Can hydrogen enable CCU? Value chain optimisation of integrated hydrogen, syngas, natural gas, heat and electricity networks with CCS and CCU

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A comprehensive optimisation of the Great Britain (GB) energy system was performed using an MILP model to assess the potential of CCS and CCU. H_2 and CO_2 value chains were included in the model, and all of the pathways from primary resources to end-products (e.g. fuels and chemicals) were represented, considering the different technologies for conversion, storage and transport of resources. Figure 1 shows the results for the "reference" case, which maximised net present value subject to a 2050 emissions target and a CO_2 trading price of £100/tCO_2. CCS was found to be preferred to CCU due to the low efficiency with which CCU utilised hydrogen. The case also included a large expansion of offshore wind capacity and a hydrogen network involving electrolysis from excess renewable electricity, hydrogen storage and hydrogen boilers for heating in homes.

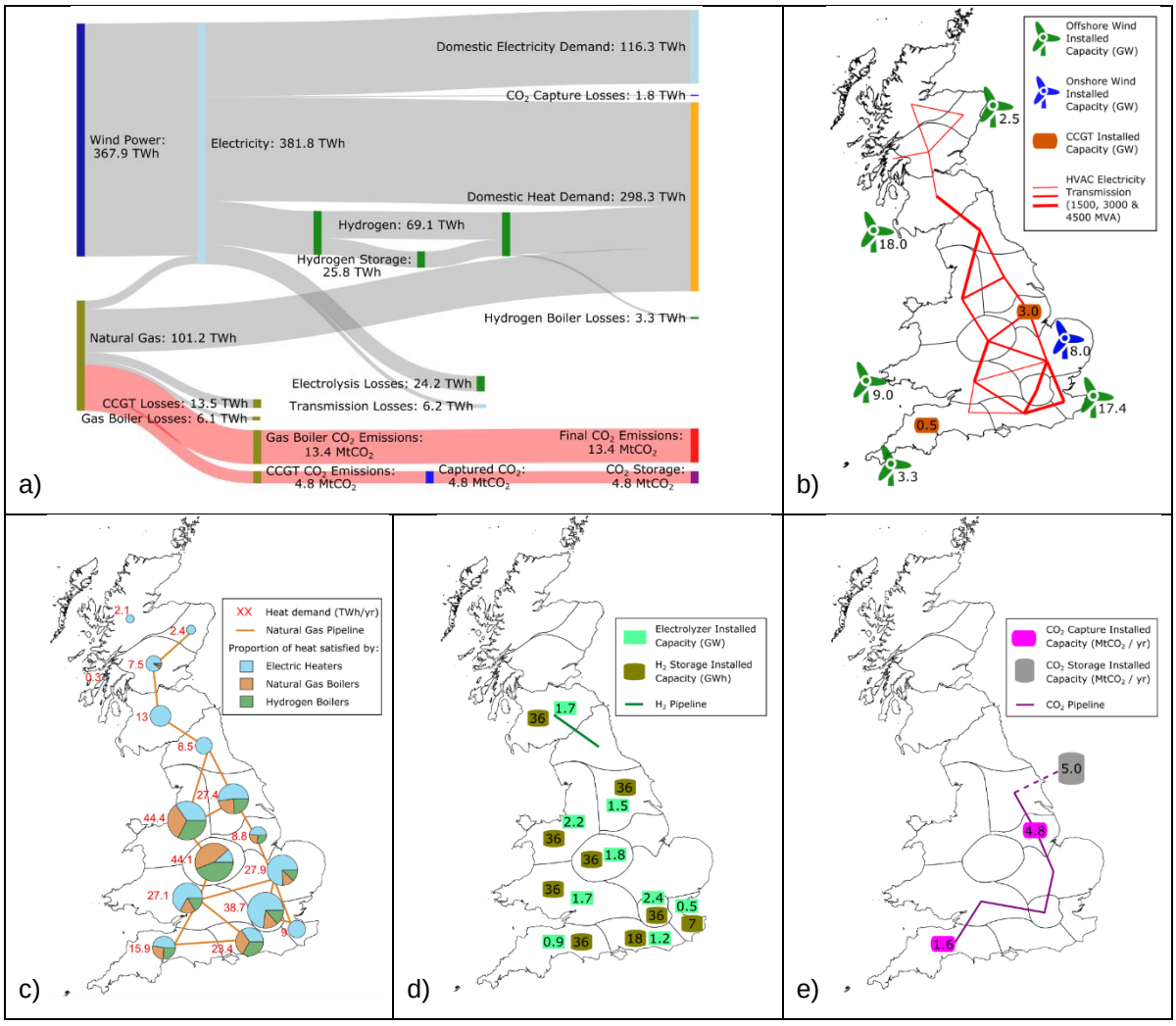

Figure 1: An optimal network design for Great Britain in 2050: (a) Sankey diagram of energy and CO_2 flows; (b) new and existing network for electricity supply; (c) new and existing network for provision of heat; (d) new hydrogen network; and (e) new CCS facilities.