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Locational Marginal Prices (LMPs) for Electricity in Europe? The Untold Story

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Locational Marginal Prices (LMPs) for electricity are real time prices which vary by node in the electricity system, where a node represents the connection between two or more circuits. In the case of LMPs nodes are usually in the higher voltage system at important locations such as points of connection of generators or transformers to lower voltage networks serving demand customers, but potentially at other potentially important network hubs which may be used to switch circuits and thereby control the flow of power across the network. The LMP is calculated as the shadow value of the power at that location, arising from a linearization of an optimization program which reflects both the area wide price of the power and the presence of constraints and energy losses on the power flow. LMPs can be volatile and hence organized markets offer financial transmission rights (FTRs) as a way a facilitating hedging of locational prices.

Early examples of nodal pricing are Chile and New Zealand. The most famous market making use of nodal pricing is PJM in the eastern US. LMPs have gradually spread to other markets across the US and South America. Nodal pricing was introduced into PJM in 1998. Between 1998 and 2014 nodal pricing was introduced across the organized markets in the US. Europe has noticeably not so far adopted nodal pricing, even though countries such as Poland have proposed to do so, and Great Britain is actively considering it.

In this paper we explore whether and how European countries should adopt LMPs. While the theory behind LMPs is strong, the evidence on their operational impact is much weaker. Many choices remain in terms of actual implementation and they would need to be implemented carefully in Europe. We consider the concept of locational prices and their use in economics. We go on to look at nodal prices in electricity in theory and practice. Next we discuss key unanswered questions about nodal pricing. Then we consider alternative actions to improve locational signals in the electricity system in Europe, including via the smarter use of LMPs.

We conclude that the benefits of LMPs in the European context are poorly understood and modelled. The US literature on the economic effects of nodal pricing is surprisingly thin and

focused on the benefits of improving the efficiency of short run dispatch. The evidence is that markets for financial transmission rights (FTRs) do not work well and that they are a highly imperfect and expensive way to mitigate the effects of exposure to LMPs. The empirical literature does not answer the two bigger economic questions which need to be asked which are: what is the impact of nodal pricing on investment incentives and what is the overall impact of nodal pricing on market power?

Long term generation and network planning are essential for the delivery of net zero. Nodal pricing is a side-show in this. The calculation of shadow nodal prices to guide short run operation of the network and to guide contracting with providers of network capacity products could be useful and system operators should do cost benefit analyses on how such a use of shadow nodal prices would improve short run operational decisions. An obvious use of shadow nodal prices is in network optimization by the system operator and in providing transparency on where constraints are around the network. In Great Britain this will allow the Future System Operator (FSO) and distribution system operators (DSOs) to better manage the network in real time, particularly with respect to congestion and losses. This could suggest network reconfigurations to increase effective capacity or more effective procurement for constraint management. The separate exposure of network users to marginal losses could provide some incentives to more efficient use of the network, without moving to full nodal pricing, while providing a fairer allocation of losses costs.

There are clearly large benefits of moving to more differentiation in energy price determination and in transmission use of system charges (TNUoS). In Great Britain TNUoS approximate to long-run zonal marginal costs but are fixed from year to year (and yet volatile and difficult to predict) and give poor short-run operational signals. There may therefore be benefits in enhanced use of real time pricing elements in TNUoS. Large benefits could come from siting interconnectors better to reflect network constraints. A significant benefit of nodal pricing is the reallocation of property rights to firm connection away from generators in export constrained zones. Changes to network access property rights are therefore likely to bring major benefits to ultimate electricity users in the future, relative to the current arrangements, through reduced network congestion, redispatch payments and relative system size. The system operator should make more use of control contracts to enhance responsiveness with respect to price.

The discussion on LMPs highlights the central importance of getting long-run planning around generation and transmission capacity right on the road to net zero. What is required is careful modelling of system to inform the indicative planning of the roll out of renewables. This will signal how costs might evolve and model large scale power flows. This will, for example, suggest the size and landing points of offshore wind. TNUoS charges should reflect the relative long-term value of location.

Interestingly the European Commission has recently considered and rejected (for now) the introduction of nodal pricing in its review of electricity market design. LMPs would seem to provide one way forward for the current overly large bidding zones within the European single market area, it is not either the obvious or best way forward for European electricity market design at the present time.

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