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Socio-economic impacts of energy crops for heat generation in Northern Greece

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Abstract

Bioenergy is considered to be an attractive option mainly due to driving forces of an environmental nature (e.g. climate change and sustainability issues). This is particularly the case for energy crops, which show higher productivity per land unit than their conventional counterparts. In addition, by comparison, such crops are more homogeneous in terms of their physical and chemical characteristics than residual resources that are often described as the biomass resource of the future. However, despite the long-term research and the considerable efforts to promote them, implementation is still rather slow across Europe. In this paper, two perennial energy crops, cardoon and giant reed, are evaluated in Rodopi, northern Greece, as alternative land use, through comparative financial appraisal with the main conventional crops.

Based on the output of this analysis, the breakeven for the two energy crops is defined and an economic and socio-economic evaluation of *a biomass district heating system* is conducted.

Results prove that energy crops can be attractive alternatives if they are properly integrated into existing agricultural activities and complement the current cropping options. As such, they provide raw material for local heat applications, thus resulting in increased income for the region and an increase in the number of jobs.

Keywords: Biomass; Socio-economics; Energy crops

1. Introduction

Among renewable energy sources, biomass is considered to be an attractive option for energy production for a number of fundamental agricultural, industrial and rural developmental reasons (Maniatis and Millich, 1998).

This is particularly the case for energy crops, which show higher productivity per land unit than their conventional counterparts. In addition, by comparison, such crops are more homogeneous in terms of their physical and chemical characteristics than residual resources that are often described as the biomass resource of the future. In the longer term, it is anticipated that biomass could contribute 20% of the current EU primary energy demand, with more than 20 million hectares used for energy crops cultivated in EU agricultural land. However, their introduction of bioenergy schemes under existing financial and legislative frameworks is still rather uncertain and in many cases seen to be uneconomic (European Commission, 2000).

Among the most promising of the identified options so far are perennial crops. They are expected to contribute to the targets of increased bioenergy development, by exhibiting low input requirements, over 10–15 years of productive life and high yields (Venendaal et al., 1997).

Greece has long-term experience in research and demonstration of energy crops, but so far there has been no large-scale commercial application (Panoutsou et al., 2000). Bioenergy in the country contributes around 950 ktoe (Biomass Department – CRES, 2004), representing 3.4% of the Greek Total Primary Energy Supply (TPES). Domestic use of wood (for water and space heating) accounted for 0.70 Mtoe of total biomass energy production (CRES, 2005). The remaining 0.25 Mtoe was produced by the combustion of wood by-products, agricultural residues and by the utilisation of biogas produced in landfills, agro-food industries and municipal wastewater treatment plants (Fig. 1).

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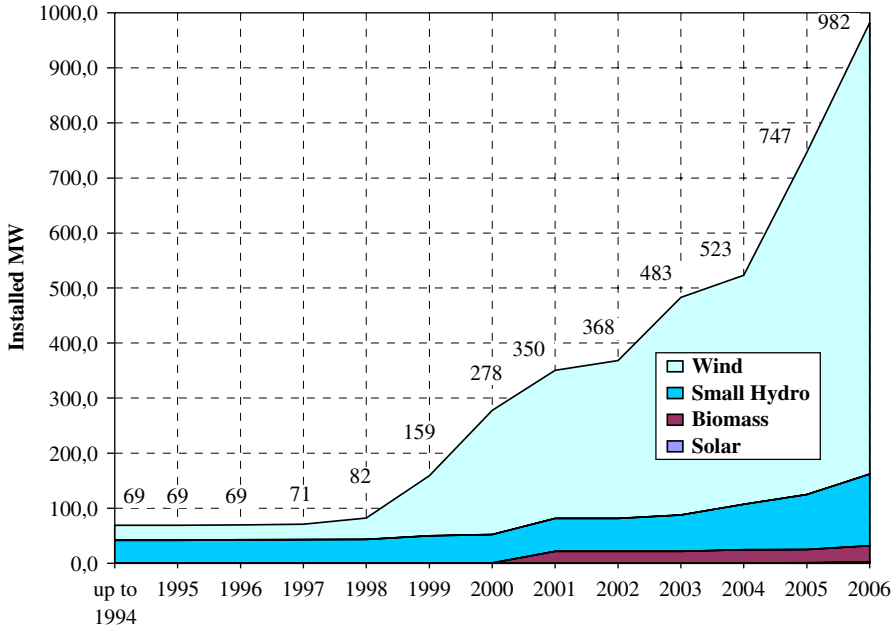

Fig. 1. Cumulative capacity of renewable energy sources (RES) installed plants for producing electricity (*Source*: Greek Ministry of Development, 2006).

Bearing in mind the aforementioned facts, the main aim of this paper is to evaluate selected energy crops under technical, economic and socio-economic aspects in Greece.

2. Approach

The paper focuses on the technical, economic and socio-economic evaluation of energy crops as raw material for bioenergy schemes at the local level in Greece, based on current bioenergy development trends, while taking into account the local and national context. A multi-disciplinary approach was applied based on the following steps:

- Site selection

  A suitable region was selected to perform the research work based on a thorough analysis of the main sectors involved in bioenergy deployment, namely economy and agriculture.
- Evaluation of energy crops suitable for the Greek climatic conditions and the local agricultural systems.

  The selection of energy crops as the biomass resource was based on the results of numerous—ongoing and completed—research and development projects with a focus on energy crops in Greece (Biomass Department – CRES, 2004; Mardikis et al., 2000).

  The selected energy crops provided certain features for the area and the bioenergy scheme, namely:
- Security of long-term feedstock supply in the ongoing bioenergy schemes under study.
- Alternative land use options to current agricultural systems—providing increased productivity per land unit with low input production systems.
- Raw material with uniform, optimised characteristics that permit the use of "modern, higher efficiency" conversion technologies.
- Locally produced biomass, establishing network links within the community and maintaining rural employment both in the agricultural and in the energy sectors.

  However, there are certain factors that may hinder or restrict energy crops integration, so that any connected planning issues should be given serious attention. These are the following:
- The region is contiguous, with a number of countries (Bulgaria, Romania and Turkey) having significantly lower costs for agricultural labour and land rent resulting in much lower agricultural production costs. This fact will increase competition and raw material imports.
- Lack of a coordinated policy and support framework leads to fractionated attempts at growing energy crops without having a secure market for the final products.

The data presented were further used as inputs in the models for the cost and socio-economic analyses.

- Cost analyses of energy crops including market distortions from subsidies.

  Detailed cost analyses were performed for important conventional crops (durum and soft wheat) as well as for the selected energy crops: cardoon and giant reed. The output of these comparative analyses assisted in defining the breakeven point for biomass crops and a respective selling price.
- Economic and socio-economic evaluation of a crop-based bioenergy scheme in the selected region.

  Following the cost analyses of the crops, the economic and socio-economic viability of a complete