Market Coupling Simulator for South East Europe
Final Report

EKC and DMS Group
April 2014
Development of a Market Coupling Simulator For the 8th region

Ordered by:

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Belgrade, Novi Sad
29th of April 2014
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1. Introduction

In accordance with the Energy Community Treaty, the South-east European countries have started a number of activities related to the establishment of the Regional Electricity market, online complying with the Network Codes which are in preparation among ENTSO-e, ACER and EC.

Network Code on Capacity Allocation and Congestion Management (CACM) clearly identifies the pan-European Market (Price) Coupling as a target model for the day-ahead electricity market. This makes Market (Price) Coupling as the only, inevitable European choice for day-ahead market, after the adoption of CACM NC. Indirectly, over Energy Community Treaty, it will also become obligatory for the EnC parties.

The Consortium of EKC Belgrade and DMS Group Novi Sad (in further text “Consultants”) is commissioned by the EnC Secretariat, to develop and procure the consultancy and a software license for the Market Coupling simulator.

This Final Report provides the description of project objectives, time schedule, project course, meeting outcomes and main deliverables. Also, expected follow-ups are announced and described in brief.

2. Objective

The required main objectives of the project are:

- Providing the Market Coupling simulator for the SEE electricity market stakeholders, modelling the NTC/ATC-based Market Coupling procedure, with corresponding documentation
- Educating SEE TSOs, market operators and market participants about Market Coupling procedures and optimisation algorithms.
- Providing simulation possibilities that would, indirectly, facilitate the assessment of perspective prices and congestion costs as well the assessment of locational signals for network congestions and needed investments, on the basis of market coupling outcomes.
- Organizing the workshop for SEE market stakeholders at the final phase of the project, for the education of participants at Market Coupling and presenting the Market Coupling simulator features and results.

Besides that, additional services and features are provided by the consultants:
• Besides required NTC-based Market Coupling solution, also the Flow-based Market Coupling simulation and expertise, expecting that FBMC would be a Continental European target for day-ahead electricity trade and capacity allocation, as supported by the provisions of ENTSO-e Network Code on Capacity Allocation and Congestion Management (CACM). Within this process inputting and usage of PTDF/MF factors and constraints is performed.

• The project requires the simulation of Market Coupling simulation software, where technical constraints (ATCs, also PTDF/MF values in case of FBMC) would be provided by the TSOs itself. In order to accomplish the calculation process (capacity calculation – bidding – market coupling simulation and results), we provided to the SEE TSOs the 1-year executive license for capacity calculation functions NTC and PTDF/MF of our software TNA, already used by SEE TSOs in different phases and project, among those also at the dry-run of coordinated flow-based auctions. The TNA license is valid until September 2014.

• According to our practice also with previous projects for SEE TSOs working groups (BETSEE at Balance Management SG, PSA_maxFlow and TNA for NACMPF SG, TNA_FORsee for CMMI WG), consultants participated regularly at all meetings of CMMI WG during the course of the Project, providing constant consulting, lectures and trainings.

• For the needs of dry-run tests and calculations by SEE TSOs and market actors, we are providing the hosting of Market Coupling Simulator server, during and after the Project course (until September 2014).

• Later, after September 2014, further administration of EnCS MC Simulator as an open tool for training and education can be agreed and provided in cooperation of EKC&DMS and EnCS.

Finally, although we do not consider as additional services and features, but rather expected, we would like to underline here:

• Geographic Scope of the project considers Albania, BiH, Croatia, FYR of Macedonia, Kosovo*, Moldova, Montenegro, Serbia and Ukraine; besides them, our MC Simulator and related consulting services will be available for all TSOs and market stakeholders covered by CMMI WG countries, i.e. including also Austria, Italy, Slovenia, Hungary, Romania, Bulgaria, Greece and Turkey.

• With a goal to enable users the flexible parameterization of MC Simulator for definition of participants, roles, areas and geographic resolution, software is configurable in this respect, according to users’ decisions and choice. These
decisions are out of the scope for us as the software providers, and users will define this configuration accordingly.

3. Market Coupling overview

Market coupling procedure as an implicit auction, coordinates and merges the day-ahead trading of the electricity and the acquisition of transmission capacity rights into a single operation. In such an implicit auction the highest purchase orders and lowest sales orders are executed while taking into account the available daily interconnection capacities. Market coupling optimizes the economic efficiency of the coupled markets: all profitable deals resulting from the matching of bids and offers in the coupled markets of the NEMOs (MCO) are executed; matching results are subject to capacity constraints calculated by the TSOs which may limit the flows between the coupled markets.

![Figure 1: Clearing at single market area; calculation of surpluses and welfare](image)

The calculation is done based on the complete order book information received from the power exchanges and the transfer limits (ATC or MF) on the network elements received from the TSOs.

Market prices and schedules of the connected markets are simultaneously determined with the use of the available capacity defined by the TSOs. The transmission capacity is thereby implicitly auctioned and the implicit cost of the transmission capacity is settled by the price differences between the markets. In particular, if no transmission capacity constraint is active, then there is no price difference between the markets and the implicit cost of the transmission capacity is null. Market Coupling simulator outputs net export positions and prices on each market and each hour, the set of executed orders, and the congestion prices on each congested network constraint. These outputs satisfy all requirements of a feasible solution, including congestion price properties.

Useful basic example of ATC-based MC is provided at the following figures (3 areas, no block bids). This example is presented at CMMI WG meeting in Athens (14.11.2013) and exercised through MC Simulator at CMMI WG meeting in Vienna (24.02.2014):
Market coupling of three areas: bids

Figure 2: Market Coupling example, bids

Isolated markets (ATCs = 0)

Figure 3: Market Coupling example, isolated markets
Coupled markets (ATCs = 50), with congestion

Figure 4: Market Coupling example, markets with congestions

Coupled markets (ATCs =100), without congestion

Figure 5: Market Coupling example, markets without congestions
4. Market Coupling application in Europe

Consultant’s role in this project is not only in development of the baseline Market Coupling Simulator, and to explain its theoretical background, but also to educate SEE TSOs about the current processes in Europe regarding the establishment and merging of Market Coupling procedures in Europe.

At the CMMI WG meetings in Vienna (30.08.2013) and Athens (14.11.2013), Consultants presented the legal background (CACM Network Code) and current MC processes in Europe.

Network Code on CACM

As a main legal background to push MC integration in Europe, Draft Network Code on Capacity Allocation and Congestion Management (CACM NC) is quested, where it is made clear that a target model for day-ahead electricity trade (and implicitly, capacity allocation) is a single pan-European Market Coupling (i.e. Price Coupling).

This makes Market (Price) Coupling as the only, inevitable European choice for day-ahead market, after the adoption of CACM NC. Indirectly, over Energy Community Treaty, it will also become obligatory for the EnC parties.

Application of MC in Europe

Consultants presented current MC applications in Europe, as well as PCR project.
Figure 7: MC processes in Europe (end 2013)

Figure 8: Price Coupling of Regions (PCR) project
As an outcome of PCR initiative, it is important to mentioned, that, exactly as expected, countries of North-Western Europe (Scandinavia) and Central-West Europe merged into a single Price Coupling mechanism, since 4th of February 2014.

The PCR solution went for the first time into operation on 4 February 2014 in North-Western Europe (NWE) and South-Western Europe (SWE), which account for about 75% of European electricity demand. Prices and net transfers are determined in a single calculation using the PCR Matcher-Broker (PMB) with its embedded algorithm “Euphemia”, based on the order books and available transmission capacities from the NWE and SWE regions. By allowing decentralised operations, PMB assures a high level of security.

Plans are already well advanced for the next phases of development of market coupling using the PCR solution within other European regions.

The CWE region is intending to implement <u>flow-based capacity calculation</u> after summer 2014. The PCR solution will play a key role in enabling this.

Expected merging with MC regions in short term:

- The prices in NWE and SWE (<u>Spain, Portugal</u>) regions are now calculated in a common synchronised mode by PCR, but transmission capacity between France and Spain is still only offered via explicit auctions. The target is that this capacity will be offered via implicit allocation in PCR by May 2014, once the necessary arrangements have been put in place. The NWE and SWE regions will then be fully integrated.

- In the <u>CSE region (Italy and bordering countries)</u> the work is progressing for Italy to adopt the PCR solution by the end of 2014. The countries bordering Italy shall also be ready for the pan-European power market. Preparation of market coupling based on the PCR solution for the northern Swiss borders is as well ongoing.

- In addition, within the <u>CEE region</u>, the “4M MC” project is underway to implement the PCR solution covering Czech Republic, Slovakia, Hungary, plus Romania (RO is expected to join CZ, SK and HU in Q4 of 2014). The region as now (CZ+SK+HU) is already applying similar approach as CWE and NWE common market coupling, so further spreading will facilitate even more the future integration of CEE with NWE/SWE, towards the common goal of pan-European single Market Coupling solution.

5. Activities and meeting during the project course

The activities at meetings during the project are listed below:

**16.07.2013** The <u>preparatory meeting</u> has been held in EnCS premises, among EnCS, Consultants and CMMI WG co-convenor. EnCS is informed on the details of a project plan and project goals, and a kick-off meeting with CMM TSOs has been scheduled.
30.08.2013  The project **Kick-off meeting** was held, as a session at CMMI WG meeting, in APG premises in Vienna.

TSOs are informed about the goals and project plan.

The 1-year license of software TNA for NTC and PTDF/MF calculation is provided to the CMMI WG TSOs, as a supporting tool for the preparation of technical inputs (network constraints) to the MC Simulator.

The basic principles of ATC-based and Flow-Based Market Coupling were presented.

The requirements by the NC CACM regarding Market/Price Coupling at D-1 level are presented, as well as current developments in different regions of Europe (Nordic, CWE, CEE, SE).

The target model of European Price Coupling (EPC), and the most mature process of Price Coupling of Regions (PCR) has been introduced.

Expectations of the development in SEE region are assessed.

02.10.2013  The Consultants provided a presentation on the project plan, goals, and a Market Coupling issues in Europe, for the SEE Regulators at a regular ECRB EWG meeting, at EnCS premises in Vienna.

14.11.2013  Second meeting with CMMI WG is held in Athens. The Consultants provided a detailed presentation on CACM NC requirements for Market Coupling.

Roles of actors within the Market Coupling are refined.

The three-zone example of ATC-based Market Coupling is presented and assessed in detail.

14.02.2014  Third meeting with CMMI WG is held in Vienna. The Consultants presented an initial solution of Market Coupling Simulator.

The three-zone example of ATC-based Market Coupling is modelled and exercised in MC Simulator.

Example of SEE as MC region is modelled and exercised in the MC Simulator for the first time.

27.03.2014  The training workshop for CMMI WG member TSO representatives and EnCS representative is organized in Sofia.

Users are provided with MC Simulator User Manual, and web coordinates - usernames and passwords for different roles: MCO, TSO, market participant, guest. EKC and DMS played the role of administrator.

The SEE region example with ATC-based Market Coupling is presented.
The second online SEE region example with ATC-based Market Coupling is jointly exercised, where participants played the role of TSOs and then market participants.

Flow-based Market Coupling example at the SEE region is jointly exercised, where participants played the role of TSOs and then market participants.

Both solutions and outcomes are jointly analysed and commented by the participants.

Figure 9: Sofia workshop, 27.03.2014

6. Workshop with SEE stakeholders

On 24.04.2014 the workshop on Market Coupling principles and MC Simulator demonstration is held in Vienna, jointly prepared by EnCS and EKC&DMS. There was a huge number of participants, from the Regulators (ECRB EWG) and SEE TSOs (RG SEE/CMMI WG).

From the side of Consultants, EnCS, and the participants, the Workshop is considered as very successful, bringing further knowledge on Market Coupling for the participants.

Figure 10: Picture from Vienna workshop 24.04.2014
The agenda of the workshop was:

**Market Coupling Simulator Workshop**

*Energy Community Workshop, in cooperation with EKC – Electricity Coordinating Center Ltd.*  
*Energy Community Premises, Am Hof 4, 1010 Vienna, Austria*  
**Thursday, 24 April 2014, 9:00 – 12:00**  
*Market Coupling Simulator Expo-session: from 13.30*

### Agenda

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<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>9:00</td>
<td>Welcome &amp; Introductions</td>
<td>Energy Community Secretariat</td>
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<tr>
<td>9:10</td>
<td>MC investigation in SEE: outcomes and expectations</td>
<td>CMMI WG convenor(s)</td>
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<td></td>
<td><strong>Part A – Presenting the Market Coupling process and MC Simulator</strong></td>
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<tr>
<td>9:30</td>
<td>Market Coupling project outline</td>
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<td>10:00</td>
<td>Market Coupling: methodological aspects</td>
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<td>10:20</td>
<td>Introducing the Market Coupling Simulator</td>
<td>EKC</td>
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<td>10:40</td>
<td>Demonstration: ATC-based example at the Market Coupling Simulator</td>
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<tr>
<td>11:10</td>
<td>Demonstration: Flow-based example at the Market Coupling Simulator</td>
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<td>11:45</td>
<td>Market Coupling Simulator project: expected results and follow-ups</td>
<td>Energy Community Secretariat</td>
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<td>12:00</td>
<td>Experiences with market coupling: the case of coupling between Italy and Slovenia</td>
<td>Italian Regulatory Authority for Electricity Gas and Water</td>
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<td>12:15</td>
<td>Lunch Break</td>
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<td></td>
<td><strong>Part B: Market Coupling Simulator expo-session</strong></td>
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<tr>
<td>13:30</td>
<td>Possibility for participants to test the Market Coupling Simulator (at presenters computers and/or at individual laptops - web based)</td>
<td>EKC</td>
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<td>15:00</td>
<td>End of the Workshop</td>
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*Figure 11: Vienna workshop 24.04.2014, final agenda*
7. MC Simulator documentation

Mathematical formulation

The objective of the Market Coupling Problem is to maximize the total welfare. Here the welfare is defined as the difference between the cumulative amount that the buyers are ready to pay and the cumulative amount that the sellers want to be paid over all markets (N) and hours (t). This difference corresponds to the sum of the surplus of the producers and the consumers, plus the congestion revenue.

\[
OBJ: \max \sum_{a=1}^{N} \left( \sum_{t=1}^{T} \sum_{k=1}^{K} p_{a,t,k}^B \cdot q_{a,t,k}^B - \sum_{m=1}^{M} p_{a,t,m}^S \cdot q_{a,t,m}^S \right)
\]

- \( p^B \) - price that Buyer is willing to pay for the accepted power quantity
- \( p^S \) - price at which Seller is willing to sell for the accepted power quantity
- \( q^B \) - accepted quantity of Buy order
- \( q^S \) - accepted quantity of Sale order

In objective function \( q^B \) and \( q^S \) represent accepted quantities from Buy and Sale orders and they are the result of optimization process. According to the properties of the orders, they can be accepted partially or in whole if, they are marked as "All or nothing". Block orders are always defined as "All or nothing".

\[
\text{Constr}_{a,t}^B: q_{a,t}^B \leq Q_k^B \quad k \in K \text{ (partial Buy orders)}
\]

\[
q_{a,t}^B = Q_k^B \quad k \in K \text{ (All or nothing Buy orders)}
\]

\[
\text{Constr}_{a,t}^S: q_{a,t}^S \leq Q_m^S \quad m \in M \text{ (partial Sell orders)}
\]

\[
q_{a,t}^S = Q_m^S \quad m \in M \text{ (All or nothing Sell orders)}
\]

Network constraints represent the balance of the market area \( a \) and constraint of the physical exchange by the available transfer capacities in each hour \( t \).

\[
\text{Constr}_{a,t}: \sum_{k=1}^{K} q_{a,t}^B - \sum_{m=1}^{M} q_{a,m}^S + \sum_{na} atc_{a-na} - \sum_{na} atc_{na-na} = 0
\]

\( na \) — neighbouring areas of the area \( a \)

\[
\text{Constr}_{a,t}: atc_{a-ab} \leq ATC_{a-ab} \quad a,b \in N
\]

In case of Flow Based approach, network constraints are defined with PTDF matrix and Available Maximum Flow (AMF) values, related to the pairs of critical branches/critical outages (cbco):

\[
\text{Constr}_{a,t,cbco}: \sum_{k=1}^{K} q_{a,k}^B - \sum_{m=1}^{M} q_{a,m}^S - \sum_{z=1}^{N} \sum_{a} q_{z,k}^S \cdot ptdf_{z-na} + \sum_{z=1}^{N} \sum_{a} q_{z,k}^B \cdot ptdf_{z-na} = 0
\]

\( ptdf_{z-na} \) — power transfer distribution factors for exchanges from area \( z \) on all interconnection lines of area \( a \)

\[
\text{Constr}_{t,cbco}: \left[ amf \right] \leq \left[ AMF \right]
\]
\( amf \) — induced physical flows by accepted orders on monitored branches for respective critical outage in hour \( t \)

\( AMF \) — available maximum flow on monitored branches for respective critical outage in hour \( t \)

**Additional constraints** to the network constraints can also be defined (not included in MC Simulator):

- In case of congestion of transmission capacity between two areas, there must be price difference between areas connected with this capacity and exchange is in the direction from area with lower price to the area with higher price.
- **Ramp rate:** can be introduced if there is a limit how much exchange on the respective border can be changed in one hour in relation to the previous hour.
- **System security limits** — i.e. to introduce composite ATC limit on overall export or import of market area in one hour.

These additional constraints are not uniquely applied across the European Market Coupling solutions, and represent a second-level constraints when compared to the main constraints (basic network limits, all-or-nothing). However, its theoretical background is explained to the participants of the TSO sessions.
User manual

The User Manual document with detailed description of Graphical User Interface, functionalities and reports of software is provided in separate file.

Figure 12: User Manual excerpts
8. Further steps

MC Simulator project already became an important building block for the understanding MC principles and practice in the region. The project of introducing Market Coupling principles to SEE stakeholders through theoretical background and through the MC Simulator already provided results, in increasing knowledge and understanding among SEE TSOs and Regulators. Theory and methodological approach of MC is presented to the SEE TSOs, and the basics are presented to the Regulators within ECRB EWG.

Test runs:

Among the following activities, it is already envisaged that TSOs within CMMI WG will continue in practicing Market Coupling through regular simulations of roles of MCO, TSO and market participants, on rotational basis. EKC will serve as an administrator (hosting) until September 2014.

After the Vienna workshop held on 24th of April, there is an increased interest of SEE Regulators on the MC Simulator, so it is agreed to include them in the test runs, perhaps together with the TSOs (playing as guests or as market participants).

Before the hosting deadline, one or two testing sessions could be organized for other interested parties, approach the Consultants with the request upon that, and having in mind that test runs by the SEE TSOs and Regulators have a priority.

Bidding data and outputs:

Current point of increased knowledge and understanding of MC opened the field for future possible fruitful outcomes of the project. One can imagine that, if the experts would run MC simulations, using as much as possible realistic data in the simulation could provide more understanding in the regional electricity network and markets. Therefore, MC Simulator could, as a lateral effect, provide additional market signals if filled with proper data, to support investment planning and optimisation and coordination of generation and transmission investments, as well as providing the coordinated priority list of regional projects, being aligned and compared at the same environment.

One typical advantage of such approach is related to the transmission infrastructure: with realistic capacities and as much as possible realistic range of bids, outputs of MC Simulator can provide an insight into the congestion locations (ATCs for certain borders, or per real network elements - critical branches at the flow-based simulations), even ranking it according to their shadow price, thus providing clear locational and economic signals for the potential network investments.

**Capacities:** Whether ATC-based or Flow-based, it is expected that the SEE TSOs are definitely capable to provide realistic transfer capacities; NTC/ATC values as regularly calculated and allocated at all borders, or PTDF/AMF values which are often calculated in SEE at previous flow-based investigations.
Bids: Placing bids at MC Simulator with realistic generation portfolio in behind would require at least knowledge on the generation facilities in modelled SEE systems. These data are not regularly collected by the TSOs, or at least impose some confidentiality issues. TSOs already collected the portion of SEE data which is available; however, it is needed to complete such data for all areas and all major power plants. For this, further research is needed on the publicly available data, and also a replacement strategy to provide the realistic ranges for the data which are not available.

Further development: Consultants are opened for further development of MC Simulator according to the application refinements across Europe (PCR, flow-based, additional constraints, etc.), and the testing and simulation needs of potential users.

After September 2014, further administration of EnCS MC Simulator as an open tool for training and education can be agreed and provided in cooperation of EKC&DMS and EnCS. This could be done in a way that the Consultants continue with administration and organizing the training/demo sessions for all interested stakeholders, also possibly with providing the demo data to facilitate the process, for a flat service fee per certain period (e.g. yearly), or charged per each session. The details of this should be further refined among the Consultants and EnCS before September 2014.
Annex: Selected slides from presentations

**MC Input data – order book**
- Posted orders are aggregated in single hourly Buy and Sell curves for all hours and respective market areas.
- Each Market Operator sends their respective order book data at the end of the day-ahead auction call phase.
- The marginal offer price for exports from one exchange is represented by a Net Export Curve (NEC).

**MC objective function**
- Coupling markets involves handling their respective supply and purchase curves jointly according to the overall merit order, taking into account the available interconnection capacities.
- The overall aim of market coupling is to maximize the total welfare of all participants.
- The total welfare is defined as the difference between the cumulative amount that the buyers are ready to pay and the cumulative amount that the sellers want to be paid over all markets and hours.

\[
W = \sum_{t=1}^{T} \left( p^B_t \cdot Q^B_t - p^S_t \cdot Q^S_t \right)
\]

- \( p^B_t \) – price that buyer is willing to pay for the accepted power quantity
- \( p^S_t \) – price at which seller is willing to sell for the accepted power quantity (negative sign)
- \( Q^B_t \) – accepted quantity of buy order
- \( Q^S_t \) – accepted quantity of sale order
- \( N \) – number of market areas
- \( E \) – number of buy orders
- \( M \) – number of sale orders

**MC constraints**

**Order constraints**
- \( q^B_k \leq Q^B_k \) (partly buy orders)
- \( q^S_k \leq Q^S_k \) (partly sell orders)
- \( q^B_k \leq M \) (number of buy orders)
- \( q^S_k \leq E \) (number of sell orders)

**Power balance constraints**
- \( q^B_k - q^S_k = 0 \) (power balance)
- \( q^B_k \) – accepted quantity of buy order
- \( q^S_k \) – accepted quantity of sale order
- \( N \) – number of market areas
- \( E \) – number of buy orders
- \( M \) – number of sell orders

**ATC network constraints**
- \( \text{Constr}_{a,b} \leq \text{ATC}_{a,b} \) (flow constraints)
- \( N \) – number of market areas
- \( \text{ATC}_{a,b} \) – available transfer capacity from area \( a \) to area \( b \)
- \( a \), \( b \) – market areas

**Flow based network constraints**
- Defined with PTDF matrix and Available Maximum Flow (AMF) values, related to the pairs of critical branches/critical outages (cbos)

**Additional constraints can be defined, such as:**
- Flow ramping
- Net position ramping
- Cumulative ATC
- Losses
- Tariffs
**MC simulation**

- Market coupling of two markets with no congestion

- Market coupling of two markets with congestion

**Forms of market coupling in Europe**

- Price coupling
  - Brings several electricity markets managed by different entities into one market area
  - Maintains the independent nature of each market

- Market Splitting
  - Harmonized market managed by a single regional entity
  - Integrates energies from several areas

- Volume Coupling
  - Used as the interim solution towards price coupling
  - Calculates only commercial flows between market areas or regions

**Forms of market coupling in Europe**

**PRICE COUPLING**

- Price coupling (Central-West Europe and Market Splitting (Scandinavia): Different paths to the same result of clearing!

**MC in Europe – current status**

- Map showing the current status of market coupling solutions in Europe.
### European price coupling

- Target model for the day-ahead timeframe is a European Price Coupling (EPC) model which will simultaneously determine volumes and prices for all price zones in Europe.

- Based on three main principles:
  - One single algorithm
  - Robust operation
  - Individual accountability

- The integrated European electricity market will be beneficial due to increased liquidity, efficiency and social welfare.

### Price Coupling of regions

- Price Coupling of Regions (PCR) is a Market Coupling project focused on the delivery of a common European price coupling solution.

- Initiative of seven European Power Exchanges to harmonize the European electricity markets (APX-ENDEX, Belpex, GME, EPEX SPOT, Nord Pool Spot, OMIE and OTE).

- First to be implemented in the NWE region and planned to go live by end of the 2013.

### Price Coupling of regions

- An important part of all regional market coupling projects, linking them all together.

- Development of a single price coupling algorithm - Euphemia.

- For TSOs, PCR can provide the tool to grant efficient capacity allocation.

- For PXs, PCR will represent decentralized solution for a single price coupling function as coordinated matching service which allows replacement of their existing matching services within the different existing PXs arrangements.

### SEE Current Status

- Power exchanges established in Italy, Austria, Slovenia, Hungary, Romania, Greece.

- Participating in market coupling:
  - Austria (participating in CWE market coupling)
  - Hungary (trilateral coupling with Czech Republic and Slovakia)
  - Italy and Slovenia (bilateral coupling)

- Initiatives in other countries (Romania, Serbia, Bulgaria...).
Day ahead market:
market coupling process

Market participants

- Power exchange products are represented in two types of orders:

1. Hourly order
   - Defined by Buy/Sell quantity and price for one specific hour
   - If accepted MCP must be equal or higher than order bid price in case of Sell order, and equal or lower than order bid price in case of Buy order
   - Can be accepted fully or partially, unless defined with "All or Nothing" condition

2. Block order
   - Defined by Buy/Sell quantity and price on set of consecutive trading hours
   - If accepted average MCP on set of consecutive hours for which it block order defined, must be equal or higher than order bid price in case of Sell order, and equal or lower than order bid price in case of Buy order
   - Can only be accepted for its full volume, i.e. "All or Nothing" condition always apply

Transmission System Operator (TSO)

- TSOs define transfer capacities on a hourly basis as an input of market coupling process

PTDF matrix and AMF values, related to the c/c/o pairs

Market Coupling Operator - MCO

- MCO (previously called NEMO) collects respective order book data from all bidding areas at the end of the day-ahead auction call phase
- In MC Simulator MCO is in charge of Market Clearing process including:
  - Selection of Market Coupling model (ATC or FB market coupling model)
  - Opening/closing “Input of transfer capacities phase”
  - Opening/closing “Bidding phase” for submitting trading orders
  - Starting Market Clearing process