Table of Contents

Classify different types of wind turbines with examples.

Wind turbines are mainly classified as follows:

1. Based on axis of rotation:

- **Horizontal Axis Wind Turbine (HAWT):** Shaft parallel to ground.
  Example: Three-blade wind turbines.
- **Vertical Axis Wind Turbine (VAWT):** Shaft perpendicular to ground.
  Example: Darrieus, Savonius turbines.

2. Based on location:

- **Onshore turbines:** Installed on land.
- **Offshore turbines:** Installed in sea or ocean areas.

3. Based on size:

- **Small turbines:** Used for domestic purposes.
- **Large turbines:** Used for commercial power generation.

Detailed Explanation of Types of Wind Turbines

Wind turbines can be grouped into different categories depending on their

construction and application. The main classifications are given below:

1. According to the Axis of Rotation

(i) Horizontal Axis Wind Turbine (HAWT):
In this type, the rotating shaft is horizontal, i.e., parallel to the ground. These turbines are mostly used for large-scale power generation and need to be aligned with the wind direction.
Example: Three-blade wind turbines used in wind farms.

(ii) Vertical Axis Wind Turbine (VAWT):
Here, the shaft is vertical, i.e., perpendicular to the ground. These turbines can work irrespective of wind direction and are suitable for areas with low or changing wind.
Example: Darrieus turbine and Savonius turbine.

2. According to Installation Location

(i) Onshore Wind Turbine:
These turbines are installed on land. They are easier to construct and maintain compared to offshore systems.
Example: Wind farms located in rural or hilly regions.

(ii) Offshore Wind Turbine:
These are installed in water bodies like seas or oceans where wind speed is generally higher, resulting in more power output.
Example: Wind farms in coastal and offshore areas.

3. According to Size or Capacity

(i) Small Wind Turbine:
Used for small-scale applications such as homes or small establishments. Their power rating is relatively low.
Example: Small rooftop wind generators.

(ii) Large Wind Turbine:
These are used for bulk electricity generation and are connected to the power grid. They have high power capacity.
Example: Utility-scale wind turbines in large wind farms.

4. According to Number of Blades

- **Single-blade type:** Rarely used due to balancing issues.
- **Two-blade type:** Economical but causes more vibration.
- **Three-blade type:** Most common due to better efficiency and smooth operation.

Example: Modern commercial wind turbines generally have three blades.

Explain the reason why large wind farms are commonly situated along the coastline of India.

India holds the fourth-largest installed wind power capacity in the world, with over 56 GW as of early 2026. This capacity is largely concentrated in coastal states like Gujarat (15.2 GW) and Tamil Nadu (12.1 GW), driven by clear geographical and physical reasons.

Land-Sea Breezes and Wind Consistency

Land heats up faster than the ocean during the day, drawing in cool sea air, and the process reverses at night. This creates steady, consistent coastal winds with minimal friction, resulting in a higher Capacity Utilization Factor (CUF) compared to inland sites.

High-Velocity Wind Corridors

Certain gaps along the coastline funnel and accelerate wind through the Venturi effect. The Muppandal Wind Farm in Tamil Nadu, located near a gap in the Western Ghats, is a prime example where compressed wind significantly boosts energy output.

Monsoon Synchronization

Nearly 70% of India’s annual wind generation occurs during the Southwest Monsoon (May to September), when powerful winds strike the western and southern coastlines with high kinetic energy — a natural advantage that coastal farms are ideally placed to capture.