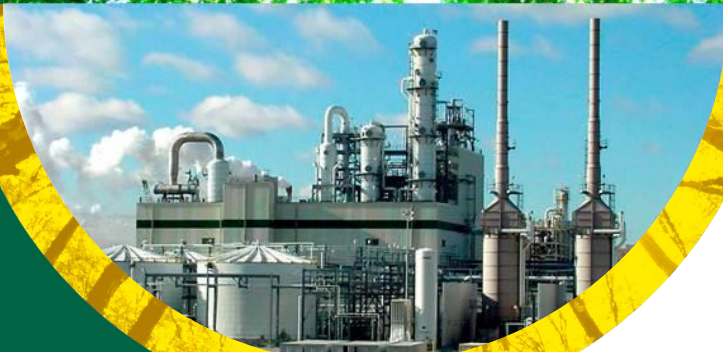


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# Integration of Advanced Biofuels in the Circular Economy

*Identifying major innovation options*

European Biofuels Technology Platform  
7<sup>th</sup> Stakeholder Plenary Meeting (SPM7)  
Brussels, Tuesday 21 June 2016



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Sustainable biomass production and valorisation for the BioEconomy by cascading and refining approaches to optimise full chain resource efficiency

€ market pyramid is leading

Pharma  
FF ingredients  
Chemicals  
Materials  
Fuels  
Energy

**Optimal sustainable biomass mobilisation & valorisation to both food and non-food within a market-pull approach should be the main focus of a BioEconomy**

GHG-emission reduction policy goals: high vol, low € markets are leading

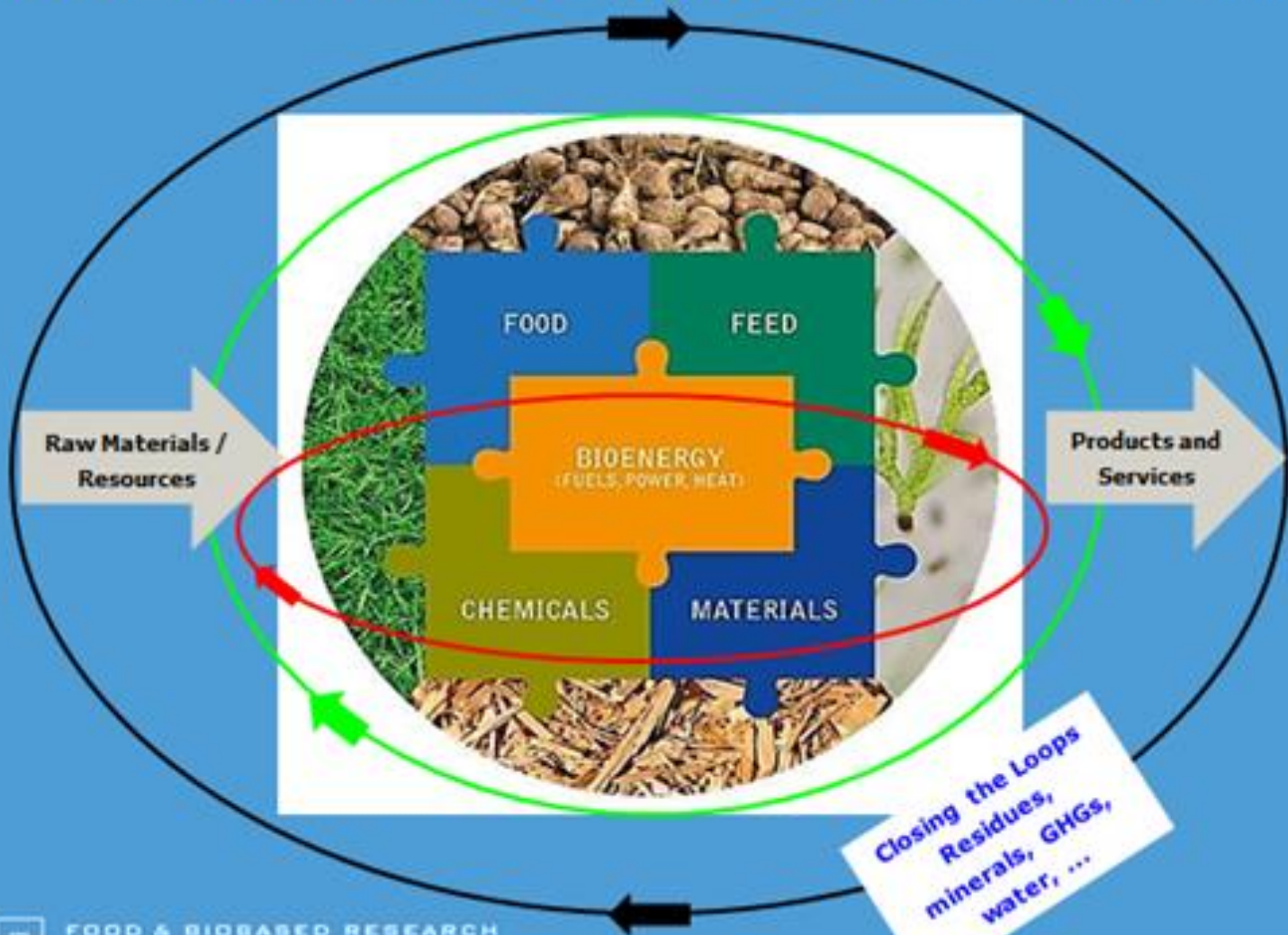
Production of advanced biofuels & bioenergy is leading and upstream cascading and refining approaches and downstream residues valorisation strategies are applied to optimise full chain sustainability

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# Bioenergy in the Circular Economy

Bioenergy – f(Biobased Economy) as f(Bio Economy) as f(Circular Economy)



# Energy and Biofuel based Biorefineries

## Energy based biorefineries

Main Product	Biorefining opportunities	Main issues
Power	<ul style="list-style-type: none"> <li>• Use of 1/2/3 residues</li> <li>• Upsteam ref. raw mat.</li> <li>• Integration existing &amp; new infrastructures</li> </ul>	Profitability (low coal €) Sustainability
Heat		
CHP		
Biogas (SNG, CHP)	<ul style="list-style-type: none"> <li>• Upstream ref. raw mat.</li> <li>• Digestate valorisation</li> <li>• Biogas/CO<sub>2</sub> valorisation</li> <li>• Digestion 2 fractionation</li> </ul>	Profitability Raw. mat. rel. policies

## Advanced biofuel based biorefineries

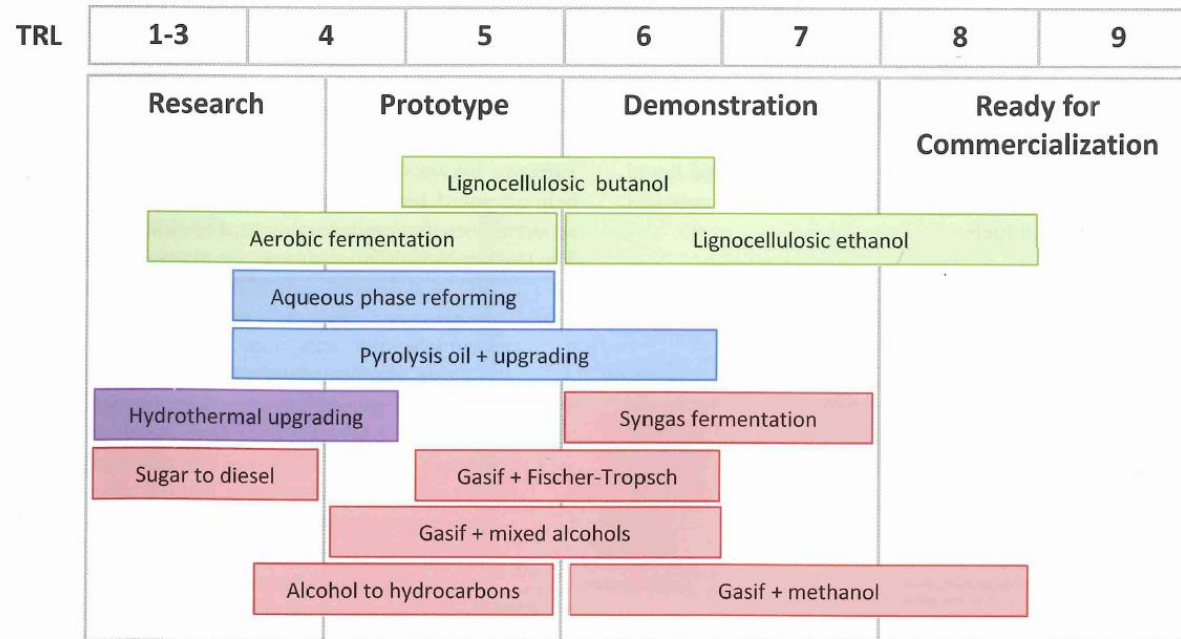
Main Product	Biorefining opportunities	Main issues
Truck fuels	<ul style="list-style-type: none"> <li>• Sugar &amp; syngas platforms</li> <li>• Lignin valorisation (c2bbp2&gt;€)</li> </ul>	Sustainability Techn SOTA
Aviation fuels		
Shipping fuels	Ligin val. in robust engines	New desulp.reg.



# Advanced Biofuel Based Biorefineries

## *Commercialisation Status (IRENA)*

International Renewable Energy Agency, BE Sustainable, 2016

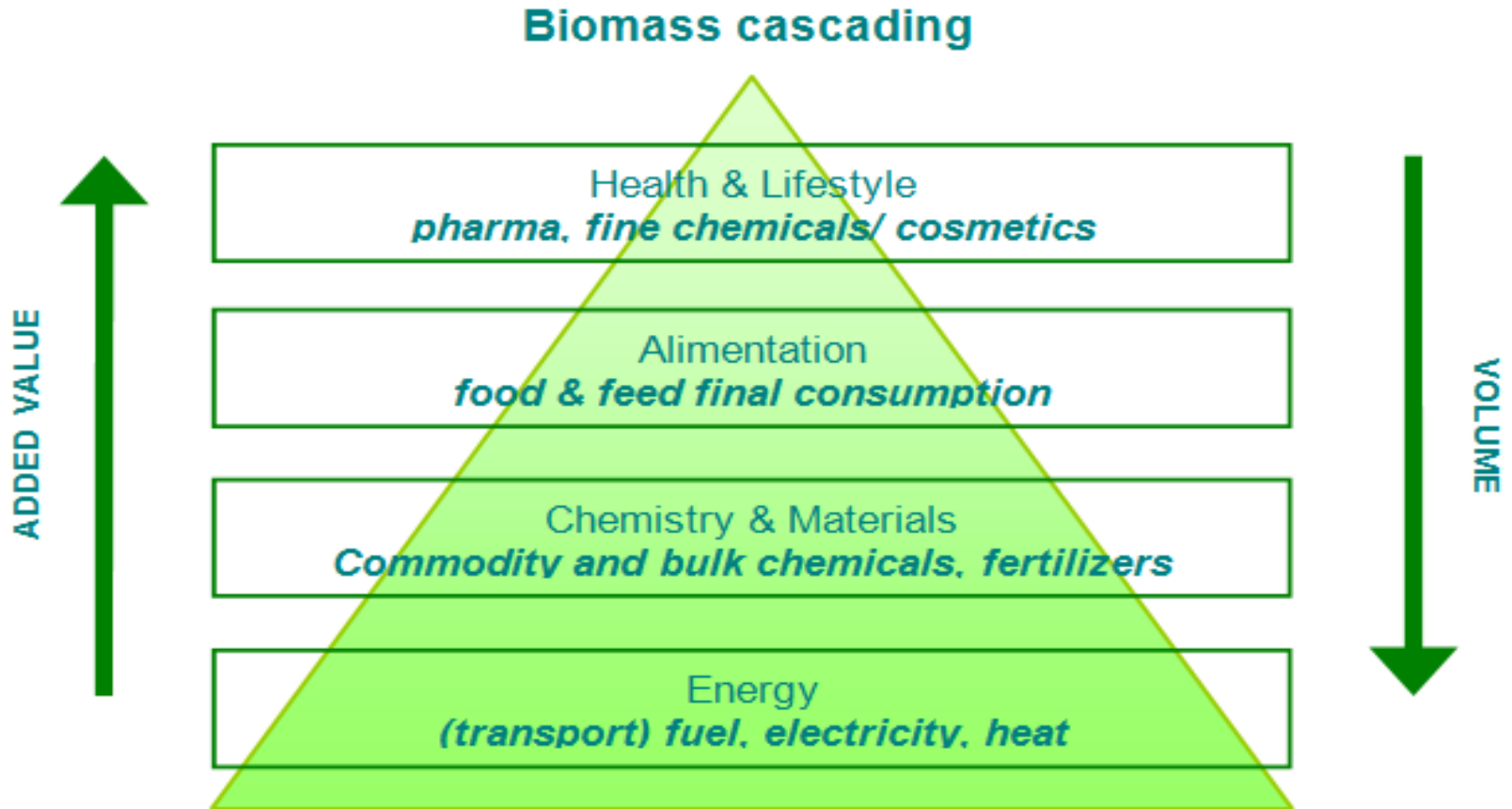


- **Main technological issues will be solved**
- **Multi-product valorisation will be necessary for full market competitiveness and flexibility**
- **Main crucial innovation issues:**
  - **Need for sustainable biomass supply: BIOCOMMODITIES**
  - **Efficient use biomass sources: BIOREFINING**

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# Optimal sustainable use of biomass CASCADING / REFINING



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Cascading in time: optimal use harvested biomass & re-use;  
Cascading in function/value: biorefining using the value pyramid

# BioEconomy Market Pull

## Product Based Biorefineries

Markets	Current sit	Biorefining opportunities
Pharma	Chem & Nat	Extraction from land/aq. crops
Food	Veg & Meat	Ingredients (proteins, CHs, oils, vitamins, ...) from biomass (reduced meat cons./neg.em.)
Feed	Crops & Res	
Chemicals	Mainly fossil	Drop-in/better performance new chem/mat (lighter, stronger, ...)
Materials	Mainly fossil	
Fuels	Fossil / 1G bio	Non-food BM to advanced fuels
Energy	Fossil / RE	Use of BR residues
Minerals	Mining	Separation and bring back to the field/process to incr. overall sustainability
Water/CO <sub>2</sub>	Use/Em. = -/-	

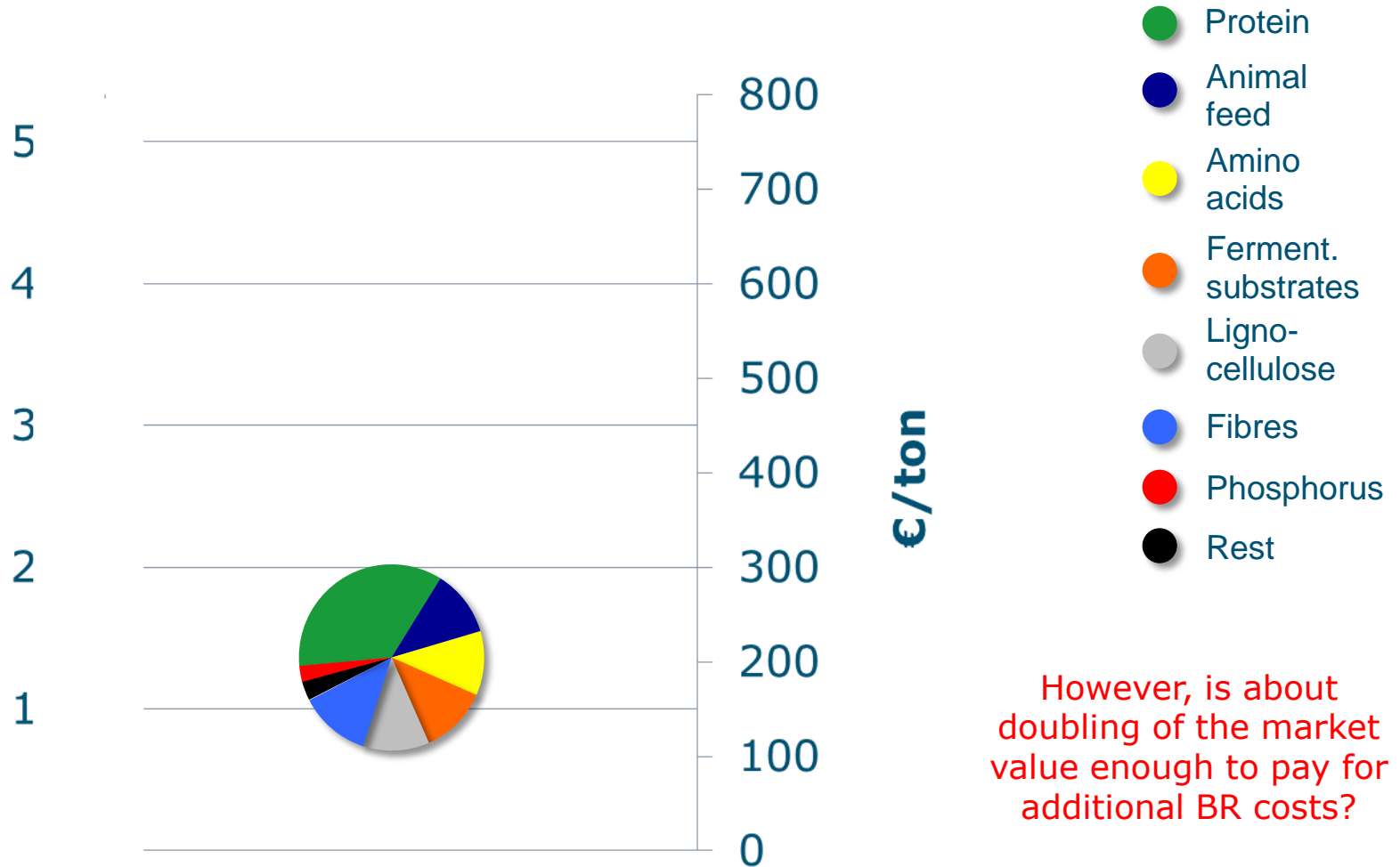
- Main INN Issues:**
- Standardisation/certification traj. > t
  - No level playing field → artificial market pull
  - Sep. "worlds" 1) Food and Non-food (reg./stak./R&D-support) & 2) Upstream<sub>7</sub> (cultivation) and downstr. (processing)
- Stakeholder Cooperation**

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# Multi vs single product focussed processes

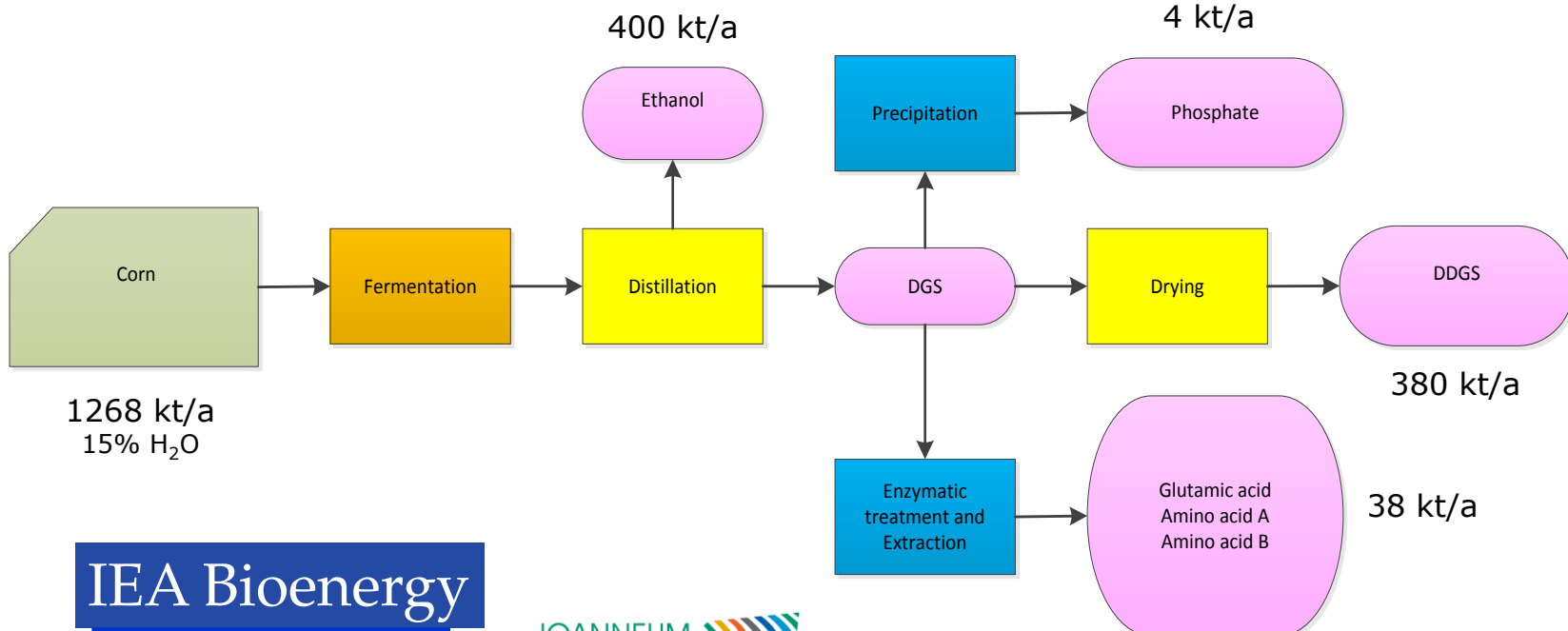
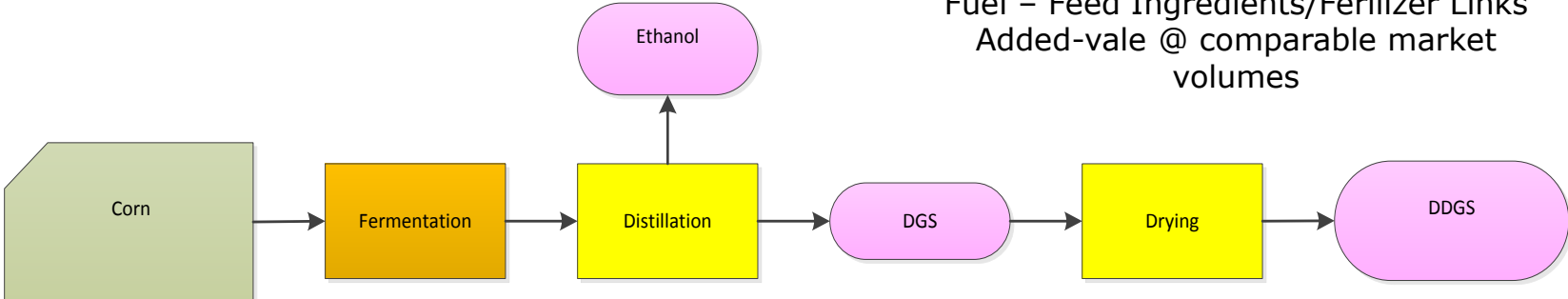
*Biorefining rapemeal increasing its overall value*



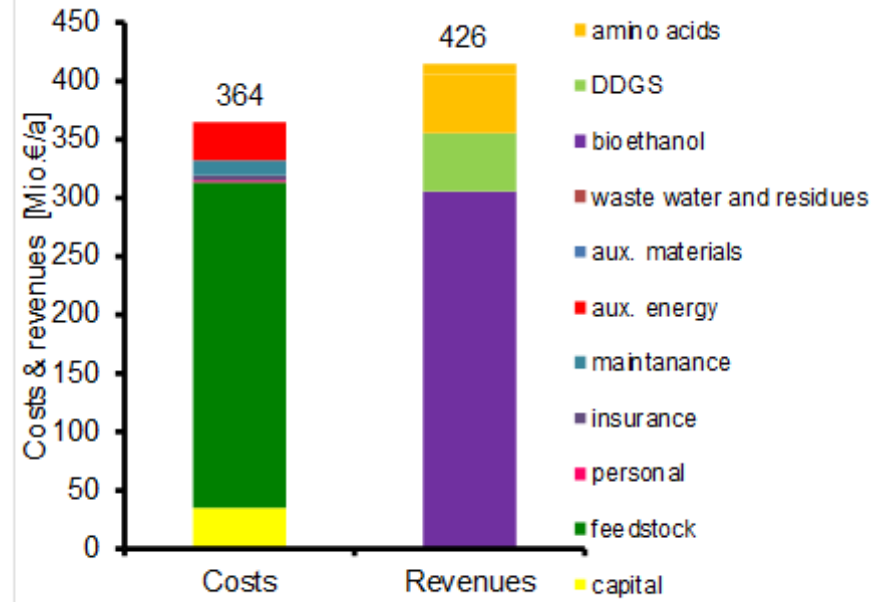
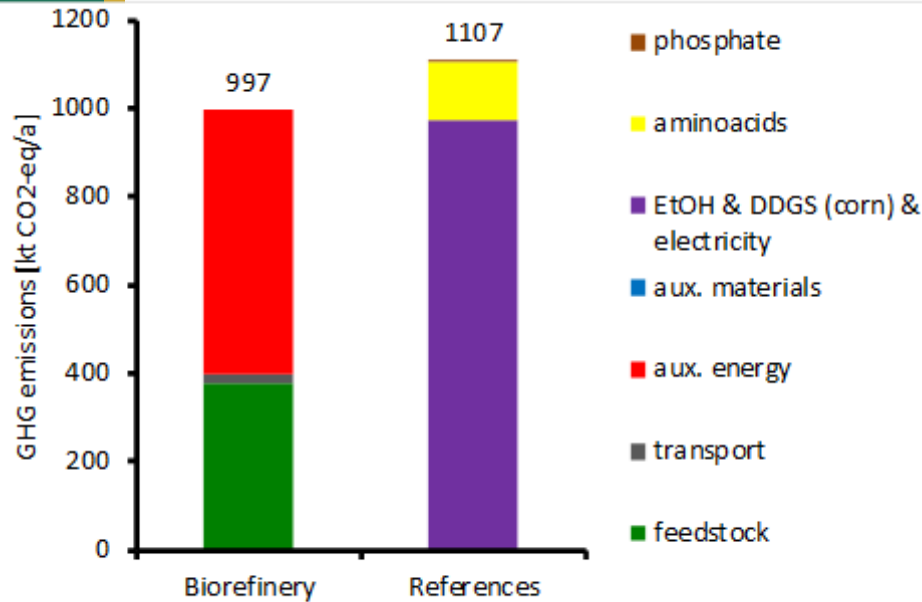


# Conventional bioethanol example

Fuel – Feed Ingredients/Fertilizer Links  
 Added-value @ comparable market  
 volumes



# Conventional bioethanol example



Co-producing proteins and phosphate from DGS before drying to DDGS decrease full overall GHG-emissions processing by about 10%

Net annual revenues (rev – costs) of the full biorefining process are calculated at about 60 M€/a. A significant part of these revenues can be realised by a relative small additional investment (extr./enz. treatment DGS)

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Report available July 2016

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[www.iea-bioenergy.task42-biorefineries.com](http://www.iea-bioenergy.task42-biorefineries.com)

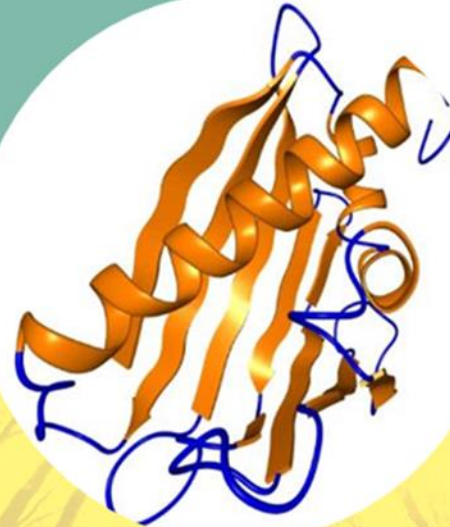
Contact:

[wim.mulder@wur.nl](mailto:wim.mulder@wur.nl)

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# Proteins for Food, Feed and Biobased Applications

*Biorefining of protein  
containing biomass*



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IEA Bioenergy: Task 42: Biorefining

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*NEW Report IEA Bioenergy Task42*

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Available free of charge from July 2016

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[www.iea-bioenergy.task42-biorefineries.com](http://www.iea-bioenergy.task42-biorefineries.com)

# Take Home Messages

1. In a Circular Economy biomass should be sourced sustainably, and synergistically processed to both Food AND Non-food Products
2. The sustainable biomass potential should be used as efficient as possible by the development and deployment of biocommodities to be used in biocascading & biorefining approaches in closed-loop systems
3. Bioenergy is inevitable to meet short and midterm RE policy goals and a critical link in the future Circular (Bio)Economy
4. Advanced biofuel based biorefineries – co-producing fuels and added-value biobased products (i.e. feed ingredients) will be major foundations for and initiators of a Circular (Bio)Economy (use of sustainable supply chains and industrial infrastructures)
5. Proteins extraction and valorisation to both food and feed and non-food (technical) applications is a major potential success factor for optimal sustainable biomass use in the Circular (Bio)Economy AND to increase the market competitiveness of advanced biofuel based BRs
6. Cooperation of stakeholders over the full value chains (biomass production – conversion – end-use) and between different market sectors is a critical success factor for a successful Circular (Bio)Economy



# IEA Bioenergy Task42 Biorefining

More info on biocascading, biorefining, Circular (Bio)Economy:  
[www.iea-bioenergy.task42-biorefineries.com](http://www.iea-bioenergy.task42-biorefineries.com)

Global knowledge dissemination platform including:  
AUS, AT, CAN, GER, DEN, IRE, IT, NL, US

## Activities 2016-2018 Triennium

1. Biorefinery Systems – Analysis and assessment of biorefining in the whole value chain
2. Product Quality – Reporting on related biobased products/ bioenergy standardisation, certification and policy activities
3. Evolving BioEconomy – Analysing and advising on perspectives biorefining in a Circular BioEconomy
4. Communication, dissemination & training – Knowledge exchange by stakeholder consultation, reporting and lecturing

## Deliverables

Biorefinery Database System – Factsheets –  
Joint Tasks Projects – **Reports on Chemicals, Materials and Proteins** – **Country Reports** –  
Task42 Brochure, Thematic Stakeholder  
Workshops together with IEA IETS, FAO and  
OECD, conference & training contributions, ...

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FOOD & BIOBASED RESEARCH  
WAGENINGEN UR



Biobased Products Innovation Plant

IEA Bioenergy



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[www.wageningenur.nl/fbr](http://www.wageningenur.nl/fbr)