

## 9. Conclusion

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In the evolution of electricity markets in Europe, day-ahead markets have received most attention. It took a long time to integrate these markets, but the process is almost complete. What was considered impossible at the start has been achieved. Intraday markets have been slower in their development, but they are becoming more important with the transition to renewable energy. In balancing markets, the definition of standard products and the creation of European platforms to exchange these products across borders is a relatively new ambition, but much has been achieved in a relatively short time. Of course, the devil is in the details, so implementation in the coming years will need to be closely monitored.

Looking back, most of the market integration process so far has required horizontal coordination between transmission system operators in different countries. Transmission constraints were first managed by defining transmission rights and organizing separate markets for these rights. The constraints were then integrated into wholesale markets and balancing markets because this proved to be the best approach. The calculation of transmission constraints has also been reorganized. The main open issues are the availability of transmission capacity across timeframes and the definition of bidding zones. We currently have large bidding zones with structural congestion inside them, and changing them is a sensitive topic.

Looking forward, vertical coordination between transmission and distribution system operators is becoming more important, and this coordination process has only just started. Distribution network constraints have always been avoided by (over-)investing in distribution networks. This approach is becoming too expensive due to the integration of wind, solar, electric vehicles and heat pumps in distribution grids. The trade-off between distribution grid expansion and using flexibility to reduce the need for investment is one of the main challenges. Flexibility can come from smart charging of electric vehicles and batteries, smart heating of homes and the use of many other smart appliances.

To allow for coordination between all the resources at different voltage levels, this flexibility deep inside the grid needs to be priced efficiently. Academics are already thinking of wholesale and balancing markets that incorporate distribution network constraints to produce distribution locational marginal prices. Practitioners in Europe currently do not consider this to be feasible. Other solutions are favoured, such as flexibility markets, smart connection agreements and distribution tariff reforms. We know from experience that these solutions can help, but they have their limitations. It seems inevitable that we will go in the direction of DLMP. The question is how long it will take.