IBM Research - Zurich GmbH

Saeumerstrasse 4
8803 Rueschlikon
Switzerland

Author: Bernhard Jansen
email: bja@zurich.ibm.com
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Subject: Contribution to D1.7 on integration of the Real Time Market with the current regulation and energy markets. As discussed in the T1.7 regular phone conferences.

1 Introduction

As the EcoGrid EU Real Time Market introduces a new market concept into the current environment market environment while leaving todays market unchanged the all participants in the new and the current market need to arrange with the new situation. The EcoGrid EU Real-Time Market is a new source of balancing power to the TSO.

The TSO in addition also needs to integrate the source of balancing power in the current operation practices and market situation. As Denmark is part of both European interconnected power systems, the ENTSO-E Regional Group Continental Europe and the ENTSO-E Regional Group Nordic the Danish TSO Energinet would need to integrate it in both systems.

1.1 Danish Power System

The Danish power system consists of DK1, which is part of the ENTSO-E RG Continental Europe and DK2, which is part of the ENTSO-E RG Nordic. Both connected power system have different products and regulations for balancing power, which are shortly described below. Deliverable D1.1 and D1.2 give a more detailed introduction.

1.1.1 DK1 – ENTSO-E RG Continental Europe

Primary Reserve - Automatic symmetric up- and downward reserve insuring grid frequency. Activation is bound to grid frequency. Activation period is up 30 seconds.

Secondary Reserve - Automatic symmetric up- and downward reserve restoring the frequency to 50hz after stabilization by primary reserve and releasing primary reserve. Activation is by a TSO signal and activation time is between seconds up to 15 minutes.

Tertiary Reserve – Manual activated symmetric up- and downward reserve. Releasing secondary reserve and ensures the balance in case of outages.

1.1.2 DK2 – ENTSO-E Nordic

Frequency-controlled normal operation reserve - Automatic symmetric up- and downward reserve insuring grid frequency within normal operation. Activation is bound to grid frequency and with a 49.9Hz to 50.1Hz band. No deadband.

Frequency-controlled disturbance reserve - Automatic upward reserve insuring grid frequency at major disturbances. Activation is bound to grid frequency starting form 49.9Hz down to 49.5Hz. Activation period is 5seconds (50%) to 25seconds (100%).

Tertiary Reserve - Manual activated symmetric up- and downward reserve. Releasing FNR and ensures the balance in case of outages.

1.2 Integration into current balancing power markets.

The integration of the Real-Time Market is on the one hand a technical issue on the other hand however it is a political question. The TSO could choose to minimize costs of regulation power procurement and act strictly technical. The optimization term for minimizing procurement cost for regulation power is discussed in D1.2. The other option the TSO has is to prefer the Real-Time Market over traditional source for balancing power if the it leads to better usage of renewable

energy sources or saves the emission of CO_2 by not powering up a fossil fuel driven balancing power source. The decision is outside the scope of D1.7

1.2.1 Integration of the Real-Time Market into DK1

In DK1 the EcoGrid EU Real-Time Market can compete with secondary and tertiary reserves. The primary reserve has to fast timing requirements for the Real-Time Market therefore there is no potential.

As secondary reserve has an activation period from seconds up to 15 minutes and is activated with a direct set point manipulation of the generation unit from the TSO there is potential to replace some of it by the capacities in the Real-Time Market. As the secondary reserve is used release the primary reserve a crucial point is the predictability of the reaction to the real time price signal. A reaction, which is lower as expected, would not release the all of the primary reserve and a reaction bigger as expected would introduce a new disturbance into the system, which would also bind primary reserve and not release it.

Tertiary reserve has an activation period up to 15 minutes and is activated manually by amending the operational schedules by the TSO and the supplier. The TSO can based on it's strategy choose to activate classical tertiary reserve or ask the Real-Time Market for balancing power. The different time slot length of tertiary reserve and the Real-Time Market can have a positive effect in a way that activate secondary reserve can be released early and taken over by the Real-Time Market instead of tertiary reserve as the activation time is maximum 6 minutes. A negative effect of replacing tertiary reserve with capacity from the Real-Time Market is again the dependency on the predictability of the Real-Time Market and therefore also the stability of longer periods of time. In case of varying balancing power over many 5-minute timeslots this will eventually bind primary and secondary reserves.

1.2.2 Integration of the Real-Time Market into DK2

In DK2, the Nordic system the Real-Time Market competes mainly with tertiary reserves. Frequency-controlled normal operation reserve (FNR) with no deadband and activation time frame of 150 seconds is as well as Frequency–controlled disturbance reserve (FDR) with a activation time frame of 5 (50%) to 25 (100%) seconds out of scope for the Real-Time Market. Both reserve types have way to fast reaction times.

As FDR is only an upward regulation reserve and DK2 is only obliged to provide a 23 MW share of FNR the reserve capacities for downward regulation are limited. Overproduction can be resolved by spillage of Wind energy or throttling thermal plants but especially the first is working against the goal of using bigger share of renewable energy. The Real-Time Market can provide additional downward regulation capacity, which has a faster response time of maximum 6 minutes than the symmetric tertiary reserve and shorter slot time. In addition with the automated sending of price signals the Real-Time Market can be seen as automatically activated.

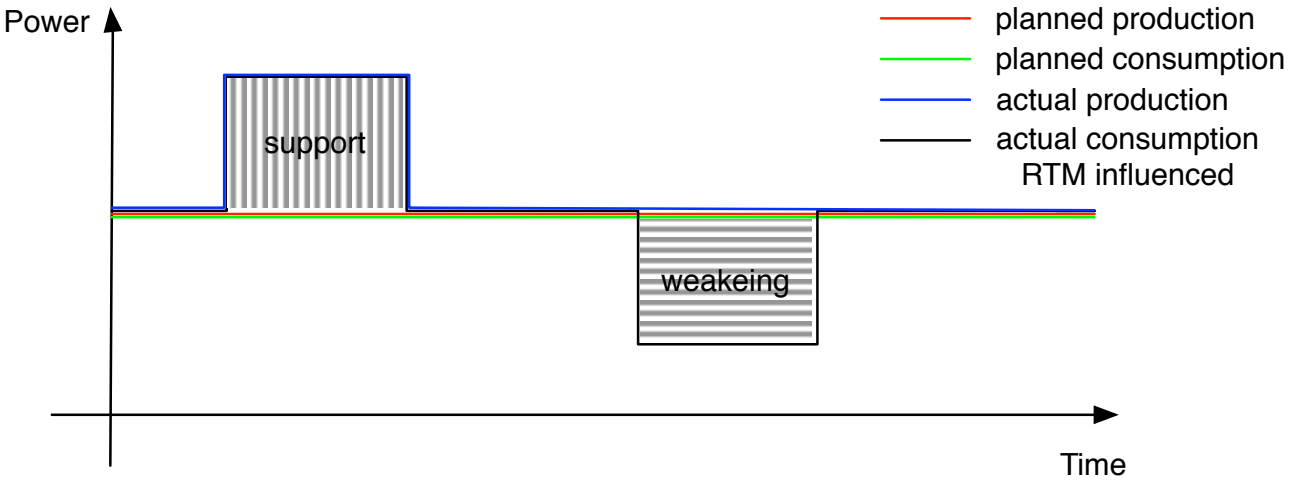
Tertiary Reserve has as in DK1 an activation period of 15 minutes and is activated manually by amending the operational schedules by the TSO and the supplier. As tertiary reserve is meant to take over from FNR as comparable to secondary reserve in DK1 the integration of the Real-Time Market with tertiary reserve is as in DK1.

1.3 Problems

1.3.1 BRP schedule deviation

If a BRP and its customers are connected to the Real-Time Market the BRP will face some schedule deviations because of taking part in the Real-Time Market. While technically this problems are resolvable it will finically it can have negative effects in the current system.

The assumption for the following example are a big share of Real-Time Market customers in the Danish power system and equal to slightly lower consumption but moveable within a foreseeable future of an EcoGrid consumer.



The above figure shows a simplified example where the Real-Time Market helps the regulate a overproduction of for example wind energy. The production is in first deviation from the plan higher than planned, so the Real-Time Market will lower the prices to enhance consumption. As the BRP is helping the grid stability by providing downward regulation power the schedule deviation won't be penalized. As the assumption is that consumption can be shifted but won't increase the deviation early will result in a deviation later on. To avoid a deviation later on the BRP can try to sell the now spare capacity on the intraday market, which will probably get harder with increasing Real-Time Market participants. D1.2 also addresses this issue bit is not answering it.

1.3.2 Separation of Real Time Market customers and conventional balancing power market

In Deliverable 1.2 it is suggested that BRPs split their schedules and settlement in two parts. One for the Real Time Market Customers and one for the customers using the conventional balancing power markets. D1.2 leaves the details of such a split open to this deliverable to define the details. The split of schedules for customers of a BRP is doable by introducing sub-BRPs for Real-Time Market Participants and normal non Real-Time Market Participants. But even then the Real-Time Market Participants are settled partly with the conventional balancing power market as they also benefit from the faster reserves like primary and secondary in DK1 and FNR and FDR in DK2. In addition the TSO will apply tertiary reserve to the Real-Time Market Participants in case the Real-Time Market can't find the requested capacity. Therefore it must say the BRP should separate settlement for Real-Time Market Participants which are settled with the Real-Time Market and the conventional balancing power market and non Real-Time Market Participants which are only settled with the conventional balancing power market.