

Task 42

Biorefining in a Future BioEconomy

Triennium 2016-2018



Task 42

Biorefining in a Future BioEconomy

Prepared by:

René van Ree, Task Leader, of Wageningen University and Research Centre, The Netherlands

Ed de Jong, Assistant Task Leader, Avantium Technologies BV, The Netherlands

Operating Agent:

Kees Kwant, Netherlands Enterprise Agency, The Netherlands

Participating countries:

Australia, Austria, Canada, Denmark, Germany, Ireland, Italy, The Netherlands, USA

Website: <http://task42.ieabioenergy.com/>

Copyright © 2019 IEA Bioenergy. All rights Reserved

Published by IEA Bioenergy

Introduction

Biorefining, the sustainable processing of biomass into a spectrum of marketable biobased products and bioenergy/biofuels, is an innovative and efficient approach to use available biomass resources for the synergistic co-production of power, heat and biofuels alongside food and feed ingredients, pharmaceuticals, chemicals, materials, minerals and short-cyclic CO₂. Biorefining is one of the key enabling strategies of the Circular Economy, closing loops of raw biomass materials (re-use of forestry, agro, process and post-consumer residues), minerals, water and carbon. Therefore, biorefining is the optimal strategy for large-scale sustainable use of biomass in the BioEconomy. It will result in cost-competitive co-production of food/feed ingredients, biobased products and bioenergy combined with optimal socio-economic and environmental impacts (efficient use of resources, reduced GHG emissions, etc.).

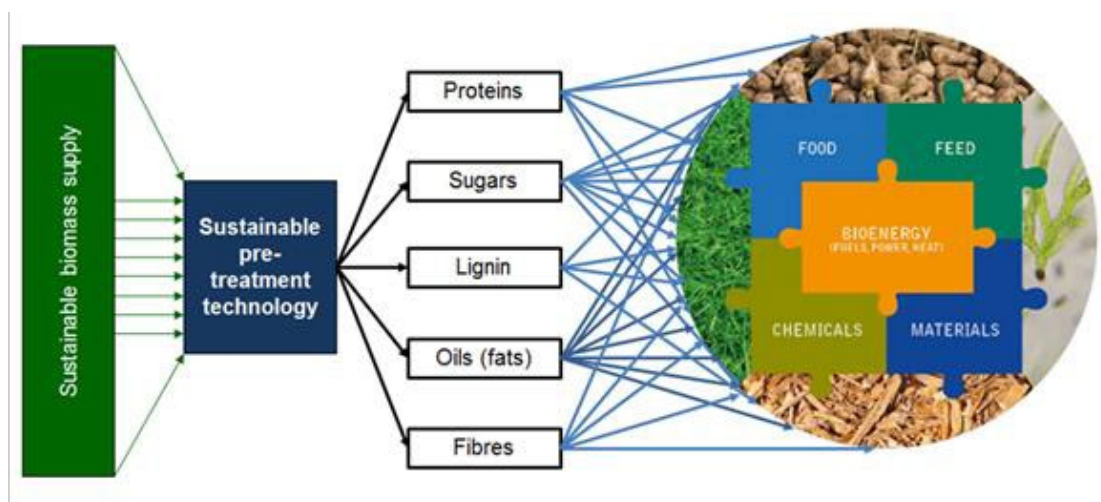


Figure 2. Bioenergy and biorefining being the lubricating oil of the Bio(based)Economy as part of the overall Circular Economy [IEA Bioenergy Task 42, 2017].

The aim of IEA Bioenergy Task 42 'Biorefining in a Future BioEconomy' is to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive biorefinery systems and technologies, and to advise policy and industrial decision makers accordingly. Task 42 provides an international platform for collaboration and information exchange between industry, SMEs, GOs, NGOs, RTOs and universities concerning biorefinery research, development, demonstration and policy analysis. This includes 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 biorefinery infrastructure and appropriate policies. Gaps and barriers to deployment will be addressed to successfully promote sustainable biorefinery systems market implementation.

Background

Biorefining is not a fully new approach. Thousands of years ago the production of vegetable oils, beer and wine already required pre-treatment, separation and conversion steps; whereas paper

production started around 100 AD. Today conventional industrial biorefineries are still mainly found in the food and paper sectors.

Within recently constructed biorefineries, bioenergy/biofuel based facilities are more common. In these biorefineries, heat, power and biofuels are the main products, and both agro and process residues are used to produce additional biobased products. In product based biorefineries, higher value food and feed ingredients, pharmaceuticals, chemicals, fibrous materials (e.g. pulp, paper) and/or fertilisers are the main products. They use low-quality agro and process residues for the production of bioenergy and less commonly, biofuels. Product based biorefineries are mainly found in the food, feed and dairy, and pulp and paper industries today.

It is expected that within the next 10-20 years the use of biomass for non-food and feed applications will shift from an energy to a more product-based approach. However, also in the longer term part of the biomass resources is still expected to be used for the production of advanced biofuels for transport (heavy duty road transport, aviation and shipping) and bioenergy (HT-heat, RES-hybrids).

In the **short-term (up to 2025)** advanced biorefineries may be introduced in a variety of market sectors, mainly by means of upgrading of existing infrastructures, reducing both initial investment costs and the time-to-market. Bioenergy will play both an initiating and central role for the market deployment of these advanced biorefineries by:

- Certified sustainable biocommodities that are now being developed and mobilised for energy applications will also be available as raw materials for the biorefinery facilities ensuring sustainable biomass supply
- Industrial bio-transportation fuel production facilities and digestion facilities can be further upgraded to integrated biorefineries co-producing fuels and added-value biobased products to optimise their overall sustainability, i.e. increase their financial market competitiveness.
- Low-quality value chain residues, i.e. residues that cannot be reused for added-value applications in an economically attractive way, such as forestry residues, agro-residues, process residues and post-consumer residues, will be used for bioenergy production.

A portfolio of new biorefining concepts - i.e. whole crop biorefineries, lignocellulosic feedstock biorefineries, oleo-chemical biorefineries, green biorefineries, thermochemical biorefineries, micro and macro algae (marine) biorefineries and next generation hydrocarbon biorefineries - is currently being developed. These concepts are expected to be implemented into the market in the **medium-term (2025-2030)**. However, the current economic conditions (low oil price, credit crisis, recessions in part of the world) might cause severe delays in their market deployment.

A very important challenge for the market deployment of product-based biorefineries is the availability of sufficient amounts of sustainable biomass resources. Product-based biorefineries potentially can accelerate their market deployment by using both the certification expertise and logistical infrastructures that are currently being developed and set-up for the use of sustainable biobased commodities for energy purposes.

Long term (towards 2050), the portfolio of product-based biorefinery concepts could expand further. Lignocellulosic feedstock, herbaceous (green), oleo-chemical and marine (microalgae and seaweeds) biorefineries may enter the market. However, expansion will require further technology development as product-based biorefinery facilities are generally less technically mature than

bioenergy/biofuel alternatives. In addition, current policy support is more favourable towards bioenergy and biofuels than the production of biobased products. As such, facilitating the market development of product-based biorefineries is likely to require more widespread policy frameworks to support biobased products, or minimally a level playing field. However, since such materials are generally higher-value products than bioenergy and biofuels, expanding markets for biobased products will be a key factor in product-driven refinery expansion.

Task objectives and work carried out

Table 1. Work Programme IEA Bioenergy Task 42 – Triennium 2016-2018.

Description	Responsible NTL [deliverable no]
Biorefinery Systems – Analysis and assessment of biorefining in the whole value chain (coordination: AT)	
Biorefineries expert system development and implementation	AT [D1]
Biorefinery Factsheets	AT [D2]
Upgrading industrial infrastructures to integrated biorefineries	AT [D3]
Product Quality – Reporting on biobased products/bioenergy standardisation, certification and policy activities at national, EU and global levels (coordination: D)	
Reporting on international developments standardisation/certification current/future biomass use	D [D4]
Evolving BioEconomy – Analysing and advising on perspectives biorefining in a circular Biobased Economy (coordination: IT)	
Role of bioenergy and biorefining in a Circular Economy (Reporting BioEconomy strategies/drivers with focus advanced biofuels/ bioenergy)	IT [D5]

Evolving BioEconomy – Analysing and advising on perspectives biorefining in a circular Biobased Economy (coordination: IT)	
Contribution to JTP Sustainable Supply Chains (Waste management strategies within a circular BioEconomy)	D [D6]
Monitoring of the Evolving BioEconomy in co-operation with EC DG JRC (Advising ExCo on BioEconomy policy support)	IT [D7]
Contributing to Biorefinery Success Stories	NL [D8]
Biorefinery Country Reporting	NL [D9]
Communication, Dissemination and Training – Knowledge exchange by stakeholder consultation, reporting and lecturing (coordination: NL)	
Biobased Chemicals Report (update)	NL [D10]
Proteins Report	NL [D11]
Biobased (Fibrous) Materials Report	AT [D12]
Task 42 Brochure, flyer, banner, poster	NL [D13-D15]
Bi-annual Task and Stakeholder Meetings (incl. excursions)	NL [D16]
Task 42 website and newsletters	NL [D17]
Contribute to Biorefining Training Activities	NL [D18]
Contribution to (inter)national conferences and workshops	All [D19]

Communication, Dissemination and Training – Knowledge exchange by stakeholder consultation, reporting and lecturing (coordination: NL)

Thematic workshops

NL [D20]

[Deliverables: see http://task42.ieabioenergy.com/](http://task42.ieabioenergy.com/)

BIOREFINERY SYSTEMS– ANALYSIS AND ASSESSMENT OF BIOREFINING IN THE WHOLE VALUE CHAIN

Biorefineries expert system development and implementation & Biorefinery Factsheets

A Biorefinery Assessment Platform Tool (BAP) [D1] was developed by the University of Graz (AT) with the input of all Task 42 NTLs. A full draft version of the platform is currently in operation, and was used in 2018 to deliver four case-study based Biorefinery Fact Sheets (BFSs) [D2]. The BFSs dealt with are:

- 2-platform (C5&C6 sugars, lignin) biorefinery to produce bioethanol, electricity & heat from corn stover;
- 2-platform (C5&C6 sugars, biogas) biorefinery to produce the biopolymer PHB, electricity & heat from sugar cane;
- 3-platform (C6 sugar, animal feed, lipids) biorefinery to produce the biopolymer PLA, animal feed & lipids from mixed food waste from the domestic sector;
- 3-platform (pulp, lignin, energy) biorefinery to produce pulp, lignin and energy from wood chips (spruce and pine).

Both the methodology/platform and some results (factsheets) have been presented in a lecture given at the IEA Bioenergy End of Triennium (EoT) Conference in San Francisco in November 2018. A report describing the platform and presenting the factsheets (combination D1 and D2) will be available on the Task 42 website for further dissemination from the middle of April 2019. The factsheets will also be put on the website separately as PDF-forms. The BAP will be used in the new triennium for assessment of an additional amount of factsheets within a Collaborative Inter-Task Project coordinated by Austria.

Upgrading industrial infrastructures to integrated biorefineries

As already explained early 2016, no activities dealing with upgrading of industrial infrastructures [D3] to integrated biorefineries took place in this triennium. The budget originally reserved for this activity was used to deliver D1 (BAP), which took more effort than originally foreseen.

PRODUCT QUALITY - REPORTING ON BIOBASED PRODUCTS/BIOENERGY STANDARDISATION, CERTIFICATION AND POLICY ACTIVITIES AT NATIONAL, EU AND GLOBAL LEVELS

The international developments in biomass standardisation and certification were monitored in this triennium by our German NTL. The results were reported in slide-decks that were made available on the T42 website.

The slide-decks 1 and 2 covering 2016 provide an overview of labels for biobased and/or compostable products, standards for agricultural feedstock, and relevant activities in the field of biobased products. Special attention is given to micro-plastics, whose role in the environment have gained huge interest. The integration of biodegradability and compostability might be a good opportunity for biobased products, as it follows the cradle-to-grave concept and avoids the micro-plastic debate. Test methods to determine those functionalities for different environmental compartments are shown. These methods are a prerequisite for product labelling. Special environmental functionalities, such as "biodegradable in soils" are used by certification bodies.

The slide-decks 3 and 4 covering 2017 summarise the progress of TC/493. They also show the final decision concerning indirect effects in bioenergy standards in Europe (CEN/TC383). Driven by the Action Plan for the Circular Economy in Europe, the question of the use of secondary raw materials for "sustainable chemicals" arose. That has led to an enquiry about the need for a standard for "Sustainable Chemicals".

Stakeholder consultation has taken place, the presentation contains an overview of relevant stakeholders; some stakeholders relevant for biorefinery activities are emphasised.

Also the existing and newly approved standards for biobased products, and standards concerning "sustainably produced biomass for energy applications" that might be adapted in the future due to the revision of the European Energy Directive, are shown. The ongoing activities for the prestandardisation activity for "Sustainable chemicals from secondary raw materials" are also displayed. In 2017, Japan has updated various standards/test methods for the determination of aerobic biodegradability of chemical substances and plastic materials in different environments or conditions. Labels for the compostability and biodegradability are shown together with the respective test methods in different countries as well as certification bodies from the US, Japan and Europe.

The biobased content can be expressed in different ways (biobased carbon content, organic matter content and biobased content); the corresponding test methods for the different approaches are shown. Furthermore an example is provided for compostable and biodegradable products and several industrial sectors in the US, Japan and Europe.

During 2018 the info in the side-decks was assessed and reported in a short summarising report [D4] that can be found on the Task 42 website.

EVOLVING BIOECONOMY - ANALYSING AND ADVISING ON PERSPECTIVES ON BIOREFINING IN A CIRCULAR BIOBASED ECONOMY

Role bioenergy and biorefining in a Circular Economy

Concerning the assessment of the role of bioenergy and biorefining in a Circular Economy [D5] a workshop in Brussels in September 2017 was organised, where representatives of IEA Bioenergy, FAO, OECD, EERA Bioenergy, ETIP Bioenergy, IRENA, JRC, and DOE were invited to present their views and activities in this field (slides available at Task42 website).

Contribution to JTP Sustainable Supply Chains

Task 42 (German NTL) participated as an observer in the Joint Tasks Project on Sustainable Supply Chains [D6], and brought in biobased products related data, wherever needed.

Monitoring of the Evolving BioEconomy in co-operation with EC DG

Together with EC DG JRC and the EU BBI JTU, our Italian NTL (ENEA) has set-up and distributed a questionnaire to monitor the evolving BioEconomy worldwide. Based on the replies, ENEA analysed the current deployment of biorefineries within this framework, presented the major results in a lecture at the EoT Conference in San Francisco in November 2018, and came-up with a summarising report [D7], which was made available on the Task 42 website, at the end of 2018.

Contributing to Biorefinery Success Stories

No activities dealing with Biorefinery Success Stories (BSS) [D8] took place in this triennium. The minor budget originally reserved for this activity was used to deliver D5/D7, which took more effort than originally foreseen. In the next triennium identification and description of these BSSs will be part of both the Biorefinery Country Reports (D2.2), the Global Biorefinery Status Report (GBSR) (D2.3), and the global mapping scheme and database on biorefineries (report, map/database for website) (D2.4).

Biorefinery Country Reporting

In this triennium, updated extensive Country Reports [D9] were produced by Australia, Denmark, Germany, Italy, and the USA, and are available for downloading from the Task 42 website.

Updates from Austria, Canada, Ireland and the Netherlands will be published on the website in Q1 2019.

Communication, Dissemination and Training - Knowledge exchange by stakeholder consultation, reporting and lecturing

Concerning Task 42 Reports, within this triennium the following glossy reports were delivered:

- Proteins for Food/Feed and Industrial Applications (2016) [D11];
- Standards and Labels related to Biobased Products (2018) [D4];
- Bioeconomy and Biorefining Strategies in the EU Member States and Beyond (2018) [D7];
- Natural Fibres and Fibre-based Materials in Biorefineries (2018) [D12].

Further, contributions were provided to:

- Workshop Report of ExCo79 on "The Role of Industrial Biorefineries in a Low-carbon Economy (2017);
- Joint Survey on Bioeconomy Policy Developments in Different Countries (2017).

An update of the Biobased Chemicals report [D10] (update) is currently (March 2019) being finalised, and will be published on the Task 42 website early in 2019. The same applies for the

final report on the Biorefinery Assessment Platform and Factsheets [D1/D2].

TASK 42 BROCHURE, FLYER, BANNER, POSTER


Other Task-related information (brochures, leaflets, newsletters, papers etc.) are available on the Task 42 website: www.task42.ieabioenergy.com.

BI-ANNUAL TASK AND STAKEHOLDER MEETINGS (INCL. EXCURSIONS)

During this triennium, the following Task Progress Meetings (TPMs), and related events, took place:

Table 2. Overview Task 42 Progress Meetings & Related Events – Triennium 2016-2018.

No. TPM	Date	Country	Place	Contribution related events
20	18/19 APR 2016	Ireland	Dublin	Discussion of biorefinery options in Ireland at a specific Irish Stakeholder Event "Irish BioEconomy Strategy Development"
21	11-14 NOV'1 6	Australia	Brisbane/ Mackay	5 lectures at Bioenergy Australia 2016 Conference, and an extensive excursion programme with visits to Wilmar Ethanol Distillery, QUT Biocommodities Pilot Plant, Mackay Sugar Cogen Plant en Sugar Australia.
22	15 MAY 2017	Sweden	Gothenburg	Joint (IEA Bioenergy/IETS) ExCo79 workshop on 16 May on "The role of industrial biorefineries in a low-carbon economy"
23	23-26 OCT'1 7	Vienna	Austria	Austrian Stakeholder Workshop and an Excursion to the Algae Photo-Bioreactor Demo Plant of ECODUNA-AG.
24	5 FEB 2018	Canada	Montreal	2 lectures contribution to International Conference BIOFOR

No. TPM	Date	Country	Place	Contribution related events
25/26	JUN/ OCT 2018	Skype Meetings		Task Progress Monitoring
27	5/6 NOV 2018	USA	San Franci sco	3 lecture contributions & Biorefining session at EoT Conference IEA Bioenergy being part of ABCL Global 2018

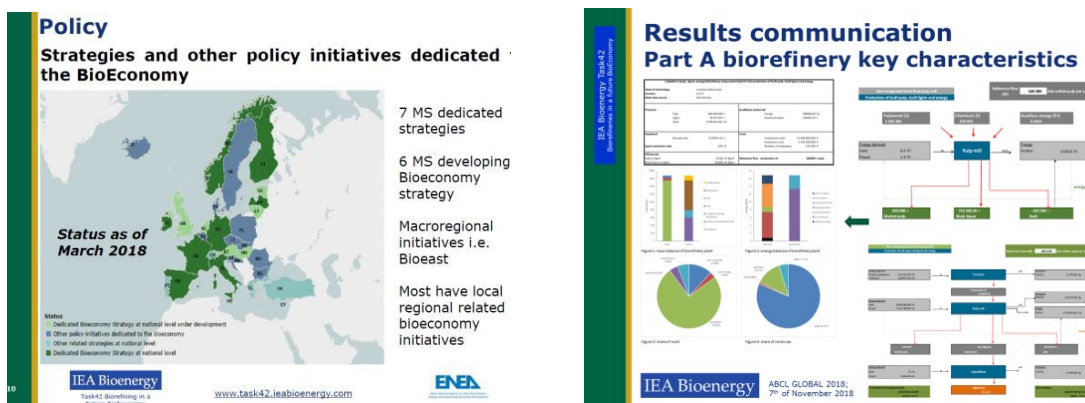


Figure 3. Selection Task 42's NTLs lecture contributions IEA Bioenergy EoT Conference in San Francisco, USA.

TASK 42 WEBSITE AND NEWSLETTERS

In this triennium a new Task 42 website: www.task42.ieabioenergy.com, directly linked to the website of IEA Bioenergy, was constructed. Several newsletters have been produced which were actively disseminated to a broader audience by Task management, and by the NTLs in their respective countries.



Figure 4. Photo compilation Task 42 Progress Meetings and Related Events

**SELECTION CONTRIBUTION TO BIOREFINING TRAINING ACTIVITIES,
(INTER)NATIONAL CONFERENCES AND WORKSHOPS**



Figure 5. Co-organised International BioBased Economy Student SymbioSUM, Wageningen, the

Netherlands, August 2016.

Task 42 organised the workshop "The role of bioenergy in the Circular Economy (CE) (incl. the BioEconomy) on 27 September 2017 in Brussels, Belgium. Task 42 invited IEA Bioenergy, FAO, OECD, EERA Bioenergy, ETIP Bioenergy, IRENA, JRC, and DOE to inform each other on: running and planned activities in the field mentioned, to analyse cooperation opportunities to be able to use available (financial) resources as efficiently as possible, and to come-up with results that will have broad support, to define one/more joint activities to be performed in the coming year(s), and to organise a joint dissemination event to communicate our views/results to a wider public (side event international conference).



Figure 6: Representatives international organisations at work at workshop.

THEMATIC WORKSHOPS

During this triennium three Thematic Stakeholder workshops have been organised, i.e.:

- Joint (IEA Bioenergy/IETS) ExCo79 workshop on 16 May on "The role of industrial biorefineries in a low-carbon economy";
- Workshop on "The role of bioenergy in the Circular Economy (CE) (incl. the BioEconomy); Task 42 invited IEA Bioenergy, FAO, OECD, EERA Bioenergy, ETIP Bioenergy, IRENA, JRC, and DOE;
- Two webinars dealing with TEE biorefinery assessments using the i-BIOREF tool developed by the Canadian NTL.

Success stories

Task 42 has produced and actively distributed several glossy reports showing the importance of the biorefining approach for the sustainable (co)production of food and feed ingredients, chemicals, materials, transport fuels, and energy as a foundation of a (future) Circular BioEconomy. However, several technical and non-technical barriers still exist that prevent large scale deployment of biorefineries into the market sector. The activities of Task 42 in this triennium, both the reports, stakeholder consultations, workshops etc. have contributed – by providing scientifically sound information/data to relevant stakeholder groups (industry, SMEs, policy makers) – to a broader consensus on the various pathways for sustainable use of the

available biomass feedstocks. The results also showed that bioenergy/biofuels – both in energy/fuel-based and product-based biorefineries – will continue to play an important role to meet the market demands in various sectors of the Circular BioEconomy.



Figure 7. Major glossy reports produced by Task 42 in the 2016-2018 triennium (the last two will be officially published early 2019).

Conclusions and recommendations

CONCLUSIONS

1. IEA scenario calculations have shown that efficient and sustainable use of biomass will be the key driver to reach 2050-2060 GHG-emission reduction targets, and the uptake of biorefineries at industrial level will be required to achieve this. **Co-production of biobased products and bioenergy by industrial symbioses can have the highest impact on both meeting the climatic goals and economic growth.** Governmental facilitation, communication and education will be needed to support large-scale market deployment [reference: minutes TSW1, May 2017].
2. Optimal sustainable biomass valorisation approaches to Food and Non-food (incl. Energy/Fuels) are countless; however, biorefining/bio-cascading is always the approach to use to maximise full sustainability. **Bioenergy can be the main driver – biofuel/energydriven biorefinery approach – or a secondary product (product-driven biorefinery approach),** but it will always be part of the optimised biomass valorisation path.

3. There are several international organisations (IEA Bioenergy, IRENA, OECD, FAO, EERA Bioenergy, ETIP Bioenergy, EC DG JRC, etc.) often working separately in the bioenergy, biorefinery and BioEconomy areas. **Cooperation** by joint activities and dissemination potentially **will increase the quality of the output of the work programmes, will use available budgets more efficiently, and will reach a broader public for knowledge dissemination** [reference: TSW2, September 2017]. Cooperation with other International Organisations on the first instance will potentially result in synergy, i.e. in time and budget reduction, however, it will sometimes also lead to a more inefficient and unclear approach with an uncertain final result [reference: AA3 BioEconomy Survey in cooperation with EC DG JRC].
4. Specifically for the energy sector, Task 42 recommends that **upstream protein extraction prior to the conversion of biomass into "energy"** and/or co-valorisation of protein-rich agro or process residues adds value and **improves the business case**.
5. **Building a Biorefinery Assessment Platform (BAP)** for the technical, economic and environmental (TEE) assessment of integrated biorefineries **is difficult but can be done**. However, **getting the right input data** to be able to do the assessments **is an even more challenging** and time consuming activity, and will need the support of the more technology specific Tasks. Broad support for the use of the BAP for these kind of assessments will be necessary by strong cooperation with other Tasks (Sustainability Assessment etc.) [reference: AA1 activities].
6. Concerning the assessment of the market deployment aspects of integrated biorefineries, it can be concluded that **there are still many technical AND non-technical barriers to be solved** before large-scale implementation of biorefineries within the circular (bio)economy will become a reality. IEA Bioenergy Task 42 can play an important role to overcome these barriers by knowledge dissemination on international best-practices, bringing together full chain stakeholders and stakeholders normally operating in different market segments, providing clear Biorefinery Fact Sheets, and producing reports on added-value products (chemicals, proteins, fibrous materials) potentially to be coproduced with bioenergy to improve its overall sustainability.
7. Industrial/SME stakeholders can be best supported in finding their way in a future BioEconomy by showing them for example by the Country Reporting and the BAP/BFSs the **international developments and clear facts on biorefinery technology** opportunities as part of full sustainable value chains.
8. Policy advice on further biorefinery deployment needs to be formulated taking into account the **market point-of-view**. IEA Bioenergy Task 42 could provide the platform to bring together market players to discuss implementation barriers and potential policies to be developed. These recommendations can be transferred to ExCo to discuss with the international/national governmental organisations.
9. Both **knowledge dissemination and training** are very important for further expertise building and technology development to provide the (technical) foundation for further biorefinery deployment feeding the circular (bio)economy.

RECOMMENDATIONS TO THE EXCO

Biorefining (and bio-cascading) is the most efficient approach to meet future Food and non-food market demands of a Circular BioEconomy. In spite of the fact that biorefineries are already applied for ages in for example the food and pulp/paper industries, further facilitation is still required to disclose its full market potential. In the short-term, bioenergy (fuels, power, heat) is expected to play an initiating role in the transition to a Circular Bio(based) Economy by providing biomass mobilisation and certification expertise, facilities and infrastructure, and chain covering stakeholders that potentially can be used to kick-start biorefinery deployment, with the aim to use the available biomass potential in a sustainable way to co-produce both food/feed ingredients, biobased products (chemicals, materials) and energy (fuels, power, heat). In the mid and longer-term bioenergy is expected to play a central role as part of efficient biocascading/biorefining approaches within the Circular Bio(based) Economy by:

- Providing sustainable biofuels – biofuels sustainably produced from non-food biomass sources – to sectors where they are the only alternative fuels to be used to reduce their GHG emissions, i.e. aviation, shipping and heavy duty transport – biofuel-driven biorefinery approach.
- Valorisation of primary (agro), secondary (process) and tertiary (post-consumer) chain residues to both power/heat to be used to meet internal product-driven biorefinery-based process energy requirements or for external use, and to sustainable biofuels to meet (part of) the logistical energy requirements for biomass sourcing and product delivery purposes – biobased product-driven biorefinery approach.
- Valorisation of biomass residues and non-food biomass sources to power/heat in highly efficient co-firing and stand-alone conversion facilities with upstream value-added products extraction and/or valorisation of process residues – energy-driven biorefinery approach.

With biorefining being one of the key enabling strategies of the Circular Economy – closing loops of raw biomass materials (re-use of agro-, process- and post-consumer residues), minerals, water and carbon – IEA Bioenergy Task 42 should be continued for another 3 years, with the main focus on:

- Provision of quantitative, scientifically sound, and understandable data on technical, economic and ecological added-value of biorefining to co-produce bioenergy and bioproducts in a sustainable way, by further developing a Biorefinery Assessment Platform (BAP) and delivering Biorefinery Fact Sheets (BFSs). The success of the further development and use of the BAP producing related BFSs is depending on cooperation with other IEA Bioenergy Tasks, both the technology oriented ones for biorefinery selection and data provision and the more chain and assessment oriented ones providing a platform for common dissemination. This activity therefore will be performed as a Collaborative Inter Tasks Project.
- Provision of global biorefineries implementation status, major deployment barriers and market data, by: performing case studies identifying Barriers and Incentives for Market Diffusion; providing Biorefinery Country Reports, a Global Biorefinery Status Report, a Global Database/Mapping of Biorefineries, reports on Sustainable Lignin Valorisation, and slide decks on international developments Biobased Products Standardisation/Certification.

- Provision of an international platform for cooperation and information exchange, by organising biannual physical Task Meetings in partnering countries preferably coupled to a national stakeholder event/excursion, 3-monthly Skype Progress Meetings, Progress Reports for IEA Bioenergy ExCos, etc.

Attachments

Participation in major events, lectures and publications

- Annevelink, B., 2018. The IEA Bioenergy Task 42 Perspective for Biorefining in a Growing BioEconomy. BIOFOR International Conference, Montréal, Canada, 6 February 2018.
- Bell, G. & E. de Jong, 2016. IEA Bioenergy Task 42 – Biorefining in a Future BioEconomy. Webinar and Participation Group Meeting, Bioenergy Australia, 25 May 2016.
- Bell, G. & E. de Jong, 2016. What is Australia’s biofuel future? Ecogeneration, 28 October 2016.
- Bell, G., 2016. Second Generation Bio-Refineries – Implications for Australia. Presentation at Irish Stakeholder Meeting combined with Task 42 Progress Meeting, Dublin, Ireland, 19 April 2016.
- Bos, H., E. Annevelink & R. van Ree, 2017. The Role of Biomass, Bioenergy and Biorefining in a Circular Economy. Presentation at IEA Bioenergy Task 34 Workshop, Paris, 10 January 2017.
- Diaz-Chavez, R., H. Stichnothe & K. Johnson, 2016. Sustainability considerations to the future bioeconomy. In: Lamers, P., E. Searcy, J.R. Hess & H. Stichnothe (eds), *Developing the global bioeconomy: technical, market, and environmental lessons from bioenergy*. Amsterdam; Boston; Heidelberg: Elsevier, pp 69-90.
- Elbersen, W., Ree van, R., 2018. The need for biocommodities to link the available biomass potential to the European feedstock and fuel needs in the coming decades. ETIP Workshop “Bioenergy towards 2030” at EUBCE-2018, Copenhagen, Denmark, 16 May 2018.
- Hess, J.R., P. Lamers, H. Stichnothe, M. Beermann & G. Jungmeier, 2016. Bioeconomy strategies. In: Lamers, P., E. Searcy, J.R. Hess & H. Stichnothe (eds), *Developing the global bioeconomy: technical, market, and environmental lessons from bioenergy*. Amsterdam; Boston; Heidelberg: Elsevier, pp 1-9.
- IEA Bioenergy – Managing Editor C.T. (Tat) Smith, 2015. *Mobilising Sustainable Bioenergy Supply Chains*, November 2015.
- Jong de, E., with input of NTLs IEA Bioenergy Task 42, 2019. *Biobased Chemicals – Update 2019*, to be published Q1 2019.
- Jong de, E., Avantium Chemicals, the Netherlands, 2018. *Biobased Chemicals – Current Status & Future Perspectives*. IEA Bioenergy EoT Conference, San Francisco, US, November 2018.

- Jong de, E., 2018. Zambezi Biorefinery: Pure Glucose from 2nd Generation Feedstocks. BIOFOR International Conference, Montréal, Canada, 6 February 2018.
- Jorgensen, H., 2016. Biorefinery RD&D in Denmark. Presentation at Irish Stakeholder Meeting combined with Task 42 Progress Meeting, Dublin, Ireland, 19 April 2016.
- Jungmeier, G. et al., 2016. Implementing Strategies of Biorefineries in the BioEconomy. Presentation at EUBCE-2016, Amsterdam, the Netherlands, 6-9 June 2016.
- Jungmeier G. et al., The Approach of Life-Cycle Sustainability Assessment of Biorefineries. Paper linked to EUBCE-2016, 2016.
- Kostova, B., 2017. Current Status of Biorefining in USA, Austrian Biorefining Stakeholder Workshop, Vienna, Austria, 23 October 2017.
- Kwant, K., Pelkmans, L., Ree van, R., Berntsson, T., The Role of Biorefineries in a Low-Carbon Economy, EUBCE-2018, Copenhagen, Denmark, 15 May 2018.
- Lamers, P., E. Searcy, J.R. Hess & H. Stichnothe, 2016. Developing the Global BioEconomy. Elsevier Academic Press, ISBN: 978-0-12-805165-8, May 2016.
- Lamers, P., E. Searcy, J.R. Hess & H. Stichnothe, 2016. Conclusions. In: Lamers, P., E. Searcy, J.R. Hess & H. Stichnothe (eds), Developing the global bioeconomy: technical, market, and environmental lessons from bioenergy. Amsterdam; Boston; Heidelberg: Elsevier, pp 187-192.
- Langeveld, J.W.A., R. Guisson & H. Stichnothe, 2016. Mobilising sustainable supply chains - biogas cases: biogas production from municipal solid waste, oil palm residues and co-digest. Wageningen: IEA, 95 p, IEA Bioenergy TR2016:04Bell, G. & E. de Jong, 2016. IEA Bioenergy Task 42 – Biorefining in a Future BioEconomy. Webinar and Participation Group Meeting, Bioenergy Australia, 25 May 2016.
- Lindorfer, J., with input other NTLs Task 42, 2019. Biorefinery Systems Analysis and Factsheets, to be published Q1 2019..
- Lindorfer, J., Energy Institute at the Johannes Kepler University Linz, Austria, 2018. Biorefinery Systems Analysis and Factsheets. IEA Bioenergy EoT Conference, San Francisco, US, November 2018.
- Mandl, M. & R. van Ree, 2017. Biorefineries in a Future BioEconomy – Activities and Current Results of IEA Bioenergy Task 42. Presentation at 4th Central European Biomass - Conference, Graz, Austria, 18-20 January 2017.
- Mandl, M.G., 2016. Green Biorefining: Grass for Generating Products and Bioenergy. Presentation at Irish Stakeholder Meeting combined with Task 42 Progress Meeting, Dublin, Ireland, 19 April 2016.
- Motola, V., Bari de, I., Pierro, N., and Giocoli, A. of ENEA, with input of T42 NTLs, 2018. Bioeconomy and biorefining strategies in the EU Member States and beyond, Reference Year 2018, IEA Bioenergy Task 42, ISBN: 978-1-910154-60-1, December 2018.
- Motola, V., Bari de, I., ENEA, Italy, 2018. Global BioEconomy Survey with a focus on Biorefineries. IEA Bioenergy EoT Conference, San Francisco, US, November 2018.

- Mulder, W., 2016. Protein-driven Biorefining: Sustainable Biomass Use for Food and Nonfood. Presentation at EUBC&E-2016, Amsterdam, the Netherlands, 6 June 2016.
- Ree, R., 2017. The Role of Biorefining and Bioenergy in the Circular Economy. BIOECONOMY POLICY DAY – Session DG ENER, Brussels, Belgium, 16 November 2017.
- Ree, R. and Jungmeier, G., 2018. Biorefineries, value chains and business models. Biorefinery Session at EUBCE-2018, Copenhagen, Denmark, 14 May 2018.
- Ree, R., 2017. IEA Bioenergy Task 42, Austrian Biorefining Stakeholder Workshop, Vienna, Austria, 23 October 2017.
- Ree, R. van, 2017. Biorefinery Approach in the EU and Beyond. Presentation at Workshop on EU-AU R&I Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA), Brussels, 23 January 2017.
- Ree, R. van & B. Kostova, 2017. Prospects of Biorefineries. Input on behalf of Task 42 to Bioenergy Roadmap IEA, February 2017.
- Ree, R. van, 2016. The Role of Biorefining in the BioEconomy. Presentation at Irish Stakeholder Meeting combined with Task 42 Progress Meeting, Dublin, Ireland, 19 April 2016.
- Ree, R. van, 2016. Integration of Advanced Biofuels in the Circular Economy. Presentation at 7th Stakeholder Plenary Meeting, European Biofuels Technology Platform, Brussels, Belgium, 21 June 2016.
- Ree, R. van, 2016. Biorefinery Market Developments. Feature article IEA Mid-term Renewable Energy Market Report, 2016.
- Soucy, E., 2017. Biorefining in the Pulp & Paper Sector in Canada, Austrian Biorefining Stakeholder Workshop, Vienna, Austria, 23 October 2017.
- Stichnothe, H., 2016. Palm oil residues for biogas production. In: Mobilising sustainable bioenergy supply chains: opportunities for agriculture: summary and conclusions from the IEA Bioenergy ExCo77 Workshop. Wageningen: IEA, pp 19-20.
- Stichnothe, H., D. Meier & I. de Bari, 2016. Biorefineries: industry status and economics. In: Lamers, P., E. Searcy, J.R. Hess & H. Stichnothe (eds), Developing the global bioeconomy: technical, market, and environmental lessons from bioenergy. Amsterdam; Boston; Heidelberg: Elsevier, pp 41-68.
- Stichnothe, H., H. Storz, D. Meier, I. de Bari & S. Thomas, 2016. Development of second generation biorefineries. In: Lamers, P., E. Searcy, J.R. Hess & H. Stichnothe (eds), Developing the global bioeconomy: technical, market, and environmental lessons from bioenergy. Amsterdam; Boston; Heidelberg: Elsevier, pp 11-40.
- Stichnothe, H., with input other Task 42 NTLs, Standards and Labels related to Biobased Products, IEA Bioenergy Task 42, ISBN 978-1-910154-51-9, 2018.
- Wenger, J., Stern, T., Schögl J.P., University of Graz, with input of Task 42 NTLs, 2018. Natural Fibers and Fiber-based Materials in Biorefineries, Status Report 2018, IEA

Bioenergy Task 42, ISBN: 978-1-910154-53-3, December 2018.

These publications are available on the website <http://www.task42.ieabioenergy.com>.

DELIVERABLES

Deliverable (What)	Due date	Status/Result
D1) Report biorefinery expert system development D2) Biorefinery Fact Sheets D3) Report Upgrading IND Infra to integrated BRs	DEC 2018 DEC 2018 X	Draft report on Task 42 Biorefinery Assessment Platform and BFSs in progress. Presentation at EoT CONF SF. Finalisation (report incl. 4 BFSs) and dissemination via Task 42 website early 2019. Continuation will be part of WP new triennium.
D4) Reports on standardisation/certification BM-use	Bi-annual DEC 2018	Progress was reported bi-annually as PPTs at the Task 42 Progress Meetings. Final report made available at Task 42 website DEC 2018.
D5) Report Bioenergy in a Circular Economy D7) Report Bioenergy Strategies and Drivers D6) Contribution to JTP Bioenergy Supply Chains	DEC 2018 DEC 2017 2016-2018	<ul style="list-style-type: none"> - Joint WS Brussels with FAO, OECD, IRENA, EC JRC, ETIP, EERA in 2016 - available at Task 42 website. - D5: Report available at Task 42 website. German NTL contributed as observer.
D8) Contribution to JTP Biomass Success Stories D9) Country Reports D10) Report Biobased Chemicals D11) Report on Biobased Proteins D12) Report Biobased Fibrous Materials	2016-2018 2016-2018 SEPT 2018 SEPT 2016 DEC 2017	No contact, no contribution Settled: AT, AUS, DK, GER, IT, NL, US To be delivered early 2019: CAN, IR Presentation at EoT CONF SF, fin/publ./diss. early 2019 Delivered early 2016, see Task 42 website Published and available at Task website DEC 2018 Flyer/poster at Task 42 website.

Deliverable (What)	Due date	Status/Result
D13/14) Task Dissemination Material	2016-2018	
D15) Task website D16) Bi-annual Task 42 Progress Meetings / Events D17) Task Newsletters D18) Contributions training courses D19) Lectures @ International Events D20) Thematic Stakeholder Workshops	2016-2018 Bi-annual Bi-annual Q1 2017 Q3 2017 Q4 2018	Update 2016, now up and running. Settled, see minutes members area website Not met due to lack input provided. New triennium more focus on. Task 42 reports & info to courses Athens 2018, Wageningen 2018 Settled by all NTLs, see list publications BR WS at ExCo79 Gothenburg (SWE) Bioenergy in BioEconomy, Brussels (BEL) Webinar i-BIOREF (CAN) – 17 OCT 4- 5 pm CEST

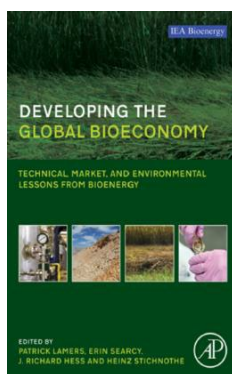
CO-ORDINATION WITH OTHER TASKS WITHIN IEA BIOENERGY AND BODIES OUTSIDE IEA BIOENERGY

Within this 2016 – 2018 triennium the following collaborations were effectuated:

- Role Bioenergy in Circular Economy: Task 36 (solid waste management); EERA Bioenergy, ETIP Bioenergy, EC DG JRC, IRENA, and FAO
- BioEconomy Monitoring: EC DG JRC and EC BBI JU
- Sustainable supply chains: Task 40 coordinated JTP
- Biorefinery Country Reporting: IEA Bioenergy/Energy 2020+
- Thematic Stakeholder Workshops: Industrial Biorefineries (IEA-IETS)
- Furthermore, scheduled cooperation with other Tasks, like Task 40 on Biorefinery Success Stories, and Task 34/Task 37/Task 39 on Biorefinery Assessments and Fact-sheeting, was not established in this triennium; however, will be one of the main goals of the new 2019-2021 Work Plan

Earlier this triennium, a joint analysis brought together expertise from three IEA Bioenergy Tasks, namely Task 34 on Pyrolysis, Task 40 on International Trade and Markets, and Task 42 on

Biorefineries. The underlying hypothesis of the work was that BioEconomy Market Developments potentially can benefit from lessons learned and developments observed in modern bioenergy markets. The question was not only how the BioEconomy can be developed, but also how it can be developed sustainably in terms of economic and environmental concerns. The results of this analysis resulted in the book "Developing the Global BioEconomy". Both the conclusions and book ordering details can be found on the IEA Task 42 website.



INDUSTRY PARTICIPATION

Industry has already been involved in the activities of Task 42, for example by: sub-coordination of Task 42 (Avantium Chemicals BV, NL), providing technical data-input for the set-up of the Biorefinery Fact Sheets, active participation in events (stakeholder meetings, workshops) organised by Task 42, data provision and data checking of Biobased Products market reports (biobased proteins, fibres materials, chemicals) prepared by Task 42, plant descriptions/information for brochures and the website, and participation in the training activities. In the next triennium it will be attempted to even further increase industrial involvement (cooperation IEA IETS, active knowledge exchange at national level, etc.).

IEA Bioenergy

Further Information

IEA Bioenergy Website
www.ieabioenergy.com

Contact us:
www.ieabioenergy.com/contact-us/