Integrating food security aspects in biomass sustainability standards and certifications through rights-based criteria

Tina Beuchelt[1], Anna Mohr[1], Rafaël Schneider[2], Detlef Virchow[1]

[1] Center for Development Research (ZEF), University of Bonn, Germany

[2] Welthungerhilfe, Bonn, Germany

Background

- International biomass demand and trade is growing. Governments shift from petroleum-based to bio-based economies.
- While bioeconomy strategies highlight food security over other biomass uses, there is little implementation action.
- The increased use of biomass for non-food purposes requires regulations that guarantee food security and the realization of the Human Right to adequate Food (RtaF).
- Environmental and social standards exist for biomass production yet food security aspects are hardly addressed and practical indicators & verifiers lack.

Objectives

(i) To identify a practical conceptual framework for the choice and definition of criteria to integrate the RtaF in existing biomass certification schemes.

(ii) To develop a best-practice set of rights-based food security criteria for biomass sustainability standards and certifications.

Activities

- Comprehensive literature and standards review
- Several stakeholder workshops
- Expert interviews with certification bodies, NGOs, scientists, ministries & enterprises, FAO and WFP
- Normative values based on the RtaF

Figure 1: Conceptual framework indicating the relevant elements for the progressive realization of food security and the RtaF when trading biomass

Food stability	Food availability	Food access	Food utilization	Cross-cutting elements
Local determinants and relevant RtaF guidelines				
Weather variability (RtaF-G. 16)	Production *(domestic production, import, food aid) (RtaF-G. 8B)*	Transport and markets (infrastructure, functioning markets, access to markets) (RtaF-G. 2,4, 8F)	Preparation (RtaF-G. 10,11)	PANTHER: participation, accountability, non-discrimination, transparency, human dignity, empowerment, rule of law (RtaF-G. 1,6, 19)
Price fluctuations (RtaF-G. 4)	Storage/Food Stocks	Income (employment, fair wage, safety net) (RtaF-G. 8A, 14)	Knowledge, Culture, Gender (RtaF-G. 11, 10)	Education (RtaF-G. 11)
Political factors (RtaF-G. 1)	Processing	Intra-household distribution of food (RtaF-G. 10)	Health / hygiene & Sanitation, child care (RtaF-G. 10,8C)	Women rights & gender equity (RtaF-G. 8, 8B, and others)
Economic factors (RtaF-G. 3,4)		Poverty & purchasing power (RtaF-G. 2, 8, 8A)	Access to clean water & Energy (RtaF-G. 8C)	Occupational health and safety (additional) (RtaF-G. 10,8C)
Economic Sustainability of investment (Business plan) (RtaF-G. 2) (additional)		Fair prices for smallholder/ outgrower (RtaF-G. 8A) (additional)	Food quality, adequacy/diversity (RtaF-G. 10); Food safety (RtaF-G. 9)	
National determinants (to be determined ex-ante)				
GUIDELINE 5 Institutions	resources for food and agriculture	GUIDELINE 13 Support for vulnerable groups	GUIDELINE 18 National human rights institutions	
GUIDELINE 7 Legal framework	GUIDELINE 12 National financial resources	GUIDELINE 17 Monitoring, indicators and benchmarks		**GUIDELINE 15 International food aid not included**

Results

- A conceptual framework combining the four dimensions of food security (access, availability, utilization, stability) with the "Voluntary Guidelines to support the progressive realization of the RtaF in the context of national food security" of the FAO to select relevant criteria and indicators (Figure 1)
- A best-practice set to integrate the RtaF in certified biomass production and trade complementing existing sustainability certification schemes
- A set of 17 themes and 45 criteria and verifiers reflecting all dimensions of food security and the RtaF (Figure 2)
- Relevant criteria for biomass producers and processors for all types of biomass and uses (e.g. feed, fibre, energy)
- A common set and some specific criteria distinguishing small and large farms/processors
- Minimum and development requirements which are adjustable to local contexts, reliable and verifiable

Figure 2: Examples of the developed „Rights-based food security criteria set"

Criteria of the rights-based food security principle			Explanation	Verified by
Stability	**1**	**Democracy, good governance, human rights and the rule of law (RtaF-G. 1)**		
	1.1	The operator must demonstrate compliance with all applicable national, regional and local laws and regulations.	For family farmers special adaption periods can be implemented according the national regulatory context.	Documents of due diligence process, self-declaration on laws, operating license, company registration
	1.2	The operator holds a written policy committing to the "Guiding Principles on Business and Human Rights" in all operations and transactions. The implementation of the policy must be documented and communicated to all levels of the workforce and operations.	Not applicable for family farmers. This must be available in all languages of the employed workers and signed. Implementation must be part of the job description of management personnel.	Documents, workers interviews without management (spontaneous in the fields), document of trainings
	2	**Strategies (RtaF-G. 3)**		
	2.1	The operator endorses existing national strategies with regard to food security and does not contradict them by any of its business activities.	Strategies: national food security strategies, poverty reduction strategies (PRSP), national development programmes, Local land use plans and climate mitigation and adaptation strategies. Not applicable for family farmers	Written reference to the strategies, maps, documents

Lessons-learned and recommendations

- Integration of the rights-based food security criteria in all sustainable biomass production standards for traded biomass possible
- Integration in national standards and for EU-RED possible
- Scientific-monitored field testing of the criteria to ensure practicability & acceptability still needed
- For the first decade, additional local monitoring of food security effects of certified production still needed
- Global monitoring of food security trade-offs related to non-food biomass use always necessary
- Awareness creation & political pressure needed to increase use and adoption

www.zef.org

Contact: Dr. Tina Beuchelt
Center for Development Research (ZEF)
University of Bonn, Walter-Flex-Str. 3, 53113 Bonn, Germany
Phone: +49 228 73 1847
beuchelt@uni-bonn.de

Zentrum für Entwicklungsforschung
Center for Development Research
Universität Bonn

welt hunger hilfe

Gefördert durch:
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages

FNR Fachagentur Nachwachsende Rohstoffe e.V.

Förderkennzeichen: 22013714

BiomassWeb

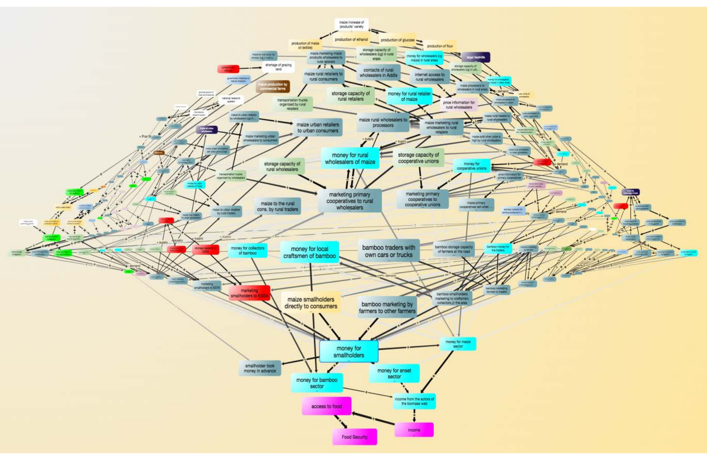
Improving food security in Africa through increased system productivity of biomass-based value webs

Manfred Denich[1], Tina Beuchelt[1], Arnim Kuhn[2], Christine B. Schmitt[1], Jelana Vajen[1]

[1]) Center for Development Research - ZEF, University of Bonn, Germany
[2]) Institute for Food and Resource Economics – ILR, University of Bonn, Germany


Participatory research & stakeholder inclusion training


Stakeholder workshops for system modelling of biomass-based value webs


From value chains to a value web in Ethiopia


Establishing farmer-managed field trials


Mechanical pressing of cassava leaves

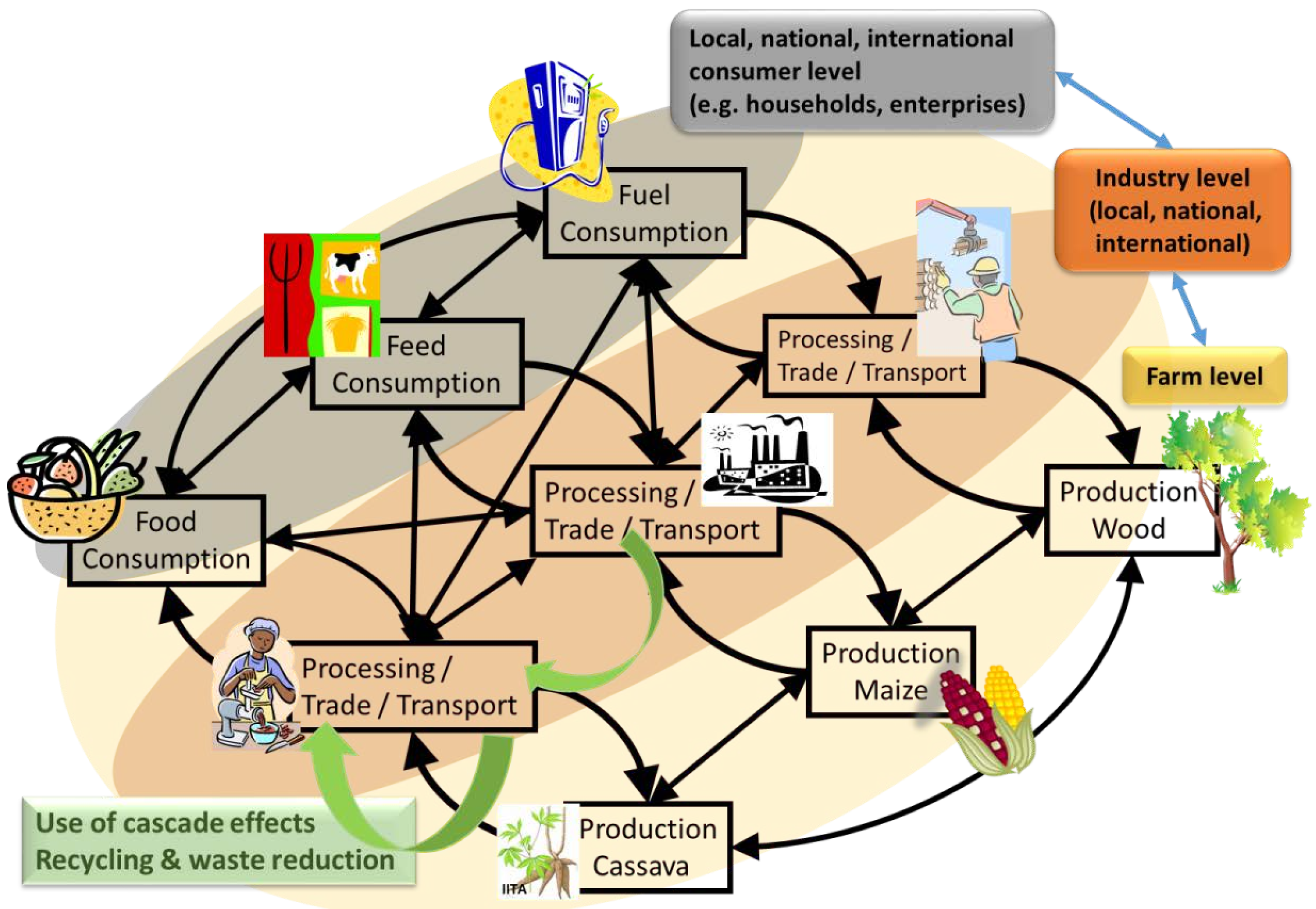
Thermochemical conversion of maize residues

Background

- Rising global demand for food and non-food biomass transforms agriculture from a food to a biomass-supplying sector.
- Concepts to ensure food security while attending growing demands for non-food biomass are still few.
- BiomassWeb is part of "Securing the Global Food Supply" (GlobE)", an initiative in the context of the German National Research Strategy BioEconomy 2030.
- The geographical focus of BiomassWeb is on Ghana, Nigeria and Ethiopia.

Objective

- BiomassWeb aims at **increasing the availability and access to food** in Sub-Saharan Africa through producing, processing and distributing of biomass for food and non-food purposes.
- This will be achieved through **research-based concepts for establishing efficient and effective value webs.**
- BiomassWeb **contributes to preparing Africa's bioeconomy for the growing global biomass demand.**



Value webs are complex systems of interlinked value chains in which biomass is produced, processed and traded: Interactions in a biomass-based value web.

Activities

- BiomassWeb research **identifies potential productivity and efficiency gains** in the biomass-producing, processing and trading system through increased integration of all value-web components.
- Based on participatory system studies, **selected value webs are analyzed**, including the value chains of maize, cassava, plantain, enset and bamboo.
- Additionally, BiomassWeb **comprises a portfolio of exemplary studies** such as land-use planning, intensification of biomass production, post-harvest production technologies, institutional settings and governance structures.
- BiomassWeb **integrates experts for transition management** to facilitate the adoption of innovations.
- **BiomassNet - a multi-stakeholder platform** for biomass-related discussions and activities will be established to build a pan-African network of scientists, experts and other actors in Sub-Saharan Africa.

Lessons learned and recommendations (preliminary)

- **Capacity development**, especially at academic levels, is essential and plays a leading part in BiomassWeb.
- **Investments** in start-up activities are important to generate biomass-based jobs and income, thus ensuring food security in rural and urban areas of Sub-Saharan Africa.
- Strengthening the African biomass sector will need the **political commitment of governments** as well as **international support**.

Zentrum für Entwicklungsforschung Center for Development Research Universität Bonn · University of Hohenheim · FSC Food Security Center · FARA · IITA · icipe · ECOFF · Horn of Africa Regional Environment Centre and Network · Jülich Forschungszentrum · ILR · ISSER · INRES · INBAR · CONSIDEO · University of Cape Coast · ETC · WASCAL West African Science Service Center on Climate Change and Adapted Land Use

www.biomassweb.org

Contact: BiomassWeb Project Office
Center for Development Research (ZEF), University of Bonn
Walter-Flex-Str. 3; D - 53113 Bonn
Phone: +49 228 73 4972
Email: biomassweb@uni-bonn.de

SPONSORED BY THE

Federal Ministry of Education and Research

Federal Ministry for Economic Cooperation and Development

Lignocellulose Baden-Württemberg

BIOECONOMY RESEARCH
BADEN-WÜRTTEMBERG

Coordination: Prof. Dr. Nicolaus Dahmen, Dr.-Ing. Daniel Forchheim
www.bioeconomy-research-bw.de

Background and Objectives

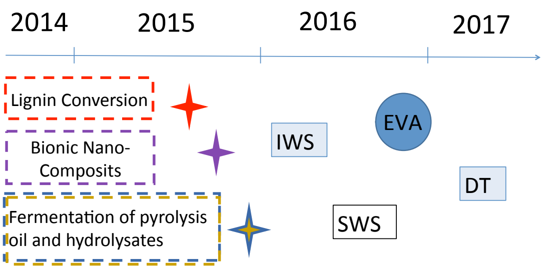
The bioeconomy Baden Württemberg program comprises among others a research network for lignocellulose. The lignocellulose network connects 23 research teams and is divided into four value chains, which are

- Upgrading of lignin,
- Fermentation of lignocellulosic hydrolysates,
- Fermentation of pyrolysis products and
- Lignocellulosic NanocompoSit materials.

Activity

The research projects along these value chains include biomass production, separation technologies and biomass conversion. Furthermore the network comprises projects which address the agricultural, forestall, economic and societal evaluation of new technologies and products.

- Networking and identification of intersection points for the exchange of information, data and material
- Product development and strategy for implementation on industrial scale
- Economic and Ecologic Evaluation of value-chains



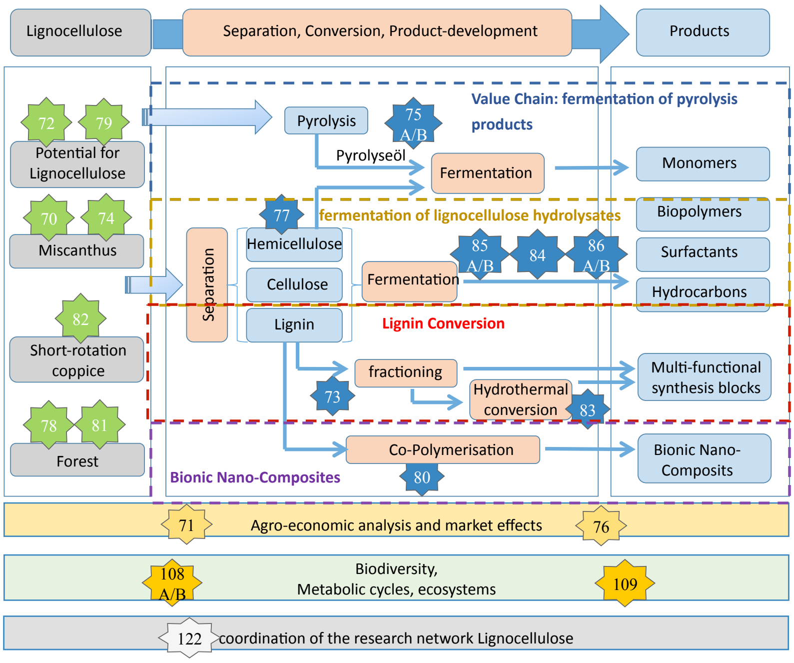
Product-clinic

IWS Including industry partners

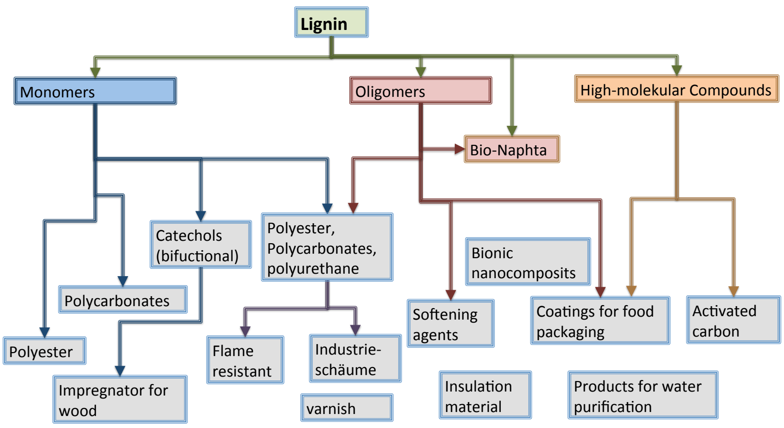
SWS Including stakeholders from society

DT Design-Thinking-Workshop

EVA Project Evaluation



Result from Product Clinic



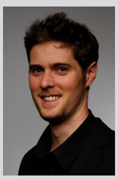
Lessons learned

Efficient networking needs spaces that facilitate the personal contact in small groups of 4 to 10 people. These spaces could be realised best in the product clinics. Also Open-Space workshops for meetings of all 40 to 50 researchers within the lignocellulosic network gave good results for information and data transfer. The main task for the coordination and organisation of these spaces is a clever definition of goals and formulating key questions.

Partners

- Fraunhofer ICT
- Universität Stuttgart
- Universität Hohenheim
- Universität Ulm
- Universität Freiburg
- Karlsruher Institut für Technologie (KIT)
- Bio-Pro Baden Württemberg
- Universität Heidelberg
- Hochschule für Forstwirtschaft Rottenburg
- FVA Forstliche Versuchs- und Forschungsanstalt Baden Württemberg

Contact:
Dr.-Ing. Daniel Forchheim
Institute for Catalysis Research and -Technology
Karlsruhe Institute of Technology (KIT)
Hermann-von-Helmholtz-Platz 1,
76344 Eggenstein-Leopoldshafen
daniel.forchheim@kit.edu
www.bioeconomy-research-bw.de



funded by
Baden-Württemberg
MINISTERIUM FÜR WISSENSCHAFT, FORSCHUNG UND KUNST

Fibre crops as bio-refinery sources: potentials and challenges

Hans-Jörg Gusovius, Ralf Pecenka, Jörn Budde, Carsten Lühr and Thomas Hoffmann

Leibniz Institute for Agricultural Engineering Potsdam-Bornim e.V. (ATB)

BACKGROUND & OBJECTIVES

Sustainable and bio-based concepts are increasingly requested within the course of bioeconomy development. Meanwhile natural fibres and materials thereof are indispensable in this context (Fig. 1) .

Growing of plants like fibre hemp, nettle or oilseed flax as well as wood, their processing and further application represent examples of sustainable economy due to favourable integration in crop rotations, development of rural based employment as well as coupled and cascade utilization of numerous products for food, feed, materials and energy.

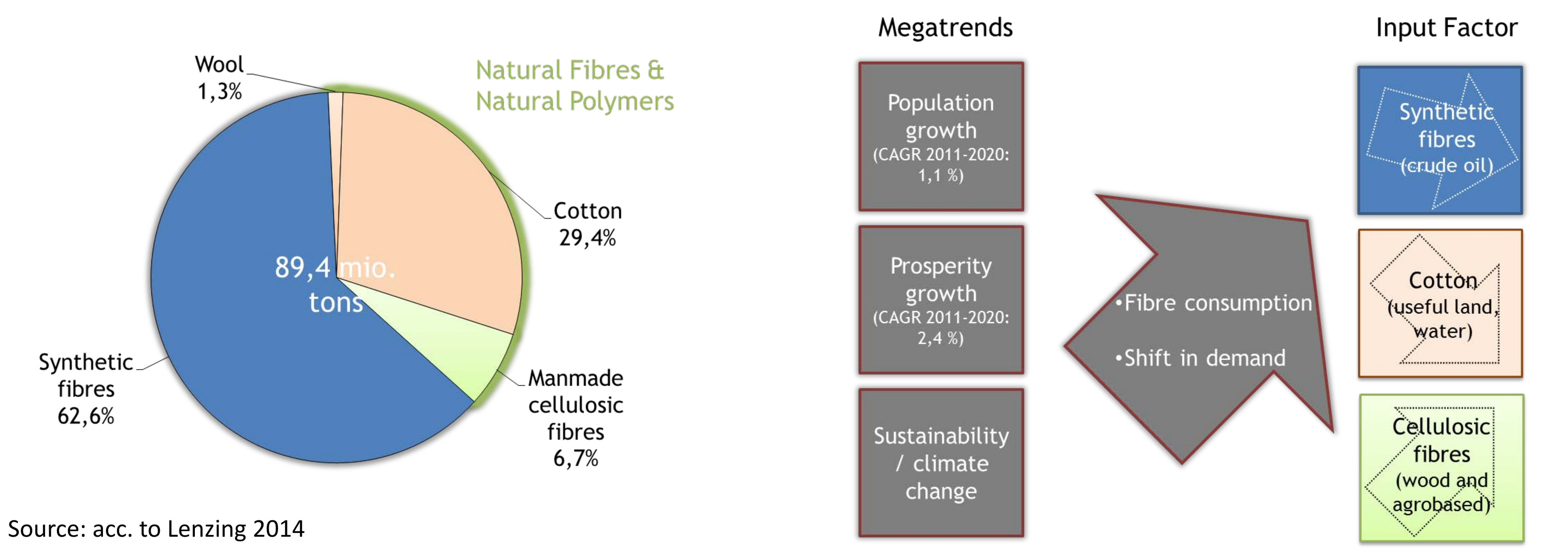


Figure 1 Global fibre production 2014 and expected structural change in fibre demand

Few of the most important prerequisites for a successful integration in industrial value added chains are the economic competiveness and the quality of raw materials and intermediates.

In regard to the supply of agricultural fibrous raw materials it has to be stated that technological improvements in harvesting, post harvesting and processing procedures still imply huge potentials to fulfil this requirements. At present, the technological status of natural fibre supply chains results in high investment and procedure costs. Most of existing processing lines are not operating reliable and are targeted on only few traditional products.

ACTIVITIES

A multitude of technological developments was and is carried out by scientists and technicians of the department of post harvesting as well as biotechnology at the Leibniz Institute for Agricultural Engineering to improve the given situation.

A new technology system for the processing of bast fibre crop straw integrating innovative modes of action for selected process steps like decortication (e.g. Fig. 2, pos. 4) was developed and investigated. Subsequently the pilot scaled test equipment was transferred to industrial activities and represent nowadays one the few available multipurpose processing plants for bast fibre crops. Linen, oilseed flax, industrial hemp, fibre nettle or even tropical crops like kenaf can be upvalued to technical or textile fibre qualities. Specific progress was achieved with a patented technology to enable a considerable improvement of value added from the woody core (shive) of fibre crops (Fig. 2, pos. 8).

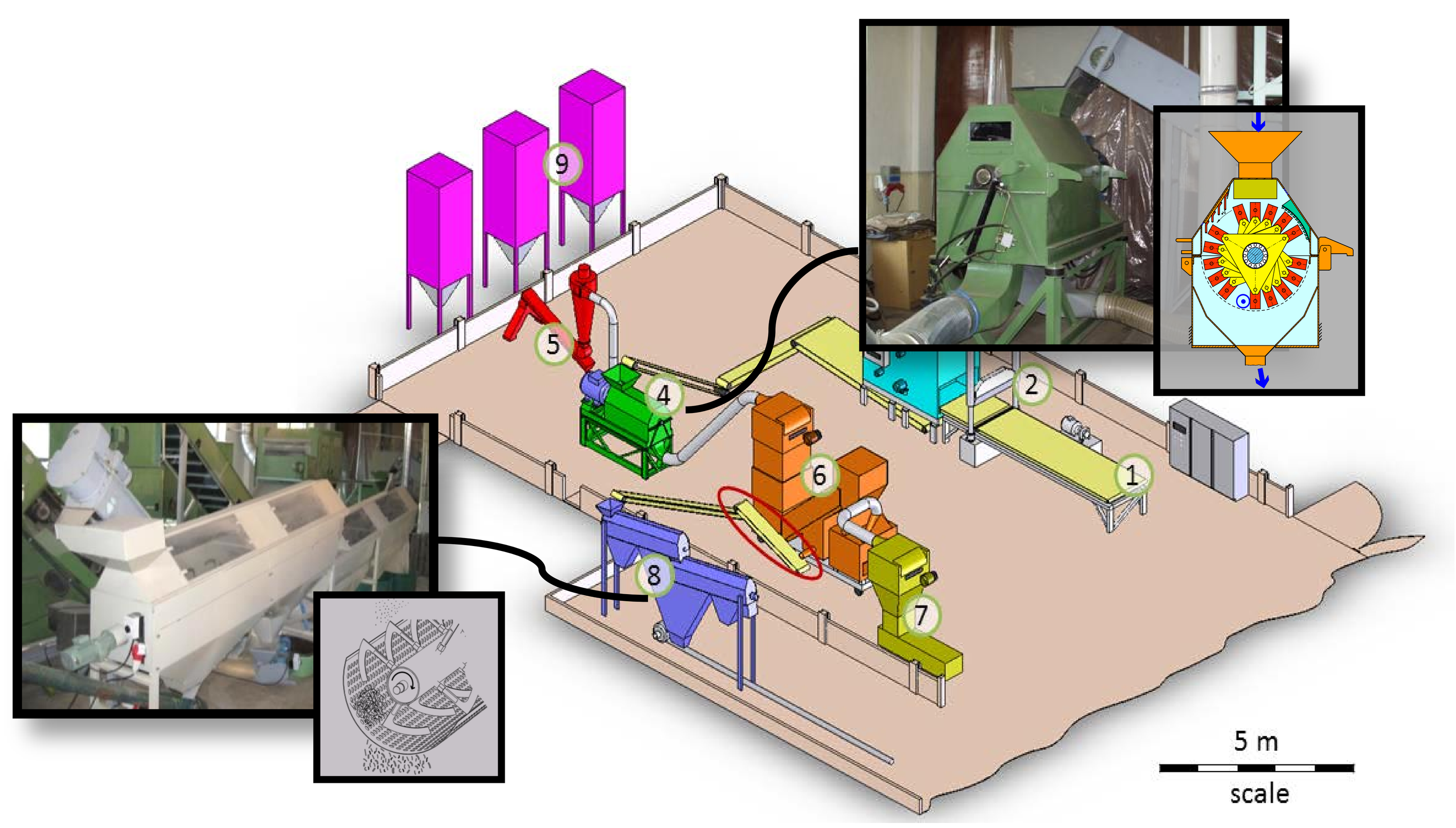


Figure 2. Scheme of an industrial fibre decortication plant
1) straw bale input; 2) straw bale cutting; 3) straw preparation; 4) decortication; 5) de-dusting; 6) fibre cleaning/opening; 7) fibre packaging; 8) shive cleaning; 9) filter system

At present a complete new and innovative supply and processing procedure for wet preserved fibre crops is under investigation at the ATB. Main focuses of research activities are the simplification of the supply steps in agriculture (harvesting and storage), the preferable integrated processing of the whole crop material into high value composites (Fig. 4) as well the utilization of so far unused components of the plant (e.g. leaves, flowers, sap). A unique pilot scaled processing line is available at ATB to carry out fundamental as well applied research on semi-industrial scale (Fig. 3).

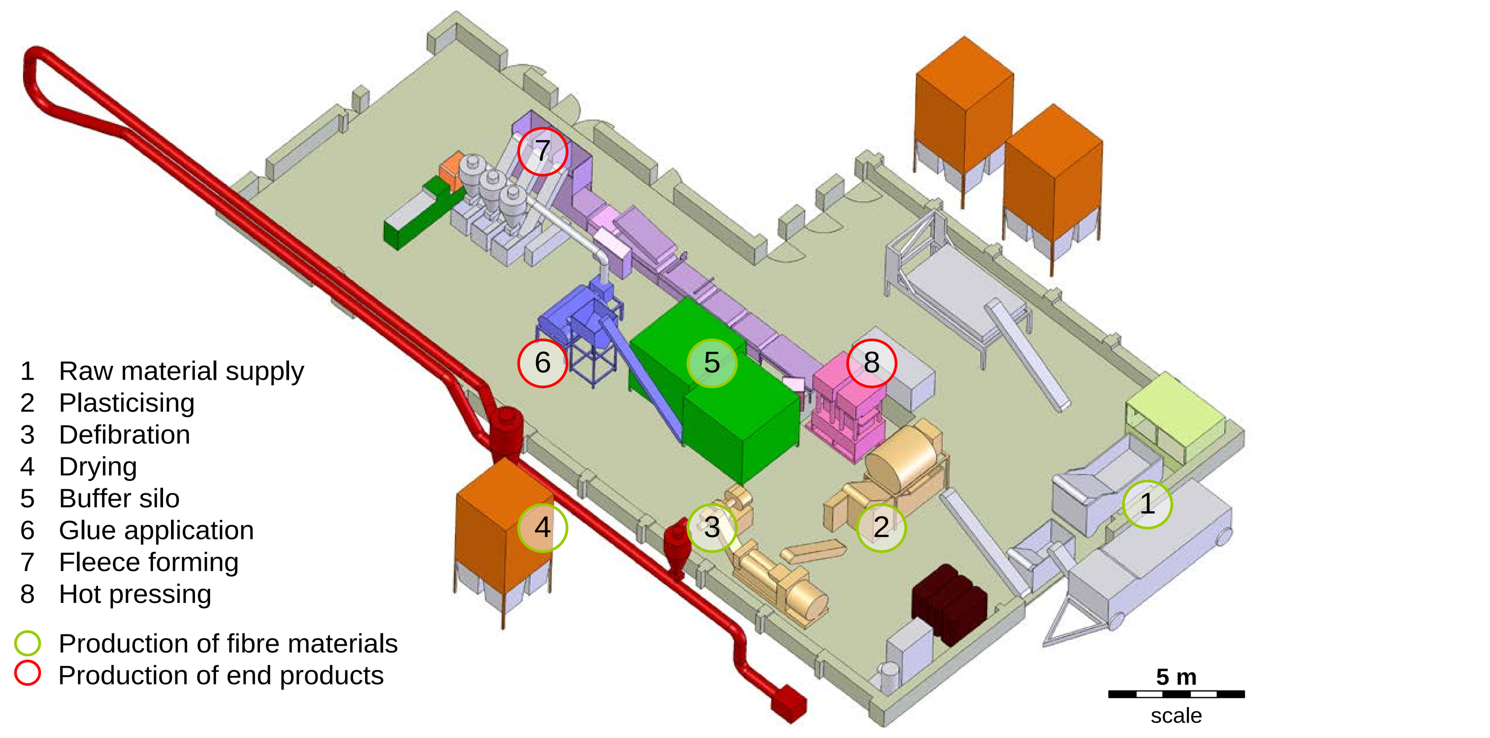


Figure 3 ATB-pilot plant for r&d on processing of wet preserved fibre crops at ATB

RESULTS

Value added from bast fibre crops can substantially be improved by means of the new technological developments for their supply and processing. Solutions are provided to match quality as well price demands from industrial applications.

The processing system for dry fibre crop straw (Fig. 2) is realized in industrial practice in Germany and Canada.

the investigations in regard to the innovative supply system for wet preserved fibre crops (Fig. 3) are continued based on selected results (Fig. 4) and focusses e.g. as part of national and European r&d projects.

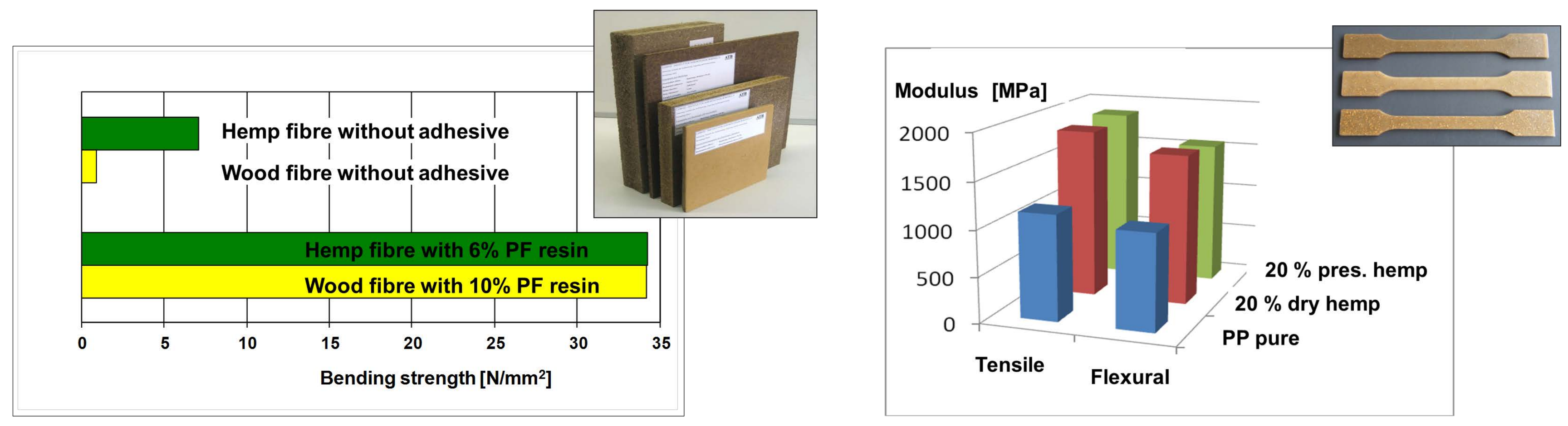


Figure 4 Selected results from the processing of wet preserved hemp into fibre boards (left) and reinforced composites (right)

Related patents granted

EP 1668175 (2005): Verfahren zur Aufbereitung von Naturfaserpflanzen

DE 19918166 (2006): Vorrichtung zur Gewinnung von Kurzfasern

DE 19756046 (2008): Verf. zur Ernte, Konservierung, Aufbereitung und Verarbeitung von Hanf

EP 2145988 (2010): Axialfraktionierer

EP 2457714 (2012): Verf. zur Herstellung von Faserstoffen und daraus hergestellte Erzeugnisse

LESSONS-LEARNED & RECOMMENDATIONS

Remarkable improvements have to be carried in order to enable value added from farm and forest based raw materials. For the successful establishment of the bioeconomy development it is important to utilize natural resources to their optimal extent. Fibre crops and their tissue components represent such a resource with already naturally given specific characteristics. Due to the competition both between crops in crop rotations as well semi and final products in industrial applications it is important to improve the exploitation of their relative exquisiteness. Recently started research activities on the improved valorisation of e.g. the hemp panicle will assist this challenge.

REFERENCES & ACKNOWLEDGEMENTS

Lühr, C.; Pecenka, R.; Gusovius, H.(2015): Production of high quality hemp shives with a new cleaning systems. Agronomy Research. 13 (1): 130-140

Budde, J.; Gusovius, H.; Hoffmann, T.; Ola, D.(2014): New process chain for seed harvesting from special crops on the example hemp. In: Proceedings. International Conference of Agricultural Engineering AgEng 2014. Zürich, p. 1-5.

Hoffmann, T.; Pecenka, R.; Schemel, H.; Gusovius, H.(2013): Process-technological evaluation of harvesting hemp in winter. Journal of Natural Fibers. 10 (2): 159-175

Wallot, G.; Gusovius, H.; Pecenka, R.; Schierl, S.; Rinberg, R.; Nendel, W.(2012): Developments in the use of fibres from wet-preserved hemp for composite production. Agricultural Engineering International the CIGR Ejournal. 14 (1): 218-223

These activities are supported by the Federal Ministry of Food and Agriculture, the Federal Ministry for Economic Affairs and Energy as well as the European Commission

Leibniz-Gemeinschaft

UNIVERSITY OF COPENHAGEN

FACULTY OF SCIENCE

Can regional green protein sustain Europe's animal production?.

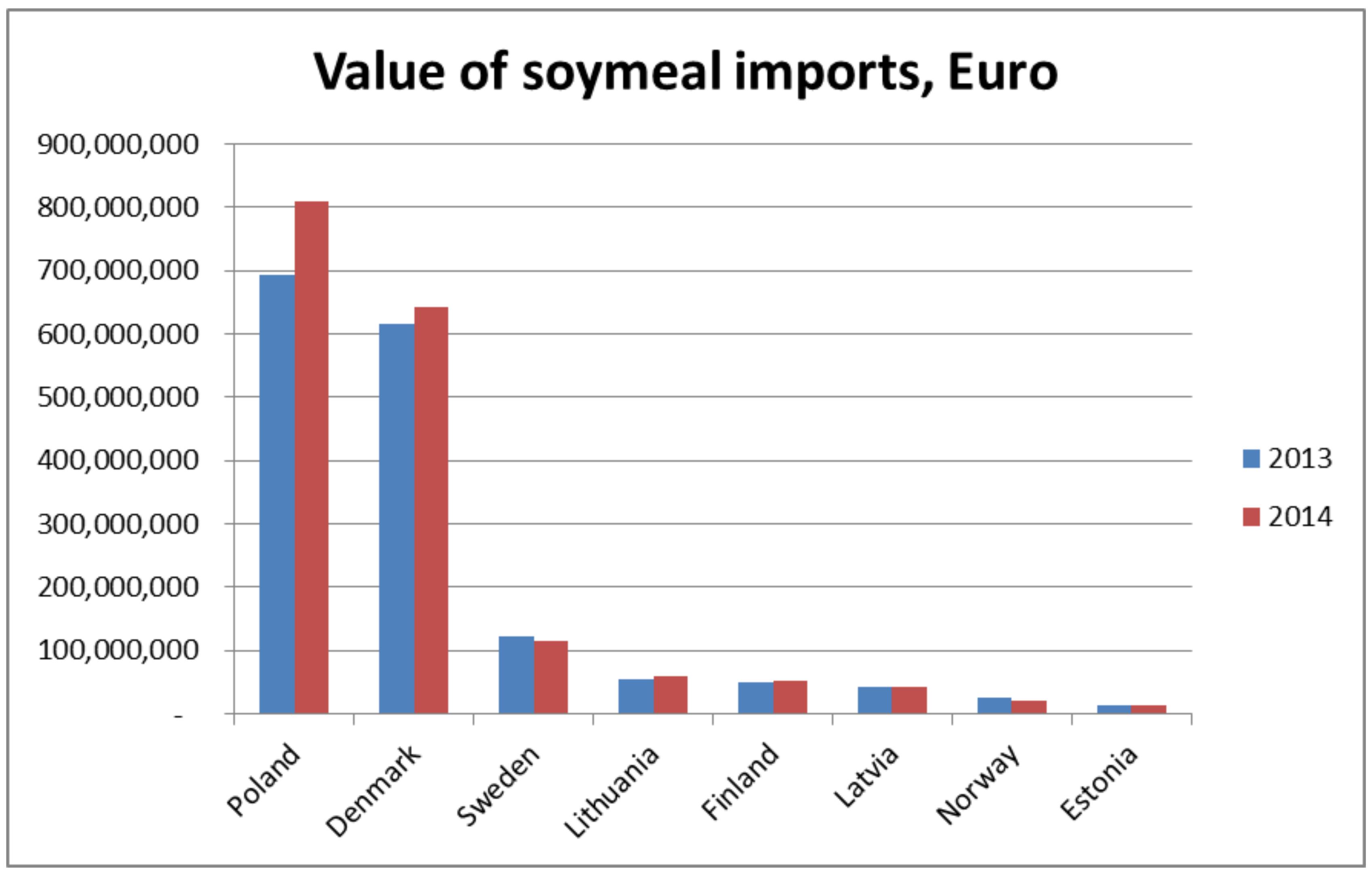
Morten Gylling, Senior Research Advisor
Department of Food and Resource Economics

Background & Objectives

- The BSR/Nordic Bioeconomy is an estimated 184,000 Mill.euro equal to 9% of the total economy and 7% of the employment (2012)
- A necessary basis to expand the bioeconomy is a sustainable supply of high quality biomass
- Results from the +10 miil. ton plan show that it is possible to expand the resource base for the Danish bioeconomy with an additional 10 million ton biomass for biorefining without compromising the existing food and feed production.
- The BSR/Nordic also have a large potential of sustainable biomass supply of high quality as agriculture and forestry constitutes close to 50% of the bioeconomy.

Regional proteins

Production of "green" grass based proteins has raised increased interest both as research projects (BIOVALUE) and as feasibility/case studies (BSR/Nordic sustainable protein production Initiative). The import of soymeal to the BSR/Nordic region has a market value of 180 Mill. €.



BIOVALUE – assessing socioeconomic issues

In the BIOVALUE project a number of Bioeconomy value chains are investigated, one of these is the green protein value chain

A platform for socio-economics, sustainability and ethics assessment has been established aiming to link results from biological/technical research into a production/value chain context.

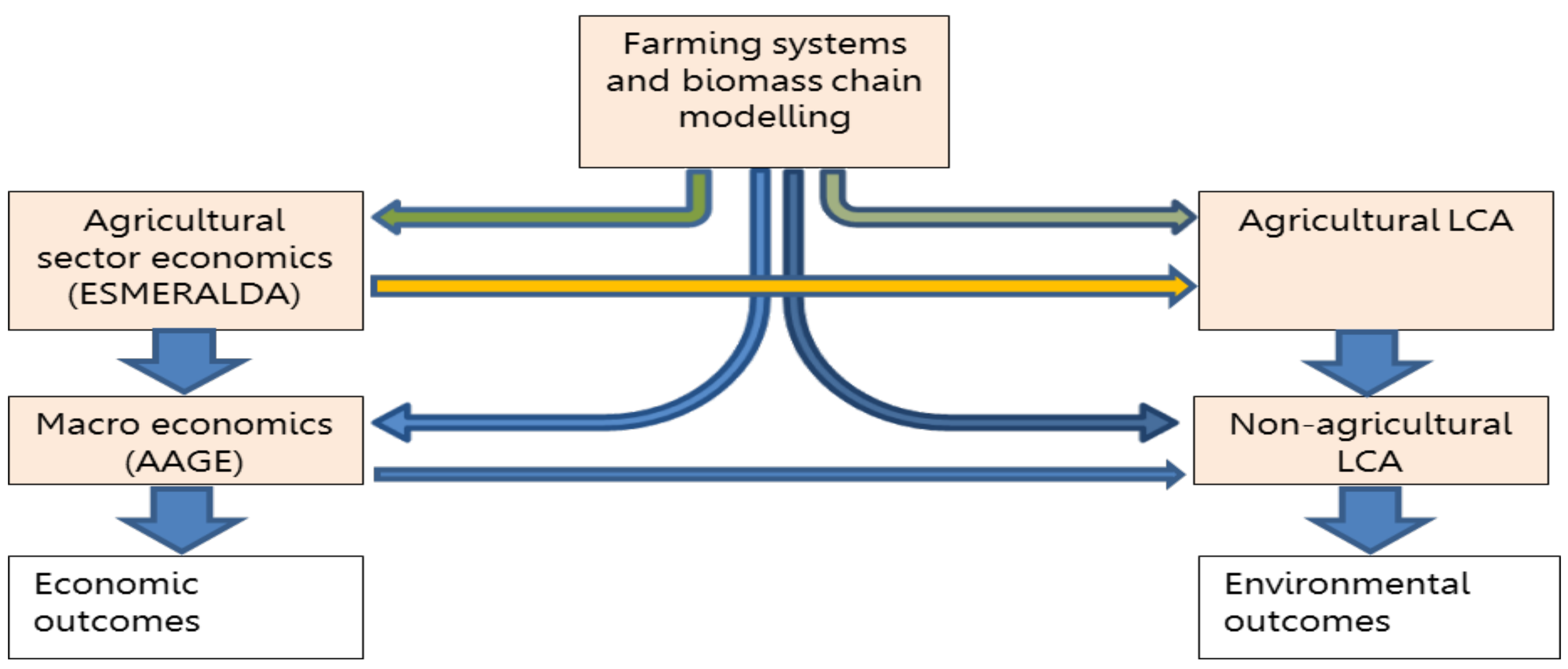
This linkage allows for an system-wide sustainability assessment of biomass production and biobased products.

The bioeconomic analyses are conducted at three levels of aggregation:

- Primary production/supply chain level.
- Agricultural sector (with a fairly detailed representation of agricultural biomass production and the interaction between different agricultural activities and farm types).
- National economy (with description of the interactions between agriculture, biorefineries and the rest of the economy).

with the largest possible consistency between the results from the three model tools.

.



Environmental impact assessment in a life cycle perspective is conducted across the whole value chains, splitting the chain in two sub-chains:

- Agricultural system
- Non-agricultural sub-chain

Results

Based on the first results from pilot scale production in BIOVALUE positive economic results are estimated both for a central and a decentral green grass based biorefinery.

Perennial grasses for protein biorefining have a number of environmental advantages compared to grain production.

The case/feasibility study study (BSR/Nordic sustainable protein production Initiative) showed that for the Baltic rim states there is:

- Sufficient available land to produce biomass for a green protein supply chain supporting the concentrated animal production in the area.
- Significant socio-economic potential of establishing a competitive protein production sector and associated increase in higher qualification jobs in rural areas.
- Positive environmental impact from positive indirect land use changes as well as direct consequences from better adapted crops to temperate climates.

Lessons-Learned & Recommendations

Developing grass based high quality protein will take a concerted action between all actors in the value chain.

Following a value chain approach, the Danish Bioeconomy Panel initiated an integrated assessment of opportunities of regionally produced protein, investigating technical feasibility, land availability, environmental impact, and socio economic potential.

Based on the assessment the Danish Bioeconomy panel put forward a number of recomendations to support the further development of green bioeconomy value chains.

References & Acknowledgements

Ambye-Jensen,M and Adamsen , A.P, (2015) : Green Biorefinery Feed Protein – feasibility study on scale of implementation. Presented at the International Conference on Renewable Resources & Biorefineries (*RRB-11*) in *York, June 2015*.

Gylling.M et.al. (2013): The + 10 million tonnes study

Gylling M: (2015) Nordic sustainable protein production – bioeconomy potentials in business and society. Unpublished

Det Nationale Bioøkonomipanels anbefalinger vedrørende nye værdikæder baseret på grøn biomasse. September 2015.

Termansen and Gylling (2015). Grøn Biomasse. DCA rapport nr. 068. September 2015

Thanks to the Bioeconomy Group at Department of Food and Resource economics

Thanks to the Danish Bioeconomy Panel

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

DBFZ

BioEconomy Cluster

Managing material flows in the bioeconomy

Alberto Bezama[1], Maik Budzinski[1,2], Arne Gröngröft[2], Jakob Hildebrandt[1], Stefan Majer[2], Franziska Müller-Langer[2], Roy Nitzsche[2], Anke Siebert[1], Daniela Thrän[1,2]

[1]Helmholtz Centre for Environmental Research - UFZ, Department of Bioenergy. Permoserstr. 15, 04318 Leipzig, Germany

[2]Deutsches Biomasseforschungszentrum gGmbH, Torgauer Straße 116, 04347 Leipzig, Germany

Objectives

In order to manage the material and energy flows within the BioEconomy Cluster, an accompanying research working group has been established to provide management tools and strategic concepts to maximise the value added as well as to assess the efficiency and sustainability of cascade use and coupled production options

In particular, this work shows the advances in the following methodological developments:

- A process design approach for biorefinery concepts, integrating economical and environmental optimization
- A social Life Cycle Assessment method for identifying hotspots and opportunities along regional supply chains
- An Indicator-based tool for monitoring the sustainability degree of selected bio-based product portfolios

Activities

Process Design

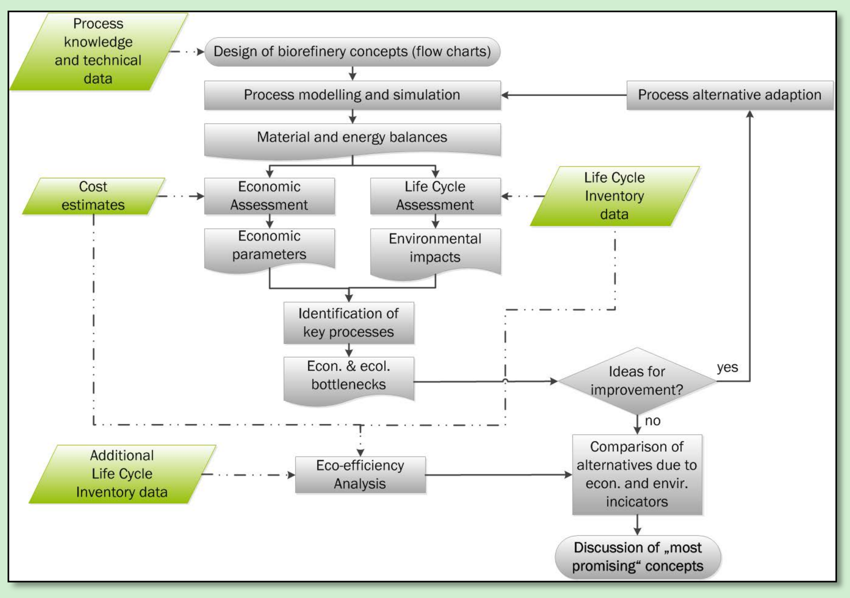


Figure 1: Approach for process design of biorefinery concepts

- Determination of material and energy balances of various biorefinery concepts
- Identification of economic and environmental optimization potential
- Eco-efficiency analysis to compare design alternatives regarding cost-effectiveness and the potential to reduce environmental impacts

Social Life Cycle Assessment

SLCA evaluates socio-economic effects of products on stakeholder along the life cycle stages through measuring organisations behaviour with social indicators and characterising the values with regional sector specific benchmarks (Fig.3)

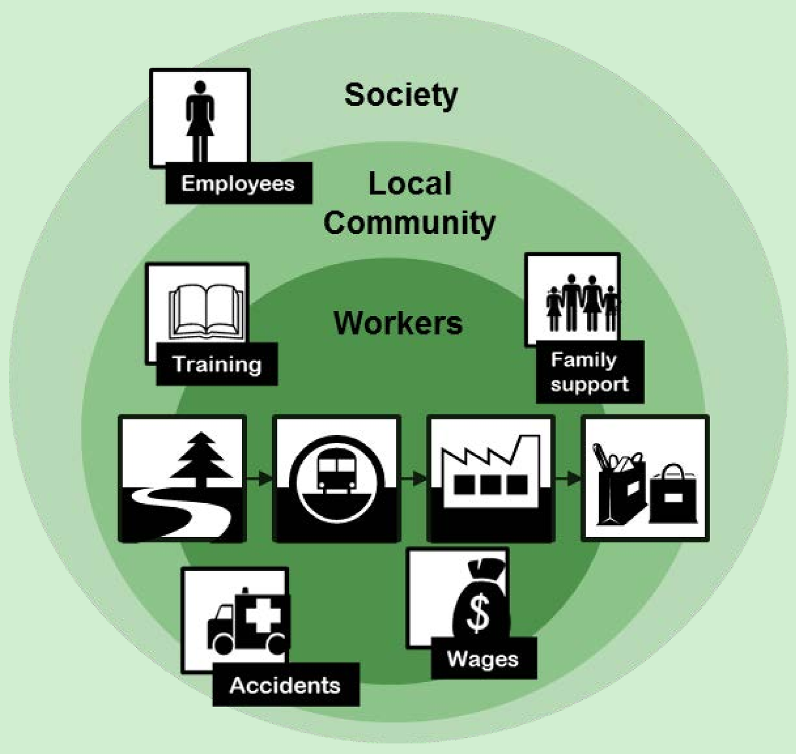


Figure 3: Stakeholder groups

Sustainability Monitoring Tool

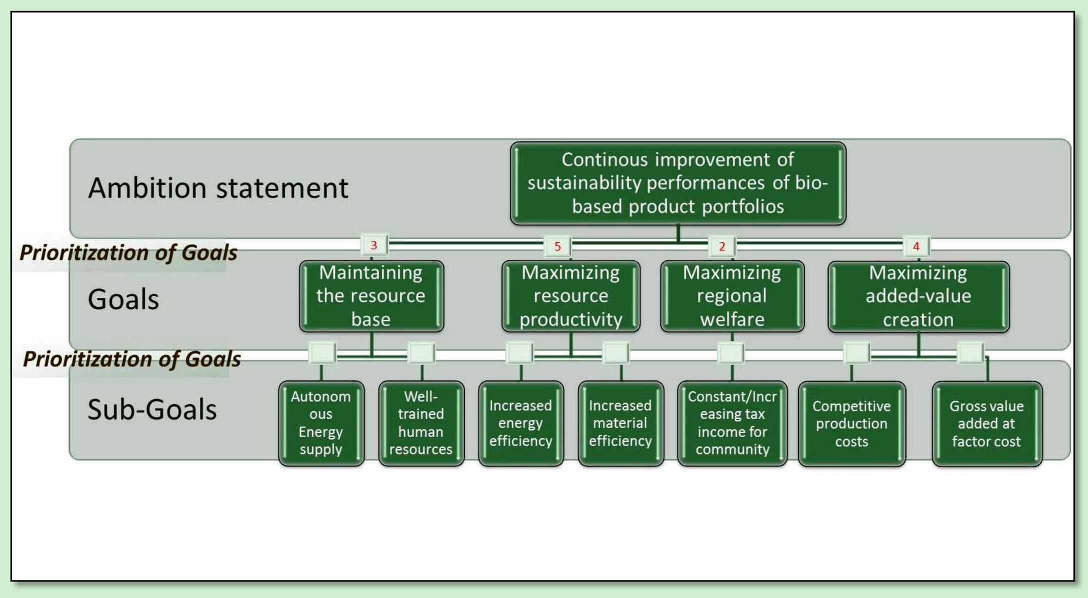


Figure 5: Hierarchical structure of a goal system for sustainability monitoring

- Integrates techno-ecological and socio-economic indicators for monitoring the performances and ambition levels in attaining sustainability goals along the added-value chains.
- Compares bio-based products against fossil-based and sector-internal sustainability benchmarks.

Results

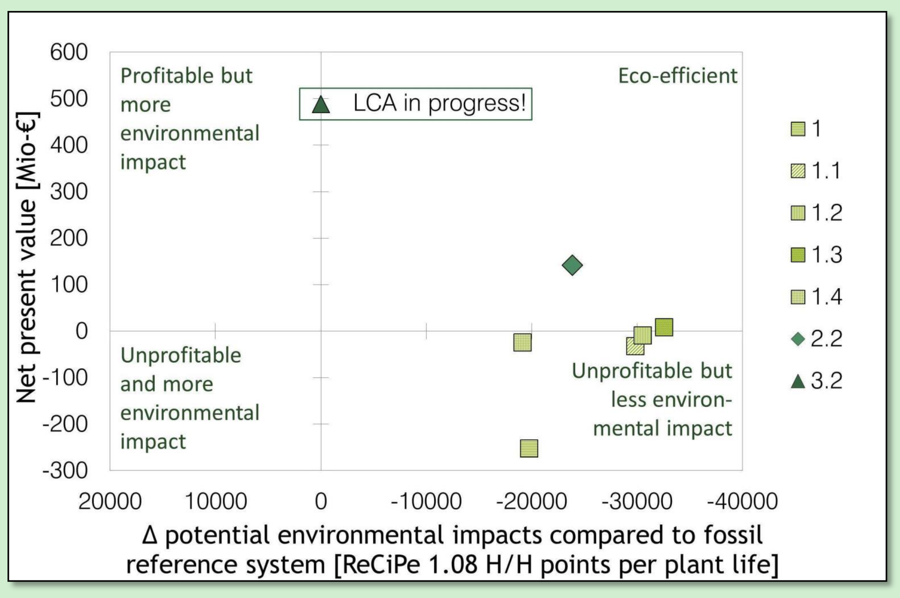


Figure 2: Eco-Efficiency Analysis of seven design alternatives for optimizing biorefinery concepts

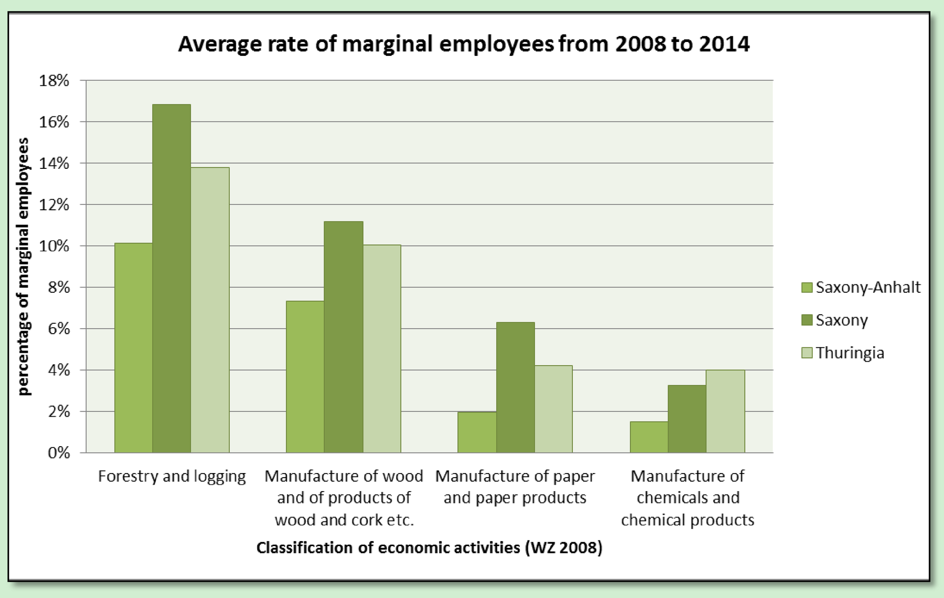


Figure 4: Regional sector-specific performance reference points for the indicator „marginal employees"

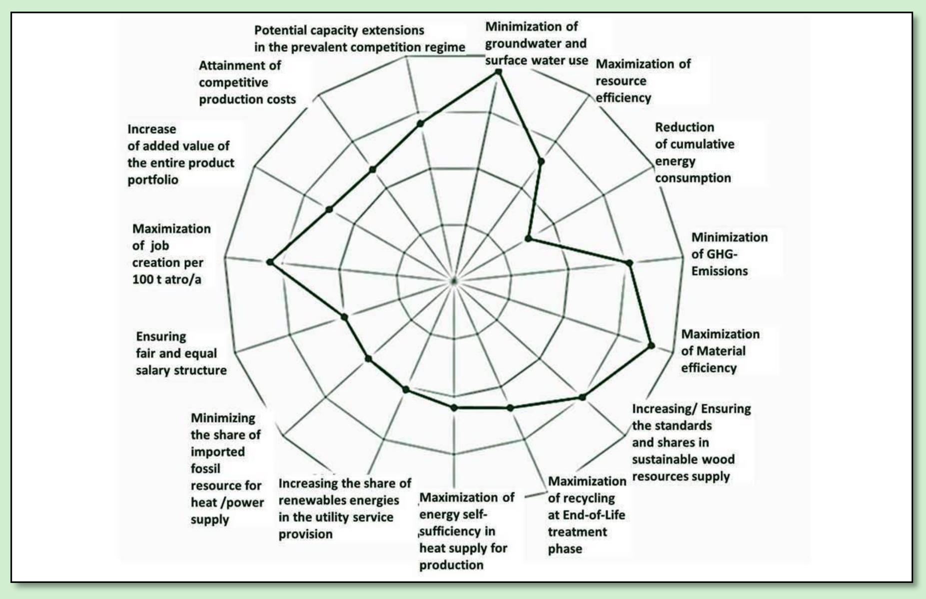


Figure 6: Typical Radar Plot for Sustainability Monitoring of value chains for Engineered Wood Products and Composites

Lessons-Learned

- Potentials of wood-based biorefineries for optimization of cost-effectiveness and reductions of negative environmental impacts do exist.
- The process design approach is available for application to further concepts.

- Identified social hotspots and opportunities can be used for internal management purposes in the cluster

- Progresses and trade-offs caused by decisions in sustainable wood resource management were monitored for a broad criteria set
- A robust and directional indicator system is available for supporting strategic alignment in achieving sustainable value chain integration

Helmholtz Centre for Environmental Research - UFZ Leipzig GmbH
Contact person: Jakob Hildebrandt, M.Sc.
E-Mail: jakob.hildebrandt@ufz.de Phone. +49(0)341-2434-389

www.bioeconomy.de

INVENTED IN GERMANY
SPONSORED BY THE Federal Ministry of Education and Research

Reducing fossil peat in growing media by biochars

Jürgen Kern, Christiane Dicke, Giacomo Lanza, Benjamin Wirth, Maja Werner, Joachim Venus, Thomas Hoffmann and Martin Geyer

ATB Leibniz-Institut für Agrartechnik Potsdam-Bornim e.V.

Leibniz Institute for Agricultural Engineering Potsdam-Bornim e.V. (ATB)

Leibniz-Gemeinschaft

BACKGROUND & OBJECTIVES

Efficient agriculture and horticulture are highly dependent on fertile soils and suitable growing media. In Europe the horticultural production is mainly based on growing media, which are dominated by peat deriving from large reservoirs of peatlands primarily in Baltic and Scandinavian countries (Fig. 1). In 1999, nearly 40 million m^3 of peat were used across the world in horticulture. Since peat cannot be considered as a renewable but as a fossil source the sustainability of its use on the long-term has to be questioned. A negative side-effect of agricultural plantations on peatlands, peat mining and the horticultural use of peat dominated growing media is the unavoidable increase of greenhouse gas emissions.

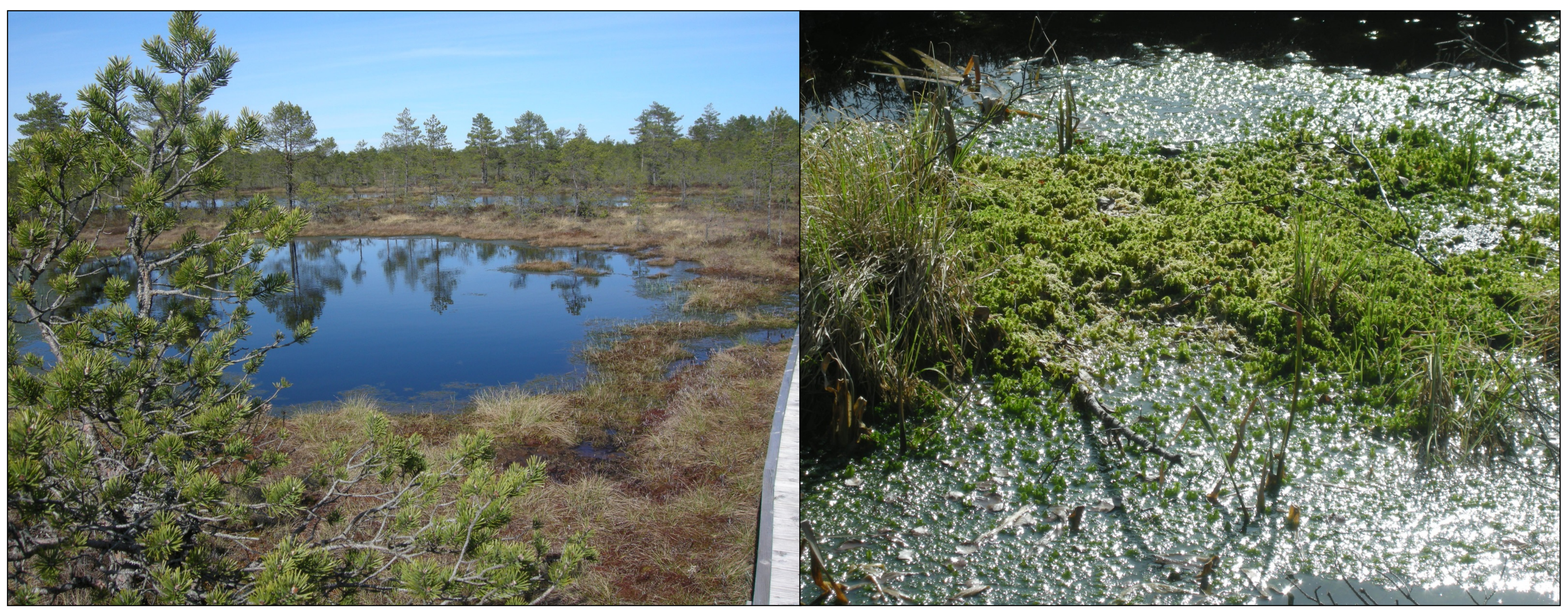


Figure 1. Undisturbed peatland in Estonia (left) and restoration of a mined peatland with *Sphagnum* moss (right), which grows about 1 cm per year

Although growers are interested in new compounds for growing media, it is not easy for them to find those organic materials, similar to peat, which may fulfil not only the demand of hobby gardeners but also the demand of the professional market (Fig. 2). As one innovative material biochar is discussed. It derives from thermal carbonisation of biomass and organic waste materials, obtaining a new value-added step. The key questions are, whether biochar can be combined with other non-peat materials such as compost, bark and fibres, which have already been established on the horticultural market, and to which extent biochar may work in growing media.

Figure 2. Uniform growth of hothouse plants with growing media

NETWORK ACTIVITIES

Since peat resources are limited and the supply of new substrates is urgently needed for the production of growing media, a workshop of the EU COST Action TD1107 *Biochar as option for sustainable resource management* was held at the Estonian University of Tartu in May 2015. This workshop aimed to discuss about *opportunities for using biochar in synergy with peat as constituents of growing media*. The view of stakeholders on new biochar based growing media has been in-volved in order to consider their business interests and to facilitate the introduction of new compounds in growing media.

RESULTS

During recent years, the utility of a couple of alternatives in growing media has been assessed. Among the organic components, which are suitable and which are already used by growers in growing media, are composts, bark, wood fibre products and coir [1]. *Sphagnum* moss, which is the most common constituent of peat itself gains in importance in recent years. The number of scientific papers on different candidate materials reflects the relevance of each new component in horticulture (Fig. 3).

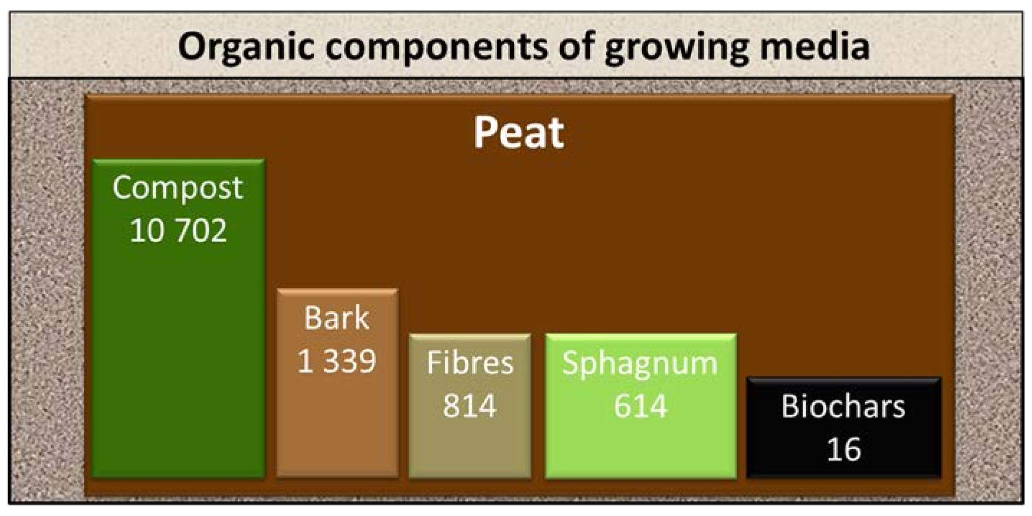


Figure 3. Main components in growing media and their corresponding number of related papers listed in the Web of Science in April 2015

Among the different components suitable for growing media, also chars may become important. They can be produced from organic residues by pyrolysis or hydrothermal carbonisation (HTC; Fig. 4). Particularly HTC chars are rather similar to peat (Fig. 5). The advantage is the utilisation of waste material and the very short time of process operation in contrast to natural formation of peat (Fig. 1).

Figure 4. Hydrothermal carbonisation at 230°C for the production of HTC chars

Growing media must ensure basic physical and chemical constituents. In today's sophisticated nurseries, tailor-made fertilisers and crop-specific growing media are essential for both yield and quality. First results on a lab scale have been reported with a range of biochar content in growing media of up to 80% [2]. On large scales, companies in Estonia and Finland have started to use biochar as absorbing agent in their growing media products.

Chemical properties	HTC (wheatstraw)	HTC (digestate)	Pyrolysis (maize silage)
Electrical conductivity	++	++	+
pH	++	+	--
Nitrate	++	++	++
Ammonium	++	+	+
Potassium	++	++	+
Biological properties	**HTC (wheatstraw)**	**HTC (digestate)**	**Pyrolysis (maize silage)**
Biological stability	++	++	++
Germination index	(+) ++	++	+

++ = as good as peat, + slightly worse, – much worse

Figure 5. Chemical and biological properties of HTC char and biochar in relation to peat

LESSONS-LEARNED & RECOMMENDATIONS

The question how much of peat might be replaced in growing media depends on functional aspects, which comprise physical, chemical and biological (e.g. pathogen interaction) properties. It can be expected that also in Germany char materials coming from local or regional sources will be used increasingly in growing media as long as availability and quality standards are guaranteed, environmental impact is reduced and their economic feasibility and competitiveness is given.

REFERENCES

[1] Schmilewski, G. (2008) The role of peat in assuring the quality of growing media. In: International Mire Conservation Group and International Peat Society (eds.), Mires and Peat, Vol. 3, Article 02.

[2] Steiner, C., Harttung, T. (2014) Biochar as a growing media additive and peat substitute. Solid Earth 5, 995-999.

OrganoCat plant and pulping combinations for the full valorisation of lignoCellulose from marginal land grown perennial plants

H. Klose[1,2], T. Damm[1,2], P. M. Grande[1,3], N. D. Jablonowski[1,4], P. Domínguez de María[3], W. Leitner[1,3,5], U. Schurr[1,4], B. Usadel[1,2,4]

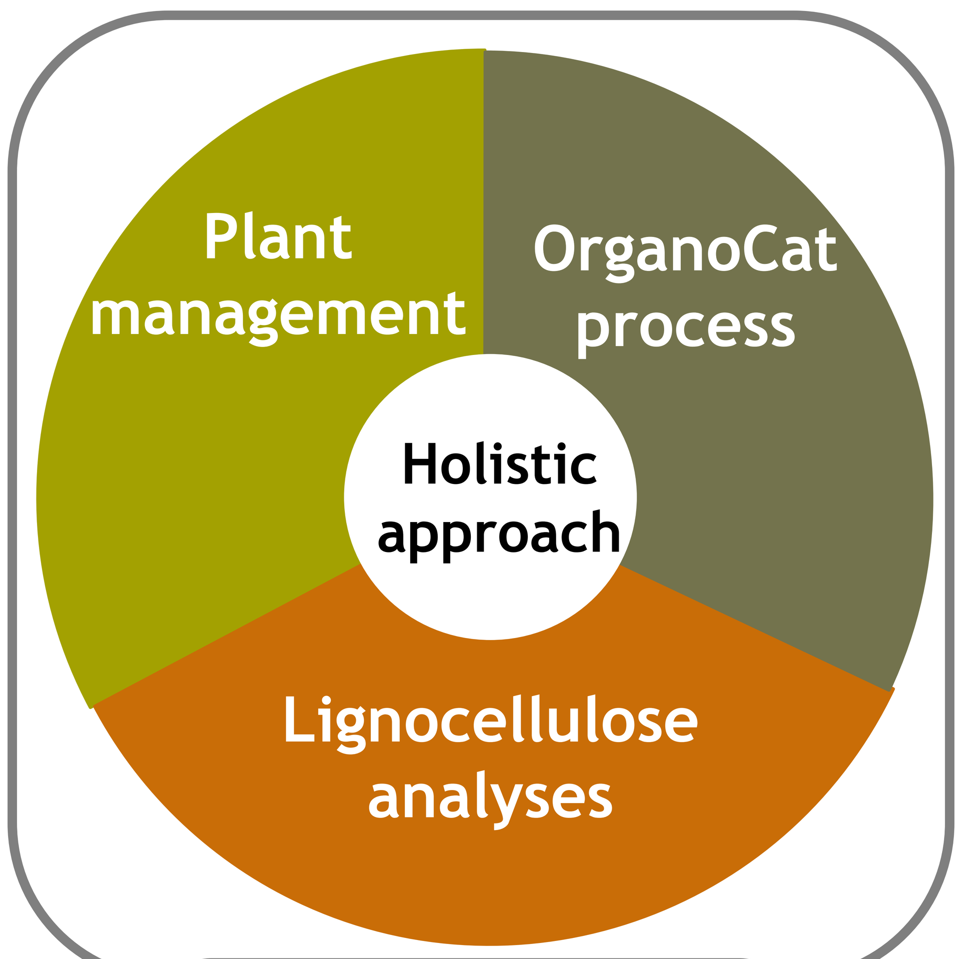
[1]Bio Economy Science Center (BioSC), [2]RWTH Aachen University, Institute of Botany and Molecular Genetics IBMG, Aachen, Germany, [3]RWTH Aachen University, Institute for Technical and Macromolecular Chemistry ITMC, Aachen, Germany, [4]Research Center Jülich, Institute of Bio- and Geosciences, IBG-2: Plant Sciences, Jülich, Germany, [5]Max-Planck-Institut für Kohlenforschung, 45470 Mühlheim an der Ruhr, Germany

BACKGROUND & OBJECTIVES

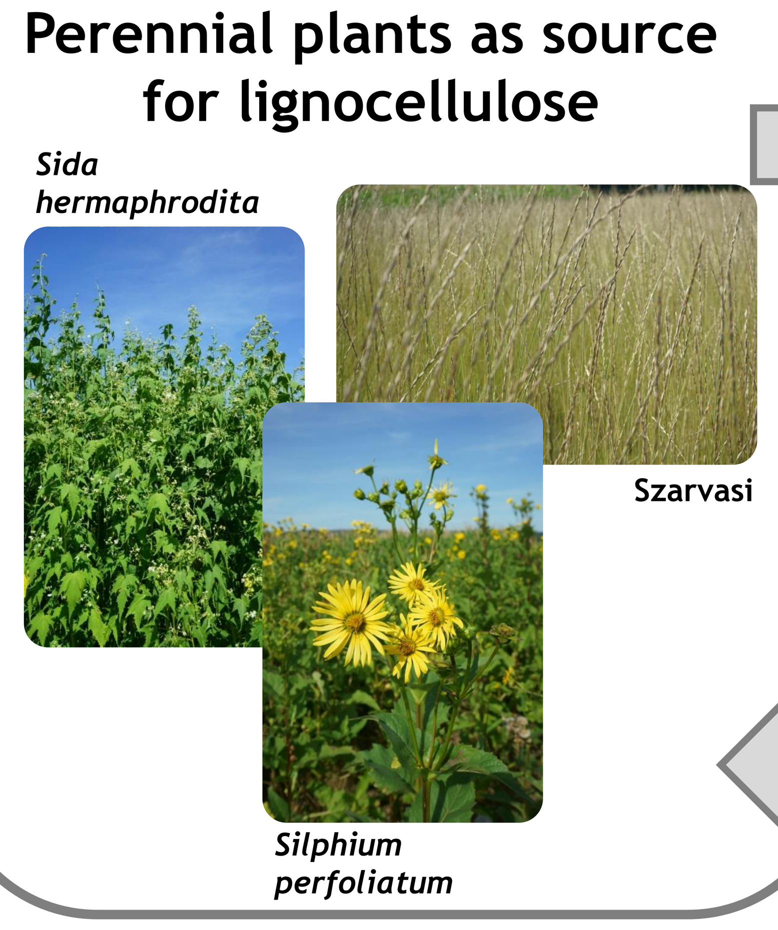
For a reliable and sustainable production of bio-based chemicals and fuels, the development and enhancement of next generation bio-refineries is of great importance. Avoiding the competition with food and feed, alternative cultivation strategies such as growing plants on marginal lands is essential for a sustainable biomass valorisation.

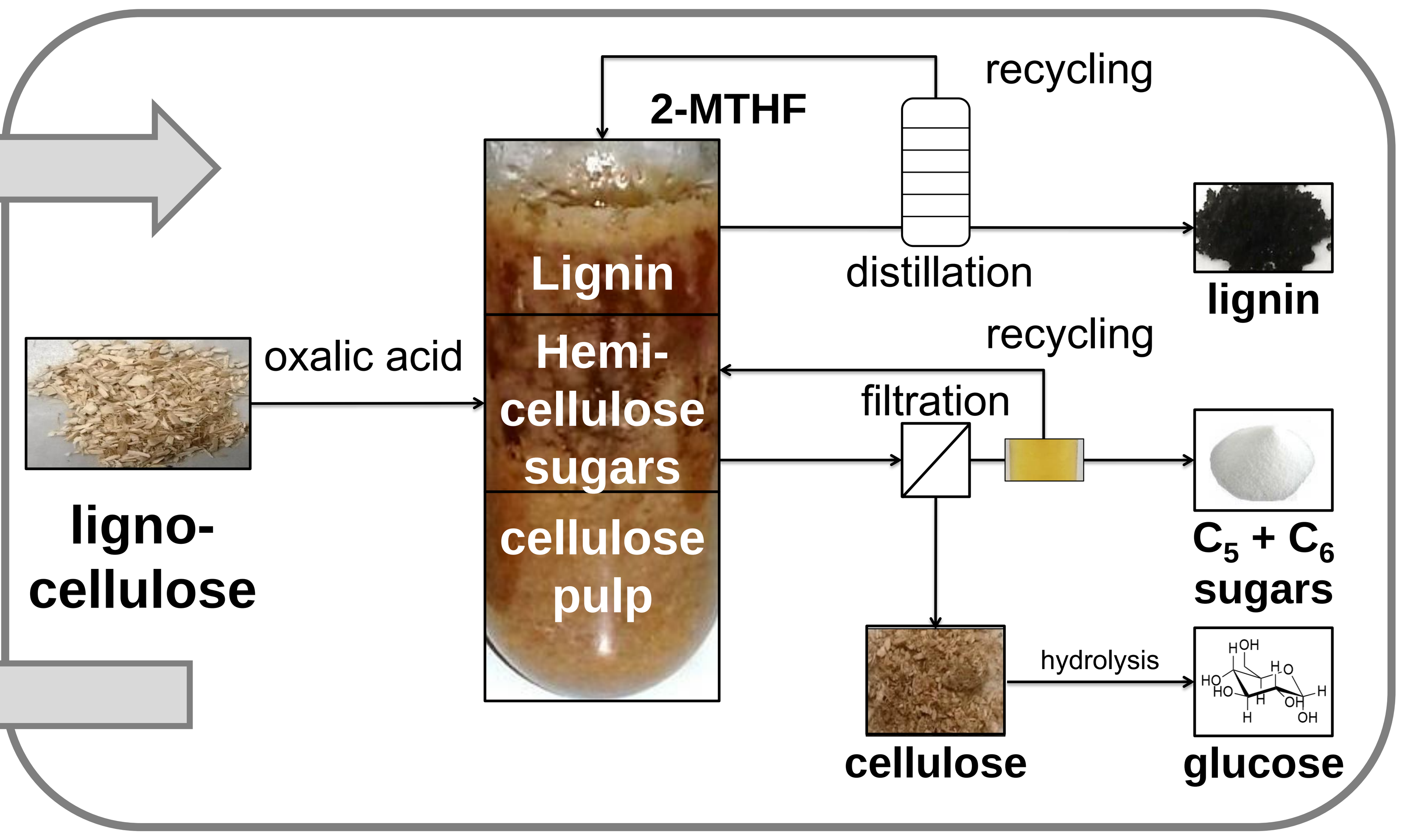
ACTIVITIES

The OrCaCel project addresses an optimized valorisation of lignocellulosic biomass by an integrated approach combining plant management and the disintegration *via* the OrganoCat process[1,2]. Correlation of the data generated by characterizing the OrganoCat product streams with the data provided by the analysis and characterization of the original biomass creates new conversion chains for biomass determined for defined chemicals and energy storage.



Future Bioeconomy

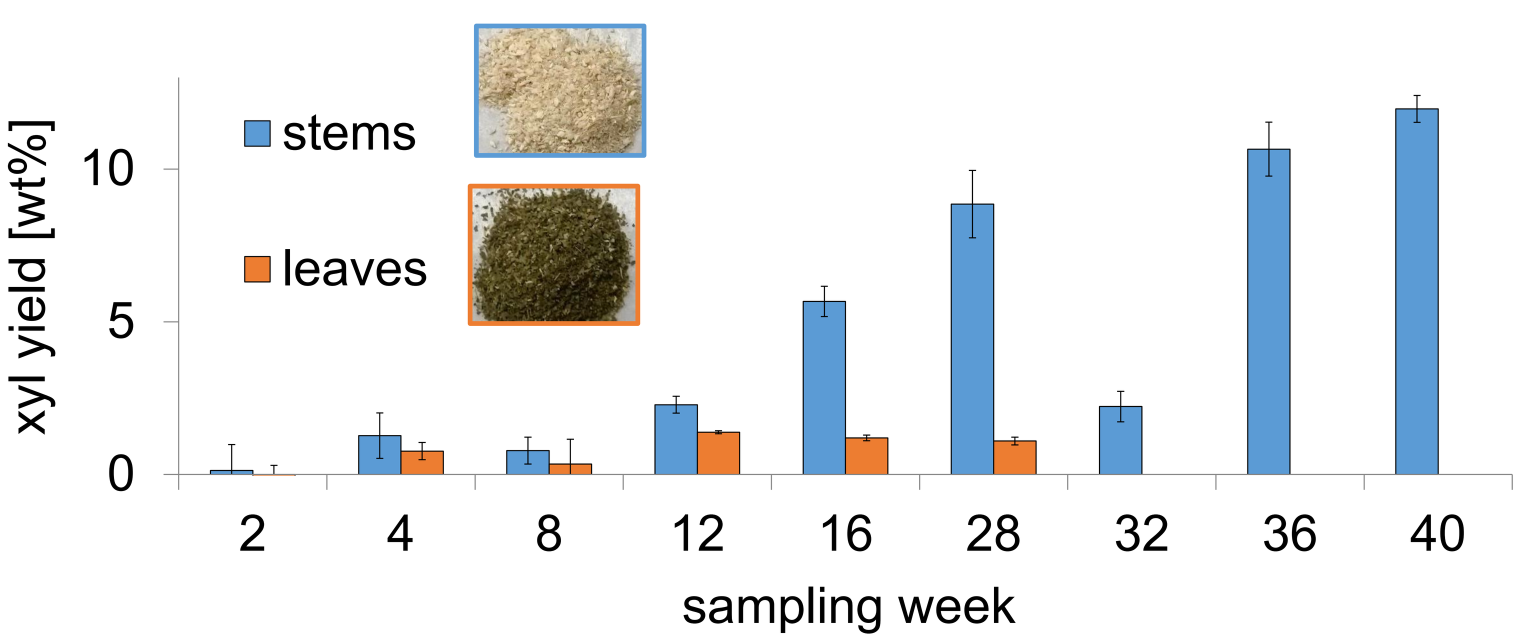


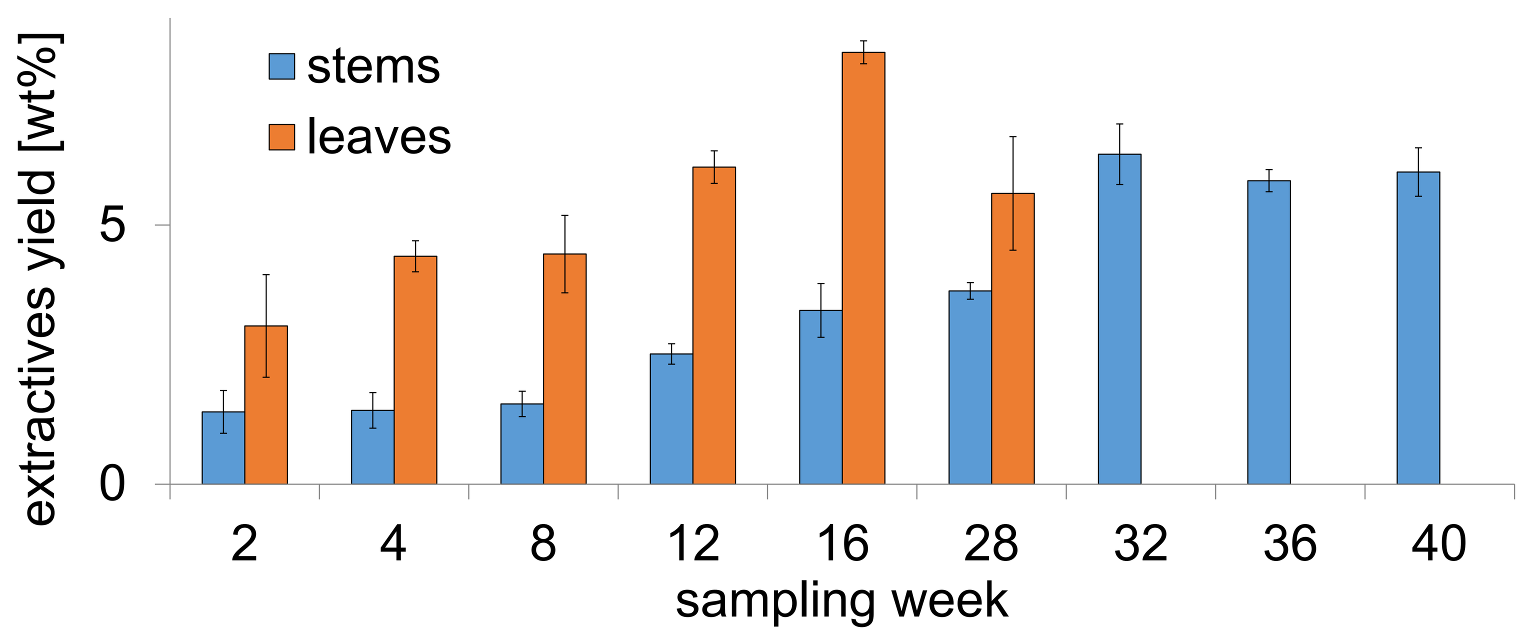


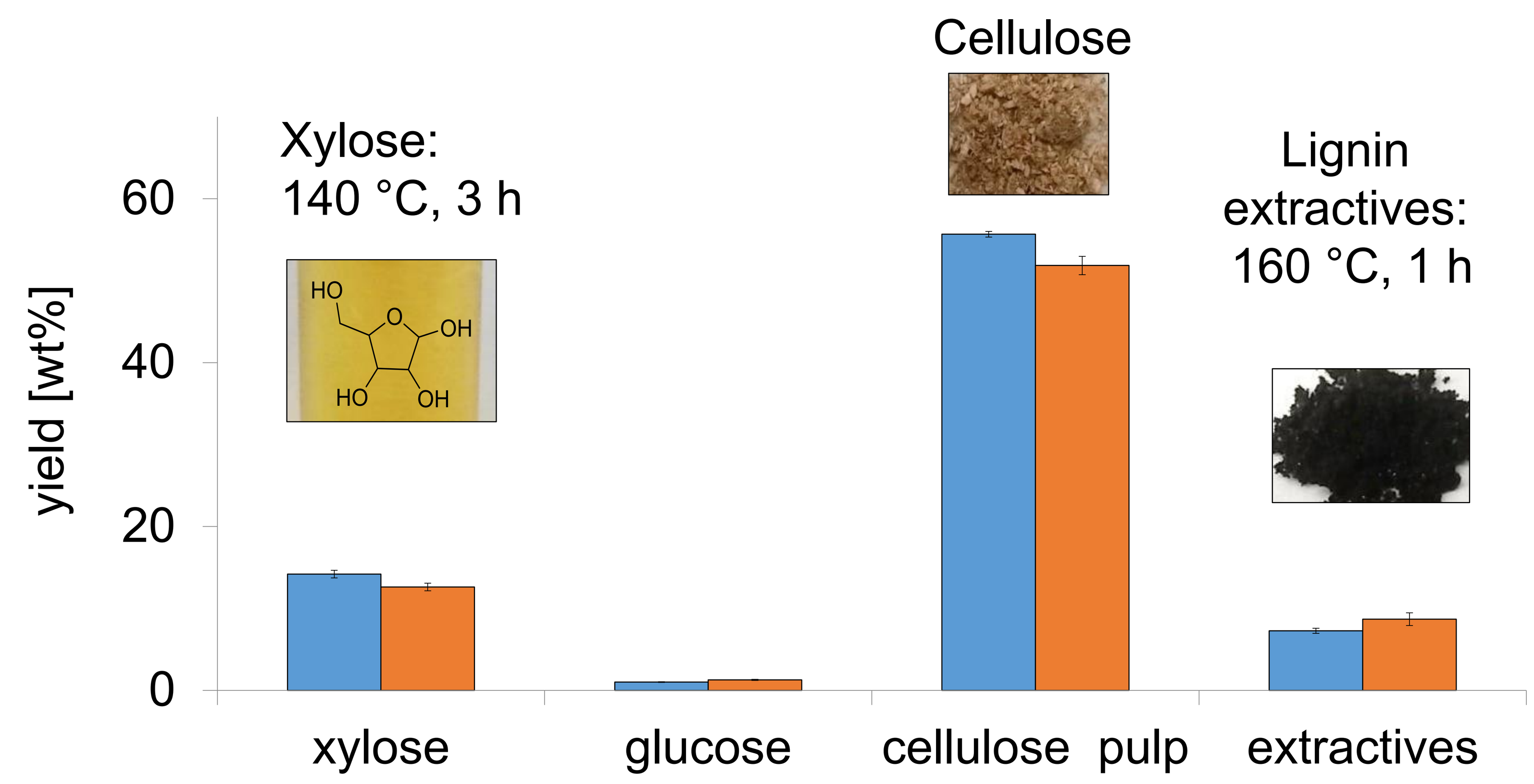
The OrganoCat process efficiently fractionates lignocellulose into its main components cellulose, hemicellulose and lignin. In a biphasic solvent system the hemicellulose is selectively hydrolyzed while lignin is *in-situ* extracted into 2-methyltetrahydrofuran (2-MTHF) as second phase.

RESULTS

- Perennial plants like *Sida hermaphrodita* generate high amounts of biomass even when cultivated on marginal soils.
- Compositional analysis identified the optimal harvest time point for a subsequent processing.
- Feedstock qualities have been determined by the ratios of the main cell wall components (e.g. pentose-hexose ratio, cellulose-hemicellulose-lignin ratio).
- The OrganoCat process was optimized due to biomass-to-solvent and -catalyst ratio leading to higher product concentrations in the effluents.







LESSONS-LEARNED & RECOMMENDATIONS

- The OrCaCel project is an innovative project integrating biomass cultivation and lignocellulose pre-treatment and fractionation to achieve an overall improved production-utilisation system.
- Understanding the influence of growth periods on the perennial biomass composition enables the selection of an appropriate harvest time point to obtain a most suitable biomass composition to be applied to the OrganoCat process.
- The OrganoCat process is an efficient way to pre-treat and fractionate lignocellulosic biomass from various sources.

REFERENCES & ACKNOWLEDGEMENTS

[1] T. vom Stein, P. M. Grande, H. Kayser, F. Sibilla, W. Leitner, P. Domínguez de María, Green Chem. 2011, 13, 1772-1777.
[2] P. M. Grande, J. Viell, N. Theyssen, W. Marquardt, P. Domínguez de María, W. Leitner, Green Chem. 2015, 17, 3533-3539.

The BioSC is supported by the federal state of North Rhine-Westphalia on a long-term basis within the framework of the NRW-Strategieprojekt BioSC. More information about the BioSC on www.biosc.de.

Institute of Bio- and Geosciences (IBG-2)

Institute for Botany and Molecular Genetics (IBMG)

Institute for Technical and Macromolecular Chemistry (ITMC)

Facts and Figures
Established: 2010
Staff: > 1400
Funding: u.a. MIWF, BMBF, DFG, EU
Internet: www.biosc.de

Contact
BioSC-Office
c/o Forschungszentrum Jülich
52425 Jülich
biosc@fz-juelich.de

Support
The BioSC is supported by the state of North Rine-Westphalia on a long-term basis within the framework of the NRW-Strategieprojekt BioSC.

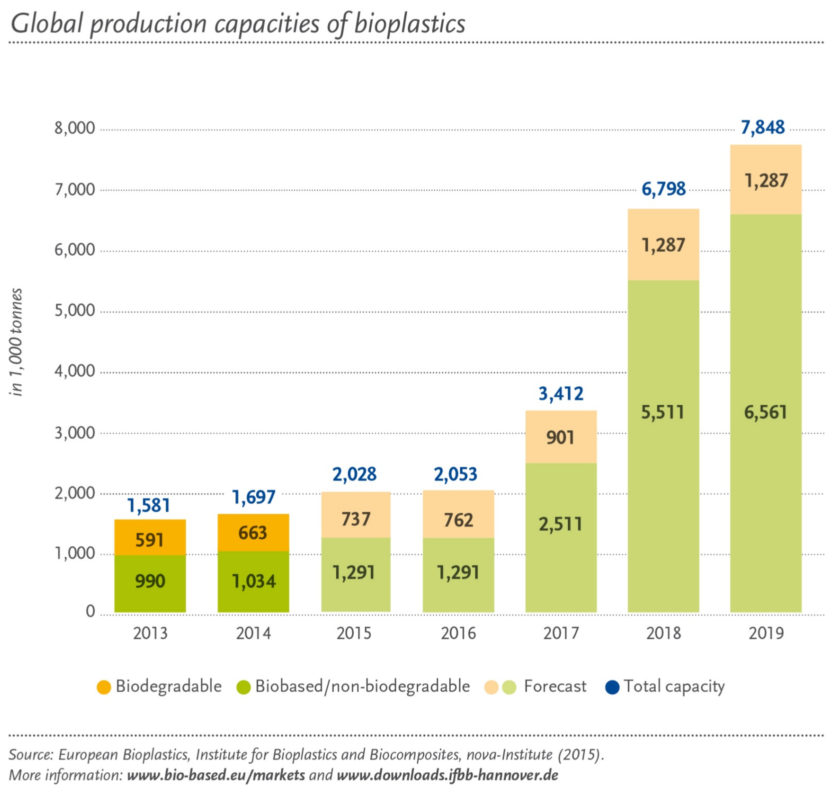
The European bioplastics industry

Kristy-Barbara Lange

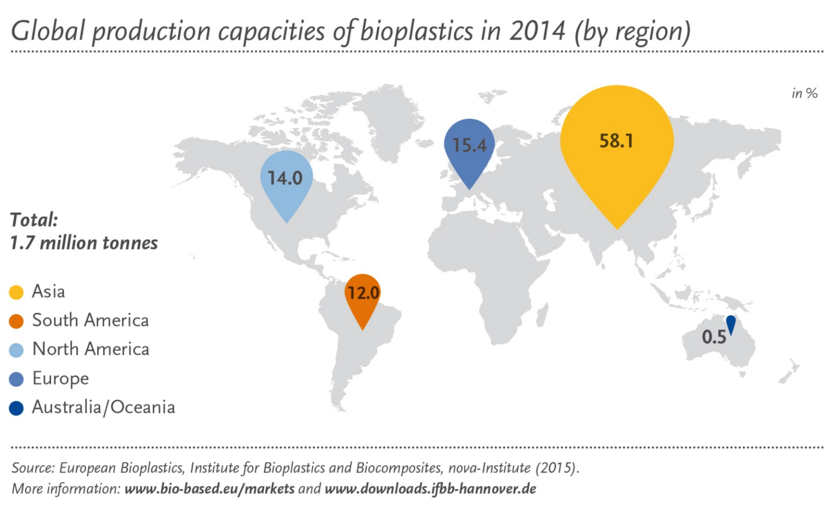
Deputy Managing Director – European Bioplastics e.V.

http://en.european-bioplastics.org/

BACKGROUND & OBJECTIVES



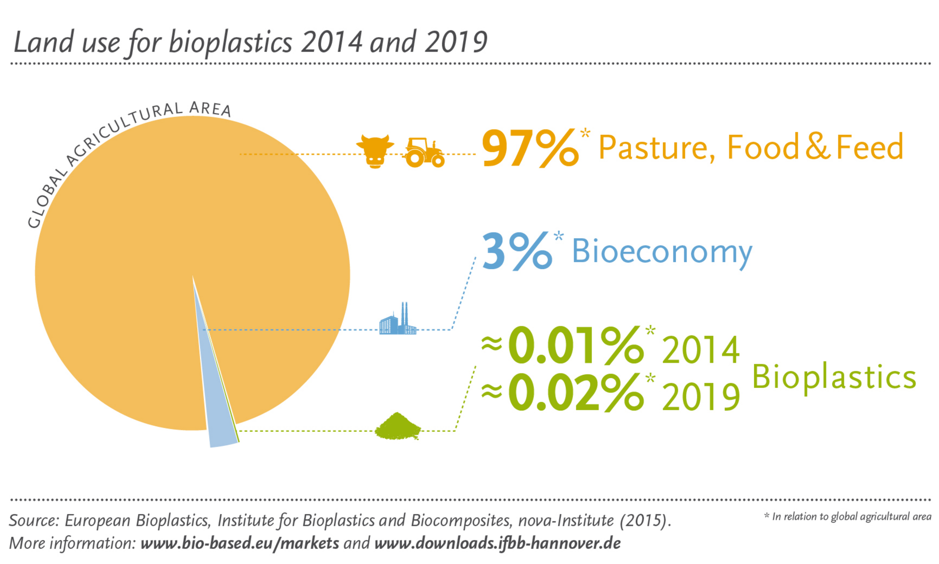
The bioplastics industry is growing at a rate well above average with production capacities of plastics that are biobased, biodegradable, or both increasing by 20 to 100 percent each year. Europe is leading in R&D and provides a huge potential market for bioplastics, yet, is lacking the necessary legislative framework to ensure and attract investments into production and conversion as well as to support a full-scale market penetration of bioplastic products. Europe is in danger of missing out on the benefits of the bioplastics industry – from reduced environmental impact to creation of high-skilled jobs.

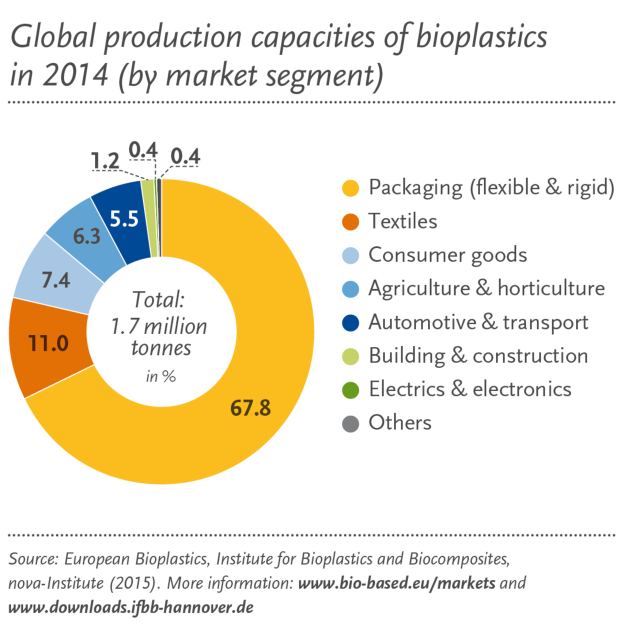


European Bioplastics' objective is to create a favourable legislative landscape across the EU for the European bioplastics industry to flourish in.

ACTIVITIES

1. Facilitating a dialogue with the EU bodies and on Member State level with regard to the role of bioplastics in the bioeconomy / circular economy focussing on issues such as agricultural feedstock availability, resource efficiency, use cascades, biorefineries, green public procurement and efficient waste management.
2. Promoting of standardisation of biobased plastic products and biodegradable/compostable plastic products.
3. Publishing an increasing set of market data, consumer information and information on technological performance of bioplastics.
4. Connecting research efforts e.g. on marine biodegradability or waste to resource projects on EU and international level.





RESULTS

1. The interest in bioplastics is increasing – within the industry, at administration, policy and consumer level.
2. EUBP is a respected knowledge partner for policy makers and institutions in Brussels on important issues of the Circular Economy Package, biobased feedstock availability, use cascades, waste targets, etc.
3. Close cooperation with networks, such as the European Bioeconomy Alliance, to increase awareness for the synergies and interdependencies of bioeconomy and cicular economy.
4. Standardisation relevant to bioplastics is progressing; market introduction and communications around the standards are being facilitated.
5. An ever-growing network comprising of relevant stakeholders from the agro-sector to waste management.

LESSONS-LEARNED & RECOMMENDATIONS

1. Bioplastics are still a relatively small industry that meets with increasing interest but unfortunately also semi-informed stakeholders, prevailing misconceptions and sometimes exaggerated expectations (time-wise); stronger links between projects (knowledge sharing) are needed as well as a broader publication of up-to-date information across Europe.
2. Standardisation and certification are well developing; labelling is also in parts available – the wealth of existing structures needs to be shared so that they can be harmonised and transparency in the market can be increased.
3. Emotional debates such as the „food vs. fuel debate“ need to be discussed on a fact-based level, otherwise we are torpedoing our innovative potential.
4. Sustainable products can only be as good as the person that uses them. Better education for consumers on sustainable consumption is needed, guidelines that are manageable and that do not conflict with a modern lifestyle.

compostable

Pictures (bottom to top): PolyOne, Toray, FKuR, DIN CERTCO, European Bioplastics; see also http://en.european-bioplastics.org/press/press-pictures/

REFERENCES & ACKNOWLEDGEMENTS

Market data European Biplastics, Institute for Bioplastics and Biocompostis (IfBB) – University of Hannover, nova-Institute; Further information at: http://en.european-bioplastics.org/; Recommended specialist publication: http://www.bioplasticsmagazine.com/en/index.php

Review of the environmental sustainability of bioeconomy value chains

Cristina T. Matos, Jorge Cristóbal, Jean-Philippe Aurambout, Simone Manfredi, Boyan Kavalov

European Commission – Joint Research Center – Institute for Environment and Sustainability

BACKGROUND & OBJECTIVES

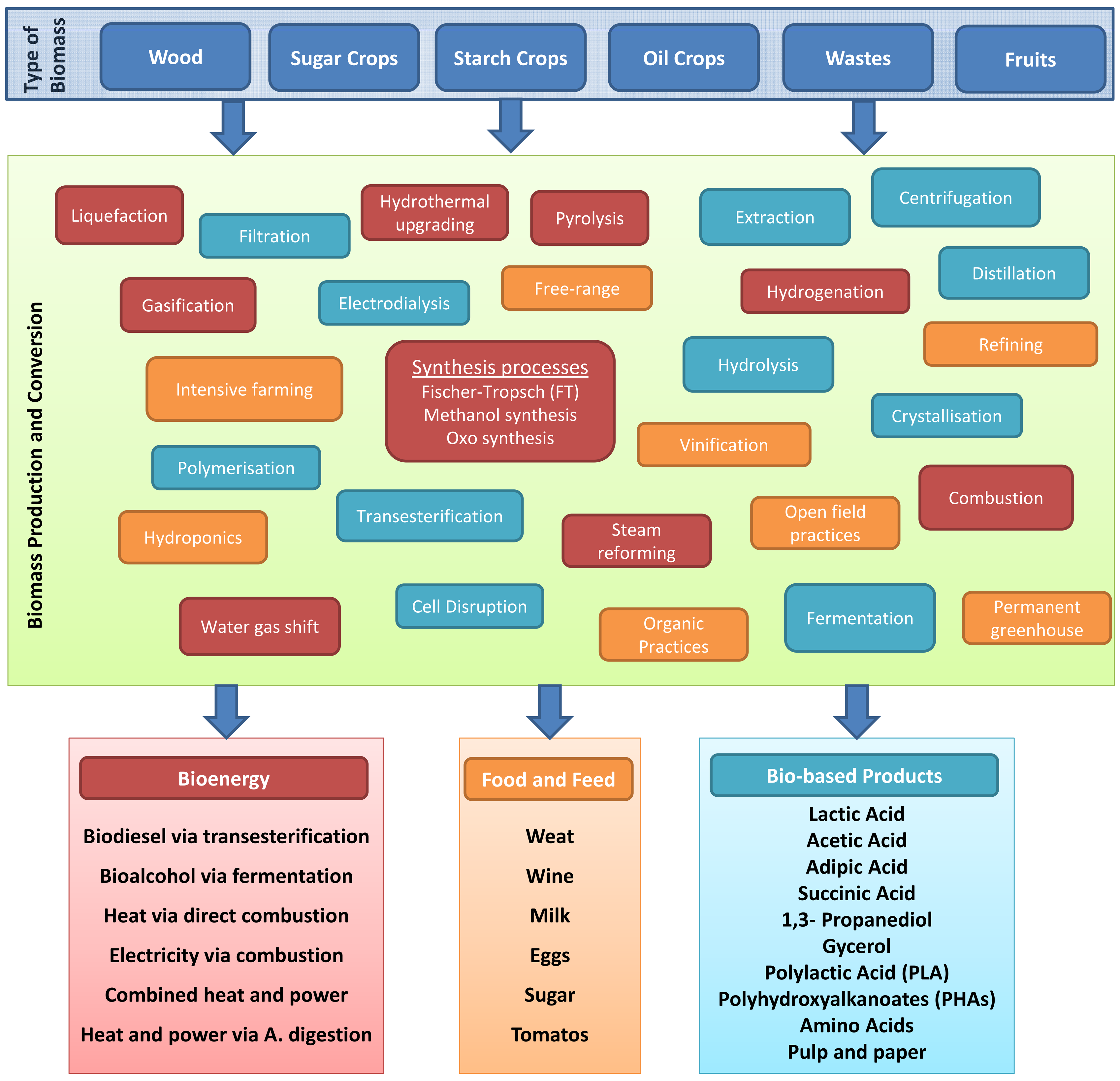
•The bioeconomy concept refers to the sustainable exploitation of renewable biological resources for the production of energy, food&feed and bio-based products.

•A comprehensive environmental sustainability assessment of bioeconomy is key to help directing policies and investments towards the most sustainable value chains and to determine the impacts of shifting from the current petrol-based economy to a more bio-based one.

•Life Cycle Assessment (LCA) is a broadly accepted method that can be used to quantify the environmental impacts along bioeconomy value chains (i.e. from cradle to grave).

ACTIVITIES

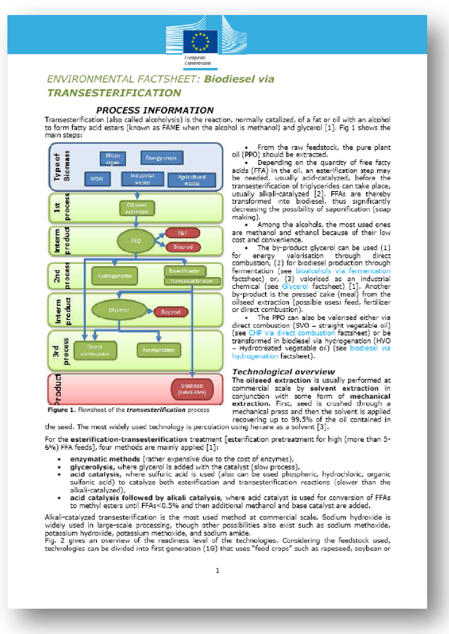
Products analysed



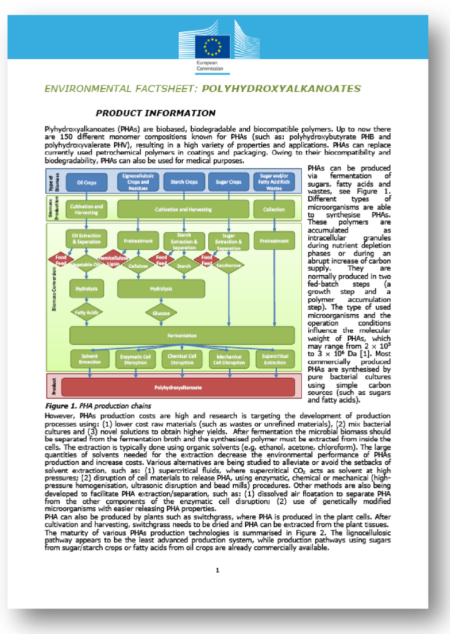
✓ **24 Environmental Factsheets were published**, structured in 3 sections:

- ***Process/product information*** including: biomass conversion pathways, technology reediness levels (TRL) of the conversion technologies and SWOT analyses;
- ***Environmental data and information***: including revision of public available LCA data, following the 14 impact categories of the Product Environmental Footprint;
- ***References and further information***.

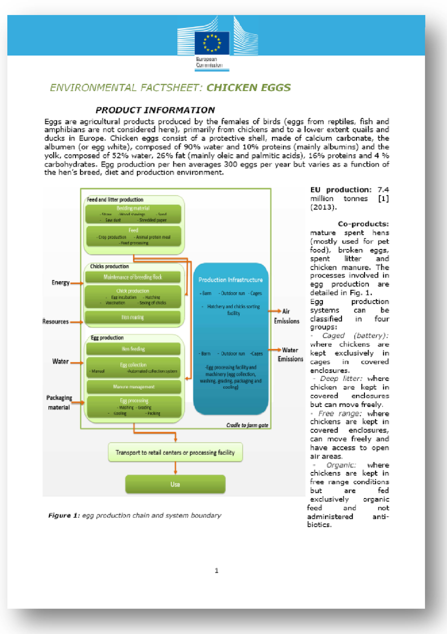
Bioenergy



Bio-based Products



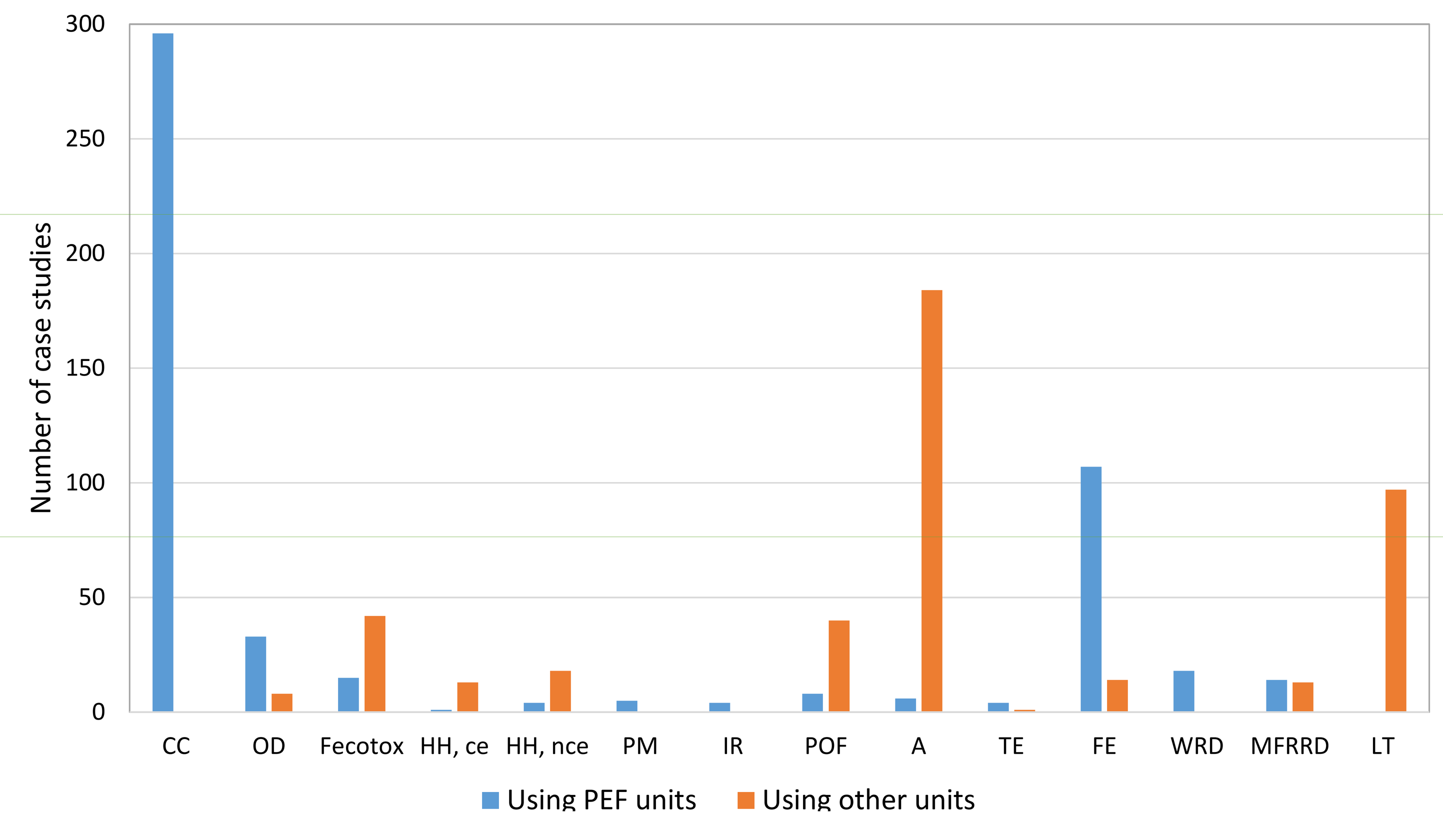
Food and Feed



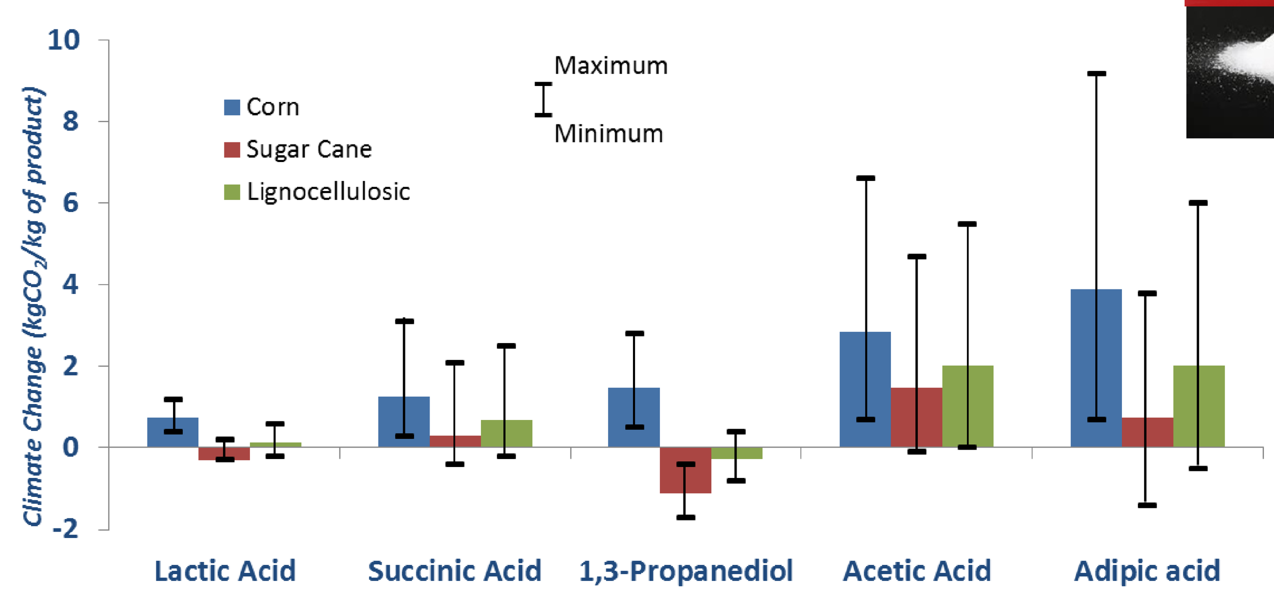
http://biobs.jrc.ec.europa.eu/analysis

RESULTS

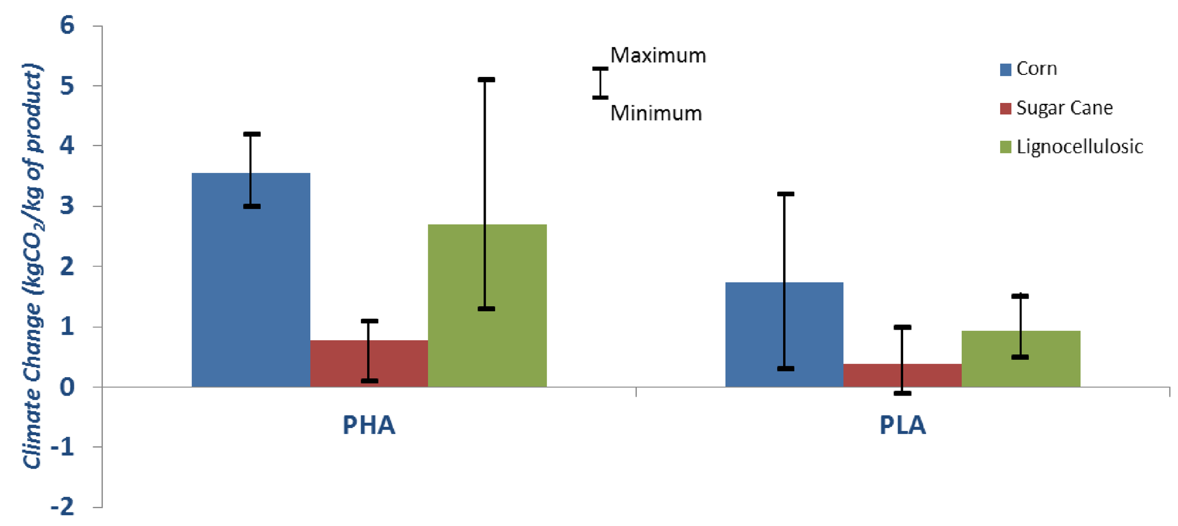
Occurrence the different impact categories in the Literature



Variation of climate change LCA results for ***chemical building blocks***



Variation of climate change LCA results for ***biopolymers***



LESSONS-LEARNED & RECOMMENDATIONS

✓ High variability within literature. Differences in assumptions and boundary make comparison difficult.

✓ Lower impacts are reported when considering the burning of waste streams (such as bagasse or lignin-rich wastes) for energy recovery.

✓ Biomass production (agriculture activities) has a significant contribution to the total environmental impacts.

✓ The approach used to model multifunctionality influences the results. Lower impacts are associated with the use of substitution. Different allocation assumptions (mass, economic, energy) can significantly impact the results.

✓ Few impact categories are reported. A complete environmental picture of bioeconomy value chains is missing.

REFERENCES & ACKNOWLEDGEMENTS

This work was produced along the Administrative Arrangement No. 341300 between DG RTD and DG JRC entitled "Bioeconomy Information System and Observatory" /BISO/.

TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Business and Economics, Chair of Environmental Management and Accounting

Dipl. Geoökol. Nadine May

The efficient use of wood as regional resource – an ecological assessment of common and new technologies for material wood processing

BACKGROUND & OBJECTIVES

In the upstream chains of wood products the regional aspects, namely the origin of the wood, play the major role for the ecological assessment. As ecosystems show different levels of sensitivity and trade-offs exist between ecosystem services, the use of primary forest has to be seen as least sustainable. New moulded plywood technologies can take pressure from such fragile ecosystems by utilizing less critical wood species. Furthermore, new areas of application e.g. in construction and furnishing can be exploited as the wood-inherent properties can be enhanced making it more resistant towards environmental impacts and, thus, making it more economically competitive. But only when bioeconomy goes hand in hand with sustainable forest management, regions can benefit from the entire spectrum of forest ecosystem services in the long run.

This research intends to systematically investigate the environmental assets and drawbacks of different wood processing technologies (naturally impregnated tropical timber, chemically impregnated wood, thermal-mechanical treatment = moulded wood) under consideration of the full life-cycle and the resilience of the concerned ecosystems.

ACTIVITIES

First of all, a comprehensive literature research has been carried out in order to identify those indicators that are eligible to assess the sustainability of the material use of wood over its entire life cycle. While supranational initiatives (UNCSD, Forest Europe) and certifier (FSC, PEFC, SFI) are more focused on sustainable forest management, indicators derived from valuation methods such as Life Cycle Assessment or Eco-Efficiency can broaden the scope to the production, use and disposal of wood products. Therefore, they have been combined for the study. Indicators were structured according to guiding principles found in the relevant literature. All prinicples have been summarized to the following key messages.

Ressource	Upstream chain	Production	Use	End of life
Maintaining the health, productivity, protective and recreational functions as well as the CO2 retention of forests (ecosystem services)	Careful logging	Production of smaller structures	Low use of impregnating agents in dependence of the application situation	Wood utilization longer than growth cycle of timber of comparable size and quality
	Priority use of low-value timber	Reduction of waste (material efficiency)	Priority use of natural or low toxic coatings	Use of recycled wood (wood cascade)
	Use of certified wood	Use of processed wood	Higher service intensity of goods and services	Use of combustion residues as fertilizer (cradle-to-cradle)
	Use of many wood species (biodiversity)	Production of durable wood products		
		Ensuring the decomposition into preferably unmixed fractions (eco-design)		

RESULTS

In total 21 indicators have been identified from the key messages. They can be transfered to an assessment model for decision-making, which takes particular account of the use of wood as regional resource. The indicators have been assigned to the individual life cycles of the wood product.

LIFE CYCLE	NO	THEME	INDICATOR	UNIT	REGIONAL ASPECT	DATABASE
RESSOURCE	**1**	**Maintenance of the health and productivity of the ecosystem**				
	1.1	Sustainable forest management	Certified forest area	qkm, %	x	Databases of certifier, statistics, literature, GIS-Analysis
	1.2	CO2 storage	Change of the forest size	qkm, %	x	Statistics (FAO), literature, expert knowledge, GIS-Analysis
			Age structure	a	x	Statistics, expert knowledge
	1.3	Biodiversity	Abundance	count, %	x	Statistics (IUCN, FAO, local authorities), literature, expert knowledge, GIS-Analysis
			Protected areas	qkm, %	x	Statistics (IUCN, UNEP, WDPA, EU, local authorities), GIS-Analysis
	1.4	Ecosystem services	Tourism, Recreation	count, €	(x)	Statistics, literature, expert knowledge
UPSTREAM CHAIN	**2**	**Conservation of resources in the upstream chain (forest management and tree felling)**				
	2.1	Energy efficiency	Energy use, fossil+RE	kWh	(x)	LCA (ecoinvent)
	2.2	Material efficiency	Waste (not r./recyclable)	t	(x)	LCA (ecoinvent)
	2.3	Global warming potential	CO2-equivalents	t		LCA, CO2 footprint (ecoinvent)
PRODUCTION	**3**	**Conservation of resources in the production process**				
	3.1	Energy efficiency	Energy use, fossil+RE	kWh	(x)	LCA (ecoinvent, literature, expert knowledge)
	3.2	Material efficiency	Waste (not r./recyclable)	t	(x)	LCA (ecoinvent, literature, expert knowledge)
	3.5	Toxicology	Toxic emissions	g/conc.	x	LCA (ecoinvent, Expertenwissen, Literatur)
	3.6	Global warming potential	CO2-equivalents	t		LCA, CO2 footprint (ecoinvent)
USE	**4**	**Conservation of resources in the use phase**				
	4.1	Chemical impregnation	Toxic emissions	g/conc.	x	LCA (ecoinvent, expert knowledge, literature)
	4.2	CO2 storage	life	a		LCA (Expert knowledge, literature)
	4.3	Application range	Substitution potential (CO2)	t		LCA (ecoinvent)
END OF LIFE	**5**	**Options for the end of life**				
	5.1	Cascading use	Count/extended life	x/a		LCA (Expert knowledge, literature)
	5.2	Recycling capability	Unmixed fractions/impurity	%	x	LCA (ecoinvent, expert knowledge, literature)
	5.3	Clean combustion	Toxic emissions	g/Konz.	x	LCA (ecoinvent)
	5.4	Cradle-to-cradle	Toxic emissions	g/Konz.	x	LCA (Expert knowledge, literature)

LESSONS-LEARNED & RECOMMENDATIONS

The future research work is about a case study in order to apply the selected indicators. Three different scenarios of wood use for exterieur will be compared (sawn wood from Indonesia, plywood from Kanada, moulded wood from Central Europe). The assessment will be done by applying quantitative and qualitative data gained by a systematic literature review, expert interviews and own calculations. Since the actual impacts on ecosystems cannot be assessed e.g. in terms of toxic concentrations, a GIS-based analysis to characterise the Eco-Vulnerability of ecosytems will be conducted as simplified approach instead of a cost-intensive on-site risk assessment.

REFERENCES & ACKNOWLEDGEMENTS

Calkins, Meg (2009): Materials for sustainable sites. A complete guide to the evaluation, selection, and use of sustainable construction materials. Hoboken, N.J.: Wiley (Wiley book on sustainable design).

FSC (Hg.) (2012): Deutscher FSC-Standard. Version 2.3.

Haller, Peer; Putzger, Robert; Wehsener, Jörg; Hartig, Jens (2013): Formholzrohre – Stand der Forschung und Anwendungen. In: Bautechnik 90 (1), S. 34–41.

MCPFE (Hg.) (2003): Improved Pan-European Indicators for Sustainable Forest Management. as adopted by the MCPFE Expert Level Meeting 7-8 October 2002. Vienna, Austria.

PEFC (Hg.) (2014): PEFC-Standards für nachhaltige Waldbewirtschaftung. Normatives Dokument PEFC D 1002-1:2014. Stuttgart.

SFI (Hg.) (2015): SFI 2015-2019 Forest Management Standard. Section 2.

United Nations (Hg.) (2007): Indicators of sustainable development: Guidelines and methodologies. 3rd ed. New York.

Werner, F.; Althaus, H.-J.; Künninger, T.; Richter, K.; Jungbluth, N. (2007): Life Cycle Inventories of Wood as Fuel and Construction Material. Final report ecoinvent 2000 No. 9. Hg. v. EMPA Dübendorf, Swiss Centre for Life Cycle Inventories. Dübendorf.

Zhewen, Fan; Musheng, Liu; Wenqing, Shen; Liansheng, Lin: GIS-Based Assessment on Eco-vulnerability of Jiangxi Province. In: 2009 International Conference on Environmental Science and Information Application Technology, ESIAT. Wuhan, China.

Kontakt: Münchner Platz 1/3, 01187 Dresden, Schumann-Bau B 246
Phone: +49 351 463-34313, Fax: +49 351 463-3776
E-Mail: bu@mailbox.tu-dresden.de
Web: http://tu-dresden.de/die_tu_dresden/fakultaeten/fakultaet_wirtschaftswissenschaften/bwl/bu

DRESDEN concept
Exzellenz aus Wissenschaft und Kultur

DBFZ
In cooperation with: HELMHOLTZ ZENTRUM FÜR UMWELTFORSCHUNG UFZ
BioEconomy Cluster

A methodological approach for the assessment and optimization of wood based biorefinery concepts

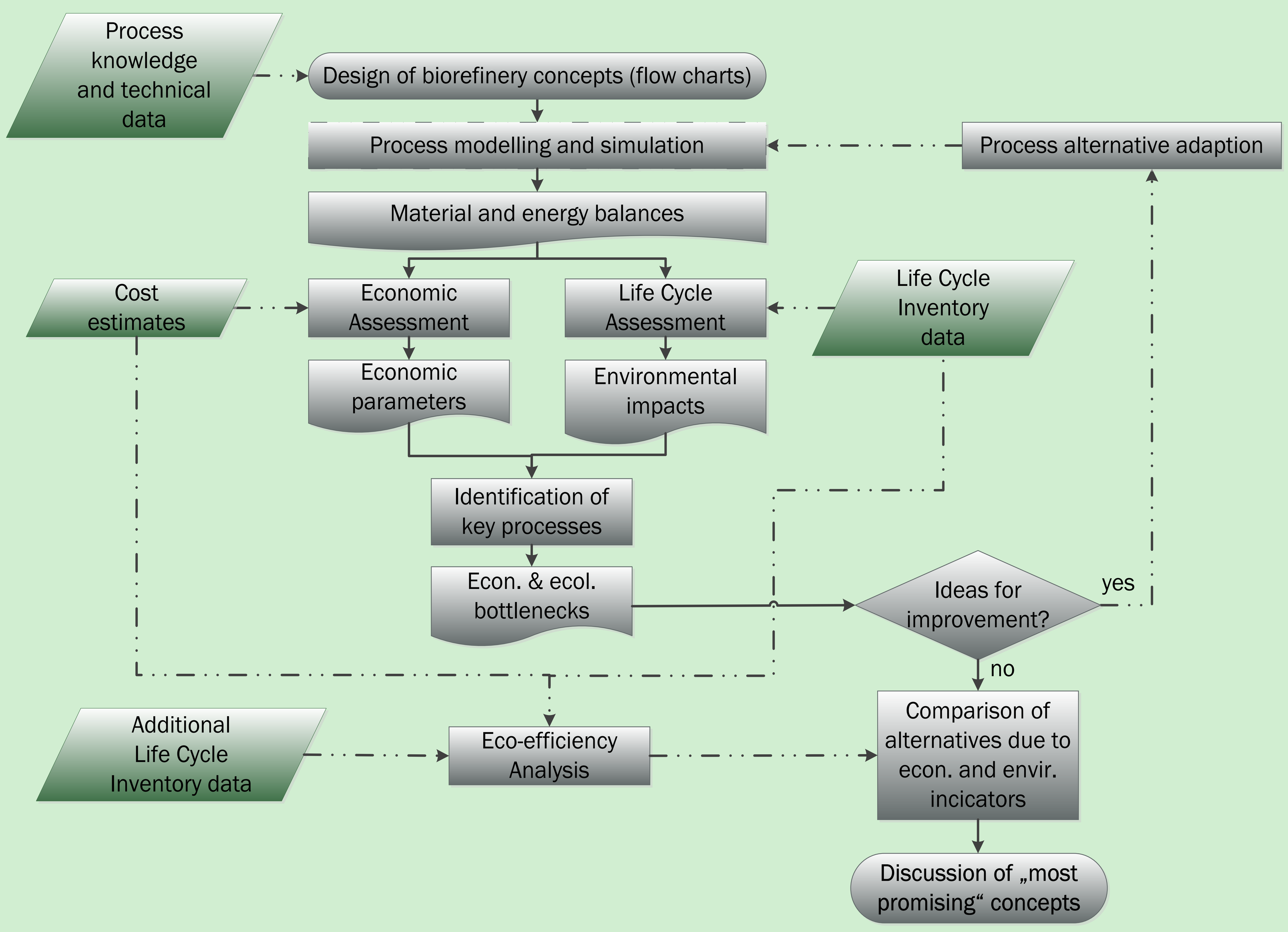
Roy Nitzsche, Maik Budzinski, Arne Gröngröft, Stefan Majer

Background and objectives

The strong global dependence on fossil fuels results from the intensive use and consumption of petroleum based derivatives. With regard to the risks of diminishing petroleum reserves, there is need for an change-over from a fossil-based chemistry to a bio-based. The utilization of biorefineries is thereby seen as a path with great prospects. Due to the multitude of possible raw materials, products and conversion pathways the development and optimization of sustainable biorefinery concepts turns out to be a major challenge. Based on this background the following objectives are pursued: (i) compilation of a methodology for the assessment and optimization of biorefineries on the basis of economic and environmental parameters, (ii) extension of the eco-efficiency analysis according to ISO 14045 and (iii) development of sustainable biorefinery concepts based on new technologies and established conversion and refining processes.

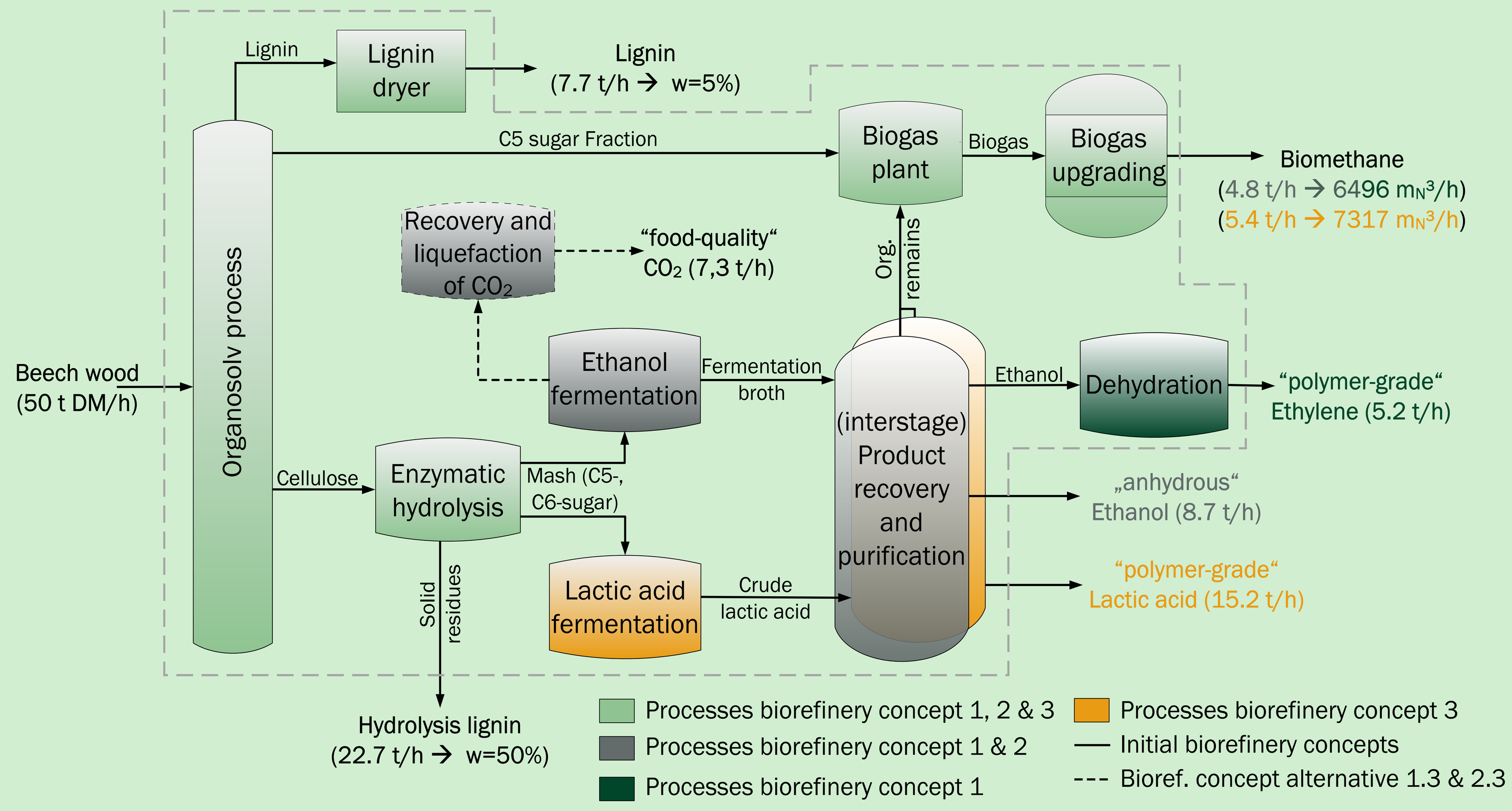
Methodology for process design

The developed methodological approach is shown in the following figure. After determination of material and energy balances of initial biorefinery concepts process specific economic and environmental optimization potential is identified to generate optimization alternatives. By an eco-efficiency analysis the various biorefinery alternatives can be compared with each other identifying the most promising concept.



Biorefinery concepts

Three initial biorefinery concepts are modeled and simulated with Aspen Plus® V8.6 taking into account data from current literature. The three different primary products of the concepts are produced per dry tonne of beech wood in an amount of 0.10 t of polymer-grade ethylene, 0.17 t of anhydrous ethanol and 0.30 t of polymer-grade lactic acid.



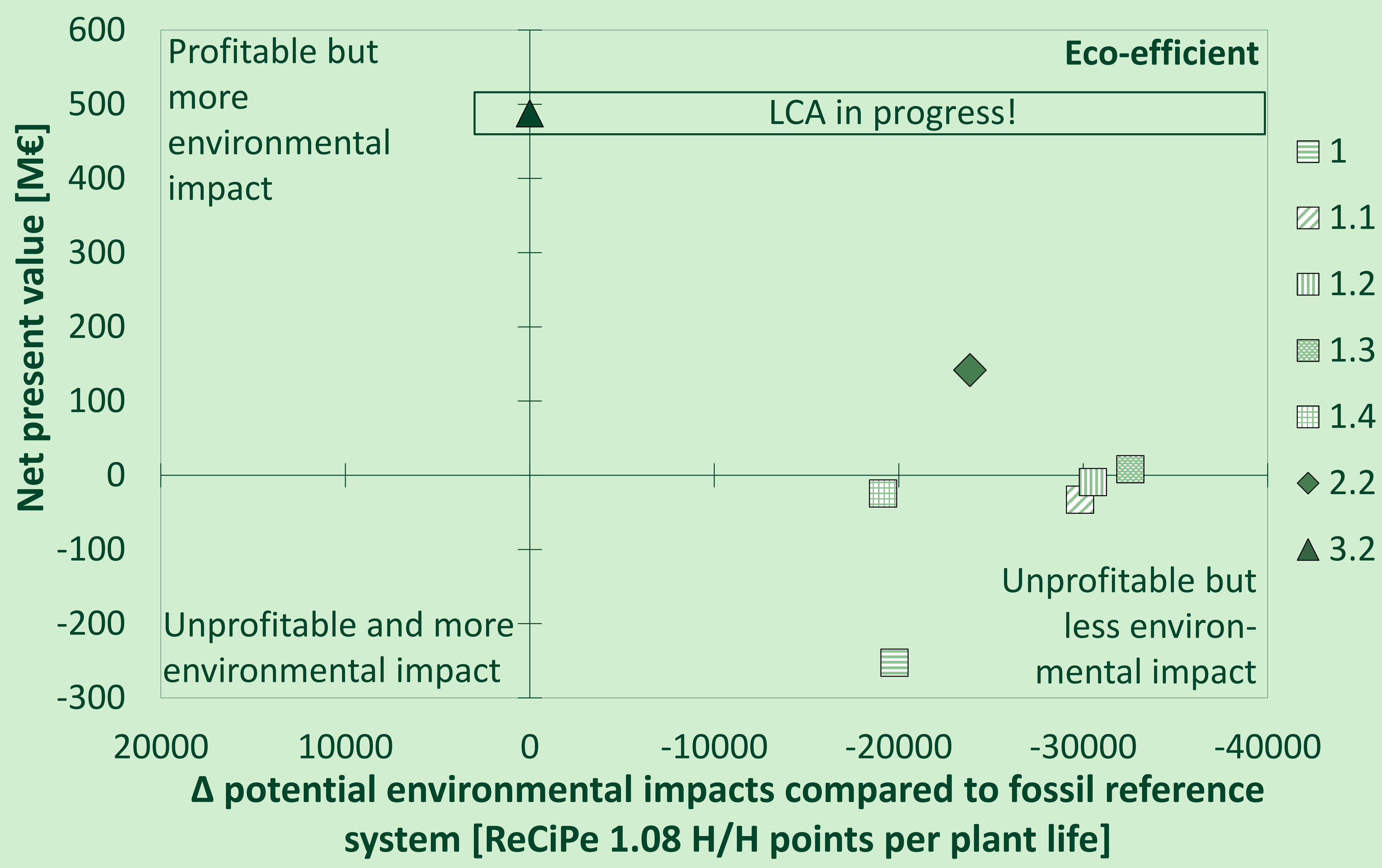
Concept and optimization alternatives

During the application of the methodology four exemplary concept and/or optimization alternatives were developed.

Alternative X.1	Alternative X.2	Alternative X.3	Alternative X.4
• Optimization of separation columns by mechanical vapor compression and thermal coupling	• Optimization of energy consumption by heat integration (Pinch analysis) • Based on alternative X.1	• Utilization of further by-products or residual materials • Based on alternative X.2	• Use of energetic residues for internal energy supply • Based on alternative X.2/X.3

Exemplary results of eco-efficiency analysis

A biorefinery concept is declared to be eco-efficient if the following two criteria are satisfied: (i) the construction and operation of the biorefinery is profitable (NPV>0) and (ii) the products of the biorefinery cause less potential environmental impacts compared to fossil reference products over the entire life cycle (ΔReCiPe score<0)



Conclusions

The assessment methodology allows distinct identification of economic and environmental key parameters and the elaboration of promising optimization approaches.

The newly developed eco-efficiency approach enables an appropriate economic and environmental comparison between different biorefinery concepts.

The exemplary calculations indicate the possibility to design profitable biorefinery concepts causing less potential environmental impacts compared to fossil reference systems.

Deutsches Biomasseforschungszentrum gemeinnützige GmbH (DBFZ)
Contact person: Dipl.-Ing. Roy Nitzsche
E-Mail: roy.nitzsche@dbfz.de Phone. +49(0)341-2434-574

www.bioeconomy.de

INVENTED IN GERMANY
SPONSORED BY THE Federal Ministry of Education and Research

MARKET ACCEPTANCE OF BIO-BASED PRODUCTS

Background

To foster an innovation-friendly market environment for bio-based products, the European Commission's Bioeconomy Strategy proposes the development of standards and standardized sustainability assessment methodologies as well as the promotion of bio-based products via public procurement. The Open-Bio project supports this policy initiative by performing co-normative research and by developing an information system to support the procurement of bio-based products.

Objective

To ensure the effectiveness of measures that support the demand of bio-based products, the research conducted at the TU Berlin aimed at the identification of key criteria for the acceptance of bio-based products and related standards and information systems, including labelling options for bio-based products.

Description of Activity

Two Delphi surveys were conducted in March/April 2014 (1st round) and April/May 2015 (2nd round) among business and procurement experts. The business survey (320 respondents from 17 EU member states) provides an overview of market drivers and barriers as well as the role of product labeling and standardization for the market uptake of bio-based products. The procurement survey (171 respondents from 12 different EU member states) focused on possible measures and informational needs for enhancing the uptake of bio-based products in public procurement.

Survey Results

Most important market drivers

1. positive public image
2. independence from fossil sources
3. savings in CO_2 emissions
4. compliance with environmental regulation

↗ The B2B market uptake of bio-based products is driven by their **positive public image** and certain **environmental benefits.**

Most important market barriers

1. higher cost of production
2. uncertainty about future regulation
3. volatility of feedstock prices
4. unsupportive regulatory environment

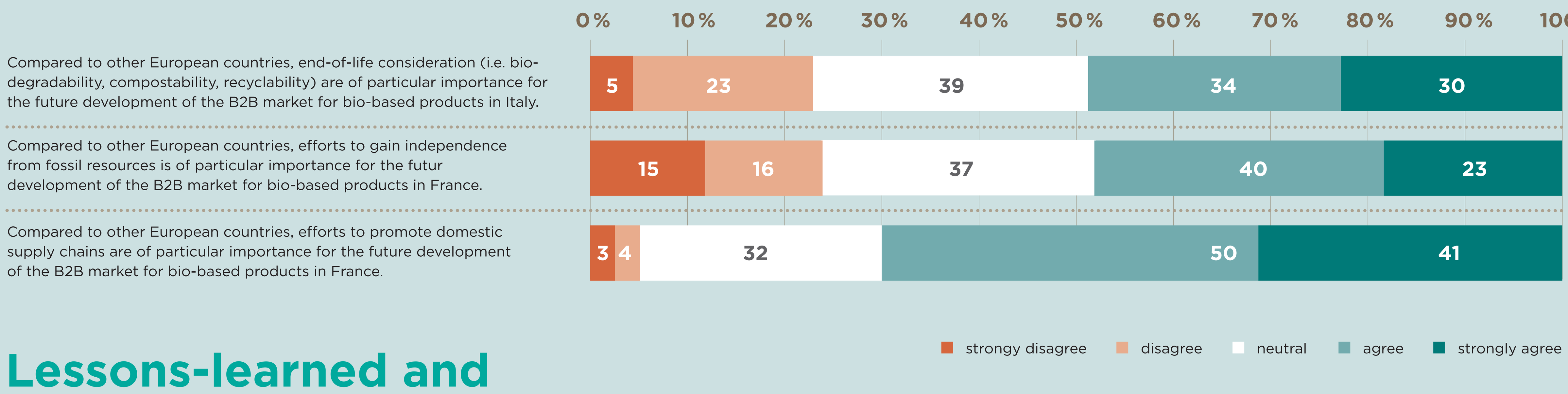
↗ **Challenges related to the regulatory environment** as well as **high production costs** and **volatile feedstock prices** are among the most important market barriers.

Most important reasons for the limited use of specifications on bio-based content in public procurement

1. The available bio-based products are frequently too expensive.
2. Specifications on bio-based content are difficult to verify.
3. Information about available bio-based products as alternative for fossil-based products is not easy to find.
4. Bio-based content is not considered a relevant product attribute.

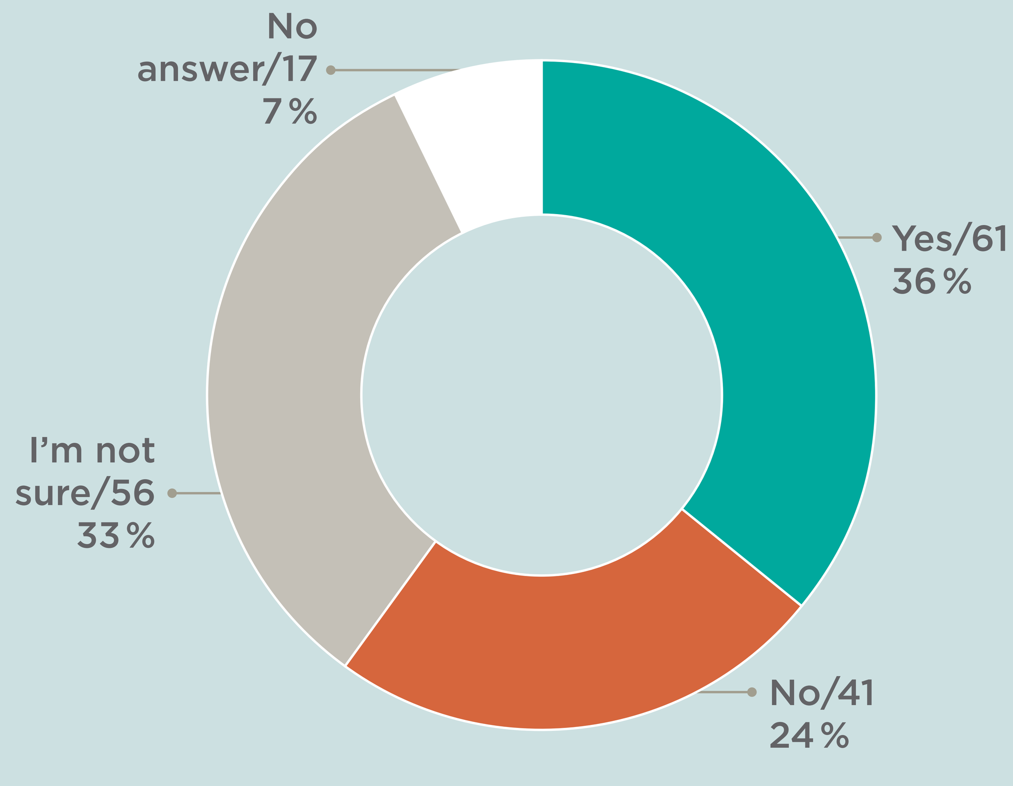
Market drivers and barriers – Key country Differences

Taking your personal experiences in the bio-based market into account, please indicate to what extent you agree or disagree with the following statements.



Public procurement and bio-based products – current practices

Would current public procurement practice in your organization allow you toutilize specifications on bio-based content as basis for taking a procurement decision?



Lessons-learned and Recommendations

↗ **Higher prices are a main barrier for market acceptance.** Higher cost of production and the volatility of feedstock prices are among the main barriers for a broader market acceptance of bio-based products.

↗ **Political commitment and stable regulatory support needed.** Business experts identify uncertain and unsupportive regulatory environment as key market barriers. Simultaneously, environmental regulation is considered a key market driver. Procurement experts identify a political decision to promote bio-based products via public procurement as a key to enabling its uptake of bio-based products in green public procurement.

↗ **Bio-based products have to comply with multiple environmental criteria.** If marketed as green products, bio-based products need to ensure compliance with a comprehensive set of environmental and sustainability criteria. Bio-based content alone is not sufficient to justify a green premium.

↗ **Country differences should be considered when developing European standards and regulations.** End-of-life considerations are of particular importance in Italy, while feedstock-related concerns and local supply chain development are especially important in France.

↗ **(Eco-)labeling can be an important vehicle for supporting the uptake of bio-based products.** A large majority of experts consider a label for bio-based product as an important instrument for promoting the uptake of bio-based products. Eco-labels represent important reference points for the practice of green public procurement. The incorporation of criteria in such labels can play an important role for their uptake in public procurement.

CONTACT: Chair for Innovation Economics, Technische Universität Berlin
Dr. Jan Peuckert: jan.peuckert@tu-berlin.de,
Dr. Rainer Quitzow: rainer.quitzow@tu-berlin.de

For more information on the Open-Bio project, see **www.open-bio.eu**

The research leading to this publication was funded by the European Commission's Seventh Framework Programme for Research and Technological Development under Grant Agreement no KBBE/FP7EN/613677.

FISCH, the cluster for sustainable chemistry in Flanders, as a catalyst for building new bio-based value chains

FISCH
Chemistry for Sustainability

Dr. Ir. Tine Schaerlaekens Program Manager tschaerlaekens@fi-sch.be www.fi-sch.be

Background

FISCH, Flanders Innovation Hub for Sustainable Chemistry, is **a public-private partnership** between the **Flemish government** and the **chemical industry**.

Objective

The mission of FISCH is to **identify, stimulate and catalyse innovations** for sustainable chemistry in Flanders. In order to reach its goals, FISCH controls an innovation budget of circa **5M € per year**.

Activities

The **innovation agenda** of FISCH consists of four programs:

Renewable Chemicals
Using nature's power

Process Intensification
Faster, smaller, better

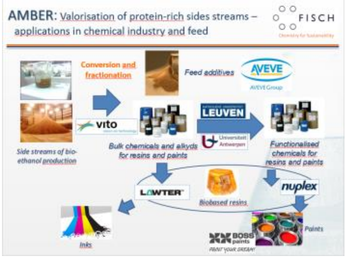
Sidestream Valorisation
Waste becomes resource

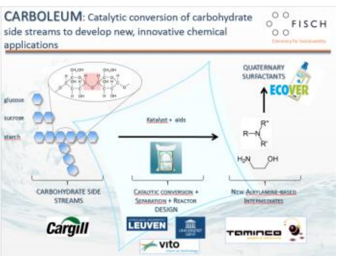
Advanced Sustainable Products
Clean and green

Within these four programs, FISCH develops strategic roadmaps and sets up innovation projects with its **member companies** and **research institutes**. The main focus is on **collaborative research and development projects** covering new value chains with short to midterm valorization by companies active in Flanders. In addition, FISCH supports **strategic basic research** with longer term valorization, **infrastructure- and incubator-related activities** and **pilot- and demonstration-scale projects.**

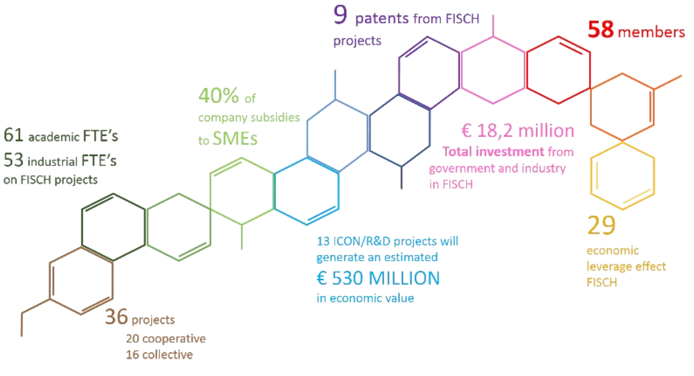
For setting up pilot projects in the domain of bio-economy, FISCH collaborates with the regions of **North-Rhine Westphalia** and the **Netherlands** within the **BIG-C consortium**.

Examples of projects:





Results



Lessons learned

A public-private partnership between industry and government, and with an important role for the research institutes, is an effective way to support the larger scale collaboration projects that are necessary for the transition towards a bio-based economy.

Agri-Food Residues as Feedstocks for the Industrial Biotechnology

Joachim Venus, Daniel Pleissner

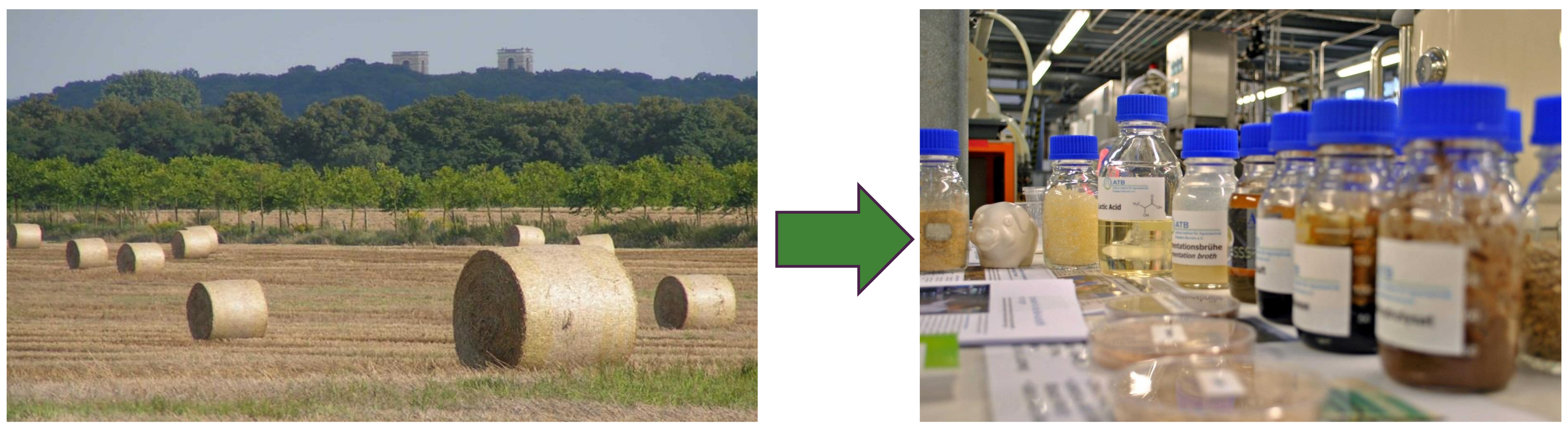
ATB Leibniz-Institut für Agrartechnik Potsdam-Bornim e.V.

Leibniz Institute for Agricultural Engineering Potsdam-Bornim e.V. (ATB)

Leibniz-Gemeinschaft

BACKGROUND & OBJECTIVES

Renewable resources can be utilized directly, e.g. as energy carriers, as packaging materials, as fibres, for the production of colouring agents or as lubricants. However, they can also be converted biotechnologically by enzymes and microorganisms, giving us access to a multitude of biocompatible products and possible uses. The industrial application of renewable resources is one of the five priority fields of action, which were identified in the "National Research Strategy BioEconomy 2030" to address a cascading and coupling use of biomass. In this context of application paths (biomass for food & feed, as industrial raw materials, energetic use) the food security always takes the highest priority followed by higher added value products like chemicals and materials.



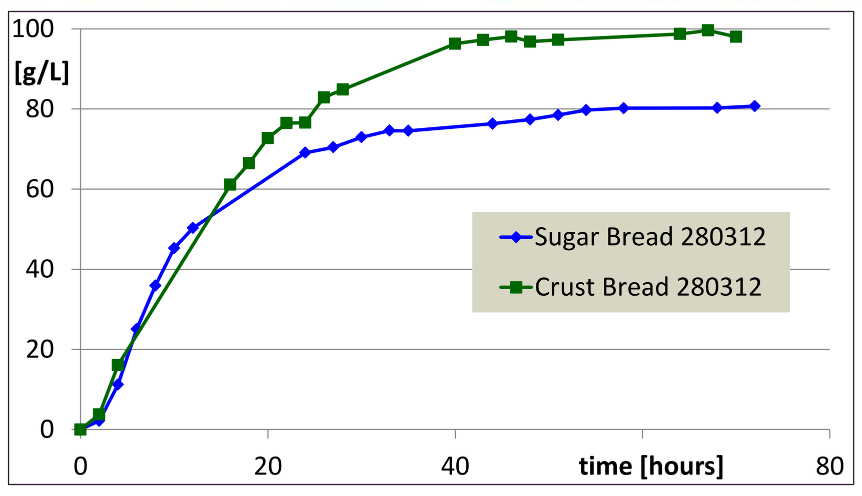
Renewable feedstocks (e.g. lignocellulosics, green biomass, agri-residues, and food waste) are being used as raw materials for the production of microbial lactic acid (LA). Lactic acid, its salts and esters have a wide range of potential uses and are extensively used in diverse fields, e.g. bioplastics (PLA).

RESEARCH ACTIVITIES & RESULTS

There have been various attempts to provide bulk chemicals like lactic acid from inexpensive raw materials also at low costs. The value of (agri/food) residues as carbon and/or nutrient source depends on their specific contents of cellulose, hemicellulose, lignin, starch, protein and minerals. The different materials have to undergo a pre-treatment and hydrolysis to release the fermentable sugar components. Various methods for the pre-treatment are available and widely used. Possible disturbing impurities and inhibitors (e.g. phenolic components from lignocellulosics, heavy metals in municipal waste or recycled paper), difficult to use components (e.g. pentoses) and partly fluctuating or relatively low concentrations of bio-available carbon sources in these materials should be considered. Special detoxification steps can help to improve the fermentability and conversion efficiency of such lignocellulosic hydrolysates.

Pilot plant facility for lactic acid fermentation at Leibniz Institute for Agricultural Engineering Potsdam-Bornim / ATB

Fermentation feedstocks already tested:



BREAD4PLA

The main objective of a EU Life+ project (BREAD4PLA) was to demonstrate the viability of lactic acid (LA) synthesis from waste products of the bakery industry and its use in the fabrication of a 100% biodegradable film to be used in the packaging of bakery products, closing the life cycle.

LESSONS-LEARNED & RECOMMENDATIONS

Because of the relatively low price of LA, one of the major challenges in its large-scale fermentative production is the cost of the raw material. Therefore an optimization is necessary to find a balance between the substitution of expensive nutrients and the limitation of interfering or undesirable components of natural raw materials, respectively. Exploitation of high quality L(+)- and D(-) lactic acid for the production of biopolymers is one of the recent applications.

REFERENCES & ACKNOWLEDGEMENTS

[1] Turon, X., Venus, J., Arshadi, M., Koutinas, M., Lin, C., Koutinas, A. (2014) Food Waste and Byproduct Valorization through Bio-processing: Opportunities and Challenges. BioResources [Online] 9: 4, 5774-5777

[2] Venus, J.: Utilization of Waste Bread for Lactic Acid Fermentation. ASABE Annual International Meeting 2014, Volume 1, 2014, Pages 557-562

[3] Pleissner, D.; Venus, J. (2014) Agricultural residues as feedstocks for lactic acid fermentation. - ACS Symposium Series, Vol. 1186 "Green Technologies for the Environment", Chapter 13, pp 247-263

This work is supported by the COST Action TD1203 - EUBis

EUBIS Chemicals from Food Waste

Contact:
Dr. Joachim Venus (Program Coordinator, Group Leader)
Leibniz Institute for Agricultural Engineering Potsdam-Bornim e.V.
Max-Eyth-Allee 100, D-14469 Potsdam, GERMANY
Fon: +49(331)5699-112 | email: jvenus@atb-potsdam.de

FPC - A Bio-Composite from Agricultural Waste to Replace/Reduce Plastics

Gordon Yu

Managing Director, Taiwan Hsinchu Green Industry Association
Chairman & CEO, eTouch Innovation Co. Ltd.
eMail: GORDONY@ETOUCHIC.COM
Mobile Phone: +886 981 012187

BACKGROUND

Although the feature of bio-degradable is desirable from the bioeconomy viewpoint, BioPlastics (Such as PLA, PHA, PBS, etc.) today has a few drawbacks, among them:

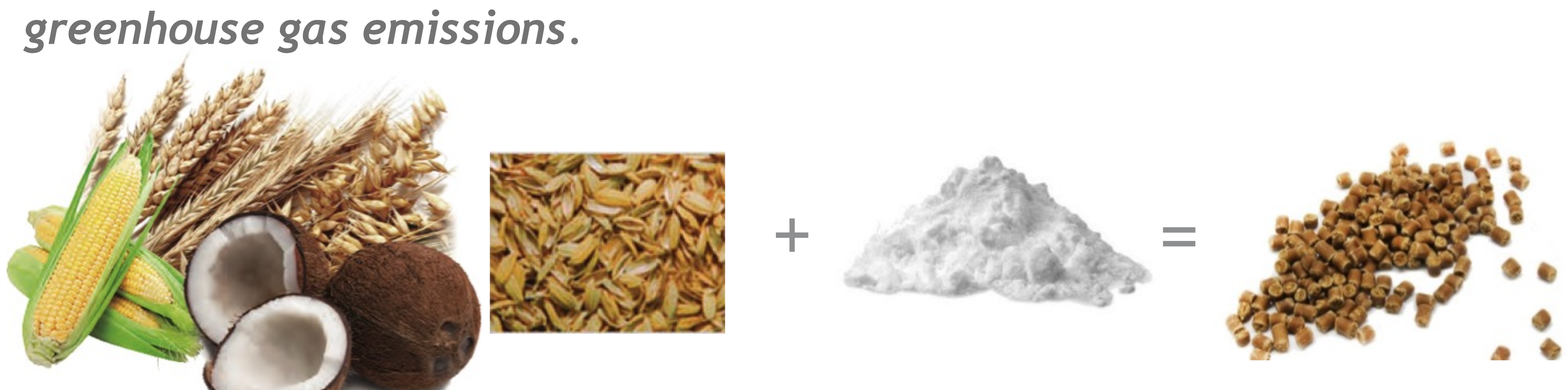
1. **Pricing:** Typically 2 times more expensive than conventional Fossil-fuel based plastics, due to its complex and high production cost.
2. **Reusable/Recyclable:** Bioplastics, such as PLA cannot be recycled in many countries, it can contaminate the waste stream, reportedly making other recycled plastics unsaleable.
3. **Competing with Food Production:** Bioplastics compete for land with biofuels and food crops (as the primary feedstock is currently corn).
4. **High Impact to the Environment:** Bioplastics' complex production process requires large amount of fossil fuel energy and large amount of land is required to produce feedstock. Study has shown that Corn-based bioplastic emits climate change gas in landfill and some need high temperatures to decompose.
5. **Truly Bio-degradable or Disintegrable ?**

OBJECTIVES

To create a new composite material from agricultural waste which is 100% Bio-degradable and Compostable, to replace or reduce the use of plastic, with pricing comparable with those from fossil fuel based plastic. It can also be Reusable, or Universal Recyclable, with production process very low impact to the environment.

DISCRIPTION OF ACTIVITY – Development of FPC

FPC (Fiber Particulate Composite) is made of 100% natural ingredients from agricultural waste* which contains fiber and proprietary natural compatiblizer (binder) in a pellet format. FPC can be used like a "plastic" and is compatible with any current plastic manufacturing methods such as injection molding, etc. It is a new type of bio-composite material that shows a significant ***reduction*** *in* ***petrochemical plastic usage*** and ***greenhouse gas emissions***.



agricultural wastes* + 100% **natural compatiblizer** = **FPC**

* such as rice/wheat husks, corn stalks, bamboo chips, sugarcane bagasse, coconut shells, wood chips, palm/coffee residues, etc.

Environmental-Friendly Production & Facility

Production process of FPC is purely *GREEN*, none artificial chemicals is added, none pollution is generated.

The only by-product is clean water.

0%
No Water pollution

0%
No Air pollution

0%
No Sound pollution

RESULTS

1. Replacement of Plastics

FPC can be used by itself; Product made by 100% FPC is truly Bio-degradable and Compostable, which is perfect for disposable items or packaging material. However, the physical strength may not be as good as plastics in certain applications.

Products Using 100% FPC to Replace Plastics or Paper Fiber.
Great for EPR (Enhanced Producer Responsibility) of Packaging Industry.

Plant Pot | Golf Tee | Disposable Plate | iPhone 3 Holder | Building Material

2. Reduce the use of Plastics

FPC can be mixed with petrochemical plastics, such as PP, PE, PVC, EVA or natural Rubber or synthetic rubbers (SBR, TPR, TPE) etc. in any combination ratio from 0~100% to create **Biohybrid Products** which combines both characteristics of Petrochemical Plastics and Bioplastics of being sustainable.

Eco FiberBoard 50% FPC + 50% EVA
Eco Slipper 65% FPC + 35% EVA
Utentials 50% FPC + 50% PP
Floor Mat 30% FPC + 70% EVA
Yoga Mat 40% FPC + 60% Natural Rubber

3. Compatible with Current Plastic Production Methods

FPC can be used alone or mixed with others in any of the current plastic production methods without the need to modifiy current production equipments. FPC is suitable for Injection, Extrusion, Forming, Thermal-forming, Hot pressing, etc.

4. Healthier than Petrochemical based Plastics

FPC based product does not have the pungent smell typically associated with the new plastic/rubber products. Instead, it emits the light fragrance of plant which is healthier especially for floor mats/Yoga mats which will be closely in contact with human bodies. Green building products such as Eco FiberBoard (made by 50%FPC+50% EVA) contains zero (0) Methanal (Formaldehyde) which is not only with low or zero carbon footage, but definitely a healthy products in terms of smell and Methanal content.

5. Enormous Effect Preventing Air Pollution

Agricultural waste would have been burnt-away in many countries/areas due to it's low economic value especially in vast countries such as China and India. FPC is one of very effective solutions to significantly reduce the un-controlled burning of agricultrual wastes. According to UN Environmental Program 2014 Year Book calls for Air Pollution as the "World's Worst Environmental Health Risk"; over 3.5 million people died each year from outdoor air pollution. Between 2005 and 2010 the death rate rose by 4% worldwide. The cost of air pollution to the world's most advanced economies plus India and China is estimated to be US$3.5 trillion per year in lives lost and ill health.

RECOMMENDATIONS

1. Education & international cooperation especially in plastic industry
2. Regulations to ban the burning of agricultural waste in open air.
3. Incentives to encourage the products to adopt bio-degradable material
4. Enforcement of EPR (Extended Producer Responsibility)
5. World-wide Investment fund for FPC (Licensing available)