Features and Characteristics of New Building Energy Standards of Japan

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Ministry of Land, Infrastructure, Transport, and Tourism
Outline

1. Brief Overview of Energy Policy in Japan
2. Evaluation Method (Commercial Buildings)
1. Brief Overview of Energy Policy in Japan
To stabilize the energy demand and supply in Japan, it is essential to take measures to reduce energy consumption in the civilian sector.

Our Goal (Civilian Sector)

The Act on the Improvement of Energy Consumption Performance of Buildings

Certification Standards
(new built buildings, retrofit buildings)

Energy Efficiency Standard
(mandatory from 2017)

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

The goal is to achieve net zero energy consumption by creating energy (e.g., via solar power) while fulfilling the higher than 50% energy saving (ZEB Ready).

- If energy savings of at least 75% is achieved, the Nearly ZEB status is granted.
- If energy savings of 100% or more is achieved, the ZEB status is granted.
- The above energy saving rate should be evaluated at the design phase.

**ZEB Ready**
(Energy saving of 50% or more)

**Nearly ZEB**
(Net energy saving of 75% or more)

**ZEB**
(Net energy saving of 100% or more)
Definition and evaluation methods of ZEBs

Energy independence

Volume of energy supply vs. Volume of energy consumption

ZEB
Reduction of 100% or more (Net Zero)

Nearly ZEB
Reduction of 75% or more

ZEB Ready
Reduction of 50% or more

Energy savings

1. Load reduction (improving heat insulation and solar shading, etc.)
2. Use of natural energy
3. Equipment and systems with improved efficiency of the equipment

Reduction of 50% or more

Reference Building
BEI = 1.00

Benchmark primary energy consumption

Volume of energy consumption

Introduction of renewable energy

Load reduction (improving heat insulation and solar shading, etc.)
Use of natural energy
Equipment and systems with improved efficiency of the equipment

Energy independence

Primary energy consumption
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.
Mid-term summary and progress schedule

- **Compliance to the Standard will be mandatory**

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<tbody>
<tr>
<td><strong>Promote Construction of Houses and Buildings with Higher Energy Efficiency Performance</strong></td>
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<tr>
<td>- Evaluation and Labeling system of energy efficiency</td>
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<tr>
<td>- Promote construction of zero-energy housing</td>
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<tr>
<td>- Promote construction of buildings which utilize advanced CO2 emission reduction technologies</td>
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<tr>
<td>- Certify and promote houses and buildings with high energy efficiency performance (Certification system of low-carbon buildings), etc.</td>
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<tr>
<td><strong>Assure Minimum Energy Efficiency Performance of Houses and Buildings</strong></td>
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<tr>
<td>Problems to be solved for realizing mandate of energy efficiency standards</td>
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<td>- Provide information about necessity and reasons of regulations</td>
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<tr>
<td>- Consider balances between regulations on houses and buildings in Japan and that in other sectors</td>
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<tr>
<td>- Give sufficient attention to small to medium sized home builders</td>
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<tr>
<td><strong>Improve Energy Efficiency of Existing Houses and Buildings</strong></td>
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<td><strong>Increase Capabilities of Individuals and Organizations</strong></td>
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<td>- Hold training courses of insulation techniques for small to medium sized firms</td>
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<tr>
<td>- Consider developing an evaluation method of energy efficiency of traditional wooden houses</td>
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<tr>
<td>- Assure and improve quality of building materials and equipment</td>
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<tr>
<td>- Increase capabilities of individuals and organizations who assess energy efficiency, etc.</td>
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</tbody>
</table>

Maintain policies to increase capabilities of individuals and organizations related to housing and building energy efficiency, after mandating standards.
The Act on the Improvement of Energy Consumption Performance of Buildings

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

Review Process

Implementations Schedule

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

*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 m$^2$].)
   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 m$^2$], 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 m$^2$) 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>Present status</th>
<th>April 2017</th>
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<tbody>
<tr>
<td><strong>Large-scale buildings (2,000 m² or more)</strong></td>
<td><strong>Mandatory Compliance</strong></td>
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<tr>
<td>Residential</td>
<td><strong>Mandatory Notifications</strong></td>
</tr>
<tr>
<td>Non-residential</td>
<td><strong>Instructions/orders etc. when markedly insufficient</strong></td>
</tr>
<tr>
<td>Residential</td>
<td><strong>Mandatory Notifications</strong></td>
</tr>
<tr>
<td>Non-residential</td>
<td><strong>Instructions/orders etc. when markedly insufficient</strong></td>
</tr>
</tbody>
</table>

| **Medium-scale buildings (From 300 m² to less than 2,000 m²)** | **Mandatory Notifications** |
| Non-residential | **Instructions/orders etc. when deemed necessary without compliance with standards** |
| Residential | **Mandatory Notifications** |
| Non-residential | **Recommendations when markedly insufficient** |
| Residential | **Recommendations when markedly insufficient** |

| **Small-scale buildings (Less than 300 m²)** | **Mandatory Role** |
| Residential Construction Client (Housing Top-Runner) | **Recommendations/orders etc. when deemed necessary** |
| Residential | **Recommendations/orders etc. when deemed necessary** |

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Masato Miyata, NILIM, Japan, miyata-m92ta@mlit.go.jp, SEforALL Workshop, February 14, 2017
Application for evaluation of compliance with energy efficiency standards

< District construction surveyor >

Building Code

Design appraisal

Application for construction certification

Compliance evaluation notice

Submit to district construction survey or designated certification and inspection organization

Certification document

Construction begins

Construction complete

Application for final inspection

Certificate of compliance

Use of building

< Applicant, construction clients >

< Administrative authorities with jurisdiction >

Evaluation of compliance with energy efficiency standards

Building Energy Efficiency Act

Certificate of compliance 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 exceeds the level of energy conservation standards (BEI<=0.80) may be received.
  
  - (*) Extensions, renovations, improvements/remodeling, installation of equipment such as A/C, repairs

![Diagram showing special exception status for renovation with floor space ratio calculation](image)

Renovation that has been certified may receive special exception status, such as for floor space ratio.
Section 7 Emphasize Energy Conservation 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

Design primary energy consumption amount of this building 25% less
- Primary energy consumption amount standards
- Envelope Performance
Labeling System (Article 7)

[source] https://www2.hyoukakyoukai.or.jp/bels/info/jireishokai.php
## Labeling System (Article 7)

### 都道府県別BELS事例一覧 — 東京都 — 事務所等

<table>
<thead>
<tr>
<th>物件名</th>
<th>KTビル</th>
<th>申請者</th>
<th>鹿島建設株式会社</th>
<th>代表取締役社長</th>
<th>押味至一</th>
</tr>
</thead>
<tbody>
<tr>
<td>設計者</td>
<td>鹿島建設株式会社 一級建築士事務所</td>
<td>施工者</td>
<td>鹿島建設株式会社</td>
<td>東京建築支店</td>
<td></td>
</tr>
<tr>
<td>評価年月日</td>
<td>2016/09/30</td>
<td>竣工年月日</td>
<td>2016年8月1日</td>
<td>申請の範囲</td>
<td>建物</td>
</tr>
<tr>
<td>外皮適合</td>
<td>適合</td>
<td>評価手法</td>
<td>通常の計算法（標準入力法・主要室入力法）（平成28年基準）</td>
<td>BEI 0.46</td>
<td></td>
</tr>
<tr>
<td>アピールポイント</td>
<td>本計画は、都内に立地する延床面積約12,000㎡の本社機能を持つオフィスビルである。コストやスペース有効活用の制約などから、CO2削減が進みにくい都市型中規模ビルをターゲットに、適応性の高い省エネルギー技術を積極的に導入している。また、今回採用した技術はコスト合理性や建築計画への親和性にも配慮している。</td>
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</tbody>
</table>

[source] https://www2.hyoukakyoukai.or.jp/bels/info/jireishokai.php
2. Evaluation Method (Commercial buildings)

- The standard used two indicators for assessing the energy performance of a building.
- **Reporting on the standards is mandatory** except small buildings and housings.

1. For the performance of the building envelope
   - Perimeter Annual thermal Load (PAL)

2. For the performance of the building equipment
   - Coefficient of Energy Consumption (CEC)
     - CEC/AC : CEC for Air-conditioning
     - CEC/V : CEC for Ventilation
     - CEC/L : CEC for Lighting
     - CEC/HW : CEC for Hot water supply
     - CEC/EV : CEC for Elevators
There are 5 criterion indices for each equipment and it is **not an index for whole building performance**.

Calculation method have not been updated for about 30 years and **some newly technique cannot be evaluated**.

The values for the PAL and CEC depend on the building type.

- **New index:** PAL* and Primary energy consumption of 5 equipment (AC, V, L, HW and EV).
- **New calculation method** is developed, which can estimate the energy consumption more accurately.
- Criterion value is defined according to **types of room**.
Primary energy consumption amount
= air-conditioning system
+ ventilation system
+ lighting system
+ hot water supply
+ elevator primary
+ other (Plug load)
- PV and cogeneration system
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
Flow of Calculation of Primary Energy Consumption for Commercial Buildings
Reference 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>
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<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>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of room (Office)</th>
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<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>
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<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>
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<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>
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<tr>
<td>H-12</td>
<td>Canteen for employees</td>
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<tr>
<td>H-13</td>
<td>Locker room</td>
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</tbody>
</table>
Measurement of the Internal Heat Gain in Actual Office Buildings

Internal heat gain (lighting)

Internal heat gain (OA equipment)

occupancy
## Example of Assumptions for the Room Usage

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Type of room</th>
<th>Operation Time for AC [h/year]</th>
<th>Internal heat gain (lighting) [W/m²]</th>
<th>Internal heat gain (metabolism) [person/m²]</th>
<th>Internal heat gain (OA equipment) [W/m²]</th>
<th>Fresh air intake [m³/m²·h]</th>
<th>Illuminance level [lx]</th>
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<tbody>
<tr>
<td>Office</td>
<td>OfficeRoom</td>
<td>3374</td>
<td>12</td>
<td>0.1</td>
<td>12</td>
<td>5.0</td>
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<td>ComputerRoom</td>
<td>3374</td>
<td>12</td>
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<td>Canteen</td>
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<td>CentralMonitoringRoom</td>
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<td>Lobby</td>
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<tr>
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<td>0.0</td>
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<td>IndoorParking</td>
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<td>GarbageStorage</td>
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</tbody>
</table>

The information in this table is based on the results of a review in the MLIT Building Code Development Promotion Project (22 survey items).
Reference value for heat-generation density
Lighting: Old Standards 25 W/m² → 12 W/m²
Human body: Old Standards 0.2 persons/m² → 0.1 persons/m²
Equipment: Old Standards 10 W/m² → 12 W/m²

### Table: Standardized room-use conditions

#### Common
- Calendar pattern
  - A
  - Pattern years: [W / m²]
  - Room-use pattern: [W / m²]
  - Room use: [W / m²]

#### Air Conditioning
- Year-round cooling
  - [W / m²]
  - [W / m²]
  - Heat ratio
  - Reference value
  - [W / m²]
  - [W / m²]
  - [W / m²]
  - [W / m²]

#### Space outside
- Reference value
  - [W / m²]
  - [W / m²]
  - [W / m²]

#### Lighting
- Reference value
  - [W / m²]
  - [W / m²]
  - [W / m²]

#### Human body
- Reference value
  - [W / m²]
  - [W / m²]
  - [W / m²]

#### Equipment
- Reference value
  - [W / m²]
  - [W / m²]
  - [W / m²]

### Graphs:
- Lighting
- Human body
- Equipment

#### Standby power considered

---

Masato Miyata, NILIM, Japan, miyata-m92ta@mlit.go.jp, SEforALL Workshop, February 14, 2017
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.
Calculation flow (air-conditioning system)

Input: building envelope
- Floor area of rooms, outdoor wall area, window area, direction of walls and windows, shading factor, etc.

Input: equipment
- Air-handling units’ capacity, supply air volume, energy consumption, control system (CAV or VAV), economizer
- Secondary pumps’ rated flow rate, energy consumption, control system (CWV or VWV)
- Heat source equipment’s capacity, energy consumption

a) Heat load calculation
- Calculation of daily heat gain
- Estimation of daily heat load
- Coefficients for load calculation
- Performance curves of heat source equipment

b) Energy calculation
- Appearance frequency of heat load
- Calculation of energy of air-handling units
- Calculation of energy of secondary pumps
- Calculation of energy of heat source equipment
- Energy of air-handling units
- Energy of secondary pumps
- Energy of heat source equipment
Concept of Room Heat Load Calculation (1)

- Daily heat loads of each room \( Q_{rL,j} \) are calculated using steady-state heat gain \( Q_{rG,j} \).

\[
Q_{rL,j}(t) = a_j \, Q_{rG,j}(t) + b_j
\]

- Two kinds of heat gain \( Q_{rG,j} \) are taken into account:
  - Heat gain through exterior walls and windows as a result of the temperature difference
    = Overall heat transfer coefficient of walls and windows 
    \( \times \) area \( \times \) indoor-outdoor temperature difference
  - Heat gain through windows as a result of solar radiation
    = Solar heat gain coefficient \( \times \) area \( \times \) shading coefficient 
    \( \times \) solar radiation
• Coefficients $a_j$ and $b_j$ are coefficients for converting static heat gain to dynamic heat load.
• These coefficients are determined by using the dynamic thermal load calculation program NewHASP.
• These coefficients are dependent on the zone, room use, and season and on the use of air-conditioning the previous day.
Concept of Energy Consumption Calculation

- Primary energy consumption of the air-conditioning system:
  \[ E_{d,AC} = E_{d,AC,AHU}(Q_{rL,j}) + E_{d,AC,PUMP}(Q_{rL,j}) + E_{d,AC,REF}(Q_{rL,j}) \]

- The concept used to calculate these values are the same.
  - The appearance time of each part load ratio (PLR) band is calculated.
  - The energy consumption of the equipment on each PLR band is calculated by multiplying the appearance of the load and the energy input, which differs depending on the control system introduced.

![Appearance frequency of load (from load calculation results)](image1)
![Energy input (from the equipment characteristics database)](image2)
![Primary energy consumption (Load appearance hours x power consumption)](image3)
Information Disclosed by NILIM and BRI

- **Official Guides**

- **BRI’s website provides technical information on the Energy Efficiency Standards:**
  - Links to various support tools
  - Instructions for the tools

- **How to use**
  [https://www.youtube.com/watch?v=lL1cqCkbFaE](https://www.youtube.com/watch?v=lL1cqCkbFaE)
Web-based Simulation Tool for Compliance with 2013 Energy Efficiency Standard

- **Design documents**
- **Computational engine on cloud computing platforms**
- **XML files**
- **Calc. results**
- **BRI Website**
- **Upload**
- **Download**
- **Calculation Results**

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

1. Input the product specification of the building equipment to the Excel file.
2. Input the product specification into the Excel file.
3. Convert XML files to Excel Sheet.
4. Download Excel Sheet from BRI Website.
5. Upload Excel Sheet to the cloud-based simulation tool.
7. Calculation results are displayed on the BRI Website.
8. Flow for evaluation of a building’s primary energy consumption.
Simplified Approach

- An alternative simple evaluation method: the Model Building Method.
- Shapes and room uses are considered for each model building use.
  - Primary energy consumption is calculated and evaluated by applying typical specifications for the building envelope and the equipment requiring calculation to the model building.

Model Building Method

- Enter only the main specifications for the envelope and the equipment to be used in the model building.
- The area of each room and the specifications for the envelope and the equipment are entered.
- Web-based program for primary energy consumption calculation

Conventional calculation method

Design value by the conventional method
Baseline value by the conventional method

Design value by Model Bldg Method
Baseline value by Model Bldg Method
モデル建物法入力支援ツール (平成25年度基準 非住宅建築物用) Ver 1.0.2 (2014.04)

計算結果
BPIm: 0.81  BEIm: 0.94


熱源 外気処理

空調設備について
- 「空調」タブでは、計算対象建物用途内にある空調設備の仕様を入力します。
- 計算対象建物用途内に設置されるすべての空調設備が計算対象となります。
Application to actual buildings

- Air-conditioning
- Ventilation
- Lighting
- OA equipment
- Lighting + OA
- Hot water supply
- Elevators
- Unknown

Annual Primary Energy Consumption [MJ/m²]

<table>
<thead>
<tr>
<th></th>
<th>Office</th>
<th>Restaurant</th>
<th>Hotel</th>
<th>Hospital</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td></td>
<td>5,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Calculated</td>
<td>1,000</td>
<td>4,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>1,000</td>
<td>5,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Calculated</td>
<td></td>
<td>4,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>1,000</td>
<td>5,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Calculated</td>
<td></td>
<td>4,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>1,000</td>
<td>5,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Calculated</td>
<td></td>
<td>4,000</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Information Disclosed by Building Research Institute

  - Announcement of an update of the program
  - Links to various programs
  - Input sheet (Excel sheet) and sample sheet
  - Instructions for the program (Building Research Institute document)
    - Rule book on how to create an input sheet
    - Details of baseline room-use conditions
    - Drawings of the model building, etc.
    - Information on intermediate and output files from the program
## Energy Efficiency Standard for Residential House

<table>
<thead>
<tr>
<th>Year</th>
<th>Standard Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980~</td>
<td>S55 Standard (S = “Showa” Era)</td>
</tr>
<tr>
<td>1992~</td>
<td>H4 Standard (H = “Heisei” Era)</td>
</tr>
<tr>
<td>1999~</td>
<td>H11 Standard (S = “Heisei” Era)</td>
</tr>
<tr>
<td>2013~</td>
<td>New Standard</td>
</tr>
</tbody>
</table>

### Envelope Performance
- 1. Heat Loss Coefficient
- 2. Solar Shade Coefficient

### Index

+ Primary Energy Consumption

### Revised standard consists of ...
- Envelope standard
  - Mean U value (Insulation factor)
  - Mean $\eta$ value (Sun shading factor)
- Energy Performance Standard
  - Designed annual energy consumption
Mean U Value

\[
\text{Total Heat Loss [W/K]} = \frac{\text{U Value} \times \text{Area} \times \text{H Coeff.}}{\text{Total Area [m}^2\text{]}}
\]

\[
\text{Mean U Value [W/m}^2\text{K]} = \frac{\text{Total Heat Loss [W/K]}}{\text{Total Area [m}^2\text{]}}
\]

Example of H Coeff.

<table>
<thead>
<tr>
<th>Outside Type</th>
<th>Crawl Space</th>
<th>Unit next door (apartment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H Coeff.</td>
<td>0.7</td>
<td>0.05 or 0.15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Value</td>
<td>0.46</td>
<td>0.46</td>
<td>0.56</td>
<td>0.75</td>
<td>0.87</td>
<td>0.87</td>
<td>0.87</td>
<td>—</td>
</tr>
</tbody>
</table>
Flow of Calculation of Primary Energy Consumption for Residential House

Common conditions (Climate, Floor Area)

- EC for Heating
- EC for Cooling
- EC for Ventilation
- EC for Lighting
- EC for DHW
- EC for Appliances

EC for the Reference House

EC for Heating + DE for Heating
EC for Cooling + DE for Cooling
EC for Ventilation + DE for Ventilation
EC for Lighting + DE for Lighting
EC for DHW + DE for DHW
EC for Appliances + DE for Appliances

Electricity Generation by PV and CG

EC for the Evaluated House

DE for the Evaluated House

Specification of the evaluated house

Efficiency
Load Reduction

- Insulation
- Solar Shading
- Natural Ventilation
- Ventilation with Heat Exchanger

- Light Control

- Low Flow Tap
- Insulation of Bathtub
- Solar Water Heater

- Specifications of Appliances are given under some assumption for Reference and Designed evaluation.

- Installation of Photovoltaic and Co-generation system

EC : Energy Consumption
DEC : Designed Energy Consumption
Example of Evaluation (Residential House)

Common conditions (Tokyo, 120m²)

- **Reference EC**
  - 18.2GJ for Heating & Cooling
  - 4.6GJ for Ventilation
  - 10.8GJ for Lighting
  - 25.2GJ for DHW
  - 21.1GJ for Appliances

- **Designed EC**
  - 17.6GJ for Heating & Cooling
  - 4.6GJ for Ventilation
  - 8.2GJ for Lighting
  - 20.4GJ for DHW
  - 21.1GJ for Appliances

- **PV Electricity Generation by PV and CG**
  - 0GJ

- **Referring to the Evaluated House**
  - 79.9 GJ
  - 71.9 GJ

\[ \frac{E_T}{E_{ST}} = 0.9 < 1.0 \]

**Specification of the evaluated house**
- Envelope H11 Standard Level
- Ventilation Normal Type
- Lighting Use of Incandescent Lighting
- DHW Normal Combustion DHW System
- Appliances Normal (Value is defined)

**Specification of the reference house**
- Envelope H11 Standard Level
- Ventilation Normal Type
- Lighting No Use of Incandescent Lighting
- DHW High Efficient DHW System
- Appliances Normal (Value is defined)
- PV Not Installation

**EC : Energy Consumption**
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 will be 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.
Reference A. Operation of Model Building Method Input Support Tool

1) Access method

The model building method input support tool is a Web program operated on the Web browser. First, visit the webpage of Building Research Institute, Japan and access the site entitled “Engineering Information Concerning Energy Consumption Performance of Buildings”. Press the button entitled “Use the Model building Method Input Support Tool Ver. 2.1” which is located in “5.1 Program and Explanation based on 2016 Energy Conservation Standards” of the above-mentioned site, and you can have access to the tool. You can also download the “model building method input sheet” for supporting the calculation from this site.

Fig. A.1 Engineering information site concerning energy consumption performance of buildings
http://www.kenken.go.jp/becc/indes.html

5.1 Program and engineering information based on energy conservation standards of 2016

Model building method

Fig. A.2 Access to the model building method input support tool
Use of the following browsers is recommended.

- Internet Explorer®  Version 8 or later
- Firefox®  Latest version
- Google Chrome™  Latest version

With browsers other than the above, information may not be accurately reproduced. Confirm your Web browser and its version before using this tool.

When you access the tool, the “Licensing conditions” window is displayed. Read them carefully and press the “Consent to the licensing conditions” button only if you consent to them before using the tool.

Fig. A.3 Licensing conditions
Model Building Method Input Support Tool
(For energy conservation standards of 2016) Ver. 2.2.1 (October, 2016)

Basic information
- Basic information used commonly for the evaluation of envelope performance and primary energy consumption of each facility is input into the “Basic information” tab.
- Japan Sustainable Building Consortium’s “Energy Conservation Support Center” publicizes “frequently asked questions and answers”.

Building name

Energy conservation standards
- Region 1
- Region 2
- Region 3
- Region 4
- Region 5
- Region 6
- Region 7
- Region 8

Applicable model building
- Office model
- Business hotel model
- City hotel model
- General hospital model
- Welfare facility model
- Clinic model
- School model
- Kindergarten model
- University model
- Lecture hall model
- Large-scale store model
- Small-scale store model
- Restaurant model
- Meeting hall model
- Factory model

Calculation target area

Model: Offices
Category of region: Region 6
### Model Building Method Input Support Tool

**Model:** Offices  
**Category of region:** Region 6

#### Basic information

- **Model:** Offsets
- **Category of region:** Region 6

#### Building shape

- **Building height**
  - **Number of stories**
  - **Total of floor height of each story**

- **Length of outer perimeter**
  - **Length of building outer perimeter**
  - **Length of outer perimeter of non-air conditioning core**

- **Direction**
  - **Direction of non-air conditioning core**
    - North
    - East
    - South
    - West
    - None

#### External wall performance

- **Area of external wall, roof and floor contacting outside air**
  - **External wall area, North**
  - **External wall area, East**

#### Envelope

- Input envelope specifications of intended usage of calculation target building into the “Envelope” tab.
- The envelope means structures of the outer perimeter of a building, which include external walls, roof, floor contacting outside air (pilotis, etc.), and windows.
- Japan Sustainable Building Consortium’s “Energy Conservation Support Center” publicizes “frequently asked questions and answers.”
<table>
<thead>
<tr>
<th>Performance of external wall, roof and floor contacting and outside air</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External wall area, South</strong></td>
</tr>
<tr>
<td><strong>External wall area, West</strong></td>
</tr>
<tr>
<td><strong>Roof area</strong></td>
</tr>
<tr>
<td><strong>Area of floor contacting outside air</strong></td>
</tr>
<tr>
<td><strong>Average heat transmission coefficient of external wall</strong></td>
</tr>
<tr>
<td><strong>Average heat transmission coefficient of roof</strong></td>
</tr>
<tr>
<td><strong>Average heat transmission coefficient of floor contacting outside air</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Window performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Window area</strong></td>
</tr>
<tr>
<td><strong>Window area, North</strong></td>
</tr>
<tr>
<td><strong>Window area, East</strong></td>
</tr>
<tr>
<td><strong>Window area, South</strong></td>
</tr>
<tr>
<td><strong>Window area, West</strong></td>
</tr>
<tr>
<td><strong>Area of window on roof surface</strong></td>
</tr>
</tbody>
</table>
Window performance:

- Average heat transmission coefficient of window installed on external wall surface
- Average solar radiation heat acquisition rate of window installed on external wall surface
- Average heat transmission coefficient of window installed on roof surface
- Average solar radiation heat acquisition rate of window installed on roof surface
### Model Building Method Input Support Tool

(For energy conservation standards of 2016) Ver. 2.2.1 (October, 2016)

**Model:** Offices  
**Category of region:** Region 6

---

**Heat source**

#### Heat source (cooling)

- **Main heat source (cooling):**
  - Water chilling unit (air cooling)
  - Turbo refrigerator
  - Screw refrigerator
  - Absorption refrigerator
  - District heat supply
  - Packaged air conditioner (air cooling)
  - Gas heat pump cooler and heater
  - Room air conditioner
  - Not used

- **Individual heat source ratio (cooling):**

- **Input method of heat source capacity (cooling):**
  - Not specified
  - Input values

- **Input method of heat source efficiency (cooling):**
  - Not specified
  - Input values

#### Heat source (heating)

- **Main heat source (heating):**
  - Water chilling unit (air cooling)
  - Absorption refrigerator
  - Small once-through boiler
  - Hot water generator
  - District heat supply
  - Packaged air conditioner (air cooling)
  - Gas heat pump cooler and heater
  - Room air conditioner
  - Electric heater, etc.
  - FF heater, etc.
  - Not used

---

**Evaluation of air conditioning facility**

- Not evaluate
- Evaluate

---

**About air conditioning facilities**

- Input specifications of air conditioning facilities located in the intended usage of the calculation target building into the "Air conditioning" tab.
- All of the air conditioning facilities installed in the intended usage of the calculation target building are subject to calculation.
- To evaluate air conditioning facilities, PAL6 to PAL23 of the "Envelope" tab also need to be input.

Japan Sustainable Building Consortium's "Energy Conservation Support Center" publicizes "frequently asked questions and answers".
<table>
<thead>
<tr>
<th>Individual heat source ratio (heating)</th>
<th>Input method of heat source capacity (heating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Input values</td>
<td>Input values</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input method of heat source efficiency (heating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not specified</td>
</tr>
<tr>
<td>Input values</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outside air processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total heat exchanger</td>
</tr>
<tr>
<td>Availability of total heat exchanger</td>
</tr>
<tr>
<td>Not available</td>
</tr>
<tr>
<td>Available</td>
</tr>
<tr>
<td>Stoppage of air-intake when pre-heating</td>
</tr>
<tr>
<td>Availability of total heat exchanger</td>
</tr>
<tr>
<td>Not available</td>
</tr>
<tr>
<td>Available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carriage control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary pump</td>
</tr>
<tr>
<td>Variable flow rate control of secondary pump</td>
</tr>
<tr>
<td>Not available</td>
</tr>
<tr>
<td>Available</td>
</tr>
<tr>
<td>Air conditioner</td>
</tr>
<tr>
<td>Variable air flow control of air conditioner fan</td>
</tr>
<tr>
<td>Not available</td>
</tr>
<tr>
<td>Available</td>
</tr>
<tr>
<td>Room usage</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>&quot;Machine room&quot;</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>&quot;Bathroom&quot;</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

### About ventilation facilities

- Input specifications of mechanical ventilation facilities located in the intended usage of the calculation target building into the "Ventilation" tab.
- The mechanical ventilation facilities installed in the "machine room", "bathroom", "kitchen" and "parking lot" in the intended usage of the calculation target building are subject to calculation. However, input is not necessary for the room usages which do not exist.
- Japan Sustainable Building Consortium's "Energy Conservation Support Center" publicizes "frequently asked questions and answers".
<table>
<thead>
<tr>
<th><strong>Motor output</strong></th>
<th><strong>Input system for motor output</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td>Input motor output per unit air volume</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Control system</strong></th>
<th><strong>Availability of high-efficiency motor</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not available</td>
</tr>
<tr>
<td></td>
<td>Available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Room usage “Parking lot”</strong></th>
<th><strong>Availability of mechanical ventilation facility</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not available</td>
</tr>
<tr>
<td></td>
<td>Available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Room usage “Kitchen”</strong></th>
<th><strong>Availability of mechanical ventilation facility</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not available</td>
</tr>
<tr>
<td></td>
<td>Available</td>
</tr>
</tbody>
</table>
Room usage “Office”

### Evaluation of lighting facility
- Not evaluate
- Evaluate

### Availability of lighting facility
- Not available
- Available

### Electric power consumption
- Not specified
- Input values

### Control system, etc.
- Occupancy detection control
  - Not available
  - Available
- Brightness detection control
  - Not available
  - Available
- Time schedule control
  - Not available
  - Available
- Initial illuminance correction function
  - Not available
  - Available

---

About lighting facilities

- Input the specifications of the lighting facilities located in the intended usage of the calculation target building into the “Lighting” tab.
- The lighting facilities installed in the room for the main intended room usage specified for each intended building usage are subject to calculation.
- Japan Sustainable Building Consortium’s “Energy Conservation Support Center” publicizes “frequently asked questions and answers”.
Model Building Method Input Support Tool
(For energy conservation standards of 2016) Ver. 2.2.1 (October, 2016)

Model: Offices  
Category of region: Region 6

Calculation result

Basic information
Envelope
Air conditioning (AC)
Ventilation (V)
Lighting (L)
Hot water (HW)
Elevator (EV)
Photovoltaic power generation (PV)

“Face-wash, hand-wash” usage
“Bathroom” usage
“Kitchen” usage

Evaluation of hot water supply facility
Not evaluate  Evaluate

About hot water supply facilities
- Input the specifications of the hot water supply facilities in the intended usage of the calculation target building into the “Hot water” tab.
- The hot water supply facilities for “face-wash, hand-wash”, “bathroom”, and “kitchen” in the intended usage of the calculation target building are subject to calculation. However, input is not necessary for the room usages which do not exist.
- Japan Sustainable Building Consortium’s “Energy Conservation Support Center” publicizes “frequently asked questions and answers”.

“Face-wash, hand-wash” usage
Availability of hot water supply facility
Not available
Available

Hot water supply facility specifications
Input method for heat source efficiency
Not specified
Input values
Pipe heat retention specifications
Bare pipe
Heat retention specification 2 or 3
Heat retention specification 1
Hot water saving equipment
Not available
Automatic hot water supply faucet

“Bathroom” usage
Availability of hot water supply facility
Not available
Available

“Kitchen” usage
Availability of hot water supply facility
Not available
Available
Model Building Method Input Support Tool
(For energy conservation standards of 2016) Ver. 2.2.1 (October, 2016)

Model: Offices
Category of region: Region 6

Calculation result

Basic information
Envelope
Air conditioning (AC)
Ventilation (V)
Lighting (L)
Hot water (HW)
Elevator (EV)
Photovoltaic power generation (PV)

Input for elevator

Availability of elevator
- Not available
- Available

Speed control system
- AC feedback control, etc.
- Variable voltage, variable frequency control system (without regeneration)
- Variable voltage, variable frequency control system (with regeneration)
Model Building Method Input Support Tool
(For energy conservation standards of 2016) Ver. 2.2.1 (October, 2016)

Model: Offices
Category of region: Region 6

Calculation result

Basic information
Envelope
Air conditioning (AC)
Ventilation (V)
Lighting (L)
Hot water (HW)
Elevator (EV)
Photovoltaic power generation (PV)

Input for photovoltaic power generation facility
Panel 1  Panel 2  Panel 3  Panel 4

Availability of photovoltaic power generation facility
- Not available
- Available

About photovoltaic power generation facilities
- Input the specifications of the photovoltaic power generation facilities located in the intended usage of the calculation target building into the "Photovoltaic power generation" tab.