

Report No 92**Special report on NCR Air Pollution: status of implementation of Hon'ble Supreme Court orders and further directions needed given the severity of the problem in winter****October 25, 2018****Environment Pollution (Prevention and Control) Authority for NCR (EPCA)**

EPCA is submitting this special report for the consideration of the Hon'ble Supreme Court to do the following:

- a. To take stock of directions given till date for different sources of pollution and to see what further needs to be done to ensure implementation
- b. To recommend further actions that need to be taken, keeping in mind the need for strengthened enforcement and to ensure that actions to combat pollution can match the scale and severity of the problem.

It is well understood today that people in Delhi and NCR (and in many other parts of the country) face a public health emergency because of extremely toxic air. This pollution is worse in winter, when the weather conditions lead to inversion (because of cold); moisture (that traps the pollutants) and poor wind (that does not allow for dispersion). This is why even though the sources of pollution remain constant through the year, the level of pollution peaks in winter. This is also why pollution is high in north Indian cities as against south or coastal India.

The Hon'ble Supreme Court has issued a number of extremely important directions to help combat this deadly pollution. Many of these directions, though aimed for Delhi and NCR, have countrywide impacts. The key objective is to ensure that there is implementation of the directions so that pollution is reduced – drastically and brings the necessary health benefits.

1. Re-checking sources of pollution to ensure actions are on track

The Union Ministry of Earth Sciences (MoES) has just released its *Emission Inventory of Delhi for 2018*. The report provides information on the sources of pollution in Delhi. It has been done using high-resolution inventory of all major air pollutants (400 metres x 400 metres resolution) for Delhi and its adjoining areas, which is then combined with ground-level information on each source of pollution. This inventory provides this city with the most recent information on each source and how much it contributes to pollution in the city.

According to this inventory (see table below) the following are key sources in 2018:

1. There has been a 40% increase in vehicular pollution between 2010 and 2018 in the region.
2. Vehicles are the key contributor to air pollution – in terms of all pollutants. **Vehicles contribute as much as 41% of the pollution in the city of Delhi.** This suggests the need to clean up vehicles through fuel/technology and to reduce and restrain growth of individual vehicles through massively augmented public transport systems.
3. In the vehicle segment, heavy commercial vehicles (trucks) and commercial/personal vehicles like taxi are the major polluting source. The report finds that CO and NOx emissions from vehicles are very high, pointing to the fact that taxis (Ula, Uber etc) travel 400 km/day, as against personal cars (55 km/day). And so, even if these vehicles use CNG, the net contribution is high. This requires restrain on the trucks entering Delhi and on ensuring that there is reduction in overall personal vehicle and that even taxi use is controlled through augmented bus and metro services. It also means that para-transit (like taxi and autorickshaw) must use the cleanest fuel and technology as the miles travelled are the highest and so is their pollution potential.
4. Other state registered 4-wheel vehicles (cars and taxis) was found to be between 40-50% in major roads of Delhi. The inventory shows that 1.1 million vehicles enter Delhi every day at just 8 entry points. This includes trucks and taxis and personal vehicles. **Clearly, this requires public transport connectivity for NCR region.**
5. **Industrial pollution has increased by a whopping 48 per cent between 2010 and 2018.** Industry now contributes 18% of the air pollution in the city.
6. Most importantly, industry contributes as much as 65% of the SO₂ emissions. This is because burning of pet coke earlier and now coal is rampant and it requires enforcement of the SO₂ standards issued under directions of the Hon'ble Supreme Court.

7. **Brick kilns** have been identified as a major source of pollution in the region, mainly because of poor technology and the extremely poor quality of fuel that is used.
8. The residential emissions have reduced by half in this period – from 2010 to 2018. This is because of the increased penetration of LPG even in the poorer areas of the city.
9. The report cautions that emissions from **burning of municipal solid waste** (MSW) and MSW treatment plants (waste to energy plants) is now emerging as the new challenge in Delhi.
10. Interestingly the report finds that there is a **26% reduction in wind-blown dust** emissions in the region; Dust contributes some 22 per cent of emissions; but this is in the form of PM 10 – as much as 50% of the total PM 10 emissions are wind-blown dust.

Emission Inventory 2018: Ministry of Earth Sciences, Government of India

SECTORS	Relative Share 2018 Delhi only (%)	Relative Share 2018 Delhi + Surrounding Area (70km x 65km) (%)	Change with respect to 2010 in a full area of 70km x 65km (%)
Transport	41	32.1%	+40
Industry	18.6	17.3	+48
Power	4.9	3.0	+16
Residential	3.0	18.5	-64
Wind Blown Dust	21.5	27.8	-26
Rest Others	11.0	13.0	Additional
			Overall Change = +15%

2. Status of implementation of directions of the Hon'ble Supreme Court and further directions sought

The Hon'ble Supreme Court has passed directions on all sources of pollution. In addition, under the directions of the Hon'ble Court, the Ministry of Environment, Forests and Climate Change (MoEF&CC) has finalised the Comprehensive Action Plan for Air Pollution Control (CAP). This plan has been notified under Section 3 and Section 5 of the EP Act and

includes actions on all the key sources of pollution. MoEF&CC has now been charged with the responsibility to ensure implementation of this plan. It is critical that this implementation is done in a timebound manner.

	Action/sector	Status of orders/implementation	Further directions needed for consideration of Hon'ble Court
1	CAP: comprehensive action plan for air pollution control with timelines and agency responsible, based on report 71 and 78 of EPCA	Order passed on 16.7.2018 directed MOEF&CC to file quarterly reports on the implementation of the plan and deadlines fixed. On 10.10.2018, the learned ASG has asked for time to file the status report. Matter listed on 15.11.2018	In light of the findings of the Emission Inventory 2018, MoEF&CC may be directed to expedite and ensure implementation of CAP measures on augmentation of public transport; non-motorised transport and inter- and intra-NCR connectivity.
2.	Vehicles		
2.1	To introduce substantially cleaner fuel/emission standards through BS 6 and to register only BS 6 vehicles as of April 1, 2020 based on EPCA report no 71 and 78	MOPNG has introduced BS6 fuel in Delhi; rest of the country will get fuel by April 2020. Order passed on 24.10.2018 that no extension will be given to vehicles; only BS6 to be sold and registered as of April 1, 2020.	
2.2	Strengthened PUC for keeping emissions from on-road vehicles under control based on EPCA report no 73 and 75 and report no 85. Implementation	Order passed on 10.8.2017 and again on 5.2.2018 that all acceptable recommendations to be implemented speedily. Annexure 1 provides update on implementation of PUC	MoRTH may be directed to provide detailed status report on the implementation of orders on PUC dated 10.5.2018

	will ensure improvement in system and also set up system for testing BS6 vehicles on road	<p>On 10.5.2018, order passed on improvement in diesel vehicle testing and remote sensing.</p> <p>On 2.8.2018, order passed on use of remote sensing technology for pollution checks and centralised testing centers for diesel vehicles.</p> <p>Report of ICAT to check on the efficacy of this technology submitted to Hon'ble Court.</p>	
2.3	Stickers on vehicles to identify age and fuel usage. Implementation of this will allow for vehicles to be restricted based on age/fuel during peak pollution days	<p>Order of 13.8.2018 directed that hologram based sticker of light blue (petrol/CNG) and orange (diesel) should be implemented in NCR by October 2, 2018.</p> <p>Matter has been listed for 28.11.2018. MoRTH has to provide clarity on procedure for existing vehicles and status and timeframe for implementation</p>	
2.4	Restriction on truck entry into Delhi as major contributor within vehicle segment: ban on entry of non-destined trucks; imposition of ECC on all Delhi-bound commercial vehicles; pre-2005 vehicles not allowed entry and setting up RFID for enforcement based	<p>Orders of 9.10.2015, 16.12.2015 and 22.8.2016 are being implemented. To strengthen enforcement, SDMC is setting up RFID system for entry of commercial goods vehicles into Delhi on 13 points. This system will be operational by November 15 on 11 points and will ensure only post 2005 vehicles are pre-registered and that there is no cash collection of ECC.</p>	<p>SDMC may be directed that only pre-registered goods vehicles will be allowed entry into Delhi after commissioning of RFID system and that diesel commercial vehicles over 10 year will not be pre-registered and given entry.</p>

	on EPCA reports of October 2015, August 2016 and Report no 83	Annexure 2 for status	
2.4	Eastern and Western Expressway (EPE and WPE) and for diversion of trucks	EPE has been commissioned and is in use. The remaining part of the WPE is expected to be commissioned by November 1 st week 2018. On 10.5.2018, Hon'ble Court directed that the State of Haryana should ensure that the concessionaire sticks to the assurance made, the date of June 30, 2018 for completion of WPE.	Government of Haryana may be directed to file commissioning schedule for WPE
2.5	Hydrogen-CNG for buses: this trial will ensure that emissions from CNG fuelled buses will be reduced, based on EPCA report 86 and 88	Order of 13.8.2018 sanctions Rs 15 crore from ECC funds to the Indian Oil Corporation for carrying out study and pilot project. Matter listed on 28.11. 2018	
3.	Industries		
3.1	Ban on pet coke and furnace oil ban in NCR states based on EPCA reports 72, 76 and 80. This ensures that the most polluting fuel is eliminated.	Order of 24.10.2017 placed ban on use of FO and pet coke in the states of UP, Haryana and Rajasthan, as of November 1, 2017. Order of 5.2.2018 directed CPCB to compile data on all permitted industries for regulation; namely, cement, calcium carbide and lime-kiln. This data is available on the website of CPCB. However, it is difficult to monitor enforcement and to ensure	

		that industries are not misusing their permission to use petcoke as explained in EPCA report 91.	
3.2	Ban on import of pet coke into India based on EPCA reports 79, 80, 87; this ensures that across the country pet coke use is restricted only to industries that use it as feedstock.	<p>Order of 26.7.2018 noted that consensus had been reached that imported pet coke would only be permitted in the following industries; cement, lime-kiln, calcium carbide and gasification. Hon'ble Court directed that the decision should be notified and implemented with immediate effect.</p> <p>On 24.8.2018, DGFT has issued notification to ban import of pet coke and its use permitted only in specified industries.</p> <p>On 6.9.2018, Hon'ble Court had allowed graphite electrode industry to use pet coke.</p> <p>On 9.10.2018 Aluminium and Calciner industry has been permitted to use pet coke.</p> <p>The matter of steel industry is pending and is listed on 14.11.2018</p>	Directions may be issued based on EPCA report 91, with regards regulation and enforcement of industries that are permitted to use pet coke (domestic and imported).
3.3	Setting up of standards for SO ₂ , NO _x for 23 industries. This ensures that emissions from combustion are monitored and	Based on directions issued by Hon'ble Supreme Court MoEF&CC has notified standards for NO _x and Sox for all industries. But the challenge is enforcement. EPCA in its report 87 had pointed out that	MoEF&CC may be directed to provide status report on implementation of Sox and NO_x standards in NCR.

	<p>controlled. It is expected that industry will move to coal or low-sulphur oil, which has lower emissions than pet coke. These standards also provide for incentives to move to natural gas, which has no emission limits.</p>	<p>enforcement is lacking and that this problem is fundamental and fatal.</p>	<p>The Pollution Control Boards of Delhi, Haryana, UP and Rajasthan may be directed to inspect all factories in their NCR districts as per the Air Act and to report on compliance with standards for Sox and NOx.</p>
3.4	<p>Natural gas for industries. Given the problems in enforcement of emission standards, it is critical that industries move to cleaner fuel, namely gas or electricity.</p>	<p>MoPNG has issued tenders for supply of natural gas in the districts of NCR. In the order of 16.7.2018, the Hon'ble Supreme Court notes that no further action is required to be taken in this regard and the issue is closed. However, the availability and supply of gas is not leading to the desired results because of higher price of this fuel as compared to more polluting fuels like coals or low sulphur oil. EPCA will file a report for the consideration of the Hon'ble Court so that further actions can be taken on this crucial matter.</p>	
3.5	<p>Measures to strengthen electricity supply in NCR to ensure that there is restricted use of generators and that</p>	<p>On 5.2.2018, the learned ASG had informed the Hon'ble Court that communication had been sent to the 3 states in NCR; namely Haryana, Rajasthan</p>	<p>UP, Haryana and Rajasthan may be directed to file responses on steps taken to strengthen electricity supply</p>

	cleaner electricity can be used to power industry and over time vehicles	and UP. On 10.5.2018, the Hon'ble Court had issued notice to the 3 states of UP, Haryana and Rajasthan on this matter.	
4.	Power Plants		
4.1	Closure of Badarpur thermal power plant as per measures listed in CAP	Implemented as of October 2018	
4.2	Bawana gas plant to be made operational so that instead of coal, the city uses power from cleaner natural gas	Order of 5.2.2018 Implemented as of July 2018	
4.3	Expeditious implementation of thermal power plant 2015 emission standards implementation, based on EPCA reports 81 and 84. This would ensure that coal based power plants would be far less polluting. The standards were to be implemented in December 2017, but Ministry of Power and industry has argued that implementation would be delayed and could not be done before 2022	Based on intervention by Hon'ble Supreme Court the deadline for implementation of emission standards has been expedited. Order of 7.9.2018 directs that 57 units, which are under central government will meet emission standard for Sox and PM by December 31, 2021 and NOx by December 2022. Private Power Plants and state power generating companies are now required to expedite schedules. Ministry of Power has to revert on EPCA's suggestion on use of merit order dispatch to incentivise implementation. Matter is listed on 27.11.2018	
5.	Others		

5.1	Brick kiln to convert to cleaner zigzag technology and to use better quality fuel for combustion	EPCA has taken up this matter directly with brick kilns in the region in coordination with the Central and state pollution control boards. As of the beginning of the 2018 season (October 2018), 35-40% brick kilns had converted to cleaner technology. As per CAP, only zigzag brick kilns will be allowed to operate in NCR districts. The state boards have to ensure enforcement of these directions of the Central government. Annexure 3 for update on brick kiln	
5.2	Biomass burning from neighbouring states of Punjab and Haryana	The Union government has taken up the matter with the state governments and has allocated funds for machinery that help farmers plough back the straw. There is high level attention on this issue and it is expected that there will be reduction in paddy straw burning incidences this season.	
5.3	MSW burning and emissions from waste-to-energy plants, has emerged as a new challenge and requires concerted efforts to contain both fires at landfills and other point sources	The Hon'ble Supreme Court is monitoring this matter	

Annexure 1/EPCA Report 92

PUC improvement: what is needed to be done

The Hon'ble Supreme Court has passed important directions for the improvement of the pollution under control (PUC) system, which is key for checking emissions of vehicles on the road. The Hon'ble Supreme Court had on August 10, 2017 considered EPCA report no 73 and 75 and issued directions, which once implemented would strengthen the enforcement system for on-road vehicles. The Hon'ble Court had issued directions on May 10, 2018 regarding trials for remote sensing equipment to be used to monitor pollution from on-road vehicles.

EPCA has reviewed the status and while there is movement on the measures, there is a need for timebound implementation of the directions of the Hon'ble Supreme Court so that PUC/on-road emissions of vehicles are kept in check.

Sno	Direction	Status	Comments of EPCA
1.	<p>Limit the number of PUC centres, upgrade them and bring them under strong supervision and quality control.</p> <ul style="list-style-type: none"> Ascertain the number of petrol stations in the NCR region and how many of them are equipped with PUC centres. Ascertain how many authorized service centres of OEMs are in the NCR region. Issue advisory to all the State Transport Departments all over the country for mandating PUC centres at every fuel station. 	<p>In Affidavit filed on 20.9.2017, MoRTH has informed the Hon'ble SC as follows:</p> <p>No of stations in NCR: 3020 Number of stations with PUC in NCR: 1083 Number of authorised service stations of OEMs in NCR: 1054 Number of authorised service stations of OEMs in NCR: 160</p>	<p>The upgradation and supervision for quality control will happen once the MoRTH has linked all the stations and provided protocols for quality control (item 2)</p>
2.	<p>All empanelled and authorized PUC centres having Type Approved Machines will be uploaded on the website of the Ministry of Road, Transport and Highways with their names, addresses and authorized personnel. In the first stage, the needful will be done within a month in</p>	<p>MoRTH has issued a notification (GSR 527 (E) on June 6, 2018 as an amendment to the Central Motor Vehicles Rules, 1989 to allow for the following:</p> <p>The emission results obtained during testing as per clause (i) or clause (ii) above shall be electronically uploaded through online</p>	<p>In its meeting on July 27, 2018, EPCA has discussed the status of this online system with MoRTH and National Informatic Centre (NIC), which is developing the software.</p> <p>The system is expected to be commissioned by end-</p>

	so far as the NCR region is concerned and thereafter for the rest of the country.	process to the state register of Motor Vehicles of the Central Register of Motor Vehicles as the case may be.” The schedule for implementation of this is as follows: NCT Delhi: June 1, 2018 Haryana, Rajasthan, UP: October 1, 2018 Rest of the country: April 1, 2018	August and Delhi PUC data will be linked to it. ARAI has been asked to submit information on the type-approval provided for such equipment so that the system can be designed and all data transferred.
3.	Introduce automatic online network for transmission of PUC data to the central server to minimize manual interference and allow proper analysis of data for remote auditing of PUC centres.	As above	The software being designed by NIC for MoRTH in compliance with the directions of the Hon’ble court will go a long way to improve the current system. State governments would upload information on the authorised and registered PUC centres allow registration of all authorised with the details of the equipment available. All PUC test data would be recorded and transmitted real-time from PUC centres to the central server, which would be linked to the VAAHAN database. It is important that this project is completed as soon as possible. Schedule for completion is needed.
4.	Mandate pre-payment of PUC fees before the tests are conducted	Done. As per information it is being implemented	
5.	Ensure 100 percent compliance by linking annual vehicle insurance with PUC certificates	MoRTH has taken up this matter with all insurance companies and after much follow-up and effort, the insurance companies have issued directions that it is mandatory to check for PUC certificate before issuance of the insurance policy. A list of 15 insurance companies that	MoRTH must continue to follow up to ensure that there is full compliance with these directions. To improve compliance and enforcement, EPCA has asked for the following to be done: Currently all insurance companies have to upload information

		have complied with the directions was sent to EPCA through email.	about the policy in the VAAHAN database. It was agreed that an additional column/field would be created requiring insurance companies to fill that they had complied with the mandatory direction at the time of issuing the policy. This would ensure compliance.
6.	Make Lambda test for petrol cars mandatory across NCR	Done. Being implemented	The effectiveness will be known once there is a system to check on the working of the authorised PUC station
7.	Introduction of roadside remote sensing screening of emissions in Delhi and NCR to complement the current PUC system	The International Centre for Automotive Technology at Manesar (ICAT) is conducting study.	ICAT report to be submitted to Hon'ble Court

Annexure 2/EPCA report 92

Implementation of RFID for improving enforcement of orders of Hon'ble Supreme Court barring entry of pre-2005 commercial vehicles into Delhi and ensuring that vehicles pay the Environment Compensation Charge, which would act as a disincentive for commercial vehicles to traverse through Delhi

The 2015 orders of the Hon'ble Supreme Court were given in order to reduce commercial vehicle entry into Delhi and by doing this, to reduce air pollution. On 22.8.2016, the Hon'ble Supreme Court had directed that the South Delhi Municipal Corporation (SDMC) would install a Radio Frequency Identification (RFID) system into entry points to Delhi to make the system effective and credible and to reduce the chances of corruption and leakages in this cash-based system.

EPCA report 82 had pointed out that collection of ECC was greatly flawed and that the directions of the Hon'ble Supreme Court are in effect being flouted and all efforts to mitigate pollution derailed. It had reiterated the need for expeditious implementation of RFID system for 13 key entry points into Delhi.

The South Delhi Municipal Corporation (SDMC) has since expedited the implementation of the RFID system on 13 entry points into Delhi. Roughly 80 per cent of the commercial vehicles enter the city from these 13 points.

The following is the schedule for implementation:

November 1, 2018:

1. Kapasera
2. Aya Nagar
3. Tigri
4. Shahdra Main
5. Shahdra Flyover

November 15

6. Kundli
7. Rajokri
8. Ghazipur (old)
9. Ghazipur (main)
10. DND

November 30

11. Kalindi kunj (may be delayed further as road is inoperative)
12. Badarpur
13. Badarpur (flyover)

EPCA has worked with SDMC to make rules for pre-registration of vehicles to ensure that there is compliance with the orders of the Hon'ble Supreme Court on exemptions to certain goods and vehicles. The objective of these rules is to ensure that leakage and corruption at the time of collection of ECC is reduced, which is rampant because of manual checks at the border.

The rules are as follows:

The following **vehicles types**, which are exempt, under the Hon'ble SC order will get exemption at the time of pre-registration:

1. CNG vehicle (with RC showing that they are CNG vehicle)
2. Milk tanker
3. Oil tankers carrying petroleum products

4. Water tanker
5. Ambulance
6. Fire fighting vehicles

The following **goods are exempt from paying ECC** and currently the system to check this is manual, which is leading to huge transaction costs and corruption:

1. Eggs
2. Salt
3. Ice
4. Foodgrains
5. Vegetable
6. Packed milk

The rules will be as follows:

1. All vehicles will be required to pay ECC at the time of entry.
2. The vehicle owner will be required to show proof that the exempt goods are being carried in the form of Bilti/challan and that the goods are destined for Delhi. This Bilti/challan will be scanned at the time of entry.
3. In the case of vegetables and open grains, where the bilti/challan is not available a photograph of the goods will be taken and used as proof
4. The exempt vehicles, carrying the necessary documentation, after audit, will get a recharge in their ECC account.
5. The process of audit and refund will take up to 1 week
6. All toll plazas have cameras to record the transaction, number plate and the nature of goods being carried, which will be used at the time of audit
7. There will be a penalty for wrong claim of reimbursement, which could lead to blacklisting.

Rules for empty vehicles bound for Delhi

As per the Hon'ble Supreme Court order of 16.12.2015, vehicles that are bound for Delhi can enter on payment of ECC of Rs 700 and Rs 1300 per vehicle depending on the category to which the vehicle belongs. The system for these vehicles, to avail, this half rate of ECC, will be as follows:

1. All vehicles will be required to pay full ECC at the time of entry.
2. The vehicle owner will be required to show proof that the vehicles is bound for Delhi in the form of: Bilti/challan, which will be scanned at the time of entry
3. In addition, cameras will take photographs of the vehicle to show that it is empty
4. The reimbursement to the empty vehicle, carrying the necessary documentation, after audit, will be given in the form of recharge in their ECC account.
5. The process of audit and refund will take up to 1 week
6. All toll plazas have cameras to record the transaction, number plate and the nature of goods being carried and also to record if the vehicle is empty, which will be used at the time of audit.
7. There will be a penalty for wrong claim of reimbursement, which could lead to blacklisting.

Annexure 3/EPCA report 92

Brick Kilns in NCR: Status of pollution control to reduce emissions

The brick kiln sector has been long considered to be extremely polluting and a major contributor to pollution in the airshed. The technology used in NCR brick kilns, known as fixed chimney bull trench (FCBT), is rudimentary and requires continuous combustion and is known to be high in emissions. The conversion of the existing brick kilns to an alternative technology, called as zigzag technology, is widely understood as the most cost-effective and feasible method to reduce pollution in this sector.

EPCA has been working with the Central and state pollution control boards to ensure that the existing brick kilns convert from FCBT to zigzag technology to reduce pollution.

Background

The Hon'ble Supreme Court in its order dated September 11, 1996 directed that "...brick kilns cannot be permitted to operate and function in the Union Territory of Delhi. These brick kilns may relocate/shift themselves to any other industrial estate in the NCR".

Following this, in 2016-17, the Hon'ble Court took up the matter of an emergency plan for Delhi and NCR, as well as the comprehensive action plan to deal with all sources of air pollution in the region. Both these plans have provisions to combat emissions from brick kilns.

The Graded Response Action Plan for Delhi & NCR (GRAP), which has been notified as per the by the MoEF&CC on January 12, 2017, deals with emissions from brick kilns by reiterating stringent enforcement of existing pollution control regulations in the "moderate to poor" category of actions. During "severe" pollution episodes, GRAP mandates the EPCA to direct authorities to shut down operations of all brick kilns in the region.

The Hon'ble Court directed the notification of the Comprehensive Action Plan for Delhi & NCR (CAP). The CPCB issued directions under Sections 3 & 5 of the Environment (Protection) Act, 1986 regarding the CAP in Delhi & NCR on June 22, 2018.

The CAP directs all NCR state pollution control boards to ensure that brick kilns are converted to "zigzag technology". It says "Only brick kilns which have converted to zig-zag technology and have been certified by the SPCB will be allowed to operate during winter 2017-2018. By July 1, 2018, only brick kilns with zigzag technology will be allowed to operate in NCR."

The need for control of pollution in brick kilns

The brick industry is one of the five largest industrial consumers of coal and there are serious environmental concerns associated with the production of fired clay bricks. Emissions from brick kilns have been identified as one of the major sources of air pollution in Delhi-NCR.

The 2015 IIT Kanpur Study on Air Pollution in Delhi has identified the various sources of air pollution within the NCT of Delhi. Although the state of Delhi does not permit the operation of brick kilns within its territory, the emissions from the nearby regions affect air quality within Delhi. The study explores the contribution of fly-ash from brick kilns operating outside Delhi and identifies these kilns as a definite factor that affects air quality.

Over the past two decades, there has been a rapid increase in the brick production capacity in the NCR region. Following the closure in Delhi brick kilns have moved to areas bordering Delhi such as Ghaziabad, Noida, Baghpat, Muzaffarnagar, Bulandshahar, Hapur, Meerut (UP), Palwal, Sonapat, Faridabad, Jhajjar, Jind, Bhiwani, Nuh (Haryana) and Alwar and Bharatpur in Rajasthan. In this period, the total brick production capacity has increased by six-ten times. This corresponds with the

increased rate of urbanization and resultant construction in the region. This has increased the pollution impact from brick kilns in this common airshed of NCR.

Strategy for pollution reduction through technology conversion

In NCR region, almost all brick kilns are based on the rudimentary FCBT technology with chimneys emitting pollutants continuously during the peak manufacturing season from mid-October to June every year.

The more advanced technologies, namely, Vertical Shaft Brick Kilns (VSBK), Hybrid Hoffman Kilns (HHKs) need high initial investment. Therefore, the most appropriate option found suitable for this sector, is the zigzag kiln. Zigzag kilns are better than FCBT kilns when it comes to the amount of coal being consumed and also reduction in pollution.

The infrastructure of zigzag kilns is similar to FCBT kilns, the only difference being that the former is always rectangular. Hot air leaves the kiln travels in a zigzag path through the stacks of green bricks, thus pre-heating them for a longer period. This makes zigzag kilns more energy efficient. The draught in these kilns can either be natural or forced. This technology also reduces the consumption of coal by 20–30 per cent and also decreases emissions, including black carbon-containing particulate matter. The SPM and black carbon emissions are reduced drastically by about 75 per cent, and the number of good quality bricks goes up by around 25 per cent.

This technology was introduced in India by Central Building Research Institute (CBRI), Roorkee, in the early 1970s but gained popularity in the mid-nineties (around 1993-1994) only in eastern India, especially West Bengal. However, other parts of the world (including Bangladesh) have rapidly moved to zigzag technology as it reduces pollution.

The pay-back period of this conversion is small – one to two years – as the quality of bricks is improved and the cost of fuel is reduced.

Table: Advantages of zigzag kiln over the FCBT Kilns

S. No.	Fixed Chimney Bull Trench (FCBT) kilns	Zigzag kilns
1.	Specific energy consumption is in the range of 1.1–1.5 MJ/kg of fired bricks	Specific energy consumption in comparison to the FCBT kilns is 20 per cent less
2.	Percentage of Class I bricks produced is between 50–60 per cent	Percentage of Class I bricks is much higher and is more than 80 per cent
3.	Range of particulate emission from FCBT kilns is from 250–1,250 mg/Nm ³	Range of particulate emission from the kiln is less than 250 mg/Nm ³ .
4.	Black carbon emission ranges from 0.07–0.27 g/kg of fired bricks	Black carbon emission is less than 0.05 g/kg of fired bricks

CPCB directions on zig zag conversion

Since 2015, the Central Pollution Control Board has issued directions to brick kilns to convert to zigzag technology in the Delhi-NCR region.

Timeline of CPCB orders:

- On December 29, 2015, CPCB issued directions under Section 18 (1) (b) of the Air (Prevention and Control of Pollution) Act directing all brick kilns in NCR to convert from natural draft to induced draft within 90 days.

- In a subsequent order in November 2016, CPCB clarified that all brick kilns must convert to a kiln design that has zig-zag brick settings and redesigned chimneys along with transition from natural to induced draught. CPCB directed that all kilns not complying with these conditions must shut down for the winter till March 31, 2017.
- On June 27, 2017, the CPCB directed all SPCBs in the NCR states to provide status on conversion of brick kilns from natural draft to induced draft (with rectangular kiln shape and zig-zag brick setting).
- On October 24, 2017, the CPCB directed the State Governments of the NCR states to close down all brick kilns operating without consent. It also reiterated that kilns that have not converted to zigzag kilns by September 30, 2017, should not be allowed to operate.
- On February 13, 2018, CPCB issued directions to all NCR district governments that they should ensure compliance of its directions, which are as follows:
 - a. Operation of brick kiln, not converted to zigzag technology (natural/induced draft with rectangular shape) should be allowed for the period March 1, 2018 to June 30, 2018 provided they have valid consents from the respective SPCB's and ensure stack monitoring facilities.
 - b. **All brick kilns that had not converted to zigzag technology would cease to operate beyond June 30, 2018.**

EPCA's interventions and current status of brick kilns

EPCA has been closely monitoring the situation of brick kiln conversion since February 2017. It has held a series of meetings to reiterate the directions of the CPCB in this matter and to ensure that there is compliance.

In October 2017, EPCA directed that FCBT brick kilns would be allowed to operate for one last season – from March 1, 2018 to June 30, 2018 – provided that they had given a signed undertaking that they would convert to zigzag.

This direction was reiterated on January 11, 2018 and made clear to all NCR state pollution control boards that from July 1, 2018 only zig-zag technology (natural/induced draft with rectangular shape) would be allowed to operate in NCR.

As of today, the status of conversion is as follows;

Table: Status of conversion of brick kilns in NCR to zigzag kilns

State	Total Brick Kilns	Zigzag kilns	Non-Zigzag Kilns
Delhi	0	0	0
Haryana	2887	1286	1601
Rajasthan	246	82	164
Uttar Pradesh*	2107	403+64 (in process)	1640
Total	5240	1835 (35%)	3405 (65%)

Source: Data provided to EPCA by SPCB's in its meeting dated September 14, 2018

*Data for Uttar Pradesh excludes the district of Shamli

At its recent meeting on September 14, 2018 convened specifically to discuss the conversion of the brick kilns before the onset of the coming season in October 2018, EPCA noted the following:

- a. Some 1835 brick kilns had converted to zigzag, which would now be allowed to operate from the coming season – October 2018. All other brick kilns, not converted to zigzag, and certified by the state pollution control board, would not be allowed to operate.

- b. It was noted that the state pollution control boards must ensure the quality of technology conversion is good and that it does not negate the efforts to control emissions. EPCA therefore, asked for quality checks and rigorous audits to ensure compliance.
- c. It was directed that all state governments must ensure all brick kilns that have not converted to zigzag must be shut down.
- d. It was also directed that all state governments must ensure that brick kilns do not use highly toxic fuel like used rubber, old rubber slippers, plastic wastes and other toxic substances are being used to fire the brick kilns. The advantage with good quality zigzag converted kilns is that the quality of combustion material is better – including the use of crushed or briquettes of agricultural residues – and this reduces pollution substantially.