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Why India is poised for a boom in emissions-reduction technology

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The India power market is going to require a whole new eco-system of equipment to meet stringent emission standards, writes Ravi Krishnan

Coal remains central to India's power needs primarily due to energy security issues.

Coal accounts for 61 per cent of the installed power generation base and 75 per cent of the generation capacity.

An estimated 70.5 GW of coal-based power is in the pipeline under various stages of construction. Bowing to international pressures, COP 21 compliance requirements and India's own initiative to go green, the Indian Ministry of Environment & Forests (MOE&F) announced stringent emission standards to regulate nitrogen oxide (NOx), sulphur dioxide (SO2), and particulate matter emissions.

These emission norms announced in December 2015 are stringent by any yardstick and comparable with standards in most Western countries. For example: NOx emission targets will range from 600 mg/Nm3 to as low as 100 mg/Nm3 and will vary depending on the commissioning date and size of the plant.

Such targets will have to be achieved in a fairly short period of time and call for some of the best available control technologies to be installed at Indian power plants.

The new norms have affected a number of utilities and independent power producers (IPPs). A total of 175 GW of existing coal-fired capacity have been impacted to varying degrees, potentially requiring over $10 billion in air quality control systems (AQCS).

The majority of the projects will be related to the removal of SO2, NOx and PM control equipment upgrades. Consequently, the market will require a whole new eco-system of equipment, auxiliaries & consumables for primary NOx control measures, selective catalytic reduction (SCR), flue gas desulfurization (FGD), electro-static precipitators (ESPs), baghouses, consumables (ex: Urea, Ammonia, Limestone, Lime, etc.), waste disposal, auxiliaries for environmental equipment etc.

Nearly two-thirds of India's installed coal-fired capacity is made up of plants commissioned after 2003 and all of them will have to be upgraded to the new requirements for NOx, SO2 and PM emissions. The remaining third, primarily older plants commissioned before 2003, will have to at least upgrade their PM control systems, if not more.

Meeting NOx standards

In order to meet the 100 mg/Nm3 NOx standard, new Indian plants will have to utilize SCR to achieve compliance. However, existing plants required to achieve the 300 mg/Nm3standard can potentially attain this through a combination of primary measures such as, combustion controls, Selective Non-catalytic (SNCR) technology and in some cases SCR technology.

SCR refers to a technology that is a proven and effective method to reduce NOx emissions from coal-fired power plants by more than 90 per cent. The technology injects ammonia into the flue gas and reduces NOx in the presence of a catalyst primarily made up of vanadium, tungsten and titanium.

Primary measures refer to non-catalytic technologies such as Low NOx burners, Overfire Air and SNCR systems. SNCR refers to injecting a reagent such as urea into the furnace flue gas in an appropriate temperature window to lower NOx. In some cases, SCR may still be required to get the 300 mg/Nm4 standard depending on the size of units and the type of coal utilized.

A major impediment in India for SCR and other NOx control systems is technology preparedness on high ash Indian fuels. Indian coals can have up to 40-45 per cent ash content and Indian utilities are keen to evaluate cases where SCR technology has been proven to be effective and cost-competitive on similar type fuels before making full-scale investments.

Unfortunately, nowhere in the world are such high ash fuels burnt in utility applications and it appears that SCRs have not been installed on units exceeding 60 gms/m3 as compared to the Indian average of about 80 gms/m3.

In order to overcome this impediment, SCR system & catalyst suppliers are piloting their technology on a split-stream demonstration basis with major Indian power producers like National Thermal Power Corporation (NTPC) that burn Indian fuel to test the performance of the SCR catalysts (i.e. honeycomb, plate, corrugated, etc.) under Indian conditions.

World’s largest FGD market

For power plants burning low sulphur Indian coal, until recently there were no SO2 emission standards. However, coastal plants burning imported coals have always required FGD technology if they are importing coals with sulfur content in excess of 0.5 per cent.

	TPP installed before 31 December 2003		TPP installed after January 2004 up to 31st December 2016		New install from 1st January 2017
Capacity	Smaller than 500MW	500MW & above	Smaller than 500MW	500MW & above	Any Size
Particulate	100mg/Nm³		50mg/Nm³		30mg/Nm³
SO_2	600mg/Nm³	200mg/Nm³	600mg/Nm³	200mg/Nm³	100mg/Nm³
NO_x	600mg/Nm³		300mg/Nm³		100mg/Nm³
Mercury	-	0.03mg/Nm³	0.03mg/Nm³		0.03mg/Nm³

New environmental standards in India place emission limits similar to those in the US and Europe

Furthermore, all new plants were asked to allocate space for an FGD scrubber for potential future retrofits. At the end of 2015, around 24 Indian plants mostly importing higher-sulphur coal had installed FGD scrubbers. These units have been achieving SO2 emission levels of approximately 150 mg/Nm3 after the FGD upgrade.

The new SO2 standards in India require power plants to attain between 200 mg/Nm3 and 600 mg/Nm3 depending on their size and commissioning date. Therefore, all new and many older coal-fired units will require an FGD. The most common technologies utilized would be wet scrubbing using slurry as absorbent usually lime or limestone and sea water scrubbing.

The majority of the new FGD systems are likely to be wet systems as seawater systems are more common in coastal areas. Given that India is increasingly getting self-sufficient in coal production, fewer power plants in the future are likely to be located in coastal areas, a factor that will favor wet FGD systems. Another key criterion that will drive technology selection is the quality of gypsum for which there is tremendous demand given India's building materials requirements. The market for FGD is expected to be an $8 billion-plus retrofit and upgrade market.

ESPs are widely used to control the PM emissions from power plants in India to meet the emission standard of 50-100 mg/Nm3 for existing power plants and 30 mg/ Nm3 for new units. Over 98 per cent of India's installed coal-fired generation capacity utilizes ESP. In spite of the continuous deterioration of coal quality and increasing ash content affecting the efficiency of ESPs, baghouses have not made inroads due to their higher O&M costs and some poor performing projects where baghouses have operated sub-optimally.

The new standards offer a series of retrofit opportunities for adding fields, rebuilding existing precipitator with taller systems, installing fabric filters and flue gas conditioning such as ammonia injection, SO3 conditioning and water fogging.

Uncertainties and pressures

The market for AQCS systems in India is exploding. However, the new regulations are not without considerable opposition from utilities & IPPs who are concerned about unrealistic compliance schedules, high capital & operating costs, inadequate environmental cost recovery mechanisms, and technology challenges concerning high ash Indian coals. These uncertainties and pressures coupled with the high capex associated with AQCS systems and their impact on tariff recovery, have created a highly cost-sensitive AQCS market.

These increased capex costs were not anticipated by Indian power plants. Many of the existing power purchase agreements (PPAs) do not have a pass through clause to the consumer. Therefore, there is currently no mechanism to pass the additional capital cost to the rate payer or customer. All these factors are putting immense pressure on Indian plants to adopt a low cost approach to achieving compliance both in terms of capital cost and variable costs.

Coal accounts for 61 percent of India's installed power

Competition is fierce with more 30 global suppliers consisting of boiler and environmental companies active in the Indian market. This plethora of manufacturers, with many of them experiencing a slow worldwide market demand for AQCS products, are offering products in India at amongst the lowest prices in an attempt to get a piece of the market. This has put further downward pressure on ownership costs. In India it is expected that the price for

environmental equipment will be close to 50 per cent of global prices. Therefore, localized manufacturing becomes very vital to be competitive in the Indian market.

Implementation delays

The new emission standards have taken the Indian power industry by storm, as none of the power producers have had much experience in the selection, procurement, commissioning, operations, maintenance or commercial evaluation of AQCS systems.

Many of them are in a learning mode as the industry grapples from lack of standardization in specifications. Some of the IPPs are struggling from the lack of compensatory tariffs and government owned utilities are concerned about the short implementation timeline. Given all these factors there is a good chance that the deadline will be extended from two years to perhaps three or four years.

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