

ELECTRIC VEHICLES

Patterns of charge

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Electric vehicles present opportunities to reduce air pollutants, including greenhouse gases, in the transportation sector. However, the degree of reduction is constrained by how the electricity charging the vehicles is generated, which is increasingly a function of the time of day. It is often assumed that electric vehicle owners will do their charging at night, when electricity prices are typically lower, but this may not be optimal from an emissions perspective. To explore this problem, Yingkai Fang at the University of Florida and colleagues from the US and Norway consider how the social cost of charging electric vehicles — that is, the cost to society caused by the impact of pollutants on the environment, GDP, and so on — changes throughout the day.

Focussing on Sacramento, California, the researchers use real data on electricity prices and emissions of CO₂, SO₂, and NO_x to construct hourly models of marginal emissions rates and marginal electricity prices. They then take a range of estimates for the social cost of CO₂ between US\$11 per ton and US\$500 per ton to construct patterns of marginal social cost of charging a vehicle, assuming a four-hour charge period. The researchers find that the pattern of social cost of charging a vehicle throughout the day varies with a very sensitive dependence on price of emissions: if the price of CO₂ is low then the social cost of charging is greatest in the afternoon, but if the price is high then it becomes better to charge vehicles in the middle of the day. That is, overnight charging of electric vehicles has a high societal cost if the price of CO₂ is high. This implies that approaches to charging behaviour require careful consideration of the price of emissions throughout the day in order to maximise the environmental impact of electric vehicles.

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