thead>
<tr>
<th>Air-conditioning domain</th>
<th>Water heating and kitchen domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbo freezer</td>
<td>IH Cooking Heater</td>
</tr>
<tr>
<td>ESCO</td>
<td>Heat pump water heater</td>
</tr>
<tr>
<td>CO2 heat pump hot air generator</td>
<td>CO2 heat pump hot air generator (used for industrial process)</td>
</tr>
</tbody>
</table>

[Example of a device using a heat pump]

- Turbo freezer
- Heat pump water heater
About Heat Pump

Heat pumps uniquely convert unused “ambient heat” into heat of utilizable temperatures, by inputting a very small amount of primary energy without burning fossil fuels as a source of CO2 emissions.

Heat pumps need electricity that is only about one-sixth. Therefore, heat pumps produce heat energy with high efficiency and can dramatically reduce the damage to the environment.

**COP**: Coefficient Of Performance

\[
\text{COP} = \frac{\text{Output energy (kW)}}{\text{Input energy (kW)}} = 6
\]

**Heat cycle**

1. Evaporation
2. Compression
3. Condensation
4. Expansion
5. Cooling
6. Heating

**Diagram**

- Compressing the refrigerant and temperature rises
- Lowering the pressure and temperature drops
- Refrigerant (vapor), Refrigerant (liquid), Heat, Energy that was put into a compressor

**Legend**

- Green: Refrigerant (vapor)
- Blue: Refrigerant (liquid)
- Orange: Heat
- Purple: Energy that was put into a compressor
- Brown: Heat pump
- Yellow: Condensation
- Pink: Expansion
- Red: Compression
- Black: Liquid
- Blue: Vapor
- Yellow: Liquid and Vapor (mixed)
Approach to the enhancement of efficiency of a heat pump

Current status of heat pump technology at home

Heat pump efficiency has almost doubled in the past ten years.

Actions (Examples)

Joint development with manufacturers

CO2 heat pump water heater (Ecocute)

Release in 2001

State-of-the-art model:
Efficiency has risen to as high as an APF of 3.9

CO2 heat pump hot air generator (Eco-sirocco)

Generates high temperature, as high as 120°C, air flow, usable for the drying process

High efficiency hot water heat pump

Enabling concurrent extraction of cold and warm water realizes high efficiency. (Overall COP: 4.5)

APF: Annual Performance Factor
(In the condition of standard mode in Japan)
The introduction of Electric Vehicles for commercial use by Kepco

◆ Kepco’s target of introducing EV

<table>
<thead>
<tr>
<th>Target year</th>
<th>The accumulated total of vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY.2009 – 2012</td>
<td>Approx. 270</td>
</tr>
<tr>
<td>By FY.2020</td>
<td>Approx. 1,500</td>
</tr>
</tbody>
</table>

Hybrid vehicle

Electric Vehicle
Use of non-combustion type heat without burning fossil fuels is the key to the reduction of CO2

Ratio of electric power to fossil fuel in energy consumption

<table>
<thead>
<tr>
<th>Sector</th>
<th>Fossil fuel (Heat)</th>
<th>Electric power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household sector</td>
<td>53%</td>
<td>47%</td>
</tr>
<tr>
<td>Commercial sector</td>
<td>43%</td>
<td>57%</td>
</tr>
<tr>
<td>Industrial sector</td>
<td>77%</td>
<td>23%</td>
</tr>
</tbody>
</table>

Reference: Energy & economy statistics directory, 2010

Examples of heat supply by utilizing unused energy

- **Heat of groundwater**
  - Kepco-Kobe Building (since 2000)
  - Utilizing the heat of groundwater as heat source for air conditioning

- **Heat of river water**
  - Kepco Headquarters Building (since 2005)
  - Utilizing the heat of river water as heat source for air conditioning

- **Heat of sewage water**
  - Accommodating heat with other remote points by utilizing sewage water (pipelines)

In FY2010: Survey of the flow rate and temperature of the sewage water
In FY2012: Demonstration test in Osaka City

Reference: Energy & economy statistics directory, 2010
Examples of an environment-friendly model building

- Eco-frame (preventing summer direct sun from entering)
- Adoption of natural ventilation
- Human sensing light control and luminance control
- Combined use of overall air-conditioning and individually adjustable air-conditioning
- Adoption of high performance windows and solar power generators

[Outline of the building]
Main application: Office
Floor space: 106,000 m²
41 stories above the ground, 5 stories under the ground
Height: Approx. 195 m

Energy saving rate: p 36%

Amount of CO₂ emission is approx. 40 kg-CO₂/m²
⇒ Less than half compared to an ordinary office building
<table>
<thead>
<tr>
<th>Name</th>
<th>Outline of the system</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-stage pricing system</td>
<td>ô Establishment of a three-stage classified pricing system according to the consumption amount</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 1st stage: Corresponds to the consumption amount of daily necessities, relatively low in price</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 2nd stage: Price approximately equal to the average cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 3rd stage: Relatively high price reflecting the tendency of rise of cost and promotion of energy saving</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ô Has been adopted since 1974.</td>
<td>[Graphical representation of electricity unit price]</td>
</tr>
</tbody>
</table>
## Price menu in the regulated domain (Hour dependent electric light)

<table>
<thead>
<tr>
<th>Name</th>
<th>Outline of the system</th>
<th>Image</th>
</tr>
</thead>
</table>
| **Hour dependent electric light** | - Establishment of **day and night dependent price**  
  - In order to **shift the load from day to night**, a relatively **high** price is set for **daytime** (7:00 to 23:00) and a relatively **low** price for **nighttime** (23:00 to 7:00).  
  - Has been adopted since **1990**.                                                                                                                                                                               | [Graphical representation of daytime and nighttime]  
  [Graphical representation of electricity unit price] |
### Price menu in the regulated domain
**Season and hour dependent electric light**

<table>
<thead>
<tr>
<th>Name</th>
<th>Outline of the system</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment of season and hour dependent price</td>
<td></td>
<td>![Graphical representation of daytime and nighttime]</td>
</tr>
<tr>
<td></td>
<td>In order to shift the load from daytime to nighttime and living hours, a relatively high price is set for daytime (10:00 to 17:00, summer time, varies depending on a season) and a relatively low price for nighttime (23:00 to 7:00) and living time (hours other than daytime and nighttime).</td>
<td>![Graphical representation of electricity unit price]</td>
</tr>
<tr>
<td></td>
<td>Has been adopted since 2000.</td>
<td>![Still higher in the summer daytime]</td>
</tr>
</tbody>
</table>
### Season and hour dependent electric power

**For commercial use** (January 1996)
**For industrial use** (January 1988)

In order to shift the load from heavy load hour (summer time: 10:00 to 17:00) to daytime & nighttime, the electricity rate for daytime (8:00 to 22:00) is set lower than that for heavy load hour and a still lower rate for nighttime (22:00 to 8:00) than that for daytime while a relatively high electricity rate is set for the heavy load hour.

### Outline of price menu in the deregulated domain

(Season and hour dependent electric power)

<table>
<thead>
<tr>
<th>Name</th>
<th>Outline of the system</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For commercial use</strong></td>
<td>In order to shift the load from heavy load hour (summer time: 10:00 to 17:00) to</td>
<td>&lt;Division of hour&gt;</td>
</tr>
<tr>
<td>(January 1996)</td>
<td>daytime &amp; nighttime, the electricity rate for daytime (8:00 to 22:00) is set lower</td>
<td><img src="image" alt="Division of hour" /></td>
</tr>
<tr>
<td><strong>For industrial use</strong></td>
<td>than that for heavy load hour and a still lower rate for nighttime (22:00 to 8:00)</td>
<td><img src="image" alt="Graphical representation of electricity unit price" /></td>
</tr>
<tr>
<td>(January 1988)</td>
<td>than that for daytime while a relatively high electricity rate is set for the heavy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>load hour.</td>
<td></td>
</tr>
</tbody>
</table>
Approach to the restriction of demand
(Hour dependent price menu)

Annual load rate tends to improve after introduction of an hour dependent price menu.

Transition of annual load rate and the number of hour dependent price menu contracts

Load rate denotes an index representing how use of electricity depends on season and hour.

Annual load rate = \frac{\text{Annual averaged electric power}}{\text{Maximum electric power in a year}} \times 100 \%
Kepco tries to introduce Smart Meter for improvement in customer service and streamlining business management.

Electricity charges are calculated by remotely-read meter readings (every thirty minutes).

Transmitted by charge-free wireless bucket-brigade system to the intensive unit.

Unit type meter

- Communication unit • Transmits reading data.
- Measuring unit • “Safe” and “effective” replacement free from power failure is allowed.
- Opening/closing unit • Switching stop/release of supply

○ The size allows comfortable fit into the installing space of the conventional meter.
○ Replacement of each unit as necessary is allowed.

As for customers being introduced Smart meter, hourly electrical usages are displayed graphically on the next day.

"Hapi-e Miruden", service offering information on use of electric power
For [1] Realization of offering meter-reading notifying service without posting at site and [2] Support for customers’ power-saving activity by visualizing actual records of electricity usage, “Electrical Usage Notifying Service” is provided with using the new meter-reading system.

Electrical usage and amount billed in the current month are displayed.

Weather and the minimum and maximum temperatures of the current day are displayed in a calendar.

Electrical usages in the past 15 months are graphically displayed.
“Simulation of energy saving and CO2 reduction” content started in 2010 in addition to the “Electrical usage notifying service”, which enables the simulation of the effect on the reduction of heating and lighting cost and CO2 emission when currently used home electric appliances such as air-conditioners and refrigerators are replaced by the up-to-date models.

(1) Input of customers' basic information

Comparison among equivalent households
Provision of information on the simulation of energy saving and CO2 reduction [2]

(2) Display screen showing comparison and ranking among equivalent households in terms of the current heating and lighting cost and CO2 emission

- Heating and lighting cost
- CO2 emission
(3) Registration of the appliances now you are using
(4) Heating and lighting cost and CO2 emission ranking display screen when the currently used appliances are replaced by the up-to-date models.

Saving 5,000 yen/year (5,500 US $)
The contents containing the information on the “energy saving ideas” that can be easily carried out at home is now being posted in our homepage.

The contents will make you understand the energy saving ideas that will be helpful for the various living scenes.

Example of air conditioning
Click on “Select the type of energy saving.”
The execution of it displays “Gained eco-points.” (5 points gained)
Ticking “Disconnect plugs in the off-season” gives you one eco-point.
(6 points in total)
Ticking “Circulate the air by using an electric fan” gives you three eco-points. (9 points in total)
Ticking “Set the room temperature to 28°C on the air-conditioner” gives you five eco-points. (14 points in total)
Ticking “Lower sensory temperature by devising clothing or types of cloth materials” gives you two eco-points. (16 points in total)
Ticking “Make you feel cool by frequent cleaning” gives you three eco-points. (19 points in total)
Not just up-to-date energy-saving actions also presents “energy-saving tips” from traditional practice in Japan as “Idea Card.”
Challenging and enjoyable while reading cartoons.
Ms. Wangari Muta Maathai

Kenyan women environmental activists. Maathai, won the Nobel Peace Prize in 2004 in recognition of achievements of afforestation activities to the wilderness of Africa, she was the Deputy Minister of Environment of the Republic of Kenya.

What she proposed was that …

“I was impressed during the visit to Japan in 2005 by Japanese. It was "mottainai".

3R + Respect = environmental wasteful
3R: Reduce, Reuse, Recycle
Not only expressed by the word just the 3R environmental activities, Irreplaceable resource for the Earth with respect, "mottainai". Maathai, protect the environment "MOTTAINAI" this beautiful Japanese has been proposed that the spread as a global common language.
Inputting the monthly used amount or price of electricity, gas, city water, gasoline, etc. shows the amount of CO2 emission in a household at a glance, and enables you to see their transition graphically. (Including comparison in ranking with other participators)
Display of the input result of the environmental household accounts

<Annual graph: Amount of CO2 emission and price>

<table>
<thead>
<tr>
<th>1月</th>
<th>2月</th>
<th>3月</th>
<th>4月</th>
<th>5月</th>
<th>6月</th>
<th>7月</th>
<th>8月</th>
<th>9月</th>
<th>10月</th>
<th>11月</th>
<th>12月</th>
</tr>
</thead>
<tbody>
<tr>
<td>261.16</td>
<td>220.22</td>
<td>202.69</td>
<td>261.16</td>
<td>220.22</td>
<td>57.66</td>
<td>163.41</td>
<td>116.2</td>
<td>77.22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Less than average

More than average

Average
PR is now being carried out to promote use of our [Environmental household accounts] and [Electrical usage notifying service]
Establishment of an environmental household accounts site, etc. aimed at employees

Set up in the environmental information portal site in 2011
An environment awareness enhancement activity has been conducted since 2008 at primary schools using green curtains for the purpose of enhancing environment awareness of the future generation.

Learning the effect of green curtains

Primary school children planting seedlings

Green curtains covering windows
In order to make school kids interested in energy and environment issues, a next generation education “Kanden e-kids club” is being conducted to 100 children in the service areas of Kepco.

Contents of the education in 2011 (October to March)

- Calling for entries
- Inauguration ceremony (October)
  - Inauguration ceremony and looking around the facilities were conducted at Nanko Power Plant
- Kids ISO 14001 performed (November)
  - Energy saving activity taken at each home
- Experience learning (November)
  - Experiencing tree climbing and a forest creating study at the Expo Park
- Facilities observation tour (December)
  - Tour of observing the recycle facilities by making use of winter holidays
- Graduation ceremony (February)
  - A certificate was awarded after looking back on the activities of the past half year

Workbook

In order to make school kids interested in energy and environment issues, a next generation education “Kanden e-kids club” is being conducted to 100 children in the service areas of Kepco.
What is an energy & environment education?

Kepco assists schools in an energy & environment education through “delivery classroom” and “observation tour.”

Kepco is helpful for “an energy & environment education.”

Thinking through data/materials, models, experiments, etc.

Experiential understanding through an observation tour of power plants and PR facilities
Kepco's employees visit schools to explain plainly about energy and global environment issues.

[Feedback from pupils]
- Detailed explanation enabled us to understand the environment issue and the system of a power plant.
- It was wonderful to know how electricity is provided for our houses and how important electricity is.
- Use of a model globe in the experiment helped us to understand the warming mechanism well.

Giving a plain explanation by the use of materials

Understanding global warming through experiments
Aiming at experiential understanding of the role and the method for utilization of energy-related facilities including a power plant.

Map of PR facilities of Kepco

- **Hydro power**
  - Wakasa Takahama ELDOLAND
  - PR Center at Okawachi Power Plant (El-Village)

- **Nuclear power**
  - PR Center at Nanko Power Plant (El-City Nanko)

- **Thermal power**
  - New Energy Park

- **New Energy**
  - PR Center at Hidaka-ko New Energy Park

**Observation tour**
- **PR Center at Hidaka-ko New Energy Park**
- **PR Center at Okawachi Power Plant (El-Village)**
- **Wakasa Takahama ELDOLAND**
- **PR Center at Nanko Power Plant (El-City Nanko)**
PR Center at Okawachi Hydro Power Plant
(El-Village Okawachi)

Main attractions

Village Hall
Information Center
Timber Land

(External view)

(Overall view)
(External view)  (Entrance)

Main attractions

First floor experience zone  Second floor experience zone  Library
Main attractions

- Wonder Tour
- Science Wonder
- Tropical Wonder

PR Center at Takahama Nuclear Power Plant
(Wakasa Takahama ELDOLAND)
Main attractions

Solar Car Circuit (Park facilities)
Methane Hydrate Introduction Area (PR Center)
Small-scale Biomass Power Generation (PR Center)
Environmental Pamphlet

Creating and distributing various type of environmental pamphlets

Kepco Group's CSR Report
A booklet summarizing CSR activities and the state of activity

Kepco Group's Approach to Environmental Issues
A leaflet describing plainly “Progressive approach to environmental issues” in the CSR report

What is good to the earth that we can do
A pamphlet introducing the actions we can take to reduce environmental load centering on the prevention of global warming

Let's look for CO2 together
A pamphlet introducing the activity of the Environmental household accounts “Eco e-life check”

Let's become natural people
A pamphlet introducing an ecological and natural life

Eco-friendly activities all of us can take part in
A pamphlet introducing everyone's eco-friendly activities centering on planting activity
Producing animation DVD’s aimed at a future generation to be used at a delivery class or in the bus on a visit to facilities

<Global environment>
A question of Mako-chan's parrot: What is the global environment?

<Recycling-based society>
What is good to the earth that we can do Recyling-based society which we should learn from Edo Period

Explaining environmental issues such as global warming in the form of animation with a story-like organization

Created in collaboration with Kyoto Seika University (Kyoto International Manga Museum)
2. Summary
Questionnaire on energy saving

Customers want energy saving activity that will not impair comfort or convenience.

¢ Which do you prioritize, environment or comfort / convenience?

Priority placed on environment over comfort/convenience: 9%
Priority placed on a comfort, convenient life over environment: 4%
If environment is compatible with comfort/convenience, a life with environment will be taken into consideration: 87%

¢ Are there anything you do related to energy saving?

No energy saving action is taken at all: 0.1%
No particular action is taken: 7.6%
Something is done occasionally: 45.6%
Something is done habitually: 46.7%

Source: Tepco’s Survey data in December of 2008
GSEP/PPA Energy efficiency improvement Workshop Guam August 20-24, 2012
Example of trial calculation of the amount of energy saved by energy saving efforts

Based on the assumption that the energy saving effect brought about by energy saving efforts is approx. 10% (i.e. comfort / convenience is not significantly impaired)

Examples of energy use at home

**Baseline**

<table>
<thead>
<tr>
<th>Load (a year)</th>
<th>Amount of consumption of primary energy (Amount of energy used)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water heater</strong></td>
<td>17GJ (Efficiency 80%)</td>
</tr>
<tr>
<td><strong>Heater</strong></td>
<td>16GJ (Efficiency 300%)</td>
</tr>
<tr>
<td><strong>Cooler</strong></td>
<td>7GJ (Efficiency 300%)</td>
</tr>
<tr>
<td><strong>Lighting</strong></td>
<td>4GJ</td>
</tr>
<tr>
<td><strong>Home appliances, etc.</strong></td>
<td>14GJ</td>
</tr>
</tbody>
</table>

Total 96GJ (Baseline)

**Energy saved by energy saving efforts**

<table>
<thead>
<tr>
<th>Amount of consumption of primary energy (Amount of energy used)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>City gas</strong></td>
</tr>
<tr>
<td><strong>Kerosene</strong></td>
</tr>
<tr>
<td><strong>Electric power</strong></td>
</tr>
</tbody>
</table>

Total 87GJ (9%)

Examples of energy use at home

<table>
<thead>
<tr>
<th>FF type</th>
<th>City gas</th>
<th>Kerosene</th>
<th>Electric power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>20GJ</strong></td>
<td>21GJ (467 m3)</td>
<td>20GJ (545 L)</td>
<td>55GJ (5,639 kWh)</td>
</tr>
<tr>
<td>FF type</td>
<td><strong>18GJ</strong></td>
<td><strong>17GJ</strong> (Efficiency 80%)</td>
<td><strong>15GJ</strong></td>
</tr>
<tr>
<td>FF type</td>
<td><strong>16GJ</strong> (Efficiency 80%)</td>
<td><strong>15GJ</strong> (Efficiency 80%)</td>
<td><strong>13GJ</strong></td>
</tr>
<tr>
<td>FF type</td>
<td><strong>14GJ</strong> (Efficiency 80%)</td>
<td><strong>13GJ</strong> (Efficiency 80%)</td>
<td><strong>12GJ</strong></td>
</tr>
</tbody>
</table>

Based on the assumption that the energy saving effect brought about by energy saving efforts is approx. 10% (i.e. comfort / convenience is not significantly impaired)
Example of trial calculation of the amount of energy saved by replacement to more highly efficient devices.

Energy saving effect achieved by an energy type-by-energy type control (replacement to more highly efficient devices) is estimated to be approx. 20%.

Baseline

Load (a year)

Replacement to more highly efficient devices

Energy saving achieved by introduction of more highly efficient devices

Amount of consumption of primary energy (Amount of energy used)

City gas

21GJ (467 m3)

(Efficiency 80%)

Water heater 17GJ

Latent heat collection type

(Efficiency 95%)

City gas

18GJ (398 m3)

(545 L)

FF type

20GJ (545 L)

(Efficiency 80%)

16GJ

(3,824 kWh)

14GJ

Highly efficient air-conditioner

(467 m3)

(398 m3)

LED

11GJ

1.6J

14GJ

Kerosene

18GJ (501 L)

Electric power

55GJ (5,639 kWh)

Electric power

37GJ (3,824 kWh)

Total 96GJ (Baseline)

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Amount of consumption of primary energy (Amount of energy used)

City gas

21GJ (467 m3)

Water heater 17GJ

Latent heat collection type

(Efficiency 95%)

City gas

18GJ (398 m3)

FF type

20GJ (545 L)

(Efficiency 80%)

16GJ

17GJ

(501 L)

Highly efficient air-conditioner

(3,824 kWh)

14GJ

14GJ

Kerosene

18GJ (501 L)

Electric power

55GJ (5,639 kWh)

Electric power

37GJ (3,824 kWh)

Total 73GJ (r 24%)

On the assumption of:

• 50% reduction by highly efficient air-conditioners,
• 60% reduction by lighting, and
• 20% reduction by home appliances replacement

Example of trial calculation of the amount of energy saved by replacement to more highly efficient devices:

Energy saving effect achieved by an energy type-by-energy type control (replacement to more highly efficient devices) is estimated to be approx. 20%.

Total 96GJ (Baseline)
Example of trial calculation of the amount of energy saved by the selection of energy type and the replacement to more highly efficient devices

Baseline

Amount of consumption of primary energy (Amount of energy used)

City gas
21GJ (467 m3)

Kerosene
20GJ (545 L)

Electric power
55GJ (5,639 kWh)

Load (a year)

Water heater
17GJ

Heater
16GJ

Cooler
7GJ

Lighting
4GJ

Home appliances, etc.
14GJ

Total 96GJ (Baseline)

Energy saving achieved by [Energy selection + Introduction of highly efficient devices]

Amount of consumption of primary energy (Amount of energy used)

CO2 heat pump water heater “Ecocute” (APF:3.3)

Highly efficient air-conditioner

• On the assumption of:
  • 60% reduction by heating
  • 50% reduction by highly efficient air-conditioners,
  • 60% reduction by lighting,
  • 20% reduction by home appliances replacement

59GJ (6,048 kWh)

Total 59GJ (39%)

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Summary

- Home users, who use small amount of energy, tend to save energy on an **energy type-by-energy type basis**.

  However, **this kind of energy saving effort has a limitation**.

- In order to realize a sizable amount of energy conservation, it is essential to induce the **selection of suitable energies** and introduction of **highly efficient devices** through which the **overall energy consumption amount will be minimized**.
Reference:

Actions taken on the supply side
Outline of measures to reduce CO₂ emission

Electric power supply side

- Expansion of use of non-fossil fuel energy

Enhancement of electric power equipment

- Development and dissemination of renewable energy
- Enhancement of efficiency of thermal power generation

Electric power demand side

- Energy saving

- Equalization of electric load
- PR activities for provision of information on energy saving
- Use of renewable energy and unused energy
- Promotion of the use of a heat storage system

International action

- Greenhouse effect gas reduction project
- Utilization of Kyoto mechanism
- Expansion of CO₂ sinks

Research and development

- Development of greenhouse effect gas reduction technology
- Development of heat pump technology, etc.
Kepco's utilization of biomass

Maizuru coal-fired power generation plant started to use woody pellets of biomass fuel, mixed with coal for power generation in 2008.

Conceptual diagram of mixed combustion of coal and biomass fuel

Outline of Maizuru power plant

<table>
<thead>
<tr>
<th></th>
<th>Rated output power</th>
<th>Date of start of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator No. 1</td>
<td>900 MW</td>
<td>August 2004</td>
</tr>
<tr>
<td>Generator No. 2</td>
<td>900 MW</td>
<td>August 2010</td>
</tr>
</tbody>
</table>
Actions are taken to expand mid- and small-scale hydro power generation through use of river maintaining flow and current equipment.

<table>
<thead>
<tr>
<th>Power generation output</th>
<th>Amount of electric energy generated</th>
<th>Start of operation (Expected date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Okuwanojiri power plant</td>
<td>490 kW</td>
<td>Approx. 3,500 MWh/year</td>
</tr>
<tr>
<td>Shinkuronagi No. 2 power plant</td>
<td>1,900 kW</td>
<td>Approx. 12,000 MWh/year</td>
</tr>
</tbody>
</table>

Power generation plan by the use of river maintaining flow (*) (Okuwanojiri power plant)

(*) River maintaining flow means;
Quantity of water flow discharged to maintain the environment of a river, preservation of the scenery of the downstream of a dam
Commercial operation started in September 2011 at Sakai Solar Power Plant (all sections)

Business operator: Sakai City and Kepco
Installation site: Chikko-Shinmatchi, Nishi-ku, Sakai
Area: Approx. 21 ha
Power generation output: 10 MW
Power generation amount: Approx. 11,000 MWh / year
Place of installation: On the ground
Start of operation: All sections to be operated in September 2011
A large scale solar power plant is planned to be constructed in Wakasa district, Fukui Prefecture.

<table>
<thead>
<tr>
<th>Site location</th>
<th>Wakasa Ohi Solar Power Plant (Tentative name)</th>
<th>Wakasa Takahama Solar Power Plant (Tentative name)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power generation output</td>
<td>Approx. 500 kW</td>
<td>Approx. 500 kW</td>
</tr>
<tr>
<td>Estimated amount of electric energy</td>
<td>Approx. 500 MWh/year</td>
<td>Approx. 500 MWh/year</td>
</tr>
<tr>
<td>Estimated date of completion</td>
<td>FY 2013</td>
<td>FY 2014</td>
</tr>
</tbody>
</table>
Solar power generation output is unstable because of its dependence on the weather. (sunlight, wind condition, etc.)

In September 2011, a study aiming at controlling demand and supply by connecting nickel hydride batteries to the power system was started in the premises of Ishizugawa substation, which is interconnected to Sakai Solar Power Plant.

[Details of the study]
- Study of a demand and supply control system that can respond to the introduction of a large amount of solar energy
- Evaluation of the suitability and life of batteries used for demand and supply control
- Search for suitable battery capacity that can match up with the scale of solar energy

Specifications of the nickel hydride batteries

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of stacks</td>
<td>48</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>576 V</td>
</tr>
<tr>
<td>Rated capacity</td>
<td>177 Ah</td>
</tr>
<tr>
<td>Energy capacity</td>
<td>Approx. 100 kWh</td>
</tr>
<tr>
<td>Output</td>
<td>250 kW*</td>
</tr>
</tbody>
</table>

* Output as a demand and supply system with the inverter interconnected
Kepco's first wind-power plant is now being built.

Perspective of the complete wind-power plant

- Planned project place: Awaji City, Hyogo
- Power generation output: 12 MW (2 MW/windmill x 6) * Tower height: 80.4 m, Rotor diameter: 80 m
- Start of commercial operation: By the end of year 2012 (estimate)
- Annual power generation amount: Approx. 20,000 MWh/year (estimate)
- Amount of electricity use at an ordinary household (equivalent to the electricity use of approximately 55,000 households)
How KEPCO addresses the problem of electric power saving

Kenji Morimoto
The KANSAI Electric Power Co., Inc.

[KEPCO]

Cut
Change
Shift

stable    some severe    severe    very severe

Electric power for industrial use
Electric power for commercial use
Electric power for household use

About 35%
About 40%
About 25%

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1. Last summer's state of supply and demand
2. Important points in promoting electric power saving
3. Power Saving at Home
4. Power Saving at Companies
5. Kepco’s Approach to Power Saving
6. Advantages Acquired by Kepco’s Approach
1. Last summer’s state of supply and demand of electric power
Necessity of reducing peak electric power and saving energy

- Electric power saving and electric load leveling become necessary as measures to lower an electric power peak (kW).

[As a result of the reduction in the electric power supply capability] (due to the earthquake of March 2011)

- The consumption of fossil fuel to supply electric power has increased.
- Economic growth of emerging nations, global warming.

It leads inevitably to an increased effort in saving energy.
Occurrence of a shortfall of the supply capability resulting from the Great East Japan Earthquake

As a result of the damage inflicted to a nuclear power station by the Great East Japan Earthquake, a substantial shortfall in the supply capability in summer occurred.

The government’s request for electric power saving in the service areas of the Tokyo Electric Power Company was a 15% suppression of the maximum electric power for use at the period and time zone in which the peak demand on electric power occurs (*).

* The data for large-scale consumers refers to weekdays from July 1 to September 22.
* The data for small-scale and household consumers refers to the time zone from 9:00 to 20:00 on weekdays from July 1 to September 22.

Itemization of the maximum peak demand in the service area of the Tokyo Electric Power Company last summer

Source: Agency for Natural Resources and Energy, “Saving Electric Power This Summer”
Measures taken to deal with the demand after the Great East Japan Earthquake

1. Large-scale consumers
   (Business operators with contracted electric power of 500 kW or more)
   - Restriction on the use of electric power on the ground of the Electricity Utilities Industry Law
   - They will draw up and implement a program for concrete measures to be taken.

2. Small-scale consumers
   (Business operators with contracted electric power of less than 500 kW)
   - They will draw up and publicize a voluntary program.
   - The government makes approaches to electric power saving thoroughly known to the public by using “the Standard Format of Electric Power Saving Action Programs”.
   - Implementation of guidance tours on electric power saving or on-site meetings for explanation for small-scale consumers

3. Households
   - Acceleration of electric power saving at home by making the “Menu of Electric Power Saving at Home” thoroughly known to the public and educating the public in electric power saving
(1) Measures for large-scale consumers (Tokyo Electric Power Company)

Consumers with contracted electric power of 500 kW or more are subject to the restriction on the use of electric power on the ground of Section 27 of the Electricity Utilities Industry Law.

Restriction based on Section 27 of the Electric Utilities Industry Law on the maximum electric power that can be used.

Consumers affected by the restriction on use: Large-scale consumers (with contracted electric power of 500 kW or more) in the service areas of Tokyo Electric Power Company.

Period of the restriction on use: July 1 to September 22, 2011 (9:00 to 20:00) for the service areas of the Tokyo Electric Power Company.

Source: Agency for Natural Resources and Energy, Restriction based on Section 27 of the Electric Utilities Industry Law.
(2) Measures for small-scale consumers (in the service areas of the Tokyo Electric Power Company)

Voluntary electric power saving was requested of small-scale consumers with contracted electric power of less than 500 kW.

**Electric power saving action program**
Using a “standard format for an electric power saving action program” covering eight category of business, consumers are kindly requested to plan an electric power saving action program to make an approach to electric power saving voluntarily.

[Standard format for an electric power saving action program]

- Office building
- Retail and wholesale stores
- Food supermarkets
- Medical institutions
- Hotels and Japanese-style inns
- Restaurants
- Schools
- Manufacturing (factories)
- Free entry forms

**Consumers covered**

**High-voltage power receiving consumers**
Contracted electric power: below 500 kW
About 280,000 consumers in the service areas of the Tokyo Electric Power Company.
Examples: Supermarkets, middle-sized factories, and

**Low-voltage power receiving consumers**
Business operators in the service areas of the Tokyo Electric Power Company.
About 3.5 million consumers
Examples: Stores, restaurants, and the like

Planning an electric power saving program with the assistance of qualified electrical engineers with license on guidance tour

Holding explanation meetings
Participants draw up their own electric power saving programs.

- The electric power saving action program you have made is publicized on “setsuden.go.jp”, the Japanese government’s portal site for electric power saving.
- An “Electric Power Saving Declaration Sticker” is given to a consumer business that has kindly publicized its action program, to be shown in its office room or elsewhere.

Source: Documents from Setsuden Support Office
### (3) Household electric power saving measures (in the service areas of the Tokyo Electric Power Company)

**Making a household electric power saving menu and making it thoroughly known to the public**

<table>
<thead>
<tr>
<th>Household electric power saving measures (in the service areas of the Tokyo Electric Power Company)</th>
</tr>
</thead>
<tbody>
<tr>
<td>① 室温28℃を心がけましょう。</td>
</tr>
<tr>
<td>“すすや”や“よし”などで夏からの日差しを和らげましょう（エアコンの節電になります）。</td>
</tr>
<tr>
<td>② 無理のない範囲でエアコンを消して、扇風機を使いましょう。</td>
</tr>
<tr>
<td>③ お風呂の温度を28℃にしておきましょう。</td>
</tr>
<tr>
<td>④ 冷蔵庫の設定を「強」から「中」に変え、要する時間をできるだけ減らし、食品をつめこまないようにしましょう。</td>
</tr>
<tr>
<td>⑤ 日中は照明を消して、夜間も照明をできるだけ減らしましょう。</td>
</tr>
<tr>
<td>⑥ 予約モデルで設定するとともに画面の輝度を下げ、必要な時以外は消しましょう。</td>
</tr>
<tr>
<td>⑦ 便座保冷・温水のオフ機能、タイマー節電機能があれば、これらを利用しましょう。</td>
</tr>
<tr>
<td>⑧ 上記の機能がなければコンセントからプラグを抜いておきましょう。</td>
</tr>
<tr>
<td>⑨ 早朝にタイマー機能で1日分まとめて炊いて、冷蔵庫に保存しましょう。</td>
</tr>
<tr>
<td>⑩ リモコンの電源ではなく、本体の主電源を切りましょう。長時間使わない機器はコンセントからプラグを抜いておきましょう。</td>
</tr>
</tbody>
</table>

Source: Agency for Natural Resources and Energy, “Menu of Household Electric Power Saving Measures”

- Always try a 28 degree room temperature.
- Turn off the air conditioner, and use a fan.
Occurrence of a shortfall of the supply capability resulting from the Great East Japan Earthquake (in the Kansai)

With nuclear power generation not allowed to go into operation again in the service areas of the Kansai (except for 2 plants), a shortfall in the supply capability occurred, and Kepco also requested the customers to save electric energy.

Maximum power in last August
(in the case of fierce heat as that of the previous year)

Supply capability in last August

Supply capability: 29.38 million kW
Demand: 31.38 million kW

Five-percent reserve rate necessary for stable supply of electric power

About 11%

The demand that a supply capability of 29.38 million kW can meet

<Period/time zone for which electric power saving is requested in last August>
1. Period: Weekdays between July 1 and September 22
2. Time zone: 9:00 to 20:00
   Electric power saving is requested of household consumers, between 13:00 and 16:00, in particular.
3. Target of electric power saving: About 15%
Features of the electric power demand in the service areas of the Kansai Electric Power Company

The maximum power in the service areas of the Kansai in 2010 was 30.95 million kW. A slightly higher weight of the industrial sector is a feature in the ratios of electric power consumption of the industrial, commercial, and household sectors.
2. Important points in promoting electric power saving
Electric power (expressed in kW) means force of electricity to do work and expressed as the product of current and voltage. Electric energy (expressed in kWh) is the product of electric power and the time during which electric power is used.
What is the electric power saving that is desired?

Two actions as means of electric power saving: “cut” and “shift”
What is “cut”?  

“Cut” is so-called “eliminating the use electric power,” being called peak cut because peak demand for electric power is restrained.

Cut  
Electric power saving during a designated time zone by means of **elimination of wasteful use**, **interruption of use of facilities**  
**Reduction** in fixed electric power  
Equipment **efficiency increase**

Source: Agency for Natural Resources and Energy, “Saving Electric Power This Summer”

Maximum electric power used [%]

- 15% restriction
- Electric power saving during the daytime
- Peak period and time zone 9:00 to 20:00 on weekdays from July to September
- Elimination of fixed electric power

Source: Agency for Natural Resources and Energy, “Saving Electric Power This Summer”
What is “shift”? 

“Shift” means shifting the use of electric power in terms of space or time, namely, shifting the peak demand.

- Shift in space
  - Shift of production from the Kanto to the Kansai region
  - Restraint scheme held jointly by consumers

- Shift in time
  - Shift in the demand time
  - Shift on an hour/day basis
  - Shift from simultaneous start to sequential start of facilities and equipment
  - Dispersal of lunch recess time zones
  - Holiday shifting
    - Operations under a rotation system such as shifting in the operation time depending on departments or processes
    - Re-examination and dispersal of periodical servicing periods for plants

[example]
Flow of practicing electric power saving [1]

1. Grasp the actual state of use of electric power.
   - Grasp the maximum electric power used and other data in the previous fiscal year.

2. Find available electric power saving measures and draw up a program.
   - Draw up an electric power saving program.

3. Implement the program.
   - Implement the program according to the plan on a participation-by-all basis.

4. Verify the program.
   - Examine the maximum electric power used, both during the practice and after the practice.
(1) Grasp the actual condition.

✔ To save electric power in a proper way, grasping how you use electric power first is important.

<Examples of Information on Your Electricity Use>

<table>
<thead>
<tr>
<th>High-voltage power receiving consumers</th>
<th>Low-voltage power receiving consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum electric power of last year</td>
<td>Electricity usage of last year</td>
</tr>
</tbody>
</table>
(2) Find available electric power saving measures, draw up a program and practice it.

✔ On the basis of how your company uses electric power actually, examine electric power saving measures from the viewpoint both of “cut” and of “shift.”

✔ When you have not grasped an itemization of use of electric power for your company, refer to the standard electric power saving action menus on a business-category basis described later for a help in drawing up your program.

✔ Eliminating fixed electric power use leads to the reduction in electric power in the peak hours.
(4) Verification

🌟 It is absolutely necessary to grasp the track records of results of the program you have implemented and to make the results known to all those involved. It is also important to have the track records in terms not only of quantities but also of amounts of money.

🌟 Approaches to the urgent need of electric power saving should not be ended in temporary actions. They can be a motive for all employees to be energy-preservation-minded or to promote energy conservation activities.
3. Power Saving at Home
A weekday’s power consumption during summer

Please cooperate to save electricity during the peak hours.

Reduce electricity intensively from 13:00 till around 16:00!

Reduce electricity from 9:00 till 20:00!
Power consumption per household (average of households when families are at home)

Even when family members are out, electricity is used for fridge, warm water washing toilet seat, standby power, etc.

Electrical Appliances Requiring Power Saving (1)

- Standby power
- Warm water washing toilet seat
- Personal computer
- Lighting equipment
- TV
- Fridge
- Air conditioner

Source: Agency for Natural Resources and Energy
<Power consumption per household by electrical appliance (average of all households)>

Source: Agency for Natural Resources and Energy
Ways to Save Electricity

Three ways to save electricity

Cut : Cut power consumption.

Shift : Shift time to use electricity.

Change : Change to other methods.
High-efficiency heat pump water heater, which has spread since 2001, the effect of power demand during the daytime shift to nighttime zone are coming out. This is a good example of a “shift”.

Heat pump water heater, boil the required amount of hot water during the nighttime, the hot water holding tank to reservoir.
<Check electrical appliances in living room/bed room.>

Source: Survey by the Agency for Natural Resources and Energy
Home appliances with high levels of power consumption (2)

<Check sanitary electrical appliances.>

<table>
<thead>
<tr>
<th>Sanitary</th>
<th>0W</th>
<th>200W</th>
<th>400W</th>
<th>600W</th>
<th>800W</th>
<th>1000W</th>
<th>1200W</th>
<th>1400W</th>
<th>5600W</th>
<th>5800W</th>
</tr>
</thead>
<tbody>
<tr>
<td>When using a warm water washing</td>
<td></td>
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<tr>
<td>toilet seat (pre-heated reservoir</td>
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<td></td>
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<td>type)</td>
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<tr>
<td>When using a warm water washing</td>
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<tr>
<td>toilet seat (instant heating type)</td>
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<td></td>
<td></td>
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<tr>
<td>Dryer</td>
<td></td>
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<tr>
<td>Washer</td>
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<tr>
<td>Washer/dryer</td>
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<tr>
<td>Vacuum cleaner</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom dryer (electric)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Iron</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Bathroom dryer

a warm water washing toilet seat

Source: Survey by the Agency for Natural Resources and Energy

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<Check electrical appliances in kitchen.>

<table>
<thead>
<tr>
<th>Kitchen</th>
<th>0W</th>
<th>200W</th>
<th>400W</th>
<th>600W</th>
<th>800W</th>
<th>1000W</th>
<th>1200W</th>
<th>1400W</th>
<th>5600W</th>
<th>5800W</th>
</tr>
</thead>
<tbody>
<tr>
<td>IH cooking heater (3 heaters)</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Fridge</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Microwave</td>
<td></td>
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</tr>
<tr>
<td>Rice cooker (electric)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Electric pot (at the time of boiling)</td>
<td></td>
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</tr>
<tr>
<td>Toaster oven</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dishwasher/dryer</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Source: Agency for Natural Resources and Energy

IH cooking heater (3 heaters)
I Living room/bed room

Air conditioner

Set room temperature to 28°C. (Parallel use of fan makes you feel cool.)

Use bamboo blind or reed screen to absorb sunlight entering through the window. (It helps to reduce cooling energy consumption.)

Clean filters periodically (roughly every other week).

Turn off air conditioner and use electric fan to a reasonable extent. (50% reduction)

Be careful about heat stroke inside the house.

Source: Survey by the Agency for Natural Resources and Energy
## Living room/bedroom

### Lighting equipment
- Keep lights turned off during the daytime, and minimize the lights turned on even at night.
  - 5% reduction
- Change incandescent light bulbs to bulb-type fluorescent lamps or LED bulbs.

### TV
- Have Power Save mode turned on, set the brightness to a lower level and turn TV off when not necessary.
  - 2% reduction

### Standby power
- Turn off the main power supply, not the switch on remote controller.
  - 2% reduction
- Unplug from outlet when not in use for a long period of time.

---

Tap with switches

Source: Survey by the Agency for Natural Resources and Energy
## Sanitary

### Warm water washing toilet seat (heated toilet seat)

- Make full use of OFF function of heated toilet seat/warm water supply, as well as a timer for Power Save mode.
- If the above functions are not available, unplug it from outlet.

### Dryer

- Avoid using from 09:00 till 20:00.

### Washer/dryer

- Do the laundry in a lump avoiding from 09:00 till 20:00.
- Refrain from the use of drying function and dry the laundry in the sun.

### Vacuum cleaner

- Avoid using from 09:00 till 20:00.
- Change paper pack frequently (in the case of paper pack-type cleaner).

Source: Agency for Natural Resources and Energy

---

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I Kitchen

Fridge
- Change the temperature setting from “Max” to “Medium,” reduce the time of opening the door as much as possible, and be careful not to cram food too much.

Rice cooker (electric)
- Cook rice for the whole day by setting a timer to work in early morning, and store it in the fridge.

Microwave
- Turn off air conditioner or other devices when using microwave. Don’t use them together.

Electric pot
- Don’t use keep-warm function for a long period of time.

Source: Agency for Natural Resources and Energy
I | Summary of Power Saving Menu

### Air conditioner
- Set room temperature to 28°C. (Parallel use of fan makes you feel cool.)
- Use bamboo blind or reed screen to absorb sunlight entering through the window. (It helps reduce cooling energy consumption.)
- Turn off air conditioner and use electric fan to a reasonable extent.

### Lighting equipment
- Keep lights turned off during the daytime, and minimize the lights turned on even at night.

### TV
- Have Power Save mode turned on, set the brightness to a lower level and turn TV off when not necessary.

### Standby power
- Turn off the main power supply, not the switch on remote controller.
- Unplug from outlet when not in use for a long period of time.

### Warm water washing toilet seat
- Make full use of OFF function of heated toilet seat/warm water supply, as well as a timer for Power Save mode.
- If the above functions are not available, unplug it from outlet.

### Fridge
- Change the temperature setting from “Max” to “Medium,” reduce the time of opening the door as much as possible, and be careful not to cram food too much.

### Rice cooker
- Cook rice for the whole day by setting a timer to work in early morning, and store it in the fridge.

### Total menus checked
- % reduction

15%
I Save energy, but don’t overdo it.

Be careful of heat stroke inside the house.

(Save energy to a reasonable extent.)

• Don’t restrain yourself so much, and avoid heat with the use of air conditioner, fan or bamboo blind.
• Devise clothing. Wear cool clothes.
• Drink water frequently.
• Take extra caution on a day it gets hot suddenly, such as the interval or the end of the rainy season.

Source: “Let’s review how we use electricity.” Tokyo Metropolitan Government, Tokyo Metropolitan Center for Climate Change Actions and Energy Conservation Center
I. Example of standby power consumption

**Electricity is consumed for maintaining functions.**
For memory, built-in clock and monitor display

**Electricity is consumed while waiting for input**
This may be applicable when the main power supply is OFF, as well as ON, waiting for input by remote controller or to operate functions.

**Electricity is consumed while just being connected.**
Some appliances consume a bit of power by just connecting to an outlet.
Standby Power Consumption (2)

<Standby power consumption per household>

Total power consumption per household
4,734kWh/year

94.0%
Power consumption by the use of electric appliances

6.0%
Standby power consumption per household 285kWh/year

Breakdown of 6.0%

- Gas water heater: 20%
- Cooling & heating air conditioner: 9%
- Telephone (excluding cell phones): 9%
- HDD&DVD player/DVD player: 6%
- Warm water washing toilet seat: 5%
- VCR: Videocassette recorder: 4%
- PC: 4%
- Oil water heater: 4%
- Integrated audio system: 3%
- TV: 3%
- Others: 33%

VCR: Videocassette recorder
Effects of reducing standby power consumption

**STEP 1**
° Using Power Save mode of appliances reduces approx. 8%.

**STEP 2**
° Turning off the main power supply when not in use reduces approx. 23%.

**STEP 3**
° Plugging off the appliances, if there will be no functional problems by doing so, when not in use reduces approx. 40%.
Today’s air conditioners save energy by approx. 14% compared to 10 years ago.

- **Energy-saving performance**
  (period power consumption)

<table>
<thead>
<tr>
<th>Year</th>
<th>Power Consumption (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1,017</td>
</tr>
<tr>
<td>2010</td>
<td>872</td>
</tr>
</tbody>
</table>

Source: Agency for Natural Resources and Energy “Energy Conservation Performance Catalogue”
Today’s fridges save energy by approx. 60% compared to 10 years ago.

- **Energy-saving performance**
  (Annual power consumption)

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption (kWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>690 to 770</td>
</tr>
<tr>
<td>2010</td>
<td>260 to 290</td>
</tr>
</tbody>
</table>

Source: Agency for Natural Resources and Energy “Energy Conservation Performance Catalogue”
Today’s LCD TVs save energy by approx. 64% compared to CRT TVs.

About 64%

**Energy-saving performance**
(Annual power consumption)

<table>
<thead>
<tr>
<th>Year</th>
<th>Type</th>
<th>Power Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>32” CRT TV</td>
<td>225 kWh/year</td>
</tr>
<tr>
<td>2010</td>
<td>32V Flat screen TV</td>
<td>81 kWh/year</td>
</tr>
</tbody>
</table>

Source: Agency for Natural Resources and Energy “Energy Conservation Performance Catalogue”
Bulb-type LED lamps save energy by approx. 80% compared to conventional electric bulb.

- Comparison of power consumption

<table>
<thead>
<tr>
<th>Conventional bulb (60 W)</th>
<th>54 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulb-type LED lamp</td>
<td>About 10 W</td>
</tr>
<tr>
<td>(Conventional bulb-type approx. 10 W)</td>
<td></td>
</tr>
</tbody>
</table>
I. What does the unified energy-saving label mean?

**Energy-Saving Label**
(Energy-Saving Labeling System)
Manufacturers indicate energy-saving performance of their own products.

**Estimated annual electricity bill**
Electricity bill is calculated as 22 yen per 1kWh (tax inclusive) based on the estimated electricity unit price.

Multistage assessment (criteria)
Energy-saving performance of the product is indicated using a five-star system.

New Standard mark is indicated when the standards have been changed.
Applicable year of the contents of this label is indicated.

Indicated for non-flon fridges only.

How you should choose good products?
Those having many marks
Those having a green e-mark of the energy-saving label
Those indicating an inexpensive estimated electricity bill

Source: “Aha! Unified Energy-saving Label” Agency for Natural Resources and Energy
I Energy-saving product replacement navigation system “Shinkyu-san”

Better consider, smart choice

Using the product

How to choose product
I Power/energy-saving lifestyle (examples)

• Make more time for the whole family to get together and enjoy.

• Have meals as a family.

• Change from a late-night person to a morning person.
Examples of power/energy saving lifestyle during the summer season

- Carry around drinks in “my bottle.”
- Go on a trip this summer.
- Going out contributes to energy saving as well.
- Dry your laundry in the sun.
- Check if there is any light too bright.

Source: “Let’s review how we use electricity,” Tokyo Metropolitan Government, Tokyo Metropolitan Center for Climate Change Actions and Energy Conservation Center
In 2000, he joined a leading Internet search company Google. As a software engineer, such as improvement of accuracy involved in the search, have been the director of the department web spam.

What he suggest is that …

Give it a try for 30 days before that wanted to do. But that's just the right length or wearing a new habit, to achieve a small goal that I know that it is to try it 30 days. Small change I'm getting sustainable long-lasting.
4. Power Saving at Companies
Features of Energy Consumption
for Respective Industries

Usage patterns of electric power greatly depend on the types of industries.
(Details of demand at peak hour by small-scale consumers)

Ratio of power consumption by use in average office building

Breakdown of power consumption (at peak hour, around 14:00)

Among varied use applications of electric power, air conditioning, lighting, and office automation equipment (PC, copier, etc.) occupy approx. 88% of entire power consumption. Power-saving measures in these fields will be especially effective.

The government prepares “Standard format for an electric power saving action program” to put forward approach to power saving.

### Enforce five basic actions

<table>
<thead>
<tr>
<th><strong>Lighting</strong></th>
<th>Power-saving effect for entire building</th>
<th>Execution check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce lighting in working area to half.</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Thoroughly switch the light off in non-working areas (conference room, passage way, etc.).</td>
<td>3%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Air conditioning</strong></th>
<th>Power-saving effect for entire building</th>
<th>Execution check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the temperature in the office to 28°C (or slightly higher, taking into consideration environment in the room such as ventilation).</td>
<td>4% (when the temperature is +2°C)</td>
<td></td>
</tr>
<tr>
<td>Stop air conditioning in non-working areas.</td>
<td>2%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Office automation equipment</strong></th>
<th>Power-saving effect for entire building</th>
<th>Execution check</th>
</tr>
</thead>
<tbody>
<tr>
<td>When leaving your seat for a long time, shut off the power supply to office automation equipment, or put it in the standby mode.</td>
<td>3%</td>
<td></td>
</tr>
</tbody>
</table>

### Review the actions below with greater power-saving effect

<table>
<thead>
<tr>
<th><strong>Air conditioning</strong></th>
<th>Power-saving effect for entire building</th>
<th>Execution check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop ventilators for a fixed period within the indoor standard range of CO2, or adjust the amount of open air intake by intermittent running of them.</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Use blind, heat shield film, eaves, bamboo blind, etc. to block solar insolation.</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Set the cold water outlet temperature of a freezer rather higher to reduce the power to a turbo freezer, heat pump, etc. (applicable to the case of the central air conditioning)</td>
<td>2%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Others</strong></th>
<th>Power-saving effect for entire building</th>
<th>Execution check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take turns and shut down with several business operators (when divided into seven groups and have two days off in a week by rotation).</td>
<td>14%</td>
<td></td>
</tr>
</tbody>
</table>

$\text{Office Building [3] Main Power Saving Effects (Lighting)}$

‡ Power-saving Effect by Reduction of Lighting

Power-saving effect expected for entire building when reducing lighting in working area to half

(Effect obtained by reduction of lighting: approx. 10%) + (Influence to air conditioning: approx. 3%) = 13%

Partially reduce lighting

ḍ Illuminance in Office Buildings

(On May 13, 2011, by Electric Power Supply and Demand Task Force)

As for the illuminance in office buildings, promote consumers’ appropriate use of lighting by definitizing and putting forward the lowest limit of JIS Standard illuminance accepted with some amount of latitude by the Ministry of Economy, Trade and Industry.

ý JIS Z9110: 2010 General Rules for Lighting Standard (revised on May 9, 2011)
(Office: Office in the working area)
Recommended illuminance: 750 lx
Illuminance range: 500 to 1000 lx
Features of Power Consumption in Manufacturers

Case example of power consumption ratio for manufacturing use applications

Breakdown of power consumption (peak hour: around 14:00)

- Since production facilities account for major share of power consumption, power-saving measures for production process will be especially effective.
- Power consumption form depends on the production process, delivery date, and required production environment (air conditioning).

n One-Day Power Consumption (on the summer-time peak day)

Daytime operation consumer
(average operation period)

All-day continuous operation consumer
(high operation period)

Main industries: Metal processing, automobile parts manufacture, electric or general machinery manufacture, etc.
Load facilities: Production machinery, electric furnace, air conditioning, lighting, etc.

Main industries: Food processing, electric, semiconductor manufacturer, etc.
Load facilities: Production machinery, air conditioning, lighting, clean room, freezing and refrigerating facilities, etc.


GSEP/PPA Energy efficiency improvement Workshop Guam 20-24, 2012

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The government prepares “Standard format for an electric power saving action program” to put forward approach to power saving

### Power saving menus for production facility

- Thoroughly execute shutting off the power supply to unnecessary or standby electrical facilities or preventing idle running of rotating equipment including motors.
- Enhance the heat insulation of electric furnaces or electric heaters.

<table>
<thead>
<tr>
<th>Power-saving effect for each machinery and facility</th>
<th>Execution check</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td></td>
</tr>
<tr>
<td>7%</td>
<td></td>
</tr>
</tbody>
</table>

### Power saving menus for utility facilities

- Decrease the supply pressure to compressors by reviewing the pressure on the usage side.
- Decrease the air intake temperature of compressor [compensating the room temperature in the installing location and outside temperature].
  (Power-saving effect: When the air intake temperature is decreased by 10°C in a unit)
- Adjust the number of units of compressors, pumps, and fans depending on the load.
  (Power-saving effect: When using the system comprising five compressors and the peak load ranges from 60% to 80%)
- Review the running method of pumps and fans having inverters.
  (Power-saving effect: When the inverter is utilized by checking and adjusting the opening of valves and the total pressure has reached 80%)
- Set the cold water outlet temperature of the freezer rather higher to reduce the power of the turbo freezer and heat pump, etc.
  (Power-saving effect: When the temperature is increased from 7°C to 9°C while checking the status on the usage side)

<table>
<thead>
<tr>
<th>Power-saving effect for each machinery and facility</th>
<th>Execution check</th>
</tr>
</thead>
<tbody>
<tr>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>8%</td>
<td></td>
</tr>
</tbody>
</table>
Remove all the obstacles around the outdoor equipment, and prevent it from direct exposure to sunlight.

In order to decrease the temperature and reduce the load to the condenser, block solar insolation (avoid direct sunlight to the outdoor equipment) by using reed screens for the outdoor equipment of air conditioner to offer full shade.

Power-saving effect of facility

10%
¢ Prevention of motor idling (example)

The conveyor keeps running even after all the products have been conveyed. It keeps running for ten seconds after works have been sent to the next stage. → Timer is improved so that the conveyor stops three seconds after conveying is finished.

Power-saving effect

4,289 kWh reduced a month

Picture: From the convention of excellent examples of power saving
For effective power saving, revision of the promotion system comprising related business operators under the top management is required.

<Key factors for promotion of power saving>

- Executives including company presidents, store managers, and factory managers should top the groups.
- Full participation
- Follow-up conference
- Power-saving patrol
5. Kepco’s Approach to Power Saving
## Approach to Power Saving (Summary)

<table>
<thead>
<tr>
<th>Object</th>
<th>How to Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common</strong></td>
<td>Website</td>
</tr>
<tr>
<td></td>
<td>SNS</td>
</tr>
<tr>
<td></td>
<td>Posters</td>
</tr>
<tr>
<td></td>
<td>Making Banners</td>
</tr>
<tr>
<td></td>
<td>Cooperation with Municipalities</td>
</tr>
<tr>
<td></td>
<td>Implementation of Street PR</td>
</tr>
<tr>
<td><strong>Household</strong></td>
<td>TV Commercial</td>
</tr>
<tr>
<td></td>
<td>Newspaper Ad</td>
</tr>
<tr>
<td></td>
<td>Distribution of Leaflets</td>
</tr>
<tr>
<td></td>
<td>Meter Reading Form</td>
</tr>
<tr>
<td></td>
<td>Challenge for Power Saving by Elementary School Students</td>
</tr>
<tr>
<td><strong>Companies</strong></td>
<td>Visiting for all large-scale consumers</td>
</tr>
<tr>
<td></td>
<td>Sending direct mails for all small-scale consumers</td>
</tr>
<tr>
<td></td>
<td>Main Charge Systems</td>
</tr>
</tbody>
</table>
Ten types of TV commercials will be made for both summer and winter, respectively.
Set temperature to 28°C
Kepco’s TV Commercial of Request for Cooperation in Power Saving (Version of Bamboo Blind)

Use bamboo blind at the window

1. 関西電力から節電のお願い

2. エアコン 53%

3. 関西電力から節電のお願い

4. 関西電力から節電のお願い

5. 熱中症には十分ご注意下さい。

6. 関西電力ホームペー
Don’t put in too much in the refrigerator
Kepco’s TV Commercial of Request for Cooperation in Power Saving (Version of Standby Electricity)

1. Turn off the main switch

2. Pull off the outlet if you don’t use for a long time

3. 関西電力から節電のお願い

4. 関西電力から節電のお願い

5. 関西電力から節電のお願い
Publication of “Request for Power Saving” in Japanese five major newspapers

Request items offered by Kepco

Specific power-saving know-hows

Promotion of utilizing Electricity Forecast

Notice of dedicated dial for power-saving
Distribution of Leaflets

Distribution of leaflets together with meter reading forms for all the customers (12 million cases)

Front:

今夏における節電のお願い

Distribution of Leaflets

(Back):

ご家庭の節電対策チェックシート

Specific power-saving know-hows

Request items offered by Kepco

Menu of household electric power saving measures

Notice of dedicated dial for power-saving
Preparation of Other Documents to be Distributed

Setting leaflets and posters in service offices of Kepco

**<Leaflet> one type**

ご家庭における節電のお願い

平日は弊社事業に対し深くお理解とご協力をお願い、厚くお礼申し上げます。

弊社は現在、電気の供給力確保のため全力で取り組んでおりますが、今夏の電力需給は極めて厳しい見通しです。

弊社は、引き続き、供給力確保に向けて最大限の努力を尽くしてまいりますが、供給力不足による停電を回避するため、お客様におかれましては、節電にご協力いただきますようお願い申し上げます。

本紙では、ご家庭における具体的な節電方法などをご紹介しております。皆さまの取組みのご参考といたしたいと考えております。

ご不便とご迷惑をおかけして誠に申し訳ございません。何卒、ご理解とご協力を賜りますようお願いいたします。

**<Poster to be posted at our service offices> two types**

節電のお願い

今夏の平日の日中において、電力需給が厳しくなるおそれがあります。
皆さまには、ご不便とご迷惑をおかけしますが、節電にご協力いただきますようよろしくお願いいたします。

【エアコン】

設定の設定温度を下げた場合

【冷蔵庫】

設定を「強」から「中」に。頻用は少なく、つめこみ過冷ではご注意。

【テレビ】

省エネモードに設定し画面の輝度を下げないときは電源オフ。

【照明】

電力消費を防ぐため、使用しない時はコンセントからプラグを抜く。

【電気温水器】

使用しない時はコンセントからプラグを抜く。

【浴室・廊下】

外屋の際にも、冷蔵庫や待機電力の対策にご協力をお願いいたします。

他の節電方法につきましては、関西電力ホームページをご覧ください。また、電気取扱事務所までお気軽にお問い合わせください。

●関西電力ホームページ ⇒ http://www.kepc.co.jp/
●節電お問い合わせ専用ダイヤル ⇒ 0120-911-777(通話料無料)

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Asking for Power Saving by Using Meter Reading Form (on Back Side)

Description of request for power saving on the back of meter reading forms for 12 million households

Request for power saving

Power-saving check sheet for households
Degree of power-saving effect can be understood by newly allowing the comparison of electricity usage in the current month to that in the same month a year ago.

<Example of information on electricity usage>
Sending Information on Power Saving by Twitter

Provision of information on demand and supply of electric power by utilizing social network service (SNS).

<Official Twitter Profile>

<Reference: Image of information to be sent>
From last winter, Facebook has been newly added to our information sending tools.

Main contents in Power-saving Facebook page

Ø Wall (board)
  • Electricity Forecast (for the current day and the next day)
    - To be provided at the timing of updating Electricity Forecast (around 8:00 and 18:00 every day)
  • Information on power saving
    - Varied information such as power saving methods and TV commercials related to power saving will be offered.

Ø Request for power saving
  • Introduction of required power-saving period and power-saving hours

Ø Kepco’s approach
  • Introduction of approach to securement of our power supplying capacity

Ø Introduction of power saving methods
  • Introduction of power-saving know-hows for electric appliances by animation
Visualization of Information on Demand and Supply

"Electricity Forecast", service of updating information on daily demand and supply on website

<Last Summer>

本日の予想（7月25日）

<table>
<thead>
<tr>
<th>時台</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>使用電力</td>
<td>2,172万kW</td>
<td>2,900万kW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>使用率(%)</td>
<td>77</td>
<td>81</td>
<td>82</td>
<td>81</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>80</td>
<td>79</td>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>

現在の状況

使用電力：2,172万kW
ピーク時供給力：2,900万kW

使用率：74%

※本日（9時～20時）の1時間ごとの使用電力予想

<Last Winter>

本日の予想（12月XX日）

<table>
<thead>
<tr>
<th>時台</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>使用電力</td>
<td>2,421万kW</td>
<td>2,720万kW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>使用率(%)</td>
<td>77</td>
<td>81</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>77</td>
</tr>
</tbody>
</table>

現在の状況

使用電力：2,421万kW
ピーク時供給力：2,720万kW

使用率：89%

※本日（9時～21時）の1時間ごとの使用電力予想

※本日（9時～21時）の1時間ごとの使用電力予想

電力のご協力いただき、ありがとうございます。
皆さんのご協力により、電気の安否は、比較的余裕のある一日となります。

関西電力の電源設備
（各月の供給力の内訳）

2,210万kW（17時～18時）
2,800万kW

電力に関するお知らせ

供給力が毎日変わる理由
関西電力の電源設備
（各月の供給力の内訳）

※本日（9時～21時）の1時間ごとの使用電力予想

ピーク時供給力
使用率
使用電力
ピーク時供給力
使用電力：2,421万kW
ピーク時供給力：2,720万kW

使用率：89%

電力のご協力いただき、ありがとうございます。
皆さんのご協力により、電気の安否は、比較的余裕のある一日となります。

現在の使用電力状況（12月XX日 XX時台）

使用電力：2,421万kW
ピーク時供給力：2,720万kW

使用率：89%

※電力の使用状況データのダウンロード
使用電力：2,421万kW
ピーク時供給力：2,720万kW

使用率：89%

電力のご協力いただき、ありがとうございます。
皆さんのご協力により、電気の安否は、比較的余裕のある一日となります。

現在の使用電力状況（12月XX日 XX時台）

使用電力：2,421万kW
ピーク時供給力：2,720万kW

使用率：89%

※電力の使用状況データのダウンロード
使用電力：2,421万kW
ピーク時供給力：2,720万kW

使用率：89%
Information about the supply capacity

When you click on this “Information about the supply capacity”, you can get information of main power station where stops on the current day.

Click on the "Information about the supply capacity" to get information of main power station where stops on the current day.

**Forecast of demand and supply of electric power for the current day**

<table>
<thead>
<tr>
<th>12月××日 8時 更新</th>
<th>Forecasts maximum electric power</th>
<th>(17時～18時)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.210万kW</td>
<td>2,600万kW</td>
</tr>
</tbody>
</table>

- **Supply capacity at the peak time**
- **Information about the supply capacity**
- **Electric usage**
- **Forecast of highest and lowest temperatures**
  - 電気の使用
  - 温度の予報

**Stable Condition**

電力の供給状況は、以下の通りです。

<table>
<thead>
<tr>
<th>時台</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>使用率(%)</td>
<td>77</td>
<td>81</td>
<td>82</td>
<td>78</td>
<td>81</td>
<td>82</td>
<td>82</td>
<td>82</td>
<td>85</td>
<td>79</td>
<td>77</td>
<td>77</td>
</tr>
</tbody>
</table>

- **Stable Condition**
- **Some severe**
- **Severe**
- **Very severe**

To explain the reason to change the supply capability every day.

To explain the reason to change the supply capability every day.
Electricity Forecast
(Breakdown of supply capacity in each month)

you can easily understand the information of power supply capacity generated by power plants in every month

Click

power supply facilities
Electricity Forecast
(Electricity usage condition of previous day)

you can check the actual record of usage condition of previous day.

Electricity usage condition of yesterday

12月XX日 XX時台

the maximum electric power 2,210万kW
supply capacity 2,800万kW

電力予想

Time zone to ask saving electricity

Electricity usage condition of yesterday

使用率（%）

80 81 85 82 81 82 82 82 85 79 77 77

昨日の実績

使用率 (85%)

12月×日×時××分

関西電力の電源設備

12月×日×時××分

（各月の供給力の内訳）

供給力に関するお知らせ

昨日の使用電力状況

現在の使用電力状況 (XX月XX日 XX時台)

現在の使用電力状況 (XX月XX日 XX時台)
Saving the data for all over the power saving period and post the data

**Last Summer**

- Only the actual record data for the current day and previous day was posted.

**Last Winter**

- The data for all over the power saving period and post the data.
Weekly “Electricity Forecast”

In addition to the data of last summer, we added the forecasts of the “Electric usage”, “Forecasted maximum electric power” and “Supply capacity at the peak time”

### Last Summer

<table>
<thead>
<tr>
<th></th>
<th>1(Mon)</th>
<th>2(Tue)</th>
<th>3(Wed)</th>
<th>4(The)</th>
<th>5(Fri)</th>
</tr>
</thead>
<tbody>
<tr>
<td>the forecast of demand and supply of electric power</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Weather Forecast</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Forecast of highest and lowest temperatures (°C)</td>
<td>(12/24)</td>
<td>(14/27)</td>
<td>(18/30)</td>
<td>(18/30)</td>
<td>(17/28)</td>
</tr>
</tbody>
</table>

### Last Winter

<table>
<thead>
<tr>
<th></th>
<th>1(Mon)</th>
<th>2(Tue)</th>
<th>3(Wed)</th>
<th>4(The)</th>
<th>5(Fri)</th>
</tr>
</thead>
<tbody>
<tr>
<td>the forecast of demand and supply of electric power</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Forecast of highest and lowest temperatures (°C)</td>
<td>(2/10)</td>
<td>(1/7)</td>
<td>(-1/5)</td>
<td>(-1/4)</td>
<td>(2/7)</td>
</tr>
</tbody>
</table>

#### Changing the publishing time

(last summer) every Friday about 18:00

(last winter) every Friday about 16:00

※Only the weekday data during the period of asking for power saving is posted.
※If the Friday is a holiday, it is posted in the previous day.

The forecasted maximum electric power may vary depending on the weather forecast.

Please see “Electricity Forecast” for the forecast of following day.

Your cooperation in reasonable conditions to save electric power would be very much appreciated.
<table>
<thead>
<tr>
<th>Date</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecast</td>
<td>需 2,640</td>
<td>需 2,660</td>
<td>需 2,640</td>
<td>需 2,650</td>
<td>需 2,570</td>
<td>需 2,320</td>
<td>需 2,340</td>
</tr>
<tr>
<td></td>
<td>供 2,820</td>
<td>供 3,060</td>
<td>供 3,070</td>
<td>供 3,030</td>
<td>供 2,950</td>
<td>供 2,670</td>
<td>供 2,740</td>
</tr>
<tr>
<td>結果</td>
<td>86%</td>
<td>81%</td>
<td>82%</td>
<td>83%</td>
<td>86%</td>
<td>89%</td>
<td>82%</td>
</tr>
<tr>
<td>Topical</td>
<td>2,616(16時)</td>
<td>2,486(11時)</td>
<td>2,546(16時)</td>
<td>2,540(14時)</td>
<td>2,582(16時)</td>
<td>2,383(14時)</td>
<td>2,27(19時)</td>
</tr>
<tr>
<td>Topical</td>
<td>2,616(16時)</td>
<td>2,486(11時)</td>
<td>2,546(16時)</td>
<td>2,540(14時)</td>
<td>2,582(16時)</td>
<td>2,383(14時)</td>
<td>2,27(19時)</td>
</tr>
</tbody>
</table>

※...Holidays

GSEP/PPA Energy efficiency improvement...shop Guam 20-24, 2012
The result of Electricity Forecast (in August)

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>当日予想</td>
<td>1 85%</td>
<td>2 87%</td>
<td>3 87%</td>
<td>4 88%</td>
<td>5 89%</td>
<td>6 82%</td>
<td>7 81%</td>
</tr>
<tr>
<td>需求</td>
<td>2,490</td>
<td>2,510</td>
<td>2,560</td>
<td>2,600</td>
<td>2,600</td>
<td>2,290</td>
<td>2,280</td>
</tr>
<tr>
<td>提供</td>
<td>2,900</td>
<td>2,880</td>
<td>2,930</td>
<td>2,930</td>
<td>2,920</td>
<td>2,770</td>
<td>2,800</td>
</tr>
<tr>
<td>実績（報価）</td>
<td>85%</td>
<td>86%</td>
<td>87%</td>
<td>88%</td>
<td>84%</td>
<td>83%</td>
<td>80%</td>
</tr>
<tr>
<td>Result</td>
<td>2,466(14時)</td>
<td>2,486(14時)</td>
<td>2,555(16時)</td>
<td>2,586(16時)</td>
<td>2,455(14時)</td>
<td>2,317(14時)</td>
<td>2,267(19時)</td>
</tr>
</tbody>
</table>
| Topical | 今夏の最大電力
| 8 90% | 9 92% | 10 91% | 11 90% | 12 86% | 13 83% | 14 84% |
| 当日予想 | 2,660 | 2,730 | 2,750 | 2,710 | 2,460 | 2,270 | 2,260 |
| 需求 | 2,930 | 2,940 | 3,010 | 2,970 | 2,850 | 2,710 | 2,680 |
| 提供 | 2,687(14時) | 2,784(14時) | 2,750(14時) | 2,600(14時) | 2,443(14時) | 2,270(19時) | 2,126(19時) |
| 実績（報価） | 91% | 94% | 91% | 86% | 85% | 83% | 79% |
| Result | 2,159(19時) | 2,278(19時) | 2,528(14時) | 2,648(14時) | 2,410(14時) | 2,070(11時) | 1,874(19時) |
| Topical | 今後の予想
| 15 80% | 16 83% | 17 92% | 18 90% | 19 87% | 20 82% | 21 81% |
| 当日予想 | 2,200 | 2,400 | 2,740 | 2,700 | 2,620 | 2,200 | 2,010 |
| 需求 | 2,730 | 2,870 | 2,970 | 2,990 | 2,990 | 2,710 | 2,660 |
| 提供 | 2,159(14時) | 2,330(19時) | 2,564(14時) | 2,590(14時) | 2,520(13時) | 2,270(13時) | 2,211(19時) |
| 実績（報価） | 77% | 79% | 85% | 88% | 80% | 77% | 75% |
| Result | 2,315(14時) | 2,437(13時) | 2,561(14時) | 2,447(14時) | 2,540(15時) | 2,280(13時) | 2,211(19時) |
| Topical | 今後の予想
| 22 85% | 23 85% | 24 86% | 25 86% | 26 88% | 27 86% | 28 84% |
| 当日予想 | 2,400 | 2,330 | 2,530 | 2,460 | 2,510 | 2,340 | 2,240 |
| 需求 | 2,810 | 2,710 | 2,930 | 2,830 | 2,830 | 2,710 | 2,640 |
| 提供 | 2,315(14時) | 2,437(13時) | 2,561(14時) | 2,447(14時) | 2,540(15時) | 2,280(13時) | 2,211(19時) |
| 実績（報価） | 82% | 89% | 87% | 86% | 89% | 84% | 83% |
| Result | 2,629(14時) | 2,637(13時) | 2,565(11時) | 2,565(11時) | 2,565(11時) | 2,565(11時) | 2,565(11時) |
| Topical | 今後の予想

※ ...Holidays

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Mail Service for providing Information on Crunch of Demand and Supply of Power

If the current status of demand and supply of power is very severe in the Electricity Forecast, the crunch time will be informed in advance by mail.

When the current status of demand and supply of power is “very severe” in the Electricity Forecast (the usage rate of electric power exceeds 97%), the crunch time will be informed by mail.

Corporative and individual customers, municipal customers (pre-registration required)

- In the case that the usage rate of electric power on the next day is expected to exceed 97% by the Electricity Forecast as of 18:00 on the previous day
- In the case that the usage rate of electric power on the current day is expected to exceed 97% by the Electricity Forecast as of 8:00 on the same day
- In the case that the usage rate of electric power that had been expected to exceed 97% is revised by the Electricity Forecast updated at 8:00 or later on the current day

* Reminder mail will be also sent two hours prior to the hour that the excess of the usage rate of electric power is expected.

Main timing of notification

Target

- Corporative and individual customers, municipal customers (pre-registration required)

Image of information to be sent

Forecast

Very severe (exceed 97%)

Notifying mail

Very severe
(exceed 97%)

携帯電話

パソコン

Reminder mail will be also sent two hours prior to the hour that the excess of the usage rate of electric power is expected.
Cooperation with Municipalities about Request for Power Saving [1]

° Status of Preparation of Publicity by Municipalities

**<Normal time>**

Three examples of tasks below required to be executed by municipalities will be shown.

- Posting Kepco's posters (leaflets) in municipal facilities
- Publication in municipalities' PR magazines
- Insertion of information materials into municipalities’ circulars

<table>
<thead>
<tr>
<th>Normal time</th>
<th>In case of crunch of demand and supply</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of municipalities executing measures</strong></td>
<td><strong>Break-down</strong></td>
</tr>
<tr>
<td>Normal time</td>
<td>In case of crunch of demand and supply</td>
</tr>
<tr>
<td>Poster</td>
<td>PR magazine</td>
</tr>
<tr>
<td>210 (151)</td>
<td>160 (28)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate actual records in last summer

° Status of municipalities’ e-mail subscription

All the municipalities in the Kansai areas completed subscription

Number of subscriber municipalities: Total 215 municipalities
Cooperation with Municipalities about Request for Power Saving [2]

- **Poster**
  (Osaka Municipal Transportation Bureau)

- **PR magazine**
  (Osaka City Organization News)
  1.03 million copies

- **Circular**
  (in each community)
Kepco tries to introduce Smart Meter for improvement in customer service and streamlining business management.

Electricity charges are calculated by remotely-read meter readings (every thirty minutes)

Transmitted by charge-free wireless bucket-brigade system to the intensive unit

Unit type meter

Communication unit
- Transmits reading data.

Measuring unit
- “Safe” and “effective” replacement free from power failure is allowed.

Opening/closing unit
- Switching stop/release of supply

○ The size allows comfortable fit into the installing space of the conventional meter.
○ Replacement of each unit as necessary is allowed.

As for customers being introduced Smart meter, hourly electrical usages are displayed graphically on the next day.
For [1] Realization of offering meter-reading notifying service without posting at site and [2] Support for customers’ power-saving activity by visualizing actual records of electricity usage, “Electrical Usage Notifying Service” is provided with using the new meter-reading system.
In addition to the activities of promoting service subscription, improvement in services taking into account users’ needs (addition of new contents) is also being implemented.

From December in 2011, the campaign was started, and in consequence, subscribers were increased by 20,000 in a month, and the accumulative total subscription of approximately 90,000 was achieved. (Conventionally, the average number of monthly new subscribers was approximately 3,000)
Making Banners

Making banners saying “Request for Power Saving” by service offices (summer: nine offices, winter: twenty-nine offices)

<Example of Kepco Head Office Building>

North Side

South Side
Implementation of Street PR in mainly during rush hours for 250 times in summer and 490 times in winter

Main objects distributed (in summer)

- Magnet (with thermometer)
- Paper fan

<Street PR>
(Approaches)
1) Prepare power-saving challenge sheet for elementary school students (by Kepco’s website or newspapers).
2) Use the power-saving challenge sheet at home, and practice an approach to power saving.
3) Send the results of practice of power-saving approach (for five days) and essay to the head office.
4) A certificate of appreciation and a small present is sent to the applicant.

Promotion of household power-saving actions by provision of challenge sheet as a tool for elementary children for approach to power saving by entire family
### Main Charge Systems

**Appropriate to Request for Power Saving**

#### Recommendation of subscribing the demand and supply adjustment special contract by sending direct mails to all the customers whose contractual high-voltage is less than 500 kW (110 thousand cases)

<table>
<thead>
<tr>
<th>Charge system</th>
<th>Outline of contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning and coordination special contract</td>
<td>For the customers restraining their demand for electric power by shifting their working days to their holidays or adjusting load during the daytime on weekdays, special rates will be given depending on the degree of restraining.</td>
</tr>
<tr>
<td>Occasional coordination special contract</td>
<td>For the customers restraining their demand for electric power on demand from Kepco in cases of crunch of demand and supply of power, special rates will be given depending on the degree of restraining.</td>
</tr>
<tr>
<td>Demand and supply adjustment special contract</td>
<td>For the customers whose maximum demand for power in last summer is decreased from that in the same month in the previous year by their approaches to power saving, special rates will be given depending on the degree of restraining.</td>
</tr>
</tbody>
</table>

---

**GSEP/PPA Energy efficiency improvement Workshop  Guam 20-24, 2012**

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6. Advantages Acquired by Kepco’s Approach to Power Saving
As a result of cooperation of the consumers, an average of 1.2 million kW was reduced in last summer. In comparison with the maximum electric power of 31.38 million kW which we supposed as an equivalent hottest summer like previous year, we conclude approximately 1.6 million kW was reduced.

\[ y = 3.9775x^2 - 151.6372x + 3,348.9979 \]

\[ R^2 = 0.9702 \]

<table>
<thead>
<tr>
<th>Itemization (listed for a second time)</th>
<th>Reduced kW</th>
<th>Reduction ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>About 1.6 million kW</td>
<td>About 5%</td>
</tr>
<tr>
<td>Household use</td>
<td>About 0.25 million kW</td>
<td>About 3%</td>
</tr>
<tr>
<td>Commercial use</td>
<td>About 0.65 million kW</td>
<td>About 5%</td>
</tr>
<tr>
<td>Industrial use</td>
<td>About 0.70 million kW</td>
<td>About 7%</td>
</tr>
</tbody>
</table>

* The values in the itemization table are obtained on the basis of estimation based on statistics values from limited sample data.
Change in the maximum power outputted by Kepco in the past (In ten thousand kW)

- **High air temperature**
  - 2002: 36.1
  - 2003: 35.3
  - 2004: 35.9
  - 2005: 37.0
  - 2006: 36.0
  - 2007: 35.7
  - 2008: 36.4
  - 2009: 34.8
  - 2010: 36.6
  - 2011: 35.6

- **Average of the highest air temperatures on the day when the maximum power occurred in the past**
  - 2002: 35.9
  - 2003: 35.9
  - 2004: 35.9
  - 2005: 35.9
  - 2006: 35.9
  - 2007: 35.9
  - 2008: 35.9
  - 2009: 35.9
  - 2010: 35.9
  - 2011: 35.9

- **Change (a)-(b)**
  - 2002: 0.2
  - 2003: ▲ 0.6
  - 2004: 0.0
  - 2005: 1.1
  - 2006: 0.1
  - 2007: ▲ 0.2
  - 2008: 0.5
  - 2009: ▲ 1.1
  - 2010: 0.7
  - 2011: ▲ 0.3

Lehman shock

Including the effect of electric power saving

Including the effect of electric power saving
Last summer, Kepco did its best to secure an additional procurement to assure its supply capability, with the daily maximum electric power having not exceeded the supply capability.
Daily supply and demand in last summer (A trial calculation with the electric power from nuclear power generation excluded)

A substantial shortfall in the supply capability would have occurred should no nuclear power generation have not in service at all.
Under the current situation in which the successive shutdown of nuclear power generation has increased the burden on fossil-fired power stations.
Change in the generated energy

The most of the decrease in the generated energy due to the shutdown of nuclear power generation will be replaced by petroleum-fired power generation.

* Interchanged energy from other utilities includes pumping-up power generation. It was assumed that hydroelectric power generation is of the same amount as the FY2011 track record and coal- and LNG-fired power generation is in all-out operation.

GSEP/PPA Energy efficiency improvement Workshop  Guam 20-24, 2012

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As the replacement of nuclear power generation, the power generation fired by LNG or petroleum has increased, which depends on fuel being priced higher and higher. This has increased the fuel expenses for fossil-fire power generation.

<table>
<thead>
<tr>
<th>FY2009</th>
<th>FY2010</th>
<th>FY2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>¥ 788.4 billion</td>
<td>¥ 837.1 billion</td>
<td>An increase of over 500 billion yen (in comparison with the previous year)</td>
</tr>
</tbody>
</table>

- **Purchased energy expenses**
- **Fuel expenses for fossil-fired power generation**
- **Fuel expenses for nuclear power generation**

<table>
<thead>
<tr>
<th>Ratio of utilization of nuclear power</th>
<th>FY2009</th>
<th>FY2010</th>
<th>About 38%</th>
</tr>
</thead>
<tbody>
<tr>
<td>77%</td>
<td>78%</td>
<td>(All nuclear power generation suspended in February 2012)</td>
<td></td>
</tr>
</tbody>
</table>
Mr. Mick Ebeling

Mick Ebeling founded the Not Impossible Foundation, a nonprofit that develops creative solutions to real-world problems. What he insist is that …

The nerve disease ALS left graffiti artist TEMPT paralyzed from head to toe, forced to communicate blink by blink. Entrepreneur Mick Ebeling shares how he and a team of collaborators built an open-source invention that gave the artist to make art again.

TEMPT said, “That was the first time I’ve drawn anything for seven years. I feel like I had been held underwater, and someone finally reached down and pulled my head up so I could breathe.”
### Practice 1 (Answer)

**Try to calculate how much you spent electricity.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>The kind of contract incurred amount A</td>
<td></td>
</tr>
<tr>
<td>Amount of electricity per month 250kWh</td>
<td></td>
</tr>
<tr>
<td><strong>&lt;unit price&gt;</strong></td>
<td></td>
</tr>
<tr>
<td>Basic charge Up to the first 15kWh</td>
<td>320.25 Yen</td>
</tr>
<tr>
<td>Electricity charge over 15kWh up to 120kWh</td>
<td>19.05 Yen/kWh</td>
</tr>
<tr>
<td>over 120kWh up to 300kWh</td>
<td>24.21 Yen/kWh</td>
</tr>
<tr>
<td>over 300kWh</td>
<td>25.55 Yen/kWh</td>
</tr>
<tr>
<td><strong>&lt;unit price of Fuel cost adjustment&gt;</strong></td>
<td></td>
</tr>
<tr>
<td>Basic charge Up to the first 15kWh</td>
<td>+1.12 Yen</td>
</tr>
<tr>
<td>Electricity charges</td>
<td>+0.08 Yen/kWh</td>
</tr>
</tbody>
</table>

(Consumption tax has been included in Sum total Charge)

### Calculation Table

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic charge</td>
<td>320.25 Yen</td>
</tr>
<tr>
<td>Over 15kWh up to 120kWh</td>
<td>2,000.25 Yen</td>
</tr>
<tr>
<td>Over 120kWh up to 300kWh</td>
<td>3,147.30 Yen</td>
</tr>
<tr>
<td>Over 300kWh</td>
<td>0.00 Yen</td>
</tr>
<tr>
<td>Fuel cost adjustment</td>
<td>19.92 Yen</td>
</tr>
<tr>
<td>Sum total charge</td>
<td>5,487 Yen</td>
</tr>
<tr>
<td>Consumption tax</td>
<td>261 Yen</td>
</tr>
<tr>
<td>Total charge</td>
<td>5,487 Yen</td>
</tr>
</tbody>
</table>

Consumption tax has been included in Sum total Charge

---

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### Practice 2 (Answer)

#### Try to calculate how much you spent electricity.

<table>
<thead>
<tr>
<th>The kind of contract</th>
<th>incurred amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of electricity per month</td>
<td>457 kWh</td>
</tr>
</tbody>
</table>

- **Basic charge**
  - Up to the first 15kWh: 320.25 Yen
  - Over 15kWh up to 120kWh: 19.05 Yen/kWh
  - Over 120kWh up to 300kWh: 24.21 Yen/kWh
  - Over 300kWh: 25.55 Yen/kWh

- **Fuel cost adjustment**
  - Up to the first 15kWh: +1.12 Yen
  - Unit price: +0.08 Yen/kWh

#### Calculation:

1. **Basic charge**
   - Up to the first 15kWh: $320.25$ Yen
   - Over 15kWh up to 120kWh: $(120-15) \times 19.05$ Yen/kWh
   - Over 120kWh up to 300kWh: $(300-120) \times 24.21$ Yen/kWh
   - Over 300kWh: $(457-300) \times 25.55$ Yen/kWh

2. **Fuel cost adjustment**
   - Up to the first 15kWh: $+1.12$ Yen
   - Unit price: $+0.08$ Yen/kWh

3. **Total charge**

#### Consumption tax

- Consumption tax has been included in Sum total Charge:
  - Sum total = $10,726$ Yen
  - Consumption tax = $510$ Yen
  - Total charge = $10,726$ Yen
Practice3 (Answer)

Try to calculate how much you spent electricity.

The kind of contract ・・・ Hapi-e time
Contract electricity ・・・ 10kVA  Mi-con 5kVA  Hapi-e plan
Amount of electricity per month ・・・ 1,250kWh
Day time 162kWh
Living time 213kWh
Night time 875kWh

For the month of May
<unit price>
Basic charge (1contract up to 10kVA) 2,100.00 Yen
(Over per 1kVA) 378.00 Yen/kVA
Amount of electricity (daytime • summer) 30.72 Yen/kWh
(daytime • other) 28.02 Yen/kWh
(Living time) 21.64 Yen/kWh
(Night time) 8.19 Yen/kWh
Mi-con discount 168.00 Yen/kVA
Happy-e plan discount (basic charge + electricity) × 10%
<unit price of Fuel cost adjustment>
Electricity charge ・・・ +0.08 Yen/kWh
(the fuel unit price of fuel cost adjustment is a temporary one)

Summer : 7/1 - 9/30
Other : 10/1 - 6/30

[3] 162kWh × 28.02 Yen/kWh
[4] 213kWh × 21.64 Yen/kWh
[5] 875kWh × 8.19 Yen/kWh
[7] 5kVA × 168 Yen/kVA
[8] 1,250kWh × 0.08 Yen/kWh

Basic charge

Up to 10kVA
[1] 2,100.00 Yen

Over 10kVA
[2] 0.00 Yen

Electricity charge

daytime
[3] 4,539.24 Yen

Living time
[4] 4,609.32 Yen

Night time
[5] 7,166.25 Yen

Sum total
[6] 16,314.81 Yen

= ([3]+[4]+[5])

Mi-con discount
[7] 840.00 Yen

Fuel cost adjustment
[8] 100.00 Yen

Hapi-e plan discount
[9] 1,841.48 Yen

= ([1]+[2]+[6]) × 0.1

Sum total Charge
[10] 15,833 Yen

= ([1]+[2]+[6]-[7]+[8]-[9]) (Round down to the nearest decimal)

Consumption tax

= [6] × 5/105 (Round down to the nearest decimal)

Total charge
[12] 15,833 Yen

= [10]

Consumption tax has been included in Sum total Charge
Practices of calculating Japanese electricity charges

Kenji Morimoto
The KANSAI Electric Power Co., Inc.
[KEPCO]
### Practice 1

#### Try to calculate how much you spent electricity.

<table>
<thead>
<tr>
<th>The kind of contract</th>
<th>incurred amount A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of electricity per month</td>
<td>250kWh</td>
</tr>
</tbody>
</table>

#### <unit price >

<table>
<thead>
<tr>
<th>Basic charge</th>
<th>Up to the first 15kwh</th>
<th>320.25Yen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity charge</td>
<td>over 15kWh up to 120kWh</td>
<td>19.05Yen/kWh</td>
</tr>
<tr>
<td></td>
<td>over 120kWh up to 300kWh</td>
<td>24.21Yen/kWh</td>
</tr>
<tr>
<td></td>
<td>over 300kWh</td>
<td>25.55Yen/kWh</td>
</tr>
</tbody>
</table>

#### <unit price of Fuel cost adjustment>

<table>
<thead>
<tr>
<th>Basic charge</th>
<th>Up to the first 15kWh</th>
<th>+1.12Yen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity charges</td>
<td>up to 15kWh</td>
<td>+0.08Yen/kWh</td>
</tr>
</tbody>
</table>

*(the fuel unit price of fuel cost adjustment is a temporary one)*

<table>
<thead>
<tr>
<th>Basic charge</th>
<th>[1]</th>
<th>Yen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 15kWh up to 120kWh</td>
<td>[2]</td>
<td>Yen</td>
</tr>
<tr>
<td>Over 120kWh up to 300kWh</td>
<td>[3]</td>
<td>Yen</td>
</tr>
<tr>
<td>Over 300kWh</td>
<td>[4]</td>
<td>Yen</td>
</tr>
</tbody>
</table>

#### Total charge

<table>
<thead>
<tr>
<th>Sum total charge</th>
<th>[6]</th>
<th>Yen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption tax</td>
<td>[7]</td>
<td>Yen</td>
</tr>
</tbody>
</table>

**Total charge**

| [8] | Yen |

Consumption tax has been included in Sum total Charge

Consumption tax has been included in Sum total Charge

\[ \text{Consumption tax} = ([1] + [2] + [3] + [4] + [5]) \times \frac{5}{105} \] (Round down to the nearest decimal)

\[ \text{Consumption tax} = [6] \times 5/105 \] (Round down to the nearest decimal)
Practice 2

Try to calculate how much you spent electricity.

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>The kind of contract</td>
<td>A</td>
</tr>
<tr>
<td>incurred amount</td>
<td></td>
</tr>
<tr>
<td>Amount of electricity per month</td>
<td>457 kWh</td>
</tr>
<tr>
<td>&lt;unit price&gt;</td>
<td></td>
</tr>
<tr>
<td>Basic charge</td>
<td>320.25 Yen</td>
</tr>
<tr>
<td>Up to the first 15kWh</td>
<td></td>
</tr>
<tr>
<td>Electricity charge</td>
<td>19.05 Yen/kWh</td>
</tr>
<tr>
<td>over 15kWh up to 120kWh</td>
<td></td>
</tr>
<tr>
<td>over 120kWh up to 300kWh</td>
<td>24.21 Yen/kWh</td>
</tr>
<tr>
<td>over 300kWh</td>
<td>25.55 Yen/kWh</td>
</tr>
<tr>
<td>&lt;unit price of Fuel cost adjustment&gt;</td>
<td></td>
</tr>
<tr>
<td>Basic charge</td>
<td>+1.12 Yen</td>
</tr>
<tr>
<td>Up to the first 15kWh</td>
<td></td>
</tr>
<tr>
<td>Electricity charges</td>
<td>+0.08 Yen/kWh</td>
</tr>
<tr>
<td>(the fuel unit price of fuel cost adjustment is a temporary one)</td>
<td></td>
</tr>
</tbody>
</table>

![Table]

- Basic charge
- Over 15kWh up to 120kWh
- Over 120kWh up to 300kWh
- Over 300kWh
- Fuel cost adjustment
- Sum total charge
- Consumption tax
- Total charge

<table>
<thead>
<tr>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum total charge = [1]+[2]+[3]+[4]+[5] (Round down to the nearest decimal)</td>
</tr>
<tr>
<td>Consumption tax = [6] × 5/105 (Round down to the nearest decimal)</td>
</tr>
<tr>
<td>Total charge = [6]</td>
</tr>
</tbody>
</table>

Consumption tax has been included in Sum total Charge.
Try to calculate how much you spent electricity.

<table>
<thead>
<tr>
<th>The kind of contract</th>
<th>Hapi-e time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract electricity</td>
<td>10kVA</td>
</tr>
<tr>
<td>Mi-con 5kVA</td>
<td>Hapi-e plan</td>
</tr>
<tr>
<td>Amount of electricity per month</td>
<td>1,250kWh</td>
</tr>
<tr>
<td>Day time</td>
<td>162kWh</td>
</tr>
<tr>
<td>Living time</td>
<td>213kWh</td>
</tr>
<tr>
<td>Night time</td>
<td>875kWh</td>
</tr>
</tbody>
</table>

For the month of May
<unit price>
| Basic charge (1 contract up to 10kVA) | 2,100.00 Yen |
| Over per 1kVA                           | 378.00 Yen/kVA |
| Amount of electricity (daytime + summer) | 30.72 Yen/kWh |
| (daytime + other)                       | 28.02 Yen/kWh |
| (Living time)                           | 21.64 Yen/kWh |
| (Night time)                            | 8.19 Yen/kWh  |
| Mi-con discount                        | 168.00 Yen/kVA |
| Happy-e plan discount                  | (basic charge + electricity) × 10% |

<unit price of Fuel cost adjustment>
| Electricity charge                      | +0.08 Yen/kWh |

| Summer                                  | 7/1 - 9/30   |
| Other                                   | 10/1 - 6/30  |

[*] Happy-e plan = 10% discount

Mi-con discount
This is applied to the equipment having functions of automatic power distribution after back calculating the time for preparing a bath.

<table>
<thead>
<tr>
<th>Basic charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 10kVA</td>
</tr>
<tr>
<td>[1] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>Over 10kVA</td>
</tr>
<tr>
<td>[2] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
</tbody>
</table>

Electricity charge
<table>
<thead>
<tr>
<th>Daytime</th>
</tr>
</thead>
<tbody>
<tr>
<td>[3] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>Living time</td>
</tr>
<tr>
<td>[4] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>Night time</td>
</tr>
<tr>
<td>[5] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum total</th>
</tr>
</thead>
<tbody>
<tr>
<td>[6] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>= ([3] + [4] + [5])</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mi-con discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>[7] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel cost adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>[8] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hapi-e plan discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>[9] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>= ([1] + [2] + [6]) × 0.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum total Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>(Round down to the nearest decimal)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>[11] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>(Round down to the nearest decimal)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>[12] 0</td>
</tr>
<tr>
<td>Yen</td>
</tr>
<tr>
<td>= [10]</td>
</tr>
</tbody>
</table>

Consumption tax has been included in Sum total Charge
Utility Outreach for Energy Efficiency

Dr. Herbert Wade

Energy Efficiency Improvement Workshop
Guam
August 20-24, 2012
Utilities and Energy Efficiency

- Supply Side Management (SSM)
  - Reduce waste in generation
  - Reduce waste in transmission and distribution

- Demand Side Management (SSM)
  - Reduce waste at the customer’s premises
Why Help Customers Reduce Use?

• Required by Government
  – Economy suffering due to high electricity costs
    ß Mostly due to high diesel fuel prices

• Some customers cross subsidised from others
  – Residential customers often get a lower rate
  – Utility loses money on sales to subsidised customers
    ß Selling less means more cash available!
• Improved customer relations

• Reduce the need for added investment in capacity
Promoting Energy Efficiency in the Pacific

(ADB PEEP2 Programme)
Promoting Energy Efficiency

- Five countries: Cook Islands, Papua New Guinea, Samoa, Tonga, and Vanuatu.
- The first phase of PEEP was concluded in May 2011.
The first phase of the Promoting Energy Efficiency in the Pacific (PEEP) project was completed in 2011 and was primarily for data gathering, understanding EE concepts in the island context and for developing at least one pilot project that demonstrates cost savings through energy efficiency.
PEEP: Phase 2: 2012-2015

• PROJECT OBJECTIVES

• The objective of PEEP Phase 2 is to implement energy efficiency (EE) measures in the five countries to:

• Contribute to achieving the overall goal of **10% reduction** in average monthly energy consumption in the residential, commercial and public sectors by *31 March 2015*

• Establish the policy and implementation frameworks to move towards the goals of **reducing fossil fuel imports by 10%** by the **end of 2018**.
How do you PEEP2?

• Follow from phase one or PEEP1
• But in some countries, still not enough statistically relevant data about energy use.
• Need to determine baseline of energy use in-order to determine:
  – Energy efficiency opportunities
  – Impact of Energy Efficiency initiatives
• PEEP1 has given some insight, that needs to be further strengthened through a statistically valid energy-use survey of energy users.
PEEP1 view for the Potential in Tonga

Consumption (kWh)

- Residential: 42%
- Commercial: 28%
- Government: 12%
- Religious: 9%
- Special: 1%
- Streetlights: 2%
- Other: 6%

Number of meters

- Residential: 75%
- Less than 10 KWh: 10%
- Government: 5%
- Special: 0.2%
- Commercial: 6%
- Religious: 1%
- Streetlights: 1%
- Other: 1%
Potential in Tonga

Maximum and Minimum TPL Load Curves 2008-2009

03-2009 06-2009
Potential in Tonga

Calculated demand curve for households

Graph from Master's thesis J. Dehnisch, M. Lindhe, “Development of a framework to assess human activities that drive energy use in the Pacific, a case-study of Tonga -A Minor Field Study-”
Energy Efficiency opportunities

- Energy efficient street-lighting
- Energy efficient buildings
- Energy auditing
- Equipment standards
- Public Education
• **Output 1: Development of Energy Use Database**
  - *Review, Compilation and validation of available energy use data*
  - *Conduct of In-country surveys for all sectors*
Output 2: Development of Energy Efficiency Policies and Procedures

- Establish practical and implementable EE targets and incorporate these into national energy policies and plans;
- Encourage the sale and use of low-energy-consumption appliances and equipment through appropriate import regulations brought about by the development and enforcement of effective minimum energy performance standards (MEPS) and/or energy labeling;
- Improve EE best practices for newly built residential, commercial, and government buildings, including energy efficiency provisions in building codes for new buildings;
- Develop and implement training programs for local experts in undertaking energy audits and in providing EE products and services; and
- Support the development of motivated and organized service providers that have incentives to implement EE activities.
Output 3: Implementation of Energy Efficiency Programs

- Energy Efficient Street Lighting Program Expansion
- Energy Efficient Lighting in Residential, Commercial and Government Sectors
- Development of Fluorescent Lamp Waste Management Strategy
- Implementation of EE Measures in Hotels and Commercial Sector
- Implementation of EE Measures in the Government Sector
- Output 4: Information dissemination and Public Awareness

  - Determination of Information Dissemination Delivery Processes Suitable and Cost Effective for the target country
  - Preparation of Consumer Information Materials Relating to Refrigeration and Air Conditioning Equipment Selection, Use and Maintenance
  - Development of School Education Modules on Energy Efficiency
  - Training for Utility Personnel in the Development and Delivery of Energy Efficiency Information
Government Energy Management

Assistance by the Utility
The Problem

• For smaller countries in particular, government energy use is a high percentage of national energy use

• Since the early 1990s, government facility energy audits have been carried out
  – Many opportunities, few changes in energy management
  – Palau Capitol an example
More of the Problem

• The people who use the energy do not pay the bills

  – Often they don’t even know how much they use since government utility bills typically go direct to finance for payment
  – No one in government departments is responsible for energy management
  – Energy using equipment, especially air-conditioners, are purchased on tender with first cost the main factor
How Can Government Improve Energy Efficiency

• Departments become directly responsible for energy use
  – Energy saved by departments does not cut budgets for the next year but adds to programming
  – Departmental Energy Managers assigned
    β Ensure that measures for energy efficiency are enforced and maintained
    β Report directly to department head
Why Should the Utility Help?

- With the high energy costs of today plus the fact that all but Vanuatu utilities are owned by the government, it makes sense for utilities to try to help their owners save money to spend for more important things like utility maintenance, infrastructure improvements and salaries.

- In some countries the government is the largest debtor to the utility but disconnection is not an option.
How Can the Utility Help?

• Provide head of departments and finance a monthly detailed electricity usage report for each department meter noting the meter location.
  
  – Important first step since nothing effective can be done if Finance and the individual departments do not know how the energy is being used among the various departments

  – Must include such government facilities as water supply systems and sewage systems since typically they are major users of electricity.
Help Government Establish Energy Standards for Government Facilities

- Purchasing standards for air-conditioners
- Purchasing standards for computers
- Construction standards for new buildings to reduce the need for A/C
- Concepts for improving existing buildings
Walk Through Energy Audits

- Utility personnel skills developed through PPA training courses for detecting energy efficiency problem areas
  - Building problems
    - Dark coloured roof or walls absorb heat that has to be pumped out by air conditioners
    - Windows to the east and west and sometimes the north need to be shaded or have some method for reducing solar heat from entering the building
    - Does the building have reflective foil insulation under the roof?
• Air Conditioners
  – Type installed
    β Window type are the least efficient
    β Split type ok if installed correctly and good quality unit is used
    β Central air conditioning can be ok for large facilities if properly installed and is capable of zone management but hard to change once in place if not efficient
  – Quality of manufacture
    β Efficiency label or rating (and is certified by a government laboratory)
• Installation
  – Window units do not fit so there are air passages around the unit
  – Condenser component (exterior) of the A/C is badly corroded or damaged
  – Condenser component of the A/C is not in the shade
  – Air flow through the condenser component of the A/C is partially blocked
• Personnel Computers
  – Use LCD screens not CRT screens
  – “Green” rated (new)
  – Set to “sleep” after non use for 15 minutes or less
  – Main power turned off at night to avoid “phantom loads”

• Servers in A/C room
  – Level of A/C used and other heat generation in the server room – not where a shared printer is located
• Laser Printers
  – Sleep between printing
  – Powered off at night
• Ink Jet printers
  – Powered off at night
• Lights
  – Switches provide per bank of lights not for the whole room
  – Type of light and use patterns
    ß Task lighting preferred
  – Excessive use of lighting
    ß Interior
    ß exterior
• Departmental break rooms and kitchens
  – Hot water delivery on demand, not constantly running pot
  – Refrigerator is energy efficient and properly sized for the needs
  – Microwave uses mechanical timer, not electronic
  ∞ Cheaper, more reliable and no power demand except when actually in use
What about Solar on the Roof

• Bills are reduced but not to be used as an excuse to ignore energy efficiency.
  – Should be added to energy efficiency so fuel imports are further reduced
Work With Government Departments

- Assist in training persons who are made departmental energy managers
  - Training sessions
  - Technical Resource
  - Participate in periodic meetings of departmental energy managers
- Equipment loans
  - Illuminometer
  - “Kill-a-Watt” type appliance meter
  - IR Thermometer
Until a few years ago, Niue Power Corporation metered each air conditioner in government and charged a much higher tariff for A/C use.

Currently Yap State Public Service Corporation charges government about a 20% higher rate than other customers to:

- Help cross subsidize low income residential customers
- Encourage government to institute energy efficiency measures
Street Lights

- Conversion of standard sodium or mercury type streetlights to high efficiency LED units
  - Government pays the bills for public area lighting
    - Can cut those bills by 30% or more by conversion to LED lighting
Evaluation of PEEP1 LED Tonga streetlight pilot

- ADB/TPL funded project
- Total cost = USD$75,000
- Replaced 109 street lighting, 150W Sylvania High-Pressure-Sodium (HPS) lamps
- Total measured electricity consumption of 56,720 kWh/year.
- 109 LED street lights installed along the same routes will be reduced to 36,800 kWh/year.
- Savings of 19,920 kWh per year or a cost savings of around USD 12,720/year
Evaluation of PEEP1 LED Tonga streetlight pilot
TransNet 100W LED Streetlight lamps used for the PEEP1 pilot project. Photos show cooling fins, automatic day/night sensor and positioning of LEDs. Courtesy of TPL
Evaluation of PEEP1 LED streetlight pilot in Tonga

Shows monthly consumption measured for each streetlight circuit (note not all streetlights were working).
HPS Streetlight

HPS-250W Illumination Contour (Lux)

HPS-250W Illumination Contour (Lux)
LED Streetlight

LED 100W Illumination Contour (Lux)

LED 100W Illumination Contour (Lux)
# LED Streetlight assessment

<table>
<thead>
<tr>
<th>Streetlight type</th>
<th>HPS 250W</th>
<th>LED 100W</th>
<th>LED Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual purchase cost (TOP)</td>
<td>$921</td>
<td>$1,145</td>
<td>+$224</td>
</tr>
<tr>
<td>Total purchase cost (TOP)</td>
<td>$100,389</td>
<td>$124,805</td>
<td>+$24,416</td>
</tr>
<tr>
<td>Average monthly consumption per streetlight (kWh)</td>
<td>50</td>
<td>36</td>
<td>-14</td>
</tr>
<tr>
<td>Average monthly consumption for total pilot (kWh)</td>
<td>5,450</td>
<td>3,882</td>
<td>-1,568</td>
</tr>
<tr>
<td>Average annual consumption for total pilot (kWh)</td>
<td>65,400</td>
<td>46,584</td>
<td>-18,816</td>
</tr>
<tr>
<td>Average cost annual consumption for total pilot (TOP)</td>
<td>$60,822</td>
<td>$43,323</td>
<td>-17,498</td>
</tr>
<tr>
<td>Average illuminance (lux)</td>
<td>7.7</td>
<td>13.1</td>
<td>+5.4</td>
</tr>
<tr>
<td>Minimum illuminance (lux)</td>
<td>2.5</td>
<td>8.9</td>
<td>+6.4</td>
</tr>
<tr>
<td>Uniformity of illuminance (min/avg)</td>
<td>0.33</td>
<td>0.68</td>
<td>+0.34</td>
</tr>
</tbody>
</table>
LED Streetlight assessment

LED Street Lighting Project impact on TPL Load Curve

Load Curve with LED-Scenario 1
Public Information Programmes for DSM

Dr. Herbert Wade

Energy Efficiency Improvement Workshop
Guam
August 20-24, 2012
Public Information Programmes for DSM

• All DSM efforts should be supported by programmes to provide the target group with relevant information about the program, its technologies, its cost and its benefits.

  – Public media (TV, radio, newspapers) are important for distributing information about residential DSM and some commercial DSM programmes

  – Workshops and meetings for information dissemination are appropriate for government and commercial/industrial DSM programmes

  – Visits by utility representatives to large electricity consumers to discuss DSM possibilities
Public Information Strategy

• Long term commitment with many repetitions of the public information message needed, especially for residential DSM.

• Use News outlets as often as possible. People pay more attention to the news than to paid advertising plus it is free!

• Public events (e.g. fairs, holiday events) provide opportunities for news coverage and to distribute brochures and other written materials.
• Energy Efficiency Information provided with electric bills or provided at the time of bill payment can be useful if kept short and informative.
  – Should be part of the bill. Separate papers tend to be thrown away unread.

• Information provided through school programmes can be very effective and can reach most households
• For commercial customers, newsletters and periodic workshops focusing on specific DSM actions are more effective than media distribution

  – Work through business associations such as the Chamber of Commerce, Hotel Association, etc.

• Giving away CFL bulbs or providing coupons for buying CFLs at a deeply discounted price can be a cost effective way to catch the attention of households
• The three keys to successful public information programmes using TV, radio or newspapers are
  – repetition of the basic message with short, humourous and interesting presentations
  – Vary the content. Cycle through at least three different presentations sending the same message. Repetition is good but gets boring if the content is always the same
  – focus on specific things that benefit customers (like lowering bills through maintenance of air-conditioners) not lofty, generic ideas (like climate change or “it’s good for the earth”)
Use Media Professionals

• It is not easy to design and produce short but humourous, interesting media presentations that get your message across. The cost of using experienced media professionals may be significantly higher than doing it yourself but the results are likely to be much better and more cost effective.

• Take advantage of the wealth of professionally prepared public information resources available from other PICs, the Internet and large countries.

  – But adapt it to your local conditions and language
Residential Energy Efficiency
What Information Dissemination Needs to Cover
• Energy Use in Households
  – Ranges widely from 25 kWh/month to over 5,000 kWh per month.
    ß Correlates closely to income patterns
  – In most countries, refrigeration is the largest single user of residential electricity
    ß May be air-conditioning, refrigerators or freezers
  – Lighting is usually the most inefficient use of energy in households in the Pacific and has the most potential for easy improvement
• The use of high demand, low cost appliances such as electric tea kettles, fry pans, toaster ovens and rice cookers does not respond well to DSM efforts.

  – Public information encouraging reduced use of those types of appliances is about the only means to reduce their usage
• TV/video can be a significant energy use in households

  – New flat screen LCD TVs are much more energy efficient than older CRT type units
  – Reduced lighting usually accompanies TV use so the household energy use may not rise as much as implied by the TV energy use alone
### Typical Home Appliance Usage

<table>
<thead>
<tr>
<th>Home Appliance</th>
<th>Typical kWh/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Door Refrigerator</td>
<td>30 - 50</td>
</tr>
<tr>
<td>Double door Refrigerator</td>
<td>40-90</td>
</tr>
<tr>
<td>Chest type freezer</td>
<td>65</td>
</tr>
<tr>
<td>Electric cook stove</td>
<td>60-110</td>
</tr>
<tr>
<td>Electric Jug</td>
<td>25</td>
</tr>
<tr>
<td>Rice cooker</td>
<td>12</td>
</tr>
<tr>
<td>Color TV/Video</td>
<td>20</td>
</tr>
<tr>
<td>Stereo</td>
<td>4</td>
</tr>
<tr>
<td>Radio</td>
<td>1.5</td>
</tr>
<tr>
<td>Table Fan</td>
<td>5</td>
</tr>
<tr>
<td>Floor or Ceiling Fan</td>
<td>9</td>
</tr>
<tr>
<td>Room AC (per room)</td>
<td>150</td>
</tr>
<tr>
<td>Computer at home (not laptop)</td>
<td>20</td>
</tr>
</tbody>
</table>
Household Energy Surveys

• Need to understand appliance usage in typical households so you need data on:

  – Inventory of appliances and lights with their daily usage patterns
  – Information about major appliances such as age, brand, size and arrangement of doors
  – Priority for appliance use (which most important?)
    - Including priority for next appliance purchase
  – Description of the type of construction used in the house
  – Number of persons and age of persons in the household
• For countries where there are many household air-conditioners the survey should:
  – Note the construction of the house
    Ø Roof colour
    Ø Wall materials
    Ø Wall colour
    Ø Roof/Attic insulation
  – Windows
    Ø Direction windows face, their size and type
  – Use patterns of the A/C
    Ø 24/7, just when rooms are occupied, just at night for sleeping
• Air conditioner characteristics and their effects on EE
  • Manufacturer
  • Model
  • Size (BTU, kJ, etc.)
  • Voltage
  • Watts when cooling
  • Age
  • Energy efficiency if on the label (EER, COP, etc.)
  • Type – split unit or “window” unit
  • Location of condenser
    • In the shade or not
    • Has good ventilation
  • Condition of air filter
Targets for Residential DSM

• Lighting is the easiest and quickest to effect.
  – Provide CFL or LED lights to replace incandescent bulbs and older “iron ballast” fluorescent tube lights

• Improving the efficiency of refrigeration type units has the greatest overall potential for residential energy use reduction
  – Finance for upgrade of equipment
  – Maintenance assistance
    - Door seal replacements for refrigerators and freezers
    - Cleaning of condensers in refrigerators and freezers
    - Cleaning of filters in A/C units
    - Proper ventilation and placement of A/C condensers
– Reduce heat entry into air-conditioned living spaces
  - Radiant barriers in roofs/ceilings
  - Insulation in ceilings
  - Awnings over windows that have sun entry problems
  - Reflective films on windows
  - Separate kitchens and laundries from A/C rooms

• Water heating and cooking

  – Replace tank type electric water heaters with solar or instant heat type heaters

  – Replace electric cook stoves with gas
School Programme for Home Audits

• Energy audits of homes are best carried out by a member of the household
  – Too expensive to send people to every house to do an audit
  – Audits of households are relatively simple and with modest training can be done by a household member
• Home audit results should be sent to the utility for analysis and programme development

• Utility prepares energy efficiency improvement programmes focusing on the areas found to be important by the household energy audits

  – Focused public information programmes addressing principal issues found in the audits

  – Focused finance programs for home energy improvement addressing issues found in the audits
What About Encouraging People To Shift to Pre-Paid Metering To Save Energy?
Pre-Paid Metering and DSM

• Pre-paid meters require customers to purchase electricity in advance
  – Widely used in several PICs
  – Help with non-payment issues
    - Avoids the cost and unpleasantness of disconnection and reconnection
    - Customers must pay or no electricity is provided.
    - Especially useful for government offices where payment is a problem
  – Option for very difficult to reach locations
    - Outer island customers where meter reading and billing is difficult or not reliable
Prepaid Metering May be Expensive

• High up-front cost
  – Prepaid meters are several times as costly as conventional meters
  – Maintenance is expected to be higher for pre-paid meters than for conventional meters in the PICs
    ß Moist, salty air is hard on complex electronics
    ß High ambient temperatures
Pre-payment Meters and DSM

- One theory is that because energy use must be planned in advance and paid for in advance that more thought is put into the efficient use of electricity

  - No real evidence to support this theory

  - Because there is a tendency to buy many small blocks of power instead of paying one big bill, the user easily loses track of what is actually being paid per month

  - People on tight budgets are the ones that are most likely to watch their payments not the wasteful high energy users who can best reduce energy usage.
• Another theory is that because the meter allows customers to shut off power by non-payment but with no penalty of a fee for reconnection, that poorer households simply allow the meter to run out when money is low thus their demand for energy is less

– This does result in lower energy use by those households and reduced fuel use by the utility but it is not the poorer households that DSM should be directed at. The large users need to be the target since percentage wise, they have a much higher impact than the low end users.
Disadvantages of Pre-Payment Meters

– Hidden costs to the utility

   ∙ Computer equipment and software to create codes is expensive and must be kept in a secure area
   ∙ Must have an identical, secure backup computer to provide codes if the main unit fails
   ∙ Many more sales transactions may have to be handled per month
Disadvantages of pre-payment meters for DSM

- May be difficult to impose tier type tariffs that are known to be effective DSM measures
  - Tier type tariffs require the meter to keep track of total usage over the month and automatically raise the kWh price when the tier limit is passed
  - Meters and software that allow tier pricing are usually more expensive and complex than single rate meters

- May be more difficult to find meters that have been bypassed
  - No visits by utility personnel on a regular basis
  - No easy way to see monthly usage to note sudden lowering of electricity use
• Use statistics suitable for design of DSM programmes become more difficult to obtain since metering of usage is random rather than about the same time each month

  – Use statistics for DSM requires that the system have the capability of determining the energy passing through a meter for a given time. This is not usually easy to do with pre-payment type meters. The only time the utility knows what energy has been used is when a new block is purchased and even then the previous block probably has not been completely used.
Helping Customers Understand Cost Savings Calculations
Payback Period

- The amount of time it takes to recover the added investment for energy efficiency from energy savings
  - True payback period considers the time value of money

  - Simple payback period ignores the time cost of money
    - Easy for the layman to understand
    - Reasonable for actions that have fast payback such as solar water heating
    - Simply divide the added cost for energy efficiency by the annual savings in energy
• Simple Payback Example:

  – Solar water heater costs $2000 to install and $25 per year average maintenance cost. 15 year life expectancy

  – Electric water costs $200 to install and has an average annual cost of operation of $350. 10 year life expectancy

  – Simple payback time
    \[ = \frac{(2000 - 200)}{(350 - 25)} = 5.54 \text{ years} \]
• Simple payback example 2:

– If refrigerators are typically replaced every 10 years which refrigerator should be purchased, one that is estimated to use 250 kWh per year and costs $800 or one that is estimated to use 180 kWh per year and costs $1000 if the electricity cost is $0.50 per kWh?
• Step 1: Compute the annual electricity cost

$0.50 per kWh x 250 = $125 per year
$0.50 per kWh x 180 = $90 per year

• Difference in cost of refrigerators = $200
• Difference in operating cost = $35 per year
• Payback for the more expensive refrigerator = $200/35 = 5.7 years
Total savings over the 10 year life = 4.3 x $35 = $150.50
Payback problem 3:

A small village store needs a new freezer. The owner needs to decide whether to buy the cheapest one at $650 that is expected to use 300 kWh/year or an expensive one at $800 that is expected to use 240 kWh/year. The freezer is expected to last 10 years.

Which one is the most appropriate to purchase if the electricity cost is $0.50 per kWh?
- What if the electricity is $0.25 per kWh?
- What if the electricity cost is $0.08 per kWh as it has been in Nauru?
• 300 kW/year = $150 per year electricity
• 240 kW/year = $120 per year electricity
• Annual savings = $150-$120 = $30
• Cost difference = $150

• How many years to break even? $150/$30 = 5 years

• So better to purchase the more expensive one because of the electricity savings.
• If the electricity is $0.25 per kWh

• 300 kW/year = $75.00 per year
• 240 kW/year = $60 per year

• savings $15 per year
• Price difference = $150

• Takes 10 years to break even. So either one has about the same cost -- but if the electricity price is expected to rise over the 10 years, then the more efficient one still is the best choice.
• At $.08 per kWh:

  • 300 kWh/year = $24
  • 240 kWh/year = $19.2
  • Savings per year = $4.80
  • Price difference = $150
  • Years to break even = $150/$4.80 = 31.25 years

• So it would be best to buy the cheap, low efficiency freezer
Energy Use Surveys

Dr. Herbert Wade

Energy Efficiency Improvement Workshop
Guam
August 20-24, 2012
Why Do Surveys

- Energy Use Surveys are not energy audits, they are surveys of users to get information needed to design DSM programs.
  
  - Typically the end result is an inventory of the energy using equipment in the user base

  - An audit includes cost information and predicts the savings that can be obtained from doing a particular energy saving activity.
Survey Design

• Design the surveys to find out about the facilities in use at the user’s location

  – To determine what types of energy efficiency measures will be effective

    ß For example there is not much use having a nice programme to replace electric water heaters with solar when only 5% of the utility customers use them
To provide data regarding what electrical equipment is in use to help forecast the market for appliance related actions

It is just as bad to be unprepared for a large response to DSM programmes from customers as it is to plan for a large response and get a small one. Forecasting is important in DSM project design.
When To Do Surveys

• After you gather all available data, determine the gaps in the data that have to be filled through a survey. Surveys are expensive and time consuming. If available data is adequate enough for energy efficiency project design do not do surveys

  – Surveys should be specifically designed fill in the gaps in the available data.
• Survey before designing the energy efficiency programme
  
  – Don’t decide on a programme and then do a survey to try to justify it. The survey should only be used to design a programme, not to justify one that is already decided.
Who to survey

- *Randomly* select customers in the category you are to work with (residential, small commercial, large commercial/industrial, government, etc.)
  
  - For user populations of under 1,000, *randomly* select at least 15% of the customers in the selected category or at least 20 customers, which ever is more. If there are 20 customers or less in the category, all should be surveyed.
  
  - For user populations of over 1,000, lower percentages can be used, with larger populations allowing smaller percentages, so long as the user selection process is truly random.
Doing a Random Selection

- Microsoft Excel has the capability of randomly selecting the number of users wanted for the survey.
  - First put all the customers of the type you want to survey into excel with one line for each customer
  - Using the Excel random number function, you can then select random line numbers from the list of all users and those will be the users selected for the survey
Who does the survey?

• Staff needed for a successful survey include:
  – Survey manager
    ⬇ Designs the survey, selects and trains survey personnel and ensures things run smoothly. Understands both survey techniques and the technology being surveyed
  – Several survey teams. Typically one team for about every 100-200 customers to be surveyed.
    ⬇ Each team will typically include:
      s Team leader
      s 6 to 10 surveyors
– Team supervisor

isión Needed if there is more than 1 team or if the teams will be widely separated geographically. If just 1 team the team leader handles supervision.

- Responsible to check survey forms each day for correctness and proper completion
- Responsible for team logistics and assignment of customers for each team to survey
How Much Do Surveys Cost

- Surveys have a wide range of costs according to geographic separation of survey sites and the complexity of the survey data that has to be gathered
  - Basic numerical surveys (e.g. survey of appliances in homes) cost from US$5 per survey site in dense urban areas up to US$25 when they are spread over a wide area
  - More complex surveys (e.g. where customers are asked many questions including ones where an opinion is required) cost from about US$15-US$50 per site again according to the geography of the survey area.
Survey Design

• Before designing a survey determine:
  – The information needed from the survey
    ß May include data that is numerical (e.g. what % of households have electric cookers), financial (e.g. what is the average household income and what are average expenditures), and sociological (e.g. what are people’s opinions about the importance of DSM)
  – The customer group to be surveyed and their general characteristics (geography in particular)
– All available data relating to the data needed
  $\text{Don't survey for data already available}$

– Availability and cost of people to be surveyors

– Availability and cost of people for data entry

– Budget available for carrying out the survey
Questionnaire design

• Minimize (hopefully eliminate) questions that require the surveyor to write in answers.
  
  – Use multiple choice selections whenever possible. Include every possible choice you can think of but always leave an “other” selection that can be written in. A good survey will have less than 1% of the answers as write in answers.
– Keep the questions as few in number and as simple as possible

β Keep tightly focused on the problem at hand. Don’t let other agencies or your own curiosity result in adding many more questions that are in fact not relevant to the problem at hand

– All data to be entered should end up in boxes in a vertical line

β If data is spread over different parts of the page, it dramatically slows both the rate and accuracy of data entry
• Code the answers in a way that minimizes confusion when entering data
  – Use numerical codes for some questions and alphabetical codes for others so when data is being entered it is easy to keep track of where you are in the questionnaire
  – For alphabetical codes avoid the letters I and O since they are easily confused with numbers
Take Photos

• Have surveyors take digital photos at each survey site

  – Cheap digital cameras or phone cameras are usually fine
  – Helps ensure that surveyors actually go to the site
  – Helps you understand the context of the data provided
  – Helps confirm the accuracy of the information provided by the customer
  – Each photo should show a card with the site ID code on it so the photo can be matched to the survey site. Never assume you can figure out the site from the sequence of the photo as taken.
Training

- All persons participating in the survey as supervisors, surveyors or for data entry should be trained for the survey being carried out
  - Classroom training of at least one day to cover procedures for asking questions and requirements for data collection
Language

- Surveys should be in the local language
  - Survey questionnaire should be in the local language so the surveyors do not have to translate the question. The question should be clear and needs to be tested during the trial survey to be sure it is easily and correctly understood
Choosing surveyors

• Experience has shown that surveyors need to be:
  – persons who have no direct interest in the result of the survey
  – who are not seen as any sort of authority figure by the people who are being surveyed
  – Reliable and competent
  – Preferably a man/woman team not just one person.
• Suggestions for surveyors include
  – Persons 25 or under
  – Unemployed school leavers
  – Persons from a technical school assigned to the project as an internship
  – Tertiary school students during school vacation time
• For surveyors, avoid:
  – Anyone holding political office or seeking office
  – Foreigners
  – Local community residents (surveyors should not survey their own communities)
  – Persons not completing at least form 5 (good literacy is required)
Practice Survey

- Do a practice survey including data entry and analysis of at least 4 sites per team - about one week

- Modify the questionnaires if problems are found with the questions or with data entry
Carrying out the survey

- Each day, teams are assigned blocks of survey sites

- Supervisors ensure that surveyors get to the sites and have the necessary transport to shift to new sites

- Each day, supervisors check every completed survey document for problems and works with surveyors to avoid those problems in the future
Data Entry

• Data entry should be started as soon as completed questionnaires are available
  – Ensures that if there are problems in the way questionnaires are filled out that the information can get back to the survey supervisors in time to correct the problem to minimize more data entry difficulties
Data Correction and Analysis

- All data entry should be checked from the original survey data sheets by a different person than the one entering the data.

- Microsoft Excel has been found to be adequate for these types of surveys. Special data analysis packages (e.g. SPSS) can be used but are hard to learn and are usually not necessary.
Analysis of data

• The data from the survey needs to be analyzed to get the information needed
  – When you do the small trial survey before the main survey, do an analysis of the trial survey data. Adjust survey questions to make analysis easier and more accurate

  – Do not start the survey until all procedures for analysis are figured out.
    ß You may need to change questions or add more questions in order to get the information from the survey using the analysis software you have available
## Sample Questionnaire

### NON AIR-CONDITIONED HOUSEHOLD SURVEY

<table>
<thead>
<tr>
<th>Survey Date:</th>
<th>MEC Meter Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Start Time:</th>
<th>District:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of person interviewed</th>
<th>Age:</th>
<th>Gender (M or F):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GPS reading at house:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

*(Surveyor note: Shaded question numbers are to be filled in by surveyor without asking the question to the respondent)*

#### 1. Construction of Main House

- W Wooden
- R Iron
- C Concrete

1a. Roof
1b. Walls

#### 2. Style of main roof

- F Flat
- S Shed (sloped)
- G Gable
- H Hip

2

#### 3. Ceiling construction (main room)

- N No ceiling, roof framing is visible
- V Vaulted ceiling (ceiling material attached to underside of roof framing)
- W Flat ceiling of wood
- G Flat ceiling of cement or gypsum board

3

#### 4. Direction of run of longest exterior wall

- E Mostly East to West
- N Mostly North to South
- D About diagonal to the compass

4

#### 5. Number of windows of each type

- Sliding
- Louvered
- Sash
- Bottom opening (outer island style)
- Fixed
- Number of windows with reflective film (tint)

5a. Sliding
5b. Louvered
5c. Sash
5d. Bottom opening (outer island style)
5f. Fixed
5g. Number of windows with reflective film (tint)

#### 6. How many persons live in the house most of the time

6
<table>
<thead>
<tr>
<th></th>
<th>Do you own and regularly use any of the following electric appliances (Enter the number owned, enter 0 if none)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Electric Cooking Stove</td>
</tr>
<tr>
<td></td>
<td>Electric Water Heater</td>
</tr>
<tr>
<td></td>
<td>Refrigerator with included freezer</td>
</tr>
<tr>
<td></td>
<td>Stand-Alone Freezer</td>
</tr>
<tr>
<td></td>
<td>Ceiling Fan</td>
</tr>
<tr>
<td></td>
<td>Floor stand fan</td>
</tr>
<tr>
<td></td>
<td>Desk Fan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>About how much per month do you have to pay for electricity?</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>What are the reasons why you do not have an airconditioner? (Enter &quot;Y&quot; for all that apply, &quot;X&quot; if not applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1. Don't feel we need it for adequate comfort</td>
</tr>
<tr>
<td></td>
<td>2. Too expensive to buy and install</td>
</tr>
<tr>
<td></td>
<td>3. Too expensive to operate</td>
</tr>
<tr>
<td></td>
<td>4. We don't own the house and cannot install one</td>
</tr>
<tr>
<td></td>
<td>5. The electrical wiring cannot handle the power</td>
</tr>
<tr>
<td></td>
<td>6. We plan to buy one soon</td>
</tr>
<tr>
<td></td>
<td>7. Other</td>
</tr>
</tbody>
</table>

What is the number one reason (if more than one is checked)?
### 10. Do you own and regularly use any of the following electric appliances (Y/N)

| Electric Cooking Stove | 10a |
| Electric Water Heater | 10b |
| Refrigerator with included freezer | 10c |
| Stand-Alone Freezer | 10d |
| Electric Clothes Dryer | 10e |
| Ceiling Fan | 10f |
| Floor Stand Fan | 10g |
| Desk Fan | 10h |

### 11. Have you had an air conditioner in this house in the past but no longer use one? If yes, why did you not replace it? (put a “Y” in all that apply and an “X” in the others)

1. We didn’t really need it, we are comfortable without it | 12a |
2. It could cost too much to buy a new air conditioner | 12b |
3. It would cost too much to run the new air conditioner | 12c |
4. Even when we had one we usually did not run it | 12d |
5. Other |
Labeling the Photos
Publication of the Analysis

• Each question should have the results shown either as a table or a graph according to the type of information that is needed.
Outreach for Businesses -- Audits

- Provision of good quality energy audits
  - Audits not only determine what and how energy is used but also notes problem areas and their possible solutions
  - Includes and estimated cost of the solutions and the amount of money implementing them will save through reduced electricity use
Investment Grade Audits

- Utility provided free audits are usually for guidance only. Once the customer knows what areas are wasting energy then an Investment Grade (sometimes called “Bankable”) audit should be done. This requires a detailed design for the energy efficiency improvement and cost estimates from suppliers. A clear analysis of the costs and benefits is included.
• Investment Grade Audits can be done through the utility but should include some cost coverage by the customer to ensure they are serious about investing.
Energy Equipment Inventories

Dr. Herbert Wade

Energy Efficiency Improvement Workshop
Guam
August 20-24, 2012
• Before a detailed energy audit is carried out, there needs to be a basic inventory of the energy using equipment in the facility

– Slightly different requirements for inventorying commercial/government buildings, hotels and tourist facilities, and hospitals.

– Ensures that auditors bring appropriate equipment for measurements and are prepared to characterize in detail the equipment in the facility.
• For most commercial and government facilities, the inventory can be accurately prepared by the users themselves.

• For hospitals, assistance from a person trained in “walk through” audits probably should be provided.
Inventory Components

• Contact Information
  – Who is the person responsible for energy at the facility and how to contact that person

• Background Information
  – Information about each building in the complex, its construction materials, age and other characteristics
• Energy Consumption Data
  – Metered electricity
  – Self-generated electricity
  – Other fuels/energy used

• Prior Energy Audits
  – Details of the audit, who sponsored it, date, etc.
• Equipment Inventory Information

  – Information about the inventory of lighting, Air-conditioners, Fans, Waterheaters, boilers, heat pumps, Refrigerators, etc.
Sample Inventory Forms

(Handout)
Residential Energy Equipment Inventory

• Refrigeration (Refrigerators/Freezers
  – Size (liters of capacity)
  – Door arrangement
    ß Vertical single door refrigerator or freezer
    ß Vertical top freezer bottom refrigerator
    ß Vertical one side freezer one side refrigerator
    ß Vertical top refrigerator bottom drawer freeer
    ß Top opening single door
Air Conditioner

• Type
  – Window unit
  – Split unit

• Capacity in Btu or other units

• Location in which room
• Television/Video Screen
  – CRT type
  – LED Type
  – LCD type
  – Plasma Type
  – Diagonal dimension (usually inches)
  – Watts on label
Video Game

- Video Game console that uses TV screen
  - Model
    - Wii
    - Sony Playstation
    - X Box
Lights

• Each light listed
  – Location
  – Watts
  – Type
    ß Incandescent
    ß Old tube type fluorescent
    ß New tube type fluorescent with electronic ballast
    ß CFL
    ß LED
Large Appliances

- Electric Cook Stove
  - Number of stove top elements
  - Is there an oven?

- Washing Machine

- Electric Clothes Dryer
Water Pumps

• Type of pump (manufacturer and model)
  – Source of water
  – Closed circuit for house
  – Open circuit to fill tank
  – Watts on label

• Swimming pool filter pump
Small Appliances

- Microwave
  - Check for phantom load
- Iron
- Hair Dryer
- Electric Kettle
- Rice cooker
- Electric Fry Pan
- Other ______________
Fans

- Ceiling Fan
- Floor Stand Fans
- Desk Fans
- Cooking Exhaust Fan
- Whole House Fan
- Window Fan
Water Heating

- Tank type electric water heater
  - With timer
- Instant Heating electric water Heater
- Solar Water Heater with electric backup
  - Automatic
  - Manual
Development of EEI-related legislation
Introduction of EEI-related systems

Taiiichi Kaizuka
The KANSAI Electric Power CO., INC.
Index (Day 3)

1. Development of EEI-related legislation Introduction of EEI-related systems
   1.1 Overview of energy conservation measures
   1.2 Why is energy conservation important?
   1.3 Why was energy conservation accelerated in the past?
   1.4 Energy conservation measures by regulation
      1.4.1 Measures for Factory/Business establishment
      1.4.2 Top runner standard and Energy saving labeling system
   1.5 Subsidy and tax reduction, etc for supporting energy conservation

2. Energy efficiency improvement business by utility
   2.1 Overview and scheme of ESCO
   2.2 Application example of ESCO
   2.3 Economic side of ESCO

3. Actual application of Energy efficiency improvement
   3.1 America - EERS
   3.2 France – Eco watt
Overview of energy conservation measures (Example of Japan)

- Divided into three sectors, “Industrial”, “Commercial & Residential”, “Transportation”
- Measures are divided into "regulation by law" and "support by tax reduction and subsidy".

<table>
<thead>
<tr>
<th></th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Energy conservation law)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Almost secured measure (Legal obligation or non-binding target)</td>
<td>• Target and degree of involvement must be carefully considered</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Data collecting is easy (Periodical report) from user</td>
<td>• Need clarification for confines of law</td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(tax reduction, subsidy, etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Need financial resources (Prepare as national budget or ADB grant)</td>
<td>• Appropriate support level (low: inactive response, high: budget shortfall)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Influence to ESCO business</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Categorize energy conservation measures and grasp overview
## Overview of energy conservation measures (Regulation)

<table>
<thead>
<tr>
<th>Regulation (Energy conservation law)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factory and business establishment (Annual energy use: 1500kl in crude oil equivalent or larger)</td>
<td>Commercial Residential</td>
<td>Consigner [sender] and carrier (above a certain size) Energy saving plan, report on energy consumption</td>
</tr>
<tr>
<td></td>
<td>Submit energy saving plan, Periodical report on the use of energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Owner of residence or building and client for construction (above a certain size)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Submit notification of energy saving measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Top Runner Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stipulate energy conservation standards for house appliances and vehicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy-saving labeling system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inform consumers of energy efficiency of house appliances</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Energy conservation law covers wide area as a comprehensive measure
## Overview of energy conservation measures (Support)

<table>
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<tr>
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<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Commercial</td>
<td>Residential</td>
</tr>
<tr>
<td>Support (tax reduction, subsidy, etc)</td>
<td>Subsidy for introduction of energy conservation facilities</td>
<td>Eco point system for housing</td>
</tr>
<tr>
<td></td>
<td>Tax reduction (special depreciation) for introduction of energy conservation facilities and construction of energy saving building</td>
<td>Tax reduction for home renovation</td>
</tr>
<tr>
<td></td>
<td>Subsidy for developing energy conservation technology (high efficiency heat pump, high-efficiency heat insulating material, etc)</td>
<td>Subsidy for clean energy vehicles</td>
</tr>
<tr>
<td></td>
<td>Provision of information related energy conservation</td>
<td>Tax reduction for ecology car</td>
</tr>
</tbody>
</table>

**Various measures need for support energy conservation**
1.2 Why is energy conservation important?
Why is energy conservation important?

✓ Contribution to energy security (Does the fuel price go up in the future?)

✓ The capital investment for infrastructure can be avoided or postponed.

✓ More effective countermeasure than building new power plant (According to one estimate in the U.S., unit cost for base load type power plant is 7.3 – 13.5 cents/kWh, unit cost for energy conservation is about 3 cents/kWh.)

✓ Energy conservation measures have high mobility. (Effects emerge in a short period. The effect of capital investment on energy conservation comes up in 1 – 3 years.)

✓ The fuel cost can be reduced by operating high-efficiency generator preferentially. (peak shift, peak cut)
Why is energy conservation important? (cont.)

✓ When the electricity rate is back spread (electricity rate is lower than cost), there is a merit by saving energy.
✓ It becomes to be widely realized the hardness to restrict using electricity. (Do people become more cooperative to build new power plant? Or still exist NIMBY? Example of “Eco Watt”)
✓ Contribution to preventing global warming
✓ To be honest.. as an electricity supplier, is it better to sell more electricity?

Demand Response

To be exact, demand responses like peak cut or peak shift are not the same energy conservation. DR aims kW reduction and energy conservation aims kWh reduction, but in wider sense, DR also contributes to KWh reduction. In this meaning, DR is also regarded as one of measures for energy conservation.
World Energy Demand outlook and comparison of self-sufficiency ratio in the energy supply

- The world energy demand is expected to increase by 1.3 times in 2030. (mainly in Asian countries)
- The competition for acquiring resource by the consuming countries like China will escalate and energy supply-demand structure will become serious.

There is a possibility of spike in fuel price in case that world energy consumption increases greatly. ⇒ The increase of energy purchase expense in the national budget

Energy conservation contributes to ensuring energy security.
Shale Gas Production Projections
Shale Gas – Widely Dispersed

Source: EIA
Effect of Peak-cut or Peak-shift

Short term: Possible to reduce fuel cost
Long term: Possible to reduce the installed generation capacity
1.3 Why was energy conservation accelerated in the past?
The efforts for energy conservation after oil crisis in Japan

- In Japan, the government and people did their best in energy conservation after the oil crisis of the 1970s.
- As a result, energy efficiency was improved by 33% during 30 years from 1979 to 2030.
- Efficiency per GDP has made little increase after the 1980s and further approach is expected.

Trends of primary energy consumption per GDP in Japan

Comparison of primary energy supply per GDP unit (2009)

(*)TOE: tonne of oil equivalent

Source: METI, cabinet office

Source: IEA
Turmoil in the oil crisis in 1970’s (Japan)

Toilet paper (bathroom tissue) had been sold out!
# Progress of energy conservation

<table>
<thead>
<tr>
<th>Year</th>
<th>World</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>The first oil shock</td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>The second oil shock</td>
<td>Enforcement of the Act on “the Law Concerning the Rational Use of Energy” (Energy conservation law)</td>
</tr>
<tr>
<td>1988</td>
<td>The 1st Intergovernmental Panel on Climate Change (IPCC) held in Geneva</td>
<td>The Oil Shock built a momentum of full-fledged deployment about energy conservation activity in Japan</td>
</tr>
<tr>
<td>1992</td>
<td>The UN Conference on Environment and Development (UNCED/Earth Summit) held in Rio de Janeiro</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>Implementation of the International Energy Star Program</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>The 3rd Conference of Parties (COP3) held in Kyoto</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td></td>
<td>Enforcement of the Act on Promotion of Global Warming Countermeasures</td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td>Establishment of the system for designating the Type 2 Designated Energy Management Factories, Introduction of the Top Runner Standard (*)</td>
</tr>
<tr>
<td>2000</td>
<td>Unceasing effort has made to fit with the times on energy conservation law</td>
<td>Introduction of the energy-saving labeling system</td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td>Enhancement of the measures for office buildings (*)</td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td>Establishment of the measures for transportation and the integrated control of heat and Electricity (*)</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td>Introduction of the system for regulating the energy use as a whole enterprise (*)</td>
</tr>
</tbody>
</table>

Source: ECCJ

(Revised of Energy conservation law)
1.4 Energy conservation measures by regulation
1.4.1 Measures for Factory/Business establishment
<table>
<thead>
<tr>
<th>Regulation (Energy conservation law)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Factory and business establishment (Annual energy use: 1500kl in crude oil equivalent or larger)</td>
<td><strong>Submit energy saving plan, Periodical report on the use of energy</strong></td>
<td>Consigner [sender] and carrier (above a certain size) Energy saving plan, report on energy consumption</td>
</tr>
<tr>
<td></td>
<td>Owner of residence or building and client for construction (above a certain size)</td>
<td><strong>Submit notification of energy saving measures</strong></td>
<td>Top Runner Standard <strong>Stipulate energy conservation standards for house appliances and vehicles</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Energy-saving labeling system</strong> <strong>Inform consumers of energy efficiency of house appliances</strong></td>
<td></td>
<td>(*)1500kl is about 330 k gallon</td>
</tr>
</tbody>
</table>
# Measures for Factory/Business establishment (1)

## Factories/business establishments with high energy consumption

<table>
<thead>
<tr>
<th>Factory</th>
<th>Business establishments</th>
<th>Factory / Business establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual energy use in crude oil equivalent (3000kl～)</td>
<td>Annual energy use in crude oil equivalent (1500kl ～3000kl)</td>
<td>The division of electricity and heat are abolished. (Formally, evaluated in kWh)</td>
</tr>
<tr>
<td>Possibility of application for in-company license</td>
<td>Appointment of a qualified person for energy management (Training Required)</td>
<td>Appointment of a qualified person for energy management</td>
</tr>
<tr>
<td>Appointment of <strong>Energy Manager</strong> (Mandatory to possess a license for a qualified person for energy management)</td>
<td>Preparation &amp; Submission of Periodical Reports</td>
<td>Preparation &amp; Submission of Periodical Reports</td>
</tr>
<tr>
<td>Preparation &amp; Submission of Mid- and long-term Plans</td>
<td>Preparation &amp; Submission of Mid- and long-term Plans</td>
<td>______________</td>
</tr>
</tbody>
</table>

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**Target and degree of involvement must be carefully considered**
Measures for Factory/Business establishment (2)

Confines of law: Annual energy use: 1500kl in crude oil equivalent or larger ⇒ cover 90% of industrial sector, 50% of commercial sector in energy usage base

Mandatory submission of annual report
1. Transition of specific energy consumption
2. State of implementation on energy conservation measures
3. State of benchmark index

Cover ratio is important, especially in energy base (not in number of customers base)

Benchmarking is one of the most effective analysis tool

In case of insignificantly insufficient level of energy conservation against judging criteria, instruction, public discloser, compliance order, fine are conducted.

(Flow of general inspection)

- Evaluation of annual report
- On site investigation
- Inspection
- Rationalization plan guidance
- Public disclosure/compliance order

If the assessment result is poor
If deemed significantly insufficient against judging criteria
In case of refuse to comply
Training System of Specialized Technical Engineers

■ Purpose of Creating the System

This system was created in FY2007 to build an environment in which each employee can work with stronger motivation and a sense of challenge. It also aims to improve the technical performance and skills of each employee and to maintain their technical abilities, which are closely related to the frontline as a power utility, and to pass them on to the next generation.

■ Target Persons

Persons who meet the following requirements are accredited as specialized technical engineers:
- Belong to an applicable office for accreditation
- Have advanced technical knowledge and skills closely related to practical work
- Have strong leadership and passion to teach technical knowledge and skills to the younger generation
- Not an officer

■ Role

A new role is given: to help solve various technical tasks in the office, and to instruct and train the younger generation on cross-cutting technical performance and skills closely related to ordinary work, mainly in the office.
Training System for Specialized Technical Engineers in the Distribution Sector

Accredited Fields

<table>
<thead>
<tr>
<th>Accredited Fields</th>
<th>Name</th>
<th>Number of persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particular Grid Failure</td>
<td>Specialized Technical Engineer (Particular Grid Failure)</td>
<td>11</td>
</tr>
<tr>
<td>Distribution Network Automation Equipment</td>
<td>Specialized Technical Engineer (Distribution Network Automation Equipment)</td>
<td>13</td>
</tr>
<tr>
<td>Measuring Equipment</td>
<td>Specialized Technical Engineer (Measuring Equipment)</td>
<td>15</td>
</tr>
<tr>
<td>Unit Substation</td>
<td>Specialized Technical Engineer (Unit Substation)</td>
<td>6</td>
</tr>
<tr>
<td>Pursuing electrical work together with other infrastructure companies (eg. water/gas company)</td>
<td>Specialized Technical Engineer (Pursuing electrical work together with other infrastructure companies)</td>
<td>10</td>
</tr>
<tr>
<td>Indoor Type Transformer (22kV)</td>
<td>Specialized Technical Engineer (Indoor Type Transformer (22kV))</td>
<td>2</td>
</tr>
</tbody>
</table>

Total: 57 persons

Roles of specialized technical engineers

- Training for young people
  1. Giving technical instruction and advice on various maintenance work such as inspection, measurement, and checking under presence
  2. Grasping the skill level of the younger generation, giving proper instruction and advice to individuals, and compiling the contents of instructions
  3. Drawing up training plans
  4. Teaching at various group education sessions

- Tackling technical challenges at the job site
  1. Investigating causes, creating and implementing countermeasures in case of power failure/troubles
  2. Addressing various technical challenges on maintenance and construction works
Specialized Skill and Engineer Activity

Main Action throughout Company

- Briefing session of activity of specialized technical engineers (Once a year)
- Study session of specialized technical engineers (Newly planed)
- Support of lecturer in the lesson to train specialized technical engineers (Jul ~ Oct)
- Support of Specialized Training in the Distribution Engineering Center (DEC)
- Participation to the Working Group of Head Office (New Meter SWG, Distribution Tower WG etc.)
- Support of Training in the branch offices, Support of work in each section, etc.

The condition of activities is grasped and the plan of activities is followed, by collecting the report of action plan periodically (Once a quarter of year) which includes activity results of specialized technical engineers.

The opinions to improve system of specialized engineers and activities are exchanged in briefing session of activity.

The leaders of each field lead to support specialized technical engineers in support action, training support, and training of next candidate.
Final energy consumption in Japan has been increasing. (except oil crisis and economy depression)
While GDP increased by 2.3 times from 1973 to 2009, total energy consumption increased by 1.3 times.
The growth rates of final energy consumption in each sector are different.
(Transportation 1.9 times, Commercial/residential 2.4 times, Industrial 0.85 times)

Increase in the commercial/residential sector which accounts for over 30% of all is remarkable.
Reinforcement in this sector is most sought. (Need to focus in the priority areas)
Introduction of benchmark classified by sector

[background]
- Fairer evaluation of business entity’s effort
- Promotion of business entity’s effort by visualization of energy saving efforts
  - It is difficult for business entity who has already tackled with energy conservation to considerable degree to accomplish further energy saving.
  - Defining the benchmark index by which business entities’ effort can be compared contribute to fair evaluation of business entities’ effort and making low-performing business entities tackle further efforts.
  - The superior business entities (10~20%) of each sector become target level.

[How to select industrial sector for benchmark]
- In FY 2008, three industrial sectors of steel, cement and electric power were chosen. It’s decided in consideration of largeness of their energy consumption (occupies 40% energy consumption in all industrial sectors), and extent of international argument in each sector.
- Paper manufacturing, oil refinery, and the chemical industry were added in FY 2009. (The cover rate of the energy consumption expanded to about 60%)
- Expansion to commercial sectors such as office, retailing, etc is considered in the future.

[Publication of benchmark results]
- In order to urge spontaneous efforts by business entity, average and standard deviation of benchmark are published.
- The names of excellent energy saving entities are published.

Source: METI
1.4.2 Top runner standard and Energy saving labeling system
### Overview of energy conservation measures (Regulation)

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<td>Top Runner Standard Stipulate energy conservation standards for house appliances and vehicles</td>
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<tr>
<td></td>
<td>Energy-saving labeling system Inform consumers of energy efficiency of house appliances</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Energy conservation standards for domestic appliances and vehicles are set in the Top Runner program.
• The concept of the program is that energy conservation standards shall be set exactly the same as or higher than the best standard value available in the market.

How to set the target standard

Best standard value available in the market (78)

Target standard (80)

Achievement is judged by weighted average per product category

(84+83+79) / 3 = 82 ≧ 80

At the time of setting the standard

Target year

Target products (23 products)

1. Passenger Vehicles
2. Freight Vehicles
3. Air Conditioners
4. Electric Refrigerators
5. Electric Freezers
6. Electric Rice Cookers
7. Microwave Ovens
8. Lighting equipment
9. Electric Toilet Seats
10. TV Sets
11. Video Cassette Recorders
12. DVD Recorders
13. Computers
14. Magnetic Disk Units
15. Copying Machines
16. Space Heaters
17. Gas Cooking Appliances
18. Gas Water Heaters
19. Oil Water Heaters
20. Vending Machines
21. Transformers
22. Routers
23. Switching Units

(※) two products are added in 2009

Target standards are subdivided according to the type and size, etc. In case of TV

TV type
• Carbon lay tube TV,
• Liquid crystal TV
• Plasma TV

Television size
• Below 19V size
• 19V ~ 32V
• 32 size or larger

Source: METI
There is obligation to comply with the standards. In case of failing to comply, recommendation, publication, order, penalty are imposed.

For each of the companies that manufacture or import machinery and equipment covered by the Top Runner Program.

1. Passenger Vehicles 2,000 vehicles
2. Freight Vehicles 2,000 vehicles
3. Air Conditioners 500 units
4. Electric Refrigerators 2,000 units
5. Electric Freezers 300 units
6. Electric Rice Cookers 6,000 units
7. Microwave Ovens 3,000 units
8. Lighting equipment 30,000 units
9. Electric Toilet Seats 2,000 units
10. TV Sets 10,000 units
11. Video Cassette Recorders 5,000 units
12. DVD Recorders 4,000 units
13. Computers 200 units
14. Magnetic Disk Units 5,000 units
15. Copying Machines 500 units
16. Space Heaters 300 units
17. Gas Cooking Appliances 5,000 units
18. Gas Water Heaters 3,000 units
19. Oil Water Heaters 600 units
20. Vending Machines 300 units
21. Transformers 100 units
22. Routers 2,500 units
23. Switching Units 1,500 units

In case of TV, manufacturers or importers whose total shipment volume is fewer than 10,000 units are exempted.
Result s of energy efficiency improvement are beyond initial expectations.

Example of energy efficiency improvement

<table>
<thead>
<tr>
<th>Product category</th>
<th>Energy efficiency improvement (result)</th>
<th>Energy efficiency improvement (initial expectation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV receivers (TV sets using CRTs)</td>
<td>25.7% (FY 1997 → FY 2003)</td>
<td>16.4%</td>
</tr>
<tr>
<td>Air conditioners (Room air conditioners)</td>
<td>67.8% (FY 1997 → 2004 freezing year)</td>
<td>66.1%</td>
</tr>
<tr>
<td>Electric refrigerators</td>
<td>55.2% (FY 1998 → FY 2004)</td>
<td>30.5%</td>
</tr>
<tr>
<td>Fluorescent light equipment</td>
<td>35.7% (FY 1997 → FY 2005)</td>
<td>16.6%</td>
</tr>
<tr>
<td>Copying machines</td>
<td>72.5% (FY 1997 → FY 2006)</td>
<td>30.8%</td>
</tr>
<tr>
<td>Magnetic disk units</td>
<td>85.7% (FY 2001 → FY 2007)</td>
<td>71.4%</td>
</tr>
</tbody>
</table>

Example of Air conditioner

Transition of energy consumption

Comparison of efficiency of top model

75.7% reduction

COP

Japan USA EU China Thai
### Overview of energy conservation measures (Regulation)

<table>
<thead>
<tr>
<th>Regulation (Energy conservation law)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory and business establishment (Annual energy use: 1500kl in crude oil equivalent or larger)</td>
<td></td>
<td></td>
<td>Consigner [sender] and carrier (above a certain size) Energy saving plan, report on energy consumption</td>
</tr>
<tr>
<td>Submit energy saving plan, Periodical report on the use of energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owner of residence or building and client for construction (above a certain size)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submit notification of energy saving measures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top Runner Standard Stipulate energy conservation standards for house appliances and vehicles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-saving labeling system Inform consumers of energy efficiency of house appliances</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The energy saving labeling system has been introduced to inform consumers of energy efficiency of home appliances and to promote energy efficiency products. 18 products are selected from targets of top runner program in consideration of high frequency usage by general consumer.

- **Energy conservation standard achievement percentage**
  - **Target year FY2006**
  - **108% 175kWh/year**
  - **91% 206kWh/year**

- **Annual Electricity Consumption**
  - **Info -1** Green: target is achieved, Orange: non-achieved
  - **Info -2**
  - **Info -3**
  - **Info -4**

Source: Agency for Natural Resources and Energy
Energy Saving labeling system (mainly for retailer)

- The obligation to make efforts to provide information by retailers was stipulated in 2006.
- 5 products are selected with consideration for largeness and variability of electricity consumption. (Air Conditioners, TV sets, Electric Refrigerators, etc)
- More detailed information is provided to consumers.

Info -1: year the label was prepared
Info -2: CFC mark represents CFC-free refrigerators
  (*) CFC: chlorofluorocarbon
Info -3: Multi-stage rating system — energy saving performance is indicated 5 stages. Arrows are placed under the stars, showing achievement and non-achievement for top runner standard.
Info -4: the same information as Energy saving labeling system for manufacturer
Info -5: Expected annual electricity bill

Source: Agency for Natural Resources and Energy “2009 Energy Conservation Performance Catalogue Summer”
National Government’s Subsidy System

- **Eco-Point System**

  - **Purposes**
    1. CO2 reduction
    2. Vitalization of the economy
    3. Familiarization of TV sets for terrestrial digital broadcasting

  - **Eligible products**
    Air conditioners, electric refrigerators and TV sets for terrestrial digital broadcasting equivalent to 4 stars (★★★★) or over of the Uniform Energy Conservation Label.

- **Products for exchange**
  1. Energy Conservation and environment-friendly products
  2. Redeemable gift certificates or prepaid cards (of environment-friendly purpose, such as sponsor’s environmental donation) that can be used nationwide
  3. Contribution to regional development (local merchandise coupon, local goods, etc.)

Source: Agency for Natural Resources and Energy “2009 Energy Conservation Performance Catalogue Summer”
1.5 Subsidy and tax reduction, etc for supporting energy conservation

~ Model cases to consider the supporting policy for energy conservation measures ~
# Overview of energy conservation measures (Support)

<table>
<thead>
<tr>
<th>Support (tax reduction, subsidy, etc)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eco point system for housing</td>
<td>Tax reduction for ecology car</td>
</tr>
<tr>
<td>Subsidy for introduction of energy conservation facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax reduction (special depreciation) for introduction of energy conservation facilities and construction of energy saving building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsidy for developing energy conservation technology (high efficiency heat pump, high-efficiency heat insulating material, etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision of information related energy conservation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Various measures need for support energy conservation
Overview and purpose

In order to promote energy saving in the commercial and residential sector as one of the measures to mitigate tight supply and demand, subsidize equipment introduction with a certain amount of energy saving effect to existing buildings.

Specifically,
(1) The targets of subsidy are limited to air-conditioning, water heater, lighting equipment, heat insulation equipment, etc in consideration on reduction effect of electricity consumption.
(2) Although in case of introduction of only equipments, subsidy can be given if the following requirements are satisfied. “replace more than half of equipments in the whole building” and “more than 10% energy saving effect”

These measures contribute to reduce electricity consumption of commercial and residential sector by promoting equipment-only replacement in building which was not covered in former subsidy system.

Subsidy rate 1/3 (for small businesses: 1/2)
Overview and purpose

- Subsidy on introduction of facilities (limited to replacement) from the energy saving measures which business utilities planned in the standpoint of “leading edge technology”, energy conservation effect”, and “cost performance”.

- Set the priority on subsidy to introduce “leading edge facility and technology”

- In order to promote energy saving investment, priority is given to small and medium-sized enterprises and energy intensive type businesses.

- Set priority on the business which has high performance for energy saving in order to help mitigation of tight supply and demand situation.

- Subsidy rate 1/3 or less (business cooperation of different capital; 1/2 or less)

Source: METI
Subsidy on promoting introduction for specified facility aiming rational use of energy

Overview and purpose

- Investments for energy saving facilities are supposed to increase reflecting the growing needs for energy saving in industrial sector, etc and energy conservation from aftermath of great East Japan earthquake.

- When the business utilities which install energy saving facilities or and top-runner equipments take out a loan from private sector financial institutions, the subsidy which serves as a low interest can be obtained.

- Subsidy rate
  fixed amount (grant-in-aid for paying interest 1.0%)

Source: METI
Overview and purpose

- Diagnosis on possibility of introduction for energy saving technology is performed to business utilities. This subsidy promotes energy saving in factories and office buildings, etc.

- In consideration of aftermath from the great East Japan earthquake, target business utility is expanded from 2012.
# Overview of energy conservation measures (Support)

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<tbody>
<tr>
<td></td>
<td>Subsidy for introduction of energy conservation facilities</td>
<td>Eco point system for housing</td>
<td>Subsidy for clean energy vehicles</td>
</tr>
<tr>
<td></td>
<td>Tax reduction (special depreciation) for introduction of energy conservation facilities and construction of energy saving building</td>
<td>Tax reduction for home renovation</td>
<td>Tax reduction for ecology car</td>
</tr>
<tr>
<td></td>
<td>Subsidy for developing energy conservation technology (high efficiency heat pump, high-efficiency heat insulating material, etc)</td>
<td>Provision of information related energy conservation</td>
<td></td>
</tr>
</tbody>
</table>

Various measures need for support energy conservation
**Information provision prescribed in Energy conservation law**

The obligation to make efforts to provide information about general consumer is prescribed to energy supply utilities.

<table>
<thead>
<tr>
<th>Energy saving information to consumers</th>
<th>Present situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly energy consumption of the corresponding month of last year used by general consumer</td>
<td>It has already provided on electricity bill</td>
</tr>
<tr>
<td>Monthly energy consumption and charge for past one year used by general consumers</td>
<td>Information service on web has started in some electric utilities.</td>
</tr>
<tr>
<td>Rough indication on reduction of energy consumption and charge by devising the usage of equipments.</td>
<td>Energy-saving advice is indicated on electricity bill. The electric power used by individual equipment is considered to offer through HEMS (Home energy management system) in the future.</td>
</tr>
<tr>
<td>Performance and subsidy information for energy saving equipments</td>
<td>Information has already provided in HP of electric utilities, etc. In the future, the further information dissemination is supposed as an energy management service by introduction of HEMS, etc.</td>
</tr>
</tbody>
</table>

Source: METI
Energy efficiency improvement
business by utility

Taiichi Kaizuka
The KANSAI Electric Power CO., INC.
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   1.2 Why is energy conservation important?
   1.3 Why was energy conservation accelerated in the past?
   1.4 Energy conservation measures by regulation
      1.4.1 Measures for Factory/Business establishment
      1.4.2 Top runner standard and Energy saving labeling system
   1.5 Subsidy and tax reduction, etc for supporting energy conservation

2. Energy efficiency improvement business by utility
   2.1 Overview and scheme of ESCO
   2.2 Application example of ESCO
   2.3 Economic side of ESCO

3. Actual application of Energy efficiency improvement
   3.1 America - EERS
   3.2 France – Eco watt
2.1 Overview and scheme of ESCO
Even if you want to start renovation work for energy-saving.......  
- Financing of initial investment is difficult.  
- Reduction of energy cost does not progress.  
- The expense of equipment maintenance may occur suddenly and hard to control cash planning  
- I do not want to have an excessive capital from the viewpoint of financial strength.

ESCO: Energy Service Company

ESCO covers expense for energy saving renovation by its saving merits (reduction of fuel and light cost, etc).  
ESCO business company provides the comprehensive service like energy audit, design and construction for renovation work, operation and maintenance for facilities.  
ESCO is characterized by its performance contract by which ESCO business company guarantees the energy saving performance to customer.
Spreading and promotion of the ESCO business
~ The ESCO market is expanding ~

- ESCO-related markets have shown rapid growth since ESCO was introduced to Japan in the mid-1990s.
- However, market size in FY 2004 decreased from FY 2003 due to a decrease in the number of large-scale projects in the industrial sector.
- Market size increased in FY 2005. In particular, the percentage of performance contracts increased.

Trends on energy-saving renovations in Japan (orders received)

Market size in the U.S. in FY 2000 was approximately 2 billion dollars.

The Kansai has affiliate company offering ESCO business (KENES: Kanden energy solution).
ESCO business provides comprehensive service

Comprehensive services of the ESCO project
(1) Energy audit and consultation for finding energy conservation measure
(2) Planning, design, construction and construction management for introducing energy conservation measures
(3) Measurement and verification of energy conservation effects after introduction
(4) Maintenance and operational management of introduced facilities and systems
(5) Project financing, arrangements with financial institutes, etc.

In the case of a general energy saving renovation work, it is difficult to guarantee energy saving effect because design contract, construction contract, and the operation & management contract for facilities become separate in usual cases.

Source: JAESCO
The feature of ESCO is performance contract

<table>
<thead>
<tr>
<th>Contract Type</th>
<th>Guaranteed savings contract</th>
<th>Shared savings contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-saving renovation costs covered by</td>
<td>Customer</td>
<td>ESCO Company</td>
</tr>
<tr>
<td>Owner of energy-saving facilities</td>
<td>Customer</td>
<td>ESCO Company</td>
</tr>
<tr>
<td>Service charge payment</td>
<td>A certain amount of money or a certain percentage of energy saving gains (saving on utility bills) is paid.</td>
<td></td>
</tr>
<tr>
<td>Division of profits after completion of the contract</td>
<td>All energy saving gains (saving on utility bills) belong to customers.</td>
<td></td>
</tr>
</tbody>
</table>
The feature of ESCO is performance contract (cont.)

<table>
<thead>
<tr>
<th>Contract Type</th>
<th>Guaranteed savings contract</th>
<th>Shared savings contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benefit for customers</td>
<td>1) Energy-saving is ensured because the amount of conserved energy is assured.</td>
<td>1) Energy-saving is ensured because the amount of conserved energy is assured.</td>
</tr>
<tr>
<td></td>
<td>2) Energy-saving facilities belong to customers because they cover the initial investment costs.</td>
<td>2) Off-balance-sheeting energy-saving facilities (facilities need not be incorporated in the balance sheet)</td>
</tr>
<tr>
<td></td>
<td>3) Customers do not have to take financial risks because ESCO companies cover the cost to install energy-saving facilities.</td>
<td></td>
</tr>
</tbody>
</table>

ESCO business company guarantees the amount of energy-saving reduction by a performance contract. For this reason, ESCO business company has incentives to execute reliable renovation work to secure design performance. ESCO business company has incentives for operation & maintenance of facility, because three is merit also to ESCO company when energy reduction effect is better than it was guaranteed.
2.2 Application example of ESCO
Support, in the forms of partial subsidy for initial investments, low-interest loans, etc., is extended to private enterprises and local governments implementing ESCO business.

ESCO projects have tended to increase their shares among “the government subsidy to disseminate and promote the projects that introduce highly-efficient energy system for residences and buildings” and “the government subsidy to assist businesses who execute the rational use of energy”.

Example of ESCO business (at a hospital)

- **Energy saving lighting**
  - Energy conservation with a three-step light-modulating inverter stabilizer

- **Steam line**
  - Insulation, integration

- **Boiler drain**
  - Toilet using gray water

- **Inverter control**
  - Reduced power for air conditioning fan/pump

- **Reduced water use when using the toilet**
  - Steam drain used as gray water

- **Gas driven absorption-type hot water system**
  - Updating to the latest Top Runner qualified equipment

- **Co-generation system**
  - Supply of electricity/heat
  - Effective use of exhaust heat

Energy conservation effect from ESCO: approximately 25%

Source: METI
Example of ESCO service by KENES

ESCO service: Guaranteed saving contract, Service start: April, 2010, Customer: university

Overview of ESCO service

【Introduction of air-conditioning control】
Schedule operation, timer operation, temperature control using computer contribute to cut waste

【GHP→EHP】
Gas engine heat pump with long running time is changed into electric heat pump.

【Air cooling heat pump package air-conditioner】
Steam driven absorption refrigerating machine, steam heat exchanger, Air conditioning air handling FCU changed into air-cooled heat pump type packaged air conditioners

【change to direct expansion air conditioning】
An air cooling heat pump chiller is improved to an efficient air cooling heat pump package.

Source: KENES
Example of ESCO service by KENES (cont.)

【Downlight changed to LED】
Introduction of LED downlight with long life, energy saving and mercury-less

【Change to fluorescent light with inverter ballast】
Fluorescent lights are exchanged to high efficient type and the motion sensors were introduced at half places.

【Reduction of water for toilets】
demo sound equipment and Automatic washing machine

【Saving energy belt】
Fans with long running time are exchanged to energy saving type.

【High efficiency transformer】
Change to high efficiency oil-immersed transformer (300kVA × 1, 200kVA × 1)

Cost reduction

-14%
before after

Source: KENES
Mechanism of heat pump (in case of cooling)

Heat pump is technology which is made to move the heat which air and water have and is used for an air conditioning, hot-water supply, etc.

Electricity is not directly used as a heat source like an electric heater, but electricity is used as a driving force for making heat transfer, and the heat filled in the atmosphere is used well.

Air conditioning utilizing “heat pump” technology

Temperature difference causes spontaneous transfer of heat.

(1) Hot liquid refrigerant is cooled by outdoor air through heat exchanger.
(2) Liquid refrigerant evaporates through valve and its temperature falls.
(3) Cold gas refrigerant removes air heat indoor (air conditioning).
(4) Compressor compresses and liquefy refrigerant.
Mechanism of heat pump (in case of heating)

1. Electricity
2. Condenser
3. Discharge of heat
4. Temperature falls by suddenly lowered pressure.
5. Evaporator
6. Refrigerant compressed by compressor raises temperature.
7. Heat absorption from the air
2.3 Economic side of ESCO
Economic Evaluation (1)

- **Lifecycle (or Lifetime) Cost**

(A) Introducing system of **low initial cost** and **low efficiency** (=high energy cost)

- Initial cost (machine and its installation)
- Annual energy cost

(B) Introducing system of **high initial cost** and **high efficiency** (=low energy cost)

Total owning cost of period for use

\[ = I + E \times (\text{Period of use}) \]

*Lifecycle Cost for 10yrs*

\[ LCC_A = I_A + E_A \times 10 \]
\[ LCC_B = I_B + E_B \times 10 \]

*Not in consideration of interest or discount rate for simple*
Economic Evaluation (2)

• Payback Period for Introducing Higher Efficiency System

Comparing (B) to (A), payback period

\[ \text{Payback Period} = \frac{(I_B - I_A)}{(E_A - E_B)} \]

(when just replacing newer system, \( I_A = 0 \))

*Not in consideration of interest or discount rate for simple
Economic Evaluation (3)

• Annual Equivalent Cost

*Annual Equivalent Cost for Lifetime of 10yrs

\[
AEC_A = \frac{I_A}{10} + E_A (= \frac{LCC_A}{10})
\]

*Not in consideration of interest or discount rate for simple
How to compare the present value and future value?

- **Present value**
  
  Present $100 > 1$ year later $100$

  \[
  \text{Present } 100$ \quad = \quad 110$ in $1$ year later
  \]
  \[
  \frac{110}{1.1} = 100
  \]

  \[
  \text{Present } 100$
  \]
  \[
  = \quad 2$ years later $121$
  \]
  \[
  \frac{121}{1.1} \times \frac{1}{1.1} = 100
  \]

  \[
  \begin{align*}
  132 + 184 + 189 &= 505, \text{ is not correct answer} \\
  \frac{132}{1.1} &= 120 \\
  \frac{184}{1.1} &= 152 \\
  \frac{189}{1.1} &= 142 \\
  120 + 152 + 142 &= 414
  \end{align*}
  \]

  \[
  \text{132} \quad 184 \quad 189
  \]

  \[
  \text{1year later} \quad \text{2years later} \quad \text{3years later}
  \]

In consideration of opportunity cost, it is discounted at the same time point.

The project cost must be discounted at the same time point.
Example for ESCO Service charge (1)

**<Target value>**

Facility installation expenses 9150
Removal 910, and other expenses is spread into annual basis

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>245</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>135</td>
</tr>
<tr>
<td>Heavy fuel</td>
<td>2,230</td>
</tr>
<tr>
<td>Oil</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>310</td>
</tr>
</tbody>
</table>

**<guaranteed value>**

ESCO service charge in case $45.7mil subsidy

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>245</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>135</td>
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</tr>
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<td>Oil</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>310</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reduction</th>
<th>1,990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>24</td>
</tr>
<tr>
<td>Electricity</td>
<td>906</td>
</tr>
</tbody>
</table>

**Customer’s merit**

| 920 |

**ESCO Charge**

| 1,070 |

**Reduction**

| 1,990 |

| 920 |

**ESCO Charge**

| 390 |

**Removal**

| 910 |

**Other expenses**

| 9150 |

100$/year

In case of 50% of a grant rate with a subsidy

before

1~15 years later

16~20 years later

ESCO service charge in case $45.7mil subsidy
Example for ESCO Service charge (2)

Since there is no subsidy, ESCO service charge goes up.

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>245</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>135</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td>2,230</td>
</tr>
<tr>
<td>Electricity</td>
<td>310</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expense for Light Heating Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
</tr>
<tr>
<td>Electricity</td>
</tr>
</tbody>
</table>

| Reduction | 1,990 |

<table>
<thead>
<tr>
<th>Customer’s merit</th>
<th>508</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESCO Charge</td>
<td>1,481</td>
</tr>
</tbody>
</table>

| Reduction | 1,990 |

<table>
<thead>
<tr>
<th>Customer’s merit</th>
<th>1,558</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESCO Charge</td>
<td>431</td>
</tr>
</tbody>
</table>

| Reduction | 1,990 |

In case of no subsidy

100$/year

before

1~15 years later

16~20 years later

<target value>

<guaranteed value>

before

1~15 years later

16~20 years later
Actual application of Energy efficiency improvement

Taiichi Kaizuka
The KANSAI Electric Power CO., INC.
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3.1 America - EERS
Policy on energy efficiency improvement to electric utilities (U.S.)

- In the U.S., the state law which defines the amount of energy-saving duty (EERS: Energy Efficiency Resources Standard) to future electricity sales has become widespread.
- Curbing electric power sales is made compulsory not to consumers or public institutions but to electric utilities. (From the side of electric utilities, it will exactly be that the income reduction by curbing electricity sales is forced.)
- As an incentive to electric utilities, cost recovery for energy saving program, lost revenue recovery, performance incentive, etc.
- It was first introduced to Texas in 1999, and 26 states have already introduced as of January 2011.

Legislation on EERS

Legislation on performance incentive for energy saving investment
Incentive scheme to support energy efficiency improvement (1)

The main schemes for making electric utilities promote energy efficient measures is as follows.
(1) Cost recovery for energy saving program
(2) Lost revenue recovery
(3) Performance incentive

(1) Cost recovery for energy saving program
Cost recovery for energy saving program like energy saving education, subsidy for replacement from electric bulb to FL (fluorescent light) is the minimum condition. Recovery schemes are
• include in rate base and collect as electricity charge
• collect by adding extra charge (ex. surcharge) to electricity charge
• recover from funds collected proportionally to electricity consumption aiming at public-interest use like subsidy to low income group (SBC:System Benefits Charge)

(2) Lost revenue recovery
(2-1) Direct compensation
• Recover decrease in electricity sales due to energy saving by adding extra charge (ex. surcharge) to electricity charge
• Weak point of direct compensation is that accurate method for measuring energy saving effect doesn’t exist. Few states have introduced.
• Moreover, since there is no mechanism of collecting the exceeding sales from an electric utilities in case of electricity sales increase, it does not lead to prevention of throughput incentive.

What is “Throughput incentive”?
• An electric power supplier as well as other manufacturers pursues profits by increasing goods, i.e., electricity sales.
• That is, it is natural to think that corporate activity seeking more electricity sales is induced.
• When discussing promotion of an energy-saving measure, this is called “throughput incentive” works.
Incentive scheme to support energy efficiency improvement (2)

(2-2) Decoupling
• The basic scheme is separation of relation between sales revenue and amount of electricity sales.
• That is, a fixed sales revenue guaranteed irrespective of amount of electricity sales.
• It is also applied to demand fluctuation resulting from weather condition or economic trends.
• If the electricity sales revenue is less than overall cost which is applied at rate revision, collects deficit by raising electricity rate and vice versa. Therefore, throughput incentive does not work.
• Since adjustment is done not by the amount of energy saving achievement but by sales revenue, measurement of the energy saving effect is unnecessary which results in becoming operational under relatively simple scheme.
• Since In order that a circulation income may aim at profits increase in the fixed bottom,
• Since pursuing profit is restricted under the fixed electric sales, electric utilities have incentives for cost reduction.
• Large quantity consumer organization (Industrial Energy Consumers of America) expresses concern over decoupling as this scheme hangs the consumer side on the risk of electric sales reduction.
### Incentive scheme to support energy efficiency improvement (3)

#### Principle of Decoupling

<table>
<thead>
<tr>
<th>Rate revision</th>
<th>FY</th>
<th>A</th>
<th>B</th>
<th>C(A/B)</th>
<th>D</th>
<th>E(D/B)</th>
<th>F</th>
<th>G(E × F)</th>
<th>H(G−A)</th>
<th>I(D−G)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Full cost($)</td>
<td>Expected sales (MWh)</td>
<td>Unit Price ($/MWh)</td>
<td>Approved revenue</td>
<td>Applied unit Price</td>
<td>Actual sales</td>
<td>Actual revenue</td>
<td>Difference</td>
<td>Balance account</td>
</tr>
<tr>
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<td>1000</td>
<td>0.100</td>
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<td>0.100</td>
<td>1100</td>
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<td>10.00</td>
<td>▼10.00</td>
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<tr>
<td></td>
<td>2</td>
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<td>90.0</td>
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<td>2nd</td>
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<td>112.00</td>
<td>0.90</td>
<td>0.00</td>
</tr>
</tbody>
</table>

#### The principal of filling lost profit

- **The usual charge design**
  - Assumption volume of sales
  - Expected sales
  - Charge income
  - Full cost

- **Direct filling**
  - Assumption volume of sales
  - Expected sales
  - Charge income
  - Full cost

- **decoupling**
  - Assumption volume of sales
  - Expected sales
  - Charge income
  - Full cost
(3) Performance incentive

• Although the schemes described above, (1) Cost recovery for energy saving program or (2) Lost revenue recovery are supposed to get rid of negative incentives when electric utilities are going to implement energy saving measures, only their use are not connected with investment on positive energy saving measures.

• For this reason, performance incentive proportional to achievement degree of energy saving is considered. Conversely, it is considered that imposing penalty is also effective for negligence.

• Specifically, there invented three kinds of schemes.

① Performance target incentives
Reward can be obtained in proportional to achievement degree of energy saving against the target prescribed in every fiscal year by the regulating authority.

② Shared savings incentives
There generated the merits like reduction of fuel procurement or elimination of construction cost for electricity supplying facilities by energy saving measures. The part of merits converted into financial value is allocated to electric utilities on the basis of its degree of energy saving effort. The rest of merits is deemed to give back to consumer side.

③ Rate of return incentives
Return rate for energy saving investment is set higher than the other investments.
# Introductory situation of incentive scheme by state

<table>
<thead>
<tr>
<th>State</th>
<th>Cost recovery for energy saving</th>
<th>Lost revenue recovery</th>
<th>Performance incentive</th>
<th>Save a watt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>rate base</td>
<td>SBC</td>
<td>surcharge</td>
<td>decoupling</td>
</tr>
<tr>
<td>Alabama</td>
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<tr>
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<td>Arkansas</td>
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<tr>
<td>California</td>
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<td>Yes</td>
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<tr>
<td>Colorado</td>
<td>Yes</td>
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<td>Delaware</td>
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<tr>
<td>District of Columbia</td>
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As of 2009, Source: ACEEE
<table>
<thead>
<tr>
<th>State</th>
<th>Cost recovery for energy saving</th>
<th>Lost revenue recovery</th>
<th>Performance incentive</th>
<th>Save a watt</th>
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<tbody>
<tr>
<td></td>
<td>rate base</td>
<td>SBC surcharge</td>
<td>decoupling</td>
<td>Direct compensation</td>
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<td>Nevada</td>
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<td></td>
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<tr>
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<td>Tennessee</td>
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<tr>
<td>Texas</td>
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<td>Utah</td>
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<tr>
<td>Vermont</td>
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<td>Yes</td>
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<tr>
<td>Virginia</td>
<td>Yes</td>
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<tr>
<td>Washington</td>
<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>West Virginia</td>
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<td></td>
<td>Yes</td>
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<tr>
<td>Wisconsin</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Wyoming</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

As of 2009, Source: ACEEE
Ten geographically dispersed states have committed to long-term targets to achieve over 10% cumulative annual savings by 2020.

Source: ACEEE
<table>
<thead>
<tr>
<th>State</th>
<th>Cumulative 2020 Target</th>
<th>State</th>
<th>Cumulative 2020 Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maryland*</td>
<td>26.70%</td>
<td>Maine*</td>
<td>13.40%</td>
</tr>
<tr>
<td>New York*</td>
<td>26.50%</td>
<td>California</td>
<td>12.94%</td>
</tr>
<tr>
<td>Massachusetts*</td>
<td>26.10%</td>
<td>Ohio</td>
<td>12.13%</td>
</tr>
<tr>
<td>Rhode Island*</td>
<td>25.26%</td>
<td>Michigan</td>
<td>10.55%</td>
</tr>
<tr>
<td>Vermont*</td>
<td>23.85%</td>
<td>Oregon*</td>
<td>10.40%</td>
</tr>
<tr>
<td>Arizona</td>
<td>22.00%</td>
<td>Pennsylvania*</td>
<td>9.98%</td>
</tr>
<tr>
<td>Illinois</td>
<td>18.00%</td>
<td>New Mexico</td>
<td>8.06%</td>
</tr>
<tr>
<td>Hawaii*</td>
<td>18.00%</td>
<td>Wisconsin*</td>
<td>7.50%</td>
</tr>
<tr>
<td>Washington</td>
<td>17.24%</td>
<td>Arkansas*</td>
<td>6.75%</td>
</tr>
<tr>
<td>Minnesota</td>
<td>16.50%</td>
<td>Texas</td>
<td>4.60%</td>
</tr>
<tr>
<td>Iowa*</td>
<td>16.10%</td>
<td>Nevada</td>
<td>3.76%</td>
</tr>
<tr>
<td>Colorado</td>
<td>14.93%</td>
<td>North Carolina</td>
<td>2.92%</td>
</tr>
<tr>
<td>Indiana</td>
<td>13.81%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Savings beginning in 2009 extrapolated out to 2020 based on final year of annual savings required

Source: ACEEE
Savings vs. Targets in 2010

Percent Savings Compared to Retail Sales

*Reference year for savings is 2009

Source: ACEEE
3.2 France – Eco watt
In the Bretagne district of northwestern France, the consumer participation type power-saving campaign “Eco Watt" was started in 2008.

This campaign is taken place in winter season (Nov - Mar) when electricity demand reaches a peak.

This campaign has been hosted by RTE (power transmission subsidiary of EDF), in addition, local government bodies, ADEME (environment and energy-saving agency), and ERDf (power distribution subsidiary of EDF) have cooperated.

Electric supply and demand situation of the day and next day is informed on the web.

If power consumption exceeds a fixed level, "alarm" will be sent through an E-mail etc. to the "cooperator" who registered in advance to urge power-saving action.

According to estimate by RTE, it is thought to be about (in the case in the Bretagne district) 2~3% effective to peak demand.
Power saving campaign in the Bretagne district - Eco Watt (2)

1. Electric situation in Bretagne
   - In Bretagne, construction plan of "Plogoff nuclear power plant" which was expected to become main power sources was abandoned in late 1970s, because of the strong opposition from local residents.
   - It is not easy to realize power plant project (not only nuclear, but the other sources like wind power) in Bretagne where ecologists have great influence. As a result, generation capacity in Bretagne can supply only 8 –10 % of local consumption.
   - Power supply in Bretagne depends on the generation sources located in the east.
   - Since it is supplied from the considerably distant nuclear and thermal power plant, the transmission capacity approaches its limit at peak hours and blackout risk increases.

The effect expected by Eco Watt
1. Energy conservation effecti under tight supply and demand situation
2. Energy saving as everyday behaviors
3. Educational role for power saving and energy saving is fairly important
Power saving campaign in the Bretagne district - Eco Watt (3)

2. How Eco Watt works?

- Power supply and demand situation of that day and the next day is shown by 3 colors, green, orange, and red on the website (www.ecowatt-bretagne.fr).
- Simultaneously, “cooperators” are sought to participate Eco Watt. Alarm is sent through e-mail and RSS feed, etc to “cooperators” who had registered in website in advance in case of tight supply and demand situation.
- As a "cooperator", three categories of individual, company, and local government body and public institution are assumed.
- The guidance "suitable action (bons gestes)“ including information for expected power saving in winter peak hours (morning and 18:00-20:00) are on the website classified into above three categories.
- The local government bodies and companies are provided "Eco Watt oath charter“ and choose concrete plan (power saving behaviors such as putting off lights in office, recommendation of Eco Watt registration to personnel) and sign.
- Participating organization makes public on its website and each cooperative organization appeals by displaying Eco Watt posters and adding Eco Watt logo to e-mail signature and aims image enhancement and popularization.
- Approach methods are devised according to target. Seminar for companies and educational DVD for children was made under the cooperation of the chamber of commerce and the board of education.

3. The result of Eco Watt campaign

- 08-09 year: Cooperator 9000, Alarm 9 times, effect of power saving was unknown
- 09-10 year: Cooperator 18500, Alarm 11 times, max power saving : 1.5% of peak demand
- 10-11 year: Cooperator 30800, Alarm 7 times, max power saving : 2.0% of peak demand
- 11-12 year: Cooperator 45000, Alarm 7 times, max power saving : 2.0%～3.0% of peak demand
(max power saving is estimate by RTE based on questionnaire result and power consumption data, etc.)
4. Result of questionnaire about Eco Watt

- In February 2011, RTE carried out the questionnaire toward "cooperators“, “local government bodies”, and “local residents" in the Brittany.
- The result proves the visibility and high evaluation of Eco Watt.
- Q. Have you heard "Eco Watt"? - Local residents 72%-YES Local governments 92%-YES
- Q. Do you evaluate Eco Watt positively? –Cooperators 100%-YES Local governments 96%-YES
  Local residents 97%-YES
- 93% Cooperator is satisfied with alarm system.
- 97% Cooperator answers that they will save power in case of receive alarm and try to save power in everyday basis.

5. Others
"Provence Azur Eco Watt campaign" was started in the Provence Azur district of south France in autumn of 2010.
Development of EEI-related legislation
Introduction of EEI-related systems

Taiichi Kaizuka
The KANSAI Electric Power CO., INC.
Index (Day 3)

1. Development of EEI-related legislation Introduction of EEI-related systems
   1.1 Overview of energy conservation measures
   1.2 Why is energy conservation important?
   1.3 Why was energy conservation accelerated in the past?
   1.4 Energy conservation measures by regulation
      1.4.1 Measures for Factory/Business establishment
      1.4.2 Top runner standard and Energy saving labeling system
   1.5 Subsidy and tax reduction, etc for supporting energy conservation

2. Energy efficiency improvement business by utility
   2.1 Overview and scheme of ESCO
   2.2 Application example of ESCO
   2.3 Economic side of ESCO

3. Actual application of Energy efficiency improvement
   3.1 America - EERS
   3.2 France – Eco watt
Overview of energy conservation measures (Example of Japan)

- Divided into three sectors, “Industrial”, “Commercial & Residential”, “Transportation”
- Measures are divided into “regulation by law” and “support by tax reduction and subsidy”.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Energy conservation law)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Almost secured measure (Legal obligation or non-binding target)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Target and degree of involvement must be carefully considered</td>
<td></td>
<td></td>
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<tr>
<td>• Data collecting is easy (Periodical report) from user</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Need clarification for confines of law</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Support**       |                          |                |
| (tax reduction, subsidy, etc) |                |                |
| • Need financial resources (Prepare as national budget or ADB grant) |                |                |
| • Appropriate support level (low: inactive response, high: budget shortfall) |                |                |
| • Influence to ESCO business |                |                |

Categorize energy conservation measures and grasp overview
## Overview of energy conservation measures (Regulation)

<table>
<thead>
<tr>
<th>Regulation (Energy conservation law)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factory and business establishment (Annual energy use: 1500kl in crude oil equivalent or larger)</td>
<td><strong>Submit energy saving plan</strong>&lt;br&gt;<strong>Periodical report on the use of energy</strong></td>
<td></td>
<td><strong>Consigner [sender] and carrier (above a certain size)</strong>&lt;br&gt;<strong>Energy saving plan, report on energy consumption</strong></td>
</tr>
<tr>
<td>Owner of residence or building and client for construction (above a certain size)</td>
<td><strong>Submit notification of energy saving measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top Runner Standard</td>
<td><strong>Stipulate energy conservation standards for house appliances and vehicles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-saving labeling system</td>
<td><strong>Inform consumers of energy efficiency of house appliances</strong></td>
<td></td>
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</table>

*Energy conservation law covers wide area as a comprehensive measure*
## Overview of energy conservation measures (Support)

<table>
<thead>
<tr>
<th>Support (tax reduction, subsidy, etc)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
<td>Residential</td>
</tr>
<tr>
<td>Subsidy for introduction of energy conservation facilities</td>
<td><img src="image1.png" alt="Icon" /></td>
<td><img src="image2.png" alt="Icon" /></td>
<td><img src="image3.png" alt="Icon" /></td>
</tr>
<tr>
<td>Tax reduction (special depreciation) for introduction of energy conservation facilities and construction of energy saving building</td>
<td><img src="image5.png" alt="Icon" /></td>
<td><img src="image6.png" alt="Icon" /></td>
<td><img src="image7.png" alt="Icon" /></td>
</tr>
<tr>
<td>Subsidy for developing energy conservation technology (high efficiency heat pump, high-efficiency heat insulating material, etc)</td>
<td><img src="image9.png" alt="Icon" /></td>
<td><img src="image10.png" alt="Icon" /></td>
<td></td>
</tr>
<tr>
<td>Provision of information related energy conservation</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Various measures need for support energy conservation**
1.2 Why is energy conservation important?
Why is energy conservation important?

- Contribution to energy security (Does the fuel price go up in the future?)
- The capital investment for infrastructure can be avoided or postponed.
- More effective countermeasure than building new power plant (According to one estimate in the U.S., unit cost for base load type power plant is 7.3 – 13.5 cents/kWh, unit cost for energy conservation is about 3 cents/kWh.)
- Energy conservation measures have high mobility. (Effects emerge in a short period. The effect of capital investment on energy conservation comes up in 1 – 3 years.)
- The fuel cost can be reduced by operating high-efficiency generator preferentially. (peak shift, peak cut)
Why is energy conservation important? (cont.)

- When the electricity rate is back spread (electricity rate is lower than cost), there is a merit by saving energy.
- It becomes to be widely realized the hardness to restrict using electricity. (Do people become more cooperative to build new power plant? Or still exist NIMBY? Example of “Eco Watt”)
- Contribution to preventing global warming
- To be honest.. as an electricity supplier, is it better to sell more electricity?

Demand Response

To be exact, demand responses like peak cut or peak shift are not the same energy conservation. DR aims kW reduction and energy conservation aims kWh reduction, but in wider sense, DR also contributes to KWh reduction. In this meaning, DR is also regarded as one of measures for energy conservation.
World Energy Demand outlook and comparison of self-sufficiency ratio in the energy supply

- The world energy demand is expected to increase by 1.3 times in 2030. (mainly in Asian countries)
- The competition for acquiring resource by the consuming countries like China will escalate and energy supply-demand structure will become serious.

There is a possibility of spike in fuel price in case that world energy consumption increases greatly.
⇒ The increase of energy purchase expense in the national budget

A million ton oil equivalent

World Energy Demand outlook

- Total 1.3 times
- India 1.9 times
- China 1.7 times

Comparison of self-sufficiency ratio in the energy supply

Energy conservation contributes to improvement of energy self-sufficiency rate

- Italy: 14%
- Japan: 4%
- Germany: 35%
- France: 44%
- U.K.: 70%
- U.S.: 61%
- China: 85%

Energy conservation contributes to ensuring energy security.
Shale Gas Production Projections
Shale Gas – Widely Dispersed
Effect of Peak-cut or Peak-shift

Short term: Possible to reduce fuel cost
Long term: Possible to reduce the installed generation capacity

- Thermal power
- Pumped storage
- Purchases and interchanges
- Hydro-power
- Nuclear
- Stored power generation

Purchases and interchanges
1.3 Why was energy conservation accelerated in the past?
The efforts for energy conservation after oil crisis in Japan

In Japan, the government and people did their best in energy conservation after the oil crisis of the 1970s.

As a result, energy efficiency was improved by 33% during 30 years from 1979 to 2030.

Efficiency per GDP has made little increase after the 1980s and further approach is expected.

Trends of primary energy consumption per GDP in Japan

Comparison of primary energy supply per GDP unit (2009)

(*)TOE: tonne of oil equivalent

Source: METI, cabinet office

Source: IEA
Turmoil in the oil crisis in 1970’s (Japan)

Toilet paper (bathroom tissue) had been sold out!
## Progress of energy conservation

<table>
<thead>
<tr>
<th>Year</th>
<th>World</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>The first oil shock</td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>The second oil shock</td>
<td>Enforcement of the Act on “the Law Concerning the Rational Use of Energy” (Energy conservation law)</td>
</tr>
<tr>
<td>1988</td>
<td>The 1st Intergovernmental Panel on Climate Change (IPCC) held in Geneva</td>
<td>The Oil Shock built a momentum of full-fledged deployment about energy conservation activity in Japan</td>
</tr>
<tr>
<td>1992</td>
<td>The UN Conference on Environment and Development (UNCED/Earth Summit) held in Rio de Janeiro</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>Implementation of the International Energy Star Program</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>The 3rd Conference of Parties (COP3) held in Kyoto</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td></td>
<td>Enforcement of the Act on Promotion of Global Warming Countermeasures</td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td>Establishment of the system for designating the Type 2 Designated Energy Management Factories, Introduction of the Top Runner Standard (*)</td>
</tr>
<tr>
<td>2000</td>
<td>Unceasing effort has made to fit with the times on energy conservation law</td>
<td>Introduction of the energy-saving labeling system</td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td>Enhancement of the measures for office buildings (*)</td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td>Establishment of the measures for transportation and the integrated control of heat and Electricity (*)</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td>Introduction of the system for regulating the energy use as a whole enterprise (*)</td>
</tr>
</tbody>
</table>

Source: ECCJ

(*)Revision of Energy conservation law
1.4 Energy conservation measures by regulation
1.4.1 Measures for Factory/Business establishment
## Overview of energy conservation measures (Regulation)

<table>
<thead>
<tr>
<th>Regulation (Energy conservation law)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factory and business establishment (Annual energy use: 1500kl in crude oil equivalent or larger)</td>
<td>Owner of residence or building and client for construction (above a certain size)</td>
<td>Consigner [sender] and carrier (above a certain size)</td>
</tr>
<tr>
<td></td>
<td>Submit energy saving plan, Periodical report on the use of energy</td>
<td>Submit notification of energy saving measures</td>
<td>Energy saving plan, report on energy consumption</td>
</tr>
<tr>
<td></td>
<td>Top Runner Standard Stipulate energy conservation standards for house appliances and vehicles</td>
<td>Energy-saving labeling system Inform consumers of energy efficiency of house appliances</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(*)1500kl is about 330 k gallon</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Measures for Factory/Business establishment (1)

<table>
<thead>
<tr>
<th>Factories/business establishments with high energy consumption</th>
<th>Factories/business establishments with medium energy consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual energy use in crude oil equivalent (3000kl~)</td>
<td>Annual energy use in crude oil equivalent (1500kl ~ 3000kl)</td>
</tr>
<tr>
<td>The division of electricity and heat are abolished. (Formally, evaluated in kWh)</td>
<td></td>
</tr>
<tr>
<td>Factory</td>
<td>Business establishments</td>
</tr>
<tr>
<td>Appointment of <strong>Energy Manager</strong> (<strong>Mandatory to possess a license</strong> for a qualified person for energy management)</td>
<td>Appointment of a <strong>qualified person</strong> for energy management (Training Required)</td>
</tr>
<tr>
<td>Preparation &amp; Submission of Periodical Reports</td>
<td>Preparation &amp; Submission of Periodical Reports</td>
</tr>
<tr>
<td>Preparation &amp; Submission of Mid- and long-term Plans</td>
<td>Preparation &amp; Submission of Mid- and long-term Plans</td>
</tr>
</tbody>
</table>

**Target and degree of involvement must be carefully considered**
Measures for Factory/Business establishment (2)

Confines of law: Annual energy use: 1500kl in crude oil equivalent or larger
⇒ cover 90% of industrial sector, 50% of commercial sector in energy usage base

Mandatory submission of annual report
1. Transition of specific energy consumption
2. State of implementation on energy conservation measures
3. State of benchmark index

Cover ratio is important, especially in energy base (not in number of customers base)

Benchmarking is one of the most effective analysis tool

In case of insignificantly insufficient level of energy conservation against judging criteria, instruction, public discloser, compliance order, fine are conducted.

(Flow of general inspection)

- Evaluation of annual report
- On site investigation
- Inspection
- Rationalization plan guidance
- Public disclosure/compliance order

If the assessment result is poor
If deemed significantly insufficient against judging criteria
In case of refuse to comply
Training System of Specialized Technical Engineers

**Purpose of Creating the System**

This system was created in FY2007 to build an environment in which each employee can work with stronger motivation and a sense of challenge. It also aims to improve the technical performance and skills of each employee and to maintain their technical abilities, which are closely related to the frontline as a power utility, and to pass them on to the next generation.

**Target Persons**

Persons who meet the following requirements are accredited as specialized technical engineers:
- Ú Belong to an applicable office for accreditation
- Ú Have advanced technical knowledge and skills closely related to practical work
- Ú Have strong leadership and passion to teach technical knowledge and skills to the younger generation
- Ú Not an officer

**Role**

A new role is given: to help solve various technical tasks in the office, and to instruct and train the younger generation on cross-cutting technical performance and skills closely related to ordinary work, mainly in the office.
Training System for Specialized Technical Engineers in the Distribution Sector

**Accredited Fields**

<table>
<thead>
<tr>
<th>Accredited Fields</th>
<th>Name</th>
<th>Number of persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particular Grid Failure</td>
<td>Specialized Technical Engineer (Particular Grid Failure)</td>
<td>11</td>
</tr>
<tr>
<td>Distribution Network Automation Equipment</td>
<td>Specialized Technical Engineer (Distribution Network Automation Equipment)</td>
<td>13</td>
</tr>
<tr>
<td>Measuring Equipment</td>
<td>Specialized Technical Engineer (Measuring Equipment)</td>
<td>15</td>
</tr>
<tr>
<td>Unit Substation</td>
<td>Specialized Technical Engineer (Unit Substation)</td>
<td>6</td>
</tr>
<tr>
<td>Pursuing electrical work together with other infrastructure companies (eg. water/gas company)</td>
<td>Specialized Technical Engineer (Pursuing electrical work together with other infrastructure companies)</td>
<td>10</td>
</tr>
<tr>
<td>Indoor Type Transformer (22kV)</td>
<td>Specialized Technical Engineer (Indoor Type Transformer (22kV))</td>
<td>2</td>
</tr>
</tbody>
</table>

Total: 57 persons

**Roles of specialized technical engineers**

- Training for young people
- Giving technical instruction and advice on various maintenance work such as inspection, measurement, and checking under presence
- Grasping the skill level of the younger generation, giving proper instruction and advice to individuals, and compiling the contents of instructions
- Drawing up training plans
- Teaching at various group education sessions

- Tackling technical challenges at the job site
- Investigating causes, creating and implementing countermeasures in case of power failure/troubles
- Addressing various technical challenges on maintenance and construction works
Specialized Skill and Engineer Activity

Main Action throughout Company

- Briefing session of activity of specialized technical engineers (Once a year)
- Study session of specialized technical engineers (Newly planed)
- Support of lecturer in the lesson to train specialized technical engineers (Jul ~ Oct)
- Support of Specialized Training in the Distribution Engineering Center (DEC)
- Participation to the Working Group of Head Office (New Meter SWG, Distribution Tower WG etc.)
- Support of Training in the branch offices, Support of work in each section, etc.

- The condition of activities is grasped and the plan of activities is followed, by collecting the report of action plan periodically (Once a quarter of year) which includes activity results of specialized technical engineers.
- The opinions to improve system of specialized engineers and activities are exchanged in briefing session of activity.
- The leaders of each field lead to support specialized technical engineers in support action, training support, and training of next candidate.
**Trends in final energy consumption in Japan**

- Final energy consumption in Japan has been increasing.
  (except oil crisis and economy depression)
- While GDP increased by 2.3 times from 1973 to 2009, total energy consumption increased by 1.3 times.
- The growth rates of final energy consumption in each sector are different.
  (Transportation 1.9 times, Commercial/residential 2.4 times, Industrial 0.85 times)

---

Increase in the commercial/residential sector which accounts for over 30% of all is remarkable. Reinforcement in this sector is most sought. (Need to focus in the priority areas)
Introduction of benchmark classified by sector

[background]
○ Fairer evaluation of business entity’s effort
○ Promotion of business entity’s effort by visualization of energy saving efforts

It is difficult for business entity who has already tackled with energy conservation to considerable degree to accomplish further energy saving.
Defining the benchmark index by which business entities’ effort can be compared contribute to fair evaluation of business entities’ effort and making low-performing business entities tackle further efforts.
The superior business entities (10~20%) of each sector become target level.

[How to select industrial sector for benchmark]
In FY 2008, three industrial sectors of steel, cement and electric power were chosen. It’s decided in consideration of largeness of their energy consumption (occupies 40% energy consumption in all industrial sectors), and extent of international argument in each sector.
Paper manufacturing, oil refinery, and the chemical industry were added in FY 2009. (The cover rate of the energy consumption expanded to about 60%)
Expansion to commercial sectors such as office, retailing, etc is considered in the future.

[Publication of benchmark results]
In order to urge spontaneous efforts by business entity, average and standard deviation of benchmark are published.
The names of excellent energy saving entities are published.

Source: METI
1.4.2 Top runner standard and Energy saving labeling system
# Overview of energy conservation measures (Regulation)

<table>
<thead>
<tr>
<th>Regulation (Energy conservation law)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Consigner [sender] and carrier (above a certain size) Energy saving plan, report on energy consumption</td>
</tr>
<tr>
<td></td>
<td>Factory and business establishment (Annual energy use: 1500kl in crude oil equivalent or larger) Submit energy saving plan, Periodical report on the use of energy</td>
<td>Owner of residence or building and client for construction (above a certain size) Submit notification of energy saving measures</td>
<td></td>
</tr>
<tr>
<td>Top Runner Standard Stipulate energy conservation standards for house appliances and vehicles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-saving labeling system Inform consumers of energy efficiency of house appliances</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*GSEP/PPA Energy efficiency improvement Workshop*  
*Guam August 20-24, 2012*
Top Runner Program (1)

- Energy conservation standards for domestic appliances and vehicles are set in the Top Runner program.
- The concept of the program is that energy conservation standards shall be set exactly the same as or higher than the best standard value available in the market.

How to set the target standard

- Target standard is set based on the best standard value available in the market.
- Achievement is judged by the weighted average per product category:
  \[
  \frac{(84+83+79)}{3} = 82 \geq 80
  \]

Target products (23 products)

1. Passenger Vehicles
2. Freight Vehicles
3. Air Conditioners
4. Electric Refrigerators
5. Electric Freezers
6. Electric Rice Cookers
7. Microwave Ovens
8. Lighting equipment
9. Electric Toilet Seats
10. TV Sets
11. Video Cassette Recorders
12. DVD Recorders
13. Computers
14. Magnetic Disk Units
15. Copying Machines
16. Space Heaters
17. Gas Cooking Appliances
18. Gas Water Heaters
19. Oil Water Heaters
20. Vending Machines
21. Transformers
22. Routers
23. Switching Units

(※) two products are added in 2009

Target standards are subdivided according to the type and size, etc. In case of TV:

- **TV type**:
  - Carbon lay tube TV,
  - Liquid crystal TV,
  - Plasma TV

- **Television size**:
  - Below 19V size
  - 19V ~ 32V
  - 32 size or larger

Source: METI
**Top Runner Program (2)**

- There is obligation to comply with the standards. In case of failing to comply, recommendation, publication, order, penalty are imposed.
- For each of the companies that manufacture or import machinery and equipment covered by the Top Runner Program.

In case of TV, manufacturers or **importers** whose total shipment volume is fewer than 10,000 units are exempted.

<table>
<thead>
<tr>
<th>No.</th>
<th>Product</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Passenger Vehicles</td>
<td>2,000 vehicles</td>
</tr>
<tr>
<td>2.</td>
<td>Freight Vehicles</td>
<td>2,000 vehicles</td>
</tr>
<tr>
<td>3.</td>
<td>Air Conditioners</td>
<td>500 units</td>
</tr>
<tr>
<td>4.</td>
<td>Electric Refrigerators</td>
<td>2,000 units</td>
</tr>
<tr>
<td>5.</td>
<td>Electric Freezers</td>
<td>300 units</td>
</tr>
<tr>
<td>6.</td>
<td>Electric Rice Cookers</td>
<td>6,000 units</td>
</tr>
<tr>
<td>7.</td>
<td>Microwave Ovens</td>
<td>3,000 units</td>
</tr>
<tr>
<td>8.</td>
<td>Lighting equipment</td>
<td>30,000 units</td>
</tr>
<tr>
<td>9.</td>
<td>Electric Toilet Seats</td>
<td>2,000 units</td>
</tr>
<tr>
<td>10.</td>
<td>TV Sets</td>
<td>10,000 units</td>
</tr>
<tr>
<td>11.</td>
<td>Video Cassette Recorders</td>
<td>5,000 units</td>
</tr>
<tr>
<td>12.</td>
<td>DVD Recorders</td>
<td>4,000 units</td>
</tr>
<tr>
<td>13.</td>
<td>Computers</td>
<td>200 units</td>
</tr>
<tr>
<td>14.</td>
<td>Magnetic Disk Units</td>
<td>5,000 units</td>
</tr>
<tr>
<td>15.</td>
<td>Copying Machines</td>
<td>500 units</td>
</tr>
<tr>
<td>16.</td>
<td>Space Heaters</td>
<td>300 units</td>
</tr>
<tr>
<td>17.</td>
<td>Gas Cooking Appliances</td>
<td>5,000 units</td>
</tr>
<tr>
<td>18.</td>
<td>Gas Water Heaters</td>
<td>3,000 units</td>
</tr>
<tr>
<td>19.</td>
<td>Oil Water Heaters</td>
<td>600 units</td>
</tr>
<tr>
<td>20.</td>
<td>Vending Machines</td>
<td>300 units</td>
</tr>
<tr>
<td>21.</td>
<td>Transformers</td>
<td>100 units</td>
</tr>
<tr>
<td>22.</td>
<td>Routers</td>
<td>2,500 units</td>
</tr>
<tr>
<td>23.</td>
<td>Switching Units</td>
<td>1,500 units</td>
</tr>
</tbody>
</table>

Possibility to application of legislation for importers in PPA countries.
Top Runner Program (3)

Results of energy efficiency improvement are beyond initial expectations.

### Example of energy efficiency improvement

<table>
<thead>
<tr>
<th>Product category</th>
<th>Energy efficiency improvement (result)</th>
<th>Energy efficiency improvement (initial expectation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV receivers (TV sets using CRTs)</td>
<td>25.7% (FY 1997 → FY 2003)</td>
<td>16.4%</td>
</tr>
<tr>
<td>Air conditioners (Room air conditioners)</td>
<td>67.8% (FY 1997 → 2004 freezing year)</td>
<td>66.1%</td>
</tr>
<tr>
<td>Electric refrigerators</td>
<td>55.2% (FY 1998 → FY 2004)</td>
<td>30.5%</td>
</tr>
<tr>
<td>Fluorescent light equipment</td>
<td>35.7% (FY 1997 → FY 2005)</td>
<td>16.6%</td>
</tr>
<tr>
<td>Copying machines</td>
<td>72.5% (FY 1997 → FY 2006)</td>
<td>30.8%</td>
</tr>
<tr>
<td>Magnetic disk units</td>
<td>85.7% (FY 2001 → FY 2007)</td>
<td>71.4%</td>
</tr>
</tbody>
</table>

### Example of Air conditioner

- **Transition of energy consumption**: 75.7% reduction
  - Yearly energy consumption from 1995 to 2009, showing a significant decrease.
- **Comparison of efficiency of top model**
  - COP values for Japan, USA, EU, China, and Thai, with Japan having the highest COP values.
<table>
<thead>
<tr>
<th>Overview of energy conservation measures (Regulation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industrial</strong></td>
</tr>
<tr>
<td>Regulation (Energy conservation law)</td>
</tr>
<tr>
<td>Factory and business establishment (Annual energy use: 1500kl in crude oil equivalent or larger)</td>
</tr>
<tr>
<td>Submit energy saving plan, Periodical report on the use of energy</td>
</tr>
<tr>
<td><strong>Commercial &amp; Residential</strong></td>
</tr>
<tr>
<td>Commercial</td>
</tr>
<tr>
<td>Residential</td>
</tr>
<tr>
<td>Owner of residence or building and client for construction (above a certain size)</td>
</tr>
<tr>
<td>Submit notification of energy saving measures</td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
</tr>
<tr>
<td>Consigner [sender] and carrier (above a certain size)</td>
</tr>
<tr>
<td>Energy saving plan, report on energy consumption</td>
</tr>
<tr>
<td>Top Runner Standard</td>
</tr>
<tr>
<td>Stipulate energy conservation standards for house appliances and vehicles</td>
</tr>
<tr>
<td>Energy-saving labeling system</td>
</tr>
<tr>
<td>Inform consumers of energy efficiency of house appliances</td>
</tr>
</tbody>
</table>


Energy Saving labeling system (mainly for manufacturer)

- The energy saving labeling system has been introduced to inform consumers of energy efficiency of home appliances and to promote energy efficiency products.
- 18 products are selected from targets of top runner program in consideration of high frequency usage by general consumer.

<table>
<thead>
<tr>
<th>Energy conservation standard achievement percentage</th>
<th>Annual Electricity Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target year FY2006</td>
<td></td>
</tr>
<tr>
<td>108%</td>
<td>175kWh/year</td>
</tr>
<tr>
<td>91%</td>
<td>206kWh/year</td>
</tr>
</tbody>
</table>

Source: Agency for Natural Resources and Energy
Energy Saving labeling system (mainly for retailer)

- The obligation to make efforts to provide information by retailers was stipulated in 2006.
- 5 products are selected with consideration for largeness and variability of electricity consumption. (Air Conditioners, TV sets, Electric Refrigerators, etc)
- More detailed information is provided to consumers.

Info -1: year the label was prepared

Info -2: CFC mark represents CFC-free refrigerators

(\(^*\) CFC: chlorofluorocarbon)

Info -3: Multi-stage rating system — energy saving performance is indicated 5 stages. Arrows are placed under the stars, showing achievement and non-achievement for top runner standard.

Info -4: the same information as Energy saving labeling system for manufacturer

Info -5: Expected annual electricity bill

Source: Agency for Natural Resources and Energy "2009 Energy Conservation Performance Catalogue Summer"
National Government’s Subsidy System

- **Purposes**
  1. CO2 reduction
  2. Vitalization of the economy
  3. Familiarization of TV sets for terrestrial digital broadcasting

- **Eligible products**
  Air conditioners, electric refrigerators and TV sets for terrestrial digital broadcasting equivalent to 4 stars (★★★★) or over of the Uniform Energy Conservation Label.

**Products for exchange**

1. Energy Conservation and environment-friendly products
2. Redeemable gift certificates or prepaid cards (of environment-friendly purpose, such as sponsor’s environmental donation) that can be used nationwide
3. Contribution to regional development (local merchandise coupon, local goods, etc.)

Source: Agency for Natural Resources and Energy "2009 Energy Conservation Performance Catalogue Summer"
1.5 Subsidy and tax reduction, etc for supporting energy conservation

~ Model cases to consider the supporting policy for energy conservation measures ~
# Overview of energy conservation measures (Support)

<table>
<thead>
<tr>
<th>Support (tax reduction, subsidy, etc)</th>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subsidy for introduction of energy conservation facilities</td>
<td>Eco point system for housing</td>
<td>Subsidy for clean energy vehicles</td>
</tr>
<tr>
<td></td>
<td>Tax reduction (special depreciation) for introduction of energy conservation facilities and construction of energy saving building</td>
<td>Tax reduction for home renovation</td>
<td>Tax reduction for ecology car</td>
</tr>
<tr>
<td></td>
<td>Subsidy for developing energy conservation technology (high efficiency heat pump, high-efficiency heat insulating material, etc)</td>
<td>Provision of information related energy conservation</td>
<td></td>
</tr>
</tbody>
</table>

## Various measures need for support energy conservation
Overview and purpose

In order to promote energy saving in the commercial and residential sector as one of the measures to mitigate tight supply and demand, subsidize equipment introduction with a certain amount of energy saving effect to existing buildings.

Specifically,

1) The targets of subsidy are limited to air-conditioning, water heater, lighting equipment, heat insulation equipment, etc in consideration on reduction effect of electricity consumption.

2) Although in case of introduction of only equipments, subsidy can be given if the following requirements are satisfied. “replace more than half of equipments in the whole building” and “more than 10% energy saving effect”

These measures contribute to reduce electricity consumption of commercial and residential sector by promoting equipment-only replacement in building which was not covered in former subsidy system.

Subsidy rate 1/3 (for small businesses: 1/2)

Source: METI
Subsidy on support for business utility aiming rational use of energy

Overview and purpose

- Subsidy on introduction of facilities (limited to replacement) from the energy saving measures which business utilities planned in the standpoint of “leading edge technology”, energy conservation effect”, and “cost performance”.

- Set the priority on subsidy to introduce “leading edge facility and technology”

- In order to promote energy saving investment, priority is given to small and medium-sized enterprises and energy intensive type businesses.

- Set priority on the business which has high performance for energy saving in order to help mitigation of tight supply and demand situation.

- Subsidy rate  1/3 or less (business cooperation of different capital; 1/2 or less)

Source: METI
**Overview and purpose**

- Investments for energy saving facilities are supposed to increase reflecting the growing needs for energy saving in industrial sector, etc and energy conservation from aftermath of great East Japan earthquake.

- When the business utilities which install energy saving facilities or and top-runner equipments take out a loan from private sector financial institutions, the subsidy which serves as a low interest can be obtained.

- Subsidy rate: fixed amount (grant-in-aid for paying interest 1.0%)
Overview and purpose

- Diagnosis on possibility of introduction for energy saving technology is performed to business utilities. This subsidy promotes energy saving in factories and office buildings, etc.

- In consideration of aftermath from the great East Japan earthquake, target business utility is expanded from 2012.

Source: METI
## Overview of energy conservation measures (Support)

<table>
<thead>
<tr>
<th>Industrial</th>
<th>Commercial &amp; Residential</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Commercial</td>
<td>Residential</td>
</tr>
<tr>
<td>Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(tax</td>
<td>Eco point system for</td>
<td>Subsidy for</td>
</tr>
<tr>
<td>reduction,</td>
<td>housing</td>
<td>clean energy</td>
</tr>
<tr>
<td>subsidy,</td>
<td></td>
<td>vehicles</td>
</tr>
<tr>
<td>etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsidy for introduction of energy conservation facilities</td>
<td>Tax reduction for home renovation</td>
<td></td>
</tr>
<tr>
<td>Tax reduction (special depreciation) for introduction of energy conservation facilities and construction of energy saving building</td>
<td>Tax reduction for ecology car</td>
<td></td>
</tr>
<tr>
<td>Subsidy for developing energy conservation technology (high efficiency heat pump, high-efficiency heat insulating material, etc)</td>
<td>Provision of information related energy conservation</td>
<td></td>
</tr>
</tbody>
</table>

**Various measures need for support energy conservation**
**Information provision prescribed in Energy conservation law**

The obligation to make efforts to provide information about general consumer is prescribed to energy supply utilities.

<table>
<thead>
<tr>
<th>Energy saving information to consumers</th>
<th>Present situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly energy consumption of the corresponding month of last year used by general consumer</td>
<td>It has already provided on electricity bill</td>
</tr>
<tr>
<td>Monthly energy consumption and charge for past one year used by general consumers</td>
<td>Information service on web has started in some electric utilities.</td>
</tr>
<tr>
<td>Rough indication on reduction of energy consumption and charge by devising the usage of equipments.</td>
<td>Energy-saving advice is indicated on electricity bill. The electric power used by individual equipment is considered to offer through HEMS (Home energy management system) in the future.</td>
</tr>
<tr>
<td>Performance and subsidy information for energy saving equipments</td>
<td>Information has already provided in HP of electric utilities, etc. In the future, the further information dissemination is supposed as an energy management service by introduction of HEMS, etc.</td>
</tr>
<tr>
<td>Useful information like rough indication of energy consumption according to contract or residential class, etc on energy saving by general consumers</td>
<td>Qualitative energy saving advice has already indicated on electricity bill. The quantitative and detailed advice is supposed to become possible by spread of smart meters.</td>
</tr>
</tbody>
</table>

Source: METI
Energy efficiency improvement business by utility

Taiichi Kaizuka
The KANSAI Electric Power CO., INC.
Index (Day 3)

1. Development of EEI-related legislation Introduction of EEI-related systems
   1.1 Overview of energy conservation measures
   1.2 Why is energy conservation important?
   1.3 Why was energy conservation accelerated in the past?
   1.4 Energy conservation measures by regulation
      1.4.1 Measures for Factory/Business establishment
      1.4.2 Top runner standard and Energy saving labeling system
   1.5 Subsidy and tax reduction, etc for supporting energy conservation

2. Energy efficiency improvement business by utility
   2.1 Overview and scheme of ESCO
   2.2 Application example of ESCO
   2.3 Economic side of ESCO

3. Actual application of Energy efficiency improvement
   3.1 America - EERS
   3.2 France – Eco watt
2.1 Overview and scheme of ESCO
What is “ESCO”?

Even if you want to start renovation work for energy-saving........

- Financing of initial investment is difficult.
- Reduction of energy cost does not progress.
- The expense of equipment maintenance may occur suddenly and hard to control cash planning.
- I do not want to have an excessive capital from the viewpoint of financial strength.

ESCO: Energy Service Company

ESCO covers expense for energy saving renovation by its saving merits (reduction of fuel and light cost, etc).

ESCO business company provides the comprehensive service like energy audit, design and construction for renovation work, operation and maintenance for facilities.

ESCO is characterized by its performance contract by which ESCO business company guarantees the energy saving performance to customer.
Spreading and promotion of the ESCO business
~ The ESCO market is expanding ~

- ESCO-related markets have shown rapid growth since ESCO was introduced to Japan in the mid-1990s.
- However, market size in FY 2004 decreased from FY 2003 due to a decrease in the number of large-scale projects in the industrial sector.
- Market size increased in FY 2005. In particular, the percentage of performance contracts increased.

Trends on energy-saving renovations in Japan (orders received)

- Market size in the U.S. in FY 2000 was approximately 2 billion dollars.

The Kansai has affiliate company offering ESCO business (KENES: Kanden energy solution).
ESCO business provides comprehensive service

ESCO comprehensive service.

- Pre energy audit
- Energy audit
- Planning of an execution plan
- ESCO service contract
- Renovation work
- Measurement and verification of the energy-saving effect
- Operation, maintenance, and inspection of facility
- Blanket Contract (turnkey Contract)

General renovation work for energy saving

- Facility investigation
- Design & Estimate
- Renovation work
- Operation
- Individual contract
- Blanket contract

Comprehensive services of the ESCO project
1. Energy audit and consultation for finding energy conservation measure
2. Planning, design, construction and construction management for introducing energy conservation measures
3. Measurement and verification of energy conservation effects after introduction
4. Maintenance and operational management of introduced facilities and systems
5. Project financing, arrangements with financial institutes, etc.

In the case of a general energy saving renovation work, it is difficult to guarantee energy saving effect because design contract, construction contract, and the operation & management contract for facilities become separate in usual cases.

Source: JAESCO
The feature of ESCO is performance contract

<table>
<thead>
<tr>
<th>Contract Type</th>
<th>Guaranteed savings contract</th>
<th>Shared savings contract</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-saving renovation costs covered by</td>
<td>Customer</td>
<td>ESCO Company</td>
</tr>
<tr>
<td>Owner of energy-saving facilities</td>
<td>Customer</td>
<td>ESCO Company</td>
</tr>
<tr>
<td>Service charge payment</td>
<td>A certain amount of money or a certain percentage of energy saving gains (saving on utility bills) is paid.</td>
<td></td>
</tr>
<tr>
<td>Division of profits after completion of the contract term</td>
<td>All energy saving gains (saving on utility bills) belong to customers.</td>
<td></td>
</tr>
</tbody>
</table>
The feature of ESCO is performance contract (cont.)

<table>
<thead>
<tr>
<th>Contract Type Item</th>
<th>Guaranteed savings contract</th>
<th>Shared savings contract</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash flow</strong></td>
<td></td>
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<tr>
<td></td>
<td><img src="image1.png" alt="Graph showing cash flow" /></td>
<td><img src="image2.png" alt="Graph showing cash flow" /></td>
</tr>
<tr>
<td><strong>Benefit for customers</strong></td>
<td>1) Energy-saving is ensured because the amount of conserved energy is assured. 2) Energy-saving facilities belong to customers because they cover the initial investment costs.</td>
<td>1) Energy-saving is ensured because the amount of conserved energy is assured. 2) Off-balance-sheeting energy-saving facilities (facilities need not be incorporated in the balance sheet) 3) Customers do not have to take financial risks because ESCO companies cover the cost to install energy-saving facilities.</td>
</tr>
</tbody>
</table>

ESCO business company guarantees the amount of energy-saving reduction by a performance contract.
For this reason, ESCO business company has incentives to execute reliable renovation work to secure design performance.
ESCO business company has incentives for operation & maintenance of facility, because three is merit also to ESCO company when energy reduction effect is better than it was guaranteed.
2.2 Application example of ESCO
Example of ESCO business (at a hospital)

- Support, in the forms of partial subsidy for initial investments, low-interest loans, etc., is extended to private enterprises and local governments implementing ESCO business.
- ESCO projects have tended to increase their shares among “the government subsidy to disseminate and promote the projects that introduce highly-efficient energy system for residences and buildings” and “the government subsidy to assist businesses who execute the rational use of energy”.

Energy conservation effect from ESCO: approximately 25%

Source: METI
Example of ESCO service by KENES

ESCO service: Guaranteed saving contract, Service start: April, 2010, Customer: university

Overview of ESCO service

【Introduction of air-conditioning control】
Schedule operation, timer operation, temperature control using computer contribute to cut waste

【GHP→EHP】
Gas engine heat pump with long running time is changed into electric heat pump.

【Air cooling heat pump package air-conditioner】
steam driven absorption refrigerating machine, steam heat exchanger, Air conditioning air handling FCU changed into air-cooled heat pump type packaged air conditioners

【change to direct expansion air conditioning】
An air cooling heat pump chiller is improved to an efficient air cooling heat pump package.

Source: KENES
Example of ESCO service by KENES (cont.)

【Downlight changed to LED 】
Introduction of LED downlight with long life, energy saving and merculy-less

【Change to fluorescent light with inverter ballast】
Fluorescent lights are exchanged to high efficient type and the motion sensors were introduced at halfplaces.

【Reduction of water for toilets】
demo sound equipment and Automatic washing machine

【Saving energy belt】
Fans with long running time are exchanged to energy saving type.

【High efficiency transformer】
Change to high efficiency oil-immersed transformer (300kVA × 1, 200kVA × 1)

Source: KENES
Mechanism of heat pump (in case of cooling)

Heat pump is technology which is made to move the heat which air and water have and is used for an air conditioning, hot-water supply, etc.

Electricity is not directly used as a heat source like an electric heater, but electricity is used as a driving force for making heat transfer, and the heat filled in the atmosphere is used well.

Air conditioning utilizing “heat pump” technology

Temperature difference causes spontaneous transfer of heat.

1. Hot liquid refrigerant is cooled by outdoor air through heat exchanger.
2. Liquid refrigerant evaporates through valve and its temperature falls.
3. Cold gas refrigerant removes air heat indoor (air conditioning).
4. Compressor compresses and liquefy refrigerant.
Mechanism of heat pump (in case of heating)

Refrigerant compressed by compressor raises temperature.

Heat absorption from the air

Temperature falls by suddenly lowered pressure.

Discharge of heat (1)+(5) =
2.3 Economic side of ESCO
Economic Evaluation (1)

• Lifecycle (or Lifetime) Cost

(A) Introducing system of **low initial cost** and **low efficiency** (=high energy cost)

(B) Introducing system of **high initial cost** and **high efficiency** (=low energy cost)

Total owning cost of period for use
= \( I + E \times (\text{Period of use}) \)

\[ \text{LCC}_A = I_A + E_A \times 10 \]
\[ \text{LCC}_B = I_B + E_B \times 10 \]

*Not in consideration of interest or discount rate for simple
Economic Evaluation (2)

- Payback Period for Introducing Higher Efficiency System

Comparing (B) to (A), payback period

\[ \text{Payback Period} = \frac{(I_B - I_A)}{(E_A - E_B)} \]

(when just replacing newer system, \(I_A=0\))

*Not in consideration of interest or discount rate for simple*
Economic Evaluation (3)

- Annual Equivalent Cost

\[ AEC_A = \frac{I_A}{10} + E_A = \frac{LCC_A}{10} \]

*Annual Equivalent Cost for Lifetime of 10yrs

*Not in consideration of interest or discount rate for simple
How to compare the present value and future value?

- Present value
  - Present 100$ > 1 year later 100$
    - \( \frac{110}{1.1} = 100 \)
  - 2 years later 121$
    - \( \frac{121}{1.1/1.1} = 100 \)

The project cost must be discounted at the same time point.
Example for ESCO Service charge (1)

*Target value*

<table>
<thead>
<tr>
<th>Maintenance 245</th>
<th>Water 135</th>
<th>Reduction 1,990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water 135</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy fuel oil 2,230</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity 310</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Customer’s merit 920

ESCO Charge 1,070

Reduction 1,990

Facility installation expenses 9150
Removal 910, and other expenses is spread into annual basis

Customer’s merit 1,600

ESCO Charge 390

100$/year

In case of 50% of a grant rate with a subsidy

Electricity

310

before 1~15 years later 16~20 years later

*guaranteed value*

<table>
<thead>
<tr>
<th>Maintenance 245</th>
<th>Water 135</th>
<th>Reduction 1,799</th>
</tr>
</thead>
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<td></td>
<td></td>
</tr>
<tr>
<td>Heavy fuel oil 2,230</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity 310</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Customer’s merit 730

ESCO Charge 1,070

Reduction 1,799

ESCO service charge in case $45.7mil subsidy
Example for ESCO Service charge (2)

**<target value>**

- **Maintenance**: 245
- **Expense for Light Heating Water**: 135
- **Heavy fuel oil**: 2,230
- **Electricity**: 310

Reduction: 1,990

**ESC0 Charge**: 1,481

**Customer’s merit**: 508

Reduction: 1,990

**Reduction**: 1,990

Since there is no subsidy, ESCO service charge goes up.

**In case of no subsidy**: 100$/year

**before**

**1~15 years later**

**16~20 years later**

**<guaranteed value>**

- **Maintenance**: 245
- **Expense for Light Heating Water**: 135
- **Heavy fuel oil**: 2,230
- **Electricity**: 310

Reduction: 1,799

**ESC0 Charge**: 1,481

**Customer’s merit**: 318

Reduction: 1,799

**Reduction**: 1,799

**before**

**1~15 years later**

**16~20 years later**

GSEP/PPA Energy efficiency improvement Workshop
Guam August 20-24, 2012
Actual application of Energy efficiency improvement

Taiichi Kaizuka
The KANSAI Electric Power CO., INC.
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3.1 America - EERS
Policy on energy efficiency improvement to electric utilities (U.S.)

In the U.S., the state law which defines the amount of energy-saving duty (EERS: Energy Efficiency Resources Standard) to future electricity sales has become widespread. Curbing electric power sales is made compulsory not to consumers or public institutions but to electric utilities. (From the side of electric utilities, it will exactly be that the income reduction by curbing electricity sales is forced.)

As an incentive to electric utilities, cost recovery for energy saving program, lost revenue recovery, performance incentive, etc.

It was first introduced to Texas in 1999, and 26 states have already introduced as of January 2011.
Incentive scheme to support energy efficiency improvement (1)

The main schemes for making electric utilities promote energy efficient measures is as follows.
(1) Cost recovery for energy saving program
(2) Lost revenue recovery
(3) Performance incentive

(1) Cost recovery for energy saving program
Cost recovery for energy saving program like energy saving education, subsidy for replacement from electric bulb to FL (fluorescent light) is the minimum condition. Recovery schemes are
• include in rate base and collect as electricity charge
• collect by adding extra charge (ex. surcharge) to electricity charge
• recover from funds collected proportionally to electricity consumption aiming at public-interest use like subsidy to low income group (SBC: System Benefits Charge)

(2) Lost revenue recovery
(2-1) Direct compensation
• Recover decrease in electricity sales due to energy saving by adding extra charge (ex. surcharge) to electricity charge
• Weak point of direct compensation is that accurate method for measuring energy saving effect doesn’t exist. Few states have introduced.
• Moreover, since there is no mechanism of collecting the exceeding sales from an electric utilities in case of electricity sales increase, it does not lead to prevention of throughput incentive.

What is “Throughput incentive”?
• An electric power supplier as well as other manufacturers pursues profits by increasing goods, i.e., electricity sales.
• That is, it is natural to think that corporate activity seeking more electricity sales is induced.
• When discussing promotion of an energy-saving measure, this is called “throughput incentive” works.
Incentive scheme to support energy efficiency improvement (2)

(2-2) Decoupling
- The basic scheme is separation of relation between sales revenue and amount of electricity sales.
- That is, a fixed sales revenue guaranteed irrespective of amount of electricity sales.
- It is also applied to demand fluctuation resulting from weather condition or economic trends.
- If the electricity sales revenue is less than overall cost which is applied at rate revision, collects deficit by raising electricity rate and vice versa. Therefore, throughput incentive does not work.
- Since adjustment is done not by the amount of energy saving achievement but by sales revenue, measurement of the energy saving effect is unnecessary which results in becoming operational under relatively simple scheme.
- Since in order that a circulation income may aim at profits increase in the fixed bottom,
- Since pursuing profit is restricted under the fixed electric sales, electric utilities have incentives for cost reduction.
- Large quantity consumer organization (Industrial Energy Consumers of America) expresses concern over decoupling as this scheme hangs the consumer side on the risk of electric sales reduction.
### Incentive scheme to support energy efficiency improvement (3)

#### Principle of Decoupling

<table>
<thead>
<tr>
<th>Rate revision</th>
<th>FY</th>
<th>A</th>
<th>B</th>
<th>C(A/B)</th>
<th>D</th>
<th>E(D/B)</th>
<th>F</th>
<th>G(E × F)</th>
<th>H(G-A)</th>
<th>I(D-G)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Full cost($)</td>
<td>Expected sales (MWh)</td>
<td>Unit Price ($/MWh)</td>
<td>Approved revenue</td>
<td>Applied unit Price</td>
<td>Actual sales</td>
<td>Actual revenue</td>
<td>Difference</td>
<td>Balance account</td>
</tr>
<tr>
<td>1(^{st})</td>
<td>1</td>
<td>100.0</td>
<td>1000</td>
<td>0.100</td>
<td>100.0</td>
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<td>2</td>
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<td>2(^{nd})</td>
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<td>111.1</td>
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<td>1010</td>
<td>112.00</td>
<td>0.90</td>
<td>0.00</td>
</tr>
</tbody>
</table>

#### The principal of filling lost profit

**The usual charge design**

- Full cost
- Assumption volume of sales
- Expected sales
- Charge income

**Direct filling**

- Full cost
- Assumption volume of sales
- Expected sales
- Charge income

**decoupling**

- Full cost
- Assumption volume of sales
- Expected sales
- Charge income
Incentive scheme to support energy efficiency improvement (4)

(3) Performance incentive
• Although the schemes described above, (1) Cost recovery for energy saving program or (2) Lost revenue recovery are supposed to get rid of negative incentives when electric utilities are going to implement energy saving measures, only their use are not connected with investment on positive energy saving measures.
• For this reason, performance incentive proportional to achievement degree of energy saving is considered. Conversely, it is considered that imposing penalty is also effective for negligence.

• Specifically, there invented three kinds of schemes.
  ① Performance target incentives
  Reward can be obtained in proportional to achievement degree of energy saving against the target prescribed in every fiscal year by the regulating authority.
  ② Shared savings incentives
  There generated the merits like reduction of fuel procurement or elimination of construction cost for electricity supplying facilities by energy saving measures. The part of merits converted into financial value is allocated to electric utilities on the basis of its degree of energy saving effort. The rest of merits is deemed to give back to consumer side.
  ③ Rate of return incentives
  Return rate for energy saving investment is set higher than the other investments.
### Introductory situation of incentive scheme by state

<table>
<thead>
<tr>
<th>State</th>
<th>Cost recovery for energy saving</th>
<th>Lost revenue recovery</th>
<th>Performance incentive</th>
<th>Save a watt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>rate base</td>
<td>SBC</td>
<td>surcharge</td>
<td>decoupling</td>
</tr>
<tr>
<td>Alabama</td>
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As of 2009, Source: ACEEE
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<td>Wyoming</td>
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As of 2009, Source: ACEEE
Ten geographically dispersed states have committed to long-term targets to achieve over 10% cumulative annual savings by 2020

Source: ACEEE
Cumulative Electricity Savings of State EERS Policies
Extrapolated to 2020

<table>
<thead>
<tr>
<th>State</th>
<th>Cumulative 2020 Target</th>
<th>State</th>
<th>Cumulative 2020 Target</th>
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<tbody>
<tr>
<td>Maryland*</td>
<td>26.70%</td>
<td>Maine*</td>
<td>13.40%</td>
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<td>New York*</td>
<td>26.50%</td>
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<td>Massachusetts*</td>
<td>26.10%</td>
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<td>25.26%</td>
<td>Michigan</td>
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<td>Vermont*</td>
<td>23.85%</td>
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<td>Indiana</td>
<td>13.81%</td>
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</table>

*Savings beginning in 2009 extrapolated out to 2020 based on final year of annual savings required

Source: ACEEE
Savings vs. Targets in 2010

*Reference year for savings is 2009

Source: ACEEE
3.2 France – Eco watt
In the Bretagne district of northwestern France, the consumer participation type power-saving campaign "Eco Watt" was started in 2008.
This campaign is taken place in winter season (Nov - Mar) when electricity demand reaches a peak.
This campaign has been hosted by RTE (power transmission subsidiary of EDF), in addition, local government bodies, ADEME (environment and energy-saving agency), and ERDf (power distribution subsidiary of EDF) have cooperated.
Electric supply and demand situation of the day and next day is informed on the web.
If power consumption exceeds a fixed level, "alarm" will be sent through an E-mail etc. to the "cooperator" who registered in advance to urge power-saving action.
According to estimate by RTE, it is thought to be about (in the case in the Bretagne district) 2~3% effective to peak demand.
1. Electric situation in Bretagne

In Bretagne, construction plan of "Plogoff nuclear power plant" which was expected to become main power sources was abandoned in late 1970s, because of the strong opposition from local residents. It is not easy to realize power plant project (not only nuclear, but the other sources like wind power) in Bretagne where ecologists have great influence. As a result, generation capacity in Bretagne can supply only 8 - 10% of local consumption.

Power supply in Bretagne depends on the generation sources located in the east. Since it is supplied from the considerably distant nuclear and thermal power plant, the transmission capacity approaches its limit at peak hours and blackout risk increases.

The effect expected by Eco Watt

1. Energy conservation effect under tight supply and demand situation
2. Energy saving as everyday behaviors
3. Educational role for power saving and energy saving is fairly important
2. How Eco Watt works?

- Power supply and demand situation of that day and the next day is shown by 3 colors, green, orange, and red on the website (www.ecowatt-bretagne.fr).
- Simultaneously, “cooperators” are sought to participate Eco Watt. Alarm is sent through e-mail and RSS feed, etc to “cooperators” who had registered in website in advance in case of tight supply and demand situation.
- As a "cooperator", three categories of individual, company, and local government body and public institution are assumed.
- The guidance "suitable action (bons gestes)“ including information for expected power saving in winter peak hours (morning and 18:00-20:00) are on the website classified into above three categories.
- The local government bodies and companies are provided "Eco Watt oath charter“ and choose concrete plan (power saving behaviors such as putting off lights in office, recommendation of Eco Watt registration to personnel) and sign.
- Participating organization makes public on its website and each cooperative organization appeals by displaying Eco Watt posters and adding Eco Watt logo to e-mail signature and aims image enhancement and popularization.
- Approach methods are devised according to target. Seminar for companies and educational DVD for children was made under the cooperation of the chamber of commerce and the board of education.

3. The result of Eco Watt campaign

- 08-09 year: Cooperator 9000, Alarm 9 times, effect of power saving was unknown
- 09-10 year: Cooperator 18500, Alarm 11 times, max power saving: 1.5% of peak demand
- 10-11 year: Cooperator 30800, Alarm 7 times, max power saving: 2.0% of peak demand
- 11-12 year: Cooperator 45000, Alarm 7 times, max power saving: 2.0%～3.0% of peak demand

(max power saving is estimate by RTE based on questionnaire result and power consumption data, etc.)
4. Result of questionnaire about Eco Watt

In February 2011, RTE carried out the questionnaire toward "cooperators", “local government bodies”, and “local residents" in the Brittany.

The result proves the visibility and high evaluation of Eco Watt.

Q. Have you heard "Eco Watt"? - Local residents 72%-YES Local governments 92%-YES

Q. Do you evaluate Eco Watt positively? –Cooperators 100%-YES Local governments 96%-YES

Local residents 97%-YES

93% Cooperator is satisfied with alarm system.

97% Cooperator answers that they will save power in case of receive alarm and try to save power in everyday basis.

5. Others

"Provence Azur Eco Watt campaign" was started in the Provence Azur district of south France in autumn of 2010.
Providing Training for Energy Management

Dr, Herbert Wade

Energy Efficiency Improvement Workshop
Guam
August 20-24, 2012
Customer Energy Manager Training
Energy Management Principles

- Larger hotels, government departments and some large commercial establishments give a staff person responsibility for controlling energy use and they become essentially the organization’s energy manager.

  - Training in energy management basics is needed.
  - Utility may offer assistance as part of energy efficiency outreach.
Mode of Training

- In the case of government, training may be simultaneous for all departmental energy managers
- For Hotels and tourism facilities, may be through the local association
- For Commercial buildings, may be through the Chamber of Commerce
- May be at the request of a building owner or company and one-on-one
Components of Training

- Provide a paper/text about doing company energy management prior to the course

- Spend half a day going through the principles of energy management in a classroom environment
  - Demonstrate the use of watt meters, kWh measuring devices and IR thermometers

- Go to one of the facilities managed by one of the participants and teach participants what to look for by helping them with a walk through audit
Training Content

• Different classes of customers
  – All classes need to look at the building itself
    ∟ Roof colour
    ∟ Roof insulation
    ∟ Wall colour
    ∟ Window location relative to solar entry and window type
- Different focus according to different energy uses of the major categories of customers

  - Government: Air conditioning, computers, lighting
  - Hotels: Television, Air conditioning, refrigeration, food preparation facilities, swimming pools, exterior lighting
  - Commercial: Air conditioning, interior lighting, exterior lighting
Energy Using Equipment Database

- Managers need to prepare an inventory of all energy using devices under their management
  - Type of device (e.g. laser printer)
  - Location
  - Watts for operation
  - Approximate hours per day of use
  - Comments (has phantom load problem, should it be replaced by more efficient unit, age, etc.)
Device Management

• Prepare proposals for replacement of inefficient energy using devices based on the inventory
  – Need to show cost of new device and estimated energy savings per year
  – Prioritise according to potential savings
User Management Guides

- Managers to prepare guides for the energy efficient use of each type of energy using device in the inventory
  - Turn off power to equipment at night
    - Avoids phantom loads
  - Adjust computers to go to sleep after 15 minutes of inactivity
  - Set A/C to higher temperature at night or turn off
  - Timer on hotel swimming pool pumps
Building Modifications

- Managers to prepare proposals for building modifications to reduce A/C, ventilation and lighting loads
  - Show expected investment and annual savings
Advise for Purchasing

- Energy managers need to be part of the new equipment purchasing process when the equipment will be using energy.
  - Propose specifications that ensure a high efficiency of energy use
  - Advise management of the probable energy cost for proposed new purchases
Set Equipment Operating Standards

• Temperature settings for A/C

  – For offices, an initial temperature of 25C when people come to work (and right after lunch) raised after an hour to 28C maintains comfort but saves much energy
• For hotels, reduce exterior lighting after midnight or whenever the pool and outside food and drink vending ceases

• Set timers for hotel swimming pool pumps to shut down when pool is not in use and start an hour before pool opens
• Where there is central air conditioning for offices and commercial buildings, chillers and circulating pumps can usually be shut down after hours

  – Be aware of special situations such as a need to provide cooling for a high performance network server.
Training for Walk Through Audits

• Monthly checks in an energy management programme
  – Notes changes in the equipment inventory
    ß May be moved to or from another department or office
    ß May be newly purchased and installed
  – Check A/C temperature settings
    ß Note violations of energy guidelines and notify users of proper actions
– Note equipment problems

β Refer for maintenance or replacement

• Note any problems not previously noted, e.g. annual change in sun’s position has caused new areas to be in the direct sun from windows

– Note any ideas for solutions
Easily the largest energy usage for government, hotels and residences is for refrigeration. That includes A/C, home freezers, home refrigerators, commercial “walk in” refrigerators and “walk in” freezers.
Cooling with Electricity

• How refrigeration/air conditioning works

  – Heat is absorbed in the space to be cooled and pumped to an area outside that space
  – Requires easy absorption of heat in the space to be cooled and easy elimination of the heat in the space outside
  – Can use a heat source (a gas flame for example) to drive the cycle or a compressor.
A/C Energy Efficiency Ratings

- Coefficient of Performance (COP)
  Units of heat energy pumped
  Units of Work Done

- Energy Efficiency Rating (EER)
  \[\text{BTU/hour}\]
  \[\text{Watts}\]
  Computed at a standard air temperature (A/C)
  (Equals COP \times 3.413)

- Seasonal Energy Efficiency Rating (SEER)
  \[\text{BTU/hour}\]
  \[\text{Watts}\]
  Different at different air temperatures (heat pump)
  \[\text{SEER} \approx \text{EER} \times 0.9\]
Low pressure

High Pressure

Sealed Compressor/Motor unit
Evaporator (Inside cold space - Cold)
Condenser (Outside cold space - Hot)
Filter and Dryer
Capillary Tube (or expansion valve)
Window Air Conditioner Unit
Refrigeration Efficiency Factors

- Surface area and type of heat delivery surface for the condenser (outside heat exchanger)
  - Large area better than small
  - Direct contact with outside air is better than indirect contact
    - Open coils and fins are better than freezer surface skin
    - Copper is better than Aluminium
  - Ambient temperature of the space where heat is delivered
• Surface area and type of heat delivery surface for the evaporator (inside heat exchanger)
  
  – Metal surface better than plastic
  
  – Frost on its surface reduces heat transfer
  
  – Temperature setting of the unit high as practical
  
  – Larger area better than smaller
• Efficiency of the heat moving process
  – Quality of compressor and motor
  – Piping arrangement and working fluid path
  – Working fluid
  – Temperature of the outside air and the condenser
    ß Sun should not shine directly on the condenser surface
• Rate of flow of heat into the cooled space from the warmer outside area

  – Insulation to block conduction of heat

  – Sun heating on the components

  – Ambient temperature of the outside area

  – Warm air entry into the cooled space
    ß Opening of doors to the warm outside area
    ß Seals around doors and other openings
    ß Type and location of doors on refrigerators and freezers
DSM measures

- Improved maintenance of existing equipment
  - Cleaning of evaporator and condenser surfaces
  - Cleaning of A/C filters
  - Maintain good door seals on refrigerators and freezers

- Improved location of condensers to aid in heat movement to the outside air
  - Clear space around refrigerator and freezers
  - Good ventilation around condensers for A/C
  - A/C and large refrigeration condensers shaded and in cool area
Residential Window Unit
Government A/C Unit (split type)
Training for Government and Commercial Energy Managers

Dr. Herbert A. Wade

Energy Efficiency Improvement Workshop
Guam
August 20-24, 2012
Lighting
Benefit increases with light usage

• Efficiency benefits increase with the percentage of the day that lighting is used

  – Upgrading the efficiency of street lights that are on all night will have a much greater benefit than upgrading similar lights at sports facilities that are only on for a few hours a day

  ß Focus programmes mainly on lights that are on for at least several hours a day. Lights in closets, storage rooms and areas where there is little active use are not good candidates for energy efficiency measures
Lighting Efficiency

• Lighting efficiency is usually measured in Lumens per Watt. Lumens are the measure of the total light coming from a source.

• Lux is the measure of the light falling on each square metre of a surface. 400 lux is typical for work areas in a brightly lit office and is sufficient for all but very detailed, specialised work.

  – Incandescent lights convert only about 2% of input energy to visible light. The rest is delivered as heat
Florescent lights convert from about 15% to 30% to visible light with the rest delivered as heat.

In air conditioned spaces, the heat from lighting has to be removed by the air conditioner meaning that improved lighting efficiency lowers not only lighting bills but also air-conditioning bills.
# Efficiency of Lighting Technologies

<table>
<thead>
<tr>
<th>Lighting Technology</th>
<th>Lumens Per Watt</th>
<th>Colour rendition</th>
<th>Rated Life</th>
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</thead>
<tbody>
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<td>Incandescent</td>
<td>6-15</td>
<td>Very Good</td>
<td>750-2000</td>
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<tr>
<td>Halogen incandescent</td>
<td>10-24</td>
<td>Very Good</td>
<td>2000-4000</td>
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<td>Iron ballast fluorescent</td>
<td>45-75</td>
<td>Good to VG</td>
<td>12000-20000</td>
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<td>Electronic Ballast fluorescent</td>
<td>70-105</td>
<td>Good to VG</td>
<td>12000-20000</td>
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<tr>
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<td>40-85</td>
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<td>10000-12500</td>
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<td>30-60</td>
<td>Fair to Good</td>
<td>12000</td>
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<td>HP Sodium Vapour</td>
<td>45-150</td>
<td>Poor to Fair</td>
<td>25000</td>
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<td>Only orange</td>
<td>18000</td>
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<td>Very Good</td>
<td>15000</td>
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<td>50-80</td>
<td>Good</td>
<td>60000</td>
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<tr>
<td>LED lamps</td>
<td>30-60</td>
<td>Poor to VG</td>
<td>50000-100000</td>
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</table>
Critical Elements in Lighting

• Level of lighting fits the task

• Location of the lighting
  – Light source should not be in the normal field of vision of the workers.
  – Surfaces in the field of vision should not be reflecting the light source and causing glare
• Coverage of the lighting
  – Lighting needs only to cover the work area at the level of illumination needed for that work.
    ß Task lighting is generally more efficient than area lighting and can provide better work conditions

• Colour of the lighting
  – Preference is for light that does not change the perception of colour from that of daylight
Types of lighting

- Outdoor area lighting
  - Street lighting level usually only has to be sufficient for safely getting around the lit area. Lowering the level of lighting often can be a means for lower lighting energy use. 10-50 lux

  \[\beta\] Exceptions being sports field lighting and work area outdoor lighting (e.g. at a wharf) where higher intensity lighting may be needed 100 lux
• Indoor area lighting needs to be sufficient to get around the space and to do non-detailed work. CFL and fluorescent tube lights with electronic ballasts are best for this type of lighting in small spaces and discharge type lamps in large spaces. 50-500 lux

• Task lighting is intended to provide bright illumination over a narrow area where a task (e.g. sewing or reading) is being undertaken. CFL and LED lighting are both good for this purpose. 500-1000 lux
• In general the most efficient lighting for homes and offices combines low level area lighting for the overall space plus bright but small area task lighting for those areas where detailed work is being done.
## Light intensity required

<table>
<thead>
<tr>
<th>Purpose for the lighting</th>
<th>Intensity Needed (Lux)</th>
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</thead>
<tbody>
<tr>
<td>General Office Work (reading &amp; Writing)</td>
<td>300</td>
</tr>
<tr>
<td>General Office Work (computer)</td>
<td>100</td>
</tr>
<tr>
<td>Detailed work area</td>
<td>500</td>
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<tr>
<td>Highly detailed work (jewelry making, precise assembly)</td>
<td>1000</td>
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<tr>
<td>Stairways, corridors, storage areas, dining areas</td>
<td>100</td>
</tr>
<tr>
<td>Sales rooms</td>
<td>500</td>
</tr>
<tr>
<td>Hotel Lobbies</td>
<td>100</td>
</tr>
<tr>
<td>General class rooms</td>
<td>300</td>
</tr>
<tr>
<td>Art and drawing class rooms</td>
<td>500</td>
</tr>
<tr>
<td>Home living room</td>
<td>50-100</td>
</tr>
</tbody>
</table>
Streetlighting

• Lighting technologies for Street Lighting
  – Florescent tube lights
    › Inexpensive, good efficiency, good colour
    › Low lighting level so coverage per light is low
  – Sodium vapour lights
    › High efficiency
    › Yellow-Orange colour not suitable for area lighting where colour is a problem (e.g. sports lighting)
    › Tend to be bulky and relatively expensive
  – Mercury vapour lights
    › Good efficiency
    › Some colour distortion but much better than sodium vapour lights
    › Tend to be bulky and relatively expensive
    › Also used for large area indoor lighting (e.g. warehouses)
• Metal Halide lights
  – Good efficiency
  – Low maintenance
  – Available in lower wattages than sodium or mercury vapour lights
  – Very low colour distortion
  – Long life
  – Compact bulbs
  – Expensive on a per Watt basis

• LED lighting
  – Low colour distortion
  – Very Long life and low maintenance
  – High Efficiency
  – Best for small area task lighting and sign illumination but can be used for street lighting and large area lighting. Can be cost effective in some cases due to their very low requirement for maintenance and high efficiency
DSM through lighting controls

- Lighting controlled by sensors
  - Activity sensors so lights are only on when there is activity in the space
  - Heat sensors so lights are only on when there is a warm body in the space
  - Timers so lights are automatically turned off at designated times
  - Light sensors so lighting is turned on or adjusted in brightness only when there is not sufficient light from other sources
DSM by using daylighting

• Daylighting

  – Lighting provided from the sun.

    Ⅲ Skylights (including “light tunnels”)
    s May bring in heat as well as light
    Ⅲ Windows shaded from direct sunlight entry
    Ⅲ Doesn’t work very well at night…..
Office Equipment
DSM for Computers

- Energy is used by:
  - The computer itself
    - Varies dramatically with the use patterns. One of the main energy users in most cases
  - Screen
    - Fairly constant energy use when operating
    - Much higher use with older bulky CRT type screens than newer flat type screens
  - Printers
    - Laser printers have much higher energy demand than ink-jet or thermal printers
    - Duty cycle is a major factor in printer energy use especially for newer laser printers that have a low power standby mode between print jobs
• Scanners
  – Modest power requirement
  – Big difference between power use during scanning and when standing-by

• UPS
  – Modest but continuous power usage

• Network equipment
  – Servers are high energy users since they are fully operating computers 100% of the time
  – Switches and wireless routers also on 24/7 but modest individual power requirements
• New computing equipment tends to be much more energy efficient than equipment 2 or more years old.

• In air conditioned spaces, energy needed to take heat from computers and peripherals out of the space may represent a significant energy use, sometimes an amount approaching that of the computers themselves.
DSM measures

- Install and use disconnect switches that turn off all computing equipment at an employees desk when they go home. No equipment remains connected to the grid when not in use.

  - Phantom power use can be significant. Switching screens, printers and computers to off does NOT entirely turn them off, only pulling the plug or having an external disconnect switch will do that.

  - UPS units will not be damaged by turning off their input power but they must be individually turned off if power is removed by a disconnect switch since they will try to keep the power on.
• Replace all old style CRT screens with new flat screen units

  – Better on the eyes and much better on the energy usage

• Ensure that all laser printers are set to automatically go into low power standby between print jobs
• All computers should have internal settings adjusted for automatic power reduction when not in use for 15 minutes or more

• When upgrading computing equipment select units that are highly “green” rated.

• “All in one” computers tend to be more energy efficient than units that have separate monitors and CPU boxes.
• Use laptop type computers instead of “desk-top” units where practical

  – Often 1/10th the energy use for office type work

• Use ink-jet printers for personal printing. Network laser printers for high volume printing
Building Envelope
Roof

- Roof needs to be white or bright metallic.
  - Special highly heat reflective paints are available to reduce metal roof heating

- Should have reflective foil type insulation (radiant barrier) under the roof

- Attic area should be well ventilated
Exterior Colour

- Light colour (preferably white) for building wall areas directly in the sun (east and west especially but also north and south if not shaded)

- Best is to have a verandah around the building. Provides both rain protection and sun protection
Windows

• Windows that are not shaded should have reflective films applied (70%-90% reflective)

• Air conditioned spaces should have tightly fitting windows, not louvered windows

• Non A/C spaces should have large openable windows, louvers preferred

• Attach shading louvers outside east and west windows to prevent direct solar heating
• Attach shading louvers or awnings or add veranda outside east and west windows to prevent direct solar heating

• Switching of lights should be set up by groups, not all at once
Training Users for Hotel and Residential Energy Management

Dr. Herbert Wade

Energy Efficiency Improvement Workshop
Guam
August 20-24, 2012
Hotel Energy Management Training

- A/C and Lighting are the same problems as Government and Commercial buildings
- Televisions and satellite receivers
  - Phantom loads
    - Vacant Rooms, turn off at the wall
  - Modern flat screen LCD or LED type (not Plasma)
  - Small room refrigerators not enclosed
    - Condenser heat has to leave easily or less efficient
    - Turn off when room is vacant
• Ceiling fans are useful even if A/C is used. Can set the temperature higher (e.g. 28°C instead of 25)
  – Staff turn them off when unoccupied
• Have staff pre-cool rooms to 25°C before arrival of occupants.
  – Tendency to over cool otherwise
• Turn off A/C and open balcony doors or windows when unoccupied
  – Reduces odors as well as saves energy
  – Can use key to turn off A/C when room is unoccupied
• Exterior lighting reduced after close of bars and pool
• Tennis court lights only on when there are players
• Swimming Pool circulation pump runs only when pool is open.
• Low Voltage LED lights for pathway marking
• Drapes should have a white or reflective backing that goes against the window or sliding door
  – Reduces solar heating in the room

• Exterior glass includes reflective film that reflects 70% to 90%.
  – Reduce solar entry and resultant A/C loading
School Programmes To Support Residential Energy Efficiency

Training Home Users for Energy Efficiency
Why Schools?

• Knowing about energy and how to use it intelligently will be increasingly important for the future so it needs to be learned now

• By including activities that include the parents and whole family, the lessons get carried beyond the school
• Add teaching modules about energy and energy efficiency to the existing school curriculum
  
  – Start about Form 1 (age 10-11) with studies about home energy use
  
  – Increasingly technical modules for later years
  
  – Combine with renewable energy studies
Curriculum Adoption

• Department of Education must approve all public school curricula in most countries

• Difficult and slow to change the curriculum and add new materials

• Most school systems have periodic curriculum reviews and revisions, that is the best time to present programmes that involve inserting new teaching modules
**Prepare a Concept for the Module**

- Present an outline of the proposed teaching module to the Department of Education for approval for addition to the existing science curriculum
  - Note any special equipment needed
  - Estimate the number of days needed for the complete module
  - Note what external resources may be available to support the module development and presentation
• Develop Textual Materials for the teaching module
  – Done by the Department of Education specialists with the technical assistance of the utility or other energy experts
  – Funding may be needed for graphics artists and printing
Train the Teachers

- Utility staff or other external experts train the teachers using the content in the texts that have been developed for the programme.
  - Typically no more than one or two days
Sample School Programme Concept
Middle School Home Energy Audits

• Focused on 10-12 year old students
  – Shown to be the age group that is most likely to involve parents in school activities
  – The level at which technology starts to be taught in school science programs
General Concept

• Teach children about energy in the home
• Teach them about how to do a basic home energy audit
• They do, with the help of their parents, a home energy audit
• The students bring back to class the audits they have done and discuss the things that need to be done in their home to improve energy efficiency

• On the day of the audit presentations, a representative from the utility gives the “auditors” a certificate and one or two high efficiency light bulbs for them to take home.
Technical School Programmes

• Most countries have a technical school that includes electrical trades instruction
  
  – Work with the school to introduce energy efficiency course modules to the existing programme
Curriculum Development for Trade Schools

- Introducing new course modules in tertiary schools typically is much simpler than in public schools.
  - Often a curriculum committee at the school makes the decision
  - For small schools, the principal may make the decision
Creating Modules

• Determine what skills are to be taught in the curriculum module
  – Energy Auditing is a common focus for an added trade school course module
    ð Needs to explain energy efficiency and the difference between efficient and inefficient equipment and how it is determined
    ð Explains how to determine if existing equipment in a building needs replacing if efficiency is to be improved
    ð Explains the importance of energy management as well as having efficient equipment
Training of Trainers

• Teachers at the school receive training in the new course module
  – External experts
  – Utility personnel
Support Equipment

• Equipment for teaching the energy audit course module will need to be purchased for the school
  – portable watt meters and watt hour meters
  – Infra red thermometers
  – Illuminometers
  – Samples of radiant barrier insulation
1. Why does roof colour make a difference in air conditioning use? What is the best colour?

2. How can energy use for swimming pools be made more efficient?

3. Why should the outdoor portion of an air-conditioner be kept in the shade?

4. If it is true that an incandescent light converts only 2% of the electricity to light, how does that have an effect on air-conditioning energy needs?
5. Name two advantages of LED lighting. Name one disadvantage.

Advantages:

Disadvantage:

6. You go into a government office and measure the general lighting level as 950 Lux. What can you immediately do to increase energy efficiency for that office?

7. Which is more energy efficient, an ink jet printer or a Laser printer?

8. What is meant by a Phantom load? Give an example for one often found in a kitchen.
9. If the Phantom load of a TV is 3 watts and the phantom load of a DVD player is 2 watts and electricity is $0.50 a kWh, what is the expected annual cost of that phantom load? Show your calculations.

Do you think that is good value for the money?

If you want to save that money what can you do?

10. Name three reasons that teaching energy efficiency to 10-13 year old students is a good way to improve residential energy efficiency.