Renewable Energy Power System

Ayush Kumar
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Outline

Renewable Energy

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- Power Generating Capacity Response
- Jobs in Renewable Energy
- Downside of Fossil fuels

- **Solar photovoltaic Power system**
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- **Installation of on-grid solar system** and calculations in detail.

- **Wind energy Power system**
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- Why wind Power, Working Principle
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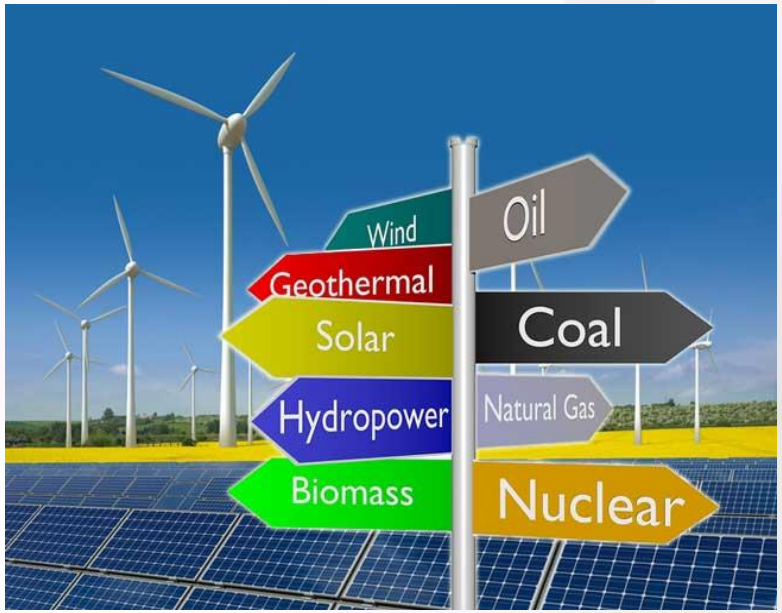
Renewable Energy is the energy that does not get depleted on used. In simple term it is clean energy that comes from the natural source and further used for various purpose**.**

Eg :- Solar energy , Wind Energy, Hydroelectric Power, biomass energy, etc.

It is evident from the fact that renewable energy contributed 18.1 % to our energy consumption and 26% to our electricity generation (2017-18).

Src:wikipedia.

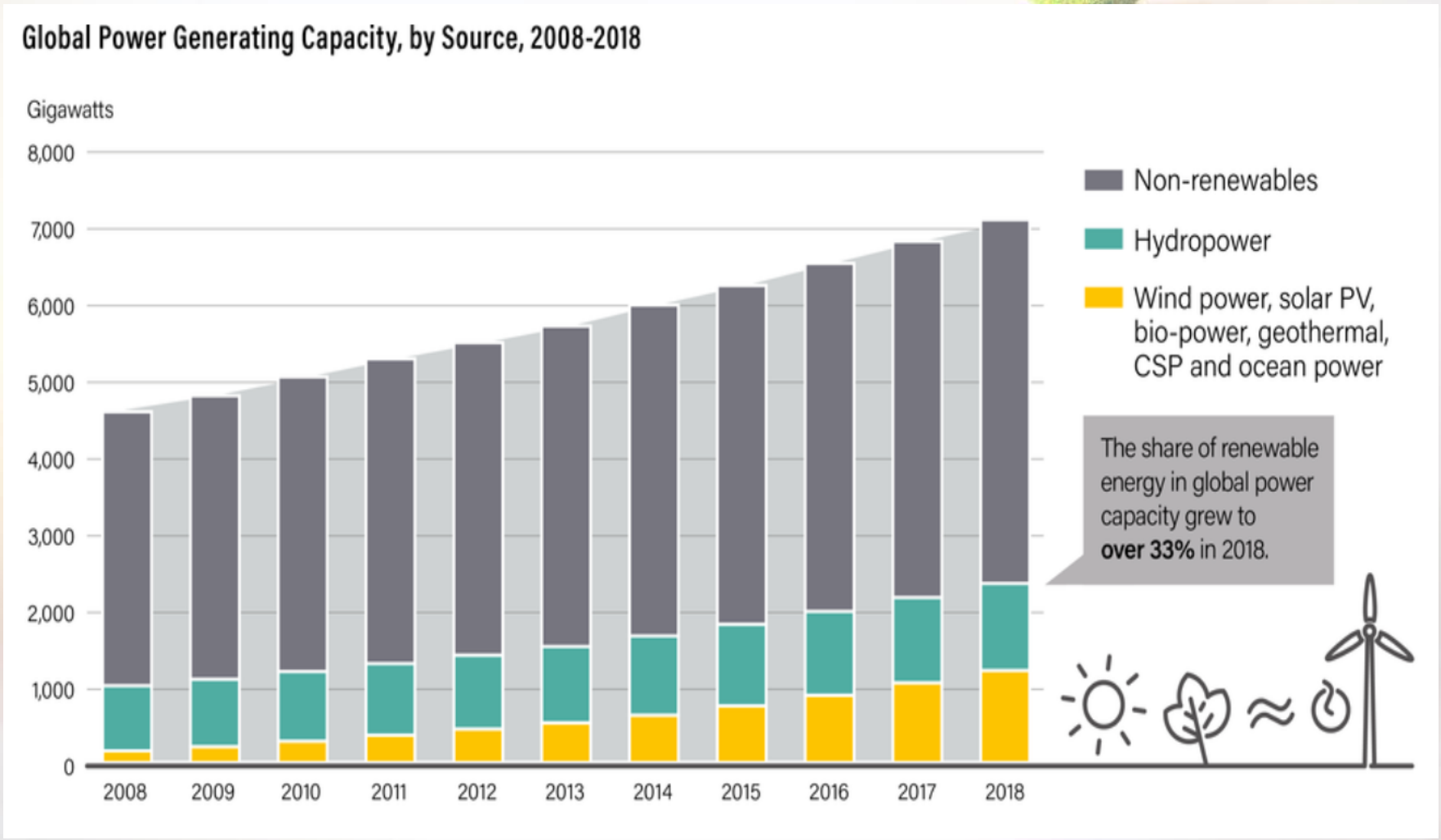


Why Renewable energy?

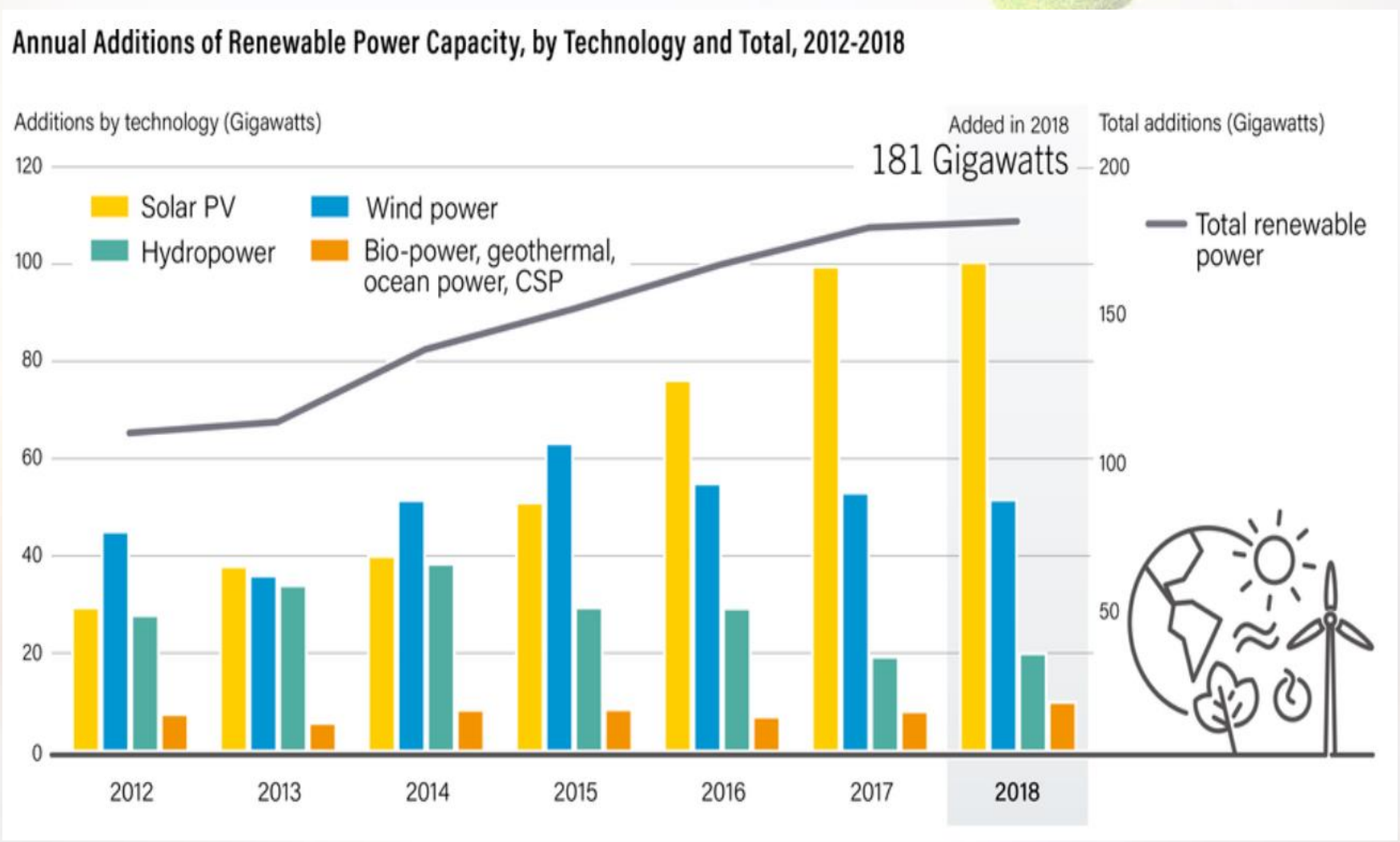
Fossil fuel (Coal ,Oil and Natural Gas) :- Comprises near about 82% of worldwide energy consumption.

We have finite supply of Fossil Fuel and use of fossil fuel produce adverse effect to environment as well as our health

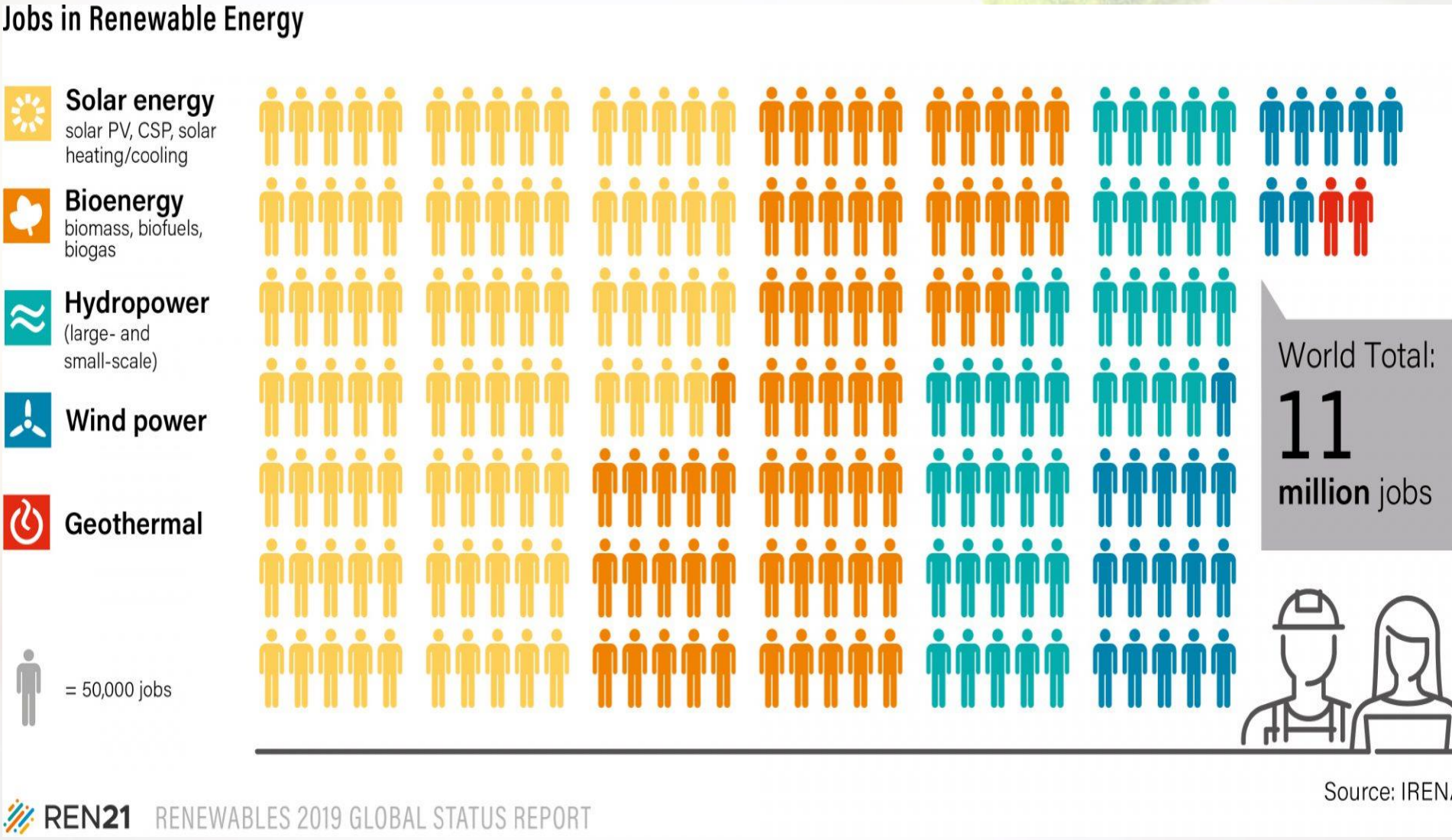
Global composition of installed renewable power capacity



Annual Renewable Power Capacity



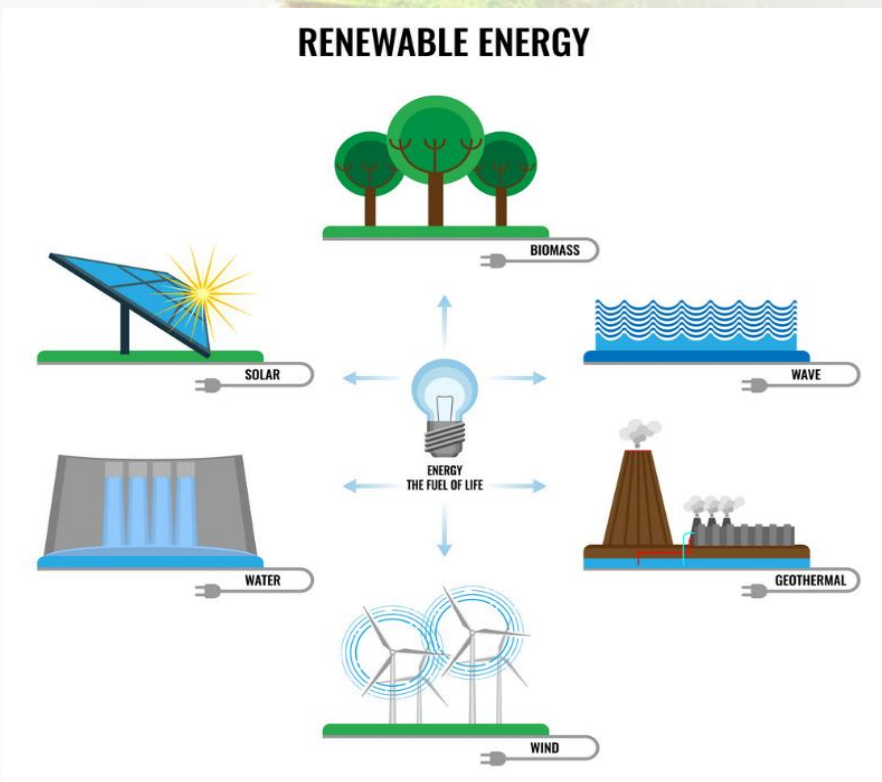
Jobs in Renewable Energy



Some of the downside on use of fossils fuel

- ✓ Carbon Emission
- ✓ Air Pollution
- ✓ Ocean Pollution
- ✓ Adverse effect in natural ecosystem

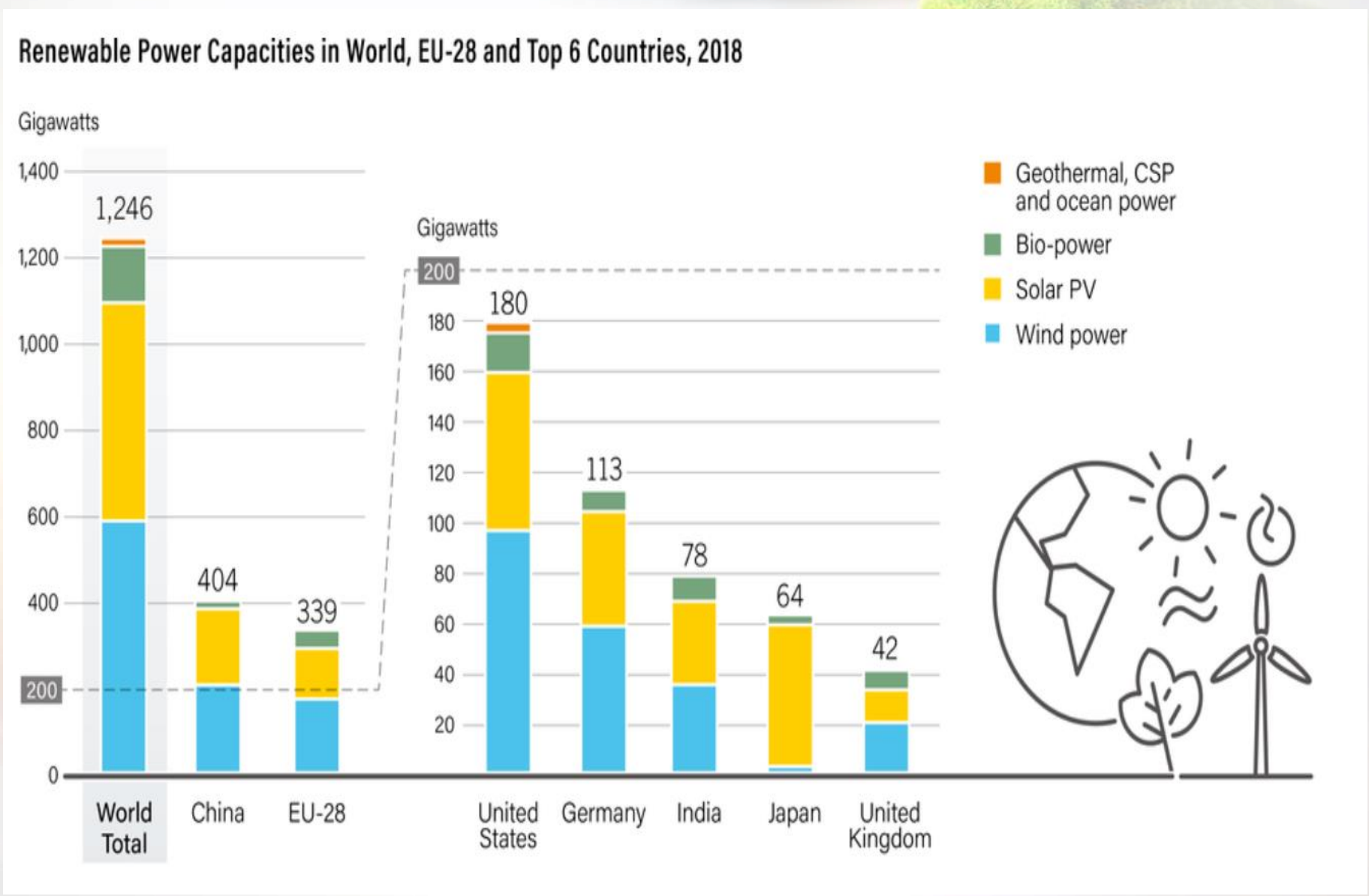
So the alternate source can be **Renewable Energy** (Wind, Solar, Hydro to produce energy)



Src: Wikipedia

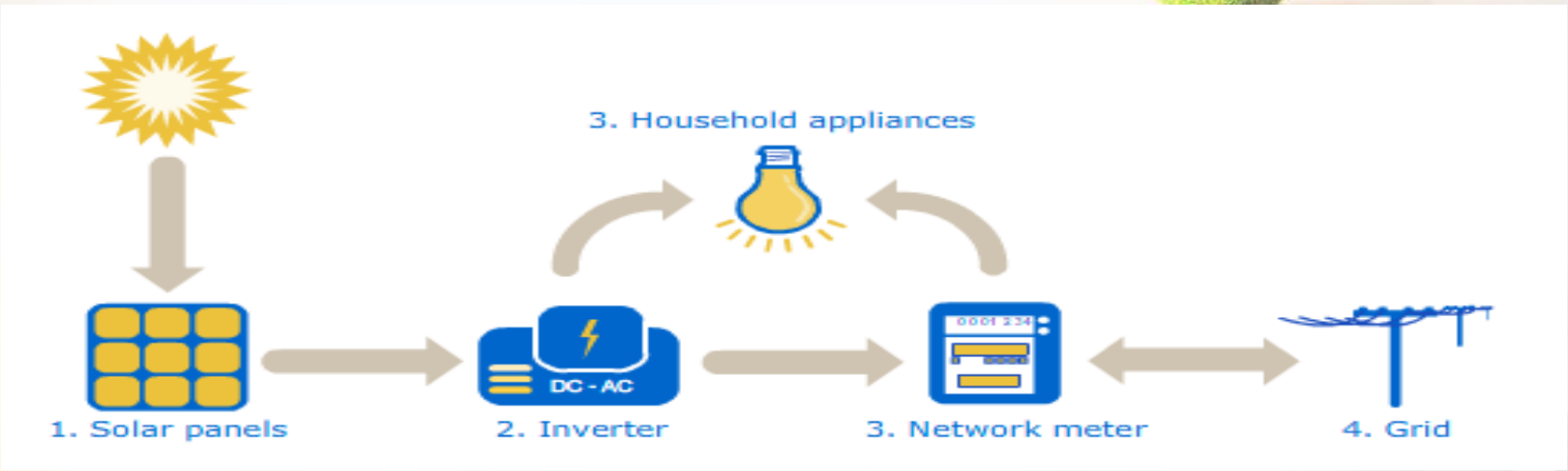
The Earth intercepts a lot of solar power: 173,000 terawatts. That is 10,000 times more power than the planet's population uses. So is it possible that one day the world could be completely dependent on solar energy.

Power Capacities in the World



Solar Photovoltaic Power System

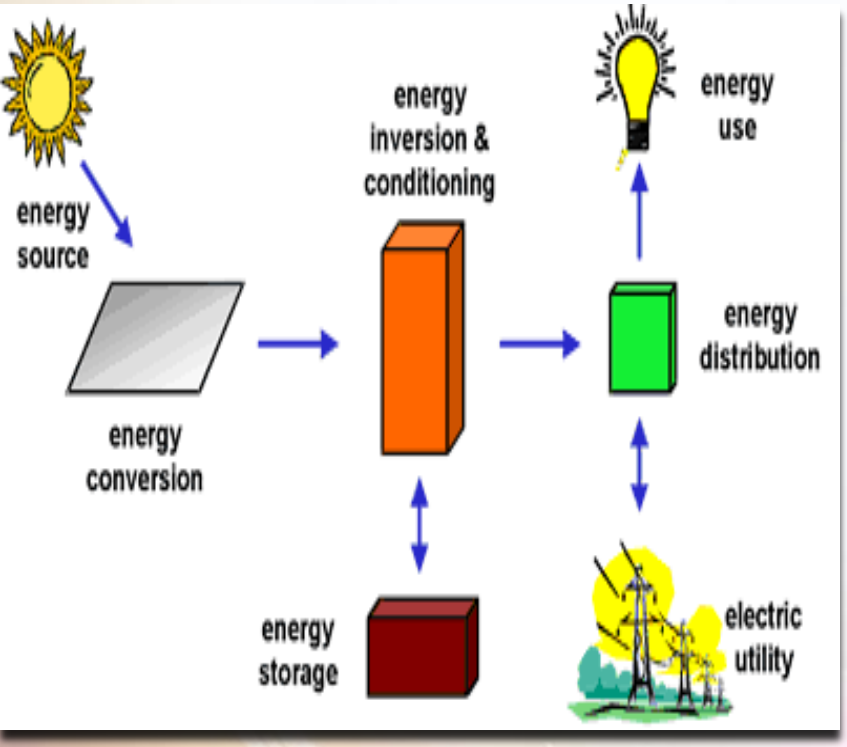
Solar Photo Voltaic System



Solar photovoltaic system convert solar energy to electrical energy.

Basically it composed of one or more solar panels combined with an invertor and some other electrical instrument.

Working Principle



- When the sun light (photons) fall into solar panel. Panel produce small amount of energy.
- And all sum of energy from other panel gives result of higher amount of energy. The electricity we get from solar is of DC type.
- Energy can be converted to AC form as per our requirement
- Energy is stored in battery for later use or to supply it to electrical loads as needed.

Advantages of solar energy:-

- ✓ Free energy in one time investment only
- ✓ Non pollution renewable source
- ✓ Long lasting and little affordable maintainance.
- ✓ When Power consumption is low then power generated from solar system will be fed back to the grid. The state government will give money for sending electricity to gird.
- ✓ Increase economy as per my calculation 5 year payback time and will get free electricity for about near about 20 years

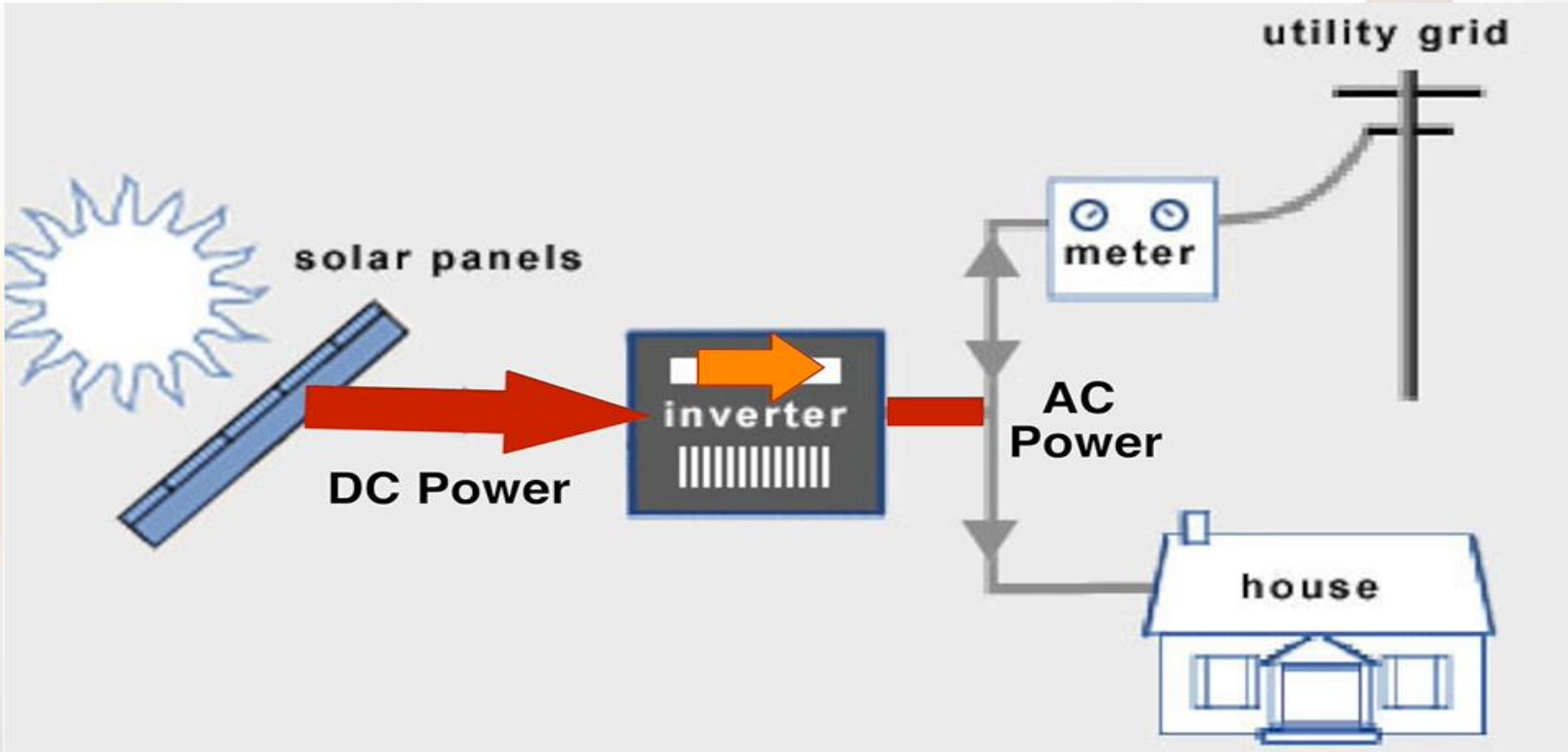
Solar Power in India:-

Seem Fast developing industry in india, Solar installed capacity reached 33.730 GW as of 31 December 2019.
Generation capacity extended 8 times from 2,650 MW on 26 May 2014 to over 20 GW as on 31 January 2018.

Installation of On-grid Solar system:-

Purpose is to install 2 KW solar system to save electricity bill.

Component required:
Panels(absorb electricity), Inverter (which convert DC into AC), Installation Kit, mounting structure(to place panel in one place), grid.



Instatallation of 2kW solar PV System considering average daily power consumption (unit) is 5-10 unit nearly (240 unit per month) @ 6 per unit (Uttar Pradesh).

Solar Rooftop Calculator

Average solar irradiation in **UTTAR PRADESH** state is **1156.39** W / sq.m

1kWp solar rooftop plant will generate on an average over the year **4.6** kWh of electricity per day (considering 5.5 sunshine hours)

1. Size of Power Plant	
Feasible Plant size as per your **Capacity** :	**2**kW
2. Cost of the Plant :	
MNRE current Benchmark Cost :	Rs. **60000** Rs. / kW
Without subsidy (Based on current MNRE benchmark) :	Rs. **120000**
With subsidy **30%** (Based on current MNRE benchmark) :	Rs. **84000**
3. Total Electricity Generation from Solar Plant :	
Annual :	**2760**kWh
Life-Time (25 years):	**69000**kWh
4) Financial Savings :	
a) Tariff @ Rs.6/ kWh (for top slab of traffic) - No increase assumed over 25 years :	
Monthly :	Rs. **1380**
Annually :	Rs. **16560**
Life-Time (25 years) :	Rs. **414000**

Carbon dioxide emissions mitigated is	**57** tonnes.
This installation will be equivalent to planting	**91** Teak trees over the life time. (Data from IISc)

Disclaimer: The calculation is indicative in nature. Generation may vary from location to location.

So from the roof top calculator above:

With subsidy it will cost near **about 84000 Rs**.
Without subsidy **1.2 lakh Rs.**

- ✓ Total electricity generation from solar Plant Annually **:- 2760 kWh.**
- ✓ For life time of 25 years :- **69000 kWh.**
- ✓ Final financial saving we get if we purchase electricity @6/ kWh monthly **1380 Rs** and annually **1380*12=16560 Rs.**

So **conclusion** is that if we switch to Solar PV system in our house, industry or in any work place we can save **huge amount of money** as well as our mother land as process does not produce any type of **pollution or any thing in practice.**

As per our calculator installation of above will equivalent to planting 91 teak tree over the life time.

Wind Energy Power System

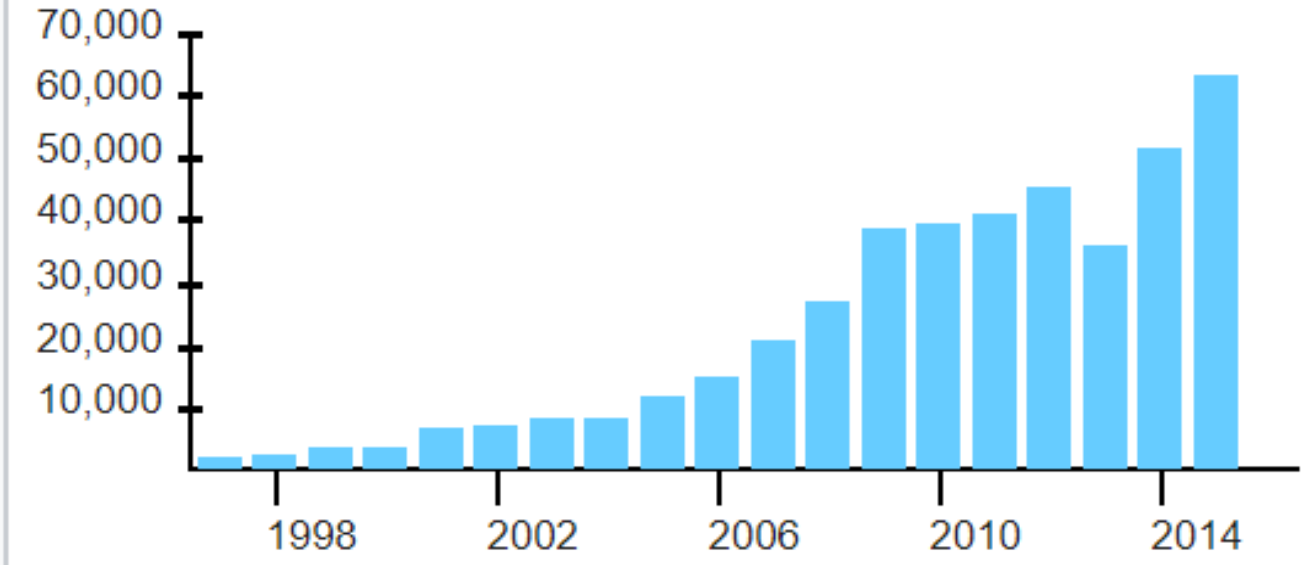
Wind Energy Power System

Basically wind is a formed of energy which is **produced because of uneven heating of the earth by the sun**. Wind **energy is renewable energy** and it help in to keep environment clean

Rough estimate:- Power $\propto V^3$ (wind velocity)
Roughly if we Double the wind speed causes 8 time increase in wind power.

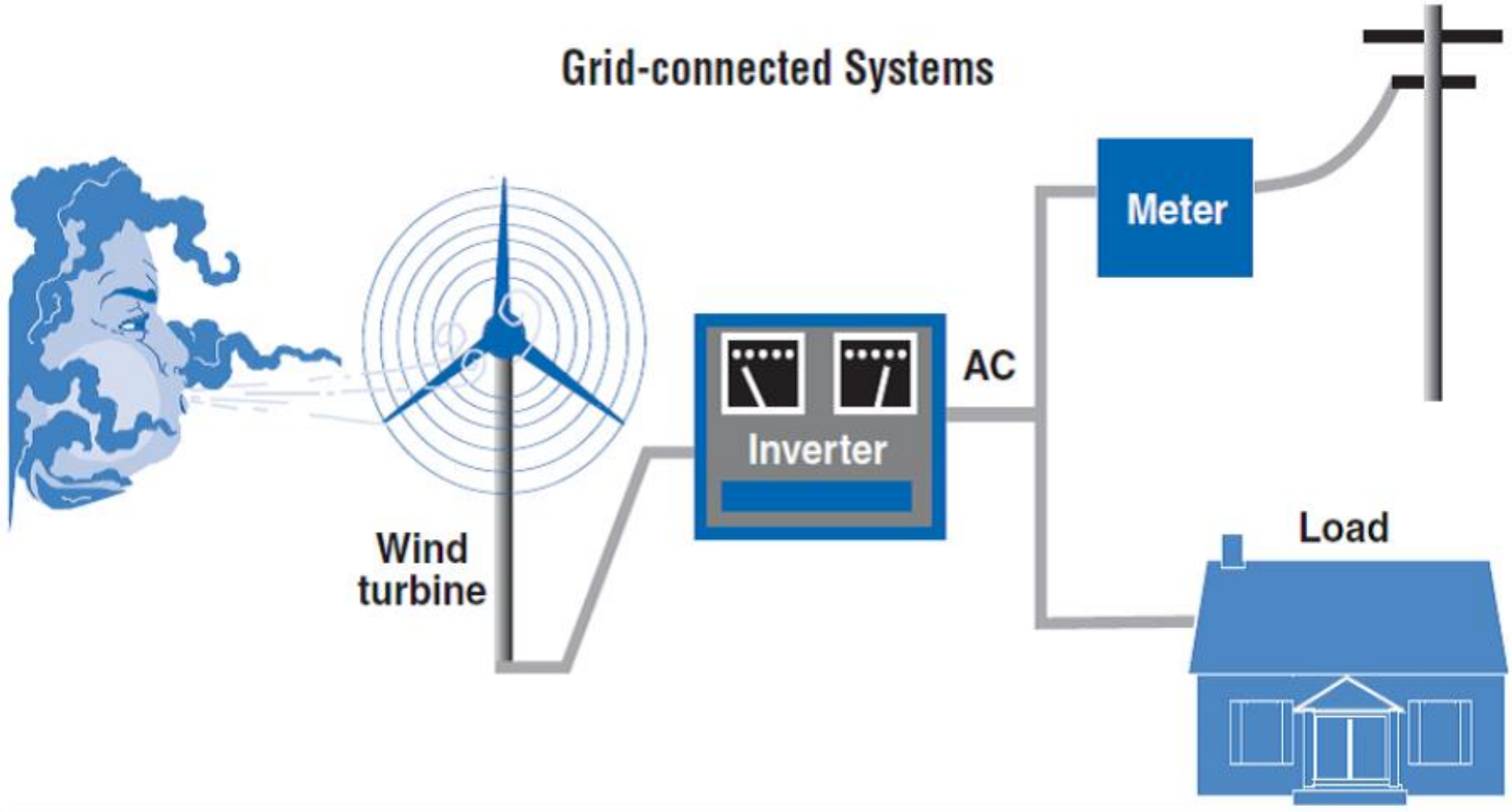
Wind energy can be used for various purpose .

- ✓ Sailing
- ✓ Grinding grain
- ✓ Electric generation



Global annual new installed wind capacity 1997–2015 (in MW)[81]:3

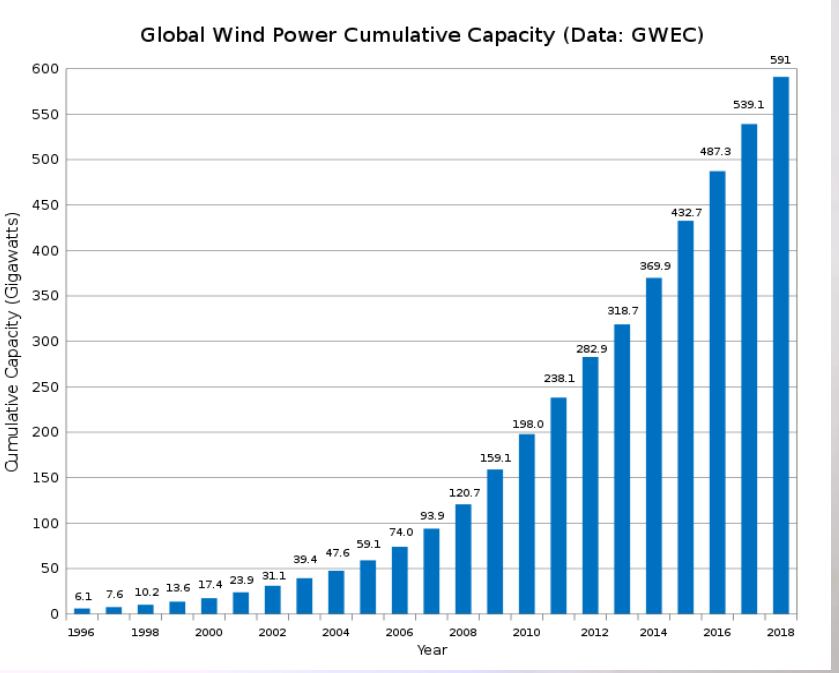
Grid Connected Wind Power System



A grid-connected wind turbine can reduce your consumption of utility-supplied electricity.

Why Wind Power Plant

- ✓ Alternative to fossil fuel : can replace fossil fuel
- ✓ Renewable in nature
- ✓ It Does not emit CO2
- ✓ Consume no water in production of electricity
- ✓ Uses Little lands in installation
- ✓ No or zero effect On environment
- ✓ It is safe energy source existing
- ✓ No need to care about depletion like fossil fuel as discussed before.
- ✓ Wind power is cost-effective:- lowest-priced energy sources available today.



Working Principle of wind Power plant:

Wind Power plant convert **wind energy into electrical energy** and is done by the wind turbine of a wind power plant turbine uses wind and generate electricity.
The **HUB or Blades called turbine/rotor**.

Behind the turbine there is engine house called **Nacelle.** The **nacelle** is mounded on the tower in order to get more wind energy, the wind will cause the blade to rotate due to this rotor start moving. And the rotor is connected to main shaft.

It spin the generator through which electricity is produced .
This electricity can **be transfer in transmission and distribution line to Homes, Industry, Hospitals etc.**

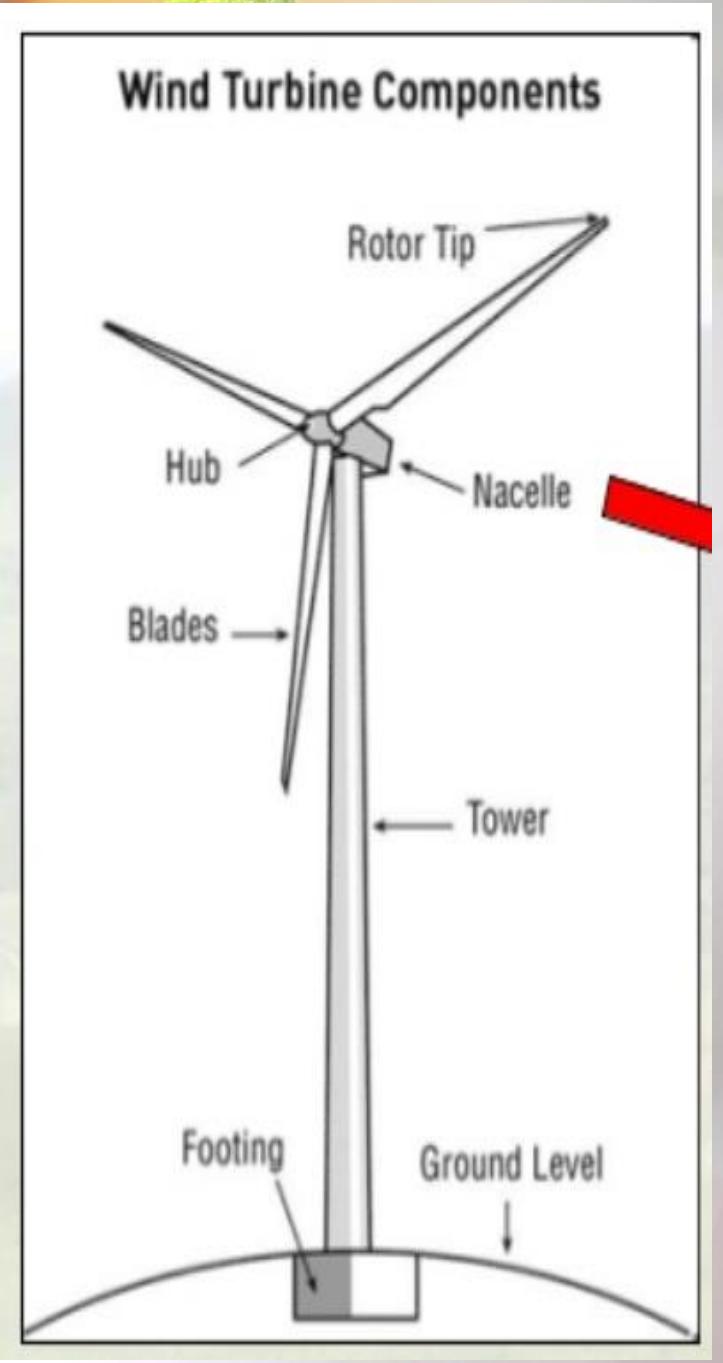
Part Of Wind Turbine

Blades:- Wind Power plant consist of 2-3 Blades. The wind will cause the blade to rotate the generator.

Shaft:- the hub is mounted in the main shaft. The rotation of blade cause the shaft to rotate. If the wind blows very fast then brakes can be applied to controlled the speed of blades and shaft.

Gear box:- used to increase the output speed.

Generator:- high speed shaft is connected to generator because of this generator rotate and electricity is produced.
This electricity can be stored in battery and can be used when ever is necessary



Wind Farms

Economic Of Wind Energy

Wind power has reached grid parity around the world (during 2005 – 2015).

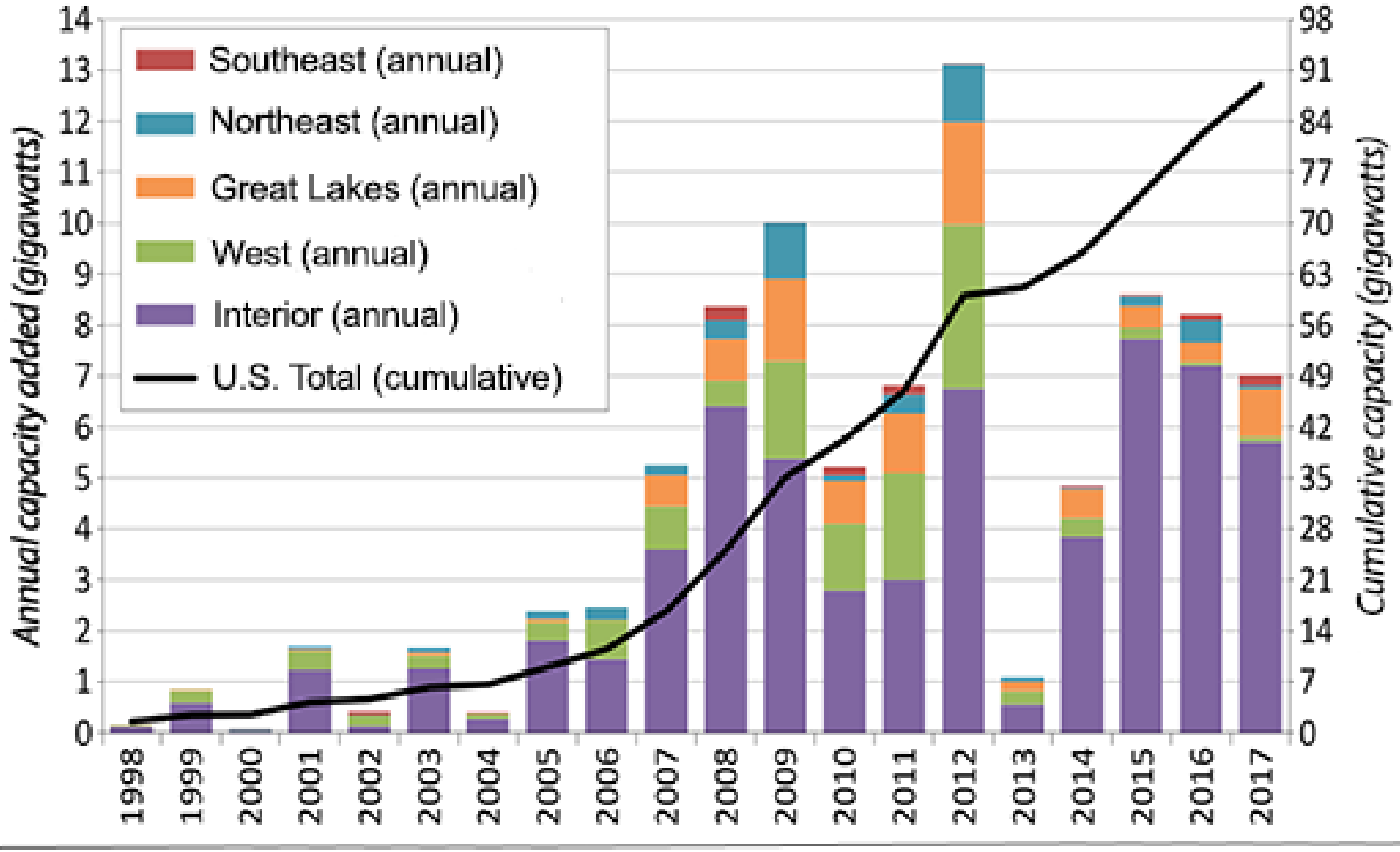
Wind power is capital intensive but has no fuel cost.

Marginal cost of wind power is little high.

Average cost is more as it will include the cost of construction of wind turbine and also transmission system.

U.S. WIND POWER CAPACITY

Annual additions by region and nationwide cumulative growth, in gigawatts



SOURCE: U.S. Office of Energy Efficiency and Renewable Energy

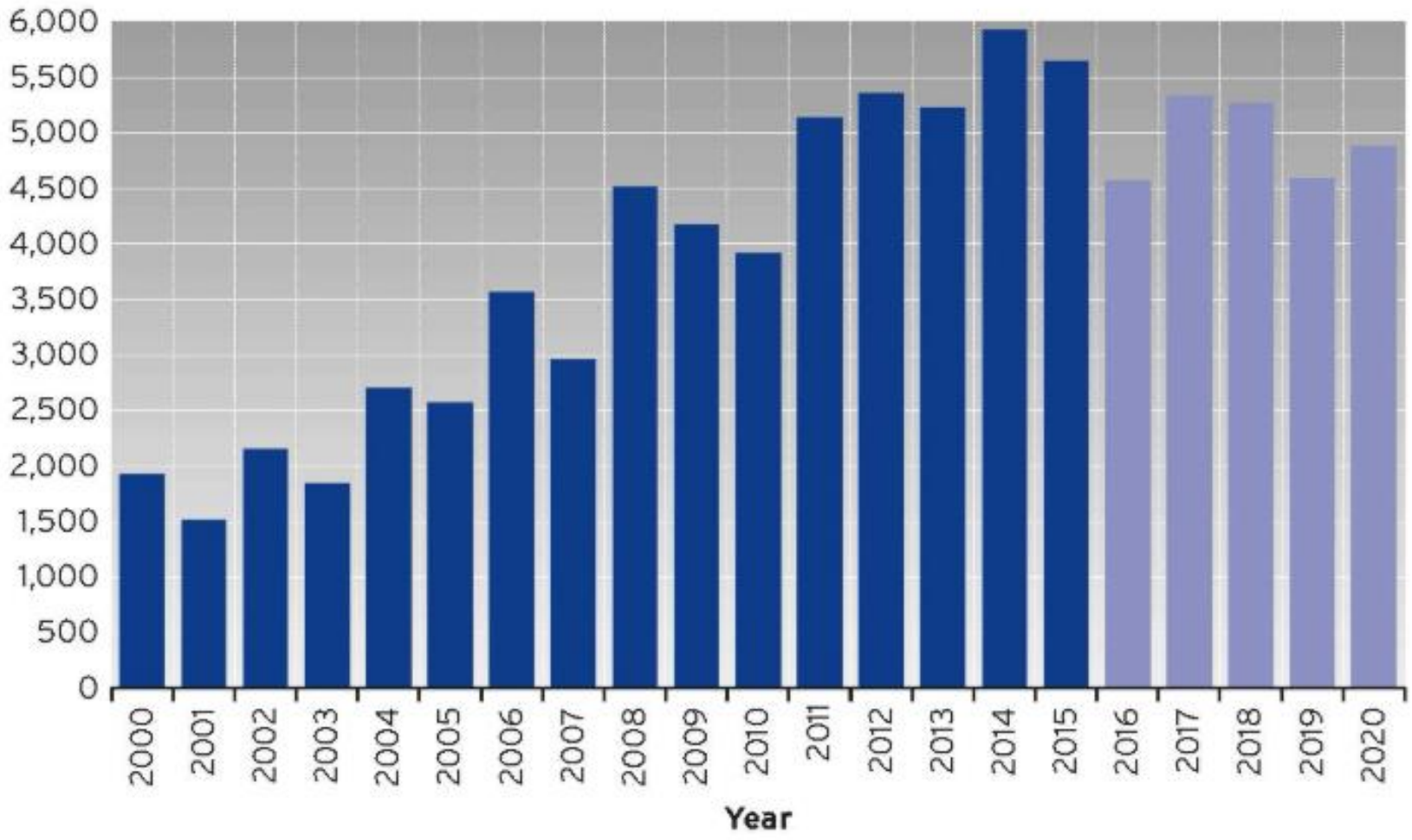
Wind Power scenario in India

- ✓ It is evident from the fact that **more than 90 percent** investments in the wind power sector come **from private sector** which indicates that we have adequate capacity and desire to harness wind energy
- ✓ The total installed capacity of wind power in **India as on 31st March 2012 was 17,351.60 MW,** which **is 8.7 per cent** of the total installed capacity in India.
- ✓ India **stands fifth in terms of total wind power** installed capacity worldwide
- ✓ A cumulative **total of 119.5 billion** units of electricity have been fed into the state electricity grids up to **31st March, 2012**
- ✓ The wind power generation capacity in India is **49,130 MW** as per the official estimates in **the Indian Wind Atlas (2010)** by the Centre for **Wind Energy Technology (C-WET)**

OFFSHORE INSTALLED COSTS FALL FROM PEAK IN 2014

Installed costs for offshore wind (year-by-year capacity-weighted average)

Source: NREL



Wind turbine roughly Installation cost:

In home or form scale wind turbine

Under 100 kW cost roughly $3000 to $8000 per kW of capacity. And installation cost of 10 kW machine is roughly $50000-80000.

Calculation of energy our system will generate:-

Relation between power and wind speed

Power = Cp*½*ρ*A*v^3

Where,

P= Power output

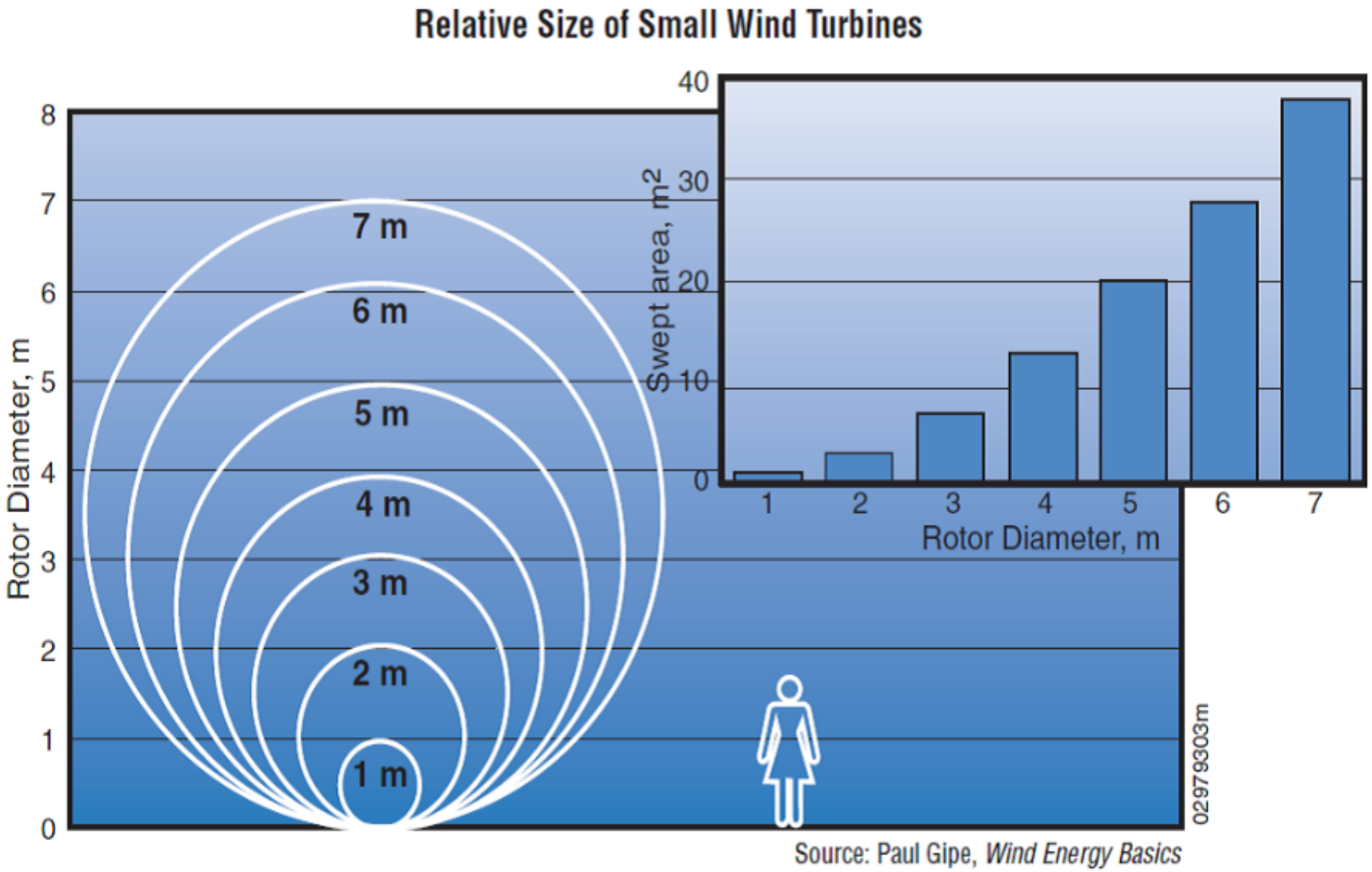
Cp = power coefficient

$\rho = 1.225\ kg/m3$

A = rotor swept area

V = wind speed

How Much Energy Will My System Generate?



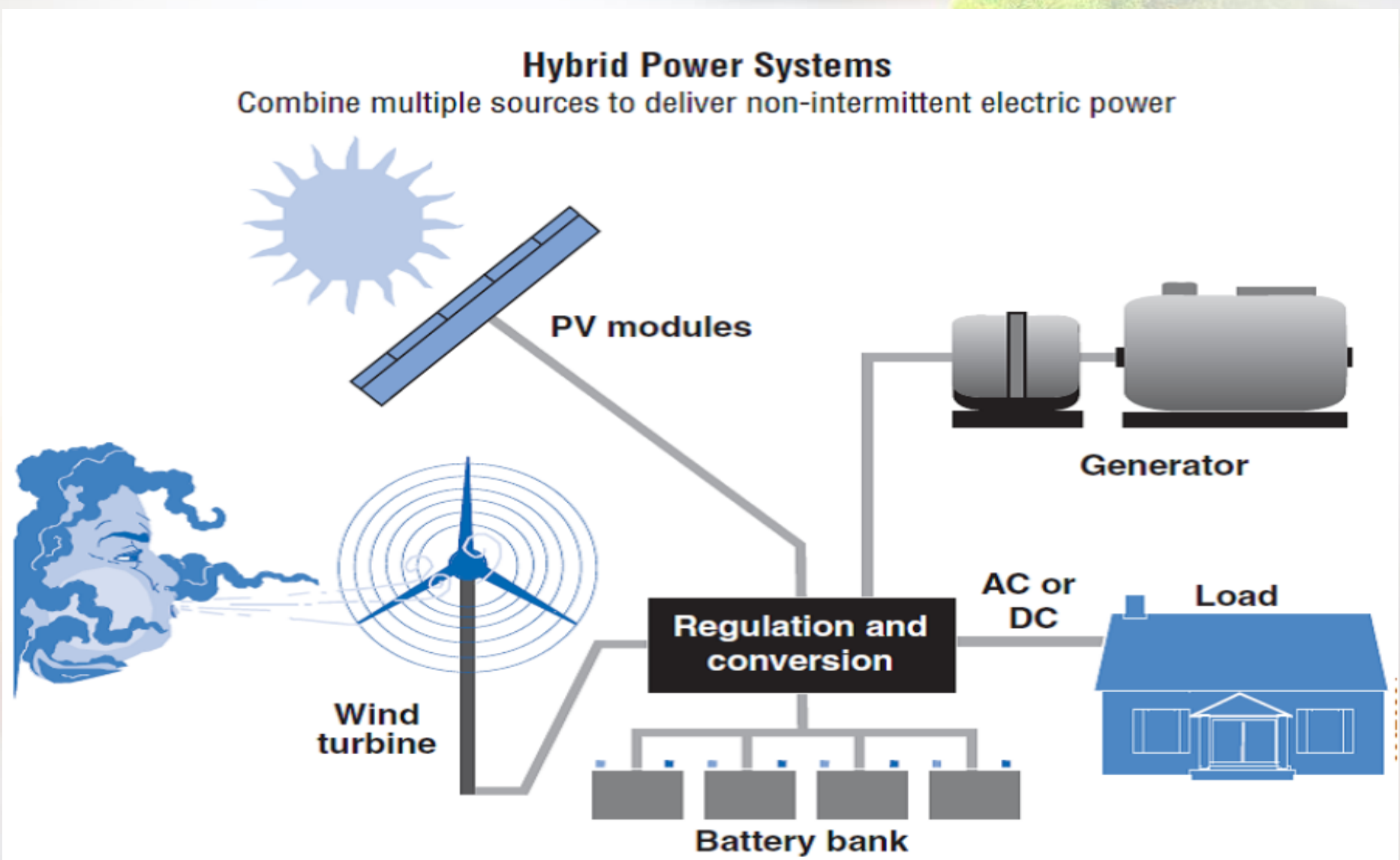
Hybrid system:-

The idea is to connect both wind turbine system and photovoltaic solar technologies together.

Advantages:-

- ✓ Off- grid power for homes, farms etc.
- ✓ Many time we see, basically **in Summer**, wind speed slows down when sun shines brighter as well as **in Winter season** wind speed goes strong when less sunlight available so this will good idea to implement **both Wind as well as Solar PV System** in the same grid and use it conveniently in order to get more benefit from it**.**

Hybrid Power Systems



A hybrid system that combines a wind system with a solar and/or diesel generator can provide reliable off-grid

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