



Features and Characteristics of New Building Energy Standards of Japan

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Masato Miyata, NILIM, Japan, February 14, 2017

Outline

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

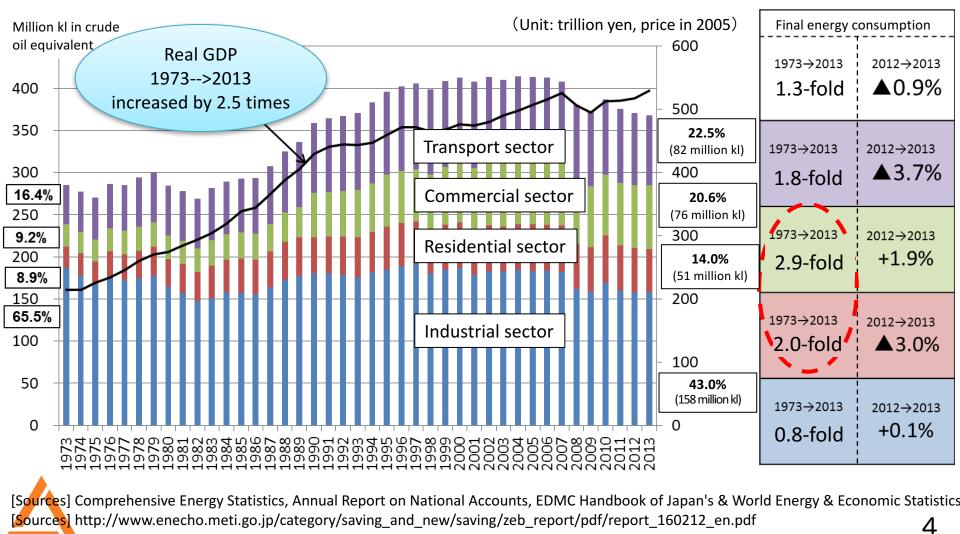


1. Brief Overview of Energy Policy in Japan



Status of energy consumption

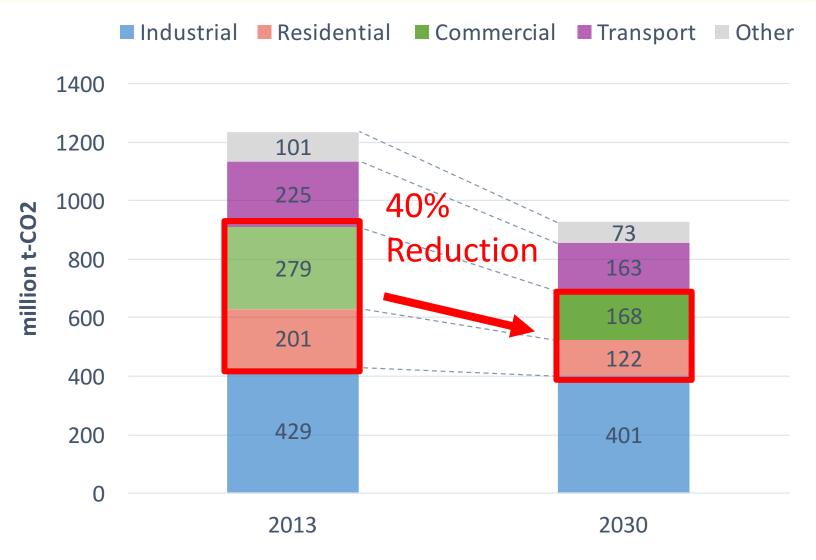
To stabilize the energy demand and supply in Japan, it is essential to take measures to reduce energy consumption in the civilian sector.



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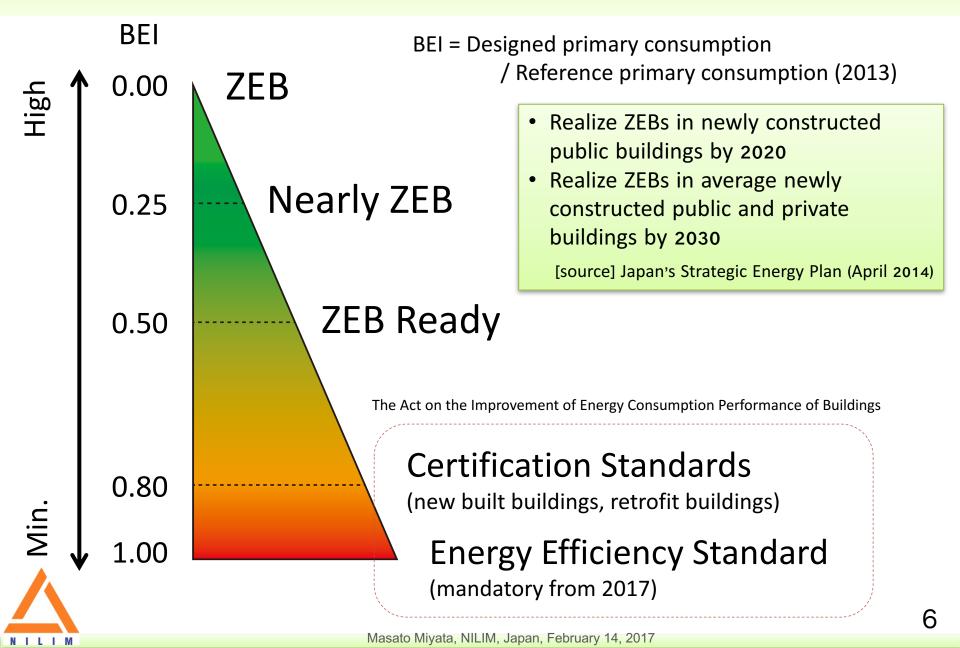
Our Goal (Civilian Sector)



[Sources] Ministry of Economy, Trade and Industry: Long-term energy supply and demand outlook July, 2015

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Targets

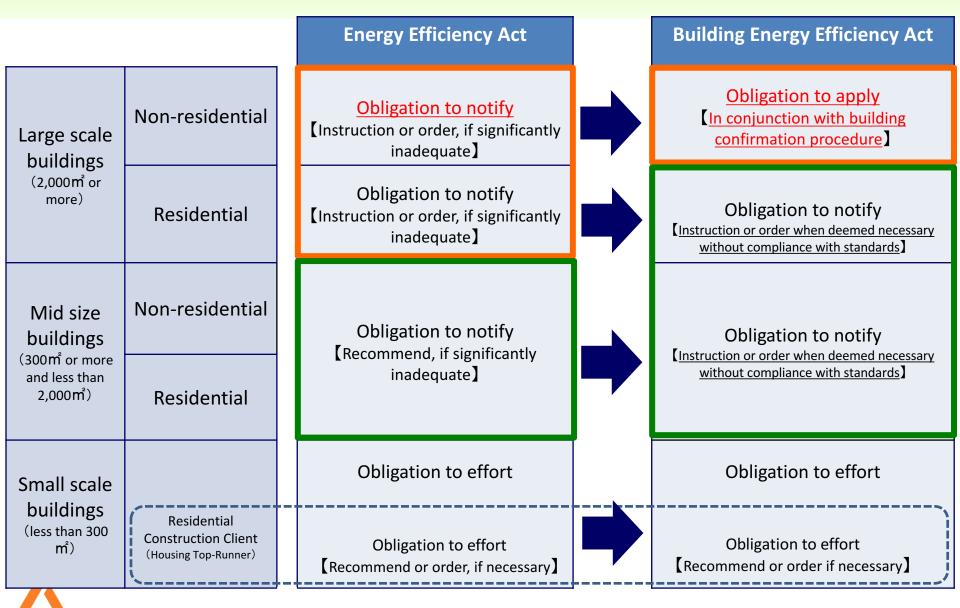


History and Future of the Building Energy Standard

- 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 <u>Reporting on the Standards was mandatory except small</u> 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.



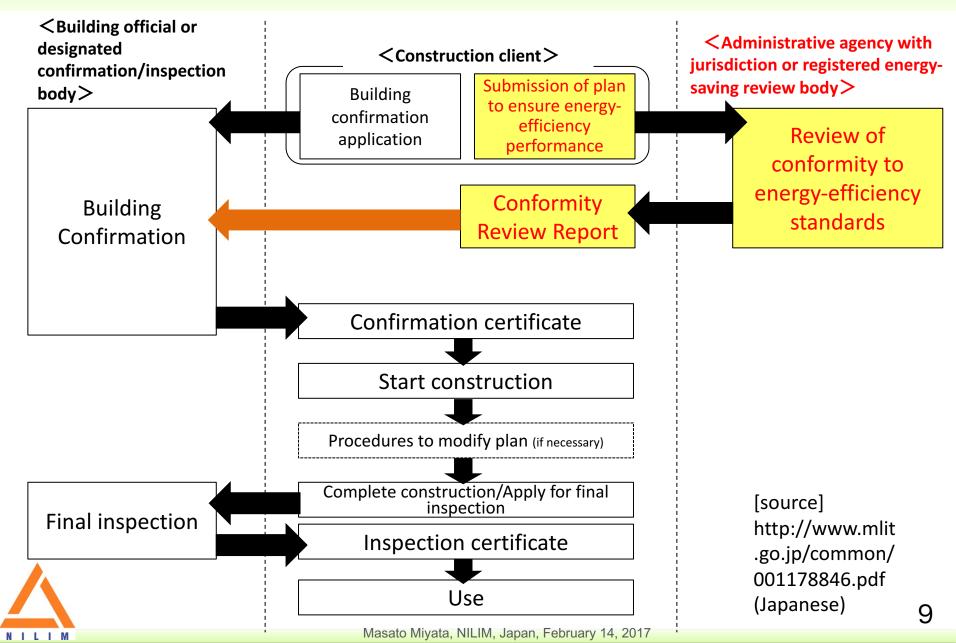
New Building Energy Conservation Act



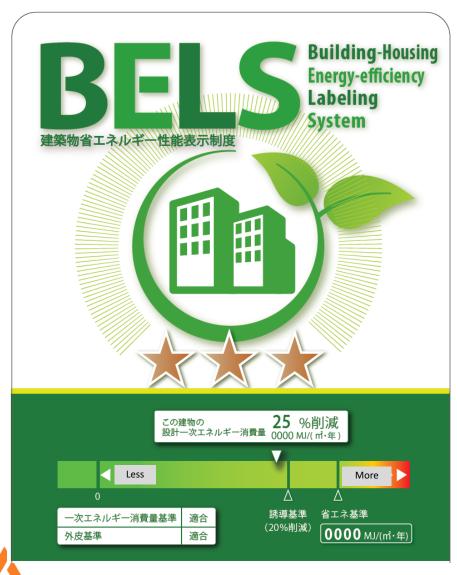
[source] http://www.mlit.go.jp/common/001178846.pdf (Japanese)

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Scheme for Evaluation of Energy Conservation Compliance and Building Certification/Inspection From April 2017



Labeling System



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Section 7 Emphasize Energy **Conservation Performance at** or above Level of Standards

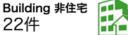
- Third party verification (BELS) label with stars.
 - $\star \star \star \star \star$ **BEI<=0.60**
 - $\star\star\star\star\star$
- **BEI<=0.70**
- $\star\star\star\star$
 - $\star\star$
- **BEI<=0.80**
- **BEI<=1.00**
- **BEI<=1.10**

[source] http://www.hyoukakyoukai.or.jp/bels/bels.html

Labeling System







Housing 住宅 3786件

平成28年4月から平成28年9月までの累計評価件数となります。

※複合建築物については、建築物に占める割合が最も多い区分にしたがい非住宅、住宅に割り当てております。





[source] https://www2.hyoukakyoukai.or.jp/bels/info/jireishokai.php

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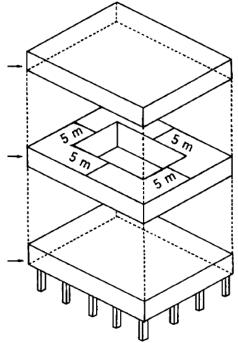
2. Evaluation Method (Commercial buildings)



Old Energy Standard for Commercial Buildings (~2013)

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



Perimeter Zone

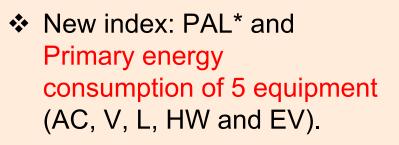


Revised Energy Efficiency Standard for Commercial Buildings (2013-)

Old Standard

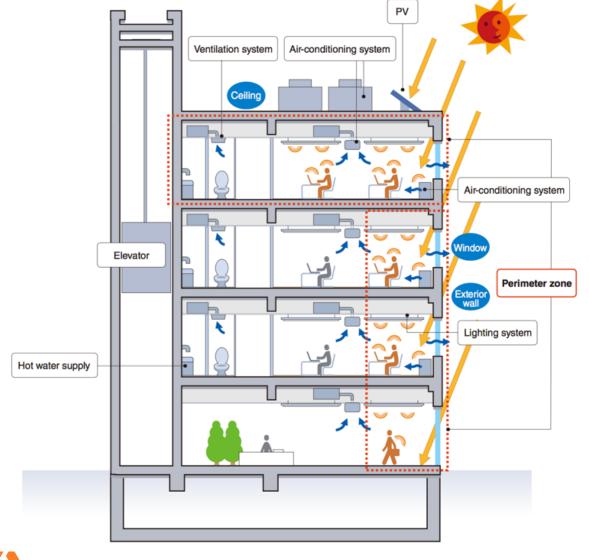
New Standard

- 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 calculation method is developed, which can estimate the energy consumption more accurately.
- Criterion value is defined according to types of room.

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



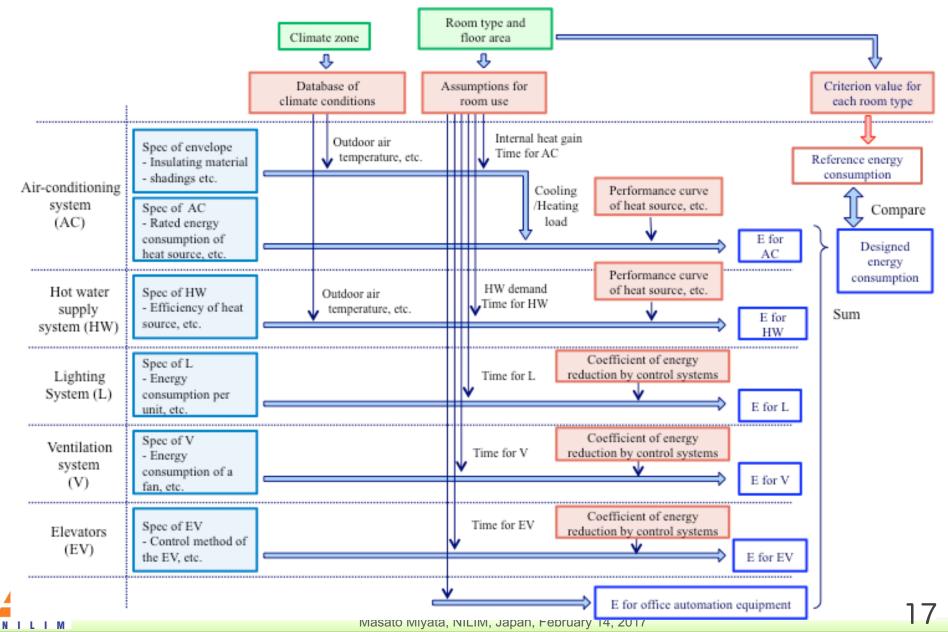
[source] http://www.mlit.go.jp/common/001134876.pdf

Calculation methodologies

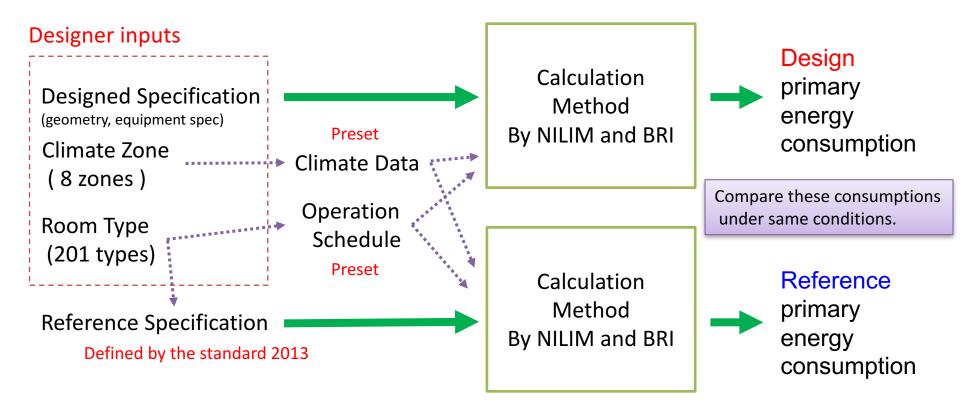
- NILIM and BRI have developed new methodologies for evaluating the primary energy consumption.
- The methodologies are expected to be suitable for the mandatory standard.
 - Easy to understand evaluation logic (simplified and streamlined)
 - Easy to understand evaluation results
 - A fair, reliable, 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)
 - = Design consumption / Reference consumption

Example of the room types

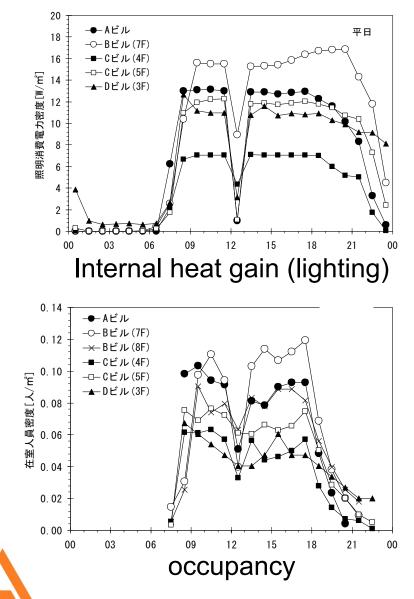
No.	Type of room (Office)	No.	Type of room (Hotel)
0-1	Office room	H-1	Guest room
0-2	Office higher heat	H-2	Guest room's bath room
0-3	Meeting room	H-3	Banquet higher heat
O-4	Tearoom	H-4	Banquet hall with medium heat emission
0-5	Central control	H-5	Banquet hall with low heat emission
0-6	Locker room	H-6	Restaurant
0-7	Canteen	H-7	Lounge
0-8	Hall	H-8	Lounge open only at night
0-9	Lobby	H-9	Shop
0-10	Toilet	H-10	Office room (24 hours)
0-11	Smoking room	H-11	Office room (closed during night)
		H-12	Canteen for employees



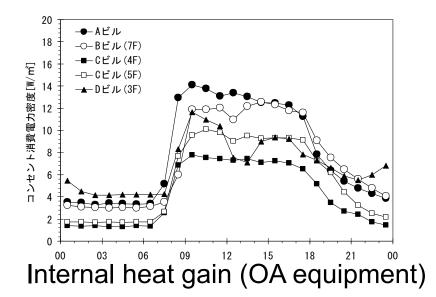
H-13

Locker room

Measurement of the Internal Heat Gain in Actual Office Buildings



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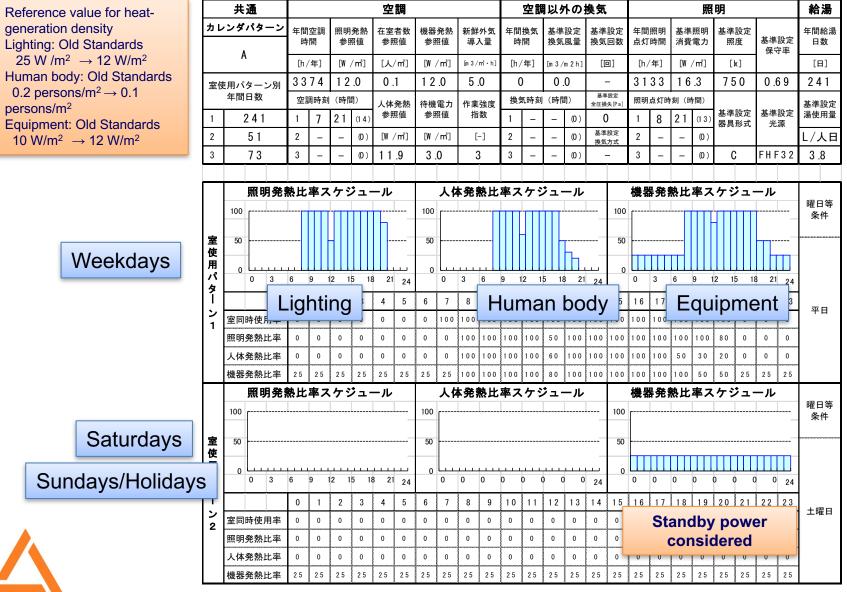
Example of Assumptions for the Room Usage

Building Type	Type of room	Operation Time for AC	Internal heat gain (lighting)	Internal heat gain (metabolism)	Internal heat gain (OA equipment)	Fresh air intake	llluminance level	
		[h/year]	[W/㎡]	[person/m]	[W/㎡]	[m ³ /m ² h]	[lx]	
Office	OfficeRoom	3374	12	0.1	12	5.0	750	
	ComputerRoom	3374	12	0.1	30	5.0	750	
	MeetingRoom	2410	10	0.25	2	12.0	500	
	TeaRoom	2410	10	0.25	2	12.0	300	
	Canteen	723	30	0.5	0	15.0	500	
	CentralMonitoringRoom	8760	20	0.15	30	4.0	500	
,	LockerRoom	3374	15	0.3	0	4.0	300	
	Corridor	3133			0	2.5	200	
,	Lobby	3133				2.5	500	
	Toilet	3133				2.5	300	
	SmokingRoom	3133	15	0.03	0	2.5	300	
	Kitchen	0			0	0.0	750	
	IndoorParking	0			0	0.0	150	
	MechanicalRoom	0	0	0	0	0.0	200	
	ElectricalRoom	0	0	0	0	0.0	200	
	Kitchenette	0	0	0	0	0.0	300	
	StorageRoom	0	0	0	0	0.0	300	
	CopyRoom	0			0	0.0	500	
	GarbageStorage	0	0	0	0	0.0	150	

The information in this table is based on the results of a review in the MLIT Building Code Development Promotion Project (22 survey items).

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Standardized room-use conditions (Office room in office building)

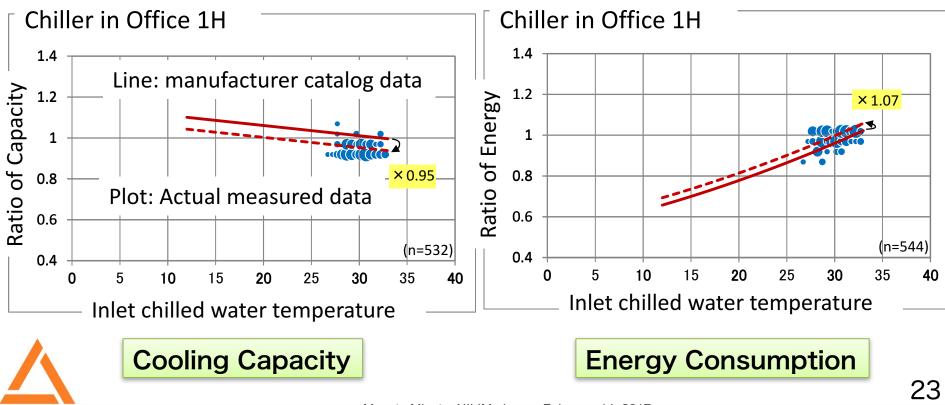


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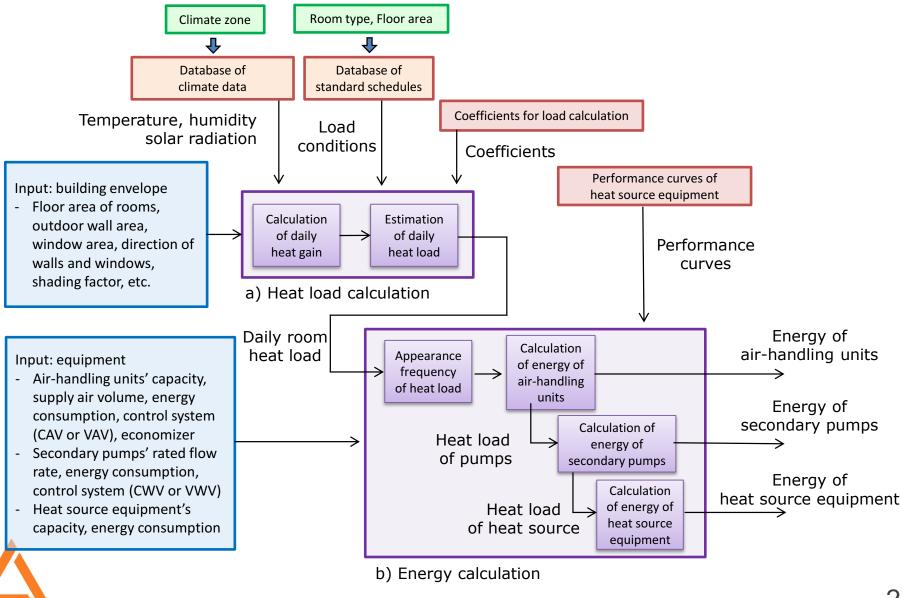
Measurement of Actual performance of Equipment

 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.



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Calculation flow (air-conditioning system)



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Concept of Room Heat Load Calculation (1)

- Daily heat loads of each room $\mathsf{Q}_{\mathsf{rL},j}$ are calculated using steady-state heat gain $\mathsf{Q}_{\mathsf{rG},j}$.

 $Q_{rL,j}(t) = a_j Q_{rG,j}(t) + b_j$

- Two kinds of heat gain Q_{rG,i} 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

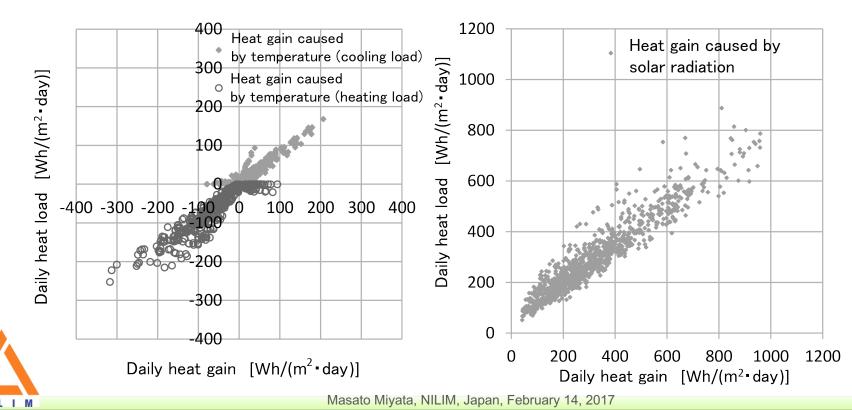
x area x indoor-outdoor temperature difference

- Heat gain through windows as a result of solar radiation
 - Solar heat gain coefficient x area x shading coefficient
 x solar radiation



Concept of Room Heat Load Calculation (2)

- 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.



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Concept of Energy Consumption Calculation

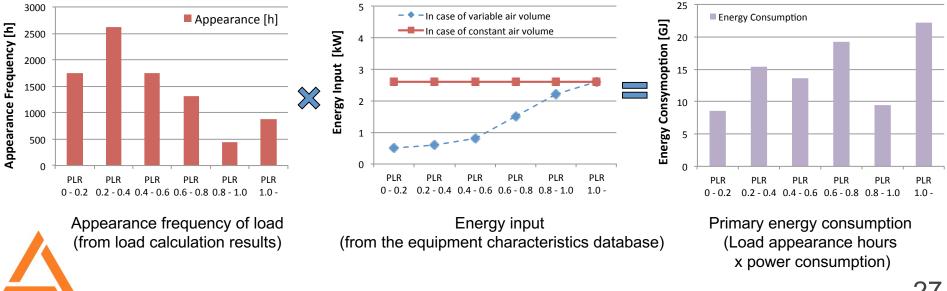
• Primary energy consumption of the air-conditioning system.

 $E_{d,AC} = E_{d,AC,AHU}(Q_{rL,j}) + E_{d,AC,PUMP}(Q_{rL,j}) + E_{d,AC,REF}(Q_{rL,j})$

• The concept used to calculate these values are the same.

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- 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.



Information Disclosed by NILIM and BRI

Official Guides



 BRI's website provides technical information on the Energy Efficiency Standards:

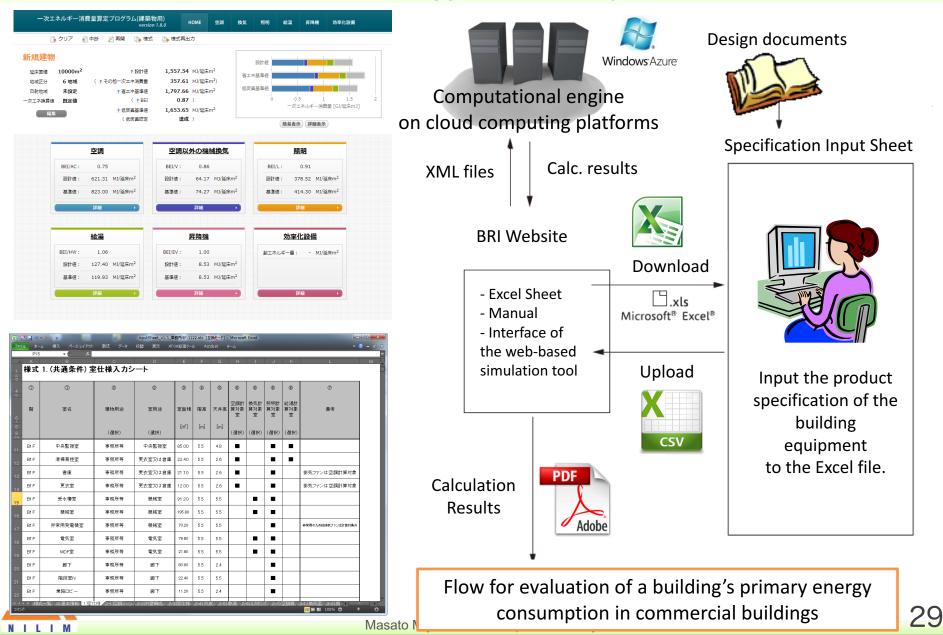
http://www.kenken.go.jp/becc/index.html

- Links to various support tools
- Instructions for the tools
- How to use



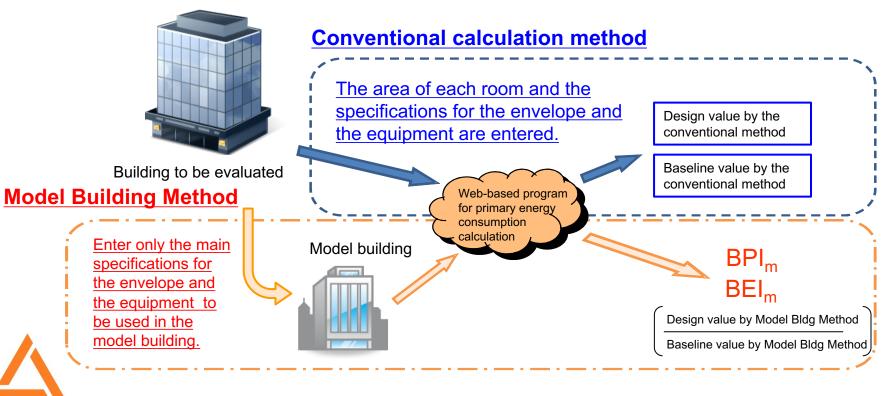
https://www.youtube.com/watch?v=IL1cqCkbFaE

Web-based Simulation Tool for Compliance with 2013 Energy Efficiency Standard



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.

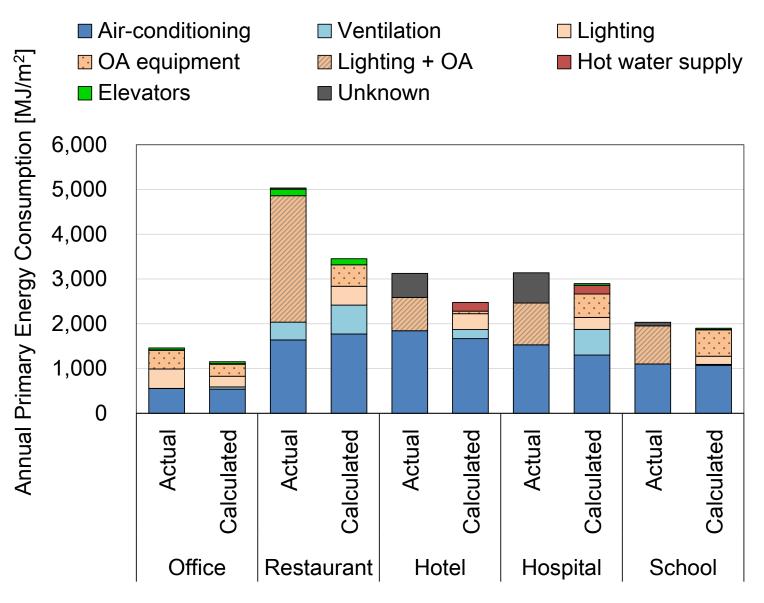


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Model Building Method Input-assist Tool



Application to actual buildings



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Information Disclosed by Building Research Institute

- Building Research Institute's website provides technical information on the Energy Efficiency Standards: <u>http://www.kenken.go.jp/becc/index.html</u>
 - 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

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 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.

