Innovative uses of digestate of biogas plants

Ahto Oja
Estonian Biogas Association
Balti Biometaan OÜ
Ahto.oja@baltibiometaan.ee
+372 5082990

Date:
GreenMeUp policy workshop
25.03.2025

Funded by the European Union

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement No. 101075676.

Solution – Biogas

- **Circular Economy and Green Deal** in practice

4 products from Biowaste:

1. gaseous fuel
2. liquid fertilizer
3. solid fertilizer
4. captured CO2

3. NO WASTE

Estonian **Biomethane Potential**

1,5 TWh (150 mln Nm3)

0,5 TWh manure

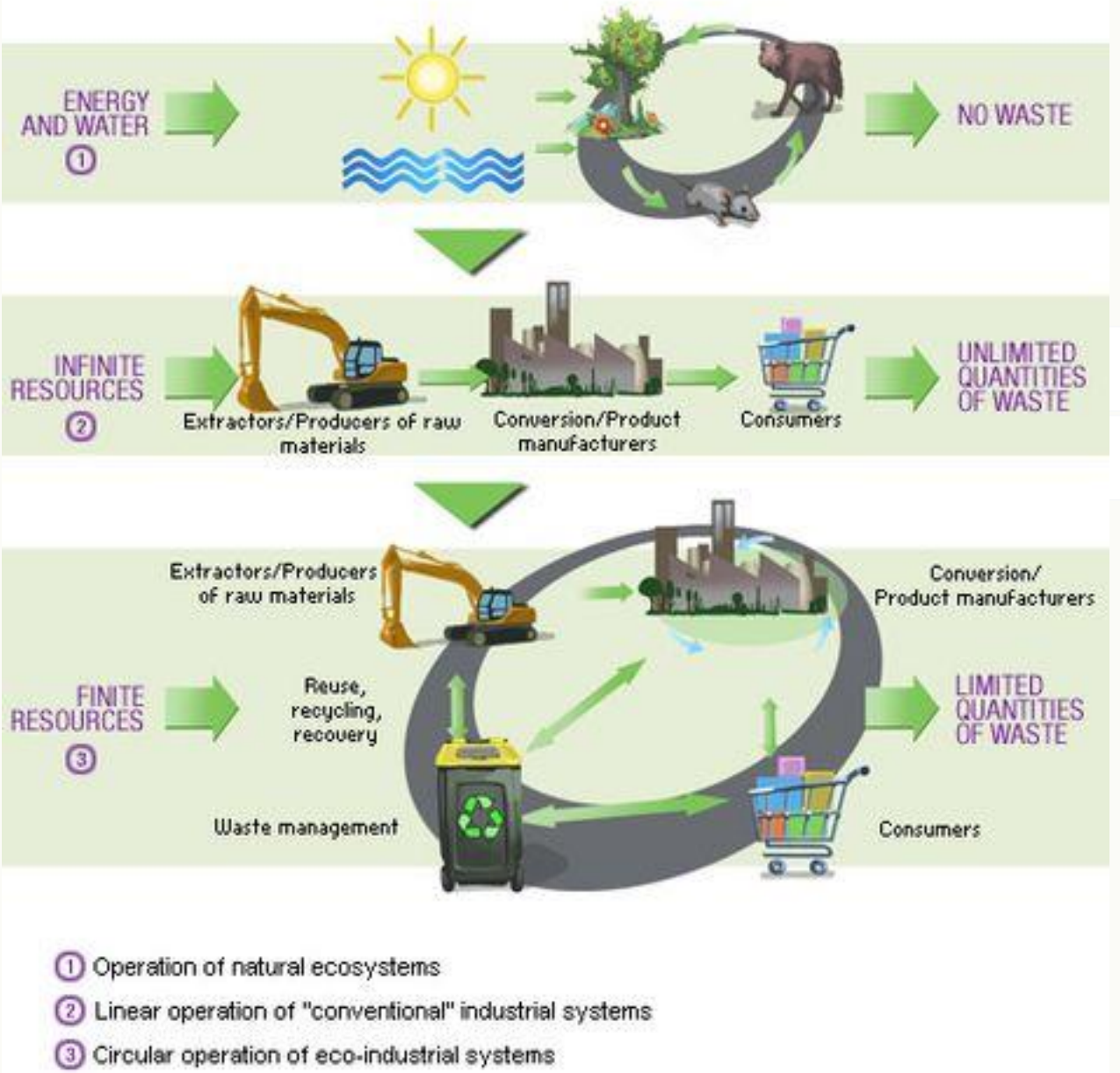
0,5 TWh biowaste

0,5 TWh sustainable cultivated green biomass, grass, hay

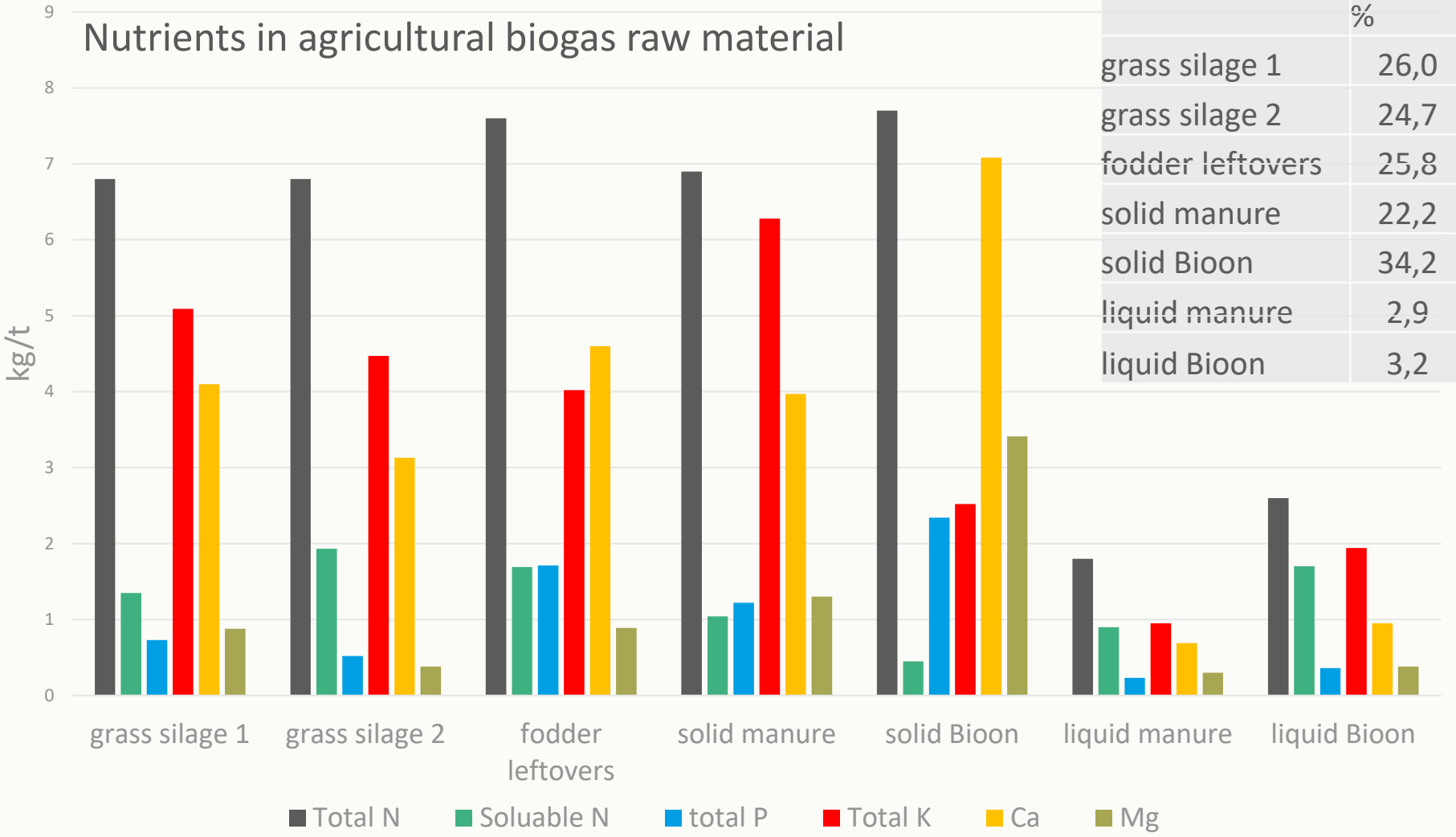
Practise

BM 2024 0,28 TWh (28 mln Nm3)

NG 2024 ca 3 TWh (300 mln Nm3)

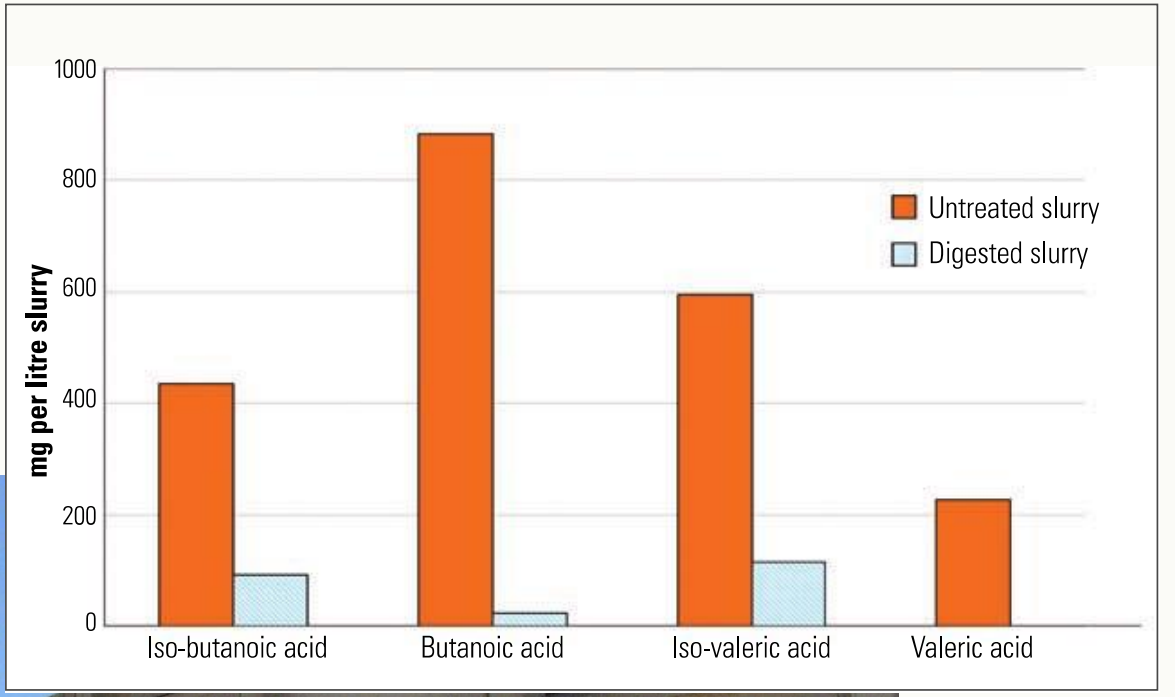


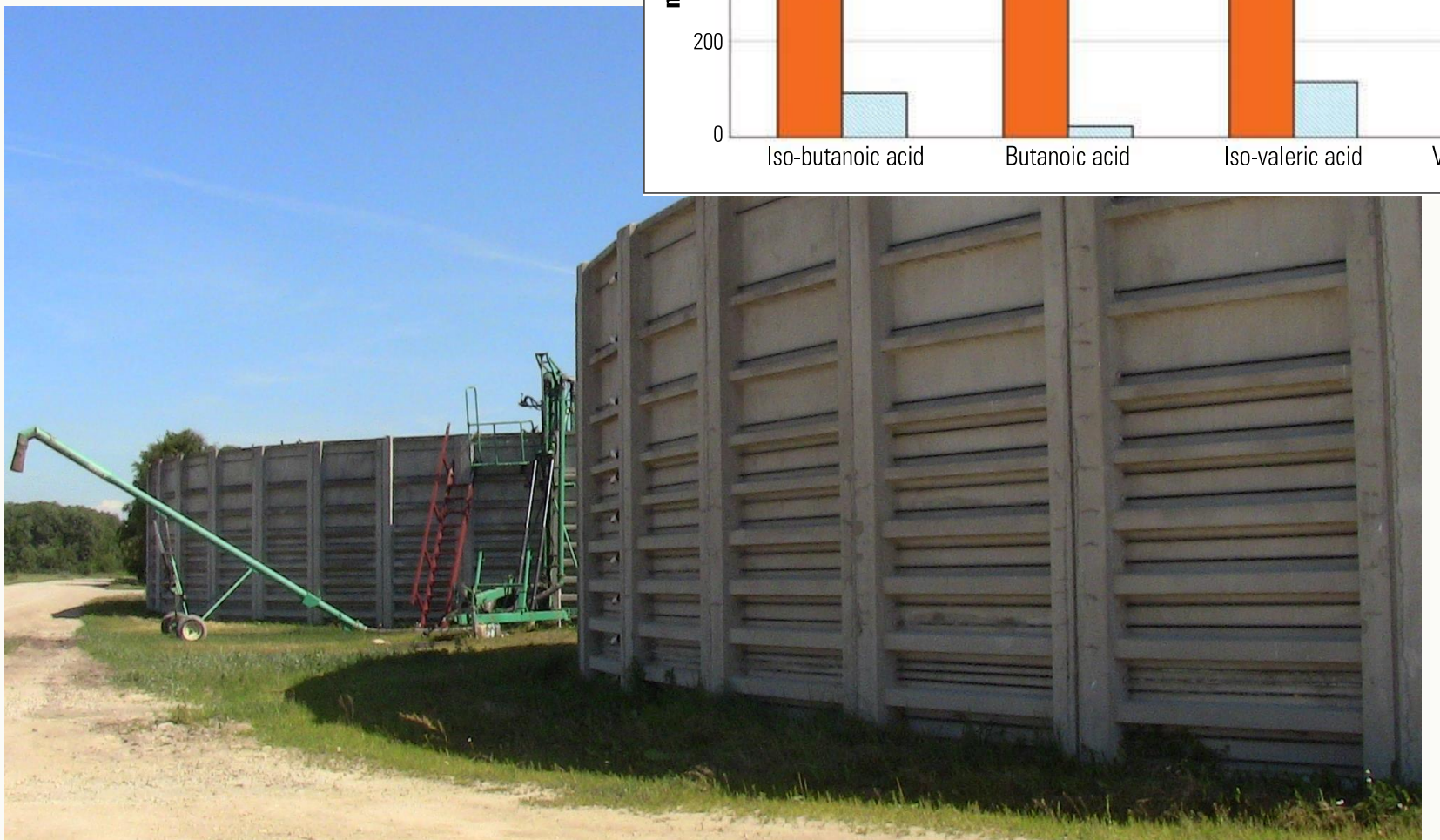
Nutrients from agricultural waste are recycled in biogas digestate



	Dry matter %
grass silage 1	26,0
grass silage 2	24,7
fodder leftovers	25,8
solid manure	22,2
solid Bioon	34,2
liquid manure	2,9
liquid Bioon	3,2

Example of non-monetary external benefit of AD





AD reduces the **smell** pollution from slurry management **significantly**, BUT in EUR …**???**

Digestate can become fertilizer

- **Regulation of Ministry of Environment of Estonia nr. 7, 08.04.2013, Requirements for compost from biowaste)** https://www.riigiteataja.ee/akt/110042013001

- **Regulation of Ministry of Environment of Estonia: Requirements for digestate from biogas production from biowaste** adopted on 10.05.2016, https://www.riigiteataja.ee/akt/119052016009#

LESSONS ON FEEDSTOCK

STABILITY, QUALITY, SEASONALITY,

ORIGIN OF FEEDSTOCK → **DETERMINES THE MANAGEMENT OF DIGESTATE →**

USING THE (… 10% …) BIOWASTE **MAKES DIGESTATE 100% WASTE**

→**REQUIRES WASTE PERMIT TO BIOGAS PLANT** [EXPENSIVE AND TIME-CONSUMING]

→REQUIRES WASTE PERMIT TO FARMERS → **WHICH FARMERS DON'T HAVE**

FOR AGRICULTURAL BIOGAS PLANTS CERTIFICATION / PASTEURIZATION OF FEEDSTOCK/DIGESTATE **IS NOT THE OPTION →CIRCULAR ECONOMY IS NOT POSSIBLE**

Manure, agricultural residues, food Industry leftovers ARE NOT WASTE, BUT SECONDARY RAW MATERIAL

- Use of secondary raw materials (residues, by-products)
- to implement a circular economy through biogas production
- has been made so difficult due to very strict waste regulations
- that it is easier for biogas producers to avoid their use
- Everyone will lose (EU, government, residue owners, biogas producers, environment, climate, green Deal and Circular Economy)

Example – ad hoc spoiled

Waste register:

02 01 03 feed waste, crop waste, plant tissue waste from agriculture, straw, used plant tissue-based growing media ARE WASTE – **OR ARE THEY?**

What is the risk to the environment and health from their use in the production of fertilizer in a biogas plant?

To use them in biogas production, a renewable energy producer must apply for a waste permit, become a waste handler, and provide a financial guarantee to the bank that they will use these secondary raw materials for biogas production – usually on the same day

Cross-sectoral solution →change EU waste directive

If biodegradable **residues**, by-products **are used** to produce **renewable energy** (biogas, synthetic gas, hydrogen, green electricity and green heat)

Then these **secondary raw materials** should not be treated as waste, but as secondary raw materials - ***this could also be reflected in the waste code*** - for example by *adding 1 instead of 0 to the first 6 digits waste code*?

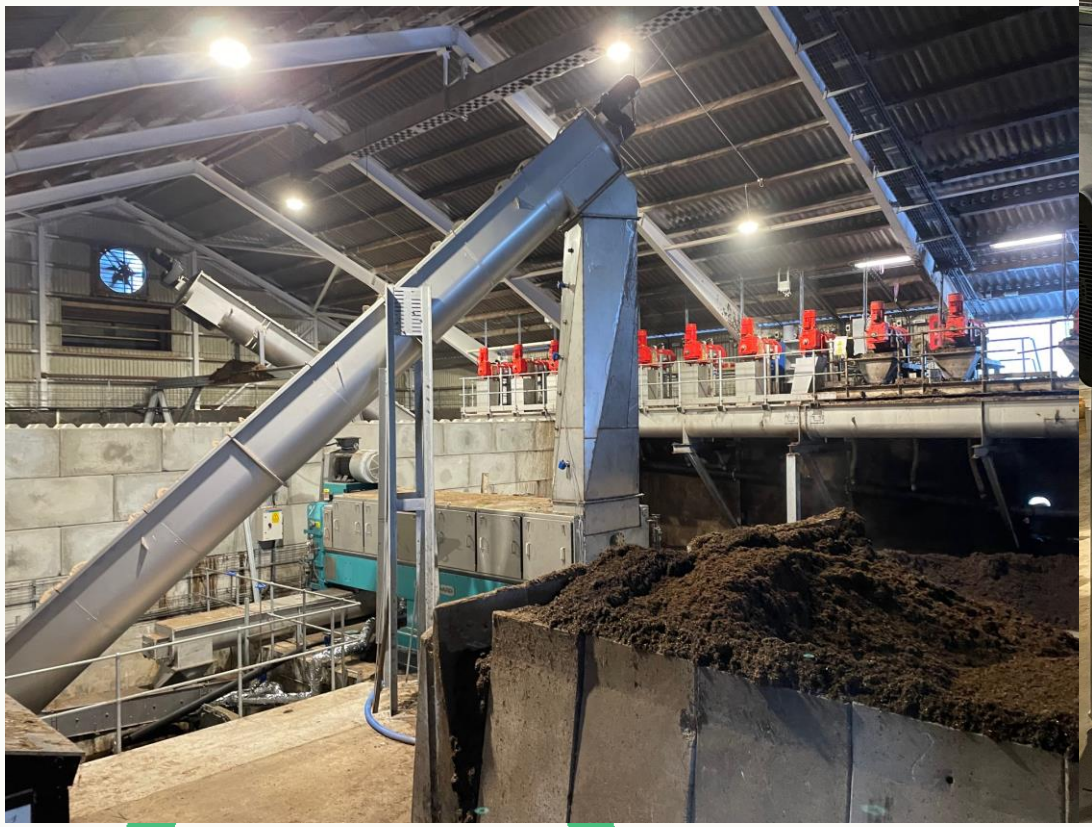
→12 01 03 silage, silage residues ... if they are used for biogas production or otherwise

Joint digestate policy drafting working group of biomethane producers and Ministry of Environment and Energy of Estonia

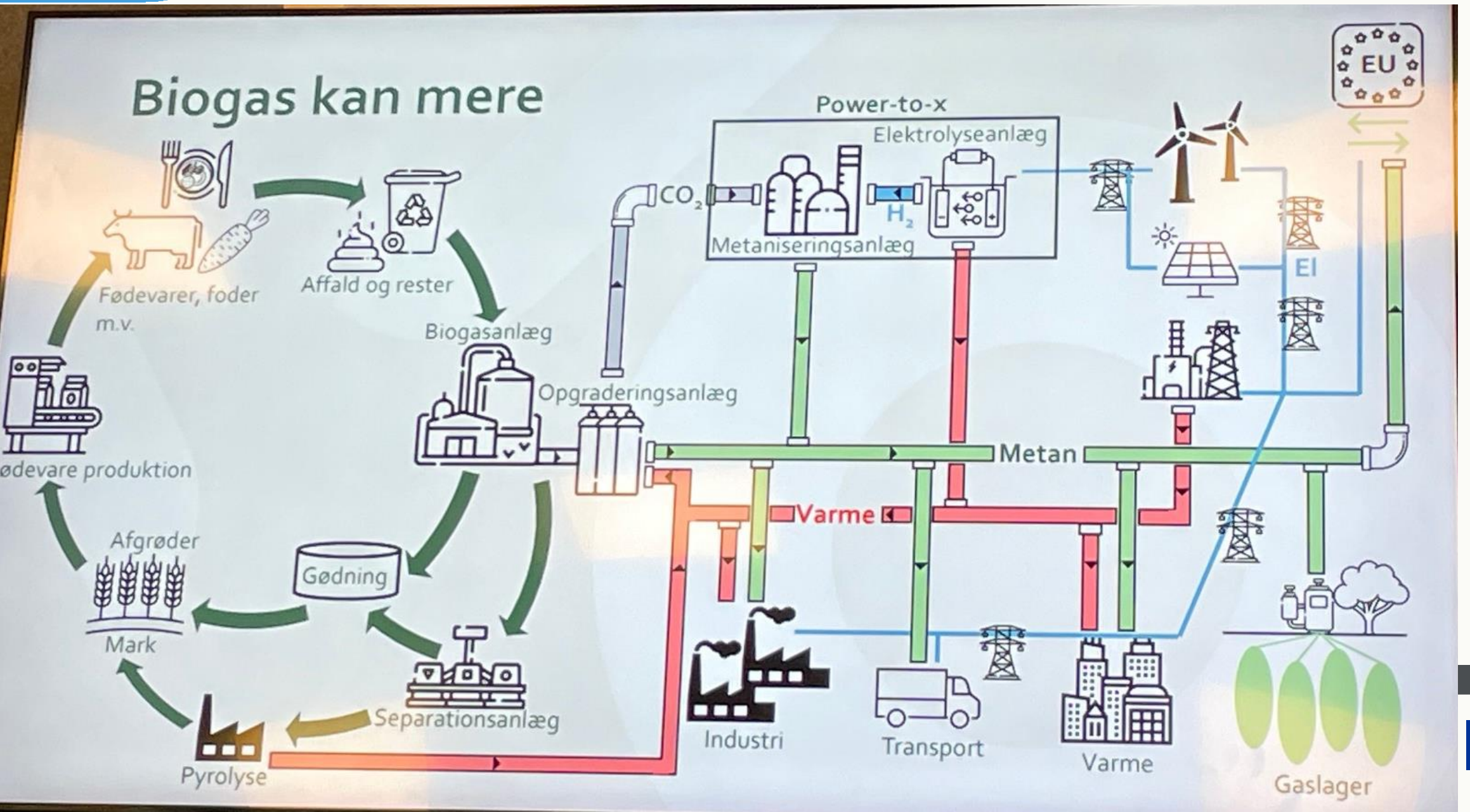
- Current legislation on digestate has become an obstacle for biogas producers
- Supervision has initiated proceedings, there is a real risk that digestate from agricultural biogas plants will be treated as waste
- Proposals
- Amend legislation with permitted waste types
- Harmonize maximum levels of undesirable substances

Additional options in digestate use

solid-liquid separation, ammonia stripping, membrane filtration pelleting, pyrolysis



Sindal biomethane plant - Denmark



Bioenergy industrial symbiosis

Regional approach → co-digestion of feedstock from certain regioon→local production and combined consumption

Waste water sludge →biogas→digestate→landscaping

→drying→**pelleting**→CHP → electricity and heat for biogas/biomethane plant

→pelleting→**pyrolysis**→biochar → soil amendment→carbon credit (CCS)

→biochar →CHP→ biomethane production

Agricultural residues →biogas →digestate→organic fertilizer

→ digestate separation → solid organic fertilizer

→ liquid organic fertilizer

Nutrients from waste to organic fertilizer - the first steps in Estonia

Solid fertilizer from biogas digestate
25 L plastic bag

Liquid Fertiliser from biogas digestate
5 l canister

BIOON

UNIVERSAL NATURAL FERTILIZER

01.

LIQUID FERTILIZER

Liquid bioon can be used on all soils and plant growth substrate to fertilize all plants and improve soil properties, both in the open and in the greenhouse.

READ MORE

02.

SOLID FERTILIZER

Solid bioon can be used on all soils and plant growth substrate to fertilize all plants and improve soil properties, both outdoors and in the greenhouse. Vegetables, vegetables and fruits fertilized with bioon, can be consumed without heating.

READ MORE

www.bioon.ee

Proposal for a Roadmap to increase sustainable biogas production and deployment in Estonia

- Development of a business model (including a business collaboration model) for circular **bioeconomy industrial parks.**
- The design of the industrial park development models
- To motivate the concentration of industry in the vicinity of already established biogas plants
- The creation and expansion of circular economy complexes in the immediate vicinity of established biogas plants.

How much biogas digestate as organic fertilizer can substitute the mineral fertilizer worldwide?

- The potential of biogas digestate to substitute mineral fertilizers globally **is significant**,
- It depends on various factors such as the scale of biogas production, the nutrient content of the digestate, and its application efficiency.
- Studies suggest that digestate can replace a **substantial portion of mineral fertilizers** due to its rich nutrient profile, including nitrogen, phosphorus, and potassium

- https://www.europeanbiogas.eu/wp-content/uploads/2015/07/Digestate-paper-final-08072015.pdf
- https://www.cambridge.org/core/journals/renewable-agriculture-and-food-systems/article/biogas-digestate-as-a-renewable-fertilizer-effects-of-digestate-application-on-crop-growth-and-nutrient-composition/B2541B3926B692C1D53BE16F753CA011

- using digestate as a fertilizer can reduce greenhouse gas emissions and promote sustainable nutrient recycling.
- However, the global substitution potential would require widespread adoption of anaerobic digestion technology and efficient management of digestate as a resource.
- Needs calculations and analyses:

INNOVATIONS 2022 AND BEYOND

Solar PV Station 250 kWel – **working** (www.biometaan.ee)
Bioon – biogas digestate to liquid and solid **fertilize** (www.bioon.ee)
tested, but on hold
Thori Tanklad OÜ – the **first mobile and autonomous CBM filling station** – **working** (www.thoritanklad.ee) – merged to Biometaan OÜ at 2025
Convion solid oxide fuel cell [SOFC] on biomethane (www.convion.fi), 4th in the world of its kind – **working** 2022
The **SOFC Convion C60 is mobile, autonomous combined heat (25%) and electricity (with 60% efficiency, 60 kW*h) generator**

Wind generaator → hydrogen + off-CO2 from biogas membrane Upgrade unit → SYNGAS – in future
H2S removal from biogas **-** possible to produce solid sulphur - in future
Off-gas CO2 from upgrading – **to purify it to liquid certified CO2 as product -** in future

Possible to produce **green hydrogen from biomethane**
– present containers can transport hydrogen

Thank you!

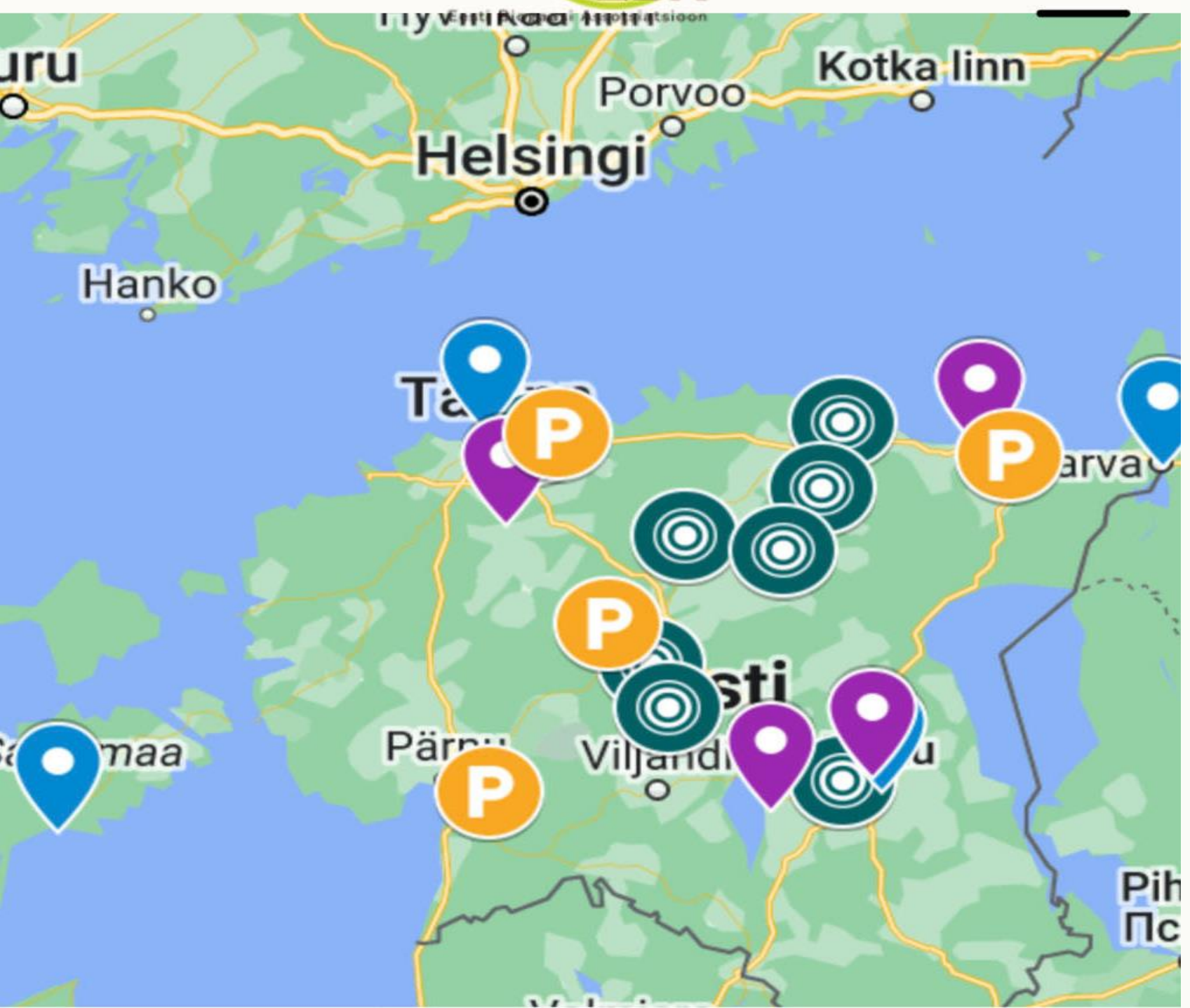
greenmeup-project.eu

GreenMeUp Project

GreenMeUp Project

info@greenmeup-project.eu

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement No 101075676



GREENMEUP

Biogas production facilities in Estonia

Sewage treatment plants

Landfills

Industrial wastewater treatment plants

Agricultural biomethane plants

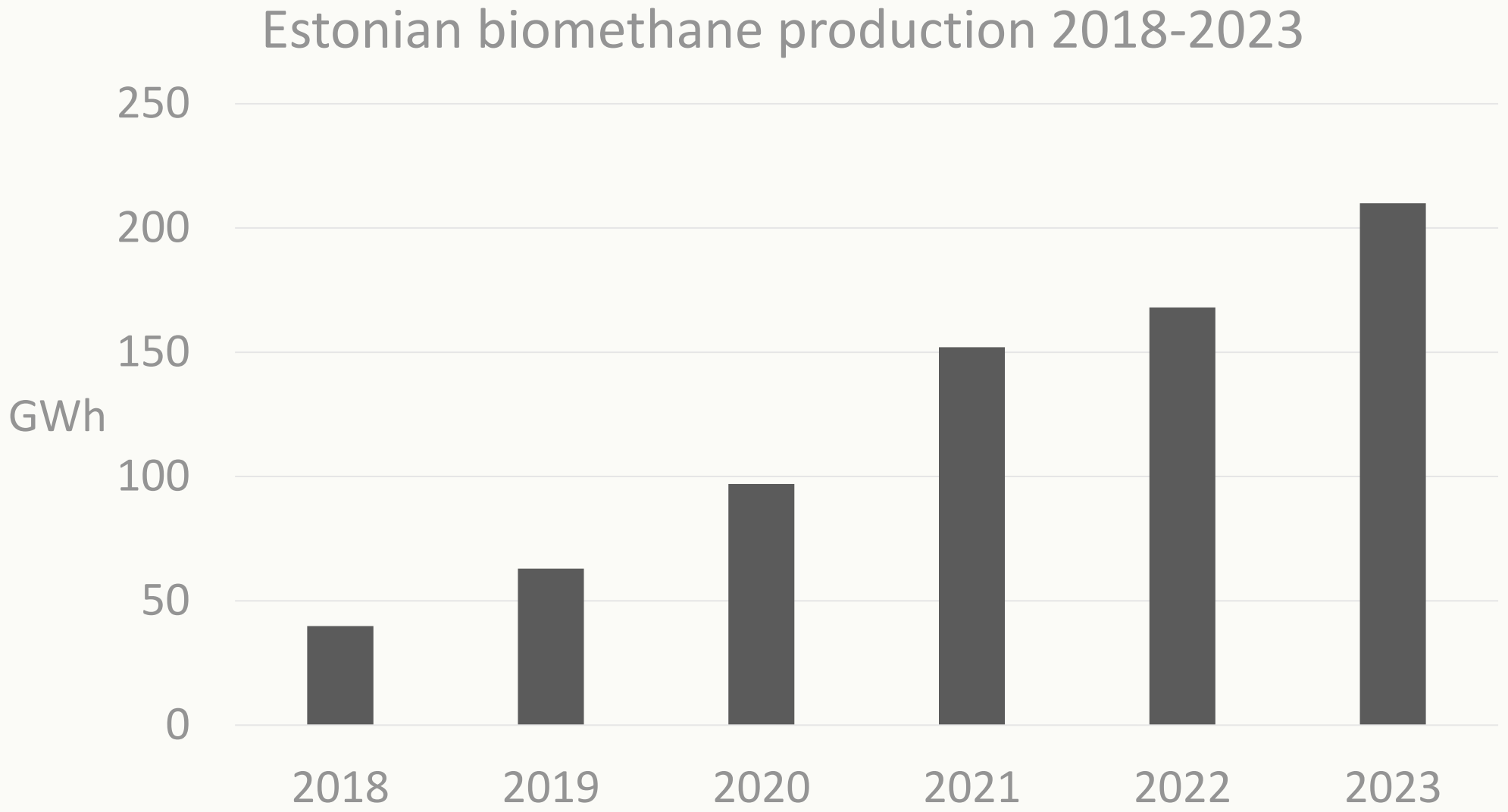
Estonian producers 2024:
12 biogas plants and **8** biomethane plants

AGRICULTURAL MIXED SUBSTRATES	
Ebavere Biogas Plant	[Bioforce Ltd]
Aravete Biogaas	[Bioforce Ltd]
Tartu Biogaas	[Eesti Biogaas Ltd]
Vinni Biogaas	[Eesti Biogaas Ltd]
Oisu Biogaas	[Eesti Biogaas Ltd]
Siimani Plant (2018)	Biometaan OÜ

Industrial process waste water sludge
OÜ Eastman /Velsicol [benosaad]
Salutaguse Pärmitehas OÜ [east prod.]
EKT EcoBio Biowaste Biomethane Plant A le Coq biogaasijaam [õlleraba]
Estonian Cell Plant (2018) Rohegaas OÜ Estover Piimatööstus AS (cheese factory)

Waste Water Sludge
Tallinna Vesi AS
Tartu Vesi AS
Narva Vesi AS
Kuressaare Veevärk AS

Biogas from Landfill
Väätsa landfill
Tallinna Prügilagaas OÜ [Jõelähtme}
Paikre OÜ [close to Pärnu]
AS Uikala Prügila



Source: [Biomethane production in Estonia (biometaan.info)]