Comparative analysis between Brazil and Japan

Laboratory of Energy Efficiency in Buildings

December 14th, 2021

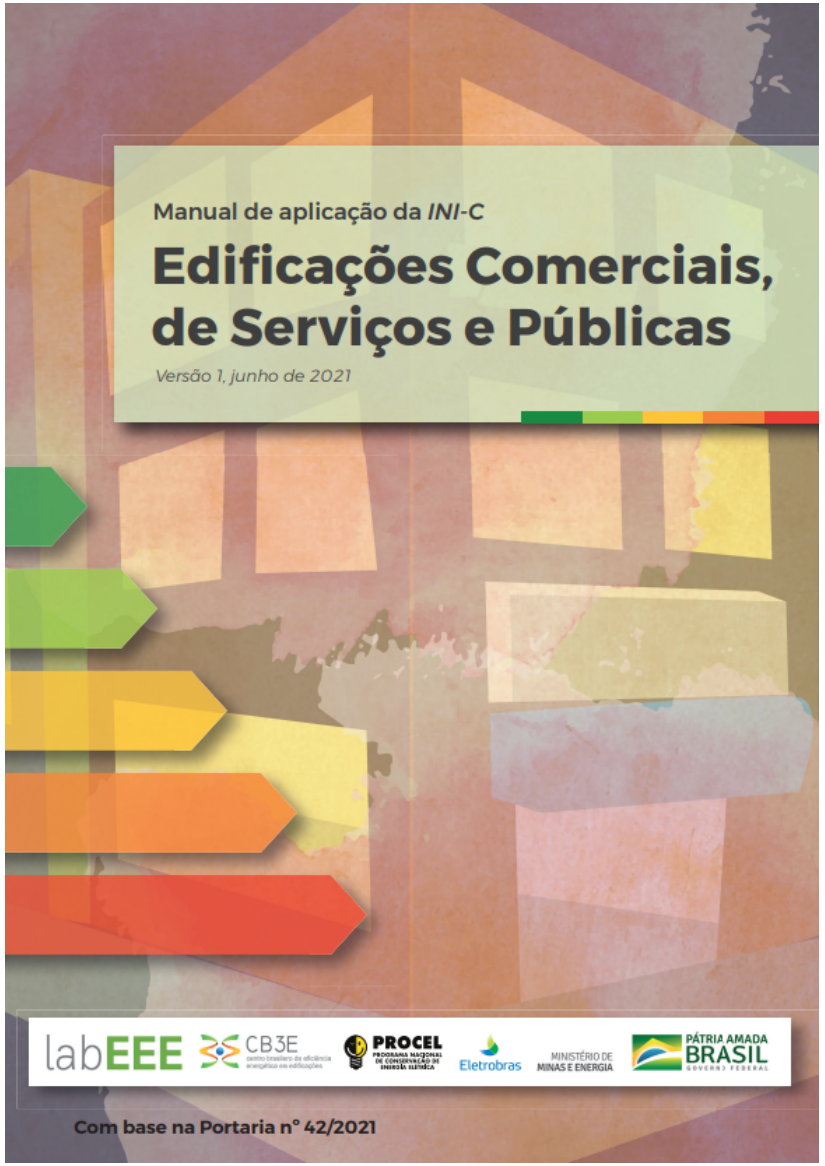
labEEE

www.labeee.ufsc.br

Objective

- Comparative analysis between INI-C (Brazilian) and BRI (Japanese) methods for evaluating energy consumption in commercial buildings.

- Example based on case of an Office building, available at presentation 3ENBCD5 by Mr. Yoshihiko Akamine on 14th October 2021

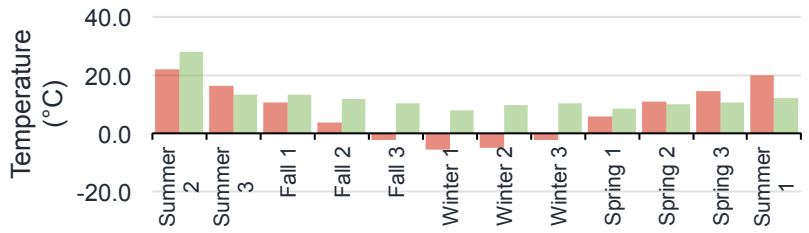


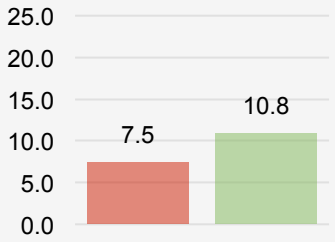
Climatic equivalence study

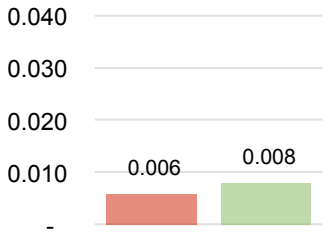
Japanese climate
Brazilian climate

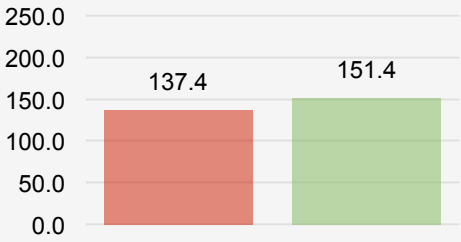
Monthly tempetaure (°C)	Average annual temperature (°C)	Average annual absolute humidity (kg/kg)	Average normal surface direct solar radiation (W/m²)

JP Sapporo (Zone 2) → BR Urubici

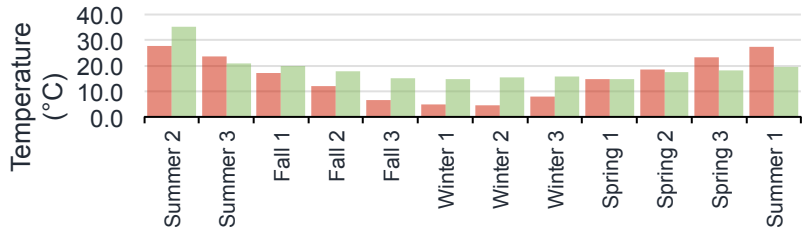


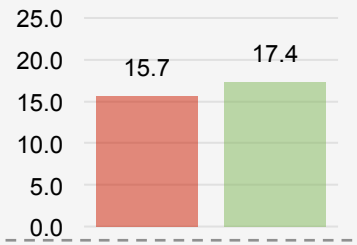


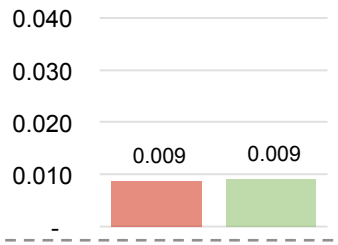


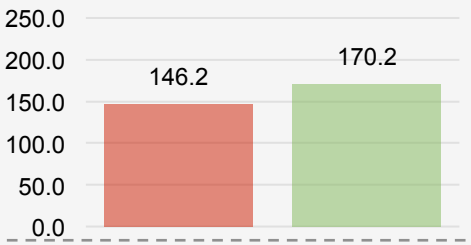


JP Tokyo (Zone 6) → BR Curitiba

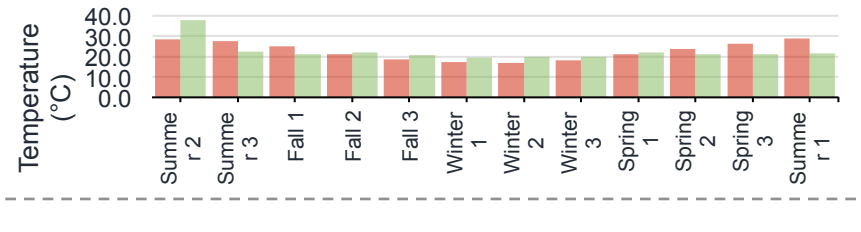


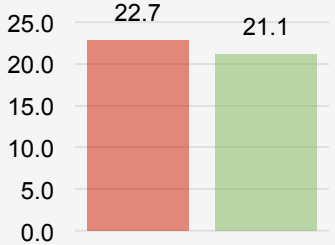


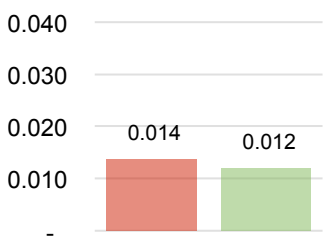


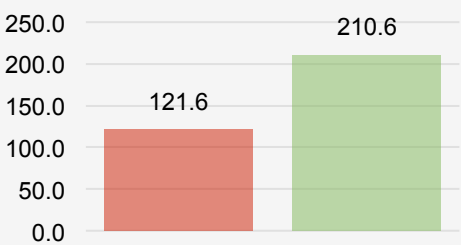


JP Naha (Zone 8)→ BR Brasília









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Monthly tempetaure (°C)	Average annual temperature (°C)	Average annual absolute humidity (kg/kg)	Average normal surface direct solar radiation (W/m²)

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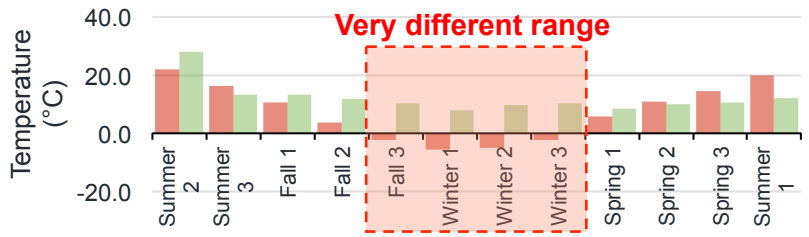
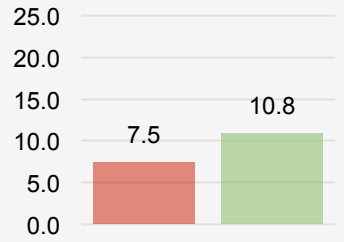
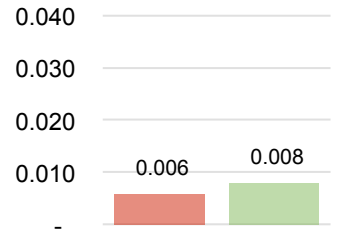
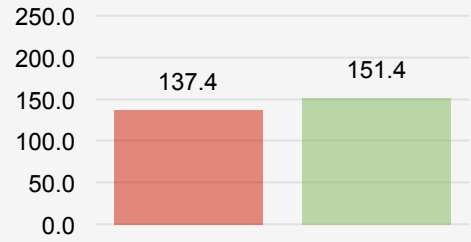
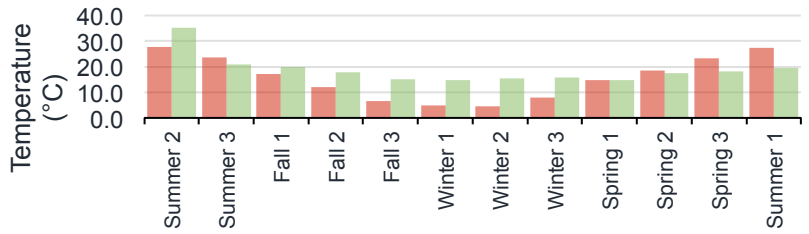


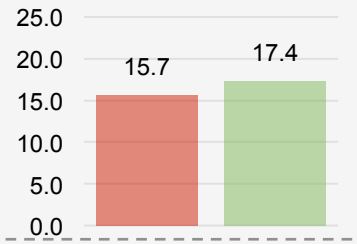


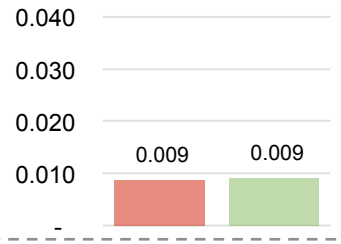


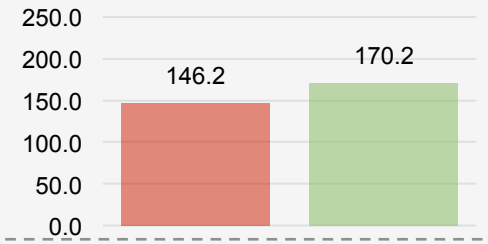


JP Tokyo (Zone 6) → BR Curitiba









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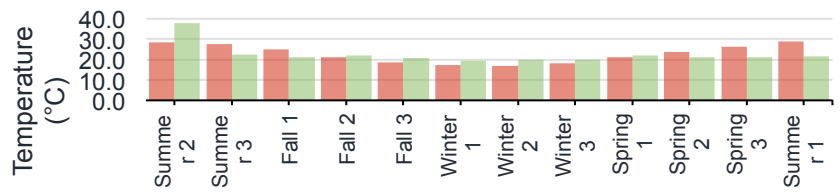
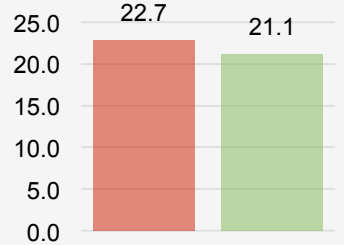
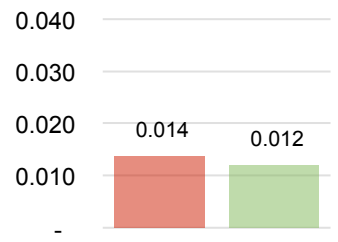
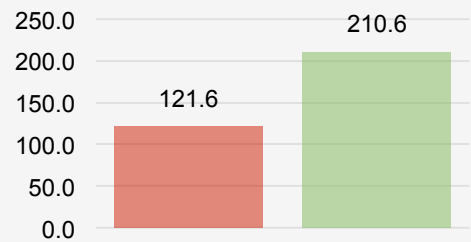


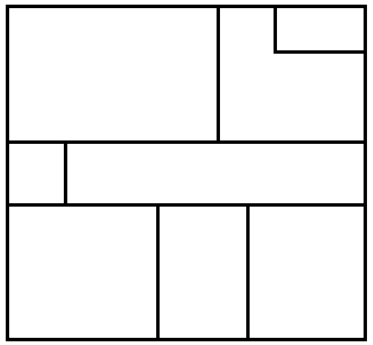




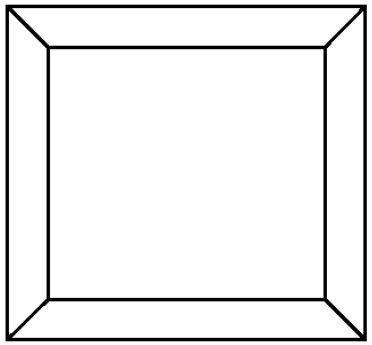


Massing model study

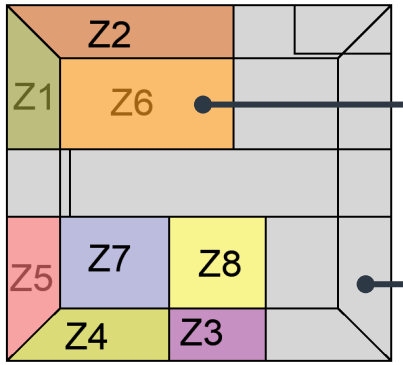
Actual building plan (**ROOMS**)



Surrogate Core and Shell model simplification (**ZONES**)



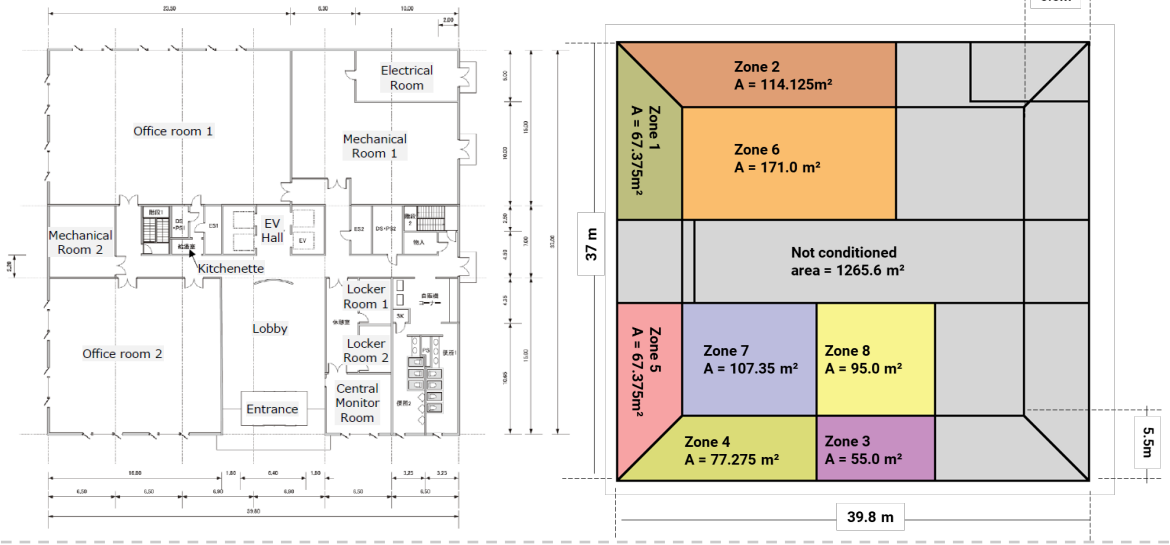
Consideration of each **ROOM** acoording to their share of floor-plan area in the total **ZONE** area



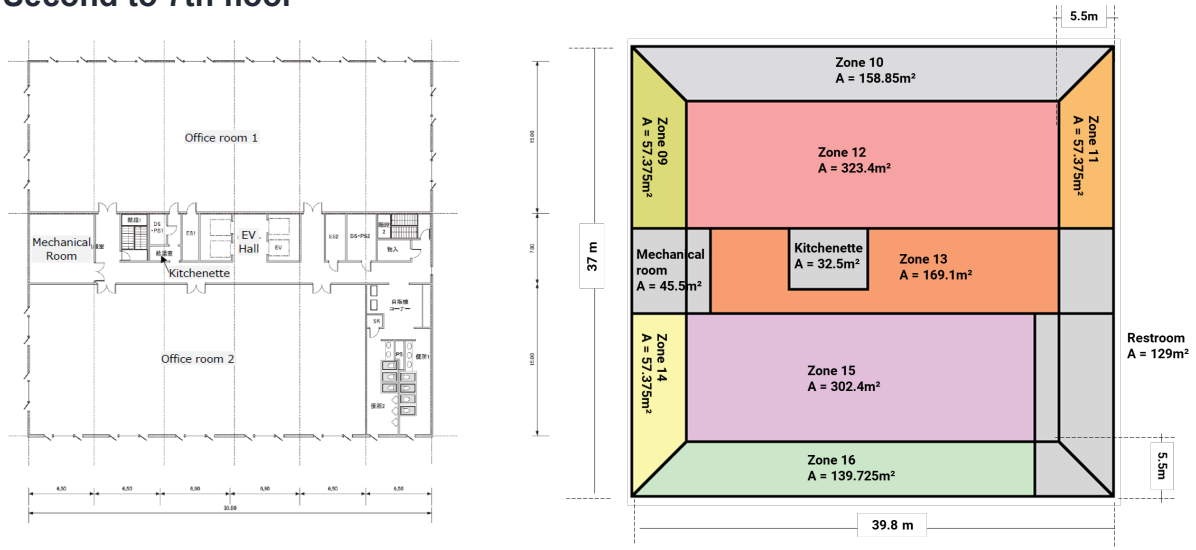
Conditioned areas (Office rooms, corridors, Lobby etc)

Unconditioned areas (bathrooms, mechanical rooms, etc)

First floor



Second to 7th floor



Parameters' definitions and assumptions

Summary of the building tested

Floor	Zone ID	Conditioned	Room type	Unit Area (m²)	Total area (m²)	Internal or Perimetral Zone	Azimuth (°)	Internal heat gain equipment [W/m²]	Internal heat gain lighting [W/m²]	Fresh air intake [ach]	Internal heat gain metabolism [person/m²]
First	Z1	Yes	Office room	67.375	67.375	P	270	30	12	0.20	0.10
First	Z2	Yes	Office room	114.125	114.125	P	0	30	12	0.20	0.10
First	Z3	Yes	Lobby	55	55	P	180	0	15	0.40	0.03
First	Z4	Yes	Office room	77.275	77.275	P	180	30	12	0.20	0.10
First	Z5	Yes	Office room	67.375	67.375	P	270	30	12	0.20	0.10
First	Z6	Yes	Office room	171	171	I	0	30	12	0.20	0.10
First	Z7	Yes	Office room	107.35	107.35	I	0	30	12	0.20	0.10
First	Z8	Yes	Lobby	95	95	I	0	0	15	0.40	0.03
First	N1	No	Bathroom	195	195	0	0	0	0	0.00	0.00
First	N2	No	Kichtenette	233.1	233.1	0	0	0	0	0.00	0.00
First	N3	No	Mechanical room	240	240	0	0	0	0	0.00	0.00
First	N4	No	Electric room	50	50	0	0	0	0	0.00	0.00

Parameters' definitions and assumptions

Summary of the building tested

Floor	Zone ID	Conditioned	Room type	Unit Area (m²)	Total area (m²)	Internal or Perimetral	Azimuth (°)	Internal heat gain equipment [W/m²]	Internal heat gain lighting [W/m²]	Fresh air intake [ach]	Internal heat gain metabolism [person/m²]
2nd to 6th	Z9	Yes	Office room	57.375	286.875	P	270	30	12	0.20	0.10
2nd to 6th	Z10	Yes	Office room	158.85	794.25	P	0	30	12	0.20	0.10
2nd to 6th	Z11	Yes	Office room	57.375	286.875	P	90	30	12	0.20	0.10
2nd to 6th	Z12	Yes	Office room	323.4	1617	I	0	30	12	0.20	0.10
2nd to 6th	Z13	Yes	Corridor	169.1	845.5	I	0	0	15	0.40	0.03
2nd to 6th	Z14	Yes	Office room	57.375	286.875	P	270	30	12	0.20	0.10
2nd to 6th	Z15	Yes	Office room	302.4	1512	I	0	30	12	0.20	0.10
2nd to 6th	Z16	Yes	Office room	139.725	698.625	P	180	30	12	0.20	0.10
2nd to 6th	N5	No	Bathroom	129	645	0	0	0	0	0.00	0.00
2nd to 6th	N6	No	Mechanical room	45.5	227.5	0	0	0	0	0.00	0.00
2nd to 6th	N7	No	Kichtenette	32.5	162.5	0	0	0	0	0.00	0.00

Parameters' definitions and assumptions

Summary of the building tested

Floor	Zone ID	Conditioned	Room type	Unit Area (m²)	Total area (m²)	Internal or Perimetral	Azimuth (°)	Internal heat gain equipment [W/m²]	Internal heat gain lighting [W/m²]	Fresh air intake [ach]	Internal heat gain metabolism [person/m²]
7th (Rooftop)	Z17	Yes	Office room	57.375	57.375	P	270	30	12	0.20	0.10
7th (Rooftop)	Z18	Yes	Office room	158.85	158.85	P	0	30	12	0.20	0.10
7th (Rooftop)	Z19	Yes	Office room	57.375	57.375	P	90	30	12	0.20	0.10
7th (Rooftop)	Z20	Yes	Office room	323.4	323.4	I	0	30	12	0.20	0.10
7th (Rooftop)	Z21	Yes	Corridor	169.1	169.1	I	0	0	15	0.40	0.03
7th (Rooftop)	Z22	Yes	Office room	57.375	57.375	P	270	30	12	0.20	0.10
7th (Rooftop)	Z23	Yes	Office room	302.4	302.4	I	0	30	12	0.20	0.10
7th (Rooftop)	Z24	Yes	Office room	139.725	139.725	P	180	30	12	0.20	0.10
7th (Rooftop)	N8	No	Bathroom	129	129	0	0	0	0	0.00	0.00
7th (Rooftop)	N9	No	Mechanical room	45.5	45.5	0	0	0	0	0.00	0.00
7th (Rooftop)	N10	No	Kitchen	32.5	32.5	0	0	0	0	0.00	0.00

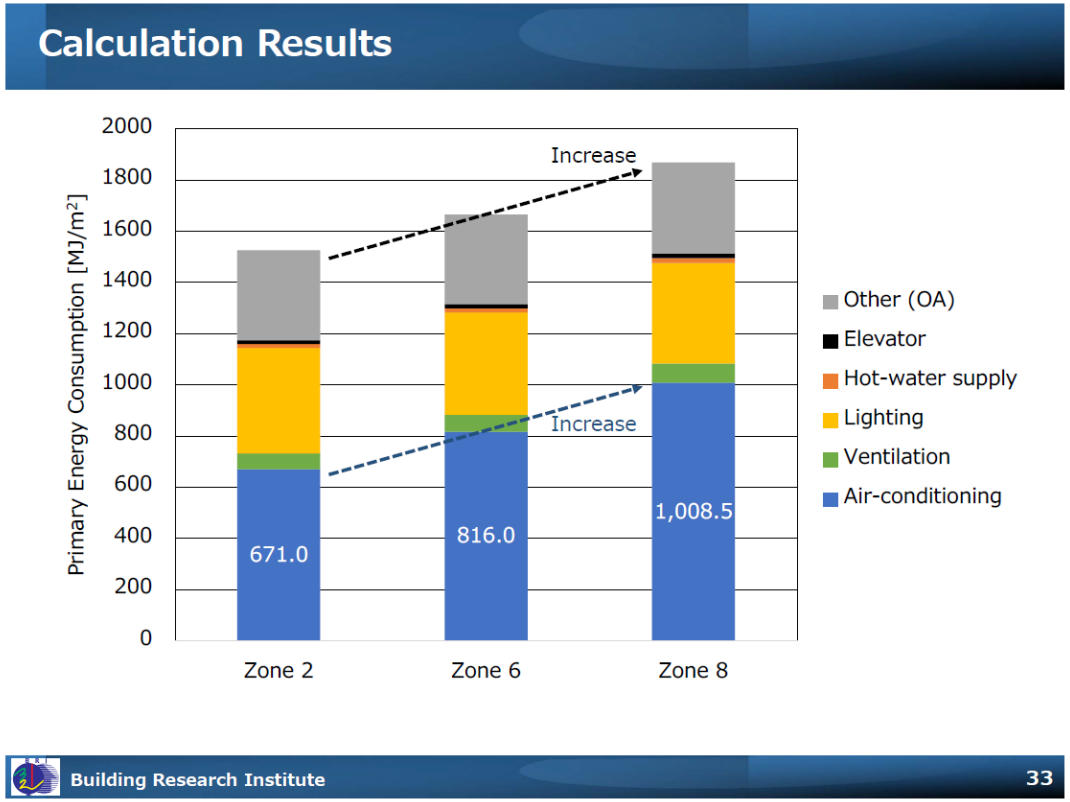
Parameters’ definitions and assumptions

Summary of the assumptions:

- Building height = 3.0 m
- WWR = 60%
- Solar Absorptance of the Exterior walls = 0.8
- Solar Absorptance of the Roof= 0.8
- No shading was considered
- Operation days in the year = 300 days
- Primary energy conversion factor for electricity in Japan = 2.71

Results

Results of the Japanese EPC



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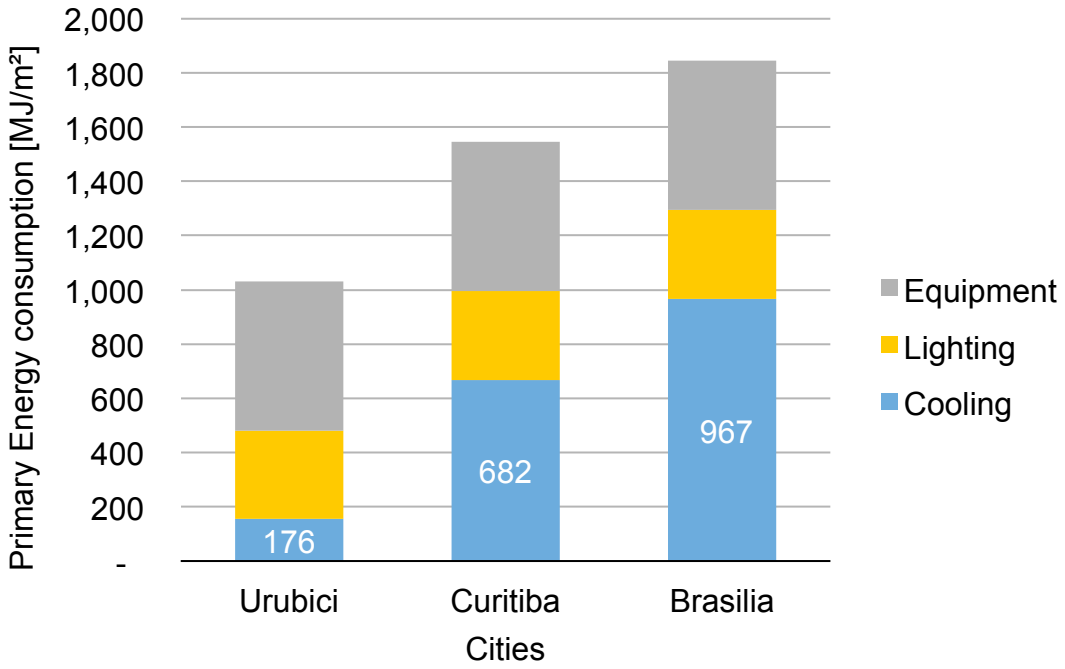

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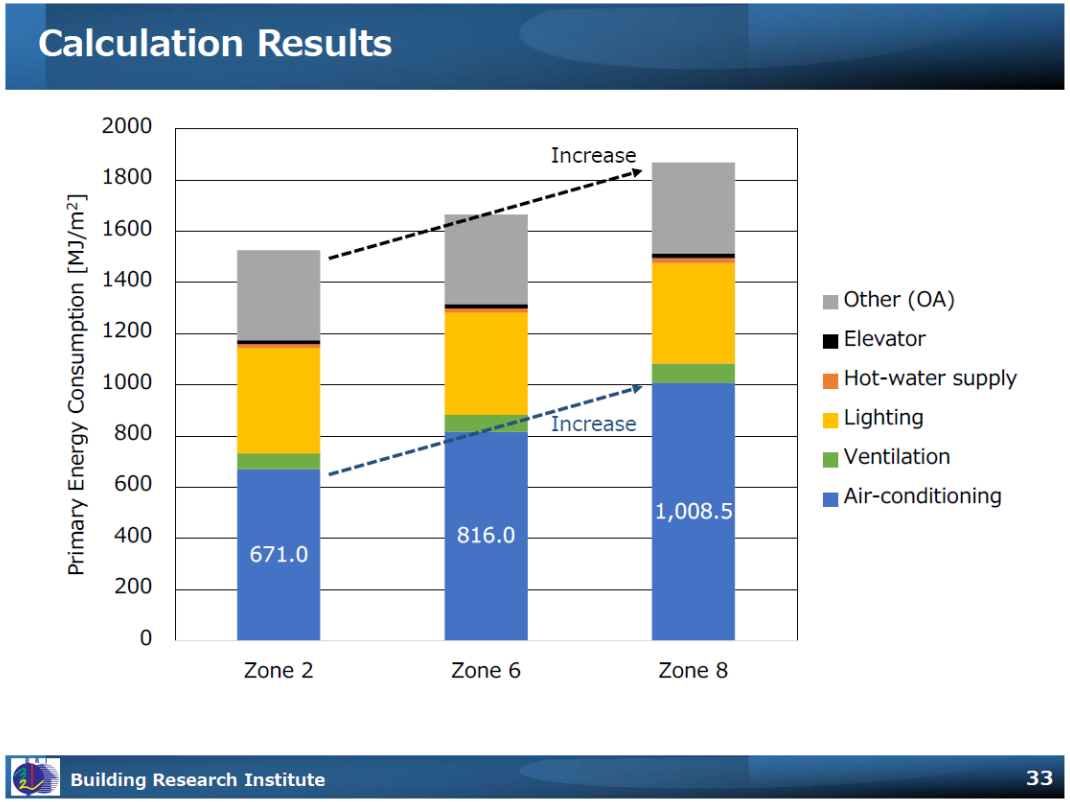

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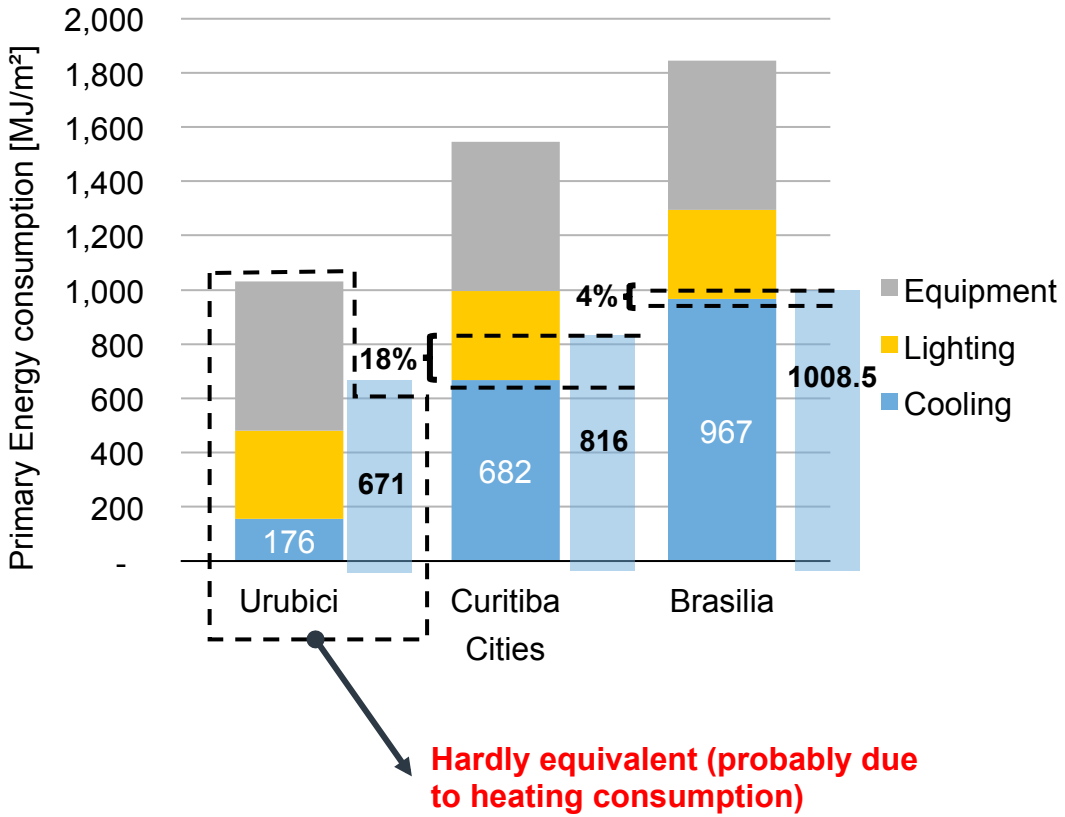


Limitations

Parameters that could be assumed accurately:

- Geometry dimensions
- Equipment power density
- Lighting power density
- Air leakage
- Occupation (and Metabolic Internal Gains fraction)
- Glazing thermal properties
- Thermal transmittance of Walls
- Thermal transmittance of Roofs

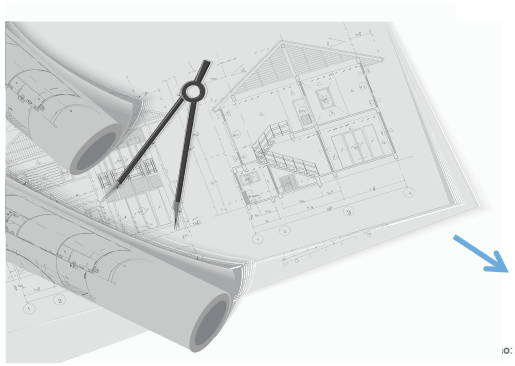
Parameters that were estimated:

- Solar absorptance of Walls
- Solar absorptance of Roof
- Shadings
- Thermal capacity of Walls
- Thermal capacity of Roofs

Main differences between methods:

- Brazilian method employs average parameters within the metamodel thermal zones while the Japanese method employs diversity of patterns and loads in thermal zones according to use.
- Japanese Method considers heating loads while Brazilian method only considers cooling loads.

Brazilian labeling process



DIÁRIO OFICIAL DA UNIÃO

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...o: Ministério da Economia/Instituto Nacional de Metrologia, Qualidade e Tecnologia

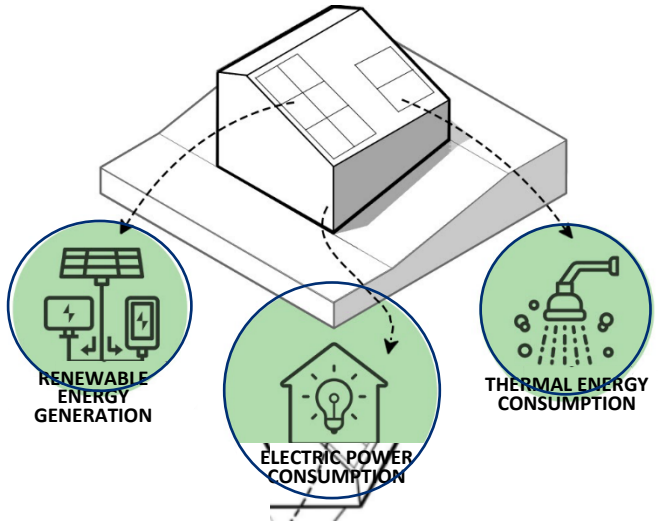
PORTARIA Nº 42, DE 24 DE FEVEREIRO DE 2021

Aprova a Instrução Normativa Inmetro para a Classificação de Eficiência Energética de Edificações Comerciais, de Serviços e Públicas (INI-C) que aperfeiçoa os Requisitos Técnicos da Qualidade para o Nível de Eficiência Energética de Edifícios Comerciais, de Serviços e Públicos (RTQ-C), especificando os critérios e os métodos para a classificação de edificações comerciais, de serviços e públicas quanto à sua eficiência energética.

*RAC = Conformity assessment requirements

Accredited Inspection Body

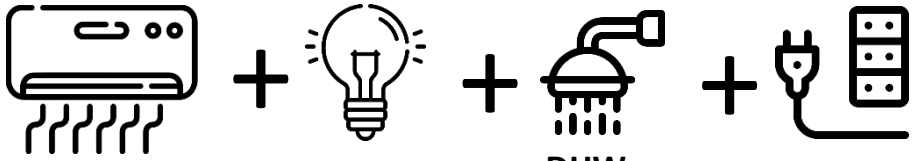
Building classification



DHW = m^3/year

X conversion factor

+

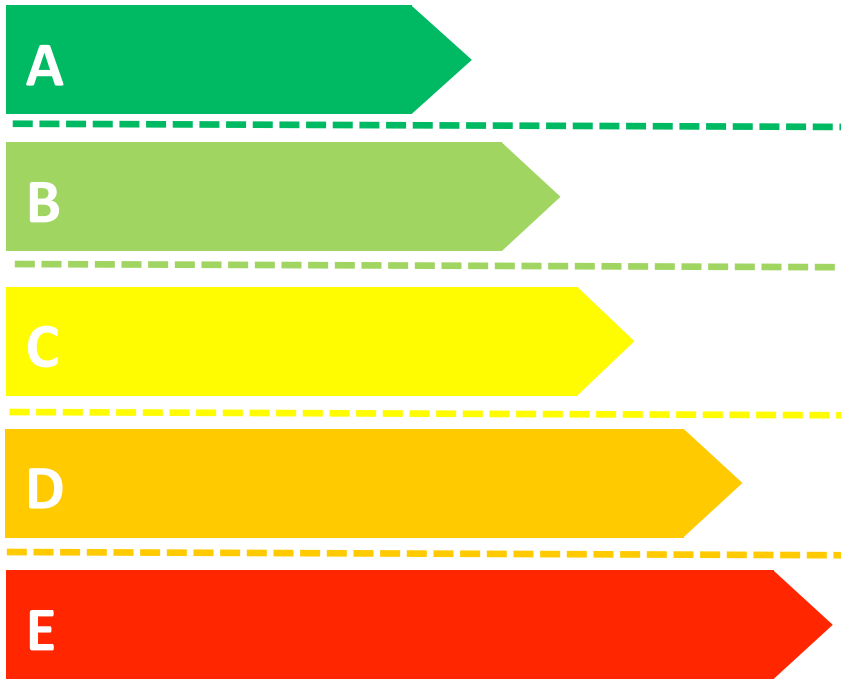


= kWh/year

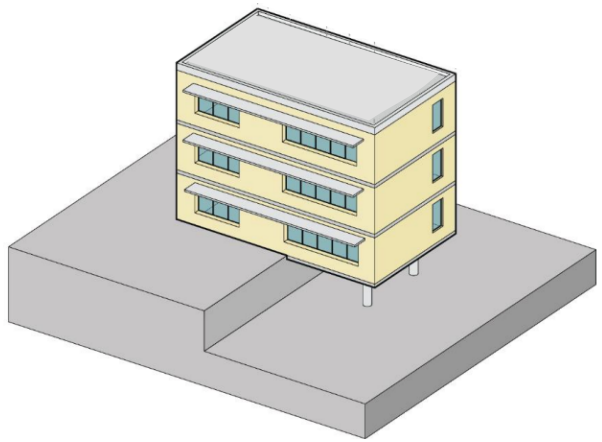
X conversion factor

=

Building consumption in primary energy

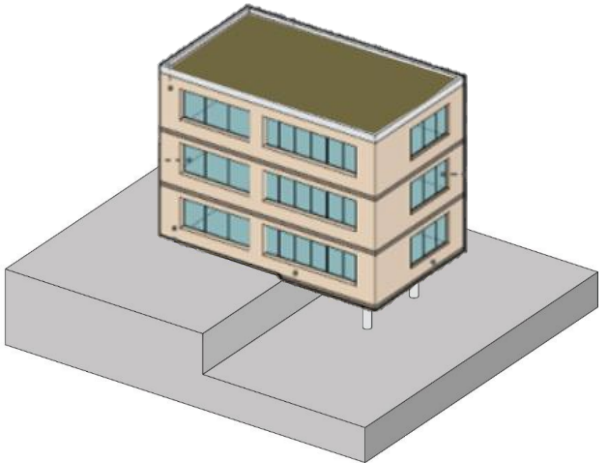


Primary energy of real building



% of savings

Primary energy of reference building



INMETRO
PBE Edifica

Eficiência Energética
Edificações Comerciais, de Serviços e Públicas

Edificação: XXXXXXXX xxxxxxxxxxxxxx

Identificação da unidade consumidora: Xxxxx
Endereço: Xxxxxxxxxxxx Xxxxxxxxxxxxxx
Cidade/UF: Xxxxx/XX
Portaria INI-C: Xxxxxx
Portaria RAC: Xxxxxx
Data da ENCE de projeto: XX/XX/XXXX

☑ ENCE PROJETO ☐ ENCE EDIFICAÇÃO CONSTRUÍDA

O nível de eficiência energética alcançado deve ser confirmado pela **ENCE DA EDIFICAÇÃO CONSTRUÍDA**

Mais eficiente

A
B
C
D
E

A

Menos eficiente

Consumo Anual de Gás: **XX,XX m³/ano**
Consumo Anual de Energia Elétrica: **XXX.XXX,XX kWh/ano**
Consumo de Energia Primária da Edificação: **XX,XX kWh/m²**

CLASSIFICAÇÃO PARCIAL DA EDIFICAÇÃO

Edificação completa (sem a geração) — **A**

Geração de energia renovável — Geração: XX% — Energia gerada: XX.XXX kWh/ano

Informativo

Uso racional de água — Economia: XX% — Equipamentos economizadores XX% — Aproveitamento da água da chuva XX%

Emissões de CO_2 — Emissões CO_2: ↓ XX%

Observações: 1 - A etiqueta de projeto tem validade de 5 anos ou até ser emitida a etiqueta da edificação constru
2 - Para verificar a validade da etiqueta, consulte a página eletrônica do INMETRO: www.inmetro

PROCEL — PROGRAMA BRASILEIRO DE ETIQUETAGEM — LOGOTIPO DO OIA — Nº. REGISTRO DO OIA

INMETRO
PBE Edifica

Eficiência Energética
Edificações Comerciais, de Serviços e Públicas

Edificação: XXXXXXXX xxxxxxxxxxxxxx
Identificação da unidade consumidora: Xxxxx xxx

CLASSIFICAÇÃO PARCIAL DOS SISTEMAS DA EDIFICAÇÃO

Envoltória	Áreas Condicionadas — Carga Térmica: XXX kWh/ano (XXXX kWh/ano/m²)	Ventilação Natural — Percentual de horas atendidas: XX,X%	Simplificado	A
Iluminação	Energia elétrica: XXX kWh/ano (XXXX kWh/ano/m²)	Potencial de integração com a luz natural: XX,X%	Simplificado	A
Condicionamento de ar	Energia elétrica: Resfriamento: XXX kWh/ano (XXXX kWh/ano/m²); Energia elétrica: Aquecimento: XXX kWh/ano (XXXX kWh/ano/m²)	Energia térmica: Resfriamento: XXX m³/ano (XXXX m³/ano/m²); Energia térmica: Aquecimento: XXX m³/ano (XXXX m³/ano/m²)	Simplificado; Simulação	A
Água quente	Energia primária: XXX kWh/ano (XXXX kWh/ano/m²)	Energia elétrica: XXX kWh/ano (XXXX kWh/ano/m²); Energia térmica: XXX m³/ano (XXXX m³/ano/m²)	Simplificado	A
Equipamentos	Energia elétrica: XXX kWh/ano (XXXX kWh/ano/m²)		Simplificado	

CLASSIFICAÇÃO DA EDIFICAÇÃO COMPLETA

Edificação completa — XX% de economia em relação à condição de referência	Energia primária: XXX kWh/ano (XXXX kWh/m²/mês); Geração de energia: XXX kWh/ano (XXXX kWh/m²/mês)	Energia elétrica: XXX kWh/ano (XXXX kWh/m²/mês); Energia térmica: XXX m³/ano (XXXX m³/m²/mês)	Simplificado	A

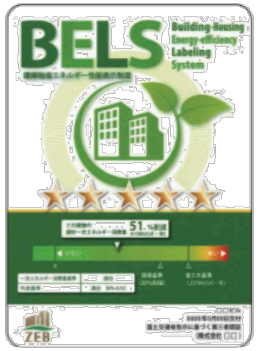
PROCEL — PROGRAMA BRASILEIRO DE ETIQUETAGEM — LOGOTIPO DO OIA — Nº. REGISTRO DO OIA

Labeling system

- Third-part verification
- Label shows energy efficiency performance in 5 levels
- Two labels: at the design stage and after completion of building

Labeling System (third-party verification)

"BELS (Building-Housing Energy-efficiency Labeling System)" can be used as a third-party verification indicator system which started from April 2016 based on the article of the "Building Energy Efficiency Act". BELS shows energy efficiency performance in 5 easy to understand levels, making it possible to promote buildings with higher energy efficient performance than the EE Standard.
Once ZEB Ready is achieved, a special indicator (ZEB mark) will be shown on the label.



Standards / compulsory

- There are no minimum buildings energy efficiency standards
- Buildings Energy Efficiency is not compulsoty (only for federal public buildings, since 2014)
- A regulatory impact analysis is being carried out

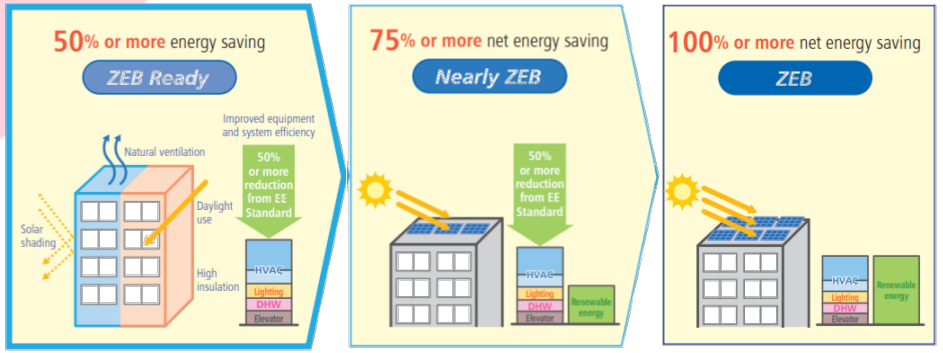
With the establishment of the Building Energy Efficiency Act in Japan, from April 2017 compliance with energy efficiency standards became compulsory for newly built non-residential buildings with a floor area of 2,000 m^2 or more. ZEB have also begun to draw attention as **an option for environmentally friendly buildings,** as an additional step for buildings beyond compliance with energy saving standards.

Definitions

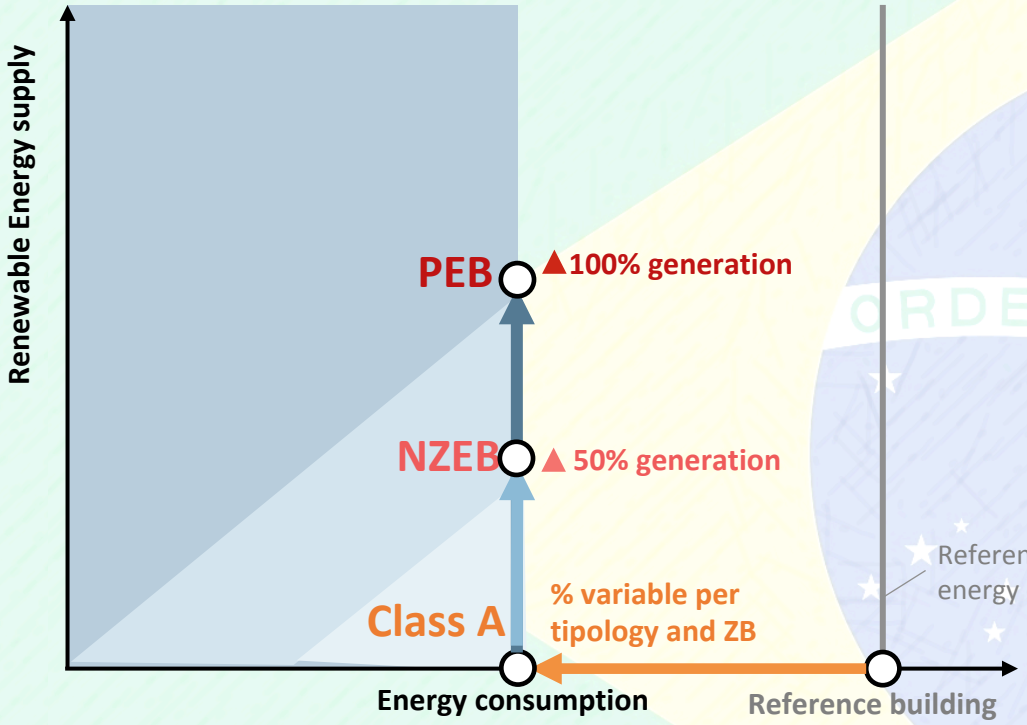
NZEB: Energy efficient building whose renewable energy generation produced within the boundaries of the building or on-site supplies 50% or more of its annual energy demand

PEB: Energy efficient building whose renewable energy generation produced within the boundaries of the building or on-site is higher than your annual energy demand

	Qualitative definition	Quantitative definition (determination criterion)
"ZEB"	A building which achieves zero or negative net annual primary energy consumption	• A building satisfying all the criteria ① and ② below: ① Reduction in reference primary energy consumption by 50% or more (excluding renewable energy) ② Reduction in reference primary energy consumption by 100% or more (including renewable energy)
Nearly ZEB	A building which achieves annual primary energy consumption close to zero while satisfying the requirements of ZEB Ready as the building almost equivalent to "ZEB"	• A building satisfying all the criteria ① and ② below: ① Reduction in reference primary energy consumption by 50% or more (excluding renewable energy) ② Reduction in reference primary energy consumption by 75% or more and less than 100% (including renewable energy)
ZEB Ready	A building which is provided with a super-insulated envelope and high-efficiency energy saving equipment as an advanced building to be ready for "ZEB"	• A building complying with the reduction in reference primary energy consumption by 50% or more excluding renewable energy

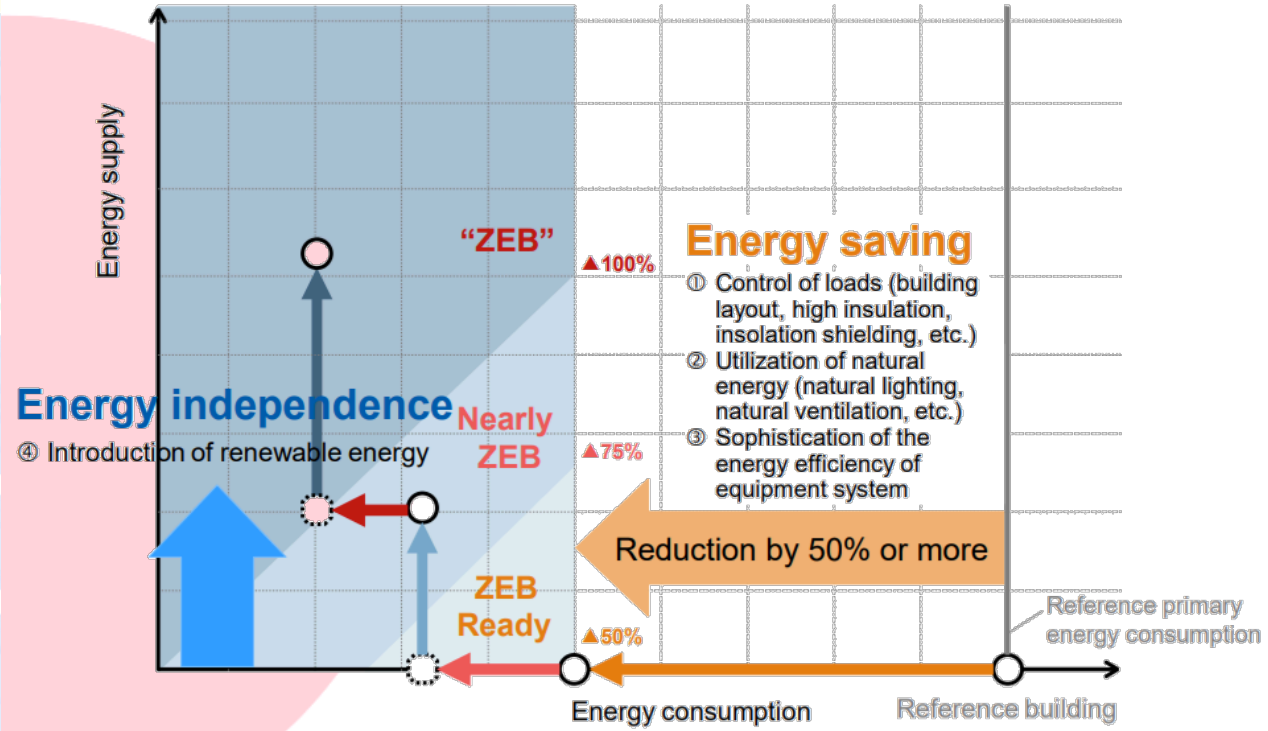


Definitions



	Residential Class A	
ZB	instant DHW	boiler DHW
ZB1 to ZB3	≥ 12%	≥ 20%
ZB4 to ZB6	≥ 20%	≥ 24%
ZB7 and ZB8	≥ 28%	≥ 30%

Energy saving
passive and active technologies



Government programs

BEE

1984 — PROGRAMA BRASILEIRO DE ETIQUETAGEM

1985 — PROCEL
PROGRAMA NACIONAL DE CONSERVAÇÃO DE ENERGIA ELÉTRICA

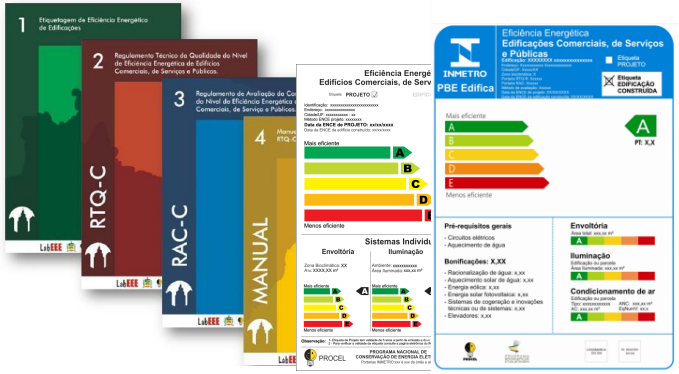
2000 — PROGRAMA DE EFICIÊNCIA ENERGÉTICA

2001 — 
LEI N° 10.295
Lei da eficiência energética

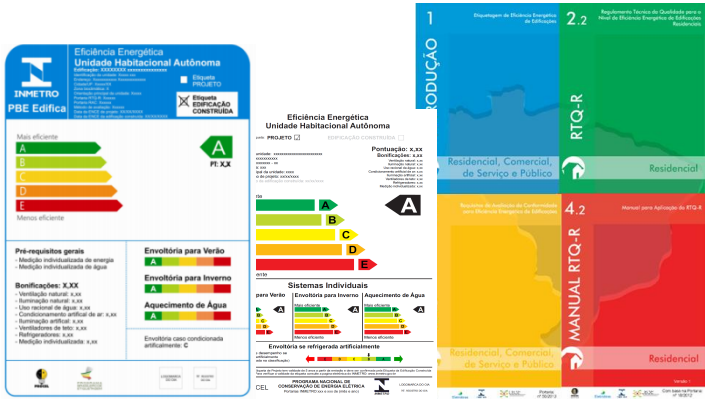
2003 — PROCEL EDIFICA
EFICIÊNCIA ENERGÉTICA EM EDIFICAÇÕES

2005 — PBE EDIFICA = PROCEL EDIFICA + PROGRAMA BRASILEIRO DE ETIQUETAGEM

Implemented actions

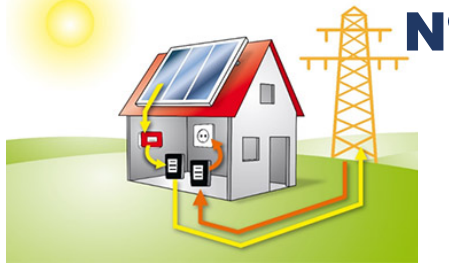


2009



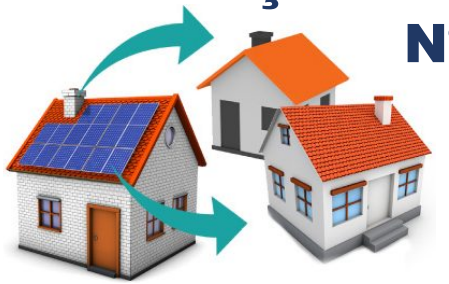
2010

RESOLUÇÃO ANEEL Nº 482



2012

RESOLUÇÃO ANEEL Nº 687



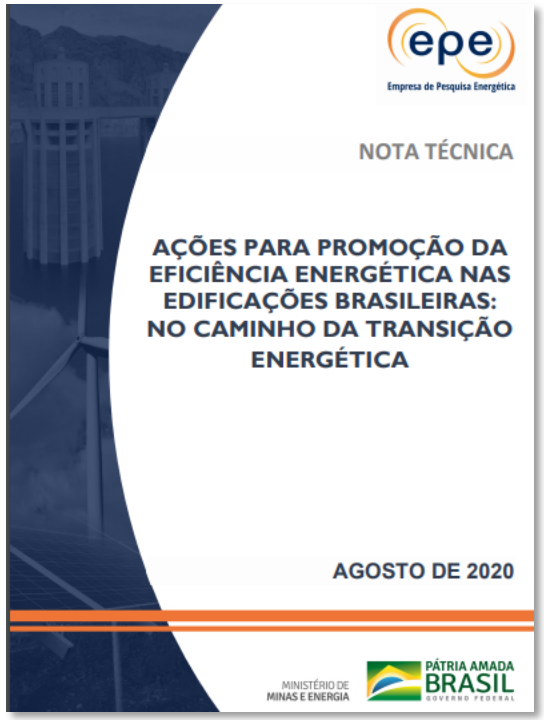
2015

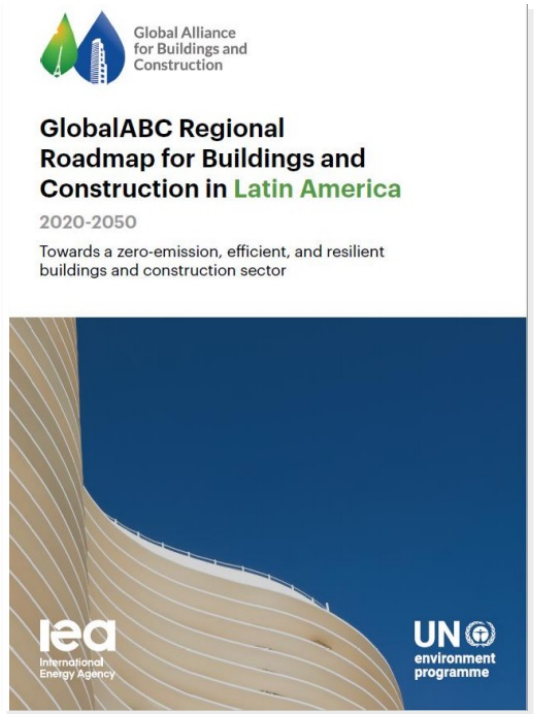
IN 02
Instrução Normativa MPOG

2014

SELO PROCEL
Edificações comerciais, de serviços e públicas

Planning actions





2020

2021

Energy Efficiency Regulation for Non-Residential buildings

2022

Energy Efficiency Regulation for Residential buildings

ISO/TS 23764:2021 translation

NZEB

GBC Brasil Zero Energy
From Aug, 2018 until Dec 2nd, 2021: 53 registered buildings of which 20 are certified

Partnership between the GBC and the Government of Paraná State aims to transform 4,000 schools in into NZEBs. The project will start with 180 schools

Energy Efficiency Program (PEE) Nº. 74/2020: 40 schools in Florianópolis will benefit from the exchange of inefficient lighting for LEDs and 16 of them will still have the installation of photovoltaic panels for energy generation.