


## CHAPTER 62

### Efficiency of energy actions under the PBE-edic and its impacts on Brazil us last 11 years 1

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#### **ABSTRACT**

This paper describes the national impact of National investments on the PBE-Edifica program context, in the last 11 years. A survey was carried out with the

R3E integrant, INMETRO, ELETROBRAS, and FISP, organized in main actions of building energy efficiency, public investments in building energy efficiency, energy labelling offices, and buildings labelled. As a result, 1126 professionals were trained and buildings all around the country were labelled, made possible by the labelling offices and laboratories sponsored by ELETROBRAS. In conclusion, such a legacy was only possible due to the State investments, by ELETROBRAS, considering that it is a new market and affected by the economy.

**Keywords:** Building Energy Efficiency, PBE-Edifica Label, Labeling office.

## 1 INTRODUÇÃO

It is estimated that worldwide the construction sector consumes between 40% and 75% of resources (MENDES, 2013) and produces about 39% of global carbon dioxide emissions (CO<sub>2</sub>) (UNEP, 2017). Part of those emissions is associated with energy consumption in buildings and the headquarters worldwide at which 86% are non-renewable energies (EPE, nd). In Brazil, residential and commercial buildings were responsible for 48% of electricity consumption in 2018 (EPE, 2019). Although only 19.7% of the country's electricity matrix is associated with non-renewable energies (EPE, sd), the increase of consumption in energy implies the use of non-renewable sources. In addition to being identified as a source of CO<sub>2</sub> emissions, the construction sector is identified as the sector with the greatest potential for reducing these emissions (IPPC, 2007, apud, GONÇALVES; BODE, 2015). In terms of legislation, the Brazilian Constitution, Art. 225 ratifies that "All has the right to a balanced and ecologically sound environment imposing on the public power and the community the duty to defend and preserve it for the present and future generations" (BRASIL, 1988), that is, the State has an important role in providing and guaranteeing means that enable the execution of this right. One of the measures of protection to the environment is, therefore, to invest in energy efficiency.

In 2001, Brazil went through an energy supply crisis. The answer, in October 2001, was the enactment of Law No. 10,295, which provides for "National Policy on Conservation and Rational Use of Energy" (BRASIL, 2001). From that initiative, it was possible to invest in energy efficiency and create the Brazilian Program on Labeling (PBE). As a result, the PBE-Edifica Label is instituted for commercial, service and public buildings (BRASIL, 2009) and for residential buildings (BRASIL, 2012). Since its publication, most of the studies focus on a qualitative method, as in the example of Maciel; Carlo (2011), Rodrigues; Days; Pedrini (2011) and Pacheco et al. (2012) and the evaluation system, like Pedrini et al. (2012) and Amorim et al. (2015). Also discussed was the need for articulation of that instrument with municipal directors and the insufficiency of the label's incorporation by the market (RODRIGUES et al., 2019), considering that the competitive logic inherent to capital leads to the production of unnecessary goods, resulting in overproduction and waste, even in context in the green marketplace (BENSAIDE, 2017).

Thus, this article discusses the importance of the State in the actions of energy efficiency at the scope of the PBE-Buildings last 11 years old and their impacts on the national territory. This article is the result of data collected carried out within the scope of the scientific initiation scholarship of the search "Process collaborative Multidisciplinary – buildings autonomously energetically to low latitude", which supported the development of doctoral research "The relationship between designers and consultants in the design in buildings, aiming at low impact

environmental and O attendance in goals in efficiency energetic at the context Brazilian", both developed at University Federal of River Great of North.

## 2 METHOD

The research is based on gathering information related to efficiency energy in buildings (3E), available from 2009 to June 2020, organized in five topics:

3E's main actions, based on the Efficiency Laboratories websites energy in buildings (LabEEE/UFSC) and O center Brazilian in Efficiency Energy in Buildings (CB3E/UFSC), and from the Comfort Laboratory Environmental (LabCon/UFRN);

investments public in efficiency energetic, second reports funds made available by the National Program for the Conservation of Energy electrical (PROCEL) us last 9 years old;

Accredited Inspection Bodies (OIAs) by the National Institute of Metrology, Quality and Technology (INMETRO), second Dice gives C o r d e n a t i o n \_ G e r a l of \_ Accreditation \_ \_ \_ \_ \_ \_ \_ \_ give \_ I n s t a n d y o u \_ \_ N a c i o n a l of \_ M e t r o l o g i a, Quality and Technology (INMETRO);

trained professionals within the scope of the Energy Efficiency Network of Buildings (R3E) during its term, 2010 to 2016, provided by Centrais Elétricas Brasileiras (Eletrobras) and by coordinators of the laboratories members gives R3E;

National Energy Conservation Label (ENCES), according to tables of issue in hang tags of INMETRO.

The energy efficiency actions were crossed with the economic data of the construction in order to contextualize the issuance of PBE-Edifica labels in the scenario national economy and by state. These data consisted in quantitative about the employability gives construction at the Brazil published fur Department gives Industry gives Construction and Mining (DECONCIC) gives Federation of industries of State of São Paulo ( FIESP, 2019 ), between the years 2007 and 2018, and in the Domestic Product Gross in civil construction, from 1991 to 2014 made available by the Union of Industry gives Construction Civil in Are Paul (SINDUSCON, sd). No he was possible rise professional performance in the area of energy efficiency in the country because it is not made available us Advice in Architecture and urbanism and O Advice Regional in Engineering and Agronomy.

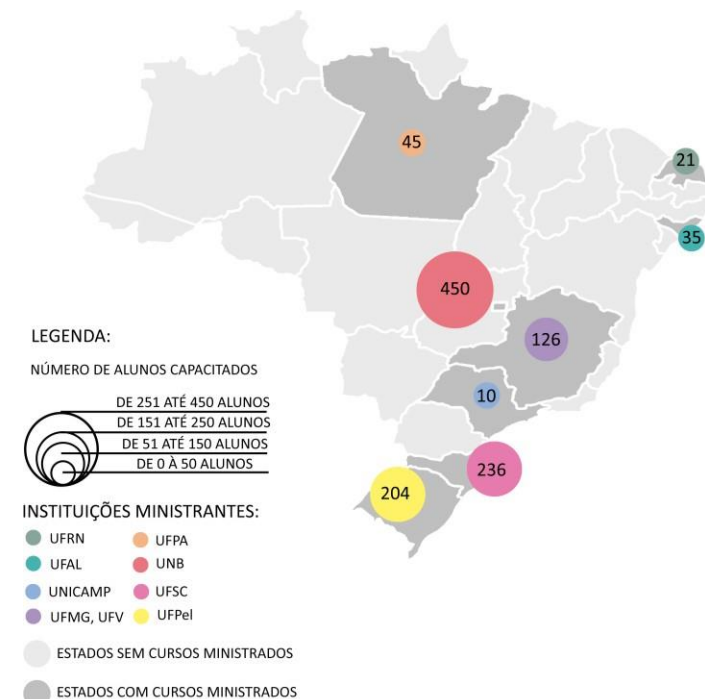
## 3 RESULTS

The actions aimed at 3E promoted by the Brazilian government, as a way of stimulate the production of energy efficient buildings, have consolidated mainly in the area of applied research, technological development and advice technique.

Among at actions in search stand out The creation gives R3E, of CB3E and of Project Energy Efficiency in Buildings (Project 3E). R3e operated from 2010 to 2016 and enabled financial contributions from Eletrobras to 12 laboratories distributed in five regions of the country. The Network was responsible for researching, articulating researchers, disseminate the PBE-Edifica Label, train professionals and form new bodies to issue in hang tags accredited (OIAs) fur INMETRO THE creation in OIAs also was articulated with an agreement between LabEEE and Fundação CERTI, first accredited body. Three OIAs were created by R3e, with the potential to formation in a bedroom. At the moment, three OIAs they are in operation ( IN M E T R O , s.d ) : \_ O L I N S E / U F P E L c o n t i n u e a t i v o , u m \_ The I A h e w a s s u s p e n s o , \_ and O The I E D I F I C A / U F R N of u l u g a r The a w h a t t o d o \_ \_ H i , \_ c r i a d o i n 2 0 1 9 , O H A B T - E D I F I C I O \_ E F I C I E N T E A R C H U I T E T O S L T D . Only one OIA was created by private initiative, without government incentives. You too much emerged in universities federal (UF). Among at main difficulties faced by OIAs were financial unsustainability in the face of high costs in operation, The low demand per hang tags and, for you linked at UFs, The lack in resources institutional.

During O period in 6 years old, you members gives R3E made possible most in 41 courses 2 in PBE-Edifica labeling training, for more than 1126 students ( Figure 1 ), among undergraduates and graduates at the Brazil, in addition of scope of your cities, in form what their formations may have been reflected in other cities, as was the example of University of Brasília (UnB) and the Federal University of Santa Catarina (UFSC), what ministered courses The distance.

Figure 1 - Students empowered per institution



Source: R3E and Eletrobras. note: elaborate by the authors (2020)

The creation of CB3E started in 2011, with one of the objectives of “Supporting technical and scientific to the PBE - Edifica, making its continuous improvement” (CB3E, nd)

and is the responsible for the new proposal for a regulation, which is in the process of being improvement after public consultation. The development of Project 3E grew out of initiative of Ministry in Mines and Energy and he was initiated in 2010 and finished in 2017, with O objective in to influence and to develop O Marketplace in efficiency energetic in buildings public and commercials (MMA, 2020).

At area in development technological, meet at tools in simulation hygrothermal and energetic DOMUS (DOMUS, 2015), elaborate for the PUC- PR, and O Simulator in Efficiency energy in buildings (S3E) (LABEEE, 2020), created fur LabEEE, you which aim assistant at the process in labeling.

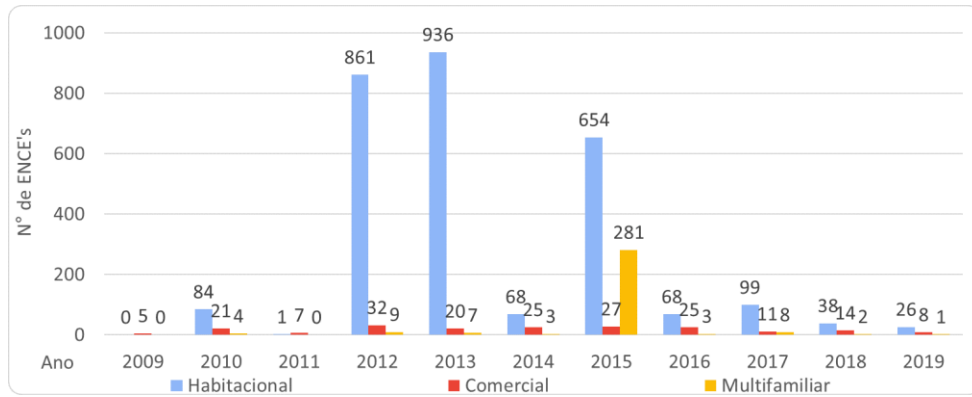
At area in advice technique, aiming your consolidation, were published recently two edicts: as O Program National in Conservation in Energy Electric (PROCEL) – Builds in 2018, which stimulated the promotion of projects commercial and residential buildings to receive the Procel Edificação Seal (ELETROBRAS, 2018) and the Nearly Zero Energy Buildings (NZEB) in 2019/2020, which aimed to contribute for construction in buildings with swing null in energy (ELETROBRAS, 2019).

THE Publication gives Instruction Normative IN 02/2014 (BRAZIL, 2014) became mandatory The labeling of public buildings financed with federal funds, from 500m<sup>2</sup>. It is possible that this action has influenced the reduction of label emissions commercial, service and public sectors at a slower pace than observed in the buildings residential ( Figure 2 ). THE reduction at issue in hang tags us years old following accompanies the retraction of approximately 21.6% in the number of occupations in the chain productive gives industry gives construction civil, The leave in 2014 (FIESP, 2019), well as the economic recession that was taking place in the country, with a drop of 3.5% of Gross Domestic Product (GDP) in 2015 (GAZETA, 2019). It is worth mentioning that until 2014, the GDP gives construction civil was in growth in Are Paul (CONSTRUCTED, sd).

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two You values are approximate why no he was possible Access The totality of information about you courses and you students in all at institutions participants gives R3E.

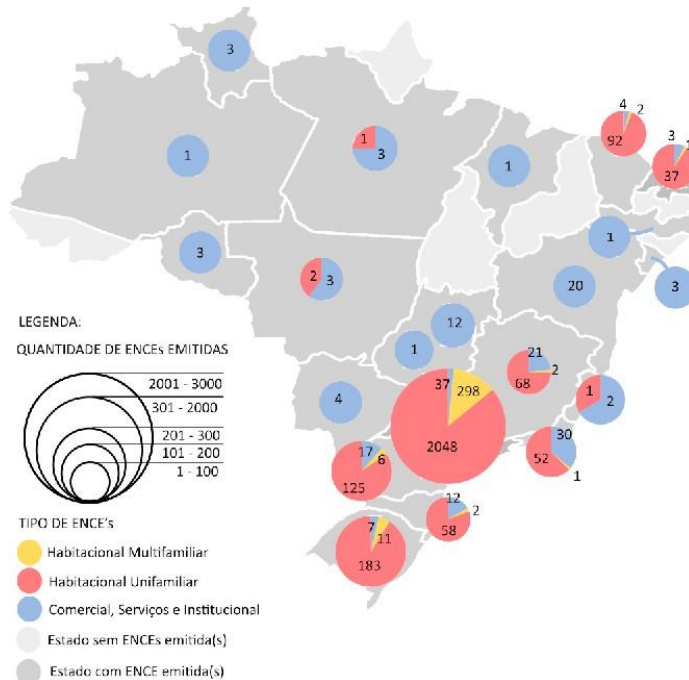
Figure 2 - Number of ENCE's issued per year



Source: tables of INMETRO ( 2020 ). note: Elaborate by the authors (2020)

Labeling is widespread in all regions of Brazil, with greater expressiveness at region Southeast, most notably at the state in Are Paul, what represents about 75% of the total ENCEs issued ( Figure 3 ). This value is consistent with the predominance of civil construction activity in the Southeast region, which presents 44% of the works in the country, with the state of São Paulo being responsible for more half of the occupations in the civil construction production chain in this region. THE South region presents approximately 13.2% of the issued labels ( Figure 3 ), followed by the Northeast with 5.2% of the tags; Midwest with 0.7% and North with only 0.3%.

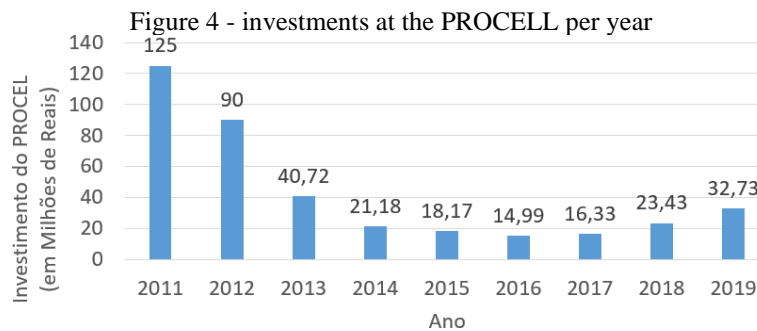
Figure 3 - Number of ENCE's issued by condition



Source : \_ \_ \_ IN METER \_ ( 2019 ) . \_ \_ No t to : \_ \_ and la bo r a d o hair \_ au tor e s \_ \_ ( 2 0 20 )

At actions in 3E were defrayed with resources gives electrobras, via PROCEL-Builds, and of Ministry in Mines and Energy, or be, with money public. You contributions financial in PROCEL reduced from 2011 to 2016 ( Figure 4 ) and started a small recovery \_ \_ \_ \_ \_ it is O the no \_ of \_ 2019 , fact j u s t i f i c a d o p and there \_ the p r o v a t i o n \_ \_ and I saw you \_ \_ \_ give \_ read no . 13,280/2016 The which force what 20% From resources capitates by

companies in energy be invested at the PROCELL (PROCELL, 2020). At the however, O value invested for PROCEL-Builds still It is little expressive, 2.1%, of PROCELL in 2019 (ELECTROBRAS, 2020 ).



Source: electrobras ( 2020 ). note: elaborate by the authors (2020)

It is possible to notice that the 3E actions promoted by the State (Figures 1 to 3) enabled the implementation, dissemination and visibility of the PBE-Edifica Label, with the issue in ENCE's in all O territory national and The empowerment in professionals in all regions. However, from 2014 onwards, there was a significant reduction in resources invested ( Figure 4 ) and a decrease in ENCES issued ( Figure 2 ), demonstrating The inability of Marketplace in foment, per yes only, at actions in 3E. In part, this difficulty lies in the economic crisis, as presented in the Dice gives FIESP ( 2019 ), but It is required consider what O Marketplace if destined to profit and no The improvement gives quality gives construction and of quite environment, values incompatible in between yes ( BENSANDE, 2017 ). That aspect reinforces The importance in if provide in the constitution the obligation of the State to preserve the environment, what runs through also, fur investment in actions in 3E.

#### 4 CONCLUSION

The energy efficiency actions within the scope of PBE-Edifica, in the last 11 years, had larger visibility us periods in larger heating gives economy, in between 2011 and 2015, consistent with the production of civil construction. Without the investments of State, per quite gives ELECTROBRAS, no it would have been possible The creation of OIAs in the UFs and the issuance of ENCES, the more its greatest legacy, which is the amount of trained professionals, essential for the dissemination of energy efficiency in the country, essential at the time of resumption of production of buildings efficient, us molds gives Tag PBE-Builds.



## REFERENCES

A m o r i m , c. \_ no. \_ d.; c i n t r a , m. \_ s.; f e r n a n d e s , j t. \_; s a n c h e z, j m. M. \_ org a n i s m o of \_ i n s p e c t i o n \_ \_

Accredited for building energy efficiency labeling (oia): an experience of business incubation at the university. Xiii national meeting and ix latino- american environmental comfort in the built environment, 2015, campinas. Annals , 2015.presentation. Domes . 2015. Available in < <http://domus.pucpr.br> >. Access in: 30 in august in 2020

Blessings, d. You dispossessed: karl marx, you thieves gives wood and o right from poor. In : marx, k (ed.). You dispossessed . Are paul: boitempo editorial, 2017.

Brazil. Law no. 10,295, of october 17, 2001 . Provides for the national policy on conservation and use rational in energy and from the others measures: daily official gives unity - section 1 - 10/18/2001, page 1 2001.

Brazil. Constitution, in 5 in october in 1988 . Constitution gives federative republic of brazil. Brasilia: senate federal, 1988.

Brazil. Rtq-c . Regulation technician gives quality of level in efficiency energy in buildings commercials, in services and audiences 2009

Brazil. Ordinance no. 18, of january 16, 2012. Technical quality regulation for the level in efficiency energy in buildings residential. Inmeter: daily official of the union. Ordinance no. 2012/18 2012.call public. Eletrobras , 2018 available in: <<https://eletrobras.com/pt/paginas/chamada-publica-procel-edifica.aspx>>. Access in: 29 in june in 2020

Constructed - indexes economic. Sindusconsp . Sd available in: <<https://sindusconsp.com.br/indices-economicos/>>. Accessed on: august 30, 2020 electrobras. Report in results procel 2020: base year 2019 \_ river in january. 2020

Epe, and. And. P. And. Consumption national in energy electrical at network per class: 1995 - 2018 \_ excel. Glued, ç. The. D. And. And. P. Ç. N.-.-. Web site epe: epe 2019  
Epe, eepe energy and electrical matrix. Acbdenergy , sd available in: <https://www.epe.gov.br/pt/abcdenergia/matriz-energetica-e-eletrica> . \_ access in: 02 set 2020

Fiesp, d. Transformation of profile from professionals and of occupations at chain productive gives construction (2007-2018) . Are paul: fiesp 2019

Gonçalves, j ç. S.; goat, k introduction. In : goat, j ç. S. G k (ed.). Building environmental . Are paul: workshop in texts, 2015.



Inmetro tables in consumption/efficiency energetic. Pbe , feb. 2020 2020 available in:  
<http://www.inmetro.gov.br/consumidor/pbe/edificacoes.asp> . Access in: 10 apr. 2020  
Inmetro accredited bodies: oia-eee . Sd available in:  
[http://www.inmetro.gov.br/organismos/resultado\\_consulta.asp](http://www.inmetro.gov.br/organismos/resultado_consulta.asp) . Access in: 02 set 2020

Maciel, lf; carlo, jc sensitivity analysis of the consumption indicator against the variables of equations in rtq-c. Xi encac, 2011, búzios. Annals , 2011.mendes, h. The construction and its impact on the environment. Green domus - development sustainable . 26 in september in 2013. Available in: <  
<http://greendomus.com.br/a-civil-construction-its-impact-on-the-environment/>> access in: 31 in august in 2020

P a c h e c o , g \_ h \_ ; o l i v e i r a , p . s . a \_ d . ; d i a s , a \_ r \_ d . ; h a z b o u n , v . ; m a r t i n s , m \_ r . ;  
p e d r i n i , a \_  
Influence of shading angles on the result of the consumption indicator of the wrap through of method prescriptive of rtq-c. Xiv entac - date national in technology of environment built, 2012, judge in outside. Annals , entac, 2012

P e d r i n i , \_ a . ; d i a s , a . R . \_ d . \_ ; a m o r i m , c . \_ n o . \_ d . ; c i n t r a , m . \_ s . ; s i l v a , a . C . \_ s . \_ b .  
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i n t e c h n o l o g y o f e n v i r o n m e n t b u i l t , 2 0 1 2 , j u d g e i n o u t s i d e . A n n a l s , 2 0 1 2

Brazil's gdp: history and evolution in graphs. People's gazette . April 29, 2019. Available in:  
<<https://infograficos.gazetadopovo.com.br/economia/pib-do-brasil/>>. Access in 27 in august in 2020  
Procell eletrobras , 2019. Available in: <<https://eletrobras.com/pt/paginas/procel.aspx>>. Access in 29 in june in 2020

Project s3e. Labeee – laboratory of efficiency energetic in buildings . 2020 available in: <<http://labeee.ufsc.br/projetos/s3e>> . A c e s o \_ i n 3 0 o f \_ a g o s t o o f \_ 2 0 2 0 .  
Project 3e. Ministry of quite environment . 2020 available

at:<<https://www.mma.gov.br/informma/item/11644-projeto3emais>> . Access in: 31 in august in 2020  
Projects. Labeee – laboratory of energy efficiency in buildings , 2020. Available in:  
<<https://labeee.ufsc.br/projetos>>. Access in: 29 in june in 2020

Rodrigues, c. Either. D m.; days, a. R. D.; jankovic, m. D m. G. D s.; assis, f. L. C. D.; pedrini,  
The. Labeling in buildings in the policies public for o future of cities. In : rosin, j the.

R. D. G and benini, s. M. (ed.). Sustainable city: a concept in construction . Tupa: anap, 2019  
Rodrigues, ç. O. D. M.; days, the. R. D.; pedrini, the. Big ones openings although shaded. Xi encac - date national in comfort at the environment built, 2011, búzios. Annals , 2011.

About cb3e. Cb3e – brazilian center for energy efficiency in buildings. [nd]. Disponi ve l \_ \_ \_ i n : <<http://cb3e.ufsc.br/sobre>>. A c e s s o i n : 2 8 o f \_ a g o s t o o f \_ 2 0 2 0

Unep, u. N. E. P. As buildings and construction sector grows, time running out to cut energy use and meet paris climate goals. Energy, 2017. Disponível em: <https://www.unenvironment.org/news-and-stories/press-release/buildings-and-construction-sector-grows-time-running-out-cut-energy>. Acesso em: 02 set. 2020.