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

ARISTOTLE UNIVERSITY OF THESSALONIKI
LHTEE

Enabling local agricultural communities to valorize bio-waste via a small-scale biogas plant

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SECTION A: 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 a biogas depot.
- Following its exit from the depot, the biogas is desulphurized and then dried and cleaned before directed via pipelines to the CHP unit where it is burned in an Internal Combustion Engine.
- Before entering the ICE for combustion and enegy production, the biogas passess from a flowmeter.

Example: 18 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: **2,190 tons**.
- Annual digestate output: **2,095 tons**. (Liquid: 1,467, Solid: 628)
- Layed over: **12,5 ha** minimum
- Total BDs volume: **160 m^3**
- Total annual electric energy produced: **c. 144.000 kWh**
- Total annual thermal energy produced: **c. 320.000 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
- Desulphurization unit
- Biogas flowmeter
- 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

Additional 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 expert 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

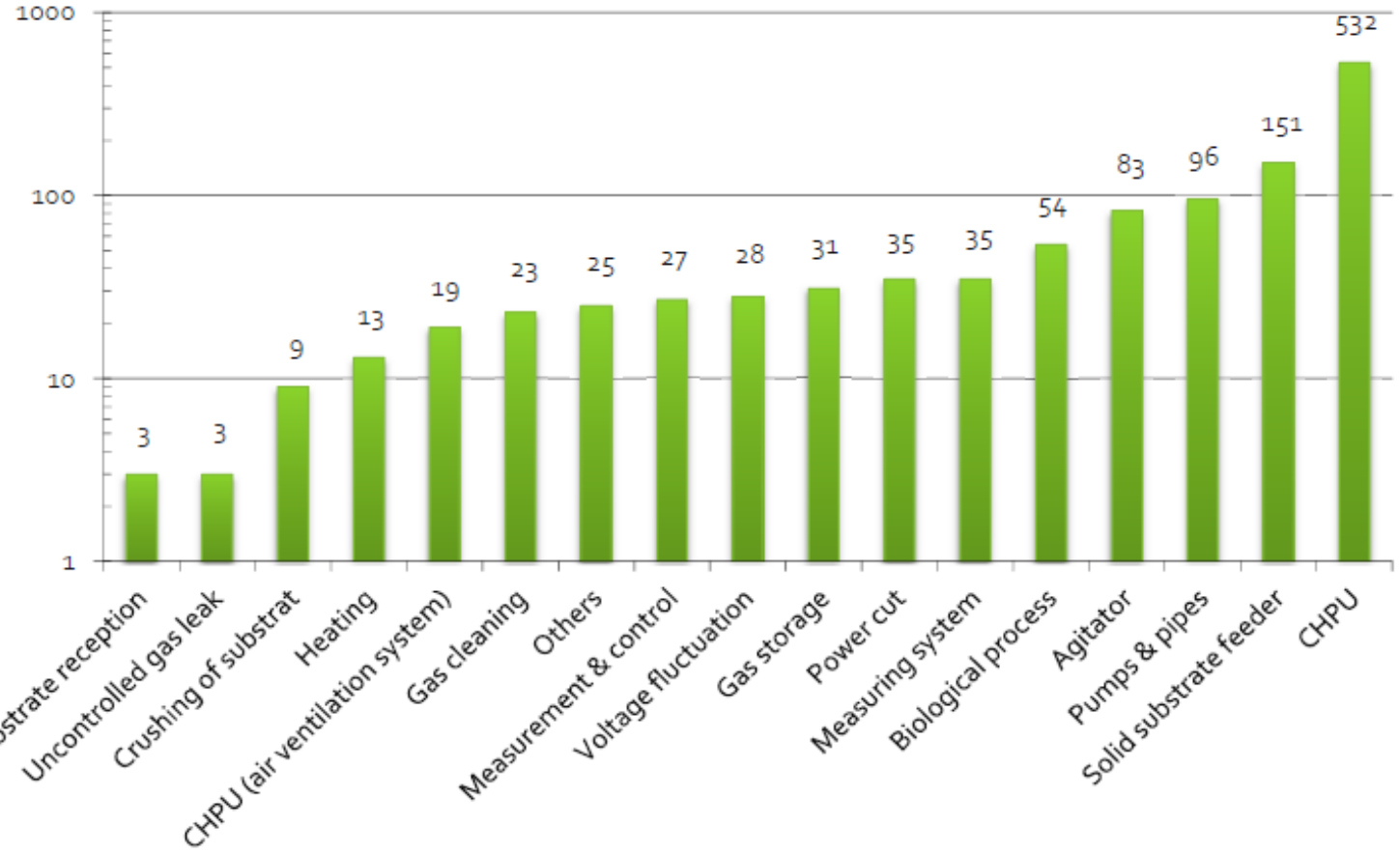
Expert's/ Consultant's scope of work

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



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SECTION B: Energy Communities Law as a tool for local installation of small-scale biogas plants under the co-operation of farmers, stockbreeders, dairy producers and municipalities

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Energy Communities Law

Law 4513/2018

A new, very promising law which promotes social and solidarity economy and innovation in the energy sector, counteracting energy poverty, promoting energy sustainability, producing, storing, self-consumption, disseminating and disseminating energy, promoting and ensuring energy security and self-sufficiency. improving energy efficiency in end use locally and regionally.

Energy communities are expected to allow decentralized, more efficient and innovative solutions for the production and use of energy based on local participation and initiative.

Energy Communities Law

Law 4513/2018

Some of the purposes of the energy community are:

a) Production, storage, self-consumption or sale of electrical or thermal or cooling energy from RES stations. or Hybrid Stations located within the Region where the headquarters of the cooperative is located,

b) management, such as collection, transport, processing, storage or disposal, of raw material for the production of electrical or thermal or cooling energy from biomass or biofuels or biogas or through energy utilization of the biodegradable urban waste fraction,
e) distribution of electricity within the Region where its headquarters are located,

c) supply of electricity or natural gas to final customers, in accordance with article 2 of Law 4001/2011 (A '179), within the Region where its headquarters are located,

Energy Communities Law

Law 4513/2018

Some of the purposes of the energy community are:

d) distribution of electricity within the Region where its headquarters are located,

e) production, distribution and supply of thermal or cooling energy within the Region where its headquarters are located,

f) demand management to reduce the end-use of electricity and to represent producers and consumers in the electricity market,

Energy Communities Law

Law 4513/2018

Main Pillars:

1) Governability: **by attracting citizens, local authorities and local stakeholders, the law tries to foster and enhance the governance within the transition to clean energy and the circular economy**

2) Promoting and enhancing locality: **main target is to generate added value from the local communities to the benefit themselves**

3) Strengthening synergies and partnerships: **the law seeks to strengthen cooperation between citizens, local authorities and small and medium-sized enterprises in the energy sector. In this context, it strives to ensure equality between stakeholders so that everyone has an equal right to make decisions within the Energy Community**

Energy Communities Law

Law 4513/2018

Benefits:

- Gives opportunity to citizens, local bodies such as municipalities, regional governments and small and medium-sized local businesses to participate in energy transition and energy planning
- Promotes energy projects, with priority in renewable energy and energy saving projects involving mild environmental interventions.
- Citizens and other local actors have a dual role as producers and consumers (prosumers).

Energy Communities Law

Law 4513/2018

Who can participate:

- Individuals with full legal capacity,
- Legal entities governed by the public law or private entities,
- Municipalities and regional governments in the region that the Energy Community is based

At least 50% plus one of the Energy Community members must relate to the place where the community is located. In particular, members as natural persons must have full or limited ownership of a property located within the regional unit that the community is located or to be residents of a municipality inside this regional unit. Members as legal persons must be established within the regional unit that the community is located.

Energy Communities Law

Law 4513/2018

The Energy Communities are in most cases of a non-profit nature. They may be for profit only in case their members are at least fifteen and if 50% plus one of them are natural persons.

In this case the balance of net profits after deducting the reserves is distributed to the members.

Energy Communities Law

Law 4513/2018

Privileges

- Exemption from the obligation to pay Annual fees for preserving a Power Production License
- Reduced amounts of letters of guarantee required in the licensing process
- Priority in project's evaluation for licensing
- Exemption from the municipal specific charge of 1.7% when municipalities or regional governments participate in them

Energy Communities Law

Best practices (examples from Europe)

- **Ecopower**, Belgium: established in 1991, 50.000 members, total investment capital of 65 mil.€ in pv parks, biomass, hydroelectric power plants
- **Middelgrunden**, Denmark: 8.552 members, owns the famous Middelgrunden wind park in Copenhagen
- **Somenergia** , Spain: in 2017 the members were aprxm. 27.000, produce enough energy which can meet the annual energy needs of 3,200 families.
- **Germany**: lists about 800 energy communities with 160.000 members. Ardent supporters of the *crowdfunding* practice

Energy Communities Law

The pilot system in Serres

- The case of the pilot system in Serres is a first kind opportunity if not a challenge, to implement a similar practice to those in Europe.
- Livestock breeders who have so far illegally dumped their animals' dung risking large fines but mainly significantly harming the environment along with potato growers and the Municipality can create an Energy Community
- The Energy Community can be non-profit, applying the method of virtual net metering. The generated electricity is counterbalanced with that of the municipality's energy consumption, while offering a reduction in municipal fees to other members (farmers, stockbreeders, etc.)
- Alternatively, if the members exceed 15, there is a possibility the energy community to be of a for-profit nature, i.e. distribution of the profits to the members from the sale of electricity

Thank you for your attention!

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