Chapter 11
Decision Criteria for Optimal Location of Wind Farms

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ABSTRACT

The objective of the present chapter is to obtain the weights of the criteria that influences a decision problem of vital necessity to the current energy perspectives, which is the optimal localisation of wind farms. The location problem posed presents a hierarchical structure on three levels. The objective or goal to be achieved is in the top level, that is to say the optimal location of wind farms. The second level is constituted by the general criteria that influences the decision and which are the environmental, orographic, location, and climate criteria. These general criteria are then divided into sub-criteria, which constitute the third level of the hierarchy. The information provided by the criteria are of different natures, with qualitative-type criteria coexisting with quantitative-type criteria, and therefore, linguistic labels and numerical values are employed to model, by means of fuzzy triangular numbers, the importance coefficients of the criteria. In order to compare different models for extracting the knowledge, two surveys are prepared based on the Fuzzy AHP methodology, which are submitted to experts in the specific field.
1. INTRODUCTION

Although Arrhenius (1896) first identified the greenhouse effect in the late 19th century, it was not until the late 20th century when through the United Nations Environment Programme (PNUMA) and the World Meteorological Organization (OMM) that the Intergovernmental Panel on Change Climate (IPCC) was developed. The IPCC developed an initial report (Working Group I-II-III, 1990) which indicated the veracity of global warming and as a result thereof, the international community became aware of the impact that the high emission levels of greenhouse gases was having on the atmosphere (United Nations & World Meteorological Organization, 1992).

With the aim of stabilizing the concentrations of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system the famous Earth Summit was held in Rio de Janeiro (United Nations, 1992). However, it was not until the development of the Kyoto Protocol (United Nations, 1997) when limits were set for net greenhouse emissions for the major developed countries and with economies in transition, with reference to the emissions in 1990 and defining a first commitment period (from 2008 to 2012). Before the end of the period of validity agreed in Kyoto, at the summit held in Doha in late 2012 (United Nations Framework Convention on Climate Change, 2013), attempts were made to reach new commitments among countries and, although the agreements were not very positive given the global economic situation, a small number of countries agreed to extend the time signed in the Kyoto Protocol until the year 2020.

From the Kyoto protocol, a favorable legislative framework was developed which set out a series of policies and measures, including most notably the increased use of renewable energy sources. The European Union had recognized the need for effective management of all available resources through a balanced fuel mix, in which each of the energy sources performed its role in order to support sustainable economic growth. Therefore in the Commission of the European Communities held in Brussels in 1996, the so-called Green Paper was introduced, which marked an ambitious target consisting of achieving a contribution of RES close to 12% of gross inland energy consumption by 2010. The Green Paper was the first stage in establishing a strategy for

Figure 1. Chronological evolution of the major advances in the fight against climate change
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