



CURRENT AFFAIRS



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Date -12 January 2024

DETERIORATING AIR QUALITY IN INDIA

This article covers 'Daily Current Affairs' and the topic details of 'Report of Respirer Living Sciences and Climate Trends about Particulate Matter Pollution in India'. This topic is relevant in the "Environment" section of the UPSC CSE exam.

UPSC MAINS GS3 Syllabus : Environmental pollution and degradation

Why in the News?

Respirer Living Sciences and Climate Trends have just published a study which revealed that the vast majority of cities are far from India's National Clean Air Programme (NCAP) clean air targets.

Key highlights of the study

PM 2.5 :

1. Only 27 of the 49 cities having continuous PM2.5 data over five years demonstrated a decrease in PM2.5 levels, with only four cities meeting or exceeding the targeted fall as per National Clean Air Campaign (NCAP) Goals.
2. The NCAP's objective is to decrease aggregate particulate matter (PM) concentrations in 131 cities by 40% by 2026.
3. The target was originally set for a 20-40% decrease by 2024, however it was subsequently postponed to 2026.

Lagging Behind

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The table shows PM 2.5 levels (annual average) in India's most polluted cities from 2019 to 2023. It remained higher than the acceptable level of 40 micrograms per cubic metre in all the years.



Rank in 2023	City	2019	2020	2021	2022	2023
1.	Delhi	108.4	95.3	107.6	99.5	102
2.	Patna	119.6	72.8	76.5	91.3	89.5
3.	Faridabad	94.5	87.6	95.6	95.3	87.9
4.	Muzaffarpur	108.1	67.4	122.6	85.7	83.6
5.	Noida	113.8	97.9	100.8	79.3	83.6

- **Regional vulnerabilities :**

1. While some places, such as Varanasi, Agra, and Jodhpur, had large reductions in PM2.5 levels, others, such as Delhi, saw just moderate reductions (only 5.9%) or even increased pollution loads.
2. Varanasi saw the most significant drop, with a 72% average fall in PM2.5 levels through a 69% decrease in PM10 levels between 2019 and 2023.

- **Challenges while monitoring**

1. Annual pollutant concentrations are heavily influenced by the availability and deployment of permanent ambient air quality monitoring.
2. However, many Indian cities do not have a sufficient number of such monitoring stations. While cities like Mumbai and Delhi have a number of such stations, other Indian cities only have a few.
3. A mere four out of 92 cities possess more than ten stations of this type.

- **Pollution Influencing Factors:** Variability in levels of pollution can be related to geographical regions, various emission sources, meteorological impacts, and the interaction between emissions and Meteorology, all of which warrant more exploration.

What is National Clean Programme

- The Ministry of Environment, Forests, and Climate Change (MoEFCC) launched it in January 2019.

- It is the nation's first attempt to develop a national framework for air quality control with a time-bound reduction target.
- The NCAP's objective is to decrease average particulate matter (PM) levels in 131 cities by 40% by 2026. The target was originally set for a 20-40% decrease by 2024, however it was subsequently pushed up to 2026.
- It applies to the 131 non-attainment cities listed by the Central Pollution Control Board (CPCB) :
 - (a) Non-attainment cities have failed to meet the National Ambient Air Quality Standards (NAAQS) for more than five years.
 - (b) NAAQs are ambient air quality standards based on numerous identified pollutant notifications made by the CPCB under the Air (Prevention and Control of Pollution) Act of 1981.
 - (c) Pollutants covered by NAAQS include PM₁₀, PM_{2.5}, SO₂, NO₂, CO, NH₃, Ozone, Lead, Benzene, Benzo-Pyrene, Arsenic, and Nickel.
- PRANA (site for Regulation of Air Pollution in Non-Attainment Cities) is a monitoring site for NCAP implementation.

About Particulate Matter

- Particulate matter is an airborne combination of solid particles and droplets of liquid. Sulphates, nitrates, black carbon, particle-bounded water, elements (cadmium, copper, nickel, and zinc), hydrocarbons, and biological components such as allergens and microbial chemicals are all Particulate matter.

Different types of PM

1. **PM 10:** Inhalable particles having sizes of fewer than 10 micrometres.
 2. **PM 2.5:** Inhalable fine particles with a diameter of less than or equal to 2.5 micrometres.
- **Sources:**
 1. Man-made causes is from Emissions from power plants, factories, industries, incinerators, diesel generators, and autos, dust from building sites and unpaved roads, and garbage burning.
 2. Natural causes include volcanic eruptions, soil erosion, sea salt, and so on.
 - **Harmful effects :**
 1. **Respiratory disorders:** Prolonged exposure can result in chronic obstructive pulmonary disease, asthma, bronchitis, chest getting tighter, and harm to the lungs.
 2. As per WHO, practically 3.7 million deaths occur prematurely each year as a result of outdoor air pollution, with respiratory illnesses and malignancies induced by PM exposure accounting for 20% of these deaths.

Initiatives Taken to Control Air Pollution?

- The National Air Quality Monitoring Programme (NAMP) has identified four air pollutants for regular surveillance across the country: SO₂, NO₂, PM₁₀, and PM_{2.5}.
- System of Air Quality and Weather Forecasting and Research (SAFAR) Portal
- The Air Quality Index (AQI) was created for eight pollutants: PM_{2.5}, PM₁₀, ammonia, lead, nitrogen oxides, sulphur dioxide, ozone, and carbon monoxide.
- To Reduce Vehicle Pollution: BS-VI Vehicles introduced, Electric Vehicle (EV) Push by government (FAME scheme, Production Linked Incentive scheme)

Way Forward :

- **Transition to Clean Energy Sources:** Promote the use of renewable energy sources such as solar, wind, and hydropower. Transition away from fossil fuels by encouraging electric vehicles and investing in public transportation.
- **Stringent Emission Standards:** Implement and enforce strict emission standards for industries, vehicles, and power plants. Regularly update and improve emission standards to keep up with technological advancements.
- Cooperation spanning regional and national jurisdictional borders will assist in the implementation of cost-effective solutions to improve air quality control.

Conclusion

The report by Respirer Living Sciences and Climate Trends highlights the ongoing problem of air pollution in Indian cities, with many cities failing to fulfil the targets set by the National Clean Air Programme. To combat particulate matter pollution in susceptible cities, focused actions, improved monitoring infrastructure, and long-term development are required.

Prelims practice question

Q1) What is the primary mechanism by which PM affects human health?

1. Direct contact with the skin
2. Inhalation into the respiratory system
3. Ingestion through contaminated food
4. Absorption through the eyes

Answer: **B**

Q2) What is the size range of particles classified as PM_{2.5}?

2. Less than 2.5 micrometers
3. Less than 25 micrometers
4. Less than 2.5 millimeters
5. Less than 0.25 micrometers

Answer: **A**

Mains practice Question

Q1) Discuss the contribution of manufacturing industries on particulate matter emissions. What steps may businesses take to lessen their environmental impact.

SUCCESSFUL TESTING OF PEM FUEL CELL BY ISRO

This article covers 'Daily Current Affairs' and the topic details of 'successful testing of PEM fuel cell by ISRO.' This topic is relevant in the "Science and Technology" section of the UPSC CSE exam.

UPSC MAINS GS3 Syllabus : Indigenization of technology

Why in the News?

ISRO has achieved success in testing a 100 W class Polymer Electrolyte Membrane Fuel Cell (PEMFC)-based Power System aboard the orbiting vehicle POEM3. POEM3, which was launched onboard PSLV-C58.

About PEMFC Test

- Its goal is to evaluate Polymer Electrolyte Membrane Fuel cell operation in space and collect data that will help in the layout of systems for upcoming missions.
- It is an electric generator that operates on electrochemical principles, similar to those used in batteries, rather than the combustion reactions used in traditional generators.
- ISRO tested a PEMFC of 100 watts that transforms both oxygen and hydrogen into energy, water, and heat. This method has various advantages over typical space power sources, which includes:

(a)

PEMFCs convert gasoline directly into energy, resulting in much higher efficiency than batteries.

(b) PEMFCs emit just water as a byproduct, avoiding the need for sophisticated waste management systems.

(c) The PEMFC water can be utilised for onboard consumption or electrolysis to generate extra oxygen. These characteristics make them excellent choices for space travel by human missions when electric power, water, and heat are required because a single system may handle numerous mission needs.

- Fuel Cells have enormous societal potential for application as well –
 - (a) They are regarded as the best choice for replacing engines in various vehicles and powering backup power systems today.
 - (b) It can provide the same range and fuel recharge time as a traditional engine, providing it an unambiguous benefit over batteries, and is projected to promote emission-free transportation.

Applications for future missions

- Fuel cells are ideal for manned space missions because they provide critical power, water, and heat from just one device.
- PEMFCs are perfect for running the envisioned Indian space station due to their great efficiency and water production capabilities.
- PEMFCs have the potential to provide a dependable and sustainable source of power for long-duration journeys to deep space destinations like Mars.
- Fuel cells have comparable performance and refuelling time to conventional engines and are intended to provide emission-free transportation.

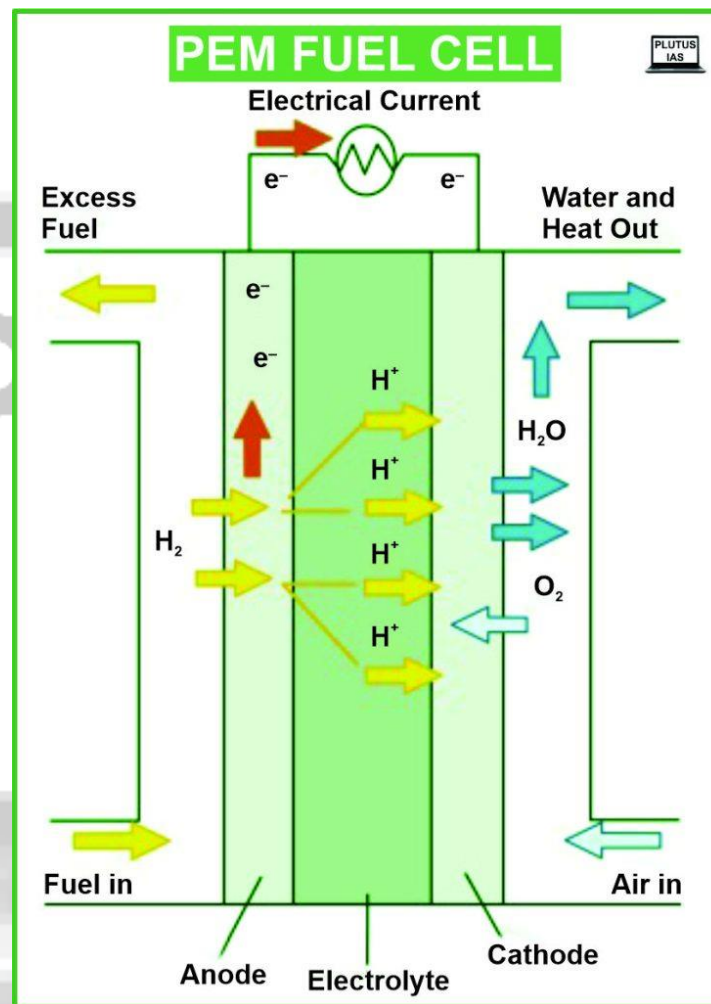
About POEM (PSLV Orbital Experimental Module) initiative

- Energy generation, telemetry, telecommand stabilisation, orbital station holding, and orbital manoeuvring are all supported by ISRO's POEM platform, which has standard interfaces and packaging.
- This enables space agencies and private enterprises to create, test, and evaluate experimental orbital payloads.
- ISRO's PSLV rocket is a four-stage rocket in its conventional configuration.
 - (a) The first three spent stages re-enter the water, while the fourth goes up in space as debris after sending satellites into orbit.

(b) The POEM programme, on the other hand, uses the wasted final stage as a “stabilised platform to conduct experiments.”

What is a Fuel Cell?

- A fuel cell is a type of an electrochemical device that directly transforms the chemical energy of a fuel (such as hydrogen) and an oxidant (such as oxygen) into electricity.
- Unlike batteries, which store chemical energy before converting it to electrical energy, fuel cells produce electricity continuously for as long as they are supplied with fuel and an oxidant.



How Fuel Cell works or its operation

- At the anode, hydrogen molecules (H_2) are divided into protons (H^+) and electrons (e^-). Only protons can travel through the PEM to the cathode.
- Electrons pass through an external circuit to the cathode, creating an electric current.
- At the cathode, oxygen molecules (O_2) from the air interact with protons and electrons to generate water (H_2O).
- Heat is produced during the reaction, and this heat can be exploited to heat certain applications.

Some important types of fuel cell –

- **Polymer Electrolyte Membrane Fuel Cells:** These fuel cells are perfect for portable applications since they incorporate a thin but solid polymer membrane as the electrolyte.

- **SOFCs (Solid Oxide Fuel Cells):** SOFCs have a ceramic electrolyte which can withstand high temperatures. They are more expensive and sophisticated than PEMFCs, but they are more efficient.
- **Alkaline Fuel Cells (AFCs):** AFCs use a potassium hydroxide (KOH) liquid electrolyte. They tend to be less efficient in comparison to PEMFCs and SOFCs, but they are more affordable and more tolerant of fuel impurities.

Prelims practice question

Q1) What environmental benefit is associated with PEM Fuel Cells?

- A) Increased air pollution
- B) Reduced greenhouse gas emissions
- C) Depletion of ozone layer
- D) Soil contamination

Answer: **B**

Q2) What is the byproduct of the electrochemical reaction in a PEM Fuel Cell?

- A) Water
- B) Carbon dioxide
- C) Nitrogen
- D) Oxygen

Answer: **A**

Mains practice question

Q1) How can PEMFCs contribute to addressing energy storage challenges in renewable energy systems?

Q2) What are the key advantages of Polymer Electrolyte Membrane Fuel Cells over other types of fuel cells?

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