Converting CO2 to Methane

Why in News

Recently, Indian Scientists have designed **a photochemical method (Photocatalyst)** to convert Carbon Dioxide (CO_2)to Methane (CH_4).

- A photochemical method is **a chemical reaction** initiated by the absorption of **energy in the form of light.**

Key Points

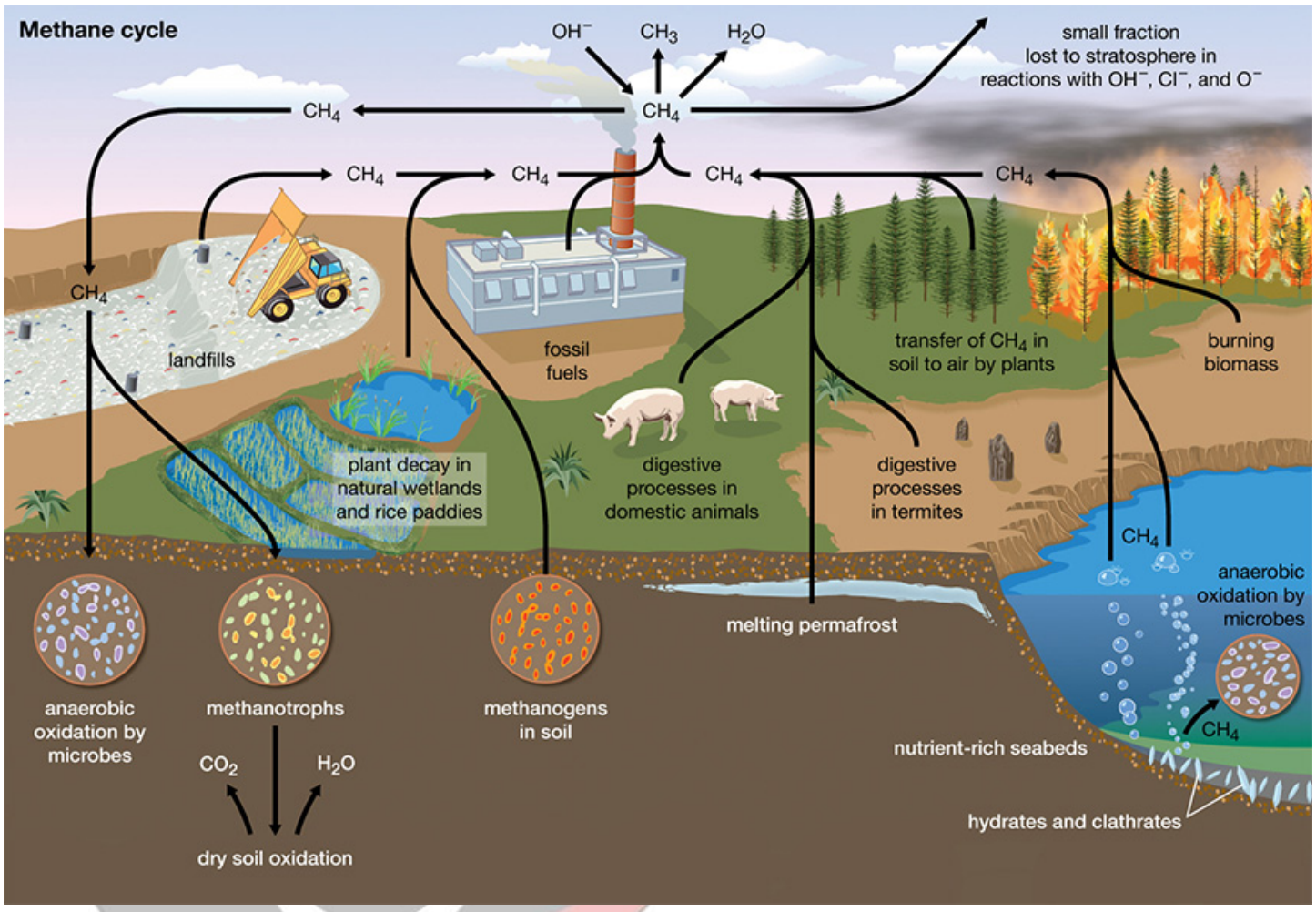
- **About:**
    - A polymer has been designed to **absorb visible light and catalyse the reaction** which reduces CO_2.
        - Most catalysts contain toxic and expensive metal counterparts. Therefore scientists designed a **metal-free porous organic polymer to overcome this drawback.**
    - The photochemical method of reducing **CO_2 uses solar light as a** renewable source **of energy.**
        - There are several ways in which CO_2 can be reduced, including photochemical, **electrochemical**, photoelectrochemical, photothermal, and so on.
- **Mechanism:**
    - The catalyst has a chemical called the **Conjugated Microporous Polymer (CMP)**.
    - It can uptake CO_2 onto its surface due to its high CO_2 intake capability at room temperature, **converting it into methane as a value-added product**.
    - There are some **key requirements** of a photo-catalyst to convert CO_2 into value-added products, which rely upon:
        - Light-harvesting property.
        - Charge carrier (electron-hole pair) separation proficiency.
        - Presence of proper electronically aligned conduction band.
- **Significance:**
    - Methane can be one of the value-added products with significant uses as the cleanest burning **fossil fuel** and can directly be used in **fuel cells** as a hydrogen carrier.
    - It is also the main component of **natural gas** and has the potential to replace coal for electricity generation and furnishing flexible supply to reinforce intermittent renewable generators.

Methane

- **About:**
    - Methane is gas that is **found in small quantities in Earth's atmosphere**.
    - It is the **simplest hydrocarbon**, consisting of one carbon atom and four hydrogen atoms

(CH_4).
- Methane is a powerful **greenhouse gas**. It is **flammable**, and is used as a fuel worldwide.
- Methane is produced by the **breakdown or decay of organic material** and can be introduced into the atmosphere by either **natural processes** – such as the decay of plant material in wetlands, the seepage of gas from underground deposits or the digestion of food by cattle – or **human activities** – such as oil and gas production, rice farming or waste management.

    - Methane is called **marsh gas because it is found at the surface of marshy places**



- **Major Uses:**

    - It is an **important source of hydrogen and some organic chemicals.**
    - It reacts with steam at high temperatures to yield carbon monoxide and hydrogen; the latter is used in the **manufacture of ammonia for fertilizers and explosives**.
    - Other valuable **chemicals derived from methane include methanol, chloroform, carbon tetrachloride, and nitromethane.**
    - The **incomplete combustion of methane yields carbon black**, which is widely used as a reinforcing agent in rubber used for automobile tires.
- **Environmental Impact of Methane:**

    - It is **84 times more potent than carbon** and doesn't last as long in the atmosphere before it breaks down. This makes it **a critical target for reducing global warming** more quickly while simultaneously working to reduce other greenhouse gases.
    - It is responsible for creating ground-level **ozone**, a dangerous air pollutant.

Source: PIB