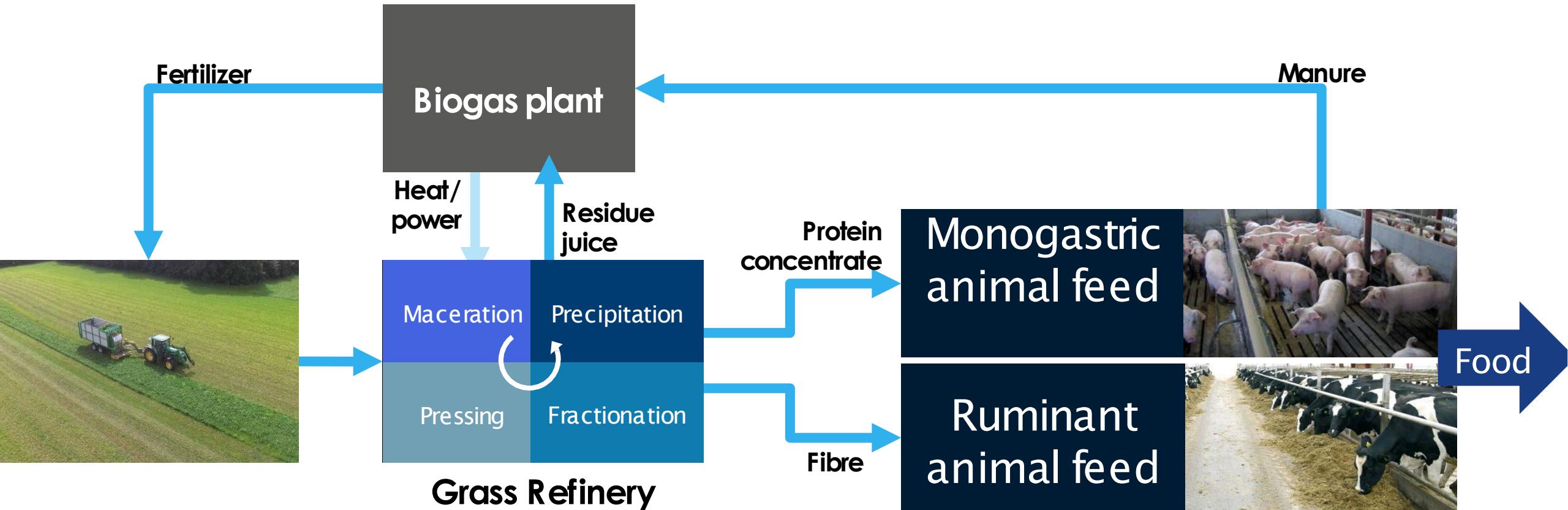


INTEGRATED BIOREFINERY PILOT- AND DEMO SCALE FACILITIES AT AARHUS UNIVERSITY FOR GREEN BIOREFINING

Center for Biorefining Technologies, Biological and Chemical Engineering, Aarhus University
Morten Ambye-Jensen, Assistant Professor

PROTEIN FEED FROM GREEN BIOMASS

BASE CASE SCENARIO



PROTEIN EXTRACTION IN GENERAL

W hole plant
DM = 100%
Protein = 100%

Wet
Fractionation

Fibre
DM = 50-70%
Protein = 40-60%



Juice



Residue juice.
DM = 10-20%
Protein = 0-10%

Protein
precipitation
& separation

Protein conc.
DM = 10-20%
Protein = 30-60%

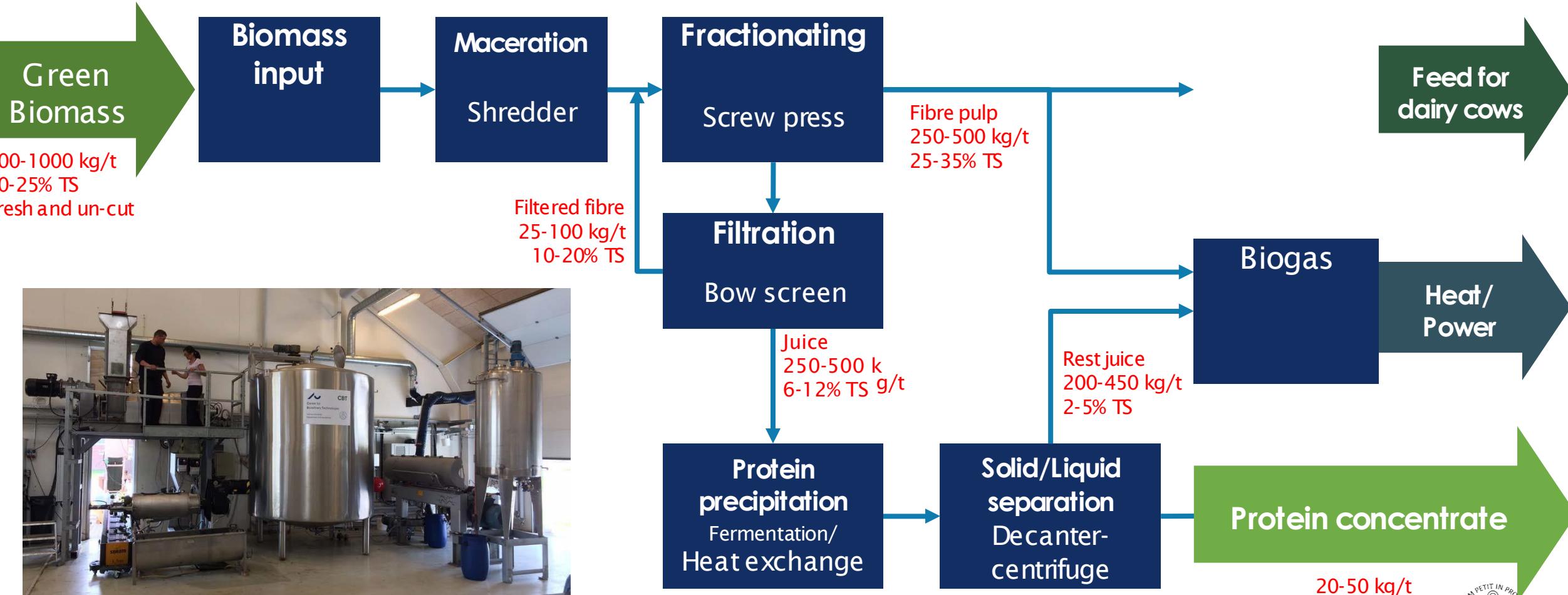


Important yield factors

- **Maturity**
- **Plant DM**
- **Protein content**
- **Fractionation & precipitation method**

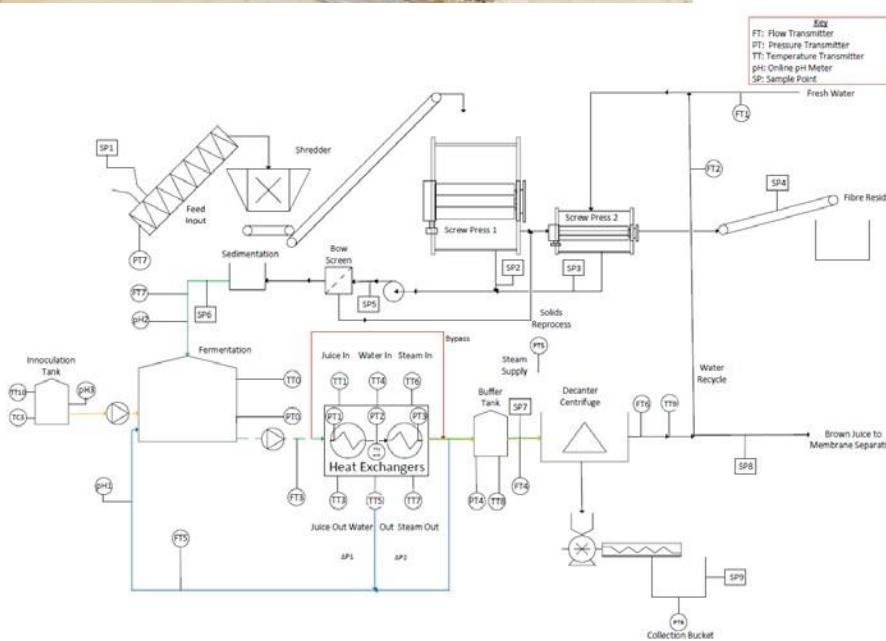


AU FOULUM PILOT PLANT FLOW DIAGRAM



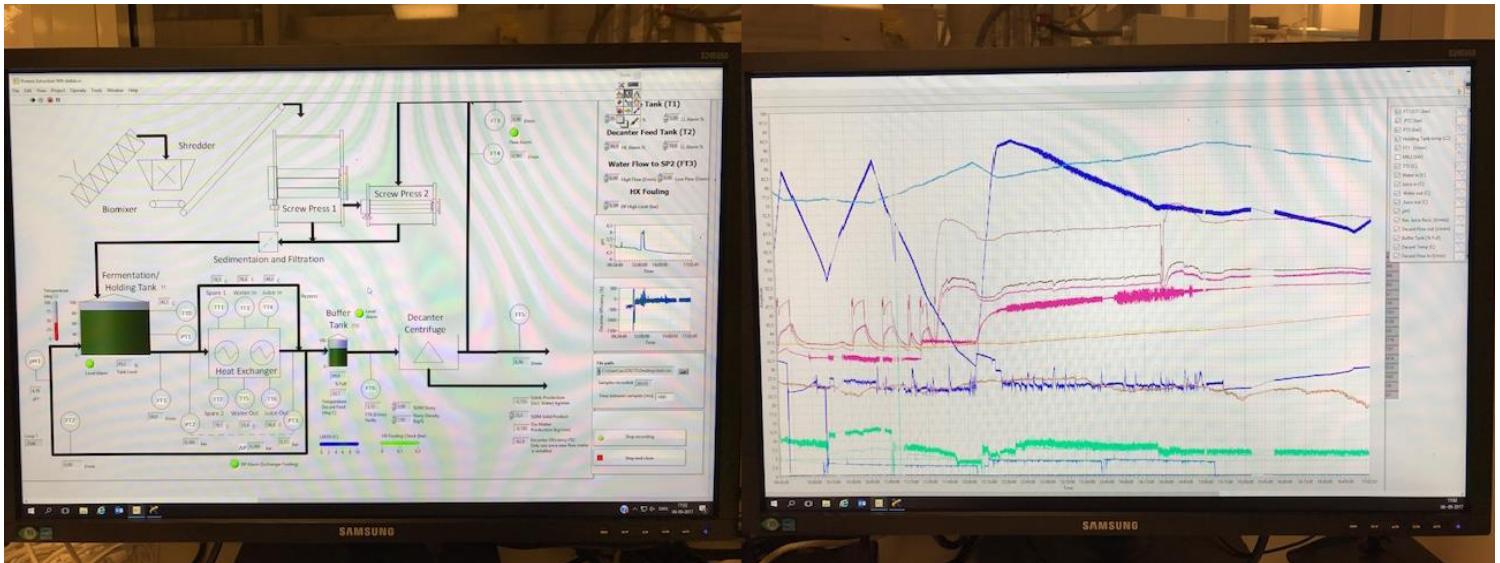


**Protein concentrate
from the centrifuge**



NUMBERS FROM PILOT PLANT 2018

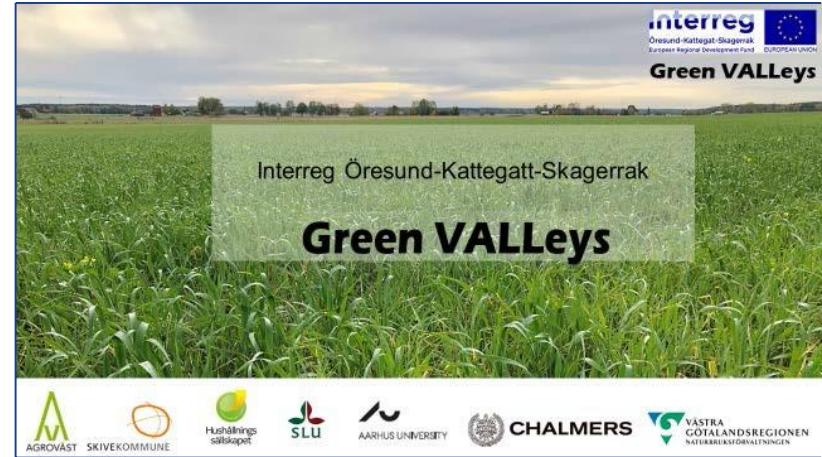
- Input capacity: **500-1000 kg fresh biomass per hour**
- Protein concentrate yield: **10-20 % of input TS** (Goal 15-25%)
- Protein yield: **20-40 % of input crude protein** (Goal 40-60%)
- Protein concentration: **30-55% of TS** (Goal 45-55%)



IMPROVING THE BUSINESS CASE

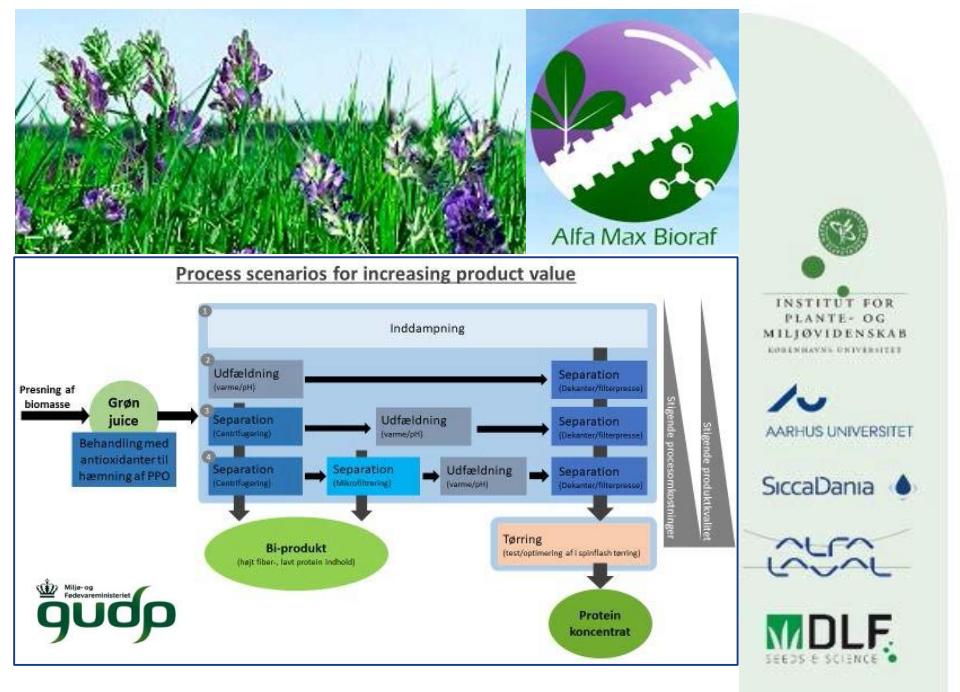
Process optimization on yield, efficiency and energy integration

- Two new projects
 - GreenVALLeys (INTERREG) collaboration with Swedish partners
 - AlfaMaxBioraf (DK national funding – GUDP)



Higher value products from the three process streams

- Protein concentrate
- Fiber pulp
- Residual juice (brown juice)



INCREASE VALUE OF PROTEIN CONCENTRATE

Basic scenario: Feed alternative to soy meal (0.34 EUR/kg)

Specialty feeds

- Extra high protein content and low fiber
- Optimized amino acid comp. (e.g. increased Cystein content)
- Getting value of the unsaturated fat (mainly α -Linolenic acid)
- Using fermentation and promote pre- and pro- biotic effects

High value is good, but high tonnage is necessary to get environmental benefits!

Food protein

- A source of plant based protein for consumption
- A source of protein ingredients with functional properties

INCREASE VALUE OF FIBER PULP

Basic scenario: Feed for ruminants (0.13 EUR/kg)

or substrate for anaerobic digestion not higher value, but different application.



Lignocellulosic feedstock for fermentation platform biorefineries

- Pretreatment, enzymatic hydrolysis and fermentation to ethanol
 - See poster M75 by colleague Carmen Hsieh

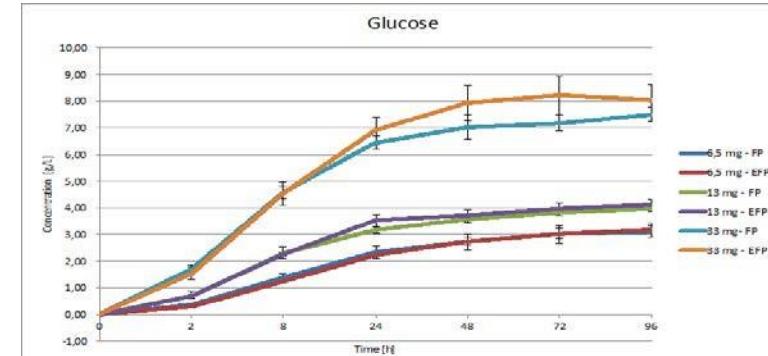
Biomaterial

- Insulation material
- Fiber boards
- Bio-composites
- Horticulture substrates
- ...



www.biowert.com

Feedstock	Pretreatment conditions
Lucerne pulp	None
	70°C ethanol extraction
	190°C hydrothermal
	Ethanol and hydrothermal
Lucerne pulp silage	Anaerobic storage
	70°C ethanol extraction
	190°C hydrothermal
	Ethanol and hydrothermal



INCREASE VALUE OF RESIDUAL JUICE



Basic scenario: Biogas of untreated brown juice for internal energy integration

Up-concentrated whole broth

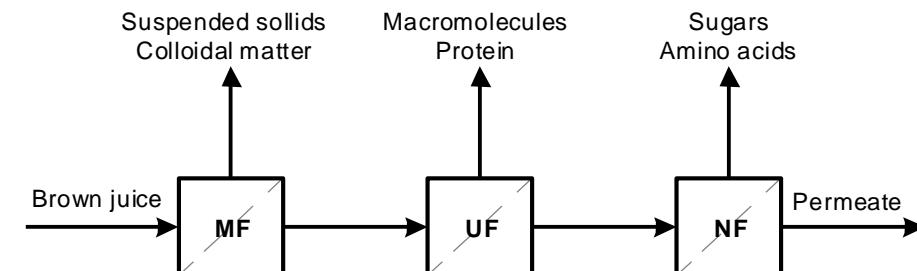
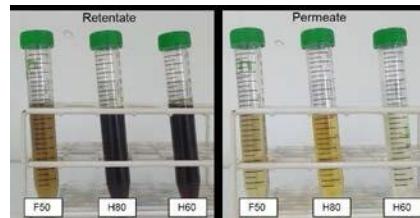
- Fermentation substrate

Brown juice	Dry matter	pH	Composition in g/kg dry matter			
			Free sugars	Organic acids	Protein	Ash
F50 Grass clover, fermented + 50°C	2.6	4.3	166.0	435.4	267.4	172.7
H60 Grass clover, 60°C	3.0	5.6	285.0	83.2	241.8	237.9
H80 Lucerne, 80°C	7.4	5.9	186.8	50.7	204.1	225.7

See poster M75 by colleague Carmen Hsieh

Separated and isolated valuable organic compounds

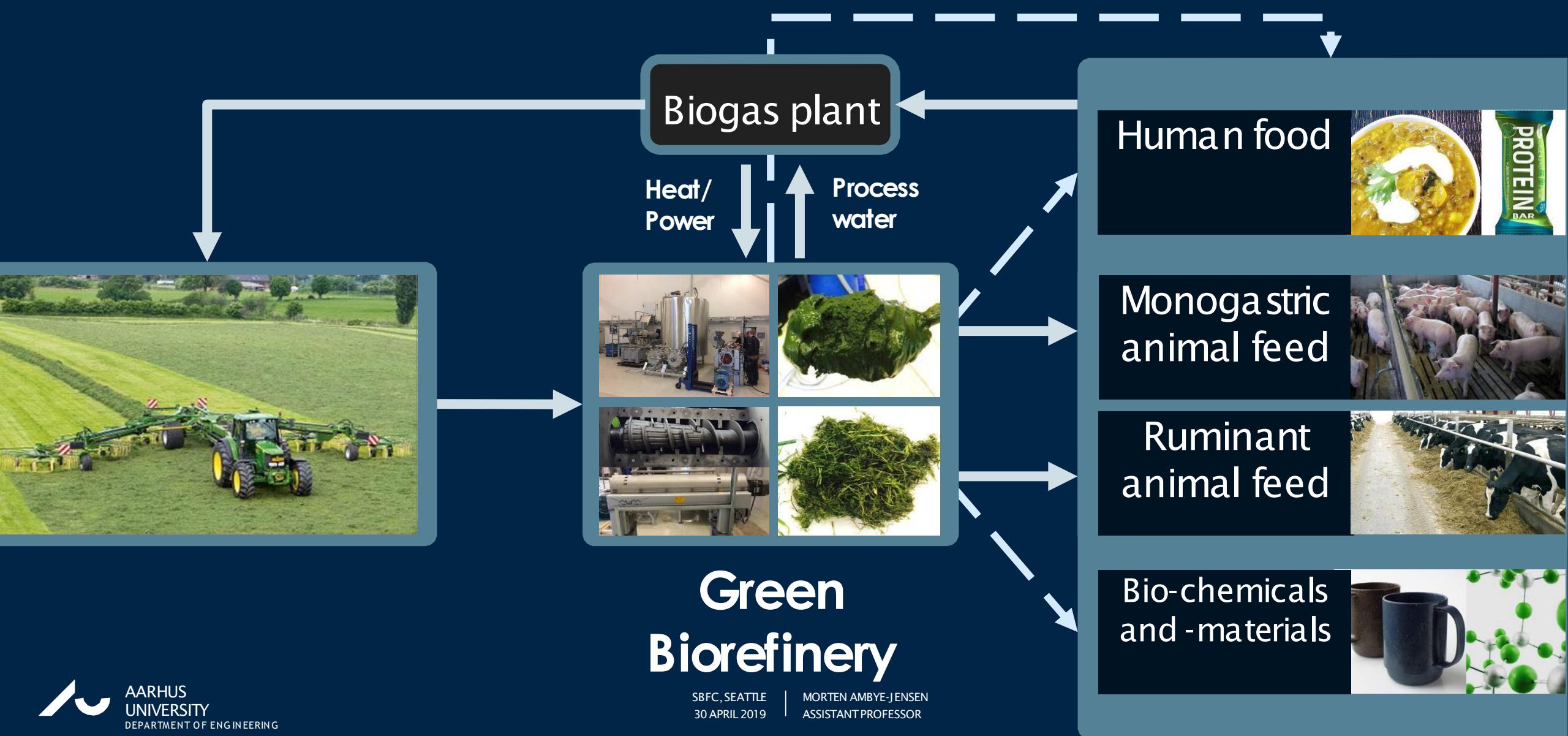
- Sugars
- Organic acids
- Amino acids, peptides or soluble proteins



Promilleafgiftsfonden for landbrug

Membrane work by:
Gossaye Weldegiorgis Tiruneh, Postdoc
Natália Hachow Motta dos Passos, Research Assistant

FURTHER DEVELOPMENT OF HIGHER VALUE PRODUCTS AND OPTIMAL USE OF RESOURCES



NEW DEMONSTRATION SCALE FACILITY IN 2019

Demonstration scale technology platform for research and development in green biorefining

10x Up-scaled and optimized demo-platform

- Location: AU Foulum
- The platform is an open R&D facility at AU ENG
- Budget: 2.01 mio EUR
- National, regional and industry funding
- Ready for projects Juli 2019



NEW DEMONSTRATION SCALE FACILITY IN 2019

Demonstration scale technology platform for research and development in green biorefining

Up-scaled and optimized demo-platform

- Input capacity: 10-20 t/hr
- Flexible design
- Automated control
- Improved unit operations

Biomass washing,

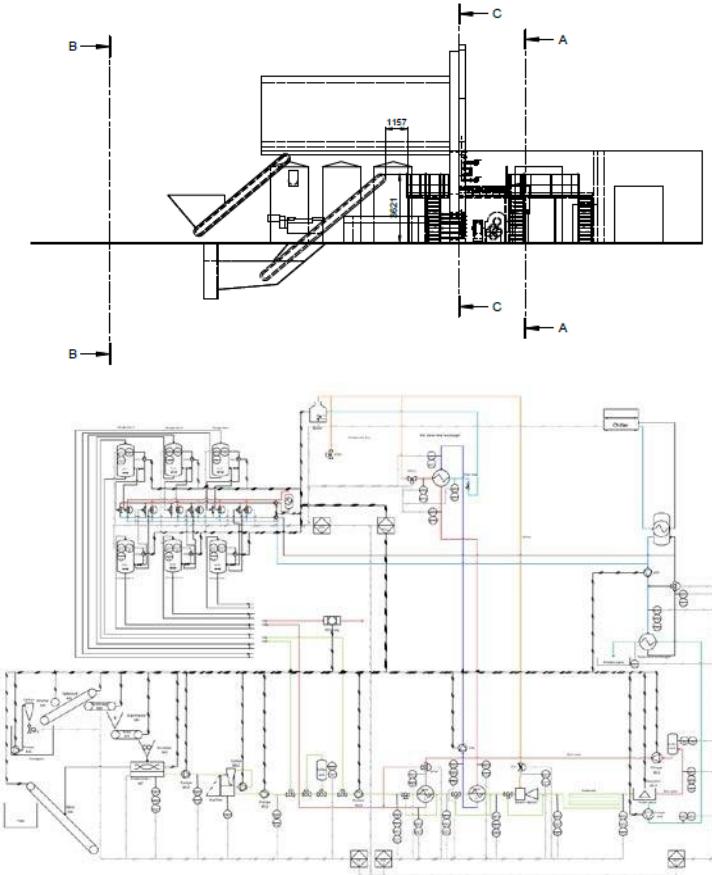
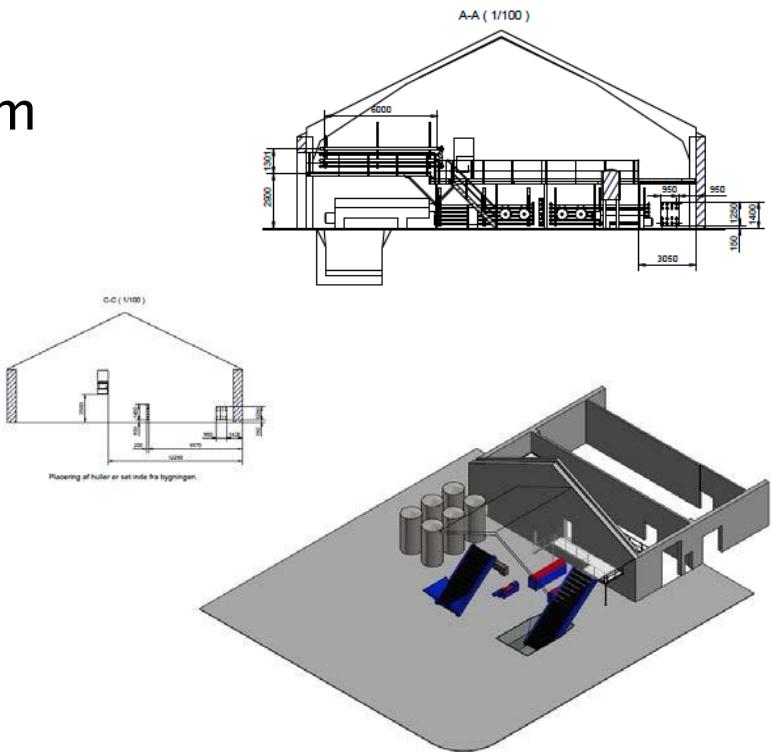
Improved maceration,

Double pressing,

Filtration and recirculation,

Efficient heat recovery and possible precipitation with steam,

Separation with both centrifugation and membrane filtration.



OFFICIAL INAUGURATION OF DEMOPLATFORM

25 June 2019 at Aarhus University, Foulum Campus, Denmark

The event is linked to the CBIO conference:

Circular Bioeconomy Days, 25-27 June

And your most welcome!

<http://conferences.au.dk/circularbioeconomydays2019/>

Programme

Circular Bioeconomy Days

- new protein sources for Europe

- How do we develop a circular bioeconomy, which supports a general sustainable development?
- What are the prerequisites for and the implications of the European protein strategy?
- What are the new protein sources for Europe?

[REGISTER HERE](#)

Grand opening of demonstration scale Green Biorefinery

25-27 June at Aarhus University, Foulum, Denmark



AGRO BUSINESS PARK
midt SEGES AARHUS UNIVERSITY VIBORG INBIOM
Central Denmark Region KOMMUNE
INTERREG GREEN VALLEYS

Morten Ambye-Jensen, Assistant Professor, maj@eng.au.dk

Carmen Hsieh, Postdoc

Gossaye Weldegiorgis Tirunehe, Postdoc

Birgit Bonefeldt, Postdoc

Natália Hachow Motta dos Passos, Research Assistant

Ib Johannsen, Visiting Researcher

Technical staff for pilot/demo processing:

Theis Kjeldsen, Per Kristiansen, Torben Laursen, Finn Nielsen

Uffe Jørgensen, AU Dep. of Agroecology

Kiril Manevski, AU Dep. of Agroecology

Marie Trydeman Knudsen, AU Dep. Of Agroecology

Søren Krogh Jensen, AU Dep. of Animal Science

Lene Stødkilde-Jørgensen, AU Dep. of Animal Science

Sanna Stenfeldt, AU Dep. of Animal Science

Trine Dalsgaard, AU Dep. of Food Science

Thank you for your attention!

And thanks to all project collaborators!



AARHUS UNIVERSITY



Promille afgiftsfonden for landbrug



Green-Eggs
Greening of Organic Egg Production

