

Day-ahead market coupling

DOCUMENTS

[Euphemia Public Description – 18.12.2025](#)

THE THEORY OF THE MARKET COUPLING

HUPX is the operator of the Hungarian spot electricity market and operates as a NEMO (Nominated Electricity Market Operator) with a license issued by MEKH (Hungarian Energy and Public Utility Regulatory Authority). HUPX cooperates with other European NEMOs and TSOs (Transmission System Operators) to achieve SDAC (Single Day-Ahead Coupling) and SIDC (Single Intraday Coupling) designated by the European Commission in Regulation 2015/1222 (Capacity Allocation and Congestion Management, CACM regulation) of 24th of July 2015.

SDAC is an initiative between NEMOs and TSOs that, according to the CACM Regulation, allows cross-border trade across Europe through implicit capacity auctions for the day-ahead electricity supply.

The primary purpose of market coupling is to ensure deeper integration of regional electricity markets. Integration also serves national and international interests, as it provides higher security of supply and several benefits for consumers and traders.

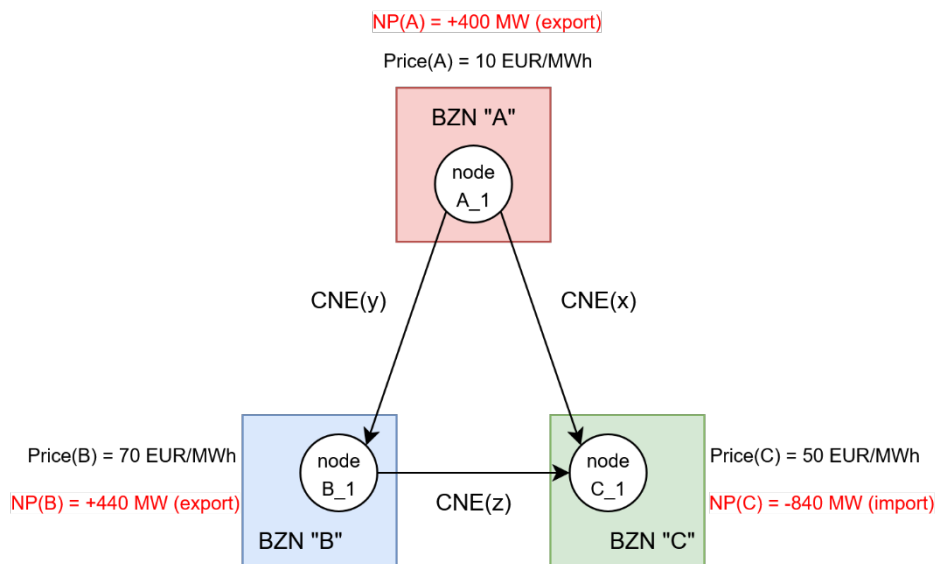
Before the introduction of market coupling, cross-border capacity and electricity had to be purchased separately. This meant that as the first step, market participants had to reserve cross-border capacity and during the second step the capacity could be used to transport the purchased electricity. Market coupling uses implicit auctions, in which market participants do not receive cross-border capacity allocations individually, they have to submit bids to the stock exchange for electricity. Then, during the price calculation process, power exchanges take into account the available cross-border capacity between coupled bidding zones in order to calculate prices that ensure the highest social welfare to European consumers and producers.

European market coupling is a robust solution that allows cross-border trading, increases competition, market efficiency and security of supply while ensuring regulatory harmonization. Market coupling promotes price convergence between regions. In practice, this usually means that energy from low-price areas flows to high-price areas until all available cross-zonal capacity is fully utilized and bottlenecks appear. In this simple example below, price convergence can be achieved between the two bidding zones: the price of the Hungarian market (left) decreases, while the price of the neighbour market (right) increases after market coupling. The traded quantity increases for both markets.

1. Figure: Price convergence between regions in an ATC model

In the flow-based (FB) network model currently in use, energy can flow “non-intuitively” from a higher price bidding zone to a lower price bidding zone. This can happen in some cases when a non-intuitive flow frees up the capacity of some other network element, which then enables an even higher, “more precious” flow from a low-price

zone to a high price zone. In the example below, highest price zone "B" is exporting, because this relieves the congestion on another network element, thus allowing more exports from the cheapest zone "A".



CNE name	PTDF(A)	PTDF(B)	PTDF(C)	RAM	flows
x	0,7	-0,6	-0,1	100	100
y	0,2	0,5	-0,7	1200	888
z	0,2	-0,1	-0,1	500	120

Figure 2 - Simplified FB model with zone-to-slack PTDF matrix

THE HISTORY OF SDAC

OVERVIEW OF THE FIRST MARKET COUPLING PROJECTS IN EUROPE

The beginnings of European market coupling go back to 1993, when a common spot market was introduced between Norway and Sweden. This coupling was extended in 1998 by the addition of Finland and later in 1999 and 2000 when the West and East Danish regions joined.¹

In Western Europe, the market coupling started back in 2006, when the first transnational merger took place. Belgium, France and the Netherlands (Trilateral Market Coupling, TMC) coupled their day-ahead markets in order to optimize cross-border transmission capacity and increase market liquidity. Germany and Luxembourg joined the TMC in 2010 and created the Market Coupling Western Europe (CWE).²

In 2007, a bilateral market splitting took place between Portugal and Spain (SWE, Southwest Europe), creating an integrated market between the two countries called MIBEL.

CZ-SK-HU MARKET COUPLING

Since 30th of May 2011, when the parties signed the Declaration of intent on the planned coupling of the Czech-Slovakian-Hungarian day-ahead electricity markets, continuous work and serious efforts have been required from all parties concerned (Nominated Electricity Market Operators, Transmission System Operators and National Regulatory Authorities) to accomplish the market coupling Go Live on the first trading day of 11th of September 2012 (the first delivery day of 12th of September 2012). HUPX Ltd. worked as project manager in the implementation process of the coupling, the company acted proactively so that the initiative would start smoothly at the beginning of September, as planned.

The Czech-Slovakian-Hungarian day-ahead market coupling was based on implicit auctions. During the result calculation, the Cosmos algorithm took into account the cross-border capacity available for the given day and hour as a strict limiting parameter, the value of which could not be exceeded by the amount of cross-border flow. The Czech-Slovakian-Hungarian market coupling also ensured the possibility of efficient connection to the MRC region. The CZ-SK-HU market coupling was a foresight and significant initiative for the full coupling of European markets.

PRICE COUPLING OF REGIONS (PCR) AND MULTI REGIONAL COUPLING (MRC)

In 2013, Austria joined the CWE group and began to link its market with other Western European markets. In 2014, a total of 15 European countries coupled their markets, including the Baltic States, Great Britain and Poland in addition to CWE and Scandinavian countries.³ This was a major milestone for European market integration. This was the first use of the pan-European Price Coupling of Regions (PCR) solution for the simultaneous calculation of market prices and flows on interconnectors, based on the Euphemia algorithm.⁴

¹ Market Coupling Handbook p.34

² <https://www.next-kraftwerke.com/knowledge/market-coupling>

³ <https://www.next-kraftwerke.com/knowledge/market-coupling>

⁴ Market Coupling Handbook p.34

The coupling was later extended to SWE countries in May 2014 and Italy in February 2015 thus creating the Multi-Regional Coupling (MRC) area. Slovenia joined MRC in 2016, while Croatia was coupled in June 2018 and Greece at the end of 2020. Bulgaria was coupled in May 2021.

In May 2015, the calculation of cross-border capacity in CWE switched to flow-based market coupling (FBMC).

THE CZ-SK-HU-RO MARKET COUPLING (4M MC)

The project was launched in August 2013 with the purpose of extending the CZ-SK-HU market coupling to Romania and implementing the PCR (Price Coupling of Regions) solution. After all parties involved had already applied the PCR solution, on 19th of November 2014, the Czech, Slovak, Hungarian and Romanian stock exchanges, as well as the TSOs and NRAs, started the day-ahead coupling (4M MC) operation. The 4M MC is an ATC-based day-ahead implicit allocation procedure that seeks the highest possible compatibility with the EU target model.

The Go Live launch took place on 19th of November 2014, after successful market participant tests and acceptance tests, as well as final regulatory approval, another milestone in the execution of a single European day-ahead electricity market.

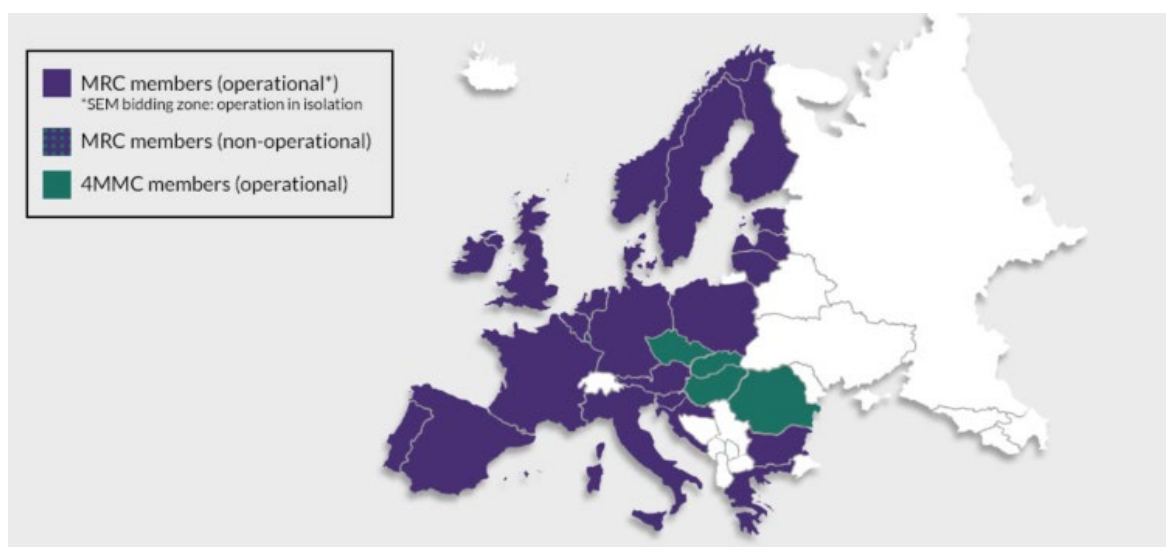


Figure: MRC and 4M MC members in SDAC during spring 2021 (before ICP Go Live)

INTERIM COUPLING PROJECT (ICP)

On 21st of December 2018, the National Regulatory Authorities of Austria, Germany, Poland and the 4M MC countries (Czech Republic, Hungary, Romania, and Slovakia) initiated the implementation of the NTC-based market coupling project between these countries, i.e. the Interim Coupling Project. Following the finalization of the High-Level Market Design by the DE-AT-PL-4MMC countries –the participants of Interim Coupling Project- one meeting was held in Budapest on 22nd of May 2019 by NRAs, TSOs and NEMOs and they confirmed their support for continuing the project. As a result, the Interim Coupling Project successfully launched on 17th of June 2021.

This project connected the 4M MC region, Poland and the Multi Regional Coupling Region (MRC) by introducing NTC-based implicit allocation on 6 new borders (PL-DE, PL-CZ, PL-SK, CZ-DE, CZ-AT, and HU-AT). The Net

Transfer Capacity (NTC) calculation method was based on the calculation of the transmission capacity of maximum amount of electricity that could be transferred between the two zones. The calculation method was compatible with the security standards and took into account the technical uncertainties related to future network conditions.

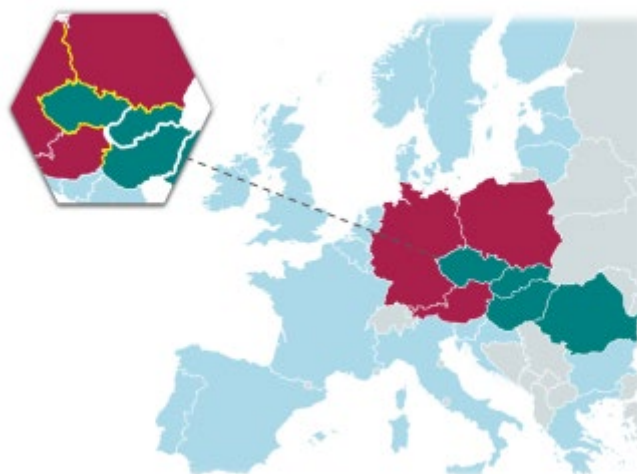


Figure: NTC-based capacity allocation at 6 new frontiers after interconnection of 4MMC and SDAC

The Interim Coupling Project was a temporary solution in the process of market coupling for the mentioned borders. The purpose is to move from NTC-based explicit allocation to flow-based implicit allocation. The Interim Coupling Project has completed the SDAC “enduring phase,” in which there is only one single European day-ahead market coupling.

CORE FLOW-BASED PROJECT

In 8th June 2022, the flow-based implicit allocation was finally implemented for the Core Capacity Calculation Region (Core CCR). This go-live also meant the end of the isolated 4MMC coupling perimeter, now fully merged within the Core and SDAC framework.⁵

The flow-based approach is a capacity calculation method in which the physical constraints of the network are based on the availability of critical network elements (branches) and Power Transfer Distribution Factor (PTDF) for all critical branches and bids of Core CCR. These factors describe how the net position (import or export) of each bidding zone changes the energy flow in each critical branch. After that, the algorithm looks for the most optimal electricity trading option among the bidding zones. The Flow-based method further increases social welfare compared to the net transmission capacity (NTC) method. The Flow-based method is more sophisticated because it takes more parameters into account and optimization states, therefore it tracks actual network conditions better. More detailed information is available [here](https://www.epexspot.com/en/marketcoupling).

⁵ <https://www.epexspot.com/en/marketcoupling>



Figure Geographical scope of Core region

NORDIC FLOW-BASED PROJECT

The Nordic Flow-Based Market Coupling (Nordic FBMC) went live on 29th October 2024 (First trading day 1st November 2024). The successful go-live of Nordic FBMC is the result of the close cooperation between all involved Nordic NEMOs, TSOs, Nordic RCC and regulatory authorities.

15 MIN MTU PROJECT

15-minute Market Time Unit (MTU) was introduced on all borders and in all Bidding Zones in Europe for Single Day-Ahead Coupling (SDAC) on 30th September 2025 (first delivery day 1st October 2025).

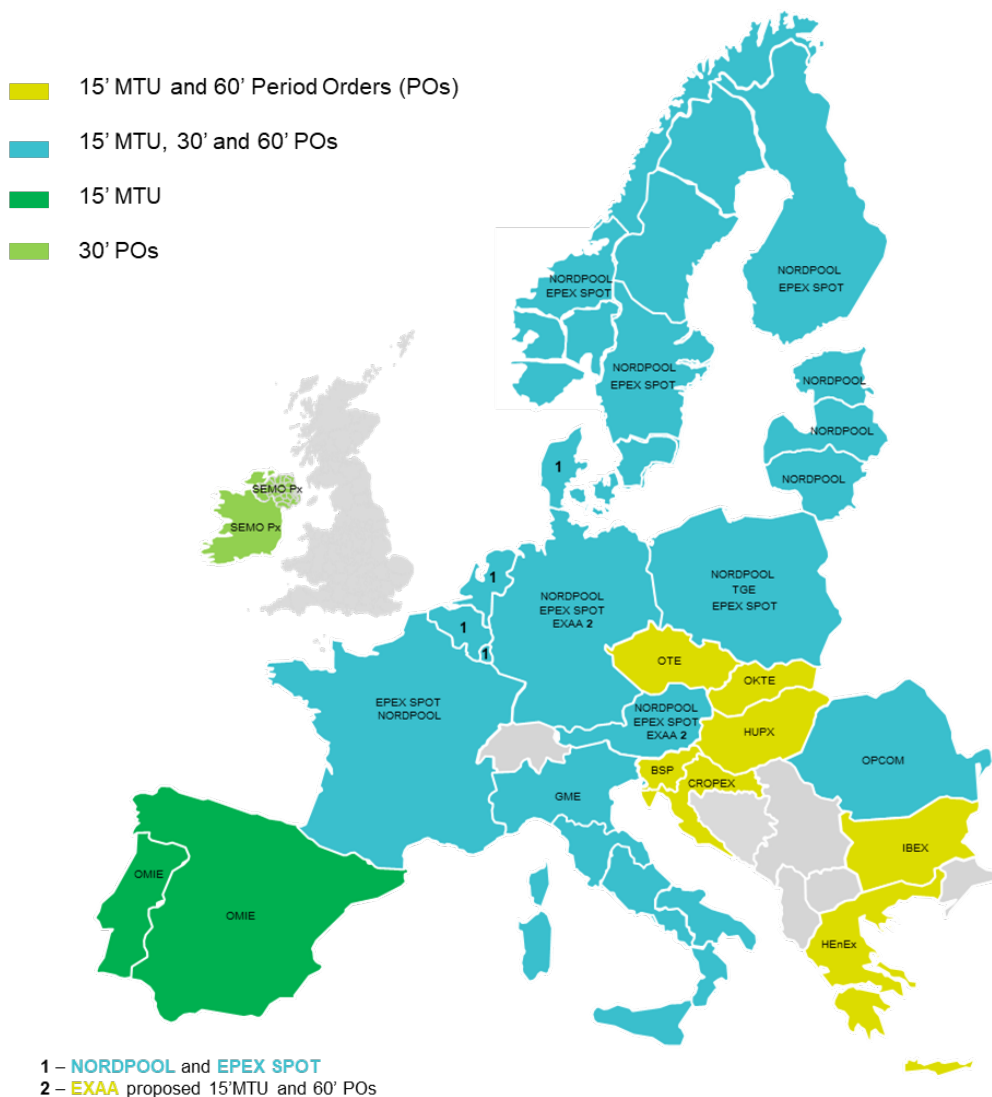


Figure: Availability of different time resolutions in SDAC following 15min MTU go-live.
Note that 15 min is the finest time resolution, available in everywhere in SDAC

Through Article 8 of the Clean Energy Package (CEP), the European Commission obliged NEMOs to provide market participants with the opportunity to trade energy in time intervals which are at least as short as the imbalance settlement period (ISP) for both day-ahead and intraday markets.

The transition to the 15-minute Market Time Unit (MTU) in the Single Day-Ahead Coupling (SDAC) marks a significant milestone in the evolution of Europe's energy markets.

The implementation of this shorter granularity aims to enhance the accurate bidding patterns enabling better integration of renewable energy sources, and promoting increased market efficiency and flexibility, potentially lowering costs ultimately benefiting market participants. To maximize trading opportunities, Cross Product Matching is offered. This feature allows market participants to bid in 60-minute, 30-minute (not available for HUPX) or 15-minute regardless of the minimum time unit of the market, ensuring that orders from different time resolutions can be matched together.

SINGLE DAY-AHEAD COUPLING – SDAC

The Single Day-Ahead Coupling (SDAC) aims to create a single pan-European cross-border day-ahead electricity market. An integrated day-ahead market facilitates effective competition, increases liquidity and is able to use of energy generation resources more efficient across Europe.

SDAC allocates limited cross-border capacities as efficiently as possible: wholesale electricity markets from different regions are coupled by a common algorithm (PCR EUPHEMIA) that continuously takes into account cross-border transmission constraints and maximizing social welfare. The purpose of Price Coupling of Regions (PCR) is to calculate electricity prices across Europe using a single, common tool to implicitly allocate cross-border capacity on auctions. The PCR solution is currently owned by nine power exchanges: EPEX SPOT, GME, HenEx, Nord Pool, EMCO, OMIE, OPCOM, OTE and TGE. The shorter version of Pan-European Hybrid Electricity Market Integration Algorithm is EUPHEMIA algorithm.

MARKET COUPLING PROCESS IN SDAC

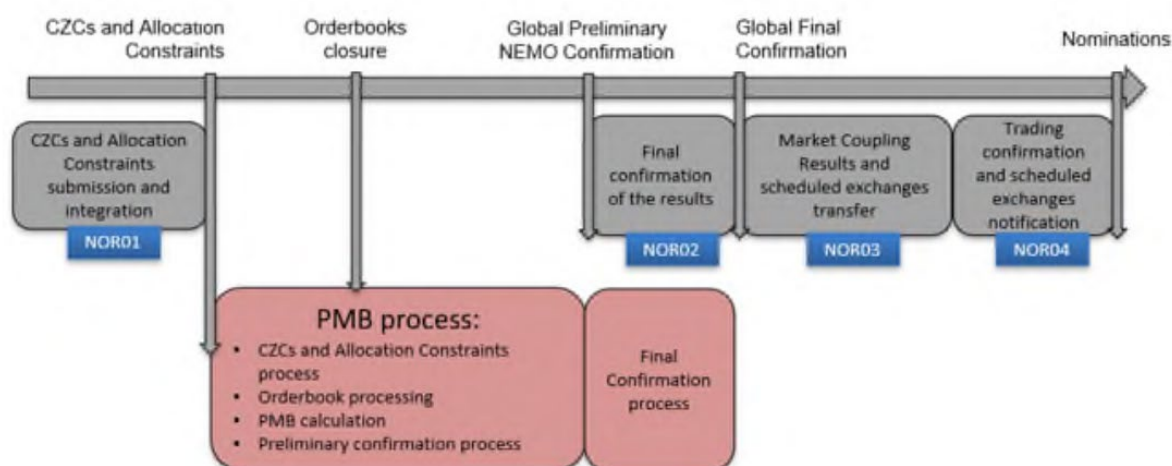


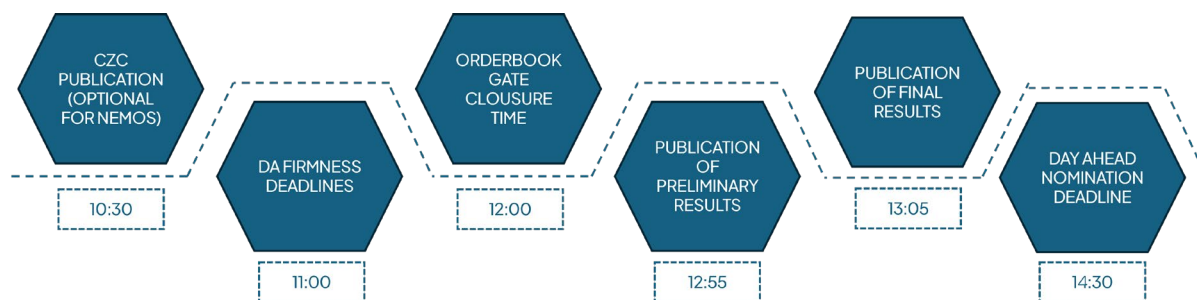
Figure: Overview of SDAC operational processes and references to procedures (figure from SDAC_OTH_01)

Normal operation and timing

Operation and timings are governed by a regime of SDAC procedures. The public versions of these procedures can be accessed from the ENTSO-E website here: [LINK](#)

Process of normal daily operation:

The actual market coupling happens between 12:00 and 13:05, which starts with closing of the orderbooks (Gate Closure Time, GCT, 12:00, in case of a technical issue the GCT is 12:20 pm CET) and ends with the publication of the final results at 13:05.



6. Figure: Normal operation of SDAC

DECOUPLING TYPES AND TIMINGS

Partial decoupling and timings in SDAC

If the market integration process cannot be completed in time and the results cannot be delivered according to normal operation, various emergency processes will be activated for troubleshooting.

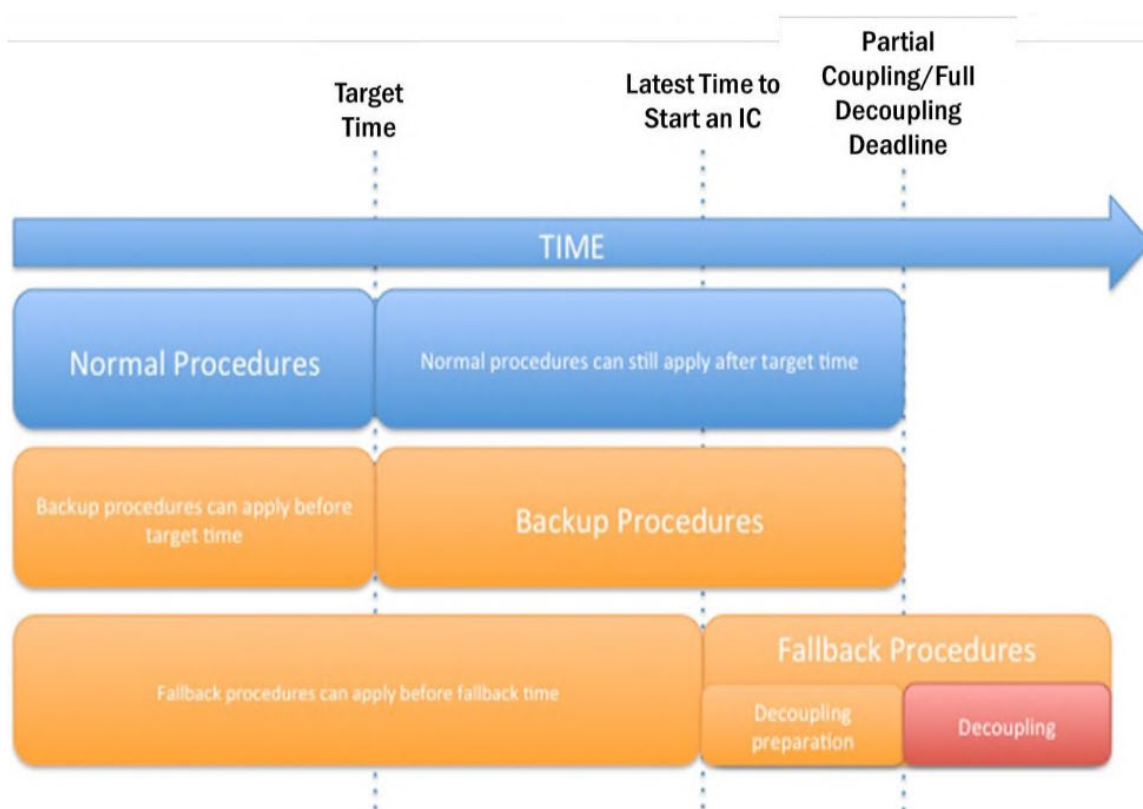


Figure: Normal, backup and fallback procedures (figure from SDAC_OTH_01)

There are two main decoupling types on SDAC level, with additional decoupling cases:

1. partial decoupling
 - a. Case PD1: Partial Decoupling for CZC-related reasons (deadline 11:30)
 - b. Case PD2: Partial Decoupling for reasons not related to the CZCs
 - c. Case PC3: Partial Decoupling known in advance

2. full decoupling

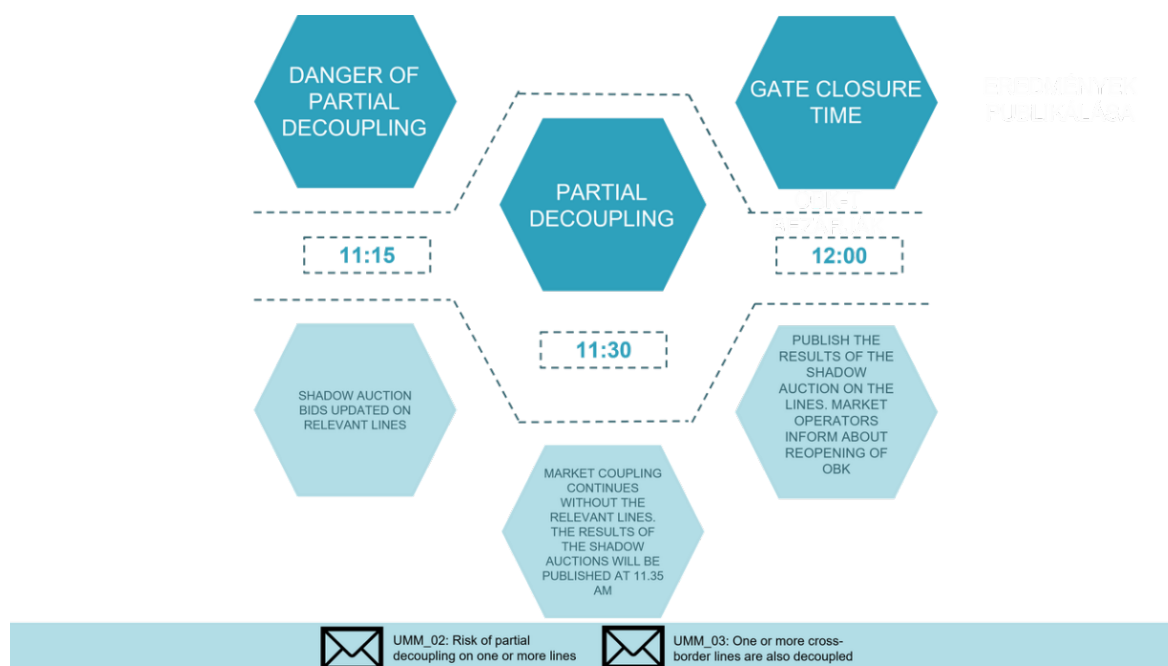
- a. Case FD1: Full Decoupling known during the daily market coupling session
- b. Case FD2: Full Decoupling known in advance

CASES OF PARTIAL DECOUPLING:

Case PD1: Partial Decoupling for CZC-related reasons:

If the problem is not solved in time, operators shall receive a message of partial decoupling at 11:30 and the process should continue without the decoupled cross-border lines. The results of the shadow auctions will be published as soon as possible after the partial decoupling becomes official at 11:35.

If there is a risk that one or more cross-border transmission lines will be decoupled, operators will be notified at 11:15 of the risk of partial decoupling of one or more lines. This message includes all relevant wires. Then the JAO will draw the attention of market participants to the possibility of participating in the shadow auction.



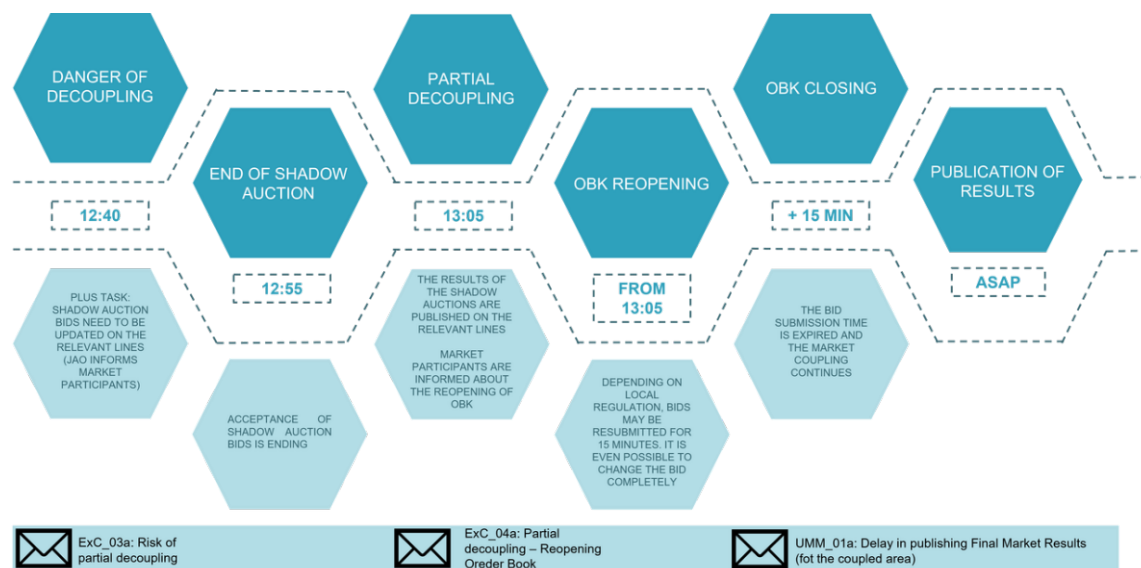
7. Figure: The operation of SDAC in case of one or more cross-border lines decoupled

Case PD2: Partial decoupling for reasons not related to the CZCs

If there are technical problems in the trading system of one or more NEMOs and they are not able to continue the market coupling process, partial decoupling will be realized in the relevant bidding zones. Operators will be informed at 12:40 of the risk of partial decoupling. The JAO will inform market participants about the possibility of shadow auctions and their submission deadline, which is 12:55 p.m. If the technical problem is not solved, the partial decoupling will become official at 13:05 by sending the appropriate message to participants.

The results of the shadow auction will be published at the same time as the other results. Whichever causes the partial decoupling, the Order Book can be reopened for 15 minutes.

Once the submission of bids is completed, the market coupling continues with the appropriate delay and the results will be published as soon as possible. Decoupled NEMOs will run their local auctions and will publish their Local Market Results independently from the remaining coupled NEMOs.



8. Figure: The operation of SDAC in case of decoupling of more or more bidding zones

Case PD3: Partial Decoupling known in advance:

A partial decoupling known in advance can be declared when the previous market coupling session has resulted in a partial decoupling. No later than 10:00, if the critical issue is still not solved, NEMOs and TSOs inform market participants about the risk of partial decoupling. If the critical issue is still not solved at 10:30, market participants are notified right after the partial decoupling known in advance was declared.

After partial decoupling was declared, the remaining coupled NEMOs continue with normal procedures, while the decoupled NEMO(s) run their local auctions.

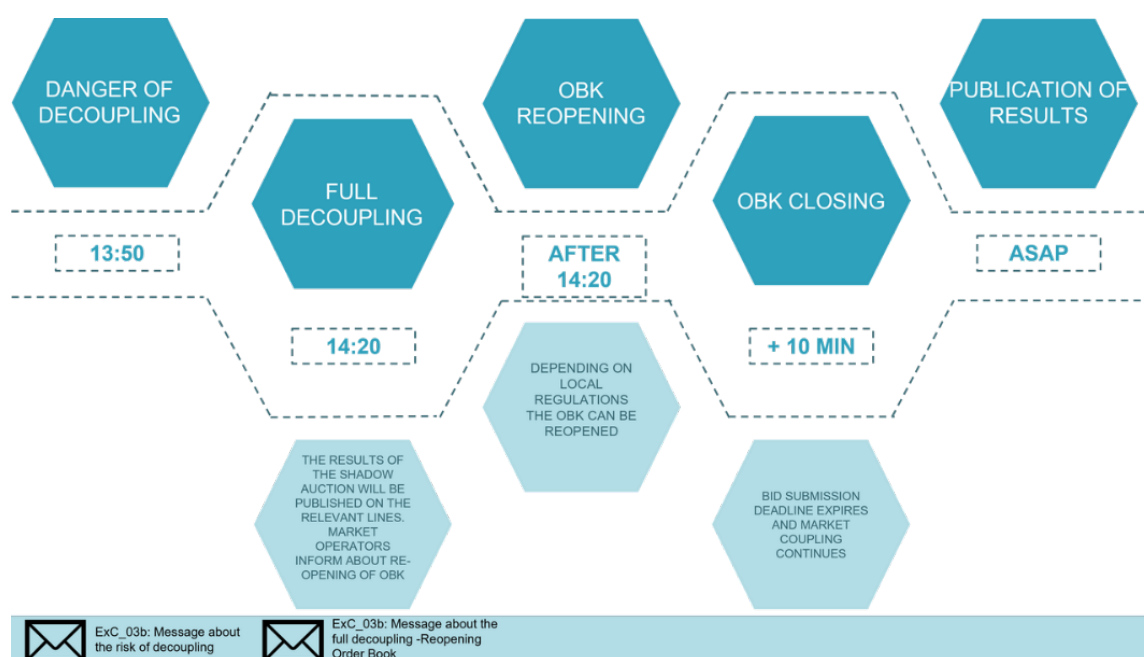
FULL DECOUPLING AND TIMINGS IN SDAC

A Full Decoupling is a situation where it is not possible to allocate the CZCs via the implicit allocation process, where a time limit has been reached and the market coupling results cannot be published before the Full Decoupling Deadline (14:20).

Case FD1: Full Decoupling known during the market coupling session

A Full Decoupling known during the market coupling session will be declared in case the market coupling results cannot be confirmed by the Global Preliminary Confirmation by the NEMOs or have been rejected in the final confirmation process.

Market participants receive a message at 13:50 about the danger of full decoupling. Bid auctions can be updated until 14:10. The message that the complete decoupling is official is sent at 14:20. The process is then the same as the partial decoupling. Local auctions are conducted with explicit shadow capacity auctions. The Order Book will be reopened after 14:20 and the results will be published as soon as possible.



9. Figure: The operation of SDAC in case of decoupling of more or more bidding zones

Case FD2: Full Decoupling known in advance

A Full Decoupling known in advance can be declared only if the previous market coupling session has resulted in a full decoupling and the corresponding critical issue has not been solved. If the critical issue is not solved during the incident committee NEMOs and TSOs inform market participants about the risk and then the declaration of the Full Decoupling.

Once Full Decoupling has been declared, NEMOs run their local auctions.

THE FUTURE DEVELOPMENTS OF SDAC

PCR EUPHEMIA already fulfils a several CACM requirements, the final purpose is completing the SDAC and implementing all CACM requirements. Furthermore, PCR EUPHEMIA has been proposed as an “existing solution” for the pricing of an intraday market coupling project (IDA), i.e. for the execution of intraday auctions. Regarding the EUPHEMIA algorithm is currently proceeding several developments, including the further extension of market coupling, the implementation of new market plans and ensuring appropriate running times:

- Geographical extension and market growth;
- Switching from NTC to Flow-based capacity calculation method;
- Introducing the 15 MTU product and pairing products with different market time units;
- Fulfilling the relevant CACM requirements for the algorithm (appropriate running time, scalability, repeatability);
- Performing new NEMO and TSO requirements;
- Implementation of topological changes.

CORE ADVANCED HYBRID COUPLING (CORE AHC)

The term hybrid coupling refers to the combined use of flow-based (FB) and Available Transmission Capacity (ATC) constraints in one single capacity allocation mechanism. There are two forms of hybrid coupling: Standard Hybrid Coupling (SHC) and Advanced Hybrid Coupling (AHC). The difference between SHC and AHC is how power exchanges are handled between Bidding Zones (BZNs) within the Core Capacity Calculation Region (Core CCR) and outside of Core CCR (but still in SDAC). SHC grants access to the scarce Critical Network Element under Contingency (CNEC) capacity by reserving Core CNEC capacity for exchanges from other CCRs before the capacity calculation, based on forecasts. By contrast, in AHC all exchanges are treated equally and compete for the same scarce CNEC capacity at the same time during market coupling.

The expectation is that by ensuring non-discriminatory competition for the scarce CNEC capacity between CCRs, AHC will lead to an increase in socio-economic welfare and improved operational grid security as well. AHC has been already implemented in the Nordic CCR, but its full benefits are expected to be realised following the implementation in Core CCR as well. Currently, only SHC is used in Core CCR, but there is an obligation to introduce AHC by 2025 Q3.

Find more information on Core AHC in the following documents:

- DA CCM 2nd amendment – Explanatory Document
https://eepublicdownloads.entsoe.eu/clean-documents/nc-tasks/Explanatory%20Document_2nd_amendment_Core%20DA%20CCM%20.pdf
- DA CCM 3rd amendment – Consolidated Clean Version
<https://eepublicdownloads.entsoe.eu/clean-documents/nc-tasks/Core%20DA%20CCM%203rd%20RfA%20-%20Clean%20version.pdf>

CO-OPTIMISATION

The Commission Regulation (EU) 2017/2195 establishing a guideline on electricity balancing proposes the application of cross-zonal capacity (CZC) allocation for the balancing process to improve competition by means of cross-zonal balancing exchanges. This implies that TSOs may allocate cross-zonal capacity available from SDAC to the same timeframe in which balancing capacity procurement is organized.

The co-optimization allocation process implies cross-zonal capacity allocation for the balancing capacity market with and at the same time as the allocation of cross-zonal capacity to SDAC. Therefore, energy supply and demand bids, together with balancing capacity bids compete at the same time for the available CZC for the next day.

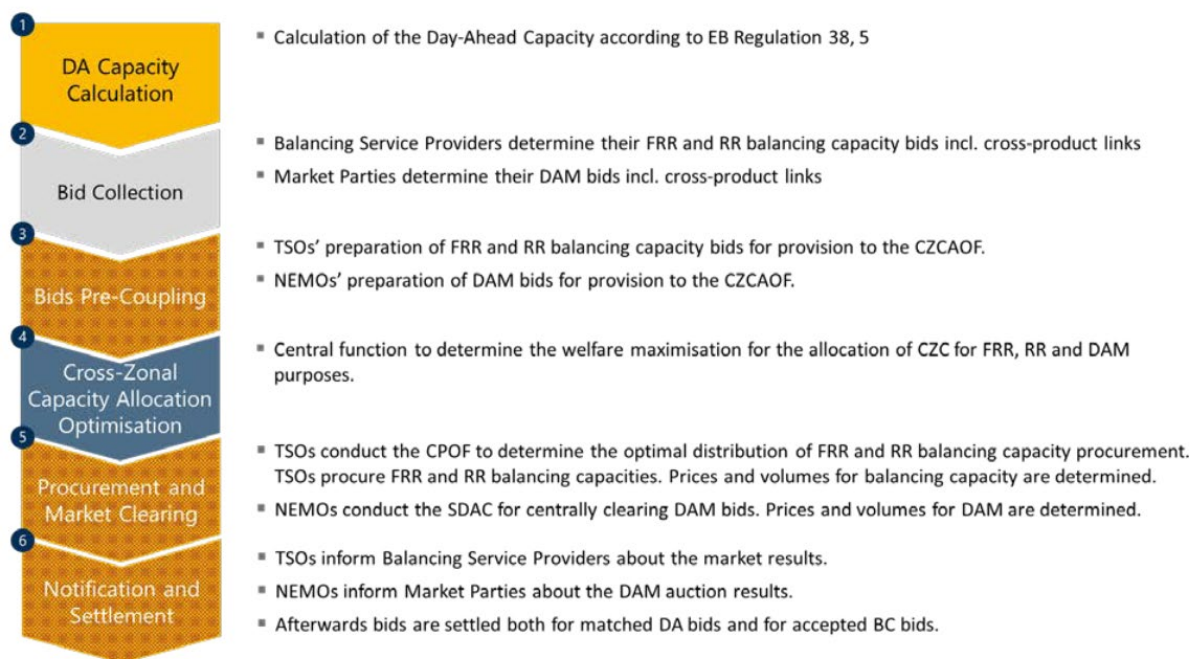


Figure Illustration of the main NEMO and TSO processes involved in Co-optimisation and how they interact⁶

MCSC NEMOs and TSOs agreed to start the first two steps of the Co-optimisation R&D in 2024. The first phase of the R&D is a conceptual study to identify a suitable approach for co-optimisation regarding the bidding structure, market impact, operational security, governance and legal aspects. Following the conceptual study, a first prototyping phase shall be launched to secure a clear definition of requirements and their high-level implications. High-level requirements and the initial bid design have been drafted based on the conceptual study and will be further specified.

Market Participants' involvement is expected to better understand market impact of co-optimisation as well as to gather feedback on implementation. MCSC NEMOs and TSOs in cooperation with ENTSO-E have conducted an informal survey in October 2024 among market participants regarding the future use of co-optimised balancing capacity and energy markets. Survey and related materials can be accessed here ([LINK](https://eepublicdownloads.entsoe.eu/clean-documents/nc-tasks/211217_All%20TSOs_Co-optimisation%20IIA%20Report.pdf)). The second R&D phase started in 2025 Q2, with simultaneous consultation with ACER and market participants.

⁶ Source: Co-optimisation IIA Report

https://eepublicdownloads.entsoe.eu/clean-documents/nc-tasks/211217_All%20TSOs_Co-optimisation%20IIA%20Report.pdf