# Bioenergy Essentials

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# What is Bioenergy?

## Our Number 1 Energy Source

Sustainable Bioenergy can grow from 140 to 406 Mtoe

## European Leader in Energy Security

Less than 5% of Bioenergy is imported

## 57% of EU Overall Renewable Energy

(Heat, power, transport, industry,...)

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# FEEDSTOCK

**69,6%**
**Woody biomass**

Forestry & wood industry residues

**15,3%**
**Biowaste**

Solid municipal biowaste, sewage

**15,1%**
**Agricultural biomass**

Crops & redidues

# TECHNOLOGY

**53,2%**

**46,8%**

Power plants

Bioliquid plants

Boilers

Heat plants

CHP plants

Stoves

Biogas plants

# OUTPUT

**74,5%**
**Heat**

**13,5%**
**Transport fuel**

**12%**
**Electricity**

Source: Eurostat and Bioenergy Europe's Statistical Reports 2021 & 2022

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# Next ...

Bioenergy &
SUSTAINABILITY

Bioenergy &
CARBON NEUTRALITY

Bioenergy &
FORESTRY

Bioenergy &
AGRICULTURE

Bioenergy &
POWER

Bioenergy &
BUILDINGS

Bioenergy in our
INDUSTRIES

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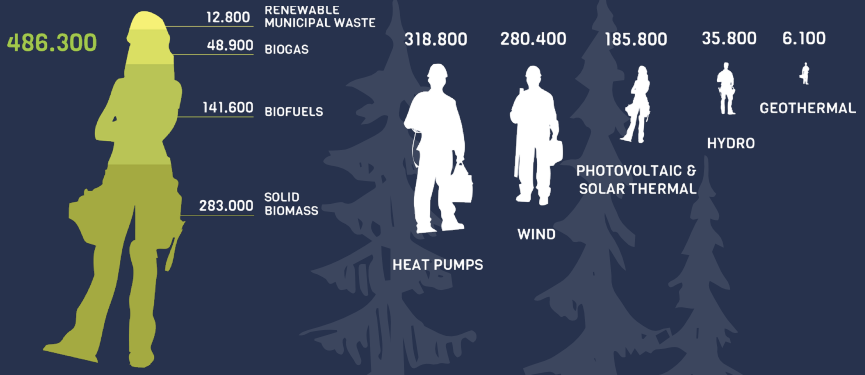
# BIOENERGY & Sustainability

**Bioenergy is sustainable in economic, social and environmental terms. It fosters rural development, creates jobs, contributes to the European bioeconomy and offers energy security.**

## EMPLOYMENT DISTRIBUTION IN RENEWABLE ENERGY (2020, EU-27)




## SUSTAINABILITY CRITERIA

The Renewable Energy Directive (RED) lays out sustainability criteria for all types of bioenergy, which makes it the only kind of energy with mandatory criteria to guarantee sustainable sourcing, irrespective of the geographic origin of the biomass.

## WHAT DO THEY GUARANTEE?

### Sustainability

✓ Biodiversity, soil quality, protection of nature, etc.

### LULUCF

✓ Maintaining the carbon stock in the forest.

### GHG

✓ Significant GHG emission savings as compared to fossil fuels.

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# What's next?

**The Renewable Energy Directive (RED) is being updated now in 2022-2023. We need a framework that promotes sustainability while not slowing our transition away from fossil fuels!**

1. **Primary woody biomass** neither indicates the quality nor the end-use of biomass. RED must avoid the creation of any artificial feedstock categories that will hamper industry.
2. **The retroactive application of criteria** should be avoided in order to create a stable, predictable and reliable framework to enable and support necessary investments.
3. **The cascading use of biomass** should be supported as a guiding principle, but rigid regulatory rules on cascading should be avoided as they will be complicated and inefficient.
4. **Flexibility** should be given to Member States to create effective criteria under the risk-based approach that works best at the local level.
5. **The exemption capacity threshold** should be maintained at a level which limits the regulatory burden on actors with limited administrative capacity.

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# BIOENERGY is Carbon Neutral

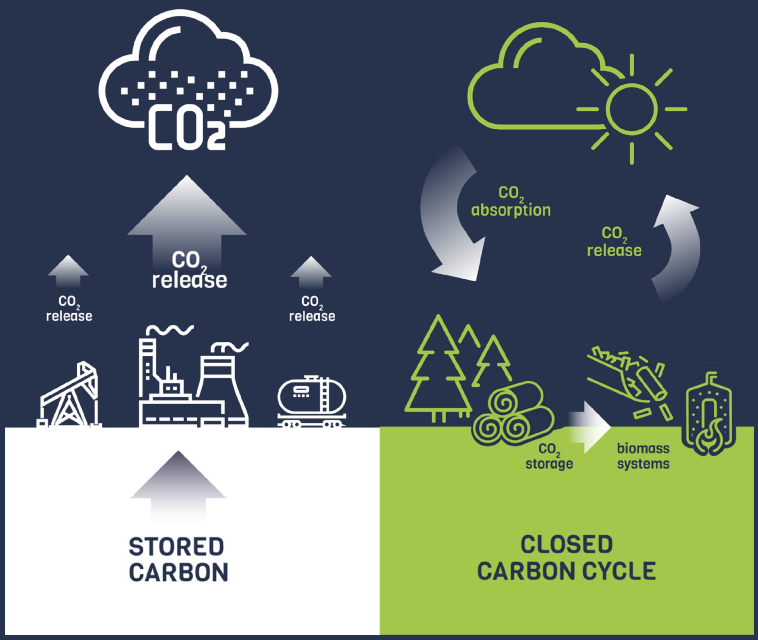
**Bioenergy is carbon neutral: carbon which plants photosynthesise is released into the atmosphere through combustion in a closed cycle. Emissions from fossil fuels are fundamentally different: the carbon being released has been stored for millions of years!**

## THE BASICS

It is vital to plant new trees and support the natural regeneration of forests after harvesting. These maintenance operations should be carried out carefully, keeping the carbon sink capacity in mind.

For agricultural biomass, carbon cycles are renewed on an annual basis.

## CARBON CYCLE: FOSSIL FUELS vs BIOMASS

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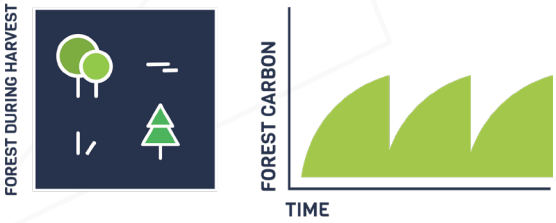
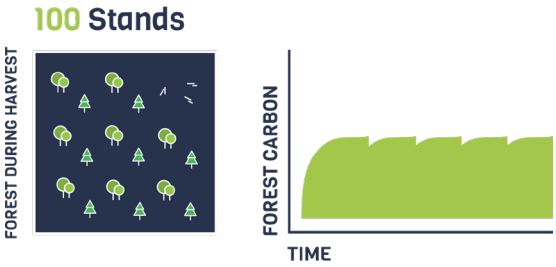
# CARBON ACCOUNTING

## 10t wood removal from...

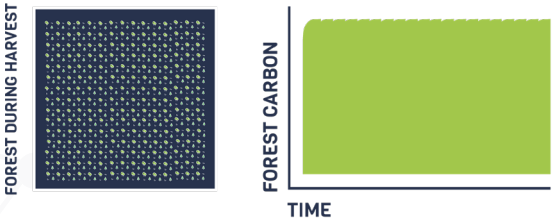
### 10 Stands




### 100 Stands




### 1000 Stands




The carbon absorption capacity of EU forests and their carbon stock is closely monitored. Changes in carbon stock should only be observed across longer timeframes and by considering a collection of forest stands* instead of a single tree or stand. This means that we should always look at the bigger geographical picture when considering carbon accounting. At the macro level, the carbon capacity should be maintained at any point in time.

*A forest stand is a contiguous community of trees sufficiently uniform in composition, structure, age, size, class, distribution, spatial arrangement, site quality, condition or location to distinguish it from adjacent communities. A productive forest is a collection of stands.

(Nyland, Ralph D. (2007). Silviculture: concepts and applications (2nd ed.). Prospect Heights: Waveland Press.)

# EXTRA MEASURES

Emissions for the processing and transportation of biomass must also be taken into account. The sustainability criteria of the Renewable Energy Directive make sure that these emissions are kept at a minimum with high-GHG-saving requirements. Good progress is also being achieved in research and development of new technologies to capture and store $CO_2$ via bioenergy with carbon capture and storage (BECCS) and the use of biochar. These technologies are removing carbon from the atmosphere.

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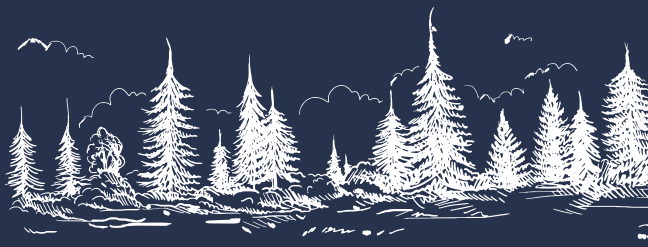
# BIOENERGY & Forestry



**Bioenergy is mostly produced from residues of sustainable forest management practices and by-products of wood-working industries, such as sawmills. These well-established synergies have environmental and economic benefits for all actors involved.**

## RESIDUES ARE KEY

Over the last 2 decades, the consumption of bioenergy has increased while the share of wood removed from forests and used for energy has remained steady. This shows that bioenergy is not the driving force behind wood removal, but rather utilises residues from other forest-based industries with increasing efficiency.

**PULPWOOD**
Paper

**LOW VALUE WOOD**
What: tops, branches, bark
Uses: bioenergy, bio-based products

**HIGH VALUE WOOD**
What: timber
Uses: Furniture, construction

95,7% of bioenergy consumed in the EU is locally sourced, yet bioenergy neither causes deforestation in Europe, nor places the carbon stock at risk. On average, more than 25% of the annual forest increment remains in the forest, thereby increasing the carbon stock. The total area of European forests is expanding by 1 football field per minute – thereby increasing the potential of the future carbon sink!

## FORESTS & BIOENERGY ARE GROWING

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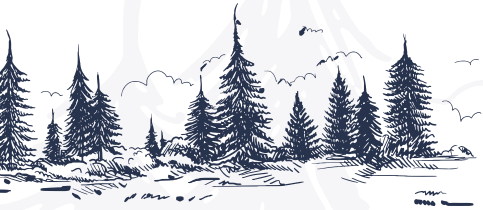
# FORESTS & CLIMATE CHANGE

Forests are an important element of climate change mitigation but at the same time must adapt to climate change. Global warming is increasing pressure on forests via wildfires, insect outbreaks and extreme weather events such as storms and droughts. Sustainable, active forest management can minimize this. Bioenergy is also economically attractive to forest owners, creating a market for forest residues that would otherwise be left on the forest floor, release $CO_2$ and act as a potential fire hazard.

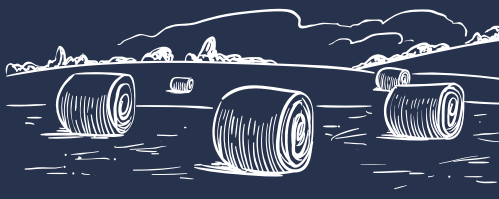


## What's next?

**WE MUST:**

1. **Increase public funding** for climate adaptation measures: Common Agriculture Policy, rural development funds must be increased to make forests and agricultural land more resilient to climate change.
2. **Create market incentives** for sustainable forest management (SFM): Bioenergy brings a market value for forest residues and will thus make SFM more economically attractive.
3. **Support a bio-based economy:** Encouraging public incentives such as a carbon tax will foster the substitution of both fossil-based material and energy, and ultimately contribute to SFM.
4. **Ensure coherence among various legislation:** When developing new legislation, consistency with existing energy, climate and environmental laws should be carefully assessed. New sustainability criteria should always be properly impact-assessed.
5. **Support the risk-based approach** to sustainability for forestry: This ensures that the sustainability of forestry is preserved while minimising the cost of proving compliance.

# BIOENERGY & Agriculture



**Energy can be harnessed from agricultural residues and dedicated energy crops. With the right policy framework, agrobiomass can reach its full potential.**

## TYPES OF AGROBIOMASS

**Agricultural residues:** on-field biomass residues like cereal straw, corn-stover, rice straw, orchard pruning (wood from orchards at the end of their lifetime), etc.

**Agro-industrial byproducts:** olive stones & olive cake, grape marc, sunflower husk, chaff, nutshells, etc.

**Miscanthus:** a high-yield, grassy and perennial energy crop. Miscanthus only requires minimal input, doesn't need fertilisers and is harvested annually. It also stores carbon in the soil.

**Short-rotation coppice (SRC):** a high-yield, grassy and perennial energy crop. Miscanthus only requires minimal input, doesn't need fertilisers and is harvested annually. It also stores carbon in the soil.

## THE POTENTIAL

According to the European Commission's long-term vision, out of all the raw materials that could be used for the production of bioenergy, agrobiomass is the one which will see the biggest growth by 2050. There is significant untapped potential for agrobiomass from valorising residues and by-products as well as from promoting the cultivation of short rotation coppice and lignocellulosic grasses on abandoned and marginal lands. Scientific studies estimate that there are more than 100 million dry tonnes of herbaceous agricultural residues (e.g. cereal straw, maize residues) and 12,5 million dry tonnes of woody agricultural pruning (from olive groves, fruit orchards and vineyards) that could be sustainably mobilised in Europe.

## LAND AVAILABILITY

Currently, only around 100.000 hectares are cultivated with lignocellulosic energy crops, which is only a small fraction of agricultural land in Europe. However, according to Joint Research Centre (JRC), up to 5,6 million hectares of agricultural land will be abandoned by 2030, which is the equivalent of around 3% of all agricultural land. That land, which is not fit for food production, can be used for dedicated energy crops with positive environmental, social and economic benefits. Investing in energy crops can stimulate diversification and economic growth in rural areas.

## CLIMATE ADAPTATION IS KEY!

Perennial energy crops contribute to climate adaptation by:

- Fighting soil erosion and preventing mud slides caused by agricultural intensification;
- Improving soil quality and helping capturing carbon;

Furthermore they:

- Improve water quality and the loss of nutrients in the soil (nutrient leaching), acting as a natural filter;
- Greatly increase biodiversity.

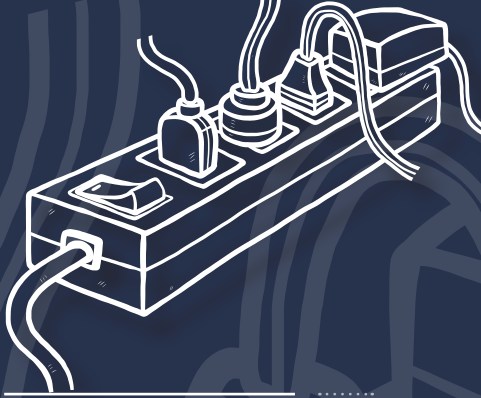
## What's next?

**WE MUST:**

1. **Develop national and regional plans** for the promotion of agrobiomass and harmonise policies to unlock agrobiomass potential as a valuable resource for achieving our climate ambition.
2. **Extend the existing ban on field burning** of stubble to all agricultural residues to abate open fire emissions and stimulate new agrobiomass value chains.
3. **Promote further investments** along the entire agrobiomass value chain, from harvesting machinery to modern energy conversion equipment, while reducing taxation on biomass fuels.
4. **Support synergies** between sustainable bioenergy and agriculture through carbon farming practices.
5. **Recognise the additional environmental benefits** of energy crops such as water protection and increased biodiversity.

# BIOENERGY & Power

Biopower (bioenergy in the form of electricity), represents around 6% of the total gross electricity generation in the EU. Our power system is increasingly based on intermittent renewable energy sources like wind and solar, and it will also need a dispatchable and flexible supply of power. Biomass is easily stored and can be used when the wind is not blowing and the sun is not shining.



## VARIOUS INSTALLATIONS

- **Power-only**: installations producing only electricity, with possible recovery of waste heat
- **Combined Heat and Power (CHP)**: simultaneous production of electricity and useful heat for industries, individual households and district heating

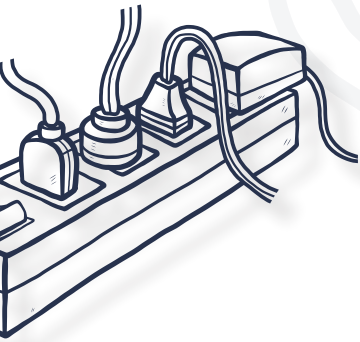
## A FLEXIBLE SOLUTION TO MEET POWER DEMAND

Our electricity supply must be continuous, and bioenergy can provide the baseload. In times of high electricity demand, flexible biomass fuels can cover peak loads.

Biomass is highly adapted to run for seasonal balancing. Running at full capacity when heat demand is high, technologies such as biomass CHP can complement the lower production of solar in wintertime.

## FOSTERING ENERGY EFFICIENCY

While 73% of bioelectricity is produced in CHP plants, the share of electricity produced in CHP in the overall energy mix makes up only 22%. Revision of the Renewable Energy Directive seems likely to bolster this trend by encouraging more co-generation.



## ONGOING
## INNOVATIONS

Innovation in the field of electrical efficiency never stops. New technologies combine the production of several outputs (e.g. CHP & bio-oil production), other offer high-efficient, small-scale solutions (micro-CHP). Research is also being done to increase plant flexibility (e.g. shortening the period of time needed to start up the plant at full capacity, or finding ways to increase the flexibility of fuels used - e.g. multifuel boilers) and the ability to combust more challenging fuels (e.g. waste wood, agricultural biomass).

## What's next?

TO UNLOCK SYNERGIES WITH OTHER RENEWABLES, WE MUST:

1. **Recognise** the complementary role of flexible and dispatchable renewables to stabilise the power system and to secure electricity supply.
2. **Create** a level playing field with various renewables.
3. **Support** R&D and demonstration projects focusing on plant and fuel flexibility to create a power system fit for the future.
4. **Exploit** opportunities for power and heat cogeneration, using heat to supply district heating networks and industries. Most biopower plants currently in operation in Europe are CHP ones.
5. **Increase** funding opportunities to finance the energy transition.

# BIOENERGY & Buildings

Bioenergy is the main source of renewable heat, with 85% of all renewable heat coming from biomass – and heating 66M households! Decarbonising our buildings calls for cost-effective solutions that maximise emission savings, like bioenergy!

## REPLACEMENT CHALLENGE:

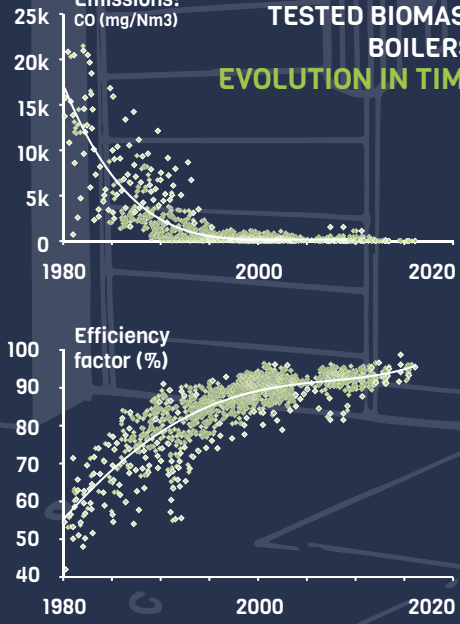
The real challenge lies in the replacement of old and inefficient heating appliances, including oil and gas boilers as well as inefficient biomass installations. This is possible with the right policy framework, to mitigate climate change and improve air quality.

## CLEAN, EFFICIENT & MODERN

Biomass heating appliances have left behind their image as old and inefficient. Today's innovative technologies guarantee that high efficiency goes hand in hand with low emissions. Renewable heat from biomass can be produced through:

- Individual biomass stoves, used as local space heaters;
- Individual biomass boilers, providing hot water and space heating for an entire house;
- District heating – providing heat for multiple buildings from a central production site.

## EMISSIONS & EFFICIENCY OF TESTED BIOMASS BOILERS: EVOLUTION IN TIME




Source: Francisco Josephinum BLT Wieselburg, compiled: Bioenergy2020+ GmbH

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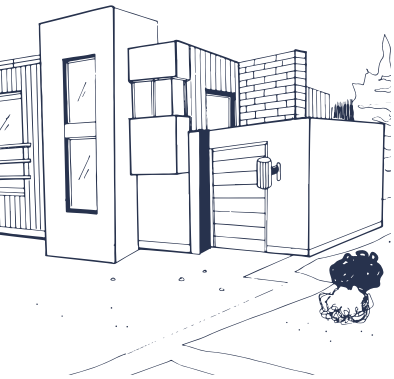


## HEATING
## WHOLE DISTRICTS

**District heating reaches high levels of efficiency with minimal emissions. Where applicable, biomass district heating or combined heat and power (CHP) should be incentivised.**

## GOOD BUT
## NOT ENOUGH

**The Renewable Energy Directive (RED) has introduced a non-binding renewable obligation to increase the share of renewable sources in the heating & cooling sector (H&C) by 1,3 percentage points each year. However...**

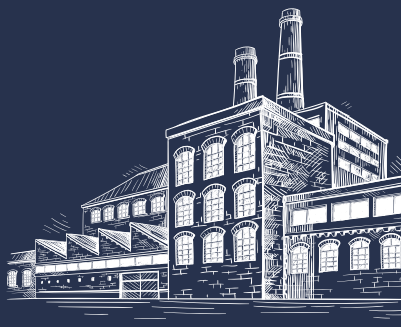
- **The obligation is non-binding for Member States. We need to ensure each Member State acts and takes appropriate measures.**
- **More is needed. Even if all Member States fulfill their obligation, the EU would not reach 40% renewables in heating & cooling by 2030. With an objective of a net-zero emissions economy by 2050, the H&C sector needs to be fully decarbonised by 2050 or before.**

## What's next?

**TO REACH CARBON NEUTRALITY IN BUILDINGS BY 2050 WE MUST:**

1. **End support for fossil fuels and put a price on all fossil carbon to further support renewable deployment.**
2. **Promote the replace of old and polluting heating systems with modern renewable systems such as state-of-the-art biomass boilers.**
3. **Establish a clear renewable heat strategy that can give a clear signal to market actors to invest in renewable heating.**
4. **Provide financial support to help consumers and ensure a just energy transition.**
5. **Promote EU energy independence and industrial competitiveness by relying more on local, sustainable and affordable solutions like bioheat.**

# BIOENERGY in our Industries



Bioenergy can provide the temperature, pressure and quantity of thermal energy that is needed for many industrial processes. These available technologies are employed at large and help to decarbonise the energy-intensive industries.

## IN 2020:

**26,3%**

of the final consumption of bioenergy was in the industrial sector (23.321 Ktoe)

**27%**

of bioelectricity was self-produced by the industrial sector (3.783 Ktoe)

## MEETING OUR INDUSTRY NEEDS

Bioenergy covers 10% of the total EU industry demand for heat. The industrial use of bioheat makes up 1/5 of the final energy consumption of bioenergy. The price of producing bioheat is often competitive with fossil fuels. It can rely on different inputs, including waste and by-products, and it reduces air emissions.

## PRESSURE, TEMPERATURE & ON DEMAND

Steam temperatures above 500°C and pressure reaching 160 Bar can be achieved with the use of solid biomass, depending on the technology and fuel quality. With thermal gasification, torrefaction and steam explosion technologies, high temperatures that are comparable to those reached through fossil fuels can be reached. Biomass is flexible and dispatchable and can therefore adapt to the needs of the industry. Multifuel technologies provide the industry with necessary flexibility to maximise resource efficiency and increase the use of renewable fuels.

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INDUSTRY SUBSECTORS

## BIOENERGY CONTRIBUTION TO FINAL ENERGY CONSUMTPTION (%)

### Biomass stream integrated in the process

| | |
|---|---|
| Wood & wood products | 57,9% |
| Paper | 43% |
| Food & tobacco | 5,2% |

### Other sectors bioenergy can help decarbonise

Fertilizers
Textile
Chemical
Food & beverage
Cement
Iron
Non-ferrous metals

## ACROSS SECTORS

The use of bioenergy in the industrial context largely varies depending on the sector. Sectors employing biomass in their processes are naturally keen to use bioenergy to improve their sustainability and resource efficiency. For example, the pulp and paper and the wood and wood product industries already cover a large portion of their energy demand with bioenergy!

## What's next?

1. The bioenergy industry's determinant consumption and labour and capital inputs have an important and positive effect on the outgrowth of the energy section.
2. With 50.000+ bioenergy businesses in the EU, bioenergy is truly a European technology and the equipment for it is manufactured in Europe. Many of the biggest equipment producers are located here and 74% of all bioenergy equipment suppliers are based in Europe.
3. Bioenergy is one of the few currently available solutions for decarbonising energy-intensive industrial processes where high temperatures and pressures are required.
4. The use of residue streams for bioenergy in industrial sectors that involve biomass as a raw material delivers resource efficiency, which allows a higher penetration of bioenergy, provides for operational flexibility and preserves existing infrastructure.
5. Further investment is needed to increase the supply and accessibility of bioenergy output, which will contribute to tackling global warming and environmental pollution.

Bioenergy
EUROPE

Bioenergy Europe is the voice of European bioenergy. It aims to develop a sustainable bioenergy market based on fair business conditions.

Founded in 1990, Bioenergy Europe is a non-profit, Brussels-based international organisation bringing together more than 40 associations and 155 companies, as well as academia and research institutes from across Europe.

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