Technology Collaboration Programme
by IEA

Bioenergy News

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IEA Bioenergy
Technology Collaboration Programme

Accelerating to Net Zero

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Bioenergy in a Net Zero Future

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IEA Bioenergy – ADEME workshop

The IEA Technology Collaboration Programme on Bioenergy (IEA Bioenergy) held its biannual workshop on 19 October 2023 in Lyon (France), in conjunction with its Executive Committee meeting (ExCo92). The workshop on 'Bioenergy in a Net Zero Future' was in hybrid form, with mostly physical and a few remote presentations and was organised in collaboration with ADEME, the French Agency for Ecological Transition. The workshop consisted of three parts:

1. The role of bioenergy in energy transition strategies, followed by a panel discussion.
2. Flexible bioenergy and the use of biogenic CO2 in future energy systems.
3. Promising developments in bioenergy concepts.

The workshop had around 80 physical participants in Lyon. More than 200 people followed the workshop online. The PowerPoint presentations and recordings are available for downloading from the IEA Bioenergy's website (link).

Key messages from the workshop

Modern bioenergy is one of the pillars of the energy transition. In the IEA Net Zero Emissions by 2050 roadmap (NZE), modern bioenergy is projected to triple from now to 2050, while at the same time traditional uses of biomass are phased out. Altogether, bioenergy represents 15-20% of total energy needs in 2050 in the IEA NZE roadmap. The demand for biomass would be within conservative estimates of biomass potentials. A reduced contribution of bioenergy - i.e. excluding or reducing below current levels - would cause dramatically increasing system costs to achieve the 2050 climate targets. This would lead to much higher challenges to balance intraday and seasonal fluctuations related to the high share of variable renewables in the energy system; make it much more expensive to provide fuels for difficult to abate transport sectors; and imply much higher levels of Direct Air Capture (DAC), which is far more expensive than capturing biogenic CO2 from bioenergy systems.

Feedstock mobilization is one the main challenges for bioenergy deployment. This requires setting up efficient collection systems; investing in biomass crops, particularly on marginal/abandoned lands; and developing approaches with local biohubs to facilitate logistics. On technology side, it is also critical to support the development and deployment of advanced technologies that can cope with wide ranges of (low quality) biomass feedstocks. While substantial amounts of sustainable biomass are available and/or can be mobilized, the resource base still has its limits. To maximize the GHG emission reduction impact, prioritisation of certain bioenergy applications may be required to make the best use of the available biomass feedstocks. Connecting bioenergy systems with CO2 capture (BECC) strongly enhances the carbon efficiency and value of biomass towards net zero energy systems. The captured biogenic CO2 from bioenergy systems can be used for permanent storage (BECCS), or for the production of additional renewable chemicals and fuels, when combined with renewable hydrogen (BECCU). The growing demand for e-fuels in the long term for long distance transport will require substantial amounts of biogenic CO2 (from bioenergy systems) or atmospheric CO2 (captured through DACC), with biogenic CO2 being much less costly or energy intensive. While GHG emission reduction and moving away from fossil fuels is priority in the next decades, reaching net zero by 2050 and net negative GHG emissions thereafter requires high amounts of carbon dioxide removal (CDR) from the atmosphere. Long term storage of captured biogenic CO2 from bioenergy projects is one of the key CDR options, with the unique advantage that BECCS provides a combination of both carbon storage and renewable energy provision. Large scale BECCS projects are starting to take off and becoming a reality, also in terms of business case, with carbon storage / negative emissions being financially rewarded in markets.

IEA Bioenergy
Technology Collaboration Programme

From the Secretariat

Andrea Rossi
ExCo Secretary

The 92nd meeting of the Executive Committee was held in Lyon, France on 17-19 October 2023, with Dina Bacovsky as Chair, Mark Brown and Birger Kerckow as Vice-chairs and Andrea Rossi as Secretary. The third day was dedicated to a workshop titled 'Bioenergy in a Net Zero Future' (see the dedicated section on page 1). The meeting was hosted by the French Agency for Ecological Transition (ADEME). The Chair expressed her gratitude to the French Agency for Ecological Transition (ADEME) for hosting the ExCo92 meeting, and she thanked ADEME's Emilie Machefaux and Aurelie Bichot for organizing the meeting.

Attendees at the ExCo92 meeting, Lyon (France), 17-19 October 2023

Changes to Executive Committee

A new Alternate Member for France was Ms Aurélie Bichot; a new Alternate Member for Ireland was Mr Owenroe Lemass; a new Member for Korea was Dr Jeong Hwan Bae, and a new Alternate Member was Mr Dongho Shin; a new Alternate Member for the Netherlands was Mr Jeroen Kruk; and a new Alternate Member for the United Kingdom was Dr Zoe Harris.

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. The main achievements since the ExCo91 meeting (May 2023) include: selection of the case studies and development of the template to be used to present them; completion of the case study templates by the relevant Tasks; organization of an expert workshop on modelling energy system services (under WP4), with a focus on general system modelling and modelling renewable hydrogen in particular; and launch of an Inter-task project page (link) on the Task 44 website.

Inter-Task project – Management of Biogenic CO2: BECCUS Inter-task Phase 2
This is a follow-up to the project 'Deployment of BECCUS Value Chains' (final publications available here). This Phase 2, 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. The main achievements since the ExCo91 meeting (May 2023) include: identification of KPIS for the assessment of case studies; achievement of preliminary results of the modelling case on installing a full-scale carbon capture facility at an existing large biomass CHP plant; organization of an expert workshop on 'Biomass combustion and CCUS' (August 2023); participation in the EERA event 'Carbon sinks in Europe: stakeholders taking action to bring out the next solutions for carbon neutrality' (September 2023), and in an Intra-Task meeting on Industry-Based Biorefineries for Sustainability of the Industrial Energy-Related Technologies and Systems (IETS) TCP (August 2023).

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. The final results of the project (link) were presented at a hybrid seminar that was held in September 2023 at the Advanced Biofuels Conference 2023 (Gothenburg, Sweden). The key message emerging from the project is that there needs to be continuous work on harmonized, clear long-term policies that allow improvement of established biofuel options as a base for decarbonization in transport, and RD&D for innovations of advanced biofuels, including hybrids with other renewables.

Communication Strategy

The Communications Team has continued with regular online meetings to oversee communications' activities and review progress with ETA Florence. Two IEA Bioenergy webinars were held in June and September 2023, and these can be viewed along with all previous webinars on the IEA Bioenergy website (link). The social media statistics showed increased numbers of followers on LinkedIn. A WeChat account has been opened. Regarding the website, users were in the same range as last year (or slightly higher), indicating the need for continued efforts. The transfer of the Tasks' websites to the new IEA Bioenergy design has been completed.

Building upon the recommendations put forward by the Communication Specialist MFM, the Communications Team has initiated a number of actions to improve the effectiveness and impact of IEA Bioenergy's communication. Among other things, the Team is overseeing the development of a set of factsheets to summarize the scientific evidence on the environmental and socio-economic benefits of sustainable bioenergy production and use.

Collaboration with other International Initiatives

Collaboration with the International Energy Agency (IEA), other IEA Technology Collaboration Programmes (TCPs) and International Organisations has continued. Under the Inter-task projects described above, exchanges were held with the Advanced Motor Fuels (AMF) TCP, the Hydrogen TCP, the Energy Technology Systems Analysis Program (ETSAP) TCP and the Industrial Energy-Related Technologies and Systems (IETS) TCP. The TCP Universal Meeting (Paris, October 2023) provided an additional opportunity to exchange views, discuss issues of common interest, and identify further collaboration opportunities with these and other TCPs and with the IEA Secretariat. At the ExCo92 meeting, it was decided to initiate an informal collaboration with the UNIDO-led Council on Ethanol-based Clean Cooking (CECC). The IEA Bioenergy TCP also continues to work closely with FAO, the Global Bioenergy Partnership (GBEP), the Clean Energy Ministerial (CEM) Biofuture Platform Initiative and the Mission Innovation (MI) Integrated Biorefineries, to implement collaborative activities in the field of bioenergy, with a focus on biofuels and biorefineries.

Renewal of TCP Term and planning for next triennium

At the ExCo92 meeting, it was decided to request the extension of the IEA Bioenergy TCP for the 2025-2030 Term. A strategic session was held, to brainstorm on the Strategic Objectives and related Priority Research Areas for the new Term; and to discuss planning for the next triennium (2025-2027), including the identification of key research topics to be addressed by IEA Bioenergy and its Tasks.

ExCo92 Study Tour

Following the ExCo92 meeting, a group of IEA Bioenergy attendees participated in the study tour, which included site visits to the Surville biomass heating plant (link), and to the Gaya demonstrator (link). The former is the largest public biomass heating plant in France. With three boilers of 17 MW, it provides heating and hot water to 45,000 homes. Gaya, which was built under a project co-financed by ADEME, is a cutting-edge R&D and highly automatized demonstration plant to produce bio/low carbon fuels from biomass & waste pyrogasification, with the first focus on biomethane/bio-SNG production. The process has now been validated at TRL 7-8 and the production chain has successfully been proven to be robust and flexible to convert several feedstocks. This is paving the way towards the industrialisation and market uptake of biomethane production from gasification, with concrete steps to a 20 MW commercial plant in Le Havre (Salamandre project), which is scheduled to be in operation from 2026.

ExCo92 Study Tour group at the Gaya demonstrator

BBEST & IEA Bioenergy Conference 2024

Bioenergy and bioproducts:
Accelerating the transition towards sustainability

October 22nd to 24th, 2024
São Paulo – Brazil
Hotel Renaissance

WE NEED A LOT MORE BIOENERGY TO KEEP THE 1.5°C GOAL IN REACH

CHALLENGES

- Modern bioenergy applications to triple
- Phase-out traditional uses of solid biomass, moving to clean and more efficient uses of biomass
- Expand the access to biomass feedstocks
- Develop/deploy advanced technologies for a wide range of feedstocks
- Create a more level policy playing field for the use of biomass for biofuels, chemicals and materials

THEMES

- **Land use**
- **Agricultural productivity**
- **Sustainability from sourcing to end use**
- **Logistics and scale**
- **Novel biomass conversion technologies**
- **Bioproducts and advanced materials**
- **Development of biorefineries, bioelectricity, power and heat**
- **Biofuels for air, sea and road transport**
- **Biogas, Biomethane, Biohydrogen**
- **Carbon capture and negative emissions**
- **Strategies for the circular carbon economy**

IMPORTANT DATE:

Registration and abstract submissions for posters and oral presentations opens March 10th, 2024

SCAN ME

More information: bbest-ieabioenergy.org

BBEST Brazilian Bioenergy Science and Technology Conference

IEA Bioenergy Technology Collaboration Programme

Task Focus:

Commercial development of fast pyrolysis and hydrothermal liquefaction

Axel Funke (Task 34)

Fast pyrolysis and hydrothermal liquefaction (HTL) have been developed for several decades to enable production of bio-based liquid energy carriers and commodities from lignocellulosics, such as e.g. wood residues. While it obvious that there has been no break-through in market uptake of these technologies, yet, we do observe very strong and promising activities in the past years that will be discussed in the following to provide an up to date overview. Given the flexibility in suitable feedstocks and the versatility of the resulting liquid product, which are important characteristics for true bio-based commodities[1], both processes are able to support the energy transition towards a net zero CO2 emission society and enable efficient bio-based value chains.

State of the Art

Fast pyrolysis is a technology that can be confirmed TRL 9 in that there are several commercially operating facilities and also several technology providers available with varying process concepts since several years. One example of a commercial fast pyrolysis installation has been described in detail as part of a larger IEA Bioenergy report around alternatives to provide bio-based high temperature process heat[2]. Some key figures of this installation have been summarized in Figure 1. It impressively shows the ability of fast pyrolysis to retain a large fraction of energy within the liquid product while efficient design/operation allows for the supply of surplus heat, potentially even together with power if said surplus heat is used to run e.g. a Rankine cycle.

The main product fast pyrolysis bio-oil is directly used to replace fossil fuels in industrial scale boilers, for which internationally relevant standards exist[3]. The existence of such standards required intense method development to achieve meaningful and reproducible parameters for this specific, previously unused matrix. This is a process that was intensively supported by Task 34 in the past[4] and also recent years[5]. Another important bottleneck in the commercialization of this technology was the necessity for registration to allow trading in local markets, such as e.g. REACH registration in the EU and TSCA in the USA. This has been concluded for fast pyrolysis bio-oil[6], but since this is a 'substance of unknown or variable composition' modifications in feedstock, plant design, operating conditions and/ or downstream fractionation might demand for additional registration processes. Added value uses of fast pyrolysis bio-oil are currently being developed. Notably, co-processing of fast pyrolysis bio-oil in fossil refineries is being demonstrated at scale to increase the share of renewable carbon in their products such as e.g. transportation fuels[7]. Other chemical and material uses are being developed at lower TRL; some examples can be found in the newsletter of Task 34[8]. HTL is in a different stage of development as compared to fast pyrolysis. At the moment there are several companies active in demonstrating this technology at scale, i.e. it can be categorized TRL 8. Given the development status, less information is available about the performance of industrial scale facilities. Some indications are provided in Figure 2 to illustrate differences to fast pyrolysis. It is well known that HTL is capable of achieving higher energy yield in the liquid main product; at the same time process integration of by-products is more complex and subject to current process development. Depending on the specific technical solutions, energy demand side of the process (electricity/ natural gas) is directly affected and can be potentially reduced. The commercial use of the main product bio-crude is also under development and the general tendency appears to be either for co-processing in existing refineries (near term) or stand-alone hydrotreatment (mid to long term) to produce liquid transportation fuels. To the best of our knowledge, there are no existing product standards and no completed registration file for market introduction as tradeable product (e.g. REACH/ TSCA) as of today. Surely, the expertise gained and disseminated during the challenges of FPBO market introduction can be of use to ramp up HTL biocrude market introduction more efficiently[4–6].

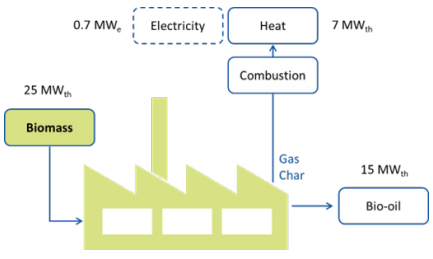

Figure 1: Example of a commercial fast pyrolysis unit based on wood (residues), adapted from[2].

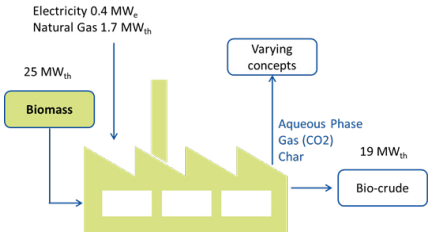

Figure 2: Example of a hydrothermal liquefaction process; figures of the energy balance are indicative and do not necessarily represent results from an available installation.

IEA Bioenergy Task 34 keeps track of commercial activities in the field of direct thermochemical liquefaction, which includes fast pyrolysis and HTL, but also other processes. There was a sharp increase in fast pyrolysis bio-oil production capacity between 2016 and 2020, but very little additional units have been observed after that (see Figure 3). This trend is clearly attributed to missing bio-oil off take, i.e. missing business cases based on slow development of incentives to promote advanced biofuels. In the current market situation, production of transportation fuels based on crops (i.e. HVO and ethanol) are commercially most viable. Technical difficulties in plant operation have been largely resolved for the case of the commercially proven technology providers and are unlikely to be the limiting factor for further market uptake. The case is different for HTL being a technology at a different development stage. Overcoming technical challenges during scale up and proving viability of long term operation at industrial scale is key for the ongoing demonstration projects. Another focus for a commercially viable operation is how to make best use of the by-produced aqueous phase. Naturally, the ongoing demonstration projects are conducted at a reasonably lower nameplate capacity as can be observed from comparing installations in Figure 3. Another challenge closely related to technical viability at scale is the fact that commercial application of biocrude produced from HTL still requires validation for the intended uses.

[1] https://www.ieabioenergy.com/wp-content/uploads/2022/06/Report-2242_IEA-43_To-be-or-not-to-be-a-biobased-commodity_Final-version.pdf
[2] https://itp-hightemperatureheat.ieabioenergy.com/wp-content/uploads/sites/14/2020/10/CS3_T34_-High-temperature-heat-from-pyrolysis-oil-final.pdf
[3] EN 16900 and ASTM D7544
[4] https://task34.ieabioenergy.com/round-robin-archive-2/
[5] https://task34.ieabioenergy.com/wp-content/uploads/sites/3/2021/08/IEA-REACH-related-compounds-in-FPBO-final2.pdf
[6] https://task34.ieabioenergy.com/wp-content/uploads/sites/3/2023/03/IEA-substance-registration-DTL-products-FINAL.pdf
[7] https://task34.ieabioenergy.com/wp-content/uploads/sites/3/2022/02/Success-story-corefining-of-pyrolysis-oil.pdf
[8] https://task34.ieabioenergy.com/pyne-archive-1996-2020/

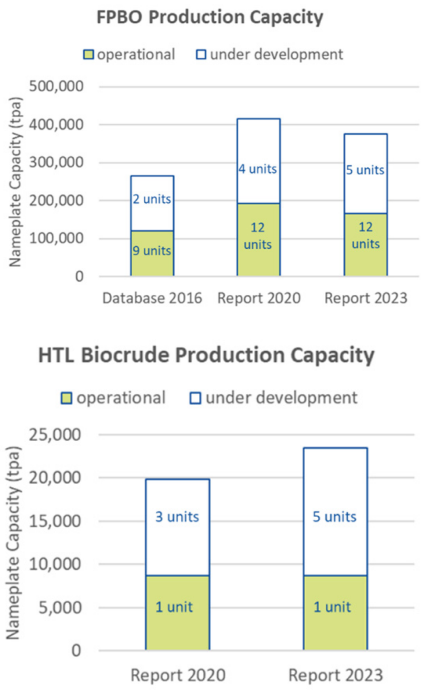

Figure 3: Number and capacity of commercial fast pyrolysis and hydrothermal liquefaction installations[9].

Future Prospects

It is obvious from the different scenarios to achieve net zero emission targets (such as e.g. the IEA Roadmap for the global energy sector[10]) that global biomass supply is limited and that its use must be directed efficiently towards well-defined targets. These targets are typically discussed along the line of hard to abate (i.e. hard to electrify) sectors such as industrial heat, flexible combined heat & power, transportation fuels, and negative CO2 emission technologies. Biomass conversion technologies to cover these hard to abate sectors are often combustion, gasification/ synthesis for transportation fuels and bioenergy with combined carbon capture and storage (BECCS). In many cases, highest emphasize is put on the role of biomass to efficiently create negative CO_2 emissions, but transportation fuels for aviation and marine sector are heavily promoted, too.

The role of fast pyrolysis is less that of a competing technology to above mentioned technical solutions but can be viewed as enabling technology to link diverse biomass resources to the sites of centralized conversion facilities through the supply of a true bio-based commodity1. It is emphasized that fast pyrolysis is capable of playing a vital role in all above mentioned hard to abate sectors and that it can do so in a flexible manner that eases the transition process. Fast pyrolysis bio-oil is applied commercially in industrial scale boilers since several years, which directly opens up the opportunity for bio-based flexible combined heat & power solutions. For the sector of bio-based transportation fuels, co-processing fast pyrolysis bio-oil in existing fossil petroleum refineries is certainly a low hanging fruit with tremendous potential for scaling up fast pyrolysis production capacity. The very same liquid product can also be used to enable efficient, large scale gasification/ syngas production to target synthetic, bio-based transportation fuels (and chemicals)[11]. This leads to the decisive characteristic that there is no lock-in risk related to ramping up fast pyrolysis production capacity because its product can be used flexibly in different biomass value chains depending on future developments in this sector. It is also noted that with catalytic fast pyrolysis, there might even be a shortcut around more complex value chains to achieve bio-based transportation fuels, i.e. with this specific technology there is also a direct competition to gasification that is available at reasonable high TRL 7-8[9].

The contribution of fast pyrolysis to enable BECCS is obvious as a bio-based commodity that enables combustion and/ or gasification. At the same time it is noted that the process itself can be designed to achieve/ promote CO2 negative emissions, to the extent that the produced bio-oil can be associated with substantial negative CO2 emissions over the harvest to production chain. This evaluation is currently being conducted within the larger framework of an IEA Bioenergy report on management of biogenic CO_2[12]. It includes both CO_2 capture/ storage and the possibility to recover biochar from the process.

The future role of HTL is very similar to that of fast pyrolysis in that it produces a commodity and links decentralized (residual) biomass waste streams to efficient central conversion facilities that make use of economy of scale. There are some differences due to product characteristics, e.g. HTL biocrude is typically anticipated for the production of transportation fuels and less as heating fuel. The main difference lies in the technical maturity of the technology, which is somewhat lower for HTL as compared to fast pyrolysis. The huge advantage of HTL is the possibility to convert wet biogenic feedstocks, such as e.g. sewage sludge, without the need of drying.

Summary

After several decades of development it is obvious that fast pyrolysis has reached TRL 9 since several years, with an existing total annual production capacity exceeding 150,000 metric tons. There are additional facilities under development/ construction with a total of 200,000 metric tons annual bio-oil production anticipated. The produced bio-oil is a mature product for application in industrial boilers, with many different added value uses under development (e.g. co-processing in refineries at TRL 8). Fast pyrolysis is a flexible technology that produces a true bio-based commodity that serves all anticipated value chains to address the hard to abate sectors high temperature heat, transportation fuels, and negative CO2 emission technologies. As such it represents a decisive technology to support fast transition towards net zero emission targets.

HTL has the potential to increase the energy recovered in the liquid product as compared to fast pyrolysis. It is a very dynamic field with several technology concepts currently being demonstrated in industrial relevant scale (TRL 8). Applications of the produced biocrude are being developed with a strong focus on aviation and marine fuels. HTL is capable of efficiently processing feedstock with high moisture content, which opens up decisive biogenic resources (such as e.g. sewage sludge) to achieve net zero emission targets. Consequently, its role is very similar to fast pyrolysis in that it provides a liquid, biobased commodity for future biomass value chains.

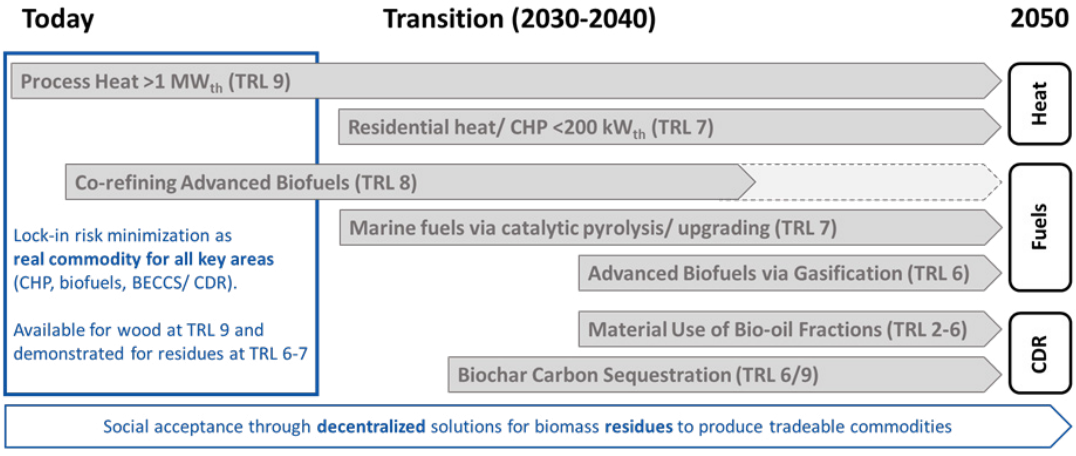

Figure 4: Contribution of fast pyrolysis to achieve net zero CO2 emission targets

[9] https://task34.ieabioenergy.com/wp-content/uploads/sites/3/2023/07/WP3.3-DTL-Final.pdf
https://task34.ieabioenergy.com/wp-content/uploads/sites/3/2020/09/DTL_Commercialization_Overview.pdf
https://task34.ieabioenergy.com/fast-pyrolysis-demoplant-database/

[10] https://www.iea.org/reports/net-zero-by-2050

[11] Dahmen, Nicolaus, and Jörg Sauer. "Evaluation of Techno-Economic Studies on the Bioliq® Process for Synthetic Fuels Production from Biomass." Processes 9, no. 4 (2021): 684.
Task 34 gasification report (unpublished)

[12] https://www.ieabioenergy.com/blog/task/management_of_biogenic_co2/

Notice board

Task 32 - Biomass Combustion

As a part of the BECCUS 2.0 project conducted by several tasks in IEA Bioenergy, Task 32 organised a workshop on 21st September 2023 aiming at describing consequences of installing carbon capture technology at biomass and waste combustion units. The workshop targeted plant operators and highlighted experiences with the development of concrete European projects as well as results of project activities of the BECCUS 2.0 project. Results of the modelling case of installation of a full-scale CC facility at an existing large biomass CHP plant and a study of BECCUS options at smaller scale biomass combustion units were highlighted. The workshop pointed out that there is a gold medal race going on to be the first full scale implementation in Sweden, Norway and Denmark. It also highlighted variation and how local needs can be decisive in the choice of capture technology. More speakers were brave to also share the doubts and open ends they face. The workshop was a hybrid event with speakers present and online and audience online. 89 had registered and 63 participated. Presentations and a recording can be downloaded from the task website (link). As a part of the Alaska Wood Energy Conference, Task 32 on 5 October 2023 held an Expert Roundtable discussing strategies for reducing air pollutants from wood combustion in stressed regions. Wood combustion, particularly in residential applications, is a significant source of air pollution. Task 32 has made an inventory of remedial actions considered by policy makers, regulatory agencies at state, provincial / territorial and municipal governments to control air quality. The purpose of the event was to bring inspirations and experiences across from Europe and North America on strategies for reducing air pollution and it was intended as an exchange between the IEA Bioenergy experts and North American stakeholders. Most of the IEA Bioenergy Task 32 member country representatives were in attendance, allowing a chance for networking and to learn about how the challenge of reaching a large number of wood combustion users is tackled in other countries.

Task 32 experts discussing boiler concept

The event was hybrid with speakers present in Fairbanks and online, and with an online audience. A summary and transcript of the event, along with the presentations from the speakers, can be found on the Task 32 website (link).

Task 32 also contributed with three presentations on emission reduction measures as well as a general overview of Task 32 activities at the conference (link). Task 32 has published three reports in 2023 – available on the Task 32 website (link).

Task 33 – Gasification of Biogenic Residue and its Applications

Task 33 organised the semi-annual meeting in Lyon, France. During this meeting the progress of the task was discussed and all remaining funds have been allocated to relevant projects. The work in the remainder of the triennium will focus on:

- Hydrogen production from gasification, what the current status is world-wide.
- Economy of gasification towards high value applications, using simple metrics to identify the potential.
- Overview on deep gas cleaning needed for catalysis, behind a gasifier, including new developments.
- Gasification update including all Task participating countries.

During the meeting in Lyon, South Africa joined as an observer. They presented some of their developments. South Africa is an interesting country with rather different requirements than other nations. They have a lot of coal and coal based gasification. Their power grid is unreliable and they have vast amounts of biogenic residues. Knowing this, in principle South Africa is a country that could quickly develop into a reliable bioenergy provider. Certainly interesting to follow the developments the coming years. Task 33 also participated in the BEE2023 in Nanchang, China, on invitation by prof. Chen. During the event the task presented some of the ongoing activities and results. These type of activities are crucial in knowledge exchange between nations. During the meeting the Chinese participation in the task was discussed as well and the possibility of the Task joining in the BEE2025 was mentioned. The workshops organized by the task in the past period deal with valuable by-products, hydrogen production or advanced fuel. The main takeaways of these workshops are:

- Clearly something is changing, allowing more gasification projects to be developed.
- Gasification is being applied very broadly nowadays, for CHP, Green Gas, Hydrogen and Fuels.
- More prominent is the creation of added value through co-products, such as bio-char or BTX.
- The role gasification plays with respect to the GHG balance is crucial, since it allows the generation of negative emissions.

Task 34 - Direct Thermochemical Liquefaction

North America shows very dynamic development, with many relevant commercial endeavours in the field of fast pyrolysis and hydrothermal liquefaction to provide bio-based, liquid commodities. A Task 34 workshop gathered many of the involved stakeholders in November 2023 at National Renewable Energy Laboratories in Golden, Colorado, USA. The result was an exciting variety of projects with new technologies and applications ranging from fractionation to carbon sequestration and roadmaps to transportation fuels. A summary of this workshop is available in the PyNe newsletter No 54 (link).

Attendees at the Task 34 workshop,
Golden (Colorado, USA), November 2023

One pathway to transportation fuels from fast pyrolysis is transporting the produced liquids and using them as feed for gasification/ (Fischer-Tropsch or DME) synthesis in a centralized facility that benefits from economy of scale. The crucial step of fast pyrolysis bio-oil gasification has now been the focus of a Task 34 report which highlights its demonstration in MW scale as well as the versatility of application e.g. in existing gasifiers located in refineries and its integration with H2 production (link).

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

Task 36 has a strong focus on exploring new solutions for handling waste to ensure resource and energy recovery as part of a circular system. During 2023, Task 36 has continued with the Regional Sustainability Workshop Series. The second workshop was a virtual one with focus on Organic and Plastic Waste in North America and took place in July; while the last one was about Food Waste in the Irish context, and it was a hybrid event hold in October in Dublin.

Attendees at the Task 36 workshop, Dublin (Ireland), October 2023

The task is already working on the forthcoming workshops for 2024 and we can announce that the next one will be about the topic of Mixed Waste Plastics, and it is expected to be in summer. Task 36 has had altogether three meetings in 2023. The first two were on-line meetings to follow up the work of the task in this triennium and were in February and July. The third one was in Dublin, in October, hosted by University College of Dublin in a hybrid format. This event included discussions on the role of Task 36 in IEA Bioenergy, updates of main topic of interested in the field in the country members or how to improve cooperation with other Tasks and gain visibility. The meeting included a technical visit to Green Generation (link), a company handling both food waste and plastic and a hybrid workshop about Food Waste in Ireland.

Task 37 - Energy from Biogas

In October 2023, IEA Bioenergy Task 37 hold a meeting in the Southwest of Germany. The meeting was hosted by Task Leader Jan Liebetrau and took place in Ringelbach, Germany. The meeting was accompanied by a site visit to a waste based renewable biomethane and CO2 production site. Additionally, the task members visited a mechanical biological treatment facility for municipal solid waste, which includes an anaerobic digestion facility. On 25 October 2023, a workshop on 'Strategies for emission control on biogas upgrading plants' was held in Niederwil, Switzerland. The workshop was organized by Task 37 in collaboration with Biomasse Suisse, Zurich University of applied Sciences (ZHAW), Association of the Swiss Gas Industry and the Research Project consortium EMMINA. Methane emissions are a significant variable influencing the overall sustainability of the biomethane production. One potential major source of emissions within the production process can be the process of upgrading of biogas to biomethane. The upgrading process

Attendees at the Task 37 workshop, Niederwil (Switzerland), October 2023

results in a gas stream containing (bio-) methane and a second gas stream containing the CO2 and an unwanted part of the biomethane, called methane slip. This CO2 rich gas stream either directly emitted to the atmosphere or its content of methane is oxidised before the release into the atmosphere, according to the applicable regulations. National regulations on the handling of the methane slip differ substantially in EU countries, Denmark, France, Austria have recently changed the thresholds, in Switzerland new regulations are discussed.

The presentations addressed the options for the reduction of the emissions and put the options for emission reduction into a context with GHG balances and national situation in Switzerland and France. The presentations are available on the Task 37 website (link). Task 37 publishes a monthly Newsletter, which gives a quick overview of the current state of the biogas sector worldwide. It is compiled by Artur Wellinger, and it describes the latest technical but also political and scientific developments. The Newsletter is available on the Task 37 website (link), where you can also subscribe to it.

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:

- Implementation Agendas: Compare-and-Contrast Transport Biofuels Policies (link).
- Biofuels in Emerging Markets (link).
- Biofuel technologies: Lessons learned and pathways to decarbonisation (link).
- Assessment of successes and lessons learned for biofuels deployment (link) with five reports:
  - WP1 report: Status of biofuels policies and market deployment in Brazil, Canada, Germany, Sweden and the United States
  - WP2 report: Meta-analysis on existing studies
  - WP3 report: Case studies technologies
  - WP4 report: Sustainable biomass supply chains for international markets
  - WP5 report: Synopsis of the project / synthesis of key issues

Task 39 organized a seminar and webinar of the Inter-task project Assessment of Success Stories and Lessons Learned in Biofuels Deployment on 22 September 2023. The webinar materials are available on the IEA Bioenergy website (link). This has also been reported as per above in five reports. One presentation was also held at the 3rd Biofuels Forum in Berlin 23 June 2023. Task 39 arranged together with IEA AMF a joint workshop on 'Ten Times More Renewable Fuels', which took place in Leipzig, Germany, on 22 October 2023, and it further discussed collaboration possibilities and opportunities. For 2024, there is in development a number of webinars on projects running in Task 39 as well as for dissemination in ongoing projects. Task 39 will have one virtual meeting in 2024, and one physical meeting in São Paulo, Brazil in October 2024, in conjunction with the BBEST IEA Bioenergy Conference.

Task 40 - Deployment of Biobased Value Chains

As part of the inter-task project 'Management of Biogenic CO2: BECCUS Inter-task Phase 2' (link), coordinated by Task 40 and involving six other IEA Bioenergy Tasks, several workshops and events took place during the last months, in which Christiane Hennig and Christian Bang (both project co-leads) participated. At the EERA event 'Carbon sinks in Europe: stakeholders taking action to bring out the next solutions for carbon neutrality' (link) in Brussels on 5 September 2023 the BECCUS 2.0 ITP (link) was presented and natural and technological carbon sink solutions at European level were discussed. Task 40 also contributed to the technology expert workshop 'Biomass combustion and CCUS' as part of the BECCUS 2.0 project in September 2023, which was organised by Task 32, with the aim of describing how carbon capture technology can be installed at biomass and waste combustion units. Task 40 also contributed to the ExCo92 workshop on 'Bioenergy in a Net Zero Future' (Lyon, France, 19 October 2023 - link) with two presentations: 'Managing biogenic CO2 in Bio-CCUS concepts' and 'Capturing and storing biogenic CO2 from biomass CHP plants in Denmark'. In September 2023, Task 40 held a three-day physical/hybrid meeting at Utrecht University in the Netherlands. One day was dedicated to a site visit to RWE's Amercentrale Geertruidenberg biomass and coal power plant. RWE's Head of Strategic Development of BECCUS gave a presentation on the project launch for installing large-scale capture and storage of CO2 at the Amer and Eemshaven power plants. This was followed by an interesting tour of the plant which RWE is trying to convert to 100% biomass.

Task 40 meeting, Utrecht (Netherlands), 12-14 September 2023

The collaboration of the inter-task project 'Assessment of successes and lessons learned for biofuels deployment' between the IEA Bioenergy Task 39 "Biofuels", Task 40 "Deployment" and

Task 45 "Sustainability" was completed in September with several publications. Task 40 contributed to the report 'Sustainable biomass supply chains for international markets' (link) and

Task 40 at RWE's Amercentrale Geertruidenberg biomass and coal power plant, Geertruidenberg (Netherlands), September 2023

also presented an input during the webinar on 21 September with a presentation.
Also in September, under the IEA Bioenergy Task 40 internal project Regional Transition 1.0, the synthesis report 'Regional transitions in existing bioenergy markets' (link) was published. Follow-up work on Regional Transitions 2.0 is on-going.

Task 42 - Biorefining in a Circular Economy

The 46th Task 42 Progress Meeting was held at the facilities of the National Renewable Energy Laboratory (NREL) in Golden, Colorado (USA), from 6 to 8 November 2023. Several informative presentations were given by key researchers at NREL. This was followed by a guided tour around the Integrated Biorefinery Research Facility and the Thermal and Catalytic Process Development Unit. The presentations can be found on the Task 42 website (link).

Task 42 guided tour, NREL, Golden (Colorado, USA), November 2023

Task 43 - Biomass Supply in Sustainable and Circular Economies

Given the intense fire season in 2023 in Canada and other countries, there is an urgent need to increase efforts to enhance wildfire resilience while promoting a sustainable and reliable biomass supply.

Biomass recovery from wildfire prevention treatments, such as thinnings, as well as post-fire harvest activities in wildfire-affected areas, has the potential to serve as a source of biomass. Nevertheless, several factors, such as the difficulties and risks posed by terrain and conditions in recently burned areas, can be challenging to manage. On October 5, 2023, a hybrid workshop titled "Wildfire Resilience and Biomass Supply" was organized by IEA Bioenergy Task 43 and Université Laval to gather insights and best practices that could inform policies to enhance community resilience against wildfires and promote a sustainable biomass supply. Key takeaways from the workshop include:

- The increasing intensity of wildfires is linked to rising temperatures, and results in higher costs and shortages of timber in Canada. Additionally, countries in central Europe, typically not affected by wildfires, are becoming more exposed to the risk.
- It is crucial to make forest landscapes and industrial structures more resilient, for example, by increasing fire-resistant species on the landscape.
- Fire salvage harvesting is also essential, although its success is influenced by factors like tree species, plantation age, fire intensity, and regulatory requirements.
- Sustainable forest management, including fuel management and biomass removal for bioenergy, can provide a win-win solution, especially for communities vulnerable to fire risk and energy insecurity.
- Effective strategies for the recovery of affected trees to reach markets can promote success, but this will require efficient coordination across the supply chain. There is also a need to utilize standardized data and burn pattern classification for recovered wood.
- It is recommended to evaluate and facilitate cost-sharing opportunities between the bioenergy sector and fuel management while also enhancing benefits at the community level, including job creation, revenue generation, and community leadership.
- Scenario investment planning, including simulating forest management alternatives and trade-offs at different planning scales for various objectives, would be valuable.
- Research involving life cycle assessment, sustainability criteria, and operational cost reduction models is critical to support policy and investment decisions aimed at promoting wildfire resilience and biomass supply.

In summary, the workshop highlighted the importance of a holistic approach to fire management and biomass supply. As wildfires increasingly impact regions traditionally unaffected, the insights shared at the workshop will play a crucial role in guiding policies and practices for a more sustainable and resilient future.

Task 44 - Flexible Bioenergy and System Integration

During the Summer of 2023, there have been some changes within Task 44: Elina Mäki has left VTT Finland and Task 44 after approximately 3.5 years. We extend our best wishes to her for her future endeavours. Stepping into new roles, Daniela Thrän from DBFZ/UFZ is now the main Task Lead, with Miia Nevander from VTT joining as the new Co-lead. Additionally, Birger Kerckow has taken over as the new Operating Agent for Task 44. We are pleased to welcome Tiia Kanto from VTT as a new member in the Synergies ITP project. Some highlights of our recent activities include:

- Task 44 contributed with a presentation to the European Biomass Conference and Exhibition in Bologna, Italy. The presentation titled 'Defining the value of bioenergy system services for accelerating the integration of bioenergy into a low-carbon economy' (link) has been selected for the conference proceedings.
- IEA Bioenergy Task 44 & Task 40 jointly published 'BECCUS and flexible bioenergy – finding the balance' as a contribution to the inter-task project ´Deployment of BECCUS value chains´. Task 44 members Christiane Hennig, Daniela Thrän both from DBFZ (Germany), and Elina Mäki from VTT (Finland) contributed to this publication (link).
- At the IEA Bioenergy Workshop 'WS30: Bioenergy in a Net Zero Future' in Lyon on 19 October 2023, Tilman Schildhauer from the Paul Scherrer Institute (Switzerland) contributed with a presentation titled 'How flexible bioenergy and other system services from sustainable bioenergy can support the transition to a renewable energy system' (link).
- Kjell Andersson from Svebio (Sweden) participated in a session at SmartCHP (link) on 27 November 2023. The session was titled 'Cogenerating a renewable future: The role of small-scale bio-CHP in Europe's energy mix', and he gave a presentation during the event in Brussels.

Furthermore, Task 44 leads the Inter-Task project on 'Synergies of green hydrogen and bio-based value chains deployment', aiming to enhance our understanding of synergy value chains and their benefits. Task 44 is also responsible for work package 4 (WP4) in this project. Recently, under WP4, Fabian Schipfer from TU Wien (Austria) and Christiane Hennig from DBFZ (Germany) have jointly organized a hybrid expert workshop on energy system modelling with the IEA Energy Technology Systems Analysis Programme (ETSAP) TCP in Torino, Italy, on 17 November 2023. With four presentations, the event focused on flexible bioenergy and renewable hydrogen within energy system models. In a concluding session moderated by Task 44, there was agreement about planning another workshop for February 2024. This upcoming workshop aims to explore methods for conducting a comprehensive assessment of flexible technologies and infrastructure within energy system models.

"Defining the value of bioenergy system services for accelerating the integration of bioenergy into a low-carbon economy" (link). Two Task 44 meetings have been held so far in 2023, one physical in Graz in January and one virtual in April. In these meetings, among other topics, the status and expectations of flexible bioenergy in member countries, technical developments, and assessment of the value of flexibility were discussed.

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

Task 45 organized an online workshop on temporary carbon storage. The purpose of the workshop was to share knowledge and discuss issues related to the temporary storage of carbon, such as in long-lived wood products, through bioenergy systems with carbon capture and utilization, and through reforestation, where the carbon is vulnerable to future reversal. The workshop comprised two sessions. In the first session (30 November) scientific considerations around temporary C storage related to timing of emissions and removals were discussed, including issues such as how the climate effects of temporary carbon storage can be quantified and under what circumstances (e.g., duration of carbon storage , timing with respect to global peak warming and long-term equilibrium temperature) temporary storage provides climate benefits. The second session (December 7) considered approaches to recognising temporary C storage in climate policy, GHG inventory and emission trading. The workshop participants discussed pros and cons of alternative approaches to recognising temporary carbon storage in corporate inventory and project accounting, and they identified arguments for and against allowing temporary carbon storage as an offset to fossil CO2 emissions. Workshop presentations and a summary report will be published on the Task 45 website. Also connected to the workshop theme, Task 45 members recently published the results of a comprehensive evaluation of metrics for quantifying the climate-change effects of land-based carbon fluxes (link). The study aims to inform decisions on use of the biosphere to reduce net greenhouse gas emissions by replacing fossil energy with bioenergy or increasing land-based carbon storage. Assessment of the effectiveness of these mitigation options requires quantification using appropriate metrics to translate biophysical changes into climate-change impacts. However, the various currently available metrics use different proxy measures (e.g. radiative forcing, temperature changes, or others) as surrogates for climate-change impacts. Use of these different proxies can lead to contradictory conclusions on the most suitable policy options. The study proposes criteria for the objective evaluation of metrics, with the aim to build understanding of the significance of choice of metric and as a step towards building consensus on the most appropriate metric to use in different contexts. The criteria score metrics according to relevance, comprehensiveness, ease of application and acceptance by the research and policy community. The proposed criteria were demonstrated in an evaluation of fifteen available metrics that represent conceptual differences in the treatment of biospheric carbon fluxes and the proxies used to approximate climate-change impacts. The criteria successfully differentiated between the fifteen metrics and could be used as a basis for selecting the most appropriate metric for specific applications.

Picture source: https://jp.linkedin.com/company/iea-etsap-energy-technology-systems-analysis-program

Publications

ieabioenergy.com/iea-publications

Commercial status of direct thermochemical liquefaction technologies

Direct thermochemical liquefaction (DTL) of biomass is an important pathway to produce liquid biofuels and biochemicals for the circular economy. DTL technologies include fast pyrolysis, hydrothermal liquefaction (HTL) and solvolysis processes.

Read more

IEA shares recommendations for the Global Biofuel Alliance at G20 Energy Transitions Ministerial Meeting

The IEA recently launched its new report "Biofuel Policy in Brazil, India and the United States – Insights for the Global Biofuel Alliance". Paolo Frankl, Head of the Renewable Energy Division at the IEA, presented key findings from the report at a special meeting of government ministers convened at the G20 Energy Transitions Ministerial Meeting, which identified Fuels For the Future as a priority area.

Read more

Assessment of successes and lessons learned for biofuels deployment – Meta-analysis of existing studies

This report presents a meta-analysis on several studies dealing with "successes and lessons learned for biofuels deployment" for advanced as well as conventional biofuels.

Read more

Opportunities of bioenergy and biofuels in developing economies – WS29 summary report

IEA Bioenergy held its biannual workshop on 22-23 May 2023 in conjunction with its Executive Committee meeting (ExCo91). The workshop on 'Opportunities of bioenergy and biofuels in developing economies' was held in virtual form and was organised in collaboration with the United Nations Industrial Development Organization (UNIDO).

Read more

Biofuels production and development in the European Union

Feature article in IEA Bioenergy Task 39 Newsletter Issue #62, by Marco Buffi and Nicolae Scarlat of the Joint Research Centre of the European Commission.

Read more

Regional transitions in existing bioenergy markets

Bioenergy is an essential component of the transition towards a climate-neutral energy sector by 2050 to meet global climate targets. However, rather than a single homogenous sector, bioenergy is a complex and diverse network of regional, national, and international value chains part of the larger bioeconomy.

Read more

Comparison of possible supply chains for forestry derived biomass for bioenergy in New Zealand

In many countries residual woody biomass from forest operations is a significant resource for bioenergy. In New Zealand this is also the case, with forest residue resources up to 4.1 million green tonnes (1.64M odt) per annum, of which only a small proportion is utilized.

Read more

Status of biofuels policies and market deployment in Brazil, Canada, Germany, Sweden and the United States

This report was delivered in the frame of the project 'Assessment of successes and lessons learned for biofuels deployment'. The transport sector is responsible for one quarter of total greenhouse gas (GHG) emissions, oil products still provide 91% of its final energy needs. There is a stark contrast between the world's announced objectives on decarbonization and energy diversity and the current status.

Read more

Case studies of advanced biofuel technologies

This report was delivered in the frame of the project 'Assessment of successes and lessons learned for biofuels deployment'. In this task, case studies from Germany, Sweden and Canada were accessed to illustrate examples of progress in developing and scaling up advanced/emerging biofuels production technologies.

Read more

Sustainable biomass supply chains for international markets

This report was delivered in the frame of the project 'Assessment of successes and lessons learned for biofuels deployment'. Cost-effective, reliable and sustainable feedstock supply chains are crucial to a successful development of advanced biofuels

Read more

Assessment of successes and lessons learned for biofuels deployment: Synopsis

The IEA Bioenergy project "Lessons learned biofuels" examined the technical, economic, societal and political reasons underlying the past and ongoing booms and busts cycles of biofuel technologies development, demonstration, deployment and replication.

Read more

Press Release – Accelerating the deployment of biofuels is crucial to decarbonize global transport sectors

There are major challenges to reach a climate neutral society by 2050, as expressed in IEA's Net Zero by 2050 roadmap. Among different sectors, transport is proving to be a very difficult sector to decarbonize.

Read more

BECCUS and flexible bioenergy – finding the balance

Given that flexibility – in terms of inputs, shifting between different outputs and varying outputs over time and place – and the ability to capture and store (or utilize) biogenic CO2 (BECCUS) are expected to be two of the more important characteristics for bioenergy systems of the future it is important to see how these two aspects interact and find strategies for how these interactions can come in the form of benefits rather than trade-offs.

Read more

Biofuels production and development in China

China has the world's largest car fleet, the second largest gasoline market and the third largest diesel market. The industrialization process in China has not yet ended, the GHG emissions in China continues to grow, and the contribution of transportation is also increasing.

Read more

IEA Bioenergy Events

Executive Committee

ExCo93 will be held online on 13-17 May 2024

ExCo94 will be held in São Paulo, Brazil, on 21-22 October 2024

BBEST & IEA Bioenergy 2024 Conference
will take place in São Paulo, Brazil, on 22-24 October 2024 (link)

Task Events

Task 32 will hold a workshop on 'Sustainable low emission wood stoves - recent developments' on 28 February - 1 March 2024 in Verona, Italy

Task 32 will hold a workshop on advanced boilers on 5-6 June 2024 in Straubing, Germany

Webinars

A webinar organized by Task 43 on 'Biohubs and the role they play in biomass supply chains' will be held on 23 January (register here)

A webinar organized by Task 34 on 'DTL technologies for biofuels and chemicals" will be held in February 2024

A webinar organized by Task 42 on 'Biorefineries global Atlas and role of renewable hydrogen in biorefineries' will be held in April 2024

A webinar organized by Task 40 on 'BECCS-BECCU tradeoffs' will be held in June 2024

Other Events

22-23 January 2024
Fuels of the Future 2024
Berlin, Germany

24 -25 January 2024
Bio360 Expo 2024
Nantes, France

31 January - 1 February 2024
Nordic Pellets Conference 2024
Malmö, Sweden

12 February - 6 March 2024
Decarbonizing New Zealand
Auckland, New Zealand

4-6 March 2024
17th Annual International Biomass Conference
Richmond, USA

5-7 March 2024
Argus Biomass Asia Conference
Singapore

5-8 March 2024
European Pellets Conference
Wels, Austria

12-13 Mar 2024
Wood Bioenergy Conference & Expo 2024
Atlanta, USA

13-15 March 2024
Advanced Bioeconomy Leadership Council (ABLC) 2024
Washington DC, USA

11-12 April 2024
International Conference & Expo on Biofuels and Bioenergy
Rome, Italy

23-25 April 2024
Argus Biomass Conference 2024
London, United Kingdom

15-16 May 2024
REGATEC 2024
Lund, Sweden

21-24 May 2024
Sustainable Aviation Futures Congress
Amsterdam, The Netherlands

5-7 June 2024
International Conference on Renewable Resources and Biorefineries (RRB)
Brussels (BE)

18-21 June 2024
3rd International Conference on Negative CO⊠ Emissions
Oxford, United Kingdom

24-27 June 2024
EUBCE 2024 - 32nd European Biomass Conference and Exhibition
Marseille, France

See the full calendar of events here.

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