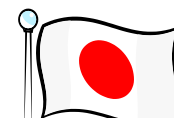
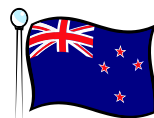
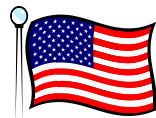




# IEA BIOENERGY



## Task42 – Biorefining



*Biorefining is the sustainable processing of biomass into a spectrum of marketable Biobased Products and Bioenergy*



**René van Ree**

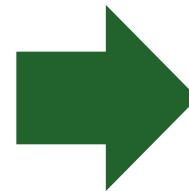
**Austrian Stakeholder Workshop, “The Role of Biorefining in a Future BioEconomy”, Graz, Austria, 24 October 2013**

## *Sustainable & Synergetic Production and Valorisation of Biomass to Food AND Non-food*

=

*framework for Biorefinery-based value chain  
development and implementation*

**Raw materials**  
Agro-cultural crops / Wood  
Aquatic biomass  
Primary (agro) residues  
Secondary (process) residues  
Tertiary (post consumer) residues

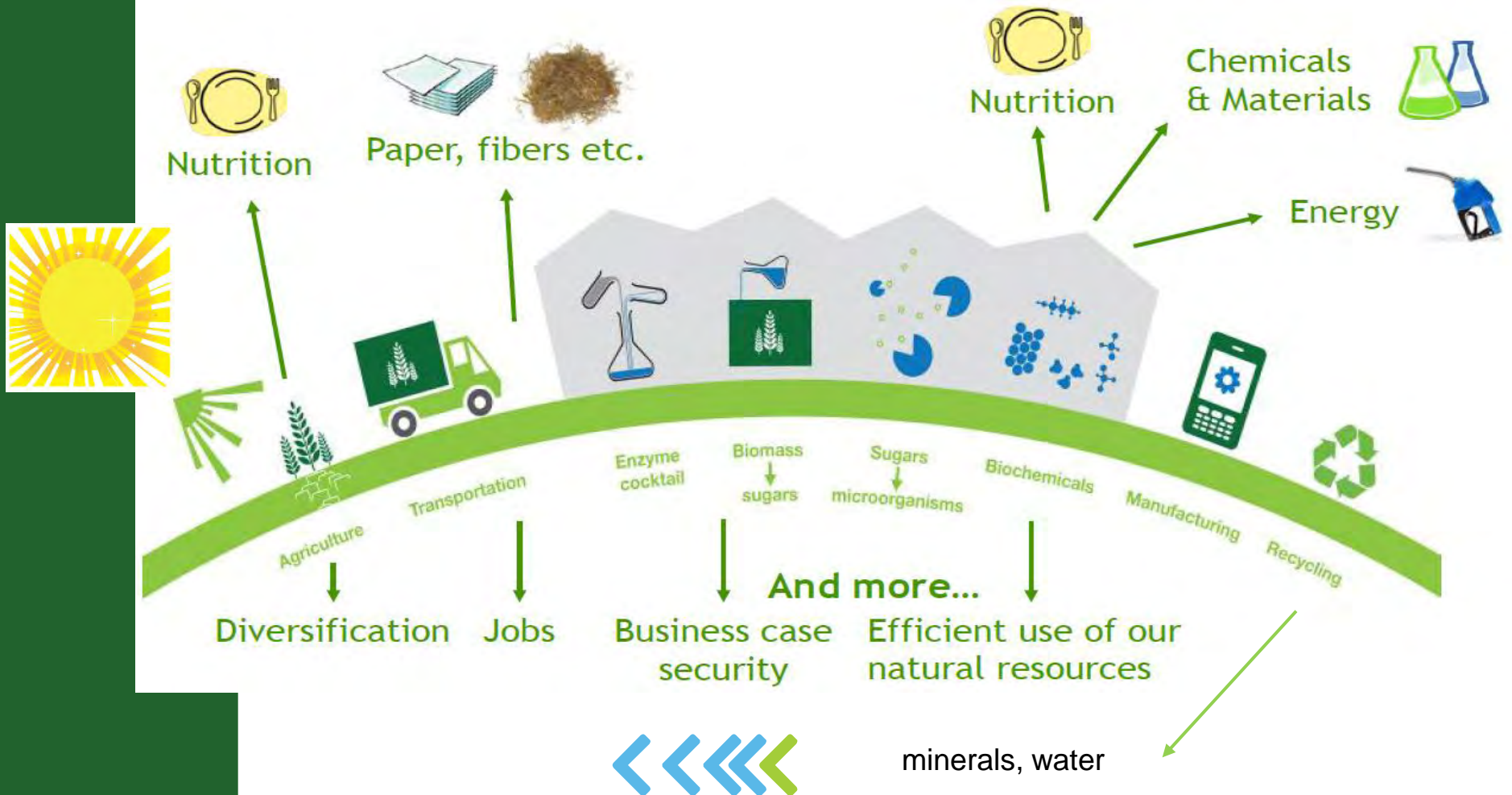


**Food/Feed Ingredients,  
Bio-based products &  
Bioenergy**  
Pharmaceuticals / Cosmetics  
Chemicals / Materials  
Fuels  
Energy  
Heat

# IEA Bioenergy

# Circular BioEconomy

## Task 42 Biorefineries

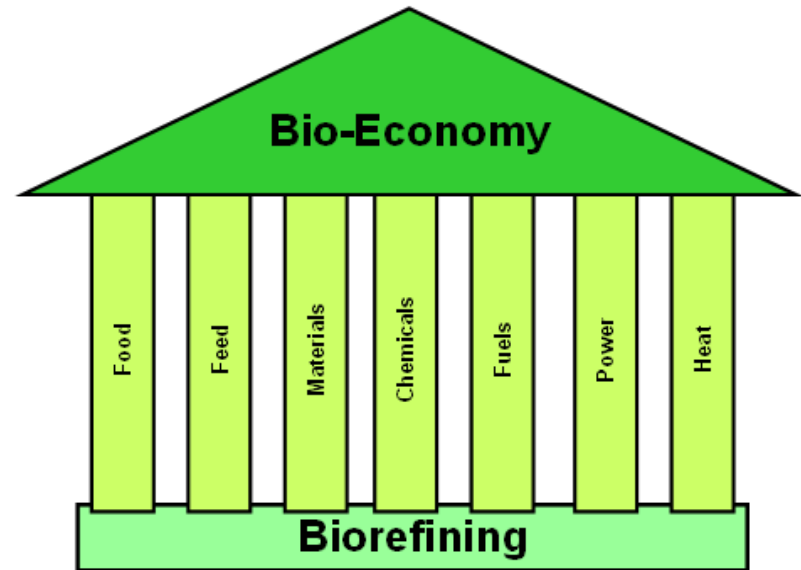


# Task framework

## BioEconomy

Sustainable production and valorisation of biomass to both food, feed, chemicals, materials, fuels, power and heat

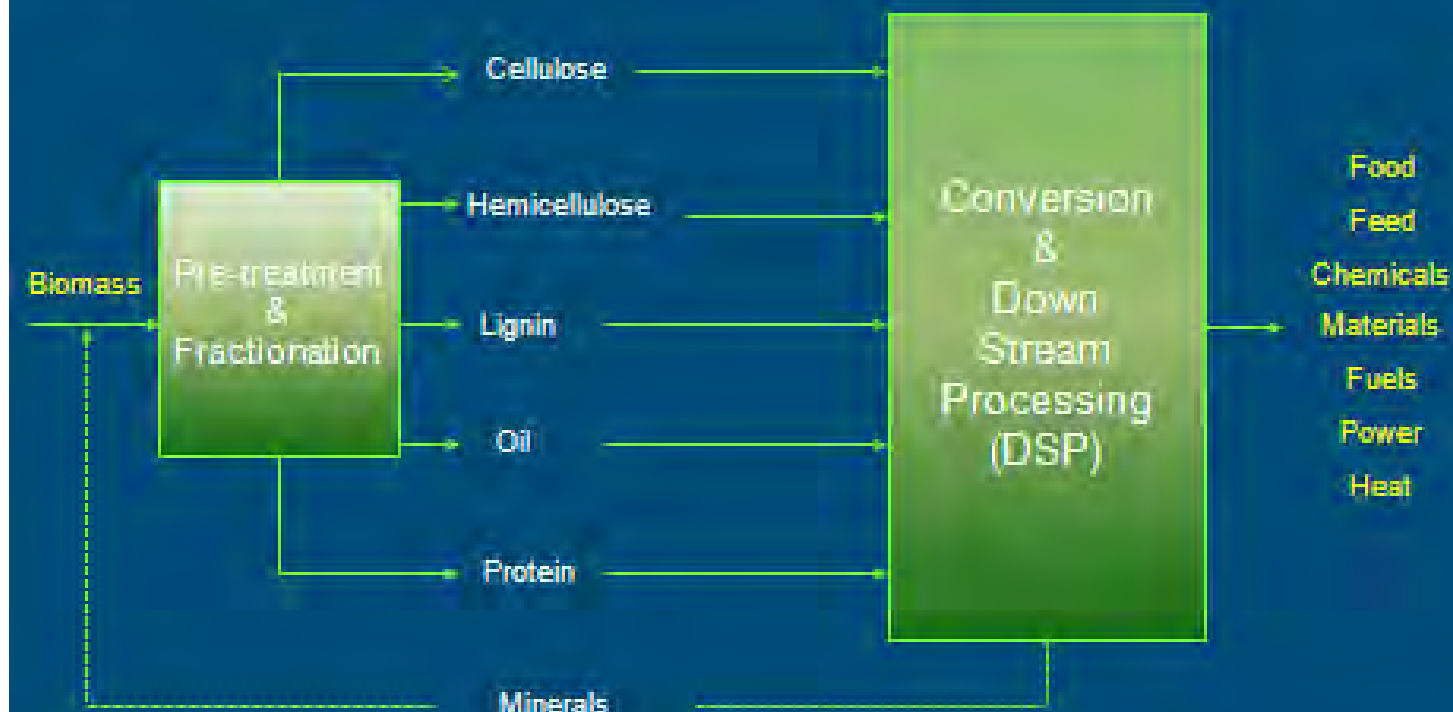
- relatively scarce raw material availability
- high-efficient zero waste conversion processes
- full sustainable value chain approach



**Biorefining approach** is main driver for large-scale biomass implementation in the future BioEconomy

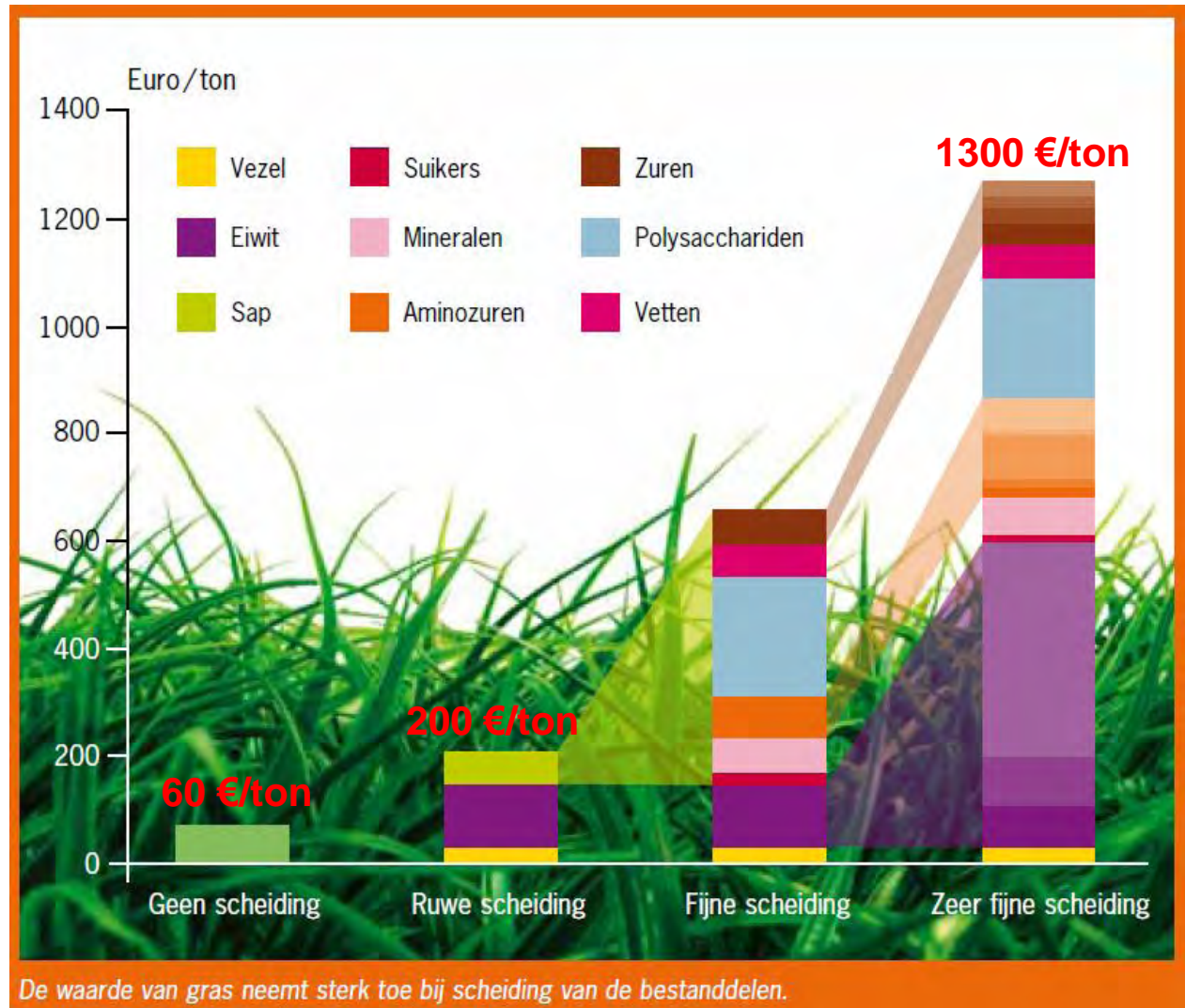
# Biorefining – Approach

## General principle Biorefining





# Biorefining – Adding Value



**(Delta market value – investment) = Biorefining BC**

- **Energy (fuel) driven BRs**
- + Infrastructure (value chains) exists (power plants, digestion plants, biofuel plants)
- Profitability questionable (often financial governmental support necessary and/or regulated market)

**Upgrading of existing plants / value chains to multi-product BRs to improve full value chain sustainability**

- **Product (food/feed ingredients, chemicals, materials) driven BRs**

- Only limited BBPs facilities in operation yet
- Chain composing key technologies often still at R&D-phase
- + High potential (interested stakeholders, advanced properties)

**Deploying new high efficient sustainable biorefinery-based value chains co-producing BBPs & BE**

***Bioenergy will be the lubricating oil in a future circular BioEconomy***

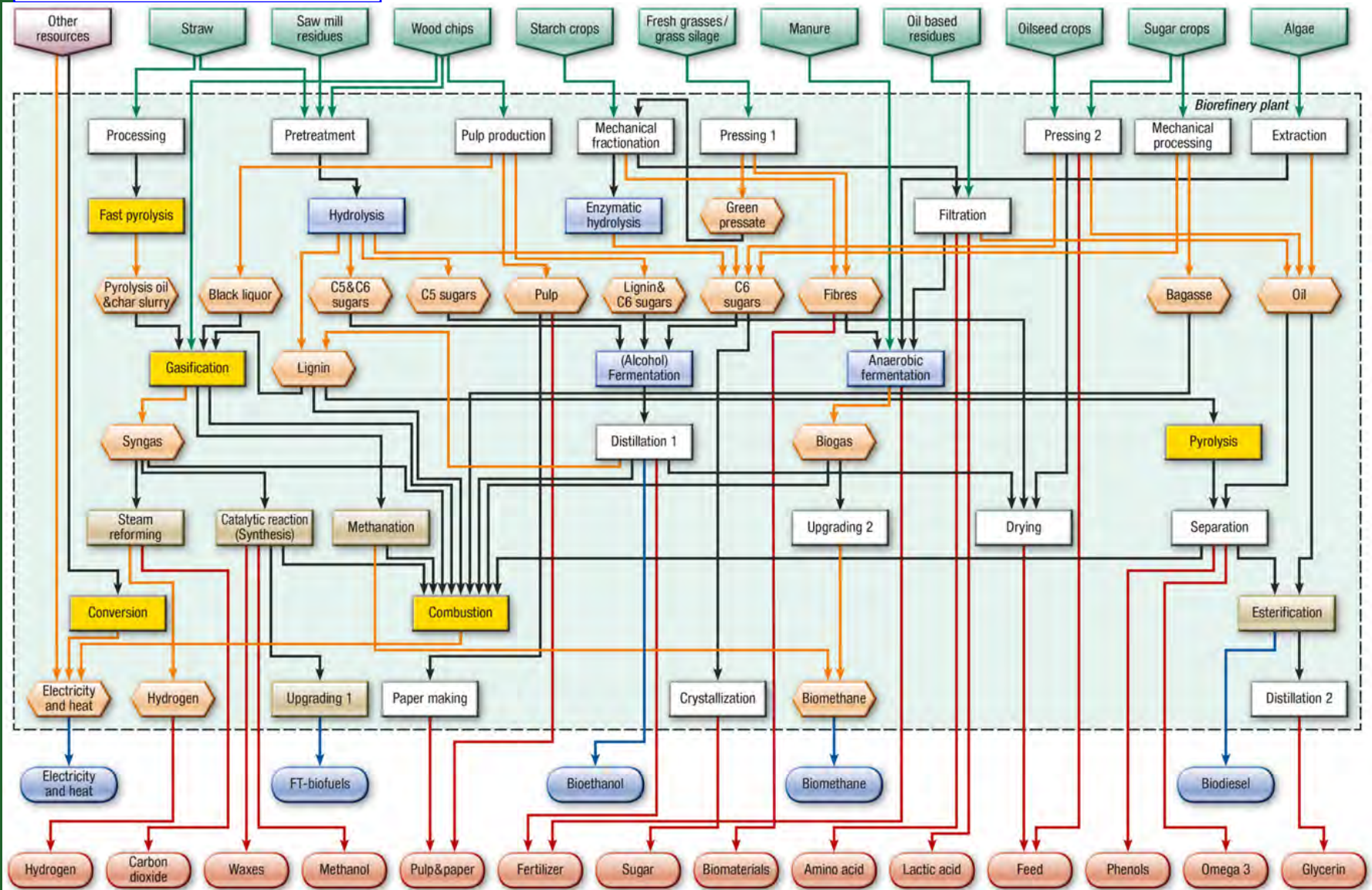
In contrast to most of the other IEA Bioenergy Tasks, **Task42 covers:**

- All market sectors being part of a BioEconomy, with a focus on the fuel/energy sectors
- Full sustainable biomass value chain development, optimisation and implementation for the synergetic production of Food and Non-food
- Multi-product biorefinery concepts and concept-composing sub-technology development
- Networking and communication with full value chain stakeholders from different market sectors (multi-sectorial co-production)



- Biorefinery definition ....
- Biorefinery classification system ...  
“a <sum platforms> biorefinery for the production of <sum products> from <sum raw materials>”
- Bi-annual Task Progress Meetings in participating countries coupled to industrial stakeholder events and excursions
- Task reports
  - Country reports
  - Bio-based Chemicals (Feb 2012)
  - Biofuel-driven Biorefineries (Feb 2013)
  - Green Building Blocks for Bio-based Plastics (March 2013)
- Biorefinery Training Courses (Amsterdam 2010, Paris 2011, Wageningen 2012)
- ....

### Task 42 Biorefining







*A pulp, off-gas, electricity & heat biorefinery for the production of kraft pulp, biomethanol, electricity and heat from wood chips  
[Alpac Forest Products Inc., Canada]*



*A sugars, lignin and syngas biorefinery for bioethanol,  
power and heat from renewable biomass and MSW  
[INEOS New Planet Bioenergy, USA]*





*A whey biorefinery for ethanol and protein-based food products from milk [Edgecumbe Milk Processing Plant, Fonterra Cooperative Group, New Zealand]*





*An oil production and refinery pilot-plant for Omega-3, fuels, chemicals from microalgae [Wageningen UR, the Netherlands]*

### Task 42 Biorefining

This report, that was prepared on behalf of IEA Bioenergy – Task42 Biorefining, addresses the main bio-based chemicals that potentially could be co-produced with secondary energy carriers in integrated biorefinery facilities. Biorefining, i.e. the sustainable processing of biomass into a spectrum of marketable Bio-based Products (chemicals, materials) and Bioenergy (fuels, power/heat) generally is seen as the optimal strategy to sustainably convert biomass into a portfolio of biomass-derived intermediates and products that will form the base for the future Bio-based Economy. The report deals with the current production of bio-based chemicals, chemicals that potentially could be produced from major biorefinery platforms (sugars, biogas, syngas, oils, algae, organic solution, lignin pyrolysis-oil), market growth predictions for the production of bio-based chemicals, economic benefits of co-producing bioenergy and bio-based chemicals, and an overview of commercial and near-market bio-based chemicals (C2-C6, Cn). The purpose of the report is to provide an unbiased, authoritative statement aimed at stakeholders from the agro-sector, industry, SMEs, policy makers, and NGOs.

## Bio-based Chemicals



## Value Added Products from Biorefineries

... (text partially obscured) ...

**IEA Bioenergy**  
Task 42 Biorefining

## Biofuel-driven Biorefineries



A Selection of the Most Promising Biorefinery Concepts to Produce Large Volumes of Road Transportation Biofuels by 2025

**IEA Bioenergy**  
Task 42 Biorefining

... (text partially obscured) ...

**Task 42 Biorefining**  
Sustainable processing of biomass into a spectrum of marketable Bio-based Products and Bioenergy

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

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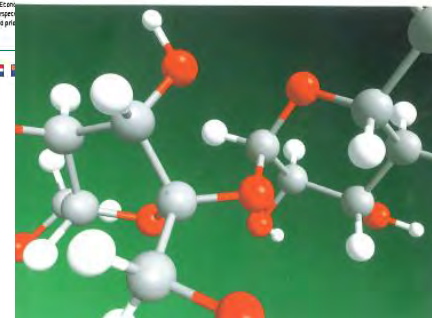
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**Task 42 Biorefining**  
Sustainable processing of biomass into a spectrum of marketable Bio-based Products and Bioenergy

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

## Green building blocks for biobased plastics

PAULIEN HARMSEN AND MARTIN HACKMANN



# **Work Programme 2013 - 2015**

# Goal, programme & partners

**Goal** To contribute to the development and implementation of sustainable biorefineries – as part of highly efficient zero-waste value chains – synergistically producing Bio-based Food and Non-food Products as base for a global BioEconomy



## Programme Tasks 2013-2015

1. Assessment market deployment potential integrated BRs
2. Support industrial/SME stakeholders finding their position in the BbE
3. Optimal sustainable biomass valorisation using market pull approach
4. Policy advice
5. Knowledge dissemination (best practices, ...)
6. Training

## Participating countries

AUS, AT, CAN, DEN, GER, IRE, IT, JAP, NL (coord.), NZ, US

# Partnering countries

## national contacts & 2013 budget

Australia – Gill Garnier

Austria – Gerfried Jungmeier

Canada – Maria Wellisch

Denmark – Henning Jorgensen

Germany – Heinz Stichnothe

Ireland – ?

Italy – Isabella De Bari

Japan – Kazunori Habu/Akihiko Kondo

Netherlands – Rene van Ree/Ed de Jong

New Zealand – Kirk Torr

U.S. – Jim Spaeth

Russia potentially also will join this Task during 2013

2013 budget: 219,000 US\$ (166.000 €)

(annual country fee: US\$ 17,500)



# 1. Assessing market deployment aspects integrated biorefineries

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## 1.1 Tackling technical and non-technical market deployment barriers

- Policies/regulations
- Level-playing-field
- Full chain stakeholder involvement *assessment & learning from each other*
- Technical barriers *(best practices)*

## 1.2 Identifying disruptive / game changing technologies

- Type of technology
- State-of-the-art *web, literature & patent assessment*
- IP position
- Stakeholders involved

## 1.3 Central vs. decentral processing

- Central processing vs. regional processing *TEE-assessment 5 country*
- Economy-of-Scale vs. Economy-of-Duplication *specific value chains,*
- International workshop (ws1) *best-practices, policy recomm.*

## 1.4 Biorefinery-Complexity-Index (BCI)

- Indication complexity BR facility
- Time-to-market
- Stakeholders involvement *Classification system ->*
- Initial investment costs *BCI; low-profile activity*
- Operational costs

## 2. Stakeholder support finding their position in a future BioEconomy

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### 2.1 Role involved market sectors

- Energy sector
- Biofuel sector
- Chemical sector
- Agro(food/feed) sector
- Co-operation best practices

*Assessment current roles, potential future roles, and roles during transition (co-operation !)*  
*International Workshop (ws2a)*

### 2.2 Upgrading of existing industrial infrastructures to Biorefineries

- Power plants
- Biofuel facilities
- Oil refineries
- Pulp/paper industry
- Food industry

*TEE-assessments (pyrolysis-based in coop. T34)*  
*Report & glossy leaflets*  
*International Workshop (ws2b) in cooperation with T39*

### 2.3 Factsheets major biorefineries / national case-studies

- Success stories
- Classification
- Mass/energy balances
- Capacity
- Costs
- Sustainability issues

*Three per country*

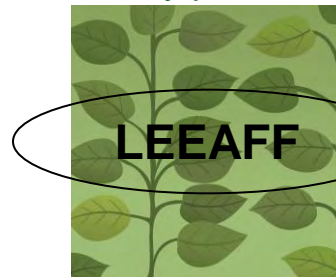
### 2.4 Added-value products from energy-driven biorefineries

- Update 2012 Bio-based Chemicals Report
- New report on Proteins for Food and Non-food Applications

### 3. Analysing optimal sustainable biomass valorisation approaches for Food and Non-food applications (market-pull approach)

#### 3.1 Sustainability assessment toolbox testing (T42/T39)

- Development LEEAFF procedure for BR SA
- One case-study per country



- Land use
- Environment
- Employment
- Acceptability (social aspects)
- Financial aspects
- Feedstock issues

#### 3.2 Sustainable bioenergy supply chains (T43/T42/T40/T39/T38/T29)

- Partnering in Strategic Fund Project (50% budget Task42, 50% budget SF)

#### 3.3 Future market demand biomass for the BioEconomy (T40/T42)

- Supply, trade, demand biomass for BioEconomy
- Improved & new value chains
- Task42: types biorefineries = f(time, location, feedstock use)
- Desk study and international workshop (ws3)

#### 3.4 Optimal sustainable biomass valorisation (T42/others)

- Development optimised and new value chains
- Food/feed demand guaranteed
- Demand chemicals/materials guaranteed
- Primary (chain), secondary (process), tertiary (consumer) residues to fuels, power and/or heat
- International seminar for discussion, knowledge dissemination and policy advice

## 4. Preparing policy advise on further needs

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### 4.1 “Roadmap” Biorefinery (T42/IEA Headquarters)

- Contributing to potential project to be defined by IEA Headquarters on “Sustainable Biomass Valorisation by the Biorefining Approach”

### 4.2 Biorefinery (related) policies in participating countries

- Assessment BR (related) policies in participating countries
- Assessment BR (related) at EC, US, ... Level
- Distribution info to GOs
- International workshop (ws4) on biorefinery (related) policy development and implementation at national and international level

### 4.3 Country reporting

- Current status and developments within partnering countries
- Reports prepared once – and updated regularly
- Reports on Task42 website
- PPTs reports made for knowledge dissemination activities

### 5.1 Bi-annual Task meetings + Tele-conferences in between

- Bi-annual closed internal Task42 progress meetings
- Bi-annual coupled open (industrial) stakeholder meetings
- Bi-annual coupled excursions

2013(1): EU (NL); 2013(2): EU (AT); 2014(1): EU (?); 2014(2): non-EU (?); 2015(1): EU (?); 2015(2): coupled to IEA Bioenergy Conference

### 5.2 Annual Task42 meetings at national level

- Organised minimally once-a-year by the national Task representative

### 5.3 Task42 website

- [www.iea-bioenergy.task42-biorefineries.com](http://www.iea-bioenergy.task42-biorefineries.com)
- A new website will be in the air from 1 December 2013 !!

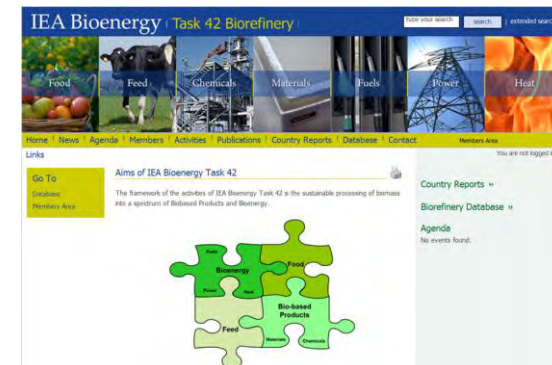
### 5.4 Task42 newsletters

- Electronically, 2 times a year

### 5.5 Task42 reports

- Activity reports (10)
- Country reports (1 per country + updates, and ppts)
- Task meeting reports (2 a year)
- Brochure, poster, leaflets

### 5.6 International workshops/seminars (6); ind. stakeholder meetings (6)





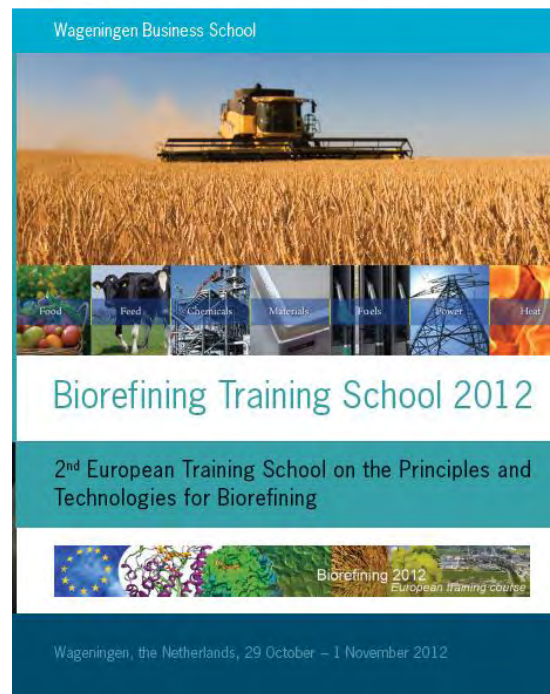
### History

- One day training course
  - Ghent, Belgium, 12 June 2009
  - Amsterdam, NL 13 September 2010
- Four day training course
  - Paris, France, 28 August 2011 – 01 September 2011 (120 att.)
  - Wageningen, NL, 29 October 2012 – 01 November 2012 (75 att.)

### 2013 – 2015

- Further development and updating
- Given minimally once-a-year in one of the partnering countries
- Lectures made available by web for teaching outside the EU
- Task42 financial involvement: paying travelling costs Task42 lecturers

- 2013 X
- 2014: 3<sup>rd</sup> European Biorefining Training School, Budapest, Hungary, 7 – 10 July 2014



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**Part of the sub-activities are co-ordinated by country representatives**

# Thank you for your attention



[www.IEA-Bioenergy.Task42-Biorefineries.com](http://www.IEA-Bioenergy.Task42-Biorefineries.com)

# International Perspectives of Biorefining in a BioEconomy

- Biorefining co-producing food/feed, bio-based products & bioenergy is the way to go for large-scale sustainable use of biomass in a future BioEconomy
- Bioenergy will be the necessary lubricating oil (closing energy and mineral loops) within a future BioEconomy
- We need a clear international level-playing-field for optimal large-scale sustainable biomass production and valorisation
- Biorefining is not new, it is already used for some time in for example the food sector; and now also in other market sectors commercial, demo and pilot facilities can be found
- Development and demonstration of chain composing technologies (separation, ...) is still necessary to further increase the overall the efficiency and lower the costs of BRs

# International Perspectives of Biorefining in a BioEconomy

- Also some non-technical critical success factors need to be solved and encouraging policies have to be developed for large-scale biomass implementation, incl. biorefining
- Please use the international knowledge and technologies available for short-term implementation to start off with the development of an efficient BioEconomy asap
- Biorefining needs a multi-stakeholder approach not only covering the full chain but also involving multiple markets; so please co-operate and talk to each other