

Horizon is a seven-year EU-funded Research and Innovation initiative to help develop a sustainable and liveable society in Europe– in addition to boost the private investment that this financial instrument will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market. Horizon will help to achieve smart, sustainable and inclusive economic growth.

Goals of Horizon Europe

The programme facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. It supports creating and better dispersing of excellent knowledge and technologies.

It creates jobs, fully engages the EU's talent pool, boosts economic growth, promotes industrial competitiveness and optimises investment impact within a strengthened European Research, the indicative funding amount for Horizon Europe for the period 2021-2027 is EUR 93.5 billion.

link: Horizon Europe - European Commission

Introduction of HUPX

HUPX, the Hungarian Nominated Electricity Market Operator with the provision of transparent market platforms and reference price effectively contributes to the development of the Hungarian electricity market. The company operates two different markets, on the day-ahead and intraday timeframes with different trading mechanisms. Completing its core activities HUPX actively participates in research and innovation actions under the framework of Horizon (TwinEU, FARCROSS and TRINITY) to facilitate the market integration.

TwinEU is creating the concept of the Pan-European digital twin based on the federation of local twins of the electricity system.

TRINITY and FARCROSS projects were the part of the "A single, smart European electricity grid" which means that they aimed to deliver solutions for increased regional cross-border cooperation in the transmission grid – *closed initiatives*



TwinEU: <u>https://twineu.net/</u> FARCROSS: <u>https://farcross.eu/about-farcross</u> TRINITY: http://trinityh2020.eu/library/

Goals of TwinEU

One of the largest projects in the EU's innovation framework is the TwinEU project, which aims to develop the concept of a digital version of the European electricity system.

TwinEU will create the basis for a digital twin of the entire European electricity system. 75 partners, 15 countries, 3 years and 50 cents less than 20 million euros of EU funding; that's how much effort is put into creating a digital twin of the European electricity system under the TwinEU project.

Not many larger ventures have been launched under the EU's innovation framework HorizonEurope than the TwinEU project. As the aim of that is to elaborate the concept for a digital version of the European electricity system. The *digital twins* will make the entire European electricity system more transparent, manageable and predictable, making energy markets more efficient, which is essential to meet the EU's 2050 climate neutrality targets.

European Comission (EC) specifically intended to support one project in this call, ensuring that the project launched will develop a concept applicable to the whole European system.

The point of the concept is not to end up with a single, all-encompassing digital twin, but with a well-functioning confederation of digital twins mimicking the elements of the electricity system, where the interoperability of data sharing between the sub-units is fully ensured. Universities, research institutes, grid operators, energy traders and software developers involved in the project are going to work to build a reliable, resilient and safely operating digital infrastructure through the confederation of digital twins. This will not only allow more renewables to be integrated into the system, but will also open the way to new business models.

Role of HUPX

As a market operator, HUPX will participate in the Hungarian demonstration of WP7.



This demo will develop a digital twin-based based artificial neural network (ANN) conductor temperature monitoring for transmission lines, a co-optimisation algorithm with dynamic transmission line ampacity and intraday products and a market auction platform for transmission capacity auction within day-ahead/intraday timeframe to enhance the grid capacity and enable a more efficient use of that capacity, especially on the cross-border relations.

HUPX will provide its expertise on day-ahead and intraday energy exchange operation, dataflows, timelines, existing order types and the applicable regulatory framework for the complex market simulation.

HUPX, as the Hungarian Nominated Electricity Market Operator easily fit to the market operator role of the energy markets operating stable IT infrastructure 7/24.

HUPX will provide historical energy market data on a dedicated platform service for the simulations, including detailed, anonymous intraday order book data. Through this data provision the demo can also consider the activity of the market participants, using algorithmic trading. In the near-real time timeframe, an important aspect can be the interaction of the algorithmic market players and smart market design mechanisms, such as co-optimisation.

Goal of the FARCROSS project (Grant Agreement No 864274) / CLOSED

One of the key objectives of the European Union's energy policies is to create a single European energy market, with harmonised regularisation, trading platforms and transparent, market-based incentives.

In order to achieve this goal, **FARCROSS** ("**FA**cilitating **R**egional **CROSS**-Border Electricity Transmission through Innovation") project was established to present innovative solutions to improve cross-border interconnections of the transmission grid using new hardware and software tools developed and implemented in the FARCROSS project.

An extended and geographically large market can also increase competition between market players and boost security of supply, as it would provide more opportunities to cover consumer's demands.

The developments of FARCROSS promote a unified and modern coupled electricity market in Europe and utilize innovative, up-to-date software and hardware solutions to increase cross-border electricity flows that support the transition process to a flow-based regional coupled market.

Drivers of the proposed solution – background



The integration of electricity markets has long been the core priority of EU, especially regarding coupling the electricity markets of the individual member states. Regarding energy trading a well-established approach is used throughout Europe, based on implicit allocation of cross-zonal reserves in a price-based market coupling of organized electricity markets. In this case the integration is already well progressed, in practice and also regarding regulation aspects.

The basis of cross-border energy-only market integration is established in the Capacity Allocation and Congestion Management (CACM) Guideline (GL) that resulted in couplings of power exchanges.

On the other hand, Electricity Balancing (EB) GL set the principles of the allocation of cross-zonal capacity and aims to harmonize the rules about exchange of balancing capacity.

In case of balancing markets, market integration is not present at all and prices of balancing capacity reserve and balancing energy can greatly differ even in neighbouring control zones, the product portfolio to be used for load frequency control and the related markets is specific.

Generally, reserve markets are organized by the TSOs. Balancing service providers (BSP) are remunerated by capacity fee for the reservation of positive and negative control bands and an energy fee in respect of the actual delivery of balancing energy, close to the real time operation.

Traditionally, capacity has been procured as long-term, yearly, quarterly, monthly auctions, while day-ahead capacity procurement is newly introduced timeframe as TSOs are legally obliged to shorten the procurement lead times by the Clean Energy Package (CEP).

With the continuous integration of balancing capacity markets the optimised allocation of cross-border capacities has utmost importance to maintain security of supply and simultaneously facilitate energy trading.

What does co-optimisation mean? Why is it so important?

EB GL defines four different approach for the optimal allocation of CZC, one of them is the framework of co-optimised allocation process and requires the TSOs to develop a proposal for a co-optimised methodology.

The co-optimised balancing procurement is based on the integration of the three main day-ahead market processes: the energy exchanges, the cross-zonal network capacity allocation and the balancing capacity.

Co-optimisation aims the integration of the European balancing capacity markets, which is a major milestone in reaching the objective of the unified Internal Electricity Market:



As CZC is a scarce resource, co-optimised capacity allocation is required, where firm balancing capacity bids and SDAC are cleared in direct competition for cross-zonal capacity at D-1 (EB GL Article 40).

Co-optimised capacity allocation means the optimization of cross-zonal capacity allocation for both energy trading and balancing purposes. The method is based on the economically sound determination of optimal bidding price for crossborder capacity, thus proper pricing of available transmission capacity.

Based on the requirements of Article 40(1) of the EB GL, an all TSO methodology was submitted to ACER which was accepted on 17th June 2020. CO CZCA (Methodology for a co-optimised allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves) sets the frame rules for the Co-optimisation process and requires from TSOs to elaborate and publish with the corporation of NEMOs an implementation impact assessment by December 2021. Meanwhile the new set of requirements for the SDAC algorithm has to be prepared by June 2022.

Objectives of co-optimised capacity allocation:

The objectives of a co-optimised capacity allocation is fostering effective competition, ensuring non-discrimination, enabling more efficient procurement and more efficient use of cross-zonal capacities, and all in all increasing transparency for market players, as the algorithm takes into account the actual value of CZC both for the exchange of energy and balancing capacity:

Target - integrate balancing capacity and energy auctions- obstacle: both markets are strictly regulated

- optimizing the usage of the available cross-border capacity for reserve procurement based on Flow-Based capacity calculation mechanism
- *simultaneous cross-border auction for energy and balancing capacity reservation*
- *state-of-the-art technologies to materialize market coupling platforms.*

The **optimisation function** should ensure the highest social welfare obtainable by cross-zonal capacity allocation.

Role of HUPX

As a market operator, HUPX's role in FARCROSS was to participate in a pilot project (Work Package 8: OPTIM-CAP DEMO: Co-optimized cross-border capacity auction algorithm), which aims to develop a new co-optimised algorithm, giving market players the opportunity to jointly submit bids for cross-border regulation reserves and energy sales.

The OPTIM-CAP demonstration delivered a high-performance prototype to enable participants to link their balancing capacity offers and energy offers on the day-ahead timeframe. OPTIM-CAP provided a complex algorithm for the optimal allocation cross-border capacity focusing on the pricing problem on the day-ahead timeframe.



The new market design was aligned to the European target model as much possible, as co-optimisation is a joint endeavour for a long time to extend the day ahead market coupling algorithm:

Based on the Decision of ACER

(No 12/2020, link:

https://documents.acer.europa.eu/Official documents/Acts of the Agency/Individual %20decisions/ACER%20Decision%2012-2020%20on%20a%20cooptimised%20allocation%20process%20of%20cross-zonal%20capacity.pdf)

co-optimised capacity allocation shall be implemented.

HUPX as a nominated market operator was in charge for the common TSO-NEMO platform hosting service, as the company has relevant know-how in the daily routine of market coupling processes and the proposed solution provides a secure testing environment for the running of the algorithm and the joint energy-reserve auctions. The company also contributed to the definition of the high-level IT architecture and processes, provided general guidelines to the IT architecture (including restrictions of data structure).

Goal of the TRINITY project (Grant Agreement No 863874) / CLOSED

The implementation of a single, unified electricity market is one of the main challenges the European Union has to face. System stability in electricity supply has to be maintained even during system disturbances such as a power plant failure or the loss of a large load. Under extreme conditions, EU Member States need to be able to rely on other market players of the neighbouring countries to meet their balancing energy needs. Although the importance of market coupling has been highlighted for a long time already, Southern European countries are not in such an mature state on this field as the Western- and Northern-European member states. Coupling European energy markets will boost the security of supply and give Southern European markets the opportunity to improve their current state.

TRINITY (**TR**ansmission system enhancement of reglo**N**al borders by means of IntellIgen**T** market technolog**Y**) project is part of the Horizon 2020 programme (Grant Agreement No 863874) was intended to support the creation of a fully unified, single smart electricity grid connecting EU and non-EU countries in the South- and Central-Eastern European regions, whilst new, innovative products developed within the framework of the project will promote higher penetration of renewables.

TRINITY defined a transnational electricity market framework, proposing solutions for improving cross-border trade, competition, transparency and security of supply at regional level. A minimum set of harmonized requirements was listed to allow intraday market coupling and common capacity services in the region.



TRINITY delivered a tool (TRINITY MARKET COUPLING FRAMEWORK) to enhance cross-border cooperation and engage electricity market integration at regional level as an important and necessary step in the integration process of the SEE countries into a single and unified European electricity market.

This platform consists of four separate modules covering different market areas - intraday electricity trade, trade of a common regional capacity reserve, bilateral trading and GO markets.

The new intraday auction platform was deployed between EU and non-EU countries to make market-coupling feasible in the Southeast-European (SEE) countries in parallel with their goal to be part of (Single Intraday Market Coupling (SIDC).

The TRINITY Intraday Auction Module enhanced the integration of less mature electricity markets by delivering a compatible IT solution with the existing trading systems widely used in PCR and CEE region.

Role of HUPX

HUPX participated in the project as the expert of the organised electricity market, supporting market coupling in the region. In addition, HUPX contributed to the product development by completing its already existing products and services with innovative developments.

The company contributed to provide a complete overview of the current state of different energy related markets in the SEE region. HUPX completed the relevant parts of the document analysing Hungarian energy markets (DAM, IDM, OTC including balancing markets and state of GoO) with highlight to the current operation of auction-based market mechanisms while introducing the details of the intraday processes. The document served as a well-established basis to facilitate the intraday segment with new products and technologies pointing out the legislative and technical obstacles between EU and non-EU countries.

HUPX provided market expertise to compose a detailed description with the contribution of SEEPEX and EPEX to perform a new cross-border intraday auction between Serbia and Hungary to enhance the integration of less mature electricity markets by delivering a compatible IT solution with the existing trading and market coupling systems widely used in MRC and 4MMC regions.

The design document elaborated in this collaboration gave a very insightful overview of the regulatory and technical background of the application of two new cross-border intraday auctions (IDAs) detailing the high-level architecture with the respective platforms and their governance by explanatory contents from different operational perspectives including data exchanges where standardisation has utmost importance.

