# How bioenergy contributes to a sustainable future

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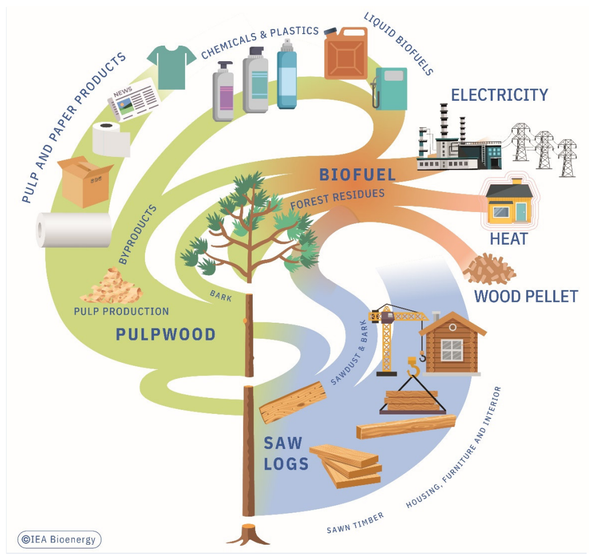
## Introduction

Bioenergy is the largest source of renewable energy today. It is versatile and can provide heat, power and transport services, and biomass can also serve as a raw material for the production of chemicals and materials. If done responsibly, and wherever it substitutes for fossil fuels, bioenergy provides substantial GHG emission savings, diversifies energy sources, improves energy supply security and provides income through regional biomass supply chains.



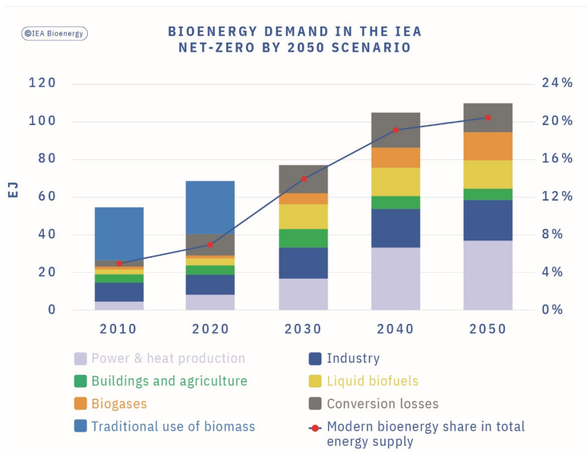

No part of a tree is wasted

However, bioenergy cannot achieve decarbonization of our energy system on its own, but rather complements other renewable energy sources, increases in energy efficiency, and reductions in energy demand.

## Net-zero energy in 2050

If we are to reach the targets of the Paris Agreement, energy provision needs to take place at net-zero $CO_2$ emissions in 2050, meaning that most of the energy supply must come from renewable resources, while the remaining emissions must be offset by carbon capture and sequestration. No single energy carrier alone will be able to achieve this, but rather all options have to work together.

Bioenergy is an important part in this picture; according to the IEA´s Net-Zero by 2050 scenario, bioenergy needs to supply one fifth of all energy by 2050. This means that modern bioenergy will have to triple from 2020 to 2050, offering the opportunity of capturing $CO_2$ from bioenergy installations and hereby even leading to negative emissions.




Modern bioenergy must triple

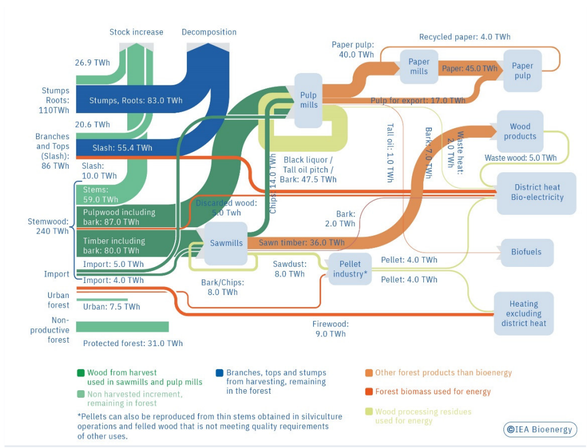
## Sustainability is key

Biomass can be derived from many sources, such as:

- Agriculture: sugar crops, starch crops, oilseed crops, energy crops, short rotation coppice, algae
- Forestry: harvest from natural or semi-natural forests or forest plantations
- Agriculture and forestry residues: crop harvesting residues, livestock residues, wood harvesting residues
- Industrial residues from agro-food processing or wood processing
- Organic fraction of municipal waste: household waste, wastewaters, post consumer wood, residues from landscape management

With the prospects of tripling bioenergy supply, care must be taken to ensure sustainability. Sustainable forest management, agricultural practices and landscape management are a must. If done right, biomass production for bioenergy can improve or maintain biodiversity, carbon sinks, and species abundance.

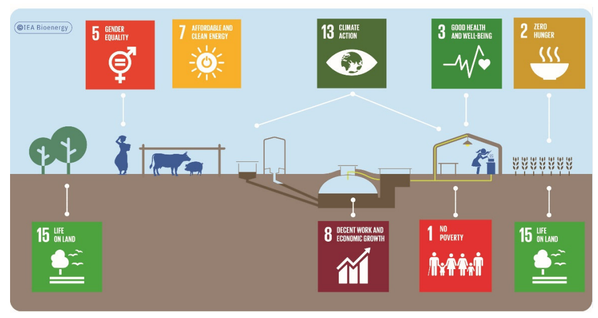
Food and feed production and the production of higher value materials have higher priority than energy, and as can be seen from the example of Sweden, bioenergy is predominantly produced from residues rather than primary biomass.




Wood use in Sweden

## Bioenergy opportunities

Bioenergy offers opportunities for regional income, also in developing countries, and contributes to many of the UN´s Sustainable Development Goals. E.g. the integration of a biomass digester for the production of biogas can make use of manure from animal husbandry and agricultural crops and residues to produce biogas that can be used for cooking and lighting. This contributes to the alleviation of poverty, access to clean cooking solutions, good health and well-being, affordable and clean energy, decent work and economic growth and climate action.




Opportunities for the Global South

## Technology development

Combustion, gasification and pyrolysis of biomass to produce heat and power, as well as anaerobic digestion for biogas production, and the production of transport biofuels from crops are already mature technologies, that need to be deployed even more widely.

However, about half of the technologies that we will rely on in 2050 are not yet fully developed, and we have to continue funding R&D activities to bring further technologies to maturity. Most needed are technologies for hard-to-abate sectors, such as fuels for heavy duty trucks, aviation and shipping, and process energy for industry. Related technologies are gasification plus synthesis, pyrolysis plus upgrading and enzymatic hydrolysis plus fermentation, all with the purpose of producing transport fuels, and carbon capture and storage technologies.

Read more about the strategic role of bioenergy, and how bioenergy technologies contribute to a sustainable future in our web-based report at:
www.ieabioenergyreview.org

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