Resource use benchmarking and performance enhancement in selected Asian Railway Stations with comparative analysis of resource use

Executive summary

Railways are a key mode of transportation for both passengers and freight throughout the world. The enormity of its network contributes to significant resource consumption (both energy and water) and generation of waste, which is quite imperative for running and operating such a huge system. This resource consumption can be attributed to two major heads—traction and non-traction. Traction energy is attributed to running the trains while non-traction energy is related to operating the facilities for running the trains and passenger interchange such as railway stations, etc. There exists a huge potential for promoting resource use efficiency in non-traction areas of railway stations. This study focusses on mapping the resource consumption in selected Asian railway stations with comparative analysis of resource use, thereby arriving at attainable benchmarks for resource consumption and waste generation for different railway stations.

Five major stations of Indian railways—Bangalore, New Delhi, Mumbai, Ahmedabad, and Howrah; along with other Asian railway stations— Dhaka, Bangladesh; Kuala Lumpur,Malaysia; and Hsinchu and Taichung, Taiwan were studied for analyzing resource consumption. Although the data for Tokyo (Japan) Railway station was also provided by the UIC (International Union of Railways), but due to the inadequacy of data, Tokyo railway station was not included in the study. For benchmarking energy consumption, two separate indicators were identified and calculated—Energy Performance Index (EPI) (kWh/m2/yr) and Energy Performance Index per Passenger (EPIP) (kWh/m2/passenger) to indicate the effect of built-up area and number of passengers using the facility, respectively. Similarly for water consumption Litres Per Capita Per Day (LPCD) was identified and calculated for the selected stations. The baseline waste generation data in terms of kg/passenger/day was also quantified for the selected stations. A benchmarking-cum-rating tool was envisaged to be developed during the project inception phase but as the study was carried out further, it was realized that due to small sample size of the data, such a tool would not be very beneficial for the performance evaluation of Asian locations.

Various achievable resource efficiency measures were also identified and the corresponding saving potential was calculated. Lighting energy consumption at station building, circulating area, and platforms constitute the major chunk (50 per cent) of the total energy consumption followed by air conditioning (26 per cent) and other equipment, such as fans, lifts, and drinking water coolers (24 per cent). For promoting energy efficiency amongst the railway stations, replacement of existing lighting fixtures with energy-efficient alternatives, such as LEDs, and ACs and fans with energy-efficient star rated equipment is recommended. Similarly, several water conservation measures were also identified to reduce the existing water demand. Thus achievable benchmarks for energy and water consumption were calculated. Cost-benefit analysis of various energy/water conservation measures was subsequently carried out which clearly showed that multitude of resource conservation measures are not only technically feasible but economically viable as well.

The mean EPI calculated for station building of five selected stations of Indian railways is 120 kWh/m2/yr, which can be reduced to 85 kWh/m2/yr, by applying energy conservation measures. Similarly, for circulating area and platforms the calculated mean baseline EPI of 6 kWh/m2/yr and 25 kWh/m2/yr, respectively, could be reduced to 3 kWh/m2/yr and 15 kWh/m2/yr, respectively. The mean EPIP for Indian stations could be reduced from 0.0232 kWh/passenger/yr to 0.0170 kWh/passenger/yr, saving around 27 per cent. The potential of renewable energy harnessing in reducing the grid dependence of railway stations was also calculated, wherein it was established that by installing photovoltaic panels on platform shelters alone could make the railway stations' energy neutral.

To reduce the water consumption, several measures were identified based on the survey conducted, discussions held with several officials on latest products/ technologies available in the market. These identified water conservation measures included both demand-side reduction such as use of water-efficient fixtures and supply-side measures such as sewage treatment plant and rainwater harvesting. There exists a water saving potential of around 71 per cent.

Resource consumption and waste generation data of other Asian locations, Dhaka (Bangladesh), Kuala Lumpur (Malaysia), and Hsinchu and Taichung (Taiwan) were also analysed with a view to perform a comparative analysis with Indian stations to identify the best practices which could be replicated at other stations to promote resource use efficiency. In terms of promoting water efficiency, Malaysian and Taiwanese railway stations were found to be the most efficient. Some of the noteworthy water-efficient practices found at these railway stations were—installation of water meters and use of water-efficient faucets. Sewage treatment plants have been installed at Taiwanese railway stations and the treated water is discharged directly into municipal drains, which could actually supplement the non-potable water demand. In Indian stations also, some significant water-saving initiatives have been commissioned, but they have been installed on a very small scale as compared to the quantum of total water consumption. These include water-less urinals and rainwater harvesting system at Mumbai (CSTM) station, and sewage treatment plants at Bangalore (SBC), Howrah (HWH) and Mumbai (CSTM) stations. At Dhaka station no specific measures to promote water efficiency have been found. In terms of solid waste management only Taiwan railway station has taken the initiative of waste segregation at source by using multi-coloured bins. However, plastic bottles crushing plant were found to be installed at New Delhi (NDLS) and Bangalore (SBC) stations. Other than these, no steps have been taken at any of the studied stations for waste management. Energy-efficient envelope has only been commissioned at Taiwanese stations, where roof insulation is used to reduce the solar gains which not only reduce the air conditioning load but also improves thermal comfort. In terms of promoting energy efficiency, Taiwanese, Indian, and Malaysian stations have taken some good initiatives such as efficient lighting systems and controls, but there still exists a tremendous potential of energy conservation in all the considered stations which could be realized easily. Taiwan stations again stand out in terms of promoting energy efficiency by using lighting controls through building management systems, which is not practised at any other station. Thus, all the studied stations could learn from the best practices of each other to keep and uphold resource use efficiency.