The role of infrastructure in meeting UK climate change targets: a case study of wind energies

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Whichever scenario of the future energy system in the UK materialises there will be a need for large-cale infrastructure changes in its delivery. At present, none of the scenario modelling used in the UK Government's Low Carbon Transition Plan takes into consideration the carbon implications of building a new energy system, albeit nuclear, wind or carbon capture and storage (CCS). However, building a new energy system is an energy-intensive process, which reduces the overall energy and carbon efficiency of the power generation. Although a new energy system can reduce direct emissions from the energy generation itself, the indirect emissions related to capital investment are very significant and have to be taken into account.
In addtion to the need to account for the embodied carbon in energy systems, there is also a limitation with the current approach associated with these calculations. Process Life Cycle Analysis (PLCA) has often been employed to establish the indirect emissions associated with energy systems and this can lead to significant truncation errors in the calculations of up to 50%. Input-output based Life Cycle Analysis (IO-LCA) on the other hand suffers from some shortcomings such as aggregation and allocation errors. Hybrid analysis methods combining the strengths of PLCA and IO-LCA have therefore been developed to reduce the limitations of both approaches and have been successfully applied in many studies.

In this study we establish a comprehensive and comparable methodology by which to assess the indirect GHG emissions of four key energy technologies (wind power, nuclear power, Combined-cycle Gas Turbine and CCS). We then build these results into the UK MARKAL model developed for the 2003 UK Energy White Paper to establish the significance of UK carbon scenarios outlined in the UK energy research council (UKERC) Scenario 2050 report.