



# DISCUSSION PAPER

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# Emissions Control in Thermal Power Stations: Issues, Challenges, and the Way Forward



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# CONTENTS

At a Glance.....	iv
Introduction .....	1
Environmental Pollution from Thermal Power stations .....	2
Emission Control Systems and the Current Status of Implementation .....	3
Control of Sulphur Dioxide Emission .....	3
FGD implementation status in the country: .....	3
Status of FGD installation in NCR .....	4
Control of Particulate Matter Emission .....	4
Control of Nitrogen Dioxide Emission .....	5
Issues and Challenges.....	6
Policy and Regulatory Developments .....	7
The Way Forward.....	8
Annexure .....	11
Phasing Plan of Emission Control Equipments .....	11
Status of Emission Control Systems in TPSs, NCR .....	12
References.....	13

## AT A GLANCE

- As per TERI analysis, of the total environmental pollution in 2016, power sector reportedly accounted for 51% of SO<sub>2</sub>, 43% of carbon dioxide (CO<sub>2</sub>), 20% of oxides of nitrogen (NOx), and 7% of PM<sub>2.5</sub> emissions.
- Ministry of Environment, Forest and Climate Change (MoEFCC) revised the emission norms for thermal power stations (TPSS) on 7 December, 2015 requiring an implementation of the emission control systems (ECSs) within 2 years from the date of notification. The deadline had to be pushed to December 2022 for all the power stations in the country in view of the sheer volume of work, implementation issues and challenges as well as the critical need for maintaining supply of electricity. Power stations in national capital region were however required to comply with the revised norms by December, 2019.
- Implementation of these measures in NCR stations brings out that the measures for control of PM<sub>2.5</sub> are on a better footing as compared to the same for control of NOx and SOx. The same holds true for other plants in the country. An action plan giving top most priority to the remaining work in NCR stations is an emergent requirement.
- Coordinated and concerted efforts are required for meeting the time-lines for control of all the pollutants in all the power stations, more importantly in the state and private sector plants, which are lagging behind considerably.
- This paper brings out the overview of new environmental norms, present status of their implementation, issues, challenges, and the way forward.

# INTRODUCTION

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Air pollution is a growing concern in many countries including India. Air pollution in the form of particulate matter (PM), SO<sub>x</sub>, NO<sub>x</sub>, mercury, etc., comes from various sources such as industries, thermal power stations, construction and demolition work. Out of 10 most polluted cities in regard to PM<sub>2.5</sub> level in world, 9 cities are in India. The Indian cities which find a place in the list are Kanpur, Faridabad, Gaya, Delhi, Gurugram, Varanasi, Agra, Lucknow and Patna.

Ambient air pollution is widely known to have severe negative impacts on human health. When emitted into the atmosphere, SO<sub>x</sub>, NO<sub>x</sub>, and mercury undergo chemical reactions to form compounds that can travel long distances. These fine particles compounds contribute to death and serious respiratory illness (e.g., asthma, chronic bronchitis). Exposure to particulate matter leads to various diseases that have short and long term health effects. Short term effects include severity of asthma and lower respiratory infections (LRI) in children and adults. Long term exposure leads to increased likelihood of suffering chronic illness including chronic obstructive pulmonary disease (COPD), ischemic heart disease (IHD), lung cancer (LC) and systemic oxidative stress, among others. The Indian Council for Medical Research (ICMR) reported India's ambient air pollution-related premature mortality at 0.67 million in 2017. A recent assessment at TERI on the health impacts of air pollution reveal that total mortality due to ambient air pollution will be 0.76 million in 2020.

Exposure to ambient PM<sub>2.5</sub> concentrations is linked with cardiovascular and respiratory diseases, and cancers. Among various pollutants, PM<sub>2.5</sub> has been found to have one of the strongest associations with mortality and morbidity (Pope, Burnett, Turner, et al. 2011). Since these particles are extremely small, they tend to get

into human organs thereby affecting them over time. As per recent estimates by the World Health Organisation (WHO), in cities and rural areas, exposure to ambient PM<sub>2.5</sub> concentrations were estimated to cause 4.2 million premature deaths worldwide per year (WHO 2018).

The coal-fired power generation is considered as one of the major source of environmental pollution in India. Of the total environmental pollution in 2016, power sector reportedly accounted for 51% of SO<sub>2</sub>, 43% of carbon dioxide (CO<sub>2</sub>), 20% of oxides of nitrogen (NO<sub>x</sub>), and 7% of PM<sub>2.5</sub> emissions (TERI Analysis). Coal based power plants have dominated the power supply mix since 1980s. As of 31 March 2019, around 56% of India's total installed capacity, 365 GW, was coal based and these thermal power stations (TPSs) accounted for 75% of the total electricity generation in the country.

Over the years, Government of India has been taking necessary action to contain environmental pollution from various sources including thermal power stations. Norms for control of emissions from thermal power stations, first notified by Ministry of Environment, Forest & Climate Change (MoEFCC) in 1984, have undergone change from time to time. On 7 December, 2015, the prevailing norms in respect of PM<sub>2.5</sub> and were revised and norms in respect of SO<sub>x</sub>, NO<sub>x</sub> and mercury were introduced.

The norms currently in vogue were notified on 7th December, 2015. Environmental concerns having become more pronounced, MoEFCC notified "Environment (Protection) Amendment Rules, 2015" for thermal power stations.

This paper aims to present an overview of new environmental norms, their implementation status, factors coming in way of their implementation, as well as suggested measures, wherever possible.

# ENVIRONMENTAL POLLUTION FROM THERMAL POWER STATIONS

“Environment (Protection) Amendment Rules, 2015” for thermal power stations notified by MoEFCC on 7th December, 2015 specify limits in respect of four pollutants as well as specific water consumption as given in Table 1.

The existing stations as well as new stations including upcoming stations were required to comply with the new standards within 2 years of issue of notification i.e. by 7 December 2017. Implementation of pollution control measures in order to comply with new standards in coal based capacity which stood at about 173 GW as on 31 December, 2015 and also in the new capacity to be commissioned within the next 2 years without impacting continuity and reliability of power supply, seemed to be a challenging task. The issues and challenges were discussed in a number of meetings. On 8 June 2016, in a meeting chaired by the MoEFCC and MoP, it was decided that a committee comprising representatives from MoEFCC, MoP, Ministry of Coal, CEA and CPCB may be constituted to look into all the issues related to the implementation of norms. In the meeting it was inter-alia decided that MOP/CEA shall submit by December, 2016 (a) plan for phasing out of power plants commissioned up to December, 2003 and (b) implementation plan in respect of units commissioned during January, 2004 to December, 2016. On 21 September 2016, Ministry of Power constituted a committee under chairmanship of Chairman, CEA to prepare an action plan. On 30 June 2017, MoP communicated to MoEFCC concerns

of various thermal power plants with regard to compliance of new emission norms, particularly w.r.t. particulate matter, SO<sub>x</sub> and NO<sub>x</sub>. Along with CEA report outlining plan of action for implementation of new norms keeping in mind the techno-economic feasibility and ensuring availability of power to all at affordable cost without any disruption.

To review the issues arising out of new environmental norms, a meeting was held on 1 September, 2017 in MoEFCC with CEA, CPCB and NTPC. In the meeting, it was decided that the action plan submitted by MoP to MoEFCC extending up to 2024 should commence from 2018 and the same be implemented by 2022 with respect to all pollutants. A revised plan accordingly prepared by CEA was submitted by Ministry of Power to MoEFCC on 13 October 2017. Taking into consideration the technical challenges and time required for installation of Flue Gas Desulphurisers (FGD) and other technologies to meet the new emission limits, MoEFCC gave concurrence to the revised implementation plan on 7 December 2017. Taking note of a study by IIT, Kanpur on Air Pollution and Green House Gases (GHGs) in Delhi (January, 2016) bringing out that 13 power plants in the radius of 300 km of Delhi are expected to contribute to secondary particles, the target date for environmental compliance in respect of the plants located in national capital region (NCR) was decided as December, 2019.

**Table 1** New environmental norms for thermal power stations (MoEFCC 2015)

Emission Parameter	TPSs (Units) Installed		
	Before 31.12.03	After 31.12.03 to 31.12.16	From 01.01.17
Particulate Matter (PM)	100 mg/Nm <sup>3</sup>	50/Nm <sup>3</sup>	30 mg/Nm <sup>3</sup>
SO <sub>2</sub>	600 mg/Nm <sup>3</sup> (For < 500 MW Unit)	200 mg/Nm <sup>3</sup> (For => 500 MW Unit)	100 mg/Nm <sup>3</sup>
NO <sub>x</sub>	600 mg/Nm <sup>3</sup>	300 mg/Nm <sup>3</sup>	100 mg/Nm <sup>3</sup>
Mercury (Hg)	NIL (< 500 MW Unit) 0.03 mg/Nm <sup>3</sup> (=>500 MW Unit)	0.03 mg/Nm <sup>3</sup>	0.03 mg/Nm <sup>3</sup>
Water	1. All plants with once through cooling (OTC) shall install cooling tower and achieve specific water consumption (SWC) up to maximum of 3.5 m <sup>3</sup> /MWh within a period of 2 years from the date of publication of the notification. 2. All CT-based plants reduce SWC up to maximum of 3.5 m <sup>3</sup> /MWh within a period of 2 years from the date of publication of the notification. 3. New plants to be installed after 1 January 2017 shall have to meet SWC up to maximum of 2.5 m <sup>3</sup> /MWh and achieve zero waste water discharge.		

# EMISSION CONTROL SYSTEMS AND THE CURRENT STATUS OF IMPLEMENTATION

Emission control systems (ECSs) in the form of Flue Gas Desulphurisation (FGD), Selective Catalytic Reduction (SCR)/ Selective Non-Catalytic Reduction (SNCR) need to be implemented and measures such as combustion modification and retrofit of Electro-Static Precipitator (ESP) are required to be taken wherever necessary for control of SO<sub>x</sub>, NO<sub>x</sub>, PM and mercury within the limits specified by MoEFCC. Phased implementation plan for the emission control systems for controlling SO<sub>x</sub> and PM is at Annexure 1.

The mercury content in Indian coal ranges between 0.01 ppm and 1.1 ppm (Rai, Raman, and, Choudhary 2013). As mercury boils at low temperatures, thermal power plant emits 90 % of its mercury in to air and 10% to land. Mercury abatement from the emission can be achieved as co-benefit of reduction of NO<sub>x</sub>, SO<sub>x</sub> and dust. A higher degree of focus as of now, therefore is towards the reduction of SO<sub>x</sub> and NO<sub>x</sub> emissions which will automatically reduce mercury emission.

## Control of Sulphur Dioxide Emission

To curtail SO<sub>x</sub> emission from power plants, various types of Flue Gas Desulphurisers (FGDs) are being installed before the inlet of power plant stack. FGD removes SO<sub>x</sub> content from flue gas using various chemical processes. For a typical coal-fired power station, flue-gas desulfurization may remove more than 90% of the SO<sub>2</sub> in the flue gases (Compositech Filters nd). Various types of FGD technologies such as wet type FGD (which use limestone, ammonia and sea water as raw material), semi-dry type FGD and dry sorbent injection (DSI) FGD are

available. Wet type FGD technology, using lime stone as raw material, is prominent world-wide mainly on account of lower capital and operating expenditure.

### FGD implementation status in the country:

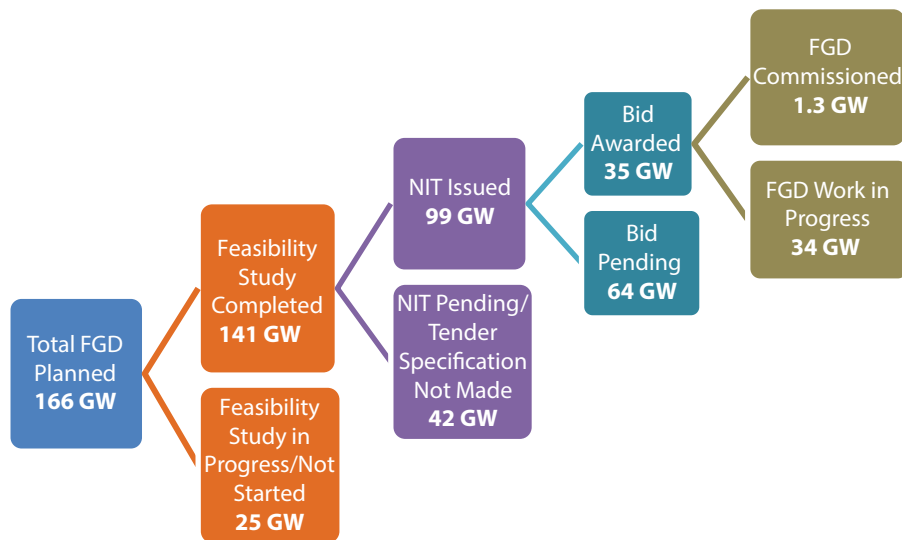
The Central Electricity Authority prepared a detailed plan in consultation with the utilities that includes FGD implementation programme, shutdown planning, etc. Table-2 gives the overall sector-wise picture in regard to the stage at which how much plant capacity stands with respect to implementation of FGD, as of September, 2019.

The latest available status shows that against the proposed plan of implementation of FGD in generating units aggregating ~166 GW, it has been installed only in ~1.3 GW (hardly 1%), feasibility study has been started in units aggregating ~162 GW and it has been completed in ~141 GW. However, bids have been awarded only for ~35 GW capacity. This is extremely low as compared to the phased implementation plan requiring implementation in plants with aggregate capacity of 5.44 GW (see Exhibit 2) by 2019 and 31.77 GW by 2020. The current status of progress in regard to FGD deployment makes it abundantly clear that majority of power plants would face a challenge in installing FGD system by the respective planned cut-off dates. Cumulative capacity planned for FGD implementation from 2018 to 2022 as shown in Exhibit-I portrays the magnitude of such a challenge.

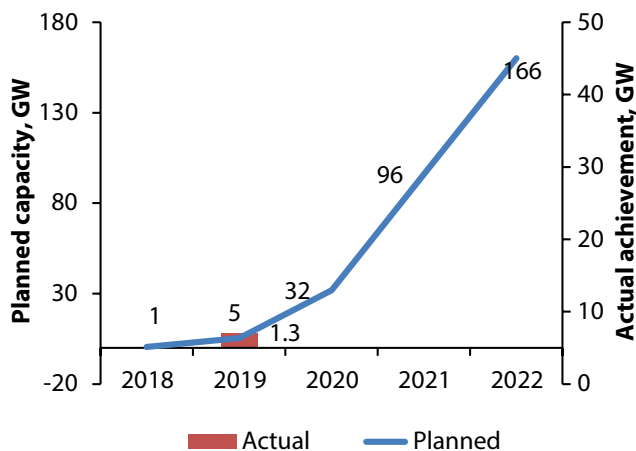
While there seems to be some action on the part of central sector plants, the ones in private and state sector are lagging behind significantly. The situation in state sector is alarming where FGD is to be installed in units

**Table 2** FGD implementation status of TPSs (September 2019) (Capacity in MW)

S. No	Sector	FGD Planned	Feasibility Study Completed	NIT Issued	Bids Awarded	FGD Commissioned
1	Central Sector	53 350	53 350	51 510	32 840	0
2	State Sector	51 885	43 965	18 625	1000	0
3	Private Sector	61 237	44 080	29 060	1320	1320
	Total	166 472	141 395	99 195	35 160	1320



**Exhibit 1** Status of FGD implementation in the country up to September 2019



**Exhibit 2** Cumulative phase implementation plan for FGD

with a total capacity of 52 GW but only 1 GW capacity had been awarded up to September, 2019.

### Status of FGD installation in NCR

In December 2017, the Central Pollution Control Board (CPCB) issued directions under Section 5 of Environment Protection Act to all coal-based power plants, affirming timelines for compliance mostly as per CEA's phasing plan, i.e. December, 2022. CPCB's directions, however, made two changes to the CEA's schedule: FGD installation was accelerated till December 2019 for plants based within a radius of 300 km of Delhi; timelines for upgrading Electro-Static Precipitators (ESP), which were not detailed in CEA's plan, were also specified. Table-3 presents an overview of the FGD installation plan and progress in the thermal power stations located in NCR.

Power Plant wise implementation status in NCR may be seen at Annexure-2. It is noted that out of a total capacity of ~12.8 GW, feasibility study has been completed for all the stations, contracts have been awarded for ~4.6 GW, and FGD has been installed only in one plant of 1.3 GW.

## Control of Particulate Matter Emission

Electro-Static Precipitators (ESPs) are deployed for control of particulate matter (PM) in thermal power stations. The power stations commissioned recently comply with the new environment norm (50 mg/Nm<sup>3</sup>) for PM. Out of a total of 197 GW of plant capacity as in December, 2017, PM non-compliant capacity was noted as 73 GW (37%), out of which 66 GW capacity has been considered for ESP implementation/up-gradation implementation plan for 65 GW (99%) is already in place.

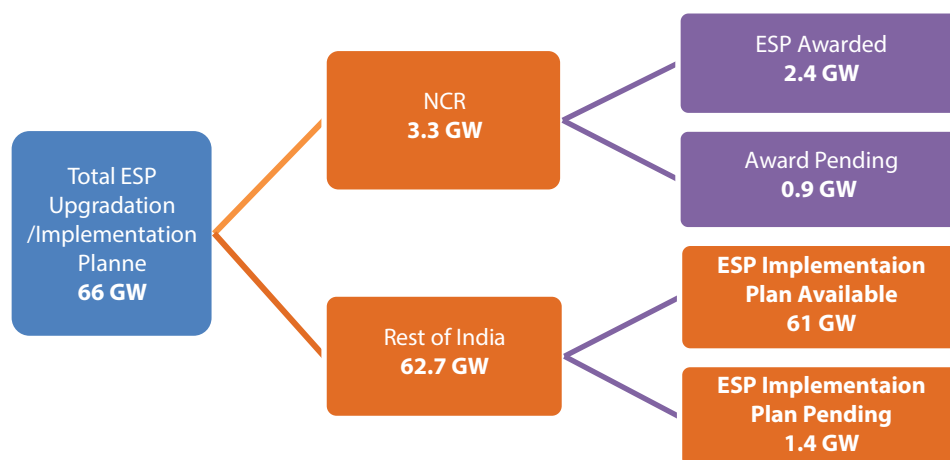
A review of implementation status of pollution control measures for control of particulate matter in thermal power stations in NCR as of 30 September, 2019 shows that out of a total capacity of 12,790 MW, statutory limits were already complied by plants with capacity of 9,450 MW, and orders for ESP had been placed for 2420 MW. Status of ESP implementation is shown in Exhibit 3.

The progress of implementation of PM emission control equipments in TPSs in the country in general and in the TPSs in the NCR region in particular therefore seems to be on track.



**Table 3** FGD implementation status of TPSs situated in NCR region (September 2019) (Capacity in MW)

S. No	Sector	FGD Planned	Tender Specifications Made and NIT Issued	Bids Awarded	FGD Commissioned
1	Central Sector	3320	3320	3320	0
2	State Sector	4770	4770	0	0
3	Private Sector	4700	4700	1320	1320
	Total	12 790	12 790	4640	1320



**Exhibit 3** Status of ESP implementation in the country up to September 2019

## Control of Nitrogen Dioxide/ Nitrogen Oxide Emission

As per the revised plan submitted by the MoP on December 2017, it was suggested that pre combustion modification such as in-situ modification in boiler, installation of Low NOx burners and over-fired air (OFA) shall be adopted besides installation of SCR/SNCR systems by 2022. An affidavit dated 20 August, 2018 (SCI 2019), was filed by CEA with respect to NOx, requesting for change of norm of 300 mg/Nm<sup>3</sup> and 100 mg/Nm<sup>3</sup> for thermal units installed after 31 December, 2003 to 450 mg/Nm<sup>3</sup> which is practically achievable with the combustion modification. With the help of Secondary over Fired Air (SOFA) provided in boiler, NOx level can be maintained at 450 mg/Nm<sup>3</sup>.

Furthermore, a meeting was held on 17 May, 2019 having participation from MoEFCC, Environment Pollution Prevention and Control Authority (EPCA), Ministry of Power (MoP), CPCB, CEA, and NTPC (India Environment Portal 2019). During the meeting it was decided that to assess NOx emissions, a joint sampling by CEA and CPCB would be carried out at TPSs having Combustion

Modification by design and CPCB shall submit Report to MoEFCC. Subsequently the joint monitoring was carried out in 7 units of 4 thermal power stations by joint team of CPCB and CEA from 13 February, 2019 to 2 April, 2019. Out of 7 monitored units, only 5 units were found complying with the NOx emission standards of 300 mg/Nm<sup>3</sup> at full load only. So, it was agreed in-principle to revise the NOx norms from 300 to 450 mg/Nm<sup>3</sup> for thermal power plants installed between 1 January, 2004 to 31 December, 2016 and same would be presented for a final decision to Secretary MoEFCC and Secretary MoP. Revision specifying relief for NOx emission is awaited.

Under the guidance of MoP, NTPC set out to test SCR/ SNCR technologies in some of the NTPC units on pilot basis to assess viability of these technologies for Indian coal, which contains high amount of ash. Installation of SCR on these units has reportedly been completed. The results of these pilot tests, once available, will bring clarity in regard to way forward for implementation of NOx control systems.

# ISSUES AND CHALLENGES

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A number of factors have impeded implementation of pollution control measures in the thermal power stations; the key inhibiting factors are presented in the following paragraphs.

A planned shutdown for implementation of emission control systems which could cause non-availability of supply and revenue loss to DISCOMs appears to be primary concern of DISCOMs and state governments in view of a number of state, private and central sector power plants supplying power to a DISCOM likely to be under shutdown at any point of time for implementation of emission control systems. Alternate power, if available, could be costly, which would add to their financial woes.

Generating companies - mostly the ones supplying power to a single State – seem to be concerned about recovery of full additional capital expenditure through tariff due to lack of clarity in regard to regulatory treatment. The power stations which plan to go ahead with requisite measures for emission control, find downgrading of the stations in the merit order despatch due to increase in marginal cost, to be an important concern. The resultant reduction in plant load factor and higher fixed charges per unit of electricity generation is another operational challenge for such plants till the time all the plants implement emission control systems to comply with the revised emission norms. This makes the lenders also wary of funding additional capital expenditure (Adcap) requirements for this purpose.

Lack of bidders for supply of FGD is coming in the way of meeting the target for implementation in time. FGD manufacturers/suppliers do not seem to be keen to

increase their manufacturing capacity as they reckon it as one-time opportunity rather than a recurring one, this translates into high lead time for supply of equipment.

Suppliers are facing an issue on the availability of 'working front' for facilities, materials, batching plant, etc., and delay in approval of drawings is leading to delay in implementation in many of the projects under execution.

Further, add-on scope such as wet stack, water treatment plant, lime handling system, etc., not being the core competence of bidders for the main equipment, lead to an increase in cost and overall implementation schedule.

Delays in decision making for placement of order by generating companies occurring at times, as well as requirement of compressed time schedule matching with phased implementation plan present difficulties for the manufacturers/supplier, particularly in the case of FGD which requires time period of the order of 30 months from placement of order to commissioning.

Lenders already being conscious in funding new generation projects in view of many of the new power stations having turned into stranded assets, are not keen to finance emission control systems to power stations having power purchase agreements (PPAs) for partial capacity. Uncertainties in regard to time frame in which payment will be received from DISCOMs, which has been a challenge for the private sector generating companies in maintaining desired cash flow, are perceived to be increasing significantly. These are some of the demotivating factors for independent power producers (IPPs) to put equity component of additional capital investment requirement.

# POLICY AND REGULATORY DEVELOPMENTS

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A number of positive developments which have been there in the last few years have brought clarity and certainty in regard to consideration of marginal cost due to implementation of ECS in merit order dispatch, approval of additional capital and operational expenditure, etc. Key developments are listed below:

- Ministry of Power issued directions under section 107 of the Act to CERC to address the Merit Order Dispatch issue as under:

*“The Phasing of the implementation of the new environmental norms has been reviewed. Accordingly, it is directed that the impact of operating costs incurred in the implementation of new Environmental Norms shall not be considered for Merit Order Dispatch of Coal Based Thermal Power Stations till 31.12.2022. For this purpose, CERC shall advise a methodology of supplementary tariff determination separately from normal tariff so that installation of FGD/other ECS (emission control system) has no bearing on the merit order dispatch till 31.12.2022”.*

- Central Electricity Regulatory Commission (CERC) Tariff Regulations, 2019 specify the modalities for submission of additional capital expenditure on account of revised emission standards, factors to be considered by the Commission for approval of the same and the admitted

expenditure on this account forming the basis of tariff determination (Section 29, CERC Tariff Regulation, 2019).

- Central Electricity Regulatory Commission has also allowed the cost claimed by the petitioner in the event of the same having been discovered through competitive bidding. Certain costs claimed by the petitioner have also been allowed by CERC subject to truing up wherever they are required to meet statutory requirements and safe operation of plant.
- Central Electricity Regulatory Commission regulations also provide for consideration of additional capitalisation and additional operation and maintenance expenses on account of implementation of revised emission standards in existing or new generating stations in their tariff [Regulation 14(2) and 29(4)].
- Central Pollution Control Board is strictly monitoring the air pollution status of 102 most polluted cities in India. National Green Tribunal (NGT) has given power to CPCB to impose penalties on industries deviating from norms. CPCB has issued notice under Section-5 of Environment (Protection) Act, 1986, to all the thermal power stations in NCR.

# WAY FORWARD

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Thermal power stations are reported to be amongst the major contributors in regard to some of the pollutants. New environmental norms notified by MoEFCC in December, 2015 are intended to reduce emission of SO<sub>2</sub>, CO<sub>2</sub>, particulate matter and mercury from thermal power stations. Despite deferment of timelines for compliance of the new norms from December, 2017 to (a) December 2022 for all thermal power stations and (b) December, 2019 for the power stations located in NCR, pace of implementation of emission control systems in the power stations is far from satisfactory.

While, power stations seem to be on better footing in regard to retrofitting/up-gradation of Electro-static Precipitators for control of PM<sub>2.5</sub>, implementation of measures for control of SO<sub>x</sub> and NO<sub>x</sub> within specified limits calls for meticulous planning and coordination, as well as hand holding and guidance by the early movers. Concerted efforts need to be made by all concerned on various fronts for timely implementation of emission control systems.

Following measures are suggested for timely implementation of remedial measures for compliance of revised emission norms:

- Phased implementation plan having been made by CEA giving due consideration to various requirements, CEA, in consultation with states, could carry out an assessment of likely shortage of power on account of shutdown of power plants in state & private sector as well as inter-state generating stations planned on account of retrofitting/implementation of emission control systems. This would help the DISCOMs/ State Governments in assessment of difficulties in maintaining power supply to consumers. In case there is difficulty in certain DISCOMs/States for certain months, their allocation from unallocated power of central generating stations may be enhanced appropriately, which can also have attendant advantage addressing their concerns regarding purchase of costly power. In case this does not suffice for certain period of time for a DISCOM, it may procure power through power

exchanges. The linking of installation of FGD with capital maintenance/annual overhaul of generating units can ease the problem. Opportunity cost towards shutdown period has already been agreed in-principle by the CERC.

- Issues such as slow pace of implementation of emission control systems to meet new environmental norms and in-principle approval of additional capital expenditure on the lines on which CERC has already opined, may be taken up in the Forum of Regulators for facilitating action on the part of concerned State Electricity Regulatory Commission (SERC).
- In order to expedite in-principle approval of additional capital expenditure, the state governments may consider, wherever required, issuing directions under Section 108 of the Act to the respective SERC to do so with the caveat that in the event of a unit not complying with the new norms by the due date would be shutdown till it complies with the new norms.
- Technology options in respect of FGD may be examined by CEA and the findings may be brought to the notice of all concerned - generating companies, power utilities, SERCs as well as CERC so as to facilitate proper and timely decision making on the part of generating companies to place orders.
- CEA may consider periodic review of base costs, for various technologies and guidelines regarding additional costs which may vary depending on specific set of condition, depending on price discovery in competitive bidding.
- Ministry of Power may consider advising PFC and/or REC to lend money to needy generating companies who approach them for loan for this purpose with safeguards towards recovery of the same as per agreed schedule.
- SERCs may expeditiously make appropriate provisions in tariff regulations necessitated on account of revised emission standards for thermal power stations.
- A proper retirement plan for old and inefficient units, causing more emission due to poor operational heat

## Revised/New Emissions Norms for Thermal Power Stations: Issues and the Road Ahead

	Issues/Concerns	Measures in Place/Suggested Measures/The Way Forward
DISCOMs	Maintaining continuity of electricity supply	Allocation of unallocated power of central generating station;
	High cost of alternate power during the shutdown period	Procurement of power through power exchanges; In-principle concurrence of CERC to opportunity cost towards shut down during ECS installation
Developers/ Gencos	1. Full recovery of Additional Capital Expenditure (Adcap) and operational expenditure* 2. Lack of promoters interest in putting equity	In- principle approval of new emission norms as Change in Law by SERCs
		In- principle approval of Adcap by SERCs
		Appropriate provisions by SERCs in the Tariff Regulations necessitated on account of new emission standards.
	Time being taken to place orders	General guidelines for technology selection by CEA to facilitate decision making in regard to technology. Alternative technologies, if found appropriate by CEA, can widen the sources of supply, thereby helping meeting the time-lines. Results of pilots for NOx control once available can accelerate action.
	Time taken in processing of petitions*	Periodic review of base cost of technology options and guidelines regarding additional costs which may vary depending on a specific set of conditions.
	Downgrading in merit order despatch*	CERC Tariff Regulations 2019 made explicit provision in regard to the steps to be followed taking the additional operating costs out of merit order despatch
	Lack of bidders	Widening technology options;
Manufactures/ Suppliers	Increase in overall implementation time due to add-on scope	Option of exclusion of balance of system from main package.
	Working front availability at power stations	Facilitation by the generating stations to the suppliers to the extent possible.
Funders	Plants with untied capacity bringing down Funders' comfort	Phasing out old and inefficient power stations; Emission based dispatch
* Concerns for funders as well		

rate, is required to be formulated rather than extending PPA for such units in view of their zero/marginal fixed cost liability. PPAs should rather be signed by DISCOMs with new and efficient thermal power plants.

- Prioritisation of Thermal Power Stations for implementation of emission control equipments based on proximity to city, specially the stations near large / metro cities as well as plants along Ganges belt would

go a long way in addressing air pollution in and around such cities.

- An interim mortality assessment due to emission from coal fired power plants at TERI has pegged total premature deaths at 77000 for 2020. The associated health cost due to mortality and morbidity is Rs 723 billion for 2020. The assessment of impact on tariff due to installation of ECS, as well as health cost on account

of emissions could help all concerned in shaping the way forward.

- Emission based dispatch of generating units should start engaging the attention of policy makers and Regulators despite the fact that it may bring certain stations with higher marginal cost into operation.
- Options of excluding auxiliaries like wet stack, water treatment plant, lime handling system, etc., can be provided in the tenders in order to optimize scope and overall implementation schedule. Parallel contracting of aforementioned to separate vendors needs to be considered by the generating companies so that pace of implementation can be increased.
- Particulate Matter limits permitted for old TPS (100mg/Nm<sup>3</sup>) may also be reduced to 50 mg/Nm<sup>3</sup>, the level specified for thermal power stations commissioned between year 2003 and 2016 in a bid to mitigate air pollution arising from all the thermal power stations.
- An inter-ministerial steering-cum-monitoring committee comprising representative of MOEFCC, MOP, CEA, CPCB, NTPC, etc., may be constituted to meet the target date for implementation of emission control system as per phased implementation plan ending in December, 2022.

# ANNEXURE

## Annexure 1: Phasing Plan of Emission Control Equipments

	S.N.	Description	Capacity (GW)
FGD	A	Present thermal coal-based power plant as on Dec 2016	187
	a	Plant identified for retirement	8
	b	Capacity already have FGD/CFBC boilers	13
	c	<b>Balance plant for new environment compliance</b>	166
	c.1	<i>Identified capacity proposed to comply in phased manner of 7 years, by 2024*</i>	149
	c.2	<i>Plants to be scrapped due to various constraints such as lack of space, etc.</i>	17

\*MoP changed the timeline to year 2022

	S.N.	Description	No. of Units
FGD	A	Total no. of units in coal power plant capacity in India	650
	a	Either complying with new emission norms or planned to phasing out or have not submitted plan for FGD (35 GW)	235
	b	FGD to be installed in	415
	B	Phasing plan of FGD installation	
	i	No. of unit by 2018	1
	ii	No. of unit by 2019	8
	iii	No. of unit by 2020	53
	iv	No. of unit by 2021	174
	v	No. of unit by 2022	178

	S.N.	Description	No. of Units
ESP	A	Total no. of units in coal power plant capacity in India	650
	a	ESP already installed in 115 GW capacity units	
	b	Either complying with new emission norms or planned to phasing out or have not submitted plan for ESP (14 GW)	9
	C	ESP to be installed in 64 GW	220
	B	Phasing plan of ESP installation	
	i	No. of unit by 2018	01
	ii	No. of unit by 2019	02
	iii	No. of unit by 2020	27
	iv	No. of unit by 2021	97
v	No. of unit by 2022	93	

Source CEA, Quarterly Review Report Renovation & Modernisation of TPSs, September 2019

## Annexure 1: Status of Emission Control Systems in TPSs, NCR

State	Station	Status	Capacity, (MW)
Uttar Pradesh	Dadri Thermal Power Plant, Gautam Buddh Nagar	<b>FGD:</b> Awarded on 26 October 2018 and on 1 February 2018. Work in progress <b>DE-NOx:</b> Combustion modification implemented in Unit 5 and scheduled for November 2019 for Unit 6 <b>ESP:</b> Statutory limits being complied	1820
	Harduaganj Thermal Power Plant, Aligarh	<b>FGD:</b> NIT Issued <b>ESP:</b> Order has been placed to M/s NTPC on 29.11.18 for pre-award services <b>De-NOx:</b> NIT floated on 08.03.2019	500
Haryana	Mahatma Gandhi TPS, Haryana CLP	<b>FGD:</b> Operation of FGD started <b>ESP:</b> Statutory limits being complied <b>DE-NOx:</b> Combustion modification completed	1320
	Panipat Thermal Power Plant, Panipat, Haryana	<b>FGD:</b> NIT Issued <b>ESP:</b> SPM values are within limits <b>De-NOx:</b> Combustion modification planned	710
	Rajiv Gandhi Thermal Power Plant, Hisar, Haryana	<b>FGD:</b> NIT Issued <b>ESP:</b> Repair of ESP fields will be carried out in the forthcoming overhauling scheduled in October–November 2019 <b>De-NOx:</b> Combustion modification planned	1200
	Indira Gandhi Thermal Power Plant, Jhajjar	<b>FGD:</b> Bid Awarded <b>DE-NOx:</b> Awarded on 29 October 2018 <b>ESP:</b> Statutory limits being complied	1500
	Deenbandhu Chhotu Ram Thermal Power Station, Yamuna Nagar	<b>FGD:</b> NIT Issued <b>ESP:</b> Repair of ESP fields will be carried out in the forthcoming overhauling scheduled in October–November 2019 <b>De-NOx:</b> Preliminary pilot study is being carried out by NTPC	600
Punjab	Guru Gobind Singh Super Thermal Power Plant, Ropar	<b>FGD:</b> NIT issued <b>ESP:</b> Already installed in Units 3 and 4, and to be installed in Units 5 and 6 in 2019–20. <b>De-NOx:</b> NOx values are below specified limits	840
	Guru Hargobind Thermal Plant, Lehra Mohabbat	<b>FGD:</b> NIT issued <b>ESP:</b> Matter being taken up with BHEL <b>De-NOx:</b> Matter being taken up with BHEL	920
	Talwandi Sabo Power Ltd, Mansa, Punjab	<b>FGD:</b> Technical bids opened <b>ESP:</b> SPM are within the limits. Need to be certified by state government <b>De-NOx:</b> NIT issued. For combustion modification	1980
	Nabha Power Ltd, Rajpura, GMR	<b>FGD:</b> Bid awarded <b>ESP:</b> Statutory limits being complied <b>De-NOx:</b> Low NOx burner installed	1,400
	Total		12,790

Source CEA, Quarterly Review Report Renovation & Modernisation of TPSs, September 2019



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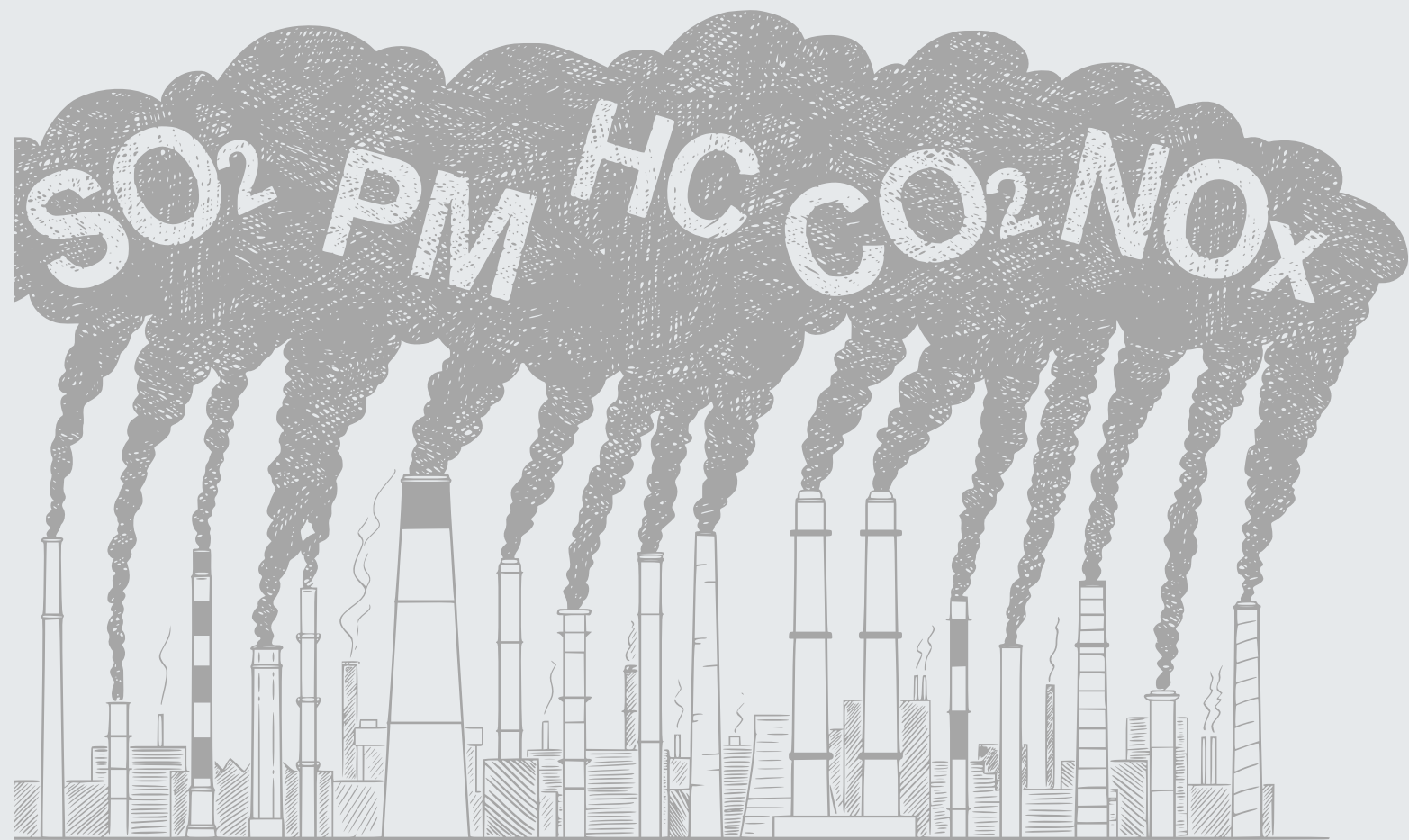
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