

Project No: 2013-1-ES1-LEO05-68066

Project acronym: DELOS

Project title:

Development of an e-learning platform for the operation and management of biogas production units

Work Package 2: *Comparative Studies*

Work Package Leader: *Green Technologies Ltd.*

Result :Training needs analysis

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I. Focus Group Meeting in Greece

I.1. Introduction

The aim of the organized focus group meeting was to inform the focus group participants with the results and conclusions drawn from the ‘State of the art analysis’ carried out in the framework of DELOS and identify possible aspects and targets not considered so far through the previous survey and, finally, draw conclusions on the e-content that will be developed in the sequel by the partners.

The focus group in Greece was organized by Green Technologies Ltd in its premises and was composed of the following participants:

- Dr. Nantia Zafeiri, Civil Engineer-PhD in Chemical Engineering, Director of Green Technologies Ltd
- Dr. Mark Sklivaniotis, Chemical Engineer, Ph.D., Technical Director of DEYAP (Patras’ Public Enterprise for Water and Sewage Management)
- MrIoannis Tsakarestos, Director of the General Directorate of Land Planning & Environmental Policy of the Decentralized Administration of Peloponissos, Western Greece and Ionion
- Dr. Ioannis Bafas, Chemical Engineer, Ph.D., representing the Directorate of Development, Regional Entity of Achaia, Region of Western Greece
- Dr. Michael Kornaros, Associate Professor, Department of Chemical Engineering, University of Patras
- Dr. Christakis Paraskeva, Assistant Professor, Department of Chemical Engineering, University of Patras

The composition of the focus group was decided in a way to include different stakeholders that could express their unbiased expert opinion regarding the targets that DELOS should aim to. Therefore, DEYAP (represented by Dr. M. Sklivaniotis) was chosen, as the municipal company of public interest responsible for municipal wastewater management in the city of Patras. The Wastewater Treatment Plant (WWTP) operated by DEYAP includes an Anaerobic Digester for the treatment of excess sludge produced in the plant during treatment of municipal wastewaters generated from the city of Patras. Dr. Sklivaniotis represented, as well as Dr. N. Zafeiri from Green Technologies Ltd, the technical-industrial stakeholders.

Mr. I. Tsakarestos and Dr. I. Bafas represented two-distinct organizations, Decentralized Administration of Peloponissos, Western Greece and Ionionand Region of Western Greece (RWG) respectively, which are responsible for environmental audits, policy making and licensing of industrial activities.

Dr. Kornaros and Dr. Paraskeva, represented academia and, in more specific, they brought their expertise regarding anaerobic treatment (biogas production) and valorization of agro-wastes and organic residues.

I.2. Identification of trainingneeds

After being informed about the results and conclusions from the survey conducted by Green Technologies Ltd, regarding the current status of biogas plants in Greece, the focus group members discussed thoroughly and made the following suggestions regarding the training needs and required content.

- ❖ All members agreed that the biogas production sector is currently at its infant stage in Greece due to late development of biomass exploitation (through biogas) plants, compared to other renewable

energy sources (RES) such as PVs and wind farms, and because of the continuing economic crisis and recession which has impact to all industrial activities, energy production included. Therefore, the seven (7) existing biogas plants recorded during the survey is expected to grow rapidly within the next few years.

- ❖ In this view, various types of waste producers are expected to become future biogas plant owners and thus can be considered as potential trainees. In this category (I), animal farmers, energy crop farmers, and agro industries' owners such as cheese making factories, olive oil producers etc. are included. These waste producers, if interested, could be trained in order to obtain fundamental knowledge of anaerobic digestion, biogas plant design and technoeconomic evaluation.
- ❖ There are existing and prospective technicians (category IIa, b) and supervisors (category IIIa, b) of biogas plant operation. Existing technicians (IIa) and supervisors (IIIa) are quite few but have to refresh their current knowledge with some fundamentals but mostly gain advanced knowledge, while new ones (IIb, IIIb) have to be trained starting from the basic level.
- ❖ Subjects that have to be taught to trainees include all levels of a biogas plant operation, i.e. starting from selection of different types of potential substrates, waste collection, transportation, temporary storage, pumping, mechanical and electrical works, treatment of produced biogas to be prepared for burning, collection and post-treatment of digestate, disposal etc. However, subjects like legislation and technoeconomical evaluation of biogas plants are also required especially at the planning stage of a new biogas plant.

1.3. Identification of training material

Following the evaluation of the interview forms and the assessment for the educational material on the sector of agro-waste treatment, as well as the suggestions from the focus group we diagnosed that there is a lack both in theoretical and technical training. Furthermore, the stakeholders should seek existing informational material in various sources, as there is no unified learning material that may cover their needs. The following indicative structure and subjects is thus proposed for the development of the e-learning platform for the DELOS project (trainees' categories are shown in parentheses).

THEORETICAL TRAINING

- 1. Introduction of anaerobic digestion process – overview (I, IIb, IIIb).**
 - Description of the anaerobic digestion process. Merits and limits
- 2. Legislation issues in the partner countries and EU policies (all).**
- 3. Design of anaerobic digesters (all).**
 - Type of digesters for agro-waste treatment
 - Typical anaerobic digesters
 - High-rate anaerobic systems
 - System selection, Merits and Limits.
 - Can two-stage anaerobic digestion increase the energy yield?
 - Merits and Limits of two-stage anaerobic digestion
 - Reactor configuration
 - Economic evaluation

4. Microbiology of anaerobic digesters (IIIa)

- Mixed cultures
- Microorganisms consortia involved in the process
- Macronutrients and Micronutrients
- Toxic compounds

5. Inhibition of the anaerobic digestion process (IIIa).

- Process control

6. Increasing the Biogas yield of a plant (I, IIIa,b).

- Pretreatment of the Biomass
- Post-treatment and recirculation
- Thermophilic anaerobic digestion

7. Techno-economic evaluation of a biogas plant(I, IIIa,b).

TECHNICAL TRAINING

1. Biogas plant components (I, IIb, IIIb)

- Feedstockstorage
- Feeding systems for wet and dry substrates
- Types of full-scale digesters
- Digestercomponents
- Biogasconditioning
- Energy recoveryfrombiogas
- Pipes and fittings

2. Selection of substrates - Co-digestion of agro-wastes (all)

- Seasonal availability of substrates and replenishment with other type of wastes

3. Process monitoring (all)

- Monitoredparameters

4. Troubleshooting(II, III)

5. Safety Practices for Anaerobic Digestion Systems (II, III)

6. Composting of digestate

1.4. Conclusions

Although there is a vast amount of information available on the subject of agro-wastes anaerobic digestion, there is a lack of complete and unified educational material that could meet the needs and cover the gaps of different trainees. Therefore the material of the DELOS platform will be firstly classified as theoretical and technical but it will be available to both new or refreshing technicians and supervisors, as well as future plant owners, depending on their level and needs.

II. Focus Group Meeting in Spain

II.1. Introduction

The focus group meeting was celebrated among three important stakeholders for DELOS project:

- Mrs Eva Fernandez – Technical General Secretariat for Aragonese Union of Farmers
- Mr Pedro Royo – APPA representative and Environmental Department Coordinator for Guascor.
- Mrs Pilar Leal – Biomass and Agrowastes Department - IDAE (National Agency for Energy Efficiency and Renewable Energy).

Each one represents different stakeholders' representative for the Delos interest. IDAE represents a public body which rules the renewable energy sector. They are responsible for policy making and are well known connoisseurs of the biogas sector. Mr Pedro Royo represents the industry point of view and he expresses their training needs for their workers. Finally Mrs Eva Fernandez represents this new stakeholder pointed out in the Spanish analysis of the training needs. Farmers, a stakeholder group not initially identified for projects' interest finally showed up as an important stakeholder group.

Information for this report have been also gathered in different conversations with other Spanish representatives of the biogas sector like Mrs Begoña Ruiz (AINIA-Centro Tecnológico, the most well-known research institute for biogas in Spain) and Mr Eduard Ruestes, Production Manager for Tractaments de Juneda.

II.2. Training needs for biogas plants operators

Any analysis concerning biogas plants in Spain must consider that the sector is suffering such a huge crisis than no more than 12 biogas plants are already working on. No more than two years ago, before the legal insecurity provoked by the Spanish Government repealing the RD661/2007law, there were almost 50 biogas plant.

This means that there is no actual need neither for hiring new workers nor training for ongoing workers, as the sector is collapsing. Despite the current situation, which is caused by the ongoing government, the situation must change because of the application of different EU directives and also because of the environmental protection. When the situation will change, training will be needed, as nowadays no one is making efforts in training biogas' workers.

Besides this juncture, the training analysis biogas workers revealed that the following topics should be addressed:

- Operators: occupational risk prevention (Basic training), boiler operator, driving trucks, chemicals handling.
- Maintenance workers: Occupational risk prevention, mechanical and electrical maintenance, pneumatics, electronics.
- Laboratory staff: Occupational risk prevention specially focused on legionella, chemical analysis.

II.3. Training needs for farmers

Pig farms in Spain is a very important sector, especially if it is compared with the European Union. Almost 80% of pig meet is exported to other European member states. In relation to that, there is a huge production of pig manure that pig farmers are not able to manage. In this sense, pig farmers are very interested in biogas production and training.

Training needs for farmers are the following:

- Costs: How to calculate the investment and finance it. They are not only interested in the profit but in the slaughterhouse waste disposal, so a zero balance will be optimal.
- Design: How to calculate the optimum design so plants are integrated in the surroundings and respond to local pig manure production.
- Legal issues: How to constitute a cooperative so all the farmers can participate in the biogas plant.
- Operation: Basic principles, transportation of manure, combination of other influents & co-digestion.
- Slaughterhouse waste disposal permits.
- Fertilizer: The compost must contain the more nitrogen as possible (15 to 46%) and must be free of pathogens.

II.4. Conclusions

Training needs have been confirmed and detailed by different stakeholders. While nowadays there is no training demand due to the juncture, it is expected that a new political commitment with renewable energy sources and the environment should produce an unexpected demand of training need that DELOS project will be able to cover.

It must be also analyzed how contents can be adapted to the new stakeholder (farmers).

III. Focus Group Meeting in Cyprus

III.1. Introduction

The focus group in Cyprus was organized by Marketmentor Ltd. The participants that were interviewed and took part in the discussion were:

- Dr. Ioannis Vyrides, Department of Environmental Science and Technology, Cyprus University of Technology (CUT)
- Ms. Lefki Theodorou, Industrial Extension officer-Department of Technology, Ministry of Commerce, Industry and Tourism
- Ms. Maria Ioannidou, Energy Education Officer, Cyprus Energy Agency (CEA)
- Mr Mixalis Papaefstathiou, Managing Director of Animalia Ltd

The composition of the focus group was decided in a way to include different stakeholders that could express their unbiased expert opinion regarding the targets that DELOS should aim to. Therefore, CUT was chosen, as an academic institution with serious expertise in the field.

Ministry of Commerce, Industry and Tourism was chosen as a governmental institution that has a first view on the policies and the directives that have to be implemented in Cyprus. Their involvement in the focus group could add value as a policy maker institution.

CEA was chosen for this group due to the direct involvement of this agency in the field of energy as well as with great experience in the topic of DELOS.

The managing director of Animalia was chosen as an expert on the use of technology as well as R&D on the Biogas Plants.

III.2. Identification of training needs

After being informed about the results and conclusions from the survey conducted by Marketmentor Ltd, regarding the current status of biogas plants in Cyprus, as well as the indicative number that the survey showed for the two other partner countries Greece and Spain, the focus group members discussed thoroughly and made the following suggestions regarding the training needs and required content.

One important aspect of the needs in training/education and further future support was the common problem found when farmers are trying to implement a business plan or strategy that they are often lost in questions, overwhelmed by the magnitude of the quest or sometimes they just have a single opinion, the one given by the constructing company, which to some farmers may seem insufficient.

The questions that the farmers would like an organized response are:

- How to build up a biogas plant? (with a view on potential use of different expanding technologies)
- Where to start?
- How to ensure that the process will be successful and not a complete failure?
- How to predict the revenues that the plant will generate?
- How to anticipate problems and how to take them into account?

The above questions that Delos may provide in the training and support services have to do with the interest of farmers on investing on procedures and structures that can easily support the changing and advancing technology. This could be also an extra and strong asset on the DELOS project outputs.

III.3. Identification of training material

The viability of the biogas plant is not depended only on the electricity production, but is a much more complex matter. The more side-effects of the biogas plant, such as heat recovery, digestate as fertilizer or biogas upgrading that are used, the bigger chance the plant has to become a good added-value to your animal production.

Some training material that could be added on the material needs that was recorded by the Delos project' partners may be:

- Project planning
- High quality input materials
- Biogas yield from different materials
- Timely and continuous cooperation with local authorities and citizens
- Reliable and certified technology
- Optimizing investment and operation costs
- Choosing the suitable combined heat and power unit
- Waste heat recovery
- Digestate as a high-quality fertilizer
- Further possibilities of using biogas

III.4. Conclusions

There is a vast amount of information available on the different stakeholder institutions regarding the subject of agro-wastes anaerobic digestion, as well as policies and plans from different institutions. But there is a gap in the gathering and unification of all those educational targets on one direct and complete training procedure/uniform material. Moreover, there is a lack of trainers. Therefore the material of the DELOS platform has to target via train the trainers procedures as well as cover this gap from the different stakeholder information and willing to educate.