SUSTAINABLE LOW CARBON URBAN MOBILITY SCENARIOS FOR INDIA: A CO-BENEFITS ASSESSMENT OF ELECTRIC VEHICLES

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Overview

Transport sector's fuel mix in India is dominated by liquid fossil fuels. The sector accounts for 13% of the total energy-related GHG emissions in India, of which urban transport accounts for a quarter (Planning Commission, 2011). Of late, India is witnessing a rapid surge in urban mobility demand as a result of its increasing population, rapid urbanization, rising income levels and the growth and spread of cities. The number of million-plus (population) urban agglomerations/towns have increased from 35 to 53 during the past decade (Census of India, 2011); the sales of LDVs in cities have grown at 26% over the same time period, and the urbanization level is expected to reach 50% in 2050 from current levels of 31% (IEA, 2009). Under the business-as-usual (BAU) approach, the fossil-fuel dependence of the increasing urban mobility demand could then have vital implications for energy security, GHG mitigation and air quality in the cities. And with India standing as one of the signatories to the UNFCCC committed to reduce emissions from carbon and local air pollutants, limiting emissions from the urban transport sector would be important as it provides opportunities to gain multiple national (GHG mitigation, energy security) as well as local co-benefits (improvement in air quality) vis-à-vis its green growth objectives.

In recent years, electric vehicles (EVs) have emerged as one of the options to mitigate the CO_2 emissions from the urban transport sector. There lies an opportunity to gain national and local level co-benefits such as a shift towards EVs could reduce oil demand and thereby improving energy security, and local air quality in cities could also improve. EVs also hold the potential to reduce carbon emissions from the urban transport sector. Missions within the India's National Action Plan on Climate Change (NAPCC) and specific policies such as the National Electricity Mobility Mission Plan (NEMMP), National Urban Transport Policy (NUTP), and Jawaharlal Nehru National Urban Renewal Mission (JNNURM) have focused on adoption of less carbon intensive modes such as EVs, public transport, and NMT. There is therefore a need to analyze the framework which could be adopted both at the national and local level keeping India's global, national and local green growth objectives in perspective so that co-benefits can be realized. Existing literature falls short on this subject and the paper aims to address this gap. The paper studies various sustainable low carbon urban mobility scenarios for India both at a national and local level and the co-benefits are assessed keeping India's long term global, national and local targets in view. The paper takes the case of Ahmedabad city, which with a population of 6 million (fifth largest in India) is one of the 53 Million-plus cities with a burgeoning urban transport sector currently. An integrated assessment modelling framework is used to delineate the energy and emission urban mobility pathways till 2050 for India and Ahmedabad city.

Methods

The paper makes use of an integrated assessment modelling framework to delineate the energy and emission urban mobility pathways till 2050 for India and Ahmedabad city. The ANSWER-MARKAL, which is a bottom up energy system model, is used to assess the energy security and GHG mitigation co-benefits for three scenarios at the national level. The Asia Pacific Integrated Assessment Enduse model (AIM/Enduse) model, which is a bottom-up linear optimization model, is then be used to model the energy demand, pathway of technological transition, CO_2 and the local air pollutant (SO_x, NO_x, PM_{10}) emissions for Ahmedabad till 2050.

Three scenarios are assessed using the model and overall system cost determined in each case. The scenarios considered are: (i) A Business-As-Usual (BAU) scenario which is the baseline scenario wherein the impact of existing and planned policies and measures is assessed. (ii) A Sustainable Electric Vehicle (SEV) scenario that envisages an increased focus on the use of electric vehicles (EVs) as a result of national and local policies. These policies would complement other mitigation strategies such as public transport, provision of dedicated lanes for non-motorized transport (NMT) and two wheelers, switch towards cleaner fuels (e.g. biofuels, CNG), travel demand reduction strategies (e.g. land-use integration and increased penetration of ICT) and technological interventions. (iii) Lastly a Green Energy and Electric Vehicle (GEEV) scenario that assumes the levy of carbon tax and decarbonisation of electricity sector thus further promoting use of EVs. The results of the scenario analysis are

expected to delineate the elements of the transformation of India's urban transport sector and quantify the co-benefits in each case.

Results

Initial results from the ANSWER-MARKAL model analyzing national level scenarios indicate that electric two wheelers (E2W) and electric four wheelers (E4W) achieve cost competitiveness in the BAU by 2035, while tax incentives in SEV scenario help in advancing this to 2020 for E2W and 2025 for E4W. However EVs do not emerge as a mitigation option for carbon emissions in the SEV scenario. The same is not the case under GEEV as when electricity decarbonisation occurs EVs emerge as a viable mitigation option.

The scenario results for Ahmedabad city carried out using the AIM/Enduse model exhibit similar findings. Similar to the national case, EVs fail to emerge as a mitigation option for carbon emissions in the SEV scenario. However, under the GEEV, carbon reduction on account of electricity decarbonisation occurs. The share of E4W rises further in 2050. Local co-benefits owing to an improvement in air quality are also gained.

Conclusions

Owing to the initiatives adopted in the SEV and GEEV scenarios, vital national co-benefits in the form of CO_2 reduction and energy security, and local co-benefits in the form of improvement in local air quality are accrued. However, it is important to note for EVs to emerge as a viable mitigation option for carbon emission reduction, decarbonization of electricity sector should happen and tax incentives to further their adoption would be initially required. Once the costs for setting up EV infrastructure and incentives for a city is known, a policy framework in terms of choosing one portfolio of policies over for more number of cities can be made. From a policy perspective, pursuing sustainable low carbon urban mobility strategies would be critical for India.

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