Technology Collaboration Programme
by IEA

Bioenergy News

Volume 34 Number 2 - December 2022

IEA Bioenergy
Technology Collaboration Programme

Accelerating to Net Zero

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Bioenergy in Austria

Hannes Bauer
Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology of Austria

30% of Austria´s energy consumption is provided through renewable energy, of which bioenergy provides more than half (53% in 2019), followed by hydropower (34%) and wind (6%). The production of bioenergy is primarily based on forest residues. The forest area in Austria currently amounts to roughly 4 million hectares (ha) of forest, which corresponds to 47.9% of the total state surface.

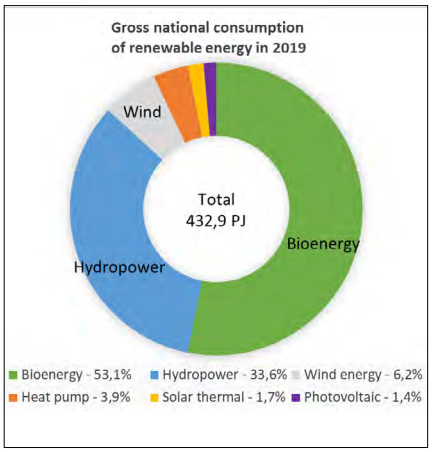


Figure 1. Gross national consumption of renewable energy in 2019.

Most of the biomass used in providing this bioenergy is woody biomass, with wood waste such as saw mill residues and bark as well as logwood being the main contributors. While logwood is a common fuel for residential heating, wood waste is used for energy production in the wood-processing industry, in power production, district heating and – in form of pellets – in residential heating.

Despite ambitious targets for the deployment of wind power, solar power (PV) and solar thermal, bioenergy is and will remain the major contributor to renewable energy production in Austria. In 2019, biomass provided 30% of heat demand, 6% of transport fuels, and 6% of electricity; district heat – being the main source of residential heat in Austria – is 50% biomass-based.

As of 2020, bioenergy in the form of heat, electricity and transport biofuels is being produced in 2,397 biomass heating plants, 151 biomass CHPs, 278 biogas facilities, 8 biodiesel facilities and one ethanol production facility. Another ethanol facility, producing advanced ethanol from the brown liquor of a specialty cellulose facility, came into operation in early 2021.

The area of Austrian forests and the stock of wood in Austria have been increasing since the 1960s, and the amount of woody biomass used is around 80% of the yearly stock increase. Around 60% of the wood goes to sawmills, some 20% to the industry (e.g. for pulp production or for material use) and the remaining 20% is used directly to provide heat. Saw dust – a residue from the saw industry – is used to produce pellets for energetic use in industry and households.

Pellets production in Austria amounted to 1.54 million tons in 2020, of which two thirds are used in Austria and one third is exported. Pellet boilers, along with log wood boilers and wood chip boilers, are an important source of residential heat in Austria. Although the number of biomass boilers is steadily increasing, fine dust emissions from space heating have largely decreased due to cleaner boiler technologies and greater boiler efficiencies.

The political framework is defined by EU regulations, with the Renewable Energy Directive being the most powerful driver for bioenergy deployment. National measures for the heating and cooling sector include the Environmental Measures Support Act, which is a support for environmental protection in general, and the guidelines for domestic environmental support, which specifically promote renewable energies. The Renewable Energy Deployment Act is the support policy for energy from renewable sources in the electricity sector. A new element herein is the possibility to form energy communities in which citizens can trade own renewable electricity production with their neighbours. For the transport sector the most important piece of legislation is the Fuel Ordinance Amendment, establishing a quota for biofuels.

The bioenergy sector provides around 24,000 green jobs and creates an annual turnover of some 3 billion €. Austria has significant technological expertise in wood-processing industries, pellet production, pellet and wood chip boilers, district heating as well as transport biofuel production. Technological expertise has been developed on the basis of a strong national demand, and many companies are now exporting their technologies. Further research and development work on bioenergy technologies is still ongoing and funded through the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology. International collaboration through IEA Technology Collaboration Programmes such as IEA Bioenergy are one important element.

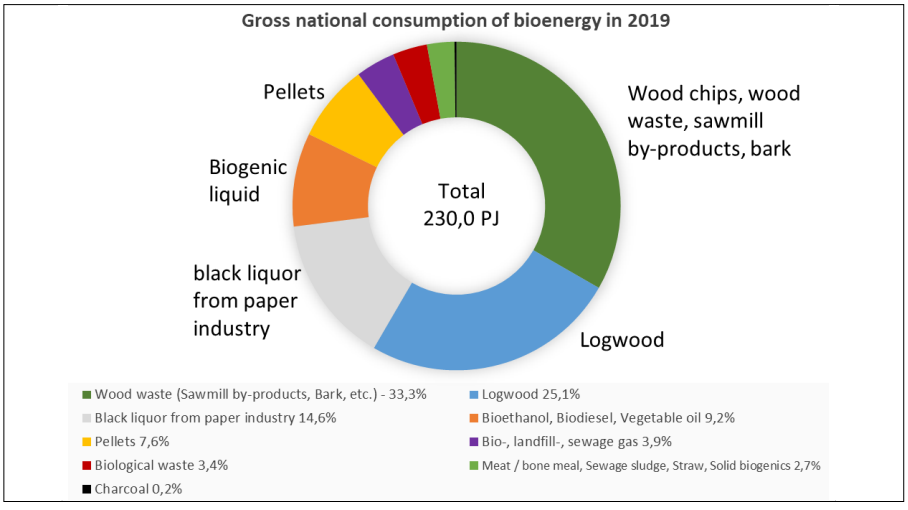


Figure 2. Gross national consumption of bioenergy in 2019.

IEA Bioenergy
Technology Collaboration Programme

From the Secretariat

Andrea Rossi
ExCo Secretary

The 90th meeting of the Executive Committee was held in Vienna, Austria on 17-19 October 2022, with Paul Bennett as Chair, Dina Bacovksy and Sandra Hermle as Vice-chairs and Andrea Rossi as Secretary. The first day was dedicated to a workshop titled 'Technology Advances in Liquid Biofuels and Renewable Gas'. The meeting was hosted by the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK). The Chair expressed the appreciation of the ExCo to Bauer and his colleagues for hosting the ExCo90 meeting, and he thanked Bacovsky and BEST – Bioenergy and Sustainable Technologies GmbH for organizing the meeting.

Changes to Executive Committee

A new Member for Denmark was Ms Ane Katharina Paarup Meyer; a new Alternate Member for Estonia was Ms Mairika Kõlvart; and a new Member for Ireland was Mr Luis Gay-Tarazona.

ExCo90 Workshop

On 17 October 2022, IEA Bioenergy held its biannual workshop, which was organized in collaboration with BMK and BEST. The event included ExCo participants, representatives from BMK and BEST, participants from IEA Bioenergy Tasks, the workshop speakers, a group of observers from Austria and numerous remote participants.

The workshop explored advances being made in new biofuels technologies, as well as technologies to produce renewable gas (biomass based), and it discussed what is needed to accelerate the roll out to the market of both sets of technologies. It included three sessions: the first session dealt with advances in renewable gas / biomethane; the second one was focused on advances in liquid biofuels; and the third session highlighted concrete developments in Austria.

The PowerPoint presentations and recordings are available here.

Progress with current Initiatives

Inter-Task project – Synergies of Green Hydrogen and Bio-Based Value Chains Deployment
The objective of this project is to identify and assess synergies in the deployment of green hydrogen and bio-based value chains that can enhance the use of both energy carriers and the energy system under different conditions. The focus is on value chains directly linked to bioenergy, i.e., biomass as a source of hydrogen and bio-based processes consuming electrolytic hydrogen. The project comprises six working packages, with three reports, two webinars and a series of factsheets foreseen as key outputs. It was kicked-off in June 2022 and it will end in November 2024. Collaboration opportunities are being explored with relevant TCPs (e.g., AMF, Hydrogen and ETSAP), in addition to the BECCUS Inter-task Phase 2.

Figure 3. Attendees at the ExCo90 Workshop.

Inter-Task Project – Deployment of BECCUS Value Chains

This project aimed to analyse technological, political and economic aspects related to near to medium term deployment of systems used for capture and utilization or storage of biogenic CO2. The project outputs can be divided into two categories: case studies, which offer brief but focused analyses of conditions in a specific sector; and system studies, which analyse issues that cut across sectors. The Synthesis Report will be published at the end of January 2023, followed by the last two case studies, one on ethanol and one on flexibility.

Inter-Task project – Management of Biogenic CO2: BECCUS Inter-task Phase 2

This project, which comprises eight working packages, aims to: facilitate cross-Task, cross-TCP and cross-sector learning on bio-CCUS; shed light on (bio)energy system integration of bio-CCUS; and address CO2 mitigation potential of bio-CCUS. It will allow for a more systemic consideration of how to take different BECCUS applications to deployment, thereby building upon, but going beyond, the first BECCUS Inter-task project described above. The project was kicked-off in June 2022 and it will run until Q4 2024. The main outputs will include four reports, two workshops and one webinar. Collaboration is foreseen with various TCPs (ETSAP, GHG, IETS), in addition to the Synergies ITP.

Inter-Task Project – Successes and lessons learned for biofuels deployment

This project included six work packages focused on studying national programmes and experiences of leading biofuels producing countries including but not limited to Brazil, Canada, Germany, Sweden and the USA. The analysis aimed to compare and contrast different producer countries' framework conditions and policy approaches as well as levels and rates of biofuel production growth that these have enabled. Due to Covid-19 related impacts, outputs have been delayed. In the first half of 2022, the following outputs were finalized:

- WP1: "Status Quo of Biofuel Projects"
- WP2: "Meta-analysis"
- WP3: "Case Studies Technologies"
- WP4: "Case Study Supply Chains".

The remaining outputs, including the Synthesis Report, should be finalized by the end of Q1 2023.

Communication Strategy

The Communications Team has continued with regular online meetings to oversee communications' activities and review progress with ETA Florence. Three IEA Bioenergy webinars have been presented since ExCo89 and these can be viewed along with all previous webinars at https://www.ieabioenergy.com/iea-publications/webinars/. The social media statistics showed increased numbers of followers on Twitter and especially LinkedIn. Regarding the website, users were in the same range as last year, indicating the need for continuing and further efforts. The transfer of the Tasks' websites to the new IEA Bioenergy design is almost complete. Regarding the collaboration with the Communication Specialist MFM, a number of recommendations to improve the effectiveness and impact of IEA Bioenergy's communication were put forward, especially in relation to media awareness, stakeholder dialogue and communication competence. These recommendations, which were discussed during a dedicated session of the ExCo90 meeting, are currently being reviewed by the Communications Team, with a view to operationalize them.

Collaboration with other International Initiatives

Collaboration with the IEA, other IEA TCPs and International Organisations has continued. Exchanges were held with the Hydrogen TCP, the ETSAP TCP and the AMF TCP in relation to the new Inter-Task project on "Synergies of Green Hydrogen and Bio-Based Value Chains Deployment"; and with the ETSAP TCP, the GHG TCP and the IETS TCP regarding the other new Inter-Task project ("Management of Biogenic CO2: BECCUS Inter-task Phase 2"). The IEA Bioenergy TCP continues to work closely with FAO and the Global Bioenergy Partnership (GBEP). A Memorandum of Understanding was signed with the Clean Energy Ministerial (CEM) Biofuture Platform Initiative, to implement collaborative activities in the field of bioenergy, with a focus on biofuels and biorefineries. Synergies are also being explored with the recently-established Mission Innovation on Integrated Biorefineries. Furthermore, IEA Bioenergy will collaborate with UNIDO on the organization of the forthcoming ExCo91 Workshop themed "Opportunities of biofuels/bioenergy in developing economies".

Election of new Chair and Vice-chairs

Dina Bacovsky of BEST – Bioenergy and Sustainable Technologies, Austria, was elected as the new Chair of the IEA Bioenergy Technology Collaboration Programme for 2023 and 2024. She follows Paul Bennett of SCION, New Zealand, who served as Chair in the past 2 years.

The IEA Bioenergy Executive Committee also appointed two new Vice-chairs to assist the Chair in her work: Birger Kerckow of FNR – Fachagentur Nachwachsende Rohstoffe, Germany, and Mark Brown of Forest Research Institute – USC, Australia.

Birger Kerckow

Dina Bacovsky

Mark Brown

ExCo90 Study Tour

Following the ExCo90 meeting, a group of IEA Bioenergy attendees participated in the study tour, which included site visits to the Technical Lab of the Vienna University of Technology, which has been testing a number of innovative gasification technologies, and to the Syngas Platform Vienna. This pilot plant is the first of its kind worldwide designed to demonstrate the use of this technology in a single, end-to-end process in an industrial environment. It was built under the Waste2Value project. This project is driving the use of waste residues to produce hydrogen-rich syngas. It focuses on waste fuels such as sewage sludge, industrial residues, waste wood and similar material. In a second process step, the syngas is synthesized into liquid fuel (high quality diesel and kerosene). The current stage of the project runs to 2023 and covers construction and start-up of the pilot facility to gain the relevant operational experience. The Waste2Value research program examines the entire process chain, starting with the waste fuel, and including syngas production, purification, treatment and synthesis through to the final refining and use of the FT fuel in fleet trials for public transport. The project results will allow the process to be evaluated in economic and technical terms, providing the basis for the planned industrial-scale implementation of the process.

For further information:

IEA bioenergy.com

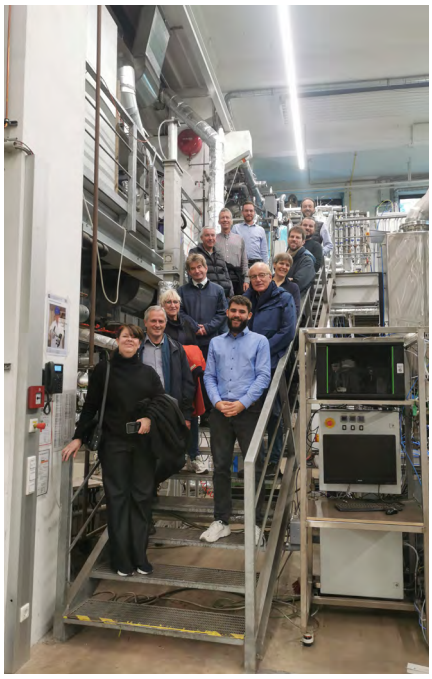


Figure 4. ExCo90 Study Tour group at the Technical Lab of the Vienna University of Technology

Figure 5. ExCo90 Study Tour group at the Syngas Platform Vienna

Task Focus:

The challenges and potential of biojet/Sustainable Aviation Fuels (SAF), and policies needed

Glaucia M. Souza & Tomas Ekbom (Task 39)

Transport is an imperative for economic and social development. It is the physical, social, and economic network that connects people to opportunities, goods to markets, and communities to prosperity. As our economies gear towards a low carbon energy matrix a special focus is needed on mitigation of emissions in aviation. IEA Bioenergy Task 39 is studying how to offset the development trajectory of the sector and its increasing emissions with the use of biojet or sustainable aviation fuels (SAF).

IEA Bioenergy Task 39 and SAF

Task 39 has conducted several projects on SAF and contributed to much new knowledge and shared information among interest groups and stakeholders for the commercialization and increased use of SAF. In May 2021, Susan van Dyk and Jack Saddler of the University of British Columbia in Vancouver, Canada published "Progress in Commercialization of biojet/ Sustainable Aviation Fuels (SAF): technologies, potential and challenges". This report was a continuation of several reports published in 2019 including the Boeing sponsored "Assessment of likely technology maturation pathways for biojet production from forest residues (ATM Project)".

The 2021 report provided an extensive analysis of the current and potential technologies for producing biojet/SAF and also highlighted several commercial-scale facilities that will come online over the next few years. As emphasized in the report, some of the biojet/SAF processes have encountered high capital and feedstock costs while some are dealing with technology challenges. The report recognized that, as biojet/ SAF fuel prices are likely to remain significantly higher than conventional jet fuel, the "right" policies will be needed to bridge the price gap and incentivize the production and use of biojet fuels.

As concluded in the report, all of the technologies/pathways to biojet/SAF will need to be pursued if we are to deliver the significant fuel volumes required to decarbonize aviation. However, although ongoing improvements and optimization of the various processes will continue to reduce the cost of biojet/ SAF production and use, meeting the sector's decarbonisation targets will be very challenging.

More recently Prof. Robert Malina, Belgium, contributed a report on "The Role of Sustainable Aviation Fuels in Decarbonizing Air Transport" for the World Bank. Here international specialists worked to identify and characterize low-carbon transport system development pathways for lower-income countries, summarized as follows:

1. The air transport sector is an integral part of economic growth and development. The decarbonization of aviation is key to achieving climate goals by mid-century. Decarbonization options for global aviation out to the year 2050 include: (1) demand change for air transport; (2) technological improvements to the aircraft system; (3) improvements related to airline operations, air traffic management (ATM) operations, and ground operations; and (4) sustainable aviation fuels (SAFs).

2. SAF is the main mitigation option that can most readily realize substantial GHG emission savings for air transport in the medium term (next 5 to 10 years). However, SAF currently accounts for only 0.1% of global aviation fuel demand and costs 2 to 5 times more than conventional jet fuel. Nevertheless, recent years have seen significant momentum in the production and uptake of SAF, but these efforts are concentrated in higher-income countries. Looking forward to 2050, SAF production can meet a large share of projected demand, but only if production expands beyond OECD countries.

3. To reach net-zero emissions in air transport by 2050, large-scale SAF deployment will need to be combined with technological and operational improvements. Additional technological and operational improvements can reduce life-cycle GHG emissions to approximately 279 to 477 million tonnes, which is up to 78% lower than total CO2 emission for 2050 considering a business-as-usual scenario (compared to a 57% mitigation potential with SAF deployment alone).

4. While current and near-future SAF production is primarily planned in OECD countries, it is estimated that SAF feedstock potential in non-OECD countries is equivalent to approximately 510 million tonnes of SAF. Furthermore, the emergence of a SAF industry in developing countries could have significant benefits for the economy as well as for the climate. However, production volumes will require significant capital expenditure (CAPEX) with estimates of an annual greenfield plant investment in the high scenario at approximately US$124 billion.

5. Despite high CAPEX needs, SAF-specific marginal abatement cost curves (MACC) for the years 2030 and 2050 show that SAF can be a cost-effective solution for decarbonization of air transport. However, this requires collective action from policymakers, industry, and financiers to overcome the economic and technological challenges to scale up production and use. Among the policy options, there are three major types that can increase the financial viability of SAF production and de-risk investments: (1) Market-based measures that cover aviation emissions and aviation GHG offset systems, which put a price on the release of GHG emissions, either directly (in the case of carbon taxes) or indirectly (in the case of emissions trading schemes); (2) SAF mandates that require the production and/or use of a certain amount of SAF, which usually

Figure 6 . Pioneering biofuels in aviation. Embraer's Ipanema (left) and Boeing B-52 Stratofortress (right).

In 1971, Embraer launched in Brazil an agricultural aircraft with an ethanol engine called Ipanema. The latest version of this aircraft is the first ethanol-powered fixed-wing aircraft. In 2005, it had achieved 80% of the market share. The US Air Force has since 1999 performed extensive testing of planes and alternative fuels. In 2006, a Boeing B-52 Stratofortress flew for the first time on synthetic jet fuel.

increases over time; and (3) cost-related policies such as feedstock subsidies, capital grants, and loan guarantees.

6. The public and private finance sector also have a role in steering investment into SAFs through green/climate financing. While the role of climate finance in the air transport sector is still in its infancy and limited to a few projects related to green energy at airports or aircraft fleet renewal, SAF-related projects could build on the significant green financing experience in the biomass and bioenergy sector.

7. Aviation decarbonization policies, including those aimed at promoting the SAF industry, should be integral to countries' broader climate targets and actions on energy transition and agricultural and environmental sustainability. There should be a comprehensive public policy and regulatory framework that defines production incentives needed to increase supply and lower costs, while incentivizing SAF usage to ensure offtake. Nevertheless, it is also recognized that continued support for sustainable aviation-fuel research and development is needed.

Projects and future developments

There are a number of Task 39 projects in development which will evaluate the key role that policy will play in the production and use of biojet/SAF including in certification schemes, as well as the technologies needed. For biojet/SAF to take off at large scale with significant production, regulators need to create a framework that mandates their use plus incentivizes production of biofuels for use in aviation. Although the ICAO has tried to implement a global SAF blending mandate, regulators at the regional, national, and local level need to develop policies to support the production and use of biojet fuels.

Aviation is included in the EU's Emission Trading Scheme (ETS) and biojet/SAF made from non-crop feedstock can also be used to meet the targets under the EU Renewable Energy Directive (RED II for 2020-2030 and to be replaced by RED III). The EU is currently in the trilogue phase. The legislative process for the ReFuelEU Aviation directive for aviation with a forced blending will start in 2025, with an estimated 2.8 million tonnes of SAF used by 2030. This will make an add-on contribution to the ETS system.

It should be noted that Norway and Sweden have imposed SAF blending mandates to cut greenhouse gas (GHG) emissions from aviation. These mandates were the first in the world with 0.5% by volume in Norway from 1 January 2020 and 0.8% carbon emission reduction in Sweden from 1 July 2021. The mandate has not changed in Norway since, but for Sweden the current mandate is 1.7% for 2022 and 2.6% for 2023. The estimated volumes of SAF in the consumed jet fuels in Sweden is some 13 000 m3 SAF annually for 2022. If air traffic resumes to pre-pandemic volumes, the value could increase to as high as 44 600 m3 SAF in 2023.

In parallel, SAF can be used in the USA to meet advanced biofuel targets under the Renewable Fuel Standard (RFS). Although annual volumes of biojet fuel have increased from <10 million litres in 2018, to possibly more than 1 billion litres by 2023 (and potentially some 8 billion litres by 2030), the vast majority of this volume will be derived from oleochemicals/lipids, according to van Dyke and Saddler.

The upgrading of fats, oils and greases to HEFA-SPK is fully commercialized and biojet production is relatively simple. It is anticipated that increased volumes of biojet will be derived via this "conventional" pathway based on expansion of current facilities and the building of new facilities. However, as demonstrated by Neste, these facilities will be primarily used for renewable diesel production with the potential to add biojet production after additional infrastructure investment such as modification of final processing, e.g. adding a distillation step. However, this will need to be driven by incentivizing policies.

Other technologies which could be producing commercial volumes of biojet fuels are Fischer-Tropsch synthesized paraffinic kerosene (FT-SPK) (based on gasification), Alcohol-to-Jet synthesized paraffinic kerosene (ATJ-SPK) and catalytic hydrothermolysis jet (CHJ). However, all of these processes produce multiple fuel products which typically include a biojet fuel fraction. Therefore, even though "stand-alone" biorefineries could produce more of the biojet fraction, this will be influenced by market demand, economics and policy drivers as currently. It should be noted that, in many cases, the biojet-range molecules are diverted to the renewable diesel fraction due to current policy drivers.

For each of the technologies, although the percentage of the jet fraction within the total liquid fuels varies, processing conditions can be modified to increase the amount of the biojet fraction. For example, if HEFA refiners were encouraged to produce biojet in addition to renewable diesel, at least 15% of the current low-carbon, drop-in fuels produced could be biojet, according to van Dyke and Saddler. This would immediately increase the amount of biojet that could be available, at a moderate investment cost.

However, it needs to be strongly emphasised that policy will play a very important role in trying to bridge this price gap. In parallel, there will be an increasing focus on cost reductions such as accessing low-cost feedstocks, optimizing supply chains, increasing product yield and diversifying the product slate to include higher value commodities. Optimistically, it is also anticipated that, as the various technologies mature, learning rates should result in significant cost reductions. However, despite these process improvements, the cost of biojet fuels will be closely linked to policies that incentivize biojet/SAF production and use. As currently being assessed by Task 39 members, these policies will provide an opportunity for companies to improve their overall sustainability, lower the carbon intensity of fuels and become more economically competitive.

References

Assessment of likely Technology Maturation Pathways for biojet production from forest residues. Front cover information panel Assessment of likely Technology Maturation (ATM) Project IEA Bioenergy: Task 39, 2019.

Malina, Robert, Megersa Abate, Charles Schlumberger, and Freddy Navarro Pineda. 2022. The Role of Sustainable Aviation Fuels in Decarbonizing Air Transport. Mobility and Transport Connectivity Series, World Bank.

IATA Fact Sheet 2 Sustainable Aviation Fuel: Technical Certification, IATA 2022.

Notice board

Task 32 - Biomass Combustion

Task 32 has a strong focus on improving air quality by reducing emissions from residential wood combustion systems. The task has recently published three reports on this topic:

- Advanced Test Methods for Pellet Stoves - Report on Consequences of Real-Life Operation on Stove Performance. This report discusses current and proposed testing methods for pellet stoves, and it summarises existing data about real life performance and the connection to lab testing results. It addresses manufacturers, research and (notified) testing bodies, standardization groups, regulation bodies (international, national, regional), and interested end users.

- Design of Low Emission Wood Stoves - Technical Guidelines. This publication 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. This provides a basis for the decision to combine primary measures with secondary technologies to obtain almost zero emission combustion products. The guideline is aimed at manufacturers but also at funding agencies or regulation bodies to set up the legal and funding framework for these emerging technologies.

- Inventory of national strategies for reducing the impact on air quality from residential wood combustion. Many countries are working on strategies for reducing the impact on air quality from small scale wood combustion. Their individual approaches may bear interesting measures, ideas or experiences which are useful for others. The report compiles national approaches concerning emission reduction strategies in the field of residential wood combustion in selected IEA member countries.

Furthermore, on this topic Task 32 has published the proceedings of a Workshop on Residential Wood Combustion held in January 2020 at the Central European Biomass Conference (Graz, Austria).

During the coming years, Task 32 will continue to address topics such as emission reduction, transition away from fossil fuels in industry, and integration and flexibility of biomass combustion. The 2022-2024 triennium was kicked-off at a task meeting in Copenhagen in September 2022, including site visits to important combustion plants – one together with members of Task 40.

Figure 7. Joint Task 32 - Task 40 visit to a combustion plant in Copenhagen, September 2022

The triennium work programme comprises four work packages:

• WP1: Substituting fossil fuels in industry

• WP2: Sustainable biomass CHP with net negative CO2 emissions

• WP3: Innovative low emission biomass heating plants

• WP4: Low emission residential boilers

Task 33 - Gasification of Biogenic Residue and its Applications

Task 33 has had two meeting in 2022. The first meeting was organized in the Netherlands in conjunction with a workshop on the production of advanced biofuels, together with the EU project Converge: Innovations in advanced biofuels production. The task meeting was held in hybrid format, with several members attending in person and a few countries participating online.

The second meeting was organized by BOKU in Austria and was also an hybrid event. In the same week, we organized a workshop on the valuable (by-)products of gasification. This workshop gave a broad overview of various pathways to produce bio-char, biofuels and/or chemicals via different gasification technologies. This meeting was complemented with a visit to the BEST Waste2Value plant in Vienna, which started producing Fischer Tropsch liquids from waste materials in the same week. A great example of how gasification technology can advance the transition of energy and materials.

In 2022, Task 33 organized and/or participated in a few events. Some of these events can be viewed online, while for other ones presentations are available.

• Webinar on Integration of gasification processes in biorefineries on 30th of June 2022

• Global Clean Energy Action Forum – Participation with RVO, Koch, Synova on the production of fuels and chemicals utilizing gasification technology – 23rd of September 2022

• Presentation on "Biorefineries in the Circular Economy Workshop", organized by CSIR in South Africa.

Task 34 - Direct Thermochemical Liquefaction

To improve dissemination of lessons learned, Task 34 has introduced a new set of reports called 'technical notes'. They aim at providing relevant information to cope with specific challenges and issues in the field of Direct Termochemical Liquefaction (DTL), and to further enhance efficient research and development. The first Technical Note explains quality aspects of mass balances and how to avoid the most common inconsistencies and artefacts. The second discusses the influence of specific compounds on safety related aspects of DTL oils to point out potential areas of risk when testing new feedstocks and/or new process conditions. Further Technical Notes are planned and will be continuously made available online (link).

This triennium (2022-2024), Task 34 is actively involved in both Inter-task projects on 'Synergies of green hydrogen and bio-based value chains deployment' and 'Management of biogenic CO2: BECCUS'. This is an important development to be able to showcase the versatile services DTL technologies can provide in a future energy system next to the production of liquid biofuels. For both projects, internal work packages have been identified to provide in-depth information for relevant case studies.

Task 36 - Material and Energy Valorisation of Waste in a Circular Economy

In times where dependency on gas import is on the minds of many European countries, national production of renewable natural gas (RNG) is a topic of high interest. The latest publication from Task 36 deals with the valorisation of biowaste in the United States and how biomethanation can be used for the production of RNG. Anaerobic digestion is an established technology to treat different sorts of bio and organic waste and produce biogas. When converting the biogas into RNG there are well established technologies, however these often comes with a relatively high cost (monetary and energetic). The biomethanation process partly replaces the traditional upgrading technologies by converting the carbon dioxine into additional methane, thus increasing the yield of the produced RNG. The main input is renewable hydrogen that is needed for the conversion. The biomethanation pathway

shows promise in that it seems more robust and can operate at lower temperatures than catalytic processes. The report can be downloaded here.

In association with a Task 36 meeting in Durban (RSA), two hybrid workshops were organised, one on the subject of "Decarbonisation of the waste sector" (Nov 29) and one on "Social acceptance and sustainability metrics" (Nov 30). For more information, please visit the Task 36 website: https://task36.ieabioenergy.com

Task 37 - Energy from Biogas

In October 2022, a Task meeting took place in Linköping, Sweden, within the Nordic Biogas Conference. Task 37 was given the opportunity to present the Task and selected results of its work during the plenary session titled "A resilient, circular and biobased economy". A presentation on "Integration of biogas systems into the energy system" was given by Jan Liebetrau. The Swedish biogas sector is focussed on utilization of waste and residues for anaerobic digestion and the biogas is used within the transportation sector. Thus, the conference was accompanied by a exhibition of vehicles running on compressed and liquified methane and the tour led to a biogas plant providing compressed and liquified biomethane to local busses and trucks for heavy duty haulage. The conference itself had an emphasis on the sustainability of biogas production and utilization. The "Nordic model" for biogas production and utilization considers not only the contribution to energy supply. There is more to biogas, as it supports recycling of nutrients, it reduces air pollution, and it improves water quality and soil fertility, among other things. For a comprehensive assessment of the technology, these effects need to be reflected by means of multicriteria analysis.

Task 39 - Biofuels to Decarbonize Transport

Task 39 regularly publishes via the peer reviewed literature, to reach the broader transport biofuels community. Listed below are selected papers, with coming report to be published in italics:

- Improvement opportunities for policies and certification schemes promoting sustainable biofuels with low GHG emissions. Part 1: A review of policy frameworks (Jinke et al. 2022; TPD).
- Challenges in determining the renewable content of the final fuels after co-processing biogenic feedstocks in the fluid catalytic cracker (FCC) of a commercial oil refinery (Su et al., 2021; Journal of Fuel) (link)

Task 39 participated in the Science Summit at the United Nations General Assembly (UNGA77) with a presentation by Glaucia Souza of the Biofuels Emerging Markets Analysis (link).

In September 2022, Task 39 also participated in the Advanced Biofuels Conference in Stockholm on Task 39 projects by: Paul Bennet, Glaucia Mendes Souza, Andrea Sonnleitner, Dina Bacovsky, Franziska Müller-Langer and Jack Saddler. In addition, Maria Georgiadou and Isabelle Ausdal made presentations related to the task work.

Task 40 - Deployment of Biobased Value Chains

Preparations for new and further projects are already in full swing. Successfully implemented in 2019-2021, the topics of the two internal projects Regional Transitions and Circular Bioeconomy Synergies will be continued and further developed (see project description here). As Task 40 leads the Inter-task Project 'Management of Biogenic CO2: BECCUS Inter-task Phase 2', the kick-off meeting with 6 other IEA Bioenergy Tasks was successfully organised in June 2022. Also in June, Task 40 organised (as co-lead) and participated in the kick-off meeting of the Inter-task Project 'Synergies of green hydrogen and bio-based value chains deployment'. This is one of the largest projects of IEA Bioenergy so far with 10 collaborating Tasks and some external partners and other TCPs, e.g., IEA Hydrogen. In both meetings, initial work was accomplished such as identifying next steps, setting a timeline and exploring core groups for collaboration in each of the work packages.

After the summer break, the first physical and long-awaited meeting of Task 40 in the 2022-2024 triennium was held. It was indeed the first meeting since November 2019 and the event was perfectly hosted by our Danish NTL Christian Bang from EA Analysis. We met in Copenhagen on 7-8 September 2022 and several Task 40 members joined also virtually, so it was very successful. Particularly important in the group was and is the exchange on the topic of the political situation and priorities in the individual countries. There were fruitful debates on the topics of planning plants for PtX, BECCUS, bio-based value chains, and furthermore on expert opinions and discussions on forests and their role for energy and materials provision. Other aspects of the meeting were the development outlines for the new Task projects and the coordination of internal participants for the work packages of the new ITP projects. Many thanks also to Morten Tony Hansen from Task 32 who arranged a guided tour for both Tasks at Copenhagen's largest pellet plant HOFOR – Amagerværket.

Also as a hybrid event, the ExCo90 meeting and the ExCo Workshop 28 entitled: "Technology Advances in Liquid Biofuels and Renewable Gas" took place in Vienna on October 17, 2022. For Task 40, Uwe Fritsche, who led the Inter-task Project 'Renewable Gas' during 2019-2021, presented the results of the project in a panel discussion. Furthermore, on October 19, under the Inter-task Project 'Synergies of green hydrogen and bio-based value chains deployment', which is jointly coordinated by Christiane Hennig (Task 40) and Elina Mäki (Task 44), a half-day workshop was held on the topic "KPIs for assessment of green hydrogen and bio-based value chains". With the aim of identifying collaboration opportunities on the subject of "Regional development opportunities based on flexible biomass value networks" within the IEA Bioenergy community, a joint workshop by Fabian Schipfer (Task 40) and Biljana Kulisic (Task 43) was organized on November 2, 2022. IEA Bioenergy Tasks 40, 42, 43, 44 and 45 took part in this inter-task discussion.

New Publications: Carbon accounting in Bio-CCUS supply chains – Identifying key issues for science and policy (link) and Bioeconomy Synergies Project, Progress & Prospect Report 2019-2021.

Figure 8. Task 40 hybrid meeting September 2022 in Copenhagen, September 2022

Task 42 - Biorefining in a Circular Economy

Task 42 report published: 'Technical, Economic and Environmental (TEE) Assessment of Integrated Biorefineries – Gasification based biorefinery case studies'.

IEA Bioenergy Task42 "Biorefining in the Circular Economy" aims at enhancing the commercialization and market development of biorefinery systems and the related technologies while considering environmental, social and economic aspects. Providing quantitative, scientifically sound, and understandable data on the technical, economic and ecological added-value of biorefining to co-produce bioenergy and bio-products in a sustainable way is an essential facilitator in this context. Therefore, an integrated assessment (technical, economic and environmental – TEE assessment) of integrated biorefineries was performed. The main objective of the current report is to:

- maintain and update the TEE approach and methodology for generic biorefinery assessments on technical, ecological and economical aspects;
- disseminate the TEE approach and methodology and enable accessibility of primary calculations;
- publish updated & new factsheets based on the TEE approach and methodology, and inform industry about market perspectives;
- discuss approaches to calculate the metrics on ecological aspects (e.g., GHG reduction effects of biorefineries) with other working groups (e.g. IEA IETS Annex XI and IEA Bioenergy Task 45) for alignment and further standardization.

The report can be downloaded here.

Task 43 - Biomass Supply in Sustainable and Circular Economies

On 2 November 2022, Task 40 on the Deployment of Biobased Value Chains, Task 43 on Biomass Sustainable Supply for Bioenergy within the broader Bioeconomy and Task 44 on Flexible Bioenergy and System Integration hosted a workshop on **Regional development opportunities based on flexible biomass value networks.** This collaborative workshop gathered 13 participants from five IEA Bioenergy Tasks: Task 42 on Biorefining in a Circular Economy and Task 45 on Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy in addition to the host Tasks.

The two hours online and structured brainstorming session was based on the parallel work made in the previous triennium on small to medium scale Bioeconomy enterprises (SMBEs), mobilizing low-value, heterogeneous biomass while providing benefits to regional communities. A case study of a winery that transitions from the linear business model of producing a single product – wine, to a circular and sustainable business model with a bundle of (innovative) bio-based products, including bioenergy, served as a starting point to develop inter-task cooperation to the next level in the new triennium. The case study, developed under the Agribiohub activity (Task 43) was placed in the context of flexible bioenergy systems to support resource efficiency and accelerate system integration (Task 44). Strategies for post-harvesting management systems to transition to bio-hubs (Task 43) intersect well as a part of strategies for supply chain networks of local low-value, heterogeneous biomass resources for a circular bioeconomy (Task 40). The workshop report outlines the identified, specific collaboration opportunities on the workshop topic between all tasks, and the broader IEA Bioenergy TCP community.

Task 44 - Flexible Bioenergy and System Integration

Task 44 activities for the triennium 2022-2024 have been started according to schedule. The first concrete output from the Task was a virtual workshop on 'Flexibility Provision from Biogenic Gases', which took place on 23 November 2022. The workshop was organized in collaboration with Task 33 and Task 37 and brought together a good number of experts from the field to share their thoughts on this very timely topic. The workshop focused on technical options and Best Practices to provide flexibility from biogenic gases through gasification, biogas and Power-to-X pathways, including links to renewable hydrogen and carbon capture and storage/use (BECCUS). The next workshop will be an IEA-Cross-TCP Workshop on the topic 'Towards a flexible, cross-sectoral energy supply'. The workshop will have a special focus on the flexibility provision via the heating sector. It will take place on 18 January 2023 as a part of the Central European Biomass Conference in Graz, Austria.

Another on-going activity within Task 44 is collecting Best Practice examples on flexible bioenergy. These examples aim at showcasing the multiple use-cases and benefits from flexible bioenergy solutions. Also in process is a country questionnaire on flexible bioenergy status and policies, whose results will be presented in a report in 2023. In November, Task 44 participated in the internal IEA Bioenergy workshop 'Regional and flexible value networks' to investigate possible collaboration on the topic with several other Tasks.

Task 44 leads an Inter-Task project on 'Synergies of green hydrogen and bio-based value chains deployment'. The project was started in June 2022 and the work focuses at the moment on the collection of case studies on hydrogen from biomass and hydrogen use in bio-based processes as well as defining the scope and KPIs for the case study assessment. A fruitful hybrid meeting was held in October in Vienna. Task 44 also participated in the kick-off meeting of Inter-Task project 'Management of Biogenic CO2 - BECCUS Inter-Task Phase 2' in June 2022.

Task 44 organized the first and long-awaited hybrid Task meeting since Covid-19 pandemic in Leipzig, Germany in September 2022, hosted by DBFZ. The event included important discussions on status of flexible bioenergy and energy transition in different countries, lab tours at DBFZ facilities, and a workshop on 'Flexible bioenergy and energy crisis'. Task 44 has had altogether one physical and three virtual meetings in 2022.

Figure 9. Task 44 hybrid meeting in Leipzig (Germany), September 2022

Task 45 - Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy

Task 45 participated in the organizing committee for the 2nd International Conference on Negative CO2 Emissions, which took place in Gothenburg, Sweden, June 14-17, 2022. During the conference, Task 45 members chaired sessions and also contributed to the invited panel presentation on carbon dioxide removal methods, and their role in meeting Net Zero. The purpose of this conference series is to bring together a wide range of scientists, experts and stakeholders, in order to engage in various aspects of research relating to negative CO2 emissions. About 300 delegates registered for the conference, and 140 papers were accepted for presentation at the conference.

Task 45 members have published scientific papers reporting results from three studies of dedicated biomass production on agriculture land in the European Union (EU). Two of the studies concern the cultivation of lignocellulosic crops on marginal/abandoned agriculture land and one study concerns the introduction of grass and ley cultivation in crop rotations dominated by annual crops. The studies show that lignocellulosic crops grown on agriculture lands can make an important contribution to bioenergy supply in the EU. Besides climate change mitigation and improved energy security, appropriate deployment of crop cultivation systems can provide co-benefits such as soil carbon sequestration and reductions in nitrogen emissions to water as well as wind and water erosion. The papers are open access and can be downloaded via the doi links below:

- https://doi.org/10.1111/gcbb.12867
- https://doi.org/10.1016/j.eiar.2022.106942
- https://doi.org/10.1111/gcbb.13015

Task 45 participated in the Inter-task Project on Lessons Learned and conducted an analysis on "successes and lessons learned for biofuel deployment" for advanced as well as conventional biofuels. Biofuels that were evaluated include: Ethanol (Sugar cane 1G), Brazil; Ethanol (Sugar cane 2G), Brazil; Ethanol (Corn 1G), Brazil; Ethanol (Corn 1 G), USA; Ethanol (Cellulosic various 2G), Europe; Biodiesel (FAME), Brazil; HVO, Europe; Biomass to Liquid (BTL)/ DME, Sweden; Biosynthetic Natural Gas (SNG), Sweden. Relevant studies were screened and indicators were established that made it possible to compare different biofuels. Indicators included policies, feedstocks, products, technologies, economics, environmental issues, social aspects, scalability and ease of implementation and reproduction in different countries or regions. The group concluded from the case studies that it is possible to supply large amounts of biofuels to help replace fossil fuels and reduce global warming. Another key conclusion was that expansion of biofuel production and the replication of successful country or regional models is challenged by the dependency on crop feedstock availability and price fluctuations that limit production, as shown by changes and postponements of mandates in several countries. Recent developments are described, and markets discussed.

Publications

https://www.ieabioenergy.com/iea-publications/

Assessment of Bio-hubs in Canada

Bioenergy from forest biomass can play an important role in Canada's transition to a low-carbon economy, considering its huge forest resources. This report – produced in the frame of IEA Bioenergy Task 43 (biomass supply) – presents a first-of-its-kind study on the assessment of bio-hubs in Canada.

Read more

Economic and operational feasibility of establishing Biohubs in the Private Native Forests of SouthEast Queensland, Australia

A biohub is a local/regional connection between supply and market demand of biomass. This report – produced in the frame of IEA Bioenergy Task 43 (biomass supply) – presents a case study to evaluate the financial and operational viability of biohubs in SouthEast Queensland, Australia.

Read more

Integrated land management using small-scale harvesting operations for biomass utilization

This study – produced in the frame of IEA Bioenergy Task 43 (biomass supply) – reports research conducted to evaluate small-scale biomass harvesting as a silvicultural thinning treatment for forest management in the Private Native Forests (PNF) of Southeast Queensland, Australia.

Read more

Environmental impacts of perennial grasses on abandoned cropland in Europe

This study quantifies spatially explicit the primary energy potentials and associated potential environmental impacts of large-scale deployment of three perennial grasses (miscanthus, switchgrass, and reed canary grass), on abandoned cropland in Europe.

Read more

Position Paper – The role of biogas and biomethane in pathways to net zero

This position paper – developed by members of IEA Bioenergy Task 37 ("Energy from Biogas") – provides central knowledge and features of biogas and biomethane. The main conclusion is that biogas and biomethane have plenty of options to be used in a pathway to net zero.

Read more

Widespread deployment of grass in crop rotations – A multifunctional climate mitigation strategy

Strategic establishment of perennial plants in agricultural landscapes can provide environmental benefits while maintaining total biomass production. One option is to include grass in rotations with annual crops to provide biomass while remediating soil organic carbon losses and other environmental impacts.

Read more

Valuable products and by-products of biomass gasification – Task 33 Workshop Report

IEA Bioenergy Task 33 (Gasification of biomass and waste) organised a workshop in Vienna on 19 October 2022 showing actual developments in products / by-products from biomass and waste gasification pathways.

Read more

Gasification based biorefineries – technical, economic and environmental (TEE) assessment for specific case studies

This report, developed by IEA Bioenergy Task42 (Biorefining in the Circular Economy) in cooperation with members of IEA Bioenergy Task 33 (Gasification of biomass and waste), is focused on case studies for gasification based biorefineries.

Read more

Sustainability assessment of ethanol and biodiesel production in Argentina, Brazil, Colombia, and Guatemala

This study assesses the production, land use, environmental impacts, and energy balance associated with ethanol and biodiesel production in Argentina, Brazil, Colombia, and Guatemala. The official data for each country are used to quantify the biofuel production and land required for their production.

Read more

Inventory of national strategies for reducing the impact on air quality from residential wood combustion

Reduction of air pollution is a major societal goal, and great efforts are currently undertaken. Over the last 30 years, significant progress has been made, but wood combustion remains a significant source of air pollution, particularly for carbon monoxide (CO) and particulate matter (PM) emissions.

Read more

Advanced Test Methods for Pellet Stoves

Pellet stoves become more popular as renewable and sustainable heating technology in Europe. Compared to manually operated firewood room heating appliances pellet stoves are featured with an automatic fuel supply into the combustion chamber and offer various options for an automatic as well as low-maintenance operation.

Read more

Technical Guidelines for the Design of Low Emission Wood Stoves

This report summarizes the experience from several recent research and development projects for low-emission wood stoves. The guidelines in this report focus on technological measures, e.g., stove design, flue gas cleaning and automatic control systems.

Read more

Supply potential of lignocellulosic energy crops grown on marginal land in the EU

This study quantifies spatially explicit the availability of marginal land in the EU, its production biomass potentials for eight different crops, and the greenhouse gas (GHG) performance of advanced biofuel supply chains.

Read more

Press Release – Biomethane expansion provides local alternatives for imported gas and synthetic fertiliser

The major advantage of biomethane production is that it can be produced from local resources and immediately fed into the existing infrastructure. This reduces dependence on energy imports, especially from Russia.

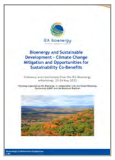
Read more

Global biorefinery status report

The Global Biorefinery Status Report of IEA Bioenergy Task 42 (biorefining) provides an overview of recent biorefinery developments. The report gives a description of the current situation of biorefineries in a representative selection of countries: how many biorefineries exist, which types, which feedstocks, which technology, what products, etc.

Read more

WS27 Summary Report: Bioenergy and Sustainable Development – Climate Change Mitigation and Opportunities for Sustainability Co-Benefits



IEA Bioenergy held its biannual workshop on 23-24 May 2022 in conjunction with its Executive Committee meeting (ExCo89). The workshop on 'Bioenergy and Sustainable Development' was held in virtual form and was organised in collaboration with the Global Bioenergy Partnership (GBEP) and the Biofuture Platform.

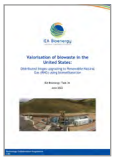
Read more

Industrial end-users' preferred characteristics for wood biomass feedstocks

The use of sustainably sourced biomass is an important tool for mitigating the effects of climate change; but biomass is far from being a homogeneous resource. Biohubs are increasingly recognized as important part in an effective raw material supply chain for pulp and paper and biomaterial industries and the energy sector.

Read more

Valorisation of biowaste in the United States through anaerobic digestion and distributed biogas upgrading to Renewable Natural Gas through biomethanation



Decentralized solutions for resource and energy recovery from waste streams are a critical aspect of the circular economy. For key fractions of organic waste such as food waste, municipal sludge, fats, oils, and greases, amongst others, they are highly correlated with population.

Read more

Position Paper – Sustainable Natural Gas production through gasification

Sustainable natural gas (SNG) is methane produced from biogenic feedstocks, also referred to as biomethane. These feedstocks are for instance forest residues, agro residues or waste streams containing plastics (MSW). With Russia's aggression against the Ukraine, the dependency on fossil natural gas is reconsidered.

Read more

Co-recycling of natural and synthetic carbon materials for a sustainable circular economy

This work presents an alternative vision to the management of carbon-based materials that integrates the two cycles and enables the phasing-out of fossil carbon from the material system. The aim is to investigate the benefits and global potential of a co-recycling system, as an alternative to conventional recycling systems.

Read more

LCA and negative emission potential of retrofitted cement plants under oxyfuel conditions at high biogenic fuel shares

In this paper, authors perform a prospective life cycle assessment of two state-of-the art cement plants, one in Sweden and one in Germany, under conventional and retrofitted oxyfuel conditions considering alternative fuel mixes with increasing bio-based fractions of forest residues or dedicated bioenergy crops.

Read more

Electrochemical transformations of fast pyrolysis bio-oils and related bio-oil compounds

Electrochemical reactions leading to deoxygenation of organic compounds are likely to reduce the bio-oils' acidity while increasing its stability and energy content. This could improve the long-term storage of pyrolysis liquids, thereby enabling subsequent upgrading treatments to further improve biofuel quality.

Read more

Turning Circle: How bioenergy can supercharge Australia's circular economy

The report highlights that by shifting from a linear waste management model to a circular economy, Australia can move from being one of the highest per capita waste generators in the world to a recycling and remanufacturing powerhouse.

Read more

IEA Bioenergy Events

Executive Committee

ExCo91 will be held online on 15-18 May 2023

ExCo workshop WS29 "Opportunities of biofuels/ bioenergy in emerging economies" will be held online in May 2023

Task Events

Task 44 will hold an online workshop on "Flexibility in energy system modelling" in February 2023

Task 37 will hold a workshop on "Economics of the biogas production and utilisation process" in Bangalore, India, in May 2023

Task 45 will hold an online workshop on "Forests, forestry and carbon balances: importance of policies and forest sector responses" in the first quarter of 2023

Webinars

A webinar organised by inter-task project "Lessons learned - Biofuels" will be held in February 2023

Exact date and title will be announced in due course.

Other Events

23-24 January 2023
20th International Conference on Renewable Mobility 'Fuels of the Future'
Berlin, Germany

1-2 February 2023
Nordic Pellets Conference 2023
Stockholm, Sweden

8-9 February 2023
Bio360 Expo
Nantes, France

8-9 February 2023
Lignofuels 2023
Helsinki, Finland

13-17 February 2023
17th International European Forum on System Dynamics and InNovemberation in Food Networks (Igls-Forum)
Garmisch-Partenkirchen, Germany

15-16 February 2023
European Biomass to Power
London, United Kingdom

28 February - 2 March 2023
International Biomass Congress & Expo 2023
Georgia, United States

28 February - 3 March 2023
World Sustainable Energy Days
Wels, Austria

1 March 2023
European Pellet Conference
Wels, Austria

22-23 March 2023
Enlit Australia
Melbourne, Australia

18-20 April 2023
Argus Biomass Conference
London, United Kingdom

18-20 April 2023
Waste Management Europe
Bergamo, Italy

25-26 April 2023
Value of Biogas East Conference
Toronto, Canada

9-11 May 2023
EXPOBIOMASA 2023
Valladolid, Spain

10-11 May 2023
World Bio Marchkets
The Hague, Netherlands

15-16 May 2023
REGATEC 2023
Berlin, Germany

5-8 June 2023
31st EUBCE
Bologna, Italy

27-28 June 2023
CEP Conference 2023
Wellington, New Zealand

25-26 July 2023
Connecting Green Hydrogen APAC 2023
Melbourne, Australia

12-13 October 2023
Biofuels 2023
London, United Kingdom

24-26 October 2023
European Biogas Conference
Brussels, Belgium

26-28 October 2023
2nd Global Conference on Biofuels and Bioenergy
Boston, United States

See the full calendar of events here.

Key IEA Bioenergy Contacts

Postal Address: Viale Giuseppe Garibaldi, 10. 50026 San Casciano in Val di Pesa (FI), Italy - Website: www.ieabioenergy.com

Secretary
Andrea Rossi
Tel: +39 340 392 0625
Email: arossi(at)biosmartstrategies.com

Technical Coordinator
Luc Pelkmans
Tel: +32 492 97 79 30
Email: luc.pelkmans(at)caprea.be

Newsletter Editor
Marco Luschi
Tel: +39 055 500 22 80 (int. 212)
Email: marco.luschi(at)etaflorence.it

Executive Committee

AUSTRALIA
Dr Mark Brown
Director of the Forest Research Institute
Locked Bag 4
University of the Sunshine Coast
Maroochydore DC
Queensland 4558
Email: mbrown2(at)usc.edu.au

AUSTRIA
Mr Hannes Bauer
Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology
Radetzkystrasse 2
1030 WIEN
Email: hannes.bauer(at)bmk.gv.at

BELGIUM
Dr Thibaut Masy
Centre wallon de Recherches agronomiques
Bâtiment Francini
Chaussée de Namur 146
5030 Gembloux
Email: t.masy(at)cra.wallonie.be

BRAZIL
Dr Pietro Adamo Sampaio Mendes
Director of Biofuels
Ministry of Mines and Energy
Esplanada dos Ministérios, Bloco U, 9° Andar
70 065-900 – BRASILIA - DF
Email: pietro.mendes(at)mme.gov.br

CANADA
Mr Oshada Mendis
Deputy Director, Clean Fuels Portfolio
Office of Energy Research & Development
Natural Resources Canada
580 Booth Street, 14th floor
OTTAWA, Ontario K1A 0E4
Email: oshada.mendis(at)canada.ca

CHINA
Dr Dongming Ren
Director of the Renewable Energy Center, ERI
B1418, Guohong Mansion, Jia No. 11 Muxidi Beili
Xicheng District, Beijing 100038
Email: rendm(at)eri.org.cn

CROATIA
Mr Andro Bacan
Head of Dept. for Renewable Energy Sources
Climate and Environmental Protection
Energy Institute Hrvoje Pozar
Savska cesta 163
10000 Zagreb
Email: abacan(at)eihp.hr

DENMARK
Ms Ane Katharina Paarup Meyer
Special Advisor
Danish Energy Agency –
Centre for Energy Administration
Niels Bohrs Vej 8D
6700 Esbjerg
Email: akpm(at)ens.dk

ESTONIA
Mr Kristo Kaasik
Head of Renewable Energy Area
Ministry of Economic Affairs and Communications
Suur-Ameerika 1
10133 Tallinn
Email: Kristo.Kaasik(at)mkm.ee

FINLAND
Mr Jussi Mäkelä
Senior Advisor
Business Finland
Kelevantie 2
FI-33100 Tampere
Email: jussi.makela(at)businessfinland.fi

FRANCE
Ms Emilie Machefaux
Cheffe de service adjointe
Service Forêt, Alimentation et Bioéconomie
20 avenue du Grésillé
BP 90406
49004 ANGERS Cedex 01
Email: emilie.machefaux(at)ademe.fr

GERMANY
Mr Birger Kerckow
Fachagentur Nachwachsende Rohstoffe e.V. (FNR)
Hofplatz 1
18276 Gülzow
Email: B.Kerckow(at)fnr.de

INDIA
Shri Sunil Kumar
Joint Secretary (Refinery)
Ministry of Petroleum & Nat. Gas
Shastri Bhawan
New Delhi – 110001
Email: jsr.png(at)nic.in

IRELAND
Mr Luis Gay-Tarazona
Programme Manager, Bioenergy
Sustainable Energy Authority of Ireland
3 Park Place
Hatch Street Upper,
Dublin 2
Email: luis.gaytarazona(at)seai.ie

ITALY
Mr Luca Benedetti
Head – Energy Studies and Statistics
Gestore dei Servizi Energetici (GSE)
Viale Maresciallo Pilsudski, 92
00197 ROME
Email: luca.benedetti(at)gse.it

JAPAN
Mr Takahisa Yano
Director Biomass Group
New Energy Technology Dept. NEDO
Muza Kawasaki Central Tower 15F
1310 Ohmiyacho, Saiwai-ku, Kawasaki,
KANAGAWA 212-8554
Email: yanotkh(at)nedo.go.jp

REPUBLIC OF KOREA
Dr In-Gu Lee
Principal Researcher
Biomass and Wastes to Energy Laboratory
Korea Institute of Energy Research (KIER)
152, Gajeong-ro, Yuseong-gu
Daejong, 34129
Email: samwe04(at)kier.re.kr

THE NETHERLANDS
Mr Bas Heukels
Advisor Sustainable Bioresources
Netherlands Enterprise Agency
Ministry of Economic Affairs and Climate Policy
PO BOX 8242,
3503 RE UTRECHT
Email: bas.heukels(at)rvo.nl

NEW ZEALAND
Dr Paul Bennett
Science Leader Clean Technologies
Scion
Te Papa Tipu Innovation Park
Private Bag 3020
Rotorua
Emal: paul.bennett(at)scionresearch.com

NORWAY
Mr Per Arne Karlsen
The Research Council of Norway
Department for Energy Research
Postboks 564,
1327 Lysaker
Email: pak(at)rcn.no

SOUTH AFRICA
Dr Karen Surridge
Programme Manager Renewables
South African National Energy Development Institute
Block C, Upper Grayston Office Park
152 Ann Crescent, Strathavon
SANDTON, 2146
Email: karenst(at)sanedi.org.za
Web: www.sanedi.org.za

SWEDEN
Mr Jonas Lindmark
Swedish Energy agency
Box 310
SE-631 04 ESKILSTUNA
Email: jonas.lindmark(at)energimyndigheten.se

SWITZERLAND
Dr Sandra Hermle
Energy Research Specialist, Bioenergy
Federal Department of the Environment, Transport, Energy and Communications DETEC
Swiss Federal Office of Energy SFOE
Renewable Energy
Pulverstrasse 13, 3063 Ittigen
Postal address:
Swiss Federal Office of Energy (SFOE)
Energy Research
BERN, CH – 3003
Email: sandra.hermle(at)bfe.admin.ch

UNITED KINGDOM
Mr Peter Coleman
Head of Bioenergy & Land Use Science
Department for Business, Energy & Industrial Strategy
Science & Innovation for Energy & Climate Directorate
1 Victoria Street
London, SW1H 0ET
Email: peter.coleman(at)beis.gov.uk

UNITED STATES OF AMERICA
Mr. Jim Spaeth
Bioenergy Technologies Office
System Development & Integration
Program Manager, Energy Efficiency and Renewable Energy
U.S. Department of Energy
15013 Denver West Parkway
GOLDEN, CO 80401
Tel: +1 720 356 1784
Email: jim.spaeth(at)ee.doe.gov

EUROPEAN COMMISSION
Ms Maria Georgiadou
Senior Expert
European Commission, Directorate-General for Research & Innovation
Unit Clean Energy Transition
Rue Champ de Mars 21, 1050 Brussels, CDMA 03/003
BELGIUM
Email: Maria.GEORGIADOU(at)ec.europa.eu

Tasks

Task 32: Biomass Combustion
Morten Tony Hansen
Ea Energy Analyses, Denmark
Email: mth(at)eaea.dk
Web: task32.ieabioenergy.com

Task 33: Gasification of Biogenic Residue and its Applications
Berend Vreugdenhil
Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek (TNO), The Netherlands
Email: berend.vreugdenhil(at)tno.nl
Web: task33.ieabioenergy.com

Task 34: Direct Thermochemical Liquefaction
Axel Funke
Fast Pyrolysis Group
Karlsruhe Institute of Technology (KIT), Germany
Email: axel.funke(at)kit.edu
Web: task34.ieabioenergy.com

Task 36: Material and Energy valorisation of waste in a Circular Economy
Mar Edo, Ph.D.
RISE Research Institutes of Sweden
Box 857, SE-501 15 Borås
SWEDEN
Email: mar.edo(at)ri.se
Web: task36.ieabioenergy.com

Task 37: Energy from Biogas
Jan Liebetrau
Rytec LLC
Pariser Ring 37
76532 Baden-Baden
Germany
Email: jan.liebetrau(at)rytec.com
Web: task37.ieabioenergy.com

Task 39: Biofuels to Decarbonize Transport
Tomas Ekbom
SVEBIO
Kammakargatan 22
SE-111 40 Stockholm
Sweden
Email: tomas.ekbom(at)svebio.se
Web: task39.ieabioenergy.com

Task 40: Deployment of biobased value chains
Uwe R. Fritsche
IINAS – International Institute for Sustainability Analysis and Strategy, Germany
Email: uf(at)iinas.org
Web: task40.ieabioenergy.com

Task 42: Biorefining in a Circular Economy
Bert Annevelink
Wageningen Food and Biobased Research (WFBR), The Netherlands
Email: bert.annevelink(at)wur.nl
Web: task42.ieabioenergy.com

Task 43: Biomass Supply in Sustainable and Circular Economies
Professor Mark Brown
Director of the Forest Industries Research Group
Forest Industries Research Group (ML16)
Locked Bag 4
University of the Sunshine Coast
Maroochydore DC, QLD 4558
AUSTRALIA
Email: mbrown2(at)usc.edu.au
Web: task43.ieabioenergy.com

Task 44: Flexible bioenergy and system integration
Elina Mäki
VTT Technical Research Centre of Finland Ltd, Finland
Tel: +358 40 648 6799
Email: elina.maki(at)vtt.fi
Web: www.task44.ieabioenergy.com

Task 45: Climate and sustainability effects of bioenergy within the broader bioeconomy
Göran Berndes
Department of Space, Earth and Environment
Chalmers University of Technology, Sweden
Tel: +46 31 772 3148
Email: goran.berndes(at)chalmers.se
Web: www.task45.ieabioenergy.com

For further Task contact details please visit:

IEA bioenergy.com