Green Valleys
Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund
EUROPEAN UNION

CBIO
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

AARHUS UNIVERSITY

GO-GRASS

Green biorefinery as the tool for disruption of Northwestern European agriculture

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

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

Northwestern European agriculture is challenged

GO-GRASS

Productivity & competitiveness

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

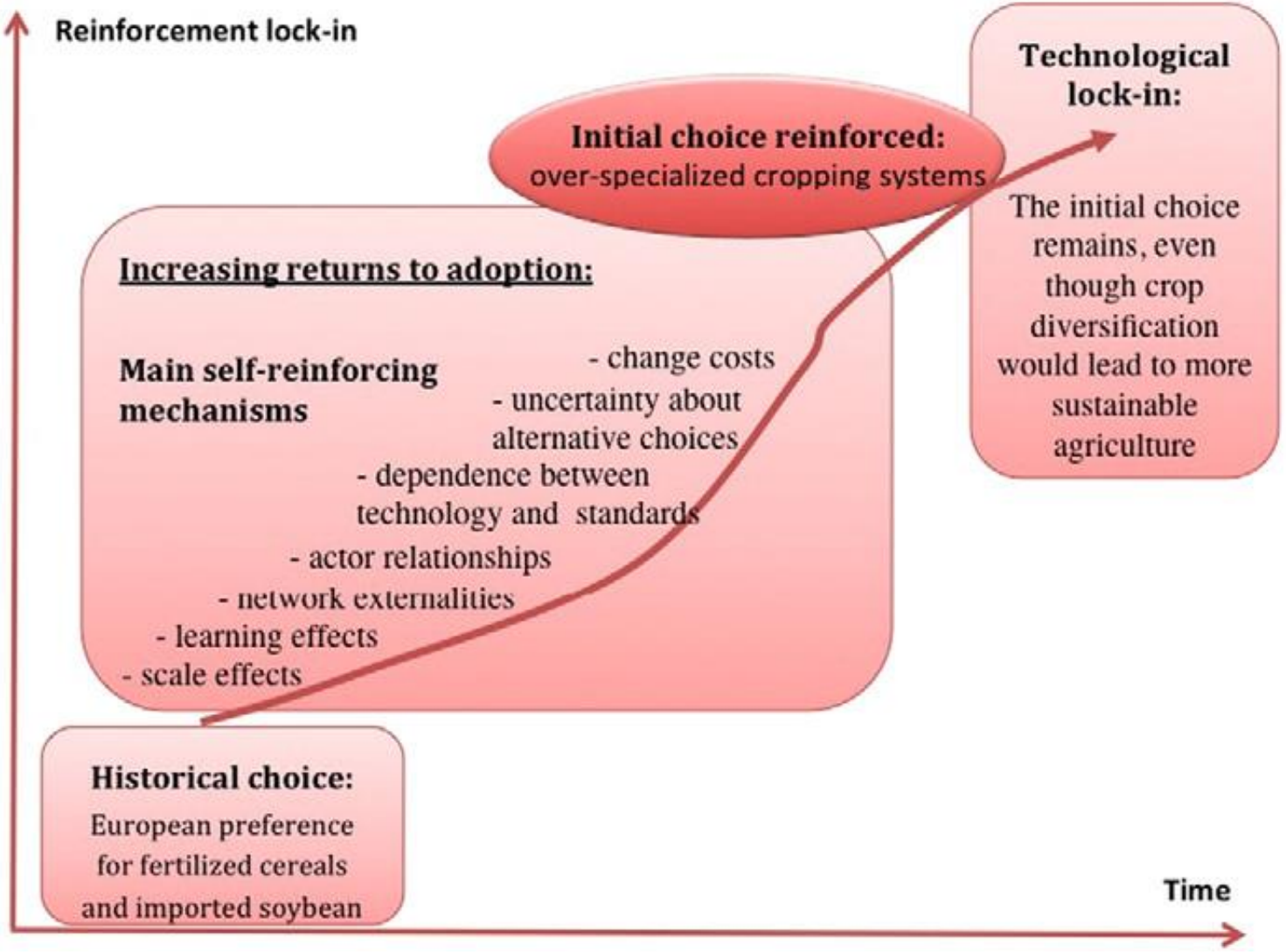
Environment

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

Time to look for radical innovation instead of just incremental

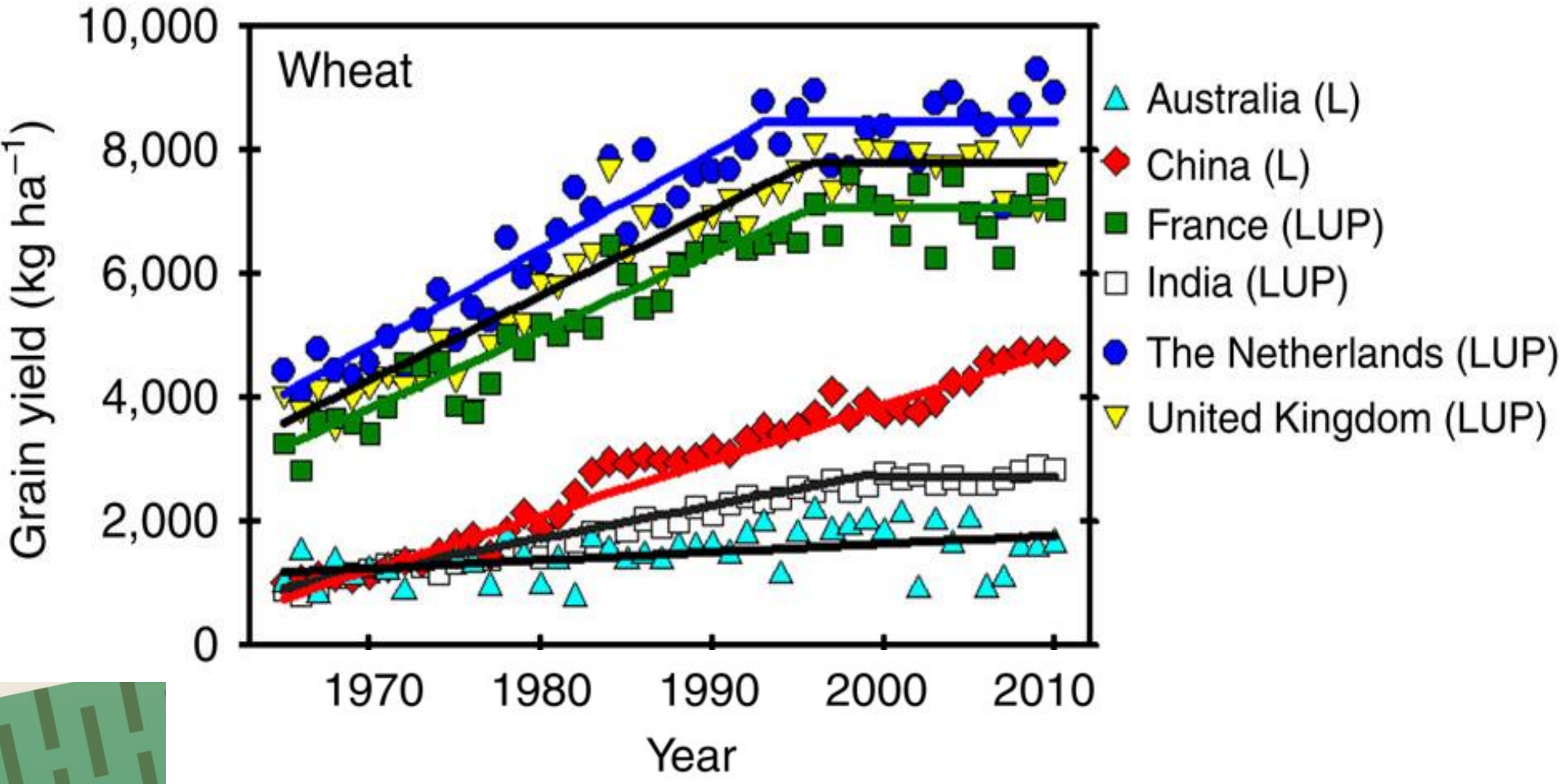
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

Agriculture is locked-in by highly specialised cropping system technology and network actors



Marie-Benoit Magrini et al., 2016. Ecological Economics, 126, 152-162

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

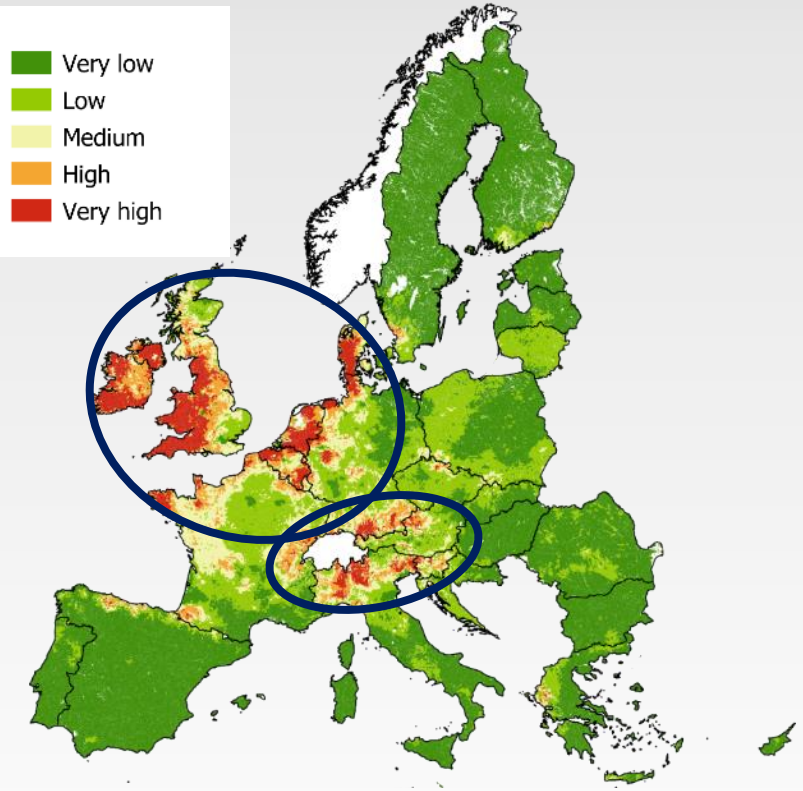


Patricio Grassini, Kent M. Eskridge & Kenneth G. Cassman, 2013.Nature Communications 4, no. 2918

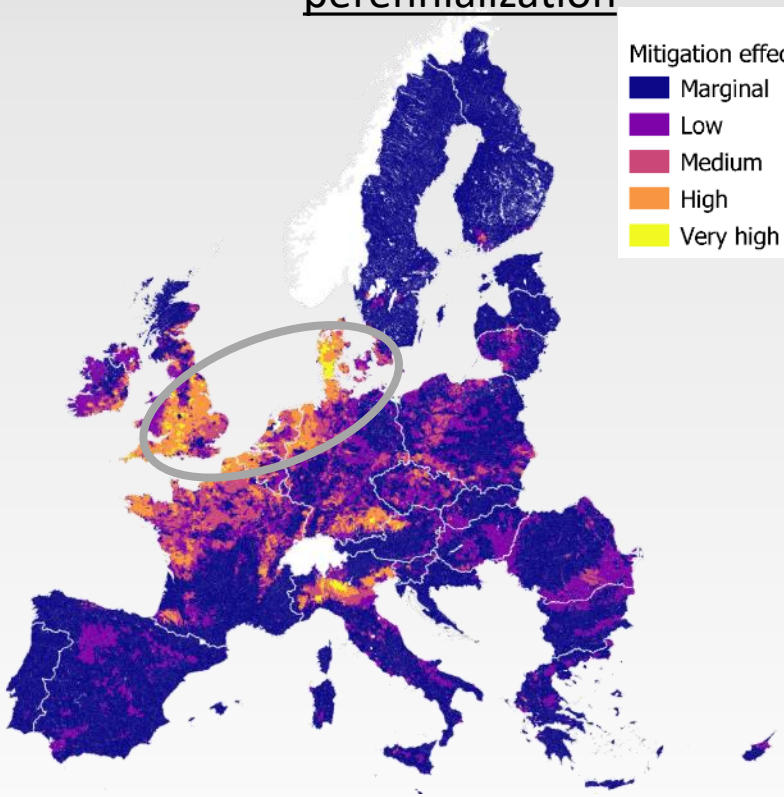
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

There are strong drivers for change - e.g. N emissions to water from agricultural land (*Englund et al., 2019*)

Degree of current impact



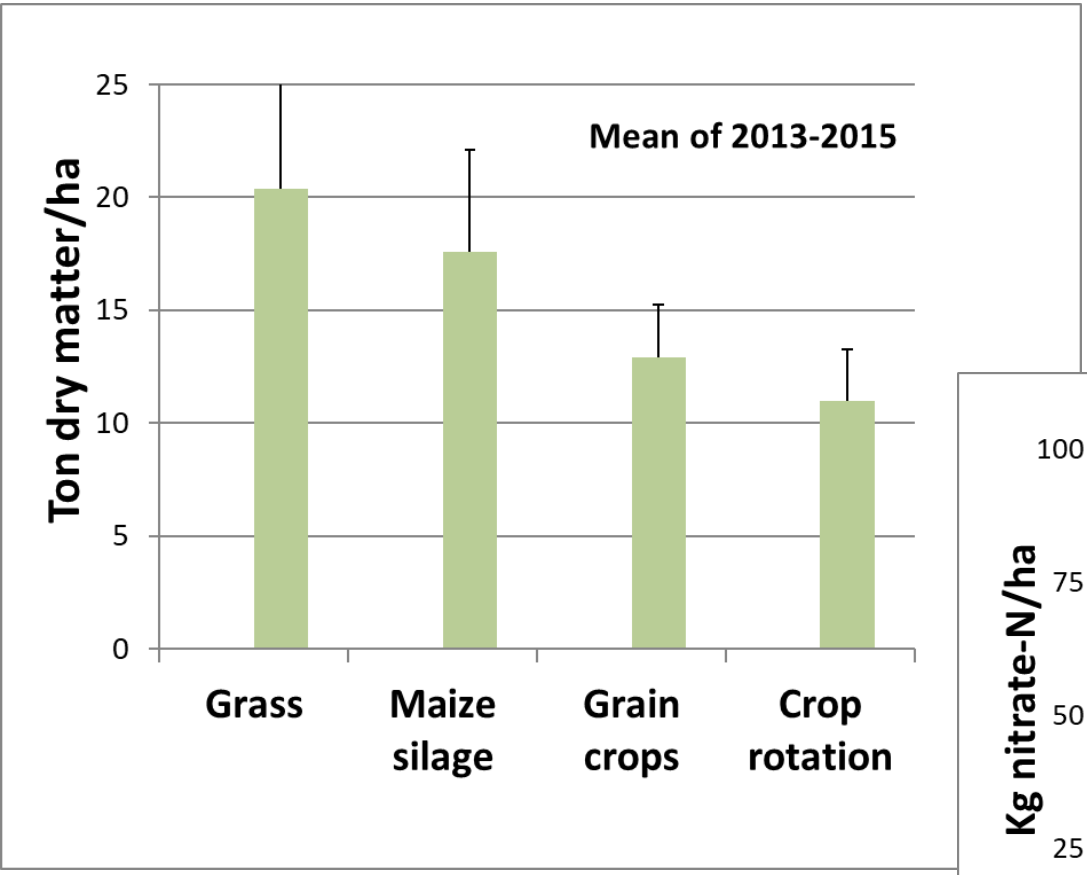
Effectiveness of strategic perennialization

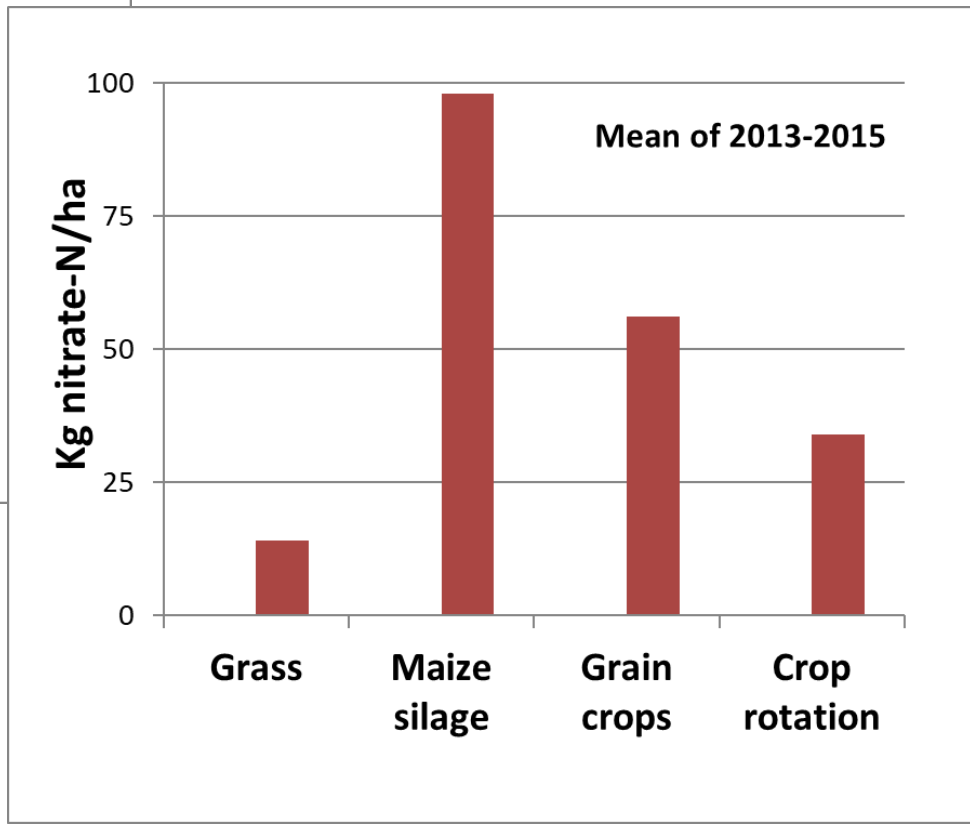


Strategic perennialization
Example

Fields can look this different in autumn – we decide

Biomass production can be doubled
and nitrate leaching halved





Manevski et al., 2017; 2018

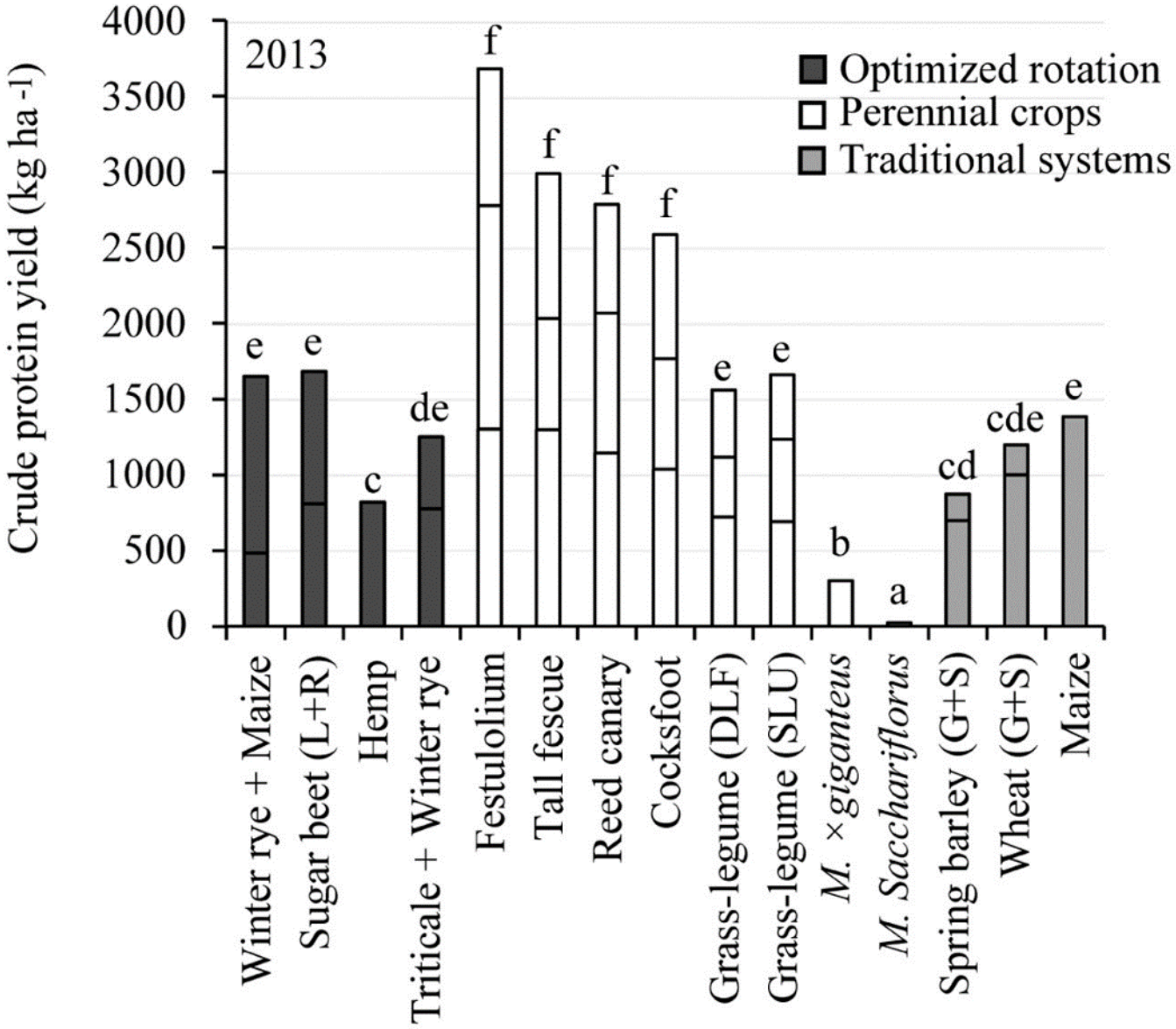
Other environmental benefits from conversion of annual crops to grass

- Reduced soil erosion
- Reduced GHG emission (0.5-3.5 ton CO_2-equiv/ha)
- Reduced pesticide use (by factor 40-50)
- Increased biodiversity

Børgesen et al., DCA Report No. 131, 2018

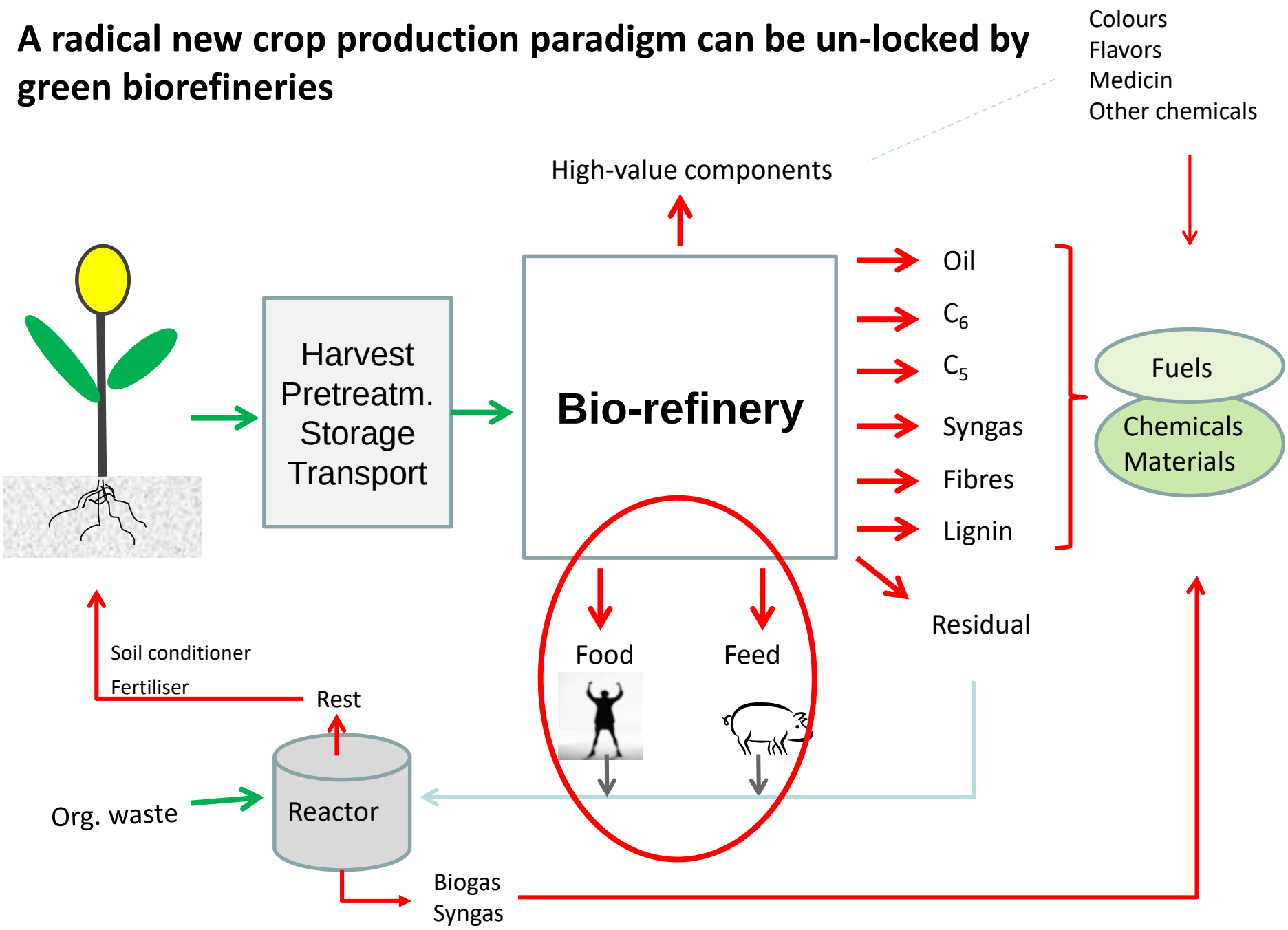
So, what to do with all that grass?

Crude protein yield higher in grasses than in other crops



Solati, Z, Manevski, K, Jørgensen, U, Labouriau, R, Shahbazi, S & Lærke, PE 2018. Industrial Crops and Products 115, 214-226.

A radical new crop production paradigm can be un-locked by green biorefineries



Green Valleys

Interreg

Öresund-Kattegat-Skagerrak

European Regional Development Fund

EUROPEAN UNION

CBIO

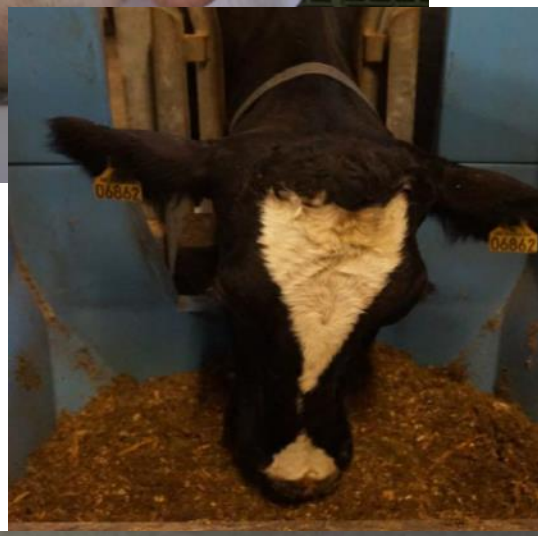
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

Feeding experiment with green protein to pigs, cows, broilers & egg layers






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.

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

Source: Morten Ambye-Jensen

Green Valleys
Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund
EUROPEAN UNION

CBIO
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

ready to pave the way for market introduction

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

GO-GRASS

Green Valleys

Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund

EUROPEAN UNION

CBIO
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 862674

GREEN BIOREFINERIES CAN DISRUPT LOCKED-IN AGRICULTURAL SYSTEMS BY CREATING NEW MARKETS AND ENSURE

GO-GRASS

Green Valleys
Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund
EUROPEAN UNION

CBIO
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**