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Economic Assessment of Measures to Improve Biogas Plant Competitiveness

An essential contribution towards improving the profitability of electricity generated from biogas are measures to reduce production costs to a competitive level. Diverse approaches are assessed with regard to their cost saving potential. The results clearly show that competitive biogas production is only possible through developing cost-efficient methods and concepts to lower production costs by half, even under favourable operational, economic and political conditions.

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Biogas, economy, costs, investments

One key-issue for future growth of biogas operations is its relative cost, since currently electricity production from biogas is still more expensive than the least-cost fossil fuel alternative [1]. The potential of biogas technology innovations to reduce electricity production costs - to EU stated cost targets - is analysed in the following sections.

Objects and methods

The required cost reduction is deducted from the present electricity production costs from biogas and the EU stated cost target until the year 2020. A sensitivity model is used to analyse future cost reductions resulting from technological improvements in biogas production. The analysed parameters include technological efficiency parameters, as well as fixed and variable costs. Only those factors directly involved in the cost structure of electricity production are considered in the analysis. The assumptions proposed are based on up-to-date technological and efficiency parameters in biogas production in Europe. Single parameters are then varied iteratively for comparing and evaluating the respective costs effects.

Results and discussion

The EU stated cost target for electricity production from biogas is 5 Cent per kWh until 2020 (*Fig. 1*) [1, 2, 3]. Presently electricity production costs from biogas range between 9 to 12 Cent per kWh [4, 5, 6, 7]. In view of the stated cost target a total cost reduction of more then 50 % (i.e. 4 to 7 Cent per kWh) is required until 2020. For this to happen, a strong progress in connection with a rapid market expansion and a substantial cost reduction is needed.

The relative costs of electricity produced with biogas are partly determined by enterprise specific conditions (e.g. plant size, heat utilisation opportunities, etc.), as well as socio-economic and political conditions. Nevertheless, the contribution of technological improvements to reduce costs is essential to future competitiveness of electricity produced from biogas. The main cost determining parameters are the biogas production rate, the specific methane yield, the system workload and the conversion efficiencies. Beside, the specific investments, the plant life spans and the biomass costs greatly influence total production costs.

Plant investments

The plant investments are considered to be a crucial factor due to its high share of total costs and its variability. Specific investment costs can be reduced by developing modular and standardised plant technologies [8]. By reducing the relative investment costs for the electricity generator by 20%, the electricity production costs can be reduced by 1.28 Cent per kWh (*Fig. 2*). A similar cost reduction is achieved by reducing investment costs for the reactor by 26% (*Fig. 2*).

System workload

Stabilising the biogas and electricity production process leads to longer generator running times and a higher capacity utilisation. Assuming ceteris paribus conditions, an increase of the generator running time from 18 to 20 hours per day results in a reduction of electricity production costs of 1.00 Cent per kWh (i.e. 15 % of the total cost reduction target) (*Fig. 2*).

Plant lifespan

Increasing the lifespan of technical components e.g. from 5 to 6 years is an efficient strategy to reduce electricity production costs by about 0.59 Cent per kWh (ceteris paribus) (*Fig. 2*). This cost effect corresponds to 10 % of the total cost reduction target.

Specific methane yield

A significant difference is observed between the potential methane yields achieved under experimental conditions and the methane yields achieved in practice [9]. An important task is to reduce this gap, since an increase

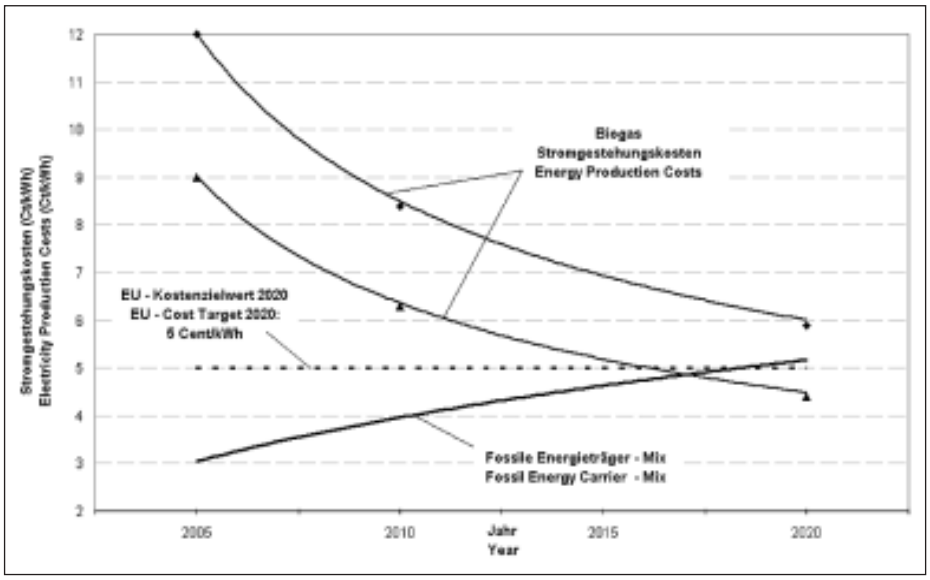

Fig. 1: Electricity production cost development from biogas compared to fossil energy carrier mix (modified [1, 2, 3])

of the specific methane yield from 0.30 to 0.35 cubic meter methane per kg organic dry matter reduces electricity production costs by 0.50 Cent per kWh (ceteris paribus) (*Fig. 2*).

Generator efficiency
Improving generator efficiencies by 1 % results in an average cost reduction of about 0.30 Cent per kWh within the considered range and under ceteris paribus conditions (*Fig. 2*).

Biomass costs
The cost effect of measures that reduce biomass related costs greatly depends on the quantity and quality of the biomass input [9]. Decreasing biomass costs by 5 € per tonne dry matter results in a reduction of electricity production costs of 0.23 Cent per kWh (*Fig. 2*), under ceteris paribus conditions and the assumption of an average OLR (organic load rate) of 3.0 kg organic dry matter per cubic meter reactor space.

Conclusion

Analysis results show that EU cost targets for electricity from biogas (i.e. 5 Cent per kWh until 2020) may only be reached by improving all relevant technological parameters by at least 20 to 30 % until 2020. Important cost reductions may be achieved by reducing investment for technical components, increasing system workloads and methane yields, and improving generator efficiencies. Extending plant component lifespans e.g. by stabilising the production process promises further cost reductions. The cost effect of improvements in the biomass supply chain mainly depends on the quantity and quality of biomass inputs. Finally, the extent to which single measures will contribute to total cost reduction in future is subject of ongoing research at ATB e.V..

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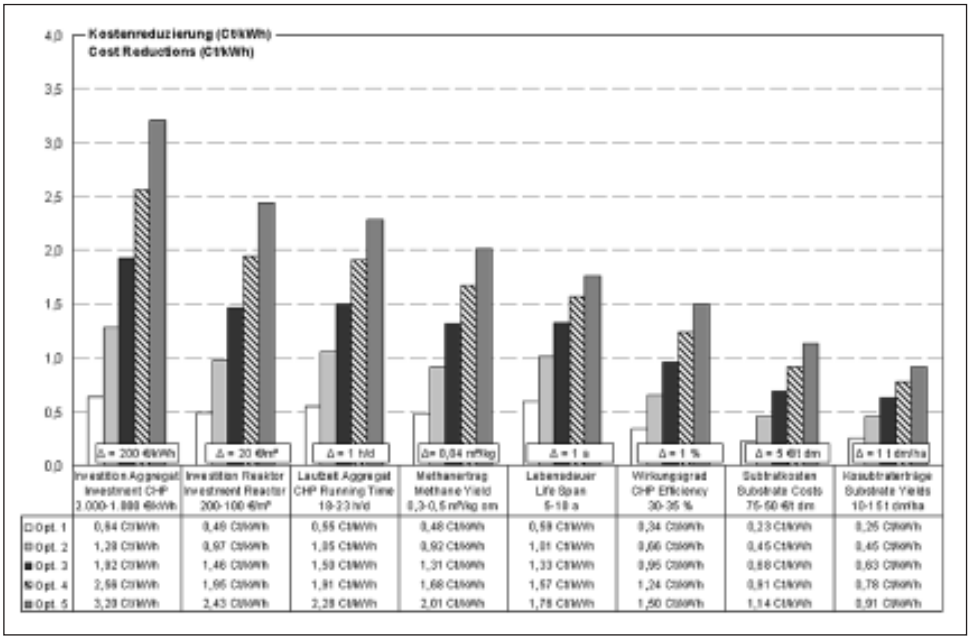

Fig. 2: Cost reductions resulting from cost optimised parameters in biogas production