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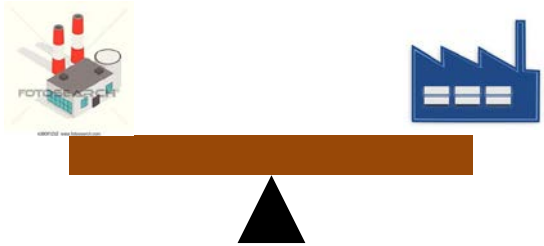
Autorità di Regolazione per Energia Reti e Ambiente

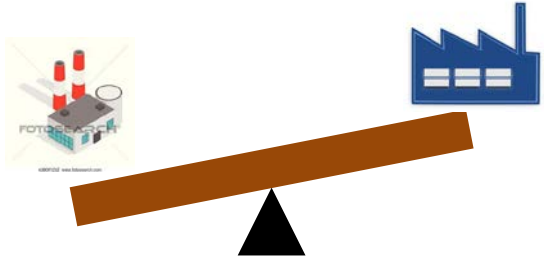
System Operation Guideline

Marco Pasquadibisceglie
SO GC TF Co-chair

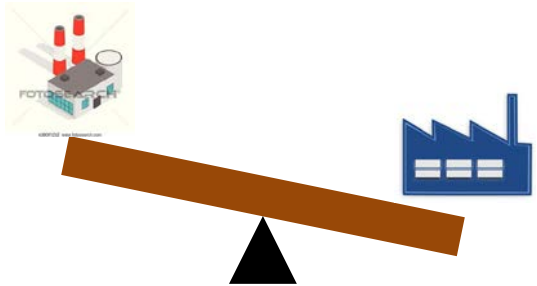
Frequency and balancing



Balanced system – 50 Hz



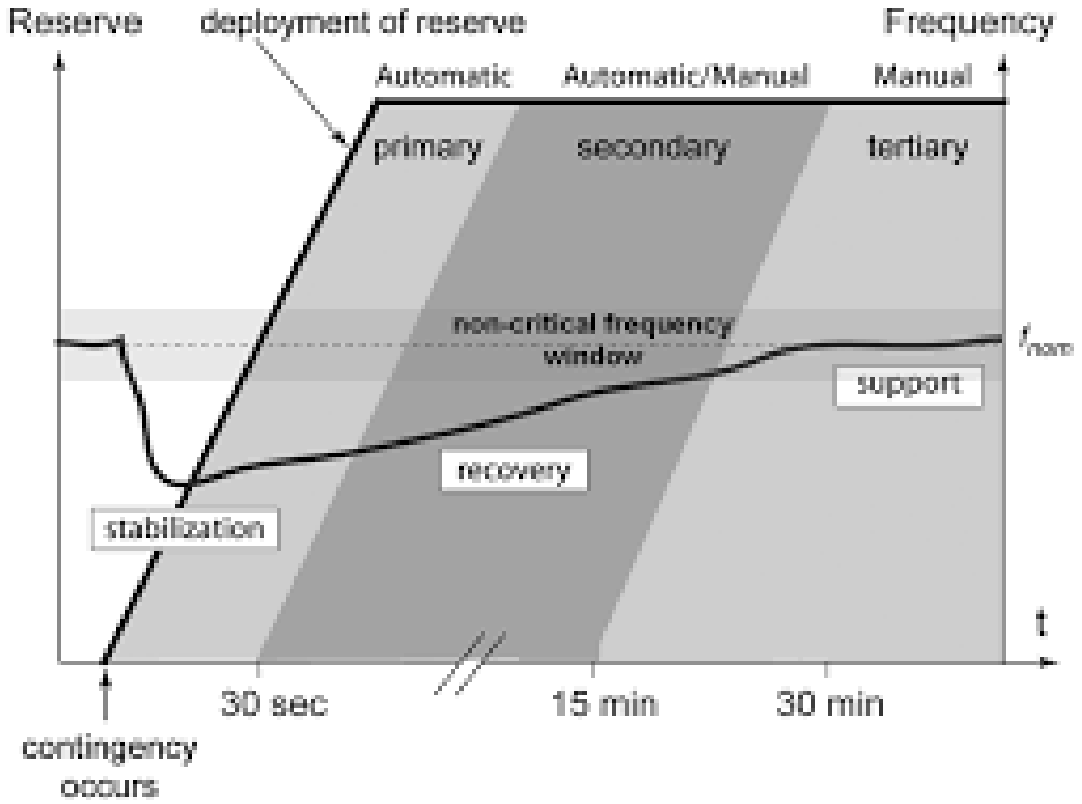
More generation – >50 Hz



More load – <50 Hz

Frequency and perturbation

Each product has a specific scope
All together aim to keep the system in balance



Frequency ancillary services

Service	Activation time	Control
Frequency containment reserve (FCR)	Some seconds	Automatic – local control
Automatic frequency restoration reserve (aFRR)	Some minutes	Automatic – central control
Manual frequency restoration reserve (mFRR)	Up to 15 minutes	Manual – disposed by TSO control room
Replacement reserve (RR)	More than 15 minutes	Manual – disposed by TSO control room

System operation in Europe

Star of Laufenburg – first reliable interconnection between Switzerland, France and Germany (1958)

UCPTE (then UCTE) – first TSO association on voluntary basis

entsoe

ENTSO-E: replacing UCTE as TSO association under third package umbrella

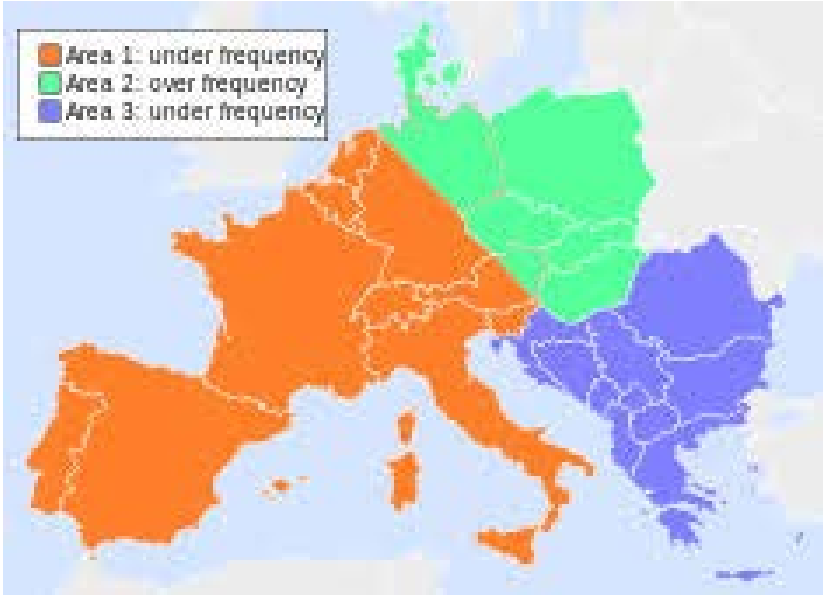
Good level of cooperation under voluntary basis

28/09/2003

- Night between Saturday and Sunday
- 3 am in the morning
- Lowest load on a weekly basis
- Lavorgo – Mettlen (Lukmanier pass line) tripped – N-1 security triggered
- Not properly coordinated remedial actions between Italy and Switzerland
- Cascading event

04/11/2006

- Conneford – Diele double circuits was opened to allow a ship to pass through the Ems river to the North Sea
- Usual request, but improperly managed
  - Disconnection originally planned at 1 am 05/11 was anticipated at 10 pm 04/11
  - Real exchanges between North and South Germany were underestimated
- Subsequent overloads – cascading event

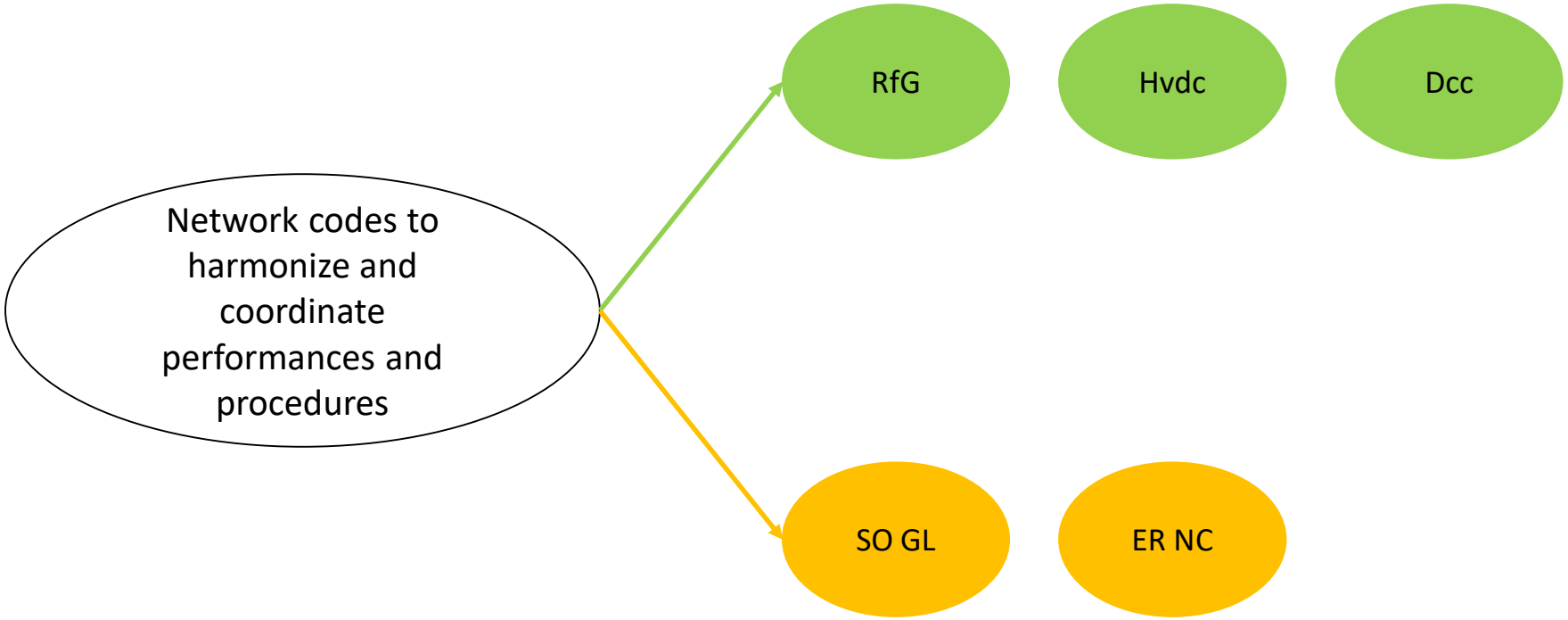


Situation aggravated by loss of DSO connected plants in the red area

Lessons learnt

- Voluntary coordination may fail
- Harmonization of rules for DSO connected plants is of utmost importance
- Each TSO shall have visibility also of the networks of the adjacent TSOs
- Training staff with the same competences across Europe may help the daily operation

Third package



SO GL

- Operational security
  - Stability, voltage, power flows, remedial actions
  - Data exchange
  - SGU compliance and training

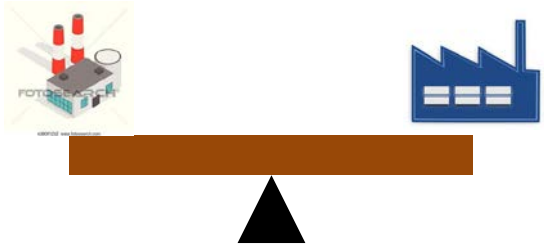
- Operational planning
  - Scenarios and common grid models
  - Operational security analysis in planning phase (RSC role)
  - Outage coordination and short term adequacy assessment

SO GL

- Load frequency control
  - Operational agreements and frequency quality
  - Load frequency control structure and operation
  - FCR, FRR and RR requirements
  - Sharing and exchanging of reserves

- Entry into force
  - 14/09/2017
  - Data exchange from 14/03/2019
  - Applicable also to third countries (Balcans, Switzerland)

Frequency and balancing



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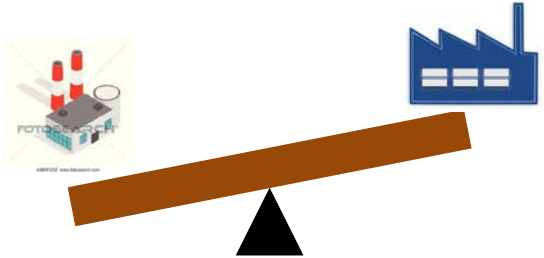

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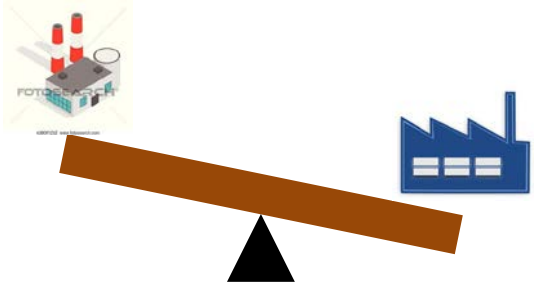

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Frequency and perturbation

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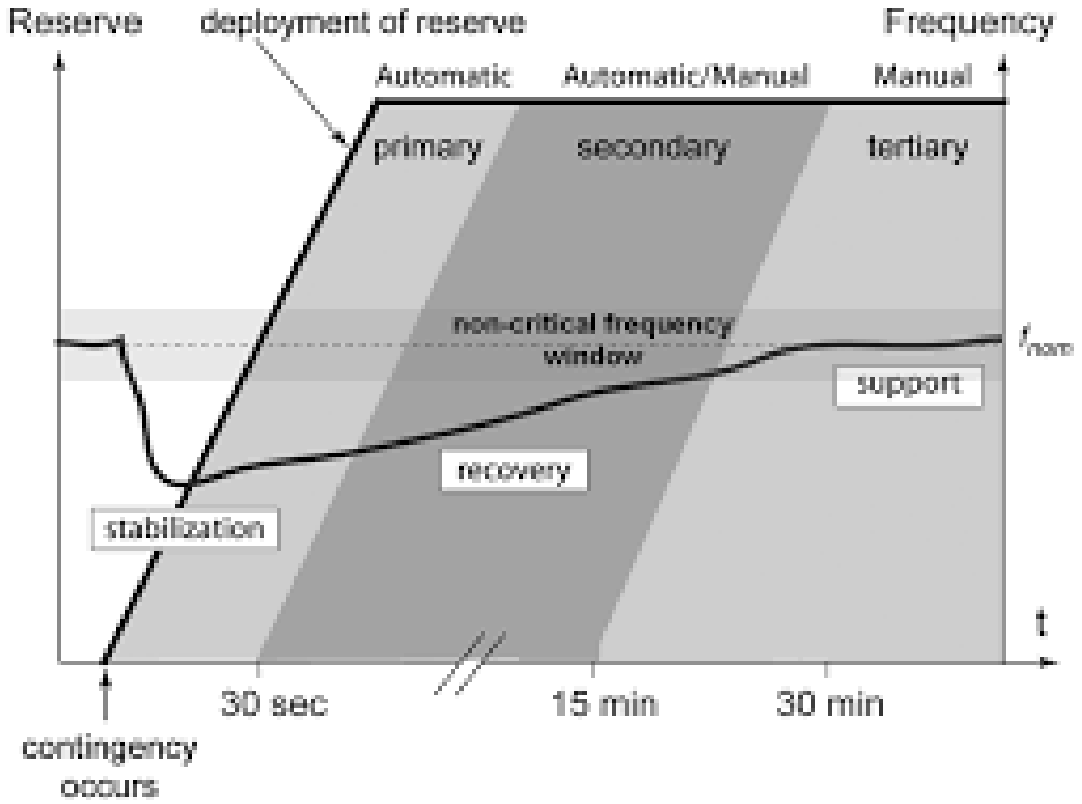

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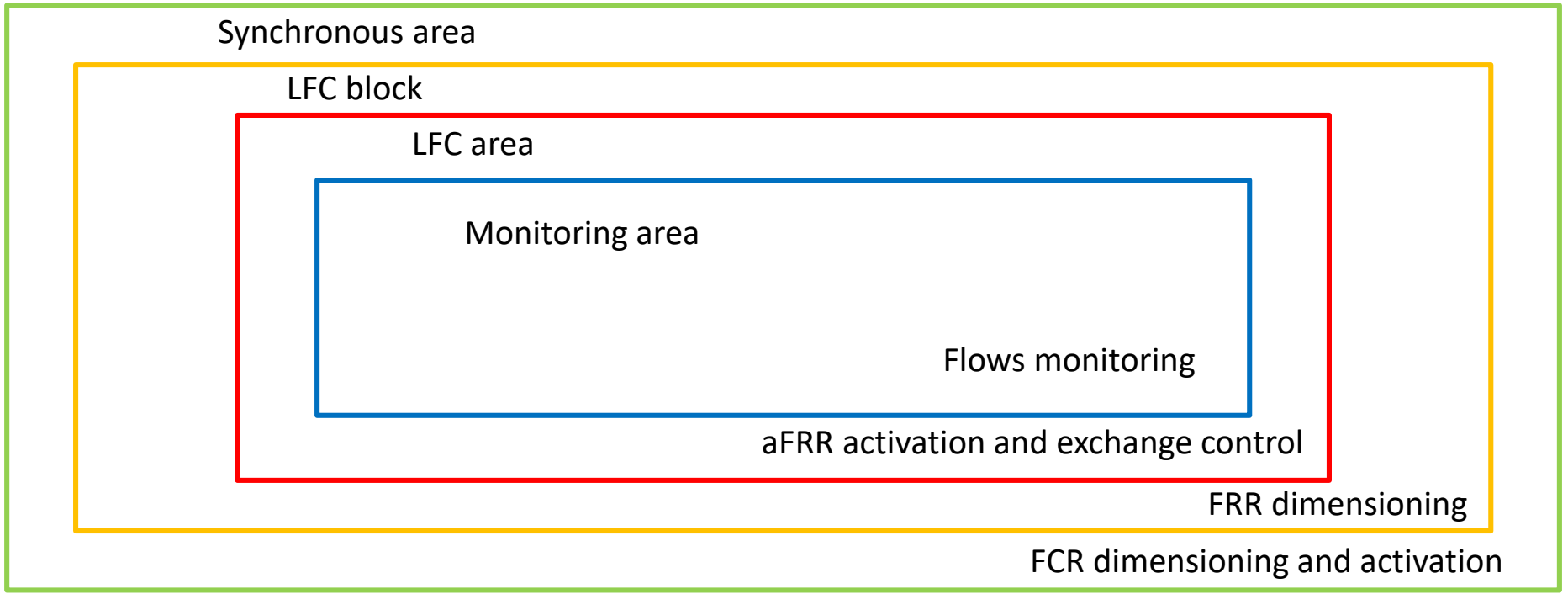
Load frequency regulation hierarchy



System states

Normal state

All conditions fullfilled

- Voltage and power flows within operational security limits
- Frequency within the standard range (50 mHz steady state deviation) or steady state deviation<200 mHz and alert state not triggered
- Active and reactive power reserves sufficient to withstand contingencies
- Operation will remain within operational security limits after the activation of remedial actions to cope with contingencies

Alert state

- Voltage and power flows within operational security limits
- TSOs reserve capacity reduced by more than 20% for longer than 30 minutes without any compensation
- Steady state deviation<200 mHz exceeding 100 mHz for longer than 5 minutes or 50 mHz for longer than 15 minutes
- At least one contingency leads to violation of operational security limits

System states

Emergency state

- At least a violation of operational security limits
- Frequency outside normal and alert state range (e.g. steady state deviation > 200 mHz)
- At least one measure of the TSO's defence plan is activated
- Failures in tools and facilities for more than 30 minutes

Blackout state

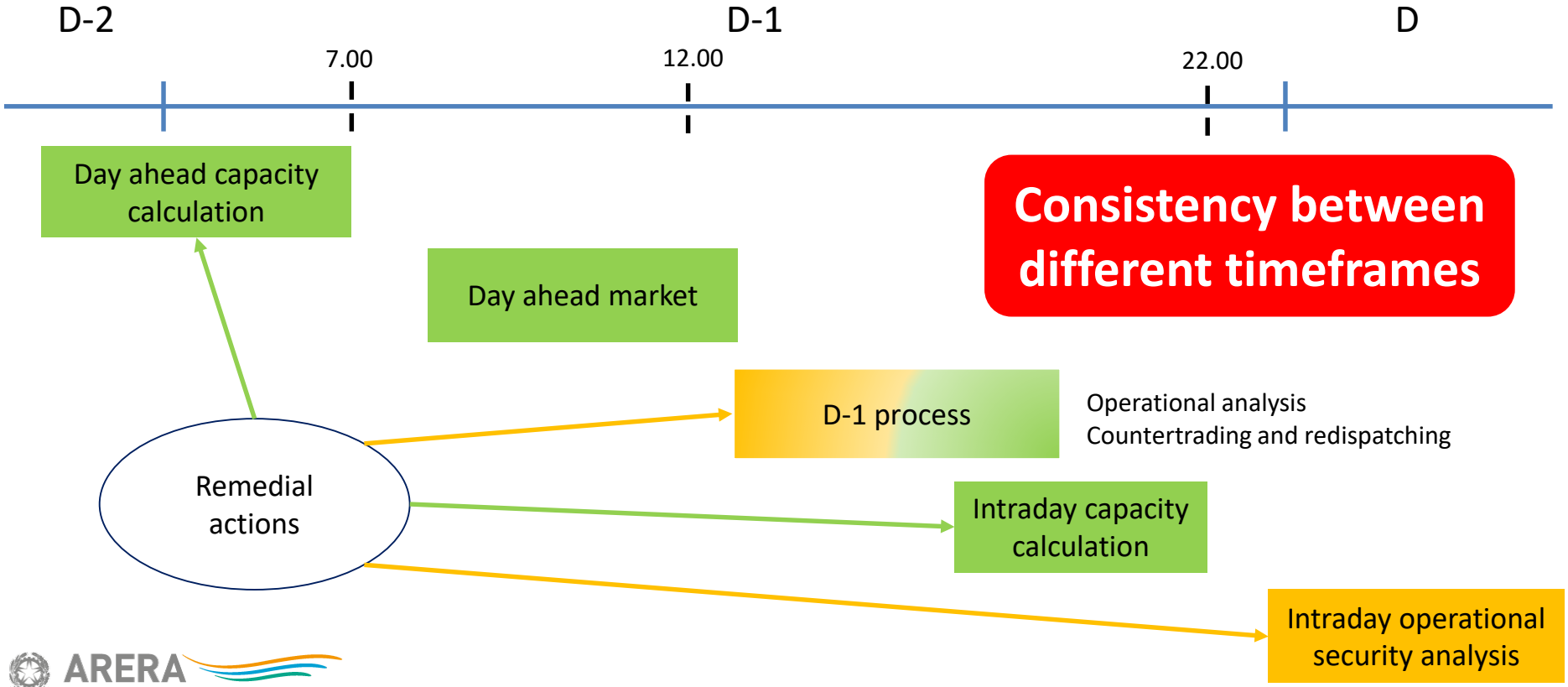
- Loss of more than 50% of demand
- Total absence of voltage for at least three minutes leading to triggering of restoration plans

System states

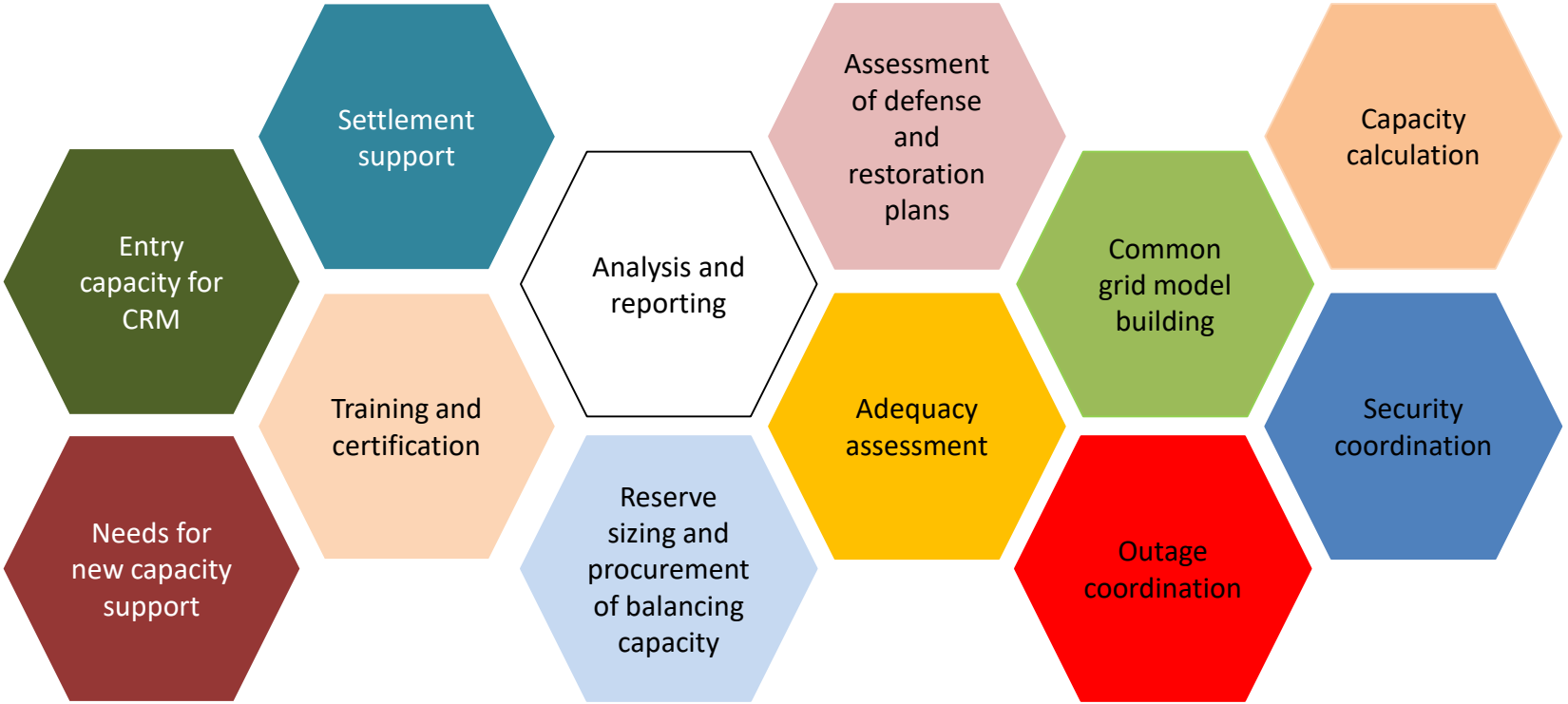
Restoration state

- Activation of restoration plan after emergency or blackout state

Operational security in planning phase



Regulation 2019/943 – RCC concept



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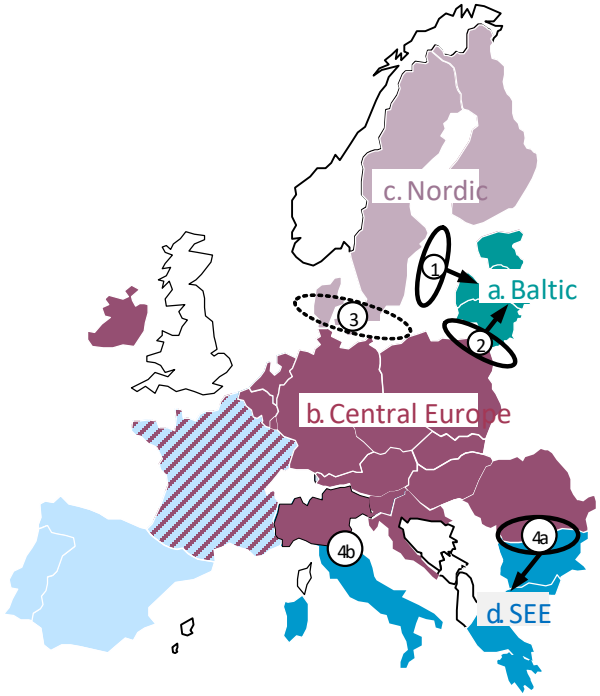
New Acer Decision – April 2022



5 SORs

- Central (Coreso and TSCnet)
- SWE (Coreso)
- SEE (SEleNe CC)
- Baltic (Baltic RCC)
- Nordic (Nordic RCC)

Agreement with 3rd countries neighbouring TSOs

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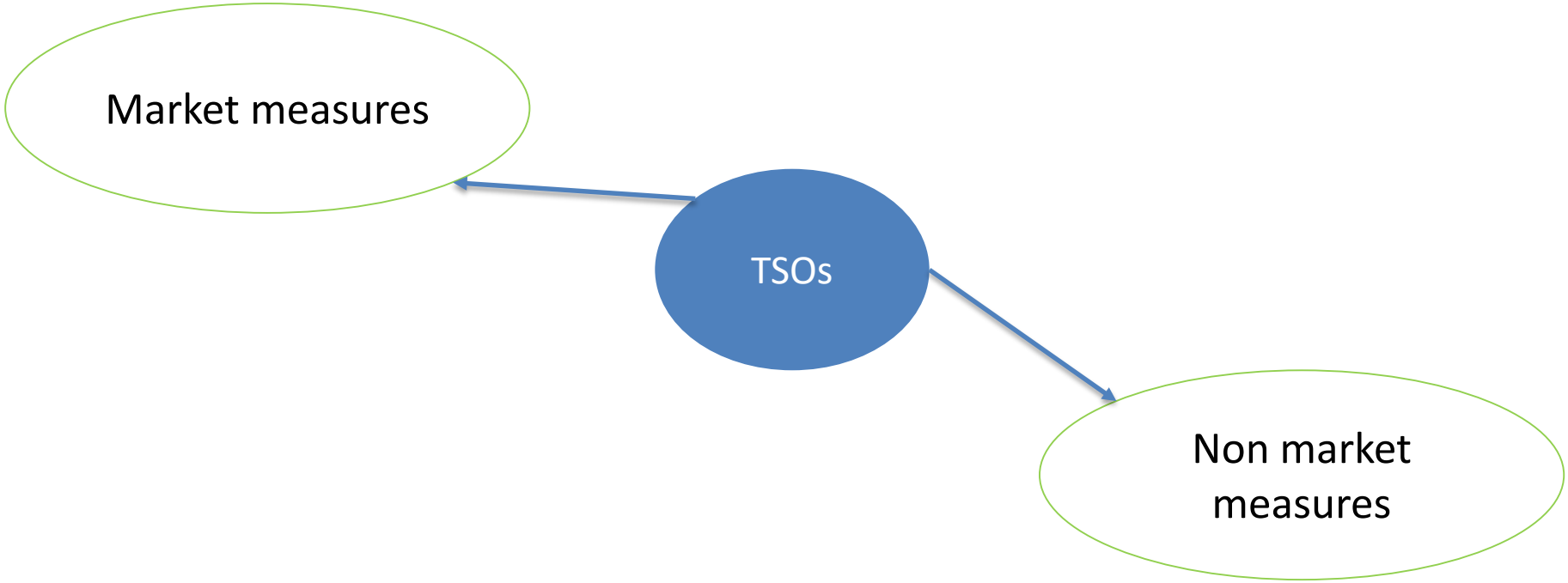
ER NC

- Defense plans with some harmonized features (e.g. low frequency demand disconnection)

- Restoration plans with some harmonized features (e.g. backup control room, 24 hours emergency power supply)

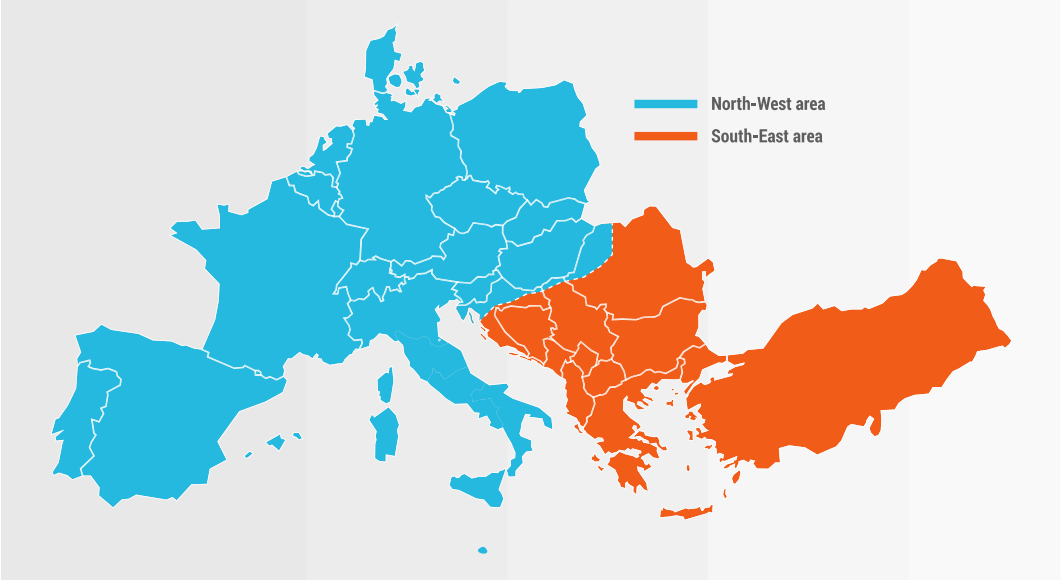
- 12 months for plants involved in the plans to comply with the technical requirements

ER NC



08/01/2021

- Busbar coupler in Ernestinovo tripped
  - It wasn't monitored in N-1 situation
  - Unusual power station operation
- High flows
  - The flows between East – West were underestimated
- Subsequent overloads – cascading event



Further lessons learnt

- High flows may turn to be close to angle stability
- Modelling bus coupler cannot be left aside
- Coordination with 3rd countries TSOs is fundamental
- New role for interruptible load as defense/emergency measures
- SO GL and ER NC need to be amended