INDEPENDENT AGGREGATION IN THE NORDIC DAY-AHEAD MARKET: POTENTIAL IMPACT OF DIFFERENT SUPPLIER COMPENSATION MECHANISMS

Kārlis Baltputnis, Riga Technical University, +371 20 061 928, karlis.baltputnis@rtu.lv
Tim Schittekatte, Florence School of Regulation, +39 55 4685 875, tim.schittekatte@eui.eu
Zane Broka, Riga Technical University, +371 29 274 626, zane.broka@rtu.lv

Overview

The adoption of the Electricity Directive (EU 2019/944) mandated the European Union (EU) Member States (MS) to transpose provisions enabling the participation of Demand Response (DR) via Independent Aggregators (IAs) in all organised electricity markets. IAs have been defined in Art. 2 (19) of the Directive (EU) 2019/944 as *«a market participant engaged in aggregation who is not affiliated to the customer's supplier».* Even though the IA's activities can be expected to bring benefits (in the form of reduced electricity costs), the suppliers whose consumers have contracted with IAs can be confronted with foregone revenues due to the actions of the independent aggregator (Alba et al., 2021). To solve this issue, a compensation payment has been proposed in many EU MSs; however, there are several ways how that can be implemented. For an overview, please consult Reif et al. (2021).

In light of this issue, this study quantifies the potential effects of IA participation in the Nordic region under different implementations of the compensation mechanisms for the suppliers. We focus on the impact of the compensation mechanism on the IA's profitability, the impact on wholesale prices, the total compensation paid to the suppliers, and, finally, the net benefit due to the introduction of IAs. To achieve this, historical supply and demand curve data from the Nordic region is used to simulate the market clearing (limited to the system price) under varying costs and volumes of DR via IAs.

Methods

The assessment of the potential impact of additional DR on the day-ahead price in the Nordic region is carried out performing simplified simulations of the market clearing. The methodology consists of two steps.

First, the actual aggregated supply and demand curves for each hourly trading interval of 2018, published by the leading electricity market operator in the region (Nord Pool), are used for identifying the original (i.e. historic) Nordic system price. This is achieved employing a curve intersection identification algorithm. The quality of the published data in conjunction with the algorithm selected allows for a satisfactory accuracy in the estimation of the hourly system price. Even though in 11.64% of the hours the calculated price differs from the original one, the annual average, median and standard deviation for the actual and reproduced prices are equal (to two significant figures). Moreover, for only 1.44% of the hours the error exceeds 0.02 €/MWh. These 126 hours with a larger difference are excluded from further consideration.

The second step involves recalculation of the system price for each considered market time unit with additional DR bids from the IAs entered in the supply curve. To study the impacts of different options on how to source the compensation payments for the negatively impacted suppliers, two extreme cases are considered – the compensation is fully socialised (e.g. paid by electricity consumers via network charges) or fully paid by the IAs themselves. In the second case, the expected compensation is priced in the IA bids. Additionally, options in between these two can be further explored. The calculations for the year in hourly resolution are repeated for both compensation mechanisms by varying two important parameters of the presumed IAs: the DR activation cost (10…80 €/MWh) and the total maximum volume of DR that can be bid in the market (0…10 GW). The new market clearing price, volume and the amount of DR successfully sold at each hour of the year is identified by finding the new curve intersection point. The added DR bids invariably cause market clearing price reduction, unless the marginal cost of IA bids is higher than the original price.

Afterwards, post-processing of the results is performed to calculate other parameters of interest per run. Each run is characterised by the implemented compensation mechanism, activation costs of DR, and DR volume bid into the market. The parameters of interest include both hourly and summarised values for the day-ahead system price reduction, electricity purchase cost reduction (from the day-ahead market), the IA's profit, compensation payments, and the resulting net consumer benefits. In case the IAs pay the compensation themselves, the net benefits equal the difference between the electricity purchase cost reduction and DR activation costs. In case the compensation is socialised, the resulting net benefit equals the electricity purchase cost reduction minus the socialised compensation payments and the DR activation costs. As an additional sensitivity, different ways to calculate the exact compensation payment, independently of who pays the compensation, are used.

Results

Evidently, if the compensation is socialised, the IA bids can be expected to be accepted more often than in the case when they have to pay the compensation themselves. This is primarily because of the foreseen compensation being priced in the DR bids. As an illustration, in a case when the compensation cost is equal to the average annual original day-ahead price (43.99 €/MWh), IA offer with the maximum volume of 200 MW and activation cost of 10 €/MWh has expectation of acceptance for 99.35% of the theoretical maximum if the compensation is socialised, but for only 11.66% if it is fully imposed on the IAs. Moreover, for the latter compensation mechanism any further increase of the DR activation cost causes rapidly declining IA activity (e.g. to 1.49% if the cost is 20 €/MWh, etc.).

Another interesting key difference which can be observed when comparing both compensation payment mechanisms is that, with the second option of allocating all compensation costs to the IAs, increasing volumes of DR bid in the market can lead to IA profitability reduction to zero within realistic DR volumes. While an IA profit cannibalisation effect can also be observed in the case with a socialised compensation, the volumes required to drive it down to zero are very (unrealistically) high, except for activation cost assumptions above 40 €/MWh. This is because of the fact that, in the case of socialised compensation payments, for the IA profitability to reach nearly 0 € per MWh of energy bid, the DR bids would have to succeed in reducing the market price down to the DR activation costs during all hours for which the original price was higher than the DR activation costs.

Our most important result is the comparison of the net benefits under the two compensation mechanisms. Figure 1 showcases first results of the net benefit obtainable with varied assumptions on the DR costs and volumes. In both charts, the benefits are expressed per MWh of the total yearly volume of energy traded. Note, in the case that all compensation is paid by the IAs, DR bids with activation costs above 50 €/MWh are rarely accepted and therefore not shown on the chart. With socialised compensation, the net benefit continuously increases with growing DR volumes offered by IAs, but only if the DR is relatively cheap (10…20 €/MWh). When the activation cost is in the medium range (30…50 €/MWh), the net benefit can turn negative with growing DR penetration, implying that socialisation can lead to a too high stimulus for IAs. But, with higher activation cost, increased IA bid volumes reach saturation (i.e. no more accepted) before the net benefit turns negative. On the other hand, with the IAs having to pay the compensation themselves, the net benefit never becomes negative (by definition). In contrast, for cheap DR, the net benefit is smaller than in the first case with a fully socialised compensation payment.

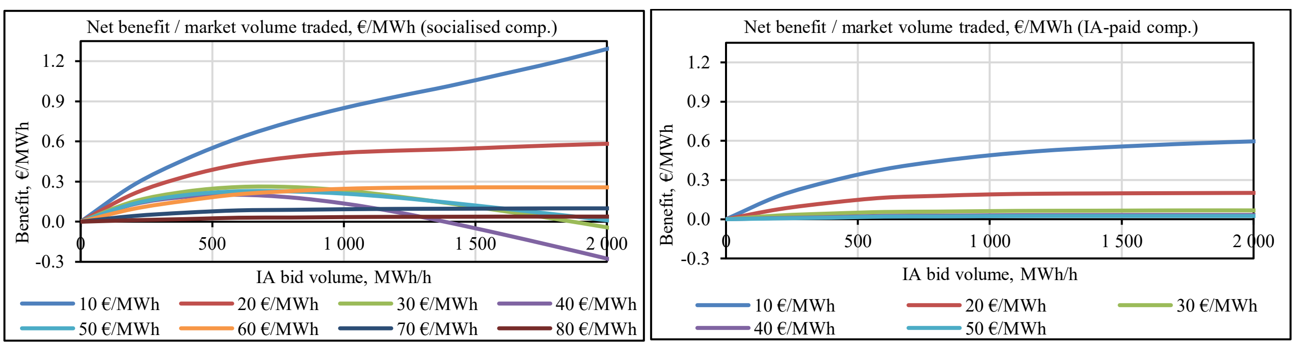

Figure 1. Net benefit per unit of market volume with varied DR bid and activation cost, case of socialised (left) and IA-paid compensation (right)

Conclusions

It can be seen from the initial results that direct bidding of DR in the day-ahead market via independent aggregators has the potential to bring benefits to the electricity consumers in the form of reduced electricity costs. Moreover, if the DR resources are cheap, the simulated benefits are overall positive even if the consumers have to pay a premium in their energy bills to source the compensation to suppliers impacted by IAs' actions. On the other hand, if the IAs have to pay the compensation themselves, this severely reduces not only their business case but also the short-term benefits they might bring to the consumers. However, initial results show that in case of a socialised compensation it is also possible to over-incentivise IAs, creating a negative net benefit. The results depend on the DR activation costs. Importantly, also the possible distortion of competition due to implicitly subsidising IAs needs to be investigated deeper. These results are preliminary, future analysis is expected to enrich the results and conclusions.

References

Alba, J.J., Vereda, C., Barquín, J., Moreda, E., 2021. Market design and regulation to encourage demand aggregation and participation in European energy markets, in: Sioshansi, F.P. (Ed.), Variable Generation, Flexible Demand. Academic Press, pp. 393–410.

Reif, V., Nouicer, A., Schittekatte, T., Deschamps, V., Meeus, L., 2021. Report on the Foundations for the adoption of New Network Codes 1. Deliverable 9.12 for the INTERRFACE H2020 project.