Glasgow Declaration on Sustainable Bioenergy

Sustainable Bioenergy at the Heart of Global Net Zero

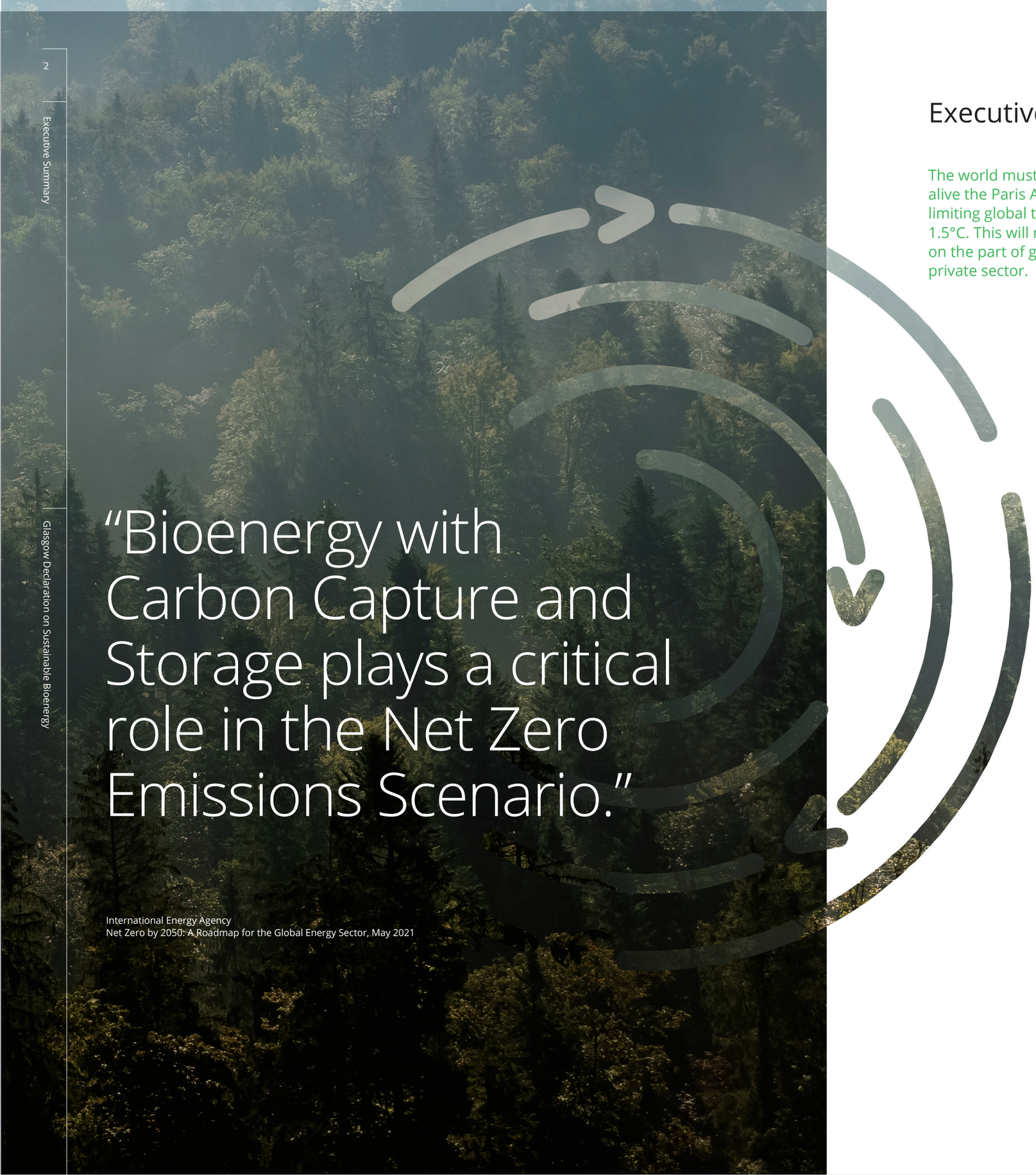
26th Conference of the Parties to the UNFCCC
Glasgow, November 2021

Contents

A digital copy of this document and additional resources are available at www.sustainablebioenergy.org.

You can download this publication from **https://sustainablebioenergy.org/**

All enquiries related to this publication should be sent to: **contact@sustainablebioenergy.org**



"Bioenergy with Carbon Capture and Storage plays a critical role in the Net Zero Emissions Scenario."

International Energy Agency
Net Zero by 2050: A Roadmap for the Global Energy Sector, May 2021

Executive Summary

The world must act urgently to keep alive the Paris Agreement's goal of limiting global temperature rise to 1.5°C. This will require decisive action on the part of governments and the private sector.

Bioenergy will play an indispensable role by replacing fossil fuels with reliable, low-carbon, renewable energy and by delivering negative emissions through bioenergy with carbon capture and storage (BECCS).

In a first of its kind, global assessment of the pathway to Net Zero, the International Energy Agency has forecast that the sustainable bioenergy industry needs to increase its output almost threefold to supply over 20% of the world's energy needs in 2050.[1]

To meet this challenge, a coalition of companies and other organisations, who are mostly focused on the wood-based sustainable bioenergy sector, have come together to develop the Glasgow Declaration on Sustainable Bioenergy.

Acknowledging that sustainable biomass is a finite resource that must be managed responsibly, the Declaration is intended to initiate a multi-stakeholder dialogue about how the sector can deliver the full potential of biomass as one of our most valuable tools for reaching global Net Zero.

The sector has played a key role in delivering decarbonisation, helping countries move away from fossil fuels and supporting the deployment of other renewables.

The Declaration represents a vision for the growth of the wood-based sustainable bioenergy sector over the next 10 to 30 years, and how it will support the transition to global Net Zero. It includes two main parts:

1. A vision for the sustainable growth of the global wood-based bioenergy sector, based on pathways set out by the International Energy Agency and others.

2. A set of sustainability principles that are already helping to deliver sustainable wood-based bioenergy and must continue to underpin the industry as it grows. These principles outline a sustainable approach to bioenergy in four main areas: managing natural resources responsibly, transparency and science-based carbon accounting, protecting biodiversity, and supporting and protecting communities.

To realise the growth of sustainable biomass will require cooperation with many stakeholders in governments, civil society, investors, the research community and beyond.

We invite all participants in the wider bioenergy sector to join us in this initiative.

1 International Energy Agency, "Net Zero by 2050: A Roadmap for the Global Energy Sector", May 2021.

Our statement on the role of sustainable bioenergy at the heart of global Net Zero

All nations of the world must act urgently to prevent catastrophic climate change and limit global warming to 1.5°C, or at least well below 2.0°C, compared to pre-industrial levels.

In the Intergovernmental Panel on Climate Change (IPCC) analysis, keeping to the 1.5°C target means reaching global 'Net Zero' around 2050.

COP26 in Glasgow is a key moment to ensure such action takes place.

According to the International Energy Agency (IEA), this will require a threefold increase in energy supply from sustainable bioenergy sources.

Bioenergy will play an indispensable role by replacing fossil fuels with reliable, low-carbon, renewable energy, and by delivering negative emissions through bioenergy with carbon capture and storage (BECCS) - a vital technology for reaching Net Zero.

This document sets out what an expanded bioenergy sector could look like in 2030 and 2050, based on the IEA's 'Net Zero Emissions' scenario. This vision is very ambitious and will require industry, governments, civil society, researchers, investors, and innovators to work together.

Biomass is a finite resource and must be managed responsibly in dialogue with many stakeholders, to ensure sustainable growth.

The document also sets out some of the principles and practices that already underpin existing sustainable bioenergy, and which must continue to apply as the sector expands and wherever bioenergy is being used around the world. These principles cover four key areas of bioenergy operations:

- Managing natural resources responsibly
- Transparency and science-based carbon accounting
- Protecting biodiversity
- Supporting and protecting communities.

As our industry expands, we will maintain our full commitment to sustainability and promote adoption of our principles of sustainability, wherever biomass is sourced. We will use the best available science to continually develop and improve practices, setting the highest standards for our industry.

We support the IEA's vision of a Paris-aligned future, in which sustainable bioenergy plays an important role in delivering global Net Zero by 2050. However, we are only one element of a much larger sector.

With this Declaration, we invite all participants in the wider bioenergy sector, including our industry counterparts, civil society, academia, and governments, to join us in delivering the full potential of sustainable bioenergy in support of global Net Zero.

Signatories

Associated British Ports

Drax Group

Eco2

Enviva

Fram Renewable Fuels

Graanul Invest

Great Resources Co. Ltd

Lynemouth Power Limited

Pellet México: Bioenergía

PD Ports

Port of Tyne

Association of Renewable Energy and Clean Technology (REA)

US Industrial Pellet Association (USIPA)

Advisors

Advisor organisations have provided independent expertise and advice during the development of the Glasgow Declaration on Sustainable Bioenergy. They in no way endorse, or claim responsibility for, the conclusions of the Declaration.

Bioenergy Europe

National Farmers' Union (NFU)

Supergen Bioenergy Hub

World Bioenergy Association (WBA)

Rising to the challenge of global Net Zero

The International Energy Agency's Net Zero Emissions (NZE) Scenario is the first comprehensive scenario to set out a pathway to global Net Zero by 2050 which is consistent with the UN's Sustainable Development Goals and includes fair access to energy for all.[2]

Within the NZE Scenario, the sustainable bioenergy industry is projected to increase its output in all its forms almost threefold to supply over 20% of the world's energy needs in 2050.[3] This ambitious expansion will deliver a significant contribution to carbon emissions reduction, negative emissions, employment and resource management. It must also go hand-in-hand with a commitment to sustainability.

Our analysis of the IEA's NZE Scenario, combined with industry data, suggests the bioenergy sector will need to develop in the following ways to help deliver global Net Zero.

Bioenergy in 2030 and 2050

1. Sustainable wood-based bioenergy will reduce net global emissions by 600 million tonnes of CO_2e (carbon dioxide equivalent) per year by 2030 and over one billion tonnes of CO_2e per year by 2050 by providing sustainable alternatives to fossil fuels and by delivering negative emissions at scale.

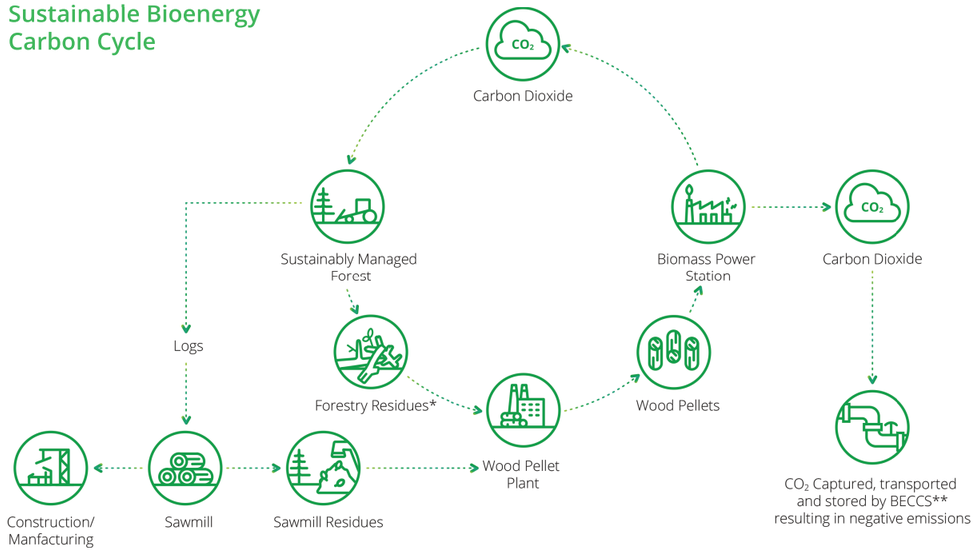
2. The use of sustainable wood-based bioenergy will expand to deliver around 20 Exajoules (EJ) by 2050, up from 7 EJ today.This will account for around 4% of global energy supply. This level of expansion is consistent with strict sustainability limits and the UN's Sustainable Development Goals. It will require the broader application of the sustainability principles that we have set out on pages 18 to 26.

3. Sustainable wood-based bioenergy supply chains will support more than 200,000 additional jobs by 2030, and more than 450,000 additional jobs by 2050. This will include a diverse workforce from rural communities to infrastructure, energy and industrial sectors.

4. Investment of more than $355 billion by 2030 will be required to scale up the wood-based bioenergy industry, and $822 billion by 2050. This is equivalent to $27 billion per year and will form part of the $4 trillion per year in clean energy transition-related investment that the IEA says is needed by 2030 to get the world on track for net zero emissions by 2050.[4]

2 International Energy Agency, "Net Zero by 2050: A Roadmap for the Global Energy Sector", May 2021.
3 International Energy Agency, "What does net-zero emissions by 2050 mean for bioenergy and land use?", May 2021.
4 International Energy Agency, "World Energy Outlook 2021", October 2021.

Sustainable Bioenergy Carbon Cycle



*Forestry residues includes branch tops and bark, thinnings and low-grade roundwood. **BECCS is a bioenergy carbon capture and storage system where CO_2 from renewable power generation is captured and stored underground.

What is bioenergy?

Bioenergy is energy generated using organic materials and it comes in many forms. It can include purpose-grown energy crops, by-products from agriculture, organic waste, and lower-value wood flows and residues from forestry.

At the heart of sustainable bioenergy is a continuous biogenic carbon cycle that helps to reduce overall greenhouse gas emissions from the energy sector and industry. In nature, plants and trees absorb carbon dioxide as they grow and they release it again as they decay. It is then reabsorbed by other plants and trees in a continuous cycle.

In the carbon cycle of sustainable bioenergy, plants and trees absorb carbon dioxide as they grow, then we use some of this plant fibre to generate energy. Emissions from this process are continuously absorbed by plant and forest growth across a sustainably managed landscape.

The biogenic carbon cycle is a recycling of carbon in the biosphere. This is fundamentally different to the process of fossil fuel combustion, which introduces additional carbon dioxide that has been locked away for millennia. Crucially, this 'new' carbon from burning fossil fuels adds to the amount of carbon in the biosphere, causing climate change.

Sustainability is central to the deployment of bioenergy technologies in the fight against climate change. Sustainable bioenergy uses feedstocks that lead to positive carbon outcomes, for example by utilising lower-value agricultural and forestry by-products, thinnings (including low-grade roundwood) and residues, or responsibly grown energy crops.

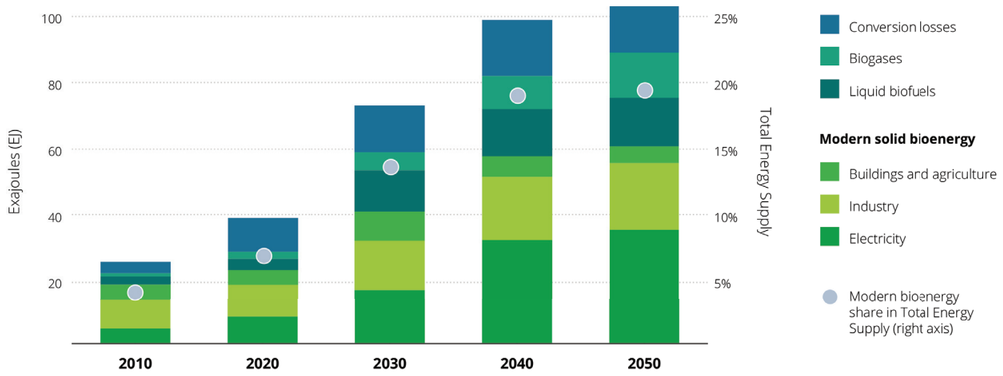
When produced sustainably, bioenergy provides a reliable, low-carbon renewable alternative to fossil fuels in the production of electricity, heat and transport fuels. Capturing and storing the emissions from energy generation with a vital negative emissions technology known as BECCS, permanently removes carbon dioxide from the atmosphere at scale. In some use cases, the carbon dioxide captured can be utilised in the construction, aggregates or food industries.

The most recent IPCC report says large-scale carbon removals, including negative emissions from BECCS, will be crucial to cap temperature rises to 1.5°C and tackle climate change. A significant portion of these carbon removals is expected to be delivered through BECCS.

Why is sustainable bioenergy crucial to achieving net zero emissions globally?

Growth of sustainable bioenergy in a Net Zero future

Source: International Energy Agency (2021), Net Zero by 2050, IEA, Paris



This graph shows the ambitious growth needed for bioenergy to fulfil its role in helping to deliver global Net Zero. In the IEA's Net Zero Scenario, the use of sustainable bioenergy is projected to grow more than threefold. Wood-based bioenergy is mostly used in electricity supply and heating, as well as some industrial uses.

Sustainable bioenergy is the world's leading form of renewable energy, generating five times more energy than wind and solar combined. Currently, bioenergy provides 11.6% of total global energy supply.[5]

Bioenergy will play an increasingly significant role in the future energy system, especially as an essential tool for tackling climate change. The UN's IPCC says that "most mitigation pathways [for limiting climate change] include substantial deployment of bioenergy technologies."[6]

Since the Paris Agreement was signed, the pathway options to limit temperature rise to 1.5°C have shrunk. The IPCC's Sixth Assessment Report now emphasises the critical need for carbon dioxide removals to prevent warming above 2°C.[7]

The need for negative emissions is urgent and growing, with current projections indicating that we are set to miss the IPCC's assessment of what is needed by 2025 by more than 80%.[8] BECCS is a proven technology that is available now to deliver these negative emissions alongside renewable power. Crucially, negative emissions work alongside emissions reduction solutions - they are not a substitute and must not detract from efforts to reduce emissions. The world needs to combine both approaches, according to all of the IPCC's major 1.5°C pathways.

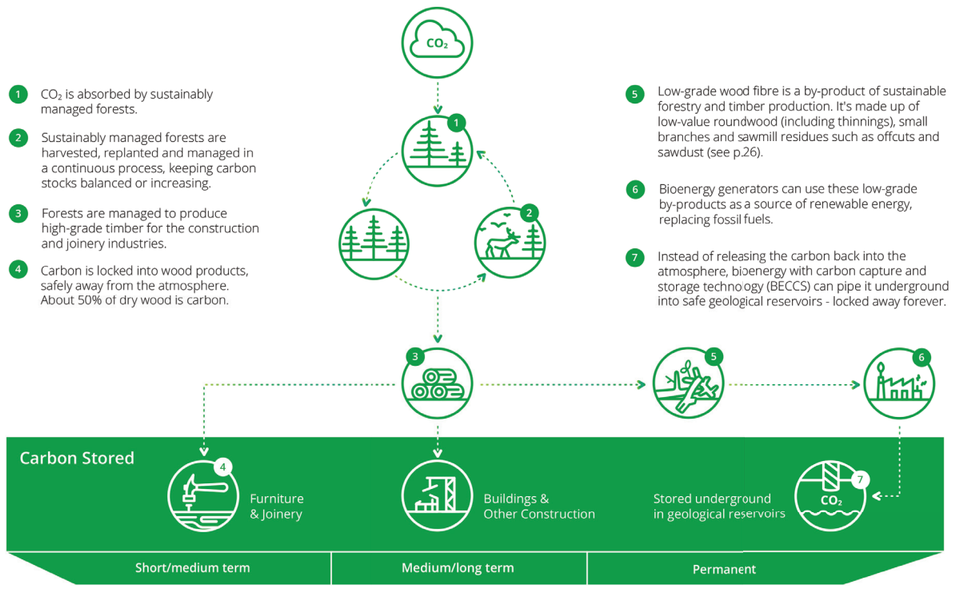
The importance of bioenergy is also recognised by other leading climate authorities. The International Energy Agency (IEA) says that sustainable bioenergy is one of seven "key pillars of decarbonisation", alongside technologies such as hydrogen and other renewables. The UK's Climate Change Committee - the independent scientific advisory panel to the UK government - says "sustainable bioenergy is essential for reaching Net Zero."[9] The European Joint Research Commission, across its eight pathways to Net Zero in the EU, projects bioenergy will need to rise to 20% of energy consumption.[10]

Bioenergy has already contributed significantly to decarbonising the energy sector by providing a reliable, low-carbon and renewable alternative to fossil fuels. It provides flexible energy, which supports a diverse low-carbon energy mix, including wind and solar power. It also provides solutions in sectors that are very difficult to decarbonise, such as industrial heat and power, or aviation.

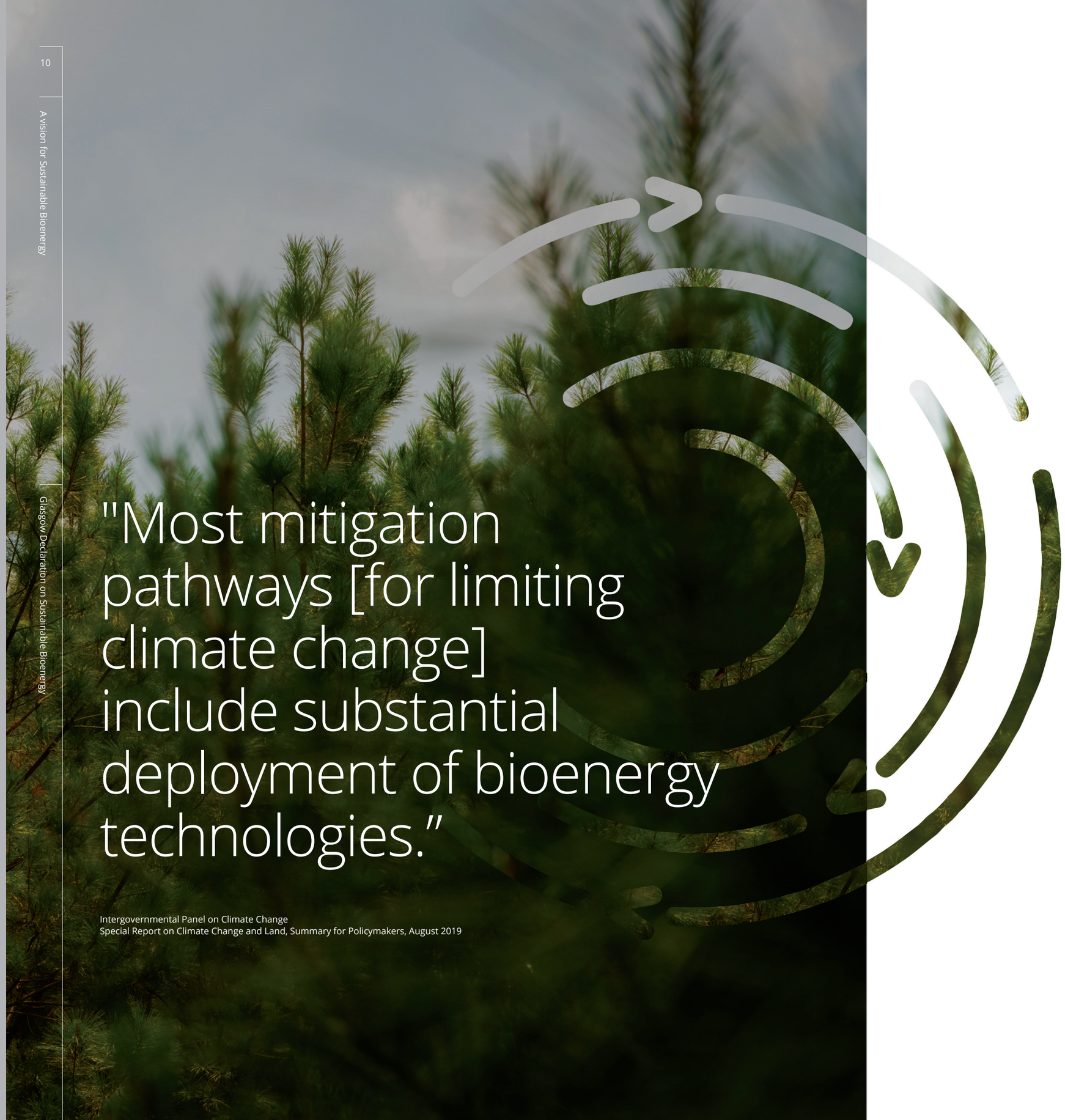
When sustainable bioenergy is combined with carbon capture and storage, it provides negative emissions by capturing carbon at scale and burying it permanently underground, which helps to offset emissions from hard-to-decarbonise sectors such as aviation and agriculture. BECCS is a proven technology, already operating at multiple sites around the world. In order to reach global Net Zero, BECCS must be scaled up worldwide to help meet the IPCC's requirement for 6-10Gt of CO_2 removal each year by 2050. Analysis from the Coalition for Negative Emissions indicates that 2-4Gt of CO_2 removals through BECCS are possible from sustainable sources without land shifts by 2030, with the figure remaining consistent to 2050.[11]

The modern bioenergy sector, through its development over the last 20 years, has provided a stable base from which we can deploy BECCS at scale around the world. It has developed the technologies, infrastructure and sustainability frameworks to ensure BECCS and other forms of sustainable bioenergy can play their essential role in delivering global Net Zero. However, it will require continuing collaboration between industry, government, academia, investors and civil society to make this goal a reality.

How BECCS delivers negative emissions



5 REN21, "Global Status Report", June 2021.
6 Intergovernmental Panel on Climate Change (IPCC), "Special Report on Climate Change and Land, Summary for Policymakers", August 2019.
7 Intergovernmental Panel on Climate Change (IPCC), "Sixth Assessment Report - Climate Change 2021: The Physical Science Basis", August 2021.
8 Coalition for Negative Emissions, "The Case for Negative Emissions", June 2021.
9 Climate Change Committee, "The Sixth Carbon Budget", December 2020.
10 European Joint Research Commission, "Towards net-zero emissions in the EU energy system by 2050", April 2020.
11 Coalition for Negative Emissions, "The Case for Negative Emissions", June 2021.



"Most mitigation pathways [for limiting climate change] include substantial deployment of bioenergy technologies."

Intergovernmental Panel on Climate Change
Special Report on Climate Change and Land, Summary for Policymakers, August 2019

A vision for sustainable bioenergy supporting the path to Net Zero

The following pages set out the headlines of how the wood-based bioenergy sector will need to evolve to meet these demands in terms of greenhouse gas emissions savings, job creation, and investment, all whilst maintaining its focus on sustainability.

This vision for the future of sustainable bioenergy is underpinned by the IEA's Net Zero Emissions Scenario but also incorporates data from industry and a range of other climate authorities.

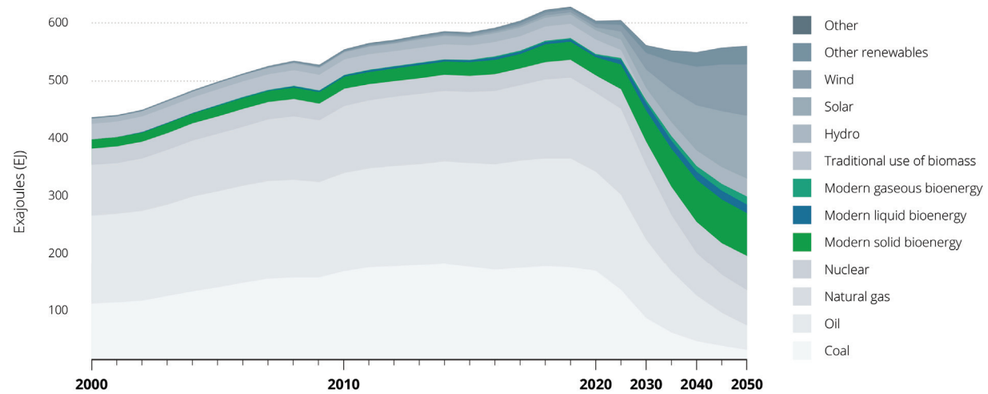
To achieve this vision, stakeholders from across the bioenergy sector must come together to support the sustainable expansion and development of essential bioenergy technologies. Robust national regulation must continue to be led by science and continuously evolve to reflect the latest research and best practice. Investment in independent research will help ensure that sustainability remains at the heart of bioenergy's contribution to global Net Zero.

Reducing emissions

Wood-based bioenergy will reduce net global emissions by 600 million tonnes of CO_2e (carbon dioxide equivalent) per year by 2030 and over one billion tonnes of CO_2e per year by 2050, by providing sustainable alternatives to fossil fuels and by delivering negative emissions at scale.

Bioenergy's share of the total energy mix in a Net Zero Future

Source: International Energy Agency (2021), Net Zero by 2050, IEA, Paris



In the IEA's Net Zero Scenario, sustainable bioenergy will be an important part of a wider renewable and low-carbon energy mix. Sustainable wood-based bioenergy is included in this graph under 'Modern solid bioenergy'.

According to the IEA's Net Zero Emissions scenario, the global bioenergy sector will provide emissions reductions of 2.8 billion tonnes of carbon dioxide equivalent (2.8GtCO_2e) by 2030 and 3.9Gt by 2050 (totalling 11% of the total GHG reductions by 2050). As part of this, the wood-based bioenergy sector will help to reduce global emissions by 600 million tonnes CO_2e per year by 2030, mostly through displacing fossil fuels as a reliable energy source (550 million tonnes of emissions saved) and by delivering negative emissions (50 million tonnes of emissions captured).

Displacing fossil fuels with renewable energy sources is the central plank of reaching global Net Zero. Bioenergy plays a special and indispensable role in the next-generation energy mix because it provides a reliable source of energy to back up other sources that depend on the weather.

Through BECCS, bioenergy offers a proven technology that can remove carbon dioxide from the biosphere at scale and lock it away safely in geological reservoirs, whilst also generating renewable electricity and heat.

By 2050, this emissions reduction will rise to more than a billion tonnes of carbon dioxide equivalent, or 1GtCO_2e per year (780MtCO_2e through displacement of fossil fuels and 260MtCO_2e of negative emissions via BECCS). This is more than the emissions from the global aviation industry in 2020[12], and more than twice the United Kingdom's current annual emissions.[13]

12 https://www.atag.org/facts-figures.html
13 Department for Business, Energy and Industrial Strategy, "Provisional UK greenhouse gas emissions national statistics 2020", March 2021.

Drax Group
Delivering negative emissions at scale in the UK

Drax Power Station, based at Selby, North Yorkshire, is the UK's single largest source of renewable electricity and it is where bioenergy with carbon capture and storage (BECCS), a vital negative emissions technology, is being pioneered.

BECCS has been successfully trialled at Drax since 2019 and plans are now in place to deploy BECCS at scale.

Drax has kickstarted the process to start building BECCS which could see construction commence as soon as 2024, creating tens of thousands of jobs and supporting a post-covid economic recovery. It has an agreement with Mitsubishi Heavy Industries Group to use its carbon capture technology in what would be the largest deployment of negative emissions in power generation anywhere in the world.

Drax's ambition is for the first BECCS unit to be operational by 2027, delivering the UK's largest carbon capture project and permanently removing at least 8 million tonnes of CO_2 a year by 2030.

Drax Power Station, Selby, UK.

Sustainable growth

The use of sustainable wood-based bioenergy will expand to deliver around 20 EJ by 2050, up from 7 EJ today. This will account for around 4% of global energy supply. This level of expansion is consistent with strict sustainability limits and the UN's Sustainable Development Goals. It will require the broader application of the sustainability principles that we have set out on pages 18 to 26.

Sustainable bioenergy must expand to help us deliver the Paris Agreement goals. However, any expansion must recognise that biomass is a finite resource and that there are important constraints on expanding the supply of biomass, including possible trade-offs at local level with other uses of land, such as for food production. These conflicts can and should be avoided while still providing a very large amount of bioenergy feedstock.

Sustainability must be at the heart of bioenergy's contribution to global Net Zero and must be factored into any calculation on bioenergy's future potential. The IEA's vision for the expansion of the bioenergy sector does this. For example, forestry residues from wood processing and forest harvesting provide 20 EJ of bioenergy in 2050. This is less than half of current best estimates of the total technical potential.[14]

The Coalition for Negative Emissions has carried out additional modelling of the potential for negative emissions through bioenergy carbon capture and storage using forestry residues. This applied several strict environmental and socio-economic sustainability filters to discount any land that might lead to conflicts. Following this, they estimate that in 2030, 2-4 $GtCO_2e$ of negative emissions are possible through BECCS globally.[15] That's up to 10% of the world's current total emissions.

Supporting forests through sustainable wood markets

Bioenergy markets help to increase the value of existing working forests, which helps to sustain them as forests in the face of other economic pressures, such as agricultural expansion and urbanisation. It also improves the health of forests against environmental pressures such as wildfires and disease.

Bioenergy provides supplementary income for foresters and landowners by providing a market for lower-value wood fibre. This allows for greater investment in active forest management and decreases reliance on under-funded public forest services.

Actively managed forests are more resilient to increasing threats driven by climate change, such as wildfires, disease and insect infestation. For example, foresters remove excess woody material from overstocked forests, which reduces the risk of wildfires. This process of removing smaller, misshapen and diseased trees is known as thinning. Thinning also ensures there is enough space and light to help the stronger, healthier trees to produce high-value sawtimber needed for construction and furniture. In addition, forest thinning provides environmental benefits as it allows more sunlight to reach the forest floor which can improve habitats for many wildlife and plant species and help to preserve and increase biodiversity.

Bioenergy improves the efficiency of wood fibre markets by providing revenues for the low-grade materials that are produced by thinning and related activities.

14 International Energy Agency, "What does net-zero emissions by 2050 mean for bioenergy and land use?", May 2021.
15 Coalition for Negative Emissions, "The Case for Negative Emissions", June 2021.

Principles of sustainability

As the bioenergy industry expands, we must always ensure sustainable and responsible practices continue throughout the global supply chain. Sustainable bioenergy means ensuring four key elements are always in place:

1. Managing natural resources responsibly
2. Transparency and science-based carbon accounting
3. Protecting biodiversity
4. Supporting and protecting communities.

We have developed a set of principles to guide bioenergy practices around the world, reflecting these four key elements of sustainability. These principles are set out in more detail on pages 18 to 26.

Regulation and certification

As a backstop to ensure that the bioenergy market is sustainable, it requires the presence of robust national legislation and regulation which must continuously evolve to reflect the latest science and best practice. For example, the EU Renewable Energy Directive's Sustainability Criteria, and their UK equivalents, ensure the legality and sustainability of biomass resources, the regeneration of the forest, environmental protection, carbon balance in the forest and substantial reduction in greenhouse gas emissions.

Within such frameworks, there is also a need for risk-based certification systems that assure the sustainable origins and management of biomass feedstocks. Because bioenergy is not the key driver of forestry activity due to its use of low-value wood fibre, it is not practical for the industry to seek to impose forest-level certification on land owners. Instead, risk-based certification is designed to ensure that biomass is only sourced from areas where sustainable forest management is well established. The Sustainable Biomass Program (SBP) is an example of one such system and is recognised in the regulatory systems of key biomass markets in geographic Europe. Robust, transparent and independent certifications play a key part in ensuring the sustainability of bioenergy.

CASE STUDY

The Sustainable Biomass Program
The promise of good biomass

The Sustainable Biomass Program (SBP) is an independent, multi-stakeholder certification system for woody biomass used in industrial, large-scale energy production. Through providing assurance on the legality and sustainability of woody biomass, and verified sustainability and energy data along the supply chain, SBP has achieved international recognition as a solution for biomass producers, traders and end-users to demonstrate compliance with regulatory requirements as a minimum. SBP requires third-party auditors to assure the data provided by certificate holders.

Certification assures that forest ecosystem health, vitality and function is maintained, features and species of outstanding or exceptional value are protected, regional carbon stocks are maintained or increased over the medium to long term, labour rights and worker safety are protected, forest productivity is maintained, and local communities' rights are respected.

SBP-certified biomass accounts for the majority of imports of woody biomass into the UK and EU, which are the largest users of industrial wood-based bioenergy. In 2020, 77% of the industrial pellets consumed in the EU-28 were SBP-certified. Globally, around one-quarter of biomass pellet production was SBP-certified. SBP has approaching 350 certificate holders across 33 countries.

SBP-certified biomass accounts for the majority of imports of woody biomass into the UK and EU.

Jobs

Wood-based bioenergy supply chains will support more than 200,000 additional jobs by 2030, and more than 450,000 additional jobs by 2050.[16]

These jobs will include farm and forestry workers, supply chain infrastructure and energy industry employees. Due to the nature of sustainable bioenergy, the industry's economic footprint will continue to be highly distributed, supporting rural and regional economies throughout the world.

In the wider, non-wood-based bioenergy sector, more than three million people will be needed around the world to deliver expansion by 2030. This figure will likely double to over six million by 2050.

It is very important that these employees and contractors are supported and treated fairly, in line with the Sustainable Development Goals. Our sustainability principles (see pages 18-26) include some of the key considerations for the bioenergy industry when working with people and communities through the supply chain.

CASE STUDY

MGT TeesREP
Biomass with CHP

TeesREP is located in Teesside in the North East of England, an area of high unemployment following the decline of the UK's steel industry. From the outset MGT funded a "Hub" for training and employment to maximise employment and supplier opportunities for people and companies in the region.

At construction peak there were 2,000 workers at the site and almost 120 different companies from England's North East region, working as sub-contractors and suppliers to the project.

When operational the project will support 150 people on the power station and dock sites, with a significant number of off-site service providers, in particular upwards of 200 specialists contracted during the annual outage periods.

MGT Tees Renewable Energy Plant in Teesside, UK.

Investment

Investment of more than $355 billion by 2030 will be required to scale up the wood-based bioenergy industry, and $822 billion by 2050.

The IEA has said that getting the world on track for net zero emissions by 2050 requires clean energy transition-related investment to accelerate from current levels to around $4 trillion annually by 2030.[17] Unlocking this capital will be crucial for ensuring the success of climate change mitigation efforts, in the bioenergy sector as elsewhere.

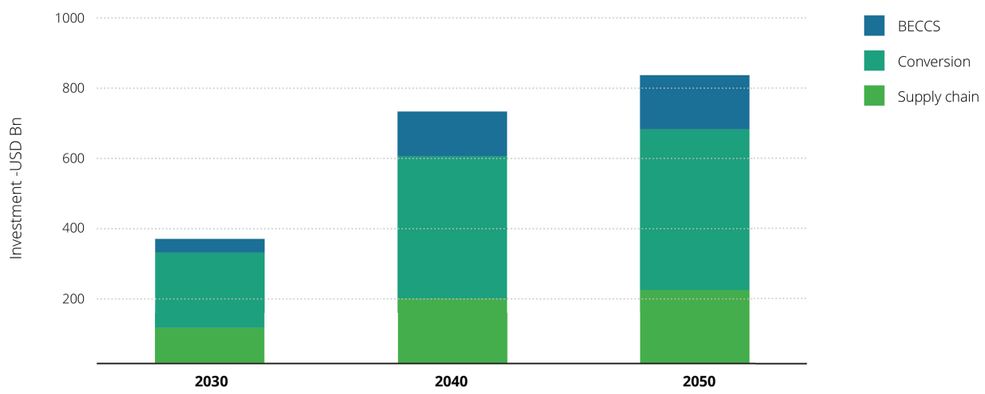
Scaling up the bioenergy industry to deliver global Net Zero will involve not only expansion of current technologies but development of new ones. In wood-based bioenergy this will likely include BECCS, gasification and other techniques. Beyond wood-based bioenergy it will involve a wide range of opportunities across the broader bioeconomy. These new technologies will help to solve challenges in decarbonising electricity, heating, heavy industries, aviation, agriculture, road transport and other sectors.

The wood-based bioenergy industry, in partnership with governments and public and private investors around the world, will need to mobilise investment of $355 billion by 2030 and $822 billion by 2050 into sustainable forestry, energy and carbon capture and storage value chains. In order for this vision to become a reality, organisations across the bioenergy sector must collaborate to mobilise impact capital.

To achieve this level of investment, the private sector will require stable and clear regulations that allow private investors to put their money into key decarbonisation technologies such as BECCS. The UK and the EU have led the development of sustainability criteria and low-carbon energy support programmes that have supported international industry investment for long-term decarbonisation. These must be maintained and expanded to deliver global Net Zero.

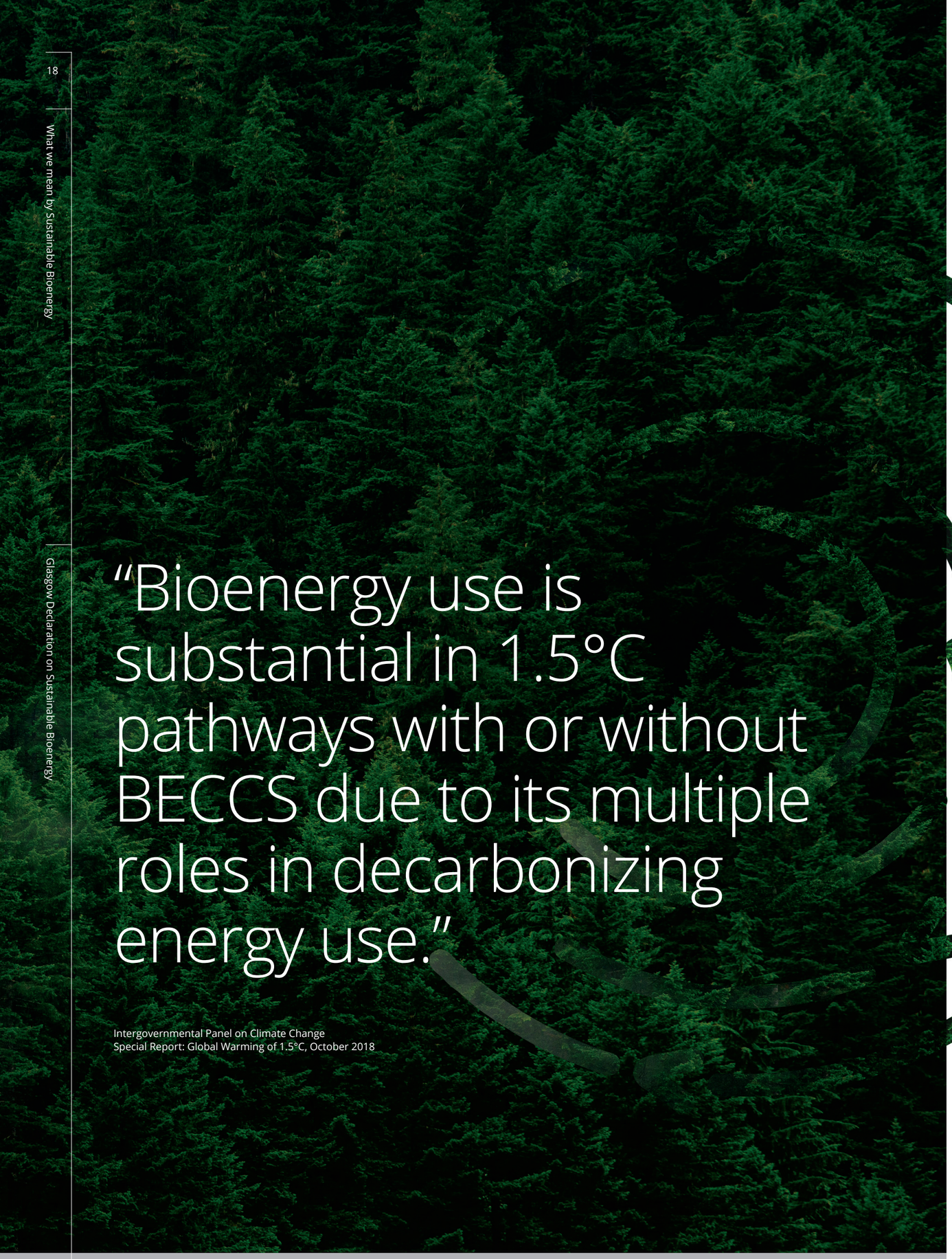
Growth in investment in wood-based bioenergy

Source: Based on data from International Energy Agency (2021)
Net Zero by 2050: Net Zero by 2050 Scenario - Data product - IEA; as modified by Energy Insights Ltd.



This chart shows the overall investment in wood-based bioenergy that will be needed by 2030, 2040 and 2050 to help achieve global Net Zero, according to the IEA. The agency says that overall clean energy investment must rise to around $4 trillion per year by 2030 to deliver the necessary energy transition.

16 These estimates are for direct jobs supported by the wood-based bioenergy supply chain, in line with data from IRENA's, "Renewable Energy and Jobs – Annual Review 2020", September 2020, and compared with industry data.
17 International Energy Agency, "World Energy Outlook 2021", October 2021.



"Bioenergy use is substantial in 1.5°C pathways with or without BECCS due to its multiple roles in decarbonizing energy use."

Intergovernmental Panel on Climate Change
Special Report: Global Warming of 1.5°C, October 2018

What we mean by sustainable bioenergy

Sustainability sits at the heart of bioenergy and its role in combatting climate change. Our industry has worked with governments to set the highest standards and promote industry best practice throughout its international supply chains. These values must be continued as the industry expands to meet the challenge of global Net Zero.

Sustainable wood-based bioenergy sourcing is a small part of a much wider forestry sector. Working forest landscapes produce high-quality timber and joinery wood, with some of the remaining low-value fibre sold for bioenergy. This system creates built-in incentives for maximising growth and carbon sequestration, because landowners are incentivised to maximise growth in high-grade timber for higher returns. Access to the biomass market helps them achieve that end (e.g. through thinning, or providing additional revenue for re-investment).

Many examples of sustainable sourcing already exist in current industry practices and regulatory frameworks, which have been developed through science-led collaboration between industry practitioners and governments. As the bioenergy industry develops internationally, these good practices offer important lessons. By setting and following high standards, sustainable bioenergy can be deployed on a global scale to support the transition to a net zero future.

Taken together, these market and regulatory systems reflect best practice and a set of principles that describe what we mean by "sustainable bioenergy". These principles must apply wherever sustainable bioenergy operates.

This section sets out the high-level principles which must underpin a sustainable bioenergy industry. These principles do not replace the need for detailed regulation and certification systems, which are important for each jurisdiction to have.

As the industry expands to meet global Net Zero, we, as sustainable bioenergy operators (including fibre suppliers, fuel producers, supply chain operators and bioenergy generators), will continue to uphold and promote these high standards of sustainability.

Together, these principles help to define "sustainable bioenergy" at the global scale and they present our industry's commitment to sustainability.

Principles of sustainable bioenergy

You can find more detail on each of these principles over the following pages.

Sustainable Bioenergy Operators...

Managing natural resources responsibly	Protecting biodiversity
• Promote healthy lands and forests • Support forests to store more carbon • Only use sustainably sourced feedstocks • Avoid and disincentivise negative land use change	• Contribute to healthy forest ecosystems • Respect conservation zones • Support the protection of unique habitats
Transparency and science-based carbon accounting	**Supporting and protecting communities**
• Adhere to internationally accepted carbon accounting rules • Comply with robust and independent certification systems • Provide transparent and independently audited sourcing data • Account for full lifecycle emissions	• Protect and invest in our communities • Support land managers in delivering sustainability • Ensure safe operations • Demand employment best practice throughout the supply chain • Respect the rights of Indigenous Peoples

SUSTAINABILITY PRINCIPLES

Managing natural resources responsibly

Promote healthy lands and forests

Sustainable biomass sourcing contributes positively to sustainable practices in forestry and farming, supporting the continual regeneration of woodlands, soils and other natural resources while avoiding activities that lead to the depletion of resources, carbon stocks or biodiversity.

Enable forests to store more carbon

Sustainable biomass sourcing contributes to greater carbon storage in the landscape where it is sourced. When carbon storage is analysed at the landscape level it can show that biomass sourcing leads to a positive or neutral balance between growth and harvesting rates.[18] Biomass is not sourced from forests where carbon stocks are declining, except where removing wood supports the health of forests.

Only use sustainably sourced feedstocks

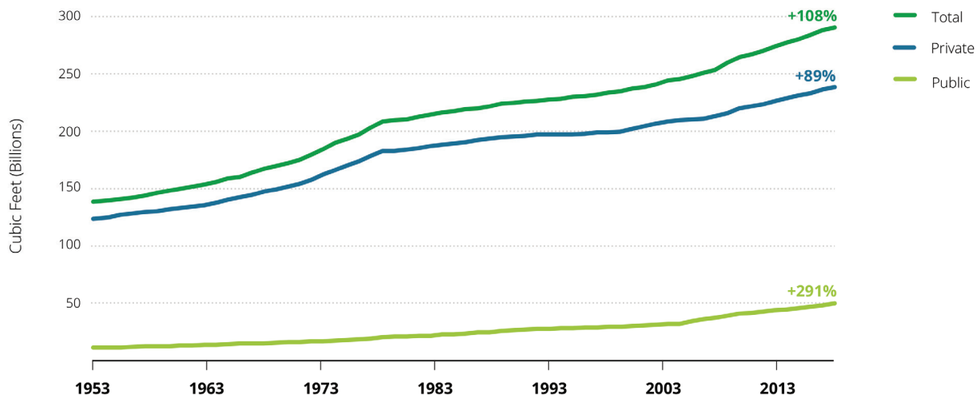
Sustainable bioenergy uses feedstocks that lead to good carbon outcomes, such as lower-value agricultural and forestry by-products, low-grade roundwood (including thinnings) and residues, or responsibly grown energy crops. It does not displace products that would have a more positive impact on climate or sustainable development goals.

Avoid and disincentivise negative land use change

Sustainable biomass sourcing never leads to deforestation, depletion or other forms of negative land use change. By providing additional income for sustainable and continuous forest management, it disincentivises negative land use change.

US Forests are storing more carbon year-on-year

Source: Forest2Market, "Historical Perspective on the Relationship Between Demand and Forest Productivity in the US South," July 2017.



The US Southern region is the world's largest single supplier of modern wood-based biomass for bioenergy, but it has been supplying other industries for many decades. This has led to investment and revenues for sustainable forest management, and more than doubled the volume of wood growing in the working forests since the 1950s.

18 Cowie AL, Berndes G, Bentsen NS, et al., "Applying a science- based systems perspective to dispel misconceptions about climate effects of forest bioenergy", GCB Bioenergy. 2021;13:1210–1231. https://doi.org/10.1111/gcbb.12844

How is carbon accounted for in the bioenergy sector?

Carbon accounting for sustainable bioenergy follows international rules designed by the UN's climate science body, the IPCC. These rules are consistent with all forest and land sector carbon accounting, not just bioenergy.

These rules state that carbon emitted by bioenergy generation should be counted in the land-use sector where the biomass originates, rather than in the energy sector where it is used. For example, if wood fibre is harvested from a forest for use in bioenergy, it must be counted as a form of carbon emission from the forest, since that wood removal constitutes a reduction in the carbon stocks of the forest.

The IPCC says this approach "provides a complete picture of a country's energy system and avoids double counting of emissions with those reported in the Agriculture, Forestry and Other Land Use (AFOLU) sector."[19]

International accounting rules must then be complemented by greenhouse gas criteria in national policy and regulations, ensuring that emissions arising throughout the supply chain, such as from processing and shipping, are fully accounted for and deliver a substantial GHG saving against fossil fuels. This is what happens under EU and UK rules.

The IPCC consists of thousands of independent scientists advising on the latest research in climate science. It reviewed the bioenergy carbon accounting system in 2019 and reaffirmed it as the best way to account for bioenergy emissions.

To ensure accuracy and effective scrutiny, the IPCC's carbon accounting rules must be applied wherever bioenergy is in operation around the world, supported by strong legislation and regulation by governments. This should include full life-cycle emission accounting for biomass supply chains, with thresholds set consistent with the Paris 1.5°C decarbonisation pathway and delivery of net zero emissions by 2050.

19 IPCC, "2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories", May 2019.

SUSTAINABILITY PRINCIPLES

Transparency and science-based carbon accounting

Adhere to internationally accepted carbon accounting rules

Sustainable bioenergy operators follow the IPCC's carbon accounting standards, under which carbon emissions are counted in the land and forestry sector.[20] This ensures reliable international data on carbon stocks in forests and avoids double counting of emissions.

Ensure robust, independent certification systems in the supply chain

Sustainable bioenergy operators employ established and internationally recognised independent certification systems and standards within their supply chains. One example is the independent Sustainable Biomass Program (SBP), which uses third-party auditing to guard against unsustainable land management using a regional, risk-based approach that reflects real-world forest economics.

Provide transparent and independently audited sourcing data

Sustainable bioenergy operators engage in transparent sourcing and supply policies, providing clear data about the origins of their feedstocks and impact on land use in supply base areas, and impact of other operations. These are communicated transparently via national regulators and other public channels.

Account for full lifecycle emissions

Sustainable bioenergy delivers significant greenhouse gas reductions compared to alternative dispatchable technologies. The emissions of the whole of the bioenergy supply chain are recorded and reported transparently to national regulators in the country of end use.

20 IPCC, "2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories", May 2019.

SUSTAINABILITY PRINCIPLES

Protecting biodiversity

Contribute to healthy forest ecosystems

Sustainable biomass sourcing contributes to the management of healthy forest ecosystems and supports ecological restoration. Sustainable bioenergy operators work with suppliers to ensure their operations contribute to the protection and enhancement of the natural environment. Without such management, forests can be more vulnerable to the effects of climate change, through wildfires (as seen in California and Australia), insect infestations (as seen in Canada) and disease (as seen in the UK).

Respect conservation zones

Sustainable bioenergy follows the management plans and supports the conservation goals of local, regional, national and international areas of nature protection, as defined by nation states and the UN, to protect biodiversity.

Support the protection of unique habitats

Sustainable bioenergy sourcing practices contribute to the conservation of unique and sensitive wildlife habitats and help to protect them from loss or degradation by working with our suppliers and stakeholders in the forest. Management of the forest ensures that features and species of outstanding or exceptional value are identified and protected.

CASE STUDY

Woodland Key Habitats (WKHs) are an important designation in protecting biodiversity.

Graanul Invest
Bioenergy and biodiversity

Graanul Invest, alongside the other signatories of the Declaration, stands for protecting biodiversity. One notable example is through its protection of Woodland Key Habitats (WKHs), which are unique sites in forests where the conditions are suitable for endangered and rare species to thrive. WKHs are often outside protection areas and therefore, when discovered and verified, need careful bordering and conservation. Sustainable biomass requirements prevent the acceptance and processing of feedstock originating from areas overlapping with known WKHs, but this needs to go beyond gate-level rejection to have a meaningful impact.

Through close cooperation with its feedstock supply chain partners, Graanul Invest have seen this voluntary requirement effectively become an obligatory one, with the number of WKHs left untouched increasing rapidly. In 2020, in over 93% of the WKH cases detected by Graanul Invest's gate systems the WKH was verified to be untouched, with the feedstock being rejected in 7% of cases when verification was not certain.

SUSTAINABILITY PRINCIPLES

Supporting and protecting communities

Protect and invest in our communities

Sustainable bioenergy operators support local forestry and farming communities through employment and training opportunities in sustainable forestry and farming practices.

Support land managers in delivering sustainability

Sustainable bioenergy operators support land managers and foresters in their sustainable management of the forest resource.

Ensure safe operations

Sustainable biomass sourcing works alongside other sustainable land use sectors such as timber supply and agriculture, helping to improve the safe delivery of land management operations.

Demand employment best practice throughout the supply chain

Sustainable bioenergy operators act fairly as employers and avoid any exploitation of people connected to their supply chains, such as contractors and their communities.

Respect the rights of Indigenous Peoples

Sustainable bioenergy practices respect the rights of Indigenous Peoples and follow the principles of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP).

CASE STUDY

Enviva
Empowering communities

Guided by its mission and values, Enviva seeks to empower communities by partnering with local leaders to create jobs and provide positive economic and environmental impact within its operational footprint. In the U.S. South, African American landowners often confront challenges when trying to create value and manage forests on their lands due to historical flaws in the U.S. legal system. Enviva partners with the Sustainable Forestry & Land Retention Project to help these landowners improve their land value through sustainable forest management.

Additionally, a study by Chmura Economics found that for every job created by Enviva, more than two additional jobs are created within the community – from loggers and truck services, to local restaurants and retail shops. Enviva works closely with scientific experts, conservation organizations, and a broad set of stakeholders to ensure its operations and wood sourcing have a positive impact on the local environment and surrounding communities.

Enviva associates recently volunteered with Habitat for Humanity of the U.S. Sandhills to repair roofs and construct wheelchair-accessible amenities in the Dobbins Heights community of North Carolina.

Where does wood-based biomass come from?

Sustainably sourced wood-based bioenergy feedstocks come from three main sources.
All of these are low-value by-products from the sustainable forestry and timber production industries.

Forestry Thinnings

As part of the process of managing forests for timber production, foresters remove smaller, misshapen or diseased trees that they can't sell for timber - a process known as thinning. This allows remaining trees to grow taller due to less competition for resources.

Sawmill Residues

This includes offcuts from shaping harvested wood into timber, as well as large amounts of sawdust.

Smaller Branches & Brushwood

Some of this is left on the forest floor to support soil health, but much of it is removed to reduce wildfire and infestation risks.

CASE STUDY

Lynemouth Power
Coal-to-biomass conversion

Lynemouth Power Station was originally commissioned as a coal-fired station in the early 1970s, providing power to the adjacent aluminium smelter until its closure in 2012. The closure of the aluminium smelter caused the loss of over 500 jobs in South East Northumberland, UK, an area already heavily impacted by the decline of the mining industry.

The conversion of the power station from coal to biomass commenced in 2016, and this has been supported by an Investment Contract (an early form of Contract for Difference) since 2018, continuing through to 2027.

This project secured significant investment into the power station and port facilities and has successfully protected over 300 jobs at the sites. Through the Investment Contract, Lynemouth demonstrates the sustainable use of biomass to generate low carbon, baseload, renewable power.

Lynemouth Power and its owners EPH foresee a potentially long future for power generation at the Northumberland site and are currently evaluating the potential for the plant to continue operation after 2027, this includes the opportunity for BECCS.

Providing a basis for continued biomass operation after 2027 will protect the emissions reductions made to date whilst maintaining and potentially significantly enhancing the positive economic impact of biomass generation at Lynemouth within the local community.

Lynemouth Power Station in Northumberland, UK.

Methodology

The expansion of sustainable bioenergy over the next 10 to 30 years set out in this document is consistent with the transformation of the energy system required to meet the International Energy Agency's Net Zero Emissions scenario.

The scenario is the world's first comprehensive study into how the world can deliver a global energy system with net zero emissions and universal access to affordable energy by 2050. As part of this scenario, bioenergy's role expands from its current level in order to replace fossil fuels and also to contribute to greenhouse gas (GHG) reductions via carbon capture and storage (CCS).

To calculate the figures in the Declaration, we used IEA data and compared it to industry data about investment, employment and typical energy outputs.

The Net Zero Emissions Scenario and detailed supporting data can be found in full at https://www.iea.org/reports/net-zero-by-2050.

Data on jobs in the bioenergy industry was also sourced from the International Renewable Energy Agency's authoritative annual review of employment in the renewable energy sectors, available at https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020.