Stakeholder Forum on Implementing the Target Model in the SEM

28th May 2013

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Overview of work by TSOs and SEMO

28th May 2013

Overview of work being carried out by TSOs and SEMO

- Since the publication of the Next Steps decision paper, the RAs asked the TSOs and SEMO to carry out initial analysis of key issues in advance of the selection and arrival of RA consultants;

- Work proposed is strictly limited to analysis of external requirements that may impact on work of RA market design consultants;

- Areas of analysis are –

    - Review and analysis of Network Code requirements;

    - Operating the power system with shorter Gate Closure times;

    - Review and analysis of Price Coupling of Regions (PCR) information;

Review and analysis of Network Code requirements

- An in-depth review of the market codes;
- Complete article by article review;
- Set out what parties have to complete what actions and in what timescales;
- Applies to methodology development as well as normal day to day processing;
- Intends to identify obligations, rights and requirements set out in the Codes;
- Focus on CACM, Forwards Capacity Allocation and Electricity Balancing but other codes will also be reviewed;

Operating the power system with shorter Gate Closure times

- To consider the like impacts on system operations of market activity closer to real time;

- Look at the operational issues that could arise, in terms of –

  - System security;
  - System economics;
  - IS system requirements;
  - Control room activities;

- First phase is a review of existing operational issues in the SEM environment;

- When Network Code analysis is advanced, implications of these new requirements will be considered;

Review and analysis of Price Coupling of Regions (PCR) information

- SEMO became associate members of Europex in Nov. 2011;

- Europex instrumental in the development of the PCR algorithm and software;

- Through our membership, we have had access to documentation covering detailed requirements including forms of orders included;

- However, detailed requirements are bound by non-disclosure agreements;

- We have been working with our colleagues in PCR to come up with public presentations;

- The areas we intend to cover relate to high level workings of the algorithm, forms of orders, and price determination;

Overview of work being carried out by TSOs and SEMO

- Areas of analysis are –
  - Review and analysis of Network Code requirements;
  - Operating the power system with shorter Gate Closure times;
  - Review and analysis of Price Coupling of Regions (PCR) information;

- Reports will be provided to the RAs in June covering the results of this work ;

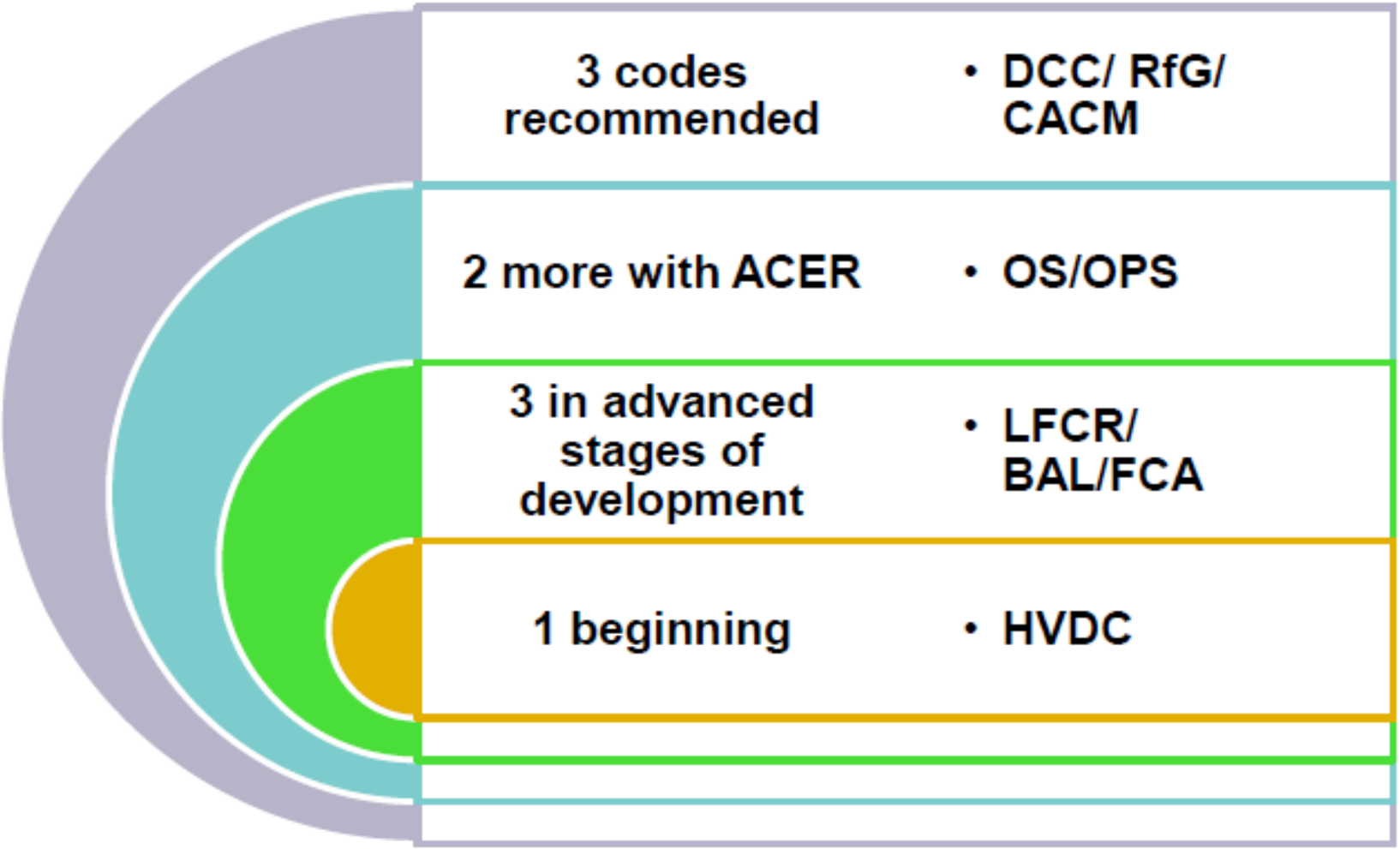
- Intention of today's presentations is to give the industry an overview;

Stakeholder Forum on Implementing the Target Model in the SEM

CACM Update, methodologies & proposed timings

28th May 2013

Where are the Network Codes at?

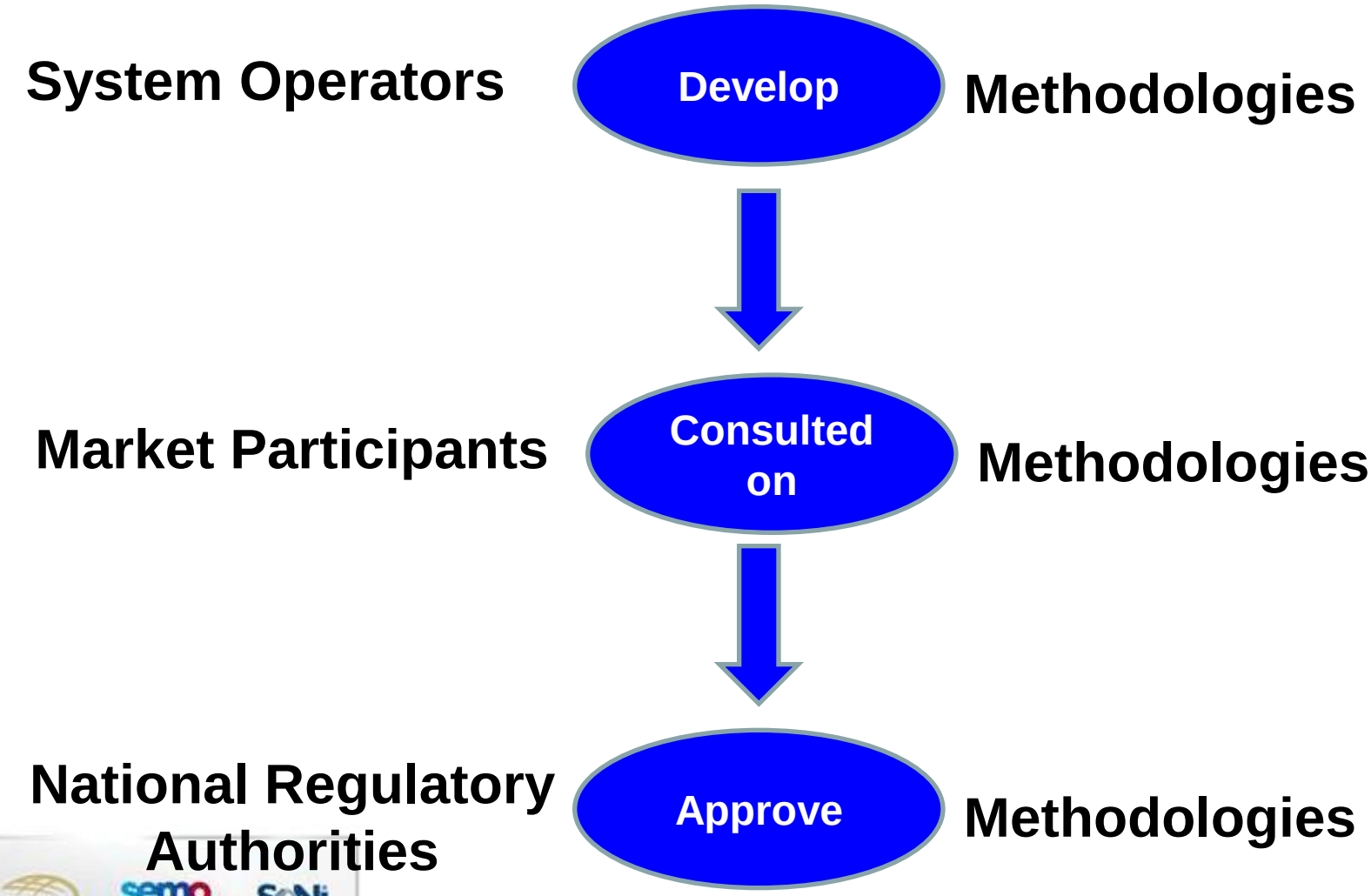


CACM – developments to date

CACM will be the <u>first</u> Network Code to go to Comitology

- 27 Sep 2012 - ENTSO-E submits NC CACM to ACER
- 12 Dec 2012 - ACER Opinion on NC CACM
- 08 Feb 2013 - ENTSO-E confirms it will not resubmit NC
- 14 Mar 2013 - ACER Qualified Recommendation to EC
- 18 Mar 2013 - ENTSO-E views on ACER QR to EC
- 18 Apr 2013 - EC merges NC CACM & GG
- 31 May 2013 - Informal Comitology meeting

CACM NC - Methodologies



Capacity Calculation Regions

- 14(1): All SOs shall make a common proposal on CCR no later than **two months** after entry into force of NC

Redispatching & Countertrading

- 81(1): All SOs shall establish a methodology for Redispatching or Countertrading no later than **eighteen months** after entry into force

Generation & Load Data

- 16(1): All SOs develop a single methodology no later than **four months** after entry into force
- 16(6): All SOs shall publish no later than **two months** after the approval by all National Regulatory Authorities:

  (a) a list of entities required to provide information;

  (b) a list of information to be provided; and

  (c) a time schedule for providing information.

Common Grid Model

- 18(1): All SOs shall develop a proposal for a Common Grid Model methodology no later than **six months** after the entry into force of this NC
- 19(1): A reassessment shall not be launched earlier than **one year** after the previous (re)assessment

Capacity Calculation

- 22(1): All SOs of each CCR shall develop a proposal for a common coordinated CC methodology no later than **twelve months** after entry into force
- 31(5): Each CCC shall report all reductions made during the validation of XZ capacity to all NRAs of the CCR, incl. location, amount, justification every **three months**
- 32(1): All SOs shall establish a European Merging Function and define rules for its operation no later than **twelve months** after entry into force
- 32(2): All SOs of each CCR shall establish the CCC(s) and define rules for it operation no later than **twelve months** after entry into force
- 36(1): All SOs shall prepare and send to all NRAs a report on the CC process no later than **two years** after entry into force

Bidding Zone(s)

- 37(4)(e): SOs involved in reviewing a BZ configuration shall make a proposal to maintain/ amend to NRA(s) within **twelve months** of the decision to launch a review
- 39(1): the efficiency of the current BZ configuration shall be assessed every **two years**
- 40(3): the first biennial technical report shall be delivered no later than **six months** after entry into force, and every second year thereafter by end March

Algorithm Development

- 43(1): All SOs jointly provide MCO(s) with set of requirements for efficient capacity allocation to enable development of algorithms no later than **six months** after entry into force
- 43(1): All NEMOs jointly provide MCO(s) with set of requirements for efficient matching to enable development of algorithms no later than **six months** after entry into force
- 43(3): MCO(s) shall develop a proposal for the algorithms, which meets the requirements of SOs & NEMOs, no later than **six months** after the provision of the requirements in 43(1)
- 43(4): If appropriate, MCO(s) shall work with SOs/NEMOs to refine the proposal for a period not exceeding **two months**
- 44(1): SOs/NEMOs & MCO(s) shall review the price coupling algorithm & continuous trading matching algorithm at least every **two years**
- 47(3): NEMOs shall consult with Market Participants, SOs & NRAs at least every **two years**

Scheduled Exchanges

- 50(1): SOs shall define and implement a methodology to be used in calculating Scheduled Exchanges resulting from the DA market no later than **twelve months** after entry into force
- 50(2): Timeline for delivering information from NEMOs to SEC shall be no later than **15.30 D-1**
- 51: Where required, SOs shall review the methodology for calculating scheduled exchanges resulting from the DA market at least every **two years**

Day Ahead Market Coupling Process

- 53(1) CCC(s) shall ensure the XZ capacity shall be provided to the MCO(s) in time to ensure the publication of the XZ capacity to the market no later than **10.00 D-1 GMT**
- 53(4) Each SO shall provide Allocation Constraints to the MCO(s) no later than **10.00 D-1 GMT**
- 54(1) DA market shall open no later than **10.00 D-1 GMT**
- 54(2) DA market shall close no later than **11.00 D-1 GMT**
- 58(2) MIA shall publish market information no later than **15.30 D-1**
- 61(4) NEMOs shall consult with Market Participants, SOs & NRAs at least every **two years**

Pricing of Intraday Capacity

- 63(2): All SOs shall develop a single methodology for the pricing of Intraday XZ Capacity no later than **twenty four months** after entry into force
- 64(1): SOs shall define and implement a methodology to be used in calculating Scheduled Exchanges following the Matching of Orders in the Intraday market no later than **twelve months** after entry into force
- 65: Where required, SOs shall review the methodology for calculating Scheduled Exchanges resulting from the Intraday Market at least every **two years**

Intraday Market Process

- 66(1): CCC(s) shall ensure the XZ capacity is provided to the MCO(s) no later than **15 minutes** prior to the intraday XZ GOT
- 66(4): Each SO shall provide Allocation Constraints to the MCO(s) no later than **15 minutes** prior to the intraday XZ GOT
- 67(3): Intraday XZ GCT shall be at a maximum **one hour** ahead
- 71(4): NRAs to review compatibility of regional auctions at least every **two years**

Firmness

- 76: All SOs shall develop a proposal for a single Day Ahead Firmness Deadline which shall not be shorter than ½ hour before DA GCT no later than **twelve months** after entry into force

Congestion Income Distribution

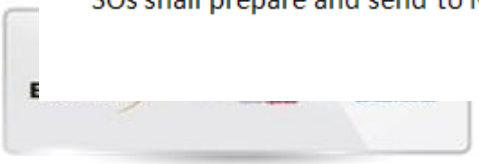
- 81(1): All SOs shall establish a methodology for sharing Congestion Income no later than **twelve months** after entry into force

Methodologies - Timelines

	After entry into force
Generation and Load Data Provision Methodology All SOs shall develop for the delivery of generation and load data required to establish CGM	4 mths
Common Grid Model Methodology All SOs shall develop a Common Grid Model	6 mths
Capacity Calculation Methodology All SOs of CCR shall develop a common coordinated Capacity Calculation Methodology	12 mths
Calculation of Scheduled Exchanges Methodology SOs shall define & implement for calculating Scheduled Exchanges resulting from the Day Ahead Market	12 mths
Congestion Income Distribution Methodology All SOs shall establish a methodology for sharing Congestion Income	12 mths
Redispatching or Countertrading Cost Sharing Methodology All SOs of CCR common methodology for Cross Border Redispatching or Countertrading cost sharing	18 mths
Pricing of Intraday Capacity Methodology All SOs shall develop a single methodology for the pricing of Intraday Cross Zonal Capacity	24 mths

Other - Timelines

	After entry into force
Capacity Calculation Regions SOs shall make common proposal regarding the Capacity Calculation Regions	2 mths
Biennial Technical Report SOs shall deliver first biennial technical report	6 mths
Algorithm Development SOs shall provide MCO with a set of requirements to enable algorithm development	6 mths
Algorithm Development MCO(s) shall develop a proposal for algorithms	6+6 mths
Capacity Calculation Process SOs shall establish a European Merging Function	12 mths
Capacity Calculation Process SOs of each CCR shall establish a Coordinated Capacity Calculator(s)	12 mths
Day Ahead Firmness Deadline SOs shall develop a proposal for a single Day Ahead Firmness Deadline	12 mths
Biennial Report on Capacity Calculation SOs shall prepare and send to NRAs a report on the Capacity Calculation Process	24 mths



Stakeholder Forum on Implementing the Target Model in the SEM

The Day-ahead Market Coupling Process

28th May 2013

Development of the Network Codes

Collectively "the Third Energy Package"

- Directive 2009/72/EC
- Regulation EC/714/2009
- Regulation EC/713/2009

Electricity Grid Connections	Capacity Allocation and Congestion Management for Electricity	Electricity System Operation	Electricity Balancing
Requirements for Generators	Capacity Allocation & Congestion Management	Operational Security	Electricity Balancing
Demand Connection Code	Forward Capacity Allocation	Operational Planning & Scheduling	
HVDC		Load Frequency Control & Reserves	

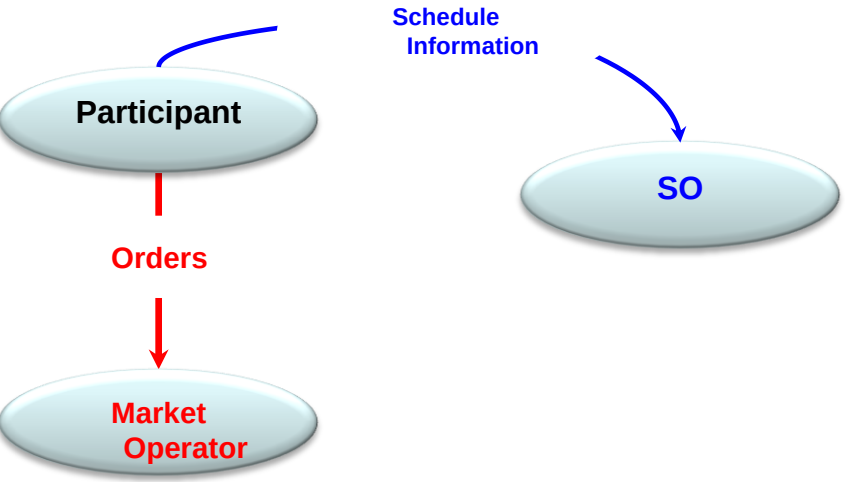
Day-Ahead Market Coupling & Continuous Intraday Trading

- The focus of this presentation is to set out the processes as defined in the Network Code for Capacity Allocation and Congestion Management;
- Based on ENTSOE version of Network Code in terms of process steps;
- Roles and functions based on EC Governance Guidelines;
- Where possible, we have avoided items that are not considered “stable”;
- Aims to set out who does what and when;
- Intends to only set out the processes that apply for day-ahead market coupling and continuous intraday trading;
- No assumptions have been made about local market arrangements;

Actors in the day-ahead & intraday processes -

- Participant;
- Market Operator;
  - Functions are –
    - Nominated Electricity Market Operator;
    - Market Coupling Operator;
    - Central Counter Party;
  - Highlighted in Red in following slides;
- System Operator;
  - Functions are –
    - European Merging Function;
    - Coordinated Capacity Calculator;
    - Scheduled Exchange Calculator;
  - Highlighted in Blue in following slides;

Day-Ahead Process Flow

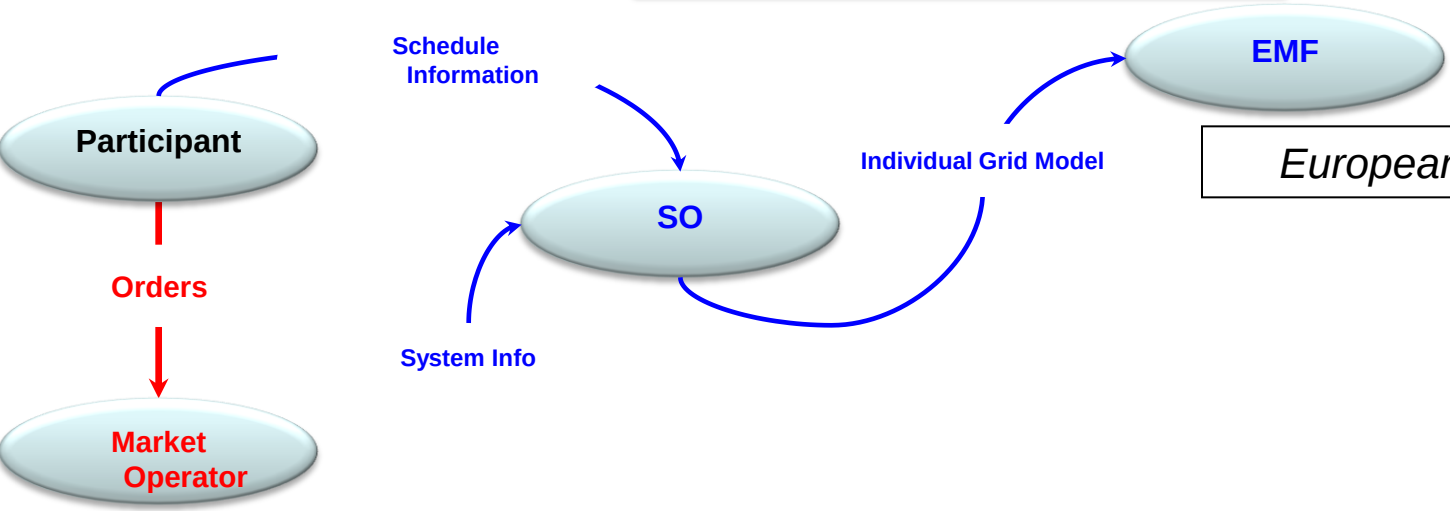


Market Operator function
System Operator function

Participant

- Provision of generation and load data to System Operator;
  - Technical data;
  - Availability;
  - Data relating to scheduling and dispatch of units;
  - In central dispatch arrangements, this equates to commercial offer data;
- Provision of “orders” to Market Operator;
  - Orders are in Euro and include relevant trading periods (Market Time);
  - Types of orders covered by PCR;
  - Gate opening for day-ahead coupling is no later than 10AM GMT on day-1;
  - Gate closure for submissions is 11AM GMT on day-1;

Day-Ahead Process Flow



European Merging Function

Market Operator function
System Operator function

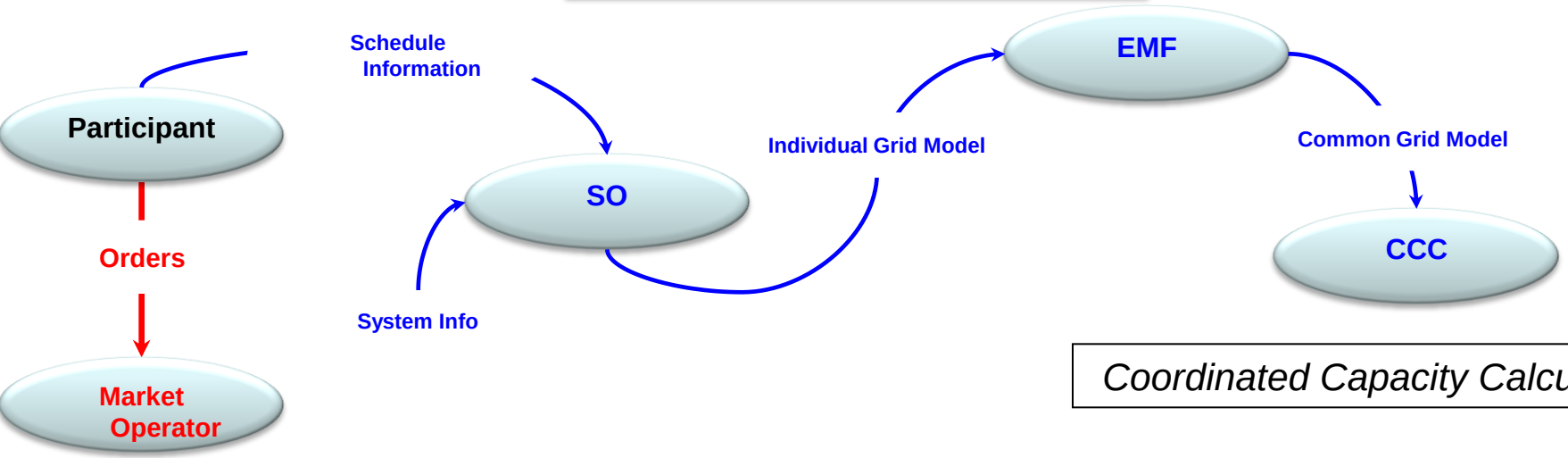
System Operator → *European Merging Function(EMF)*

- Creates Individual Grid Model
- Each Individual Grid Model will include –
  - latest demand and generation forecasts;
  - topology of the Transmission system;
  - aggregated generation for Distribution connected facilities;
  - proposed remedial actions;
  - Individual Grid Models will be created for a set of scenarios;

"Remedial Actions" – actions intended to relieve physical congestion

- The individual Grid Model feeds into the European Merging Function;

Day-Ahead Process Flow



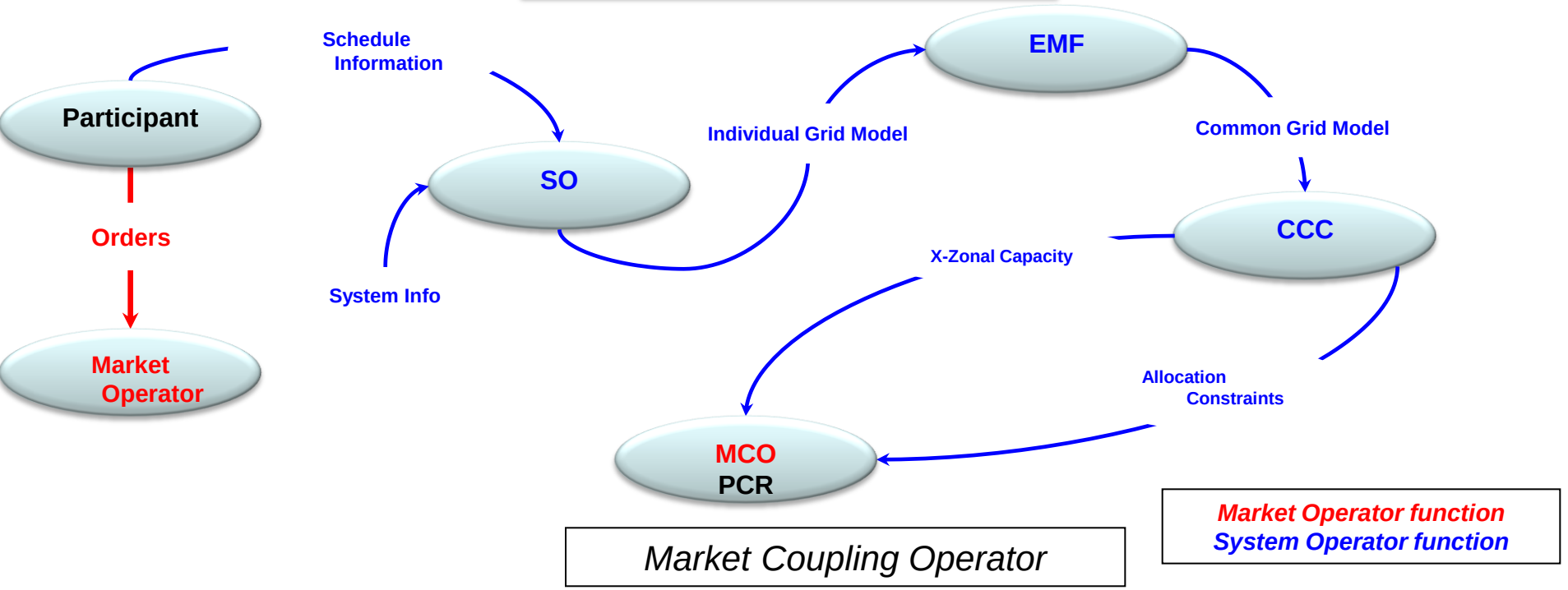
Coordinated Capacity Calculator

Market Operator function
System Operator function

European Merging Function(EMF) → *Coordinated Capacity Calculator (CCC)*

- Role assigned to System Operators;
- Task of creating a single Common Grid Model for all connected areas;
- Same level of detail as the Individual Grid Models;
- A model of the transmission system with the location of relevant generation and load units;
- A Common Grid Model is to be created for each of the defined scenarios as used in the creation of the Individual Grid Models;
- Output is provided to the Coordinated Capacity Calculator (CCC);

Day-Ahead Process Flow



Coordinated Capacity Calculator (CCC) ⟶ *Market Coupling operator (MCO)*

- Each CCC carries out the capacity calculation for its capacity calculation region (CCR);

- Regions to be defined;

- While NC indicates existing European Regional Initiatives, note that a bidding zone border can only belong to one CCR;

- Inputs to this process -

    - Operational security constraints;
    - Generation Shift Keys;
    - Remedial Actions;
    - Reliability Margins;
    - Allocation Constraints;
    - Previously allocated cross zonal capacity;

Coordinated Capacity Calculator (CCC) ⟶ *Market Coupling operator (MCO)*

- Each CCC carries out the capacity calculation for its capacity calculation region (CCR);

- Regions to be defined;

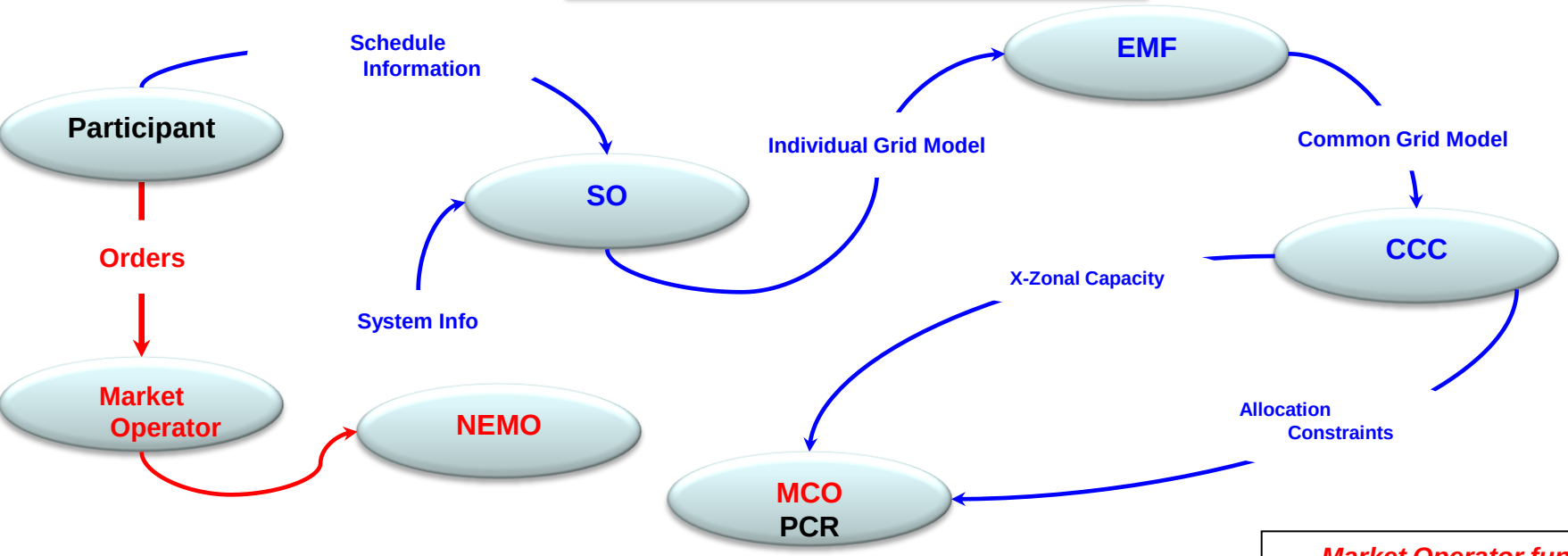
- While NC indicates existing European Regional Initiatives, note that a bidding zone border can only belong to one CCR;

- Outputs of this process -
  - Allocation Constraints;
  - Cross Zonal Capacity;

- Values are first submitted to the System Operators of the capacity calculation region for validation;

- CCC submits data to the Market Coupling Operator by 10AM GMT on day-1;

Day-Ahead Process Flow



Market Operator function
System Operator function

Nominated Electricity Market Operator (NEMO)

- Designated by the member state, subject to opinion of NRA;

- Designation criteria includes –

  - adequately resourced to operate day-ahead and intraday processes;
  - have sufficient IT systems;
  - can fulfil requirements of the Market Coupling Operator (MCO);
  - proven ability to deliver the requirements;

- Other requirements include –

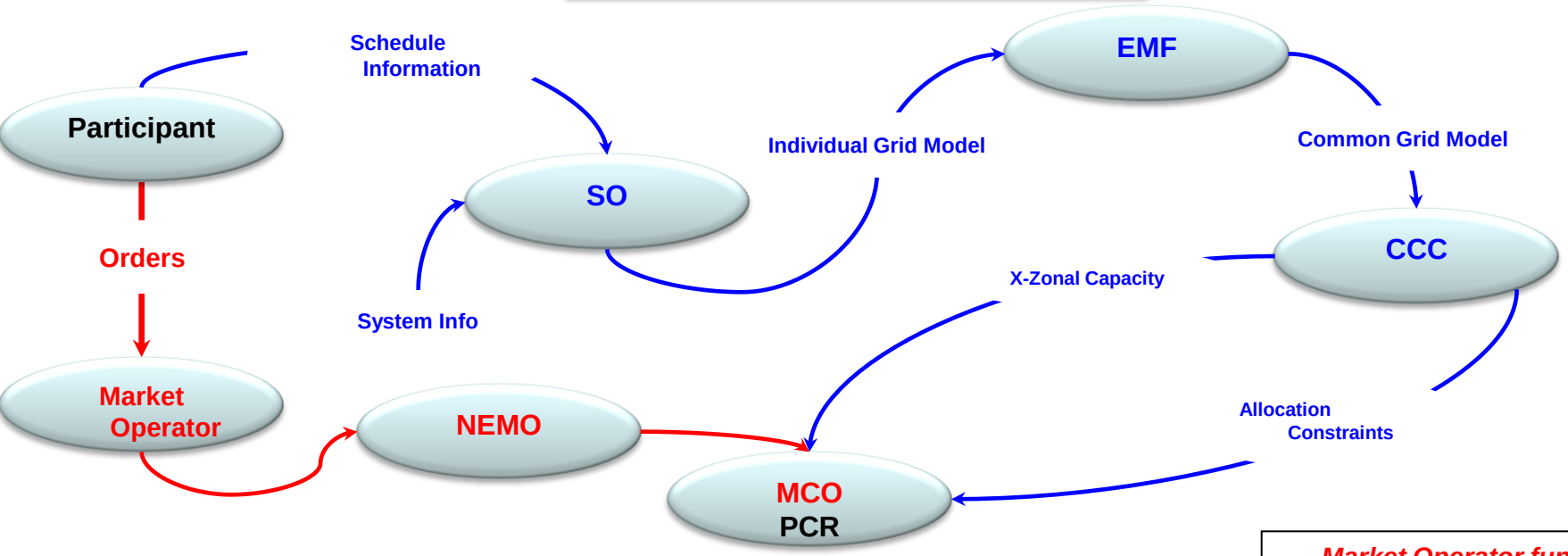
  - cost efficient;
  - independent from market participants;
  - act in non-discriminatory manner;
  - provide appropriate transparency while respecting confidentiality agreements;
  - provide market clearing services;

Nominated Electricity Market Operator (NEMO)

- Roles and responsibilities of the NEMO are –
  - operating local markets;
  - receiving orders for European arrangements;
  - sharing anonymous orders with Market Coupling Operator (MCO);
  - publication of prices;
  - informing participants of results of MCO processes;
  - act as Central Counter Party;
  - settle and clear contracts (executed orders);

- Additional points –
  - coordination with other NEMOs;
  - operating the MCO functions;
  - implementing back up procedures;
  - submission of costs to NRAs;

Day-Ahead Process Flow



Market Operator function
System Operator function

Market Coupling Operator(MCO)

- The MCO is a role which will be carried out by one of participating NEMOs

- Roles and responsibilities of the MCO are –

  - receiving order information from the NEMOs;
  - operation of the day-ahead market coupling process and systems;
  - validation of results;
  - communication of results back to NEMOs;

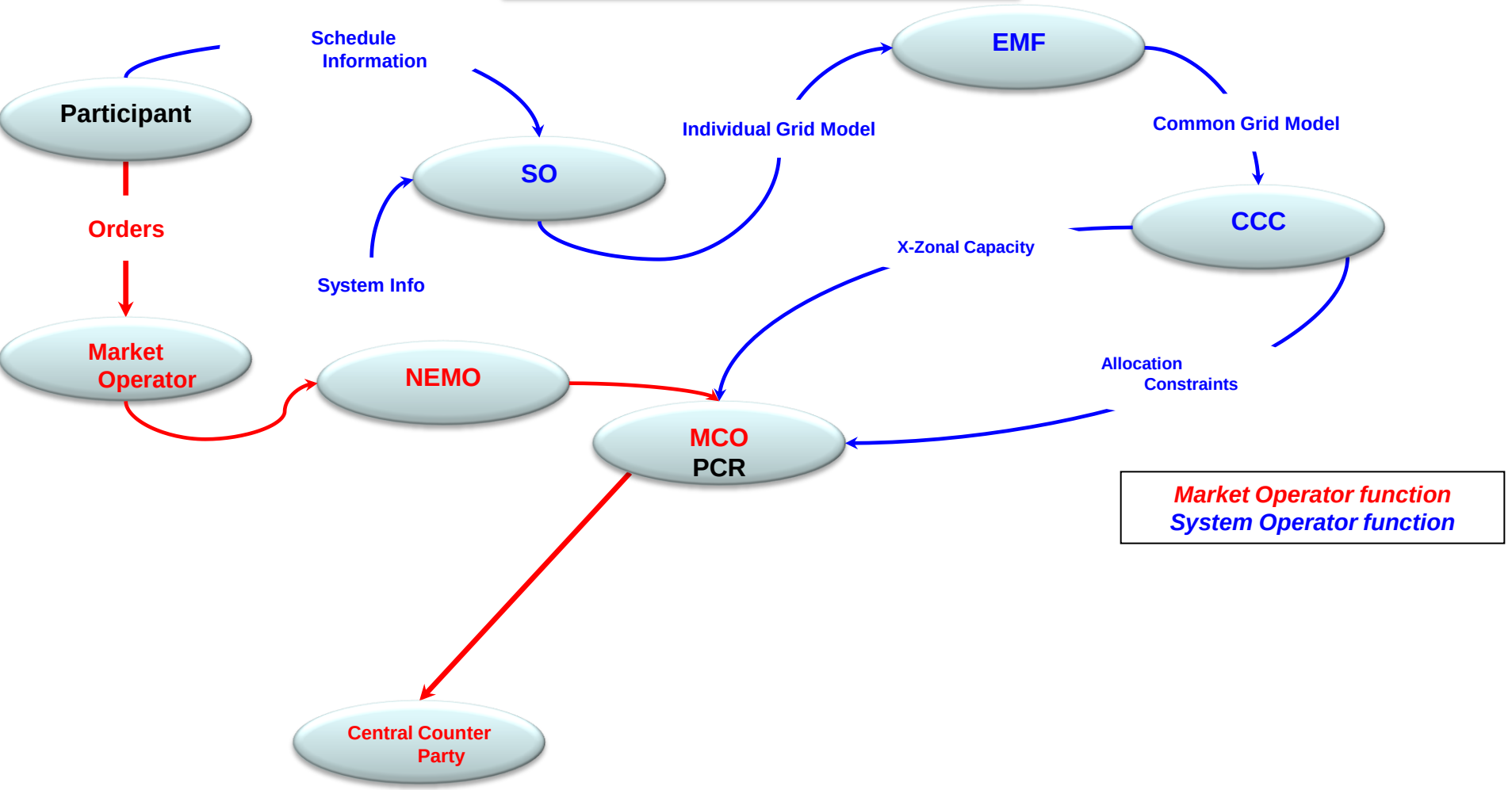
- The day-ahead market coupling process has as inputs –

  - Cross Zonal capacities for all bidding zone borders;
  - Anonymized participant orders;

- The process has as outputs –

  - Net positions;
  - Executed Orders;

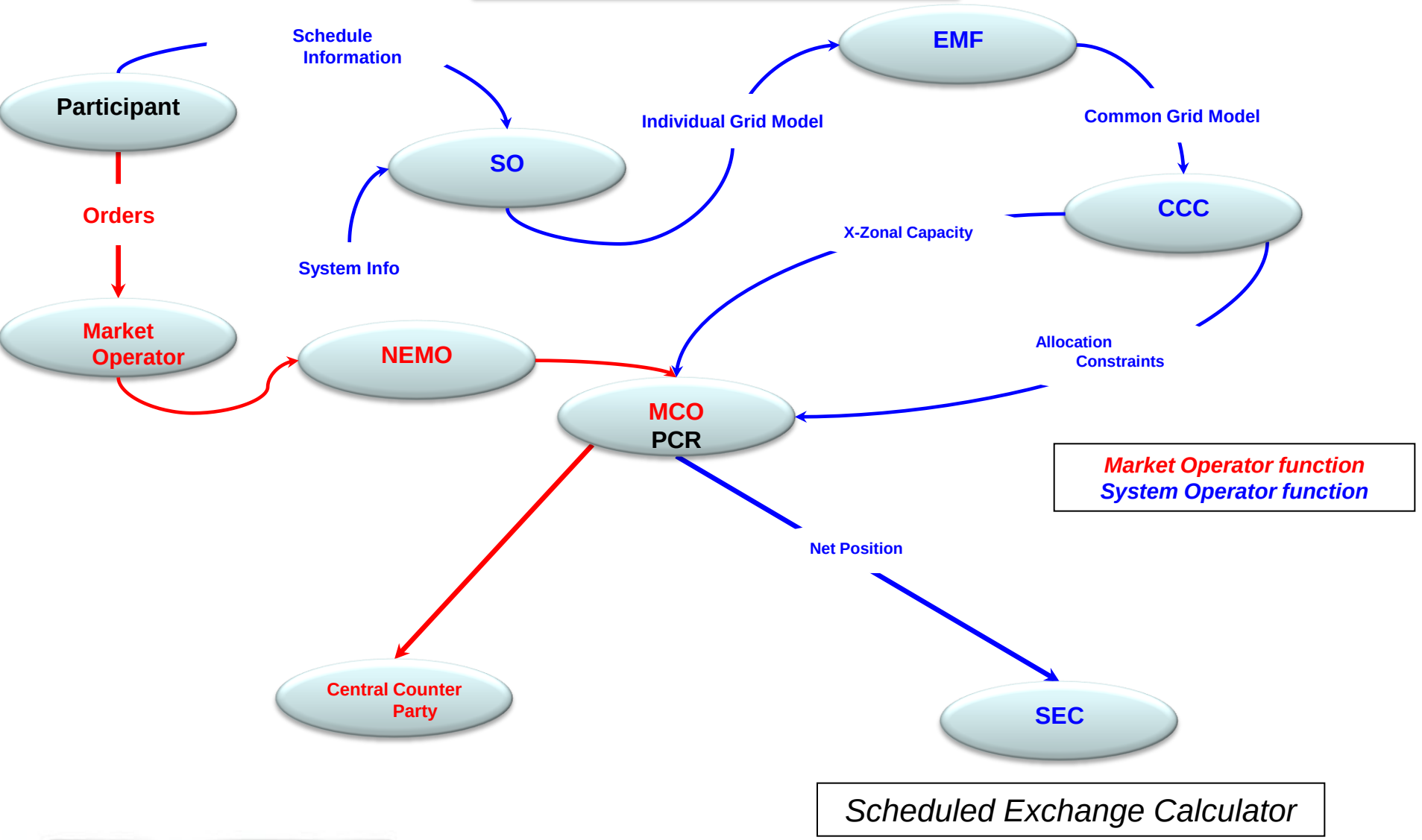
Day-Ahead Process Flow



Market Coupling Operator(MCO) ⟶ *Central Counter Party (CPP)*

- Outputs - Executed Orders
- In essence, commercial offers that are in merit;
- Data back to NEMO will be anonymous based on NEMO's submissions;
- Market results will be communicated to participants;
- Market prices will be published by NEMO;
- This will be the basis of participant's trading in the day-ahead coupled market;
- In today's terms, this will be market schedule quantity and price;
- Market prices from the MCO will be a common pan-European price for all participants where bidding zone borders are uncongested;

Day-Ahead Process Flow



Market Coupling Operator(MCO) ⟶ *Scheduled Exchange Calculator*

- Outputs – <u>Net Position</u>

- The netted sum of exports and imports for each market time period for each bidding zone border;

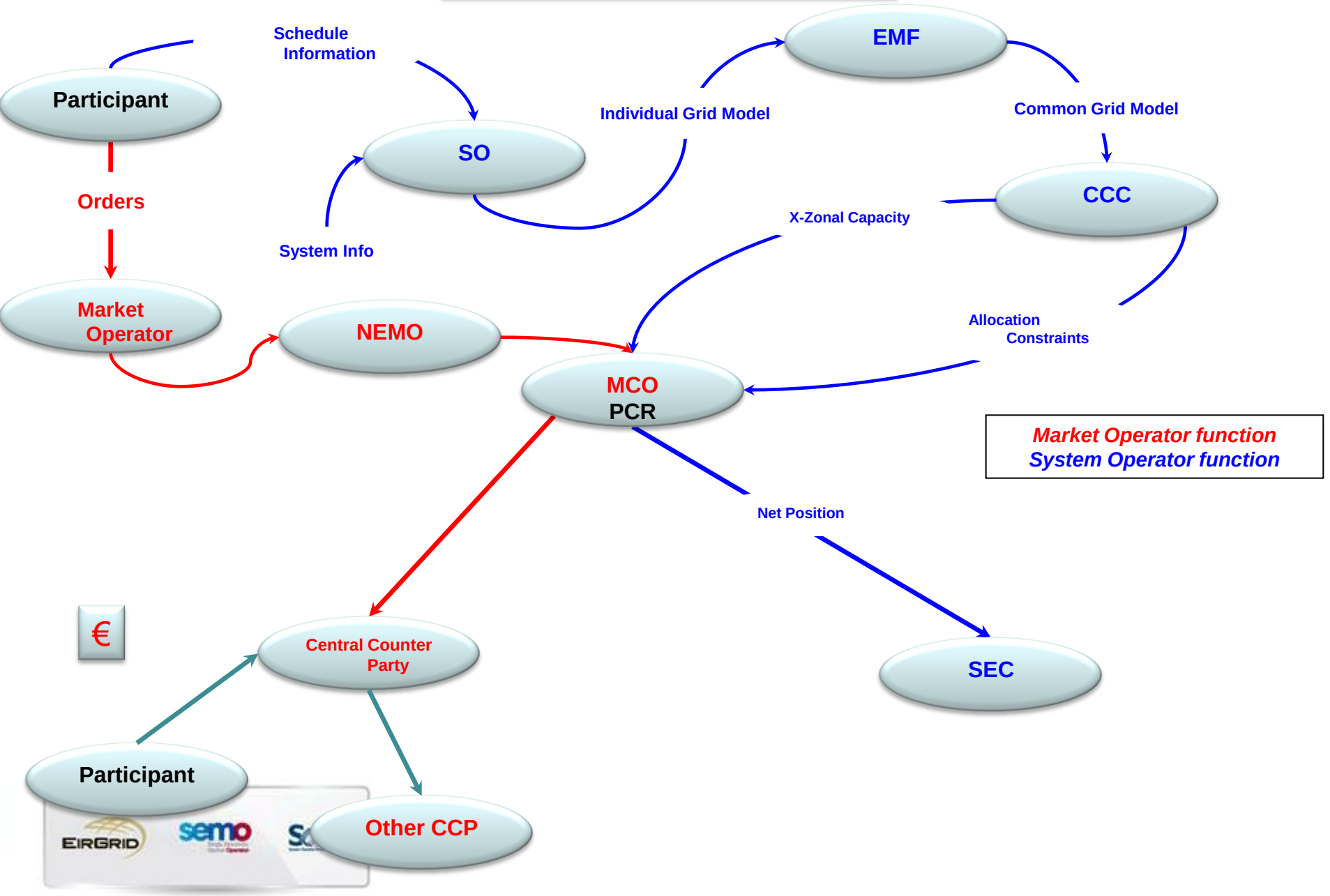
- Note bidding zone border is a single point between two market areas;

- SEM and BETTA currently have one bidding zone border;

- Bidding zone border = sum of interconnectors between to zones;

- Net position is updated flows between market areas, including any pre-market coupling flows (explicit allocations nominated) and results of PCR process;

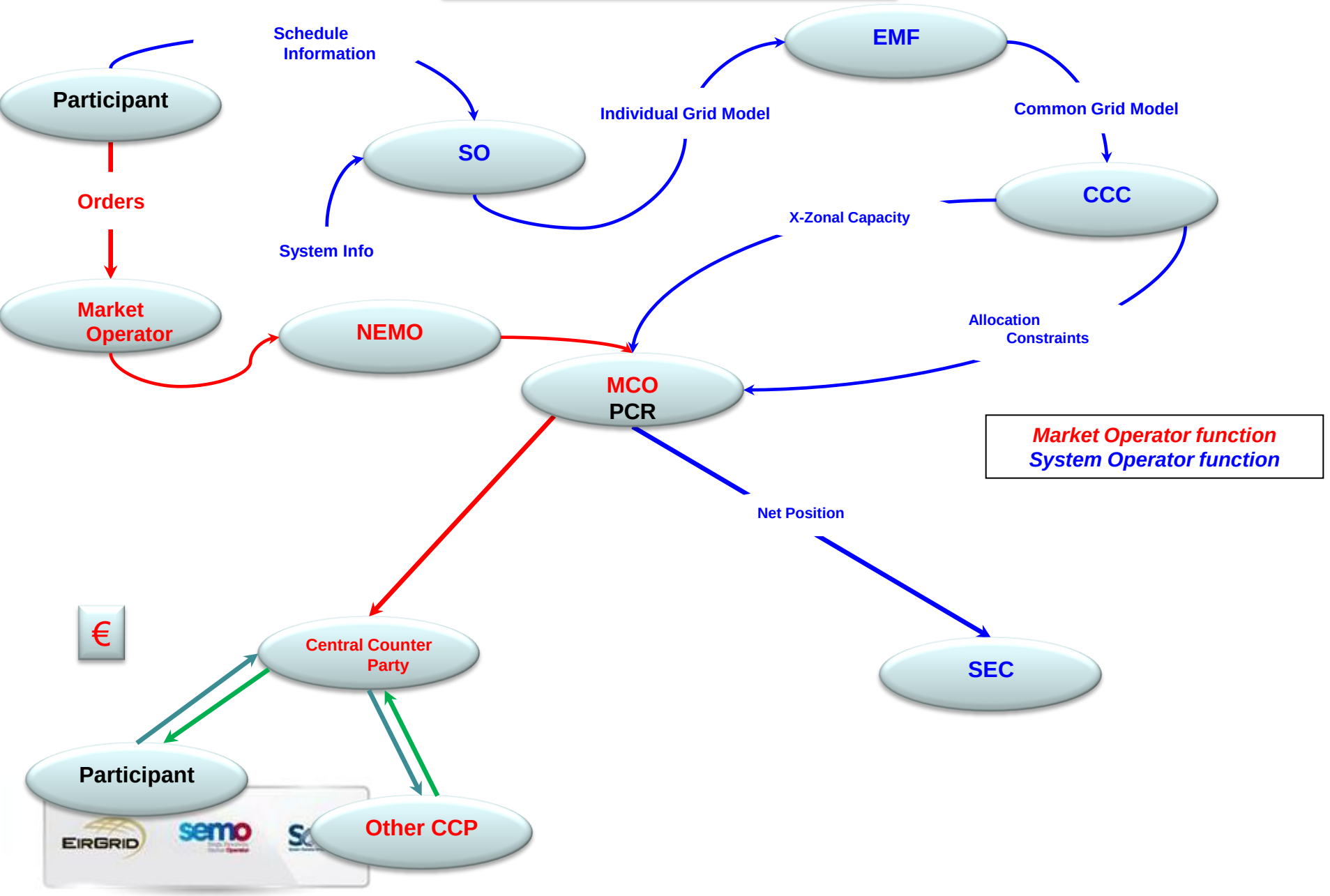
Day-Ahead Process Flow



Central Counter Party (CCP)

- Role assigned to the NEMO;
- Act as counterparty to participants for their matched trades;
- Act as counterparty to CCP in other market area for imports/exports;
- Settlement of imports - money flows from participants (purchases) to Central Counter Party in this market area;
- CCP pays to CCP in other market area(Bidding Zone);

Day-Ahead Process Flow



Central Counter Party (CCP)

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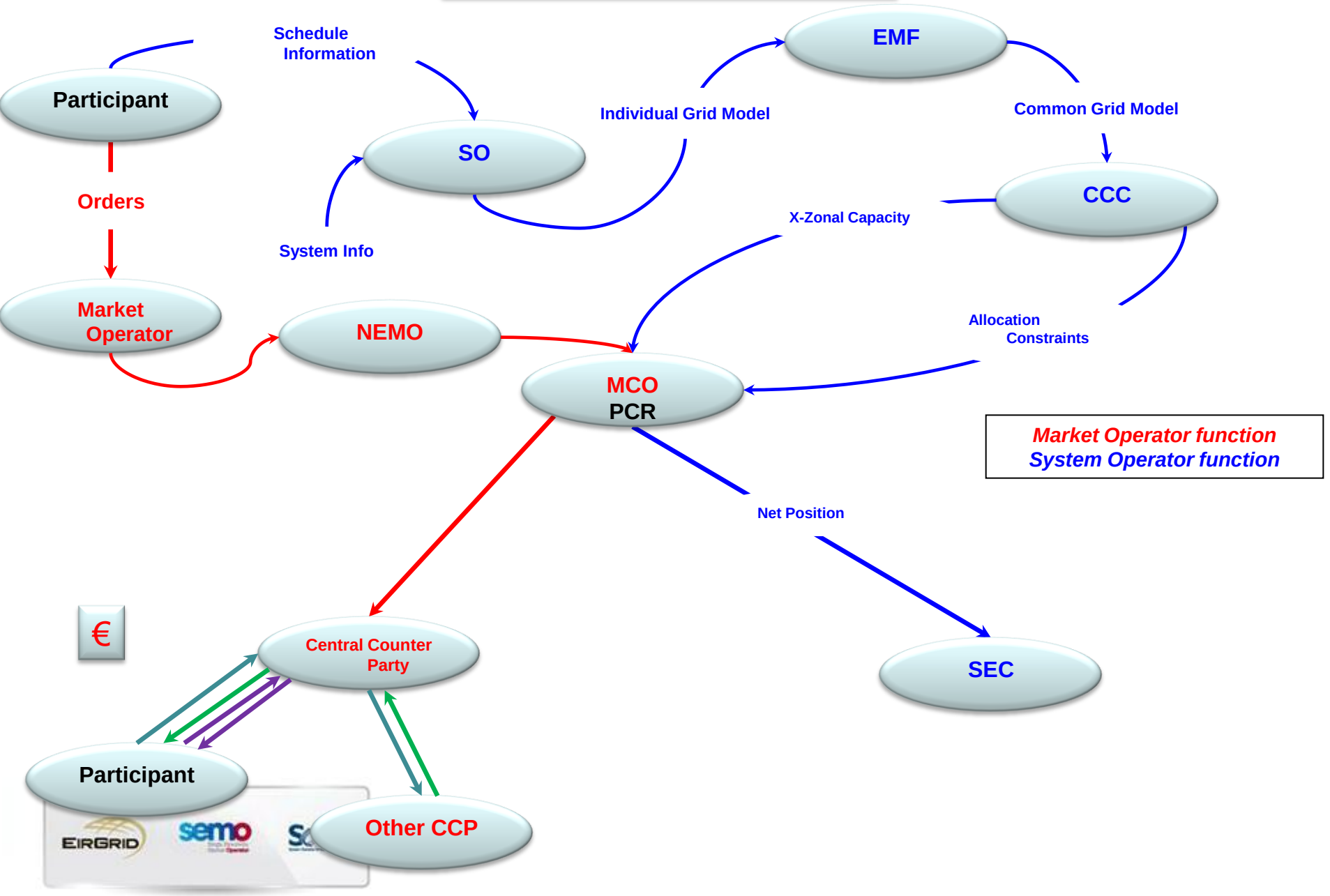
- Act as counterparty to participants for their matched trades;
- Act as counterparty to CCP in other market area for imports/exports;
- Settlement of imports - money flows from participants (purchases) to Central Counter Party in this market area;
- CCP pays to CCP in other market area(Bidding Zone);
- Settlement of exports – money flows from central counter parties from other market areas (Bidding Zones) representing purchases elsewhere to the Central Counter Party, who in turn pays participants (sales);

Day-Ahead Process Flow



Central Counter Party (CCP)

- Role assigned to the NEMO;
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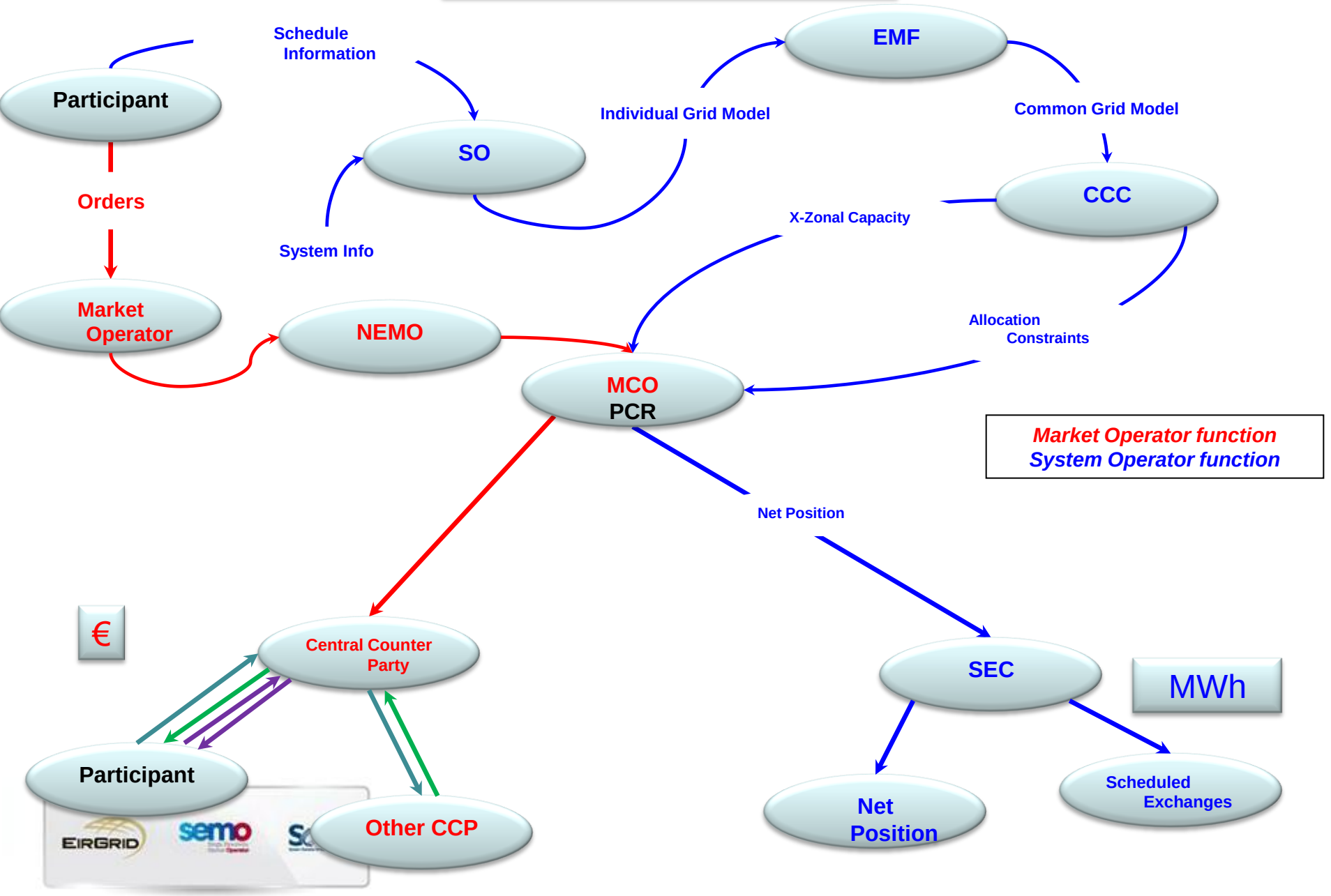
- Act as counterparty to CCP in other market area for imports/exports;
- Settlement of imports - money flows from participants (purchases) to Central Counter Party in this market area;
- CCP pays to CCP in other market area(Bidding Zone);
- Settlement of exports – money flows from central counter parties from other market areas (Bidding Zones) representing purchases elsewhere to the Central Counter Party, who in turn pays participants (sales);
- Settlement of local trades – where PCR schedules local load and generation within the market area, monies for sales and purchases flow through Central Counter Party;

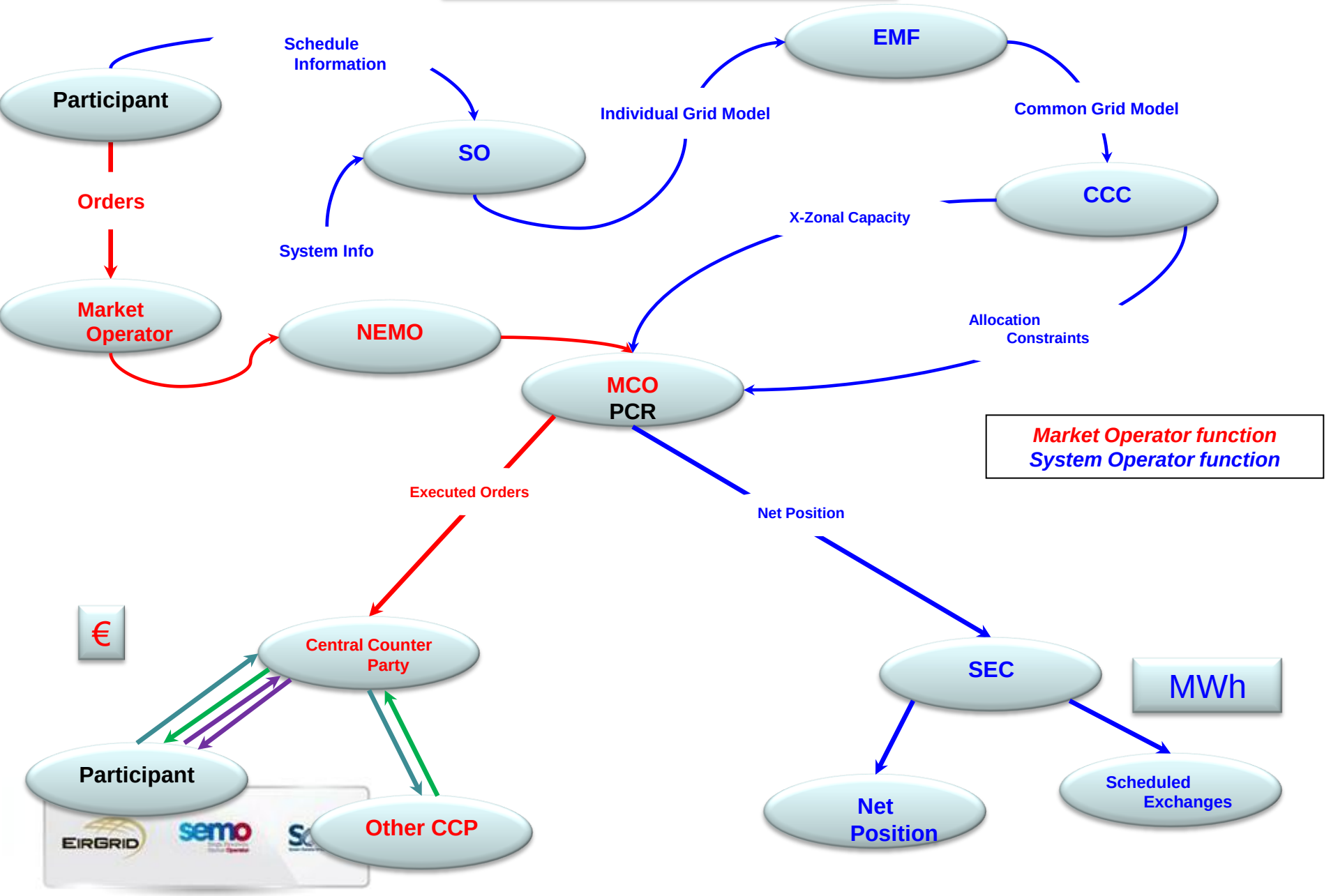
Day-Ahead Process Flow



Scheduled Exchange Calculator (SEC)

- Role assigned to the System Operator;
- Translate net positions into scheduled exchanges;
- A scheduled exchange is actual dispatch schedule;
- This is the process by which aggregate flows between market areas are converted into explicit flows on an interconnector;
- To take the current market as an example,
  - *Net Position = flow between SEM & BETTA;*
  - *Scheduled Exchange = flow on Moyle and flow on EWIC;*
- At the end of this process, flows are scheduled to match the trades that resulted from the PCR process;

Day-Ahead Process Flow



Day-Ahead Process Flow

Stakeholder Forum on Implementing the Target Model in the SEM

The Continuous Intraday Trading Process

28th May 2013

Intraday Gates

- **Intraday Cross Zonal Gate Opening Time** means the point in time when Cross Zonal capacity between Bidding Zones is released for a given Market Time Period and a given Bidding Zone Border;

- **Intraday Cross Zonal Gate Closure Time** means the point in time where Cross Zonal Capacity Allocation is no longer permitted for a given Market Time Period. There is one Intraday Cross Zonal Gate Closure Time for each Market Time Period for a given Bidding Zone Border;

- **Intraday Energy Gate Opening Time** means the point in time when energy trading for a Bidding Zone is permitted for a given Market Time Period. There is one Intraday Energy Gate Opening Time for each day of delivery per Bidding Zone. The Intraday Energy Gate Opening Times of at least the Bidding Zones adjacent to a Bidding Zone Border shall be prior or equal to the Intraday Cross Zonal Gate Opening Time of this Bidding Zone Border;

- **Intraday Energy Gate Closure Time** means the point in time when energy trading for a Bidding Zone is no longer permitted for a given Market Time Period within the Intraday Market. There is one Intraday Energy Gate Closure Time for each Market Time Period per Bidding Zone. The Intraday Energy Gate Closure Times shall be after or at the same time as the Cross Zonal Intraday Gate Closure Time;

Intraday Gates

➢Continuous Trading occurs between the Intraday Cross Zonal Gate Opening Time and the Intraday Cross Zonal Gate Closure Time (*Article 59.1* and definition of *Intraday Market*);

➢ So, trading starts at Intraday Cross Zonal Gate Opening Time;

➢ And trading stops at Intraday Cross Zonal Gate Closure Time;

➢ Intraday Cross Zonal Gate Closure Time to be proposed by System Operators, subject to public consultation and approval by all NRAs;

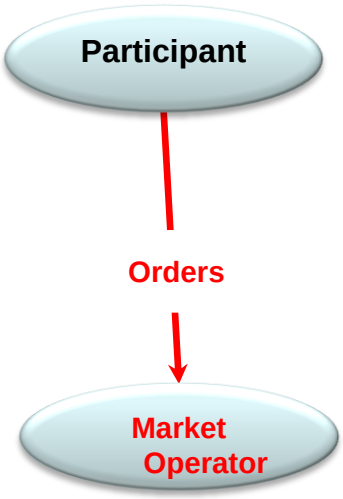
➢ Intraday Energy Gates are within a bidding zone;

➢ Intraday Cross Zonal Gates are for crossing bidding zone borders;

➢ No reference to Intraday Energy Gates or Intraday Cross Zonal Gate Opening in the consultation or regulatory approvals sections of the Network Code;

➢ Expected that Intraday Cross Zonal Gate Opening will occur after publication of day-ahead market coupling results;

Intraday Process Flow

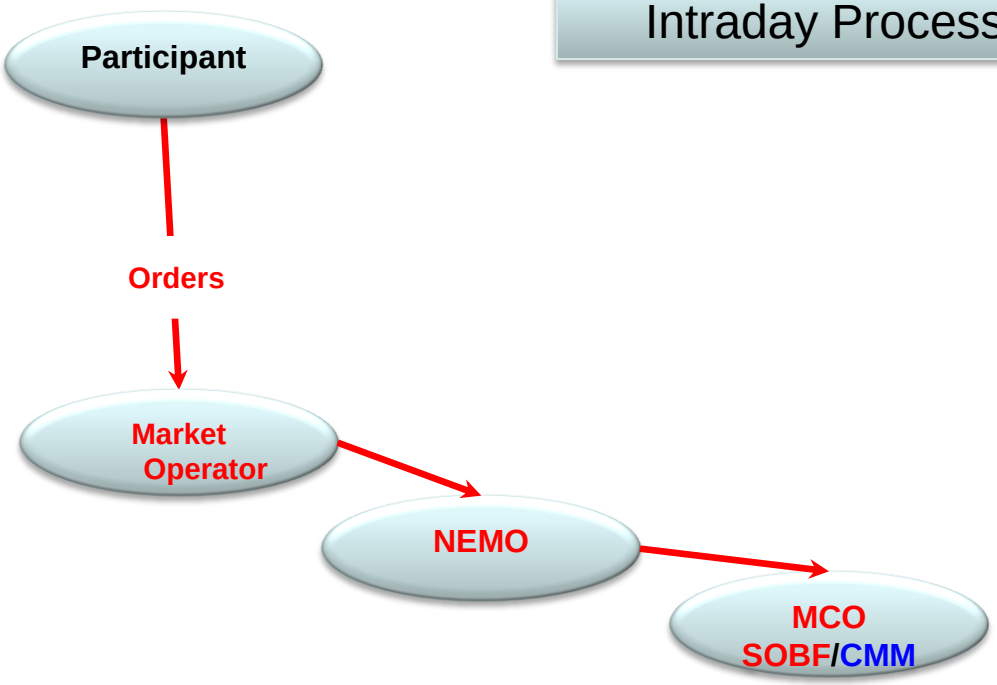


Market Operator function
System Operator function

Participant

- Provision of “orders” to Market Operator/NEMO;
  - Orders are in Euro and include relevant market time period;
  - Orders are understood to be simple buy/sell orders;
  - Orders can be for one or more market time periods (block orders to be accommodated);
  - Submissions to the NEMO required by Intraday Energy Gate Closure Time;

Intraday Process Flow

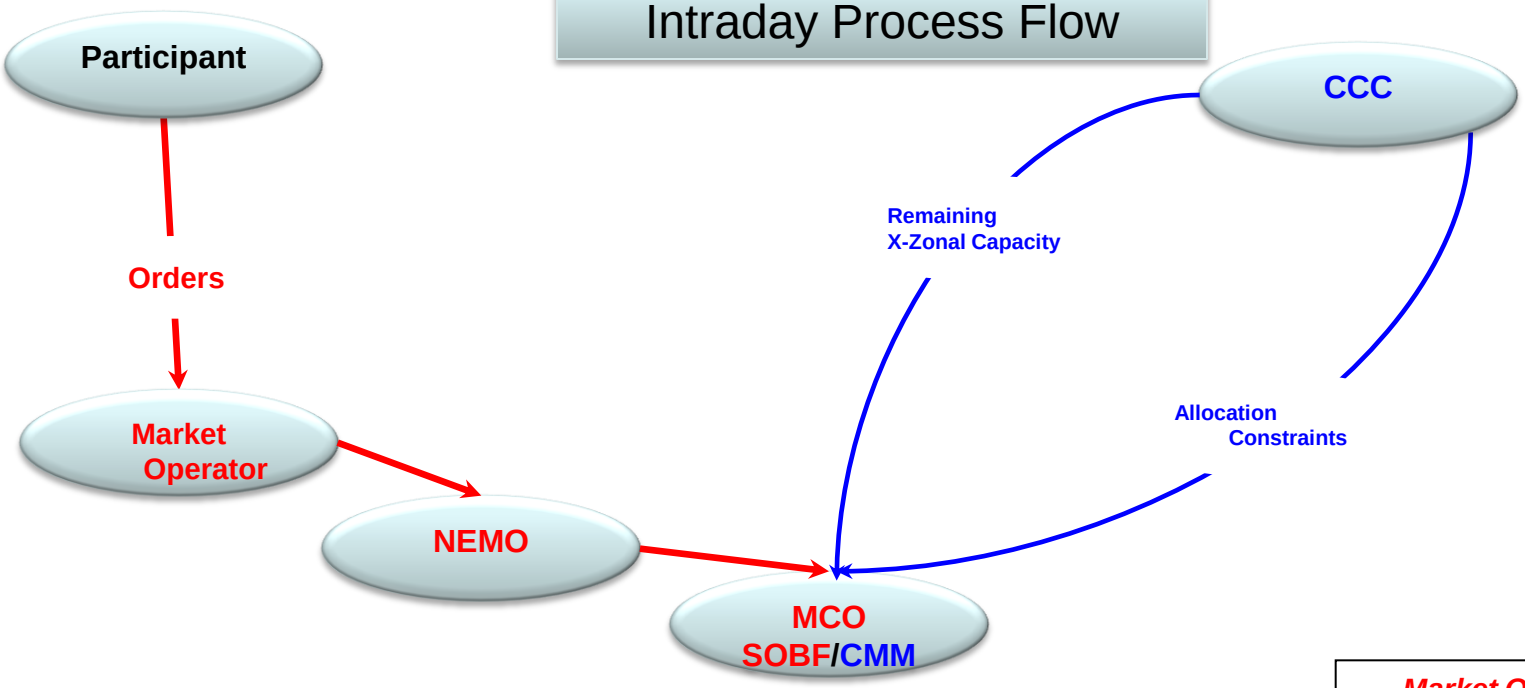


Market Operator function
System Operator function

NEMO

- Provision of “orders” to Market Operator/NEMO;
  - Anonymized orders submitted to the Market Coupling Operator (MCO);
  - Submissions to the MCO required by Intraday Cross Zonal Gate Closure Time;
  - Intraday Cross Zonal Gate Closure Time at maximum one hour before market time period;

Intraday Process Flow



Market Operator function
System Operator function

Coordinated Capacity Calculator (CCC) ⟶ *Market Coupling operator (MCO)*

- Provision of remaining capacity after day-ahead market coupling is complete;

- CCC submits data to the Market Coupling Operator by 15 minutes before IDT Gate Opening;

- CCC also provides Allocation Constraints to Market Coupling Operator;

Market Coupling operator (MCO)

- The Market Coupling Operator is responsible for managing the matching process for continuous intraday trading;

- The matching algorithm must –

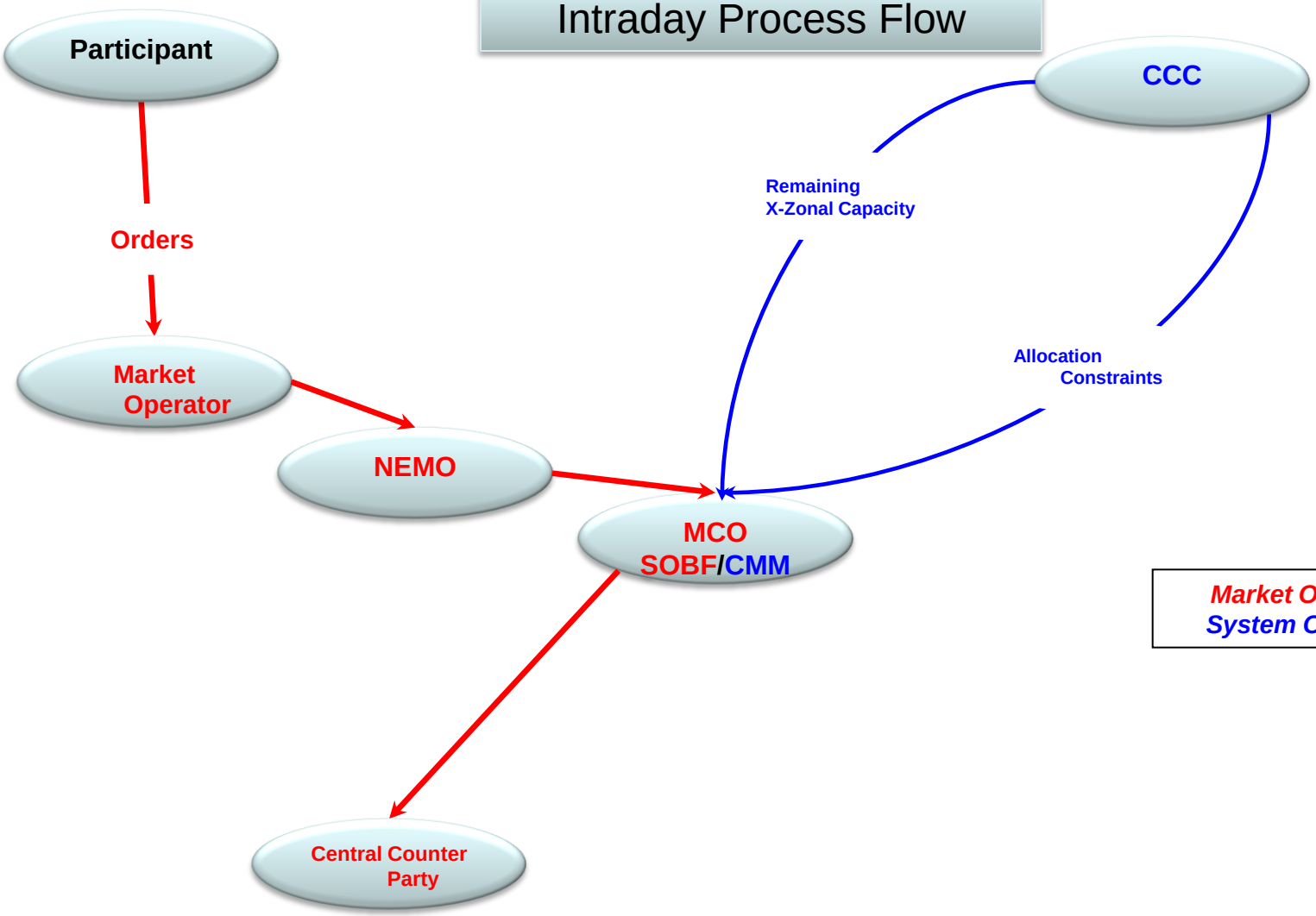
    - maximises Economic Surplus per Trade;
    - respects Allocation Constraints;
    - respects Cross Zonal Capacity;
    - is repeatable and scalable;

- Trades get matched on a first come, first served basis;

- Matching is on the basis of buy and sell orders where capacity exists between the buyer and the seller;

- Trades are matched on orders based on price and delivery time;

Intraday Process Flow

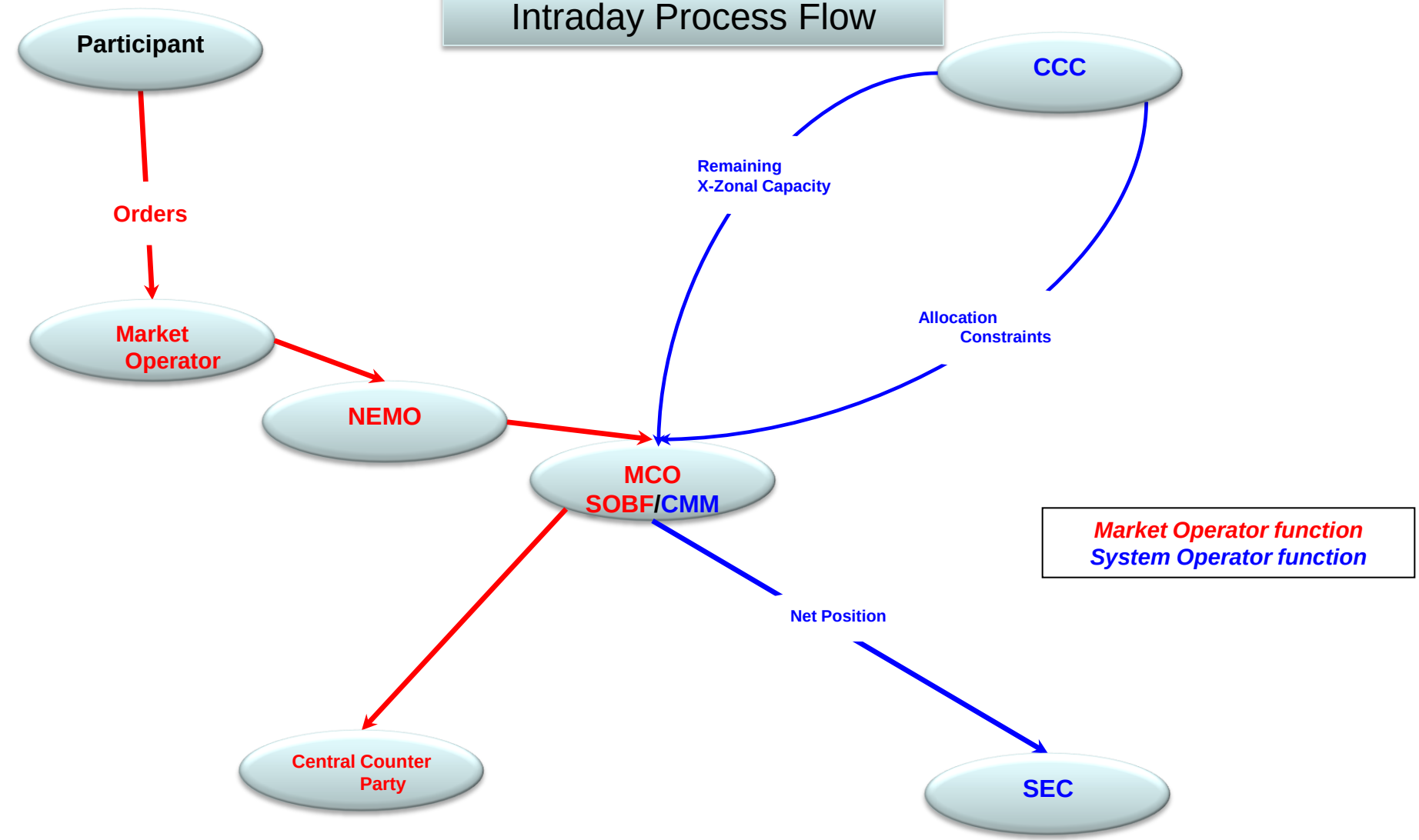


Market Operator function
System Operator function

Market Coupling Operator(MCO) ⟶ *Central Counter Party (CPP)*

- Outputs - <u>Executed Orders</u>
- In essence, orders that were matched;
- Data back to NEMO will be anonymous based on NEMO's submissions;
- Market results will be communicated to participants;
- Market prices are particular to this trade;
- This will be the basis of participant's trading in the intraday market;

Intraday Process Flow



Market Coupling Operator(MCO) ⟶ *Scheduled Exchange Calculator*

- Outputs – <u>Net Position</u>

- The netted sum of exports and imports for each market time period for each bidding zone border;

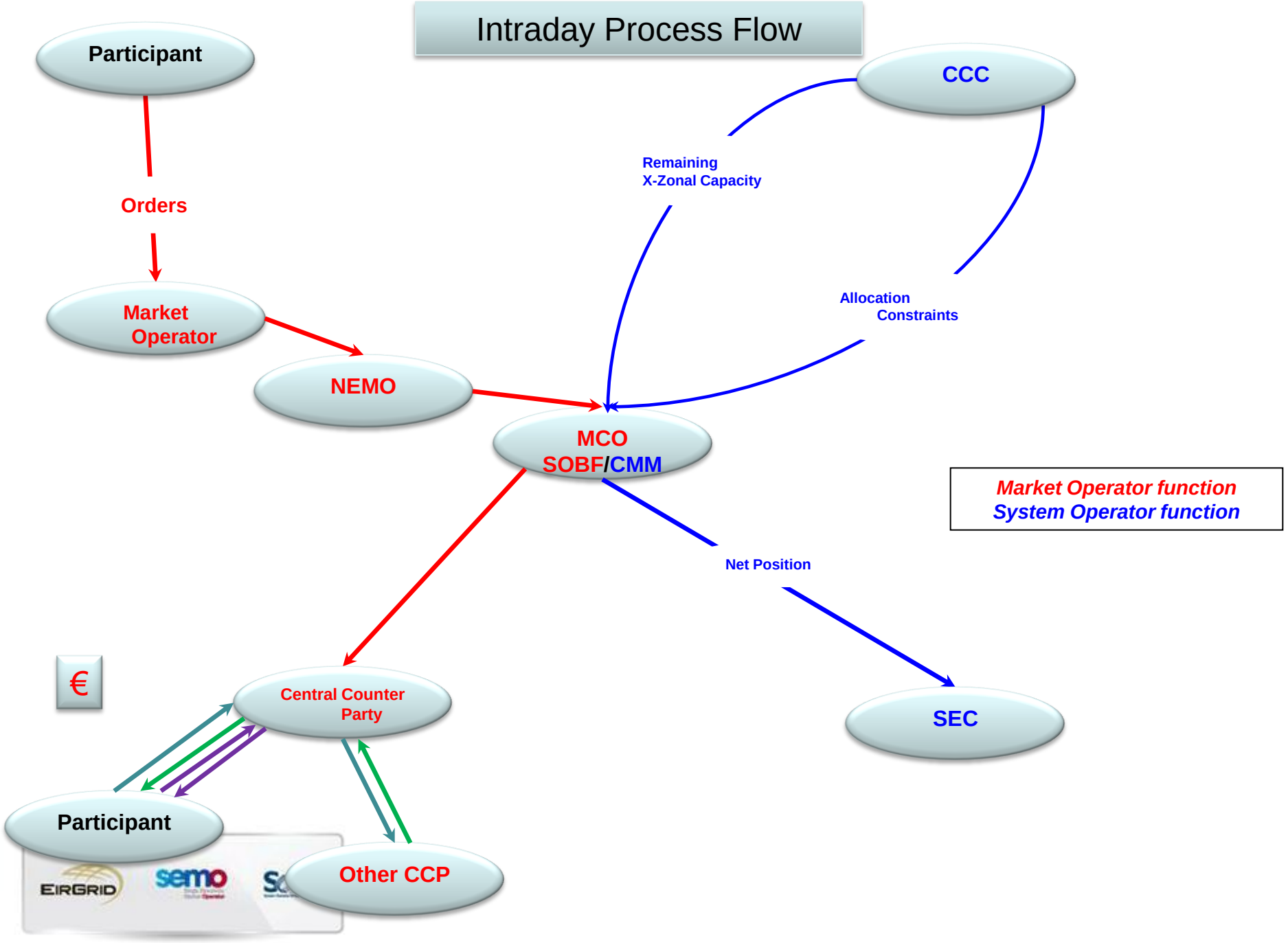
- Note bidding zone border is a single point between two market areas;

- SEM and BETTA currently have one bidding zone border;

- Bidding zone border = sum of interconnectors between to zones;

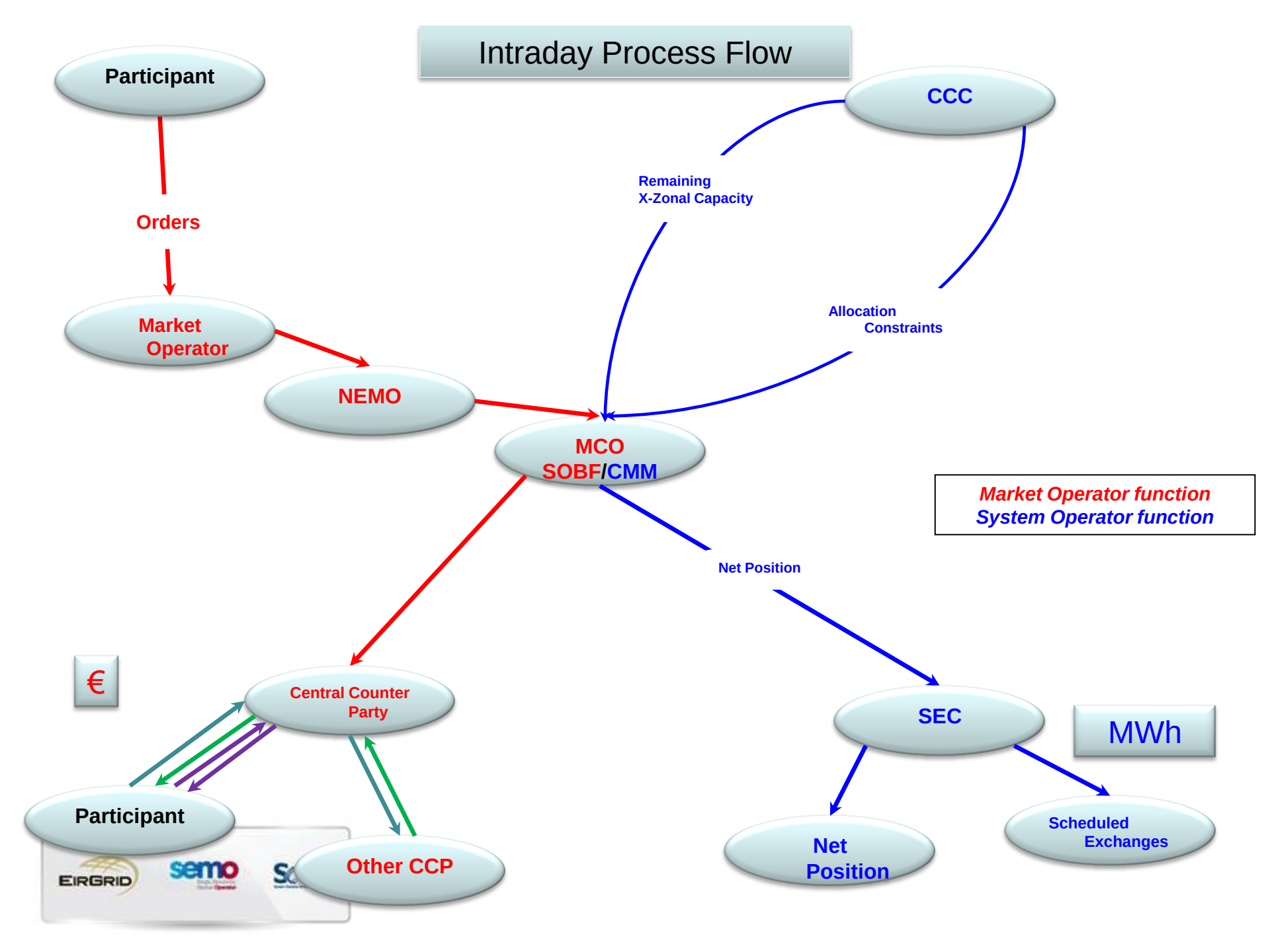
- Net position is updated flows between market areas, including any pre-market coupling flows (explicit allocations nominated) and results of PCR process;

Intraday Process Flow



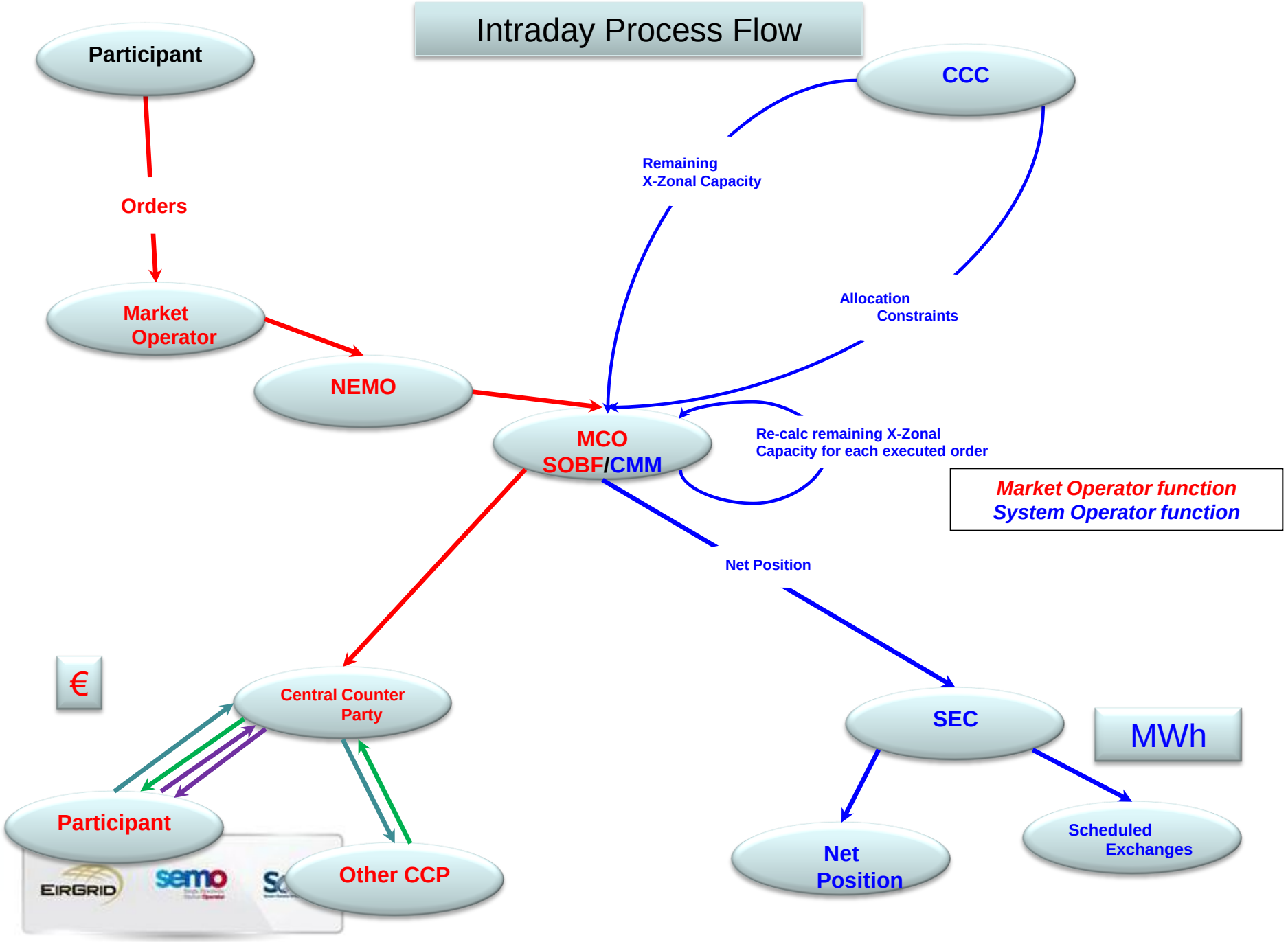
Central Counter Party (CCP)

- Role assigned to the NEMO;
- Act as counterparty to participants for their matched trades;
- Act as counterparty to CCP in other market area for imports/exports;
- Settlement of imports - money flows from participants (purchases) to Central Counter Party in this market area;
- CCP pays to CCP in other market area(Bidding Zone);
- Settlement of exports – money flows from central counter parties from other market areas (Bidding Zones) representing purchases elsewhere to the Central Counter Party, who in turn pays participants (sales);
- Settlement of local trades – where PCR schedules local load and generation within the market area, monies for sales and purchases flow through Central Counter Party;


Intraday Process Flow
Participant
Orders
Market Operator
NEMO
CCC
Remaining X-Zonal Capacity
Allocation Constraints
MCO SOBF/CMM
Market Operator function
System Operator function
Net Position
€
Central Counter Party
Participant
Other CCP
SEC
MWh
Net Position
Scheduled Exchanges

Scheduled Exchange Calculator (SEC)

- Role assigned to the System Operator;
- Translate net positions into scheduled exchanges;
- A scheduled exchange is actual dispatch schedule;
- This is the process by which aggregate flows between market areas are converted into explicit flows on an interconnector;
- To take the current market as an example,
  - *Net Position = flow between SEM & BETTA;*
  - *Scheduled Exchange = flow on Moyle and flow on EWIC;*
- At the end of this process, flows are scheduled to match the trades that resulted from the PCR process;


Intraday Process Flow
Participant
Orders
Market Operator
NEMO
CCC
Remaining X-Zonal Capacity
Allocation Constraints
MCO SOBF/CMM
Re-calc remaining X-Zonal Capacity for each executed order
Market Operator function
System Operator function
Net Position
€
Central Counter Party
Participant
Other CCP
SEC
MWh
Net Position
Scheduled Exchanges

Capacity Management Module (CMM) → *Market Coupling operator (MCO)*

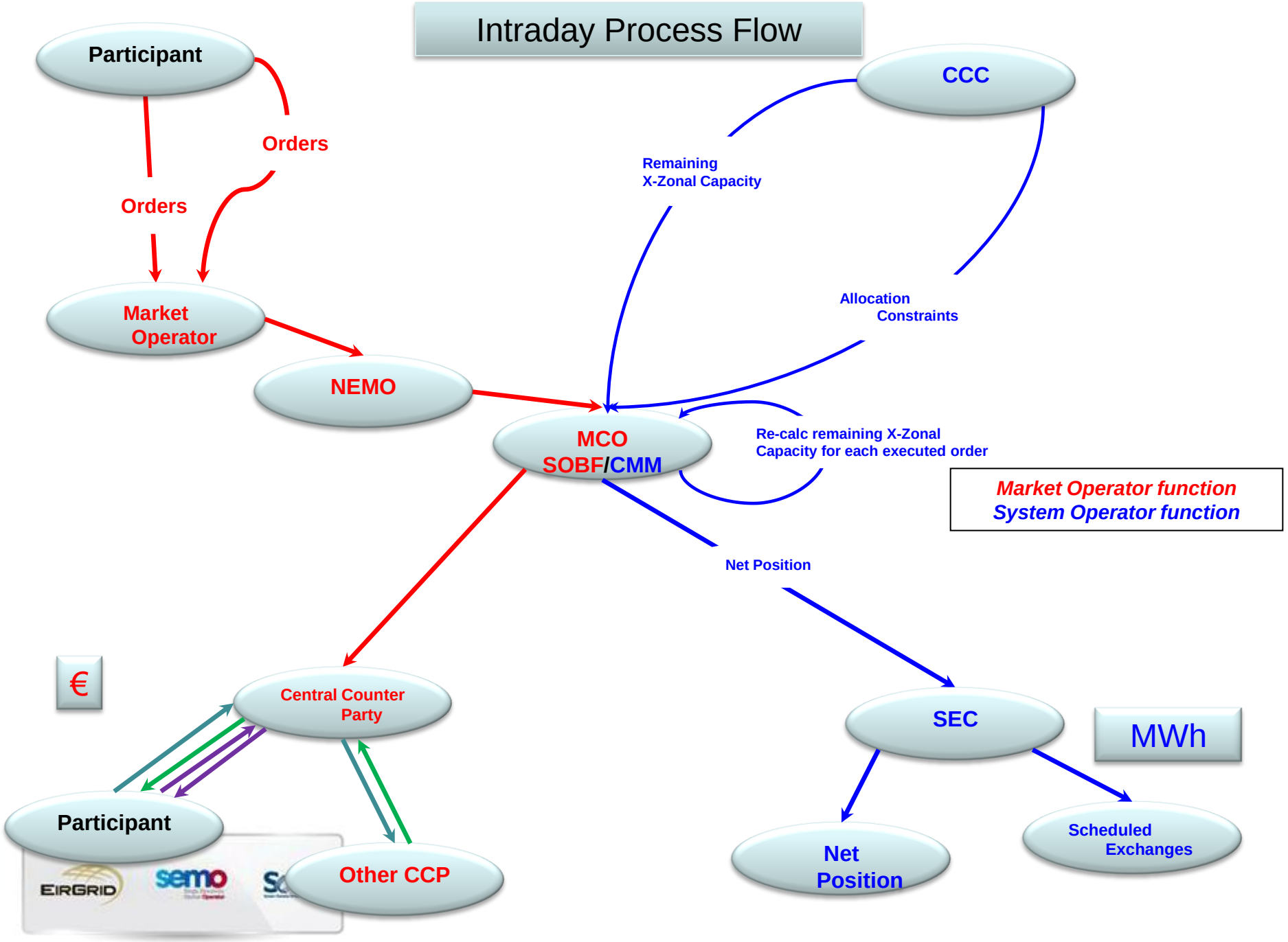
- The Capacity Management Module is responsible for allocating cross zonal capacity in the intraday market;

- As trades are matched, the CMM recalculates cross zonal capacity for all bidding zone borders affected by the relevant trade;

- E.g., a trade between Ireland and France will affect –

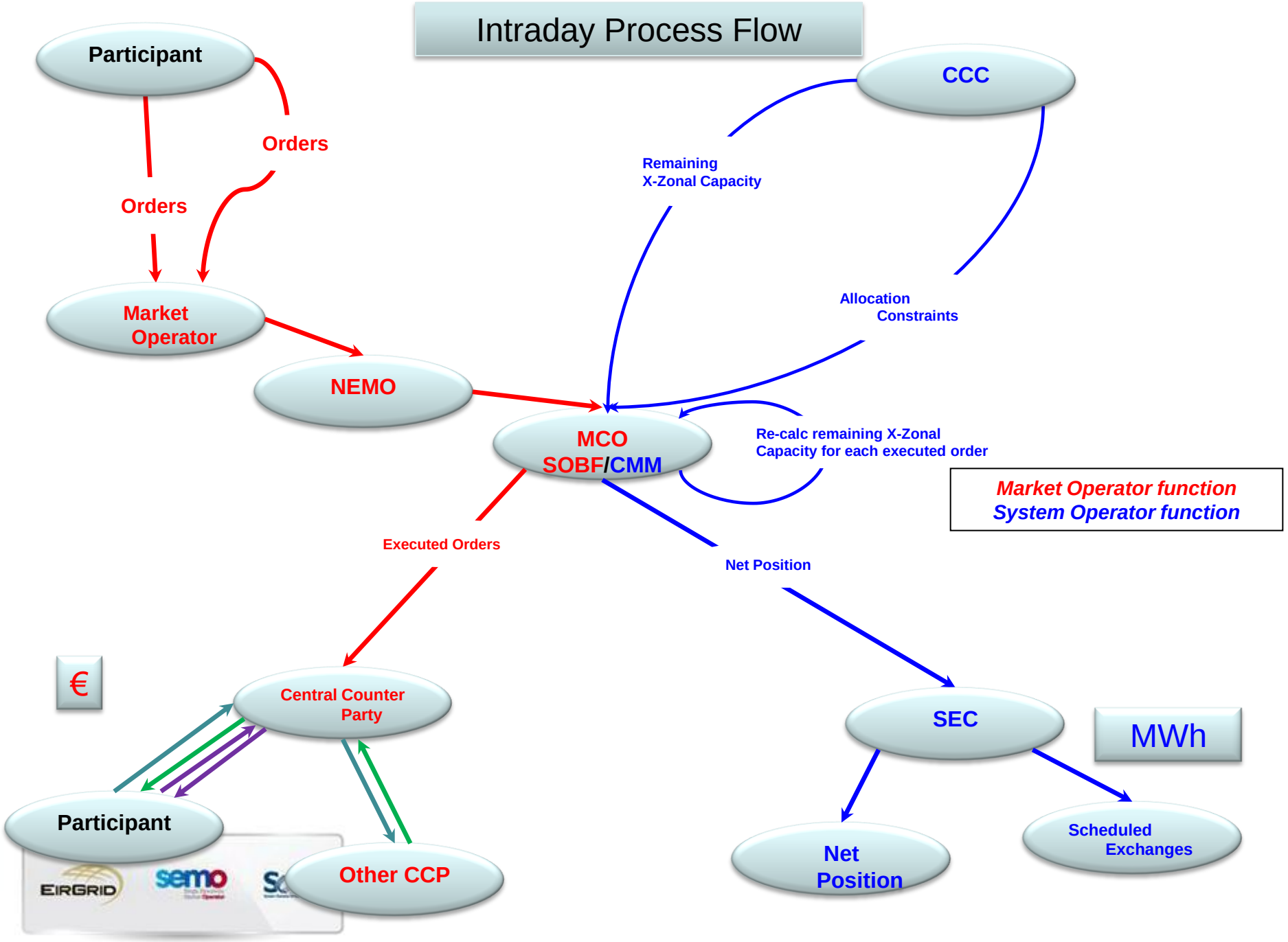
    - SEM – BETTA;
    - BETTA – France;

- Updated capacity values loop back to the Market Coupling Operator for consideration in next posted orders;


Intraday Process Flow
Participant
Orders
Orders
Market Operator
NEMO
CCC
Remaining X-Zonal Capacity
Allocation Constraints
MCO SOBF/CMM
Re-calc remaining X-Zonal Capacity for each executed order
Market Operator function
System Operator function
Net Position
€
Central Counter Party
Participant
Other CCP
SEC
MWh
Net Position
Scheduled Exchanges

Participant

- Provision of “orders” to Market Operator/NEMO;
- Participant can submit new orders;
- Submissions can continue up to one hour ahead of delivery hour;
- Considered that this will facilitate Participants with variable generation and load;
- Opportunities for both buyers and sellers to trade or alter positions from earlier markets;


Intraday Process Flow
Participant
Orders
Orders
CCC
Remaining
X-Zonal Capacity
Allocation
Constraints
Market
Operator
NEMO
MCO
SOBF/CMM
Re-calc remaining X-Zonal
Capacity for each executed order
Market Operator function
System Operator function
Executed Orders
Net Position
€
Central Counter
Party
SEC
MWh
Participant
Other CCP
Net
Position
Scheduled
Exchanges
EIRGRID
semo

Intraday Process Flow

Stakeholder Forum on Implementing the Target Model in the SEM

Price Coupling of Regions (PCR)

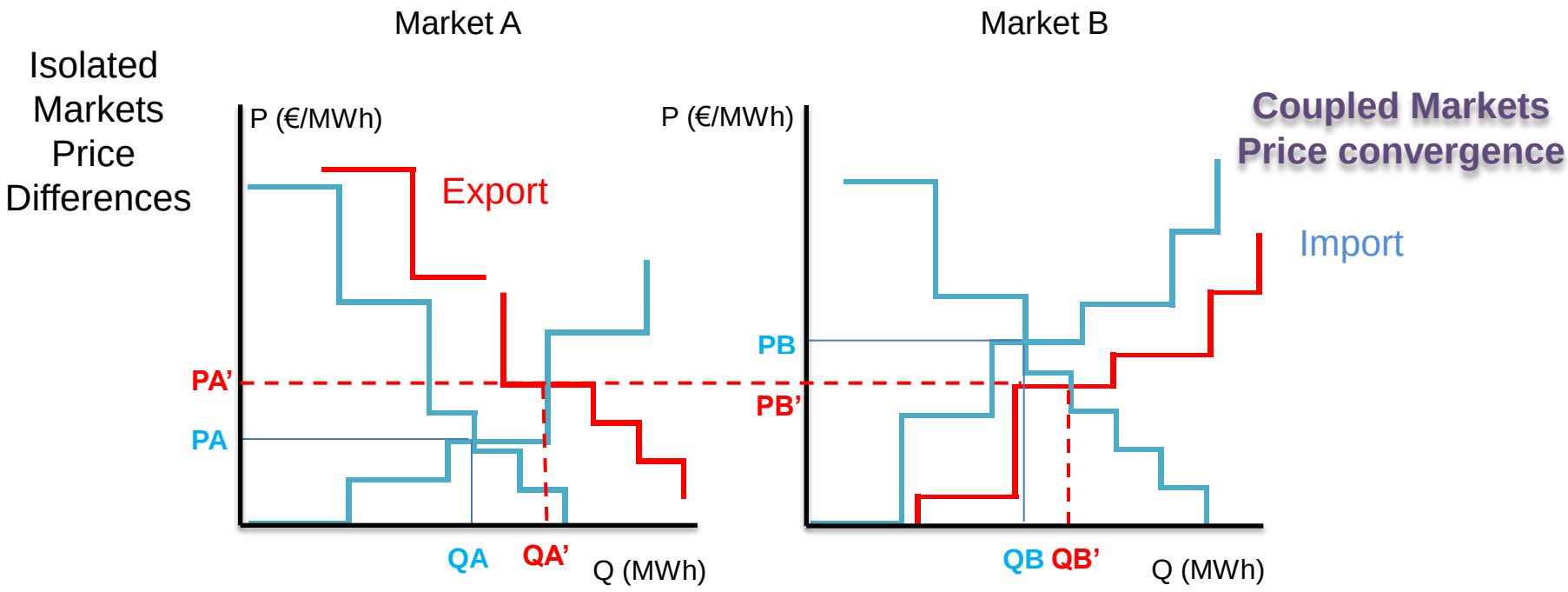
28th May 2013

INTRODUCTION

PCR
PRICE COUPLING OF REGIONS

PCR can have two functions:

- **For Power Exchanges:** **Most competitive price will arise & Overall welfare increases**



- **For TSOs:** **Efficient capacity allocation**

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How does PCR work?…

PCR
PRICE COUPLING OF REGIONS

ALGORITHM EUPHEMIA

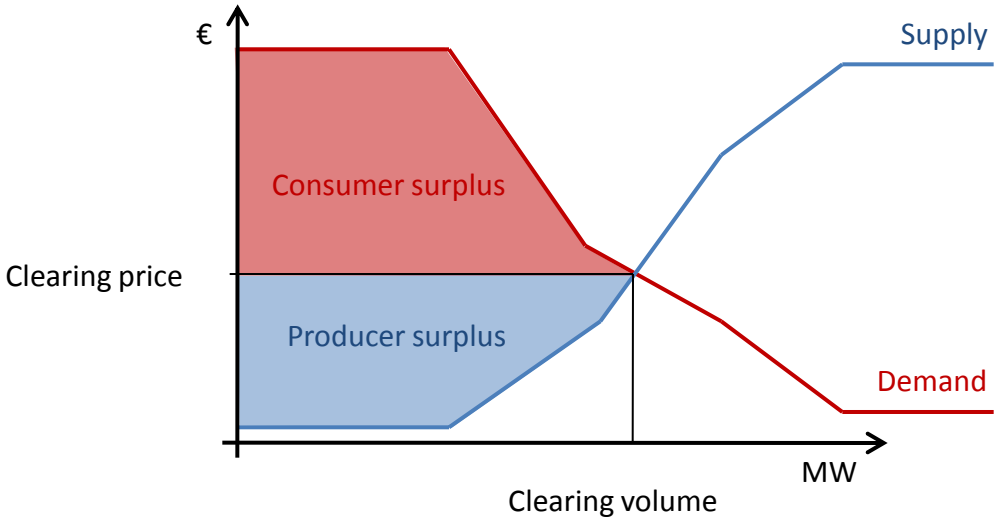
- EUPHEMIA is an algorithm that solves optimally the market coupling problem.
  - EUPHEMIA means: Pan-European Hybrid Electricity Market Integration Algorithm.
  - Hybrid: It is hybrid because it supports both ATC-based and flow-based network models, both standalone and in combination.

- It maximizes the welfare of the solution

PCR
PRICE COUPLING OF REGIONS

CLEARING PRICES

For one hour in a single Bidding Zone where all lines are uncongested:



- The intersection is the point where, for the same volume, the marginal price the buyers are ready to pay is equal to the marginal price the producers are asking

- But it is also the point where the shaded area (=welfare) is maximal.

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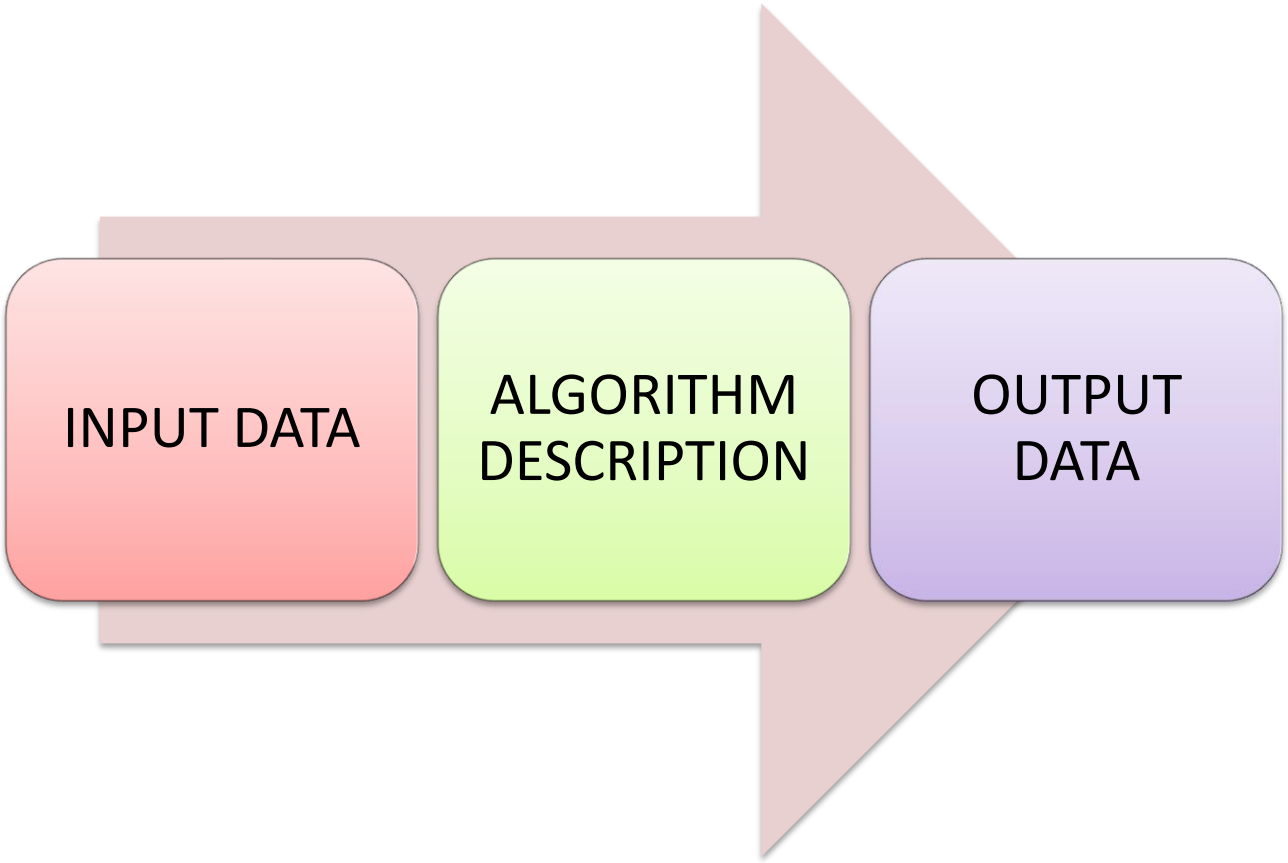
PRICE COUPLING OF REGIONS

1. GENERAL DESCRIPTION



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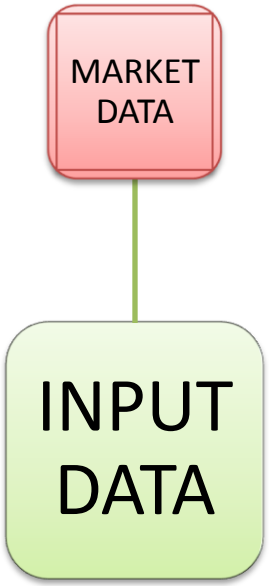
PRICE COUPLING OF REGIONS

INPUT DATA



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MARKET DATA

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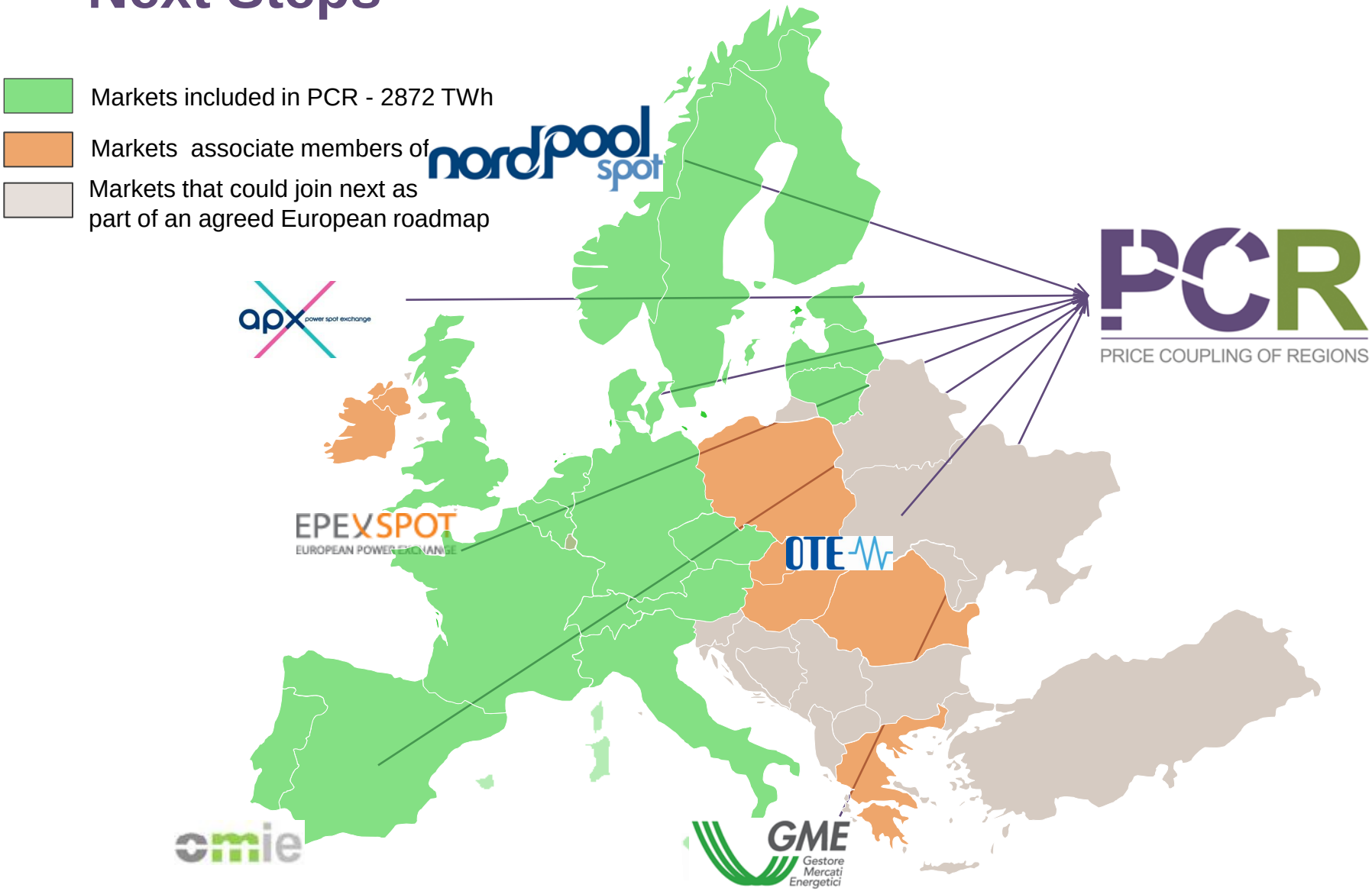
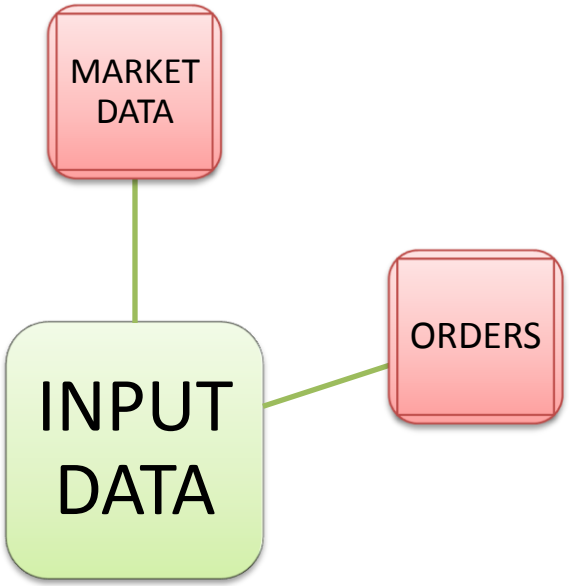
Towards Single European Market: Next Steps



INPUT DATA



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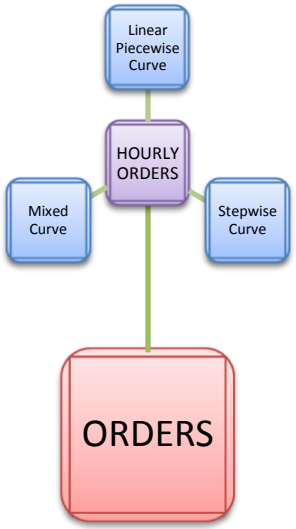
ORDERS



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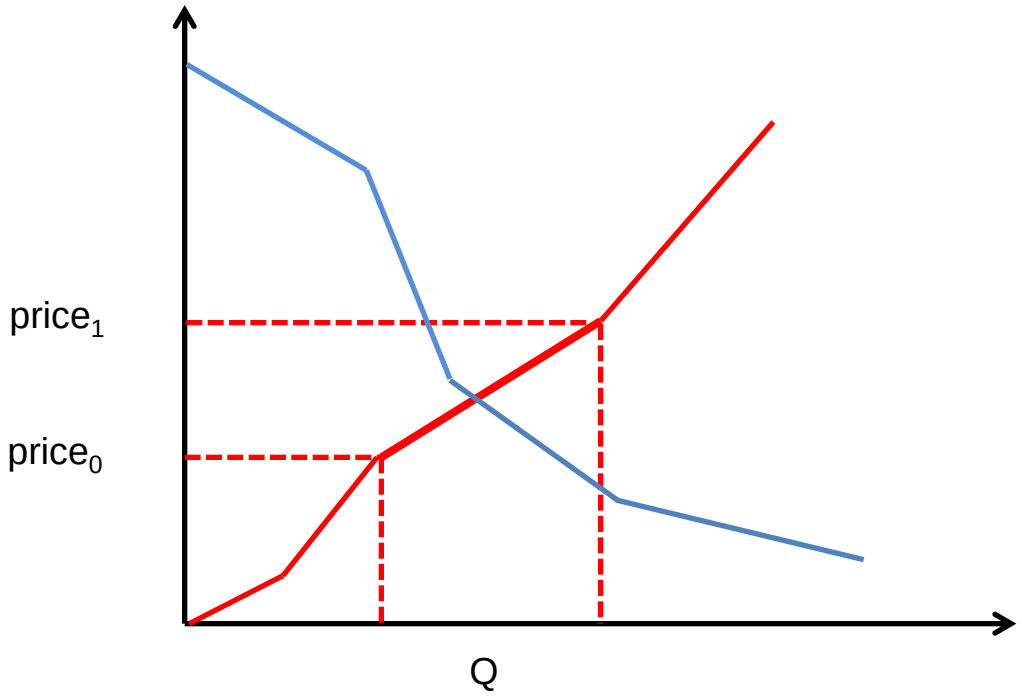
PRICE COUPLING OF REGIONS

LINEAR PIECEWISE HOURLY ORDERS

The volume term is delimited by an initial price at which the hourly order starts to be accepted and a final price at which the order is completely accepted.

NORDPOOL and EPEX manages these kind of orders.



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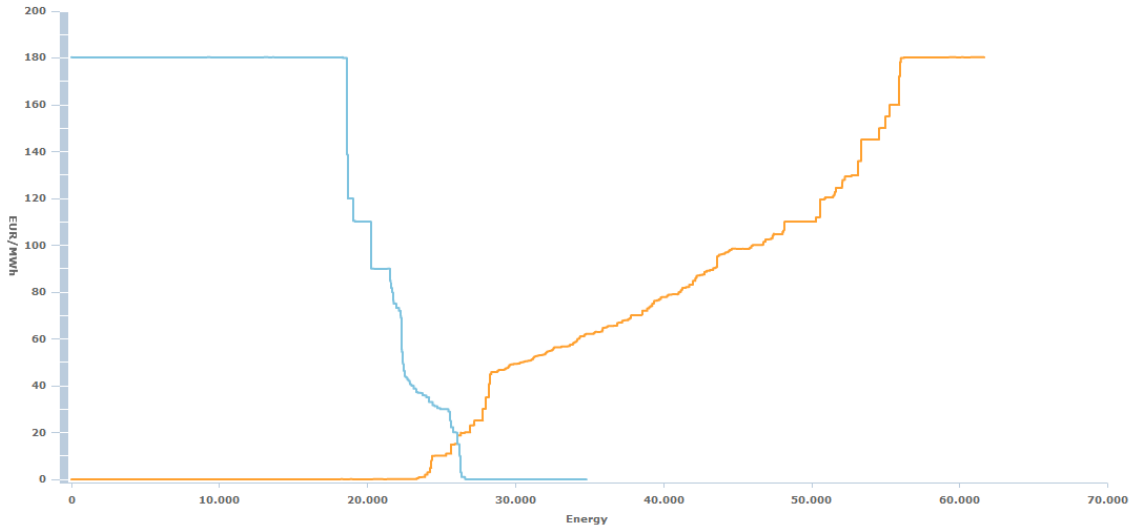
STEPWISE HOURLY ORDERS

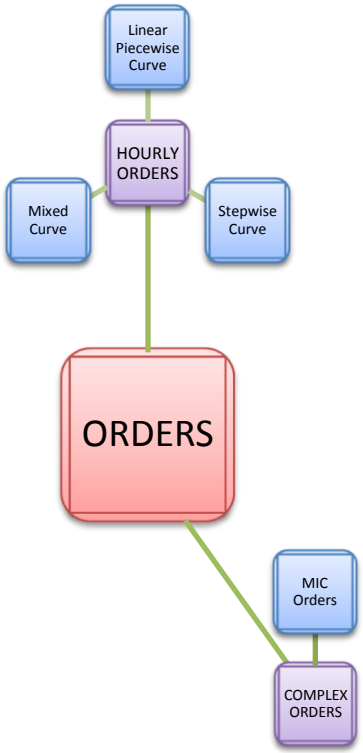
The volume term is delimited by an initial price and a final price which are equal.

OMIE, APX, BELPEX, GME and OTE manage these sort of orders.



PCR
PRICE COUPLING OF REGIONS

ORDERS



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COMPLEX ORDERS. MIC ORDERS

MIC Orders are Stepwise Hourly Orders under an economical condition defined by two terms:

•Tf: Fixed Term in Euros which shows the fixed costs of the whole amount of energy traded in the order.

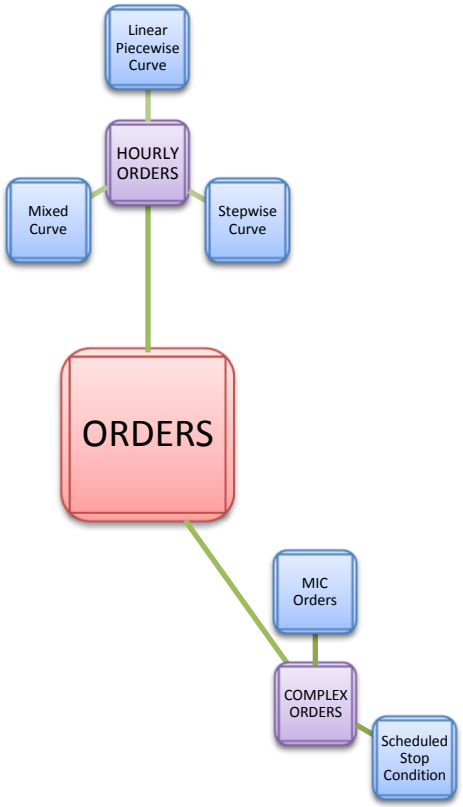
•Tv: Variable Term in Euros per accepted MWh which shows the variable costs of the whole amount of energy traded in the order.

The same acceptance rules for Stepwise Hourly Orders are applied to MIC Orders plus the acceptance of the economic condition which is defined mathematically as:

$$Tf + Tv \cdot (\Sigma_h \Sigma_{o \in h} [q_o \cdot x_o]) \leq \Sigma_h (MCP_h \cdot (\Sigma_{o \in h} [q_o \cdot x_o]))$$

PCR
PRICE COUPLING OF REGIONS

ORDERS



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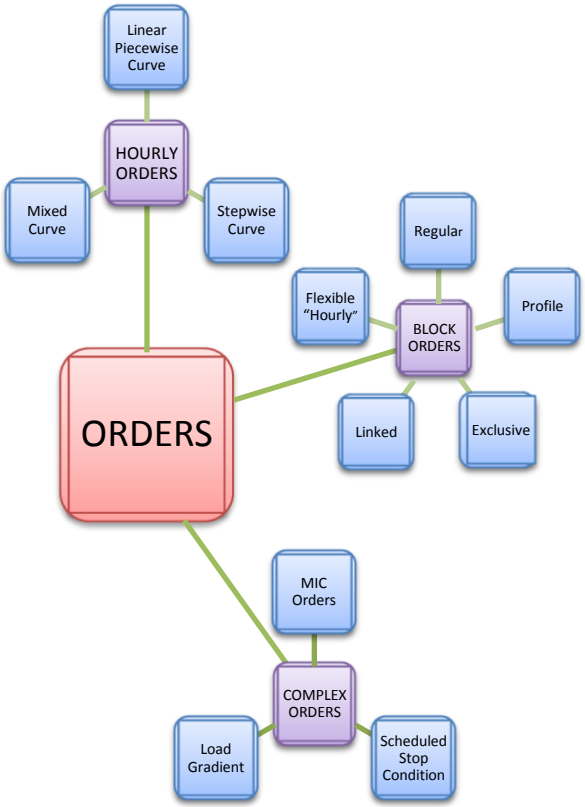
SCHEDULED STOP CONDITION

- It only applies to deactivated MICs.
-
- It applies to periods declared as Scheduled Stop by the MIC.
- A MIC order can declare a maximum of three periods as Scheduled Stop interval. Periods 1, 2 or 3.
- The hourly sub-orders in the periods declared as Scheduled Stop interval must have decreasing energy as period increases.
- The first hourly sub-order will remain active (although the MIC is deactivated).
- For a deactivated MIC, its active hourly sub-orders corresponding to Scheduled Stop periods will be accepted if they are in/at the money (as any other hourly order).

PCR
PRICE COUPLING OF REGIONS

ORDERS



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LOAD GRADIENT ORDER

The load gradient condition limits the variation between the accepted volume of an order in a period and the accepted volume of the same order in the adjacent periods.

A Load Gradient Order (LG) is defined by the next terms:

- ***Increase Gradient:*** Maximum increase gradient in MWh.

- ***Decrease Gradient:*** Maximum decrease gradient in MWh.

LG Orders must fulfill the following gradient condition:

$$(\Sigma_{o \in h+1} [q_o \cdot x_o]) \leq (\Sigma_{o \in h} [q_o \cdot x_o]) + \text{Increase Gradient}$$

$$(\Sigma_{o \in h+1} [q_o \cdot x_o]) \geq (\Sigma_{o \in h} [q_o \cdot x_o]) - \text{Decrease Gradient}$$

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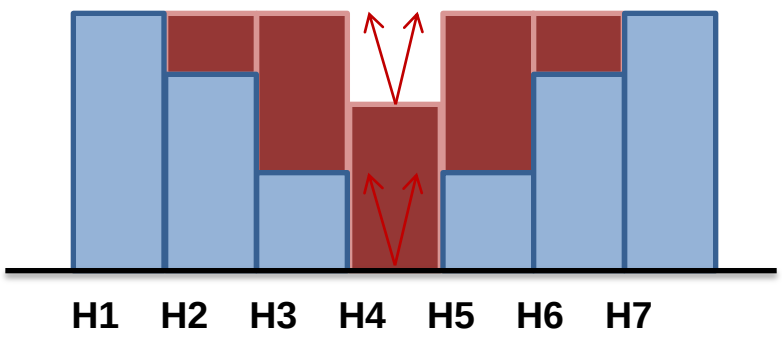
LOAD GRADIENT ORDER

Orders with LG condition will behave like orders without LG as long as no load gradient limit is binding in the optimal solution.

In the presence of active load gradients, hourly supply orders which are out-of-the-money might be accepted if these conditions are fulfilled:

•The money loss incurred will be at least compensated by other adjacent hourly supply orders.

•The compensating orders belong to the same LG order.



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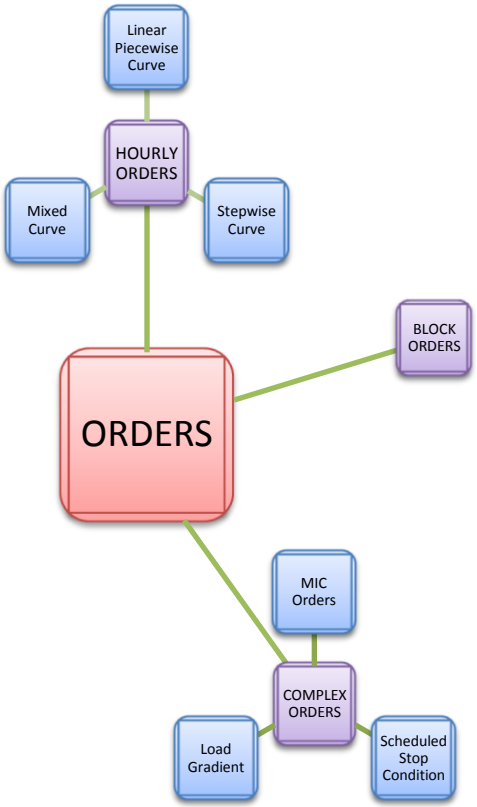
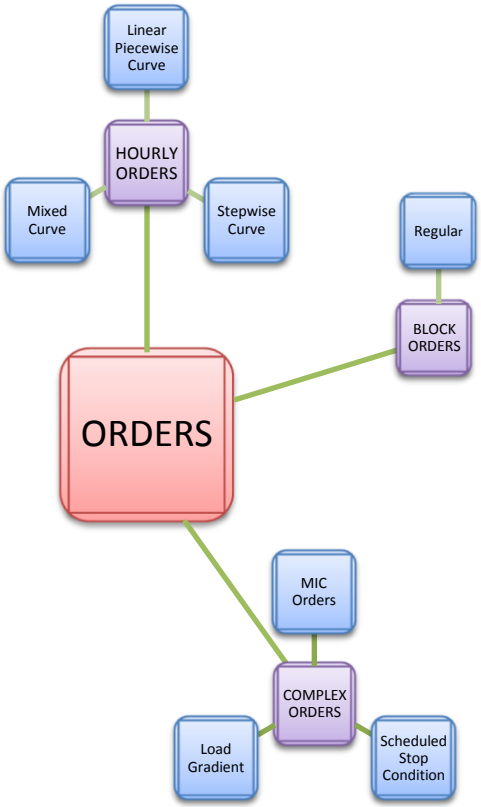
PRICE COUPLING OF REGIONS

ORDERS



PCR
PRICE COUPLING OF REGIONS

ORDERS



PCR
PRICE COUPLING OF REGIONS

REGULAR BLOCK ORDERS

A participant can submit a Block order made up of:

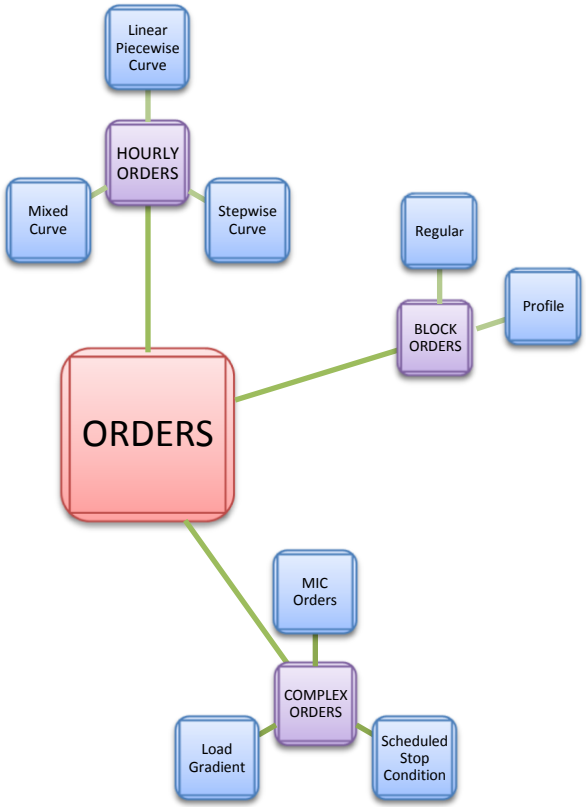
•Block type (buy or sell).
•Block Price: Fixed price limit.
•Block Volume: Volume of the block.
•Block Period: Consecutive hours over which the block spans.

A Block order cannot be accepted partially. Actually, it is either totally rejected or accepted when several blocks have the same characteristics.

BLOCK DESCRIPTION	BLOCK PERIOD	BLOCK PRICE	BLOCK VOLUME
BLOCK B	Hours 1-24	40 Euros	-200 MWh
BLOCK S	Hours 8-12	40 Euros	50 MWh

PCR
PRICE COUPLING OF REGIONS

ORDERS



PCR
PRICE COUPLING OF REGIONS

PROFILE BLOCK ORDERS

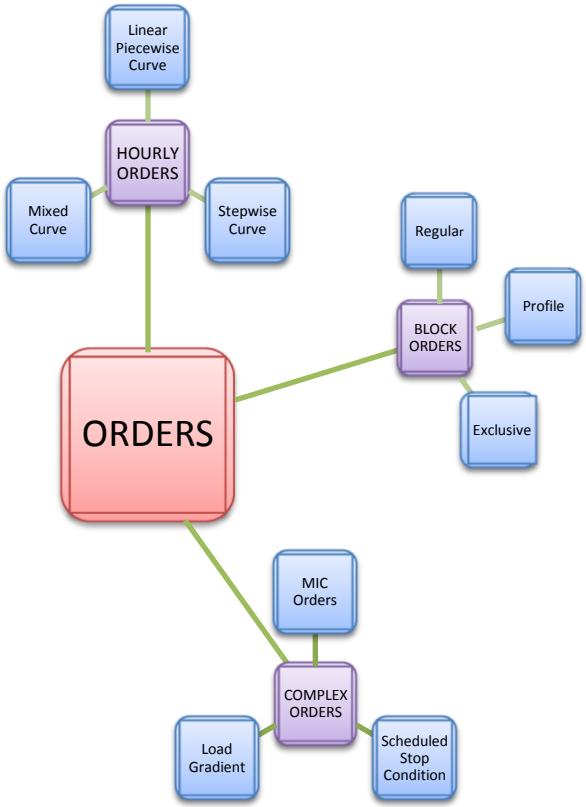
A Profile Block Order is a particular sort of Regular Block Order in which the kill or fill condition is associated with an acceptance percentage. The participant can submit a Block order made up of:

- Block type (buy or sell).
- Block Period: Hours over which the block spans.
- Block Price: Fixed price limit.
- Minimum Acceptance Ratio: Minimum volume acceptance ratio in case the block is accepted.
- Block Volume: Volume of the block.

BLOCK DESCRIPTION	BLOCK PERIOD	BLOCK PRICE	MINIMUM ACCEPT RATIO	BLOCK VOLUME
SELL BLOCK A	Hours 1-24 Hours 8-12	40 Euros	50%	80 MWh 220 MWh

PCR
PRICE COUPLING OF REGIONS

ORDERS



PCR
PRICE COUPLING OF REGIONS

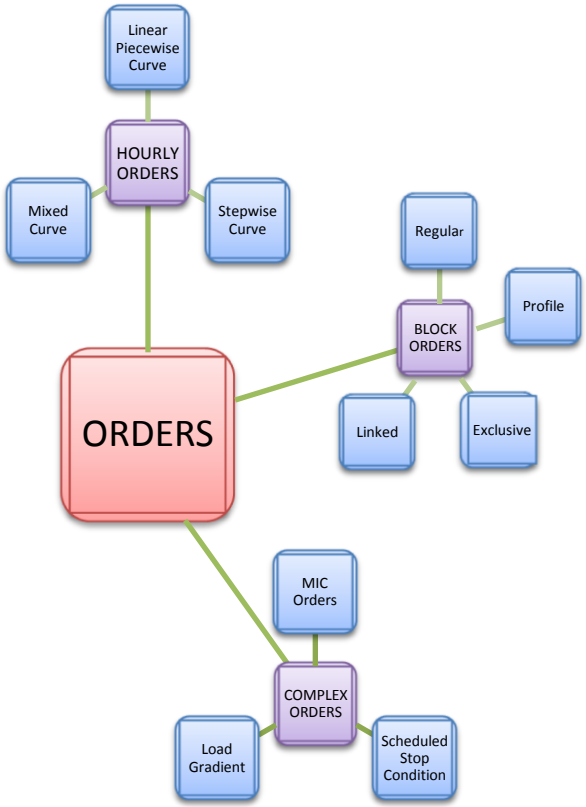
EXCLUSIVE BLOCK ORDERS

An Exclusive group is defined as:

- A set of Profile Block Orders in which the sum of the acceptance ratios cannot exceed 1.
- The acceptance rules of Profile Block Orders are totally applied.
- There is no limit on the number of blocks that belong to the same Exclusive Group.
- There is a special case in which profile blocks are defined to have a minimum acceptance ratio of 1 (fill-or-kill). This fact implies that at most one of the blocks inside this Exclusive Group can be accepted.

PCR
PRICE COUPLING OF REGIONS

ORDERS



PCR
PRICE COUPLING OF REGIONS

LINKED BLOCK ORDERS

Regular and Profile Block orders may be linked together:

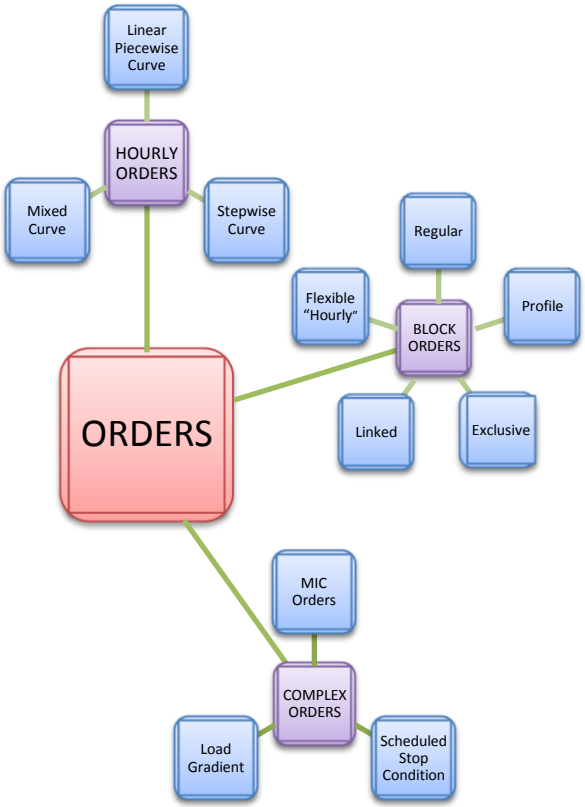
- The acceptance of individual Block Orders depends on the acceptance of other Block Orders.

Two kinds of Linked Regular Blocks:

- *Parent Block*
- *Child Block*

PCR
PRICE COUPLING OF REGIONS

ORDERS



PCR
PRICE COUPLING OF REGIONS

FLEXIBLE HOURLY BLOCK ORDERS

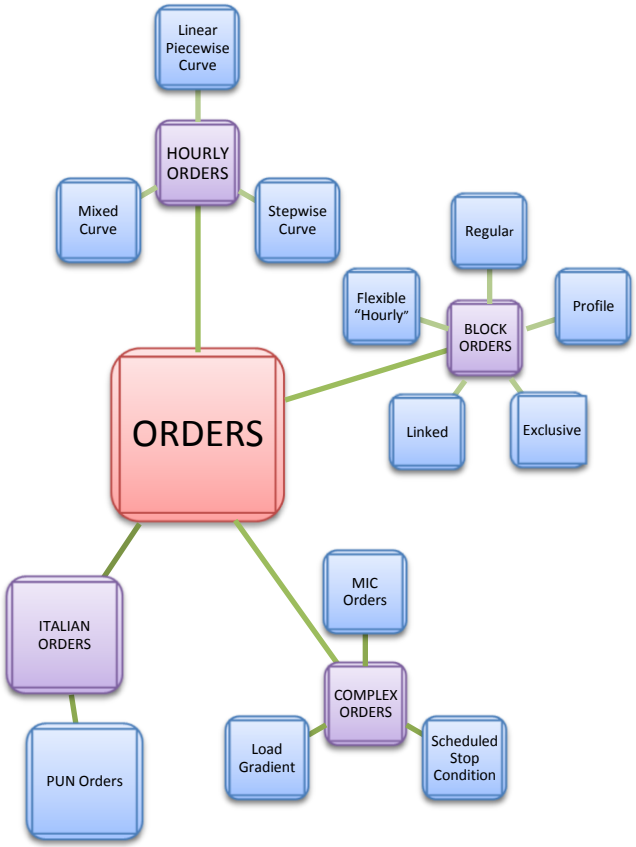
- A Flexible Hourly Order is a Regular Block Order which lasts only one period. The period is said to be flexible and will be determined by the algorithm.

- In case of acceptance, it will only occur in one hour, but the hour is flexible and that means it is not defined by the participant.

- The acceptance rules of regular Block Orders are totally applied.

PCR
PRICE COUPLING OF REGIONS

ORDERS



PCR
PRICE COUPLING OF REGIONS

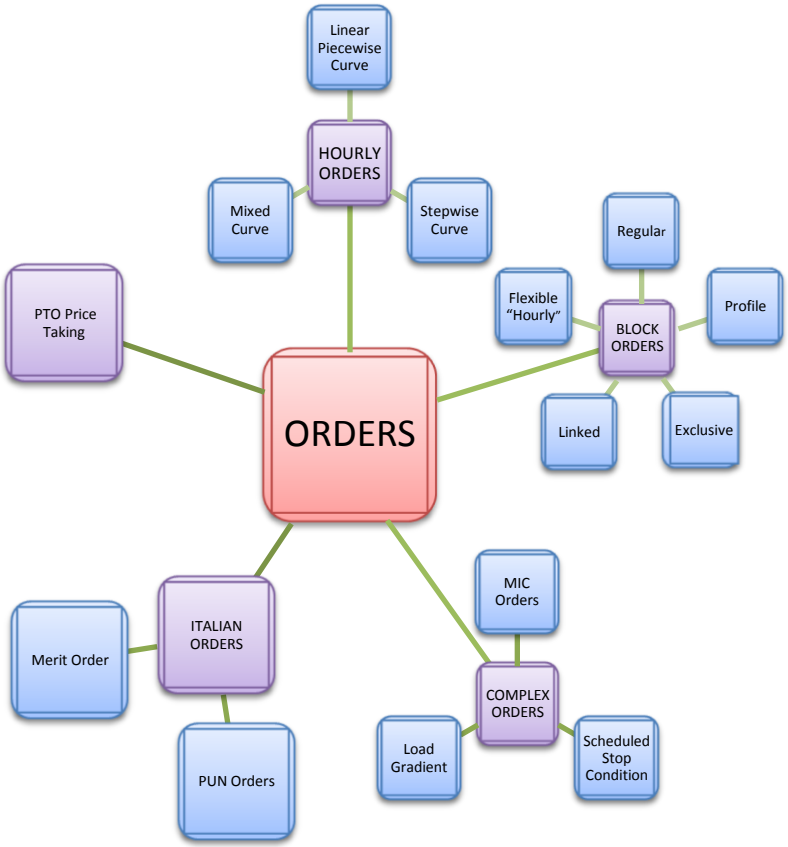
PUN REQUIREMENT

Prezzo Unico Nazionale (PUN)

- National demand of Italy (with the exception of storage pumps) is submitted to a single purchase price (PUN), regardless of its location
- This price must ensure that the revenues coming from the consumers paying the PUN must be equal the revenues that would have come from consumers with zonal prices (minimum tolerance accepted)
- Acceptance/rejection of buying bids subject to PUN must respect the following conditions
  - Buying bids in-the-money (Offered price > PUN) are fully accepted
  - Buying bids out-of-the-money (Offered price < PUN) are fully rejected
  - Buying bids at-of-the-money (Offered price < PUN) can be curtailed
- In order to respect the aforementioned requirements, PUN and zonal prices must be calculated simultaneously (PUN cannot be calculated ex-post)

PCR
PRICE COUPLING OF REGIONS

ORDERS



PRICE COUPLING OF REGIONS

PUN ORDERS

In GME:

•Selling offers receive their Bidding Zone marginal price.

•Some of the buying bids pay their Bidding Zone price. These are called no-PUN bids, related to pump plants **and buying bids on cross-border capacities**

•The rest of the buying bids (the ones related to national consumption) pay the common national PUN price which is different from their Bidding Zone price → ***PUN ORDERS***

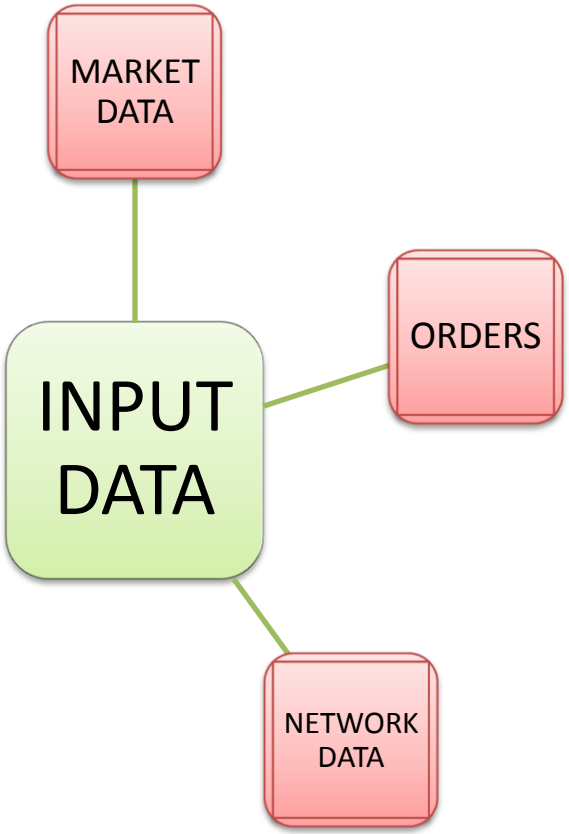
This PUN price is defined as the average price of GME zonal marginal market prices, weighted by the purchase quantity assigned to PUN Orders in each Bidding Zone. That is:

$$P_{PUN} * \Sigma_z Q_z = \Sigma_z P_z * Q_z + \epsilon$$

$$-1 € \leq \epsilon \leq 5 €$$

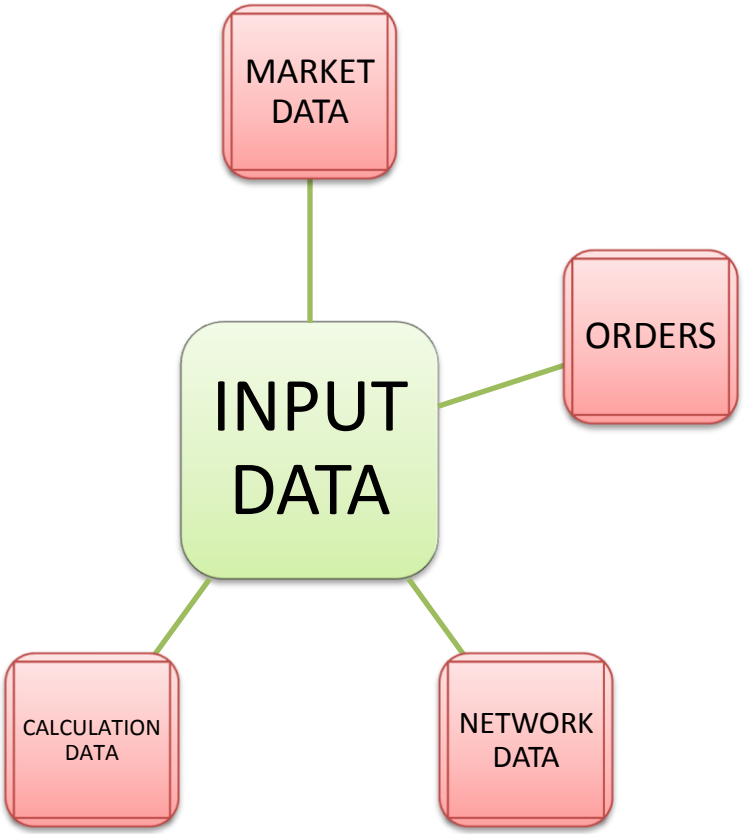
PRICE COUPLING OF REGIONS

INPUT DATA



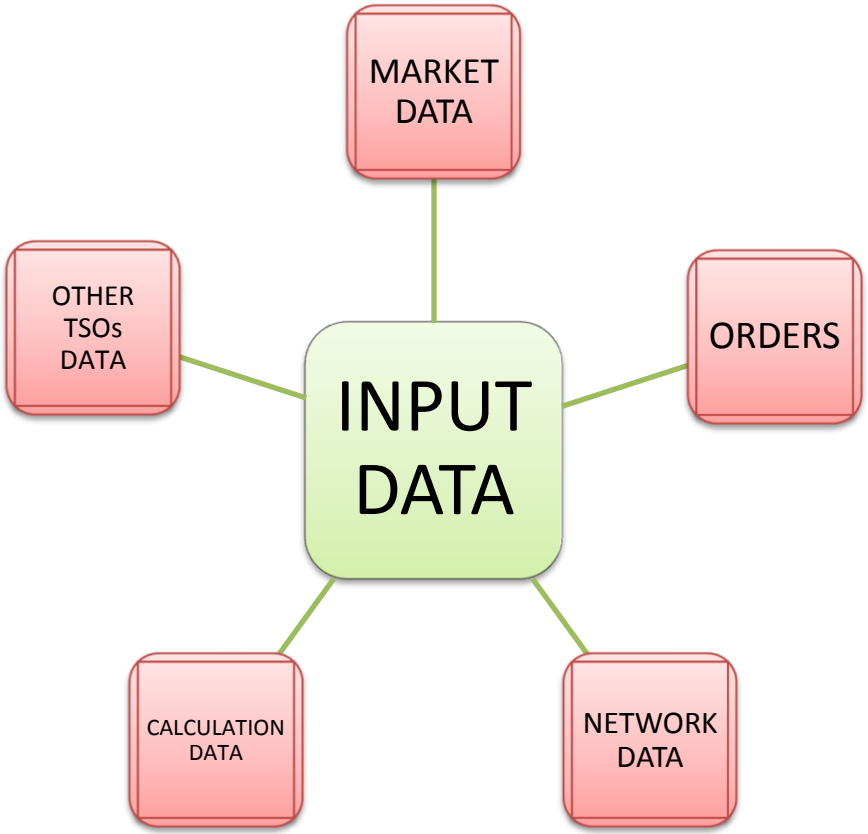
PCR
PRICE COUPLING OF REGIONS

INPUT DATA



PCR
PRICE COUPLING OF REGIONS

INPUT DATA



PCR
PRICE COUPLING OF REGIONS

Thank You

PCR
PRICE COUPLING OF REGIONS

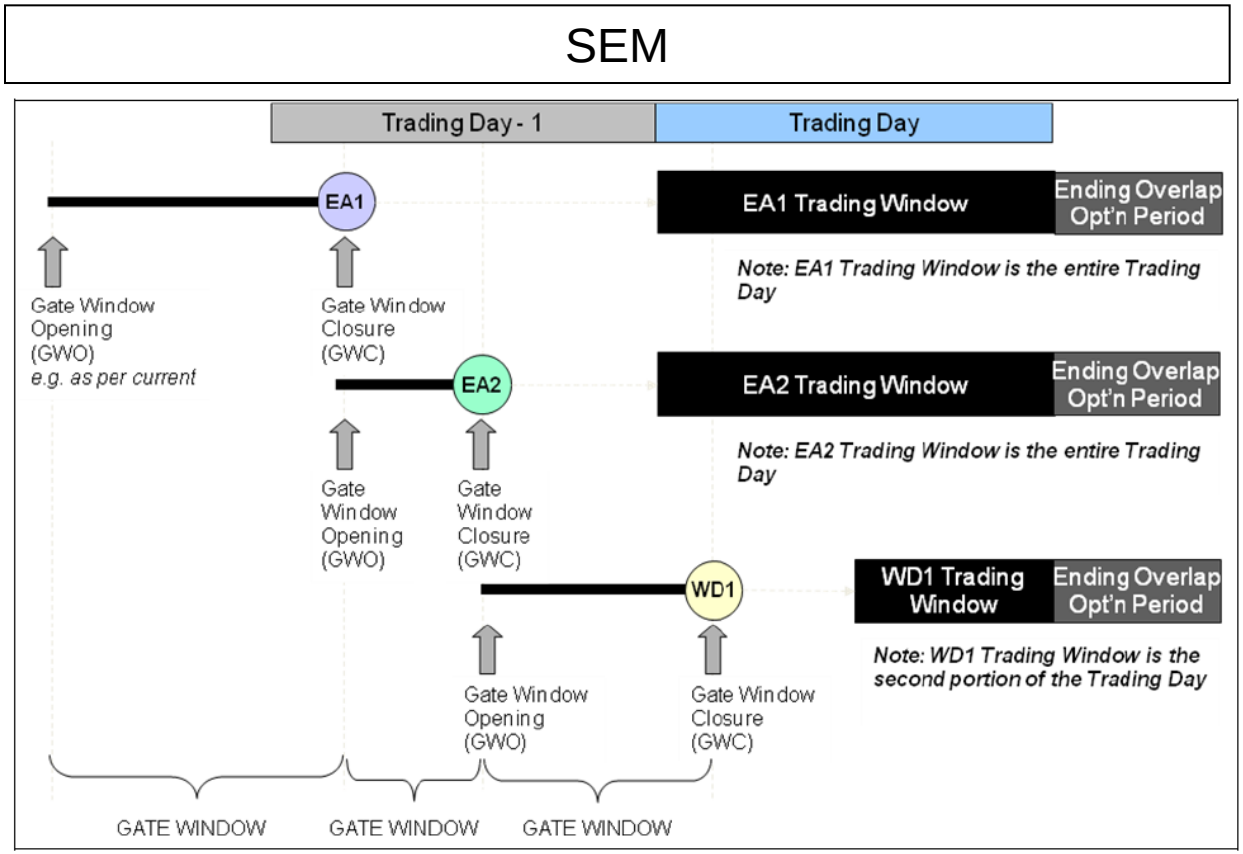
Stakeholder Forum on Implementing the Target Model in the SEM

System Operations

28th May 2013

•**Operating the System with Shorter Gate Closure** – The TSOs will carry out a review of the high level issues associated with operating the system with gate closures much closer to real time. It is expected that this will also look at how the requirements of the balancing Network Code will be accommodated. As part of this the TSOs will examine issues such as improvements in market and dispatch software, accommodating system constraints and remedial actions that might be required.

System Security - Existing Environment



High degree of flexibility afforded to the TSO within SEM to maintain system security

- TSO commits and schedules generation independent of market positions apart from interconnector flows

- TSO scheduling ensures provision of system services and constraint management

- TSO scheduling variables close to real time – demand / wind forecast and plant availability.

- Gate timings EA1 09.30 , EA 2 11.30 and WD1 08.00

Interconnector schedules fixed and known to the TSOs at least approx 8 hours before real time

Market scheduling does not consider –

•Generation notification times (time from SO dispatch to sync)

Units may appear in the market schedule but cannot be physically connected for hours in actual operation

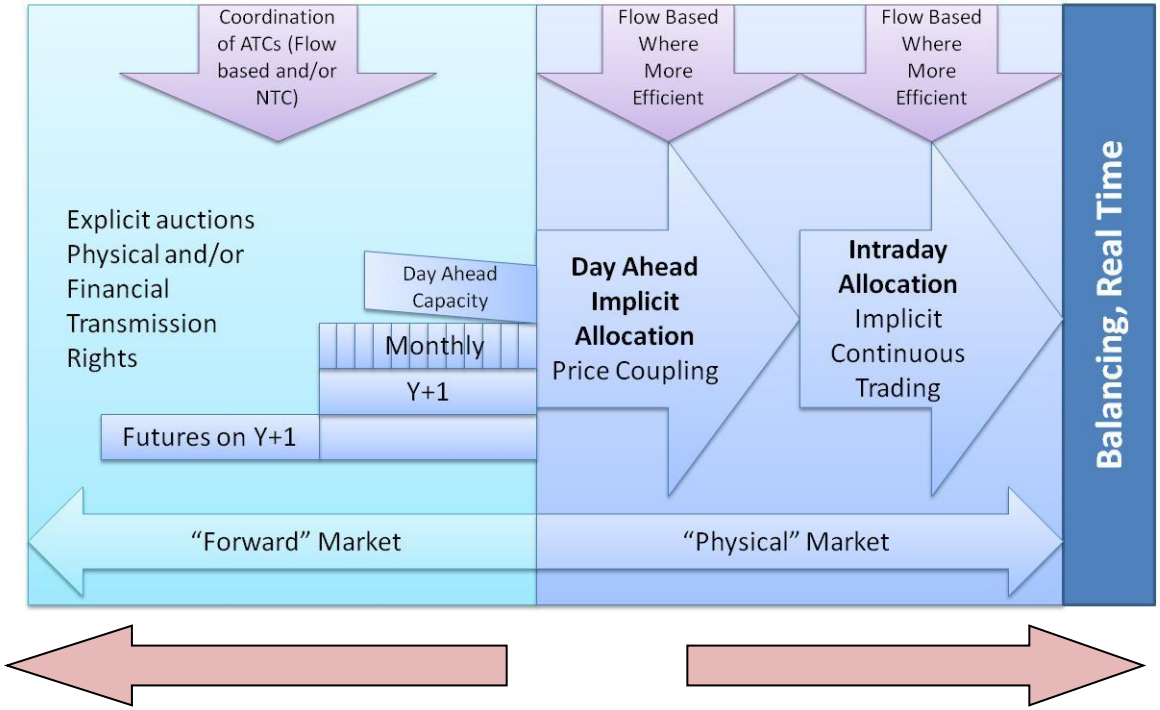
•Generation heat state loading (time for sync to min gen heat state dependant)

Units go straight from sync to min gen in the market schedule

Both can lead to interconnector flows sourced from generation that is not available in the physical timelines and consequently flows that cannot be delivered

No ability to change established interconnector flows to maintain security apart from counter trading which is non firm

System Security New Market



Before 11.00 AM on D-1	**11.00 AM on D-1**	Continuous from 11.00 AM gate to Hour ahead	**Hour-1 to delivery**

CODES		
FCA	CACM	BALANCING

Trading Day 11.00 PM – 11.00 PM

Operational environment changing

- New market arrangements to be designed

  - Day ahead

Existing	Gate EA2	11.30 D-1 for TD 06.00 – 06.00
New	Gate closure	11.00 D-1 for TD 23.00 – 23.00

  - Continuous intraday trading on interconnectors up to one hour ahead of real time (Bid matching)

  - Balancing Intraday gate to real time (one hour)

- Increasing levels of intermittent generation

  - Additional uncertainly – increased reliance on forecast / reserves
  - Additional operational restrictions SNSP, inertia etc

EIRGRID semo SONI

Operational environment changing

Interconnector flows will be continually changing through out the day at one hours notice to the TSO

- Less time for scheduling applications to run
- Less time to physically schedule plant
- Less time to counter trade

System Service provision ? – effected by changes in interconnector flows

Reaction to changes in plant availability ? (trips etc) Mitigation

More questions than answers at this stage !

Identifying Issues