

IEA Bioenergy

Task 42

Biorefineries

**Co-production of Food, Feed, Chemicals,
Materials, Fuels, Power and Heat from
Biomass**

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IEA Bioenergy

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IEA Bioenergy

Overcoming the environmental, institutional, technological, social, and market barriers to the near and long-term deployment of bioenergy technologies

IEA Bioenergy

Background

- IEA Bioenergy is one of a number of Implementing Agreements (IAs) established by the International Energy Agency (IEA)
- IAs operate within an institutional structure comprising IA Executive Committees, Tasks, ...
- IAs should contribute both to the IEA technology collaboration programme and national programmes of the Contracting Parties
- Establishment IEA Bioenergy – 30 years ago

One of two IEA Implementing Agreements with major relevance for Bioenergy/Biofuels (the other IEA-AMF (Advanced Motor Fuels))

Annual budget over 2 M US-\$ (2010)

Strategic Plan 2010 - 2016

Vision

To achieve a substantial bioenergy contribution to future global energy demands by accelerating the sustainable production and use of bioenergy, providing increased security of supply whilst reducing greenhouse gas emissions from energy use.

Sustainable

- Environmentally sound
- Socially accepted
- Cost competitive

Strategic Plan 2010 - 2016

Mission

To facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive bioenergy systems and technologies, and to advice policy and industrial decision makers accordingly.

Strategic Plan 2010 - 2016

Strategy

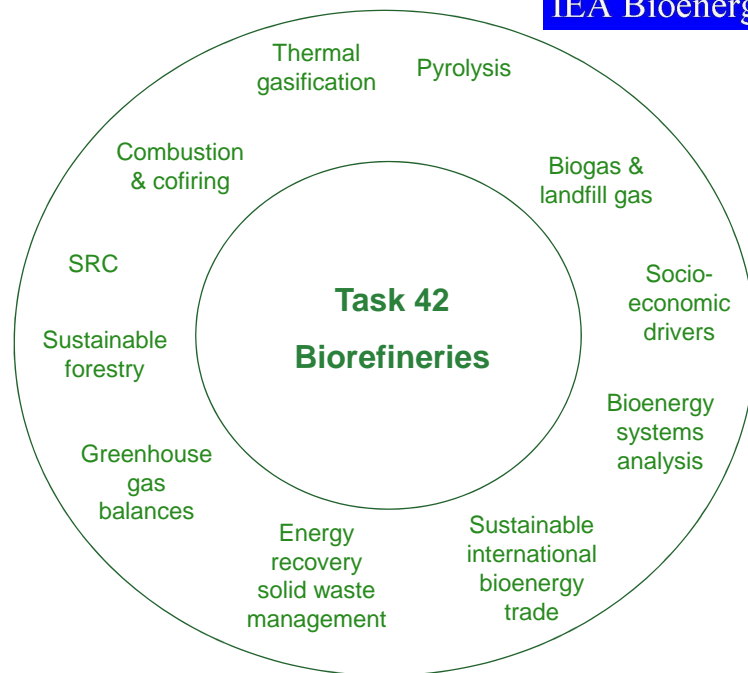
To provide platforms for international collaboration and information exchange in bioenergy research, development, demonstration and information exchange.

This includes:

- the development of networks
- dissemination of information
- provision of science-based technology analysis
- support and advice to policy makers
- involvement of industry
- encouragement of membership by countries with a strong bioenergy infrastructure and appropriate policies

22 Contracting Parties (Member Countries)

- | | |
|-----------------------|---------------------|
| • Australia | • Ireland |
| • Austria | • Italy |
| • Belgium | • Japan |
| • Brazil | • Netherlands |
| • Canada | • New Zealand |
| • Croatia | • Norway |
| • Denmark | • South Africa |
| • European Commission | • Sweden |
| • Finland | • Switzerland |
| • France | • United Kingdom |
| • Germany | • United States |
| | (Turkey is pending) |



Task 42: Biorefineries

Focus on:

Biorefinery as a facility that optimises the integrated production of food, feed, chemicals, materials, fuels, power and heat, maximising the value derived from a biomass feedstock.

Aims to:

Assess the worldwide position and potential of biorefineries.

Gather new insights of the possibilities for the simultaneous manufacture of Bio-based Products and Bioenergy.



Partners Task 42

Founding members (8):

Austria, Canada, Denmark, EU, France,
Germany, Ireland, **the Netherlands**

New Members:

2009: Australia, Italy

2010: USA, United Kingdom, Turkey
(to be decided: Belgium)

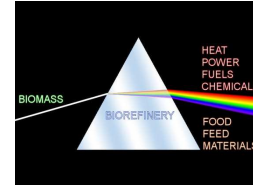
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Task 42: Results 2007 - 2009

- Common definition for biorefineries
- Common classification system for biorefineries.
- Country reports on current processing potential and mapping of existing plants.
- Identification of biorefinery related RD&D programmes in participant countries.
- Annual biorefinery seminar for stakeholders.
- Linking of ongoing international activities through joint events and new initiatives

Task 42: Definition Biorefineries

Biorefining is the sustainable processing of biomass into a spectrum of marketable Bio-based Products and Bioenergy



Sustainable: maximising economics, socially acceptable, optimal environmental performance

Processing: upstream processing, transformation, fractionation, thermo-chemical and biochemical conversion, extraction, separation, downstream processing

Biomass: residues, crops, algae

Spectrum: multiple product outlets

Marketable: volumes, prices

Bio-based Products: food, feed, chemicals, materials

Bioenergy: fuels, power, heat

Task 42: Definition Biorefineries

In general Product-driven and Energy-driven Biorefineries can be distinguished

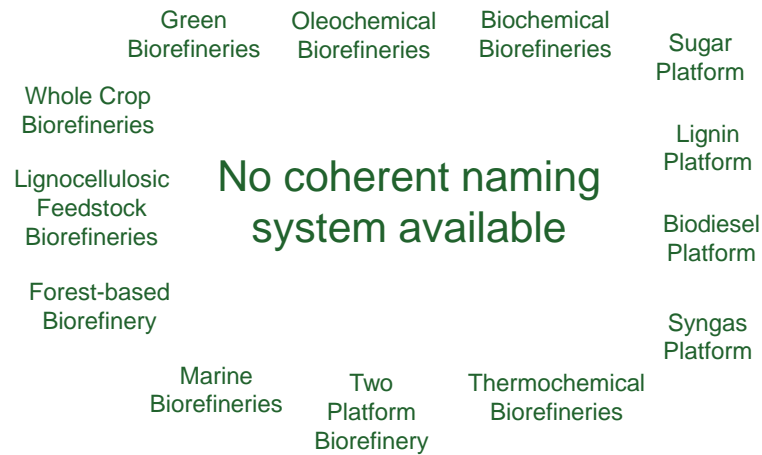
PDB: main goal is the production of one/more Bio-based Products; process residues are used to produce Bioenergy for internal/external use

EDB: main goal is the production of one/more Energy Carriers (Fuels, power and/or heat); process residues are valorised to BBPs to maximise the economic profitability of the overall process

In Task 42 both types of BRs are dealt with, however, with a focus on EDBs (IEA Bioenergy)

Task 42: Classification System

Current Naming in Literature



Task 42: Classification System

Aim Classification System

Should be unambiguous for all stakeholders within the Biorefinery field

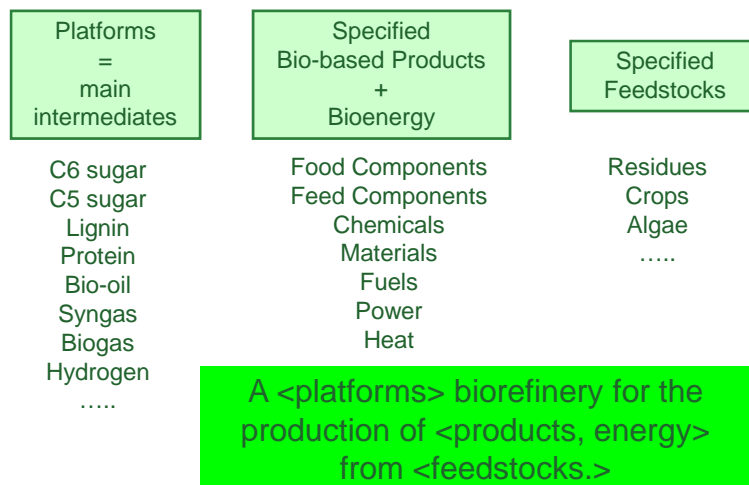
Both the feedstocks used and the main intermediate and final products produced should be part of the naming

The naming should reflect the complexity of the Biorefinery facility

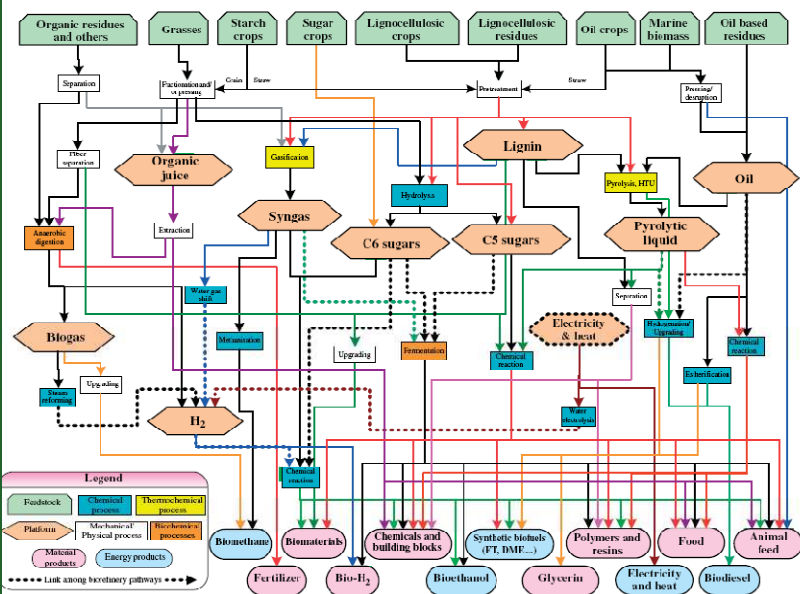
The naming should be as specific as possible

Task 42: Classification System

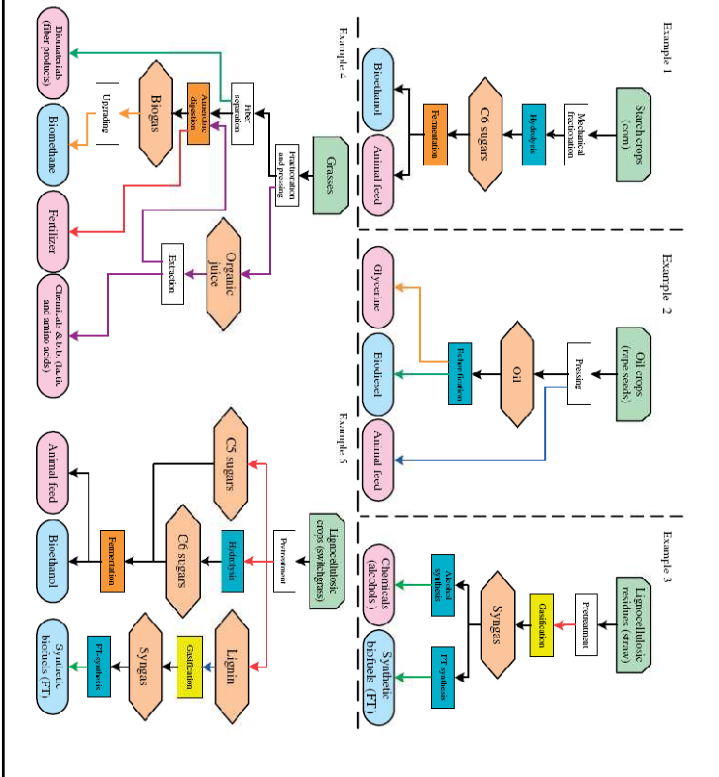
Classification System



Network Classification System



Examples Classification System (see also Brochure)



Further reading:
Paper in BioFPR

Modeling and Analysis

Toward a common classification approach for biorefinery systems



Francesco Cherubini, Institute of Energy Research, Graz, Austria
 Gerfried Junnecker, Institute of Energy Research, Graz, Austria
 Maria Wallisch, CornetENERGY, Ottawa-Ontario, Canada
 Thomas Wilke, Institut für Agrartechnologie und Biosystemtechnik, Braunschweig, Germany
 Ioannis Skiadas, Aalborg University, Balleup, Denmark
 René Van Ree, WUR, Wageningen, The Netherlands
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 Received June 19, 2009; revised version received July 16, 2009; accepted July 16, 2009
 Published online in Wiley InterScience (www.interscience.wiley.com); DOI: 10.1002/bbb.172;
 Biofuels, Bioprod. Bioref. (2009)

Highmark Renewables (Canada)

Classification: C6 sugars and biogas biorefinery for bioethanol, animal feed, fertilizer, electricity and heat from starch crops and organic residues

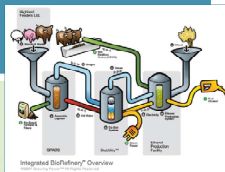
State-of-the-art: Commercial

Owner: Highmark Renewables

Feedstocks: Wheat, manure, slaughtering waste

Products: Bioethanol, animal feed, fertilizer, electricity and heat

Stakeholders:

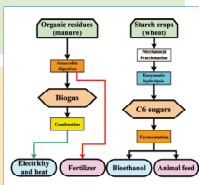


Highmark Renewables is developing the first Integrated BioRefinery™ in Canada. Their unique process converts grain (e.g. high-starch wheat) into fuel ethanol. The residual, distillers grains, is fed to cattle at a nearby feedlot. Cattle manure is used to generate biogas, which is converted to electricity and steam in a GasMoby process. The highly integrated process is targeted for the most cost and energy efficient production of fuel ethanol. The Integrated BioRefinery™ once it is in full production, will generate 40 million litres of ethanol, 10 thousand tonnes of DistFertizer, and over 75 thousand tonnes of greenhouse gas emissions credits each year. Agricultural and food industry residues, often thought of as waste, are converted into valuable energy and other renewable products. Highmark Renewables is proud of their technology development capability, technology portfolio, experience in developing renewable energy facilities, facility operation skills and work-class management team.

Highmark Renewables, a designer and operator of renewable energy facilities, developed the Farming Power Anaerobic Digestion System (FPADS) which can derive energy from high-starch and fibrous organic wastes (manure, industrial residues and municipal solid waste). After more than ten years of operations, the system now can generate special value from tough to handle wastes. FPADS, our first large scale installation is the largest feedlot manure - energy plant in the world. It processes about 15% of the manure from a 36,000 head feedlot which is managed by our partners Highland Feeders and the Spring Creek Ranch (producers of verified premium Alberta beef). FPADS, currently producing 20 tonnes of biofertilizer along with up to 24,000 kWh of electricity each day is expected to grow four times in size while its technology may in the future be applied elsewhere. Highmark Renewables vision is to generate the maximum return on available resources with minimal risk.

Contact: Highmark Renewables, Vegreville, Alberta, Canada.
Projects@highmark.ca

Further
reading:
Biorefinery
Brochure



Task 42: Country Reports

For the Task founding countries Austria, Canada, Denmark, France, Germany, Ireland, and the Netherlands so called “Country Reports” have been prepared.

Content

- National biomass energy use
- Non energy national biomass use
- Biomass related national policy goals
- National oil refineries
- Bioethanol, biodiesel and biogas: production and capacity
- Existing biorefinery industries
- Pilot and demonstration plants
- R&D Activities
- National Task Leaders

The country reports are integrated in one Task Report. This report can be downloaded from the IEA Bioenergy Task 42 website:

www.IEA-Bioenergy.Task42-Biorefineries.com

Task 42: Stakeholder Workshops

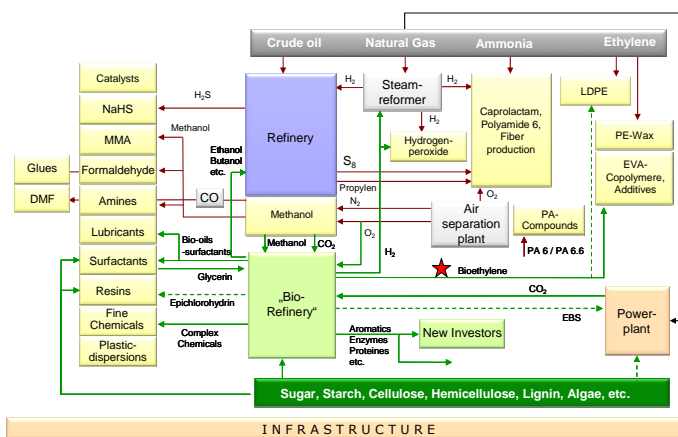
In the first triennium open (industrial) stakeholder workshops have been organised coupled to the closed bi-annual Task meetings in: the Netherlands, Austria, Canada, Ireland and Germany

The Presentations given at these Stakeholder workshops can be downloaded from the IEA Bioenergy Task 42 website

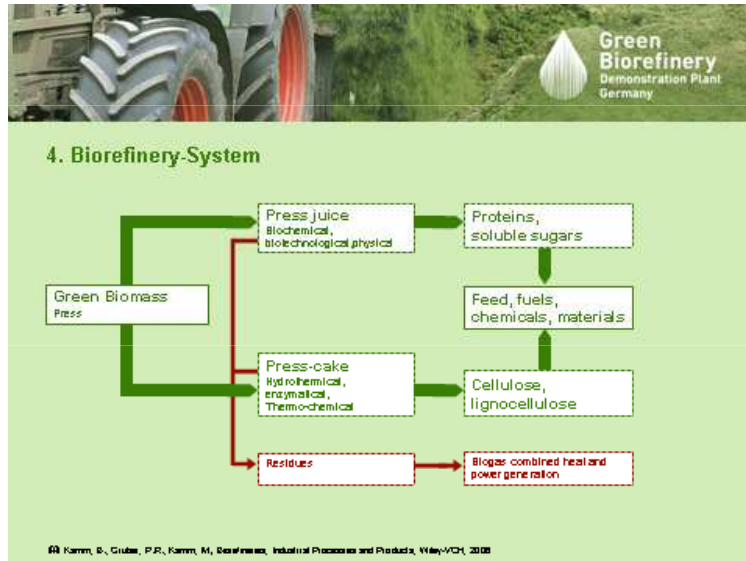
www.IEA-Bioenergy.Task42-Biorefineries.com

Task 42: Stakeholder Workshop – BR Example 1.

Vision „Biorefinery Leuna“ –
Integration of Bioethylene in the value chain

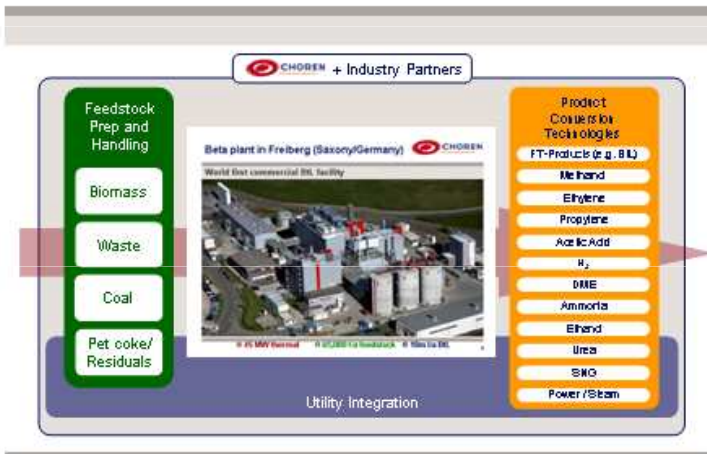


Task 42: Stakeholder Workshop – BR Example 2.



Task 42: Stakeholder Workshop – BR Example 3.

Syngas "Biorefinery" for the production of Biofuels/Biochemicals from biomass, waste and fossil fuels

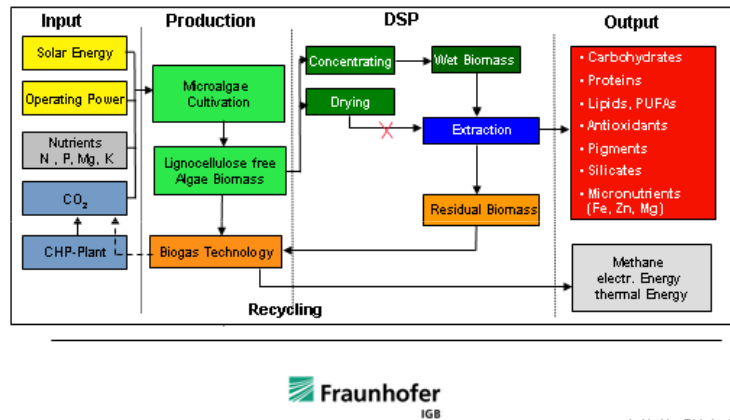


Task 42: Stakeholder Workshop – BR Example 4.

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Carbohydrates, proteins, lipids, and biogas Biorefinery for Bio-based Products and CHP for microalgae



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Task 42: Work Programme 2010 - 2012

1. Developing a **biorefinery complexity index**, similar to what they use in the petroleum industry (Nelson complexity index), based on the Classification System.
2. Identifying the most **promising bio-based products** – i.e. food, feed, added-value materials (a.o. fibre-based) and chemicals (functionalised chemicals and platform chemicals (building blocks)) to be co-produced with bioenergy.
3. Assessing the current status and development potential of both Energy-driven Biorefineries (incl. biofuels) and Product-driven Biorefineries based on a **Full Value Chain approach**.
4. Providing a review of approaches and developing a guidance document for **sustainability assessment**, including economic, environmental and social acceptance aspects of biorefineries.
5. Preparing a **Summarizing Paper** concerning “Adding Value to the Sustainable Utilisation of Biomass on a Global Scale – Biorefinery” to be used by a.o. national/international governmental organisations for their policy developments.

Task 42: Work Programme 2010 - 2012

6. The organisation of bi-annual **Task Meetings**, workshops inviting national stakeholders, and visits to running pilot/demo and commercial facilities. External **knowledge dissemination** in general will be done by: i) set-up and management of the Task website, including linkage to many other national/international websites, ii) preparation and distribution of a Task newsletter (at least 2 times a year). Internal knowledge dissemination will be done by means of an intranet-site coupled to the Task website.
7. Update of the **Country Reports** on Biorefinery Mapping and Biorefinery-related RD&D Programmes to help national governments to define their national biorefinery policy goals and related programmes.
8. Developing and delivering a broad **Biorefinery Summer School** to enable students, policy makers and industrial stakeholders to become familiar with the integral concept-

Task Meetings/Summer School: 2010 – France, US; 2011 – Italy, Australia; 2012 – Netherlands/Belgium, Denmark/Canada

Thank you for your attention

Further information:

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www.IEA-Bioenergy.Task42-Biorefineries.com

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