Cleaner Methods of Energy Generation

Source: TH

Why in News?

India must adopt **cleaner methods of energy generation**, as **coal-based electricity generation** causes significant **air pollution**, harming crops, humans and animals.

- Cleaner methods of energy generation use **renewable, and low-carbon technologies** to produce electricity with **minimal pollution and environmental impact.**

Note: Nitrogen dioxide and **ozone** from coal plants **reduce wheat and rice yields by over 10%** in some parts of India.

- It negated **six years of agricultural growth** despite **better crops, irrigation, and mechanization.**

What are Available Cleaner Methods of Energy Generation?

- **Osmotic Power**: It generates electricity using **osmotic pressure differences** between **freshwater and seawater**.
  - India has a vast **coastline of 7,500 km**, where rivers drain into the sea, and this technology can effectively **generate electricity.**
  - **Osmotic power (salinity gradient energy)** generates electricity using the **salt concentration difference** between freshwater and seawater through **osmotic pressure.**
- **Nuclear Power:** Nuclear power plants use nuclear fission to **heat water, create steam, and spin turbines** to generate electricity.
  - India's Nuclear power generation capacity stands at **8,180 MW in 2024** and is projected to **triple to 22,480 MW** by **2031-32**.
  - The government has set an **ambitious target of 100 GW** nuclear power capacity by **2047**.
- **Biomass Energy:** Organic materials **(wood, crop waste, algae**) are burned or converted into **biofuels** to produce electricity.
  - India produces **450-500 million tonnes** of biomass annually, supplying **32%** of the country's **primary energy.**
- **Hydrogen Fuel Cells:** They convert **hydrogen into electricity** through electrochemical reactions.
  - They are used in **vehicles and backup power systems,** emitting **only water vapor as a byproduct.**
- **Waste-to-Energy (WTE):** It converts **municipal solid waste (MSW)** and other waste materials into **electricity, heat, or fuel** through various technologies like
  - **Incineration:** Waste is burned at **high temperatures** to produce **steam,** which drives a turbine to **generate electricity.**

    - **Gasification:** Converts waste into **syngas (a mixture of CO, H_2, and CH_4),** a raw material for **fuel.**
    - **Pyrolysis:** Organic waste is decomposed at **high temperatures without oxygen,** producing **bio-oil, syngas, and biochar** as usable fuels.
- **Wind Energy:** It involves the use of **wind power** by placing **windmills** to generate electricity.
    - India, the world's **4th largest** wind power producer, generates **50 Gigawatts** (GW) **of electricity** across **nine windy states.**
- **Solar Energy:** It involves setting up **solar panels** on houses, buildings or large-scale solar farms that **absorb sunlight and convert light into electricity**.
    - India is the world's **3rd largest** solar power generator after **China (1st) and USA (2nd).**
- **Hydropower:** It involves blocking part of a **river by a dam** and then water is released to generate **electric power.**
    - The top five dams across India together generate as much as **50 GW** of hydroelectric energy.

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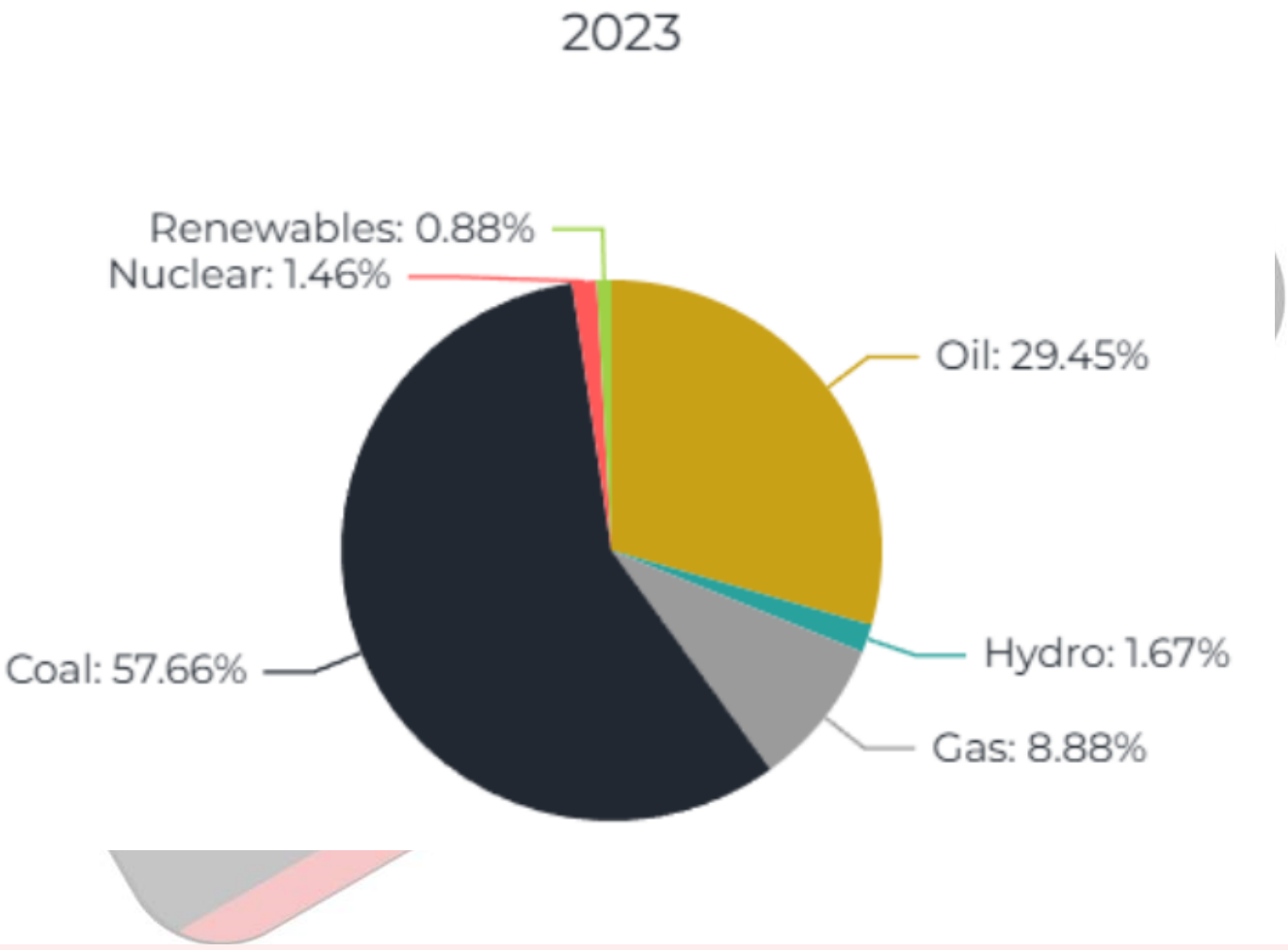

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q. Which of the following are the reasons/factors for exposure to benzene pollution? (2020)

1. Automobile exhaust
2. Tobacco smoke
3. Wood burning
4. Using varnished wooden furniture
5. Using products made of polyurethane

Select the correct answer using the code given below:

(a) 1, 2 and 3 only

(b) 2 and 4 only

(c) 1, 3 and 4 only

(d) 1, 2, 3, 4 and 5

Ans: (a)

Mains

Q. In the context of solving pollution problems, what is/are the advantage/advantages of bioremediation technique? (2017)

1. It is a technique for cleaning up pollution by enhancing the same biodegradation process that occurs in nature.
2. Any contaminant with heavy metals such as cadmium and lead can be readily and completely treated by bioremediation using microorganisms.
3. Genetic engineering can be used to create microorganisms specifically designed for bioremediation.

Select the correct answer using the code given below:

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Ans: (c)