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Abstract

Promoting electric vehicles (EVs) is an important measure to ensure energy security, improve air quality, and mitigate global climate change. However, the emission reduction impacts of EVs in China have been widely debated and the conclusions of existing studies are still controversial. In this study, we adopted the life cycle assessment (LCA) method to evaluate the carbon dioxide (CO₂) and air pollutant emissions from the stage of vehicle production, vehicle use and vehicle end-of-life. We further compared the emissions of three types of passenger vehicles in China, including internal combustion engine vehicle (ICEV), plug-in hybrid electric vehicle (PHEV), and battery electric vehicle (BEV). Compared with ICEV, BEV and PHEV were found to reduce the emissions of CO₂, VOCs, and NO_X, but increase the emissions of PM_{2.5} and SO₂. These differences were primarily caused by EV's high fuel efficiency and high fuel consumption of ICEV. Additional findings indicate that the emissions of PM_{2.5} and SO₂ of BEV were 2.6 and 2.1 times that of ICEV, respectively; and the emissions of PM_{2.5} and SO₂ of PHEV were 1.8 and 1.5 times that of ICEV, respectively. Moreover, we found the emissions of PM_{2.5} and SO₂ of EV will be higher than that of ICEV in high renewable energy scenario with higher biomass share if keeping the emission factor of electricity constant.

Keywords

Electric vehicle; Carbon dioxide emissions; Air pollutants; Life cycle assessment; China