

# Österreichische Mitarbeit in IEA Bioenergy Task 42 „Biorefining“

## Best of 2014

Gerfried Jungmeier

bmvit Bioenergie Fachgespräch

Wien 21. November 2014

*The Austrian participation in Tasks 42 of IEA Bioenergy is financed by the Federal Ministry for Transport, Innovation and Technology / Department for Energy and Environmental Technologies*



# Top #10: Presentations of Austrian Task 42 Participation


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- **The Possible Role of Biorefineries in a BioEconomy – Activities of IEA Bioenergy Task 42 “Biorefining”**, 4th Central European Biomass Conference Graz/Austria, January 15 – 18, 2014
  - **Internationale Entwicklungen am Beispiel der IEA Bioenergy Task 42 “Biorefining”**, VDI-Expertenforum, “Bioraffinerien – Klassifikation und Nachhaltigkeitsbewertung”, 20. Mai 2014, Düsseldorf
  - **Facts, Figures and Integration of Biorefineries in a Future BioEconomy – Findings in IEA Bioenergy Task 42 “Biorefining”**, 22th European Biomass Conference , Hamburg, Germany, June 23 – 27, 2013
  - **Facts&Figures of Biorefineries Integrated in the Pulp&Paper Industry – Case Studies in IEA Bioenergy Task 42 “Biorefining”**, FUTURE.FORUM PAPER – The Austrian Paper Conference, June 4 – 5, 2014, Graz, Austria
  - **The Possible Role of Wood-biorefining in a Biobased Industry**, International Conference on Processing Technologies for the Forest and Bio-based Products Industries (PTF BPI) Kuchl, September 24 -26, 2014
-

# Top #9: Stakeholder-Workshop

IEA Bioenergy  
Task 42 Biorefining

Workshop @ i-SUP2014



The role of industry  
in a transition  
towards the  
BioEconomy (BE) in  
relation to  
biorefinery

i-SUP2014, Antwerp, Belgium,  
Wednesday afternoon 3 September 2014

## ■ Scope

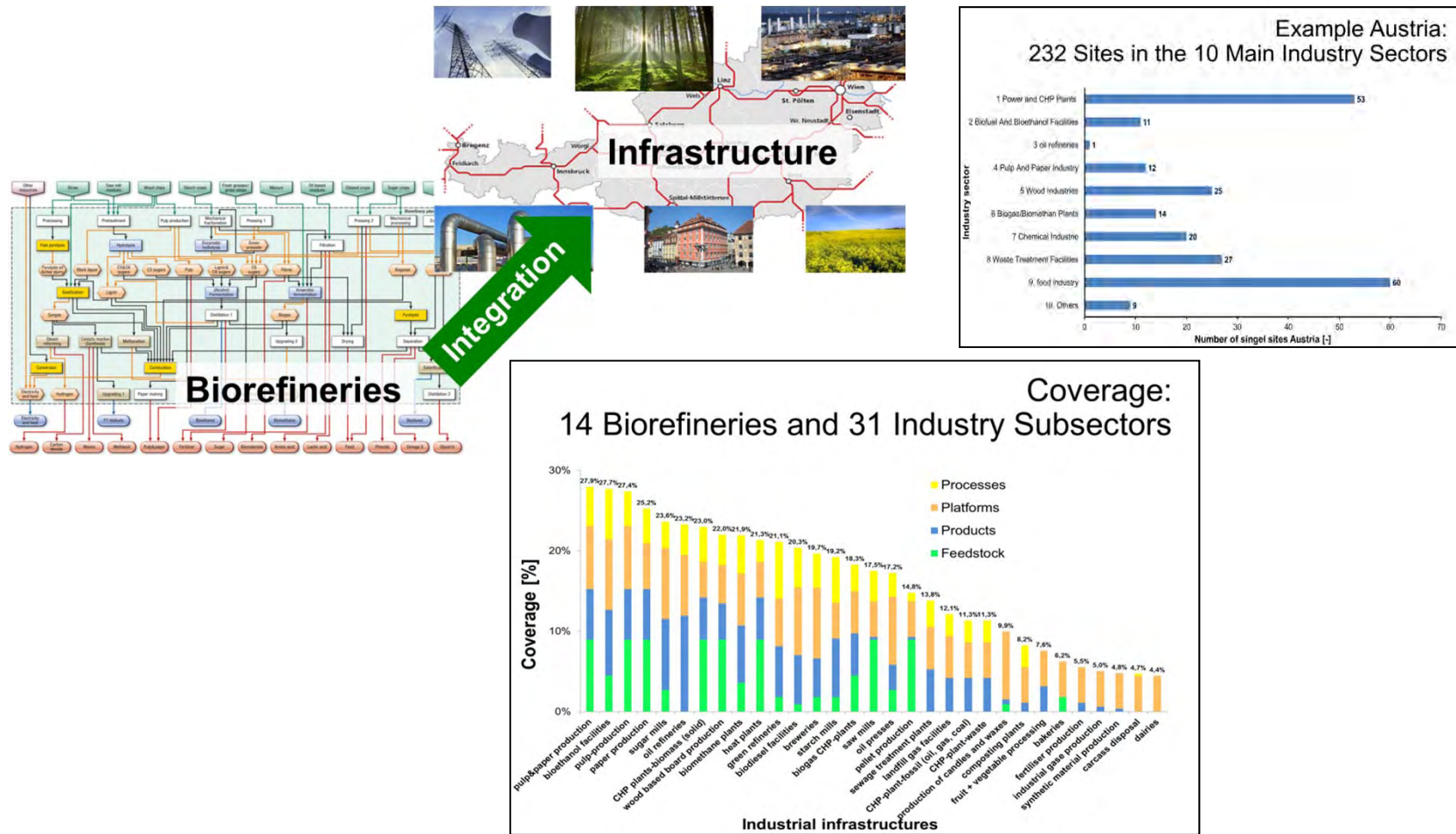
- What are the opportunities for upgrading existing industrial infrastructures to sustainable biorefineries?
- What are the changing roles of the different industrial stakeholders (agro, energy, chemical, feed/food industry) in the transition to a BE?

## ■ Approach

- The Role of the Energy Sector
- Questionnaire (also distributed to stakeholders incl. Austria)
- Approach Integration of Biorefineries in Existing Industrial Infrastructures



# Top #8: Integration of Biorefineries into Existing Industrial Infrastructure



# Top #7: IEA Bioenergy and BioEconomy

Australia		Country specific, decisive information
1	Scope of strategies *	Description of scope considered
	Bioeconomy (BE)	South Australia
	Bioeconomy (BBE)	Biofineries
	Biobased Industries (BI)	Pulp + Paper
	Bioenergy (BE)	Biomass feedstocks and supply
2	National strategies **	Description of documents
	Document name	Opportunities for Primary Industries in the Bioenergy Sector / National Research, Development and Extension Strategy
	Scope	BE
	Published by	Governmental Rural Industries Research and Development Corporation
	Year	2014
	Priorities	Primary Industries Sustainability, biomass feedstocks, supply logistics, policy analysis, capacity building
	Language	English
	Other documents ***	
	Document name	Pulp and Paper Industry Strategy Group - Final Report
	Scope	BB
	Published by	Pulp and Paper Industry Strategy Group
	Year	2010
	Priorities	Innovation (i.e. potential of bioenergy/biofuel production integrated in P&P processes), support of establishing a Biofineries Research Institute, investment (i.e. expansion of timber plantations), sustainability (i.e. sustainable biomass growth) and productivity
	Language	English
	Document name	Australian Government response to the "Pulp and Paper Industry Strategy Group Report"
	Scope	BB
	Published by	Australian Government, Minister for Industry and Innovation
	Year	2012
	Priorities	Establishment of Manufacturing Industry Council, measures taken to support P&P industry strategy (i.e. incentives for private sector investment in new biomass plantations), no statement concerning the establishment of a Biofineries Research Institute
	Language	English
	Document name	Biofineries Scoping Study: Tropical Biomass
	Scope	BBE
	Published by	Forcell Consulting/BIOEDGE (commissioned by Governmental Department of Innovation, Industry, Science and Research)
	Year	2010
	Priorities	Advice to government for development of Bioeconomy Strategy, focusing on the use of sugarcane
	Language	English
	Document name	Scoping Biofineries: Temperate Biomass Value Chains
	Scope	BBE
	Published by	Perrett & Associates (commissioned by Governmental Department of Innovation, Industry, Science and Research)
	Year	2010
	Priorities	Advice to government for development of Bioeconomy Strategy, focusing on the use of temperate biomass
	Language	English
	Document name	Biotechnology and Australian Agriculture
	Scope	BBE
	Published by	ICOL/Tasman (commissioned by Governmental Department of Agriculture, Fisheries and Forestry)
	Year	2008
	Priorities	Advice to government for development of a Strategy for agricultural biotechnology: optimising the contribution of the next generations of biotechnologies to Australian agriculture and downstream markets as part of an emerging bioeconomy
	Language	English
	Document name	Building a bioeconomy in South Australia 2011-2015
	Scope	BE
	Published by	Government of South Australia
	Year	2011
	Priorities	Strategy to foster the bioeconomy in South Australia, focusing on medical devices, environmental solutions, water management and cleantech
	Language	English
	Webresources	
	Title	The Bioeconomy
	Source	CSIRO
	Link	<a href="http://www.csiro.au/Organisation-Structure/Division/Ecosystem-Science/The-Bioeconomy.aspx">http://www.csiro.au/Organisation-Structure/Division/Ecosystem-Science/The-Bioeconomy.aspx</a>
	Title	Bioeconomy and Industrial Biotechnology
	Source	Australian Government, Department of Industry
	Link	<a href="http://www.industry.gov.au/Industry/Biotechnology/Industry/BioeconomyandIndustrialBiotechnology.aspx">http://www.industry.gov.au/Industry/Biotechnology/Industry/BioeconomyandIndustrialBiotechnology.aspx</a>
	Title	BioSA
	Source	South Australian Government
	Link	<a href="http://www.bioenergy.gov.au/">http://www.bioenergy.gov.au/</a>
3	Visions ***	
4	Targets ****	
5	Addressed economic sectors	References to documents listed above
	Forestry	a, b, c, d, e
	Agriculture	a, b, c, d, e, f
	Food and feed processing	
	Pulp+Paper	b, c
	Woodworking industry	
	Chemical industry	a, c, f
	Metals manufacturing	b, e, f
	Bioenergy	a, b, c, d, e, f
*	Definitions of Scope	
	Bioeconomy (BE)	Food and feed industries (agriculture, forestry, horticulture, fisheries and aquaculture, plant and animal breeding, the nutrition and beverage industry) + Bioeconomy
	Bioeconomy (BBE)	
	Biobased Industries (BI)	Non-food industries: Biochemical, biomaterial, biomedicine, pulp+paper and wood industries + Bioenergy (including biofineries)
	Bioenergy (BE)	Individual sectors of Non-food industries: Biochemical, biomaterial, biomedicine, pulp+paper and wood industries
	Bioenergy (BBN)	Research, heat, transportation biofuels, gaseous and solid energy carriers
**	National strategies	Governmental Strategies
***	Other documents	Strategies and reports by industry, research and consulting, governmental responses to such strategies
****	Visions, Targets	Only if there is a national BE/BBE strategy

## Identification BioEconomy Strategies in IEA Bioenergy Member Countries

- current status
- approaches
- opportunities for IEA Bioenergy

## Cooperation Italy and Austria

- JOANNEUM: 11 Task 42 countries (Australia, Austria, Canada, Denmark, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, United States)
- ITABIA/ENEA: 11 non-Task 42 of IEA Bioenergy (Belgium, Brazil, Croatia, Finland, France, Korea, Norway, South Africa, Sweden, Switzerland, UK )

# Top #6: 3<sup>rd</sup> European Biorefinery Training Course

**3rd European Biorefining Training School**

Budapest  
7-10 July, 2014

The 3rd European Biorefining Training School aims to offer an introduction to the key subjects and provide insight into many of the diverse issues that surround the bioeconomy transition. The school will deliver the latest knowledge and developments by internationally renowned researchers to PhD students, decision makers and professionals on the emerging field of bioeconomy.

**Partners**

The concept of the school has been developed and trademarked by three world class research institutes: the National University of Athens of Greece, Wageningen University of the Netherlands and INRA of France. The 3rd edition of the school will be organized by Climate KIC Central Hungary.

**Media partners**

greenea  
NNECC  
IL BIOECONOMISTA  
Bio-based Industries Consortium

INRA  
IEA Bioenergy  
Task 42 Biorefineries

- Presentations:
  - 9 Plenary presentations
  - 18 presentations in parallel modules
- 80 participants (Austria: 5)
- Task 42 contributions:
  - „IEA Bioenergy Task 42 Biorefining – Sustainable Processing of Biomass for Food and Non-food Applications“, Rene van Ree, Task leader
  - “Value Chain Assessment of Biofuel-driven Biorefineries”, Gerfried Jungmeier, Austrian Team Leader



# Top #5: Working Document „Biorefinery Complexity Index“

*Working Document - 2014-07-09*

## The Biorefinery Complexity Index

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with contributions from: Rene van Ree<sup>2</sup>, Henning Jørgensen<sup>3</sup>, Ed de Jong<sup>4</sup>, Heinz Stichnothe<sup>5</sup>, Maria Wellisch<sup>6</sup>

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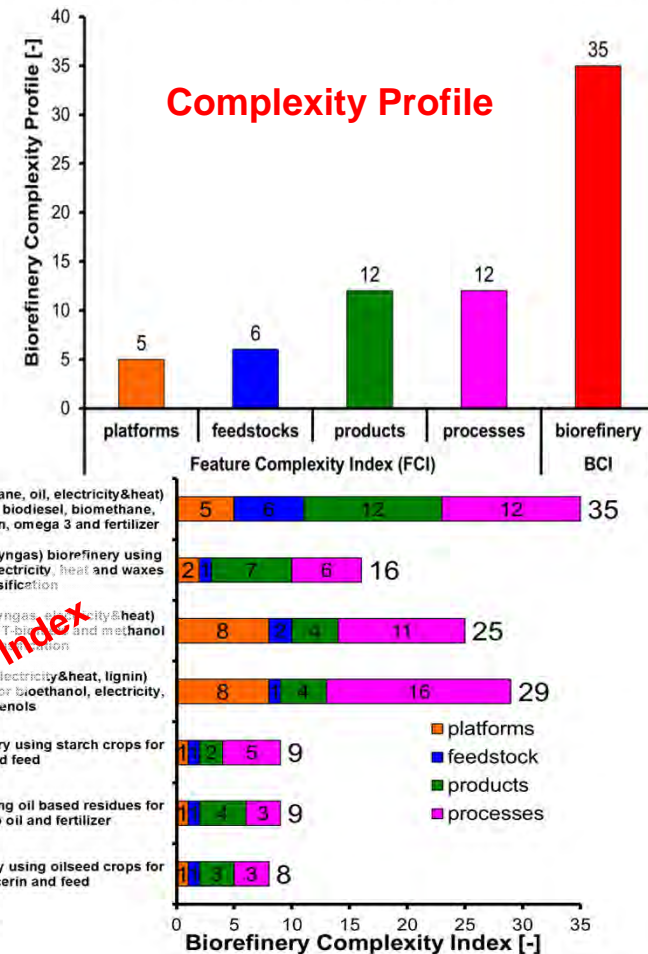
*Working document*

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Page 1



# Top #4: Austrian Country Report 2014

The image displays a grid of 41 thumbnail images, each representing a slide from the 'Austrian Country Report 2014'. The slides are numbered 1 through 41 and cover a wide range of topics related to bioenergy and biorefining in Austria. The topics include:

- Country Report Austria (1):** Overview of the report.
- Content (2):** Key findings and structure.
- Country specific energy consumption (3-8):** Detailed data on energy use in Austria, including pie charts and tables.
- Biomass use for energy and non-energy applications (9-18):** Analysis of biomass utilization, including charts and tables.
- Biomass related national policy issues (19-27):** Discussion of government policies and incentives.
- Biorefinery pilot plants (28-34):** Information on various pilot-scale biorefineries.
- Major R&D projects (35-40):** Overview of significant research and development initiatives.
- Major national stakeholders involved in the field of biorefining (37-40):** Lists of key organizations and institutions.
- Store info (41):** Contact information for the report.



# Top #3: Biorefinery Fact Sheets

## Part A: Biorefinery Plant

**Biorefinery FACT SHEET**  
"2-platform (electricity&heat, syngas) biorefinery using wood chips for FT-biofuels, electricity, heat and waxes with steam gasification"

**Part A: Biorefinery plant**  
The demonstration scale energy driven biorefinery "2-platform (electricity&heat, syngas) biorefinery using wood chips for FT-biofuels, electricity, heat and waxes with steam gasification" is shown in Figure 11.

Within the "2 platform (electricity&heat, syngas) biorefinery using wood chips for FT-biofuels, electricity, heat and waxes with steam gasification" the wood chips are gasified with steam to produce a product gas, which is used to produce raw FT-biofuels via a catalytic reactor (FT-synthesis). The final quality of the transportation FT biofuel is reached in the upgrading step, e.g. hydroprocessing. The process residues are combusted to produce electricity and heat. As a further product waxes are produced.

Depending on the further successful development beside the steam gasification of wood, which is suitable for smaller to medium sized gasifiers also the gasification with oxygen for large applications (e.g. entrained flow gasification) might become interesting. The large amount of syngas will then be an optimal starting point to produce additional synthetic products depending on the market demand for biomass based chemicals, e.g. methanol.

*Case study, example*

Figure 11: 2 platform (electricity&heat, syngas) biorefinery using wood chips for FT-biofuels, electricity, heat and waxes with steam gasification

**Table 3: Key characteristics of biorefinery plant – Austrian feasibility study**

Biorefinery plant	
Biorefinery Complexity Index (Products/Platform/Feedstock/Process/Step)	14.5 (4.5/3/2/5)
State of technology:	conceptual
Products	Auxiliaries (external)
FT-diesel: 105 [t/a]	heat: 0 [PJ/a]
FT-gasoline: 70 [t/a]	heat: 0 [PJ/a]
heat: 0.3 [PJ/a]	materials: 29 [t/a]
waxes: 10 [t/a]	
Feedstock	Costs
wood chips: 1.459 [t/a]	investment: 900 [Mio €]
water content: 45% [wt]	bedstock: 100 [t/a]
	man: energy
Efficiencies	input to products: 12.4%
	input to transportation bucket: 11.8%
	49%

**Figure 12: Mass balance of biorefinery plant**

**Figure 13: Energy balance of biorefinery plant**

**Figure 14: Share of costs**

**Figure 15: Share of revenues**

## Part B: Value Chain Assessment

**Part B: Value Chain Sustainability Assessment**  
The method of the sustainability assessment – economic and environmental – is given in Annex 1. The main assumptions and modeling choices are documented in Annex 2.

In future the following improvements of the assessment might be possible:

- Reduction of investment costs
- Use of renewable energy for auxiliary energy
- Further products made from glycolysis with higher revenues
- Lower area demand due to an yield increase
- Using of straw for various products

**Table 4: Key characteristics of biorefinery value chain – generic example**

Whole value chain	
Greenhouse gas emissions (range)	
biorefinery: 70 (60 to 81)	26 CO <sub>2</sub> -eq [t]
reference system: 690 (640 to 740)	26 CO <sub>2</sub> -eq [t]
change: -58 (57 to -60)	[%]
Calculated energy demand	
total	
biorefinery: 0.6 (0.56 to 0.66)	[PJ/a]
reference system: 9.2 (8.5 to 11)	[PJ/a]
change: -8.6 (8 to -9)	[%]
total	
biorefinery: 14.9 (14 to 17)	[PJ/a]
reference system: 9.8 (9 to 11)	[PJ/a]
change: -5.0 (5 to -5.7)	[%]
Agro-territorial area demand	
bedstock: - (0 to 0)	[ha]
Costs	
annual costs: 220 (200 to 250)	[Mio €/a]
specific costs: 1.200 (1100 to 1400)	[€/t]
Revenues	
annual revenues: 220 (210 to 260)	[Mio €/a]
specific revenues: 1.200 (1100 to 1500)	[€/t]

**Figure 16: Comparison of biorefinery with conventional reference system on whole value chain (incl. "end of life treatment")**

**Figure 17: Estimated cumulative fossil energy demand of biorefinery and reference products**

**Figure 18: Estimated cumulative energy demand of biorefinery and reference products**

**Figure 19: Estimated greenhouse gas emissions of biorefinery and reference products**

**Figure 20: Estimated cost and revenues of biorefinery plant**

**Annex:**

**Methodology of sustainability assessment and data with references**

- 8 Biorefinery Fact Sheets are ready
- Cooperation with Task 34 "Liquid Fuels" and Task 37 "Pyrolyses": identify 2 – 4 common biorefinery fact sheets

# Top # 2: New Task 42 Brochure 66 pages with 4 Austrian Biorefineries

IEA Bioenergy is an international collaboration set-up in 1976 by the International Energy Agency (IEA) to improve international co-operation and information exchange between national bioenergy R&D programmes. Its Vision is that bioenergy is, and will continue to be, a substantial part of the sustainable use of biomass in the BioEconomy. By accelerating the sustainable production and use of biomass, particularly in a Biorefining approach, the economic and environmental impacts will be optimised, resulting in more cost-competitive bioenergy and reduced greenhouse gas emissions. Its Mission is facilitating the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive bioenergy systems and technologies, and to advise policy and industrial decision makers accordingly. Its Strategy is to provide platforms for international collaboration and information exchange, including the development of networks, dissemination of information, and provision of science-based technology analysis, as well as support and advice to policy makers, involvement of industry, and encouragement of membership by countries with a strong bioenergy infrastructure and appropriate policies. Gaps and barriers to deployment will be addressed to successfully promote sustainable bioenergy systems. The purpose of this brochure is to provide an unbiased, authoritative statement on bioenergy in general, and of the specific activities dealt with within IEA Bioenergy Task42 on Biorefining, aimed at stakeholders from the agro-sector, industry, SMEs, policy makers, and NGOs.

**IEA Bioenergy**  
IEA Bioenergy – Task42 Biorefining

## IEA BIOENERGY Task42 BIOREFINING

**Sustainable and synergetic processing of biomass  
into marketable food & feed ingredients, chemicals,  
materials and energy (fuels, power, heat)**

### RFI bioCRACK Pilot Plant (Austria)

**State of the art:** Pilot Plant  
The RFI bioCRACK is a pilot plant (operating) set up by the producer of diesel fuel, paraffins and bio-ethanol from wheat biomass.

**Location:** RFI Energy Substrate/Triana, Austria  
**Owner:** RFI - Biorefining International AG  
**Facilities:** 1 generation biomass (wheat) and diesel refinery, fine distillation, paraffins and diesel.

**Description:** RFI - Biorefining International AG is creating and exchanging with the consortium of industrial partners from the BioEconomy. Following the successful start-up of the RFI bioCRACK, the consortium is planning to build a second generation plant with a capacity of 100,000 tonnes per year. The plant will be used for the production of bio-ethanol, paraffins and diesel. The plant will be used for the production of bio-ethanol, paraffins and diesel. The plant will be used for the production of bio-ethanol, paraffins and diesel.

**Figure 15:** Process flow diagram of RFI bioCRACK Pilot Plant (Source: Biorefining AG)

### AGBANA Bioenergy Puchelhof (Austria)

**State of the art:** Commercial Scale  
The AGBANA Bioenergy Puchelhof is a commercial scale biorefinery for the production of bioethanol, wheat starch and paraffins and diesel. The plant is currently in operation and is producing bioethanol, wheat starch and paraffins and diesel.

**Location:** AGBANA Bioenergy Puchelhof, Austria  
**Owner:** AGBANA Bioenergy Puchelhof GmbH  
**Facilities:** 1 generation biomass (wheat) and diesel refinery, fine distillation, paraffins and diesel.

**Description:** The biorefinery produces the AGBANA Bioethanol (used for bioethanol) and paraffins and diesel. The plant is currently in operation and is producing bioethanol, wheat starch and paraffins and diesel. The plant is currently in operation and is producing bioethanol, wheat starch and paraffins and diesel.

**Figure 16:** Process flow diagram of AGBANA Bioenergy Puchelhof (Source: AGBANA Bioenergy Puchelhof GmbH)

### Ecodoma Algae Biorefinery (Austria)

**State of the art:** Demonstration Plant  
The Ecodoma Algae Biorefinery is a demonstration plant for the production of bioethanol, paraffins and diesel from algae. The plant is currently in operation and is producing bioethanol, paraffins and diesel.

**Location:** Ecodoma Algae Biorefinery, Austria  
**Owner:** Ecodoma Algae Biorefinery GmbH  
**Facilities:** 1 generation biomass (algae) and diesel refinery, fine distillation, paraffins and diesel.

**Description:** The Ecodoma Algae Biorefinery is a demonstration plant for the production of bioethanol, paraffins and diesel from algae. The plant is currently in operation and is producing bioethanol, paraffins and diesel. The plant is currently in operation and is producing bioethanol, paraffins and diesel.

**Figure 17:** Process flow diagram of Ecodoma Algae Biorefinery (Source: Ecodoma Algae Biorefinery GmbH)

### Pilco Biorefinery (Austria)

**State of the art:** Commercial Scale  
The Pilco Biorefinery is a commercial scale biorefinery for the production of bioethanol, paraffins and diesel. The plant is currently in operation and is producing bioethanol, paraffins and diesel.

**Location:** Pilco Biorefinery, Austria  
**Owner:** Pilco Biorefinery GmbH  
**Facilities:** 1 generation biomass (wheat) and diesel refinery, fine distillation, paraffins and diesel.

**Description:** The Pilco Biorefinery is a commercial scale biorefinery for the production of bioethanol, paraffins and diesel. The plant is currently in operation and is producing bioethanol, paraffins and diesel. The plant is currently in operation and is producing bioethanol, paraffins and diesel.

**Figure 18:** Process flow diagram of Pilco Biorefinery (Source: Pilco Biorefinery GmbH)



# Top # 1: Classifications System is used more and more...

**NACH SUPER E10: WELCHE ROLLE FÜR BIODIESELSTOFFE?**  
Fakten, Trends und Perspektiven

**Green building blocks for biobased plastics**  
PAULIEN HARMSEN AND MARTIJN HACKMANN  
WAGENINGEN UR For quality of life

**Joint European Biorefinery Vision for 2020**  
Star-COLIBRI  
STRATEGIC TARGETS FOR 2020 – COLLABORATION INITIATIVE ON BIOREFINERIES

**European Bio**

**VDI-RICHTLINIEN**  
Februar 2014  
VEREIN DEUTSCHER INGENIEURE  
Klassifikation und Gütekriterien von Biorafinerien  
VDI 6310 Blatt 1 Entwurf

Classification and quality criteria of biorefineries  
Eingriffe bis 2014-07-31  
• vorgeschrieben über das VDI-Richtlinien-Erstellungsportal <http://www.vdi.de/erstellungsportal>  
• in Papierform an VDI-Gesellschaft Technologies of Life Sciences Fachbereich Biotechnologie Postfach 10 11 39 40002 Düsseldorf

Inhalt	Seite	Inhalt	Seite
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1 Anwendungsbereich	3	6.2 Beschreibung der Anlage - Biover-	39
2 Normative Verweise	4	6.3 Ökonomische Bewertung	41
3 Begriffe	4	6.4 Ökologische Bewertung	46
4 Technologie der Biorafinerie	6	6.5 Soziale Bewertung	51
4.1 Klassifizierung von Biorafinerieanlagen	6	6.6 Wahrnehmung gesellschaftlicher Verantwortung	51
4.2 Technologische Konzepte	8	6.7 Fazit aus der Anwendung der Gütekriterien	52
5 Definition von Bewertungsmethoden und zugehöriger Kenngrößen	14	Schlussfolgerung	52
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VDI-Gesellschaft Technologies of Life Sciences  
Fachbereich Biotechnologie

VDI-Handbuch Biotechnologie  
VDI-Handbuch Energietechnik  
VDI-Handbuch Ressourcenmanagement in der Umwelttechnik  
VDI-Handbuch Technik Biomasse/Boden  
VDI-Handbuch Verfahrenstechnik und Chemieingenieurwesen, Band 1: Bewertung/Stoffwerte  
VDI-Handbuch Verfahrenstechnik und Chemieingenieurwesen, Band 2: Planung/Projektierung  
VDI-Handbuch Verfahrenstechnik und Chemieingenieurwesen, Band 5: Spezielle Verfahrenstechnik

**Roadmap Biorefinerien**  
im Rahmen der Aktionspläne der Bundesregierung zur stofflichen und energetischen Nutzung nachwachsender Rohstoffe



IEA Bioenergy aims to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost competitive bioenergy systems and technologies

Activities

Knowledge dissemination

Market deployment

Stakeholder positioning

Sustainable biomass valorisation

Policy advice

Training



Task 42 Biorefining: Sustainable processing of biomass into a spectrum of marketable food & feed ingredients, bio-based chemicals, materials,...

Read more



News

New map of US biorefineries available
March 28, 2014

Project results presented at conference
February 17, 2014

Tomorrow...
September 6, 2013

Biofuel-driven Biorefineries Report 2013
February 1, 2013

Poster IEA Bioenergy Task42

Calendar

- April 8, 2014 - 7th Int...
May 12, 2014 - Conference
9th Biopolymer Symposium- Philadelphia, USA

More calendar

Recent publications

Green Building Blocks for

Austrian Team Leader

Gerfried Jungmeier
JOANNEUM RESEARCH
gerfried.jungmeier@joanneum.at

- Multi-sectoral stakeholder involvement in the development and implementation of sustainable value chains
Technology development and biorefinery scale-up using best

www.IEA-Bioenergy.Task42-Biorefineries.com
www.nachhaltigwirtschaften.at/iea