

BioreFuture 2009, Brussels, 30 March

Technical description of Green and Whole Crop Biorefineries

presented by:

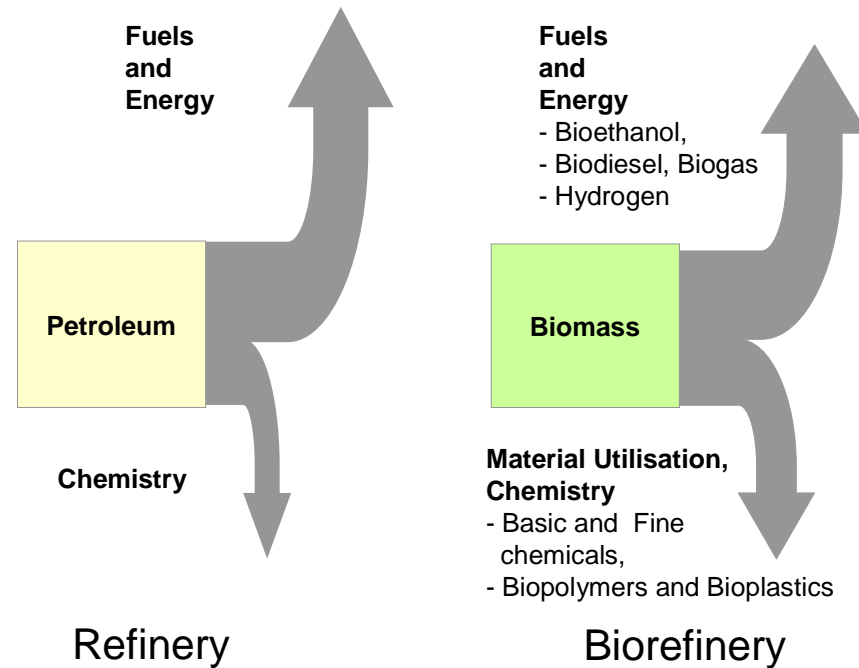
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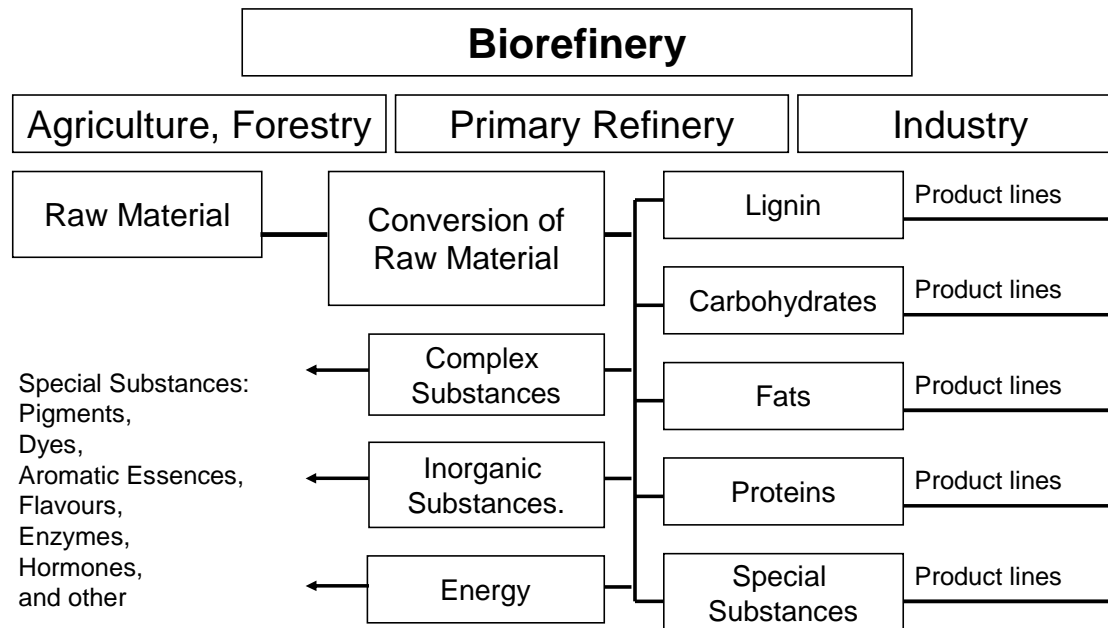
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Biobased industrial products can only compete with petro-chemically based products if the raw materials are optimally exploited and a variety of value-creating chains are developed and established.
→ development of substance-converting basic product systems and multi product systems, especially biorefineries.

Biorefineries combine necessary technologies between biological raw materials and the industrial intermediates and final products.



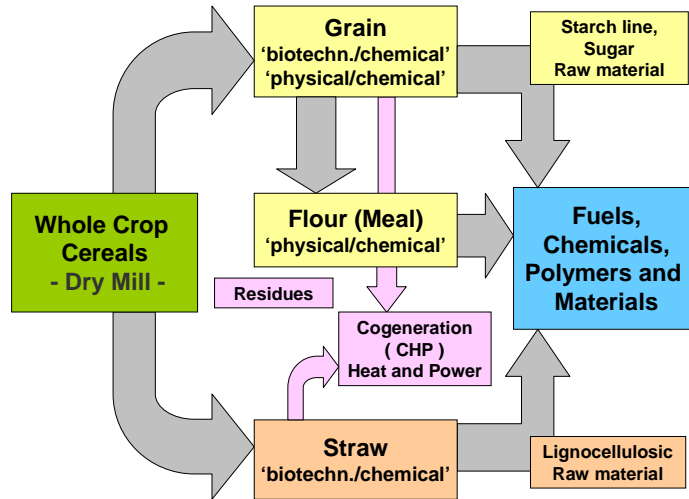
After providing code-defined basic substances (via fractionation) it is necessary to develop industrially relevant Product Family Trees.

Currently four Biorefinery Systems are forced within research, development and practice:

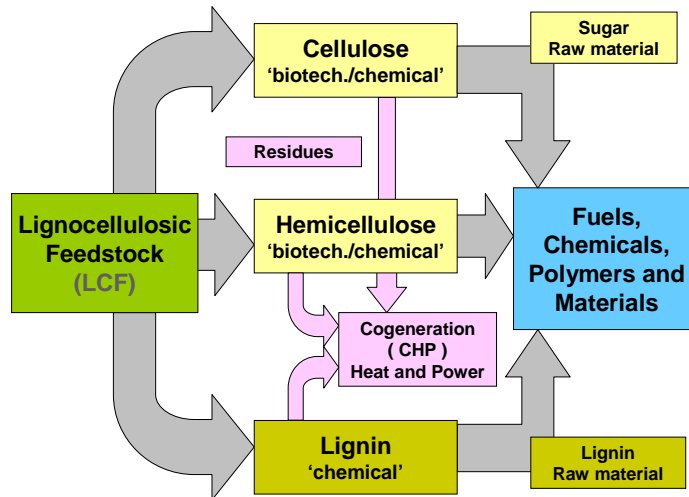
- **The Whole Crop Biorefinery (WC-BR)**
raw material: cereals, maize etc..
- **The Green Biorefinery (G-BR)**
raw material: 'nature-wet' biomasses, green grass, lucerne, clover, immature cereals a.o..
- **The Lignocellulose Feedstock Biorefinery (LCF-BR)**
raw material: 'nature-dry' biomasses, wood, straw, corn stover, cellulose-containing biomass and waste.
- **The Two-Platform Concept**
production of syngas and/or sugar as platforms for biobased products and fuels.

2. Biorefinery-Systems

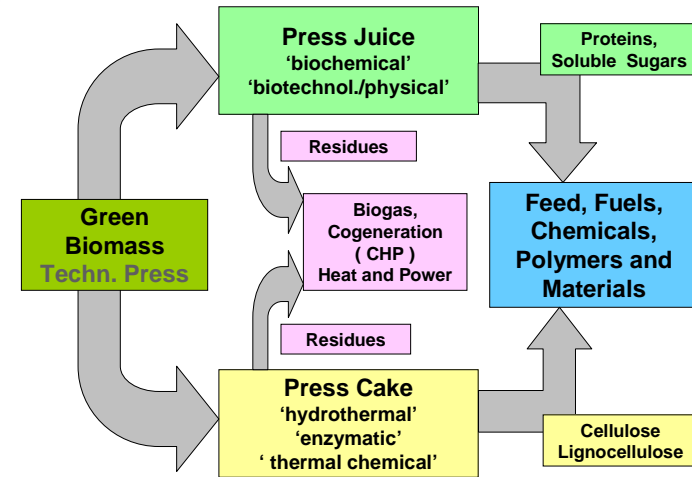
Whole Crop Biorefinery
 (dry mill)



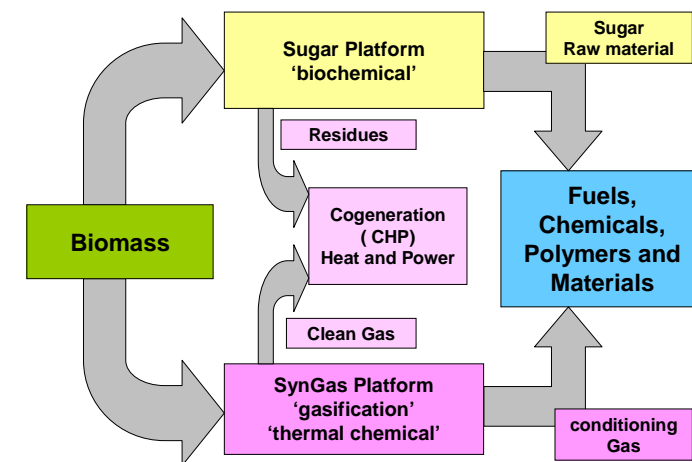
Lignocellulosic Feedstock
 Biorefinery



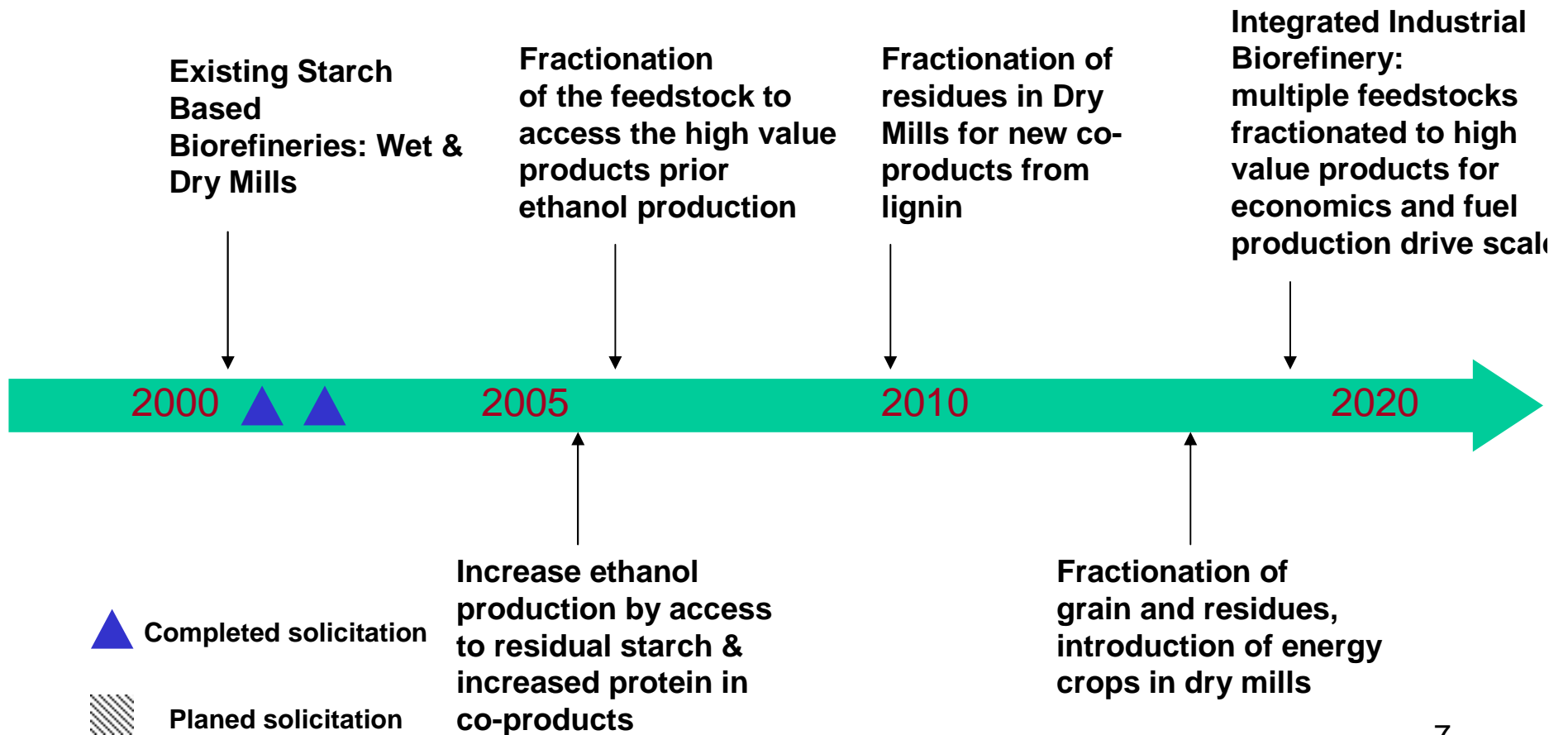
Green Biorefinery



The Two-Platform Concept



3. Integrated Biorefinery - Technical Objectives & Future Solicitations



Integrated Biorefinery Options



Hydrolysis
Acids, enzymes

Sugars and Lignin

Use:
Fuels
Ethanol
Biodiesel
Hydrogen
Power
Electricity
Heat
Chemicals
Plastics
Solvents
Chemical
Intermediates
Phenolics
Adhesives
Furfural
Fatty acids
Acetic Acid
Carbon black
Paints, Dyes,
Pigments,
Ink, Detergents
etc.
Food & Feed



Gasification
High heat, low
oxygen

Synthesis Gas

Digestion
Bacteria

Bio-Gas

Pyrolysis
Catalysis, Heat,
Pressure

Bio-Oil



Extraction
Mechanical,
Chemical

Carbon-Rich Chains



Separation
Mechanical,
Chemical

Plant Products

4. Europe: Integrated biorefineries in construction (Selection)



**Plants/
Company
Country**

**Raw material
(Capacity)**

Main-Products



**LCF biorefinery
Abengoa Bioenergy
Spain**

**Corn stover
Wheat straw
Hay (70t/d)**

**Ethanol
Lignin**



**LCF biorefinery
Icelandic Biomass
Iceland**

**Alaska
Lupine Straw
Barley Straw
Hay (20kt/yr)**

**Ethanol
Lignin**



**Green biorefinery
Austria
Industrial Consortium**

**Grass
(5t/h)**

**Lactic acid,
amino acid
Fibres, biogas**

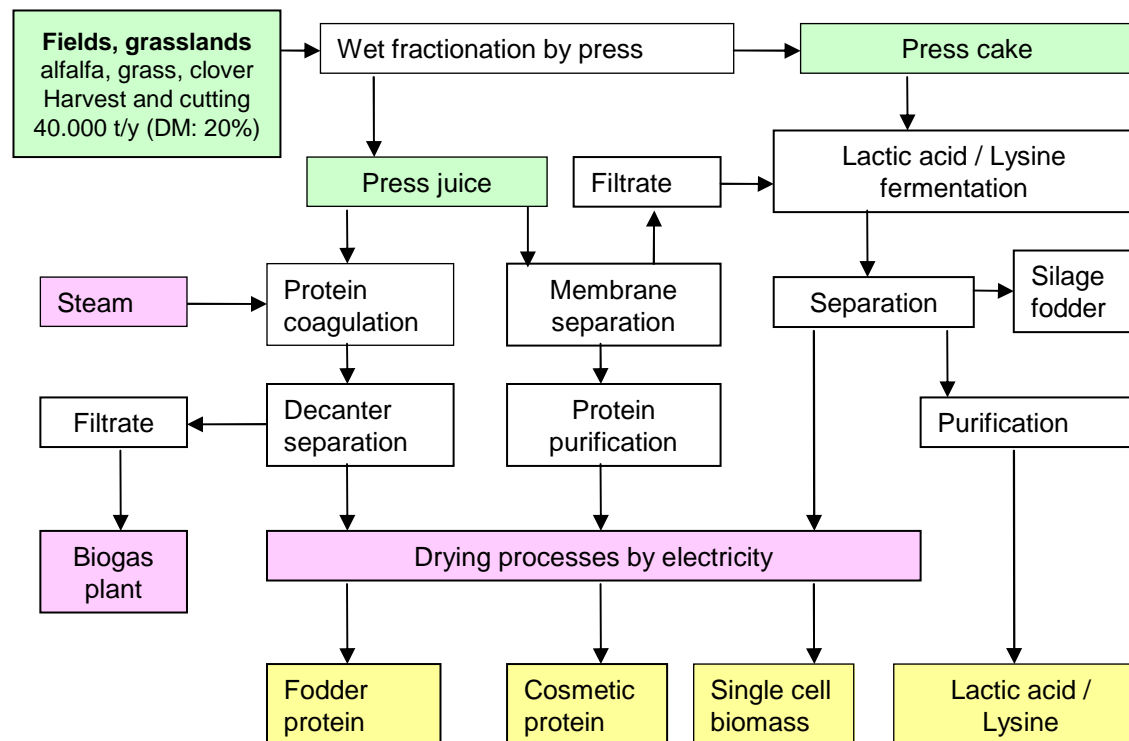
**Green biorefinery
Germany
Industrial Consortium**

**Alfalfa/ wild
mix grass
(30kt/a)**

**Proteins,
Lactic acid
Animal feeds,
biogas**

5. Green Biorefinery

Example:
Selected and simplified processes of a green biorefinery



Mass balances and energy input

Green Biorefinery

scenario 1: Lactic acid

input:

	quantity	unit
Cut green biomass (Lucerne, Clover, Grass)	DM: 20 % 40.000	t
Heat	2.200	GJ
Electricity	1.3 Mio	kWh

output:

Silage fodder	DM: 40 %	13.000	t
Fodder-Protein 80 %	DM: 90 %	400	t
Cosmetic-Protein 90 %	DM: 90 %	29	t
Lactic acid 90 %	DM: 90 %	660	t
Residue to Biogas plant TS: 2 %		17.690	t
Single cell-Biomass	DM: 90 %	33	t

(as Fodder-Protein 60 %)

Green Biorefinery scenario 2: Lysine

input:

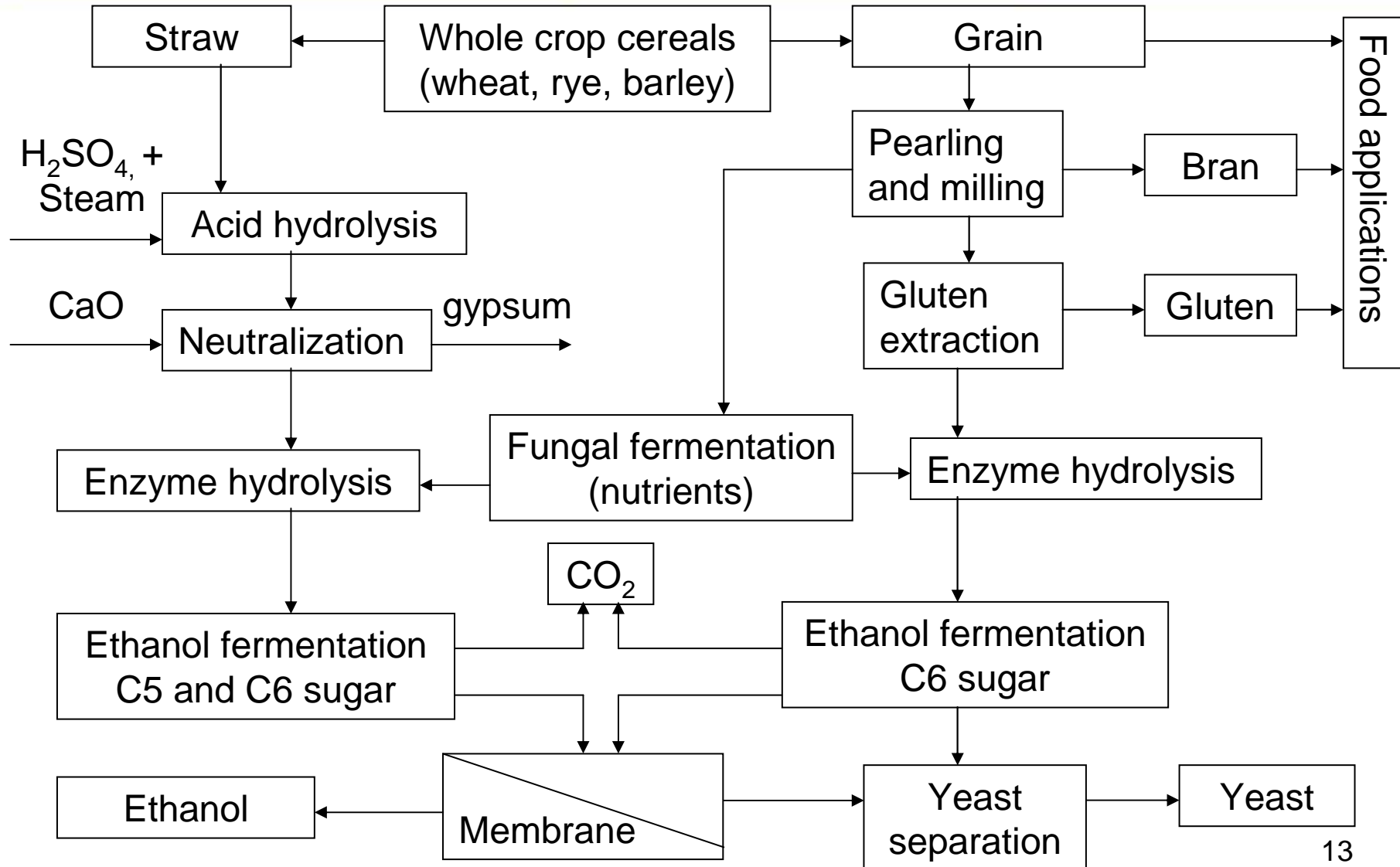
	quantity	unit
cut Green Biomass (Lucerne, Clover, Grass) DM: 20 %	40.000	t
Heat	2200	GJ
Electricity	0,492 Mio	kWh

output:

Silage fodder DM: 40 %	13.000	t
Fodder-Protein 80 % DM: 90 %	400	t
Cosmetic-Protein 90 % DM: 90 %	30	t
Lysine-HCl, 50% DM: 90 %	620	t
Residue to Biogas plant DM: 2%	17.770	t
Single cell-Biomass DM: 90 %	31	t

(as Fodder-Protein 60 %)

6. Whole Crop Biorefinery



General Summary

Biorefineries present :

- **Complex and integrated systems of sustainable technologies based on biological raw materials.**
- **Economically self-consisting enterprises and economic entities.**
- **Bearing pillars of the future biobased economics.**
- **Motors of research and development in the 21th century.**
- **Selected examples for technical implementation of green and whole crop biorefineries have been presented**

Contact

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Potsdam and Teltow in the Greater Berlin,
Germany

A photograph of the Brandenburg Gate in Potsdam, Germany, at night. The gate is illuminated with warm lights, and a large fountain in the foreground is spraying water upwards. The sky is dark blue.

City of Potsdam - Market Square
State of Brandenburg,
Greater Berlin, Germany

Thank you for your attention!