Notes to the Post
Environmental Emissions Market in India –Are We Prepared Enough?

By Dr Prasad Modak

The Pilot Emission Trading Scheme

The Ministry of Environment & Forests (MoEF) launched a Pilot on Emission Trading Scheme (ETS) during the period when Jayaram Ramesh was the Union Environment Minister. The Central Pollution Control Board (CPCB) was made as the nodal agency for the project, with J-PAL South Asia, led by a team of researchers from Harvard, Yale and University of Chicago, engaging as partners in the design and evaluation of this scheme. (See http://www.theigc.org/wp-content/uploads/2015/02/Greenstone-Et-Al-2012-Policy-Brief.pdf and http://www.hks.harvard.edu/index.php/content/download/69831/1252134/version/1/file/Pande_Harvard_Sust_Science_Forum_110919.pdf)

The MoEF initiated the pilot in industrial areas of three states—Gujarat, Maharashtra and Tamil Nadu—because they have maximum number of air polluting industries and critically polluted areas. The scheme allowed the regulators—CPCB and PCBs—to set a cap on the **aggregate level of pollution permitted in an industrial cluster (75 kms radius),** and then allow the industries to self-regulate to ensure that pollution does not exceed this cap. Industries that emit excess pollutants can buy points from industries that overachieve targets just like in the GHG emission trading system.

Some **key features** of the ETS are as follows (taken from http://switchboard.nrdc.org/blogs/sreddy/can_the_invisible_hand_of_the.html)

- It is designed to apply not to States as a whole or to individual industrial units (i.e. point sources) but to clusters or regions of industries.
- An overall limit or cap will be identified for each cluster by the relevant regulator, i.e. the SPCB, to be lowered over time.
- Permits will be allocated to various units within each area, relative to the area's baseline emissions. The initial allocation is most likely to be free.
- Once allocated, permits can be sold and purchased by individual industrial units to match their emission levels. For instance, if one unit emits less SPM than its permits allow, it can sell some of its permits to another unit whose emissions exceed its permits. This allows the cost of abatement to shift more towards industrial units that can cheaply reduce their emissions, rather than those for whom it is more expensive to reduce emissions (and cheaper to buy permits).
- The overall cap of the area remains static, and will be lowered over time, so in the aggregate, pollution will be reduced from all areas.

(I will recommend article by Abhishek Mohanty at http://www.lawctopus.com/academike/emission-trading-scheme-overview-indian-perspective/ for a good literature review of various emission trading schemes)

The pilot project is considered as a two-part exercise. The first part involves the testing of continuous emissions monitoring systems or CEMS, which would provide real time data on industrial pollution to regulators; Part two proposes using the data generated as the basis for a market-based regulatory

programme. Baseline emission levels can be most accurately estimated using CEMS and this is one reason why ETS is contingent on a successful completion of CEMS trial.

CEMS refers to the instrumentation and associated computing hardware and software used to measure pollutant levels in exhaust gas from industrial sources at a high frequency (e.g., once or more per minute). Most CEMS device technologies employ indirect measurement principles and therefore require calibration to smoke stack conditions before use. For instance, light scattering CEMS technology, which is commonly used to measure PM emissions, calculates the concentration of pollutants based on changes in the optical properties of stack gas.

As per proposed timelines, permits were to be issued by the third quarter of 2011, and compliance (including start of trading) was to begin in January 2012. The pilot scheme was expected to last through mid-2014, after which lessons from the pilot will hopefully be used to expand the scheme to the rest of the country in 2015. Today, we are nowhere close to these "ambitious targets"

"The monitoring mechanism to keep track of particulate matter emission was put into place, but the trading process never started. Practical on ground challenges on continuous emission monitoring, technology and data linkages, need for stronger regulatory framework, etc. are some reasons why the takeoff has been slower than expected," says Vivek Adhia, head (business engagement), World Resources Institute India (sourced from http://www.livemint.com/Politics/nuk1yqmbZLj6foZY1kzh2I/CanmarketmechanismshelpIndiafightclimatechange.html)

Officials with MoEF say that the modalities of the scheme are still being sorted out. These include determining the charge of permits, how it will be calculated and the provisions for penalty if any industry emits more than the prescribed permit. There are many questions still unanswered e.g. how the emission cap will be fixed and how will trading happen on operational level. There are also concerns on cost-sharing between the Center and the States for installation and operation of CEMS.

PM emissions in an industrial cluster comprise not just emissions from industrial stacks, but are contributed by host of other sources such as transport emissions and others (especially open burning) that may play a significant role. Further, there could be distant sources outside the "bubble" (i.e. of 75 kms radius as defined in the ETS) that could contribute as transported by wind. Finally, focus of emission reduction is on point or stack based emissions of particulates whereas many times particulate emission release in industries happens due to fugitive sources like in handling and storage of materials.

Building of the database on emissions is critical for the ETS and especially if the scheme was to be launched at the national level. On February 5, 2014, the CPCB issued directions to all SPCBs/ PCCs under Section 18 (1) (b) of Water Act and Air Act that continuous monitoring systems must be installed (for both emissions and effluents) by March 31, 2015.

The directive was issued as below

- To install online continuous Stack Emission Monitoring Systems (CEMS) in 17 categories of highly polluting industries and in Common Hazardous waste and Biomedical waste incinerators for the parameters(industry/sector specific parameter) mentioned in the consent to operate/authorization not later than by March 31,2015;

- To install online effluent quality monitoring system at the outlet of effluent treatment plants of the 17 category industries and in CETPs for the measurement of the parameters(industry/sector specific parameter) like flow, pH, COD, BOD, TSS and for other consented parameters as per the guidelines provided; not later than by March 31, 2015;

- To connect and upload the online emission and effluent monitoring data at SPCBs/PCCs and CPCB server in a time bound manner but not later than by March 31,2015;

- To ensure regular maintenance and operation of the online system with tamper proof mechanism having facilities for online calibration;

- To submit bank guarantee of 25 % of the cost of online monitoring systems (emission and effluent whichever applicable) for ensuring timely installation of online monitoring systems within 90 days from the date of receipt of directions issued by SPCBs/PCCs to the industries;

Consequently, CEMS today are installed by several industries under pressure of the PCBs.

CEMS

While continuous monitoring makes information collection highly automated, it also requires that regulators and industry build new competencies in maintaining the CEMS device and associated computer hardware and software. Since the first plants to install CEMS devices began reporting data to SPCBs in late 2013, industries faced a range of challenges. There included downtimes as a result of inadequate cleaning or maintenance of the device and internet connection that transmits data to the SPCB and CPCB servers. The PCBs were not capacitated to respond to “big data” and “IT protocols” – and many are not still weak in this arena.

Software was developed as part of the CPCB ETS project to allow industries to see their emissions in real time, to track progress toward reducing emissions over time, and to receive notification by SMS when SPCB stops receiving pollution data.

Central Pollution Control Board, Delhi released 9 websites set up by various CEMS equipment providers. Out of the 9, following four seem to work. Do access these sites to understand the quality and completeness of the on-line emission data. I am sure however that the situation will gradually improve.

1. CPCB – http://cpcb.gov.in/caaqm
2. M/s Thermo Fisher Scientific India Pvt. Ltd. – http://182.71.166.202
3. M/s Yokogawa India Ltd.– http://cpcb.yilrc.net
   - User name: cpcb Password: cpcb1 User Type: CPCB
4. M/s Forbes Marshall Codel Pvt. Ltd. – http://203.145.138.170:8080/plantconnect/aqms

I would recommend you to visit http://www3.epa.gov/ttn/emc/cem.html for more information on CEMS in general.

CEMS Vs PEMS

CEMS is expected to account for highest market size in the emission monitoring systems market during forecast period MarketsandMarkets estimates the world market of emission monitoring system as 2.81 billion USD by 2010 at a CAGR of 10.4% between 2015 and 2020.

http://www.marketsandmarkets.com/Market-Reports/emission-monitoring-systems-market-72002872.html.

The rise in stringent rules and regulations regarding pollution monitoring across various industries has increased the market of CEMS. Further, the increasing demand for process control improvements is another factor contributing to this growth.

The market for PEMS is expected to grow at a high CAGR due to the fact that PEMS requires low capital expenditure as well as much lower operational and maintenance cost. Thus, a majority of manufacturers prefer PEMS over CEMS.

APAC accounted for the largest share of the emission monitoring systems market in 2014; the market in the region is expected to grow at a high CAGR between 2015 and 2020. The growth is attributed to increasing industrialization and urbanization in the APAC region. Further, stringent air pollution regulations and growth in power generation companies in emerging countries are key factors responsible for the increasing adoption of emission monitoring systems.

Major players involved in the development of emission monitoring systems include ABB Ltd. (Switzerland), Emerson Electric Co. (U.S.), General Electric (U.S.), Rockwell Automation Inc. (U.S.), Siemens AG (Germany), Parker Hannifin Corp. (U.S.), Teledyne Technologies Inc. (U.S.), and Thermo Fisher Scientific Inc. (U.S.) among others.

Table 1 below provides a comparative

Table 1: Comparison between CEMS and PEMS (built from http://cmcpems.com/pems-vs-cems/)

CEMS	PEMS
CEMS are always vulnerable to analyzer obsolescence and replacement. The replacement of 2 analyzers can be equal to the purchase of a PEMS system.	Lower system capital cost. PEMS do not require EPA protocol calibration gases, piping, wiring, gas regulators or software to operate the auto-calibration sequence.
CEMS provide outputs of stack emissions and do not typically provide process data or source efficiency beyond unit load, fuel feed, or fuel consumption data. CEMS do not provide any insight as to the cause of an excess emission or the ability to facilitate process control or correction of the problem. CEMS cannot point	A CMC PEMS provides accuracy that is equal to that of a CEMS. PEMS inherently do not drift. PEMS rely on process inputs and instruments that typically drift no more than 0.5 to 1% per year. Typical models utilize 12 or more input parameters that are in some cases redundant. The resulting emissions prediction is resilient to input failure and drift, such that no single input parameter is critical to the accuracy of the stated

the operator to the cause or solution of excess emissions.	emission. PEMS can be used to determine the source of excess emissions**.**

Perform Achieve Trade (PAT) scheme

Indian Government launched in 2008 the Perform Achieve Trade (PAT) scheme. This Scheme was announced under National Mission on Enhanced Energy Efficiency (NMEEE) in National Action Plan on Climate Change (NAPCC). It aims to improve energy efficiency in industries by trading in energy efficiency certificates in energy-intensive sectors the 2010 amendment to the Energy Conservation Act (ECA) provides a legal mandate to PAT. Participation in the scheme is mandatory for Designated Consumers under the ECA. It is being administered by the Bureau of Energy Efficiency (BEE) that sets mandatory, specific targets for energy consumption for larger, energy-intensive facilities.

The PAT Scheme is being implemented in three phases- the first phase runs from 2012-2015 covering 478 facilities from eight energy-intensive sectors, namely aluminum, cement, chor-alkali, fertilizer, iron and steel, pulp and paper, textiles and thermal power plants. This accounts for roughly 60% of India's total primary energy consumption. It targets energy consumption reductions of 6.6 million tons of oil equivalent in the 478 covered facilities.

The scheme imposes mandatory specific energy consumption targets on the covered facilities with less energy efficient facilities having a greater reduction target than the more energy efficient ones. A facility's baseline is determined by its historic specific energy consumption between 2007-2010. Facilities making greater reductions than their targets receive "EsCerts" or "energy saving certificates" which can be traded with facilities that are having trouble meeting their targets, or banked for future use. The PAT scheme establishes plant-specific targets rather than a sectoral target, with the average reduction target being 4.8% that is to be achieved by the end of the first phase (2015).

The approach was as follows:

- Specification of specific energy consumption (SEC) norm for each designated consumer in the baseline year and in the target year;
- Verification of the SEC of each designated consumer in the baseline year and in the target year by an accredited verification agency;
- Issuance of Energy Savings Certificates (ESCerts) to those designated consumers who exceed their target SEC reduction;
- Trading of ESCerts with designated consumers who are unable to meet their target SEC reduction after three years;
- Checking of compliance, and reconciliation of ESCerts at the end of the 3-year period. In case of non-compliance, a financial penalty is due.

A newly established company Energy Efficiency Services Ltd (EESL) is expected to administer or coordinate trading in Phase II.

The industrial consumer could achieve the SEC reduction target in one of the following manner:

- Capital Investment using own funds to invest in new technologies/processes to reduce SEC;

- Purchase of ESCERTs equal to the gap in meeting SEC target; and
- Using an Energy Service Company (ESCO) to undertake the investment in Energy Performance Contract (EPC) mode. In this mode, the industry could avoid investments and yet achieve the targets

In the subsequent phases of the PAT scheme the scheme is expected to broaden to include other energy-intensive sectors like petroleum refineries, petrochemicals, chemicals etc. The government may also consider the tightening of the targets.

In the PAT scheme, firms that have been able to achieve certain levels of energy efficiency will be able to sell Energy Saving Certificates (ESCerts) for the amount of their surplus energy improvements. Trading will happen through the two power exchanges (viz. Indian Energy Exchange (IEX) and the Power Exchange of India Ltd (PXIL)) while prices will be fully determined by the market.

Government expects energy saving under the PAT scheme to amount to 6.6 million tonnes of oil equivalent in its first phase. However, as with the REC programme (described below), regular monitoring and strict compliance will be essential for the scheme to take off

(I would highly recommend report "Analysis of the potential of Mandatory Trading in energy saving certificates to drive energy efficiency in the Indian industrial sector" at http://www.cii.in/webcms/Upload/Mandatory%20Report_Final.pdf)

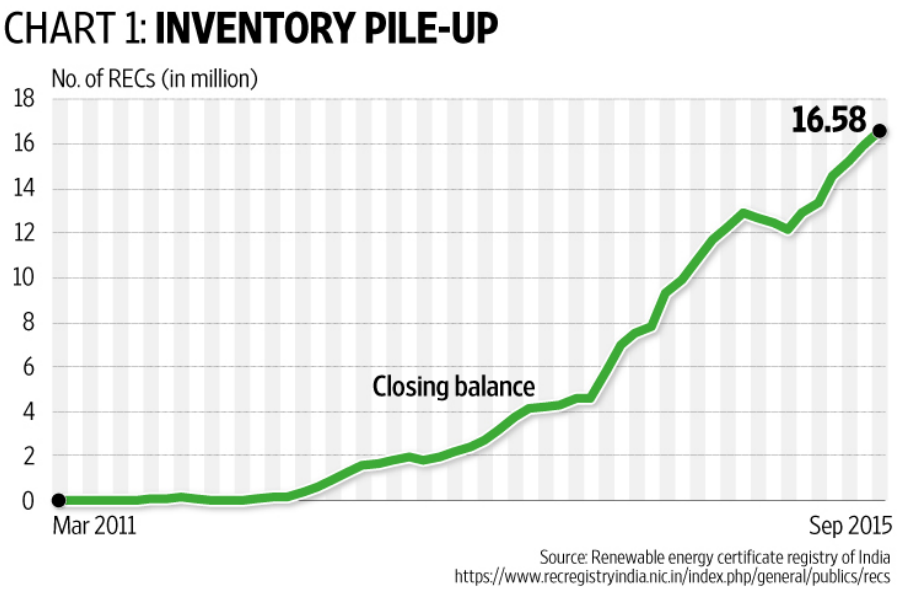
Renewable Energy Certificates

[This section has been drawn from an excellent article on Livemint by Ragini Bhuyan. See http://www.livemint.com/Politics/nuk1yqmbZLj6foZY1kzh2I/CanmarketmechanismshelpIndiafightclimatechange.html.

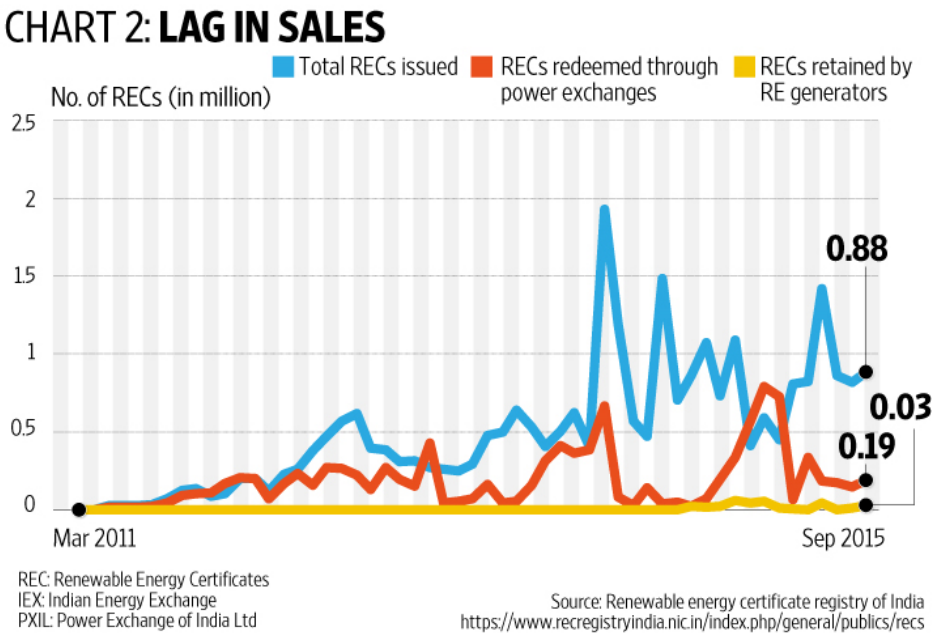
Another MBI that India embarked upon is the trading in Renewable Energy Certificates (RECs), where power utilities have to buy a share of their power from renewable energy producers. REC's are managed by the REC registry under MNRE. Under this scheme, utilities have to purchase a certain proportion of their power from renewable energy producers. If they aren't able to do so, they can make this up by buying the RECs.

These certificates are tradable via two power exchanges: Indian Energy Exchange (IEX) and the Power Exchange of India Ltd (PXIL). Each REC, which is generated by a renewable energy producer after getting clearances, is the equivalent of 1 megawatt hour (1 MWh). Unfortunately, so far, this scheme has not had much success.

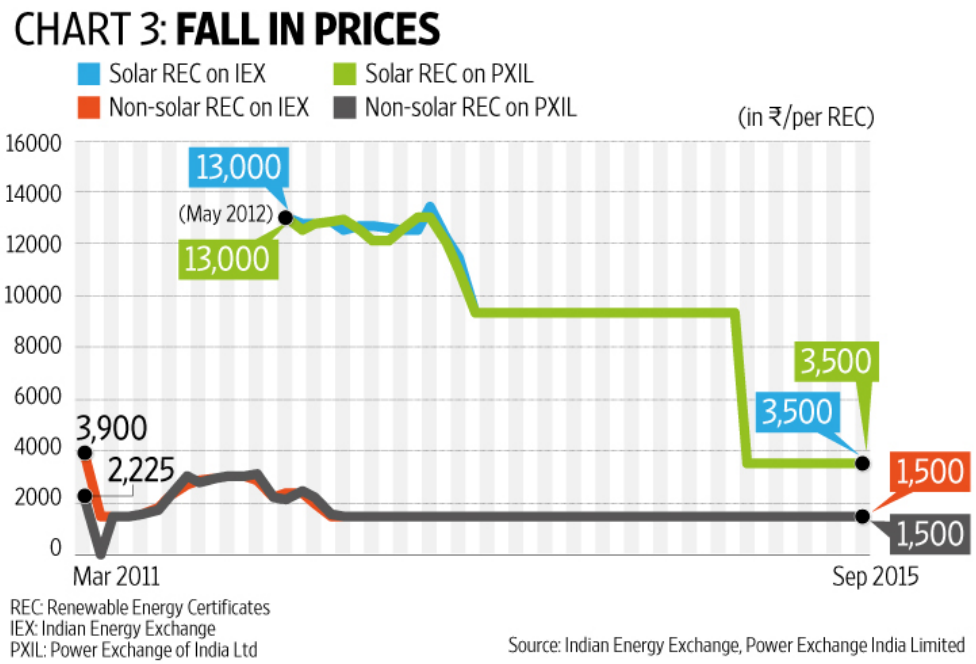
As Chart 1 shows, there has been an inventory pileup of RECs as there are few takers. REC inventory was 17 million certificates at the end of February, 2016. The certificates are valid only for three years, and hence, the buildup is not good news for renewable energy producers. The pileup has happened simply because of noncompliance by utilities. As Chart 2 shows, there is a huge difference between number of RECs available for sale in the exchanges and the actual amount purchased by utilities.



Why aren't utilities buying these certificates? Because they can't afford to do so given their poor financial conditions. State distribution companies (discoms) supply power at cheap rates to various classes of consumers which has led to a huge pile of debt in their balance sheets. Renewable energy, till recently, was the most expensive source of power, making it difficult for utilities to meet their obligations.



For instance, when RECs from solar power were introduced in 2012, they were traded as high as `13,000 apiece, as Chart 3 shows. The central electricity regulatory commission (CERC), which sets the trading band for RECs, has since cut the price to `3,500` 5,800, owing to poor compliance by buyers. But that is not the sole reason for falling prices. The cost of generating renewable energy too has fallen, contributing to lower REC prices.



But despite the falling prices, there have been few takers. One reason is that state discoms are able to get away without meeting their renewable power purchase obligations. The CERC has recommended that entities at fault be penalized by making them purchase RECs at their upper ceiling price. However, the final decision on this has to be taken by state level electricity regulators.

It is expected that the penalties will be rarely imposed, and if at all, then only in those States whose state electricity regulatory commissions are vigilant.

There has been a slight pickup in REC trading volumes after a Supreme Court judgment in May, 2015 which required captive power plants to be compliant with renewable power purchase obligations. Further, bulk of the trading is expected to happen towards the end of the financial year, when most companies rush to fulfil their renewable purchase obligations.

Many feel that the scheme is good scheme but it is failing because of poor enforcement of RPO (renewable purchase obligation) Even though compliance is increasing, the early setback to the system, in the form of piled up certificates, etc., has already discouraged new investors from setting up plants which will sell power through RECs.

The lessons from the REC fiasco are that stricter monitoring and greater compliance are needed to ensure that market mechanisms help to reduce GHG emissions.