

TARGET MAINS 2022

CURRENT AFFAIRS

SCIENCE AND TECHNOLOGY-1

COP
26

- Panchamrit Goals:
 - Net-zero by 2070
 - Mission 500 GW (RE)
 - 50% from RE by 2030
 - Reducing carbon intensity by 45%
 - Carbon emissions by 1 billion tonnes CO₂

1.5°C

Panel formed to prepare energy transition roadmap for India

By Urmi Goswami & Sanjeev Choudhary, ET Bureau • Last Updated: Dec 31, 2021, 06:23 AM IST

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India targets 85% of energy needs from green sources

Union Budget 2022-23 provides roadmap for clean energy and climate mitigation – a development priority for the next 25 years

(Ministry of Environment, Forests and Climate Change
&
Ministry of New and Renewable Energy)

February 25, 2022

- Short and Medium term
 - Electricity
 - Coal gasification
 - Transportation
 - Methanol and Ethanol Blending
- Long-term: Renewables with hydrogen
 - Replace electricity with hydrogen as energy carrier
 - Electric vehicles
 - 2 and 4 wheeler: Fuel cell
 - Public transport: Hydrogen-run IC engines

47%

Topics in news

Theme	Topic in news
Coal conversion	<ol style="list-style-type: none"> 1. National Coal Gasification Mission 2. Methanol blending 3. Biomass co-firing
Hydrogen Economy	<ol style="list-style-type: none"> 1. National Green Hydrogen Mission
Electric Vehicles	Issues - 2030
Battery technology	<ol style="list-style-type: none"> 1. Li-ion batteries: Opportunities and Challenges 2. Grid-scale batteries 3. Batteries v/s Fuel Cells

Theme	Topic in news
Renewables: Solar energy	Solar farms PM-KUSUM, Solar Rooftop Scheme
Biofuels	<ol style="list-style-type: none"> 1. Compressed Biogas 2. 4th Generation biofuels 3. Ethanol blending: 20% by 2025

INDIA
33-35%

2030

Carbon capture and coal gasification can be a game changer for India

Gasification with CCUS needs to be engineered and applied in a way which preserves the economics, growth, quality, and scale of operation of the industrial economy

Atanu Mukherjee • Mar 12, 2019, 03.24 PM IST

India to divert 100mn t coal to gasification projects

Published date: 01 September 2020 India is aiming to convert 100mn t of thermal coal into synthetic natural gas and chemical products in the coming decade, as part of its broader push to promote cleaner sources of energy.

Share:



Coal India to set up new Rs 5,800-cr coal gasification project in Bengal

By: FE Bureau | September 1, 2020 9:16 AM

Coal ministry to focus on coal gasification to produce methanol, fertilisers over 3 years

During the gasification process, oxygen and water molecules oxidize the coal and produce syngas - a gaseous mixture of carbon dioxide (CO₂), carbon monoxide (CO), water vapour (H₂O), and molecular hydrogen (H₂)

Anshul Joshi • ETEnergyWorld • Updated: March 11, 2020, 11:22 IST

47%
300 billion } 5th largest
largest

Govt to Issue a Policy on Methanol Use as Alternative Fuel Soon

E-methanol, which is made from captured carbon dioxide and green hydrogen, is another method of producing methanol. Because of its abundant reserves, methanol derived from coal is the most economically viable option for India, according to the NITI-Aayog.

Shivam Dwivedi Updated 19 June, 2022 12:15 PM IST



Practice Questions

- What are the different coal conversion technologies? Describe briefly coal-to-products obtained from different coal conversion technologies.
- What is coal gasification? What are the advantages?
- A push for Methanol Economy is said to make India self-reliant for its energy needs. Comment

gas
liquide



Burning of Coal

Coal

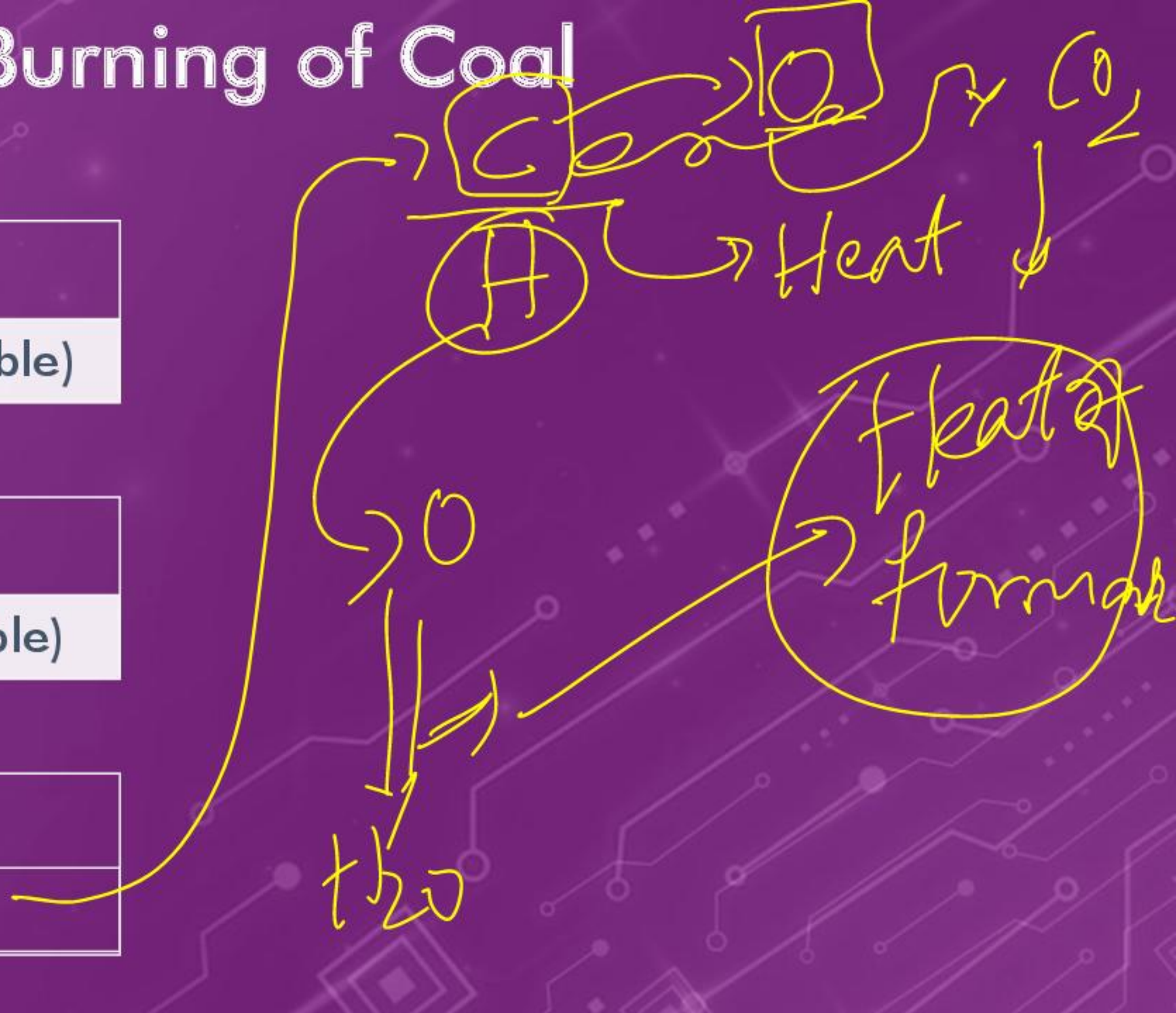
Moisture (non-combustible)

Dried Coal

Volatiles (non-combustible)

Fixed Carbon

Carbon, Hydrogen,
Oxygen (combustible)



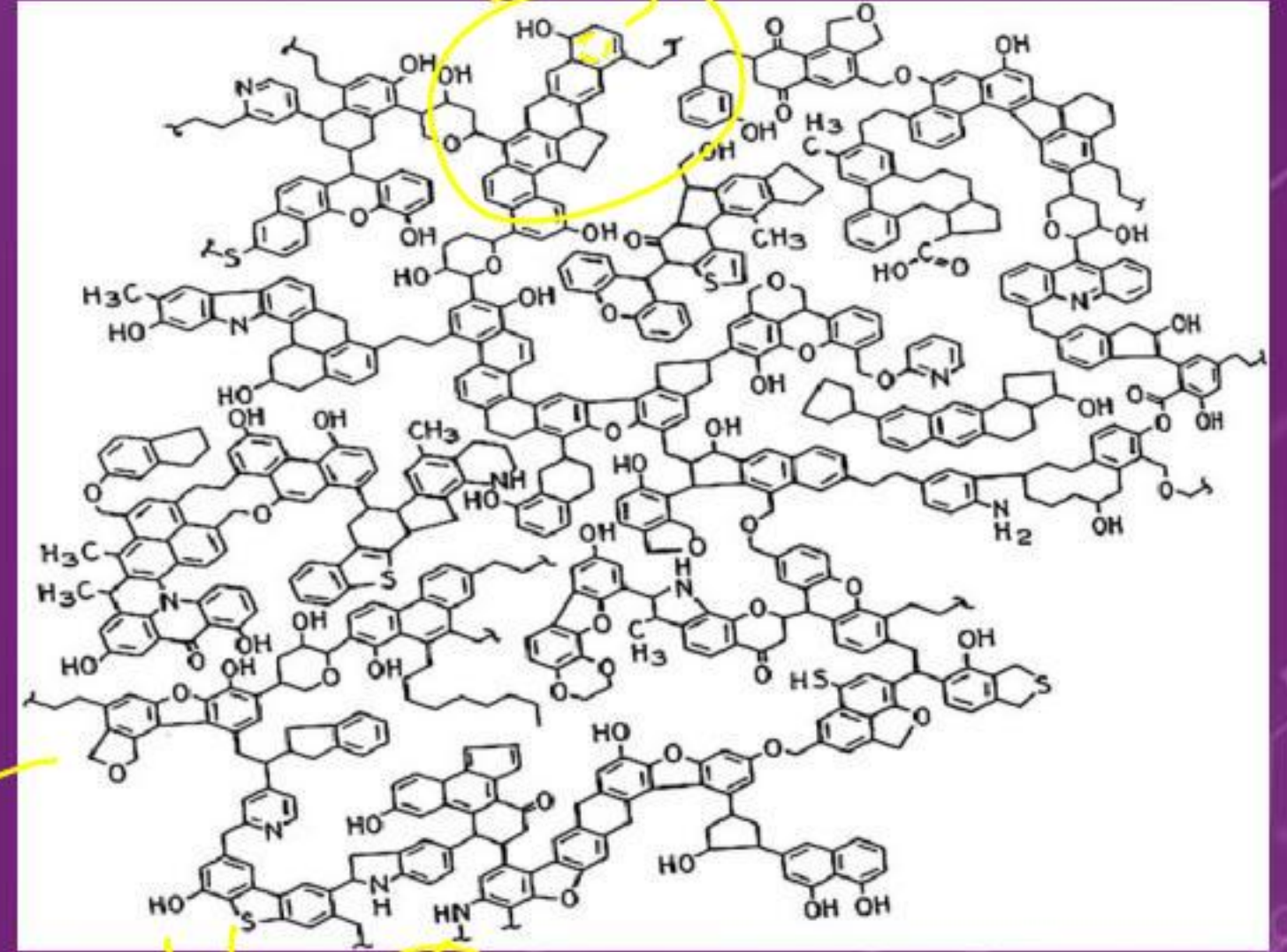
Gasification

- Convert combustible solid into combustible gases.
- Advantage
 - Solid waste is reduced
 - Gas-based plants release half of CO₂ compared to coal-based plants

Liquefaction

- Add hydrogen to get Methanol
- Advantage
 - Higher heating value
 - Fly-ash reduced
 - Can be made from low-quality coal

Coal Conversion



Coal Conversions

Gasification

Burn coal with air----> CO₂

Burn Coal with controlled oxygen ----> CO

Burn Coal with Steam: ----> Syngas
(carbon monoxide + hydrogen)

Hydrogasification(Add hydrogen get Methane)

Liquefaction

Add hydrogen at suitable pressure and temperature : Methanol

Hydrogen

IC-engine

15%

20%

85%

Coal-to-products

Process	Product	Advantages
Gasification	Producer gas Syn gas Methane Blue Hydrogen	Low carbon emissions Low SO _x and NO _x emissions No solid residues
Liquefaction	Methanol	Higher heating value No solid residues Hydrogen carrier Can be made from low quality coal

- Post-combustion
- Pre-combustion
- Oxy-fuel combustion

Indian prime minister announces National Hydrogen Mission

Indian Prime Minister Narendra Modi said green hydrogen will play a significant role in achieving India's decarbonization goals. He also announced the nation's ambitions to become a global hub for green hydrogen production and export.

Draft of National Green Hydrogen Mission under inter-ministerial consultations

The mission envisages commercial production of green hydrogen production in the nation from the financial year 2025-26 onwards.

DECEMBER 17, 2021 **UMA GUPTA**

Running cars on hydrogen: A look at India's National Hydrogen Mission

India has announced a National Hydrogen Mission that will draw up a roadmap for using hydrogen as an energy source. The initiative has the potential of transforming transportation.

Relevance

India, Germany ink pact on green hydrogen during Modi's Berlin visit

U.S.-India Hydrogen Task Force Hosts Industry Roundtable on the Role of Hydrogen in Energy Transition

Indigenous Push To Green Hydrogen:
Oil India Limited Commissions Pilot
Plant In Assam

Oil India Limited commissions India's first
99.999% pure Green Hydrogen pilot plant

Assam

Hydrogen: The ultimate fuel?

- Why the push? ✓

- Nature ✓

- Ways to make ✓

- Ways to transport ✓

- Ways to use ✓

→ 2003 — 2005

Nature of Hydrogen

- Combustible
- Highest energy per gram
- Lowest energy per litre

Challenges

- How to store?
- How to transport?
- Can I replace gasoline with it?

IC engine

2-4 stroke engine

$\frac{1}{10} \times 30 \text{ l}$

Way to use

- Burn it: IC Engines
- Pull out electrons: Fuel cell

Public
~~H+CNG~~

Gadkari's green new wheels—All about 'Mirai', India's first hydrogen-powered FCEV

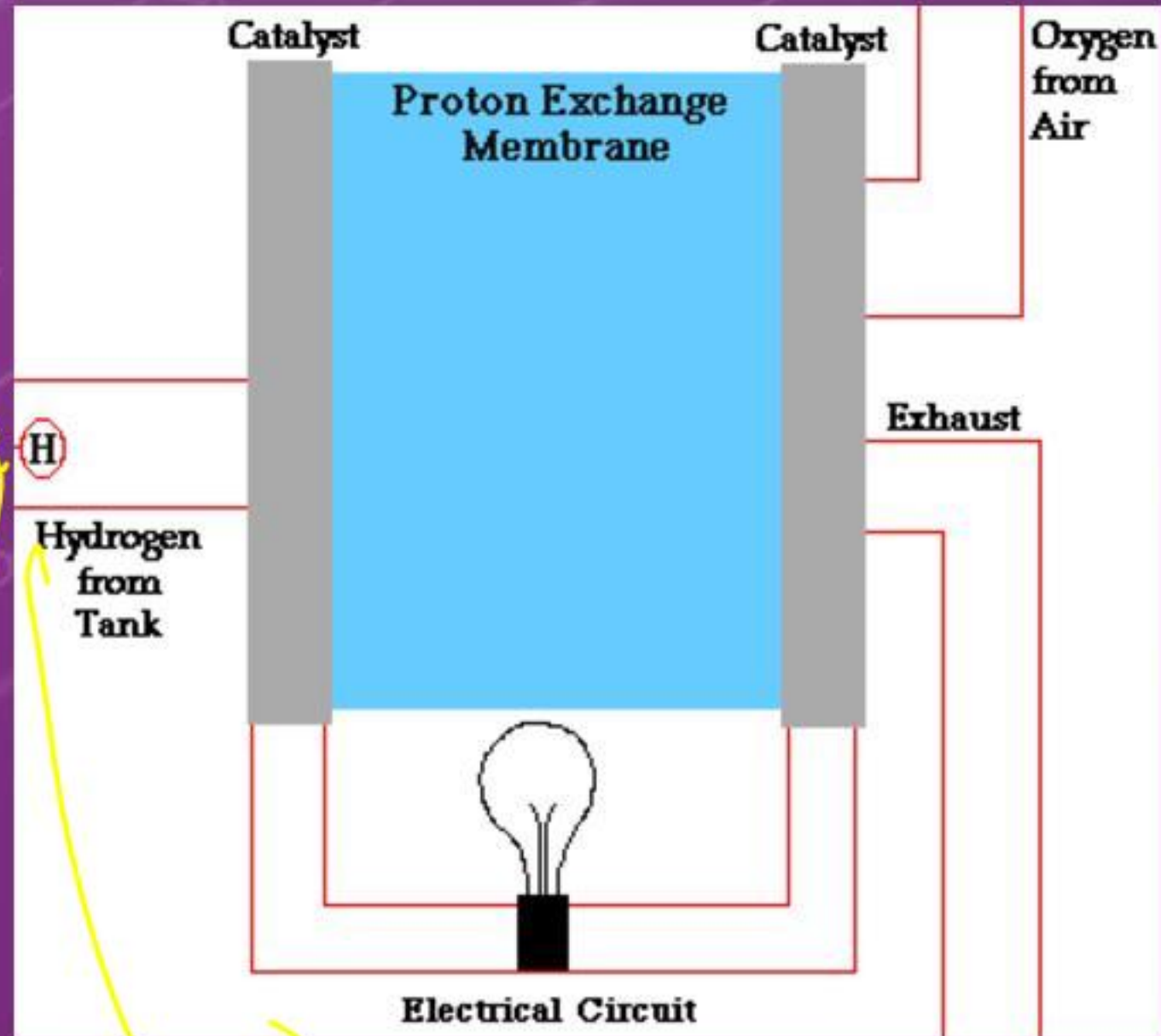
Mirai is a green hydrogen-powered Fuel Cell Electric Vehicle, capable of running 600 kms in full tank. Toyota Kirloskar Motor, along with the International Center for Automotive Technology (ICAT), is conducting a pilot project to study and evaluate the world's most advanced FCEV Toyota Mirai, which runs on hydrogen, on Indian roads and climatic conditions.

Tata's hydrogen bus gets nod for roadworthiness trials from govt

Fuel Cell

Types

- Proton-exchange membrane
- Solid-oxide: H₂ from Methane/Ethanol



Fuel cell v/s Batteries

- Low efficiency
- No charge/discharge cycle
- 1 step conversion
- Quick recharge
- Lighter

5-10 min
Turn around

FC

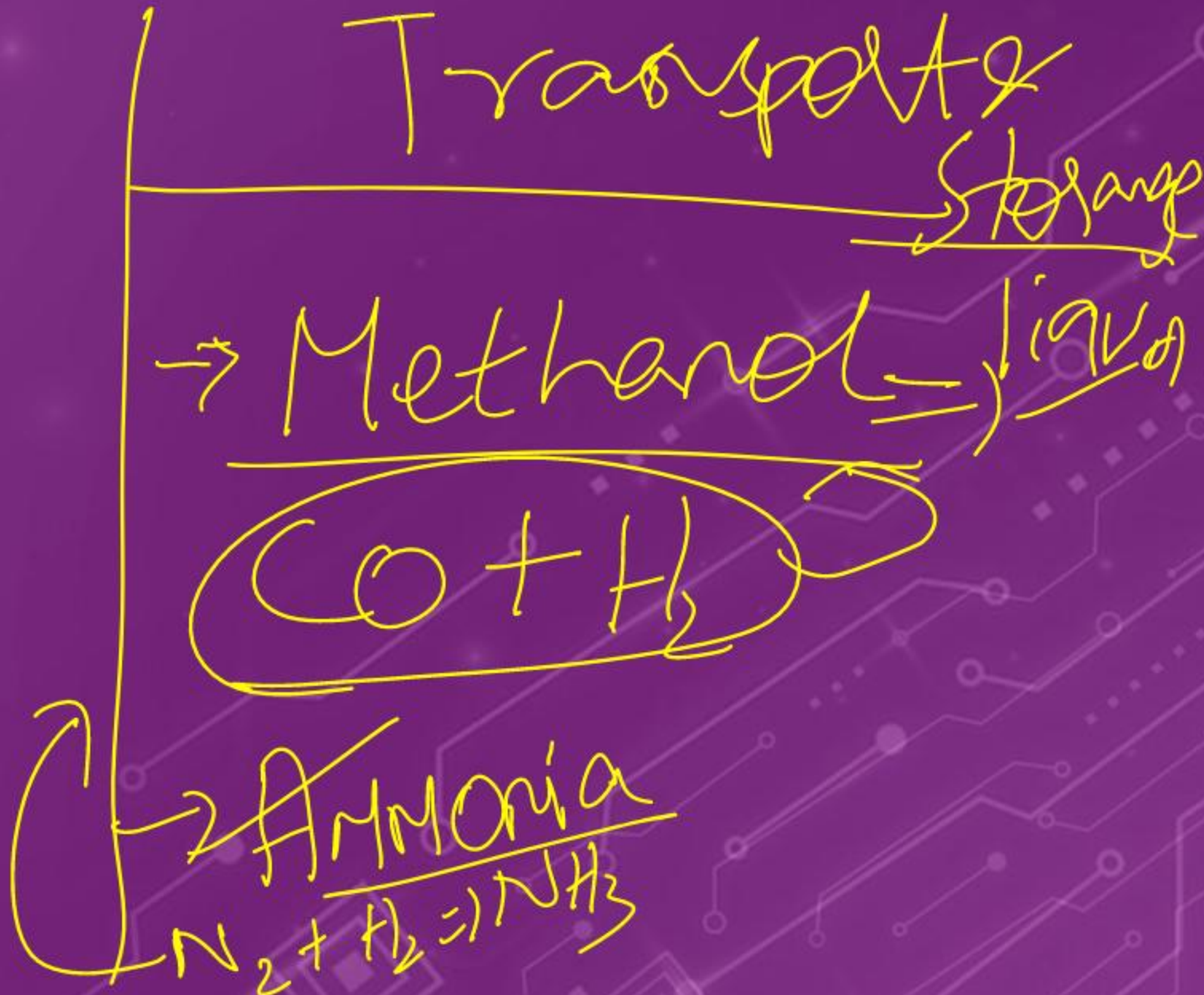


- Hydrocarbons

- Water \rightarrow electrolyzer \Rightarrow \boxed{PH}

Way to generate

- Grey
- Blue
- Green



Practice questions

- Hydrogen is an essential component of low-carbon future for India. Justify the statement.
- Do you think hydrogen can replace electricity as energy carrier in the future?
- What are the challenges to move towards a hydrogen-based economy? What are steps we need to take to overcome them?



- Li-ion
- Sodium-Sulphur
- Aluminum-Air batteries
- Flow batteries

Science

Lithium-ion batteries makers win 2019 Nobel Prize for chemistry

Reuters | STOCKHOLM, Oct 9 | Updated On: Oct 09, 2019

Policy Push Required for Driving Li-Ion Revolution in India

Lithium ion batteries are bringing in a whole new reality to the world of energy. With battery technology going through a revolution, the new age lithium ion batteries are opening up new possibilities be it mobile phones and laptops, electronic gadgets or automobiles.

Written by **Guest**

November 25, 2021 3:09:46 pm



OPINION: Li-ion batteries: The mainstay of the new rechargeable world

There is no doubt that with the right government support, India has a tremendous scope of becoming global EV leader and battery manufacturing hub in the years ahead.

India working on an 'Energy Storage' policy



India has 100 gigawatt (GW) of installed solar and wind capacity, with another 63GW under construction. (Photo: Reuters)

India has 100 gigawatt (GW) of installed solar and wind capacity, with another 63GW under construction. (Photo: Reuters)

2 min read . Updated: 12 Oct 2021, 08:05 AM IST

Govt eyes 14GWh battery storage system in Kutch



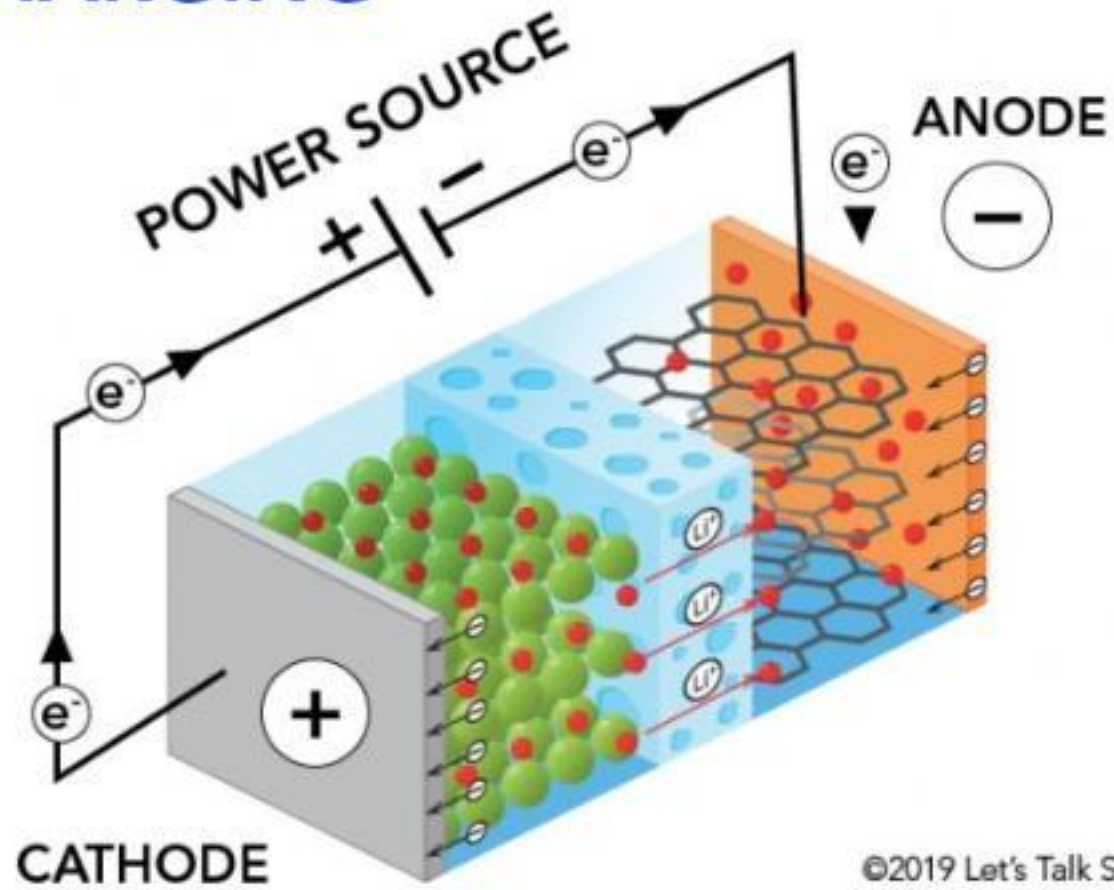
1GWh battery capacity can power 1 million homes for 1 hour

1GWh battery capacity can power 1 million homes for 1 hour

3 min read . Updated: 20 Sep 2021, 05:58 AM IST

Basic Principle

CHARGING



Li-ion: Why and Why not?

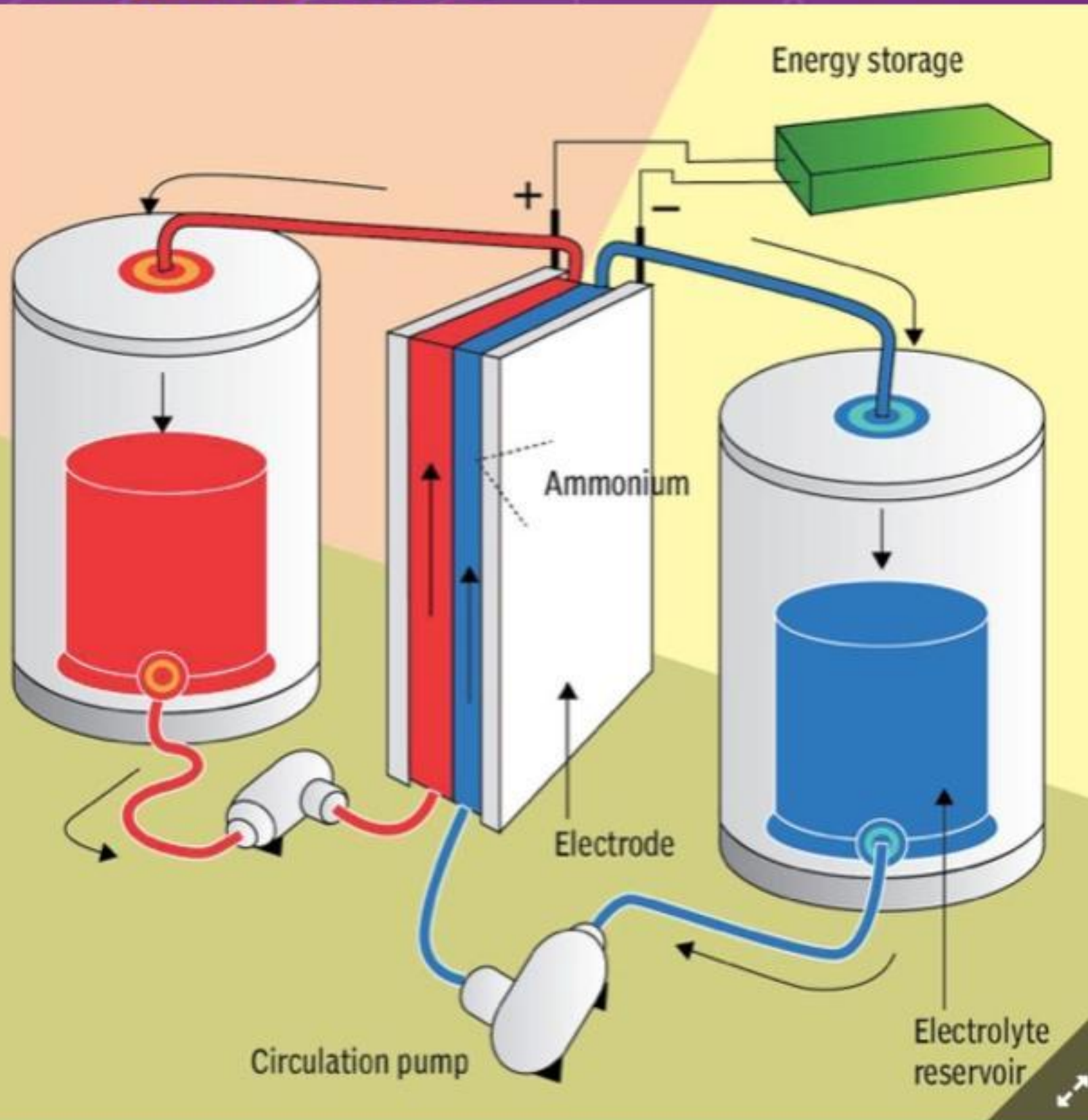
Advantages

- Energy density
- Charge-discharge cycles

Limitation

- Faster discharge

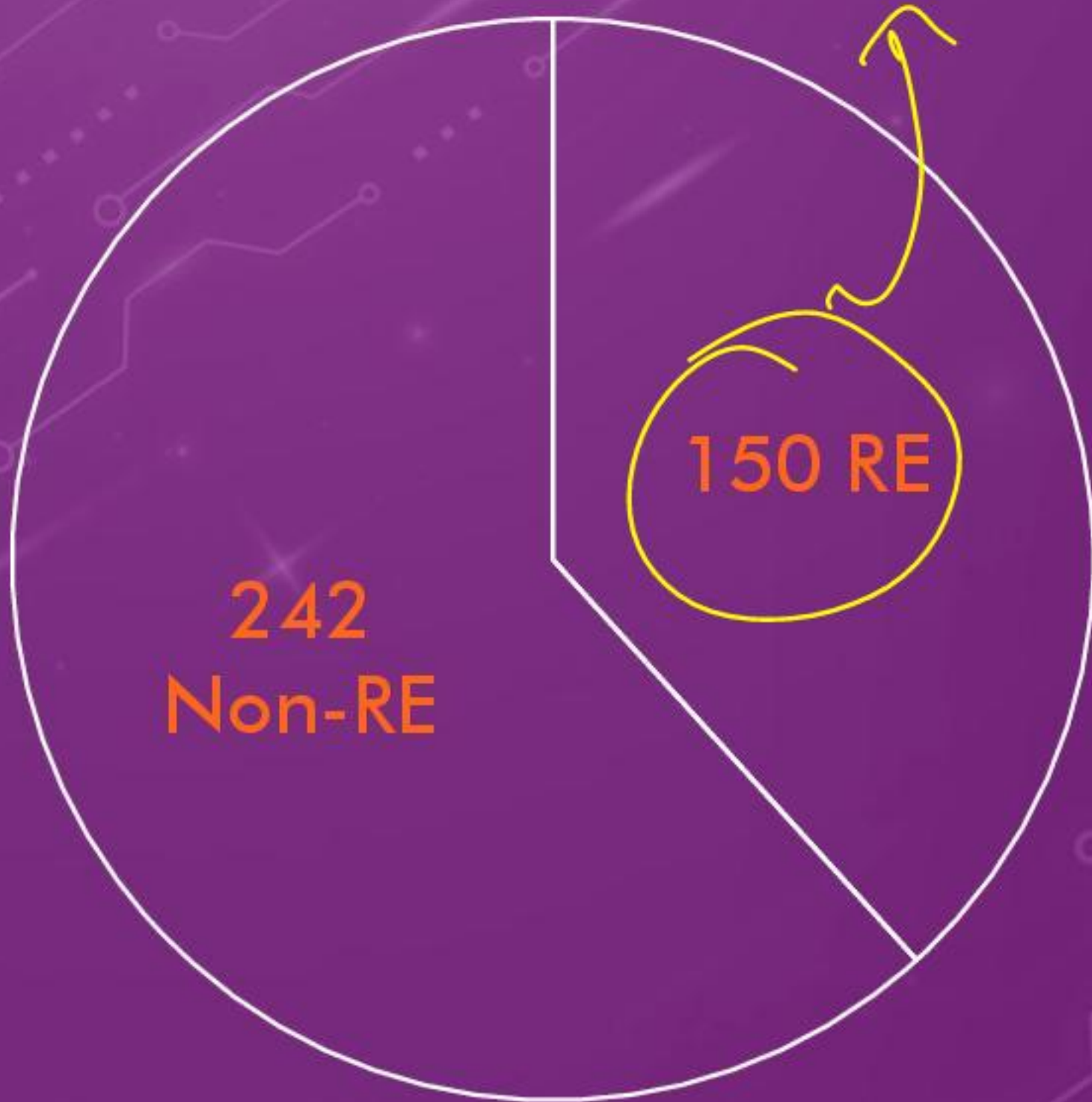
Flow batteries

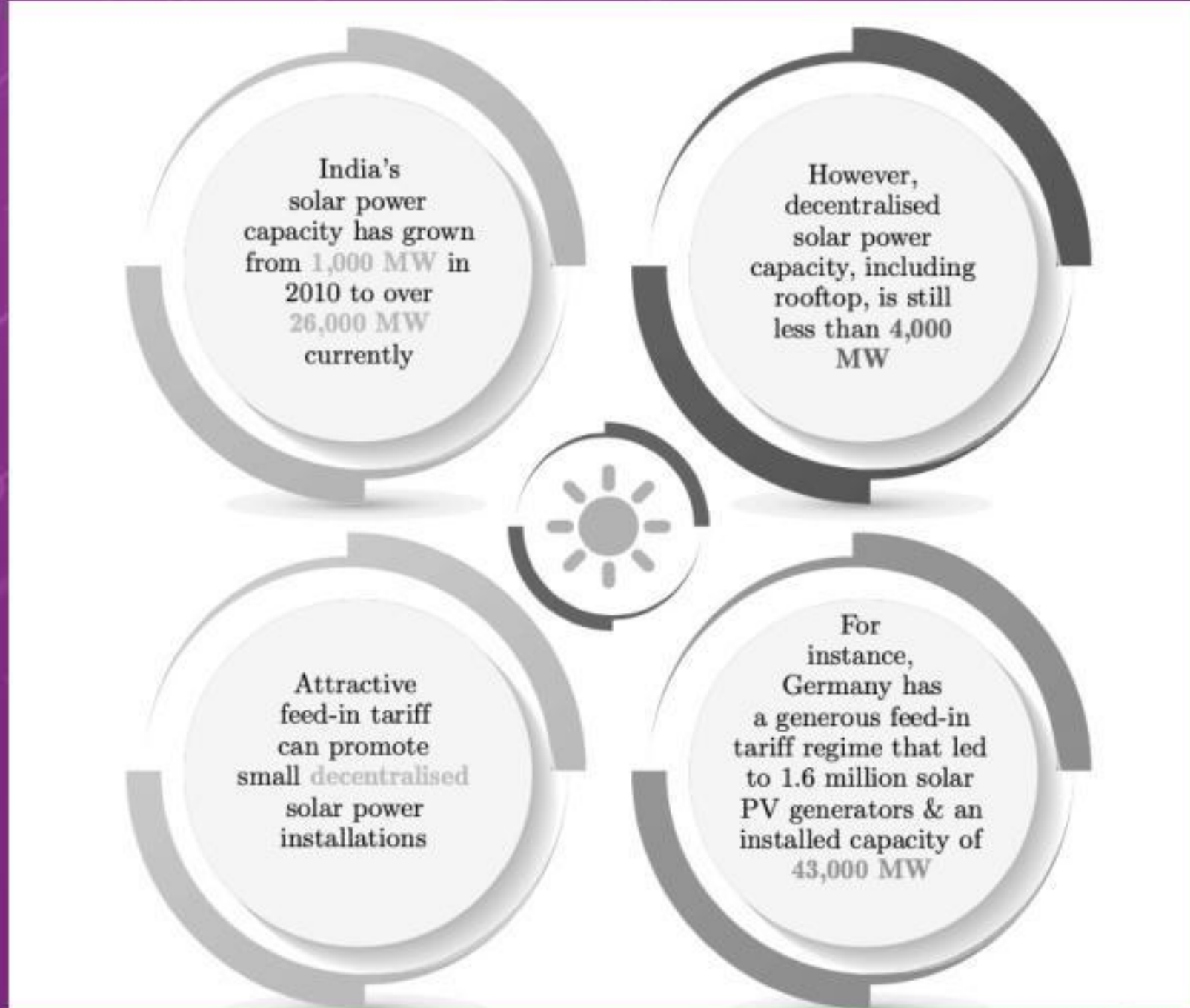


Mission 500 GW and 50%

Total Energy Capacity = 392 GW

Pathway: Solar-Wind hybrid



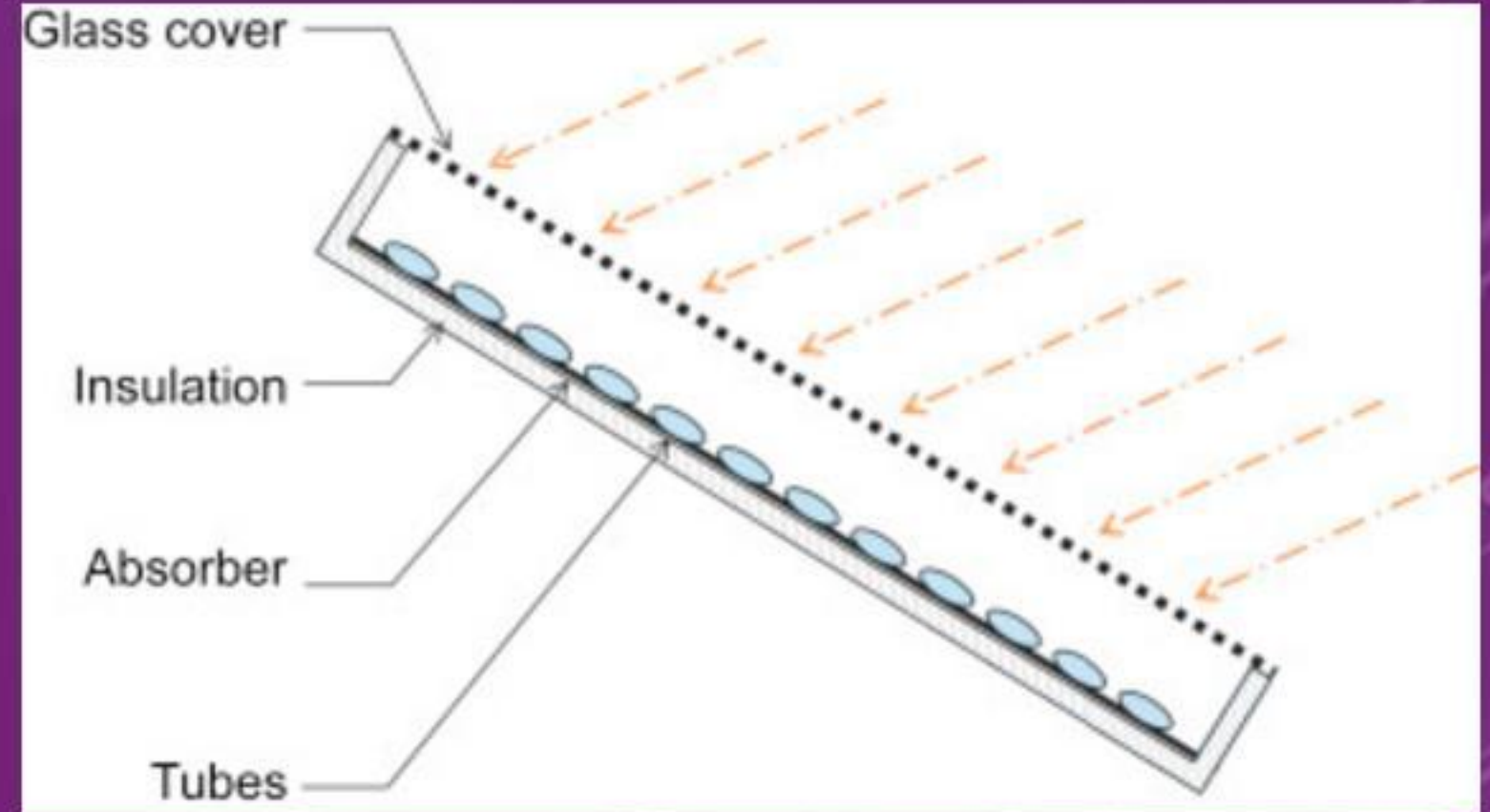


Solar Energy: Pathways

- Solar Thermal
- Solar PV
- Solar towers

Solar Thermal

- Principle: Greenhouse effect



Advantages	Disadvantages
70% Efficient	Scalability

Solar PV

Type of PV	Material	Efficiency	Limitation
1 st Gen	Silicon crystal	16%	Thick
2 nd Gen	CdTe, CIGS, Amorphous Si	15%	
3 rd Gen	Perovskites		

