

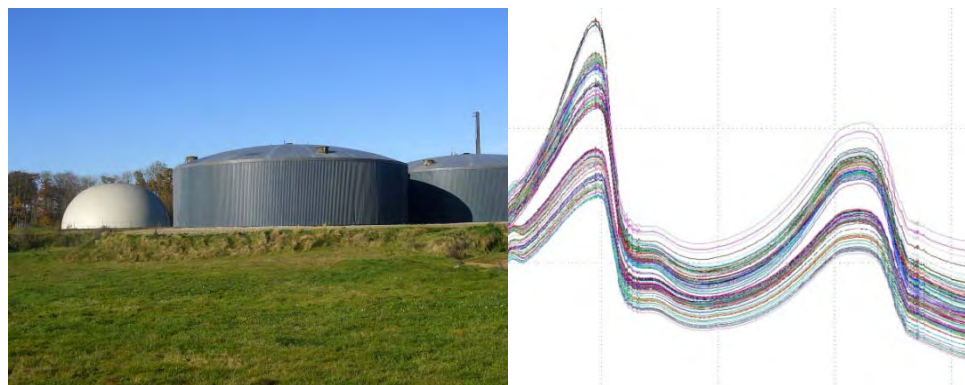
Biogas plants in Denmark 2009 and forward

-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



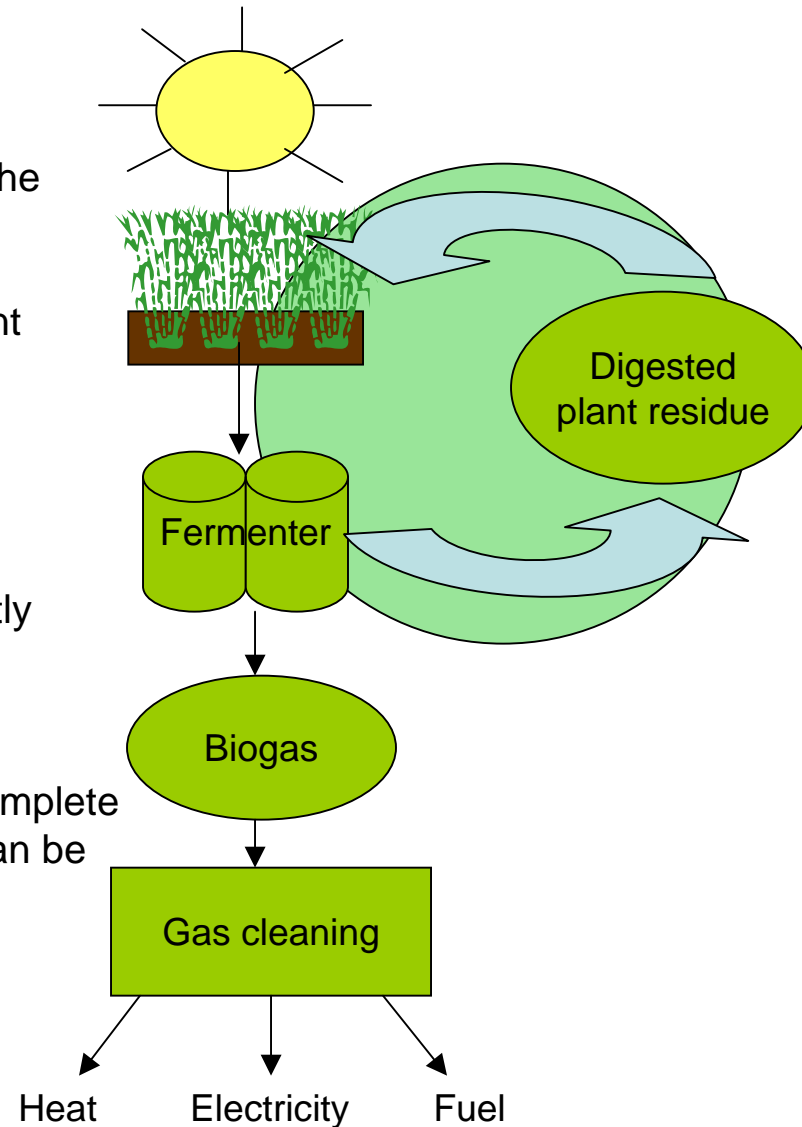
Future society needs & demands!

- 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/financing
- 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

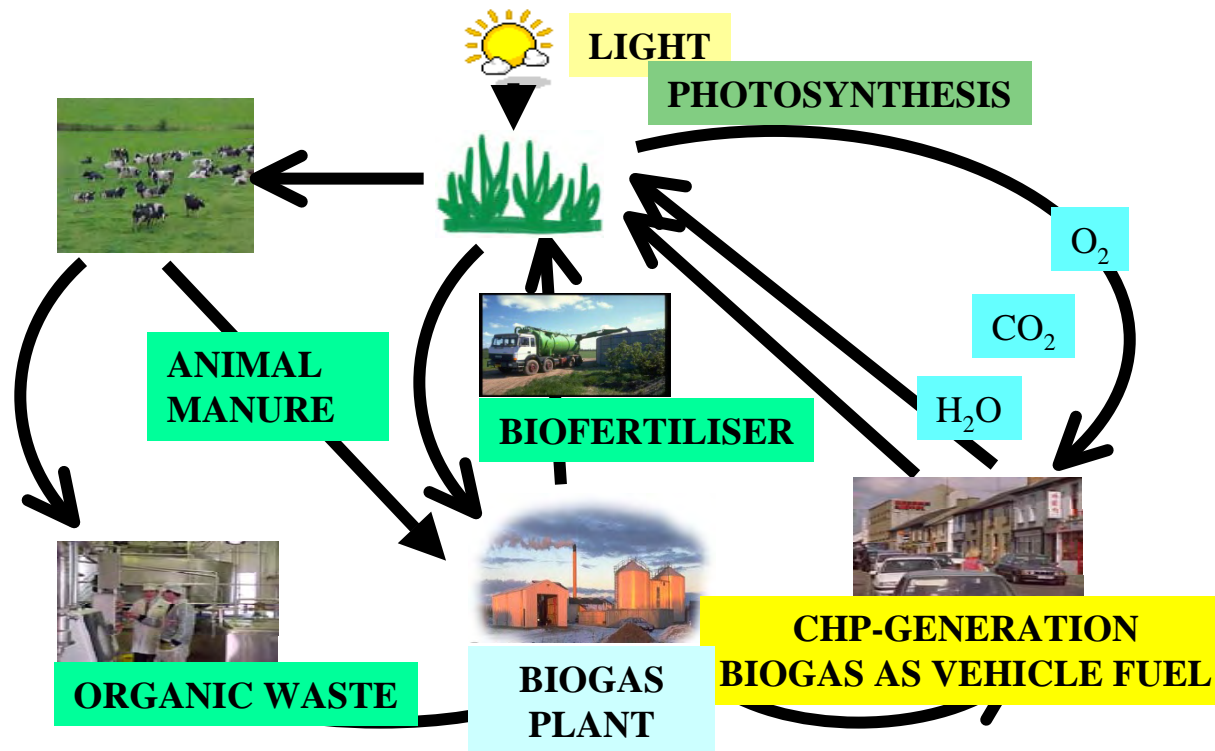


Energy crops → Paradigm shift through land productivity and energy balance

- 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; bioethanol/biogas/biodiesel



Biogas for a sustainable clean environment and renewable energy production



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

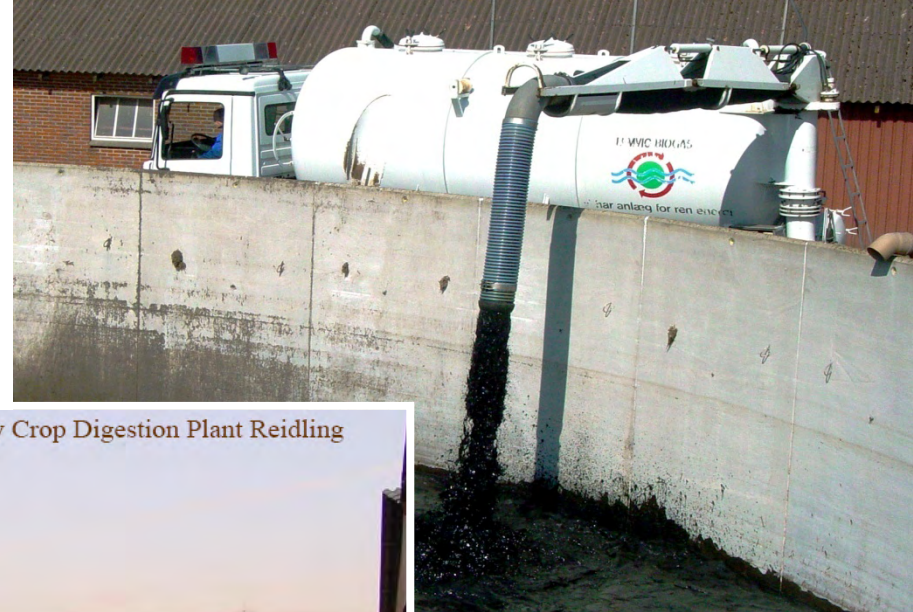
Energy potential of pig and cattle manure in EU-27

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/m³; 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 forecast Biogas	60 Mtoe
Biogas can cover 1/3 of EU's total RES 20% demands year 2020	



Maize silos, digester and gas storage of the Energy Crop Digestion Plant Reidling



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

AD Co-digestion -
heterogeneous
feedstock's



Biogas and biogas + separation, upgrading facilities



Animal manure

– from farming problems to
society resources!

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



● 21 biogasfællesanlæg

● 60 gårdbiogasanlæg

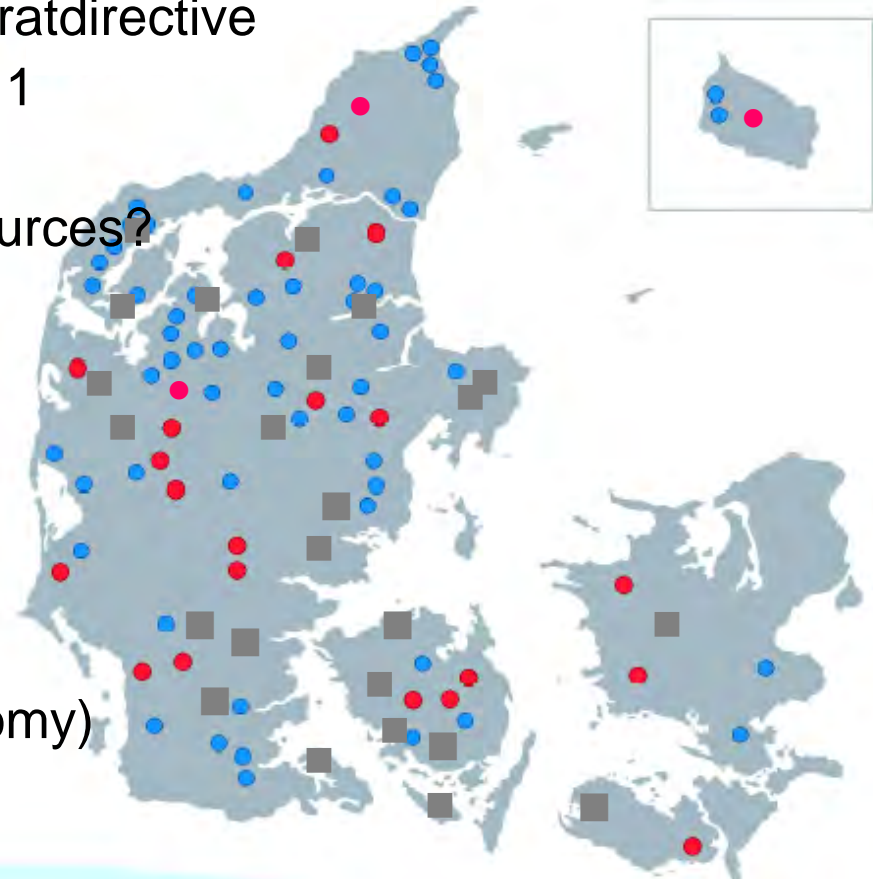
Big biogas interests from the farming society

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



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

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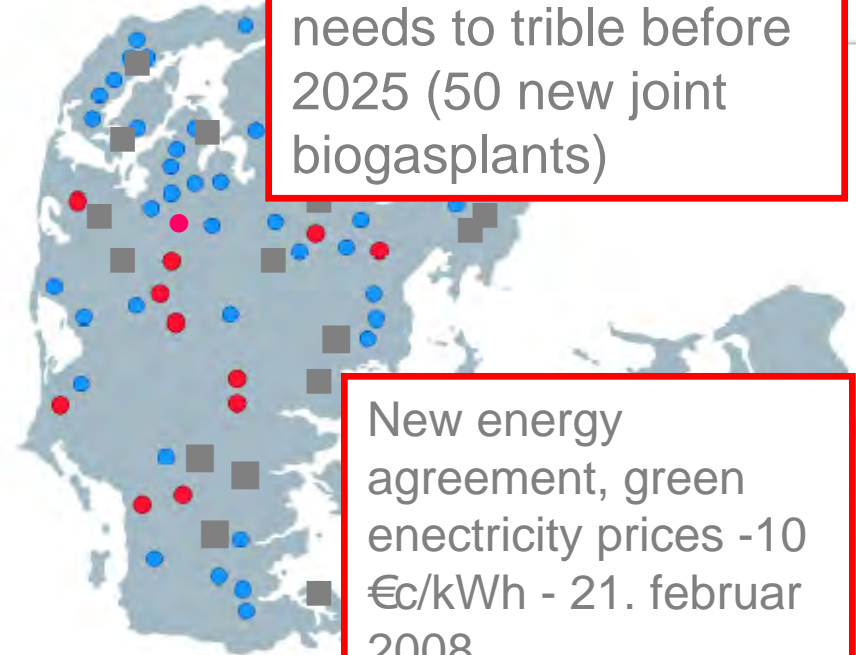
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DK government
19. januar 2007:

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

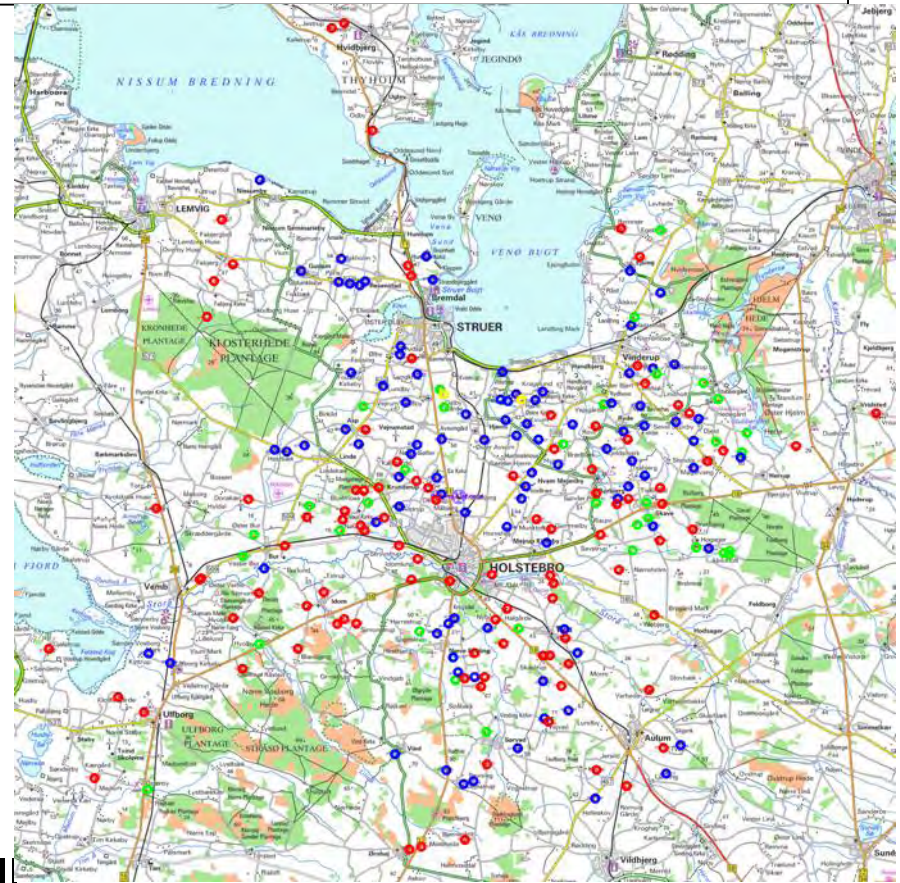


New energy
agreement, green
electricity prices -10
€/kWh - 21. februar
2008

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

Society benefits from biogas

- Joint biogas and farm biogas
- Cheap Kyoto tool 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 throughout the year
 - Environmental technology to all kinds of farms



Samfundsmæssige fordele ved biogas

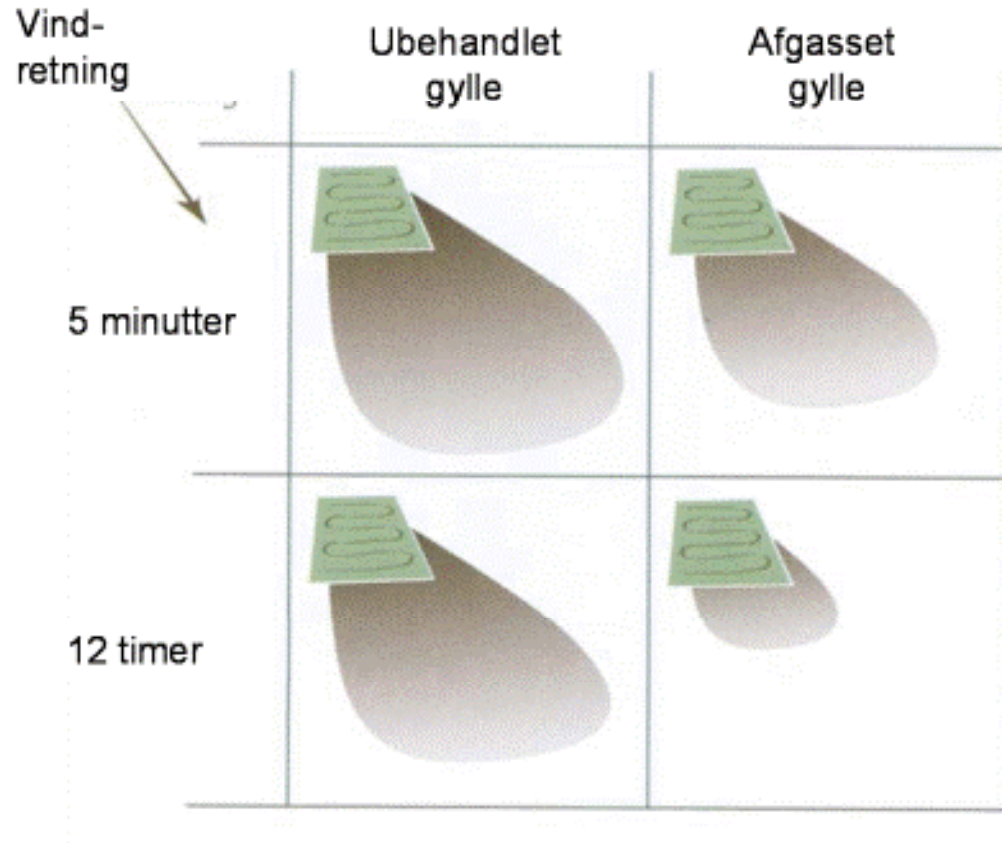
- Fællesanlæg og gårdanlæg
- Billigt Kyotoredskab 40 kr/ton
- Genanvendelse af affald
- Effektiv omfordeling af gylle
- Deklareret gødningsindhold
- Fri for ukrudt og patogener

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



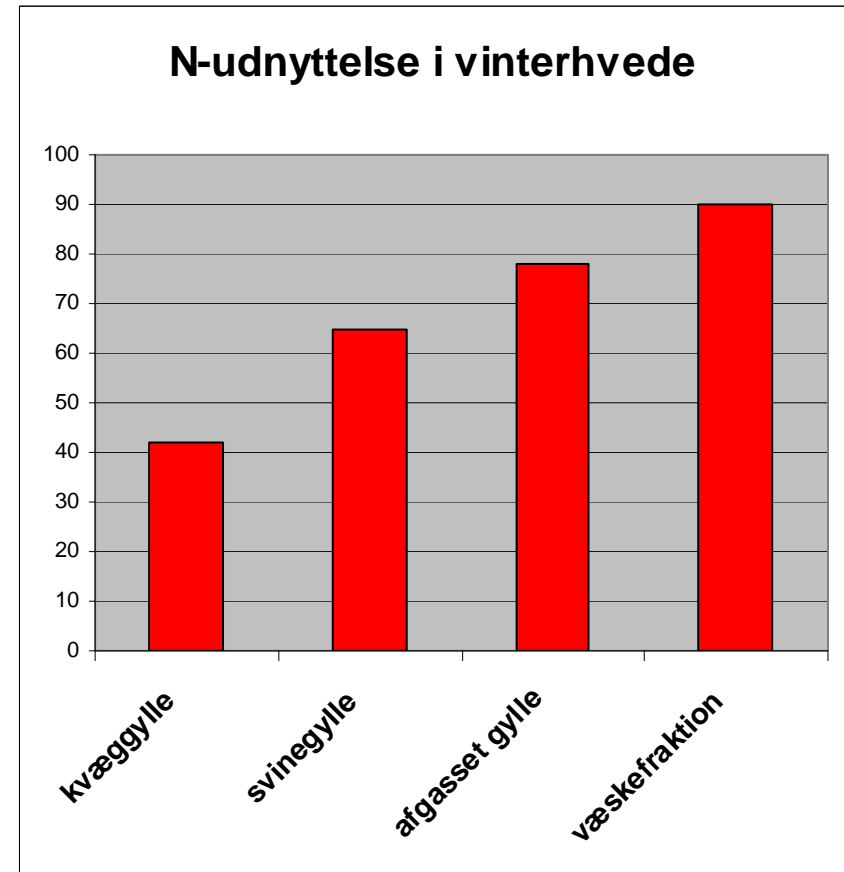
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- Mindre lugt ved udbringning
- Lettere at få afsat gyllen



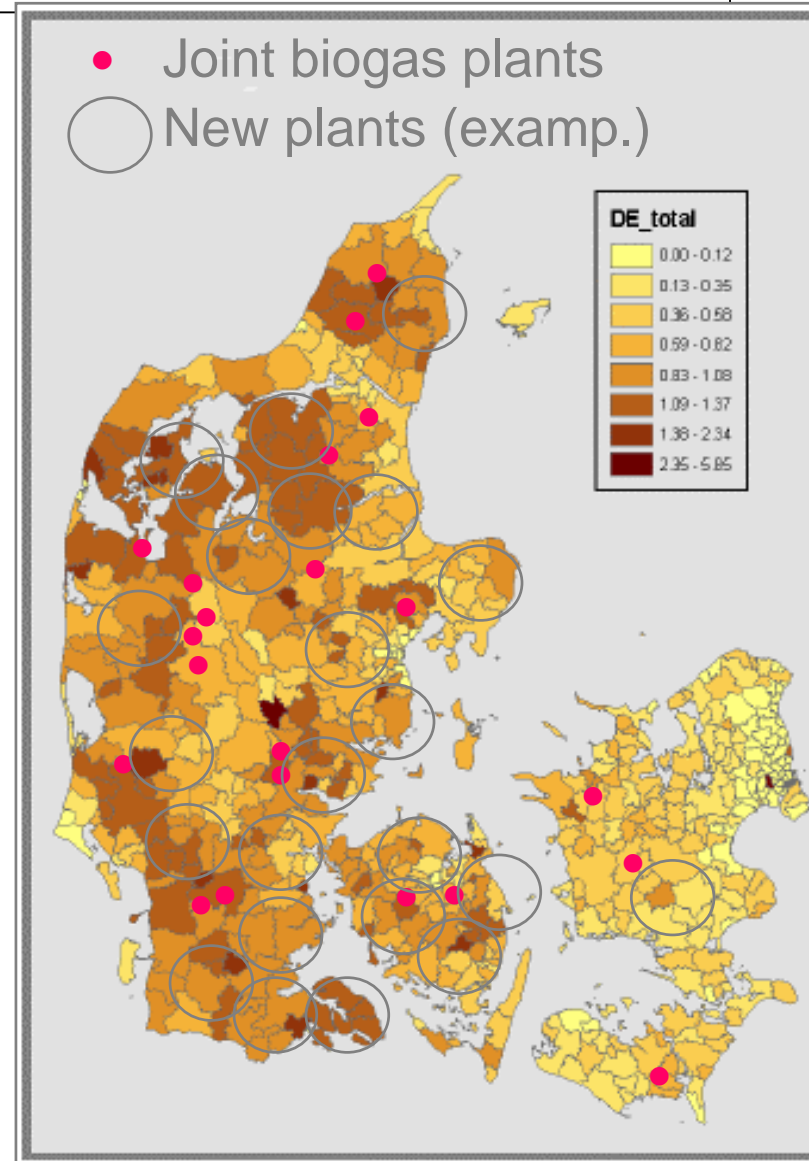
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- Højere kvælstofudnyttelse
- Lavere udvaskningsrisiko
- Mulighed for separation



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



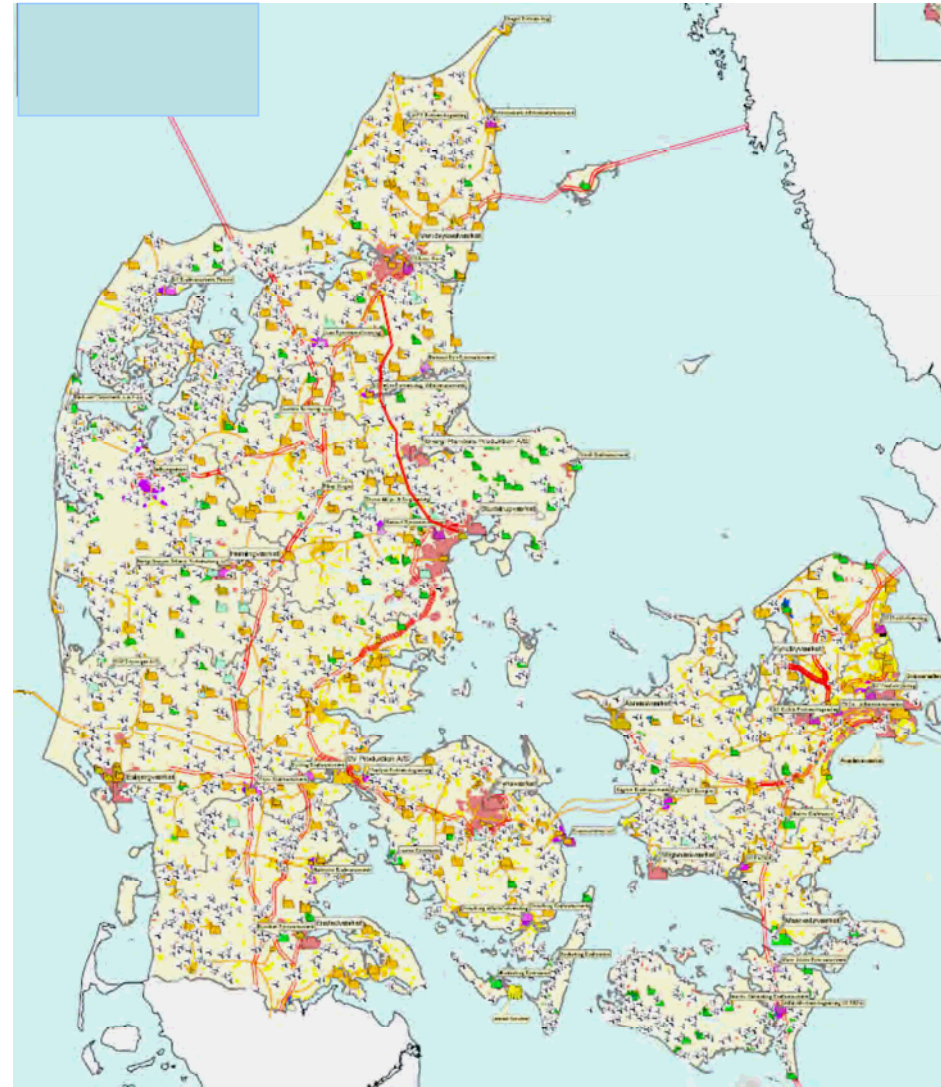
Where to utilize the biogas?

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



Animal manure

– from farming problems to
society resources!

Conclusion

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

- Converting heterogeneously 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

