Interreg – IPA CBC
EUROPEAN UNION
CCI 2014 TC 16 I5CB 009
ZEFFIROS
Zero-waste energy-efficient agricultural communities in the Greece-Republic of North Macedonia cross-border area

Harnessing bio-waste energy potential through the production of biogas

WP 4, Deliverable 4.3.3
Event title, date, venue (tbd)

ENERVIS as SFADIS S.A.'s sub-contractor for SFADIS S.A.'s contribution
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Project co-funded by the European Union and national funds of the participating countries

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Installation - operation - management of a small-scale biogas station

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Brief description of the plant's operation

- A biogas plant processes bio-waste, such as manures, whey, SHW, rotten potatoes' pulp, olive mill residues (mix) but also whole crops like e.g. silages
- The bio-waste is introduced into reception tanks where it is mixed through agitation and formulate a final substrates' mix ready for a process named «Anaerobic Digestion-AD».
- The mix is pumped and transferred to sealed and properly isolated tank(s), the Bio-Digesters (BDs) -> digestion process is taking place -> biogas is released from the respective biodegradation of the mix -> biogas is collected, cleaned and transferred to a Combined Heat and Power (CHP) unit for combustion in an Internal Combustion Engine (ICE)

Brief description of the plant's operation

- The CHP unit produces electrical and thermal energy
- The produced electricity is injected to the LV/ 0.4 kV grid and sold to the utility
- The produced thermal energy is partially used to heat the BDs and possibly sold for the needs of nearby (e.g. Greenhouses).

Brief description of the plant's operation

- The wet mixture exiting the BDs (Digestate) is pumped and transported to a separating tool (Separator) where it is separated into liquid and solid forms

- The liquid fraction is deposited into a «Lagoon».
- The solid fraction is bagged after it has been dried.
- Both of them are deposited in adjacent farms cultivations during the summer periods for fertilizing purposes.

- The reception of the bio-waste streams takes place in reception tanks after shredding (if needed) and their mixing is assisted by mounted agitators before entering the BDs.

Brief description of the plant's operation

- The biogas produced from each bioreactor is collected inside biogas depots on top of the BDs.
- In the depots the biogas is cleaned and then directed via pipelines to the CHP unit where it is at first dried.
- Finally, the biogas is compressed and directed to the ICE for combustion and enegy production.

Example: 40 kW pilot biogas plant

Purpose: Showcasing a circular economy model for the benefit of the local production and the local society

Facts & Figures:

- Annually processed bio-waste: **3.285 tons**.
- Annual digestate output: **3.121 tons**. (Liquid: 2.185, Solid: 937)
- Layed over: **69,2 ha** minimum
- Total BDs volume: **180 m^3**
- Total annual electric energy produced: **c. 300.00 kWh**
- Total annual thermal energy produced: **c. 350.000 kWh**

Plant’s operational management and monitoring

- The plant will operate 365 days per year excluding scheduled maintenance days. Required staff*
- - 1 Lead Engineer with overall responsibility over the overall management/ supervision of operating and maintenance processes
- - 1 Operator with responsibility for managing bio-waste reception and disposal of Digestate (liquid and solid fraction)
- - 1 Technician responsible for the maintenance of the plant's electromechanical equipment

**for the pilot case study*

Plant's operational management and monitoring

- The operation of the plant will be automated with ability of remote monitoring and control through a SCADA system installed in the control room of the Technical container. Operating parameters :
  - ❖ Temperature of the BD's chambers from all digital thermometers installed on it
  - ❖Volume of biogas supplied at the inlet of the ICE
  - ❖Charging level of the BDs
  - ❖Generator output power
  - ❖CHP unit's operating hours

Plant's operational management and monitoring

Controlled monitoring by the SCADA system will be provided for the operation of the following equipment of the plant.

- Substrates' mix/ digestate handling pumps
- Digestate's screw separator
- Closed hot water circuit's circulation pump
- Reception agitators
- BDs mixers
- Scrubbers
- Biogas blower
- All pneumatic valves controlling the circulation of the substrates' mix and biogas in the respective pipelines
- Especially the pneumatic valve diverting the biogas flow towards the safety Flare
- The sparkling torch of the safety Flare

Plant's operational management and monitoring

Addittional parameters to be physically checked, recorded and archived:

- The pH value (alkalinity) of the substrates' mix (daily)
- The composition of the produced biogas (daily)
- The content of the substrates' mix in short-chained fatty acids
- The phenol content of the substrates' mix during the supply period of olive mill waste
- Analyses will also be carried out on samples of the substrates' mix and the produced digestate, in order to detect and record the content of substances/ elements as they are dictated by the applicable laws and at the frequency of checks as required by such laws.

Plant's operational management and monitoring

Operational aspects of the plant

Control	• Quality • Safety • Emissions
Maintenance	• Repairs • Service
Documentation	• Self-control, troubles, diagnostics • Official reporting requirements

Idea and go – no go decision

Evaluation of the agricultural resources

- Your fields and farms: Clearly identify the available substrates and estimate the quantity in tons per month/year for each of them
- Animal waste (manure, dung, slurry, etc.)
- Agricultural residues (like fodder leftover, grain litter etc.)
- Agro-industrial company (organic industrial waste)
- Others
- Get in contact with a national biogas experts for consultancy and advice
- How much will it cost
- First (preliminary) calculations of the farm's biomass potential and the annual costs for the plan
- Make calculations for a first assessment of the economic feasibility of your planned project

Idea and go – no go decision

Evaluation of logistics

- Assessment of existing roads' infrastructure
- Can trucks freely use those roads?
- Which substrates have to be transported (tons/year)?
- How much will the logistics be (€/year) and is it worthy for it (normally less than ca. 20 km distances ensure profitability)?

Idea and go – no go decision

Project purpose

- Determine the energy production and energy consumption
- Are there selling opportunities? (e.g. selling of the heat)
- Price set for electricity fed into the grid in Greece is based on FiT at €0,225/kWh_{el} for stations below 1 MW.

Idea and go – no go decision

Kind/structure of the plant management company

- Inform yourself about the most common forms of company and their specificities.
- Identify the persons who may take part in your project. Discuss with them about their involvement and their responsibilities.

Feasibility study - Business plan

Specifics to be addressed within the feasibility study

Substrates	• Quantity & Logistics • Quality (e.g. biogas yield)
Biogas plant	• AD Technology • Parameters • Location
Energy output	• Annual Energy production • Annual Energy utilization
Economy	• Detailed costs on annual basis • Detailed revenues on annual basis
Type of company	• Legal form of the biogas project • Role of the farmere/stakeholder
Obstacles	• Identify bottlenecks • Describe solutions

Tasks for realization

Tasks within the realization phase

Permits	• Providing needed documents, plans and information
Funding	• Providing documents and reports for banks • Providing documents for funding programme
Acceptance	• Neighbourhood should accept/approve biogas project
Contracts	• Conclude contracts with e.g. external heat costumer
Ask for tender	• Request for offers • Placement of orders
Building the plant	• Schedule the project • Controlling • Start plant operation

General permits' framework

The regulations relating to the construction and operation include:

- construction planning act
- occupational health and safety law
- water protection legislation
- nature conservation law
- waste legislation
- fertilizer act
- hygiene legislation.

Expert's/ Consultant's scope of work

Documents for approval

- Building application forms / application forms on emission control regulatory approval
- Qualified location map/drawing
- Land Registry abstract
- Plant and Operations description
- Emission / immission
- Noise certificates, odour surveys and/or emission source plan
- Waste management / utilisation
- Plant Safety

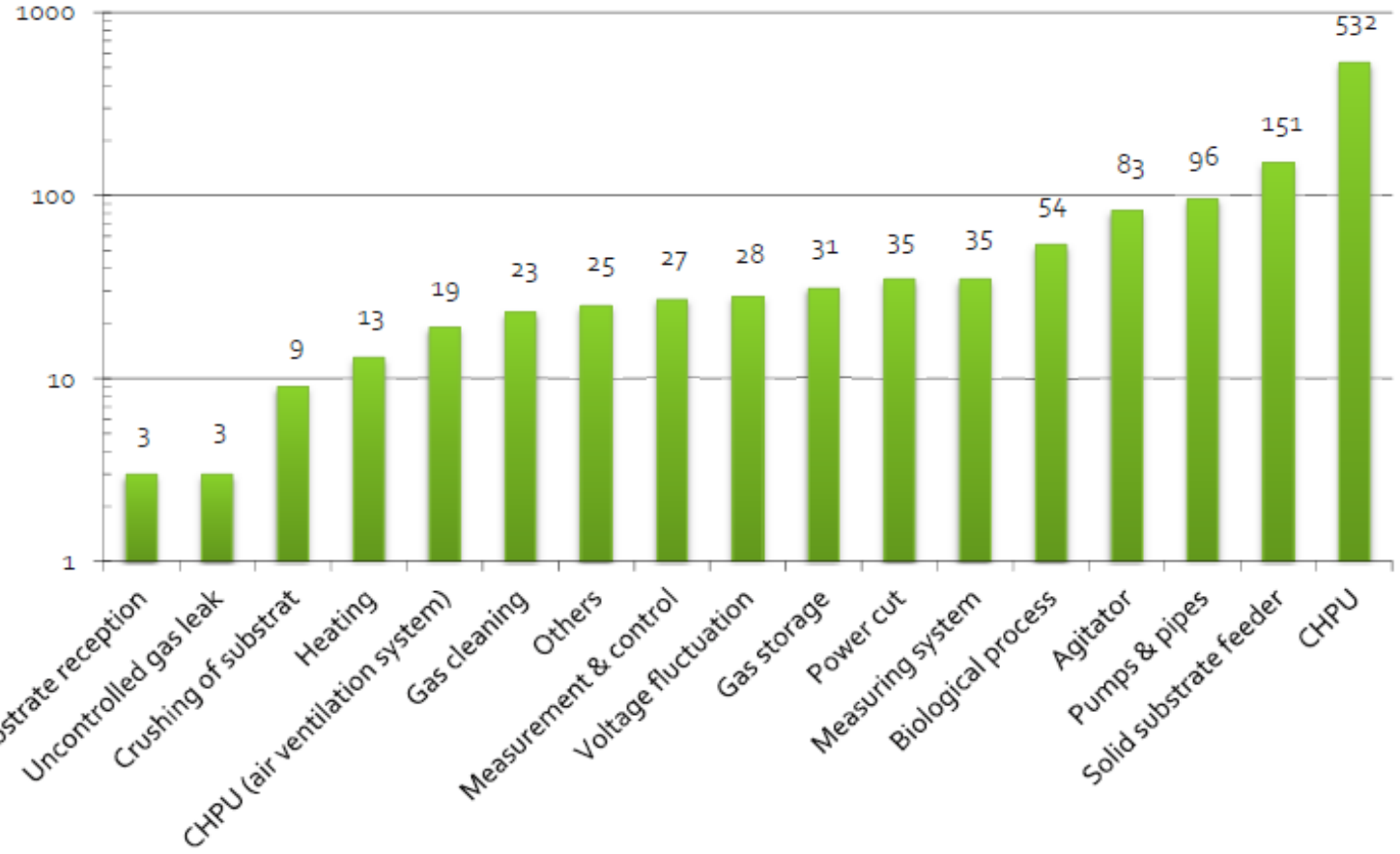
Expert's/ Consultant's scope of work

Documents for approval

- Intervention in nature and landscape
- Authorization under EU-regulation for animal by-products
- Site plan with distance space
- Structural calculations for major components of the biogas plant
- Installation plan
- Detailed drawings

Possible malfunctions

These results point out the importance of consequent process control. Most significant indication for a process disturbance is a noticeable decrease of biogas yield respectively methane concentration



Thank you for your attention!

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