

## Biogas and Bio-syngas Production

### TECHNICAL HIGHLIGHTS

■ **PROCESS AND TECHNOLOGY STATUS** – Biogas and bio-synthetic gas (bio-SNG) uses are versatile: production of electricity and heat, or injection in the grid, and use as transportation fuel after upgrading to bio-methane. Production of biogas by anaerobic digestion of organic feedstock in digesters or landfills is commercially well established while production of bio-SNG by gasification is less mature. Feedstock for bio-chemical production of biogas includes organic wastes (municipal, industrial and agricultural wastes), sewage sludge, wastewater, human and animal manure, and crops (energy crops, crop residues, fresh or silage). Woody biomass is not suitable to anaerobic digestion because of its high content of lignin, but can be converted into bio-SNG by thermo-chemical gasification. From one country to another one, the biogas sources vary distinctively. In Europe, Germany and UK are the main producers of biogas, from farm digesters in Germany and landfills in UK. The use of manure and energy crops are considered as the main sources of future biogas production, but co-digestion of multiple types of feedstock offers the greatest potential mixing energy crops (maize being well established for biogas production), manure, sludge and food industry and household waste. In developing countries, family-scale biogas digesters contribute the supply of local energy for cooking, lighting and heating, and may contribute to rural electrification when associated with power generation. The digestate resulting from the production of biogas is a nutrient-rich fertilizer which can replace the mineral fertilizer.

■ **PERFORMANCE AND COSTS** – The total capital cost for an AD facility varies from USD 5000 to 7500 per Nm<sup>3</sup>/h of biogas production capacity, depending on the size of the digester. The investment cost for biogas-to-bio-methane upgrading units ranges from USD 1950 to 2600 per Nm<sup>3</sup>/h, for raw gas capacities larger than 800-1000 Nm<sup>3</sup>/h. Much higher costs are observed for smaller-scale facilities. Bio-SNG production costs are estimated in the range of 15 to 20 USD/GJ bio-SNG (feedstock excluded); these costs are expected to decrease 10-15% over the next 10 to 15 years. Gasification and gas cleaning and upgrade represent each 35% of total bio-SNG production costs. When associated with electricity production, the additional costs of the prime mover represent a small part of the total, from 5% to 15%. The typical investment costs of landfill gas collection and flaring system are around USD 6/m<sup>3</sup>.

■ **POTENTIAL AND BARRIERS** – The rapid development over the last decade was the result of incentive policies related to renewable energy and climate change (more particularly feed-in tariffs for electricity) but also waste management. While the sector rapidly grows, it hasn't received the same attention as for example liquid biofuels for transportation. Future development of the sector will continue to be dependent on incentive policies. Moreover, the development of an integrated gas infrastructure including pipelines (including an easy access to it), upgrade units, heat network, filling stations is key to an increased production and use of biogas and bio-SNG. Advancements in upgrading and gas cleaning are expected to contribute to accelerate the commercial penetration of gasification, which would permit the use of woody resources, which cannot be digested.