ENTSO-E Cross Border Electricity Balancing Pilot Projects

2 Month Report on Pilot Project 1 (GCC)

Pavel Zolotarev – TransnetBW

25 June 2015

1. Introduction

This report comprises of the following general issues:

1. The main information of the pilot project;
2. The implementation of relevant targets ahead of the Network code on Electricity Balancing (NC EB);
3. An update on any specific targets of the pilot project not directly linked to NC EB, but key for the pilot project itself;
4. An update on any additional general and particular success/monitoring indicators of each pilot project, taking into account what pilots are or not under a "go live" phase;
5. Balancing products: products implemented/to be implemented at pilot project level, analysing the possibility to harmonise between different pilot projects that deal with the same type of balancing product.

The table below indicates when information has been last updated.

	Last updated
2.a Participating TSOs	
2.b Scope and goals of the pilot project	
2.c Recent achievements of the pilot project	
2.d Learning points	
2.e Specific questions	
3.a Updated project roadmap	
3.b Impact on current practice and future market design	
3.c Cross-border exchange relevant data	
3.d Matching, ATC management and bids update process	
3.e Pricing-Settlement	
3.f Experience from the implementation	
3.g Extensibility and cooperation	
4.a Pilot project roadmap in comparison to NC EB	
4.b Contribution to standard product definition	

2. Executive summary

a) Participating TSOs

50Hertz Transmission GmbH, Amprion GmbH, Tennet TSO GmbH, TransnetBW GmbH

b) Scope and goals of the pilot project

Since GCC already implements

- Imbalance Netting;
- CMO for activation of aFRR;
- CMO for activation of mFRR;
- cost optimal procurement of aFRR and mFRR (Capacity CMO);

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

- harmonised standard products;
- harmonised settlement of aFRR, mFRR and FCR;
- joint dimensioning;
- harmonised imbalance settlement; and
- cooperation with other initiatives (e.g. IGCC)

it can be seen as regional implementation of the FGEB.

Therefore, the objective of GCC as a Pilot Project on Electricity Balancing is to further develop the technical and organisational cooperation in the field of balancing using as basis

- the existing scalable and reliable framework; and
- positive experiences from more than five years of operation.

The pilot project is structured into two work packages:

1) Cooperation with other pilot projects and TSOs including
   a) communication and exchange of experience with other TSOs;
   b) further development of cooperation within IGCC and other regional initiatives;
   c) feasibility studies related to possible harmonisation of balancing markets.

2) Upgrade of the real-time congestion management activation of aFRR and Imbalance Netting
   a) implementation and operation of real-time flow-based approach (in parallel with ATC-based approach);
   b) coordination of flow-based approach within GCC area and ATC-based approach within IGCC area.

c) Recent achievements of the pilot project

Since July 2014 the real-time flow-based aFRR and Imbalance Netting congestion management is in operation, and feasibility studies with other pilot projects described below.

d) Learning points

Learnings Q1: Identify learnings that can be useful for other pilots or collaboration initiatives in general

Overall Technical and Operational Success Factors

GCC was developed step by step starting from Imbalance Netting and ending in a common dimensioning and procurement of aFRR and mFRR. Although the technical complexity increased in the course of the extension of the cooperation, the complexity could be managed with the following success factors:

- **sequential increase of the number of optimisation functions** and roll out of intermediate steps to real operation;
- **continuity and consistency of concepts and technical infrastructure** based on a “plug and play approach” for optimisation functions, operational tools and concepts **from Imbalance Netting to aFRR-CMO**;
- **keeping the IT communication channels between reserve connecting TSO and its aFRR providers** while implementing the optimisation via communication between TSOs;

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

- **robust client-server solution for mFRR activation** combining automated communication processes from the mFRR optimisation system to mFRR providers with the automated communication processes between TSOs;
- continuous **adjustment of operational rules** to the new developments;
- **full transparency** of operational information in real-time, daily reporting and monitoring;
- **organisational structures** (steering groups and working groups).

Imbalance Netting Success Factors

GCC was first implementation of Imbalance Netting in CE and starting from scratch took approximately 6 months (06/2008 – 12/2008). This time period includes the technical design and stability analysis phase, technical implementation and trial operation.

Due to the fact that Imbalance Netting was a new concept, two of the success factors were its inherent dynamic stability and easy implementation.

- **The stability of the Imbalance Netting** implementation in GCC, which subsequently served as model for other imbalance netting implementations, **is ensured structurally**, i.e. it is independent of aFRR controller parameters or aFRR provider behaviour.
- The structural stability goes along with the **simple implementation** which requires control signals which were already available, i.e. ACE and currently activated aFRR (the latter one was not available for all TSOs in the beginning of implementation but can be easily approximated from the aFRR set point).

Besides the technical concept, the success in real operation can be attributed to two main origins:

- From the beginning, the Imbalance Netting algorithm included the **functionality of taking transmission capacity limitations into account in real-time** (this functionality was later developed to flow-based GCC congestion management).
- Imbalance Netting could be switched off at any time without endangering the operational security with **single aFRR control loops as a fall-back solution.**

aFRR-CMO Success Factors

The next step, aFRR-Assistance, was implemented in May 2009. aFRR-Assistance was an intermediate step for the participating German TSOs allowing the basic functionality of cross-border aFRR activation while the cost optimization future was not implemented yet. The aFRR-Assistance function (which is also now part of the algorithm) served as basis for common dimensioning and common procurement of aFRR and was followed by the implementation of aFRR-CMO in September 2009.

The main success factor for the quick implementation of aFRR-CMO was that **Imbalance Netting and the aFRR-CMO implementation in GCC rely on the same technical concept and the same set of input and output signals for the optimisations algorithm**. In particular, this has the following advantages:

- The coordination of the aFRR controllers of the participating TSO does not need to be changed, i.e. the upgrade from Imbalance Netting to aFRR-CMO is an upgrade of the optimisation logic, not the interface to the TSOs (quick implementation).
- The stability of aFRR-CMO implementation is ensured structurally as it is the case with Imbalance Netting.
- Consistent congestion management approaches for Imbalance Netting and aFRR-CMO

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

- Continuity for operational staff

mFRR-CMO Success Factors

The main success factor for mFRR-CMO (July 2010) is the IT solution for mFRR activation which is based on a client-server architecture as well as the flexible mFRR product which combines the direct physical response with schedule based settlement and TSO-TSO exchange.

- All TSOs have a “TSO client” software enabling the activation of reserves.
- All providers have a “provider client” software to receive activation requests.
- The TSO-TSO energy exchange is implemented through schedule blocks (simple implementation).
- All TSOs have the full transparency of the information.
- There are fall-back solutions in case of problems with the communication or software.
- The mFRR optimisation system is integrated into the operational concept of the German TSOs and also includes congestion management.

Importance of Flow-Based Congestion Management in Balancing

As the cooperation between the German TSOs was supplemented by the international cooperation within IGCC, there was an increasing need for monitoring and, if necessary to maintain operational security, limitation of the resulting flows. Due to the size of the cooperation the flow-based approach allows a higher degree of transparency and supports the operators in their assessment of the situation.

The recent experience with the flow-based approach in the optimisation of aFRR and Imbalance Netting is positive and is a success factor for the German pilot project. For other pilot projects the additional benefits for operation might vary, especially with the size of the cooperation, its geographical and network structure.

Cooperation in all Processes and Single Regulatory Framework

The cooperation between German TSOs covers all processes **including procurement and dimensioning of reserves.** The extent of the cooperation has the advantage of providing a **harmonised operational framework and market rules** creating significant optimisation potentials (cf. section 2e, question 1).

Moreover, the advantage of one regulatory framework creates a level playing field for all balancing market participants with respect to product definitions and imbalance settlement. The level playing field allowed to concentrate on the implementation project while feasibility studies were limited to the technical implementation and operational aspects (comparison of market design, definition of standard products, harmonisation etc. were not necessary) which makes the implementation faster in comparison to a non-harmonized environment (e.g. among IGCC Members).

Learnings Q2: Identify learnings that can be useful towards the NC EB implementation

Besides the success factors mentioned above, the experience in GCC shows that the implementation of quick wins is the key to success. Quick wins can be achieved by relying on existing technical solutions (e.g. derivation of aFRR-CMO from aFRR-Assistance which itself is an extension of Imbalance Netting) or by cooperation in fields with lower complexity (FCR).

The technical framework of GCC already serves as a model for other initiatives on Imbalance Netting (IGCC, eGCC, INC). Nonetheless, the GCC pilot project was not confronted with the challenge to collect experience with harmonization of international regulatory frameworks which present the significant challenge of the NC EB implementation.

e) Specific questions

Potential Q1: What are the expected benefits? (quantify) Who will benefit and how are the benefits distributed (e.g. grid tariffs)? Since the pilot project demonstrates an already existing market, it is difficult to quantify the benefits. According to the analysis performed on behalf of the German regulator before the full market harmonization in Germany in 2010 (based on data from 2009) the overall balancing energy cost reduction of aFRR (due to Imbalance Netting and CMO) amounts to approx. €120 Million per year. The cost reduction due to joint dimensioning and procurement amounts to approx. €140 Million. Due to the fact that the cooperation had a significant effect on the markets which at the same time were influenced by other factors such as increase of RES capacity, introduction of 15 min products in the intraday market, weekly tendering of aFRR (instead of monthly tendering), it is difficult to provide a good number based on the historical data of the last years. The balancing energy costs are passed to BRPs and the reserve procurement costs are covered by the grid users via the grid tariffs.
Potential Q2: Is the potential benefit of any other balancing cooperation affected by this initiative? No
Key regulatory/legal issues overcome or blocking at each pilot project
No regulatory or legal issues

3. Detailed of the pilot project

a) Updated project roadmap

The detailed project roadmap is to be added in the Annex 1 of this report. Deliverables of WPs and milestones in the project implementation should be shown in it. Please report and additional information to that here.

Additional information on the pilot project road map

b) Impact on current practice and future market design

Scope/influence 1: Are there side-effects on existing markets (price, liquidity, gate-closure time)? The question is not applicable since the pilot project already corresponds to the existing market
Scope/influence 2: Does the pilot provide for a better integration of renewable / demand-side flexibility into the market? All reserve providers have to fulfill the same requirements which are checked by prequalification.
Incentives 1: Are there any changes to BRP incentives? (e.g. via imbalance settlement, to be

balanced in day-ahead/real-time, to help restoring the system balance, to become active in day-ahead/intraday trading) The question is not applicable since the pilot project already corresponds to the existing market
Incentives 2: Does the pilot provide special incentives to certain BSP units (generators/load)? (Incentives for investment in new/existing technology enforced/void) All reserve provides have to fulfill the same requirements which are checked by prequalification.
Incentives 3: What are the TSO's incentives for economic efficiency? The procedures for procurement and activation of reserves are part of the national regulatory and legal framework.
System security: Q1: Does the pilot project provide an enhancement/impairment to system security in the involved control zones? The pilot project provides an enhancement of system security due to imbalance netting and closer cooperation between TSOs.
Transparency Q1: What is the (additional) operational information that is provided to BSPs and BRPs in the participating systems? All the relevant information is published at www.regelleistung.net.
Transparency Q2: Is there a continuous evaluation and communication of quality? See "Transparency Q1".

c) Cross-border exchange relevant data

Cf. 2e)

d) Matching, ATC management and bids update process

Matching algorithm (First Come First Served or CMO through an optimisation tool or others) CMO through an optimisation tool
Cross border capacity management (ATC/flow based) and its interaction with intraday market and previously activated slower balancing products. Both approaches in parallel, high flexibility since Germany is one bidding zone. The capacity is allocated to market participants first. Redispatch is used to guarantee the availability of transmission capacity for balancing. In case, short-term measures are needed, the system operator has the possibility to set limits for cross-border aFRR and mFRR activation in real-time (which results in an activation deviating from the CMOs). The flow-based approach promises a significant increase of operational transparency related to physical impacts of cross-border balancing.
Balancing bids update process and how this update process is coordinated with previous intraday energy market and previously activated slower balancing products Currently, there is no updating of bids.

e) Pricing – Settlement

Information on TSO-TSO settlement scheme

In Germany, the TSOs forward the costs related to balancing energy to the BRPs. The TSO-TSO settlement ensures that the TSO which has activated reserves gets the respective costs covered by the TSO with the BRPs which have caused the imbalance. Fictional example:
• BRP A is 100 MWh short.
• The imbalance is measured by TSO A.
• TSO A transmits the information to the Activation Optimisation Function.
• The reserves connected by the TSO B are cheaper, therefore,
• the Activation Optimisation Function calculates a power interchange which results in
• TSO A activates no balancing energy
• TSO B activates +100 MWh for e. g. 50 €/MWh from BSP B
• The settlement process is now conducted as follows:
  ○ TSO B pays BSP B 5000 €
  ○ TSO A pays TSO B 5000 €
  ○ BRP A pays TSO A 5000 €

Information on TSO-BSP settlement scheme Pay-as-bid
BRP´s imbalance settlement scheme The costs for balancing energy are covered by the BRPs,
How cross border balancing actions will be taken into account at the imbalance settlement mechanism? See fictional example. Settlement of quantities resulting from Imbalance Netting with other TSOs is currently treated in the same way as settlement of balancing energy.
Details about imbalance settlement period at pilot project level The settlement period is 15 min: • The imbalance of one BRP for one settlement period is either positive or negative. • Negative and positive balancing energy is settled separately.

f) Experience from the implementation

CBA finished for a certain process.
Internal regulatory change approval, cost recognition from NRAs.
Update about on-going internal regulatory changes associated with pilot project objective.
Reporting about contracts signed (at TSO-TSO level, for instance MoU signature between participating TSOs, at TSO – platform owner level, etc.)
What were the implementation costs and risks? The costs are mainly related to the operation of the IT-Systems
Governance issues: platforms management and ownership.
Flow based approach (and associated feasibility study accomplished, if proceed). The flow-based approach promises a significant increase of operational transparency related to physical impacts of cross-border balancing.
Reporting about stakeholder involvement at pilot project level (Workshops held, relevant feedback

obtained from stakeholders)
Cross Border capacity reservation experience
Other comments.

g) Extensibility and cooperation

Extensibility Q1: Identify any potential extensions of this project towards other pilots or other areas in general

The recent achievements related to work package 1 are:

- Cooperation with pilot project 5:
  - Feasibility study completed
- Cooperation with pilot project 7:
  - Feasibility study completed
- Cooperation with pilot project 2:
  - The German TSOs have joined the Pilot Project.

Extensibility Q2: Please provide details about potential harmonisation of balancing products of the same process or justify any possible barriers

The technical principles of Imbalance Netting are harmonised with IGCC and eGCC.

Extensibility Q3: Under which conditions can the cooperation be extended? (Reciprocity for BRPs and BSPs is guaranteed, specific regulatory/legal framework required?)

Extensibility Q4: What is the regional extensibility of the method, due to technical restrictions? (Uniformly applicable within regions of limited extension or no restrictions on extensibility)

4. Contribution of Pilot Project to NC Implementation

a) Pilot project roadmap in comparison to NC EB

Where relevant explain briefly the expected or the already achieved contribution of each pilot to any of the NC milestones (A-J) listed below and also complete the timing in the corresponding table.

A. Proposal of regional implementation framework:

The project delivers a working example for maximum optimisation potential between TSOs without constraints of different regulatory frameworks and can serve as basis for step-by-step implementation of Imbalance Netting, aFRR-Assistance, joint procurement of FCR, aFRR and mFRR as well as the CMOs for aFRR and mFRR.

B. Implementation of the regional integration model:

Implementation with other TSOs is subject to positive CBA-analysis (cf. feasibility studies).

C. Proposal of modification of the European integration model

There are no proposals so far.

D. Proposal of the European implementation framework

The project covers all targets of the NC EB.

E. Proposal of common settlement rules

The pilot projects already implements common settlement rules including a TSO-TSO settlement function. Currently, no change of existing rules is intended.

F. Proposal of settlement harmonisation

The pilot projects already implements common settlement rules including a TSO-TSO settlement function. Currently, no change of existing rules is intended.

G. Proposal of standard products definition

The pilot projects already implements common definitions for standard products. Currently, no change of existing rules is intended.

H. Proposal of standard products pricing

The pilot projects already implements common definitions for standard product pricing. Currently, no change of existing rules is intended.

I. Proposal of standard products algorithms

The pilot projects already implements: Imbalance Netting Process Function, Capacity Procurement Optimisation Function , Activation Optimisation Function

J. Proposal for common settlement rules of intended exchanges of energy associated to the Frequency Containment Process

not applicable

Other expected contributions? (if yes, explain contribution and indicate both NC road map and pilot project road map)

The main expected contribution is the implementation of the optimisation functions, real-time operation and experience with the implementation of the TSO-TSO model.

The timing of the pilot project in relation to the NC EB implementation schedule (A-J), should be completed where applicable. Note: EIF is estimated in Q4 2015.

Process										
Imbalance netting	A	B	C	D	E	F	G	H	I	J
Deadline from NC EB (EiF+)	6 m	2y	3y	4y	2y	3y	1y	1y	1y	
Pilot Project 1	12/2008	12/2008	12/2008	12/2008	12/2008	12/2008	12/2008	12/2008	12/2008	

Process										
mFRR	A	B	C	D	E	F	G	H	I	J
Deadline from	2y	4y	4y	5y	2y	3y	1y	1y	1y	

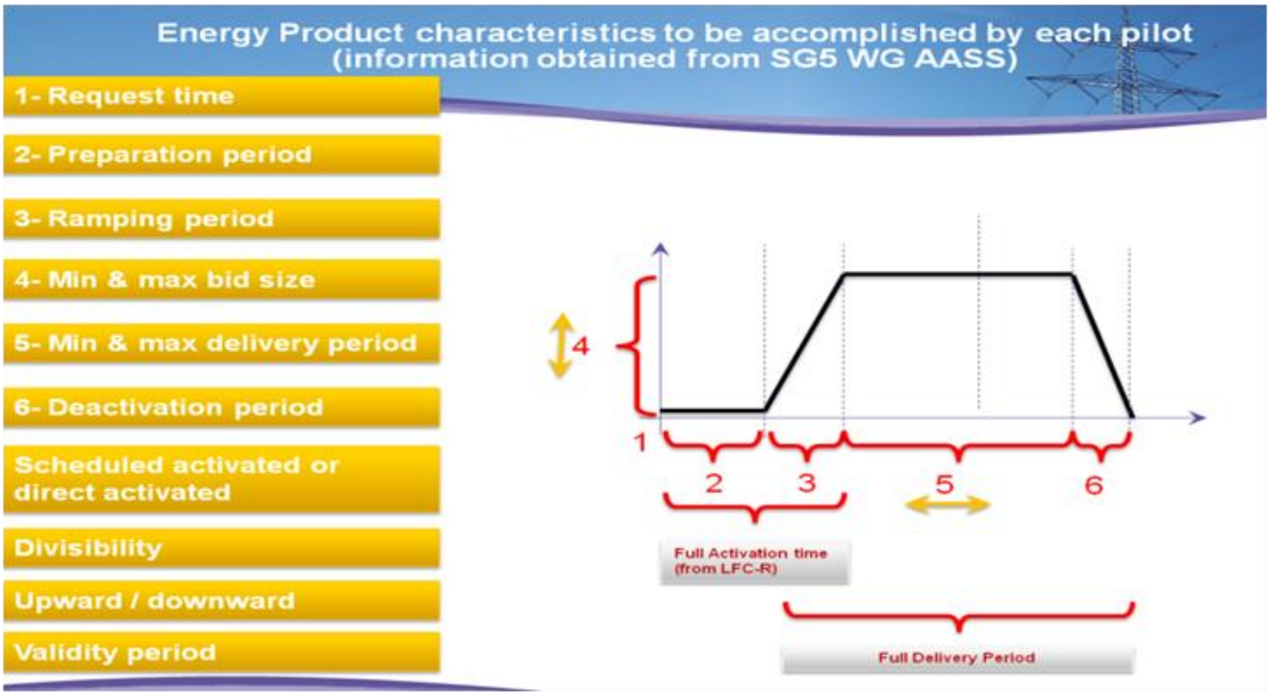
NC EB (EiF+)										
Pilot Project 1	05/2010	05/2010	05/2010	05/2010	05/2010	05/2010	05/2010	05/2010	05/2010	

Process										
aFRR	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Deadline from NC EB (EiF+)	**3y**	**4y**	**4y**	**5y**	**2y**	**3y**	**1y**	**1y**	**1y**	
Pilot Project 1	09/2009	09/2009	09/2009	09/2009	09/2009	09/2009	09/2009	09/2009	09/2009	

Describe current or expected mismatches of pilot project with respect to the NC EB. Currently, the pricing methodology of balancing energy and reserves is pay-as-bid. Moreover, there is no possibility to update bids. The further development of the German balancing market is currently under investigation.
Describe the reasons behind these mismatches. Historical development of the balancing market and no need to change up till now.
Describe (if feasible) forecasted date to overcome mismatches. No fixed date

b) Contribution to standard product definition

The table below provides details about the technical characteristics of the standard product that is to be exchanged in the scope of the pilot project. The explanation of the terms used is given below:



Automatic FRR	
Request time	Not applicable
Preparation period	30 seconds
Ramping period	Not applicable
Full Automatic FRR Activation Time	5 minutes
Minimum and Maximum bid size	Minimum bid size: 5 MW, 1 MW increment
Minimum and Maximum delivery period	No minimum delivery period, for the maximum delivery period see “Validity”
Deactivation period	Not applicable
Scheduled activated or direct activated (when applicable)	Not applicable
Divisibility: only divisible bids or divisible/indivisible conditions allowed?	No indivisible bids allowed
Upward/downward (specify if there is symmetry at product characteristics for upward/downward); if not, fulfil 2 tables: one for upward product, the other one for downward product	Separate bids for upward and downward direction
Validity period of the bid (next hour, ...):	• The auction for the aFRR (secondary control reserves) is a weekly auction which (usually) takes place Wednesdays, the bids for reserves must be submitted till 15:00 • The bids can be submitted for one or both delivery time frames “High Tarif” (08:00 – 20:00 on working days) and “Low Tarif” (20:00 – 08:00 and on weekends or holidays) • During the delivery time frame in the respective week the reserves

	must be continuously available (for "High Tarif" this would mean Monday - Friday between 08:00 and 20:00) • During the whole delivery time frame in the respective week a bid may be continuously activated
Manual FRR	
Request time	Not applicable
Preparation period	Not applicable
Ramping period	Not applicable
Full Manual FRR Activation Time	15 minutes
Minimum and Maximum bid size	Minimum bid size: 5 MW, 1 MW increment
Minimum and Maximum delivery period	No minimum delivery period, for the maximum delivery period see "Validity"
Deactivation period	Not applicable
Scheduled activated or direct activated (when applicable)	Both, scheduled and direct activation. Typically scheduled activation is used by the operators.
Divisibility: only divisible bids or divisible/indivisible conditions allowed?	Indivisible bids ≤ 25 MW are allowed
Upward/downward	Separate bids for upward and downward direction
Validity period of the bid (next hour, ...):	• The auction for mFRR (tertiary control reserves) takes place daily before the start of the EPEX day-ahead trading • There are six delivery time frames with 4 hours each: 00:00 – 04:00, 04:00 – 08:00, 08:00 - 12:00, 12:00 - 16:00, 16:00 - 20:00 and 20:00 – 24:00 • During the delivery time frame in the respective week the reserves must be continuously available (e.g. on Monday between 04:00 and 08:00) • During the whole delivery time frame in the respective week a bid may be continuously activated

5. Additional relevant information of the pilot project

The detailed description of the balancing market in Germany is available in English language on www.regelleistung.net in the section "Market Description".

The following table compares the current mFRR product in Germany (last column) with the current mFRR standard product proposals which are discussed by WG AS:

	P-DA-15-15/30 (mFRR)	**P-DA-10-10/25 (mFRR)**	**P-DA-5-5/20 (mFRR)**	**P-Sch-15-0/15 (mFRR)**	**P-Sch-30-15 (RR)**	**P-Sch-15-15 (RR)**	**GER: P-DA/SCH-15-7,5/22,5**
FAT	15	10	5	15	30	15	15
Min delivery	15**	10**	5**	0	15	15	7,5
Max delivery	30**	25**	20**	15	15 / 60	15	22,5
Temporal divisibility	Mandatory yes. between min and max. Minute based resolution	Mandatory yes.	Mandatory yes.	NO	NO	NO	Mandatory yes. between min and max. Minute based resolution
Links (temporal)	No	No	No	No	Yes / No	No	No
Activation method	Continuous process	Continuous process	Continuous process	Continuous process, or clearing	clearing	clearing	Continous process and clearing at the end
Ramps (financial settlement)	7.5 min*	5 min*	2.5*	no	no	no	no
Bid size	1 MW (tbc) to 9999 MW						5 MW

Appendix 1. Project road map Summary

Currently, the further development of the project focuses on feasibility studies with other Pilot Projects. The road map will be updated as soon as next steps are defined.