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A review on the integration between urban and energy planning considering the planning tools

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1. INTRODUCTION

Integration between energy and urban planning is of great importance considering that the need for energy, the control of greenhouse gases (GHG) and air pollution are directly related to the physical, social, economic and environmental aspects of cities. Recent studies relate the urban form to the behavior of energy demand, or even propose models of integration between urban and energy planning in order to reduce energy consumption and/or make it more efficient as well as reduce GHG emission. Such studies are part of a sequence of researches that end up influencing or were influenced by the movement of researchers who highlight the importance of integrating planning in order to influence lifestyles through urban planning.

2. OBJECTIVES

Considering the relevance of the theme, we propose a systematic review of the literature with the objectives: i) to identify the main proposals for the integration of urban and energy planning; ii) to highlight the main techniques, strategies and solutions on the theme, disregarding studies that deal with separate plans; iii) to highlight the main planning tools that approach the theme in an integrated manner in order to obtain the necessary basis to propose a solution taking into account the Brazilian scenario, due to the country's peculiar characteristics such as the increased use of DG using photovoltaic (PV) power.

3. METHODOLOGY

The review is conducted following specific questions: "What are the existing tools and criteria applied for integrated planning?" and "What are the principles and criteria for assessing the Integration of Urban and Energy planning?". The specific review protocol is defined using a specific tool for systematic reviews, in order to include the maximum possible number of studies in the area.

The exclusion criteria are: Study related to the use of BIPV, situation of the use of DG, simply representing a literature review, that is, without proposing a new contribution, dealing with specifically related regulatory acts the generation of electric energy; and present case studies not applicable to the Brazilian scenario, Aesthetic impact of solar energy systems, CO2 emissions and urban and energy resilience.

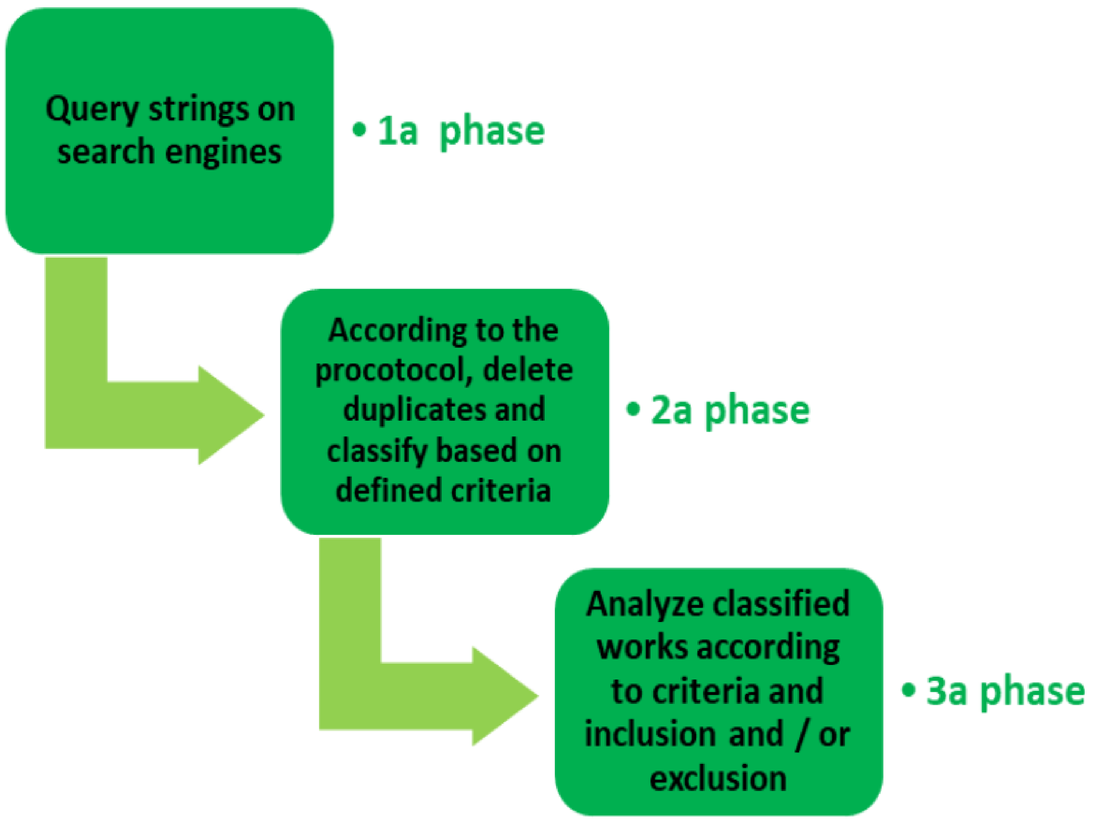

Fig. 01 – Flowchart of the Systematic Review process "1st phase, 2nd phase, 3rd phase"

The 120 articles classified with very high priority were read in full and of these 34 were selected due to the relationship of congruence with the topic under study and importance to answer the questions proposed in this work.

4. REVIEW RESULTS

After the evaluation of selected articles that deal with integration tools between urban and energy planning, 20 programs with characteristics within the scope of the research are identified: Balmorel, CEA, Dieter, District ECA, EnergyPlan, EnergyPro, Grid LAB–D, Homer PRO, HUES, iHOGA, Insel, Oemof, OSeMOSYS, RETScreen, SIREN, Solarius PV, SOLergo, Synergi Electric, Urbs and WebOpt. For each paper and according to the literature, five functionalities are analyzed: 1) Simulation; 2) Scenario generation capacity; 3) Energy conditioning; 4) Tool integration with GIS; 5) Capacity of integration with cities master plans.

Fig. 02 shows the number of functionalities that each tool has. This becomes a selection factor for choosing tools that deal with the integration between energy and urban planning, since the two biggest differentials are GIS, which provides local climatic and related conditions, and Integration with Master Plans, which subdivides and classifies the city between socially and environmentally appropriate regions and the unviable regions.

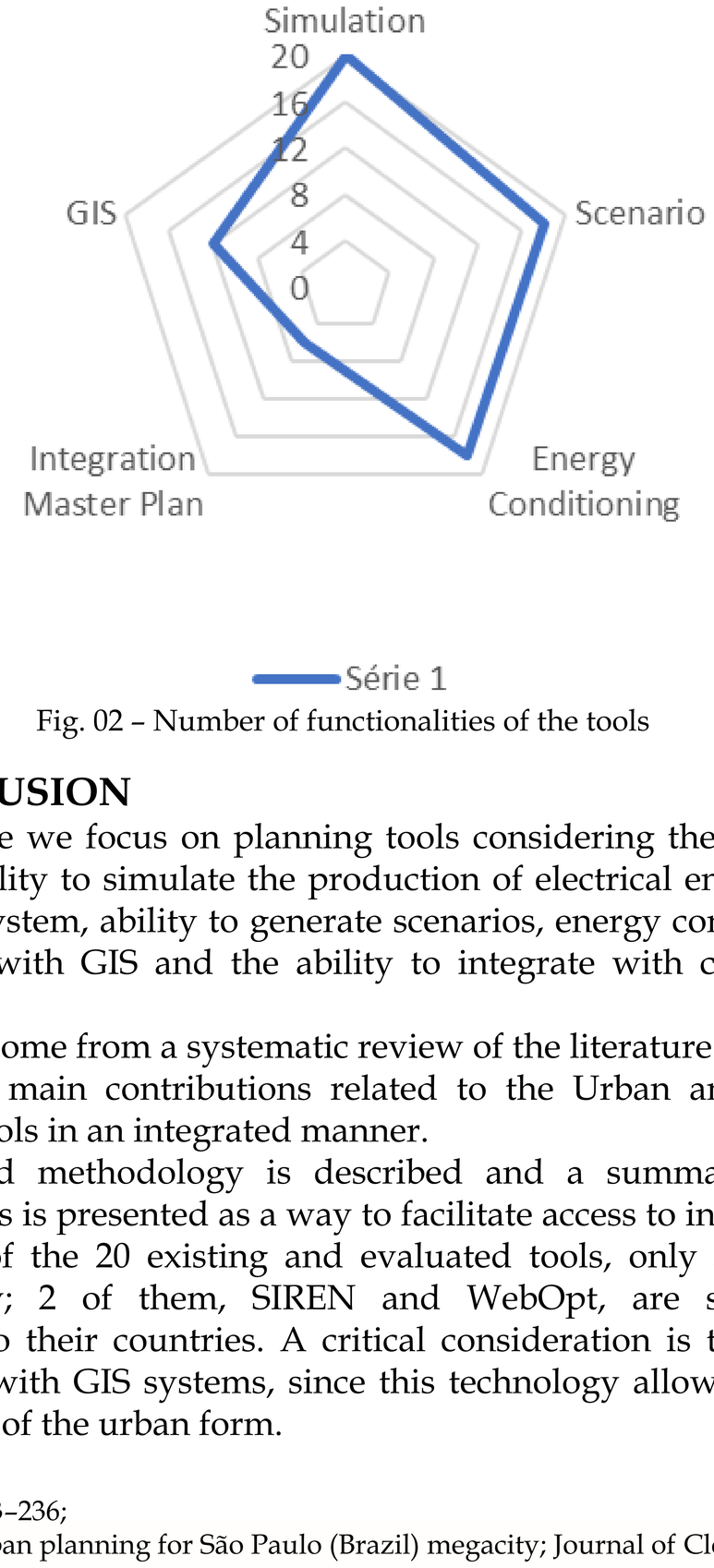

Fig. 02 – Number of functionalities of the tools

5. CONCLUSION

In our article we focus on planning tools considering the following features: ability to simulate the production of electrical energy from an energy system, ability to generate scenarios, energy conditioning, integration with GIS and the ability to integrate with city master plans.

The results come from a systematic review of the literature seeking to analyse the main contributions related to the Urban and Energy Planning Tools in an integrated manner.

The adopted methodology is described and a summary of the selected tools is presented as a way to facilitate access to information. Currently, of the 20 existing and evaluated tools, only 5 meet all functionality; 2 of them, SIREN and WebOpt, are specifically applicable to their countries. A critical consideration is the lack of integration with GIS systems, since this technology allows the real-time update of the urban form.

6. BIBLIOGRAPHY

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