



IEA Bioenergy  
*Technology Collaboration Programme*

# Annual Report 2020



IEA Bioenergy is an international collaborative agreement set up in 1978 by the International Energy Agency (IEA) to improve international co-operation and information exchange between national bioenergy RD&D programmes. IEA Bioenergy aims to achieve a substantial bioenergy contribution to future global energy demands by accelerating the production and use of environmentally sound, socially accepted and cost-competitive bioenergy on a sustainable basis, thus providing increased security of supply whilst reducing greenhouse gas emissions from energy use.



Paul Bennett, new Chair of the IEA Bioenergy TCP in 2021

To: IEA Headquarters, Paris

#### IEA BIOENERGY ANNUAL REPORT 2020

Under the IEA Framework for International Energy Technology Cooperation the Executive Committee of each Technology Collaboration Programme (TCP) must produce an Annual Report for IEA Headquarters.

This document contains the report of the IEA Bioenergy Executive Committee for 2020. This year, we have presented a special feature 'Technical, ecological and economic assessment of biorefinery cases', prepared by Task 42

The contributions from the Task Leaders and Operating Agents to this report are gratefully acknowledged.

Paul Bennett  
Chair

Pearse Buckley  
Secretary

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Further information on IEA Bioenergy can be obtained from the Executive Committee Secretary, see back cover of this Annual Report.

The opinions and conclusions expressed in this report are those of the authors.

# IEA Bioenergy – Selected Highlights from 2020

## 1. Contribution of sustainable biomass and bioenergy in Industry Transitions towards a circular economy

An eWorkshop in collaboration with ADEME, the French Agency for the Ecological Transition was held in conjunction with the IEA Bioenergy ExCo86 Virtual meeting on the 20<sup>th</sup> October 2020. The theme of the workshop was *Contribution of sustainable biomass and bioenergy in INDUSTRY TRANSITIONS towards a circular economy*. Key messages from the workshop were:

- Biomass is a key component to reduce the climate impact of industries, next to electrification, hydrogen & CCUS (carbon capture and utilisation/storage). It is important to increase awareness of the role of biomass and bioenergy, both to industry and authorities
- Industries need to take a long term perspective and make real engagements towards net carbon neutrality
- The main challenge is the low cost of fossil alternatives (if carbon cost is not accounted for)
  - A correct and global CO<sub>2</sub> price for fossil resources would be needed. In the absence of a global carbon price regime, other policy options need to be implemented
  - Due to different stages of development (also for biobased products), support for research, development and demonstration projects and de-risking measures for pre-commercial investments are required
- Availability and access to biomass is crucial to increase the role of biomass in industry transitions
  - This requires mobilising biobased resources – also taking into account potential other uses – and setting up sustainable biomass supply chains
  - Medium scale industries can often match their biomass demand to regionally available biomass
  - Energy intensive industries need to look more widely for their feedstock sourcing and consider combinations with other solutions (e.g. electrification, hydrogen, CCUS) to further reduce their carbon footprint
- Specific market strategies can be applied for low-carbon and biobased products, based on strong and credible green labels. Brand owners can also create a market pull, by requiring inputs with low carbon footprint to reduce their own carbon footprint

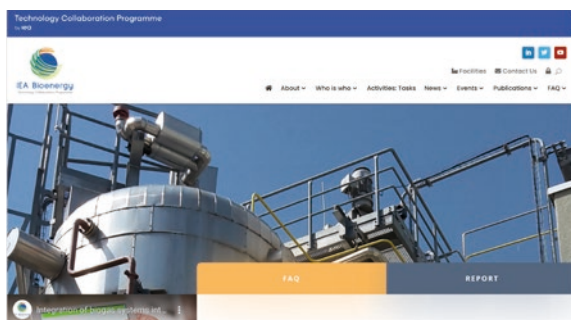


Biomass boiler generating process steam for a potato processing company in the Netherlands, courtesy of PEKA KROEF BV

More detailed conclusions and priority actions identified during the workshop together with the workshop notes which cover all sessions and presentations are available in the report at <https://www.ieabioenergy.com/blog/publications/iea-bioenergy-eworkshop-contribution-of-sustainable-biomass-and-bioenergy-in-industry-transitions-towards-a-circular-economy/>.

## 2. IEA Bioenergy launches new website and graphic identity

IEA Bioenergy launched its new redesigned website along with a new brand identity and logo in a webinar presented on the 20<sup>th</sup> May 2020 – see <https://www.ieabioenergy.com/publications/iea-bioenergy-webinar-iea-bioenergy-global-collaboration-on-sustainable-bioenergy-a-look-forward/>. IEA Bioenergy collaborated with the website development and marketing team of ETA-Florence Renewable Energies to provide a more comprehensive, intuitive, and user-friendly source of information and browsing experience, adapted to reflect the organisation’s main purposes and core values. The new website features a fresh and clean design with a new menu structure delivering information in an easy to navigate and aesthetically pleasing approach. The new website’s improved features include a quicker and easier access to central information such as publications, reports and events, offering a more comprehensive understanding of the organisations’ mission and objectives.



### 3. The use of forest biomass for climate change mitigation: dispelling some misconceptions

Articles and statements in the media have raised concerns over the climate effects of bioenergy from managed forests. As some of these statements seem to reflect misconceptions about forest bioenergy, IEA Bioenergy prepared a brief document presenting key facts about the use of forest biomass for climate change mitigation – see <https://www.ieabioenergy.com/blog/publications/the-use-of-forest-biomass-for-climate-change-mitigation-dispelling-some-misconceptions/>.

The key points are summarised below.

- Burning biomass for energy emits carbon that is part of the continuous exchange of carbon between the biosphere and the atmosphere (biogenic carbon flows). In contrast, fossil fuel emissions represent a linear flow of carbon from geological stores to the atmosphere. Therefore, the effect on the atmospheric GHG concentrations of switching from fossil fuels to biomass cannot be determined by comparing CO<sub>2</sub> emissions at the point of combustion.
- To determine the full effect of bioenergy on atmospheric GHG concentrations, assessments need to consider biogenic carbon flows together with other GHG emissions associated with the life cycle of the bioenergy system, and compare with GHG emissions in a realistic reference situation (counterfactual scenario) where energy sources other than bioenergy are used.
- Forest stands are typically not cut for bioenergy alone, but to produce a range of forest products (e.g., construction wood, biomaterials, fuels and chemicals) that can contribute to climate change mitigation by replacing greenhouse-gas intensive products such as cement, steel, and petroleum-based plastics and chemicals, as well as fossil fuels.
- Managed forests usually consist of a mosaic of stands of different ages, which are harvested at different times to obtain a continuous flow of wood for the forest industry. The harvest/replanting cycle maintains the forest in an active stage of growth, thus maintaining the forest carbon sequestration in tree growth. Due to the staggered harvest, carbon losses in harvested stands are balanced by carbon gains (growth) in other stands, so across the whole forest the carbon stock in managed forests is roughly stable.
- Effects on the climate from increased production and use of biomass for energy should therefore be assessed at the forest landscape level (i.e. at the scale that forest estates are managed), not the stand level. Determination of the counterfactual is a critical step in assessments. Some studies make the unrealistic assumption that forests planted for commercial use are left unharvested when there is no demand for bioenergy, ignoring that most forest biomass used for bioenergy is a by-product of higher value timber production.
- The longer-term development of the forest carbon stock depends on biophysical context such as soil and climate conditions, historic and current management regimes, and events such as storms, fires, and insect outbreaks. If harvest volumes (for wood products and energy) and losses related to mortality and disturbances (e.g. storms, insects, fire) do not exceed the growth across the whole forest, there is no net reduction in forest carbon stock.

- Increased biomass use for energy could lead to lower carbon stock and lower sequestration rate in the forest compared to a scenario with less biomass use. However, an increase in demand for bioenergy and other forest products can also incentivise reforestation and improved forest management to increase growth, potentially increasing forest carbon stock compared to the without-bioenergy situation. Forest management generally also reduces the risk of carbon stock losses due to wildfire and diseases/insect outbreaks, issues that are increasingly prevalent in warming climates.
- Concerning GHG emissions, in addition to impacts of bioenergy systems on biogenic carbon flows, full supply chain emissions must be considered. Fuel use for collection, chipping/pelletising and truck transport typically corresponds to less than 10-15% of the energy content in the supplied biomass. Moreover, studies have found that long-distance transport does not negate the climate benefits of biomass as a renewable energy source. For example, GHG emissions associated with transporting pellets between North America and Europe represent less than 5% of the life cycle GHG emissions of hard coal.
- Sustainability governance is required to avoid or mitigate adverse outcomes for the climate and to manage trade-offs with other societal goals. A key requirement is that forests are regenerated and that carbon uptake capacity in the forest is maintained (*such as specified in the Recast of the EU Renewable Energy Directive*).

Concluding, the most important climate change mitigation measure is the transformation of energy, industry and transport systems so that fossil carbon remains in the ground. Bioenergy plays a strategic role in supporting this transformation. Switching from fossil fuels to biomass from sustainably-managed forests can reduce atmospheric CO<sub>2</sub> over time scales relevant to climate stabilisation.

## 4. The Role of Renewable Transport Fuels in Decarbonising Road Transport

In the light of climate change, there is an urgent need to decarbonise our societies. The road transport sector is specifically challenging, as transport demand is growing, and so are the sector's GHG emissions. Electric mobility powered by renewable power will not be able to solve this on its own, and renewable transport fuels will be needed to bridge the gap between GHG emission reduction targets and the projected actual emissions.

A team of experts has assessed the transport sector and its projected development up to 2030 and 2050 for a number of countries, including Germany, Sweden, Finland, the USA, and Brazil. The work was initiated and carried out jointly by two Technology Collaboration Programmes of the International Energy Agency, namely the IEA Bioenergy TCP and the Advanced Motor Fuels TCP, with support of the Directorate General for Energy of the European Commission. The analysis is based on current national policies, projections of the vehicle fleet, and on the availability of renewable transport fuels.

The objective of the assessment was to quantify the role that renewable fuels play in decarbonising the road transport sector, and to provide insights to policy makers on how individual countries differ from one another, which options for decarbonisation they have, and best practice examples of successful policies.



A key message from the project is that decarbonisation of the transport sector can only be reached with a set of measures and fuel/energy options, of which biofuels constitute an important part. There is sufficient biomass available to support the large-scale roll-out of biofuels, and current vehicles can accommodate these amounts.

For more information see <https://www.iea.bioenergy.com/blog/publications/new-publication-the-role-of-renewable-transport-fuels-in-decarbonizing-road-transport/>. A webinar to launch the report on 17 November 2020 can be viewed at <https://www.youtube.com/watch?v=1Qj7MyYtVv0&list=PLgQVBpVgvxhvHmtoo8S5tdgvelLnmK318&index=9>



# Technical, ecological and economic assessment of biorefinery cases

## A continuing attempt to accentuate the characteristics of the combined production of biobased products and bioenergy

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## Biorefining and the momentum of sustainable recovery towards the circular economy

Despite the worldwide challenges of the COVID-19 pandemic, the topic of sustainable energy supply and production systems is still prominent. Concerning sustainability, the sustainable development goals (SDGs) developed by the United Nations in particular address economic, social and environmental aspects regarding a sustainable development, and there is also a goal defined that concerns sustainable energy [1]. The global challenges concerning global warming and resource scarcity emphasise the importance of renewable sources for energy and at the same time for products. Hence, also the versatile and much used concept of biorefining is coming into the spotlight of considered answers to these challenges [2]. On the EU level, the European Commission adheres to the new Bioeconomy Strategy and the European Green Deal Agenda, whereby among others, the importance of decarbonising the energy system is highlighted [3]. In the EU Biodiversity Strategy for 2030 one important factor mentioned for the decarbonisation of the energy system and the fight against climate change is sustainable bioenergy [4]. Furthermore, the relevance of the energy system in order to achieve the EU goals is also highlighted in the EU Strategy for Energy System Integration where, in the context of biomass, the potential of renewable fuels and the decarbonisation potential of carbon capture, storage and use is emphasised [5]. Similar initiatives are underway in many countries around the world.

The IEA Bioenergy Technology Collaboration Programme (IEA Bioenergy TCP) works on multiple aspects and barriers regarding the sustainable deployment of bioenergy and biobased products. The vision is that bioenergy is, and will continue to be a substantial part of the sustainable use of biomass in the bio-based economy. By accelerating the sustainable production and use of biomass, the economic and environmental impacts will be optimised resulting in more cost-competitive bioenergy and reduced greenhouse gas emissions. This is addressed via strong international cooperation also taking into account biobased production [6]. Sustainable biomass is essential for aiming at climate neutrality, due to its potential to substitute petrochemical based materials

and enhance renewable energy [7]. Regarding sustainable biomass production, it is important to analyse its production potential and energy sources as well as having in mind its influence on relevant extended aspects, such as the specific impacts, among others, on ecosystems, environment, biodiversity or land use. In particular, land use and indirect land use change (ILUC) is linked to the discussion of biomass sustainability. The availability of land in the context of biomass production and use is a highly relevant aspect in order to ensure sustainability [8]. The CO<sub>2</sub> emissions that are released as a consequence of land use change due to increased biomass demand have to be taken into account [9]. As bioenergy and biobased products are produced from biomass, the sustainability of the potential solutions largely depends on sustainable biomass production [10, 11]. Therefore, the whole value chain, including all relevant steps such as, land conversion, feedstock growing and harvesting, processing, conversion and distribution of products and energy carriers, as well as the product use phase and end-of life options needs to be addressed concerning sustainability aspects. At each step of the value chain the related challenges have to be considered to ensure a sustainable biomass valorisation towards future-proofed production systems [11]. However, due to the different types of biomass and the related advantages and disadvantages for different valorisation options, frequent estimations and improvements of the information value and its representativeness are required. This is a task that remains challenging [7].

Realising negative greenhouse gas emissions is a more recently envisioned strategy to support climate targets. Approaches to this end are, for example, afforestation or through carbon capture and storage (CCS) and carbon capture and utilisation (CCU). Afforestation implies a conversion of land into forests or increasing the stocking density [7]. Although the topic of CCS and CCU has evolved for addressing fossil technologies, the biogenic CO<sub>2</sub> released in biomass conversion processes is an emerging topic as bioenergy with carbon capture and storage (BECCS or Bio-CCS) can contribute to the climate goals though generating negative emissions, although it is sensitive to the process set up and boundary conditions [7, 12]. There are several points of relevance to potentially combining the conversion of biomass and CCS technologies, including – among others – biorefinery concepts addressing the cascading valorisation of renewable carbon [13]. In order to take full advantage of the CCS potential the appropriate infrastructure for transport as well as for storage of CO<sub>2</sub> is required on a regional level. Not only the transport and storage infrastructure influences the required biomass values for BECCS, but also competing technologies and the general public acceptance provide an impact on BECCS [7]. Furthermore, the potential of BECCS itself again depends on the amount of sustainable biomass available [14].

Focusing on proven as well as innovative options of biobased energy and biobased products for reducing fossil-based resources, as well as the increased use of renewable raw materials to combat climate change, offer significant possibilities for enhancing a sustainable production [15].

*Biorefinery concepts are an important option when it comes to integrally processing renewable resources and adding value to biomass [16]. Consequently, biorefinery processes and the related products can have a positive impact on the efficient use of biomass [17]. According to the IEA Bioenergy Task 42 definition, "biorefining is the sustainable processing of biomass into a spectrum of marketable biobased products and bioenergy" [18].*

The idea of biorefining is in itself not new. Various developed production facilities, for example paper, starch, etc. already practically apply a biorefinery approach. However, advanced biorefinery concepts aim to valorise a wide variety of biomass (forestry, agriculture, and aquaculture, as well as many residues) into a broad range of biobased products and bioenergy carriers [2]. Therefore, in biorefineries several technologies are combined to sustainably convert and transform biomass into products and energy [19]. On the one hand, the biobased products resulting from a biorefining process include chemicals and materials and on the other hand, the bioenergy that results from the processing of biomass can be biofuels, power and heat [20]. Due to the evidence that through biorefining processes it is achievable to close loops of materials, water and carbon, these concepts can act as enablers for the realisation of a circular economy strategy among other activities [10]. IEA Bioenergy Task 42 is covering the topic of "Biorefining in a Circular Economy" and aims at supporting the commercialisation and market deployment of biorefineries and related technologies that are not only advantageous regarding environmental and social aspects, but also offer economic benefits [21]. Through the use of biomass for energy and material recovery, an economic system based on strong sustainability criteria is potentially enhanced to serve the needs of diverse economic sectors. Moreover, a growing number of players recognise the related opportunities in this field to generate increasingly viable business cases via the development of renewable raw material valorisation pathways. An increased biomass utilisation not only safeguards but can also create new jobs especially in the agricultural sector. However, as already mentioned, in order to ensure sustainable biomass use, the whole value chain has to be taken into account to be able to assess biorefineries and their multiple outputs [2]. The assessment of the whole value chain, consequently supporting its claim is not only to include environmental, but also economic and social aspects. Furthermore, the assessment of impacts concerning for example water consumption and water quality, land-use changes, competition for food, biodiversity and soil quality and fertility is highly relevant to do [17].

It is a very difficult task to meet the multiple requirements on the one hand and to ensure the viability of a practical approach to evaluate and assess the potential of biorefinery concepts and their products on the other hand. Such a viable approach, ready for application, is described in detail in the following method section. The implemented assessment includes a technical, economic and environmental perspective. In addition, the importance of stakeholder involvement and the limitations of the applied assessment methodology are discussed. Moreover, the results of the assessment are presented and in the discussion part of the article, associated challenges concerning biorefining technologies and bioenergy are addressed.

## Providing the metrics to understand the specific case

Recently, research has been conducted to assess biorefinery sustainability. However, the balance between the pillars of sustainable development is not entrenched, as studies focus more on environmental assessments to the detriment of socio-economic dimensions. In addition, socio-economic assessments of biomass projects are often limited to economic metrics, which are not sufficient to evaluate the spatial dimension and regional implications. [22] Therefore, abundant literature is devoted to the environmental assessment of these systems with a focus on environmental impacts such as greenhouse gas emissions or air pollutants. Nevertheless, although the environmental component is a key element in the evaluation of biorefinery projects and value chains, it seems that the economic and social pillars of sustainable development are mentioned less frequently [23]. Nonetheless, before producing the desired effects at the global scale, biorefineries first generate positive, but potentially also some negative impacts at the micro level. Under these circumstances, the described assessment methodology is proposed as a support tool for stakeholders who are directly or indirectly affected or interested in any way in the investigated biorefinery concept/value chain. [22]

The development of new, versatile, bio-based production pathways incrementally increases the size and complexity of the biorefinery process, which results in a greater uncertainty in valuations. Therefore,

*it is difficult to predict which type of emerging biorefinery will eventually prove to be technically, economically, and environmentally viable at an industrial scale. Conducting rigorous bottom-up and case-specific biorefinery assessments is essential to overcome these barriers and uncertainties.*

While some methods have been developed for the socio-economic appraisal of bioenergy projects, none have focused solely on the assessment of biorefinery systems. Accordingly, the development of this approach is inspired by criteria used in the socio-economic assessment of bioenergy units. In addition, the criteria used in social life cycle assessment have been considered, as this method accounts for the stakeholders involved in the product life cycle [24, 25, 26, 27, 28]. The concepts themselves are subject to constant change, leading to challenges in standardising and assessing highly variable concepts using coherent metrics [2]. In this context, the concept of biorefineries still offers a broad scope and need for research and development work. The potential of the versatile biorefinery technologies can only be realised if a large number of possible products can meet the quality and price requirements of the market. In addition, it is necessary to identify and optimise site-adapted biorefinery technologies and recycling paths from the multitude of potentially available raw materials and conversion paths, and to implement a process of continuous improvement. This approach supports the future establishment of selected biorefinery technology paths and products on the market and leads to economically viable and ecologically sustainable processes and products.

Therefore, it is of fundamental importance to address the methodological challenges of sustainability assessment first in a bio-based system, and then during research and development with an adequate choice of system boundaries and functional units in a combined study of both. The goal is to open up a possibility space in the evaluation to allow the identification of alternative options of action (e.g., technology foresight and eco-efficiency). In this way, all the required dimensions of analysis can be presented clearly. [29]

The technical, economic and environmental potential of bio-based products produced with biorefinery technology is estimated frequently through a techno-economic assessment (TEA) [29, 30] and a life cycle assessment (LCA) [31, 32], respectively (see Figure 1). These methods are based on experimental and simulated data and reliable analytical tools for evaluating various products and processes. In addition, an uncertainty assessment (UA) using mathematical techniques is applied to reflect the uncertainty in the results [33]. The primary parameters for these sustainability-related metrics are compiled in Figure 1. Additional sustainability metrics need to be developed using criteria reported in the literature [35, 36].

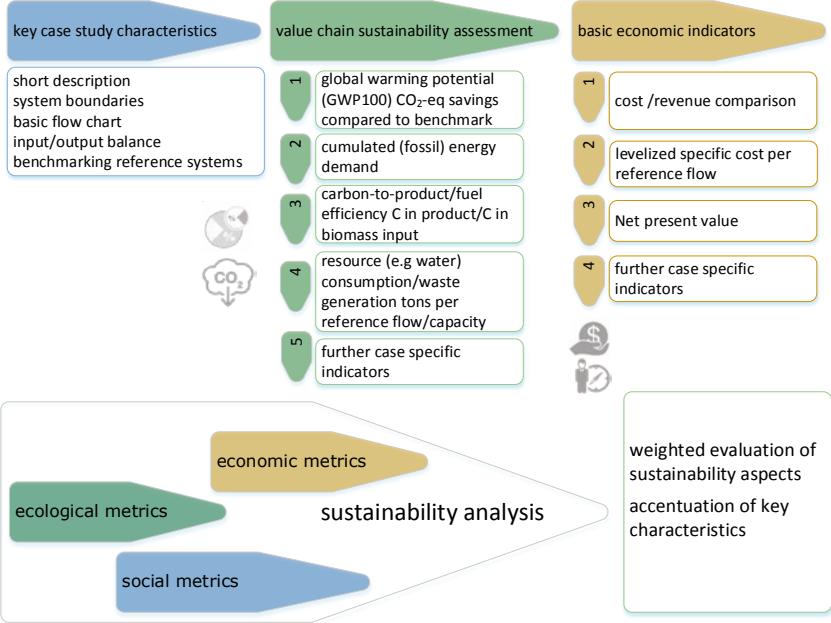


Figure 1: Coherence between sustainability assessment approaches to quantify impact on resources and the environment

These assessment methods are combined to provide decision makers with feasibility data determining the most promising coproduction pathways (see Figure 1). Furthermore, ideally the results suggest avenues (e.g. new research directions to cope with bottlenecks) for accelerating the commercialisation of the technology. Although a number of studies have considered the Technology Readiness Levels (TRL) for conducting assessments, there are only a few standardised approaches available for e.g. estimating cost growth with unexpected problems for low-TRL technologies, which means that uncertainty is high. Therefore, technical, ecologic and economic (TEE) assessments should preferably focus on biorefining technologies at a greater TRL level of at least 6 (Technology demonstrated in relevant environment) within the activities of IEA Bioenergy Task 42. Consequently, potential biorefineries for TEE should be either already implemented in the market or currently in a demonstration or pilot phase.

Although many studies have been undertaken to develop a multitude of sustainability assessment methods, only few guidelines and criteria have been established to help researchers and practitioners find the most appropriate approach and method for a specific case. The objective of the work in the activity area "biorefinery system assessment" within IEA Bioenergy Task 42 is to provide a standardised but practically feasible TEE methodology, resulting in an open access fact sheet approach to enable the creation of a strong knowledge community. A more detailed description of the methodical approach used can be found in the IEA Bioenergy Task 42 report by Lindorfer et al. (2019) [34]. For a basic overview of the open access fact sheet structure, see Figure 2.

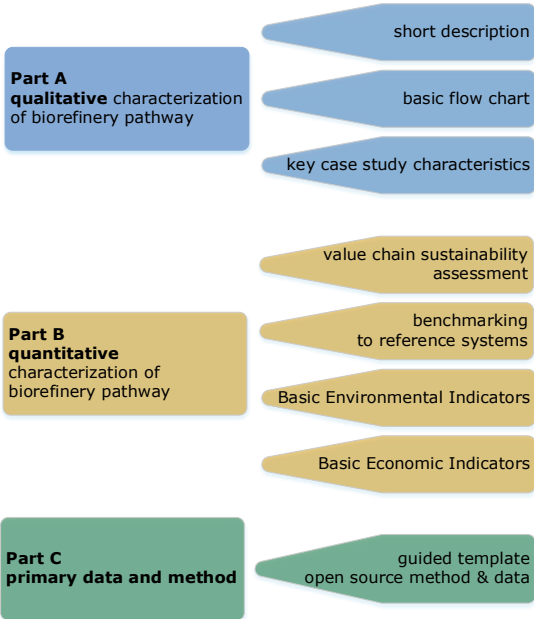


Figure 2: Structured approach of the TEE Assessment in IEA Bioenergy Task 42 [34]

*IEA Bioenergy Task 42 is currently running a Collaborative Inter Task Project (CITP) on the topic of technical, economic, and environmental (TEE) assessment of integrated biorefineries. The primary goal of this activity is to generate and publish relevant results on TEE assessment of biorefinery pathways. As an outcome, selected biorefineries provide showcases by generating biorefinery fact sheets for publication. The pathways covered can include a wide range of technologies and products and are not limited at the outset.*

The nature of the TEE assessment of biorefineries provides the potential for adapting the given pathways in an easy and comprehensible manner. It is therefore possible to integrate input data on feedstock, conversion efficiencies, and economic values, thus creating new case-specific fact sheets. However, it is worth noting that this approach does not include detailed modeling or optimisation of pathways up to now. [34]

## Stakeholder involvement as crucial step for information mining

Biomass use for energy and material/chemicals production purposes is a topic on which perceptions in society differ widely. In this context, it has to be pointed out that the involvement of relevant stakeholders from research, agricultural producers, as well as technology/service providers, industry and the public sector is crucial. This means that the assessment process should be open to anyone capable of making a substantive contribution to answering the questions of the assessment. Stakeholder involvement is highly relevant in deploying a working bioeconomy as this is naturally driven by initiatives, concepts and projects promoted by stakeholders [37]. Therefore, it is important to gain information about the stakeholders, including their influence, importance, and attitude towards a new value chain or project for deploying biorefineries [38]. Furthermore, a comprehensive stakeholder analysis is crucial to develop novel biorefinery value chains [37] as it helps to design targeted stakeholder involvement measures and participation processes [39] to ensure a project's success [40]. A practical approach for applying stakeholder analysis on biorefinery development and establishment was applied repeatedly by the authors. Planning a stakeholder involvement process can start with streamlined stakeholder identification and categorisation. First, stakeholders are identified and categorised as to whether they are key, primary, or secondary stakeholders [41, 42, 43]. The identified stakeholders are then attributed to clusters. In the next step, an importance-influence classification is performed by setting up a context diagram [44]. In the end the "importance"<sup>1</sup> and "influence"<sup>2</sup> as well as the attitude (supporter, neutral, ambivalent, opponent) of a stakeholder are rated by experts directly involved in biorefinery value chain development or implementation. Figure 3 shows an example of the results of such a stakeholder analysis obtained for a wood-to-biobased chemical value chain at an early design stage.<sup>3</sup>

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- 1 Importance (Interest): The interest stakeholders have on the the biorefinery case/biobased value chain. How active/passive are they?
  - 2 Influence (Power): How much power does the stakeholder have to change the direction of the specific biorefinery case/biobased value chain?
  - 3 The results were obtained by expert judgment of influence and importance of 15 experts directly or indirectly involved in investigating the novel wood residue-to-biobased chemicals value chain.

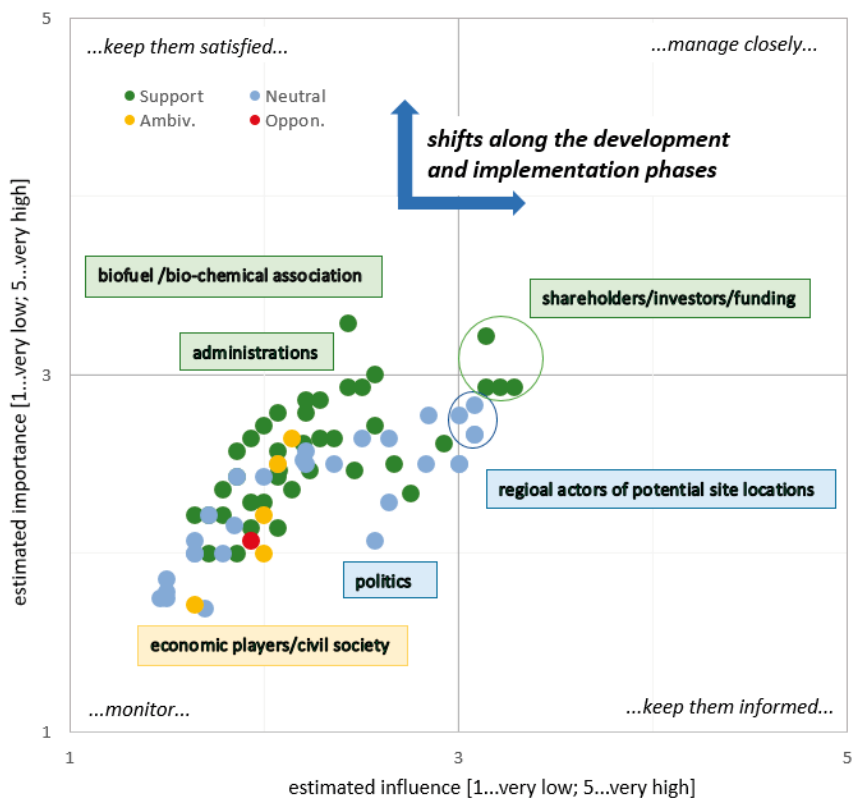


Figure 3: Results of stakeholder mapping for a wood residue-to-biobased chemical value chain at an early design stage (TRL 3-5) for key and primary stakeholders

As shown in Figure 3, only a few stakeholders belong to the section “manage closely” and “keep them informed” in this example of an ongoing value chain design in a development and implementation process. Stakeholders belonging to these categories are those who need to be prioritised in a stakeholder involvement process and provided with all relevant information on technical details. In an early development and implementation stage of the value chain, most of the stakeholders are attributed to the “monitor” section, which means there is no current need to actively involve them.

*At an early design stage, the shareholders and investors, potentially funding organisation in particular; in addition to regional actors of the potential site location, were identified as being of high relevance especially also related to the TEE assessment approach and resulting performance indicators to be shared with them. In line with the evolution of the development and implementation of a project/value chain, stakeholder roles and positions shift and the need for information can grow significantly.*



The importance/influence of certain stakeholders may also change as value chain development evolves [37]. It is certain that biomass suppliers, by-product users, off-takers, licensees, suppliers for plant equipment, energy suppliers/contractors, end consumers, and similar actors will gain importance and influence if a technology/value chain is at TRL 9. Accordingly, a stakeholder analysis helps to determine the most relevant stakeholders to engage along the development pathway of a novel concept until it has reached its full potential. IEA Bioenergy Task 42 therefore chose to involve views from various forums (science, authorities, business, NGOs) by conducting a joint fact-finding, in which stakeholders participated. To this end, an online survey<sup>4</sup> was completed, meetings with other tasks were organised, and interviews with industry stakeholders were conducted.

*The primary objective is clearly to generate a database that is as robust as possible for quantifying the technical, ecological and economic characteristics of a biorefinery technology concept or a value chain.*

A great challenge for the sustainability assessments however is, that there are multilayered perceptions and underlying arguments on climate, land use, air quality, social, economic, and natural aspects in areas of origin of biomass which are also inventoried and mapped. The TEE-Assessment proposed aims to generate quantitative information to accentuate key characteristics. Due to the normative character of sustainability, the negotiation about if or how sustainable the assessed concepts are, is out of scope. To give an example, it was found in the surveys that the application of “cascading,” the use of biomass to the highest possible quality, optimally and efficiently, is widely supported, but there are many possible interpretations of the concept of biorefining. For authorities and stakeholders in other daily businesses, naturally the complexity of the overarching discourse on biomass use evokes questions such as: What are the best choices? What are the trade-offs? Which technologies are accepted by society? These questions exemplify the need for data about biorefinery technologies’ sustainability implications to enable target-oriented R&D, the development of effective policies and efficient instruments or a public discourse.

## The complexity is high, full coverage is tight

The ideal set up for the TEE assessment always relates its results to a well-defined functional unit that is the same for all variants/systems considered, e.g. 1 ton of product/1 GJ of energy. This functional equality enables a quantitative comparison of different variants under “fair” conditions, always with regard to the same function to enable the comparison of fossil and biobased options, of separated or integrated process routes for biobased products and bioenergy. In any case, this is a challenge for the practical implementation and balancing of case studies under consideration. The spatial dimension, thus physical, but also economic and social changes that occur in the territory related to the development and establishment of a biorefinery concept demand more specific case studies than the generic results the actual TEE assessment approach is providing. The fact is that, as biorefinery operators interact with the territory’s stakeholders,

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4 Online survey for stakeholder identification was conducted under the Link <https://energieinstitut-linz.typeform.com/to/LZh8RZ>

they increase the awareness of their activity and, consequently, their territorial embeddedness. To support this process towards optimal deployment some general recommendations from the assessment activities and stakeholder analysis can be drawn:

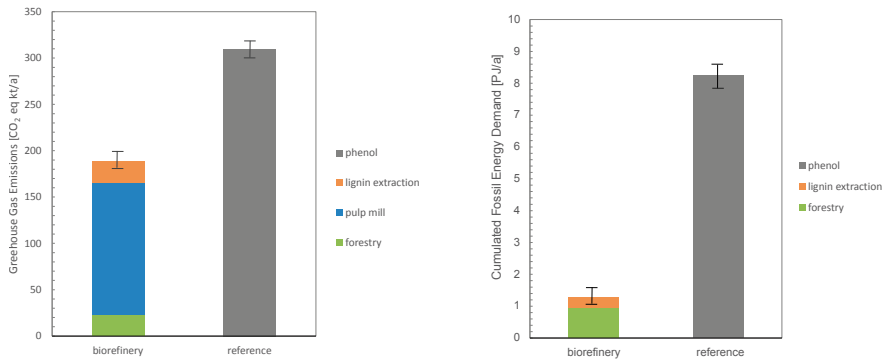
- Clusters for biomass valorisation via groups of similar, interconnected, and often complementary companies that share infrastructures and a common institutional environment. The participation of the biorefinery operator in these networks is important because it not only demonstrates their openness to the local economic community, but also these networks promote the dissemination of technical and professional knowledge. [22]
- Industrial symbiosis proposes the collaboration of biorefinery operators with related industries at the specific location through the exchange of flows and materials, since synergies allow the minimisation of the impacts and processes of waste production. [22]
- Academic and scientific collaboration between facility managers and regional R&D is essential to biorefinery deployment due to its character as an innovative industry.
- Communication and stakeholder engagement to appraise the cultural embeddedness and biorefinery's public image via knowledge of the biorefinery and its activities. This is an essential field of application for the results of the TEE assessments to be shared at an international, national, regional, or local scale.

## Identification of benefits in factsheets

This article started from the premise that alongside other climate-neutral technology options, biobased products and bioenergy, as part of the larger bioeconomy, will play a larger role in the attempt to recover prosperity after the COVID-19 pandemic. There has been broad support from political parties, governments, activists, and academia across a large number of countries [45, 46, 47] to ensure that investments to pull countries out of economic recession are spent in a way that combats global warming, provided that biomass is produced sustainably.

*The substantial intention of this ongoing work is to highlight the benefits of an integrated biorefinery approach versus separate production system approach for the provision of bioenergy and biobased products.*

The TEE assessments are deliberately conducted with a limited number of indicators to reduce complexity and to conserve key points for the stakeholder audience. The approach is certainly simplified and incomplete from a scientific point of view, and there is no "one size fits all" recipe in the implementation. So the approach needs to be adopted in a case specific manner where stakeholder involvement is crucial. To be able to carry out a characterisation and description of the various biorefineries, key information is requested and systematically collected to provide a biorefinery fact sheet. Figure 4 provides a snapshot of a simple illustration on selected characteristics of a lignocellulosic biorefinery case study extracting lignin in a commercial scale kraft pulp mill for substitution of fossil based phenol.



*Greenhouse gas emissions of biorefinery case study and reference system*

*Cumulated fossil energy demand of biorefinery and reference*

Figure 4: Simple illustration on selected elaborated characteristics of a biorefinery case study [48] (1-platform (black liquor) biorefinery to produce pulp, lignin and energy from wood chips)

This information is directly queried from the respective players in the biorefinery case. An increase in the number of biorefinery assessment cases can be achieved through cooperative partnership work. On the one hand, there are already existing biorefinery concepts at higher TRL. On the other hand, systems under development are characterised together with relevant actors, since a comparison of the systems should be available. The results are summarised in a tabulated and graphically presented comparison of the technologies. In addition to the achievable greenhouse gas emission savings, other environmental impact categories are also considered. In combination with the quantification of product cost from key economic data, a comprehensive performance assessment is facilitated. The characterisation of biorefineries and process concepts will be continued in accordance with the TEE method developed in IEA Bioenergy Task 42, and in particular applied to new “types” of biorefineries. The technological overview of the diverse biorefinery processes is consequently kept up to date. If necessary, the methodology is adapted and extended. While sustainability assessments gradually become a natural part of larger technology development projects, these assessments often remain on paper or cannot be effectively applied to deliver the quality expected. By creating and enhancing background databases, as well as advancing standardisation and integration processes, there are future research goals that will benefit from the actual practical application in case studies [49].

## **A discussion on what is most beneficial cannot be terminated, it must be evidence based**

To determine how biomass can be valorised optimally, the principle of cascading can be applied, whereby biomass is prioritised in cases where its use brings the most benefits. Understanding the benefits associated with biomass production and use may change over time. Different time horizons affect the usefulness of biomass in reaching climate neutrality objectives. Therefore, as the discussion on the sustainability of woody biomass is still underway, it may be worthwhile to expand the use of alternative biomass types, such as wastes and residues, especially those that can support the circular economy framework. That being stated, not all sectors are able to immediately make use of any type of biomass for energy and biobased products; as with other clean energy sources, technological innovation and commercial scale-up may be required to effectively deploy (for both production and consumption) alternative fuels derived from biomass, such as biogas or biomethane.

Current sustainability assessment practices need a robust framework to overcome concerns recognised in the scientific community regarding whether the various available examples of assessment are really comprehensive and robust, moving from integrated assessment towards sustainability assessments [50]. Each subsequent phase of research is characterised by an increase in the quantity and quality of performance data, as well as a decrease in the level of uncertainty of the technology application. To meet the increasing need to organise, coordinate and manage interdisciplinary research collaborations [51], as well as meet the increasing demand to monitor sustainability in research projects, we need effective structural frameworks and concepts [52] to foster communication and life cycle thinking [53].

This still requires further criteria to determine exactly what is most beneficial.

It also requires normative and political decisions to prioritise conceivably clashing policy objectives and the degree to which policy or the market should promote certain outcomes. In the course of the assessment process, the emphasis shifted more and more from a search for facts to the identification of underlying perspectives on combined biomass valorisation for energy and material products. Facts turned out not to be the only, and perhaps not even the most important source of debate. The debate is also primarily about interpreting those facts in light of divergent perspectives, worldviews, and interests. They reflect divergent opinions and presuppositions about and valuations of social goals between which there are trade-offs: economic development and volume growth, climate goals, biodiversity preservation, soil management, food production, use of materials, and the pace and potential for change in the economy and society.

These divergent views strongly determine the discussion of biomass valorisation in general but cannot be solved through a discussion of one sector or one valorisation chain. It is necessary to identify and optimise the site-adapted biorefinery technologies and recycling paths from the multitude of potentially available raw materials and conversion paths. However, it is questionable if there will be a one size fits all solution comparable to fossil-based refineries. Biorefinery concepts must consider regional situations and account for available raw material mixes

and the resulting platforms that are based on the biorefinery products. Furthermore, research and development should address these aspects in order to develop a regionally adapted decentralised biorefinery solution. Technical research on biorefinery concepts must be accompanied by systemic and structural research in order to design biorefinery pathways of the right scale, right raw material mix, and right platforms for their specific site location.

Today's biorefinery processes still show significant optimisation potential, while the production processes of fossil-based products are technically mature and optimised. Technical developments in the biorefinery sector continue to generate new knowledge, and as they are commercialised and deployed, these are likely to lead to further improvements via economies of scale. As a result, it is expected that the production cost for biorefinery products will decline in the future and that the products will become more competitive over time. Until this is achieved, biorefinery pathways will continue to rely on targeted policy measures and public support programmes to drive development. The constantly demanded political decisions are based on the gathering of additional knowledge and social considerations. In the long run the optimisation potential of biorefinery concepts also can be detected in technical possibilities to fulfill the future need for biofuels, green gas, and bio-feedstock with less biomass by increasing conversion efficiencies and optimising by-product valorisation pathways. Currently existing biorefinery technologies show cascading use and by-product valorisation concerning process energy generation: in a significant number of cases the energy to convert (woody) biomass into high-quality fuels and feedstocks comes from the biomass (its by-products of the conversion process) itself. But future biorefinery concepts should go beyond and strive for a more complex integration into the energy system. There are studies that show that if not only biomass, but also green or blue hydrogen is used in production, the conversion losses of the carbon content of the biomass used can, in theory, be reduced by a factor of 2 to 2.5 [54]. This means that there is considerable additional potential to capture, for example, electricity from wind or solar sources into hydrocarbons such as methane, diesel, kerosene, or raw materials for plastic production.

Accordingly, for biorefinery value chain development an increase in complexity can be expected in future. It will be the task of TEE assessment and accompanying stakeholder assessment and involvement to contribute to complexity reduction in order to achieve a better understanding of the impacts of biorefinery concepts on sustainability, bioeconomy and circular economy. Not least these approaches support the selection of promising biorefinery concepts on a regional level based on feedstock potential, energy system and market needs, materials demand, infrastructure demand, etc.

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# International Energy Agency (IEA)

## Mission

The IEA (<https://www.iea.org/>) works with governments and industry to shape a secure and sustainable energy future for all and is at the heart of global dialogue on energy, providing authoritative analysis, data, policy recommendations, and real-world solutions to help countries provide secure and sustainable energy for all. The IEA was created in 1974 to help co-ordinate a collective response to major disruptions in the supply of oil. While oil security remains a key aspect of its work, the IEA has evolved and expanded significantly since its foundation. Taking an all-fuels, all-technology approach, the IEA recommends policies that enhance the reliability, affordability and sustainability of energy. It examines the full spectrum of issues including renewables, oil, gas and coal supply and demand, energy efficiency, clean energy technologies, electricity systems and markets, access to energy, demand-side management, and much more.

IEA analysis is built upon a foundation of activities and focus areas including data and statistics, training, innovation and international cooperation. The areas of work of the IEA are:

- Promoting energy efficiency: helping governments improve standards, advising them on developing, implementing, and measuring the impact of efficiency policies
- Ensuring energy security: work on energy security ensures that markets remain well supplied, providing information to governments, and helping improve system resilience
- Programmes and partnerships: working with governments, organisations and agencies around the world to deliver programmes focused on countries, regions or topics
- International collaborations: working with a broad range of international organisations and forums to ensure secure, affordable and sustainable energy systems
- Promoting digital demand-driven electricity networks: working on digital, demand-driven solutions offering significant benefits to cost reduction, emissions abatement and enhanced energy efficiency
- Data and statistics: data collection has been at the heart of the IEA's work since its creation, with official energy statistics from more than 100 countries collected on a monthly or annual basis
- Training: carrying out training activities around the world on energy statistics, modelling, technology, energy efficiency and renewable policies
- Technology collaboration: with about 40 research collaborations and about 6,000 experts, IEA's technology programme provides the basis for international public and private research partnerships
- Global engagement: since 2015, IEA has opened its doors to eight major emerging economies for a new era of international energy co-operation
- Industry engagement: meeting with various industry groups on a regular basis, gaining precious insights on how policies shape real-world investments and actions

## Structure

The IEA is an autonomous body within the OECD framework. The Governing Board is the main decision-making body of the IEA, composed of energy ministers or their senior representatives from each member country. Through the IEA Ministerial Meeting that takes place every two years, the IEA Secretariat develops ideas for existing or new work programmes, which are then discussed with member countries in various IEA committees and ultimately presented to the Governing Board for approval. In addition to the Governing Board, the IEA has several Standing Groups, Committees and Working Parties made up of member country government officials that meet several times a year.

## Member Countries

Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, The Netherlands, Turkey, the United Kingdom and the USA. The European Commission also participates in the work of the IEA.

## Association Countries

Brazil, China, India, Indonesia, Morocco, Singapore, South Africa and Thailand

# Introducing IEA Bioenergy

Welcome to this Annual Report for 2020 from IEA Bioenergy.

IEA Bioenergy is the short name for the international bioenergy collaboration under the auspices of the International Energy Agency – IEA. A brief description of the IEA is given on the preceding page.

Bioenergy is energy derived from biomass. Biomass is defined as material which is directly or indirectly produced by photosynthesis and which is utilised as a feedstock in the manufacture of fuels and substitutes for petrochemical and other energy intensive products. Organic waste from forestry and agriculture, and municipal solid waste are also included in the collaborative research, as well as broader 'cross-cutting studies' on techno-economic aspects, environmental and economic sustainability, systems analysis, bioenergy trade, fuel standards, greenhouse gas balances, barriers to deployment, and management decision support systems.

The IEA Technology Collaboration Programme (TCP) on Bioenergy, which is the 'umbrella agreement' under which the collaboration takes place, was originally signed in 1978 as IEA Forestry Energy. A handful of countries took part in the collaboration from the beginning. In 1986 it broadened its scope to become IEA Bioenergy and to include non-forestry bioenergy in the scope of the work. The number of participating countries has increased during the years as a result of the steadily increasing interest in bioenergy worldwide. By the end of 2020, 26 parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, China, Croatia, Denmark, Estonia, Finland, France, Germany, India, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Norway, South Africa, Sweden, Switzerland, the United Kingdom, the United States of America, and the European Commission.

IEA Bioenergy is now 43 years old and is a well-established collaborative agreement. All OECD countries with significant national bioenergy programmes are now participating in IEA Bioenergy, with very few exceptions. The IEA Governing Board has decided that the Technology Collaboration Programmes may be open to non-Member Countries, i.e., for countries that are not Members of the OECD. For IEA Bioenergy, this has resulted in a number of enquiries from potential participants, and as a consequence new Members are expected. Five non-Member Countries currently participate in IEA Bioenergy – Brazil, China, Croatia, India and South Africa.

The work within IEA Bioenergy is structured in a number of Tasks, which have well defined objectives, budgets, and time frames. The collaboration which earlier was focused on Research, Development and Demonstration is now increasingly also emphasising Deployment on a large-scale and worldwide. There were 12 ongoing Tasks during 2020:

- Task 32: Biomass Combustion
- Task 33: Gasification of Biomass and Waste
- Task 34: Direct Thermochemical Liquefaction
- Task 36: Materials and Energy valorisation of waste in a Circular Economy
- Task 37: Energy from Biogas
- Task 39: Commercialising of Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks
- Task 40: Deployment of biobased value chains
- Task 41: Bioenergy Systems Analysis
- Task 42: Biorefining in a Circular Economy
- Task 43: Sustainable biomass supply integration for bioenergy within the broader bioeconomy
- Task 44: Flexible Bioenergy and System Integration
- Task 45: Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy

Members of IEA Bioenergy are invited to participate in all of the Tasks, but each Member is free to limit its participation to those Tasks which have a programme of special interest. The Task participation during 2020 is shown in Appendix 1.

A progress report for IEA Bioenergy for the year 2020 is given in Sections 1 and 2 of this Annual Report.

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# Progress Report

## 1. THE EXECUTIVE COMMITTEE

### Introduction and Meetings

The Executive Committee (ExCo) acts as the 'board of directors' of IEA Bioenergy. The committee plans for the future, appoints persons to do the work, approves the budget, and, through its Members, raises the money to fund the programmes and administer the Technology Collaboration Programme (TCP). The Executive Committee also scrutinises and approves the programmes of work, progress reports, and accounts from the various Tasks within IEA Bioenergy. Other functions of the ExCo include publication of an Annual Report, production of newsletters and webinars, and maintenance of the IEA Bioenergy website. In addition the ExCo produces technical and policy-support documents, and organises workshops and study tours for the Member Country participants.

*The COVID-19 pandemic, which spread globally in early 2020, has had a significant effect on the activities of the IEA Bioenergy TCP and on how it conducted its business. The most visible impact was the preclusion of in-person gatherings, either as ExCo or Task meetings or workshops/conferences, all of which are important aspects of the TCP programme. Despite this, much normal business was conducted using online platforms for meetings and workshops and indeed there were beneficial effects from more frequent interactions on these platforms as time and expense associated with travel was not a factor.*

The 85<sup>th</sup> ExCo meeting was held as a Virtual meeting on the 27<sup>th</sup> April 2020 with 37 participants. The 86<sup>th</sup> ExCo meeting was held as a Virtual Meeting in three separate sessions on 21-22 October 2020 and there were 38-40 participants in each session. Kazuhiro Kurumi and Jean-Baptiste Le Marois represented IEA Headquarters at ExCo86.

Jim Spaeth of the USDoE chaired both ExCo meetings in 2020 with Paul Bennett of SCION in the role of Vice-chair. At ExCo86, Paul Bennett was elected as Chair for 2021. Following the ExCo86 meeting a selection among candidates for the positions of Vice-chairs was carried out by email and Dina Bacovsky and Sandra Hermle were selected. They were approved as Vice-chairs for 2021 by ExCo through a written procedure.

## **Secretariat**

The ExCo Secretariat is currently based in Dublin, Ireland under the Secretary, Pearse Buckley. The fund administration for the ExCo Secretariat Fund and Task funds is consolidated with the Secretariat, along with production of ExCo publications and newsletters, and maintenance of the website.

The contact details for the Executive Committee can be found in Appendix 7 and for the Secretariat on the back cover of this report. The work of the ExCo, with some of the achievements and issues during 2020, is described below.

## **Implementing Agreement**

The current term of the IEA Bioenergy Technology Collaboration Programme (TCP) covers the period 1<sup>st</sup> March 2020 to 28<sup>th</sup> February 2025.

## **Contracting Parties/New Participants**

A complete list of the Contracting Parties to IEA Bioenergy is included in Appendix 3.

China joined the IEA Bioenergy Technology Collaboration Programme in 2020, bringing the number of contracting parties to 26.

## **Supervision of Ongoing Tasks, Review and Evaluation**

The progress of the work in the Tasks is reported to the Executive Committee twice per year at the ExCo meetings. In order to improve efficiency, the ExCo has decided that in future Task Leaders attend the second meeting in each year so that they can make presentations on the progress in their Task and programme of work personally. Participation by Task Leaders in ExCo meetings has improved the communication between the Tasks and the Executive Committee and has also increased the engagement of the ExCo with the Task programmes.

The work within IEA Bioenergy is regularly evaluated by the IEA Committee for Energy Research and Technology (CERT) via its Renewable Energy Working Party (REWP) and is reported to the IEA Governing Board.

## Approval of Task and Secretariat Budgets

The budgets for 2020 approved by the Executive Committee for the ExCo Secretariat Fund and for the Tasks are shown in Appendix 2. Total funds invoiced in 2020 were US\$2,023,200 comprising US\$287,200 of ExCo funds and US\$1,736,000 of Task funds. Appendix 2 also shows the financial contributions made by each Member Country and the contributions to each Task. Very substantial 'in-kind' contributions are also a feature of the IEA Bioenergy collaboration but these are not shown because they are more difficult to recognise in financial terms.

## Fund Administration

The International Energy Agency Bioenergy Trust Account in Bank of Ireland Global Markets in Dublin continues to function smoothly. The Trust Account consists of a Call Deposit account and a Fixed Deposit account both of which bear interest. The Call Deposit account is the account used to receive funds from the contracting parties and to distribute funds to the Task Leaders. It can be accessed electronically and transactions can be executed by the Secretary at all times. The Fixed Deposit account is a separate account that attracts a higher level of interest (approximately a factor of 10 higher than the Call deposit account). Funds in this account can only be transferred to the Call Deposit account following a written request from the Secretary and with a delay of several days. Both accounts are denominated in US dollars. The currency for the whole of IEA Bioenergy is US Dollars. Details for making payments are provided with each invoice.

The main issues faced in fund administration are slow payments from some Member Countries and fluctuations in exchange rates. As of 31 December 2020, there was US\$63,900 of Member Country contributions outstanding.

At ExCo84, unanimous approval was given to the appointment of KPMG, Dublin as independent auditor for the ExCo Secretariat Fund until 31 December 2021. The audited accounts for the ExCo Secretariat Fund for 2019 were approved at ExCo85.

The Tasks also produce audited accounts. These are prepared according to guidelines specified by the ExCo. The accounts for the Tasks for 2019 were approved at ExCo85, with the exception of Tasks 33, 39, 40 and 45 whose accounts were approved by written procedure prior to ExCo86.

The audited accounts for the ExCo Secretariat Fund for the period ended 31 December 2020 have been prepared and these will be presented for approval at the ExCo87 Virtual meeting.

## **Task Administration and Development**

### ***Task Participation***

In 2020 there were 113 participations in 11 Tasks. Please see Appendix 1 on page 112 for a summary of Task participation.

There were two active projects under Task 41 and five Inter-Task projects in 2020 – see below under '**Strategic Fund/Strategic Outputs**'.

## **Strategic Planning and Strategic Initiatives**

### **Strategic Plan**

The Executive Committee of IEA Bioenergy have adopted a new Strategic Plan for the term 2020-2025. The objectives of the plan are to enable bioenergy to substantially contribute to future global energy demand within a growing global bioeconomy; provide significant greenhouse gas savings across all energy sectors; and contribute to the Sustainable Development Goals. The Plan recognises that bioenergy can and must deliver increasing results in decarbonising transport, heat, power and electricity, including through its capacity to deliver negative emissions by, among many pathways, bioenergy with carbon capture and storage/utilisation (BECC/BECCUS)

### **Technical Coordinator**

In 2020 the Technical Coordinator continued his close engagement with the Tasks including keeping updated on Tasks' publications and supporting the associated dissemination activity. He was able to participate in a greater number of Tasks' meetings in 2020 due to the fact that they were online because of COVID-19 restrictions on travel. He was involved in Inter-Task and Task 41 projects and assisted in the preparation of two additional Inter-Task projects on BECCUS and Lessons Learned – Biofuels, which became active in 2020. He led the TCP response to negative media commentary on bioenergy and initiated and supported the development of the work programme for the upcoming triennium 2022-2024. The Technical Coordinator coordinated the preparation of the programme for the ExCo86 workshop and led the drafting of the summary and conclusions report from it. He leads the working group charged with the preparation of the IEA Bioenergy End-of-Triennium Conference, which will be held online in November/December 2021. The Technical Coordinator has continued to be a key actor in the execution of the Communication Strategy (see below) including the preparation and presentation of webinars and specifically in 2020 the development of the new branding and visual identity of the TCP. Regarding the IEA Secretariat, he has facilitated IEA Bioenergy responses to specific queries, provided a review of the Renewables 2020 Market Report and participated in the IEA EUWP Transport Coordination Group. The Technical Coordinator continued to facilitate interaction with other IEA TCPs and international organisations including the IEA Hydrogen and GHG TCPs, GBEP, the BioFuture Platform, IRENA and the ART Fuels Forum.



## Communication Strategy

The focus on communications intensified in 2020 with nine meetings of the Communications Team. A key development during the year was the launch of the new IEA Bioenergy TCP brand and visuals, which had been developed by ETA Florence, through a webinar in May 2020 – see <https://www.ieabioenergy.com/blog/publications/iea-bioenergy-webinar-iea-bioenergy-global-collaboration-on-sustainable-bioenergy-a-look-forward/>. Activity on social media continued throughout the year. Increased visibility of the TCP was evident from significantly expanded following on both Twitter and LinkedIn and from anecdotal evidence from ExCo members. The successful webinar programme has continued and consideration is being given to increasing the annual frequency. In 2020 seven webinars were presented, one of which was funded through Task 41 project 9 “Potential for cost reduction for novel and advanced renewable and low carbon Fuels”. The webinars included (i) *The past, present and future for biomass gasification*, (ii) *Bio-based Chemicals – A 2020 Status Update*, (iii) *Advanced Biofuels – Potential for Cost Reduction*, (iv) *IEA Bioenergy, Global Collaboration on Sustainable Bioenergy, A Look Forward*, (v) *Deployment of Bioenergy Combined with Carbon Capture and Storage or Utilisation*, (vi) *Trends and drivers in alternative thermal conversion of waste* and (vii) *The contribution of renewable fuels to road transport decarbonisation*. The recordings and presentations are available at <https://www.ieabioenergy.com/iea-publications/webinars/>.

## Strategic Fund/Strategic Outputs

At ExCo53 it was agreed that from 2005, 10% of Task budgets would be reserved for ExCo approved work. The idea was that these ‘Strategic Funds’ would be used to increase the policy-relevant outputs of IEA Bioenergy.

Progress with strategic initiatives has continued. The summary and conclusions from the ExCo86 workshop ‘Contribution of sustainable biomass and bioenergy in industry transitions towards a circular economy’, which was held online, has been published and can be download at <https://www.ieabioenergy.com/wp-content/uploads/2021/01/IEA-Bioenergy-ExCo86-eWorkshop-Final-1.pdf>. All previous ExCo workshop publications are available at <https://www.ieabioenergy.com/iea-publications/workshops/>.

**Task 41 Project 10: The contribution of Advanced renewable Transport Fuels to transport decarbonisations in 2030 and beyond:** This project has been completed and the final report is available at <https://www.ieabioenergy.com/blog/publications/new-publication-the-role-of-renewable-transport-fuels-in-decarbonizing-road-transport/>. The report was launched with a webinar which can be viewed at <https://www.ieabioenergy.com/blog/publications/iea-bioenergy-webinar-the-contribution-of-renewable-fuels-to-road-transport-decarbonisation/>.

**Task 41 Project 11: Renewable Gas – Hydrogen in the grid:** This project is linked to the Inter-Task project on 'Renewable Gas – deployment, markets and sustainable trade'. The work includes compiling data on strategies for greening the grid with hydrogen in selected countries, including within the European Union, Germany, Denmark, The Netherlands, Sweden, Australia, Japan and the United States of America. It will identify and discuss the numerous challenges and hurdles for the gradual replacement of natural gas by renewable gas, with emphasis on hydrogen addition to the gas grid and dedicated hydrogen grids. The project experienced some delay due to COVID-19 restrictions and is expected to be completed by the end of June 2021 with a final report.

**Inter-Task Project: The role of bioenergy in a WB2/SDG world:** From this project a first report 'Roles of bioenergy in energy system pathways towards a well below 2° Celsius (WB2) world' has been published and is available at <https://www.ieabioenergy.com/wp-content/uploads/2020/07/Roles-of-bioenergy-in-energy-system-pathways-towards-a-WB2-world-Workshop-Report.pdf>. Some key messages include the near and long term complementarity of bioenergy in an energy system that varied in both space and time, the dependence of near-term progress on the transition from fossil fuels and the positive contribution of bioenergy to sustainable land use. The project is expected to be completed on time in the 4<sup>th</sup> quarter of 2021.

**Inter-Task Project: Renewable gas – deployment, markets and sustainable trade:** The project is examining the status of renewable gas and includes non-biological renewable technologies. It is also looking at sustainable trade potential, including aspects such as gas pipelines and green liquid natural gas. Collaboration with, inter alia, the European Biogas Association (EBA) and GBEP is an important aspect. It is expected that the project will make a contribution to the EUBCE Conference in April 2021. The project is expected to be completed in the second quarter of 2021.

**Inter-Task Project: Bioenergy for high temperature heat in industry:** Four case studies have been completed and are available at <https://www.ieabioenergy.com/blog/publications/new-publications-case-studies-illustrating-how-bioenergy-is-used-in-industry-to-provide-high-temperature-heat/>. These include low grade biomass producing steam in a potato processing industry, gasification of paper rejects to displace natural gas, fast pyrolysis bio-oil providing process steam in a dairy and a waste-to-energy plant providing steam in a paper mill. Many technology combinations are available and further potential exists in process industries using steam. The policy report will include an overview of the potential. The project will be completed in September 2021.

**Inter-Task Project: BECCUS:** This project was approved by written procedure prior to ExCo86 and is led by Task 40. It will complement an ongoing collaborative project on BECCUS with four additional case studies: BECCUS in cement production; BECCUS in bioethanol production; Biopower flexibility and CO<sub>2</sub> removal; and Carbon accounting in BECCUS supply chains. The case studies will be carried out in quarter 1 to quarter 3 of 2021, the project being completed in quarter 4 of 2021 with a synthesis report.

**Inter-Task Project: Lessons Learned – Biofuels:** This project was approved by written procedure prior to ExCo86 and is led by Task 39. It will evaluate the reasons for the past and ongoing boom and bust cycles of biofuel technologies development, demonstration and deployment. It aims to answer two main questions: what is required to re-stimulate vigorous biofuels development and scale-up? what are the key factors for the success of sustainable advanced biofuel projects. The project will be completed in November 2021.

### **ExCo Workshops**

Prior to ExCo86 an e-workshop on 'Contribution of sustainable biomass and bioenergy in industry transitions towards a circular economy' was held on the 19-20 October 2020. It was organised in collaboration with ADEME, the French Agency for the Ecological Transition and included three separate two-hour sessions on the role of biomass in different sectors/applications:

1. Medium and high temperature heat in industry
2. Energy intensive industries – steel and cement sectors
3. Chemical industries

Each session was concluded with a short panel discussion on challenges for such industry transitions and what is needed in terms of policies and market conditions to increase the role of biomass in these sectors. The workshop sessions each had between 200 and 250 participants.

The presentations and the summary report from the workshop are available at <https://www.ieabioenergy.com/blog/publications/iea-bioenergy-eworkshop-contribution-of-sustainable-biomass-and-bioenergy-in-industry-transitions-towards-a-circular-economy/>.

### **Seminars, Workshops, and Conference Sessions**

Every year a large number of seminars, workshops, and conference sessions are arranged by individual Tasks within IEA Bioenergy. However, in 2020 COVID-19 restrictions proved to be an insurmountable barrier to normal business activity, with the result that in-person events from the beginning of March 2020 were not possible. Nonetheless all Tasks made use of online platforms to continue their Task activities and also to engage with stakeholders in e-workshops and e-conferences.

### **Collaboration with other Technology Collaboration Programmes and International Organisations**

The Executive Committee of the IEA Bioenergy TCP continues to place strong emphasis on collaboration with other Technology Collaboration Programmes and International Organisations, including those mentioned in the following.

## **Advanced Motor Fuels Implementing Agreement**

Collaboration with the Advanced Motor Fuels (AMF) Technology Collaboration Programme has continued particularly in AMF Annex 58 'Transport Decarbonisation' and AMF Annex 60 'The Progress of Advanced Marine Fuels' with IEA Bioenergy Task 39. Other possible areas to be considered in the future include 'Electrofuels', 'Aviation fuels' and 'Fuel Matrix'.

## **GBEP**

There is collaboration with IEA Bioenergy Task 39 on identifying good examples of experiences in advanced liquid biofuels which is ongoing, although progress has been slowed by the impact of COVID-19. With IEA Bioenergy Task 45 discussions have centred on the role of bioenergy in the broader context of the bioeconomy. Under Activity Group 4, GBEP is working with IEA Bioenergy to organise dialogue focused on links between FLR (Forest Landscape Restoration) and wood energy.

## **FAO**

IEA Bioenergy, particularly through the IEA Bioenergy Tasks, and FAO continue to examine areas for greater cooperation under the MoU between the two organisations.

## **IRENA**

IEA Bioenergy and IRENA continue to share information on work programmes, particularly through the Technical Coordinator and to consider areas of mutually beneficial cooperation.

## **Biofuture Platform**

The interaction with the Biofuture Platform has continued to deepen and discussions are ongoing on an MoU, which would also include IEA Headquarters. The Biofuture Platform has been placed under the Clean Energy Ministerial (CEM), with the secretariat for both being facilitated by IEA Headquarters. Areas for IEA Bioenergy engagement with the Biofuture Platform include the latter's policy blueprint for the bioeconomy and the CEM Biofuture Initiative, which was formulated by the Biofuture Platform to raise the visibility of bioenergy and accelerate market uptake and scale-up of the bioeconomy. Both parties recognise the complementarity between each other's activities, with many areas for collaboration.

## **Promotion and Communication**

Effective communication of IEA Bioenergy activities to the broader stakeholder community is a high priority for the Executive Committee of IEA Bioenergy. The engagement of ETA Florence has continued to have a significantly beneficial impact on communications. In May 2020 a new TCP brand identity and logo together with a redesigned website was launched. The redesigned website provides a more comprehensive, intuitive and user friendly source of information.

The 2019 Annual report included the special colour section on “*Gasification – a versatile technology*”. A limited number of printed copies were produced, with substantially increased distribution in electronic format.

The newsletter ‘IEA Bioenergy News’, which is distributed in June and December each year following ExCo meetings, continues to be widely circulated. Two issues were published in 2020. As a special theme the first issue in 2020 featured the launch of ‘IEA Bioenergy’s new website and graphic identity’ and an article by the Technical Coordinator titled “Creating trust through fact based communication is key for deployment of sustainable bioenergy”. The second issue in December 2020 featured an article by the Technical Coordinator titled “Contribution of sustainable biomass and bioenergy in industry transitions towards a circular economy”. The newsletter is also produced in electronic format and is available from the IEA Bioenergy website. An electronic news bulletin covering recent ExCo and Tasks’ activities was also produced and distributed at the end of March and September 2020. A free subscription to the TCP newsletters is offered to all interested parties and there is wide distribution outside of the normal IEA Bioenergy network.

Two contributions under the banner ‘IEA Bioenergy Update’ were provided to the journal Biomass and Bioenergy in 2020 bringing the total to 69. This initiative provides excellent access to bioenergy researchers as the journal finds a place in major libraries worldwide.

### **Interaction with IEA Headquarters**

Despite the impacts of COVID-19, there was continuing contact between the IEA Bioenergy TCP and IEA Headquarters in Paris in 2020. The Chairman, Technical Coordinator, Secretary, and key Task Leaders have worked closely with Headquarters staff at both administrative and technical levels. In 2020 the Technical Coordinator provided input to the Renewables 2020 Market Report and participated in the IEA EUWP Transport Coordination Group. He continued to maintain regular engagements to facilitate information exchange from IEA Bioenergy to IEA Headquarters and vice-versa.

The Chair of IEA Bioenergy, Jim Spaeth, attended the REWP online meeting in April 2020 and presented the IEA Bioenergy Annual Briefing report to the IEA. Jim also attended the REWP online meeting in October.

Kazuhiro Kurumi and Jean-Baptiste Le Marois attended ExCo86 on behalf of IEA Headquarters and made a presentation to the IEA Bioenergy Executive Committee on activities in the IEA. This participation by Headquarters is appreciated by the Members of the ExCo and helps to strengthen linkages between the Technology Collaboration Programme and relevant Headquarters initiatives.

Status reports were prepared by the Secretary and forwarded to the Desk Officer and the REWP following ExCo85 and ExCo86. Status reports were also sent to Carina Alles, Vice Chair of the End Use Working Party (EUWP) for the Transport sector. This forms part of the exchange of information between Technology Collaboration Programmes and the Working Parties.

### **IEA Bioenergy Website**

The IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) has been completely redesigned in 2020. The new website features a fresh and clean design with a new menu structure delivering information in an easy to navigate and aesthetically pleasing approach. The new website's improved features include a quicker and easier access to central information such as publications, reports and events, offering a more comprehensive understanding of the organisations' mission and objectives

## 2. PROGRESS IN 2020 IN THE TASKS

### TASK 32: Biomass Combustion

#### Overview of the Task

Task 32 aims to stimulate expansion of biomass combustion for the production of heat and power on a wider scale. The widespread interest in the work of the Task illustrates the relevance of biomass combustion in society and the integration in energy systems with variable renewable energy sources. Combustion applications vary from domestic woodstoves to industrial combustion technologies, dedicated power generation and co-firing with fossil fuels.

Biomass combustion technologies are commercially established with high availability and a multitude of options for integration with existing infrastructure on both large and small-scale levels. Nevertheless, there are still challenges for further market introduction, the importance of which varies over time. The areas covered by the Task through different activities in the current triennium are:

- WP1 – Improvement of small-scale biomass combustion
- WP2 – Biomass combustion in industry
- WP3 – Integration and deployment of efficient and flexible large-scale biomass CHP

The specific actions of Task 32 involve collecting, analysing, and sharing the policy aspects of results of international and national R&D programmes in the above areas. The results of these actions are disseminated in workshops and reports and potentially as well via handbooks and databases etc. In addition, specifically designed, strategic actions are carried out by the Task to catalyse this process.

While most of the above areas are of a technical character, Task 32 also addresses non-technical issues on fuel logistics and contracting, environmental constraints and legislation, public acceptance, and financial incentives.

*Participating countries:* Austria, Canada, Denmark, Germany, Japan, The Netherlands, Norway, Sweden, and Switzerland

**Operating Agent:** Ms Lærke Skov Hansen, Danish Energy Agency, Denmark

**Task Leader:** Morten Tony Hansen, Ea Energy Analyses, Denmark

**Co-Task Leader:** Anders Hjörnhede, RISE, Sweden

The Task Leader directs and manages the work programme, assisted by the co-Task leader. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 32, please refer to Appendices 2, 4, 5 and 6; the Task website [task32.ieabioenergy.com](https://task32.ieabioenergy.com) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## **Progress in R&D**

### **Task Meetings and Workshops**

In 2020, Task 32 organised only one physical Task meeting which was held in Graz, Austria in January. Focus was on work progress and country reports. COVID-19 forced subsequent meetings to be virtual. Three virtual Task meetings were held during 2020 – one in June and two in December. The first virtual meeting focussed on work programme progress while the December meetings focused on the future work programme and also took up country reporting. Country reports typically include sharing current developments on application of biomass combustion in the member countries of the Task and thereby facilitating an important learning effect of the meetings. 2020 has shown quite some differences in the public perception of biomass in the member countries. While e.g. the Netherlands and Denmark experience resistance, demonstrations and political measures taken against the utilisation of bioenergy, Austria and Germany see biomass as an important means to substitute fossil fuels for heating and electricity generation.

Workshops are a proven concept to gather and disseminate information in a structured and effective manner. Normally, invited speakers present the latest insights on one aspect of biomass combustion and thereby provide expert information for the participants. The workshops are usually organised in conjunction with high-profile bioenergy conferences to attract as wide an audience as possible. The results of the workshops are reported and published on the Task website, and key results are fed back to both the Task participants and the ExCo for evaluation and further dissemination.

In January, Task 32 held a workshop on residential biomass combustion in Graz, Austria at the Central European Biomass Conference and as such lived up to this classic approach. Two further workshops on combustion experiences in large CHP plants were planned for 2020, however, due to COVID-19 they had to be postponed several times. At the Task meeting in December, it was decided to postpone the workshops and the attempt from Task 32 to create a high-profile event by pooling the two workshops and site visits to new and remarkable combustion units, until the next triennium and to revise the budget accordingly.



## Work Programme and Outputs

In 2020, all proposed activities have progressed as shown below.

### *D1.1 Testing methods and real-life performance of pellet stoves (Austria)*

The main project activities were carried out in the second half of 2019 and the main results were presented at the workshop in Graz in January 2020. Reporting has experienced some delay due to COVID-19. A final draft was presented in December 2020 and the final report is expected to be public in Q1 2021.

### *D1.2 Technical guidelines for design of low emission wood stoves (Denmark)*

Preliminary results were presented at the workshop in Graz in January. A draft guideline has been presented for comment in Q3-4 and is ready to be edited and published in Q1 2021. The guideline focuses on primary measures such as fire chamber design, ignition principles, load, air control and automation while secondary measures such as catalysts and filters (ESP, bag filters, chimney fans) are described in general terms.

### *D1.3 Internal WS and report: National strategies for reducing the impact on air quality from residential and commercial wood combustion (Germany)*

The project aims to gather information from each participating country on strategies to mitigate PM immision. A comprehensive template has been prepared in draft and will be finalised in Q1 2021. Each participant is asked to fill in information on their respective country. The country reports will form the basis for the main report that has been re-scheduled for the end of 2021.

### *D1.4 WS: Improved combustion in stoves and small biomass boilers (Austria)*

As mentioned above the workshop was held in connection with the Central European Biomass Conference 2020 (CEBC) in January in Graz, Austria. The workshop was a parallel event at the conference on the 23<sup>rd</sup> of January and benefited from the abstracts sent to the conference on small scale biomass combustion. CEBC proved to be a great opportunity to disseminate news and findings from Task 32 to a wider group. Presentations and a short summary are available on the Task website.

### *D2.5 Biomass for high temperature heat in industry (Inter-Task project, managed by Task 32, Netherlands)*

During 2020, four case story reports have been finalised and published on the project website: <https://itp-hightemperatureheat.ieabioenergy.com/> as well as on the general IEA Bioenergy website. The case studies were presented at the ExCo eWorkshop in October. A policy synthesis report is being drafted and will be published during 2021.

### *D3.6 Biomass-based CHP for balancing an energy system with a large portion of uncontrollable production (Sweden)*

This project is dedicated to feed into the activities in Task 44 on Flexible Bioenergy and System Integration. Task 32 has contributed with a presentation of the results of the Task 32 project “The future role of Thermal Biomass Power in renewable energy systems – a study of Germany” to the Task 44 workshop that was held at the CEBC in January in Graz, Austria. Task 32 is considering how to best contribute to the Task 44 study and the corresponding questionnaire that has been distributed.

### *D3.8 Workshop: Experiences with combustion of wood chips for CHP production (Denmark)*

The first planning steps have been taken within the Task as well as with external stakeholders. It had been decided to organise the two workshops on the same occasion, however, due to COVID-19 the event has been postponed twice. As uncertainty remained at the end of 2020, it was decided to postpone the workshops and site visits to the next triennium.

The event involves cooperation with Task 40 with plans for a Task meeting in Copenhagen as well as with members of IEA CCC and members of VGB Powertech.

## **Website**

During 2020 the Task website has been updated with recent publications. A list of changes has awaited the transfer to a new server and will be implemented in 2021.

## **Collaboration with other Tasks/organisations/networking**

The Task collaborates directly with industry and through industrial networks such as VGB Powertech. Within the IEA family, interaction is also solicited with other Bioenergy Tasks or other TCP’s such as the Clean Coal Centre. Market relevance is also enhanced by the active involvement of ExCo Members in the selection of Task participants, based on their national programmes. Utility companies are currently directly involved in the Task. Effective coordination is achieved through joint events, and the exchange of meeting minutes and reports.

Examples of cooperation activities in during 2020:

Danish BMA Workshop 2020:	Announcing the 2020 workshop (subsequently cancelled)
VGB Powertech:	Contact regarding meetings in TG biomass (41 <sup>st</sup> meeting was cancelled) and TG Biomass Ash
Tasks 33, 34, 36, 40:	Inter-Task collaboration on high temperature heat for industry
Task 40:	Collaboration on planning workshop on experiences with wood chips combustion in large plants
IEA CCC:	Contribution with suggestion of speakers and announcement on website of IEA CCC co-firing workshop in Japan in February 2020
IEA Combustion TCP	Contribution to generation of ideas for potential new Task topics.
IEA Renewable Energy Division	Supporting the division with inquiries on the flexibility of bioenergy plants and data residential heating systems.

Through the year, Task 32 has supported several project proposals on combustion issues as well as responded to several inquiries from parties around the world.

## **Deliverables**

The following milestones were achieved in 2019:

- Presenting annual report and audited accounts at the ExCo85 meeting
- Organising and reporting of one physical and three virtual Task meetings
- Organising workshop on residential biomass combustion in Graz, January 2020
- Publishing case studies in the Inter-Task project on high temperature heating
- Updating and maintenance of the Task website
- Preparing and presenting the progress report for the ExCo86 meeting
- Participating in the ExCo86 meeting, strategy workshop and e-workshop
- Initiating preparations of Task 32 work programme proposal for the 2022-2024 triennium
- Preparing annual report (this report)
- Preparing audited accounts for the ExCo87 meeting.

# TASK 33: Gasification of Biomass and Waste

## Overview of the Task

The objectives of Task 33 are (1) to promote commercialisation of biomass gasification, including gasification of waste, to produce fuel and synthesis gases that can be subsequently converted to substitutes for fossil fuel based energy products and chemicals, and lay the foundation for secure and sustainable energy supply; (2) to assist IEA Bioenergy Executive Committee activities in developing sustainable bioenergy strategies and policy recommendations by providing technical, economic, and sustainability information for biomass and waste gasification systems.

*Participating countries:* Austria, Germany, Italy, The Netherlands, Sweden, United Kingdom and United States of America

**Task Leader:** Berend Vreugdenhil, TNO, The Netherlands

**Operating Agent:** Kees Kwant, Netherlands Enterprise Agency, The Netherlands

The Task Leader directs and manages the work programme, assisted by sub-Task leaders for specific areas. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 33 please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task33.ieabioenergy.com/>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and Workshops and Webinars

The first Task 33 meeting for 2020 was held 29-30 June online, due to the COVID-19 situation. This was also the reason that no workshop was organised for this meeting. The Task business meeting was held on the first day, with limited time available due to different timezones (13:00-17:00 CET) and on the second day the country updates were given during the same hours.

The second Task 33 meeting was held again online on 18-19 November. Due to COVID-19 travelling was still not allowed. The organisation was similar to the previous one and did not include a workshop

On the 30<sup>th</sup> of January a webinar was organised on the past, present and future of gasification. This webinar was well attended.

## **Work Programme and Outputs**

The scope of work for the current triennium is built upon the progress made in the previous triennia. In the previous years, information exchange, investigation of selected sub-Task studies, promotion of coordinated RD&D among participating countries, selected plant visits, and industrial involvement in technical workshops at Task meetings have been very effective. These remain the basic foundations for developing and implementing a programme of work that addresses the needs of the participating countries.

Furthermore, the aim is to increase the number of countries participating in Task 33. Australia, Brazil, Canada, France, Japan, and the United Kingdom, for example, are very active in thermal biomass gasification and their membership would be profitable for all participants. In the current triennium, the United Kingdom is a new participant in the Task. Initial discussions were started at the end of 2020 on Belgium participating in the Task. This would be a good addition to the members.

The Task monitors the current status of key operations and R&D efforts relating to biomass and waste gasification, and identifies hurdles to advance further development, operational reliability, and economics of gasification systems. The Task meetings provide a forum to discuss the technological advances and issues critical to scale-up, system integration, and commercial implementation of these processes. These discussions lead to selection of sub-Task studies and/or technical workshops that focus on advancing the state-of-the-art technology and identify the options to resolve barriers to technology commercialisation.

The Task has continued the practice of inviting industrial experts to the Task workshops to present their practical experiences and to discuss the options for development of critical process components to advance state-of-the-art biomass and waste gasification systems. The interaction with industry provides the opportunity for the National Team Leaders (NTLs) to evaluate refinements to existing product lines and/or processes. Academic experts are also invited to share information and foster cooperation in order to address and support basic research needs.

## **Work Program/Sub-Task Studies**

The current work program includes the following elements:

- Plan and conduct semi-annual Task meetings, where due to COVID-19 the regular workshops were not organised. Also the technical tours that are normally part of the meetings have not taken place. This is a downside to the work program of 2020
- Prepare and publish reports on issues relating to gasification of biomass and waste. During 2020 no Task reports were finalised. The Task meeting reports have been published online.

- Survey the current global biomass and waste gasification RD&D programmes, commercial operations and market opportunities for gasification, and identify the technical and non-technical barriers to commercialisation of the technology. Use the survey results to prepare and update Country Reports for information dissemination. An important outcome of this ongoing survey is the role gasification can play in refinery settings. Task 33 has identified 4 possible routes to contributing to traditional refineries and in a new defined Task project this will be further investigated. The work on intergrating gasification into refineries or converting existing industries into biorefineries has started in 2020. Results will follow in 2021
- Conduct joint studies, conferences, and workshops with related Tasks, Annexes, and other international activities to address issues of common interest to advance biomass and waste gasification technology. In 2020 conferences and workshops have not really taken place.
- Identify research and technology development needs based on the results from the work described above as a part of the workshop reports.
- Publish results of the work program on the Task website ([www.task33.ieabioenergy.com](http://www.task33.ieabioenergy.com)) for information dissemination. Maintain the website with Task updates.
- Maintain Task 33 database on thermal gasification facilities worldwide.

### **Observations from Workshops:**

No workshop has been organised

### **Observations from Webinars:**

The webinar organised in January was well attended and a lively discussion took place during and after the presentations. There was a limit on the amount of attendees (100) and this was soon reached. The webinar is available online via the following link, <https://www.ieabioenergy.com/blog/ieaevent/iea-bioenergy-webinar-the-past-present-and-future-for-biomass-gasification/>

### **Website and database**

The Task website ([www.task33.ieabioenergy.com](http://www.task33.ieabioenergy.com)) is the most important tool for dissemination of information and results from this Task. Descriptions of the gasification process and a description of the Task including the contact details of national experts are provided. Within 2 weeks after each Task meeting, all presentations in PDF form (Country Reports, Workshop presentations) can be found on the Task website. The Minutes are posted in the member's area of the website as soon as all Task members provide their feedback. The summaries of the workshops can be found on the website in report format.

A Google-map based interactive database of deployments of gasification plants has been incorporated into the Task website. At the moment, there are over 150 gasification facilities, mostly in member countries, registered in the database. The database is interactive, which means that the technology, type, and status of the gasifiers can be chosen to filter all the gasification facilities registered in the database. The possibility to filter also based on the feedstock/raw material was recently added to the database. The database is updated regularly and provides a good overview on gasifiers throughout the world. During the current triennium, the aim of Task 33 is to extend this triennium report on gasification with relevant countries, who are not yet members. France, Spain and Brazil have agreed to provide information.

### **Collaboration with Other Tasks/Organisations/Networking**

The inter-Task project on high temperature heat started in 2019. The initial template was sent out and is currently being filled with data. This is a collaboration between Tasks 32, 33, 34, 36 and 40. The report was published in 2020 and can be found here.

<https://itp-hightemperatureheat.ieabioenergy.com/publications/industrial-heat-case-study-2-gasification-of-paper-reject-to-displace-natural-gas-usage-in-a-pulp-and-paper-process/>

The collaboration with Task 42 has started as well. Task 33 will develop 4 case studies on how gasification can be implemented to convert industrial processes into bio-refineries. The case studies will become available in 2021 and Task 42 will develop techno-economic assessments (TEAs) for these case studies.

### **Deliverables**

The Task deliverables include planning and conducting two semi-annual Task meetings focused on the workshops selected by the Task participants, involving academic and industrial experts; the preparation and distribution of workshop reports; updating and publishing country reports; conducting joint studies and providing webinars on the content, conferences, and workshops with related Tasks, Annexes, and other international bodies to address mutually beneficial issues; and preparation of periodic progress, financial and annual reports as required by the IEA Bioenergy Executive Committee (ExCo).

## TASK 34: Direct Thermochemical Liquefaction (DTL)

### Overview of the Task

The objective of Task 34 is to advance the international implementation of bioenergy technology through strategic information analysis and dissemination in the areas of direct thermochemical liquefaction of biomass (including bio-based waste) for bioenergy applications such as heat, power, transportation fuel, and the production of chemicals.

'Direct Thermochemical Liquefaction' is the controlled thermal degradation of biomass in any form to derive valuable energy and chemical products. It includes thermal and catalytic fast pyrolysis, hydrothermal and solvo-thermal liquefaction.

The Task contributes to standardisation efforts of these energy intermediates, the resolution of critical technical areas and disseminating relevant information particularly to industry and policy makers. The scope of the Task is to monitor, review, and contribute to the advancement of issues that will permit more successful and more rapid implementation of biomass liquefaction technology, including identification of opportunities to provide a substantial contribution to bioenergy.

The Task scope includes all steps in a process of liquid fuels production from biomass extending from reception of biomass in a raw harvested form to delivery of a marketable product as liquid fuel, heat and/or power, chemicals and char by-product. The technology review may focus on the thermal conversion and applications steps, but implementation requires the complete process to be considered. Process components as well as the total process are therefore included in the scope of the Task, which will cover optimisation, alternatives, economics, and market assessment.

The work of the Task aims at concerns and expectations of stakeholders such as:

• Conversion technology developers	• Bio-oil/biocrude application developers
• Equipment manufacturers	• Bio-oil users
• Chemical producers	• Utilities providers
• Policy makers	• Decision makers
• Investors	• Planners
• Researchers	

Industry is actively encouraged to be involved as Task participants, as contributors to Workshops or Seminars, as Consultants, or as technical reviewers of Task outputs to ensure that the orientation and activities of the Task match or meet their requirements.



*Participating countries:* Canada, Denmark, Finland, Germany, The Netherlands, New Zealand, Norway, Sweden, and United States of America

**Task Leader:** Dr.-Ing. Axel Funke, Karlsruhe Institute of Technology (KIT), Germany

**Operating Agent:** Birger Kerckow, Fachagentur Nachwachsende Rohstoffe e.V. (FNR), Germany

The Task Leader directs and manages the work programme, assisted by National Team Leaders (NTLs) that are responsible for specific work packages and/or deliverables. An NTL from each country is responsible for coordinating the national participation in the Task.

For further details on Task 34, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task34.ieabioenergy.com/>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## Progress in R&D

This year the national team leaders worked on a variety of efforts to advance research in thermally liquefied biomass for use as energy carriers, with the additional goal of providing value to Task 34, the international thermal liquefaction research community, as well as the interests of the individual member states. Typically, these efforts are supported by Task meetings held in conjunction with both international and regional bioenergy conferences and workshops. This was not possible in 2020 due to the impact of the ongoing COVID-19 pandemic. Instead, a series of regular videoconferences was conducted with the primary aim to keep track of Task related work packages and discuss findings/news.

Information dissemination to stakeholders was continued through the PyNe newsletter, journal publications, web resources, and circulation of articles that may have broader use among member countries.

The overview of work efforts in 2020 included:

- A continued series of videoconferences to replace physical meetings.
- Continued publication of the bi-annual electronic PyNe newsletter to highlight current research, standards work, collaborations, and successes in bioenergy through direct thermal liquefaction of biomass.
- Participation in European R&D projects, specifically regarding co-processing of fast pyrolysis bio-oil in existing refineries. This work will contribute significantly to development of associated analytical standards in Europe. Task 34 provides a platform for the involved researchers to connect and exchange information.

- Reporting and publicising ongoing collaborations and research in bioenergy in the form of country reports by country representatives at Task meetings. These country reports have also been published on the Tasks' website.
- Publication of the results from the latest Round Robin in a scientific journal (ACS 'Energy & Fuels') that was conducted within the scope of Task 34.
- Publication of a brochure to explain the concept of direct thermochemical liquefaction to a broader audience.
- Publication of a report on latest commercial activities, i.e. commercial and demonstration plants, in the field of direct thermochemical liquefaction with brief descriptions/key metrics of each individual project.
- Updates are being maintained on the web-based demonstration plant database developed by BEST – Bioenergy and Sustainable Technologies.

### **Task Meetings and workshops**

Nine videoconferences were conducted in 2020 to replace the originally planned two face-to-face meetings. The main focus was on initiating and discussing a website content renewal, which is almost completed (entering final review stage).

Regular items of these online meetings like keeping track of work packages, PyNe publication, country reports, communication with ExCo/other TCP Bioenergy Tasks etc are not explained further here. Detailed minutes are available on the Task's website.

### **Work Programme and Outputs**

Country reports have been made available on the Task's website early in 2020. This report provides an overview of research activities, demonstration activities and commercial applications of Direct Thermochemical Liquefaction in Finland, Germany, the Netherlands and Sweden.

A brochure was created and published to explain the background of direct thermochemical liquefaction, structure different approaches, provide a state of the art overview, and characterise products/applications. This brochure addresses a broader audience with little background knowledge in this field.

The increasing uptake of fast pyrolysis and HTL technology in the bioenergy market is summarised in a new report from Task 34 showcasing 20 industrial DTL projects for biofuel production of today. Only operating commercial installations and industrial demoplants have been included.

Task 34 contributed to the Inter-Task project on 'Bioenergy for High Temperature Heat in Industry' with a commercial case study concerning bio-oil from fast pyrolysis. Bio-oil is produced from woody residues in the Netherlands by Empyro in a 25 MW<sub>th</sub> polygeneration unit together with steam and electricity. The produced bio-oil is used by the dairy company FrieslandCampina in their production process for milk powder to co-fire a 29 MW<sub>th</sub> steam boiler. This steam boiler was designed by Stork Thermeq and is capable of co-firing up to 70% fast pyrolysis bio-oil with natural gas.

Results from the latest Round Robin were published as an article in a scientific journal. This Round Robin was conducted in the previous triennium within the scope of Task 34 and focussed on the analysis of nitrogen, sulphur, and chlorine in bio-oils from both fast pyrolysis and hydrothermal liquefaction. These heteroatoms play an important role for direct combustion applications of bio-oils due to emission regulations and potential material issues. Important directions for further development of analytical methods towards standardisation (i.e. reproducibility in a meaningful parameter range) were concluded from this study.

## **Newsletter**

In 2020 the PyNe newsletter was produced twice to publicise and highlight ongoing research and collaborations in member countries, with particular emphasis on active research and growing commercialisation efforts. A variety of pyrolysis and hydrothermal liquefaction activities was featured in both issues. There is constantly a large audience accessing PyNe newsletters.

All PyNe newsletters, including previous ones, are accessible on the Task's website:

<https://task34.ieabioenergy.com/pyne-archive-1996-2020/>

## **Website/Dissemination**

The Task 34 website was updated on a continuous basis regarding events, participants, and the PyNe newsletter. A refresh of website content was initiated and most pages have been thoroughly revised. This process is in its final review stage and the updates will be published early 2021.

A database of published PyNe articles has been created to enable a search for authors, keywords, countries etc. This database is now online as a separate page on the Task's website for ease of access to the PyNe newsletter repository.

Website traffic is definitively up and increasing significantly. Most page views are focused on pyrolysis reactors, followed by bio-oil applications and the PyNe newsletter. The increase in views for bio-oil applications is particularly noteworthy since it indicates an increased maturity, i.e. commercial maturity, of these products. Significant traffic from non-member countries to Task 34 still includes India, China, UK, and Brazil suggesting potential areas for outreach.

## Collaboration with Other Tasks/Organisations/Networking

Task 34 participates in the IEA Bioenergy ITP 'Bioenergy for High Temperature Heat in Industry' and has finalised its contribution to the report by creating a case study (see below). It is continuing to collaborate with Task 44 'Flexible Bioenergy and System Integration'. Collaboration with Task 39 'Commercialising Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks' is also part of the proposal for this triennium and being followed up.

## Deliverables

Deliverables for 2020 included:

- Review of techno-economic assessments of DTL technologies (D1.1, delayed to Q1/2021)
- Technical notes on R&D and commercialisation experiences (D3.2, delayed to Q3/2021)
- Publication of two PyNe newsletter issues (D4.1c/d, **completed**)
- Direct liquefaction brochure (D4.2, delayed from Q4/2019, **completed**)
- Website content refresh (D4.3, delayed to Q1/2021)
- Two workshops, seminars, and/or site visits with key stakeholders (D4.4c/d, cancelled due to pandemic induced travel restrictions)
- Country Report (D4.6a, delayed from Q4/2019, **completed**; D4.6b delayed to Q1/2021)
- Assessment of MSDS data of fast pyrolysis bio-oil (DAdd3.1, delayed to Q4/2021)
- Commercialisation overview (DAdd3.3 Q2/2020, **completed**)
- Report on Round Robin from last triennium (delayed from 2018, **completed**)
- Page with PyNe article database (Q3/2020, **completed**)
- Case study on the use of FPBO in industrial boilers (DITP1 Q3/2020, **completed**)

# TASK 36: Material and Energy valorisation of waste in a Circular Economy

## Overview of the Task

In 2012, the World Bank estimated that around 1.3 billion tonnes of municipal solid waste are generated per year globally and that this will grow to 2.2 billion tonnes per year by 2025. They attributed this rise in waste generation to increased urbanisation in developing and emerging economies and the associated increase in per capita generation of waste. This trend is a considerable challenge for many countries that will have to work towards intensive legislative, managerial and institutional changes, including the introduction of strategic direction aimed at decreasing and controlling waste generation; and the development of recycling, reduction and re-use as well as energy technologies to decrease the impact of waste. IEA Bioenergy Task 36 investigates the interface between waste management and energy recovery, and the role of waste-to-energy in a circular economy. Our prime aim is to understand the implications of technical and policy changes in the waste area that impact the integration of energy into solid waste management and their integration in a circular economy; and to provide support by disseminating and exchanging information on these developments.

Waste generation varies markedly across the world, in terms of composition and quantity. Strategies and solutions that are appropriate in one region may not be right elsewhere. The consequence of this is that countries have different approaches to challenges in waste arisings, reflected in different mixtures of treatment and disposal. Nevertheless, there are also common themes. Uppermost in these are concerns relating to the increasing quantities of waste needing to be treated and the impact of landfilling mixed wastes on the environment. In some cases, additional pressure arises from decreasing available landfill void space. This is driving policy makers to examine alternatives to landfill, including reduction and recycling of waste, and recovery of value from waste, commonly encompassed in the 'Waste Hierarchy', which is governed by a set of principles dedicated to minimising the impacts of waste and improving resource use. In some regions, there are calls for 'zero waste to landfill' and for policy to encourage the circular economy or 'smart waste management'. These moves are most advanced in the European Union and other regions where landfill is expensive or scarce. Elsewhere, notably in North America and Australia, countries continue to rely on landfill, but in these countries, there are also increasing pressures to reduce waste production and to recycle or recover where possible, leading to increased interest in recovery of energy from the residual waste. Globally, these policy pressures have led to a proliferation of research work on waste management, including policy development, environmental systems analysis, technology development and economic drivers. Whilst this has assisted in the development of more sophisticated waste management systems, in many cases it has also delayed deployment of energy recovery systems (specifically for residual wastes), in particular due to confused policy making, public awareness (and opposition) and uncertainty over environmental performance and technology performance.

Against this background decision makers continue to require guidance and information on waste and resource management systems that are environmentally and economically sustainable. Task 36 provides a unique opportunity to draw together information on how systems, policies and technologies are being applied in different countries to provide guidance for decision makers on key issues.

*Participating countries:* Australia, Germany, Ireland Italy, Norway, South Africa, Sweden, and the United States of America.

**Task Leader:** Mr. Inge Johansson, RISE Research Institutes of Sweden, Sweden

**Operating Agent:** Mr. Jonas Lindmark, Swedish Energy Agency, Sweden

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 36, please refer to Appendices 2, 4, 5 and 6; the Task website [www.task36.ieabioenergy.com](http://www.task36.ieabioenergy.com) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task meetings and workshops

The Task's core work was undertaken as structured Task meetings, each of which was accompanied with a themed workshop. The aim of these workshops is to allow Task members to present work on the nature of the issues concerned within their own country; to invite speakers to present work of relevance and to allow discussion of the issues presented. Due to the arrival of the COVID-19 epidemic, all the events during 2020 were organised as online events.

#### **Workshop – Waste for feedstock recycling: Challenges and opportunities, Online, June 2020**

**Workshop aim:** This workshop was designed to complement a previous workshop held in 2019 about technology pathways for waste to energy, where different solutions for the end product energy was discussed. In this workshop the focus moved towards making higher value chemicals and biomaterials from the waste as an alternative to energy.

### **Workshop outcomes:**

The workshop identified and then prioritised between several different potential waste feedstocks where the participants recognised a large potential for valorisation as new chemicals/biomaterials. Top four out of those were:

1. Organic fraction of Municipal solid waste
2. Mixed plastics
3. Biosolids (sewage sludge)
4. Manure

The most likely intermediates to be produced from the waste streams were identified as volatile fatty acids, lactic acid, and ethanol.

The potential for mechanical recycling is deemed limited, chemical recycling would complement it to reach higher recycling rates. There are a number of challenges both technical and economical. Differences between countries and lock-in effects from the selection of certain technologies are also factors to consider. There needs to be a larger exchange of experiences on the research and development to speed up the advance of chemical recycling.

A summary report of the workshop can be found at the Task website.  
(<https://task36.ieabioenergy.com/>).

### ***Webinar – Valorisation of fly ash from Waste-to-Energy, Online, October 2020***

**Webinar aim:** The fly ash/APC-residues from waste incineration are generally considered as a hazardous waste stream. There is a limited agreement on the classification, handling, disposal and potential valorisation. The webinar aimed at giving an overview on some technologies for valorisation of this complex stream.

### **Webinar outcomes:**

The webinar gave an overview of the fly ash treatment in Japan as well as a brief outline of that in Europe as an introduction to the presentations about valorisation technologies.

Seven different technologies in different stages of commercial maturity were presented. A number of those are focused on extracting salts from the residues and in addition possibly recovering metals like zinc. Others have a focus on producing a stable/inert material that could be used for construction purposes.

Technological challenges that were identified:

- Development of new technologies to industrial scale is always challenging and takes time
- Handling a heterogeneous material like fly ash and designing a process that is robust but flexible at the same time is challenging. The type of flue gas treatment will both affect the composition of the residues as well as the access to process streams that could be utilised in the valorisation process.

Barriers identified are to a large extent related to the fact that landfilling is still a widely accepted solution. There is also a general lack of policy support for the development of secondary raw material markets and clear standards and legislation through larger markets (such as the European Union).

Video recordings of the presentations as well as a short summary report are available at the Task website (<https://task36.ieabioenergy.com/>).

### **Task Meetings and site visits**

Due to the COVID-19 pandemic the physical meetings that were planned to be held in Seattle and Johannesburg were replaced with online meetings. They were also broken down into several shorter meetings. There were online meetings arranged regularly between March and December.

For the same reason there were no site visits.

### **Work Programme and Outputs**

Most actions regarding the work programme are already mentioned in the previous section. In addition, two draft reports have been produced that are outstanding deliverables from the previous triennium. The other outputs so far are described in the section for deliverables.

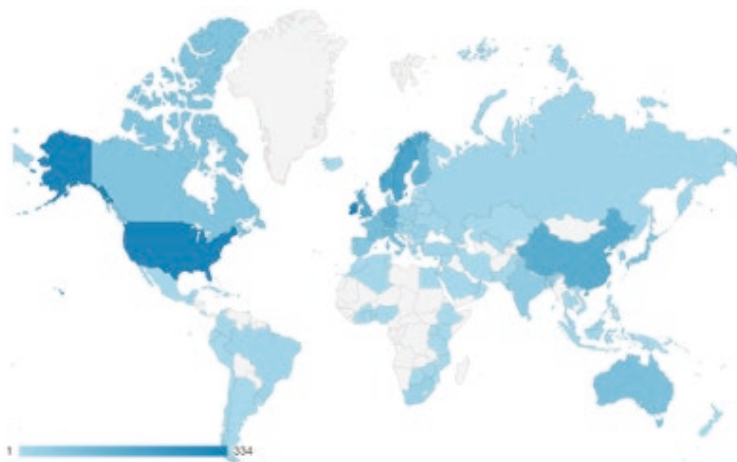
### **Website**


The website (<http://task36.ieabioenergy.com/>) is the key tool used for dissemination of information from the Task. It provides access to the latest publications produced by the Task. The website also provides access to past reports, articles, case studies and presentations at workshops associated with Task meetings. During 2020, the website has been updated with the content of Newsletters and proceedings from workshops/webinars as well as three new reports from the Task.

In addition, the website provides a 'members only' forum, to allow rapid access to the latest drafts of documents and to information on Task meetings. During 2020, the website received almost 3200 visitors. This corresponds to a 70% increase compared to 2019.



The origin of the visitors to the website can be seen in the figures below, but the most hits were received from Ireland, USA, and Sweden.



1.  Ireland	<b>334</b> (10,40 %)
2.  United States	<b>330</b> (10,27 %)
3.  Sweden	<b>201</b> (6,26 %)
4.  Norway	<b>189</b> (5,88 %)
5.  United Kingdom	<b>182</b> (5,66 %)
6.  China	<b>168</b> (5,23 %)
7.  Germany	<b>153</b> (4,76 %)
8.  Finland	<b>137</b> (4,26 %)
9.  Italy	<b>110</b> (3,42 %)
10.  Netherlands	<b>108</b> (3,36 %)

## Collaboration with Other Tasks/Organisations/Networking

The main collaboration with other Tasks has been the participation in inter-Task/common projects. Task 36 is involved in two of those, the first one concerning BECCS/U and the other one regarding the use of High temperature heat from biomass in industry.

## Deliverables

The deliverables for the Task in 2020 have included presentations from the workshops and minutes from the Task meetings; as well as presentations of several Task members in the Green Chemistry & Engineering conference representing the Task; two newsletters published during 2020, contribution to the IEA Bioenergy Newsletter and 3 reports.

# TASK 37: Energy from Biogas

## Overview of the Task

In 2019-2021 Task 37 proposes work on three broad themes: the role of biogas in energy systems; sustainability of biogas systems and methods to ensure good practice; and integration of biogas into processes.

To mitigate climate change, it is essential to develop integrated and sustainable decarbonised renewable energy systems. Heat and transport together, account for about 80% of final energy consumption. Significant progress has been made in renewable electricity but decarbonisation of transport fuel is problematic. Gaseous renewable energy carriers, such as renewable 'green gas' can have a considerable impact in future energy systems and play a key role in decarbonising heat and transport. Green gas<sup>5</sup> at present is dominated by biomethane, which can be generated from the anaerobic digestion of organic biomass and residues produced in agriculture, food production and waste processing. In 2018, there were 577 biogas-upgrading plants in operation in the 15 IEA Bioenergy Task 37 countries. The market for biomethane is still growing. Sweden, the United Kingdom, Switzerland, France and the Netherlands have all increased their biomethane production significantly in the last six years. In the short term, the development of green gas projects, including the injection of biomethane into gas networks will be the primary focus of this developing industry. Management of this process and broad scale implementation will require a green gas certificate scheme to ensure sustainability, credible GHG reductions and to allow trade.

Recent policy measures facilitate the development of green gas and hydrogen pathways with progressively increasing obligations on decarbonisation. The share in renewable and low-carbon transport fuels will need to increase rapidly to meet climate targets. Biomethane can provide advanced sustainable biofuel for intercity buses, waste management truck fleets and heavy duty commercial vehicles. The on-going requirement to decarbonise will lead to integration of anaerobic digestion systems in other processes, be they agricultural, food and beverage processing, or other industrial and waste management. Anaerobic digestion is also seen as an integrated element in future innovative biorefineries and circular economy systems.

The approach of Task 37 involves the review and exchange of information and promotion of best practices for all steps of these process chains including anaerobic digestion for the production of biogas as a clean renewable fuel for use either directly in combined heat and power generation or after up-grading to biomethane where it replaces natural gas. In addition, there is growing interest in the use of biogas and biomethane to help stabilise power grids that are increasingly fed from variable sources of generation like wind and solar.

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5 Referred to as renewable natural gas (RNG) in North America

The Task also addresses utilisation of the residues of the digestion process, the digestate, and the quality management methods for conversion to high quality organic fertiliser. Only in the past number of years has the environmental performance and greenhouse gas footprint of biogas production and utilisation been assessed in detail. Recent studies have identified key sources of emissions of greenhouse gases at various stages of the biogas production chain. Task 37 has addressed emissions and is directing attention to environmental and carbon sustainability of biogas production and utilisation and is working towards defining best practices for emissions reduction.

Through the work of the Task, communication between RD&D programmes, relevant industrial sectors and governmental bodies is encouraged and stimulated. Continuous education is addressed through dissemination of the Task's publications in workshops, conferences and via the website. Information and data collected by the Task is used increasingly for providing support to all levels of policy making and the drafting of standards in Member Countries.

*Participating countries:* Australia, Austria, Brazil, Canada, China, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Korea, Norway, The Netherlands, Sweden, Switzerland and the United Kingdom.

**Task Leader:** Prof Jerry D Murphy, MaREI Centre, Environmental Research Institute, University College Cork, Ireland

**Operating Agent:** Matthew Clancy, Sustainable Energy Authority of Ireland, Dublin, Ireland

The Task Leader directs and manages the work programme, assisted by sub-Task leaders for specific areas. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 37, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task37.ieabioenergy.com/about-task-37.html>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## Progress in R&D

### Work Programme and Outputs

In 2020 the work programme consisted of the following Topics:

- Preparation of technical reports;
- Case Studies;
- Country reports;
- Task Meetings and Workshops;
- Website, Videos, Newsletters and Webinars;
- Deliverables of Task 37 in 2020.

## Preparation of Technical Reports

Our published reports may be viewed at <http://task37.ieabioenergy.com/technical-brochures.html>

The reports we have completed and are still working on are described below:

### ***D7. Biomethane as a transport fuel***

*Target audience: Policy makers, Municipalities or Regional Authorities, Haulage Fleet, Bus services, Distribution services (Light Good Vehicle fleet), Biogas producers/developers, Gas Grid operator, Filling Stations*

*Champions: Sweden, United Kingdom*

*Contributors: Brasil, Norway, Estonia*

*Collaboration: Jim McMillan of Task 39 will review the report*

*Expected completion date: Q3, 2021*

## Contents

1. Introduction to biogas systems
2. Technology for biomethane as a transport fuel
3. Market and economics
4. Environmental/Sustainability performance
5. Policy
6. Exemplars
7. Concluding Chapter

### ***D8. Technical aspects of integration of biogas systems into the energy system:***

*Target audience: Biogas producers/developers, Grid operators, Energy customers, Municipalities, Policy makers.*

*Champions: Germany, Ireland*

*Collaboration: with Task 44 (Flexible bioenergy and system integration)*

Report published in August 2020 as below:

Liebetrau, J., Kornatz, P., Baier, U., Wall, D., Murphy, J.D. (2020). *Integration of Biogas Systems into the Energy System: Technical aspects of flexible plant operation*, Murphy, J.D (Ed.) IEA Bioenergy Task 37, 2020:8

Both the report and the two page summary are available for free to download at:

<http://task37.ieabioenergy.com/technical-brochures.html>

**Learning outcomes:** *Biogas is a versatile energy carrier which can be used to produce electricity, heat and after upgrading serve all functions of natural gas, including transport. Biogas systems are highly scalable in their energy output according to the demand from the particular energy sector. The flexibility of biogas systems can facilitate electricity production at a dynamic schedule to match an electricity demand profile, while facilitating voltage and grid stability. As a decentralised component of the overall energy system biogas systems can function as an infrastructure hub for local energy consumers in rural areas. Biogas can play an essential role (together with PV and wind) as part of a virtual power plant in local distribution energy grids. Biogas systems can operate as a biological battery in coupling the electricity and gas grids using surplus electricity to produce hydrogen to react with biogenic CO<sub>2</sub> in biogas producing biomethane and increasing the output of biomethane (typically by 70 %). Innovation and ingenuity will be required of biogas operators in future energy systems.*

#### **D9. Green gas certification & sustainability criteria:**

*Target audience: Policy makers, Biogas producers/developers, Gas Industry (Gas Grid Operators, Gas Traders), Gas customers*

*Champions: Germany, Ireland, Finland*

*Collaboration: Inter-Task project including European Commission DG Energy, IEA Bioenergy Germany, IEA Bioenergy Sweden, IEA Hydrogen and IEA Bioenergy Tasks 37/40 & 45.*

*Expected completion date: Q3, 2021*

The work includes collaboration on Renewable Gas and a second broader collaboration "Renewable Gas – Hydrogen in the grid" led by Uwe Fritsche.

Task 37 will also produce a report structured as below:

1. Background and scope
2. Terms and Definitions
3. Legislation
4. State of the art of renewable gases – methane
5. Trade of Biomethane
6. State of the art of renewable gases – hydrogen
  - 6.1 Blue hydrogen
  - 6.2 Green Hydrogen
  - 6.3 Sustainability of hydrogen
  - 6.4 Injection of hydrogen to the gas grid
  - 6.5 Power to methane
7. Evaluation and wrap up, synthesis report

***D10. Drivers for successful biogas schemes and their sustainability: International perspectives:***

*Target audience: municipalities, academics, practitioners, farmers, agri-food, utility gas grid operators, stakeholders, policy makers*

*Champions: Canada,*

*Contributor: all.*

The report is published and can be referenced as follows:

*Wellisch, M., Green, J., McCabe, B., Rasi, S., Siemens, W., Ammenberg, J., Liebetrau, J., Bochmann, G., Murphy, J.D. (2020). Drivers for Successful and Sustainable Biogas Projects: International Perspectives – Report of a symposium held on March 26, 2020. Green, J., Wellisch, M., Szlachta, P., Murphy, J.D. (Ed.) IEA Bioenergy Task 37, 2020: 5*

**Learning outcomes:** *The drivers for successful and sustainable anaerobic digestion projects are country and context specific. The challenge that such projects face – in all countries – is how to make anaerobic digestion projects financially viable. We know from countries that have biogas plants, that supportive policies are required in a number of areas, including waste management, renewable energy and climate change mitigation. To make these projects work, financial assistance, such as capital grants and multi-year power purchase agreements with a significant premium, is needed to attract the necessary investment. In this symposium we heard from seven IEA Bioenergy Task 37 Member countries – Australia, Finland, The Netherlands, Sweden, Germany, Austria and Ireland. Collectively they painted a picture of how the right combination of feedstocks, technologies and policies are required for a successful and sustainable project. The solutions are not “one size” fits all, but country specific.*

The report is available for free to download at:  
<http://task37.ieabioenergy.com/technical-brochures.html>

### ***D11. Integration of anaerobic digestion into farming systems:***

*Target audience: farmers, agricultural stakeholders, policy makers*

*Champions: United Kingdom, Australia, Canada, Italy*

The report is published and can be referenced as follows:

*McCabe, B., Kroebel, R., Pezzaglia, M., Lukehurst, C., Lalonde, C., Wellisch, M., Murphy, J.D. (2020). Integration of Anaerobic Digestion into Farming Systems in Australia, Canada, Italy, and the UK. Lalonde, L., Wellisch, M., Murphy, J.D (Ed.) IEA Bioenergy Task 37, 2020: 8*

**Learning outcomes:** *The four countries – Australia, Canada, Italy, and United Kingdom – differ with respect to their size, climate, and type of agricultural production. Canada and Australia have the largest landmass but vastly different climates. Anaerobic digestion and biogas production in the agriculture sector is highest in Italy, followed by the United Kingdom, Australia, and Canada.*

*The adoption of anaerobic digestion (AD) has grown in all four of these countries over the last decades, albeit at different rates. In all cases, energy and climate change policies have been the dominant drivers that have enabled growth. The environmental sustainability of agriculture has many facets. In this section of the report, each country description provides a different lens on sustainability and the role of anaerobic digestion.*

The report is available for free to download at:  
<http://task37.ieabioenergy.com/technical-brochures.html>

### ***D12. Increasing the range of feedstocks for anaerobic digestion***

*Champions: Switzerland,*

*Contributors: Austria, Canada, Estonia*

*Audience: operators of biogas facilities, farmers and agricultural organisations, feedstock suppliers, policy makers and consultants*

*Expected completion date: Q3, 2021*

Scope:

- Describe substrate characteristics which define anaerobic degradability;
- Give examples and describe the characteristics, source and potential of recalcitrant feedstocks;
- Give an overview of possibilities and concepts for further treatment of digestate such as thermal conversion;
- Give an overview of technically available pre-treatment technologies for poorly degradable substrates and possibilities to implement them into the anaerobic digestion process;
- Present an overview of technically available concepts to enhance substrate digestibility through AD process alteration such as: multi-stage digestion; inline treatment (such as ultrasonic or maceration) or leaching processes followed by UASB.
- Detail decision making processes for assessing suitability of low-quality feedstocks.
- Provide examples of successful implementation of a range of expanding processes for substrate utilisation.

### ***D14. Integration of anaerobic digestion into industrial bioprocessing:***

*Champions: Austria,*

*Contributors: Australia, Canada, China, Norway, Finland, Sweden*

*Audience: operators of biogas facilities, farmers and agricultural organisations, feedstock suppliers, policy makers and consultants*

*Expected completion date: Q3, 2021*

The report will focus on food and beverage and pulp and paper industries. A number of examples will be presented including abattoirs, dairies, breweries, distilleries, olive mills, sugar factories, potato industry, wineries, juice factory. The analysis will include feedstock, fermentation, process integration, gas utilisation and energy balances.



## **Technical Report 8: Manure potential, economics, government investment, economics**

*Champions: Germany,*

*Contributors: Canada, Austria, Australia, Denmark, Sweden, Ireland, China, India, Norway, Switzerland, United Kingdom)*

*Audience: operators of biogas facilities, farmers and agricultural organisations, feedstock suppliers, policy makers and consultants*

*Expected completion date: Q2, 2021*

This report is seen as very focused. It will initially provide details on models for collection and distribution of slurries, digestion of slurries and methods of use of the produced biogas at different users distributed by a variety of means. The resource of manure and slurries (from beef cattle, dairy cattle, piggeries and poultry) will be assessed including the spatial distribution of said resource. The temporal availability of the resource will be assessed; for example the availability of slurry where cattle are only housed in winter will be discussed. We will assess cost of transport of slurry, methods of transport of slurry (piping, tankers), scale of digester (farm scale or centralised digestion), segregation of manure, costs of segregation of manure, potential to pipe slurries to larger digesters or digest slurries at farm scale and piping of biogas to centralised upgrading processes or users. We will examine situations in a range of countries and apply the processes as discussed to each country.

### **D.13. Case Stories**

Four case stories were published in 2020 and are available at

<http://task37.ieabioenergy.com/case-stories.html>:

Green methanol from biogas in Denmark a versatile transport fuel, November 2020.

Deep bedding: a co-digestion substrate with significant potential Danish experience with handling and feeding deep bedding, November 2020.

Production of food grade sustainable CO<sub>2</sub> from a large biogas facility GO/CO<sub>2</sub> at The Korskro Biogas Plant, Denmark, November 2020.

Compact and Automated on-farm Biogas Production in Southwestern Ontario, Canada, April 2020 Case Story Canada.

### **Country Reports**

IEA Bioenergy Task 37 – Country Reports Summaries 2019 published in March 2020 available from: <http://task37.ieabioenergy.com/country-reports.html>

Four further individual country report presentations from Germany, Norway, Sweden and the United Kingdom were published in 2020 and are available <http://task37.ieabioenergy.com/country-reports.html>.

## **Task Meetings and Workshops**

### *Task 37 Meeting, Toronto, Canada, 25-26 March 2020*

A Task meeting was held from 25-26 March 2020 using GoToMeeting

IEA Bioenergy presented seven 20 minute presentations at the Canadian Biogas Association Conference which had 200 participants. These were uploaded to:

<http://task37.ieabioenergy.com/workshops.html>

1. Agro-Industrial Wastes Matching technology with feedstock – Bernadette McCabe, National Centre for Engineering in Agriculture, University of Southern Queensland, Australia
2. Sustainability of grass biomethane according to RED2 – Saija Raisa, Natural Resources Institute Finland (Luke)
3. Netherlands Roadmap – Wouter Siemers, Netherlands Enterprise Agency
4. Sweden Roadmap – Jonas Ammenberg, IEI – Dept of Management and Engineering, Linköping University, Sweden
5. Efficiency of the biogas process – results of a monitoring program – Dr.-Ing. Jan Liebetrau, Ryttec Germany
6. Digester Types – Guenther Bochman, University of Natural Resources and Life Science, Vienna, Institute for Environmental Biotechnology, Austria
7. Advanced gaseous biofuel produced by integrating biological, thermo-chemical and power to gas systems in a circular cascading bioenergy system – Jerry Murphy, MaREI Centre, Environmental Research Institute, University College Cork, Ireland

### *Task 37 Meeting Switzerland, 9-11 September 2020*

A Task meeting was held from September 9 to 11 in Switzerland, conducted by Zoom.

Six IEA Bioenergy delegates presented at the BioSweet Conference: Biomass to energy in Switzerland: Achievements and Perspectives on the 10th September 2020.

<https://www.sccer-biosweet.ch/annual-conference-10-september-2020/?back=1>

These are available online at: <http://task37.ieabioenergy.com/workshops.html> and are listed below:

1. Prof. Urs Baier, Biomass to Biogas
2. Dr. Peter Kornatz, Perspectives of valorisation of manure and conversion of existing biogas plants to biomethane plants in Germany
3. Prof. Jerry Murphy, A perspective on power to methane systems
4. Dr Jan Liebetrau, Combination of biomethane filling station and power generation to serve different profiles of fuel consumption
5. Prof. Timo Kikas, Nitrogen Explosive Decompression pretreatment,

6. Dr. Kari-Anne Lyng, Life Cycle Assessment of the Products and Services of an Anaerobic Digestion Plant.

### *Planning of Future Task Meetings and Workshops*

The Task meetings in 2021 are as follows:

- Virtual Meeting (12 and 19<sup>th</sup> January, 2021)
- Vienna, Austria (April 14 to 16, 2021).
- Australia (November 2021)

### **Website, Videos, Newsletter and Webinars**

#### *Newsletters*

There were 12 newsletters issued for Task 37 in 2020.

#### *Webinars*

A webinar was held on the 6<sup>th</sup> May with Australia Bioenergy entitled "Decarbonising the gas network-potential, projects and policies" which included 4 presentations as follows:

1. *Decarbonisation of the gas network: an international overarching perspective* – Jerry D Murphy IEA Bioenergy Task 37 Leader
2. *Decarbonising the Gas Network: The quiet revolution of biogas and RNG in Denmark* – Claus Mortensen International Business Developer in Agro Business Park and the Danish Innovation Network for Bioresources.
3. *Potentials in methanation* – Ole Hvelplund CEO at Nature energy
4. *Australia: opportunities, policy options and Future Fuels project* – Joshua Moran Commercial Manager at Jemena

Presentations available at:

<https://cdn.revolutionise.com.au/cups/bioenergy/files/iaxdenknz2kvm7sd.pdf>

Recording available here: <https://www.dropbox.com/s/fxpqrokb7u55fc2/Bioenergy%20Australia%20webinar%206%20May%202020%20-%20recording.mp3?dl=0>

An IEA Bioenergy webinar entitled "Integration of Biogas Systems into the Energy System" presented by Prof Jerry D Murphy and Dr Jan Liebetrau was held on January 21. The audience included 367 people from 54 countries. The webinar was recorded and is available on line at:

<https://t.co/UnykedOCTF?amp=1>

## **Presentations**

"Flexible biogas systems" Richard O'Shea, Jan Liebetrau and Jerry D Murphy presented at Central European Biogas Conference Graz Austria at a workshop held by IEA Bioenergy Task 44 on the 24 January. See: <https://www.ieabioenergy.com/blog/ieaevent/task-44-workshop-flexible-bioenergy-and-system-integration/>

## **Website**

The website ([www.iea-biogas.net](http://www.iea-biogas.net) & <http://task37.ieabioenergy.com>) is updated on a regular basis with: technical reports and corresponding two page summaries; case stories; databases, country report summaries; workshop proceedings; webinars.

## **Deliverables**

The deliverables are outlined in the publications list in Appendix 4. The first year of the triennium is very much a year of preparation and scoping of detail of works. The full technical reports tend to be published in year 2 (2020) and more frequently year 3 (2021).

# **TASK 39: Commercialising Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks**

During 2020 Task 39 continued its work to advance the development and deployment of sustainable, lower carbon-intensive transport biofuels. With an overall goal of facilitating the decarbonisation of the multi-faceted transport sector using "conventional" and "advanced" transport biofuels.

Four relatively arbitrary categories of transport biofuels have been covered by Task 39. They include:

- "Conventional" biofuels
  - Ethanol from sugar/starch (e.g. sugarcane, corn, sugar beet and wheat)
  - Biodiesel from oleochemicals/lipids (Fatty acid methyl ester (FAME))
- "Advanced" biofuels
  - Cellulosic ethanol (1.5G and 2G), oleochemicals/lipids from algae, biomethane/renewable natural gas (RNG), green hydrogen, etc.

- “Conventional” drop-in biofuels via oleochemical/lipid feedstocks
  - Hydrotreated esters and fatty acids (HEFA), hydrotreated vegetable oil (HVO), hydrogenation-derived renewable diesel (HDRD), renewable diesel, green diesel, etc., produced from lower carbon intensity feedstocks and waste materials such as used cooking oil (UCO)/tallow/tall oil and higher carbon intensity feedstocks such as vegetable oils
- “Advanced” drop-in biofuels via lignocellulosic biomass feedstocks
  - Production and upgrading of biocrude liquid intermediates from lignocellulosic feedstocks (sometimes algal oils) via standalone biorefineries or by co-processing in existing petroleum refineries
  - Production by upgrading of other bio-feedstock derived intermediates, e.g., Alcohol-to-Jet, Sugar-to-Jet, Gasification-followed-by-Fisher-Tropsch synthesis, etc.

Despite significant obstacles such as ongoing, relatively low oil prices, slower-than-anticipated progress in commercialising cellulosic ethanol/other advanced biofuels technologies, ongoing uncertainty around future biofuels policies and, more recently, the COVID-19 pandemic, relatively good progress has been made in the biofuels area during 2020. The long-distance transport sector continues to play a vital role in maintaining the delivery of essential goods and services (e.g., medical supplies, food, energy, etc.). However, shorter term economic challenges created by the pandemic will be compounded by the mounting urgency to deal with carbon emissions and climate change. In response, many governments who have developed economic recovery packages include strategies that reduce the carbon intensity of their future economies.

Via its coordinated focus on technology, commercialisation, sustainability, policy, markets and implementation, Task 39 was able to assist low carbon transport stakeholders in their efforts to develop and deploy biofuels. The Task coordinated comparative technical and life cycle assessment of various biofuels and compared-and-contrast the various policies used (with varying levels of effectiveness) to increase the production and use of biofuels. The success of the Task continues to be a direct result of providing a forum for these types of integrated discussions with the active involvement of participants from industry, government and academia.

During 2020, Task 39 delivered or helped deliver five cooperative research projects (three internal projects and two Inter-Task projects). Task 39 published the, “Comparison of biofuel life cycle analysis tools, Phase 2, Part 2: biochemical second generation (2G or cellulosic) ethanol production and distribution”. Task 39 also published, “Implementation Agendas: 2018-2019 Update – Compare and Contrast Transport Biofuels Policies”. Task 39’s global pilot and demonstration biofuels production plants database was recently updated by Austria’s BEST – Bioenergy and Sustainable Technologies organisation. More information on these internal projects is provided in section “Work Programme and Outputs”.

In addition to internal project activities, Task 39 contributed to two special Inter-Task project reports initiated by the IEA Bioenergy Executive Committee (ExCo): 1) Advanced biofuels – potential for cost reduction; and 2) “The Role of Renewable Transport Fuels in Decarbonising Road Transport”. More information on Task 39’s contribution to the Inter-Task projects is provided in the “Work Programme and Outputs” section.

Task 39 participants have also been encouraged to publish its work in the peer reviewed literature (to increase access to its work). For example, “Biofuels policies that have encouraged their production and use: An international perspective” based on the Task 39 Implementation Agenda’s report was published in the Energy Policy Journal ([link](#)<sup>6</sup>)

In addition, Task 39 members presented the insights and results of two Inter-Task projects as part of IEA Bioenergy webinars, “Advanced biofuels – potential for cost reduction” in an [IEA Bioenergy Webinar](#)<sup>7</sup> held on 23 April, 2020 and “The Role of Renewable Transport Fuels in Decarbonising Road Transport”, an [IEA Bioenergy Webinar](#)<sup>8</sup>, held on November 17, 2020.

As part of its communication strategy Task 39 organised three, very well attended, virtual meetings via Zoom. Task 39 members also organised and participated in several virtual biofuels-related conferences and workshops. The business meetings minutes are posted in the members only section of Task 39’s website (access to minutes is limited to Task 39 members and business meeting participants).

In addition to publishing reports and organising webinars, Task 39 disseminated information through its periodic newsletters. The newsletters featured country reports, hyperlinks to recent Task 39-relevant media stories and updates of global progress in the biofuels area. Task 39 published three newsletters that summarised Task 39 progress updates with feature articles highlighting technical and policy developments related to biofuel production and use in Germany (Issue #54 in May), Sweden (#55 in September) and India (#56 in December). The newsletters are distributed to over 2500 biofuels stakeholders.

The Task’s website is visited regularly and it routinely receives enquires that are typically handled by the Task coordinator and webmaster. Alternatively, the enquiries are referred to experts within Task 39’s network. Website statistics are reported in the Progress Reports submitted to the IEA Bioenergy ExCo.

Task 39 continued strengthening its collaboration with the other IEA Bioenergy Tasks, i.e., Tasks 33, 34, 36, 37, 40, 42, 43, as well as the deployment (Task 44) and sustainability (Task 45) Tasks. We continued our good rapport with other, allied stakeholder groups such as IEA HQ, IRENA, the IEA Advanced Motor Fuels Technology Collaboration Program (AMF TCP), UN FAO and various national programs (e.g. US DoE).

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6 <https://www.sciencedirect.com/science/article/abs/pii/S0301421520306182>

7 <https://www.ieabioenergy.com/publications/iea-bioenergy-webinar-advanced-biofuels-potential-for-cost-reduction/>

8 <https://www.ieabioenergy.com/blog/ieaevent/iea-bioenergy-webinar-the-contribution-of-advanced-renewable-transport-fuels-to-transport-decarbonisation-in-2030-and-beyond/>

It should be emphasised that Task 39 continues to benefit from extensive industry input from companies and institutions at the forefront of biofuels development such as Boeing, Borregaard DSM, ENI, GoodFuels, International Air Transport Association (IATA), IFPEN, ISCC, Haldor Topsoe, LanzaTech, LBST, Licella, Neste, Novozymes, Renewable Energy Group (REG), Roundtable on Sustainable Biomaterials (RSB), (S&T)<sup>2</sup> Consultants, skyNRG, Steeper, UPM, World Wildlife Federation, to mention just a few

## Overview of the Task

The goal of Task 39 is to facilitate the commercialisation of low carbon-intensive transportation biofuels including conventional and advanced biofuels produced through various technology routes such as oleochemical, biochemical, thermochemical and hybrid conversion technology pathways. The success of the Task continues to be, in large part, a direct result of providing a forum for integrated discussions aided by the active involvement of participants from industry, government and academia. The Task continues to lead and coordinate activities in three main program areas:

### 1. Technology and Commercialisation

- a. Help develop and commercialise improved, cost-effective processes for the production of sustainable low carbon intensity biofuels, particularly the production and use of “drop-in” biofuels from oleochemicals and lignocellulosic feedstocks (biocrudes) to decarbonise the long-distance transport sector;
- b. Work with other Tasks to assess and help develop cost-effective oleochemical, biochemical, thermochemical and hybrid technologies as well as to co-optimize fuel-engine systems to maximise transport performance efficiencies and associated greenhouse gas reduction potentials using advanced biofuels; and
- c. Assess and describe advancements and challenges in emerging less developed advanced transport biofuels technologies and processes such as biomass-to-hydrogen, algae-to-biofuels, etc.

**2. Policy, Markets, Implementation and Sustainability** encompasses issues that address policy/legislative/regulatory and infrastructure concerns and needs regarding expanding conventional and advanced transport biofuels. This Task activity also provided information and analyses of policies, markets, and implementation issues that have fostered commercialisation of sustainable low carbon biofuels. The broad goal is to replace non-renewable fossil-based fuels by helping deploy conventional (so-called first generation) biofuels while supporting the development of advanced biofuels and ‘future-generation’ biofuels. The Task also continues work to better clarify commonalities and the main differences in methodological structures, calculation procedures and assumptions used within leading LCA models (i.e., EU’s BIOGRACE, Canada’s GHGENIUS, USA’s GREET and Brazil’s VSB).

**3. A Multifaceted Communication Strategy** was used to facilitate knowledge transfer, information dissemination, outreach to stakeholders and coordination with related groups both within IEA Bioenergy and externally. In 2020, Task 39 organised three virtual business meetings. Task 39 members also participated in two Inter-Task projects, “Advanced biofuels – potential for cost reduction”, and “The Role of Renewable Transport Fuels in Decarbonising Road Transport”. Webinars based on these reports; two IEA Bioenergy Webinars were held on 23 April, 2020 and November 17, 2020, respectively. In addition, the Task published three newsletters that included progress updates on Task 39 activities and featured articles on biofuel production and use technical and policy developments in Germany, Sweden and India. The newsletters also highlighted recent news articles and reports of interest to biofuels stakeholders).

The Task 39’s demonstration plants website provided a database of advanced biofuels production facilities both in Task 39 member countries and the rest of the world (<https://demoplants.best-research.eu/>).

As part of its outreach to stakeholders, Task 39 is fortunate to have the active participation of many experts from industry, government and universities/research centres.

The Task’s structure allows participants to work together in a comprehensive manner on prioritised issues and challenges identified across the broad area of transport biofuels.

*Participating countries:* Australia, Austria, Brazil, Canada, Denmark, European Commission, Germany, India, Ireland, Japan, Korea, The Netherlands, New Zealand, Norway, Sweden and the United States of America (USA)

**Task Leader:** Jim McMillan, National Renewable Energy Laboratory, USA

**Task Co-Leader:** Jack Saddler, University of British Columbia, Canada

**Operating Agent:** Alex McLeod/Oshada Mendis, Natural Resources Canada, Canada

**Task Manager:** Mahmood Ebadian, University of British Columbia, Canada

The Task leadership is shared between the National Renewable Energy Laboratory (USA) represented by Jim McMillan, and the University of British Columbia (Canada) represented by Jack Saddler. Both Task Leaders are engaged in all aspects of the Task’s operations. Task leaders are assisted by Mahmood Ebadian (UBC), who serves as the coordinator of all Task activities and programmes, Editor of the Task Newsletter as well as Webmaster for the Task’s website. Dina Bacovsky (Austria) manages the Task’s demonstration plants database. Franziska Müller-Langer is the Task’s primary liaison to IEA’s AMF TCP. Country Representatives (also known as National Team Leaders) for each Task 39 participating country are responsible for coordinating their respective nation’s participation in the Task.

For further details on Task 39, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task39.ieabioenergy.com/>) and the IEA Bioenergy website (<https://www.ieabioenergy.com/>) under ‘Our Work: Tasks’.



## Progress in R&D

### Task Meetings and Workshops

As part of its organisational/communication strategy, Task 39 typically holds two business meetings per year, usually in conjunction with related conferences and workshops to help justify the extensive travel required for many Task 39 members to attend. In 2020, the Task held three virtual business meetings (April, June and November) due to the coronavirus pandemic which restricted travel and physical meetings. These business meetings involved significant knowledge exchange between participants in the form of country updates and project updates, highlighting industry progress and challenges.

The first business meeting of Task 39 in 2020 was held virtually on 2 April, 2020, using Zoom, after the postponement of the [BBEST 2020 and Biofuture Summit II conference](#)<sup>9</sup> and the cancellation of IEA Bioenergy meetings in São Paulo, Brazil. These included the Task 39 business meeting on 2 April and the Task 39-Task 45 Joint Workshop on the "Sustainability of Biofuels" planned for 3 April 2020. The original meeting agenda, (planned for a full day in São Paulo, 2 April) was condensed into a 3-hour virtual meeting. Progress updates on each of the Task 39's projects (11 projects) underway in the current triennium were provided by the "champions" of each project team and discussed within the larger group. A list of the Task 39 projects for the 2019-2021 triennium is provided in Task 39 newsletter- issue#54 ([link](#)<sup>10</sup>).

The second virtual Task 39 business meeting was held on June 23, 2020. The meeting's objectives were to review and discuss active projects, provide a forum for Task 39 members to share questions, thoughts and ideas regarding the scope, objectives and methodology of each project and to discuss Task budget allocation and the potential to "leverage" Task 39 funds with additional resources/funds. Some of project leaders described what they saw were the next steps in their project and how other funding (such as Boeing supporting the Task biojet studies) might help deliver some of the Task projects. The group was excited to have India's newly appointed country representative, Mr. Ravi P. Gupta, General Manager of Bioenergy Research Centre at the Indian Oil Corporation joining the meeting despite the difficult time zone challenges.

The third Task 39 virtual business meeting was held on November 23-24, 2020. The objective of this meeting was for project leaders to provide project updates and describe next steps on how they might complete their projects in the current triennium projects. The virtual meeting also provided a forum for Task 39 members to share questions, thoughts and ideas regarding the scope, objectives, methodology and interim findings of each project.

Task 39 invited Adam Brown of Energy Insights Ltd to kick off the meeting by updating the group on recent activities at IEA headquarters concerning renewable energy and the Biofuture Platform initiative. Adam also updated the group on the government-led, multi-stakeholder "Biofuture Platform (BFP)" initiative, which is a 20-plus country effort to promote a sustainable, innovative and scalable advanced low carbon bioeconomy.

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9 <http://bbest-biofuture.org/v2/>

10 <http://task39.sites.olt.ubc.ca/files/2020/06/IEA-Bioenergy-Task-39-Newsletter-Issue-54-Final-Draft.pdf>

Ravi P. Gupta, India's new lead representative to Task 39, provided an overview of India's energy use and activities underway and plans to reduce the carbon intensity of its energy sector.

On 25 November 2020 Task 39 and Task 44 organised a joint workshop. This workshop's objective was to obtain insights into concepts for more flexible biofuel and biopower production, discuss the challenges and success factors to implement these concepts in energy systems with high shares of renewables and explore potential Task 39-Task 44 collaborations related to the future role of biofuels-producing biorefineries in grid balancing. A key challenge that was identified within the workshop is the generally higher capital costs required for biorefinery designs that enable greater grid flexibility. For example, increased costs are required to install additional feedstock handling, power generation or hydrogen production capacities that will only be used to balance the grid some of the time. Discussions highlighted the need for further research into compelling schemes as well as the potential for industrial symbiosis-oriented plant designs to mitigate cost barriers. For example, by leveraging existing "stranded" capital or co-locating adjacent complementary facilities to help to reduce the otherwise higher capital cost of provisioning biorefineries for increased grid balancing capability.

Task 39 also continues to actively organise and participate in virtual webinars and conferences to share their insights on how decarbonisation of the transport sector can contribute to a "green economic recovery".

### **Crystal Ball Gazing Panel Webinar with Canada's BC SMART Biofuels Consortium**

IEA Bioenergy Task 39 and the [BC-SMART Biofuels Consortium](http://www.bc-smart.ca/)<sup>11</sup> have been working with a "coalition-of-the-willing" of industry, government and academic stakeholders who are committed to decarbonising transport, especially long-distance transport. Leveraging this network Task 39 jointly (with the BC-SMART Biofuels Consortium) hosted a webinar entitled, "**Crystal ball gazing: How do we decarbonise long distance transport during/after COVID-19?**" on 30 June, 2020,

Invited panel members included representatives of the oil refining, aviation, marine, rail/trucking and feedstock sectors. The purpose of this panel discussion was to provide an update on the status of the long-distance transport sector during the COVID-19 pandemic and to anticipate how things might look like on the other side of the pandemic. Panel members were asked to gaze into their figurative crystal balls and speculate what the future might hold for their sectors. Using Canada as an example, panel members discussed how the long-distance transport sector might decarbonise while simultaneously driving national and international economic recovery and growth. Panel members collectively agreed that greening the long-distance transport sector needs to be an integral part of the world's low-carbon economic recovery.

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<sup>11</sup> <http://www.bc-smart.ca/>

About 180 participants attended the webinar, mainly from North America, South America and Europe. A recording of the webinar and the presentation slides are posted on the Task 39's website ([link](#)<sup>12</sup>).

## **e-EUBCE 2020**

Task members participated in, "The contribution of advanced renewable transport fuels to transport decarbonisation in 2030 and beyond" which was a virtual EUBCE 2020 session "IBO.8 – Strategies and Initiatives". The main message was that assessments clearly show that all available options – including biofuels, electric vehicles and efficiency gains in internal combustion engines – will have to be applied in order to reach future decarbonisation targets. The measures taken to decarbonise the transport sector will have to include the development of a transport efficient society, efficient vehicles, and renewable energy carriers. As it takes around 20 years to completely renew the passenger car fleet the uptake of new vehicles alone will not be sufficient to reach ambitious future decarbonisation targets. Thus, further policy measures are needed and it is important that they are widely accepted.

## **Virtual IEA Bioenergy Task 39/BC-SMART Biofuels Consortium webinar on, "Decarbonising the Marine Sector: Progress and Aspirations", (held 4 December 2020)**

IEA Bioenergy Task 39 co-sponsored a free "virtual" panel discussion on decarbonising the marine sector. The panel included global leaders in the marine sector representing ports, shipping and logistics, lower carbon intensity fuel production and renewable fuel policy development. While the world plans for an effective post-COVID-19 economic recovery the panel members were asked to discuss progress and future aspirations for reducing marine sector emissions.

The panel highlighted several success factors that will be critical to substantially decarbonising the marine sector. First, the active participation of all members of the sector will be essential if it is to effectively decarbonise. Key players are making significant efforts to decarbonise through collaborative projects involving the participation of multiple stakeholders. Second, biofuels will play an important role in decreasing sector emissions and increased drop-in biofuels use in the sector is anticipated. However, there are also challenges such as limited volumes/availability of sustainable biofuels/biofuels, the costs of feedstocks as well as overall logistical challenges. It was recognised that strong policy support will be needed to incentivise and de-risk the marine sector's decarbonisation effort.

About 110 participants attended the webinar and the list of panel members and their short bios are posted on Task 39's website ([link](#)<sup>13</sup>). Hyperlinks to the meeting minutes and a recording of the panel discussion are available on the BC Smart Biofuels Consortium's website ([here](#)<sup>14</sup>).

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12 <http://task39.ieabioenergy.com/events-conferences/>

13 <http://task39.ieabioenergy.com/events-conferences/>

14 <http://www.bc-smart.ca/resources/>






The active participation of most country team leaders and representatives at Task 39 meetings is evidence of the value Task 39 plays in promoting effective international information exchange.

### Work Programme and Outputs

Summary of reports completed or advanced during 2020:

*Comparison of biofuel life cycle analysis tools, Phase 2, Part 2: Second generation (2G or cellulosic) ethanol production and distribution*

This study was part of a project which compared the leading LCA models used to assess the sustainability of various biofuels pathways. The goal was to better understand and quantify why the different life cycle assessment (LCA) models – the EU’s BIOGRACE, Canada’s GHGENIUS, USA’s GREET and Brazil’s VSB – sometimes resulted in disparate results when they are based on the same scenarios when using the same model inputs. The report focused on cellulosic (“second generation”) ethanol produced from either corn stover, wheat straw, sugarcane bagasse and/or straw and forest residues. The [full report](#)<sup>15</sup> is available at Task 39’s website.

					
<b>Model version</b>	4d (2015)	5.0a (2018)	2017	2017	2018
<b>Developed for regulatory use</b>	Yes	No	Yes	Yes	No
<b>IPCC GWP method</b>	2001	1995, 2001, 2007, 2013	2013	2013	2013
<b>Default global warming gases</b>	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, CO, VOC, NO <sub>x</sub> , fluorinated compounds	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O
<b>Lifecycle data</b>	JRC (2008)	Internal	Internal	JRC (2017)	Ecoinvent
<b>Functional unit</b>	MJ	km, MJ	km, mile Btu, MJ	MJ	km, MJ
<b>Default allocation</b>	Energy	Mostly substitution	Variable	Energy	Economic
<b>Land use change</b>	C stocks	Internal model	CCLUB/GTAP	C stocks	-

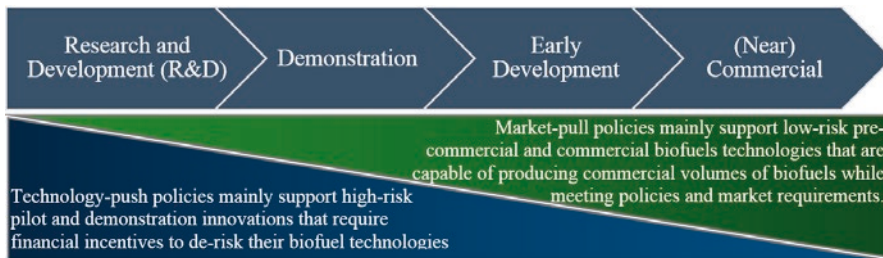
*Implementation Agendas: 2018-2019 Update – Compare and Contrast Transport Biofuels Policies*

IEA Bioenergy Task 39 strives to increase production and use of sustainable transport biofuels, and periodically issues its Implementation Agendas report to summarise the policies being used around the world to promote greater deployment of biofuels. The updated report describes the current policies in use and levels of biofuels market penetration being achieved within Task 39-member countries. China, which is one of the world’s major countries also aspiring

15 <http://task39.sites.olt.ubc.ca/files/2020/02/Task-39-Phase-2.2-Ethanol-2G-Comparison-of-Biofuel-Life-Cycle-Analysis-Tools.pdf>

to increase its production and use of biofuels, was also included. The [full report](#)<sup>16</sup> and the [executive summary](#)<sup>17</sup> are available on Task 39's website.

A Task 39's peer-review manuscript entitled, "Biofuels policies that have encouraged their production and use: An international perspective", was published in the *Energy Policy Journal*. This manuscript summarises the policies currently used to promote the greater production and use of biofuels in Task 39-member countries as well as India (which has since become a member of Task 39) and China. This manuscript is published open access and can be viewed or downloaded here ([link](#)<sup>18</sup>):



The technology-push and market-pull biofuel policies assessed in Task 39's implementation agendas report were summarised and discussed in the recently published *Energy Policy Journal* article. Countries that use a mixture of market-pull and technology-push policy instruments have been most successful at increasing biofuels production and use and also at developing and deploying less mature advanced biofuels production technologies.

### *Updating Task 39's demonstration plants database*

Task 39's global pilot and demonstration biofuels production plants database. Technologies covered include gasification, fermentation, hydrotreatment, fast pyrolysis, hydrothermal liquefaction and lignin depolymerisation. This database was recently updated, with information on all European facilities (121) verified and updated. There are now 226 currently active entries. This database can be accessed via Task 39's website or here ([link](#)<sup>19</sup>).

16 <http://task39.sites.olt.ubc.ca/files/2020/02/IEA-Bioenergy-Task-39-Implementation-Agendas-Final-Draft-Feb-4-2020.pdf>

17 <http://task39.sites.olt.ubc.ca/files/2020/02/IEA-Bioenergy-Task-39-Implementation-Agendas-Final-Draft-Executive-Summary-Feb-4-2020.pdf>

18 <https://doi.org/10.1016/j.enpol.2020.111906>

19 <https://demoplants.best-research.eu/>



Snapshot of Task 39’s online demonstration plants database

### Inter-Task Projects (as part of Task 41)

Task 39 contributed to two Inter-Task projects: 1) Advanced biofuels – potential for cost reduction; and 2) The Role of Renewable Transport Fuels in Decarbonising Road Transport.

*Advanced Biofuels – Potential for Cost Reduction.* This project is now completed and the full report is available on Task 39’s website (click [here](#)<sup>20</sup>). For this report, Task 39’s management team (Drs. McMillan, Saddler and Ebadian) distributed the project questionnaire to 25 advanced biofuels companies in North America and then collected and compiled cost data from 10 responding companies, subsequently contributing a section summarising this information. Task 39 also prepared two other sections, one on feedstock costs and availability in North America and the other on the role of biofuels policy in the potential cost reduction of advanced biofuels. Members of the project team presented the main findings and results in an [IEA Bioenergy Webinar](#)<sup>21</sup> held on 23 April, 2020

20 <http://task39.sites.olt.ubc.ca/files/2020/02/Advanced-Biofuels-Potential-for-Cost-Reduction-Final-Draft.pdf>

21 <https://www.ieabioenergy.com/publications/iea-bioenergy-webinar-advanced-biofuels-potential-for-cost-reduction/>

# IEA Bioenergy

## WEBINAR SERIES

### Advanced Biofuels – Potential for Cost Reduction

Thursday 23 April, 2020

04:00 pm - 05:00 pm Central European Summer Time  
10:00 am - 11:00 am North American Eastern Standard Time  
03:00 pm - 04:00 pm British Summer Time



**Presenter**  
Adam Brown  
Energy Insights Ltd,  
UK



**Co-author**  
Lars Waldheim  
Waldheim Consulting,  
Sweden



**Co-author**  
Ingvar Landälv  
Fuel & Energy Consulting,  
Sweden



**Co-author**  
Jack Saddler  
University of British Columbia,  
Canada,  
IEA Bioenergy Task 39



**Co-author**  
Mahmood Ebadian  
University of British Columbia,  
Canada,  
IEA Bioenergy Task 39

*The Role of Renewable Transport Fuels in Decarbonising Road Transport.* Experts from the IEA Bioenergy and Advanced Motor Fuels Technology Collaboration Programmes with support from the European Commission's Directorate General for Energy completed a study on the role of renewable fuels in reducing the climate impact of road transport for a number of countries, including Brazil, Germany, Finland Sweden, and the United States of America. The analysis considered developments up to 2050 based on national policies, vehicle fleet projections, and the availability of renewable transport fuels. The objective of the assessment was to quantify the role that renewable transport fuels play in decarbonising road transport as well as to provide insights to policy makers about how individual countries differ from one another, which options for decarbonisation they have, and to provide best practice examples of successful policies.

An IEA Bioenergy webinar held on November 17, 2020 presented the study's main conclusions and recommendations.

## WEBINAR SERIES

### The Contribution of Renewable Fuels to Road Transport Decarbonisation

November 17, 2020

4:00 pm - 5:30 pm Central European Time  
10:00 am - 11:30 am North American Eastern Standard Time  
3:00 pm - 4.30 pm Greenwich Mean Time



**Presenter**  
**Dina Bacovsky**  
Unit Head Biofuels,  
BEST - Bioenergy and  
Sustainable Technologies,  
Austria



**Presenter**  
**Juhani Laurikko**  
Senior Research  
Scientist, VTT,  
Finland



**Presenter**  
**Adam Brown**  
Managing Director,  
Energy Insights,  
UK/France

IEA Bioenergy TCP webinar held 17 November 2020

The report was completed on November 23, 2020, and is available on the IEA Bioenergy website ([here](#)<sup>22</sup>). Task 39 contributed to three chapters, (1) Role of policy on production and use of emerging biofuels; 2) Availability and costs of sustainable bioenergy feedstocks; and 3) GHG emissions of emerging biofuels pathways) as well as assisted with finalising the report.

### Newsletters

In addition to commissioned reports, conference and workshop proceedings, Task 39 disseminates information through its periodic newsletters. The newsletters include feature stories highlighting developments in a member country or region of interest while providing hyperlinks to media stories and reports of interest to the biofuel's stakeholder community. The newsletters detail the latest developments in industry and government policies pertaining to transport biofuels. Three newsletters were published and distributed to over 2500 recipients. The newsletters featured articles on biofuel production and use and policies in Germany, Sweden and India and are available at the Task 39 website: <http://task39.ieabioenergy.com/newsletters/>.

Task 39's Newsletter issue #54 was published in May 2020 and included a feature article on "Biofuels Production and Consumption in Germany: Status, Advances and Challenges", a summary of Task 39's virtual business meeting in April 2020 and a short description of current project activities, which continues to span technology, policy, sustainability and commercialisation issues.

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22 <https://www.ieabioenergy.com/blog/publications/new-publication-the-role-of-renewable-transport-fuels-in-decarbonizing-road-transport/>



Task 39's Newsletter issue #55 was published in September 2020 and included a feature article entitled, "Sweden targets world's highest biofuel blending". It also included a summary of Task 39's second virtual business meeting in June 2020 and the joint workshops that Task 39 organised and participated in.

Task 39's Newsletter issue #56 was published in December 2020 and included a feature article entitled, "India Biofuel economy roadmap- Challenges & Prospects" It also included a summary of Task 39's third virtual business meeting and Task 39-Task 44 joint workshop in November 2020 as well as the Task's recent progress with publications and information dissemination.

The country (or regional) specific lead/feature article in each newsletter provides a unique source of information to global biofuel stakeholders. We regularly receive requests for permission to republish these reports in other magazines, e.g., *Oils and Fats* and *Biofuels Digest* and on other websites, e.g., Advanced Biofuels USA (<https://advancedbiofuelsusa.info/>).

## **Website**

The Task continues to increase its influence within the international community that is working on decarbonising transport (using biofuels). The Task's website is well visited and routinely receives enquires that are typically handled by the Task coordinator and webmaster, or referred to experts within Task 39's network. Specific website statistics are reported in the Task's progress reports.

## **Collaboration with Other Tasks/Organisations/Networking**

In 2020, Task 39 continued strengthening collaborations with other IEA Bioenergy Tasks (Tasks 33, 34, 36, 37, 40, 42 and 43 as well as with other groups such as the IEA AMF TCP and IEA HQ). As mentioned earlier, Task 39 contributed to two special Inter-Task projects (funded by Task 41), namely: 1) Advanced biofuels – potential for cost reduction; and 2) The Role of Renewable Transport Fuels in Decarbonising Road Transport. The project comparing LCA models for GHG calculations was a collaboration with IEA Bioenergy Task 38 (now part of Task 45). The outcomes of this project have helped inform the previous IEA Bioenergy inter-Task project on Sustainability. Task 39 and Task 44 organised a joint workshop on 25 November 2020. The objective was to explore potential Task 39-Task 44 collaborations related to the future role of biofuels-producing biorefineries in grid balancing

Task 39 continued its good rapport with other groups such as IEA HQ, IRENA, the IEA AMF TCP, UN FAO, GBEP, and various national programs. Task 39 also benefited from extensive industry involvement from companies and institutions at the forefront of biofuels development such as Boeing, Borregaard DSM, ENI, GoodFuels, IATA, IFPEN, ISCC, Haldor Topsoe, LanzaTech, LBST, Licella, Neste, Novozymes, REG, RSB, (S&T)<sup>2</sup> Consultants, skyNRG, Steeper, UPM, etc.

In 2020, India officially joined Task 39 for the current 2019-2021 triennium. Mr. Ravi P. Gupta, General Manager of Bioenergy Research Centre at the Indian Oil Corporation has been joining and participating in Task 39 meetings as India's representative to the Task. Other countries that are prospects to become new members of IEA Bioenergy and Task 39 in the current triennium include Chile, China, Indonesia, Malaysia, Mexico and Thailand. The economies in each of these countries are growing, with increased manufacturing and consumption leading to more heavy duty freight transport (i.e., long-distance trucking, rail, shipping and aviation). We remain optimistic that these countries will eventually join IEA Bioenergy and Task 39.

## **Deliverables**

In summary, the 2020 deliverables for Task 39 include:

1. Organised three virtual Task 39 business meetings;
2. Published three newsletters (issues #54, 55 and 56);
3. Submitted its progress report and audited financial accounts statement;
4. Maintained and further developed the Task 39 website;
5. actively organised and participated in several virtual webinars and conferences to share their insights on how decarbonisation of the transport sector can contribute to a "green economic recovery"
6. Updated Task 39's advanced biofuels demonstration plants database;
7. Completed three internal projects": "Comparison of biofuel life cycle analysis tools, Phase 2, Part 2: biochemical second generation (2G or cellulosic) ethanol production and distribution"; "Implementation Agendas: 2018-2019 Update – Compare and Contrast Transport Biofuels Policies"; "Updating Task 39's demonstration plants database".
8. Published a manuscripts in a peer-reviewed journal.
9. Contributed to two InterTask special projects (Task 41 funded): 1) Advanced Biofuels – Potential for Cost Reduction; and (2) The Role of Renewable Transport Fuels in Decarbonising Road Transport.

All of the Task's published reports are available at <http://task39.ieabioenergy.com/>.

## TASK 40: Deployment of biobased value chains

### Overview of the Task

The Task 40 objective is to support deploying viable, efficient bioenergy value chains in the context of

- sustainable, national and international markets,
- reflecting on policy developments, and economic aspects, including financing
- international, national and regional trade of biomass,

recognising the diversity in biomass resources, value chains and competitive applications for bioenergy, biobased materials and products.

The focus of Task 40 in the new triennium is on the **development and design of efficient, economically viable and bankable value chains in order to support a larger deployment of sustainable biomass for energy, but also for biobased products and materials, taking into account food, feed and fiber markets.**

**In short, the Task works on deploying sustainable biomass for energy in the context of the larger bioeconomy.**

Within this scope, international, national and regional biomass trade remains vital. However, Task 40's scope is widened to understanding the functioning and improving the efficiency of entire biomass value chains, taking into account regional supply and use, in a balanced way and avoiding distortions and instability that can threaten investments in biomass production, processing, logistics and infrastructure, and conversion capacity.

It is key to understand biobased value chains and how to sustainably extend them. For this, the barriers and drivers for widespread and sustainable biomass deployment will be identified, and policy developments reflected that could foster biomass uptake in existing and new (emerging) markets.

A **key new** issue to be addressed from a deployment point of view will be the **financing aspect of bioenergy projects** (e.g., de-risking, sustainable profitability after initial support).

Task 40 aims to provide vital contributions to respective decisions for market players and financial institutions, policy makers, international bodies as well as civil society organisations (CSO, e.g., consumer and environmental groups, labor unions). It aims to do so by providing high quality information, analyses, and synthesis.

The scope of work will holistically support the provision and use of sustainable biomass in different national and international markets, with a focus on bioenergy.

*Participating countries:* Austria, Belgium, Denmark, Germany, Japan, The Netherlands, Sweden, and the United States of America.

**Task Leader:** Uwe R. Fritsche, IINAS, Germany

**Co-Task Leaders:** Christine Hennig, DBFZ (Germany) and Olle Olsson, SEI (Sweden)

**Secretary:** Ms. Nora Lange, DBFZ, Germany

**Operating Agent:** Birger Kerckow, Fachagentur Nachwachsende Rohstoffe e.V. (FNR), Germany

The Task Leader directs and manages the work programme, together with the Co-Task Leaders (team approach). A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 40, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task40.ieabioenergy.com/>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and workshops

In 2020, all planned physical meetings were canceled due to the COVID-19 pandemic. Instead, regular virtual meetings (on average: every 6 weeks) took place and a continuous offline exchange of information through a dedicated **OneNote book**.

### Future Meetings and Workshops

Task 40 had planned a joint meeting and workshop with Task 32 for May 26-28, 2020 in Copenhagen, but this was canceled due to the COVID-19 pandemic restrictions. Similarly, physical meetings in September 2020 in the United States of America, and in March 2021 in Japan were canceled.

All meetings in 2021 are expected to be online (via GotoMeeting).

## Work Programme and Outputs

Task 40 has **three core areas of operation** that all include Inter-Task project proposals considering the various biobased value chains, markets and applications, as it sees itself as “horizontal” among the IEA Bioenergy TCPs.

### *WP1: Market developments*

- Regional transitions in existing bioenergy markets – **flagship** project of Task 40
- New regional bioenergy markets – key actors, policies and regulation, and technological challenges (e.g., future CHP) regarding deployment, and trade – due to the COVID-19 pandemic, this issue has been **postponed** to the next triennium.
- Market perspectives and deployment for aviation and marine biofuels – this became part of the “Advanced biofuels: Lessons learned” Inter-Task project
- Globalised sustainable biobased value chains, incl. market perspectives and synergies between bioenergy and bioeconomy – this project has started in Summer 2020

### *WP2: Industrial Heat and Processes*

- Task 40 contributes to the Strategic Inter-Task project on Industrial heat
- Task 40 leads the Strategic Inter-Task project on BECCS/U

### *WP3: Deployment Strategies*

- Deployment guidance regarding technological barriers, economic aspects & financing – due to the COVID-19 pandemic, this issue has been **postponed** to the next triennium.
- Task 40 leads the Strategic Inter-Task project on Renewable gas – deployment, markets and sustainable trade
- Task 40 leads the Task 41 Special Project on “Renewables Gas – Hydrogen in the grid”
- Task 40 contributes to the WB2/SDG Strategic Inter-Task project

## Reports and papers to be finalised in 2021

- Synthesis report of the BECCS/U Inter-Task project
- Final report for the Task 41 Special Project on “Renewables Gas – Hydrogen in the grid”
- Synthesis report of the Task 40 “Regional Transitions” project
- Synthesis reports on the Strategic Inter-Task Projects Industrial Heat and Renewable Gas and will contribute to the reports of the Strategic Inter-Task Project “Role of Bioenergy in a well-below 2 °C/SDG world”.

In addition, Task 40 will prepare several scientific articles and conference contributions.

## **Collaboration with Other Tasks/Organisations/Networking**

Collaboration with IEA Bioenergy Tasks focused on all Strategic Inter-Task projects (Role of Bioenergy in a well-below 2 °C/SDG world; Renewable Gas; Industrial Heat, BECCS/U).

Task 40 also contributed to the IEA Bioenergy ExCo online workshops and leads the Task 41 Special Project on “Renewable Gases – Hydrogen in the grid” which started in February 2020 as well as the strategic inter-Task project Renewable gas deployment, markets and sustainable trade which re-kicked off in September 2020 and runs in parallel.

## **Deliverables**

Task 40 Newsletter June 2020 [https://task40.ieabioenergy.com/wp-content/uploads/sites/6/2020/06/Task-40\\_Newsletter-June-2020.pdf](https://task40.ieabioenergy.com/wp-content/uploads/sites/6/2020/06/Task-40_Newsletter-June-2020.pdf)

# **TASK 41: Bioenergy Systems Analysis**

## **Overview of the Task**

The objective of the Task is to supply various categories of decision makers with scientifically sound and politically unbiased analyses needed for strategic decisions related to research or policy issues. The target groups are particularly decision makers in Ministries, national or local administrations, deploying agencies, etc. Depending on the character of the projects some deliverables are also expected to be of direct interest to industry stakeholders. Decision makers, both public and private, have to consider many aspects, so the Task needs to cover technical, economic, and environmental data in its work. The Task’s activities build upon existing data, information sources, and conclusions. It does not intend to produce new primary scientific data.

The Task differs from the other Tasks in that it does not have networking as one of its prime objectives, nor do the Task’s activities have continuous and repeating components, e.g., biannual meetings, country updates, etc. The work programme has a pronounced project emphasis with each project having very specific and closely defined objectives. Because of its special character in terms of participation, financing and cross-cutting orientation, the Task aims to be a valuable resource and instrument to the ExCo serving the ExCo with highly qualified resources to carry out projects, involving several parties (e.g., other Tasks and organisations) as requested by the ExCo. Due to the close contact with the other Tasks, Task 41 is intended to develop into a platform for joint Task work and a catalyst for proposals from the Tasks to the ExCo.

A project leader directs and manages the work of each project. For new projects an appropriate project leader is appointed by the project participants acting through the Executive Committee. The ExCo Member from each participating country acts as the national Team Leader and is responsible for coordinating national input to the projects undertaken.

## Progress in R&D

### Work Programme

The work programme is comprised of a series of projects. Each project has its own budget, work description, timeframe, and deliverables and is approved by the participants. The focus is on the needs of the participants by way of project outputs. Three projects were active in 2020 as follows:

#### **Project 9: Potential Cost reduction for novel and advanced renewable and low carbon fuels**

The objective of this project was to identify the scope for cost reduction for novel advanced biofuels, to develop a model for likely costs as deployment grows and to examine the impact of policy measures, including carbon pricing, on the competitiveness of novel biofuels.

*Participating countries:* European Commission, Germany, Sweden and The Netherlands

**Status:** The project was completed in February 2020 with a final report – <https://www.ieabioenergy.com/blog/publications/new-publication-advanced-biofuels-potential-for-cost-reduction/>. A webinar presenting an overview of the report was held in April 2020 and can be viewed at <https://www.ieabioenergy.com/blog/publications/iea-bioenergy-webinar-advanced-biofuels-potential-for-cost-reduction/>.

#### **Project 10: The contribution of Advanced Renewable Transport Fuels to transport decarbonisation in 2030 and beyond**

The objective of this project was to bring together the expertise of IEA AMF, IEA Bioenergy and national experts to showcase the role of advanced renewable transport fuels to transport decarbonisation by 2030 and beyond. The project analysed national strategies for decarbonising transport. It also identified possible challenges and hurdles for the implementation of advanced renewable transport fuels. The project assessed the potential of ART Fuels from three different angles: a) Policy b) Markets and c) Technology.

*Participating countries:* European Commission, Finland, USA, Brazil, Germany, Sweden and IEA AMF

**Status:** The project was completed in November 2020 with a final report – <https://www.ieabioenergy.com/blog/publications/new-publication-the-role-of-renewable-transport-fuels-in-decarbonizing-road-transport/> – and webinar – <https://www.ieabioenergy.com/blog/publications/iea-bioenergy-webinar-the-contribution-of-renewable-fuels-to-road-transport-decarbonisation/>.

### **Project 11: Renewable Gas – Hydrogen in the grid**

The objective of this one-year project is to carry out a thorough study on renewable gas and the effect of hydrogen addition in the grid as well as applications at increased concentrations up to 100%. The expertise of IEA Bioenergy and national experts is fundamental to the success of this study which could be of significant value in the decarbonisation policies by 2050 and beyond. The project will collect existing data, performance indicators, information on renewable gas studies and projects and will analyse national strategies. It will also identify and discuss the numerous challenges and hurdles for the gradual replacement of natural gas by renewable gas, with emphasis on hydrogen addition to the gas grid and dedicated hydrogen grids.

*Participating countries:* European Commission, Germany and Sweden

**Status:** The project is expected to be completed in the second quarter of 2021 with a final report.

## **TASK 42: Biorefining in a Circular Economy**

### **Overview of the Task**

The goal of Task 42 'Biorefining in a Circular Economy' 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. For this 2019-2021 triennium, the focus of the activities will be on:

- provision of quantitative, scientifically sound, and understandable data on the technical, economic and environmental added-value of biorefining to co-produce bioenergy and bio-products in a sustainable way (Biorefinery Assessment Platform, Biorefinery Fact Sheets, Reports on sustainable lignin valorisation);
- provision of global implementation status, major deployment barriers and market data (Biorefinery Country Reports, Global Biorefinery Status Report, Report on major non-technical deployment barriers, monitoring of international developments in biobased products certification and standardisation);



- provision of an international platform for cooperation and information exchange (Task 42 website, newsletters, lectures, webinars, thematic workshop on the role of biomass, bioenergy and biorefining in a Circular Economy, national stakeholder events, training).

The real added value of Task 42 'Biorefining in a Circular Economy' is its holistic approach of optimal sustainable use of biomass for a spectrum of non-food applications within the framework of a Circular BioEconomy. Therefore, Task 42 plays a central role in IEA Bioenergy linking the more (single) technology oriented Tasks to the Tasks dealing with biomass supply, climate and sustainability assessment, deployment. Its activities, often performed in cooperation with the other Tasks, will provide real added value information for the other Tasks by providing technological, market and stakeholder data to further optimise their biomass conversion technologies to integrated biorefineries optimising their overall sustainable performance.

*Participating countries:* Australia, Austria, Denmark, Germany, Ireland, Italy, The Netherlands and Sweden

**Task Leader:** Bert Annevelink, Wageningen Food & Biobased Research, The Netherlands.

**Assistant Task Leaders:** Ed de Jong, Avantium, The Netherlands & Michael Mandl, tbw Research GesmbH, Austria.

**Operating Agent:** Kees Kwant, NL Enterprise Agency, Ministry of Economic Affairs, The Netherlands

The Task Leader directs and manages the work programme, assisted by two assistant Task leaders for specific areas. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 42, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task42.ieabioenergy.com/>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings, Workshops & Webinars

#### ***32<sup>nd</sup> Task Progress Meeting on Skype for business, 20 February 2020***

##### *Webinar on Biobased chemicals – a 2020 status update, 24 February 2020*

This webinar was organised by Bioenergy Australia and presented by Ed de Jong & Geoff Bell. The recording is available at: <https://www.bioenergyaustralia.org.au/events/61261/>

##### *Webinar on Biobased chemicals – a 2020 status update, 10 March 2020*

This webinar was organised by IEA Bioenergy and presented by Ed de Jong & Bert Annevelink. The recording is available at: <https://www.ieabioenergy.com/publications/iea-bioenergy-webinar-biobased-chemicals-a-2020-status-update/>

##### *Webinar on Lignin and other sustainable carbon sources as metallurgical coal substitutes, 30 April 2020*

Bioenergy Australia organised this Webinar supported by IEA Bioenergy Task 42. It was given by Samane Maroufi & Geoff Bell. The recording and presentation are available at the Task42 website: <http://task42.ieabioenergy.com/news/australia-webinar/> and more information can be found at: <https://www.bioenergyaustralia.org.au/events/64864/>

#### ***33<sup>rd</sup> Task Progress Meeting on Skype for business, 7 May 2020***

#### ***34<sup>th</sup> Task Progress Meeting on Skype for business, 25 June 2020***

#### ***Special session organised by IEA Task 42 during NWBC2020, 14 October 2020***

The postponed NWBC2020 was held online instead of in Stockholm. Four IEA Task 42 presentations were given in a special session on Biorefineries in a circular economy:

- IEA Bioenergy Task 42 – Biorefineries in the Nordic context – Johanna Mossberg
- Biobased Chemicals: Current status and future outlooks – Ed de Jong, Heinz Stichnothe & Henning Jorgensen
- Alternative and sustainable carbon sources as substitutes for metallurgical coal – Geoff Bell
- TEE assessment of integrated biorefineries – Johannes Lindorfer, Michael Mandl & Franziska Hesser

The recordings of these presentations will become available on the Task 42 website once they are released by the organisation of NWBC2020.

## **35<sup>th</sup> Task Progress Meeting on MS Teams, 15-16 October 2020**

### **Planned Meetings/Workshops 2020-2021**

The Task 42 Progress Meetings will all be virtual on MS Teams in 2021. The scheme is:

- 36<sup>th</sup> Task 42 Progress meeting in January 2021 – Country updates meeting.
- 37<sup>th</sup> Task 42 Progress meeting in March 2021 – Regular full progress meeting
- 38<sup>th</sup> Task 42 Progress meeting in May/June 2021 – Intermediate progress meeting
- 39<sup>th</sup> Task 42 Progress meeting in September/October 2021 – Regular full progress meeting
- 40<sup>th</sup> Task 42 Progress meeting November/December – End of Triennium meeting

Furthermore, Task 42 Workshops and Webinars will be organised on biorefining related subjects.

### **Work Programme and Outputs**

#### ***WP1. Provide quantitative, scientifically sound, and understandable data on the technical, economic and environmental added value of biorefining to co-produce bioenergy and bio-products in a sustainable way***

An on-line questionnaire was sent-out in February to the coordinators of all other Tasks with the request to distribute it within their Tasks, and the request to fill it in if applicable. The NTLs were asked to distribute the link to the survey within their network and it was placed on the Task 42 website. So far 63 stakeholders started to fill-in the questionnaire but only 21 of them finished it completely (33%). People dropped out at the characterisation part and when a contact person was requested. However, four solid contacts were obtained, with one potential link (SENAI CETIQT in Brazil) for data sharing necessary for a factsheet development. Almost nobody wanted to provide cost data. Environmental data response was a bit higher.

It will be hard to get real industrial data. A good alternative will be to get in contact with the European Bio Based Industries (BBI) JU Programme. They have sponsored several biorefinery demonstration and flagship initiatives that have to come-up with LCA type data-sets that also have to be published.

The TEE assessment will start now and for that purpose the new pathways for assessment will need to be selected via a second questionnaire that is being prepared to select and prioritise the cases studies. Task 33 (gasification) has made a subtask on TEE where the cooperation with Task 42 has been defined.

Four new factsheets have been published by IEA Bioenergy Task 42. More details can be found in the updated report 'Technical, Economic and Environmental Assessment of Biorefinery Concepts – Developing a practical approach for characterisation'.

**WP2. Monitor the biorefineries deployment and market potential, incl. non-technical deployment barriers, in the Circular Economy**

**T2.1 Barriers and Incentives for the Market Diffusion**

This activity was started in Q1 2020. The type of deliverable is to be a case study. The methodology used will be a multi-perspective & multi-stakeholder approach called Importance-Performance-Gap-Analysis that is based on a recently published paper. The activity will identify and analyse specific barriers to and incentives for implementation/commercialisation of biorefineries. An online survey will be held, with experts from research & industry. The chosen case study will be the Green Biorefinery, which is relevant e.g. for Denmark, Ireland and the Netherlands.

**T2.2 Prepare Biorefinery Country Reports**

In April the first Swedish country report was published. The Irish country report is being finalised.

**T2.3 Publish a Global Biorefinery Status Report (GBSR)**

The report will be an integrated summary of the recent Task 42 deliverables (e.g. the status as mentioned in the country reports, an analysis of the information in the Task 42 data base, etc.). Also cooperation will be sought with the running Biorefinery Outlook EC-project. The report was originally scheduled for the end of 2020, but has now been postponed to Q3 of 2021, among others to take advantage of all the new information that is being collected now.

**T2.4 Global mapping scheme and database on Biorefineries**

Database – At the beginning of 2020 it was assessed if it possible to merge the Task 42 database with the IEA Bioenergy data-base managed by BEST - Bioenergy and Sustainable Technologies. This turns out to be difficult because of a different set-up (not dealing with bio-based products but mainly with bioenergy). The same is the case with the JRC Seville database on the bioeconomy. Task 42 had a meeting with JRC Seville and JRC Ispra to discuss a possible cooperation with their database (aimed at Europe) and dashboard website. We can probably work together on data collection but not on merging the databases. However, this still has to be approved by the DG-R&D. The Biorefinery Outlook project (led by E4Tech) has made a recent update based on the JRC database, and Task 42 is in contact to see if these data can also be added to the Task 42 database after the finalisation of that project (in February 2021). So in the end it was decided that Task 42 will look carefully at those databases and extract cases/data wherever possible. Task 42 will also provide those databases with biorefinery data if applicable. For biorefineries the Task 42 database and mapping/portal has to become the most extensive and complete one, so a real added-value product for both IEA Bioenergy and beyond. The Task 42 biorefinery database has been continuously updated during 2020. Some 900 BRs are included at the moment. Some 200 global BRs were added. Harmonising the data has been an ongoing activity.

Global mapping scheme – A WebGIS application was developed, which will enable industry and policy makers to get a visual overview of the distribution of biorefineries in the world. The current version is a basic testing prototype portal, which means we have the capability to improve it further: speed up data and maps download, change design on portal and DB, also modify charts and graphs rendering, include other sources. All NTLs were invited to have a look at the online version to give their comments. These comments and suggestions of the NTLs were taken into account to improve the interface. In 2021 it will be decided when the database can be put online for external contributors from industry e.g. to add data.

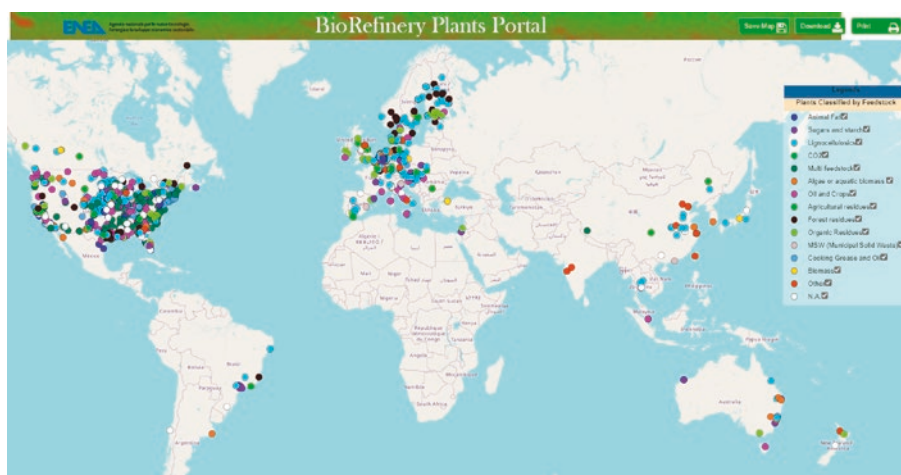


Figure 1. Draft version of Biorefinery Plants Portal.

### ***T2.5 Reports on markets for biobased products to get insight in deployment strategies***

This activity will deliver the report 'Sustainable Lignin Valorisation in the Circular Economy (2020)'. A clear link has been established with the EU COST initiative LignoCOST coordinated by Richard Gosselink of WUR (The Netherlands) by working together on several items. The content of the report will be as follows: Chapter 1 on 'Lignin descriptions and current global interest' is almost completed. Chapter 2 'Mapping and description of international networks and projects on lignin' contains a description of EU-projects in technical sheets. Input is still needed from the NTLs. Chapter 3 is on lignin derived products. An finally Chapter 4 on 'Process layouts for the conversion of lignins to target products of interest' deals with computational tools to assess these layouts. The work is carried out together with the University of Athens from the LignoCOST project. A draft of the report was circulated for review purposes. Input on all chapters is requested from the NTLs.

### ***Task 2.6) Monitor international developments biobased products standardisation/certification***

The activity is addressed at each progress meeting to give updates. However, no specific report will be delivered during this Triennium.

### **WP3. Dissemination & Communication**

To involve more relevant stakeholders in Task 42, and to increase its platform role (central international scientifically based platform for information exchange) Task 42's existence will be actively communicated to the outside world. This will be done by means of operating an up-to-date Task 42 website (external communication) with password protected members area (internal communication), publishing biannual Task 42 newsletters, lecturing at international conferences, using new social media, organising a Thematic Stakeholder Workshop, and contributing to Biorefinery Training Schools.

No face-to-face meetings with stakeholders could be organised given the COVID-19 restrictions. This hindered our dissemination and communication, both internationally and nationally in the member countries. Fortunately some of the scheduled meetings like the Task 42 session at the NWBC2020 conference could be replaced by an online activity. So dissemination & communication were performed by giving webinars on specific topics related to finalised reports, by giving three presentations at the online conference NWBC2020 and by publishing news items on the Task 42 and the IEA Bioenergy websites. It has been difficult to get enough material at a certain point in time to fill and produce a 'traditional' newsletter. So unfortunately no newsletter was published in this period due to the COVID-19 situation. Therefore, our approach in 2021 will be to work more with separate news items on the website.

#### **Website**

The dedicated Task 42 website was built in the previous Triennium. It is located at <http://task42.ieabioenergy.com>. This website was updated in April 2019 with the description of the new Triennium plan, and with a list of the (new) team members. Furthermore, the TEE report, the newsletter and country report slide decks were published. Finally events and news were added, when they occurred.

#### **Collaboration with Other Tasks/Organisations/Networking**

The cooperation with other Tasks and organisations was continued in 2020:

- Initial talks have been held with JRC Seville and Ispra on cooperation regarding the JRC database on the bioeconomy (also containing biorefineries) and the IEA Task 42 database. The cooperation depends on the approval of the EC.
- The EC was asked for permission to use the results of the BR Outlook project, that is led by E4Tech. These results include data that are valuable for the Task 42 database, but also for the global BR status report. The IEA current and former Task 42 leaders are also participating in that project (as researchers of Wageningen Research) and also FNR and BTG are involved as project partners.

- The cooperation with other IEA Bioenergy Tasks within the Collaborative Inter Task Project (CITP) TEE Technical, Economic and Environmental (TEE) assessment of integrated biorefineries has started. Task 33 (gasification) has made a subtask on TEE where the cooperation with Task 42 has been defined. Establishing contacts with Task 37 (biogas) is under development.
- The work on the lignin report is being carried out together with the University of Athens from the LignoCOST project.

The collaboration with industry will be established in several ways, i.e.:

- WP1: For the TEE-assessments input-data can be provided by industry.
- WP2: Industry will be asked by the NTLs to provide input for both the biorefinery country reports, the Global Biorefinery Status Report, and the mapping scheme and database on biorefineries.
- WP3: Industry will be asked by the NTLs to provide input for the Task 42 website and the biannual newsletters. Webinars in cooperation with industrial stakeholders will be organised. At workshops major industrial stakeholders will be asked to come-up with their views. The NTLs will organise industrial/SME stakeholder events at national level to get in direct contact with key players in their respective countries to both disseminate Task 42 results and to collect information on requirements of these market parties. Biannual physical Task 42 Progress Meetings will be coupled if possible to national stakeholder meetings, conferences and/or excursions to further improve information exchange between Task 42 and interested stakeholders.

## Deliverables

- Report on 'Bio-Based Chemicals: A 2020 Update'  
(<http://task42.ieabioenergy.com/publications/bio-based-chemicals-a-2020-update/>)
- Report on Technical, Economic and Environmental Assessment of Biorefineries  
(<https://task42.ieabioenergy.com/publications/tee-2019/>)
- Four new factsheets of Biorefinery Concepts  
(<http://task42.ieabioenergy.com/document-category/factsheets/>)
- Country report of Sweden  
(<http://task42.ieabioenergy.com/publications/sweden-country-report-2020/>)
- Report on Alternative sustainable carbon sources as substitutes for metallurgical coal  
(<http://task42.ieabioenergy.com/publications/alternative-sustainable-carbon-sources/>)
- Presentation at the NWBC2020 online conference: IEA Bioenergy Task 42 – Biorefineries in the Nordic context – Johanna Mossberg

- Presentation at the NWBC2020 online conference: Biobased Chemicals: Current status and future outlooks – Ed de Jong, Heinz Stichnothe & Henning Jorgensen
- Presentation at the NWBC2020 online conference: Alternative and sustainable carbon sources as substitutes for metallurgical coal – Geoff Bell
- Presentation at the NWBC2020 online conference: TEE assessment of integrated biorefineries – Johannes Lindorfer, Michael Mandl & Franziska Hesser
- Bioenergy Australia Webinar on Biobased chemicals – a 2020 status update (<https://www.bioenergyaustralia.org.au/events/61261/>)
- IEA Bioenergy Webinar on Biobased chemicals – a 2020 status update (<https://www.ieabioenergy.com/publications/iea-bioenergy-webinar-biobased-chemicals-a-2020-status-update/>)
- Bioenergy Australia Webinar on Lignin and other sustainable carbon sources as metallurgical coal substitutes (<http://task42.ieabioenergy.com/news/australia-webinar/>)



Figure 2. *Bio-based Chemicals* report produced by Task42 in 2020.

Other Task-related information (brochures, leaflets, newsletters, papers etc.) are available at the Task42 website: <https://task42.ieabioenergy.com/>.



## **TASK 43: Sustainable biomass supply integration for bioenergy within the broader bioeconomy**

### **Overview of the Task**

The Task will explore technical and economic strategies to increase the quantity of biomass available, improve the quality of the biomass delivered for different energy purposes, and explore strategies to increase the value and foster confidence in biomass supply, for both direct and cascade use of biomass for bioenergy. The Task will work exclusively with terrestrial biomass sources including residues, by-product or co-product production from forest and agriculture production systems; residues, by-products or co-products from bio-based manufacturing industries; cellulosic biomass from post-consumer waste; as well as dedicated biomass crop systems as part of broader land management strategies. The Task focus will be on the production and supply of biomass feedstock for energy leading to value creation within the broader context of bioeconomy.

*Participating countries:* Australia, Belgium, Canada, Croatia, Finland, Germany, Sweden, and the United States of America

**Task Leader:** Mark Brown, USC Australia, Australia

**Deputy Task Leader:** Ioannis Dimitriou, SLU, Sweden

**Work Package leaders:** Biljana Kulisic – Work Package 1 Leader, Croatia Évelyne Thiffault – Work Package 2 Leader, Canada

**Task Secretary:** Kelly Murphy, USC Australia, Australia

**Operating Agent:** Mrs Shahana McKenzie, Bioenergy Australia, Australia

The Task leader, together with the Work Package (WP) leaders, manages the work of the Task. A Steering Committee (SC), consisting of the Task Leader, WP leaders and the National Team Leaders (NTLs), is responsible for reviewing progress and making overall priorities. Each NTL forms a national team of experts that support the NTL in making national contributions to the collaboration. Other associated experts are also involved.

For further details on Task 43, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task43.ieabioenergy.com/>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## Progress in R&D

### Task meetings, workshops and webinars since last ExCo meeting

Event (What/Where)	When	Status/Result
Task Leadership Meeting 5/2019 via videoconference	25 September 2019	Minutes available upon request
Task Leadership Meeting 6/2019 in Sopron videoconference	11 October 2019	Minutes available upon request
Joint workshop with BioEast in Sopron, Hungary " <i>Bio-hubs as keys to successful biomass supply integration for bioenergy within the bioeconomy</i> "	10 October 2019	<a href="http://task43.ieabioenergy.com/publications/bio-hubs-as-keys-to-successful-biomass-supply-integration-for-bioenergy-within-the-bioeconomy-joint-iea-bioenergy-task-43-and-bioeast-initiative-workshop-10-october-sopron-hungary/">http://task43.ieabioenergy.com/publications/bio-hubs-as-keys-to-successful-biomass-supply-integration-for-bioenergy-within-the-bioeconomy-joint-iea-bioenergy-task-43-and-bioeast-initiative-workshop-10-october-sopron-hungary/</a>
Task Leadership Meeting 7/2019 via videoconference	9 December 2019	Minutes available upon request
Task Leadership Meeting 1/2020 via videoconference	13 February 2020	Minutes available upon request
Task Leadership Meeting 2/2020 via videoconference	19 May 2020	Minutes available upon request
Task Leadership Meeting 3/2020 via videoconference	17 June 2020	Minutes available upon request
Task Leadership Meeting 4/2020 via videoconference	16 September 2020	Minutes available upon request
Task Leadership Meeting 5/2020 via videoconference	26 November 2020	Minutes available upon request

## Targets reached and deliverables

Deliverable (What)	When	Status/Result
Sustainable Landscape Management for Bioenergy and the Bioeconomy – Report from Workshop	July 2019	Available online: <a href="https://task43.ieabioenergy.com/publications/sustainable-landscape-management-for-bioenergy-and-the-bioeconomy-report-from-joint-iea-bioenergy-task-43-fao-workshop-11-12th-october-2018-rome-italy-tr2019-07/">https://task43.ieabioenergy.com/publications/sustainable-landscape-management-for-bioenergy-and-the-bioeconomy-report-from-joint-iea-bioenergy-task-43-fao-workshop-11-12th-october-2018-rome-italy-tr2019-07/</a>
Attractive Systems for Bioenergy Feedstock Production in Sustainably Managed Landscapes – Contributions to the Call	July 2019	Available online: <a href="https://task43.ieabioenergy.com/publications/attractive-systems-for-bioenergy-feedstock-production-in-sustainably-managed-landscapes-contributions-to-the-call/">https://task43.ieabioenergy.com/publications/attractive-systems-for-bioenergy-feedstock-production-in-sustainably-managed-landscapes-contributions-to-the-call/</a>
Bio-hubs as keys to successful biomass supply integration for bioenergy within the bioeconomy – Joint Task 43 and BioEast Initiative	October 2019	Available online: <a href="https://task43.ieabioenergy.com/publications/bio-hubs-as-keys-to-successful-biomass-supply-integration-for-bioenergy-within-the-bioeconomy-joint-iea-bioenergy-task-43-and-bioeast-initiative-workshop-10-october-sopron-hungary/">https://task43.ieabioenergy.com/publications/bio-hubs-as-keys-to-successful-biomass-supply-integration-for-bioenergy-within-the-bioeconomy-joint-iea-bioenergy-task-43-and-bioeast-initiative-workshop-10-october-sopron-hungary/</a>
Dry matter losses during biomass storage: Measures to minimise feedstock degradation	January 2020	Available online: <a href="https://task43.ieabioenergy.com/publications/dry-matter-losses-during-biomass-storage-measures-to-minimize-feedstock-degradation/">https://task43.ieabioenergy.com/publications/dry-matter-losses-during-biomass-storage-measures-to-minimize-feedstock-degradation/</a>
Bio-hubs as keys to successful biomass supply integration for bioenergy within the bioeconomy	April 2020	Available online: <a href="https://task43.ieabioenergy.com/publications/bio-hubs-as-keys-to-successful-biomass-supply-integration-for-bioenergy-within-the-bioeconomy-tr2020-01/">https://task43.ieabioenergy.com/publications/bio-hubs-as-keys-to-successful-biomass-supply-integration-for-bioenergy-within-the-bioeconomy-tr2020-01/</a>
Novel regional and landscape-based approaches to govern sustainability of bioenergy and biomaterials supply chains	September 2020	Available online: <a href="https://task43.ieabioenergy.com/publications/novel-regional-and-landscape-based-approaches-to-govern-sustainability-of-bioenergy-and-biomaterials-supply-chains-tr2020-03/">https://task43.ieabioenergy.com/publications/novel-regional-and-landscape-based-approaches-to-govern-sustainability-of-bioenergy-and-biomaterials-supply-chains-tr2020-03/</a>
Sustainability Governance of Canada's Agriculture-based Bioeconomy	October 2020	Available online: <a href="https://task43.ieabioenergy.com/publications/sustainability-governance-of-canadas-agriculture-based-bioeconomy-tr2020-04/">https://task43.ieabioenergy.com/publications/sustainability-governance-of-canadas-agriculture-based-bioeconomy-tr2020-04/</a>

## On-going key activities

The following Task 43 supports activities are continuing with reports due to be submitted over the next 12 months:

- *Developing a web-based tool to merge SWOT analysis results from international biohub and supply chain case studies* – Mohammad Ghaffariyan
- *Integrated biomass residue management in Sandalwood Plantations* – David Lee
- *Current and future biobased industrial raw material demand and supply* – Dan Bergstrom
- *Bioenergy in remote Indigenous communities* – Sam Van Holsbeeck
- *Innovative ecological pile cover for biomass chip storage* – Robert Prinz and Johanna Routa
- *Development of Techno-economic Model for Assessment of Bio-Hubs in Canada* – Amit Kumar
- *Agrarian bio-hubs* – Biljana Kulisic
- *Lessons learned from case studies of response of biomass supply chains to COVID-19 crisis* – Beth Hawkins
- *Forecast report on biomass supply in the post-COVID-19 economy* – Biljana Kulisic
- *Assessment of a Bio-hub to facilitate a profitable bioeconomy for the Albany region, Western Australia* – Justine Edwards
- *Integrated land management using small-scale harvesting operations for biomass utilisation* – Michael Berry
- *Biohub case study SE QLD* – Michael Berry
- *Sustainability assessment of biohub archetypes using life cycle assessment* – Rory Monaghan (inter-Task activity)
- *The benefits of developing biobased commodities to bring biomass to markets* – Wolter Elbersen
- *Improving framework conditions for bioenergy supply chains within bioeconomy – an approach for shaping evidence-based policies* – Biljana Kulisic, Blas Mola, Ioannis Dimitriou and Jorg Schweinle

There are still two projects from the previous triennium that are in their final stages and will be completed within the next 2-3 months.

## Website

The Task website (<http://task43.ieabioenergy.com/>) has been updated in line with changes to the IEA Bioenergy website. Extensive information concerning the Task 43 work is available and updated constantly.

## Collaboration with Other Tasks/Organisations/Networking

The *Biohub in the development and deployment of efficient biomass supply chains* project will involve collaboration with Task 45 and a number of contributors to the previous triennium that have elected not to proceed as part of Task 43.

## Deliverables

### Work Package One

D1. Strategies to integrate innovated biomass crops to leverage and expand existing residue and co-product supply chains

- Agrarian bio-hubs
  - Scientific paper – March 2021
  - Final Report – September 2021
  - Presentation – October 2021

D2. Scale of different biomass crops to economically supply bioenergy production as sole source and as an integrated contribution to residue supply chains

- Integrated land management using small-scale harvesting operations for biomass utilisation
  - Final Report – May 2021
  - Webinar and publication – June 2021
- Inventory of LUC and ILUC in tools, instruments and policies
  - Final Report – December 2020 (draft received)

D3. Quantifying the socioeconomic values of biomass crops as a part of local, regional and national renewable energy strategies.

- Bioenergy in remote Indigenous communities
  - Findings published – March 2021
- Forecast report on biomass supply in the post-COVID-19 economy
  - Publication – September 2020
  - Workshop – November 2020
- Assessment of a Bio-hub to facilitate a profitable bioeconomy for the Albany region, Western Australia
  - Webinar/presentation – 30 December 2020
  - Final Report – 31 March 2021
- Improving framework conditions for bioenergy supply chains within bioeconomy – an approach for shaping evidence-based policies
  - Final report – June 2020

D4. Influencing biomass sustainability through strategies to increase volume, value and quality of biomass supply.

- Integrated biomass residue management in Sandalwood Plantations
  - Draft report – August 2021
  - Final report and analysis – September 2021
  - IEA Webinar and published findings – October 2021
- Sustainability assessment of biohub archetypes using life cycle assessment
  - Final Report – August 2022
- If advanced biofuels assume biomass growing, how should we think when deciding about the optimal production system and what about the potential trade-offs?
  - Publication – December 2020

## *Work Package Two*

D5. Key biomass quality drivers as they relate to bioenergy technology needs

- Current and future biobased industrial raw material demand and supply
  - Final Report – 30 September 2021
  - Submission of manuscript to scientific journal – 30 December 2021

D6. Identifying and managing technology bottlenecks in biomass supply chains

- Lessons learned from case studies of response of biomass supply chains to COVID-19 crisis
  - Template for data entry and case study summary – 31 October 2020
  - Final report – 31 January 2021

D7. Opportunities to economically extend the range of biomass supply chains through new and emerging biomass technology.

- Development of Techno-economic Model for Assessment of Bio-Hubs in Canada
  - TEA Tool – 1 February 2022
  - Final Report – 1 March 2022
- Biohub case study SE QLD
  - Final Report – August 2021
  - Webinar and publication – September 2021
- The benefits of developing biobased commodities to bring biomass to markets
  - Journal article – 30 June 2021
  - Final Report – 30 June 2021

D8. Improving biomass quality and value with pre-processing or pre-treatment within the supply chain. Deliverable specifics:

- Developing a web-based tool to merge SWOT analysis results from international biohub and supply chain case studies
  - Tool and user guide – 30 September 2021
- Innovative ecological pile cover for biomass chip storage
  - Peer reviewed journal article – 30 September 2021
  - Technical Report – 31 October 2021

# TASK 44: Flexible Bioenergy and System Integration

## Overview of the Task

Task 44 contributes to the development and analysis of bioenergy solutions that can provide flexible resources for a low-carbon energy system. The objective is to improve understanding on the types, quality and status of flexible bioenergy, and identification of barriers, framework conditions and future development needs in the context of the entire energy system (power, heat and transport).

Bioenergy has some unique properties that can address many of the problems related to the ongoing transition to a low-carbon energy system. When sustainably sourced and used, bioenergy can (i) operate as a key element in the coupling of different energy sectors; (ii) provide low-carbon energy to complement wind and solar (residual load and grid stabilisation); (iii) store electricity chemically into fuels to enable more efficient use of wind and solar; (iv) provide sustainable fuels for sectors where other decarbonisation options are not available or exceedingly expensive; (v) provide high temperature heat to industry, and low temperature heat for buildings (and sanitary water) during dark and cold seasons; (vi) coproduce heat, electricity, fuels and other products in a single high-efficiency processing plant. Achieving these objectives requires a fundamental shift in the way bioenergy is being used, but there is currently a limited understanding on the details of such change.

Task activities in the current triennium are divided into four work packages that together address the main objectives of the Task:

WP1 – Flexible bioenergy concepts for supporting low-carbon energy systems,

WP2 – Acceleration of implementation,

WP3 – System requirements for bioenergy concepts, and

WP4 – Inter-Task projects and collaborative projects.

These actions involve collecting, sharing, and analysing existing information in the above mentioned areas. The results are disseminated through workshops, webinars, reports and databases.

*Participating countries:* Australia, Austria, Finland, Germany, Ireland, The Netherlands, Sweden, Switzerland and the United States of America

**Task Leader:** Elina Mäki, VTT Technical Research Centre of Finland Ltd., Finland

**Assistant Task Leader:** Prof Dr-Ing Daniela Thrän, Helmholtz Centre for Environmental Research – UFZ, Germany

**Operating Agent:** Aila Maijanen, Business Finland, Finland



The Task Leader directs and manages the work programme, assisted by Assistant Task Leader. A National Team Leader from each country is responsible for coordinating national participation in the Task.

For further details on Task 44, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task44.ieabioenergy.com/>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## **Progress in R&D**

### **Task Meetings and workshops**

In 2020 Task 44 organised five internal meetings. The internal meetings were used to initiate, coordinate and monitor progress in different Task activities and to plan new activities. The first meeting was organised in January 2020 in Graz, while the others were held as virtual meetings due to the prevailing COVID-19 situation.

Task 44 organised or participated in three workshops in 2020. In January 2020 Task 44 organised a workshop on Flexible Bioenergy in conjunction with the Central European Biomass Conference in Graz, Austria. The content for the WS was planned and executed in collaboration with the IEA Bioenergy's "technical" Tasks and proposed approaches covered combustion, gasification, pyrolysis as well as biogas based solutions. The presenters discussed the needs of future energy systems that operate with increased variability and the way in which the flexibility offered by bioenergy could meet those demands. In April 2020 an inter-TCP webinar on Integrated Energy Systems was organised by the IEA. The aim of the webinar was to discuss how to best model future energy system flexibilities from different options. Task 44 presented an overview on flexibility options available for balancing the demand and supply. Task 39 and Task 44 co-organised a workshop on the role of biorefineries in grid balancing in November 2020. Several concepts to produce heat, electricity, fuels and other products in single high-efficiency plants are under development. The aim of the WS was to provide an overview on the flexibility options, get insights into concepts for more flexible biofuels and biopower production, and discuss the challenges and success factors to implement the concepts in energy systems with high shares of variable renewable energy production.

### **Work Programme and Outputs**

Task objectives are advanced through the following work packages

#### **WP 1 – Flexible bioenergy concepts for supporting low-carbon energy systems**

focusses on the assessment and categorisation of flexible bioenergy technologies. The Task prepared a questionnaire for gathering information on different flexibility concepts. The technical descriptions were filled in together by "technical" Tasks 32, 33, 34 and 39, and Task 44. Additional contacts have been identified through Task NTLs. The final report will be published in the 1st quarter of 2021 and results will be disseminated in a webinar in March 2021.

**WP 2 – Acceleration of implementation** focusses on policy and market analysis of flexible bioenergy through country cases. All contracting parties participating in the Task have been covered in addition to a few additional countries. A questionnaire for gathering information was prepared and responses have been evaluated. The final report will be published during the 1st quarter of 2021 and results will be disseminated in a webinar in March 2021. As a follow-up action Task 44 will start collecting Best Practice examples on flexible bioenergy concepts and their implementation on the Task 44 website during 2021.

**WP 3 – System requirements for bioenergy concepts** focusses on reaching out to other IEA TCPs to foster discussion on flexible energy system. Initial contacts were made during the 4th quarter of 2019 and an inter-TCP workshop was organised by the IEA virtually on 6 April 2020.

#### **WP4 – Inter-Task projects and collaborative projects**

The Task was involved in the Inter-Task project “The Role of Bioenergy in a WB2/SDG world” and is currently involved in the Inter-Task project “Renewable gas”.

#### **Website**

The Task website (<http://task44.ieabioenergy.com>) operating difficulties were resolved in January 2020. During 2020 the website has been updated with relevant content.

#### **Collaboration with Other Tasks/Organisations/Networking**

One collaborative activity of Task 44 has been participation in an Inter-Task project “The Role of Bioenergy in a WB2/SDG world”. The IEA Bioenergy Tasks worked together in this project regarding deployment (Task 40), resource potential and supply chains (Task 43), flexibility and system integration (Task 44) as well as sustainability (Task 45 – project lead). Many scenarios that meet the target of limiting global warming to well below 2 degree (WB2) include a significant and increasing contribution of biomass-based energy supply, but vary concerning the potential and usage of biomass at global as well as regional scale. To identify and disseminate strategies for bioenergy implementation that contribute positively to a societal transition towards the WB2 target, while simultaneously contributing to other SDG objectives, the Inter-Task project assessed the role of bioenergy in these scenarios. That also included assessment of trade-offs and concerns about possible negative impacts of bioenergy expansion, mitigation of these challenges and the identification of synergies between bioenergy deployment and SDG implementation. Furthermore interactions of biomass uses with other opportunities for land-based mitigation, such as afforestation, reforestation, and biochar production and use to enhance carbon storage in vegetation and soils were included in the integrated assessment approach. The report on a workshop of the Inter-Task ‘The Role of Bioenergy in a WB2/SDG world’ was published in July 2020.

Task 44 has also participated in meetings organised by the Inter-Task project “Renewable gas”.

## Deliverables

The following milestones were achieved in 2020. Organising two Task meetings and three shorter Task progress meetings. Hosting a workshop on Flexible Bioenergy. Contributing to inter-TCP webinar on Integrated Energy Systems, organised by the IEA. Co-organising a workshop on the Role of biorefineries in grid balancing. The Task provided an article on bioenergy flexibility to the IEA Bioenergy newsletter. The Task maintained and updated a [LinkedIn group on Flexible Bioenergy](#)<sup>23</sup> and produced progress reports for the ExCo.

## TASK 45: Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy

### Overview of the Task

The Task works on identifying and addressing critical issues related to the climate and other sustainability effects of bioenergy and biobased products and systems. The objective is to promote sound development for bioenergy as an integral component of the overall bioeconomy. One key goal is to increase understanding of the environmental, social and economic impacts of producing and using biomass for bioenergy, within the broader bioeconomy. A central aspect concerns the development and application of science-based methodologies and tools for assessing the effects of biobased systems.

The Task will identify and address issues from several points of view (e.g., product/project level; regional, national and global levels; specific sectors or subsectors and applications) and will consider commercial, near- commercial and emerging/conceptual systems. An important point of departure is that bioenergy systems are commonly components in value chains or production processes that also produce other biobased products (including food, feed and fiber) and they may be shaped to address specific needs such as organic waste management, or water and soil protection.

Three Work Packages (WPs) represent the main elements to achieve the Task objectives:

- WP1 – Metrics, methods, and tools for assessing climate change effects of bioenergy
- WP2 – Metrics, methods and tools for assessing sustainability effects of bioenergy (excluding climate change effects)
- WP3 – Sustainability stakeholders and implementation approaches (governance)

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<sup>23</sup> <https://www.linkedin.com/groups/13682476/>

The work in the Task is relevant for a broad group of stakeholders including academia, commercial interests and private sector producers, exporters, importers, financing organisations, governments, policymakers, civil society organisations and others such as IRENA, GBEP and FAO. The Task also has high ambitions concerning scientific publishing and communication with the scientific community.

*Participating countries:* Australia, Brazil, China, Denmark, Finland, France, Germany, Ireland, The Netherlands, Norway, Sweden, the United Kingdom and the United States of America

**Task Leader:** Professor Göran Berndes, Chalmers University of Technology, Sweden

**Work Package leaders:** Annette Cowie, NSW Department of Primary Industries, Australia, Floor van der Hilst, Copernicus Institute, The Netherlands, Uwe Fritsche, International Institute for Sustainability Analysis and Strategy (IINAS), Germany

**Task Secretary:** Gustaf Egnell, Swedish University of Agricultural Sciences, Sweden

**Operating Agent:** Mr Jonas Lindmark, Swedish Energy Agency (STEM), Sweden

The Task Leader directs and manages the work programme, assisted by sub-Task leaders for specific areas. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 45, please refer to Appendices 2, 4, 5 and 6; the Task website (<http://task45.ieabioenergy.com/>) and the IEA Bioenergy website ([www.ieabioenergy.com](http://www.ieabioenergy.com)) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and workshops

In 2020, Task 45 has carried out monthly remote meetings for Task members, to exchange information, monitor progress of ongoing activities and to plan future activities. No face-to-face meetings have taken place due to the pandemic.

Task 45 organised a virtual workshop on forests and the climate, May 13-14, 2020.

Task 45 organised a virtual workshop series "RED2 implementation and beyond", together with Task 40, ERIP Bioenergy and Sustainable Biomass Partnership. The series consisted of five workshops:

- workshop 1: Ongoing developments in EU Member States and the role of REDII (October 5, 2020)
- workshop 2: Biomass supply from in- and outside the EU (October 19, 2020)
- workshop 3: How to ensure that using biomass maintains and protects biodiversity (November 9, 2020)

- workshop 4: Carbon, forests and climate impacts of woody biomass (November 30, 2020)
- workshop 5: Social impacts of woody biomass (January 20, 2021)

The Brazilian Task 45 team (lead by Glaucia Souza) were part of the organisation committee for the international BBEST 2020/BioFuture Summit II conference. The conference was originally planned to take place in Sao Paulo March 30 – April 1 but was transitioned into a series of virtual events (webinars):

- The biofuture principles for post-COVID recovery: an agenda for Brazil (August 13, 2020)
- Biofuel technologies: the sustainability challenge (August 20, 2020)
- Building back better with bio: Biofuture principles for post-COVID recovery and acceleration (October 15, 2020)
- Biofuels use: engines, stationary and aviation applications (October 22, 2020)
- Virtual conference: BBEST2020/BioFuture Summit II (November 30 – December 2, 2020)

The final stage is a virtual conference, May 24-26<sup>th</sup>, 2021, where T45 organises a session “Governing a sustainable bioeconomy: assessment and monitoring”, and contributes to panel discussions. It can be concluded already that the organisers have successfully transitioned from the originally planned physical conference into a highly appreciated series of virtual events.

The international conference on negative CO<sub>2</sub> emissions, co-organised with IEA IETS, IEA GHG and Chalmers University of Technology, was postponed from May 2020 to Q3 or Q4 2021.

## **Work Programme and Outputs**

The objective of the Task is to promote sound development for bioenergy as an integral component of the overall bioeconomy. This objective will be achieved by providing analyses that support well-informed decisions by landowners, communities, businesses, governments and others. A central aspect concerns the development and application of science-based methodologies and tools for assessing the effects of biobased systems to contribute to available knowledge and experiences. The Task builds on previous work in IEA Bioenergy Tasks and inter-Task activities in the 2016-18 triennium and previous triennia that have considered issues of sustainability assessment and governance.

The Task works within a dynamic area undergoing rapid change and the work programme is shaped to provide flexibility and capacity to respond constructively to emerging science and policy developments in the countries participating in the Task, as well as international developments. Ad hoc groups are formed within the Task to respond promptly to requests from ExCo or other key international organisations. The ad hoc groups also provide expert scientific and technical review of relevant reports and proposals, as appropriate. This will enable the Task to establish a position and provide input to important policy processes as opportunities arise and thereby support policy development concerning topics covered by the Task.

The Task also seeks to inform and address misconceptions about bioenergy in a wider sense, since public perceptions of bioenergy will determine the future role of the bioenergy industry; unless there is acceptance by academics, NGOs and the general public, policy support for bioenergy will diminish, and the climate-change mitigation potential of bioenergy will not be realised.

The three WPs represent the main elements to achieve the general Task objectives. Specific focus areas and associated work and activities are outlined for each WP:

WP1 builds on the work of Task 38 and its predecessor Tasks, that operate at the science- policy interface, contributing balanced and science-based input to the ongoing debate on the climate effects of bioenergy. These Tasks have contributed to i) the development of methods for reporting and accounting for national greenhouse gas inventories under the UNFCCC and Kyoto Protocol, ii) development of rules for project level accounting for emissions trading and product certification, and iii) national policies on renewable energy.

WP1 aims to build the body of knowledge to equip the community of practice to undertake well-informed studies on the climate effects of bioenergy. We are working to develop, demonstrate, refine and promote metrics, methods and tools to quantify climate effects of bioenergy. Methods applied include a hybrid approach that combines product- focused LCA and integrated assessment modelling (including land use and energy systems) and aims to ensure that each method informs the other. WP1 is also preparing a guide to the many tools, including calculators, models and databases, available to support carbon footprint and LCA assessment. No single approach can provide full understanding; using many different approaches is expected to provide useful and robust insights.

The objective of WP2 is to inform academia, industry, policymakers and other stakeholders on the potential sustainability effects of bioenergy and the possible contribution of bioenergy deployment to the SDGs. To this end, WP2 will contribute to, and combine ongoing efforts on, developing and demonstrating metrics, methods and tools to quantify and qualify environmental, social, and economic effects of bioenergy systems, to support multi- stakeholder processes that seek to balance sustainability trade-offs and identify opportunities to realise synergies between several SDGs. While the focus is on bioenergy systems, the work is also relevant for many other types of biobased products. As many of the potential effects of bioenergy are related to land use and LUC, biomass production in managed landscapes is a focus area in this work package.

The role of WP3 relates to the statement in the IEA Bioenergy Roadmap that *“Making the transition to a low-carbon energy system will require massive investment (...) The principal barriers to investment in bioenergy technologies relate to the risks as perceived by potential developers and, in particular, by other investors (...) The additional risks associated with the need to provide for the long-term supply of fuels or feedstock at an affordable cost and which meet appropriate sustainability criteria, are a significant complicating factor for financing bioenergy projects.”*

WP3 aims to create broader support among stakeholders for sustainable bioenergy as an integral part of the broader bioeconomy, as outlined in the IEA Bioenergy Roadmap, through three interrelated lines of activities:

- (i) identifying perspectives of stakeholder and promoting exchange of views among relevant stakeholders to bridge international and local scales;
- (ii) suggesting ways to make indicators and tools provided by WP1 and WP2 useful for implementation procedures and instruments (governance);
- (iii) engaging with identified stakeholders to discuss barriers and risks associated with bioenergy investment, and identifying respective de-risking approaches, and support the implementation of such procedures and instruments.

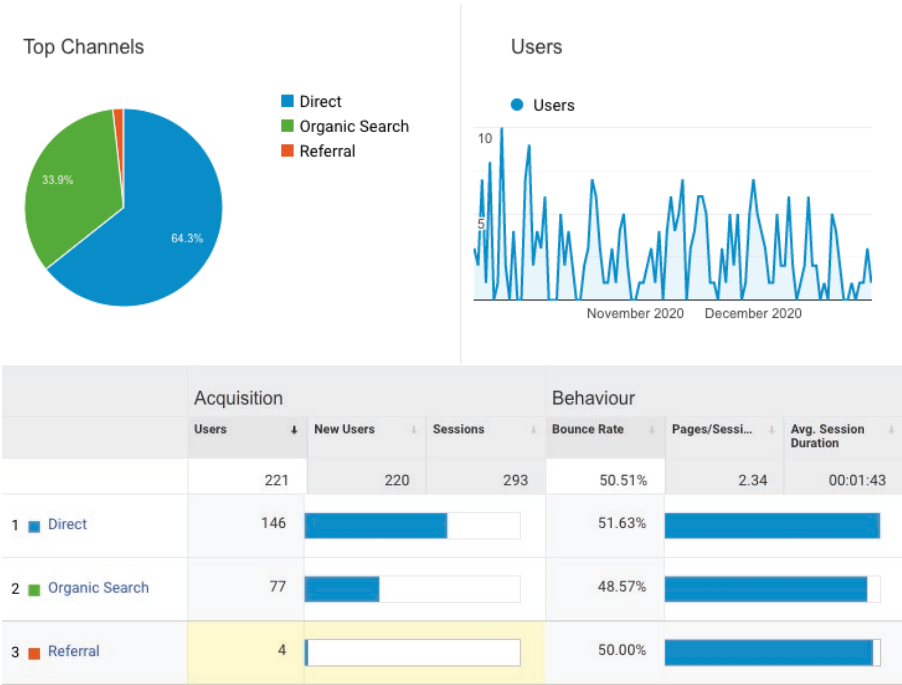
Key activities in WP3 so far have been the (continuous) “mapping” of relevant actors and their positions towards bioenergy, and the participation in various stakeholder events related to bioenergy/bioeconomy governance (with a focus on EU activities).

Furthermore, WP3 is active in the preparation of a follow-up to the 2019 Utrecht workshop.

**Website**

The Task website (<http://task45.ieabioenergy.com/>) primarily targets an external audience and information concerning the Task 45 work is available and updated regularly. Considering that this is a new Task a large part of output from the Task work is yet to come.

Since September 21 the webpage is set to allow for google analytics. The period from September 21 to December 31, 2020 shows a moderate traffic on our webpage.



Website statistics (<http://task45.ieabioenergy.com/>) from September 21 to December 31 2020

The website has not yet been updated in line with changes of the IEA Bioenergy website. However, we have confirmed that the Task will cover the cost for the conversion and based on e-mail correspondence expect that the conversion to take place in Q1 2021.



## Collaboration with Other Tasks/Organisations/Networking

- Cooperation with Tasks 37, 39, 40, 43 and 44 in inter-Task projects:
  - Role of Bioenergy in a well-below 2 °C/SDG world
  - Renewable Gas
  - BECCS/U
  - BioHubs
- Cooperation with GBEP, IRENA, and Biofuture Platform
- Work on Forest Landscape Restoration – Bioenergy (with Task 40, GIZ, GBEP, IRENA and UNCCD).
- Cooperation with European Biogas Association (in Renewable Gas Inter-Task project), and Bioenergy Europe for overall Task work.
- Cooperation with IEA-GHG, IEA-IETS and Global Carbon Project related to the International Conference on Negative CO<sub>2</sub> Emissions
- GHG Protocol (WRI & WBCSD): Participation in Technical Working Group and Advisory Committee associated with work to expand the GHG protocol to cover land use issues

## Deliverables

The following milestones were achieved in 2020:

- Workshop, Forests and the climate
- Workshop series, “RED2 implementation and beyond”. In total 5 workshops
- BBEST 2020/BioFuture Summit II virtual events
- IEA Bioenergy publication: Roles of bioenergy in energy system pathways towards a “well-below-2-degrees-Celsius (WB2)” world
- IEA Bioenergy publication: The use of forest biomass for climate change mitigation: dispelling some misconceptions
- Publications in scientific journals

## APPENDIX 1: TASK PARTICIPATION IN 2020

TASK	AUS	AUT	BEL	BRA	CAN	CN	CRO	DEN	EST	FIN	FRA	GER	IND	IRE	ITL	JAP	KOR	NEL	NZE	NOR	SA	SWE	SWI	UK	USA	EC	Total
32		•			•		⊗					•				•		•		•		•					9
33		•										•			•		⊗					•		•			7
34					•		•			•		⊗					•	•	•	•		•			•		9
36	•											•		•	•					•	•	⊗			•		8
37	•	•			•	•	•	•	•	•	•	•		⊗	•		•	•	•	•		•		•			18
39	•	•		•	•		•	•				•	•	•		•	•	•	•	•		•			•	•	16
40		•					•	•				⊗				•	•	•				•			•		8
42	•	•					•	•				•	•	•	•		⊗					•					8
43	⊗		•		•					•		•										•			•		8
44	•	•								⊗		•		•				•				•			•		9
45	•			•		•	•	•		•	•	•		•				•		•		⊗		•	•		13
<b>Total</b>	<b>7</b>	<b>7</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>2</b>	<b>1</b>	<b>7</b>	<b>1</b>	<b>5</b>	<b>2</b>	<b>11</b>	<b>1</b>	<b>6</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>9</b>	<b>2</b>	<b>6</b>	<b>1</b>	<b>11</b>	<b>3</b>	<b>3</b>	<b>8</b>	<b>1</b>	<b>113</b>

⊗ = Operating Agents

• = Participant

## APPENDIX 2: BUDGET IN 2020 – SUMMARY TABLES

### Budget for 2020 by Member Country (US\$)

Contracting Party	ExCo funds	Task funds	Total
Australia	13,700	108,000	121,700
Austria	13,700	106,500	120,200
Belgium	8,700	30,000	38,700
Brazil	9,700	44,000	53,700
Canada	11,700	77,000	88,700
China	8,700	29,000	37,700
Croatia	7,700	15,000	22,700
Denmark	13,700	109,500	123,200
Estonia	7,700	14,000	21,700
Finland	11,700	77,000	88,700
France	8,700	29,000	37,700
Germany	17,700	171,000	188,700
India	7,700	15,000	22,700
Ireland	12,700	93,000	105,700
Italy	10,700	63,000	73,700
Japan	9,700	45,000	54,700
Korea	8,700	29,000	37,700
Netherlands	15,700	139,500	155,200
New Zealand	8,700	33,000	41,700
Norway	12,700	93,500	106,200
South Africa	7,700	16,500	24,200
Sweden	17,700	171,000	188,700
Switzerland	9,700	44,000	53,700
UK	9,700	44,000	53,700
USA	14,700	124,500	139,200
European Commission	7,700	15,000	22,700
<b>Total</b>	<b>287,200</b>	<b>1,736,000</b>	<b>2,023,200</b>

## BUDGET IN 2020 – SUMMARY TABLES

### Budget for 2020 by Task (US\$)

Task	Number of participants	Annual contribution per participant	Total Task funds
Task 32: Biomass Combustion	9	15,000	135,000
Task 33: Gasification of Biomass and Waste	7	15,000	105,000
Task 34: Direct Thermochemical Liquefaction	9	18,000	162,000
Task 36: Material and Energy valorisation of waste in a Circular Economy	8	16,500	132,000
Task 37: Energy from Biogas	18	14,000	252,000
Task 39: Commercialising Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks	16	15,000	240,000
Task 40: Deployment of biobased value chains	8	15,000	120,000
Task 41: Bioenergy Systems Analysis <sup>24</sup>	3		
Task 42: Biorefining in a Circular Economy	8	17,500	140,000
Task 43: Sustainable biomass supply integration for bioenergy within the broader bioeconomy	8	15,000	120,000
Task 44: Flexible Bioenergy and System Integration	9	15,000	135,000
Task 45: Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy	13	15,000	195,000
<b>Total</b>			<b>1,736,000</b>

<sup>24</sup> In 2020 the European Commission contributed US\$70,000 to Task 41 Project 11 'Renewable Gas – Hydrogen in the grid'. Other participants contributed in-kind support.

## **APPENDIX 3: CONTRACTING PARTIES**

Bioenergy Australia (Forum) Ltd

The Republic of Austria

The Government of Belgium

The National Department of Energy Development of the Ministry of Mines and Energy (Brazil)

Natural Resources Canada

Energy Research Institute ERI (China)

The Energy Institute "Hrvoje Pozar" (Croatia)

The Ministry of Transport and Energy, Danish Energy Authority

The Ministry of Economic Affairs and Communications (Estonia)

Commission of the European Union

Innovation Funding Agency Business Finland

L'Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME) (France)

Federal Ministry of Food and Agriculture (Germany)

Ministry of Petroleum & Natural Gas (India)

The Sustainable Energy Authority of Ireland (SEAI)

Gestore dei Servizi Energetici – GSE (Italy)

The New Energy and Industrial Technology Development Organization (NEDO) (Japan)

Ministry of Knowledge Economy, the Republic of Korea

NL Enterprise Agency (The Netherlands)

SCION (New Zealand)

The Research Council of Norway

South African National Energy Development Institute (SANEDI)

Swedish Energy Agency

Swiss Federal Office of Energy

Department of Business, Energy and Industrial Strategy (United Kingdom)

The United States Department of Energy

## APPENDIX 4

### The Executive Committee

Final Minutes of the ExCo85 Virtual meeting, April 2020.

Final Minutes of the ExCo86 Virtual meeting, October 2020.

IEA Bioenergy Bulletin March 2020

IEA Bioenergy News Volume 32(1), July 2020

IEA Bioenergy Bulletin September 2020

IEA Bioenergy News Volume 32(2), December 2020

IEA Bioenergy Update. Number 67. Biomass & Bioenergy, Volume 133

IEA Bioenergy Update. Number 68. Biomass & Bioenergy, Volume 141

IEA Bioenergy Update. Number 69. Biomass & Bioenergy, Volume 145

**Anon.** Developing business models for efficient use of biomass. Summary and Conclusions from the IEA Bioenergy ExCo84 Workshop. IEA. Bioenergy ExCo:2020:01

**Anon.** IEA Bioenergy Annual Report 2019. IEA Bioenergy ExCo:2020:02.

**Thrän, Daniela et al.** Roles of bioenergy technologies in energy system pathways towards a WB2 world – Report from an Inter-Task project workshop, Berlin, 25 November 2019. IEA Bioenergy ExCo:2020:03.

All publications listed are available on the IEA Bioenergy website: [www.ieabioenergy.com](http://www.ieabioenergy.com)

## TASK 32

### Task documents List

- 2019 annual report
- Minutes of the Task meeting in Graz in January
- Progress report for ExCo86
- Annual report 2020 (this report).

### Publications List

Please visit the Task website and the inter-Task project website for the reports and workshop presentations:

- <http://task32.ieabioenergy.com/>
- <https://itp-hightemperatureheat.ieabioenergy.com/>
- <https://www.ieabioenergy.com/blog/publications/new-publications-case-studies-illustrating-how-bioenergy-is-used-in-industry-to-provide-high-temperature-heat/>

## TASK 33

### Task documents List

- Minutes of Task online meeting in June
- Business slides of online meeting in June
- Minutes of Task online meeting in November (pending approval)
- Business slides of online meeting in November

### Publications List

- Inter-Task Project: Industrial heat case study – Gasification of paper reject to displace natural gas usage in a pulp and paper process

Please visit the Task website for the reports and original presentations:

<http://task33.ieabioenergy.com/>

<https://itp-hightemperatureheat.ieabioenergy.com>

## TASK 34

### Task documents List

- Minutes from online videoconferences.
- Progress report for TCP Bioenergy ExCo86

### Publications List

- Country Report 2019 (Finland, Germany, The Netherlands, Sweden):  
<http://task34.ieabioenergy.com/country-report-2019/>
- Brochure explaining principles of direct thermochemical liquefaction:  
<https://task34.ieabioenergy.com/dtl-brochure/>
- Report showcasing commercial and operational facilities in the field of direct thermochemical liquefaction: <https://task34.ieabioenergy.com/dtl-commercialization-report/>
- Case study on the use of fast pyrolysis bio-oil in an industrial steam boiler:  
[https://itp-hightemperatureheat.ieabioenergy.com/wp-content/uploads/sites/14/2020/10/CS3\\_T34\\_-High-temperature-heat-from-pyrolysis-oil-final.pdf](https://itp-hightemperatureheat.ieabioenergy.com/wp-content/uploads/sites/14/2020/10/CS3_T34_-High-temperature-heat-from-pyrolysis-oil-final.pdf)
- Scientific article to report from the latest Round Robin (available open access):  
<https://pubs.acs.org/doi/10.1021/acs.energyfuels.0c02090>

Please visit the Task website for the reports and original presentations:

<http://task34.ieabioenergy.com/>

## TASK 36

### Task documents List

- Minutes from four Task meetings
- Progress report to ExCo

### Publications List

- Summary report from the workshop on chemical recycling of waste
- Presentations and a workshop report from the webinar about valorisation of fly ash from Waste to energy plants
- Presentations in the Green Chemistry & Engineering conference that were held as an online event (originally to be held in Seattle in June 2020), June 2020 (not available at Task website due to copyrights)



- Contribution to the IEA Bioenergy Newsletter
- Report: Trends in the use of solid recovered fuels, May 2020
- Report: Trends and drivers in alternative thermal conversion of waste, September 2020
- Case study: Waste-to-Energy for the production of steam for paper production, November 2020
- Progress reports to ExCo

Please visit the Task website for the reports and original presentations:

<http://task36.ieabioenergy.com/>

## TASK 37

### Task documents List

- Minutes from Task 37 Meeting, Toronto, Canada, 25-26 March 2020
- Minutes from Task 37 Meeting Switzerland, 23-25 October 2020

### Publications List

- Three technical reports
  - *Wellisch, M., Green, J., McCabe, B., Rasi, S., Siemens, W., Ammenberg, J., Liebetrau, J., Bochmann, G., Murphy, J.D. (2020). Drivers for Successful and Sustainable Biogas Projects: International Perspectives – Report of a symposium held on March 26, 2020. Green, J., Wellisch, M., Szlachta, P., Murphy, J.D. (Ed.) IEA Bioenergy Task 37, 2020: 5*
  - *Liebetrau, J., Kornatz, P., Baier, U., Wall, D., Murphy, J.D. (2020). Integration of Biogas Systems into the Energy System: Technical aspects of flexible plant operation, Murphy, J.D (Ed.) IEA Bioenergy Task 37, 2020:8*
  - *McCabe, B., Kroebe, R., Pezzaglia, M., Lukehurst, C., Lalonde, C., Wellisch, M., Murphy, J.D. (2020). Integration of Anaerobic Digestion into Farming Systems in Australia, Canada, Italy, and the UK. Lalonde, L., Wellisch, M., Murphy, J.D (Ed.) IEA Bioenergy Task 37, 2020: 8*

- Four case stories
  - Green methanol from biogas in Denmark a versatile transport fuel, November 2020
  - Deep bedding: a co-digestion substrate with significant potential Danish experience with handling and feeding deep bedding, November 2020
  - Production of food grade sustainable CO<sub>2</sub> from a large biogas facility GO'CO<sub>2</sub> at The Korskro Biogas Plant, Denmark, November 2020
  - Compact and Automated on-farm Biogas Production in Southwestern Ontario, Canada, April 2020 Case Story Canada
- IEA Bioenergy Task 37 – Country Reports Summaries 2019 published in March 2020 available from: <http://task37.ieabioenergy.com/country-reports.html>. Four further individual country report presentations from Germany, Norway, Sweden and the UK were published in 2020 and are available <http://task37.ieabioenergy.com/country-reports.html>
- Two workshops
  - Six IEA Bioenergy delegates presented at the BioSweet Conference: Biomass to energy in Switzerland: Achievements and Perspectives on the 10th September 2020, available online at: <http://task37.ieabioenergy.com/workshops.html>
  - IEA Bioenergy presented seven 20 minute presentations at the Canadian Biogas Association Conference which had 200 participants. These were uploaded to: <http://task37.ieabioenergy.com/workshops.html>
- Two webinars
  - IEA Bioenergy webinar entitled "Integration of Biogas Systems into the Energy System" presented by Prof Jerry D Murphy and Dr Jan Liebetrau was held on January 21. The audience included for 367 people from 54 countries. The webinar was recorded and is available on line at: <https://t.co/UnykedOCTF?amp=1>
  - Australia Bioenergy entitled "Decarbonising the gas network-potential, projects and policies: <https://cdn.revolutionise.com.au/cups/bioenergy/files/iaxdenknz2kvm7sd.pdf>
- **Newsletters:** 12 issues in 2020

Please visit the Task website for the reports and original presentations:

<http://task37.ieabioenergy.com/about-task-37.html>

## TASK 39

### Task documents List

- Minutes/Agenda/Presentations from three virtual business meetings
- Progress report for ExCo85
- Progress report for ExCo86
- Ebadian (Ed.) IEA Bioenergy Task 39 Newsletter Vol. 54, May 2020.
- Ebadian (Ed.) IEA Bioenergy Task 39 Newsletter Vol. 55, September 2020.
- Ebadian (Ed.) IEA Bioenergy Task 39 Newsletter Vol. 56, December 2020.

### Publications List

Please visit the Task website for the reports and original presentations:

<http://task39.ieabioenergy.com/publications/>

## TASK 40

### Task documents List

- Task 40 Newsletter June 2020 [https://task40.ieabioenergy.com/wp-content/uploads/sites/6/2020/06/Task-40\\_Newsletter-June-2020.pdf](https://task40.ieabioenergy.com/wp-content/uploads/sites/6/2020/06/Task-40_Newsletter-June-2020.pdf)

### Publications List

Olsson, O. Bang C., Borchers M., Hahn A., Karjunen H., Thrän D. & Tynjälä T. (2020) *Deployment of BECCS value chains: technological pathways, policy options and business models*, IEA Bioenergy Task 40 Report <https://task40.ieabioenergy.com/wp-content/uploads/sites/6/2020/06/IEA-Bioenergy-Task-40-Deployment-of-BECCS-Value-Chains.pdf>

Schipfer, Fabian; Kranzl, Lukas; Olsson, Olle & Lamers Patrick (2020) *European residential wood pellet trade and prices dataset*, Data in Brief 32: 106254 <https://doi.org/10.1016/j.dib.2020.106254>

Schipfer, Fabian; Kranzl, Lukas; Olsson, Olle & Lamers Patrick (2020) *The European wood pellets for heating market – Price developments, trade and market efficiency*, Energy212 <https://doi.org/10.1016/j.energy.2020.118636>.

Please visit the Task website for the reports and webinar presentations:

<http://task40.ieabioenergy.com/>

## TASK 42

### Task documents List

- Minutes from the 32<sup>nd</sup> Task 42 progress meeting, Skype for Business, 20 February 2020.
- Minutes from the 33<sup>rd</sup> Task 42 progress meeting, Skype for Business, 7 May 2020.
- Minutes from the 34<sup>th</sup> Task 42 progress meeting, Skype for Business, 25 June 2020.
- Minutes from the 35<sup>th</sup> Task 42 progress meeting, Skype for Business & MS Teams, 15-16 October 2020.
- Progress report for ExCo86, MS teams, October 2020.

### Publications List

Bell, G., 2020. Alternative and sustainable carbon sources as substitutes for metallurgical coal. Power Point presentation at NWBC2020 online conference.

Jong, E. de, H. Stichnothe, G. Bell & H. Jørgensen, 2020. Bio-Based Chemicals: A 2020 Update'. IEA Bioenergy, Task 42, 2020:01, 78 pp.

Jong, E. de, H. Stichnothe, G. Bell & H. Jørgensen, 2020. Biobased Chemicals: Current status and future outlooks. Power Point presentation at NWBC2020 online conference.

Lindorfer, J., M. Mandl & F. Hesser, 2020 TEE assessment of integrated biorefineries. Power Point presentation at NWBC2020 online conference.

Mossberg, J., 2020. Biorefineries in the Nordic context. Power Point presentation at NWBC2020 online conference.

Please visit the Task website for the reports and original presentations:

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

## TASK 43

### Task documents List

- Minutes from the Task meeting, September 2019.
- Minutes from the Task meeting, October 2019.
- Minutes from the Task meeting, December 2019.
- Minutes from the Task meeting, February 2020.
- Minutes from the Task meeting, May 2020.
- Minutes from the Task meeting, June 2020.
- Minutes from the Task meeting, September 2020.
- Minutes from the Task meeting, November 2020.

## Publications List

TR2019-01 – Economic and Social Drivers for Optimal Bioenergy Implementation (<http://task43.ieabioenergy.com/wp-content/uploads/2019/02/TR2019-01f.pdf>)

TR2019-02 – Report on expert workshop on variable demand for biofuels (<https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2019/03/TR2019-02.pdf>)

TR2019-03 – Forest biomass as part of silvicultural systems and its potential contribution to the lowcarbon transition of heavy industries ([https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2019/05/Report\\_Forest-biomass-procurement-as-part-of-larger-forestry-and-industrial-systems-Part-1\\_compressed.pdf](https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2019/05/Report_Forest-biomass-procurement-as-part-of-larger-forestry-and-industrial-systems-Part-1_compressed.pdf))

TR2019-04 – Governance of sustainable forest management and bioenergy feedstock harvesting in Ontario, Canada (<https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2019/06/TR2019-04r1.pdf>)

TR2019-05 – Using “BEAST” to support the local dialogue on lignocellulosic cropping for energy use, climate protection and sustaining ecosystem services ([https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2019/05/TASK43-BEASTrev\\_fin\\_Formatted-2.pdf](https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2019/05/TASK43-BEASTrev_fin_Formatted-2.pdf))

TR2019-06 – Attractive Systems for Bioenergy Feedstock Production in Sustainably Managed Landscapes ([http://task43.ieabioenergy.com/wp-content/uploads/2019/07/Contributions-to-the-Call\\_final.pdf](http://task43.ieabioenergy.com/wp-content/uploads/2019/07/Contributions-to-the-Call_final.pdf))

TR2019-07 – Sustainable Landscape Management for Bioenergy and the Bioeconomy ([http://task43.ieabioenergy.com/wp-content/uploads/2019/07/FAO\\_T43\\_workshop\\_REPORT\\_final.pdf](http://task43.ieabioenergy.com/wp-content/uploads/2019/07/FAO_T43_workshop_REPORT_final.pdf))

TR2019-08 – Dry matter losses during biomass storage ([http://task43.ieabioenergy.com/wp-content/uploads/2020/01/EIA-Dry-Matter-Loss\\_Final.pdf](http://task43.ieabioenergy.com/wp-content/uploads/2020/01/EIA-Dry-Matter-Loss_Final.pdf))

TR2020-01 – Bio-hubs as keys to successful biomass supply integration for bioenergy within the bioeconomy ([https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2020/04/TR2020\\_01-Sopron\\_T43\\_workshop\\_REPORT\\_final.pdf](https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2020/04/TR2020_01-Sopron_T43_workshop_REPORT_final.pdf))

TR2020-02 – Bio-hubs as Keys to Successful Biomass Supply for the Bioeconomy (Canada) ([https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2020/07/Canadian-Bio-hubs-Workshop-Report-Task-43-FINAL\\_LP-002.pdf](https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2020/07/Canadian-Bio-hubs-Workshop-Report-Task-43-FINAL_LP-002.pdf))

TR2020-03 – Novel regional and landscape-based approaches to govern sustainability of bioenergy and biomaterials supply chains (<https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2020/09/Novel-regional-and-landscape-based-approaches-to-govern-sustainability-of-bioenergy-and-biomaterials-supply-chains.pdf>)

TR2020-04 – Sustainability Governance of Canada’s Agriculture-based Bioeconomy (<https://task43.ieabioenergy.com/wp-content/uploads/sites/11/2020/10/IEA-Bioenergy-Sustainability-Gov-Ag-Bioeconomy-full-copy-Final-Oct-26-2020.pdf>)

## TASK 44

### Task documents List

- Minutes from the Task meeting in Graz, Austria, January 2020.
- Minutes from the Task progress meeting, virtual, March 2020.
- Minutes from the Task progress meeting, virtual, June 2020.
- Minutes from the Task progress meeting, virtual, September 2020.
- Minutes from the Task meeting, virtual, November 2020.
- Presentations from the Flexible bioenergy workshop, Graz, Austria, January 2020.
- Presentations from the inter-TCP webinar on Integrated Energy Systems, virtual, April 2020.
- Presentations from the Role of biorefineries in grid balancing workshop, virtual, November 2020.
- Progress report for Exco85, virtual meeting, April 2020.
- Progress report for ExCo86, virtual meeting, October 2020.

### Publications List

Please visit the Task website for the reports and original presentations:

<http://task44.ieabioenergy.com/>

## TASK 45

### Task documents List

Minutes from the Task planning meetings are found on the Task 45 OneNote pages. The Task Secretary provides information about the minutes: please contact [Gustaf.Egnell@slu.se](mailto:Gustaf.Egnell@slu.se).

- Progress report to ExCo86, October 21-22, 2020

### Publications List

Please visit the Task website for the reports and original presentations:

<http://task45.ieabioenergy.com/>

## APPENDIX 5: KEY PARTICIPANTS IN EACH TASK

### TASK 32 – Biomass Combustion

**Operating Agent:** Ms Laerke Skov Hansen, Denmark. For contacts see Appendix 7.

**Task Leader:** Morten Tony Hansen, Ea Energy Analyses, Denmark.  
For contacts see Appendix 6.

**Assistant Task Leader:** Anders Hjörnhede, Research Institutes of Sweden, Sweden.  
For contacts see Appendix 6.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below. An up-to-date list can be found on <http://task32.ieabioenergy.com>

Country	National Team Leader	Institution
Austria	Christoph Schmidl	BEST – Bioenergy and Sustainable Technologies
Canada	Sebnem Madrali	National Resources Canada
Denmark	Morten Tony Hansen	Ea Energy Analyses
Germany	Hans Hartmann	Technologie- und Förderzentrum
Japan	Masayuki Mizuno	New Energy and Industrial Technology Development Organization (NEDO)
The Netherlands	Jaap Koppejan	Pro Biomass BV
Norway	Øyvind Skreiberg	SINTEF
Sweden	Anders Hjörnhede	RI.SE
Switzerland	Thomas Nussbaumer	Verenum

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### TASK 33 – Gasification of Biomass and Waste

**Operating Agent:** Kees Kwant, Netherlands Enterprise Agency, The Netherlands.  
For contacts see Appendix 7.

**Task Leader:** Berend Vreugdenhil, TNO, The Netherlands.  
For contacts see Appendix 6.

**Assistant Task Leader:** Jitka Hrbek, Universität für Bodenkultur (BOKU), Austria.  
For contacts see Appendix 6.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below. An up-to-date list can be found on <http://task33.ieabioenergy.com/>

Country	National Team Leader	Institution
Austria	Jitka Hrbek	University of Natural Resources and Life Sciences
Germany	Thomas Kolb	KIT
The Netherlands	Berend Vreugdenhil	TNO
Sweden	Joakim Lundgren	Swedish Center for Biomass Gasification (SFC)
UK	Patricia Thornley	Aston University
USA	Robert Baldwin	National Renewable Energy Laboratory (NREL)
Italy	Donatella Barisano	ENEA

## TASK 34 – Direct Thermochemical Liquefaction

**Operating Agent:** Birger Kerckow, Fachagentur Nachwachsende Rohstoffe e.V. (FN R), Germany. For contacts see Appendix 7.

**Task Leader:** Dr.-Ing. Axel Funke, Karlsruhe Institute of Technology (KIT), Germany. For contacts see Appendix 6.

**Assistant Task Leader:** Alexandra Böhm, Karlsruhe Institute of Technology (KIT), Germany. For contacts see Appendix 6.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, an up-to-date list can be found on <http://task34.ieabioenergy.com/>

Country	National Team Leader	Institution
Canada	Benjamin Bronson	CanmetENERGY, Natural Resources Canada
Denmark	Lasse Rosendahl	Aalborg University
Finland	Christian Lindfors	VTT (Technical Research Centre of Finland Ltd.)
Germany	Axel Funke	Karlsruhe Institute of Technology
Netherlands	Bert van de Beld	BTG (Biomass Technology Group)
New Zealand	Kirk Torr	Scion
Norway	Kai Toven	RISE PFI
Sweden	Linda Sandström	RISE Energy Technology
USA	Justin Billing	PNNL (Pacific Northwest National Laboratory)

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## TASK 36 – Material and Energy valorisation of waste in a Circular Economy

**Operating Agent:** Jonas Lindmark, Swedish Energy Agency (SWEA), Sweden. For contacts see Appendix 7.

**Task Leader:** Inge Johansson, RISE Research Institutes of Sweden, Sweden. For contacts see Appendix 6.

**Assistant Task Leader:** Mar Edo, RISE Research Institutes of Sweden, Sweden. For contacts see Appendix 6.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, an up-to-date list can be found on <http://task36.ieabioenergy.com/>

Country	National Team Leader	Team Leader Institution
Australia	Daniel Roberts	CSIRO
Germany	Dieter Stapf	KIT
Ireland	Fionnuala Murphy	UCD
	Tom Curran	
Italy	Giovanni Ciceri	RSE
Norway	Michäel Becidan	SINTEF
South Africa	Cristina Trois	University of KwaZulu-Natal
Sweden	Inge Johansson	RISE
USA	Beau Hoffman	Department of Energy – Bioenergy Technology Office U.S



## TASK 37 – Energy from Biogas

**Operating Agent:** Matthew Clancy, Sustainable Energy Authority of Ireland, Dublin, Ireland. For contacts see Appendix 7.

**Task Leader:** Prof Jerry D Murphy, MaREI Centre, Environmental Research Institute, University College Cork, Ireland.  
For contacts see Appendix 6.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, an up-to-date list can be found on <http://task37.ieabioenergy.com/about-task-37.html>

Country	National Team Leader	Institution
Australia	Bernadette McCabe	University of Southern Queensland
Austria	Bernhard Drosch	BOKU University, IFA-Tulln
	Gunther Bochmann	BOKU University, IFA-Tulln
Brazil	Maycon Vendrame	Itaipu Binacional, Foz do Iguaçu, Brazil
Canada	Maria Welsch	Agriculture and Agrifood Canada
China	Renjie Dong	State International Center for BioEnergy Science and Technology (BEST), Ministry of Science and Technology
Denmark	Teodorita Al Seadi	BIOSANTECH
	Jakon Lorenzen	Dansk Fagcenter for Biogas-DFFB
Estonia	Timo Kikas	Estonia University of Life Sciences
Finland	Saija Rasi	Natural Resources Institute Finland (Luke)
France	Olivier Théobald	ADEME
Germany	Jan Liebetrau	Rytec, Germany
	Peter Kornatz	DBFZ, Leipzig, Germany
Ireland	Jerry D Murphy	MaREI centre, University College Cork
	David Wall	MaREI centre, University College Cork
Italy	Marco Pezzahlia	Italian Biogas Consortium
Korea	Soon Chul Park	Korea Institute of Energy Research
Netherlands	Bert van Asselt	Netherlands Energy Agency
Norway	Kari-Anne Lyng	Norwegian Institute for Sustainable Research
Sweden	Jonas Ammenberg	Linköping University
	Mats Eklund	Linköping University
Switzerland	Urs Baier	ZHAW Zürcher Hochschule für Angewandte Wissenschaften
	Hajo Nagele	Wissenschaften
United Kingdom	Clare Lukehurst	Probiogas UK

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## **TASK 39 – Commercialising Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks**

**Operating Agent:** Alex MacLeod/Oshada Mendis, Natural Resources Canada, Canada.  
For contacts see Appendix 7.

**Task Leader:** Jim McMillan, NREL, USA. For contacts see Appendix 6.

**Associate Task Leader:** Jack Saddler, University of British Columbia, Canada.  
For contacts see Appendix 6.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, and an up-to-date list can be found at <http://task39.ieabioenergy.com/about/experts/>.

<b>Country</b>	<b>National Team Leader</b>	<b>Institution</b>
Australia	Steve Rogers	Licella
Austria	Dina Bacovsky	Bioenergy and Sustainable Technologies
Brazil	Glauca Mendes Souza	University of São Paulo and FAPESP Bioenergy Program BIOEN
Canada	Jack Saddler	University of British Columbia
Denmark	Sune Tjalfe Thomsen	University of Copenhagen
European Commission	Michael Persson	Danish Bioenergy Association
	Nicolae Scarlet	Joint Research Centre, European Commission
Germany	Adrian O'Connell	Deutsches Biomasseforschungszentrum (DBFZ)
	Franziska Mueller-Langer	Karlsruhe Institute of Technology
India	Nicolaus Dahmen	Bioenergy Research Centre at the Indian Oil Corporation
	Ravi P. Gupta	
Ireland	Stephen Dooley	University of Dublin
Japan	Shiro Saka	Kyoto University
	Yuta Shibahara	New Energy and Industry Technology Development Organization
The Netherlands	Paul Sinnige	Netherlands Enterprise Agency
	Johan van Doessum	DSM
New Zealand	Paul Bennett	Scion
Norway	Duncan Akporiaye	SINTEF Industry
South Korea	Jin Suk Lee	Korean Institute of Energy Research
Sweden	Tomas Ekbohm	Swedish Bioenergy Association
	Leif Jonsson	Umea University
USA	Jim McMillan	NREL

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## TASK 40 – Deployment of biobased value chains

**Operating Agent:** Birger Kerckow, Fachagentur Nachwachsende Rohstoffe e.V. (FNR), Germany. For contacts see Appendix 7.

**Task Leader:** Uwe R. Fritsche, IINAS, Germany. For contacts see Appendix 6.

**Co-Task Leader:** Christiane Hennig, DBFZ (Germany), Olle Olsson, SEI (Sweden). For contacts see Appendix 6.

**Task Secretary:** Nora Lange, DBFZ, Germany.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, and an up-to-date list can be found at <http://task40.ieabioenergy.com/>

Country	Name	Org	Role
AT	Lukas Kranzl	TU Vienna	Alternate NTL
AT	Fabian Schipfer	TU Vienna	NTL
AT	Michael Wild	Wild&Partner / International Biomass Torrefaction Council	industry
BE	Ruben Guisson	VITO	NTL
DK	Christian Bang	EA Energy Analyses	NTL
DE	Christiane Hennig	DBFZ	NTL & WP3 Lead
DE	Nora Lange	DBFZ	Task Secretary
DE	Daniela Thrän	DBFZ/UFZ	Alternate NTL
DE	Uwe R. Fritsche	IINAS	TL
DE	Birger Kerckow	FNR	Operating Agent
JP	Hiroyuki Asano	NEDO	NTL
NL	Ric Hoefnagels	Utrecht University, Copernicus Institute	NTL
NL	Ronald Zwart	RWE	industry
SE	Olle Olsson	SEI	NTL & WP2 Lead
US	Richard Hess	INL	NTL
US	Chenlin Li	DOE	Alternate NTL

## TASK 42 – Biorefining in a Circular Economy

- Operating Agent:** Kees Kwant, NL Enterprise Agency, Ministry of Economic Affairs, The Netherlands. For contacts see Appendix 7.
- Task Leader:** Bert Annevelink, Wageningen Food & Bio-based Research, The Netherlands. For contacts see Appendix 6.
- Assistant Task Leader:** Ed de Jong, Avantium Technologies B.V., The Netherlands. For contacts see Appendix 6.
- Michael Mandl, tbw Research GesmbH, Austria.  
For contacts see Appendix 6.
- Secretariat:** Wageningen UR, +31-317481165, [secretariaat.bbp@wur.nl](mailto:secretariaat.bbp@wur.nl)

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, an up-to-date list can be found on <http://task42.ieabioenergy.com/>

Country	National Team Leader	Institution
Australia	Geoff Bell	Microbiogen Pty Ltd
Austria	Michael Mandl Johannes Lindorfer	tbw Research GesmbH Energie Institut an der Johannes Kepler Universität Linz
Denmark	Franziska Hesser Solange I. Mussatto	WoodKplus DTU Bioengineering
Germany	Heinz Stichnothe	Thünen-Institute of Agricultural Technology
Italy	Isabella de Bari Vincenzo Motola	ENEA C.R. TRISAIA ENEA C.R. ISPRA
Ireland	J.J. Leahy	University of Limerick
Netherlands (coordinator)	Bert Annevelink Ed de Jong René van Ree	Wageningen Food & Biobased Research (WFBR) Avantium B.V. Wageningen Food & Biobased Research (WFBR)
Sweden	Johanna Mossberg	RISE Research Institutes of Sweden (RISE Innventia AB)

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## TASK 43 – Sustainable biomass supply integration for bioenergy within the broader bioeconomy

- Operating Agent:** Shahana McKenzie, Bioenergy Australia, Australia. For contacts see Appendix 7.
- Task Leader:** Professor Mark Brown, University of the Sunshine Coast, Australia. For contacts see Appendix 6.
- Deputy Task Leader:** Ioannis Dimitriou, SLU, Sweden. For contacts see Appendix 6.
- Work Package Leaders:** Biljana Kulišić – Work Package 1 Leader, Croatia.  
Évelyne Thiffault – Work Package 2 Leader, Canada.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, an up-to-date list can be found on <http://task43.ieabioenergy.com/>

Country	National Team Leader	Institution
Australia	Mark Brown	University of the Sunshine Coast
Belgium	Lucas Gossiaux	ValBiom
Canada	Bruno Gagnon and Daniel Mazerolle (alternate)	Natural Resources Canada
Croatia	Veljko Vorkapic	Energy Institute Hrvoje Pozar
Finland	Johanna Routa	Natural Resources Institute Finland
Germany	Jörg Schweinle	Thünen Institute of International Forestry and Forest Economics
Sweden	Ioannis Dimitriou and Dan Bergström (alternate)	Swedish University of Agricultural Sciences
USA	Tomas Schuler	USDA Forest Service

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### TASK 44 – Flexible Bioenergy and System Integration

**Operating Agent:** Aila Maijanen, Business Finland, Finland. For contacts see Appendix 7.

**Task Leader:** Ms Elina Mäki, VTT Technical Research Centre of Finland Ltd., Finland. For contacts see Appendix 6.

**Assistant Task Leader:** Prof Dr-Ing Daniela Thrän, Helmholtz Centre for Environmental Research – UFZ, Germany. For contacts see Appendix 6.

**Work Package Leaders:** Tilman Schildhauer (Switzerland)  
Daniela Thrän (Germany)  
Elina Mäki (Finland)

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, an up-to-date list can be found on <http://task44.ieabioenergy.com/>

Country	National Team Leader	Institution
Australia	Amy Philbrook	ARENA
Austria	Erns Höftberger	BEST - Bioenergy and Sustainable Technologies
Finland	Elina Mäki	VTT
Germany	Daniela Thrän	UFZ
Ireland	Brian O'Gallachoir	UCC
The Netherlands	Jaap Kiel	TNO
Sweden	Kjell Andersson	Svebio
Switzerland	Tilman Schildhauer	PSI
USA	Ian Rowe	USDOE

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## **TASK 45 – Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy**

**Operating Agent:** Mr Jonas Lindmark, Swedish Energy Agency (STEM), Sweden. For contacts see Appendix 7.

**Task Leader:** Professor Göran Berndes, Chalmers University of Technology, Sweden. For contacts see Appendix 6.

**Work Package Leaders:** Annette Cowie (Australia) For contacts see Appendix 6.

Floor van der Hilst (The Netherlands) For contacts see Appendix 6.

Uwe Fritsche (Germany) For contacts see Appendix 6.

The Task is organised with 'National Teams' in the participating countries. The contact persons for 2020 (National Team Leader) in each country are listed below, an up-to-date list can be found on <http://task45.ieabioenergy.com/>

<b>Country</b>	<b>National Team Leader</b>	<b>Institution</b>
Australia	Annette Cowie	NSW Department of Primary Industries
Brazil	Glaucia Souza	University of Sao Paulo
China	Dou Kejun	China National Renewable Energy Centre
Denmark	Niclas Scott Bentsen	University of Copenhagen
Finland	Kati Koponen	VTT
France	Miriam Buitrago	ADEME
Germany	Stefan Majer	DBFZ
Ireland	Rory Monaghan	National University of Ireland
The Netherlands	Peter-Paul Schouwenberg	RWE
Norway	Francesco Cherubini	NTNU
Sweden	Gustaf Egnell	Swedish University of Agricultural Sciences
United Kingdom	Zoe M. Harris	Imperial College London
USA	Alicia Lindauer	US DOE

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## APPENDIX 6: OPERATING AGENTS AND TASK LEADERS

### Operating Agent Task 32: Denmark

*(duration 1 January 2019-31 December 2021)*

OA: Ms Laerke Skov Hansen

TL: Morten Tony Hansen

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DENMARK

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Anders Hjörnhede (assistant Task Leader)

Research Institutes of Sweden  
Box 857  
S-501 15 Borås  
Sweden

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### Operating Agent Task 33: The Netherlands

*(duration 1 January 2019-31 December 2021)*

OA: Kees Kwant

TL: Berend Vreugdenhil

Nederlandse Organisatie voor toegepast-  
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Westerduinweg 3  
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Jitka Hrbek (assistant Task Leader)

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### **Operating Agent Task 34: Germany**

*(duration 1 January 2019-31 December 2021)*

**OA:** Birger Kerckow

**TL:** Axel Funke

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Karlsruhe Institute of Technology (KIT)  
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Technology (IKFT)  
Hermann-von-Helmholtz-Platz 1, Building 727  
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### **Operating Agent Task 36: Sweden**

*(duration 1 January 2019-31 December 2021)*

**OA:** Mr Jonas Lindmark

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### **Operating Agent Task 37: Ireland**

*(duration 1 January 2016-31 December 2018)*

**OA:** Matthew Clancy

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Cork  
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Email: [Jerry.Murphy@ucc.ie](mailto:Jerry.Murphy@ucc.ie)

### **Operating Agent Task 39: Canada**

*(duration 1 January 2019-31 December 2021)*

**OA:** Oshada Mendis

**TL:** Jim McMillan

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