Council of Enviro Excellence

Topic :-
FGD Implementation –Various Challenges & Suggestions

ENvX
3rd NATIONAL POWER-GEN ENVIRONMENT EXCELLENCE SUMMIT & AWARDS 2024

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FGD Implementation –Various Challenges & Suggestions

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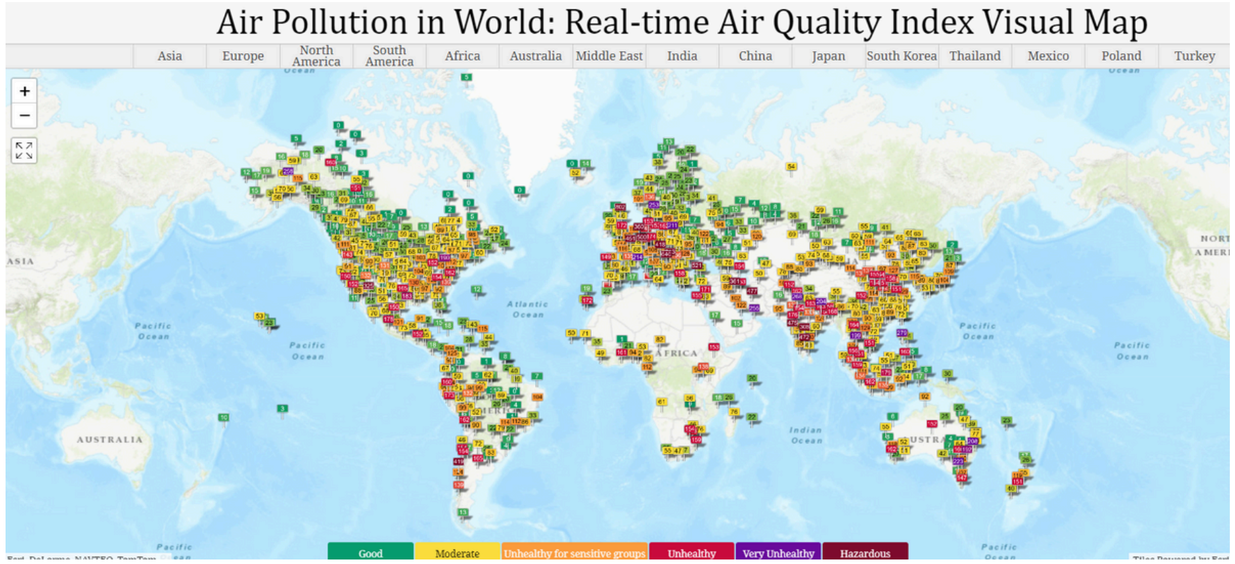
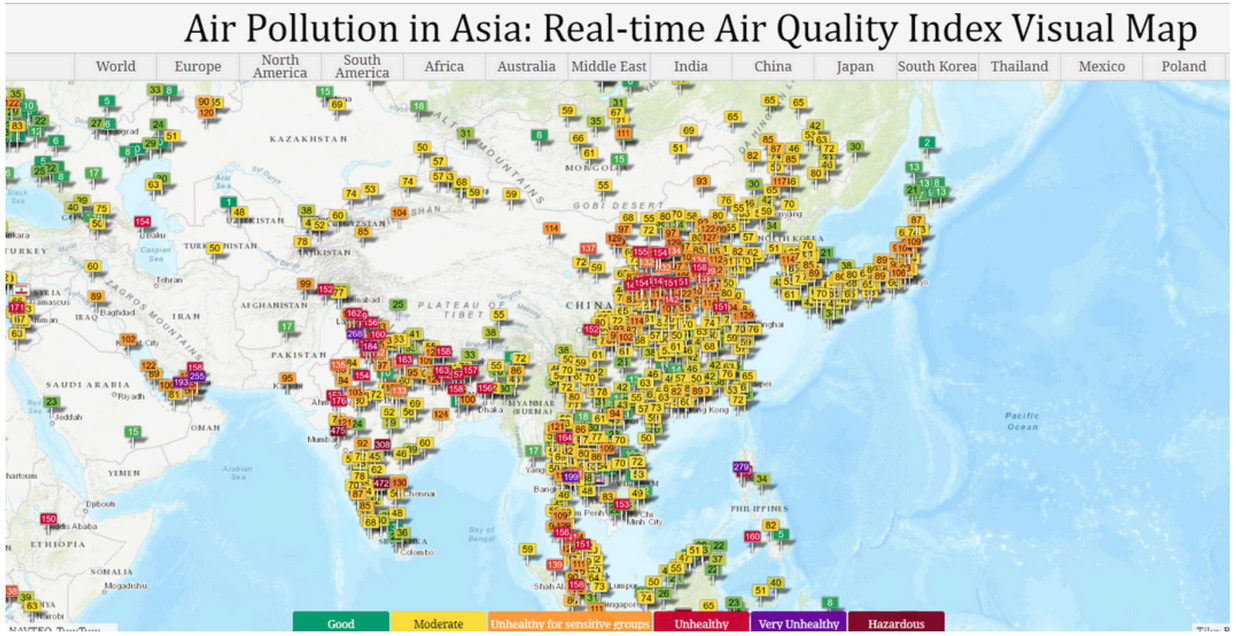
CEE 3rd National Powergen Environment Excellence Summit & Awards 2024

Air Pollution on 25/06/2024 18:32 PM: Real-time Air Quality Index Visual Map

Air Pollution in World: Real-time Air Quality Index Visual Map

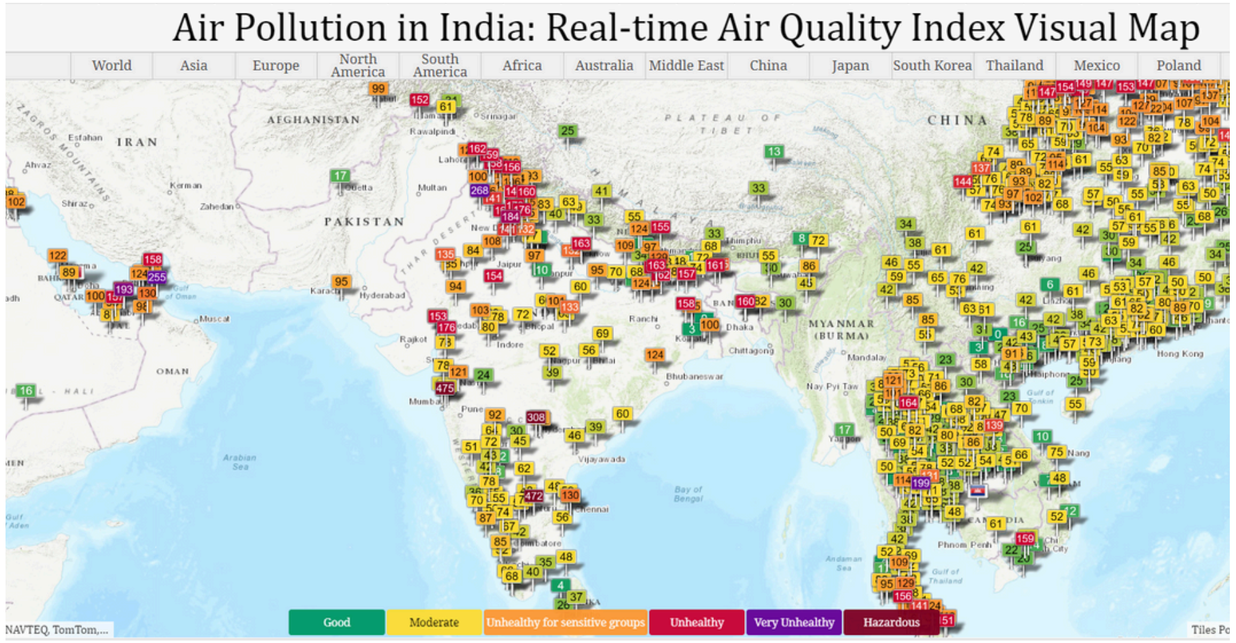


Air Pollution in Asia: Real-time Air Quality Index Visual Map

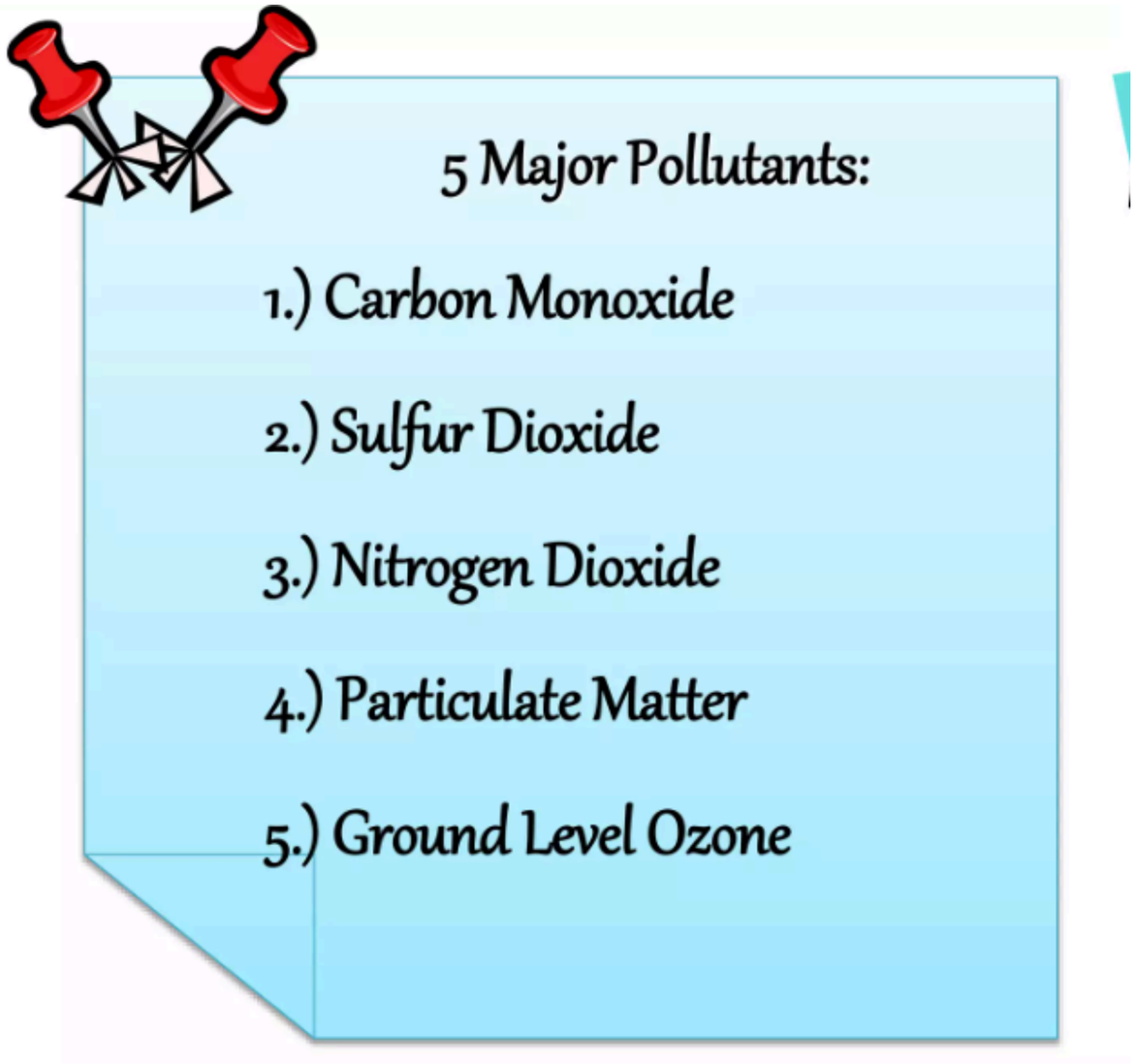


Air Pollution in China: Real-time Air Quality Index Visual Map

Air Pollution in India: Real-time Air Quality Index Visual Map



5 Major Pollutants



What is Sulphur Di-Oxide

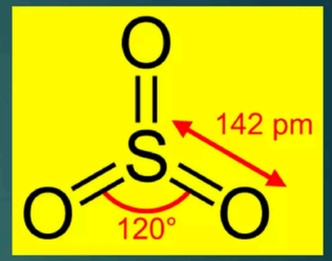
ulfur dioxide (SO_2) is a colorless, oxic, reactive gas emitted from the urning of coal and oil in electrical nergy generation or heating or from nternal combustion engines.

is also release in the industrial roduction of sulfuric acid.

he greatest threat is when combines ith water vapor in the air and form ulfuric acid and sulfates.

is irritating to the respiratory system nd when released in massive mounts may increase the tmospheric acidity

Physical properties of SO_2



- It is a colorless gas.
- It has a very pungent smell.
- It is heavier than air.
- It is a toxic gas.
- In the presence of defects and water, Sulphur dioxide can be highly corrosive.

Sources of SO_2

There are mainly 2 types of Sources of SO2

- Natural Sources :

Volcanic Eruption, Forest Fire, Decaying Plant and Matter, Hot Springs.

- Manmade Sources :

Power Plant, Automobiles, Cement Industry, Oil refineries, Various kinds of Industrial Emissions.

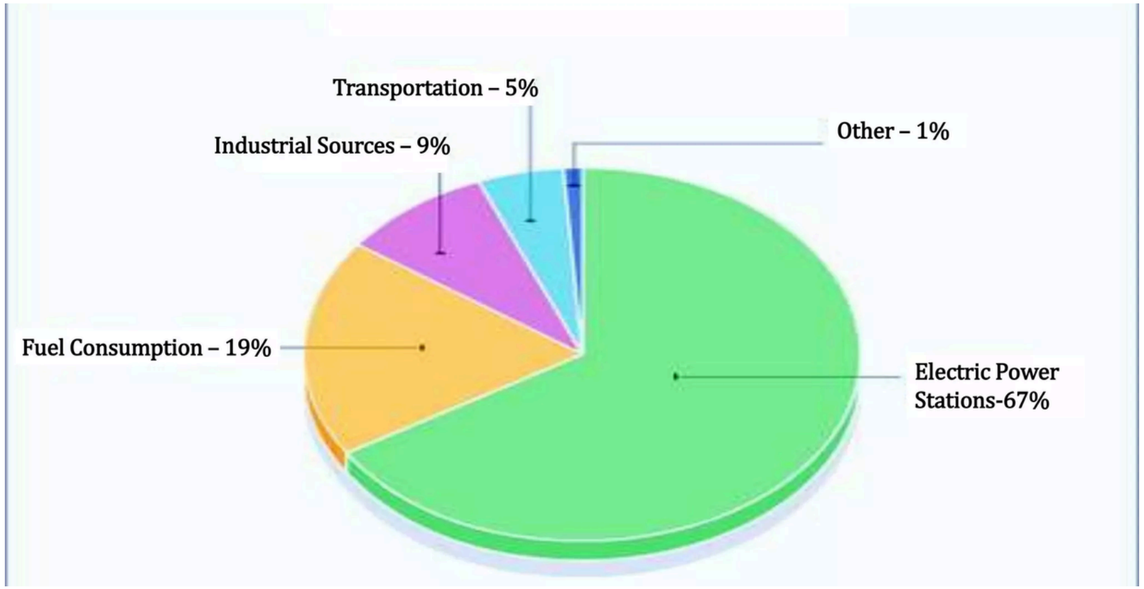
Toxic Effect of Sulphur Di-Oxide

Other Effect of Sulphur Di-Oxide

IMPACT OF SO2 ON PLANTS

- Effect on overall morphology and growth of plants:

- Prolonged exposure to SO2 fumigation have impact of up to 50% reduction of annual height and 70% reduction of diameter increase rate.
- Besides this, yellowing of leaf tissues and upward curling of leaf lamina under low doses of SO2 have been observed. With the increase in SO2 concentration, lamina curling was observed to be associated with drying and developing brittleness.
- In Pigeon Pea(Cajanus cajan), Amaranthus paniculatus, stomatal frequency of both lower and upper surface of leaves, had been observed to be increased with exposure to elevated concentrations of SO2. The increase in stomatal frequency was explained by the fact that Sulphur dioxide inhibits the growth and expansion of leaf surface thus increasing the frequency of stomata.



Effects of SO_2 on Property

- Deteriorating Buildings

Acid rain damages buildings and structures because it dissolves the stone or corrodes the metal that is exposed to the weather. Before people became aware of the problems that acid rain caused, they often used metals, limestone and marble as building materials exposed to rain and fog. Some of these materials contain calcium carbonate or calcium-based compounds, which can be dissolved by acid rain. Sandstone holds up better to acid rain, but can be marred by black surface deposits over time.

Effect of Acid Rain on TAJ MAHAL

Effect of atmospheric SO2 on papers

Paper surface

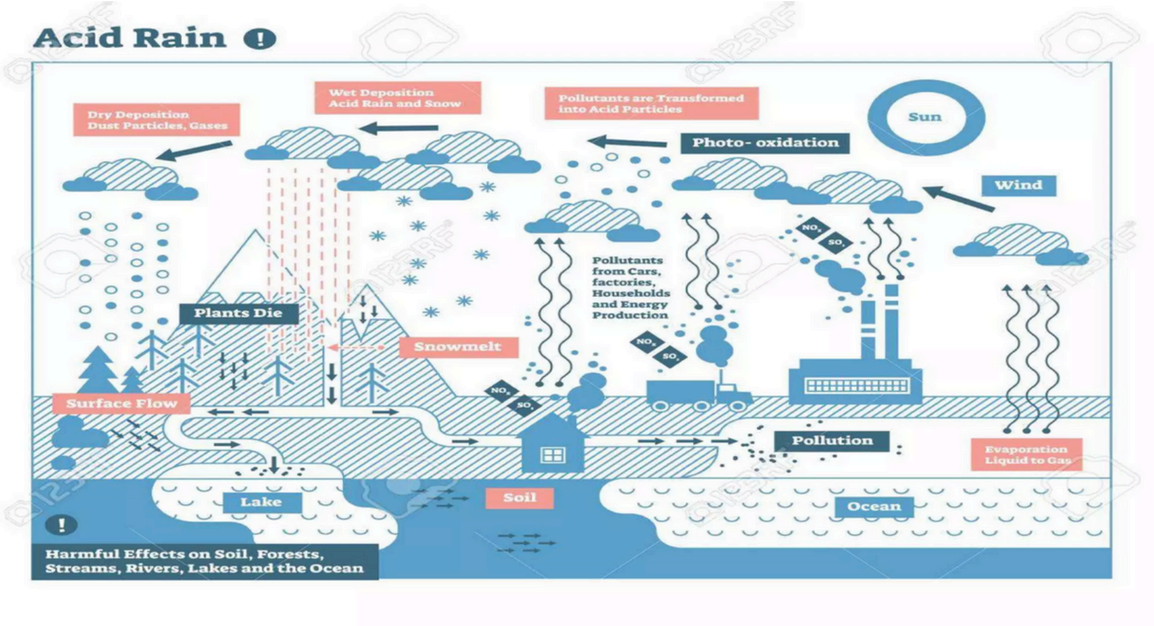
H2SO4 formation on the surface

The result

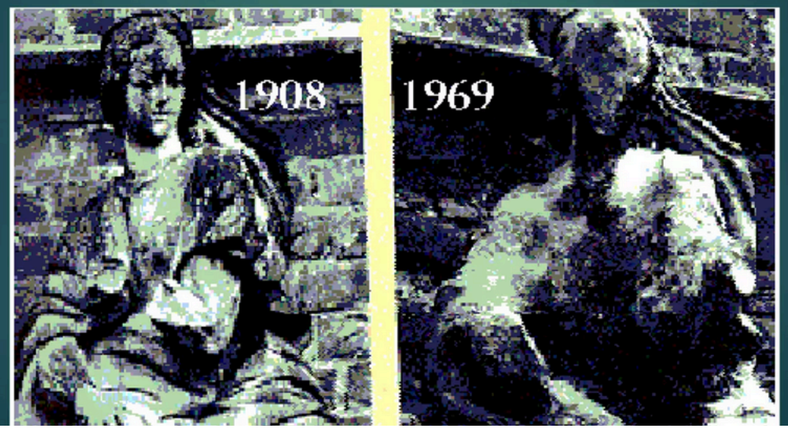
Horrible Effect of Acid Rain due Sulphur Di-Oxide

Acid Rain

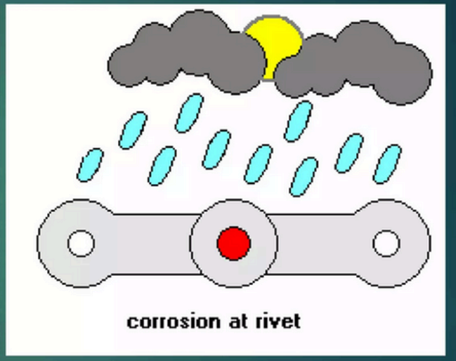
- **Acid rain**, also called acid precipitation or acid deposition, precipitation possessing a pH of about 5.2 or below primarily produced from the emission of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) from human activities, mostly the combustion of fossil fuels.
- This phenomenon results when Sulphur dioxide dissolves in moisture in the air, forming Sulphur acids, which eventually fall to the surface of the earth as acid rain.
- Acid rain directly attacks the protective coating of plants, acidifies lakes and soils which may result in the formation of substances that are toxic to plants and animals.



A sandstone statue in Westphalia, Germany, photographed in 1908 (left) and again in 1968 (right).



Acid rain: electrolyte and the hydrogen ion serves the reduction (electron uptake)



Air pollution induced electrochemical corrosion resulted in the collapse of Silver bridge over Ohio river on 15-th. Dec. 1967.

FGD FOR REMAINING PLANT REQUIRED OR NO ?

FURTHER TIMELINE EXTENSION OR NO ?

FGD TECHNOLOGY MIX OR ONLY WET LIME?

Current Scenario

- Coal-based installed capacity is expected to at 249 GW – 259 GW by 2032 as per National Electricity Plan's projections.
- The government has also announced 80 GW of new thermal capacity.
- SOx emissions regulations in 2015 initially placed a two-year window to power plants to upgrade and install FGDs. Over the years, extensions were granted and as per the latest extension in September 2022, TPPs have been given time till 2026 to install FGDs.
- Power plants are in various stages of installing FGDs to meet these deadlines.
- FGDs have been commissioned and are operational for 26 units with a total capacity of 11,590 MW.
- Further, bids have been awarded for 225 units, aggregating 101,970 MW in capacity.
- Tenders have been issued for 27,445 MW capacity spanning 96 units.
- FGD technology selection by developers largely depends on SOx removal efficiency requirements. Operators and technology providers also need to prudently manage cost economics and additional capex burden, while also factor in project commissioning delays and shutdown times for FGD installation.
- They also need to take into assessments such as space availability, salebility of by-products, topography of the plant sites, boiler design and operating characteristics.
- Wet FGDs is being taken up due to its advantages in handling high-sulfur coal and producing valuable by-products as well as strong supply chain for inputs, however, dry FGD with its own advantages, such as lower water consumption and lower capex and opex has also been considered. Seawater, ammonia-based FGD and circulating dry scrubbers are other FGD technology options which have been considered by developers. But all these Tech requires huge Lime Stone /Water /Aux Power Consumption /Huge land requirement for landfill if if bi-product is not use /All these technology produces CO_2 which is counter productive to initiatives .
- Time to look for alternate technology like Catalyst Based Technology /Ammonia based and other innovative technologies with does not require reagent and bi-product is useful with no CO_2 emission .

Will coal-based thermal power plants ever meet emission norms?

New Delhi, June 23, 2023: India's coal-based thermal power plants continue to drag their feet in meeting emission norms, says a new analysis done by Centre for Science and Environment (CSE). Sulphur dioxide (SO_2) emissions are a case in point: the CSE analysis finds that a mere 5 per cent of the installed capacity in this sector has put in place an air pollution control device – flue gas de-sulfurization (FGD) system -- for controlling SO_2 emissions.

The CSE analysis is based on the updated FGD status released by the Central Electricity Authority (CEA), the technical arm of the Union Ministry of Power, for April 2023.

New state-level analysis by CSE of compliance with sulphur dioxide emission norms throws up alarming indications of feet-dragging by the sector

Only 5 per cent of capacity meeting the norms currently. Plants in all the eastern states are non-compliant. Very few plants in the remaining regions are meeting the norms, says the CSE analysis

Courtesy : Sri Nimit Yadav /CSE Report

Eastern region

- None of the states in the eastern region -- Bihar, West Bengal, Odisha, Assam, and Jharkhand – have any thermal power plants that (TPPs) are at present complying with the emission norms. Although, apart from West Bengal, TPPs in all other states in this region are likely to meet the norms by their respective deadlines.
- As per the CSE analysis, Southern REPL TPS and Hiranmaye TPS (total capacity of 435 MW) in West Bengal will miss the deadline.
- Another 3,365 MW capacity belonging to Odisha, Jharkhand and West Bengal is still at the very initial stages of compliance -- seven years after the emission norms were introduced.
- Except Jharkhand, the remaining four states in the eastern region have commissioned coal-based power plants of total 6,962 MW capacity after January 1, 2017. All these plants were built without a provision for FGD systems, despite the fact that the notification had been introduced in 2015.

- The states and locations in this region are Delhi-NCR, Haryana, Punjab, Rajasthan and Uttar Pradesh. The Dadri TPP and Unchhar TPS in Uttar Pradesh and the Mahatma Gandhi TPP in Haryana (cumulative capacity of 3,150 MW) are the only plants in the northern region that are complying with the norms.
- These plants account for a mere 7 per cent of the total capacity in the region.
- Also, 1,025 MW capacity in Punjab and Uttar Pradesh is at a very initial stage of compliance. In the case of Uttar Pradesh and Rajasthan, 6,440 MW capacity was commissioned after January 1, 2017, two years after the enforcement of the emission norms -- yet these plants are not complying with the norms.
- In the case of **Delhi and the National Capital Region (NCR)**, 10,075 MW is likely to comply with the norms. Of this, 3,390 MW has awarded bids, 3,180 MW has floated tenders, 2,480 MW has finalised tender documents and 1,025 MW is still at a feasibility stage.
- The Panipat TPS (710 MW), owned by the state-run Haryana Power Generation Corporation Ltd (HPGCL), is unlikely to meet the 2024 deadline as the plant is yet to award a work order for FGD

Western region

- All states in this region – Chhattisgarh, Gujarat, Madhya Pradesh and Maharashtra – have some TPPs that are complying with the SO_2
- The Bandakhar TPP (300 MW) and Nawapara TPP (600 MW) in Chhattisgarh are reported to 'claim to be SO_2 compliant' – but there is no evidence to justify these claims.
- If the capacity of all the plants in the region is combined, the compliance level stands at 7 per cent of the total capacity in this region.
- Maharashtra has the highest coal thermal capacity in the country; but only 11 per cent of the state's capacity is currently complying with the norms.
- Cumulatively, almost 6 per cent of the capacity in the three states of Chhattisgarh, Gujarat and Maharashtra is unlikely to comply with the norms.
- In Madhya Pradesh, apart from the plants that are complying, or have CFBC boilers, or have been identified for decommissioning, the remaining capacity (72,310 MW) is likely to meet the norms by the deadlines.

Southern region

- In Karnataka, which had reported zero compliance in the December 2021 CEA status report, 260 MW now claims to be SO_2
- In Tamil Nadu and Andhra Pradesh, there is a substantial increase in the capacity that is likely to meet the norms.
- Andhra Pradesh has the highest coal power capacity among all states in the region which would miss the deadlines; this capacity has already completed its most efficient operational life of 25 years.
- The Dr Narla Tata Rao TPS, Vizag TPP (Andhra Pradesh), Muthiara TPP, North Chennai TPS (Tamil Nadu), and the Thoothukudi Station-IV TPS (Telangana) are likely to miss the deadlines.
- Not a single power plant in Andhra Pradesh and Telangana is complying with the norms till date.
- The region also has the highest capacity (9,245 MW) in the country that is still exploring the feasibility of SO_2 control on the premises of the plants.
- Around 6,270 MW capacity was commissioned in this region after 2017 in the states of Tamil Nadu, Telangana and Karnataka – but these plants still do not have SO_2 control measures in place.

Courtesy : Sri Nimit Yadav /CSE Report

Post Notification Studies by IIT and NEERI

for FGD implementation in TPP. To explore such a feasibility, the 24hr avg.(max) SO2 ground based measured levels (CPCB, 2018 data) were categorized into 5 distinct levels:

i. Level I : above 40 µg/m3
ii. Level II : 31-40 µg/m3
iii. Level III : 21-30 µg/m3
iv. Level IV : 11-20 µg/m3
v. Level V: 0-10µg/m3.

An MOU between CEA and IIT Delhi was signed on 12.12.2022 to survey ambient atmospheric SO2 concentrations in different category of cities based on their vicinity to thermal power plants (TPPs). Baseline survey of ambient SO2 concentration will be conducted in three category of cities-

Category-1: City with no coal based TPP,
Category-2: City with a coal based TPP in which FGD has not been installed and the TPP is located within 10km from the city boundary
Category-3: City with a coal based TPP in which FGD has been installed and the TPP is located within a distance of 10km from the boundary of the city.

Further, an additional study (Phase II) on the direction of Hon'ble Minister where simultaneous measurements of ambient atmospheric SO2 concentrations at two different locations in three different category of cities namely, Gautam Buddha Nagar, Kota and Lucknow based on their vicinity to coal based thermal power plants (TPPs) is to be conducted and the status of FGD installation in these TPPs.

As per direction of Hon'ble Minister of Power in meeting dated 26.09.2023, IIT Delhi was asked to conduct further survey/study during Phase-III in same cities with addition to few comparable towns/cities with and

Courtesy :Quarterly Review Report/Renovation & Modernization of Thermal Power Stations/Quarter: Jan–Mar., 2024/I.S.O.: 9001: 2015

POLLUTION

A central meeting showed pushback against tech in power plants to reduce SO2 emissions. Here's why it's a bad idea

New IIT-D study has challenged need for flue gas desulfuphisation in thermal power plants

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By Anubha Aggarwal
Published: Friday 10 May 2024

Some findings of IIT-Delhi on ambient atmospheric SO2 concentration and impact of FGD installation in different category of industries

Parameter	Category 1 cities (without TPP)	Category 2 cities (TPP without FGD)	Category 3 cities (TPP with FGD)
SO2 concentration in ambient air due to TPP emissions	No effect	No effect	No significant difference observed in SO2 ambient air concentration despite FGD
Secondary particulate matter (PM 2.5) from SO2 emissions	2 +- 2%	4 +- 1%	4 +- 2%
Secondary particulate matter (PM 10) from SO2 emissions	1 +- 1%	3 +- 1%	3 +- 1%

Source: Author's compilation from office memorandum detailing the minutes of the meeting

- A high-profile meeting to review the results of a study conducted by IIT-Delhi on ambient atmospheric Sulphur dioxide (SO2) concentrations and the effect of installing flue gas desulphurization (FGD) technology on SO2 emissions in various categories of cities, as defined by them.

  • The meeting was attended by senior officials, including secretaries and joint secretaries from the Ministry of Power, chief engineers and deputy directors from Central Electricity Authority (CEA), a director and an additional secretary from the Ministry of Environment, Forest and Climate Change (MoEF&CC), a scientist from Central Pollution Control Board (CPCB), members and advisors from apex public policy think tank Niti Aayog and general managers and executive directors from NTPC Ltd.
- The emission standard for SO2 from coal-fired thermal power plants (TPP) is acknowledged to be the most challenging to meet. This is largely because FGD, the technology to control sulphur levels in the exhaust emissions of power plants, is expensive and was, until recently, heavily reliant on imports.
- In the last 8.5 years, the technical and financial complexities of FGD installation, as well as related regulatory issues, have been used as reasons to extend the deadlines for complying with the emission norms set by the MoEF&CC in 2015.

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trajectory of compliance by thermal power plants with the emission norms. Almost every time a deadline has approached, these government institutions have invariably managed to find some "compelling" reason to delay the Instead of defending the standards it had established, the MoEF&CC noted that it might be "difficult" to "modify" the SO2 norms after eight years since their introduction.implementation of the norms.

- With just a few months remaining for nearly 19 gigawatts (GW) of installed capacity to meet the SO2 standards by December 2024, the new study discussed at the meeting has significantly discredited the importance of FGD for TPPs in India.

- An office memorandum detailing the minutes of the meeting was assessed by Delhi-based think tank Centre for Science and Environment (CSE). It states that the SO2 emissions from coal-fired TPP stacks have no significant impact on ambient air quality beyond a 60-kilometre radius from the power plant.
- It also disputes the significant formation of secondary particulate matter (both PM 2.5 and PM 10) from SO2 emissions from coal-fired TPPs. The study's key findings, as recorded in the minutes of the meeting, are summarised in the table:
- In simple terms, the findings loosely suggest that the SO2 standards for power plants might not have been necessary to set in the first place. If it weren't for the documented evidence, an observer of these meeting proceedings might mistakenly conclude that coal power plants are among the cleanest industries!

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•Niti Aayog took a more progressive stance, albeit with a focus on promoting carbon capture from coal TPPs rather than other environmental issues. VK Saraswat, a member of Niti Aayog, stated that implementing a carbon capture and utilisation (CCU) plant would require the installation of FGD to reduce SO2 in the flue gas.

•NTPC, which has awarded contracts for FGD installation covering 93 per cent of its operating capacity and has already installed the technology in three of its plants, opined that FGD operation in power plants could reduce import dependency for gypsum and sulphuric acid.

•CEA) submitted that the cost of FGD has increased to Rs 1 crore per megawatt (MW), leading to an additional charge of 0.50 paise per unit of electricity if the technology is installed in power plants. It is worth noting that the cost of FGD has surged from Rs 35 lakh to Rs 1 crore per MW in the last eight years.

•Although consumers would bear the additional costs if FGD is implemented, the coal power plants and regulators are seemingly absolved of any responsibility for the technology prices being subject to market forces.

•While it has been shown that controlling SO2 from TPP might not have a significant impact on ambient air quality, concerns about increased water consumption and CO2 emissions from FGD operation were raised in the meeting.

The deliberations led to the issue of following action points:

•CEA is to conduct a cost-benefit analysis of FGD installation, assessing its impact on electricity tariffs, benefits from gypsum production and its impact on CO2 emissions.

•CEA and NTPC will study and present to the Ministry of Power the cost-economics of a CCU system.

•CEA will compile a list of imported items required for FGD manufacturing, with the aim of promoting domestic production of these components.

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- The latest office memorandum appears to be an attempt to justify scrapping SO2 standards or, at the very least, making them case-specific. In these 8.5 years, work orders for FGD installation have been awarded for a 100 GW capacity, 9 GW has installed FGD and manufacturing has advanced to the point where only 17 per cent of FGD components are imported.

- This despicable attempt to 'do away' with SO2 norms altogether raises two pertinent questions. First, does it imply that MOEF&CC and CPCB applied zero consideration when setting the emission standards for coal power plants?
- Second, if these organisations are at fault for establishing SO2 norms for power plants, who can say that the National Ambient Air Quality Standards, against which the new findings have been assessed, serve as a reliable benchmark for the mindfulness of these scientists?

- Regarding regulatory and policy efforts, considerable resources have been spent on legal battles over deadline extensions, norm relaxations, petitions for tariff changes and regulatory processes aimed at simplifying implementation.
- Was all this in vain? This office memorandum threatens to undermine the systems set up over the past eight years to comply with the norms.

It is sad to observe the poor state of environmental governance in the country, said CSE.

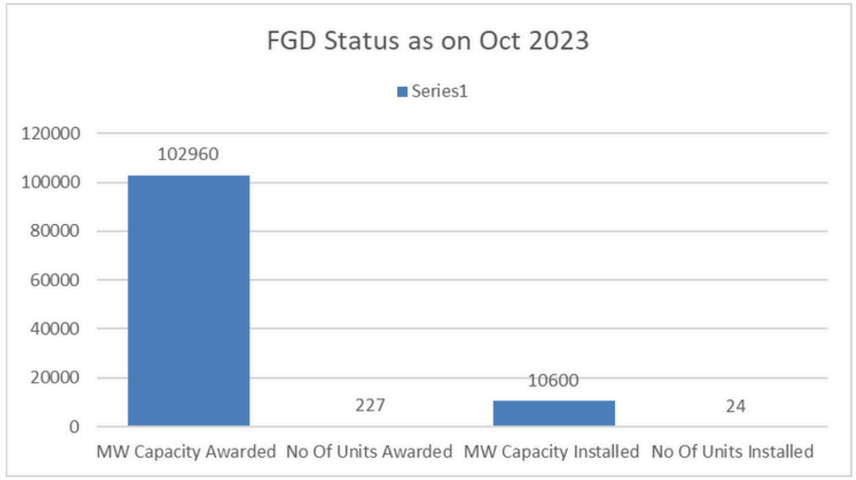
Unit_wise_FGD_implementation_status_and_summary_sheet_October_2023

General Summary (MW)

S.No.	Sector	Total (MW)	CFBC	Claims SO2 compliance	Retired	Feasibility study not started	Feasibility Study started	Feasiblity Study Completed	Tender specification made	NIT issued	Bid opened	Bid Awarded	FGD installed
1	Central	67250	750	0	430	0	210	0	0	1110	2390	58710	3650
2	State	67741.5	1075	0	1004	0	2437.5	10430	5050	17545	11490	18710	0
3	Private	76528	4101	1430	0	1370	6430	6395	5730	7240	11342	25540	6950
	Total	211519.5	5926	1430	1434	1370	9077.5	16825	10780	25895	25222	102960	10600

General summary (No. of units)

S.No.	Sector	Total (No. of units)	CFBC	Claims SO2 compliance	Retired	Feasibility study not started	Feasibility Study started	Feasiblity Study Completed	Tender specification made	NIT issued	Bid opened	Bid Awarded	FGD installed
1	Central	168	4	0	3	0	2	0	0	6	11	133	9
2	State	221	7	0	7	0	11	38	16	65	29	48	0
3	Private	211	42	6	0	2	24	16	13	18	29	46	15
	Total	600	53	6	10	2	37	54	29	89	69	227	24



Suggestions

- CEA to allow plant owner to adapt FGD technology of their choice complying norms .
- Plants retiring in 2-5 years needs to be exempted .
- Various location and age of the plants needs to be allocated different emission norms.
- FGD technologies producing CO2 in process and waste bi-products needs to be banned .
- Ban from FGD Equipment Import from China to be lifted for timely completion of projects
  & smooth O&M at reduced cost ..
- FGD Policy scarping will have serious impact on human ,plant and animal life hence it should be made further stringent .
- FGD Policy scarping will have serious impact on many project under execution and EPC companies will be exposed to huge losses and bankruptcy etc .
- MoP to create plateform for easy buy and sale of related reagent and bi-products also Reagent Price Control and Gypsum buy back .
- Govt to take FGD under viability gap funding scheme .
- No further extension and strict high penalty for non compliance .
- Revision of Norms by 2025 .
- Nox reduction norms to be stricter

Disclaimer : Views are of authors only and the information taken from public domain.

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