

A STUDY ON THE USE OF PUBLIC POLICIES OF ECONOMIC INCENTIVES TO PROMOTE ECO-EFFICIENCY IN THE CONSTRUCTION INDUSTRY

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ABSTRACT

In the last ten years, Brazil has been suffering from economic variations, bringing insecurity to the macroeconomic context that, therefore, makes it difficult to definitively come out of the crisis. Government policy measures have largely focused on economic growth, rather than encouraging sustainable development aimed at improving the economy, society, and the environment. The civil construction sector, responsible for a large portion of the Brazilian economy, plays a key role in this context, because despite its economic importance, this is the sector that generates the most environmental and social liabilities in the country. In this context, a responsibility is created for the Public Administration to implement policies that aim to increase the positive economic, social, and environmental aspects of this sector and reduce the negative ones. In this scenario, this paper presents its main objective: to provide support that can assist in decision making for establishing public policies that promote sustainable practices, from the perception of civil construction companies. The research involved a literature review related to the topics Sustainability, Eco-efficiency, Civil Construction, Green Buildings, and Tax Incentives, adopting as a methodology the use of interviews with companies from the civil construction sector to validate the proposals of possible public policies. This is a bibliographical, documental, and field study, with direct and applied observation. The work resulted in proposed improvements for the Public Administration to optimize its policies of promoting eco-efficiency, such as reducing the bureaucracy of processes for obtaining licenses and transparency of information on public policies, encouraging organizations in the civil construction sector to improve their activities in terms of reducing the production of solid waste and emissions of polluting gases, without hindering the economic development of these companies.

KEYWORDS: Sustainability; Civil Construction; Green Buildings; Tax Incentives; Public Policies.

1. INTRODUCTION

Nowadays, much has been discussed about the role played by the Public Administration in fostering activities that aim at the sustainable development of Brazil as a whole and of its units (States and Municipalities). It is known that the adoption of sustainable organizational practices and their beneficial effects on the environment and Brazilian society has a wide field of study among academics. Nevertheless, the State's action to encourage these activities, not only through regulatory policies, but also by granting economic incentives to companies that respect and contribute to the improvement of the environment and the evolution of society, must be expanded.

According to the Brazilian Chamber of the Construction Industry (CBIC, 2017), most of the environmental protection laws of Brazil focus on the polluter-payer principle and not the protector-recipient principle, i.e., legislation is generally reactive to events involving the environment and society, going against the global trend, in which those who protect receive benefits.

The participation of States and Municipalities in the education of the whole Brazilian society is necessary because Brazil has an extensive territory, with a gigantic social inequality that limits the access to information of the poorest layers of the country, preventing the Federal Government and the whole society from educating them in terms of the importance of sustainable development.

According to Ajayi *et al.* (2015), the construction industry is the largest contributor to natural resource use and global gas emissions, accounting for 50% and 30%, respectively, of all use and emission in the world. For this reason, it is important that industries move away from the conventional construction method and start using sustainable methods.

One of the tools used by the Public Administration to encourage organizations to practice sustainability is the adoption of tax benefits, that is, the State waives a certain amount of its revenue so that its taxpayers have the financial power to carry out certain actions that benefit society.

The study seeks to answer the following question: how to improve public policies to be adopted by municipal governments for the development of sustainable practices?

The research mainly aims at providing support that can help in the decision-making process for the establishment of public policies that promote sustainable practices, based on the perception of civil construction companies.

2. THEORETICAL FOUNDATION

Eco-efficiency in Civil Construction

According to Ajayi *et al.* (2015), the construction sector is the largest contributor to natural resource use and global gas emissions, accounting for approximately 50% and 30%, respectively, of all use and emission in the world.

Ajayi and Oyedele (2017) found that in the UK, a 2013 data suggests that out of 100% of the waste generated, 44%, 14%, 13%, 13%, 9%, and 7% are due to construction, commercial, industrial, domestic, mining, and agricultural activities, respectively, showing that the construction industry contributes the largest proportion of UK waste to landfill. Similar patterns exist in other major economies. Construction sector activities in the US generate approximately 29% of landfill waste, while industry landfills reach 40%, 44%, 27%, and 25% in Brazil, Australia, Canada, and Hong Kong, respectively.

In contrast, according to Ajayi *et al.* (2015), the construction industry contributes a significant portion of the global economy, employing much of the population worldwide, accounting for 13% of the global economy and contributing an annual amount of \$12 trillion, which is expected to reach \$15 trillion by 2025, according to a 2013 analysis by Global Construction Perspectives. Therefore, it is necessary to create incentive methods for this segment to develop sustainably, both economically and socially, as well as environmentally, giving rise to the concept of green or ecological constructions.

The construction sector, according to Kurda *et al.* (2018), is a major contributor to environmental impacts in relation to energy consumption, emissions released to the atmosphere, and natural resources extracted. Thus, it is essential that eco-efficiency in construction be promoted to reduce ecological impacts during the construction, service, maintenance, and end-of-life phases of a building.

In recent years, Behera *et al.* (2014) point out, the large investment in the construction industry and the increasing need for homes in urban areas due to the development of the economy and the high population growth rate have created a huge demand for conventional building materials. The depletion of good quality aggregates, along with the increase in demand make the availability of raw materials scarcer. In addition, materials tend to become more expensive due to increased transportation costs, accompanied by increasing movement in some regions.

Abanda *et al.* (2016) point out that according to the recent IPCC (Intergovernmental Panel on Climate Change)

and AR5 (Fifth Assessment Report), buildings accounted for about 32% of energy consumption and 19% of energy-related greenhouse gas emissions in 2010. These actions have negative impacts on the environment and communities through global warming. With this, it is no surprise that the construction industry is beginning to address the need for energy-efficient buildings.

Chiroli *et al.* (2015) state that the construction sector is a major generator of ecological impacts, and its activities can create different types of pollution, highlighting land deterioration, and noise, water, and air pollution, especially when it comes to waste generation and consumption of non-renewable resources. In addition, the industry has caused a major change in the natural landscape. The construction industry is responsible for consuming large amounts of natural resources, such as wood, sand, stone, and others.

According to Huang *et al.* (2018), the construction sector generates 315 million tons of direct CO₂ emissions, accounting for 5.5% of the total CO₂ emissions from this sector. Fossil fuels account for 99.5 percent of direct energy use in the global construction sector. This fossil fuel is mainly used for on-site construction operation, especially the operation of construction machinery and equipment.

Kono *et al.* (2018) found that the environmental impact of the life cycle of buildings was dominated by the energy consumption of the use phase. Even with energy-efficient buildings, the impact of this consumption in the use phase was around 50% of the total impact. The Energy Performance of Buildings Directive (EPBD) requires the energy consumption of new buildings in Europe to be close to zero from 2020 onwards; however, the importance of the impacts associated with material production will increase.

Green or ecological constructions and other sustainable solutions

There is public awareness, according to Zuo and Zhao (2014), about green building. However, there have been discussions about what a green building would be or what a green building should cover. Indeed, the lack of a clear concept creates challenges for the promotion and implementation of green building.

Authors Zuo and Zhao (2014) found that studies on green buildings can generally be classified into three categories: the definition and scope of green buildings; benefits and costs of green buildings; and ways to achieve green building.

According to Xu and Shi (2018), in recent decades, the development of green building materials has been significantly undertaken by the higher sustainability standards in the

construction industry. To date, two major trends of finding eco-efficient solutions for building materials have been (I) replacing non-renewable aggregates with recycled materials and (II) using SCM (fly ash, blast furnace slag, etc.) to replace Portland cement partially or completely.

According to Kurda *et al.* (2018), concrete is the most widely used building material worldwide. The annual demand for aggregates (the main components of concrete) will increase to an expected 52 x 10⁹ tons in 2019.

Behera *et al.* (2014) found that concrete is a material composed of different constituents, such as binder materials, water, aggregates, and additives. Among these ingredients, aggregates play a crucial role, occupying the largest volume of concrete, around 60% to 75%, and are indispensable for any construction work. The versatility of concrete as a building material for large construction sites lies in its high strength, low maintenance value, and its excellent performance.

The authors state that for better performance, the construction industries could use recycled aggregates (RA).

RAs can be of different types, such as aggregates from brick, glass, asphalt and bitumen, concrete, tiles, and marble recycled from flooring, finishes, and ceramic products.

According to Ajayi *et al.* (2015), materials reuse is a crucial approach to diverting waste from landfill sites. Unlike recycling, materials reuse involves using the materials with little or no change to their physical state, and without any change in their chemical constituents.

Ismaeel (2018) brings up the relevance of assessing a building to characterize it as a green building. Environmental building assessment should follow a globally accepted method for the benefit of the public and private sectors, facilitating the use and application of environmental certification systems and integrating with national goals.

Both construction companies and certifying authorities should use the life cycle assessment tool to make sure that the construction will be considered green and will reduce environmental effects.

The relevance of knowing the life cycle of an enterprise can be observed, since there is a worldwide trend that seeks to know not only the background of the company, but also of its suppliers.

Rashid and Yusoff (2015) conceptualize life cycle assessment as a methodology for estimating a depreciation of environmental impact over the product's life cycle, from cradle to grave.

The construction industry must know, in addition to the benefits that a green building has throughout its life, the expenses that the entire life cycle of its development will have until the end of its useful lifetime. Life cycle costing is “a process for determining the sum of all expenses associated with a product or project, including acquisition, installation, operation, maintenance, refurbishment, and disposal costs” (Zuo *et al.*, 2017, p. 362).

According to Kamali *et al.* (2018), “conventional” stick-built (on-site) buildings are similar to those constructed using the modular construction method in that they are permanent structures. These two types of developments differ in their respective life-cycle stages in the design and construction phase. In the case of modular construction, the building is designed based on several modules in which they are manufactured in a modular construction facility for most of the work and then transported to the construction site and placed on a permanent foundation.

Modular construction is one of the leading off-site construction methods and offers several advantages: construction speed, safety, productivity, product quality, and less environmental impact.

A major point of disagreement and discussion in academic, organizational, and governmental circles are the demands of social and environmental issues on organizations that use natural and social resources to generate their financial results. On the one hand, there is the figure of the businessman and the business organizations that demand the aforementioned resources to generate income; on the other hand, there is the figure of the governmental entities that need to protect the environment and society.

Brazilian Program for Habitat Quality and Productivity

According to Barbosa and Vilintis (2017), there was a problem for the Brazilian government in creating methods to enable the development of competitiveness in the construction industry. In response, the federal government instituted the “*Programa Brasileiro de Qualidade e Produtividade no Habitat*” - PBQP-H (Brazilian Habitat Quality and Productivity Program), seeking to improve the quality and productivity of Brazilian organizations linked to the sector. The construction companies adopted the PBQP-H seal, related to planning, projects, materials, labor, and on-site specifications.

Still according to the authors, PBQP-H aims to foster Brazilian modernization by improving quality, increasing productivity, and reducing costs in housing construction. It has as its design several segments of the productive chain, ranging from material companies to construction companies, besides other governmental bodies, financing and promot-

ing agents, universities, research centers, and non-governmental organizations for the development of several actions foreseen by the program.

According to Chiroli *et al.* (2015), the PBQP-H aims to organize the civil construction sector involving two main issues: improvement of habitat quality and productive modernization. Since 2001, this program has been the most widely used tool in the search for differentiated competencies to achieve the sector’s desired goals.

According to Chiroli *et al.* (2015), PBQP-H has certification levels A, B, C, and D. These levels are inserted in quality criteria and focus on continuous improvement, contemplating social and environmental responsibilities. According to the agreement, the construction companies have 24 months to obtain the maximum level of certification (level A). To do so, they must meet the criteria of the “*Sistema de Avaliação da Conformidade de Empresas de Serviços e Obras da Construção Civil*” – SIAC (Conformity Evaluation System of Civil Construction Service and Construction Work Companies) of the PBQP-H Program.

According to Finger *et al.* (2015), PBQP-H certification is a requirement for construction companies entering Minha Casa Minha Vida Program (PMCMV) projects, and for other lines of financing from Caixa Econômica Federal and other banks in Brazil.

Green IPTU

Jahnke *et al.* (2013) point out that the IPTU (Property Tax) is a tax provided for in Article 156 of the Federal Constitution of 1988, and it is a municipal competence to institute taxes on urban property, such as an apartment, commercial room, or house. Still according to the authors, many property owners prefer to occupy all the land space for buildings, leaving the property without any area or green space. Thinking under this optic and to encourage the conservation or the implementation of these areas, the IPTU Green was created.

With the intention of encouraging the sustainable model, there have been projects for Municipal Laws dealing with the possible reduction of the IPTU when sustainable practices are verified or that promote actions beneficial to the environment.

Jahnke *et al.* (2013) list some municipalities that encourage their citizens through the Green IPTU concept. The authors state that in the city of São Vicente, São Paulo, to get the discounts:

“The owners who prove that their property meets sustainability criteria, receive discounts of

up to 25% in the Property Tax (IPTU). If a house is built with ecological bricks, the owner receives a 0.1% discount; if more than 15% of the land has permeable soil areas, there is an additional 0.07%. In all, there are 22 criteria that help reduce water, energy, and waste consumption.” (Jahnke *et al.*, 2013, p. 420)

The authors also point out that the maximum tax rebate in the city of Guarulhos will be 20% for five consecutive years, counting from the next fiscal year in which the improvements are effectively implemented. According to Jahnke *et al.* (2013), property owners must implement two or more of the following measures:

I - rainwater harvesting system: three percent (3%) discount;

II - water reuse system: three percent (3%) discount;

III - solar hydraulic heating system: three percent (3%) discount;

IV - solar electric heating system: three percent (3%) discount;

V - construction with sustainable material: three percent (3%) discount;

VI - use of passive energy: three percent (3%) discount;

VII - wind energy use system: five percent (5%) discount;

VIII - installation of a green roof on all the roofs available in the property for this type of covering: three percent (3%) discount;

IX - separation of solid waste, benefit to be granted exclusively to horizontal or vertical condominiums and which, demonstrably, allocate their collection for recycling and reutilization: five percent (5%) discount.” (Jahnke *et al.*, 2013, p. 421)

Cunha (2013) points out that the city of Vila Velha, Espírito Santo, grants taxpayers the possibility of a 50% discount on the IPTU (property tax); however, unlike the aforementioned cities, the incentive benefits the taxpayers who can prove the existence of a regularly built sidewalk and tree(s), and it is necessary to file the request with the municipal departments involved, such as Urban Development and Environment:

I - 10% (ten percent), if they take proper care of their regularly built sidewalks, or build them by adopting the City’s standard “citizen sidewalk” project;

II - 10% (ten percent), if they have or plant 01 (one) tree with a minimum height of 1.50m (one meter and fifty centimeters) in front of their property, observing the criteria and norms adopted by the Municipal Secretary of Environment - SEMMA;

III - 12% (ten percent), if they have or plant 02 (two) trees with a minimum height of 1.50m (one meter and fifty centimeters) in front of their properties, observing the criteria and norms adopted by the Municipal Secretary of Environment - SEMMA;

IV - 18% (eighteen percent), if they have or plant 03 (three) trees with a minimum height of 1.50m (one meter and fifty centimeters) in front of their properties, observing the criteria and norms adopted by the Municipal Secretary of Environment - SEMMA.” (Cunha, 2013, p. 83)

Jahnke (2013) says that the Municipality of Curitiba, in Paraná, grants a discount on the IPTU for taxpayers who have a green area with native woods, isolated pines or trees with a large canopy volume, according to Municipal Law No. 9,806, of January 3, 2000 - Forest Code. Residents who meet the requirements of the legislation must apply for the discount on the IPTU at the Municipal Finance Department. The discount in the city of Curitiba can reach 100% of the tax value, depending on the extension of the green area and the number of native trees.

3. RESEARCH METHOD

This is a qualitative Research because, according to Gray (2012):

“Qualitative research is highly contextual, and is collected in a natural, ‘real-life’ context, often over the course of long periods. As such, it goes beyond a simple snapshot or cross-section of events and can show how and why things happen.” (Gray, 2012, p. 137)

In the case of this article, we seek to show how to provide support that can assist in decision making for the implementation of public policies that promote sustainable practices. This is based on the perception of professionals in the area who work in civil construction companies, a perception validated by aspects found in the literature.

Data collection instrument

As to the means of investigation, the research can be considered a survey or field research conducted in the State

of Rio de Janeiro, where information was gathered on the effects of tax incentives and national sustainability policies. From this, the perception of professionals from companies in the civil construction sector was verified.

According to Gray (2012), analytical survey research attempts to test a theory in the field, with the primary purpose of exploring and testing associations between variables.

According to Lakatos and Marconi (2010), field research is considered a source of data survey that uses quantitative methods for collection: questionnaires, interviews, and other techniques for the delineation or analysis of characteristics of a given population. The method chosen for this work was the structured interview.

In the first part, we tried to identify the respondent's and the company's profiles. This survey aimed to better define those who interact with the organization, as well as the type and size of the company.

The respondents are part of the administration of the companies, one at the management level, aged between 31 and 45 years, working between 10 and 15 years in the company and the other at the management level, aged between 46 and 50 years, working up to 5 years in the company, both male.

Both respondents' organizations are entrepreneurial limited companies (Ltd) operating in the construction market for 10 to 20 years, one small and the other medium-sized.

4. RESULTS ANALYSIS

The interviews with the construction companies aimed at identifying the level of adhesion of these companies to the Brazilian Habitat Quality and Productivity Program (PBQP-H), in addition to listing the difficulties encountered in becoming certified and remaining in the program. In addition, it was proposed to identify the level of knowledge of the tax benefit known as IPTU Verde ("Green IPTU") and the existence of demand from society for buildings with sustainable technologies. The answers are presented in Chart 1.

In the second part of the interview, the critical factors for PBQP-H certification were listed, as well as the difficulties and opinions about the program.

In question 9, the level of PBQP-H certification was asked, and both answered that they are certified at level "A", and one of them has its certification expired since December 2015, according to the PBQP-H website.

According to the Brazilian Chamber of the Construction Industry (Câmara Brasileira da Indústria da Construção -

CBIC, 2017), there are 9,833 construction companies in the state of Rio de Janeiro, of which 537 construction companies have the PBQP-H certification. Of this total, only 64 companies have their certificates in effect, that is, 11.91% of the certified companies are in effect, according to the PBQP-H website. When compared to the total number of construction companies, this percentage is reduced to 0.65%. For every 154 companies in the state of Rio de Janeiro, only one has the PBQP-H certification. According to Barbosa and Vilntis (2017), the main purpose of the PBQP-H was to enable an increase in competitiveness in the construction industry; however, we can only see a small group of construction companies that have this certification.

In question 10, the companies were asked about their level of satisfaction with the PBQP-H. Both responded that they were satisfied with the program. However, in question 11, they were asked to list the main obstacles the companies encountered in obtaining the PBQP-H certification. One of them mentioned the cost, and the other listed the training of suppliers to meet all the standards' requirements. The difficulties reported by the construction companies reduce the possibilities for new companies, especially micro and small ones, to get the certification and even to keep it. According to Finger *et al.* (2015), PBQP-H certification is a requirement for construction companies entering the Minha Casa Minha Vida Program (PMCMV) projects and for other lines of financing from the Caixa Econômica Federal and other banks in Brazil, meaning that few companies in the state of Rio de Janeiro would be able to participate in this program.

For the construction company to obtain the certificate, it needs to perform a life-cycle assessment of its project, in addition to performing life-cycle costing, corroborating with the statements of Zuo *et al.* (2017), who argues that life-cycle costing is "a process for determining the sum of all expenses associated with a product or project, including acquisition, installation, operation, maintenance, refurbishment, and disposal costs." (Zuo *et al.*, 2017, p. 362).

In question 12, it was stated that the PBQP-H has achieved advances and improvements in construction, aiming at eco-efficiency. One company affirmed its full agreement, and another company affirmed its partial agreement. These responses partly ratify the statement by Barbosa and Vilntis (2017) that the PBQP-H aims to foster Brazilian modernization by improving quality, increasing productivity, and reducing costs in housing construction. Thus, only one builder disagreed in terms of the enterprise cost.

In question 13, it was asked if there were actions that the City Halls could take to assist the civil construction sector in obtaining the PBQP-H certificate. One firm did not know how to answer, and the other answered that the City Halls should not spend resources on this, but could help in several

Chart 1. Comparison of responses between the two companies

Question	Answer Company A	Answer Company B
2. What is your position level in the company?	Management	Direction
3. How old are you?	Between 31 and 45 years old	Between 46 and 50 years old
4. How long have you worked in this company?	Between 10 and 15 years old	Up to 5 years
5. What is your gender?	Male	Male
6. What is the company type?	Limited Liability Company	Limited Liability Company
7. What is the size of the company?	Small company	Empresa de médio porte
8. How long has the company been in the civil construction market?	Between 10 and 20 years	Between 10 and 20 years
9. Does the company have PBQP-H certification? What level?	Yes, A.	Yes, A.
10. What is the company's satisfaction level with PBQP-H?	Satisfied	Satisfied
11. What are the main obstacles that the company faced to obtain the PBQP-H certification?	Costs	Training of suppliers to meet the requirements of the standard.
12. The Brazilian Habitat Quality and Productivity Program (PBQP-H) has achieved great advances and improvements in construction aiming at eco-efficiency in civil construction.	Partially Agree	Fully Agree
13. What actions could the Municipalities take to contribute to the civil construction sector in obtaining the PBQP-H certificate?	The municipalities should not spend resources on this, and could help in other ways, such as by debureaucratizing the licensing process.	Did not know how to answer
14. Is the company aware of the "IPTU Verde" ("Green IPTU") tax benefit granted to taxpayers who own houses that meet some sustainability criteria?	Does not know	Did not know how to answer
15. Has the company noticed an increased demand from its clients for building projects that minimize the social and environmental impact, such as green buildings, in the last decade?	There was an increase only for items that generate financial savings for the buyer, such as individualized water and electricity consumption efficiency. The others, unfortunately, did not feel this increase in demand.	Did not know how to answer
16. The tax incentive known as IPTU Verde ("Green IPTU") could be relevant in increasing the demand for green buildings.	Relevant	Did not know how to answer
17. The company is committed to eco-efficiency (control of solid waste and its disposal, amount of water used, and others) in relation to its real estate projects during the execution of the works, that is, before the delivery of the property.	Relevant	Did not know how to answer
18. The company is committed to eco-efficiency (emission of pollutants, reduction of electric power and water consumption, and others) in relation to its real estate projects after the delivery of the property to the client and during the life cycle of the project.	Relevant	Did not know how to answer
19. In the company's evaluation, the cost increase in implementing the green or ecological building concept is coherent with the environmental and social benefits (water reuse, solar water heating system, installation of solar panels, and ecological building materials, among others).	Totally agree	Did not know how to answer

20. Replacing the conventional method with green or ecological construction will influence the social and environmental development of the regions where these constructions are implemented.	Totally agree	Did not know how to answer
21. Does the company use recycled or reused materials in its constructions?	If so, very little.	Did not know how to answer
22. What would be the greatest difficulties encountered by the organization in relation to its ventures that could be reduced by the Public Administration?	Debureaucratization of the process of obtaining licenses to start construction and the Occupancy Certificate (habite-se) to hand it over.	Did not know how to answer
23. What would be the main actions that construction companies could take to become more sustainable and help the sustainable development of the region where they operate?	Did not know how to answer	Did not know how to answer

Source: The authors (2020)

other ways, such as reducing bureaucracy in the licensing process.

The removal of unnecessary procedures in the process of granting licenses would be an action that the city governments could take, according to the construction company, to help in obtaining the certificate. According to Machado (2013), this action would meet the principle of cooperation, explicit in art. 6, VI, of Law 12.305/2010, which states “the cooperation between the different spheres of government, the business sector, and other segments of society. Cooperation between the three spheres of government and the private sector is essential for a public policy that promotes sustainability to be effective.

In the 3rd part of the interview, the objective was to identify the knowledge of construction companies in the State of Rio de Janeiro about the tax benefit known as Green IPTU offered by some Municipalities, thus revealing their clients’ demand for buildings that have eco-efficient technologies, such as water reuse, solar water heating systems, and the installation of solar panels, among others.

In question 14, it was asked whether the organization is aware of the Green IPTU tax benefit, granted to taxpayers who own houses that meet some sustainability criteria. The companies replied that they are unaware of the incentive.

In question 15, the companies were asked if they felt an increase in their clients’ demand for enterprises that minimize the social and environmental impact, such as ecological constructions, in the last decade. One company answered that “there was an increase only for items that generate financial savings for buyers, such as individualized water and electricity consumption efficiency. Other than that, unfortunately, this increase in demand has not been felt.” This information goes along with what is stressed by Zuo and Zhao (2014). The authors stated that there is a growing level of public awareness about green building. However, there have

been extensive debates over what green building is or what it should cover. In fact, the lack of a clear definition creates challenges for the promotion and implementation of green buildings. The lack of knowledge in society, especially in Brazil, about the benefits of buildings constructed with eco-efficient technologies hinders the increase in demand for these types of enterprises.

In question 16, it was asked if the Green IPTU could contribute to the increase of this demand. One response was positive, as the benefit generates financial savings for taxpayers, corroborating the statement by Kluger and DeNise (apud Ajayi and Oyedele, 2017, p. 62), suggesting that incentives and deterrence are key tools to encourage or discourage certain behavioral patterns among the population.

The 4th part aimed to get to know the commitment of the construction companies in relation to their projects during and after the construction. Additionally, a space was opened for the construction companies’ final considerations. Only one of the companies was able to answer.

Questions 17 and 18 were related to the level of the company’s commitment to the project’s eco-efficiency during and after construction. One of the construction companies answered that it considers relevant the actions during the construction work, such as control of solid waste and its disposal, amount of water used, and others. The company also considers relevant emissions of pollutants, reduction of energy and water consumption, etc., in relation to its real estate projects after the delivery of the property to the client and during the life cycle of the project.

The environmental impacts caused before and after construction should be controlled by the building company. Kono *et al.* (2018) state that the environmental impact of the life cycle of buildings was dominated by the energy consumption of the use phase, i.e., after the delivery of the enterprise. The author also states that by 2020 the Energy

Performance of Buildings Directive (EPBD) requires the energy consumption of new buildings in Europe to be close to zero. To this end, eco-efficient technologies are growing in importance.

In question 19, it was asked if, in the companies' evaluation, the cost increase for implementing the green or ecological building concept is coherent with the environmental and social benefits. In question 20, it was asked whether the substitution of the conventional method for the green construction will influence the social and environmental development of the regions where these constructions are implemented. Both answers agreed for one of the companies, i.e., the company assesses whether the cost versus benefit of green buildings is interesting for society.

According to Zuo *et al.* (2017), for analyzing environmental impacts, both construction companies and certifying authorities should use the life-cycle assessment tool. This way, they can certify that the project will be considered green and will reduce negative environmental impacts.

In question 21, it was asked whether the company uses recycled or reused materials in its developments and the answer was "If yes, very little". The answer contradicts the trends mentioned by Xu and Shi (2018) of finding sustainable solutions for building materials by (1) replacing non-renewable aggregates with recycled materials and (2) using SCM (fly ash, blast furnace slag, etc.) to replace Portland cement partially or completely.

Question 22 aimed to list the greatest difficulties encountered by the organization in relation to its projects, which could be reduced by the Public Administration. Again, the answer was the debureaucratization of the process for obtaining licenses to start construction and the *habite-se* (Occupancy Certificate) for its delivery.

In question 23, it was asked what are the main actions that civil construction companies could take to become more sustainable and help in the sustainable development of the region to which they belong. The question was not answered by the interviewees.

Proposals for Public Policies

Thus, some improvement opportunities were analyzed for the public policies to promote sustainability that should be a study object for the leaders of the governmental units:

- I) The Public Policies of the Public Administration spheres, whether Federal, State or Municipal, must be based on the transparency of their actions, not only in the dissemination of data, but also in the clarity of

the information provided. When the Public Sphere creates an economic benefit that promotes sustainability, knowledge must be generated in terms of the extra-fiscal nature of this incentive, in order to bring an understanding of the advantages to society that go beyond the pecuniary ones;

- II) The use of the protector-recipient principle to generate demand in the construction market for eco-efficient technologies is a tool that should be used, but its intrinsic benefits should be disseminated. Brazilian consumers, in principle, look for developments that reduce financial impacts during the life cycle of the building, such as water reuse, solar water heating, and alternative energy, among others, and are not concerned with environmental and social impacts;
- III) Actions must be created that impact not only one part of the production chain of the civil construction sector, but all stages, in order to avoid the whiplash effect, as pointed out by the companies that responded to the interview when mentioning the difficulty in finding qualified suppliers that meet the requirements for certification in PBQP-H.

5. CONCLUSIONS

Based on the discussion, it was possible to conclude through the results of the research that a policy focused on the protector-recipient principle, without the dissemination of knowledge about the extra-fiscal benefits of these incentives, cannot modify society's behavior. Thus, the effectiveness of the incentives is not yet complete.

Civil construction companies, like any for-profit organization, are concerned about optimizing their results. Public policies that increase their costs without compulsory character are analyzed by market aspects, that is, a company will only get the PBQP-H certification for three apparent reasons: to participate in specific programs such as *Minha casa Minha vida*; if, after financial-economic analysis, the certification costs are outweighed by the benefits received; and if the certification gives a marketing advantage over its competitors.

Lastly, the responding construction companies understand that the role of the Municipalities is to release licenses and "Habite-se" (Occupancy Certificate). They do not understand municipal agencies as agents responsible for sustainable development. However, it was observed that there are municipalities that take their role as eco-efficiency promoters seriously, using the Green IPTU incentive to benefit their responsible taxpayers, as well as disseminating the concept

of eco-efficiency to society, without compromising the fiscal effect of the IPTU for the municipality.

In this context, it is understood that this research can contribute to the effective improvement of public policies for municipal eco-efficiency, providing conditions for process improvements, giving greater transparency to the actions of municipalities, getting off the paper activities that benefit the environment without causing negative effects on the construction industry, which is one of the largest contributors to the global economy.

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