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## Urban form and ecological footprint:

# Urban form and ecological footprint: A morphological analysis for harnessing solar energy in the suburbs of Cuenca, Ecuador.

Giovany Albarracin<sup>\*a</sup>

<sup>a</sup> *Catholic University of Cuenca, Ecuador*

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### Abstract

This article discusses the potential of incorporating solar energy in suburban environments rapidly expanding to new growth models, the case study is Cuenca, representative city of Ecuador and Latin America, Cuenca is an intermediate city where 65% of the population is already urban, and projections for the next 30 years make Cuenca one of the cities with one of the fastest growth rates in Latin America. Therefore, incorporating renewable energy could contribute to a reduction of the ecological footprint.

A brief literature review was conducted to establish the conceptual basis of the investigation; three zones most peripheral growth in this city were identified for morphological analysis to answer the following questions: What is the energy demand of the neighborhood?; What is the solar potential of this area? and especially what you are able to meet demand this potential? All this information allowed simulation exercises in order to look at the impact of settlements against the consumption of land according to the use of different types.

The most important results achieved in this study are to establish the relationship between typology and land consumption, areas of optimal solar collection, and especially affirm the possibility of making the transition from fossil fuels to renewables, specifically solar energy in the suburban area of Cuenca - Ecuador.

It is expected that this information is relevant to decision making by designers and planners is the most successful in this search for new growth models using renewable energy reduce the ecological footprint and simultaneously improve the quality of life of the people who live there.

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\* Corresponding Author: Tel: +593-6313-26766  
*Email Address:* [galbarracin@ucacue.edu.ec](mailto:galbarracin@ucacue.edu.ec)

## 1. Introduction

The beginning of the XXI century will be remembered as the moment in which the world's population lives more in cities than in the countryside and it is estimated that by 2050 75% of the population will live in cities (1), Latin America and the Caribbean is one of the most urbanized regions of the planet (2). The city of Cuenca meets the ideal characteristics for this study, since 65% of its population is already urban and its growth in the next 30 years will be one of the highest in Latin America (2), Being the consumption of soil a primary concern of the city, knowing also that this growth is occurring in the edge areas , a border zone, diffuse, that call suburban; forming large urban spots in decline and also with a high risk of compromise: water bodies, agricultural land, environmental corridors, etc. With negative environmental consequences and detriment of the quality of life of this city.

The Paris Agreement recognizes that climate change is a problem of all mankind and the importance of taking measures to cope, further noting the importance of ensuring the integrity of all ecosystems and biodiversity protection. Keeping the global temperature increase well below two degrees Celsius compared to pre-industrial levels, and continue efforts to limit the temperature rise to 1.5 degrees C. recognizing that this will considerably reduce the risks and effects of climate change. (3) Therefore the biosphere, soil, as the most precious resource not only as support activities but as a supplier of resources that allow the lives of all the species that inhabit the planet, including humans, as well as responsible for absorbing the waste; has exceeded its carrying capacity has reached its ecological limit, (4) in consequence their rational use is imminent. Urbanism and architecture, have a great responsibility in this generation being responsible for 30% of Co2 emissions on the planet (5). Therefore it is necessary to rethink and change the paradigm of urban growth, preserve the legacy nature as a treasure will be necessary to resist. (6) Observation of land use is very important to look ahead and try to propose systems environmentally responsible.

There are many reasons for these settlements are in the periphery: high urban land cost, subsidized fuel derived from fossil sources, etc., allowing the irrational use of individual transport, resulting in the degradation of the environment and the quality of life (7); considering the complexity of the problem and focus only linked to a pair of variables an understanding of it is intended through the morphological analysis of three areas of peripheral growth, which aims to observe the following:

a.- Theoretical Framework: The objective of this section is to understand the story that justifies the ecological urbanism considered relevant today, starting in the mid-nineteenth century with the thought of Patrick Geddes, Lewis Mumford and Ian McHarg, to end these days with renowned researchers such as William Rees and Jeremy Rifkin.

b.- Definition Case Study: Cuenca - Ecuador is the case study selected to be a representative city of this country and the region, has been selected three study areas where the greatest growth is producing city to finally make the morphological analysis to extract relevant information to achieve sustainable growth.

c.- Ecological footprint and urban form: the actual information Nourished energy consumption of the study areas and once established and pre sizing the required area of photovoltaic solar capture, simulate precedent models under different variables such as growth are: density , types, forms of organization, etc. Provide relevant information to designers and urban planners that enables the creation of new models of planning that promote growth that respects the environment and at the same time meet the growing demand for housing.

The results provide with guidelines optimum occupancy rates in relation to soil density, solar gain and type, capable of providing clean energy to meet the energy needs and not compromise the needs of future generations (8) ; and allow make more informed when facing new patterns of sustainable design decisions.

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