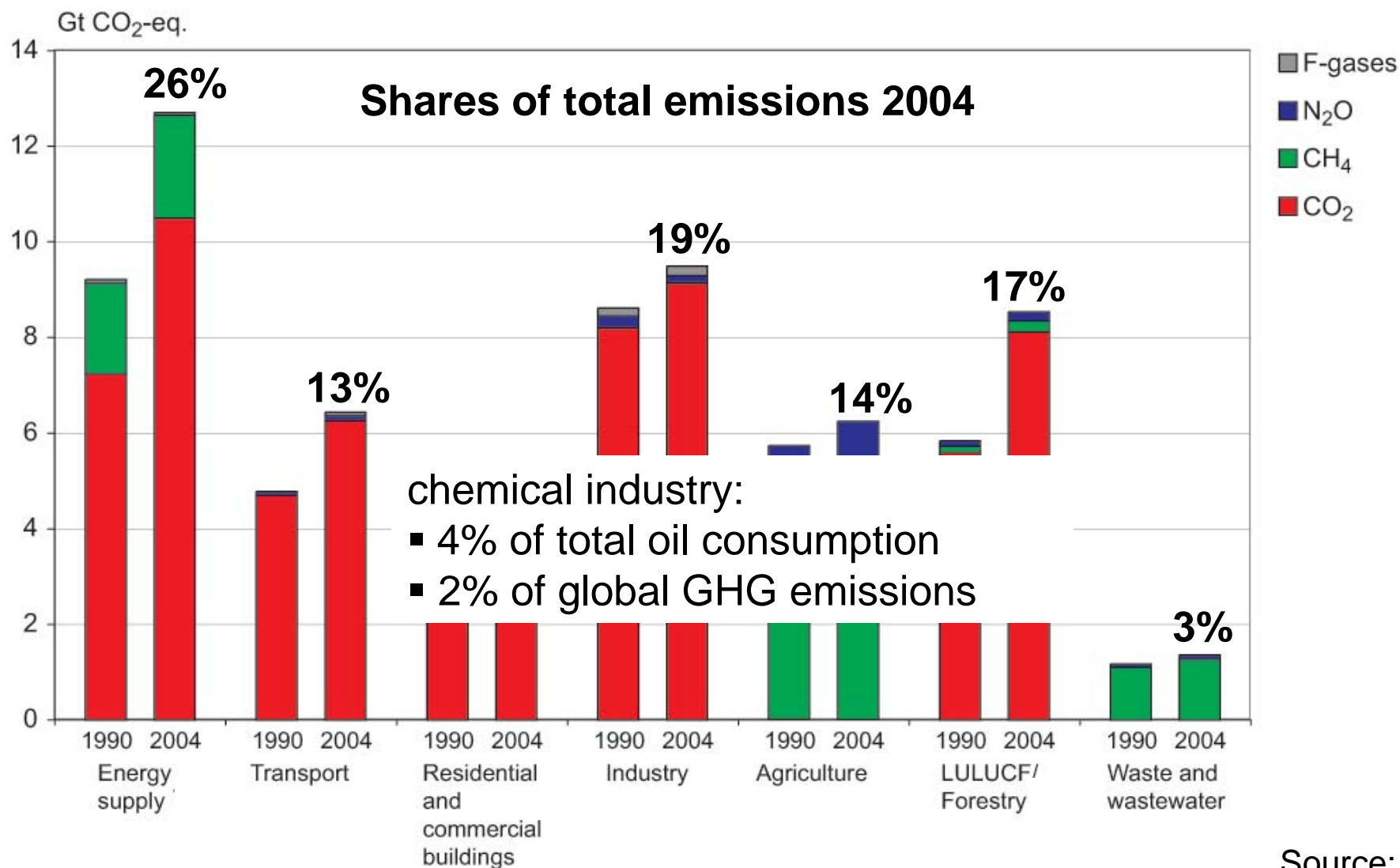


Biorefineries for Eco-efficient Processing of Biomass – Classification and Assessment of Biorefinery Systems

G. Jungmeier, J. Pucker
Joanneum Research, Graz, Austria
and the colleagues of IEA Bioenergy Task 42 „Biorefineries“

PTF BPI 2010
October 7, 2010, Kuchl, Austria

Development Greenhouse Gas Emissions per Sector 1990 - 2004

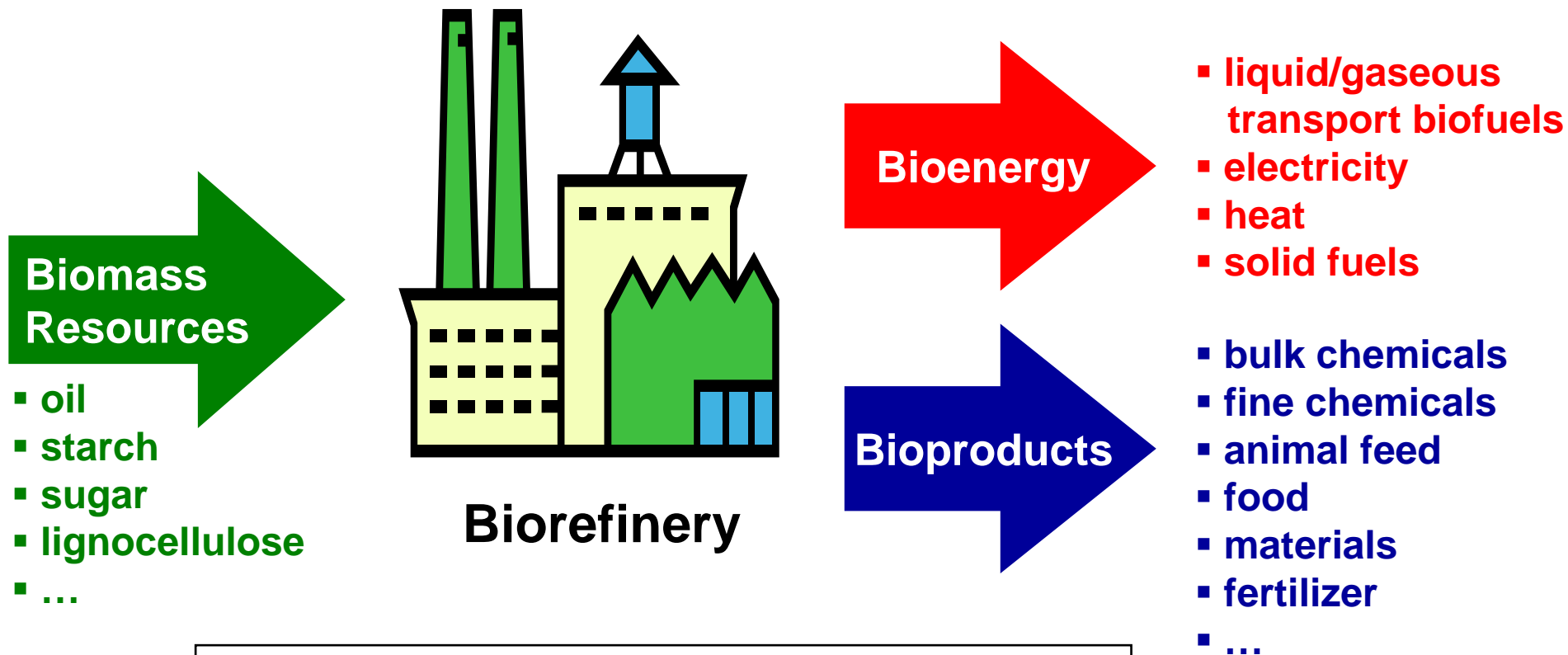




Outline

- Introduction
- Classification
- Assessment
- Examples
- Conclusions

Scheme of a Biorefinery



Based on different conversion processes:

- bio-chemical
- thermo-chemical
- physical-chemical
- ...

What is a „Biorefinery“?

„**Biorefinery** is the

- **sustainable processing of**
- **biomass** into a
- **spectrum of marketable products.**“

Definition by IEA Bioenergy Task 42 Biorefineries



Outline

- Introduction
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The 4 Features to Classify a Biorefinery System

1. Platforms

2. Products

Biorefinery

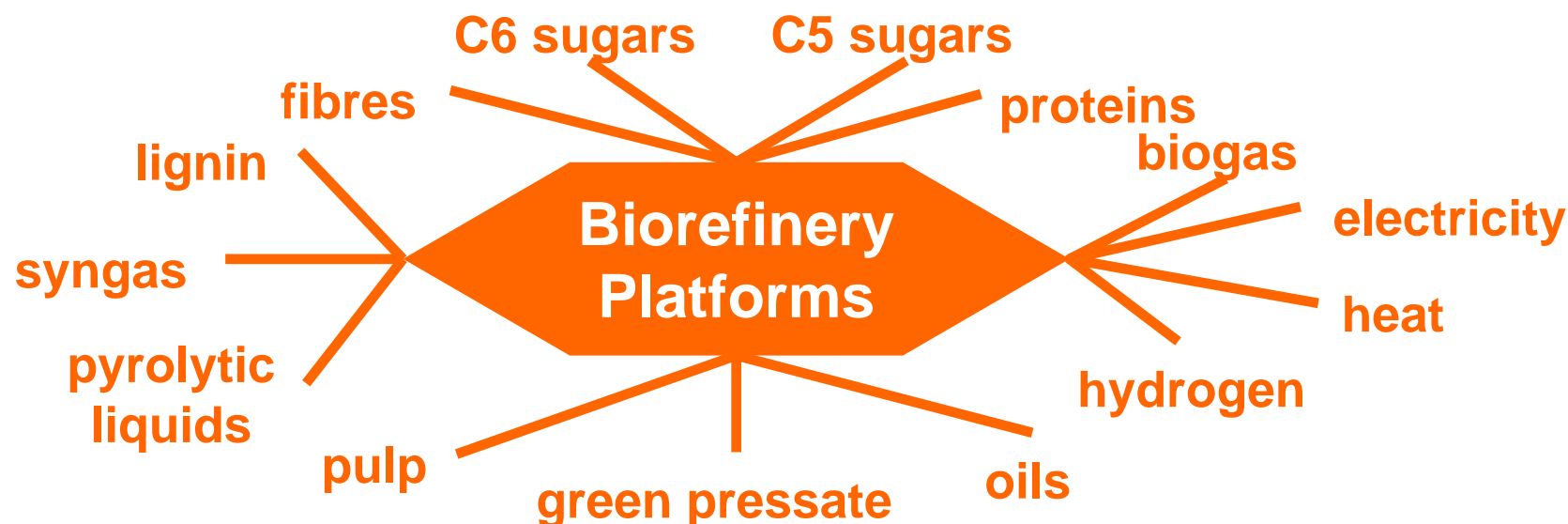
3. Feedstock

4. Processes

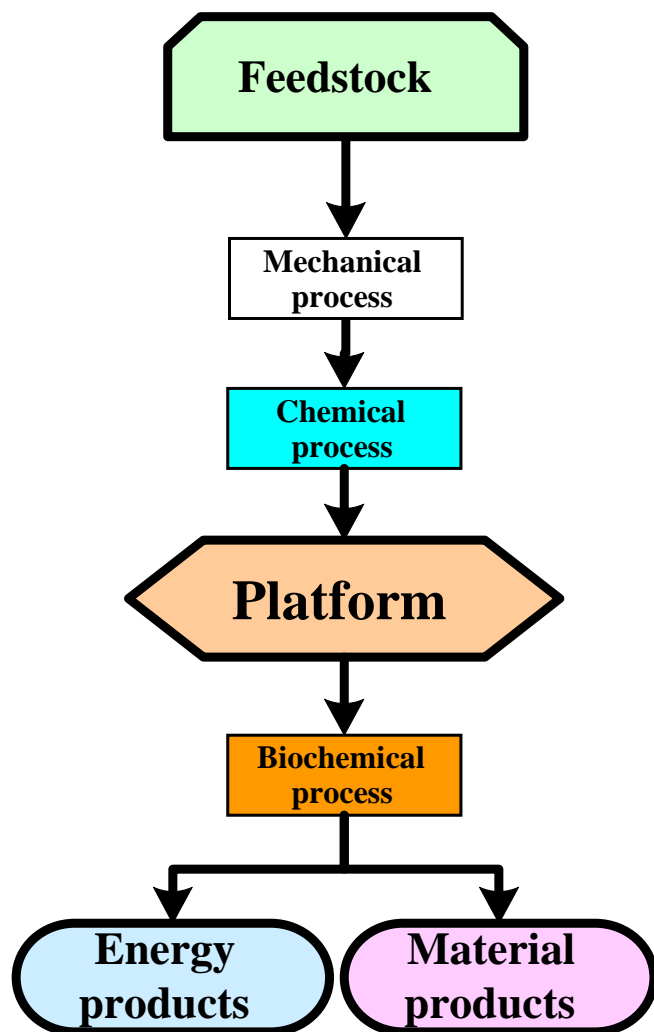
Feature 1: Platforms of a Biorefinery System

Platforms:

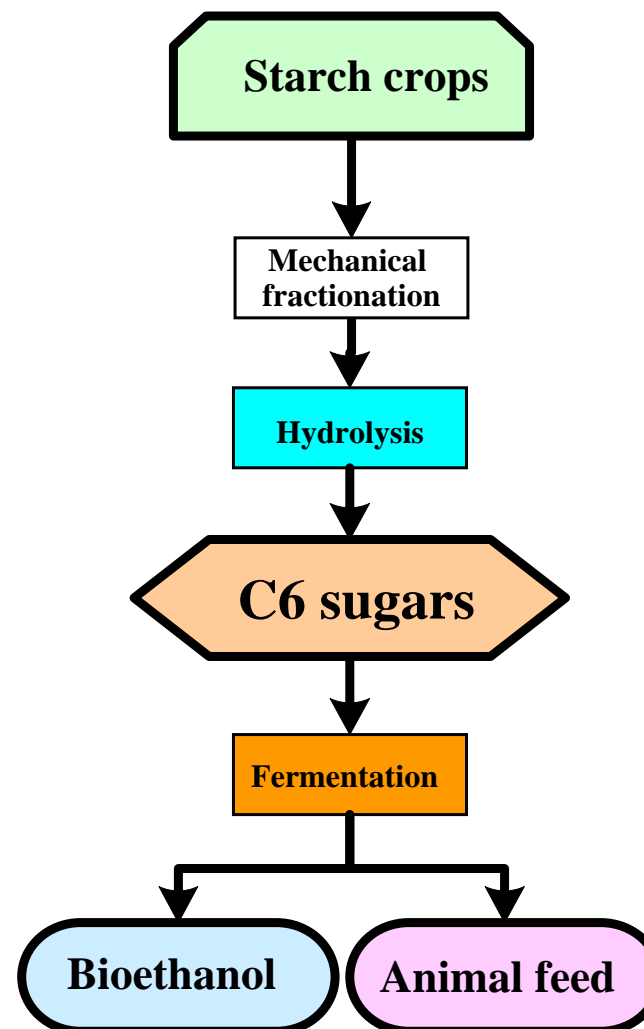
- **intermediates** from feedstock towards final products
- **linkages** between different biorefinery concepts
- **final product** of the biorefinery
- combined platforms possible (e.g. C6 & lignin, C5 & C6)

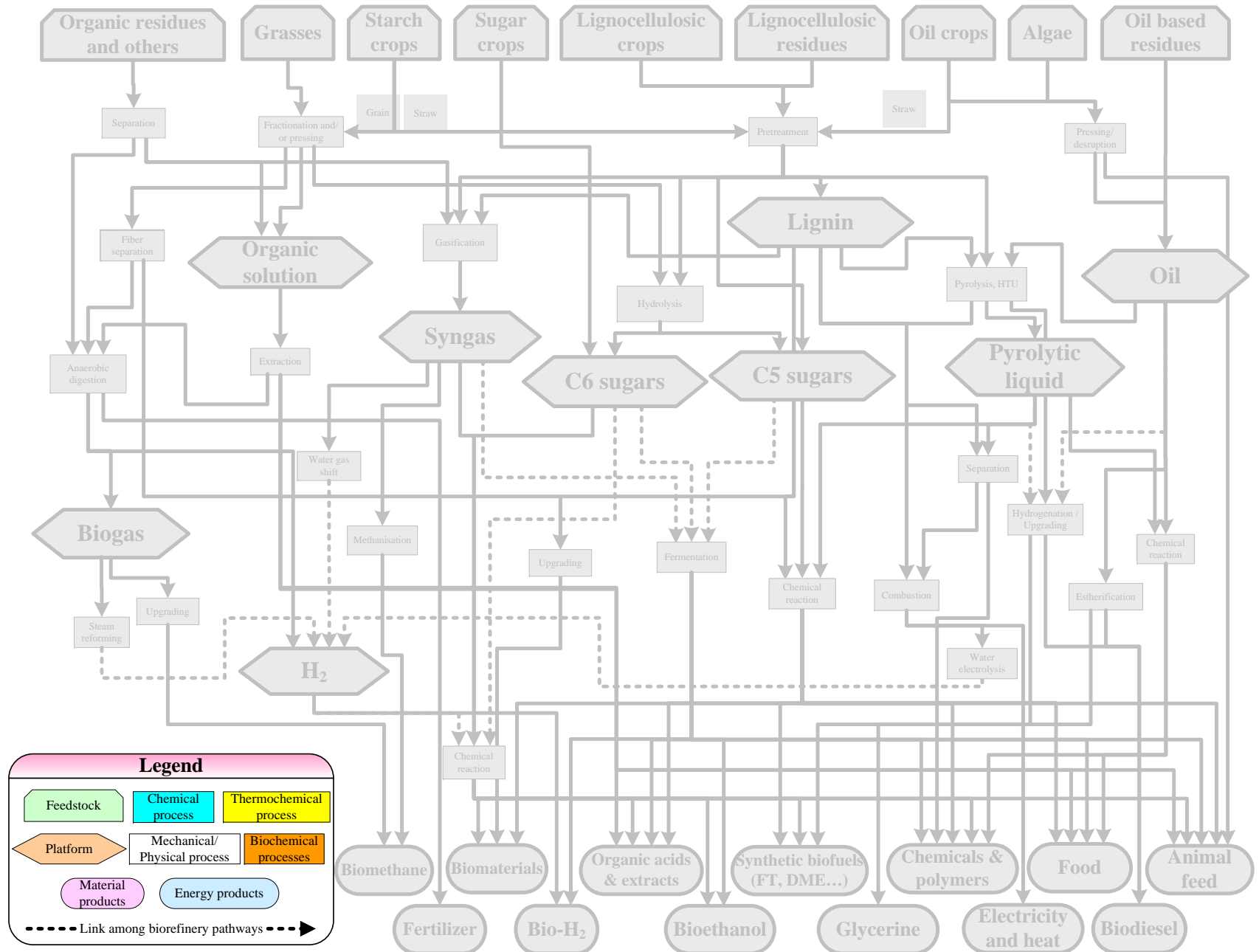


Generic System

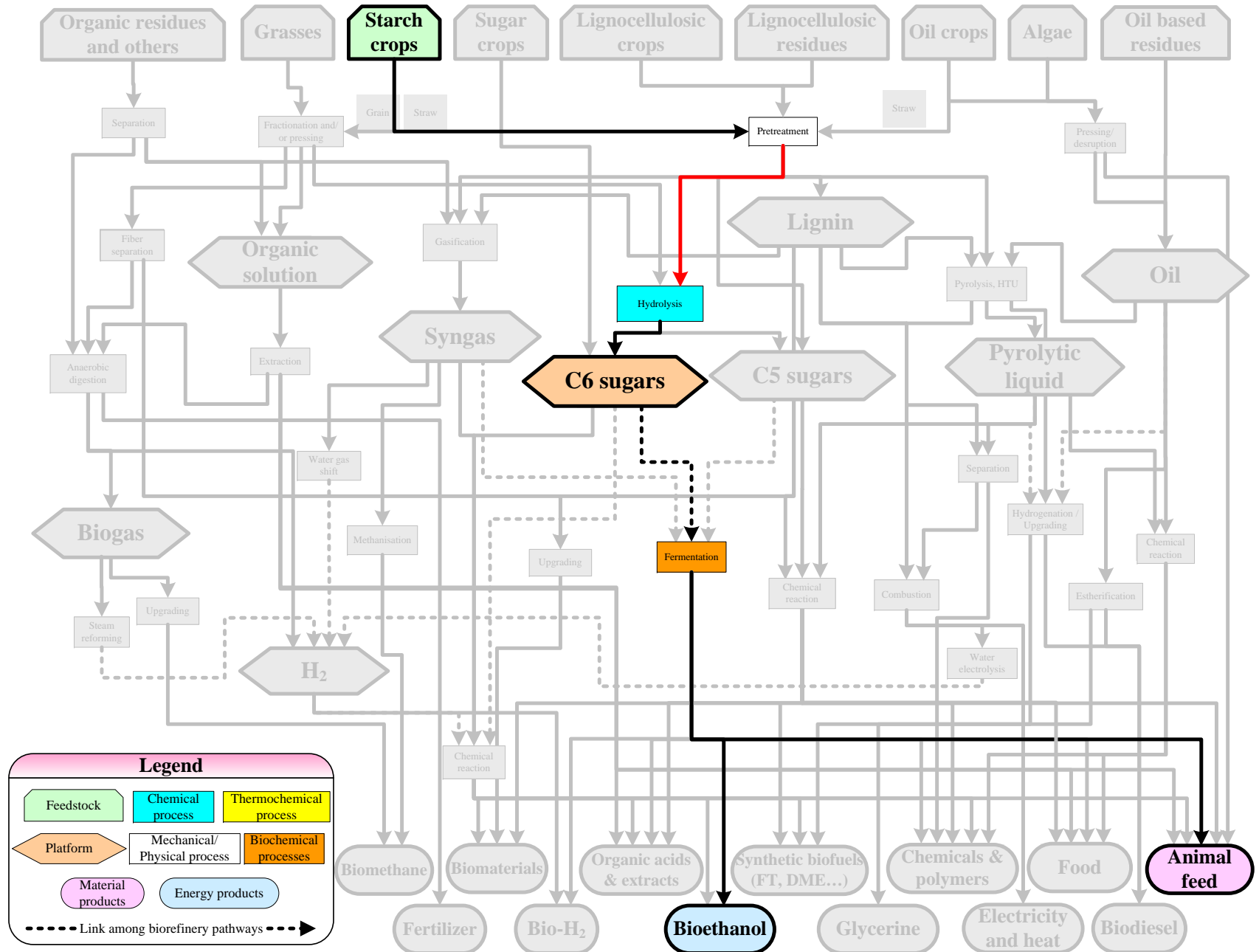


Example



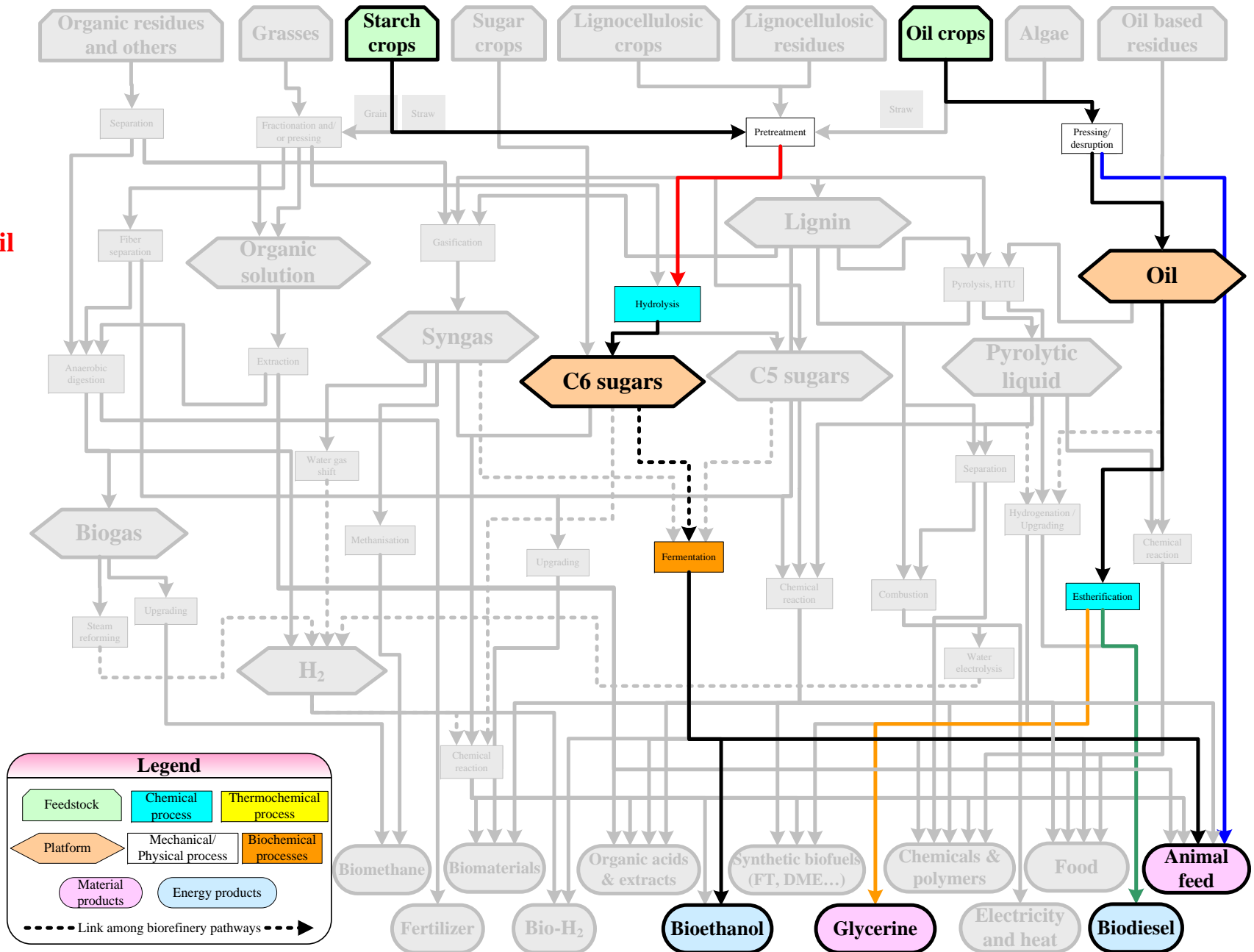


1. Bioethanol from starch

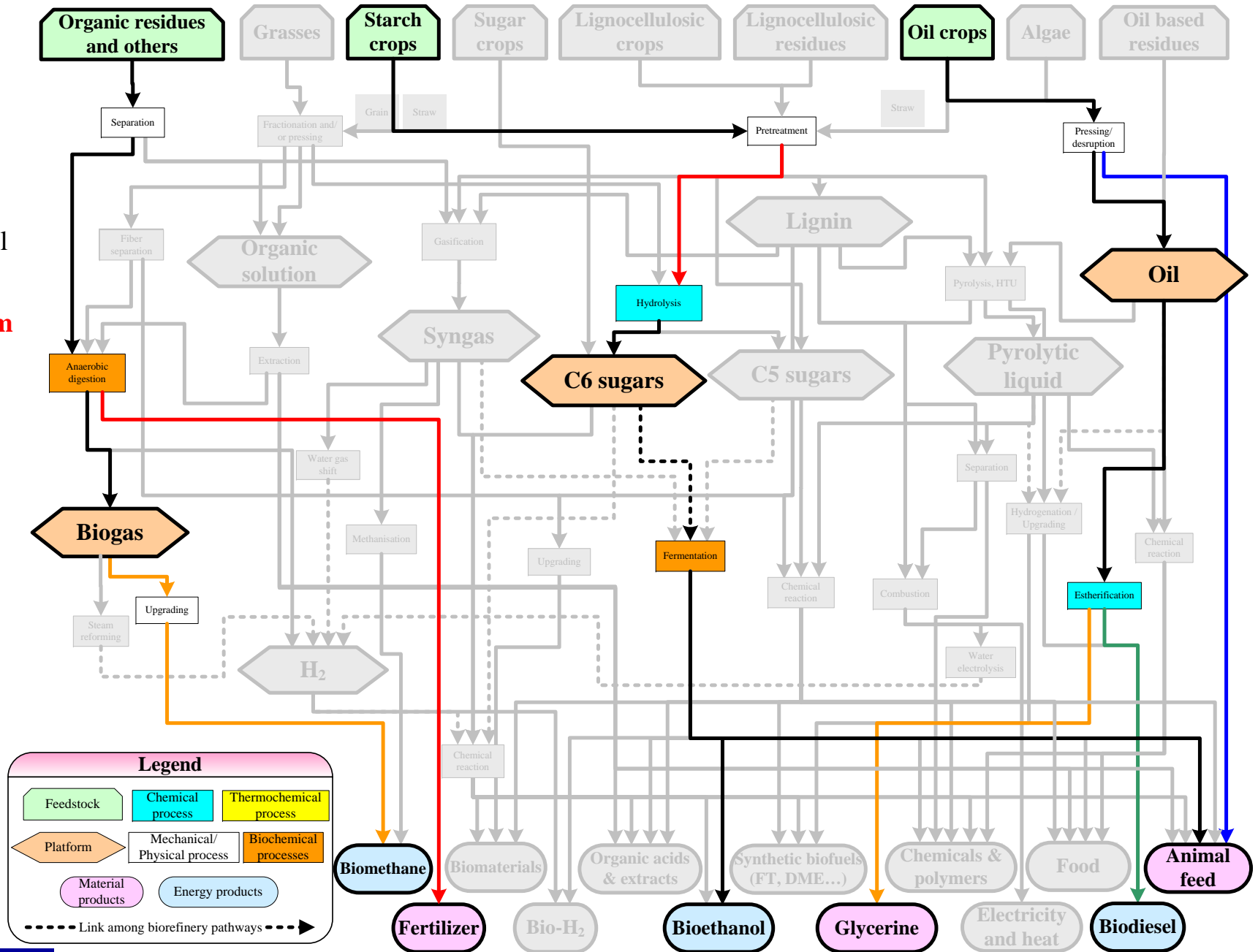


1. Bioethanol from starch

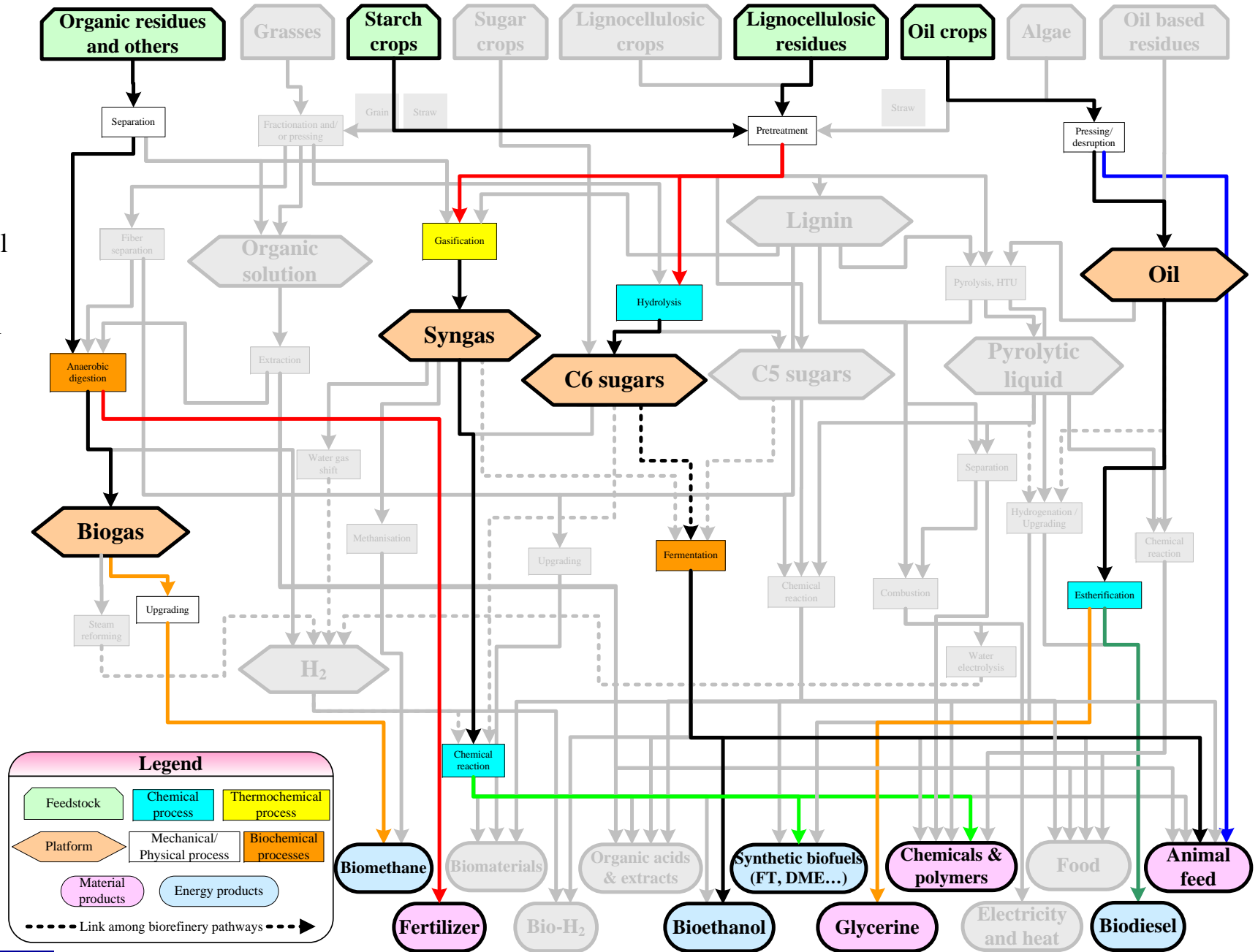
2. Biodiesel from oil crop



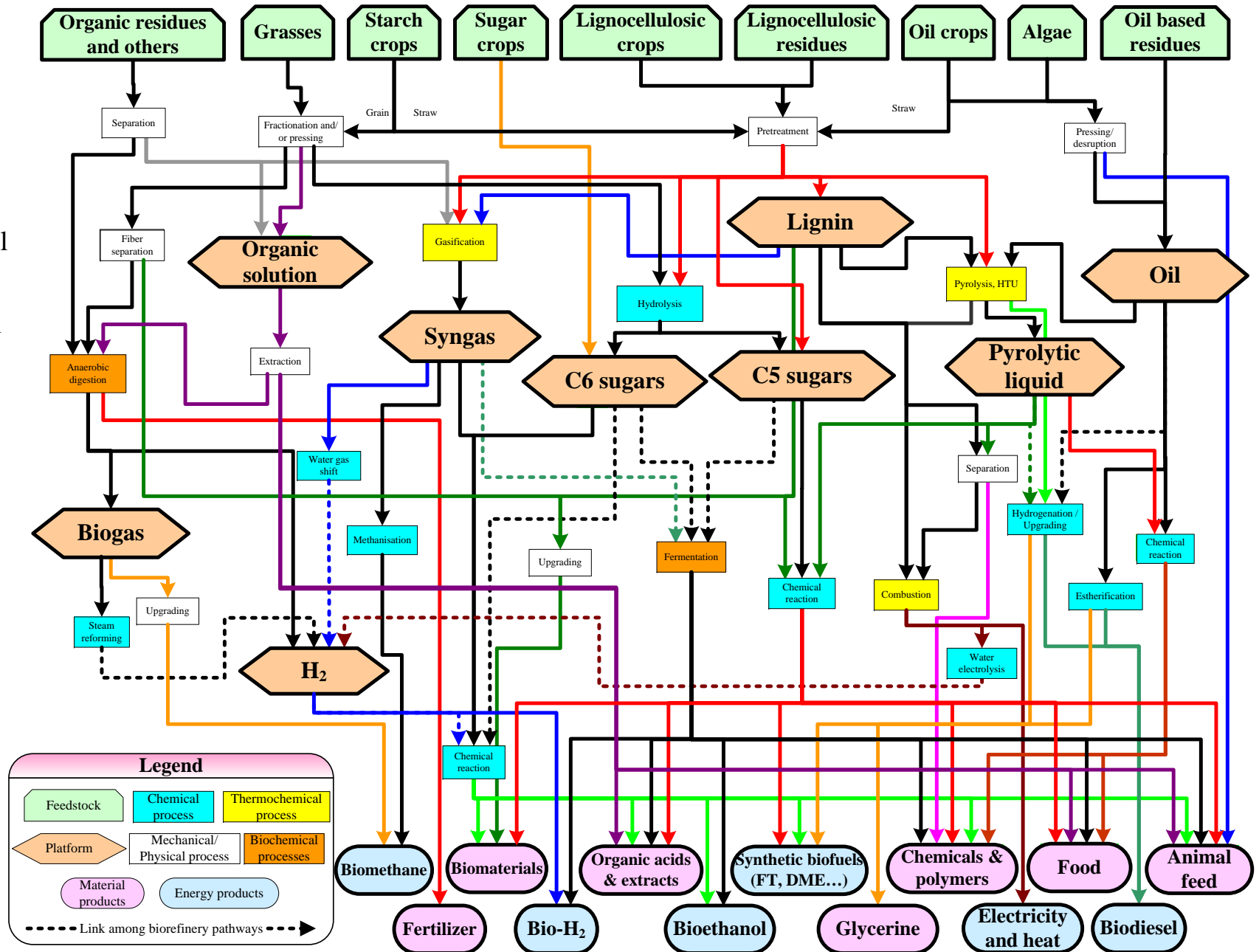
1. Bioethanol from starch
2. Biodiesel from oil crop
3. Biomethane from organic residues



1. Bioethanol from starch
2. Biodiesel from oil crop
3. Biomethane from organic residues
4. FT-Fuels from lignocellulosic residues



1. Bioethanol from starch
 2. Biodiesel from oil crop
 3. Biomethane from organic residues
 4. FT-Fuels from lignocellulosic residues
- ...

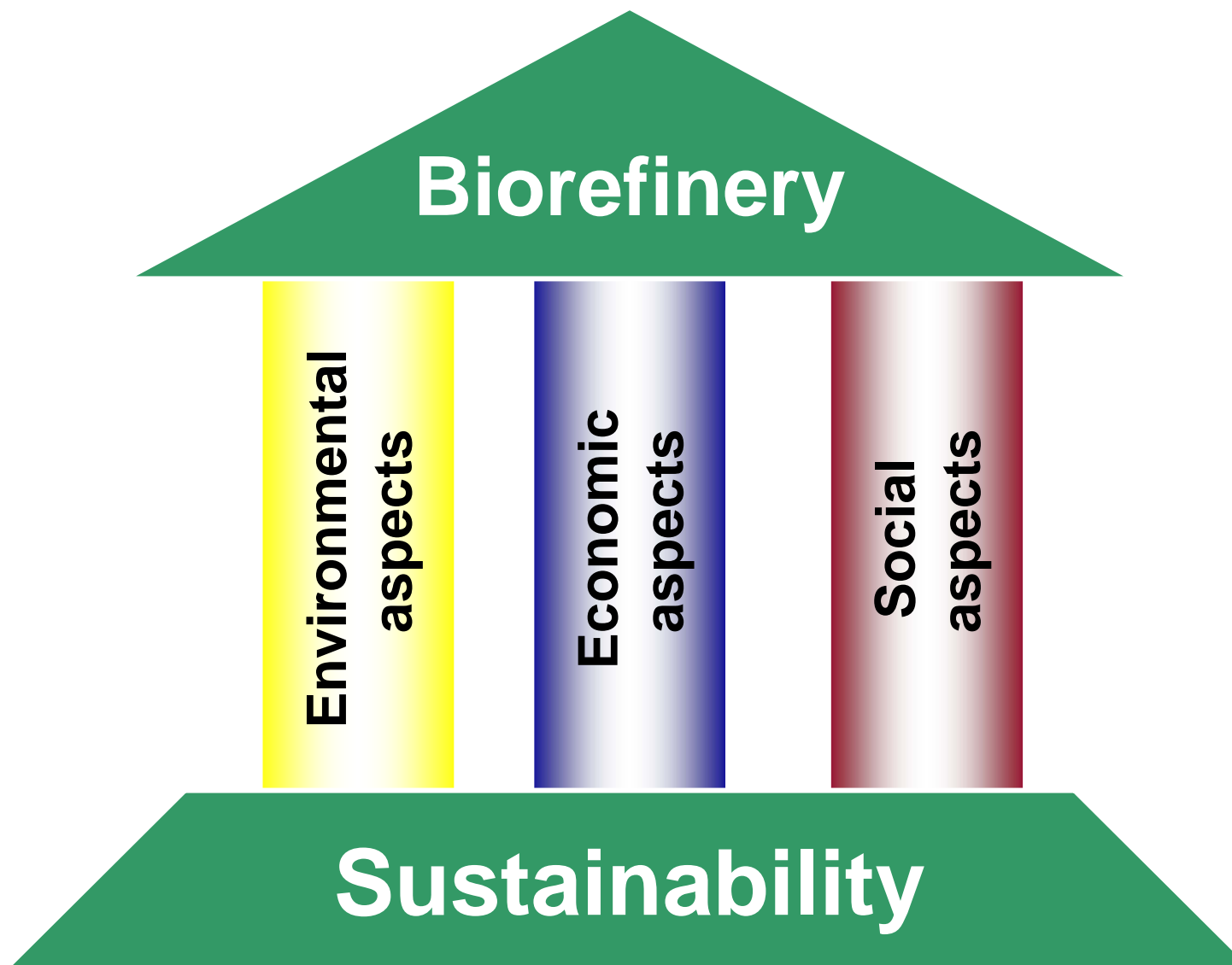




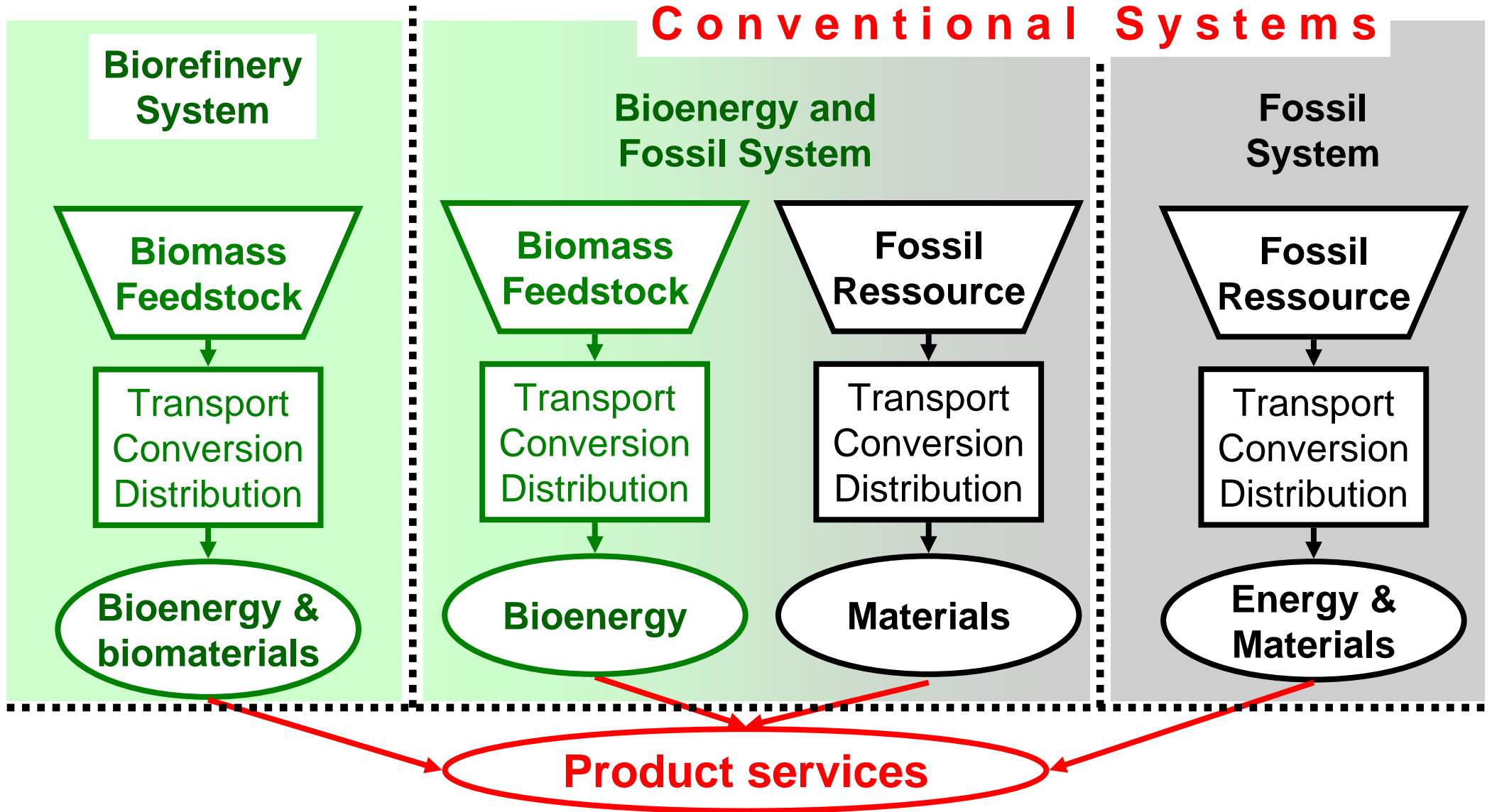
Outline

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Assessment of Advantages & Disadvantages of Biorefineries

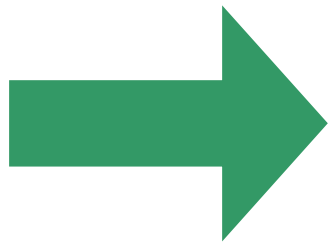


What are „Conventional Systems“?



Basics of Comparing Biorefineries to Conventional Systems

- ✓ Same amount of products with the same service
- ✓ Same amount and type of biomass must be considered
- ✓ Same amount of agricultural area and forestry area used
- ✓ Whole chain approach e.g. life cycle, value chain



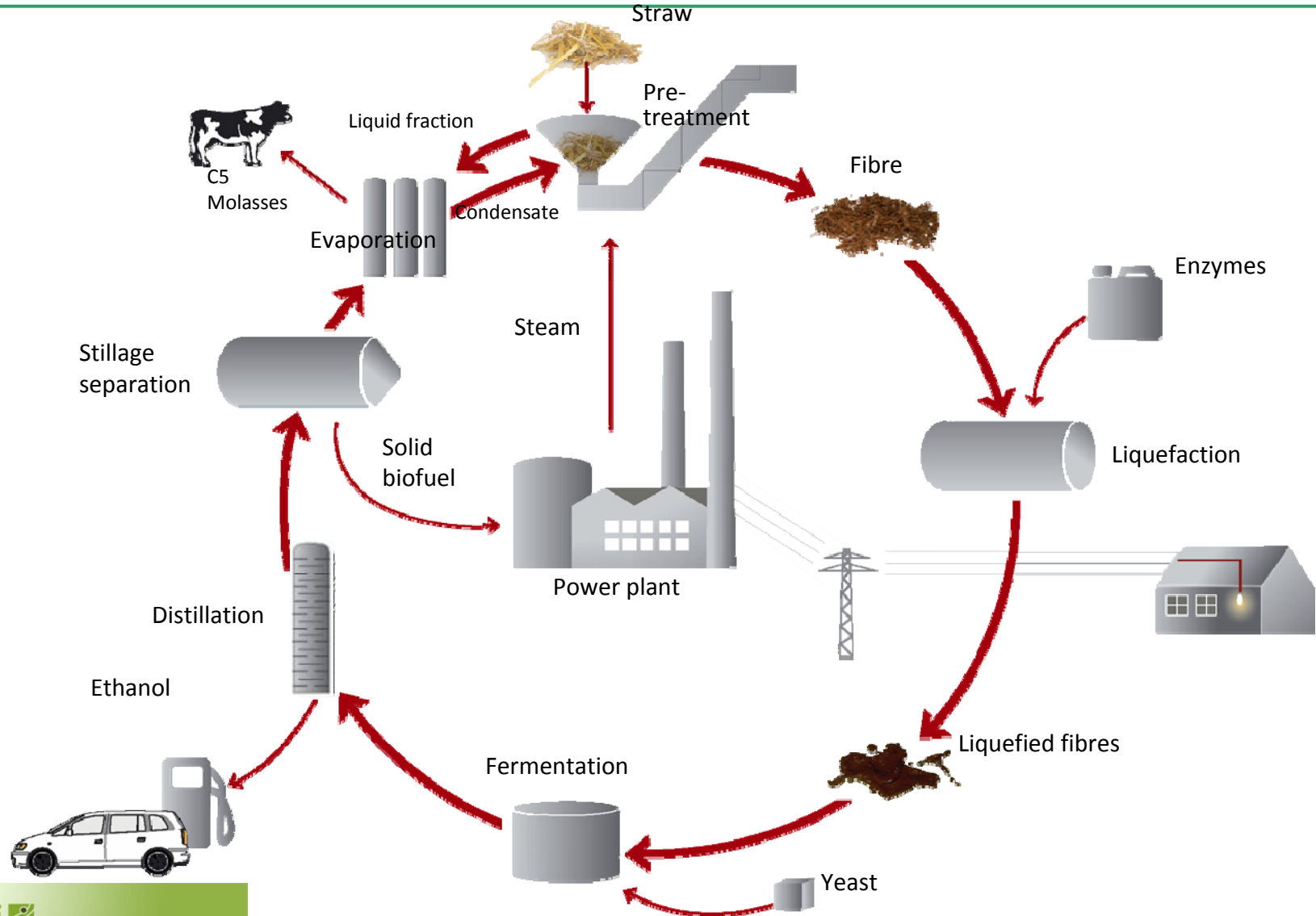
**Relevant for all aspects of sustainability:
economic, environmental and social**



Outline

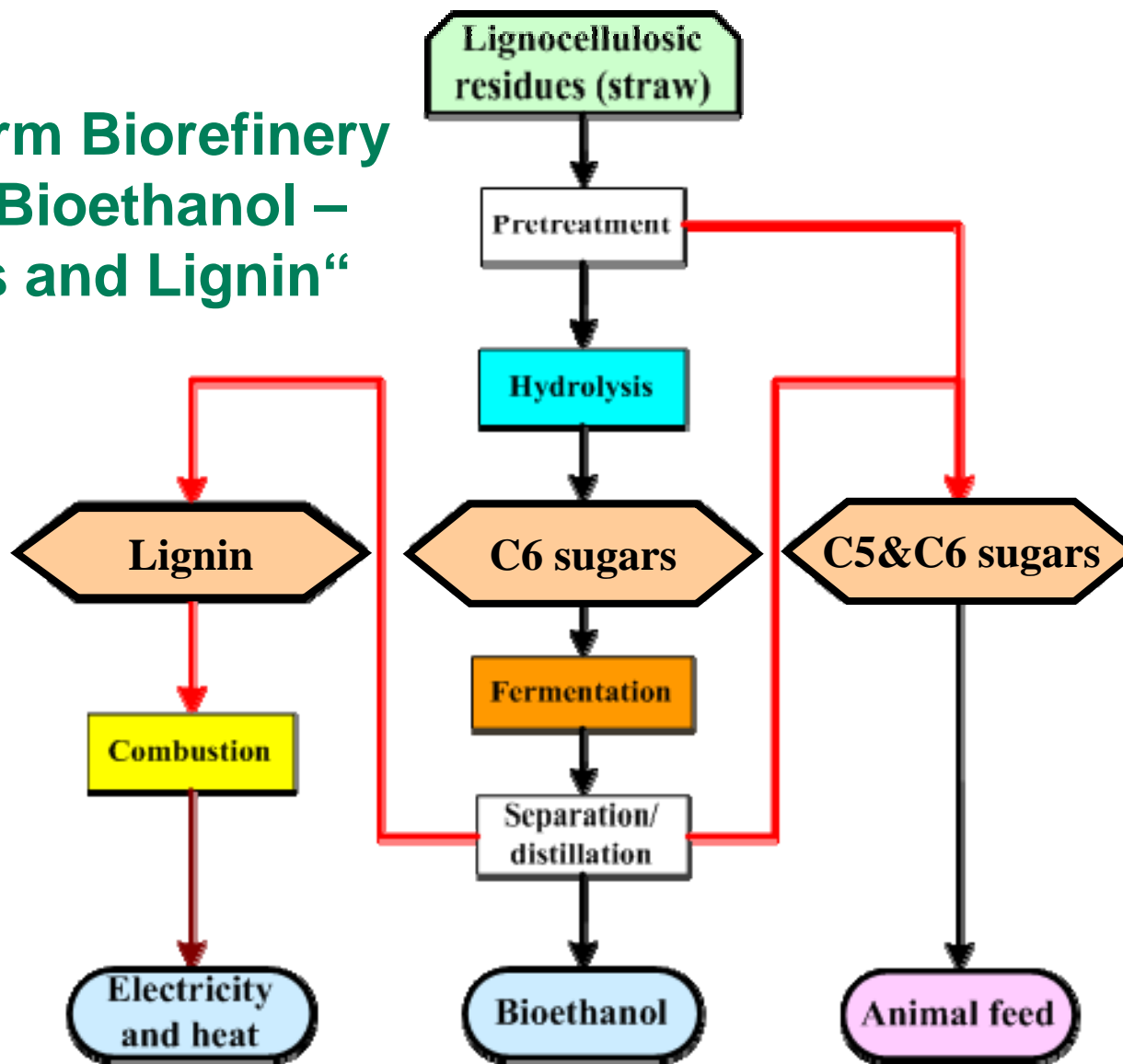
- Introduction
- Classification
- Assessment
- **Examples**
- Conclusions

Example 1: Demonstration Plant IBUS Biorefinery Denmark



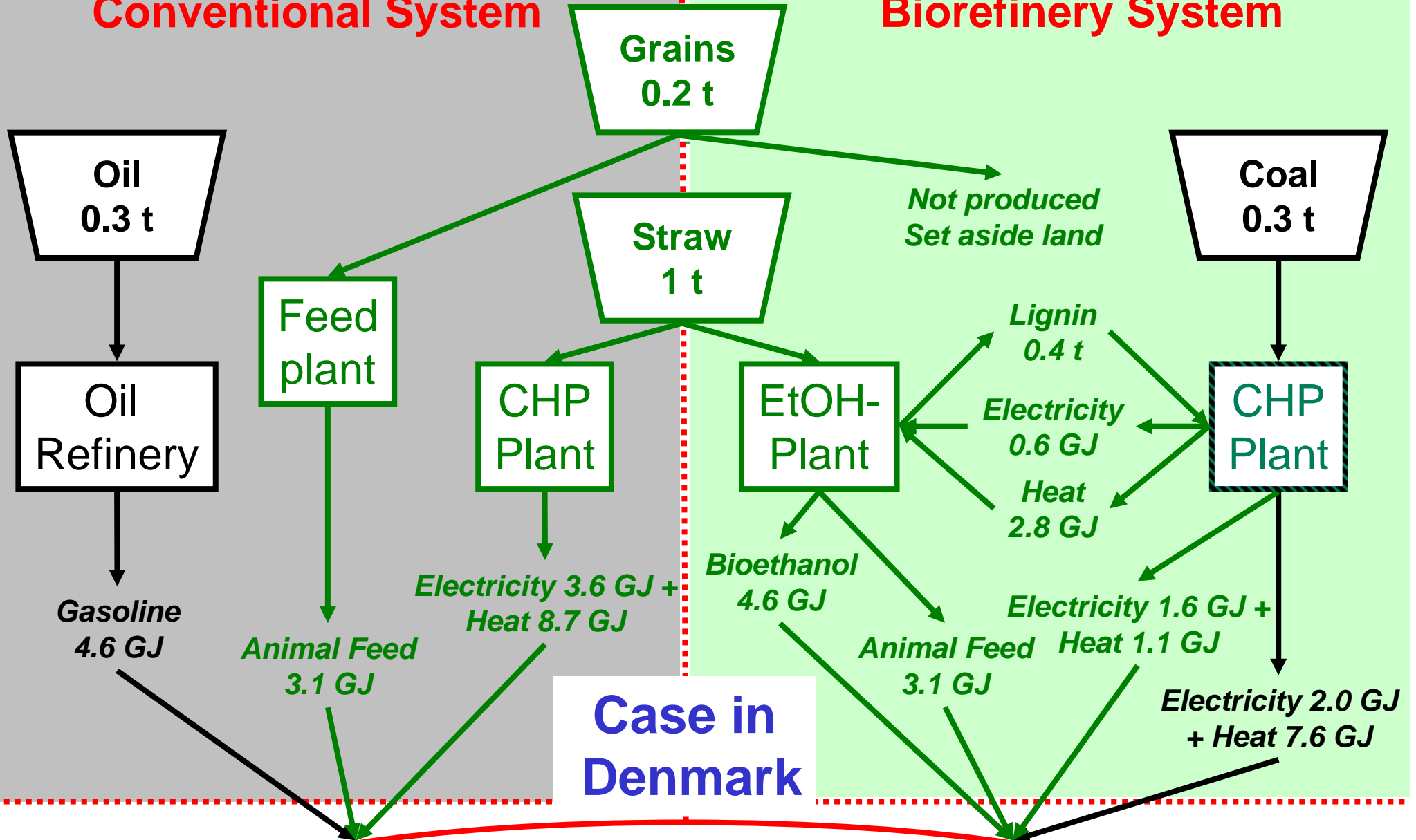
Example 1: Classification: IBUS Biorefinery Denmark

„A Three Platform Biorefinery
with Straw for Bioethanol –
C6&C5 Sugars and Lignin“



Conventional System

Biorefinery System



4.6 GJ Transportation fuel + 3.6 GJ Electricity + 8.7 GJ Heat + 3.1 GJ Animal Feed

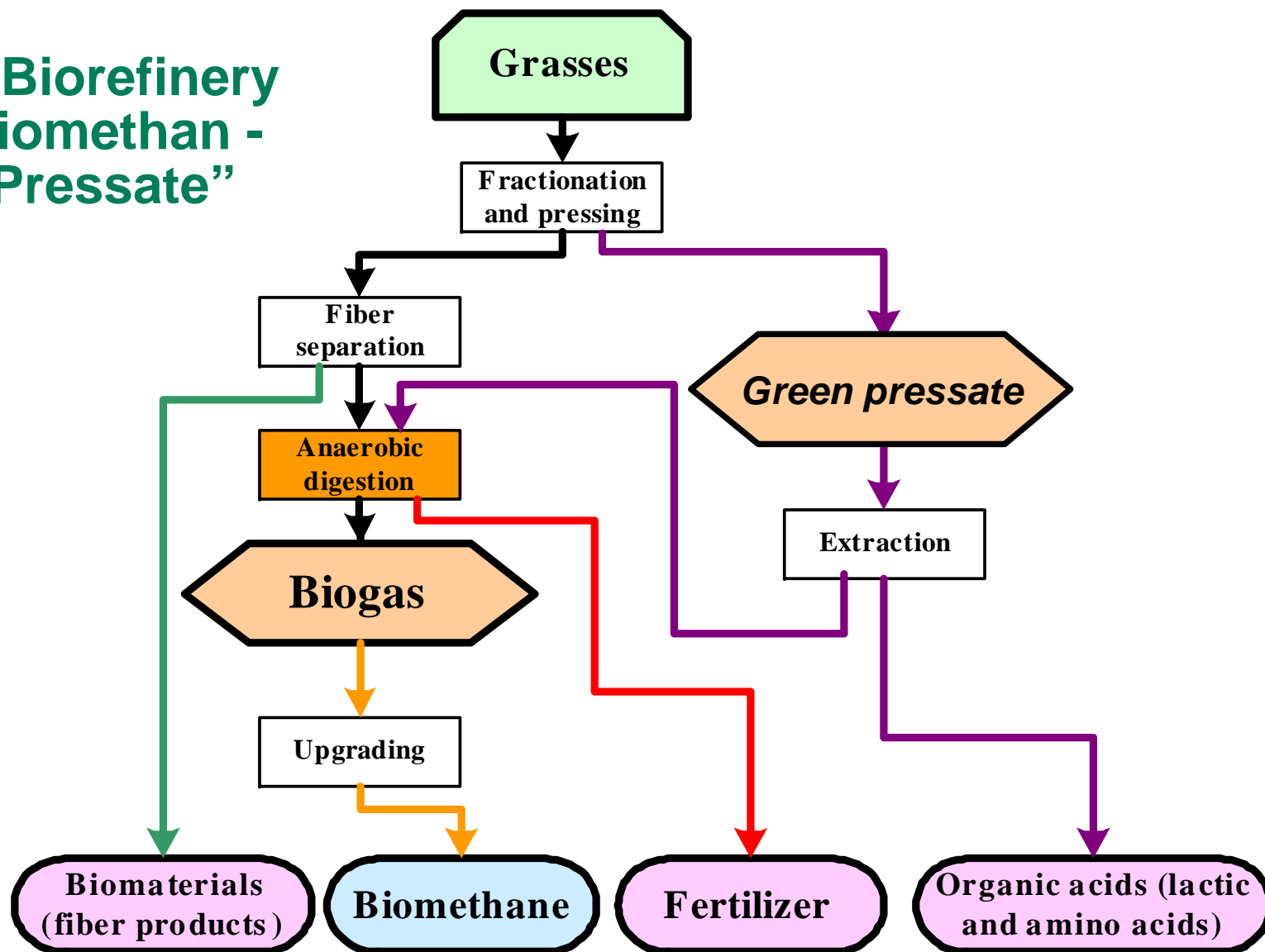
Example 2: Demonstration Plant „Green Biorefinery“, Austria

- Feedstock: Mixture of grass, clover, lucerene silage
- Products:
 - Organic acids (lactic and amino acids)
 - Fertilizer
 - Biomethane
 - Optional: fibres products



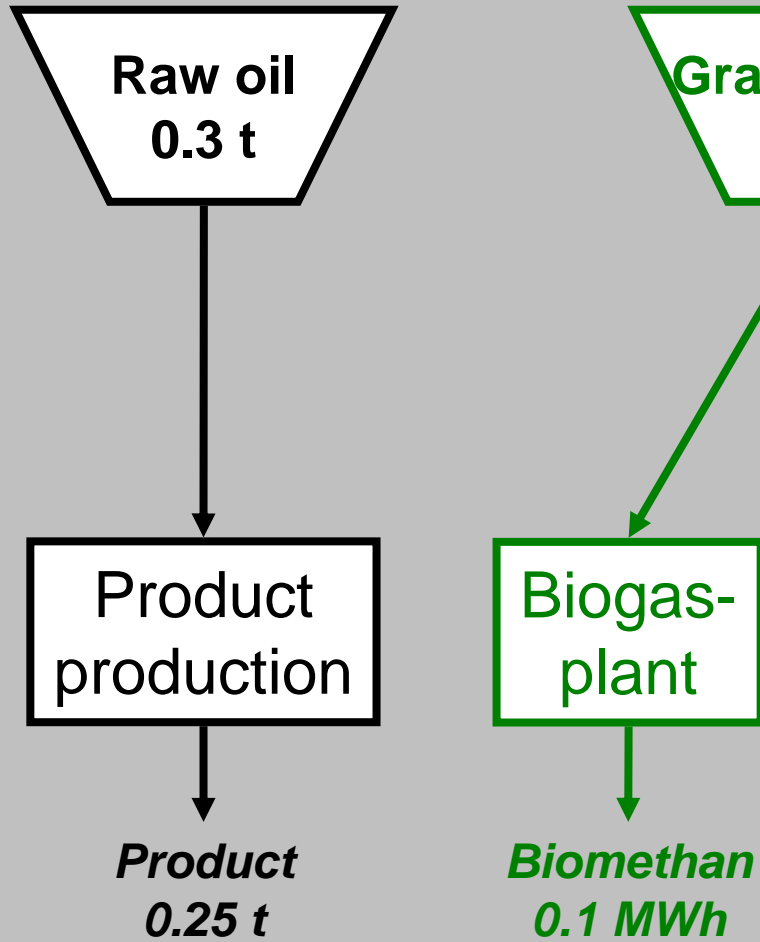
Example 2: Demonstration Plant „Green Biorefinery“, Austria

“A Two Platform Biorefinery with Grass for Biomethane - Biogas, Green Pressate”



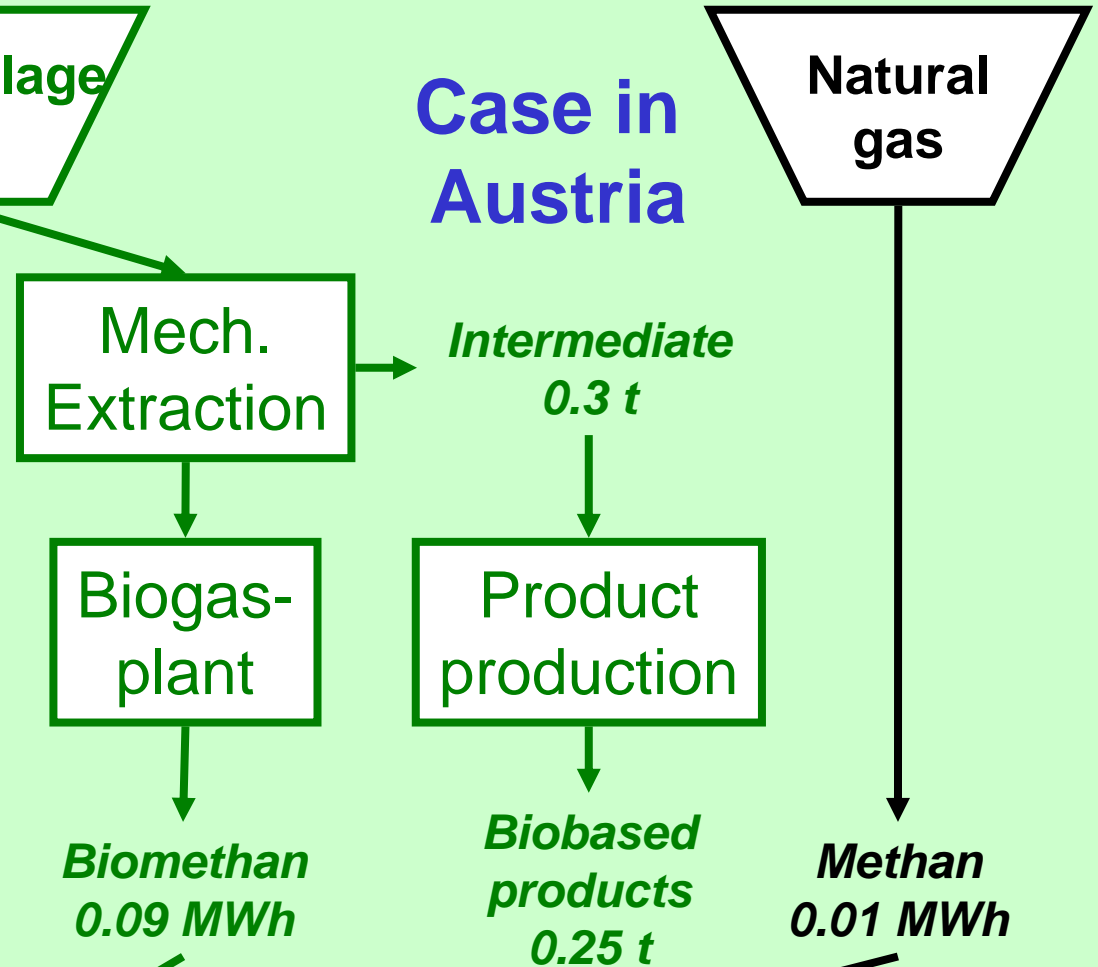
Conventional System

Biogas and raw oil



Biorefinery System

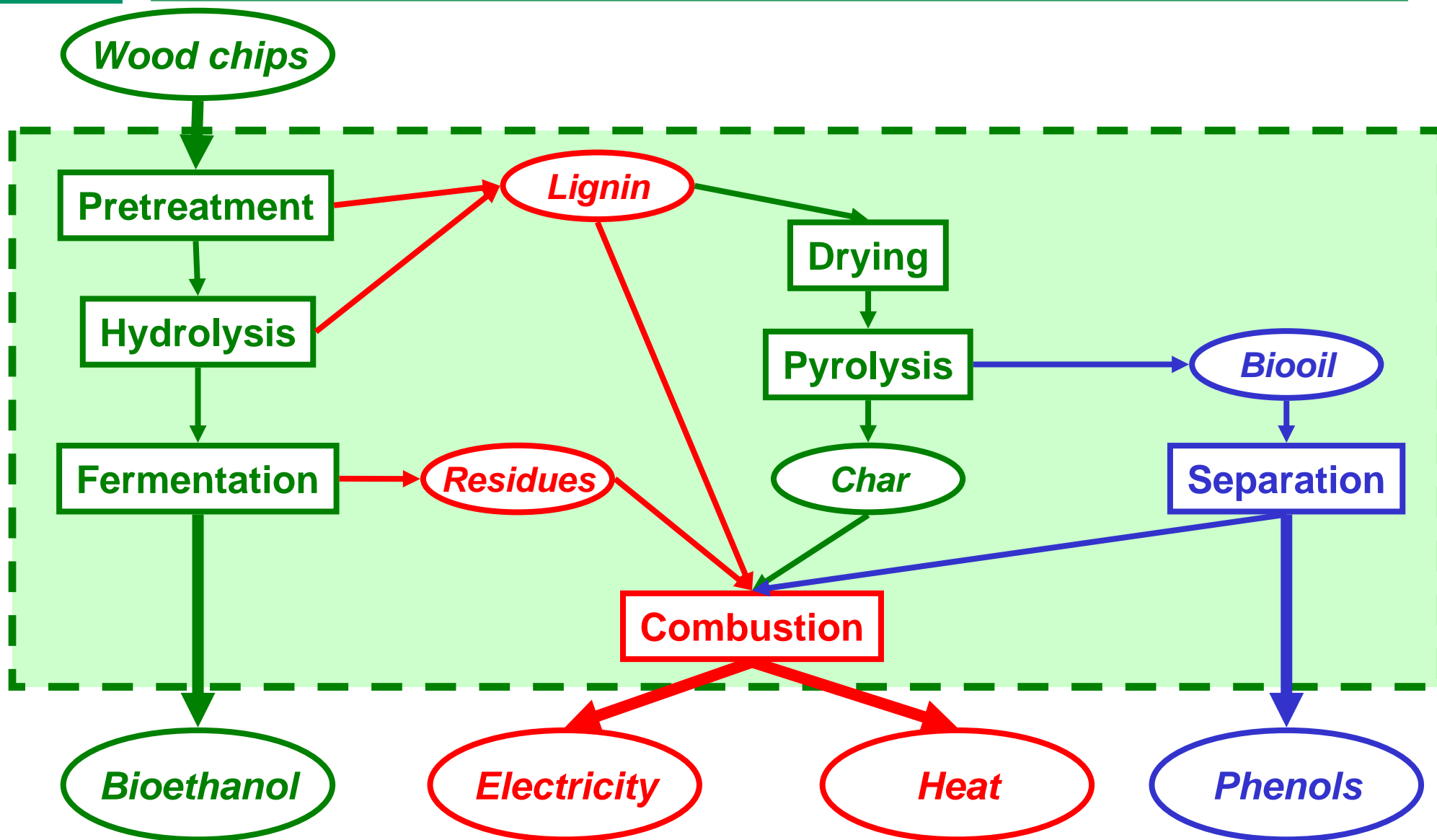
Biorefinery and natural gas



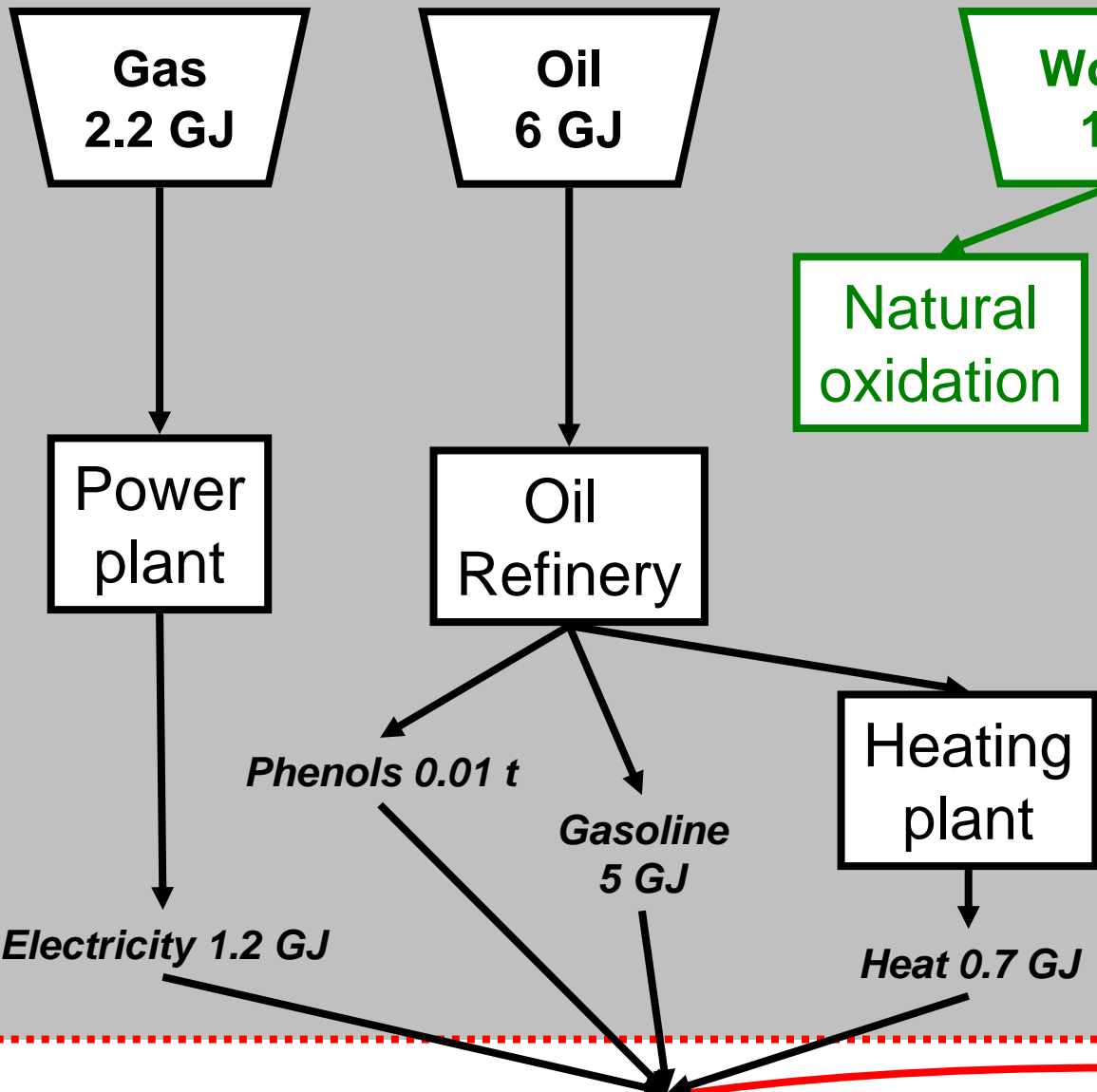
Case in Austria

0.1 MWh Methan and 0.25 t Products

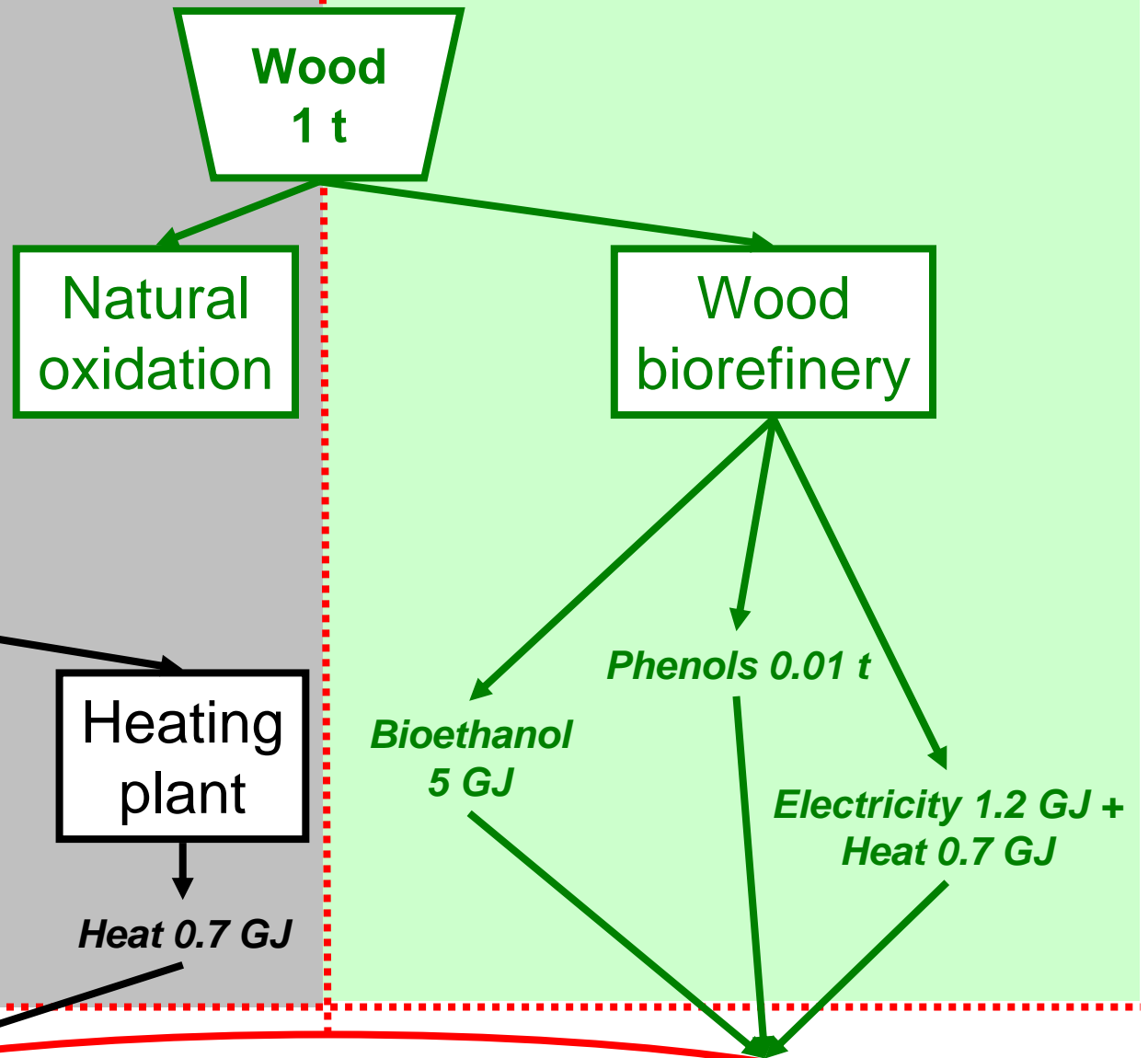
Example 3: Wood Bioethanol Biorefinery



Conventional System



Biorefinery System



**5 GJ Transportation fuels + 1.2 GJ Electricity
+ 0.7 GJ Heat + 0.01 t Phenols**

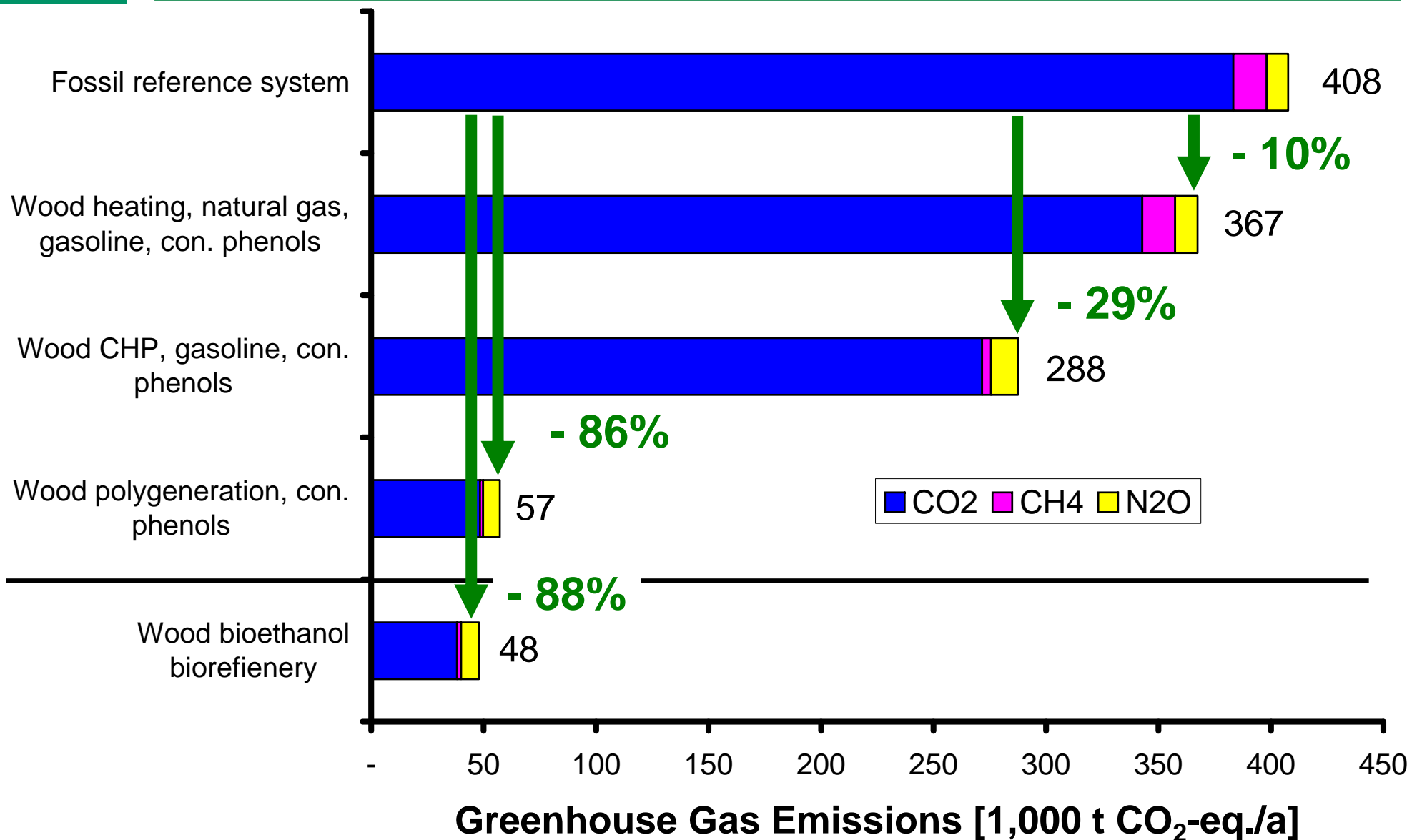
Conventional Systems for Wood Bioethanol Biorefinery

Systems	Product services			
	Heat 110 GWh/a	Electricity 175 GWh/a	Transportation service *) 1,000 Mio. km/a	Phenols 5,600 t/a
Wood bioethanol biorefinery	wood			
Wood polygeneration, con. phenols	wood			oil
Wood CHP **), gasoline, con. phenols	wood	gasoline		oil
Wood heating, natural gas, gasoline, con. phenols	wood	natural gas	gasoline	oil
Fossil reference system	oil	natural gas	gasoline	oil

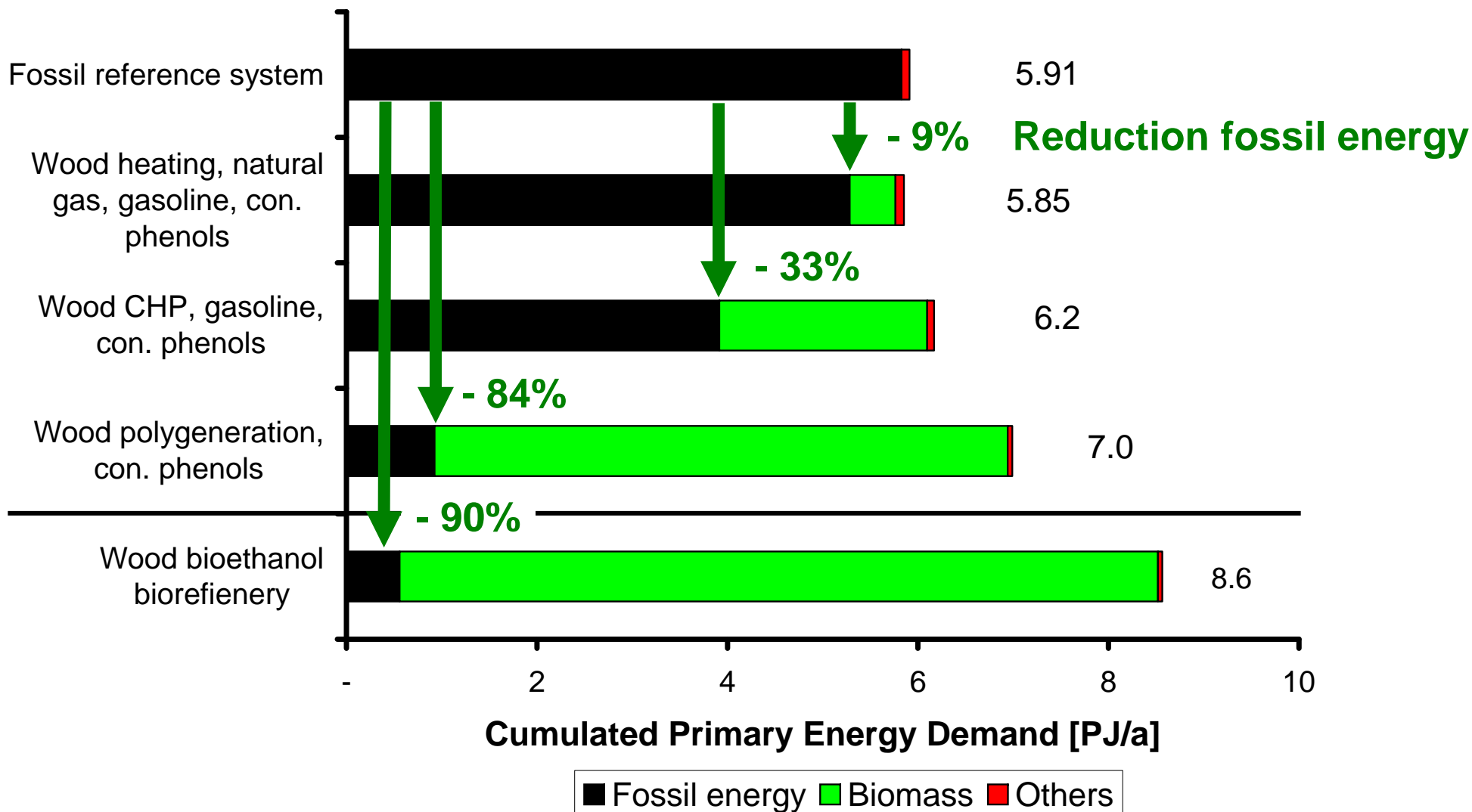
*) Bioethanol: 100.000 t/a
 **) Combined heat and power

Conventional systems

Annual Greenhouse Gas Emissions



Annual Primary Energy Demand





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Conclusions + Outlook

Task 42 will identify the 12 most interesting biofuel driven biorefineries

Task 42 „Biorefinery“ works out examples for sustainability assessment

Conventional system includes fossil and biomass based systems (e.g. for heat&electricity)

Comparative assessment of systems on whole chain approach by using same amount of biomass and land

Unique classification possible via platforms, products, feedstock and processes

Biorefinery systems coproduce bioenergy and biomaterials (key driver transportation biofuels)

IEA Bioenergy-Task42 Website

More information:
www.biorefinery.nl/ieabioenergy-task42