Economic Consulting Associates
Viewpoint

Renewable energy's pretty little secret: power market cost reflectivity can handle intermittency

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"Clean energy's dirty secret" was last month's provocative headline in the Economist. Prevailing structures for power market pricing, it claimed, are unfit for purpose in the new world of intermittent, zero marginal cost generation. While the disruption is substantial and some redesign is undoubtedly required, this view greatly underestimates the robustness of cost reflectivity in the current price finding processes.

A capacity-constrained market

The primary point of concern raised in the article is the potential for the near-zero variable cost of wind and solar plants to crash wholesale prices. A theoretical 100% renewables market, it is feared, will practically eliminate revenues.

This fundamentally misunderstands how wholesale energy pricing is formed. Pricing in energy-only markets are set to account not only for fuel costs, but all long-run fixed and operating costs. These may be recovered because when markets become constrained during times of system stress, scarcity rents may be drawn. In thermal-dominated systems the level of available capacity determines the tightness of the constraint and will adjust to a point the long-run marginal cost (LRMC) may be recovered.

As the penetration of wind and solar increases on a system, so do periods of excess capacity, forcing thermal plant to operate at lower load factors. This will concentrate the periods in which these plant must recover costs and so prices may become peakier, but this does not inherently undermine the concept of pricing by kilowatt-hour.

Concern over the ability of wholesale energy markets to fully reflect constraint signals – whether that is due to regulatory uncertainty, differences in commercial and social discount rates used to value outages, the political acceptability of price spikes, or other market frictions and uncertainties – is not new. Consensus is lacking both on the need for dedicated capacity markets to address these concerns and their appropriate structure. Recently, the balance of policymaker views has swung more in favour than against. Increased intermittent generation has encouraged this shift, but is not the only driver and an assessment of the various risks involved and options for addressing them deserves a dedicated article.

A zero marginal cost world

So what happens if with further cost reductions we reach a point where only renewable sources of power exist on the network, backed up by storage to smooth out its intermittency? How will pricing be formed?

In this instance we may move in part from the capacity-constrained model to an

energy-constrained one. This is similar to hydro-dominated systems where capacity may be plentiful but the availability of energy is dependent on water inflows and storage. Pricing is formed effectively through a repeated game that incentivises an efficient level of market entry for long-run cost recovery.

Another example from the energy industry is the GB gas market (dominated by pipelined gas). Here the market is energy-constrained with high fixed costs and low marginal costs. The commodity price is set to recover LRMC and this is underpinned by take-or-pay contracts with limited premium for flexibility; spot prices tend to reflect contract prices (i.e. LRMC).

Pricing against "guaranteed" supply as opposed to kilowatt-hours makes sense for network pricing (as we have previously argued) but not for paying the power providers themselves. Smart meter capabilities may increase the flexibility in pricing structures that can be offered to end consumers, but it seems fanciful that this would stretch to widespread acceptance of unplanned, frequently interruptible power supply.

Imbalance and system operation

Where the impact of wind and solar on market design is much more keenly felt is at the sharp end of the power markets – the real time trades for balancing energy supply and demand and ensuring secure system operation, otherwise known as ancillary service markets. Yet even here, market models already in operation provide most of the cost reflective price signals required.

The GB market and EU Target Model are based on a range of forward markets running to less than an hour ahead of delivery, supplemented by a real-time balancing market for balance responsible parties (generators and load). Late gate closure can minimise forecast error while cost reflective imbalance prices mean those who cause the imbalance are responsible for payment.

In the GB system this cost reflectivity goes a step further still in that the imbalance price calculation integrates operating reserves contracted by the National Grid and flagged as being run within the settlement period for *energy-related* purposes.

The well-known duck curve in California does highlight the potential need for new ancillary markets dedicated to securing the required ramping services (as recently implemented both in the Californian and the mid-continent systems and planned for the new Irish market). Integration of the costs imposed into imbalance pricing to retain cost reflectiveness will need consideration and create additional market complexity, but this remains a minor issue in relation to overall revenues.

The clearest area where changes in technology composition are threatening the cost reflectiveness of electricity markets is those ancillary services provided for *system-related* reasons; namely frequency and voltage control. These costs are currently socialised in most markets through use of system charges.

The drop in system inertia that comes with the increasing penetration of wind and solar plant has repercussions for the rate-of-change-of-frequency experienced on the system when major outages occur. Meanwhile their variability affects the management of ongoing minor frequency deviations from desired levels. These issues are particularly acute in smaller, relatively isolated systems such as Ireland and South Australia.

The introduction of new markets for inertia, fast frequency response and regulation in Ireland, GB and PJM reflects

the growing concerns. Nevertheless, this is a niche area and far from the fundamental restructuring of power market design foreseen in the Economist article.

Focused changes

That the technology changes currently taking place in electricity markets are causing substantial disruption to the business models of many market players is unarguable. This is inevitable when new entrants' technologies render existing assets uneconomic before their costs have been fully recovered, irrespective of whether that change is driven by subsidy or technological change.

Rapid change also affects the ability of markets to find new equilibria around long-run costs and capacity markets may provide some security against this threat having wider repercussions. Meanwhile, the best design for procuring ancillary services to address the new challenges in system operation remains an open and very real issue.

Nevertheless, none of these changes represent the kind of existential threat to the way electricity is priced and paid for that is implied in the Economist article. As evidenced in the gas market, efficient price structures in an energy-constrained market based on long-run costs are not new. There is little reason to believe wholesale pricing for commoditised kilowatt-hours of electricity cannot perform likewise.

Indeed clean energy's "pretty secret" is that under strongly cost reflective markets such as GB it already pays for the overwhelming majority of costs imposed by its intermittent and uncertain nature. Policymaker led changes in market design will be required, but these interventions need to be focused on the true nature of the challenges the sector faces.

Economic Consulting Associates was established in 1997 to provide economic and regulatory consulting services to industry and government. Our senior staff have many years' experience of carrying out economic, market and policy analyses in the electricity, natural gas and water sectors.

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