



Rising Methane Levels and the Threat to Climate Stability

For Prelims: Termination-Level Transition, [Methane](#), [Greenhouse Gas](#)

For Mains: [Impacts of methane emissions on global warming](#), Role of hydrocarbons in termination-level transition

Source: DTE

Why in News?

The surge in [methane levels](#) in Earth's atmosphere has raised concerns about the planet's ongoing climate transition.

- As methane, a potent greenhouse gas, gains momentum in its growth, it raises questions about whether **Earth is undergoing a 'termination-level transition' similar** to past climate shifts.

What is Termination-Level Transition?

- The concept of a **"termination-level transition"** refers to a **significant and abrupt shift in Earth's climate from one state to another**.
- These transitions are marked by **rapid and substantial changes in various climatic factors**, which can have far-reaching consequences for the planet's ecosystems, weather patterns, and overall environmental stability.
- Earth's climate has undergone termination-level transitions throughout its history.
 - These transitions are often associated with the **end of [ice ages](#)** (It was during the Pleistocene, epoch spanning from approximately 2.6 million to 11,700 years ago, which witnessed the most recent instances of global cooling, or ice ages) and the subsequent shift to warmer interglacial periods.
- Various factors, including **changes in ocean currents, and atmospheric composition, can trigger termination-level transitions**.

How Does Methane Threaten Warming Limits?

- **Potency of Methane as a Greenhouse Gas:**
 - Methane is much more effective at trapping heat than [carbon dioxide\(CO₂\)](#).
 - It has a shorter atmospheric lifespan of less than a decade compared to CO₂'s centuries.
 - While present in smaller quantities than CO₂, methane's heat-trapping capacity is **approximately 28-36 times stronger over a 100-year period**.
 - Methane was about **0.7 parts per million (ppm) in the air** before humans began burning fossil fuels. **Now it is over 1.9 ppm and rising fast**.
 - This enhanced warming potential **intensifies its impact on the [greenhouse effect](#)**.
- **Challenges in Limiting Warming:**
 - The rapid increase in methane levels complicates efforts to **limit global warming to safe levels**.

- Elevated methane concentrations contribute to the overall greenhouse gas effect, **exacerbating temperature rise**.
- Rising methane levels can push the **planet closer to dangerous temperature thresholds**.
- Warming caused by methane can lead to further methane release from **thawing permafrost and [melting Arctic ice](#), amplifying its warming effects**.
- **Effects on Ecosystems:**
 - The increased methane concentrations can impact ecosystems, **disrupt natural processes, and affect biodiversity**.
 - Vulnerable ecosystems, such as **wetlands, are particularly sensitive to methane-related changes**.
- **Implications for Sea-Level Rise:**
 - Elevated methane levels can contribute to [sea-level rise](#) by accelerating the melting of polar ice and glaciers.
 - Sea-level rise threatens **coastal communities and exacerbates the impacts of climate change**.

Methane

- Methane is the **simplest [hydrocarbon](#), consisting of one carbon atom and four hydrogen atoms (CH₄)**.
- It is flammable and is used as a fuel worldwide.
- Methane is a powerful **greenhouse gas**.
- Methane has more than **80 times the warming power of carbon dioxide** over the first 20 years of its lifetime in the atmosphere.
- Roughly three-fifths of methane emissions come from **fossil fuel use, farming, landfills and waste**. The remainder is from **natural sources, especially vegetation rotting in tropical and northern wetlands**.

What are the Initiatives to Tackle Methane Emissions?

- **Indian:**
 - **'Harit Dhara' (HD): Indian Council of Agricultural Research (ICAR)** has developed an anti-methanogenic feed supplement **'Harit Dhara' (HD)**, which can cut down cattle methane emissions by 17-20% and can also result in higher milk production.
 - **India Greenhouse Gas (GHG) Program:** The India GHG Program led by WRI India (non-profit organization), Confederation of Indian Industry (CII) and **[The Energy and Resources Institute \(TERI\)](#)** is an industry-led voluntary framework to measure and manage greenhouse gas emissions.
 - The programme builds comprehensive measurement and management strategies to reduce emissions and drive more profitable, competitive and sustainable businesses and organisations in India.
 - **National Action Plan on Climate Change (NAPCC):** [NAPCC](#) was launched in 2008 which aims at creating awareness among the representatives of the public, different agencies of the government, scientists, industry and the communities on the threat posed by climate change and the steps to counter it.
 - **Bharat Stage-VI Norms:** India shifted from [Bharat Stage-IV \(BS-IV\) to Bharat Stage-VI \(BS-VI\)](#) emission norms.
- **Global:**
 - **[Methane Alert and Response System \(MARS\)](#):** MARS will integrate data from a large number of existing and future satellites that have the ability to detect methane emission events anywhere in the world, send out notifications to the relevant stakeholders to act on it.
 - **[Global Methane Pledge](#):** At the **[Glasgow climate conference \(UNFCCC COP 26\)](#)** in 2021, **nearly 100 countries had come together in a voluntary pledge**, referred to as the Global Methane Pledge, to cut methane emissions by at least 30% by 2030 from the

2020 levels.

- **India is not a part of the Global Methane Pledge.**
- **Global Methane Initiative (GMI):** It is an international public-private partnership focused on reducing barriers to the recovery and use of methane as a clean energy source.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Q1. Which of the following statements is/are correct about the deposits of 'methane hydrate'? (2019)

1. Global warming might trigger the release of methane gas from these deposits.
2. Large deposits of 'methane hydrate' are found in Arctic Tundra and under the sea floor.
3. Methane in atmosphere oxidizes to carbon dioxide after a decade or two.

Select the correct answer using the code given below.

- (a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (d)

Exp:

- Methane hydrate is a crystalline solid that consists of a methane molecule surrounded by a cage of interlocking water molecules. It is an "ice" that only occurs naturally in subsurface deposits where temperature and pressure conditions are favourable for its formation.
- Regions with suitable temperature and pressure conditions for the formation and stability of methane hydrate- sediment and sedimentary rock units below the Arctic permafrost, sedimentary deposits along continental margins, deep-water sediments of inland lakes and seas, and, under Antarctic ice. **Hence, statement 2 is correct.**
- Methane hydrates, the sensitive sediments, can rapidly dissociate with an increase in temperature or a decrease in pressure. The dissociation produces free methane and water, which can be triggered by global warming. Hence, statement 1 is correct.
- Methane is removed from the atmosphere in about 9 to 12 year period by oxidation reaction where it is converted into Carbon Dioxide. **Hence, statement 3 is correct.**
- **Therefore, option (d) is the correct answer**

Q2. Consider the following: (2019)

1. Carbon monoxide
2. Methane
3. Ozone
4. Sulphur dioxide

Which of the above are released into atmosphere due to the burning of crop/biomass residue?

- (a) 1 and 2 only
(b) 2, 3 and 4 only
(c) 1 and 4 only
(d) 1, 2, 3 and 4

Ans: (d)

