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MARKET DESIGN OPTIONS FOR ELECTRICITY MARKETS WITH HIGH VARIABLE RENEWABLE GENERATION

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Market design options for electricity markets with high variable renewable generation[1]

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BACKGROUND

Ireland's climate policy focuses on electrification of heat and transport and decarbonisation of the electricity sector via increases in variable renewable generation (RES-E)[2], such as wind and solar. 70% RES-E is targeted for 2030.

High levels of RES-E present challenges for electricity market design. At present, generation providers earn revenue from energy and capacity markets. Electricity generators sell their electricity in realtime in the energy market. The capacity market remunerates generators for their ability to reliably provide electricity at any hour of the year, whether or not they actually generate electricity.

Renewable generators have limited ability to participate in the capacity market, as their availability is determined by the weather and so they cannot guarantee generation at any hour of the year. RES-E therefore participates almost exclusively in the energy market. This presents several challenges. First, energy market revenues are variable, but RES-E costs are (almost entirely) fixed. Conventional generators, in contrast, have access to both fixed (from the capacity market) and variable (from the energy market) revenue streams. They are therefore better able to match their revenues to their costs. Second, RES-E, when available, displaces generation from fossil fuels, lowering the price of electricity during those time periods. The electricity price is consequently lower, on average, during those hours that RES-E can earn electricity market revenue compared to hours when RES-E is not available to generate. This is known as the *price cannibalisation* effect, and reduces RES-E revenue.

[1] This Bulletin summaries the findings from: Lynch, M., Longoria, G. and Curtis, J.: "Market design options for electricity markets with high variable renewable penetration", *Utilities Policy*, Available online: https://doi.org/10.1016/j.jup.2021.101312

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[2] RES-E refers to "Renewable Energy Sources: Electricity".

MARKET DESIGN OPTIONS

These problems will become more prevalent as RES-E increases. A market redesign that facilitates the unique challenges from high RES-E is therefore advised. In this research, we propose several market redesign options and present a subset of these below:

Adjust the time scale of the electricity market

At present, supply and demand in the electricity market are balanced every hour, with a new price arising each hour. Clearing the market more frequently, at 15 or 5 minute intervals, would give generators greater control over their output and the prices they face. In addition, there would be a decreased requirement to rebalance supply and demand within hours. This would reduce costs and therefore prices faced by consumers.

Split wholesale and retail markets into dispatchable and renewable markets

This proposal splits energy markets into two, for consumers and generators. One market is for energy that is available "on demand" – whenever a consumer wishes to use electricity, it is available, as at present. The other market is for energy "as available" – consumers use electricity from this market when available and curtail their demand otherwise. Consumers can choose whether to purchase energy exclusively from the "on demand" or "as available" market, or from a blend of the two.

This market split allows consumers to shift demand to the flexible "as available" market. This provides opportunities for "smart" appliances that operate under certain conditions (e.g., when wind is high). However, regulation may be required to ensure vulnerable consumers are not forced to excessively curtail their electricity usage due to an inability to afford "on demand" electricity.

Move towards service-type retail contracts

As renewable generation, with high fixed costs and no variable cost, increases, consumers' bill may need to evolve. At present, electricity bills have fixed and variable charges, and so their bill increases as energy usage increases. However, a "service-type" bill, where customers pay a fixed fee for "all you can use" energy, may suit a renewable-based system better.

This option reduces uncertainty for both customers and generators. However, it may undermine energy efficiency incentives, and may also disproportionately impact less affluent and/or vulnerable households.

CONCLUSION

The current electricity market design is unlikely to support the levels of renewable electricity envisaged in the coming decades, at least on an isolated system such as Ireland. Policy makers and regulators should begin to explore options for a redesign now, to maintain reliability and affordability throughout the decarbonisation of the electricity system.

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