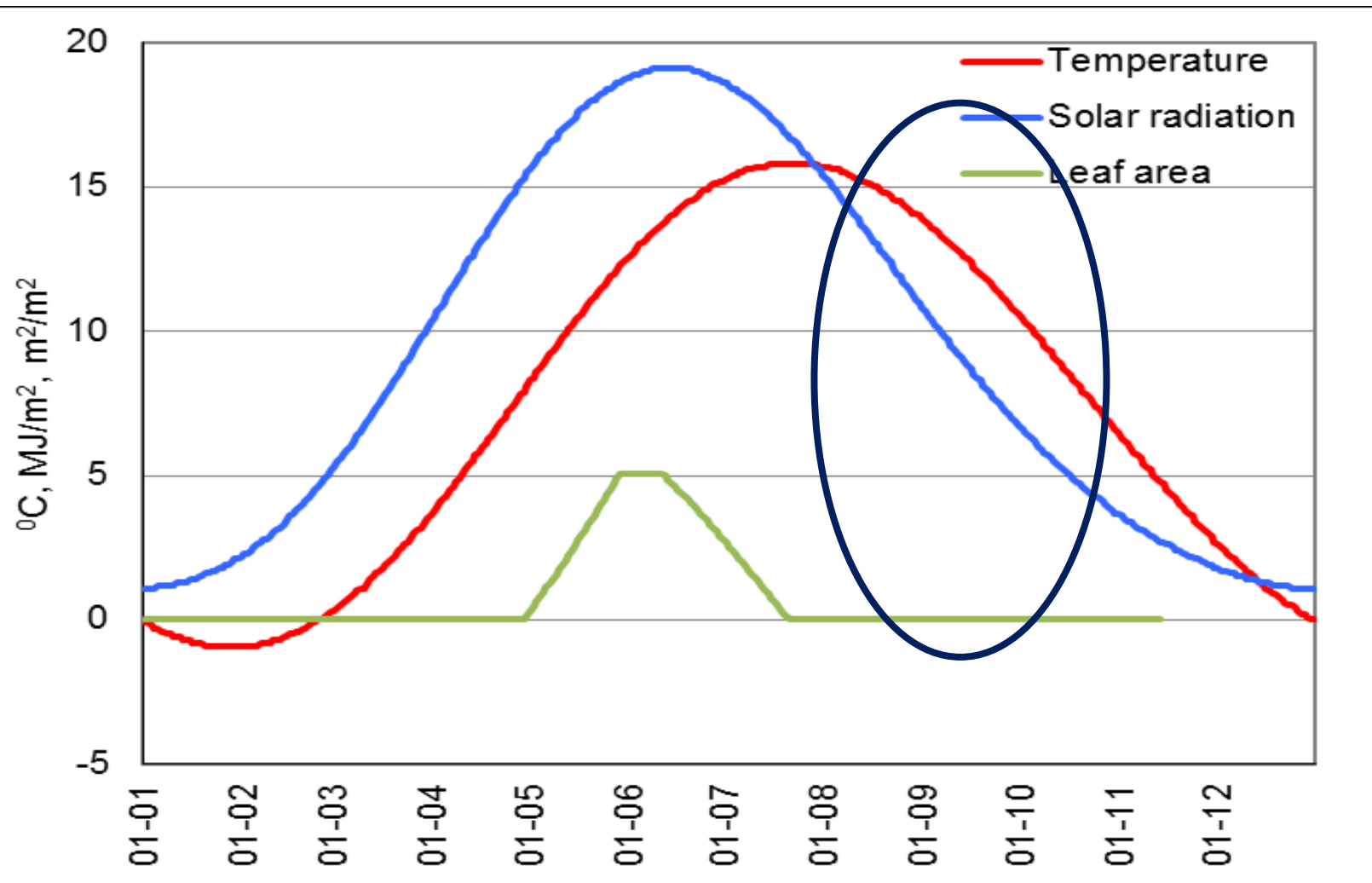


# The AU green biorefinery platform – Where is the soil carbon?

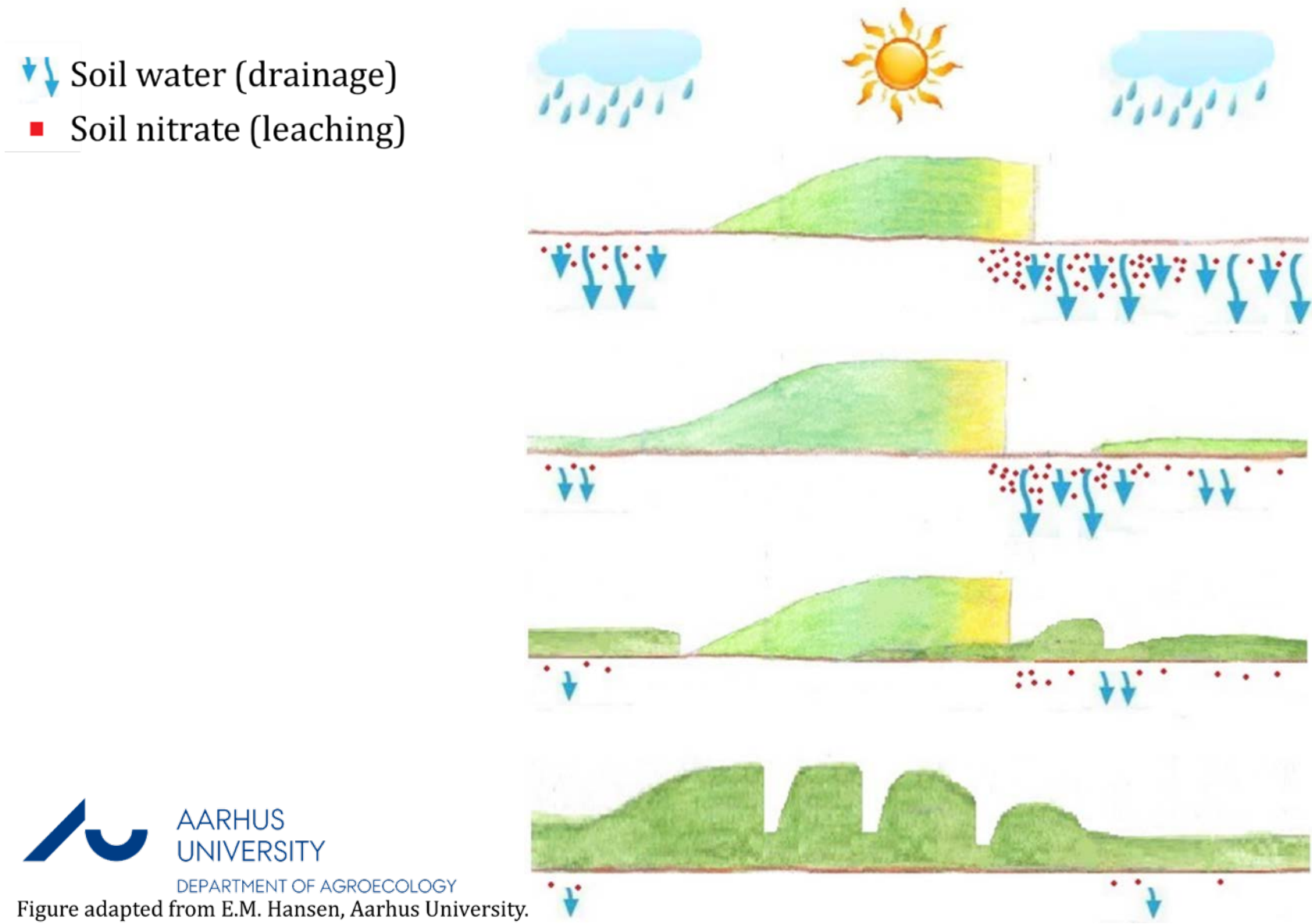
Uffe Jørgensen Department of Agroecology, Aarhus University Foulum



# When we grow grain crops we only utilize part of the growing season; Case: spring barley in Denmark



# When we grow grain crops we need to tighten the nitrogen cycle



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

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ONOMY



# Production systems designed to optimize productivity are investigated at two sites since 2012

## Optimized Crop Rotation

- Energy maize + Winter rye (direct sowing end October – one cut spring)
- Energy beets
- Hemp + Triticale
- Triticale early harvest (10-15 July) + undersown grass clover/rape (two cuts: autumn and spring)

## Conventional crop rotation

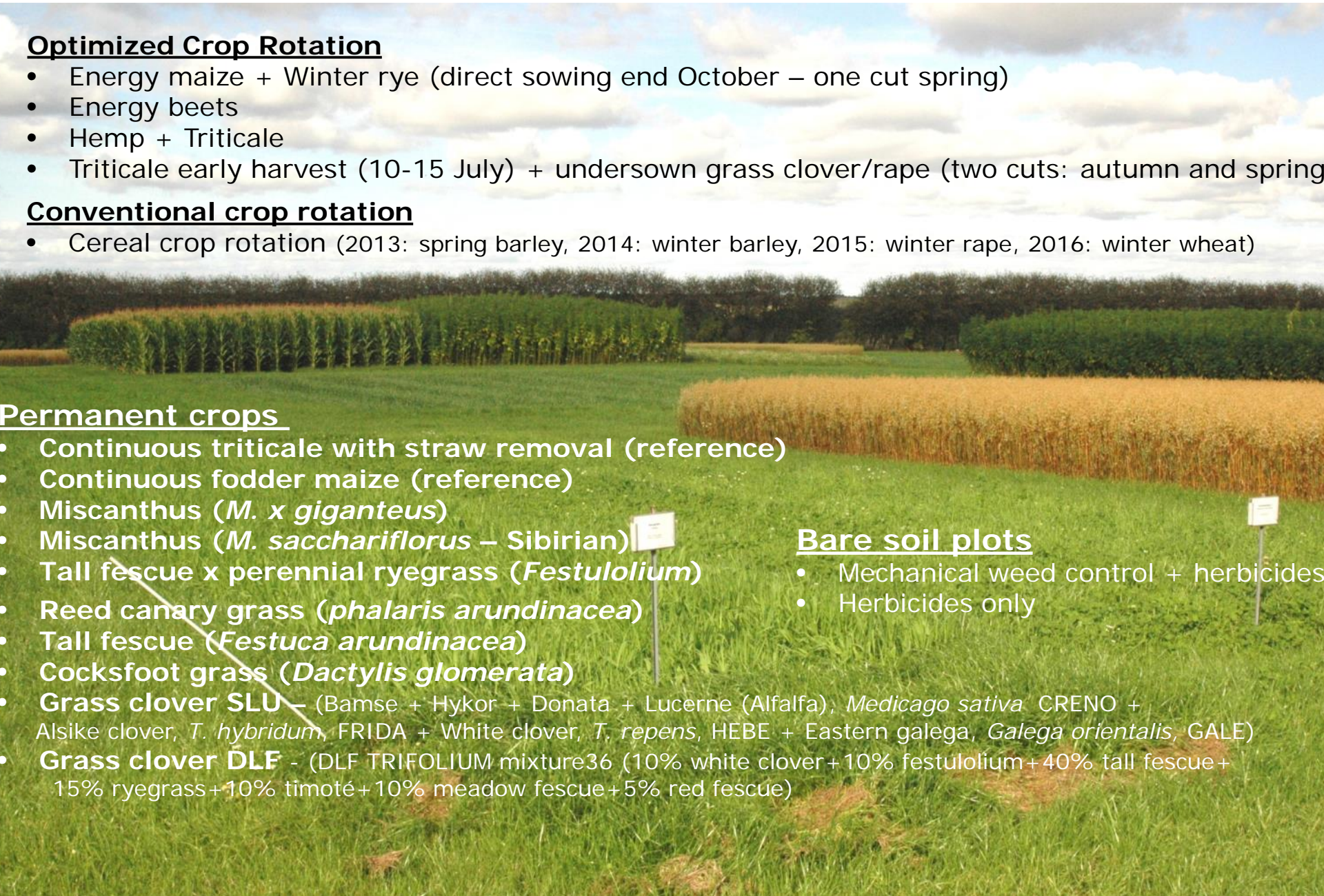
- Cereal crop rotation (2013: spring barley, 2014: winter barley, 2015: winter rape, 2016: winter wheat)

## Permanent crops

- Continuous triticale with straw removal (reference)
- Continuous fodder maize (reference)
- Miscanthus (*M. x giganteus*)
- Miscanthus (*M. sacchariflorus* – Sibirian)
- Tall fescue x perennial ryegrass (*Festulolium*)
- Reed canary grass (*phalaris arundinacea*)
- Tall fescue (*Festuca arundinacea*)
- Cocksfoot grass (*Dactylis glomerata*)
- Grass clover SLU – (Bamse + Hykor + Donata + Lucerne (Alfalfa), *Medicago sativa* CRENO + Alsike clover, *T. hybridum*, FRIDA + White clover, *T. repens*, HEBE + Eastern galega, *Galega orientalis*, GALE)
- Grass clover DLF - (DLF TRIFOLIUM mixture36 (10% white clover+10% festulolium+40% tall fescue+15% ryegrass+10% timoté+10% meadow fescue+5% red fescue)

## Bare soil plots

- Mechanical weed control + herbicides
- Herbicides only

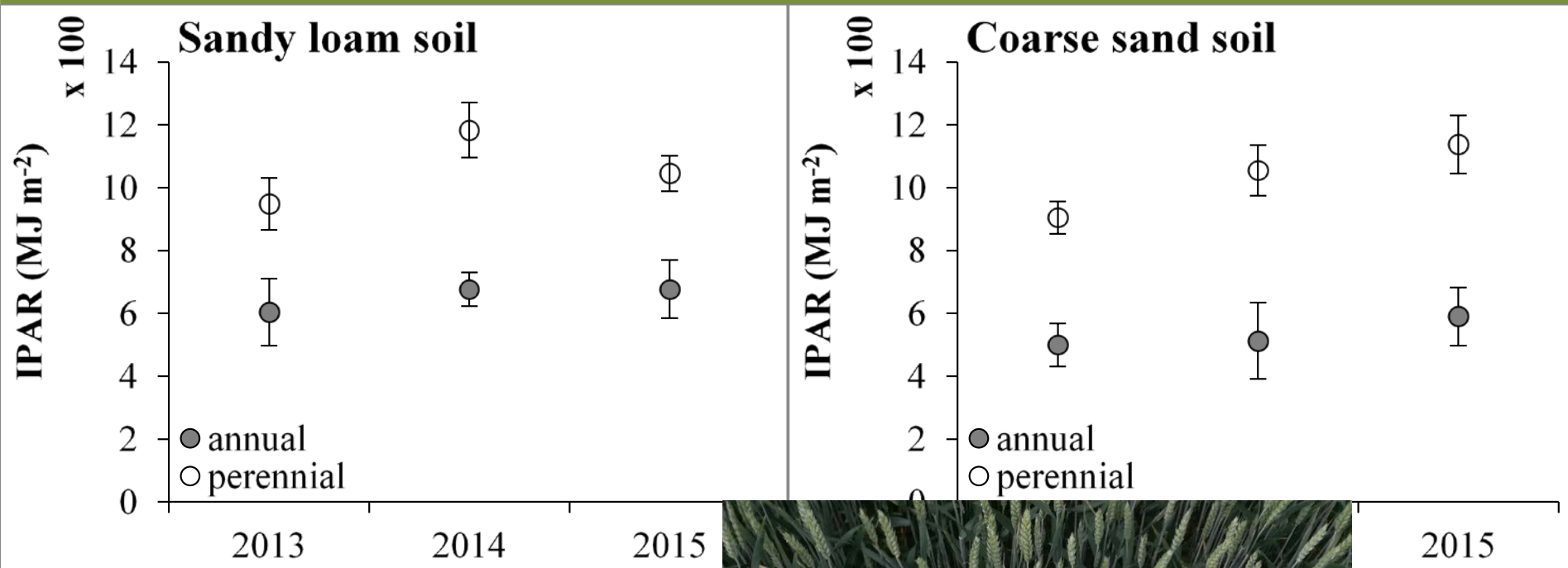




# Fields can look this different in autumn

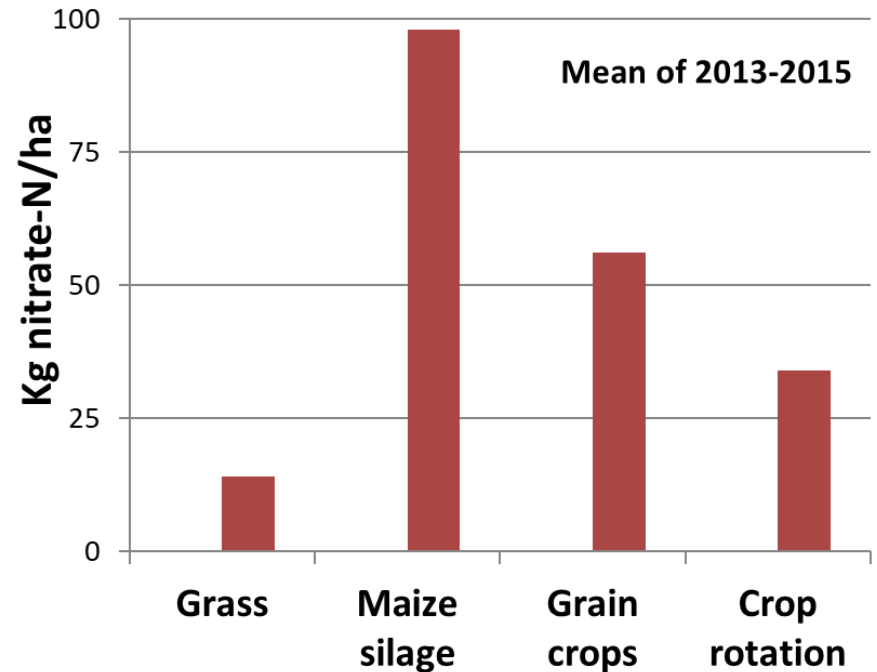
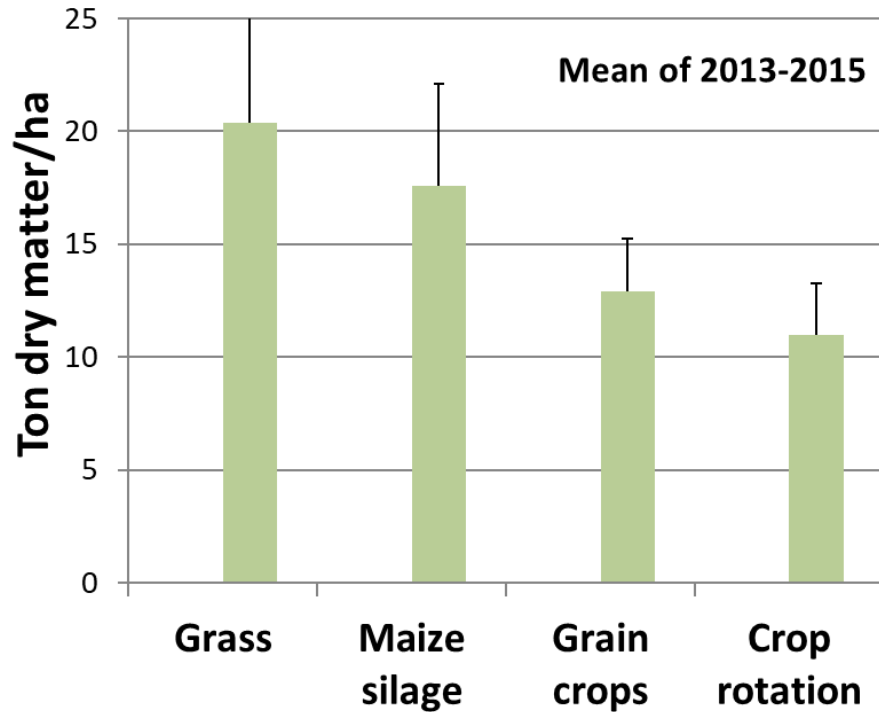


# Intercepted PAR almost doubled in grasses



Manevski et al., 2017

# 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<sub>2</sub>-equiv/ha)
- Reduced pesticide use (by factor 40-50)
- Increased biodiversity





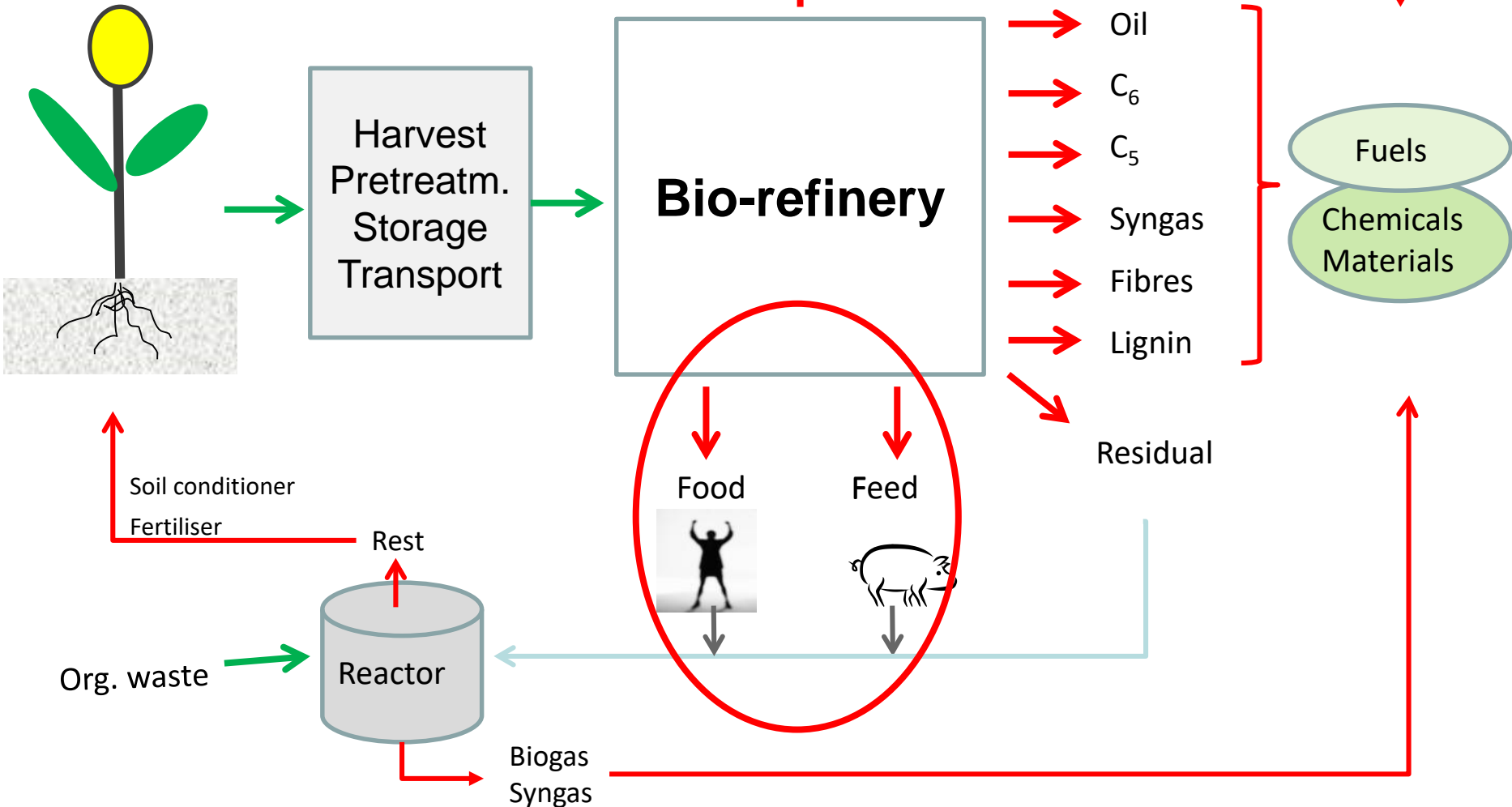
# So, what to do with all that grass?



# We will biorefine the grass into protein concentrate and a range of other products

Colours  
Flavors  
Medicin  
Other chemicals

High-value components





# Demo-plant for green biorefinery now ready to pave the way for market introduction

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

GO-GRASS



29 MAJ 2018

UFFE JØRGENSEN  
SENIORFORSKER

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



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CIRKULÆR BIOØKONOMI

# 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



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CIRCULAR BIOECONOMY



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# SOILS WERE SAMPLED IN 2012 + 2017, AND JI IS ANALYZING RESULTS ON SOIL C

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We expect grassland area to increase in DK but when doing that there are many uncertainties with respect to optimizing soil C effects:

- Pure grass / grass clover / forbs
- Cut grass / grazing / cutting intervals
- Regular re-seeding / permanent grassland
- Fertilization levels
- Etc.