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Decarbonising UK transport: Implications for electricity generation, land use and policy

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Transitioning away from internal combustion engine private vehicles in favour of public transport, including electric and hydrogen alternatives, is recognised as an essential part of the solution to reduce the scale of climate change and meet net zero in the UK by 2050. This decarbonisation transition to low carbon transport will likely result in an increase in energy demand which will have impacts on both ecosystem services (ES) and natural capital (NC). Robust projections of societal energy demands post low carbon transition are therefore required to ensure adequate power generation is installed. In this study, we project the energy demand for electric and hydrogen cars, buses and trains between 2020 and 2050 based on the number of vehicles and distance travelled using the Transport Energy Air Pollution UK (TEAM-UK) model outputs. In this work, the spatial requirements of additional renewable energy (onshore/offshore wind and solar), nuclear and fossil fuels, on ES and NC was predicted by considering the expected electricity generation mix expected by 2050, the number of generation installations and energy density of each energy source. The outcomes of this analysis can assist policymakers in better understanding what energy types and transport networks need to be prioritised to efficiently meet net zero. Legislation requires increased low carbon electricity generation, though the impact on ES and NC are not currently quantified.

Energy demand was lower for electric transport (136,599 GWh) than hydrogen transport (425,532 GWh) for all vehicle types in 2050, however a combination of both power types will be needed to accommodate the full range of socioeconomic requirements. In addition, to power electrical transport, 1,515 km^2 of land will be required for solar, 1,672 km^2 for wind and 5 km^2 for expansion of the average nuclear power station by 2050. This will be approximately doubled for hydrogen provision due to the additional energy and conversions required to generate hydrogen.

In reality the finer scale mix between hydrogen and electric transport types in the future will depend on geographical location and resource availability. Rural areas may favour hydrogen power due to range restrictions, with electric transport more readily suited to urban areas with greater installed infrastructure. To reduce the requirements for additional electricity and maximise carbon output decreases, minimising the impact on NC and ES, policymakers need to focus on

encouraging a modal shift towards low carbon public transport from private vehicles and to ensure a more sustainable route to decarbonising transport.