BIOGAS TRANSPORT GRIDS,
CASE STUDY “PROVINCE OF WEST-FLANDERS”

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Title and Co-authors

BIOGAS TRANSPORT GRIDS,
CASE STUDY “PROVINCE OF WEST-FLANDERS”

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Overview

This presentation:

• Introduction
  Digesters in the Province of West-Flanders
  Biogas transport grid
  Combined Heat and Power, efficiency

• Method
• Results
• Conclusions
Intro, Digesters in West-Flanders

38 digesters in the Province of West-Flanders, Belgium

Hooglede, 1 MW

Address
Power (kW_e)
Biomass source

N = 38

60.5%
18.4%
7.9%
2.6%
10.5%
Intro, Digesters in West-Flanders

Farm site digester and biogas CHP

Electricity

Heat

Biogas CHP

Heat is often used to dry the digestate before the digestate is transported

Other ways of digestate treatment may not need the heat at the farm site......

Therefore, production of electricity and heat off site may be more profitable ......
Recent work:

Collection of biogas to a hub, using pipelines, costs and energy use of biogas transport to a hub

Biogas infrastructures from farm to regional scale, prospects of biogas transport grids. E.J. Hengeveld c.s., Biomass & Bioenergy, 2016
Intro, CHP efficiency

Biogas CHP, scale dependency electrical efficiency

Example: range $10 \text{kW}_e - 100 \text{kW}_e$

\[ \eta_{el} = 0.29667 \ C^{0.0503} \]

\[ C = \text{Power in kW}_e \]

Additional electrical power

Biogas-CHP produces electricity and heat; heat may not be needed at farm sites

CHP location moved from farm site to a hub to match heat supply and demand; use of a biogas grid.

CHP scale advantage in electrical efficiency; additional electrical energy produced

Costs of biogas transport
Research question:

How can the costs per kWh additional electrical energy be estimated, if a hub structure is implemented?

Sub-questions
  What is the increase in electricity production?
  What are costs of transport of biogas to the hub?
Digesters, mainly Agricultural feedstock (> 20 m³h⁻¹)

Biogas grid; digesters in the Province of West-Flanders,

Example simulation: hub at digester site “Hooglede”, no.35

Which digesters are to be incorporated in the grid?
Method

Transport costs to hub no. 35

digester site “Pittem”
Digesters, mainly Agricultural feedstock (> 20 m$^3$h$^{-1}$)

Biogas grid; digesters in the Province of West-Flanders,

Example simulation: hub at digester site “Hoogelege”, no. 35

Include digester no. 16 in the biogas grid; assume a larger CHP at the hub (with increased efficiency)
Digesters, mainly Agricultural feedstock (> 20 m³h⁻¹)

**Additional** electrical power as compared to no biogas grid:
62.1 kWhₑ (+ 2.4%)

Transport costs biogas:
219.3 k€ a⁻¹

Costs per kWh additional electrical energy:
0.44 € kWh⁻¹

Example simulation: hub at digester site “Hooglede”, no.35

Include digester no.16 in the biogas grid; assume a larger CHP at the hub (with increased efficiency)
Digesters, mainly Agricultural feedstock (> 20 m$^3$h$^{-1}$)

Biogas grid; digesters in the Province of West-Flanders,

Example simulation: hub at digester site “Hooglede”, no.**35**

Include digester no.**16** in the biogas grid; assume a larger CHP at the hub (with increased efficiency)

Include digester no.**18** in the biogas grid; assume a larger CHP at the hub.
Method

Digesters, mainly Agricultural feedstock (> 20 m³h⁻¹)

**Additional** electrical power as compared to no biogas grid:

279.2 kWₑ (⁺ 3.0%)

Example simulation: hub at digester site “Hoogklede” (nr 35)

Include digester nrs 16 and 18 in the biogas grid; assume a larger CHP at the hub (with increased efficiency)

Transport costs biogas:

725.4 k€ a⁻¹

Costs per kWh additional electrical energy:

0.31 € kWh⁻¹

Etc…. etc….
Additional electrical power

Results

+2.4%
+6.4%
+8.9%
Results

Biogas transport costs

![Graph showing biogas transport costs in k€ a⁻¹ vs. biogas scale at the hub in m³h⁻¹]

- Biogas transport costs in k€ a⁻¹
- Biogas scale at the hub in m³h⁻¹

11/13/2017

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Results

Costs per kWh additional electrical energy
Results

Electrical power needed in biogas transport

![Graph showing electrical power needed for biogas transport.](image)

- Extra electrical power
- Power needed for compression
Conclusions

- Scale advantage in CHP efficiency may be a driver to collect biogas at a hub using a biogas grid
- Biogas transport costs are attributed to additional electrical energy (increased efficiency)
- Costs of additional electrical energy is in the range of 0.20 - 0.45 € kWh$^{-1}$ (in the example)
- Potential of matching heat supply and demand

Further research ...

- Identify heat sinks in the region to be used as hub
- Assess scale advantage investment costs CHP
- Improve biogas transport calculation; adapt costs of pipeline to local condition
- Legal aspects and subsidy regulations
Thank you for your attention.

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