NRP 70 Electricity supply

Hybrid AC/DC overhead lines in Switzerland

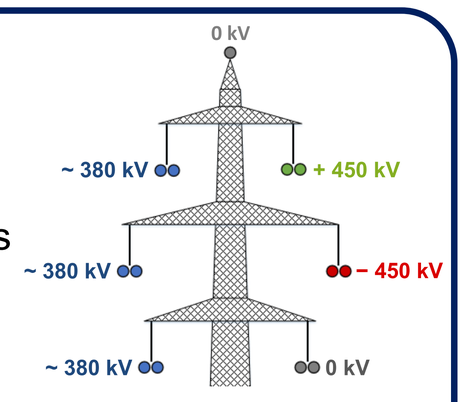
Overview

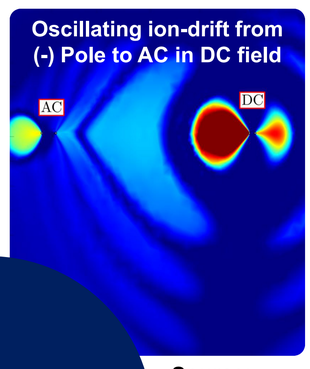
Motivation for hybrid AC/DC overhead lines

- HVDC overhead lines can be operated at increased transmission capacities compared to conventional AC systems due to higher voltages, the lack of skin effect and reactive power and offer high flexibility [Bahrman & Johnson 2007]
- In contrast to the support of renewables and the energy transition public acceptance for new overhead lines, as needed for long distance transmission, is low [Cain & Nelson 2013]
- Converting conventional AC overhead lines to hybrid AC/DC transmission using existing towers and conductors could increase capacity by up to 220 % [Straumann & Franck 2011]
- Assuming high acceptance due to low visual impact, change in benefit and environmental impact are to be investigated

Technology of Hybrid AC/DC towers

- Possible transmission capacity increase?
- Need of new insulators for 'hybrid' fields?
- Would tower support additional conductors or split of AC-bundles?
- Which corona effects to be expected?





Source: Guillod 2013

Hybrid coupling and corona effects

- How does ion drift increase ground electric field?
- Saturation of transformer for coupled currents?
- Will corona noise increase due to field offset?
- Compaction of tower for magnetic field criterion?
- Optimized conductor placement compromise?

Acceptance of hybrid lines

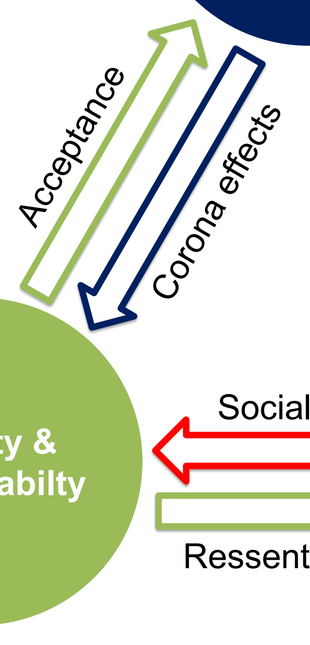
- What are possible reasons for ressentiments against new high voltage overhead lines?
- How important is visual impact and technical modifications ?
- Is local acceptance lower than general acceptance? ('NIMBY')
- Importance of grid extension for the energy transition?
- Benefit over risk perception?

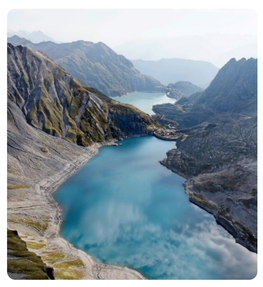
Source: axpo.ch

Integration of DC in AC grid

- In which corridors are hybrid lines most beneficial?
- How to control and react in case of 'hybrid' faults?
- Impacts of converter on AC?

Source: swissgrid.ch





Economic benefits

- How could hybrid lines reduce bottlenecks?
- Could pump storages profit from cheap wind?

Source: IWS/Nant de Drance

Partners and Collaboration

System operators

- Load flow & short circuits
- Economic assessment

Manufacturers

- Grid protection & fault reaction
- Outdoor insulation systems

Testing institutes

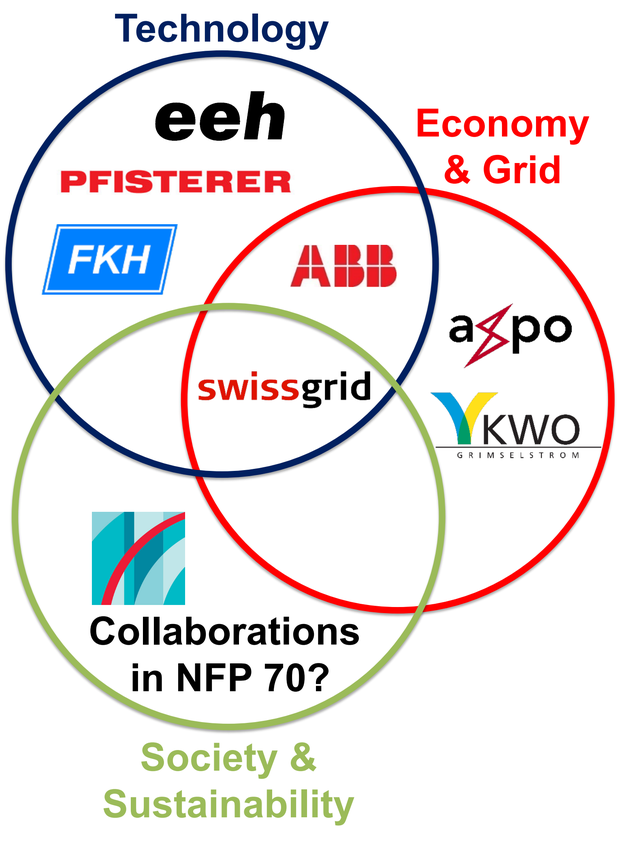
- Outdoor testing of HV-devices

Power generation

- Operation of pump-storages

Social sciences

- Behavior & acceptance studies



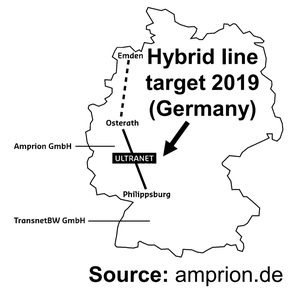
Energy Turnaround

Grid extension & energy efficiency

- Due to growth of population, electric vehicles and new consumer electronics energy consumption increase expected [Prognos 2012]
- Larger renewable energy sources as well as major storage sites to smoothen fluctuations are expected away from urban and industrial load centres [Energiestrategie 2050]
- Hybrid transmission could accelerate planning periods for the grid extension and transmit with higher energy efficiency than AC lines
- As step to a European Supergrid hybrid lines could reduce frontier bottlenecks for wind power imports and increase grid stabilty

Integration of renewables

- Low loss transmission over large distances permits integration of diverse renewable sites
- Reducing the need of new lines, public support of the energy turnaround might increase



Source: amprion.de

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