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The Large Scale Roll-Out of Electric Vehicles: The Effect on the Electricity Sector and CO2 Emissions

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The UK government has set the ambitious targets of 20 and 50% reduction in greenhouse gas emissions by 2020 and 2050 respectively. The transport sector accounts for 21% of total CO2 emissions in the UK and can, therefore, be important for achieving the emissions reduction targets. Within the transport sector, electric vehicles (EV) are considered as one of the important mitigation options. However the effect of EVs on emissions and the electricity sector is subject to debate.

We use scenario analysis to investigate the emission reduction potential of EVs and their interaction with electricity sector. Since emission factors for the electricity grid vary with time, it was expected that time of charging would affect the emission performance of EVs. However, evaluation of this hypothesis in the UK context indicates that time of charging would not have significant effects on the mitigation potential of EVs mainly because emissions from the marginal power plants remain almost unchanged during 16 hours of the day (i.e. from 8:00 to 24:00) and distribution of vehicles charging at different times during these 16 hours has little effect on the amount of emissions.

Number of EVs is found to be the main the factor affecting the mitigation potential. Our findings indicate that in the UK, by 2030, EVs could result in up to 32% emissions reduction compared to advanced internal combustion engines. Sensitivity ansyslis is used to account for the uncertainties in the assumptions. Results of sensitivity anaylsis shows that while emission reduction of seveall million tonnes of CO2 are achievable through introduction of EVs to the fleet, effects of charging

pattern of EVs and emission factors from the grid (marginal or average) are limited to several kilo-tonnes of CO2 emission.

Nontheless, we show that managing the charging patterns could reduce adverse effects of EVs on the electricity sector. In other words, the analysis shows that effective implementation of EVs load shifting policies would not only reduce the EVs' electricity demand by up to 33% at peak times, it would also help leveling the electricity demand curve and therefore improve the overall efficiency of the system. This would lead to more effective use of the existing capacity and would reduce the overall cost of electricity for all consumers including both EV and non-EV users.

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