How can biomass supply for bioenergy deliver multiple benefits and contribute to sustainable development goals?

Report from Joint IEA Bioenergy and GBEP Workshop held online on 15 - 16 June 2021

IEA Bioenergy

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Report compiled by Paniz Pahlavanlu, Andrew Klain, Jean-Martin Lessard, Jean Blair and Bruno Gagnon.

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Executive Summary

Scenarios that limit global warming to well below 2°C by 2050 usually rely on a significant increase in bioenergy supply to help displace carbon-intensive and fossil-based energy. An increasing demand for bioenergy will, in turn, necessitate an increase in biomass feedstock from a variety of sources.

In support of the United Nations' (UN) 2030 Agenda for Sustainable Development, all UN Member States adopted the UN Sustainable Development Goals (SDGs) in 2015. The SDGs serve as a comprehensive framework to guide holistic national and international development. Such an approach is of particular interest for the sustainable production of biomass for bioenergy and other bio-based products, since biomass growth, harvesting, collection, storage, transport, processing and use can positively or negatively impact people, communities and ecosystems.

Under the IEA Bioenergy inter-task project "The Role of Bioenergy in a Well Below 2°C and Sustainable Development Goals World," a virtual workshop was held on June 15th and 16th, 2021. The objectives of the workshop were to: explore the importance of the SDGs for biomass supply chains and how this relationship differs across different geographies and biomass feedstocks; share best practice case studies among leading experts where biomass supply chains for bioenergy have provided multiple social, economic and environmental benefits; and explore and propose preliminary recommendations on how governance can help align biomass supply chain development with the SDGs. This workshop report summarizes the presentations, panel discussions and workshop activities held across both days.

The first day of the workshop began with six presentations and a short panel discussion on the relationships between biomass supply chains and the SDGs. Presenters first emphasized the importance of using integrated approaches to maximize the social, environmental and economic benefits of supply chains and minimize the negative impacts on communities and regional development. Presenters also raised the importance of using financial incentives to help initiate development of supply chains, while highlighting the role that the SDGs could provide in guiding sustainable biomass supply chain development. There was general agreement in the follow-up discussion that all three of these themes were important, and that the SDGs can help inform a shared understanding of sustainability for projects around the world.

Participants were then divided into breakout groups to discuss the potential contributions or impacts of agricultural, forestry or waste biomass supply chains on the SDGs. Participants generally agreed that a holistic approach to supply chain development, that also considers local factors, is essential in achieving multiple socioeconomic, cultural and environmental benefits. The following SDGs were identified as the most important to consider for each supply chain:

Agricultural	Forestry	Waste/Other
2 Zero Hunger	1 No Poverty	8 Decent Work and Economic Growth
6 Clean Water and Sanitation	3 Good Health and Well-being	2 Zero Hunger
8 Decent Work and Economic Growth	8 Decent Work and Economic Growth	6 Clean Water and Sanitation
12 Responsible Consumption and Production	11 Sustainable Cities and Communities	12 Responsible Consumption and Production
13 Climate Action	13 Climate Action	13 Climate Action
15 Life on Land	15 Life on Land	

The first day of the workshop concluded with a panel discussion exploring how the SDGs could promote sustainable development of biomass supply chains. Panellists agreed that while SDG contributions are currently monitored at the national and international levels, solutions to implement them should be flexible and consider community-level circumstances to support effective and meaningful implementation. There was also general agreement that considering the greater bioeconomy when using the SDGs to promote sustainable biomass supply chain development might be more effective, given that bioenergy is often generated as a co-product from the manufacturing of other bioproducts.

The second day of the workshop began with the presentation of four best practice case studies from around the world exploring the strategic use of crops, land-use and resource management practices to provide biomass for bioenergy while simultaneously providing several other environmental, social and economic benefits. The presenters demonstrated how methods like strategic perennialization, land-use degradation neutrality, and biomass integration with forestry or agricultural supply chains could provide multiple benefits to local and regional ecosystems, as well as new economic opportunities for people and communities.

Participants were then divided into five breakout groups where they first listened to another supply chain specific case study presentation. Building on this presentation, and their own expertise and experiences, participants discussed actions, policies, and/or regulations that could enable or prevent the implementation of best practices for relevant supply chains. There was general consensus from the breakout groups that a combination of supporting policies, funding, and knowledge sharing activities were important enablers for maximizing the benefits of biomass supply chains. Conversely, competing land and biomass use, limited demand and market access for feedstocks, as well as low economic viability were identified as barriers to biomass supply chain development.

The workshop concluded with a panel discussion on the potential role governance could play in supporting the implementation of the SDGs in biomass supply chains designed for bioenergy. Panellists identified the need to develop governance systems that focus on the broader bioeconomy, not just bioenergy. There was also agreement that governance systems designed to support cascading supply chains, nature-based solutions and integrated land management would likely support progress towards the SDGs. Lastly, panellists agreed that policy development and financial support would be needed to support further biomass supply chain development that is competitive against non-renewable energy and material alternatives.

Overall, three key themes emerged from the workshop:

- Sustainable implementation of biomass supply chains, regardless of their end-use, will require integrated approaches that maximize environmental, social, cultural and economic benefits for the communities and people for which they serve.

- Given the need for holistic approaches, the SDGs are well-situated to guide the development of bioeconomy and the biomass supply chains it relies upon, and could be used to help promote a shared understanding of ‘sustainability’.

- The SDGs can support a balance between local, national and international scale supply chain implementation by providing non-prescriptive guidance to sustainable development.

Building on a growing body of knowledge and ongoing initiatives under IEA Bioenergy, GBEP and the Biofutures Platform, further work could be conducted on the interdependency between

bioeconomy governance and national SDG implementation as well as on the alignment of current bioeconomy governance systems with the SDGs. This would help identify potential changes required to improve sustainable bioeconomy governance systems, but also help to support the use of SDGs as a holistic framework through which to balance environmental, social and economic policies. Another potential area of work stemming from the conclusions of the workshop is the development of a toolkit to help policy makers review existing bioeconomy policies or develop new ones while considering the SDGs.

Contributors

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Reviewers

Daniela Thrän, Constance Miller, Sören Richter.

Acknowledgments

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We are grateful to the many facilitators, speakers, and note takers who guided the presentations, panels, and breakout groups. We also thank the workshop organizing committee (Uwe R. Fritsche, Göran Berndes, Martin Junginger, Daniela Thrän, Biljana Kulišić and Annette Cowie) for support throughout the planning and delivery of the event

We gratefully acknowledge the contributions of all workshop participants who provided valuable inputs in the workshop sessions and participated collegially in the group discussions.

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Introduction

Bioenergy is the largest source of renewable energy and, as countries strive to meet their climate change goals and continue to transition to low-carbon fuel alternatives, the demand for bioenergy is expected to increase significantly from 3% to 18% by 2050 (IRENA, 2021). This will undoubtedly increase demand for biomass that must be sustainably procured from agricultural, forest, waste and other sources.

In 2015, United Nations (UN) Member States adopted the Sustainable Development Goals (SDGs, Figure 1) as part of the UN's 2030 Agenda for Sustainable Development. The SDGs are intended to support national and international development by offering a holistic framework through which to balance environmental, social and economic policies. Such an approach is essential to the sustainable production of biomass for bioenergy and other bio-based products, since its growth, harvest, transportation and processing can have significant positive or negative implications for people, communities and ecosystems.

Figure 1. UN Sustainable Development Goals (SDGs).

The IEA Bioenergy strategic inter-task project on the "The Role of Bioenergy in a Well Below 2°C and Sustainable Development Goals World" aims to identify and disseminate bioenergy implementation strategies that work towards SDG objectives and the well-below 2°C climate target. The inter-task project assesses the benefits and impacts of implementing biomass supply chains for bioenergy and subsequent contribution of these supply chains to the SDGs. In a recent review task members reported that biomass supply chains for bioenergy are intrinsically tied to progress on SDG 7 Affordable and Clean Energy, but were also likely to contribute to other SDGs, including SDG 2 Zero Hunger, SDG 6 Clean Water and Sanitation, SDG 8 Decent Work and Economic Growth, SDG 9 Industry, Innovation and Infrastructure, SDG 12 Responsible Production and Consumption, and SDG 15 Life on Land (Blair et al., 2021). Overall, the SDGs were found to be an effective framework through which to develop sustainable biomass supply chains for bioenergy, and also the broader bioeconomy, in support of a breadth of policy objectives.

Building from this initial review, the IEA Bioenergy inter-task project hosted a workshop with leading bioenergy experts in June 2021. The objectives of the workshop were to:

- explore how biomass supply chains can positively or negatively contribute to the SDGs;
- discuss, identify and share best practices using case studies from around the world; and

- explore key themes and/or issues in aligning the governance of biomass supply chains with the SDGs.

About seventy participants from across Europe, North America, South America, Africa, Asia, and Australia registered for the workshop (Figure 2**Error! Reference source not found.**). Participants expressed shared interests in sustainability, planning for climate change and energy transitions, and collaboration (Figure 3).

Figure 2. Registrants spanned Europe, North America, South America, Africa, Asian, and Australia.

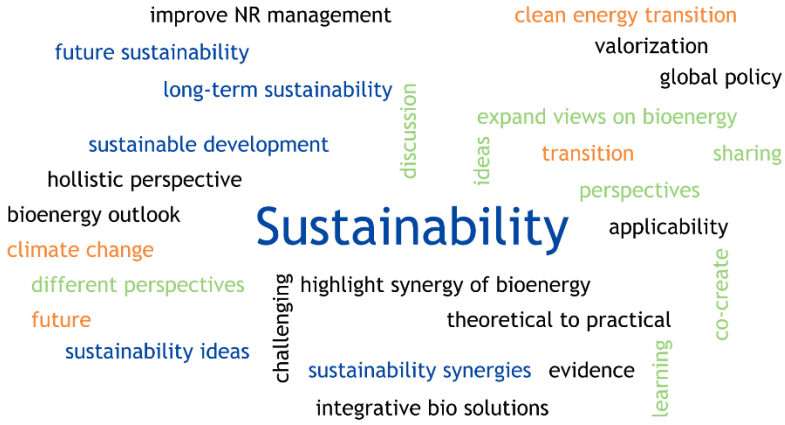

Figure 3. At the beginning of the workshop, participants were asked to briefly explain why the workshop topics were important to them. A word cloud was generated from their responses and shared live.

Overall, the workshop focused on the relationships between the SDGs and different biomass supply chains and regions, while sharing best practice case studies from around the world. Participants then built upon these case studies to discuss the role of governance in ensuring the sustainability of biomass supply chains and alignment with the SDGs.

Day 1 Presentations: Sustainable Development Goals and Biomass Supply Chains

The workshop began with six presentations and a short panel discussion with representatives of several intergovernmental organizations on the relationships between SDGs and biomass supply chains. Several key conclusions were shared among the presenters:

- biomass supply chain policy should be well-informed to maximize co-benefits and minimize adverse effects;
- integrated approaches to biomass supply chain production will maximize co-benefits;
- financial incentives could alleviate barriers to sustainable supply chain development;
- SDGs provide a common language through which to promote sustainable biomass supply chain development.

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Moderator: Bruno Gagnon, Natural Resources Canada

An overview of each presentation is provided in the sections below.

NATURE-BASED SOLUTIONS, BIOMASS SUPPLY, AND SDGS

Henry Neufeldt, UNEP DTU Partnership

Working with nature is an integral aspect of sustainable development and, more specifically, the SDGs. The UNEP Adaptation Gap Report 2020 discusses recent progress in planning for, financing, and implementing nature-based adaptation solutions (UNEP et al., 2021). Nature-based solutions are low-cost options that bring environmental, economic, and social benefits to a wide range of stakeholders. But, the effective capacity of these solutions is fundamentally limited by climate change. Therefore, greenhouse gas mitigation must accompany nature-based solutions as much as possible while simultaneously considering human well-being and biodiversity co-benefits.

Nature-based cooling solutions can indirectly support hazard management efforts like flooding strategies. Despite this potential, it is difficult to motivate private organizations to pursue nature-based solutions due to high opportunity and transaction costs, the involvement of large numbers of stakeholders, and slow returns on investments. Public-private partnerships could help promote the uptake of nature-based solutions. Nature-based solutions also carry potential risks; for example, ineffective implementation may have adverse effects on local communities, local biodiversity, and water availability. Lastly, a thoughtful, integrated approach is essential to minimize interactions and trade-offs between goals for the bioeconomy and those specific to agri-food.

BIOECONOMY DEVELOPMENT AND BIOMASS SUSTAINABILITY

Jim Philp, the Organization for Economic Co-operation and Development (OECD)

In 2012, the OECD Council published recommendations to governments, businesses, and consumers on assessing the sustainability of bio-based products (Philp, 2013). Then, in 2021, the OECD published a follow-up report that investigated the relevance and implementation of these recommendations for different nations (OECD Council, 2021). There were several unexpected findings in the report. For example, the report brought to light discrepancies between the development and implementation of bioeconomy strategies within nations. Importantly, the report found that *Recommendation 9*, on cooperation with non-member countries, had not yet been implemented in most nations. Governments could be encouraged to implement more general bioeconomy policies by pairing them with value chain specific policies (Marvik & Philp, 2020). Indeed, many different aspects of the bioeconomy, such as biotechnology, energy, and food, share common SDGs that should be addressed in coordination.

ASSESSING SUSTAINABILITY – THE GBEP SUSTAINABILITY INDICATORS FOR BIOENERGY

Constance Miller, Global Bioenergy Partnership, Food and Agriculture Organization

The Global Bioenergy Partnership (GBEP) has developed the most widely recognized and agreed upon set of indicators for the assessment and monitoring of bioenergy sustainability. They are voluntary, have a scientific basis, facilitate harmonization of sustainability assessments across different regions, and touch upon all forms of bioenergy. To date, fourteen countries have implemented the GBEP sustainability indicators (GSI) (Global Bioenergy Partnership, 2011). Participants can use the measurement of the indicators over time to show progress towards or away from a sustainable development path and to monitor policy impacts. Most economic and all environmental and social GSIs are linked to the SDGs (Fritsche et al., 2018). By extension, GSI implementation can facilitate data collection for SDG monitoring. GBEP is introducing a Rapid Implementation Framework and an associated online platform with dedicated data entry sheets to increase accessibility and reach of the GSI.

BIOFUTURE PRINCIPLES FOR POST-COVID RECOVERY AND ACCELERATION

Andrea Rossi, Biofuture Platform

Bioenergy plays a large role in the IEA's global net-zero scenario. By 2050, modern bioenergy use is expected to rise to 100 EJ, meeting almost 20% of total energy demand and thus becoming the second largest supply of energy. It is one of the most labour-intensive energy industries, employing ~3 million people around the world. In 2020, biofuels production declined for the first time in two decades due to reduced transport activity and shrinking demand related to the COVID-19 pandemic. Low gasoline and diesel prices also challenged the business case for biofuels. To address this decline, the IEA developed a sustainable recovery plan aimed at boosting global economic growth by an average of 1.1% per year while saving and creating roughly 9 million jobs a year. Likewise, Biofuture Platform has set five principles for post-COVID bioeconomy recovery and acceleration: do not backtrack on policies; consider short-term COVID support for producers to address cash availability issues; reassess fossil fuel subsidies while oil prices are low; build back better with bio by integrating the bioeconomy in broader recovery programmes; and reward sustainability (Biofuture Platform, 2021).

SDG IMPLEMENTATION IN THE EU CONTEXT

Luisa Marelli, European Commission Joint Research Centre (EC JRC)

The European Commission Joint Research Centre aims to support the European Union's regulation agenda by better understanding how current, and future, policies and strategies align with the SDGs. Moreover, the Commission aims to design and evaluate EU policies transparently, comprehensively with respect to SDGs, based on scientific evidence, considering all different steps of the policy cycle, and to unveil synergies and trade-offs and avoiding burdens. To assist in these goals, the Commission developed a database that maps EU policies to different SDGs. This database is now available on the Commission's platform (European Commission, 2021) and was informed by workshops with stakeholders, allowing the Commission to identify and define 100 indicators relevant to the bioeconomy. Furthermore, this work has led the Commission to suggest that the bioeconomy can contribute significantly to the SDGs, except for SDG 3 Good Health and Wellbeing and SDG 16 Peace, Justice and Strong Institutions, and therefore should be developed holistically to ensure the benefits of the bioeconomy can contribute to as many SDGs as possible.

THE ROLE OF BIOENERGY IN A WB2/SDG WORLD: CONTRIBUTION OF BIOENERGY SYSTEMS TO SDG IMPLEMENTATION

Jean Blair, Natural Resources Canada (NRCan)

Biomass production is expected to increase significantly to meet temperature targets set out in the Paris Agreement. There is concern that these projected increases in biomass production for bioenergy could lead to unintended, negative consequences. Biomass production systems that contribute positively to multiple SDGs were explored in a recent report (Blair et al., 2021). The report scanned the academic literature to better understand the potential impacts of bioenergy and biomass supply chains on the SDGs, with identified interactions between biomass production for bioenergy evaluated for targets underneath the SDGs. Bioenergy is most likely to be linked to SDG 7: Affordable and Clean Energy, but potential impacts of biomass production on the other SDGs vary between supply chains and are more likely to be connected to land use and resource management. Best practices for sustainable biomass production were also identified for different supply chains. In general, best practice case studies had multiple benefits, existing land management and resource production systems were integrated, and there was cooperation between multiple stakeholders. Moving forward, there should be a focus on expanding biomass to other non-energy sectors with defined incentives and mechanisms.

Day 1 Breakout Discussions: Identification and prioritization of SDG interactions vis-à-vis biomass by supply chain

Within breakout groups, participants decided which SDGs would be most positively or negatively impacted by a given agricultural, forest or waste/other biomass supply chain. Since bioenergy supply chains are known to be closely tied to SDG 7: Clean and Affordable Energy, participants chose from the remaining SDGs. In these open discussions, participants shared their knowledge of existing supply chains or best practices for supply chain management. In addition, some participants spoke to best practices and case studies for which they had first-hand experience, while others used their expertise to more broadly speak to best practices

An overview of the chosen SDGs and discussion topics for each biomass supply chain are included in the tables below. Overall, participants agreed that a holistic approach that balances a breadth of environmental, cultural and socioeconomic factors will maximize the benefits and mitigate or prevent the unintended consequences of supply chains. Several groups discussed the need to include local stakeholders in policy and supply chain development. Participants agreed that understanding local circumstances was integral to determining whether supply chain development would positively or negatively impact SDGs. Participants also agreed that best practices would likely contribute to progress on one or more SDGs, while ill-informed implementation could have significant and wide-spread negative impacts.

Agriculture Supply Chain	
Positively impacted SDGs	Negatively impacted SDGs
2 Zero Hunger ○ More efficient resource use could increase economic return for farmers and reduce food waste	2 Zero Hunger ○ Poor resource management and allocation could exasperate food inequality, especially if small land holders are left out of the conversation
12 Responsible Consumption & Production ○ Best practices include using resources efficiently and being accountable for carbon exports	6 Clean Water and Sanitation ○ Uninformed crop, fertilizer, and irrigation choices could exacerbate water pollution and scarcity
13 Climate Action ○ Replacing fossil energy with residues, applying agricultural practices to increase sequestration and carbon in soils, and reducing fertilizer and animal demand would promote climate neutrality	13 Climate Action ○ Poor agricultural practices could threaten biodiversity, soil health, and increase GHG emissions as well as soil carbon losses
15 Life on Land ○ Using agricultural best practices could protect biodiversity and pollinators, and allow more efficient agricultural land use	15 Life on Land ○ Poor land management could harm biodiversity, water, and soil health ○ Innovation in agriculture is essential
8 Decent Work & Economic Growth ○ Increasing resource efficiency could diversify markets and increase economic return	
Other: 1 No Poverty; 3 Good Health & Well-being	Other: 10 Reduced Inequalities; 8 Decent Work & Economic Growth; 9 Industry, Innovation & Infrastructure

Forest Supply Chain	
Positively impacted SDGs	**Negatively impacted SDGs**
1 No Poverty ○ Provide job opportunities in the supply chain, particularly in rural and remote areas	1 No Poverty ○ Unequitable development of supply chains could increase poverty in areas, particularly rural and remote regions
8 Decent Work & Economic Growth ○ Create economic opportunities for people and their communities ○ Integrate cascading use of woody biomass to improve resource-use efficiency	3 Good Health & Well-being ○ Maintaining traditional uses of biomass could impact local air and water quality
13 Climate Action ○ Use residues for bioenergy and displace carbon intensive fossil fuels ○ Use sustainable forest management practices to improve carbon sequestration in forests and improve climate change resiliency	13 Climate Action ○ Deforestation reduces global carbon sinks
15 Life on Land ○ Sustainable forest management (e.g. thinning practices, intercropping, improved post-harvest practices) could improve soil quality and improve forest health and biodiversity	15 Life on Land ○ Unsustainable harvesting could increase deforestation and impact biodiversity ○ Harvesting could also impact soil quality and/or lead to desertification
11 Sustainable Cities & Communities ○ Improve sustainability by replacing fossil-fuels with bioenergy ○ Support sustainable local and regional development	
Other 5 Gender Equality 9 Industry, Innovation & Infrastructure 10 Reduced Inequalities 14 Life Below Water	Other 2 Zero Hunger 5 Gender Equality 11 Sustainable Cities & Communities 12 Responsible Consumption & Production

Waste/Other Supply Chains	
Positively impacted SDGs	**Negatively impacted SDGs**
8 Decent Work & Economic Growth ○ Waste could be used to provide opportunities for local employment, drive growth and development, and create new sources of income	2 Zero Hunger ○ Competing uses for biomass could increase the price of biomass for food, feed and energy, making them less accessible to vulnerable populations
12 Responsible Consumption & Production ○ Material consumption and waste generation should be reduced and material circularity should be enhanced ○ It is easier to see the positive impact of waste use compared to other resources that need to be cultivated and harvested	6 Clean Water & Sanitation ○ Water quality could be affected by industrial water pollution or a lack of soil cover ○ Untreated water could affect local communities and water bodies
13 Climate Action ○ GHG emissions could be reduced through manure management and by replacing fossil fuel energy with energy from low-carbon waste-derived sources ○ Carbon sequestration in the soil occurs when processed residues, such as biochar, are returned to the land	15 Life on Land ○ Untreated agri-waste could be toxic or act as a pollutant ○ Agri-waste use could increase the value of agricultural investments and result in an expansion of the cultivated area
Other 1 No Poverty 2 Zero Hunger 9 Industry, Innovation & Infrastructure	Other 13 Climate Action 11 Sustainable Cities & Communities 9 Industry, Innovation & Infrastructure

Day 1 Panel Discussion: How might the SDGs Help to Sustainably Expand Biomass for Bioenergy and the Bioeconomy?

A panel discussion on the potential of the SDGs to promote the sustainable expansion of biomass for bioenergy and the broader bioeconomy concluded the first day of the workshop. The questions asked to the panellists as well as their responses are summarized below. The discussion emphasized the following items:

- While progress towards SDGs is monitored at the national or international level, flexibility and independence in prioritizing, and implementing, the SDGs at the local level is essential.
- Local collaboration, public participation and consultation are important in prioritizing goals, building acceptance of biomass supply chains and implementing the most locally appropriate solutions.
- Monitoring and attributing impacts directly to bioenergy is difficult since bioenergy is connected to the broader bioeconomy. Therefore, it may be more beneficial to assess the contributions of the broader bioeconomy to the SDGs, rather than considering bioenergy in isolation.

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Moderator: Uwe R. Fritsche, IEA Bioenergy

Questions 1 & 2: Can SDG implementation at the national level help sustainable deployment of biomass supply chains for bioenergy? To what extent are the SDGs used in bioenergy development, or resource management more broadly, in your country?

There was general consensus from the panellists that the implementation of the SDGs could support the deployment of sustainable biomass supply chains for bioenergy, given that the implementation of sustainable biomass supply chains also requires a holistic and integrated approach. Panellists also agreed that a bottom-up approach to the implementation of both the SDGs and biomass supply chains was necessary to ensure community-level needs were considered alongside regional, national and international level priorities.

One panellist followed up with this point, citing an example from Sweden, as to whether or not sustainable forest development is the responsibility of local forest owners or a centralized governing body, and the implications that private responsibility versus centralized responsibility over forest management would have on the sector itself. Other panellists added that these types of conversation were also being held at the international level, with large multi-lateral institutions making decisions on behalf of national governments.

Lastly, panellists agreed that definitions of sustainability differ between stakeholders and that this is worth considering as it could impact policy and regulatory decisions at different levels of governance.

Question 3: Is demonstrating the contributions of biomass to the SDGs a critical component or element in creating acceptability for bioenergy, and other bio-based products, especially in the social domain? Will that help us, as the debate about bioenergy continues on?

Panellist agreed that using the SDGs to communicate the benefits of bioenergy was important to demonstrate how it could contribute to more than just sustainable energy production. An example from Canada was given to demonstrate how a number of anaerobic digesters were previously developed to help lower electricity costs, but since then other renewable energy sources have become cost competitive. However, using the SDGs to demonstrate the other benefits of anaerobic digesters, such as improving waste management, has been helpful in further promoting their development in Canada.

The panellists also agreed and highlighted that the SDGs could be used to promote and communicate a universal understanding of sustainability and sustainable development. An example from Sub-Saharan Africa was given by one panellist to demonstrate how gender equality is intrinsically linked to bioenergy as many women walk upwards of 20 kilometres a day to collect firewood. By supplying these women with sustainable bioenergy, not only do they have clean and accessible energy, but they are able to engage in other economic activities to support their families.

Question 4: Is there a need for regional or international agreement on the implementation of the SDGs? Could the SDGs also support developing agreements on the sustainable development of biomass supply chains?

There was general agreement among the panellists that a balance between local implementation and national and international integration is required in implementing both the SDGs and bioenergy systems. Both are necessary to ensure sustainable implementation on a local scale while ensuring consistent methods and tools on the international scale to provide decision makers with comparable data. Striking a balance between spatial scales would also ensure that the methods and tools used to measure sustainability align with current reporting systems (e.g. regulatory or voluntary environmental reporting, including GHG emissions), thus limiting contradictions and redundancies in reporting and measurement practices.

Panellists also proposed that a balance between spatial scales could be achieved through a bottom-up approach whereby national and international frameworks were informed by local data and conditions, thereby being adapted to them, rather than imposing national or international frameworks onto local communities that did not align with their own circumstances. The Paris Agreement was cited as a non-prescriptive example for communally addressing a problem, wherein greenhouse gas emission targets were set internationally, but countries were given discretion in how to meet these targets based on their own set of circumstances.

Question 5: How do you ensure that the SDGs are not taken advantage of to cover unsustainable practices, such as illegal harvesting of wood or unreported fishing?

It was proposed by one panellist that the question worth considering first might be who decides what is considered 'sustainable'? Citing the European Union's (EU) ban on palm oil harvesting, the panellists noted that both the Malaysian and Indonesian governments were likely to have a different perspectives than the EU on palm oil production given the importance of the industry to their national economies. Building from this question, another panellist proposed that one should consider how the same materials and products could be sourced more sustainably rather than banning them altogether. They argued that looking at methods to improve practices and minimize negative impacts on both the environment and people is a better way to frame such discussions, since it takes into account the needs of countries and regions while also supporting broader efforts to encourage sustainable development.

Question 6: Should we be considering the sustainability of supply chains beyond bioenergy and into the broader bioeconomy?

There was general agreement from the panellists that, given the integration of bioenergy in the broader bioeconomy, both are often considered simultaneously. Panellists also agreed that bioenergy is often a co-product from the manufacturing of other bioproducts, emphasizing that bioenergy and the broader bioeconomy are inherently intertwined.

It was also proposed by one panellist that looking at biomass supply itself, rather than end-uses, to consider potential impacts on people or the environment might be more beneficial than concentrating on specific sectors within the bioeconomy. It could help to highlight potential impacts of certain feedstocks rather than their end-uses, which could help to inform policy.

Day 2 Presentations: Global and national case studies

The second day of the workshop began with presentations sharing best practice case studies for sustainably implementing biomass supply chains for bioenergy while maximizing other environmental, social, cultural and economic benefits. Four global and national case studies were shared with participants, followed by a short panel discussion. The presentations highlighted several best practices which included:

- Strategic perennialization to provide biomass feedstocks while simultaneously providing several other environmental, social and economic benefits.
- Sustainable land-use to mitigate land degradation and climate change.
- Procurement of renewable low-carbon fuels that support and incentivize sustainable forest management practices.
- Integrated solutions in agriculture for local bioelectricity and bioheat generation.

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Mid Sweden University

Barron Joseph Orr
United Nations Convention to Combat Desertification

Keith L. Kline
Oak Ridge National Laboratory

Guido Bezzi
CIB – Italian Biogas Consortium

Moderator: Bruno Gagnon, Natural Resources Canada

An overview of each presentation is provided in the sections below.

BENEFICIAL LAND-USE CHANGE IN EUROPE

Oskar Englund, Mid Sweden University

Growing biomass can be done in a manner that enhances ecosystem services and biodiversity while also providing feedstock for the bioeconomy. One way to do this is through strategic perennialization, where specific perennials are grown to provide local environmental benefits such as reducing soil erosion. This type of strategic land-use change is often implemented in intensively managed agricultural areas that are subject to resulting environmental impacts. Recent studies have found that this type of land-use change can have a number of positive impacts on local agricultural land and watersheds while producing biomass for the bioeconomy. For example, one study found that riparian buffers and windbreaks using specific perennials in Europe could reduce nitrogen runoff from agricultural land into local watersheds, while also helping to reduce soil loss from wind erosion (Englund et al., 2021). Another study found that in-rotation grass production in Europe increased soil carbon, reduced water and wind erosion and helped to mitigate localized flooding (Englund et al., 2020). While these are promising results, more work using high-resolution modeling at the landscape scale is necessary to improve spatial planning and regional implementation of this type of land-use change.

BIOENERGY AND LAND DEGRADATION NEUTRALITY

Barron Joseph Orr, United Nations Convention to Combat Desertification (UNCCD)

Many of the world's international emergencies are intertwined, but so too are their solutions. This is especially true when land is made part of the solution. The United Nations 2021 Report: *Making Peace with Nature* and the International Panel on Climate Change 2019 *Special Report on Climate Change and Land* emphasized the reciprocal relationship between climate change and land degradation. Land Degradation Neutrality (LDN), whereby the amount and quality of land resources necessary to support ecosystems and enhance food security remain stable or increase within specified temporal and spatial scales, is a concept that could be implemented regionally, and globally, to maintain a balance between land-use and conservation. A key component of this type of land-management framework is land governance that must holistically consider environmental, social, economic and cultural aspects of land management. The bioenergy community should integrate LDN into future planning, as well as develop a governance framework that supports this initiative ensuring biomass feedstock and bioenergy production is consistent with sustainable land management.

EFFECTS OF THE SOUTHEASTERN USA WOOD PELLET SUPPLY CHAIN ON SDGS

Keith Kline, Oak Ridge National Laboratory

Deforesting land for urban development in the southeastern United States is increasingly threating the country's 'timber basket'. However, increasing demand for sustainably sourced wood pellets for heat and electricity generation may provide an incentive for many private land owners to actively manage these forests for their valuable wood fibre, rather than harvesting and selling the cleared land to urban developers. As a result of this increasing demand for wood pellets, the US Forest Inventory Analysis has been gathering data to examine the potential effects and changes over time across the region's forests, carbon stocks, biodiversity, and greenhouse gas emissions. The sector's contributions to the UN SDGs are also being monitored. A preliminary analysis of the wood pellet supply chain suggested that the supply chain contributed to SDGs 7 Affordable and Clean Energy, 8 Decent Work and Economic Growth, 9 Industry Innovation and Infrastructure, 12 Responsible Consumption and Production, and 15 Life on Land, with some variation depending on geographic and socioeconomic contexts. This analysis also highlighted that the wood pellet supply chain could have negative impacts if inappropriate forest management practices are implemented. Their analysis recommends that monitoring should continue while stakeholders are engaged from across the supply chain.

BIOGASDONERIGHT® AND AGRO-ECOLOGICAL CONVERSION OF AGRICULTURE

Guido Bezzi, Italian Biogas Consortium (CIB)

Biogasdoneright is a sustainably designed bottom-up approach to on-farm biogas production where farmers use intercropping techniques to grow supplementary crops that are used for biogas production which is then applied to power farm operations. The digestate from biogas production is also used as fertilizer. The integrated approach is part of a broader agro-ecological transition focused on integrating bioenergy production with agriculture to maximize land-use, reduce unintended land-use change, improve soil health by intercropping crops that add nutrients to local soils, improve on-farm sequestration through additional crop growth as well as the circularity of on-farm energy production. The model provides farmers with new revenue-generating opportunities to supply biomethane to local electricity grids. When paired with livestock production, the model can further reduce agricultural runoff by using animal waste to produce biogas and reduce on-farm methane emissions. When paired with CIB's Farming For Future strategy, Biogasdoneright meets a majority of GBEP's Global Sustainability Indicators and could help to reduce as much as 30% of direct emissions from agriculture.

Day 2 Presentations and Breakout Discussions: Best practice case studies to enhance co-benefits from biomass supply

Participants were divided into breakout groups to discuss actions, policies, and/or regulations that could enable best practices or be barriers for enabling best practices for specific supply chains. Prior to each group's discussion, another supply chain specific presentation was given to facilitate the discussion. While some groups focused in on specific case studies, others used the case studies as a starting point for broader discussions of each supply chain type. An overview of these discussions, as well as identified enablers and barriers to best practices, are provided below. Best practices involved integrated solutions that provide a broad range of co-benefits, from invasive plant removal, to land restoration, to diversifying revenue streams for land-holders. Supporting policies, adequate funding and knowledge transfer were identified broadly as enablers of best practices, while competing land and biomass use, lack of market demand or access, and low economic viability were identified as barriers.

USE OF INVASIVE SPECIES IN SOUTH AFRICA FOR BIOENERGY

Floor van der Hilst
Copernicus Institute of Sustainable Development

This case study highlighted how invasive plants in South Africa could be used for bioenergy production while providing other environmental and socioeconomic benefits. The study found that the use of invasive plants could be used for bioenergy, displacing petroleum-based energy and reducing greenhouse gas emission, while also providing jobs through the removal and transportation of these plants, and improving other ecosystem services such as water availability for other non-invasive plant species. Further environmental and socioeconomic benefits from the removal of invasive plant species for bioenergy depend on subsequent land-use.

Supply Chain	Best Practice	Enablers	Barriers
Forestry	Use of forest harvest residues for modern solid biofuels.	Policies that support biomass collection of low-value feedstocks. Policies that support distributed energy and pyrolysis. Greenhouse gas emission reduction policies and commitments. Policies that support invasive species removal. Land-use management plans that account for rehabilitation following invasive plant removal.	Unestablished biomass supply chain, labour market and transportation logistics. Capital and infrastructure required to expand supply chain, fund harvest and transport, and create bioenergy combustion facilities. Perception of carbon debt associated with biomass harvesting and use. Unclear impacts on soil health and land-use policy after harvesting biomass.
Agriculture	Use of native invasive scrub and agricultural residues for bioenergy.		
Waste	Use of invasive species for bioenergy.		

DISRUPTING HIGHLY CONTESTED INTENSIVE AGRICULTURE BY CHANGING TO GRASS AND LEGUME PRODUCTION FOR BIOREFINERIES

Uffe Jørgensen
Centre Director CBIO,
Senior Researcher

This case study highlighted the benefits of incorporating perennial grass and legumes in European agriculture to support biorefineries using a case study from Denmark. The study found that incorporating perennial grass and legumes can reduce local soil erosion and nitrate leaching, reduce the need to use pesticides, and improve biodiversity by planting a variety of crops. This feedstock can also be used to support local biorefineries, which in turn can help support the development of markets for this same feedstock. Supply chains such as these can also contribute to a number of the UN's SDGs further highlighting the benefits developing sustainable supply chains and biorefineries.

Supply Chain	Best Practice	Enablers	Barriers
Agriculture	Intercropping using mixed species to improve sustainability and productivity of agricultural systems, by improving soil quality, reducing erosion and agricultural run-off and improving local biodiversity.	Policies that support integrated land-use of agricultural land. Carbon pricing policies and credit markets that support biofuels and bioproducts which would increase demand for sustainable feedstocks.	Lack of policy coordination across different government departments and agencies. Lack of incentives to reward 'best practices'. Existing markets and infrastructure that are reluctant to change (i.e. lack of demand for biomass supply).
	Precision farming, emerging technology and artificial intelligence to improve data collection on local environmental conditions and establish sustainable land-use.	Carbon pricing policies and credit markets that support sustainable land-management and provide opportunities to generate revenue. Policies that provide ecosystem service payments and reward sustainable land management.	Low prices on carbon. Continuing subsidies to petroleum-based products and energy and not rewarding land-management in the same way. Unintegrated land management initiatives among many land-holders/owners.

BIOMASS FOR HEAT IN REMOTE NORTHERN INDIGENOUS COMMUNITIES

Cara Sanders
Askii Environmental

This case study highlighted the multiple co-benefits of developing bioenergy projects and biomass supply chains in two remote communities in northern Ontario, Canada that did not previously have an active forest sector. In both communities, the biomass heating projects are integrated with a youth sawmill program in which local youth are employed to operate a small sawmill. The sawmills produce lumber and other wood products that are sold locally, with the offcuts and residues used to fuel biomass boilers that heat the band-owned school in each community. Up to ten youth in each community are employed full time and trained in forest harvesting, sawmilling, wood construction, biomass processing (chipping) and storage for the biomass boiler, boiler operations and financial management, giving them knowledge and skills that will help to build a foundation for their future.

Supply Chain	Best Practice	Enablers	Barriers
Forestry	Use the entire tree, including residues, following circular economy principles.	Sufficient funding, equipment and capacity. Leverage biomass markets to utilize lower value wood.	Limited awareness of funding opportunities. Demanding funding applications. Lack of biomass markets.
	Learn about, develop and follow sustainable forest management practices. Seek third-party sustainability certification.	Train local forest operators. Develop connections with other remote communities.	Limited capacity and knowledge to develop plans locally. Long-term training demands.
Agriculture	Improve productivity and sustainability of biomass production through precision agriculture, multi-rotation, variable rate harvesting and other agricultural strategies.	Certain industrial partners and land owners are willing to invest in best practices. Availability of agricultural land with low food productivity.	Short growing season in far northern or southern regions. Lack of biomass markets. Competing high value land use.
	Establish perennial biomass crops to provide complimentary co-benefits.	Financial support from land owners and government to invest in perennial crops.	Lack of support for establishing perennial crops. Lack of markets for lignocellulosic biomass.
Waste	Maximize waste diversion and energy recovery.	Certain municipal governments invest in waste-to-energy systems. Technologies such as AI can improve waste diversion.	Waste is inexpensive to get but expensive to process into an usable fuel.
Multiple	Provide appropriate support and training to operate energy systems and source biomass supply at the local level.	Funding for training and people to lead and develop programs.	Training programs have not been established and are most effective when delivered in communities.
	Focus on the co-benefits of energy production from biomass.	An integrated approach in which multiple benefits are considered and valued.	Biomass procurement for energy not integrated in the broader value chain.

BIOGAS AND FERTILISER PRODUCTION FROM AGRICULTURAL WASTE

Christian Colindres
Grupo Central Agricola

This case study highlighted the business model of a biogas plant in Guatemala City that uses poultry manure for electricity and heat production and digestate for organic fertilizer production. This project adds value to agri-food supply chains, diversifies the operating income of farmers and results in a more resilient, low-emission disposal system. Yet, there are several barriers to the development, financing and implementation of such plant, such as the lack of know-how, the poor competitiveness of bioenergy in the market, the lack of knowledge about the conversion technologies and business models. Clustering of farmers to share high capital costs and risks, facilitating product transactions, along with government incentives for renewable energy and waste management are key factors in facilitating the development of similar projects. Partnerships between governments and local communities are needed.

Supply Chain	Best Practice	Enablers	Barriers
Forestry	Apply best management practices appropriate for site conditions.	Certification and chain-of-custody that provides assurance of sourcing.	Lack of awareness of best management practices.
	Use native species adapted to site conditions.	Support to productive forests and integrated land use planning.	Different value systems imposed on local forest owners.
	Identify best use for residues.	Long-term purchase agreements.	Low viability compared to subsidized fossil fuels.
Agriculture	No tillage, cover crops and biomass production near to conversion plants to reduce fossil fuel use.	Awareness of the environmental performance of biofuels through life cycle assessment & carbon markets.	Lack of knowledge of opportunities of biofuels. Subsidies on fossil fuels and fertilizers.
	Integrated farming and processing practices rather than a single crop, single product model.	Biorefineries allow the conversion of more feedstocks into more products.	Biofuel production for crop/food product residues still challenging. Lack of knowledge sharing.
Waste	Export of surplus biomass for bioenergy production abroad.	Farmers associations and policies.	Mill owners reluctant to engage in value sharing with feedstock producers.
	Clustering of farms and accepting off-farm sources of organic material (e.g. municipal wastewater).	Environmental regulations that enforce best practices for waste management.	Lack of standards/regulations for the use of digestates.
		Incentives to renewable energy, including grants.	High capital costs of anaerobic digestion.
Multiple	Social amelioration program for workers.	Fairer distribution of benefits across the workforce.	Lack of socio-economic data on conditions of workers.
	Engage with and support local champions.	Ensure broad support through multi-level public-private partnerships	Disagreement in the public and scientific community on sustainability.
	Integrate bioenergy as one co-product from improved resource management.	Carbon pricing. Eliminate fossil fuel subsidies.	Political and social rejection of bioenergy as sustainable option.

AGRO-FORESTRY PRACTICES USING GLIRICIDIA IN SRI LANKA

Lucky Dissanayake
Serendib Assets, Biomass Group

Sri Lanka is highly vulnerable to the impacts of climate change, deforestation, and soil degradation. Native gliricidia trees offer a holistic nature based solution to these challenges, providing fuelwood, carbon capture, nitrogen fixation and companion planting co-benefits. Biomass Group is a woman-led organization that works with smallholder farmers to plant gliricidia as bordering or intercropping trees to their cash crops, producing fuelwood for industry steam boilers in local factories. More than forty thousand farmers have registered in this program to date and there is a strong emphasis on financial literacy and empowering rural women as village coordinators. The Biomass Gliricidia project deliver on the following SDGs: 1 - No Poverty; 2 - Zero Hunger; 3 - Good Health and Well-Being; 5 - Gender Equality; 7 - Affordable and Clean Energy; 13 - Climate Action; and 17 - Partnerships for the Goals.

Supply Chain	Best Practice	Enablers	Barriers
Forestry	Use woody residues and side streams for bioenergy.	Developing greater biomass conversion capacity for bioenergy.	High demand for biomass for other bioeconomy products. Large distances between residue sources and mills are uneconomical.
	Design forest management systems to simultaneously enhance biomass production and carbon sinks.	Government support Available market for new wood production/products. Wildfire mitigation.	Biodiversity and soil carbon impacts may conflict with residue harvesting. Smallholders may not be able to afford sustainability certification.
Agriculture	Use climate models for land-use planning and agricultural management.	Availability of open-source software and models.	Lack of awareness/capacity for farmers to access and implement models.
	Engage smallholder farmers in agroforestry systems for cotton production.	Support for initial start-up investments	Lack of awareness of this market among farmers. Competing biomass or land use.
	Incorporate riparian buffers.	Carbon credits and seed funding.	Competing land use.
Waste	Make biogas from e.g. manure, rice straw, cassava.	Local awareness of waste issues. High biomass availability.	Inconsistent biomass composition. Lack of market need and/or market access.
Multiple	Engage local stakeholders in land-use planning and resource management decisions and incorporate private sector investment in biomass production.	Inclusive planning processes with meaningful stakeholder consultation.	Centralized planning without consideration of local priorities and private sector interests.

Day 2 Panel Discussion: How can bioenergy and bioeconomy governance frameworks support the implementation of the SDGs?

The workshop closed with a panel discussion on the potential role that governance systems for bioenergy and the broader bioeconomy could play in supporting the implementation of the SDGs. The questions asked to the panellists as well as their responses are summarized below. The discussion emphasized the following items:

- An integrated approach to the broader bioeconomy, including food, feed and bioenergy, is essential to maximizing the use of limited biomass feedstock. The SDGs are a helpful framework to guide this integrated approach.
- Nature-based solutions and sustainable biomass are effective strategies to prevent land degradation and promote decarbonisation.
- Procuring sustainable biomass requires "doing the right thing, in the right place, at the right scale." In addition, the "best use" of biomass will be contextual and will need to be determined by local stakeholders.
- Resource and land use efficiency could be maximized through the development of cascading supply chains and the incorporation of integrated land management techniques.
- The growth of the global bioeconomy must be inclusive, with consideration for local biomass access and needs, land tenure rights, and flexible financial support for different regional contexts.
- Policies and financial incentives are needed to further support development of bioenergy, and the broader bioeconomy, particularly to meet decarbonisation goals.

Uwe R. Fritsche
IEA Bioenergy

Warren Mabee
Queen's University

Michela Morese
Global Bioenergy Partnership

Ana Kojakovic
Food and Agriculture Organization

Paolo Frankl
International Energy Agency

Moderator: Martin Junginger
Utrecht University, SBP Standards Committee

Question 1: Are current bioenergy governance systems aligned with the SDGs, and if so where do they align well already and if not, where is there room for improvement?

There was a general consensus among panellists that instead of focusing on the alignment of bioenergy governance systems with the SDGs, emphasis should be placed on aligning bioeconomy governance system with the SDGs, since bioenergy is often a co-product or by-product of other manufactured goods in the bioeconomy. Panellists agreed that integrated approaches would ultimately encompass sustainable bioenergy governance.

One panellist added that developing financing regimes alongside governance frameworks was also imperative to ensure sustainable development of biomass supply chains. They suggested that the SDGs could help to guide responsible financing practices by both investors and those seeking investment partners.

Panellists came to the conclusion that more could be done to improve national bioeconomy governance systems, but that the SDGs were well suited as a framework to help guide future governance systems, policies and regulations.

Question 2: How do we develop governance frameworks internationally that align with the needs of importing and exporting countries involved in global markets, especially where frameworks designed for specific end-uses or geographic regions already co-exist?

Panellist agreed that developing governance frameworks that aligned with both the needs of countries and the international community could begin with reframing how we define the bioeconomy, often only understood as high-value bioproducts and bioenergy. As one panellist highlighted, the bioeconomy is already readily identifiable via the food and animal products people use every day, and therefore emphasis should be placed on expanding the bioeconomy, and subsequently governance frameworks, to also include modern bioenergy and other high-value bioproducts. Doing so would also help make the bioeconomy more recognizable and understandable for people and decision makers, which in the long run would help to develop more integrated governance frameworks.

There was also consensus among panellists that understanding different end-uses for biomass, as well as how demand for biomass is anticipated to grow, could help create sustainable resource management and procurement strategies to balance the needs of individual countries within international governance frameworks. The SDGs could also be used to help inform these strategies and also create a shared understanding of sustainable development at the international level.

Questions 3 & 4: Biomass, like any resource, is finite. How can we ensure the most efficient use of this resource and how can governance support this? How can we also ensure that communities where biomass is grown and harvested have access to the resource for their own benefit?

Panellists agreed that ensuring the most efficient, yet sustainable, use of biomass would require a whole-of-government approach. One panellists emphasized that this would likely need to be led by the Ministry of Finance in each respective country to ensure that financial incentives to incentivize the growth of the bioeconomy were available, while also ensuring that future infrastructure investments were appropriately integrated to leverage industrial symbiosis across economic sectors and maximize the benefits of the bioeconomy.

Panellists also agreed that unfortunately current economic systems have led to global imbalances, and countries who have historically benefitted from these systems should support less fortunate countries. Again, panellists mentioned that the SDGs could be used to address these imbalances and improve current governance systems, providing a common understanding of future sustainable development and the need to ensure global equity.

Conclusion

The workshop brought together leading experts in bioenergy systems and biomass supply chains from around the world to discuss how biomass supply chains, when designed primarily for bioenergy, could contribute to the SDGs beyond SDG 7, in the context where an increased demand for bioenergy to support the global transition to a net-zero economy is anticipated. The workshop's primary objectives were to:

- Explore the importance of the SDGs for biomass supply chains and how this relationship differs across different geographies and biomass feedstocks.
- Share best practices case studies among leading experts where biomass supply chains for bioenergy have provided multiple social, economic and environmental benefits.
- Explore and propose preliminary recommendations on how governance can help align biomass supply chain development with the SDGs

Over the course of two day workshop, these objectives were met through a series of presentations on both the SDGs and best practice case studies from around the world; breakout group sessions used to discuss and identify among participants how various supply chains could contribute and/or hinder progress on the SDGs; and panel discussions with leading experts to discuss necessary tools, methods and governance systems to ensure sustainable implementation and development of biomass supply chains.

From these workshop activities three key themes emerged:

- Sustainable implementation of biomass supply chains, regardless of their end-use, will require integrated approaches that maximize environmental, social, cultural and economic benefits for the communities and people for which they serve.
- The SDGs are well-situated to guide an integrated approach to the development of the bioeconomy, and the biomass supply chains on which it relies upon, and could be used to help promote a shared understanding of 'sustainability'.
- The SDGs can support a balance between local, national and international scale supply chain implementation by providing non-prescriptive guidance to sustainable development.

Given these key themes, and general agreement from participants over the course of the workshop, it is clear that the SDGs can serve as a valuable framework in guiding the sustainable development of biomass supply chains for both bioenergy and the broader bioeconomy. This is closely related to ongoing work done in IEA Bioenergy tasks on the contribution of sustainable biomass supply and bioenergy systems to multiple policy objectives. For example IEA Bioenergy Task 40 is focused on developing viable and efficient bio-based value chains, Task 43 is focused on improving supply chain sustainability and economics to improve both the quality and quantity of biomass feedstock, Task 44 is focused on flexible low-carbon bioenergy systems, and Task 45 is focused on identifying the environmental, social and economic impacts of producing and using biomass for bioenergy within the broader bioeconomy.

Building on a growing body of knowledge (Iriarte et al., 2021) and ongoing initiatives under IEA Bioenergy, GBEP and the Biofutures Platform, future work could investigate to what extent bioeconomy governance depends on stronger national SDG implementation, as well as assess how current bioeconomy governance systems, consisting of a more or less well integrated suite of local, regional, national and international approaches, align with the SDGs. This would help identify changes that may be required to improve existing sustainable bioeconomy governance

systems, but also help to support a common understanding of sustainability using the SDGs as holistic framework through which to balance environmental, social and economic policies. Another potential area of work is the development of a toolkit on SDGs for policy makers, for example guidance material or assessment methodologies, to facilitate the review of existing bioeconomy policies or the development of new ones, to ensure sustainability across biomass supply chains upon which the bioeconomy relies.

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Appendices

Appendix 1 - Workshop Programme

Day 1 – June 15th 13:30-17:30 CEST

13:30 – 13:45	Introduction • Opening remarks, objectives and program of the workshop: Biljana Kulišić, EIHP • Overview of the IEA Bioenergy WB2/SDG inter-task project: Göran Berndes, IEA Bioenergy
13:45 – 15:00	SDGs and biomass supply chains • Nature-based solutions, biomass supply and SDGs: Henry Neufeldt, UNEP DTU Partnership • Bioeconomy development and biomass sustainability: Jim Philp, OECD • Global Bioenergy Partnership (GBEP) Sustainability Indicators for Bioenergy: Constance Miller, GBEP • Biofuture Platform principles: Andrea Rossi, Biofuture Platform Facilitation Team • SDG implementation and biomass supply: Luisa Marelli, EC JRC • Overview of contributions of biomass supply to SDGs: Jean Blair, NRCan
15:00 – 15:10	Health break
15:10 – 16:10	Work session in breakout groups Identification and prioritization of SDG interactions vis-à-vis biomass by supply chain
16:10 – 16:30	Summary from breakout groups in plenary
16:30 – 17:25	Panel discussion How do SDGs help sustainably expand biomass supply for bioenergy and the bioeconomy? Moderator: Uwe Fritsche, IEA Bioenergy
17:25 – 17:30	Closing remarks: Biljana Kulišić, EIHP

Day 2 - June 16th 13:30-17:30 CEST

13:30 – 13:40	Introduction • Recap of day 1 and program for day 2: Biljana Kulišić, EIHP
13:40 – 14:50	Global and national case studies • Beneficial land use change in Europe: Oskar Englund, Mid Sweden University • Bioenergy and land degradation neutrality: Barron Joseph Orr, UNCCD • Effects of the Southeastern USA woody pellet supply chain on SDGs: Keith Kline, Oak Ridge National Laboratory • BiogasDoneRight: Guido Bezzi, CIB
14:50 – 15:00	Health break
15:00 – 16:10	Work session in breakout groups Group discussions on best practices and governance to enhance co-benefits from biomass supply preceded by local and regional case studies: • Use of invasive species in South Africa for bioenergy: Floor van der Hilst, Utrecht University • Disrupting highly contested intensive agriculture by changing to grass and legume production for biorefineries: Uffe Jörgensen, Aarhus University • Biomass supply for bioheat in remote northern Indigenous communities: Cara Sanders, Askii Environmental • Biogas and fertiliser production from agricultural waste: Christian Colindres, Grupo Central Agrícola • Agro-forestry practices using Gliricidia in Sri Lanka: Lucky Dissanayake, Founder Serendib Assets and Biomass Group
16:10 – 16:30	Summary from breakout groups in plenary
16:30 – 17:20	Panel discussion How can bioenergy and bioeconomy governance frameworks support the implementation of the SDGs? Moderator: Martin Junginger, Utrecht University, SBP Standards Committee
17:20 – 17:30	Closing remarks: Biljana Kulišić, EIHP

Appendix 2 - Participant List

First Name	Last Name	Organization
Ana	Kojakovic	UN Food and Agriculture Organization
Ana María	Majano	LEDS LAC
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Cara	Sanders	Askii Environmental
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Jean-Martin	Lessard	Natural Resources Canada
Jesus	Esparza Serrano	Solidaridad Network
Jim	Philp	The Organization for Economic Co-operation and Development
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First Name	Last Name	Organization
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Oskar	Englund	Mid Sweden University
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IEA Bioenergy

Technology Collaboration Programme