# Air quality benefits of odd-even vehicle rationing programme in Delhi: An analysis of week 1

## Environment Pollution (Prevention and Control) Authority for NCR

## January 8, 2016

## 1. Overall pollution level this winter is higher than last winter. This demands emergency action

This winter has witnessed extremely high level of pollution. Typical winter conditions -- cold temperature, lower mixing height of air, calm and no-wind conditions trap air and pollution. As a result, pollution builds up very quickly and peaks. This is why winter months require tougher emergency action to reduce pollution. Weather is an important constraint in pollution management.

The winter months of November and December 2015 show higher number of days in severe category - four times the safe standard – which is the worst category according to the National Air Quality Index. November 2015 had 73% cent of days in severe category against 53% in November, 2014. December 2015 has 67% of days in severe category as against 65% in December 2014. December 2014 at least had 3% of days in good and satisfactory category but December 2015 has none. There has not been a single good air quality day this winter. On several consecutive days, the PM2.5 levels have remained in the worst category according to the national air quality index.

The odd and even programme has been implemented as an emergency action to arrest the high emergency peak when the overall pollution levels have gone 5 to 6 times higher than the standards. This is needed to protect public health in a city where every third child has impaired lungs.

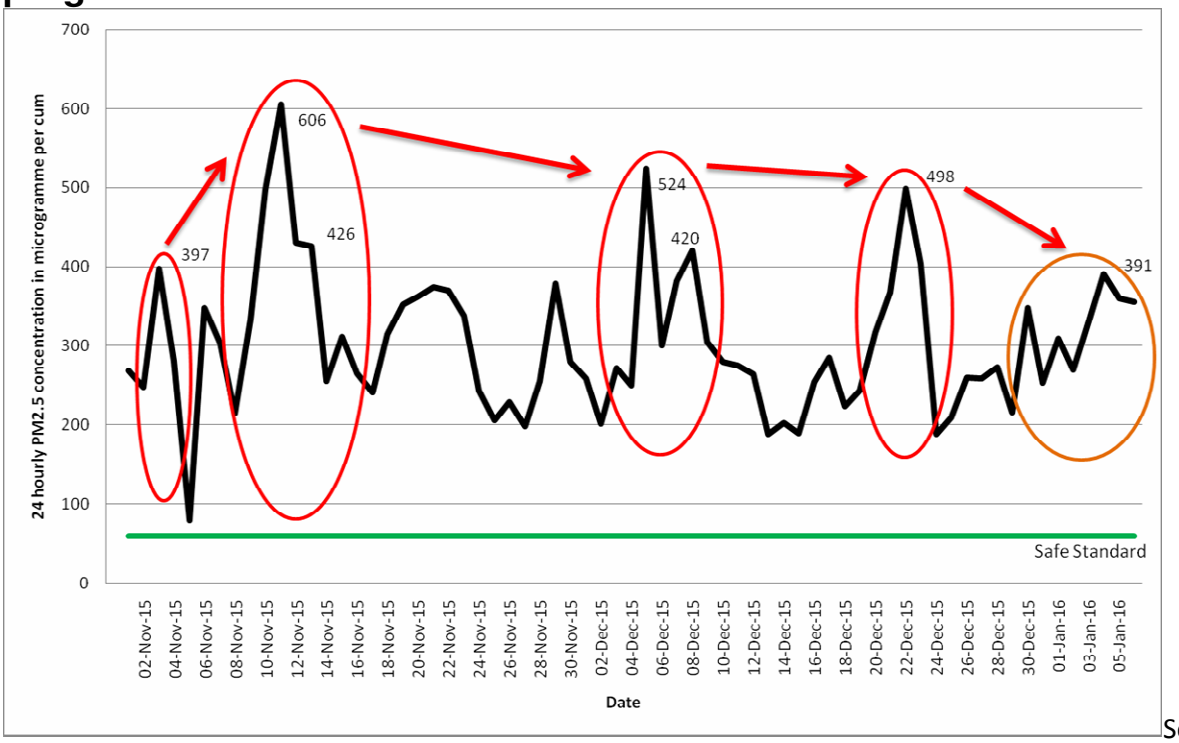
This is also not the only action that is being taken in the city to arrest runaway air pollution. The Supreme Court has taken firm steps to check heavy commercial vehicles from entering Delhi; it has issued directions on enforcement of construction and road dust as well as garbage burning. The Delhi government is also bringing action against the Badarpur Thermal Power Plant. The odd-even scheme is designed for immediate refief as it

takes off the roads almost half the private cars, which contribute to pollution from their tailpile and pollution because of congestion.

## 2. The odd-even scheme has resulted in the lowest pollution peak compared to the previous high smog episodes this winter

This winter out of all the severe smog episodes so far (with several consecutive days in severe category) the peak pollution during odd and even programme has been the lowest. This shows that despite the hostile weather conditions - no wind, temperature dip and western disturbance, the peak pollution during odd and even scheme has been much lower. The earlier smog episodes have seen much higher peaks and much more rapid build up compared to the rise that happened during the first week of odd and even programme. This proves reduced traffic volume has arrested the peaking of pollution. This validates the importance of emergency action.

**Graph 1: Drop in the intensity of smog episodes due to odd and even programme in week 1**



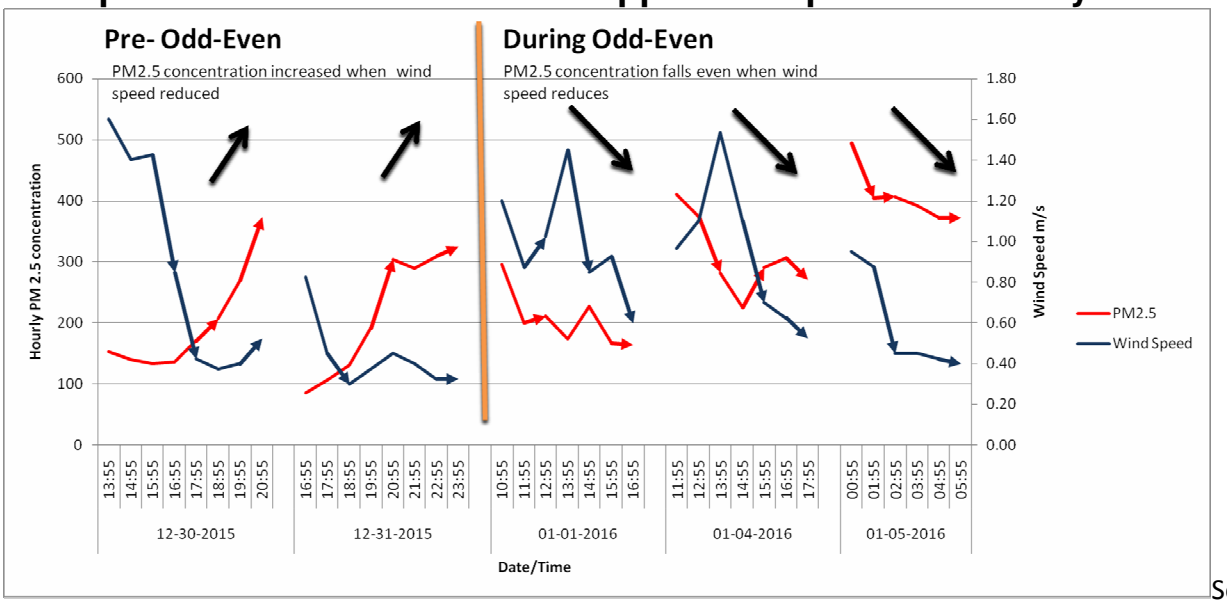

Source : CSE analysis of DPCC real time pollution monitoring data

**This simply means that current weather condition in Delhi currently is at emergency levels** – the Western Disturbance has brought moisture, which traps pollutants but this combined with near still and no-wind conditions means conditions are very bad for air quality. Similar weather conditions – with less severe conditions of no-wind and moisture had lead to peaks of pollution that are alarming and hazardous for health. This we have been in this winter itself. But this time, because of the odd-even scheme in operation, the pollution peak is less and so air is less hazardous (or not as hazardous as it could have been in these conditions. This is why governments take emergency action. This is why odd-even scheme is so necessary in winter months, when pollution peaks.

## 2. During odd-even programme daytime even with lower wind speed has shown faster drop in pollution

It is also clearly evident from the air pollution data that despite the lower wind speed in some days during odd and even scheme, pollution has fallen during those hours. In fact, it is notable that during days before the programme was started pollution levels had increased when wind speed was low. This brings out the clear impact of the odd and even scheme on the pollution levels. Even when wind was not there to blow it away the scheme succeeded in arresting the upward trend. Both the real time pollution and wind data are from the Delhi Pollution Control monitoring stations.

**Graph 2: Odd and even days in Delhi show that even on days without wind pollution levels declined as opposed to pre-scheme days**



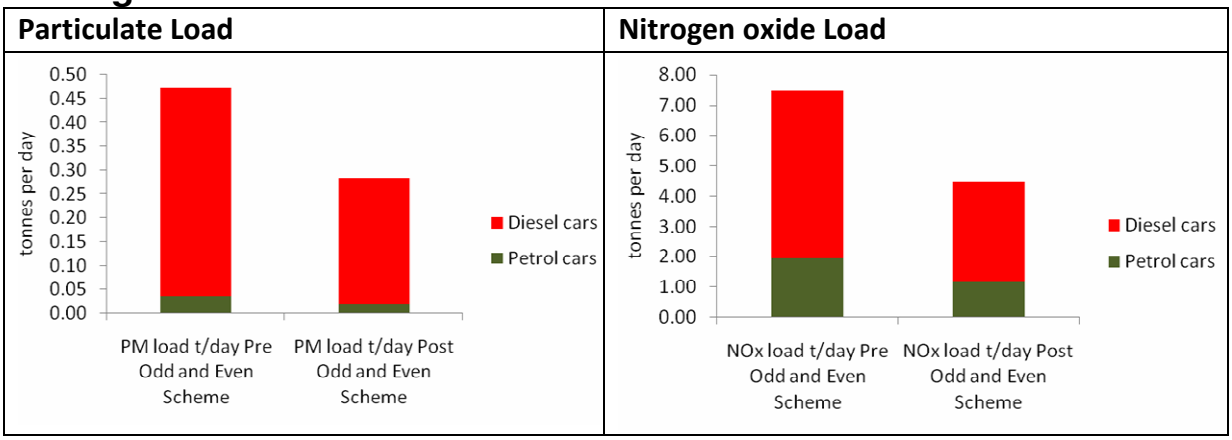

Source: CSE analysis of DPCC real time pollution data

## 3. Pollution load from cars are lower; per capita emissions of car users is also down during odd and even programme

Both particulate and nitrogen oxide load from the cars has reduced substantially during odd and even programme – by as much as 40%. Higher share of pollution benefits have come from reduction in diesel cars.

This indicates reduced exposure to toxic pollution from vehicles on roads and close to road side. It is estimated by the US based Health Effect Institute that the maximum impact of vehicular pollution is upto 500 meters from road side and 55% of Delhi's population live within that zone. This has serious public health implications. Studies by researchers of University of California, Berkeley have shown that in Delhi the pollution level on the road and close to road side are at least 1.5 times higher and peaks 15 times higher than the ambient concentration. This programme has therefore contributed to the reduction in exposure to toxic fumes.

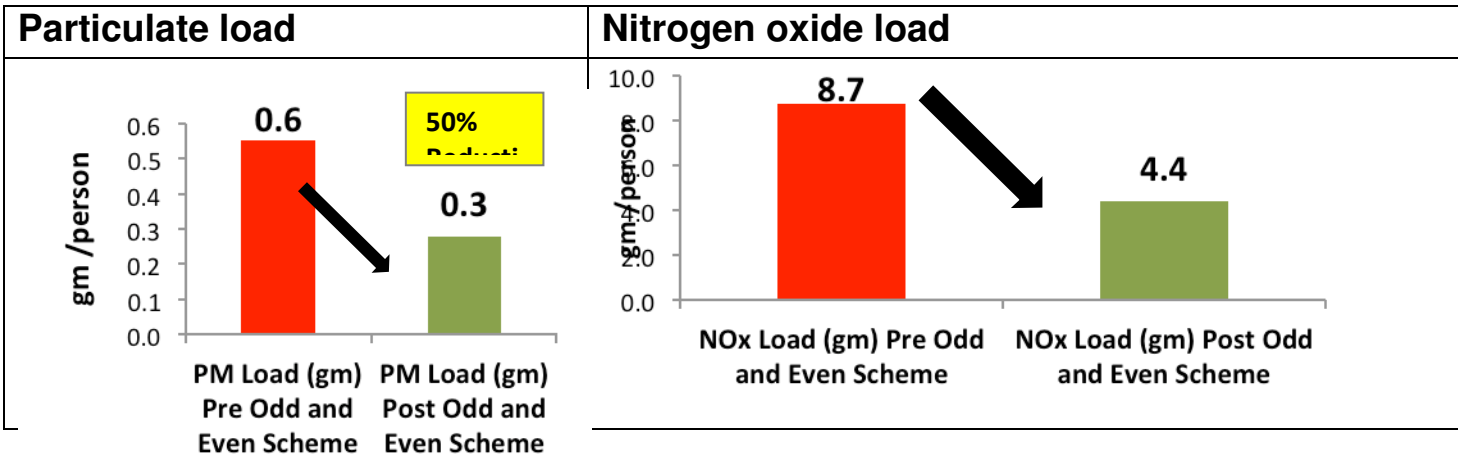
## Graph 3: Particulate and nitrogen oxide load reduction from cars during odd-even scheme




Source: Centre for Science and Environment

Moreover, higher occupancy of cars due to car pooling and sharing has also reduced per capita toxic emissions of car users substantially. Shift to other modes can be even more substantial. This is a significant contribution of Delhiites to the pollution control efforts that needs to be respected and encouraged for longer term solution.

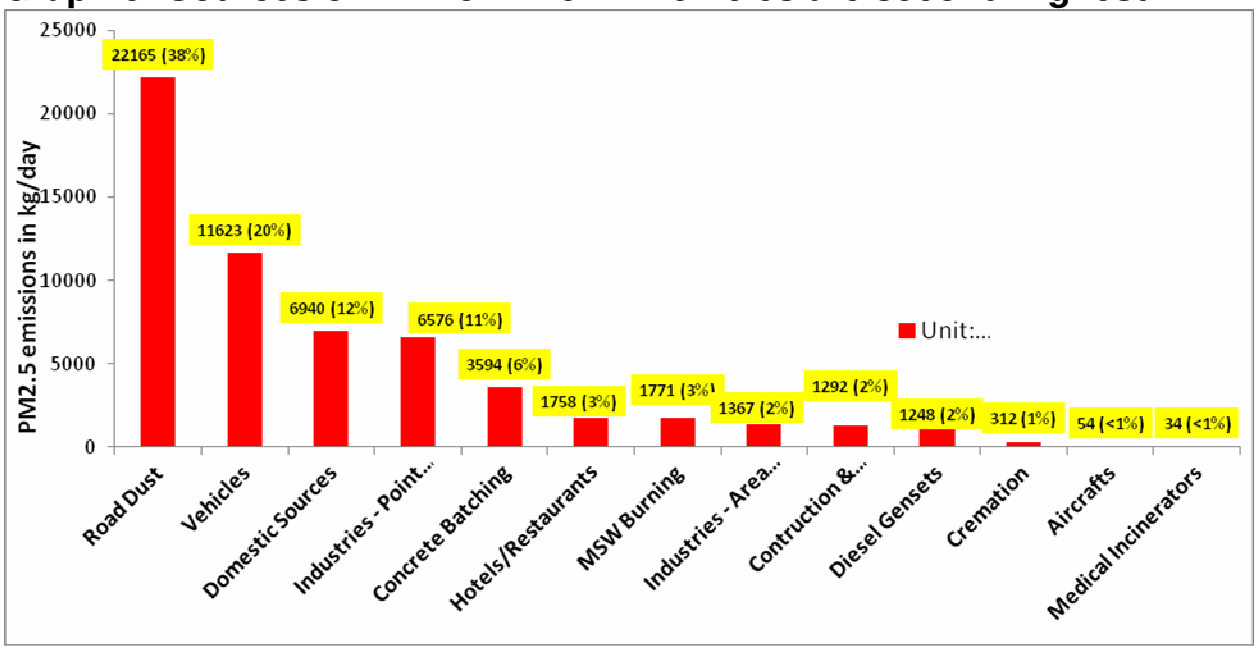
## Graph 4: Reduction in per capita emission of PM and NOx due to car pooling car during odd and even programme




## 4. Vehicles need special attention as they are the second highest polluter in the city. Vehicles need to be included in emergency action

The most recent study by IIT Kanpur on assessment of pollution sources to Delhi's air has established that overall vehicles are the second largest emitter of PM2.5 after road dust. It also shows that vehicles in Delhi not only have high primary emissions of particulate but also gases like nitrogen oxides that convert to nitrate particles in the air and add to the overall PM2.5 levels in the city. This further enhances the role of particulates.

**Graph 5: Sources of PM2.5 in Delhi: Vehicles are second highest**

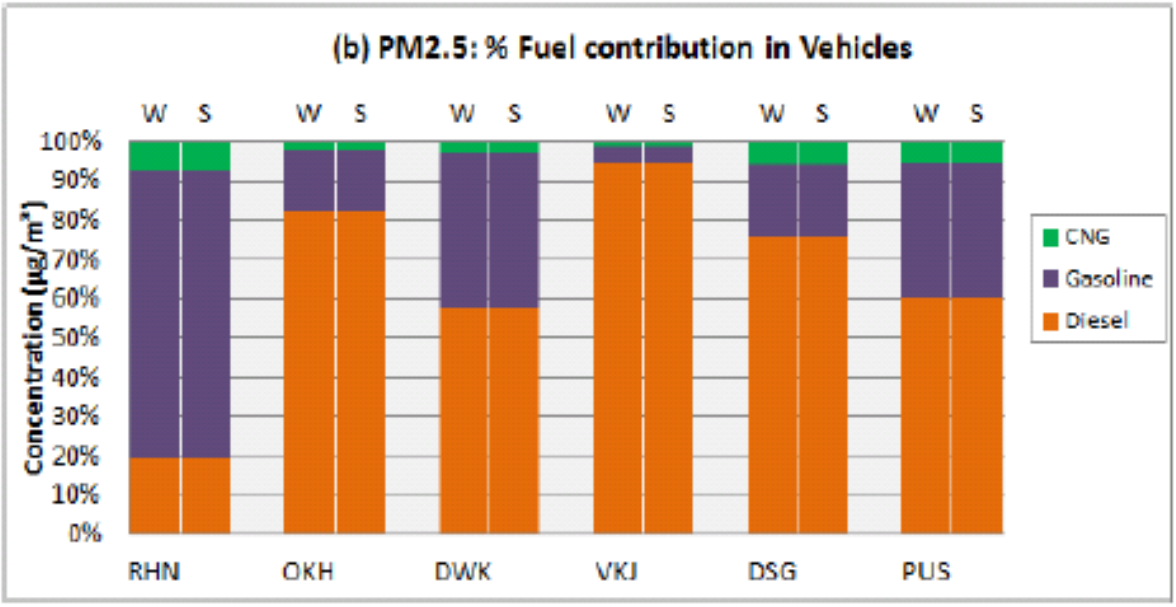



Source: IIT Kanpur's Comprehensive Study on Air Pollution and Green House Gases (GHGs) in Delhi (Draft Report: Air Pollution)

Cars are also the emitters of toxic pollutants. For example, the Kanpur IIT study has shown that in different locations of their study in Delhi diesel vehicles contribute hugely to PM2.5 – from 60% to 90% of PM2.5 from vehicles. According to the California Air resources Board the number of excess cancer cases per million people due to lifetime exposure to diesel fume is 300 as opposed to 29 for benzene that comes from petrol.

A significant study by the Health Effect Institute, Boston, published in Environmental Health Perspective recently, has found that particles from coal and diesel are more harmful than wind blown dust. These increase ischemic heart disease related deaths. This is dangerous as the global Burden of Disease for India attributes half of air pollution deaths to heart disease.

**Graph 6: Contribution of fuels in vehicular pollution**




Note: RHN: Rohini; OKH: Okhla; DWK: Dwarka; VKJ: VasantKunj; DSG: Dilshad Garden; PUS: Pusa
Source: Draft Report 2015 - Comprehensive study on Air Pollution and Green House Gases (GHGs) in Delhi (for Delhi Government) by IIT Kanpur

Vehicles especially contribute to air toxins like polycyclic aromatic hydrocarbons (PAH) whose levels have been found to be high in Delhi. The IIT study has found high levels of PAH in different locations in Delhi. Total PAH levels (14 compounds) in winter is very high at 80 ng/m3 (annual standard is 1 ng/m3).

Even road dust is not harmless because of vehicular pollution. A 2015 study by the University and Birmingham has studied road dust in Mathura Road, Delhi, in summer of June 2013 and found several elements, including copper, zinc, cadmium and lead in high concentrations. Tailpipe emissions and non-exhaust sources in vehicles like wear and tear of brakes, tyres and other auto parts are one of the major contributors along with industrial and biomass sources. To reduce toxic effect of road dust further reduction in vehicular emissions and also environmental regulations for car tyres are needed.

## 6. Impact of odd and even number programme on air quality in other countries

Several countries have implemented odd and even formula as an emergency action to reduce peak pollution levels. Many of those programmes are more stringent in terms of duration, penalty and minimal exemptions. There are evidences of impact on air quality in those global cities.

With this programme several cities have reported a wide range of benefits including reduction in air quality, reduced congestion, improvement in public transport ridership etc. Lowering of pollution levels have been reported in in different cities. In Paris for instance that has implemented this programme in March 2014 and repeated in March 2015, saw 18 % reduction in traffic volume and 6% in pollution levels. **But Beijing that has a longer and a more stringent programme has shown 38% reduction in PM10.**

This indicates that even this percentage reduction is necessary and is possible in the short term to reduce smog peaks.

## 7. Overall benefit of the programme and our recommendation

Delhi is piloting its first ever-emergency action to reduce peak pollution levels. This is consistent with global best practice. Vehicles that are second highest emitters in the city are responsible for very high exposure and health impacts. Smog peak reduction will need action on vehicles.
The first few days of the programme has already demonstrated that the peak pollution levels are lower than the normal smog peaks of the season – despite the adverse weather conditions.

In other countries duration of the programme is adjusted according to the severity and persistence of the severe pollution problem. Given the current pollution levels and adverse weather conditions it is recommended that the Delhi Government be allowed to complete the programme as planned. The government should be able to create the right template for the programme to be able to roll it out as and when needed. This is needed to protect public health. Lung of every third child is impaired in this city.

The other benefit of the programme is the reduced congestion that has further contributed towards lowering of pollution. Emissions from vehicles caught in congestion increases two times due to idling and frequent acceleration and deceleration.

Reduced congestion has also improved the journey speed for all road users including car users. This saves time, fuel and stress. A study on traffic volume and speed survey carried out by School of Planning and Architecture, New Delhi, at 11 locations during the first few days of odd and even scheme in Delhi has found that due to lowering of traffic volume the travel time has reduced by 35%. This brings out the importance of reducing traffic volume.

Another important benefit of the programme is the improved efficiency of the public transport system – bus, auto and taxis that can now do more trips, more kilometers and carry more people due to freeing up of road space. This benefit will have to be sustained for longer-term solution to pollution problem in the city.

It is also important to note that the people of Delhi and neighbouring states are following the rule – it shows their cooperation and their desire to be part of the solution to check this toxic and deadly air pollution. It is clear that we need to do more and not less to arrest air pollution and also make this scheme more successful, by reducing exceptions.

It also means that the government of Delhi must now work to greatly augement public transport so that the city can go car-free more often and as a general practice. This will be the big transition that the city needs for truly effective and durable action against deadly and toxic air pollution.

**Delhi government must be permitted to continue with the odd-even vehicle-rationing scheme and if these adverse weather conditions continue then our recommendation is that the programme should also be continued.**