

## BIOENERGY COMBINES IN DISTRICT HEATING SYSTEMS: PROSPECTS FOR A FUTURE GROWTH INDUSTRY?

E. Axelsson<sup>1</sup>, A. Sandoff<sup>2</sup>, C. Overland<sup>2</sup>

<sup>1</sup>Profu, Gothenburg, Sweden.

<sup>2</sup>Department of Business Administration, University of Gothenburg, Sweden.

### ABSTRACT

District heating offers opportunities for integration of bioenergy production (e.g. of biofuel). The aim of this paper is to assess the environmental benefit and the economic value of such integration, in order to evaluate the prospect for bioenergy combines in district heating systems. Since the detailed characteristics of the district heating system are crucial for the feasibility for integration of bioenergy production, the assessment is based on four real district heating systems. The environmental evaluation shows that the decrease in green house gas emissions from a combine are in proportion to the increase in output of CO<sub>2</sub> neutral energy products. However, the CO<sub>2</sub> reduction per used quantity of biomass is higher in conventional combined heat and power production as long as marginal electricity is related to high CO<sub>2</sub> emissions. Also the economic evaluation show ambiguous results: two cases had negative net present value even for low discount rates, while the two other cases showed to be more economically robust. In addition to this, a more detailed analysis of the industrial conditions for the integration shows a need for achieving a fit regarding several operational, strategic and economic circumstances for this type of business ventures. Two important conclusions that can be drawn from this is that: 1) not all district heating systems are suitable for bioenergy combines 2) there are many barriers for a wide spread adoption of bioenergy combines.

### INTRODUCTION

District heating is a technology that receives increasing interest as it has great potentials in several ways. One unique characteristic of the district heating technology is the use of low temperature energy flows for large scale energy distribution. In contrast to other energy transformation technologies (e.g. condensing power or distributed gas heating), district heating can interact with energy flows that otherwise do not have any alternative use (e.g. industrial residual heat). Although this is one of the competitive advantages of the technology and a fundamental platform for its business model, this can further enhance the scope of the business: by backward integration it is possible to increase profitability in other industrial processes with waste heat as a by-product.

One industrial branch that shows promising prospects in this respect is bioenergy production, i.e. production of various kinds of biofuel, biogas and solid biofuel.

Integration of bioenergy production to district heating production eventuates in a bioenergy combine where the residual heat from the bioenergy production can be utilised for district heating. Moreover, the integration can, in many cases, offer additional positive synergies, e.g. regarding the use of steam and combustible by-products.

The fact that worldwide bioenergy production as well as the number of bioenergy products offered is increasing is a result of changing demand, which in turn offers new business opportunities. However, one of the great issues with large-scale production of bioenergy products is the growing concern over the negative externalities (social and environmental aspects as well as resource efficiency). Since energy production and consumption shows strong path dependence **Fel! Hittar inte referenskölla.**, there is an urgent need to develop and establish production technologies that help minimize the negative externalities. Utilizing the taiga and deciduous forest resources in the Northern hemisphere for this purposes is, arguably, a promising alternative. The majority of these natural resources exist in harvested forests, typically found in regions with, or suitable for, district heating.

This paper investigates the prospects of using district heating production as a base for bioenergy production and its potential to become a wide spread technology. For this purpose, we use data from four existing district heating companies to which a bioenergy production unit is fitted. By acknowledging the complexity of this integrative business venture, it is possible to get credible assessments of the magnitude in energy efficiency, environmental gains and economic profits. Equally important is the possibility to detect potential limitations for bioenergy combines to become a complement to district heating. Finally, conclusions are made to acquire clues to important restrictions to a wide spread adoption.