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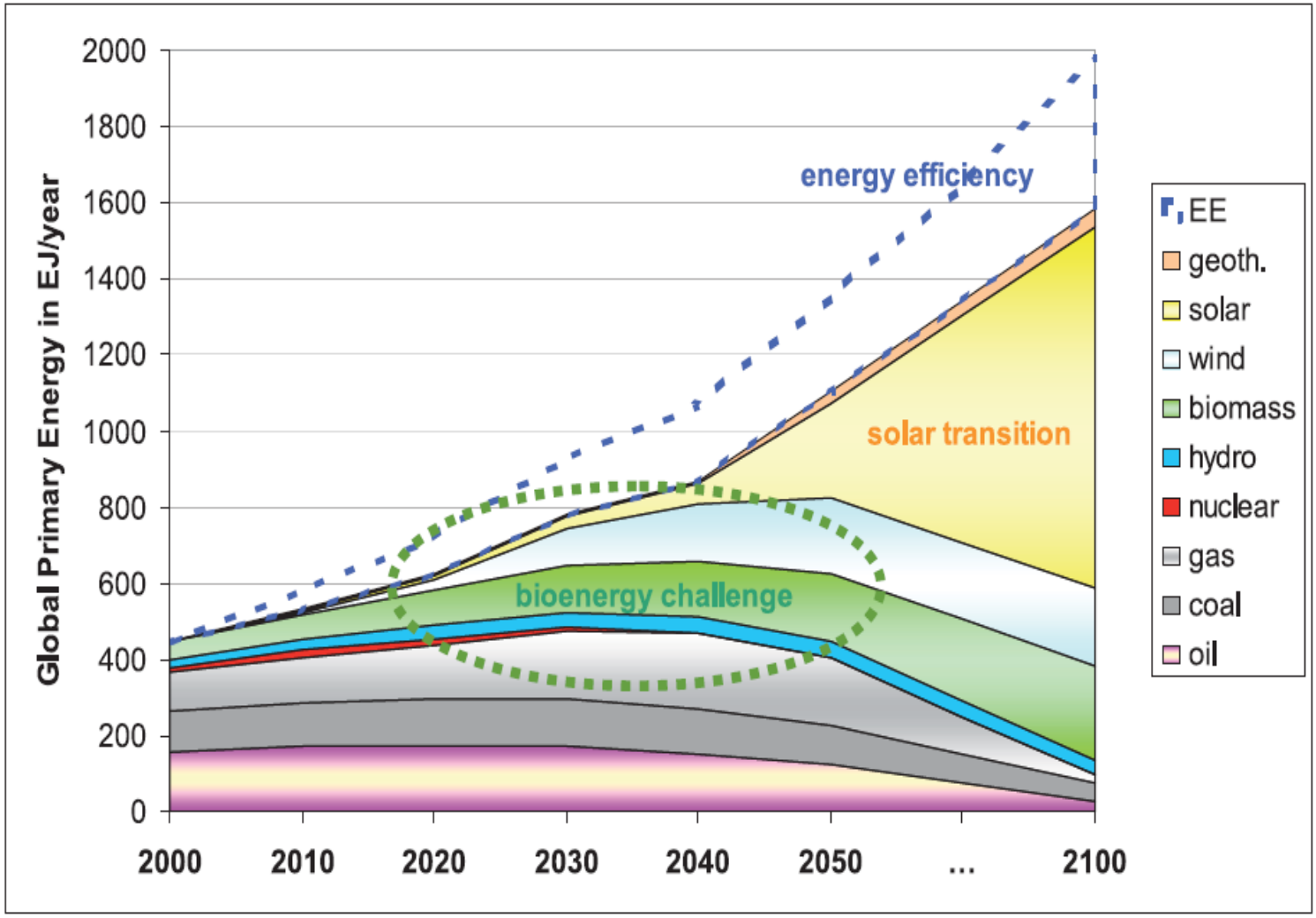
The technology platform for agricultural based lignocellulosic substrates – Case examples from R&D and full scale implementations.

The 3.rd IBBA workshop,
Malmoe, Sweden, September 10.th , 2015

by
Jens Bo Holm-Nielsen, Ph.D. - et al.
Head of Center for Bioenergy og Green Engineering
Department of Energy Technology,
Aalborg University, Denmark
Niels Bohrs vej 8, 6700 Esbjerg
Cell; +45 2166 2511
E-mail: jhn@et.aau.dk
www.et.aau.dk; www.aau.dk ~ search JBHN;

Sustainable Global Energy

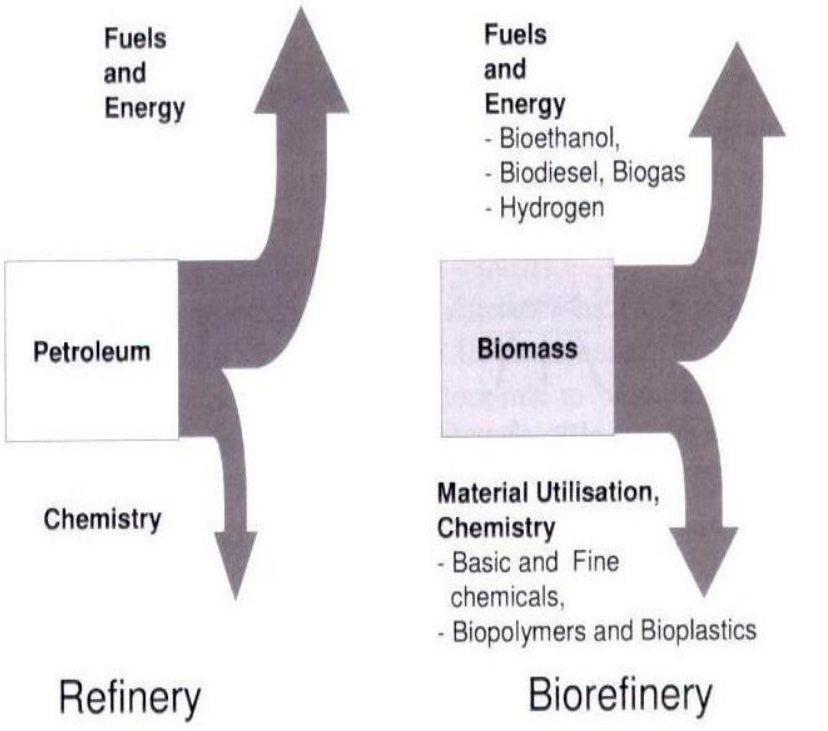
Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology



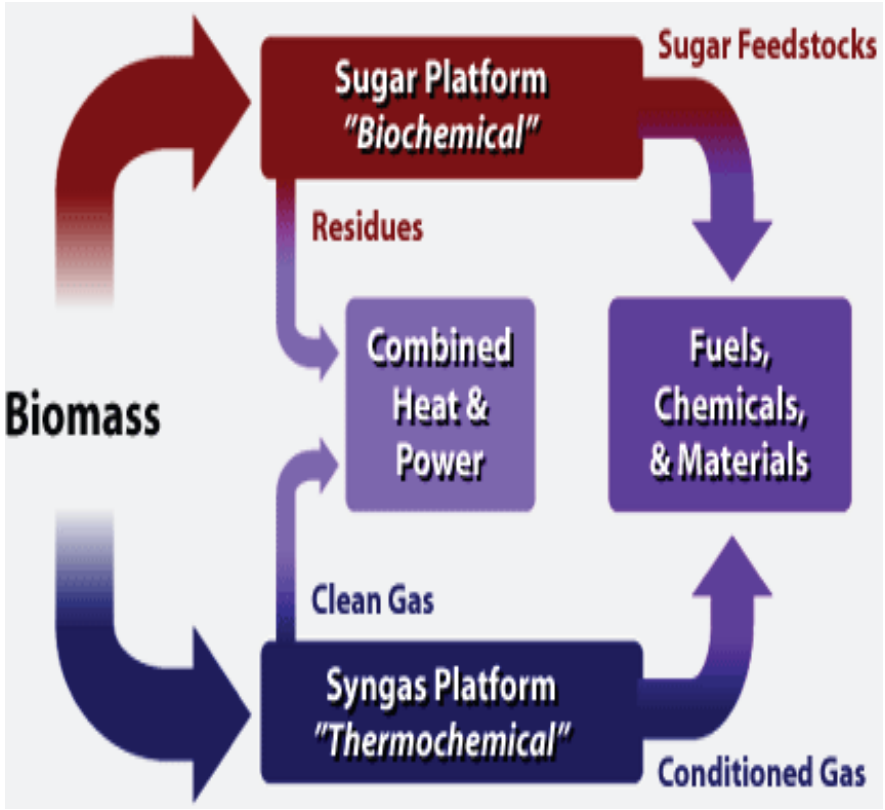
Source: IEA (2007), IPCC (2007), UNPD (2004) and WBGU (2003)

→ Bioenergy will be here to stay, and grow!

Biorefineries



Comparison of the basic principles of the petroleum refinery and the biorefinery, Source: Kamm et al. 2006



Two-platform biorefinery concept
Source: NREL 2006, Biomass Programm, DOE/US]

Energy potential of pig and cattle manure in EU-27

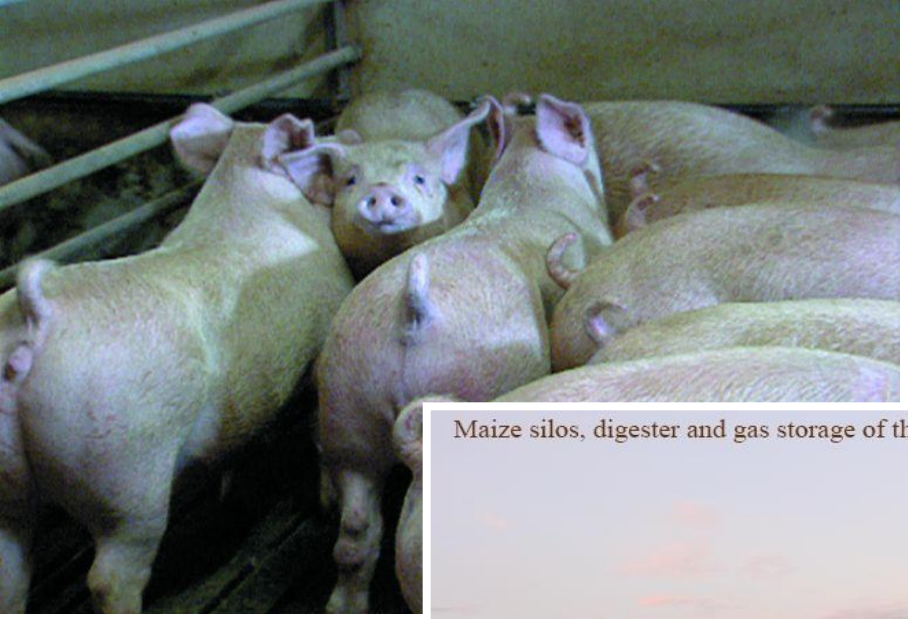
Total manure	Biogas	Methane	Potential	Potential
[10^6 tons]	[10^6 m^3]	[10^6 m^3]	[PJ]	[Mtoe]
1,578	31,568	20,519	827	**18.5**

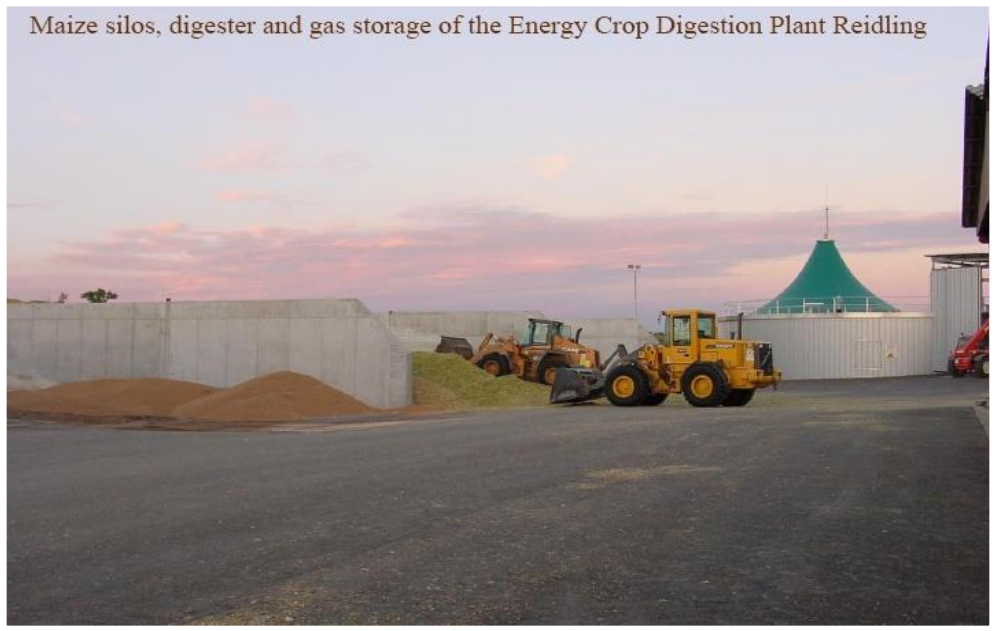
Methane heat of combustion: 40.3 MJ/m^3; 1 Mtoe = 44.8 PJ
Assumed methane content in biogas: 65%

Biogas Production & Forecast:

Actual 2010 production of biogas in EU 27:	10 Mtoe
2012-2015 EU forecast	15 Mtoe
Manure potentials	18.5-20 Mtoe
Organic waste and byproducts	15-20 Mtoe
Crops and crop residuals	20-30 Mtoe
Total long term forcast Biogas	**60 Mtoe**

Biogas can cover 1/3 of EU's total RES 20% demands year 2020





AD Co-digestion - heterogeneous feedstock's

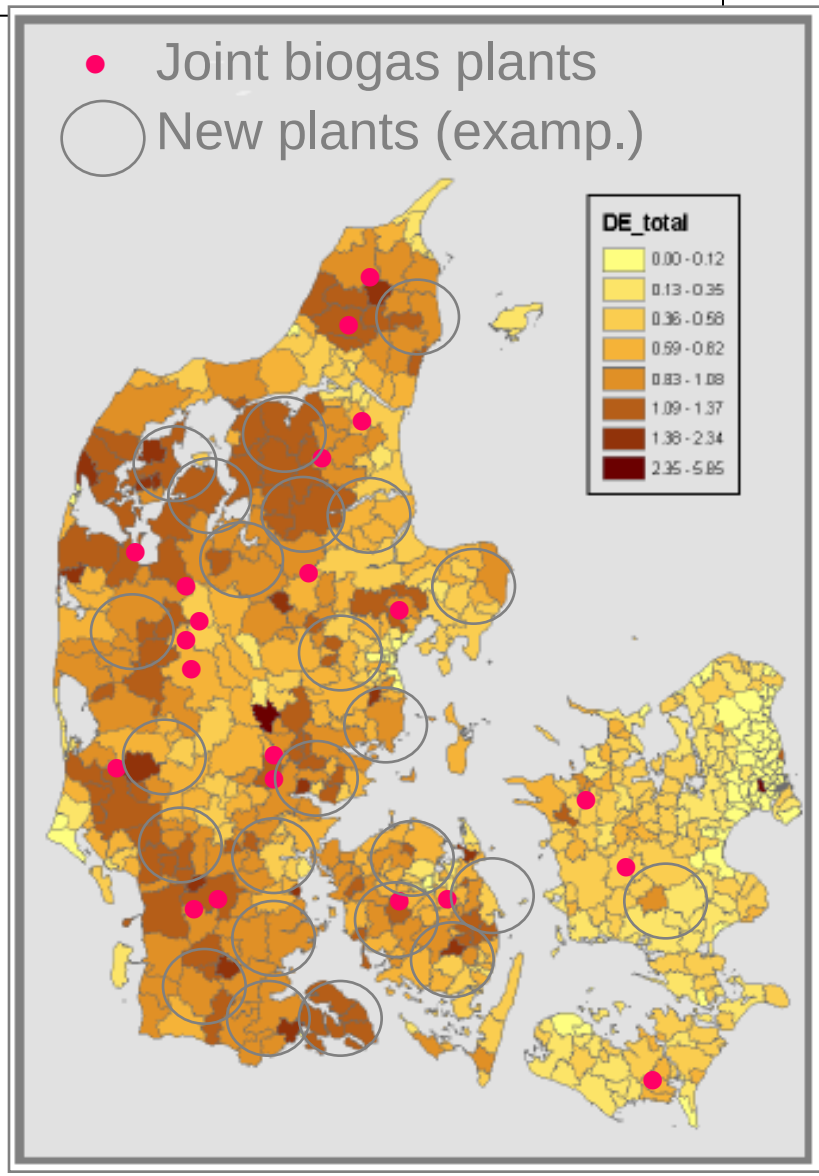
- Manure
- Food waste
- Organic by-products
- Crops

Biogas

- **Redistribution and treatment facilities**
- **Organic fertilizer plants**
  - Bioslurry, biofibres and other biomasses.
  - Redistribution and surplus treatment as organic fertilizer sale products
  - Electricity, heat and transportation fuels
  - Water environment, Climate combat and odour reduction
  - Further treatment of fibres
  - Digested fibre incineration /gasification
- **Increased utilisation of biogas**
  - Local and further distances from the biogas plants – gas
  - CHP utilisation and the transport sector

*** Biogas are biorefinery platforms step 1.**

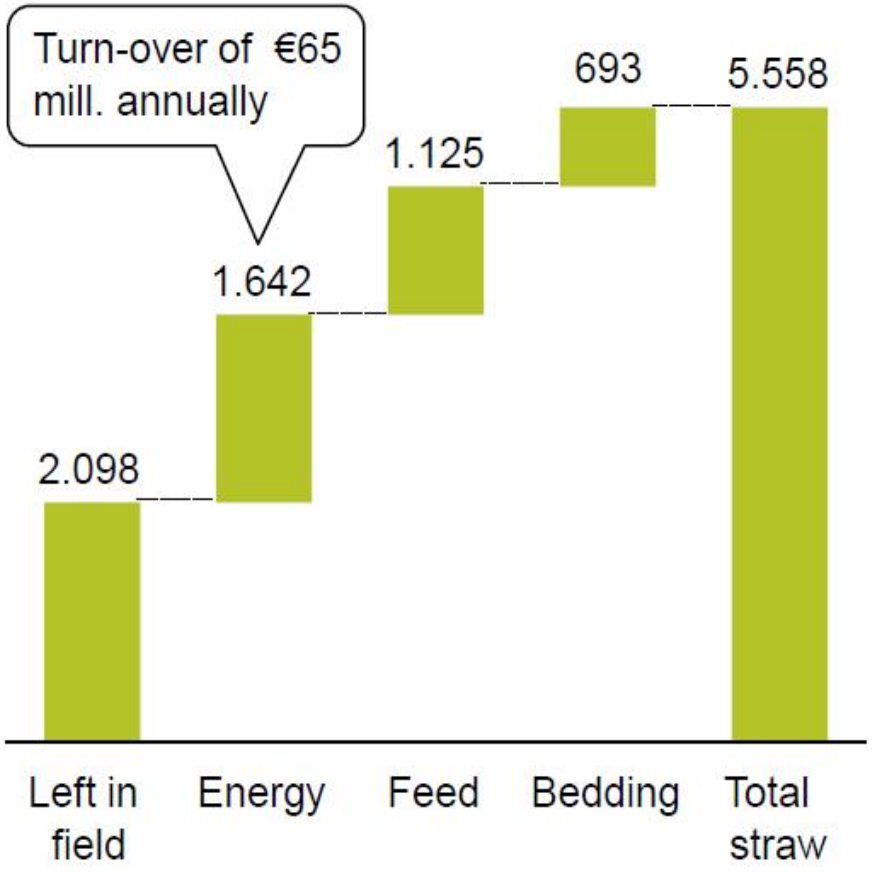
- This is the future challenge 2012-2020
- Need fast tracks, by all new projects



Use of Straw in Energy Production

- In Denmark a large share of the collected straw is used for energy
- Annual turn-over from straw for farmers is € 65 million

Use of straw million tons average 2006-2010:




MULLERUP

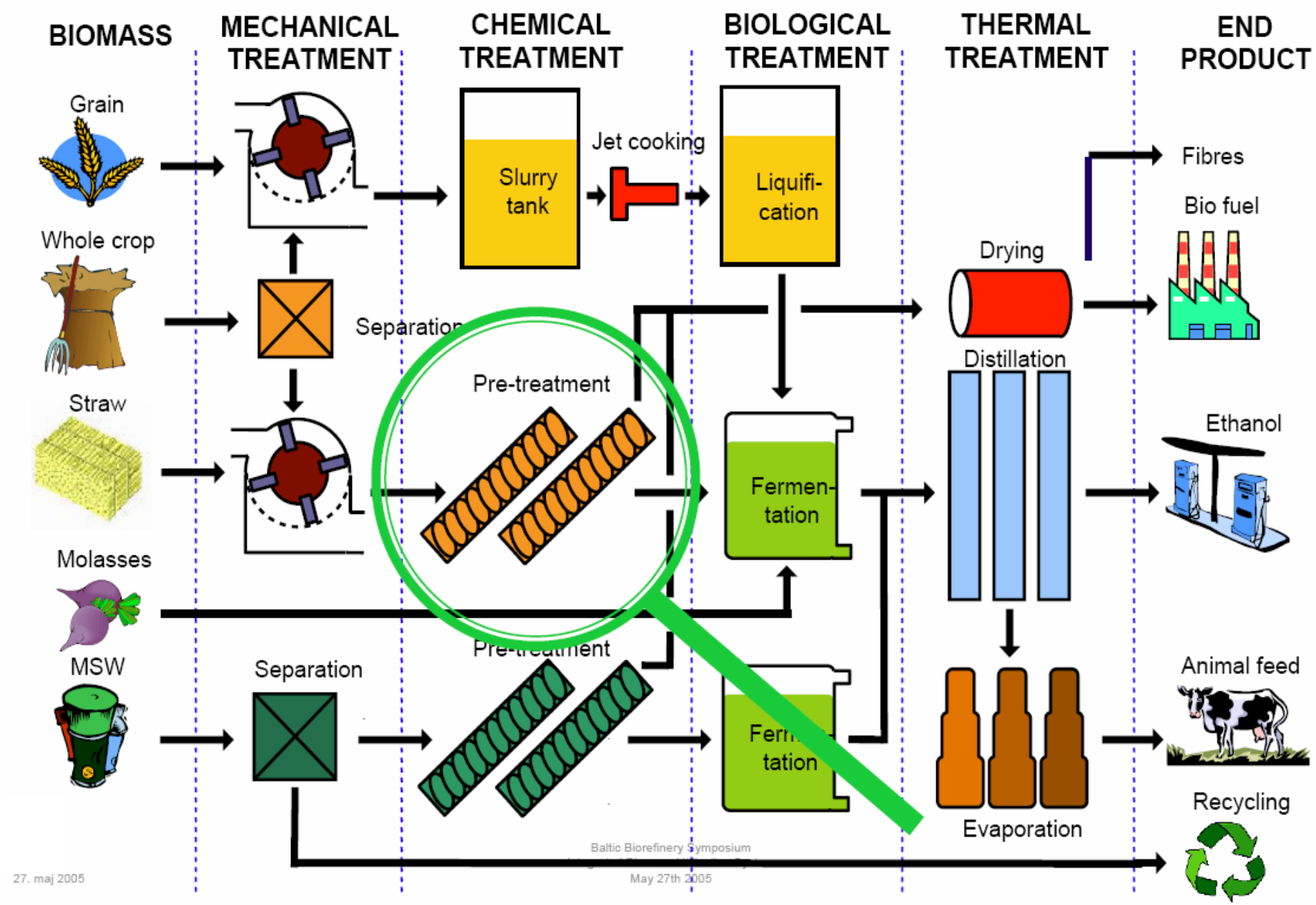

BIOMASS
MECHANICAL TREATMENT
CHEMICAL TREATMENT
BIOLOGICAL TREATMENT
THERMAL TREATMENT
END PRODUCT
Grain
Whole crop
Straw
Molasses
MSW
Separation
Slurry tank
Jet cooking
Liquifi-cation
Pre-treatment
Fermen-tation
Drying
Distillation
Evaporation
Fibres
Bio fuel
Ethanol
Animal feed
Recycling

Figure 30 Product container directly after the flash, releasing a lot of steam

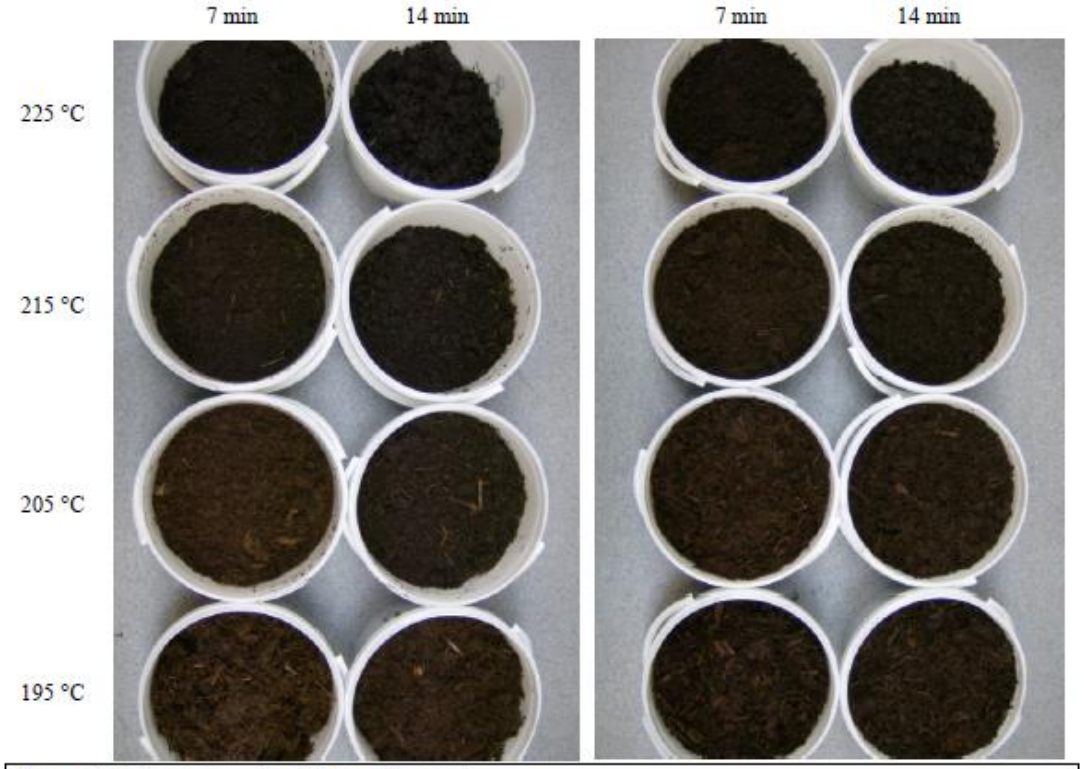


Figure 31 Left: straw series; Right: willow series

Figure 32 Left: willow without flash; Middle: willow at same conditions with one flash; Right: willow at same conditions with double flash

Koczała biogas plant (2009) – 2 x 1063 kW

POLDANOR'S BIOGAS PLANTS:

No.	BIOGAS PLANT	LOCATION (commune)	COMMISSIONED	POWER [kWe]
1.	**Pawłówko**	Przechlewo	2005	**946**
2.	**Płaszczyca**	Przechlewo	2008	**625**
3.	**Kujanki**	Człuchów	2008	**330**
4.	**Koczała**	PKoczała	2009	**2 126**
5.	**Nacław**	Polanów	2010	**625**
6.	**Świelino**	Bobolice	2010	**625**
7.	**Uniechówek**	Debrzno	2011	**1 064**
8.	**Giżyno**	Kalisz Pomorski	2011	**1 064**

Total installed capacity: **7,405 MW el.** and **8,140 MW heat**

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Large Scale Bioenergy Lab

Project focus 2012 -2015. New biomass, innovations technologies, meeting the challenges, peoples acceptance and green jobs in the cross border region.

Identification, Analysis, Mapping and Management of Sustainable Biomass Resources in the Region of Southern Denmark-Sleswig-K.E.R.N., Germany:

- Biomass from nature conservation
  - Protected nature: meadow, marshland
- Biomass from permanent grassland
- Agricultural residues
  - Manure / straw
- Biomass from other areas
  - Airports
  - Roadside grass
- Biomass from recreational areas
  - Parks
  - Football fields/ Golf courses etc.
- Others..
  - Algae, seaweed
  - Household waste
  - Industrial waste

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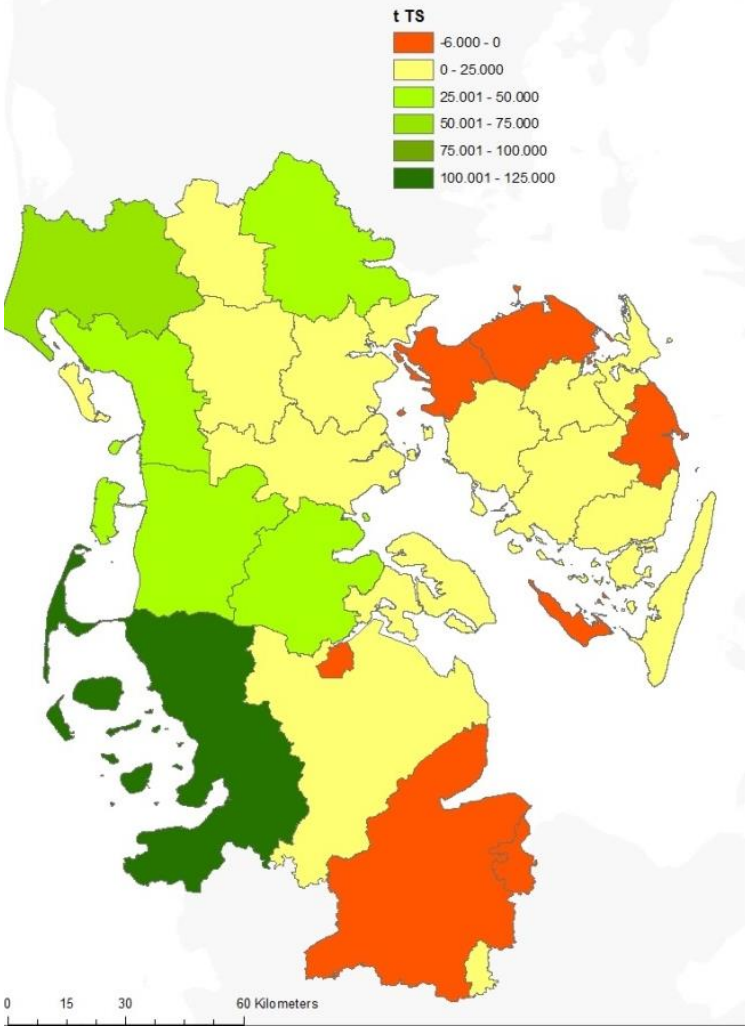
Potential from unutilised grass production from agricultural land



Uncertainties:

- Grass yields (DK ↑)
- Different systems for feeding!
- Differences in data level!

”Engen er agerens moder”
(Meadow - the ”mother” of arable land)

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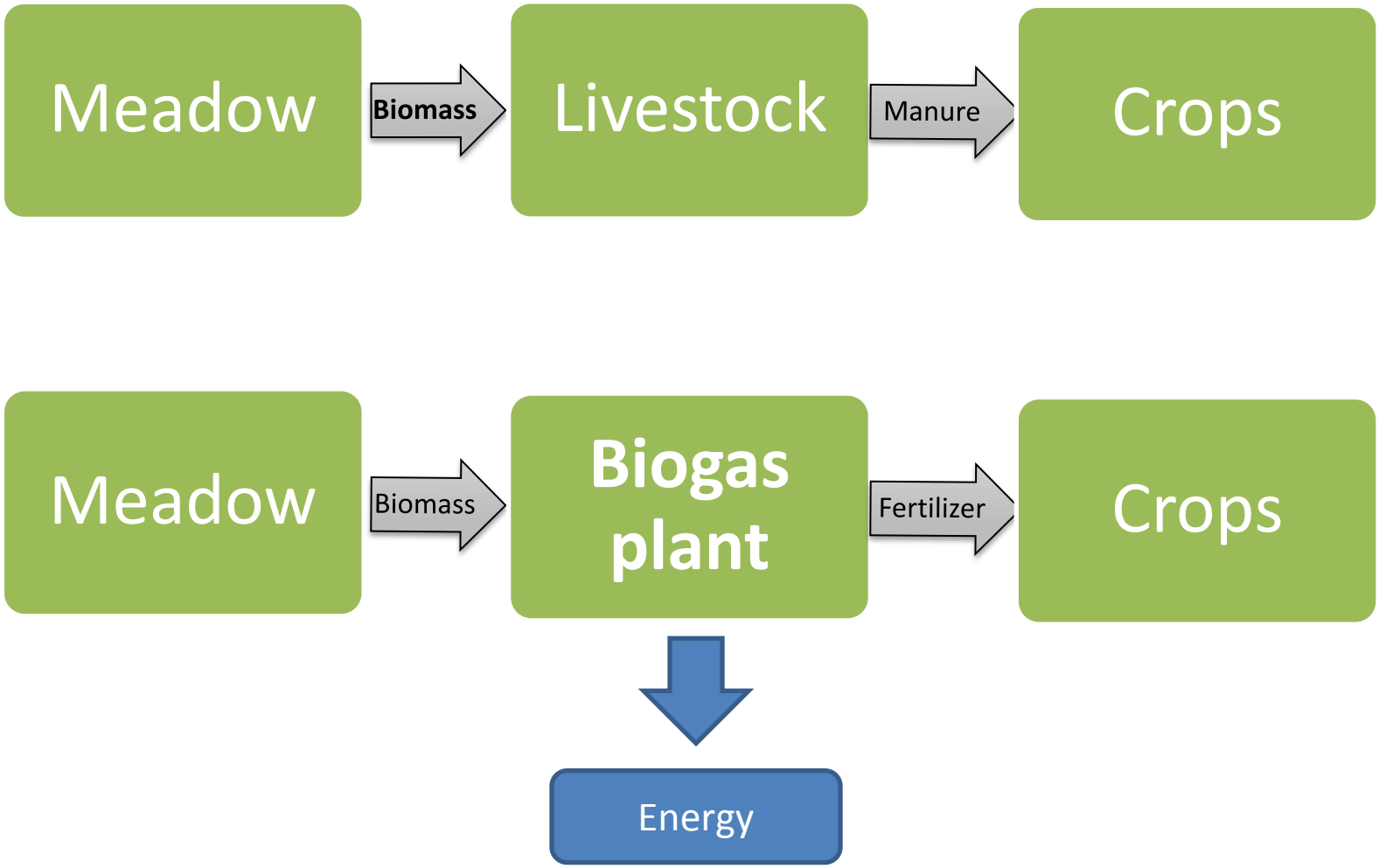
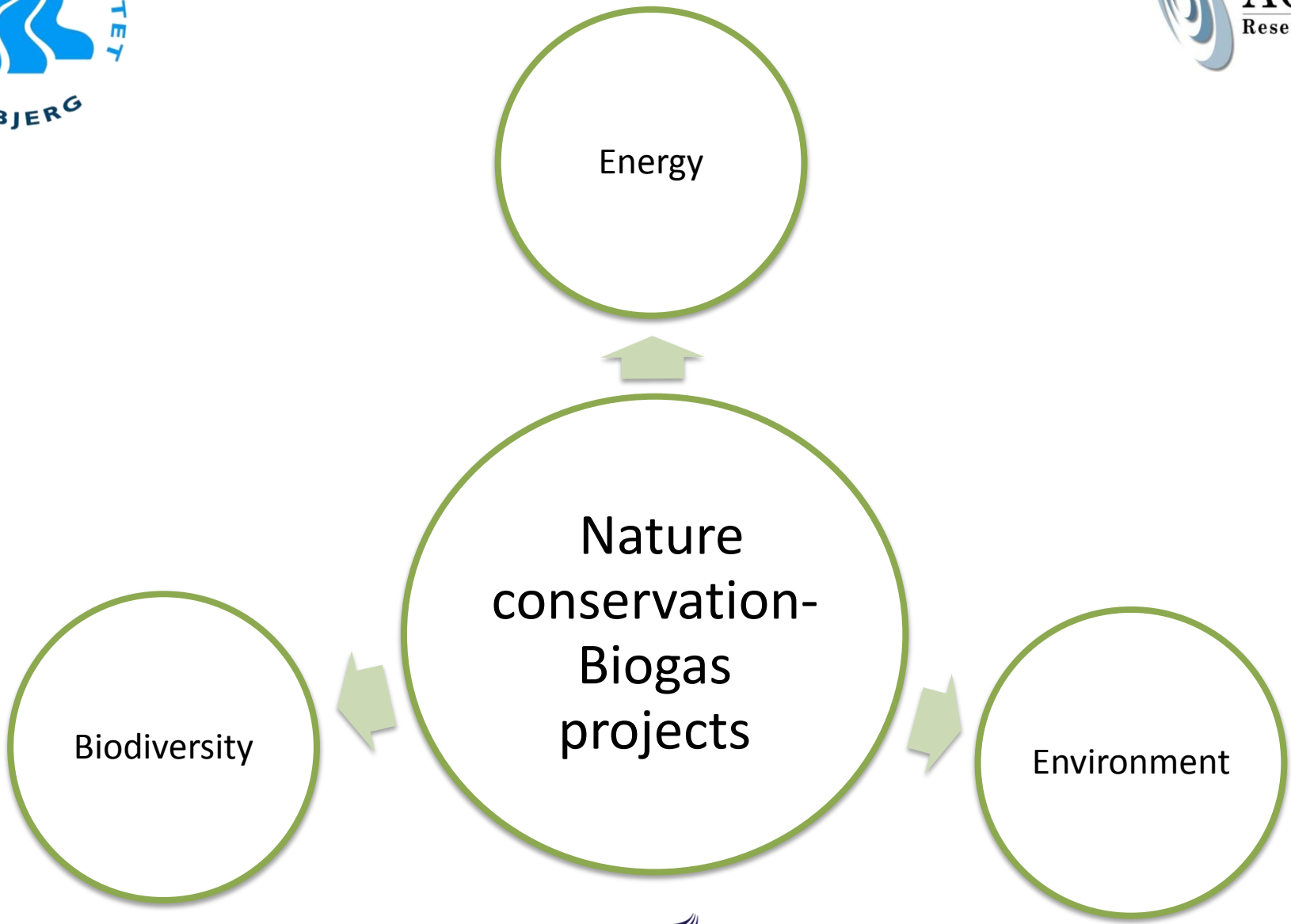
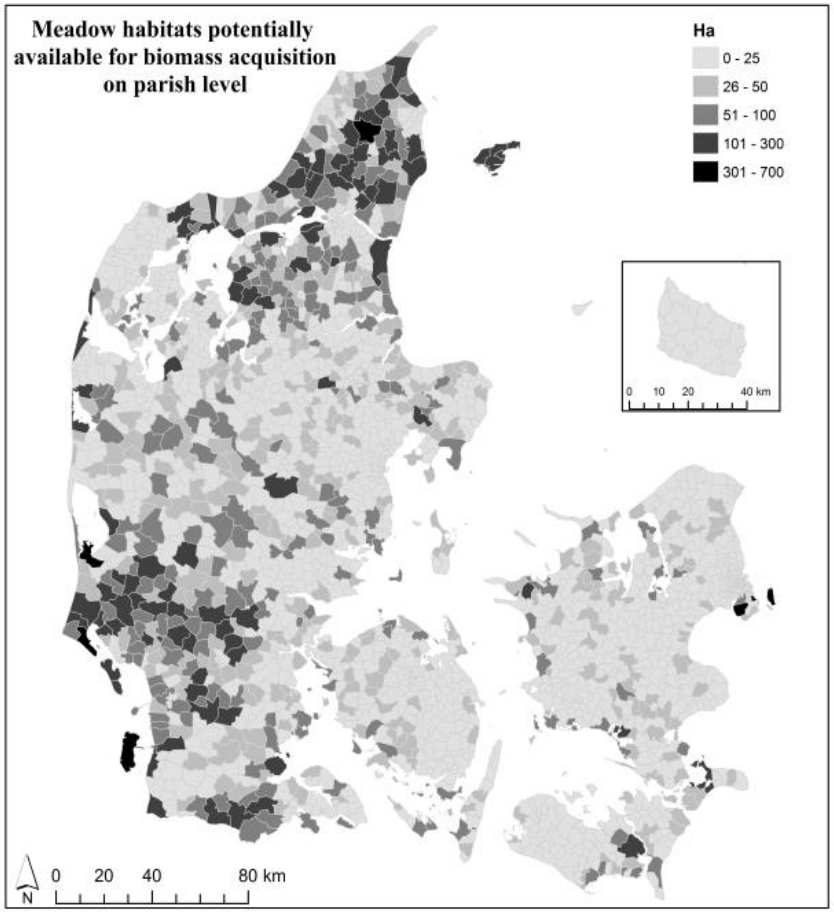
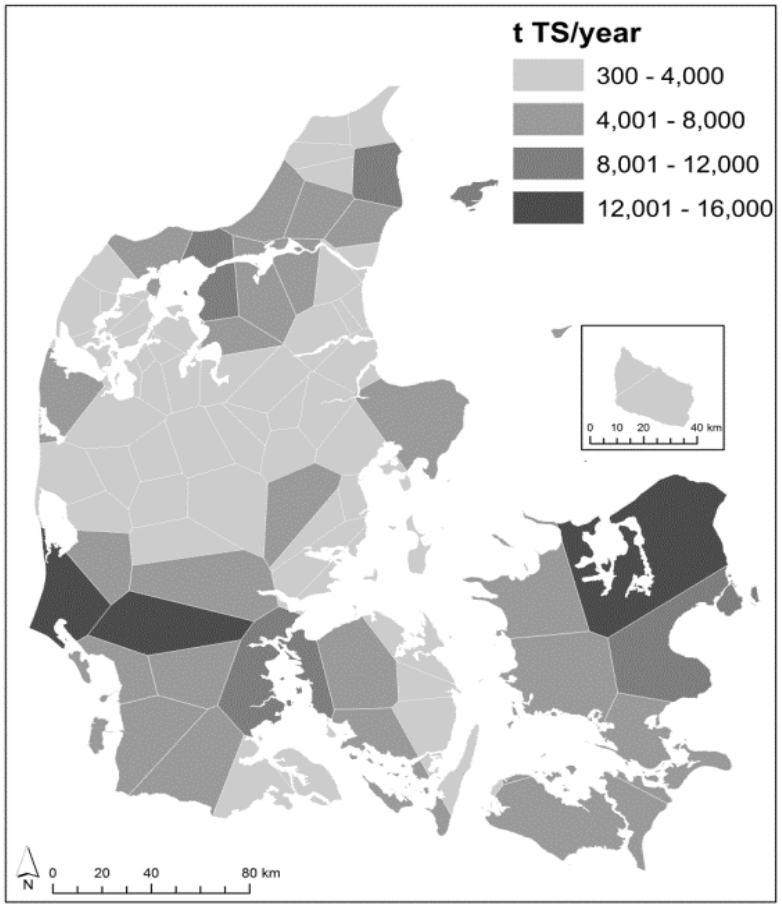



Energy
Nature conservation- Biogas projects
Biodiversity
Environment

Naturpleje græs (Fersk eng og strandeng)





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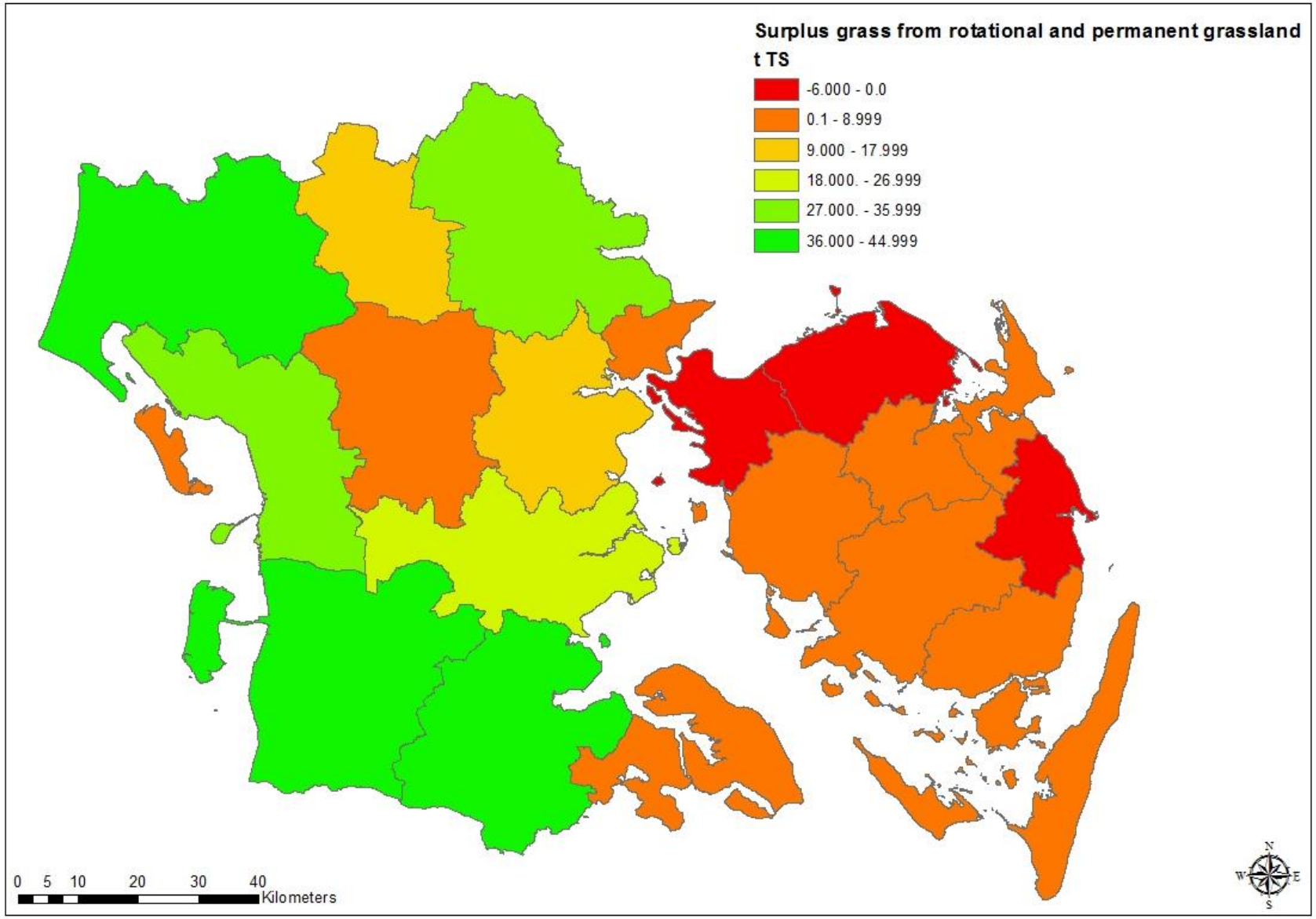
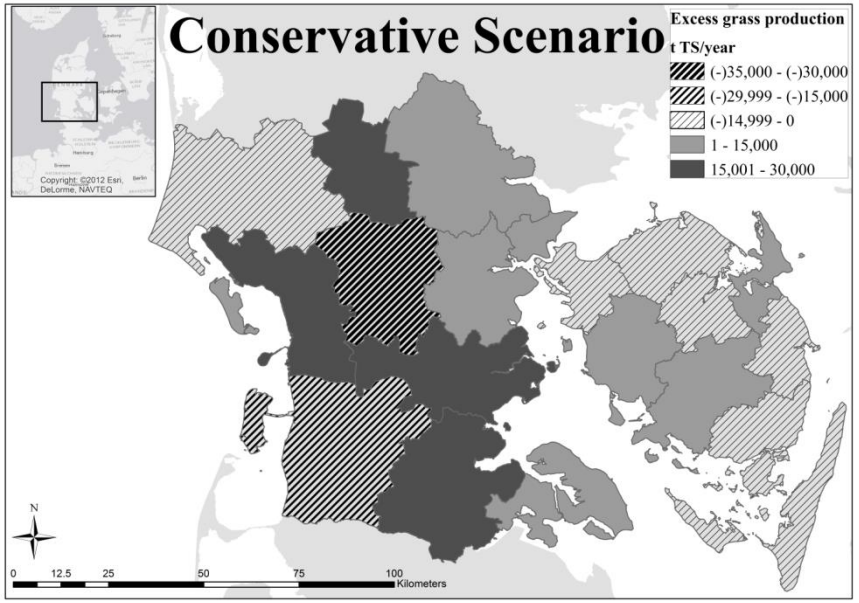
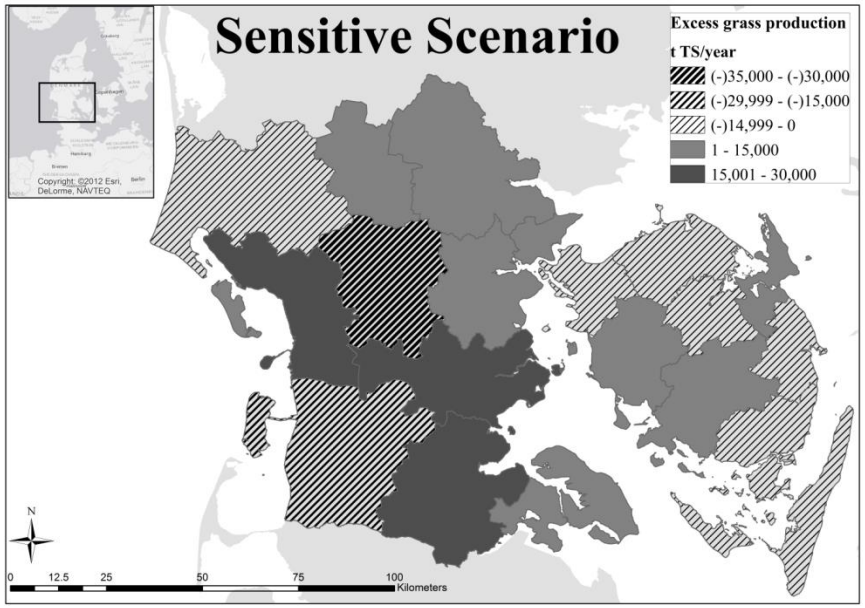
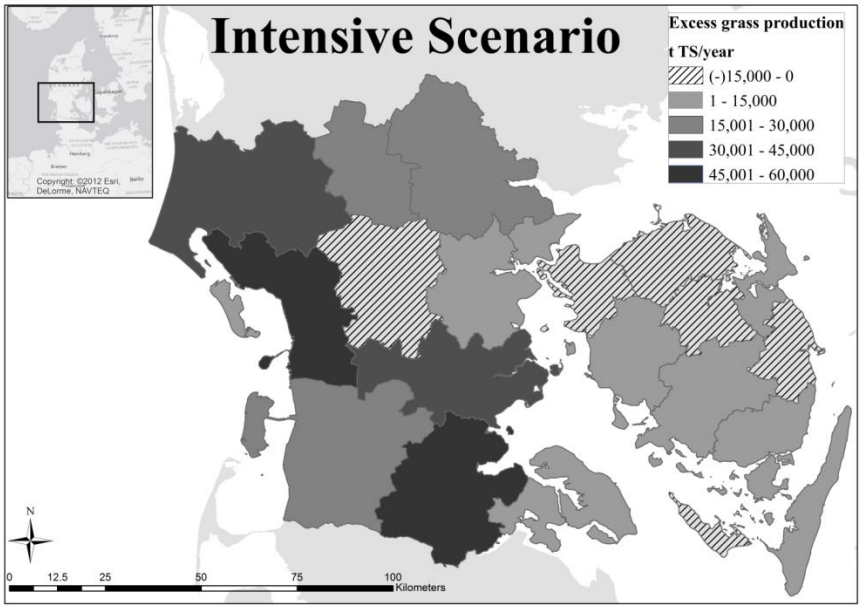


Overskudsproduktion af græs fra landbrugsarealer
(Græs i omdrift og permanente græsarealer)







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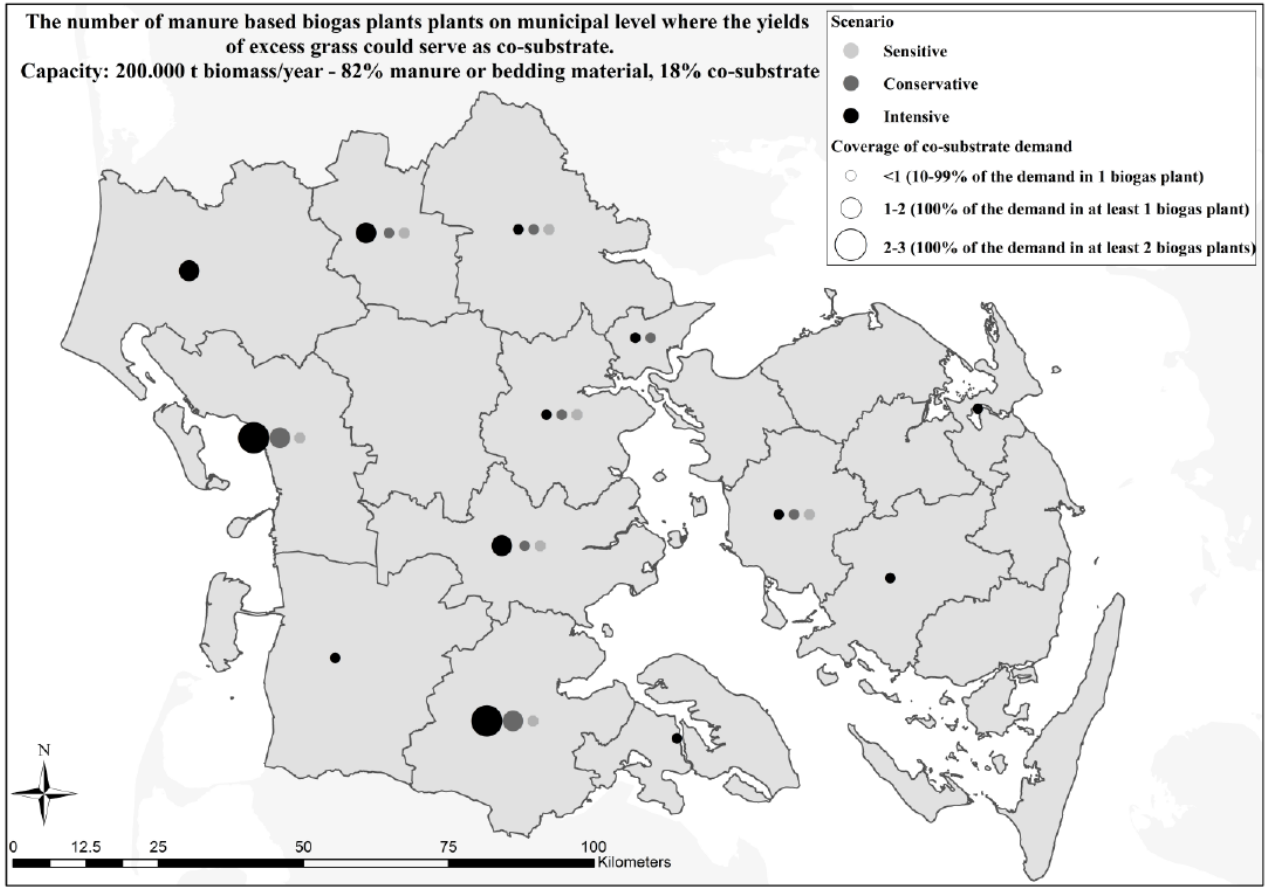

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Source: T. Al Seadi, Department of Bioenergy, SDU, Denmark

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ENVIRONMENTAL AND NATURE CONSERVATION CONSIDERATIONS; PERMANENT GRASSLAND AND PASTURES – AT SUCH AREAS THE NATURE HAS THE HIGHEST PRIORI

- TO SUPPORT THE MANAGEMENT OF SPECIES-RICH
- GRASSLAND. TO MAINTAIN A HIGH BIODIVERSITY

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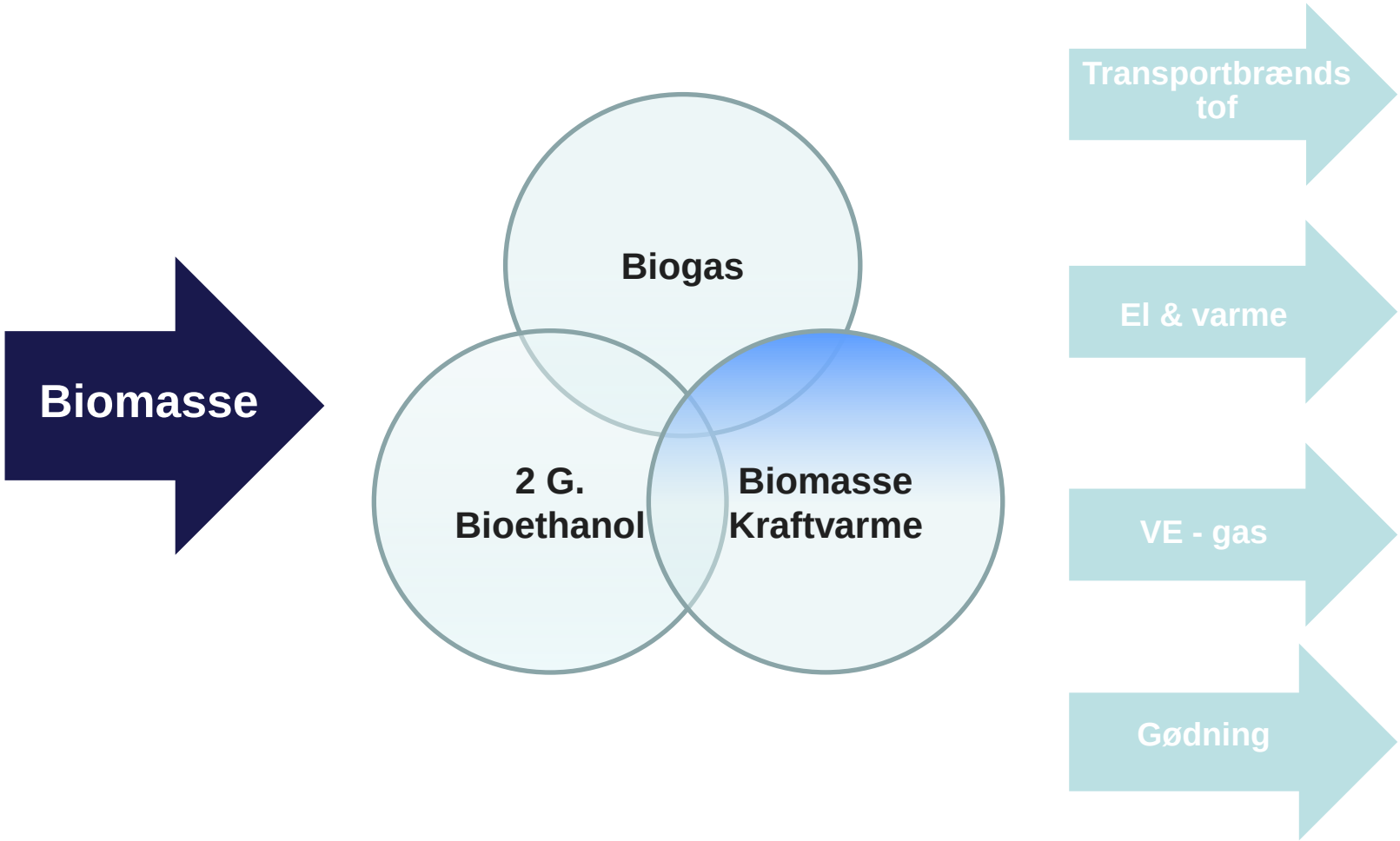
MEC konceptet

Udnyttelse af synergi i råvareomsætning og procesanlæg



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Thank you for your attention!
Q & A 's

R, D & D cooperation partners in LSBEL;

- **University of Flensburg**: Center for Renewable Energy Systems (ZNES); *Sönke Bohm, Simon Laros and Olav Hohmeyer*
- **FHF, Germany**; Biogas R&D group - *Lars Jürgensen, Torsten Stefan, Miria Frances Agunyo & Jens Born*
- **AAU-Campus Esbjerg, Denmark**: Bioenergy Research Group; - *Ane Katharina Paarup Meyer, Chitra Sangaraju Raju & Jens Bo Holm-Nielsen*

Jens Bo Holm-Nielsen, Ph.D.,
Head of Center for Bioenergy and Green Engineering,
Head of Energy Section – Esbjerg Campus,
Institute of Energy Technology,
Aalborg University
Cell: +45 2166 2511
E-mail: jhn@et.aau.dk
www.et.aau.dk;

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