Policy and Programs for Energy Efficient Houses and Buildings

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When we consider transition of final energy consumption, the commercial and residential sectors account for over 30% of final energy consumption in Japan. The graph on the left shows that these sectors have seen a more significant increase than the transportation and industrial sectors. Therefore, strengthened energy efficiency measures are called for mostly in the commercial and residential sectors.
Comparison of Energy Consumption per Household in the World

- The ratio of energy consumption for space heating is much smaller in Japan compared with European and North American countries where the ratio is very high, whereas the ratio of energy consumption for water heating and lighting / home appliances in energy consumption is higher in Japan.
- Climate and lifestyle differ greatly by country or region and, as a result, the situation of energy consumption differs. Thus, energy saving measures that suit their own country or region are needed.

Energy Consumption per Household (GJ/household, year)

<table>
<thead>
<tr>
<th>Country</th>
<th>Space Heating</th>
<th>Water Heating</th>
<th>Lighting/home appliances</th>
<th>Others</th>
<th>Cooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>US (2005)</td>
<td>40 (40%)</td>
<td>20 (20%)</td>
<td>30 (30%)</td>
<td>8 (8%)</td>
<td>99 (100%)</td>
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<tr>
<td>UK (2007)</td>
<td>41 (55%)</td>
<td>18 (24%)</td>
<td>14 (18%)</td>
<td>75 (100%)</td>
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</tr>
<tr>
<td>France (2007)</td>
<td>44 (60%)</td>
<td>7 (11%)</td>
<td>4 (6%)</td>
<td>10 (15%)</td>
<td>61 (100%)</td>
</tr>
<tr>
<td>Germany (2007)</td>
<td>43 (70%)</td>
<td>7 (11%)</td>
<td>2 (3%)</td>
<td>10 (15%)</td>
<td>61 (100%)</td>
</tr>
<tr>
<td>Japan (2008)</td>
<td>10 (23%)</td>
<td>15 (34%)</td>
<td>3 (7%)</td>
<td>15 (34%)</td>
<td>44 (100%)</td>
</tr>
</tbody>
</table>

Source: Sep. 2010 Report of Jyukankyo Research Institute Inc. (compiled based on statistical data of each country)

*Note: Figures in parentheses are years of latest data of each country. Cooking of the US is included in lighting, home appliances and others. Households of two or more people excluding one-person households in case of Japan. Cooking of Japan is for gas and LPG excluding space heating and water heating, and excluding power for cooking. Data of European countries does not include cooling.

For example, when compared with Germany,  
- energy consumption for heating is one-fourth,  
- energy consumption for water heating and lighting / home appliances is 50 percent to 100 percent greater.

Asahikawa (northern most region)  
- Thick insulation  

Naha (southernmost region)  
- Long eaves to keep the sun out
Trend of Energy Saving Standard Compliance Rate

- As a result of making the regulations more strict, the compliance rate of non-residential buildings has reached approx. 90%.
- As for housing, the standard compliance rate, which used to be less than 20%, increased to approx. 50% as a result of the introduction of housing eco-point program.

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### Trend of Energy Saving Standard Compliance Rate of Newly Constructed Buildings*

*Ratio of floor space of buildings that comply with energy saving standard (1999 standard) out of all buildings with a floor space of 2,000㎡ or more whose construction was certified in the applicable year*

* Estimate until FY2010 is based on a survey on distribution of the number of households complying with housing insulation standard, and estimate for FY2011 (provisional figure) is based on the number of households for which eco points are issued (detached house) as well as notification survey of energy saving act (condominium, etc.)

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### Trend of Energy Saving Standard Compliance Rate of Newly Constructed Housing*

It rose to approx. 50 percent in FY2011 as a result of the introduction of housing eco-point program.

* Types of buildings required to report their energy saving measures were widened in April 2010.

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*Energy saving measures notification became required in April 2003.*

*Energy saving measures notification became required in April 2006.*
Position of Japan in the world

Latitude: 45 degrees North
### Building Energy Efficiency Policies in Japan

<table>
<thead>
<tr>
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<td></td>
<td></td>
<td>2009~ (Introduction of housing top-runner standard)</td>
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<tr>
<td><strong>Assessment and Labeling System</strong></td>
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<tr>
<td><strong>Incentives</strong></td>
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<tr>
<td>Loans</td>
<td></td>
<td>2007~ (Flat 35S (long-term fixed rate housing loans))</td>
<td></td>
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<tr>
<td>Grants</td>
<td></td>
<td>2008~ (Housing and Building CO2 Emission Reduction Promotion Grant Program)</td>
<td>2008~ (Energy-Efficient Renovation Promotion Grant Program)</td>
<td>2010~ (Housing Eco-Points)</td>
<td>2012~ (Zero-Energy Housing Grant Program)</td>
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<tr>
<td>Tax</td>
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<tr>
<td>Incentives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2008~ (Tax incentives to promote energy efficient renovations)</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>2009~ (&lt;Long-life Quality Housing Promotion Act&gt;) Certification of Long-life quality housing (tax deduction for housing loan, property tax reduction, etc.)</td>
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<td></td>
<td>2012~ (&lt;Low-Carbon Cities Promotion Act&gt;) Certification of low-carbon buildings (tax deduction for housing loan, preferred floor area ratio, etc.)</td>
</tr>
</tbody>
</table>
Overview of Energy-Conservation Law

It seeks for increasing energy efficiency in each sector of industry, business, household and transportation.

### Plant / workplace
- **Announcement of effort obligation, judgment standard of business operator**
  - **Specific operator / specific catenation operator**
    - (Energy use 1,500kl/year)
      - Obligation to choose energy supervisor, etc.
      - Obligation to make regular report on energy usage, etc.
      - Obligation to submit mid and long-term plan

### Transportation
- **Announcement of effort obligation, judgment standard of business operator**
- **Specific transportation operator (cargo / passenger)**
  - (The number of owning vehicles 200 or more trucks, 300 or more train cars, etc.)
    - Obligation to submit mid and long-term plan
    - Obligation to make regular report on energy usage, etc.
- **Cargo owner**
  - (Annual transportation amount is 30 million km or more)
    - Obligation to submit plan
    - Obligation to make regular report on energy usage, etc. concerning outsourcing transportation

### Housing / buildings
- **Announcement of effort obligation, judgment standard of owner / proprietor**
- **Specific building**
  - (Total floor space 300㎡ or more)
    - Obligation to submit application concerning energy-conservation measure for owners who construct new buildings and execute large-scaled revamp, report on preservation and maintenance.
- **Housing supplier**
  - (150 or more annually)
    - Obligation to comply with the target to increase energy-conservation performance for ready-built housing that supply

### Machinery & appliances
- **Announcement of effort obligation, judgment standard of manufacturers / import traders of machinery & appliances that consume energy**
- **Top runner system (26 machinery & appliances)**
  - It requires better performance of machinery & appliances than those of the best commercialized ones like passenger car, air conditioner, television, etc. (Covering about 70% of household energy consumption)

### Providing information to general consumers
- **Obligation of business operator to provide information to general consumers**
  - Providing energy-conservation information (annual consumption of electricity, fuel efficiency, etc.) at retailers of house appliances
  - Expanding use of energy-conservation machinery & appliances, providing information, etc. by electric / gas companies
### Obligation to submit a plan of energy efficiency measures

- Report to the local government on energy efficiency measures was required for commercial buildings (floor area $\geq 2,000$ m²) in 2003, for residential buildings ($\geq 2,000$ m²) and large-scale renovation of building ($\geq 2,000$m²) in 2006, for construction of buildings $(\geq 300$m²) in 2010.
- Administrative actions such as recommendation may be taken when the building energy efficiency measures are deemed materially insufficient according to the Energy Efficiency Standard.

### Buildings for which reporting of building energy efficiency measures are mandatory

<table>
<thead>
<tr>
<th>Target buildings (floor area)</th>
<th>Type 1 Specified Buildings</th>
<th>Type 2 Specified Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000m² or more</td>
<td>300m² or more, but less than 2,000m²</td>
<td></td>
</tr>
<tr>
<td>Target work</td>
<td>New construction, addition and rebuilding beyond a fixed scale</td>
<td>New construction, addition and rebuilding beyond a fixed scale</td>
</tr>
<tr>
<td>Repair or a change of roof, wall, or floor beyond a fixed scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of air conditioners or repair thereof beyond a fixed scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actions to be taken by the local government</td>
<td>Instruction, publication, order or penalties</td>
<td>Recommendation</td>
</tr>
</tbody>
</table>
Promoting Energy-Efficiency Measures for Housing/Buildings


**Energy-efficiency for housing / buildings**

1. **Regulation under energy-efficiency standards**
   - Approach to spread the 2013 energy-efficiency standards (Lecture for small / middle-sized builders, carpenters)
   - Review to make it obligatory, system adjustment
     - Reviewing evaluation method for traditional wooden housing, etc.
     - Ensuring/improving performance/quality of building material/equipment
     - Adjusting evaluation/inspection system

2. **Evaluation / Indication of energy-efficiency performance**
   - Reviewing housing performance indication standards, etc.
     - Introducing primary energy consumption to standard considering revision of energy-efficiency standard
     - Examining evaluation/indication system of energy-efficiency performance including existing stock

3. **Granting incentives**
   - Supporting excellent housing/buildings in terms of energy-efficiency, such as low-carbon housing, zero-energy housing.
   - Promoting energy-efficiency renovation for existing stock (including long-life quality housing of existing housing)

**Realizing low-carbon society**

Together with the above ①～③, addressing gradual obligatory application to energy-saving for new housing / buildings standards (till 2020)

To realize low-carbon society, with considering necessity, degree, balance of regulation, gradual application to energy-efficiency standards for new housing / buildings will be obligatory by 2020. To achieve this, adjusting environment for smooth enforcement will be addressed considering development of enforcing technology of small/middle-sized builders and position of traditional wooden housing.

("Japan reconstruction strategy" cabinet approval on June 14th, 2013)
At present, only the thermal insulation levels of housing envelope are evaluated.

Only thermal insulation levels are evaluated.

Merits of energy efficiency are unclear to consumers.

Although 30% of residential energy consumption is from hot water and lighting, efficiency improvements in hot water supply and lighting systems are not evaluated.

Energy production by solar panels and solar heaters are not counted.

Residential Energy Efficiency Standard has been revised so that the housing energy efficiency is evaluated comprehensively by primary energy consumption, including energy performance of equipment and use of renewable energy.

Comprehensive evaluation, including equipment performance, etc.

The estimation energy consumption is less than the standard value.

Judgment criteria
Simplified Calculation Method of Envelopes (Specification table per part)

It makes available for envelope performance assessment by simplified calculation after fixing specification table for envelope part (combination of building materials).

① Spec. table per part

Pick up spec. number from the list of each part.

<table>
<thead>
<tr>
<th>U value</th>
<th>Layer construction and spec. number of part</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.65</td>
<td>WI-101 Metal sash + Multi-layered glass type A &lt;Area: 2.05㎡&gt;</td>
</tr>
<tr>
<td></td>
<td>WI-102 Metal sash + Single board + single board &lt;Area: 2.05㎡&gt;</td>
</tr>
<tr>
<td></td>
<td>WI-103... Plastic sash + Low-E type B &lt;Area: 2.05㎡&gt;</td>
</tr>
<tr>
<td>4.07</td>
<td>WI-301 Metal sash + Low-E Multi-layered glass &lt;Area: 3.0㎡&gt;</td>
</tr>
<tr>
<td></td>
<td>WI-302 Metal sash + Multi-layered glass &lt;Area: 3.0㎡&gt;</td>
</tr>
<tr>
<td></td>
<td>WI-303... Metal sash + Single board + single board &lt;Area: 3.0㎡&gt;</td>
</tr>
<tr>
<td>0.53</td>
<td>WI-101 ...</td>
</tr>
</tbody>
</table>

② Area of part, number of windows / doors

Pick up areas of wall, ceiling, floor, and number of windows, doors from drawing.

Window① South: 3 windows
Total in each direction: 6 windows

Window② South: 2 windows
Total in each direction: 4 windows

Wall South: 39.22㎡
Total in each direction: 151.72㎡

Door: 1 door

③ Simplified calculation

Assess envelope heat performance by calculating simply at calculator level.

<table>
<thead>
<tr>
<th>Part</th>
<th>Spec. No.</th>
<th>(Heat transflux ratio[W/(㎡・℃)])</th>
<th>Area of part [㎡],etc.</th>
<th>Heat transflux amount [W/(㎡・℃)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor</td>
<td>FL-105</td>
<td>(0.48)</td>
<td>x 62.10</td>
<td>= 29.81</td>
</tr>
<tr>
<td>Wall</td>
<td>WL-101</td>
<td>(0.53)</td>
<td>x 151.72</td>
<td>= 80.41</td>
</tr>
<tr>
<td>Ceiling</td>
<td>CL-110</td>
<td>(0.24)</td>
<td>x 67.91</td>
<td>= 16.30</td>
</tr>
<tr>
<td>Window①</td>
<td>WI-102</td>
<td>(4.65)</td>
<td>x 6 windows (12.3)</td>
<td>= 57.20</td>
</tr>
<tr>
<td>Window②</td>
<td>WI-303</td>
<td>(4.07)</td>
<td>x 4 windows (12.0)</td>
<td>= 48.84</td>
</tr>
<tr>
<td>Door①</td>
<td>DR-220</td>
<td>(4.65)</td>
<td>x 1 door (3.24)</td>
<td>= 15.07</td>
</tr>
</tbody>
</table>

Calculate η value (Average insolation acquiring ratio) by the following:

\[ η = \frac{\text{Area of window \times Insolation per window}}{\text{Total area of window}} \]

Multiply η by heat flux rate to get heat transflux amount.

Total: 309.27 = 247.63

※ It is available to calculate η value (Average insolation acquiring ratio) by the above method.

※ Different point is to multiply factor per direction.

※ In the case of using customized products such as window, door, calculate it by entering area of window.
**Example of wooden housing filling insulation approach**

Heat resistance (R) = Thickness of material, divided by heat conductivity λ = 0.085, divided by 0.038 = 2.24 > 2.2

<table>
<thead>
<tr>
<th>Part</th>
<th>Heat transflux ratio (unit: ( \frac{\text{W}}{\text{m}^2 \cdot \text{K}} )) (As for basis, unit: ( \frac{\text{W}}{\text{m} \cdot \text{K}} ))</th>
<th>Details of specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior wall</td>
<td>0.35</td>
<td>In the case of insulation structure with attaching insulation material that R is more than 1.3 (more than 25 mm of thickness) on outside of frame, filling insulation material that R is more than 2.2 (more than 100 mm of thickness) between frame.</td>
</tr>
<tr>
<td></td>
<td>0.53</td>
<td>In the case of insulation structure with filling insulation material that R is more than 2.2 (more than 85 mm of thickness) between frame.</td>
</tr>
<tr>
<td></td>
<td>0.92</td>
<td>In the case of insulation structure with filling insulation material that R is more than 0.9 (more than 20 mm of thickness) between frame on outside of earth wall.</td>
</tr>
</tbody>
</table>

Not only the example of notice, but this concept can also be used for various specifications.
For housing, the nation was divided into 6 regions in order to establish standards for thermal insulation, sun-light shading and other items for each region.

For buildings, the energy saving standard of the building is made of energy conservation performance standards of construction and equipment (CEC) standard for thermal insulation performance (PAL).


### Image of insulation of wooden houses
- Exterior wall thermal insulation: 100mm
- Continuous moisture-proof airtight layer
- Sun shade for east-and-west-facing windows
- Insulation strengthening of the outer wall with insulation material

### Comparison of the annual heating and cooling energy consumption

<table>
<thead>
<tr>
<th>Region</th>
<th>Heating Energy Consumption (GJ/year*door)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1980</td>
<td>28</td>
</tr>
<tr>
<td>1980 Standard</td>
<td>20</td>
</tr>
<tr>
<td>1992 Standard</td>
<td>17</td>
</tr>
<tr>
<td>1999 Standard</td>
<td>13</td>
</tr>
</tbody>
</table>

### Image of energy conservation measures for buildings

- **Outer wall, window, etc.**
  - Insulation strengthening of the outer wall with insulation material

- **Air conditioning**
  - High efficiency of the heat source unit and the air conditioner machine

- **Lighting**
  - Introduction of high-efficiency lighting fixtures, etc.

- **Ventilating**
  - The air volume control by inverter, etc.

- **Hot water supply**
  - High efficiency water heater, etc.

- **Elevator**
  - Introduction of the speed control system, etc.

### Comparison of energy consumption in buildings

<table>
<thead>
<tr>
<th>Standard</th>
<th>Heating Energy Consumption (GJ/year*door)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1980</td>
<td>1</td>
</tr>
<tr>
<td>1980 Standard</td>
<td>0.925</td>
</tr>
<tr>
<td>1993 Standard</td>
<td>0.85</td>
</tr>
<tr>
<td>1999 Standard</td>
<td>0.75</td>
</tr>
</tbody>
</table>

※ When used as a energy consumption of 1980 reference prior same energy consumption required to obtain the indoor environment of similar (Energy consumption index)
In order to realize low-carbon cities, it is required to bring new perspectives, such as living in Aging Society and living environmentally friendly in Low-carbon city development plan, together with the private sector and citizens. So the "Act on the promotion of Low-carbon city" is enacted.

The purpose of Low-carbon city (the matter indicated to the basic policy)

- Integration of urban functions and promote the use of public transport
- Energy efficiency of houses and buildings, and efficient use of energy
- Green preservation and creation

Certificated Low-carbon Buildings

- Administrative agencies with jurisdiction certify that buildings meet the leading standards.

Low-carbon city development plan

- Municipalities can develop a plan to promote comprehensive measures for Low-carbon city.
Primary energy consumption should be less than 10% compared with energy efficiency standards of the Energy Conservation Law.

Other measures to contribute to be low-carbon should be taken.

Quantitative evaluation items (Essential Items)
- Primary energy consumption (other than energy consumption of home electrical appliances) should be less than 10% compared with energy efficiency standards of the Energy Conservation Law. (※)

Selective Items
- Among the following measures which contribute to be low-carbon and are not included in energy efficiency standards, what are above a certain level should be taken.
  - Installing HEMS
    - Promoting action to contribute to Low-Carbon of residents by "visualization" of energy use,
  - water-saving measure
    - Taking measures to contribute to saving water like using rain water and adopting water-saving instrument.
  - Using wooden material
    - Using materials like wooden material which contribute to be Low-Carbon.
  - Countermeasures against heat island phenomenon
    - Taking measures to contribute to control heat island like planting trees on the site, roof top and wall surface.
### Housing Performance Indication System (2000～)
A system based on the Housing Quality Assurance Act, in which a fair and independent organization evaluates housing performance by common rules and standards, and indicates the performance by a grade, through examination of drawings and specifications, or inspection at a construction site.

#### [Example] 「⑤ Thermal Environment」

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-conservation measures grade</td>
<td>Grade 4</td>
<td>A measure for <strong>significant</strong> reduction of energy is taken. (1999 Energy-Efficiency Standard level)</td>
</tr>
<tr>
<td></td>
<td>Grade 3</td>
<td>A measure for <strong>certain level of</strong> reduction of energy is taken. (1992 Energy-Efficiency Standard level)</td>
</tr>
<tr>
<td></td>
<td>Grade 2</td>
<td>A measure for <strong>small</strong> reduction of energy is taken. (1980 Energy-Efficiency Standard level)</td>
</tr>
<tr>
<td></td>
<td>Grade 1</td>
<td>Others (no thermal insulation, etc)</td>
</tr>
</tbody>
</table>

- Housing Units evaluated by the system in FY2011: 197,748 units (23.5% of all new housing starts)
① Housing/buildings CO2 emission reduction promotion grant
Support for housing / buildings leading project which contribute to spreading / enlightening CO2 saving technology

Main supporting target: Maintenance cost for building construction relating to leading-edge CO2 saving technology, cost for verifying effect, etc. [Supporting ratio] 1/2

② Zero-energy housing promotion grant program
Support for tackling zero-energy housing at middle and small-sized builders

Main supporting target: Additional amount by building zero-energy housing, etc. [Supporting ratio] 1/2 (Max. amount of support 165 mil. Yen/house)

③ Energy-efficiency renovation on buildings promotion grant program
Energy-efficiency renovation on buildings that energy consumption is declined by more than 15% and barrier-free renovation with energy-saving renovation

Main supporting target: Cost for energy-efficiency renovation, barrier-free renovation (※1), cost for verifying effect, etc. [Supporting ratio] 1/3
Maximum amount: Buildings: 50 mil. Yen/case (In the case of executing barrier-free renovation, it is 75 million yen/case)

④ Long-life quality renovation  [New: Framework for prioritized agenda]
Support for leading-edge approach of renovation which contributes to long service life of existing housing

Main supporting target: Cost for renovation contributing long service life of existing housing, etc. [Supporting ratio] 1/3  [Maximum amount] 1 million yen /case, etc.

Amount of budget request for FY2014: 22,868 million yen  (Framework for promoting prioritized agenda: 6,478 million yen)