Chapter 93
A GIS Based Methodology in Renewable Energy Sources Sustainability

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ABSTRACT

The exploitation of renewable energy sources has assumed a significant role, especially in an integrated vision of problems concerning energy policies, The 2009/28/EC Directive of the European Parliament and Council has indicated ambitious energy and climate change objectives for 2020 (according to the so-called "EU2020 Strategy"): greenhouse gas emissions reduction for 20%, renewable energy increase for 20%, improvement in energy efficiency for 20%. The aim of this paper is to present a GIS based methodology able to support decision-making in energy supply from Renewable Energy Sources (RES), focusing on two specific case-studies: Photovoltaic (PV) and Wind energy. To decide what type of renewable energy font is the best choice for a specific territory, it's important to know the local energetic situation, exploring the potential renewable energy sources available in that specific area, deciding what is the territory more compatible/sustainable among them, and if it's exploitable by suitable environmental and economic point of view. The methodology is largely directed towards the development of a tool to support siting decision.

INTRODUCTION

In recent years, both by necessity and in response to international policies, interest towards alternative energy forms, i.e. not derived from conventional sources like fossil fuels, has considerably grown. Photovoltaic (PV), solar thermal, wind, biogas, biomass, geothermal are commonly used terms and the

DOI: 10.4018/978-1-4666-9845-1.ch093

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associated technologies are reaching very high expertise standards, with considerable interest in world markets. The spirit that leads towards such technologies comes from to answer a real sustainable development need as well a rational resources use (Šúri et al., 2005; Pearce, 2002).

One of the most interesting renewable sources features is their dispersion in the territory. This characteristic is on the one hand a strength, because potentially everywhere it is possible to exploit solar energy, wind power, etc., on the other is a limiting factor, because the energy concentration is reduced. Moreover, the diffuse nature of renewables can combine energy production with the fight against land depopulation and degradation phenomena, supporting the technological and economic development of small urban and rural reality. Renewable Energy Sources (RES) exploitation implies a more direct communities and local administrations involvement in finding the best solution for each energy source, use and location (Hiremat et al., 2007), promoting the concept of thinking globally and acting locally. In this perspective, and in a modern land management, it is also necessary to take into account potential and actual impacts due to installations for renewable sources production, privileging the landscape ecology assessing (Benson & Roe, 2000).

Changes in landscape take continuously place, with significant repercussions on quality of life and natural habitat ecosystems, mainly through their impacts on soil and ecosystems (Antrop, 2000). Landscape planning is strongly related to sustainable development issues, especially considering that landscape is both an influencing factor and a resulting product of the people-place relationship (Fichera et al., 2012; Modica et al., 2012). As pointed out in the European Landscape Convention (Council of Europe, 2000), the analysis of landscape can allow to understand the wellbeing/discomfort condition of population in relation with their environment. A significant problem for some types of production plants, mainly those solar and wind, is related to their possible negative effects in terms of visual impact. A careful planning of single plant integration and the choice of devices less "visible" could reduce the problem, but certainly not eliminate it.

Unlike purely anthropic settlements, the energy production installations from RES, in a global vision, have a positive value because they are intended to produce energy in a sustainable way and in order to reduce the causes of deterioration and consumption of natural resources. Their inclusion in the territory should be considered in light of two fundamental aspects:

1. The environmental cost of their implementation, expressed in terms of consumption of resources, habitat loss, land use;
2. The real energetic vocation of a territory in terms of potential energy obtainable.

The production of electric energy from renewable source plants, being constituted by complex infrastructures that need space, can produce impacts on the natural environment. The clean energy quantification, that such technologies can produce, represents the value of sustainability that they have, in relation to interferences that they produce.

In this framework, the use of Geographic Information Systems (GIS) represents the most significant technological and conceptual approach to spatial data analysis, in order to provide reliable information for both planning and decision-making tasks. The GIS tool fits perfectly in this kind of survey and assessment, providing the mean to combine several features as ecological, territorial, socio-economic aspects, etc., useful to support landscape analysis to deal with issues concerning environmental impacts (Šúri et al., 2004). Moreover, projections for 2020 indicate that renewables could cover, for that date, from 20% to 30% of the world's energy needs (European Union, 2009). A set of effective actions to

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