The ecosystem services provided by grassland –

soil carbon storage, reduced nutrient losses, reduced pesticide use, and increased biodiversity







Photosynthesis is the most cost-effective and scalable process to create negative emissions



However, grain crops are poor "solar panels" seen across a year



Green Valleys







GO-GRASS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant

agreement N° 862674

Field experiments at Aarhus University since 2012 on the effects of cropping systems



grant agreement **N° 862674**

Biomass production (carbon capture) can be doubled and nitrate leaching halved





Other environmental benefits from conversion of annual crops to grass, clover or alfalfa

- Reduced soil erosion
- Reduced GHG emission (0.5-3.5 ton CO₂-equiv/ha)
- Reduced pesticide use (by factor 40-50)
- Increased biodiversity
- Increased infiltration capacity



So, what to do with all that grass?





High crude protein content in grasses may be utilised



Solati et al., 2018

innovation programme under grant agreement N° 862674





Green Valleys







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Feeding experiment with green protein to pigs, cows, broilers & egg layers – positive results!



Business evaluation of decentralized green biorefineries in Denmark

Economic assumptions:

- Biorefinery CAPEX : 3.36 mio EUR
- Depreciation time: 15 year
- 5% Interest rate , 5% Maintenance

• Grass price

- Organic: 0.15 EUR/kg
- Conventional: 0.13 EUR/kg
- Protein price (soya)
- Organic: 0.67 EUR/kg
 Conventional: 0.34 EUR/kg
- Fiber pulp price
 - Identical to grass price
- Residue juice is not given any cost or value -It is used for internal energy production at the biogas plant.

Green Valleys



Economy		
	Scenario	
	Organic	Conventional
	Mio. EUR	Mio. EUR
Income		
Protein concentrate +	4.70	3.25
Fibre		
Expenses		
Grass	3.33	2.90
Energy and salary	0.19	0.19
Maintenance	0.17	0.17
Depreciation and	0.32	0.32
interest		
Result	0.66	-0.34

Source: Morten Ambye-Jensen





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Green biorefinery demo-plant now paving the way for market introductions – so far two commercial plants







Biodiversity in grassland: number and species of earthworms higher in permanent grassland than in annual crops







Changes in soil C from 2012 (red) to 2017 (green) in the plow layer







Significant difference in soil C change over 5 years between annual and perennial crops – new samples are now taken after 10 years







Grassland can be expanded to deliver raw material for biorefineries to produce new biobased products AND ecosystem services by:









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