11/09/23

MT-2

Solar DV (Photovoltaic).

Solar DV

Solar Energy → Electricity (DC) of low values

1 module = n × n cells

Array

Solar

One sun one world one Grid (OSOWOG). 49.5Hz to 50.2Hz.

* Earlier we used to have 4 grids in India, but now we have 1 grid in Delhi.

If we are not able to supply 24×7, we need to give highest extent of electricity. Eg 20hrs.

While landline power station used to charge but now, every house requires electricity. 50% dependency should be reduced to 20-30% on fossil fuels & Target by government

conventional energy resources.

Govt. Initiatives & Govt. Data (2014)

Subsidies are given by government.

Solar plants in Delhi are bidirectional, (no need it can charge from main, if there is a sunny day extra energy goes to main, which goes to electricity board/grid (later govt. pays for it).

Globally, India stands at 4th position in wind power & Solar power (Dec 2022 data).

• In 2014 to Dec 2022 :

1) All renewable energy sources, 76.37 GW to 167.75 GW.
(almost double) rate at which govt. is expanding use of RE sources.

2) Solar energy is 24 times (2.63 GW to 63.30 GW).

3) 134.77 GW power from solar plant only. (out of 167.75 GW total energy)

PM Kishan Urja Shiksa UM Yojna ⟹ 88.45 GW capacity of solar plants were installed. } component A
1.81 lakh,
↳ Subsidized solar panel are given to farmer (independent of grid).
5-10 HP 1 pump each farmer.
Component B } 1174 pumps are reported for connected to grid.

Rooftop solar plant Phase 2 ⟹ Till dec 2022, out of 4 GW, they've achieved 1.64 GW (government just provided subsidies), its your own wish

Grid connected rooftop solar plant 7.6 KW.

The gov. has selected states & places name through projects, target is to achieve 39.28 GW. Highest producer of solar energy ⟶ Rajasthan
Gujrat.

State wise energy production : —

~~142 GW~~ (Rajasthan)
142.31 GW

111.05 GW (J&K).

22.83 GW (UP) } Potential is 1/7 th as compared to Rajasthan.
16 GW (Uttarakhand)

8,500 MW (Gujrat), 16,340 MW (Rajasthan), Karnataka, TN, Telangana, ~~Rajasthan~~ Maharashtra, AP, UP

10 UP
14 Uttarakhand.

Projected solar installation will not be achieved in UK.

By 2022-2023, 1500 MW target

Solar Parks — major states UP (7) Mirzapur biggest solar park proposed 100 MW gen. 65 MW
(57)

Maharastra (2)
Mizoram (1)

In gas stoves, solar power ones, they gives us battery life of 10 years.

Konark Sun Temple Carea selected for solar power generation)

E-rickshaw (not feasible as 2KW is required & converter is 100W)
↳ can be charged by mains only

off grid comp. → 50 no. of solar tree in konark city + 200 solar lights
on grid comp

Problems → Thiefs may stole it (mounted at a particular heights) 1 lakh cost of light

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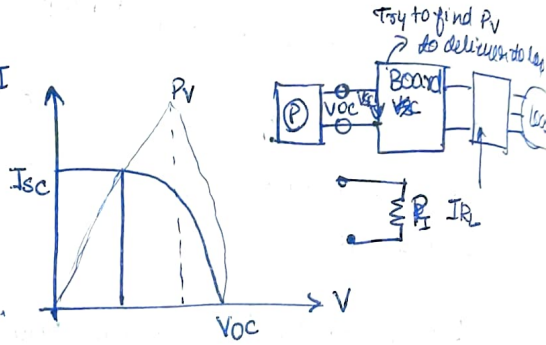
Solar Photovoltaic

Large jump to solar energy. After installation, solar panels require minimum maintainance. Solar PV cells (more than 20 years).

Solar cell concept came 1954, used for satellite communication only. In 1973, people starting using solar panel as their lifeline i.e started using for commercial purposes.

Profile of solar cell / solar panel



We can improve the efficiency of solar panel by altering the voltage.

Power output is load dependent.

Voltage more current more overall power is more.

Efficiency of solar panels are 10 - 20 % for commercial use.

For higher efficiency, it will be higher cost, so higher efficiency solar panels are not available.

For 1 day, $1 m^2$, solar panel (consistently getting irradiance) will produce 1 unit of energy.

1.5 Kwh

The size constraint in the panel is the main issue

$1 m^2$ .5V of potential difference & 200A of current.

No mechanical part, so it's portable. Wherever load requirement is there, they can be placed there only.

Major uses of solar panels

- Space satellite
- Remote Radio Communication Booster station eg. Ladakh's some places where electricity isn't available.
- Marine warning light (recently)
- Lighting
- water pumping
- Solar powered vehicle
- Battery charging Eg. Small solar panel installed in calculator.

=> Solar panel can extract power from any source exe except sun.

Major advantages of Solar PV systems over conventional sources.

1) Converts solar → electrical @ directly without going through thermal mechanical link.
2) They are reliable, modular (fix them depending on the space), durable & generally maintainance free.
3) These systems are quite compatible with almost all environments, respond instantaneously to solar radiation & have expected lifespan of 20 years or more. (no time warning req).
4) It can be located at the place of use and hence no or minimum distribution is required as available everywhere.

High altitude P↓ power production by diesel engines decreases but their efficiency is not being affected.

Disadvantages

1) At present, the cost of solar cells are high making them economically uncompetitive with other conventional power sources. Infrastructure should also be available. Shopkeepers prefer HONDA (petrol based generator) bic it's economically feasible than solar panel
2) The efficiency of solar cells is low as solar radiation density is also low. Large area of solar cell modules are required to generate sufficient useful power.
3) cloud diffused rays, rainy less power, in evening & night no radiant is available, so less power is produced.

As solar @ is intermittent, some kind of electrical @ storage is required to ensure the availability of power in absence of sun, makes the system more expensive

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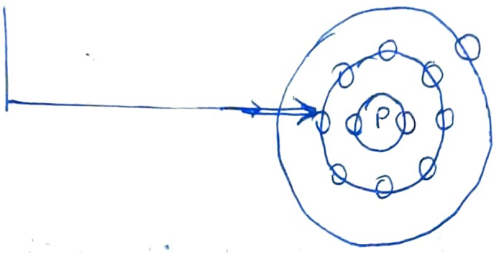
- Conductors → ⓔ (1-3) valence bond → Smooth conduction of current
- Semiconductors → ④ eg. Silicon & Germany → we want free e^-'s
- Insulators → ⑧ → no conduction

1) provide temperature
bond breaks & e^- moves to the conduction band
eg. Si



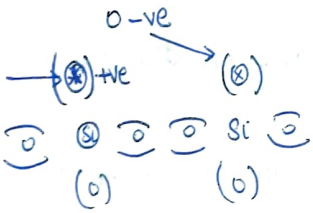
Pure only Si

→ 1 photon ⓔ to leave valence band

PV cells got P & N junction
(we use Si in it).

At absolute 0 temp, Si acts as an insulator.

Photon bombarding is required for the movement of e^-'s in Si

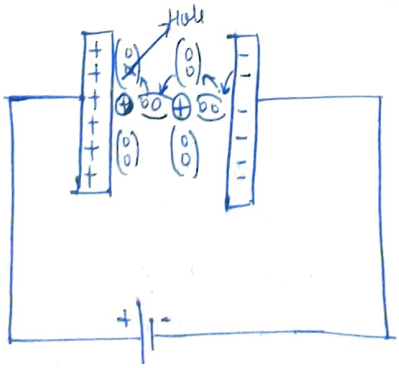


Recombination of e^-'s in the Si
mov. from V to C & recomb.
Bond break to recombination => Time taken in the process <= Life time of Si crystal

- At any instant, following conditions exists in Si:—

1) Some free e^-'s holes are created.
2) " " " " being recombined
3) " " " & holes exists temporarily awaiting recombination.

Sub



Because of natural phenomena, we got a hole created & we apply voltage
e^- vacancy all over & finally e^- from -ve plate shifts

Electron movement from one side to other side of the battery.
Create a current flow in the material

Holes creation is the reason of current flow.

- Pure Si → intrinsic material
- Pure Si + impurity ⟹ extrinsic "

Either create holes or free e^-'s in Si for current conduction.

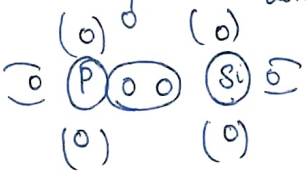
⇓ How?

- Pentavalent material } Arsenic, Antimony, Phosphorus
- Trivalent material } Al, Ga, In

We add pentavalent / trivalent material into the pure Si material ⇒ Doping

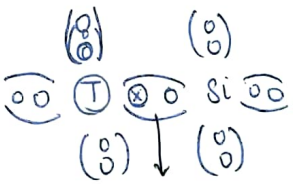
donor (providing 1 free e^-'s like a conductor)

(1)



- More is the doping, more is the contribution of current.

(2)



hole creation ⇒ mov. of e^-'s

less resistance offered by material in case (1) too.

Auxillary bond formation

Energy band in

Sub When adding trivalent, how holes are being created & similarly for pentavalent?

Sub Formation of energy gap