

# **Virtual Power Plants**

**Dr. Ulrich Focken** ESIG, 2019 Meteorology & Market Design for Grid Services Workshop 04. June 2019



## **VPP** as control center for distributed generation and load



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## Agenda

- Overview of our Virtual Power Plant (VPP) Solution
  - Power Trading
  - Regulation Power
  - Demand-Side-Management
  - Assistence for grid operation

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## Trading of wind and solar power: VPP and forecasting



#### **Virtual Power Plant**



## Monitoring of decentralized units: Technical overview





## **Curtailment procedure of VPP**



# VPP generates curtailment schedule for individual plants



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## **Regulation power**

- Assets connected to VPP can supply primary, secondary or tertiary reserve power
- mostly pre-qualification by grid operator required
- VPP has to cover high standards on availability and security
- wind farms often participate



## **Regulation power: tertiary reserve with wind farms**





## **Regulation power: secondary reserve with CHP units**





## **Regulation power: primary reserve with battery**



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## **Assistence for grid operators**

- Grid Operator Control for TenneT
- Remote Controlling of wind farms on substation level





## Assistence for grid operator

- Grid Operator Control for TenneT
- Remote Controlling of wind farms on substation level



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#### **Planning of Redispatch Actions**

**Redispatch** refers to interventions in the generation capacity of power plants in order to protect grid line sections from overload.



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## Implementation of virtual power plants

- Customer has to decide on different concepts
- In-house:
  - VPP software is operated on customer's server
  - Customer has to operate and maintain IT infrastructure
  - Vendor needs remote access for updates and trouble-shooting
  - No need to hand out data to third party
- Service as a Software solution:
  - VPP is used as software-as-a-service ("private cloud")
  - 24/7 support by vendor of VPP
  - No need for own IT infrastructure and operation
  - Data processed by vendor



## Lessons learned

- VPP are very successful to integrate decentralized units into market processes
- VPP is proven technology for monitoring and remote control of many thousands of plants
- VPP will play a key role in the digital energy transition
- VPP need to cover the main business and decision processes of the users
- Technology is not the problem, business models for very small scale has to be discussed
- Still many good concepts to be implemented: e.g. separate basic energy supply and flexibility in tariffs for controllable loads

# Thank you for your attention

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## About energy & meteo systems

### Company



## **Services**



#### Owner-managed since its founding in 2004

- Located in Oldenburg, Germany
- 90 employees (software developers, physicists, meteorologists and industrial engineers)
- Accurate power forecasts for solar, wind and demand
- Market-leading Virtual Power Plant (SaaS)
- Consultancy and R&D



- Transmission, Distribution and Independent System Operators
- Energy trading companies
- Plant operators (IPPs, utilities etc.)



## About energy & meteo systems

#### International business activities



Currently, we are forecasting about 280 GW of wind power and nearly 130 GW of solar power



## **Diverse Customer Base. A Selection.**



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## **Our Virtual Power Plant**

- Market-leading Virtual Power Plant solution
- Supports all standard interfaces
- Software-as-a-Service with 24/7 service
- Customized set-up of VPP by emsys
- Used by internationally leading aggregators such as Statkraft, EnBW, Vattenfall etc.
- Controls high number of assets (more than 1,000)
- More than 50 GW in Germany, Austria, France, UK, Ireland, Netherlands, Belgium, Turkey, Finland, Denmark etc.



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Statkraft and energy & meteo systems – First virtual power plant to integrate renewable power, storage and flexibility assets in the UK

05 03 2019

Londor/Oldenburg, 5 March 2019 – Statkraft, Europe's largest provider of market access services, and energy & meteo systems, a leading provider of forecasting services and virtual power plants are connecting intermittent wind and solar generation with battery storage capacity and flexible gas engines in one virtual power plant in UK. This will help integrating the increasing share of renewable power into the British energy market.

"Our business model in the UK to producers of renewable power involves marketing renewable assess with maximum efficiency – for our patters, but also towards the power market. The idea is to match renewable power production with market demand within seconds," says Duncan Dale, Vice President Sales & New Products of StatAraft in the UK. "The increasing share of renewable energy in the UK will require a maximum of feability in the British power grid. By integrating batteries and engines into the virtual power plant and optimising their operations we can provide this leability relability."



## Managing non-availabilities in VPP

Parent element	Related to	Type of outage	Available capacity	Installed capacity	Valid from	Valid to	reason	Source	Last changed
Wind park 216	Wind park 216	Curtailment	9500	10500	15.03.2019 00:00:00	16.03.2023 00:00:00	Maintanance	VPP client	14.03.2019 15:03:45
Solar power plant 404	Solar power plant 404	Partial shutdown of park or plant	636.53	879	29.08.2018 18:00:00	01.01.2020 00:00:00	Maintanance	VPP client	29.04.2019 17:10:32
Solar power plant 595	Solar power plant 595	Grid or plant shutdown (completely)	0	557	20.06.2018 00:00:00	25.04.2019 15:00:00	Maintanance	Import	25.04.2019 13:50:55
Solar power plant 621	Solar power plant 621	Grid or plant shutdown (completely)	0	600	21.07.2018 00:00:00	03.05.2019 12:00:00	Maintanance	Import	03.05.2019 09:53:29
Solar power plant 673	Solar power plant 673	Grid or plant shutdown (completely)	0	750	21.07.2018 00:00:00	01.01.2020 00:00:00	Maintanance	Import	29.03.2019 10:35:08
Solar power plant 688	Solar power plant 688	Grid or plant shutdown (completely)	0	730	21.07.2018 00:00:00	01.01.2020 00:00:00	Maintanance	Import	29.03.2019 10:32:27
Wind park 744	Wind park 744	Partial shutdown of park or plant	2600	3200	13.03.2019 00:00:00	14.03.2023 00:00:00	Maintanance	VPP client	12.03.2019 17:20:59
Wind park 902	Wind park 902	Curtailment	1300	1500	13.03.2019 00:00:00	14.03.2023 00:00:00	Maintanance	VPP client	12.03.2019 16:21:02
Wind park 1649	Wind park 1649	Partial shutdown of park or plant	1000	3000	05.03.2019 00:00:00	01.01.2020 00:00:00	Maintanance	VPP client	05.03.2019 16:53:04
Solar power plant 1779	Solar power plant 1779	Grid or plant shutdown (completely)	0	165	29.12.2018 00:00:00	01.10.2019 00:00:00	Maintanance	VPP client	28.12.2018 17:06:05
Wind park 2097	Wind park 2097	Curtailment	2000	2400	06.03.2019 00:00:00	01.01.2020 00:00:00	Maintanance	VPP client	05.03.2019 15:19:03
Wind park 2173	Wind park 2173	Curtailment	8200	10000	06.03.2019 00:00:00	01.01.2020 00:00:00	Maintanance	VPP client	05.03.2019 17:02:14
Solar power plant 2244	Solar power plant 2244	Grid or plant shutdown (completely)	0	749.88	28.02.2019 00:00:00	01.01.2020 00:00:00	Maintanance	VPP client	27.02.2019 10:33:17
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## **IT security**

- As soon as relevant share of wind or solar plants is connected, VPP has to be considered as critical infrasructure
- Rules on cyber security are made by national bodies
  - best-practice in IT-security in energy systems with specific requirements
  - but converge to international standards, e.g. between U.S. and Europe
- Key role:
  - Information security management system (ISMS) as framework to establish, monitor and improve processes on cyber security
  - ISMS standards: e.g. ISO27001 or ISO27019
- Growing importance for VPP and stricter rules to be expected!



## **VPP – communication with assets**

Exchange of measurement data and schedules between VPP and plant control unit through save VPN connection





## **Grid Operator Control Room**

#### View of Vertical Grid Load components



#### Selected controllable substation



## **Controllable loads / demand side management**

- Cooled warehouse(s) connected to VPP as controlable load
- Load acts as storage
- VPP used to optimize energy supply and purchase via spot market and regulation market
- Production units such as wind farms and solar plants added
- Also used to minimize impact of forecasting errors





## **Cooled ware house (demand side management)**

Basic idea: load shifting





## Load control: balancing forecasting errors



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## Calculation of trading's open positions in real time mode

Trading Volume

3,500 h

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le Export View Extras Window Help

Trading entries

alancing group EIC: rading interval

rading type:

ortfolio:

Trading

Intraday

PREVIENTO

Sum of all balancing groups

● 15 Minutes ● 30 Minutes ● 60 Minutes

Control Market Information Analysis Cockpit Map

08:52:49



## **Plant control visualization**





## Monitoring of decentralized units: Map overview





## Trading of wind and solar power: VPP and forecasting

Deviations of forecast can be settled on intraday market to reduce balancing costs.





## **Overview availability of measurement data**

Measurement Availabil	lity Measurement A	vailability Chart	MSCONS Availability	MSCONS Assignment	Blacklist	Prequalification	Forecast Evalua	ion Power Re	eduction Analysis				
Parameter													
Deservator													
Parameter													Start
Time Range:	from 28.04.2019 00:00	🔲 to 29.04	4.2019 00:00	Today < > Zoo	m out								Save Results
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	Solar power plant 1030	28											
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	Wind park 925	6								_			
	Solar power plant 1010	07											
	Solar power plant 178	3											
	Solar power plant 200	9											
	Solar power plant 339	02											
	Solar power plant 636	64											
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	Biogas plant 635	54											
	Laufwasserkraftwerk 434	16											
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