BEFS

Bioenergy and Food Security

BEFS OLT Agricultural residues Exercise: Livestock residues

Kiev, 6 July 2016

Introduction

- Company BIOENERGY Ltd. Submitted a for a loan provided through TurSEFF programme.
- The company plans to construct a biogas plant on cattle manure and maize silage in the Municipality of Konya.

1. Pretreatment tank 2.Feeding pump 3. Digester 4.Storage pool 5.Biogas storage bags 6. Biogas generator 7.Desulfurizer and dehydrator 8. Biogas storage tank 9.Biogas pump

Project description

Project “Biogas CHP plant Konya” proposed by BIOENERGY Ltd. includes construction of a biogas plant (Figure 1) with a combined heat and power (CHP) unit for production of electricity and heat. Feedstock will include cattle manure and maize silage. The plant will operate under continuous-type mesophilic digestion, with a temperature range of 40-42° C. The plant will be constructed in the industrial zone of Konya municipality, in Turkey. A pre-feasibility study has been prepared for the project. Technical parameters of the foreseen biogas plant are presented in the following table.

Total installed capacity (MW)	0.85
Electric installed capacity (MW_e)	0.41
Thermal intalled capacity (MW_t)	0.44
Annual electricity generation (MWh)	3000
Annual heat generation (MWh)	1700

The internal energy needs of the biogas plant amount 7% of the foreseen electricity production and 10% of heat. BIOENERGY Ltd. singed a contract for sale of electricity with the regional market operator, who will purchase 2790 MWh/year. A nearby industrial facility will purchase 306 MWh/year of heat for their processing purposes. Both contracts are valid for 12 years. The use of the remaining heat is to be defined in the coming months.

Annual feedstock requirements for operating the biogas plant 7446 h/yr under full capacity are:

- 6,500 t of maize silage
- 12,300 t of cattle manure.

Maize silage will be supplied from agricultural fields owned by the BIOENERGY Ltd. in the 3 km radius of the biogas plant. The expected dry matter content of maize silage is somewhat above 30%. Manure will be obtained from 3 dairy farms, each keeping 800 cows. All three farms located in the 10 km radius of the biogas plant. Dry matter content of the manure will be less than 10%. Long-term contracts, valid for 12 years, have been signed for the supply of manure.

Components of the project

Project assessment using the BEFS-OLT (Agricultural residues) tool will cover the following components of the livestock residue pathway:

- Silage production
- Silage Transport
- Silage storage II
- Manure storage - farm
- Manure transport
- Biogas plant

Silage storage I (storage at the location of silage production) is not included in the assessment as silage will be transported to the biogas plant immediately after harvest.

Silage production, transport and storage

- **Silage production**

Maize silage will be produced on the existing cropland under rainfed conditions. Expected silage yield in the region is 50 t/ha. Nitrogen requirements of maize silage is around 150 kgN/ha. Half of that will be supplied by organic fertilisers and the rest by mineral fertilisers.

- **Silage transport and storage**

Maize silage will be transported from the fields to a storage at the location of the biogas plant by tractors (distance up to 3 km). Maize silage will be stored in a concrete bunker silo. The silo will be built on a parcel next to the biogas digestor, which is currently covered with gravel and designated in the local spatial plans as contruction area. The silo will have capacity to store silage in the amounts larger than the plant's annual requirement. The silage will be rolled by tractors, and packed as firmly as possible in order to press out the air. Minimising oxygen content is necessary as to avoid aerobic processes and silage degradation. For the same reason the silage will be covered by a plastic foil (Figure 3).

Figure 1. Transport of maize silage (uncovered tractor-trailer)

Figure 2. Storage of maize silage at the biogas plant location (concrete bunker silo with impermeable base and walls)

Manure storage and transport

Manure is stored at the livestock farms in lagoons which comply with legal requirements. Minimum distance from a residential area is 2 km and from surface waters is at least 500 meters.

Manure will be stored at dairy farms for no longer than a few days before being transported to the biogas plant. Manure will be transported in vacuum tankers of 15 m^3 capacity (Figure 4). Only the existing roads will be used for transport, thus construction of additional roads is not foreseen.

Figure 1. Transportation of manuer in vacuum tankers

Biogas plant – environmental impacts

Total annual energy generation of the plant will amount 3000 MWh electricity and 1700 MWh heat.

Prior to combustion in the CHP unit, biogas from the digester gas storage will be transported by underground pipeline to the gas conditioning unit for drying and additional desulphurization with activated carbon. This will improve biogas combustion properties and reduce pollutant emissions into the atmosphere.

Biogas plant will have overpressure protection system with a relief system for surplus biogas, thus preventing any damage to the biogas storage. The release of eventual surplus biogas however has a negative impact on the environment and poses fire and explosion risks in the surroundings due to methane presence.

Biogas produced at the plant will contain about 52.5% of methane. Methane is a greenhouse gas (GHG) that contributes to the climate change. The global warming potential (GWP) of methane is 25, meaning that its impact on the climate change is 25 times greater than that of CO_2. These environmental risks will be minimized by the installation of flares to burn the excess biogas (Figure 5). Digester feeding system will also be closed to reduce methane emissions.

Figure 1. Biogas flare. (Source: Direct industry[1])

Figure 2. Digestate storage - covered to capture additionally released biogas. (Source: IEA Bioenergy[2])

Digestate

Around 17,800 t of digestate will be produced annually. It will be stored in the digestate storage, constructed from steel with no insulation. The storage capacity will be sufficient for digestate generated during four months' operation. The storage will be covered to capture additional biogas released from the digestate (Figure 6). This will increase energy production of the plant and reduce methane emissions to the atmosphere.

Digestate will be separated into liquid and solid phase with a screw type separator. The liquid phase will then be used for dilution of feedstock before feeding it into the digester. Dry matter content of the feedstock entering digester should not be higher than 12%.

On the other hand, 75% of solid digestate will be applied on the BIOENERGY Ltd. fields and sold to the farmers in the vicinity. Use of the remaining 25% still has to be defined.

Noise

- In order to reduce noise emissions of the plant and thus mitigate impacts on the surrounding residential area, the following noise abatement measures will be implemented:
- Use of noise reduction components (attenuators applied on critical places, e.g. exhaust stack, cooling system, air supply and exhaust grilles),
- Noise insulated room for CHP unit,
- Process scheduling.