

IMPACT OF DELHI METRO IN CLEAN AND GREEN TRANSPORT SECTOR

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ABSTRACT: *The World Health Organization has positioned Delhi as the most polluted city for air pollution on the world. Among all, developing number of vehicles is the major reason for air pollution in Delhi. So, elective method of transportation ought to be adopted to decrease air pollution. This paper shows a far reaching survey and appraisal of air pollution before and after the different Phases of metro. With the new age metro, commuters are now using metro instead of their own vehicles. The usage of Metro shows colossal decrease in vehicle emissions, as a result of decrease in number of vehicles and decrease in congestion on roads of Delhi. The inspiration for this paper originates from existing adverse health effects of air pollution. This paper mainly deals with the alternative transport system; especially it centers around decrease of vehicles out and about by Metro rail. DMRC prevents emission of 90,000 tons of carbon dioxide in just two years 2004-2006 and 2.6 million tons in most recent 12 years. This paper also focus on the how the reduction in vehicles have affected the concentration of CO, NOx and PM.*

This paper is to analyze the link between the Delhi Metro and Air pollution.

Keywords - Delhi Metro, Air pollution, Vehicular Emission, Central Pollution Control Board

INTRODUCTION

Air Quality Delhi, in terms of air pollution, is positioned among the most polluted cities in the world. The ambient air quality observing is completed routinely by Central Pollution Control Board and Delhi Pollution Control Committee. The Delhi Metro Rail Corporation (DMRC) has been enrolled as the world's first transport sector project under the Program of Activities (PoA) of the United Nations Framework Convention on Climate Change (UNFCCC), empowering it to measure environmental change advantage from all Metro operations in India. The move will likewise encourage the fast-tracking of Clean Development Mechanism (CDM) enlistment of all the up and coming rail-based activities in the nation which will qualifies them for carbon credits for the extent of reduction in emissions, which could be exchanged the global carbon advertise for cash. DMRC has transported more than 369 crore commuters over the most recent 12 years, saving 2.9 million tons of carbon dioxide because of move from different mode of travel, hence lessening an reducing global warming and environmental change, as indicated by a senior DMRC official.

In this way, to claim carbon credits in future, DMRC will be the managing entity for every single other metro of India under the Program of Activity (PoA) mechanism which will likewise facilitate fast-tracking of their CDM registration.

METHODOLOGY USED

Subsequent to doing its bit for the city by presenting a method of transport that helps cut down on emission of poisonous gases, the Delhi Metro Rail Corporation (DMRC) is looking inwards. This paper examines the impact of the Delhi Metro, an intra-city mass rail travel system, on air pollution inside Delhi. The pollution loads are calculated based on information collected from the Central Pollution Control Board (CPCB), Environment Protection Agency and past investigations completed in such manner by various important agencies. Data is also collected from most recent different News Letters.

INCREASING RIDERSHIP

The new age Metro trains are equipped with the Unattended Train Operation (UTO) technology. These trains operate with the Communication Based Train Control(CBTC) signaling technology which encourage development of trains in short frequencies to reduce the utilization of different vehicles by commuters. The cumulative ridership of the Delhi Metro within a financial year crossed the one billion(100crores) building up DMRC as the mass transportation backbone of the National Capital Region (NCR). Since the first of April, 2016, an aggregate of 1.001 billion (100.165crores) passengers have traveled by the Delhi Metro till the previous evening, enrolling a 6.56 percent development in normal every day ridership since the last financial year 2015-16. The average daily ridership has expanded by 43 percent in the last five years.

Table 1: Delhi Metro Riders

Year	Ridership(in millions)	Average daily ridership (in millions)	Network length
2012-13	702.95(70.29cr)	1.93	190
2013-14	801.70(80.17cr)	2.2	190
2014-15	870.91(87.09cr)	2.39	193
2015-16	946.95(94.69cr)	2.59	213
2016-17(till 29th Dec,17)	1001.65(100.165cr)	2.76	213

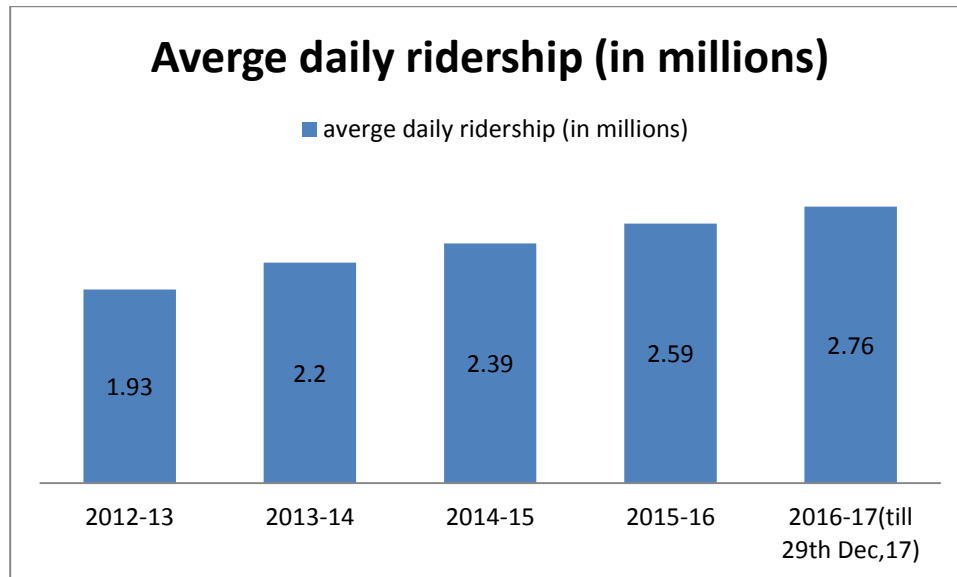


Figure :- 1 Delhi Metro's Cumulative Ridership for the financial year 2016-2017 crosses one billion (100 crores)

DECREASING VEHICLES OFF THE ROAD

The growth rates of registered cars, two-wheelers, three wheelers, taxicabs and buses in Delhi are ascertained as 9.8, 11, 8, 5 and 7 percent, separately utilizing information for these vehicles for the period 1971-2002. RITES (1995a) has announced that out of the aggregate enrolled vehicles, just 28 percent of cars, 40 percent of two-wheelers and 65 percent of taxis and three wheelers are on the roads. It is additionally reported, depending on the zone and the density of population through which the Metro line passes, that exclusive 30 percent of vehicles on road are affected by Phase I,II and III of the Metro. It is additionally specified that 45 percent of cars, 70 percent of two-wheelers, and 25 percent of buses out of the influenced traffic are diverted to Metro. It is expected that methods of transport like taxicabs and three wheelers are out and about by decision and subsequently they won't be redirected because of the Metro. The DMRC today has more than 270 train sets of four, six and eight coaches. In excess of a hundred trains of six coach configuration and more than 60 trains of eight coach arrangement are at present operational.

Table 2: Vehicles off the road

Year	Cars& Jeeps	Two wheelers	Buses	Total
2005-06	50586	284433	3398	338418
2010-11	80731	479286	4767	564784
2015-16	238737	1496497	12388	1747622
2020-21	381006	2521685	17374	2920065
2025-26	608055	4249185	24368	4881609
2030-31	970409	7160124	34178	8164711

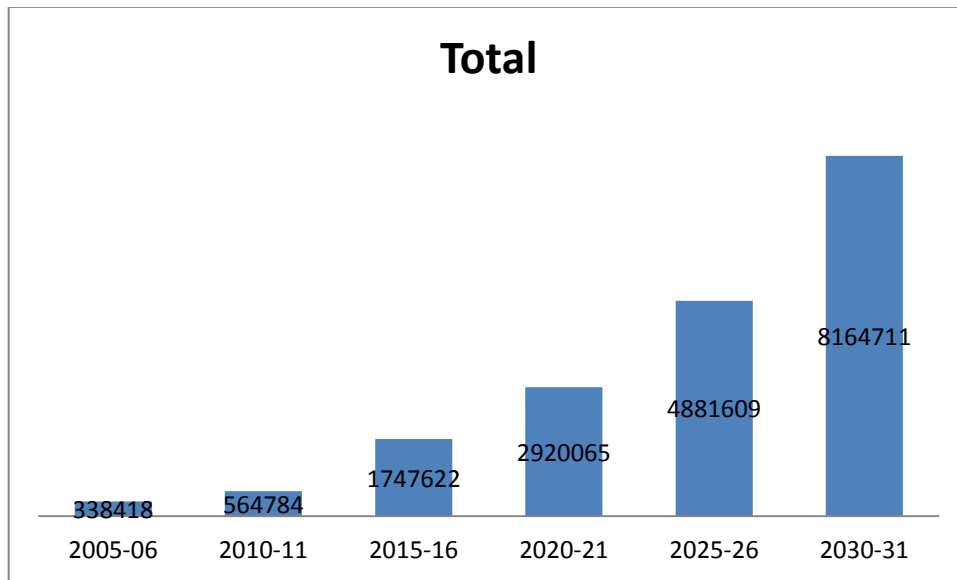


Figure:- 2 Vehicles Off the Road

REDUCING CO2 EMISSIONS

Metro officials said on a news letter distributed in June,2017 that the Metro 3 project would reduce carbon dioxide emissions on a bigger scale over the long run than the decrease in emissions because of the cutting of trees for the project. In Delhi, obviously for the yellow and blue lines, which are the longest, the gains are better, the fact is that the longer trip, the more emission can be prevented.

Director (Projects), DMRC said a review directed by them demonstrated that the 2,800 trees that are influenced by the Metro 3 project reduce carbon dioxide emissions by 61 metric tons every year, while the Metro 3 would reduce emissions by 9907 metric tons consistently.

The Metro 3 will likewise save 2.43 lakh liters of petroleum by 2021, saving the city nearly Rs 2 crores daily in fuel cost, and one hour of a person's transit time. It will likewise reduce the crowd on the railways by 25 per cent .

Table 3: Fuel Saved in Tons

Year	Fuel(saved in Tons)
2007	24691
2011	106493
2014	276000
2018	20000000

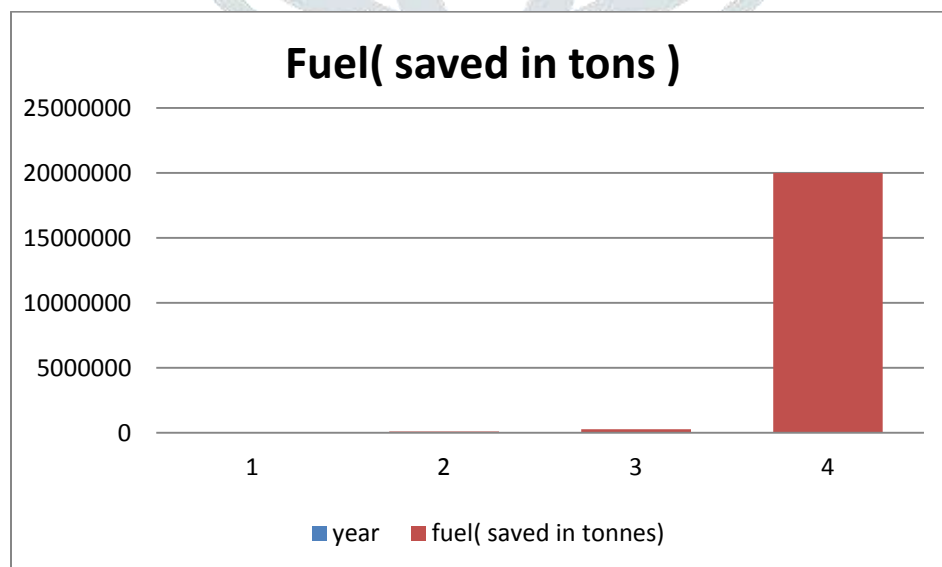


Figure 3: Fuel consumption

Taking all things together, seventeen Tunnel Boring Machines (TBMs) will be utilized for Metro 3, the first of them being brought down in October in Naya Nagar. The project reduces on average 529,043 tons CO2per annum in the first crediting period.

Estimated amount of emission reductions:

Table 4: CO₂ Emission

Year	Annual Estimation of Emission Reductions in TCO ₂
2011(8 MONTHS)	305077
2012	477389
2013	497989
2014	519448
2015	541799
2016	565077
2017	591082
2018(4 MONTHS)	205443
TOTAL ESTIMATED REDUCTIONS 1st CREDITING PERIOD (TONNES OF CO₂)	3703304
TOTAL NUMBER OF CREDITING YEARS(1st crediting period)	7
ANNUAL AVERAGE OVER THE CREDITING PERIOD OF ESTIMATED REDUCTIONS (Tco₂)	529043

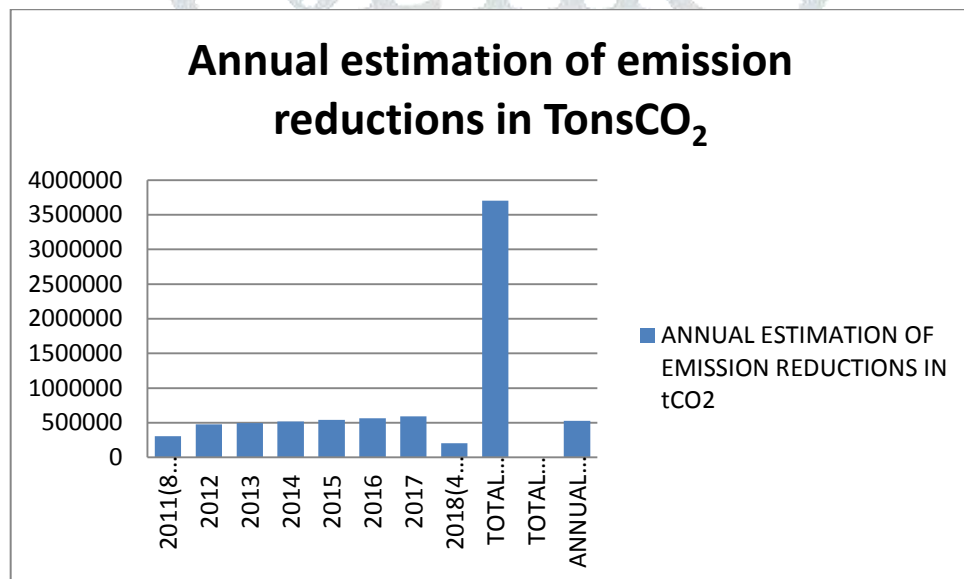


Figure 4: Estimated amount of emission reductions

REDUCTION IN CO, NO_x AND PM₁₀ EMISSION FACTORS

DMRC is providing appropriate services for the commuters so that they divert their mode of transportation from their own vehicle to Delhi Metro. This have reduced the air pollutants like CO, NO_x and PM in air.

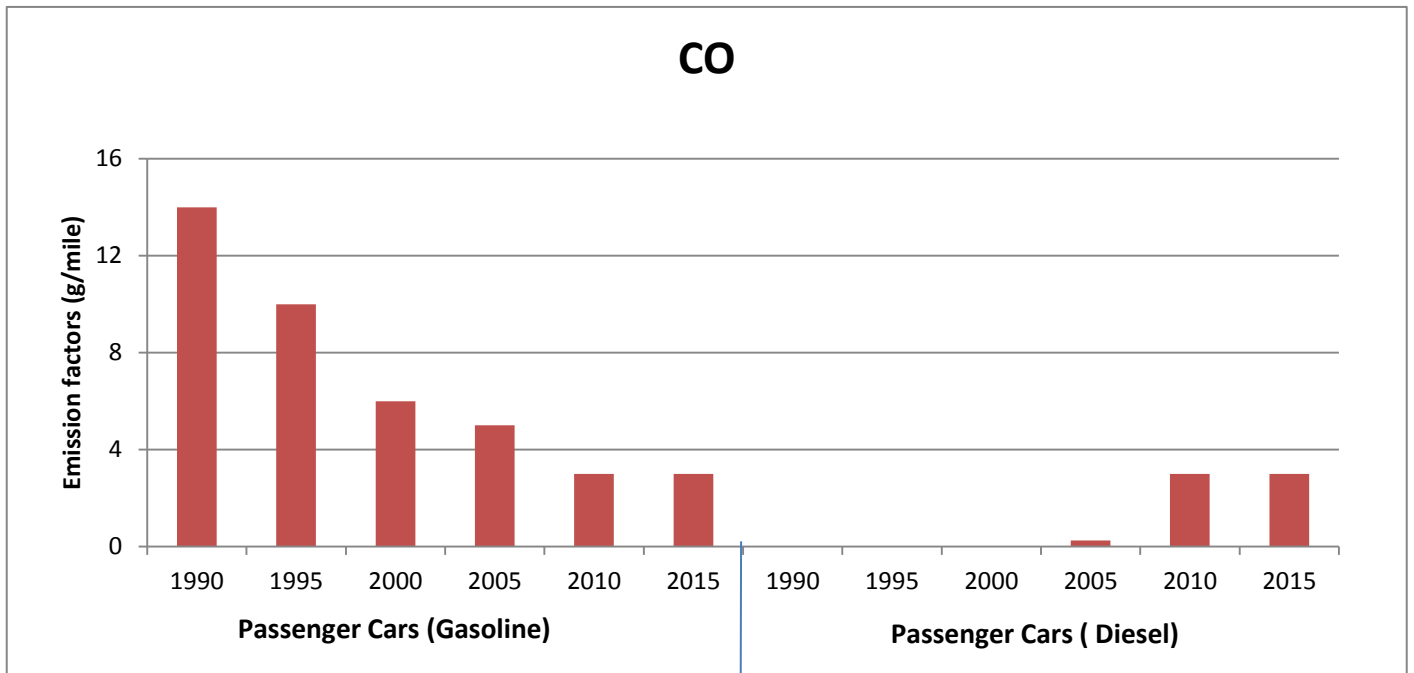


Figure 6: Reduction in CO emission

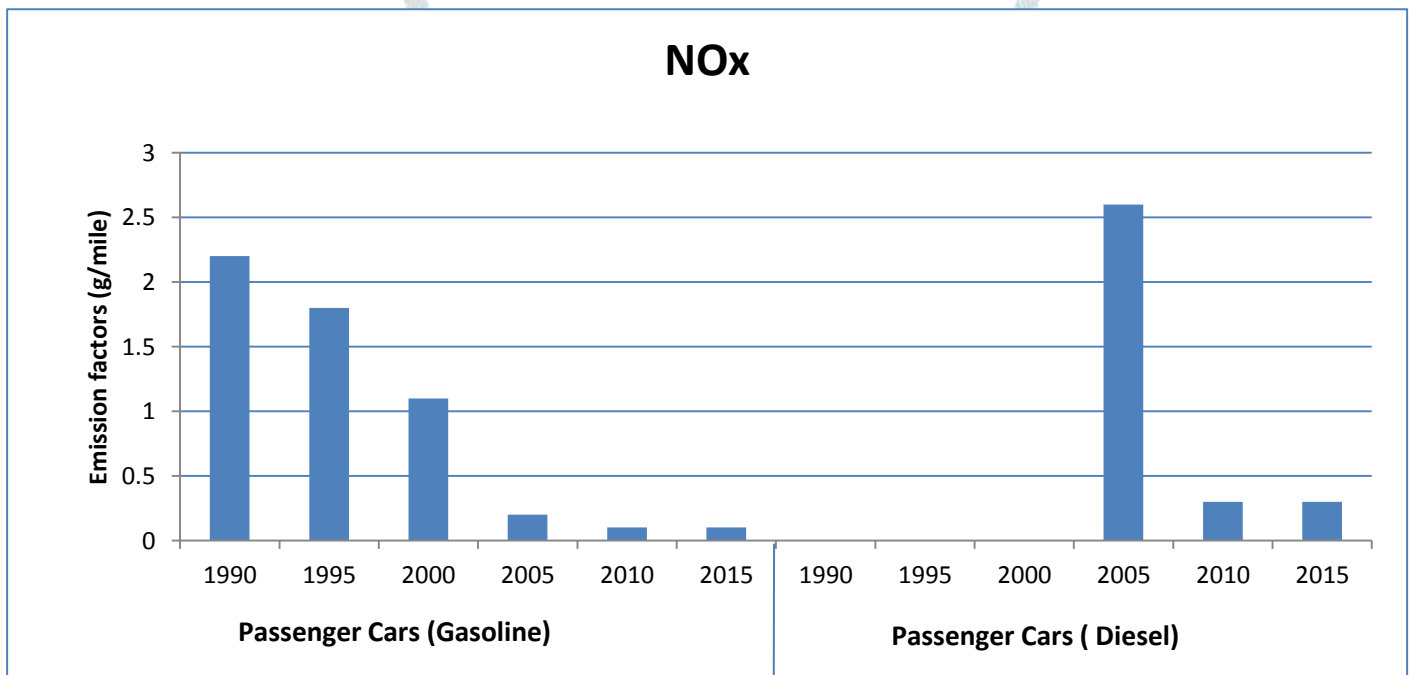


Figure 7: Reduction in NOx emission

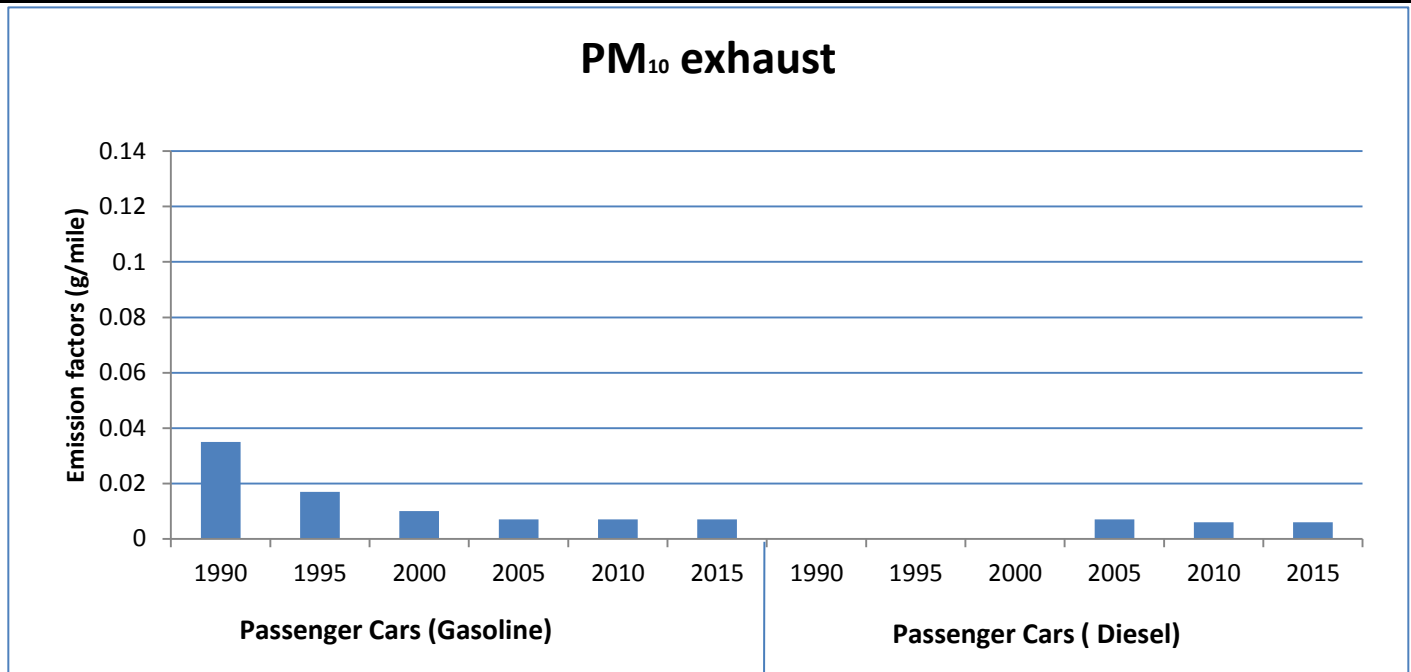


Figure 8: Reduction in PM₁₀ emission

PROFIT BY REDUCING CARBON FOOTPRINT

The first project that earned the DMRC carbon credits was the 'regenerative braking' system under the clean development mechanism. This system recover and store energy that would be otherwise be lost to the brake discs as heat. The railway's system cuts back on energy use by about 30 percent by powering trains with energy harnessed while braking. As trains' brakes are applied, the force drives three traction-phased motors to produce electricity, which is then sent to the electricity lines to reduce the overall energy requirement. General Electric division GE Locomotive said it was designing a hybrid train for Indian Railways to capture energy dissipated during braking and store it in batteries to be used later. The design could reduce fuel consumption by 15 percent and emissions by 50 percent. At whatever point our trains apply brakes, three phase-traction motors produce electrical energy which returns into the overhead electricity lines. Quickening trains — running on a similar line — utilize this recovered vitality, in this way saving money on the general vitality utilize.

In the wake of procuring carbon credits through regenerative braking, the Delhi Metro Rail Corporation (DMRC) is presently making benefits from its second project — Modal Shifts — by successfully reducing its carbon footprint and selling the credits subsequently earned in the international market.

Carbon credits resemble shares that are sold in the international market with a view to relieve the development in concentrations of greenhouse gases. One carbon credit is equivalent to one metric ton of carbon dioxide or carbon dioxide equal gases.

It's a one of a kind part of DMRC — we gain by selling carbon credits. One project was at that point authorized by the United Nations Framework Convention on Climate Change. In any case, now, we are earning revenue from our second project— the Modal Shift. DMRC has possessed the capacity to show that the carbon footprint of travelling by Metro is not as much as that caused while travelling in different methods of transport. Hence, we could procure carbon credits and sell them in the international market.

At present, around 25 lakh people travel by the Metro, which is a non-polluting and an environment friendly system. Had the Metro not been there, these individuals would have travelled by cars, buses two-and three-wheelers, which would have brought about higher emission of greenhouse gases. Subsequently, the United Nations Body administering the clean development mechanism (CDM) under the Kyoto Protocol has ensured that the DMRC has helped reduce emissions.

The income from sale of carbon credits, in any case, has dwindled throughout the years. The CERs (Certified Emission Reductions) was selling as high as \$20 per endorsement at one point in the carbon market. Today, it is not as much as an euro. The West's own endeavors to reduce carbon footprints has impacted the cost of CERs. Be that as it may, it is as yet critical for us as the wonder just demonstrates that the DMRC is an extremely clean mode of transport."

METRO TAKES ENVIRONMENTAL JOURNEY

In new Phases, every one of the 90 new stations to be 'green buildings' with water saving, waste management arrangements, adding that particular arrangements have been made for conservation of energy and also better carbon-dioxide saving, water saving and waste management arrangements.

The string of energy-saving arrangements that will be set up incorporate decreasing the 'heat island effect' which will see tops of stations either completed with high intelligent materials or finished with vegetation. The plant species utilized for landscaping of stations will be either local or versatile that expend less water,

Further, the walls, rooftop and windows of metro stations will be protected to enhance indoor thermal comfort for occupants, low water consuming installations, for example, double flush water storage rooms and low-flow taps will be introduced at stations and just low volatile

organic compound paints, cements and sealants that don't have numerous chemicals will be utilized in development. Fresh air will likewise be coursed to keep the 'sick building syndrome', the announcement said.

Aside from stations, the Delhi Metro's getting sub-stations and its forthcoming private quarters will be planned in a similar way.

It has additionally set up rooftop with best solar power plants at huge numbers of its stations. DMRD is now generating 20 megawatts (MW) of solar power, after adding new solar power facilities that produce 2.6 MW across the Metro network. All stations under construction corridors are being built as green buildings. In the present period of Delhi Metro's development, the DMRC is nearing the finish of 160 kilometers of Metro lines which will weave a web of Metro corridors along the city's Ring Road connecting with numerous different territories in NOIDA, Ghaziabad, Bahadurgarh and Ballabhgarh.

CONCLUSION

The detailed data is gathered for presenting this paper is to reducing our own climate impact as much as possible. The emissions that are actively managed with a view to achieving the climate protection target make up almost 40% of the total emissions. Praising the Delhi Metro for its initiatives to reduce carbon-footprints , CO, NOx and PM exhaust, Prem C Jain, Chairman, IGBC, said: "DMRC was the first one to become a green Metro. The platinum ratings they have got is very hard earned and a lot of toil has gone into the process."

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