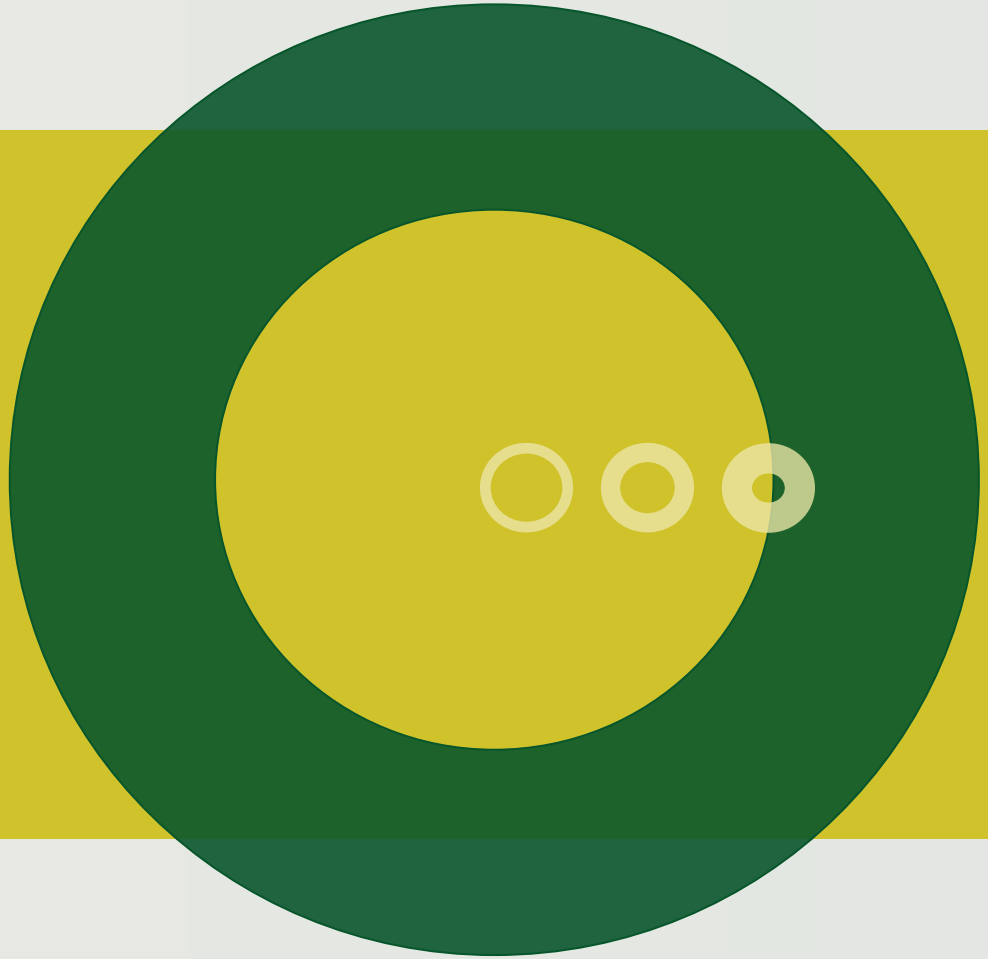
VIDENCENTRET FOR LANDBRUG

biochain

WP5: Logistics & Economics

Logistic of Biogas Production



PARTNER I DLBR

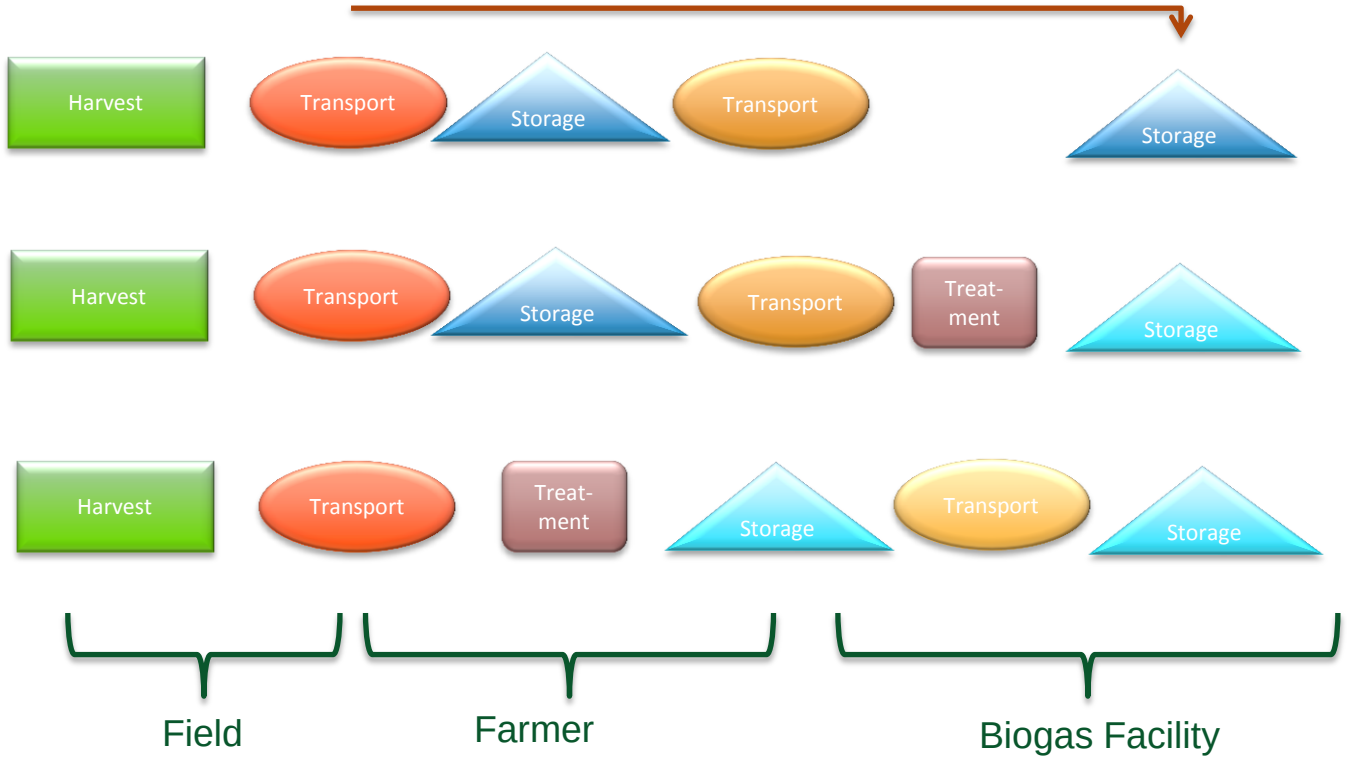
WP5: Logistics & Economics

Milestones	2013				2014				2015				2016			
1. Selection of biomasses	X	X														
2. Simplw submodel for two biomasses		X	X													
3. Maternity Leave				X	X											
4. Improved submodel for two bio-masses						X	X	X								
5. Modelling of additional biomasses							X	X	X	X						
6. Final model for calculation revenue on sale of individual biomasses										X	X	X				
7. Model integrated into yearly variation of biomass demand and availability												X	X			
8. Seminars								X					X			

Progress: On schedule

- ✓ Biomasses have been selected
  - Wheat straw, rape straw, grass from meadows, maize straw, beets
- ✓ Simple and improved submodel for two biomasses is ready
  - Wheat straw, rape straw
- ✓ Modelling of additional biomasses has been initiated
  - Grass from meadows ready, maize and beets ready before end of 2014

Designing the model



Example: Wheat straw

Straw bale or briquette?

Transport in field/on road?

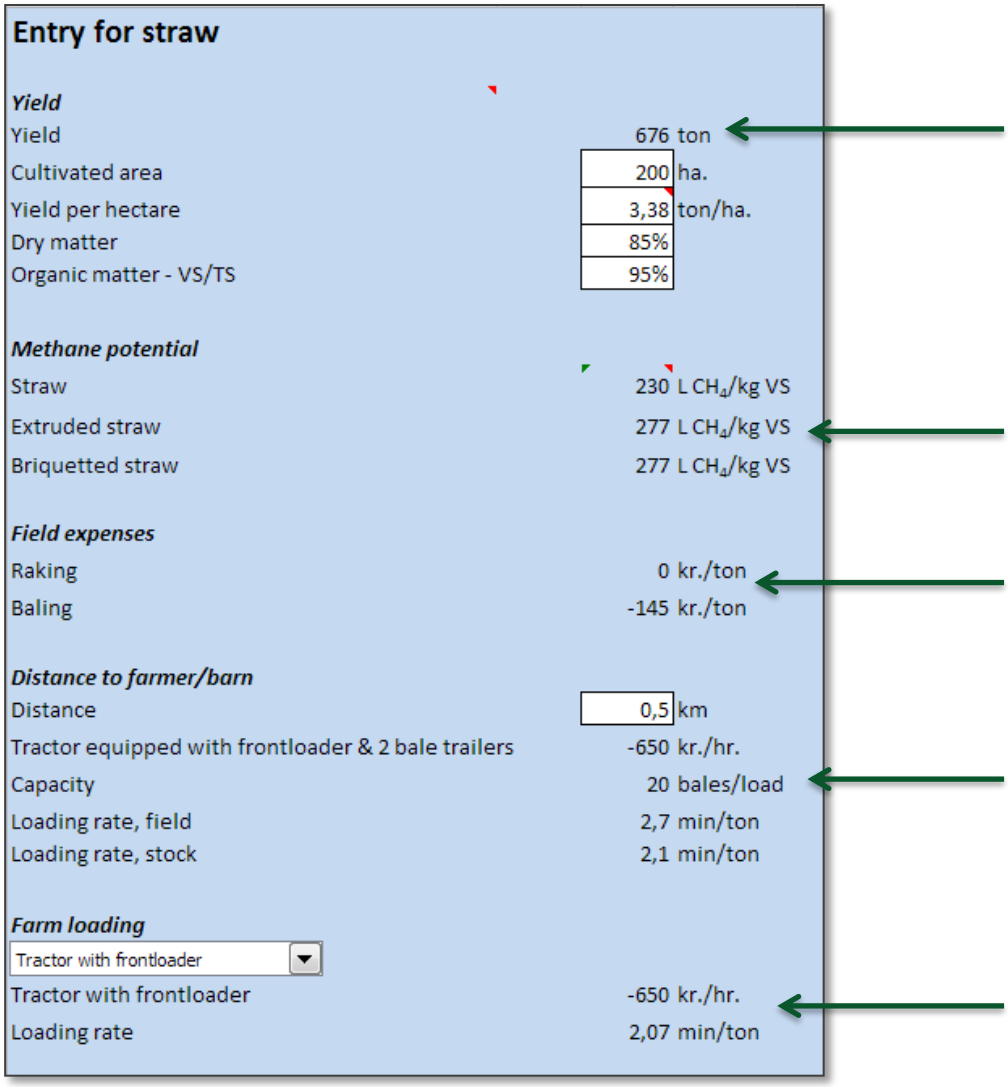
Loading/unloading?

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

Density 0.2T/m3

Ø= 7-9 cm
Density 0.5 T/m3

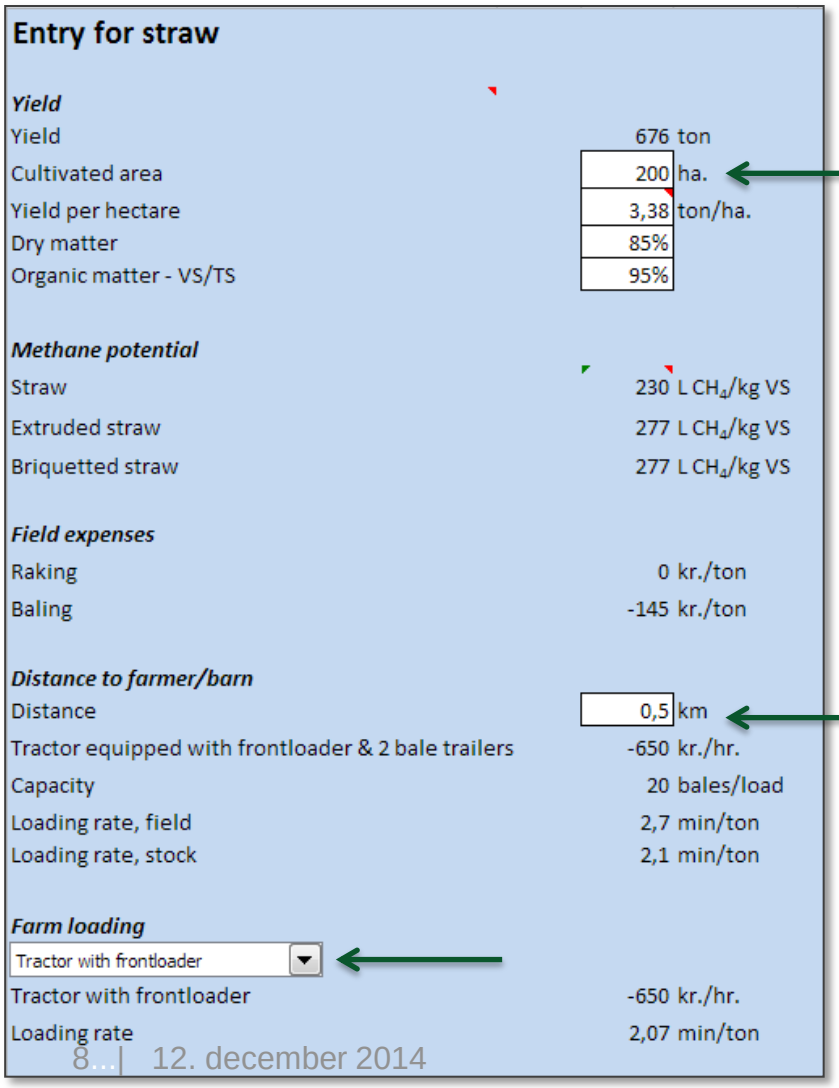
Example: Wheat straw, Data entry sheet



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

Example: Wheat straw, Data entry sheet



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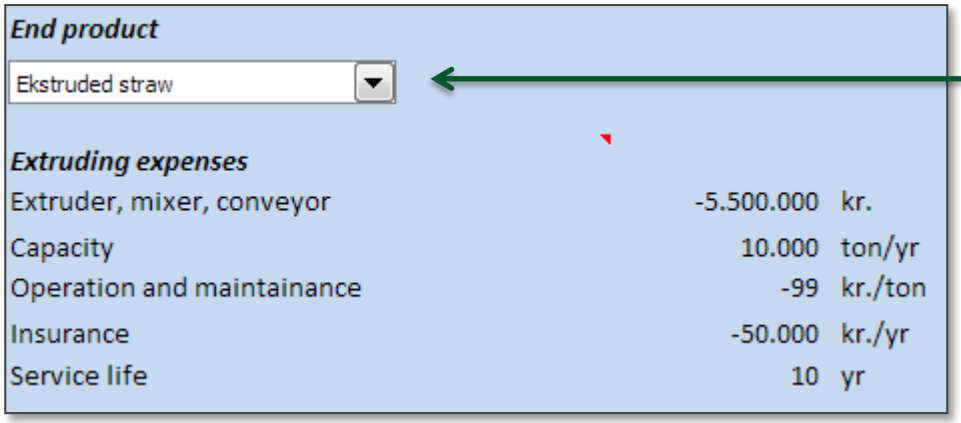
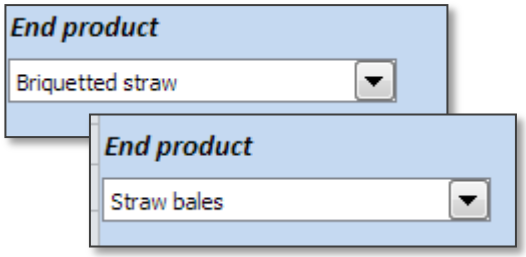
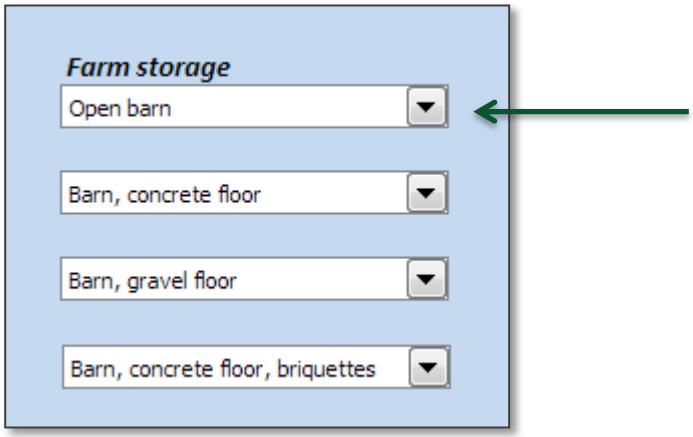
White boxes signify required user input

Example: Wheat straw, Data entry sheet



Choose end product





Choose type and size of storage at farm and at facility

Example: Wheat straw, Comparison sheet

Wheat straw calculator

End product:	Straw bales	
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.**

Decentral briquetting

End product	Briquetted straw	
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.**

Example: Wheat straw Print sheet

Economy : Straw to Biogas

Printet 21-10-2014

Harvest		
End product	Straw bales	
Cultivated area	200 ha.	
Transport: Field to farmer	0,5 km with Tractor & frontloader	
Transport: Farmer to facility	20 km with Truck & trailer	
Loading equipment	Tractor with frontloader at farm, Telescopic loader at facility	
Yield		
Yield	3,38 Ton/ha.	
Dry matter	89%	
Ash	3%	
Gas potential	277 L CH4/kgVS	
Gas yield	805 m3 CH4/ha.	
Storage		
Storage needed	4225 m3 bales or 1502 m3 briquettes	
Farmer site, storage	Open barn, 5000 m3	
Facility, storage	Barn with concrete floor, 5000 m3 *Note: Storage facility used for multiple purposes*	
Pretreatment		
Briquetting		
Cost, yearly	-kr. 626.590	
Hereof, paid by straw	6 % (straw) and 80 % (other)	
Economy		
Expected costs	kr.	-511.237
Expected yield	kr.	916.298
Difference	kr.	405.062

Models for rape straw and meadow grass are ready, too

Produktionsomkostninger for rapshalm til biogas

Udskrevet d. 21-10-2014

Høstmetode		
Færdigt produkt	Ekstruderet halm	
Transport til landmand	0,5 km med Traktor med halmvogn og frontlæsser	
Transport til anlæg	100 km med Traktor og halmvogn	
Maskiner anvendt til læsning	Traktor med frontlæsser hos landmand og Traktor med frontlæsser på anlæg	
Udbytte		
Opdyrket areal	60 ha.	
Udbytte	195 Ton/ha.	
Tørstofindhold	91%	
Askeindhold	9%	
Gaspotentiale	356 L CH4/kgVS	
Gasudbytte	945 m3 CH4/ha.	
Lagring		
Lagerbehov	1218 m3 halmballer eller 433 m3 briketter	
Valgte lagre hos landmand	Staklade på 5000 m3	
	Bemærk: Lagrene fyldes delvis med andet end halm	
Valgte lagre på anlæg	Staklade på 5000 m3	
	Bemærk: Lagrene fyldes delvis med andet end halm	
Forbehandling		
Ekstrudering		
Årlige låneomkostninger	-kr. 729.673	
Procentvis udnyttelse af maskine	1,9 % til halm og 92 % til andet	
Økonomi		
Forventet omkostninger	kr.	-231.401
Forventet udbytte	kr.	322.772
Difference	kr.	91.371

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 CH4/KgVs	
Gasudbytte	1017 m3 CH4/ha	
	Bemærk: Gasudbytte afhænger af græsblanding og høsttidspunkt	
Lagring		
Lagerbehov	249 stk rundballer	
Valgt lagringsmetode	Ingen lagring/lagring i det fri	
	Bemærk: Kun lagret på anlæg	
Forbehandling		
Ikke valgt		
Økonomi		
Omkostning, landmand	-80 øre/kgTS	
Forventet omkostninger	kr.	-44.025
Forventet udbytte	kr.	69.502
Difference	kr.	25.477

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