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Towards solar urban planning: A new step for better energy Performance case of study Ibenbadis, Constantine (Algeria)

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Abstract

The energy consumption in Algeria has a fast growing rate 1 % per year. The actual reserves of natural gas and oil will be only covering the demand of the Algerian population for the next 50 years in the case of oil, and for the next 70 years in the case of natural gas as Algeria is considered the 3rd country in the world for the natural gas reserve, and in addition to that fossil fuel use is associated with significant environmental impacts such as global climate change, air pollution. Therefore the integration of renewable energies is a vital priority for the third world countries such Algeria. The aim of this paper is to apply and explore a methodology of solar integration in the urban planning in order to reach zero energy buildings (ZEB) target. To achieve the objective several analyses has to be made such as a solar potential, urban and environmental analysis.

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Keywords: zero energy building; solar energy; urban planning; photovlotaic systems; urban analysis; Algeria

1. Introduction

According to the French urban planner Le Corbusier [1] urban planning is a science which organizes lands in scientific, aesthetic and orderly manner, it aims is to create good physical, social and environmental conditions as well as promoting the health and well-being of communities. The rapid increase of the population in the third world countries forces a high level of urbanization affects the social and environmental situation and creates problems such as deforestation and the reduction of agriculture lands, as well as site degradation etc. For the past decades urban

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planners and scientists works with several tools and models in order to integrate renewable energies for the urbanization as an example the geographic information systems [2]; Cellular automat (CA) tool which is a model for urban growth applicable for cities expansion, the model operates to help urban planner to define the pattern of land and the zoning use and the urban expansion, the CA tools operates with the geographic information systems [3]; GUUD model developed by Amado & Poggi [4] which is a model that assumes the division of an urban area into cellular units according to delimitation criteria (population density, construction time line, data for renewable energies and urban morphology), the process of GUUD model is the collection of data inputs and which are the basis of the workflow that combines GIS with parametric modelling and renewable energies dynamic analysis, it aims in enhancing the use of renewable energies in urban areas in order to reduce energy loads and GHG and other pollutants.

Several urban planners and scientists have started the development of sustainable urban plans to protect the environment and guarantee that the expansion of the cities process lead to a sustainable outcomes [5], on this paper the methodology of Amado & Poggi [4] (see Fig. 1) which has been developed in order to integer the solar energy in urban planning for the city of Alcabideche (Portugal) to reach a goal of Zero Energy buildings have been explained and applied to a case of study Ibenbadis (Constantine, Algeria).

2. The program of intervention and description of energy model

The situation of the studied area which have a surface of 4.4 ha (see Table 1, [6]) is Ibenbadis, a town far 40 km from the city of Constantine in Algeria [6]. The intervention program on the urban area will cover: the environmental protection, social and economic development that has a direct relation to the studied area. On this paper the solar energy is the only renewable energy that has been taken into consideration.

3. Model analysis and description

3.1. Urban Analysis

The urban planning tool POS (plan of occupation of sols) of Constantine allows the definition of the studied area land use pattern which means it shows the current zoning and the nature of activities such as: commercial, education, and living houses; it allows a zoning regulation and type of houses and roofs; it also give us an indication about a the social criteria number of population and their level of education etc. The POS gives the information about the built environment with its total build surface and the available surface for expansion on the studied area. The use of the AutoCAD software and ArcGIS allows the creation of the studied area as well as the use of Google map in order to give an update situation (see Fig. 1).

3.2. Energy Analysis

Sonalgaz Constantine [7] allows the collection of the energy data such as the electricity consumption and use by sector kWh/inhab/y, it also allowed to define the price of electricity DA/kWh, an assumption of the type of photovoltaic technology have been assumed as the same technology used by Amado & Poggi. According to the report of German Aerospace Agency (DLR) [8] about Algeria solar energy data of the global, direct and diffused radiation have been defined (see Table 2).