

Bioenergy: Powering the World with Plants?

What is bioenergy?

Bioenergy refers to energy that comes from living or recently living biological materials such as plants and organic waste. These materials, called biomass, can be converted into useful forms of energy like heat, electricity, and liquid fuels. The key idea is that plants capture sunlight and store it as chemical energy, which can later be released when they are burned or processed. In this way, bioenergy provides an alternative to fossil fuels and is considered a renewable source of energy.

Why does bioenergy matter?

One of the biggest advantages of bioenergy is its potential to reduce reliance on fossil fuels. Since plants can be regrown, the supply of biomass is renewable, provided it is managed sustainably. Another important benefit is that bioenergy can be close to “carbon neutral”. When biomass is burned, the carbon dioxide released is roughly equal to the amount that plants absorbed while growing, creating a balanced carbon cycle.

Bioenergy is also highly versatile compared to some other renewables: it can generate electricity in power stations, provide heating for homes and industries, or be refined into transport fuels such as biodiesel and bioethanol. This flexibility means it could play a key role in moving toward a more sustainable energy system.

The carbon question

As mentioned previously, bioenergy *can* be close to “carbon neutral”. However, this balance depends significantly on how the biomass is produced. For example, if bioenergy crops are grown on land with trees that have been deforested to provide enough space for these crops, the dilemma that remains is whether the carbon savings from using bioenergy is greater than the initial release of carbon dioxide from deforestation. If the assumption does not follow, it means the overall carbon footprint of bioenergy increases.

Challenges of Bioenergy

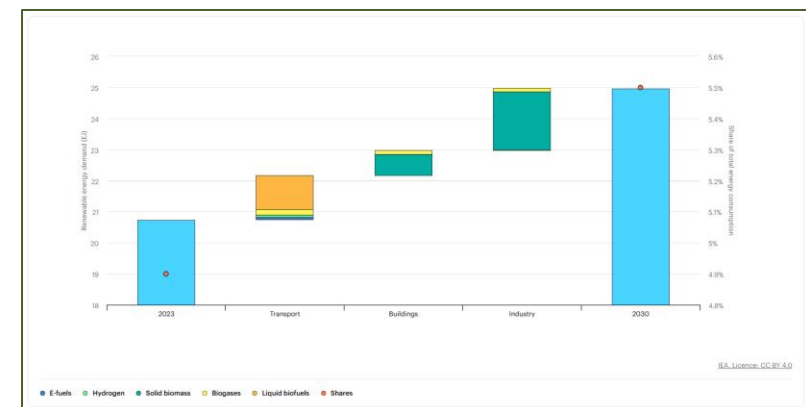
- **Land Competition**
Growing crops for biofuels can take up land that could instead be used for food production, leading to concerns about food security and inflation of food prices, which is an increasing concern in the eyes of the many members of the public as of recent.
- **Water Use**
Many bioenergy crops require large amounts of water. In water-scarce regions, this can put stress on local supplies and harm ecosystems. Is the adoption of bioenergy worth depriving local residents of water?
- **Deforestation and Habitat Loss**
Expanding farmland for bioenergy can lead to destructing habitats, releasing stored carbon and causing biodiversity loss.
- **Air Pollution and Environmental Damage**
Burning biomass for energy can release pollutants like particulate matter and nitrogen oxides, which can trigger respiratory problems in humans or worsen conditions for those with lung conditions already; the produced nitrogen oxides can react with water vapour in the air to form acid rain which damages the environment and buildings.
- **Energy Efficiency**
Some biofuels take nearly as much energy to produce as they provide when burned, limiting their effectiveness as a sustainable energy source.
- **Economic Costs**
Building bioenergy infrastructure requires high upfront investment, and biofuels can be more expensive than fossil fuels without government subsidies.

Bibliography

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The increasing use of bioenergy

Globally, bioenergy accounts for a significant portion of renewable fuel growth (95%). Almost 55% of renewable energy is accounted for by modern bioenergy (over 6% of global energy supply). The use of bioenergy is said to have been observed to increase by 4% every year since 2010 up until 2023, and will continue to keep increasing. While traditional biomass use persists in developing nations for cooking and heating, modern bioenergy is growing in importance for sectors like aircraft and shipping. Scaling up modern bioenergy sustainably can help meet climate goals and energy needs simultaneously (though it would be highly wise to consider the drawbacks this will have on the environment as well).



Types of Bioenergy

- **Solid biomass** is for heating and electricity.
Examples include: wood & forestry residues, animal and agricultural waste, and domestic house waste.
- **Biogas** is used for heat or power.
Examples include: agricultural waste, animal waste, municipal house waste, and sewage sludge.
- **Liquid biofuels** is used for transportation
Examples include: bioethanol, biodiesel, biocrude, bio-oil, and bio-jet kerosene.