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Modeling decision making as a support tool for policy making on renewable energy development

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HIGHLIGHTS

- We applied ANP to the investors' preferences on biomass power plants projects.
- The aim is to improve the advising tools for renewable energy policy making.
- A case study has been carried out with the help of two experts.
- We designed two scenarios: decision making as it is and how could it be improved.
- Results prove ANP is a fruitful tool enhancing participation and transparency.

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ABSTRACT

This paper presents the findings of a study on decision making models for the analysis of capital-risk investors' preferences on biomass power plants projects. The aim of the work is to improve the support tools for policy makers in the field of renewable energy development.

Analytic Network Process (ANP) helps to better understand capital-risk investors preferences towards different kinds of biomass fueled power plants. The results of the research allow public administration to better foresee the investors' reaction to the incentive system, or to modify the incentive system to better drive investors' decisions.

Changing the incentive system is seen as major risk by investors. Therefore, public administration must design better and longer-term incentive systems, forecasting market reactions. For that, two scenarios have been designed, one showing a typical decision making process and another proposing an improved decision making scenario.

A case study conducted in Italy has revealed that ANP allows understanding how capital-risk investors interpret the situation and make decisions when investing on biomass power plants; the differences between the interests of public administrations's and promoters', how decision making could be influenced by adding new decision criteria, and which case would be ranked best according to the decision models.

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1. Introduction

In Italy, the use of renewables (wind, solar, biomass, etc.) for energy purposes has been increasingly promoted over the past 10 years by the Gestore dei Servizi Energetici (GSE, http://www.gse.it/), the state-owned company which promotes and supports renewable energy sources in Italy. The total renewable energy production has increased from 50,990 GWh in 2000 to 76,964 GWh in 2010, most of it due to the photovoltaic power system development (GSE, 2010).

This evolution has been continuously supported by both the State and the Regional Governments, although submitted to various law modifications to control the development of this market. The 2008 Financial Law has set a new national target for electricity production from renewable sources to obtain about 25% of the gross domestic production by 2012 (Legge 24 dicembre, 2007). According to the text, the "spirit of the law" was:

- reducing greenhouse gases (GHG),
- increasing domestic production for energy self-sufficiency,

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- development of the energy industry,
- creation of stable employment,
- reduction of fossil fuels energy production by developing renewable sources.

In practice, the 2008 Italian Financial Law has led to major investments in photovoltaics (PV), with a great economic outcome, to the detriment of the investment in other renewable energy sources. Italy saw a 124% growth in clean energy investments in 2010, the 3rd highest among G-20 members. Sixty two percent of these 2010 clean energy investments ($8.6 billion) were directed toward small scale solar projects (The Pew Charitable Trusts, 2010).

However, the authors of this paper and the involved experts maintain the hypothesis that the "photovoltaic boom" has not met the spirit of the Financial Law. A proof of the Italian government awareness about this problem is the series of ministerial decrees in recent years frequently updating the incentive system for promoting other renewable energy sources (DM 28/07/2005, 2005; DM 06/02/2006, 2006; DM 19/02/2007, 2007; DM 6 agosto 2010, 2010; DM 5 maggio 2011, 2011). This frequent updating is seen as one of the main risks for investors on renewable energy (Aragonés-Beltrán et al., 2010).

According to Demirbas et al. (2009) biomass is expected to be the following technology with the strongest development and investment. In fact, one of the objectives of the GSE's incentive system is fostering competitiveness of biomass power plants. In the last years, in Italy the number of biomass power plants and production capacity grew much more slowly than photovoltaic power production (GSE, 2009) (Fig. 1). Public administration, however, fears that biomass development could also fail to meet the spirit of the Financial Law (Legge 24 dicembre, 2007). The incentive system aims at promoting the use of as many biomass sources as possible and reducing the amount of organic waste. It is also a way of encouraging capital risk investors to support a wide range of renewable power projects rather than only the most profitable ones.

With the current incentive system, the production of electricity by biomass fueled plants which came into operation after 31st December 2007 is supported for a period of 15 years as follows (Legge 24 dicembre, 2007):

- For power plants larger than 1 MWe, Green Certificates are issued with a new unit value (reported to 1 MWh), equal to the difference between 180 €/MWh (reference value) and the annual average sale price of electricity established by the Italian Authority.
- For installations smaller than 1 MWe electricity production is supported with a comprehensive system of fixed feed-in-tariffs paid for each kWh produced (28 c€/kWh).

Between 1999 and 2009 the average biomass plant power grew from 3.2 MWe to 4.8 MWe (GSE, 2009) and investors are lobbying to produce a growth process similar to that of PV power plants. However, the Financial Law and the incentive system aims at a renewable energy development based on diverse and small power plants (less than 1 MWe) in order to take advantage of as many biomass sources as possible (waste from pruning, energy crops, agro-industrial waste, etc.). Therefore a new revision of the incentive system is needed for the expected vast augment of the biomass fueled power production to achieve this goal.

For this reason, the aim of this paper is to clearly understand how capital-risk investors interpret the incentive system, which are their preferences towards different kinds of biomass fueled power plants, and how their preferences would change with changes in the incentive system. The results of the research allow public administration to better foresee the investors' reaction to the incentive system, or to modify the incentive system to better drive investors' decisions.

The issue addressed in this paper is of great importance as it can help energy policy makers in the design of better strategies for the promotion of renewable energies, such as biomass, which meet all sustainability requirements defined as a set of complex and interdependent criteria. Additionally, policy makers should also take into account the preferences of capital risk investors. Up to the knowledge of the authors, there is little evidence in the literature of an approach for the design of energy policies based on the Analytic Network Process. This study opens a new line of research of great interest for energy decision makers.

2. Biomass fueled plants as investment projects

Biomass fueled plants are typically financed by capital-risk investors or the owners of the biomass sources. Currently capital risk investors are the main promoters (Couture and Gagnon, 2010) and a change is not expected with the current incentive system. However, capital-risk investors are promoting only a particular type of projects designed to make the most profit from the

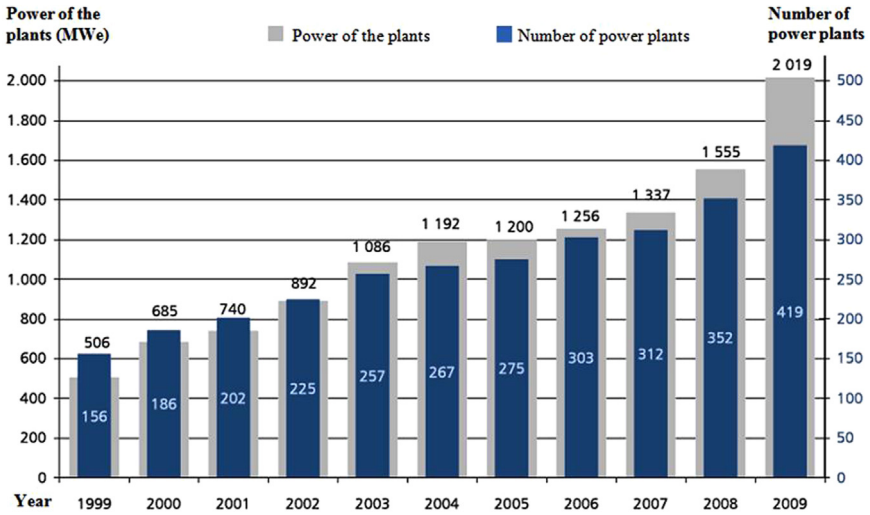

Fig. 1. Italian biomass fueled power plant evolution from 1999 to 2009.

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