ENERGY CROPS & BIOGAS: PATHWAYS TO SUCCESS

Summary of Topic 3 "Overall energy balance of crop to Biogas systems"

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Introductory presentation "Energy balances of crop to biogas systems in relation to other biotransformations", Dr. Andre Faaij, Copernicus Inst. for Sustainable Development, The Netherlands.

André Faaij presented a study on learning curves for digesters realised in Denmark, gave the results of an older study on waste treatment technologies and the role of digestion in this technology field, and gave some notions on energy crops.

Realisation of digestion in Denmark has been very successful. The technology has booked progress, as can be shown from two learning curves. In the first, the investment costs per daily digester capacity (in m^3 / day) decrease by a factor of two as a function of daily capacity. In the second, the biogas production costs decrease sharply as a function of cumulative Danish biogas production in the first part of the curve (up to 1992), in the second part the biogas production costs stay the same. At the same time, biogas yield and income has increased. An important reason for the Danish success is the stability of government policy.

Some years ago, a study was performed towards optimisation of the Dutch waste treatment infrastructure. It included a broad range of waste treatment technologies and focussed on two cases: 1) optimising energy yield and 2) minimising costs. The study took into account separation, re-use, post-treatment and heat distribution before / after the waste treatment and considered a broad range of biomass and waste materials ranging from clean wood, straw, grass and manure to contaminated waste materials like car tyres and shredder and household waste. The results of the study show that digestion, in comparison with other waste treatment technologies, has:

- a small scale (a few MW_{th} maximum, other technologies go up to 1000 MW_{th} and more);
- relative high treatment costs;
- a relative low energy yield (in Energy primary out / Energy in).

The main conclusion for digestion is that it can have a role also on the longer term, however, the HTU (Hydrothermal Upgrading) process can be a strong competitor in the future.

On energy crops André Faaij states that, on the longer term, lignocellulosics (perennial) crops have better energy and environmental balances and better economics than annual crops. Therefore, thermal conversion is a strong competitor for digestion when converting energy crops to energy. Rape seed is expensive (low yield, high price); financial stimulation for production of rape seed is purely agricultural policy. Energy crops are too expensive to be grown in The Netherlands, apart from some possible applications on grounds with dual use. In the near future, eastern European countries might rapidly start to grow energy crops.

"Energy analysis and environmental analysis of biogas systems", by Dr. Pal Börjesson, Department of Technology and Society, Lund University, Sweden.

University of Lund has performed system studies towards the conversion of different types of feedstock (waste, byproducts, crop residues and crops) by different digestion technologies to heat, electricity and/or upgraded biogas (natural gas substitute). The system is complex to analyse, the choice of systems boundaries and reference system will have a significant impact on the results. The conclusions are:

Energy efficiency
– The energy input is normally equivalent to 20-40 % of the biogas output
– Some energy rich feedstock can be transported up to ~700 km before energy balance is negative
Greenhouse gases
– Biogas systems will lead to reduced GHG, except when the alternative is combustion of the biomass
– Important to minimize losses of methane
Eutrophication and acidification
– Significant benefits from indirect effects, which is this is often neglected in fuel cycle analyses
Other air pollutants
– Reduced emissions in most cases, especially when the biogas is used as a transportation fuel

" Energetic use of biomass – Competing or complementing technologies?", by Samuel Stucki, Paul Scherrer Institute (PSI), Switzerland

Although Swiss electricity production is CO_2 free as production is from hydro and nuclear power, Swiss researchers try to answer question what comes after nuclear power. Several technologies are promising for the longer term. How do we link new technologies to existing network?. Electricity to electricity grid is known option (biomass combustion, gasification + engine, turbine or fuel cell). Linking to the gas grid is another option, for instance gasification+methanation, upgraded biogas, hydrothermal gasification. PSI has performed economic modelling using a Markal model, which showed that at increasing oil prices in 2005 of between 100 and 130 US$ / barrel, new technologies like methanation and wood gasification would be economically feasible. In a vision, three networks (electricity, natural gas + biogas, and heat) are fed with bio-energy and are linked together by several (gas-, biomass- and home-CHP plants).

General discussion

Q: Considering those options where you do not use the biogas in a gas engine, and given that you need heat to keep the digester running: how will you heat the digester?

A: (Börjesson) Heating of the plant is an important consideration when looking at the overall system. We use straw burner to heat the digester. Straw is difficult to use, whereas biogas is valuable.
(Bo Holm Nielsen) Why not use the heat for cooling! A lot of energy is being used for cooling!
(Rathbauer) Whether this can be done is very site specific.

Q: Are there differences in social acceptance of different technologies?

A: (Rathbauer)This is a very important issue. If you run a digester at a low efficiency (20% electricity) as in Germany, then you can expect that the public opinion is against. Besides, the larger plants nobody wants to have in their environment. Not in my backyard! Therefore, even when it is clear that a plant is environmentally sound, there is resistance.
(Woods) Resistance against MSW incineration in the UK is because of environmental groups using dioxins to have focus on prevention of waste instead of incineration.

Q: The digestion systems in Germany, are they socially accepted?

A: (Weilander) In the past it was no problem. Nowadays people see more traffic and smell is sometimes a problem. The general public does not know the overall advantages. So there is some resistance.
(Ridley) We haven't felt the pain yet! In the UK, the petrol passed 1 pound per litre recently, which is an important physical barrier. But we can afford it and people pay. It's only when we are afraid that we run out of oil, that we start to think differently. We have to prepare for that change of thinking, we should have a message ready for when people get afraid to run out of oil.

Q: What did Tony Blair announced recently about stimulation of renewables in the UK?

A: (Banks) The government has put little money in biogas, but has put money in other forms of renewables.
(Woods) They are technology blind! The stimulation says nothing about the technology to be applied. This is good for wind-energy, but has forced other new technologies further from market.
(Jönsson) Biogas has in most of Europe been focussed just on electricity production. This is like standing on one leg. If someone cuts it, you fall. You should stand on 2 legs. Look for more markets at the same time.
(Banks) We are thinking in terms of easiness of use, not in energy balances. If we will run out of oil, we will take this into consideration, including the use of heat, minimisation of transport cost, the use of existing gas networks, etc.
(Woods) If you make energy balance, it all depends on what you put in. You can get a good energy balance including transport by large truck over distances as long as 300 km. But if you use a smaller truck, you cannot go further than 30 km. You should put in the conditions of very specific cases.
(B. Elbersen) You have to look at the biomass chain at local region. So indeed you need very specific boundary conditions. Now very broad studies are made. We have to go to detailed chains, take into account all the regional details.
(Woods) I fully agree. Detailed LCA studies on chains are needed, in particular for fuels. Many details do matter!, like transport, nitrogen use in agriculture, how far the methanol is transported after production, etc.