PSTs as a tool in coping with new operational challenges within Continental Europe interconnection

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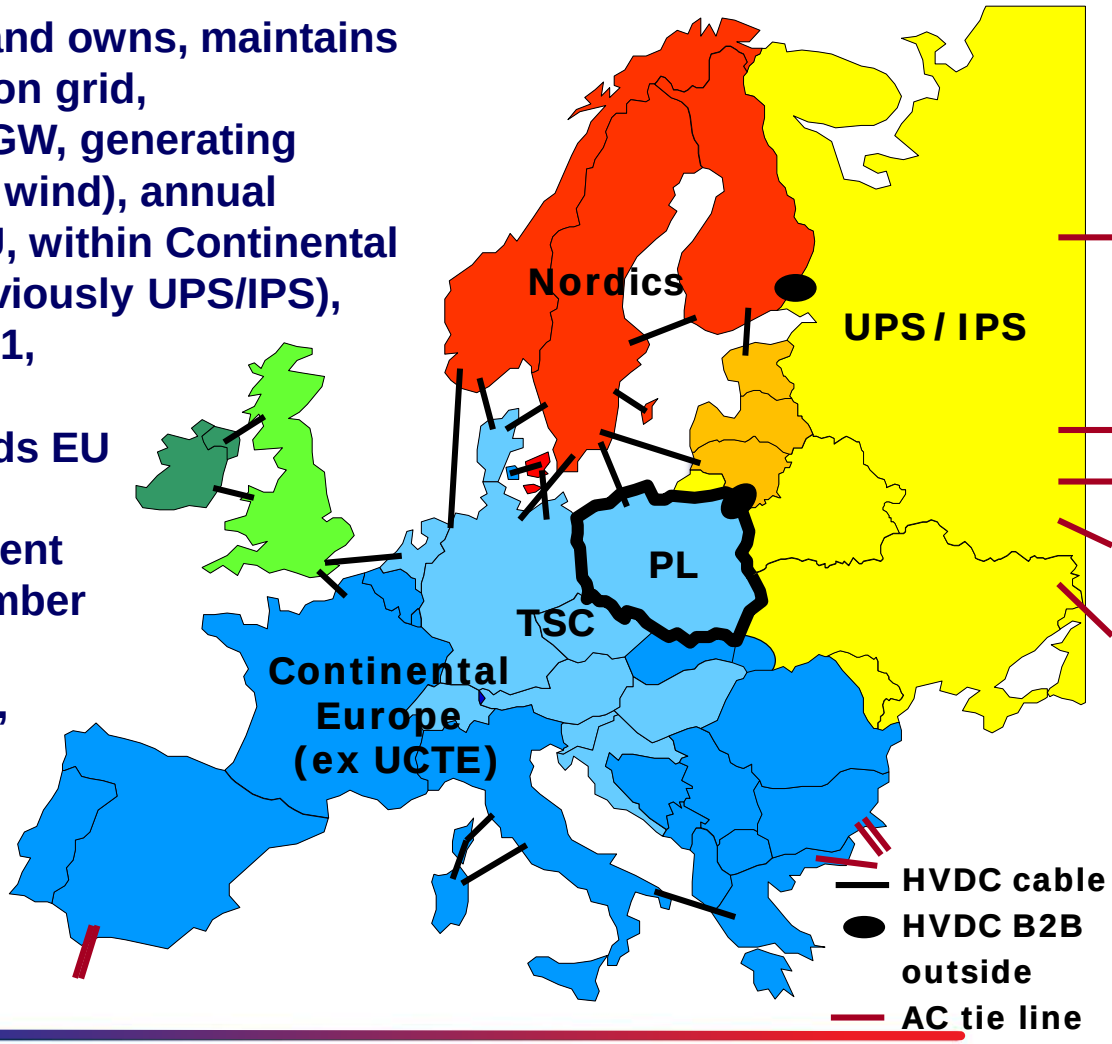
PSE – Polish TSO

- operates the Polish power system and owns, maintains and develops the Polish transmission grid,
- Polish power system (ca): peak 23 GW, generating capacity 38 GW (incl 6 GW of RES - wind), annual energy 150 TWh – roughly 5% of EU, within Continental synchronous area since 1990s (previously UPS/IPS),
- PSE runs the market in PL from 2001,

- since then ongoing activities towards EU wide market integration including:
  - efforts of harmonizing very different national schemes across EU member states – 3rd Energy package, implementationof network codes,
  - dealing with increasing physical interdependencies between systems – regional initiative TSO Security Cooperation (TSC) set up back in 2009.

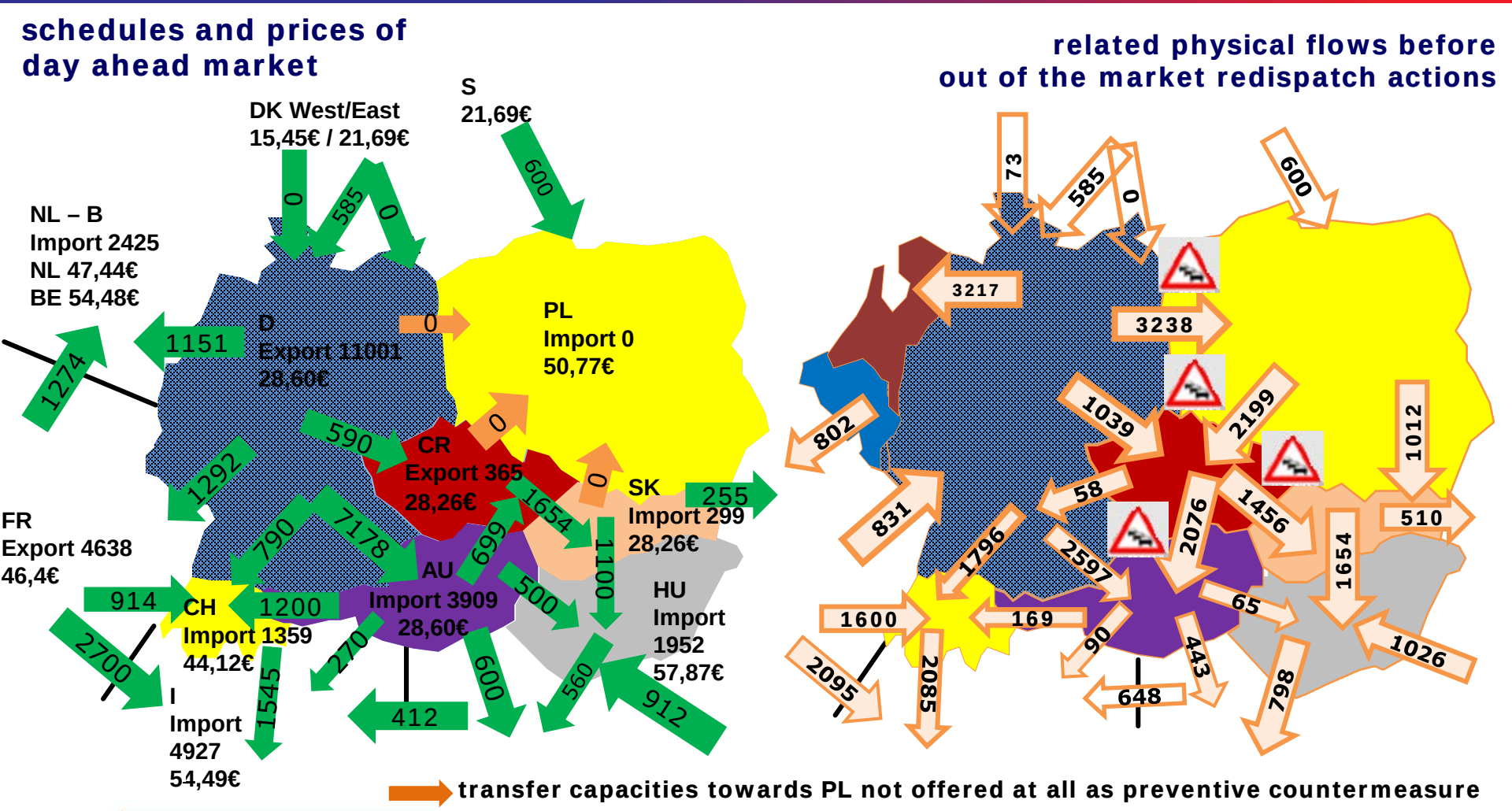


System operating conditions in the Continental interconnection (ex UCTE)

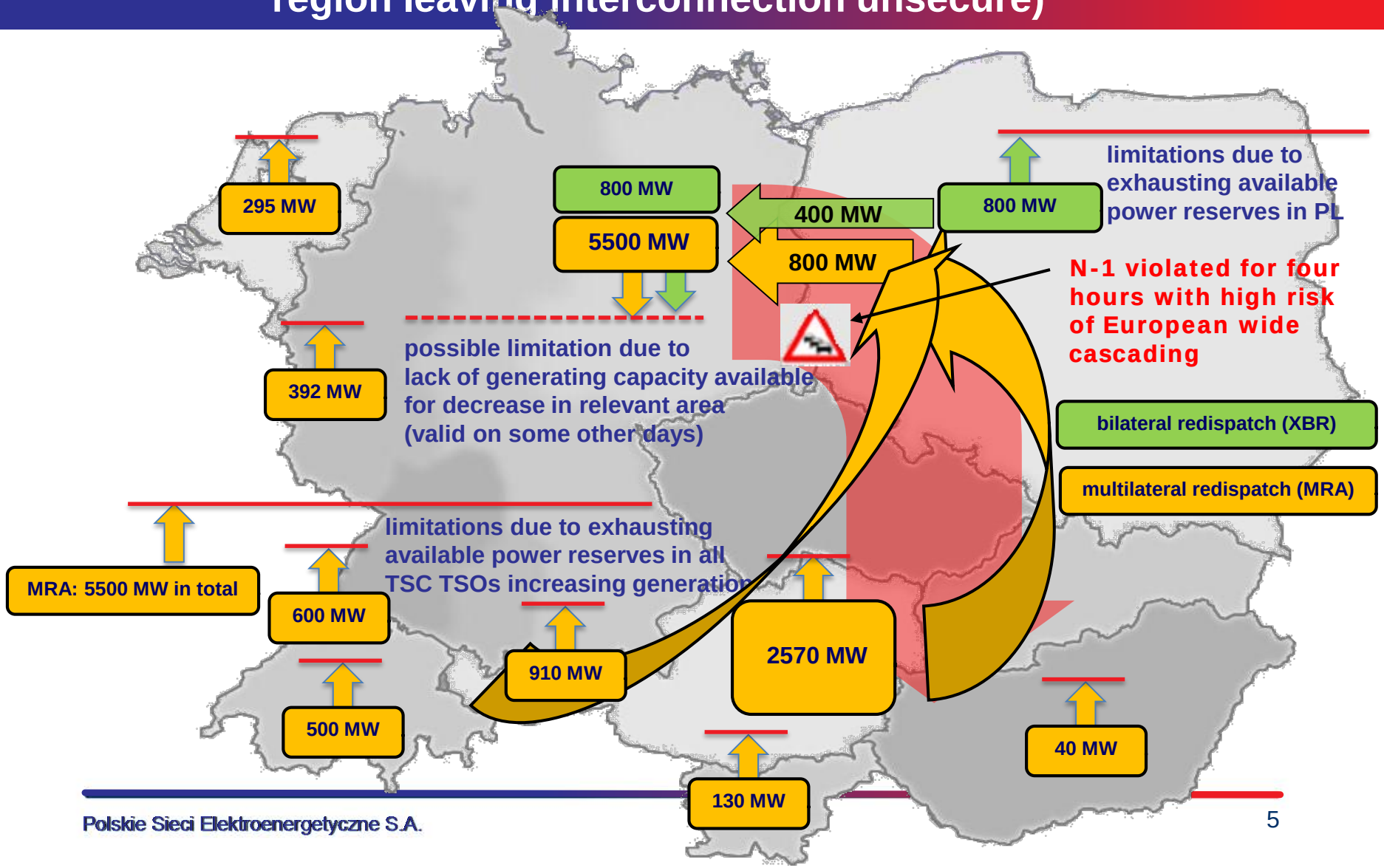
- Continental interconnection developed for first 40 years with the primary aim to increase security by mutual support and sharing of reserves,
- fundamental changes over the latest two decades:
  - implementation of market mechanisms,
  - volatile renewables (wind, PV) integration on a large scale,
- more and more long distance flows with more frequent changes of load flow patterns (driven by wind and PV generation = weather pattern),
- zonal market design with copper plate approach within zones allows to reflect physical constraints on the zone (= country*) borders only,
- lack of coordination between borders** and not proper configuration of the zones*** result in unscheduled flows decreasing economic efficiency (need of out of market redispatch actions) and endangers system security (once redispatch is exhausted)

*except DK, IT, NO and SE; **except Nordic and Benelux areas; ***e.g common DE and AT zone

Unscheduled flows – the result of mismatch between market results and related physical flows (example from a difficult day of summer 2015)

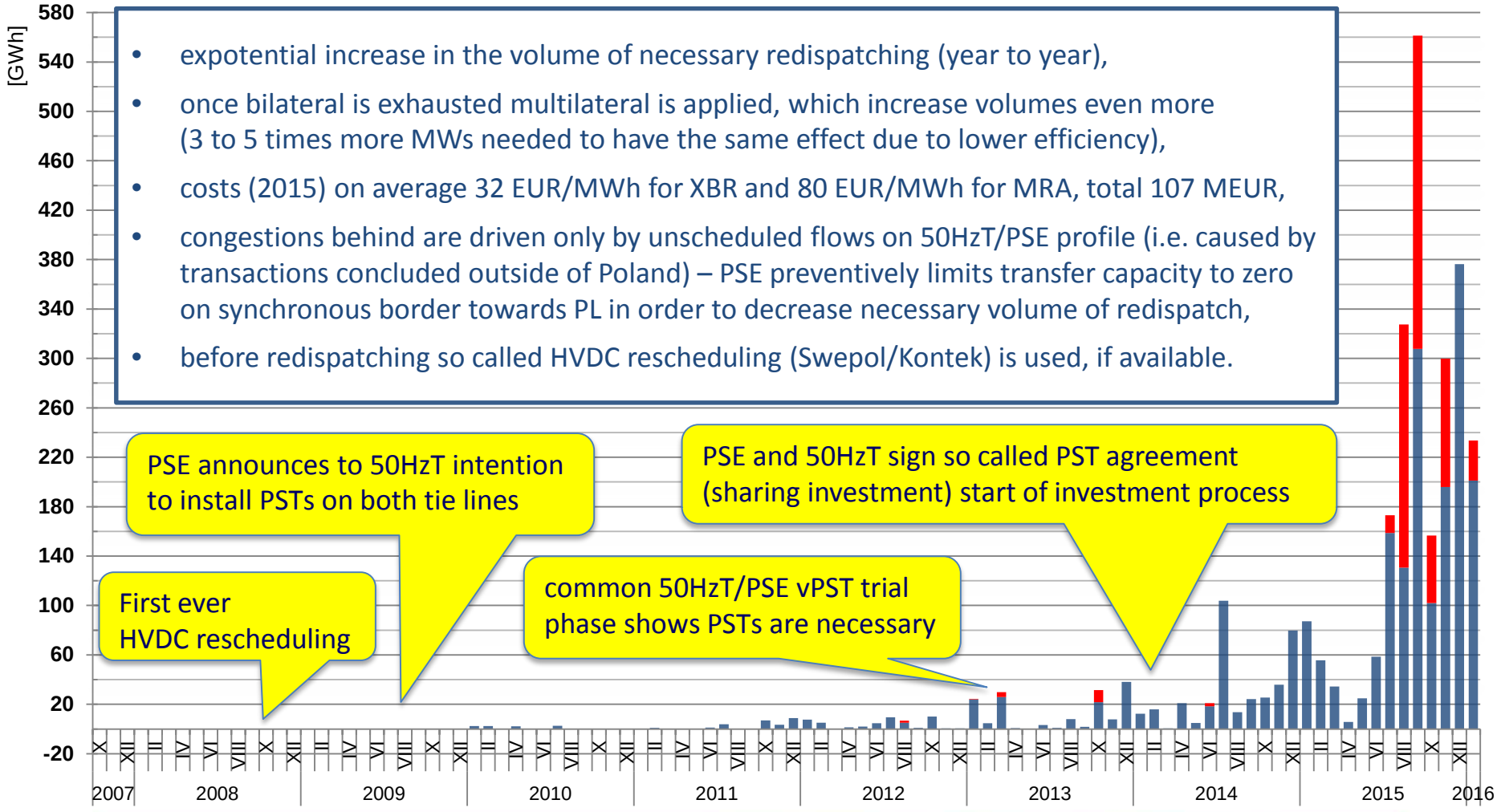


Redispatch actions (out of the market) applied (example of the same day as on the previous slide, redispatch potential exhausted within the entire TSC region leaving interconnection unsecure)



Monthly volumes of bilateral and multilateral redispatching necessary to keep 50HzT/PSE profile in n-1 secure state (up to 2015)

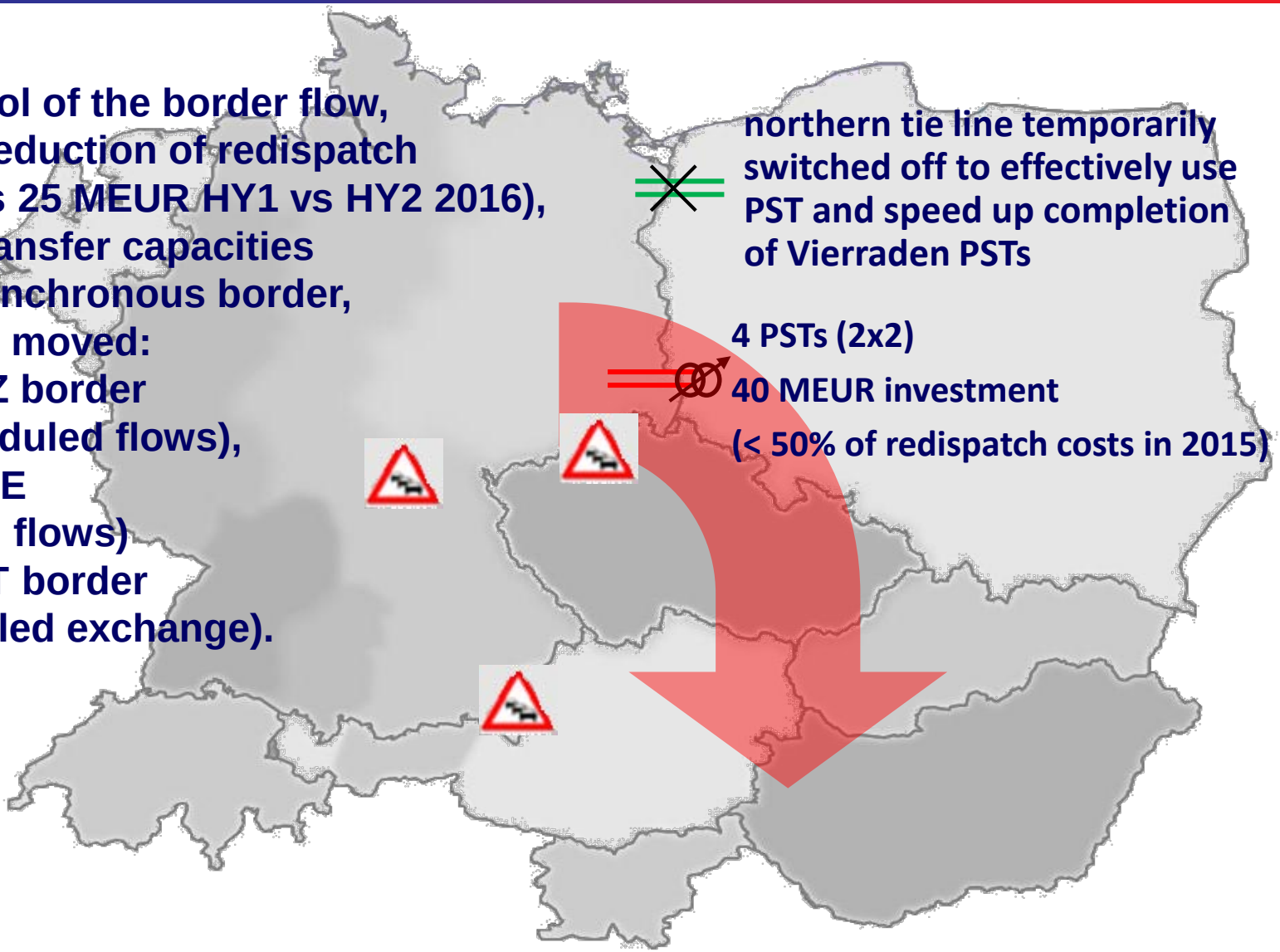
- expotential increase in the volume of necessary redispatching (year to year),
- once bilateral is exhausted multilateral is applied, which increase volumes even more (3 to 5 times more MWs needed to have the same effect due to lower efficiency),
- costs (2015) on average 32 EUR/MWh for XBR and 80 EUR/MWh for MRA, total 107 MEUR,
- congestions behind are driven only by unscheduled flows on 50HzT/PSE profile (i.e. caused by transactions concluded outside of Poland) – PSE preventively limits transfer capacity to zero on synchronous border towards PL in order to decrease necessary volume of redispatch,
- before redispatching so called HVDC rescheduling (Swepol/Kontek) is used, if available.



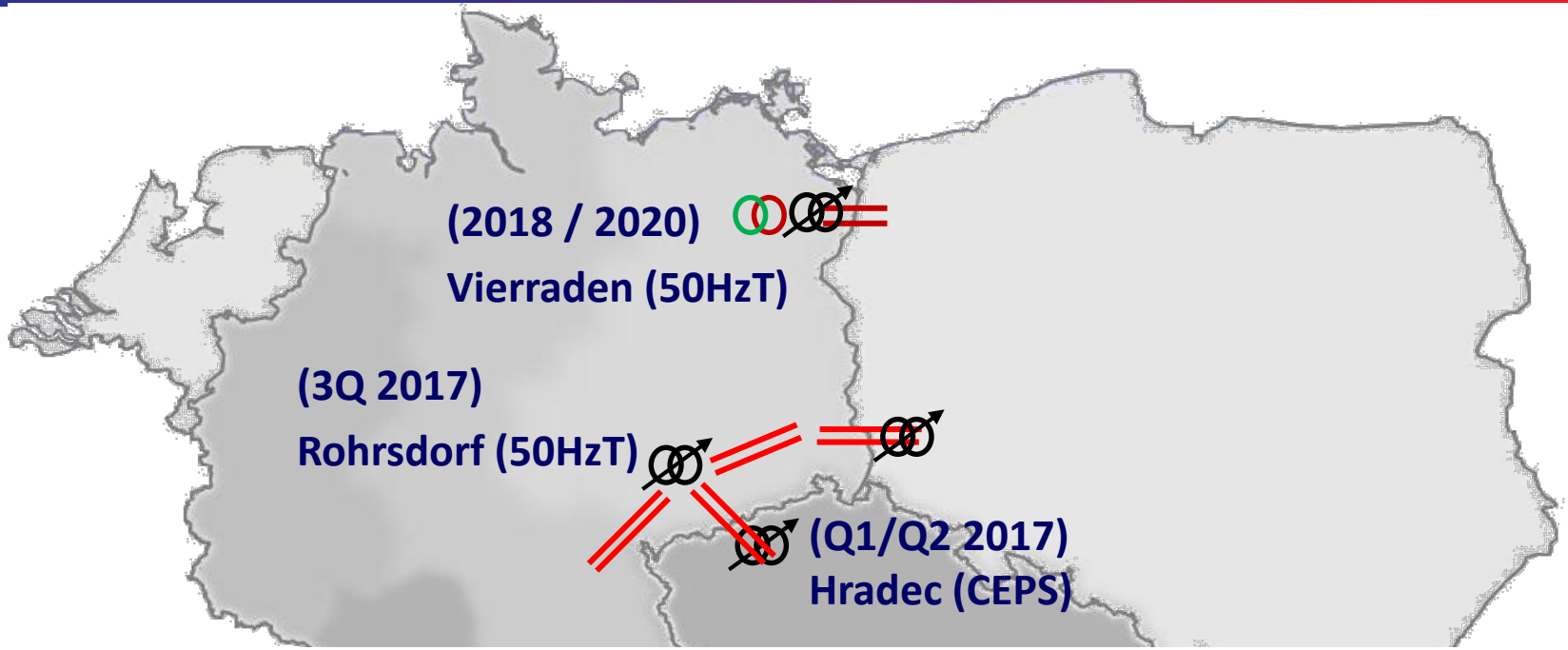
Temporary measures on PL/DE border applied in June 2016

Results:

- partial control of the border flow,
- significant reduction of redispatch volume (2 vs 25 MEUR HY1 vs HY2 2016),
- increased transfer capacities on Polish synchronous border,
- congestions moved:
  - to DE/CZ border (unscheduled flows),
  - within DE (internal flows)
  - to DE/AT border (scheduled exchange).

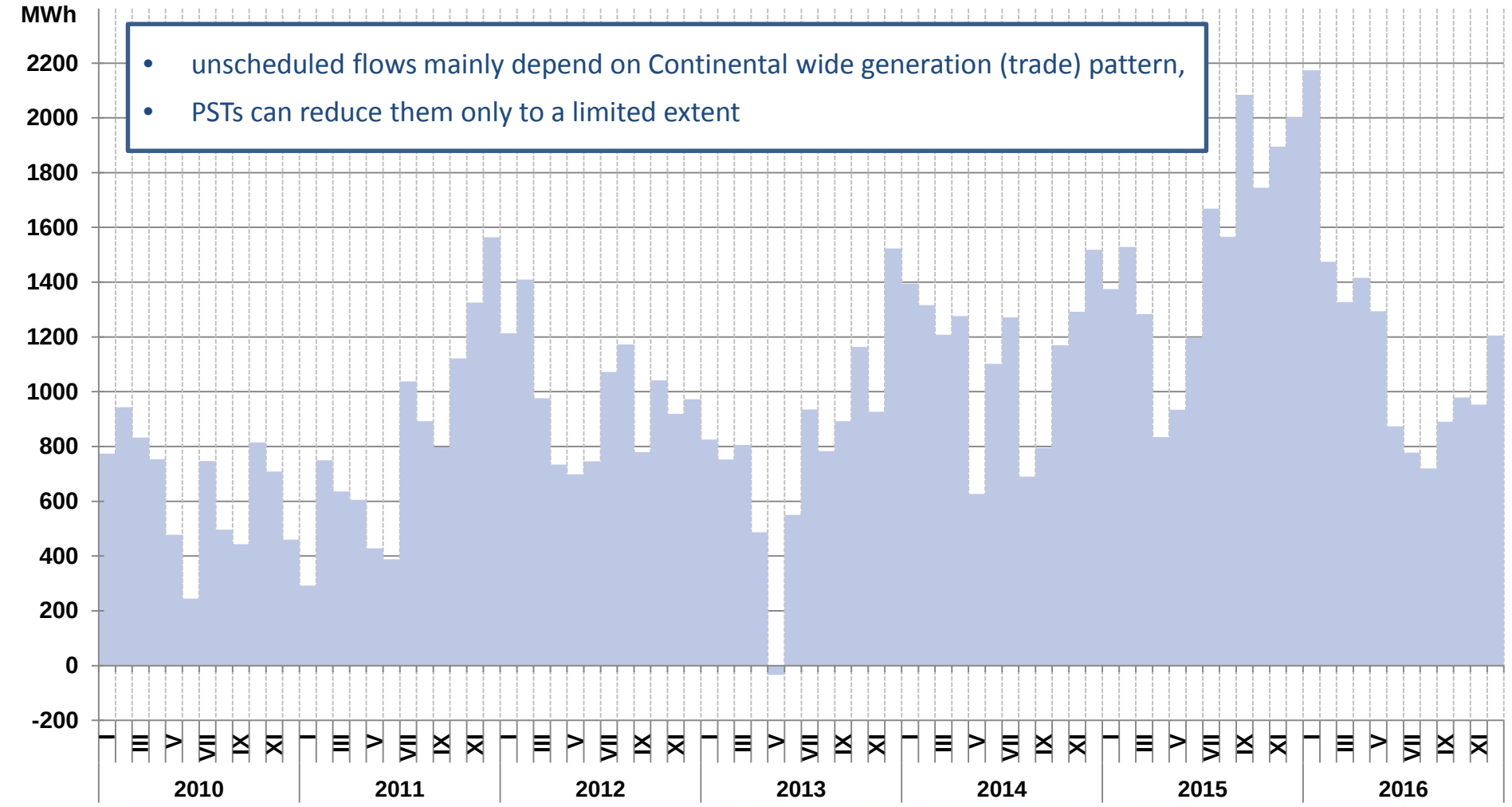


Forthcoming PSTs in the neighbourhood



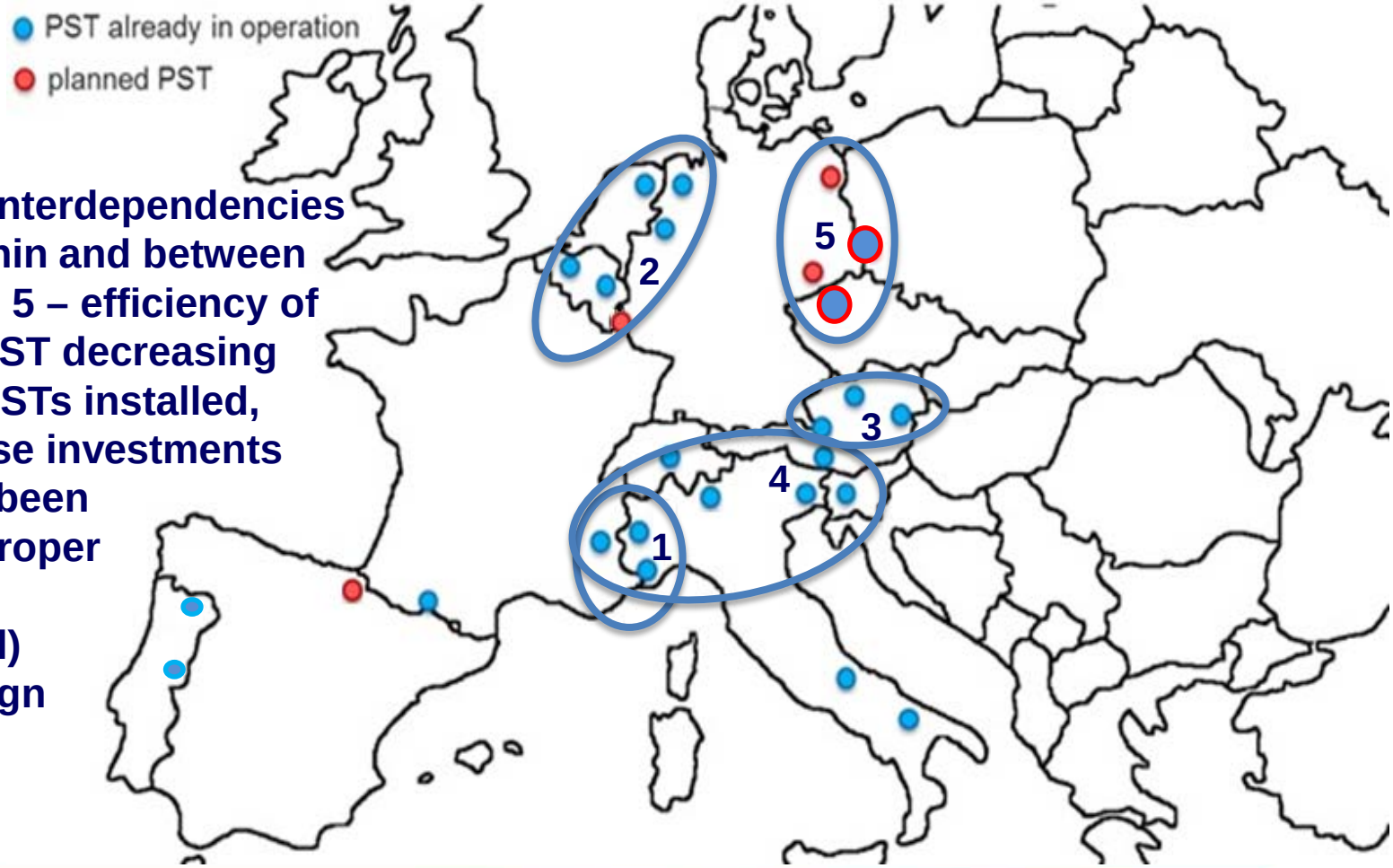
- coordinated use of PSTs necessary from the very beginning,
- coordination of all remedial actions, including redispatch required:
  - the option of replacing PST by redispatch actions,
  - thus redispatch cost sharing issue involved,
- the more PSTs installed the more complex it is,
- ultimate solution: regional (Continental) wide coordination also at the stage of capacity calculation (root cause of unscheduled flows).

Average monthly unscheduled flows on DE/PL border (eastwards)



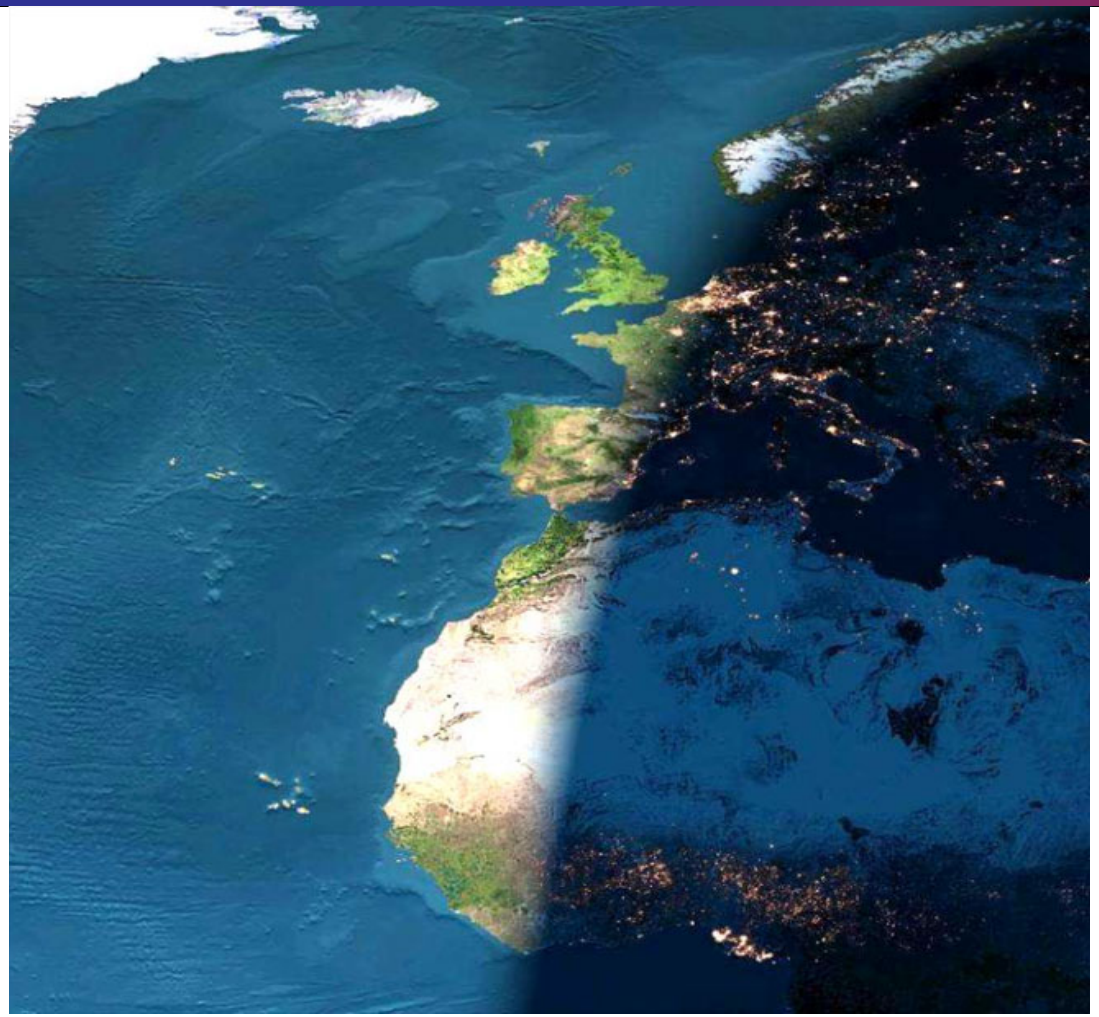
PSTs within the Continental interconnection
(Mikułowa and Hradec PSTs were the 22nd and 23rd ones on the Continent and form the 5th „PST region”)

- increasing interdependencies of PSTs within and between regions 1 to 5 – efficiency of individual PST decreasing with no of PSTs installed,
- most of these investments could have been avoided if proper regional (Continental) market design is in place.



Main features of proper market design

- correct market prices necessary to effecively operate power systems:
  - correct prices as the only means for coordinated control in the whole interconnected power system,
  - sufficient locational resolution of prices allows to send right signals to all market participants and result in market outcomes consistent with power system needs,
  - sufficiently short time resolution allows to recognize dynamics necessary to accomodate volatility caused by intermittent renewables,
- LMP (nodal) market design supports all of the above,
- under zonal market design FBA can be treated as a surrogate to cope with locational aspects at interconnection level,
- need to complement energy market with a capacity related commodity at least during the transformation period:
  - capacity market is a market based way to correctly renumerate the service provided by generation for the overall security of supply,



Thanks for your attention

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