

Pilot project R2 non-CIPU

Workshop

03/06/2016

Agenda

- 1. Introduction**
2. Fundamentals of the R2 product
3. R2 process
4. Important aspects and conclusions of the R2 wind pilot project
5. Challenges of R2 non-CIPU
6. Project information

Existing products

<http://www.elia.be/en/products-and-services/ancillary-services>



New terminology	Current terminology	Description	Types	Sourcing	Offered by
Frequency Containment Reserves (FCR)	Primary reserves (R1)	Very fast common European reserves with as objective to stabilize the frequency deviation after an incident.	R1- 200mHz	Monthly Weekly (August 2016)	CIPU
			R1-Down / R1-load / R1 100mHz	Monthly Weekly (August 2016)	CIPU & Load
Automatic Frequency Restoration Reserves (aFRR)	Secondary reserves (R2)	Fast <u>automatic</u> reserves with as objectives to restore the balance of the Belgian control area.	R2-up	Monthly Weekly (August 2016)	CIPU
			R2-down	Monthly Weekly (August 2016)	CIPU
Manual Frequency Restoration Reserves (mFRR)	Tertiary reserves (R3)	<u>Manual</u> reserves to support the aFRR to restore the balance of the Belgian control area.	R3-PROD	Yearly/monthly	CIPU
			R3-DP	Yearly/monthly	Load + Generation (TSO and DSO connected)
			ICH	Yearly	Interruptible contract holder (load)

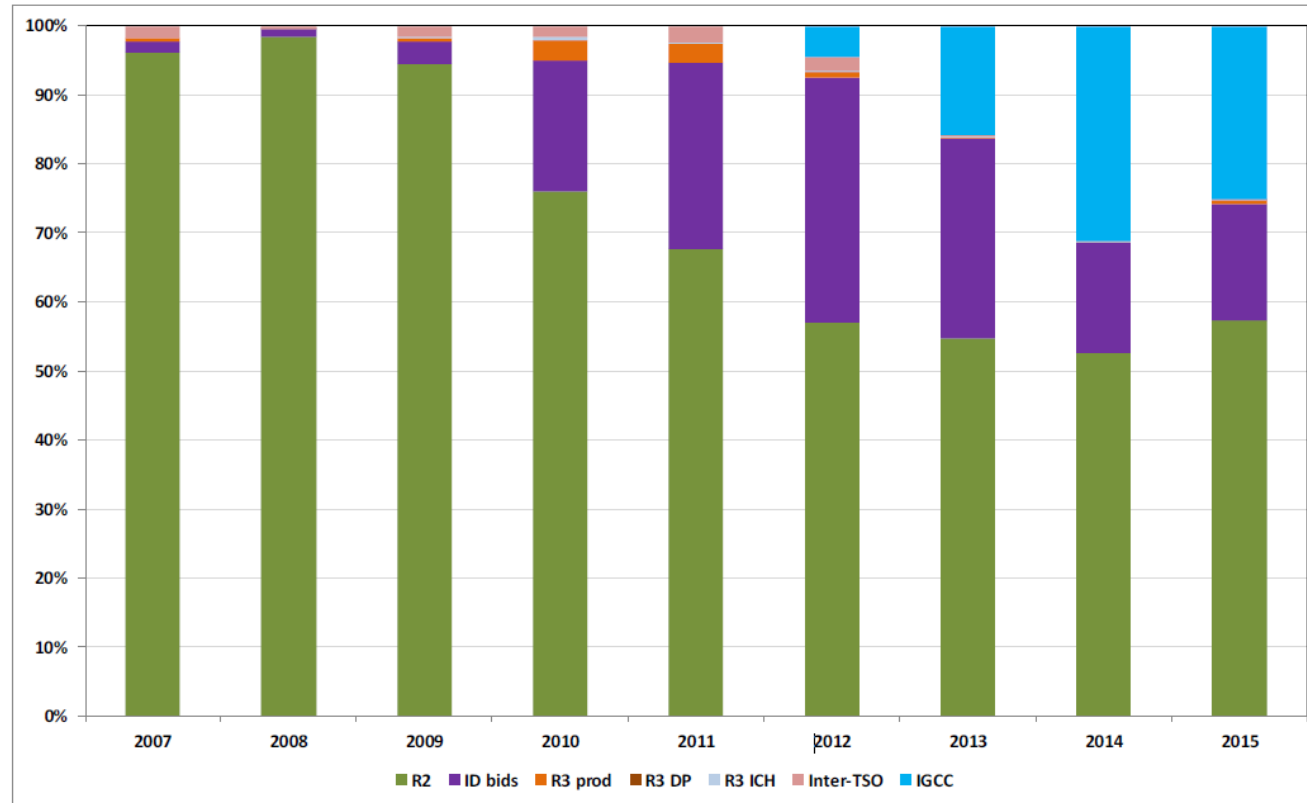
High level description of R2 product today

Product	Detailed description	Types	Offered by
Secondary reserves (R2) = aFRR	<ul style="list-style-type: none"> • automatically and continually activated both upwards and downwards. • It kicks in quickly (between 30 seconds and 15 minutes) and remains active as long as it is needed. 	R2-up	CIPU
		R2-down	CIPU

- main purposes: continually restore balance in the Elia control area;
- Continuously activated upwards and/or downwards
- a signal transmitted by Elia's dispatching center to the grid user's dispatching center automatically orders an increase or decrease in the power injected

product	R1	R2	R3
Frequency	+++	+++	+
Energy	+	+++	+++

Share of R2 activation



Figuur 92: Activering van de bronnen van de onevenwichtscompensatie in de periode 2007-2015 (MWh) met inbegrip van de deelname aan de IGCC

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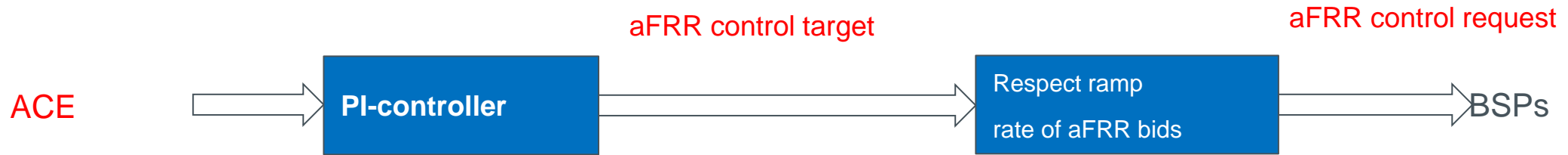
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Fundamentals of R2 product

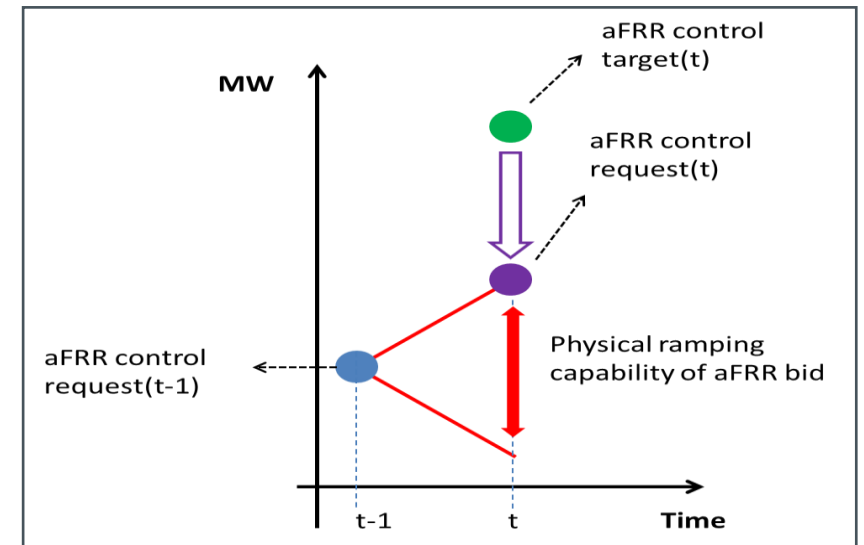
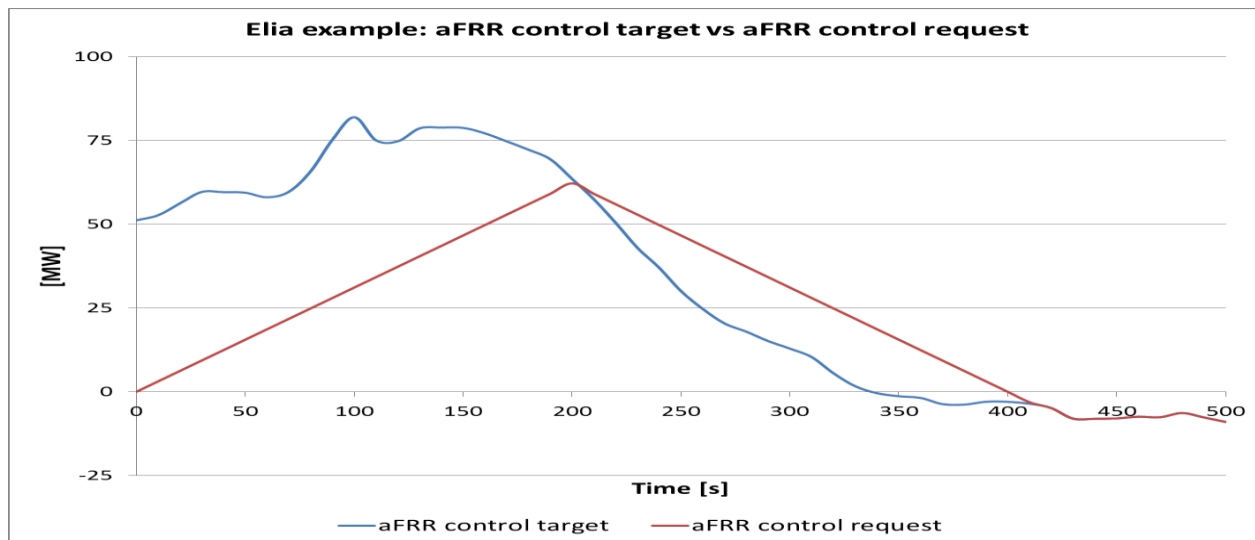
- Quickly activated
 - Full activation time of 7.5 minutes
 - Activated within 30 seconds
- Automatically activated
 - The ability to adjust its output on the basis of an external set point (R2 set point) sent by Elia
- Minimum communication requirements (real-time and off-line)
 - R2 set point from Elia to BRP (real-time, 10 seconds)
 - Mirrored R2 set point from BRP to Elia (real-time, 10 seconds)
 - P_{measured} from BRP to Elia (real-time, 10 seconds)
 - Pref: Injected power of R2 production unit without R2 activation from BRP to Elia (real-time, 10 seconds)
 - R2 nomination volumes and prices (D-1, before 15h00)
 - Penalties for discrepancy (ex-post)
 - ...
- 100% availability

These fundamentals will not change for the pilot project R2 non-CIPU!

Activation process: (simplified) functioning of secondary controller



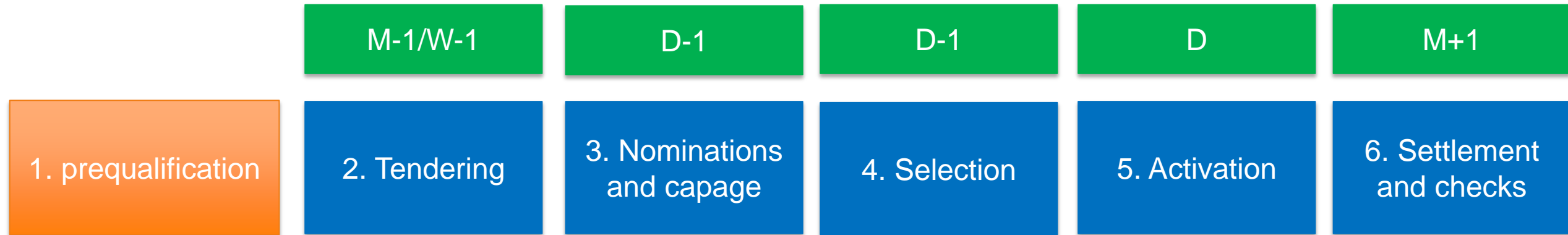
- Secondary controller is a PI controller having the ACE as an input
- The outcome of the PI controller is the desired aFRR activation, the so-called aFRR control target:
 - does NOT respect the ramping rate constraints of the aFRR bids / cannot necessarily be physically delivered
- A second calculation is performed to define the aFRR control request:
 - respects the limited ramp rate of the aFRR bids / can be physically delivered (in case of perfect activation)
 - aFRR control request is sent by Elia to the BRPs that deliver aFRR
- The aFRR control target and control request are calculated typically every 4 – 10s



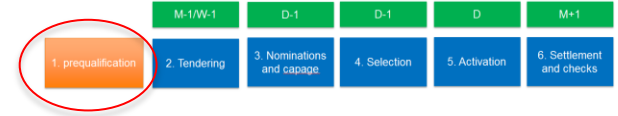
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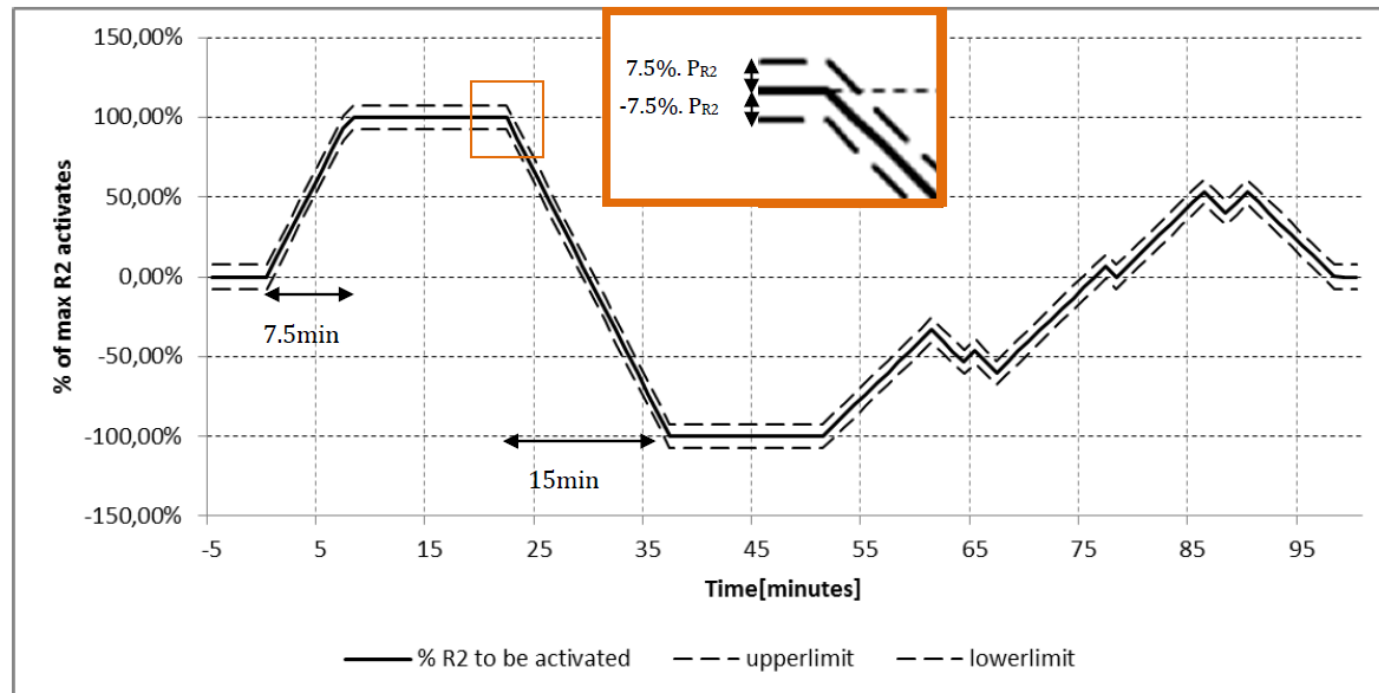
Process



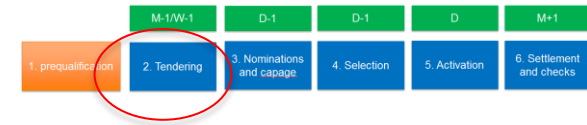
1. Prequalification



- Organizational requirements:
 - Minimum communication requirements (real-time and off-line).
- Technical requirements:
 - Simulation of the following signal



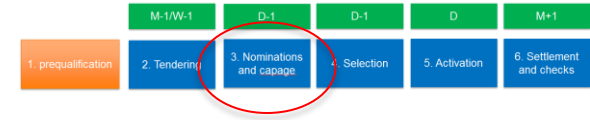
2. Tendering



- Frequency: Monthly and from August weekly
- Valid capacity bid [MW]:
 - Volume up and/or down [MW], minimum 1 MW with increments of ± 1 MW
 - Unit price for reservation [€/MW/h]
 - portfolio based
 - peak, L-off-peak or base offers
- Bidding sheet / combined R1 & R2 offers
- Separate upward / downward R2 procurement
- 140 MW
- Introduction of a day-ahead secondary market for providers to exchange R2 obligations
- ID secondary market in case of FO from 01/01/2017



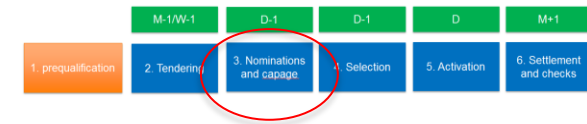
3. Nominations + capage



- Nominations

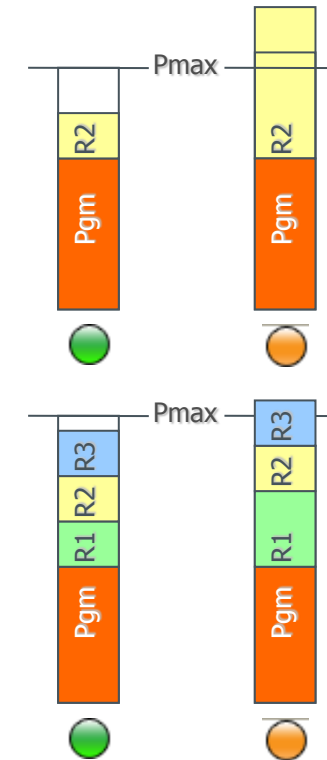
- D-1 @ 15h00
- Obligation for contracted capacity (DA secondary market) to bid in for energy in D-1
- Non-contracted capacity can bid in for energy in D-1 (\Leftrightarrow no capacity remuneration)
- Valid energy bid [MWh] per Qh:
 - Combination of production units that will provide the Secondary Control Power Obligations
 - Price bid [€/MWh] with cap and floor.
 - Floor: 0€/MWh
 - Cap: FC+ 40€/MWh
 - Quantity up and down [MW], minimum 1 MW with increments of ± 0.1 MW

3. Nominations + capage

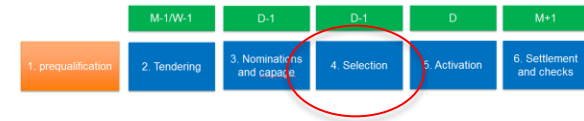


- Check

- nominated production programs (E-programs)
- technical parameters (availability, Pmin, Pmax)
- nominated ancillary services
 - Individual check and cross-check with other ancillary services nominated on the unit.
 - $P_{nom} - R_{down_nominated} > P_{min}$
 - $P_{nom} + R_{up_nominated} < P_{max}$
- Confirmed nominated R2 volumes
- CIPU contract

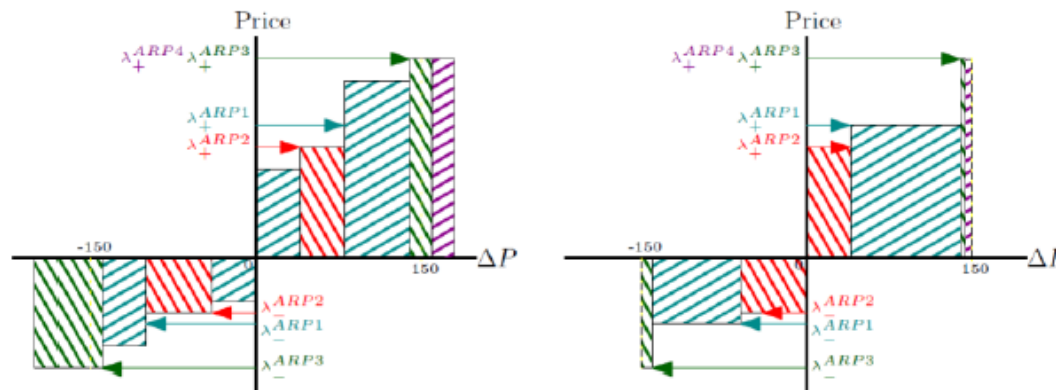


4. Selection

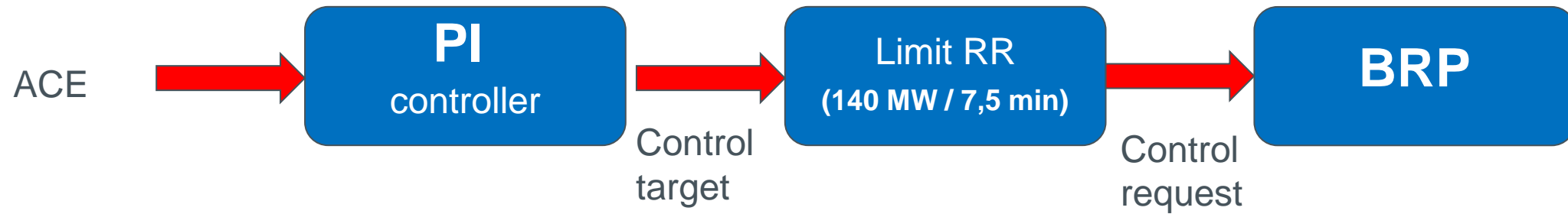


- 2 separate merit order lists per Qh (see left graph below) :
 - Merit order for upward R2 energy bids in order of increasing price;
 - Merit order for downward R2 energy bids in order of decreasing energy prices.

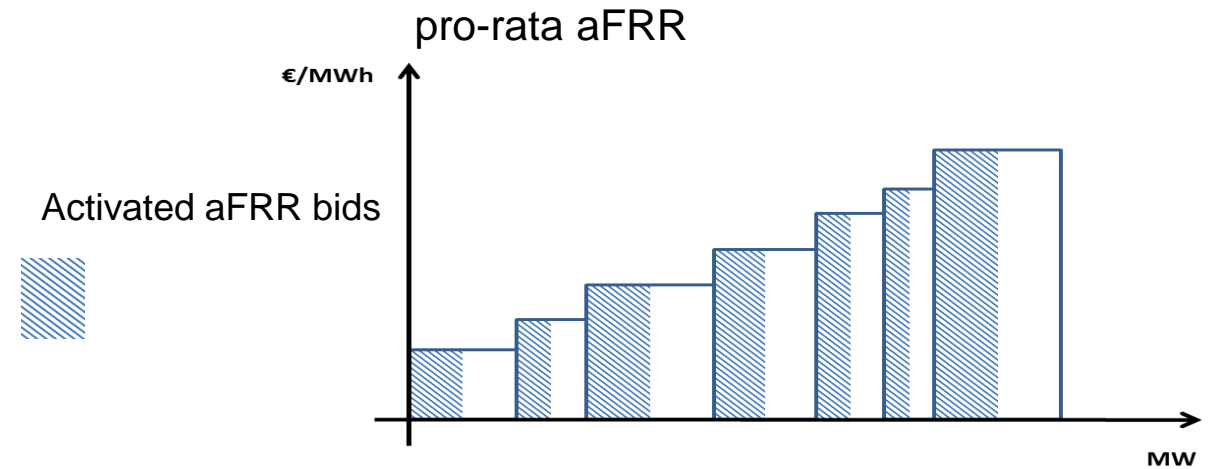
- Per merit order list
 - Selection of the cheapest R2 energy bids for the contracted volume = SELECTED R2 volumes.
 - Summation per BRP
 - average weighted price for the selected R2 volumes per BRP
 - average weighted price for the selected R2 up and down volumes (in total)
 - A participation factor per BRP per R2 direction



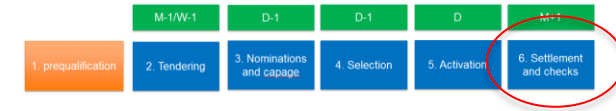
5. Activation



- Pro-rata activation
 - Pro rata split up of R2 activation signal to all selected bids
 - All bids are continue activated



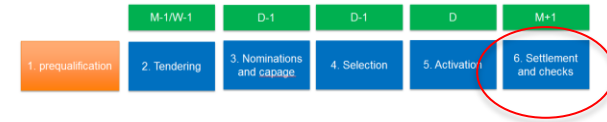
6. Settlement



- remuneration for reservation (M+1)
 - Product of
 - The unit price, in €/MW/h; for the contracted R2 capacity,
 - The number of MW of said contracted R2 capacity and
 - The number of corresponding hours of the Delivery Period concerned.

- remuneration for activation (M+1)
 - Pay as bid
 - Product of:
 - Volume (brut) of upward (downward) R2, activated with the concerned BRP, during Qh.
 - The volume weighted average price of the offers for Upward R2 (downward) selected with the concerned BRP during Qh.

6. Checks








- Availability control (M+1)
 - Comparison of the confirmed nominated R2 volumes and the contracted R2 volumes.
 - Per Qh
 - Elia will apply a penalty if R2 obligations are not fulfilled.
 - The penalty is based on the Clean Spark-Spread and is based on the quantity of confirmed nominated R2 volumes.
 - The penalty applies to any missing MW and for any quarter-hour of the considered month in which ELIA establishes that the quantity of the R2 obligations has not been reached.
- Activation control (M+1)
 - The quantity of R2 upwards and/or downwards physically supplied by the BRP during month M must meet the R2 control request or ΔP send by Elia.
 - Elia will apply a penalty if the above obligations are not fulfilled.
 - Penalty: 45€/MWh for discrepancy
 - An exemption of the penalty for non-compliance with the R2 control request is foreseen in certain specific circumstances.

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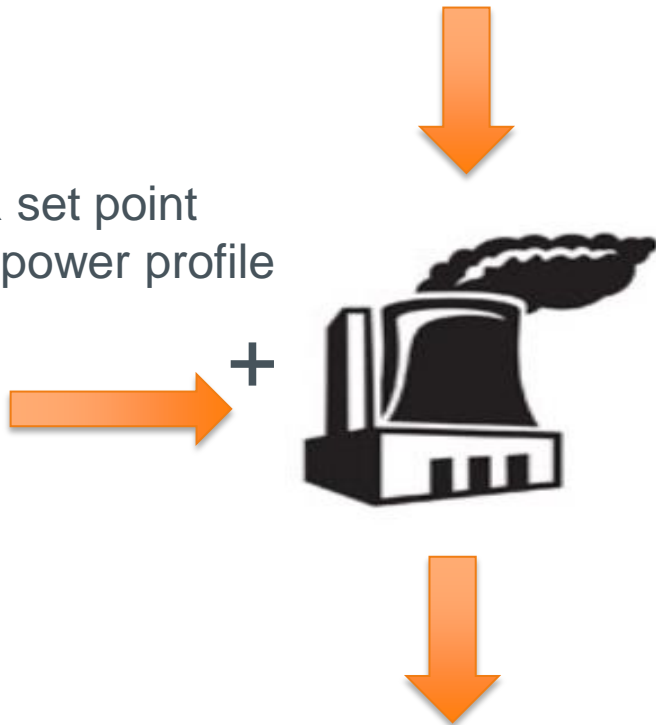
aFRR- Wind project: technical pilot project

Involved parties	<div></div> <p>Owner wind farm of Estinnes</p> <div></div> <p>Manufacturer wind farm</p> <div></div> <p>BRP R2 contract</p> <div></div> <p>TSO</p>
Scope of pilot project	<ul style="list-style-type: none">• Check technical capability of wind farms to provide downward aFRR<ul style="list-style-type: none">• Focus on downward regulation due to loss of green certificates• Perform a two month period test where wind farms participate in downward secondary control (aFRR-) at Elia
Wind farm of Estinnes	<ul style="list-style-type: none">• Direct driven (variable speed) synchronous generator / full convertor• 10 x ENERCON E-126: 7,5 MW• 1 x ENERCON E-126: 6 MW <div></div>

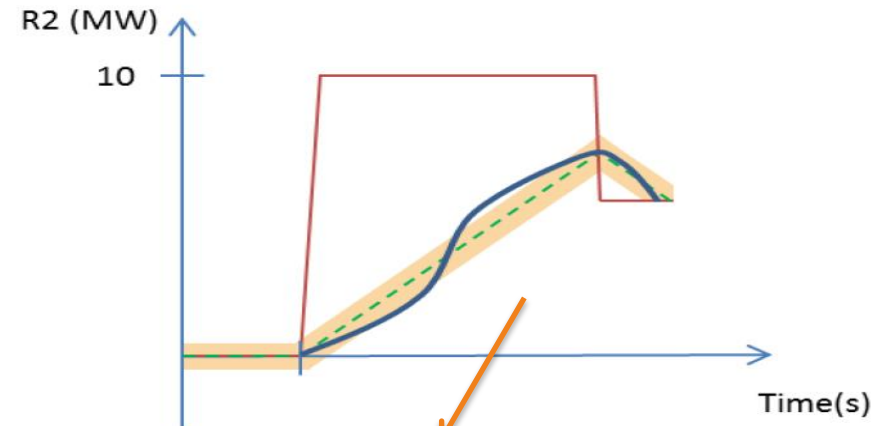
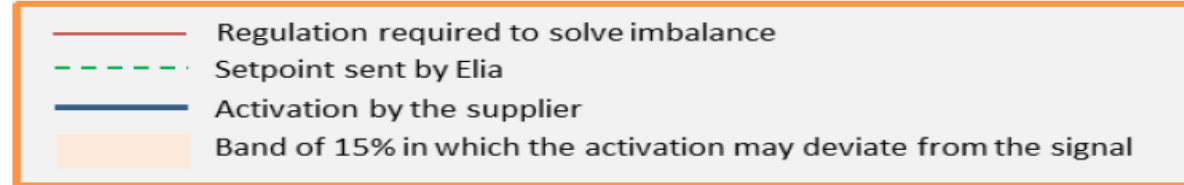
Ancillary services in Belgium: aFRR product

Pref power profile (defined by producer for own purposes)

Elia aFRR set point (**delta_P**) power profile

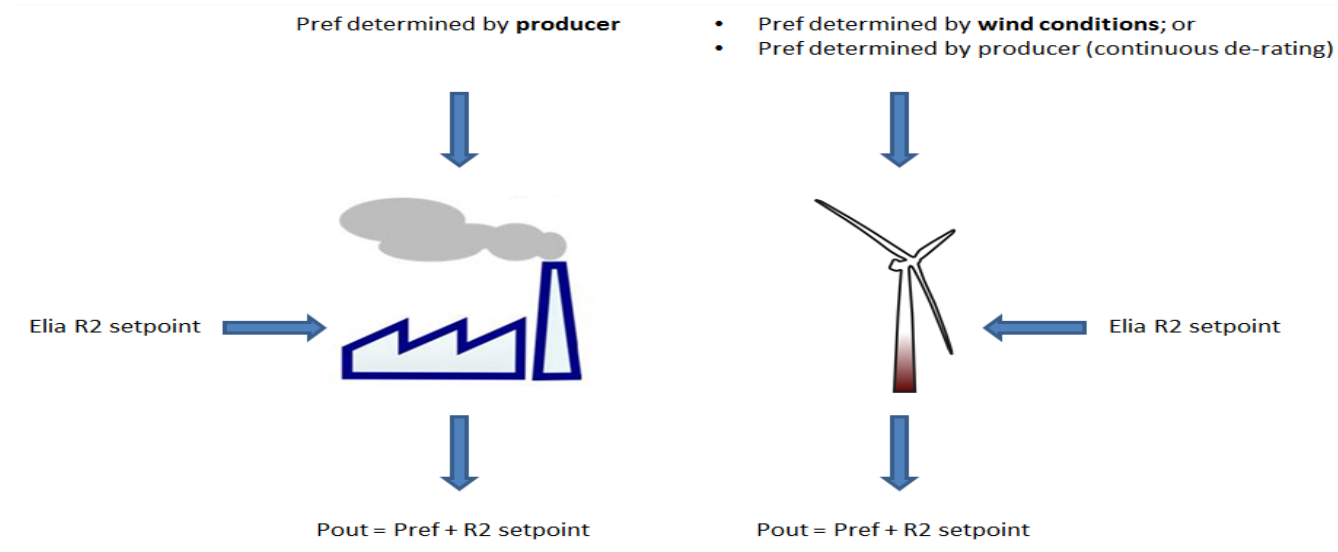


Required power output profile of the unit



- Providers must **deliver the Elia aFRR delta_P set point (power profile) on top of their Pref (for own purposes)**
- **Elia aFRR delta_P set point**
 - is sent every **4 sec**
 - respects a **full activation time of 7,5'**

aFRR- delivery by wind: concept



Baselining: for a windfarm the Pref isn't known

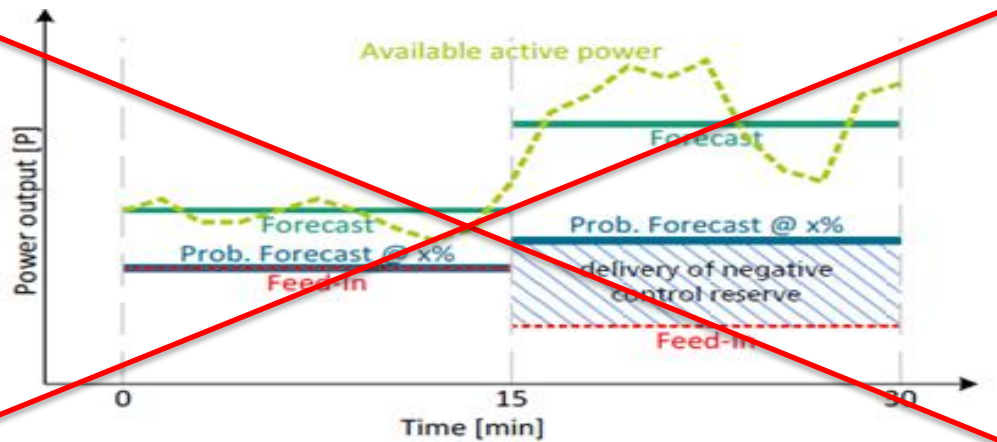
Balancing control mechanism:

- Continuous de-rating towards Pref (starting point for regulation) with high forecasting reliability

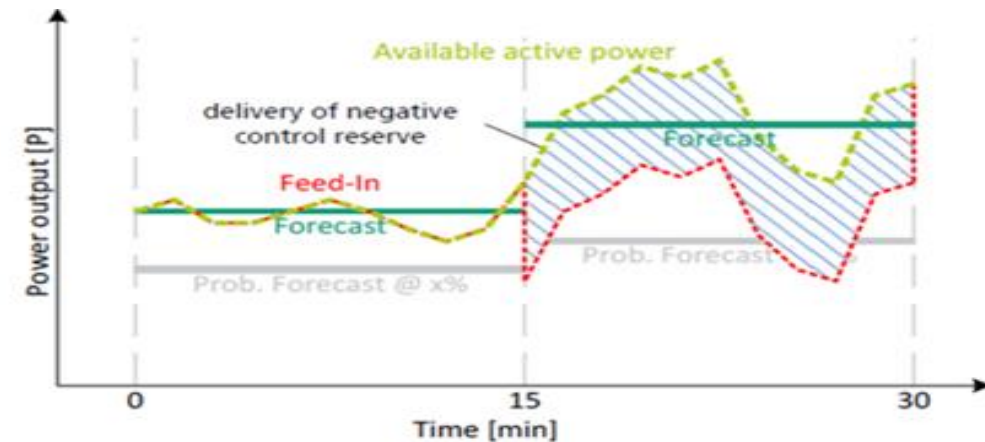
Active Available Power (AAP) mechanism:

- Calculation of the Pref on the basis of power infeed, pitching of the blades, wind speed; or physical model

Balancing control mechanism

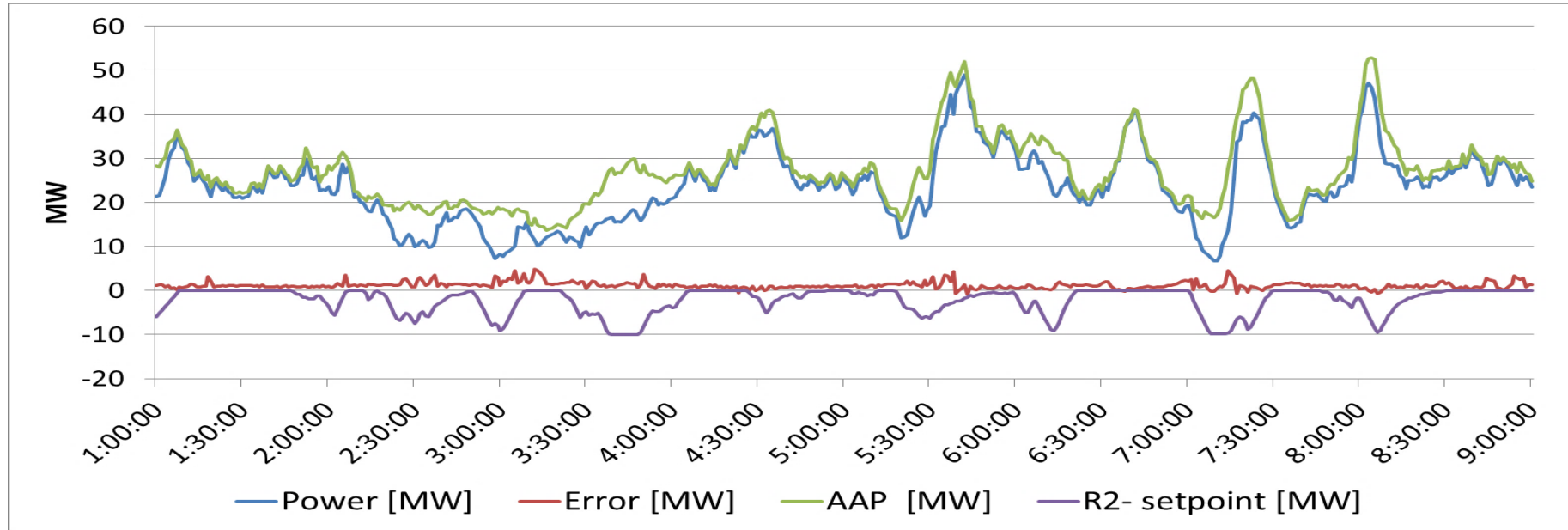


AAP mechanism



Source: Jansen, M., Speckmann, M., "Wind turbine participation on control reserve markets", EWEA 2013, February 4-7 2013, Vienna, Austria

aFRR- delivery by wind: technical results



AAP

Infeed

Error

Elia aFRR setpoint

Wind farms are highly flexible (low Pmin, high ramp rates,...) and can follow a set-point

- Promising performance of wind farm of Estinnes in providing aFRR- service to Elia

AAP quality, both under curtailed and non-curtailed conditions, is key:

- AAP is starting point for regulation; hence wrong estimation leads to incorrect delivery of the service. In general good performance during tests;
- Wind farm effect (overestimation of AAP during curtailment) to be avoided; and
- Some working points identified for AAP, but improvement towards future expected.

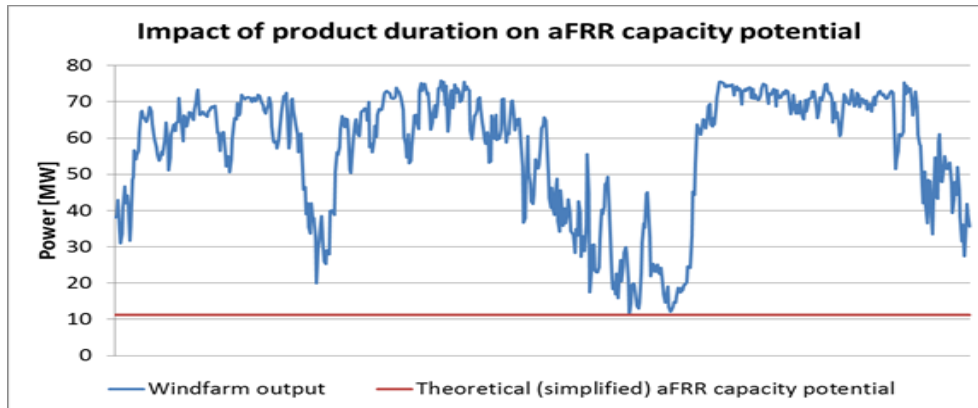
Bidding gate closure time & product resolution

Today in Belgium:

- Monthly procurement of aFRR capacity (obligation to submit aFRR energy bids in D-1)
- Product resolution: peak and long offpeak (incl. WE)
- GCT for aFRR energy bids: day-1 at 15h00

Pilot project shows that higher procurement cycle and lower product resolution would facilitate participation of wind in downward aFRR capacity market:

Weekly wind farm production



Potential of produced energy that could be offered as downward capacity (if perfect forecasting and no minimum power)

	Product duration / product resolution	Peak & long-off-peak	8h blocks	4h blocks
Onshore wind farm	Month	0%	1%	1%
	Week	4%	5%	8%
	Day	34%	50%	65%
BE aggregated offshore production	Month	1%	1%	1%
	Week	6%	7%	11%
	Day	47%	65%	78%

Technical pilot project: general conclusions

Wind farms are highly flexible and can provide ancillaries to the grid

- High ramping / low minimum power / ...

AAP method very promising to ensure efficient delivery of aFRR capacity by windfarms

- Pilot project elaborates some testing methods for AAP quality under curtailed and non-curtailed conditions

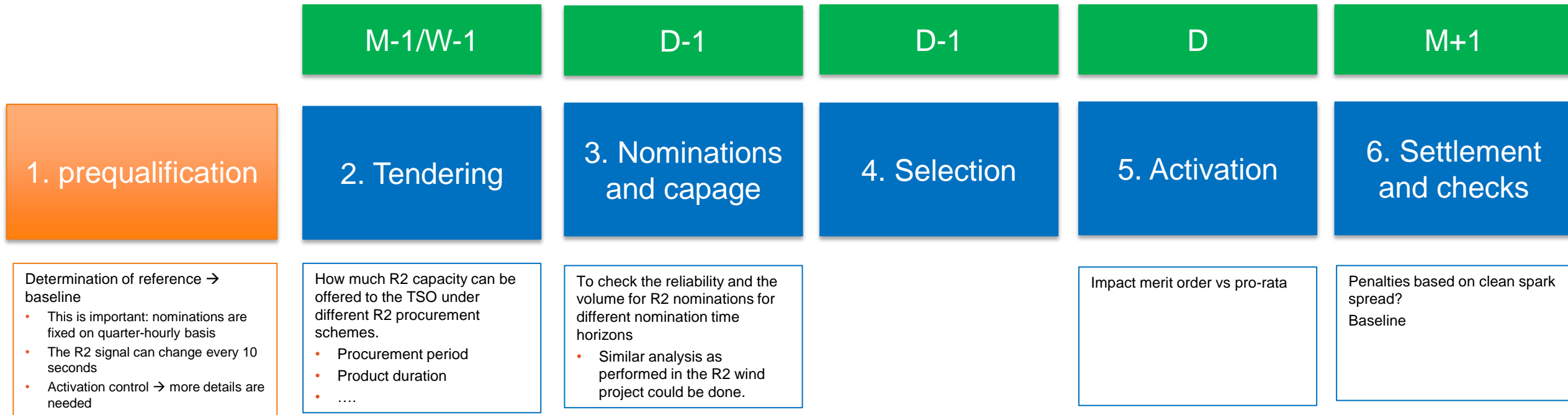
Pilot project identifies both technical and market aspects that need to be investigated further for provision of aFRR-capacity by windfarms

- How to handle loss of green certificates, transition to daily procurement of aFRR capacity, improvements for AAP calculation,...
- Project sets forward required technical aspects for future participation of wind farms in aFRR markets (nevertheless targets to be set in a next stage in broader consultation)

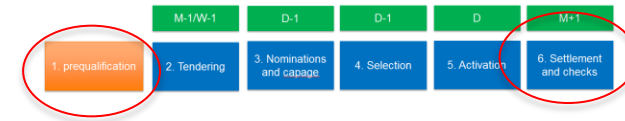
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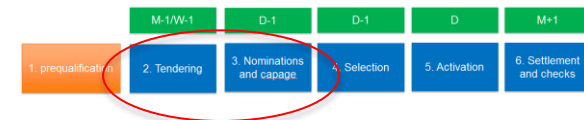
R2 non-CIPU challenges



Baseline



- Goal: Establish reference value for calculating delivered energy in case of activation used for:
 - Prequalification: compliancy verification with requirements of product
 - Calculation of activated energy
 - Imbalance adjustment
 - Transfer of Energy (long term)
- Wind:
 - Baseline is calculated based on power infeed, pitching of the blades, windspeed, ...
- Load:
 - Baseline:
 - Consumption/production is a fixed value for the next 15 minutes
 - Consumption/production varies within 15 minutes → a more detailed baseline is required based on:
 - Historical consumption/production
 - Forecasted consumption/production
 - Measurements



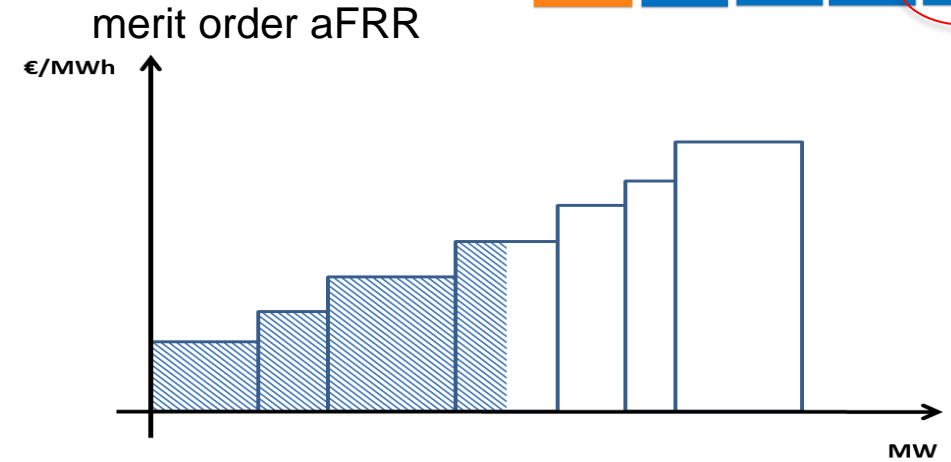
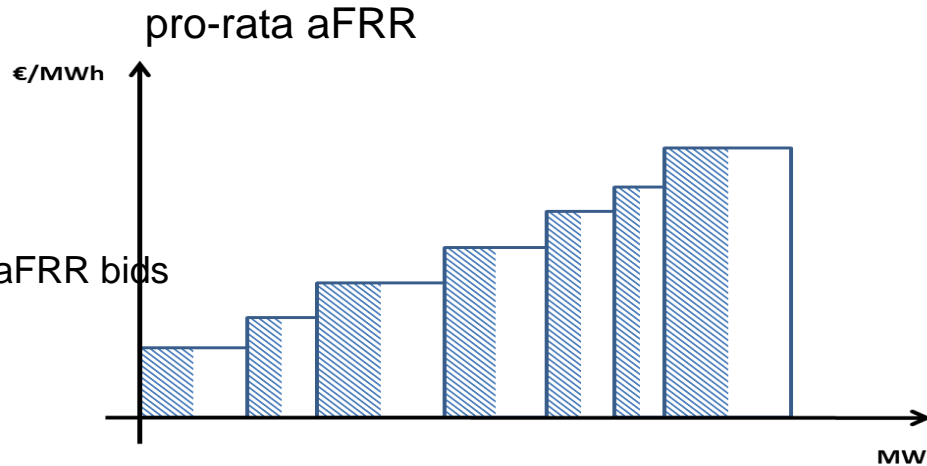
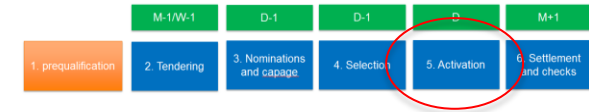
R2 procurement impact for non-CIPU

Table 7: Impact of product duration on aFRR capacity potential

	Product duration / product resolution	Base delivery	Peak & long-off-peak	8h blocks	4h blocks
Onshore wind farm	Month	0%	0%	1%	1%
	Week	2%	4%	5%	8%
	Day	25%	34%	50%	65%
BE aggregated offshore production	Month	0%	1%	1%	1%
	Week	3%	6%	7%	11%
	Day	36%	47%	65%	78%

Source: Delivery of downward aFRR by wind farms

R2 activation Merit order versus pro-rata activation



- Pro-rata activation:

- All bids are continue activated
- Cap/floor for prices

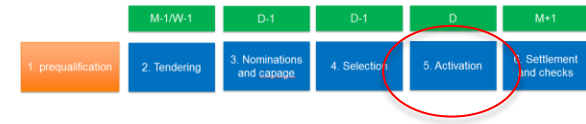
- Merit order activation:

- X cheapest bids are activated
- No Cap/floor for prices required

- R2 non-CIPU challenges

- Which activation scheme fits best to R2 non-CIPU: pro-rata or merit order?
- What is the impact of the activation scheme on the volumes offered for R2?

Merit Order Activation (to be investigated!)



Two options to assess the Merit Order Activation

- Scenario 1:
 - Simulation of a merit order activation versus a pro rata activation
- Scenario 2:
 - Participation at the R2 market.
 - If 140 MW of R2 is activated, than a signal is send to the participants to activate their secondary reserves.

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Scope pilot project

Only non-CIPU flexibility

Preference for aggregated portfolio with significant share of load

Access point with positive net off take with decentralized production are not excluded

Finally decisions to be take in function of the possible candidates

Who can participate at the R2 non-CIPU project?

- Non-CIPU
- Connection:
 - TSO connected
 - DSO connected
- Minimum amount of power to deliver?
 - R2 contract: minimum 1 MW → not required for pilot, but feasibility/controllability is important
- Fulfilment of technical and organizational requirements
 - As explained in the current R2 contract
 - R2 contract is published on website: <http://www.elia.be/en/products-and-services/ancillary-services/purchase-of-ancillary-services>.
- Agreement of all involved parties (DGOs, BRPs, ...) to participation at a R2 non-CIPU pilot project.
- Not in combination with R3 but combination with R1 is possible

Potential selection criteria for R2 non-CIPU project for Elia

- Which types of flexibility can participate?
 - Only non-CIPU
 - Load
 - Distributed generation
 - Pool of load and distributed generation
 - TSO connected
 - DSO connected subject to DSO approval
 - ...
- How much power can be provided:
 - Minimum power per day/weekend/peak/ ...
- The duration of the delivery of the R2 product:
 - Blocks of 4/8/ ... hours
- Controllability of the real-time production/consumption.
- No remuneration is foreseen.
- Expected costs for the partners: cost recovery to be decided.

Potential selection criteria for R2 non-CIPU project for Elia

- Can the project start in begin 2017?
 - Participation at all phases of the project
 - Is the product ready to participate
 - Available resources + know-how by partners
- Fulfilment of technical and organizational requirements.
- For both TSO connected as DSO connected, all involved parties (DGOs, BRPs, ...) should agree on the participation at a R2 non-CIPU pilot project.

Information needed from Elia?

- Input needed to participate at the R2 non-CIPU project?

—

Pilot project R2 non-CIPU (proposal)

- **Technical part**

- Initiation stage:
 - Define baselining mechanism and Check quality baselining mechanism
 - Check the ability to follow the R2 set point, i.e. to control its output on the basis of a R2 set point sent by Elia
- Second stage
 - Actively participate in R2 delivery for a certain period and investigate:
 - nomination quality/reliability
 - data exchange
 - Baselining mechanism quality
 - Reaction on a R2 set point

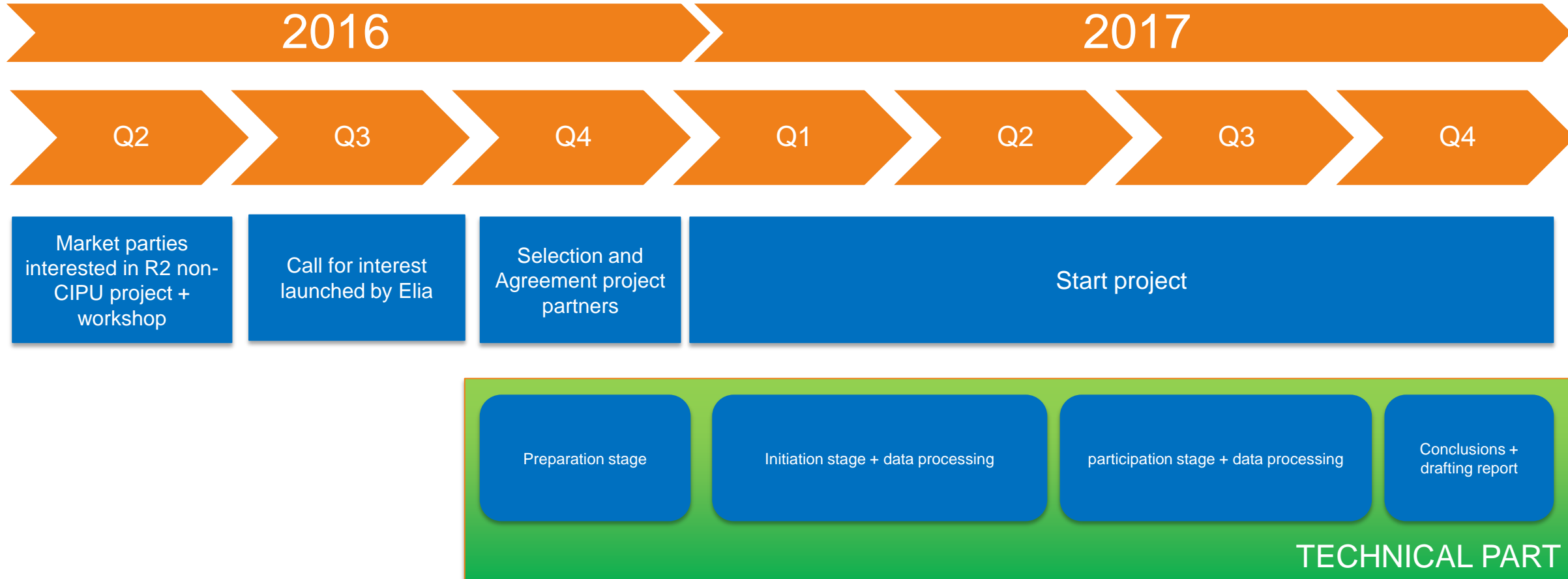
- **Market analysis (high level)**

- Investigation of the procurement period and the product duration
- Investigation of potential of R2 non-CIPU
- Investigation of the activation of R2
 - Now pro rata (continue activation + cap/floor for prices)
- Difference between pro rata and merit order

- **Goal**

- To check the potential for R2 non-CIPU to participate in the R2 balancing energy market

Timeline R2 non-CIPU project: first proposal



Challenging planning:

- Wind project: 2 years
- Complicated project with multiple partners

MARKET ANALYSIS

Next steps

- Feedback of market parties on workshop R2 non-CIPU (deadline 17/06/2016)
- Possible candidates to participate at the pilot project

Many thanks for your attention!

Kristien Clement

ELIA SYSTEM OPERATOR
Boulevard de l'Empereur 20
1000 Brussels

+32 2 546 70 11
info@ elia.be

www.elia.be
An Elia Group company