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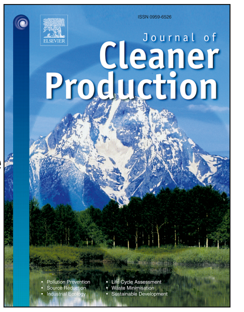

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Traffic and emissions impact of the combination scenarios of air pollution charging fee and subsidy

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Abstract

The growth of motor vehicle usage has not only increased traffic congestion in urban areas, but also air pollution in cities due to vehicle exhaust emissions. To solve these problems, from an environmental impact perspective, a charging and subsidy mechanism was first introduced. Then to establish the vehicle pollutants emissions reduction management model, a system dynamics method was used. By using the grey system theory and regression analysis method to determine the main parameters and equations, carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), and particulate matter (PM) were chosen as the major pollutant factors. To verify the validity of the model, the degree of grey incidence, mean square error ratio, and little probability of error were used. Through policy simulation, the dynamic changes of the key pollutant factors, including the amount of vehicle trips and supply level of public traffic (SLPT), were explored to determine the appropriate range of charging and subsidies offered. It was found that the single policy schemes have limitations. By integrating the subsidy and charge schemes, the advantages of these two policies are leveraged which not only reduces the emission of vehicle pollutants and alleviate traffic congestion, but also significantly improved the SLPT.

Keywords: Vehicle emissions; air pollution; emission reduction; traffic congestion; combination policy

1 Introduction

The key pollutants from vehicular exhaust such as carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), and particulate matter (PM) have been reported to be very high in urban corridors (Lipfert and Wyzga, 2008). In Europe, the contribution of vehicle emissions to NO_x and CO levels amounted to 40% and 26% in 2011, respectively (EEA, 2013). Traffic-related emissions have become one of the major sources of air pollution, especially in Chinese cities such as Beijing, Guangzhou, and Shanghai (Cen et al., 2016; Cui et al., 2015; Wang et al., 2014; Yang et al., 2011). Therefore, the urban traffic problem, which encompasses exhaust emissions, congestion, and level of safety, has become more serious. Due to their large adverse impact to the environment and