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REGIONS FOR BIOECONOMY

POWER4BIO webinar series: Food & Feed, session 3. 28 October 2020, 11 am CET

Examples connected to sustainability ambitions, upcycling and complete biomass valorisation

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818351

Introduction

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- In various situations sustainability ambitions are strong drivers to develop new ideas; some of these are successfully implemented in practice

- Developments from different drivers:
  - Additional value creation
    - offering new, sustainable end-products (webinar 2)
    - clean label (webinar 4)
  - Legislation, reducing waste
  - Subsidy
  - Relatively recent driver: sustainability & circularity
    - improve resource utilisation, total valorisation
    - circular systems

Subsidy (case biogas)

- Subsidy as a tool to overcome start up problems
- Should not be essential for long term business case

- Dependency on subsidies
- Biogas at farm level in Germany, Italy, etc. collapsed when subsidies are ended.

https://bio-based-solutions.eu/#/project/102

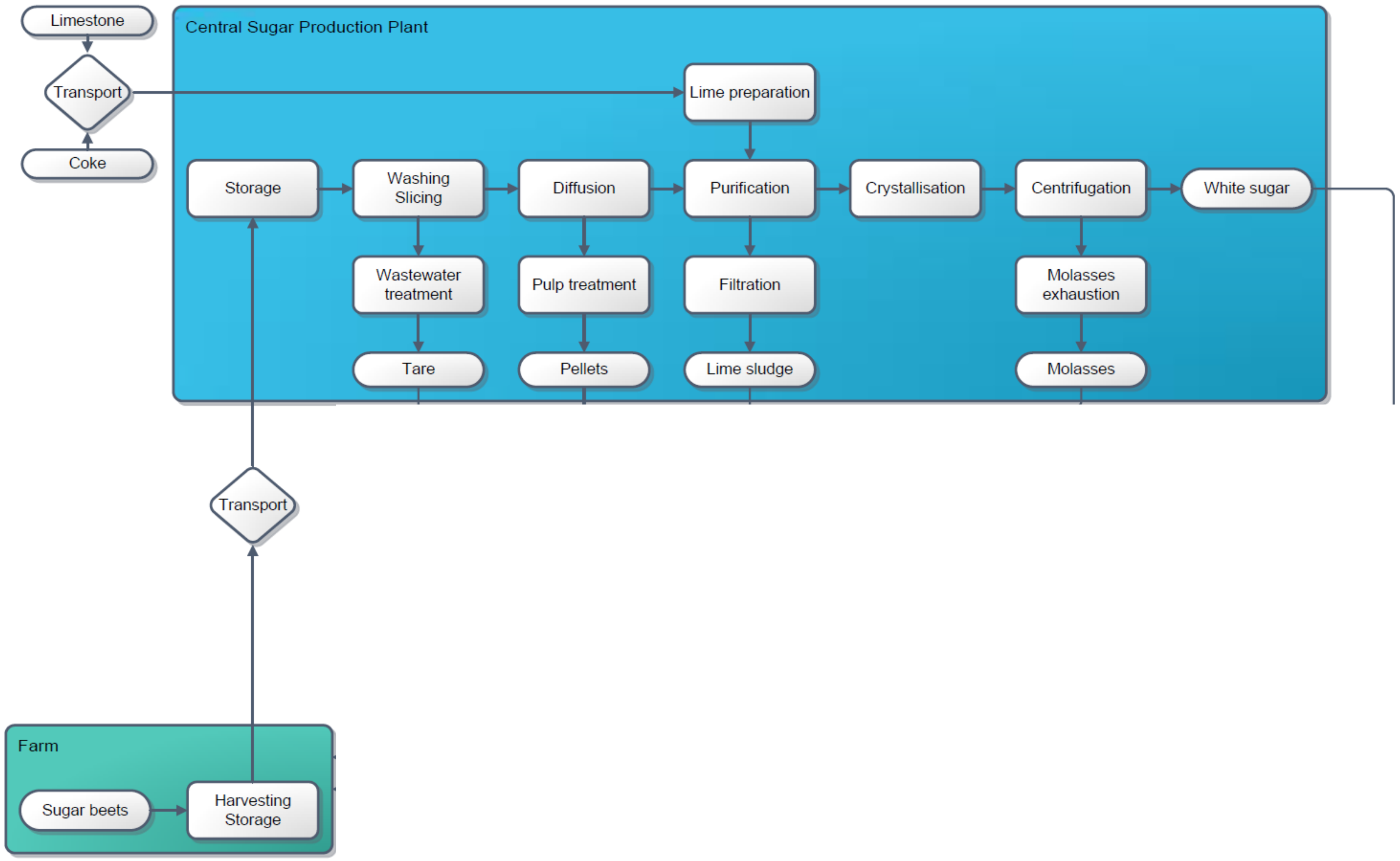
https://bio-based-solutions.eu/#/project/130

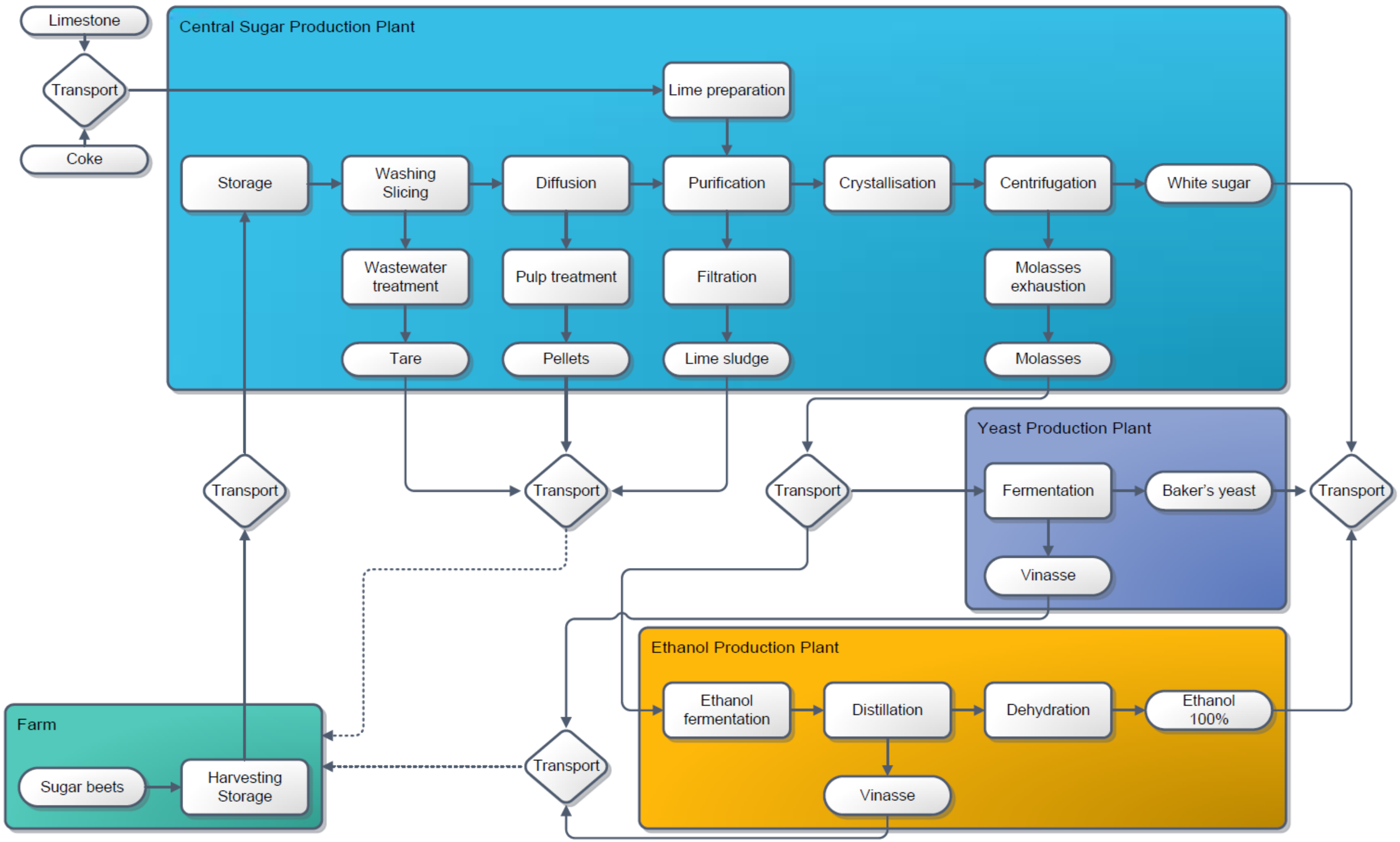
https://bio-based-solutions.eu/#/project/162

Improved resource utilisation, total valorisation

- Sugarbeet
- Hemp

Whole crop use: sugar beet




Limestone
Transport
Coke
Central Sugar Production Plant
Lime preparation
Storage
Washing
Slicing
Diffusion
Purification
Crystallisation
Centrifugation
White sugar
Wastewater
treatment
Pulp treatment
Filtration
Molasses
exhaustion
Tare
Pellets
Lime sludge
Molasses
Yeast Production Plant
Transport
Transport
Transport
Fermentation
Baker's yeast
Transport
Vinasse
Ethanol Production Plant
Ethanol
fermentation
Distillation
Dehydration
Ethanol
100%
Vinasse
Farm
Sugar beets
Harvesting
Storage
Transport

Whole crop use: sugar beet

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- New value chains: Beet sugar to plastics
- Upgrading residues: Pulp to pectin and cellulose
- Unused residues: Leaves to protein

Green Protein https://bio-based-solutions.eu/#/project/77

Sugar to 1,4-BDO chemical by Novamont https://bio-based-solutions.eu/#/project/171

Sugar to HMF chemical by AVA Chem https://bio-based-solutions.eu/#/project/94

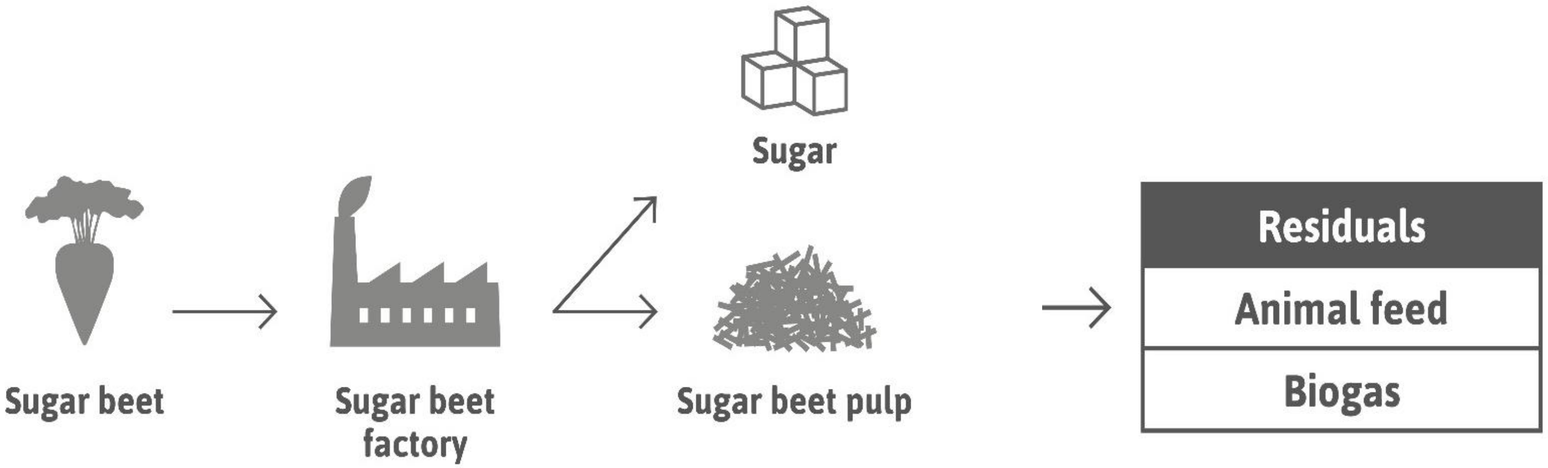
PLA

Video Series on Bioeconomy – Bioplastics from Sugar Beets

https://bloom-bioeconomy.eu/2020/04/01/video-series-on-bioeconomy-bioplastics-from-sugar-beets/

Sugar beet pulp

- Major residual stream from the sugar beet industry
- Currently valorised as low value feed and/or green gas
- In Europe sugar beet pulp accounts for a production volume of approx. 13 million tonnes per year.



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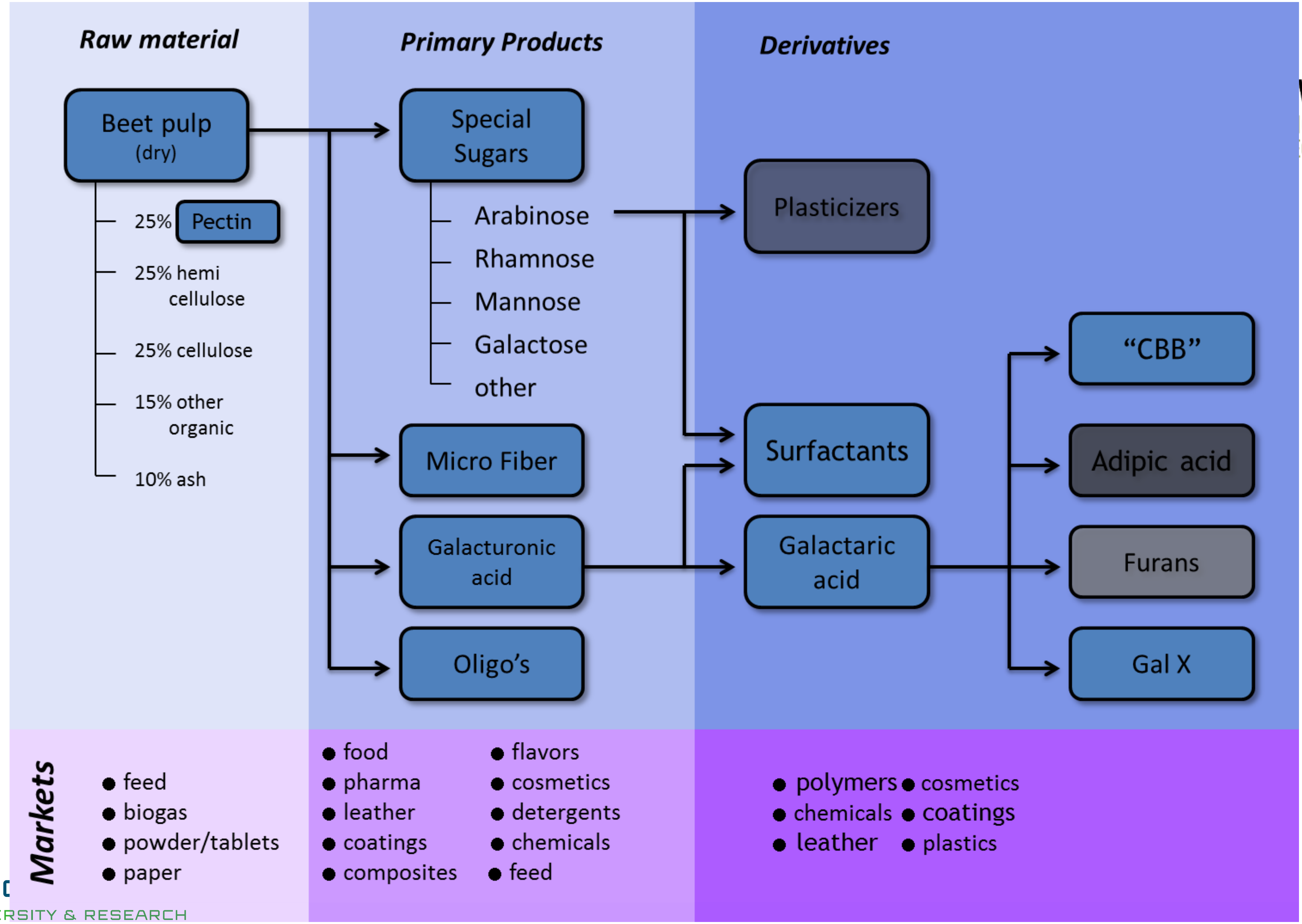
Raw material
Primary Products
Derivatives
Beet pulp (dry)
25% Pectin
25% hemi cellulose
25% cellulose
15% other organic
10% ash
Special Sugars
Arabinose
Rhamnose
Mannose
Galactose
other
Micro Fiber
Galacturonic acid
Oligo's
Plasticizers
Surfactants
Galactaric acid
"CBB"
Adipic acid
Furans
Gal X
Markets
feed
biogas
powder/tablets
paper
food
pharma
leather
coatings
composites
flavors
cosmetics
detergents
chemicals
feed
polymers
chemicals
leather
cosmetics
coatings
plastics

Valorisation sugar beet pectin

- Extracting pectin-rich components
- Aim
  - Designing a biorefinery for the total valorization of sugar beet pulp, emphasis on the pectin rich fraction
  - Application of (modified) pectin rich fractions to replace fossil based ingredients in non-food products

TKI-AF 14263 & 17024
"Non-food applications of pectin rich polysaccharides from sugar beet pulp"
https://www.wur.nl/en/Research-Results/kennisonline/Non-food-applications-of-pectin-from-sugar-beet-pulp.htm

Valorisation sugar beet pectin

- Out of the box
- Fraction used in
  - Leather industry
  - Dishwashing detergent

Patent WO2020011764A1

- Replacing non degradable polymers

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Smit & Zoon to use beet pulp in leather processing

The Netherlands

Published: 09 December, 2019

The Dutch chemicals manufacturer said research has shown that pectins from sugar beet pulp are suitable as bio-based ingredients in the production of leather.

Credit: Markus Skispe

Carried out in collaboration with Wageningen Food & Biobased Research, Smit & Zoon said the research has shown that replacing petrochemical raw materials with biobased alternatives can reduce CO_2 reduction. The pectins from sugar beet pulp serve as functional substitutes for non-degradable polymers in the wet production process at the end of leather production. For instance, they can influence the colour intensity, according to the chemical supplier. Furthermore, the ingredients are claimed to contribute to the reduction of environmental and health risks since there is no exposure to certain chemicals. "Replacing petrochemical raw

https://internationalleathermaker.com/news/fullstory.php/aid/7757/Smit___Zoon_to_use_beet_pulp_in_leather_processing.html

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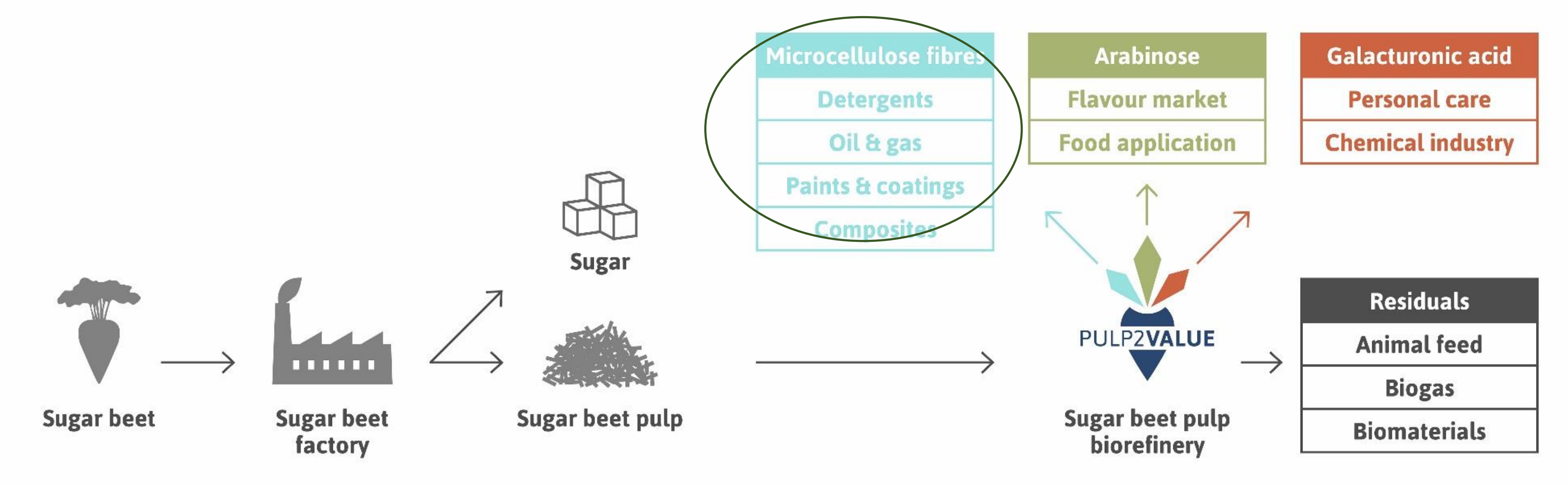
Project data Pulp2Value

- PULP2VALUE receives funding from the Bio-based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 669105.

- PULP2VALUE is one of the two demonstration projects in the Bio-based Industries Joint Undertaking (BBI JU) Call 2014.
  - PULP2VALUE relates tot the BBI annual work plan topic BBI VC3.D4 2014: "Functional additives from residues from the agro-food industry".
- Budget:
  - Total cost: 11.4 million Euro; Funding: 6.6 million Euro
- Duration: July 1, 2015 – June 30, 2019

Pulp2Value scope & objectives



- Main objectives:
  - To optimize, scale up and integrate processes.
  - To build long lasting value chains.
- The ultimate goal is to set up a **demonstration plant** which refines sugar beet pulp in an **integrated and cost-effective cascading biorefinery**.

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cosunbiobased.com/product-portfolio/betafib-mcf/3

Sample request → Search...

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Beta*fib*® MCF

Our biobased structuring agent

Beta*fib*® MCF is a 100% natural biopolymer (cellulose) and is COSMOS and ECOCERT certified. We've designed it to help stabilize your formulations, modify rheology, and suspend (encapsulated) particles.

This makes it the ideal multifunctional ingredient for many microplastic-free home care and personal care formulations, such as body washes, shampoos, creams, scouring agents, and detergents.

Biorefining of sugar beet leaves

Leaves:
40 ton/ha

Sugar beets:
80 ton/ha

Protein (RuBisCo)

Protein (feed)

Biopolymers

Compostable

Biogas

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First step: harvesting

- Mechanised harvester constructed
  - Capacity 1 ha/hr
  - 20 – 40 ton/hr
- Harvesting without stems & dirt
  - Avoid abrasion and microbial decay
  - Increase protein content of the material (leaves > stems)
- Harvesting installation can be mounted on beet harvester
  - Less vehicles on the field
  - Harvesting in a single pass

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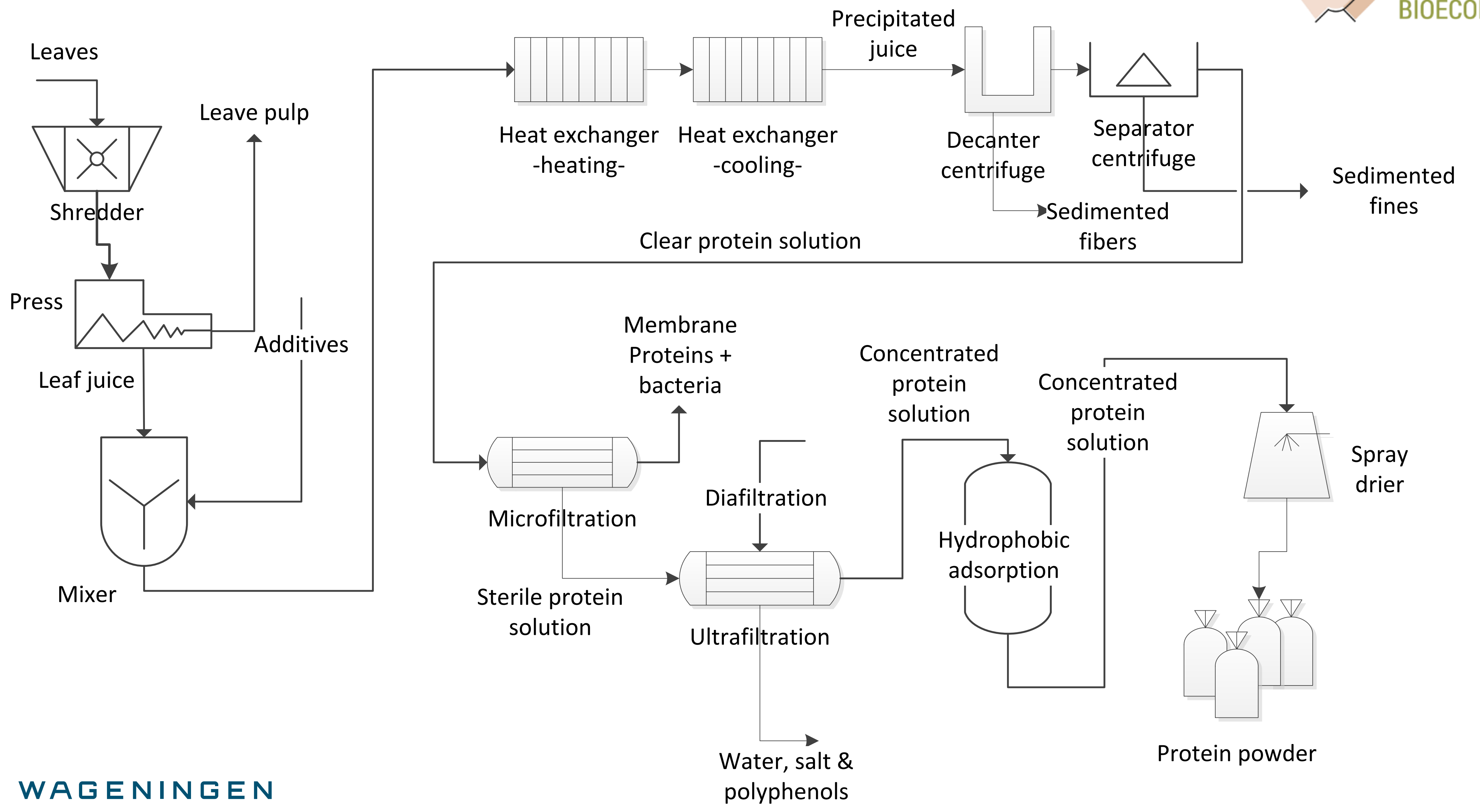
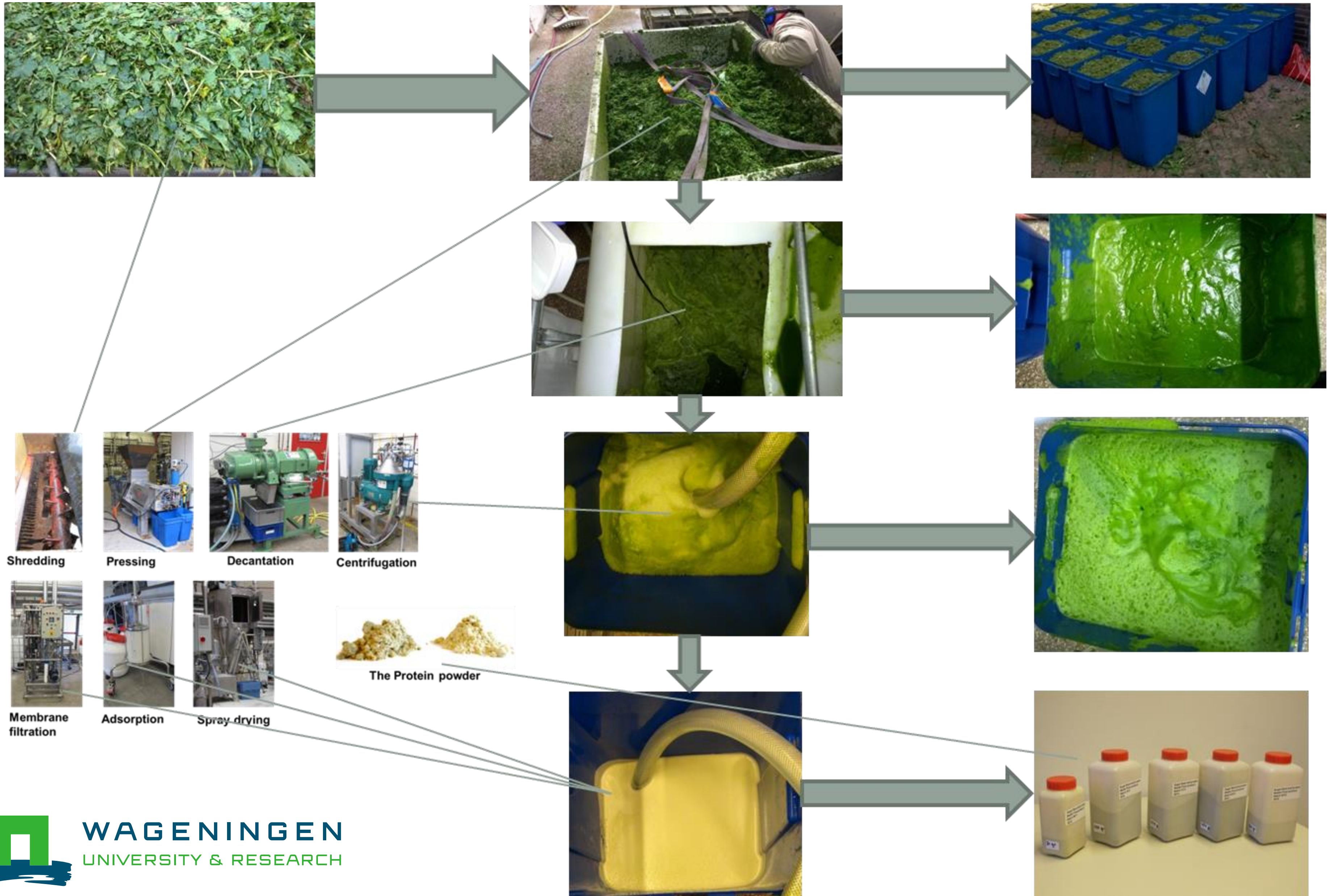
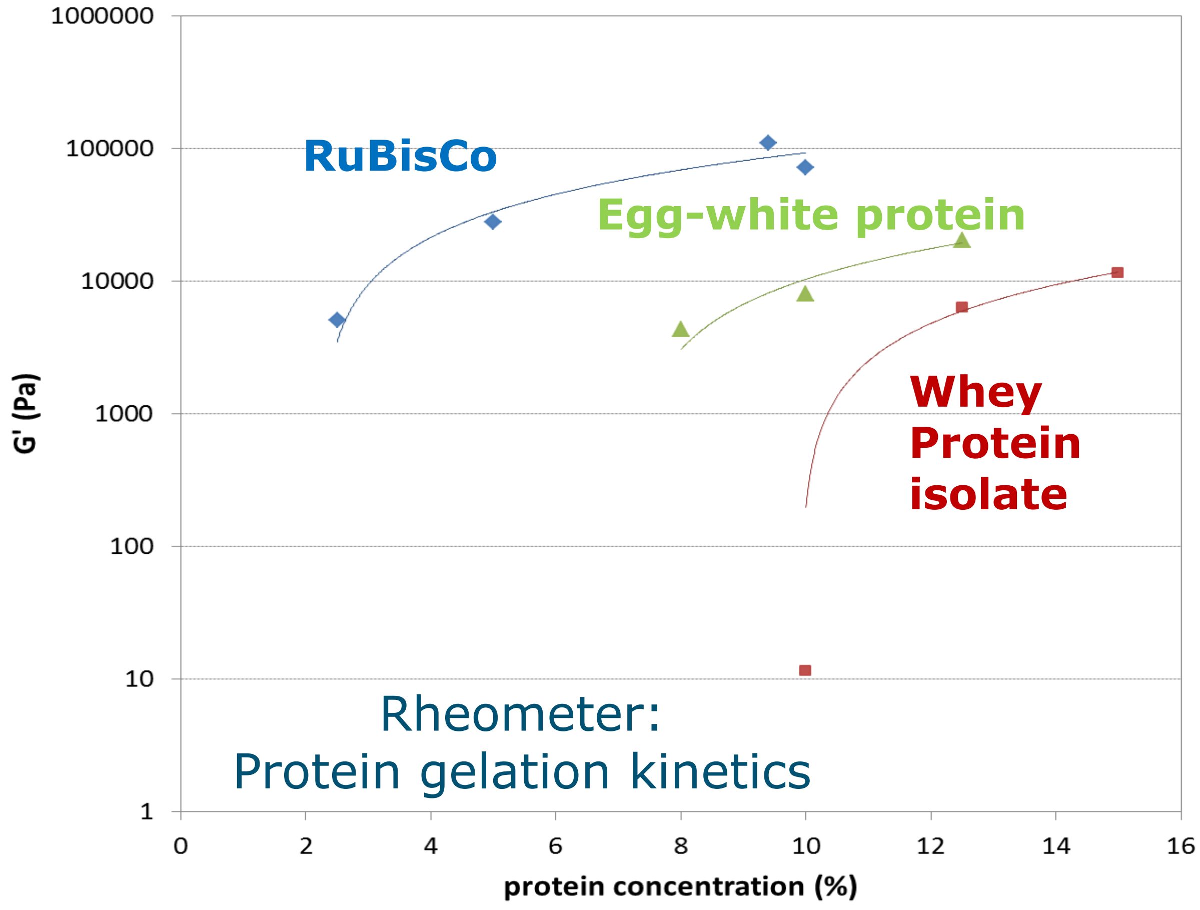
Process design: from leaves to protein

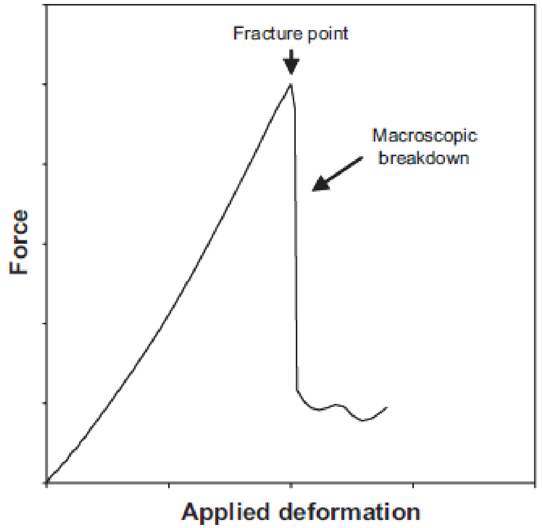


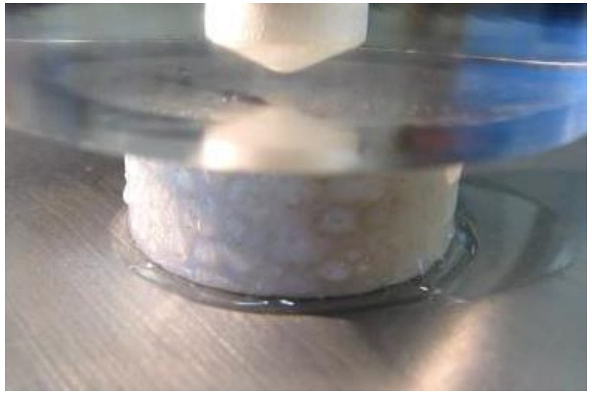
The pilot process in product pictures



Benchmarking your product







Texture analyzer:
Protein eating properties

MARTIN AH, NIEUWLAND M, DE JONG GAH, 2014 J. AGRIC. FOOD CHEM. 62:10783-10791

MARTIN AH. CASTELLANI O, DE JONG GAH, BOVETTOL, SCHMITT C, 2019 J. SCI. FOOD AGRIC. 99: 1568-1576

Learnings from the pilot

- Various batches of sugar beet leaves processed
  - Steep learning curve, substantial protein losses in first weeks
  - < 1hour from harvest to processing to prevent protein losses

- Approximately 5 kg of RuBisCo produced
  - 85 - 90% pure, soluble and functional (gelling, foaming and emulsifying)

- RuBisCo yield from biomass:
  - 5% on laboratory scale (dw)
  - 1% on production scale (dw)

Pilot plant development

Shredding & pressing

Heat coagulation

Decantation

Centrifugation

Micro- ultra- & diafiltration

Purification

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GreenProtein

Conclusions leaves

- RuBisCo can be produced from sugar beet leaves
- Functional properties comparable or better than from animal derived sources
- Replacer of for instance egg and milk proteins in several applications.
- Harvesting of leaves without stems and dirt realised
- Chlorophyll and phenolics can be removed
- Fast processing is of key importance
- Demo Plant opened in 2019
- Currently RuBisCO protein extracts from different plant sources undergo tests to get approved under the Novel Food Regulation.

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Hemp

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- Renewed advance
- Traditionally used for its fibres in ropes, paper and textile
- Now in construction, food supplement CBD (different from the psychoactive THC)
- Residue from extraction is expected valuable protein product

Circular systems

- Insects, Aquaponics
- Integrated on farm: Lemna and Grass
- Municipalities: EU project City Loops

Insects

- Insects for feed:
  - Valorising ‘wastes’ that cannot be used for feed
- Drivers:
- Success condition:
  - (expected) european legislation
  - Temporal tolerated
- Insects for food:
  - New exciting food

Aquaponics

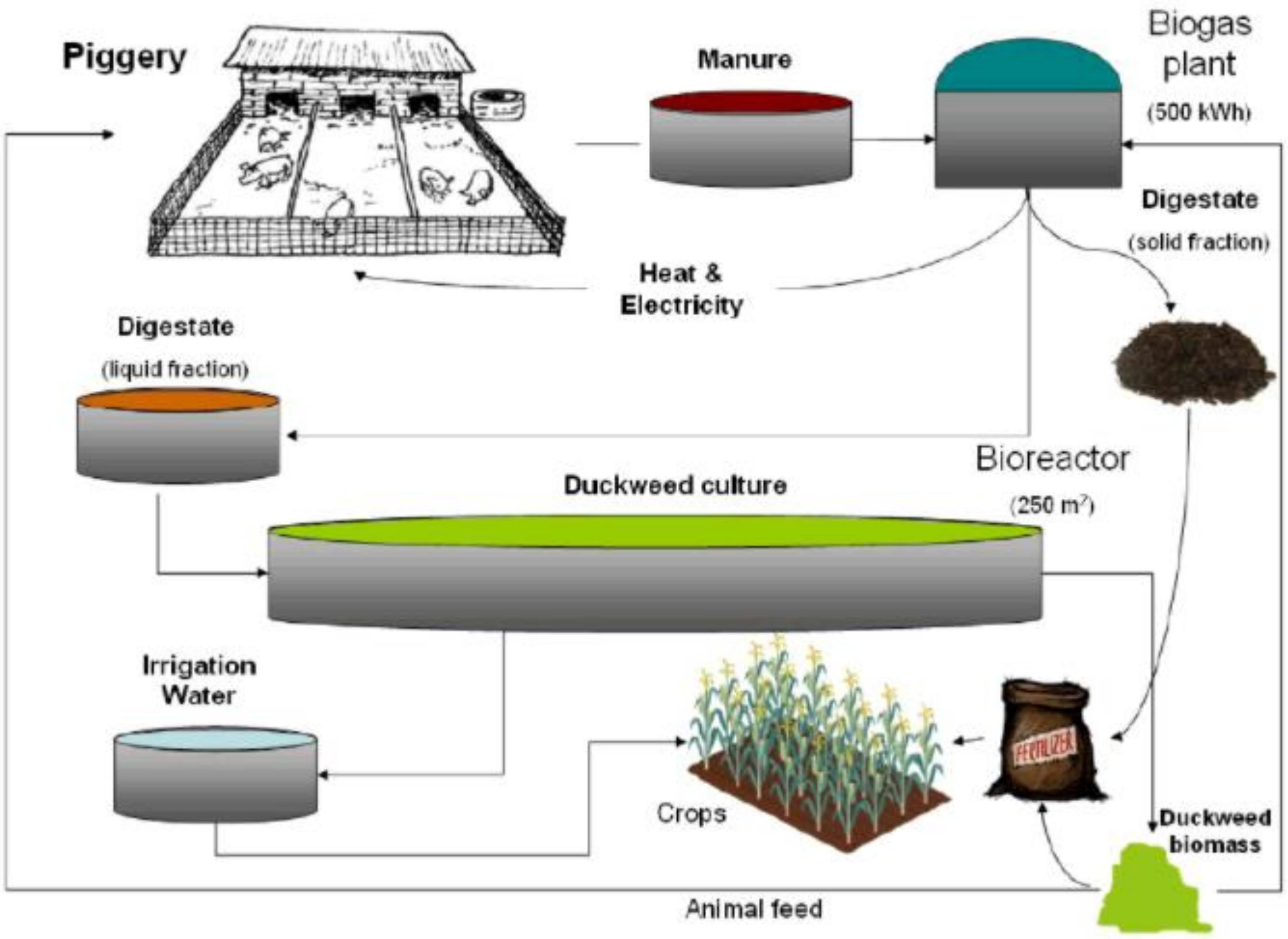
- Relatively simple recirculation system for co-production
- Fresh vegetables and fish
- 1000 companies; half is making a profit
- Local prices for products need to be high

https://resource.wur.nl/nl/show/Aquaponics-rarely-viable.htm

Circularity in agriculture

- As local as possible:
- Manure instead of fertilizer
- Local feed instead of soy

- Effective use of biomass
- Better use of residues



http://www.life-lemna.eu/

Regional biorefinery at small scale

Solving the problem of low functional density of biomass

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- Advantages
  - Lower transportation costs
  - Water and minerals stay on site
  - Less waste treatment on (central) factory
  - Increased storage times
  - More income to farmers
  - Faster innovations
  - Optimal process for region
  - Better product quality due to fast delivery
  - Safety
- Disadvantage
  - Economy of scale

DADTCO

Starch from Cassava in Nigeria

Kleinschalige bioraffinage PPS 2013-2016
Analysis success & failure, Design rules
http://www.kleinschaligebioraffinage.nl/nl/kbr.htm

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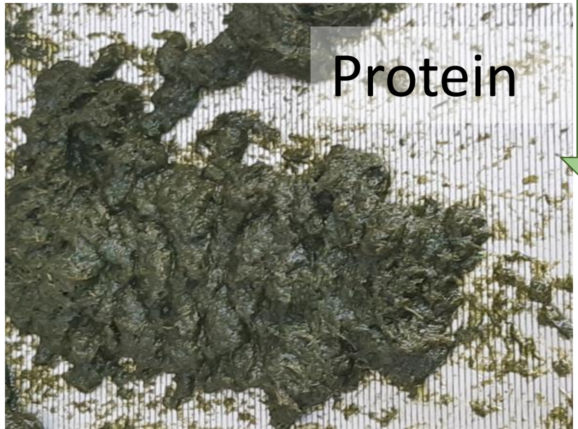
Aarhus University’s practical demo
GREEN BIOREFINERY

Grass transport and washing

Refiner



Protein

Fibre

Integrated feed biorefinery

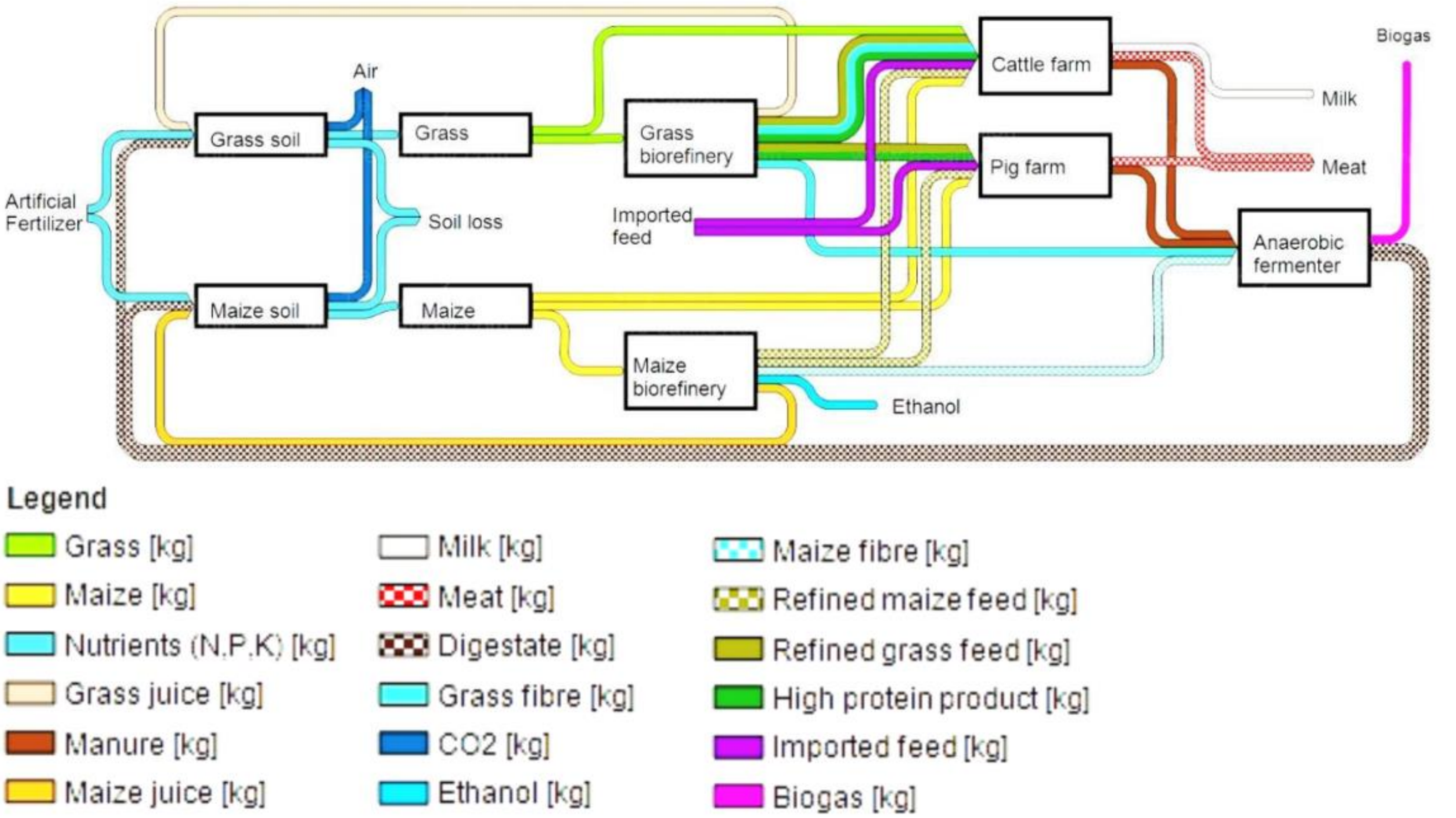


Figure 1, schematic overview of the blocks in the agricultural region and the links between the blocks.

https://bio-based-solutions.eu/#/project/162 https://bio-based-solutions.eu/#/project/161

https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/biomotion_best_practice_examples_en.pdf

CityLoops

EU-funded project

7 European cities

Circular economy solutions for materials

Bio-waste

Construction and demolition waste

Goal:

To better understand how local governments can best promote the transition to a circular economy (CE) in their city.

Closing urban material and resource loops, and thereby reducing the environmental footprint, increasing regenerative capacities, and stimulating new business opportunities

www.Cityloops.EU

Why bio-waste?

According to the European Commission, **the European Union produces approximately 130 Mt of bio-waste per year**, a number, projected to increase by 10% by 2020.

Bio-waste consists of organic fractions of municipal solid waste as well as bio-waste from commercial sources and public spaces. Overall, 68% of bio-waste produced annually in the EU consists of food waste originating from food manufacturing and packaging processes (39%), household scraps (42%), and restaurants/grocery stores (19%).

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Core actions

Implement a series of CE demonstration projects for **construction and demolition waste** and **bio-waste** flows

Evaluate success and impact & **document** implementation process

Embed, **upscale** and **replicate** measures in the city, region and across Europe

Porto

Porto plans to work with its social economy sector and the tourism sector to **promote the reduction of food** waste through procurement and smart decision making about food purchases.

Porto will **monitor bio-waste streams, design a decision-making tool for both sectors to prevent food waste, and support hotels in providing social institutions with donated food** – closing the loop locally.

Porto also wants to **increase separated bio-waste collection in residential areas**, and will pilot new separate collection systems.

215,284
inhabitants

Take home message

- Total valorisation leads to more efficient use of biomass
- Circular systems are relevant for sustainability
- Value creation is a solid driver
- High value examples: protein, functional biopolymers, food additives (webinar 4)

- Challenges:
  - Diversity of products and thus markets
  - New products need legislation development (food)
  - Subsidy should provide learning curve

Thank you for your attention

Next series on 4 November 2020, 9 am CET

- Session 4: Examples connected to trends in food
- Session 5: Technical examples of regional initiatives
- Session 6: Learnings for high potential value chains

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