



# Biogas tool to support the investment decision in farm-scale biogas production

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Photo: Lilli Frondelius

- ▶ What is biogas?
- ▶ Why biogas?
- ▶ Biogas tool:
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- ▶ Three technologies:
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# What is biogas?

- ▶ Biogas is a gas mixture containing:
  - ▶ ca. 60% methane
  - ▶ ca. 40% carbon dioxide
  - ▶ traces of other gases
- ▶ Natural gas, on the other hand, is almost pure methane
- ▶ Biogas can be up-graded to biomethane (>92% CH<sub>4</sub>)
- ▶ Biogas is formed when organic biomass is degraded in anaerobic conditions
- ▶ Raw materials:
  - ▶ municipal sewage sludge
  - ▶ separately collected biowaste
  - ▶ side streams from food industry
  - ▶ manure
  - ▶ grass, straw, crop residues
- ▶ Can be used in:
  - ▶ heat production
  - ▶ combined heat and power production (CHP)
  - ▶ traffic fuel
  - ▶ replacing natural gas in industry

# Why biogas?

- ▶ Landfilling of organic waste not allowed (since 2016):
  - ▶ Composting / Anaerobic digestion
- ▶ Pressure for more environmentally friendly and resource-efficient agriculture
  - ▶ Reducing emissions
  - ▶ Combining food and energy production
- ▶ Scope in Handiheat:
  - ▶ Decentralized heat production
  - ▶ Agricultural / farm-scale biogas plants
  - ▶ Replacing fossil fuels with biogas in heat production

# Biogas tool

- ▶ HANDIHEAT - Northern Periphery and Arctic Programme
- ▶ In co-operation with:
- ▶ Turku University of Applied Sciences, Ukipolis, Metener and Demeca
- ▶ Part of Luke's MAATALOUSINFO service
- ▶ <https://maatalousinfo.luke.fi/en/laskurit/biogas>
- ▶ <https://maatalousinfo.luke.fi/fi/laskurit/biogas>
- ▶ <https://maatalousinfo.luke.fi/sv/laskurit/biogas>

# Developed to support farm-scale (max 15 000 t/year) biogas production

- ▶ Aim: Increase knowledge in biogas processing
  - ▶ Lower the threshold for farmers to build an own biogas plant
  - ▶ Improve energy and nutrient self-sufficiency on the farms
  - ▶ Decrease emissions from agriculture
  - ▶ Replace fossil fuels
- ▶ Users: Farmers
  - ▶ Energy companies interested in co-operation with farmers
  - ▶ Energy advisers in agriculture
  - ▶ Consultants
  - ▶ Students

# Three technologies provided in the tool

	Wet digestion	High dry matter digestion	Dry digestion
Feedstock mixture	Dry matter (DM) content $\leq 12\%$	DM content $\leq 20\%$	DM content $> 20\%$
Process type	Continuously stirred tank reactor (CSTR)	CSTR with raw material pre-treatment and circulation of liquid fraction	Batch process, no stirring
Reactor type	Reactor tank built from concrete, partly underground	Modular container structure, process steps take place in separate containers	Based on a leach bed reactor, percolate liquid recycled through the mass in a silo

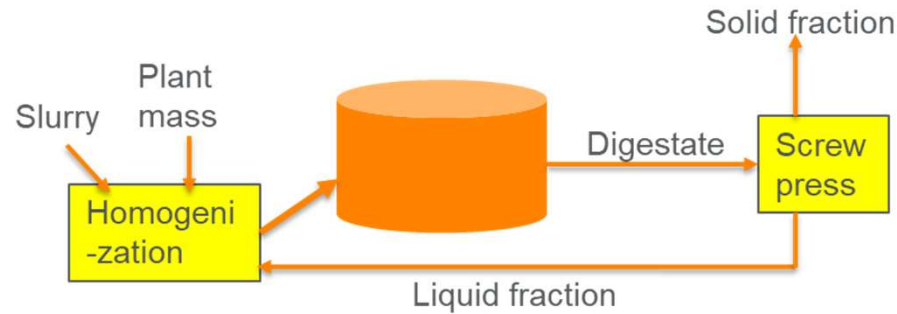
# Wet digestion



Photo: Sari Luostarinen

- ▶ Feedstock mixture with a dry matter content  $\leq 12\%$
- ▶ Dilution with water if needed
- ▶ Continuously stirred tank reactor (CSTR),  $35^{\circ}\text{C}$
- ▶ Optional post-digestion tank (CSTR), no heating,  $30^{\circ}\text{C}$
- ▶ Reactor tank built from concrete, partly underground

# Solid digestion



- ▶ Feedstock mixture with a dry matter content  $\leq 15\%$
- ▶ CSTR
- ▶ Pre-treatment (homogenization)
- ▶ Separation of digestate, and circulation of liquid fraction, if feed DM = 15-20%
- ▶ Dilution with water if feed DM  $>20\%$
- ▶ Modular container structure, the process steps (pretreatment, digestion, gas purification) take place in separate containers

# Dry digestion



Photo: Erika Winqvist

- ▶ Feedstock mixture with a dry matter content  $>20\%$
- ▶ Batch process, no stirring
- ▶ Based on a leach bed reactor, percolate liquid recycled through the mass in a silo

# How to use the tool

## ▶ INPUT

- ▶ Raw materials selected from a list with given properties or using own values
- ▶ Technical solutions for the biogas plant and digestate handling
- ▶ Operational parameters

## ▶ OUTPUT

- ▶ Biogas production
- ▶ Biogas plant energy consumption and net energy production
- ▶ Fertilizer value of the digestate
- ▶ Income from net production of heat, electricity and/or biomethane
- ▶ Investment and operating costs
- ▶ Profitability (annuity method, payback period)

# Future outlook for biogas production

- ▶ EU/national renewable energy and GHG emission reduction goals
- ▶ Combining food and energy production for better resource efficiency and profitability
- ▶ Nutrient recycling in agriculture
- ▶ Significance of 'Green consumers' increases, branding of agricultural products
  - ▶ Carbon neutral milk production
  - ▶ Biogas used in greenhouse production

# Thank you!

► Luke's team behind the tool:

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