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DECARBONISING HEAT THROUGH ELECTRICITY: COSTS, BENEFITS AND TRADE-OFFS FOR THE IRISH POWER SYSTEM

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Decarbonising heat through electricity: costs, benefits and trade-offs for the Irish power system[1]

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INTRODUCTION

Heat demand in Ireland makes up about 40% of total Irish energy usage, and residential home heating accounts for 25% of energy-related CO_2 emissions. Decarbonisation of the Irish heating sector has been slow to date, with Ireland falling well short of 2020 targets for renewable heat. The Climate Action Plan envisages that this sector will be decarbonised by retrofitting 400,000 existing dwellings to a minimum B2 BER standard and installing 600,000 heatpumps in Irish homes by 2030. Achieving a high usage of renewable electricity generation therefore allows a net decarbonisation of the heating sector.

The impacts for the electricity system of significant electrification of the heating sector have not been examined in detail. Increased electrification will require new generation, new transmission lines and increased storage. Furthermore, different decarbonisation policies, as well as the spatial rollout of heatpumps, will impact on the power system in different ways. This research examines these questions.

METHODS AND RESULTS

The methodology employed in this paper is the Electricity Network and Generation INvEstment (ENGINE) model. The ENGINE model determines the necessary investment in generation and transmission assets for the whole island of Ireland, for different sets of inputs and policy assumptions. In so doing, ENGINE determines the generation and transmission assets required to meet increased electricity demand, a change in the geographic location of energy demands, a given renewable energy target and/or a decarbonisation policy. The investment and

[1] This Bulletin summaries the findings from: Gaur, A.S., Fitiwi, D.S., Lynch, M. and Longoria, G. (2022). Implications of heating sector electrification on the Irish power system in view of the Climate Action Plan. *Energy Policy* Vol. 168, 113136. Available online: https://www.sciencedirect.com/science/article/abs/pii/S0301421522003615

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operation of both generation and transmission assets is determined by ENGINE in a least-cost manner.

In this research, we examine the impact of different levels of electrification, different spatial distributions of electrification, and different electricity decarbonisation policies. In particular, we consider the impacts of meeting 20% and 30% of residential heat demand from heatpumps, and include the costs of retrofitting those dwellings. Regarding their spatial distribution, we consider the impacts of rolling heatpumps out at the same rate across the whole country compared to locating heatpumps in the least-cost locations. Regarding the decarbonisation of the electricity sector, we compare the impacts of meeting a renewable electricity penetration target of 70% by 2030 with a decarbonisation target of reducing emissions to the level that would prevail under 70% renewable electricity. Thus, the same climate target is modelled, in a renewable-specific manner and in a technology-neutral manner.

The results indicate that the new electricity demand from electrified heat requires a significant investment in generation assets, and a small decrease in transmission assets. This suggests that the transmission network can be used more efficiently when electricity demand is more dispersed. The greatest cost increase, however, comes from the retrofit of dwellings, which is far greater than the electricity system costs. Electrified heating allowed a more efficient utilisation of renewable resources, reducing hours of excess electricity supply. Optimising the spatial rollout of heatpumps leads to a small decrease in total costs, with the location of heatpumps driven by the regions with high demand for heat, such as Dublin, rather than by regions with high supply of renewable energy, such as the West Coast. In contrast, the technology-neutral targets saw a far greater reduction in total costs compared to the renewable-focused policy, by relying on a greater investment in carbon capture

POLICY IMPLICATIONS

There are several policy implications of this research. The significant capital cost of retrofitting the existing housing stock, which dominates over the cost of increased generation requirements, may prompt a re-examination of electrification as the primary method of decarbonising the heating sector. The small benefit to electrifying in the cheapest areas may not be sufficiently large to justify concentrating heatpump rollout in one area over another, and so policy-makers may choose to maintain a policy of even spatial rollout of heatpumps given these results. Following on from this result, the fact that the optimal location of heatpumps is driven by areas of high demand for heat, rather than areas of high supply of renewable electricity, is a useful insight for planning sustainable energy communities. Finally, the significant additional cost of a renewables-based decarbonisation policy, to the exclusion of other low-carbon alternatives such as carbon capture and storage, should be taken into consideration if challenges arise in reaching our carbon reduction targets over the next decade.

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