

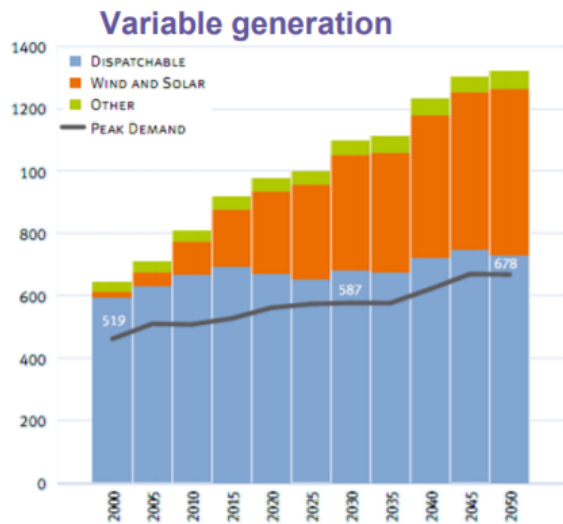
欧州における Balancing Marketの統合と TSOの役割について

170719 京大再エネ講座研究会

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The IEM: meeting Europe's low carbon target



Thousands of small units



Huge flows all over Europe



Challenges

System Stability, Resource Variability, Uncertainty, New connections, Changed power flows

市場統合の目的

■4つのチャレンジ

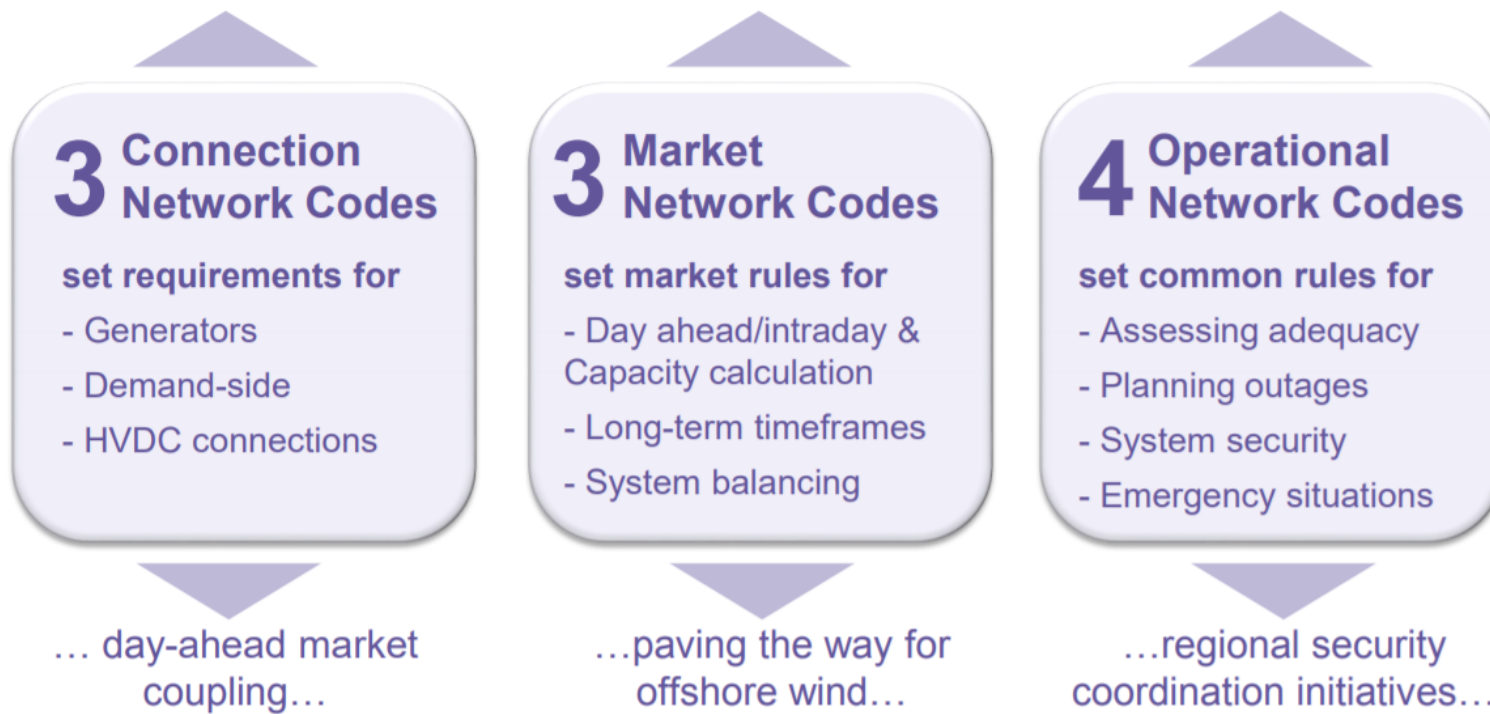
- Competitiveness, Security of supply, Climate change, Smartness

■ENTSO-Eの役割

1. ハード面(送電網)の改善→10-year Network Development Plan (TYNDP、2年ごとに更新)。現在、200のプロジェクトがあり、計€100 billionの投資。
2. ソフト面(Network codeの策定による制度構築)
 - TSO-TSOのinter-connectionを強化、TSO-DSO間の連携。価格を通じてよく機能する市場の構築。
 - ACERやEU comissionと協働。

Therefore: network codes matter; they form the foundation on which the IEM is being built

Internal electricity market



Overview of current & future network codes

Grid Connection Related Codes

- Requirements for Generators (RfG)
- Demand Connection Code (DCC)
- HVDC Connection Code (HVDC)

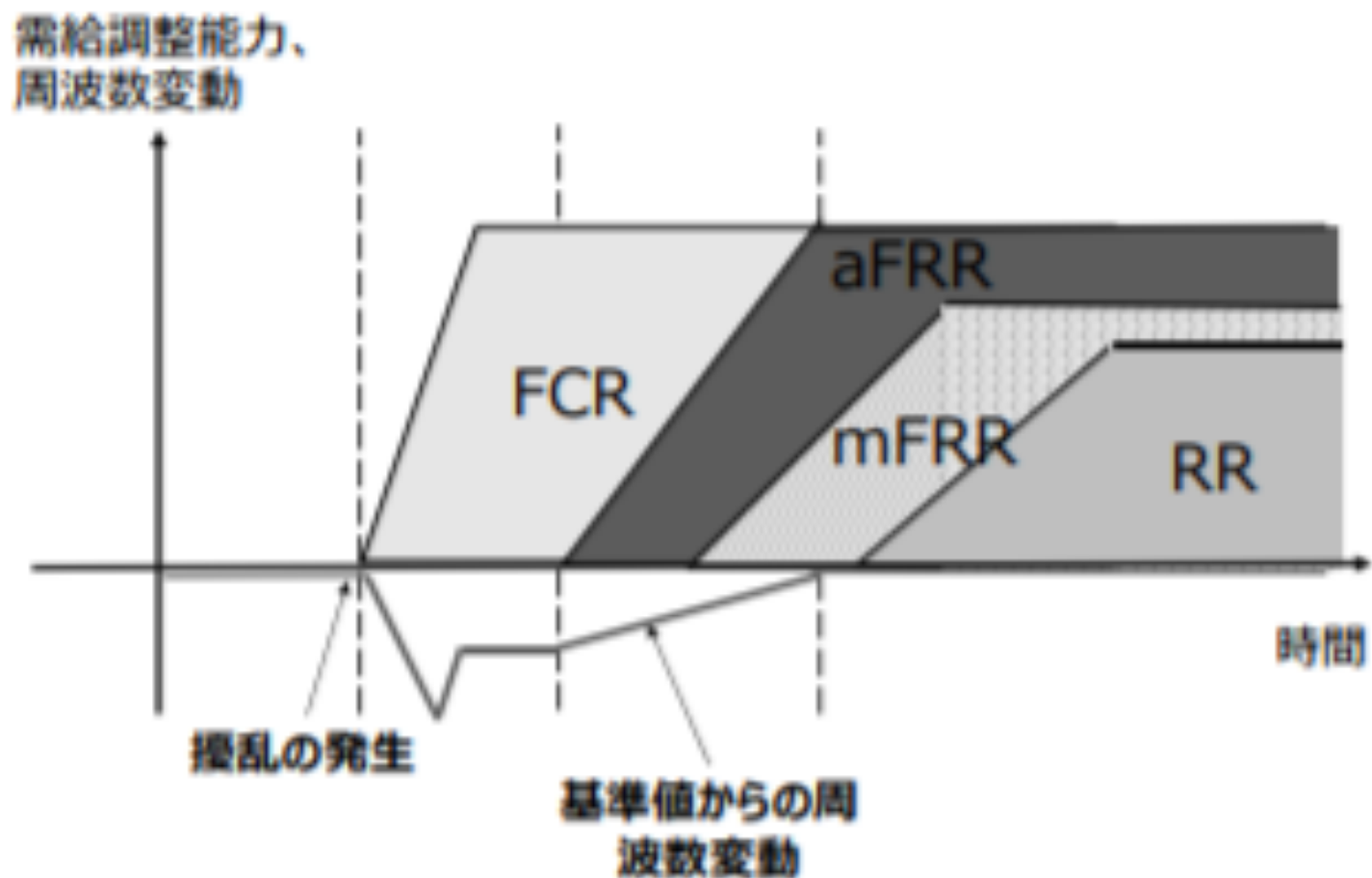
System Operation Related Codes

- Operational Security Network (OS)
- Operational Planning & Scheduling (OPS)
- Load Frequency Control & Reserves (LFCR)
- Operational Procedures in an Emergency (EP)

Market Related Codes

- Capacity Allocation & Congestion Management (CACM)
- Forward Capacity Allocation (FCA)
- Balancing Network Code (EB)

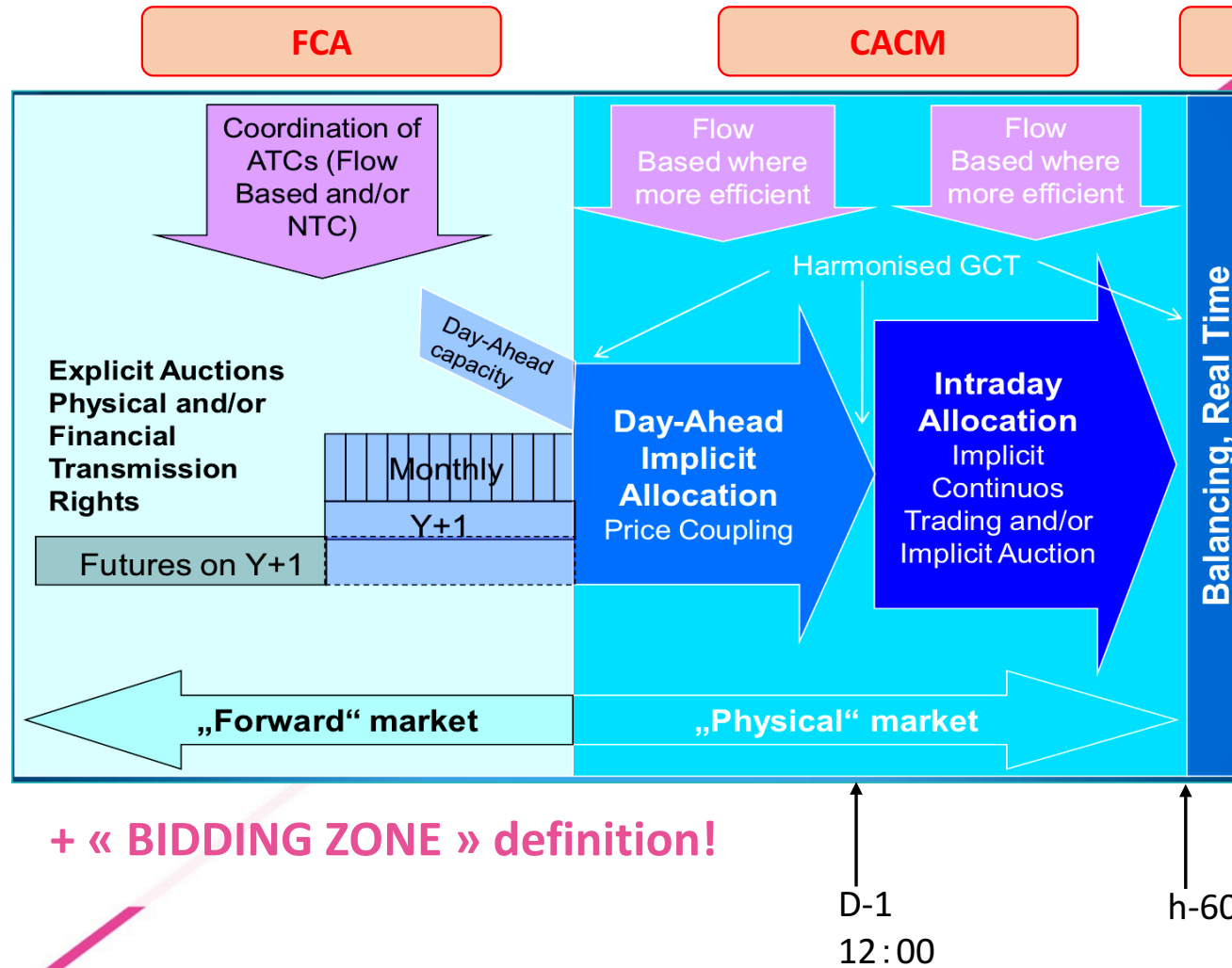
(参考)周波数コントロールの種類 (NC LFCRに定められる)



(参考) regional coordinationとOperational code について

- Operational codeのうち、Operational Planning and Scheduling (NC OPS), Operational Security (NC OS), and Load Frequency Control and Reserve (NC LFCR)は、2015年に、1つのSystem Operation Guidelineに統合することに合意している。
- System Operation Guideline: 2016年5月4日にドラフト
- system operations guidelineでは、regional coordination centerを確立。
- Regional coordination center に対してcapacity calculation, grid models, outages and operation security planning and forecasting end scenario を行う権限を与える。

EU Target Model (as to be described in Market Codes)



Network Code on: Capacity Allocation and Congestion Management

Code Overview

Purpose: Translate the vision for a pan European Target Model into a binding set of rules.

Status: An ACER recommendation to adopt the code and proposals for change was made on 14 March 2013. The EC is currently preparing the network code for the Comitology process.

Contents:

- Capacity Calculation
- Bidding Zones
- Day Ahead Markets
- Intraday Markets
- Remedial Actions
- Firmness rules
- Cost recovery

Links to other codes/areas

- **OS/OPS** – Build on the CGM in CACM.
- **FCA** – Bidding zones and capacity calculation are common. Structure is similar.
- **EB** – Strong link with intraday markets and common capacity calculation, bidding zones & structure.
- **OPS** – Schedules are relevant in day ahead markets.
- **Transparency regulation** – Vital to efficient market functioning.

Flow base で
容量計算を行う。



Network Code on: Forward Capacity Allocation

Code Overview

Purpose: To set rules for calculating and buying capacity in timescales before day ahead and for hedging price risk between bidding zones.

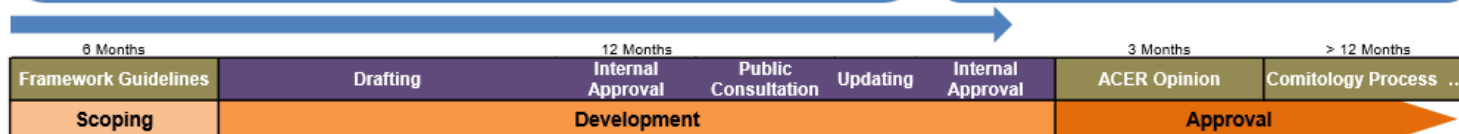
Status: ENTSO-E will submit the network code to ACER in late September 2013

Contents:

- Governance
- Capacity Calculation for FCA
- Bidding Zones
- The Forward Capacity Market
- Single Platforms for Allocation and Secondary Trading
- Allocation Rules
- Firmness and Congestion Income Distribution

Links to other codes/areas

- **CACM** – Similar processes and consistency with capacity calculation.
- **MIFID** – Sets capital and organisational requirements for investment firms and markets operators when dealing with financial instruments/impact on TSOs and joint platforms.
- **Transparency Regulation** – Impacts on the information that is published.



Network Code on: Balancing

Code Overview

Purpose: To define rules for the development, implementation and operation of a pan-European balancing market.

Status: Over 2100 from 42 organisations were received via the public consultation which ended in mid August. ENTSO-E is now updating the code for delivery in December.

Contents:

- The Electricity Balancing System
- Procurement of Balancing Reserves
- Use; Allocation and Reservation of Cross Zonal Capacity for Balancing Reserves
- Settlement
- Balancing Algorithm Development
- Reporting, Transitional Arrangements

Links to other codes/areas

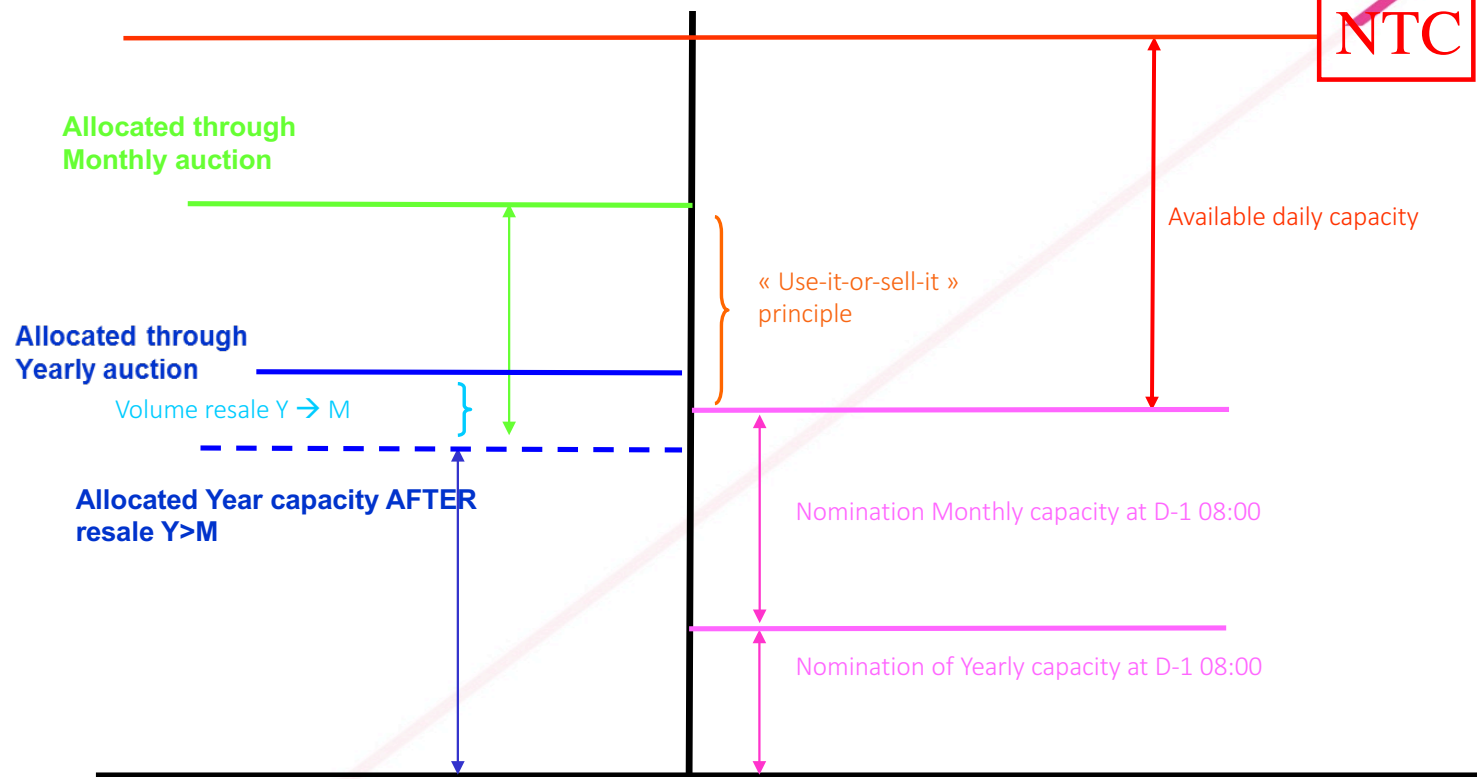
- **LFCR** – Strong link with LFCR setting rules for the volume of reserves to be procured & BAL creating rules to procure them.
- **CACM** – Overlap with capacity calculation and links to intraday markets (which close before balancing opens).
- **RfG/DCC** – Important that connection rules are reflected in products available on balancing markets.



国際連系線の容量配分の流れ



Y → M → D Available Capacity



DAMとIDMにて使われなかった容量が、最終的にBalancingに使われる。
取り置く場合は、TSOがその妥当性を証明する必要がある。

Elia提供資料

NC CACMに基づく DAM&IDMのcapacity calculation regions(CCRs)

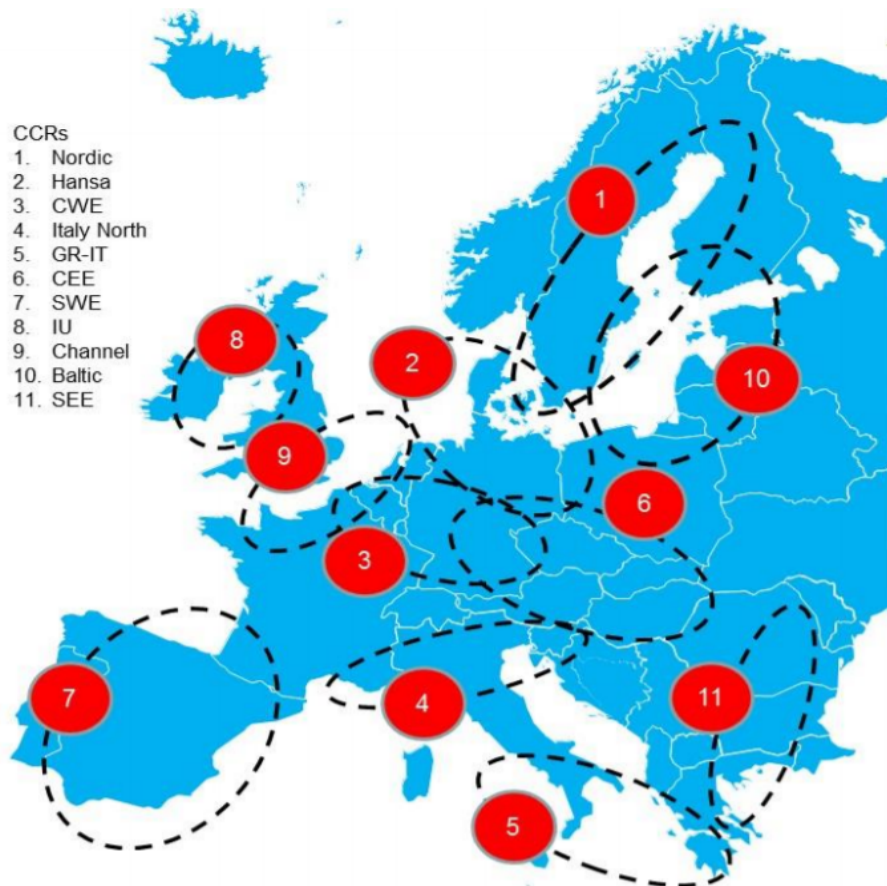
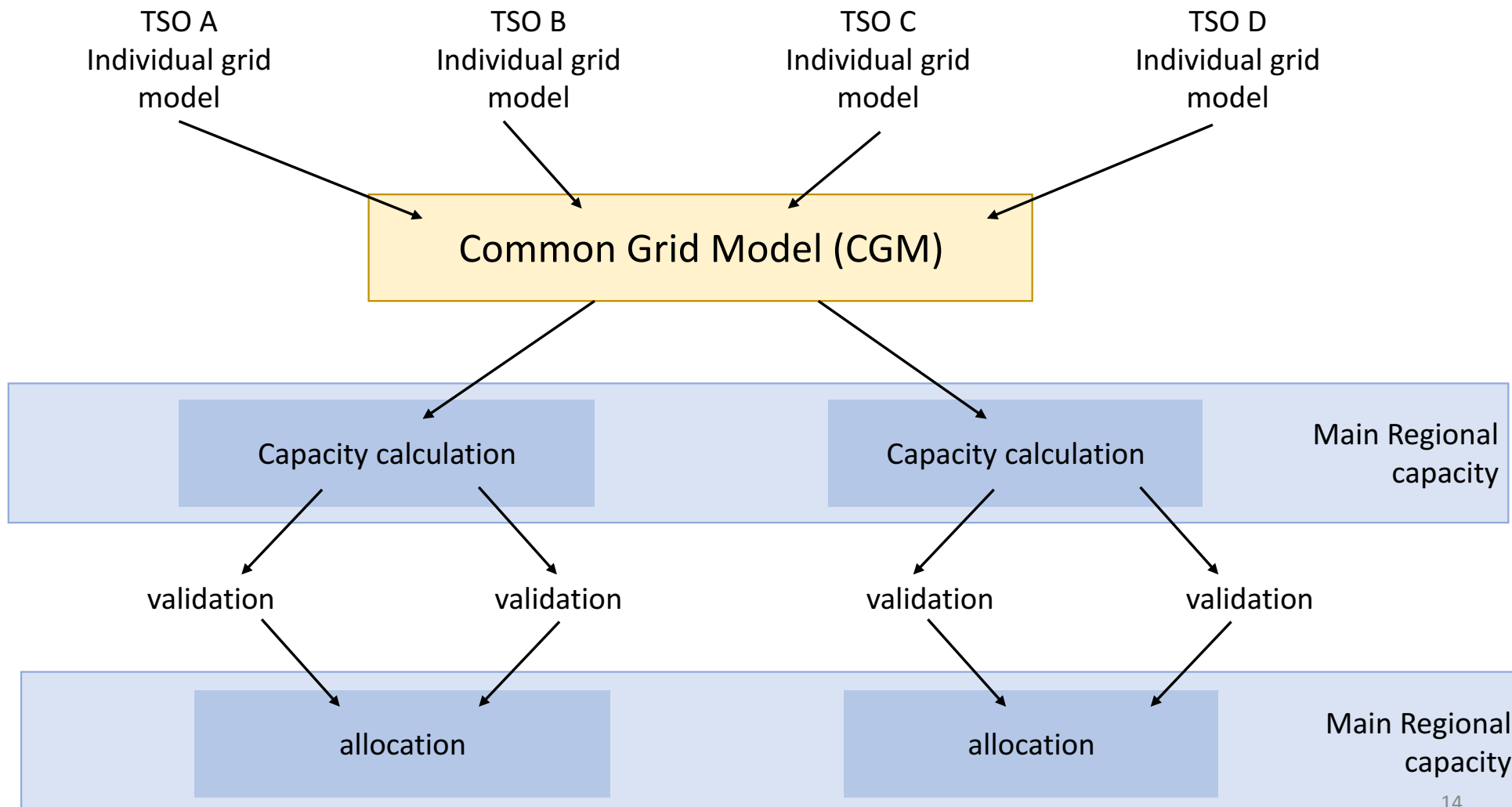


Figure 1. Rough geographic location of the proposed CCRs (without prejudice to the changes presented in Chapters 3.2 to 3.12 and Annex 1).

- 例: ③Central-west Europe (CWE):
(ベルギー、フランス、オランダ、ドイツ、ルクセンブルク)
- Bidding zone borders
 - France – Belgium (FR – BE)
 - Belgium – Netherlands (BE – NL)
 - France – Germany/Luxembourg (FR – DE/LU)
 - Netherlands – Germany/Luxembourg (NL – DE/LU)
- 一つのbidding zone borderは、一つのCCRsに属することが原則。

Common Grid Modelに基づくCapacity Calculation

ENTSO-E(2016)



Forward Capacity Allocation Network Code (FCA)

- FCAの役割

1. Allocation ruleの設定
2. EU単一のプラットフォームの創出

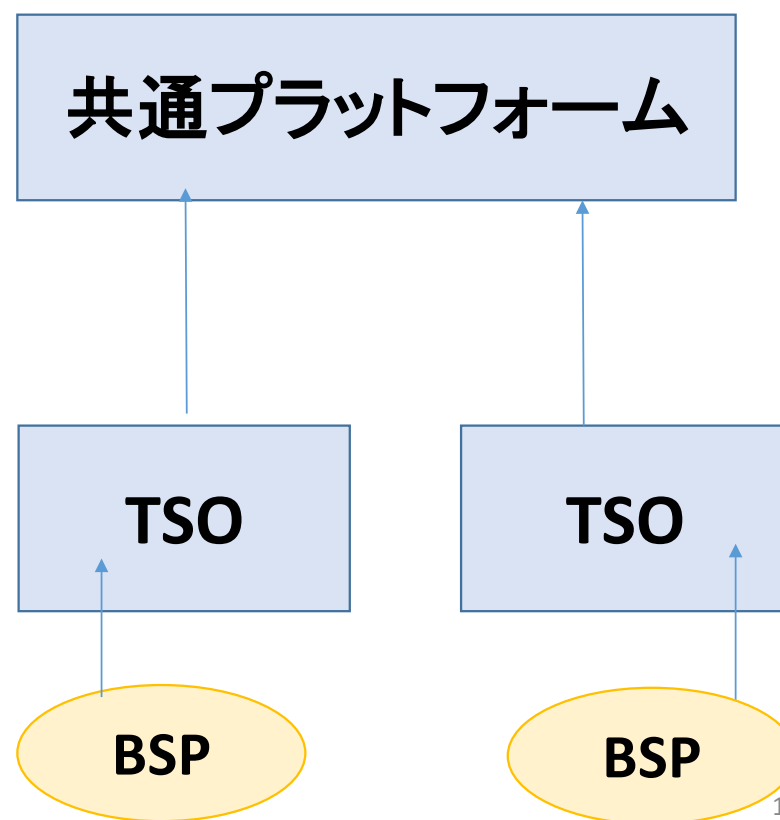
- 国際送電線のcapacity calculationは、Common Grid Modelを使用する。

- Firmness

- Market spread based compensation with caps

Balancing Market : Basic Element (target model: TSO-TSO model)

- 効率的なBMの構築
 - 最小コストで安定供給を保証。
 - バックアップの発電を減らす。
 - → 広域的なBMを作れば、
 効率性がアップする。
- アンシラリーサービス
 - black startの能力
 - 周波数コントロールを素早く行う。
 - 追加的な電力を必要な時に供給。



Balancing Market について

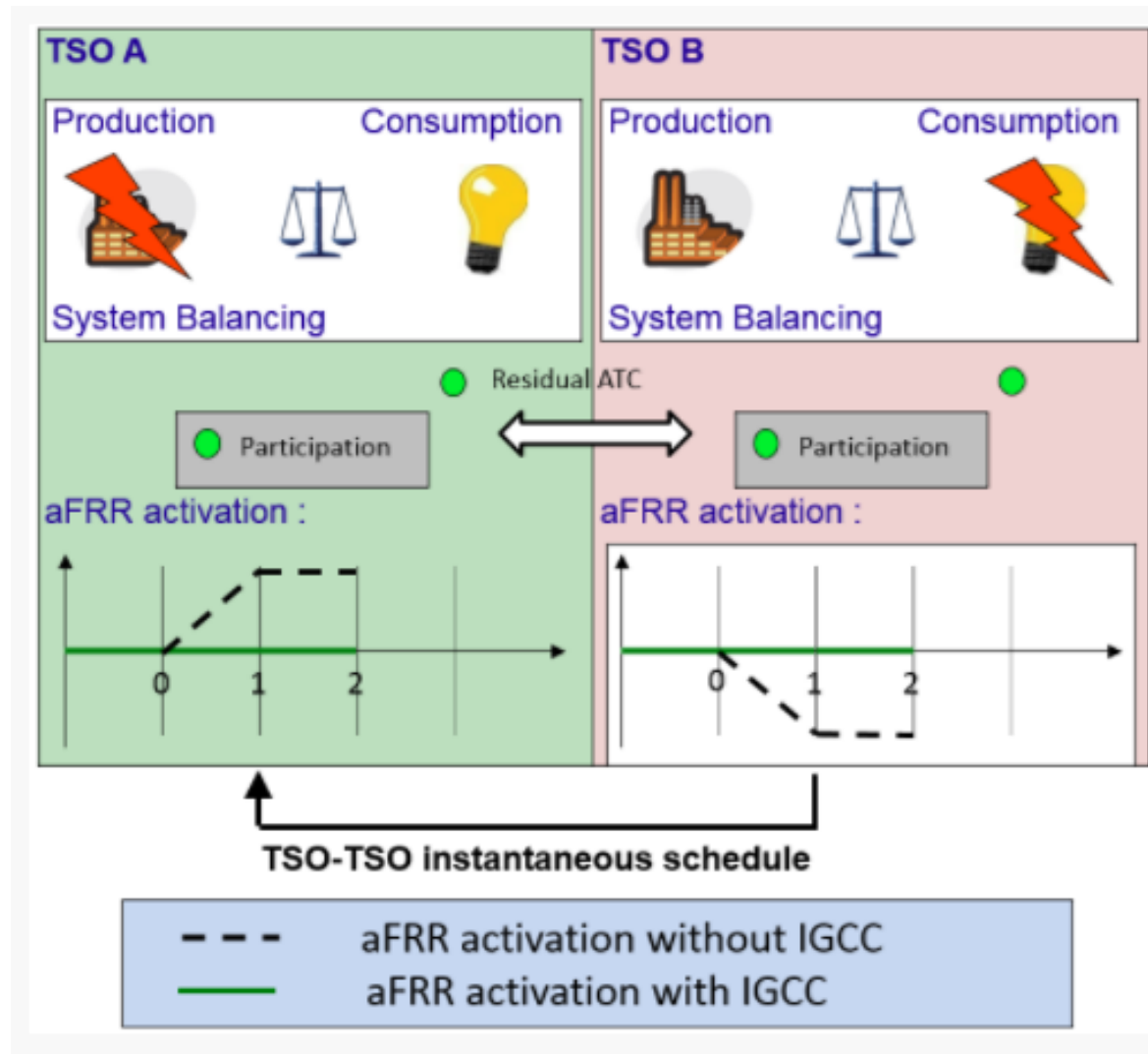
- NC EBは今年中に発効する予定。(ENTSO-E,2017b)
- →そうすると、EU共通のフレームワークを構築していくことになる。
- →フレームワークは課題ごとに段階的に構築。

- インバランスネットティング
- mFRR/aFRR: ミニッツ、セカンダリ(4年後にoperational)
- Imbalance settlement (3年後にproposal)
- * 各項目において、共通の実施するフレームワークを構築し、TSOはそれに従うことになる。ただし、猶予期間(derogation)が最大二年ある。

NC EBにおけるimbalance nettingのパイロットプロジェクト

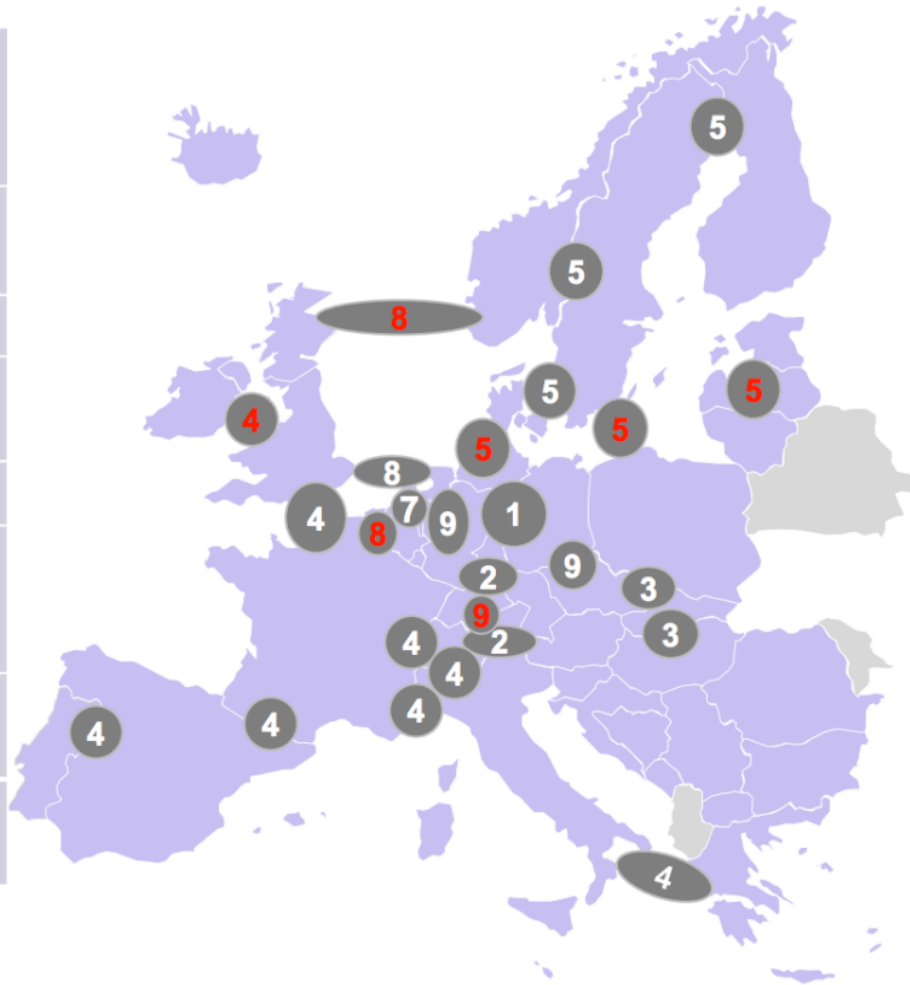


NC EBにおけるimbalance nettingについて



Overview of 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 (project on hold)
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
8	BritNed / TenneT / National Grid Balancing Services (project on hold)
9	IGCC Imbalance Netting, aFRR-Assistance and Flow-Based Congestion Management.

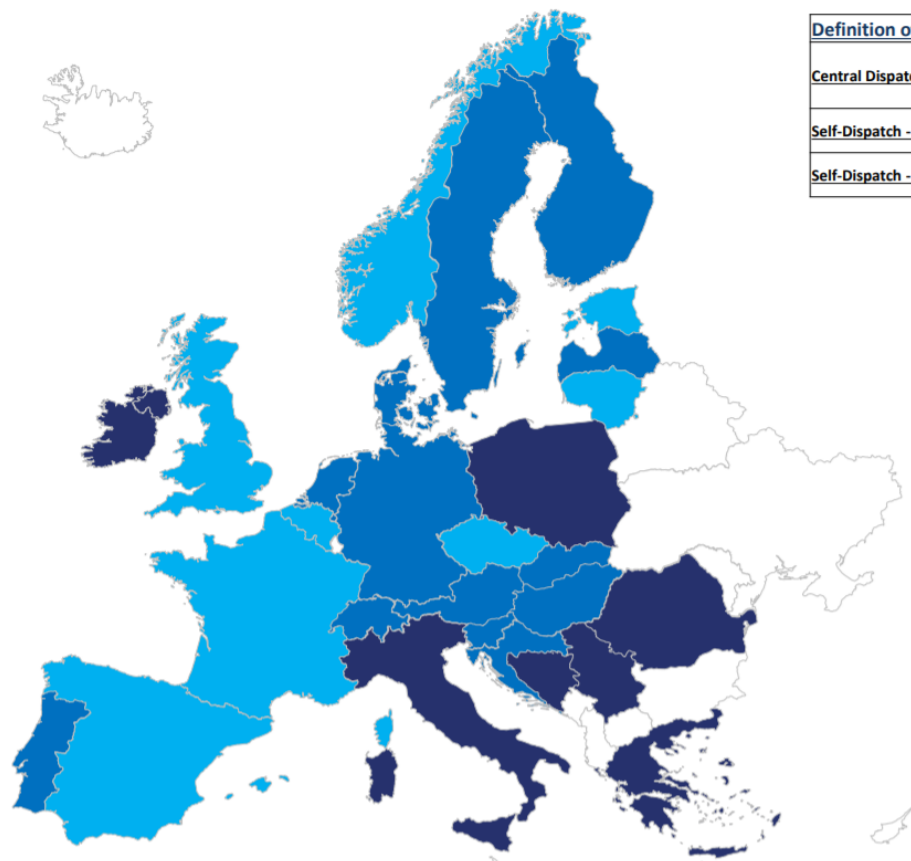


TSOs involved
TSO possible future involvement

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






Balancing Marketの仕組みの違い

What is the balancing process in place?



Definition of answer	
Central Dispatch	Central dispatch means a dispatch arrangement in a Relevant Area where the Transmission System Operator determines the commitment and output of a majority of generation or demand and issues dispatch instructions directly to them.
Self-Dispatch - Portfolio Based	A portfolio of units/generators (or other plant types) follow an aggregated schedule of actions to start/stop/increase output/decrease output in real time.
Self-Dispatch - Unit Based	Generators (or other plant types) following their own schedules of actions to start/stop/increase output/decrease output in real time.

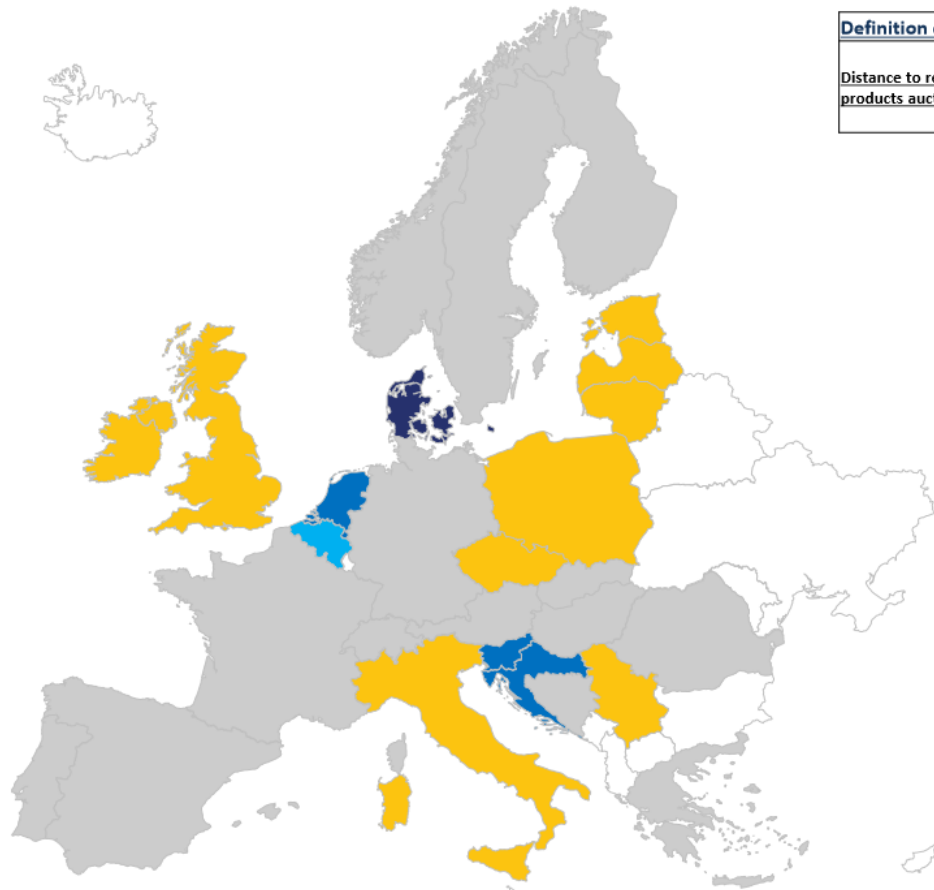
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	Central Dispatch
	Self-Dispatch - Portfolio Based
	Self-Dispatch - Unit Based

aFRR (セカンダリ) の調達時期の違い

AS6.3

Frequency Restoration Reserve (Automatic) - Capacity - Distance to real time of reserve products auctions



Definition of question	
Distance to real time of reserve products auctions	The time ahead from real time when auction/agreement for a specific balancing product takes place (for instance = 1 year in the case of a reserve agreement signed 1 year ahead of real time).

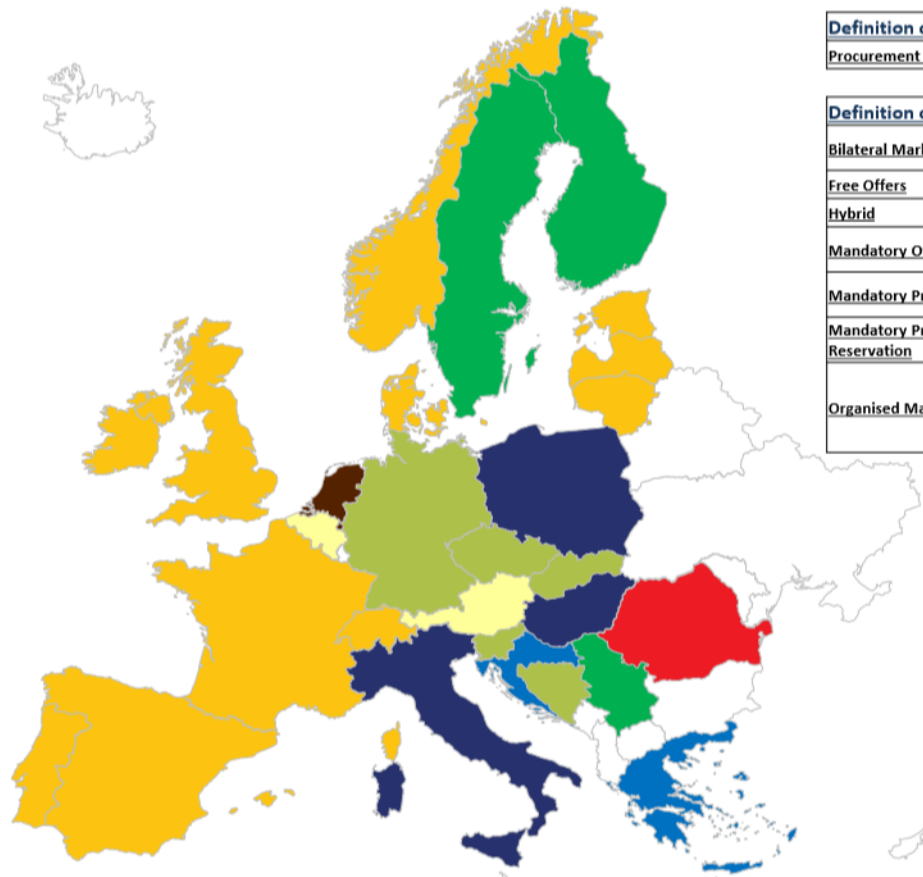
Key:

Missing data	White
N/A	Yellow
Year or more	Dark Blue
Month(s)	Medium Blue
Week(s)	Light Blue
Day(s)	Grey

セカンダリ(エネルギー)の調達方法の違い

AS2.6

Frequency Restoration Reserve (Automatic) - Energy - Procurement Scheme



Definition of question	
Procurement Scheme	Background of the offer, which is closest to the real operation time.
Definition of answer	
Bilateral Market	A grid user and TSO negotiate a contract regarding the offered service and price/price system.
Free Offers	Non-regulated offers.
Hybrid	Combination.
Mandatory Offers	Generators connected to the grid are obligated to offer the remaining capacity/available capacity.
Mandatory Provision	Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free.
Mandatory Provision without Reservation	It is mandatory for dispatchable units to be able to provide frequency containment reserve, but these units are not required to reserve capacity to provide this service.
Organised Market	There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract.

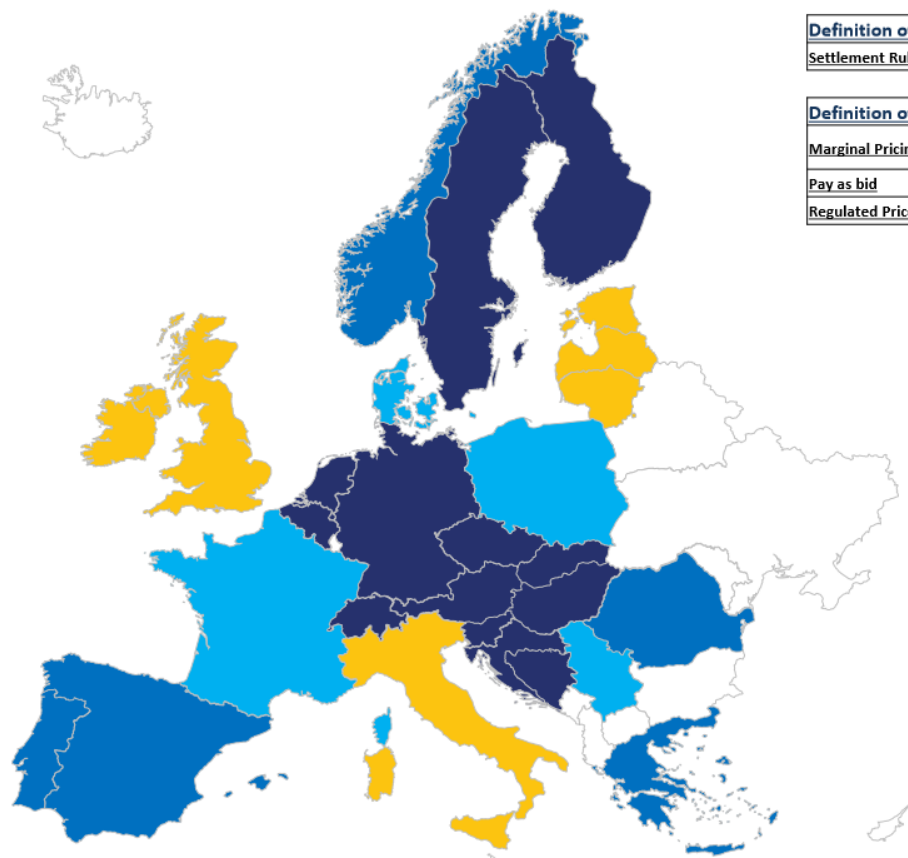
Key:

Missing data	Missing data
N/A	N/A
Mandatory Offers	Mandatory Offers
Mandatory Provision	Mandatory Provision
Mandatory Provision without Reservation	Mandatory Provision without Reservation
Bilateral Market	Bilateral Market
Organised Market	Organised Market
Hybrid	Hybrid
Other	Other
Pre-contracted Offers only	Pre-contracted Offers only
Pre-contracted and Mandatory Offers	Pre-contracted and Mandatory Offers
Pre-contracted and Free Offers	Pre-contracted and Free Offers

aFRRのインバランス清算方法の違い






AS9.3

Frequency Restoration Reserve (Automatic) - Capacity - Settlement Rule



Definition of question	
Settlement Rule	The pricing rules for settlement.

Definition of answer	
Marginal Pricing	Marginal pricing is the change in total cost that arises when the quantity produced changes by one unit.
Pay as bid	Contracted parties who provide a service are paid based on their offer price.
Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.

Key:	
	Missing data
	N/A
	Pay as bid
	Marginal Pricing
	Regulated Price

まとめ

- 欧州においては、安定供給と効率的な電力市場の構築を進めるために、NCが策定されており、その策定に、TSOが大きくかかわっている。
- DAMやIDMが効率的に働くことが大前提。したがって、最終的な調整を行うBalancing Marketのために、送電容量が事前に確保されることはない。
- Balancing Marketも、市場統合が図られるが、現在の市場制度国ごとに異なり、競争を進めるためにどのような制度設計を行うかは、今後の議論で決まっていく。
- Balancing Marketの特にインバランス清算の仕組みは、DAMやIDMの活発な利用を促すために重要である。

參考資料

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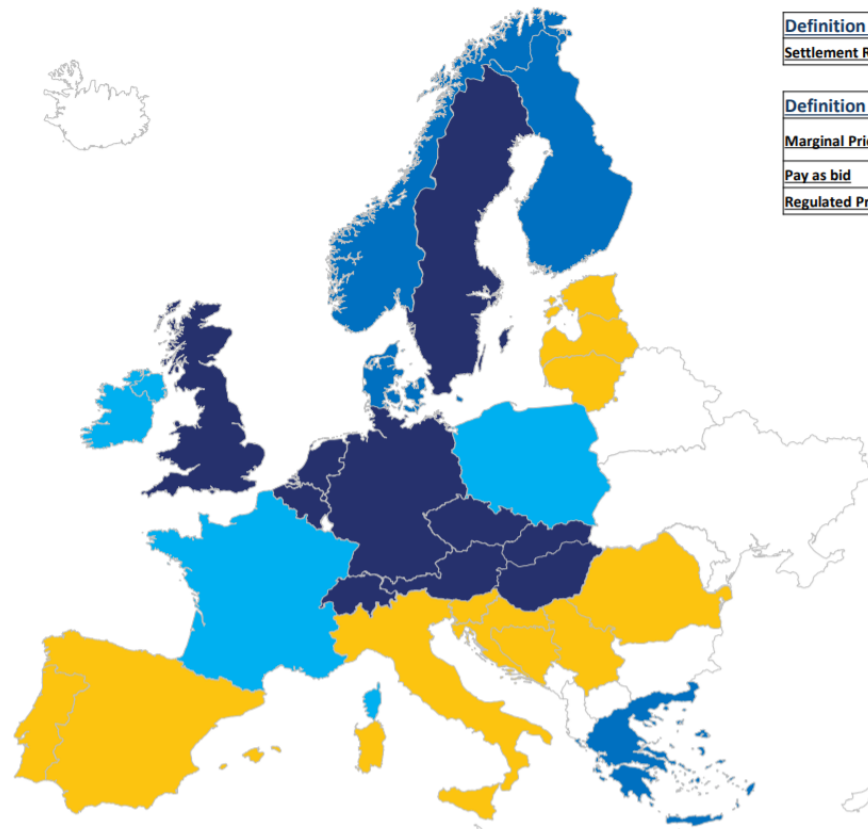
參考資料

7. ENTSO-E(2017a) Network Code on Electricity Balancing ,
https://www.entsoe.eu/Documents/Network%20codes%20documents/NC%20EB/Informal_Service_Level_EBGL_16-03-2017_Final.pdf.

aFRR (セカンダリ) における

ANS.1

Frequency Containment Reserve - Capacity - Settlement Rule

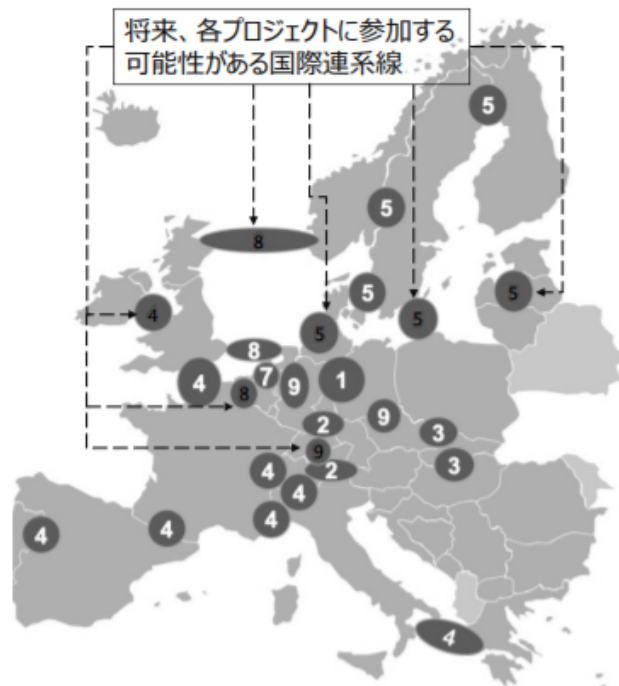


Definition of question	
Settlement Rule	The pricing rules for settlement.

Definition of answer	
Marginal Pricing	Marginal pricing is the change in total cost that arises when the quantity produced changes by one unit.
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Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.

Key:

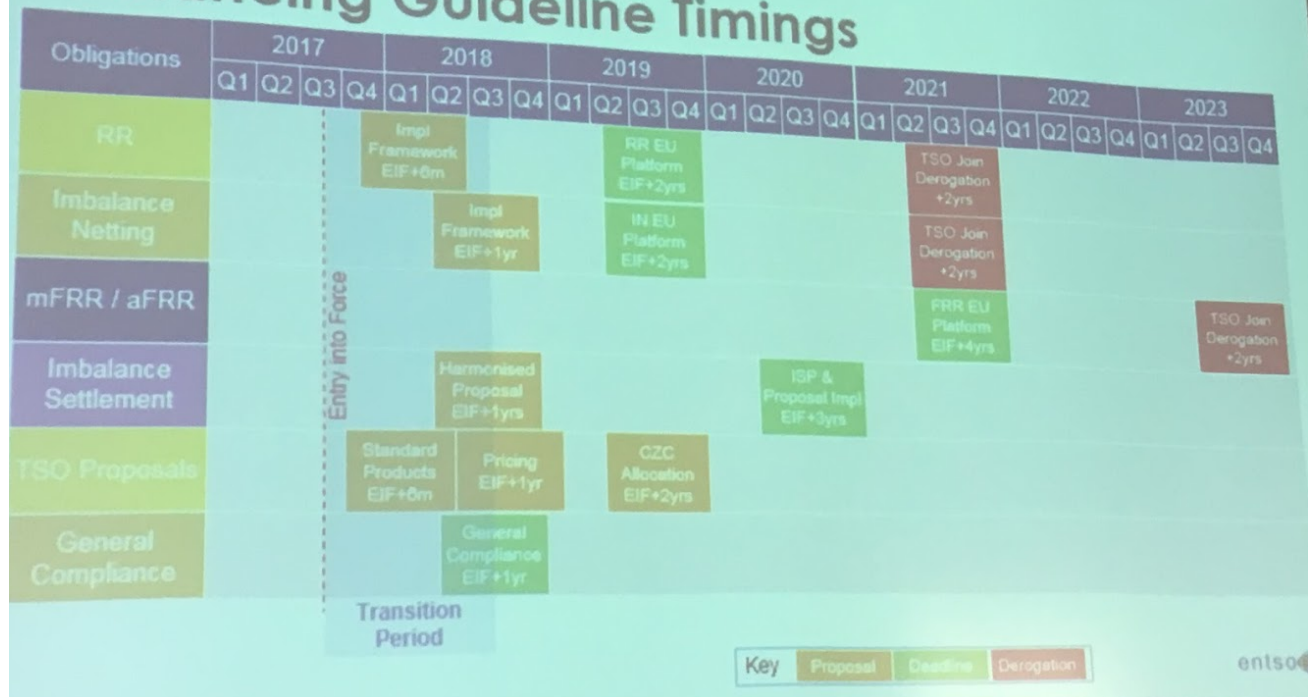
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	Pay as bid
	Marginal Pricing
	Regulated Price



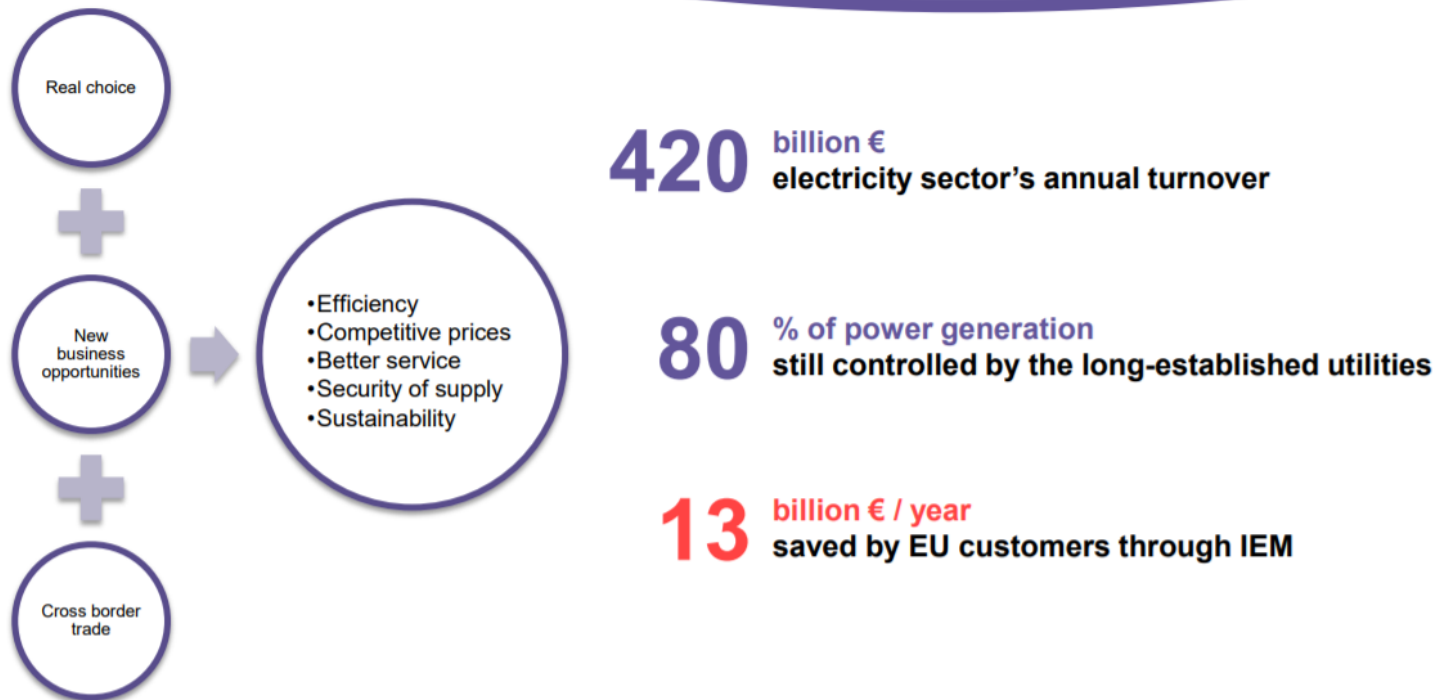
プロジェクト番号

1	Flow-based送電混雑解消の手法を用いたaFRRとmFRRの共通メリットオーダーの作成
2	FCRのための国際連系線の活用
3	e-GCC(保留中)
4	Trans-European Replacement Reserve Exchange (TERRE)
5	Nordic Regulation Power Market (NRPM)
7	Xボーダー (クロスボーダー)
8	BriNeDを活用した需給調整能力の融通(保留中)
9	IGCC (International Grid Control Cooperation)

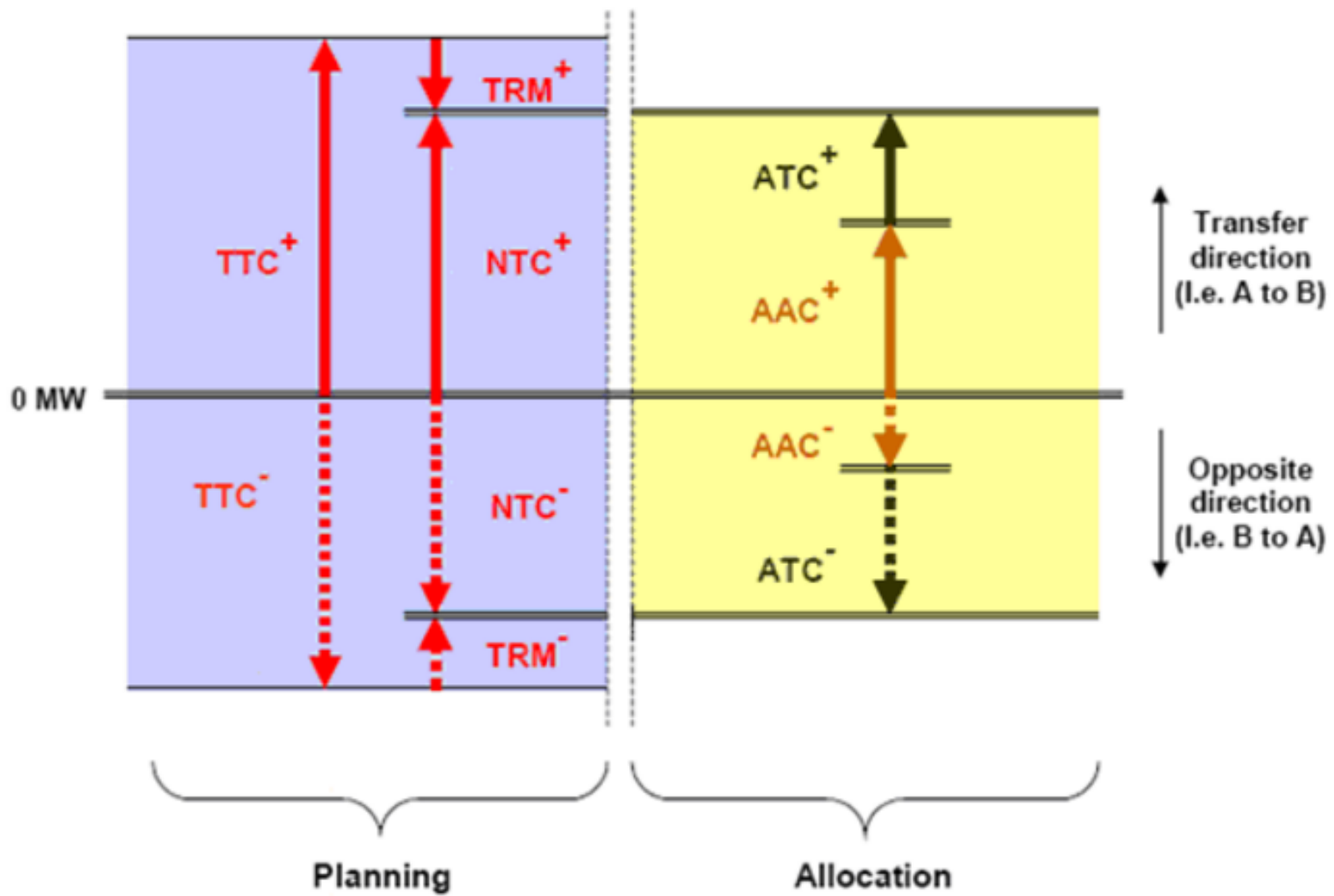
Balancing Guideline Timings



The IEM: creating benefits for European customers



Source: 3rd Energy package and EC communications



ETSO (2001a). *Definitions of transfer capacities in liberalized electricity markets.*