# Zonal market coupling in Europe – Flow-based capacity allocation with integrated redispatch

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## Overview

With the introduction of the Flow-based capacity allocation, an improved representation of physical transmission constraints has been realized in European electricity markets. However, there has been debate about an insufficient level of cross-border capacity, which led to the introduction of so called minimum remaining available margins (minRAM) to increase commercial capacities and cross-border trade.

To further increase the capacity domain given to the market, Transmission System Operators contemplate the integration of costly remedial actions into the market clearing algorithm. The basic idea is that in case a critical network element (CNE) limits cross-border exchange, costly redispatching measures would be considered to increase the remaining available margin on this line. Based on a multi-stage optimization approach covering capacity calculation and allocation as well as optimization of redispatching measures we assess the effects of this new element.

Preliminary results show that compared to a reference case without capacity increasing measures, making redispatch potential available to the market (integrated redispatch) reduces the total cost across market clearing and redispatch. While comparisons show minRAM to be more effective in reducing zonal costs, the total savings when including the necessary redispatch are higher when using integrated redispatch.

## Methods

The analysis is based on a multi-stage optimization approach covering capacity calculation and allocation as well as optimization of redispatching measures. The proposed further development is compared with three cases, i.e. nodal pricing, the CORE[1] FBMC as implemented today, and CORE FBMC with minRAM. The objective function minimizes variable generation costs subject to constraints like generation capacities and system balance. Consequently, the considered cases differ with respect to the representation of transmission constraints within the market clearing which are either based on node-to-node or zone-to-zone sensitivities. For the FBMC with integrated redispatch both types of sensitivities are combined. As under today's CORE FBMC, a change in the zonal net position is translated into a changed flow on a CNE using zone-to-zone sensitivities. In case a CNE is congested and limits cross-border exchange, redispatch (potential) can be activated and is translated into a reduced flow on the CNE using node-to-node sensitivities. Further constraints like balanced redispatch amounts and potential redispatching measures are defined.

## Results

The results reveal a decrease of market clearing costs for the FBMC with integrated redispatch as binding transmission constraints are relaxed. Consequently, net exports of congested market zones, e.g. Germany, can be increased leading to a higher price convergence across the CWE region. However, the decrease of market clearing costs comes at additional costs during the redispatch stage as the changed dispatch during the zonal stage causes inefficiencies at the later stage. Nevertheless, overall costs can be decreased even though the costs of the "first best solution", i.e. nodal pricing, cannot be achieved. Compared to minRAM, which increases capacities available to the market via a different method, the total system cost savings using integrated redispatch are higher. While minRAM achieves higher zonal cost savings, these are almost completely outweighed by increased redispatching costs.

[1] CWE + CEE

## Conclusions

From our preliminary results we conclude that integrating redispatch potential into the market clearing stage decreases overall system costs. Compared to minRAM, the approach seems to strike a more advantageous balance between enabling more trade while keeping redispatching costs at a level where they do not offset the savings achieved in the market. Further calculations are underway to estimate the impact of combining minRAM and integrated redispatch.