Chapter 2.6
Development of an Information System for the Assessment of Different Bioenergy Concepts Regarding Sustainable Development

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ABSTRACT

From an environmental, economic, social, and technical perspective, this chapter focuses on a sustainability assessment of concepts for the energetic use of biomass in order to provide decision support for different options of biomass use. In rural areas, bioenergy concepts are of particular interest in this context. These can for example be biogas plants which are operated by electric service providers, or a biogas plant owned by one farmer, or bioenergy villages. The topic relates to the development of suitable criteria and to the adaption of existing indicator systems to the special requirements of sustainable biomass use for energy. The results of this sustainability assessment consider the different biomass concepts' advantages and disadvantages, which are illustrated by multi-criteria valuation methods. Furthermore, the sustainability assessment of bioenergy concepts has specific requirements with regard to an information system in terms of data and information's demand and supply side.

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INTRODUCTION

The use of biomass for energy is gaining attention among policy-makers, energy supply companies, and the public (BMU, 2009; Leitl, 2007). There are several motives for this increased attention: firstly, due to bioenergy's potentially lower carbon dioxide emissions, it is expected to contribute less to climate change than the use of fossil energy resources. Secondly, biomass use for energy would preserve fossil energy reserves. Thirdly, it could strengthen rural development by giving the farmers an alternative source of income besides food production. Finally, by using local biomass for energy, the domestic energy supply will be stabilized, thus reducing dependency on other – potentially unstable – countries for the import of energy resources (oil, uranium, natural gas, etc.) (IEA, 2004; Van Loo & Koppejan, 2008).

However, in discussions on sustainable development in terms of the use of biomass for energy, not only positive effects are mentioned. There are also concerns that the use of mono-cultures will increase due to a higher demand for energy crops, which would result in massive land-use changes to accommodate more high-productive crops like maize. In addition, an increase in transport activity is expected in rural areas, which would aggravate air pollution and disturbance. Another point relates to the direct emissions of energy plants, such as fine dust and sulfur dioxides, which could be hazardous to the local human health. The designation of areas for energy crop production is a highly controversial issue, too. In cases where areas for food production, nature conservation or grassland are used for the production of energy crops, criticism is to be expected with regards to the ethical aspects and the environmental effects (e.g., more carbon dioxide emissions through the ploughing of grassland and a reduction in the biodiversity) (Jessel, 2008; Fritsche et al., 2009).

With this as a backdrop, several concepts for biomass use for energy have been realized or are in the planning stage in Germany. However, economic, ecological, and social aspects have to be considered when following the principles of sustainable development. Therefore, the decision process concerning the biomass plant's type and dimension has become increasingly complicated and multi-criteria-decision models may need to be applied to arrive at the best agreement (Bucholz, Rametsteiner, Volk & Luzardis, 2009). Linked to the decision model is the crucial management of considerable amounts of diverse data. The coordination of these data and their processing to arrive at different visualized results pose a challenge for the decision model's central information system. The requirements and challenges of this information system are the same as those demanded by a corporate environmental information system. The latter is a system for the acquisition, processing, and communication of relevant environmental data, which originate from different scientific fields (biology, physics, chemistry, geology, meteorology, psychology, social and economic sciences). Furthermore, such data are extensive as well as time and space dependent (see Rautenstrauch, 1999; Page & Rautenstrauch, 2001). Thus, the information management should provide suitable methods to collect and condense data in different formats and from heterogeneous sources.

BACKGROUND

Over the past years, many concepts for bioenergy alternatives have been developed on a local scale in Germany. The idea of an energy-self-sufficient village emerged from a group of scientists at the Interdisciplinary Centre for Sustainable Development (IZNE, in German: Interdisziplinäres Zentrum für Nachhaltige Entwicklung) at the University Göttingen in 1998. The main aim was to have a village produce at least as much electric energy as needed by the residents and the local industry. The production of heat had to cover at least two-third of the demand. Another requirement was that the heat customers and the farmers