

Task 33

Gasification of Biomass and Waste

Triennium 2016-2018



IEA Bioenergy

Task 33 Gasification of Biomass and Waste

Prepared by:

Kevin Whitty, Task Leader, University of Utah

Jitka Hrbek, Task Secretary

Operating Agent:

Jim Spaeth, US DoE, USA

Participating countries:

Austria, Denmark, Germany, Italy, The Netherlands, Norway, Sweden, Switzerland, USA

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Introduction

IEA Bioenergy Task 33 is a forum for National Team Leaders representing member countries to exchange, review and evaluate information about biomass and waste gasification research, development and demonstration (RD&D) programmes and operating commercial, demonstration and pilot plants. Task activities assist the development of national bioenergy programmes and aim to help advance the state-of-the-art of biomass gasification.

The objectives of Task 33 are to foster cooperation among the participating countries and industry to eliminate technological impediments to the advancement of thermal gasification of biomass and waste. The ultimate objective is to promote commercialisation of efficient, economical, and environmentally preferable biomass gasification processes, for the production of electricity, heat, and steam, for the production of synthesis gas for subsequent conversion to chemicals, fertilisers, hydrogen and transportation fuels, and also for co-production of these products. Information sharing and advocacy is achieved through regular meetings and correspondence of National Team Leaders (NTLs), organisation of public workshops on biomass gasification issues and development of special projects and reports on matters associated with technical or market aspects of biomass gasification.

In recognition of the opportunity value and potential tipping fee-incurred negative fuel cost of waste resources including construction and municipal solid waste (MSW), as well as the upgraded variants refuse derived fuel (RDF) and solid recovered fuel (SRF), in the 2016-2018 triennium Task 33 expanded its scope to include waste resources and changed the name of the Task accordingly. The Task continued its interaction with industrial and academic experts to coordinate technology and product development. These activities were useful for participating countries to refine national bioenergy plans as well as to explore cooperative RD&D projects with other NTLs.

This report provides a summary of Task 33 activities during the triennium 2016-2018, including the special projects and workshops arranged through the Task.

Background

The scope of work for the 2016-2018 triennium was built upon the progress made in the previous triennia. In the previous years, information exchange, investigation of selected sub-task studies, promotion of coordinated RD&D among participating countries, selected plant visits, and industrial involvement in technical workshops at Task meetings have been very effective. These remain the basic foundations for developing and implementing a programme of work that addresses the needs of the participating countries.

The Task monitored the current status of the critical unit operations and unit processes that constitute the biomass gasification process, and identified hurdles to advance further development, operational reliability, and reducing the capital cost of biomass and waste gasification systems. The Task meetings provided a forum to discuss the technological advances and issues critical to scale-up, system integration, and commercial implementation of biomass gasification processes. Generally, these discussions lead to selection of sub-task studies and/or technical workshops that focus on advancing the state-of-the-art technology and identify the options to resolve barriers to technology commercialisation. The Task has continued the practice of inviting industrial experts to the Task meetings to present their practical experiences and to

discuss the options for development of critical process components to advance state-of-the-art biomass and waste gasification systems. The interaction with industry provides the opportunity for the National Team Leaders to evaluate refinements to existing product lines and/or processes. Academic experts are also invited when the need arises to seek information and cooperation in order to address basic and support research needs.

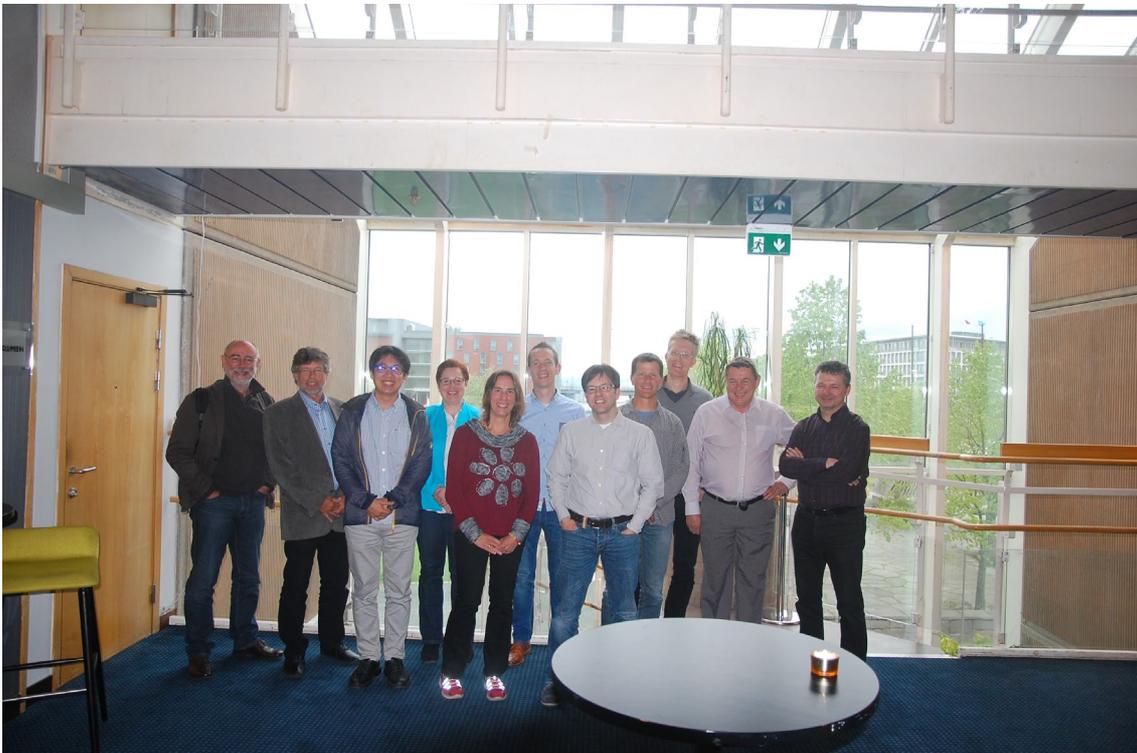
The work programme included the following elements:

- Task 33 planned and conducted semi-annual Task meetings including workshops on topics studies selected by the NTLs, and addressed matters related to the Task mission and objectives. Meetings and workshops are summarised below.

Meeting	Associated Workshop	Dates and Location
1st Task meeting	WS1: "Aviation Fuels through Biomass Gasification"	24-26 May 2016 Trondheim, Norway
2nd Task meeting	WS2: "Gas Sampling and Analysis in Thermal Gasification Processes"	25-27 Oct 2016 Lucerne, Switzerland
3rd Task meeting	WS3: "Small Scale Gasification for Combined Heat and Power"	2-4 May 2017 Innsbruck, Austria
4th Task meeting	WS4: "Fluidized Bed Conversion of Biomass and Waste" – Held jointly with IEA-FBC	23-25 Oct 2017 Skive, Denmark
5th Task meeting	WS5: "Workshop on Waste Gasification"	7-9 May 2018 Alkmaar, Netherland
6th Task meeting	WS6: IEA Bioenergy 2018; end of triennium conference jointly with all Tasks	5-8 Nov 2018 San Francisco, USA

- Several special projects (Task projects) were conducted by NTLs and outside partners, resulting in a series of useful reports published as IEA Bioenergy documents and available through IEA Bioenergy and Task 33 websites. Details of these special projects are given later in this report.
- NTLs surveyed the current biomass and waste gasification RD&D programmes, commercial operations and market opportunities in member countries, and identified the technical and non-technical barriers to commercialisation of the technology. NTLs used the survey results to prepare and update country reports for information dissemination. Country reports and presentations were posted on the Task website (task33.ieabioenergy.com).

- The Task 33 website was kept updated, including reports from member countries, workshop summaries and presentations, selected gasification publications, and meeting schedules.
- Task 33 maintained a database of gasification facilities, available through the Task website



Task objectives and work carried out

The objectives of Task 33 specified in the 2016-18 triennium proposal are presented below.

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

The objectives were realised through a combination of Task meetings, workshops, special Task reports, hosting of a website for information dissemination and maintenance of a facilities database to track the state-of-the-art in biomass and waste gasification in member countries. Summaries of these activities are given in the sections that follow.

TASK MEETINGS AND WORKSHOPS

Five workshops were organised by Task 33 throughout the triennium. Content and outcomes from the workshops are described below. Presentations from the workshops as well as workshop summary reports can be found online at the Task 33 website.

Workshop 1: Aviation biofuels through biomass gasification

Trondheim, Norway: May 2016

The workshop was attended by Task members and representatives from industry, government and academia. Presentations ranged from broad-view discussions of the role and potential for aviation biofuels to detailed technical presentations about some of the technologies associated with production of aviation biofuels such as gasification and Fischer-Tropsch synthesis. The workshop was very relevant and timely, since worldwide, flights produce over 750 million tons of CO₂ and are responsible for 12% of all transport-related CO₂ emissions. Alternative fuels, particularly sustainable biofuels, have been identified as excellent candidates for helping achieve the industry and climate targets. Biofuels derived from biomass such as algae, jatropha and camelina have been shown to reduce the carbon footprint of aviation fuel by up to 80% over their full lifecycle. If commercial aviation were to get 6% of its fuel supply from biofuel by 2020, this would reduce its overall carbon footprint by 5%. It is clear that it will not be possible to cover 100% of aviation fuels only by renewables in the near future. However, partial usage of biofuels will be able to reduce the CO₂ footprint of aviation. Research and development projects in Europe and the United States are advancing technology for economic production of biofuels and several demonstration projects and partnerships coming on-line are helping with commercialisation.

Workshop 2: Gas sampling, measurement and analysis in thermal gasification processes

Lucerne, Switzerland: October 2016

Technologies like the gasification of biomass for power generation or as a basis for further products from synthesis gas have strict quality requirements for the product gas. Trace components like H₂S, NH₃, HCN, dust or organic components like tar are responsible for corrosion, deposits, catalyst impairment and cause increased emissions. To prevent components, assemblies and processes from damage the gas quality at typical plant conditions has to be measured. There are many different principles and methods to determinate the concentration of different pollutants. This workshop brought together experts from around the world to discuss the state of the art in research and application of gas analysis methods. The workshop offered a very good overview and important information on instrumentation, techniques, collaboration networks and regulatory matters. The workshop received good attendance and a wide range of academic, industrial and governmental organisations were represented. A key takeaway from the workshop was that robust, reliable methods of sampling and gas analysis are important but challenging to achieve, and that continued attention to the topic and occasional workshops such as this are beneficial to the entire community.

Workshop 3: Small-scale gasification for combined heat and power

Innsbruck, Austria: May 2017

The focus of the workshop was thermal gasification of biomass at comparatively small scale with electricity production of at most a few hundred kilowatts, since there are hundreds of biomass gasifiers at that scale operating throughout the world and further are planned. Fiftysix experts from 11 countries representing government, industry and academia participated in the workshop. Twelve presentations covering experience with small-scale gasification, and byproducts from thermal gasification systems were given. Many of the speakers represented also companies either providing or operating small-scale gasifiers and it was clear that these types of gasification systems have achieved commercial maturity and can reliably be continuously operated.

Workshop 4: Fluidised bed conversion of biomass and waste

Skive, Denmark: October 2017

Fluidised bed technology is well-suited for thermal processing of solid fuels such as biomass and waste. Combustion and gasification, in particular, are demonstrated technologies and today there

are many commercial installations processing biomass-based feedstock in fluidised bed reactors. The workshop on Fluidized Bed Conversion of Biomass and Waste was jointly organised by IEA Bioenergy Task 33 (Gasification of Biomass and Waste) and IEA-FBC (Fluidized Bed Conversion) and included 15 presentations from experts on R&D, implementation, challenges and successes of fluidised bed processing. Over 40 experts from 16 countries all over the world participated in the workshop. The presentations covered state-of-the-art in fluidised bed technology as well as operational experience and lessons from commercial installations. The participants of the workshop had a possibility to visit Skive gasification plant as well as Østerild - National Test Centre for Large Wind Turbines on the second day.

Workshop 5: Workshop on waste gasification

Petten, The Netherlands: May 2018

Several companies, including ECN (Netherlands), EDF (France), EQTEQ (Spain), Proerg (Italy), Syncraft (Austria), Synova (Netherlands) and Valmet (Finland) presented their technology in the area of waste gasification. The gasifier of ESKA, which processes paper rejects, was introduced in a workshop presentation and was also one of the stops on the technical tour held the day after the workshop. The workshop demonstrated that waste gasification technology is a reality and that there are industrial plants operating in many countries throughout Europe. The presentations also highlighted the range of designs and flexibility of gasification to be able to process various qualities of feedstock



SPECIAL TASK PROJECTS

During this triennium several special projects were completed by Task 33. These projects culminated in reports that are available on the Task website. Brief summaries of the projects are given below.

SP-1: Gasification of waste for energy carriers

This project, led by the Swedish NTL for Task 33 Lars Waldheim, focused on development of a report on waste gasification, including waste resources and opportunities as fuel, policies and

regulatory considerations, technologies for gasification of waste, gas cleaning, final products including chemicals and fuels, and notable facilities worldwide. The comprehensive report has a lot of historical information and considers issues to be addressed if waste gasification technology is to move forward, including R&D needs, policy and economics. The final report, including appendices, is over 250 pages long and is available to the public.

SP-2: Fuel pretreatment for gasification

This project, which was conducted jointly with IEA Bioenergy Task 36 (Integrating Energy Recovery into Solid Waste Management Systems), was Task 33's contribution to an IEA Bioenergy inter-Task project on fuel pretreatment. The specific case under consideration in this project was pretreatment of municipal solid waste to improve its applicability as a fuel to be processed alone or through cofiring with biomass in gasification systems. Two pretreatment technologies were considered, mechanical pretreatment and mechanical-biological pretreatment. The report examines technical and economic aspects, and case studies in Germany and Italy are presented. The evaluation highlights that pretreatment of MSW can allow waste to meet the physical and chemical specifications required of gasification facilities.

SP-3: Biomass gasification for CC(U)S

This project was carried out jointly by SINTEF (Norway) and ECN (Netherlands) and focused on evaluating the potential for biomass gasification to contribute to carbon capture, utilisation and storage, so-called CC(U)S. Two case studies were evaluated: (1) indirect gasification with production of substitute natural gas (SNG) and entrained-flow gasification for production of biofuels via Fischer-Tropsch synthesis. The results show that the application of CCS in biofuel production processes can have a considerable impact on the reduction of greenhouse emissions. In both scenarios considered, the addition of CCS to a biofuel production value chain doubles the amount of avoided CO₂ from 0.6 to 1.1 Mton/y, but with an associated price increase of the final product.

SP-4: Biomass gasification success stories

This was a small project that involved contributing information to a larger overall IEA Bioenergy inter-Task project on bioenergy success stories. The Danish NTL for Task 33 compiled a summary of a few biomass gasification installations that have not only been technical successes operating on a continuous basis, but also economic successes.

SP-5: Gasification based hybrid systems

This project aimed to identify and quantify the potential for biomass gasification to serve as the heart of a hybrid energy system that would include other renewable sources such as wind and solar. It was shown that renewable hydrogen, produced using electrolysis from excess wind or solar energy, could be further utilised in a combination with carbon oxides from thermal gasification product gas. In this way, production of renewable energy carriers in gaseous or liquid forms can be as much as doubled from the same amount of biomass due to better employment of carbon oxides, especially CO₂.

SP-6: Hydrogen production via gasification

This project was performed by Bioenergy 2020+ in association with several of the Task members. The study gives an overview of possible ways to produce hydrogen via biomass gasification. Firstly, an overview of the current market situation is given. Then, hydrogen production based on biomass gasification is explained. Two different hydrogen production routes, based on biomass gasification, were investigated in more detail. Hydrogen production was investigated for steam gasification and sorption enhanced reforming. Both routes assessed, appear suitable for hydrogen production. Biomass to hydrogen efficiencies (LHV based) of up to 69% are achieved and a

techno-economic study shows a hydrogen selling prices of down to 2.7 EUR·kg⁻¹ (or 79 EUR·MWh⁻¹).

SP-7: Biomass and waste gasification status report

This report gives an overview on the thermal biomass gasification technology, projects/facilities in countries participating in IEA Bioenergy Task 33, their status, size and technology applied as well as detailed information concerning e.g. feedstock, output, etc. The report is based on Country reports from member countries and an interactive online database of thermal biomass gasification facilities, which is a part of the IEA Bioenergy Task website.

SP-8: History of biomass gasification and lessons learned

This project involved a historical look at biomass gasification technology, projects and outcomes. It considered not only large, high-profile biomass gasification systems but also smaller systems. Particular emphasis was placed on identifying the reasons that gasification systems fail. A key takeaway from the report was that lack of success was often a result of economic or policy issues and not necessarily technical. In many cases, smaller systems, less than 10 MW_{th}, are more successful than larger ones. Large plants disrupt the local feedstock supply due to their size, which in turn can jeopardise the success of the plant. It is therefore necessary to ensure long term, stable feedstock supply and also to factor in the longevity of any economic incentives that are necessary for plant success. In nearly all situations, a large biomass gasification plant will be uncompetitive compared to fossil fuel alternatives. A comprehensive report summarises the findings of the project.

SP-9: Valorisation of byproducts from small scale gasification

Hundreds of small-scale gasifiers with less than 1 MW thermal input operate throughout IEA Bioenergy member countries. Primary products include heat and/or power generated in reciprocating engines. Due to their small size, such systems may struggle to break even economically. The aim of this project was to identify opportunities for other revenue streams from small-scale systems to help improve economics. Byproducts such as ash and charcoal have potential value as complementary revenue streams. The report resulting from this project evaluates such opportunities and comments on practical aspects such as receiving approval for selling these products.

SP-10: Gas analysis for biomass and waste gasification applications

This special report compiles a representative part of the extensive work developed in the last years by relevant actors in the field of gas analysis applied to (biomass and waste) gasification. The approach of this report was based on the creation of a team of contributing partners who supplied material to the report. This networking approach was complemented with a literature review. The report is composed of a set of two documents. One describes the available analysis techniques (both commercial and under development) for the measurement of different compounds of interest present in gasification gas. The objective is to help the reader to properly select the analysis technique most suitable to the target compounds and the intended application. The second part is a series of factsheets and a collection of video blogs describing best practices for gas sampling.



Website

The Task website (<http://task33.ieabioenergy.com/>) is the most important tool for dissemination of results. Descriptions of the gasification process and information about Task 33 including the contact data of national experts are given. Within two weeks after each Task meeting, all presentations in PDF form can be found at the website. The summary of the workshops can be found at the website in a report form. During this triennium the Task website was updated to provide an enhanced user experience and to make navigation more intuitive and effective.

Biomass Gasification Database

A Google-map based interactive database of implementations of gasification plants was kept updated in the Task website during this triennium. The database is interactive. The database is updated regularly and provides a good overview on gasifiers throughout the world. The facilities in the database can be filtered by type, technology and status. All the important information including location, technology, raw material used, input and output data, products, facility type, partners, total investment (if known), status and start up is displayed. Also a short technology brief or a flow sheet is given. If more information is desired, a contact person for the facility is given.



Success story

The most successful aspect of Task 33's activities during the 2016-18 triennium was the new focus on waste as a biomass resource. For this triennium, the name of the Task was changed from "Thermal Gasification of Biomass" to "Gasification of Biomass and Waste" to emphasise this. Historically, biomass gasification systems have struggled to be economically profitable and without government incentives such as feed-in tariffs, few plants would be operated. This unfortunate truth has been realised in recent years as several notable gasification facilities, such as the Güssing plant in Austria, have shut down because the feed-in tariff period expired. Waste, however, offers an opportunity to shift the situation such that plant operators are paid to receive feedstock material, in the form of tipping fees paid by those disposing of waste, rather than having to pay for biomass feedstock that is becoming more expensive as competition from other bioenergy producers increases.

During this triennium, one of the special Task projects focused on waste gasification. The Swedish NTL Lars Waldheim led this effort and produced a very comprehensive, 295-page report that discussed waste as a gasifier fuel, waste resources and quantities, policies and regulatory considerations, technologies for gasification of waste, use of syngas from such gasifiers, and historical activities in gasification of waste. The report is published as an official IEA Bioenergy report and is available on IEA Bioenergy and Task 33 web pages. The value of this report and corresponding interest is demonstrated by the fact that the French Environment & Energy Management Agency (ADEME) is translating the report into French.

The fifth Task 33 workshop of the triennium focused on gasification of waste. The workshop was held in Petten, The Netherlands in May 2018 and was well attended. Presentations covered many

topics ranging from fundamental processes associated with conversion of waste via gasification to design and operation of several different designs of waste gasifiers to projects and experience with gasification of waste. The slides used by the presenters as well as a summary of the workshop are available on the Task 33 website.

A final activity related to waste gasification was the development of a report on pretreatment of municipal solid waste (MSW) for gasification applications. This was co-authored by representatives from Karlsruhe Institute of Technology in Germany and RSE, Italy. Compared to conventional biomass, MSW can be more challenging to feed to a gasification system and conversion may not progress the same way. This can be overcome in part by pretreating the MSW to improve its physical and chemical properties. The report presents two methods, mechanical pretreatment and mechanical-biological pretreatment, to better make MSW work in gasification systems, either alone or through co-firing with biomass.

These activities expanded the focus of Task 33 to include waste as a resource for energy conversion. Naturally, this overlaps with the scope of Task 36, Integrating Energy Recovery into Solid Waste Management Systems, so there was strong collaboration between the two Tasks during the triennium. As waste-to-energy becomes more prevalent, interest in gasification will continue to increase. So, the new emphasis on waste as a feedstock is timely and the success of this direction during the 2016-18 triennium is expected to continue.

Conclusions and recommendations

Task 33 has been primarily a technical Task whose objective is information exchange, investigation of selected sub-task studies, promotion of coordinated RD&D among participating countries, selected plant visits, and industrial involvement in technical workshops at Task meetings. The activities of the Task have been very effective. The Task monitored the current status of the critical unit operations and unit processes that constitute the biomass gasification process, and identified hurdles to advance further development, operational reliability, and reducing the capital cost of such systems. These were reported throughout the triennium and remain the basic foundations for developing and implementing a programme of work that addresses the needs of the participating countries.

The Task has continued the practice of inviting industrial experts to the Task workshops to present their practical experiences and to discuss the options for development of critical process components to advance state-of-the-art biomass and waste gasification systems. The interaction with industry has provided the opportunity for NTLs to evaluate refinements to existing product lines and/or processes. Academic experts were also invited to provide information and cooperate to address basic and support research needs.

Overall, Task 33 has played a useful role for policymakers, technology providers, end users and other interested parties. The workshops, reports, facilities database and web site have proven to be valuable resources, and the national team leaders are recognised as knowledgeable experts on gasification technology.

For the 2019-21 triennium, Task 33 will continue to focus commercialisation of gasification technology for renewable biomass and waste fuels. Planned activities relate less to specifics of biomass conversion than in previous triennia and instead consider broader issues relating to successful deployment of gasification technology. Specific projects focus on (1) status of emerging

gasification technologies for biomass and waste, (2) enabling market uptake of large scale gasification technology including technical and regulatory considerations, (3) health and safety guidance for biomass and waste gasification, and (4) update on biomass gasification activities worldwide.

In terms of recommendations for ExCo, Task 33 feels that it is important to maintain self-governance of individual Tasks. There has been a trend in recent years to promote broad ExCo-level inter-Task or strategic projects, and proposals to redirect Task funds more towards ExCo activities have been suggested. There is certainly a place for such overarching projects, but for many followers of IEA Bioenergy, the most value comes from Task-level activities, workshops, and reports. Task membership is composed of individuals recognised for their expertise in particular field. Through their networks and engagement in their particular area, Task members have the best understanding of the interests, needs and direction of their area. De-emphasising the “narrow and deep” focus of specific Task activities in favour of “broad and shallow” projects risks alienating a crucial segment of IEA Bioenergy followers, a consequence that may already be in progress.

With the continued increase in CO₂ emissions and climate change, the mission of IEA Bioenergy is more important than ever. IEA has good name recognition and reputation and IEA Bioenergy is well positioned to have a strong impact promoting biomass as an important contributor to renewable energy. To ensure that the message of IEA Bioenergy reaches as many people as possible, the communications initiative started during the 2016-18 triennium should continue. ExCo could also make resources available to individual Tasks to help them communicate with the public.

Attachments

STATE-OF-THE-ART AND TECHNOLOGY PROGRESS REPORTS

At the beginning of the triennium, Task 33 prepared a report describing the state of biomass gasification and providing an update on technology progress. The report is available on the Task 33 website.

PARTICIPATION IN MAJOR EVENTS

Task 33 was visible as a participant and organiser in various workshops and conferences throughout the triennium. These are listed below.

- Symposium “Aviation Biofuels through Biomass Gasification,” May 2016, Trondheim, Norway.
- Workshop “Gas Sampling, Measurement and Analysis in Thermal Gasification Systems,” October 2016, Lucerne, Switzerland.
- Presentation “Gasification of Biomass and Waste – Recent Activities and Results from IEA Bioenergy Task 33” held at the 5th Central European Biomass Conference, January 2017, Graz, Austria.
- Workshop “Small Scale Gasification for Combined Heat and Power,” May 2017, Innsbruck, Austria.

- Symposium "Fluidized Bed Conversion of Biomass and Waste," October 2017, Skive, Denmark.
- Workshop on Waste Gasification, May 2018, Petten, The Netherlands.
- Presentation on waste pretreatment for gasification at the Workshop on Production and Utilization Options for Solid Recovered Fuels held in association with the European Biomass Conference, May 2018, Copenhagen, Denmark.
- Several presentations at the 2018 ABLC Conference, November 2018, San Francisco, USA.

In addition to these events, many of the national team leaders represented Task 33 at local or national meetings in their respective countries.

DELIVERABLES

Many deliverables resulted from Task 33 activities during the 2016-18 triennium. These are listed below.

Task Project Reports. Several reports resulted from the various special reports conducted by the Task during the triennium. The reports were prepared as official IEA Bioenergy reports and are available on the Task web site.

- Gasification of Waste for Energy Carriers – A Review
- Biomass Pre-Treatment for Bioenergy. Case Study 3: Pretreatment of Municipal Solid Waste (MSW) for Gasification
- Implementation of Bio-CCS in Biofuels Production
- Thermal Gasification Based Hybrid Systems
- Hydrogen from Biomass Gasification
- Lessons Learned about Thermal Biomass Gasification
- Valorization of By-Products from Small Scale Thermal Gasification
- Gas Analysis in Gasification of Biomass and Waste

Workshop Reports. These reports provide a summary of the workshops coordinated by Task 33 during the triennium. They are available on the Task web site.

- Symposium "Aviation Biofuels through Biomass Gasification," May 2016, Trondheim, Norway.
- Workshop "Gas Sampling, Measurement and Analysis in Thermal Gasification Systems," October 2016, Lucerne, Switzerland.
- Workshop "Small Scale Gasification for Combined Heat and Power," May 2017, Innsbruck, Austria.
- Symposium "Fluidized Bed Conversion of Biomass and Waste," October 2017, Skive, Denmark.

- Workshop on Waste Gasification, May 2018, Petten, The Netherlands.

Note that PDF copies of most of the presentations from the workshops are also available on the Task website

- **Web Site.** The Task 33 web site hosts all information relating to the Task, including reports, workshop proceedings and the facilities database. The web site was redesigned during the triennium to make it more appealing and navigable.
- **Gasification Facility Database.** Task 33 maintains a database of gasification facilities within member countries and in some non-member countries. Facilities can be identified using a map interface and detailed information regarding status, scale, feedstock and products is given.
- **Country Reports.** National team leaders provided updated reports on the status of biomass gasification in their respective countries throughout the triennium. The most up-to-date report from each country is always available on the Task 33 web site.
- **Task Meeting Minutes.** Minutes from Task 33 business meetings are posted on the members area of the Task web site.
- **Reports for ExCo Meetings.** Several status reports and an end-of-triennium report were prepared for the IEA Bioenergy Executive Committee over the course of the triennium.

COORDINATION WITH OTHER TASKS WITHIN IEA BIOENERGY

Several projects were coordinated with other IEA Bioenergy Tasks during the triennium. The joint activities are listed below.

- Task 33 and 36 worked jointly on issues relating to gasification of waste such as MSW and SRF, including a presentation during the 2018 European Biomass Conference.
- Tasks 32, 33, 34 and 36 coordinated on the project on pretreatment of biomass resources. Task 33's contribution was a report on pretreatment of MSW for gasification applications, which had input from members of Task 36.
- Task 33 participated in the inter-Task project on bioenergy success stories and provided contributions to that effort relating to successful biomass gasification operations.

COORDINATION WITH OTHER BODIES OUTSIDE IEA BIOENERGY

During the 2016-18 triennium, several activities were coordinated with bodies outside IEA Bioenergy. Those are summarised below.

- A symposium on Fluidized Bed Conversion of Biomass and Waste was organised jointly with IEA-FBC (fluidised bed conversion) October 2017. The workshop was very well attended by members of both bodies as well as unaffiliated public.
- Bioenergy 2020+ worked jointly with members of Task 33 to prepare a report on hydrogen generation through biomass gasification.
- FEE of Germany provided useful information on small-scale gasification systems for the report on valorisation of byproducts and also contributed to the gasification facility database.

- Representatives from a variety of national research organisations and governmental bodies were represented at the various workshops during the triennium.

INDUSTRY PARTICIPATION

Task 33 has exceptionally strong participation from industry. Nearly all of the national team leaders in the Task have background in industrial biomass gasification, and many have either worked in industry or are currently working with an industrial company associated with biomass energy. The focus and direction of the Task is driven largely based on the experience of the Task leaders and their familiarity with current and past biomass gasification projects.

Throughout the triennium, individuals representing industrial scale gasification technology providers, small-scale gasification technology providers, catalyst development and technology providers, syngas cleaning technology providers, feedstock suppliers, end-users, electric utilities, energy consultants and environmental consultants all contributed to the Task by providing input to reports, participating in workshops, attending Task business meetings or presenting at Task 33-organised conference sessions.

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Further Information

IEA Bioenergy Website
www.ieabioenergy.com

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