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Organization of the current U.S. biopower industry: A template for future bioenergy industries

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ABSTRACT

The development of biomass based industries face many challenges. Technological and environmental questions are paramount. However, the organization of developing biomass based industries could be a key non-technical barrier. Given that industrial organization is not the focus of many research agendas, this article attempts to fill the void.

Biomass sources could be a low cost feedstock for energy production such as cellulosic ethanol. This potential low cost hinges on effective and efficient methods of exchange. One way to address the need to understand the organization of future biomass based industries is to examine current related industries such as the United States biopower industry.

This article first examines the broad industrial structure of the current biopower industry by briefly discussing inputs, technology, function and production trends. Then the discussion is narrowed to focus on the type of organizational form used to procure or transfer ownership of biomass materials in the current U.S. biopower industry. Based on survey evidence the current biopower industry is found to be highly vertically integrated with little use of spot markets. This result is found to be consistent across the type of biomass fuel used.

1. Introduction

The development of bioenergy industries based on cellulosic feed stocks faces many challenges. The need for technological improvements in processing technologies and proof of environmental benefits are primary among these. However, a lingering non-technical issue is the organization of biomass based industries. How will input suppliers and processors interact? What supply mechanisms will they use? Will long term contracts or vertical integration prevail? Will spot markets for biomass develop? Will the costs of governing these relationships be kept low enough that the technologies can still be competitive? One way to shed light on such questions is to observe the current U.S. biopower industry. The organization of the current biopower industry could provide a template for how future biomass based industries will develop.

This article first reviews the biomass and bioenergy literatures with a focus on articles that address organizational issues. Second, the broad industrial structure of the current biopower industry is briefly described based on data from the U.S. Energy Information Administration. Third, based on a survey of biopower producers, current organizational mechanisms are revealed.

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2. Biomass and bioenergy literatures

Much of the biomass and bioenergy literatures are focused on technical questions while organization of future industries is overlooked. Energy policy has received some attention [1]. Klass [2] points out that industrial organization issues are often overlooked when biomass and bioenergy researchers make technical recommendations for the industry. He points to storage and shipping strategies in wood product markets as an example as solutions that have been prescribed by biomass and bioenergy researchers but have not been adopted in industry practice [2, p. 554]. He cites the failure to consider organizational issues as potential barriers to nascent biomass industries as a reason that these industries have not been developed.

As van Loo and Koppejan [3] have documented, there are also cases where organizational adaptations have solved technological problems. Their work underscores the importance of understanding organizational issues.

Downing et al. [4] and Overend [5] confront the organizational issue directly, although they come to different conclusions. Downing recommends vertical integration while Overend considers spot markets and short term contracts most efficient. Downing et al. [4] describes and recommends agricultural cooperatives as examples of research, financing and exchange mechanisms in the agro-bioenergy industry. Cooperatives are a type of biomass exchange mechanism that should be considered. Cooperative cases can be compared to contracting and spot market systems that also exist in the U.S. biopower industry.

Klass [2] too suggests a highly vertical system. However, he goes one step further and suggests horizontal integration where various bioenergy production functions are linked with co-products fed into lateral bioenergy production systems under unified ownership.

Overend [5] provides a description of the main features of a general biomass industry, but does not suggest a highly vertically integrated system. The author concludes: ''The industry must rely on short term contracts or the spot market for fuel purchases'' [5, p. 2]. This contradiction compared to the arguments made by Klass and Overend helps focus the discussion to the choice of organizational form.

Organizational questions have received some attention in the literature but tend to be secondary considerations for many authors. This article shows that the biopower industry today currently relies on captive supplies and integrated systems, contrary to some recommendations. Thus if future biomass based industries develop similarly to the current biopower industry, vertically integrated systems are more likely.

3. The US power industry

The overall power industry is typically described as having three main functions: power generation, long distance transmission and local distribution. Retailing and input/fuel production and processing could also be added to create five functions of the power industry:

1 input/fuel procurement,
2 power generation,
3 long distance transmission,
4 local distribution and
5 retail.

An efficient input/fuel procurement stage is essential for the biopower industry to be competitive. One of the advantages biopower typically has over conventional sources of fuel is that biopower has relatively low feedstock costs. However, this advantage can be negated if the supply chain system is inefficient, driving up the organizational costs and hence the effective cost of the fuel source.

3.1. *Structure of the power industry*

The structure of the electricity industry has typically been highly vertically integrated, since large regional companies own and operate assets at the generation, transmission, distribution, and retail stages. The regulated component of the industry includes 3200 utilities. In the 1990s, investor-owned utilities provided about 71 percent of the electricity consumed, 10 percent was from publicly owned facilities, 4 percent was from cooperatives, 8 percent was from federal power producers, and 7 percent by non-utilities [6]. Most investor-owned utilities are vertically integrated across the functions of the electric industry. The majority of publicly owned utilities and cooperatives specialize in retail and distribution while federal utilities specialize in generation (mostly hydropower). The greater separation of generation from the other functions has led to an increase in the size of the wholesale market where retail utilities purchase power from generating utilities rather than produce it themselves. There are both long term and short term contracts in this exchange [6].

Municipal and cooperative utilities have tended to be less integrated, focusing on generation or retail only. Biopower from wood has not tended toward the general trend of vertical integration between generation, transmission and distribution since mostly non-utility generators produce biopower from wood. These generators have not integrated forward into transmission or distribution and tend to operate at a smaller scale than the integrated utilities. However, biopower producers have tended to be integrated between input and power production stages.

Traditionally, 300–600 MW plants were needed to realize the potential economies of size for generation units. However new combined-cycle plants reduce the minimum efficient size to as low as 100 MW. This change in technology implies that generation could become less of a natural monopoly. Most biopower facilities are in the 1–50 MW range. As a reference point, 1 MW is enough power for about 600 homes.

4. The current biopower industry

The biopower industry is a complex array of power utilities and non-utilities using many technologies and many inputs to produce electricity. Utilities are regulated by the state public