Österreichische Mitarbeit in IEA Bioenergy Task 42 „Biorefining“

Highlights 2012 - 2015

Gerfried Jungmeier

bmvit Bioenergie Fachgespräch
Wien 18. März 2016

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

Most Sustainable Use of Biomass?

IEA Bioenergy Task42 Biorefining

JOANNEUM RESEARCH LIFE

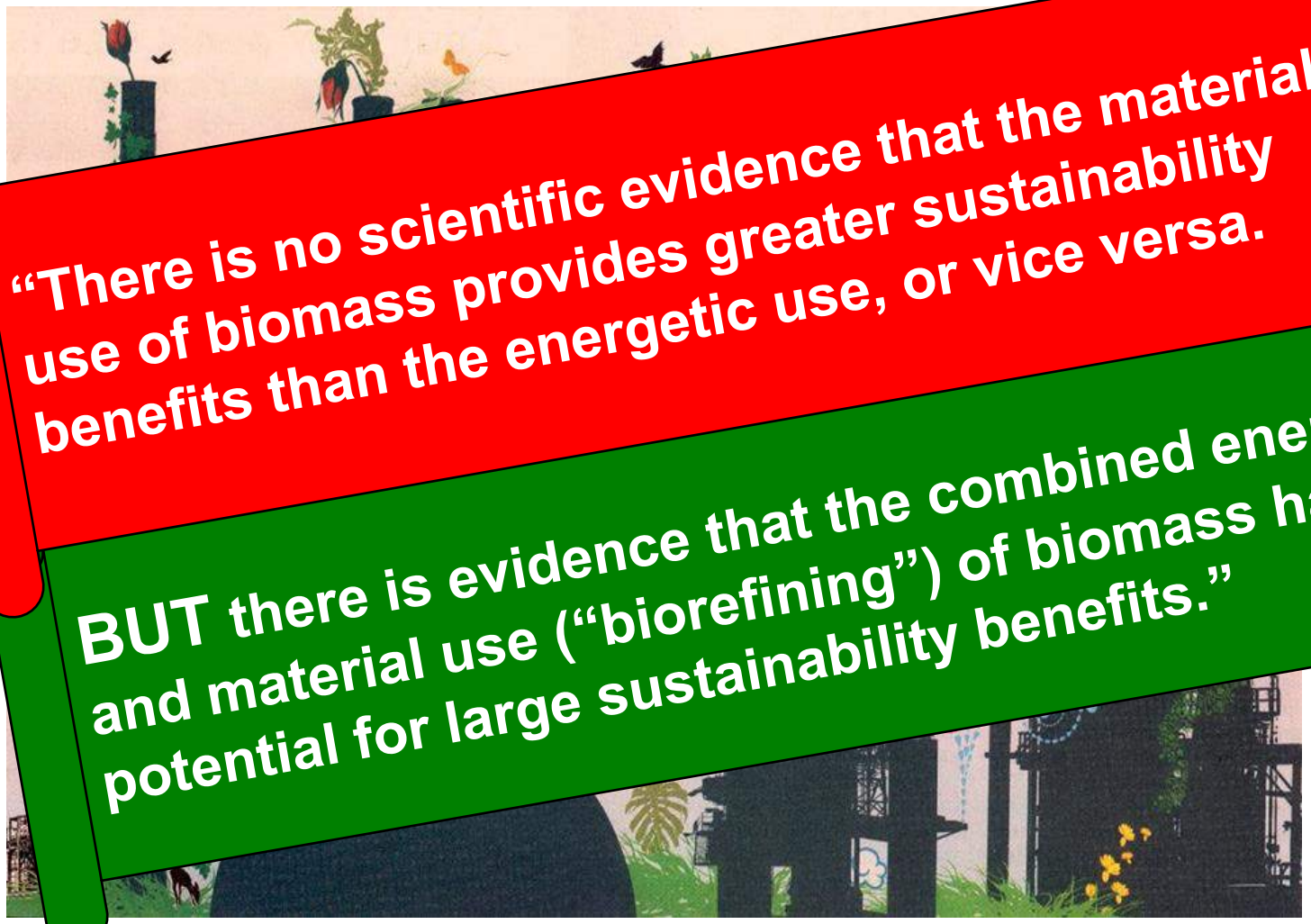
Example maize

This plastic bag is made from maize, a renewable resource, and decomposes naturally

Do we need both for the BioEconomy?

This biofuel is made from maize, a renewable resource to reduce GHG emissions

A Statement

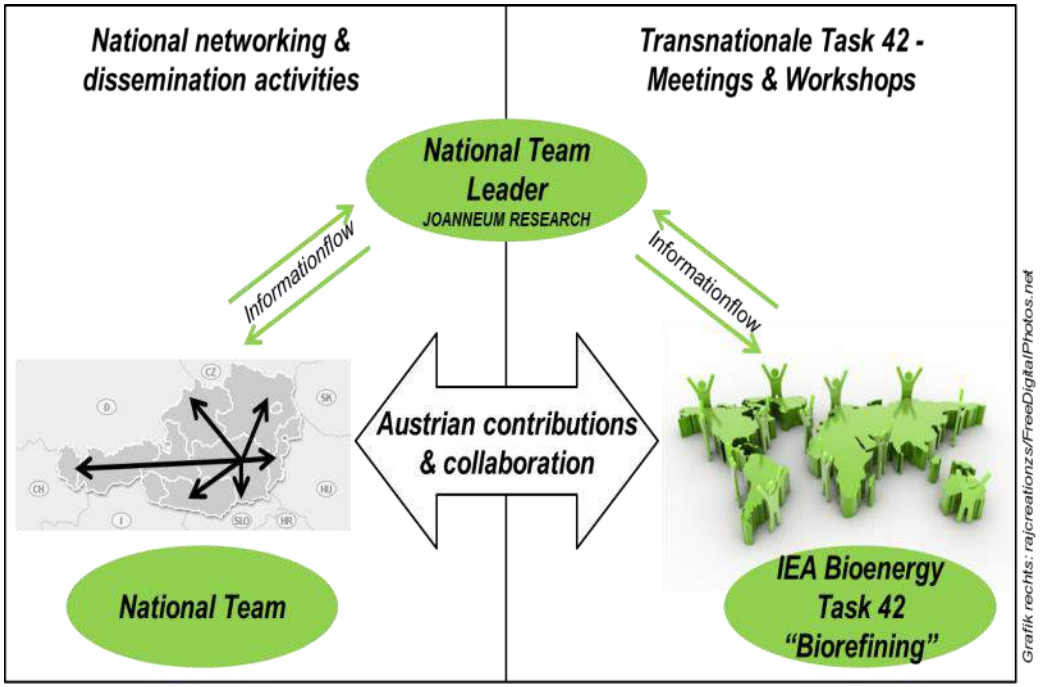


"There is no scientific evidence that the material use of biomass provides greater sustainability benefits than the energetic use, or vice versa.

BUT there is evidence that the combined energetic and material use ("biorefining") of biomass has the potential for large sustainability benefits."

Vernetzung und Wissensverbreitung - Österreich

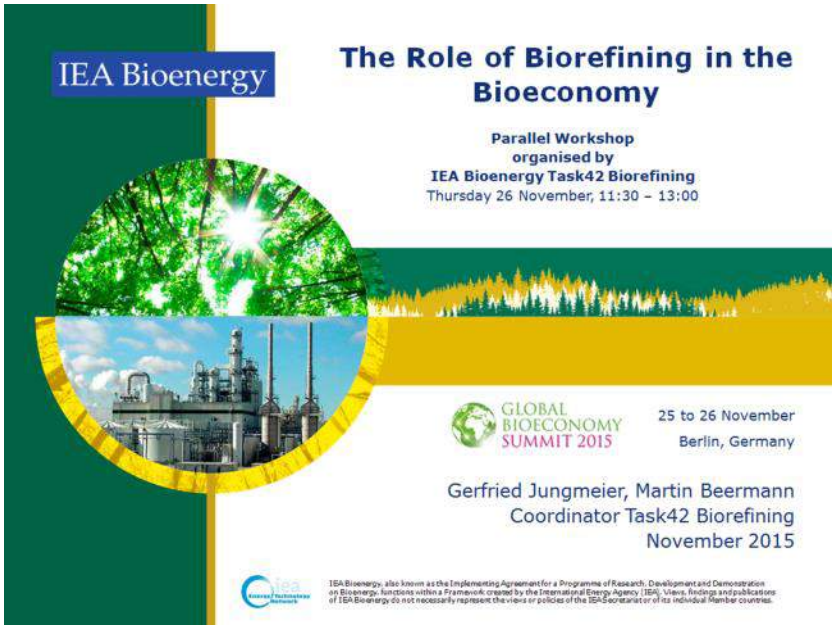
- **7 Task Meetings**
- **5 Stakeholder – Workshops**
  - 10/2013, Graz/Austria
  - 09/2014, Antwerpen/Belgien
  - 12/2014, Guelph/Canada
  - 05/2015, Sassari/Italien
  - 11/2015, Berlin/Deutschland



- **24 Publikationen von Österreich**
- **31 Präsentationen, davon 7 in Österreich**
- **1 Bioraffinerie-Trainingskurs:** „Value Chain Assessment of Biofuel-driven Biorefineries“, Budapest, 07/2014

Stakeholder Workshop
Global Bioeconomy Summit

"present & discuss the potential role of biorefining and its stakeholders in the transition to a future BioEconomy using biomass for co-production of food, feed, biobased products and bioenergy"



- Leading stakeholders on the transition towards a BioEconomy
- **Role of Biorefining** within this transition process
- Main **drivers** that support this transition process
- Main technical **barriers** that hinder this transition process
- **Role** of national and international governments
- **Supporting** policies & instruments

Brochure with 4 Austrian Biorefineries

IEA Bioenergy
Task42 Biorefining

JOANNEUM RESEARCH LIFE

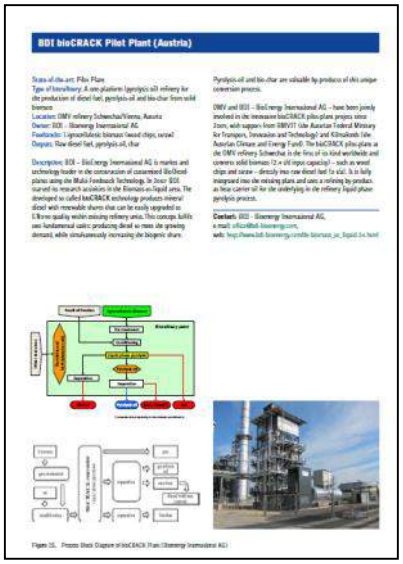
IEA Bioenergy is an international collaboration set-up in 1978 by the International Energy Agency (IEA) to improve international co-operation and information exchange between national bioenergy RD&D programmes. Its Vision is that bioenergy is, and will continue to be a substantial part of the sustainable 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 biorefining 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.

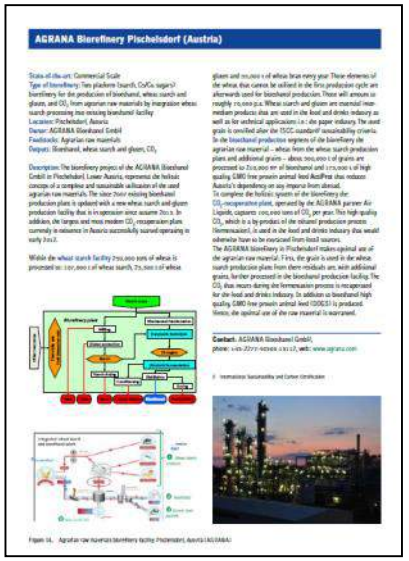
IEA Bioenergy

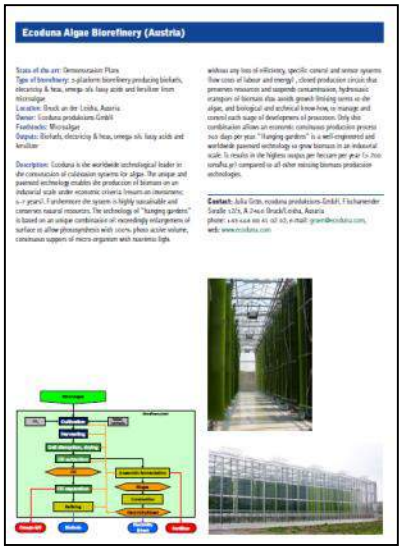
IEA Bioenergy – Task42 Biorefining

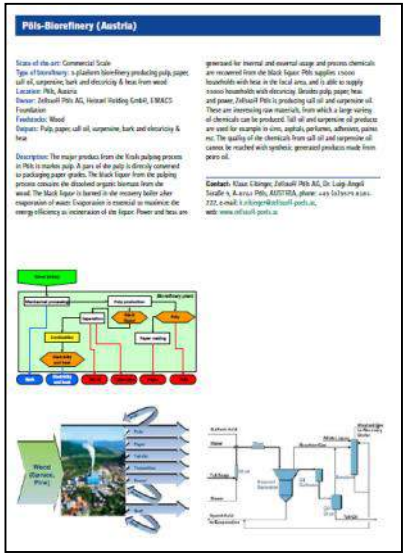
IEA BIOENERGY Task42 BIOREFINING

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

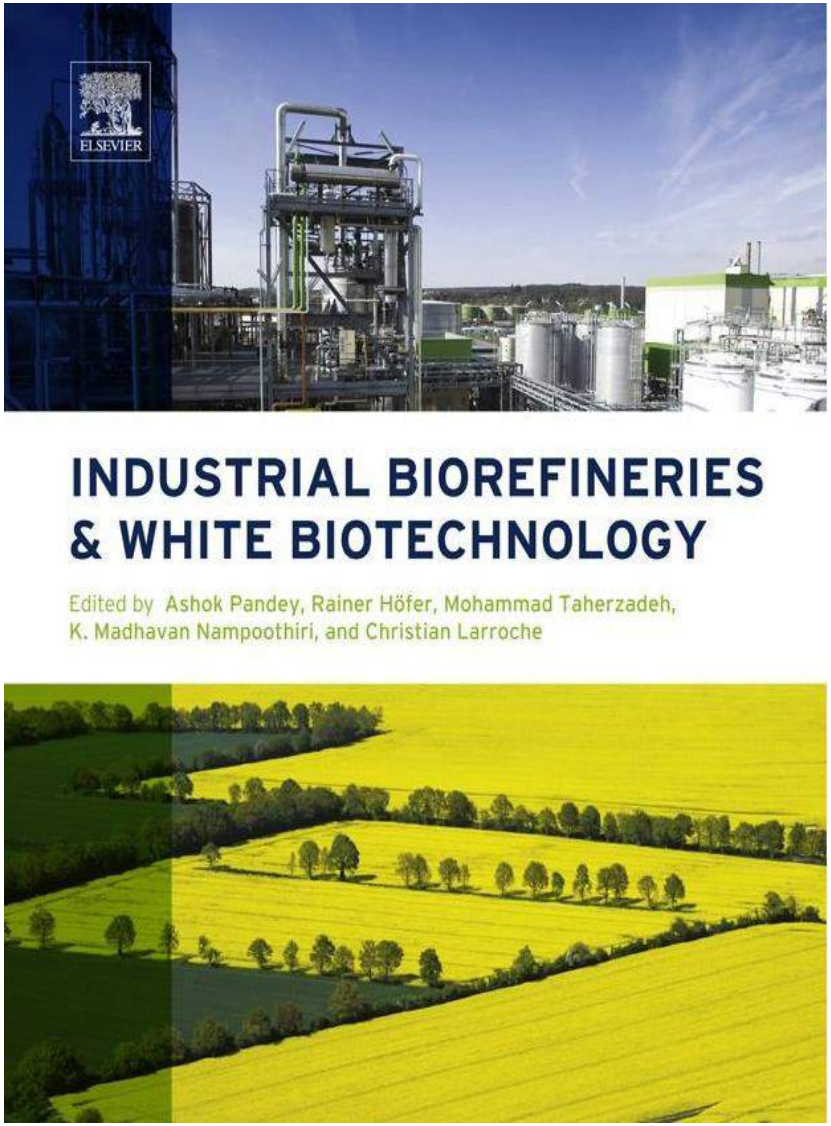








Book Chapter on Biorefineries

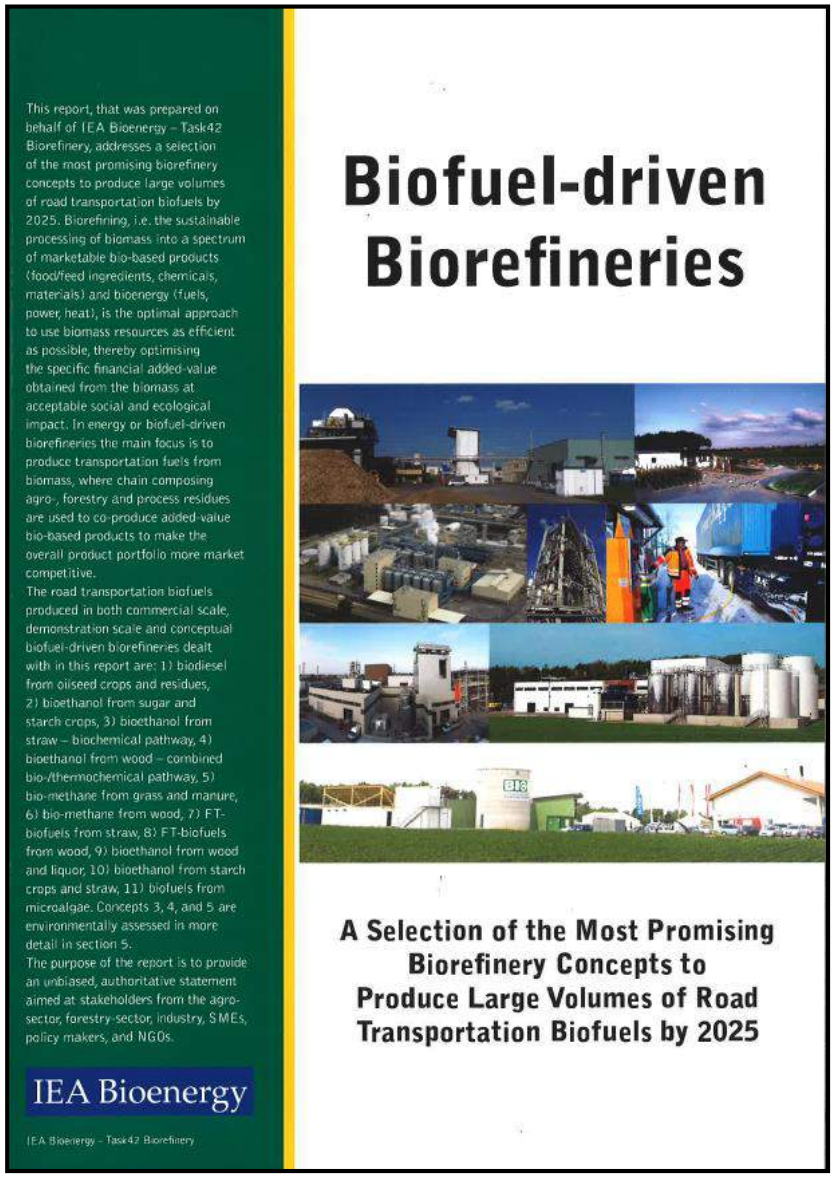


Based on the classification system of biorefineries and the "Nelson´s complexity index" for oil refineries a **Biorefinery Complexity Index** (BCI) is developed by assessing the **Technology Readiness Level** (TRL) of each features of a biorefinery.

8. Olec
9. Lign ock Biorefinery
10. Syn orefinery (Thermochemical Biorefinery)
11. Ne n Hydrocarbon Biorefinery
12. G inery
13. M orefinery
14. C Development
15. Biorefinery Concepts in Comparison to Petrochemical Refineries
16. Biorefinery Complexity Index
17. Discussion and Conclusions

References

Report on “Biofuel-driven Biorefineries“



Coordinated by Austrian participation

…..Based on this ***first selection of most promising biorefinery concepts to produce large volumes of road transportation biofuels by 2025*** *the Task 42 is assessing the sustainability of these biorefinery concepts by analyzing economic, environmental and social aspects in comparison to conventional processes and products.*

In a next step a “biorefinery fact sheet” *for each of these selected “energy driven” biorefineries is developed, key characteristics for a specific production capacity of road transportation biofuel ……..”*

Poster Award 2015

IEA Bioenergy
Task42 Biorefining

JOANNEUM RESEARCH LIFE

JOANNEUM RESEARCH RESOURCES

BioEconomy Strategies in the Member Countries of the IEA Bioenergy Implementing Agreement

– current status, approaches and opportunities

Beermann Martin[1], Jungmeier Gerfried[1], Pignatelli Vito[2], Monni Matteo[2], Van Ree René[3]

CONTACT

[1]JOANNEUM RESEARCH Forschungsgesellschaft mbH
RESOURCES Institute for Water, Energy and Sustainability
Martin Beermann
Elisabethstrasse 18/II
A-8010 Graz
Phone +43 316 876-6000
Fax +43 316 876-6010
martin.beermann@joanneum.at
resources@joanneum.at
www.joanneum.at/resources

[2]ITABIA Italian Biomass Association
Via Venafro 5
00159 – Roma, Italy
Phone +39 06 70 21 118
itabia@enea.it

[3]Wageningen UR Food & Biobased Research
Bornse Weilanden 9, Building 118
6708 WG Wageningen, The Netherlands
Operating Agent Task 42 «Biorefining» in IEA Bioenergy
Phone +31 317 480 710
rene.vanree@wur.nl

Objectives

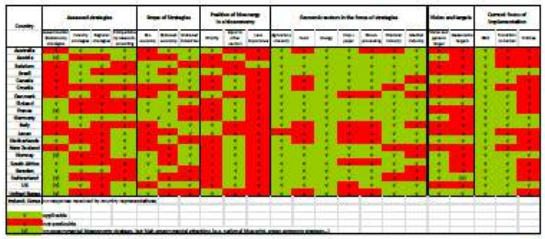
This contribution presents results of a survey on bioeconomy strategies in the 22 member countries of the IEA Bioenergy Implementing Agreement IA, aiming at getting a broad overview of the progress and the priorities of such strategies inside and outside Europe. Strategy documents were analyzed in a framework of questions to compare patterns as

- Scope (governmental, regional, industry sectors)
- Position of bioenergy (including biofuels) in a future BioEconomy
- Main economic sectors in a future BioEconomy
- Current focus of implementation (R&D, transition to markets, policy development)
- Vision and (measurable) targets

Status of BioEconomy strategies (2014)

- **Germany** (Task 42–member)
  National policy strategy bioeconomy (2014)
  National research strategy bioeconomy 2030 (2010)
- **The Netherlands** (Task 42–member)
  Framework memorandum on the Bio-based Economy (2012)
  De Overheidsvisie op de bio-based economy in de energietransitie (2007)
- **Finland**
  The Finnish Bioeconomy Strategy (2014)
- **South Africa**
  The Bio-Economy Strategy (2013)
- **Sweden**
  Swedish Research and Innovation Strategy for a Bio-based Economy (2012)
- **Austria** (Task 42–member)
  Research, Technology and Innovation Strategy for Biobased Industries (2014)
- **Denmark** (Task 42–member)
  Growth plan for water, bio and environmental solutions (2014)
- **Japan** (Task 42–member)
  Biomass Industrialization Strategy (2012)
- **United States** (Task 42–member)
  National Blueprint Bioeconomy (2012)
- **Norway**
  Research Programme on Sustainable Innovation in Food and Bio-based Industries 2012 - 2022 (2012)
- **France**
  Les usages non alimentaires de la biomasse (2012)
- **Switzerland**
  Green Economy: Report and Action Plan (2013)
- **United Kingdom**
  Waste or resource? Stimulating a bioeconomy (2014)

Results



Conclusions

- Bioeconomy is an important part of national transition strategies in 60% of the countries (AT, FI, FR, DE, JP, NL, NO, ZA, SE, CH, UK, US)
- the energy sector is almost always important in national transition strategies, and in most (65%) cases bioenergy has an equal position to other sectors in the BioEconomy, and is a priority in AU, BR, DK, IT, JP, US
- bio(based) development is almost always a top-down (policy driven) approach
- most countries have a BioEconomy vision and general targets instead of measurable policy targets (measurable targets in CA, FI, NL, US)
- for market deployment all countries focus on R&D, 70% on transition aspects and 25% on additional policy development
- in all countries the agriculture, forestry and the energy sector are priority areas for the transition to a BioEconomy, and in 80% of the countries also the chemical sector is identified as a priority area
- in half of the countries biorefining is identified as key technology for successful BioEconomy deployment

Acknowledgement

This survey was commissioned and financed by the IEA-Bioenergy Task 42+Biorefining+ and performed by JOANNEUM RESEARCH in cooperation with ITABIA with the support of national representatives in the IEA Bioenergy Implementing Agreement.

IEA Bioenergy Task 42 Biorefining

THE INNOVATION COMPANY

EUBCE 2015
1 - 4 JUNE | VIENNA - AUSTRIA
Messe Wien Congress and Exhibition Center
23rd European Biomass Conference & Exhibition

G. Jungmeier, V. Pignatelli, M. Monni, M. Beermann, K. Kwant, K. Sipilä, R. Van Ree

have been nominated by the official jury for the Poster Award for the topic "Biomass Policies, markets and sustainability"

The Poster entitled

"BioEconomy Strategies in the Member Countries of the IEA Bioenergy Implementing Agreement - Current Status, Approaches and Opportunities "

was deemed to be a particularly valuable contribution to the

23rd European Biomass Conference and Exhibition
Vienna, Austria, 1 - 4 June 2015

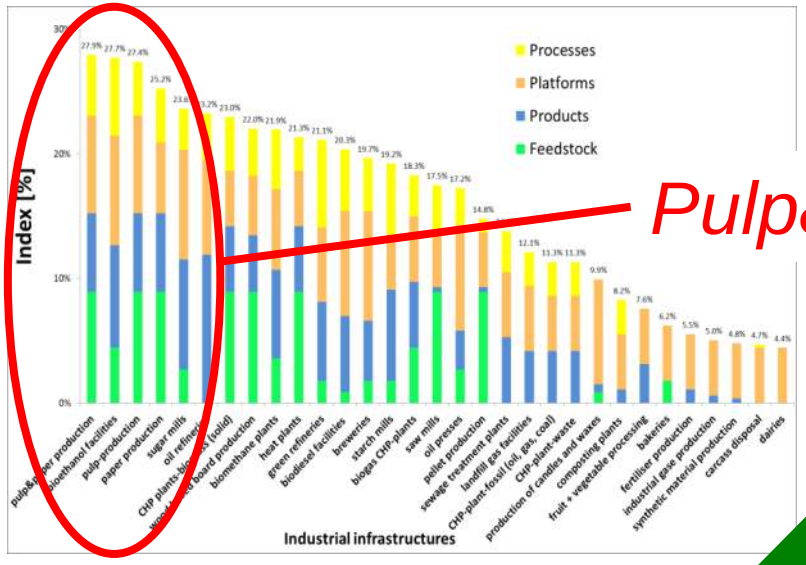
Ingwald Obernberger	David Baxter	Dimitrios Sidiras	Peter Helm	Angela Grassi
Conference General Chairman	Technical Programme Chairman	Poster Awards Coordinator	Executive Committee	Executive Committee

Upgrading industrial infrastructures to integrated Biorefineries in Biobased Industry

IEA Bioenergy Task42 Biorefining

JOANNEUM RESEARCH LIFE

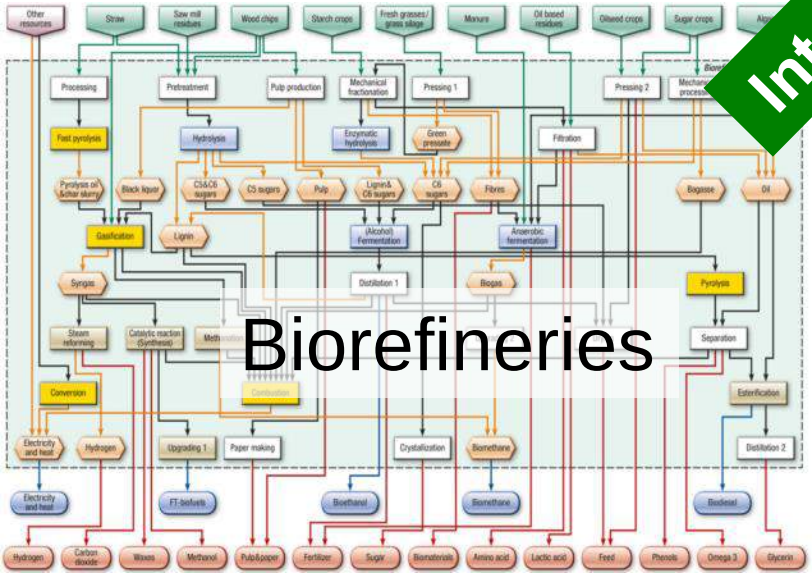
Methodology&Tool developed in Austria and now used in IEA Task 42

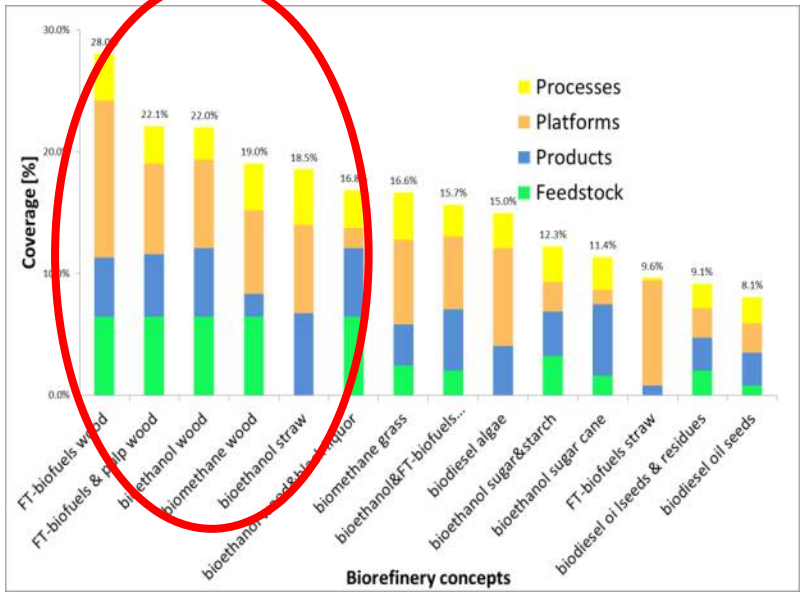


Pulp&paper industry

Infrastructure

Integration





Internationale Sichtbarkeit österreichischer Zusammenarbeit von Industrie & Forschung

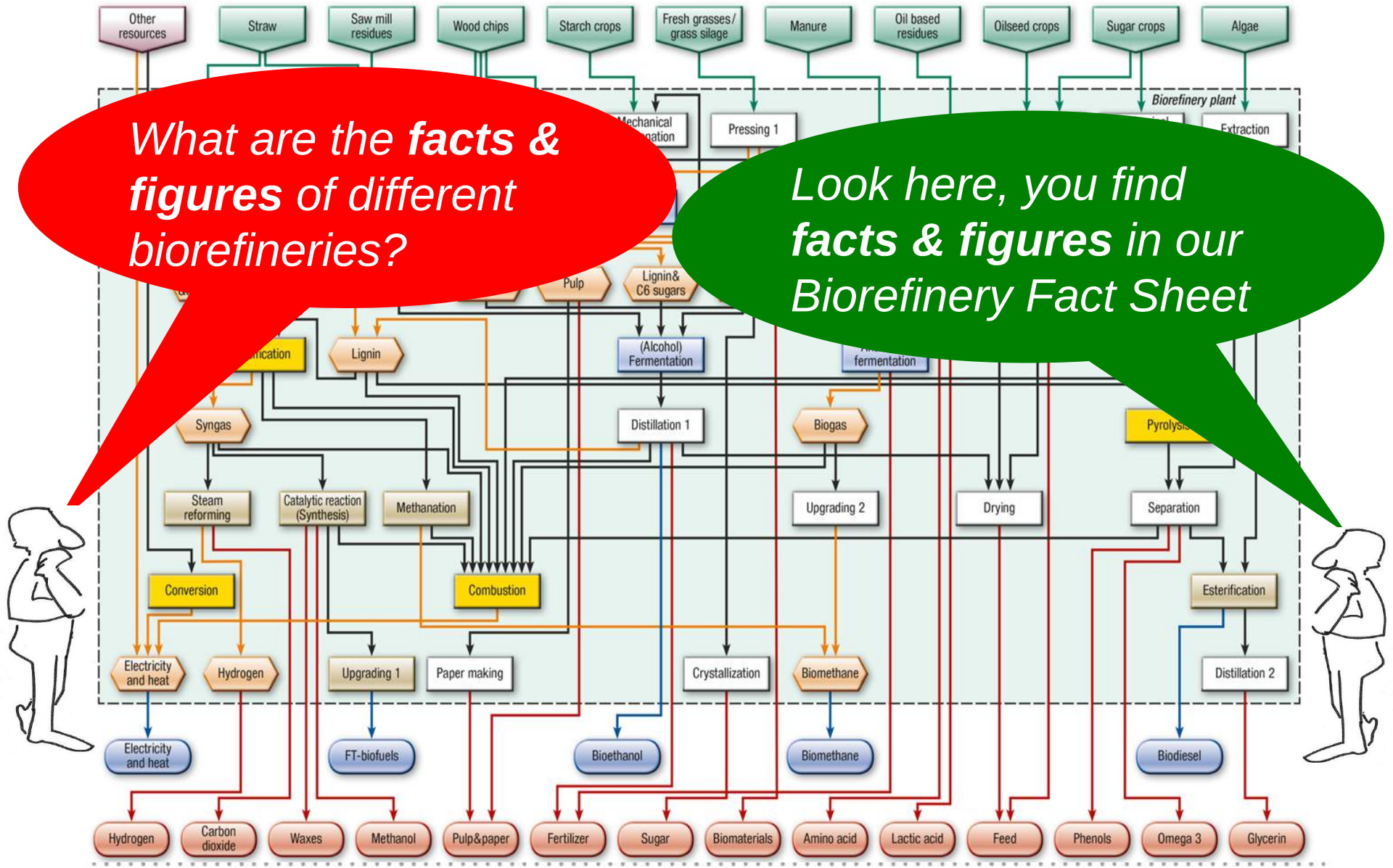
„Biorefining of ligno-cellulosic feedstocks integrated in an oil refinery - experiences from the Austrian demo plant“

Peter Pucher, BDI - Bioenergy International AG, und Gerfried Jungmeier, JOANNEUM RESEARCH, präsentierten in Berlin bei der Bioenergy Conference der Internationalen Energieagentur (IEA) **aktuelle Technologie-Entwicklungen** und Zukunftsperspektiven zur Erzeugung von **Biotreibstoffen aus Holz.**

Biorefineries for the Biobased Industry

IEA Bioenergy Task42 Biorefining

JOANNEUM RESEARCH LIFE



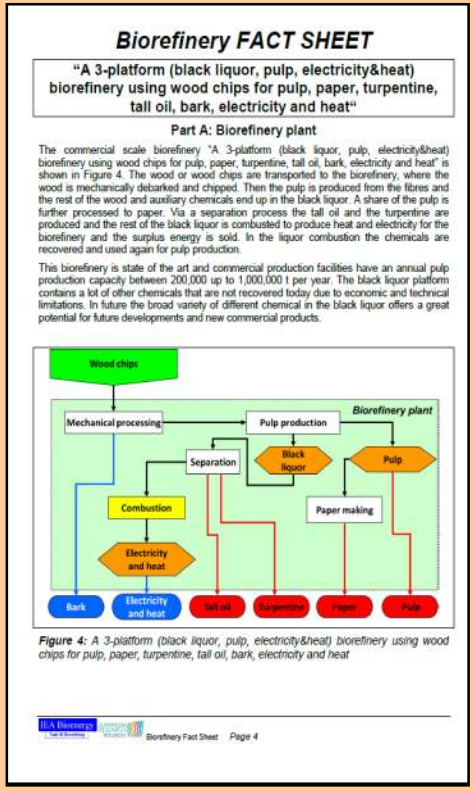
Biorefinery Fact Sheet

IEA Bioenergy Task42 Biorefining

JOANNEUM RESEARCH LIFE

Developed in Austria and now also used in IEA Bioenergy Task 42

Part A: Biorefinery Plant



Biorefinery FACT SHEET

"A 3-platform (black liquor, pulp, electricity&heat) biorefinery using wood chips for pulp, paper, turpentine, tall oil, bark, electricity and heat"

Part A: Biorefinery plant

The commercial scale biorefinery "A 3-platform (black liquor, pulp, electricity&heat) biorefinery using wood chips for pulp, paper, turpentine, tall oil, bark, electricity and heat" is shown in Figure 4. The wood or wood chips are transported to the biorefinery, where the wood is mechanically debarked and chipped. Then the pulp is produced from the fibres and the rest of the wood and auxiliary chemicals end up in the black liquor. A share of the pulp is further processed to paper. Via a separation process the tall oil and the turpentine are produced and the rest of the black liquor is combusted to produce heat and electricity for the biorefinery and the surplus energy is sold. In the liquor combustion the chemicals are recovered and used again for pulp production.

This biorefinery is state of the art and commercial production facilities have an annual pulp production capacity between 200,000 up to 1,000,000 t per year. The black liquor platform contains a lot of other chemicals that are not recovered today due to economic and technical limitations. In future the broad variety of different chemical in the black liquor offers a great potential for future developments and new commercial products.

Figure 4: A 3-platform (black liquor, pulp, electricity&heat) biorefinery using wood chips for pulp, paper, turpentine, tall oil, bark, electricity and heat

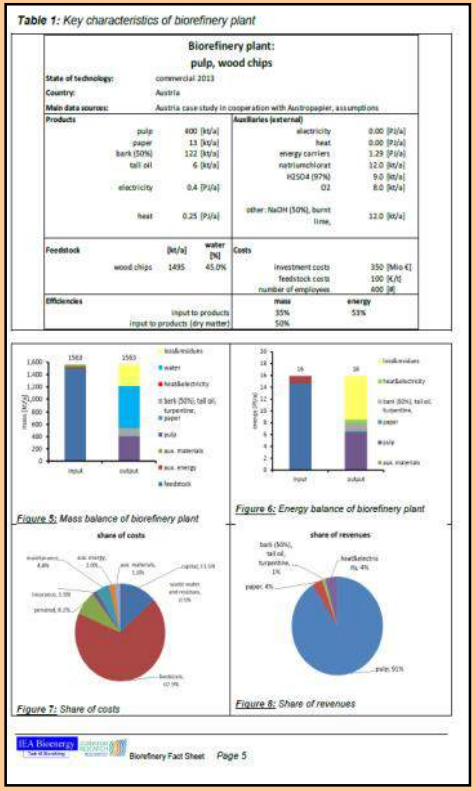


Table 1: Key characteristics of biorefinery plant

Biorefinery plant: pulp, wood chips

State of technology:	commercial 2013		
Country:	Austria		
Main data sources:	Austria case study in cooperation with Austropapier, assumptions		
Products		**Auxiliaries (external)**	
pulp	400 [kt/a]	electricity	0.00 [PJ/a]
paper	13 [kt/a]	heat	0.00 [PJ/a]
bark (50%)	122 [kt/a]	energy carriers	1.29 [PJ/a]
tall oil	6 [kt/a]	natriumchlorat	12.0 [kt/a]
electricity	0.4 [PJ/a]	H2SO4 (97%)	9.0 [kt/a]
		O2	8.0 [kt/a]
heat	0.25 [PJ/a]	other: NaOH (50%), burnt lime,	12.0 [kt/a]
Feedstock	[kt/a]	water [%]	**Costs**
wood chips	1495	45.0%	investment costs 350 [Mio €]
			feedstock costs 100 [€/t]
			number of employees 400 [#]
Efficiencies		mass	energy
input to products / input to products (dry matter)		35% / 50%	53%

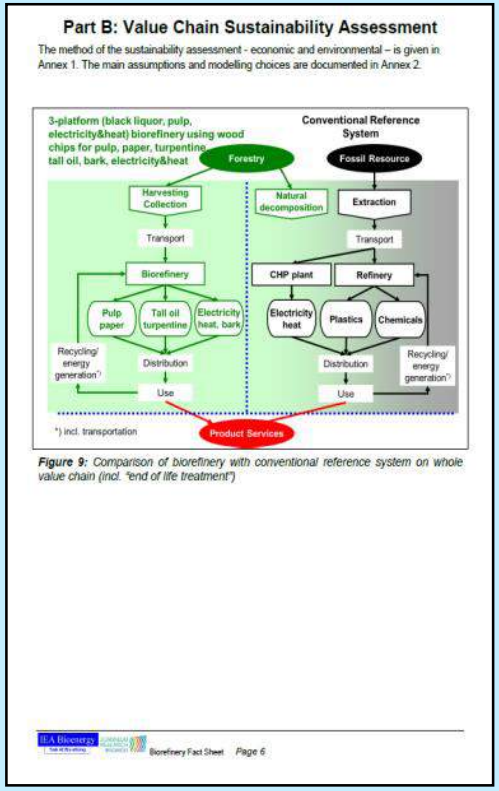
Figure 5: Mass balance of biorefinery plant

Figure 6: Energy balance of biorefinery plant

Figure 7: Share of costs

Figure 8: 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 modelling choices are documented in Annex 2.

Figure 9: Comparison of biorefinery with conventional reference system on whole value chain (incl. "end of life treatment")

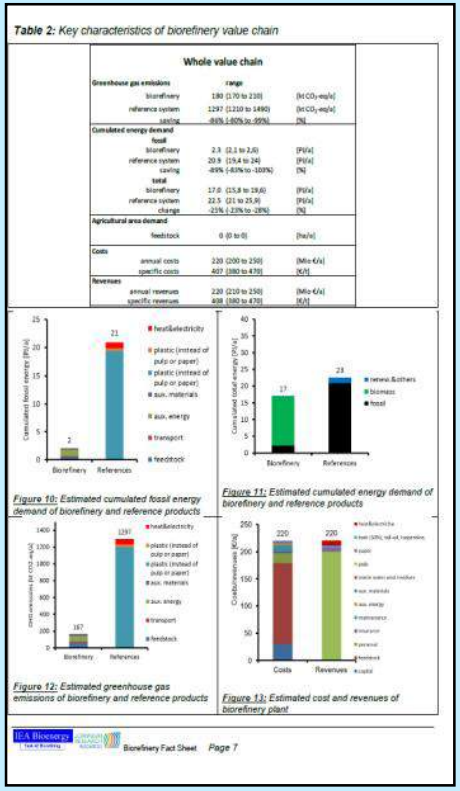


Table 2: Key characteristics of biorefinery value chain

Whole value chain

Greenhouse gas emissions	range	
biorefinery	180 (170 to 210)	[kt CO_2-eq/a]
reference system	1297 (1210 to 1490)	[kt CO_2-eq/a]
saving	-86% (-80% to -99%)	[%]
Cumulated energy demand		
fossil		
biorefinery	2.3 (2.1 to 2.6)	[PJ/a]
reference system	20.9 (19.4 to 24)	[PJ/a]
saving	-89% (-83% to -100%)	[%]
total		
biorefinery	17.0 (15.8 to 19.6)	[PJ/a]
reference system	22.5 (21 to 25.9)	[PJ/a]
change	-21% (-23% to -28%)	[%]
Agricultural area demand		
feedstock	0 (0 to 0)	[ha/a]
Costs		
annual costs	220 (200 to 250)	[Mio €/a]
specific costs	407 (380 to 470)	[€/t]
Revenues		
annual revenues	220 (210 to 250)	[Mio €/a]
specific revenues	408 (380 to 470)	[€/t]

Figure 10: Estimated cumulated fossil energy demand of biorefinery and reference products

Figure 11: Estimated cumulated energy demand of biorefinery and reference products

Figure 12: Estimated greenhouse gas emissions of biorefinery and reference products

Figure 13: Estimated cost and revenues of biorefinery plant

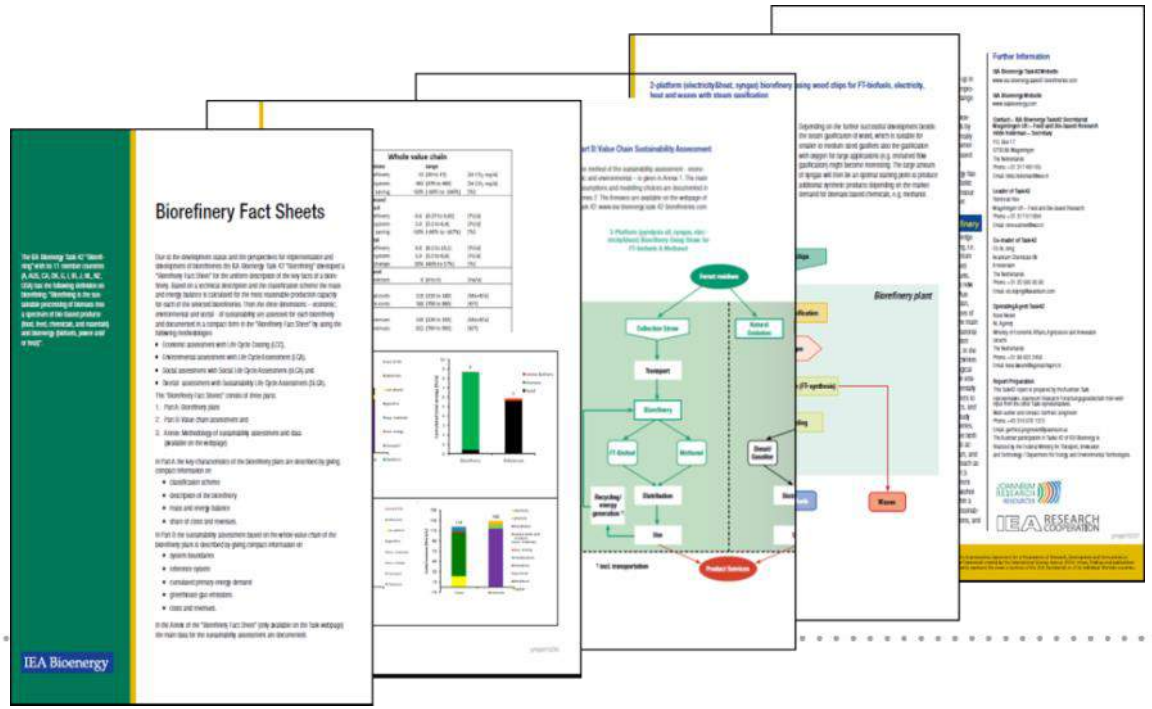
Annex:

Methodology of sustainability assessment and data with references

Biorefinery Fact Sheets are available

- 5 Glossy Fact Sheets
- 15 online on webpage
- incl. 2 Austrian Cases
  - Biorefinery Pöls AG (Steiermark)
  - Biorefinery BioCRACK (Schwechat)
- 5 non public
- 7 in progress (e.g. biogas, pyrolysis, protein, rubber dandelion, algae..)

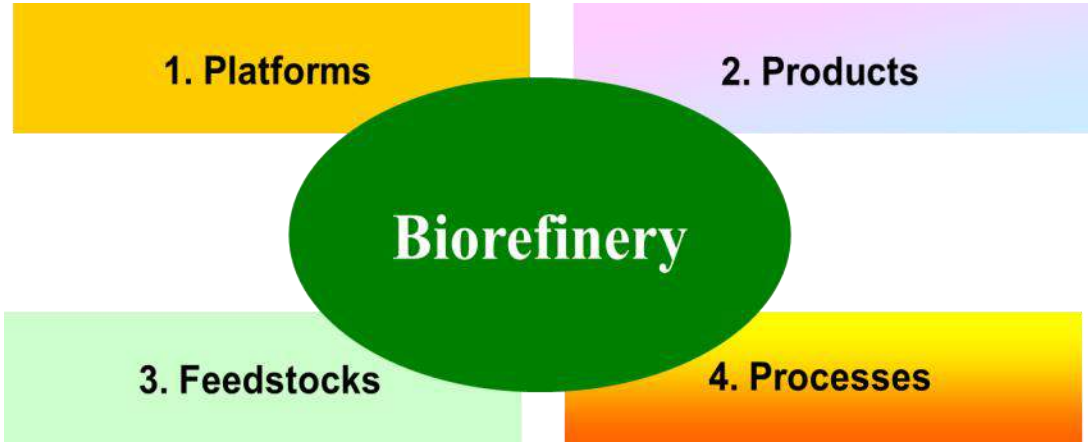
All sheets are made with the **„Biorefinery Fact Sheet Calculator (V 2.1)“** developed and owned by JOANNEUM RESEARCH



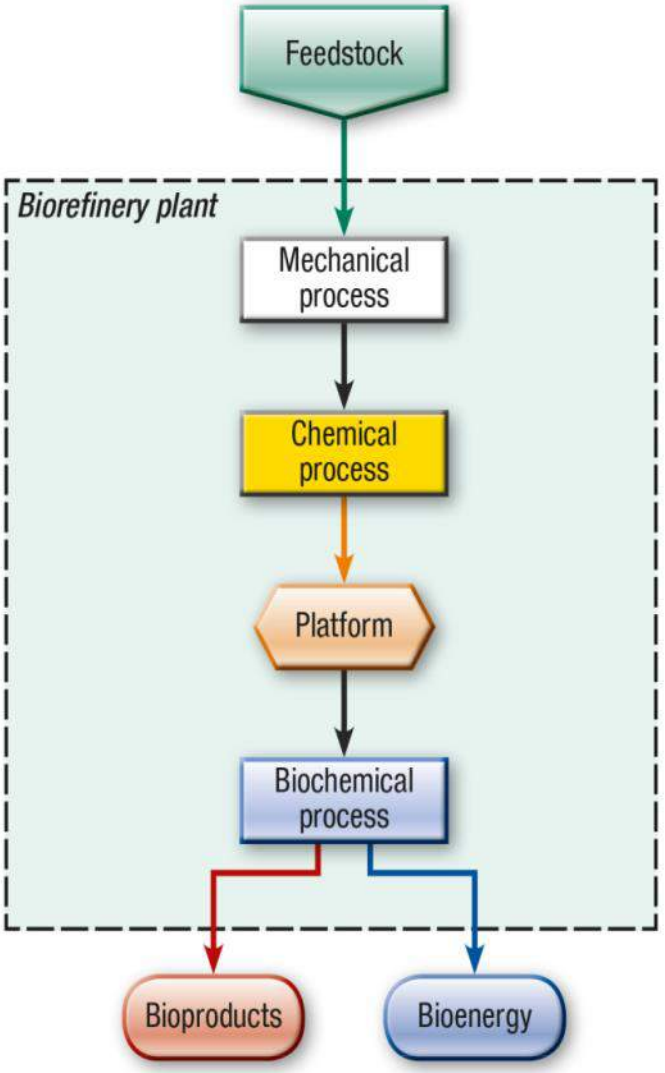
The Classification System of Biorefineries

Developed in Austria and now used in IEA Bioenergy Task 42

The 4 Features to Characterise A Biorefinery Systems



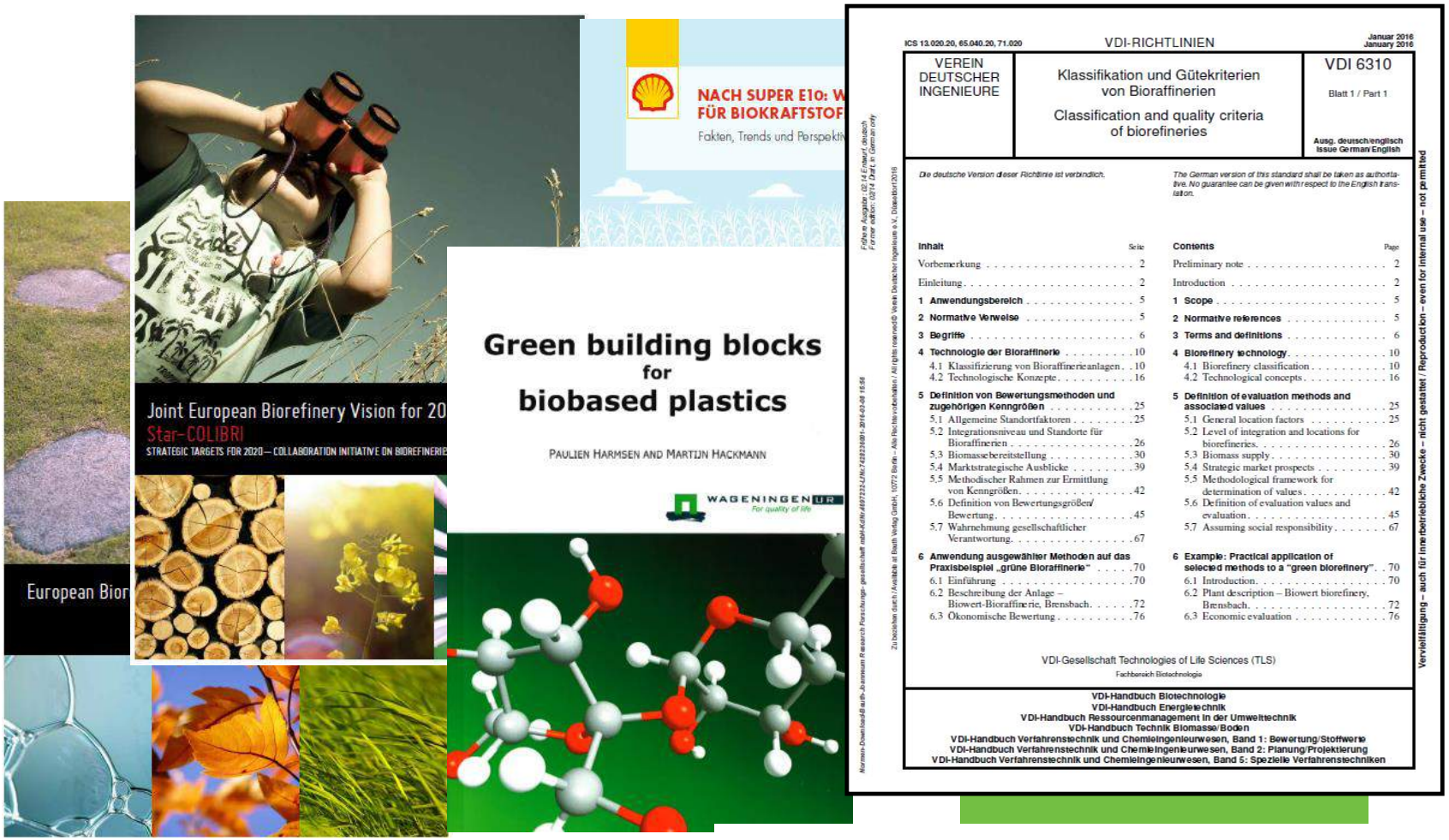
Generic system



Naming:

- *Principle: Number platforms (Name of platforms)/Feedstock/Products/Processes*
- *example: „2-platform (electricity&heat, syngas) biorefinery/wood chips/FT-biofuels, electricity, heat, waxes/steam gasification"*

Classification System is used…



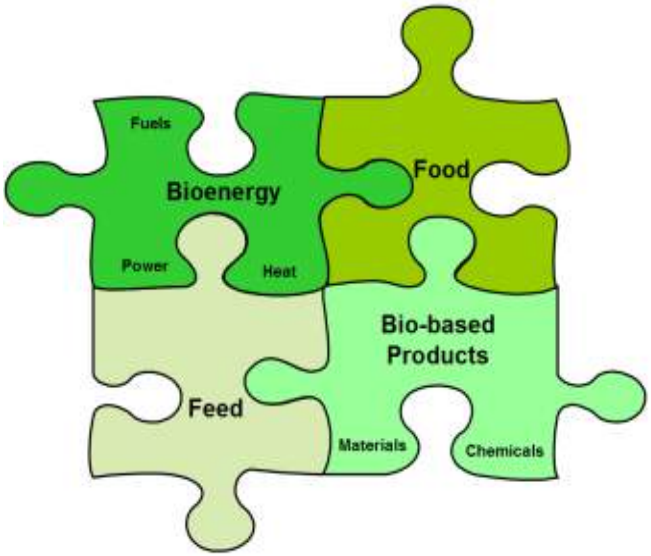
VDI 6310 Jänner 2016: „Klassifikation und Gütekriterien von Bioraffinerien“

The New Way in BioEconomy: From Competition to Integration

IEA Bioenergy Task42 Biorefining

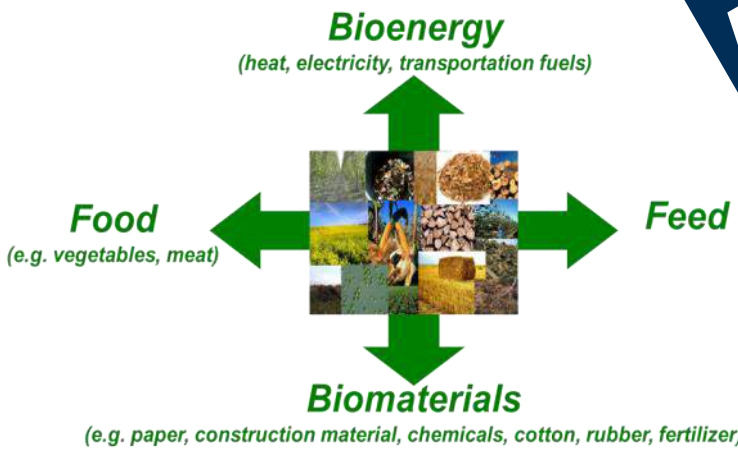
JOANNEUM RESEARCH LIFE

Integration

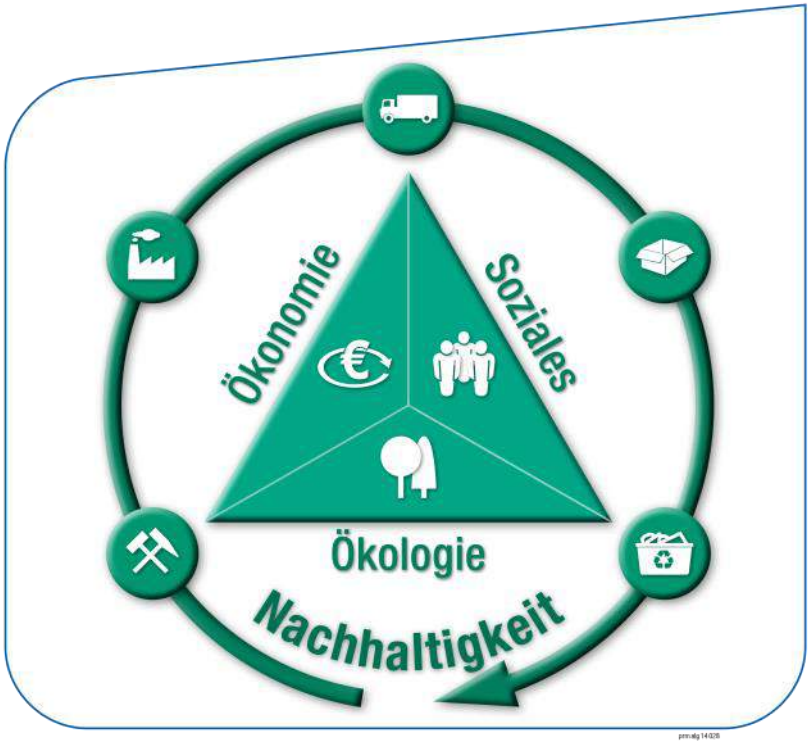


Towards BioEconomy

Competition



Your Contact



JOANNEUM RESEARCH Forschungsgesellschaft mbH

LIFE – Centre for Climate, Energy and Society

DI Dr. Gerfried Jungmeier

Elisabethstraße 18, 8010 Graz

+43 316 876-1313

gerfried.jungmeier@joanneum.at

www.joanneum.at

LIFE – Zentrum für Klima, Energie und Gesellschaft

LIFE – Zentrum für Klima, Energie und Gesellschaft

- Entwicklung wirtschaftlicher **Chancen** aus dem Klimawandel
  - **Low Carbon Society** – Entwicklung und Übergang zu einer kohlenstoffarmen Wirtschaft / Gesellschaft bis 2050
  - Stärkung der **Resilienz** gegenüber Klima- und Wetterrisiken
  - **Erneuerbare Energieversorgung**
  - **Zukunftsfähige Lebensstile**
- Etablierung eines **europäischen interdisziplinären Forschungszentrum**
- Wissenschaftliche Exzellenz in **drei Forschungsgruppen**
  - Wetter- und Klimarisiko-Management
  - **Zukunftsfähige Energiesystem und Lebensstile**
  - Internationale Klimapolitik und -ökonomie

Die VIER Einflüsse der Treibhausgas-Emissionen

Zukunftsfähiges Energiesystem

Lebensstile

$$tCO_{2Äq} = \frac{t_{CO2Äq}}{GJ_{Energie}} * \frac{GJ_{Energie}}{DL} * \frac{DL}{P} * P$$

1) Emissions-faktor (z.B. erneuerbare Energie)

2) Energie-effizienz

3) Dienst-leistungen (DL) pro Person

4) Anzahl der Personen

Quelle: nach “IPAT-Formel” von A. und P. Ehrlich

Zukunftsfähige Energiesysteme und Lebensstile