



Wind Energy

It Blows You Away



Submitted By:

Praveen.V



"Coal, gas and oil will not be the three kings of the energy world for ever. It is no longer folly to look up to the sun and wind, down into the sea's waves"

Introduction



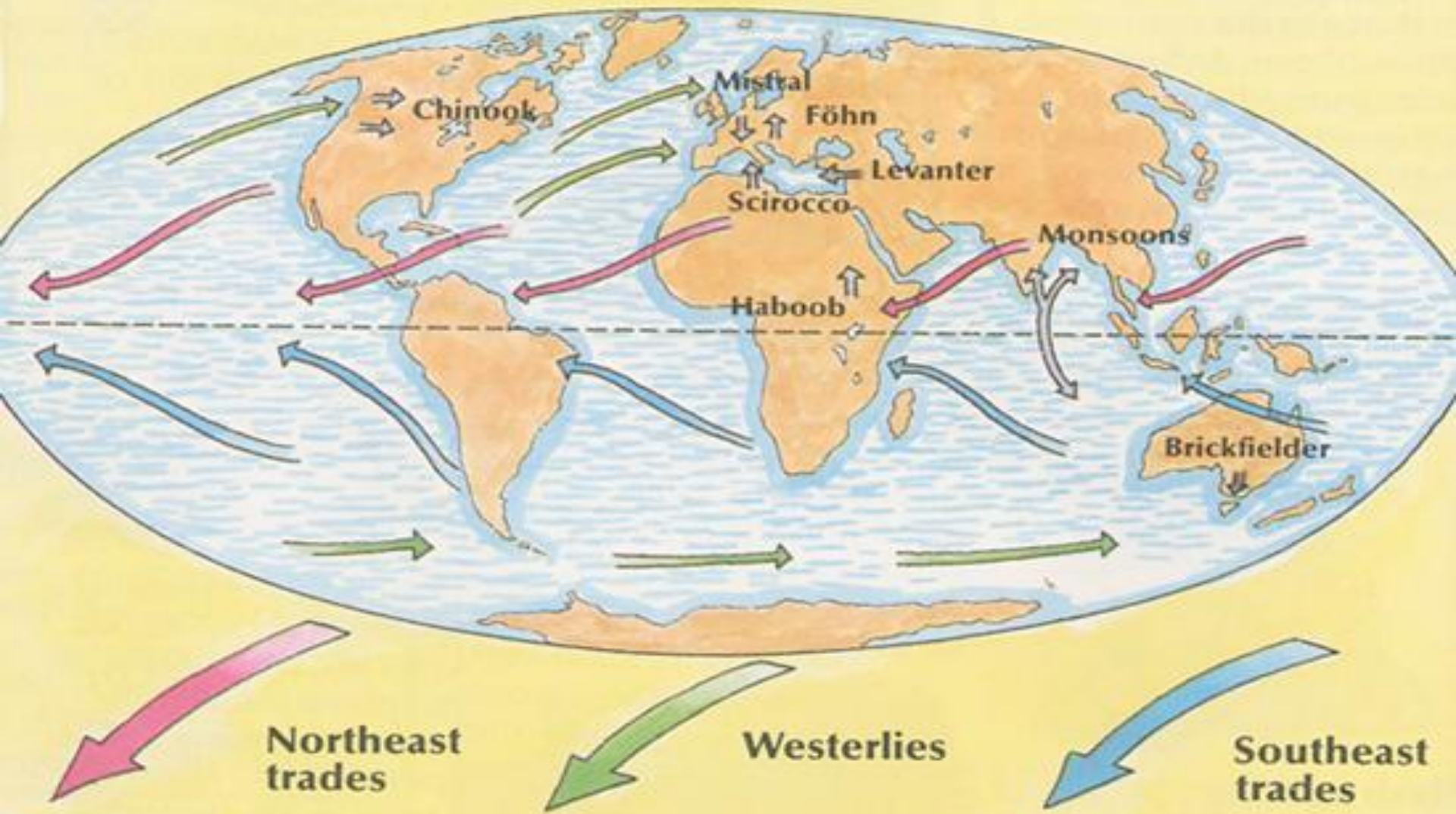
- Energy is a major input for overall socio-economic development of any society
- The prices of the fossil fuels steeply increasing
- So renewable are expected to play a key role
- Wind energy is the fastest growing renewable
- Wind turbines are up to the task of producing serious amounts of electricity

Principles

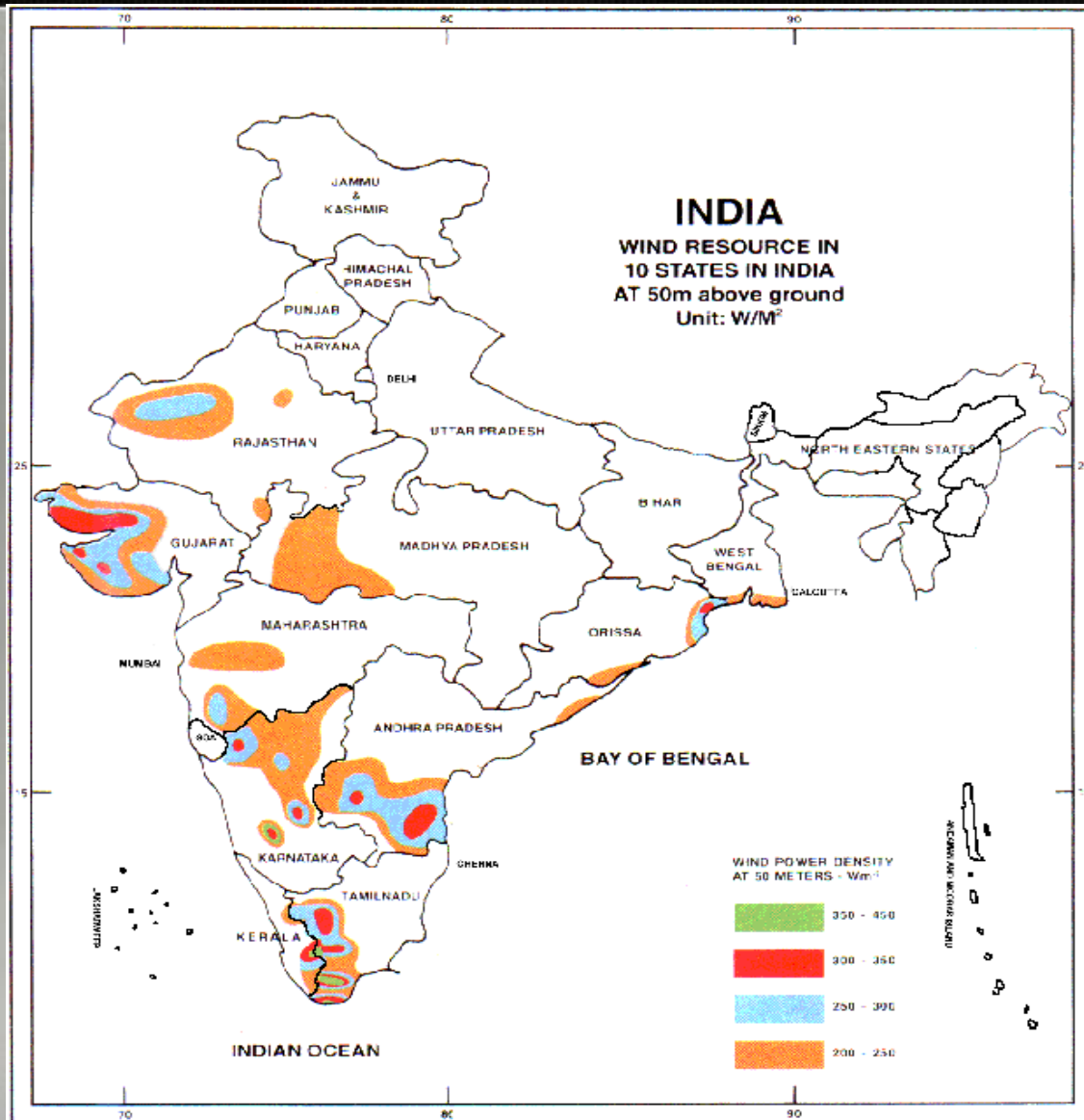


Uneven heating of earth's surface and rotation

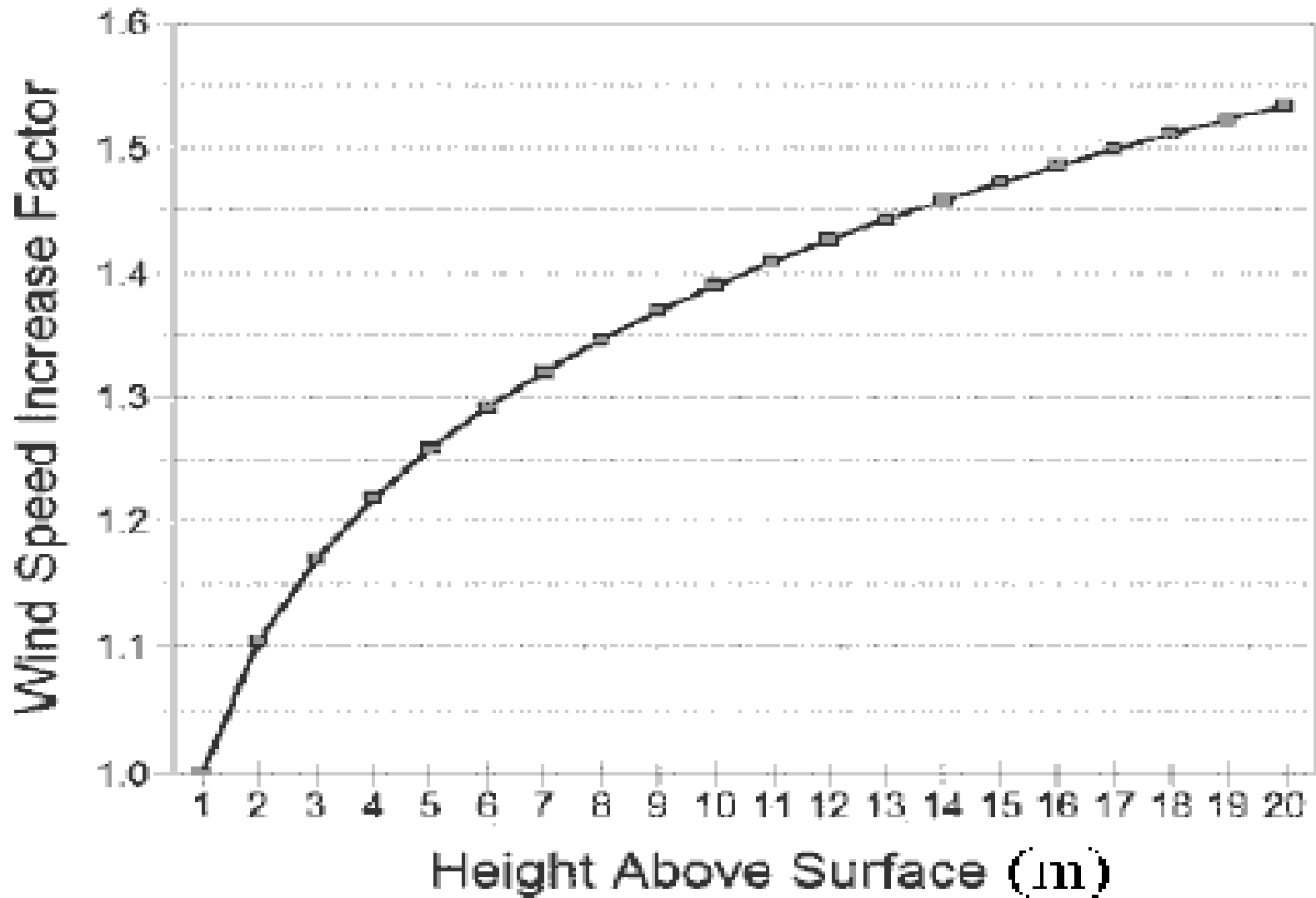
Map of world winds



Wind Power Density of India



Velocity with Height



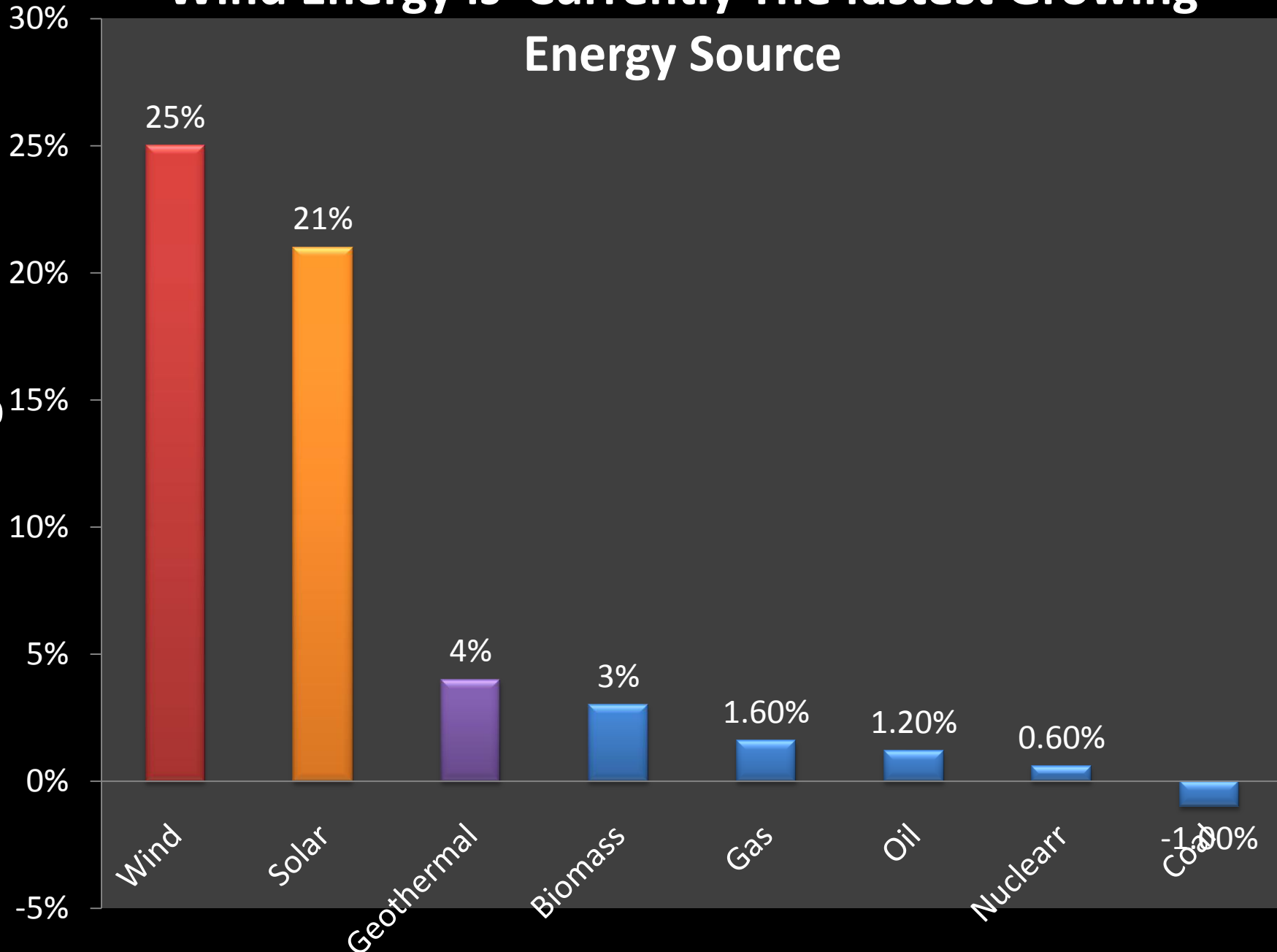
Potential



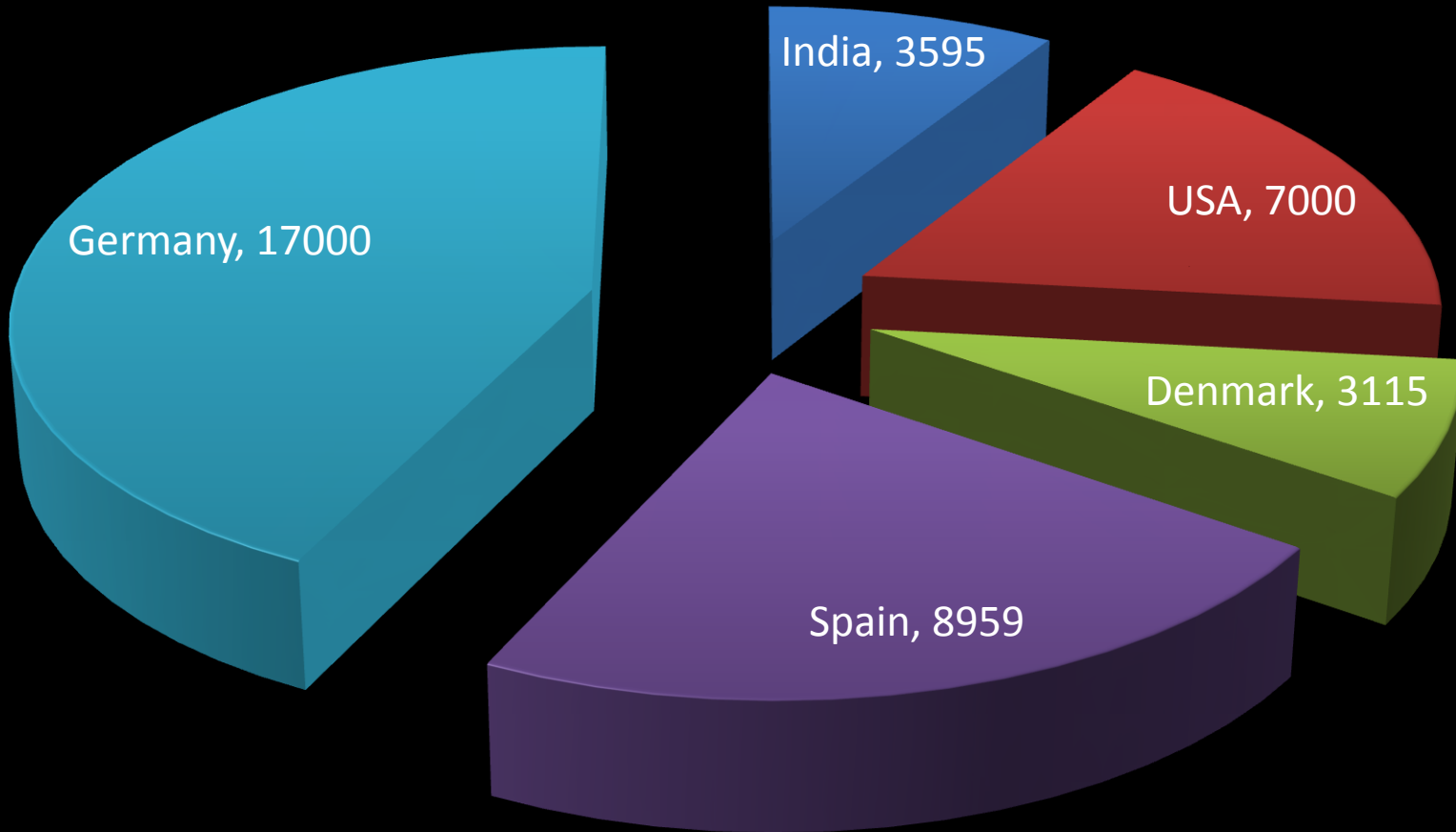
- Huge potential exists
 - Available potential can contribute five times the world energy demand
- 0.4% contribution to total energy

Wind Energy is Currently The fastest Growing Energy Source

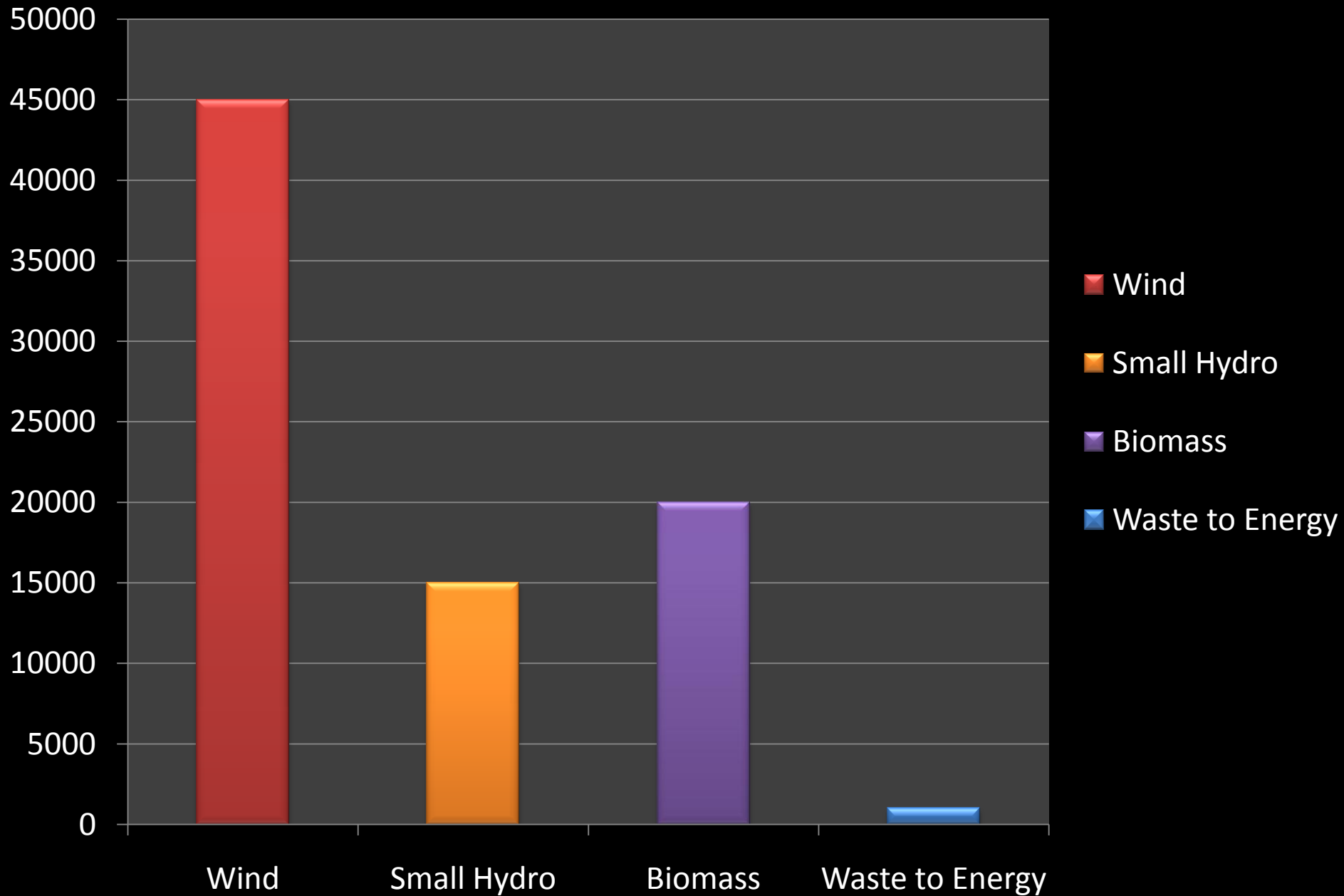
10 Years Average Growth



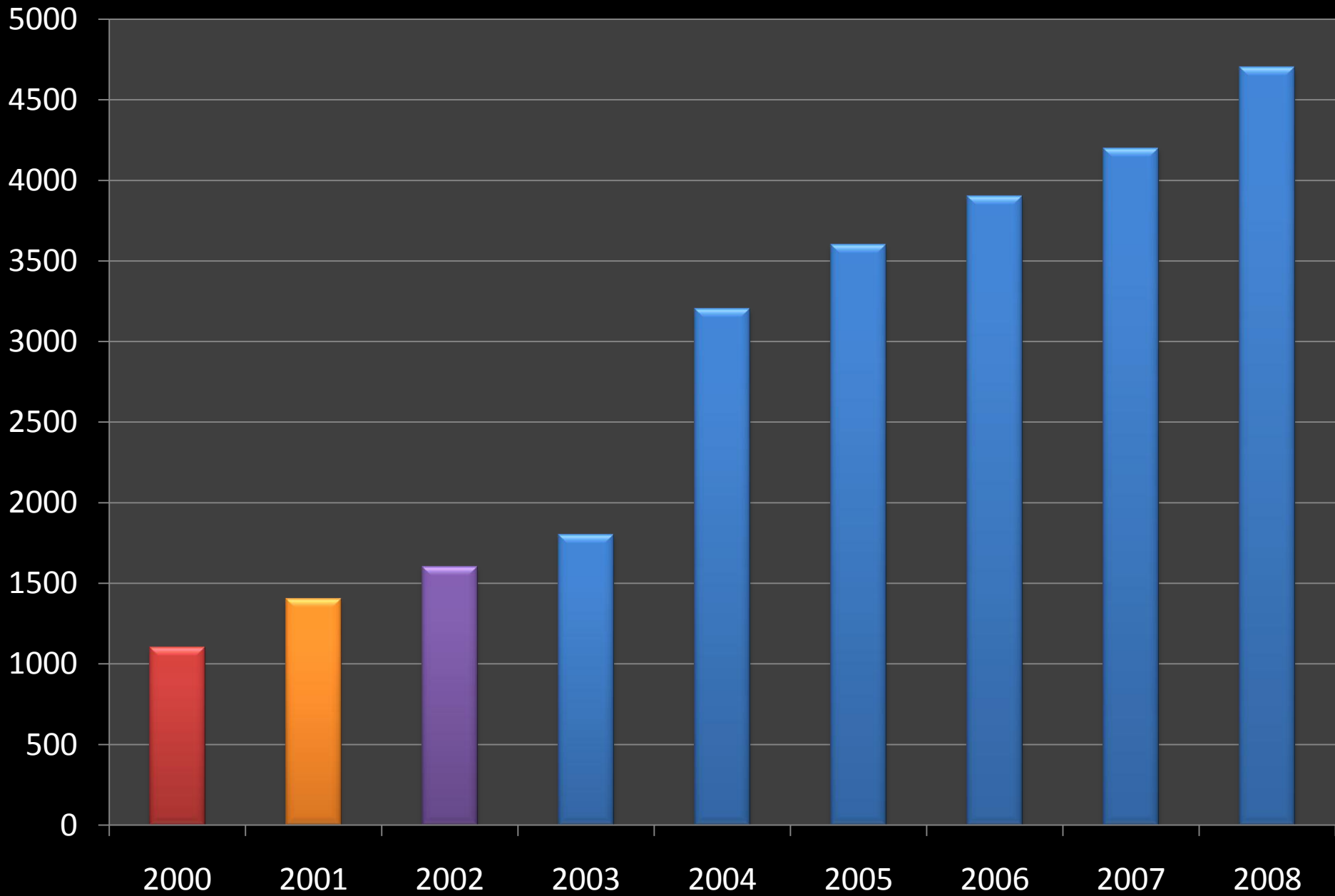
Installed Capacity (MW) in 2007



Available Potential in India



Installed Capacity (MW) in India



State wise potential in India, 2005

Sl. No.	State	Gross Potential (MW)	Technical Potential (MW)	Installed Capacity (MW)
1.	Andhra Pradesh	8275	1920	121.1
2.	Gujarat	9675	1780	667
3.	Karnataka	6620	1180	847
4.	Kerala	875	605	2.0
5.	Madhya Pradesh	5500	845	58
6.	Maharashtra	3650	3040	1485
7.	Orissa	1700	780	2
8.	Rajasthan	5400	910	470
9.	Tamilnadu	3050	1880	3460
10.	West Bengal	450	450	1.6
11.	Other States	-	-	0.5
	Total	45195 MW	13390	7114 MW

Technology



Turbine Evolution



Used for

- Pumping water
- Grinding grain



Mainly used for

- Generating Electricity



Two Types of Wind Turbines

Horizontal Axis Wind Turbine



Horizontal Axis Wind Turbine



VAWT [Vertical Axis Wind Turbine]

- Drag is the main force
- Nacelle is placed at the bottom
- Yaw mechanism is not required
- Lower starting torque
- Difficulty in mounting the turbine
- Unwanted fluctuations in the power output



HAWT [Horizontal Axis Wind Turbine]

- Lift is the main force
- Much lower cyclic stresses
- Yaw mechanism is required
- 95% of the existing turbines are HAWTs
- Nacelle is placed at the top of the tower

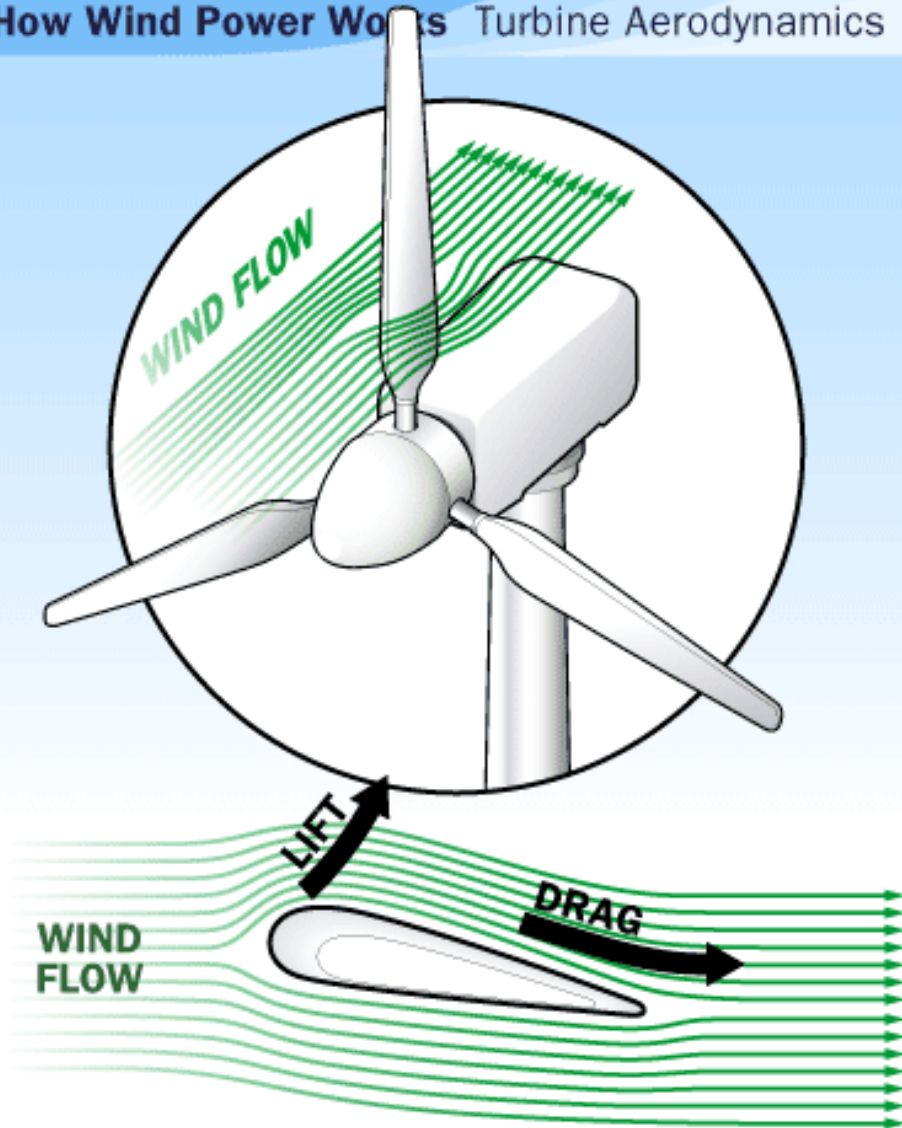


Turbine design and construction

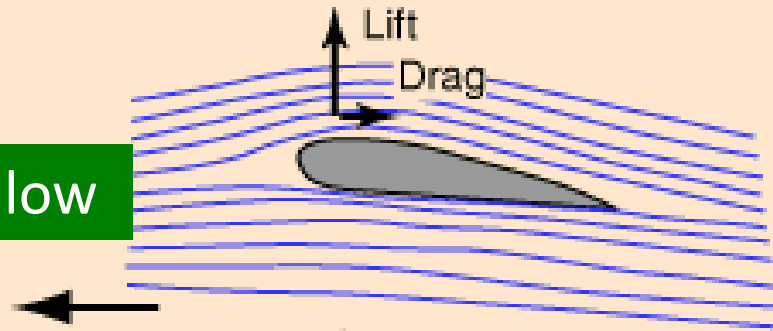
- Blades
 - Material used
 - Typical length
- Tower height
 - Heights twice the blade length are found economical

Turbine Aerodynamics

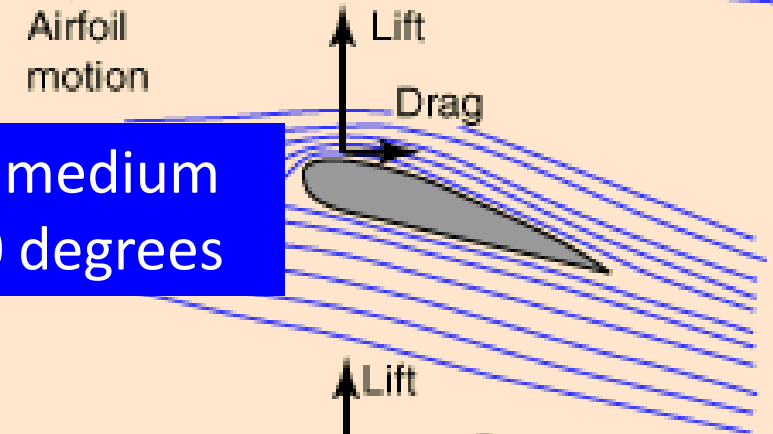
How Wind Power Works Turbine Aerodynamics



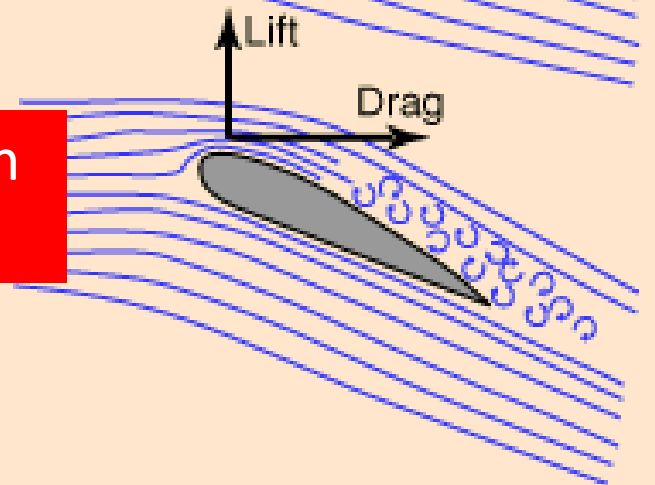
$\alpha = \text{low}$



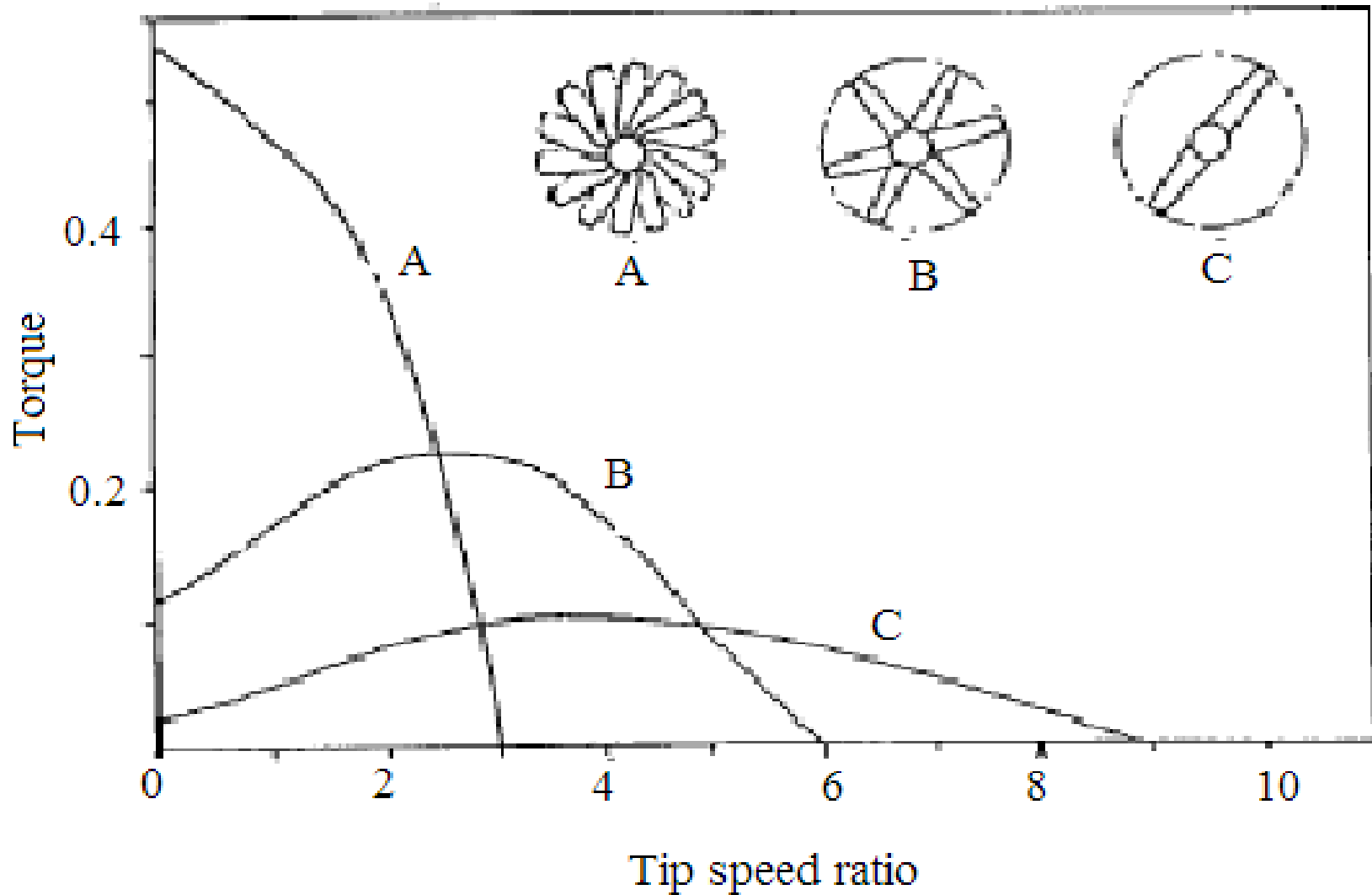
$\alpha = \text{medium}$
 $< 10 \text{ degrees}$



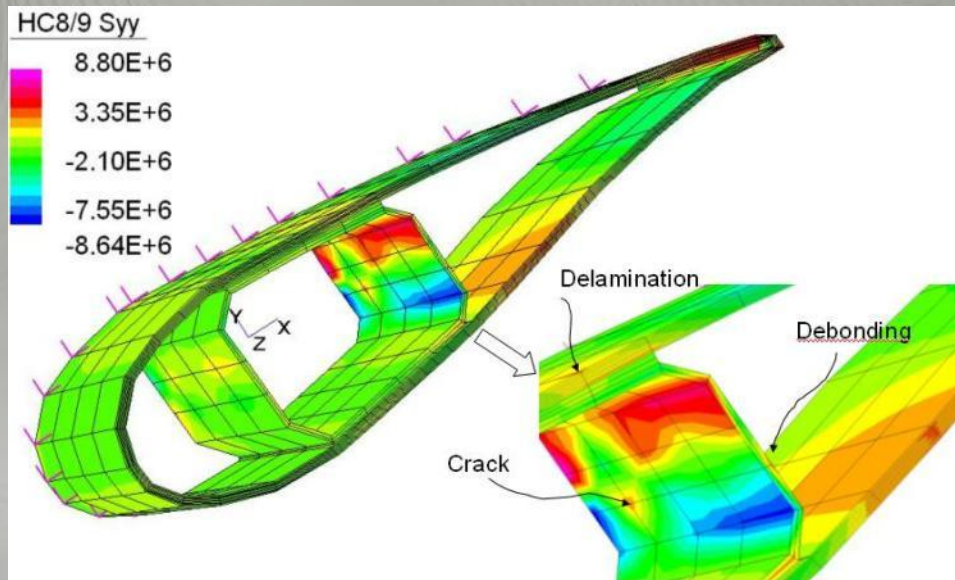
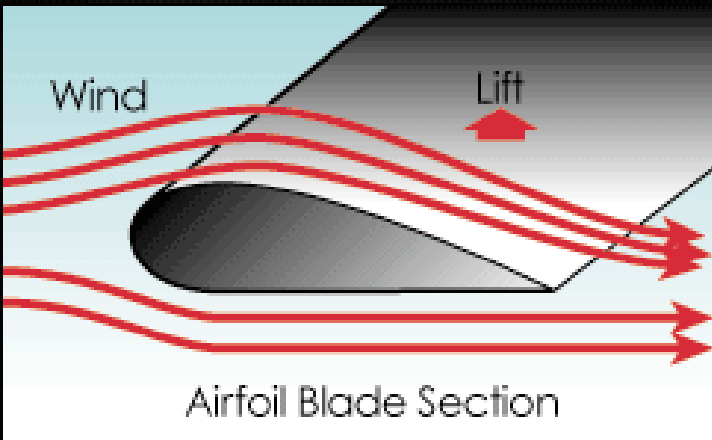
$\alpha = \text{High}$
Stall!!



Why Only Three



Airfoil Shape

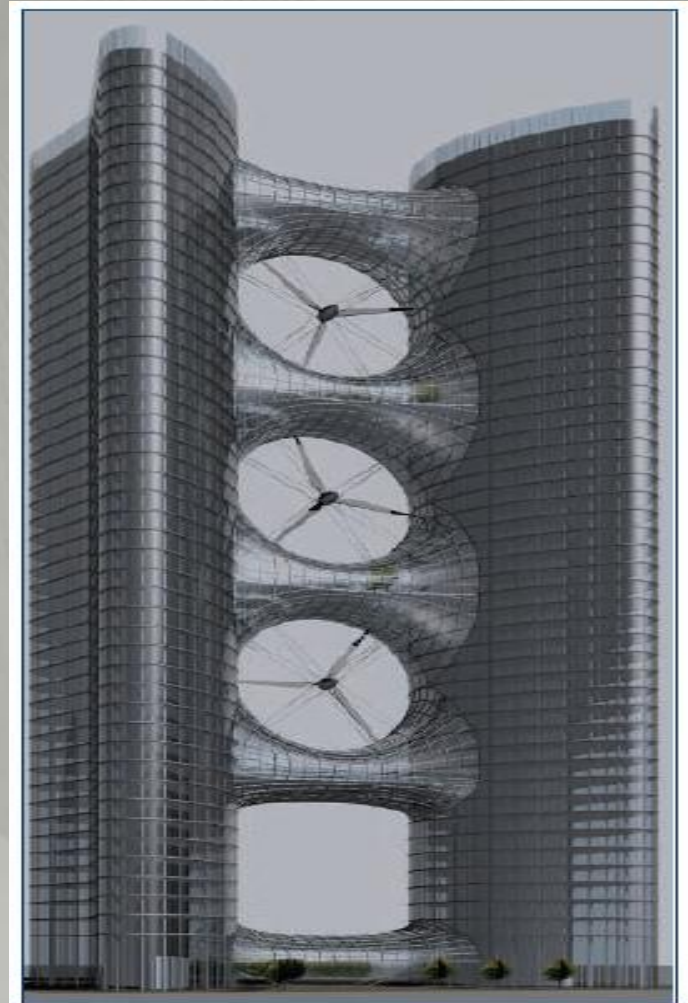


A Typical HAWT



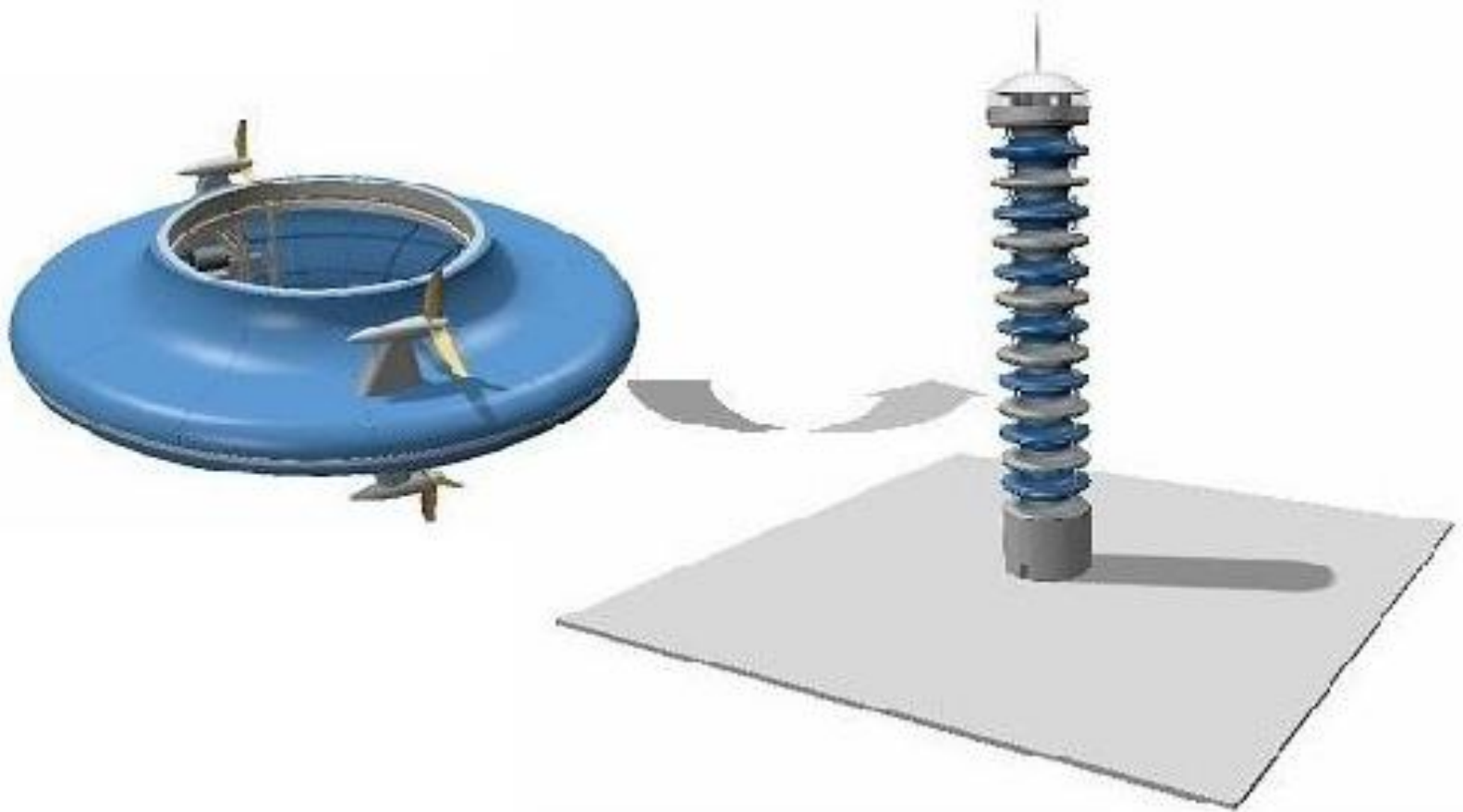
Improvements

- Concentrators



Future Wind Turbines

Wind Amplified Rotor Platform



The Modular WARP™ System Design

Disc type wind turbine

- Much more efficient than HAWT
- Requires less height
- Low noise
- Works in any wind direction



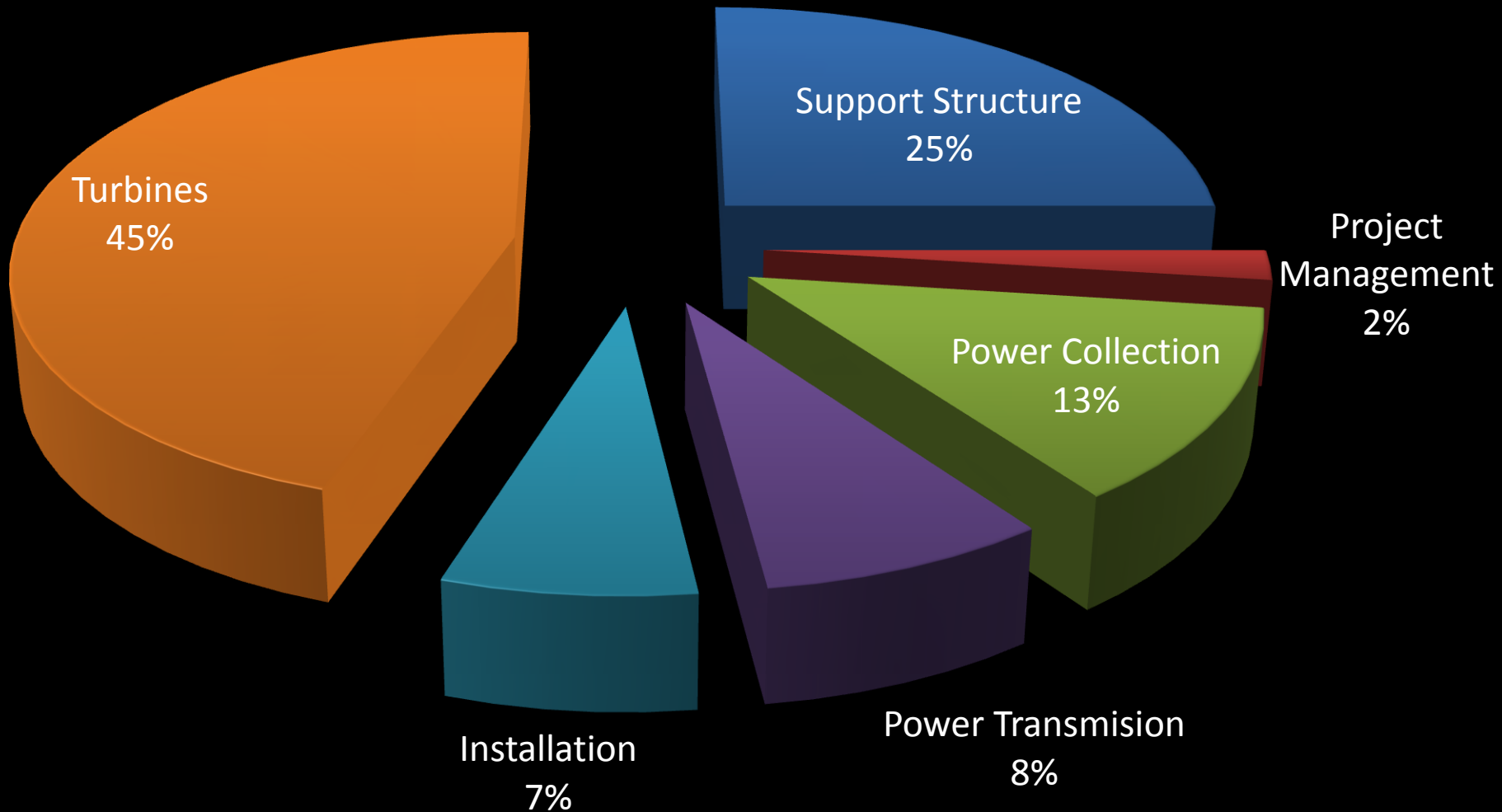
Economics



Determining Factors

- Wind Speed
- Turbine design and construction
- Rated capacity of the turbine
- Exact Location
- Improvements in turbine design
- Capital

Break Down Of Capital Cost



Energy Cost Trend

1979: 40 cents/kWh

2000:
4 - 6 cents/kWh



- Increased Turbine Size
- R&D Advances
- Manufacturing Improvements

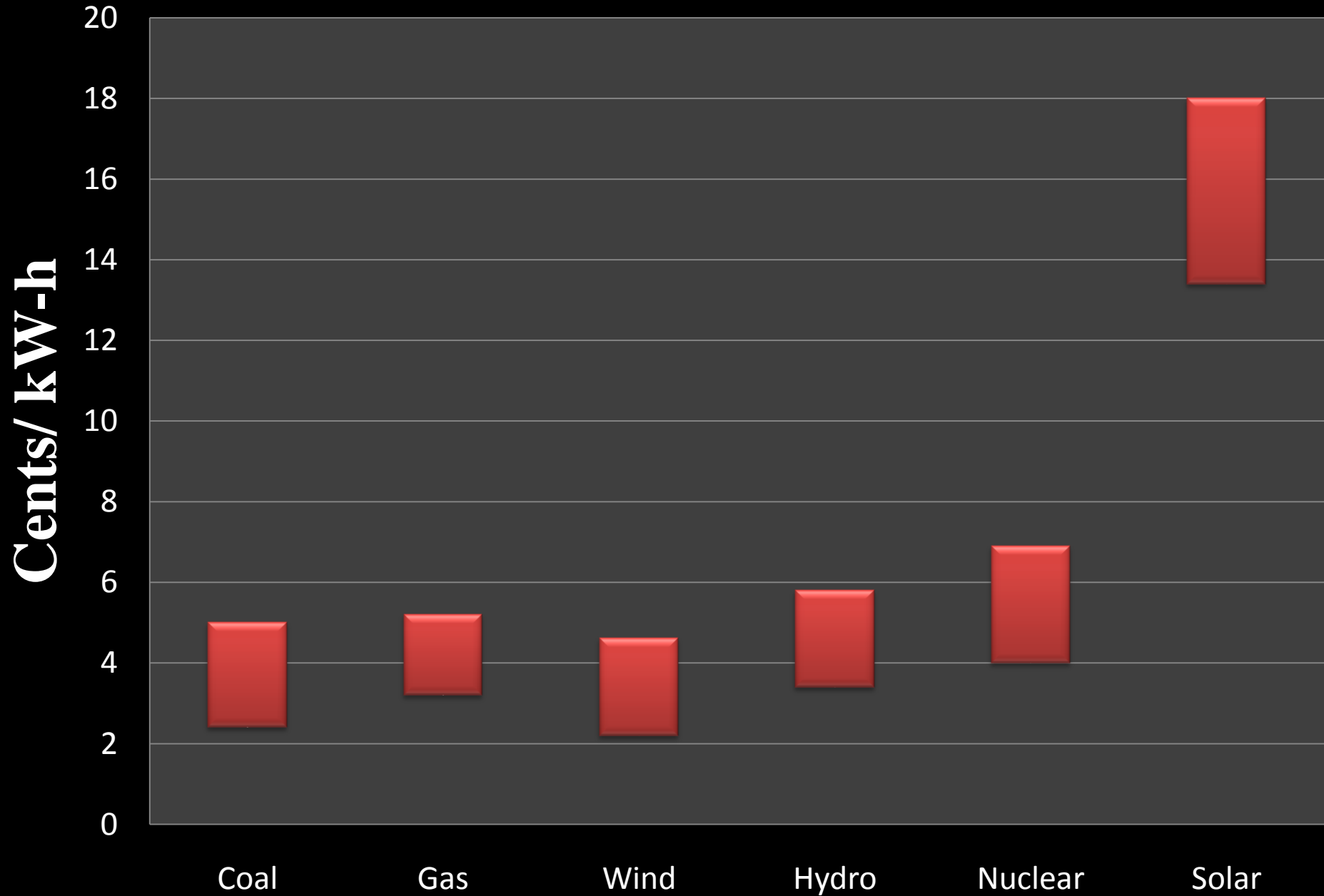
2008:
2.1 – 3.4 cents/kWh

Economic Advantages



- Greater fuel diversity
- No delay in construction
- Low maintenance costs
- Reliable and durable equipment
- Additional income to land owners
- More jobs per unit energy produced
- No hidden costs

Cost Comparision

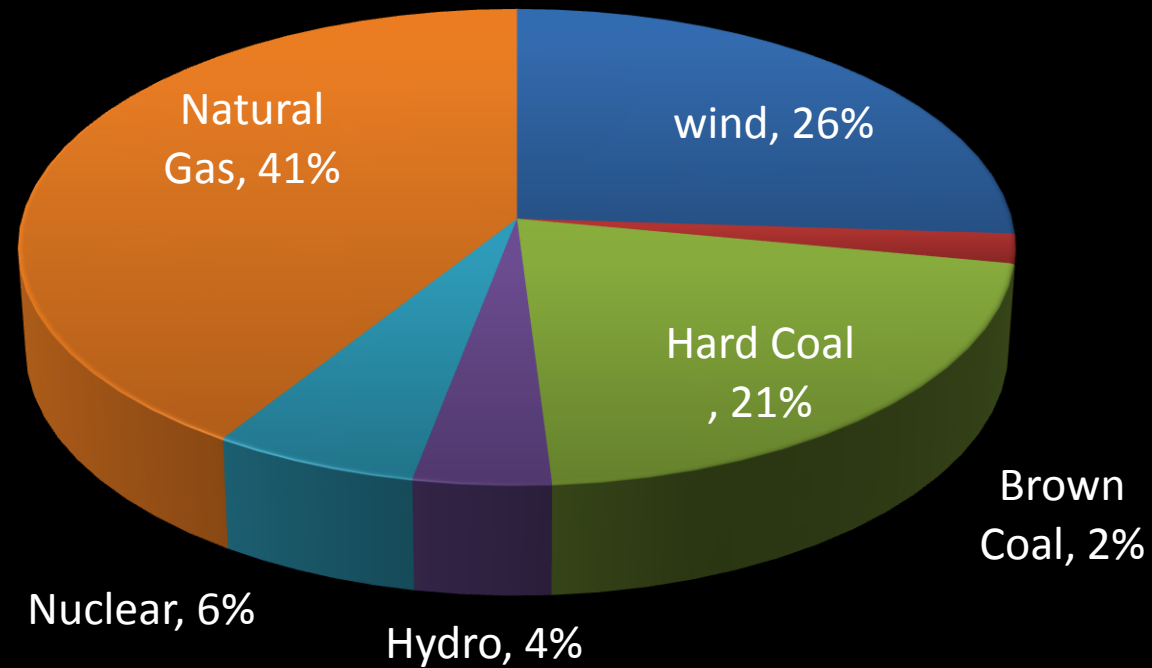


Future



Germany now and 2020

- At present 10% of the country's energy is supplied by wind energy
- By 2020 it is expected to go up to 26%



So.....

- Price of wind power is coming down
- There is enormous capacity
- Energy storage, however, is still a problem

Conclusion



- Wind energy is pollution free and nature friendly
- Wind energy has very good potential and it is the fastest growing energy source
- The future looks bright for wind energy because technology is becoming more advanced and windmills are becoming more efficient

THANK YOU

