GRID CONGESTIONS IN CENTRAL EUROPE: ISSUES AND CONSEQUENCES IN AND AROUND GERMANY

Hydrobalance User meeting
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SUMMARY

1. CONTEXT OF GERMAN POWER SYSTEM

2. PROBLEMS AND CONSEQUENCES OF GRID CONGESTIONS AROUND GERMANY

3. WHICH SOLUTIONS?
CONTEXT OF GERMAN POWER SYSTEM
GERMANY HAS A HIGH COMPETITIVE ELECTRICITY MIX

A huge evolution in production mix since 2004:
- Increase of intermittent RES production (2012-2013: +12%).
- Nuclear phase-out since 2011 (Fukushima).
- Increase of coal and lignite production because of low CO2 and coal prices.

- Decrease of electricity consumption since 2008 (economic crisis, energy efficiency?).
- Increase of German export since 2003 (2013: 34 TWh).

Source: AGEB
Most of **low cost production** (wind power, lignite, coal) is located in the **North**, whereas **most expensive production** (gas) and high rate of **demand** are located in the **South**.

The imbalance should increase by 2020 with the planned nuclear phase out.
PROBLEMS AND CONSEQUENCES OF GRID CONGESTIONS AROUND GERMANY
GERMAN INTERNAL GRID IS ALREADY UNDER STRESS

- TSOs are required to take **more and more redispatch measures** in order to prevent congestions of power lines, infringements of (n-1) criterion or voltage collapse.

  2011 – 2012: increase of 42% (7160 h vs. 5030 h, i.e. 2.6 TWh in 2012). Most affected areas = 50 Hz and TenneT control areas.

- In addition, **network operators operate RES curtailments**: 385 GWh in 2012 (milder conditions reported to 2011). 93% wind power plants, 4% PV installations, only 2% on transmission network.

**Main elements affected by electricity-related redispatch in Germany - 2012**

**Figure 2**: Electricity-related redispatch measures on the most strongly affected network elements in 2012 as notified by TSOs. Source: Own graph based on EnerIA CI.
German power trade exports have hugely increased since 2011, because of a more competitive production mix.

- Germany mostly exports to Austria, the Netherlands and France.

But …
**GERMAN POWER TRADE EXPORT POSSIBILITIES ARE MORE AND MORE LIMITED BY THE GRID**

- **Export transmission capacities with FR and NL:**
  - *Decrease when German wind power production is important,*
  - *Increase when German solar production is important.*

- **Consequence:** cross border capacities with FR and NL are more and more frequently *saturated* (high correlation with german wind power production). Then *German export possibilities can be reduced* (saturation DE→FR : 30% (2012), 41% (2013)).

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Source: Internal study – EDF R&D 2014
UNSCHEDULED POWER FLOWS: DEFINITION

Difference between scheduled flows (cross zonal commercial schedules or intra-zonal exchange) and physical flows caused by 1st Kirchhoff law

Unscheduled flows: • internal or • external … divided in 2 types:

- Loop flows:
  Physical flows occurring in external control areas caused by origin and destination of a scheduled flow within one control area (intra-zonal exchange). This is not related with cross zonal commercial schedules.

- Transit flows:
  Physical flows stemming from a scheduled flow between 2 adjacent control areas or bidding zones, but occurring in other external control areas.

Source: THEMA report 2013-36, October 2013, p 8
PHYSICAL FLOWS ALSO HAVE AN IMPACT ON GERMANY NEIGHBOURS

The inadequacy between the localizations of German production and consumption, and the current grid structure/topology in Central Europe bring about important loop flows (mainly in Poland and Czech Republic).

- Import/export commercial schedules and physical flows are in the opposite side on French and Polish borders.

- Consequence: German and Polish TSOs have to reduce transmission capacities (NTC) on DE-PL border (NTC = 0 MW very often).

**Monthly average NTC DE → PL (MW) – 2009-2012**
WHICH SOLUTIONS?
SHORT-TERM SOLUTIONS FOR DE-PL BORDER

- **Inter-TSOs cooperation** allows (by using curative actions) to limit the danger on SoS but is insufficient:

  First alerts to reach secure limits (N-1) between DE and PL because of unplanned power flows.

  - « HVDC reschudeling »: simultaneous change of schedules on 2 HVDC links to deload DE-PL border (depending on availability of capacity of HVDC cables).

  - « HVDC reschudeling »:

  - Multilateral redispatch with TSC TSOs (PL, CZ, AT etc.)

  - Bilateral (DE – PL) cross-border redispatch with a 50/50 cost sharing.

- Inefficiency of operational measures in certain situations ⇒ PSE plan to install Phase Shift Transformers (PST) in DE-PL border by 2016 / 2017.

- As physical PSTs are not expected before 2016/2017, 50 Hz and PSE agreed to implement a **special cross-border redipatch regime** aiming at limiting unplanned cross border power flows between DE and PL: **virtual PST (vPST).**

- Objective of vPST: by using coordinate redispatch measures, limit physical flows (DE→PL) and increase NTC DE → PL (+52% during pilot phase) and thus commercial power trades, without reaching over secure limits.

Source: Report on vPST pilot phase experience (Avril 2014)
GRID DEVELOPMENT SUFFERS FROM DELAYS

- **EnLAG law 2009**: Power grid expansion act to speed-up the installation of extra high-voltage power lines in order to secure future supplies in Germany (growing share of RES).

- 23 projects, 1855 km of new routes, initially aims at being completed in 2015.

- Today (2nd quarter 2014): 416 km completed (22%), 50% planned in 2016. Delays are due to public opposition and administrative approval procedures.

- Delays can endanger security of supply: example of Thuringian power bridge (project n°4), probably commissioned in 2017, whereas Grafenrheinfeld nuclear power plant should phase out before in May 2015 \(\rightarrow\) higher risk for SoS in Bavaria.
The grid developments allow to reduce congestions on North/South lines, mainly between TenneT and 50 Hz TSOs areas. Some congestions remain in the surroundings of the border with NL (interest for DC corridors development ?)
The national grid developments in Germany allow to decrease structural congestions (mainly because of security criterion N-1), which imply an increase of possible export mainly to the North and the East of the country (strong wind generation).

If the grid developments are not realized, the transmission capacities of Germany towards Eastern and Northern countries are strongly reduced.

Source: EDF R&D study (2012)
Unique ten-year onshore network development plans are produced every year since 2013. Federal Requirements Plan Act are then voted every 3 years (first one in 2013 from NEP 2012) to speed-up priority projects.

Scenarios (2023 / 2033) are developed by TSOs, with considering more or less RES development. Sc. B is considered as the main one by TSOs and BNetzA.

Main projects: development of 3 HVDC corridors by 2023 in order to reduce the imbalance North-South → best solution to reduce loop flows. But: public opposition, in particular with corridor D (Green-Washing → increase the use of lignite production instead of RES ?).
Thank you