Integration of heat, electricity, and transport: use of curtailed renewable energy using Poolbeg case study

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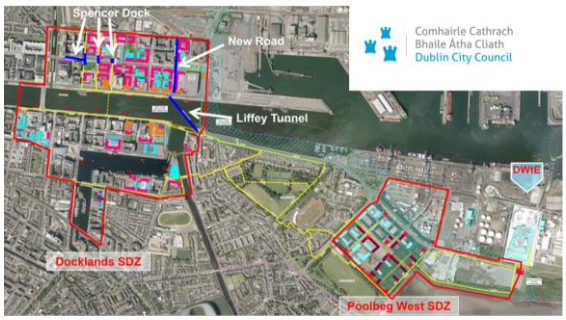
Abstract

This project investigates energy system integration opportunities in Dublin, using the Poolbeg area as a case study. The project's key goal is to examine the potential for energy system benefits from linking separate energy sectors together. Specifically, it considers how to make use of curtailed electricity from offshore wind farms and from the waste-to-energy plant in Poolbeg, while utilising existing and planned energy infrastructure in the area.

Research Outcomes

Upgrades needed for future electricity demand and generation are not fully understood for a net zero energy system. Further work is needed to understand the scale, type, and investment in infrastructure required. Modelling shows average curtailment and oversupply levels to be 6-23% for 2030-2035, and 14-16% for 2040. There are no clear policy measures to address excess renewables on the electricity system for a 2040-time horizon. The priority order of measures to reduce excess renewables has not been defined – this is a key step in future planning. District heat can reduce curtailment by up to 70-86% in 2030 if the national district heat target of 2.7 TWh was achieved. Heat storage for the Dublin District Heating Scheme in Poolbeg is approximately 1% of the cost and uses less than 10% of the land area compared with battery storage. Curtailed electricity could supply 53.2% of heat demand in the Dublin District Heating Scheme by 2030. The Dublin District Heating Scheme could reduce national curtailment by 8.6% in 2040. Further research is needed into electricity grid services that could be provided through thermal storage & district heating, to explore its significant potential. Green hydrogen production can be a future heat source for district heat. This can increase the efficiency of green hydrogen production from 60%-70% to up to 95%. The cost of electricity from offshore wind in Ireland needs to reduce in future for green hydrogen production in Ireland to be competitive with other countries. Green hydrogen can substantially reduce curtailment while increasing renewable energy levels. However, the business model for hydrogen production using solely curtailed wind energy appears to carry a high risk for developers. Modelling an electrolyser located at Poolbeg indicates a levelised cost of hydrogen production in the range of €3.8-7.1/kg, considering a range of operating models for the electrolyser. Dublin-adjacent areas other than Poolbeg may be more favourable for locating hydrogen production due to the complexities of locating such facilities.



Recommendations

A detailed net zero roadmap should be carried out by Government or its agencies, to understand the scale of energy system infrastructure and investment required. This should include a hierarchy of uses for excess / wasted renewable electricity and how this applies across different geographical areas of Ireland. The feasibility of developing large-scale hydrogen storage technologies both onshore and offshore in Ireland, including the East Coast of Ireland should be examined. The opportunities for heat storage to reduce wasted renewable electricity should also be investigated. For example, a cost-benefit analysis on heat source distance from heat demand in a district heat network for the use-cases of heat from wasted electricity, and waste heat from hydrogen electrolysers. This could provide further opportunities for district heating where offshore wind power comes ashore adjacent to urban or town centres. Further research into electricity grid services that could be provided through thermal storage & district heating would also be beneficial. Considerations should include how this could be enabled – particularly for non-traditional actors in electricity market (e.g., district heat companies), with a focus on revenue streams, awareness, and technical & market requirements to facilitate this.