Indian Market for Emission Control Expected to See Explosive Growth

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Coal remains central to India's power needs primarily due to energy security issues. Coal accounts for 61% of the installed power generation base and 75% 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, Conference of Parties or 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), Sulfur Dioxide (SO_2), 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 (BACT) to be installed at Indian Power Plants.

The new norms have impacted 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). Majority of the projects will be related to the removal of SO_2, 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 2/3rd 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, SO_2 and PM emissions. The remaining 1/3rd, primarily older plants commissioned before 2003 will have to at least upgrade their PM control systems, if not more.

Exhibit 1: New Environmental Standards Place Emission Limits Similar to US & Europe

	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 500MW	Smaller than 500MW	500MW & Above 500MW	Any Size
Particulate	100mg/Nm³		50mg/Nm³		30mg/Nm³
SO_2	600mg/Nm³	200mg/Nm³	600mg/Nm³	200mg/Nm³	100mg/Nm³
NOx	600mg/Nm³		300mg/Nm³		100mg/Nm³
Mercury	-	0.03 mg/Nm³	0.03 mg/Nm³		0.03mg/Nm³

Exhibit 2: Breakdown of Units by Commissioning Date

Unit Size	Installed before 31.12.2003		Installed after 31.12.2003	
	No. of Units	Total Capacity	No. of Units	Total Capacity
Up to 250 MW	313	47628	110	19014
From 250-500 MW	27	13500	49	15220
More than 500 MW	0	0	137	80495

Meeting NOx Emission Control 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/Nm³ standard 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 90%+. 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/Nm³ 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% 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.

India Emerging as the World's Largest FGD Market

For power plants burning low sulfur Indian coal until recently there were no SO_2 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%. Furthermore, all new plants nationwide were asked to allocate space for an FGD scrubber for potential future retrofits. At the end of 2015, approximately 24 Indian power plants mostly importing higher sulfur coal had installed FGD scrubbers. These units have been achieving SO_2 emission levels of approximately 150 mg/Nm³ after the FGD upgrade.

The new SO_2 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.

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+ retrofit and upgrade market.

ESPs Dominate India's PM Control 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% 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 effi-

ciency 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, SO_3 conditioning and water fogging.

Market Exploding but Highly Cost-Sensitive

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.
Competition is fierce with more 30 global suppliers consisting of boiler and environmental companies active in the Indian market. The plethora manufacturers, 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% of global prices. Therefore, localized manufacturing becomes very vital to be competitive in the Indian market.

Exhibit 3: AQCS Price Comparisons

	Expected Indian Price	Global Prices	Pollutant Removed
Low NOx Burners	$10,000/MW	$20,000/MW	NOx
SNCR	$12,000/MW	$25,000/MW	NOx
SCR	$45,000/MW	$120,000/MW	NOx
FGD	$90,000/MW	$250,000/MW	SO_2
SCR Catalyst	$3,500/MW	$5,000- $6,000/MW	NOx
ESP Renovation	$25,000/MW	$30,000/MW	PM

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 2 years to perhaps 3 or 4 years.

Krishnan & Associates, Inc. has announced the release of its latest study Indian Power Generation Market – Strategic Review & Forecast, 2016. K&A's study takes an in-depth look at how new emission regulations and other market developments will shape the future of the Indian fossil-fuel fired power generation industry. For more information visit http://krishnaninc.com/analytics/power-market-reports/

About the Author

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Sadbhav Infrastructure signs EPC agreement with its four subsidiaries

Sadbhav Infrastructure Project, a leading road BOT company in India that specializes in the development, operation and maintenance of highways, roads and related projects, has signed EPC agreement with its four subsidiaries worth Rs. 283 crore for maintenance and repairs works.
The first agreement is with Sadbhav Rudrapur Highway for Rampur-Kathgodam (I) section of NH-87, length 43.45 kms valued at Rs. 69 crore. The second agreement is with Sadbhav Nainitat Highway for Rampur- Kathgodam (II) section of NH-87, length 49.78 kms valued at Rs. 73 crore. The third agreement is with Sadbhav Bhavnagar Highway for Bhavnagar-Talaja section of NH-8E, length 48.05 kms valued at Rs. 82 crore. The fourth agreement is with Sadbhav Una for Una-Kodinar section of NH-8E, length 40.95 Kms valued at Rs. 59 crore.

Petrochemical complex to be set up in Andhra Pradesh

Union minister for Petroleum and Natural Gas (independent charge) Dharmendra Pradhan has recently said that a petro-chemical complex will be set up in Andhra Pradesh in the current (2016-17) fiscal year at a cost of Rs. 35,000Cr.
Speaking at a public meeting at the Vangali area under Sabbavarm mandal in Vizag district after Chief Minister N. Chandrababu Naidu laid the foundation stone for Indian Institute of Petroleum and Energy (IIPE) in the presence of Union ministers M. Venkaiah Naidu, Y. Sujana Choudhary and P. Ashok Gajapathi Raju, Mr. Pradhan said the foundation stone for petrochemical complex would be laid in this year. "Though the UPA government had included the proposed petro-chemical complex in the AP Reorganisation Act-2014, it mentioned that it was subject to feasibility. But, we have taken a decision to set up the petrochemical complex in AP in be-tween Vizag and Kakinada region," he added.
Saying that his ministry has planned to invest crores of rupees to make AP a petro-chemical and gas hub, Mr. Pradhan said the capacity of HPCL-VR refinery in Vizag would be enhanced from 8.5 million tonnes to 15 million tonnes by December 2016 at an investment of Rs. 21,000Cr, and there were plans for LPG pipeline supply in the state at a cost of about Rs. 62,000Cr.
"The IIPE will produce top experts within four years in petroleum, oil and gas sector and the campus will be ready in three to four years at the Vangali area in around 200 acres," Mr. Pradhan added.