Balancing pilot projects update

April 2016

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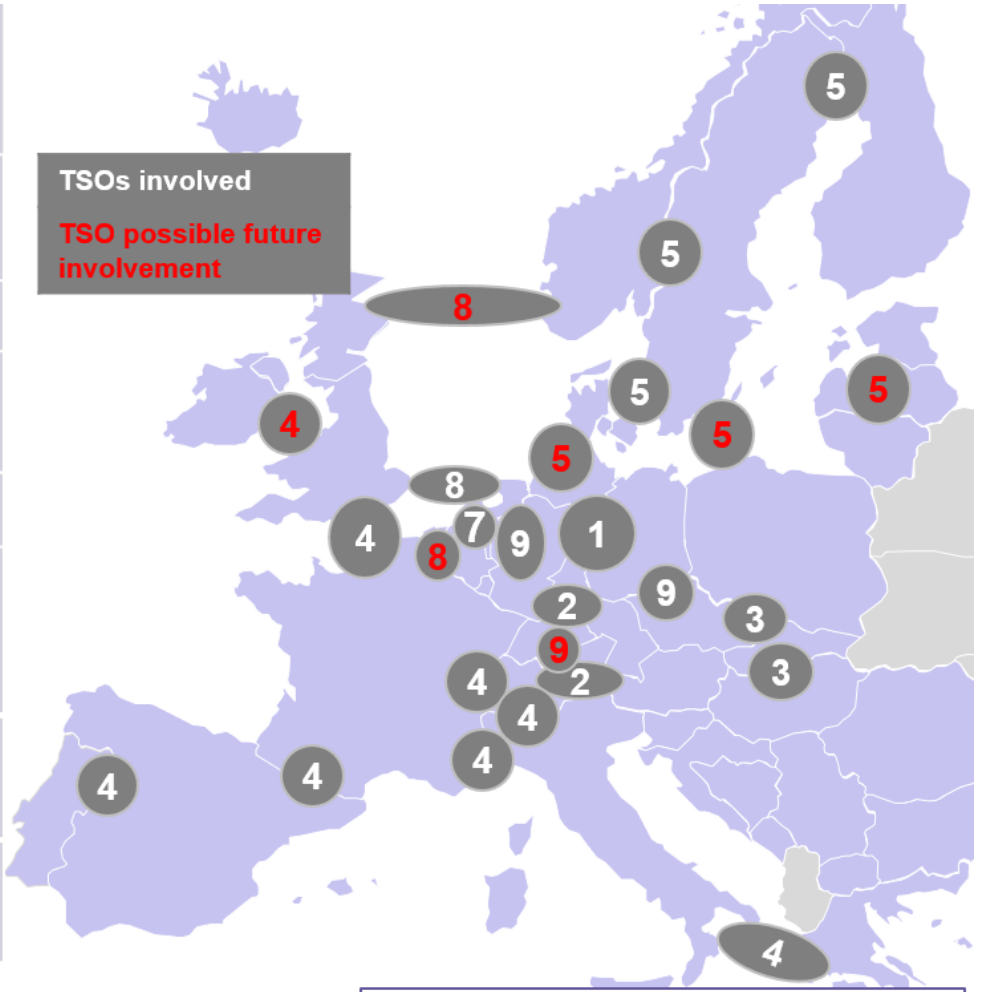
Contributions and geographic extension of Pilot Projects

- **Increase of social welfare and market liquidity**
- Pilot projects in operation are demonstrating that XB balancing is increasing social welfare and is giving more flexibility for TSOs (especially needed with increasing RES penetration). Challenge to keep local adequate incentives for BRPs in a cross border balancing market with marginal pricing.
- **Geographical extension**
- Several pilot projects have increased the number of participating TSOs / geographic scope because TSOs see benefits in wider cooperation:
- Pilot 1: feasibility studies for cooperation with PP 5 and 7,
  - aFRR cooperation with Austria scheduled to go live in Q2/2016
  - There has been no merger between the EXPLORE study and pilot GCC/pilot project 1.
- Pilot 2: extension towards German, Austrian, Dutch and Swiss TSOs went live on April 7th; Preparations for joining of Elia (Belgium) on 01.08.2016 and RTE (France) in 2017 are ongoing.
- Pilot 4: Consultation period towards stakeholders of design document finished. Approval package from NRA´s going on as a pre-requisite to launch implementation phase
- Pilot 5: feasibility studies with Baltics, Poland and pilot 1
- Pilot 7: currently Project on hold (in parallel, Explore study going on)
- Pilot 9: MLA signed, RTE joined IGCC (begin of operation since February 22nd)

Pilot projects are actively contributing to the early implementation of NC EB and extend in geographical size. Harmonization increases among more TSOs

Current Pilot Projects

1	Common Merit Order (CMO) for mFRR and aFRR with real time flow based congestion management
2	Cross-border market for FCR based on TSO-TSO model
3	E-GCC
4	TERRE: Trans-European Replacement Reserves Exchange
5	Development of the Nordic RPM
7	Design and evaluation of a harmonised reactive balancing market with XB optimisation of Frequency Restoration (**project on hold**)
8	BritNed / TenneT / National Grid Balancing Services (**project on hold**)
9	IGCC Imbalance Netting, aFRR-Assistance and Flow-Based Congestion Management.



mFRR – manual Frequency Restoration Reserves
aFRR – automatic Frequency Restoration Reserves
RPM – Regulating Power Market
IGCC – International Grid Control Cooperation
E-GCC - Grid Control Cooperation in CZ, SK and HU

Pilot projects and current proposal of manual products

	P-DA/SCH-15-15/30 (mFRR)	P-DA-10-10/25 (mFRR)	P-DA-5-5/15 (mFRR)	P-Sch-30-15 (RR)
FAT	15	10	5	30
Min delivery	15*	10*	5*	15
Max delivery	30*	25*	20*	15 / 60
Temporal divisibility	yes	yes	yes	No
Links (temporal)	No	No	No	Yes
Activation method	Continuous process/Clearing	Continuous process	Continuous process	clearing
Pilot projects	**Pilot 5 (DA) and Pilot 1 (SCH)**	**Pilot 5**	**Pilot 5**	**Pilot 4**

(*) Min and Max delivery still under discussion

Additional updated info from pilot projects

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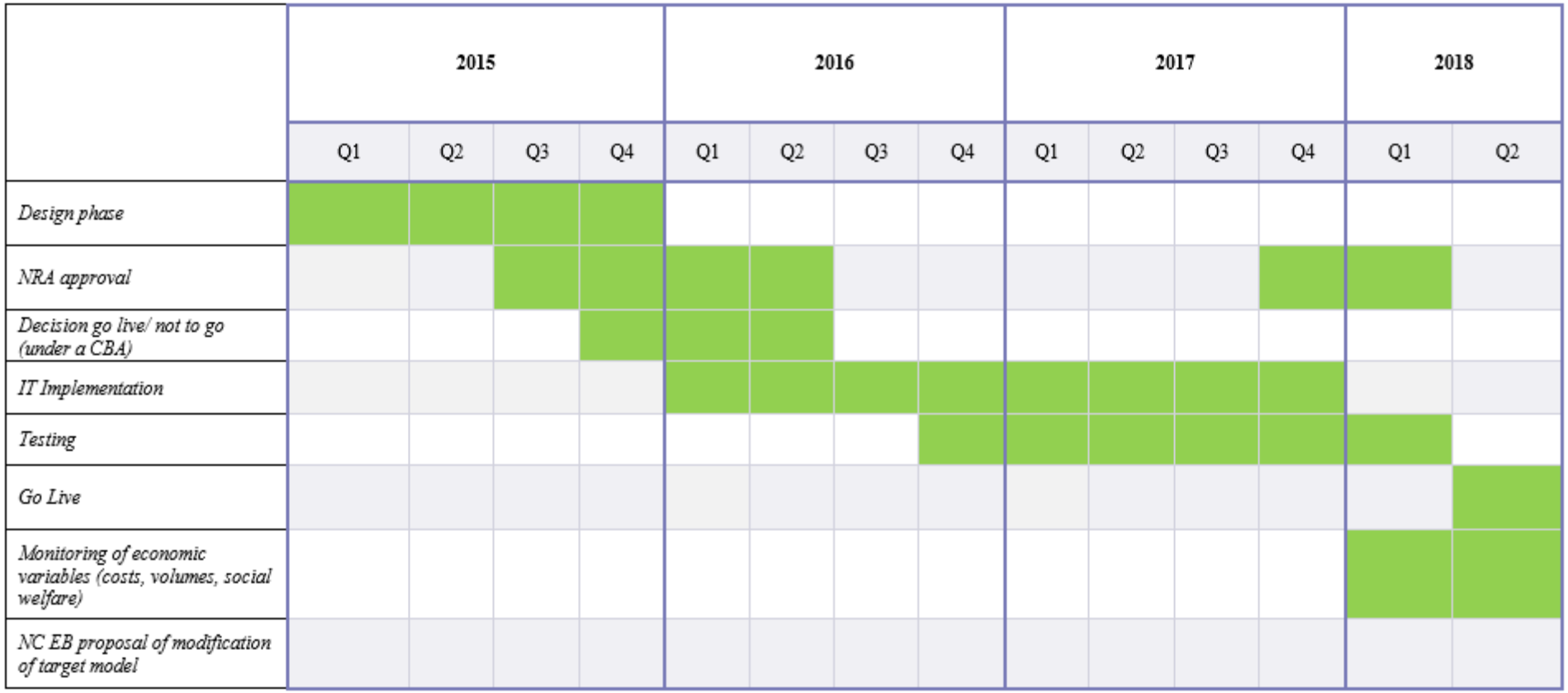
Pilot 4 – TERRE (i)

- **Key Learnings**
- TSOs are willing to cooperate and harmonize knowing the challenges derived from increasing the number of involved TSO´s. These challenges can be either technical (e.g. DC link between FR-GB) or market oriented.
- Despite the fact that there are many TSOs involved in TERRE with different local market designs, the parties set up a design solution on which these TSOs all agree.
- Interaction of RR process with Intraday market:
  - TSOs are requesting the harmonization of ID markets (GCT and resolution).
  - The interaction with XBID project is important and the definition of the ID GCT could has an important impacts on the TERRE process.
- Challenging project:
  - Target of setting up of an implicit XB balancing solution/market
  - Expected timescales

Pilot 4 – TERRE (ii) 2016

- **Achievements**
- Finalizing of the design phase:
  - The algorithmic optimization was tested
  - The optimization mix a netting of need and activation of offer
  - The CMO will allow elasticity at TSOs need
  - Regarding settlement issues: it is envisaged the application of marginal price and the treatment of congestion rents
- Consultation phase was closed on the 01st of April
- The NRA approval package is being submitted by TERRE TSOs Modular IT solution
- The simulation on balancing market for 2013 highlighted a potential benefit for BRP of 150M€ per year

Road map pilot 4 2016



The Pilot – 5 was refocused in December 2015

In Dec. 2015 the Pilot project 5 decided to refocus the Project, focus is now on:

- Drafting a dedicated mFRR CoBA agreement between DK, FI, NO and SE, and ensuring equal treatment of connections to and from all external Nordic borders
- Towards Germany, focus is on developing CoBA-CoBA exchange models. At present the markets are still quite different. Marginal pricing/pay-as-bid, 15 min Vs 60 min imbalance settlement period and very different views on imbalance price calculation.
- Towards Baltic, focus is on developing CoBA-CoBA exchange models as a first step, and merging of Nordic and Baltic CoBA as a possible next step
- Towards Poland, No ongoing actions

Important Note:
The recent discussions on not to have the CoBA's at all is not reflected in the present learning document

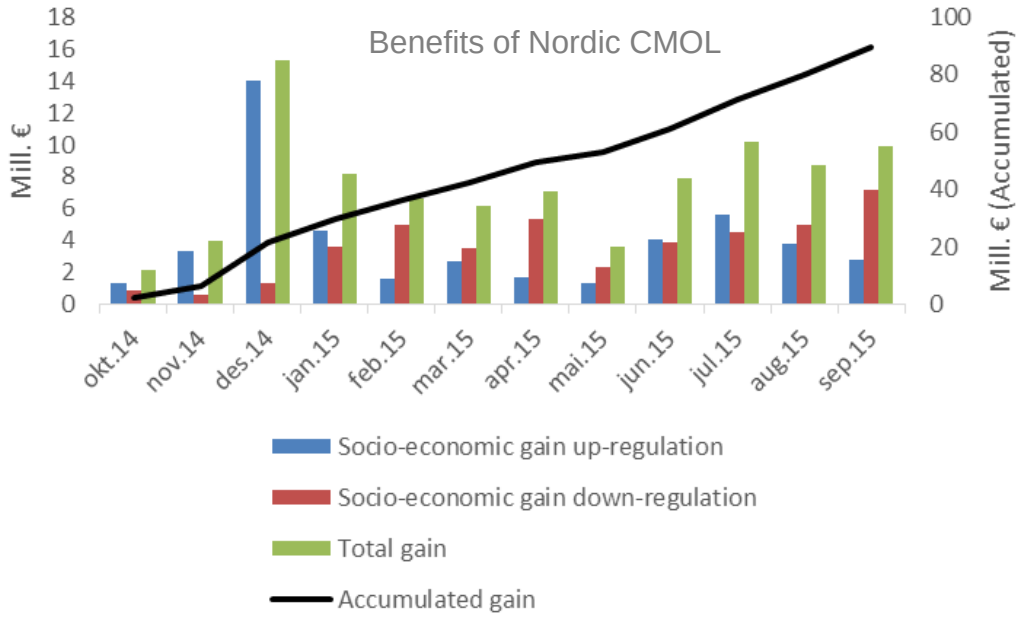
As the roadmap on how to achieve the EIM constantly is changing only very limited IT investments will be made

Welfare and feasibility

- Estimations indicate a large welfare gain from having a Nordic CMOL today – yearly in the range of 100 mEUR

- Feasibility studies indicate a clear potential for increased gain from integrating Nordics with other countries, but there are still large uncertainties related to size of gain, that has to be compared to the implementation cost.

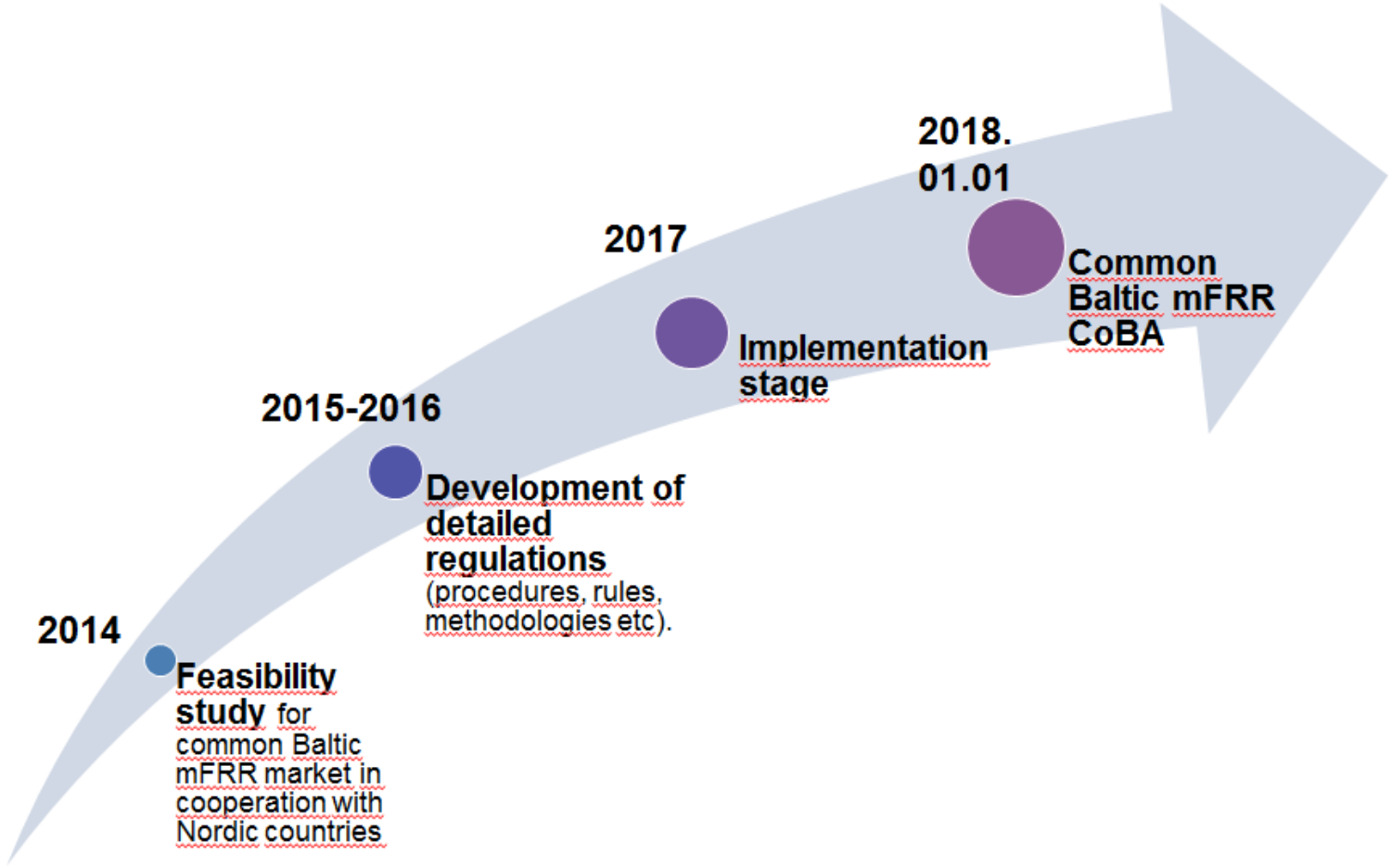
- Main barriers to integration:
  - Nordic – DE: Large differences in market design and balancing methodology, hence focus is on CoBA-CoBA exchange as a first step[#].
  - Nordic-Baltic: Foundations of Baltic market for mFRR needs to be developed first – see roadmap
  - Nordic-Poland: Central vs self dispatch – Need to convert Polish bids to enable trade
  - Increased complexity in Nordic operation. IT systems needed to manage coordination with other control areas. It cost and implementation time should not be underestimated.



#
Voluntary bids is the main source of balancing energy in the Nordic, this is however still not allowed in DE.

Roadmap towards Baltic CoBA

- Development of a dedicated Baltic CoBA is ongoing.
- Learnings from the Nordic design are being provided directly to the Baltic TSO's
- CoBA-CoBA exchange models are being developed



Learning on Governance

The market governance of the common Nordic Balance Market is taken care by a Market Steering Group (MSG), that consist of one market director per TSO, basically the Entso-E MC member.

MSG refers directly to the Nordic CEO's, who meets 2-4 times per year.

Regulatory approval: there is need for finding new solutions for cooperation with NRA's when we go from bilateral to multilateral agreement and also how to involve market participations. Currently very different national processes (also in the Nordic) are in place and more common process is needed.

Governance: with GL EB some Nordic operational agreements will change into market agreements and this will also change the governance from operational to market governance structures. At present there is no regional Entso-e Market Governance Structure, Do we need such a regional ENTSO-e structure for say CoBA governance ? In the Nordic governance is ensured via the Nordic MSG

Standard mFRR products used in the Nordic

	P-DA-15-15/30 (mFRR)	P-DA-10-10/25 (mFRR)	P-DA-5-5/20 (mFRR)
FAT	15	10	5
Min delivery	15**	10**	5**
Max delivery	30**	25**	20**
Ramps (financial settlement)	7.5 min*	5 min*	2.5*
Typically fraction used compared to all mFRR activations	10%	45%	45%

FAT = Full Activation Time

The Nordic primarily uses mFRR for balancing, and hence fast manual products are needed. 90% of the mFRR needs are today covered by products with a FAT of 5-10 minutes. All products are however on the same Nordic CMOL, where the only requirement today is a FAT of 15 min. The fact is however that most of the bids (Hydro) are much faster than 15 min. Hence the Nordic will use both 15,10 and 5 minutes FAT products. When Nordic market for aFRR is established, the need of 5-10 minutes products might decrease.

Pilot 8 – RR on BritNed (currently on hold)

- **Key Learnings**
- The current different market models used in GB and the Netherlands make the exchange of cross border energy very difficult
  - Proactive balancing in GB vs Reactive balancing in NL
- The main barrier is that GB is more likely to use an RR service as it provides the system operator with greater balancing tools.
- NL is very unlikely to ever use RR as they very rarely use products of this type.
- It may not be possible to fully develop replacement reserves between the two countries.
- Potential to combine Pilot 8 with Pilot 4, but significant differences in market design exist between GB and CE.

Pilot 8: some questions and answers (i)

- **Why would further clarification from NCEB be decisive for pilot project 8?**
  - Requirements in NCEB may restrict the number of CoBAs that a TSO can join. If GB is prevented from joining different CoBAs for different products, then it is severely limited in its ability to develop other services with different TSOs, which is not truly in the spirit of cooperation and coordination. (e.g. by joining TERRE, why should GB be prevented from joining a FRR pilot project with different TSOs to TERRE if it is technically and commercially possible to do so?)

- **Why not consider mFRR? Possibility to merge pilot 8 with pilot 7 regarding mFRR?**
  - NGET and TenneT have met to discuss the possibility of establishing a mFRR service over BritNed, both sides agree it would be beneficial for NGET to meet with TenneT and Elia to establish if it might be possible for NGET to join BPP7.

What incompatibilities need to be harmonized to enable cooperation between proactive and reactive systems?

- NGET manages its system proactively, and so uses RR products in timescales further ahead than 15 minutes to balance its system according to forecasts. TenneT does not do this, and so does not need/use RR services. TenneT's approach is to enable BRPs to maintain the balance of its portfolio in real time: TenneT reacts only to any residual imbalance in its control area.
- In separate discussions it has been established that there are similarities in the FRR products that both TSOs use. There is also a desire to make the current frequency response services under trial in GB over BritNed available to Continental Europe as well. An Ad Hoc Frequency Coupling WG has been set up.
- The differences between proactive and reactive system management techniques by the TSOs are the most significant barrier to developing a RR service. However, the similarities in the use of FRR products by the TSOs could offer an opportunity for the development of SO-SO services. NGET and TenneT are in discussion to establish if it is commercially and technically possible to do so, firstly on a bilateral basis, but with a long term view to integrating with other TSOs if possible.
- Any service requires the involvement of BritNed, which will expect payment for their services. The involvement of merchant interconnectors in the balancing process needs to be further developed in the NCEB.

Pilot 9 – IGCC: Achievements

- The IGCC Multilateral Agreement (MLA) has been signed in January 2016.
  - Clear governance rules and decision making process
  - Flexible contract that can be adapted
- Quick guide on how TSOs can become IGCC members has been created.
- RTE has joined the IGCC on February 22nd, 2016.
  - Experience with new accession process
- New settlement method is applied since February 2016

Pilot 9 – IGCC: Key Learnings

- Imbalance netting can be easily implemented even if the participating TSOs do not have same national legal and balancing frameworks.
  (8 countries = 8 different legal and balancing frameworks)
- There is no need for a standard product (no need to harmonize technical preconditions for BSPs) and for any kind of a contract with BSPs.
- Based on the MLA experience to combine multiple legal frameworks, to set a common framework for cooperation, to agree on a governance structure and on a decision making process takes some time (2,5 Y) even if it is only TSO-TSO cooperation.
- Establishing well-functioning governance bodies with the right experts is essential for the cooperation. All participants must be highly involved and want to cooperate, otherwise, further development is impossible (bottom-up approach).
- Opportunity pricing scheme is quite flexible solution. However, without harmonization of national market designs some TSOs can have different monetary benefits than the others. Even though, the cooperation still brings significant benefits to all.

Pilot 9 – IGCC: Further Development

Questions

- Envisaged steps and barriers to constitute future IN CoBA?

Steps

- All TSOs are invited to contact IGCC for information and to start the process to join IGCC.
- The IGCC, and its IGCC MLA, is endorsed to be used and to facilitate the IN CoBA.
  - IGCC MLA contains the processes to adapt if needed and to accommodate connection of further TSOs.

Barriers

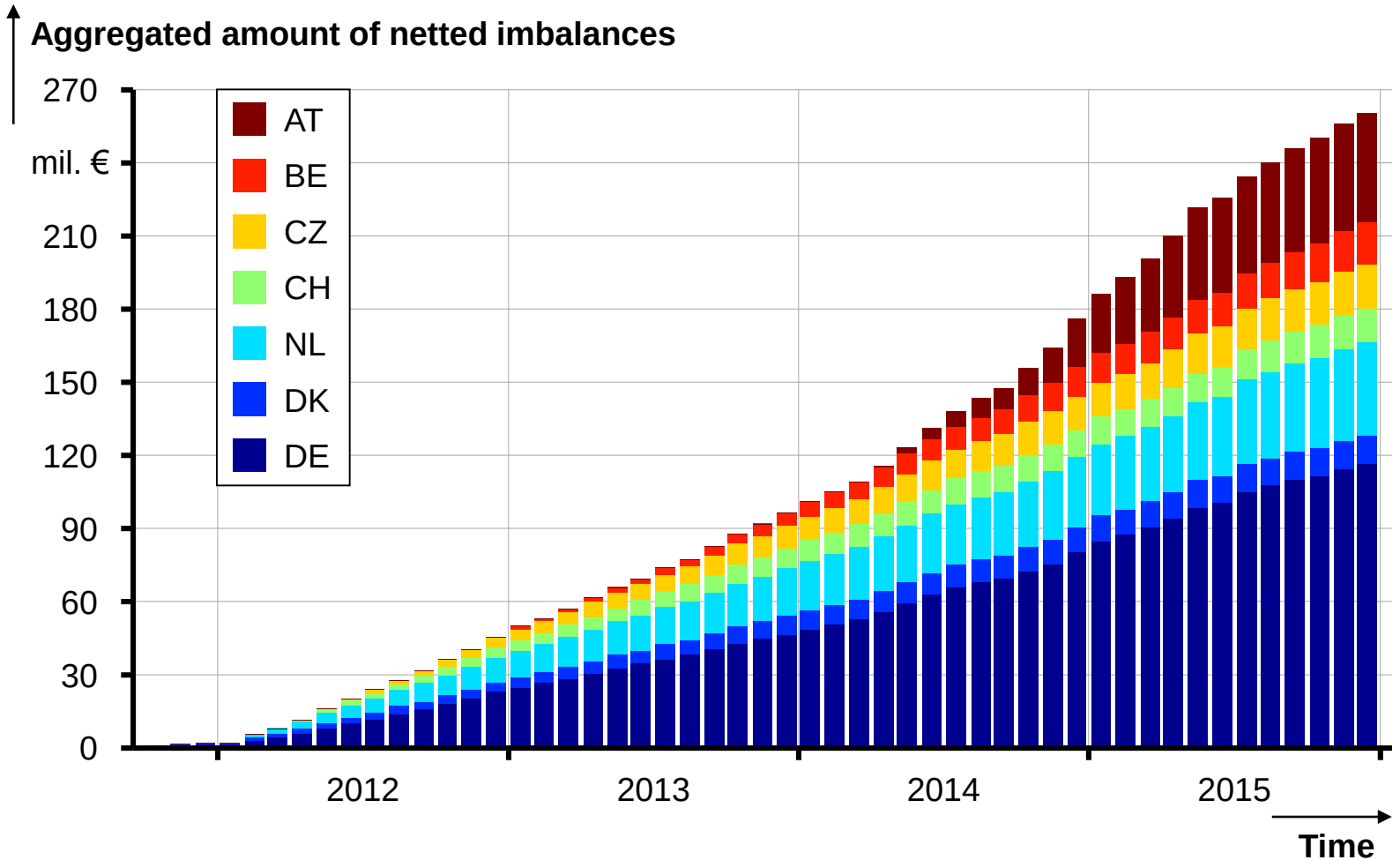
- The technical implementation needs enough time (national implementation).
- National legal and regulatory changes could take time.
- Agreement on settlement needs time, especially as long as the aFRR markets are not harmonized.

Ongoing development

- Further development is planned in flow-based congestion management; in settlement in order to ensure more robust benefit distribution; and in a document sharing the IGCC principles.

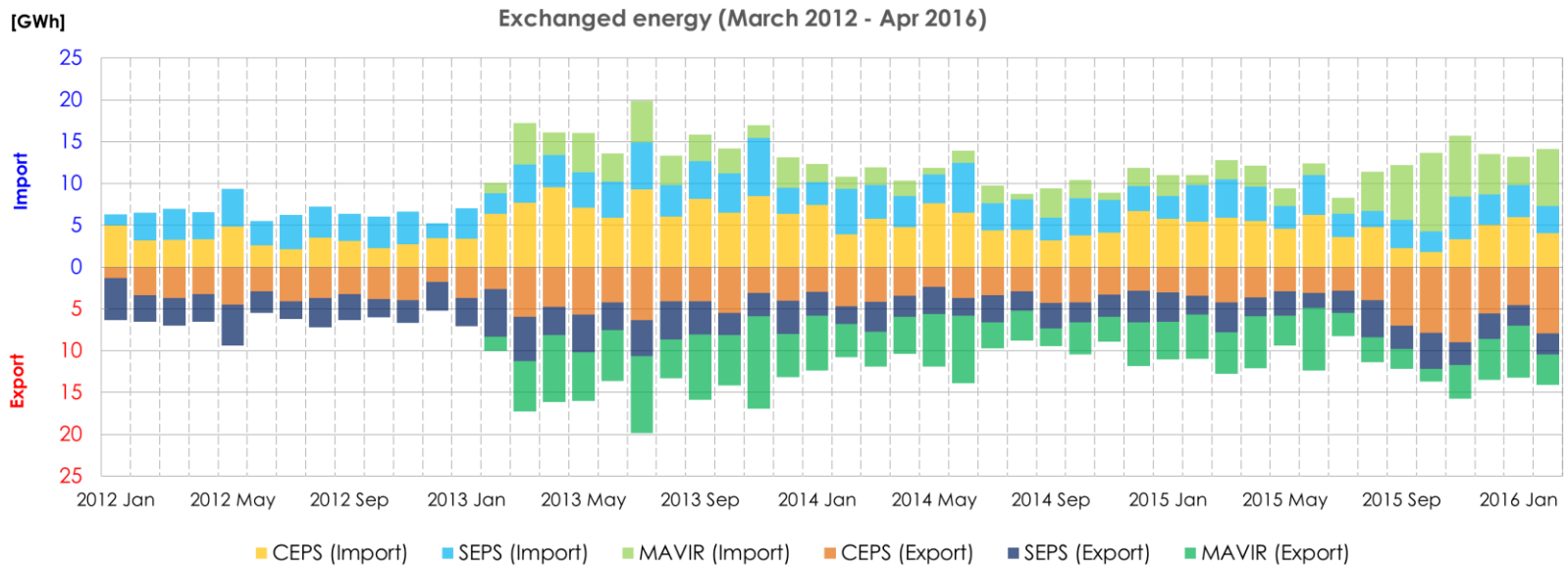
Pilot 9 – IGCC: Social Welfare and Market Liquidity

- Aggregated value of monthly netted imbalances (long and short)



Pilot 3 – e-GCC

- **Key Learnings**
  - Experiences gained from TSO-TSO real-time cooperation and settlement.
  - Multilateral agreement, as this is the basic document for the cooperation. It contains the operational rules, settlement rules, liability rules and define boundaries of the cooperation in general.
- **Achievements**
  - Important savings of aFRR activation and appropriate good experience running automatic e-GCC Imbalance settlement scheme

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