FLEXIBILITY FOR MARKETS AND GRIDS

Economic and Technical Evaluation of the hybrid-VPP Concept

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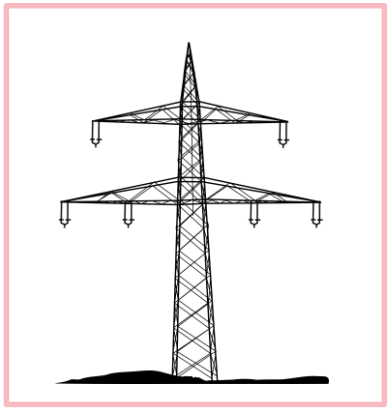
IAEE 2017, Vienna, 5. September 2016

HYBRID-VPP CONCEPT



Distribution grid

HYBRID VPP4DSO

Flexibility

Market

AGENDA

1. Project overview
2. Use case description
3. Use case Market & Customer
4. Use Case Market & DSO support
5. Analysis of regulatory framework
6. Conclusions of hybrid-VPP concept
7. Outlook: InteGrid project

INTRODUCTION TO HYBRID-VPP4DSO

Hybrid operation of a VPP

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

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

- 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)

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Duration: 04/2014 – 06/2017

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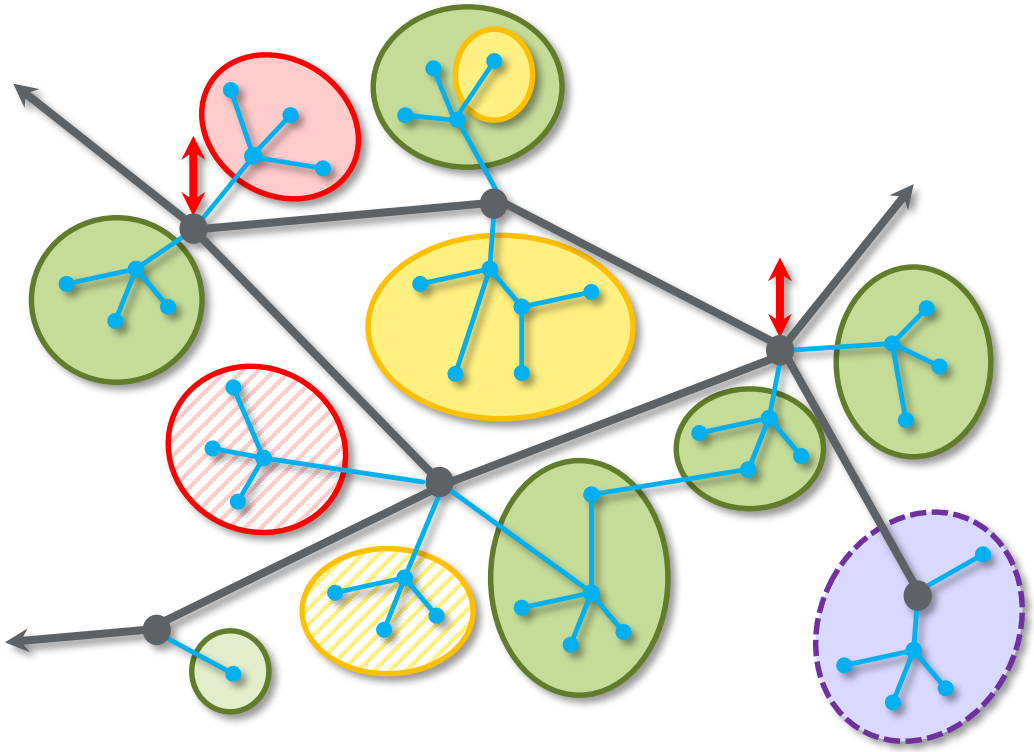


Noncritical:
VPP operation P↕ permitted

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 OF USE CASES FOR FLEXIBILITY

Market	• (1a) Participation in flexibility markets • (1b) Participation in flexibility markets with restrictions from distribution grid • (1c) Cost minimization of supply from energy only markets (day ahead, intraday)
Customer	• (2a) Minimization of grid connection costs for new generators • (2b) Minimization of grid connection costs for new consumers
Grid (DSO)	• (3a) Optimization of grid investments of DSO • (3b) DSO-Support during maintenance and special switching states in case of a quality regulation scheme

USE CASE “MARKET & CUSTOMER”

Participation of VPP on the Tertiary Balancing Market and Minimization of grid connection costs for new generators in parallel

New customer (wind park) applies for connection to the grid at an under-dimensioned connection point.

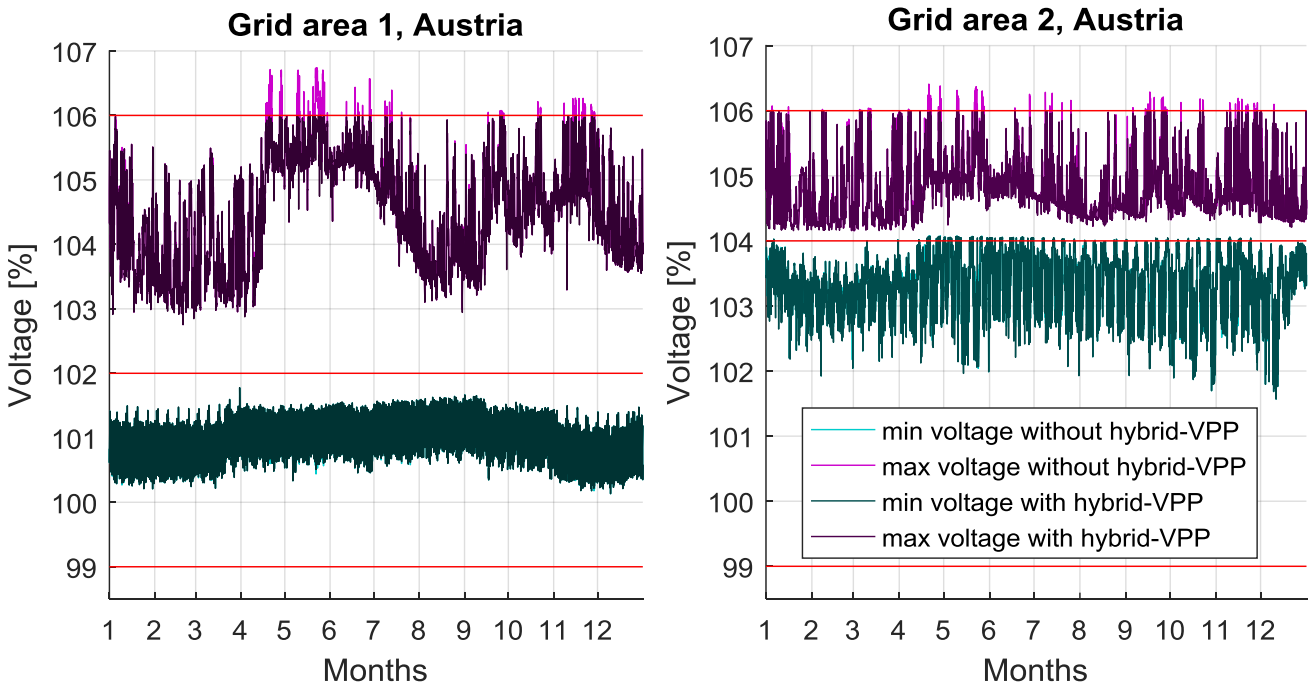
Classic approach:
Customer needs to invest into a new line to the closest feasible connection point or bear costs of grid reinforcement.

Hybrid-VPP approach:

- Customer agrees to be curtailed during critical hours

⇒ **Cost savings due to lower grid connection costs**

⇒ **Additional benefits of participation in the balancing market**



ECONOMIC EVALUATION OF VPP OPERATION

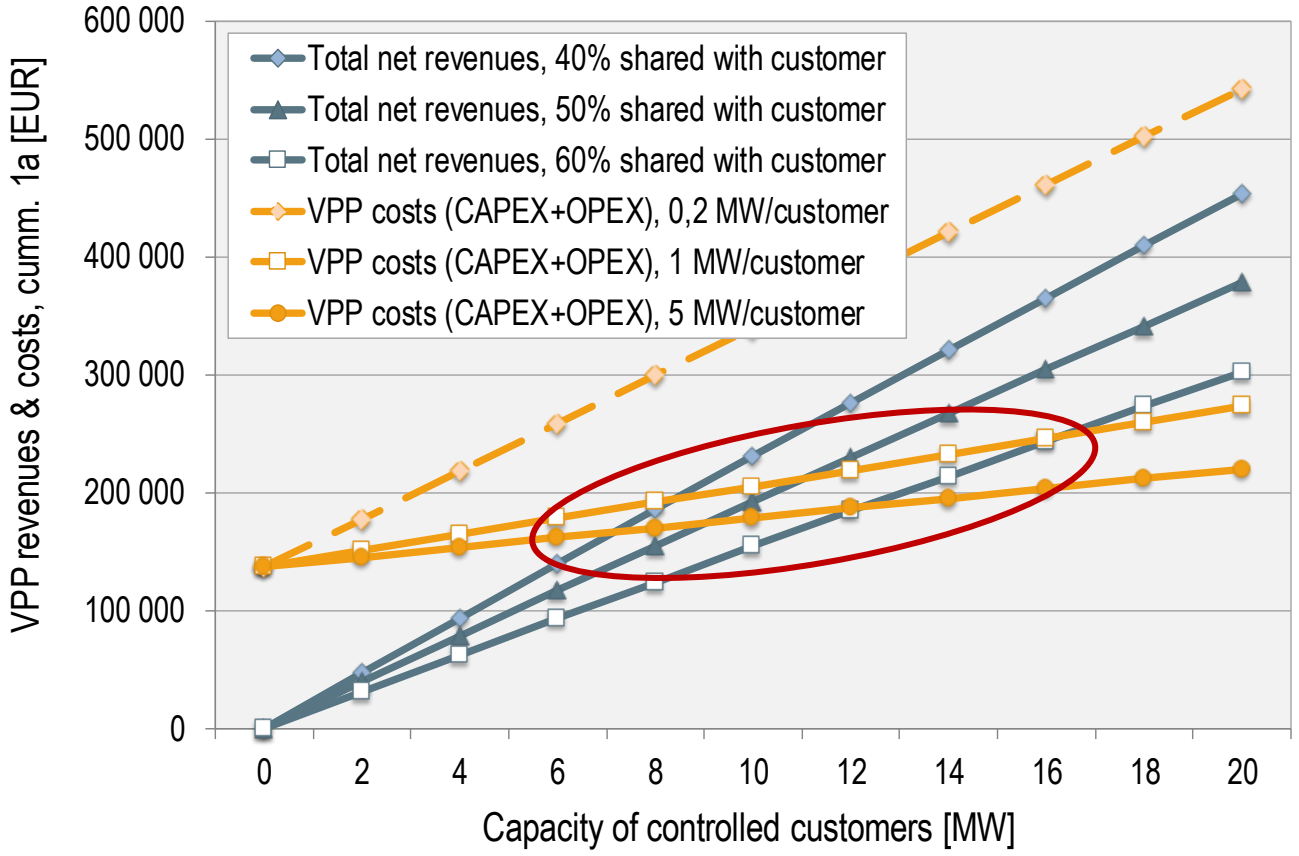
Business Case of VPP:

- CAPEX and OPEX for VPP basically depending on capacity of customers and on availability of 24/7 control room
- Revenues from market participation are difficult to predict (high volatility)

⇒ Positive Business Cases feasible in tertiary balancing market (AT, SI; 2015)

Business Case of hybrid-VPP:

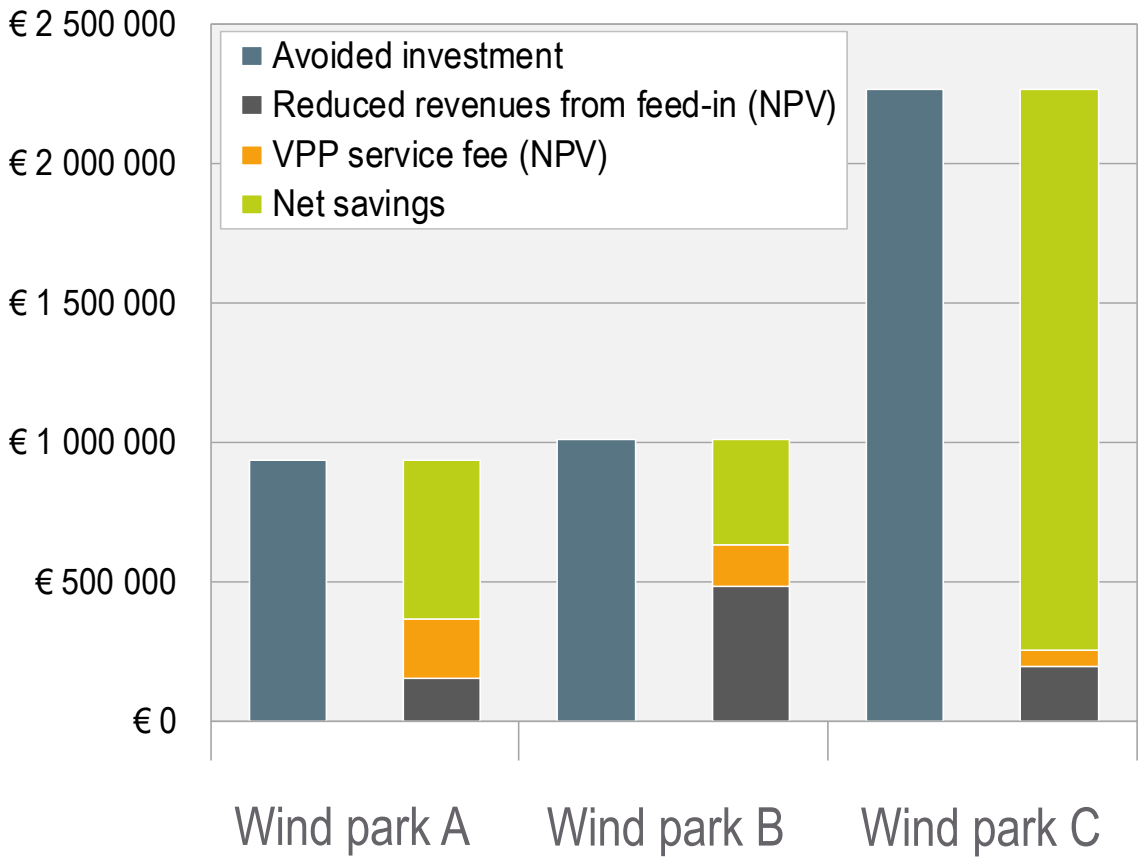
- Additional costs for interface with DSO
- Additional benefits from customer use case
- Difficult regulation for remuneration of grid-supporting flexibility
- Mainly non-financial drivers (customer access)



ECONOMIC EVALUATION OF CUSTOMER USE CASE

Economic evaluation from customers' perspective:

- Customers agree to **curtail their feed-in or consumption** on demand of the DSO during critical hours. Use case is strongly dependent on grid topology and value of curtailed feed-in (or consumption).
- Simulations showed a duration of required **curtailment of maximum 300 h/a**.
- **Substantial savings** are possible especially for new generators.
- In our case study for an industrial customer the costs of shifted load should not exceed 42 €/MWh to be economically feasible (also highly dependent on grid typology, etc.).



USE CASE “MARKET & DSO” (A)

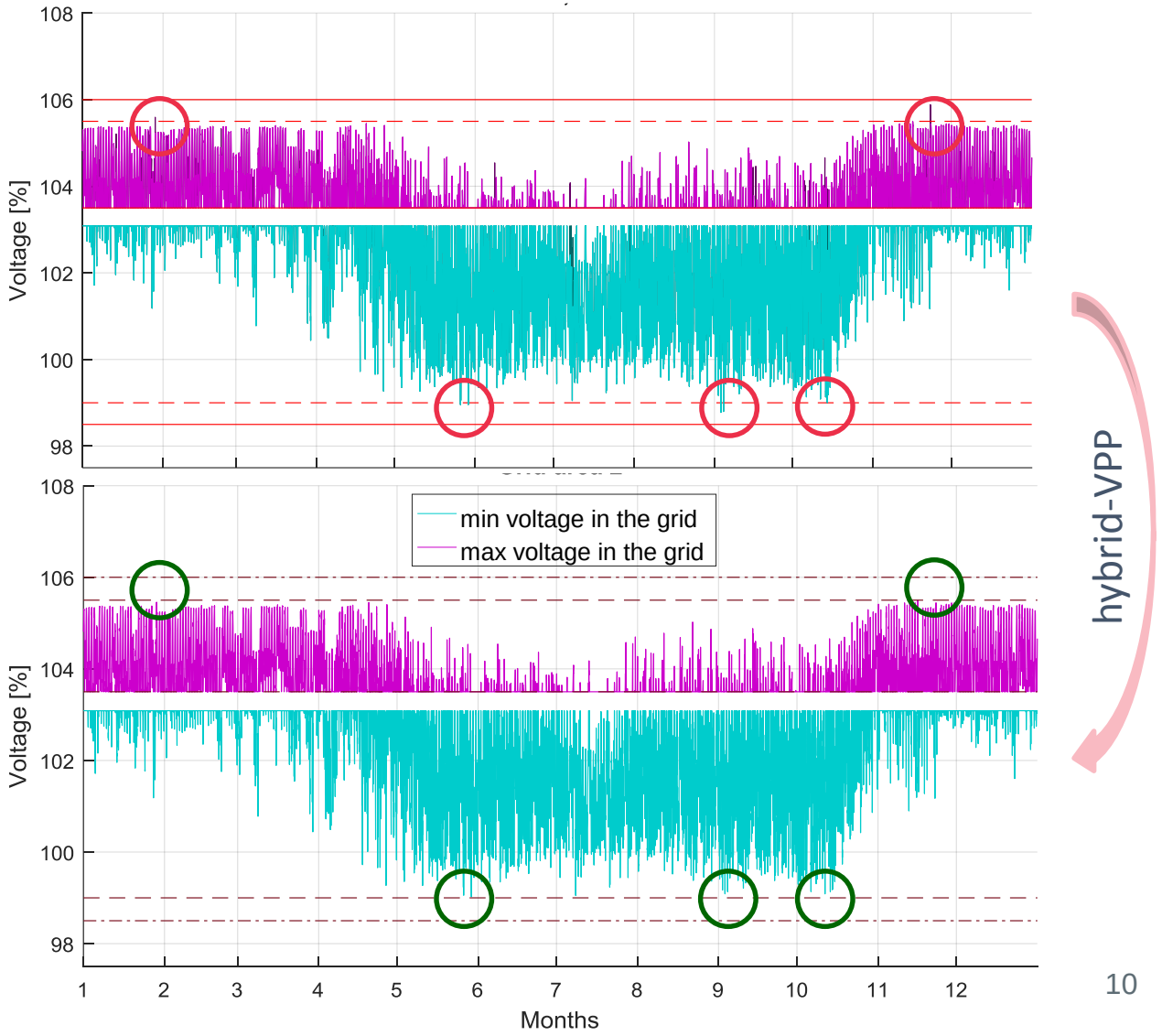
Optimization of DSO’s grid investments & Participation in Tertiary Balancing Market

Over voltage issues in winter due to market participation of VPP

Under voltage issue in summer due to delayed grid investments

⇒ **Issues caused by ancillary service provision being avoided**

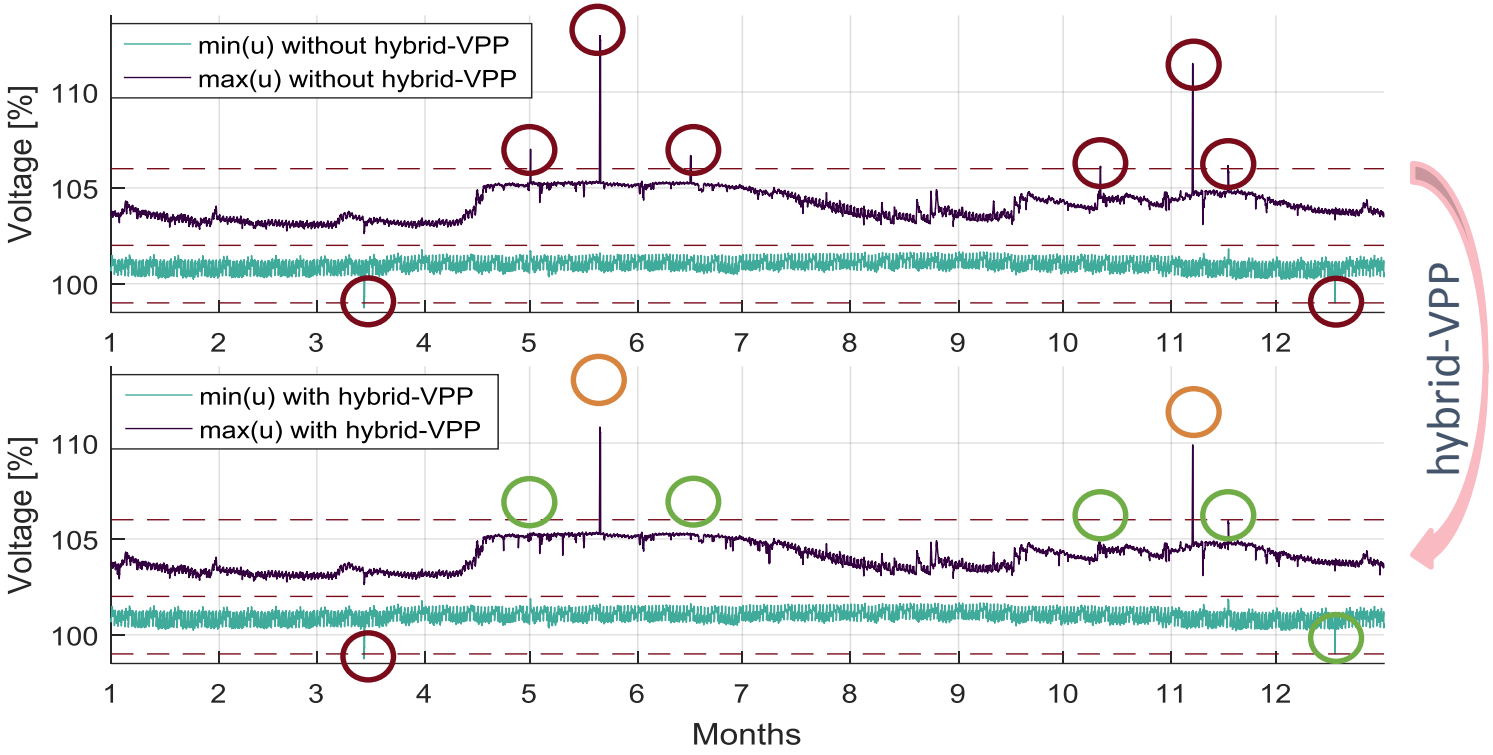
⇒ **All voltage issues could be solved by applying the traffic light system**



USE CASE “MARKET & DSO” (B)

Supporting of DSO during maintenance and special switching states + Participation in Tertiary Balancing Market

hybrid-VPP supports the DSO by reducing voltage problems during special switching states and thus preventing tripping of customers.



⇒ **During non-critical hours, all units of the hybrid-VPP can participate in the balancing market.**

REGULATORY ANALYSIS OF USE CASES

Market

No regulatory issues for pure market partcipation

Customer

Minimization of grid connection costs:
General connection requirement

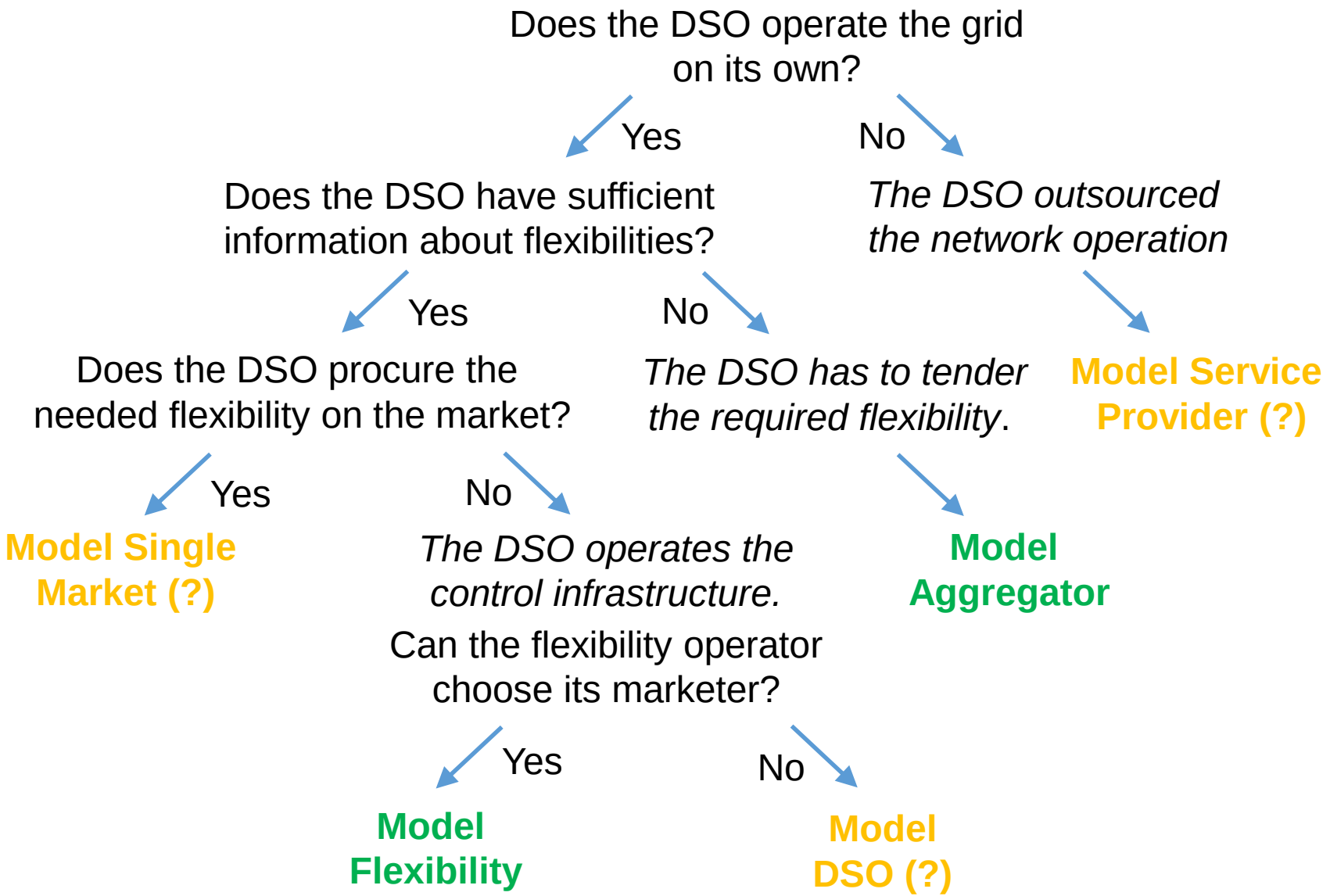
Benefit for network users possible,
but no legal claim

Grid (DSO)

Optimization of grid investment costs:
Highly reliable network infrastructure in Austria,
Short-term benefits of hybrid-VPP for deferral of grid investments

Maintenance and special switching states: exceptional grid state
Quality regulation scheme would create incentives for hybrid-VPP

POSSIBLE COORDINATION SCHEMES



CONCLUSIONS

- **Support of DSOs in parallel to active participation on a national market** for tertiary control feasible
- Recommendation **of diverse pool with units in different locations and include demand side management as well as different types of (renewable) generators** (Applicability of hybrid-VPP depends on grid topology and connection points, capacity and type of available flexibilities)
- Added value of a hybrid-VPP is related to **multitude of different use cases** using the same hybrid-VPP platform (as for example reduction of investment costs for new users who connect to the grid as well as prevention/deferral of grid investments of DSOs)
- **Regulatory barriers** for the integration of the hybrid-VPP for the remuneration of grid-supporting flexibility operation and for the definition of the connection point
- Two promising solutions for the configuration of hybrid-VPP operator: i) aggregator as hybrid-VPP-operator and ii) DSO as market facilitator

This work was funded by the Austrian Research Funding Association (FFG) under the scope of the e!mission program.

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OUTLOOK: H2020 PROJECT INTEGRID

Overview of the InteGrid project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731218.

- **Traffic Light System** as investigated in hybrid-VPP4DSO will be **further developed** in the **InteGrid project.**
- **InteGrid** aims at demonstrating how DSOs can enable different stakeholders to actively participate in the energy market, by testing and validating solutions in an **integrated environment**. Among these tools, the Traffic Light System will be refined in order to comply with multiple markets designs and to reach a higher Technological Readiness Level.
- State of the art **forecasting and optimisation algorithms** (like multi-period Optimal Power Flow) will be integrated to realize the Traffic Light System as a tool for DSOs.
- This concept will be implemented using a **Grid and Market Hub platform** to simplify communication with DSOs and tested by the DSOs Elektro Ljubljana (SI) and EDP Distribuição (PT) in the scope of Pilots of technical and commercial VPPs. This means a further development of the hybrid-VPP coordination scheme “Flexibility”.
- **Scalability and Replicability Analysis** will be performed for several countries

Project Homepage: www.integrid-h2020.eu

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MANY THANKS FOR YOUR KIND ATTENTION!

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