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Assessment of air quality and climate co-benefits of decarbonisation of the UK energy system using remote sensing and model simulations – the case for prioritizing end uses in urban areas

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The UK has a binding obligation to reduce GHG emission by 80% (based on 1990 levels) by 2050. Meeting this target requires extensive decarbonisation of the UK energy system. Different pathways that achieve this target at the lowest system costs are being explored at different levels of policy and decisions on future energy infrastructure.

Whilst benefits of decarbonisation are mainly focused on the impacts on climate change, there are other potential environmental and health impacts such as air-quality. In particular, a decrease in fossil fuel use by directly substituting current systems with low-carbon technologies could lead to significant reductions in the concentrations of SO_2, NOX, CO and other atmospheric pollutants. So far, the proposed decarbonisation pathways tend to target the electricity sector first, followed by a transition in transport and heating technologies and use. However, the spatial dimension of where short term changes in the energy sector occur in relation to high density population areas is not taken into account when defining the energy transition strategies. This may lead to limited short-term improvements in air quality within urban areas, where use of fossil fuels for heating and transport is the main contribution to overall atmospheric pollutant levels.

It is therefore imperative to explore decarbonisation strategies that prioritise transition in sectors of the energy system that produce immediate improvements in air quality in key regions of the UK. This study aims to use a combination of Remote Sensing observations and atmospheric chemistry/transport modelling approaches to estimate and map the impact on NO_x of the traditional approach of decarbonising electricity first compared to a slower transition in the electricity sector, but faster change in the transport sector. This is done by generating a set of alternative energy system pathways with a higher share of zero emissions vehicles in 2030 than the energy system optimization model would choose if the only goal was the 80% GHG emissions reduction. Our overarching goal is to provide an additional standard to compare future energy system pathways beyond the traditional metrics of cost and GHG emissions reductions.