TSOs’ perspective of the CACM requirements

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Introductory remarks

• Value creation
• Elements of the target model
Step-wise integration of European Markets

- Triateral market coupling (2006)
- CZ-SK-HU Market Coupling (2012)
- Market coupling of SWE and NWE (2014)
- Market coupling CWE (2010)
- Market coupling NWE (2014)
- 4M Market coupling (2014)

Source: ENTSO-E & FTI study on NG value creation
Step-wise integration of European Markets

Value creation

**DAY-AHEAD MARKETS**
- **1 B€** in social welfare
- **~100 M€/year** of benefits from flow-based in CWE
- **84%** efficient use of capacity given to the market
- **1500 TWh (~50% of consumption)** traded on exchanges

**INTRADAY MARKETS**
- **120 TWh** traded on main power exchanges in 2016
- **3,6%** average annual volume growth last 5 years

**DERIVATIVES MARKETS**

- Efficient day-ahead markets
- Market trust
- Liquid derivatives
- Efficient planning
- Efficient hedging

**STATES WITH INTRADAYMARKETS**
- Continuous trading
- Auctions
- Interim solutions before XBID

**2008-2016**
- Spot-volume growth (TWh/yr). EPEX and NordPool combined
- Derivative-volumes picking up (TWh/yr). EEX and NasdaqOMX combined

Source: ENTSO-E & FTI study on NC value creation
Elements of the target model

- Coordinated available transmission capacity (ATC)
  - Flow based approach (FB)
- Capacity calculation
- Balancing Energy Auction
  - Intraday Implicit Continuos Trading, Implicit Auction or “First-come-first-served”
  - Day-Ahead Implicit Allocation (Market Coupling)
  - Balancing Capacity Auction
- Coordination of interconnector capacities (flow based or ATC)
  - Monthly auction
  - Yearly auction
  - Monthly auction
  - Yearly auction
  - Day-Ahead capacity
- Explicit auctions
  - Implicit auctions
  - Explicit auctions
  - Implicit auctions
- CACM
- CACM
- CACM
- EB
- FCA

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Elements of the target model

Day-ahead market – Market coupling

Market coupling enables an efficient use of the transmission grid through strong interactions between local markets and an efficient European wide price formation. A single price coupling algorithm to be defined across Europe. Clearing prices, net positions for all bidding zones and cleared orders are calculated by the Price Coupling Algorithm.
**Elements of the target model**

**Intraday market – Continuous trading**

European target model cross-zonal intraday (XBID) capacity allocation and energy trading based on implicit continuous allocation (continuous trading)

A continuous intraday market let positions be fine-tuned close to real time. This is vital to managing wind and solar variability.

The target models setup pools all liquidity to maximize economic benefits.
TSOs’ perspective of the CACM requirements

Capacity Calculation

• CCRs
• Flow-based market coupling
Capacity calculation

What is a capacity calculation region (CCR)?

- A geographical area in which coordinated capacity calculation is applied.

What is coordinated capacity calculation?

- Interdependencies between the respective borders are considered
- Capacity calculation is reliable and optimal capacity is made available to the market

How are the CCRs defined?

- The CCRs are defined by bidding zone borders
- Each bidding zone border can be only assigned to one CCR

Impact of the definition of CCRs?

- CCRs will also be the basis for the regional work defined in the CACM Regulation, such as the capacity calculation methodologies, countertrading and redispatching methodologies and cost sharing
Each Bidding Zone border shall be attributed to one Capacity Calculation Region according to CACM regulation:
Capacity calculation

Nov 2015
- All TSOs’ proposal for the determination of CCRs
- 11 CCRs proposed

Nov 2016
- ACER decision on the determination of CCRs
- 10 CCRs approved

July 2017
- All TSOs’ proposal for amendment to the CCR determination
- Inclusion of a new BZ border (BE-GB) to an existing CCR
Capacity calculation

The Common Grid Model

TSO A: Individual grid model
TSO B: Individual grid model
TSO C: Individual grid model
TSO D: Individual grid model

Common Grid Model (CGM)

Centralized activity

Capacity calculation

Validation

Allocation

Min. Regional activity
Flow-based market coupling

• Flow-based market coupling is the target model for the future
• Flow-based methodology in the CWE region go-live: May 2015
• The current model is in principle scalable and can be extended to other regions
• Ongoing project for extending the flow-based capacity calculation to the whole CORE region
• Methodology to be developed and implemented by Q1 2019
Flow-based market coupling

To start with: the zonal concept

Assumptions

- “Perfect grid” inside each zone
- All commercial transactions inside the zone are guaranteed
- No trading restrictions within the zone
- Cross-border congestions are visible to the market
- Aiming at boosting liquidity

Result

- Internal congestions within the zone are not visible to the market
- TSOs have to solve those internal congestions

Solution

- Flow-based market coupling as an attempt to maximise welfare and optimise the capacities
Flow-based market coupling

The basic elements of flow-based in CWE

Base case
- Grid model used for capacity calculation
- Created considering foreseen exchanges

Generation Shift Keys (GSK)
- Approximation of power plants behaviour
- Linking the TSO balance to the individual power plants

Critical Branch
- How much can we exchange between zone?
- Definition: Branch + outage + remedial action
Flow-based market coupling

Calculation steps

1. DC load flow
2. Power flows
3. Sensitivities
   - Nodal PTDF
   - Zonal PTDF
   - Transfer PTDF
4. Repeat for every contingency

Maximum flow

Reference flow
Margin
Reliability Margin

Energy Community Secretariat
Flow-based market coupling

Creation of the flow-based domain

<table>
<thead>
<tr>
<th>Monitor Lines</th>
<th>Outage scenario</th>
<th>Margin left (MW)</th>
<th>A→B</th>
<th>A→C</th>
<th>B→C</th>
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<td>10%</td>
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<td>Outage 4</td>
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</tr>
</tbody>
</table>

Influence of exchange on lines (PTDF)

Constraints

Security of supply domain
Flow-based market coupling

Comparing with ATC

ATC coupling

- Supply and demand for two areas coupled
- Coupling is limited by the technical import/export limits

Flow-based coupling

- Global process for optimising on regional level
- Goal is to maximise the exchanges taking into consideration the physical limitations
Challenges in the implementation

• Agents to be involved
• TSOs-NEMOs relation
Challenges in the implementation of CACM

- Involved parties
  - All TSOs
  - TSOs in each capacity calculation region
  - NEMOs
  - ACER/ NRAs
  - ENTSO-E
  - ENTSO-E in cooperation with ACER
  - MESC
  - CACM Coordination Group
Challenges in the implementation of CACM

Pan-European deliverables

- Qualified majority voting (QMV) if no consensus
- TSOs / NEMOs representing at least 55% of the Member States (MS); and
- TSOs or NEMOs representing MS with at least 65% EU population
- One vote per MS / allocation voting powers if multiple TSOs / NEMOs

ENTSO-E All TSOs Process
Challenges in the implementation of CACM

Regional deliverables

- TSOs qualified majority voting (QMV) if no consensus + at least 5 MS
  - representing at least 72% of the MS + MS with at least 65% of the region population
  - blocking minority
- If regions with less than 5 MS: consensus

CACM: Capacity Calculations Regions (CCRs)

SO: Synchronous Areas (SA), CCRs, LFC Area. LFC Block

FCA: CCRs

Different regions

EB: CCRs, SA, geographical areas with relevant services
Challenges in the implementation of CACM

Governance of the single DA and ID coupling

CACM target model
- Single DA and ID coupling
- Based on existing regional projects

Cooperation TSOs / NEMOs on CACM deliverables
- Algorithms
- Back-up procedures
- Multi-NEMOs arrangements

Day-to-day management
- Joint organisation;
- EC and ACER observer.
Concluding remarks

• CACM is the first Market-related Guideline to enter into force
• CACM introduces rules for cross-zonal capacity allocation and congestion management in the day-ahead and intraday markets
• The harmonisation of the requirements and methodologies is to be conducted both on pan-EU and regional level
• TSOs play a pivotal role in the implementation of CACM
• Since the entry into force, all the pan-EU required methodologies have been submitted to the NRAs
• Important focus is also put on the regional proposals and developments