hybrid-VPP4DSO:

Providing flexibility from distributed resources under consideration of the needs of the DSO

Project overview

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Introduction to hybrid-VPP4DSO

Hybrid operation of a VPP:

- hybridVPP: Market participation AND active grid support ⇒ Synergies
- Focus on provision of ancillary services to the TSO by resources located inside distribution grids with significant restrictions

Simulation and Proof-of-concept of the hybrid-VPP

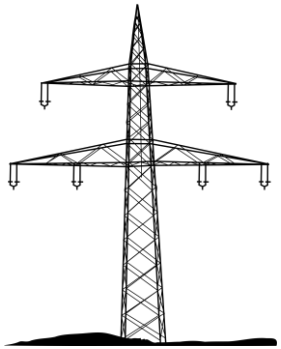
- in two distribution grid sections in Austria and Slovenia
- Grid sections with diverse characteristics (urban/rural, feed-in from windpower/PV/hydropower vs. flexible loads, different topologies, etc.)

Consortium

- AIT (Lead, research), cyberGRID (IT, market analysis), Energienetze Steiermark (DSO), Energie Steiermark (Trader), Elektro Ljubljana (DSO), Elektro Energia (Trader), Grazer Energieagentur (Consulting), TU Wien (research), Energetic Solutions (Consulting)

Duration: 04/2014 – 06/2017

The idea of hybrid-VPP concept



HYBRID VPP4DSO

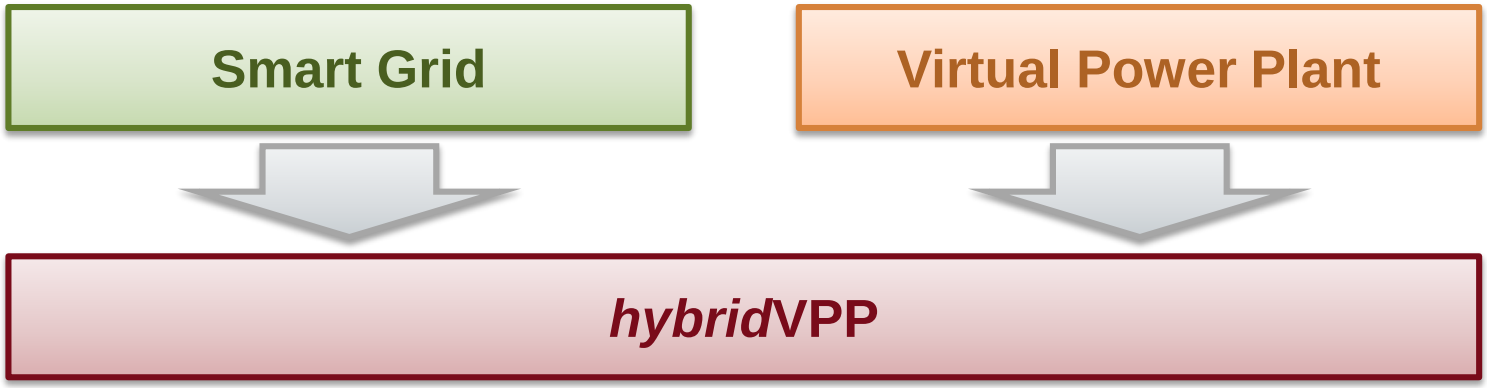
Borzen eex

SOUTH POOL EXAA Energy Exchange Austria

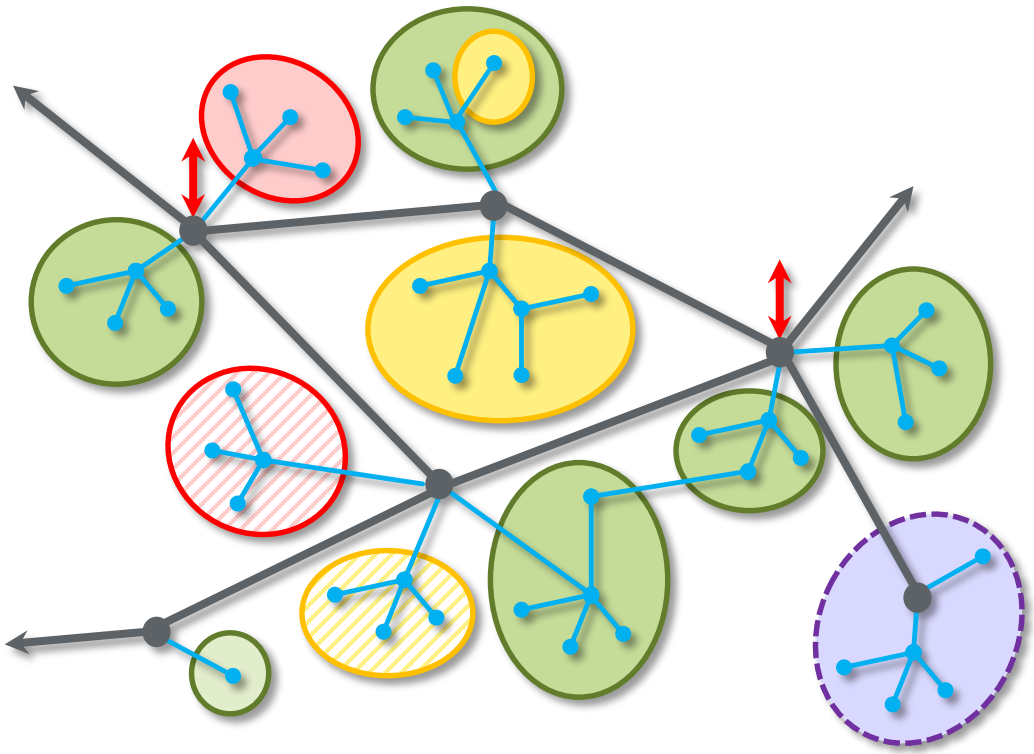
EPEX SPOT EUROPEAN POWER EXCHANGE

Benefits of a hybrid-VPP concept

- Combination of virtual power plant and smart grid applications
- **Synergies** by multiple use of infrastructure
- **Additional revenues** for virtual power plants
- **Reduced amortization period**, improved economic feasibility
- **Faster integration of new renewable generators** into the distribution grid
- **Reduced connection costs for generators**
- **Improved cooperation** between generators, traders and the DSO
- **Reduced costs for infrastructure development, increased stability**



hybrid-VPP concept



Noncritical:
VPP operation P↕ permitted

Semi-critical:
only P↓ permitted

Critical:
P↓ required by DSO

Semi-critical:
only P↑ permitted

Critical:
P↑ required by DSO

Highly critical:
VPP operation prohibited

MV grid

HV grid

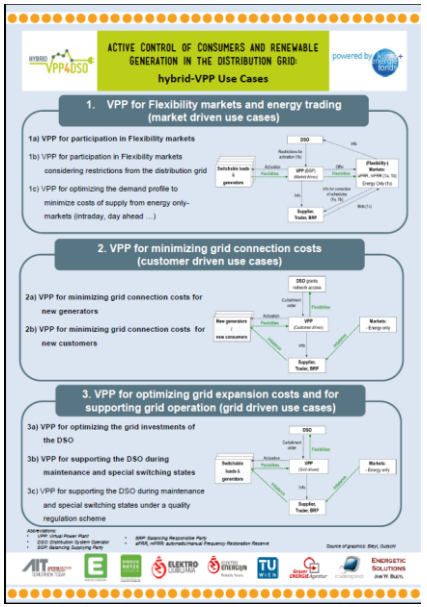
HV connection to neighboring HV grid

Transformer to transmission grid

Overview about the use cases

- Market (VPP) driven use cases
  - (1a) Participation in Flexibility markets
  - (1b) Participation in Flexibility markets considering restrictions from distr. grid
  - (1c) Optimization of demand profiles to minimize costs of supply from energy only-markets (intraday, day ahead …)
- Customer driven use cases
  - (2a) Minimization of grid connection costs for new generators
  - (2b) Minimization of grid connection costs for new consumers
- Grid (DSO) driven use cases
  - (3a) Optimization of grid investments of DSO
  - (3b) Support of DSO during maintenance and special switching states
  - (3c) Support of DSO during maintenance and special switching states under a quality regulation scheme

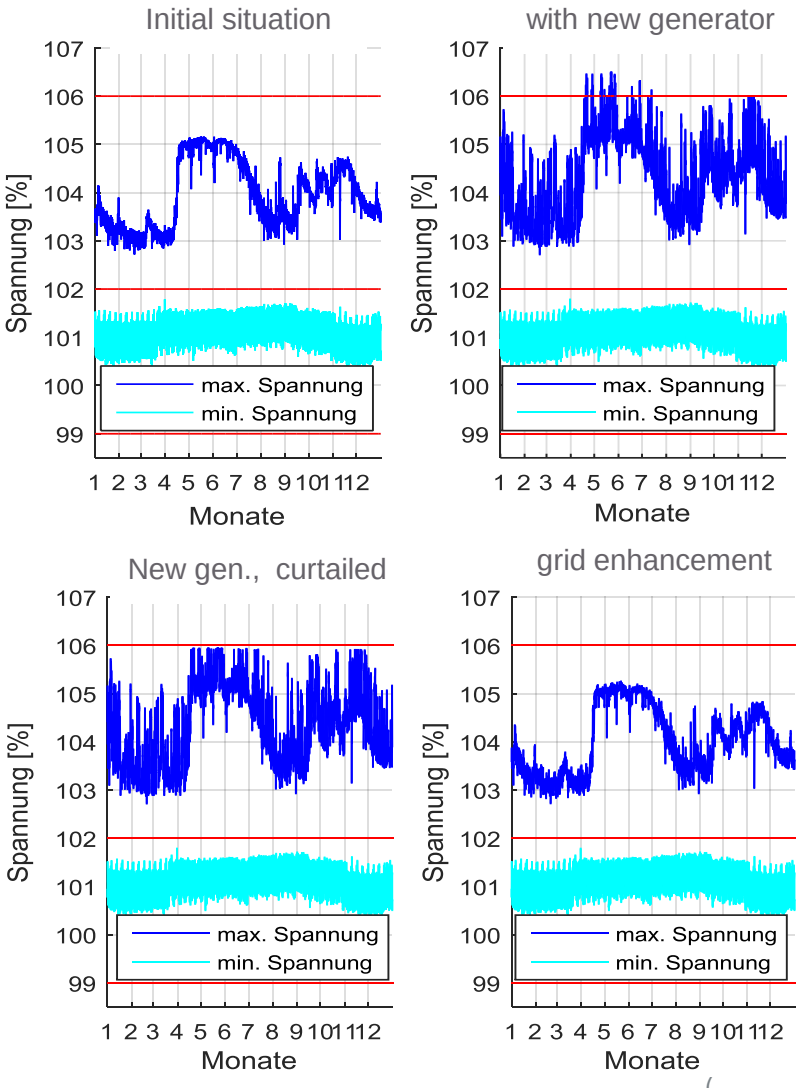
see Poster & Handout



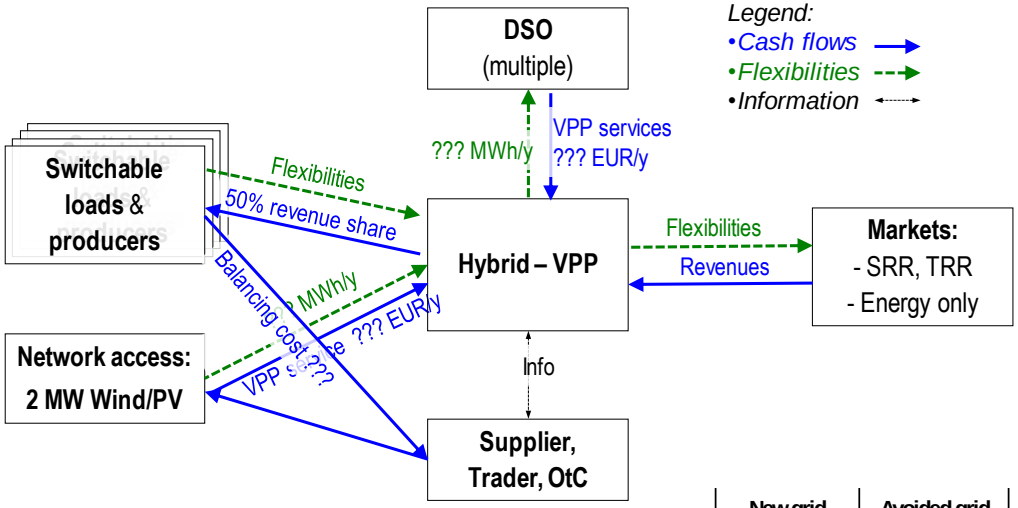
Grid Simulations for conventional and hybrid approaches

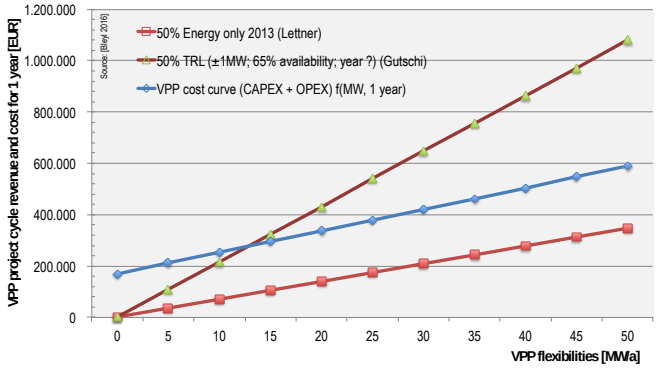
Minimizing costs for grid connection

- New windpower plant should be connected to section in the distribution grid with temporary overvoltage problems
- „conventional“ *approach:*
  new customer must pay all required investment for grid enhancement (new infrastructure)
- „hybrid-VPP“ *approach:*
  customer agrees to be curtailed during critical hours
- Economic assessment indicates that hybrid-VPP approach is much favorable



Business models and economic feasibility

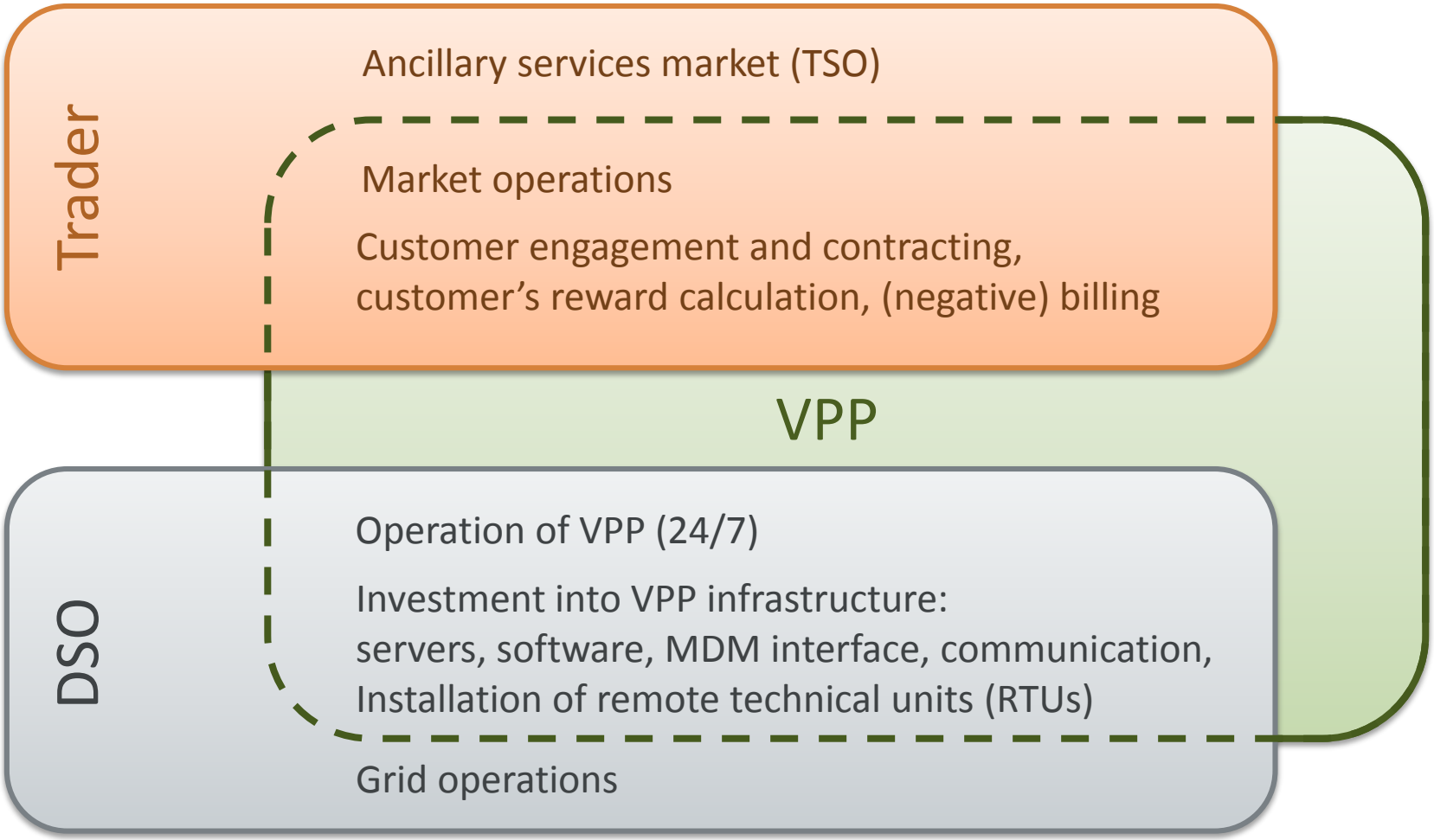




unit	New grid connection (Reference)	Avoided grid connection (w. VPP)	VPP (network-driven)	DSO	Supplier, Trader	Markets
Revenues / Benefits . .	**0** (1 - 3,3 T.EUR/y)	**- 3,1 - 10,4 T.EUR/y** (lost revenues)	**??? EUR/y/MW** (VPP services; additional)	**incentive regulation => higher RoI**	**Customer relationship**	-
Cost	**0** (220 T.EUR) **0** (0,5%/y maint. cost)	**- 220 T.EUR** (avoided cost) **- 0,5%/y** (avoided maint. cost) **??? EUR/y/MW** (VPP service price)				
Profit/Loss (10 years) **T.EUR**	0	**116 - 189**	**++**	**+**		not involved
KPI: **Payback** (static) **years**	**21 - 71**					

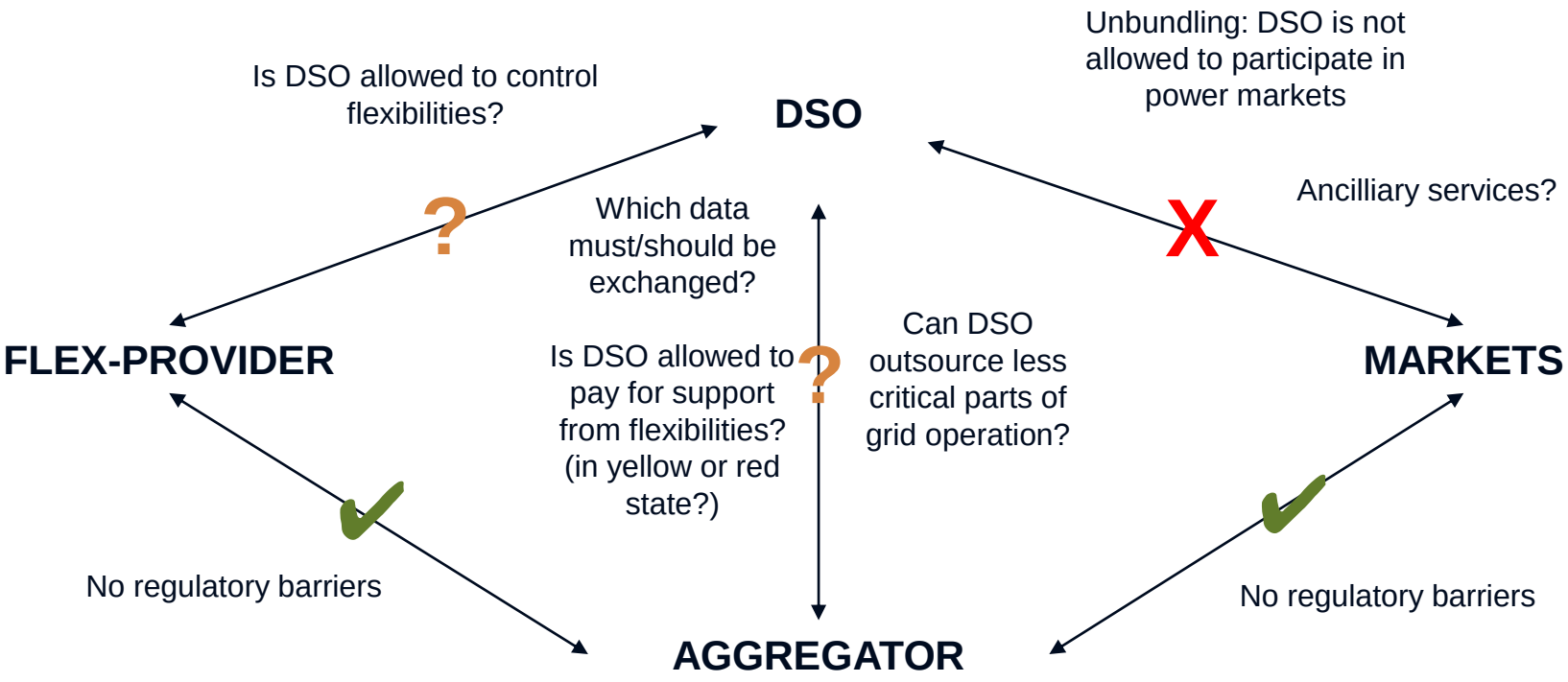
New Roles?

Trading company procures VPP services from DSO.



DSO offers VPP services to power traders.

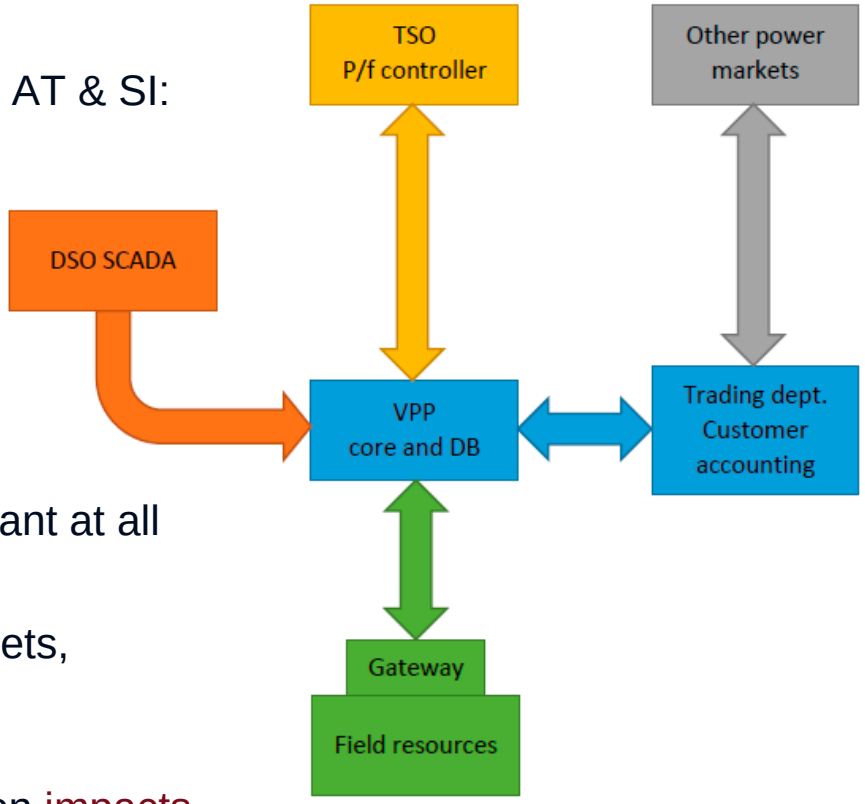
Legal and regulatory framework: Adaption needed?



Security analysis

- Examined the threats for the sub-systems in AT & SI:
  - Field resources – VPP
  - TSO – VPP
  - DSO – VPP
  - Trading Dept. – VPP
  - VPP
- 3 threat levels identified, with justification:

  Highly relevant, Some relevance, Not relevant at all
- Different classes of threats considered
  - Physical attac, Outages, Loss of IT assets, Failures, Accidents, Interception, Reconnaissance, Abuse
- Most relevant threads are identified based on impacts and likelihood
- Countermeasures/controls for most relevant threads are considered in the architecture proposal.



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