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IEA Bioenergy
Task 37

Energy Efficiency in Energy Crop Digestion
Based on an Evaluation of 41 Austrian Full Scale Biogas Plants

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Berlin, May 2007

Keywords
Anaerobic digestion, biogas from energy crops, efficiency criteria, best biogas practice benchmarking, data envelopment analysis, DEA

Abstract
During the last decade, numerous anaerobic bio-waste treatment plants have been built in many European countries. Several hundreds of digesters are in operation, treating source separated bio-wastes, industrial wastes, as well as agricultural residues and by-products. Furthermore, in countries like Germany or Austria, a remarkable promotion of renewable energy technologies was achieved in the last years. Favourable legislation allows short payback-times for installations feeding electricity into the grid. Among other renewable energy technologies, an exceptional boom in agricultural biogas plants recently occurred in Austria. The number of plants rose from 119 at the end of 2003 to 298 by the end of June 2005 and has reached about 350 by end of 2006. However, up to now the promotion of energy crop digestion was hardly linked to any efficiency criteria. As a result many different technologies and specific applications occurred on the market, some of it neither energy-efficient nor reliable.

In this paper introductorily some examples of biogas installations in waste treatment, as well as renewable energy recovery will be shortly presented. The contribution further on concentrates on investigations, aiming at the definition and measurement of energetic, business economic, ecological, and socio-economic parameters, characterising the overall production chain of biogas systems and their performance. The production chains studied, range from the cultivation and supply of energy crops (including on-site transport and storage), to bioconversion (pre-treatment, digestion), on to final biogas utilisation and use of the residual digestate. In total about 250 parameters were identified, allowing for an accurate, multi-dimensional description and evaluation of biogas recovery from energy crops. Parameters included, allow for a detailed functional description, and comprise measurable performance parameters as well as derived (calculated) efficiency parameters. Based on this pre-defined list of parameters, detailed data have been collected over the last two years from a set of 41 full-scale and operational Austrian biogas plants. The collected data have been used to examine the productivity of the plants, including data envelopment analysis (DEA). Results from the benchmarking analysis show considerable differences in production efficiency, depending on the choice of substrate, plant size, and operational conditions. From the experience gained, guidelines for best biogas practice, respectively successful and reliable plant operation could be derived.

Finally, the evaluation programme performed, allowed an estimation of the overall energy demand in cropping, pre-treatment, digester operation and digestate handling. Energy balances (Output : Input) were calculated for the whole production chain of biogas from energy crops, resulting in highly varying values from 1.2-16.5.