
Climate Change – An Opportunity for Sustainable Development : The DMRC Experience

Dr. E. Sreedharan

Managing Director

Delhi Metro Rail Corporation Ltd., New Delhi.

Prologue

Shri E. Sreedharan, 'Metro Man' as he is widely known, has become a legend for timely completion of mega projects. The building of the Konkan Railway and the Delhi Metro being the shining examples.

In this Paper, 'Climate Change : An Opportunity for Sustainable Development', the Author examines the various aspects of climate change and Delhi Metro's comparative advantage in being able to address them. He brings out that if left unabated, climate change would most certainly reverse the hard-earned development gains; and the poorest were likely to suffer the earliest and the most.

As is well-known by now, the most likely causes of global warming and climate change are the anthropogenic greenhouse gas (GHG) emissions, mainly carbon

dioxide (CO₂) from burning of fossil fuels and the changing land use. Transport sector contributes 20-25% of GHG emissions worldwide. There is therefore a pressing need to scale up support to sustainable transport and urban development programmes. But such programmes for mitigating and adapting to climate change increase the cost of development. If we have to reconcile development and climate change then what is needed is not development *per se*, but sustainable development, and arranging the required technologies and investments.

The Author recapitulates the steps Delhi Metro Rail Corporation (DMRC) has taken in this direction and their outcomes.

- Editor

In Delhi Metro, it has been our endeavour not to plan just for the next phase, but for the next generation. Delhi Metro considers it a comparative advantage to be able to address the challenges of climate change as early as possible. If it is left unabated, climate change would most certainly reverse the hard-earned development gains in which the poorest are most likely to suffer the earliest and the most. Some of

the major impacts include water scarcity problems, increased intense tropical storm activity, storm surges and hurricanes, food security concerns and adverse health impacts. The most likely causes of global warming and climate change are the anthropogenic greenhouse gas (GHG) emissions, mainly carbon dioxide (CO₂) from burning of fossil fuels and changing land use. India is world's fourth largest economy and fifth largest greenhouse gas (GHG) emitter. Transport sector contributes 20-25% of GHG emissions worldwide. There is therefore a pressing need to scale up support to sustainable transport and urban development programmes. But such programmes for mitigating and adapting to climate change increase the cost of development. If we have to reconcile development and climate change then what is needed is not development per se but sustainable development by adopting the requisite technology and arranging investments. A few steps that Delhi Metro has taken in this direction and some of the outcomes are presented in this Article.

Climate Change : The Indian Perspective

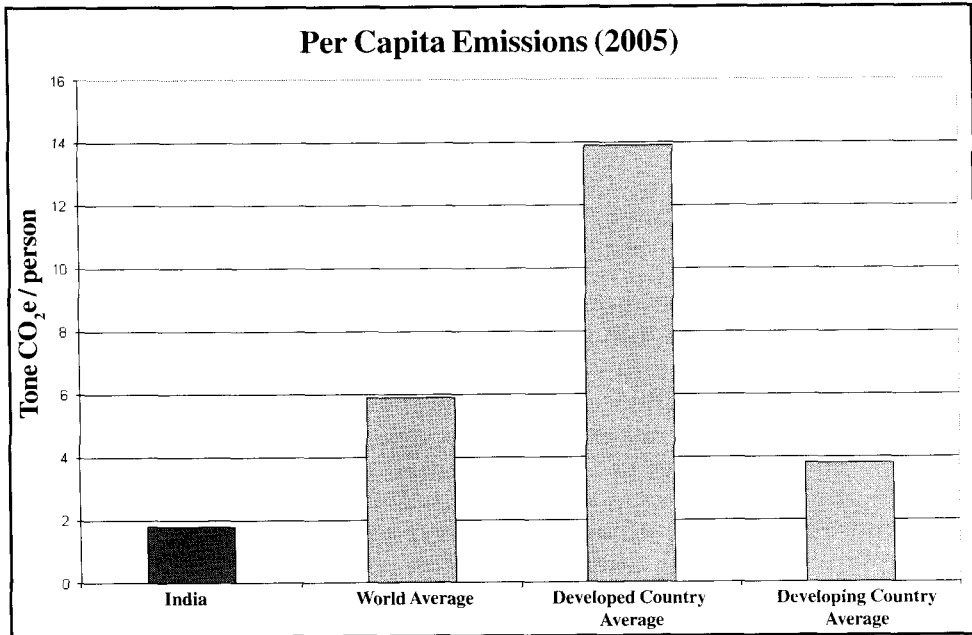
Carbon pollution is causing climate change, resulting in higher temperatures, more droughts, rising sea levels, adverse health and more extreme weather. The twelve hottest years in history have all been in the last thirteen years and Intergovernmental Panel on Climate Change (IPCC) scenarios project temperature rises between 1° and 6.4°C over the next century relative to 1980–99.

Some of the key impacts of climate change as far as the Indian sub-continent is concerned are:

- Water scarcity problems: Many of the drought-prone, semi-arid areas are expected to become even more drier. Low income groups are among the most vulnerable to water and other resource scarcities.
- Increased intense tropical storm activity, storm surges and hurricanes: Over time, sea level rise presents an imminent threat to small island states such as Maldives and low-lying densely populated coastal areas which include large portions of the Indian Peninsula.
- Food security concerns: As little as 1°C rise in temperature is estimated to result in a 5 to 10 percent yield reduction of major cereal crops. Rainfed agriculture, such as ours, is highly vulnerable to reduced rainfall and shifts in rainfall timing and distribution.
- The health status of millions of people will be adversely affected by extreme weather events, which would increase diarrheal diseases or alter the distribution of infectious disease vectors.

According to a report of the Pew Center on Global Climate Change (USA) and TERI (The Energy & Resources Institute, New Delhi), while India is the world's fourth largest economy, it is also the fifth largest greenhouse gas (GHG) emitter,

accounting for about 5% of the global emissions. India's emissions increased by about 65% between 1990 and 2005, and are projected to grow by another 70% by 2020. Still, India's emissions are low as compared to those of the other major economies. India accounts for only 2% of cumulative energy-related emissions since 1850. On a per capita basis, India's emissions are 70% below the world average and 93% below those of the United States.



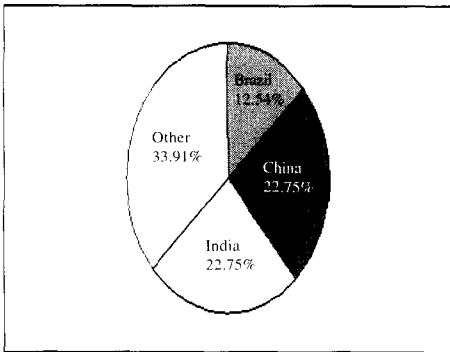
India remains home to the world's largest number of poor people with nearly 25% living below the poverty line. Its economy is growing rapidly, with GDP rising about 7% a year over the past five years. According to a recent report on an Integrated Energy Policy prepared by an Expert Committee of the Planning Commission, India needs to sustain 8 to 10 per cent economic growth rate, over the next 25 years, if it is to eradicate poverty and meet its human development goals. Consequently, the country needs, at the very least, to increase its primary energy supply three or four-fold over the current levels.

The government projects an energy demand growth of 5.2% a year for the next 25 years, driven by annual GDP growth rates of 8-10%. It is thus evident that India's economic growth would most certainly involve increase in Green House Gas (GHG) emissions from the current extremely low levels. But we should be willing to contain our GHG emissions as long as we are compensated for the additional cost involved. The country needs to chart out a roadmap for itself vis-à-vis climate change. Developing countries like India must adopt new energy-efficient technologies. The high cost usually associated with transfer of such technologies can be met by a very innovative mechanism of Carbon Finance; and this is what the Delhi Metro has done.

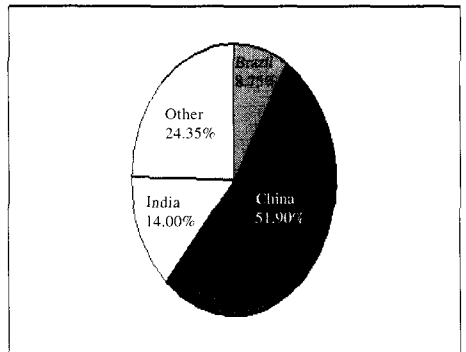
Carbon Finance and Climate Change

As is well known, India is a party to both, the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. As of now, India has no binding emission limits under the Protocol, being a non-Annex I (developing) country. However, India is an active participant in the Clean Development Mechanism (CDM) established by the Protocol. The CDM grants marketable emission credits for verified reductions in developing countries. Developed countries buying these credits can apply them towards their Kyoto targets. Clean Development Mechanism (CDM) is a market-driven mechanism and offers an opportunity to contribute towards environmental sustainability through business operations, while at the same time generate revenue by selling carbon credits. Revenue thus generated by selling carbon credits can be used to partly offset the high cost of Green technology. Under this scheme, nations which can not reduce their Green House Gas emissions can purchase carbon credits from other nations. The carbon credits, also called emission reduction units, can also be traded in a carbon market.

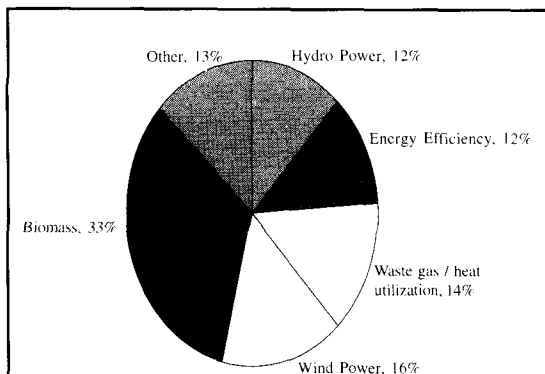
Various Indian enterprises have so far registered more than 375 CDM projects with the UNFCCC, greater than any other country, and about a third of all projects globally. However, in terms of the overall Certified Emission Reductions (CER), China ranks first with 51% followed by India at 14%. The largest project categories are biomass and wind power.



Registered Project Activities



Expected Average Annual CERs from Registered Projects



Types of Registered CDM Projects

There is an ever growing need in support of carbon market development through investments in long term assets. The additional resources needed to tackle climate change are unprecedented. Current climate-related financial flows to developing countries – including the Clean Development Mechanism (CDM) and Global Environment Facility (GEF), and other sources cover only a small fraction of the estimated amounts that developing countries would need over several decades. *It will be impossible to fully cover the financing gap unless adequate global policy and financial mechanism is negotiated under the UNFCCC.*

Sharing DMRC's Experience

Climate change can be mitigated in many ways, such as improving the efficiency of energy-intensive devices, vehicles and buildings, all of which involve direct and indirect gas emissions. DMRC has installed energy-efficient braking system in its rolling stock and earned carbon credits, the revenue from which will go towards offsetting the additional cost involved in using this technology. Globally, the transportation sector is responsible for almost one quarter of carbon dioxide emissions. However, there are few CDM projects on transportation; and this makes DMRC's achievement very special. The project was registered with the UNFCCC in December 2007 and on date we have already completed the initial verification audit successfully. This has made DMRC the first railway and metro rail project in the world, and only the second project in the transportation sector, to be registered with UNFCCC.

DMRC's CDM project on regenerative braking is titled "Installation of Low Green House Gases (GHG) emitting rolling stock cars in metro system". Over the past one year, this project has aroused much interest and has been discussed at great length in national and international proceedings on climate change. I will, therefore, only briefly touch upon the project philosophy, which is quite simple and works like this. DMRC has an electrically driven Mass Rapid Transport System which uses 4-cars rolling stock on different service lines. A typical rolling stock used by DMRC consists of two units, each comprising of two cars, a Driving Trailer Car (DT) and a Motor Car (M). The Delhi Metro System is designed for rolling stock where the coaches are equipped with 3-phase AC traction motors with regenerative braking system. By employing the regenerative braking technology in the braking system, DMRC's trains are able to 'generate' electricity when brakes are applied. The braking technology employed in DMRC is different from the prevalent system adopted by the other metro systems in the country, which uses conventional electro-dynamic rheostatic braking system. *The electro-dynamic rheostatic braking system converts the kinetic energy of decelerating Rolling stock into the thermal energy of rheostats, which is dissipated as heat.* DMRC's regenerative braking system generates electricity while braking. On an average 35% of electricity is regenerated. On a per kilometer basis, 5.26 kWh/Km of energy is regenerated. The electricity is fed back into the system and is utilized by other trains, which are in the loop at different locations on the track and are not in the braking mode. At any given point of time some trains will be in braking mode as they

reach a station, while some will be in powering (accelerating) mode as they leave the station and pick up speed. Some others will be traveling at the required speed before brakes will be applied as the destination station approaches. The electricity regenerated by trains in braking mode is used by trains in other modes of operation. This translates into reduction of load on the national grid equivalent to the amount of electricity regenerated. In the absence of the regenerative braking system, this requirement for electricity would have been met by drawing power from the national grid. Since the power plants use coal which releases enormous amount of carbon dioxide, we have avoided CO₂ emissions. The project activity relates to Phase-I of metro network of DMRC comprising 65 km with 70 numbers of rolling stock operational and running on the existing three service lines. UNFCCC has defined the project as Type III; other project Activities and Category III.C. "Emission reductions by low-greenhouse gas emitting vehicles, of the indicative simplified baseline and monitoring methodologies for selected small scale project activities categories".

For a ten year crediting period, the estimated CO₂ emissions are given in the Table below.

Amount of Emission Reductions

Years	Annual Estimation of Emission Reduction (in tonnes of CO ₂ e)
2007-2008	41,160
2008-2009	41,160
2009-2010	41,160
2010-2011	41,160
2011-2012	41,160
2012-2013	41,160
2013-2014	41,160
2014-2015	41,160
2015-2016	41,160
2016-2017	41,160
Total estimated reductions (tonnes of CO ₂ e)	411,600
Estimated Average Annual reduction (tonnes of CO ₂ e)	41,160

In addition to the above Certified Emission Reductions (CERs), 90,000 t of CO₂e Voluntary Emission Reductions (VERs) have also accrued to DMRC for the period from 2004 to 2007 end .

DMRC's Other Contributions to Climate Mitigation

The development challenge is to accelerate *infrastructure growth despite the asymmetric impacts on climate*. As with many other projects, some of DMRC's core activities on their own contribute to climate mitigation by reducing or avoiding GHG emissions. DMRC's operations are inherently geared towards reducing car ridership, thereby reducing significant amounts of carbon emissions. DMRC has been facilitating support infrastructure for increasing ridership and catchment areas by running shuttle buses and providing parking spaces. It has instituted an environmental policy that is followed by its staff and is also working on an EMS (Energy Management System).

The first crediting period under Kyoto Protocol shall expire in 2012 by which time at-least 185 km of metro network would be operational in Delhi and the NCR region. By expansion of metro network and improvement in connectivity to metro stations, there is expected to be a reduction in private vehicle demand of 58297 vehicles daily in 2009. This reduction is estimated to increase to 154,582 vehicles daily by the end of first crediting period in 2012. In the same period, it is estimated that reduction in travel time would also have gone up from 33 minutes per passenger per trip presently to 40 minutes per passenger per trip in year 2012. There would also be reduction in pollution load of CO, HC, NOx, PM, SO2 which is 4428 tonnes per year now, to 8322 tonnes per year in 2012.

DMRC has also planted 194,200 trees and by 2012, a total of 314,275 trees would have been planted.

DMRC's second CDM project is being developed, based on the shift of public traveling from cars/buses and other means of road transport to the metro trains. This modal shift from road transport, which emits Green House Gases, to the Metro, which does not, has significant Carbon Credit potential. For such type of projects, a methodology for calculation, monitoring and verification of emission reductions is required, which is not available. The same is being developed and is currently undergoing review with the UNFCCC. This is a time-consuming process but we are hopeful of attaining positive results by the end of the year.

DMRC's Future Plans

DMRC is also considering carbon-foot printing of all its activities. With the inventorisation of GHG emissions from all sources/processes used in DMRC, we shall be in a better position to reduce emissions and move towards being carbon neutral. The carbon foot printing exercise is an overarching strategy that directly responds to the National Action Plan on Climate Change (NAPCC). Carbon foot printing exercise will enable DMRC to understand, document, reduce and manage its carbon emissions. Other measures proposed include:

- Participating in Greening Common Wealth Games 2010 by incorporating/ offering carbon neutral train rides to commuters.

- Certifying the Metro Bhawan, using a third party verification system such as LEED India, by early 2010.
- Reassessing the energy consumption and incorporating additional energy efficiency measures without any major retrofits.
- Developing CDM projects and achieving available benefits of carbon trading.
- Benchmarking DMRC operations/climate change impacts with other global transit agencies.

Conclusion

It has by now been clearly established that climate change redressal requires unprecedented global cooperation involving a concerted action by countries at different development stages supported by transfer of finance and technology from developed to developing countries.

The developed nations have contributed most to the emissions and will retain higher energy use per capita for many years ahead. Mitigating and adapting to climate change increases the cost of development. There are added risks and costs of unabated climate change on the one hand, while on the other, significant cost is involved in combating climate change. Hence, there is a need for technological and financial transfer from developed to developing nations. This transfer should not be at the cost of or due to diversion of funds from other development programmes; instead additional funding should be made available.

There is an urgent need to enhance the knowledge and capacity of our staff to analyse and manage development – climate linkages at the local and project levels.

The country needs to chart out a roadmap for itself in the light of the recent reports on consequences of climate change. Developing countries like India must adopt new energy-efficient technologies.

Affordable and safe public transport, such as the Delhi Mass Transit, needs policy support in the form of lower taxes and promotion of usage. On its part, DMRC shall support climate actions in country-led development processes, and support deployment of new technologies that lower the GHG emissions in its operations.