

## **Developing Low Carbon Cities in Asia: A Study of Bhopal, India**

Aashish Deshpande<sup>1</sup>, Manmohan Kapshe<sup>2</sup>, Sheuli Mitra<sup>2</sup> and Kshama Puntambekar<sup>2</sup>

Cities all over the world are a major contributor to the Greenhouse Gas emissions and cities in India are no exception. In pursuit of environment friendly development, many cities in various parts of the world have attempted to design and implement climate change mitigation and adaptation strategies. Developing Low Carbon Cities is a step in that direction.

Developing LCS studies at city level gives a platform where researchers interact with stakeholders and policymakers to integrate their knowledge and build relevant scenarios for transition towards a low carbon society. These scenarios provide possible and potential ways and measures to develop low carbon cities or re-orient existing cities towards low carbon pathways. The LCS roadmaps thus achieved for cities will help in integration of development activities, prioritize investments in urban infrastructure, and provide incentives for use of innovative technologies to improve efficiency. Another important contribution will be to promote behavioral and lifestyle changes in cities.

Methodologies to work out a broad framework would be needed to define the pathways towards reaching the desired goal of low carbon society. This is to be done by analyzing the present situation for timely interventions that in turn may depend on social political and economic considerations. The city level LCS framework also looks at the opportunities of co-benefits apart from the direct GHG emissions reduction. Such co-benefits, like improved local ambient air quality and health benefits works towards minimizing social costs.

To analyze the role that large urban settlements can play in moving towards low carbon society, it would be necessary to take cases studies of cities which show diverse characteristics. It would be useful to take-up large number of studies before any generalizations can be drawn as the cities that have grown over the years have distinct individualities that cannot be easily generalized. More so, in case of a large country like India, the diversity in terms of climate, topography, resource-potential, economic-base and socio-cultural practices has resulted in a variety of development patterns. To explore and analyze the role of rapidly urbanizing metropolitan cities in India, towards moving on low carbon pathways, a case study of Bhopal located in Central India has been taken up.

In the present study, simulations for two possible scenarios of Bhopal in 2035 are developed and emission reduction potentials of various counter measures are quantified Using the AIM/ExSS model. In consultation with policymakers and city planners, action plan and policy measures are suggested for moving towards the low carbon society Bhopal 2035. The simulations show that the GHG emission and energy consumption increase in the both the

---

<sup>1</sup> Maulana Azad National Institute of Technology, Bhopal, India

<sup>2</sup> School of Planning and Architecture, Bhopal, India

scenarios. The GHG emissions of Bhopal in 2005 were around 2.5 million ton CO<sub>2</sub> which rise by around 6 times to 14.2 million ton CO<sub>2</sub> in the target year 2035 under the BaU. However, with energy efficiency improvements, development of renewable energy, and other policies to promote sustainable development across all sectors, Bhopal has about 40% GHG emission reduction potential over BaU level in the possible Low Carbon Society Scenario. The simulation assessment shows that, of the total emission reduction potential, 50% would be due to fuel switch which is prominent in residential, commercial and industrial sectors, more than 40% would be due to energy efficiency improvements mostly from residential, commercial, and transport sectors, and remaining close to 10% would come from reduction in energy service demand in residential and transport sectors.

The present literature on sustainable development and low carbon society indicates that it would need a significant transformation in the world energy use pattern. High energy intensity is an area of major concern and quantification of emissions reductions from current policy baseline is necessary. The study outcome shows that, Bhopal has rising population and higher share of tertiary sector in occupational pattern. To transform it into a low carbon society would require an aggressive portfolio of policy measures coupled with strong environmental awareness, conservationist values and environmental integrity. The key policy measures for improving energy intensity (attainable with reducing energy service demand, lifestyle changes) along with access to low carbon power (hydro, nuclear), fuel switch in industrial and transport sectors and measures promoting end-use device efficiency specifically in transport, industrial and residential sectors, would be needed.

This study is of especial significance because the pathways to achieve the low carbon society are open for the developing countries and a framework for a low carbon society from the perspective of developing countries is evolving. It could be said that fast growing Indian cities have an opportunity to contribute to the climate change mitigation by developing on a low carbon pathway.

We would like to acknowledge policymakers, city planners and government officials from Bhopal, India who have contributed with useful insights and information. We are thankful to Yuzuru Matsuoka, Reina Kawase, Kei Gomi, (Kyoto University, Kyoto, Japan); Go Hibino, Tomoki Ehara, Kazuya Fujiwara, Yuko Motoki and Kazuyo Oyamada (Mizuho Information and Research Institute, Tokyo, Japan); Mikiko Kainuma, Toshihiko Masui, Junichi Fujino, Shuichi Ashina, Osamu Akashi, Shinichiro Fujimori (National Institute for Environmental Studies, Tsukuba, Japan) for their suggestions and contributions in completing this study.

