

Structural differences in the economics of contrasting approaches to urban H₂ infrastructure development for transport

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If hydrogen vehicles are to be deployed, an infrastructure must be developed to supply the hydrogen and refuel the vehicles. While hydrogen from existing industrial capacity could serve small-scale vehicle demonstrations, dedicated facilities for hydrogen production are likely to be required for significant levels of deployment.

Hydrogen has a much lower volumetric energy density than conventional liquid fuels and is therefore less well-suited to the traditional approach of distribution by road, as each journey delivers less energy. Delivery by pipeline is an efficient, but capital-intensive, inflexible and potentially expensive alternative delivery option. Other approaches are considered to minimise the need for H₂ distribution, such as distributed production. The approach to H₂ distribution has a strong effect on the scales of production facility that might be considered.

Even for a given approach to infrastructure development, the various options for H₂ production can have quite different characteristics that affect their competitiveness. Production costs for electrolysis and steam methane reforming depend strongly on the prices of their feedstock (electricity and natural gas respectively). Electricity prices are determined by the domestic market and vary diurnally as well as seasonally; by contrast, natural gas prices vary seasonally and the UK is increasingly dependent on foreign sources of gas. A further option for H₂ production in cities is gasification of municipal waste, which has quite different characteristics, as its feedstock is effectively 'negative cost' due to the fees available for waste processing.

The economics of H₂ infrastructure development also depend on uncertainty and risk, as well as the rate of demand growth. Large-scale, capital intensive infrastructures are favoured by low-risk situations and high demand growth, to reach full utilisation as quickly as possible. Situations with higher risk or slowly growing H₂ demand are more suited to more incremental infrastructure development.

This paper builds on analysis of hydrogen infrastructure for London and analyses the economic characteristics of different options for urban H₂ infrastructure development and how expected trends will affect these options. It examines the circumstances (e.g. technology costs, energy prices, waste policy, intermittency) in which different options might be favoured and policies that might affect such choices.