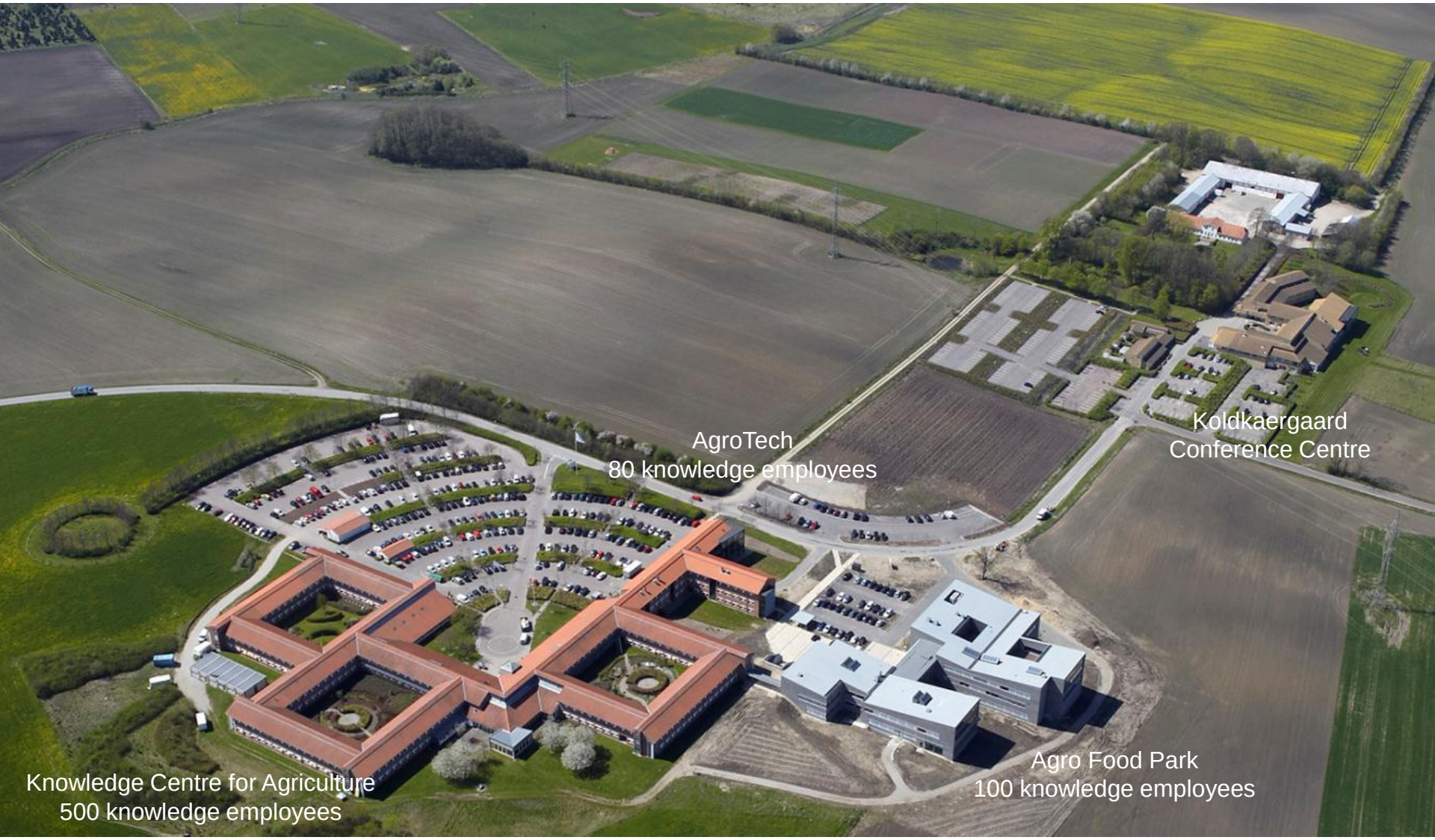
KNOWLEDGE CENTRE FOR AGRICULTURE

Putting knowledge to work

Biochain – Project partners workshops
27. January 2014

Michael Støckler
Head of department
Bioenergy

PARTNER IN DLBR


AgroTech
80 knowledge employees
Koldkaergaard
Conference Centre
Knowledge Centre for Agriculture
500 knowledge employees
Agro Food Park
100 knowledge employees

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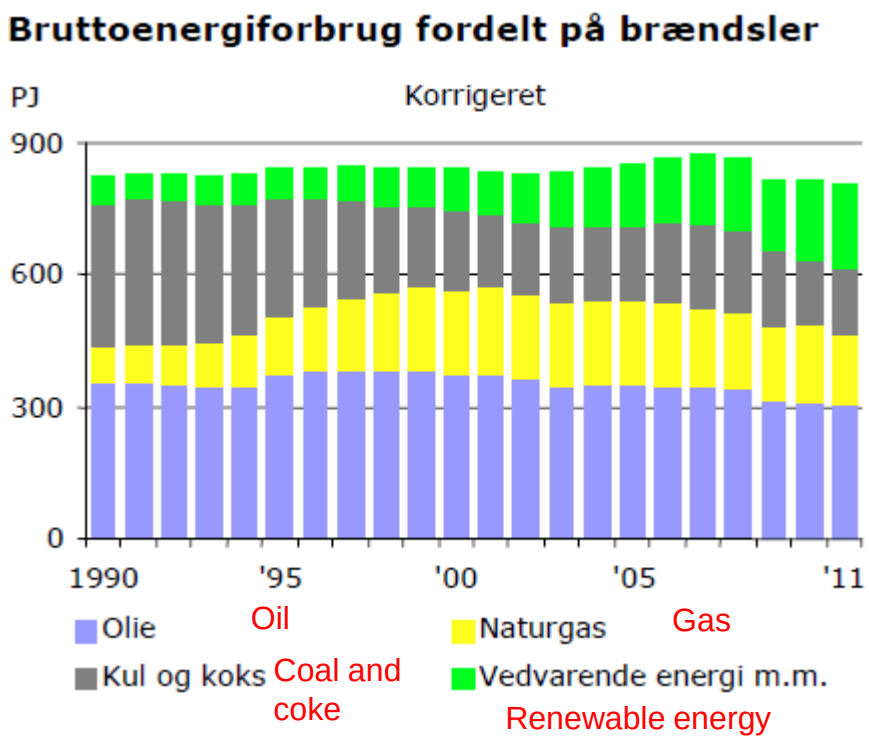
Work package 5

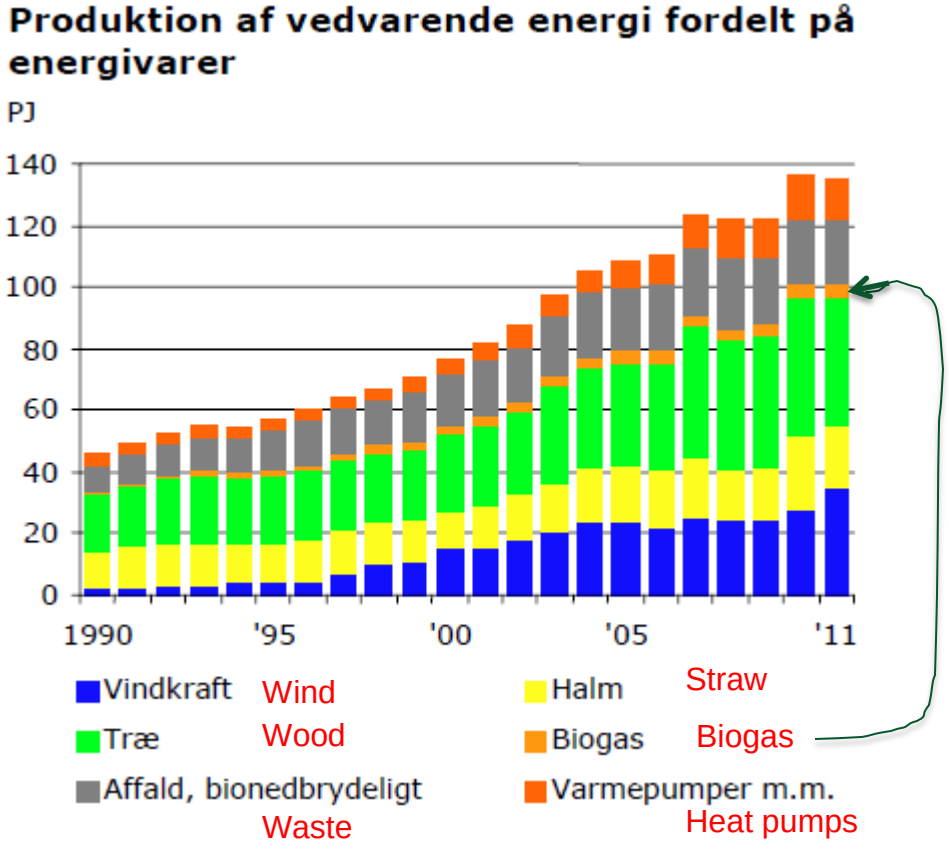
Logistics & Economics

The total energy consumption in Denmark

Gross energy consumption by fuel

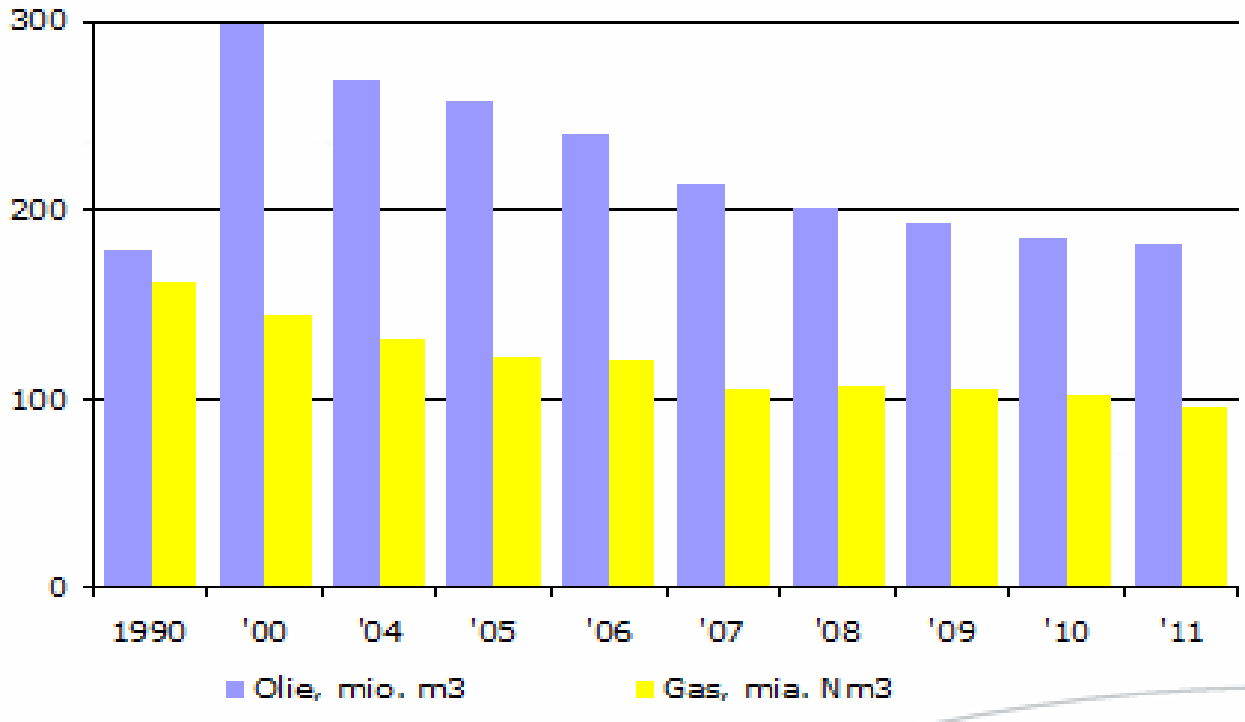


Production of renewable energy by energy products



Oil and gas reserves

Olie- og gasreserver



5

ENERGI STYRELSEN

Energistyrelsens energistatistik 2012

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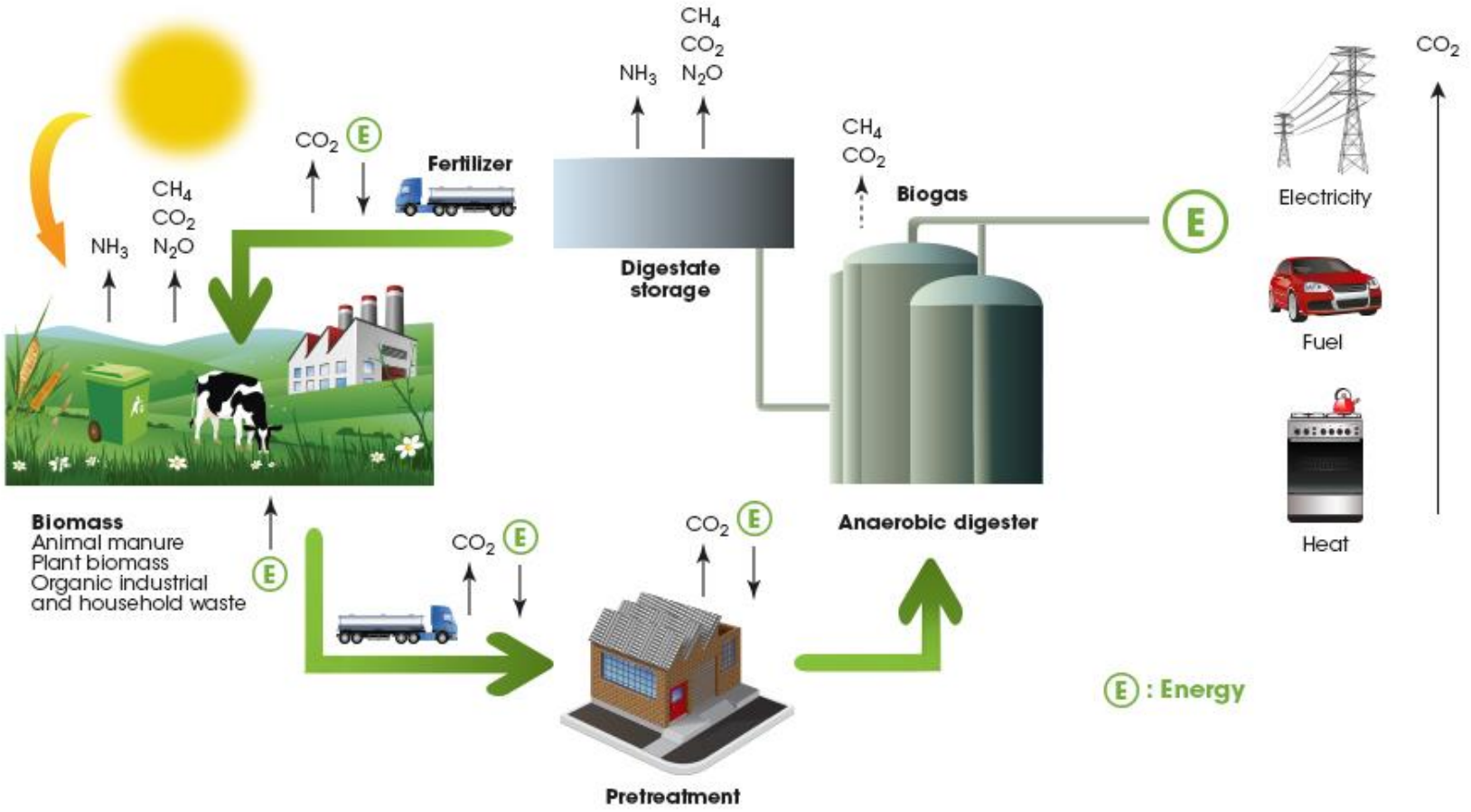
Supply circuit

Biogasplant

Market



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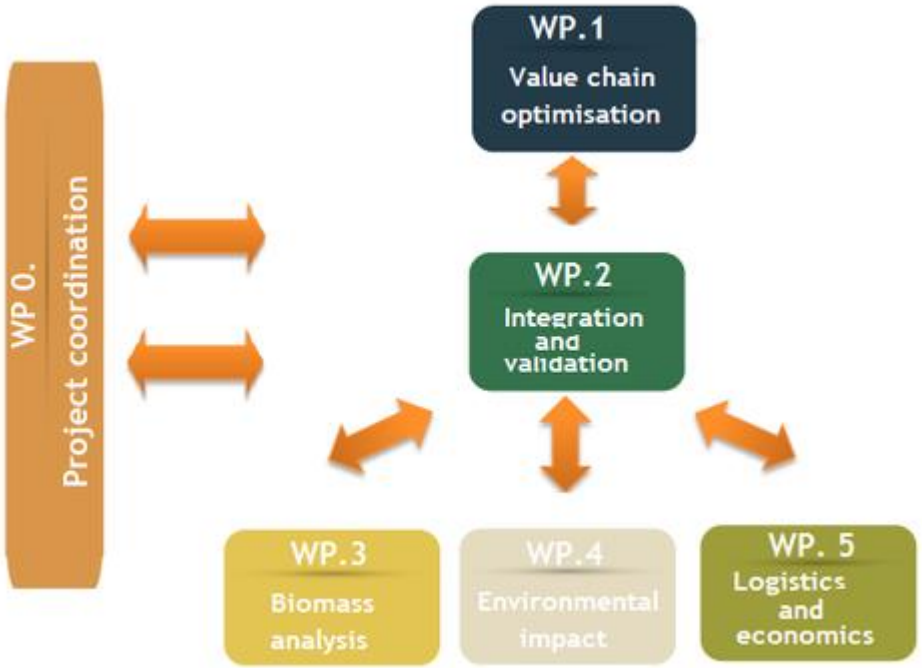
WP 0.
Project coordination
WP.1
Value chain optimisation
WP.2
Integration and validation
WP.3
Biomass analysis
WP.4
Environmental impact
WP. 5
Logistics and economics

Biogas plants need a planning tool for biomass

- What is available?
- How much is available?
- When?
- Where?
- What is the quality?
- What is the gas production potential?
- What does it cost?

Biogas plants want to

- Have a steady production of biogas
- Have a high production
- Avoid process failure (due to inhibition, temp. etc.)
- Have biomasses that can be handled
- Have biomasses that can be stored
- Optimize the logistics to minimize the costs
- Optimize the use of biomass
- Make sure it is available all year round
- Avoid smell

Objective of WP5:

- is to determine the availability of various biomasses
- is to determine the production costs for various biomasses including transport, pretreatment prior biogasification and storage of the biomass
- is to develop a model integrating these informations

Results of WP5:

- Decision support for farmers/consultants and biogas plants

Biomasses

- Wheat straw
- Beets
- Meadow grass
- Corn silage
- Deep litter
- Rapeseed straw

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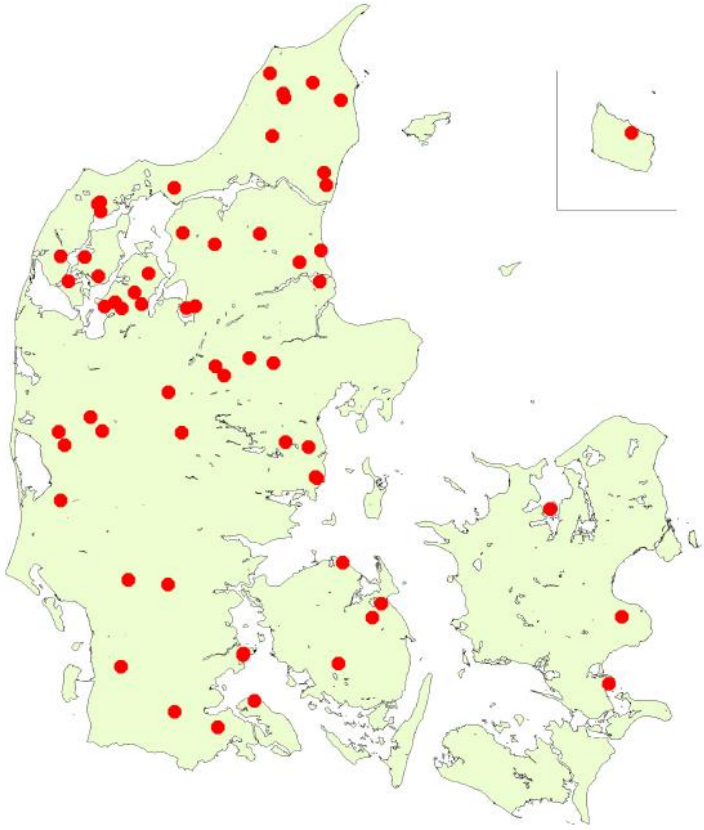
Common biogas plants

Farm biogas plants



More under construction

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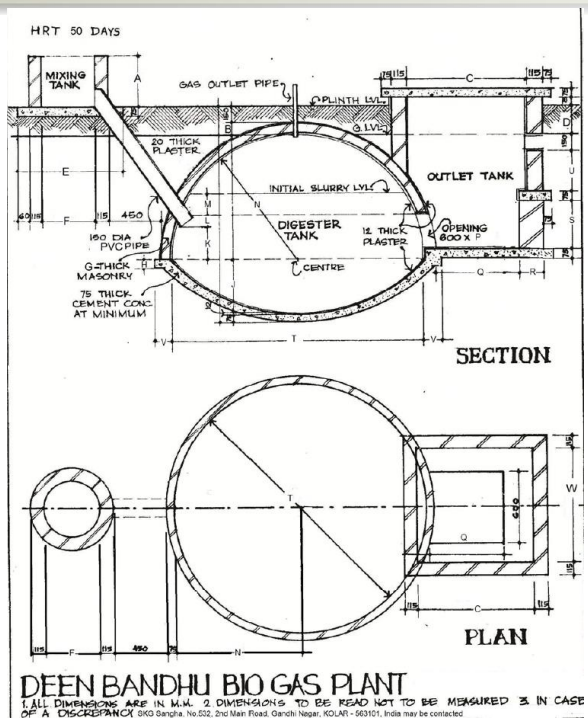
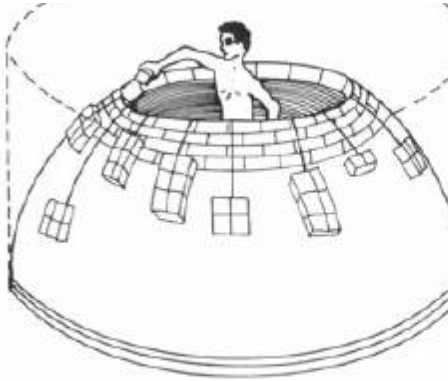

HRT 50 DAYS
MIXING TANK
GAS OUTLET PIPE
PLINTH LVL
20 THICK PLASTER
INITIAL SLURRY LVL
OUTLET TANK
DIGESTER TANK
12 THICK PLASTER
OPENING 800 x
160 DIA PVC PIPE
CENTRE
G-THICK MASONRY
75 THICK CEMENT CONC AT MINIMUM
SECTION
PLAN
DEEN BANDHU BIO GAS PLANT
1. ALL DIMENSIONS ARE IN M.M. 2. DIMENSIONS TO BE READ NOT TO BE MEASURED 3. IN CASE OF A DISCREPANCY
BKG Sangha, No.532, 2nd Main Road, Gandhi Nagar, KOLAR - 563101, India may be contacted



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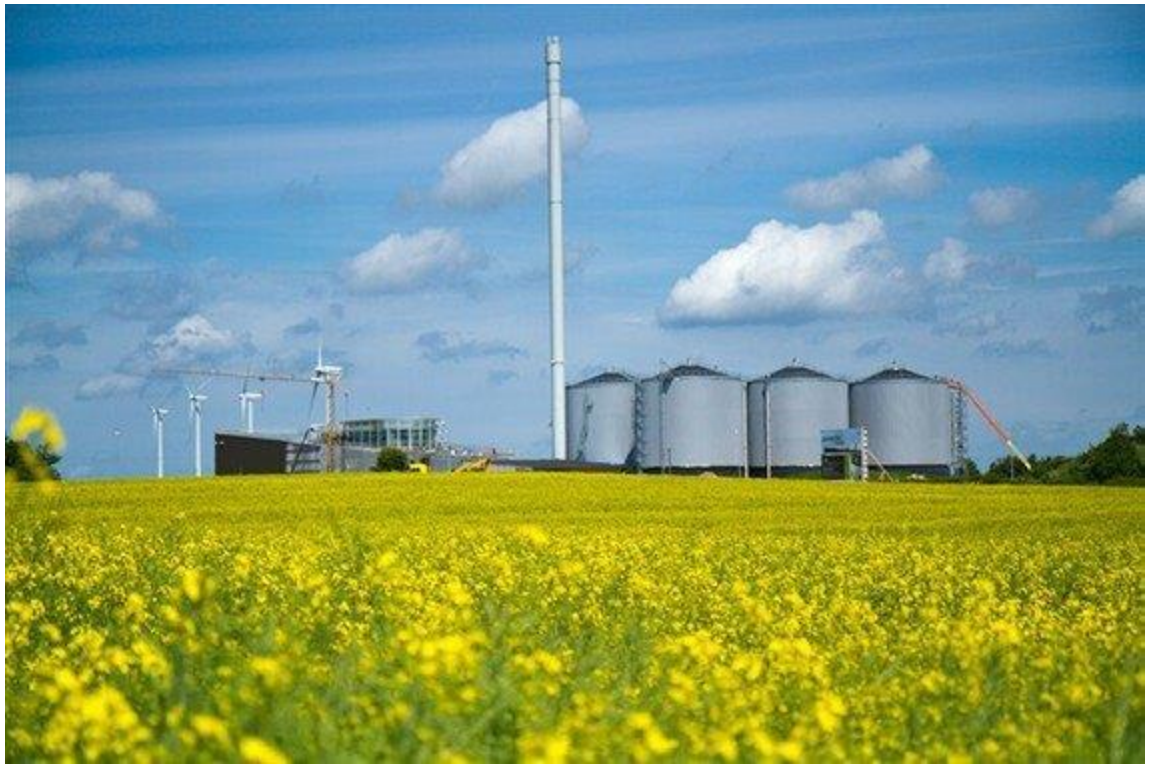
Bånlev Biogas



Worth knowing about Maabjerg BioEnergy:

- Converts approx. 650,000 tons of biomass/year of clean energy - heat and electricity.
- Annual production of 17.8 million cubic meters of biogas. Total investment of 398 million. Kr.
- Net gain of 45 million. kr./year.
- Energy efficiency is equivalent to heating and electricity for approx. 5,000/12,000 homes.
- Reduces carbon footprint by 50,000 tonnes CO2/year.
- Reduces nitrogen and phosphorus in the aquatic environment - both with approx. 300 tons / year.
- Retains 300 jobs in the agricultural and food industries.

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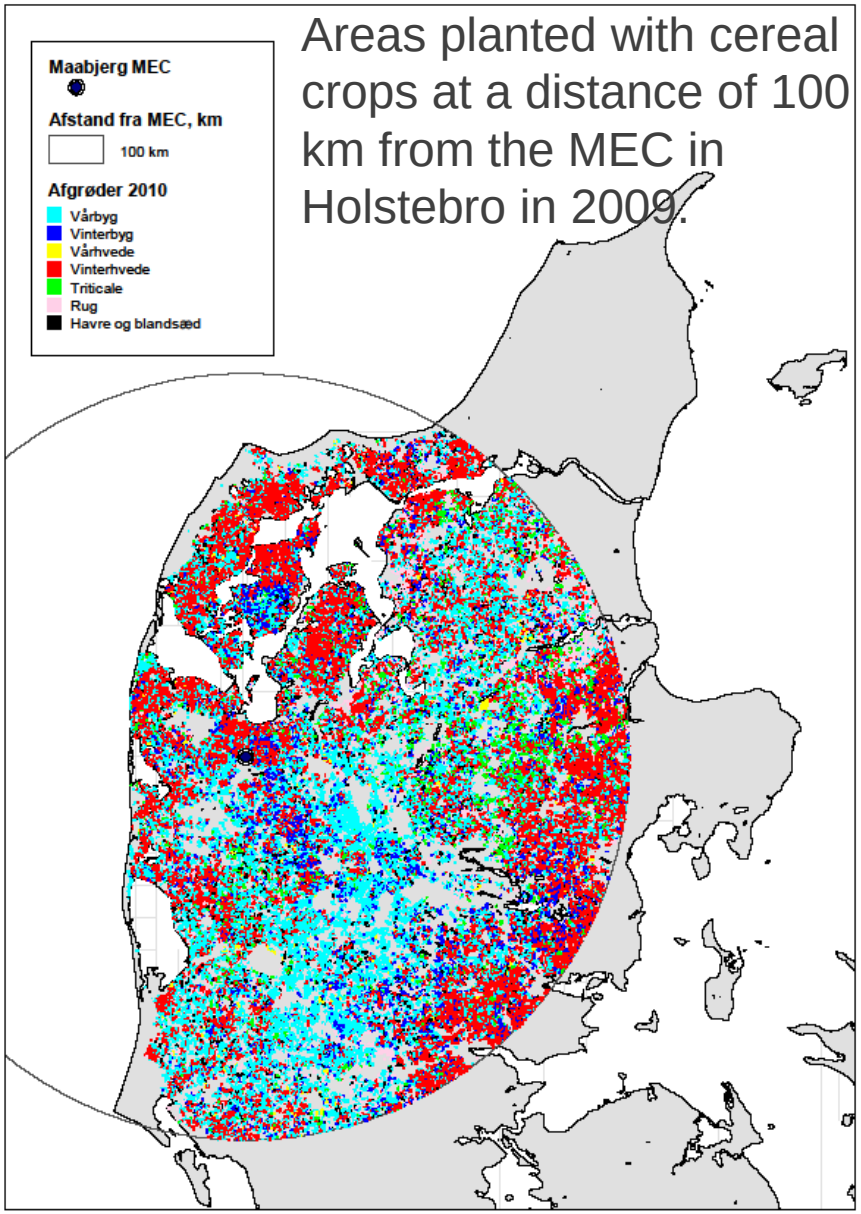
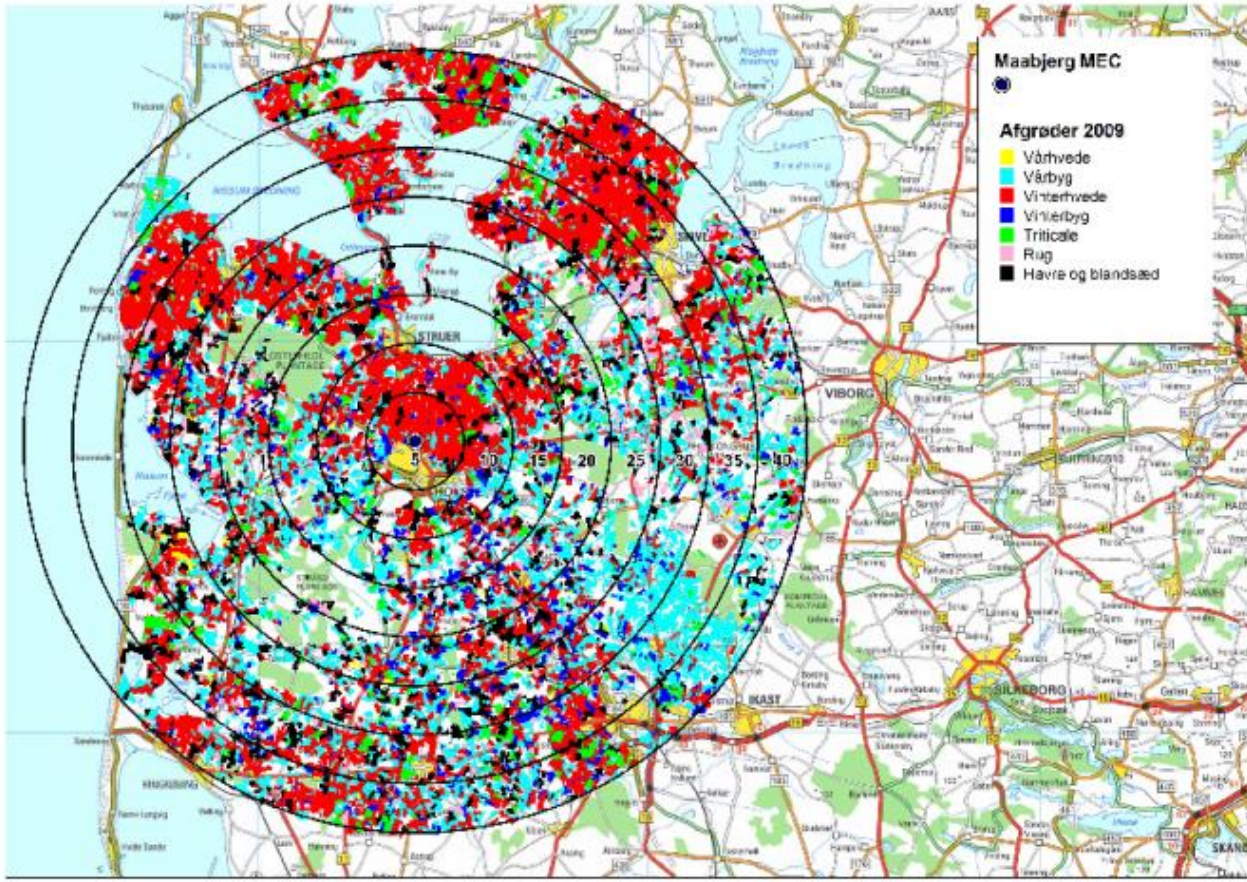
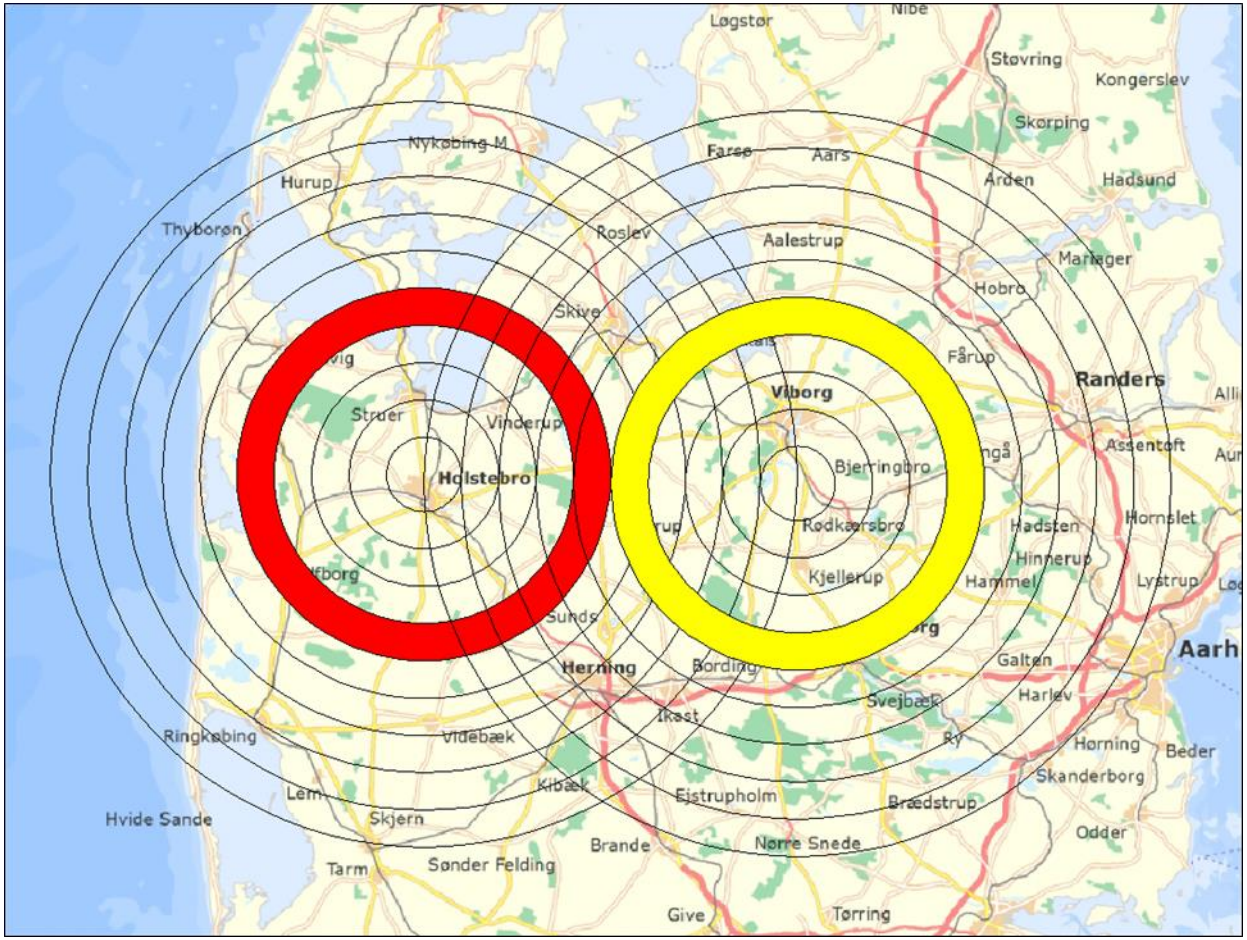
Areas planted with cereal crops at a distance of 100 km from the MEC in Holstebro in 2009.



Areas planted with cereal crops in the catchment area for MEC 2009. The statement is made in concentric circles around Holstebro with 5 km intervals.

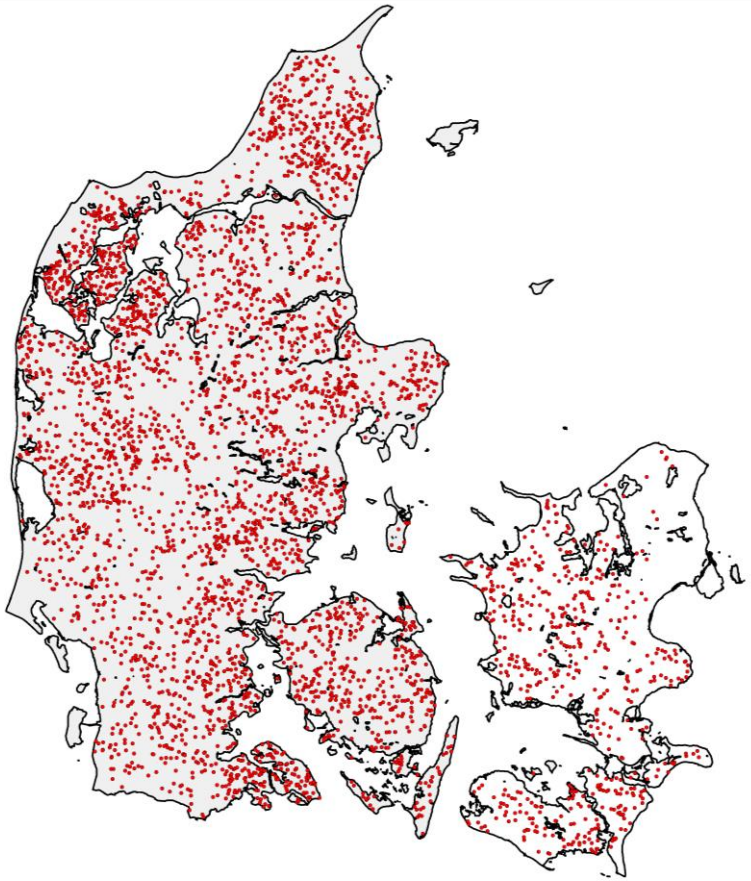


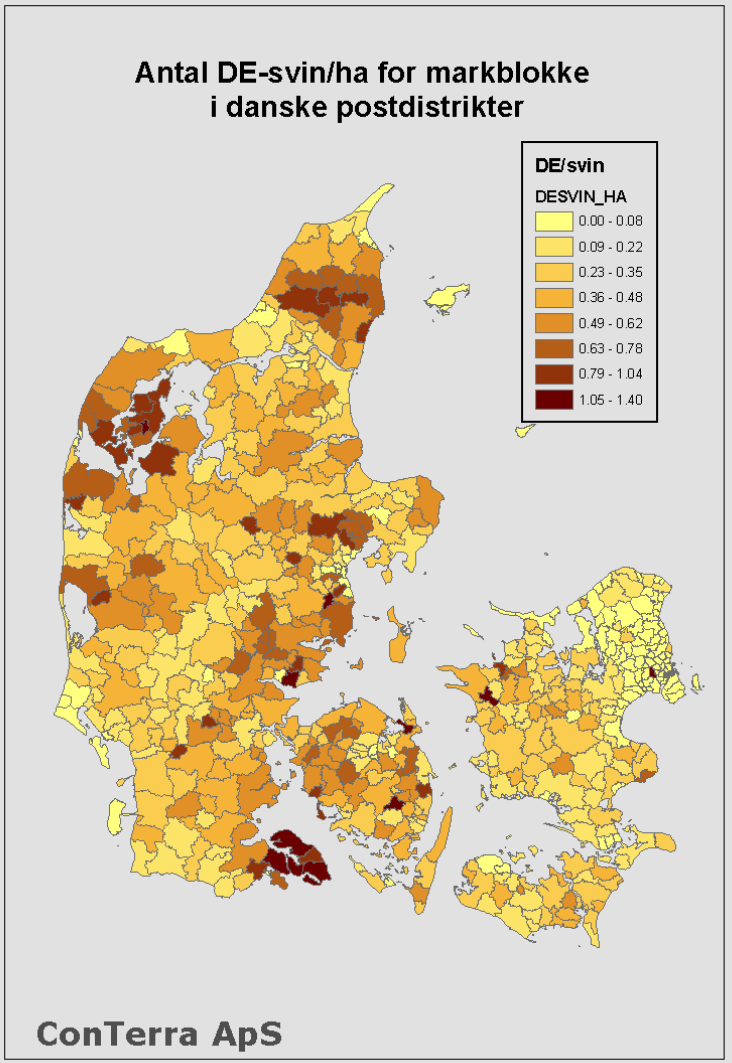


When is a conflict of interest for biomass occurs !
Is it dependent of the distance ?

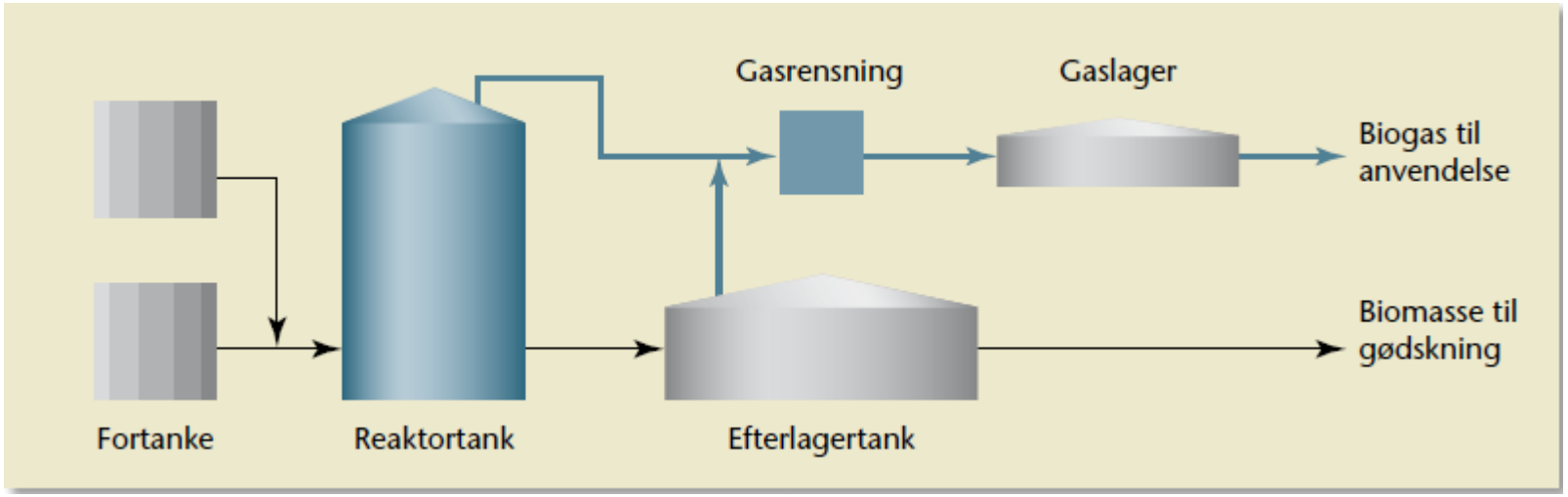
Manure is the most important biomass for biogas

Distribution of pig farms in DK

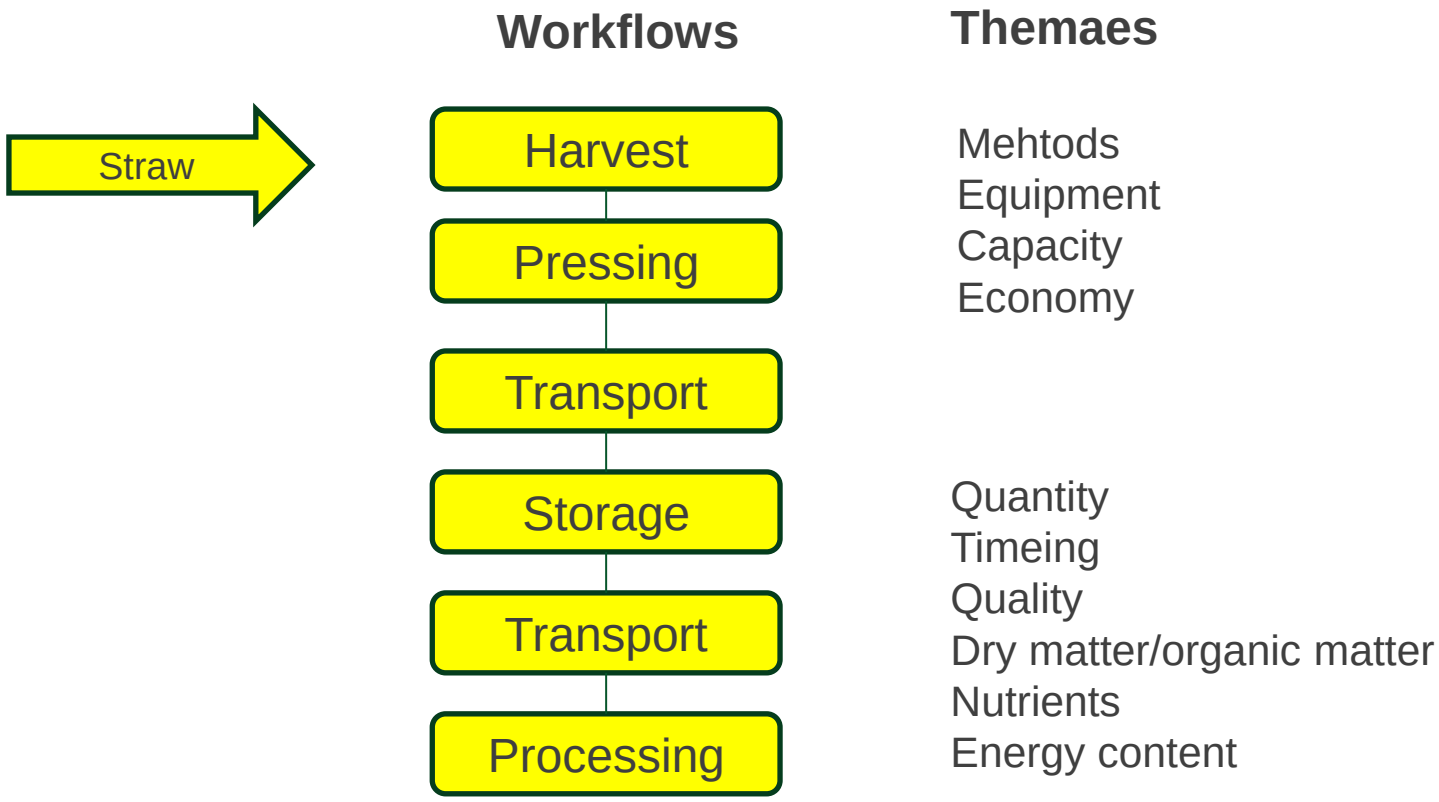




Biogasprocessen

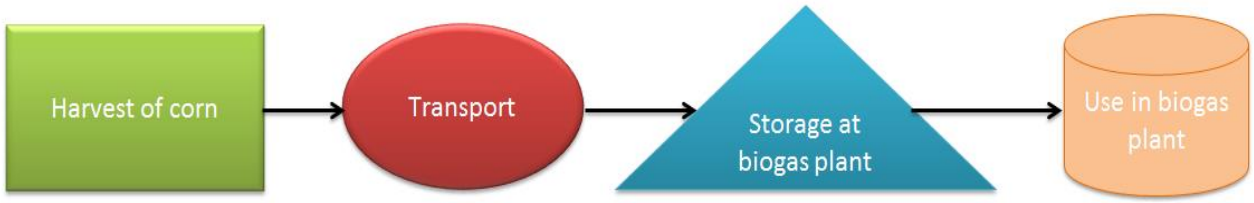


Logistics example for straw

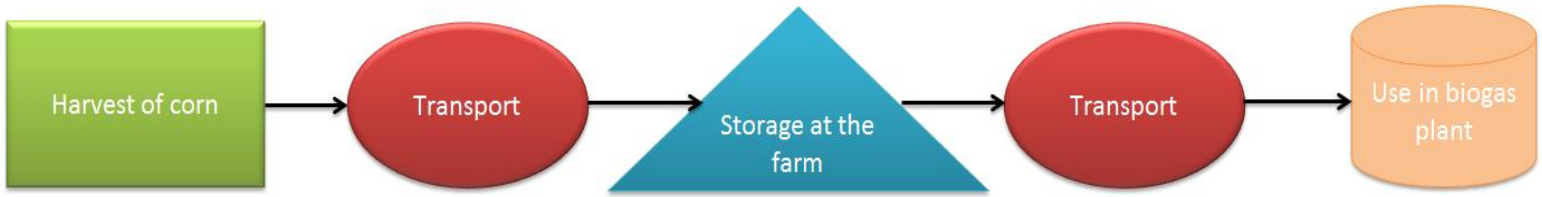


Flow chart of maize silage

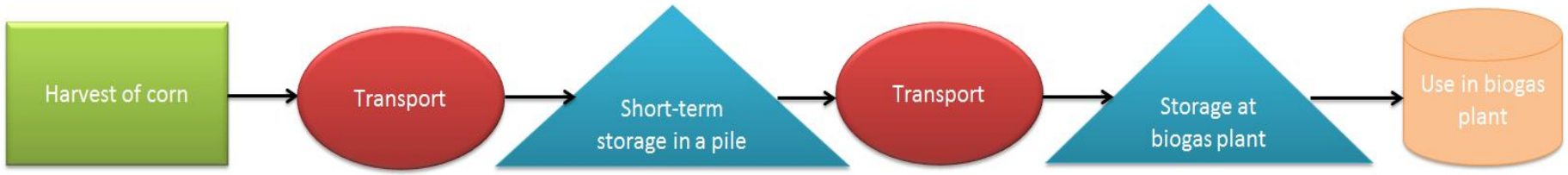
1. scenario



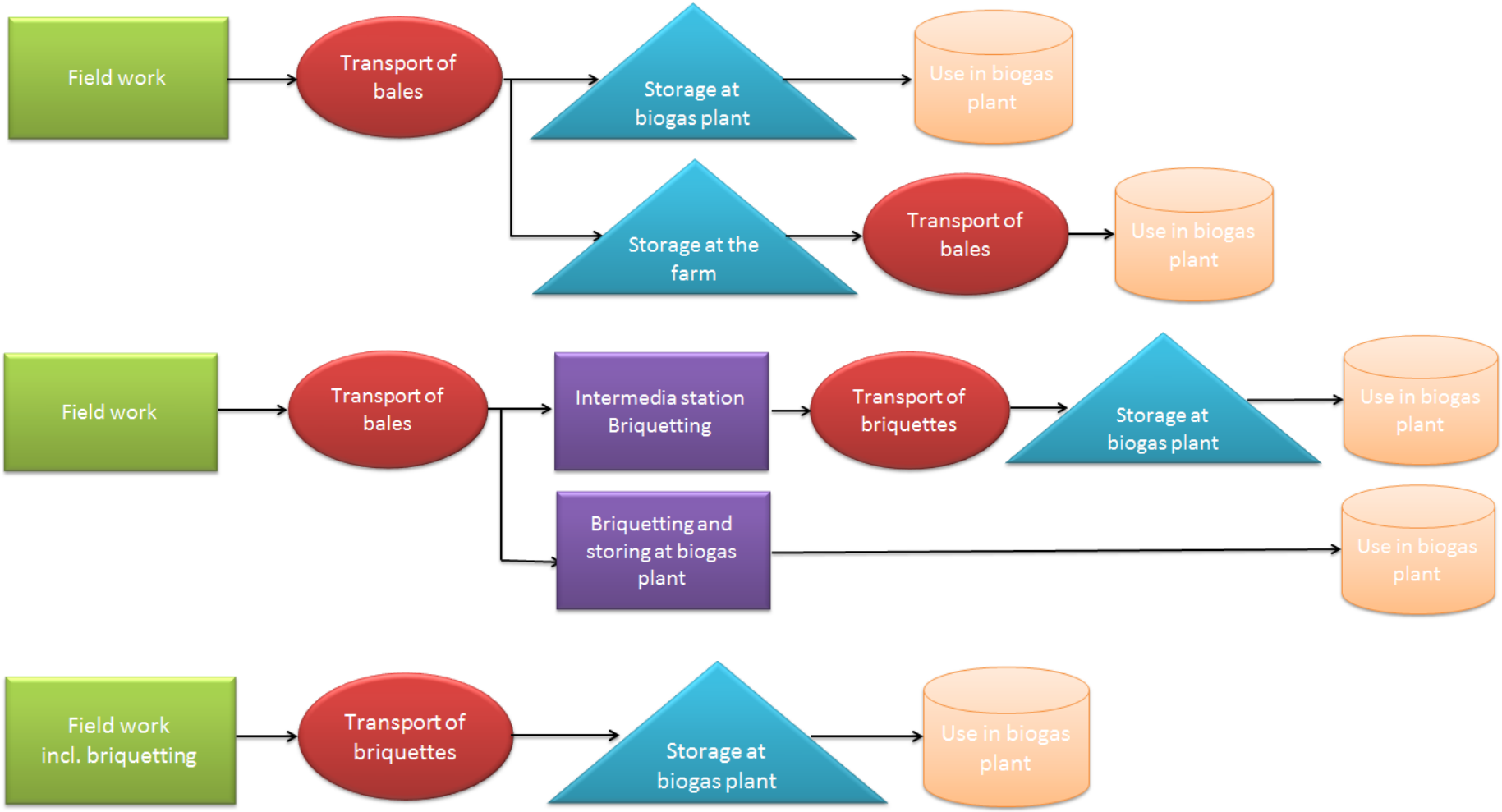
2. scenario



3. scenario



Flow charts - straw



Example of concept model work

Wheat straw	
Biomass	
Yield of wheat straw, tons/ha	3,5
Dry matter, %	85%
Yield in dry matter, tons DM/ha	3,0
Density of wheat straw, ton/m3	0,14
Weight, big bales, ton/bale	0,55
Density of briquettes (bulk), ton/m3	0,45
Field, ha	17142
Time of harvest:	Just after harvest of grain. August/September
Collecting at field	
Straw turning and collecting	
Turning/collecting, kr/kg	-0,07
Turning/collecting, kr/ha	-245
Capacity, ha/hour	4
Turning/collecting, kr/ton	-70
Straw baling in field	
Baler, big bales, kr/kg	-0,15
Capacity, bales/hour	24
Baler, big bales, kr/ton	-149
Loading with tractor with front loader	
Number of bales, bales/ha	6,4
Tractor cost, kr/hour	-625
Loading and unloading of bales, hours/ha	0,5
Loading and unloading of bales, kr/ha	-313
Loading, kr/ton	-89
Total costs for field work, kr/ton	***-308***

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Example of concept model work

Storage

Barn with fixed floor		Barn with gravel ground		Barn "Staklade"		Barn for briquettes with fixed floor	
Price/loan, kr	1.816.500	Price/loan, kr	1.391.500	Price/loan, kr	1.001.500	Price/loan, kr	1.816.500
Capacity, m3	5.000	Capacity, m3	5.000	Capacity, m3	5.000	Capacity, m3	5.000
Utilisation of barn, %	90%	Utilisation of barn, %	90%	Utilisation of barn, %	90%	Utilisation of barn, %	80%
Storage capacity, m3	4.500	Storage capacity, m3	4.500	Storage capacity, m3	4.500	Storage capacity, m3	4.000
Number of big bales, stk	1.145	Number of big bales, stk	1.145	Number of big bales, stk	1.145	Service life, years	3
Service life, years	30	Service life, years	30	Service life, years	30	Interest, %	4%
Interest, %	4%	Interest, %	4%	Interest, %	4%	Fee, kr/year	kr. -105.04
Fee, kr/year	-105.048	Fee, kr/year	-80.471	Fee, kr/year	-57.917	***Fee, kr/ton***	***-6***
Fee, kr/ton/year	***-168***	***Fee, kr/ton/year***	***-129***	***Fee, kr/ton/year***	***-93***		

Pretreatment

Pelletising in field, mobile		Briquet plant		Extruder at the biogas plant		Chain crusher	
Cost price, kr	5.069.400	Cormall hammer mill, straw conveyer, straw bale breaker, €	411.000	Extruder, mixer, conveyer, kr	5.500.000	Price/loan, kr	2.319.314
Service life, year	20	Currency	7,455	Service life, year	10	Service life, years	1
Interest, %	5,5%	Cormall equipment, kr	3.064.005	Interest, %	5,5%	Interest, %	5,5%
Yearly fee, kr/year	-424.204	Briquet plant, kr	1.250.000	Fee, kr/year	kr. -729.673	Fee, kr/year	kr. -307.69
Yearly fee, kr/ton	-7	Capacity of briquetter, ton/year	10.000	Fee, kr/ton	-73	Fee, kr/ton	-
Operation costs, €/ton	-48	Number of plants, stk	6	Operation costs, kWh/ton	-123	Equipment, intensive treatment, kr/ton	-1,1
Curency, kr/€	7,5	Briquet plants, kr	7.500.000	Capacity, ton/year	10.000	Operation, kr/ton	-3,0
Operation costs, kr/ton	-358	Other things (installation etc.), €	50.000	Maintenance costs, kr/ton	-25	Capacity, ton/year	27.900
Capacity, ton/hour	2,5	Total price for plant, kr	10.936.755	Energy price, kr/kWh	0,4	Costs at max capacity, kr/ton	-1
Capacity, ton/year	4.650	Interest, %	5,5%	Operation costs, kr/ton	-49	***Costs, kr/ton***	***-2***
Costs at max capacity, kr/ton	-449	Service life, year	10	Depreciation, %	10%		
Total costs, kr/ton	***-450***	Yearly fee, kr/year	-1.450.955	Depreciation, kr/ton	-55		
		Fee, kr/ton	-24	Costs at max capacity,kr/ton	-147		
		Maintenance costs, kr/ton	-40	***Costs, kr/ton***	***-202***		
		Energy price, kr/kWh	-0,4				
		Energy use, kWh/ton	60				
		Operation costs, kr/ton	-24				
		A hire building, kr/year	-120.000				
		Insurance, kr/year	-50.000				
		Staff, kr/year	-1.860.000				
		Depreciation, %	10%				
		Depreciation, kr/year	-1.093.676				
		Costs, kr/ton	***-140***				

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Example of concept model work

Transport

Transport scenario 1

Transport of bales from field to biogas plant

Distance to biogas plant (and back), km	50
Truck vehicle, kr/hour	-525
Speed, km/hour	45
Capacity, big bales/load	24
Number of loads, ha-1	0,27
Time consumption, loading, hours/load	0,25
Time consumption on road, hours/load	1,11
Time consumption, unloading, hours/load	0,25
Time consumption, total, hours/load	1,61
Costs, kr/load	-845,8
Costs, kr/ha	-224
Costs, kr/ton	***-64***

Transport of bales from field to briquet station

Distance to biogas plant (and back), km	10
Truck vehicle, kr/hour	-525
Speed, km/hour	45
Capacity, big bales/load	24
Number of loads, ha-1	0,27
Time consumption, loading, hours/load	0,25
Time consumption on road, hours/load	0,22
Time consumption, unloading, hours/load	0,25
Time consumption, total, hours/load	0,72
Costs, kr/load	-379
Costs, kr/ha	-101
Costs, kr/ton	***-29***

Transport scenario 2

Loading of briquettes to tipper

Hourly rate for tractor with frontloader, kr/hour	-625
Time consumption for loading, hours/load	0,33
Capacity of tipper, m3/load	60
Capacity of tipper, ton/load	27
Costs, kr/load	-208
Costs, kr/ton	***-8***

Transport of briquettes from briquet station to biogas plant

Distance to biogas plant, km	40
Truck with tipper, kr/hour	-600
Speed, km/hour	50
Capacity, m3/load	60
Capacity, ton/load	27
Number of loads, ha-1	0,13
Time consumption, loading, hours/load	0,3
Time consumption on road, hours/load	0,8
Time consumption, unloading, hours/load	0,08
Time consumption, total, hours/load	1,18
Costs, kr/load	-708
Costs, kr/ha	-92
Costs, kr/ton	***-26***

Biogas potential and income

	Untreated straw	Briquetted straw	Extruded straw
Potential, m3 CH4/ton VS	197	221	229
VS% af DM	95%	80%	87%
CH4, m3/ha	556	526	593
CH4, m3/ton	159	150	169
Energy in CH4, kWh/m3	10	10	10
Energy, kWh/ton	1589	1503	1693
Gasmotor:			
Electricity, %	40%	40%	40%
Heat, %	50%	50%	50%
Electricity, kWh/ton	636	601	677
Heat, kWh/ton	795	751	847
Price of electricity, kr/kWh	0,79	0,79	0,79
Price of heat, kr/kWh	0,25	0,25	0,25
Income from electricity, kr/ton	502	475	535
Income from heat, kr./ton	199	188	212
Income in total, kr/ton	***701***	***663***	***747***

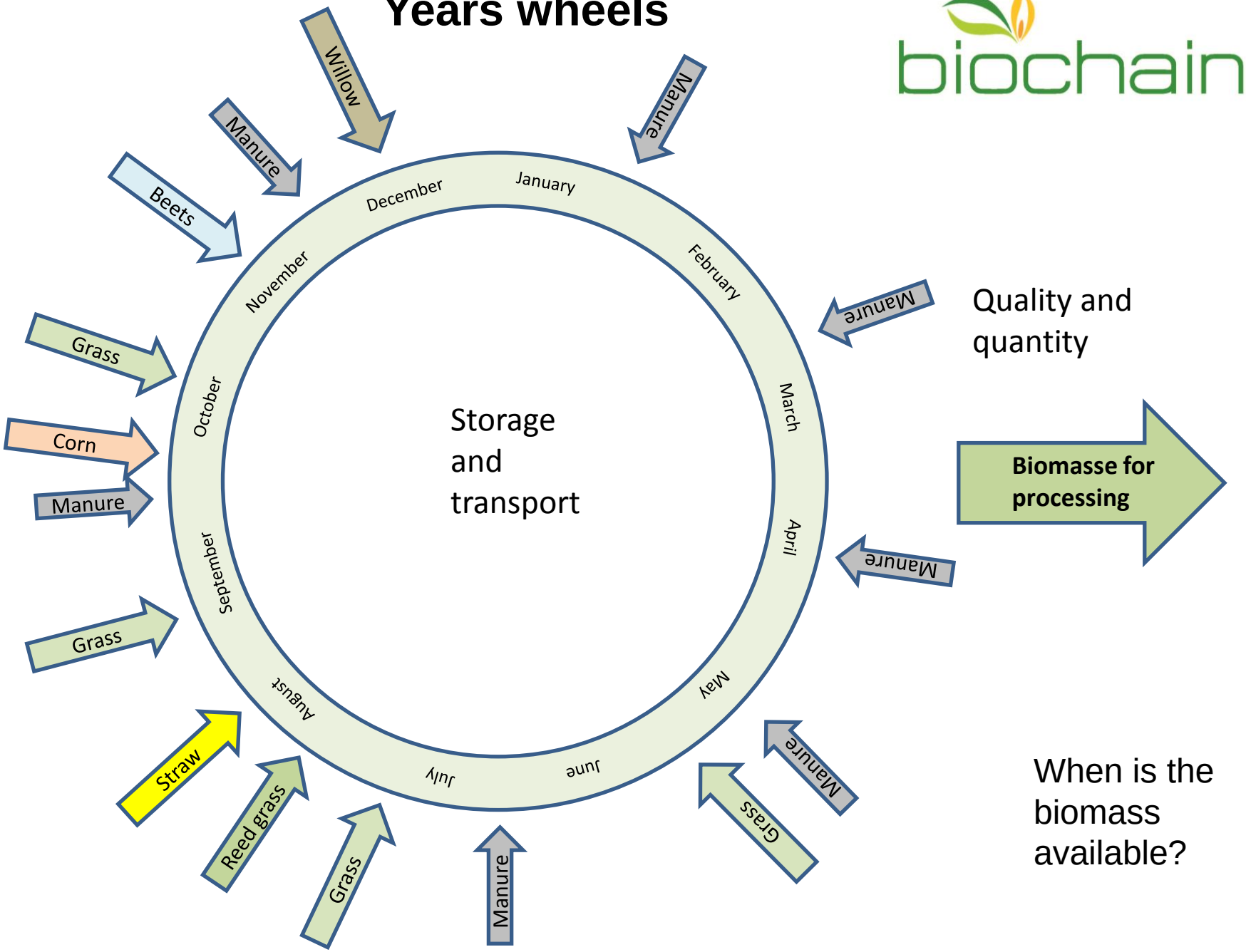
Total costs

	Untreated straw	Briquetted straw	Extruded straw
Costs, Kr/ton:			
Scenario 1, barn with fixed floor	-541		
Scenario 1, barn with gravel floor	-501		
Scenario 1, Staklade	-465		
Scenario 2, barn with fixed floor		-431	
Scenario 3, barn with fixed floor			-743
Scenario 3, Barn with gravel floor			-703
Scenario 3, Staklade			-667
Scenario 4, barn with fixed floor		-541	
Scenario 4, barn with gravel floor		-501	
Scenario 4, staklade		-465	

Profit

	Untreated straw	Briquetted straw	Extruded straw
Profit, kr/ton:			
Scenario 1, barn with fixed floor	160		
Scenario 1, barn with gravel floor	200		
Scenario 1, Staklade	236		
Scenario 2, barn with fixed floor		232	
Scenario 3, barn with fixed floor			4
Scenario 3, Barn with gravel floor			43
Scenario 3, Staklade			79
Scenario 4, barn with fixed floor		122	
Scenario 4, barn with gravel floor		161	
Scenario 4, staklade		198	

Years wheels



When is the biomass available?

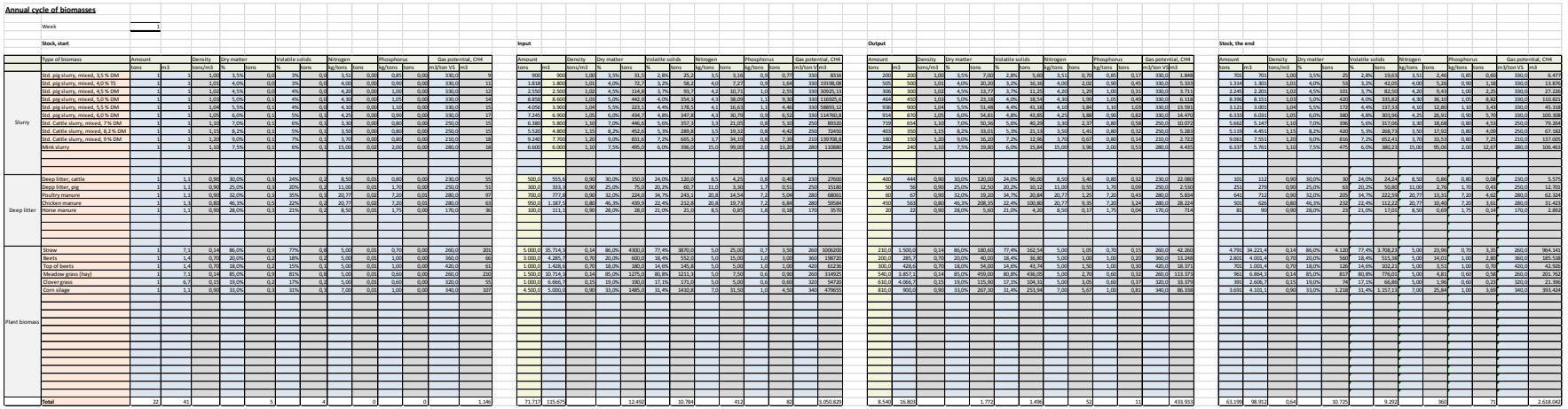
Years wheels

Type of biomass		Amount		Density	Dry matter		Volatile solids		Nitrogen		Phosphorus		Gas potential	CH4
		tons	m3	tons/m3	%	tons	%	tons	kg/tons	tons	kg/tons	tons	m3 CH4/kg VS	m3
Slurry	Std. pig slurry, mixed, 3,5 % DM	46.800	46.800	1,00	3,5%	1.638	2,8%	1.310	3,51	164	0,85	40	330	432.432
	Std. pig slurry, mixed, 4,0 % TS	94.536	93.600	1,01	4,0%	3.781	3,2%	3.025	4,00	378	0,90	85	330	998.300
	Std. pig slurry, mixed, 4,5 % DM	132.600	130.000	1,02	4,5%	5.967	3,7%	4.873	4,20	557	1,00	133	330	1.608.107
	Std. pig slurry, mixed, 5,0 % DM	460.616	447.200	1,03	5,0%	23.031	4,0%	18.425	4,30	1.981	1,05	484	330	6.080.131
	Std. pig slurry, mixed, 5,5 % DM	210.912	202.800	1,04	5,5%	11.600	4,4%	9.280	4,10	865	1,10	232	330	3.062.442
	Std. pig slurry, mixed, 6,0 % DM	376.740	358.800	1,05	6,0%	22.604	4,8%	18.084	4,25	1.601	0,90	339	330	5.967.562
	Std. Cattle slurry, mixed, 7 % DM	331.760	301.600	1,10	7,0%	23.223	5,6%	18.579	3,30	1.095	0,80	265	250	4.644.640
	Std. Cattle slurry, mixed, 8,2 % DM	287.040	249.600	1,15	8,2%	23.537	5,2%	15.070	3,50	1.005	0,80	230	250	3.767.400
	Std. Cattle slurry, mixed, 9 % DM	480.480	400.400	1,20	9,0%	43.243	7,2%	34.595	3,70	1.778	0,80	384	210	7.264.858
	Mink slurry	343.200	312.000	1,10	7,5%	25.740	6,0%	20.592	15,00	5.148	2,00	686	280	5.765.760
Deep litter	Deep litter, cattle	26.000	28.889	0,90	30,0%	7.800	24,0%	6.240	8,50	221	0,80	21	230	1.435.200
	Depp litter, pig	15.600	17.333	0,90	25,0%	3.900	20,2%	3.157	11,00	172	1,70	27	250	789.360
	Poultry manure	36.400	40.444	0,90	32,0%	11.648	34,7%	12.640	20,77	756	7,20	262	280	3.539.172
	Chicken manure	49.400	61.750	0,80	46,3%	22.872	22,4%	11.066	20,77	1.026	7,20	356	280	3.098.368
	Horse manure	5.200	5.778	0,90	28,0%	1.456	21,0%	1.092	8,50	44	1,75	9	170	185.640
Plant biomass	Straw	260.000	1.857.143	0,14	86,0%	223.600	77,4%	201.240	5,00	1.300	0,70	182	260	52.322.400
	Beets	156.000	222.857	0,70	20,0%	31.200	18,4%	28.704	5,00	780	1,00	156	360	10.333.440
	Top of beets	52.000	74.286	0,70	18,0%	9.360	14,6%	7.582	5,00	260	1,00	52	420	3.184.272
	Meadow grass (hay)	78.000	557.143	0,14	85,0%	66.300	80,8%	62.985	5,00	390	0,60	47	260	16.376.100
	Clover grass	52.000	346.667	0,15	19,0%	9.880	17,1%	8.892	5,00	260	0,60	31	320	2.845.440
	Corn silage	234.000	260.000	0,90	33,0%	77.220	31,4%	73.359	7,00	1.638	1,00	234	340	24.942.060
	Total	3.729.284	6.015.090					560788,2				4254,18		158.643.083

Years wheels

1. week

Stock start | Input | Output | Stock end



Annual cycle of biomasses

Week 1

Stock, start | Input | Output | Stock, the end

	Type of biomass	Amount		Density	Dry matter		Volatile solids		Nitrogen		Phosphorus		Gas potential, CH4	
		tons	m3	tons/m3	%	tons	%	tons	kg/tons	tons	kg/tons	tons	m3/ton VS	m3
Slurry	Std. pig slurry, mixed, 3,5 % DM	1	1	1,00	3,5%	0,0	3%	0,0	3,51	0,00	0,85	0,00	330,0	0
	Std. pig slurry, mixed, 4,0 % TS	1	1	1,01	4,0%	0,0	3%	0,0	4,00	0,00	0,90	0,00	330,0	11
	Std. pig slurry, mixed, 4,5 % DM	1	1	1,02	4,5%	0,0	4%	0,0	4,20	0,00	1,00	0,00	330,0	12
	Std. pig slurry, mixed, 5,0 % DM	1	1	1,03	5,0%	0,1	4%	0,0	4,50	0,00	1,05	0,00	330,0	14
	Std. pig slurry, mixed, 5,5 % DM	1	1	1,04	5,5%	0,1	4%	0,0	4,55	0,00	1,10	0,00	330,0	15
	Std. pig slurry, mixed, 6,0 % DM	1	1	1,05	6,0%	0,1	5%	0,1	4,25	0,00	0,90	0,00	330,0	17
	Std. Cattle slurry, mixed, 7% DM	1	1	1,10	7,0%	0,1	6%	0,1	3,30	0,00	0,80	0,00	250,0	15
	Std. Cattle slurry, mixed, 8,2 % DM	1	1	1,15	8,2%	0,1	5%	0,1	3,50	0,00	0,80	0,00	250,0	15
	Std. Cattle slurry, mixed, 9 % DM	1	1	1,20	9,0%	0,1	7%	0,1	3,70	0,00	0,80	0,00	210,0	18
	Mink slurry	1	1	1,10	7,5%	0,1	6%	0,1	15,00	0,02	2,00	0,00	280,0	18
Deep litter	Deep litter, cattle	1	1,1	0,90	30,0%	0,3	24%	0,2	8,50	0,01	0,80	0,00	230,0	55
	Deep litter, pig	1	1,1	0,91	25,0%	0,3	20%	0,2	11,00	0,01	1,70	0,00	250,0	51
	Poultry manure	1	1,1	0,92	32,0%	0,3	35%	0,3	20,77	0,02	7,20	0,01	280,0	97
	Chicken manure	1	1,1	0,93	46,3%	0,5	22%	0,2	20,77	0,02	7,20	0,01	280,0	60
	Horse manure	1	1,1	0,90	28,0%	0,3	21%	0,2	8,50	0,01	1,75	0,00	170,0	38
Plant biomass	Straw	1	7,1	0,14	86,0%	0,9	77%	0,8	5,00	0,01	0,70	0,00	260,0	203
	Beets	1	1,4	0,70	20,0%	0,2	18%	0,2	5,00	0,01	1,00	0,00	360,0	69
	Top of beets	1	1,4	0,70	18,0%	0,2	15%	0,1	5,00	0,01	1,00	0,00	420,0	61
	Meatlow grass (hay)	1	7,1	0,14	85,0%	0,9	81%	0,8	5,00	0,01	0,60	0,00	260,0	210
	Clover grass	1	6,7	0,15	19,0%	0,2	17%	0,1	5,00	0,01	0,60	0,00	320,0	55
	Corn silage	1	1,1	0,90	33,0%	0,3	31%	0,3	7,00	0,01	1,00	0,00	340,0	107
	Total	22	41			5		4	0	0	0			1.146

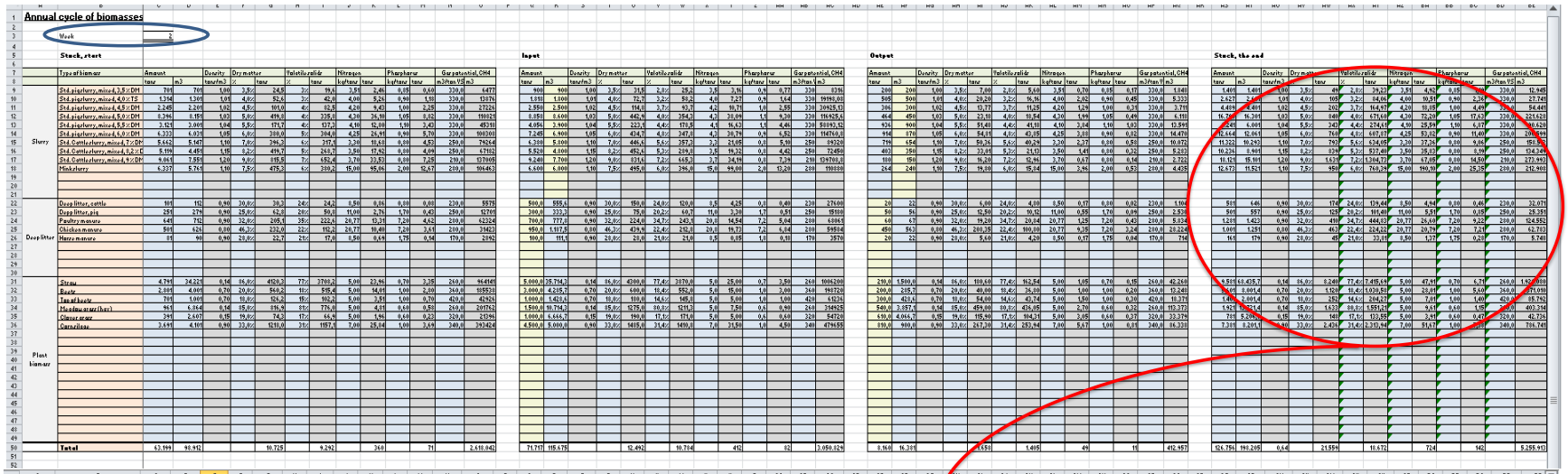
	Type of biomass	Amount		Density	Dry matter		Volatile solids		Nitrogen		Phosphorus		Gas potential, CH4	
		tons	m3	tons/m3	%	tons	%	tons	kg/tons	tons	kg/tons	tons	m3/ton VS	m3
Slurry	Std. pig slurry, mixed, 3,5 % DM	900	900	1,00	3,5%	31,5	2,8%	25,2	3,5	3,16	0,9	0,77	330	8316
	Std. pig slurry, mixed, 4,0 % TS	1.818	1.800	1,01	4,0%	72,7	3,2%	58,2	4,0	7,27	0,9	1,64	330	19198,08
	Std. pig slurry, mixed, 4,5 % DM	2.550	2.500	1,02	4,5%	114,8	3,7%	93,7	4,2	10,71	1,0	2,55	330	30925,13
	Std. pig slurry, mixed, 5,0 % DM	3.858	3.750	1,03	5,0%	192,9	4,0%	154,3	4,3	16,05	1,1	3,30	330	51925,5
	Std. pig slurry, mixed, 5,5 % DM	4.056	3.900	1,04	5,5%	223,1	4,4%	178,5	4,1	16,63	1,1	4,46	330	58893,12
	Std. pig slurry, mixed, 6,0 % DM	7.245	6.900	1,05	6,0%	434,7	4,8%	347,8	4,3	30,79	0,9	6,52	330	114702,6
	Std. Cattle slurry, mixed, 7% DM	6.380	5.800	1,10	7,0%	446,6	5,6%	357,3	3,3	21,05	0,8	5,10	250	89330
	Std. Cattle slurry, mixed, 8,2 % DM	5.520	4.800	1,15	8,2%	452,6	5,3%	289,9	3,5	19,32	0,8	4,42	250	72450
	Std. Cattle slurry, mixed, 9 % DM	9.240	7.700	1,20	9,0%	831,6	7,2%	665,3	3,7	34,19	0,8	7,39	210	139708,8
	Mink slurry	6.600	6.000	1,10	7,5%	495,0	6,0%	396,0	15,0	99,00	2,0	13,20	280	110880
Deep litter	Deep litter, cattle	500,0	555,6	0,90	30,0%	150,0	24,0%	120,0	8,5	4,25	0,8	0,40	230	27600
	Deep litter, pig	300,0	333,3	0,90	25,0%	75,0	20,2%	60,7	11,0	3,30	1,7	0,51	250	15180
	Poultry manure	700,0	777,8	0,90	32,0%	224,0	34,7%	243,1	20,8	14,54	7,2	5,04	280	68061
	Chicken manure	990,0	1.107,1	0,89	46,3%	459,0	22,4%	212,8	20,8	20,73	7,2	6,84	280	59584
	Horse manure	100,0	111,1	0,90	28,0%	28,0	21,0%	21,0	8,5	0,85	1,8	0,18	170	3570
Plant biomass	Straw	5.000,0	35.714,3	0,14	86,0%	4300,0	77,4%	3870,0	5,0	25,00	0,7	3,50	260	1006200
	Beets	3.000,0	4.285,7	0,70	20,0%	600,0	18,4%	552,0	5,0	15,00	1,0	3,00	360	198720
	Top of beets	1.000,0	1.428,6	0,70	18,0%	180,0	14,6%	145,8	5,0	5,00	1,0	1,00	420	61236
	Meatlow grass (hay)	1.500,0	10.714,3	0,14	85,0%	1275,0	80,8%	1211,3	5,0	7,50	0,6	0,90	260	314925
	Clover grass	1.000,0	6.666,7	0,15	19,0%	190,0	17,1%	171,0	5,0	5,00	0,6	0,60	320	54720
	Corn silage	4.500,0	5.000,0	0,90	33,0%	1485,0	31,4%	1410,8	7,0	31,50	1,0	4,50	340	479655
	Total	71.717	115.675			12.492		10.784		412		82		3.050.829

	Type of biomass	Amount		Density	Dry matter		Volatile solids		Nitrogen		Phosphorus		Gas potential, CH4	
		tons	m3	tons/m3	%	tons	%	tons	kg/tons	tons	kg/tons	tons	m3/ton VS	m3
Slurry	Std. pig slurry, mixed, 3,5 % DM	200	200	1,00	3,5%	7,00	2,8%	5,60	3,51	0,70	0,85	0,17	330,0	1.848
	Std. pig slurry, mixed, 4,0 % TS	505	500	1,01	4,0%	20,20	3,2%	16,16	4,00	2,02	0,90	0,45	330,0	5.333
	Std. pig slurry, mixed, 4,5 % DM	306	300	1,02	4,5%	13,77	3,7%	11,25	4,20	1,29	1,00	0,31	330,0	3.711
	Std. pig slurry, mixed, 5,0 % DM	464	450	1,03	5,0%	23,18	4,0%	18,54	4,30	1,99	1,05	0,49	330,0	6.118
	Std. pig slurry, mixed, 5,5 % DM	936	900	1,04	5,5%	51,48	4,4%	41,18	4,10	3,84	1,10	1,03	330,0	13.591
	Std. pig slurry, mixed, 6,0 % DM	934	870	1,05	6,0%	54,83	4,8%	43,85	4,25	3,88	0,90	0,82	330,0	14.470
	Std. Cattle slurry, mixed, 7% DM	710	654	1,10	7,0%	50,36	5,6%	40,29	3,30	2,37	0,80	0,58	250,0	10.072
	Std. Cattle slurry, mixed, 8,2 % DM	403	350	1,15	8,2%	33,01	5,3%	21,13	3,50	1,41	0,80	0,32	250,0	5.283
	Std. Cattle slurry, mixed, 9 % DM	180	150	1,20	9,0%	16,20	7,2%	12,96	3,70	0,67	0,80	0,14	210,0	2.722
	Mink slurry	264	240	1,10	7,5%	19,80	6,0%	15,84	15,00	3,96	2,00	0,53	280,0	4.435
Deep litter	Deep litter, cattle	400	444	0,90	30,0%	120,00	24,0%	96,00	8,50	3,40	0,80	0,32	230,0	22.080
	Deep litter, pig	90	56	0,90	25,0%	12,50	20,2%	30,10	11,00	0,55	1,70	0,09	250,0	2.530
	Poultry manure	60	67	0,90	32,0%	19,20	34,7%	20,84	20,77	1,25	7,20	0,43	280,0	5.834
	Chicken manure	450	560	0,80	46,3%	208,35	22,4%	100,80	20,77	9,35	7,20	3,24	280,0	28.224
	Horse manure	20	22	0,90	28,0%	5,60	21,0%	4,20	8,50	0,17	1,75	0,04	170,0	714
Plant biomass	Straw	210,0	1.500,0	0,14	86,0%	180,60	77,4%	162,54	5,00	1,05	0,70	0,15	260,0	42.260
	Beets	200,0	285,7	0,70	20,0%	40,00	18,4%	36,80	5,00	1,00	1,00	0,20	360,0	13.248
	Top of beets	300,0	428,6	0,70	18,0%	54,00	14,6%	43,74	5,00	1,50	1,00	0,30	420,0	18.372
	Meatlow grass (hay)	540,0	3.857,1	0,14	85,0%	459,00	80,8%	436,05	5,00	2,70	0,60	0,32	260,0	113.373
	Clover grass	610,0	4.066,7	0,15	19,0%	115,90	17,1%	104,31	5,00	3,05	0,60	0,37	320,0	33.373
	Corn silage	830,0	900,0	0,90	33,0%	267,30	31,4%	253,94	7,00	5,67	1,00	0,83	340,0	86.336
	Total	8.543	16.803			1.772		1.496		52		13		433.993

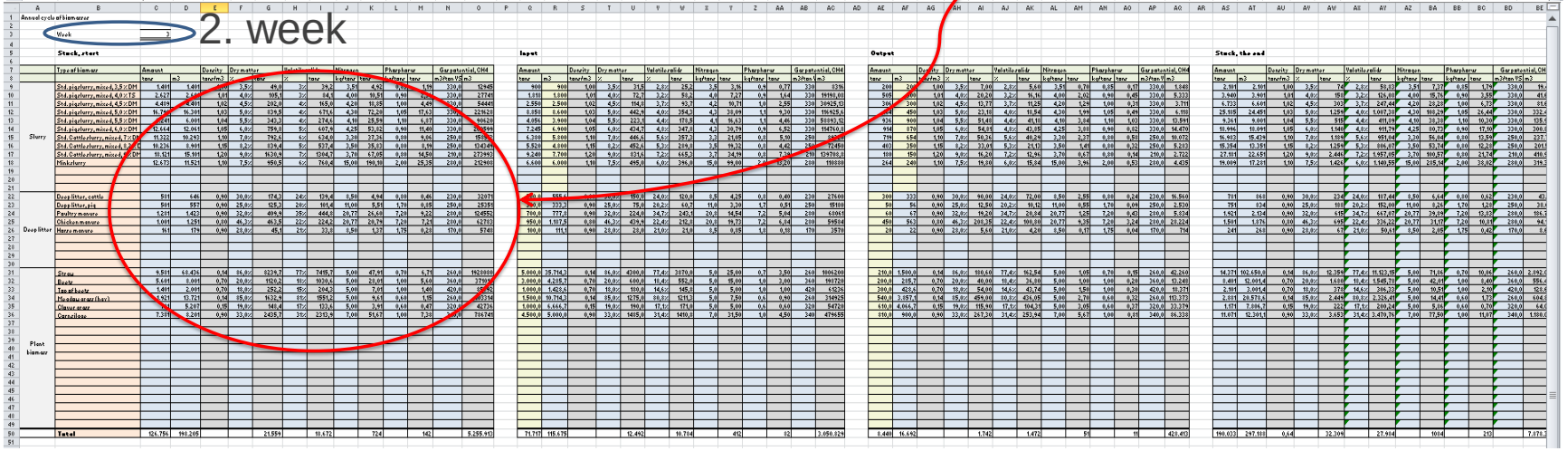
	Type of biomass	Amount		Density	Dry matter		Volatile solids		Nitrogen		Phosphorus		Gas potential, CH4	
		tons	m3	tons/m3	%	tons	%	tons	kg/tons	tons	kg/tons	tons	m3/ton VS	m3
Slurry	Std. pig slurry, mixed, 3,5 % DM	701	701	1,00	3,5%	25	2,8%	19,63	3,51	2,46	0,85	0,60	330,0	6.477
	Std. pig slurry, mixed, 4,0 % TS	1.314	1.301	1,01	4,0%	53	3,2%	42,05	4,00	5,25	0,90	1,18	330,0	13.836
	Std. pig slurry, mixed, 4,5 % DM	2.245	2.202	1,02	4,5%	101	3,7%	82,50	4,20	9,43	1,00	2,25	330,0	27.226
	Std. pig slurry, mixed, 5,0 % DM	8.396	8.151	1,03	5,0%	420	4,0%	335,82	4,30	36,10	1,05	8,82	330,0	110.821
	Std. pig slurry, mixed, 5,5 % DM	3.121	3.001	1,04	5,5%	172	4,4%	137,33	4,10	12,80	1,10	3,43	330,0	45.318
	Std. pig slurry, mixed, 6,0 % DM	6.319	6.031	1,05	6,0%	380	4,8%	303,94	4,25	26,91	0,90	5,70	330,0	100.308
	Std. Cattle slurry, mixed, 7% DM	5.662	5.147	1,10	7,0%	396	5,6%	317,06	3,30	18,68	0,80	4,53	250,0	79.264
	Std. Cattle slurry, mixed, 8,2 % DM	5.119	4.451	1,15	8,2%	420	5,3%	268,73	3,50	17,92	0,80	4,09	250,0	67.182
	Std. Cattle slurry, mixed, 9 % DM	9.061	7.551	1,20	9,0%	816	7,2%	652,41	3,70	33,53	0,80	7,25	210,0	157.605
	Mink slurry	6.337	5.761	1,10	7,5%	475	6,0%	380,23	15,00	95,06	2,00	12,67	280,0	106.483
Deep litter	Deep litter, cattle	101	112	0,90	30,0%	30	24,0%	24,24	8,50	0,86	0,80	0,08	230,0	5.575
	Deep litter, pig	251	279	0,90	25,0%	63	20,2%	50,86	11,00	2,76	1,70	0,43	250,0	12.705
	Poultry manure	641	712	0,90	32,0%	205	34,7%	222,59	20,77	13,31	7,20	4,62	280,0	62.324
	Chicken manure	503	626	0,80	46,3%	233	22,4%	112,27	20,77	10,45	7,20	3,67	280,0	31.423
	Horse manure	81	90	0,90	28,0%	25	21,0%	17,01	8,50	0,69	1,75	0,14	170,0	2.862
Plant biomass	Straw	4.791	34.221,4	0,14	86,0%	4.120	77,4%	3.708,23	5,00	23,96	0,70	3,35	260,0	964.141
	Beets	2.801	4.001,4	0,70	20,0%	560	18,4%	515,38	5,00	14,01	1,00	2,80	360,0	185.538
	Top of beets	701	1.001,4	0,70	18,0%	126	14,6%	102,21	5,00	3,51	1,00	0,70	420,0	42.926
	Meatlow grass (hay)	961	6.864,3	0,14	85,0%	817	80,8%	776,01	5,00	4,81	0,60	0,58	260,0	201.762
	Clover grass	891	2.606,7	0,15	19,0%	76	17,1%	66,86	5,00	1,96	0,60	0,23	320,0	21.396
	Corn silage	3.693	4.101,1	0,90	33,0%	1.218	31,4%	1.157,13	7,00	25,84	1,00	3,69	340,0	393.424
	Total	63.199	98.912	0,64		10.725		9.292		360		75		2.618.042

Years wheels

1. week

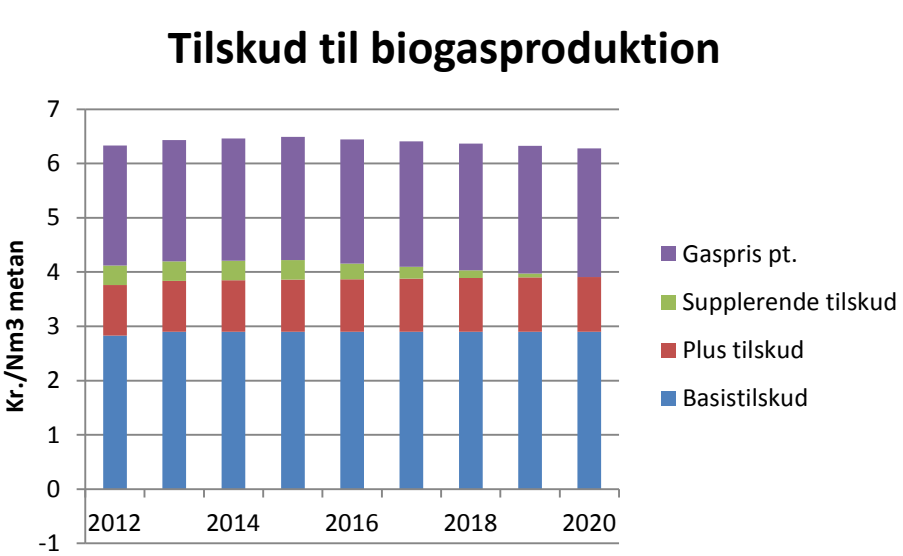


2. week

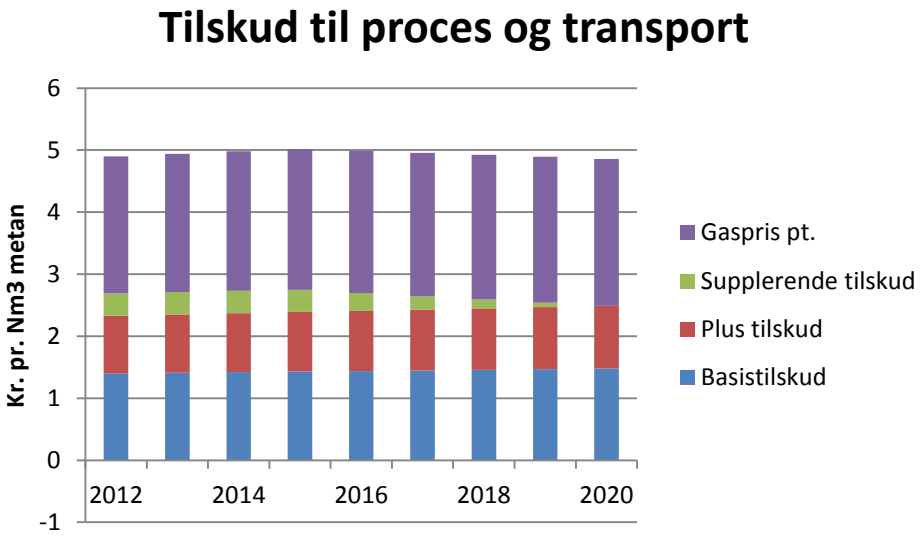


biochain

Importance of energy agreement - biogas



Use of biogas for heat and power and grid injection



Use of biogas for proces and transportation

Besides this the posibility to trade green certificates

Example of concept model work

Thank you for your attention!