GO-GRASS

GO-GRASS

Grass-based circular business models
for rural agri-food value chains

Danish DEMO

#EUGreenWeek online event, 22.10.2020
GO FOR GRASS
Exploiting Grassland Potential

AARHUS UNIVERSITY

CBIO
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

Food & Bio Cluster Denmark

mKjeldal

velas

DK DEMO Partners:

Aarhus University (Dep. of **Agroecology**, **Engineering** and **Animal Science**)
VELAS (Agricultural consultancy – involving local farmers)
Food & Bio Cluster (Cluster of knowledge inst. and industry)
IFAU (Institute for foodstudies and agroindustrial development)

Consultant: mKjeldal (Consulting for harvest machinery and logistics)

Base case value chain

Main drivers for the DEMO development

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Fertilizer

Biogas plant

Manure

Heat/ power

Residual juice

Grass refinery

Protein concentrate

Fibre

Monogastric animal feed

Ruminant animal feed

Food

- Reduced N-leaching
- Reduced pesticide use
- Increased soil carbon

- Increase the value from grass
- Tech. R&D for the bioeconomy
- Business possibilities in rural areas

- Local production of protein feed
- Reduce environmental impact of animal feed

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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Large focus on biorefineries producing proteins from grasses and legumes in DK

For several reasons:

- Danish agriculture is one of the worlds most **intensive agricultural productions**
- World leader in pig breeding and pig meat production - **produces 31.8 mio pigs/yr** (2019)
- This is sustained due to **import of 1 mio ton feed protein per year**

- DK agriculture has **environmental challenges**, especially with **nitrogen leaching**, causing eutrophication, and **pesticides leaching** into groundwater reservoir.
- Danish agriculture has a **specific challenge to apply to the EU Water Directive**

  Directive 2000/60/EC – framework for Community action in the field of water policy

- The Danish Climate Act from 2019 sets a target to reduce Denmark's emissions by **70 percent in 2030 compared to 1990 and against climate neutrality by 2050**.
- Agriculture accounts for 20% of the total GHG emission in DK

Minister for Environment and Food in Denmark, Jakob Ellemann-Jensen, visiting AU ENG - tasting green protein, 2018

Minister for Environment and Food in Denmark, Mogens Jensen, inaugurating the first commercial plant in DK, Aug 2020

→ **Strong academic, political and industrial interest** in a fast implementation in DK

>15 ongoing R&D projects on Green Biorefining and 2 commercial projects 2020/2021

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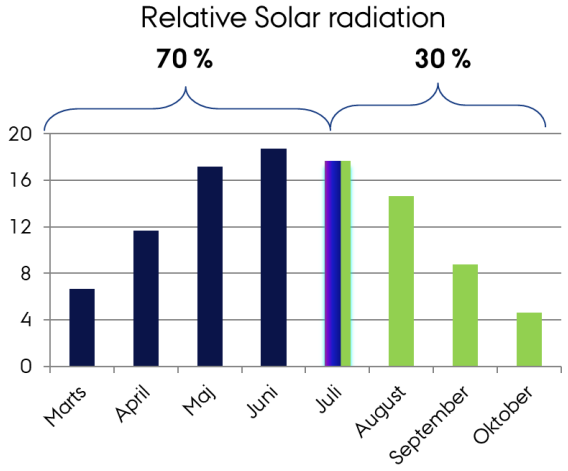
R&D on the green biorefining value chain since 2013

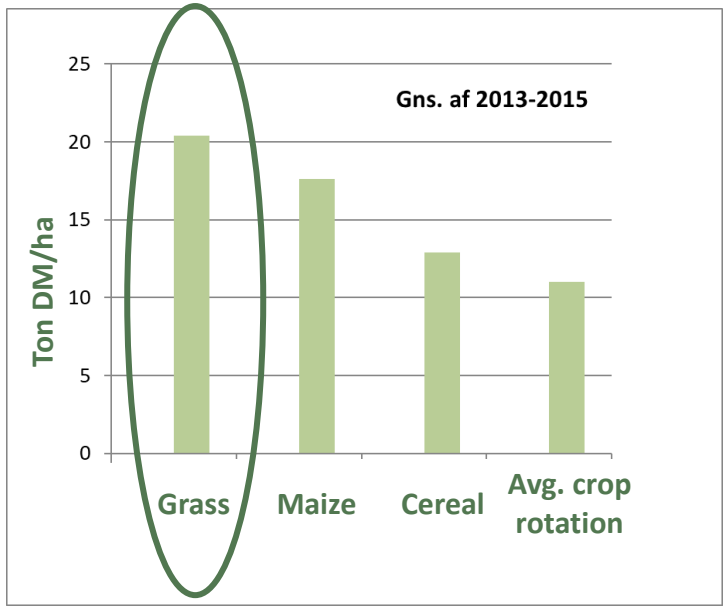
In the field

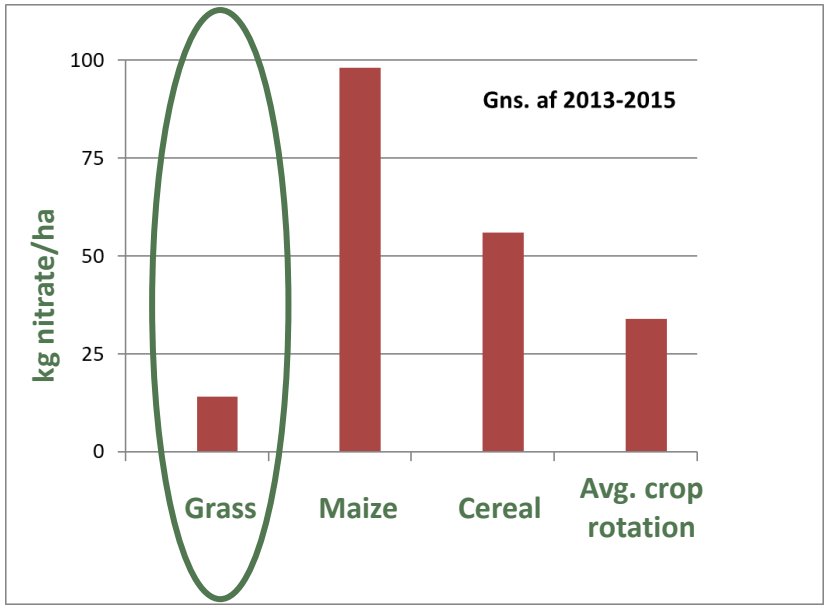
GO-GRASS



Grasses can be a tool for sustainable intensification

High yields – low environmental impact





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R&D on the green biorefining value chain since 2013

From lab scale to pilot scale to feed trials

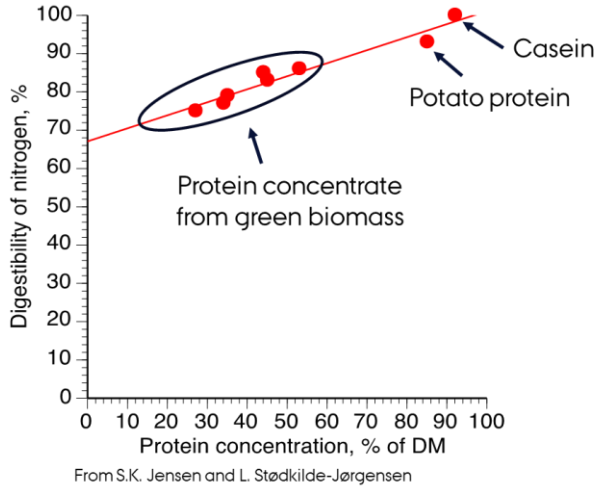
FIGUR 6: Fodringsforsøg med pressekage og almindelig græsensilage til malkekøer (Projekt BioValue).

2015

2016

2017

FIGUR 3: Fodringsforsøg med stigende mængder græsprotein til æglæggende høner (Projekt: OrganoFinery).



From S.K. Jensen and L. Stødkilde-Jørgensen

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Increasing quality of protein concentrate

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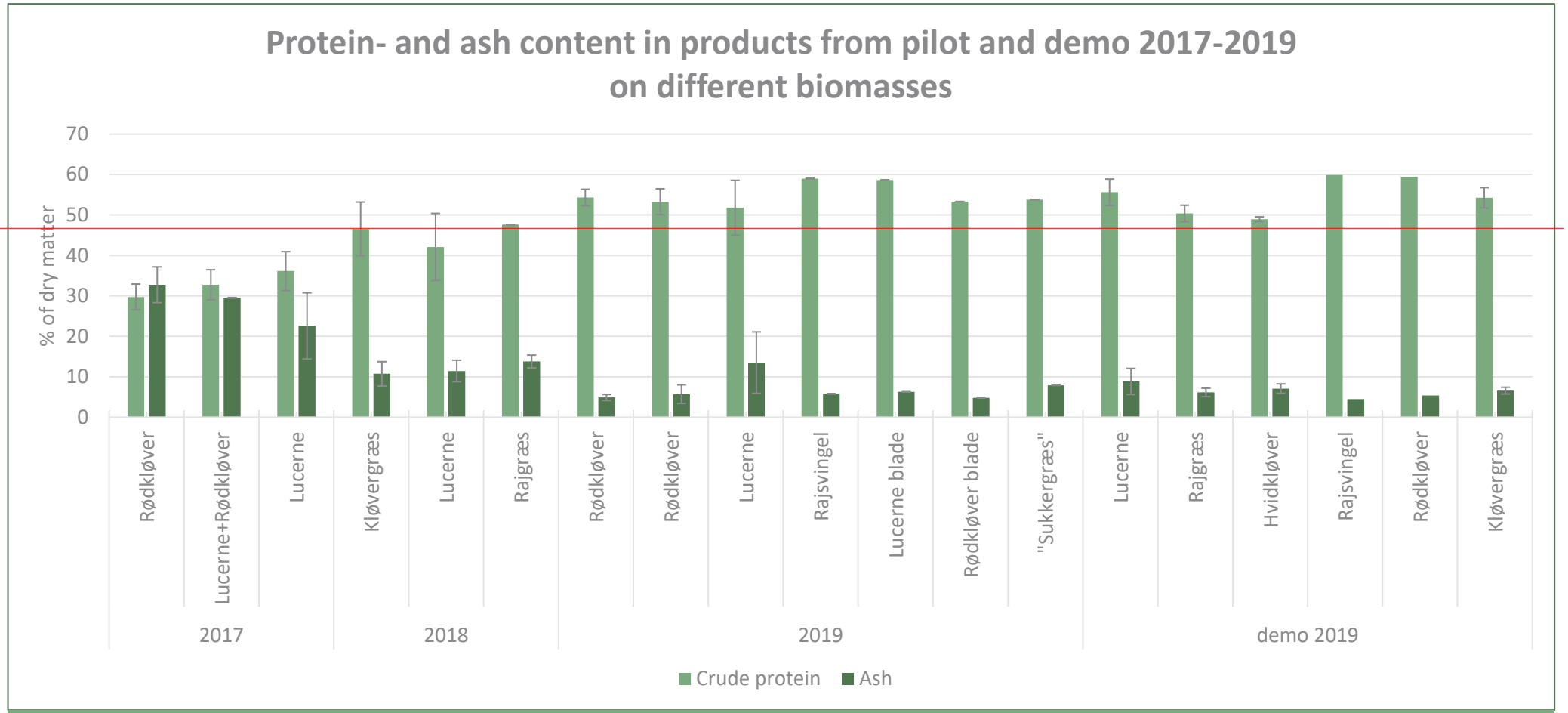
Average % CP in Soybean meal



Many different green biomasses has been tested these are just examples and include: grasses (e.g. Ryegrass, Festulolium), Redclover, White clover, Lucerne (Alfalfa), and Grass clover mixtures.

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Deployment of existing Demonstration Platform for Green Biorefining

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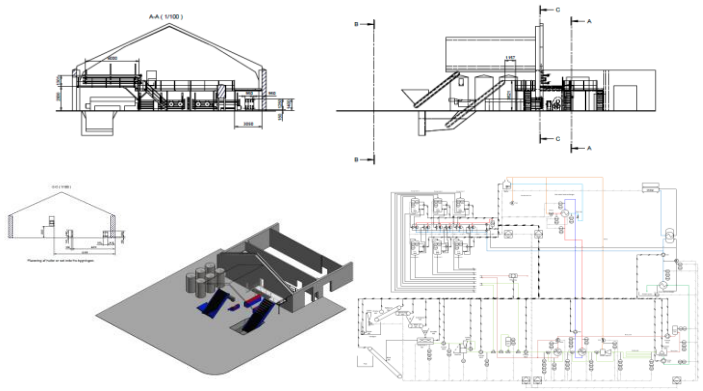
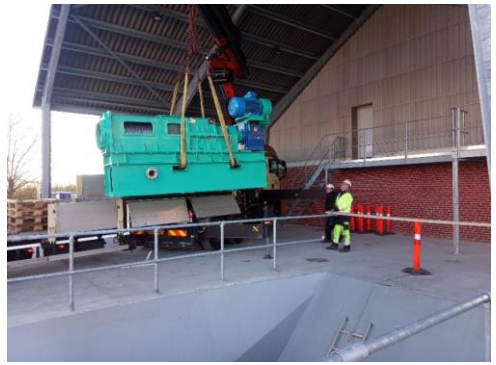


- Phase 1: Process design (Jan. 2018 – Jul. 2018)
- Phase 2: Establishment and commissioning (Jun. 2018 - May 2019)
- Phase 3: Run-in and process validation (May 2019 – Sep. 2019)




Info about the Demonstration Platform for Green Biorefining

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Location: AU Foulum

Budget for establishment: 2.01 mio EUR

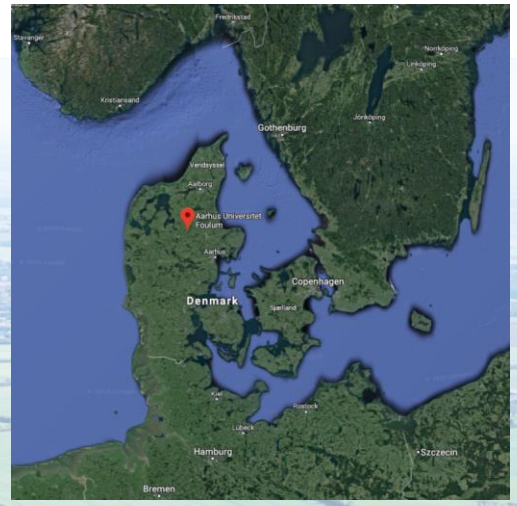
National, regional and industry funding

The platform is an open R&D facility (Currently >11 projects)

Input capacity: 1-10 ton/hr

Flexible process design for testing, optimization and tech. integration

Automatic control and extensive data collection



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Arla

DANISH CROWN

dlg

gudp

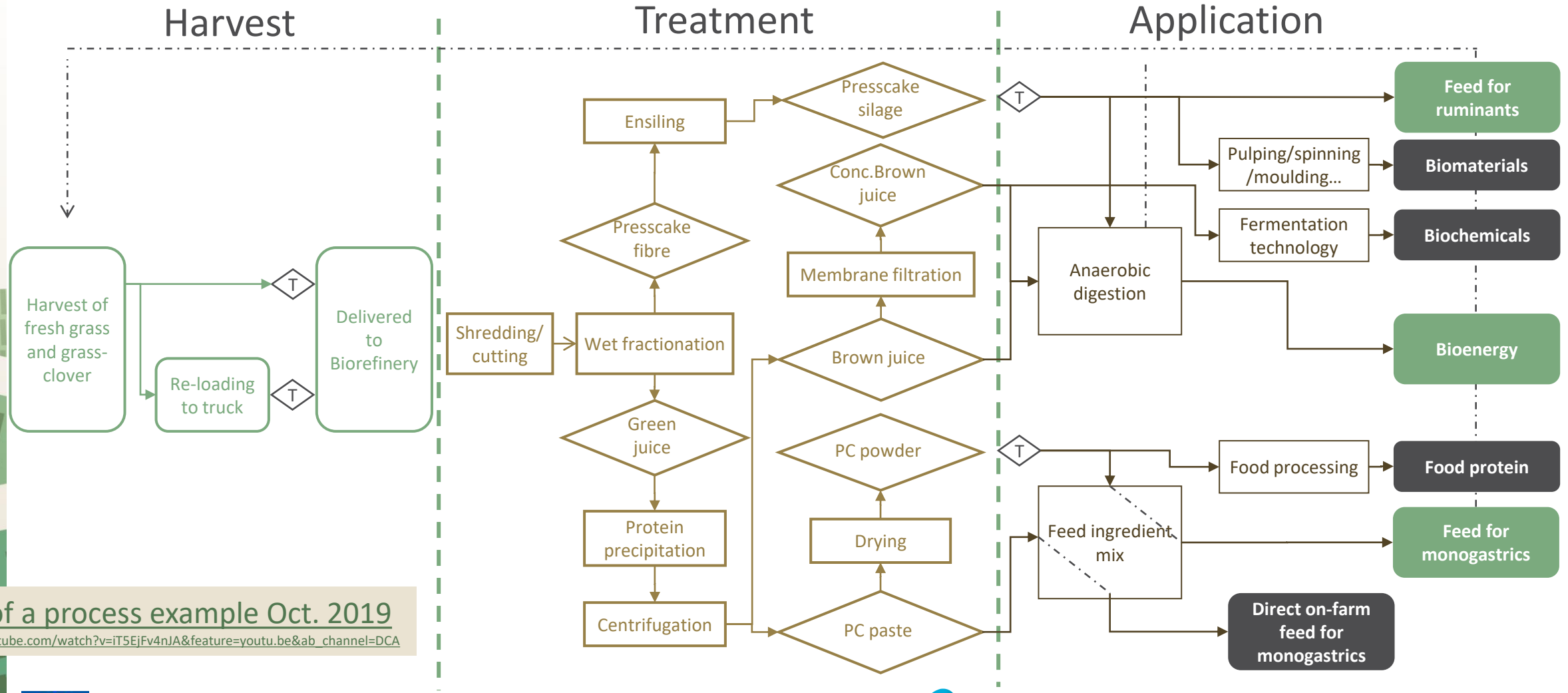
midt
regionmidtjylland

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

DLF
SEEDS & SCIENCE

Process Flow Diagram

Danish DEMO Overview



Video of a process example Oct. 2019

https://www.youtube.com/watch?v=iT5EjFv4nJA&feature=youtu.be&ab_channel=DCA

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Operational plan for DK DEMO

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Tests and experimental work in the pipeline in GO-GRASS:

- Harvest test and logistics in DEMO scale (e.g. ± fine-cutting in the field)
- Ongoing process optimization for yield and product quality
- Test of drying methods for dehydration of protein concentrate
- Animal feeding trial in 2021 and 2022 (Both protein for monogastrics and fibre for ruminants)
- Production trials from paludiculture biomass from wetlands

Establishing tall fescue and reed canary grass suitable for growth on sites with ground water tables at 10-30 cm below soil surface

Drying of separated protein concentrate

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Already two industrial consortia's are building commercial production facilities

TailorGrass – Ausumgaard, Vestjyllands Andel, R&D engineering og SEGES
Press release from the consortia
Inaugurated 4th Sep 2020

Fra grønt protein til køledisken –DLG, Danish Agro og DLF (BioRefine DK)
Press release from BioRefine Denmark
Planned operation from Spring 2021

Both are supported by DK funding through GUDP (Green Development & Demonstration Programme)

Focus on organic protein feed products from grass, clover and lucerne together with feed for dairy cows and biogas production.
Scale will be approx. 4x the AU Demonstration platform.
Processing green biomass from 1000-2000ha agricultural land.

Minister for Environment and Food in Denmark, Mogens Jensen, inaugurating the first commercial plant in DK, Aug 2020

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for rural agri-food value chains

Tak !

And Thank you for listening

Contact:
maj@eng.au.dk

web: Green Biorefining Technologies Group

@AUBiorefining

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GRØNBIORAF
DEMONSTRATION SCALE TECHNOLOGY PLATFORM
RESEARCH AND DEVELOPMENT IN GREEN BIOREFINING

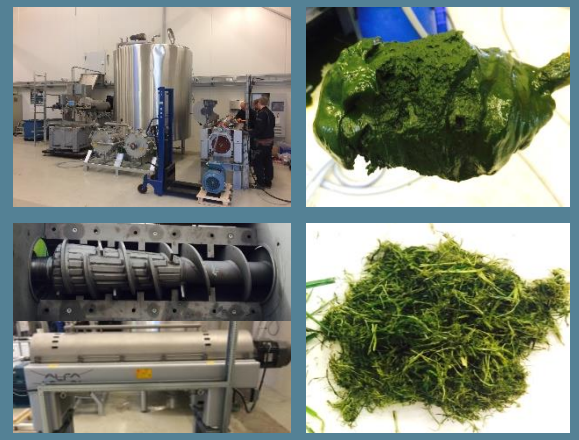
Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund
EUROPEAN UNION
Green Valleys

FURTHER DEVELOPMENT OF HIGHER VALUE PRODUCTS AND OPTIMAL USE OF RESOURCES

Biogas plant

Heat/P ower

Process water



Green Biorefinery

Human food

Monogastric animal feed

Ruminant animal feed

Bio-chemicals and -materials

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DEPARTMENT OF ENGINEERING

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GREEN BIOREFINING TECHNOLOGIES GROUP | MORTEN AMBYE-JENSEN
ASSISTANT PROFESSOR

Increasing quality of protein concentrate

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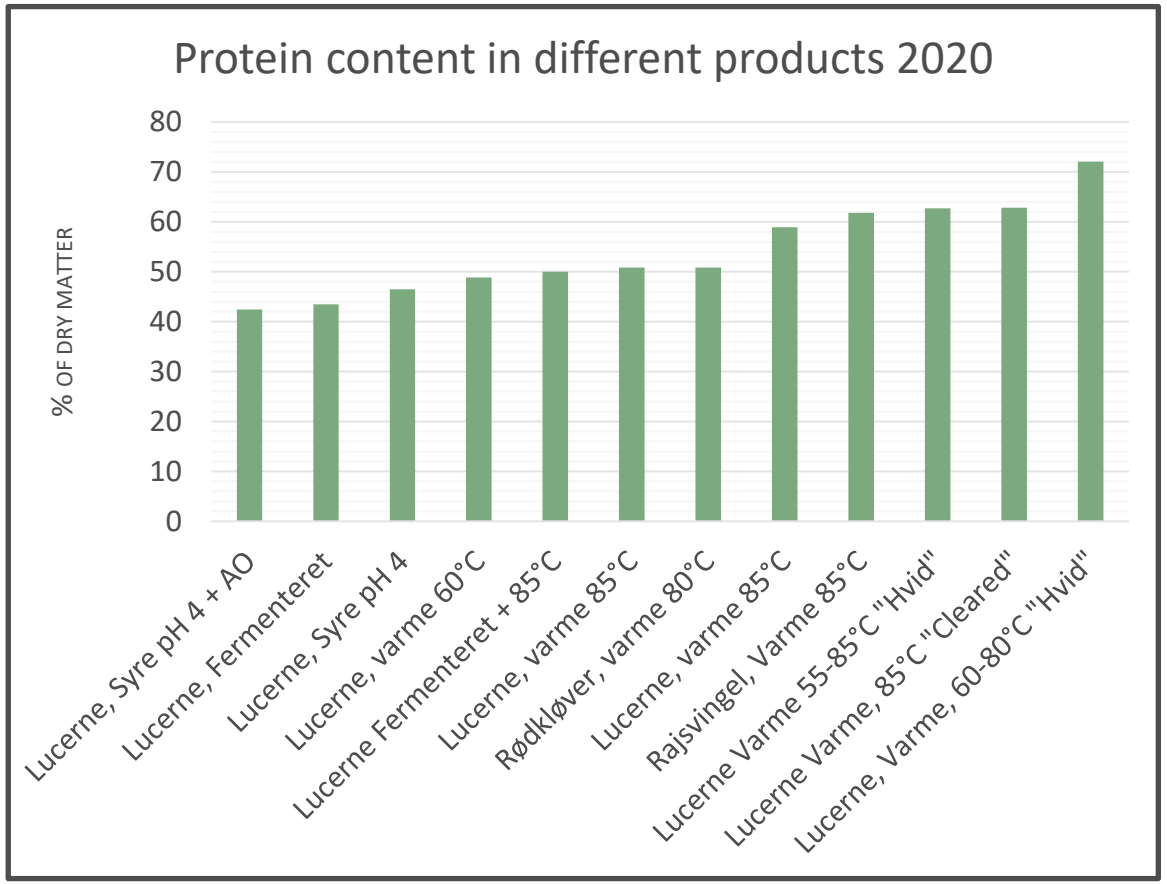
Example with different process configurations and different biomasses, June 2020

Acidified with HCL
Fermented
Heated to 85 ° C
Heated to 60 ° C followed by 85 ° C



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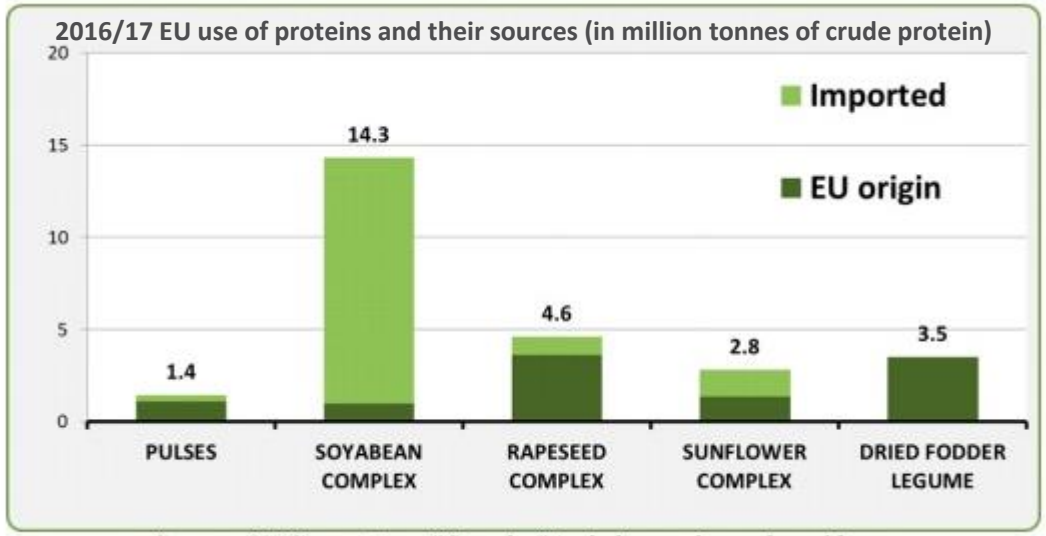
The protein challenge: **Protein deficit in EU**

- Meat production in EU is 63% dependent on soy import
- Equal to a production area the size of England
- Increased soy production adds to deforestation and soil depletion
- EU agro- and food industry is vulnerable to world market changes

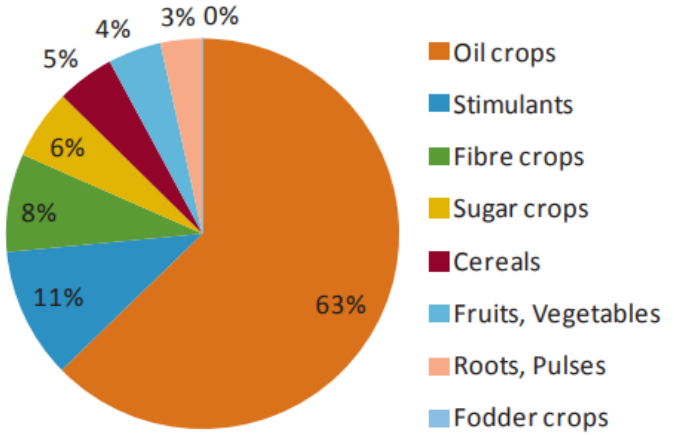
REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT on the development of plant proteins in the European Union, Brussels, 22.11.2018 COM(2018) 757



Source: EU Commission. "Complex" includes meals, seeds and beans

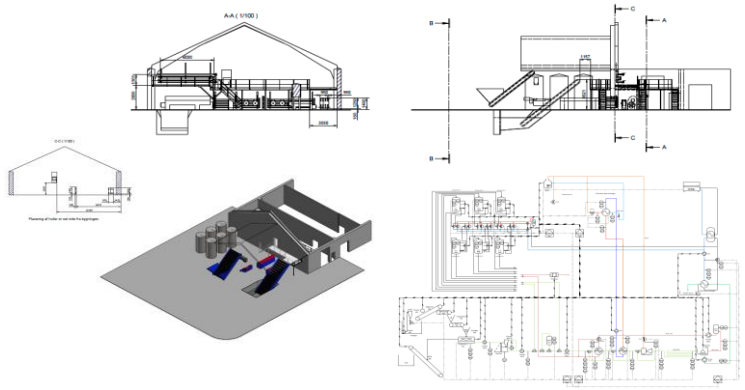
D. Cuypers, et al,. Impact of EU Consumption on Deforestation: Comprehensive Analysis of the Impact of EU Consumption on Deforestation. European Commission, Technical Report - 2013 – 063 (2013)

Deforestation embodied in traded crop commodities, by crop groups, for the period 1990-2008, totaling 22.4 Mha



New Demonstration scale platform

For research and technology development in green biorefining



Input: 10 ton/hr

Flexible process design

Automatic control and extended datacollectoin

Improved unit operations and processing

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http://cbio.au.dk/

Cross disciplinary AU center for development of bioeconomy

Agroecology Engineering Animal Science Food Science Chemistry

Research areas

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Test of harvest method and time from harvest to pressing

Test last week, Sep 2020

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Direct collection

Lay in swath and collecting with cutting

Direct cutting and collection

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New biomasses and agro-systems for green biorefining

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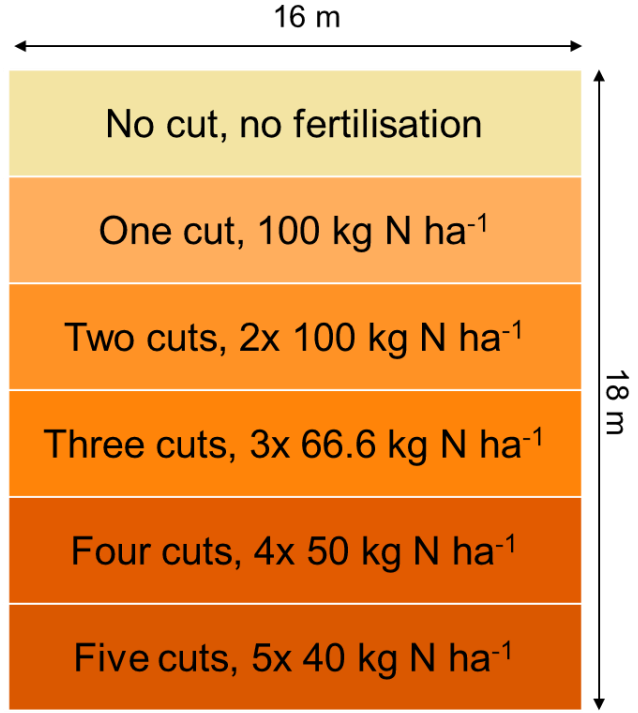
Paludiculture: biomass production from wetlands or rewetted peatlands

Experimental site on a poorly drained fen peatland in the Nørreå stream valley

Rewetting of drained peatland is needed to reduce GHG emission!

Cuts	Harvest weeks
One	32
Two	24, 36
Three	20, 32, 42
Four	20, 24, 36, 42
Five	20, 24, 32, 36, 42



Mineral fertiliser: NPK (18-0-16)

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Lab-scale protein extraction from tall fescue and reed canary grass

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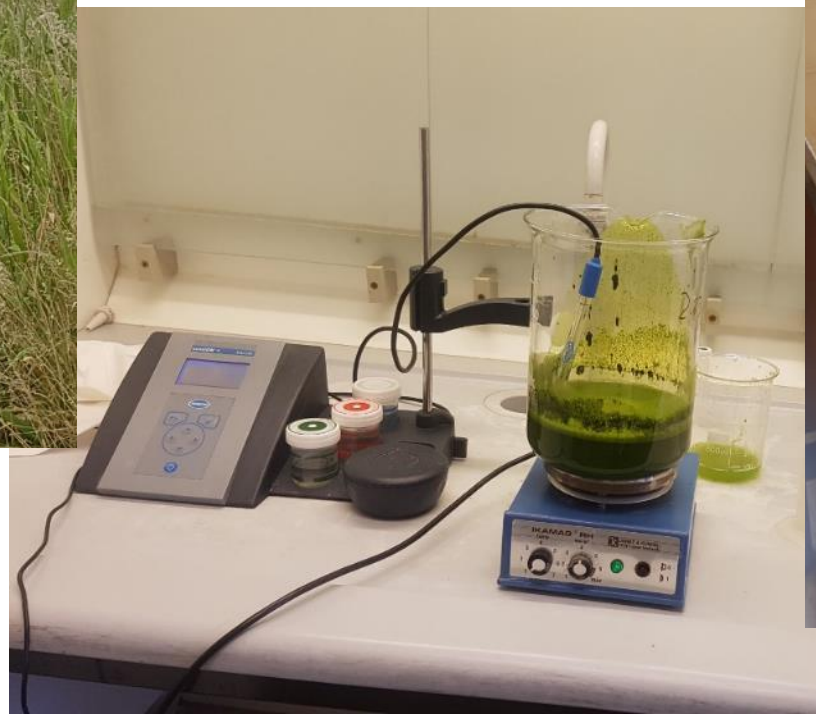
PhD student
Claudia Kalla Nielsen



Demo site in St. Vildmose (bog peatland)

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Establishing tall fescue and reed canary grass suitable for growth on sites with ground water tables at 10-30 cm below soil surface

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Typha plugs ready for planting

GO-GRASS

Manual planting of Typha plugs

Typha is suitable for growth in complete flooded conditions

GO GRASS AU

17.09.20

Agenda

- Introduction - BioRefine
- Nybro Tørreri
- Grass/Alfa protein - feed, pellets, bales, fresh
- From the farmers view – crop to sell
- Conclusions/discussion

BioRefine - Why

- Local produced climate efficient organic protein
  - Secure supply of protein locally
  - Able to substitute soja
- More grass or alfalfa in Denmark/EU
  - Strong contribution to environment and reduction CO2 footprint

Environment – data from Foulum/AU

Nitratudvaskning på sandjord:

Vinterkorn:	70-100 kg N/ha/år
Majs:	80-110 kg N/ha/år
græs:	**10-30 kg N/ha/år**

Pesticid behandlingshyppighed

Vinterkorn:	3,00
Raps:	3,70
Græs:	**0,07**

Flerårige græsmarker øger jordens kulstofpulje

Danske forsøg viser størrelsesordenen 1,1 t/ha

BioRefine – Who?

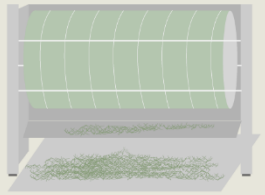
- **DA, DLF og DLG in new partnership**
- GUDP-project
- Acquire Nybro Tørreri a.m.b.a 1. maj 2020
- Start of factory spring 2021
- 2.500 Ha of raw material 4-5 cuts
- 5.000 tons of Protein 50 %

Grass protein – how?

PRINCIPSKITSE
FOR FREMSTILING AF GRÆSPROTEIN

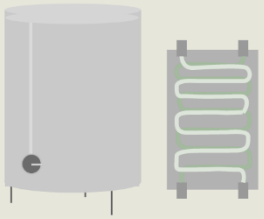
GRÆSHØST

PRESNING



PRESSEKAGE
Kvægfoder

PROTEINUDFÆLDNING
med varme eller syrning



CENTRIFUGERING

BRUNSAFT
Biogasproduktion

PROTEIN-KONCENTRAT
svine- og hønsefoder

SEGES

Where does it go

- Feed for Cattle, Pigs and Poultry
  - Substitution of Soy
  - Egg layers, chickens, pigs and cows
  - Green protein
- Protein for humans
  - Technology is developed – products 2022
  - White protein

Green crop as alternative to 1 year crops

- Competitive
- Protein as an alternative to Tons of Dry matter
- Synergies – Farmers - Biogas
- Diversity of crops

Conclusions

- 3’rd to 4’th generation
- Can you manage the quality of raw materials
- Synergies
- Different set ups
- Competitive
- Perspectives

Questions for further R&D

Harvest and logistics:

- Wich harvest method is most economical?
- What are optimal logistics? - How far can we transport fresh biomass? Should the process be split?

Protein extraction:

- How can we further increase product yield and quality and how does better quality affect the animal feeding?

Increasing value of co-products:

- Is it possible to achieve higher feed quality of the fiber fraction (press cake) for ruminants?
- Is it possible to produce competetive materials (packaging or textiles) from the fibres?
- What are the most attractive alternative products from brown juice besides biogas? – Biochemicals…?

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System questions

How to increase the sustainable green biomass delivery for biorefineries?

- Production and harvest of paludiculture crops on rewetted organic soils
- Integration of grass delivery into existing farmers production systems
- Integrated and optimized harvest and logistic systems
- Motivation and integration of stakeholders within the production circle

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Animal feed

Fibre utilization

Process optimization, modelling and assessment

Brown juice utilization

Green-Eggs
Greening of Organic Egg Production

Grass protein for organic egg production
Grant: GUDP (DK)
2017 - 2020

Feed trial 2020
Svineafgiftsfonden

Grass protein for organic pork production
Grant: ICROFS (DK)
2017 - 2019

Alfa Max Bioraf

Optimizing protein yield and qu… from …
…22

INBIOM
INNOVATIONSNETVÆRKET FOR BIOMASSE

Cellulose textile from non-wood biomass (fiber pulp)
Grant: INBIOM (DK)
2019

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DEMONSTRATION SCALE TECHNOLOGY PLATFORM
RESEARCH AND DEVELOPMENT IN GREEN BIOREFINING

Demonstration sc… R&D pla…
Grant:
…K)

Grass Biochar

Pyrolysis of fibres & biochar for feed applications
Grant: GUDP (DK)
2020-2023

Græs Prof

Grass breeding, Harvest & transp… Maceration & ju… Search for tanni…
Grant: GUDP (DK)
2020-2024

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

Development with SE and focus on energy utilization/production
Grant: Interreg (EU)
2018 - 2021

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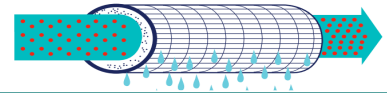
Grass-based circular business models
for rural agri-food value chains

Demo-case comparison of utilizing grass
Grant: H2020 (EU)
2020 - 2024

Promilleafgiftsfonden for landbrug
Brown juice filtration



Concentrating brown juice with nanofiltration
Grant: PAF (DK)
2018 - 2021

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INSTITUT FOR INGENIØRVIDENSKAB

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CENTER FOR BIOREFINING TECHNOLOGIES

Experimental site on a poorly drained fen peatland in the Nørreå stream valley

Rewetting of drained peatland is needed to reduce GHG emission!

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Fertilisation and harvest strategies optimising protein production in tall fescue and reed canary grass

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Mineral fertiliser: NPK (18-0-16)

Establishing tall fescue and reed canary grass suitable for growth on sites with ground water tables at 10-30 cm below soil surface

40

Typha plugs ready for planting

GO-GRASS

Manual planting of Typha plugs

Spraying a suspension with Typha seeds

Video of the process in action

Dry input and pressing of grass, May 2020

Grass input and fiber output, May 2020

Grass cutting and juice filtration, May 2020

Video of AU Green Biorefining DEMO, Oct. 2019

Video of AU Green Biorefining Pilot, Sep. 2018

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