A journey towards Pan-European ancillary services

Symposium on European Grid Service Markets

Dr. Bastian Schwark, Head of TSO Markets
Lucerne, 6th July 2017
Agenda

1. The Swiss balancing market
2. FCR cooperation
3. IGCC imbalance netting cooperation
4. TERRE project (replacement reserves)
5. MARI project (mFRR)
6. Swiss project on “integrated market”
### Key figures for ancillary services in Switzerland

<table>
<thead>
<tr>
<th>Balancing energy</th>
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<tbody>
<tr>
<td>Primary reserves (FCR) +/− 74 MW</td>
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<tr>
<td>Secondary reserves (aFRR) +/− ca. 380 MW</td>
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<tr>
<td>Tertiary reserves positive (mFRR) + ca. 415 MW</td>
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<tr>
<td>Tertiary reserves negative (mFRR) − ca. 240 MW</td>
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<tr>
<td>Balancing energy per year c. 710 GWh</td>
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<tr>
<th>Other ancillary services</th>
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<tr>
<td>Active power losses per year c. 890 GWh</td>
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<tr>
<td>Reactive power per year (for voltage stability) c. 12.6 Tvarh</td>
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<td>Black start capable power plants on transmission level 8</td>
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Procurement cost for balancing reserve provision reduced significantly since 2009 below CHF 200 Mio./year

- **2013**: Water and energy shortage in spring
- **2016**: Potential critical situation in spring, forecast
Switzerland largely dependent on pumped hydro power for ancillary services

Swiss electricity generation 2014
100% = 69'600 GWh

- Pumped hydro power is **the flexible electricity resource** in Switzerland
- Share of pumped hydro **97% of the prequalified capacity for aFRR** in Switzerland
- About **80% of the Swiss frequency reserves cost** driven by aFRR
- Pumped hydro power plants are also used for **redispatch** in cases of network security constraints

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1 Biomass, biogas, PV, and wind
Dependency on pumped hydro for aFRR reflected in volatile seasonal prices

Average price for aFRR in 2016 (CHF/MW/h)

Planned mitigation measures:
- **Introduction of an asymmetric aFRR product** in 2018
- **Introduction of daily products** within next years
- For 2022, **participation of Switzerland in aFRR cooperation**
- For coming years, **partially early procurement of reserves**
Aggregation concept introduced in 2013 allowing decentral flexibility to participate in Swiss AS market

Prequalified small-scale technologies for pooling in mFRR (as of 20.3.2017)

- Concept allows aggregation of technical units on grid levels 5 & 7 (50kV & 400 V), including RES benefiting from Swiss subsidy scheme (KEV)
- Share of aggregators continuously increasing (currently ~4% of all bids; ~9% of awarded bids)
International cooperations essential driver for Swissgrid to increase liquidity of the AS market

Swissgrid has introduced many measures for the promotion of competition within the primary, secondary and tertiary control power markets

- Modification of tendering procedure, optimization of products
- Introduction of pooling concept
- Collaboration with foreign TSOs (e.g., start of FCR cooperation in 2015)
- Pre-qualification of CRF\(^1\) systems within the AS market such as solar PV or wind

\(^1\) CRF = Cost-covering remuneration for feed-in to the electricity grid
The EU energy legislative framework

1996-98: First energy package
- First elements of market opening

2003: Second energy package
- Market opening
- Unbundling
- National Regulatory Authorities (NRAs)

2009: Third energy package
- ACER, ENTSO-E
- Full unbundling
- Process to make detailed market and technical rules (NCs)

2017: “Clean Energy for all Europeans” package
European platforms for standard products

- Development of European Balancing Markets
  - RR market – 2019
    - Project TERRE
  - mFRR market – 2021
    - Project MARI
  - aFRR market – 2022
    - ENTSO-E aFRR project
Swissgrid is active participant in several international balancing energy cooperations

**FCR and imbalance netting process**

- **FCR cooperation**
  - Largest market for primary energy reserves in Europe with ~1’400 MW (inc. Austria, Belgium, France, Germany, the Netherlands, and Switzerland)
  - **Corresponds to nearly half of the FCR amount of Continental Europe**
  - Enlargement of DK planned in the future
  - Central Clearing System (CCS) operated at Swissgrid with core algorithm

- **IGCC: International Grid Control Cooperation**
  - Netting of the secondary reserves across borders before its actual usage
  - Uses free cross-border capacity after Intraday gate closure

**Standard products**

- **TERRE project: Trans European Replacement Reserves Exchange**
  - The entire projected volume of all participating TSOs will be optimized on a central platform with the offers from the balancing service providers
  - Members countries: UK, FR, ES, PT, IT and CH
  - Go live planned for early 2019

- **MARI project (Manually Activated Reserves Initiative)**
  - 19 European TSOs agree to further cooperation on mFRR platform
  - Signed beginning of 2017
  - Design phases within next 12 months
Agenda

1. EB GL and Swiss situation

2. FCR cooperation

3. IGCC imbalance netting cooperation

4. TERRE project (replacement reserves)

5. MARI project (mFRR)

6. Swiss project on “integrated market”
Overview of the FCR cooperation

- **Current status:** 9 TSOs from 5 countries are member of the cooperation

- **Common demand of 1’400 MW in common auction:** more than half of Continental European demand

- **Extension to France (RTE) completed in early 2017; expansion to Denmark (EnDK) planned in the future**

- **Pilot project of ENTSO-E**
System structure and challenges (e.g., «decoupling»)

- **Flexible system structure:**
  - BSPs bid on their national systems
  - «Central Clearing System» aggregates the national or regional systems

- **Adaptions and (country) extensions possible** without changing the customer interface

- **Introduction of a common market despite national differences** (no complete harmonization yet)

- **Diverging rules can lead to decoupling cases** (e.g., divisible bids in Germany, non-divisible bids in Switzerland)

- **Further harmonization necessary**, especially for further enlargement of the cooperation
FCR price development of participating countries

Common market leads to converging prices for all cooperation partners
Yearly imports and exports

<table>
<thead>
<tr>
<th></th>
<th>Import</th>
<th>Export</th>
<th>Import</th>
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<td><strong>2015</strong></td>
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<tr>
<td>DE</td>
<td>20</td>
<td>7</td>
<td>12</td>
<td>27</td>
<td>16</td>
<td>29</td>
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<tr>
<td>CH</td>
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<td>AT</td>
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<td>FR</td>
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<td><strong>2016</strong></td>
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<td><strong>2017</strong></td>
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Exchange per country
Overview of main questions of the FCR stakeholder survey

<table>
<thead>
<tr>
<th>Auction frequency</th>
<th>Product duration</th>
<th>Secondary market</th>
<th>Bid design</th>
<th>Auction algorithm</th>
</tr>
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<tbody>
<tr>
<td>Weekly</td>
<td>Weekly</td>
<td>YES</td>
<td>Indivisible</td>
<td>No indivisible/linked</td>
</tr>
<tr>
<td>Daily</td>
<td>Weekly peak/off peak</td>
<td>NO</td>
<td>Divisible</td>
<td>Reject both divisible/indivisible</td>
</tr>
<tr>
<td>Working days</td>
<td>Hourly</td>
<td></td>
<td>Exclusive</td>
<td>Reject only indivisible</td>
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<td></td>
<td>4 hours</td>
<td></td>
<td>Non exclusive</td>
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<td>Daily</td>
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<td>Time linked</td>
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<td>Non time linked</td>
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<td>Symmetric</td>
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<td></td>
<td>Asymmetric</td>
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<td></td>
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<td></td>
<td>Linked asymmetric</td>
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TSO BSP Settlement
- Pay as Bid
- Marginal Pricing
Conclusions from the consultation should be implemented in 3 independent packages:

- **Package A consists in introducing indivisible bids in all countries**, removing exclusive bids in Switzerland and changing the TSO-BSP settlement to marginal pricing. Package A could be implemented 9 months after NRA approval at the latest.

- **Package B consists in implementing daily auction with 4h products**. Package B could be implemented by TSOs 18 months after NRA approval at the latest.

- **Package C consists in implementing a first step of further harmonization of FCR market rules**. TSO proposal to be done by end of December 2018 at the latest.

The 9 months (for package A) and 18 months (for package B) implementation periods include the needed time to adapt the national contracts and rules, in cooperation with NRAs, where applicable.

Public consultation on the detailed proposal will therefore be carried out in September 2017. (announced as part of the EB GL implementation).
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IGCC background

- Since May 2010, all four German TSOs have launched the so-called Grid Control Cooperation (GCC) to optimize secondary control procurement and activation.

- Currently involves 11 TSOs from 8 countries: APG, Elia, Swissgrid, CEPS, 50Hz, Amprion, TenneT DE, TransnetBW, Energinet.dk, RTE, TenneT NL.

- RTE joint in Feb. 2016; other TSOs have initiated accession.

- ENTSO-E pilot project for the Imbalance Netting process.
### Imbalance Netting Principle

**Control Area 1**
- aFRR-Activation
- aFRR-Request
- Control Area Balance
- Secondary Controller
- aFRR
- ACE
- Correction

**Control Area 2**
- aFRR-Activation
- aFRR-Request
- Control Area Balance
- Secondary Controller
- ACE
- Correction

**Other Control Areas**
- aFRR-Request
- aFRR-Demand
- Correction

**Optimisation System**
- aFRR-Demand
- aFRR-Demand
- Correction
Available Transfer Capacity after Intraday Market is considered for determining the netting
### Market development: IGCC-Settlement – Basic principle (methodology applied from 01/02/2016)

<table>
<thead>
<tr>
<th>Opportunity Prices for Imbalance Netting</th>
<th>Opportunity Price = Opportunity Value/IGCC Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>without IGCC</strong></td>
<td><strong>with IGCC</strong></td>
</tr>
<tr>
<td>[ \text{SCE}<em>{\text{before IGCC}} \ [\text{MWh}] \times \text{SCE price}</em>{\text{before IGCC}} \ [\text{€/MWh}] ]</td>
<td>[ \text{IGCC exchange} ]</td>
</tr>
<tr>
<td>[ \text{SCE}<em>{\text{after IGCC}} \ [\text{MWh}] \times \text{SCE price}</em>{\text{after IGCC}} \ [\text{€/MWh}] ]</td>
<td>[ \left[ \left( \text{SCE}<em>{\text{before IGCC}} \times \text{SCE price}</em>{\text{before IGCC}} \right) - \left( \text{SCE}<em>{\text{after IGCC}} \times \text{SCE price}</em>{\text{after IGCC}} \right) \right] / \text{IGCC exchange} ]</td>
</tr>
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- **IGCC Initial Settlement Price** ($C_{\text{IGCC}}$): **Energy weighted** ($E_{\text{Imp},i}$ and $E_{\text{Exp},i}$) average of the **opportunity prices** ($C_{\text{Imp},i}$ and $C_{\text{Exp},i}$)

- Symmetric price for IGCC imports and exports

\[
C_{\text{IGCC}} = \frac{\sum_{i=1}^{n} (C_{\text{Imp},i}E_{\text{Imp},i} + C_{\text{Exp},i}E_{\text{Exp},i})}{\sum_{i=0}^{n} (E_{\text{Imp},i} + E_{\text{Exp},i})}
\]

- In case of negative individual benefits for one or more IGCC Members but positive overall benefit of the IGCC, an ex-post adjustment of settlement is performed in order to guarantee TSO neutrality.

- IGCC adjusted settlement prices ($C'_{\text{IGCC}}$) which may vary from member to member depending on their benefit before the adjustment

- Cost reduction for a participant is driven by the spread between the opportunity price and the IGCC adjusted settlement price

\[
R_{\text{IGCC}} = \sum_{i=1}^{n} (C_{\text{Imp},i} - C'_{\text{IGCC}}) \cdot E_{\text{Imp},i} + \sum_{i=1}^{n} (C'_{\text{IGCC}} - C_{\text{Exp},i}) \cdot E_{\text{Exp},i}
\]
IGCC benefit: Monthly avoided activation of SRE >250 GWh since France joined in Feb. 2016
IGCC benefit: Monthly value of netted imbalances

- Total cumulated value of IGCC netted imbalances over EUR 320 Mio. until end of 2016
- IGC Cooperation will gradually extend to European imbalance netting platform
IGCC next steps towards European imbalance netting process

- **Imbalance netting implementation framework** (timeline, functions and principles): 6 months after EIF
  - The European platform shall apply a multilateral TSO-TSO model to perform the imbalance netting process: The **functions** are to be designated in the implementation framework
  - The detailed principles for sharing the common costs, including the detailed categorisation of common costs to be included in implementation framework
  - Algorithm description: shall minimise the counter activation of balancing resources by performing the imbalance netting process
- At least CE TSOs should use the platform: 1 year after approval of implementation framework
- TSO-TSO settlement rules 1 year after Entry into Force
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TERRE project Mission and Participants

Develop a XB platform for RR products

- TERRE project will involve the design, development, implementation and operation on a cross-border platform for the balancing products (RR)
- The first phase of the design finalized with a consultation proposal, and has been validated by the NRAs and the market participants (stakeholder)

Toward efficient cooperation in balancing in Europe

- The proposed RR product together with the project governance should be aligned with Guidelines on Electricity Balancing.
- The established platform should support the future European balancing vision to assure the security of the energy supply
- The RR is not the only balancing product which is in development and should therefore be aligned with the ongoing projects (mFRR balancing regions), mainly to assure liquidity of balancing
- The TERRE platform is a suitable candidate for other balancing products such as mFRR.

Potential participants to TERRE project

Following TSOs were included in the cooperation

**Full Participants:**
- France (Rte)
- Italy (Terna)
- Portugal (REN)
- Spain (RED)
- Suisse (Swissgrid)
- GB (National Grid)

**Candidates:**
- Greece
- Norway
- Sweden
- Finland
- Denmark
- Czech Republic
- Romania
- Poland
- Hungary
- Croatia

![Map of Europe with full participants and candidates]
TERRE planning

Libra platform development

- The RFP process is the cornerstone to establish the algorithmic optimization solution and the technical design of the Libra Platform. The TERRE project will conclude the first phase of the main RFP Lots by end of summer, followed by functional design of the platform.

TERRE scope: RR market harmonization and consultation

- Next to the technical implementation of the platform, the harmonization of the RR balancing market will be handled by a public consultation. The stakeholders will be involved to provide their feedback on the proposed design. Followed by the publication under the EBGL scope with participation of all European RR TSOs.

TERRE stakeholder meeting:
12th of July in London
TERRE Libra platform ambition

- **LIBRA** will be composed of 3 independent lots

- Different zones using the same and/or different types of product can be optimised by the platform using different CMOL

- It is also possible to have one single Merged CMOL for the same type of product, for TSOs from different Cooperation

- **LIBRA** aimed to optimize balancing energy activation → Other scheduled balancing product can be optimised by the platform in different processes and timelines
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MARI-Project (*Manually Activated Reserves Initiative*): 19 European TSOs agree to cooperate on mFRR platform

**Scope of Application & Goal of Cooperation:**

- Involved parties affirm their intention to jointly design, implement and operate a mFRR Common Platform to integrate their balancing markets
- Focus on enhancing efficiency of balancing within system security limits
- Aim at integrating European mFRR balancing energy markets within principle of TSO-TSO model.

➔ Go-Live 2022
MARI high level principles

- Optimizing social welfare
- Facilitating netting of TSO mFRR needs
- Optimizing the allocation of cross-zonal capacities given to the Platform
- TSO-TSO settlement based on cross-border marginal pricing scheme

“It is expected that a well-designed platform not only fulfils the EB GL requirements, but also reinforces the security of supply and increases the efficiency and cooperation in balancing across Europe.”
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Idea of “integrated market” in Switzerland

- One single market for manually activated products
- No split between bids for mFRR/RR and redispatch
- Distributed generation can be offered into the market

Concept currently under discussion with market participants with potential go-live for beginning of 2018.
Overview of planned “integrated market” in Switzerland

**SITUATION TODAY**

**Tertiary Reserve Auction**
- Pay-as-bid

**Tertiary Energy Bids**
- Portfolio-based bidding
- Pay-as-bid
- Obligation to submit energy bids for successful bidders of reserve auction, additional free bids possible

**Congestion Management**
- Power plants on transmission grid have to provide their remaining capacity for CM
- Regulated remuneration

**INTEGRATED MARKET**

**Tertiary Reserve Auction**
- Pay-as-bid

**Integrated Market (from 2018)**
- One common energy market for balancing and congestion management
- Nodal bidding for power plants on transmission grid
- Portfolio-based bidding for power plants on lower grid levels
- Can be activated for balancing and congestions management,
- Pay-as-bid
- Obligation to submit energy bids for successful bidders of reserve auction, additional free bids possible
- Congestions management with regulated prices and obligation to participate remains as backup in case of insufficient bids in integrated market
Conclusion from balancing cooperations

- **FCR and IGCC already advanced cooperations with continuous geographical enlargements**; first driven by voluntarily TSO cooperation, now institutionalized with NRAs.

- **TERRE showed significant and positive progress** becoming one of the leading pilot project for the EB GL; **MARI project followed** with large number of TSOs involved.

- Pilot projects are a significant step in the **European electrical market integration**, main concepts which will be implemented will be used as basis for other cooperations.

- **TSO engagement goes beyond the EB GL** with its market consultation and goal of TSOs to harmonize market rules required to create a level playing field along.

- **Balancing and congestion so far dealt separately, but could be integrated** into an integrated market for manually activated products.
Questions and discussion
swissgrid