GrassMargins Green Valleys BIOVALUE SPIR

AARHUS UNIVERSITY

Production of grasses in nitrate sensitive areas can secure local farmers licence-to-produce

Senior Scientist Uffe Jørgensen, Department of Agroecology
Head of Aarhus University Centre for Circular Bioeconomy (www.cbio.au.dk)

CBIO
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund

EUROPEAN UNION

Danish agriculture faces numerous challenges

Productivity

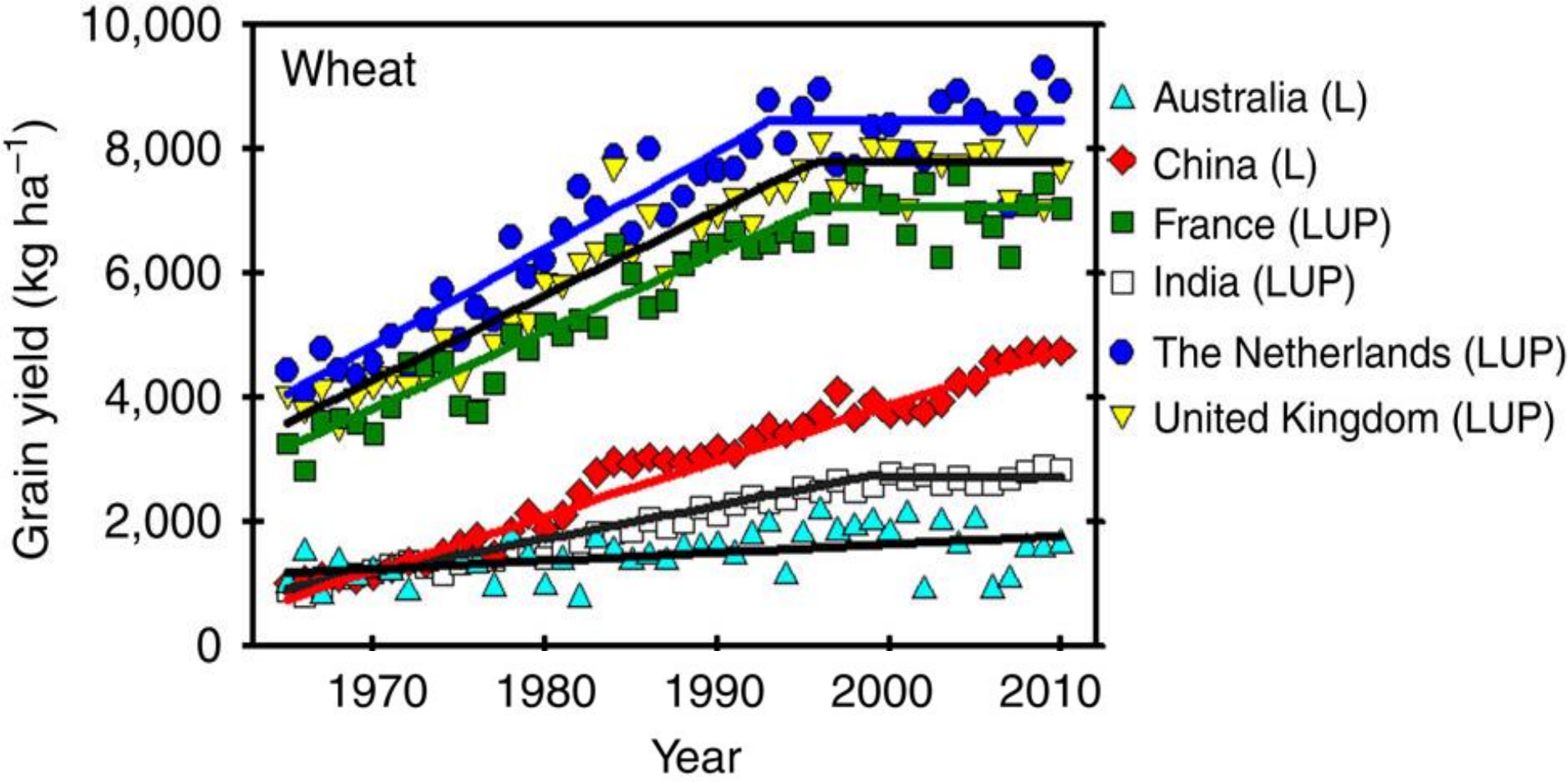
- Biomass for food, feed, material and energy
- Stagnating yields
- Large import of protein feed

Environment

- High nutrient leaching (Nitrate and Water Framework Directives)
- High pesticide use
- Agriculture must contribute to EU climate goals (EU climate policy)

Time to look for radical innovation instead of just incremental

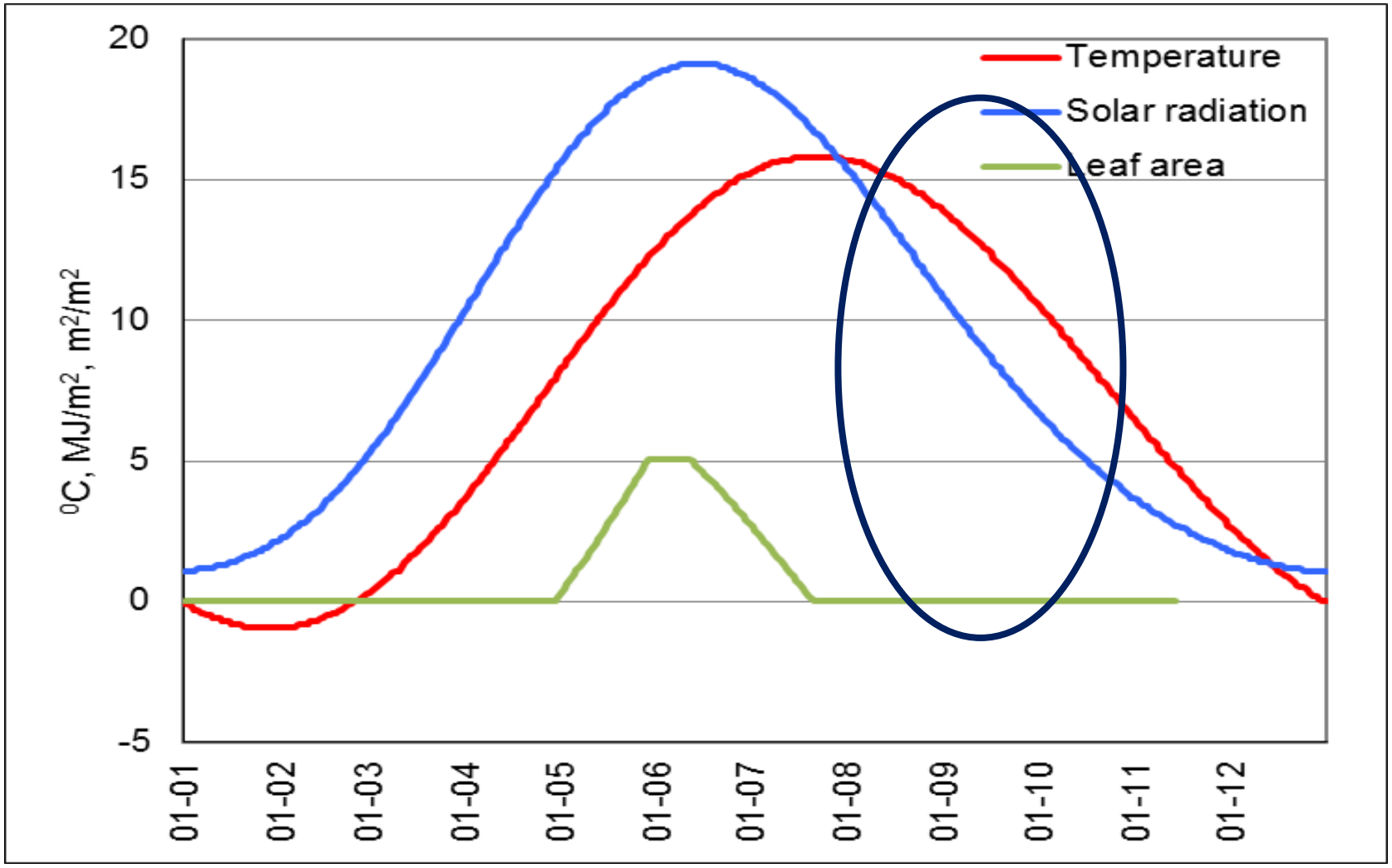
It seems hard to increase yields (sustainably) in existing crops in Europe



Patricio Grassini, Kent M. Eskridge & Kenneth G. Cassman, 2013.Nature Communications 4, no. 2918

Grain crops utilize only part of the growing season

Case: spring barley in Denmark



Tightening the nitrogen cycle is a major policy focus in Denmark

- Soil water (drainage)
- Soil nitrate (leaching)

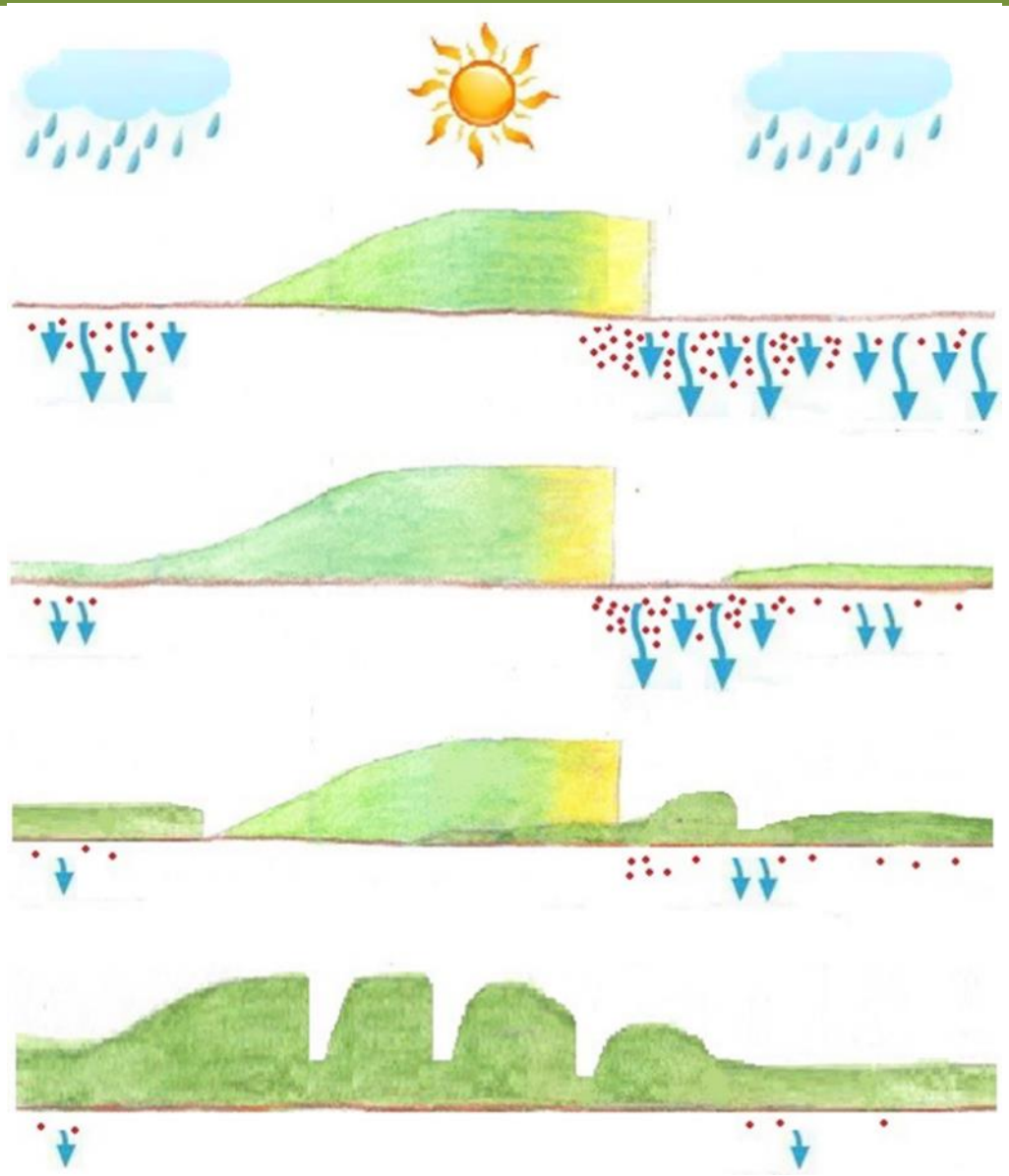
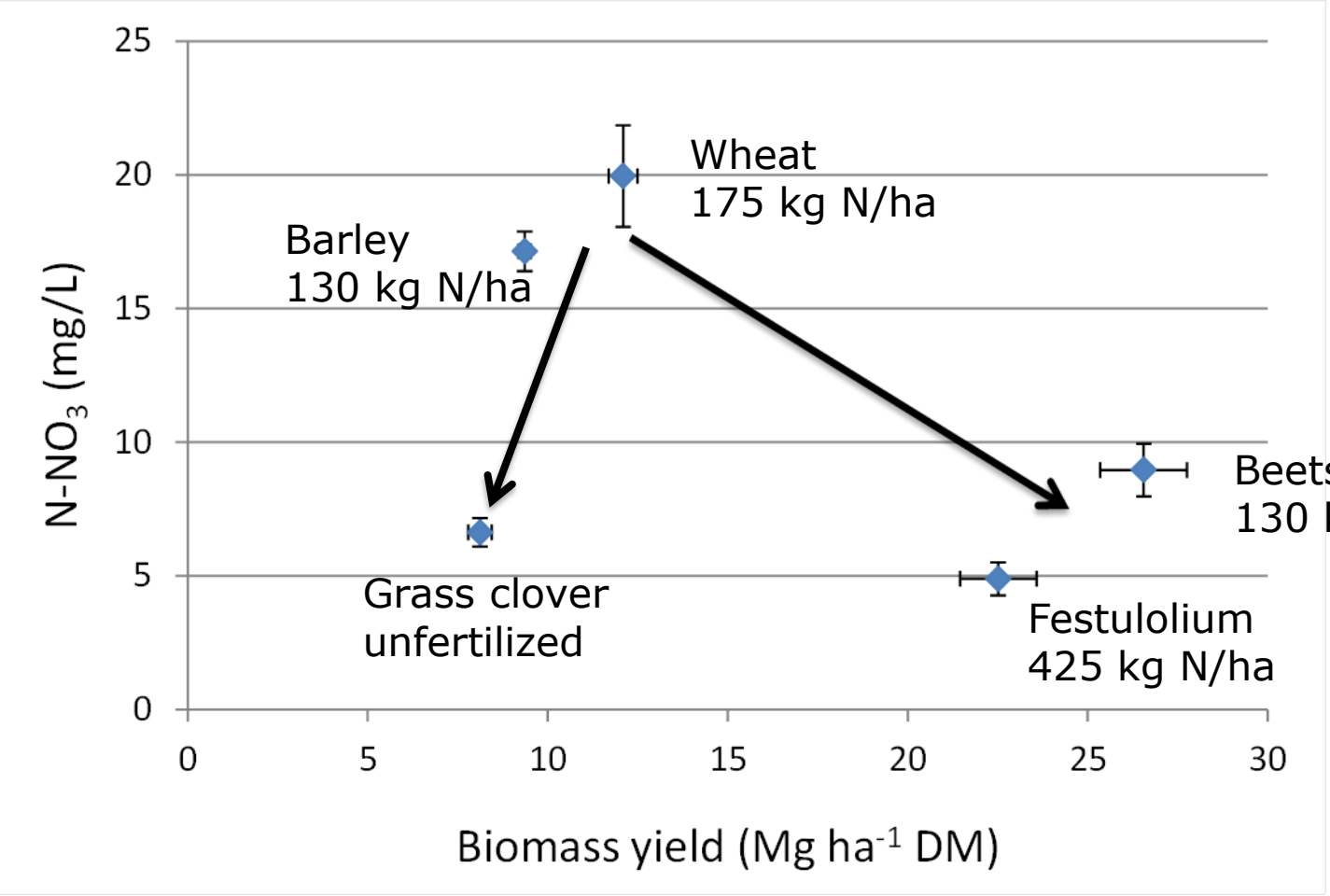


Figure adapted from E.M. Hansen, Aarhus University.


Production systems designed to cover the whole year investigated at Aarhus University

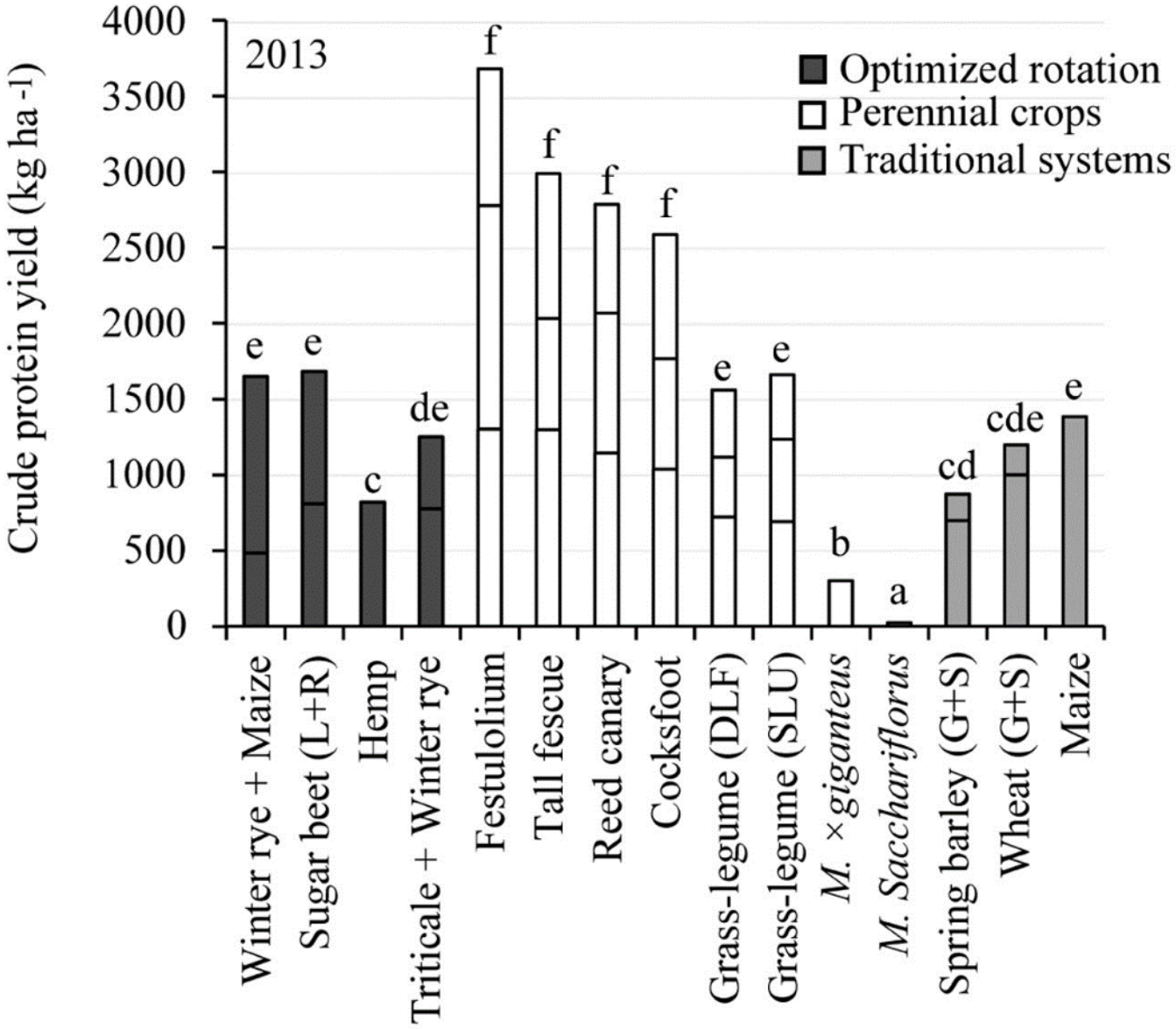
It is possible to increase yield AND to decrease nitrate leaching



Jørgensen & Lærke, 2016

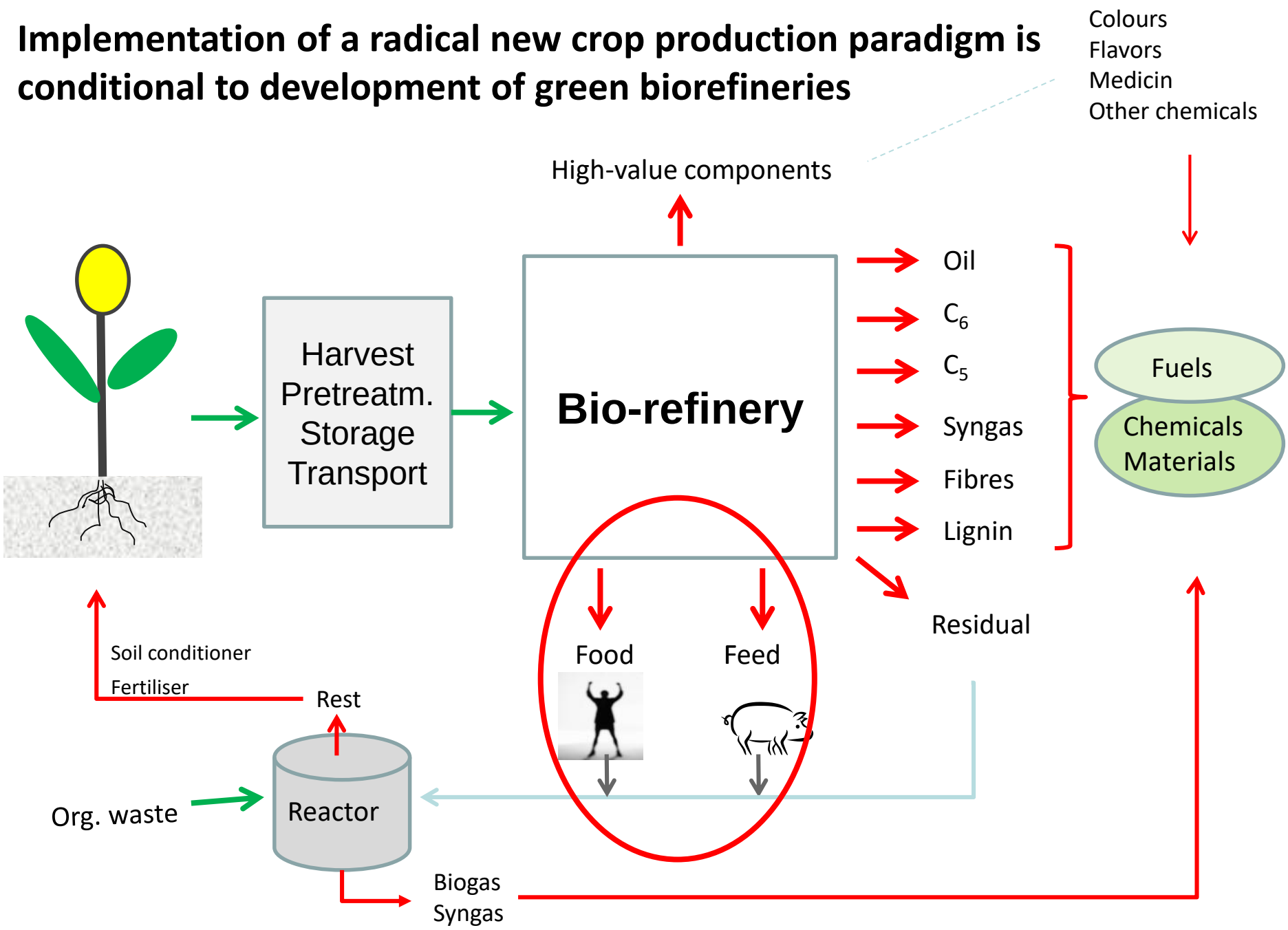
So, what to do with all that grass?

Crude protein yield higher in grasses than in other crops



Solati et al., 2018

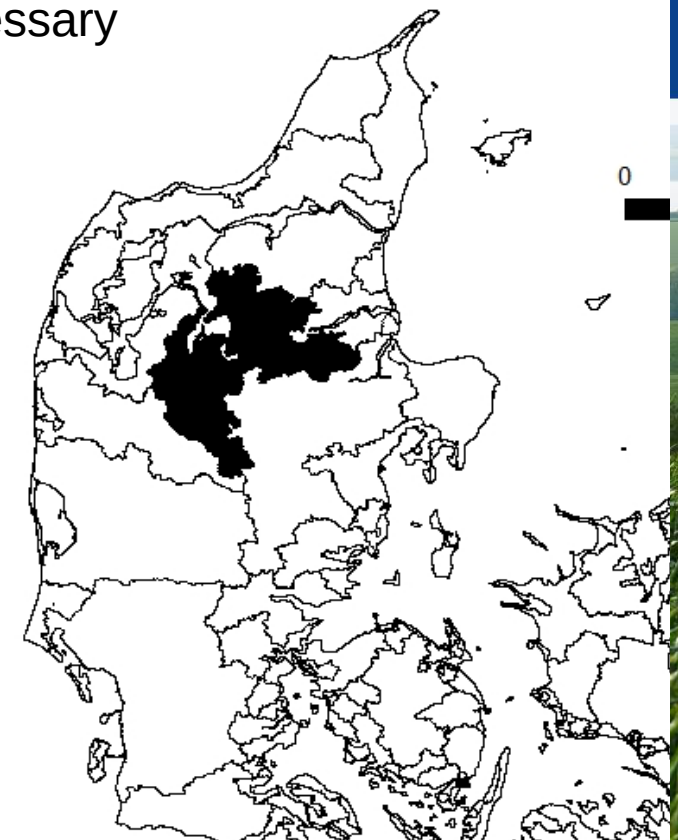
Implementation of a radical new crop production paradigm is conditional to development of green biorefineries



Policy analysis EPA: can increased biomass production around Limfjorden fulfil the Water Framework Directive?

A reduction of 976 T N annually has been postponed till after 2021

Current measures seem not able to fulfil this reduction, and set aside may be necessary

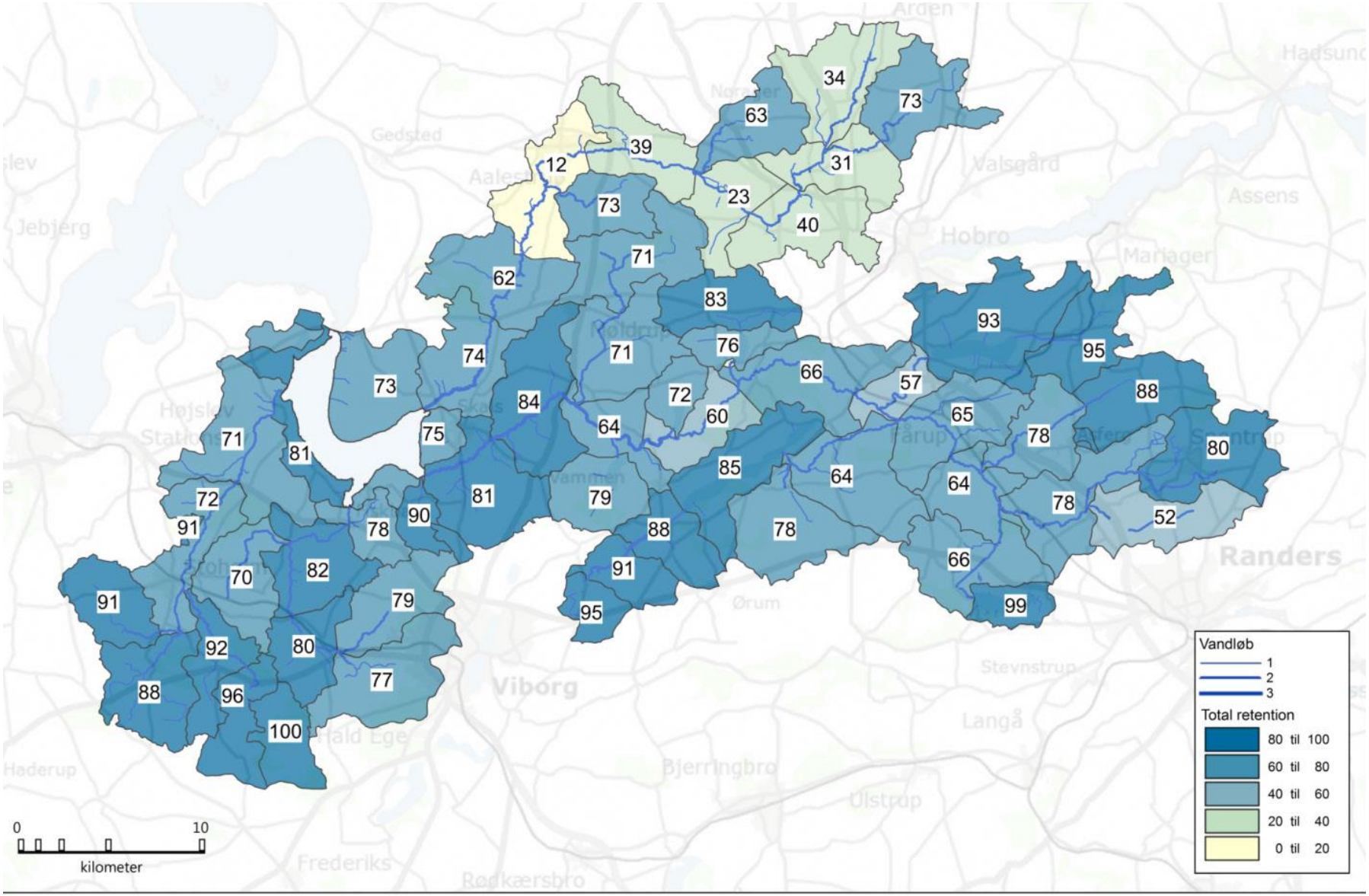


Scenarios analysed

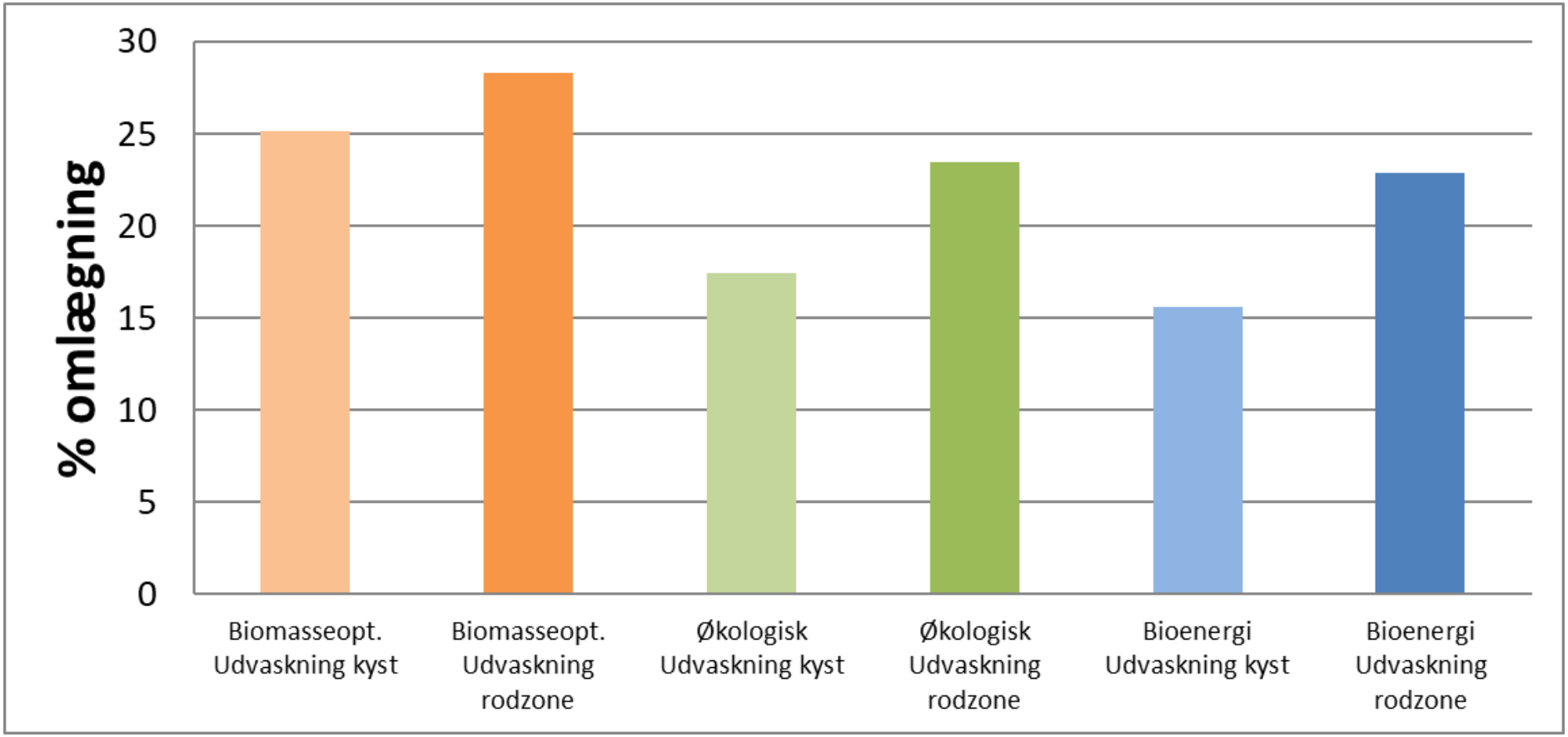
1. Business as usual (large proportion of annual crops)
2. Biomass optimised Scenario (conversion into pure grass, highly fertilised)
3. Organic Scenario (conversion into grass clover, low fertiliser level)
4. Bioenergy Scenario (conversion into energy willow, low fertiliser level)

- Data from national registers (CHR, GLR, soil map, fertilisation etc.) were used to model nitrate leaching from each field
- All scenarios were modelled with and without including the effect of soil retention (nitrate reduction in deep soil layers)
- The grass production was converted in biorefineries into a protein concentrate, a fibre fraction for cattle feed, and a brown juice for biogas.
- Willow was used for local heating plants

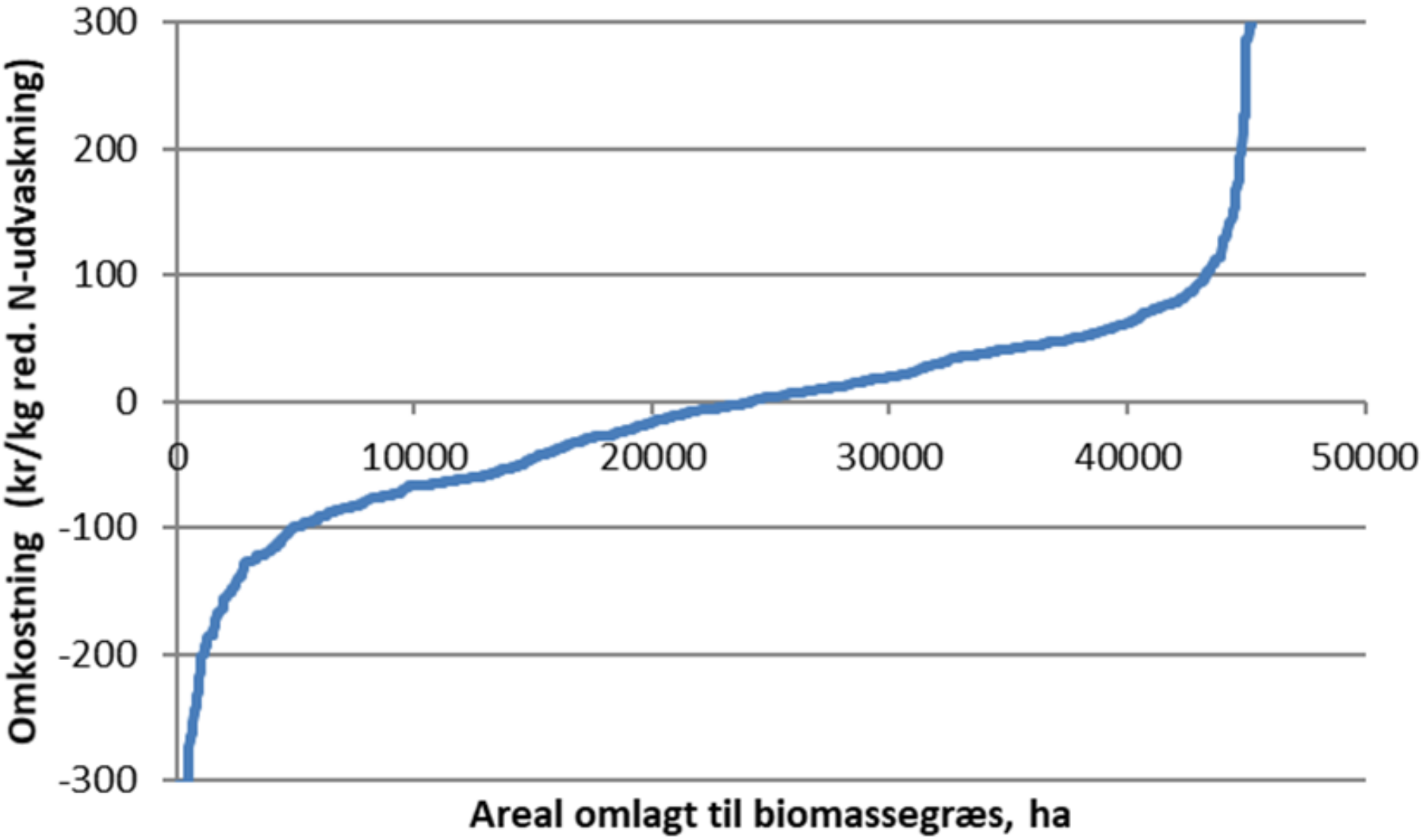
Situating crop conversion for max effect: N-retention in the watershed of Hjarbæk Fiord



Crop conversion necessary to reduce nitrate leaching to the coast by 977 T N annually



Economic analysis for conversion into intensive grass




SOROTO
6.0m
MULTIMIX

Feeding experiment with green protein to organic broilers

Miljø- og Fødevareministeriet

gudp

ICROFS Organic RDD

GRASS PULP FOR DAIRY COWS

BIOVALUE SPIR

ICROFS
International Centre for Research in Organic Food Systems

Grass pulp versus grass silage for cows

- Dry matter intake unaffected
- Milk production increased by approx. 10%

Vinni K Damborg phd dissertation 2019

Decentralized facility–prerequisites

In:

Capacity: 20.000 tonnes DM Clover grass
(+/- 2.000 hectares)
Investment : 20.000.000 DKK
Maintenance : 5% of facility investments
Depreciation : 10 - 15 years
Operating time facility: 3.000 hours/year

Out :

3.600 ton DM Dried protein concentrate
14.000 ton DM Pulp
2.500 ton DM Brown juice

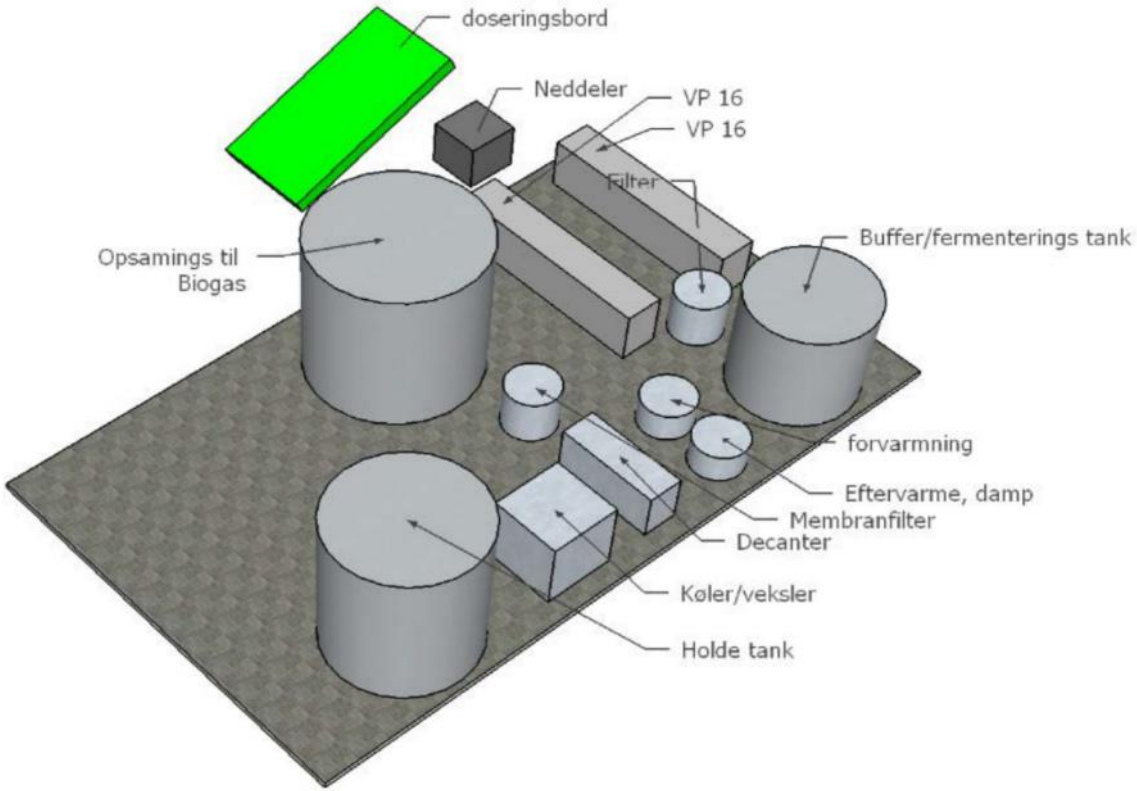
Source. Morten Ambye Jensen

Economic result for decentralized green biorefineries

	Conventional (kDKK/year)	Non-GMO (kDKK/year)	Organic (kDKK/year)
Income			
Dried protein (Soy equivalent)	9.445	13.789	18.889
Pulp	12.633	12.633	12.206
Brown juice	-396	-396	-396
Total income	21.682	26.026	30.699
Costs			
Grass	22.601	22.602	22.551
Energy, auxiliary mat.	2.871	2.871	2.871
Labour	1.474	1.474	1.474
Cost of capital	2.834	2.834	2.834
Total costs	29.780	29.781	29.730
Net result	-8.098	-3.754	969

Demo-plant for green biorefinery under construction for 2019

Supported by public funding and Arla, Danish Crown, DLG & DLF



Conclusions on grass production to secure farming licence in nitrate-sensitive areas

- Grass can approx. double productivity and halve nitrate leaching per ha compared to cereals
- Extract the high protein content in grass & legumes and feed the fibre to dairy cattle
- Fibre fraction may be in excess if local cattle production is limited; can then be used for biogas, fermentation, or…..
- Feeding trials on mono- and poly-gastric animals are promising
- Positive business case for organic production
- May be a cheaper way to fulfill the WFD than other measures

Farmers are eager to produce grass – if there is a market

Environmental gains may be used in marketing