LCA of biogas from different purchased substrates and energy crops

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Introduction

- Most Biogas in CH from sewage sludge, slurry, or biowaste.
- In order to improve the yield of biogas plants, operators often purchase or cultivate substrates with high energy content.
- Environmental impacts of biogas from these substrates?



Substrates considered in this study

Sugar beet

Fodder beet

Beet residues





Substrates considered in this study

Maize silage

Molasses

Glycerine

- a) From vegetable oil
- b) From waste oil





Life cycle inventory analysis

- New LCI of biogas from different substrates
 - Literature data
 - Results from survey (ENERS)
- New LCI of methane purification technologies
- Updated LCI of biogas combustion in cogeneration unit
- Modelling of biogas based car driving with ecoinvent data



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Biogas system overview



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Results: car transportation with biogas

Greenhouse gases





Results: car transportation with biogas

Ecological Scarcity



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Allocation







Allocation: scenario







Scenario: Including application of digestates Ecological Scarcity



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Results: yield and impact per hectare



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Results: yield and impact per hectare



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Results: yield and impact per hectare

- Yield and environmental impacts of producing biogas from cultivated energy crops are in the same range as compared to liquid biofuels.
- The case of sugar beets indicates that the bioethanol route is more efficient than the biogas conversion route for producing biofuels.

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Results: electricity generation from biogas

Ecological Scarcity





Conclusions 1

- Some environmental benefits of using biogas from purchased substrates compared to fossil fuels
- Higher environmental impacts of biogas from purchased substrates compared to waste substrates
- Allocation of digestate application has a high impact on results



Conclusions 2

- Pure biogas production from purchased substrates does mostly not comply with thresholds for tax reductions
- In contrast to electricity from biogas produced with wastes, electricity from biogas produced with cultivated crops is not favourable from an environmental view: emissions from crop cultivation and biogas combustion



Conclusions

The current trend towards using high energy substrates made from agricultural crops leads to higher environmental impacts and a worse environmental performance of biogas.



Thank you very much for your attention!

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Download the study and electronic data: <u>http://www.lc-inventories.ch/</u>

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Additional Slides

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Results: car transportation with biogas

Eco-Indicator 99 (H, A)



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Allocation of biowaste digestion in ecoinvent v2.2

Agricultural digestion			
plant (Biowaste)			
	Substrate treatment	Biogas production	Digestate application
Biogas plant		100%	-
Energy consumption	55%	45%	-
NH3 & N2O emissions	47%	39%	14%
CH4 & HS emissions	55%	45%	-
Emissions into soil	50%	-	50%
Anaerobic digestion			
plant (Biowaste)			
	Substrate treatment	Biogas production	Digestate application
Biogas plant	69%	31%	-
Energy consumption	69%	31%	-
Ammonia emissions	64%	22%	14%
CH4 & HS emissions	69%	31%	-
Emissions into soil	50%	-	50%



Biogas purification

3 Technologies in CH

- pressure swing adsorption (PSA)
- glycol washing
- amino washing



Glycol washing in Pratteln