



# Energy resources

23/MC/082

Lokesh Godara



# 01

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## **Introduction to Energy Resources**

# ●● Definition and Importance

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01



## What are Energy Resources

Natural sources used to generate power  
Classified into renewable and non-renewable categories  
Essential for transportation, industry, and residential use

02



## The Role of Energy Resources in Society

Fundamental to economic growth and development  
Influence the quality of life and technological advancements  
Critical for national security and geopolitical stability

03



## Historical Overview of Energy Usage

Early reliance on biomass and animal power  
Industrial revolution and the shift to coal  
20th-century rise of oil, gas, and the nuclear age

# ●● Types of Energy Resources

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## **Renewable Energy Resources**

Solar power harnesses sunlight for electricity and heat  
Wind power utilizes turbines driven by wind  
Hydropower generates electricity from flowing water



## **Non-Renewable Energy Resources**

Fossil fuels include coal, oil, and natural gas  
Nuclear energy derived from uranium and thorium  
Abundant now but finite and environmentally impactful



## **Emerging Energy Technologies**

Development of hydrogen fuel cells  
Advancements in geothermal energy extraction  
Growth of tidal and wave energy systems



# 02

## Renewable Energy Resources



# ●● Wind Energy

## Wind Energy Technology



Onshore wind turbines: Installed on land, capturing wind energy to generate electricity.

Offshore wind turbines: Placed in bodies of water, typically with stronger and more consistent winds.

Vertical-axis wind turbines: An alternative design to traditional horizontal-axis turbines, suitable for urban areas.

## Benefits of Wind Energy



Clean energy source: Wind energy is pollution-free and does not emit greenhouse gases.

Cost-effective: Wind power has become one of the cheapest sources of electricity.

Creates jobs: The wind energy sector generates employment opportunities in manufacturing, installation, and maintenance.

## Issues and Solutions



Noise and visual impact: Wind turbines can be disruptive to local communities.

Wildlife concerns: Turbines can pose threats to birds and bats.

Intermittency: Advances in energy storage and grid management help mitigate fluctuations in wind power availability.

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# ●● Hydropower

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## Types of Hydropower Plants

Impoundment facilities: Dams store water in reservoirs, which is released to generate electricity.

Run-of-the-river systems: Use the natural flow of rivers without large reservoirs.

Pumped storage: Moves water between reservoirs at different elevations to store and generate electricity as needed.

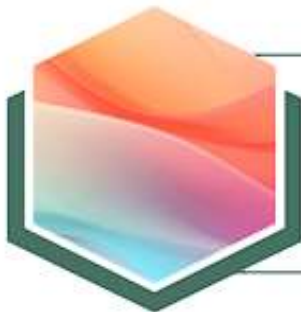


## Environmental Impact

Ecosystem disruption: Dams can alter habitats and affect local wildlife.

Water quality changes: Altered river flows can impact water temperature and quality.

Relocation: Large hydropower projects may require the resettlement of communities.



## Future Trends in Hydropower

Small-scale hydropower: Increasing focus on less invasive, community-level projects.

Technological advancements: Improved turbine designs and smart grid integration.

Sustainability strategies: Emphasis on minimizing environmental impacts and enhancing ecological health.



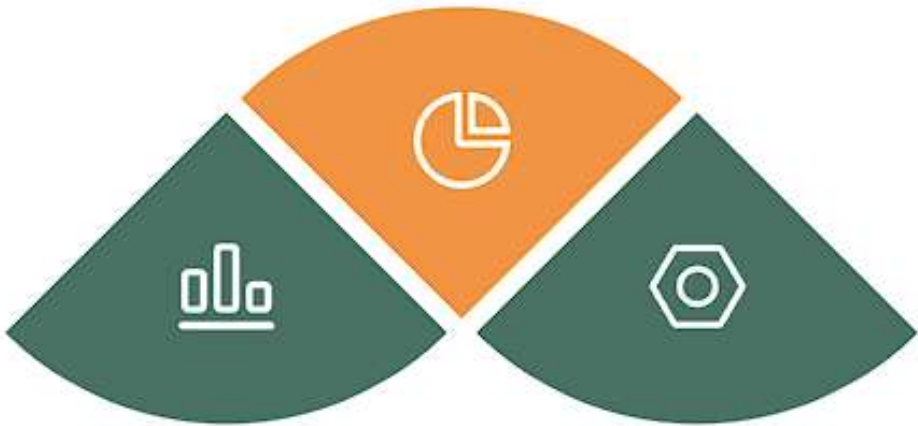
# ●● Biomass Energy

## Biomass Conversion Technologies

- Combustion: Burning biomass directly to produce heat and electricity.
- Gasification: Converting biomass into synthetic gas for energy production.
- Anaerobic digestion: Breaking down organic matter in the absence of oxygen to produce biogas.

## Sources of Biomass

- Agricultural residues: Crop wastes, like straw and husks.
- Forestry by-products: Wood chips, sawdust, and logging residues.
- Organic waste: Food scraps, animal manure, and municipal solid waste.



## Sustainability of Biomass Energy

- Carbon neutrality: Biomass can be considered carbon-neutral if managed sustainably.
- Resource management: Ensuring biomass production does not compete with food production or lead to deforestation.
- Life-cycle analysis: Evaluating the environmental impact from production to end-use of biomass energy.

# 03

## **Non-Renewable Energy Resources**



# ●● Fossil Fuels

01

## Types of Fossil Fuels



Coal Origin, types (bituminous, lignite, anthracite), and primary uses.  
Oil: Formation, types (crude oil, petroleum), and various applications.  
Natural Gas: Composition (methane, ethane), extraction methods, and uses.

02

## Extraction and Usage



Mining Techniques Surface mining and underground mining for coal extraction.  
Drilling Methods: Onshore and offshore drilling for oil extraction.  
Processing and Refining: Steps involved in refining crude oil into usable products.

03

## Environmental Concerns



Air Pollution Emission of greenhouse gases (CO<sub>2</sub>, methane) from burning fossil fuels.  
Water Pollution: Oil spills and chemical runoff from mining operations.  
Habitat Destruction: Land degradation and deforestation associated with mining and drilling.





# ●● Nuclear Energy



## Basics of Nuclear Power

**Nuclear Fission**How energy is produced by splitting atomic nuclei.

**Nuclear Reactors:** Types (PWR, BWR, CANDU), and their operation principles.

**Fuel Cycle:** Uranium mining, enrichment, and fuel rod production.



## Safety and Risks

**Radiation Exposure**Potential health impacts on workers and the public.

**Accident Scenarios:** Historical events (Chernobyl, Fukushima) and their consequences.

**Regulatory Measures:** Safety protocols and international guidelines (IAEA standards).



## Nuclear Waste Management

**Waste Classification**Types of nuclear waste (low-level, high-level, spent fuel).

**Storage Solutions:** Temporary storage and long-term disposal methods (deep geological repositories).

**Reprocessing:** Techniques to recycle and reduce the volume of nuclear waste.



# ●● Natural Gas

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01



## Production and Distribution

Extraction Methods Fracking, horizontal drilling, and conventional drilling.  
Processing: Separation of hydrocarbons and removal of impurities.  
Distribution Network: Pipeline systems, LNG transportation, and storage facilities.

02



## Role in Energy Mix

Electricity Generation Use of natural gas in power plants.  
Heating and Cooling: Role in residential and industrial applications.  
Transition Fuel: Compared to coal and oil, natural gas as a bridge to renewable energy integration.

03



## Economic and Environmental Impact

Market Dynamics Price fluctuations, demand, and geopolitical influences.  
Emissions and Renewability: Lower CO<sub>2</sub> emissions compared to coal and oil.  
Ecological Footprint: Impact on land use, water resources, and potential for methane leaks.

The background of the slide features a city skyline at night, with various skyscrapers illuminated against a dark blue sky. A large, semi-transparent green shape covers the left and center portions of the image. A thin orange line with a small vertical tick mark and dots at its ends is positioned horizontally across the green area.

# 04

## **Sustainable Energy Practices**

# ●● Energy Efficiency

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## Importance of Energy Efficiency

Reduces energy consumption and operational costs.

Mitigates environmental impact by lowering greenhouse gas emissions.

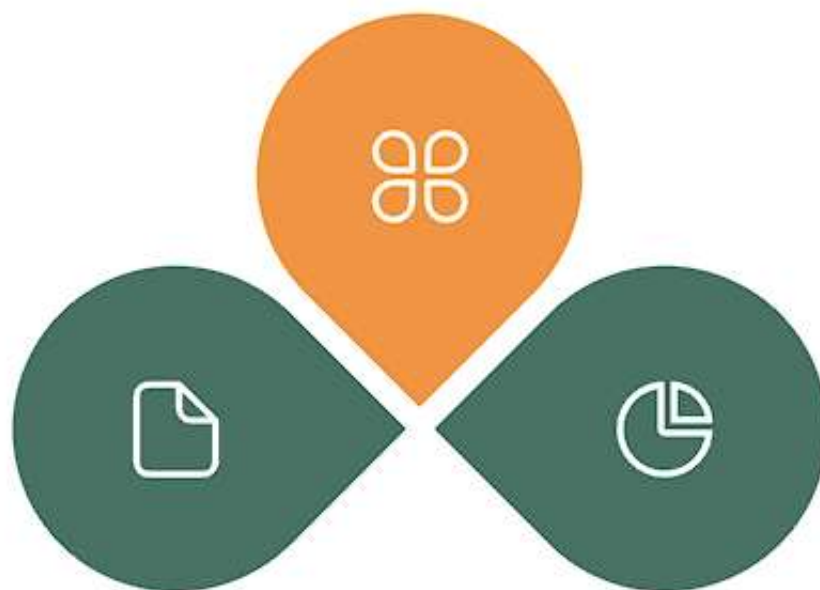
Enhances energy security by reducing dependence on fossil fuels.

## Energy-Efficient Technologies

LED lighting: Offers significant energy savings over traditional bulbs.

High-efficiency HVAC systems: Improves air quality and lowers energy use.

Smart thermostats: Optimize heating and cooling based on occupancy patterns.



## Policy and Regulations

Government incentives for energy-efficient buildings and appliances.

Mandates on energy performance standards for various industries.

Penalties for non-compliance with energy efficiency regulations.



# Thanks

**Lokesh Godara**  
**23/MC/82**