Briefing

Why now is not the time for locational marginal pricing of electricity

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green alliance...

Summary

The government is considering radical, structural change to electricity markets by introducing new 'locational marginal pricing' (LMP) to reflect the difference in the cost of supplying electricity to different areas.

This risks slowing down investment in necessary renewables construction and grid reinforcement. Our assessment is this would jeopardise expected energy transition savings which are up to nine times more than any benefits that could arise from locational electricity pricing.

Instead, we recommend exercising more caution and implementing alternatives which would improve the electricity system's efficiency now, without risk to investment.

Locational marginal pricing (LMP)

In places like Scotland, which have high renewable generation but low demand, using electricity generated locally is cheaper than transporting it across the country. But power system pricing does not reflect these variations. Instead, the cost of the grid is borne equally across the country. Shifting to LMP would add the cost of network congestion and transmission losses to the wholesale price of electricity at any given location, leading to different prices in different places at different times. The theory is this would drive a shift in the location of demand and generation to minimise the cost of transporting electricity.

The rationale for LMP is clear: the UK is seeing rising grid constraint management costs. Today's transmission network is not always able to transport electricity from areas of surplus to where it is needed, and the transfer of electricity between certain areas has become 'congested'. As a result, renewable generators, often in Scotland, are sometimes paid to stop generating, while fossil fuel generators, often in England, are simultaneously paid to turn up their output. These are known as 'constraint management costs'.

Although LMP is responding to this problem, there are good reasons why it may not solve it.

LMP risks stalling the transition to renewables

An electricity system dominated by cheap renewables will be the most cost effective system.[1] To achieve it, vastly greater renewable capacity and low carbon flexible generation needs to be built at pace.[2] Action to minimise the cost of transmission should not be allowed to get in the way.

Wind and solar generation constitute around 30 per cent of the UK's electricity mix, but this needs to grow to around 80 per cent of an expanded electricity supply by 2035, which will require a boom in investment.[3,4] Savings to be derived from accelerating renewables deployment to this level are between five and nine times greater than might be achieved by LMP.[5]

RenewableUK has highlighted that LMP would take years to implement.[6] The Canadian province of Ontario started moving to LMP in 2019 but has still not completed the process in 2023. Energy UK has warned about the potential impact of this on investor confidence, as it would take time for developers to fully understand the impacts of such a widespread change to electricity markets and alter their financial planning accordingly.[7] Citizens Advice warns that huge political and institutional bandwidths are required to implement LMP successfully. [8]

This major risk to the UK's clean energy plans won't reassure investors at a time of rising interest rates and inflationary pressures on supply chains.[9] The latest contract for difference auction round, which secured no provision for new offshore wind developments, demonstrates that an investment hiatus is a real risk.[10]

Furthermore, the benefits of LMP do not hold up well to scrutiny, as we explain below.[11]

Claims made about LMP benefits

Claim one:
It is an incentive for electricity generators to choose optimal locations

It is claimed that LMP would lead to electricity generators moving to the best locations for the system, ie areas of high demand, where they can command higher prices.[12] But, for two reasons, this is unlikely.

First, other drivers affecting the choice of location are likely to be stronger than LMP. Port proximity, solar, wind, wave and tidal resource availability, planning constraints and access to grid connections are more likely to trump even substantial differences in locational price signals.

Second, LMP provides only short term dispatch signals which are difficult to predict several years ahead when decisions about where to build would need to be made.

Regen suggests that only the siting of large scale solar may be influenced by locational pricing.[13] Energy storage facilities might also be encouraged to locate at pinch points in the network where they could help lessen congestion.

But there are other, faster and less disruptive ways to achieve the same outcome. Updating Transmission Network Use of System (TNUoS) charges or introducing a location dependent contracts for difference (CfD) strike price could have the same effect. Experts have also called for more transparent forecasting of expected future constraints, which would allow energy storage developers and flexibility services to react in ways that would reduce them.[14]

Claim two:
It leads to better siting of energy demand

It is believed that LMP could lead to better location decisions for energy demand. But this is also unlikely.

Households consume 30 per cent of the electricity generated in the UK, but most existing LMP markets in other countries shield individual consumers from locational signals.[15] The location of household demand is, in any case, largely inelastic. Responsiveness to price signals is only really possible in decisions around the siting of new housing and, even then, will only be one of many factors influencing siting decisions, with planning considerations and access to local amenities likely to be more important.

Of the remaining 70 per cent of electricity used by business and industry, only businesses whose costs are dominated by the price of electricity, such as data centres and gigafactories, might consider their location on this basis. These uses are unlikely to cover more than 2.4GW of demand, which is around 1.5 per cent of total electricity demand expected in 2035.[16]

Claim three:
LMP will help to optimise energy dispatch

Electricity generation patterns in Kent (where the source is mostly solar) can be different to Scotland (where the source is mostly wind), so the optimal time to charge an electric vehicle in each area may differ. It is believed that locational price signals could improve system efficiency in relation to these differences.

However, while this may be true, the effect will be small. On most days, there will be a need to transmit most of the wind generated power from Scotland and the North Sea southwards, so the transmission network will still need to be built and consumers will be expected to pay for this through their bills. With adequate transmission infrastructure, locational pricing might avoid some transmission losses, which are now only around two per cent, for part of the day on some days.[17]

What are the alternatives?

There is no debate about the urgent need to accelerate the expansion of grid infrastructure. The government's Electricity Networks Commissioner has shown how this could be done, but it will still take time.[18]

In the near term, there are alternatives to LMP which would achieve meaningful reductions in constraint management costs sooner, including:[19]

- Accelerating the deployment of energy storage.
- Increasing transparency around expected future constraints.
- Encouraging the development of new regional flexibility markets covering the most congested parts of the transmission network.
- Speeding up the digitalisation and automation of energy system operator control room functions.

What should happen now?

To stay on the right track to bring consumer energy prices down and meet climate targets, the energy transition must proceed at an unprecedented pace. The imperative is to invest in both generation and infrastructure. However, investment in doing so is currently being tempted away from the UK. For instance, to the US through new incentives under the Inflation Reduction Act, or to the EU via the European Green Deal. Given its limited benefits, now is not the time to introduce LMP and risk driving investment away.

To avoid this, we recommend the following:

- The government's Review of Electricity Market Arrangements (REMA) should omit locational marginal pricing from its assessment of options.
- REMA should prioritise other ways to send locational signals to the electricity market, such as reformed TNUoS charges.
- Ofgem should encourage network operators to expand and upgrade their networks as soon as possible to relieve congestion.
- The changes we recommend above to energy system operator activity and the creation of flexibility markets should be implemented.
- The provision of more energy storage and digitalisation should be accelerated to relieve congestion costs.

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Endnotes

[1] Climate Change Committee, March 2023, *Delivering a reliable decarbonised power system*
[2] See Green Alliance's January 2023 briefing 'The building blocks of a secure 2035 zero carbon power system'
[3] 'Digest of UK energy statistics' (DUKES), chapter 5: 'Electricity', Department for Energy Security and Net Zero
[4] Green Alliance, January 2023, op cit
[5] Without accelerated renewables deployment, power in future is likely to continue to be supplied by gas, biomass and nuclear power, at an estimated cost of around £125/MWh at current prices (based on existing contracts for difference (CfD) or Regulated Asset Base (RAB) contracts and volatile gas prices). The cost of cheap wind and solar electricity in recent CfD auctions has been below £55/MWh (at 2012 prices) and is unlikely to increase much beyond this. Accounting for inflation, which turns £55 (2012) into £75 (2023) according to the Bank of England inflation calculator, and an additional £25/MWh to balance the variable nature of renewables, as suggested by the Climate Change Committee in its sixth carbon budget, we can expect cheap renewables to save at least £25 for each MWh generated. This compares to ambitious estimates of the savings that introducing LMP might provide, which could be in the region of £1.7-2.1 billion per year by 2035, according to modelling by FTI Consulting for Ofgem's 'Locational Pricing Assessment'. In a system which might require 400-600TWh of generation in 2035, these costs equate to around £2.90-£5.20/MWh. Thus, every MWh generated by renewables, even when accounting for balancing costs, will save approximately five to nine times more than the potential savings offered by LMP.
[6] Cornwall Insight for RenewableUK, August 2023 'REMA: reform to support mass low carbon power'
[7] Energy UK, June 2022, 'The future of the UK power market'
[8] E Graham, A Manning and R Fuller, June 2023, 'It's all about location', Citizens Advice
[9] Vattenfall recently announced it would stop work on the large Norfolk Boreas offshore windfarm.
[10] *Sky News*, 7 September 2023, 'Offshore wind power warning as government auction flops'
[11] M G Pollitt, July 2023, *Locational marginal prices (LMPs) for electricity in Europe? The untold story,* University of Cambridge Energy Policy Research Group
[12] S Gill, C MacIver and K Bell, February 2023, *Exploring market change in the GB electricity system: the potential impact of locational marginal pricing*, University of Strathclyde
[13] J Gowdy, June 2022, 'Wild Texas wind', Regen
[14] J Gowdy and B Bardsley, August 2022, 'Seven solutions to the rising cost of transmission network constraint management', Regen
[15] 'Digest of UK energy statistics' (DUKES), op cit
[16] Data centres are expected to demand up to 1,600MW in 2030, according to: BloombergNEF, Statkraft and Eaton, October 2021, 'Data centers and decarbonization: unlocking flexibility in Europe's data centers'. Gigafactories are expected to require 100MW each, according to: *Computer World*, 9 September 2014, 'If Tesla's gigafactory can run on 100% renewable energy, why can't others?'. The Labour Party have pledged to build eight gigafactories, which might total 800MW. Altogether, this would be 2,400MW of demand which might be strongly influenced by locational pricing.
[17] losses.ukpowernetworks.co.uk
[18] N Winser, August 2023, 'Accelerating electricity transmission network deployment: Electricity Networks Commissioner's recommendations', Department for Energy Security and Net Zero
[19] J Gowdy and B Bardsley, op cit; and J Gowdy, S Gill and E Brundrett, July 2023, 'Improving locational signals in the GB electricity markets', Regen