

Clean Air: Delhi



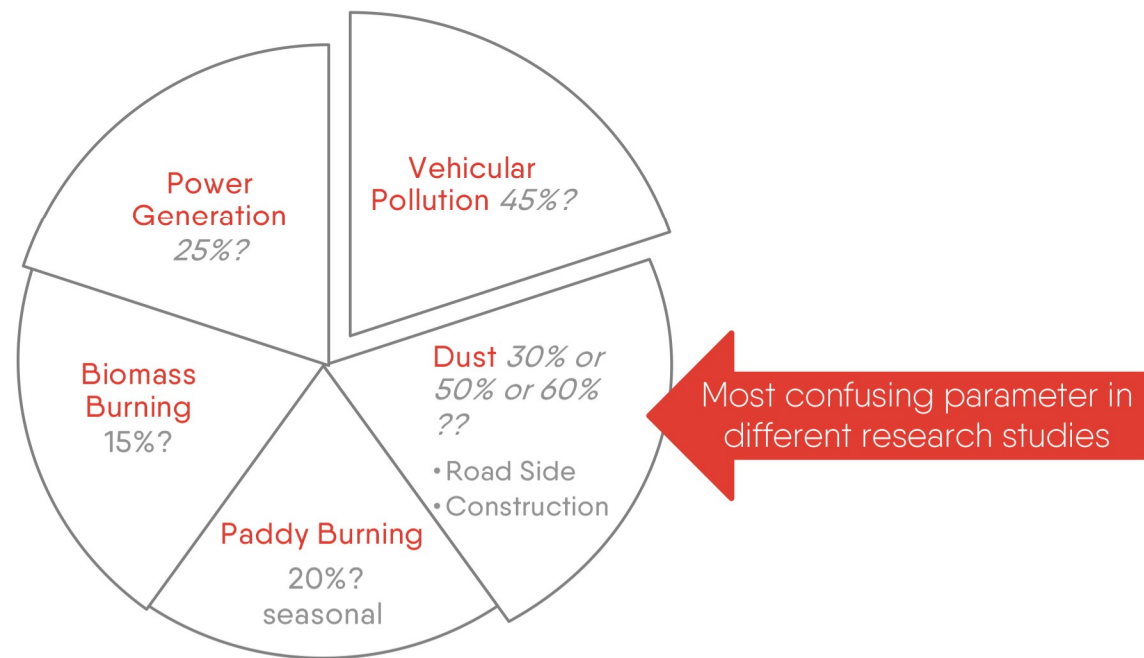
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Massive Earth Foundation

What is choking Delhi



While there is visibility on sources, but very little clarity on the quantum or the magnitude of each source



What is choking Delhi



Is it Paddy Burning ?

Is it Vehicular/Aerial Traffic ?

Is it Dust ?

The Popular belief that it is Paddy Burning



Why did Paddy Burning Start ?



- 1 Farm Mechanization
- 2 As an unintentional effect of government policy

Arvind Kejriwal Blames Punjab For Higher Delhi Pollution Since October 25

CM Kejriwal, who showed satellite images of stubble burning in Punjab, said the incidents of stubble burning were more in Punjab this year than in Haryana.

Delhi | Indo-Asian News Service | Updated: November 01, 2018 17:19 IST

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(CriticalUnion)

• [New Site Finds the Cheapest Flights in Seconds!](#)
(FlightFinder)

AIR

Paddy fields burning: Smog shrouds national capital

The smoke resulting from burning crop residues combined with vehicular emissions make the air we breathe deadly



NEXT NEWS >

By Usman Nasim
Last Updated: Monday 07 December 2015



Farm Mechanization: Key to yield improvements?



Global Spotlight: Share in GDP v/s Farm Mechanization



Source: World Bank Indicators, CIA Fact book, Mechanisation and Farm Technology Division of Department of Agriculture and Cooperation, Trading Economics, FAO Yearbook 2013

High level of Farm Mechanization in North India

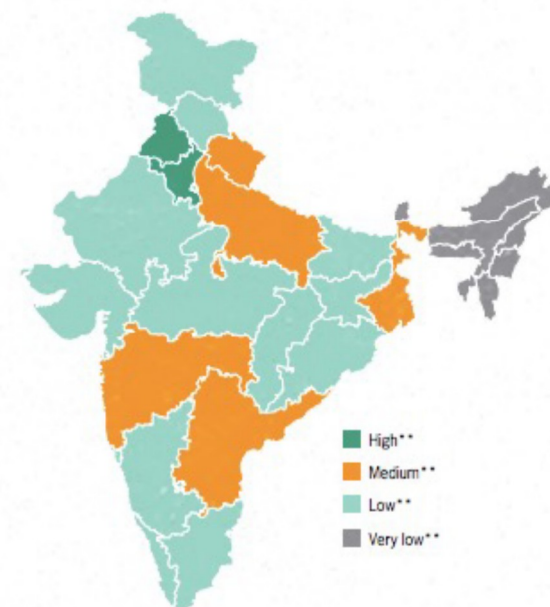


Figure 15: India relative development of mechanisation

Source: State of Indian Agriculture, Department of Agriculture report, 2012-13

** Based on relative scale of farm power availability as shown in the report

Farm Mechanization: Harvester Residue



- Paddy when harvested by human labour it is cut very close to the ground
- Decreasing labour supply, increasing labour wages & other factors led to higher harvester sales
- Harvesters, though faster than human labour, **leave more crop residue** burning which causes more smoke

India combine harvesters trade (units):

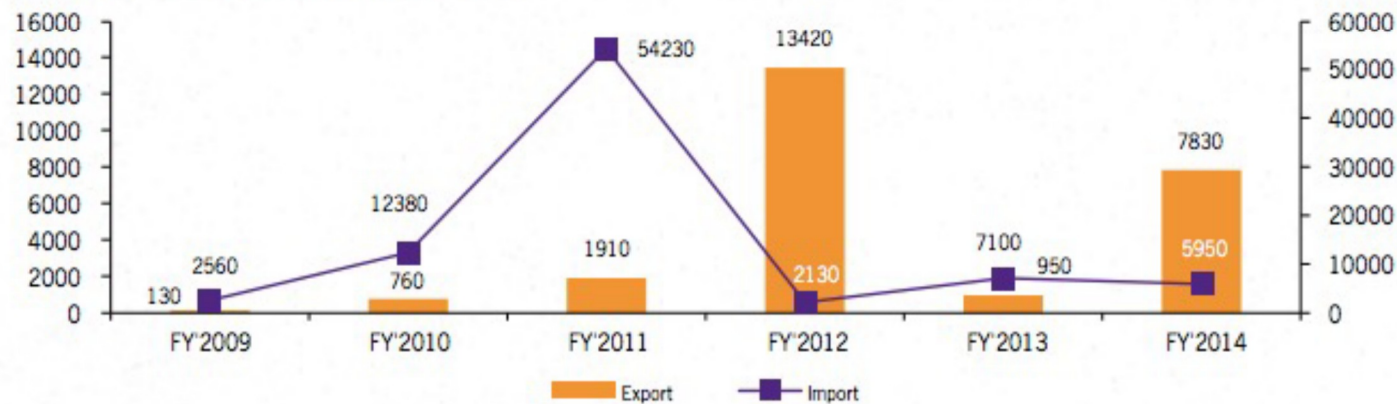


Figure 20: India combine harvesters trade

Source: Ministry of Commerce and Industry, Government of India

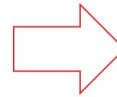
Government Policy: Environmental Impact Assessment?



- Firstly, the government aligned towards Paddy by buying it at high **Minimum Support Price (MSP)**, giving farmers an incentive to grow paddy over other crops.

Paddy is very water-intensive

- Thereafter, policy to save sub-soil water leads to change in time of harvesting when wind direction is from Punjab towards Delhi.



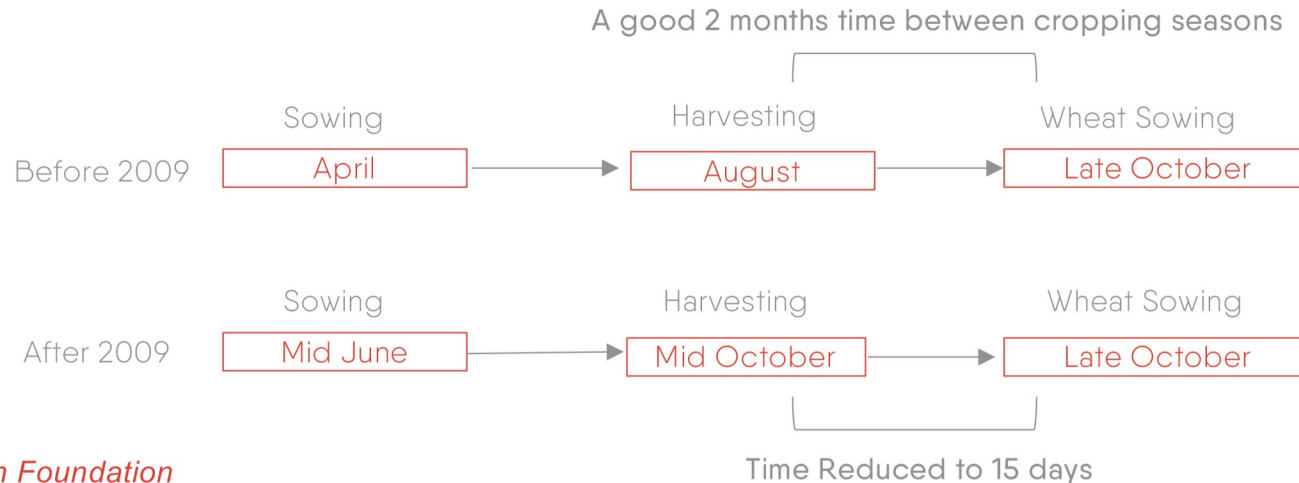
The Punjab Preservation of Subsoil Water Act, 2009

- According to this law, farmers can no longer sow rice in April, but have to wait until the middle of June to do so. Haryana too has copied Punjab & passed a similar law.

Crop Residue + Government Policy: Lethal Combination



- Impact of The Punjab Preservation of Subsoil Water Act, 2009
 - Paddy Cultivation Period -120 days between growing and harvesting.
 - Wheat Sowing has to start in October otherwise there is a steep decline in the yield.
 - Due to the reduction in the period between paddy harvest & wheat sowing **farmers are forced to ready the farm as soon as possible** & hence adopt cheap & fast method of burning crop residue.



Solutions: Policy + Innovation



- Policy Changes:

- Increasing the MSP, which currently doesn't take into account the cost of Paddy straw management, a rather costly process.
- Millets made up 40% of all cultivated grains before the green revolution these can be a substitute for paddy. Millets are rich in nutrients and resistant to droughts, and thus are ideal for small farmers.
- Modifying laws that put unnecessary burden on farmers

- Innovation

- Using Paddy Straw to manufacture biodegradable pulp, which can be used in application such as bio-degradable utensils, drinking straws etc. This will also reduce consumption of single use plastic. Investments required to manage supply chain & build economies of scale.
- Other uses of Paddy Straw to be encouraged:
 - As a feed to Bio-CNG plant that produces CNG & Fertilizer
 - As feed to Ethanol Plant.

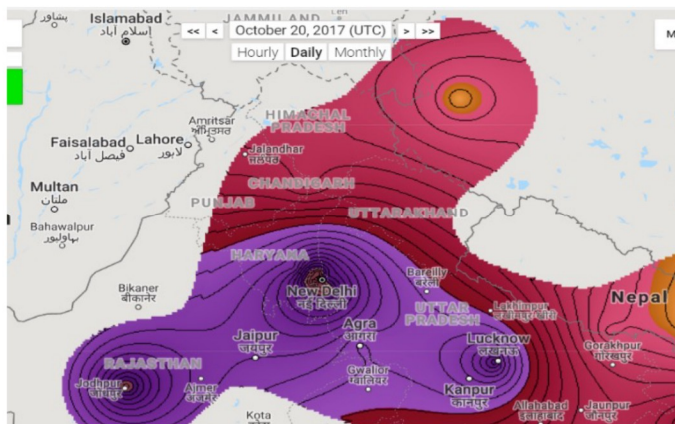
Is Paddy Burning the only reason ?



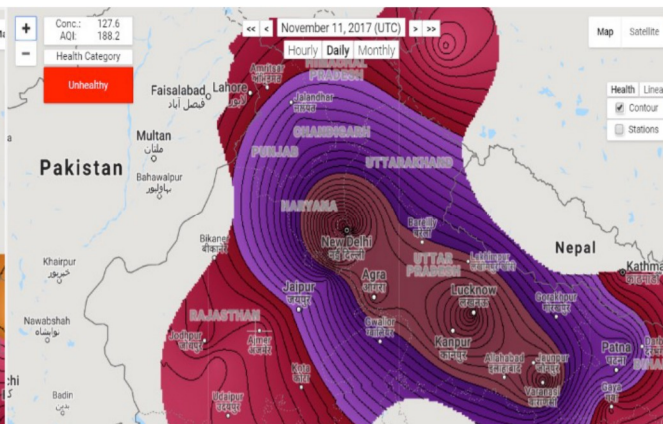
Looking at some images



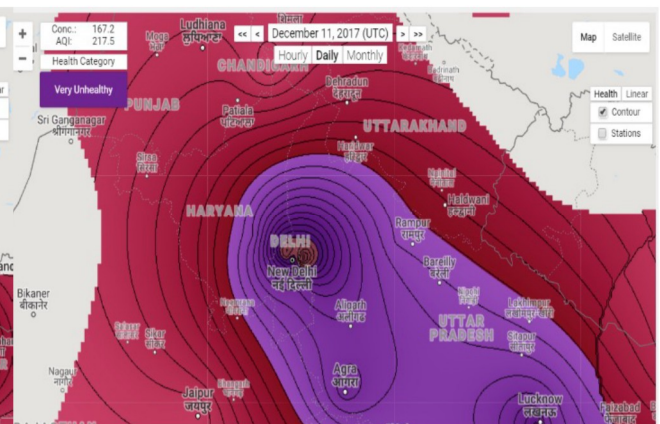
Paddy burning takes place in the month of October, but we can see from below images that Delhi is in very unhealthy region in December as well.



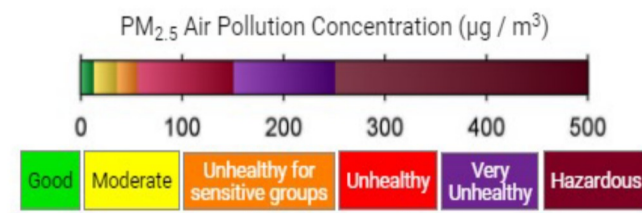
October 2017



November 2017

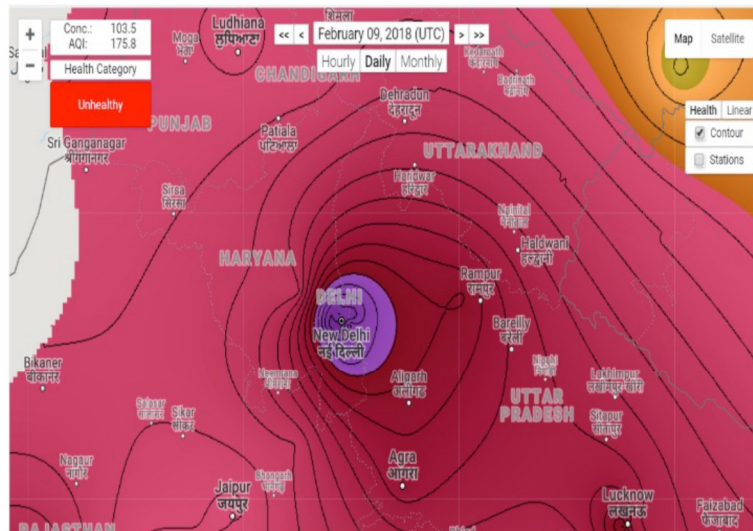


December 2017

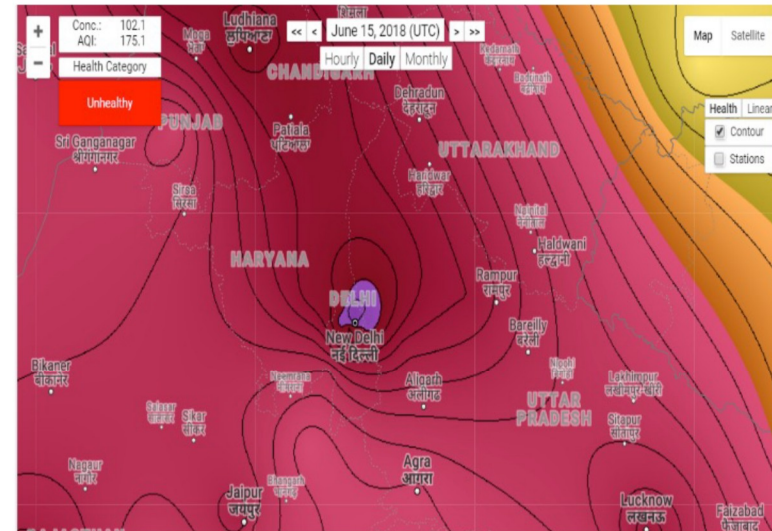


Source: <http://berkeleyearth.org/air-pollution-overview/>

What about 4-6 Months Later



February 2018



June 2018

Source: <http://berkeleyearth.org/air-pollution-overview/>

Observing conditions after 4-6 months Delhi still is in very unhealthy region.

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Emissions from Vehicles

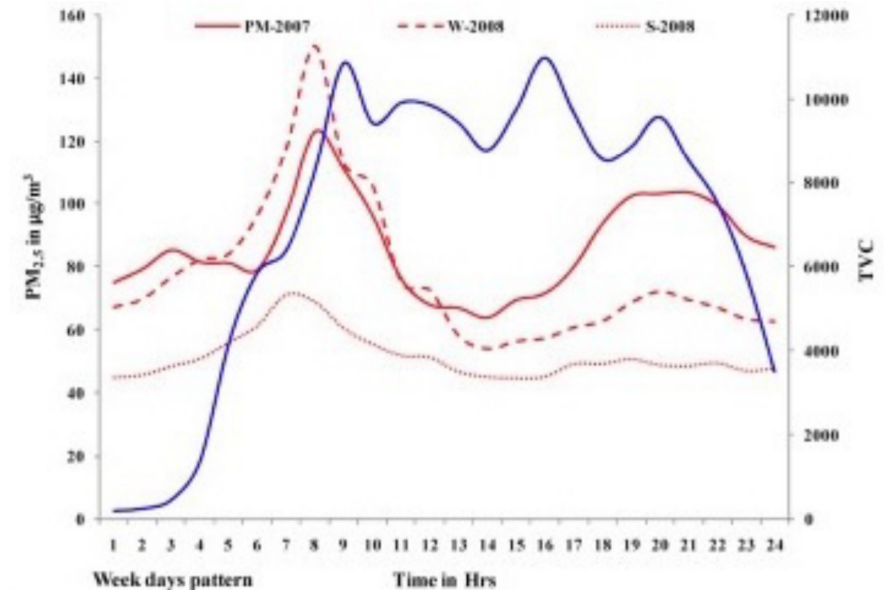


Proving the point: Extrapolating Chennai Case Study



- A study conducted in Chennai in which Particulate Matters were studied across different seasons.
- Like $PM_{2.5}$, PM_1 & PM_{10} , also had considerable increase during morning & evening office hours.
- Very high correlation between peak pollution levels and vehicular traffic in all seasons.
- Clearly concluding that vehicular emissions definitely contribute to Air Pollution.

$PM_{2.5}$ Levels on Week days
PM- Post Monsoon, W- Winters & S- Summers



Quick Fact

Delhi has over 33,000 Kms of Roads,
which almost 10x of road length in Chennai

Solutions: Policy + Innovation



- Policy Changes:

- Integrated Public Transport: Improving the connectivity across transport modes so that public transport becomes a viable alternative to car travel, in other word door to door transport.
- Multiple Office Timings to prevent congestions during the peak hours.
- Programs like Odd-Even and preferred parking locations for employees who choose to carpool.

- Innovation

- Electric Mobility: Starting with public transport (auto rickshaws, taxi & buses) and slowly transitioning to Passenger Vehicles and two wheelers.
- Smart Pollution Capturing Devices: Retrofit devices that capture soot from vehicles and DG sets.

What is choking Delhi



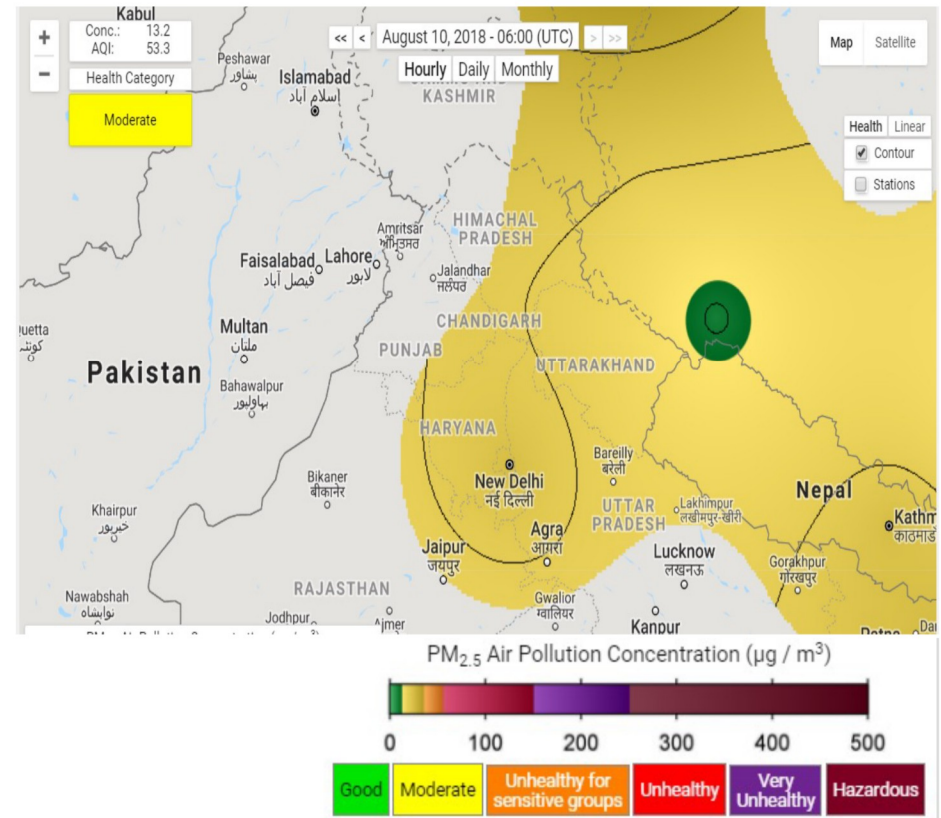
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Delhi- During Monsoon

- The good air quality during monsoon season shows that at least, in monsoon, people in Delhi can breathe good air.



Source: <http://berkeleyearth.org/air-pollution-overview/>

The Hidden Culprit: Dust



The footprint of dust in India, by default is large...



Home BIZ WRAP Economy and Politics Story

Delhi gasps for breath as air pollution worsens due to dust storms

While the pollution in winters is mainly attributed to stubble burning and lack of wind, the dust storm due to high wind speeds seems to have caused severe air pollution in the national capital region (NCR) around this time of the year.

[BusinessToday.In](#) Last Updated: June 15, 2018 | 16:14 IST



PRESS TRUST OF INDIA 14 JUNE, 2018 10:41 IST

DELHI AIR POLLUTION HAS RISEN BEYOND 'SEVERE' LEVEL DUE TO DUST STORMS IN WESTERN INDIA



The CPCB data showed that the PM10 (particles with a diameter less than 10mm) level was beyond "severe" at 778 in Delhi-NCR area and 824 in Delhi particularly, leading to hazy conditions and limiting visibility.

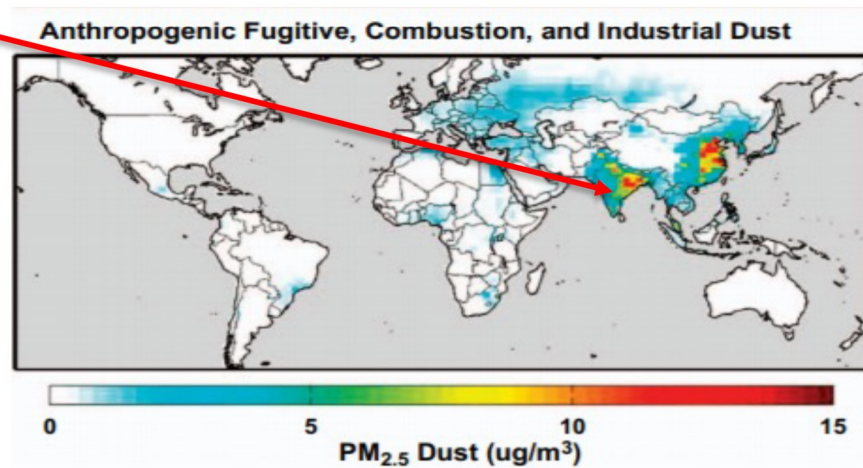
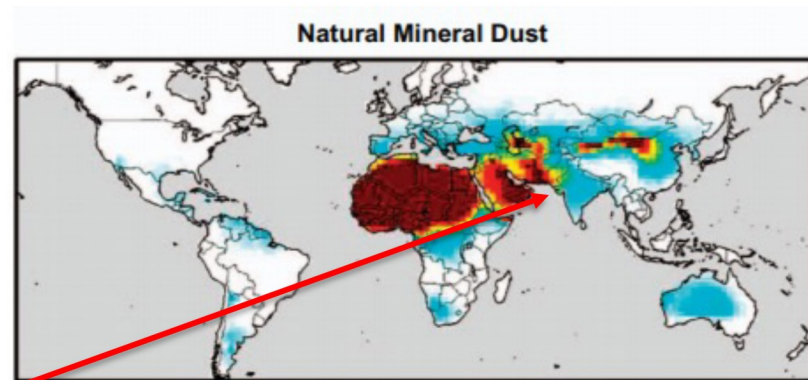


High pollution levels in Delhi were mainly due to dust storms from Rajasthan, the Environment Ministry said after [air quality in Delhi](#) deteriorated beyond "severe" level on Wednesday and predicted that dusty conditions were likely to prevail over the next three days.





It can be seen from these images India has both Natural as well as other types of dust i.e. Anthropogenic, Combustion & Industrial Dust.



Source: Sajeev Philip et al 2017 Environ. Res. Lett. 12 044018

Sources of Dust



However adding to natural source of dust is total ignorance or lack of sensitivity towards dust



DUST FROM CONSTRUCTION



Global Standards
Construction Tarps



In India



Delhi has over 33,000 km of Roads that translates to 66,000 km of roadsides



ROADSIDE DUST



Global Standards



In India



Complete apathy of civic agencies due to lack of regulations



Sector 29, Noida
Delhi-NCR

A typical situation post
infrastructure development in India



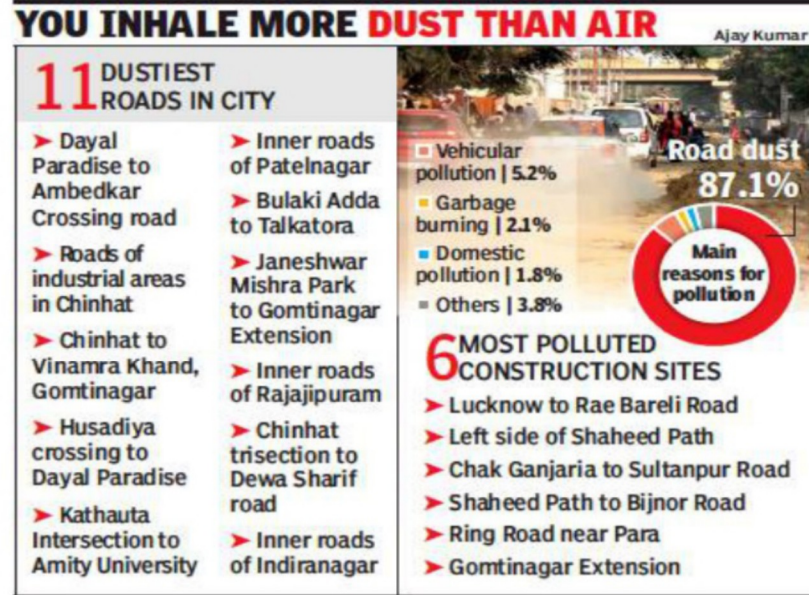
Throwing Dust in your eyes



Source: <https://timesofindia.indiatimes.com/city/delhi/before-short-term-ban-long-term-harm-how-theyre-throwing-dust-in-your-eyes/articleshow/66452135.cms>

Dust is a big component of polluting particles and it is calculated that more than 131 tonnes of dust in generated daily in the city.

© Massive Earth Foundation



Source: <https://timesofindia.indiatimes.com/city/lucknow/dust-is-snatching-your-breath-of-fresh-air-daily/articleshow/66408170.cms>

Dust accounts for major PM10 pollution in Lucknow air i.e. 87 %, followed by vehicular pollution and burning 5.2% and 2.1% respectively.

Solutions: Policy + Engagement



- **Policy Changes:**

- Formalize & enforce guidelines on handling of dust / construction material.
- Every construction site bigger than 100 yard need to have an air quality monitor.
- Scaffolding sheet coverage of under construction building as mandatory.
- Deployment of Air quality monitor at every square km to see change in air quality

- **Citizen's Engagement: Increase awareness about Dust**

- Fact of matter is 99% of population is oblivious to dust
- So target shall be to make aware that dust exists, and what can be done to sort it out.

- **Initiate Public-Private-Partnership Programs**

- Plantation of shrubs / creepers along the roads
- Trial dust binding chemical solutions
- Plantation of border forests around Delhi to handle flow of dust from neighboring states

What is choking Delhi



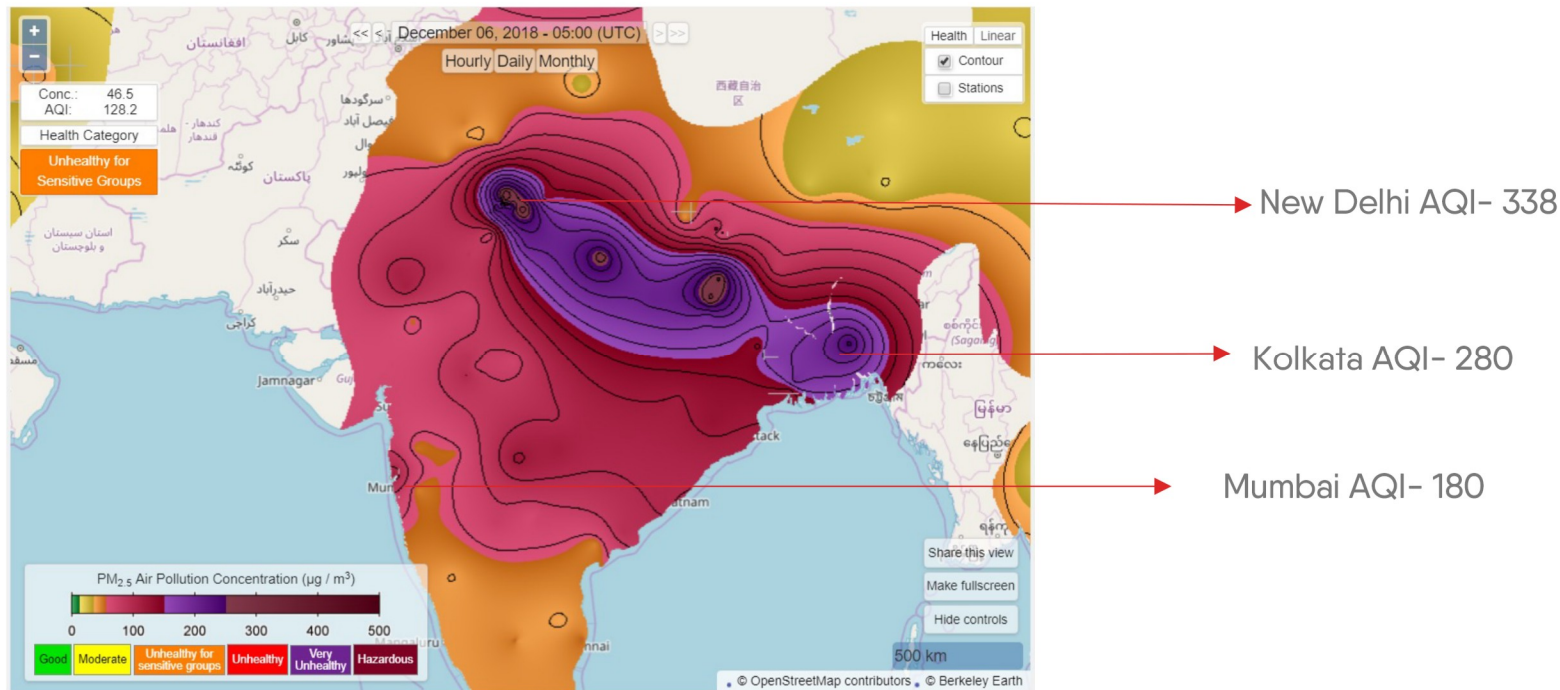
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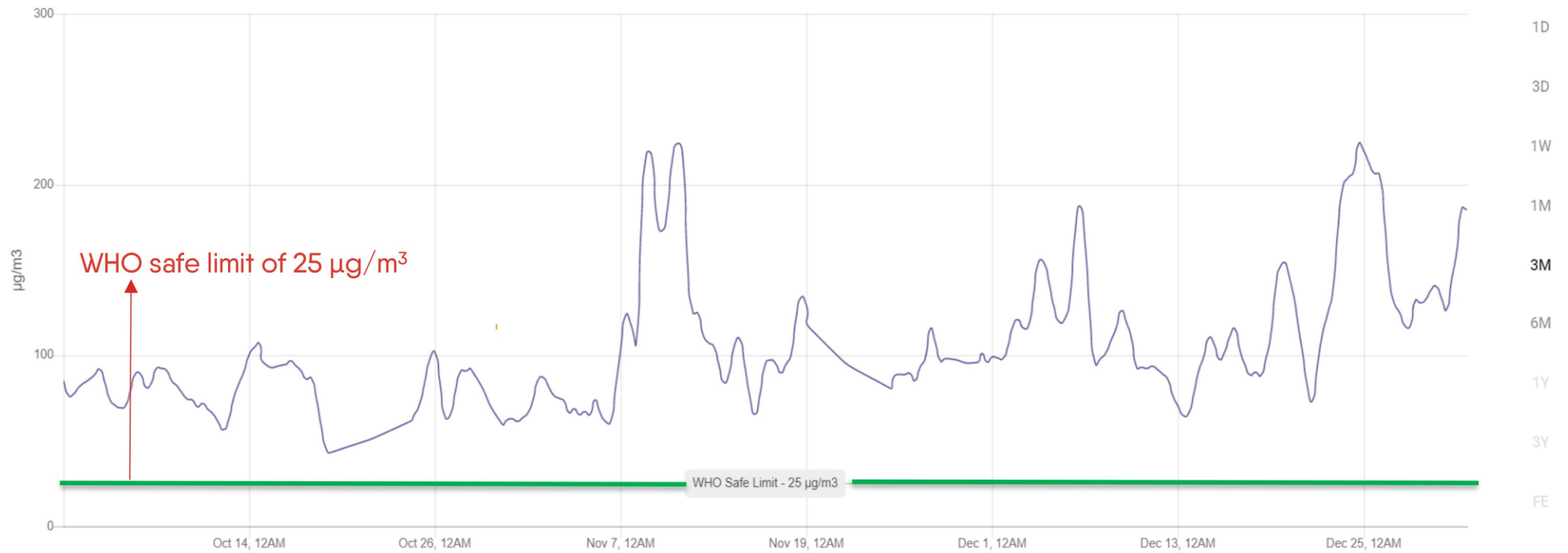
Do we really know what is choking Delhi ?

Looking at the Big Picture- December 2018



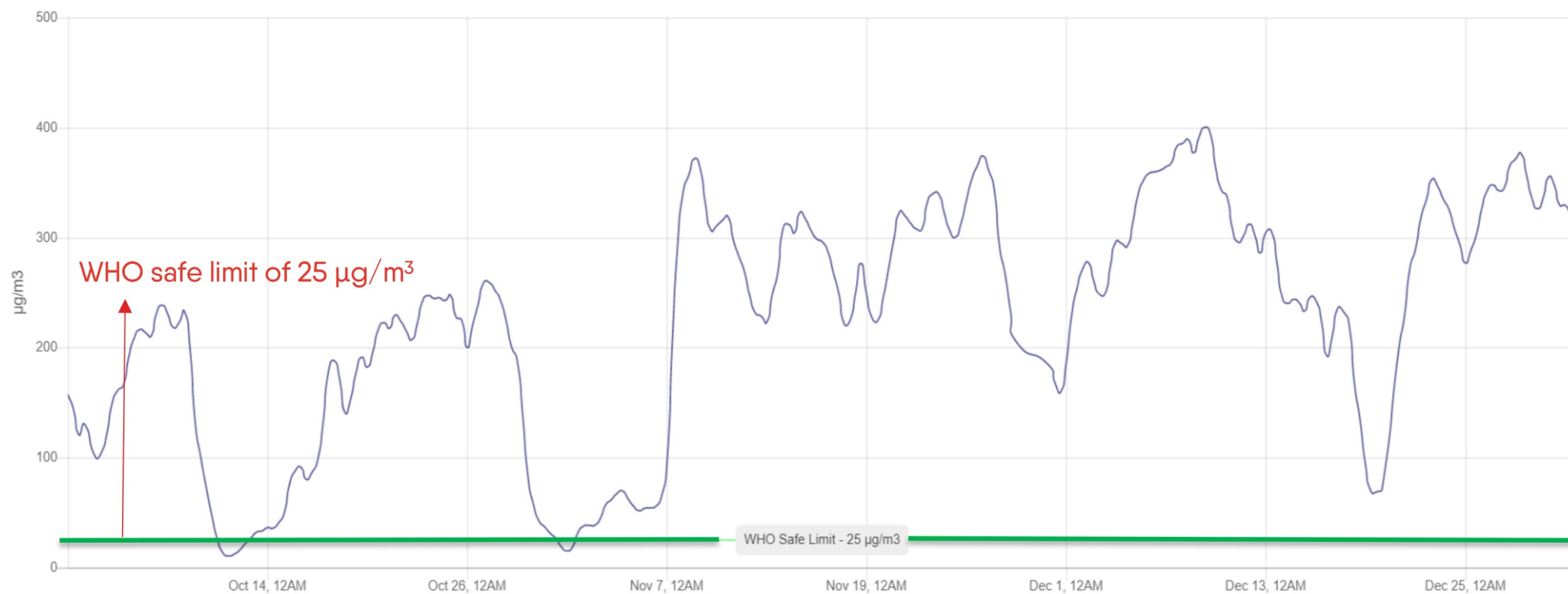
Two months since Paddy Burning the situation remains dire, event cities as far away as Mumbai have poor Air Quality

Mumbai



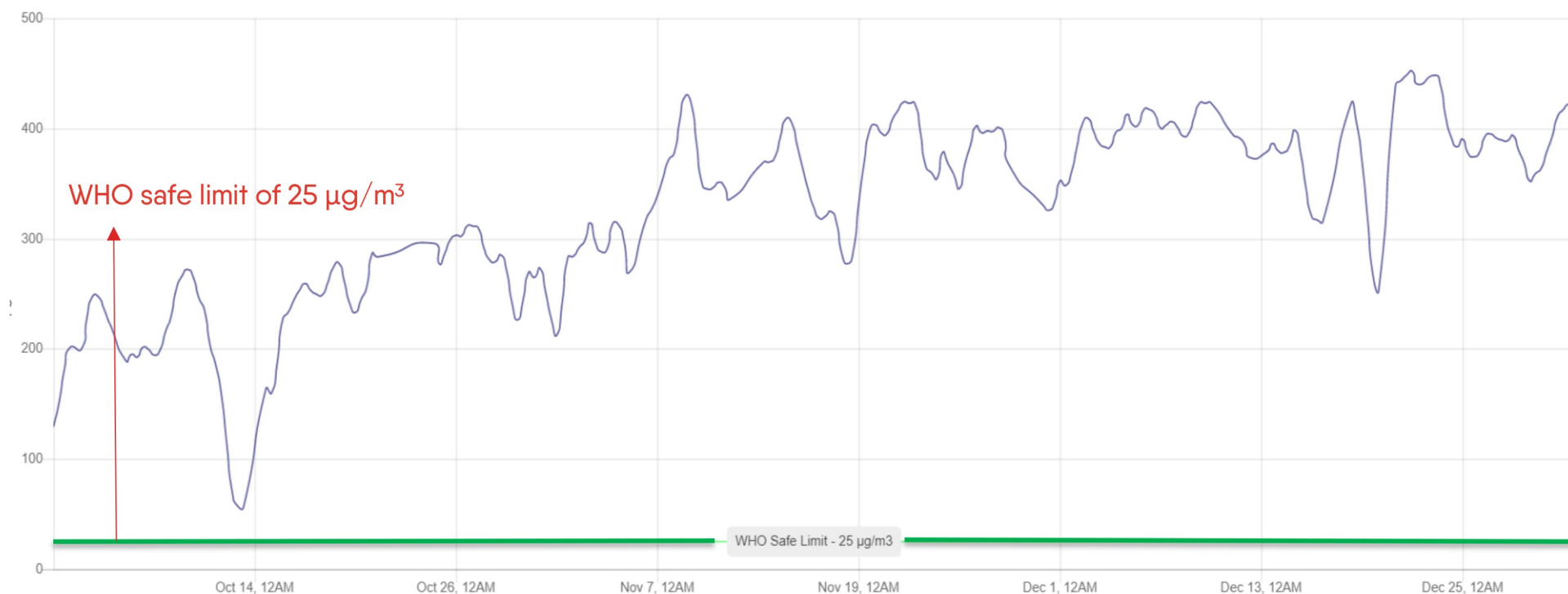
PM 2.5 Concentration remains way above WHO safe limit of 25 $\mu\text{g}/\text{m}^3$

Kolkata



PM 2.5 Concentration remains way above WHO safe limit of 25 $\mu\text{g}/\text{m}^3$

Patna



PM 2.5 Concentration remains way above WHO safe limit of 25 $\mu\text{g}/\text{m}^3$

Is there sufficient & correct data?



- What we really need is Better Monitoring
 - As a thumb rule by CPCB, Delhi needs a total of 77 monitoring stations. An ambient monitoring station can represent an area covering 2 km radius, which translates to 15 km² (rounded off). As of Sept-17 Delhi had only 35 air monitoring stations that is insufficient.
 - Current devices being used are of very low quality having R² value of 0.066.
 - Monitoring sensors need to be standardized. Current sensors used are of varying quality, accuracy and calibration.



Is there sufficient & correct data?



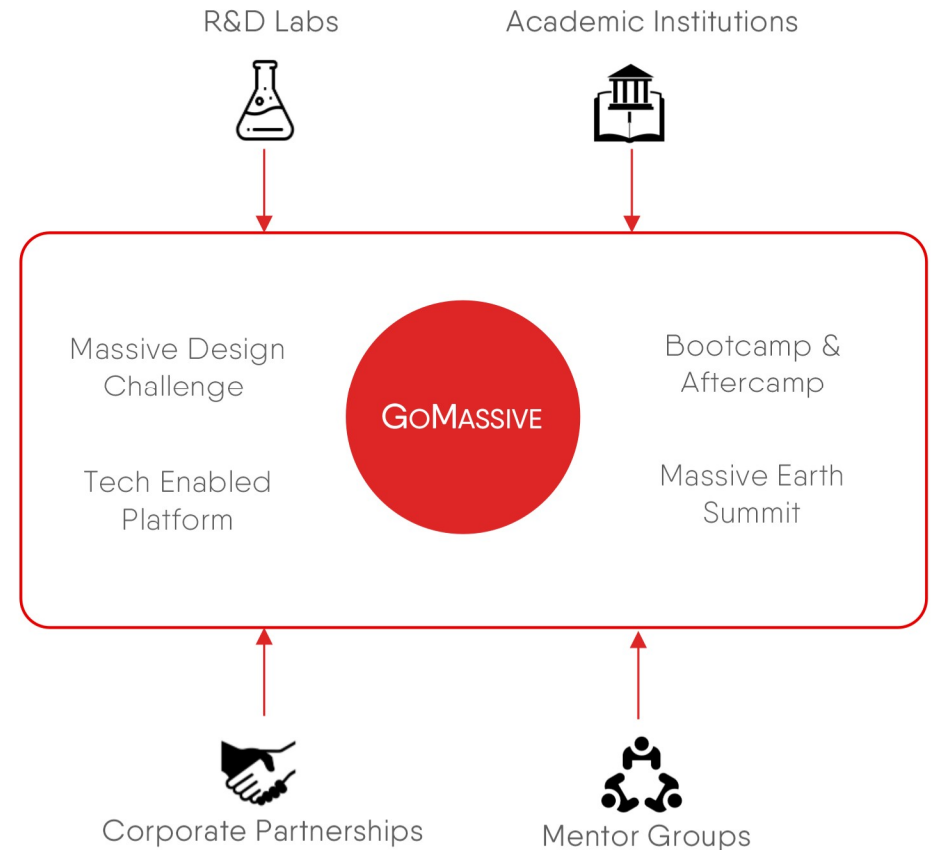
- Transparent real-time research data & comprehensive pollution database
 - There is high variability, the study conducted should have ample number of observations along and should be done covering more than 2 seasons to account for seasonal effects.
 - The studies done are funded with big lobby groups and big corporations and data may have been manipulated.
https://www.healtheffects.org/system/files/GBD-MAPS-SpecRep21-India-revised_0.pdf
 - There is a lack of data certification, thus with a different set of sensors collecting data from various sources, no accounting for seasonal variations adds up to the problem.



About GoMassive



- GoMassive is a stage-agnostic investment network that brings together Investors, Corporates & Deep science Research Institutions.
 - GoMassive promotes disruptive Startups solving Massive Problems of the Earth in areas pollution (food, water & air), clean energy, recyclables (e-waste, plastics), clean mobility & sustainable built environment.
- Startups in these sectors not only require funds but also need access to an enabling ecosystem.
 - Our ecosystem will be a combination of advocacy events, incubator, access to research institutes & industry as a whole.



Team



Shailesh Vickram Singh

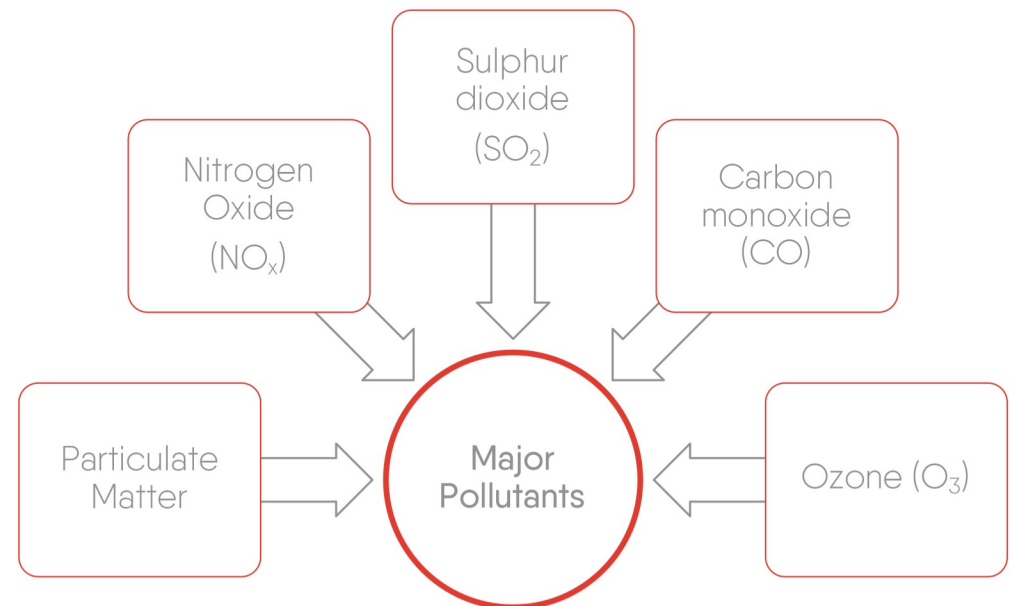


Abhinav Tyagi

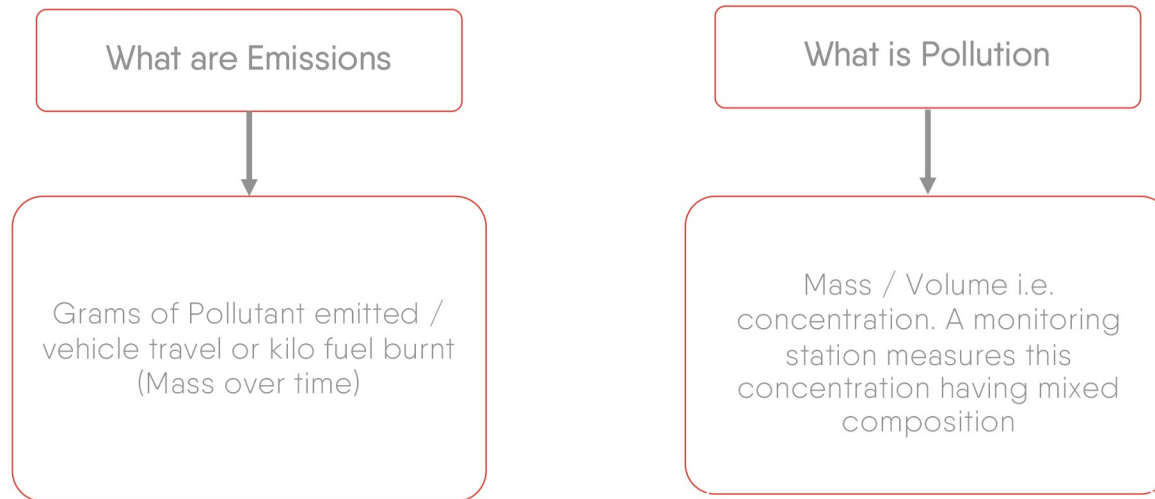
Annexure A

- Anything that burns will at least produce one of the pollutants and if you put a control on one pollutant you are likely to control others as well.

Quick Fact
PM2.5 was added to the list of criteria pollutants in 2009, and now measured in 40+ Indian cities using continuous monitoring stations



Annexure B



Quick Fact
Emission inventory is based on administrative boundary, thus sources present at the borders may contribute to ambient pollution but not to emission inventory.

Annexure C

