FLUE GAS DESULPHURISATION - ENVIRONMENT

NEWS: A study commissioned by the **Principal Scientific Adviser's Office** recommended **rolling back** the 2015 mandate requiring **Indian coal-fired plants** to install **Flue Gas Desulphurisation (FGD) systems.**

WHAT'S IN TH NEWS?

- The **Ministry of Environment, Forest & Climate Change (MoEFCC)** in **2015** mandated all of **India's 537 coal-fired plants** to install FGD systems to reduce sulphur dioxide (SO2) emissions.

- Under a 2022 notification, **penalties for non-compliance increase based on the delay in implementation.** The penalties are applied per unit of electricity, with higher charges for longer delays.

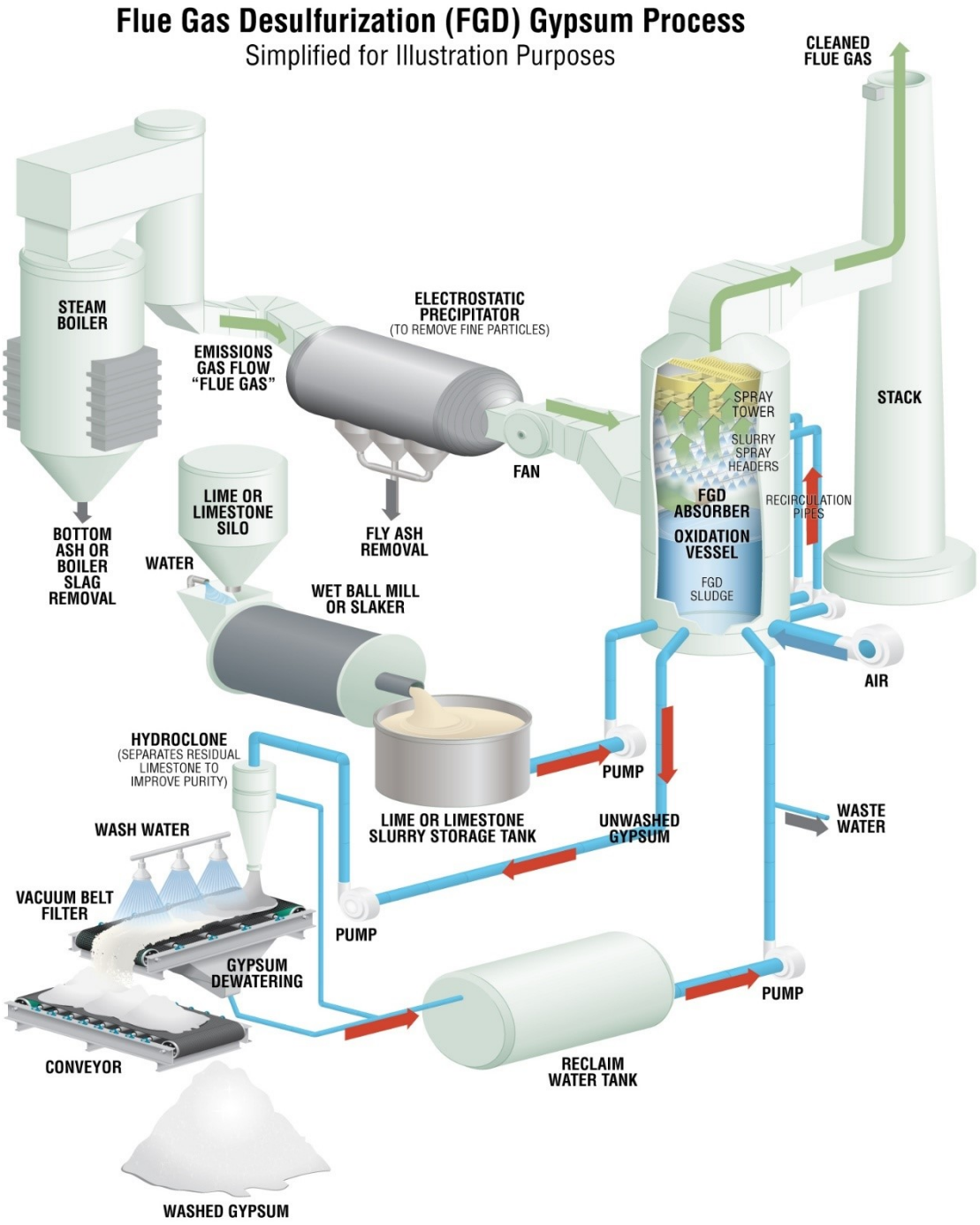
Rationale Behind Rolling Back the FGD Mandate

a. Low Sulphur Content in Indian Coal

- **Data-backed Observation**: According to studies by the National Institute of Advanced Studies (NIAS) and IIT-Delhi, about **92% of Indian coal contains only 0.3% to 0.5% sulphur**.

- **Implication**: Since Indian coal is naturally low in sulphur, the need for Flue Gas Desulphurisation (FGD), which targets sulphur dioxide (SO_2) emissions, is significantly reduced.

- **Conclusion**: A **blanket mandate for installing FGDs** across all thermal power plants is seen as **unnecessary and inefficient**.



b. Environmental Trade-Offs

- **Water and Power Consumption**: FGDs require substantial **freshwater and energy** inputs to operate, increasing the **environmental footprint** of power generation.
- **Greenhouse Gas Impact**: Between 2025 and 2030, widespread use of FGDs could result in **69 million tonnes of additional CO_2 emissions**, while removing only **17 million tonnes of SO_2**.

- **Net Impact**: This trade-off makes **climate change mitigation efforts counterproductive**, as the CO_2 rise outweighs the SO_2 reduction.

c. Availability of Cost-Effective Alternatives

- **Electrostatic Precipitators (ESPs)**: Devices like **ESPs manufactured by BHEL** can reduce **particulate matter (PM) emissions by 99%**.
- **Cost Comparison**: While **FGDs cost ₹1.2 crore/MW**, **ESPs cost only ₹25 lakh/MW**, making them **nearly five times cheaper**.
- **Pollution Prioritization**: Since particulate matter is a major pollutant in India, **ESPs offer a more relevant and impactful solution**.

About Flue Gas Desulphurisation (FGD)

a. Definition and Working Principle

- **FGD Technology**: FGD is a **scrubbing process** that removes sulphur dioxide (SO_2) from the flue gas of coal-fired plants using **alkaline reagents** like **calcium or sodium compounds**.
- **Chemical Reaction**: The alkaline slurry (often limestone mixed with water) reacts with SO_2 to form **calcium sulphite or gypsum**, preventing its release.

b. Effectiveness

- **High SO_2 Removal**: FGD systems can **remove up to 95% of SO_2**, making them highly efficient in **SO_2-specific emission control**.

c. Flue Gas Composition

- **Definition**: Flue gas, also known as **stack or exhaust gas**, is the byproduct of fuel combustion in power plants and other industrial settings.
- **Pollutants in Flue Gas**:
    - **Particulate Matter (PM)** or dust.
    - **Sulphur Oxides (SOx)** including SO_2.
    - **Nitrogen Oxides (NOx)**.
    - **Carbon Monoxide (CO)**.
    - **Traces of heavy metals** like **mercury** and gases like **CO_2**.

- **Dominant Pollutant**: **Nitrogen oxides often dominate** in untreated flue gas from Indian coal plants due to combustion characteristics.

d. Environmental Impact of Untreated Flue Gas

- **Local and Regional Air Pollution**: Continuous emission of untreated flue gas **degrades air quality**, contributing to **respiratory diseases** and **environmental degradation**.

e. FGD Process Overview

- **Absorber Tower Mechanism**: In a typical FGD system, **unclean flue gas is sprayed with limestone slurry**, which chemically reacts with SO_2.
- **Result**: The resulting compound is collected, and **cleaned flue gas is released** into the atmosphere.

Impact of Sulphur Dioxide on the Environment

a. Toxicity and Air Pollution

- **Human and Ecological Hazard**: SO_2 is a **major air pollutant**, known to cause **respiratory issues**, **crop damage**, and **harm to animals**.

b. Acid Rain Formation

- **Chemical Reaction in Atmosphere**: SO_2 reacts with **water vapor in the air**, forming **sulphuric acid**, which falls as **acid rain**.
- **Effects of Acid Rain**:
    - **Forests**: Damages foliage and weakens trees.
    - **Aquatic Systems**: Kills fish and aquatic insects by lowering pH of water bodies.
    - **Soils**: Leaches essential nutrients, reducing fertility.

c. Infrastructure and Cultural Damage

- **Material Corrosion**: Acid rain **corrodes buildings**, bridges, and metal structures.
- **Heritage Sites at Risk**: Accelerates **weathering of monuments**, statues, and historic stonework, leading to **cultural loss**.

Electrostatic Precipitators (ESPs) vs Flue Gas Desulphurisation (FGD)

Aspect	Electrostatic Precipitators (ESP)	Flue Gas Desulphurisation (FGD)
Primary Purpose	Targets **particulate matter (PM)**, especially fine dust.	Designed specifically to remove **sulphur dioxide (SO_2)**.
Cost of Installation	Approx. ₹25 lakh per MW – **economical** and scalable.	Approx. ₹1.2 crore per MW – **very expensive**.
Pollution Control Efficiency	Can eliminate **up to 99% of PM**, highly effective against visible pollution.	Removes **up to 95% of SO_2**, but **limited effect** on PM and other pollutants.
Resource Requirements	Consumes **less water and power**, reducing operational cost and environmental stress.	Requires **substantial water and energy**, increasing **environmental and economic load**.
Suitability for Indian Conditions	Ideal for Indian coal, which has **high ash** and **low sulphur**, making PM control more critical.	Less relevant, as Indian coal's **low sulphur content** makes SO_2 less of a threat.

Source: https://www.thehindu.com/sci-tech/energy-and-environment/study-funded-by-principal-scientific-adviser-recommends-end-to-environment-ministrys-order-on-de-sulphurising-coal-plants/article69461308.ece