IEA Bioenergy
Technology Collaboration Programme

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

Final Task Report
Triennium 2019-2021

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

Final Task Report
Triennium 2019-2021

Prepared by:
Göran Berndes, Task Leader, Chalmers University of Technology, Sweden;
Annette Cowie, Co-Task Leader, NSW Department of Primary Industries, Australia;
Floor van der Hilst, Co-Task Leader, Copernicus Institute, The Netherlands;
Uwe Fritsche, Co-Task Leader, IINAS, Germany;
Gustaf Egnell, Co-Task Leader, Swedish University of Agricultural Sciences, Sweden

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

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

Website:
https://task45.ieabioenergy.com/

Published by IEA Bioenergy

INTRODUCTION & BACKGROUND

Bioenergy and other biobased systems are of major significance for the economy in many countries. The demand for land and biomass is expected to increase, as a growing and wealthier global population requires more food, paper, construction wood, etc. Additional biomass demand arises as countries, organizations and companies adopt policies, regulations and strategies aligned with climate targets and visions about a circular bioeconomy, formulated in response to concerns about resource scarcity and a multitude of negative impacts associated with the use of fossil fuels and other non-renewable resources. At the same time, bioenergy and other biobased solutions are being questioned from various sustainability points of view and bioenergy specifically is by some stakeholders criticised for impeding the development of biobased solutions in industry. Further, the bioenergy sustainability debate increasingly affects the bioeconomy development in a wider sense, since much of the debate concerns effects of land use, which provides biomass also for other purposes than bioenergy.

IEA Bioenergy Task 45 was started as a new Task in 2019, taking up the issue of climate effects previously addressed in Task 38 (now closed) and the "horizontal" broader sustainability theme addressed previously in other Tasks, especially Tasks 40 and 43. The Task identifies and addresses critical issues related to the climate and other sustainability effects of bioenergy and biobased products and systems. The objective is to promote sound development for bioenergy as an integral component of the overall bioeconomy. One key goal is to increase understanding of the environmental, social and economic impacts of producing and using biomass for bioenergy, within the broader bioeconomy. A central aspect concerns the development and application of science-based methodologies and tools for assessing the effects of biobased systems.

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

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

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

Besides activities within the three Work Packages, Task 45 engages in collaborative activities with other Tasks through inter-Task projects:

- Renewable gas - deployment, markets, and sustainable trade
- The Role of Bioenergy in a WB2/SDG world
- Deployment of BECCUS value chains
- Lessons learned success stories in biofuels
- Sustainability assessment of biohub archetypes using life cycle assessment

The work in the Task is relevant for a broad group of stakeholders including academia, commercial interests and private sector producers, exporters, importers, financing organizations, governments, policymakers, civil society organizations and others such as IRENA, GBEP, BioFuture Platform, and FAO.

The Task also has high ambitions concerning scientific publishing and communication with the scientific community.

REPORT ON THE TASK'S OBJECTIVES

The overall Task objective is to promote sound development for bioenergy as an integral component of the overall bioeconomy. This objective will be achieved by providing analyses that support well-informed decisions by landowners, communities, businesses, governments, and others. One key goal is to increase understanding of the environmental, social, and economic effects of producing and using biomass for bioenergy, within the broader bioeconomy. A central aspect concerns the development and application of science-based methodologies and tools for assessing the effects of biobased systems to contribute to available knowledge and experiences.

The three WPs listed above represent the main elements to achieve the Task objectives and specific focus areas and associated activities were developed within each WP. We therefore present an evaluation of the work carried out that is structured around these three WPs. But it should be noted that the WPs are inter-linked, and many topics are relevant for more than one WP.

Work Package 1: Metrics, methods, and tools for assessing climate change effects of bioenergy

WP1 aimed to build the body of knowledge to equip the community of practice to undertake well-informed studies on the climate effects of bioenergy. The objectives of WP1 for the triennium 2019-2022 included:

- enhancing the body of knowledge on metrics, methods, and tools for quantifying climate change effects of bioenergy, including providing guidance on the "standard methodology" developed by Task 38;
- expanding the "standard methodology" approach to encompass complementary system-level assessment approaches;
- reconciling insights from top-down systems modelling and bottom-up approaches, concerning climate change effects of bioenergy;
- producing case studies that demonstrate good practice in quantifying climate change effects of bioenergy; and
- undertaking studies to address identified knowledge gaps, produce syntheses on specific topics.

To support these objectives, activities undertaken in WP1 included:

- organising three online workshops on forests, carbon balances and the climate (13-14 May and 30 November 2020, and 15 April 2021; and a seminar hosted by Members of the European parliament (10 December 2022).
- Publishing a paper comparing the results of top-down modelling using integrated assessment models with bottom-up estimates of mitigation potential of bioenergy, including consideration of the limitations of IAMs especially with respect to modelling of bioenergy and BECCS, due to their simplistic approach to modelling biomass production and land use for bioenergy and other production purposes
- compiling a "Guide for the confused" that builds on the Task 38 standard methodology plus new insights from recent research, to provide easy to use guidance on selecting and using tools available for quantifying climate change effects of bioenergy, indicating appropriate methods for different

purposes. The guide is in final stages of development. Results from the project was presented at the IEA Bioenergy webinar An introduction to quantifying the climate effects of bioenergy, April 1, 2022.

- developing guidance for practitioners on good practice in quantifying climate change effects of bioenergy. Outputs include a paper quantifying sources of uncertainty in the carbon footprint of biofuels, published in Biofuel Research Journal, a paper on evaluating alternative metrics for climate change impact assessment that has been submitted for publication, and a book chapter on how to undertake consequential lie cycle assessment, currently in press.

- commencing a project, jointly with WP2, aimed at integrating life cycle assessment methodology with integrated assessment modelling to analyse the future impacts of bioenergy, as described in reporting for WP2 below.

Three Task 45 members and several collaborators of Task 45 and the former Task 38 were involved as authors in the IPCC's Sixth Assessment Report Working Group III report on Climate change mitigation. This was a valuable opportunity to provide a balanced, evidence-based synthesis of the relevant literature on the potential of bioenergy to deliver climate change mitigation, and furthermore, to describe how the perceived risks and trade-offs associated with bioenergy expansion can be managed.

WP1 participants completed outstanding deliverables from Task 38, namely papers on evaluating metrics for climate change impact assessment, quantifying sources of uncertainty in the carbon footprint of biofuels, providing guidance on the application of life cycle assessment in policy-making, and evaluating indirect land use change associated with biofuels.

Due to COVID restrictions some planned activities, that require face-face-face interactions for discussion and brainstorming were not able to be progressed and will be undertaken in the 2022-2024 triennium. This applies to plans to study the role of bioenergy in the context of short-term targets for emissions reduction and long-term requirement for climate stabilisation, in contrast with retaining forests as carbon sinks.

One overall conclusion from the WP1 activities is that it will remain very important to disseminate science-based info on climate effects of bioenergy, and at the same time will remain a challenge to reach a large audience with a clear message as many organizations disseminate conflicting messages on this topic leading to noise and confusion. It is a dilemma that successful dissemination (in terms of reach) requires that messages be shaped to be heard through the noise, as a synthesis of science on bioenergy and climate is that "It is complicated and it depends". It is easier to get attention for simplistic messages claiming that "Bioenergy solves the climate crisis" or "Bioenergy destroys the world's forests". This is further discussed in Section 4 - Conclusions and recommendations.

Work Package 2: Metrics, methods and tools for assessing sustainability effects of bioenergy (excluding climate change effects)

In the task proposal for the 2019-2022 triennium, we defined the following topics and activities for WP2:

1. Assessment of the availability and applicability of metrics, methods and tools to measure and monitor sustainability of biobased systems (also other than bioenergy) and comparison of the sustainability performance of different biobased systems (link to inter-Task project on applied sustainability assessment). The work will be carried out in collaboration with ongoing efforts within as well as outside the bioenergy community (i.e., ISO, GBEP, SDGs).

2. Methods and tools for spatio-temporal assessment bioenergy induced land use change and related environmental and socio-economic effects of biomass production (including effects on ecosystem services), e.g., using remote sensing tools, and the integration with methods to assess life cycle impacts.

3. Methods and tools for the assessment of social and economic net effects of the bioeconomy as part of the wider economy across geographical regions and societal groups (e.g., social LCA, disaggregated I/O, PE/CGE models).

4. Methods and approaches to inform and guide sustainable land use and other resource planning for biomass production (by making use of, e.g., landscape design, multimetric spatial optimization, and active exchange of knowledge with other initiatives and organizations working on sustainable land use and restoration (e.g., LDN, UNCCD, Bonn Challenge, REDD+)

5. Methods and tools for the assessment of location specific trade-offs, considering uncertainties and stakeholder objectives. Together with WP3, assess the stakeholder perspectives on the relative importance of the different effects and objectives.

In the task meeting in Utrecht May 2019 (back-to-back with the ExCo meeting and workshop on Governing sustainability in biomass supply chains for the bioeconomy), we held an internal Task 45 workshop following up the outcome of the kick-off meeting in Stockholm, February 2019, where task members had identified key concerns related to the sustainability of bioenergy as well as expertise and ongoing activities in participating countries and task members' networks. At this workshop, it was agreed to adopt an integrated perspective on sustainability of bioenergy in relation to the climate impacts, rather than focussing on selected environmental or socio-economic impacts (besides climate impact). Scope and aim for three activities were developed and subsequently refined into three Task projects that addressed specific WP1 and WP2 topics outlined in the approved Task 45 proposal for the 2019-2021 triennium:

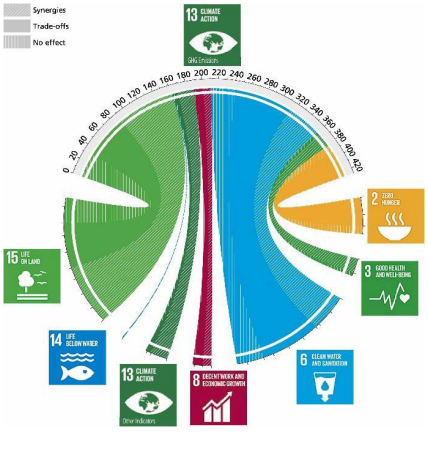
1. IMMABS: Indicators to measure, monitor and assess bioeconomy sustainability. This project is mostly related to topic 1 of WP2.
2. Synergies and Trade-offs: Synergies and trade-offs of sustainability implications of land use for bioenergy. This project is mostly related to topic 1, 4 and 5 of WP2 and WP1.
3. IAM-LCA: Combining Life Cycle Assessment (LCA) and Integrated Assessment Modelling (IAM) to analyse the future impacts of bioenergy. This project is mostly related to topic 1, 2 and 4 of WP2 and to WP1.

The **IMMABS project** aims to to provide (i) an overview of sustainability indicators for a variety of assessment goals and monitoring scopes; (ii) critical review of the methodological status of the indicators and possible “proxies” in cases where methods and/or data are missing; and (iii) publications and dissemination activities including relevant knowledge providers to inform interested stakeholders about project outcomes. The project was in an early initiation phase when the pandemic broke out and prevented organization of physical stakeholder meetings, and continuing challenges related to the pandemic eventually lead to a decision to postpone to IMMABS project to the next triennium (2022-2024).

The **Synergies and Trade-offs project** quantifies and analyses synergies and trade-offs between various sustainability implications of land use for bioenergy, to allow for informed decision-making on sustainable land use planning. The project activities started in April 2020, involving a group of researchers with broad expertise in sustainability science coordinated by Ivan Vera at Utrecht University. A systematic literature review was carried out to (i) map synergies and trade-offs between GHG emissions reduction (SDG13- Climate action) and other SDGs; and (ii) identify the key contextual factors that influence these synergies and trade-offs.

The key findings of the study are:

- Using land for dedicated energy crops results in almost an equivalent number of observations of synergies and trade-offs between SDG 13 and other SDGs. See Figure.



- More synergies were found for SDGs 3- Good health and well-being, 13-Climate Action, 14-Life below water and 15-Life on land, and more trade-offs for SDGs 2-Zero Hunger, 6 Clean water and sanitation and 8-Decent work and economic growth.
- A combination of context-specific conditions influences synergies and trade- offs.
- Most synergies were observed when perennial crops were produced on marginal land, previous arable land or pasture under temperate climate conditions and clayey soils.
- Regardless of the feedstock type, allocating natural or semi-natural areas, including forests, to the production of dedicated energy crops generally leads to trade-offs.

Results and insights from the project were presented at the IEA Bioenergy end of Triennium conference November 2021 and a scientific publication titled Land use for bioenergy: Synergies and trade-offs between sustainable development goals was published in the journal Renewable and Sustainable Energy Reviews (RSER, Elsevier) in early 2022. The work behind the paper involved 19 members and colleagues of IEA Bioenergy Task 45 and the study is now the basis for follow-up activities addressing synergies and trade-offs in the 2022-2024 triennium.

The IAM-LCA project concerns state-of-the art in combining Integrated Assessment Modelling (IAM) with Life Cycle Assessment (LCA) to enable consistent assessment of environmental impacts of bioenergy systems. The objective is to use LCA to broaden the assessment of bioenergy beyond climate impacts, and to use IAMs to support prospective LCA by providing a basis for assumptions about future values for impact categories. These include appropriate representation of future contexts, especially in cases where bioenergy plays a major role. Based on a literature review and discussions among participating task members and other experts, priority areas have been identified and existing methods of linking LCA and IAMs have been reviewed. Based on that, four methodological steps have been taken: 1) IAM scenarios are developed to generate input values for LCA; 2) The IAM inputs are used to transform Life Cycle Inventory databases; 3) LCA results are obtained for specified scenarios and future years; 4) The environmental indicator values from the LCA are fed back to IAMs.

The project was carried out by Task 45 members and associated experts and the steps outlined above were successfully completed, although required establishment of more in-depth linkages between IAM and LCA than what was originally anticipated. The work confirmed that assessments combining IAM and LCA represent a significant step towards improved understanding of environmental impacts of bioenergy in scenarios where bioenergy deployment contributes significantly towards climate targets. At the same time, methodological issues remain and the work in this area will continue in the 2022-2024 triennium.

Work Package 3: Sustainability stakeholders and implementation approaches (governance)

WP3 aimed to create broader support among stakeholders for sustainable bioenergy as an integral part of the broader bioeconomy through three interrelated lines of activities:

1. identifying perspectives of stakeholder and promoting exchange of views among relevant stakeholders to bridge international and local scales (WP 3.1),
2. suggesting ways to make indicators and tools provided by WP1 and WP2 useful for governance (WP 3.2), engaging with identified stakeholder to discuss barriers and risks associated with bioenergy investment, and identifying respective de-risking approaches, and
3. support the implementation of such procedures and instruments (WP 3.3).

The COVID-19 pandemic seriously impacted WP3 work regarding stakeholder interaction, though.

The first WP3 activity was to identify key supranational and selected national stakeholders concerned with sustainable bioenergy governance on various levels and help to better inform and link supra-national stakeholders with local ones and their issues and priorities. An extensive stakeholder map was be produced as an internal OneNote book.

The financing of sustainable bioenergy was key to the second activity: Through personal contacts and meetings with EC DG DEVCO and the European Investment Bank as well as screening of activities of international funds supporting sustainable bioenergy investments and financial institutions (e.g., World Bank). Due to the COVID-19 pandemic, these activities have been put on hold in Spring 2020 but will be carried on in the next triennium. Work will aim at options to de-risks bioenergy investment, and how IEA Bioenergy can be helpful for designing and initiating novel and coherent implementation strategies for sustainable bioenergy, e.g., within biomass-based value-chains.

With regard to implementation procedures, WP3 exchanged views with international institutions aiming to support, coordinate and influence regional and national efforts to develop sustainable bioenergy (e.g., GBEP, Biofutures Platform, IRENA, UN organizations), and sought contacts with business and industry and respective associations that are implementing bioenergy projects and those who actively seek to develop sustainability implementation procedures, as well as civil society organizations. A key activity was to organize and contribute to the IEA Bioenergy workshop "Governing sustainability in biomass supply chains for the bioeconomy", Utrecht May 23, 2019.

In collaboration with GBEP and as a contribution to the WB2/SDG Intertask project, a synthesis report of the current state and perspectives of sustainability governance of bioenergy and the bioeconomy was prepared[1].

The project "Approaches to sustainability compliance and verification for forest biomass" (C&V) developed, together with the major certification systems, a synthesis on which sustainability concerns, and under which claims (criteria, indicators), and what systems may fit which purpose. It provided definitions of "compliance" and "verification", and sketched pros & cons of approaches, discussed respective evaluation criteria (costs, administrative burden, etc.), and methods to conduct bench-marking (to identify what are "good" systems matching policymaker expectations). This will be continued in the 2022-2024 triennium.

Finally, a new approach towards dissemination of results through social media was developed and tested: Three packages of animated graphics were developed and published and shared with the ExCo comms group to consider broader uptake within IEA Bioenergy. The social media impact will be analyzed and continuation of this new approach is planned for the 2022-2024 triennium.

[1] Iriarte, Leire; Fritsche, Uwe & van Dam, Jinke (2021) Sustainability governance of bioenergy and the broader bioeconomy. Technical Paper prepared by for IEA Bioenergy Task 45 and GBEP http://www.globalbioenergy.org/fileadmin/user_upload/gbep/docs/TFS/Bioeconomy/IINAS_2021_Sustainability_governance_of_bioenergy_and_bioeconomy_-_final.pdf

SUCCESS STORY

As noted above, Task 45 members and associates have engaged in ongoing scientific activity and in the public debate about the climate effects of forest-based bioenergy. The aim has been to enhance understanding and address misconceptions observed in scientific literature and broader public discourse. Contributions include arrangement of three workshops (13-14 May and 30 November 2020, and April 15, 2021) and a webinar hosted by Members of the European parliament (10 December 2022), participation in processes relating to the topic (e.g., review of draft Chatham House report on the use of US-sourced woody biomass in the EU and UK; contributions to work of the Greenhouse Gas Protocol), and production of IEA Bioenergy publications and scientific publications. Task members have also been involved in interactions between IEA Bioenergy and EASAC. However, we have mixed experiences from this type of interactions, which may not qualify as success stories since both EASAC and Chatham House continues to publish very critically on bioenergy, especially forest-based bioenergy. We have also in other ways experienced that interaction with other organizations, to promote dialogue and detoxify the debate, can be challenging because not all organizations/individuals are interested in dialogue and may participate in events because they see an opportunity to broadcast their campaign messages rather than engaging in dialogue.

At the same time, we consider it important to maintain this dialogue, as it helps us to understand how misunderstandings can be addressed. Also, critical positions on bioenergy can arise from sound analyses and real experiences in locations where bioenergy systems are associated with significant negative impacts. Information exchange and dialogue with organizations and individuals bringing forward such examples are critical for advancing sustainable bioenergy solutions.

One key deliverable from Task 45 in this area was the paper "Applying a science-based systems perspective to dispel misconceptions about climate effects of forest bioenergy" (https://doi.org/10.1111/gcbb.12844). This paper was the 2nd-most downloaded paper in the journal Global Change Biology Bioenergy in 2021. The paper emphasises the need to apply a systems perspective in assessing options and developing policy for forest bioenergy (Figure 1).

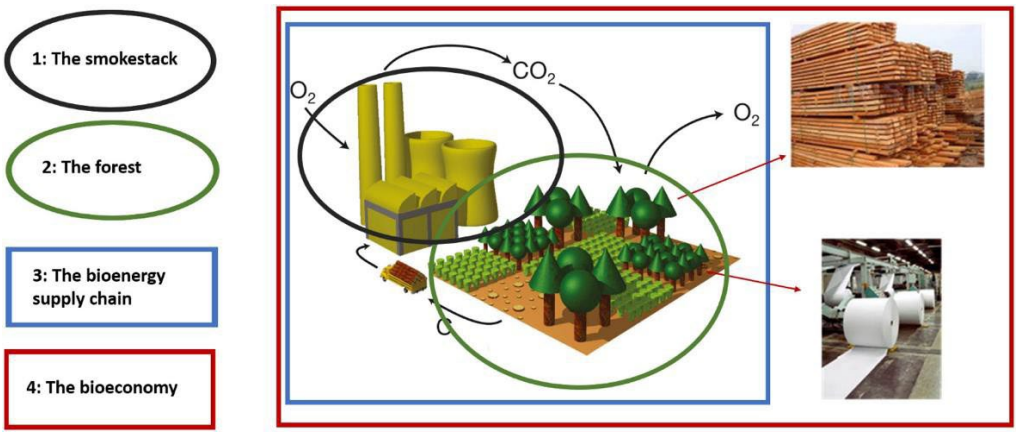


Figure 1. Alternative system boundaries have been applied in studies assessing climate effects of forest-based bioenergy, which leads to divergent results even when the same system is studied. Option 1 (black) considers only the stack emissions; Option 2 (green) considers only the forest carbon stock; Option 3 (blue) considers the bioenergy supply chain; Option 4 (red) covers the whole bioeconomy, including wood products in addition to biomass. A systems perspective (Option 4) is needed to fully understand the climate effects of forest-based bioenergy. Source: Cowie et al., 2021.

CONCLUSIONS AND RECOMMENDATIONS

During the 2019-2021 triennium, Task 45 has disseminated science-based information on a range of sustainability issues related to bioenergy. Climate impacts of bioenergy is one of the key issues addressed and the task has – as described above – tackled misconceptions and misunderstandings on various aspects related to this issue. Both climate effects and other sustainability issues need to be handled sensitively and wisely. Public perceptions of bioenergy will determine the expansion of the bioenergy industry; unless there is acceptance by academics, NGOs and the general public, policy support for bioenergy will diminish, and the potential of bioenergy will not be realised. Strong negative perceptions towards bioenergy amongst NGOs and ecologists are now influencing policymakers and the public in many countries. Diminishing respect for science has played a role. It is challenging to effectively counteract misconceptions and to influence the debate from a scientific perspective due to the perception that IEA Bioenergy is a lobbyist.

Task 45 has highlighted the importance of a systems approach in assessing options and developing policy for bioenergy. Assessment should consider the whole bioeconomy across sectors affected, including the life cycle of bioenergy systems, effects on land management and landscape carbon stocks, and other impacts. Specifically concerning the climate effects of forest bioenergy, focussing on carbon balances of individual forest stands, emissions at the point of combustion, and short-term emissions reduction targets, neglects system-level interactions and obscures the significant role that bioenergy can play by displacing fossil fuels now, and supporting energy system transformation.

Methods for quantifying the climate effects of bioenergy include product-focused LCA, energy systems modelling, landscape and broader spatial scale assessments, and sectoral assessments. No single approach can provide full understanding; using multiple approaches will provide useful and robust insights.

Among specific issues that remain important to address is the increasingly pervasive campaign to persuade politicians, policymakers and the public that forests are eternal carbon sinks and the most effective way to mitigate climate change is therefore to stop harvesting all forests, so that they can assimilate as much carbon as possible. This idea has appeal because it appears "easy" to leave forests undisturbed to sequester carbon and it can be promoted as a win-win for biodiversity and climate.

We have learned that it is difficult to shift those who have entrenched views; external webinars and large group discussions have not made much headway in achieving constructive dialogue. An alternative approach is to work pro-actively by targeting key actors that have not yet established a firm position on bioenergy. Small group dialogues, preferably face to face, are most likely to be effective in building relationships, developing mutual understanding of the basis for alternative views, and influencing thinking. COVID restrictions have unfortunately precluded such dialogue during the 2019-2021 triennium, but we expect that the new triennium will offer better opportunities.

Building on the work of Task 45 2019-2021 and predecessor Tasks addressing climate change effects of bioenergy, Task 45 will continue to refine, disseminate and demonstrate methods for quantifying climate and broader sustainability effects of bioenergy, and tackle the ongoing challenge of communicating the significant role that bioenergy can play in realizing sustainability development goals, especially to enable energy system transformations towards meeting energy security requirements and the climate stabilisation goal of the Paris Agreement.

We have identified that some opposition to bioenergy is based on misunderstanding or poor methodology, so Task 45 has sought to inform the debate by preparing science-based guidance and communication material that explains valid approaches to assessing bioenergy systems. Considering the ongoing debate and policy development addressing land use and biomass production for bioenergy and bioeconomy, we expect that continued dissemination of information on climate and sustainability outcomes of bioenergy will be needed in the next triennium. Considering the war in Ukraine, we expect that energy security will be much more important to consider in our work.

Therefore, in the 2022-2024 triennium, Task 45 plans to continue to build the body of knowledge to equip the community of practice to undertake well-informed studies of bioenergy systems. This will be done by developing, demonstrating, refining and promoting metrics, methods and tools to quantify climate and sustainability effects of bioenergy. We will apply a range of methods, as no single approach is adequate to provide complete understanding of the full effects of bioenergy deployment. We will publish scientific papers and technical reports, to contribute to the base of credible academic literature required to underpin policy development. These publications will be complemented with "plain English" summary publications. Workshops will involve researchers from diverse disciplines to facilitate knowledge exchange, especially between those with divergent methods and views.

The specific topics to be addressed and activities planned are described in the approved prolongation proposal for the 2022-2024 triennium, so will not be elaborated here.

ATTACHMENTS

LIST OF PARTICIPATING COUNTRIES AND NATIONAL TEAM LEADERS

Country	National Team Leader	Institution
Australia	Annette Cowie	Australia
Brazil	Glaucia Mendes Souza	Brazil
China	Dou Kejun	China
Denmark	Niclas Scott Bentsen	Denmark
Finland	Kati Koponen	Finland
France	Miriam Buitrago	France
Germany	Stefan Majer	Germany
Ireland	David Styles	Ireland
The Netherlands	Peter-Paul Schouwenberg	The Netherlands
Norway	Francesco Cherubini	Norway
Sweden	Gustaf Egnell	Sweden
UK	Zoe Harris	UK
USA	Daniel B. Fishman	USA

TASK LEADERSHIP AND OPERATING AGENT

Task Leader	Göran Berndes, Chalmers University of Technology, Sweden
Co-Task Leader, WP1	Annette Cowie, University of New England, Australia
Co-Task Leader, WP2	Floor van der Hilst, Utrecht University, The Netherlands
Co-Task Leader, WP3	Uwe Fritsche, IINAS, Germany
Task Secretary	Gustaf Egnell, Swedish University of Agricultural Sciences, Sweden
Operating Agent	Jonas Lindmark, Swedish Energy Agency, Sweden

TASK MEETINGS

Physical meetings were held in the first year of the triennium

- Joint Task kick-off meeting in Stockholm 27 February – 1 March, 2019, together with T40
- Task 45 meeting b2b with the ExCo workshop in Utrecht, the Netherlands in May 2019
- Join task meeting with T40 in Germany in Nov 2019

When the corona pandemic prevented physical meetings, the task started working with virtuaLmeetings. These have been held monthly with few exceptions. Notes from these meetings can be found on the Task OneNote page accessible for all participants. In addition to that, Task project meetings have been organized on ad-hoc basis planned by the respective leader of Task project.

DELIVERABLES

Publications and communications from IEA Bioenergy

- Sustainability governance of bioenergy and the broader bioeconomy. Technical paper prepared for Task 45 and GBEP Task Force on Sustainability. Available here
- There are concurrent media campaigns and publications questioning the use of woody biomass for renewable energy production. This publication comments some of the issues raised in the campaign. *Campaigns questioning the use of woody biomass for energy are missing key facts*. Available here
- Biomass supply chains and their contribution to the Sustainable Development Goals. IEA Bioenergy report. Available here
- Special Feature article IEA Bioenergy Annual Report 2021: 'Sustainability of Biomass for the Biobased Economy' (van der Hilst, F., G. Berndes, A. Cowie, U. Fritsche). 2021. Available here
- Key findings and notes from the round table discussion on the IPCC report on climate change and land. Available here
- Articles and statements in the media have raised concerns over the climate effects of bioenergy from managed forests. As some of these statements seem to reflect misconceptions about forest bioenergy, IEA Bioenergy has prepared a brief document presenting key facts about the use of forest biomass for climate change mitigation *The use of forest biomass for climate change mitigation: dispelling some misconceptions*. Available here
- Report of a workshop held on 25 November 2019 in Berlin, and synthesis of presented studies. *Roles of bioenergy in energy system pathways towards a "well-below-2-degrees- Celsius (WB2)" world*. Available here
- Governing sustainability in biomass supply chains for the bioeconomy – Summary and conclusions from the IEA Bioenergy workshop, Utrecht (Netherlands), 23 May 2019. ExCo report 2019:7. Available here

Scientific publications associated with Task activities

- On quantifying sources of uncertainty in the carbon footprint of biofuels: crop/feedstock, LCA modelling approach, land-use change, and GHG metrics. Biofuel Research Journal, 9 (Issue 2 (In progress)), 1608-1616. Online version available here
- Indirect effects negate global climate change mitigation potential of substituting gasoline with corn ethanol as a transportation fuel in the USA. Frontiers in Climate, p.33. Online version available here
- Land use for bioenergy: Synergies and trade-offs between sustainable development goals. Renewable and Sustainable Energy Reviews (161). Online version available here
- Strategic deployment of riparian buffers and windbreaks in Europe can co-deliver biomass and environmental benefits. Communications Earth & Environment, available open access here
- Supply potential of lignocellulosic energy crops grown on marginal land and greenhouse gas footprint of advanced biofuels—A spatially explicit assessment under the sustainability criteria of the Renewable Energy Directive Recast. GCB Bioenergy (13), Issue 9 p. 1425-1447. Available here
- Applying a science-based systems perspective to dispel misconceptions about climate effects of forest bioenergy. Global Change Biology Bioenergy, available open access here
- Bioenergy for climate change mitigation: scale and sustainability, Global Change Biology Bioenergy, available open access here
- Contribution of Biomass Supply Chains for Bioenergy to Sustainable Development Goals. Land 2021, 10(2), 181; available open access here
- The modelling approach determines the carbon footprint of biofuels: The role of LCA in informing decision makers in government and industry. Cleaner Environmental Systems, 2, p.100027. Online version available here
- Special Issue 'Land and Bioenergy' for Scientific journal 'Land'. More information here

- Restoring degraded lands. Annual Review of Environment and Resources, 46, pp.569-599. Online version available here
- Land sector impacts of early climate action. Nature Sustainability, 4(12), pp.1021-1022. Online version available here
- Bioenergy for climate change mitigation: Scale and sustainability. GCB Bioenergy, 13(9), pp.1346-1371. Online version available here
- Co-benefits and trade-offs of climate change mitigation actions and the Sustainable Development Goals. Sustainable Production and Consumption, 26, pp.805-813. Online version available here
- Bioenergy in the circular economy. In Handbook of the Circular Economy. Edward Elgar Publishing. Online version available here
- Biochar in climate change mitigation. Nature Geoscience, 14(12), pp.883-892. Online version available here
- Net-zero emissions targets are vague: three ways to fix. Nature, 591(7850), pp.365-68. Online version available here
- Pyrolysis of invasive woody vegetation for energy and biochar has climate change mitigation potential. Science of The Total Environment, 770, p.145278. Online version available here
- Which practices co-deliver food security, climate change mitigation and adaptation, and combat land degradation and desertification?. Global Change Biology, 26(3), pp.1532-1575. Online version available here

Workshops, seminars, webinars, other events organized by Task 45

Location and date	Event
Utrecht, 22 May, 2019	ExCo83 Workshop: *Governing sustainability in biomass supply chains for the bioeconomy*
Stockholm, 2 September, 2019	Seminar & Roundtable on the IPCC Special Report *Climate Change and Land*
Berlin, 25 November, 2019	Workshop: *Roles of bioenergy technologies in energy system pathways towards a WB2/SDG world*
Virtual, 13-14 March, 2020	Workshop: *Forests and the climate*
Virtual, 5 October 2020 – 20 January, 2021	Five virtual workshops on different aspects of REDII and biomass sustainability. Organized together with Sustainable Biomass Program and ETIP Bioenergy • Workshop 1: *Ongoing developments in EU Member States and the role of REDII*, 5 Oct 2020 • Workshop 2: *Biomass supply from in and outside the EU*, 19 • Oct 2020 • Workshop 3: How to ensure that using biomass maintains and protects biodiversity, 9 Nov 2020 • Workshop 4: Carbon, forests and climate impacts of woody biomass, 30 Nov 2020 • Workshop 5: Social impacts of woody biomass, 20 Jan 2021
Virtual, 15 April, 2021	Workshop: *Forest biomass and climate* (Organized with European Forest Institute and Royal Swedish Academy of Agriculture and Forestry), 15 April 2021. The presentations can be viewed here and downloaded as pdf:s here

Virtual, 24-26 May, 2021	Conference sessions at BBEST-BIOFUTURE Conference. Recorded presentations available here • Governing a Sustainable Bioeconomy: Assessment and Monitoring (Experience and Perspective) • Innovative Landscape Approaches for Sustainable Bioenergy • Climate effects of forest-based bioenergy Contribution of sugarcane fertilization and byproduct management to GHG emissions in the context of the Renovabio legislation
Virtual, 15-16 June, 2021	Workshop: *How can biomass supply for bioenergy deliver multiple benefits and contribute to sustainable development goals?* Arranged with T43 within the inter-Task project Role of bioenergy in a WB2/SDG world. Presentations (pdf) and recorded sessions are available on the here.
Virtual, 23 August, 2021	Webinar: *Biomassans klimatpåverkan - sant och falskt*. Dissemination event complemented with Swedish translation of IEA Bioenergy FAQ on woody biomass. Organized with ETIP Bioenergy and The Swedish Knowledge Centre for Renewable Transportation Fuels (f3). Webinar available here.
Virtual, 29 November – 9 December, 2021	IEA Bioenergy Triannual Conference Online Conference. T45 was responsible for a session under the title "*Realising sustainable bioenergy pathways towards climate goals*". Session pages can be found on the here.
Virtual, 10 december, 2021	Webinar: Climate effects of biomass - true and false. Follow up on the webinar Aug 23, Dec 10 2021. Webinar available here.
Virtual, 31 March, 2022	IEA Bioenergy Webinar – *An introduction to quantifying the climate effects of bioenergy*. Presentations available here

Task website

https://task45.ieabioenergy.com/

Comms-project

In July 2021 the T45 "Creative Comms" Group (CCG, lead by UK NTL Zoe Harris) successfully launched the first campaign within our social media content development project, including videos

and GIFs (see screenshots below). To track the progress of the campaign, we signed up for BrandMention - which was shared with the ETA Florence group for their benefit.

VARIATIONS FROM ORIGINAL PROPOSAL

The corona pandemic has affected the work in T45 with cancelled physical meetings and more digital events.
We have decided to not produce any publications this triennium in the Task project "Combining LCA and Integrated Assessment Modelling to analyse the future impacts of bioenergy". The reason is that the complexity of the work at hand, and time frame for associated research projects, which necessitate extension into the next triennium.
Two other Task projects "Indicators to measure, monitor and assess bioeconomy sustainability" and "Synergies and trade-offs of sustainability implications of land use for bioenergy" will also continue into the next triennium. For the "Synergies" project, the continuation into next triennium is mainly to make it possible to carry out a physical expert workshop, which is now tentatively planned to be placed b2b with ExCo89 and the ExCo workshop around the results of the WB2/SDG intertask project.

WP3 work on economic aspects and financing of sustainable bioenergy investments planned for this triennium has been postponed to the next triennium due to difficulties arranging physical meetings and unclear dynamics in this area (COVID-19 recovery plans, EU Taxonomy).

Finally, the 2nd International Conference on Negative CO2 Emissions was postponed twice. The dates for the conference is now June 14-17, 2022.

The extension of these Task activities into the next triennium has been considered in the preparation of the prolongation proposal for Task 45 and the plan is that the activities will be carried out based on funding committed to these activities in the current triennium.

CO-ORDINATION WITH OTHER TASKS WITHIN IEA BIOENERGY

Co-ordination and collaboration with other IEA Bioenergy Tasks were part of all Inter-Task projects. Task 45 also contributed to IEA Bioenergy ExCo online workshops and the End-of-Triennium conference.

CO-ORDINATION WITH OTHER BODIES OUTSIDE OF IEA BIOENERGY

Cooperation/interaction with GBEP, IRENA, and Biofuture Platform was during this period associated with workshops and co-publication with GBEP Task Force on Sustainability. Within the WB2/SDG Intertask project we collaborated with the IEA Headquarter, and IEA GHG. We also had exchanges with the FAO and IRENA. Limited cooperation with IEA-GHG, IEA-IETS and Global Carbon Project related to the 2nd International Conference on Negative CO2 Emissions, since this conference was postponed to 2022. Additional cooperation associated with events: European Forest Institute, The Royal Swedish Academy of Agriculture and Forestry, ETIP Bioenergy and The Swedish Knowledge Centre for Renewable Transportation Fuels (f3), OECD, IEA-HQ

INDUSTRY PARTICIPATION

Drax was represented in the UK Task 45 group and may have used some of the Task analyses and publications.The workshop series on different aspects of REDII and biomass sustainability was organized together with the Sustainable Biomass Program and ETIP Bioenergy. These workshops were the only ones where industry had an active role in the workshop planning and dissemination of outcomes.

Besides this, industry representatives have had opportunity to participate in Task workshops, seminars and webinars, but we have not collected feedback from industry participants to clarify whether they found the events useful.

IEA Bioenergy

Technology Collaboration Programme

Further Information

IEA Bioenergy Website
www.ieabioenergy.com

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