Success story of energy efficiency policy development in Japan

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Outline

1. Brief Overview of Energy Policy in Japan
2. Evaluation Method (Commercial Buildings)
1. Brief Overview of Energy Policy in Japan
Status of energy consumption

Real GDP 1973--->2013 increased by 2.5 times

Million kl in crude oil equivalent

Transport sector
Commercial sector
Residential sector
Industrial sector

(Unit: trillion yen, price in 2005)

Final energy consumption

1973→2013
1.3-fold ▲0.9%
1973→2013
1.8-fold ▲3.7%
1973→2013
2.9-fold +1.9%
1973→2013
2.0-fold ▲3.0%
1973→2013
0.8-fold +0.1%


Yasuhiro Miki, NILIM, Japan, Webinar 3: Energy Efficiency Actions in ASEAN-Japan-Tokyo, Aug. 28th, 2017
Our Goal (Civilian Sector)

Targets for the Goal

BEI = Designed primary consumption / Reference primary consumption (2013)

- Realize ZEBs in newly constructed public buildings by 2020
- Realize ZEBs in average newly constructed public and private buildings by 2030

[source] Japan’s Strategic Energy Plan (April 2014)

The Act on the Improvement of Energy Consumption Performance of Buildings

Certification Standards
(new built buildings, retrofit buildings)

Energy Efficiency Standard
(mandatory from 2017)
History and Future of the Building Energy Standard

1979  The Energy Conservation Law was established.

1980  The Building Energy Standard was established according to the law. No obligation was taken on building owners. So the Standard was similar to recommendation.

1992  The Standard for housings was revised owing to the Gulf War.

1993  The Standard for buildings was revised as well as for housings.

1999  The levels of the Standard were enhanced because of the Kyoto Protocol.

2009  Reporting on the Standards was mandatory except small buildings and housings.

2013  The whole Standard was revised. Primary energy consumption is needed as criterion index, in addition to envelope performance.

2020  Compliance to the Standard will be mandatory for all new buildings and residences.
The Act on the Improvement of Energy Consumption Performance of Buildings

**Review Process**

- March 24, 2015: Cabinet decision
- June 4: Unanimously passes in House of Representatives
- July 1: Unanimously passes in House of Councilors, and is adopted
- July 8: Promulgation of law

Promulgation of Cabinet/ministerial ordinance etc.

**Advisory measures within 1 year of promulgation of law** (April 2016)

1. Announcement of basic policy
2. Mandating efforts of construction clients/owners etc., and business operators in selling and leasing of building
3. Performance Improvement Planning Approval System (Floor space ratio exceptions)
4. Display System
5. Preparations for Registered Energy Conservation Evaluation Institutions and Registered Energy Conservation Performance Appraisal Institutions (applying for registration etc.)

**Regulatory measures within 2 years of promulgation of law** (Planned for April 2017)

1. Instruct/advise construction clients, designers/builders, construction material manufacturers
2. Mandate/evaluate compliance, register etc. Registered Energy Conservation Evaluation Institutions
3. Notification System, instructions/orders etc. via administrative agencies with jurisdiction
4. Minister-authorization system for special structure/equipment, register etc. Registered Energy Conservation Appraisal Institutions
5. Housing Top-Runner Program
   - Abolish Energy Conservation Act-based regular report system for renovations, remodeling, installations and repairs and notification system
Mandatory Compliance with Standards by Construction Clients of Specified Buildings

- **Section 11 Mandatory Compliance with Standards**
  - When construction client attempts to undertake specified construction (*1), the **specified building** (Limited to non-residential) must comply with the building energy efficiency standards.
  - The stipulation in the preceding paragraph is one of relevant provisions of Building Code in Japan.

*1 **Specified construction**
  1. **New construction** on a specified building (*2)
  2. **Extension/renovation** on a specified building (The scale of the extension/renovation for non-residential portions shall only be for the Cabinet-ordered scale or larger [planned to be 300 m²].)
  3. Extension on buildings other than specified buildings (The scale of the extension for non-residential portions shall only be for the Cabinet-ordered scale or larger [planned to be 300 m²], and when the building in question will become a specified building after the extension construction.)

*2 **Specified buildings**
This refers to buildings that are at the Cabinet-ordered scale or larger (planned to be 2,000 m²) and are of a scale large enough to particularly require the attainment of energy consumption performance for a non-residential area.
### New Building Energy Conservation Act

<table>
<thead>
<tr>
<th>Scale of Buildings</th>
<th>Non-Residential</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Large-scale buildings</strong> (2,000 m² or more)</td>
<td>Mandatory Compliance 【Synched with building certification procedures】</td>
<td>Residential</td>
</tr>
<tr>
<td><strong>Medium-scale buildings</strong> (From 300 m² to less than 2,000 m²)</td>
<td>Mandatory Notifications 【Instructions/orders etc. when deemed necessary without compliance with standards】</td>
<td>Residential</td>
</tr>
<tr>
<td><strong>Small-scale buildings</strong> (Less than 300 m²)</td>
<td>Residential Construction Client (Housing Top-Runner)</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Scheme for Evaluation of Energy Conservation Compliance and Building Certification/Inspection From April 2017

< District construction surveyor >

< Applicant, construction clients >

Application for construction certification
Application for evaluation of compliance with energy efficiency standards

Compliance evaluation notice
Submit to district construction survey or designated certification and inspection organization

Certification document
Construction begins
Construction complete
Certificate of compliance
Use of building

< Administrative authorities with jurisdiction >

Evaluation of compliance with energy efficiency standards

Building Code

Design appraisal

Certification document cannot be issued without an evaluation notice

Final inspection
Certification Standards (Article 29)

- When carrying out new construction and renovations for energy conservation(*), certification of compliance with guidelines that exceed the level of energy conservation standards (BEI<=0.80) may be received.
  - (*) Extensions, renovations, improvements/remodeling, installation of equipment such as A/C, repairs

Renovation that has been certified may receive special exception status, such as for floor space ratio.
Labeling System (Article 7)

Emphasize Energy efficiency Performance at or above Level of Standards

- Third party verification (BELS) label with stars.

- ★★★★★ BEI<=0.60
- ★★★★ BEI<=0.70
- ★★★ BEI<=0.80
- ★★ BEI<=1.00
- ★ BEI<=1.10
2. Evaluation Method (Commercial buildings)
Calculation methodologies

• NILIM and BRI have developed new methodologies for evaluating the primary energy consumption.

• The methodologies are expected to be suitable for the mandatory standard.
  – Easy to understand evaluation logic (simplified and streamlined)
  – Easy to understand evaluation results
  – A fair, reliable, and transparent evaluation logic
  – Streamlined and efficient evaluation and review
    • Provision of evaluation-assistance simulation tools
  – Defined and unified evaluation rules
    • Same results regardless of who makes data entries
    • Same results regardless of who performs a review
Index: Primary Energy Consumption

Primary energy consumption amount
= air-conditioning system
+ ventilation system
+ lighting system
+ hot water supply
+ elevator primary
+ other (Plug load)
- PV and cogeneration system
Flow of Calculation of Primary Energy Consumption for Commercial Buildings

- **Designer inputs**
  - Designed Specification (geometry, equipment spec)
  - Climate Zone (8 zones)
  - Room Type (201 types)
  - Reference Specification
    - Defined by the standard 2013

- **Calculation Method**
  - By NILIM and BRI

- **Design primary energy consumption**
  - Compare these consumptions under same conditions.

- **Reference primary energy consumption**

- **BEI (Building Energy Index)**
  - \( \text{BEI} = \frac{\text{Design consumption}}{\text{Reference consumption}} \)
### Example of the room types

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of room (Office)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-1</td>
<td>Office room</td>
</tr>
<tr>
<td>O-2</td>
<td>Office higher heat</td>
</tr>
<tr>
<td>O-3</td>
<td>Meeting room</td>
</tr>
<tr>
<td>O-4</td>
<td>Tearoom</td>
</tr>
<tr>
<td>O-5</td>
<td>Central control</td>
</tr>
<tr>
<td>O-6</td>
<td>Locker room</td>
</tr>
<tr>
<td>O-7</td>
<td>Canteen</td>
</tr>
<tr>
<td>O-8</td>
<td>Hall</td>
</tr>
<tr>
<td>O-9</td>
<td>Lobby</td>
</tr>
<tr>
<td>O-10</td>
<td>Toilet</td>
</tr>
<tr>
<td>O-11</td>
<td>Smoking room</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of room (Hotel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Guest room</td>
</tr>
<tr>
<td>H-2</td>
<td>Guest room’s bath room</td>
</tr>
<tr>
<td>H-3</td>
<td>Banquet higher heat</td>
</tr>
<tr>
<td>H-4</td>
<td>Banquet hall with medium heat emission</td>
</tr>
<tr>
<td>H-5</td>
<td>Banquet hall with low heat emission</td>
</tr>
<tr>
<td>H-6</td>
<td>Restaurant</td>
</tr>
<tr>
<td>H-7</td>
<td>Lounge</td>
</tr>
<tr>
<td>H-8</td>
<td>Lounge open only at night</td>
</tr>
<tr>
<td>H-9</td>
<td>Shop</td>
</tr>
<tr>
<td>H-10</td>
<td>Office room (24 hours)</td>
</tr>
<tr>
<td>H-11</td>
<td>Office room (closed during night)</td>
</tr>
<tr>
<td>H-12</td>
<td>Canteen for employees</td>
</tr>
<tr>
<td>H-13</td>
<td>Locker room</td>
</tr>
</tbody>
</table>
Reference value for heat-generation density
Lighting: → 12 W/m²
Human body→ 0.1 persons/m²
Equipment:→ 12 W/m²

<table>
<thead>
<tr>
<th>共通</th>
<th>空調</th>
<th>空調以外の換気</th>
<th>照明</th>
<th>給湯</th>
</tr>
</thead>
<tbody>
<tr>
<td>カレンダパターン</td>
<td>年間空調時間</td>
<td>照明発熱率</td>
<td>在室者数</td>
<td>機器発熱</td>
</tr>
<tr>
<td>A</td>
<td>[h/年]</td>
<td>[W/m²]</td>
<td>[人/m²]</td>
<td>[W/m²]</td>
</tr>
<tr>
<td>室使用パターン別</td>
<td>年間日数</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

### Lighting
- **Atmospheric condition**: Sundays/Holidays
- **Office room**: Office building

#### Lighting

- **Lighting**: 12 W/m²
- **Human body**: 0.1 persons/m²
- **Equipment**: 12 W/m²

#### Standby power considered

**Weekdays**

**Saturdays**

**Sundays/Holidays**

**Standby power considered**
Measurement of Actual performance of Equipment

- In order to estimate the primary energy consumption accurately, NILIM and BRI measured the actual performance of the building equipment in several buildings and developed a method to estimate the actual performance based on manufacturer catalog data.

![Graph showing the relationship between inlet chilled water temperature and energy consumption for Chiller in Office 1H. The graph includes a line representing manufacturer catalog data and a plot for actual measured data. The x-axis represents the inlet chilled water temperature, and the y-axis represents the ratio of energy consumption. The graph shows a significant difference between the catalog and actual data, with a correction factor of 0.95 for cooling capacity and 1.07 for energy consumption for the office chiller.](image-url)
Information Disclosed by NILIM and BRI

• Official Guides

• BRI’s website provides technical information on the Energy Efficiency Standards: http://www.kenken.go.jp/becc/index.html
  – Links to various support tools
  – Instructions for the tools

• How to use https://www.youtube.com/watch?v=IL1cqCkbFaE
Web-based Simulation Tool for Compliance with 2013 Energy Efficiency Standard

Computational engine on cloud computing platforms

XML files → Calc. results

BRI Website

- Excel Sheet
- Manual
- Interface of the web-based simulation tool

Design documents

Specification Input Sheet

Input the product specification of the building equipment to the Excel file.

Calculation Results

Flow for evaluation of a building’s primary energy consumption in commercial buildings
Simplified Approach

Building to be evaluated

Model Building Method

Enter only the main specifications for the envelope and the equipment to be used in the model building.

Web-based program for primary energy consumption calculation

Conventional calculation method

The area of each room and the specifications for the envelope and the equipment are entered.

Design value by the conventional method

Baseline value by the conventional method

Model building

$BPI_m$

$BEI_m$

Design value by Model Bldg Method

Baseline value by Model Bldg Method
Application to actual buildings

- Air-conditioning
- Ventilation
- Lighting
- OA equipment
- Lighting + OA
- Elevators
- Unknown

Annual Primary Energy Consumption [MJ/m²]

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restaurant</td>
<td>5,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Hotel</td>
<td>3,000</td>
<td>2,500</td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary

• The building energy standard was revised in April 2013.
  – Primary energy consumption is needed as criterion index, in addition to envelope performance.

• Until 2020, compliance to the standard will be mandatory for all newly built buildings and housings.
  – From April 2017, compliance with the standard is mandatory for large scale non-residential buildings.

• NILIM and BRI have developed the on-line calculation tools for the new energy standard and certification system.