Section Five: Biomass Energy

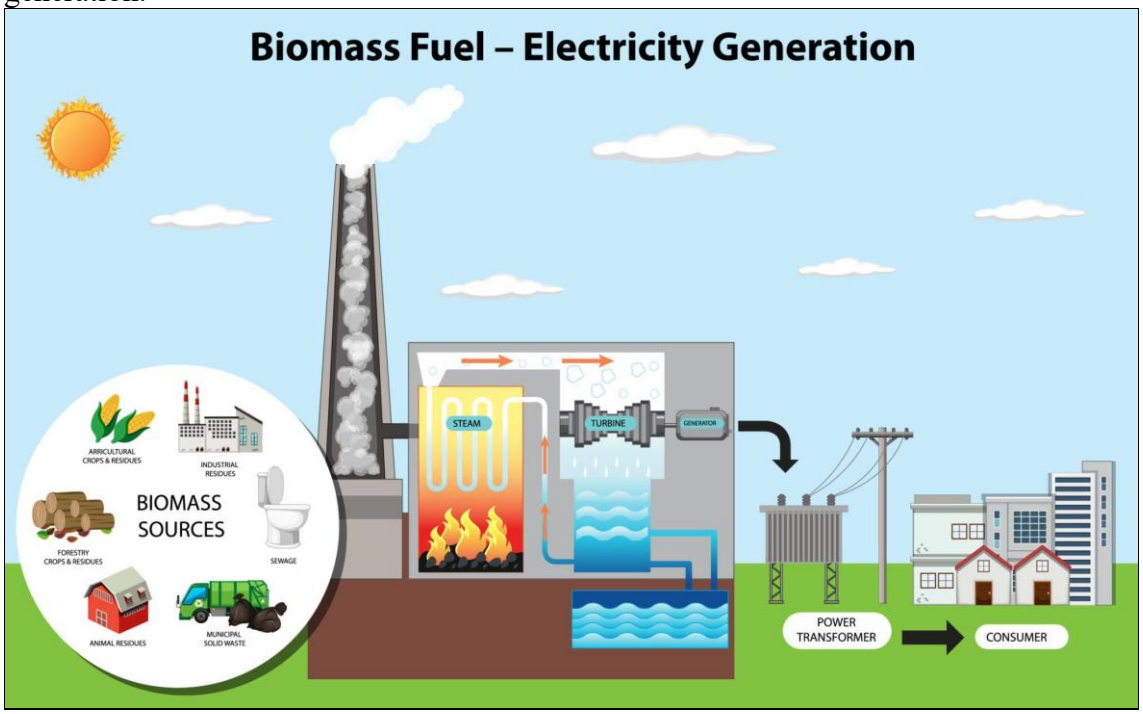
What Is Biomass Energy?

Biomass energy is a form of renewable energy created from organic materials like plants, wood, agricultural waste, and even food scraps. It converts stored chemical energy from biological matter into heat, electricity, or fuels.

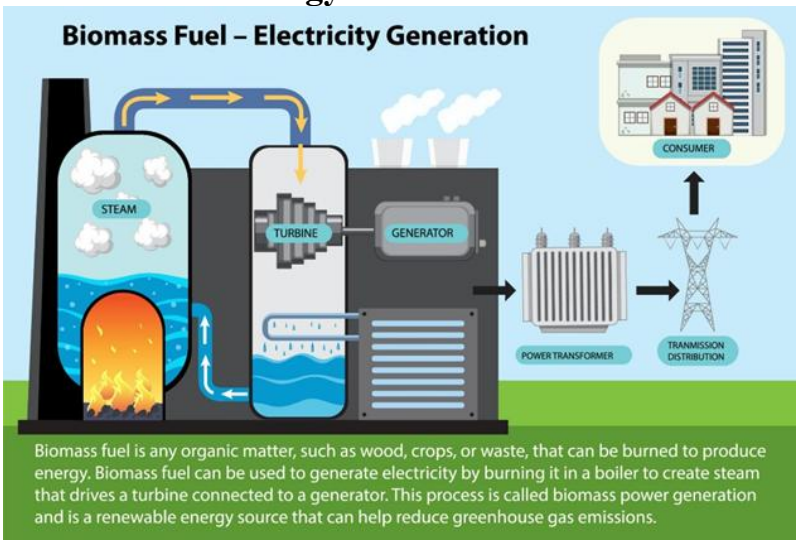
Biomass refers to any material derived from living or recently living organisms. Plants absorb sunlight through Photosynthesis, storing solar energy in chemical bonds — and biomass energy simply releases that stored energy.

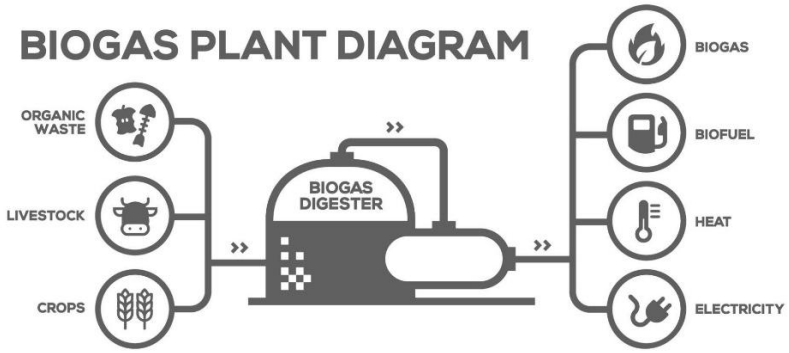
🔎 Key Points

- Considered renewable when sources are replanted or managed sustainably.
- Can reduce reliance on fossil fuels.
- Often described as part of the carbon cycle because new plants absorb CO_2 released during energy generation.



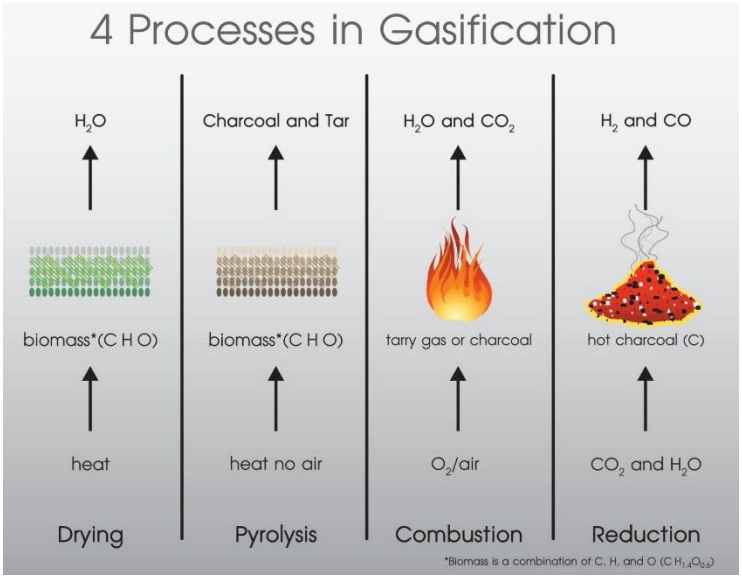
⚙️ How Biomass Energy Works





There are several main processes used to convert biomass into energy:

1. Combustion (Burning)
   - Biomass like wood chips or pellets is burned to produce heat.
   - Heat creates steam → spins turbines → generates electricity.
   - Common in district heating and power plants.
2. Anaerobic Digestion
   - Microorganisms break down organic waste without oxygen.
   - Produces biogas (mostly methane).
   - Used in farms and wastewater plants.
3. Gasification
   - Biomass heated with limited oxygen.
   - Produces "syngas" that can power engines or turbines.
4. Biofuel Production
   - Biomass converted into liquid fuels like ethanol or biodiesel.
   - Often used in transport.



Types of Biomass Energy

Biomass sources vary widely, but they generally fall into these categories:

1. Woody Biomass

- Forest residues
- Wood chips
- Sawdust
- Pellets

2. Agricultural Biomass

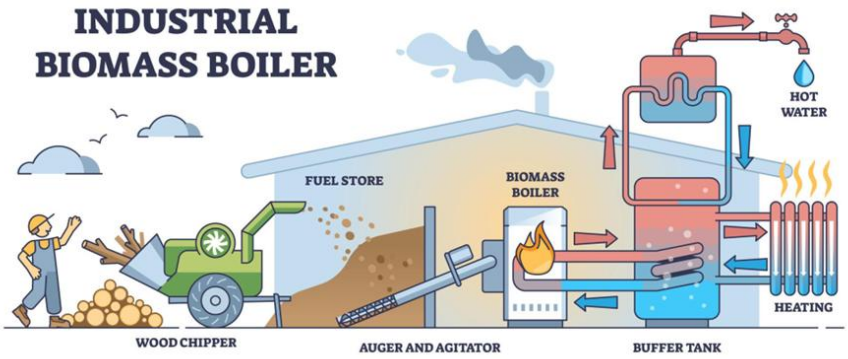
- Straw
- Corn husks
- Rice husks
- Animal manure

3. Energy Crops

- Fast-growing plants like switchgrass or willow.

4. Organic Waste

- Food waste; Yard waste; Municipal solid waste.



✅ Advantages vs ⚠️ Challenges

👍 Advantages

- Renewable and widely available.
- Can reduce landfill waste.
- Provides energy storage in fuel form.
- Supports rural economies and agriculture.

⚠️ Challenges

- Air emissions if not controlled.
- Land use concerns for energy crops.
- Transporting bulky biomass can be costly.
- Must be sustainably managed to stay carbon-neutral.

Is Biomass Energy Widely Used in the UK?

Yes — biomass energy is widely used in the United Kingdom, and it plays an important role in the country's renewable energy system.

⚡ Share of Biomass in the UK Energy Mix

- Biomass provides about 10 to 12% of the UK's total energy demand.
- It produces around 14% of the UK's electricity generation when including bioenergy sources.
- It is considered the second-largest renewable electricity source after wind in the UK.
- In some years it contributes around 6 to 8% of the electricity mix directly from biomass plants.

This means biomass is a **major renewable energy source**, though it is smaller than wind power.

🔥 How Biomass Is Used in the UK

Biomass energy in the UK is used in several ways:

1️⃣ Electricity Generation

- Large power stations burn wood pellets or biomass fuels to generate electricity.
- One of the biggest plants is the Drax Power Station, originally a coal plant converted to biomass.

2️⃣ Heating

- Biomass boilers provide heat for homes, schools, and businesses.
- Often used in district heating systems.

3️⃣ Biogas Production

- Farms and wastewater plants use anaerobic digestion to produce biogas from organic waste.

4️⃣ Transport Fuels

- Biofuels such as bioethanol and biodiesel are blended with petrol and diesel.

Major Biomass Power Plants in the UK

The UK has dozens of biomass facilities, but a few large plants produce most of the electricity. Many are located in industrial regions near ports or former coal power stations, making it easier to import biomass fuel and use existing infrastructure.

Power Station	Location	Capacity / Notes
Drax Power Station	North Yorkshire, England	Largest biomass plant in the UK and one of the biggest in the world. Drax Power Station
Lynemouth Power Station	Northumberland, England	Converted from coal to biomass; about **420 MW capacity**. Lynemouth Power Station
Tees Renewable Energy Plant (Teesside)	Teesside, England	Large biomass CHP facility near the River Tees. Tees Renewable Energy Plant
Tilbury Green Power	Essex, England	Waste-wood biomass plant at the Port of Tilbury. Tilbury Green Power
Templeborough Biomass Power Plant	Rotherham, South Yorkshire	Generates electricity using waste wood. Templeborough Biomass Power Plant
Blackburn Meadows Biomass CHP	Sheffield, England	Combined heat and power plant supplying district heating. Blackburn Meadows Biomass Power Plant
Markinch Biomass CHP Plant	Fife, Scotland	Provides renewable heat to local district heating network. Markinch Biomass CHP Plant

🌎 Geographic Pattern in the UK

Biomass plants are usually located:

- **Near ports** (Tilbury, Teesside) → for importing wood pellets.
- **Near former coal power stations** (Drax, Lynemouth) → using existing power infrastructure.
- **In industrial areas** → where heat and electricity can be used locally.

Large plants like Drax Power Station dominate the sector and alone generate a significant portion of UK biomass electricity.

📈 Why Biomass Is Important for the UK

Biomass helps the UK because it:

- Provides reliable electricity that can run even when wind or solar are low.
- Supports the UK's net-zero emissions goal by 2050.
- Uses organic waste and agricultural residues that might otherwise be discarded.

⚠️ Ongoing Debate

Although widely used, biomass energy is debated because:

- Burning wood releases CO_2 immediately, while trees take time to regrow.
- Some biomass fuel is imported from other countries.
- Government subsidies for biomass power plants have been controversial.

📚 Quick Revision Summary

Definition: Energy from organic matter.
Main Processes: Combustion, digestion, gasification, biofuel conversion.
Types: Woody biomass, agricultural waste, energy crops, organic waste.
Applications: Electricity, heating, transport fuels, waste management.