The ATHENA project: Analysis of a Strategic Hydrogen Refuelling Infrastructure

With the pressured timescale in determining effective and viable net zero solutions within the transport sector, it is important to understand the extend of implementing a new refuelling infrastructure for alternative fuel, such as hydrogen. The purpose of this project is to analyse freight logistics data and determine the geographic location and capacity of the hydrogen refuelling infrastructure required to serve the specified region. The ATHENA framework entails three components which encapsulates the analyses of freight logistics data in estimating the freight refuelling demand and incorporates an optimisation model in determining the hydrogen refuelling network design with an agent-based model simulating the system.

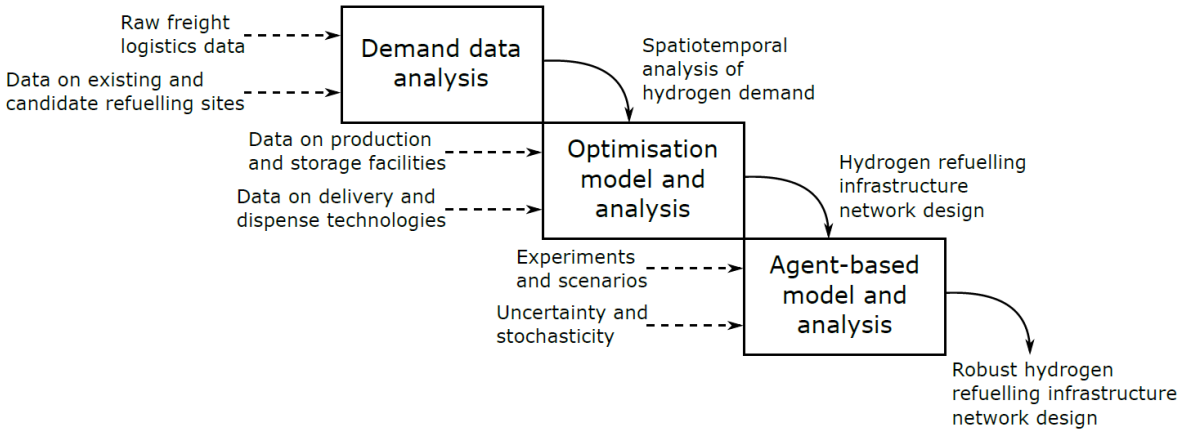

Figure: The ATHENA framework.

The framework is implemented to the NP11 region in Great Britain. During the data analysis phase, the heavy goods vehicle demand is geographically mapped with 14 current refuelling sites identified as possible locations for hydrogen refuelling stations in the rollout phase and 200 current refuelling sites for the mature phase. In the optimisation model, the number of hydrogen refuelling stations with their locations and capacities are provided and for each the supply configuration between on-site and/or off-site hydrogen production supply is determined.

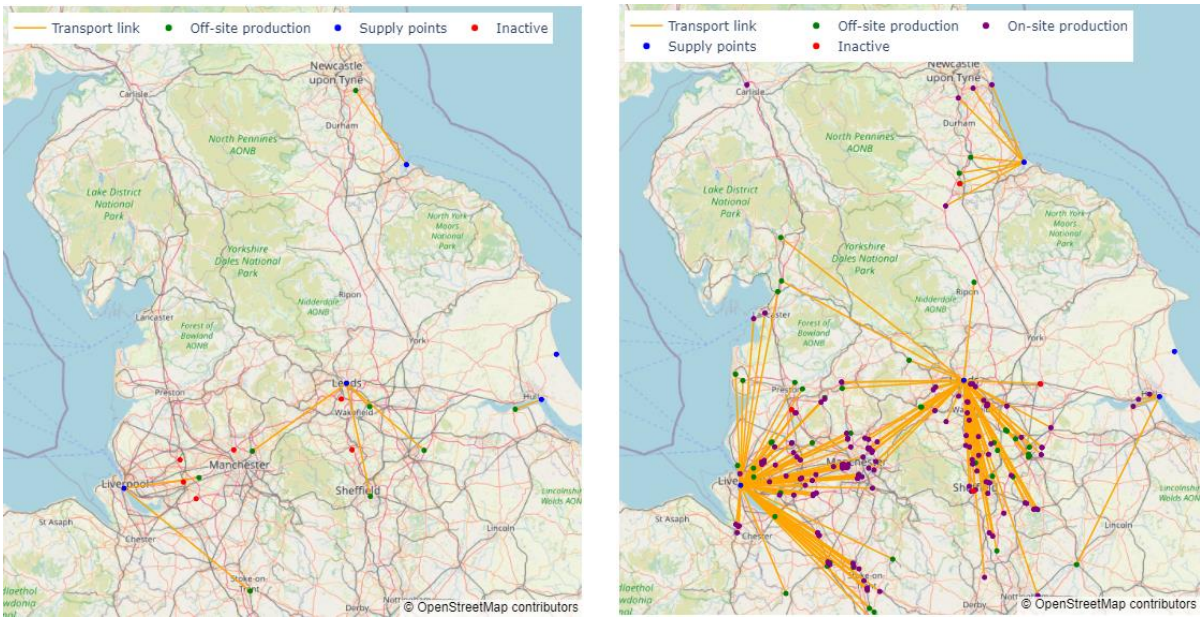

Figure: The optimisation model output for the rollout phase (estimated in 2027) on the left and the mature phase (estimated in 2040) on the right providing a map of the current refuelling sites identified as potential refuelling stations for

hydrogen indicating which are recommended to serve as hydrogen refuelling stations, the type of supply production (i.e. on-site and/or off-site) and the transportation link for off-site supply from the centralised production facilities.

Analysis is performed in calibrating parameters and investigating the on-site and off-site production supply alternatives. It is concluded that the system optimality is limited by the feasible number of tube trailer deliveries per day which suggests an opportunity for alternative delivery methods. In the agent-based model, the trade-off between savings and unserved demand is considered when calibrating the required size of a hydrogen refuelling station. The approaches utilised in the study may contribute to further research relating to the deployment of hydrogen refuelling infrastructure. This may serve to inform and support decisions of policy makers, practitioners, technology providers, energy suppliers and other role-players.