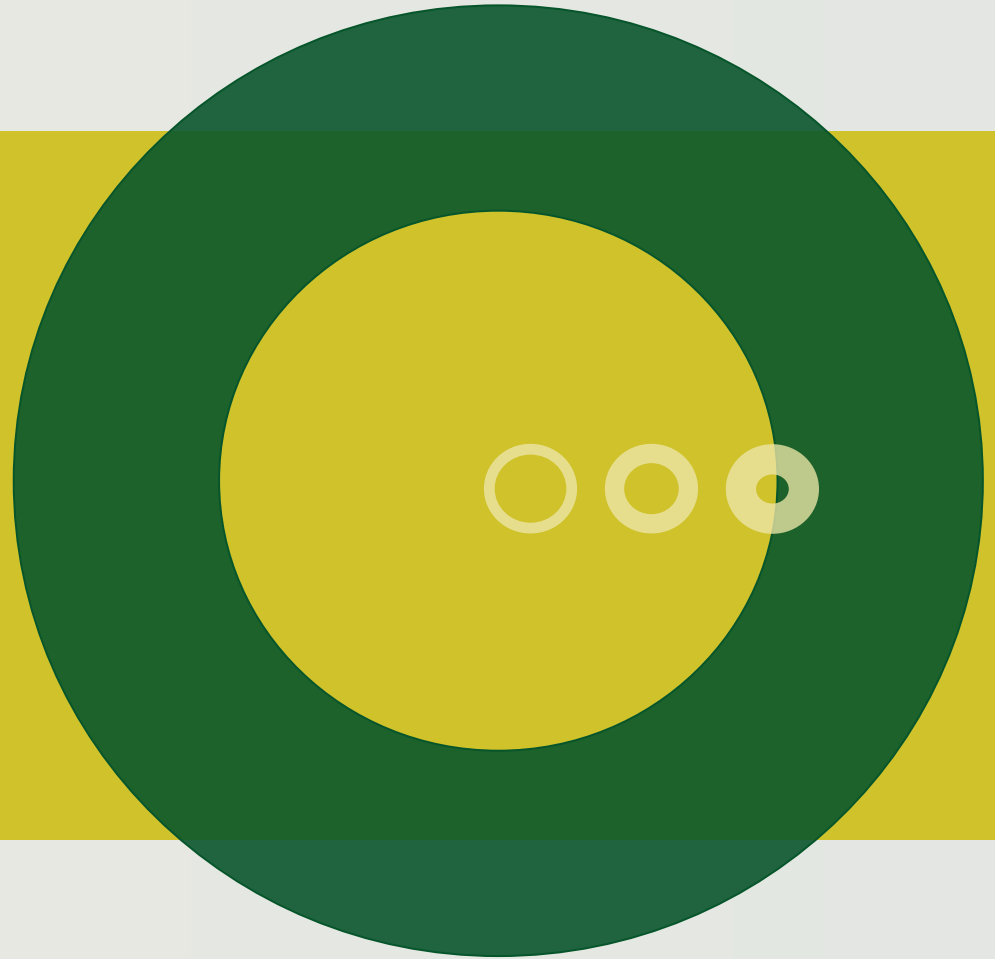




VIDENCENTRET FOR LANDBRUG



Logistic of Biogas Production



Logistic in production of biogas

How is production, transport and storage optimized?

Many parameters need optimization and coordination



Wheat straw as an example:

Straw bale or briquette?

Transport in field/on road?

Loading/unloading?

Stored in open barn, closed barn, silo, container?



Density 0.2T/m³



Ø= 7-9 cm
Density 0.5 T/m³



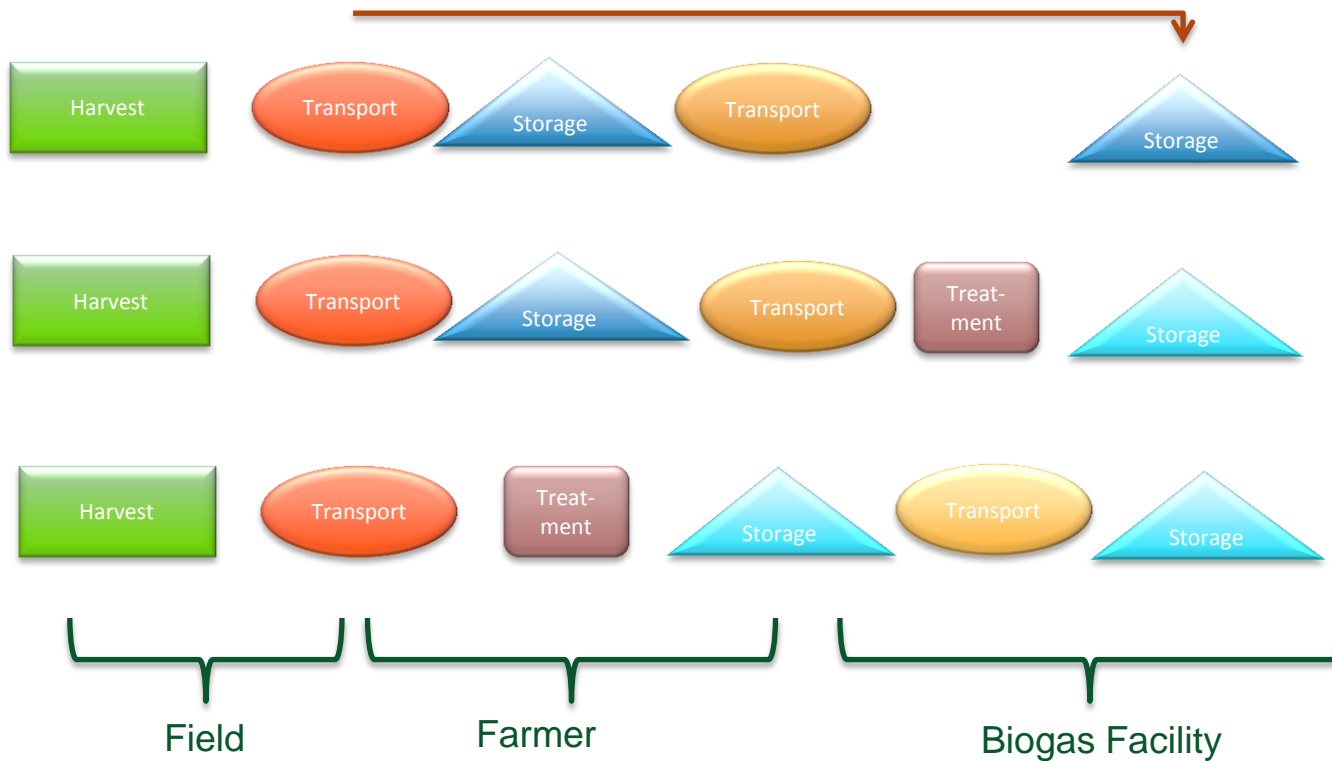
Logistic in production of biogas

How can all these parameters be optimized?

Which parameters inflict most on economy?

This calls for a model !!!

Identification of value chains



Example: Wheat straw, Data entry sheet

Entry for straw	
Yield	
Yield	676 ton
Cultivated area	200 ha.
Yield per hectare	3,38 ton/ha.
Dry matter	85%
Organic matter - VS/TS	95%
Methane potential	
Straw	230 L CH ₄ /kg VS
Extruded straw	277 L CH ₄ /kg VS
Briquetted straw	277 L CH ₄ /kg VS
Field expenses	
Raking	0 kr./ton
Baling	-145 kr./ton
Distance to farmer/barn	
Distance	0,5 km
Tractor equipped with frontloader & 2 bale trailers	-650 kr./hr.
Capacity	20 bales/load
Loading rate, field	2,7 min/ton
Loading rate, stock	2,1 min/ton
Farm loading	
Tractor with frontloader	
Tractor with frontloader	-650 kr./hr.
Loading rate	2,07 min/ton

These entries are locked

- Can be changed in a separate sheet if need be

Example: Wheat straw, Data entry sheet

Entry for straw

Yield

Yield 676 ton

Cultivated area ha.

Yield per hectare ton/ha.

Dry matter

Organic matter - VS/TS

Methane potential

Straw L CH₄/kg VS

Extruded straw L CH₄/kg VS

Briquetted straw L CH₄/kg VS

Field expenses

Raking kr./ton

Baling kr./ton

Distance to farmer/barn

Distance km

Tractor equipped with frontloader & 2 bale trailers kr./hr.

Capacity bales/load

Loading rate, field min/ton

Loading rate, stock min/ton

Farm loading

Tractor with frontloader kr./hr.

Loading rate min/ton

7... | 12. december 2014

White boxes signify required user input

Example: Wheat straw, Data entry sheet

End product

Ekstruderet straw ▼

Extruding expenses

Extruder, mixer, conveyor	-5.500.000	kr.
Capacity	10.000	ton/yr
Operation and maintainance	-99	kr./ton
Insurance	-50.000	kr./yr
Service life	10	yr

Choose end product

End product

Briquetted straw ▼

End product

Straw bales ▼

Farm storage

Open barn ▼

Barn, concrete floor ▼

Barn, gravel floor ▼

Barn, concrete floor, briquettes ▼

Choose type and size of storage at farm and at facility

Example: Wheat straw, Comparison sheet

Wheat straw calculator

End product:	Straw bales
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Expected costs:

Baling and raking	-145 kr./ton
Farm storage	-349 kr./ton
Plant storage	-267 kr./ton
Transport	-211 kr./ton
Pretreatment	- kr./ton
Cost per ton	-972 kr./ton
Total cost	-657.402 kr.

Expected income:

Energy yield	2.185 kWh/ton
- Electricity	874 kWh/ton
- Heat	1.093 kWh/ton
Income from electricity	970 kr./ton
Income from heat	273 kr./ton
Income per ton	1.243 kr./ton
Total income	840.447 kr.

Difference, kr	183.045 kr.
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Decentral briquetting

End product	Briquetted straw
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Expected costs:

Baling and raking	-145 kr./ton
Farm storage	-42 kr./ton
Plant storage	-356 kr./ton
Transport	-181 kr./ton
Pretreatment	-1.001 kr./ton
Cost per ton	-1.725 kr./ton
Total cost	-1.166.294 kr.

Expected income:

Energy yield	2.632 kWh/ton
- Electricity	1.053 kWh/ton
- Heat	1.316 kWh/ton
Income from electricity	1.168 kr./ton
Income from heat	329 kr./ton
Income per ton	1.497 kr./ton
Total income	1.012.191 kr.

Difference, kr	-154.103 kr.
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Example: Wheat straw Print sheet

Economy : Straw to Biogas

Printet

27-10-2014

Harvest

End product	Briquetted straw
Cultivated area	200 ha.
Transport: Field to farmer	0,5 km with Tractor & frontloader
Transport: Farmer to facility	60 km with Truck & trailer
Loading equipment	Telescopic loader at farm, Tractor with frontloader at facility

Yield

Yield	3,38 Ton/ha.
Dry matter	89%
Ash	3%
Gas potential	277 L CH ₄ /kgVS
Gas yield	805 m ³ CH ₄ /ha.

Storage

Storage needed	4225 m ³ bales or 1502 m ³ briquettes
Farmer site, storage	Open barn, 5000 m ³
Facility, storage	Barn with concrete floor, 5000 m ³ <i>Note: Storage facility used for multiple purposes</i>

Pretreatment

Briquetting	
Cost, yearly	-kr. 626.590
Hereof, paid by straw	6 % (straw) and 80 % (other)

Economy

Expected costs	kr.	-542.137
Expected yield	kr.	916.298
Difference	kr.	374.162

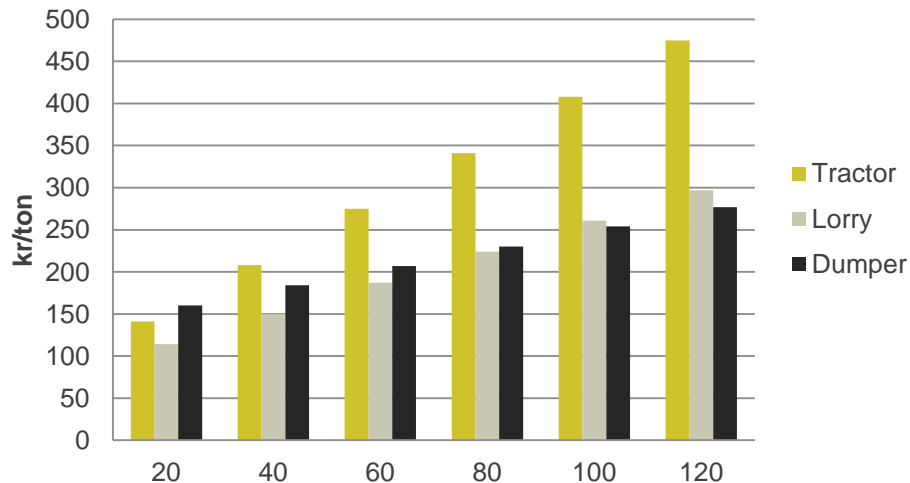
Print sheets can be used to compare costs

Produktionsomkostninger for enggræs til biogas		
Udskrevet d.		22-10-2014
Høstmetode		
Færdigt produkt	Ingen forbehandling	
Transport til landmand	Dækket af høstomkostninger	
Transport udover 12 km	5 km med Traktor med halmvogn	
Maskiner anvendt til høst	Pistemaskine	
Maskiner anvendt til læsning	Skal ikke omlæsses	
Udbytte		
Areal	12 ha.	
Udbytte	69,6 Ton/ha.	
Tørstofindhold	80%	
Askeindhold	5%	
Gaspotentiale	234 L CH ₄ /KgVs	
Gasudbytte	1017 m ³ CH ₄ /ha	
<i>Bemærk: Gasudbytte afhænger af græsblanding og høsttidspunkt</i>		
Lagring		
Lagerbehov	249 stk rundballer	
Valgt lagringsmetode	Baller under presenning	
<i>Bemærk: Kun lagret på anlæg</i>		
Forbehandling		
Ikke valgt		
Økonomi		
Omkostning, landmand	-108 øre/kgTS	
Forventet omkostninger	kr.	-59.685
Forventet udbytte	kr.	69.502
Difference	kr.	9.817

Produktionsomkostninger for enggræs til biogas		
Udskrevet d.		21-10-2014
Høstmetode		
Færdigt produkt	Ingen forbehandling	
Transport til landmand	Dækket af høstomkostninger	
Transport udover 12 km	5 km med Traktor med halmvogn	
Maskiner anvendt til høst	Pistemaskine	
Maskiner anvendt til læsning	Skal ikke omlæsses	
Udbytte		
Areal	12 ha.	
Udbytte	69,6 Ton/ha.	
Tørstofindhold	80%	
Askeindhold	5%	
Gaspotentiale	234 L CH ₄ /KgVs	
Gasudbytte	1017 m ³ CH ₄ /ha	
<i>Bemærk: Gasudbytte afhænger af græsblanding og høsttidspunkt</i>		
Lagring		
Lagerbehov	249 stk rundballer	
Valgt lagringsmetode	Ingen lagring/lagring i det fri	
<i>Bemærk: Kun lagret på anlæg</i>		
Forbehandling		
Ikke valgt		
Økonomi		
Omkostning, landmand	-80 øre/kgTS	
Forventet omkostninger	kr.	-44.025
Forventet udbytte	kr.	69.502
Difference	kr.	25.477

Use of model to calculate transport costs

Case: Straw is transported from the field to the farmer and further to the facility. It can be transported directly from the farmer to the facility as bales or 17 km as bales to a local briquetting station and then further to the facility. Briquettes are transported using a dumper. Cost includes transport as bales and loading/unloading of bales/briquettes.



	Tractor	Lorry	Dumper
Kr./hr	550	625	650
Load	24 bales	24 bales	22 ton
Km/hr.	25	52	52

Cost calculations – questions answered by the model

- "How is cost affected if..."
 - Another type of storage is chosen?
 - The methane potential increases?
 - The straw is pretreated?
 - Beets are produced instead of maize?
 - The distance to the facility changes?
 - Straw is briquetted locally instead of at the facility?
 - Electricity cost changes?
 - Trucks are used for transport instead of tractors?
- 50-100 parameters can be varied for each crop
- The outcomes can easily be compared

WP5: Logistics & Economics

