The electricity system impacts of publicly-acceptable renewable energy development[1]

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BACKGROUND AND CONTEXT

Ireland has high renewable electricity targets for 2030, which will be met primarily by wind and photovoltaic (PV) solar power. However, there has been significant public opposition to the development of some renewable energy projects, as well as the enabling grid infrastructure.

This opposition has been observed in other countries across the world. Consequently, several measures to increase community acceptance have been proposed and utilised in various jurisdictions. Such measures include: (i) increasing the setback distance of energy projects, such that they cannot be within a predetermined distance from residences, (ii) limiting the scale of energy projects, by capping their installed capacity at any given location and (iii) increasing self-sufficiency, whereby locally-installed renewable energy projects serve a greater proportion of local electricity demand.

The electricity system development that arises as a result of the policy measures above will potentially deviate from that which would arise under a least-cost policy. However, policy-makers may consider this extra cost to be justified if public opposition is sufficiently reduced. In order to provide evidence on this question, we perform an analysis of the optimal long-run development of the power system, under a development that minimises the cost of the investment, operational and carbon costs of electricity, and under a policy-driven development that limits the installed renewable capacity at each location on the grid. Limiting the capacity at each location on the grid captures the effects of increased setback distances, increased self-sufficiency and decreased scale. We perform the analysis under high and low storage costs scenarios, because the future cost of battery storage exhibits

[1] This Bulletin summaries the findings from: Fitiwi, D., Lynch, M.Á. and Berstch, V. (2020), "Power system impacts of community acceptance policies for renewable energy deployment under storage cost uncertainty", *Renewable Energy*, In Press.

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considerable uncertainty, and increased storage capacity may lead to a significantly altered renewable energy development.

RESULTS

The results indicate that the increase in costs from the policy-driven electricity system development is slight – total costs increase by about 3%. However, the spatial development of energy investment varies considerably. Far more locations see some small energy investment under the policy-driven development, while the least-cost development sees large installations at fewer locations. The transmission system requires more upgrades under the least-cost scenario, as renewable supply must be exported from high generation regions to high demand regions. The policy-driven development sees less demands on the transmission system, as more energy is generated and consumed locally.

The cost of storage makes a considerable difference. High storage costs see higher installations of solar PV installations in the Dublin region. This is because Dublin has a high electricity demand and a poor wind resource, and so when storage is expensive, it is cost-effective to install solar PV to meet renewable energy targets. However, solar PV rollouts in Dublin are substantially reduced under lower storage costs. Instead there is a greater utilisation of wind energy outside of Dublin, facilitated by increased storage. The impacts on the transmission system are also reduced by increased storage development as excess energy supply can be stored at each location and used at a later time, rather than exported via the transmission system to a location experiencing excess demand.

The analysis above was performed for a renewable energy target of 55% in 2030. Increasing this target to 70% by 2030 leads to a cost differential between the least-cost and the policy-driven development of 5%. This suggests that the extra cost of community acceptance policies increases non-linearly as renewable energy itself increases. However, increasing the amount of renewable energy that can be accommodated on the grid at any one time can reduce this cost.

POLICY CONCLUSIONS

There are two main policy conclusions from this work. Firstly, the increased cost of public acceptance policies is relatively small, but the local effects vary significantly. This underlines the importance of spatial modelling in power systems research. Policy makers may consider the increased costs to be justified if costs from public opposition, such as delays to infrastructure development, are sufficiently high.

Secondly, the increased costs from the policy-driven scenario increase as the renewable energy target itself increases. This increase in costs is ultimately borne by consumers, which may in turn fuel opposition to renewable energy development. Therefore, policy-makers should be cognisant of the trade-off from policies that increase both public acceptance and electricity costs in determining the optimal set of renewable energy targets and renewable development policies.

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