BIOGAS
Energy and nutrient solutions

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WP leader - Manure Energy Use

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The project is partly financed by the European Union
European Regional Development Fund

Acknowledgements

- This work was only possible because of the following excellent colleagues:
  - Mats Edström, Mikael Hansson, Henrik Olsson, Johan Anderson, Andras Baky – **JTI, Sweden**
  - Karola Elberg, Andrea Schüch – **Rostock University, Germany**
  - Ksawery Kuligowski, Dorota Skura, Marek Ziółkowski, Andrzej Tonderski – **Pomcert, Poland**
  - Sigitas Lazauskas, Virmantas Povilaitis, Vita Tilvikiene – **LAMMC, Lithuania**
  - Valters Kazulis, Arvids Celms, Vilis Dubrovskis – **LLU, Latvia**
  - Argo Normak, Tauno Trink, Ahto Oja – **EMU, Estonia**
  - Saija Rasi, Sanna Marttinen, Ville Pyykkönen, Eeva Lehtonen – **MTT, Finland**
  - Knud Tybirk – **ABP, Denmark**

Photo: Mats Edström / JTI

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Biogas technology…

- …makes use of microbiological degradation of organic materials, such as manure, in anaerobic, closed digesters
- …produces two end-products
  - Energy-rich biogas (methane + carbon dioxide)
  - Nutrient-rich digestate (more soluble nitrogen)
- …enables mitigation of emissions from manure with other proper choices
- …can be designed for different scales from farms to large plants



Photos: Sari Luostarinen / MTT

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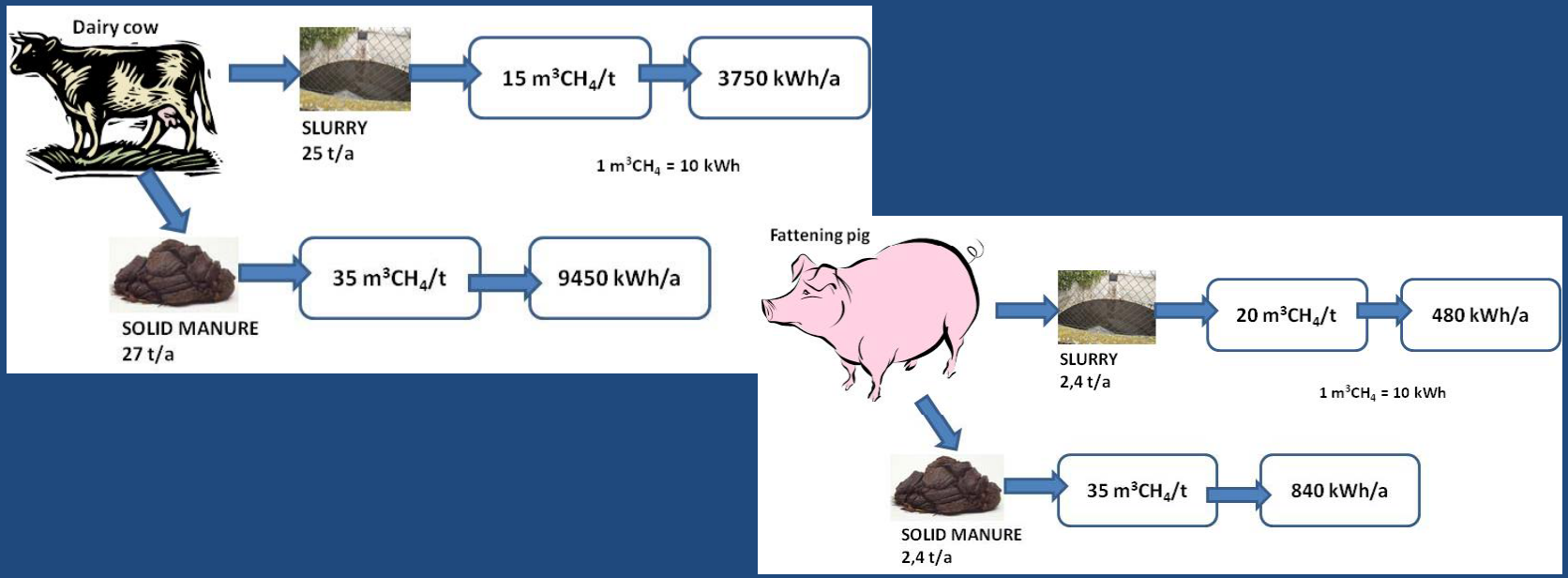
Biogas from manure – energy(1)

- Undegraded organic matter in manure can be turned into biogas
- Different manures have different energy content



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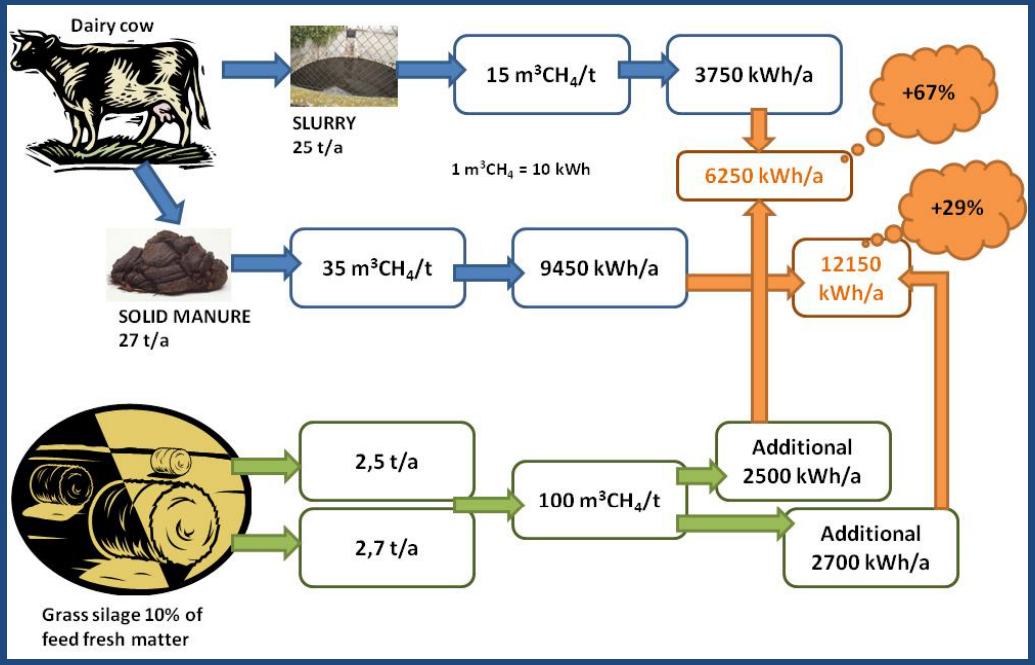
Biogas from manure - energy (2)

- Energy yield of manure based biogas can be increased with suitable co-substrates



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Biogas from manure – Nutrients and emissions

- Nutrients are preserved during digestion
  - Organic nitrogen mineralised into soluble and readily plant-available ammonium
  - Possibility to recycle also nutrients from other organic materials (co-substrates)
- Direct GHG emissions from manure can be reduced
  - Also reduction of GHGs by replacing fossil energy
- Ammonia emissions and nutrient run-off can be reduced

- **TO ACHIEVE ALL THESE GOOD EFFECTS, THE WHOLE MANURE MANAGEMENT CHAIN MUST BE OPTIMISED**
  - Quick collection from barn
  - Sufficient retention time in digester
  - Post-digestion
  - Covered storage
  - Optimal timing and method for digestate spreading
  - Optimal dose of digestate as fertiliser

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Manure energy potential in the BSR

Country	Manure (t/a)	Theoretical EP Min (TWh/a)	Theoretical EP Max (TWh/a)	Techno-economical EP Min (TWh/a)	Techno-economical EP Max (TWh/a)
Finland	13 543 967	2.41	5.20	0.850	1.78
Sweden	21 743 000	3.38	7.04	1.34	2.78
Denmark	34 395 100	4.38	9.13	2.19	4.57
Germany*	23 765 348	2.95	6.16	1.63	3.41
Poland	69 775 669	20.0	36.8	9.32	18.62
Lithuania	12 321 471	2.69	5.69	0.782	1.65
Latvia	7 585 496	1.16	2.62	0.512	1.17
Estonia	3 621 000	0.677	1.52	0.352	0.781
TOTAL	**186 751 051**	**37.65**	**74.16**	**16.98**	**34.76**

*Mecklenburg Western-Pommerania & Schleswig-Holstein only

Including cattle, pig and poultry manure
In more detail: http://www.balticmanure.eu/download/Reports/bm_energy_potentials_web.pdf

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RES production
571 TWh/a
in the BSR
(2010)

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Manure energy use as biogas in 2012

Country	No of biogas plants	No of biogas plants treating manure	Amount of manure digested (t/a)
Finland	35	17	180 000
Sweden	50	40	350 000
Denmark	150	80	2 500 000
Germany	7320	NR	3 500 000… 6 000 000
M-WP*	325		
S-H**	561		
Poland	28	16	269 000
Lithuania	5	0	0
Latvia	30	30	725 000
Estonia	10	2	140 000

NR = not reported
* Mecklenburg-Western Pommerania; **Schleswig-Holstein

4.2 million t manure/a to biogas out of 187 million t/a available
(excluding the two German states)

SIGNIFICANT POTENTIAL STILL AVAILABLE

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Manure based biogas

Incentives and bottlenecks NOW

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Incentives for manure biogas in the BSR

- Investment grants
  - Usually max 30% of the investment costs, but may come with prerequisites
- Feed-in tariffs / fixed prices
  - Vary significantly between BSR, detailed prerequisites
- Tax exemptions
- Other observations
  - Manure valued differently in different countries
    - EXAMPLE 1: the target in Denmark is to have 50% of manure in energy production (=biogas) by 2020 – subsidies available / planned to promote manure based biogas in particular
    - EXAMPLE 2: the feed-in tariff for biogas electricity in Finland is not available for plants with less than 100 kVA of efficiency – rules out all smaller, manure based biogas plants

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Bottlenecks for manure biogas in the BSR

- Profitability
  - High investment cost, mostly rather modest subsidies
  - Manure alone not sufficient for income – need for co-substrates
- Changing political scene and legislation
  - Avoidance of risky investments due to uncertainties
- Heavy permission processes (in some countries)
- Value for nutrient recycling and avoided emissions
- Lack of knowledge
- Attitudes: NIMBY

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Technological bottlenecks

- **Significant share of the energy potential in solid manure**
  - Ratio of slurry : solid manure about 50:50 in the BSR
    - Differences between countries: 80% slurry in Denmark, 10% slurry in Poland
  - Better solutions for solid manure are needed
    - Co-digestion with slurry
    - Pre-treatments to pulp into pumpable form and to increase degradability
      - Beneficial also for other ligno-cellulosic materials
    - Possibly new digester designs for high dry matter contents
      - E.g. two-stage process (separate hydrolysis and leachate digestion)
- **Challenges with plant operation**
  - Technical problems: no sufficient knowhow
  - No operation strategy

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Incentives for the future

WHAT SHOULD BE DONE?

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Recommendations for manure based biogas

Farmer / entrepeneur

- Plan biogas plants to answer to farm-specific requirements and ensure constant feed supply
- Take time to find all possibilities to increase profitability
- Understand manure based biogas as part of the entire manure management chain in order to take full advantage of all the benefits involved

Policy / decision maker

- Understand manure based biogas as part of the entire manure management chain in order to support the right actions
- Create well-defined and stable subsidy systems and give extra credit to solutions including manure
- Create support for not only renewable energy, but also nutrient recycling and emission mitigation

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Manure based biogas offers…

- Renewable energy
- Recycling of nutrients from different organic by-products
- Enhancement of nitrogen utilisation
- Mitigation of emissions
- More efficient food production by decreasing the agricultural use of fossil fuels and mineral fertilisers

WHEN IT IS DONE IN THE RIGHT WAY!

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More information:

www.balticmanure.eu

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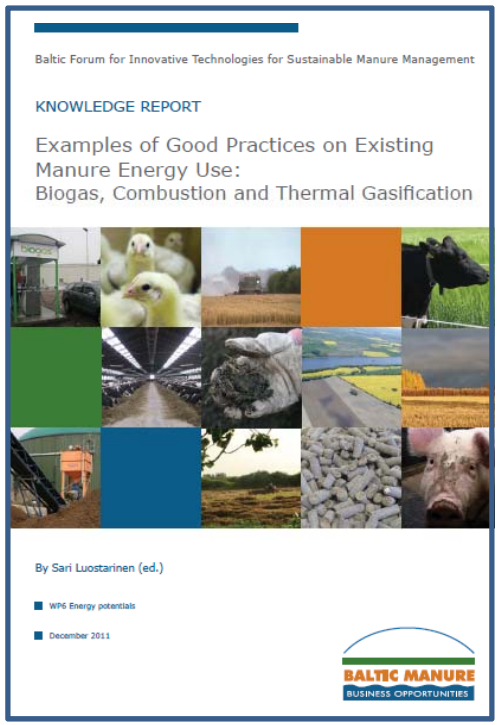

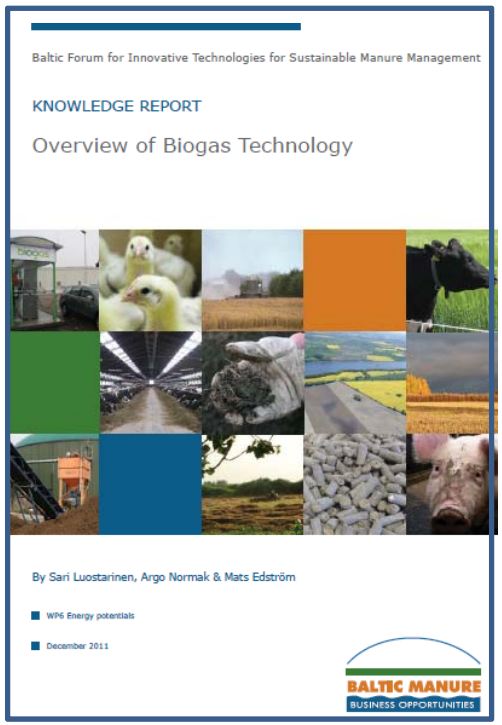

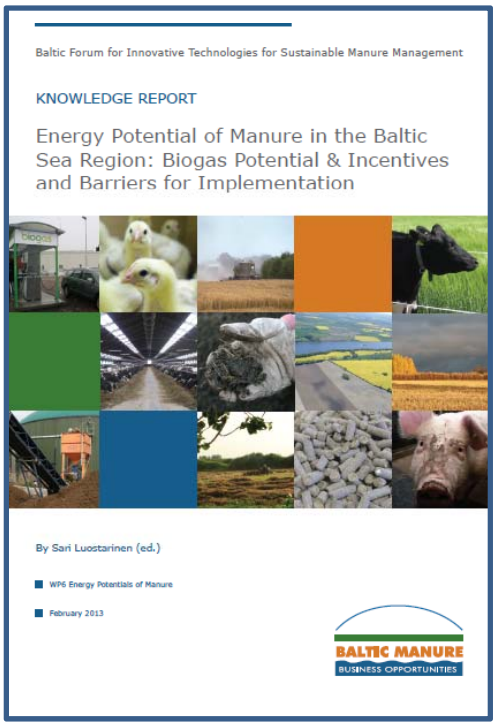

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