

# Fermentation as possible energy source of the organic greenhouse horticulture

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# Introduction

- The province Flevoland started in 2009: the project Agropark Flevoland
- Issues:
  - sustainable energy,
  - combined logistics
  - sustainable soil use
  - ..
- Ultimate aim:
  - A cradle to cradle closed agriculture

# Noordoostpolder 1

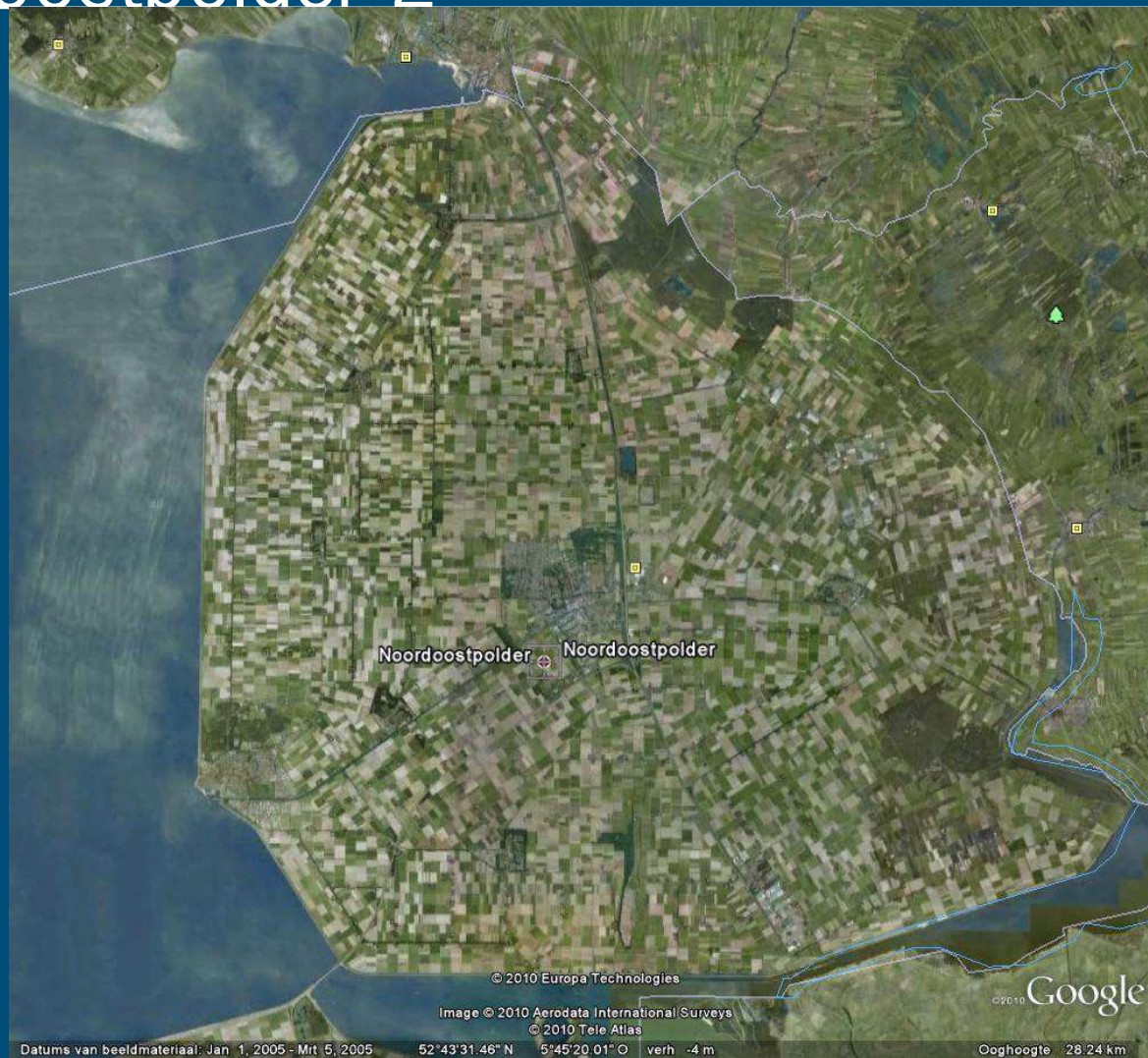
- New land surrounded by dikes
- Created in 1940's
- Surface: 450 km<sup>3</sup>
- Soil: sandy loam



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*For quality of life*

# Noordoostpolder 2



# Noordoostpolder 3

- a very intensive cultivation plan with main crops:
  - Seed potatoes
  - Flower bulbs
  - Sugar beets
- to keep the soil healthy:
  - a high need of organic material input
  - a high need of minerals
- Result:
  - **Continuous import of farmyard manure from other regions outside the province!**

# Case study Ens 1:

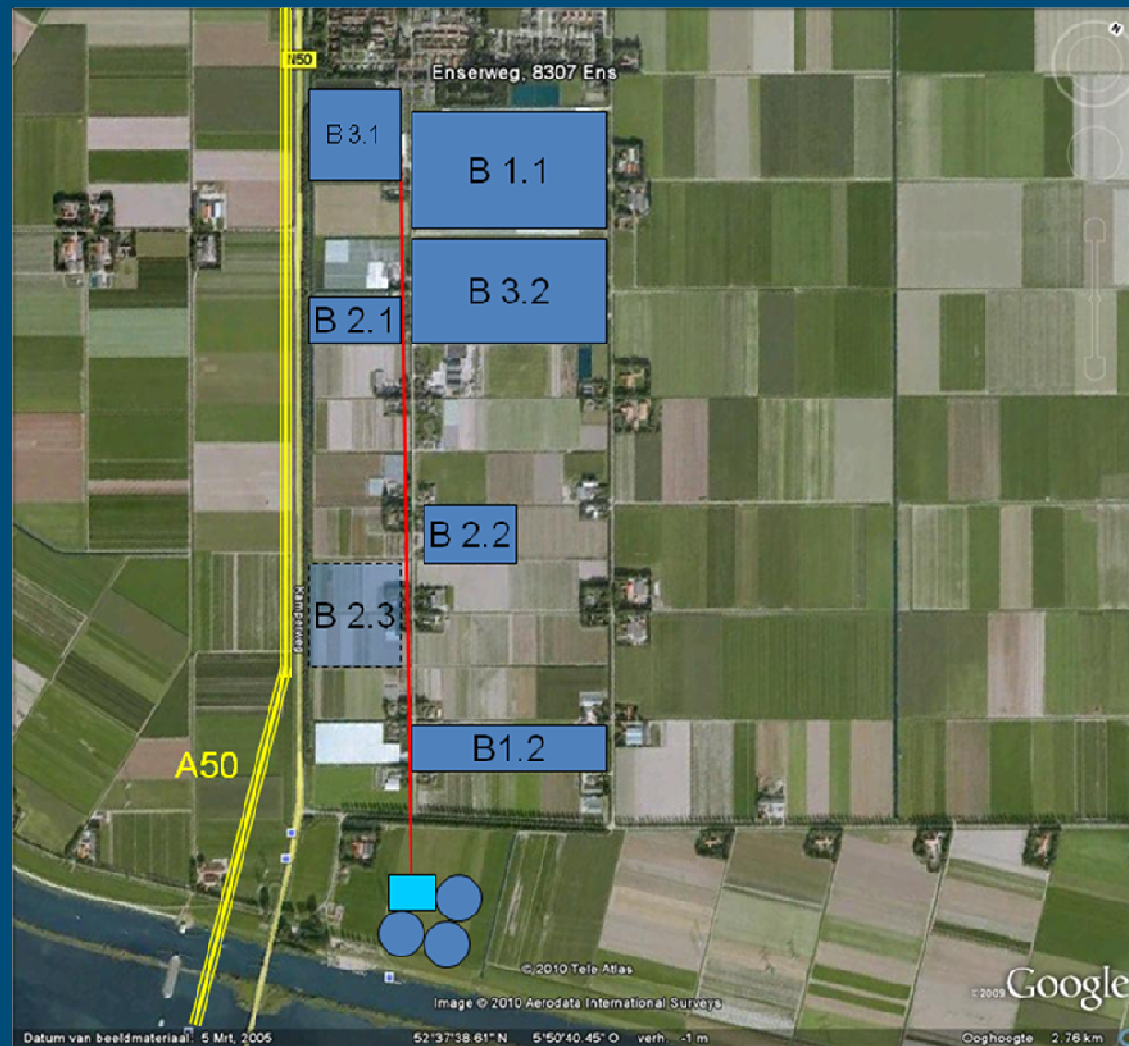
- Subject:
- How to make a double use of this manure?
  - Use it in fermentation plant to make biogas and combust the biogas in a CHP
    - Use the heat and CO<sub>2</sub> in greenhouses
    - Put the electricity in electricity grid
  - Use the fermented manure and organic material, the digestaat, to upgrade the soil

# Case study Ens 2:

- The main subjects of the case study are:
  - The heat demand during the year
  - Kind of heat production yet
  - The capacity of a fermentation plant to fill in this heat demand (partly)
  - The consequences of the use of this fermentation plant
  - The kind of organisation to manage this plant



# Case study Ens 3:

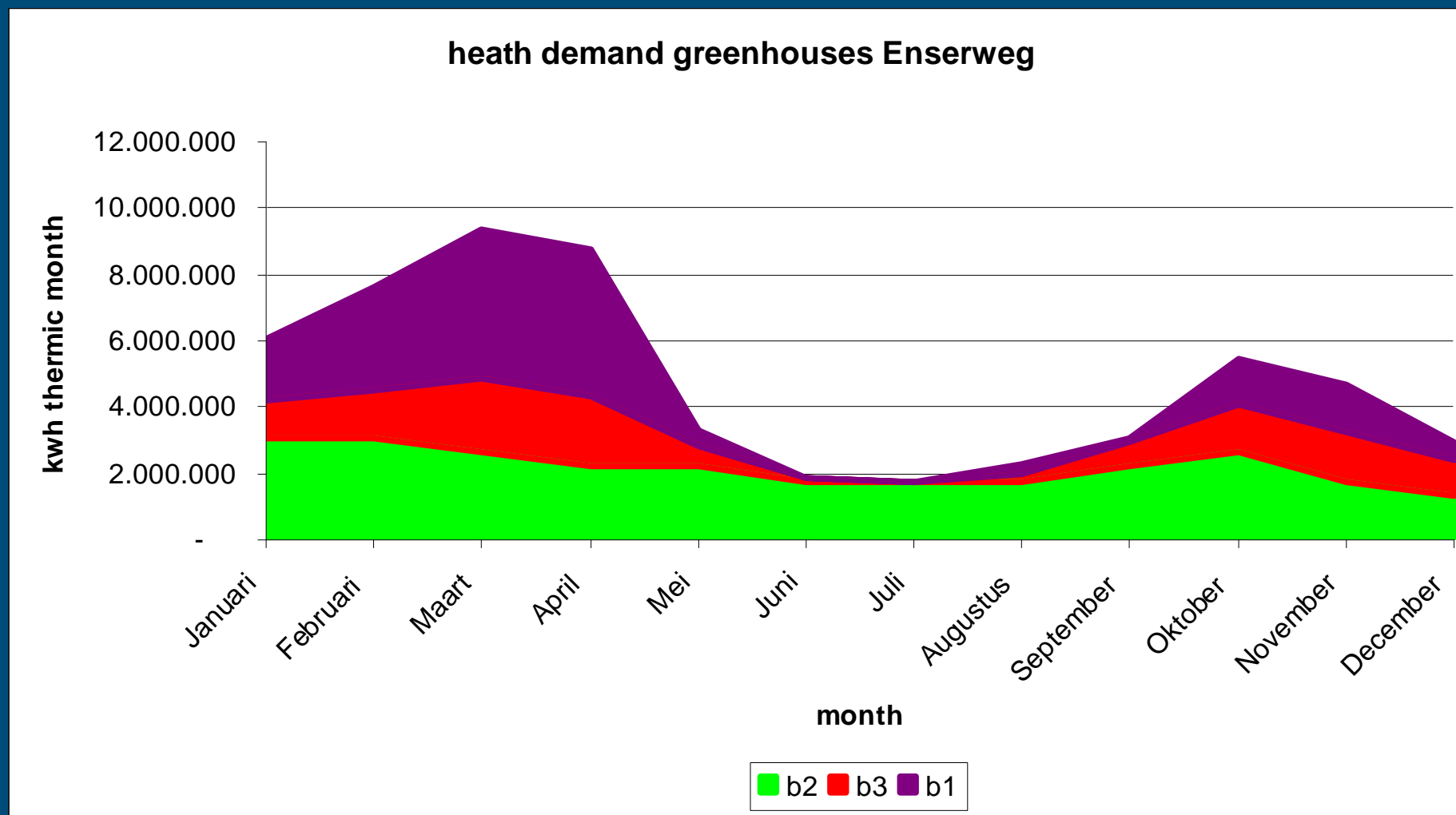




# Input data case study

Grower		B1	B2	B3
Crop		Garden plants	Organic vegetables	Garden plants
Area greenhouses	ha	24	8	20
Gas boiler	MW	6	8	
Electric power CHP	MW	1.5		2.7
Wood boiler	MW	6		
Natural gas boiler	m <sup>3</sup> /m <sup>2</sup> /year	4.2	37.5	
Natural gas CHP	m <sup>3</sup> /m <sup>2</sup> /year	8		13
Electricity	kWh/m <sup>2</sup> /year	4	7	

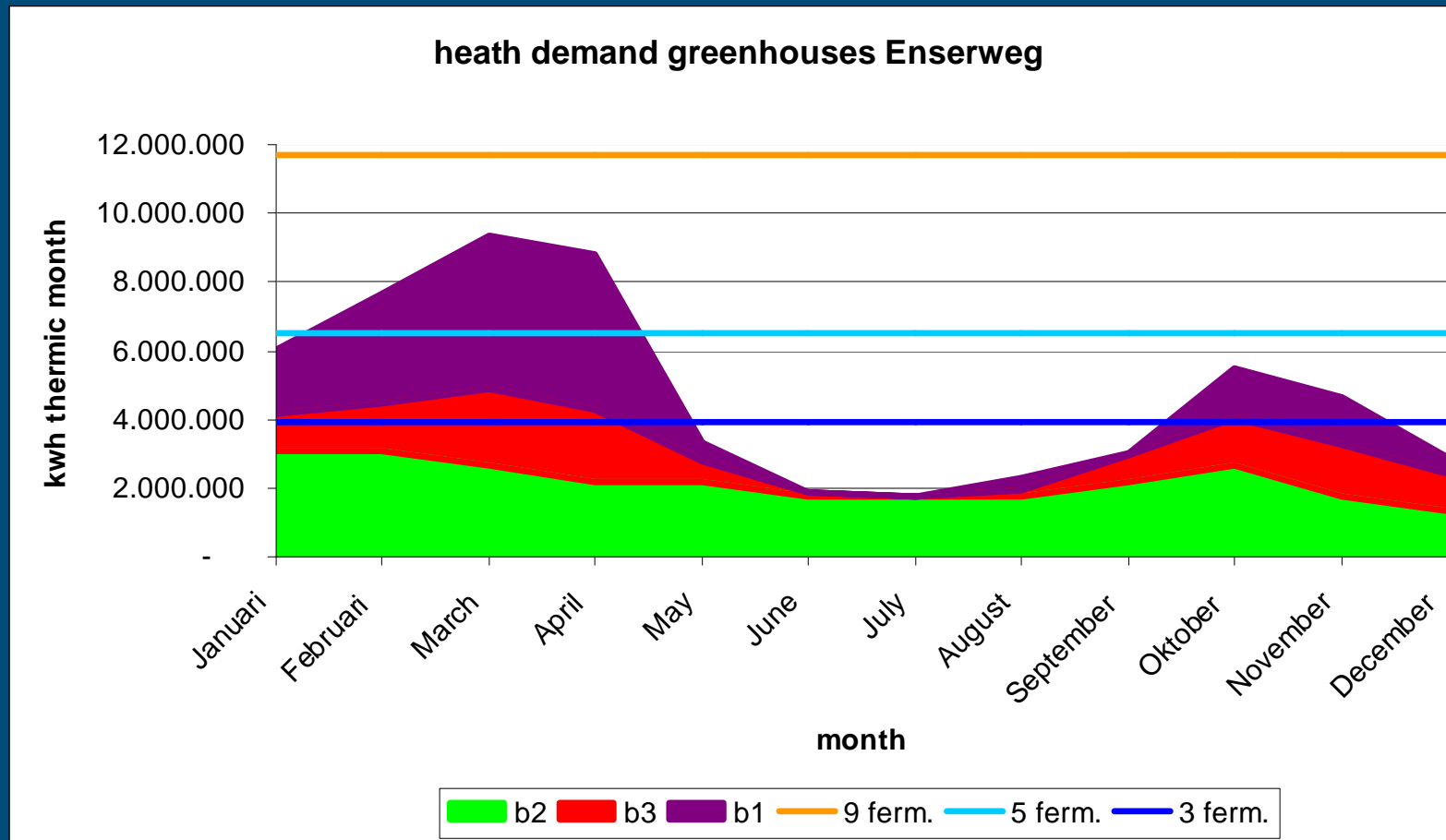
# Energy use Ens, Enserweg greenhouses



# Fermentation options

		High	Middle	Low
Fermentation units		9	5	3
Total fermentation cap.	kTon/year	405	225	135
Co generation units		18	10	6
Power electric co gen.	MW <sub>el</sub>	36	20	12

# Fermentation options



# Results fermentation options

		High	Middle	Low
Methane production	Mm <sup>3</sup> /year	64	36	21
Heath production CHP	TWh	360	200	120
Electr. Production CHP	TWh	288	160	96
Efficiency heath use	%	54	80	88
Saleable heath	%	42	67	85
Soil use fermentation plant	Ha	9	6	3
Transport moves	trucks /year	22.000	12.000	7.500

# Conclusions fermentation options

- The high option and middle option → overproduction heat
- The low options → 88 % heat used
- Global economics → low option: the best
- Organization:
  - → need of excellent management
  - → 24 hours 7 days a week control
  - → growers don't want to do it themselves
  - Make a separate organization of the fermentation plant



# Discussion 1

- Is the use of food products for fermentation ethical allowed for the production of heat and electricity?
- Maybe the use of organic house waste is a solution, but this depends of what the restrictions of the organic agriculture will be.

## Discussion 2

- The input of 65 kTon maize will have a great influence at the market price of maize in the surrounding of Ens. That will have a negative influence at the profitability of the fermentation.

# Discussion 3

- There will be a competition between the price of the heat that is necessary to explore the fermentation profitable and the price that the growers want to pay to be competing with the actual gas price.

# Discussion 4

- Will the exploitation of the fermentation plant be a governmental task, because of the positive effect at the environment and the low profitability?

# Wageningen UR Greenhouse horticulture

## Innovations for and with the greenhouse horticulture

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