MINISTÉRIO DE MINAS E ENERGIA

PÁTRIA AMADA BRASIL GOVERNO FEDERAL

National Policy of Conservation and Racional use of Energy

Buildings Sector

October 14th, 2021

Main updates since last presentation (feb, 2021):

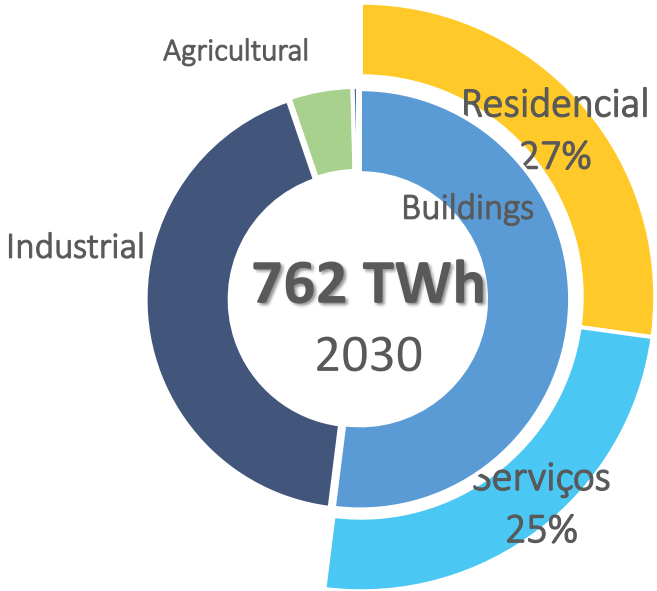
Slide 14: updates on EPC Asset and AIR procedures;

Slide 15 - 18: work 01, standards of energy efficiency for buildings in Brazil;

Slide 47 onwards: DEO project updates.

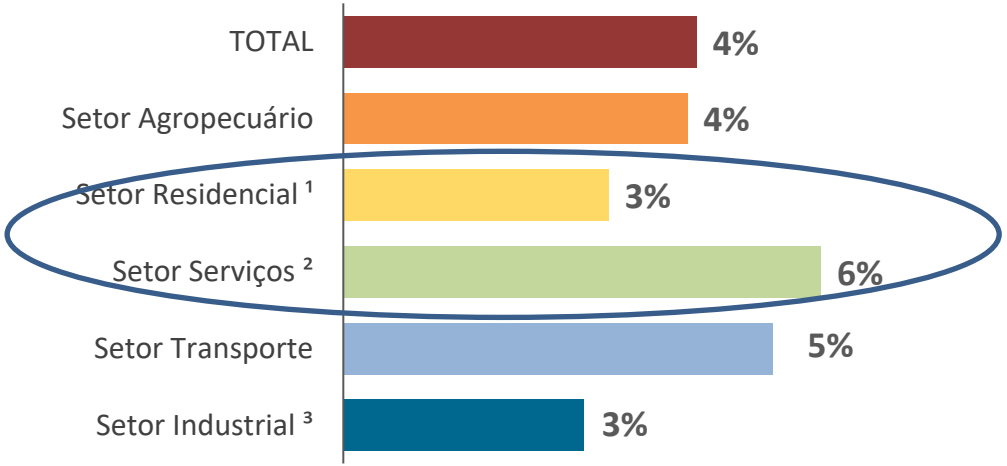
Relevance of the building sector to energy planning

PDE 2030 | Perspective of Electricy Consume



The Buildings – residencial, commercial and public – will consume 392 TWh of electricity

Sectorial contribution to electric efficiency gains in 2030



Notes: Base year 2019
(1) Energy consume urban and rural
(2) Includes commerce, services, públic, street lighting and sanitation.
(3) Includes the energy sector.

REGULATION – LEGAL INSTRUMENTS

Law nº10.295/ 2001 – Nacional policy of conservation and rational use of energy

Art. 4o ***The executive power will develop instruments to promote energy efficiency of buildings in the country****.*
Art. 5o ***Before the establishment of indicators*** *of specific energy consume, or of energy efficiency, of this Law, representative institutions of industry and importers of energy consume equipment,* ***architects and builders, consumers****, academic institutions and other stakeholders* ***must be listened in public hearings****, with proposals prior disclosure.*

Decree. nº9.864/ 2019 (Dec. nº4.059/2001) – Regulates Law 10.295; creates Buildings WG

Art. 1º The ***maximum levels of energy consume or minimim levels of energy efficiency*** *of energy consume equipments traded in the country, and* ***of buildings in the country****, will be regulated by this Decree, based on technical indicators,* ***established through the Steering Comitee of Indicators and levels of energy efficiency*** *(CGIEE- in portuguese), under coordination of MME.*

REGULATION – LEGAL INSTRUMENTS

Dec. nº9.864/ 2019 (Dec. nº4.059/2001) *cont.*

Art. 2º CGIEE is a deliberative body, which is responsible for:
I – to implemente the National policy of energy Conservation (Law nº 10.295, de 17 de outubro de 2001) in accordance with the national energy plan;
(...)
VI – deliberates about the proposals of Buildings WG;
VII – proposes to the responsible intitutions, the criation or changing of standards, projects, programs and actions which contribute to the implementation of Law nº 10.295, de 2001; and
(...)
Art. 18. The Buildings WG ***is responsible to propose to CGIEE*** *:*
I – the adoption of ***evaluation procedures*** *of buildings* ***energy efficiency****;*
II – the technical indicators that will be a reference of the energy consume of buildings to certificate their conformity with energy efficiency; and
III – the necessary technical requirements to make the buildings to achieve the indicators mentioned in II.

REGULATION – LEGAL INSTRUMENTS

Ordinance n 02 /MPOG (2014) about mandatory labelling to public federal buildings– It determines the rules to acquire or renting equipments by the federal administration, and the use of the National Label of Energy Conservation (ENCE) to new and existent buildings.

Ordinancertaria nº23 (12/02/2015) – Establishes good practices of management and use of water and electricity of Federal Administration and defines the monitoring of these consume. Reinforces the implementation of Ordinane no 2 and proposes indeicators to monitor electricity and water consume, among others.

PBE EDIFICA - BRAZILIAN LABELING PROGRAM **- TIMELINE**

1984
Brazilian Labeling Program

1985
Programa Nacional de Conservação de Energia Elétrica (PROCEL)

2001
Energy crisis: Energy Efficiency Law

2003
PROCEL Edifica Creation

2008
National Plann of Energy 2030

2009 - 2010
PBE Edifica
Buildings Energy Efficiency Labeling – Non residential and residential buildings

2011
National Plann of Energy Efficiency

2014
Selo Procel for non residential buildings

2014
Mandatory Class "A" for Federal Public Services Buildings

2020
Selo Procel Residential Buildings

2020
AIR

2021
PBE Edifica - New EPB Method Release

Energy Efficiency – Law 10,295/2001

CGIEE

- **Steering Committee on Energy Efficiency Indicators and Levels**
  - Minimum energy efficiency levels should be set according to specific regulations

Buildings Working Group

- Discuss procedures for the assessment of the energy efficiency of buildings constructed or retrofitted in Brazil

Procel Edifica
PBE Edifica
Standards ISO 52000
Housing policies
Public sector
Information systems
Building capacity

Members:

- Ministry of Mines and Energy
- Ministry of Science, Technology and Innovation
- Secretary of Management of Ministry of Economy
- National Secretary of Housing of Ministry of Regional Development (MDR)
- Research Center of Electricity (CEPEL)
- Energy Research Company (EPE)
- National Program of Energy Conservation (Procel)
- National Program of Rational Use of Oil derivatives and Natural Gas
- Brazilian Chamber of Building Industry
- Brazilian Council of Architecture and Urbanism
- Federal Council of Engineer, Architecture and Agriculture
- Representative of Brazilian Academy, specialist in energy and buildings

ENERGY EFFICIENCY CERTIFICATIONS FOR BUILDINGS

ENCE:

- Classifies the efficiency from A to E
- Provides the technical basis to the sector

Procel Seal:

- Recognizes high performance buildings ;
- Stimulates efficiency raise of the sector
- Wide recognition

EFFICIENT ESPLANADE

*Public call to select energy efficiency projects in public sector and implementation of photovoltaic systems in Esplanade buildings with the adoption of Energy Management Systems based on **ISO 50.001**.*

Execution: 1º Semester – 2021 (public call)

Budget: R$ 100 millions (US$ 20 millions)

PDEf *– Deccennial Plan of Energy Efficiency*

Structuring project coordinated by Eletrobras / Procel in partnership with strategic agents.

Detailed proposals for structural energy efficiency actions and impact on the sectors of final consumption (residential, public, commercial, sanitation, lighting, industry, etc.) in order to point out a set of alternatives to make energy efficiency gains feasible and support the medium term, which will be incorporated into the 10-Year Energy Expansion Plan 2029.

For buildings….

Execution: ***Nov/ 2019 to Feb/2021 – R$1.755.000,00 (US$ 351.000,00)***

labEEE | LABORATÓRIO DE EFICIÊNCIA ENERGÉTICA EM EDIFICAÇÕES

PROCEL · Eletrobras · MINISTÉRIO DE MINAS E ENERGIA · PÁTRIA AMADA BRASIL GOVERNO FEDERAL

Public Call
NZEB Brasil – Procel Edifica

Public call for projects NZEB **aiming to disseminate this concept** in the country, **promoting inovation** and maximizing the results into building sector.

The target is to create a **demonstration effect** of NZEB Buildings and verify the **techinical and financial viability** for the construction and operation of NZEB Buildings in Brazil.

Released in Apr/2020. 4 projects selected to receive up to US$ 200,000.00. All NZEB will **open to public visitation**.

NZEB Brasil – Procel Edifica

UnB. Fonte Procelinfo

CEPEL. Fonte Procelinfo

UFPel. Fonte LABCEEE

New evaluation method for commercial, service and public buildings based on primary energy

Published in march (Inmetro);

Requirements for Conformity Assessment (RAC) under review and forthcoming publication;

*** Residential EPC Method - public review process ongoing.**

Regulatory Impact analysis

Project of 2nd Procel´s Resources Application Plan

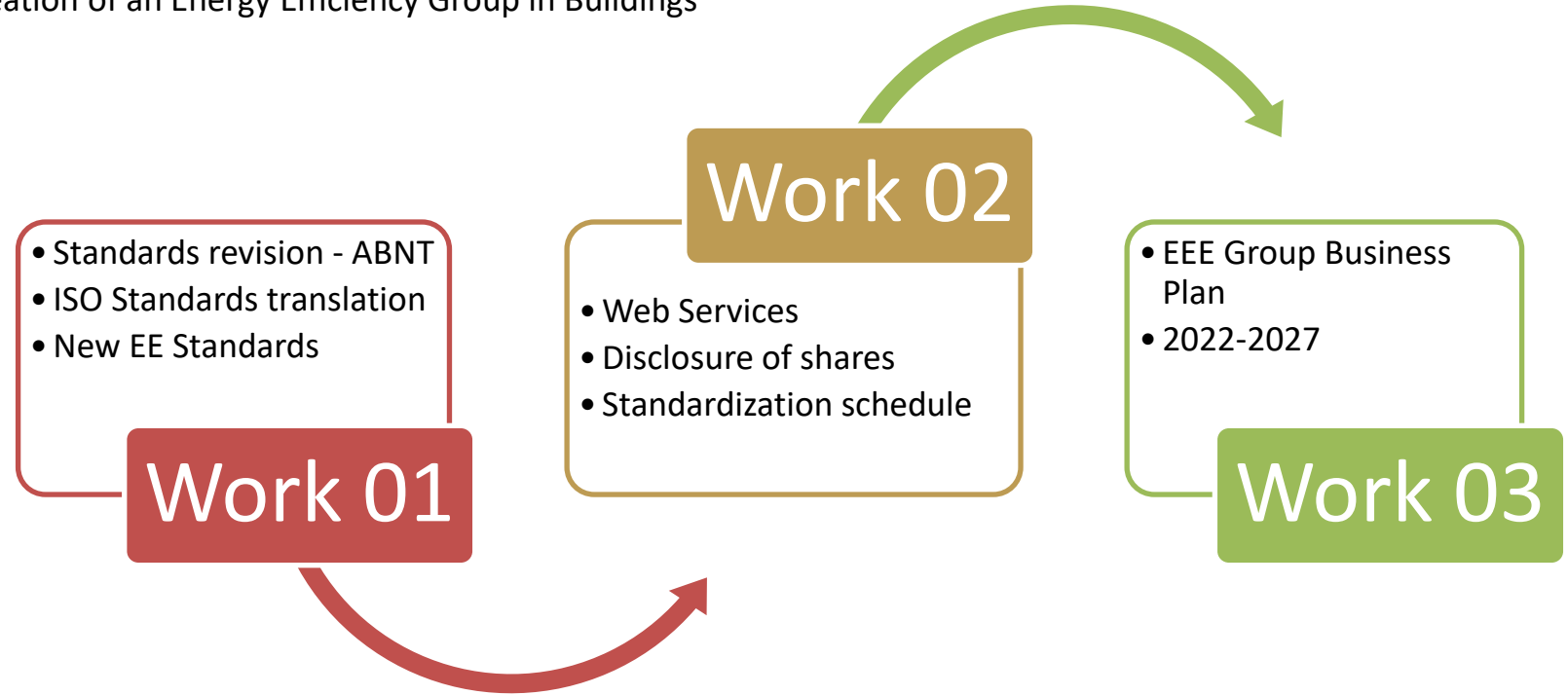
18 months: start May/2020 – to be postponed until July/2022

Federal government methodology

2 products: - Regulatory Impact Analysis
- Mandatory implementation Plan

Standards of energy efficiency for buildings in Brazil

Creation of an Energy Efficiency Group in Buildings



Work 01

Standards revision

- Daylighting Part 2: Calculation of daylight availability *(under review)*
- Daylighting Part 3: Calculation procedure for the determination of daylighting levels in internal environments *(to be revised)*
- Daylighting Part 4: Experimental evaluation of internal illuminance levels in buildings - Method of measurements *(to be revised)*

- Thermal performance in buildings Part 2: Building components and building elements — Thermal resistance and thermal transmittance — Calculation methods *(ISO 6946 modified - ballot)*
- Thermal performance in buildings Part 3: Brazilian bioclimatic zones *(under review)*

Work 01

ISO Standards translation

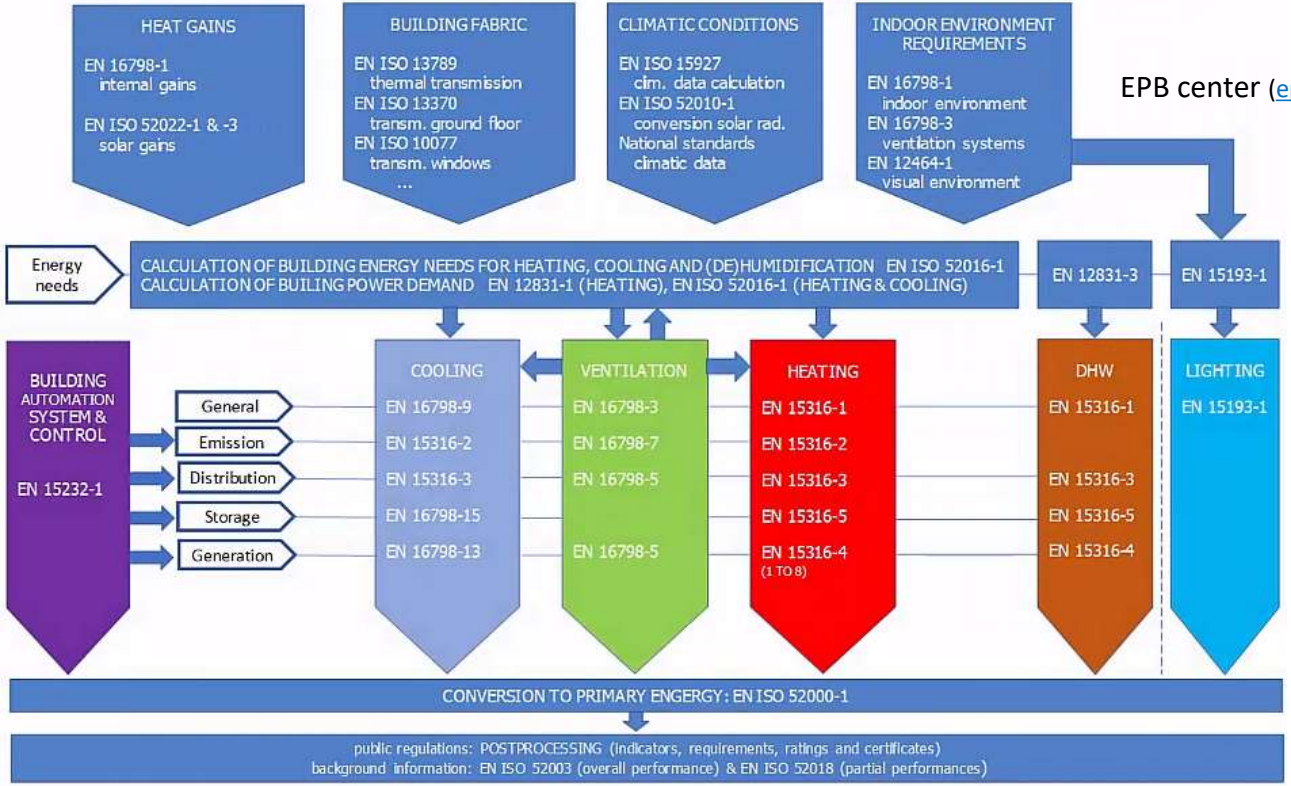
- ISO 52010-1 Energy performance of buildings — External climatic conditions — Part 1: Conversion of climatic data for energy calculations *(ballot)*
- ISO 10456 Building materials and products — Hygrothermal properties — Tabulated design values *(under review)*
- ISO 10211 Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations *(under review)*
- ISO 9050 Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors *(to be revised)*
- ISO 10077 Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 1: General *(to be revised)*
- ISO 52000-1 Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures *(to be revised)*

Work 01

ISO Standards translation

- ISO 52016-1 Energy performance of buildings — Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads — Part 1: Calculation procedures *(to be revised)*
- ISO 52017 Energy performance of buildings — Sensible and latent heat loads and internal temperatures — Part 1: Generic calculation procedures *(to be revised)*
- ISO 52031 Energy performance of buildings — Method for calculation of system energy requirements and system efficiencies — Space emission systems (heating and cooling) *(to be revised)*
- ISO 13789:2017 Thermal performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method *(to be revised)*
- ISO 25745-1:2012 Energy performance of lifts, escalators and moving walks — Part 1: Energy measurement and verification *(to be revised)*
- ISO 25745-2:2015 Energy performance of lifts, escalators and moving walks — Part 2: Energy calculation and classification for lifts (elevators) *(to be revised)*

Inspiration: EPBD



EPB center (epb.center)

PROCEL EDIFICA + PROGRAMA BRASILEIRO DE ETIQUETAGEM = PBE EDIFICA

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How to get the ENCE

1ª Step
Project evaluation

Documents inspection by Accredited Inspection Body based on PBE Edifica requirements

ENCE of the project

Published in Inmetro´s website and in pbeedifica.com.br

Valid for 5 years or up to the completion of the construction

2nd Step
Building evaluation

In loco inspection by an OIA based on the evaluated project

ENCE of the Building

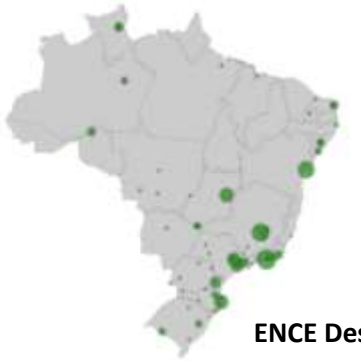
Published in Inmetro´s website and in pbeedifica.com.br

Does not expires

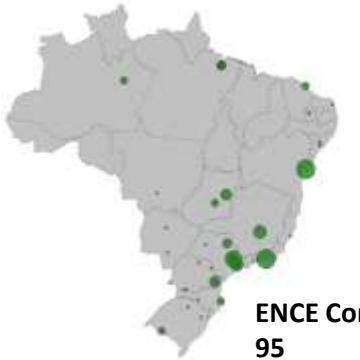
Labels - PBE edifica

Non-residential buildings

ENCE: 245



ENCE Design: 158



ENCE Constructed: 95


CDTI: AM


Sede Piracanjuba: GO


Deleg. Rec. Federal: MG


Arena das Dunas: RN


Deleg. Rec. Federal: RO


Sebrae: Cuiabá


Biotrigo: Passo Fundo


SESC Av. Paulista: SP

Hotel Venit: RJ


SESC Birigui: SP


Premium: DF


Hangar Bussiness Park: BA


Deleg. Receita Federal: MG

ENCE Residential

Residential units

Evaluates the efficiency of:

1. Envelope during summer
2. Envelope during winter
3. Solar water heating
4. Bonifications

Multifamily units

Weighted average of the separeted units labels

Common areas

Evaluates the efficiency of:

1. Frequent used areas
2. Eventually used areas

PROCEL EDIFICA + PROGRAMA BRASILEIRO DE ETIQUETAGEM = PBE EDIFICA

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Labels - PBE edifica

Residential units

ENCE: 5.059

Multifamily units

ENCE: 59

Common areas

ENCE: 20


HAbt0: RN


Euroville: RS


Smart Morom: RS


Casa Azul: MT


Lumina: SC


Casa Eficiente: SC


Sunset: SC


Paço Verde: CE


Jardim Perdizes (Reserva Manacá, Recanto Jacarandá, Bosque Araucária, Residencial Time)**: SP**

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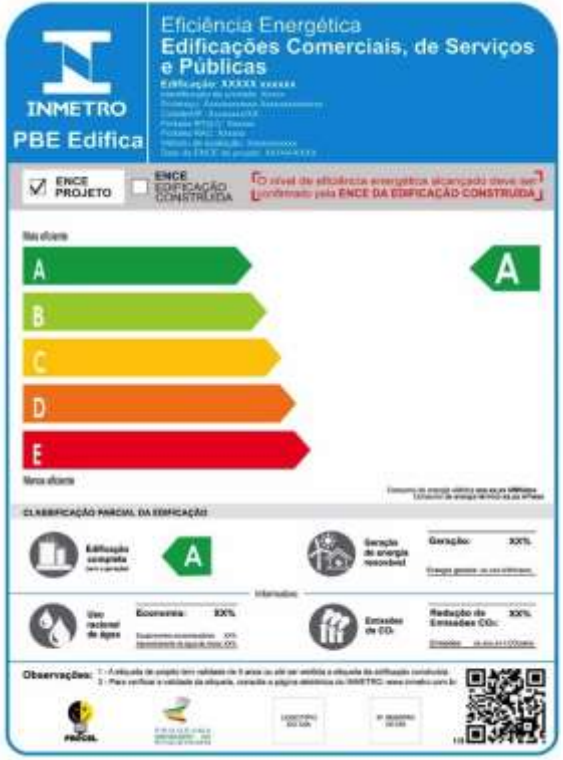
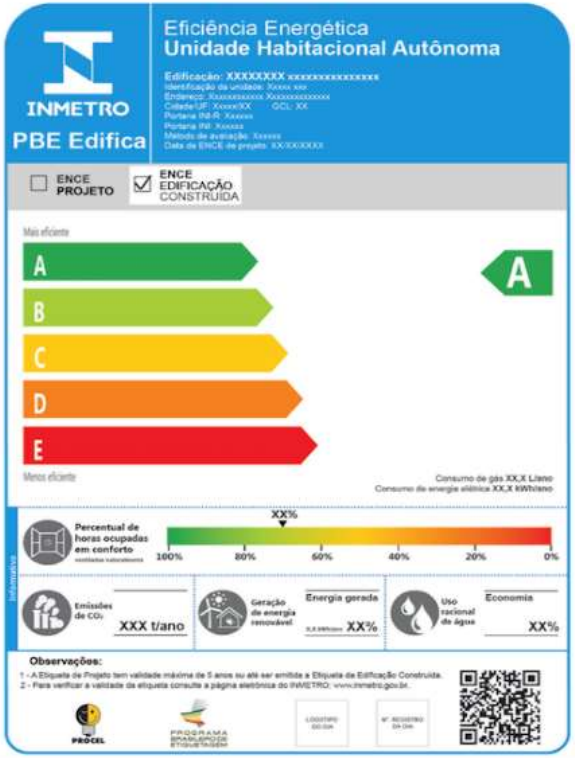


Non-residential Buildings



Residential Buildings

NEW EPC ASSET RATING LABEL

Simplified (ANN) and Simulation Methods

ENVELOPE
Non-residential and residential

AIR CONDITIONG SYSTEMS
Non-residential and residential

HOT WATER
Non-residential and residential

LIGHTING
Non-residential

RENEWABLE ENERGY GENERATION

Localized energy generation through one or more of the following renewable energy sou… solar, biomass, wind and qualified cogeneration. The system MUST BE INSTALLED IN THE ASSESSED BU… in which it is located. The systems also must be connected to the building's energy meter… they serve.

NZEB Assessment

- Energy Efficient Building (Class A)
- Own 50% - or more - of its annual energy demand supplied by local renewable energy generation

Energy Positive Buildings (EEP) Assessment

- Energy Efficient Building (Class A)
- Local renewable energy generation higher than its annual energy demand
- Result in a Class “A+” building

PROCEL EDIFICA + PROGRAMA BRASILEIRO DE ETIQUETAGEM = PBE EDIFICA

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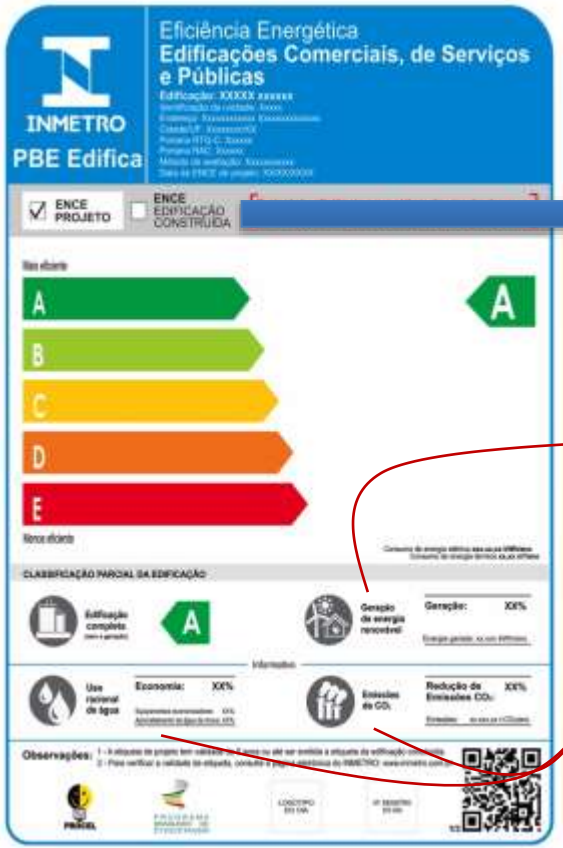
NON-RESIDENTIAL BUILDINGS

NEW EPC ASSET RATING LABEL
Non-residential Buildings

Energy efficiency classification based on primary energy (kWh/year)

Reference level based on class “D”, which varies according with the building typology.

Building EE classification disregarding the on site energy generation



- Design phase; or
- Constructed building

Energy generation on site

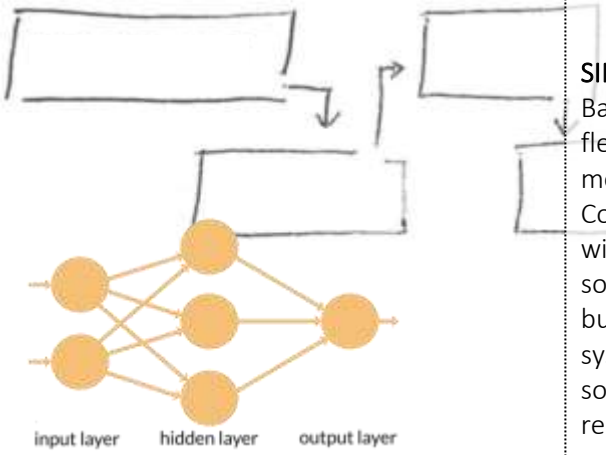
Rational water use of and carbon dioxide emissions – only informative

BUILDINGS TYPOLOGIES – Reference inputs

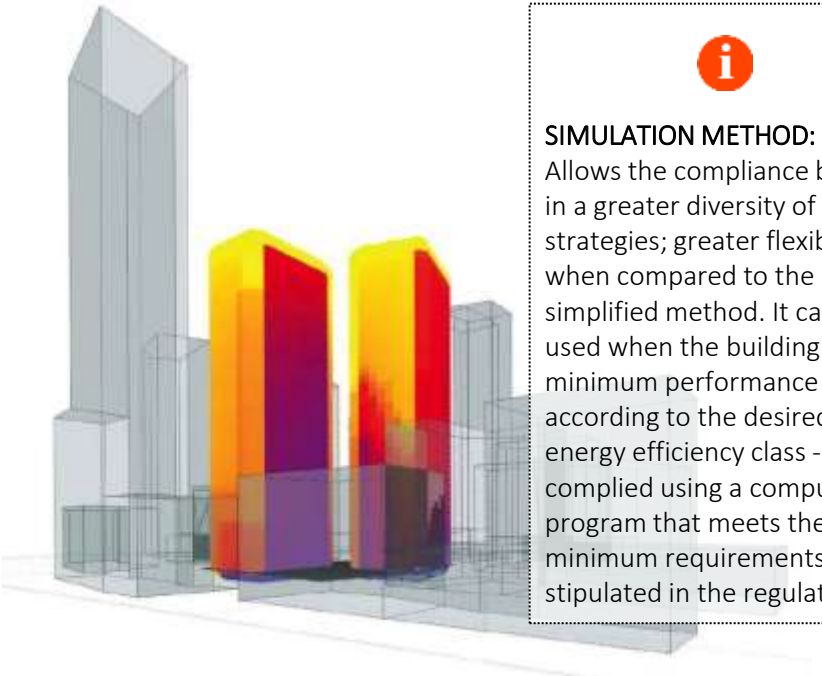
Uso típico	Edificações de escritórios	
	Condição real	Condição de referência
Geometria		
Forma	Condição real	
Orientação solar (°)	Condição real	
Pé-direito (piso a teto) (m)	Condição real	
Aberturas		
PAF - Percentual de abertura da fachada (%)	Condição real	50
PAZ - Percentual de abertura zenital (%)	Condição real	0
Componentes construtivos		
Upar - Transmitância da parede externa (W/m²K)	Condição real	2,39
αPAR - Absortância da parede (adimensional)	Condição real	0,5
CTpar - Capacidade térmica da parede (kJ/m²K)	Condição real	150
Ucob - Transmitância da cobertura (W/m²K)	Condição real	2,06
αCOB - Absortância da cobertura (adimensional)	Condição real	0,8
CTcob - Capacidade térmica da cobertura (kJ/m²K)	Condição real	233
Vidro	Condição real	Vidro simples incolor 6mm
FS – Fator solar do vidro (adimensional)	Condição real	0,82
Uvid - Transmitância do vidro (W/m²K)	Condição real	5,7
AHS - Ângulo horizontal de sombreamento (°)	Condição real	0
AVS - Ângulo vertical de sombreamento (°)	Condição real	0
AOV - Ângulo de obstrução vertical (°) *	Condição real	Condição real
Iluminação e ganhos		
DPI - Densidade de potência de iluminação (W/m²) **	Condição real	14,1***
Ocupação (m²/pessoa)	10,0	10,0
DPE - Densidade de potência de equipamentos (W/m²)	9,7	9,7
Horas de ocupação (horas)	10	
Dias de ocupação (N_{ano})****	260	
Condição do piso	Condição real	
Condição da cobertura	Condição real	
Isolamento do piso	Condição real	Sem isolamento
Condicionamento de ar (refrigeração)		
COP - Coeficiente de performance (W/W)	Condição real	2,60
Temperatura setpoint (°C)	24,0	
Aquecimento de água*****	-	

OFFICES, EDUCATIONAL, HOTELS, MEDICAL CLINICS, TRADE/RETAIL, STORES AND SUPERMARKETS, FOOD, AND OTHER BUILDINGS...

The EPC ASSET RATING LABEL FOR NON-RESIDENTIAL BUILDINGS can be performed using one of the two proposed methods: SIMPLIFIED or SIMULATION;



SIMPLIFIED METHOD:
Based on ANNs; less flexible than the simulation method, but easy to apply. Covers most of the widespread architectural solutions. However, the building evaluation systems must comply some predetermined requirements; calculation process is performed using a web interface



SIMULATION METHOD:
Allows the compliance based in a greater diversity of design strategies; greater flexibility when compared to the simplified method. It can be used when the building minimum performance - according to the desired energy efficiency class - is complied using a computer program that meets the minimum requirements stipulated in the regulation.

ENERGY CONSUMPTION BY SOURCE

Non-residential buildings

HVAC - Cooling

(Annual cooling load — **Neural Networks ISO 52016:1-2017** − Cooling from cogeneration) ÷ COP or SPLV = **Consumption** kWh (Electric)

HVAC- Heating

= Considered not significant in Brazil (but it can be assessed using the simulation method)

Hot water heating

(Hot Water Demand ✖ Energy do heat − Solar Fraction/ Rejected heat) = **Consumption** kWh (Electric) or m^3 (Thermal)

ENERGY CONSUMPTION BY SOURCE

Non-residential buildings

Plug loads

Installed power density ✖ Area ✖ Use hours = **Estimated energy consumption (kWh)**

Lighting

Installed power density ✖ Area ✖ Use hours = **Estimated energy consumption (kWh)**

DPE and DPI values are defined based in the building typology

TOTAL PRIMARY ENERGY CONSUMPTION?

Non-residential Buildings

TOTAL ENERGY CONSUMPTION
Primary energy [kWh/ano]

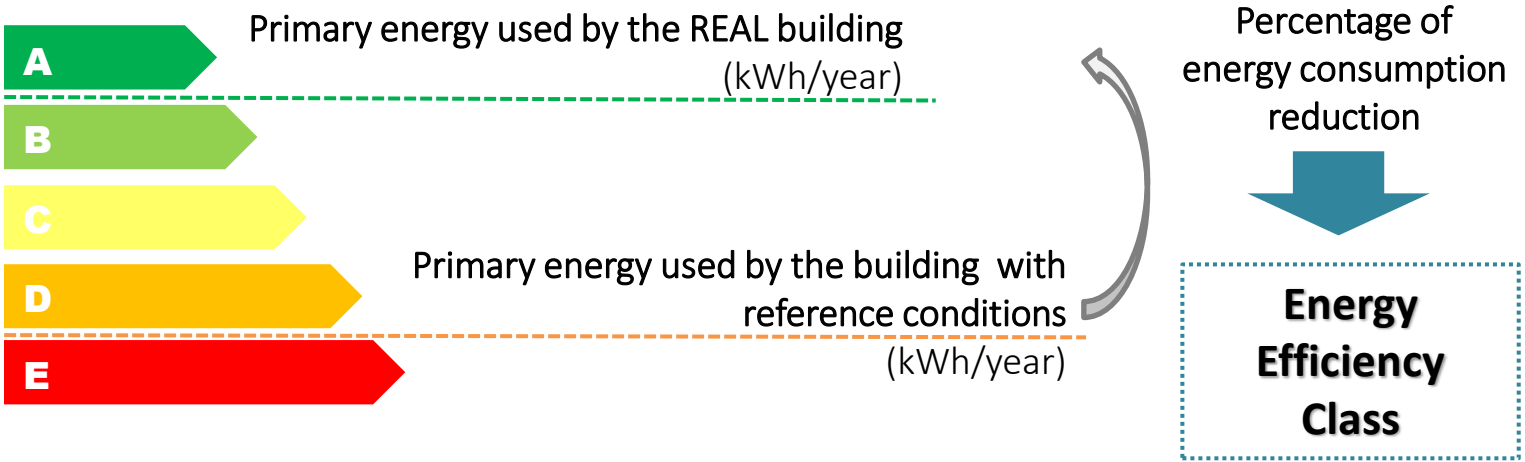
$$C_{EP} = (C_{EE} . fc_E) + (C_{ET} . fc_T) - (G_{EE} . fc_E)$$

Eletric energy consumption

Thermal energy consumption

PRIMARY ENERGY CONVERSION FACTORS

ENERGY EFFICIENCY CLASS



THE NEW EPC (non-residential buildings):

The new method was consolidated and is ready to be published (feb or march);

Ministry of Mines and Energy working group on buildings is discussing the strategy to transform the building labelling compulsory (asset rating)

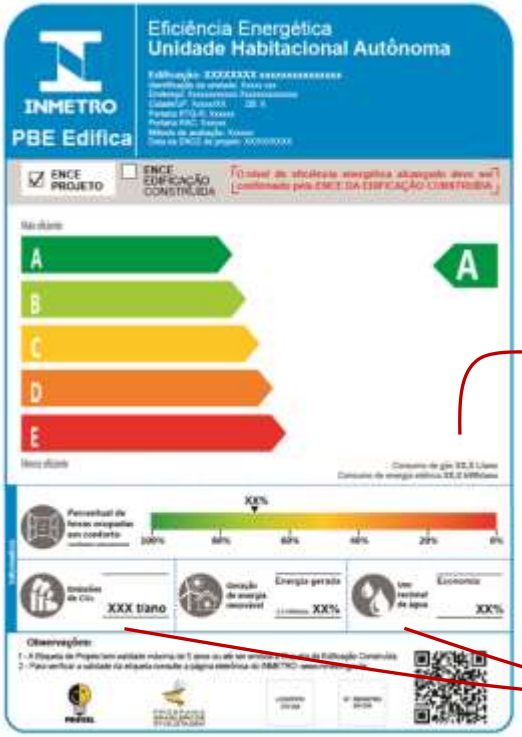
RESIDENTIAL BUILDINGS

NEW EPC ASSET RATING LABEL
Residential Buildings

Level of efficiency based on primary energy consumption (kWh/ano)

Reference level based on Class "C"; aligned with NBR 15575

Building Assessment



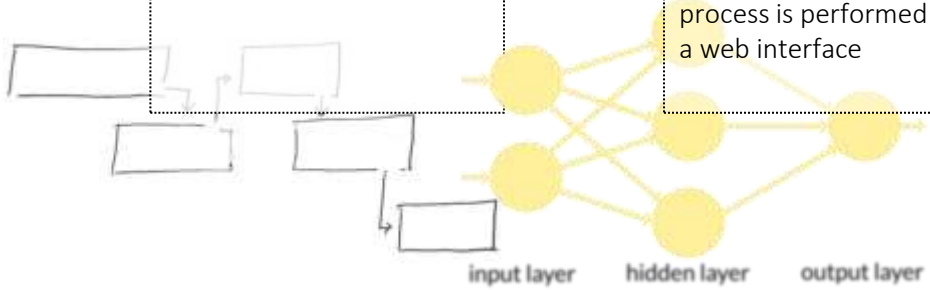
Energy Efficiency Classification considering the on site renewable energy generation.

Final consumption of thermal and eletric energy

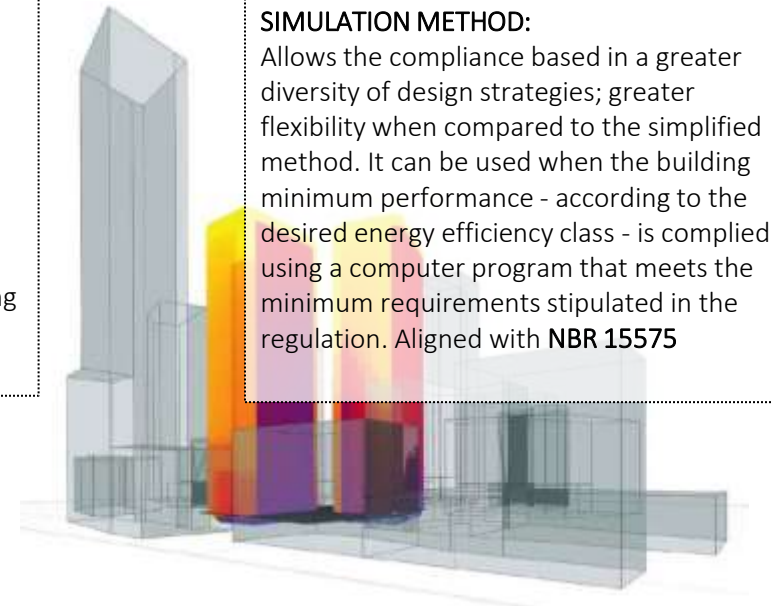
Rational water use of and carbon dioxide emissions – only informative

The EPC ASSET RATING LABEL FOR RESIDENTIAL BUILDINGS can be performed using one of the three proposed methods: PRESCRIPTIVE, SIMPLIFIED or SIMULATION;

PRESCRIPTIVE METHOD:
meet pre-determined requirements. Suitable for Social Interest Housing or other types that meet the application limits (under development);



SIMPLIFIED METHOD:
Metamodel less flexible than the simulation one; easy to apply; however, the building evaluation systems must comply some pre-determined requirements; calculation process is performed using a web interface



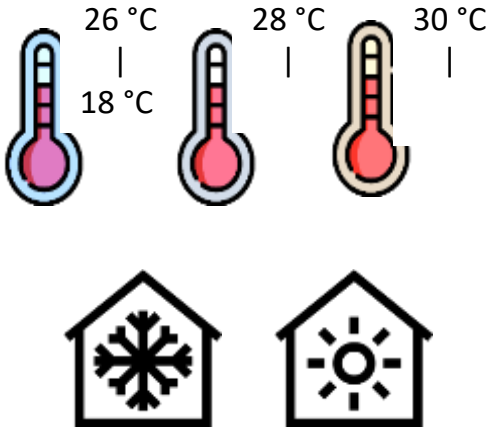
SIMULATION METHOD:
Allows the compliance based in a greater diversity of design strategies; greater flexibility when compared to the simplified method. It can be used when the building minimum performance - according to the desired energy efficiency class - is complied using a computer program that meets the minimum requirements stipulated in the regulation. Aligned with **NBR 15575**

SIMULATION METHOD

Real **Reference**

Annual thermal performance of the housing envelope compared to itself with reference “C” characteristics.

1. Percentage of hours occupied within a determined operative temperature range (PHFT)
2. Maximum annual operative termperature limits - (Tomáx) and mínima (Tomin) – for occupied hours
3. Total annual thermal load (CgTT)



SIMULATION METHOD - phases

UH

Real and reference models constructions

Simulation 1
Naturally Ventilated

Simulation 2
Without natural ventilation

Parâmetros

1. Calculation of PHFT);

2. Identification of the Tomax e Tomin during the occupied hours

3. Calculation of the total annual thermal load (CgTT) (cooling + heating*)

* Only for climates with DBT < 25 °C

X

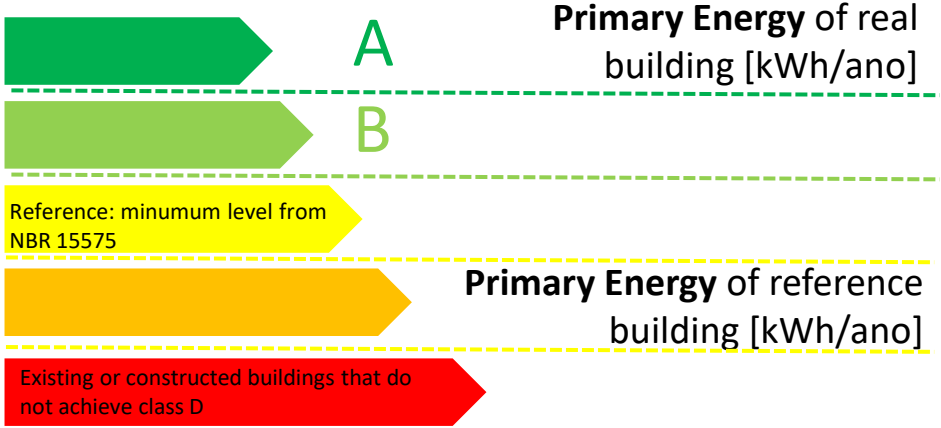
Determination of the thermal performance level (INTERMEDIATE and SUPERIOR)

THERMAL LOAD: INTERMEDIATE AND SUPERIOR THERMAL PERFORMANCE

RESIDENTIAL ENERGY EFFICIENCY CLASS

Class A	 $\Delta PHFT \geq \Delta PHFT_{mín}$ Tomáx real ≤ Tomax ref + ΔTomax Tomin real ≥ Tomin ref - ΔTomín (ZBs 1 a 4) $RedCgTT \geq RedCgTT_{mín}$
Class B	 $\Delta PHFT \geq \Delta PHFT_{mín}$ Tomáx real ≤ Tomax ref + ΔTomáx Tomin real ≥ Tomin ref - ΔTomín (ZBs 1 a 4) $RedCgTT \geq RedCgTT_{mín}$
Class C	 PHFT real > 0,9 PHFT referência Tomáx real ≤ Tomax ref + ΔTomax Tomin real ≥ Tomin ref – Δtomín (ZBs 1 a 4) RedCgTT ≥ 0%
Class D	 PHFT real > 0,9 PHFT referência Tomáx real ≤ Tomax ref + ΔTomax Tomin real ≥ Tomin ref – Δtomín (ZBs 1 a 4) $RedCgTT \geq RedCgTT_{mín}$

ENERGY EFFICIENCY CLASS



% reduction of the primary energy consumption

*The reference condition is based on the minimum level stipulated by Brazilian Standard **NBR 15575***

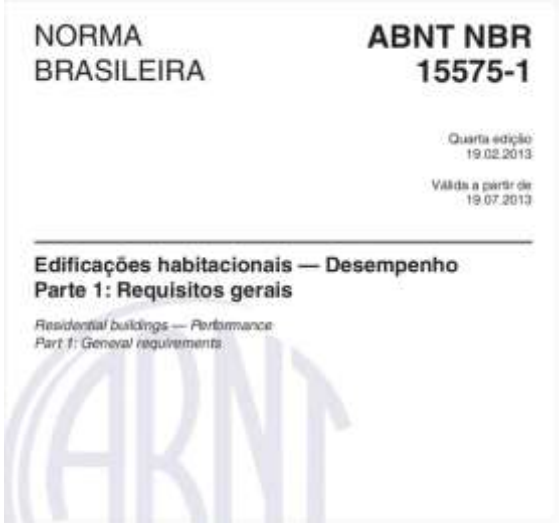
THE NEW EPC (residential buildings):

The new method is under revision and will be published in 2021;

Ministry of Mines and Energy working group on buildings is discussing a strategy to transform the building labelling compulsory (asset rating)

Review of the Brazilian residential building performance standard (NBR 15575) - thermal performance scope

Latest version: 2013.
Newest version: 2020


NORMA BRASILEIRA

ABNT NBR 15575-1

Quarta edição
19.02.2013

Válida a partir de
19.07.2013

Edificações habitacionais — Desempenho
Parte 1: Requisitos gerais

Residential buildings — Performance
Part 1: General requirements

As most Brazilian residential buildings depend on ventilative cooling, natural ventilation was introduced to the national standard.

Single-family and multi-family building were considered, and simulations were conducted for different climates across the 8 bio-climatic zones that divide the country.

The user behavior has significant impacts on building thermal performance. Thus, the user interaction with the building systems is considered.

Also, different types of construction components, shading devices and window glass were analyzed.

Review of the Brazilian residential building performance standard (NBR 15575) - thermal performance scope

Latest version: 2013.
Newest version: 2020

Improvements:

Whole year simulation (reviewed) x
Typical summer/winter day (current)

With internal loads (reviewed) x
Internal loads disregarded (current)

Operable windows and variations on air changes according to wind speed and direction (reviewed) x
Constant infiltration rate (current)

Thermal performance indicators:

Building **Reference building**

- Percentage of occupied hours with natural ventilation within a temperature range;
- Min/max operative temperature in the indoor environment;
- Cooling and heating loads.

MINISTÉRIO DE MINAS E ENERGIA

PÁTRIA AMADA BRASIL GOVERNO FEDERAL

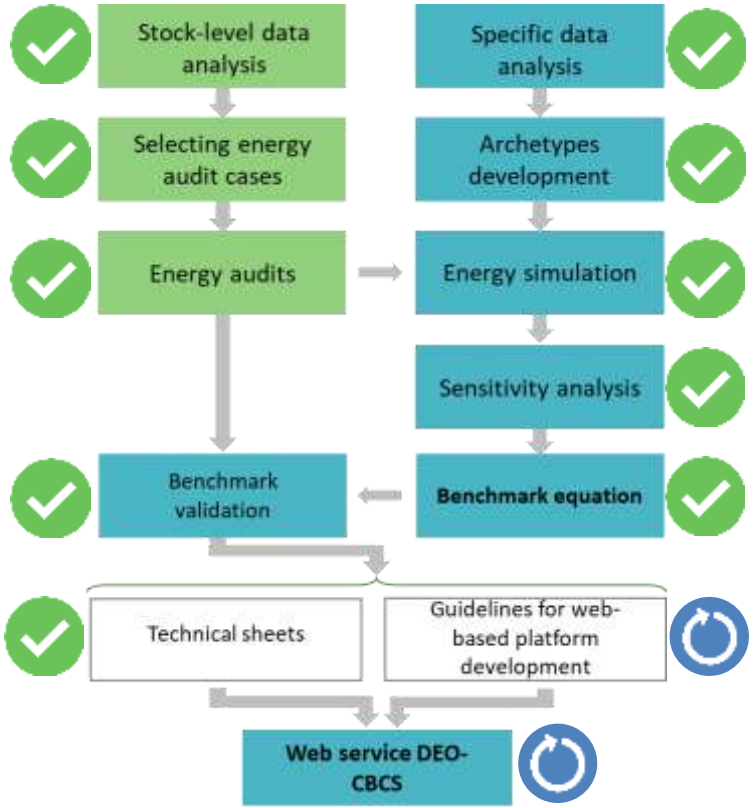
DEO – Operational Energy Performance

Consumption benchmarks in public and private buildings (non-residential)

DEO DESEMPENHO ENERGÉTICO OPERACIONAL EM EDIFICAÇÕES

METHODOLOGY

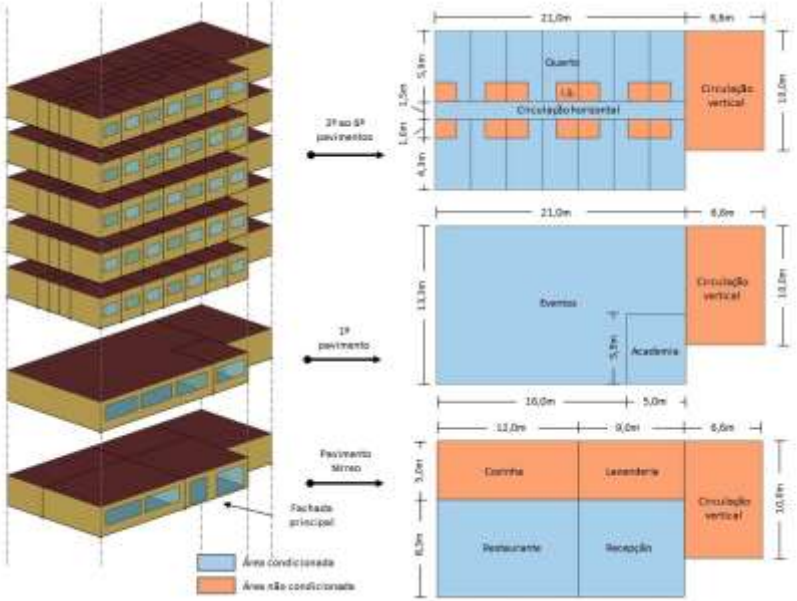
Project concluded, some final refinements ongoing on specific activities.

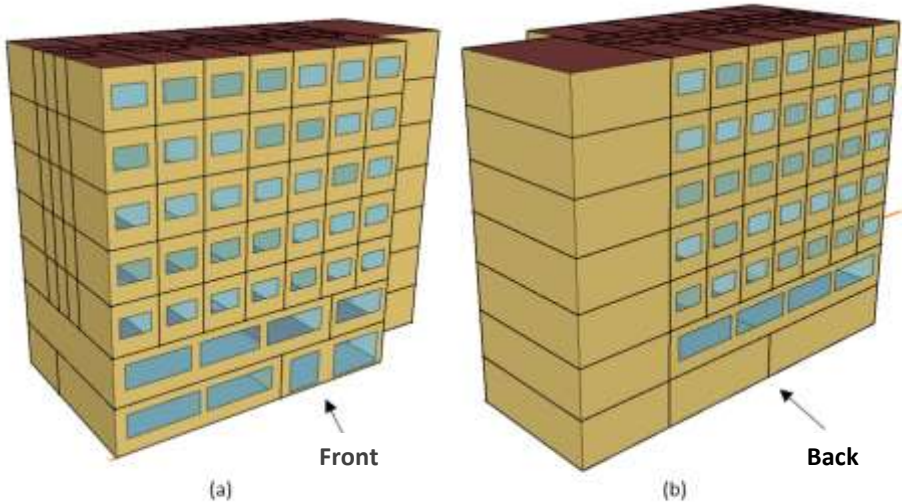


Concluded activity

Ongoing activity

ARCHETYPES COMPOSITION – LARGE AND MID-SIZE HOTEL

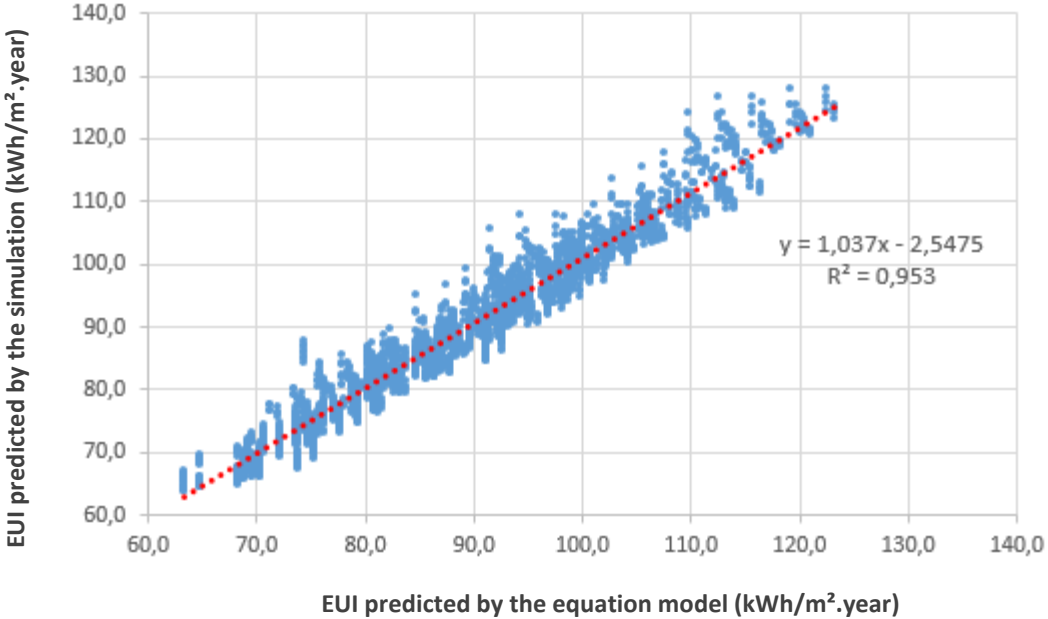




Perspective views of the archetype model

(this example is for Large and Mid-size Hotel)

MULTIPLE LINEAR REGRESSION MODEL



Cross-validation of the EUI predicted by the simulation and by the benchmark equation

(this example is for Large and Mid-size Hotel)

BENCHMARK EQUATIONS – LARGE AND MID-SIZE HOTEL

Cities with CDH lower than 54.000

FINAL CONSUMPTION [kWh/m²/year] = (((24.42 + 7.268 logCDH - 3.626 logHDD + 7.661 HVAC + 1.9096 ILUM + 2.851 SOMB)* N_OF_ROOMS * AVERAGE_ROOM_SIZE* OCCUPATION) + ((-0.42 + 3.843*logCDH - 1.691*logHDD + 3.3214*AVAC + 6.2306*LUM) * OTHER SPACES)) / (ROOM'S FLOORSPACE + OTHER SPACES)

Where:

CDH – Cooling Degree Hours;

HDD – Heating Degree Days;

HVAC – Type of HVAC systems (1- Fans, 2 - Central VRF, 3 - Split Unitary);

ILUM – Lighting density power (W/m²);

SOMB – Shading (0 – with shading, 1 – without shading);

N_OF_ROOMS – Number of rooms;

AVERAGE_ROOM_SIZE – Average room size (m²);

OCCUPATION – Occupation rate (%);

ROOM'S FLOORSPACE – Total floorspace of rooms (m²);

OTHER SPACES – Floorspace of other spaces (m²).

Cities with CDH higher than 54.000

FINAL CONSUMPTION [kWh/m²/year] = (((-396.8 + 93.95 logCDH + 10.292 HVAC + 2.1325 ILUM + 4.433 SOMB + 3.892 ASOL + 8.983 RENO)* N_OF_ROOMS * AVERAGE_ROOM_SIZE * OCCUPATION) + ((-138.09 + 31.86*logCDH + 3.0480*HVAC + 6.3322*ILUM + 4.728*RENO + 5.601*CIRC) * OTHER SPACES)) / (ROOM'S FLOORSPACE + OTHER SPACES)

Where:

CDH – Cooling Degree Hours;

HDD – Heating Degree Days;

HVAC – Type of HVAC systems (1- Fans, 2 - Central VRF, 3 - Split Unitary);

ILUM – Lighting density power (W/m²);

ASOL – Solar Absorptance of the envelope (0,7 – dark colour, 0,3 – light colour);

RENO – Air renovation (0 – no renovation, 1 – renovation according to NBR 16401-3);

CIRC – Aisles with air conditioning (0 – No, 1 – Yes);

N_OF_ROOMS – Number of rooms;

AVERAGE_ROOM_SIZE – Average room size (m²);

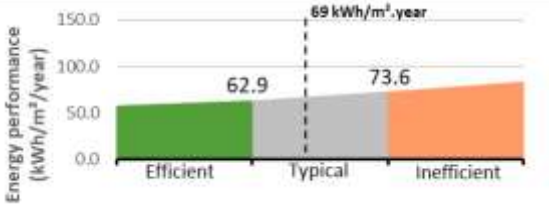
OCCUPATION – Occupation rate (%);

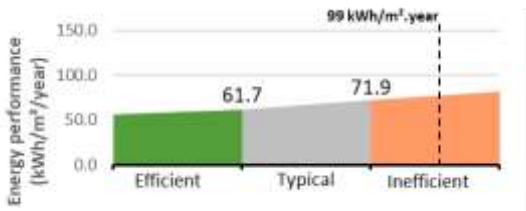
ROOM'S FLOORSPACE – Total floorspace of rooms (m²);

OTHER SPACES – Floorspace of other spaces (m²).

ACTUAL APPLICATION

(those are examples of Large and Mid-size Hotels)





THE BENCHMARKING EQUATION ON THE DEO WEB SERVICE

GHR – **Choose city**;

AVAC – HVAC System

ILUM – Lighting density (W/m²);

SOMB – Shadding by neighbors (0 – with shadding, 1 – without shadding)

ENVO – Envelope – external sealing elements and roofing

Room number

Equations by typologies: Small Hotels and inns, CITIES WITH GHR > 54 THOUSAND

TOTAL BUILDING CONSUMPTION [kWh/m²/ano] = (-12.304 + 2.7787 logGHR + 0.55515 AVAC + 0.10775 ILUM + 0.14230 SOMB + 0.06860 ENVO)*n° rooms

THE BENCHMARKING EQUATION ON THE DEO WEB SERVICE

Construção Sustentável

SAME CONSUMPTION [kWh/M².year], BUT DIFFERENT LEVELS OF EFFICIENCY!

WEB SERVICE - DEO, 2021

www.cbcs.org.br

- COORPORATE BUILDINGS
- PUBLIC SERVICES BUILDINGS
- Bank branch;
- Resort-like hotel;
- Large and mid-size hotel;
- Small hotel and inn;
- Shopping center;
- Supermarket;
- Retail and large trade;
- Small business;
- Restaurant and food preparation;
- Infant school;
- Elementary and high school;
- University and technical education institution;
- Hospital;
- Health buildings and social assistance;
- Data center and CPD.

Q&A?

THANK YOU!

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