PRODUCTIVITY AND EFFICIENCY MEASUREMENT OF THE DANISH CENTRALIZED BIOGAS POWER SECTOR

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Overview

The widespread use of the renewable energy sources in the future's energy production is necessary, in order to avoid the predicted environmental, economic and social effects which primarily can be derived from the use of fossil fuels. Denmark has announced to be fossil fuel independent with a renewable energy based heat and power source by 2050. Theoretically, the centralized biogas combined heat and power plants can play a determinant role in the subsequent Danish energy supply scheme, due to its feature to satisfy base load demand. Other types of renewable energy are mainly intermittent energy sources. The environmental policies of the 1980s contributed to the wide spread of the Danish centralized biogas CHP plants. However, the uncertainties caused by liberalization process of the energy market – replacing the fixed-price subsidy scheme with market determined price – resulted in no further expansion of the Danish centralized biogas sector.

Method

The productivity and efficiency analysis of the currently operating Danish centralizes biogas CHP power plants offers an opportunity to assess whether there is a most efficient power plant which can be introduced as a "best practice" innovative technology for the future's Danish biogas power plants. It also gives the possibility to evaluate the productivity changes during the period. Higher productivity gains in renewable energy sources than in traditional energy sources are necessary if these energy sources are going to be competitive in the future.
In this paper we use the Malmquist total factor productivity DEA method to analyze the change in the efficiency and productivity of the Danish centralized biogas power plants in the period 1992-2005. The annual data is from nineteen power plants with a two inputs – animal manure and other organic waste, and a single output – biogas production – case has been considered. The biogas which is the primary product generated in the power plant can be further used to create electricity (by running a generator) or to produce district heat (by burning it in a gas-fired plant).

Results

The results show that the average annual total factor productivity increased by 2.5% annually in the period. The technical change was 3.6% while the technical efficiency change was decreasing by 1.1%. So, the driver of total factor productivity growth was technical progress, because the technical efficiency effect ("catching up effect") was negative. The pure technical efficiency was decreasing by 1.2%, while the scale efficiency was increasing by 0.1%. The scale of production was therefore improved only very slightly in the period and the reason for increased technical inefficiency was due to increasing pure technical inefficiency. This means that the production in the period on average became more and more inefficient, however only to a minor extent. The technical changed mainly happen in the first 7 years when new plants entered the sector and in the later period the gain in total factor productivity was mainly due to catching up effects.

Conclusion

The benchmark firms are diverse. One firm didn't experienced technical progress, but had high technical efficiency scores, meaning that this firm optimized their production. Another firm was entering after some years and it "went" directly to the frontier and stayed there. A third firm determined in many years the frontier also in the beginning of the period and therefore it had a relative high technical progress. A fourth firm entered in 1998 using less of one of the inputs than other firms and by induced technical progress it "moved" the frontier.
The energy policy in early 90'ties was supporting biogas while in the later part of period there was specific support or subsidies. Therefore a future energy policy for biogas, if the focus is on technical progress, needs to focus on investment subsidies – at least this is what this study shows.

References

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