SYSTEMIC
Circular solutions for biowaste

Atria (Seinäjoki, Finland)

A short introduction to Atria

Atria Biogas and NRR Plant project is located in Seinäjoki (Finland), a region characterized by intensive primary production.
A-Farmers is a part of Atria Group and has been responsible of the project's first steps.
The plant will be built in 2019 and will have an estimated treatment capacity of 164,000 tonnes/year in the beginning.
Produced biogas (70 GWh) will be purified and liquefied and mainly used as LBG for heavy traffic. CHPs will provide electricity and heat for the plant.

Table 1. Technical information of the biogas plant

Characteristics	
Date of construction	2019
Size	17 tons of LBG/day 1.6 MWel
Volume (m^3)	>16 000
Digester type	Mesophilic digestion

Drivers for Nutrient Recycling

Nutrient recovery can provide a solution for the limited capacity to spread manure on land in the region. When manure can be valorised to recovered products, this would enhance the development of primary production of A-farmers in the neighbourhood of slaughterhouses.
This would also decrease transportation costs and contribute to better management practices of environmental aspects of primary production. Hereby the competition capability of Finnish meat in the global market will be enhanced.

In Finland, growing season is quite short. There are only <2 months per year when the digestate spreading makes sense, since spreading into frozen land is not allowed nor useful. The rest of the year, the produced digestate has to be stored, which requires a very large storing capacity.
Atria realized that digestate spreading as such is not going far enough in nutrient recycling, nor from the environmental or economic point of view and therefore nutrient recovery will be a central aspect in the new plant.

In a sustainable business there is also need for renewable energy in the production chain (industry, logistics) and the AD plant can supply for this.
And last but not least, business itself was also a driver for building an AD plant with nutrient recovery.

Feedstocks

In the beginning, the co-digestion plant will treat about 164 kt of feedstock per year out of which 70% is manure (i.e. pig, cattle, poultry). Co-substrates include slaughterhouse waste and food industry waste (Table 2). The capacity will be enlarged later into 240 kt at least. Environmental impact assessment has been made for 360 kt per year.

Table 2. Origin of Atria feedstock (estimated for business plan)

Type	Mass per year
Pig slurry	50 kt
Solid fraction of pig slurry	20 kt
Cow manure	10 kt
Chicken manure	10 kt
By-products slaughterhouse	22 kt
Food industry waste	10 kt
Plant biomass	20 kt
Potato fluid	20 kt
Total	**164 kt**

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Horizon 2020

The H2020 EU-project SYSTEMIC (Systemic large scale eco-innovation to advance circular economy and mineral recovery from organic waste in Europe) receives funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement no. 730400

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Biogas production

The biogas produced will be around 10 Mm^3/year (estimation, Table 3). The biogas is mainly upgraded and liquefied into LBG and used as fuel for heavy traffic. The amount of LBG produced is estimated 50 GWh. Biogas plant own energy (electricity, heat) will be produced by CHPs.

Table 3. Yearly biogas production and average composition before purification

Component	Estimation
CH_4 (%)	65
CO_2(%)	34
H_2S (ppm)	500
Total biogas production (Mm^3/year)	10
Biogas per tonne of feedstock (m^3/t)	60

Nutrient Recovery and Reuse (NRR) Technology

The envisaged process works as follows:

- Feedstocks are received into a continuously mixed tank and diluted into 12% with recycled water if needed.
- After the receiving tank, mixed feedstock is directed into a pre-digester/hydrolysation tank before pumping through hygienisation into the mesophilic digesters.
- Digestate (8% dry matter, DM) is sent to a centrifuge for solid/liquid separation. Coagulation and flocculation are enhanced by the addition of polymer which is prepared with recovered water from the RO.
- The solid fraction, containing ~70% of the initial total phosphorous (P) of the feedstock, is stored in the plant for 1 – 2 months before transport into end-users which use it as such in agriculture as a fertilising soil conditioner. The liquid fraction from which DM content will be <2% is directed through a step screening unit to a evaporation. The screen will purify rests of animal hairs, straw, fouling particles etc. before the evaporation unit. Acid (H_2SO_4) is used to maintain nitrogen in a NPK-concentrate produced by evaporation unit.
- To the produced condensate a small amount of base (NaOH) may be added to adjust the pH before going to the RO. This will ensure the required recovery of nitrogen and soluble organic compounds (biological oxygen demand (BOD)) before discharging on waters. The concentrate from the RO has low nutrient levels and it is used for polymer manufacturing or feedstock dilution.

Products and market

The digestate treated with the NRR process will be transformed into 35 kt of biosolids (solid fraction digestate), 35 kt of NPK-concentrate and 70 kt of water. Part of the NPK-concentrate can be mixed with the solid fraction to improve the fertiliser properties of solid fraction. Product characteristics are listed in table 4.

Table 4. Composition of the recovered products (target values)

	Biosolids	NPK-concentrate
Dry matter (%)	30	20
Organic Matter (% of DM)	50	70
Organic Carbon		
N-total g/kg	10	25
P_2O_5-total g/kg	8	2.5
K_2O-total g/kg	2	5

Economic and environmental benefits

- <50% of incoming material amount needs to be stored and transported: less costs and emissions
- Concentrated nutrient products can be transported economically into areas where nutrients are really needed: use of excess nutrients, less emissions to surface –and ground water
- Nutrients can be used in a more sustainable way, e.g. valuable quality nutrient products and using according to plant needs: less emissions to air and water
- Approximately 200 m^3 of water will become available for recycling and discharging on site, the amount of water doesn't have to be transported as diluted digestate or treated as waste water
- Fresh water need is very low: less costs of fresh water and waste water

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