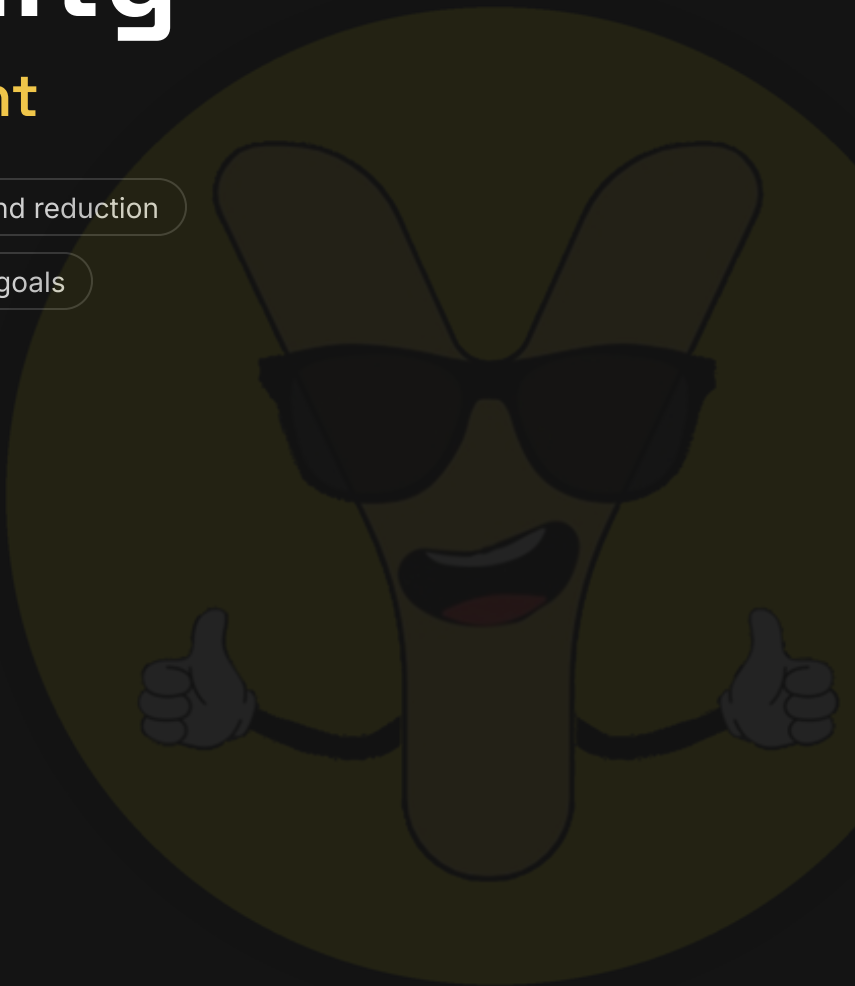
AKTU · 1ST YEAR · AAC101 / AAC201

# Environment & Sustainability

## Unit 4 — Climate Change and Sustainable Development

- Global warming and greenhouse effect
- Climate change: causes and impacts
- Carbon footprint: concept and reduction
- Sustainable development: definition and need
- UN Sustainable Development Goals (SDGs): overview of the 17 goals
- Renewable energy: solar, wind, and biomass awareness
- Calculating and reducing personal carbon footprint




DECODED BY

**Chirag Jain**

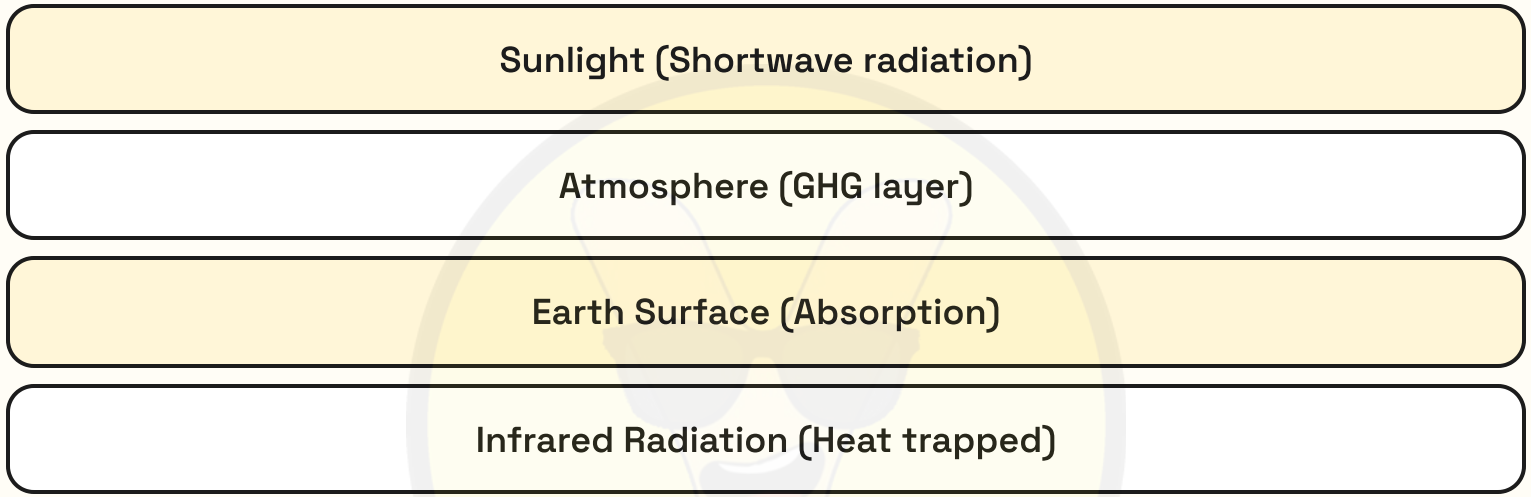
Founder, Ycotes · Gold Medalist in Artificial Intelligence, IIT Madras · taught 10,000+ students

# Global Warming and Greenhouse Effect

Understanding the mechanism behind Earth's rising temperatures.

- Greenhouse Effect: Natural process where atmospheric gases trap heat to maintain Earth's temperature.
- Greenhouse Gases (GHGs): CO2, Methane (CH4), Nitrous Oxide (N2O), and Water Vapor.
- Global Warming: The abnormal increase in Earth's surface temperature due to human-induced GHG emissions.
- Mechanism: Solar radiation enters the atmosphere; Earth radiates infrared heat; GHGs absorb and re-radiate this heat back to the surface.

# Greenhouse Effect Mechanism

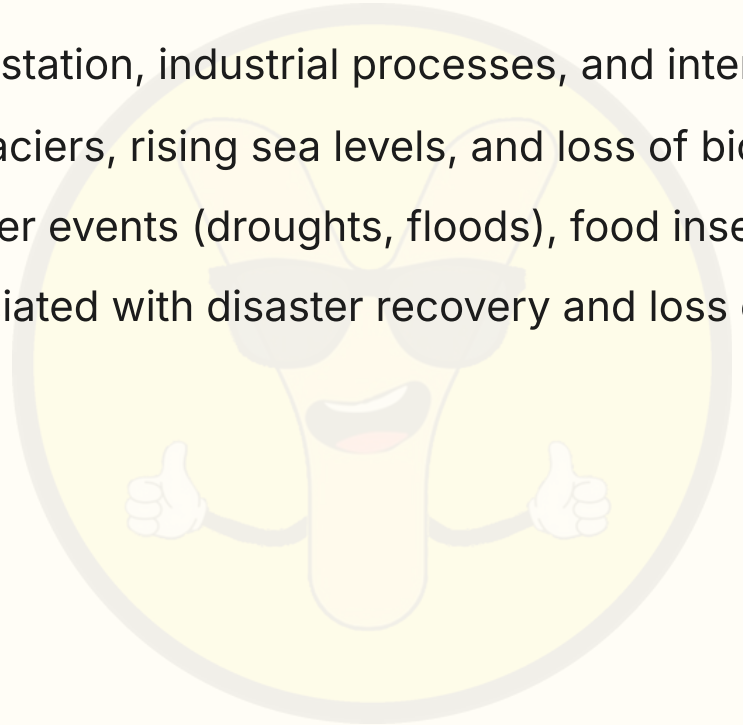



Solar energy penetrates the atmosphere, is absorbed by Earth, and reflected heat is trapped by GHGs.

# Climate Change: Causes and Impacts

Climate change refers to long-term shifts in temperatures and weather patterns.

- Causes: Burning fossil fuels, deforestation, industrial processes, and intensive agriculture.
- Impacts on Ecosystems: Melting glaciers, rising sea levels, and loss of biodiversity.
- Impacts on Society: Extreme weather events (droughts, floods), food insecurity, and health risks.
- Economic Impact: High costs associated with disaster recovery and loss of agricultural productivity.



# Carbon Footprint

**CARBON FOOTPRINT**

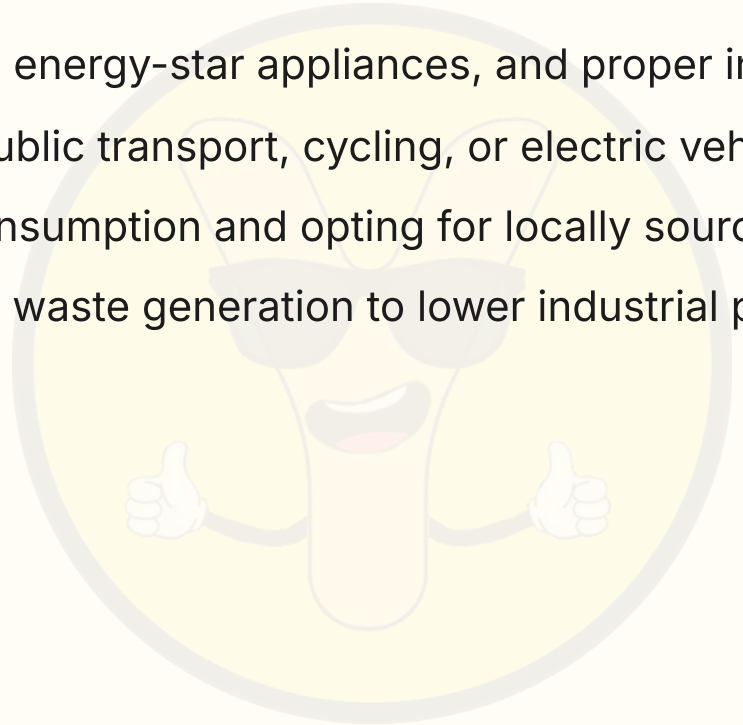
The total amount of greenhouse gases (including carbon dioxide and methane) generated by our actions.

- Measured in units of carbon dioxide equivalent (CO2e).
- Includes direct emissions (fuel combustion) and indirect emissions (electricity consumption).
- Scope: Can be calculated for an individual, an event, an organization, or a product.

# Carbon Footprint Reduction Strategies

Practical steps to minimize individual and organizational carbon impact.

- Energy Efficiency: Using LED lights, energy-star appliances, and proper insulation.
- Sustainable Transport: Preferring public transport, cycling, or electric vehicles.
- Dietary Choices: Reducing meat consumption and opting for locally sourced seasonal food.
- Reduce-Reuse-Recycle: Minimizing waste generation to lower industrial production emissions.

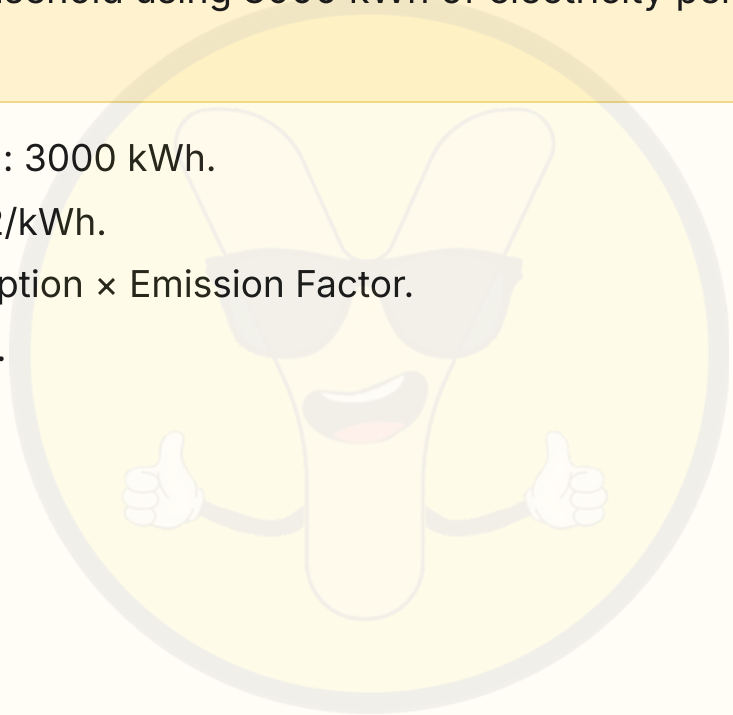


# Calculating Personal Carbon Footprint

Calculate annual CO2 emission for a household using 3000 kWh of electricity per year. (Emission factor = 0.85 kg CO2/kWh)

1. Identify total annual energy consumption: 3000 kWh.
2. Identify the emission factor: 0.85 kg CO2/kWh.
3. Apply formula: Total Emission = Consumption × Emission Factor.
4. Calculation: 3000 × 0.85 = 2550 kg CO2.

**2550 kg CO2 per year.**



# Sustainable Development

**SUSTAINABLE DEVELOPMENT**

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

- Coined by the Brundtland Commission (1987).
- Focuses on balancing economic growth, social inclusion, and environmental protection.
- Need: To prevent resource depletion and ensure long-term planetary survival.

# UN Sustainable Development Goals (SDGs)

A universal call to action to end poverty, protect the planet, and ensure prosperity.

- Adopted by all UN Member States in 2015 as part of the 2030 Agenda.
- Consists of 17 integrated goals.
- Goals cover social, economic, and environmental dimensions.
- Emphasis: 'Leave no one behind'.



# Overview of 17 SDGs

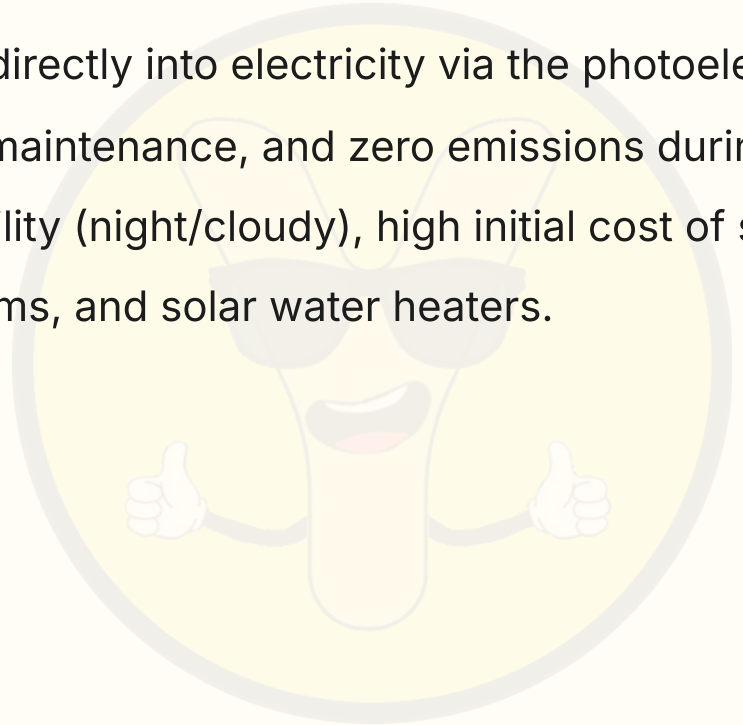
Summary of the global goals for transformation.

- Poverty & Hunger: No Poverty (1), Zero Hunger (2).
- Health & Education: Good Health (3), Quality Education (4).
- Equality & Infrastructure: Gender Equality (5), Clean Water (6), Affordable Energy (7), Decent Work (8), Industry/Innovation (9), Reduced Inequalities (10).
- Sustainability: Sustainable Cities (11), Responsible Consumption (12), Climate Action (13), Life Below Water (14), Life on Land (15), Peace/Justice (16), Partnerships (17).

# Renewable Energy: Solar Power

Harnessing energy from the sun using photovoltaic (PV) cells.

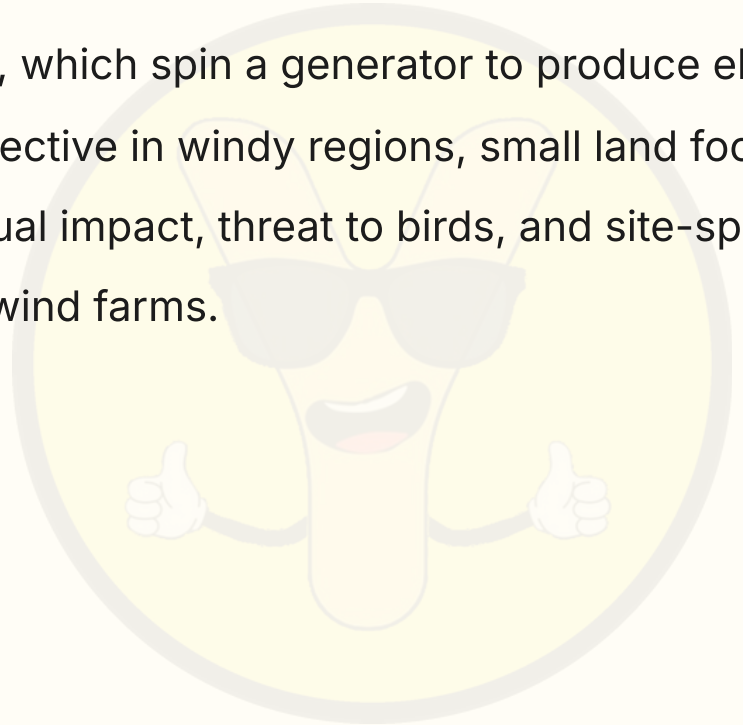
- Working: PV cells convert sunlight directly into electricity via the photoelectric effect.
- Advantages: Abundant, silent, low maintenance, and zero emissions during operation.
- Disadvantages: Intermittent availability (night/cloudy), high initial cost of storage (batteries).
- Application: Rooftop solar, solar farms, and solar water heaters.



# Renewable Energy: Wind Power

Converting kinetic energy of wind into mechanical or electrical energy.

- Working: Wind turns turbine blades, which spin a generator to produce electricity.
- Advantages: Clean source, cost-effective in windy regions, small land footprint.
- Disadvantages: Noise pollution, visual impact, threat to birds, and site-specific.
- Application: Onshore and offshore wind farms.



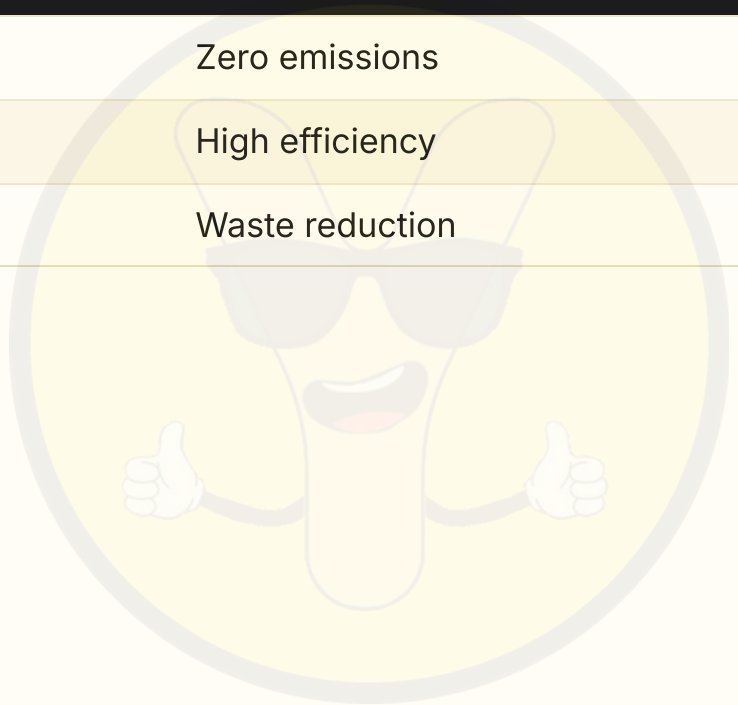
# Renewable Energy: Biomass

Energy derived from organic matter (plants, animals, waste).

- Working: Combustion, fermentation, or anaerobic digestion to produce heat, electricity, or biofuels.
- Advantages: Carbon neutral (the CO2 released equals CO2 absorbed during growth), utilizes waste.
- Disadvantages: Requires land, potential for deforestation if not managed, air pollutants if burned inefficiently.
- Application: Biogas plants, wood pellets, and biodiesel.

# Comparison of Renewable Energy Sources

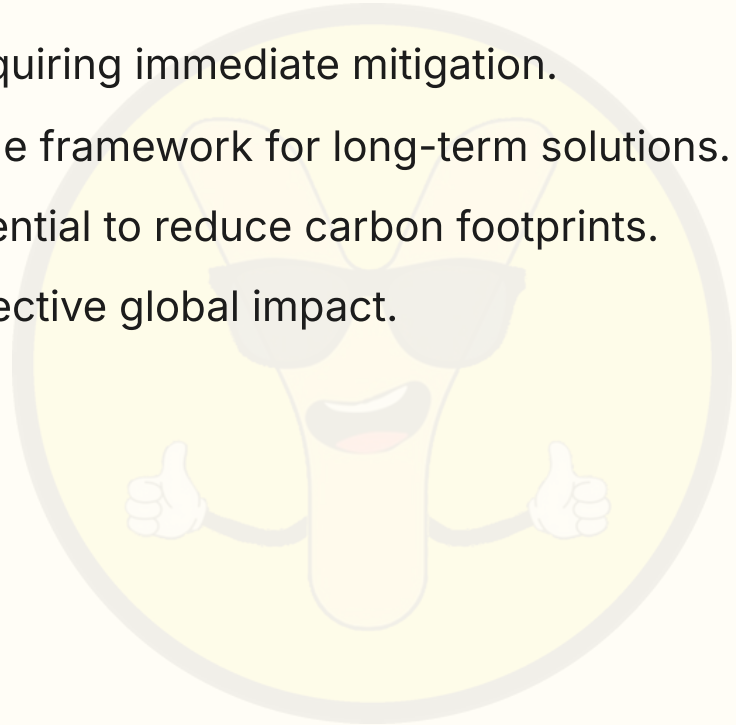
| Source | Primary Input | Main Advantage | Main Disadvantage |
|---|---|---|---|
| **Solar** | Sunlight | Zero emissions | Intermittency |
| **Wind** | Air flow | High efficiency | Noise/Visual |
| **Biomass** | Organic matter | Waste reduction | Land use |



# Summary of Climate Action

Integrated approach to sustainability.

- Climate change is a global crisis requiring immediate mitigation.
- Sustainable Development acts as the framework for long-term solutions.
- Renewable energy transition is essential to reduce carbon footprints.
- Individual actions contribute to collective global impact.



# Exam corner

**Q1** Explain the mechanism of the greenhouse effect and its contribution to global warming.

**Q2** Differentiate between natural and anthropogenic causes of climate change.

**Q3** Define Carbon Footprint and discuss three methods to reduce it.

**Q4** What is Sustainable Development? Explain the need for it in the present era.

**Q5** List and briefly explain any five UN Sustainable Development Goals.

**Q6** Compare Solar, Wind, and Biomass energy in terms of working and limitations.

**Q7** Calculate the carbon footprint of a household consuming 5000 kWh/year if the emission factor is 0.7 kg CO2/kWh.

# Unit 4 done. You are exam-ready.

Revise the Exam corner once more, then open Unit 5 on theycotes.com. Every AKTU subject, unit by unit, free. Notes by Chirag Jain, Ycotes.

