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Green Factor Certification: The Experience Of Fortaleza And Its Potential For Advancing The Sustainable Development Goals (SDGs) And The Energy Transition In Cities

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Abstract:
Background: *Urban sustainability certification procedures in Brazil, commonly referred to as green labels, play a relevant role in encouraging practices aimed at mitigating environmental impacts and fostering the energy transition in metropolitan areas. In this context, the municipality of Fortaleza launched the Green Factor Certification Program in January 2017, inspired by international methodologies such as LEED and AQUA. The initiative seeks to align urban development with the Sustainable Development Goals (SDGs) established by the 2030 Agenda.*
Materials and Methods: *This study adopts a qualitative research design, based on documentary and bibliographic analysis. The investigation examines the legislative framework and recent municipal regulatory instruments related to urban sustainability. Particular attention is given to the integration between the City Code (Complementary Law No. 270/2019) and the New Participatory and Sustainable Master Plan (Complementary Law No. 450, of November 27, 2025), which together structure the local governance model for sustainable urban development.*
Results: *The analysis demonstrates that the articulation between these regulatory instruments has strengthened mechanisms aimed at improving energy and water efficiency in buildings. The 2025 legislation introduced urban incentives, including the Green Granting of Development Rights, which expanded the operational scope of the Green Factor Certification and reinforced its role within municipal planning and control processes.*
Conclusion: *The findings indicate that the institutionalization of incentives linked to sustainability certification has consolidated the Green Factor as an effective governance instrument. The experience of Fortaleza not only contributes to the achievement of the SDGs but also prepares the built environment for decarbonization. As such, it stands out as a reference model for the formulation and implementation of large-scale public policies focused on technological innovation, energy transition, and climate resilience.*
Key Word: *Green Label; Energy Transition; Master Plan; Urban Planning; Fortaleza.*

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I. Introduction

The movement associated with green certification processes and, consequently, with sustainable buildings is directly connected to the early stages of social agglomerations and their subdivisions during the formative periods of society as it is known today. The first cities were built based on locally available materials and in accordance with the climatic particularities of different regions of the world.

Subsequently, discussions related to the environmental agenda, already within a more developed societal context and guided by the impacts resulting from the Industrial Revolution, gained prominence. The revolutionary transformation of production processes came to be understood as a key factor in the intensification of environmental degradation, particularly with regard to the global climate scenario. As a result, environmental issues became the subject of ongoing debate, with the aim of enabling socioenvironmental improvements across multiple spheres.

From this perspective, green certifications emerge as a form of remediation for agents responsible for environmental degradation. By encouraging the adoption of good practices in construction processes and urban land use, these certifications contribute to the requalification of environmental structures in relation to consolidated urban frameworks (Keeler & Burke, 2011).

Still within the context of awareness in the construction sector and urban occupation, the role of external agents that influence and disseminate these ideas must be highlighted, particularly international organizations and their respective commissions dedicated to advancing the environmental agenda. In this regard, the United Nations (UN) has played a central role through the establishment of climate conferences that have enabled broad and effective discussions on tools to combat climate change (Keeler & Burke, 2011).

One of the instruments adopted in this context is the Sustainable Development Goals (SDGs), defined as a global call to action to end poverty, protect the environment and the climate, and ensure that people everywhere can enjoy peace and prosperity. These goals are monitored through the 2030 Agenda, which encompasses 17 Sustainable Development Goals and 169 global targets, established by the United Nations General Assembly in 2015 through an agreement signed by 193 Member States.

In 2017, the municipality of Fortaleza launched the Green Factor Certification Program, designed in accordance with sustainability guidelines derived from international climate agreements and their outcomes. This certification was structured around four core dimensions: Land Subdivision, Construction, Activities, and Products (Municipality of Fortaleza, 2021).

The Green Factor Certification Program aims to encourage the use of sustainable methodologies, products, and/or construction systems, as well as environmental actions intended to reduce socioenvironmental impacts and consequently improve urban quality of life and environmental conditions (Yergin, 2014). The program is based on a set of criteria organized into the following dimensions: Sustainable City Factor; Healthy Environmental Factor; Energy Factor; Water Factor; Materials and Waste Factor; and Social Factor.

Normative Instruction SEUMA No. 01, of July 15, 2021, regulates the procedures for issuing certificates associated with the Green Factor Certification Program. In addition, the program is provided for in the City Code, Complementary Law No. 270, of August 2, 2019, of the Municipality of Fortaleza, which establishes the guiding principles to ensure the effectiveness of certification and compliance with the SDGs.

In light of the above, the objectives associated with this review of the Fortaleza experience, focusing on the green certification label as an initiative to promote the Sustainable Development Goals and the energy transition, seek to understand the applicability of current legislation on the subject. This analysis correlates the definitions and proposals of the certification with the realities faced by large cities.

The study adopts a qualitative and descriptive approach, employing two research procedures: bibliographic research and documentary analysis.

The general objective of this study is to analyze how the integration between the City Code (Complementary Law No. 270/2019) and the New Participatory and Sustainable Master Plan (Complementary Law No. 450, of November 27, 2025) enhances the energy and water efficiency of buildings.

The specific objectives are as follows: to analyze the dimensions and technical criteria of the Green Factor Certification Program, identifying its requirements, indicators, and contributions to the promotion of sustainable practices in the urban environment; to examine the applicable legal framework, from environmental licensing to the City Code, assessing its coherence, scope, and impact on the implementation of policies and projects focused on sustainability and the energy transition; and to investigate how the guidelines of the Fortaleza 2040 Plan incorporate the energy transition, analyzing its strategic objectives, implementation instruments, and alignment with sustainable urban development goals.

This scientific article was carefully structured to ensure not only clarity in the presentation of ideas but also coherence among the arguments and the academic rigor required for this type of scholarly work. Accordingly, the text was developed to meet strict academic standards while remaining accessible to the reader.

The first section, the Introduction, presents the contextualization of the topic, the research problem, and the objectives guiding the investigation. This section is essential for providing the reader with a comprehensive overview of the issues addressed in the study.

The subsequent Methodology section clearly and systematically describes the research procedures, as well as the methods and techniques applied throughout the investigation.

The Theoretical Framework discusses the main normative and conceptual references that underpin the proposed analysis. This section is particularly important, as it establishes the theoretical foundations that support and guide the research.

Finally, the Final Considerations compile and systematize the main findings of the study, highlighting its significant contributions to the field. In addition, this section points to potential avenues for future research, indicating directions that subsequent studies may follow in order to further deepen understanding of the topic addressed.

II. Material And Methods

The approach adopted for this research is qualitative and descriptive in nature. This methodological choice allows for an in-depth analysis of public policies and social phenomena that cannot be adequately quantified solely through numerical data, focusing instead on understanding the implementation of the green certification label within the urban context of Fortaleza. As noted by Flick (2009, p. 20), "qualitative research is oriented toward the analysis of concrete cases in their temporal and local particularities, based on the expressions and activities of people within their local contexts."

Regarding research procedures, bibliographic and documentary research were employed. Official documents issued by the Municipality of Fortaleza were analyzed, including the City Code and normative instructions published by SEUMA, as well as technical data from institutions such as ANEEL and IPECE. According to Gil (2021, p. 44),

Documentary research closely resembles bibliographic research, with the essential distinction lying in the nature of the sources: while bibliographic research primarily draws on the contributions of various authors on a given subject, documentary research relies on materials that have not yet undergone analytical treatment.

The five most relevant authors and institutions for the development of this study, listed in chronological order of the referenced works, are as follows: Keeler and Burke (2011), whose contributions are fundamental to understanding sustainable building design; Yergin (2014), essential for discussions on energy issues and the modern environmental context; UN Brazil (2017), which provides the basis for contextualizing the Sustainable Development Goals (SDGs); the Municipality of Fortaleza (2017/2019), serving as the primary source on the creation of the Green Factor Certification Program and the City Code; and ANEEL (2022), which provides statistical data on the wind and solar energy generation matrix.

III. Theoretical Framework

This theoretical framework was organized into three subsections. The first examines in detail the operation of the Green Factor Certification Program and its evaluation criteria. The second discusses the municipal legislative framework that underpins environmental policies, with particular emphasis on the City Code. The third analyzes the integration of these initiatives with the Fortaleza 2040 strategic plan and its energy transition targets.

The Green Factor Certification Program: Dimensions and Technical Criteria

The Green Factor Certification Program of Fortaleza is a voluntary urban policy instrument designed to encourage the adoption of construction methodologies and systems that reduce socioenvironmental impacts. The certification structure is organized into four levels—Bronze, Silver, Gold, and Diamond—granted according to compliance with mandatory criteria and the accumulation of points from optional criteria.

The technical assessment is carried out by a multidisciplinary team from the Municipal Secretariat of Urbanism and Environment (SEUMA), composed of architects, civil and environmental engineers, environmental managers, and biologists. To obtain the Bronze certification, for instance, compliance with at least twelve mandatory criteria is required. The following sections detail the dimensions (factors) that constitute the analytical framework of the Green Factor for Construction, which serves as the technical basis for the other certification modalities, namely Land Subdivision, Activities, and Products.

Sustainable City Factor

This factor evaluates the integration of the development into the urban context and its contribution to biodiversity and mobility. Mandatory criteria focus on the preservation of water resources, facilitated access to public transportation, and the implementation of so-called urban amenities, defined as on-site interventions that generate benefits for public space. Optional criteria include urban connectivity, rehabilitation of historic assets, the use of active façades to stimulate street dynamics, and soil permeability levels exceeding the minimum legal requirements.

Healthy Environment Factor

This dimension addresses the quality of life of building occupants and overall environmental comfort. Mandatory criteria establish natural lighting as a basic requirement to ensure health conditions and reduce reliance on artificial lighting. Optional criteria encompass thermal and acoustic comfort, natural ventilation, indoor air quality, and the installation of green infrastructure, such as green roofs and vertical gardens, which contribute to mitigating urban heat island effects.

Energy Factor

This is one of the central dimensions for energy transition and the reduction of greenhouse gas (GHG) emissions. Mandatory criteria require the use of efficient lighting systems throughout all project areas.

Optional criteria encourage on-site renewable energy generation, such as photovoltaic systems, building automation, the use of high-efficiency elevators, and the monitoring of GHG emissions associated with the development.

Water Factor

This factor focuses on the rational management of water resources, which are particularly scarce in the semi-arid region. Mandatory criteria include the use of low-consumption sanitary fixtures and fittings, as well as the compulsory installation of rainwater harvesting systems for non-potable uses. Optional criteria involve smart water metering through individual telemetric systems, efficient irrigation technologies, and advanced graywater reuse systems.

Materials and Waste Factor

This dimension evaluates the life cycle of construction activities and the environmental impact of generated waste. Mandatory criteria require selective waste storage, strict control of impacts during the construction phase, and proper disposal of construction and demolition waste. Optional criteria award projects that adopt prefabricated systems, use regional materials to reduce transportation-related carbon emissions, incorporate recycled materials, and employ certified wood.

Social Factor

The final dimension focuses on human impact and awareness-building. Mandatory criteria include socioenvironmental education for workers and users, as well as sustainability-oriented communication strategies. Optional criteria encompass universal accessibility, inclusive design, and social participation in decision-making processes related to the development.

Relevant Legislation: From Environmental Licensing to the City Code

The development of Fortaleza, currently the fifth most populous state capital in Brazil and home to the eighth largest economy in the country (IBGE, 2023), poses complex challenges for public administration. Rapid population densification requires effective mechanisms capable of reconciling urban expansion with the preservation of environmental assets (Han, 2019). Within this context, the capital of Ceará has consolidated a legislative framework that positions sustainable development not merely as a guiding principle, but as a strategic condition for metropolitan consolidation.

The Green Factor Certification operates as the operational arm of a multilevel normative framework. At the national level, the program aligns with the National Energy Efficiency Policy (Law No. 10,295/2001) and the National Solid Waste Policy (Law No. 12,305/2010). At the local level, its structure was initially grounded in the City Code (Complementary Law No. 270/2019) and has since been significantly strengthened by Complementary Law No. 450, of November 27, 2025, which established the new Participatory and Sustainable Master Plan of the Municipality of Fortaleza (Municipality of Fortaleza, 2025).

The integration between the City Code (Arts. 19–21) and the new Master Plan (CL 450/2025) establishes four foundational pillars supporting environmental certification:

1. **Innovation and Economic Efficiency**
   The legislation encourages technological innovation and the transition toward a low-carbon economy. With the enactment of the new Master Plan, Sustainable Development Zones (SDZs) were established, within which incentives for eco-efficiency leverage public procurement power and urban concessions to foster green markets (Municipality of Fortaleza, 2025).
2. **Impact Management and Urban Resilience**
   In addition to adopting rigorous criteria for public procurement, the new Master Plan prioritizes the mitigation of environmental damage through Nature-Based Solutions (NBS). The legal framework reinforces mandatory measures to combat urban heat islands and ensure water security, effectively transforming Green Factor criteria into licensing parameters (Municipality of Fortaleza, 2025).
3. **Recognition and Urban Planning Incentives**
   A distinctive feature of CL 450/2025 is the creation of the Green Granting of Development Rights (Outorga Onerosa Verde). This mechanism allows developers who meet high-performance Green Factor requirements to obtain benefits related to building indices, thereby recognizing socioenvironmental practices through economic feasibility (Municipality of Fortaleza, 2025).
4. **Continuous Improvement and Monitoring**
   The legislation ensures that environmental management keeps pace with demographic dynamics, requiring continuous updating of municipal services and transparency in disseminating a culture of sustainable consumption (Municipality of Fortaleza, 2025).

Thus, Fortaleza's legal framework, consolidated by the 2025 Master Plan, moves beyond a merely restrictive approach to become an active inducer of best practices. It provides the legal certainty necessary for the private sector to adopt the efficiency criteria proposed by the Green Factor, definitively integrating the city into the urban resilience and sustainability targets projected for 2040 (Municipality of Fortaleza, 2025).

The New Master Plan of Fortaleza (Complementary Law No. 450, of November 27, 2025) and Sustainability

The enactment of Complementary Law No. 450 on November 27, 2025, establishes a new paradigm for urban development in Fortaleza, consolidating sustainability not merely as a conceptual aspiration but as a mandatory guideline for territorial planning. This new Participatory Master Plan (PMP) functions as the primary governance instrument for addressing the challenges of a metropolis seeking to align population densification with climate resilience (Municipality of Fortaleza, 2025).

Unlike previous legislation, CL 450/2025 integrates environmental certifications, such as the Green Factor, into the system of urban planning incentives. Sustainability is addressed through three fundamental axes that are directly connected to energy transition and water efficiency criteria:

Eco-efficiency Incentives and the Green Granting of Development Rights

The new Master Plan establishes compensation mechanisms for developments that adopt Nature-Based Solutions. Buildings demonstrating high performance in energy efficiency and water reuse, in accordance with Green Factor Certification parameters, may receive benefits related to the Floor Area Ratio, thereby converting sustainable investment into direct economic feasibility for the construction sector (Municipality of Fortaleza, 2025).

Decarbonization and Active Mobility

The legislation prioritizes the "15-Minute City" concept, encouraging mixed land use and the implementation of active façades. This strategy aims to reduce the urban carbon footprint by decreasing dependence on motorized transport and promoting walkability, directly contributing to the targets of SDG 11 (Sustainable Cities and Communities).

Environmental Management and Water Resilience

CL 450/2025 reinforces the mandatory adoption of sustainable drainage systems and the maintenance of permeable areas in new subdivisions and large-scale developments. These measures are essential for mitigating urban heat islands and preventing flooding, ensuring that the built environment operates in harmony with the local hydrological cycle.

In summary, the 2025 Master Plan removes the Green Factor Program from a purely voluntary domain and positions it as a strategic licensing instrument. By requiring that economic development respect the limits of natural resources, the legislation prepares Fortaleza to attract green investments and to consolidate its position as a national reference in technological innovation and sustainable public governance (Municipality of Fortaleza, 2025).

Energy Transition and the Fortaleza 2040 Plan

Energy transition in Brazilian metropolitan areas requires more than a mere change in the electricity generation mix; it demands integrated urban planning that takes into account demographic growth and building efficiency. In the case of Fortaleza, this strategic vision is consolidated through the Fortaleza 2040 Plan, a long-term urban development instrument that has reached a stage of maturation after completing its first four-year implementation cycle between 2017 and 2020.

The Fortaleza 2040 Plan was designed to structure a more equitable and resilient city and is organized around strategic axes of action. Axis 4, which specifically addresses Environmental Quality and Natural Resources, constitutes the core of the municipality's energy transition strategy (Municipality of Fortaleza, 2021). Its strategic objectives are grounded in four fundamental pillars: (i) natural resources, resilience, and environmental comfort, focused on mitigating urban heat islands and promoting climate adaptation; (ii) basic sanitation, essential for public health and environmental preservation; (iii) renewable energy and energy efficiency, which promotes decentralized energy generation and the use of clean sources; and (iv) water security, which is vital for the sustainability of a capital city located in a semi-arid region.

Within this framework, Fortaleza 2040 acts as a consolidating platform for practical initiatives, such as environmental certification programs. The Green Factor label thus becomes an executive instrument that delivers buildings, activities, and products aligned with these sustainability parameters, enabling the private sector to contribute directly to the achievement of the global targets established by the Sustainable Development Goals (SDGs).

Complementing these guidelines, the municipality implemented the Fortaleza Sustainable City Program (Programa Fortaleza Cidade Sustentável – FCS). This program prioritizes the Municipal Environmental Policy and strengthens investments in sanitation, revitalization of public spaces, and restoration of green areas. Its structure seeks to promote a balanced integration between the built and natural environments, ensuring that urban expansion does not occur at the expense of local ecosystems.

According to Hallack et al. (2023), energy transition should be understood as a process that integrates energy security, economic development, and socioenvironmental justice. In this context, local public policies play a decisive role, as they establish the necessary conditions for the adoption of renewable energy sources, improvements in energy efficiency, and the reduction of inequalities in access to energy. In Fortaleza, sustainable urban planning and municipal structuring programs are aligned with this perspective, promoting a transition that combines technological innovation, public governance, and social inclusion, thereby linking the city's energy agenda to global sustainability trends and contemporary demands for a just transition.

Energy transition in Fortaleza is therefore fostered through the creation of these governmental planning instruments. They ensure continuity in public actions and encourage the private sector to adopt advanced technologies, such as photovoltaic microgeneration and building automation systems, enabling the capital of Ceará to progress toward greater energy autonomy and the systematic improvement of its citizens' quality of life.

IV. Conclusion

The research fully achieved its proposed objectives, as it made it possible to analyze how Fortaleza's Green Factor Certification Program operates as a catalyst for sustainable urban development, now under the framework of the New Participatory Master Plan (Complementary Law No. 450/2025). Based on the evidence gathered, it became clear that the certification has moved beyond the condition of a purely voluntary instrument to assume a strategic role in the implementation of the 2030 Agenda, linking criteria related to construction, activities, and products to Sustainable Development Goals (SDGs) 7, 11, 12, 13, and 17.

The study demonstrates that environmental certifications should be understood as central pillars of urban energy transition and decarbonization processes (IEA, 2021). The analysis of Ceará's electricity matrix, characterized by the prominent role of wind and solar energy, indicates that the regional infrastructure is highly conducive to technological innovation (Ceará, 2011). Nevertheless, the findings reveal that the effectiveness of these policies depends on systemic integration between governmental planning instruments, consolidated through the Fortaleza 2040 Plan and the New Master Plan, and the active engagement of the private sector (Municipality of Fortaleza, 2025). The introduction of mechanisms such as the Green Granting of Development Rights and the Sustainable Development Zones (SDZs) in the 2025 legislation illustrates that the success of sustainable urban governance lies in converting environmental targets into urban planning incentives and economic feasibility.

Finally, it is recommended that the municipal government expand transparency mechanisms for disseminating the results of certified and pre-certified developments. The consolidation of the Green Factor's credibility among civil society and the real estate market depends on the clear and public demonstration of tangible efficiency gains, such as the effective reduction of greenhouse gas (GHG) emissions and savings in water resources. In addition, continuous improvement of fiscal incentives, such as the Green Property Tax (IPTU Verde), is suggested to ensure that sustainability becomes the normative standard for new developments in Fortaleza.

Future research may focus on the quantitative monitoring of the energy and water performance of buildings after extended periods of operation, comparing actual performance with project-phase self-declarations. It is also relevant to conduct studies on the impact of the New Master Plan on the real estate valuation of certified assets, with a view to refining local criteria and assessing the potential replication of this model in other Brazilian metropolitan areas seeking alignment with climate resilience and the global energy transition.

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