Technological Forecasting & Social Change 76 (2009) 978–990

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

Future prospects of alternative agro-based bioenergy use in Finland—Constructing scenarios with quantitative and qualitative Delphi data

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ARTICLE INFO

Article history:
Received 10 December 2007
Accepted 16 December 2008

Keywords:
Agriculture
Bio energy
Delphi method
Renewable energy
Scenario planning
Technological foresight

ABSTRACT

In this paper, the potential of bioenergy production in agriculture (preferred and probable futures) is scrutinised using the Delphi method. We present a case of northern possibilities to utilise renewable energy sources within agriculture in a form of alternative bioenergy scenarios. Altogether 20 experts participated in the Delphi process which outlines the future of bioenergy production in Finland. The first round of the Delphi study was carried out by semi-structured interviews and the second feedback round by means of a mail questionnaire. Background information of key variables was presented to the panellists who responded with their views on developments between 2004 and 2025. Alternative scenarios were then constructed from these dimensions with cluster analysis in line with the Disaggregative Policy Delphi (DPD) approach. Quantitative statements were complemented with the experts' argumentation. Five scenarios were constructed: 1) Renewable prosperity, 2) Incremental change, 3) Vision of sun, wind and wood, 4) Let's burn it all, and 5) Flood of waterpower. After the Delphi rounds, a dialogue seminar for the agri-technology experts and policy-makers was organised. These results bring to the table an agri-food technology expert community view of the future directions for Finnish agro-bioenergy use.

1. Introduction

The interest in bioenergy and other forms of renewable energy has risen in tandem as the price of fossil fuels has increased and climate protection has been raised on the policy agenda. As a result, the member states of the European Union (EU) have agreed together on new policy goals for bioenergy production. New goals which try to increase the share of renewable energy have also been stated nationally in the EU [1,2]. The decisions which are stated in these strategies mean extensive increase in different sources of biomass utilisation. Agro-based bioenergy production also increases competition both in energy and food markets. This question has risen because at the same time with the bioenergy boom, agricultural commodity prices rose sharply in 2006 and 2007. One of the reasons behind higher prices is the use of food as a raw material for producing biofuels. The emerging biofuels market is a new and significant source of demand for some agricultural commodities. These are especially sugar, maize, cassava, oilseeds and palm oil in the bioethanol and biodiesel production [3]. For farmers, producing raw material can be seen as a new opportunity to compete with their crops in markets. In addition, agro-policies need to face up to the question as to how much agricultural production of energy crops can increase their cultivated field area without endangering food production.

Food production accounts for 15% of total energy consumption in Europe. Of this 15%, only 5% is consumed by agriculture including mineral fertiliser production [4]. Bioenergy, in its different forms, relates mostly to forests in relation to available national resources in

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0040-1625/$ – see front matter © 2008 Elsevier Inc. All rights reserved.
doi:10.1016/j.techfore.2008.12.001

Finland since the country is located in the Boreal vegetation zone. However, as the price of oil increases, biomass production from agriculture has also become a relevant and widely discussed policy issue in national policy [1,5]. Due to the economic structure emphasised by the pulp and paper industry, as well as by the steel and electronic industries, energy consumption in Finnish agriculture accounts for only a few percent points of the total national economy energy consumption. Within Finnish agriculture, the main energy sources are fuel oil (73%), energy wood (12%), electricity (10%), natural gas (2%), gasoline (1.5%), peat (1%), and district heating (0.5%) [6,7]. From these sources, a minor but increasing share is the farms' own production.

Agriculture has at least two roles in the development of bioenergy solutions (Fig. 1). It can be a self-sufficient utiliser of its own energy production or a supplier of biomass to the refining industry. The role of agricultural biomass in energy usage involves producing, in the main, biomass feedstock which means crops, grasses, trees, and crop and livestock wastes [8]. These are then converted through a range of processes, for example, fermentation, gasification and combustion to produce fuels, power and fibre-based energy products. Many OECD member countries have recently established policy goals and targets to develop bioenergy production from agriculture. There are several reasons explaining the growing interest by governments. The main reasons are climate change (avoiding fossil fuels), energy security, environmental effectiveness, rural development, economic efficiency, and market innovation (solutions to energy technologies) [5].

Technological change has been traditionally one of the most studied futures research targets as it represents the possibilities of human capacity to develop new and innovative technology. There are at least three possible future approaches on which to take a stand—passive, reactive, or proactive [9]. Over recent years, the agricultural policy planning and formation process has included features which are drawing planning processes closer to a more proactive futures studies methodology, e.g. consensus conferences in Finland [10]. Through these novel and proactive planning practices which also welcome stakeholders from the broader field of society, the depth of strategic discussions increases and the outcomes afford more alternatives and arguments to form the basis of decision making.

The potential of and future scenarios for bioenergy development have been studied widely recently [11–16]. These studies give several reasons to decrease the reliance on fossil fuels. Bioenergy has the potential to become a fundamental player in a sustainable energy system [12]. Furthermore, it contributes to the reduction of greenhouse gas emissions. In rural areas, it can generate new job opportunities and improve income distribution. Also, the reliance on imported energy generally decreases as well as in the food production sector. However, as the expectations of the bioenergy potential varies in public debate, there is a need to clarify the differing future views on the bioenergy production of agricultural stakeholders and interest groups for the purposes of long-term planning. One technique which can facilitate this approach is the Delphi method. Delphi, as one of the main methods in futures studies, is especially suitable as a method for generating future information for long-range planning in topics where changes in current trends are expected. There is a variety of views on these changes, where strong interest ladenness can be observed and more mathematical methods lack adequate data [17–20].

In our research project as a whole, the focus was on three main agricultural themes according to their policy relevancy: the future of alternative bioenergy sources, the agricultural production technology, and biotechnology and transgenic crop production in Finnish agriculture. These themes interact with each other, but the analysis in this paper is based on the bioenergy section in the Delphi process. We produce alternative bioenergy scenarios according to the chosen Delphi panellists. We concentrate also on the arguments of experts concerning the future of renewable energy production in Finland between 2004 and 2025. One of the goals in this study is also to present alternative scenarios as tools for strategic interactions between researchers, decision makers and other

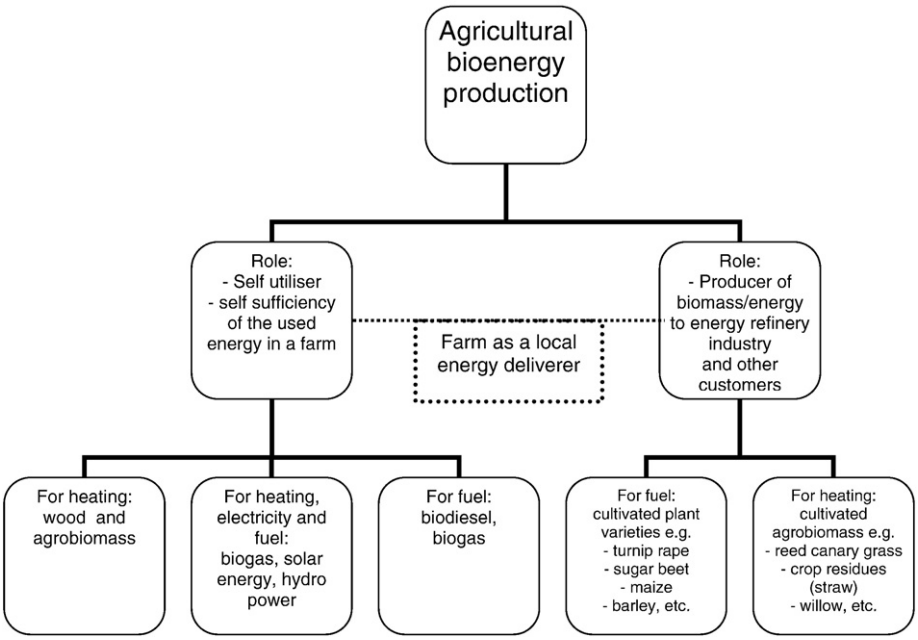

Fig. 1. The role of agriculture in bioenergy production.