

Teacher: Sayan Chakraborti

Student:

## Sources of Energy for Generating Electricity

### Objective

To understand the different sources of energy used to generate electricity, differentiate between renewable and non-renewable energy sources, and discuss the environmental impacts, benefits, and challenges associated with each.

### 1. Non-Renewable Energy Sources

#### Fossil Fuels (Coal, Natural Gas, and Oil):

CO<sub>2</sub> Emissions: High; major contributors to greenhouse gas emissions and climate change.

Benefits: Widely available, high energy density, and cost-effective with current infrastructure.

Problems: Finite supply, environmental degradation, air and water pollution.

#### Nuclear Energy:

CO<sub>2</sub> Emissions: Low; during operation, but lifecycle emissions include mining, transportation, and waste disposal.

Benefits: High energy output, reliable, low operational emissions.

Problems: Radioactive waste, high upfront costs, risk of accidents.

### 2. Renewable Energy Sources

#### Solar Power:

CO<sub>2</sub> Emissions: Very low; emissions mainly from manufacturing and transportation of solar panels.

Benefits: Abundant, sustainable, low operating costs, minimal environmental impact.

Problems: Intermittent, requires large areas for large scale generation, energy storage challenges.

#### Wind Power:

CO<sub>2</sub> Emissions: Very low; mainly from manufacturing and installation of turbines.

Teacher: Sayan Chakraborti

Student:

Benefits: Sustainable, low operating costs, can be built on existing farms or ranches.

Problems: Intermittent, visual and noise impact, potential threat to wildlife.

**Hydroelectric Power:**

CO2 Emissions: Low; mainly from construction and flooding of reservoirs.

Benefits: Renewable, consistent, and controllable power supply.

Problems: Environmental and social impact of dam construction, disruption of aquatic ecosystems.

**Biomass and Biofuels:**

CO2 Emissions: Variable; can be carbon neutral if managed sustainably.

Benefits: Utilizes waste materials, can be used for both electricity and transport fuel.

Problems: Competition with food production, deforestation, water use.

**Geothermal Energy:**

CO2 Emissions: Low; emissions from plant construction and operation.

Benefits: Reliable, high capacity factor, small land footprint.

Problems: Geographically limited, upfront costs, potential for induced seismicity.

**In-Class Discussion Questions**

**Sustainable Choices:** Considering the CO2 emissions and environmental impacts, which energy source do you think is most sustainable for future electricity generation? Why?

**Energy Transition:** What are the biggest challenges in transitioning from non-renewable to renewable energy sources? Discuss economic, technological, and social factors.

**Personal Impact:** How can individuals contribute to reducing the reliance on non-renewable energy sources? Discuss actions that you and their families can take.