Cross border requirements for storage devices

Initial Response

ENTSO-E

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Storage devices

NC RfG and DCC:

- Storage devices are not part of RfG and DCC (Article 3.2.d, except for pump-storage)

Questions received:

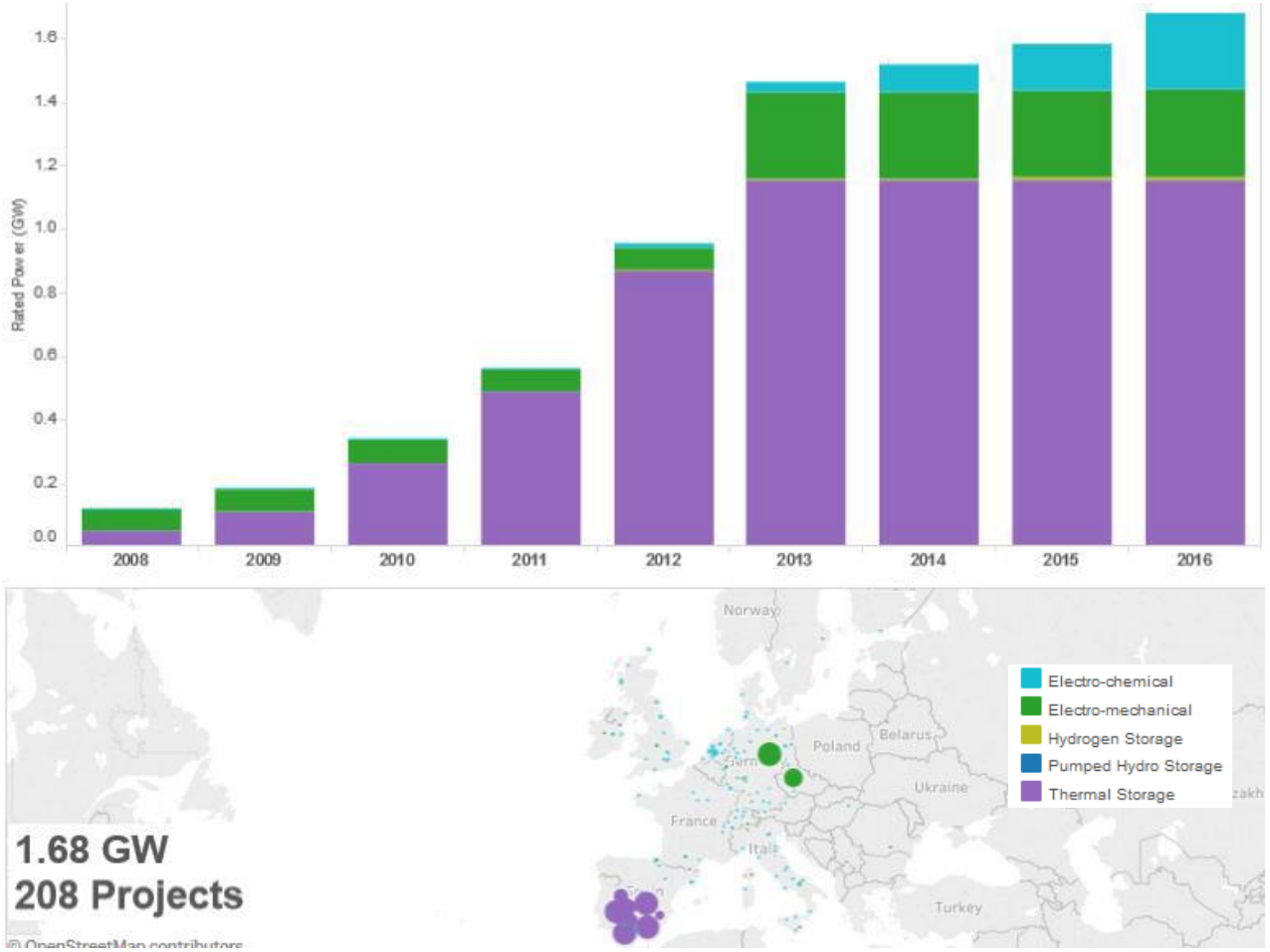
- Are connection requirements for storage devices (batteries) at European level justified? Is there cross border relevance? – Addressed in the following slides
- Can SO GL provisions be imposed on batteries? – This question remains open until further coordination with system operation experts
- Battery storage devices and RfG definitions of SPGM and PPM? - Since RfG explicitly excludes storage, it does not seem necessary to explain/argue whether the current definitions can be applied to storage. If RfG was amended to include storage, it would however be necessary to revise these definitions

Energy storage devices of diverse technologies:

- Pumped Storage Power (synchronous generators)
- Compressed air Energy Storage (synchronous generators)
- Flywheels (synchronous generators)
- Superconductive Magnetic Energy Storage Systems
- Supercapacitors
- Battery systems
- etc.

Growth of Energy Storage Technologies

- Between 2008 and 2016, 1.68 GW of energy storage projects (excluding PHS) have come into operation
- Technological breakthroughs since 2000:
  - Significant improvements in performance
  - Decreasing costs
  - Massive research efforts, numerous demonstration projects, and emerging commercial



Source: European Association for Storage of Energy.

EU 28 + Norway, Switzerland.
Source: US DOE Storage Database.

Cross border relevance of connection requirements for storage?

Storage devices for electrical energy (batteries) have become a common, mature equipment of electricity supply systems

- Number of units and size has increased

- Many small units foreseen in the near future
  - Electrical cars
  - Energy neutral buildings with small electrical storage systems
  - Batteries to merge capabilities for PPMs.

- Development in large units
  - Fast cost decline of batteries
  - Units commercially available up to 10 – 15 MW and already in operation.

- Installed capacity > 0,1% annual consumption of a synchronous area
  => storage devices for electrical energy cannot be considered as emerging technologies (as defined by RfG, Articles 66 and 67), but are rather significant users already

Cross border relevance of connection requirements for storage?

Different functional application of batteries:

- LFSM-U, LFSM-O and FSM capability
- Contribution to synthetic inertia
  - Very fast active power response possible
- Demand Response
  - demand response system frequency control
  - demand response very fast active power control.

Few national examples for storage requirements

Germany
- Storage is part of the German Grid Codes
- Treated as a source and has to comply with RfG requirements

Denmark
- Separate Grid Code for batteries (also type D storage)

UK
- Proposal to modify the Grid Code to define technical requirements for storage

Spain
- No discussions yet until the regulatory framework is clarified

France
- Under investigation – to comply with RfG requirements (for PPMs)

The Netherlands
- No considerations yet but batteries already in place for FSM

Italy:
- Storage connected to MV and LV grids are dealt with in standards of Italian Electrical Committee
- Possible amendment to Grid Code (type D) under evaluation.

Conclusion

Based on:

- Expected number of units and size of storage systems in the near future and
- Different functional applications of storage systems.

Storage systems have cross-border relevance

This is only an initial position subject to further investigation and confirmation