**19TH OSCE ECONOMIC AND ENVIRONMENTAL FORUM**
"Promotion of common actions and co-operation in the OSCE area in the fields of development of sustainable energy and transport"
**CONCLUDING MEETING**
Prague, 14-16 September 2011
SPECIAL SESSION 1

EEF.NGO/18/11
15 September 2011

ENGLISH only


# CHARTING THE WAY FORWARD FOR THE OSCE ENGAGEMENT ON ENERGY

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The satellite-derived estimates, although annually variable, predict that the total photoautotrophic primary production for the Earth was 105 Gt of carbon per year for terrestrial habitats and sea-surface chlorophyll for the oceans together. Of this, roughly 54% was produced by terrestrial organisms, while the remaining 46% was supplied by oceanic production [1]. Humans use only a fraction of this vegetation biomass for food, feed or as industrial material yet the quantities of organic waste affect our environment. The main environmental threat from organic waste is the production of methane and carbon dioxide from landfills, which accounted for some 3% of total greenhouse gas emissions in the EU-15 in 1995 (European Commission Environment, 2011). In addition, excessive composting of organic material to reduce its bulk in some countries is also estimated to contribute significantly leading thus to loss of extractable energy to environment and releasing greenhouse gases to the atmosphere. Three decades ago biological treatment of waste was limited to a few biogas and composting plants for treating unsorted organic waste. Meanwhile anaerobic treatment of organic waste became topical as an alternative method due to the oil crisis in the seventies of the past century. In the last decade biogas plant production has been continuously rising with Germany as the leading country in biogas production having established approximately 5.000 biogas installations.

Many benefits arise from using biogas as an energy source. One of the major benefits is obvious – this technology is centered on renewable resources and not on fossil fuels. Thus, the carbon, nitrogen, phosphorus and other nutrients that are released by biogas plants en course of biogas production, are taken up into novel plant biomass that fuels the next cycle of biogas production. All organic material had previously been grown in the form of live plants. Thus, biogas productions is a way of harnessing the solar energy stored in plant biomass, manure

and other organic materials into combustible gas with high energy value. Cattle manure which serves as inoculum in biogas plant and is converted to carbon dioxide and methane during anaerobic fermentation is otherwise decomposed releasing two main gases that cause global climate change: nitrous oxide ($N_2O$) and methane ($CH_4$) are 310 and 21 times more potent greenhouse gases, respectively, than carbon dioxide ($CO_2$). When using manure in biogas plant, the resulting methane is used as an energy source for production of electric and heat energy. In addition to and in combination with manure, almost any organic substrate from food or feed industry, agriculture, waste-water treatment plant sludge, other organic industries and municipal organic waste can be used for biogas production under anaerobic conditions under various yields. Much of the energy upon the full anaerobic decomposition remains in the spent dehydrated substrate that could be further put to use if only coupled to downstream aerobic processes or used in optimized lignocellulose biomass combustion technology with oxygen. In addition, increased yields can be obtained upon additional selective substrate preparation and combination in biogas production that are being in the center of interest of biogas producers.

Company Keter Group, Slovenia, is a forward-looking investment company with experience in the field of strategic investment and covers a wide range of fields combined in individual divisions. As a parent company, it has supported its subsidiary Keter Organica that is focused on biogas plant technology development, engineering, construction next to follow-up monitoring and end user consulting. It is an environmentally oriented company that offers green energy solutions – biogas technology development, biogas plant establishment and production of biogas, electric and heat energy. Fully functional biogas plants with excellent biogas production and process stability are the result of Slovenian knowledge and innovation, combining the latest technological solutions. It is one of the most successful Slovenian companies in the energy sector and is expanding rapidly to the markets of South-eastern Europe, Russia and South America. To the date Keter Organica has built 9 operating biogas plants in Slovenia, which offer additional green power supply to the country, while a number of plants is under construction or just before the full cycle start up. Keter Organica also established the technology and fully operating first biogas plant that is focused on complimentary processes producing biogas and valuable primary material ethanol in its own fermentations. This ranks Keter Organica among the few leading companies in the development of such technologies in the world, integrating research, innovation and development into operating and functional technologies on industrial scale. Thus, the company is striving to fulfill its share in the efforts of The Republic of Slovenia to increase the fraction of energy obtained from renewable resources, in accordance with EU guidelines on energy production. Keter Organica started to make further steps in 2011 with the establishment of its own biogas laboratory KeterLab testing novel and less used substrates that are difficult to degrade or need to be utilized in their most optimal combinations such as

various substrates with high lignocellulose content, concentrates such as vinasse, residual waste and various waste-waters from different kinds of food industry. Data analysis and modelling allow us to predict most optimal combinations that can be further tested for confirmation before being used at full scale. As one of the main objectives of the laboratory establishment is to evaluate biogas production for novel untested substrates to be used at full scale, one of the key topics is also the coupling of research approaches targeting conventional functional and less explored organismal levels to reveal both types of responses. In addition, the company is going to also actively participate in the full scale testing of various enzymes that enhance microbial conversion of organic matter in energy crops and novel substrates to biogas and thus help to increase the utilization of less fashionable substrates in biogas production.

We are already looking forward to maximize yields of certain plants which are not commonly used in biogas production, because of their originally low methane yields (such as different types of grass and green trim), and thus making our produced energy even more green than it already is. It is certain that most of energy from renewable resources will be provided from bio waste of food or other organic industries. We are already testing different substrates, their most optimal mixtures for codigestion in our laboratory and exploring their potential for biogas production. Biogas plants using locally available substrates with low transportation and management costs are gaining importance on energy market, however they are bringing also operational uncertainties and pose certain problems to biogas production. As an example, the state sanitation requirements in accordance with EU legislation currently preclude the use of 200,000 tons per year of waste water treatment plants sludge in Slovenia only for biogas production, due to the difficulties of spent substrate deposition legislation. This sludge is most often deposited on landfills or composted and its energy value gets lost or transported abroad for combustion. The use of sludge in biogas production and the subsequent use of dehydrated spent substrates as fuel for aerobic combustion on site and further energy production is currently not permitted although that would close the organic cycle completely and solve many problems on landfills. Thus waste-water treatment plants sludge represents a challenge and changes in legislation and also plant operation are needed to allow the complete energy bonus to be extracted from available substrates, but of course retaining ecological and sanitary sustainability. Frequent substrate changes and shifts in loading rates of substrates delivered to biogas plants in this more dynamic organic material market represent a challenging opportunity to biogas producers based on classical recipes of manure and maize combination.

It is not all about using alternative sources of substrates. Keter Organica is also working on the most efficient production of alternative organic substrates in our own and specialized growth chambers, using excessive heat and carbon dioxide, exploring the most efficient and economically viable production of mixed cultures of algae in fluctuating environment, polishing of recirculate waters and effluent gases from motors by fast growing plants and

various microbial cultures taking up residual nutrients thereby closing the nutrient circle and decreasing the greenhouse gas fingerprint of the biogas plant. In this manner, it is not all about novel substrates either, as also co-functional technologies must develop at least at the same pace. For instance, technologies for purifying biogas are already available making biogas of comparable quality to that of natural gas. Biogas plants are thus readily integrated into the natural gas networks, for example in Sweden and Germany, allowing end users to make the choice to use the available energy source when and where it is needed.

On the other hand, the chase to use novel substrates in optimal combinations should not make end users believe that the biogas technology is almighty and can deliver impossible or solve all environmental issues. For example, the use of wood to produce biogas has also been explored by some, but the classical approaches such as gasification or aerobic combustion in most optimal conditions might prove more economically and ecologically acceptable. The future of biogas lies in the complete use of all available organic sources that can be readily combined in such a way that sufficient quantities of high quality biogas are produced in real time on industrial scale using stable and not overly complex technology and that as much energy is harnessed as possible. In this way, one has also to rethink about the other half of the biogas paradigm, the use of excessive heat generated during combustion of biogas. Keter Organica has opted to implement temperature exchangers in order to extract additional 10-18% of electricity from heat on some plants, while redirecting the excessive heat for additional services such as harvest dehydrating facilities or drying chambers, all year agricultural greenhouses, frost preventing facilities or specialized businesses as flower potting. Thus one can do ones best to harness as much renewable energy as possible and spare the use of conventional fossil fuels.

There is also no doubt that in the future a decrease in the use of energy crops for biogas production has to be anticipated. Non-governmental organizations (NGOs) have started to draw attention to the use of food for production of electricity as more biogas facilities around the globe run on so called “energy crops”, such as corn and beet silage. The pressures exerted on the governmental level have brought or are at least beginning to bring changes to the Regulations governing this area. One of the more profound changes was the decision to prevent establishment of novel biogas plants using energy crops in biogas production, despite the fact that large areas of arable land in many EU countries are out of food production cycle and lay unused for decades due to food surplus in EU in addition to EU subsidized food production. The necessity to explore and use various substrates on market, make use of most of the energy produced from biogas plants calls for adjustments in some parts of the legislation that regulates biogas production and biogas plant functioning. Biogas plants presence on energy crops market provide an additional option of choice as farmers can gain independence of the major food crop purchasers. It is obvious that agricultural biomass has already gained much more importance in the field of energy supply and this has already

influenced the agricultural approaches used by farmers today. In our opinion the restricting policy should be seriously and carefully considered as the governmental adjustments in regulations could fundamentally affect the fraction of biogas produced. The situation in our country (The Republic of Slovenia) is promising as we are happy to admit. There are governmental regulations that define the area of biogas production. On the other hand, despite the commitment to deliver as much green energy as possible, the whole group of biogas designers and operators in Slovenia are faced with different technical obstacles, local initiatives tied to food production lobbies and governmental bureaucracy that is slow or reluctant to respond to novel developments in the field of biogas production. These factors hamper or at best slow down the development in the biogas production area, mainly because the legislation is lagging behind and we are facing uncharted areas where it is hard to define what is right or wrong, or changes in legislation make the energy production much more stringent, yet hardly economically viable. We see OSCE as an organization and partner that could bring together the various initiatives, help bridge the gaps and provide novel guidelines in biogas field development implementation in member states and provide good practice to follow in nonmember states.

This role is needed as the biogas production field as a whole needs such partner to provide stable environment to steer the technological development, research and investment into the technology of the right choice and potential that can deliver the requested energy and respond to ecological demands of the future at economically plausible scenarios. So far and for so long our company Keter Organica has been proud to be successful in “breaking the new ground” for the better future. For better environment. For the Earth. We are certain to deliver even more in the future.

[1] Field, C.B.; Behrenfeld, M.J., Randerson, J.T. and Falkowski, P. (1998). Primary production of the Biosphere: Integrating Terrestrial and Oceanic Components. Science 281 (5374): 237–240