Biogas plants in Denmark 2009 and forward

-New tendencies and projects in the pipeline.

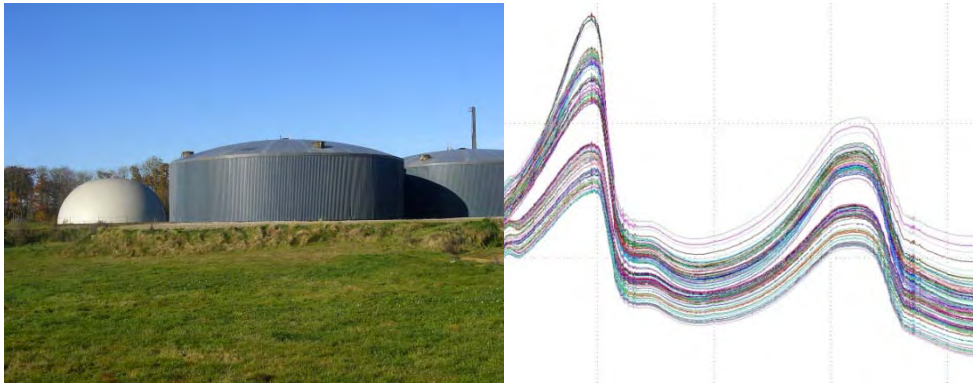
By Jens Bo Holm-Nielsen
at

IEA Bioenergy Task 37 Meeting

Energy from Biogas and Landfill Gas

Country updates

Denmark 2009

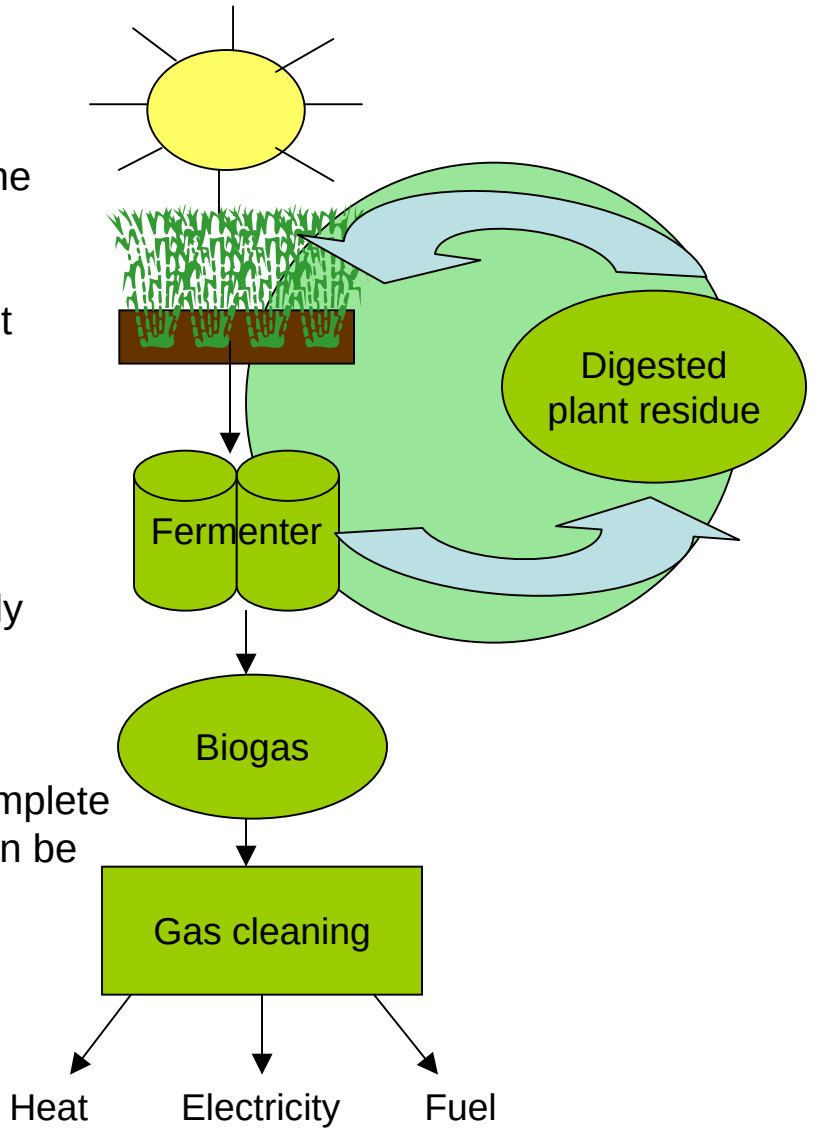


Future society needs & demands!

- Minimizing the fossil fuel dependencies
- Making the food production more sustainable
  - Increasing the nutrient recirculation
  - Minimizing the odour from animal production
  - Increased rural employment, new jobs
- Balanced resource utilization
  - Energy, nutrients/fertilizers, land use, money/finanzing
- Developing new knowledge based industries
- Minimizing greenhouse gas release
  - **Too big focus on the energy sector / single sectors**
  - **New focus on more diversified areas of the society**
    - farming and rural development,
    - transportation sectors,
    - consumers and living conditions
    - Biogas and renewables will be increasing tools

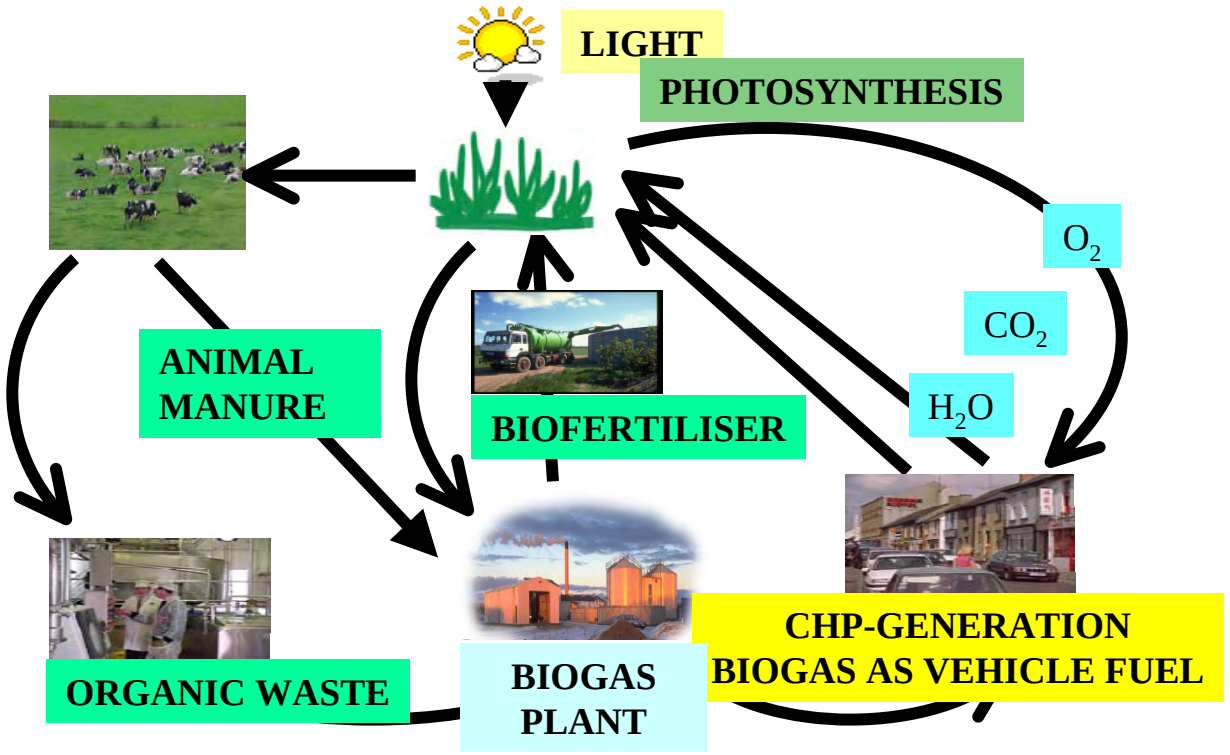
Energy crops → Paradigm shift through land productivity and energy balance

- The Sun as energy source
- Special energy crops that use the entire vegetation period
- Total digestion of the whole plant
- Nutrient cycle possible
  Low Input → High Output
- Large installations work efficiently and are friendly towards the environment
- Upgrading of biogas enables complete utilisation of the crop (the gas can be stored)
- Biorefineries;biothanol/biogas/ biodiesel



Source: KWS

Biogas for a sustainable clean environment and renewable energy production



Source: JBHN/TAS

Estimated amounts of animal manure in EU-27 (based on Faostat, 2003)

Country	Cattle	Pigs	Cattle	Pigs	Cattle manure	Pig manure	Total manure
	[1000Heads]	[1000Heads]	1000livestock units	1000livestock units	[10^6 tons]	[10^6 tons]	[10^6 tons]
Austria	2051	3125	1310	261	29	6	35
Belgium	2695	6332	1721	529	38	12	49
Bulgaria	672	931	429	78	9	2	11
Cyprus	57	498	36	42	1	1	2
Czech R.	1397	2877	892	240	20	5	25
Denmark	1544	13466	986	1124	22	25	46
Estonia	250	340	160	28	4	1	4
Finland	950	1365	607	114	13	3	16
France	19383	15020	12379	1254	272	28	300
Germany	**13035**	**26858**	**8324**	**2242**	**183**	**49**	**232**
Greece	600	1000	383	83	8	2	10
Hungary	723	4059	462	339	10	7	18
Ireland	7000	1758	4470	147	98	3	102
Italy	6314	9272	4032	774	89	17	106
Latvia	371	436	237	36	5	1	6
Lithuania	792	1073	506	90	11	2	13
Luxembourg	184	85	118	7	3	0	3
Malta	18	73	11	6	0	0	0
Netherlands	3862	11153	2466	931	54	20	75
Poland	5483	18112	3502	1512	77	33	110
Portugal	1443	2348	922	196	20	4	25
Romania	2812	6589	1796	550	40	12	52
Slovakia	580	1300	370	109	8	2	11
Slovenia	451	534	288	45	6	1	7
Spain	6700	25250	4279	2107	94	46	140
Sweden	1619	1823	1034	152	23	3	26
U.K.	10378	4851	6628	405	146	9	155
EU-27	**91364**	**160530**	**58348**	**13399**	**1284**	**295**	**1578**

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 2008 production of biogas in EU 27:	7 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 and biogas + separation, upgrading facilities

Biogas in Denmark 2009

- Joint biogas and farmbased biogas

Amounts of manure and organic waste 2008:

Animal manure t/y	1.742.156
Organic waste t/y	450.708
Total t/y - 2008	2.192.864

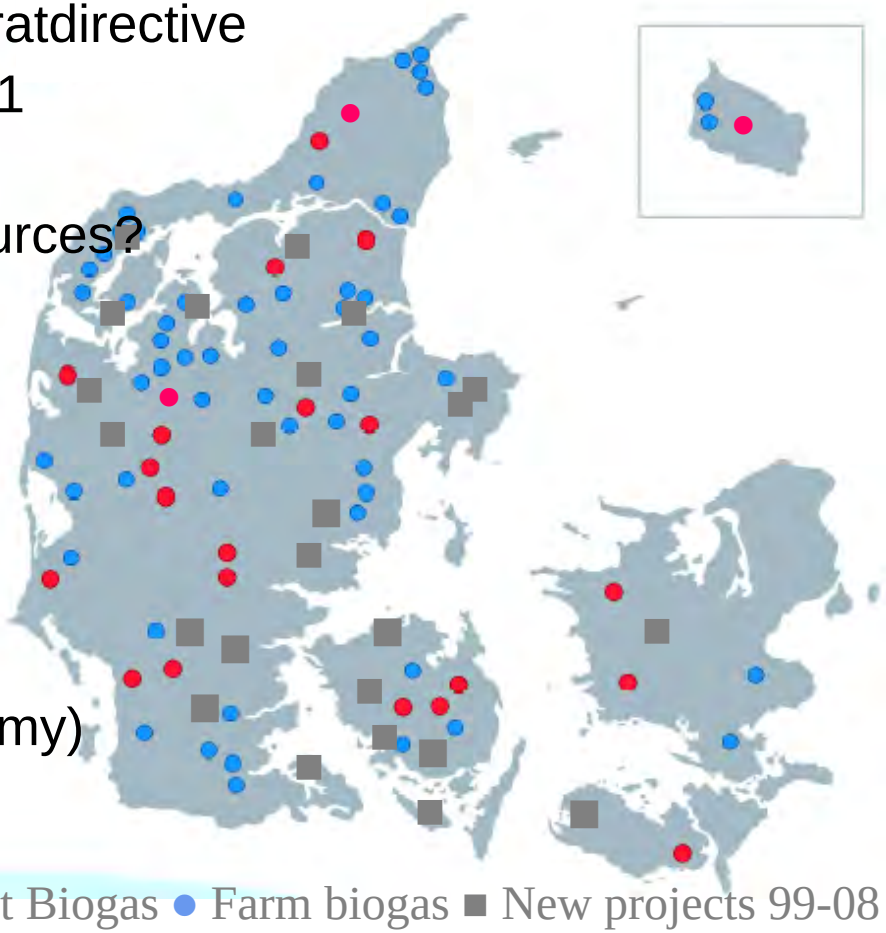
Big biogas interests from the farming society

New environmental demands – nutrients and green house gasses

- Freshwater planning-, Habitat- and nitratdirective
- Water environmental actionplan-4 2011
- Manure treatment before application?
- Methan release, N2O, Soil-Carbon sources?

Needs/demands?

- Reduction of Odour
- Redistribution of Manure
- Reduction of surplus (N/P)
- Recovering and recyc. of P (resource)
- Optimal utilization of N (enviro., economy)
- Carbon source sustainability



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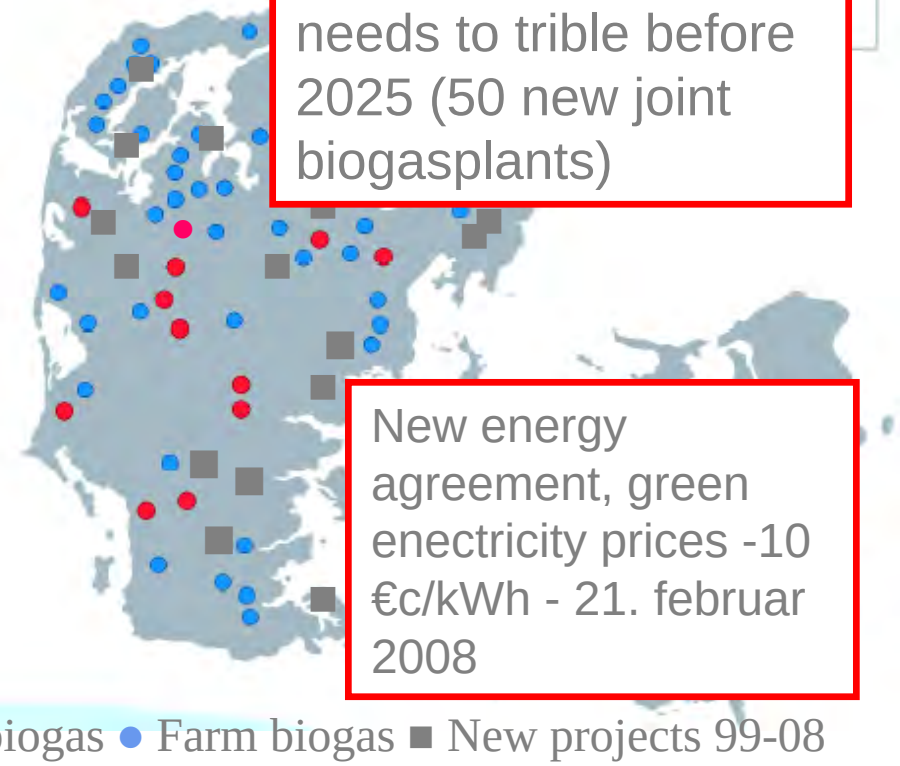
DK government 19. januar 2007:

Biogas production needs to trible before 2025 (50 new joint biogasplants)

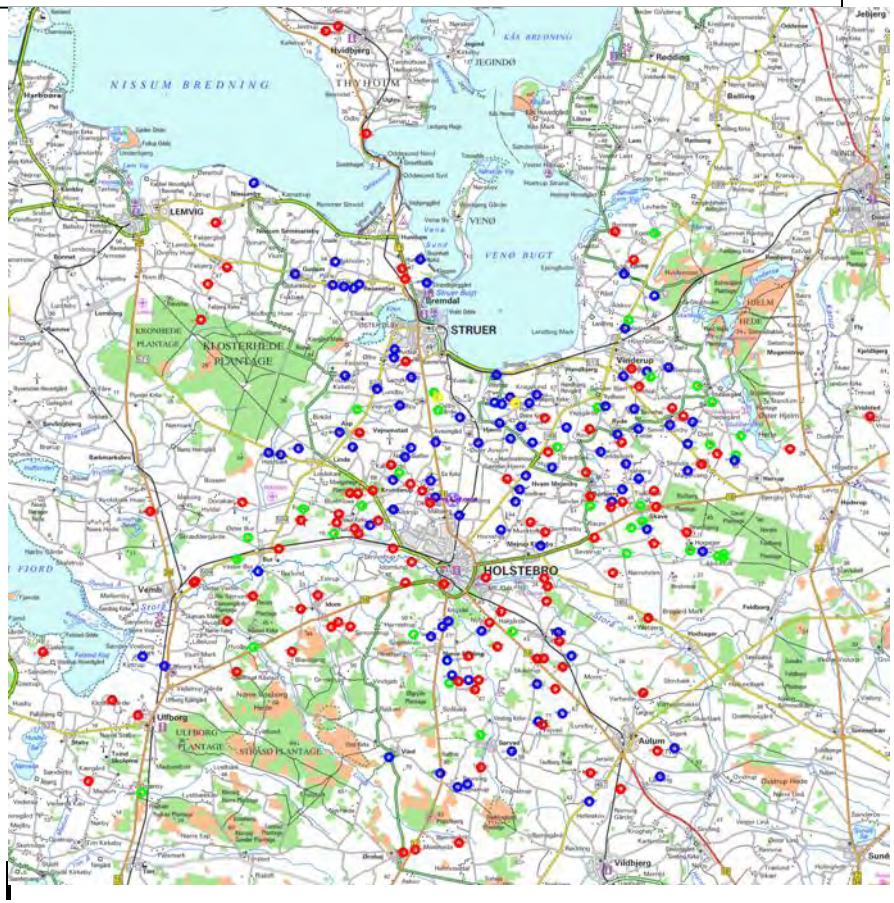


New energy agreement, green enectricity prices -10 €c/kWh - 21. februar 2008

● Joint biogas ● Farm biogas ■ New projects 99-08

Society benefits from biogas

- Joint biogas and farm biogas
- Cheap Kyototool 40 kr/ton CO2
- Recycling of organic waste
- Efficient redistribution of manure
  - From animal farms to crop farmers
  - From stables to decentralized slurry tanks in the fields
  - Trucking througout the year
  - Environmental technology to all kinds of farms



Samfundsmæssige fordele ved biogas

- Fællesanlæg og gårdanlæg
- Billigt Kyotoredskab 40 kr/ton
- Genanvendelse af affald
- Effektiv omfordeling af gylle
- Deklareret gødningsindhold
- Fri for ukrudt og patogener

Kg/ton	
Total N:	5,0
NH4-N:	4,0
P:	0,9
K:	2,8

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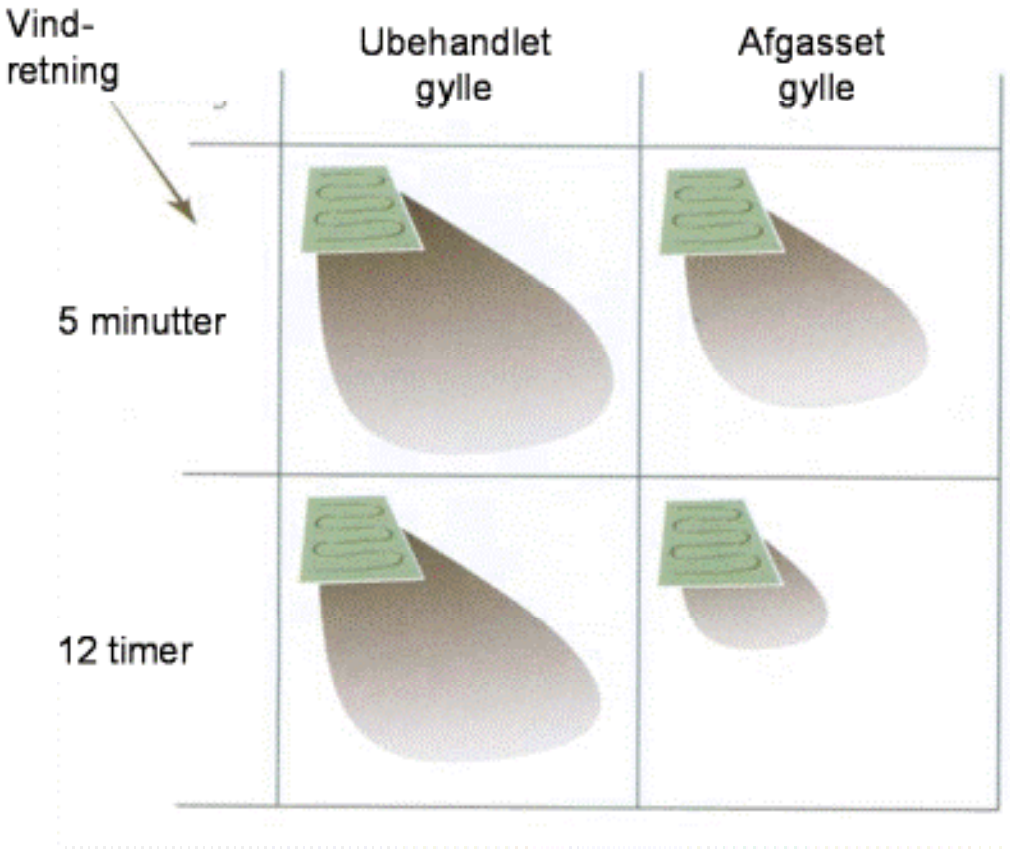
- Lettere at få afsat gyllen



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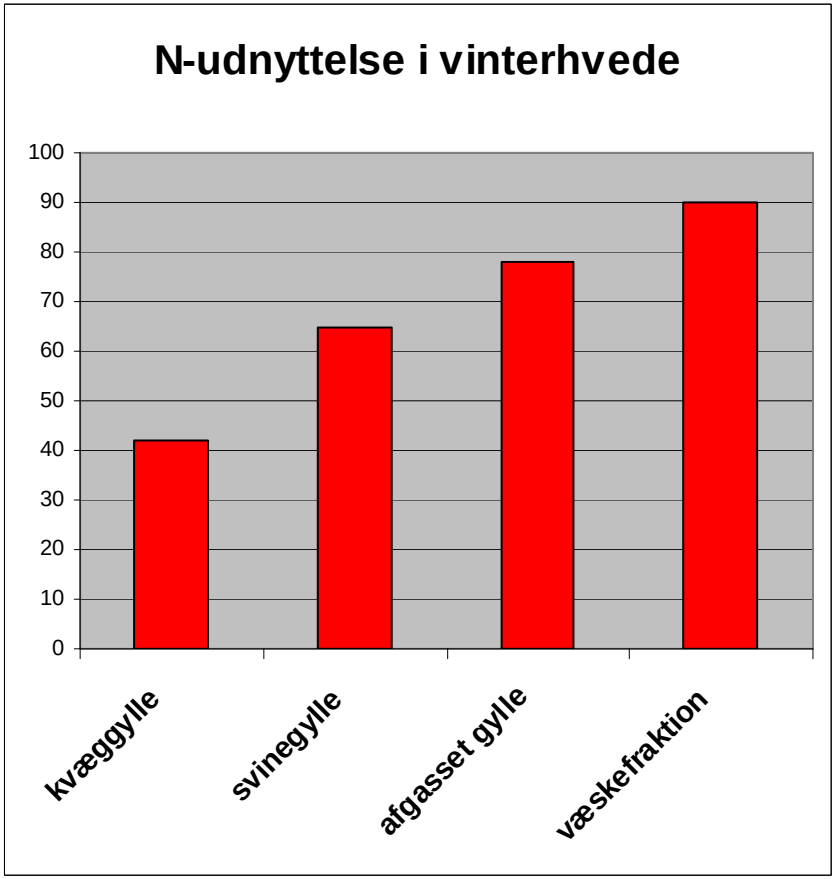
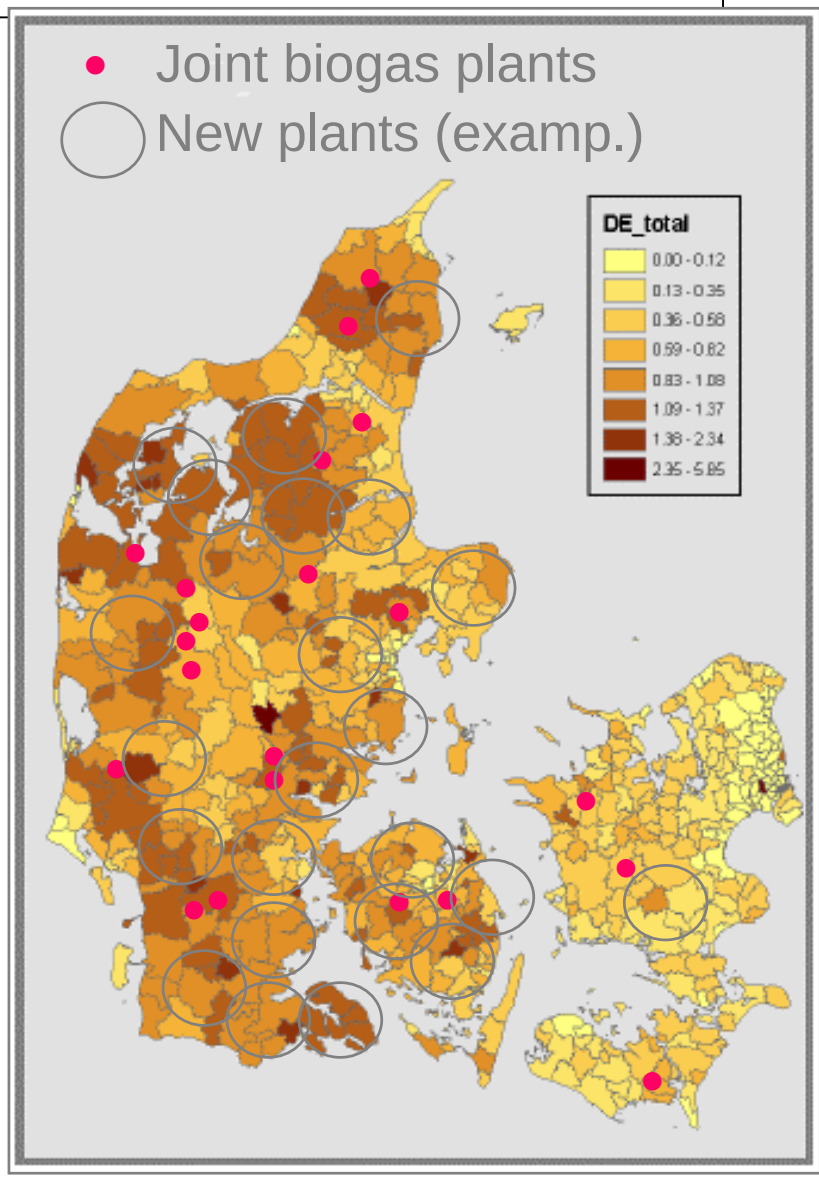
- Højere kvælstofudnyttelse
- Lavere udvaskningsrisiko
- Mulighed for separation



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 tool and odour reduction
  - Further treatment of fibres
  - Digested fibre incineration /gasification
- **Increased utilisation of biogas**
  - Local and further distances from the biogas plants – gas grid injection.
  - CHP utilisation and the transport sector



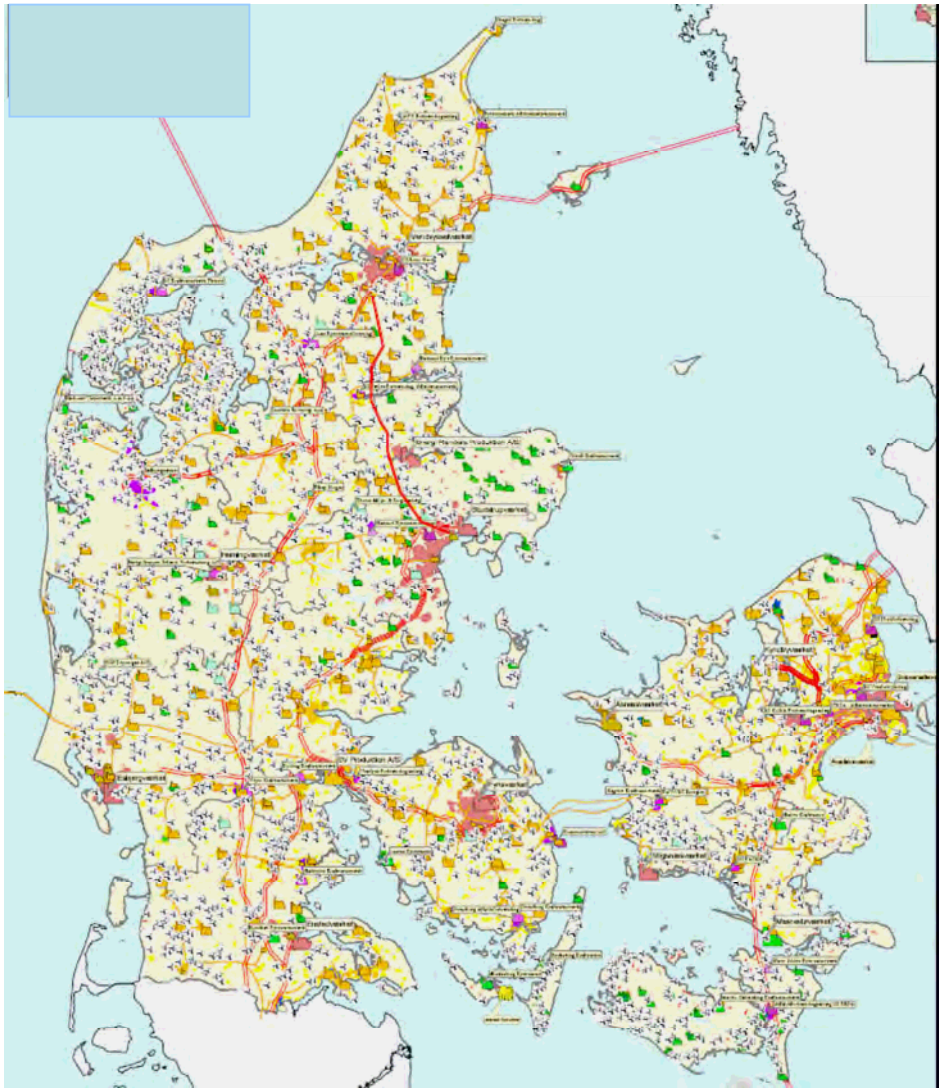
Where to utilize the biogas?

Decentralized CHP

- Direct transmission
  - Cheap and simple
  - Local integration?
- Naturgas grid trans.?
  - Possibilities of storing
  - Better heat utilisation?
  - Expensive upgrading
  - Downgrading of N-gas

Transportfuels

  - Most efficient biofuels, low carbon footprint!



Biogas and biogas + separation, upgrading facilities

Conclusion

Biogas is an efficient conversiontechnology, converting biomass to high value products as electricity, heat and/or transportation fuel and organic fertilizer

- Converting heterogeniously biomass to values
- Flexible and stable supply of – power, heat, fuels
- Energy sector bridge from demands of today to future needs of:
  - CHP solutions and transport
  - CHP applications and fuel cells
  - Stationary or mobile
- Society trouble-shooter regarding solutions:
  - Climate, water-environment, agriculture and rural development