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Policies for green buildings and Housing Programs in Brazil

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Abstract

Objective: This paper is proposed to analyze, in a descriptive and prescriptive way, Public Policies that carry the concept of sustainable civil construction, and that are related to the issue of housing in Brazil.
Methodology: The legal framework pertinent to this scenario is presented through content study, policy evaluation and information for policy formulation.
Relevance: The paper discusses the existing gaps in the legal and fiscal scope of Brazilian public policies aimed at the sustainability in the civil construction sector.
Results: The public policies analyzed to encourage sustainable construction lack a preventive focus, especially regarding the generation of waste and waste of natural resources.
Contributions: Additional efforts, mainly political, are needed to increase the effectiveness of the application of environmental policies inherent to this theme, to guarantee the right to housing and environmental protection, both provided for in the Brazilian Federal Constitution.

Keywords: Sustainable buildings. Social interest housing. Minha Casa, Minha Vida Program. Minha Casa Verde e Amarela Program. Policy analysis.

Políticas para construções sustentáveis mediante a questão da habitação no Brasil

Resumo

Objetivo do estudo: O presente artigo se propôs a analisar, de forma descritiva e prescritiva, as Políticas Públicas que possuem perspectiva de uma construção civil sustentável, e que estão relacionadas com a questão da habitação no Brasil.
Metodologia: A análise do arcabouço legal pertinente a esse cenário é apresentada por meio de estudo de conteúdo, avaliação da política da construção civil sustentável e informação para formulação de novas políticas.
Originalidade/Relevância: É realizado um levantamento das lacunas que existem no âmbito legal e fiscal das políticas públicas brasileiras voltadas à sustentabilidade do setor da construção civil, com vistas a fornecer conhecimentos para formulação e aprimoramento delas.
Resultados: As políticas públicas analisadas, para estímulo de construções sustentáveis, carecem de foco preventivo, principalmente no tocante à geração de resíduos e desperdício de recursos naturais não-renováveis.
Contribuições: São necessários esforços adicionais, especialmente políticos, que elevem a eficácia de aplicação das políticas ambientais inerentes à temática tratada, para garantia do direito à habitação e proteção ambiental, ambos previstos na Constituição Federal brasileira.

Palavras-chave: Edificações sustentáveis. Habitação de interesse social. Programa Minha Casa, Minha Vida. Programa Minha Casa Verde e Amarela. Análise de políticas.

Políticas para construcción sostenible con relación al tema de la Vivienda Urbana en Brasil

Resumen
Objetivo: Para este artículo se aplicó un análisis, de manera descriptiva y prescriptiva, sobre Políticas Públicas que tienen una perspectiva de construcción civil sostenible, y que están relacionadas con el tema de la vivienda en Brasil.
Metodología: La legislación pertinente a este escenario se presenta a través del estudio de contenido, evaluación de políticas e información para la formulación de políticas.
Relevancia: Se investigó sobre las brechas que existen en el alcance legal y fiscal de las políticas públicas brasileñas orientadas a la sostenibilidad del sector de la construcción civil.
Resultados: Las políticas públicas analizadas, para incentivar la construcción sustentable, carecen de un enfoque preventivo, especialmente en lo que se refiere a la generación de residuos y desperdicio de recursos naturales.
Aportes: Son necesarios esfuerzos adicionales, principalmente políticos, para incrementar la efectividad de la aplicación de las políticas ambientales inherentes a este tema, para garantizar el derecho a la vivienda y la protección ambiental, ambos previstos en la Constitución Federal Brasileña.

Palabras-clave: Edificaciones sustentables. Vivienda de interés social. Programa Minha Casa, Minha Vida. Programa Minha Casa Verde e Amarela. Análisis de políticas.

Introduction

Launched in 2009, the Minha Casa, Minha Vida (PMCMV) Program is the largest governmental housing program in the recent history of Brazil (Thery, 2017). Since the program's launch, there were changes in the implementation stages, which were always aligned with the different political contexts in the country. In the first stage, the PMCMV achieved the goal of offering one million homes to the Brazilian population with an income of up to ten minimum wages, the objective was to reduce the housing deficit of 5.998 million homes at the time (Fundação João Pinheiro, 2012; Thery, 2017)

Based on a prospective study of the PMCMV between 2009 and 2017, Fundação Getúlio Vargas and the Brazilian Association of Real Estate Developers (2018) verified a future housing deficit of 7.77 million homes. Since the numerical growth of the program did not surpass the vegetative growth of the Brazilian housing deficit, there is currently a record considering the last 10 years, since the program's conception.

From the perspective of overcoming this new deficit, through Federal Law nº. 14.118 (Brazil, 2021), Brazil's current federal government launched the Casa Verde e Amarela Program (PCVA) to replace the PMCMV. According to the legislation, the housing of social interest (HSI) is "understood in its broad sense of housing, with the integration of the physical, urban, land, economic, social, cultural and environmental dimensions of the space in which the citizen's life takes place" (Brasil, 2021, p. 1). The PCVA has the goal of serving 1.6 million low-income families by 2024, increasing by 350,000 households the target of the former PMCMV housing program (Verdélio, 2020).

Concerning the scope of HIS, there is a need to employ sustainable construction methods in line with the current market demand (CBCS, PNuma & MMA, 2014). In this sense,

it is understood that the sustainable use of materials, aligned with the reduction of construction waste, constitutes one of the main challenges for the management of constructions for HSI.

The conception of efficient management of constructions emerged in the early 90s, when the lean construction philosophy was introduced, which at the time aimed to reduce costs and waste with a strictly economic focus. This philosophy was developed from the work of the Finnish researcher Koskela (1992), who presented a report consisting of 11 principles. Such work emerged from the lean production manufacturing style practiced by the Japanese and aims to incorporate project management practices to improve the effectiveness and and efficiency of processes in civil constructions. Subsequently, social and environmental objectives were included in balance with economic ones when the concept of sustainability emerged from the Triple Bottom Line - TBL strategy (Elkington, 1998).

The studies of Martínez-Jurado and Moyano-Fuentes (2014) and Ciccullo *et al.* (2018) sought to understand the interrelationships between lean thinking and sustainability in the evolution of scientific research about project management. These authors identified that there is a gap in achieving the social objective provided by the TBL. However, Ciccullo *et al.* (2018) clarify that corporations first need to consolidate lean practices, as they are essential to achieve environmental performance in line with sustainable development.

Sustainable performance in civil construction encompasses several requirements, which should promote environmental and socioeconomic benefits. In the context of housing, this performance becomes even more significant, as the optimization of the processes of these civil constructions is fundamental so that there is no delay in the delivery, which would lead fewer families to being served (Euphrosino *et al.*, 2019). Thus, in addition to the economic and environmental benefits arising from the reduction of wasted resources, there are social benefits from overcoming housing deficits. Also, it is important to emphasize the importance of the effectiveness of public HIS policies, since environmental regulation, required in these projects, is a way of combating the informality that generates a lot of environmental damage (CBCS, PNuma & MMA, 2014).

A large part of the environmental problems arising from civil construction come from the intensive use of natural resources and the generation of waste. The Brazilian Association of Public Cleaning and Special Waste Companies (Albrepe, 2020), states that municipal cleaning services collected 44.5 million tons of construction and demolition waste (CDW) in 2019, these may represent 50% to 70% of the total generated. This data has shown an increase since the enactment of the National Solid Waste Policy (PNRS) in 2010, which was then equivalent to 33 million tons, representing a high and unsustainable generation of waste that affects Brazilian urban territories.

This characterizes a problematic generation of CDW, as only a small part of the waste is designated for recycling due to the narrow opening of the existing market. About 50% of

Brazilian municipalities still send waste to irregular locations and do not recycle it to use it in civil construction works (Abrecon, 2018). It is estimated that 35% of construction and demolition waste is sent to landfills and does not return to the value chain (Menegaki; & Damigos, 2018)

Therefore, the main focus for sustainability in the construction sector must consist of the sustainable consumption of environmental resources, because it implies the reduction of waste generation. The Brazilian Council for Sustainable Construction (2014) considers this a priority and emphasizes that joint actions must the employed, such as actions capable of maximizing the life of structures, strategies to reduce losses and failures, strategies for the improvement of the management process, and strategies to increase the waste recycling, in line with the National Solid Waste Policy.

Furthermore, concerning the economic aspect of the Brazilian civil construction, it is included in the segments that compose the basic industry and this gives it a pro-cyclical character, that is, it is directly influenced by the behavior of the country's economy (Gonçalves, 2015). Due to the vulnerability of the sector to the country's economic fluctuations, a portion of the sector appears which seeks to innovate to consolidate in this branch, starting from the use of quality materials, the industrialization of the construction sites, and which values methods to make work easier and reduce costs. This innovation aims to attract more and more customers and consolidate the sector's sustainability to survive such economic fluctuations (Capela, 2014).

Given the above, this paper is a preliminary study to analyze Public Policies focused on Sustainable Constructions regarding sectoral and housing programs in Brazil.

Methodology

To develop this research, a survey on the legal and political framework that involves the perspective of sustainable civil construction with a focus on the issue of housing in Brazil was performed. This paper has a qualitative approach, in which a theoretical foundation was structured from exploratory research that comprises two parts: the International Agreements to which Brazil is a signatory, and the National Public Policies relevant to the theme.

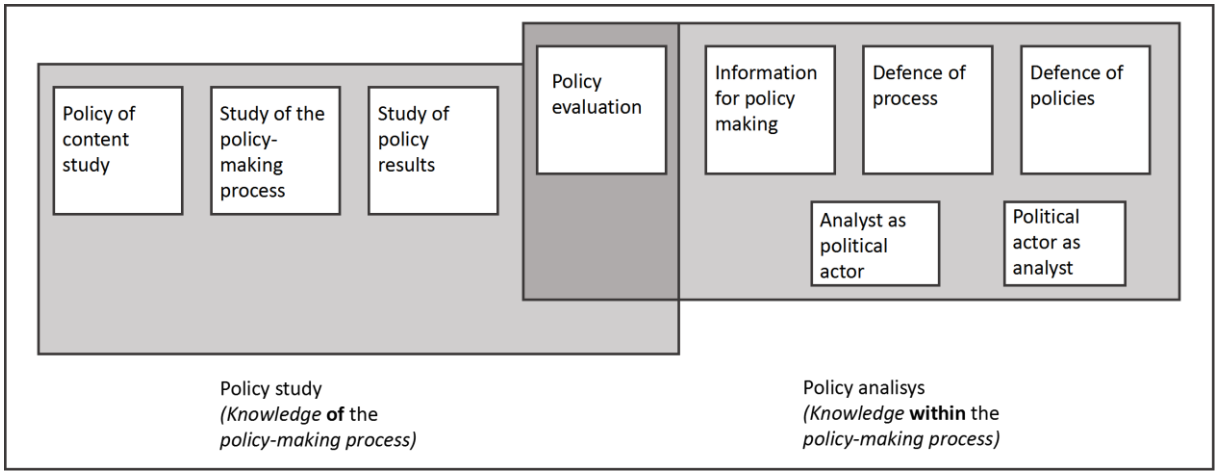
According to Gil (2017), an exploratory research aims to develop, clarify and modify concepts and ideas, to formulate more precise problems or hypotheses for further research. Also, according to the author, an exploratory research aims to provide greater familiarity with the problem, aiming to make it more explicit or to build hypotheses.

Therefore, a descriptive and prescriptive analysis is presented (Dagnino et al., 2002). Given this, different types of policy analysis are used (Figure 1): policy study, policy evaluation (intersection), and policy analysis. Finally, in the conclusion section, recommendations are

made for improving the processes involved in the elaboration and implementation of these policies.

Figure 1

Typologies of policy analysis



Source: Dagnino *et al. (*2002).

International agreements

In 1987 the construction of the Brundtland report, better known as Our Common Future, presented the definition of sustainable development:

> "One that meets the needs of the present without compromising the ability of future generations to meet theirs." (WCED, 1987).

Five years later, the consecrated Agenda 21 (UN, 1992) presented in chapter 7 the need to promote sustainable activities in the civil construction chain. The content addresses the issue of sustainable development of human settlements. In addition, pointed out as an objective access to safe and healthy housing as a human right essential to well-being. The document places cooperation between governments and the private sector as the main strategy to consolidate housing, infrastructure, and employment, without harming the environment. Although the agenda establishes specific objectives, there is a gap regarding the proposition of indicators, and this makes it impossible for the signatory countries to monitor their practices effectively.

The concept of sustainable development was incorporated into the civil construction sector in the following years, more specifically in 1994, by the *Conseil International du Bâtiment* (CIB), which defined sustainable construction as the:

> "Creation and operation of healthy built environments based on material efficiency and ecological design" (Kibert, 2008, p. 6).

Closely related to Agenda 21, the so-called Millennium Goals (MDGs) emerged in the 2000s. the eight MDGs aimed at carrying out specific actions to combat poverty by the year 2015. MDG 7 dealt with ensuring environmental sustainability and aiming for a significant improvement in the lives of at least 100 million inhabitants of environmentally degraded neighborhoods (UN, 2000).

With the arrival of 2015, the Sustainable Development Goals (SDG) appeared, which brought together goals to be achieved by the year 2030. Also known as the 2030 Agenda for Sustainable Development, it presents SDG 11, related to making cities and settlements inclusive, safe, resilient, and sustainable, to promote sustainable urbanization, prioritizing slum areas (UN, 2015). It also presented SDG 12, regarding the importance of sustainable inputs, as it aims to "Ensure sustainable production and consumption patterns", covering changes in production patterns and a transition to a more ecological and inclusive global economy. Countries, including Brazil, have taken on this global agenda for a common sustainable future, which, unlike Agenda 21, is monitored through indicators (Pereira et al., 2019).

The following year (2016) the Habitat III conference took place in Quito with important discussions on the New Urban Agenda (NAU). The NAU's principles and guidelines are guided by SDG 11, whose role is to guide the achievement of concrete goals, which have as a focus the achievement of sustainable urban development (Pereira et al., 2019). Such an event was aimed at achieving an agreement on a common urban agenda among the countries of the globe, in consonance with the global agenda of sustainable development. The first Conference, called HABITAT I, took place in Vancouver, in 1976; HABITAT II took place in Istanbul, Turkey, in 1996. At the 2016 Conference, several managing bodies and social organizations participated in the process of building the "World Charter for the Right to the City", with the perspective of including it as a human right (UN, 2019).

According to this perspective of the right to the city, a view emerges that for its consolidation it is necessary to incorporate sustainability, and, therefore, emerges the concept of "sustainable city" expressed in SDG 11. An ecocity, a name used in the declaration of the World Ecocity Summit (2008), a pioneer in the topic, is a city that is based on sustainable development and is designed to favor the quality of life of its ecosystems. The document points out that the development of an ecocity requires ecological security, ecological sanitation, ecological industrial metabolism, the integrity of the ecological landscape, and ecological awareness of its inhabitants. More recently, the parallel concept of smart cities was introduced, which aims to optimize urban sustainability through technologies to increase infrastructure efficiency (Ahvenniemi et al., 2017).

For the implementation of constructive sustainability, specific assessments were developed to verify the effectiveness of practices in the field of civil construction, giving life to the now adopted Green Building denomination. This way, the environmental certification process grants the builders of sustainable buildings the recognition and incentive for mitigating environmental impacts and reducing the use of natural resources (Conto et al., 2017). The objective is to encourage changes with a focus on sustainability in the construction sector.

The environmental certification process validates sustainability criteria used in the construction of civil structures, based on systematic evaluations of the materials and methods adopted. The first building environmental assessment system was launched in 1990 in England. The so-called Building Research Establishment Environmental Assessment Method (BREEAM) had an initial focus on new office buildings in the construction phase (BRE, 2016). However, the scheme gradually expanded to encompass buildings in use as well.

Other certifications are available at the local level. For example, in China, there is the China Green Building, adopted in Beijing only. In Pakistan, there exists the Pakistan Green Building Guideline. Just as in Brazil, the Green Building Councils, which integrate the global network (WorldGBC), develop and manage certification tools around the world (GBCBR, 2016).

National public policies

In the legal context of Brazil's federation, the Federal Constitution (CF), in its article 225, provides for the right to an ecologically balanced environment, since it is good for the common use of the entire nation and essential for the healthy maintenance of its quality of life (Brazil, 1988). This article still imposes the duty, both for the public power and the Brazilian society, to defend and preserve it for the present and future generations. And in the case of individuals or legal entities exercising harmful actions or conducts that are harmful to the environment, they will be subject to criminal and administrative sanctions, regardless of the obligation to repair the damage caused (Brasil, 1988).

Article 170 of the Federal Constitution, which deals with the economic order of the country, has environmental protection as one of its principles. For this, differentiated treatment must be presented considering the environmental impacts in the elaboration of products and provision of services (Brasil, 1988). Art. 6, regarding social rights, provides for the right of all Brazilians to housing, guaranteeing decent housing for the population (Brasil, 1988).

At the level of public environmental policy in Brazil, Federal Law nº 6.938 of 1981 instituted the National Environmental Policy - PNMA. The Policy presents as one of its instruments, disciplinary or compensatory penalties to guarantee compliance with the

measures necessary for the preservation or correction of environmental degradation, including all activities that generate waste (Brasil, 1981).

However, it was only in 2010 that Federal Law nº. 12.305 (Brasil, 2010a) was enacted, which instituted the National Solid Waste Policy (Brasil, 2010b), and represents the legal framework for advancing Solid Waste Management in Brazil, aligned with the PNMA. This public policy aims to solve economic, social, and environmental problems arising from inadequate waste management and disposal, in articulation with the National Environmental Education Policy (Brasil, 1999) and with the Federal Basic Sanitation Policy (Brasil, 2007). Therefore, it brings together a set of principles, objectives, instruments, guidelines, goals, and actions, with a view to the integrated management and environmentally appropriate management of solid waste (Brasil, 2010a).

Among the instruments of the PNRS, there is the solid waste management plan provided for in Article 8. In Article 20, the policy mentions the obligation to prepare a solid waste management plan for civil construction projects (Brasil, 2010a). In addition, it establishes shared responsibility for the life cycle of products, which must be implemented individually and in a chained manner, and therefore encompasses the entire civil construction chain, covering the construction materials industry, distributors, builders, developers, and contractors.

The PNRS makes it very clear that it aims to reduce material waste with shared responsibility. In this sense, it is necessary for construction companies to make production efficiency compatible, either by reusing waste or recycling it.

The National Environment Council (Conama), whose resolutions and norms aim to guarantee environmental protection, proposed in 2002 a definition for civil construction waste (CDW) through Resolution nº 307 (Conama, 2002). This definition is related to the origin of these wastes (constructions, renovations, repairs, demolitions, preparation, and excavation of land). The resolution also defines that the management of RCC must cover the maximum number of actions carried out, directly or indirectly, at the points of collection, treatment, discrimination, transshipment, transport, and adequate final destination of tailings and solid waste (Conama, 2002). In addition, it establishes for municipalities and the Federal District the function of elaborating an Integrated Plan for the Management of Civil Construction Waste. This plan must include the following items: a) Municipal Civil Construction Waste Management Program and b) Civil Construction Waste Management Projects.

In 1998, there was the emergence of programs to reduce losses and quality management in civil construction, which boosted the sector's concern with sustainability. As an example, we have the conception of the Brazilian Program for Quality and Productivity in Housing Construction (PBQP-H), which seeks to optimize civil construction based on two great precepts: productive modernization and the ideal qualification of the habitat (Fernandes, 2011). The PBQP-H was established on December 18th, 1998, by the then Ministry of Planning

and Budget. The program remains existing to date and aims to modernize and implement quality management in the civil construction chain, reduce the housing deficit in the country and reduce the costs of housing projects (MDR, 2020).

The institution of the PBQP-H promoted the adoption of quality systems in the industry through the creation of Sectorial Quality Programs (PSQs), such as ceramic blocks, Portland cement, and adhesive mortar. PSQ's aim is to promote technical compliance, encourage technological innovation, increase productivity standards, and reduce costs and waste (MDR, 2020). Initially what was seen as a high effort, just to adhere to the PBQP-H, came to be seen as an economic advantage due to the reduction of waste and less need for maintenance of products certified by the PSQs (Vieira & Oliveira Neto, 2019).

However, although there are incentives from the Brazilian government, a large part of the construction sector remains conservative, traditional, and not very innovative, when compared to other sectors such as mechanical, electrical, electronic, and information technology (Shreiber & Dusan, 2016; Deloitti Spain, 2020; Charron Júnior & Quesado Fillho, 2020). It is worth noting that the sector has different levels of innovation. On the one hand, there are the traditional construction companies that remain at obsolete levels of technology, but still, dominate a good part of the market due to the cultural aspect. There are also the so-called *construction techs*, companies that adopt digital processes with decentralized execution of projects, use advanced technologies (BIM, home automation, 3D printing, artificial intelligence), and that have enormous potential to add value throughout the project's life cycle (Charron Júnior & Quesado Filho, 2020).

A point worth mentioning in the PBQP-H is the integrated structuring of the program, which allows the actors involved to guide specific actions that are aimed at the implementation of technologies, methodologies, and tools. The latter include people management; quality management; supply management; management of information and production flows; project management (MDR, 2020). This way, the so-called lean thinking, which in the 90s was incorporated into supply and quality management, gains strength in the national scene with the PBQP-H. Economic and social incentives are included, such as modernizing the sector and reducing the country's high housing deficit.

To meet the demands of the areas involved in the civil construction chain and create specific requirements for such, the PBQP-H has three different assessment systems. Each system refers to a type of certificate and is divided into compliance of service and construction companies; materials qualification; and new technologies. These systems are the System of Conformity Assessment of Services and Works Companies (SiAC), which works in the certification of construction companies, analyzing, mainly, their management; the Qualification System for Materials, Components and Construction Systems Companies (SiMaC) in which processes and product quality in industries related to the manufacture of construction materials

are analyzed; and the National System of Technical Assessment (SINAT) which includes the verification of new materials and new technologies to be introduced in the civil construction industry (MDR, 2020).

The SiAC provides for the inclusion of sustainability indicators at construction sites that include water conservation, energy efficiency, and the reduction of waste generation. However, the program does not have adequate parameters for specific scenarios of civil works, thus comprising a gap that is reflected in the absence of management plans with a standard methodology to unify control and reduce consumption (Frofe, Mello & Soares, 2020). It is worth noting that, in the national scenario, inadequate monitoring (quantification and analysis) of waste generated in civil constructions is common (Froufe, Mello & Soares, 2020).

The PBQP-H follows the principles of the quality management system standard (QMS) ISO 9001, which, due to the demands of the contracting market, was incorporated by the program's builders by compatibility. Following the same logic, there was a search for ISO 14001 certification regarding environmental management systems (EMS), because it was a market requirement for hiring, seen as a competitive opportunity both for small and medium-sized companies (Vechi, Gallardo & Teixeira, 2016), and also for large companies, that are very interested in certifications because they comply with international standards required in processes of credit assignment.

The most recent SiAC update of 2017 did not adhere to the new ISO 9001:2015 structure and, therefore, it was not possible to establish a usual equivalence between them. Thus, as reported by Nercolini (2019), there was a drastic reduction in adherence to ISO 9001. According to the author, companies claim that the investment required by certification is high and that it is only worthwhile if the program considers it. This reveals the reactive behavior of the construction companies that participate in the program.

In 2013, NBR 15575 “Housing Buildings – Performance” came into force, which contributes to the technological modernization of Brazilian construction and progress in housing quality (ABNT,2013). The standard follows international performance standardization models, so “for each user need and exposure condition, there is a sequence of performance requirements, performance criteria, and respective evaluation methods” (ABNT, 2013). The standard is structured in six parts, in which the construction elements are registered due to requirements related to safety, habitability, and sustainability (ABNT, 2013).

Federal Law nº. 14,118 (Brasil, 2021), instituted under the current federal government, created the Casa Verde e Amarela Program (PCVA) to replace the PMCMV from the perspective of overcoming the country's housing deficit and implementing social housing. The main different aspects of government programs are listed in Table 1.

Table 1

Main distinctions between the Minha Casa, Minha Vida Program (PMCMV), and the Casa Verde e Amarela Program (PCVA)

PMCMV	PCVA
• Objective of reducing the housing deficit and stimulating economic development.	• Aims at promoting the right to housing associated with economic development and raising standards of living, habitability, and quality of life.
• Income limit of BRL 9 thousand.	• Income limit of BRL 7 thousand.
• Single modality: Subsidized and financed housing production.	• Inclusion of modalities of urban land regularization and housing improvement in urban and rural areas.
• PMCMV resources come from OGU, FAR, FDS, FGTS.	• PCVA resources will come from the Union, FNHIS, FAR, FDS, FGTS, Union credit operations signed with multilateral organizations; public or private donations, financial contributions, and others.
• Absence of requirements aimed at the urban insertion of projects that deal with aspects such as innovation, quality, safety, comfort, and environmental preservation.	• Inclusion of Ordinance No. 959/2021 of technical, urban, and socio-territorial requirements structured in four axes: urban insertion, project design, execution of works, and carrying out socio-territorial development actions, which occur largely in the stage of post-occupancy. The ordinance aims to encourage the adoption of sustainable measures in housing developments of social interest.

Source: Brasil (2020).

The PCVA has the goal of serving 1.6 million low-income families by 2024, through the increase of 350 thousand residences in comparison to the targeted by the old housing program (PMCMV), however, it did not include the subsidy policy that was the main innovation previously adopted (Verdélio, 2020).

The PMCMV structure corresponded to the plaintiffs' income range, up to R$9,000.00, which implied the various government subsidies involved. Social Interest Housing (HIS) projects for low-income families with income up to R$ 1,800.00 (Track 1) were mainly developed through the state, which subcontracted private companies to implement them with subsidies from up to 90% of the property value (Triana, Lamberts & Sassi, 2015).

With the transition from the PMCMV to the PCVA, there was a change in the range classification for groups, which implies a reduction in the interest rate charged according to income statements, and no more subsidies, to finance properties - Group 1, families with an income of up to R$ 2 thousand; Group 2, families with income between R$2 and R$4 thousand; and Group 3, families with incomes between R$4,000 and R$7,000 (Depieri & Ramos, 2020). Thus, the lowest stratum, which makes up 70% of the housing deficit, called range 1, was extinguished by the new program.

In addition to this modification, the PCVA added land regularization and housing improvement as measures that could make up the investment value of the program's operation

(Brasil, 2021). However, it is relevant to point out that such actions, as they encourage the entry of private capital, can increase the phenomenon of real estate speculation (Depieri & Ramos, 2020).

Regarding the economic benefits of the PMCMV, the program's investments created the equivalent of 75% of the sector's GDP in 2017, and the generation of about 13% of the average national formal employment in civil construction in the period between July 2009 and December 2017 (Brazil, 2018). As for the collection of taxes, R$106 billion were collected in the sector itself, totaling R$163.4 billion with direct impacts, which translates that over nine years the collection provided by the program exceeded the sum of subsidies given in the period, indicating a return on the resources invested in society (Brasil, 2018).

Despite the PMCMV having offered a significant number of housings, some studies report that most of the projects aimed at middle social classes (bands 2 and 3), were located in more central regions and with greater provision of urban infrastructure, unlike those aimed at the low-income population that were allocated in peripheral regions (Shimbo, 2016; Depieri; Ramos, 2020). This differentiation reflects a socio-spatial inequality inherent to the occupation of urban space, which is a persistent problem in the implementation of the country's housing policy (Depieri, 2016, Kowaltowski et al, 2018; Brasil, 2020).

The urban insertion of projects in housing programs is a challenge that must be overcome to guarantee sustainability guidelines in the implementation of financed projects (Brasil, 2021). Thus, the law establishing the PCVA, in its art. 7, provides that the Union may allocate real estate to private entities, without specific legislative authorization, to achieve the objectives of public housing policies. Therefore, the inclusion of such a provision in the law has the potential to facilitate the administrative procedures for the destination of the Federal Union’s properties, which contributes to the production of housing development on land located in more structured areas and closer to the supply of jobs (Brasil, 2020).

Although most studies on the subject state that the price of land was the main reason for choosing peripheral areas in PMCMV projects, according to Duren (2017) the possibility of building large projects through economies of scale is the main reason homebuilders prefer these locations. This is reinforced by the policy practiced by the above-mentioned sectoral programs, which encourage the execution of large-scale lean constructive practices and operations while maintaining the quality of production.

In this sense, the articulation between the spheres of government and the management of housing programs should seek to consolidate urban development and the resolution of environmental problems, mainly because the raising of the constructive standard has provided more efficient buildings throughout the life cycle. The recently published Ordinance nº. 959 of 2021 presents requirements for innovation, quality, safety, comfort, and environmental preservation, encouraging the adoption of sustainable measures in PCVA HSI projects. The

ordinance's requirements cover four axes: urban insertion, project design, the execution of constructions, and carrying out socio-territorial development actions, which largely occur in the housing post-occupancy stage (BRASIL, 2021). Therefore, this normative enactment represents an advance in the normative scope that contemplates all phases of the projects and aims at a sustainable housing development under the social and territorial aspects.

It should be noted that the high level of standardization in most HSI projects carried out in Brazil, added to the low complexity of the building systems adopted, constitute an opportunity to include measures, specifications, and practices related to the efficiency and sustainability of the building. WRI Brasil (2017) demonstrates the potential result of the use of certain technologies to deal with problems such as water scarcity or drops in energy distribution, either by infrastructure capacity or by variations in climatic conditions, without necessarily requiring a large investment additional to HIS projects.

The real estate market demand for sustainable buildings has been growing, however, it is restricted to large corporations, in which their acquisition is a competitive advantage arising from the global requirements already mentioned here (Lucena, Miotto & De Mori, 2020). There was the dissemination of assessment tools throughout Brazil, the LEED (Leadership in Energy and Environmental Design) for Homes, the AQUA Process, and the first Brazilian methodology, Selo Casa Azul, are the most used in the national territory (Grünber, et al. 2014).

The LEED for Homes was created in 2008, developed by the United States Green Building Council (USGBC). Aimed at the international certification of residential buildings, it is destined to integrate energy and water savings in line with the economy of financial resources. The USGBC (2012) states that "green" and efficient buildings have an engagement in the real estate market far above those that do not incorporate such concepts.

Brazil maintains the 4th position in the world ranking of LEED projects, behind only the United States, China, and the United Arab Emirates (GBCBR, 2018). This certification is already disseminated in more than 160 countries and has four segments, according to the needs of each enterprise. The criteria to attest to the sustainability of the construction refer to location and transport, sustainable space, efficiency in the usage of water, energy, and atmosphere, materials and resources, internal environmental quality, innovation and processes, regional priority credits (GBCBR, 2016).

For AQUA certification process, achieving a building with environmental quality requires a focus on project management in each of its stages, even those not constituted by technical procedures. That is, all flows are considered, accounting for the entire life cycle of building materials. In addition, it is necessary to observe the scenario where the building is inserted, which includes culture, people, buildings, natural and built surroundings, economy, technology, among others. THE AQUA has 14 technical axes, grouped into four themes, all of

which are related to one another, and which must be implemented in the building (Laranja, Alvarez & Campos, 2014).

The genuine Brazilian Selo Casa Azul was developed by Caixa Econômica Federal (CEF) and is an important tool for sustainable construction. It applies to all types of housing development projects submitted to CEF, including HSI projects (CEF, 2010). The acquisition of the Seal is optional and must comply with pre-established quality rules so that the official document indicating compliance with such rules may be issued. The aspects that the CEF (2010) creates for analysis are broad, but they all encompass economic, technical, and social benefits. Enumerating the general categories, we have Urban Quality (category 1); Design and comfort (category 2); Energy efficiency (category 3); Conservation of Material Resources (category 4); Water Management (category 5); Social Practices (category 6).

The bidder who aims to obtain the Casa Azul Seal will have the possibility to obtain the seal in the bronze, silver, or gold category. Although the process of acquiring the seal gives recognition for the good practices carried out, encourages the management of the construction life cycle, and consequently generates a positive image in the market, it is seen that the adhesion of the projects is still small. (Alves, Freitas & Santos, 2017).

The institution of the Education Policy for Sustainable Consumption through Federal Law nº. 13,186 (Brasil, 2015), also drives the market for the acquisition of real estate with sustainable design. This is because it aims to encourage the reduction of consumption in the residential area, environmental certification, and promote the dissemination of the life cycle of products. However, the legislation does not present instruments and indicators for the realization of these goals, which weakens its implementation.

Finally, it is worth mentioning that in 1998 Federal Law nº. 9.605 was created, which deals with Environmental Crimes, in which all and any damage or loss caused to the elements that make up the environment are considered an environmental crime (Brasil, 1998). Such legislation determines that criminal and administrative sanctions are derived from conduct and activities that are harmful to the environment in Brazil (Brasil, 1998). This legislation is relevant to any socio-economic activity, such as civil construction, which may be unable to guarantee environmental protection in the face of its execution.

Conclusions

The economic development in Brazil is linked to the advancement of several sectors, among them, the civil construction sector. This sector is responsible for one of the biggest and most important challenges in the country: guaranteeing the right to housing. Driven by structuring programs of the Federal Government, the share of the Brazilian civil construction chain dedicated to housing in Brazil, in addition to overcoming the housing deficit, must commit

to sustainability, starting from the production of inputs, until the respective consumption of materials and possible generation of waste.

In this context, programs and policies were developed to encourage the productive and sustainable modernization of the construction chain, to meet the housing demands of the entire Brazilian population (MDR, 2020). These programs focus on consolidating the quality of the habitat through sectoral incentives, mainly in the construction industry, through quality certifications, performance evaluations of construction materials, seals, and sustainability certifications, linked to government subsidies for the execution of housing constructions.

The problem of the large housing deficit in Brazil is not just the lack of homes, but the expressive number of precarious, unhealthy, and excessively dense homes (cohabitation in rooms or cohabiting families). Most of the population does not have access to housing either through the market or through public policies. From this perspective, it is important to point out that the new governmental program “Casa Verde e Amarela” must be able to consider these aspects from a sustainable perspective.

Furthermore, through this study, It was possible to verify that the sector’s policies are fundamental for the incentive of sustainable construction, and, therefore, should not only cover the developers, but the entire civil construction chain and the respective life cycles of construction materials. Waste management policies focus only on the construction phase and leave out the phase in which they can be projected, in this case, the industry. Therefore, it is necessary to implement an agreement between the project team and the suppliers, so that unused materials can be recovered.

Efforts with a preventive focus provided for in environmental policies still need incentives so that they are implemented. This is because there are political obstacles that prevent compliance with the sanctions inherent to disrespect to the legislation, and which interfere with sensitive socio-economic aspects such as the generation of jobs.

The accumulation of waste that exists along the construction chain since the acquisition of materials, characterizes the ineffectiveness of waste management. Today, significant volumes of waste are still sent to landfills and do not return to the value chain. This constitutes an imminent challenge not only in Brazil but in many developing countries (Begum et al., 2006; Li et al., 2020; Seror & Portnov, 2020).

The development of strategies as economic and political instruments of the information constitutes an alternative to optimize the management of civil construction waste. In addition, the current legislation based on command and control can be strengthened with concrete goals, and the respective regulation through coercive requirements.

There can also be created economic instruments to strengthen the recycling market policy, provided for in the PNRS, such as charging the use of non-renewable resources, subsidies for recycled materials and construction waste treatment equipment, as well as the

taxation of waste deposition in landfills. These economic incentives are also able to reduce the cost of secondary materials and increase popularity use of sustainable materials.

In the case of information policies, the objective is to create and strengthen mechanisms for the dissemination of technical information, a platform with the presentation of sustainable possibilities for the sector and respective cost savings, labeling of recycled products and products with a lower ecological footprint, in addition, of course, to the technical qualification.

In the specific scope of the implementation of the programs for HIS, some requirements can fit as part of the requirements for approval of construction projects in the PBQP-H, such as: considering the deconstruction during the project phase as well as the possible reforms; requiring a manager specially designated for waste management; reducing points in the program for the management of mixed waste with inadequate segregation; establishing a proportion in the project for recycled materials; specifying sizes; taxing the disposal of mining waste; reusing waste at the construction site.

In Brazil, there is still a lack of a Fiscal Policy that can affect the industrialization of construction sites, to encourage the use of modular structure solutions with the least possible handling. Therefore, even if there is strict legislation, sophisticated incentives are needed to make economic growth compatible with environmental protection.

Finally, it is worth highlighting the importance of public policies, after all, housing and environmental protection are social rights. Only through them is it possible to establish sustainable scenarios, so that the topic does not rest at the mercy of governmental changes.

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References

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities?. *Cities*, *60*, 234-245. https://www.doi.org/10.1016/j.cities.2016.09.009

Alves, D. D. C. M., de Freitas, G. C., & dos Santos, J. L. O. (2017). O Selo Casa Azul como política urbana de incentivo à habitação sustentável e sua relação com o direito à cidade. *Revista Nacional de Gerenciamento de Cidades*, *5*(33). https://www.doi.org/10.17271/2318847253320171604

Associação Brasileira para Reciclagem de Resíduos de Construção Civil e Demolição - Abrecon. (2018) *Reciclagem de resíduos da construção e demolição no Brasil.* Retrieved 05 mar. 2021 from: http://abrecon.org.br

Abrelpe (2019). Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. *Panorama dos resíduos sólidos no Brasil*. https://abrelpe.org.br/panorama/

Begum, R. A., Siwar, C., Pereira, J. J., & Jaafar, A. H. (2006). A benefit–cost analysis on the economic feasibility of construction waste minimisation: the case of Malaysia. *Resources, conservation and recycling*, *48* (1), 86-98. https://www.doi.org/10.1016/j.resconrec.2006.01.004

Brasil (1981). *Lei nº 6.938, de 31 de agosto de 1981.* Dispõe sobre a Política Nacional do Meio Ambiente, seus fins e mecanismos de formulação e aplicação, e dá outras providências. Diário Oficial da União. Brasília, DF: Presidência da República, 1981.

Brasil (1988). *Constituição da república federativa do Brasil. Brasília: Senado Federal, Centro Gráfico*.

Brasil (1998). *Lei nº 9.605, de 12 de fevereiro de 1998*. Dispõe sobre as sanções penais e administrativas derivadas de condutas e atividades lesivas ao meio ambiente, e dá outras providências. Diário Oficial da União. Brasília, DF: Presidência da República, 1981. Retrieved July 12, 2020 from http://www.caurr.gov.br/wp-content/uploads/anexos/leisdecretos/lei_9605_98.pdf

Brasil (2010a). *Lei n. 12.305, de 2 de agosto de 2010.* Política nacional de resíduos sólidos. [recurso eletrônico]. – 2. ed. – Brasília: Câmara dos Deputados, Edições Câmara.

Brasil (2010b). *Decreto nº 7.404, de 23 de Dezembro de 2010*. Regulamenta a Lei no 12.305, de 2 de agosto de 2010, que institui a Política Nacional de Resíduos Sólidos, cria o Comitê Interministerial da Política Nacional de Resíduos Sólidos e o Comitê Orientador para a Implantação dos Sistemas de Logística Reversa, e dá outras providências Retrieved July 12, 2020 from http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7404.htm

Brasil (2015). *Lei nº 13.186, de 11 de novembro de 2015.* Institui a Política de Educação para o Consumo Sustentável. Diário Oficial da União. Brasília, DF: Presidência da República.

Brasil (2018) Ministério das Cidades*. Oportunidades para aperfeiçoamento dos Programas de Provisão Habitacional no Brasil 2019 -2022.* Brasília - DF*.* Retrieved February 03, 2022 from https://antigo.mdr.gov.br/images/biblioteca_snh/2019_2022__Oportunidades_para_Aperfei%C3%A7oamento_dos_Programas_de_Provis%C3%A3o_Habitacional_no_Brasil.pdf

Brasil (2020). Conselho de Monitoramento e Avaliação de Políticas Públicas. *Relatório de Avaliação Programa Minha Casa, Minha Vida.* Brasília - DF*.* Retrieved February 03, 2022 from https://www.gov.br/economia/pt-br/acesso-a-informacao/participacao-social/conselhos-e-orgaos-colegiados/cmap/politicas/2020/subsidios/relatorio-de-avaliacao-cmas-2020-pmcmv

Brasil (2021). *Lei nº. 14.118, de 12 de janeiro de 2021.* Institui o Programa Casa Verde e Amarela. Diário Oficial da União. Brasília, DF. Retrieved March 12, 2021 from http://www.planalto.gov.br/CCIVIL_03/_Ato2019-2022/2021/Lei/L14118.htm

Depieri, M. Á. L.; Ramos, A. P. (2020). Austeridade e pandemia: perspectivas para as cidades brasileiras. Ponto-e-Vírgula: Revista de Ciências Sociais, (27), 135-150. https://www.doi.org/10.23925/1982-4807.2020i27p135-150

Global, B. R. E. (2016). BREEAM International New Construction 2016. *Technical Manual SD233*, 2 ed.

Caixa Econômica Federal (2010). *Selo Azul.* Boas Práticas para Habitação mais sustentável. Coordenadores: Vanderley Moacyr John, Racine Tadeu Araújo Prado . São Paulo: Páginas & Letras - Editora e Gráfica, Retrieved June 19, 2020 from http://www.labeee.ufsc.br/projetos/manual-selo-casa-azul-caixa

Charron Júnior, F. P., & de Oliveira Quesado Filho, N. (2020). A influência das startups no mercado da construção civil brasileiro. *Brazilian Journal of Developmen*t, 6 (8), 56860-56875. https://www.doi.org/10.34117/bjdv6n8-192

Ciccullo, F., Pero, M., Caridi, M., Gosling, J., & Purvis, L. (2018). Integrating the environmental and social sustainability pillars into the lean and agile supply chain management paradigms: A literature review and future research directions. *Journal of Cleaner Production*, *172*, 2336-2350. https://www.doi.org/10.1016/j.jclepro.2017.11.176

Conselho Brasileiro de Construção Sustentável, Programa das Nações Unidas para o Meio Ambiente & Ministério do Meio Ambiente (2014). A*spectos da Construção Sustentável no Brasil e Promoção de Políticas Públicas*. 111 p. Retrieved June 19, 2020 from http://www.cbcs.org.br/website/aspectos-construcao-sustentavel/show.asp?ppgCode=31E2524C-905E-4FC0-B784-118693813AC4

Conselho Nacional de Meio Ambiente (2002). *Resolução nº 307, de 5 de julho de 2002*. Estabelece diretrizes, critérios e procedimentos para a gestão dos resíduos da construção civil. Publicada no DOU de 17 de julho de 2002, Seção 1, p. 95 e 96.

Conto, V., de Oliveira, M. L., & Ruppenthal, J. E. (2017). Certificações ambientais: contribuição à sustentabilidade na construção civil no Brasil. *Revista Gestão da Produção Operações e Sistemas*, *12*(4), 100. https://www.doi.org/10.15675/gepros.v12i4.1749

Dagnino, R. (2002). *Metodologia de análise de políticas públicas.* Campinas: Grupo de Análise de Políticas de Inovação, Universidade Estadual de Campinas.

Deloitte Spain. (2020). *Global Powers of Construction.* Spain: Deloitte Spain. Retrieved March 22, 2020 https://www2.deloitte.com/content/dam/Deloitte/at/Documents/presse/Deloitte-Global-Powers-of-Construction-2019.pdf

Depieri, M. Á. D. L. (2016). *O Programa Minha Casa Minha Vida: política habitacional dos governos Lula e Dilma no período de 2009 a 2014*. (Doctoral dissertation).

Depieri, M. Á. L.; Ramos, A. P. (2020). Austeridade e pandemia: perspectivas para as cidades brasileiras. Ponto-e-Vírgula: Revista de Ciências Sociais, (27), 135-150. https://www.doi.org/10.23925/1982-4807.2020i27p135-150

Elkington, J., & Rowlands, I. H. (1998). Cannibals with forks: the triple bottom line of 21st century business. *Alternatives Journal*, *25*(4), 42.

Euphrosino, C. A., Pimentel, L. L., Camarini, G., Ortigara, Y. V. B., Ruiz, P. V., & Fontanini, P. S. P. (2019). Mapeamento do processo produtivo e construtivo de alvenaria de

tijolo de solo-cimento para habitação de interesse social. *Matéria (Rio de Janeiro)*, *24*(4). https://www.doi.org/10.1590/s1517-707620190004.0848

Fernandes, W. A. (2011). *O movimento da qualidade no Brasil*. 1nd. ed. São Paulo: Essential Idea Publishing.

Froufe, M. M., de Brito Mello, L. C. B., & Soares, C. A. P. (2020). Indicadores de sustentabilidade em canteiros de obras, segundo o PBQP-h/Sustainability indicators on construction sites, according to PBQP-h. *Brazilian Journal of Development*, *6*(3), 10149-10163. https://www.doi.org/10.34117/bjdv6n3-044

Fundação Getúlio Vargas e Associação Brasileira de Incorpordora Imobiliárias (2018). *Análise das Necessidades Habitacionais e suas Tendências para os Próximos Dez Anos*. Abrainc: São Paulo. 64 p. Retrieved June 19, 2020 from https://www.abrainc.org.br/estudos

Fundação João Pinheiro (2012). *Déficit habitacional no Brasil 2009.* 1nd ed. Belo Horizonte: Centro de Estatística e Informações. 200 p. Retrieved June 19, 2020 from http://www.bibliotecadigital.mg.gov.br/consulta/verDocumento.php?iCodigo=76700&codUsuario=0>

Gonçalves, R. (2015) *Ciclo e tendência na construção civil.* São Paulo: Fundação Getúlio Vargas Projeto, Economia, 2015. . Retrieved January 19, 2021 from https://fgvprojetos.fgv.br/sites/fgvprojetos.fgv.br/files/artigo_robson.pdf

Green Building Concil Brasil (2016). *Estatuto do Green Building Council* – Brasil - GBC Brasil. Retrieved June 19, 2020 from http://www.gbcbrasil.org.br/pdf/Modelo_publicacao_site_05_07_2016.pdf

Green Building Concil Brasil (2018). *Brasil ocupa o 4º lugar no ranking mundial de construções sustentáveis certificadas pela ferramenta internacional LEED.* 18 jan 2018. Retrieved June 19, 2020 from https://www.gbcbrasil.org.br/brasil-ocupa-o-4o-lugar-no-ranking-mundial-de-construcoes-sustentaveis-certificadas-pela-ferramenta-internacional-leed/

Grünberg, P. R. M., Medeiros, M. H. F. D., & Tavares, S. F. (2014). Certificação ambiental de habitações: comparação entre LEED for Homes, Processo Aqua e Selo Casa Azul. *Ambiente & Sociedade*, *17*(2), 195-214. https://www.doi.org/10.1590/S1414-753X2014000200013

Kibert, CJ (2008). *Sustainable Construction:* Green Building Design and Delivery. 2nd ed. New Jersey: John Wiley & Sons Hoboken.

Koskela, L. (1992). *Application of the new production philosophy to construction* (Vol. 72). Stanford: Stanford university.

Kowaltowski, D. C. C. K.; Muianga, E. A. D.;Granja, A, D.; Moreira D. C. M., Bernardini, S. P.; Castro, M. R. (2019). A critical analysis of research of a mass-housing programme, *Building Research & Information*, 47:6, 716-733, https://www.doi.org/10.1080/09613218.2018.1458551

Laranja, A. C., Alvarez, C. E. D., & de Paula Campos, N. (2014). Contribuição dos estudos de Alta Qualidade Ambiental à legislação brasileira. *Labor E Engenho*, *8*(1), 93-99. https://www.doi.org/10.20396/lobore.v8i1.226

Li, J., Yao, Y., Zuo, J., & Li, J. (2020). Key policies to the development of construction and demolition waste recycling industry in China. *Waste Management*, *108*, 137-143. https://www.doi.org/10.1016/j.wasman.2020.04.016

Lucena, A. F. E., Miottob, J. L., & De Morib, L. M. (2020). Avaliação de práticas sustentáveis aplicáveis ao projeto e construção de edificações do setor financeiro. *Revista de Engenharia*, (57), 50-58.

Martinez-Jurado, J. (2017). P., & Moyano-Fuentes, J.(2014). Lean Management. *Supply Chain Management and Sustainability: A Literature Review. Journal of Cleaner Production*, *85*, 134-150. https://www.doi.org/10.1016/j.jclepro.2013.09.042

Menegaki, M., & Damigos, D. (2018). A review on current situation and challenges of construction and demolition waste management. *Current Opinion in Green and Sustainable Chemistry*, 13, 8-15. https://www.doi.org/10.1016/j.cogsc.2018.02.010

Ministério do Desenvolvimento Regional (2020). *O PBQHP-H. 2020.* Retrieved June 19, 2020 from http://pbqp-h.mdr.gov.br/pbqp_apresentacao.php

Nercolini, R. V. (2019). *Avaliação do impacto da transição da certificação ISO 9001: 2015 e o não alinhamento com PBQP-H SiAC: 2017 na estratégia organizacional em construtoras de edificações de Curitiba* (Master's thesis, Universidade Tecnológica Federal do Paraná).

Pereira, R. H. M., Nadalin, V. G., Gonçalves, C. N., & Nascimento, I. F. (2019). T*ornar as cidades e os assentamentos humanos inclusivos, seguros, resilientes e sustentáveis:* o que mostra o retrato do Brasil? IPEA: Brasília.

Schreiber, P., & Dusan, I. A. (2016). Análise das práticas de inovação em construção civil. Contextus: *Revista Contemporânea de Economia e Gestão*, Fortaleza , 14 (2), 6-35, 2016.

Seror, N., & Portnov, B. A. (2020). Estimating the effectiveness of different environmental law enforcement policies on illegal C&D waste dumping in Israel. *Waste Management*, *102*, 241-248. https://www.doi.org/10.1016/j.wasman.2019.10.043

Shimbo, L. (2016). Sobre os capitais que produzem habitação no Brasil. *Novos estudos CEBRAP*, 35, 119-133. https://www.doi.org/10.25091/S0101-3300201600020007

Théry, H. (2017). Noveaux paysages urbains du Programme Minha Casa, Minha VidaNovas paisagens urbana do Programa Minha Casa, Minha Vida. *Mercator (Fortaleza)*, 16, 1-14. https://www.doi.org/10.4215/rm2017.e16002

Triana, M. A., Lamberts, R., & Sassi, P. (2015). Characterisation of representative building typologies for social housing projects in Brazil and its energy performance. *Energy Policy*, 87, 524-541. https://www.doi.org/10.1016/j.enpol.2015.08.041

United Nations (1992). *Agenda 21 - Action Plan for the Next Century*. Rio de Janeiro: UNCED. Retrieved June 19, 2020 from https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

United Nations (2000). *Millennium declaration.* Geneva: United Nations. Retrieved June 19, 2020 from https://undocs.org/

United Nations (2015). *The sustainable development goals report.* New York: United Nations. Retrieved June 19, 2020 from https://undocs.org/

United Nations (2019). *Nova Agenda Urbana* (versão em português). New York: United Nations. Retrieved June 19, 2020 from https://nacoesunidas.org/onu-habitat-lanca-versao-em-portugues-da-nova-agenda-urbana

United States Green Building Concil (2012). Retrieved August 19, 2020 from http://www.usgbc.org

Vechi, N. R. G., Gallardo, A. L. C. F., & Teixeira, C. E. (2016). Aspectos ambientais do setor da construção civil: uma contribuição para a adoção de sistema de gestão ambiental pelas pequenas e médias empresas de prestação de serviços. *Sistemas & Gestão*, 11(1), 17-30. https://www.doi.org/10.20985/1980-5160.2016.v11n1.733

Verdélio, A (2020). *Governo lança Programa Casa Verde e Amarela*. Agência Brasil. Brasília. Retrieved July 01, 2020 from: https://agenciabrasil.ebc.com.br/economia/noticia/2020-08/governo-lanca-programa-casa-verde-e-amarela

Vieira, E. S., & de Oliveira Neto, J. M. (2019). Qualidade na Construção Civil: PBQP-H-Análise do Programa Brasileiro de Qualidade e Produtividade do Habitat. *ETIS-Journal of Engineering, Technology, Innovation and Sustainability*, 1(1), 54-64.

World commission on environment and development. (1987) *Our common future*, v. 17, p. 1-91. Retrieved March 12, 2021 from https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/8942/WCED_79365.pdf?sequence=1&isAllowed=y

World Ecocity Summity. (2008) *San Francisco Ecocity declaration*. Ecocity Media (blog), San Francisco. Disponível em: http://ecocity.wordpress.com/2008/05/15/san-franciscoecocity-declaration

WRI Brasil (2017) *Sustentabilidade em Habitação de Interesse Social* - Benefícios e custos de medidas para eficiência no consumo de água e energia. https://wribrasil.org.br/sites/default/files/Sustentabilidade-em-Habitacao-de-Interesse-Social_mar18.pdf