

Renewable energy production based on
biobased waste streams:

Biogas, pyrolysis and gasification





Renewable energy from waste streams

The agricultural sector generates a significant volume of organic waste streams, including manure, crop residues, and food processing by-products. Several renewable energy technologies utilize these waste streams to produce energy while addressing environmental and economic challenges. Here we look into some key technologies.



Biogas Production

Biogas is produced through a natural process called anaerobic digestion, in which organic materials—such as organic waste, plant residues, and livestock manure—are broken down by microorganisms in an oxygen-free environment. This process produces a mixture of gases, primarily **methane (CH₄)** and **carbon dioxide (CO₂)**, making biogas a renewable energy source. One of the main advantages of anaerobic digestion is that it reduces the mass and odour of organic waste, stabilising it and converting it into valuable products like **biogas** and **biofertiliser**. Biogas can be used for electricity and heat generation or upgraded to biomethane for vehicle fuel or grid injection.

Benefits:

- Reduces greenhouse gas emissions from untreated manure.
- Provides renewable energy that offsets fossil fuels.
- Produces digestate that can be used as a biofertilizer.



Pyrolysis

Pyrolysis is a process where organic material is heated to a high temperature in the absence of oxygen. This heat causes the material to break down chemically, producing gases, liquids, and solid residues, such as charcoal or biochar.

During pyrolysis, the heat breaks the chemical bonds in the material, causing it to decompose into simpler compounds.

The main products of pyrolysis are:

- **Bio-oil:** A liquid that can be used as a fuel or further processed into chemicals.
- **Syngas** (synthetic gas): A gas mixture that can be used to generate energy or be converted into other chemicals.
- **Biochar:** A solid, carbon-rich material that can be used as a soil amendment or for carbon sequestration.

Pyrolysis is used to convert biomass (like wood, agricultural waste, or other organic materials) into useful products, and it's a promising technology for producing renewable energy and reducing waste.



Gasification

Gasification is a process where organic materials (like biomass, coal, or waste) are heated in a controlled, limited-oxygen environment to produce syngas (synthetic gas). Unlike pyrolysis, where the material breaks down in the absence of oxygen, gasification uses a small amount of oxygen or steam to partially oxidize the material.

The gasification process converts carbon-rich materials into:

- Syngas: A mixture of carbon monoxide (CO), hydrogen (H₂), and carbon dioxide (CO₂),
- Solid byproducts: Such as ash

Gasification is an efficient way to produce renewable energy, especially from biomass or waste materials, and is often seen as a cleaner alternative to traditional combustion methods. The syngas produced can be used in gas engines, turbines, or even converted into liquid fuels.



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