

## Task 40

# Sustainable biomass markets and international trade to support the biobased economy

Triennium 2016-2018



## **Task 40**

# **Sustainable biomass markets and international trade to support the biobased economy**

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## Introduction and Background

IEA Bioenergy Task 40, which has been active since 2004, consisted of 10 member countries in the 2016-2018 triennium. Over the past decade, Task 40 has supported the global development of international sustainable bioenergy trade. The focus on international biomass trade remained a vital priority in the 2016-2018 work programme of Task 40, but it was anticipated that biomass will increasingly also be utilised in the biobased economy (BBE) for new material purposes, such as bio-plastics, biomaterials and other applications before/next to direct use for energy. Developing the sustainable and stable, international biomass markets for energy and materials is a long-term process. It is particularly important to develop both supply and demand for biomass and energy carriers derived from biomass in a balanced way and avoid distortions and instability that can threaten investments in biomass production, infrastructure and conversion capacity. The Task aims to provide a vital contribution to such (policy making) decisions for market players, policy makers, international bodies as well as NGO's. It aims to do so by providing high quality information and analyses. Also, much has been achieved to guarantee the sustainable production and international trade of biomass for energy, yet, these mechanism may also become barriers for trade, and they should also be applied for other end uses in the biobased / circular economy.

The core objective of the Task is: 'to support the development of sustainable, international markets and international trade of biomass, recognising the diversity in biomass resources and applications for bioenergy and bio-materials in the biobased economy.'

To achieve this aim, the work programme of Task 40 consisted of the following four general topics:

1. Dedicated market studies, both focusing on existing markets (e.g. pellets, wood chips, waste streams) and markets for new bioenergy products (e.g. torrefied material & pyrolysis oil etc.), but also on regions which have not been charted before (e.g. the Pacific rim).
2. Continued (case) studies on how to mobilise sustainable biomass for trade and demonstrate benefits (of bioenergy) in the biobased economy (a.o. critically assess the role of sustainability certification vs. risk-based approaches, binding legislation vs. BMPs etc) – what can the BBE learn from bioenergy?
3. Making things happen / stimulate (investments in) trade – needs to increase dramatically over the next decade.
4. Need for high-quality bio-fuels/feedstocks and advanced/smart logistics (dedicated infrastructure) to achieve cost price reductions – logistics typically are 30-50% of final costs of bioenergy. While advanced logistics and better feedstock may even increase cost at first, they are likely to reduce cost once deployed on a larger scale, and allow for system cost reductions (when taking the advantages at the end user, e.g. a biorefinery into account).

## Task objectives and work carried out

Below, the main activities and deliverables of IEA Bioenergy Task 40 are summarised. In Table 1, a comparison is made between the initially planned deliverables and the ones ultimately achieved, including the additional work performed.

**Table 1. Overview of planned vs achieved deliverables**

Deliverable planned	Achieved	Comment
1.1 Renewal of comprehensive market study for wood pellets	Yes	1.1 Renewal of comprehensive market study for wood pellets
1.2 A joint study with Task 36 and Task 38 on trade of waste-to-energy (WTE) streams,	Yes	Task 38 was unable join due to capacity and budget constraints, but Task 36 contributed to the report
1.3 Optional smaller study	No	Task members decided not to prioritise
2.1 Two workshops with EU and North American policy makers and industry on the ongoing development of sustainability assurance frameworks for solid biomass and consequences for bioenergy trade	yes	In fact, 4 workshops were organised (Gothenburg, Copenhagen (2x) and San Francisco)
2.2 A comprehensive study on the governance of sustainable biomass production and trade	yes	As was stated in the work program, the elements of the study were incorporated within the inter-Task project
3.1 Investigate the role(s) of actors: i.e. companies and organisations	No	Svebio had suggested this deliverable, but could not lead it after retirement of Bo Hector
3.2 Develop a 'layman' s guide to biomass trading	No	Too low industry participation/interest

Deliverable planned	Achieved	Comment
3.3 Highlight bioenergy success stories.	Yes	This was done in the form of an inter-Task project led by Uwe Fritsche.
4.1. Best practices logistics study	No	Not enough interest by partners
4.2 Logistics for biorefineries	Partly	The scope was widened to "Building a Biorefinery Business: Strategies for Successful Commercialisation"
4.3 Update of the long-distance low-cost supply chains study	Partly	Part of inter-Task pretreatment project. Explored new trade routes (Indonesia – Japan) but only focussed on torrefaction
4.4 Workshop: Biomass trade & co-firing across the Pacific Rim: joint outreach event	Yes	With Task 32 and ExCo

Additional deliverables originally not foreseen		
Response to Chatham House report	Yes	Jointly with Annette Cowie and Goran Berndes
Socio-economic assessment of forestry production for a developing pellet sector in Brazil	Yes	
Socio-economic assessment of the pellets supply chains in the USA	Yes	

### Additional deliverables originally not foreseen

Comprehensive overview of production and trade streams of wood pellets, liquid biofuels, industrial roundwood and emerging energy biomass	Yes	
Margin potential for a long term sustainable wood pellet market	Yes	
International bioenergy trade in climate change mitigation strategies: projections and uncertainties	Yes	With collaboration with PBL
The future of biomass and bioenergy deployment and trade: a synthesis of 15 years IEA Bioenergy Task 40 on sustainable bioenergy trade	Yes	
Special Task 40 issue in BioFPR	Yes	Published in April 2019

## 1. DEDICATED MARKET STUDIES

The report Global Wood Pellet Industry Market published in 2011 has been the most downloaded document of IEA Bioenergy Task 40 in the years after. Given the ever-increasing demand and trade of wood pellets witnessed in recent years, it was decided to update the report and bring new insights on market trends and trade of the global wood pellets, namely Global Wood Pellet Industry and Trade Study 2017. The report shows that the global wood pellet market has increased dramatically since 2011, with an average increase rate of 14% per year. New countries have entered the market for both pellet production (such as those from South-East Europe) and pellet consumption (such as East Asia). Also the global wood pellet trade has increased. Intercontinental flows are dominated by the trade relation between the U.S. and the UK, while the non-industrial use is still mainly an intra-European business. This work was both published as a

major 200 page comprehensive market overview report, and as a peer-reviewed article in a special issue of the journal BioFPR, highlighting many of the recent achievements of Task 40.

Another study also built on previous work of Task 40 from earlier triennia, aiming to provide a comprehensive overview of production and trade streams of wood pellets, liquid biofuels, industrial roundwood and emerging energy biomass, also highlighting statistical and methodological issues such as the concept of indirect bioenergy trade and the need for better data for many of the investigated trade flows. Total trade of biomass for energy purposes is estimated as having increased twofold from around 780 PJ in 2004 to 1250 PJ in 2015. Despite the importance of the bioenergy market and the growth of biomass trade for energy, accurate evaluation of energy-related biomass trade faces several methodological challenges, such as uncertainties in international statistics, inconsistent data regarding export and import volumes, as well as limited information about the final use of traded products. The work was published in two papers in the same special issue of BioFPR in April 2019.

A much less recognised yet significant market is the trade of (contaminated) waste wood, which is seldom described in the literature. The study Transboundary flows of biomass waste streams investigated how much solid (biomass) waste feedstock is being transported for energy purposes around Europe in the years of 2010-2017, and the underlying drivers, incentives and implications. The report was jointly carried out with IEA Bioenergy Task 36, and published in December 2018.

Last but not least, Task 40 members and the Netherlands Environmental Assessment Agency collaborated on the study "International bioenergy trade in climate change mitigation strategies: projections and uncertainties". The study compares global trade simulations of bioenergy among 8 different global integrated assessment models. The results show that global trade of bioenergy is projected to increase significantly. Most models showed that Latin America and Africa are projected to be the main exporting regions, with the EU, the USA and Asia likely being importers. The study found that robust sustainability governance is needed for global bioenergy trade and although many regions are likely to depend on imported biomass, this is not likely to lead to significant energy security concerns. Given the importance of international bioenergy trade in meeting strict climate change mitigation goals, successful mitigation strategies are dependent on the development of large-scale bioenergy markets and relevant legislation. A resulting article (with several Task 40 members as co-authors) has been submitted to Climatic Change and is currently under review.

## **2. CONTINUED (CASE) STUDIES ON HOW TO MOBILISE SUSTAINABLE BIOMASS FOR TRADE AND DEMONSTRATE BENEFITS (OF BIOENERGY)**

Improvement of socio-economic conditions is a relevant goal for the further development of biomass and bioenergy production and trade. The production of woody biomass depends mostly on forestry related sectors. The report on Socio-economic assessment of forestry production for a developing pellet sector assesses the forestry sector in a part of Brazil, which has grown strongly and shows positive socioeconomic developments, explained by the close relationship between the forestry industry and the local communities. Selected criteria, index and indicators to assess the socio-economic impacts were applied in a selected region in Santa Catarina, Brazil. Data was gathered from industry and government sources and combined with primary data gathered from in-depth interviews and visits to the region. The results show that in Santa Catarina, there is availability of resources from the forestry production, but the pellet production sector is yet incipient and mainly for regional use. From a socio-economic point of view, the research has shown that the wood and forest sector plays a crucial role in the Lages region, through jobs and income creation, by contributing to local GDP, and other multiplier effects on the local economy.

A second, similar report was published in December 2018 on focussed on the socio-economic assessment of the pellets supply chains in the USA. As bioenergy and especially the production of wood pellets depends heavily on the forestry related sectors, it is required to sustainably produce biomass for energy purposes to extend the positive impacts they have and to minimise negative impacts on society, guaranteeing the mitigation of vulnerability in rural areas, and assuring the disassociation of rurality and backwardness. In the case of the USA, the pellet production to export has reached 7 million tons in recent years providing positive socio-economic impacts in the regions but also some socio-economic issues that need to be further improved. The main aim of this report is to understand the dynamics between local development and forestry activities related to the production and export of pellets on local communities. This report assesses selected issues and indicators for the socio-economic analysis: the following indicators were chosen: Job creation, Land property, Human Development Index, Income Gini Index, Labour conditions, Gender and Diversity, Community Impacts, Sustainable Forest Management Certification and logistics. The assessment included a mixed method using secondary data from the literature and statistical data from the Census and data from interviews of stakeholders in the selected States or related to the sector. The analysis regarding employment opportunities showed that job creation in feedstock production (wood) in the USA grew very slowly in 2010-2014. Growing demand for pellets may entail job expansion in pellets production with possible knock-on effects on feedstock production that will increase demand for labour. Also, any job growth in pellet production and bioenergy projects more widely should ensure greater participation of women in the workforce. Overall, it can be said that the forestry sector plays a role in helping create employment along the feedstock production chain in the three states examined here, although at a modest scale. Nevertheless, as some interviewees observed, local communities, for the most part, welcome this contribution.

Next to these specific studies carried out by Task 40 on socio-economic effects of bioenergy supply chains, the vast majority of time and resources related to mobilise sustainable biomass for trade was spent leading and contributing to the inter-Task project on *Measuring, governing and gaining support for sustainable bioenergy supply chains*. This project aimed at addressing the following questions:

1. Objective 1: How to measure and quantify progress towards more sustainable practices?
2. Objective 2: How to improve the input, output and throughput legitimacy of existing and proposed governance systems?
3. Objective 3: How to engage more successfully with the broad range of stakeholders so that policies and sustainability governance are perceived as legitimate and helpful for build-up of social capital, trust, and support among all stakeholders?

The project was started in 2016 and completed by the end of 2018. A multitude of studies were initiated focusing largely on the agricultural and forestry sectors, and on biogas systems. Several compact summary papers are available sharing the main findings and recommendations from the work carried out with regard to these three questions. A shorter summary is also available in the IEA Bioenergy 2018 Annual Report, with presentation of three illustrative case studies and some general conclusions (IEA Bioenergy, 2019). The initial multitude of studies is being published as scientific articles or IEA Bioenergy reports. References to these are provided in the three comprehensive summary reports and on the website of this [intertask project](#). Members of Task 40 led the work on the third objective, contributed to several case studies, (co-)organised one webinar and four dedicated workshops and published the results in a number of scientific papers.

### **3. MAKING THINGS HAPPEN**

Given the wider setting of Task 40 of supporting markets in the wider bio-economy, Task 40 completed a study on Building a Biorefinery Business: Strategies for Successful Commercialisation. This study aimed to explore and analyse what barriers to commercialisation can be successfully overcome by biorefineries, and which may require support from additional actors within the system, such as policy makers. The study found that when building a biorefinery business, it is crucial to decide the kind of strategy and corresponding business model. Careful attention needs to be paid to the ability to mobilise biomass resources and to establish supply and demand structures at the same time. A collaborative approach, leveraging resources and building a web of favorable system components, has proven a viable strategic approach towards developing and commercialising biorefineries.

In March 2018, Task 40 also commissioned a study on the margin potential for a long term sustainable wood pellet market. The aim of this study is to identify strategies for the operational continuation and viability of present wood pellet supply chains. The analysis will review present market and supply chain cost structures, identify potential cost reduction strategies (technology component) and new (presently niche) markets for wood pellets. It is assumed that through a continuous development and improvement of present production technologies and the utilisation of 'stepping-stone' markets, wood pellets could become a viable central feedstock supply to the future bioeconomy. The study was initially led by INL (Patrick Lamers, US), and was later taken over by Uwe Fritsche (Germany), the new leader of Task 40 as of 1.1.2019. The final report was presented at the ExCo83 meeting in May 2019. It also features in a IEA Bioenergy Webinar in November 2019 on the prospects for wood pellet markets. .

### **4. NEED FOR HIGH QUALITY BIOFUELS/FEEDSTOCKS AND ADVANCED/SMART LOGISTICS**

This fourth aim of Task 40 was covered by a comprehensive case study on torrefied supply chains. The trade of solid biomass across countries, especially long distance like across oceans, is limited by the characteristics of biomass energy carriers, such as high water content and low (energy) density. Pre-treatment to reduce the water content and increase the energy density of solid biomass is required to reduce long distance transport cost. This report, which is one out of six separate case study reports that illustrate the added value of pretreatment technologies in specific fuel supply chains, analyses the effects of pretreatment on supply chain efficiency by comparing the energy consumption along the supply chain of White Wood Pellets (WWP) supply with Torrefied Wood Pellet (TWP) supply. While WWP have become a global standard energy commodity in the recent decade, TWP are just at the beginning of the industrial implementation phase. TWP are made using the same raw material as WWP, implementing an almost similar machinery set up with the additional roasting of biomass to increase the energy density (22,2 GJ/mt instead of 17,56 GJ/mt taken as industry average values) and improve the handling, storage and grinding properties.

Whether energy can be saved across the supply chain by producing TWPs instead of WWPs depends on the balance between increased processing energy consumption and decreased transport energy consumption. For the supply chain analysed in this study, from Indonesia to Japan, overall energy savings of 6.7% at minimum can be reached by shifting from WWP to TWP, resulting from a 16% increase in bioenergy, used for drying and torrefaction, a reduction in the consumption of liquid fossil fuels of 20.9% (Diesel, MDO and IFO) and a 2.3% reduction of electricity consumption on MJ/GJ supplied basis. The energy reduction across the chain results in a 10.3% GHG emission reduction for TWP compared to WWP.

The additional torrefaction processing step of roasting the biomass, requires additional heat. This heat is partially supplied by the combustion of syngas which is released during the torrefaction process, reducing the required fuel wood input proportionally, resulting in a very similar overall thermal efficiency to WWP processing. The pelleting of torrefied wood does consume slightly more electricity than the pelleting of WWP per tonne pelletised but is slightly more efficient if compared on energy basis. A sensitivity analysis concerning the influence of shipping distance shows an increased advantage of TWP with increased shipping distances. The raw material moisture content also impacts the savings on otherwise similar supply chains, with increased moisture content reducing the relative advantage of TWP. Thus the thermal efficiency in the TWP is lower, resulting in fewer savings when the drying energy becomes more dominant in the overall supply chain energy balance. As improved grinding characteristics is another benefit of torrefaction, this would allow for the use of briquettes instead of pellets in traditional power plants as coal mills could grind both pellets and briquettes. The production of briquettes requires less electricity, resulting in a 10.3% energy saving and 33% GHG saving across the chain.

## 5. MISCELLANEOUS

As Task 40 in its current form (with a strong focus on trade) has come to an end at the end of 2018, the Task members decided to bundle the main achievements of the current and past triennia in a joint article entitled [“The future of biomass and bioenergy deployment and trade: a synthesis of 15 years of IEA Bioenergy Task 40 on sustainable bioenergy trade”](#). This was also the feature article of the special issue of BioFPR in which Task 40 published a number of its key results.

## Success story

One particular success that addressed several of the objectives Task 40 was the organisation of a workshop in Tokyo, Japan, on the future perspectives of bioenergy development in Asia. Many East and South East Asian countries see rapid development in the use of both liquid and solid biomass for modern bioenergy. Apart from using domestic biomass, Japan and South Korea have started to import large volumes of biomass (wood pellets and palm kernel shells) for co-firing with coal from countries in the Pacific Rim such as Indonesia, Vietnam and Western Canada. In Thailand, Malaysia, Indonesia and several other Asian countries, the trade and use of liquid biofuels in transport and the modern use of solid agro-residues for combustion and anaerobic digestion is increasing rapidly, facilitated by conducive support frameworks.

This workshop focussed on potential technical and organisational improvements to biomass supply chains, including pre-treatment technologies, bio-refineries, logistics/trade, final conversion/end-use and overarching topics such as sustainability assurance frameworks and policy support options. The workshop provided technical information to decision makers in Asian member countries, but also demonstrated how IEA Bioenergy can support these countries in their development.

The event was attended by approximately 70 industrial stakeholders as well as policy makers, academics and local biomass associations from Japan and other countries in Southeast Asia. The organisation of this workshop was led by IEA Bioenergy Task 32 (Biomass Combustion and Cofiring) and Task 40 (Sustainable Biomass Markets and Trade) and the IEA Bioenergy Executive Committee, with additional inputs from other IEA Bioenergy members on the Pacific Rim (Korea, Australia, New Zealand and Canada). Practical local organisation (hosting) of the event was

provided by NEDO and METI.

The workshop was a success for many reasons: the high attendance from multiple countries illustrated both the interest in the topic and the need for more structural knowledge exchange – as the IEA Bioenergy TCP can offer. It also highlighted both the opportunities of increased bioenergy deployment and trade (with nowadays both the USA and Canada exploring options to export wood pellets to Japan and Korea), but also the risks involved with regard to sustainable sourcing, and the possibilities to learn from experiences gained within the IEA Bioenergy Tasks on these topics in previous years. The workshop clearly led to a renewed interest in IEA Bioenergy, which was shown by amongst others Japan (re-)joining Task 40 for the 2019-2021 triennium. Also, it was recently reported that the Japanese Ministry of Economy, Trade, and Industry (METI) is considering requiring sustainability, legality, and traceability for palm kernel shell (PKS), similar to requirements of other biomass types in many EU member states and the RED-II. The increased collaboration could ideally lead to more widely accepted standards for sustainable biomass sourcing and trade for bioenergy and the wider bioeconomy across the globe. Key insights have also recently been published in June 2019 in *Sustainability Science*.

## Conclusions and recommendations

Task 40 members decided to bundle the main achievements of the current and past triennia in a joint article entitled "[The future of biomass and bioenergy deployment and trade: a synthesis of 15 years of IEA Bioenergy Task 40 on sustainable bioenergy trade](#)". The following conclusions and recommendations have been taken from this article:

"Biomass will continue to play an important role as a feedstock for renewable energy (SDG7) and materials. In-line with an emerging industry, the past decades have largely focused on establishing and evaluating specific supply chains and/or use cases. Future top challenges and research opportunities however are the integration and optimisation of bioenergy on multiple levels: Feedstock production for the (global) biobased economy will have to be part of integrated landscape management and should contribute to achieving other SDGs as well (e.g. food, water, growth and employment). A further harmonisation of sustainability analysis, certification frameworks and evaluation criteria is important to ensure carbon and other co-benefits of bioenergy deployment.

A significant share of agricultural, forestry, and food residue streams remain unused, even when taking into account others existing uses (e.g. fodder) and environmental removal constraints, e.g. to prevent erosion and preserve soil organic carbon and nutrients. Integrated concepts are required to create value-add for actors along the supply chain to ensure their mobilisation.

On the user side the number of biobased-products is increasing and an expansion of the market for biofuels, biochemicals, biopower, and other biomass-derived products can be noted. Moreover, the optimal use of biomass for electricity, heat, transport fuels and materials will shift over time, also with increasing emphasis on cascading biomass, increasing shares of other renewables, and the need for negative emission technologies and the potentially significant role that BECCS and BECCU can play.

Therefore, we conclude that it is critical for industry to develop and demonstrate innovative and integrated value chains for biofuels, bioproducts, and biopower that can respond with agility to

market factors while providing economic, environmental, and societal benefits to international trade and markets. This requires development of innovative and efficient technologies that reliably transform lignocellulosic biomass and waste materials into high value intermediates and products at scale. Furthermore, flexible biogenic carbon supply nets based on broad feedstock portfolios and multiple energy and material analysis has highlighted that the reason for this is due to utilisation pathways, which will reduce risks for involved stakeholder and foster the market entry and uptake of various densified biogenic carbon carriers.

The role of international biomass trade in all of this is very likely to increase. With increasing deployment of biomass in the bioeconomy, the need to link regions with abundant biomass supply with those requiring increasing amounts will likely grow – based on various scenarios from integrated assessment models, on the longer term, traded volumes in the same order as oil and coal today may be reached. However, this will only be possible under global sustainability frameworks to ensure amongst others, carbon benefits, food security and contributions or other SDGs. Only under such circumstances, stakeholder support is likely to develop such supply chains. Also, this will depend on the development of fungible bio-commodities/intermediates that can both handle the diverse set of feedstocks and multiple energy and material utilisation pathways.

In light of these expectations, also IEA Bioenergy Task 40 will continue in the coming years, focusing on various issues around the further deployment of bioenergy. The above-mentioned emerging issues and concepts are considered and further developed, in close collaboration with other IEA Bioenergy Tasks (especially the new "Sustainability Task, see [www.task45.ieabioenergy.com](http://www.task45.ieabioenergy.com)), and opening up to more stakeholders from the bioeconomy, and civil society. In these Tasks, new biomass deployment concepts such as provision of high-temperature industrial heat, the role of renewable gases as well as the requirements and suitability of BECCS and BECCU applications will be looked at. The design and impact of globalised sustainable biobased value chains and the respective synergies between bioenergy and the broader bioeconomy play a key role in the further bioenergy deployment. It all needs to be framed by the role of bioenergy in a well-below-2 °C/SDG world, i.e. a future in which not only climate change mitigation is paramount, but the Sustainable Development Goals are met simultaneously. Sustainable bioenergy within the broader bioeconomy will be instrumental in delivering on that."

## Attachments

### Task meetings and participation in major events

Workshop: Technical Requirements for Torrefied Biomass, Rotterdam	25-26 Jan 2016
Task 40 meeting in Utrecht, The Netherlands	28-29 Jan 2016
Task meeting in Stockholm, Sweden	22-24/05/16
Workshop on Sustainable and Intelligent Bio-economy, Stockholm, Sweden	24-26/04/16

Webinar on Cascading of Wood Biomass – Principles, Policies and Effects on Market and Trade	01/09/16
Webinar on Torrefaction (jointly with Task 32)	26-10-2016
Task 40 meeting, Miami, Florida	5 Nov. 2016
3 Presentations and two breakfast sessions (on cascading and the updated wood pellet market study) during USIPA wood pellet conference	6-8 Nov. 2016
Webinar on The European Wood Pellet for Small-Scale Heating	14 March 2017
Task meeting in Copenhagen, Denmark	15-16 May 2017
Workshop on Measuring, governing and gaining support for sustainable bioenergy supply chains, Gothenburg, Sweden	18-19 May 2017
Task meeting in London, UK	03-04 October 2017
Site visit Drax, Selby	5 October 2017
Task 40 meeting in Brussels, Belgium	March 2018
Conference Governing sustainability of bioenergy, Copenhagen, Denmark	16-19 April 2018
Workshop Measuring, governing and gaining support for sustainable bioenergy supply chains, Copenhagen, Denmark	15 May 2018
Task meeting in Utrecht, the Netherlands /goto meeting online	29-30 August 2018

International workshop on <b>Future perspectives of bioenergy development in Asia</b>	03-05 September 2018
Task 40 meeting in San Francisco, USA	5 November 2018
Task 40 presentations at the ABLC conference	7 November 2018
Task 40 goto meeting, online	11 December 2018

- Deliverables (Task meetings, conference papers, seminar proceedings, technical notes, newsletters, Industry Days, scientific publications, books, etc.), including website address and dissemination of results

## TASK DOCUMENTS

For all ExCo meetings, progress reports are available. Also for all Task 40 meetings as outlined above, detailed minutes are available for Task 40 members. Three annual reports have been published, as well as a contribution to the colour section of the IEA Bioenergy annual report on the inter-Task sustainability project.

## REPORTS

Daniela Thrän, David Peetz, Kay Schaubach (Lead authors) (2017) *Global Wood Pellet Industry and Trade Study*. IEA Bioenergy Task 40. June 2017.

Rocio Diaz-Chavez, Arnaldo Walter, Pedro Gerber (2017) *Socio-economic assessment of forestry production for a developing pellet sector, The case of Santa Catarina in Brazil*. IEA Bioenergy: Task 40. ISBN 978-1-910154-32-8

Rocio Diaz-Chavez, Arnaldo Walter, Pedro Gerber (2018) *Socio-economic assessment of forestry production for a developing pellet sector: The case of South East US*. IEA Bioenergy Task 40.

Martin Junginger, Mika Järvinen,;Dr. Olle Olsson, Christiane Hennig, Pranav Dadhich. (2018): *Transboundary flows of woody biomass waste streams in Europe 2018. Transboundary flows of woody biomass waste streams in Europe*. IEA Bioenergy: Task 40: 2018: 12.

Olle Olsson, Laura Kasnitz, Philip Peck Patrick Lamers (2018): *Building a Biorefinery Business: Strategies for Successful Commercialization*. IEA Bioenergy: Task 40: 2018: 03

Contributions of Christiane Hennig, Jussi Heinimö, Laura Craggs, Martin Junginger, Olle Olsson, Ruben Guisson, Svetlana Proskurina, Thuy Mai-Moulin, Uwe Fritsche, Chenlin Li, Richard Hess (2018): IEA Bioenergy Country Report series (Austria, Belgium, Germany, Finland, Italy, the Netherlands, United Kingdom, United States)

## **SCIENTIFIC ARTICLES**

Junginger, M. et al. (2019) The future of biomass and bioenergy deployment and trade: a synthesis of 15 years IEA Bioenergy Task 40 on sustainable bioenergy trade. *Biofuels, Bioprod. Bioref.* 13:247–266 (2019); DOI: 10.1002/bbb

Daniela Thrän, Kay Schaubach, David Peetz, Martin Junginger, Thuy Mai-Moulin, Fabian Schipfer, Olle Olson, Patrick Lamers (2019) The dynamics of the global wood pellet markets and trade – key regions, developments and impact factors. *BioFPR*, 13(2), pp. 267-280, DOI: 10.1002/bbb.1910.

Svetlana Proskurina, Martin Junginger, Jussi Heinimö, Beysin Tekinel & Esa Vakkilainen (2019), Global biomass trade for energy: Part 2 - Production and trade streams of wood pellets, liquid biofuels, industrial roundwood and emerging energy biomass, *BioFPR*, 13(2), pp. 371-387.

Svetlana Proskurina, Martin Junginger, Jussi Heinimö, Esa Vakkilainen (2019) Global biomass trade for energy: Part 1 - statistical and methodological considerations. *BioFPR*, 13(2), pp. 358-370.

Martin Junginger, Jaap Koppejan, Chun Sheng Goh. Sustainable bioenergy deployment in East and South East Asia: Recent trends, challenges and opportunities. *Sustainability Science*, Published online, <https://rdcu.be/bIaTg> June 2019, DOI:10.1007/s11625-019-00712-w

## **CO-ORDINATION WITH OTHER TASKS WITH IEA BIOENERGY**

Task 40 collaborated with Task 36 (in the waste trade study), Task 32 (in the inter-Task project on pretreatment and on the organisation of the Asian outreach event). Also, there was intensive collaboration with Tasks 38 and 43 as part of the inter-Task project on sustainability.

## **CO-ORDINATION WITH OTHER BODIES OUTSIDE OF IEA BIOENERGY**

No co-ordination between Task 40 and other Implementing agreements. Within the inter-Task project on sustainability, there was involvement of FAO and GBEP.

## **INDUSTRY PARTICIPATION**

Several industrial partners participated directly within Task 40: Drax, Hofor, Miktech, RWE and Wild & Partner. Also, Task 40 participated in several industry conferences (e.g. the USIPA wood pellet conference) and has invited industry stakeholders to Task 40 workshops (e.g. in Tokyo). Task 40 has always appreciated industry input, often providing valuable data and insights to researchers, checking assumptions on input data and identifying important knowledge gaps /ongoing developments.

# IEA Bioenergy

## **Further Information**

IEA Bioenergy Website  
[www.ieabioenergy.com](http://www.ieabioenergy.com)

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