

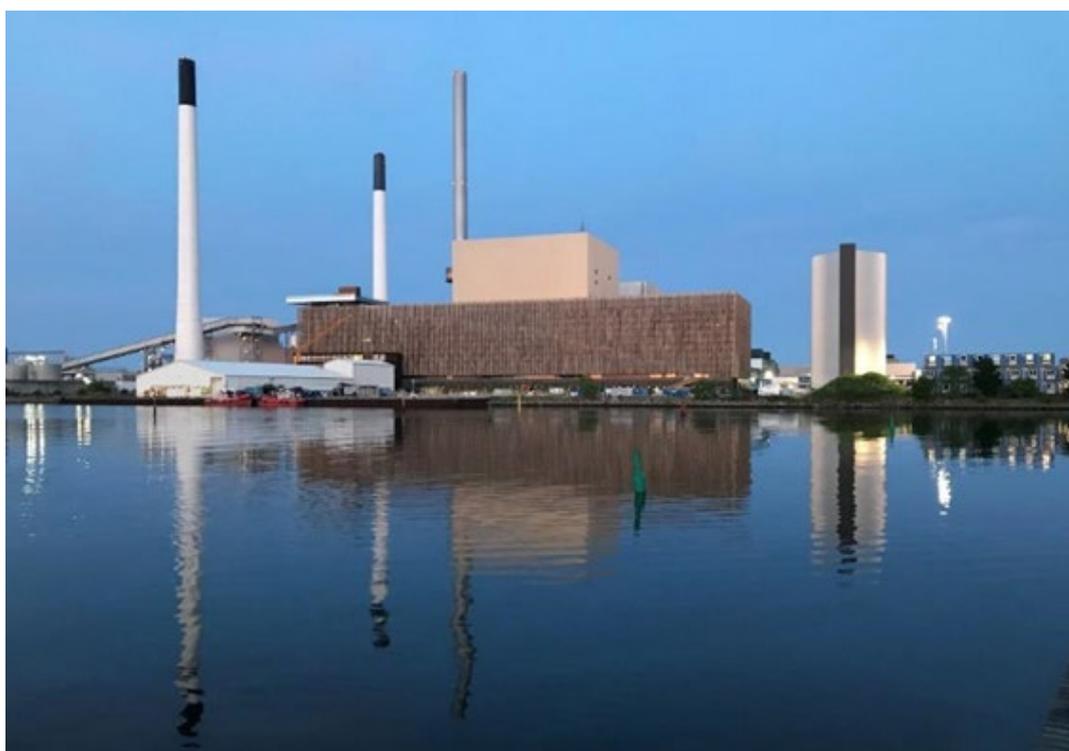


IEA Bioenergy
Technology Collaboration Programme

Task 32

Biomass Combustion

Final Task Report
Triennium 2019-2021





IEA Bioenergy
Technology Collaboration Programme

Task 32 Biomass Combustion

Final Task Report
Triennium 2019-2021

Prepared by:
Morten Tony Hansen, Task Leader, Ea Energy Analyses, Denmark

Operating Agent:
Mr. Mikael Pedersen, Danish Energy Agency, Denmark

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

Website:
<https://task32.ieabioenergy.com/>

Copyright © 2022 IEA Bioenergy. All rights Reserved

Published by IEA Bioenergy

INTRODUCTION

The objective of Task 32 is to collect, analyse, share, and disseminate strategic, technical and non-technical information on biomass combustion, leading to further acceptance and performance in terms of environment, costs and reliability, and to support the existing momentum in market introduction of improved combustion in its member countries.

Biomass combustion is one of the dominant renewable energy technologies for generation of renewable heat and power. Applied worldwide in all sizes of units - from small stoves with a capacity of a few kW to large units with multi MW capacities - and with input of a large variety of feedstock, biomass combustion delivers the ability to cook food, heat dwellings, generate electricity and conduct industrial processes. In many cases, these services may be delivered while obtaining net negative GHG emissions, while supporting the deployment of variable renewable sources like solar and wind energy and/or while generating socio-economic benefits such as employment.



Straw handling at district heating plant in Havnbjerg, Denmark. Photo by LIN-KA Energy.

Prior to the triennium, Task 32 proposed to prioritise amongst a list of challenges and concentrate the work on four main topics:

- Mitigating emissions - especially in small scale heat applications as they typically do not have secondary emission abatement systems and are situated in urban areas
- Generating high temperature heat for industrial processes while replacing fossil fuels
- Bringing cheaper feedstock for power and heat into play - supporting a further transition from clean and well-defined fuels to lower grade residues
- Fitting biomass combustion into renewable energy-based energy systems - evaluating the expected role that biomass-based power and heat generation can play in future energy systems while evaluating options for increased flexibility of biomass combustion plants.

The topics and corresponding actions were formulated by the Task 32 member country representatives, in discussion with their national stakeholders and the Executive Committee of IEA Bioenergy with the aim to make a maximum impact from the available resources, to serve the IEA Bioenergy Strategic Plan and to secure collaboration with stakeholders such as equipment suppliers, research organisations, end users, environmental NGO's and government agencies as well as policy makers and other tasks within IEA Bioenergy.



Unit 4 at Amagerværket in Copenhagen has been taken into operation in 2020. It is considered the World's largest wood chip fuelled circulating fluidized bed CHP plant. Photo: Morten Tony Hansen.

This report reflects the work of Task 32 in the period 2019-2021, done in various specific projects.

BACKGROUND

The above-mentioned priority areas that were identified by Task 32 are described below.

Lower emissions

Both the country representatives of Task 32 and the ExCo acknowledged that the most important challenge for biomass combustion applications is the mitigation of emissions in the small-scale heat market. This is due to the fact that in small scale combustion applications (stoves and boilers) it is much more challenging to achieve optimal combustion than in larger scale industrial boilers, while at the same time these applications are typically located in urban areas where emissions directly influence local air quality. This topic has been addressed by looking at possibilities to support the development and commercialisation of better stoves and boilers on the one hand, and opportunities for better flue gas cleaning technologies for small scale applications on the other.

High temperature heat for industrial processes

Decarbonisation of high temperature heat in industry is already done by replacing fossil-based steam by biomass-based steam - especially in industries that generate biomass residues themselves. The task is more challenging in industries that do not have their own biomass fuel or in processes where direct heat is required, such as drying, roasting, baking etc. A fuel switch from natural gas or coal to biomass may not only result in different flame temperature profiles, but also in a change in chemical composition. Both effects may influence product characteristics. Task 32 has been leading an inter-task project on industrial process heat that has produced case stories highlighting options for decarbonising industries that do not have their own fuel at hand.

Bringing cheaper fuel sources for baseload power and heat into play

In an ideal bioeconomy, high quality biomass sources are often used first for the production of high value chemicals and food, while energy production is done using the residues. A further transition in

available fuels is therefore anticipated, from clean and well-defined fuels to lower grade residues. This has immediate consequences for the design and operational integrity of combustion systems in terms of mitigating corrosion, ash deposition etc at acceptable costs, to maintain competitiveness. On the shorter run, there is a challenge to introduce more efficient agricultural residue-based CHP systems. Task 32 planned to address this topic by holding two open workshops on experiences with large scale combustion of wood chips and pulverised non-woody biomass.

Fitting biomass combustion into RE based energy system

In an energy system where fossil energy sources are phasing out against the introduction of VRE such as wind and solar, there is a need for a further increase in flexibility of biomass-based heat and power generation capacity. Task 32 proposed to evaluate the expected role that biomass-based power and heat generation can play in future energy systems, while at the same time evaluating options for increased flexibility of biomass combustion plants. An implication of this is the transition from baseload energy (based on high CAPEX/low OPEX solutions using low quality and inexpensive fuels) to peaking power (based on low CAPEX/high OPEX solutions using high quality pre-treated fuels) to replace fossil energy sources that now play this role.

REPORT ON THE TASK'S OBJECTIVES

Testing methods and real-life performance of pellet stoves

Following the work on standards and advanced testing methods for firewood stoves, Task 32 has produced a report on automatic testing methods for pellet stoves.

Pellet stoves gain more and more relevance on the direct heating market as they are convenient, economically competitive and “environmentally cleaner” compared to firewood stoves. Testing standards for pellet stoves have been established in several regions worldwide (e.g. Europe and the U.S). Recent research projects had shown that the performance of pellet stoves could differ significantly between constant load laboratory testing and real-life conditions. New testing concepts had been proposed recently which include typical real-life operation phases.

The report summarizes and discusses current and proposed testing methods for pellet stoves and summarises existing data about real life performance and the connection to lab testing results. The report addresses manufacturers, research and (notified) testing bodies, standardization groups, regulation bodies (international, national, regional) and interested end users.

The work has been carried out by Austria with contributions from Germany, Norway, Canada, Switzerland and Denmark. The main results were presented at the workshop in Graz in January 2020 while the final results were presented at the webinar on residential wood combustion in May 2021. Reporting had experienced some delay due to the pandemic. The final draft is being edited and the final report will be published in the first half of 2022.

Technical guidelines for design of low emission stoves

Under this theme, a guideline for the design of woodstoves has been produced following the previous work in Task 32 and giving an overview of available primary design measures and emission abatement technologies as well as suitable control concepts for small-scale applications. The guide is based on the existing work in ERA NET and focus is on characteristic properties measured under real-life conditions but also on Eco Design values.

The guideline focuses on primary measures such as fire chamber design, ignition principles, load, air control and automation while secondary measures such as catalysts and filters (ESP, bag filters, chimney fans) are described in general terms. This gives a basis for the decision for combining primary measures with secondary technologies to obtain almost zero emission combustion products.

The guideline is aimed at manufacturers but also at funding agencies or regulation bodies to set up the legal and funding framework of these emerging technologies.



Testing combustion chamber design at a woodstove. Photo: Danish Technological Institute.

The work has been carried out by Denmark with contributions from Germany, Austria, Norway and Switzerland. Preliminary results were presented at the workshop in Graz in January 2020 while the final results were presented at the webinar on residential wood combustion in May 2021. The final draft guideline is being edited and will be published in the first half of 2022.

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

Many countries are working on strategies for reducing the impact on air quality from small scale wood combustion. Their individual approaches may bear interesting measures, ideas or experiences which are useful for others.

The procedure suggested was that each interested member in Task 32 would prepare a dedicated Country Report for an internal Task 32 workshop from which a structure of a "National Strategy Report" should be derived. The internal workshop has been replaced by virtual discussions partly due to the pandemic.

A comprehensive template has been prepared and country members have collected and reported national data during 2021. An additional country report has been prepared by a colleague from Italy (AIEL). The country reports have formed the basis for the main synthesis report.

The primary work has been carried out by Germany with contributions from Austria, Canada, Denmark, The Netherlands, Norway, Sweden, Switzerland and Italy. The work was presented in draft at the Task 32 session on biomass and renewable heat at the IEA Bioenergy Conference on the 7th of December 2021. The synthesis report is being prepared and will be published medio 2022.

The work has involved extensive collaboration within the task and outside IEA Bioenergy with Italy as well as with stakeholders such as national environment protection agencies and others in the member countries. It has been described as the evermost ambitious collection and comparison of emission strategies across countries and Task 32 aims at continuing the work in the new triennium with a series of expert workshops to discuss strategies, exchange experiences and benefit as much as possible from the collected data.

Workshop: Improved combustion in stoves and small biomass boilers

Results of the ongoing projects on small scale combustion and the previous work of Task 32 has been disseminated in a workshop aimed at developers, engineers, manufacturers, scientists and/or associations who would hear about the newest achievements, techniques and knowledge to improve the design of log wood stoves and pellet stoves including those with water jackets for central heating as well as small biomass boilers. The workshop also updated participants on societal strategies for reducing the impact on air quality from residential wood combustion.

The workshop was organised by Austria with contributions or participation from member countries. It was held in connection with the Central European Biomass Conference 2020 (CEBC) in January in Graz, Austria. The workshop was a parallel event at the conference on the 23rd of January and benefited from the abstracts sent to the conference on small scale biomass combustion. CEBC proved to be a great opportunity to disseminate news and findings from Task 32 to a wider group. Presentations and a short summary are available on the task website. A workshop report has been prepared in German and will be translated and published on the task website in the first half of 2022.



*Residential biomass boilers from KWB exhibited at the CEBCS 2020 in Graz, Austria.
Photo: Morten Tony Hansen.*

Bioenergy for high temperature heat in industry

Task 32 has been leading a strategic intertask project on how bioenergy can play a role in providing high temperature heat for industrial purposes. The project provides information to industry stakeholders about options of supplying process heat from renewable resources in a straightforward and effective manner.

Within the intertask project four separate case study reports elaborated by Task 32, 33, 34 and 36 describe examples of biomass process heat applications, based on different conversion technologies combustion, gasification, pyrolysis oil and waste incineration. During 2021, the policy report "Decarbonizing industrial process heat: the role of biomass" was finalised by Task 40 and published on the project website as well as on the general IEA Bioenergy website. The report concluded the intertask project and provides information on market deployment opportunities/potential and effective ways to address existing technical and non-technical barriers.

Task 32 has decided to use the template for four additional case studies related to biomass combustion for generation of process heat. One new case study from Switzerland was published on the website next to the existing four cases. In the first part of 2022 the remaining three case studies from Austria, Sweden and Denmark will be published.

The project coordination and combustion case study has been carried out by the Netherlands and has involved close collaboration with other tasks. The four case studies were presented at the ExCo eWorkshop in October 2020. The policy report and the two Task 32 cases were presented at the Task 32 session on biomass and renewable heat at the IEA Bioenergy Conference on the 7th of December 2021.



Wood chips and grain residues-fired boiler (KCO Kohlbach) with SNCR (ERC) (left) and electrostatic precipitator (Scheuch) (right) for process heat supply in the largest bakery in Switzerland. Photo by Verenum.

Task 32 has experienced high interest in the project and options for replacing fossil fuels from industry and especially in easy ways to find cases that match ones own industry. Task 32 has planned that the eight cases will form the beginning of the searchable list of cases that Task 32 will establish during the new triennium as inspiration for interested industry decisionmakers. The list will take in already existing cases from the success stories part of the IEA Bioenergy website as well as further cases from boiler manufacturers. If funding allows, further case studies should be produced for the list based on the same template.

Bio based CHP for balancing an energy system with a large portion of uncontrollable production

Prior to the triennium, Task 32 planned to take part in the collaborative project of the newly emerged Task 44 "Flexible bioenergy and system integration" focusing on how biomass combustion can play a role in supporting the balancing needs in future energy systems with a higher share of variable renewable energy (VRE) sources. Task 32 would contribute to the collaborative project with technical specialist knowledge on biomass combustion plants such as cost effectiveness of various solutions including technical opportunities and limitations for biomass power and biomass CHP such as full load hours, robustness of currently implemented combustion systems in a changing energy landscape with more VRE.

Task 32 expected that the study would describe the potential of using biomass-based CHP as a regulating power in a future system dominated by intermittent power in different countries and under what market situation conditions this might be economically feasible.

The lead was with Sweden and with contributions from Switzerland, the Netherlands and Denmark. Task 32 has contributed with a presentation of the results of the Task 32 project "The future role of Thermal Biomass Power in renewable energy systems - a study of Germany" to the Task 44 workshop that was held at the CEBC in January 2020 in Graz, Austria. The primary work has been pending due to the pandemic and other reasons including relatively limited funding compared to the other projects. It was expected that new resources that have been involved in the project and additional funding would

enable the contribution to Task 44 in 2021 or in the first part of 2022. However, after having examined potential options, the project lead has towards the end of the triennium regretfully concluded that it will not be possible to contribute to Task 44 as originally expected. Task 32 thus has suggested that the funding is carried over to the 2022-2024 triennium to enable contribution to the new inter-task project proposed by Task 44 "Synergies of green hydrogen and bio-based value chains deployment".

Workshops: Experiences with combustion of pulverised non-woody solid biofuels and with combustion of wood chips for CHP production

Task 32 anticipated to organise two open workshops on experiences with large scale biomass combustion.

In an increasing competition to lower operational costs of biomass-based electricity generation from partly or fully converted condensing or CHP units it is of interest to plant operators to seek for cheaper fuels. Other fuels than wood may be more challenging than pulverised wood to handle and combust in terms of grinding, transporting and igniting and in relation to corrosion, slagging and fouling, keeping a stable flame, amount of unburnt fuel in the ash etc. and staying below the emission limits. The first workshop should build on previous discussions in Task 32 on options and limitations for using cheaper fuels in existing plants and aim at gathering researchers, suppliers and industry to further share experiences on this topic.



Wood chips at CHP plant in Assens, Denmark. Photo by Torben Skøtt.

In some member countries, forest wood chips are currently booming for energy generation in utilities, district heating and in industrial applications. With Värtanverket, Sweden had the largest wood chip CFB combustion plant in the World. Denmark followed in 2019 with unit 4 at Amagerværket and also sees an increase in wood chip consumption in other large plants as well and in smaller DH plants and in industries. The second workshop would focus on the advancements of wood chip combustion to learn from experiences and considering aspects from the whole supply chain - security of supply, fuel specifications, logistics, suppliers, price- fluctuation, technology aspects, different applications etc.

The first workshop was supposed to be organised by Canada, the second by Denmark. Collaboration was anticipated both externally with utilities, industry, other IEA TCPs as well as external groups, universities and associations. The first workshop would feed in to the collaborative project "Low-quality feedstocks / waste" that was proposed by Task 36. The second workshop should be co-organised with Task 40 and include presentations on BECCUS.

The first planning steps had been taken early within the task as well as with external stakeholders and it was decided to organise the two workshops at one event in Copenhagen and include more site visits.

The event involved collaboration with Task 40 as well as with members of IEA CCC and members of VGB Powertech. Due to the pandemic the two workshops had to be postponed multiple times. As uncertainty remained in the beginning of 2021, it was decided to hold the workshops and site visits in Q2 2022 - still as a part of the 2019-2021 triennium which was approved by ExCo. However, as the pandemic continued creating uncertainty for the first half of 2022 it was decided to postpone the event for the 2022-2024 triennium aiming at updating the concept to respond to the potential new focus in industry and holding it in Q3 2022 in Copenhagen. Task 32 has suggested that the remaining funding is carried over to the 2022-2024 triennium to fund this event.

Additional project: study of the nitrogen cycle in biomass combustion plants (phase I)

Due to the pandemic, only a minor part of the triennium budget for travel costs and meeting costs have been spent. This development has enabled Task 32 to already in 2021 initiate new activities that were planned for the 2022-2024 work programme. Task 32 has initiated a study of the nitrogen cycle in biomass combustion plants based on research carried out by BEST in Austria. The project is led by the representatives from Austria and the Netherlands and aims at quantifying reactive nitrogen flows along the whole biomass combustion cycle. The result of phase I is a scoping report based on the Austrian study defining the work and data collection to take place in phase II. The report will be published in the first half of 2022. Phase II will be carried out during the 2022-2024 triennium.



Tight emission thresholds in the NL require extensive flue gas cleaning at small scale district heating CHP plant: 2 x SNCR + cyclone + SCR + economiser + bag filter + condenser. Photo by ProBiomass BV.

General experiences

Along the work carried out on planned projects in the triennium, members of Task 32 have collaborated nationally and internationally on bioenergy topics as a result of their involvement in Task 32 or in their respective positions. The following describes some of the experiences that have formed during the triennium.

- Emission reductions remain important both for small scale appliances for residential heating that have typically come without secondary abatement equipment and for larger scale combustion plants found in small district heating systems. Emissions of particulate matter and organic compounds are the main focus areas for small scale residential heating while emission of NO_x from small to medium sized district heating plants have increasingly become a focal point.



Advanced NOx load calculations are taken in use by authorities to approve new biomass combustion plants for district heating. Illustration: ProBiomass BV.

- While many business areas have already been moving away from fossil fuels and much also can be served from other renewable sources, the transition away from fossil fuels in industry, in particular for high temperature heat applications, remains an important focal point for biomass combustion. Electrification may serve many needs but does not fit in all industries.
- Energy systems worldwide are under rapid development and benefit from other renewable options such as wind turbines and photovoltaics becoming less dependent on subsidies. Further, GHG emissions may be further reduced by biomass-based carbon capture and storage or utilisation where the carbon is synthesized into new fuels to replace fossil fuels (BECCS or PtX). It thus becomes relevant to highlight how biomass combustion-based technologies can contribute to this development and how the operation may be influenced.

	Pellet boilers			All boilers		
	2019	2020	Diff	2019	2020	Diff
Jan	627	876	40%	1303	1548	19%
Feb	599	1077	80%	1211	1764	46%
Mar	700	1626	132%	1422	2511	77%
Apr	761	2317	204%	1556	3532	127%

Pellet boiler market in Germany exploded in 2020 due to new subsidy to replace oil boilers.

- Utilisation of solid biomass for energy purposes currently is under debate - in some member countries more than in others. Members of Task 32 have discovered that significant funding from large foundations are targeted to miscredit bioenergy and especially woody biomass. Collaboration in Task 32 has revealed quite large differences in the public perception of biomass across the member countries. While e.g. the Netherlands and Denmark experience serious opposition through demonstrations, analyses and political measures taken against the utilisation of bioenergy, Austria and Germany see biomass as an important means to substitute fossil fuels for heating and electricity generation.
- Public perception of the sustainability of bioenergy seems to have changed. Critics especially question carbon neutrality of woody biomass and biodiversity in large scale supply chains. It seems that negative campaigns are currently prevailing in some countries and have gotten hold of NGO's, journalists, researchers and even politicians and other decision-makers. Being more mature and deployed than other technologies, biomass combustion seems to be the primary scape goat - this is where the criticism is experienced first-hand.



Dutch school children demonstrating against biomass utilisation.

SUCCESS STORY

Bioenergy offers a unique opportunity to replace fossil fuel sources in industry to provide heat for high temperature processes that are not easily supplied from other renewable sources or technologies. The potential is vast and the interest of ExCo members outspoken, and this path was picked up by Task 32 in the planning process of the 2019-2021 triennium and approached in the intertask project on "Bioenergy for high temperature heat in industry" that is described above.

Task 32 has in close collaboration with other IEA Bioenergy tasks and involved industries succeeded in highlighting bioenergy conversion options in five (soon to be eight) case stories and has furthermore contributed to describing options and barriers in a policy report.

The reports have been published at the project website and the IEA Bioenergy website and the results have been presented at numerous occasions, not least at the ExCo eWorkshop in October 2020 and at the Task 32 session on biomass and renewable heat at the IEA Bioenergy Conference in December 2021.

The project has paved the way for a continued effort within IEA Bioenergy on promoting bioenergy for process heat. Task 32 plans to continue the work during the new triennium to assist decisionmakers in industries to easily find inspiration that will enable their decision to transition to bioenergy even if they do not have their own biomass residues at hand.

CONCLUSIONS AND RECOMMENDATIONS

Task 32 has a unique role to provide an independent platform for hands-on information exchange amongst both manufacturers and operators of biomass combustion plants, and to translate findings of fundamental and applied R&D work to industry and policy makers.

In the 2019-2021 triennium, Task 32 had planned to conduct projects representing the broad range of technologies within biomass combustion - from improving performance of domestic wood stoves while reducing emissions and improving test methods for pellet stoves over transition to bioenergy for process heat in industry to large operation and integration of flexible biomass CHP plants - while collaborating with other tasks and stakeholders from industry.

The triennium has been characterised by the pandemic that has prevented physical events like workshops and conferences that Task 32 members typically organises or attends. Task 32 has had to delay two important events numerous times and finally move them to the next triennium. Also, the conduction of projects and the related production of topical reports has been influenced by the at times limited working options. Thus, some reports will be published during the first half of 2022.

During the triennium, Task 32 members have identified important challenges for the future work that form the basis for the proposed work to be carried out in the 2022-2024 triennium:

- Emission reductions remain important - small and larger scale
 - PM important in small scale - residential heating
 - NOx important in small to medium sized district heating
- Transition away from fossil fuels in industry
 - Becoming even more important
 - Electrification not always desired
 - Efficiency improvement and co-generation could be included
- Integration and flexibility of biomass combustion
 - Role of biomass combustion in energy systems
 - Role of biomass combustion in a CCS and PtX future
- Public perception and sustainability
 - Carbon neutrality of woody biomass
 - Biodiversity in large scale supply chains
 - Negative campaigns currently prevailing in some countries

Task 32 proposes to continue supporting the deployment of boilers for domestic heating and district heating, industrial boilers and utility size units while addressing the above topics with a technical approach focusing on these key technical, economic, environmental, and social issues that impede market dissemination of biomass combustion technologies. The proposed work programme consists of the following four work packages:

- WP1: Substituting fossil fuels in industry
- WP2: Sustainable large scale biomass CHP with net negative CO₂ emissions
- WP3: Innovative low emission biomass heating plants
- WP4: Low emission residential appliances

ANNEXES

1. List of Participating Countries and National Team Leaders
2. Task leadership and Operating Agent
3. State-of-the art Report
4. Technology Progress Reports
5. Task meetings and participation in major events
6. Deliverables
7. Variations from original proposal - deliverables, deadlines, budgets
8. Co-ordination with other Tasks within IEA Bioenergy
9. Co-ordination with other bodies outside of IEA Bioenergy
10. Industry participation

Annex 1

LIST OF PARTICIPATING COUNTRIES AND NATIONAL TEAM LEADERS

- Christoph Schmidl (Austria)
- Sebnem Madrali (Canada)
- Morten Tony Hansen (Denmark)
- Hans Hartmann (Germany)
- Masayuki Mizuno (Japan)
- Jaap Koppejan (Netherlands)
- Øyvind Skreiberg (Norway)
- Anders Hjörnhede (Sweden)
- Thomas Nussbaumer (Switzerland)

Affiliation and contact information can be found on the task website:
<https://task32.ieabioenergy.com/about/task-32-members/>.

Annex 2

TASK LEADERSHIP AND OPERATING AGENT

Operating agent:

Mr. Mikael Pedersen, Danish Energy Agency, Denmark

Task leader:

Mr. Morten Tony Hansen, Ea Energy Analyses, Denmark

Co-task leader:

Mr. Anders Hjörnhede, RI.SE, Sweden

Contact information can be found on the task website:

<https://task32.ieabioenergy.com/about/task-32-members/>

Annex 3

STATE-OF-THE ART REPORT

Please refer to separate file - the Task 32 work programme proposal for 2019-2021.

Annex 4

TECHNOLOGY PROGRESS REPORTS

Task 32 has produced three progress reports and corresponding slides for ExCo84, ExCo86 and ExCo88 meetings.

Task 32 has produced three annual reports as contributions to the IEA Bioenergy annual reports. Please refer to separate files.

Annex 5

TASK MEETINGS AND PARTICIPATION IN MAJOR EVENTS

Task meetings, webinars and workshops



Feedstock for production of steam exploded pellets in at Arbaflame in Norway, photo taken at one of the rare physical task meetings in the 2019-2021 triennium.

2019

In the beginning of the year, effort was put into fitting the proposed work programme to a reality with less member commitment than in previous years (9 countries compared to 13).

In 2019, Task 32 organised one physical task meeting and two virtual meetings. The first virtual meeting was used to kick-off the work programme of the new triennium while the physical meeting was used to monitor progress in different task activities. The second virtual meeting was focused on planning of a workshop on residential biomass combustion.

The workshop on residential biomass combustion that was held in Graz, Austria in January 2020 at the Central European Biomass Conference was planned during 2019 and lived up to this classic approach to have task meetings and workshops with conference events.

2020

In 2020, Task 32 organised only one physical task meeting which was held in Graz, Austria in January. Focus was on work progress and country reports. Covid-19 forced subsequent meetings to be virtual. Three virtual task meetings were held during 2020 - one in June and two in December. The first virtual meeting focussed on work programme progress while the December meetings focused on the future work programme and also took up country reporting.

Regarding country reports, 2020 showed quite some differences in the public perception of biomass in the member countries. While e.g. the Netherlands and Denmark experience resistance, demonstrations and political measures taken against the utilisation of bioenergy, Austria and Germany

see biomass as an important means to substitute fossil fuels for heating and electricity generation.

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

2021

In 2021, Task 32 held virtual task meetings only. Each meeting comprised three sessions of each two hours to allow time enough to discuss all necessary topics. Focus was on work programme progress, country reports and planning of the 2022-2024 triennium. Three virtual task meetings sessions were held in March to May 2021 and one session was held in December (the two remaining sessions were held in January 2022).

During 2021 the already experienced differences in the public perception of biomass in the member countries have deepened. The Netherlands and Denmark experience resistance, demonstrations and political measures taken against the utilisation of bioenergy, Austria and Germany see biomass as an important means to substitute fossil fuels for heating and electricity generation.

During the pandemic, webinars have become the norm serving the same purpose as workshops and often reaching much higher numbers of participants. It can be discussed if the outcome is the same as for physical events, but an advantage is that if recorded, presentations and debates may be seen multiple times and by an even wider audience.

On 6th of May 2021, Task 32 hosted a webinar "Residential Wood Combustion - Towards Low Emission Systems" on advances within residential wood combustion in collaboration with the IEA Bioenergy communication team from ETA Florence. The webinar comprised a general introduction to emissions and emission reduction measures as well as the two Task 32 reports on improvements of wood combustion (please see below). The webinar can be seen and presentations downloaded [here](#).

At the virtual IEA Bioenergy (End-of-triennium) conference in 2021, Task 32 hosted a session "Biomass and renewable heat" on the 7th of December. The topics of the session were biomass for high temperature heat generation in industry respectively strategies to reduce the impact on air quality from wood combustion. The session can be seen and presentations downloaded [here](#).

The two workshops on combustion experiences in large CHP plants that were planned for the triennium had to be postponed several times due to the pandemic. While there was always a hope to hold the workshops within the triennium - potentially in the beginning of 2022 - it was in December decided to postpone the workshops and the attempt from Task 32 to create a high-profile event by pooling the two workshops and site visits to new and remarkable combustion units, until the next triennium.

Annex 6

DELIVERABLES

Publications and dissemination of project results

D1.1 Testing methods and real-life performance of pellet stoves

- Main results were presented at the workshop in Graz in January 2020
- Final report will be published in the first half of 2022

D1.2 Technical guidelines for design of low emission wood stoves

- Preliminary results were presented at the workshop in Graz in January 2020
- Final guideline will be published in the first half of 2022

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

- Internal workshop replaced by country reports
- Draft results were presented at the IEA Bioenergy Conference in December 2021
- Synthesis report will be published medio 2022

D1.4 Workshop: Improved combustion in stoves and small biomass boilers

- Short report and presentation online [here](#)
- The workshop report in English will be published in the first half of 2022

D2.5 Biomass for high temperature heat in industry incl. additional combustion cases

Results were presented at ExCo eWorkshop in October 2020 and at the IEA Bioenergy Conference in December 2021

- Case reports online on [project website](#)
- Policy report online on [project website](#)

Additional project: Study of the Nitrogen Cycle in Biomass Combustion Plants (Phase I)

- Scoping report will be published in the first half of 2022

Webinars

On 6th of May 2021, Task 32 hosted a webinar "Residential Wood Combustion - Towards Low Emission Systems" on advances within residential wood combustion in collaboration with the IEA Bioenergy communication team from ETA Florence. The webinar comprised a general introduction to emissions and emission reduction measures as well as the two Task 32 reports on improvements of wood combustion. The webinar can be seen and presentations downloaded [here](#).

At the virtual IEA Bioenergy (End-of-triennium) conference in 2021, Task 32 hosted a session "Biomass and renewable heat" on the 7th of December. The topics of the session were biomass for high temperature heat generation in industry respectively strategies to reduce the impact on air quality from wood combustion. The session can be seen and presentations downloaded [here](#).

Website and news

During the triennium the task website has been updated with relevant events, recent publications, new bios, and a significant effort was done to get rid of malfunctions inherited from the merge of the previous website to a newer design. The website was transferred to another server under which links to publications were compromised. This might have affected the activity level. The website has been redesigned and re-edited during the last part of 2021 and a list of changes has been implemented in collaboration with ETA Florence. The new design will be put online in the first part of 2022.

Task 32 has contributed to the news bulletin ad newsletter of IEA Bioenergy.

Administrative documents

Minutes, notes, slides and country reports from task business meetings:

25 April 2019: Virtual task meeting - triennium kick-off

18-19 June 2019: Task meeting in Norway incl. site visits

10 October 2019: Virtual task meeting on workshop

22 January 2020: Task meeting in Graz, Austria incl. workshops and site visit

30 June 2020: Virtual task meeting on work progress

8 December 2020: Virtual task meeting on planning of new triennium

17 December 2020: Virtual task meeting on work progress and country reports

25 March 2021: Virtual task meeting on work progress

8 April 2021: Virtual task meeting on country reports

4 May 2021: Virtual task meeting on planning of new triennium

16 December 2021: Virtual task meeting on work progress

11 January 2022: Virtual task meeting on planning of new triennium

19 January 2022: Virtual task meeting on country reports

Three progress reports, three contributions for the annual reports and three audited accounts.

Annex 7

VARIATIONS FROM ORIGINAL PROPOSAL

Towards the end of the triennium, the effects of the pandemic became more visible. In combination with general business of the members, the pandemic has contributed to a slight delay in more deliverables. It is expected that all deliverables to be delivered will be delivered before the end of the first half of 2022 and also within the current budget. Please refer to the previous paragraph and the Gantt chart below for details.

The two workshops on combustion experiences in large CHP plants were planned for 2020, however, due to Covid-19 they had to be postponed several times. At the task meeting sessions at the end of 2021, it became clear that carry-over could not be avoided as it was decided to postpone the workshops until the next triennium.

Also due to the pandemic, only a minor part of the triennium budget for travel costs and meeting costs have been spent. Furthermore, only a minor part of the budget for the co-task lead has been spent. This development has enabled Task 32 to adjust a number of budget items and already in 2021 initiate new activities that were originally planned for the 2022-2024 work programme.

The following points briefly describe how the task members agreed to allocate the unspent funds:

- Increasing the funding for D2.3 Inventory of national strategies on emission reduction to encourage members as well as an Italian colleague to elaborate country reports and to enforce the synthesis work
- Increasing funding for the D3.6 Biomass-based CHP for balancing the energy system (input for Task 44) as the original funding level was almost symbolic and did not match the funding level for other activities
- Four new case studies for the High temperature heat in industry ITP - from Switzerland, Austria, Sweden, and Denmark
- Study of the nitrogen cycle in biomass combustion plants as described in the 2022-2024 triennium proposal - lead by Austria and the Netherlands
- Website redesign and updating
- Coverage of a higher number of task meeting sessions and participation in more ExCo meetings than budgeted for as well as more hours spent on triennium planning

By the end of the triennium it became clear that the D3.6 could not be carried out as expected. After having examined potential options, the project lead towards the end of 2021 regretfully concluded that it would not be possible to contribute to Task 44 as originally expected. Task 32 has contributed with a presentation to the Task 44 at the Central European Biomass Conference in January 2020 in Graz, Austria but suggests that funding for the primary project is carried over to the 2022-2024 triennium to enable contribution to the new inter-task project proposed by Task 44 "Synergies of green hydrogen and bio-based value chains deployment".

Annex 8

CO-ORDINATION WITH OTHER TASKS WITHIN IEA BIOENERGY

Task 32 and Task 40 have kept lines warm through the triennium regarding the joint organisation of the workshop on experiences with large scale wood chip combustion that has now finally been delayed to the new triennium (Q3 2022)

Within the inter-task project on high temperature heat for industry, Task 32 has collaborated closely with Task 33, 34 and 36 regarding case studies and with Task 40 around the policy report.

Collaboration has also taken place with Task 40 and Task 44 regarding contribution from Task 32 to the upcoming intertask projects on BECCUS respectively Synergies with hydrogen/PtX.

Annex 9

CO-ORDINATION WITH OTHER BODIES OUTSIDE OF IEA BIOENERGY

The Task collaborates directly with industry and through industrial networks such as VGB Powertech. Within the IEA family, interaction also takes place with the Renewable Energy Division and with other TCPs such as the International Centre for Sustainable Carbon (previously Clean Coal Centre) and IEA Combustion. The pandemic has somewhat decreased collaborative initiatives. This has e.g. limited the interaction with industry at site visits and at conferences.

Examples of cooperation activities in during the triennium:

Danish Biomass Ash Workshop:

- Presentation of the Task 32 report "Options for increased use of ash from biomass combustion and co-firing" (March 2019)
- Announcing the 2020 workshop (subsequently cancelled)

VGB Powertech:

- Presentation of the Task 32 report "The future role of Thermal Biomass Power in renewable energy systems - a study of Germany" (May 2019)
- Contact regarding meetings in TG biomass (41st meeting was cancelled) and TG Biomass Ash

IEA International Centre for Sustainable Carbon (previously CCC):

- Contribution to biomass co-firing report
- Suggestion of speakers and announcement on website of IEA CCC co-firing workshop in Japan in February 2020

IEA Combustion TCP:

- Contribution to generation of ideas for potential new task topics

IEA Renewable Energy Division and BEIPA:

- Presentation concerning experiences with biomass-based district heating and straw combustion technology with focus on Danish experiences at the 2019 Global Biomass Energy Innovation Development Summit Forum in Beijing (November 2019)

IEA Renewable Energy Division:

- Supporting the division with inquiries on the flexibility of bioenergy plants and data residential heating systems
- Collaboration to assist with country specific data on investment costs (incl. subsidies) and maintenance costs for pellet stoves and pellet boilers and assisting the division with designing and testing their [online heat economics calculator](#) that was launched with the Renewable Energy Market Report 2021.

Industry stakeholders

- Collaboration with process industries on their respective industry case stories
- Visits to industries and mutual exchange of ideas (e.g. KWB (Austrian boiler manufacturer), Arbaflame (Norwegian steam exploded pellet manufacturer))
- Discussion with boiler manufacturer to list relevant industry cases where biomass has replaced fossil fuels as a supplement to the produced case stories
- AIEL, Associazione Italiana Energie Agroforestali
Collaboration on the Task 32 project on national strategies

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

Annex 10

INDUSTRY PARTICIPATION

Apart from the collaboration briefly described in Annex 9, more utility companies have been actively and directly involved in the task: Canadian Nova Scotia Power and Ontario Power Generation have been acting as industrial observers in task business meetings along with the Canadian national representative.

Danish HOFOR (The supply company of Copenhagen) has actively been involved in discussing the content of the planned workshops as well as a site visit.



IEA Bioenergy
Technology Collaboration Programme

Further Information

IEA Bioenergy Website
www.ieabioenergy.com

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