

Virtual Power Plants (VPPs) for short term solar/wind power forecast optimizations

Dr. Varun Gaur

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Agenda

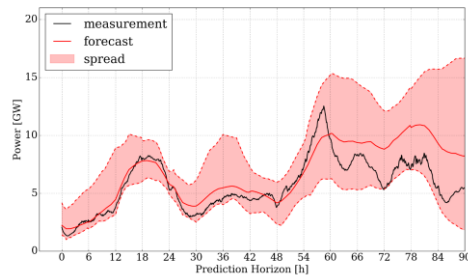
1. Company Profile
2. VPPs and optimization of solar/ wind power forecasts
 - a. Inputs for forecast optimizations (real time data acquisition from power plants, monitoring and validation)
 - b. Combination of power forecasts
 - c. Real time forecast correction based on power plants real time data
 - d. Incorporating the impact of real time field events such as TSO curtailments, park breakdowns, etc.

Company Profile

- Founded in 2004
- Based in Oldenburg, Germany
- 180 employees

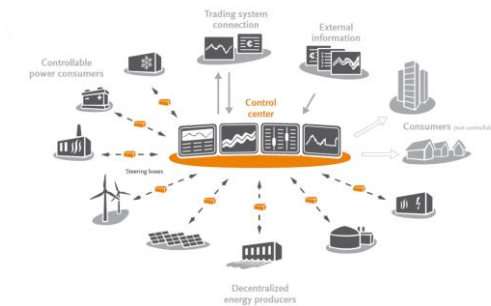


Power Forecasts



- Leading international provider of solar and wind power forecasts (500 GW)
- Single plants, portfolios, balancing areas, markets

Virtual Power Plant



- Digital aggregation of power assets
- Monitoring, remote-control and trading of electricity production
- Market-leading SaaS solution

FuturePowerFlow

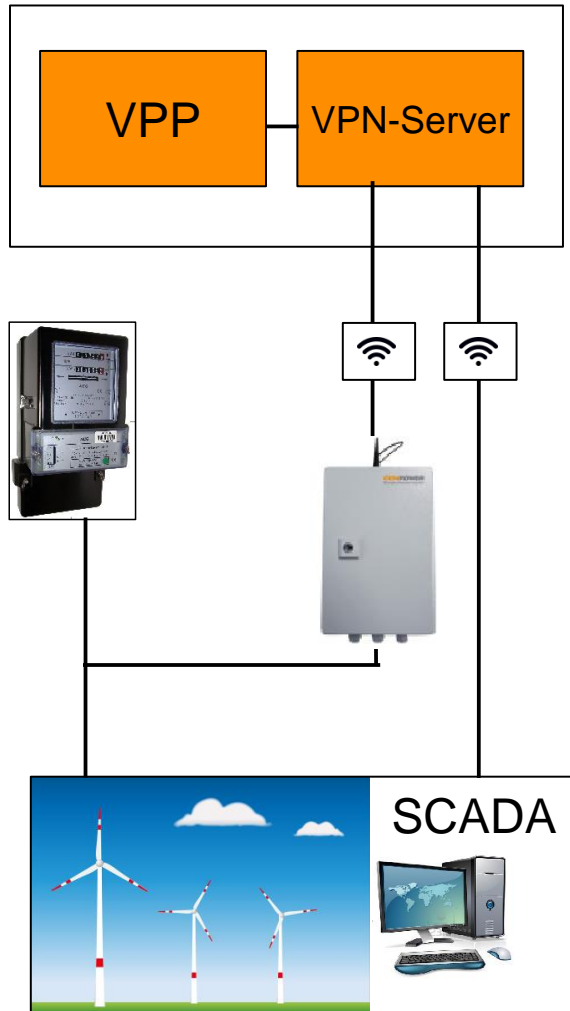


- Forward-looking congestion management

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VPPs- Data collection



Hundreds of different interfaces and protocols like

Interfaces	Protocols
Enercon Vestas Senvion Gamesa Conpower Quantec Scada International EP Grid TeDatCo ...	OPCXML-DA Apache Thrift SOAP Webservice Modbus-TCP IEC 60870-5-104 IEC 61400-25 ...

Standardize all data

VPPs- Data collection

Collecting unavailabilities from different assests of portfolio

- Operator Portal
- API to software system of O&M service provider

The screenshot displays the user interface for managing plant unavailabilities. At the top, there is a navigation bar with links for 'Start', 'Information', 'My Plants', 'Profile', and 'Contact'. The user is logged in as a greyed-out name with a '(logout)' link, and the language is set to 'DE|EN'. Below the navigation bar, there is a search bar with 'SP' and a date range filter set to 'from 3/15/17 to 4/15/17'. A secondary navigation bar includes 'Map', 'Standing Data', 'Non-Availabilities' (highlighted), 'Power Production', 'Schedules', 'Power Curve', and 'Curtailments'. An information icon (i) is followed by a message: 'Please fill in your planned and unplanned plant outages. Automated messages from external systems or manufacturers are also shown here. Please check the messages and update them if necessary.'

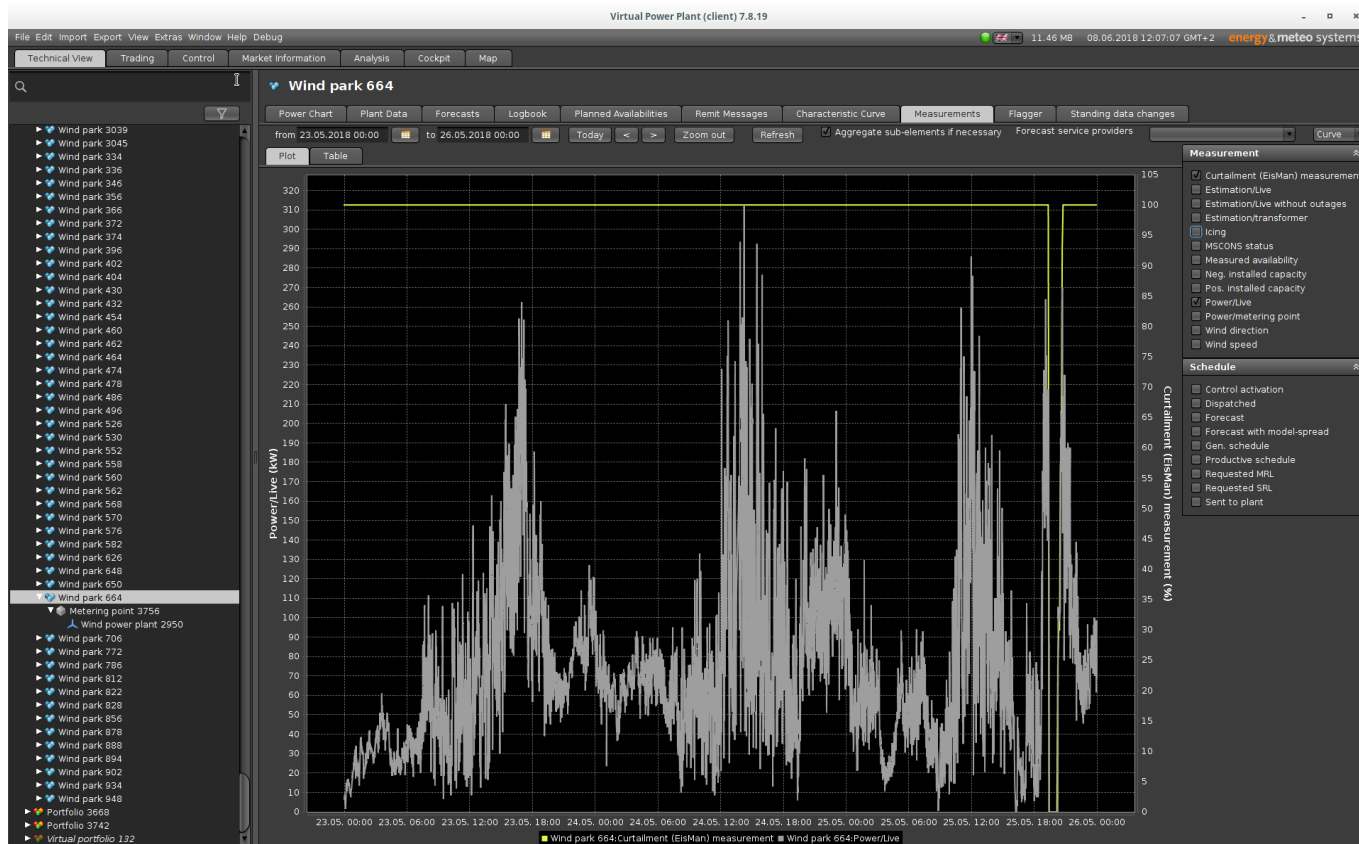
The main content area shows a list of plants. The first plant is 'SF' with a power rating of '(3557 kW) [+]' and the note 'no non-availabilities listed yet for the time span.'. The second plant is 'E_DUMMY_' with a power rating of '(3557 kW) [+]' and the same note. A modal window titled 'Create new non-availability:' is open over the 'E_DUMMY_' plant. The modal contains the following fields:

- From:** 3/16/17, 3:00 PM
- To:** 3/16/17, 4:00 PM
- Reason:** Grid or plant shut down (completely) (dropdown menu)
- Limit to:** 0 kW
- Comment:** (text input field)

At the bottom of the modal, there are two buttons: 'add' and 'cancel'.

VPPs- Data Standardisation

e.g icing is an error code at enercon machine, but a data point at GE machine



VPPs- Data monitoring & validation: Corrupt data

Detection of blacklist and corrupt data:

- Live power data exceeding installed plant's capacity
- Missing data from some turbines
- Deviation between live and meter point data
- Time shifts in live and meter point data
- ...

Virtual Power Plant (client) 7.8.25

File Edit Import Export View Extras Window Help Debug 2.95 MB 12.06.2018 12

Technical View Trading Control Market Information Analysis Cockpit Map

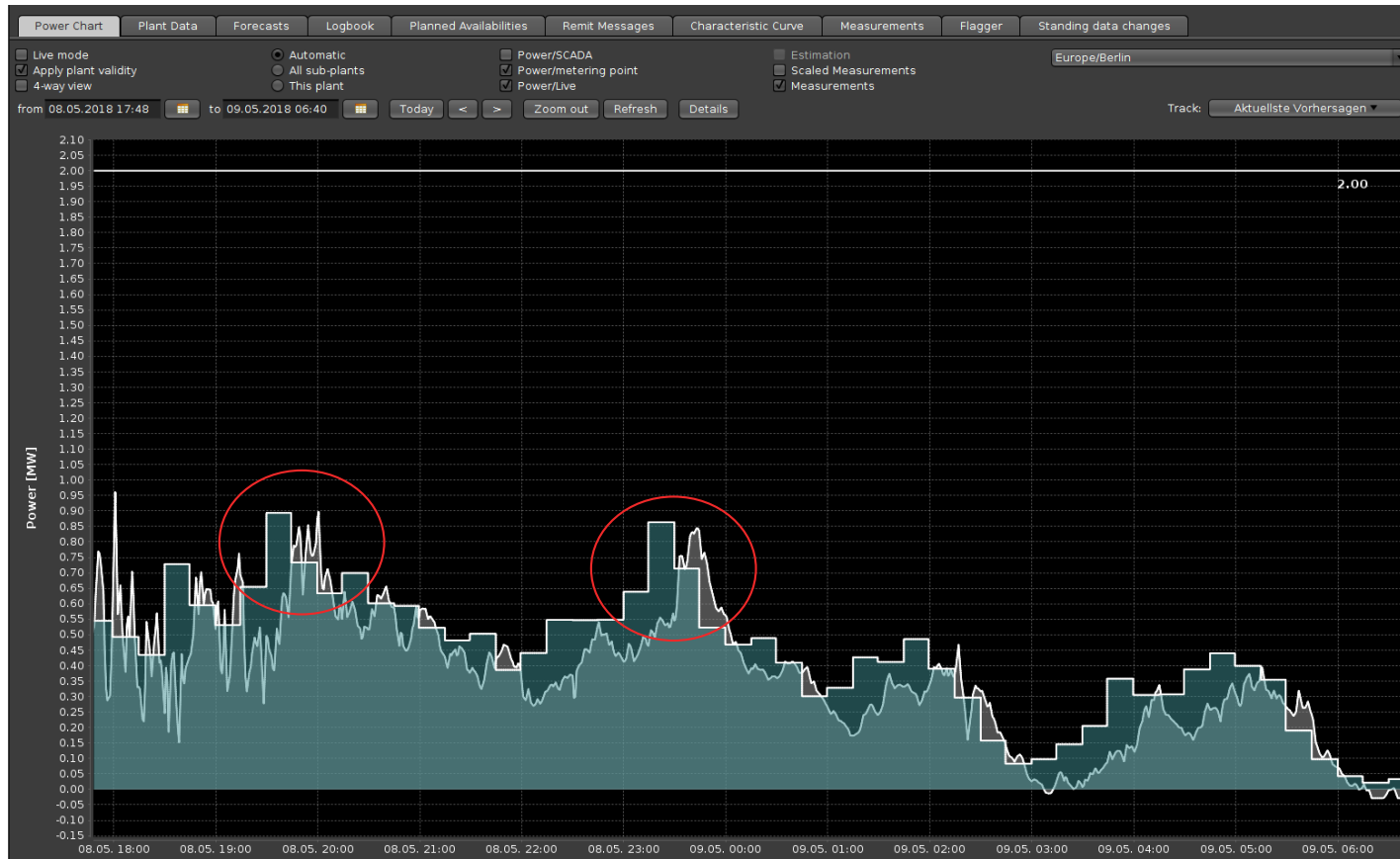
Plant Availability Measurement Availability Measurement Availability Chart MSCONS Availability MSCONS Assignment Blacklist Manually-Suppressed-Flag-List Forecast Evaluation

Measurement type: Power/Live Load Entries

Blacklist Entries				Comments			
Park	Plant	Measurement type	In process	From	To	Description	Flag number
Wind park 222	Wind park 222	Power/Live	Yes	16.05.2018 02:00:00	13.06.2018 02:00:00	Die Messung weist eine zu geringe Korrelation zur gegebenen MSC...	15
Wind park 260	Wind park 260	Power/Live	No	19.05.2018 02:00:00	13.06.2018 02:00:00	Die Messung weicht im Mittel zu sehr von der MSCONS-Messung ab.	20
Control Circuit 284	Wind park 388	Power/Live	No	12.06.2018 02:00:00	13.06.2018 02:00:00	Zeitversatz zwischen TRAF0- und Angefragten-Daten	19
Wind park 464	Wind park 464	Power/Live	Yes				
Wind park 496	Wind park 496	Power/Live	Yes				
Wind park 552	Wind park 552	Power/Live	Yes				
Wind park 576	Wind park 576	Power/Live	Yes				
Wind park 1236	Wind park 1236	Power/Live	Yes				
Wind park 1510	Wind park 1510	Power/Live	Yes				
Wind park 1894	Wind park 1894	Power/Live	Yes				

VPPs- Data monitoring: Blacklisted or corrupt data

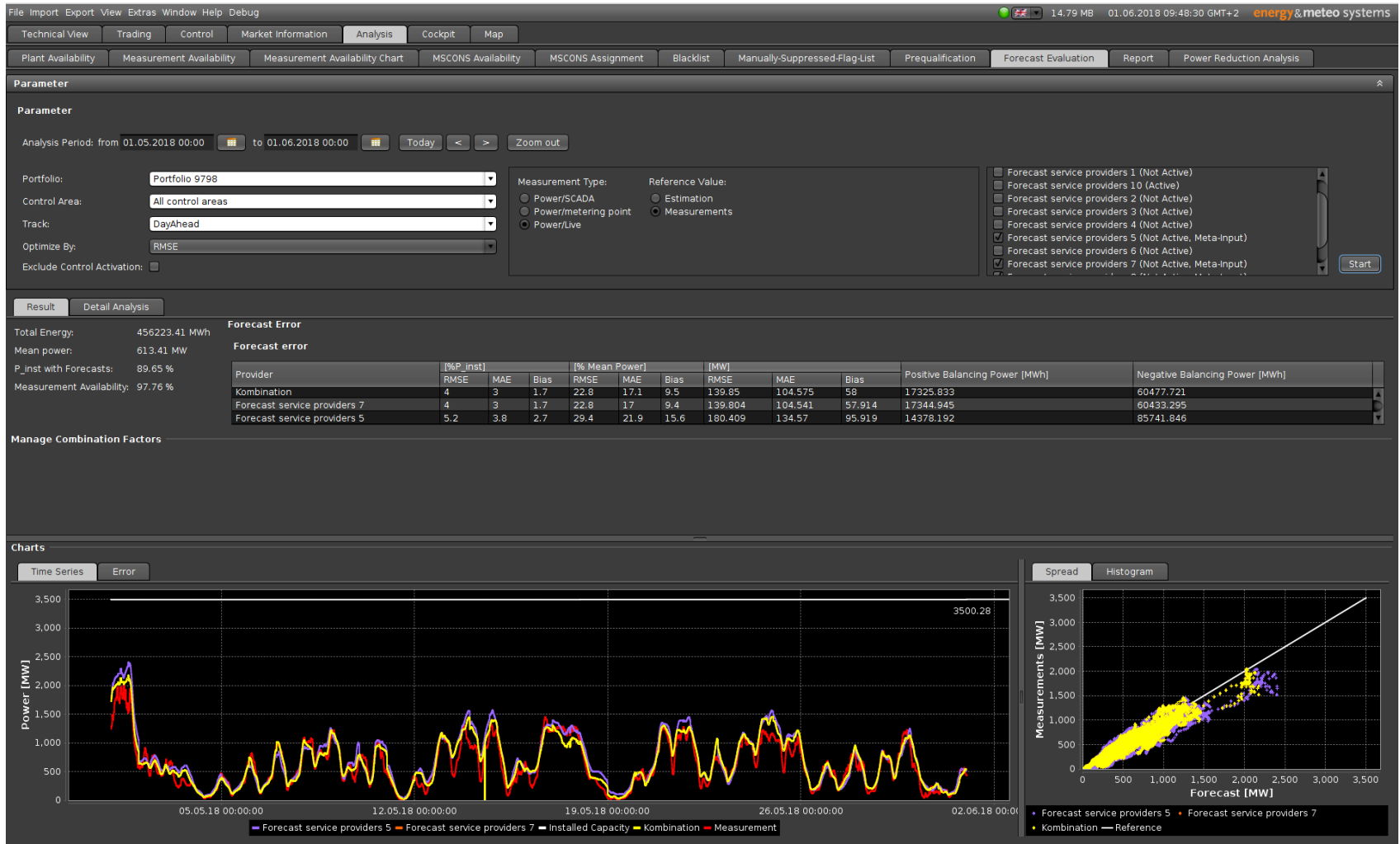
Eg. Time shifts between live and metering data



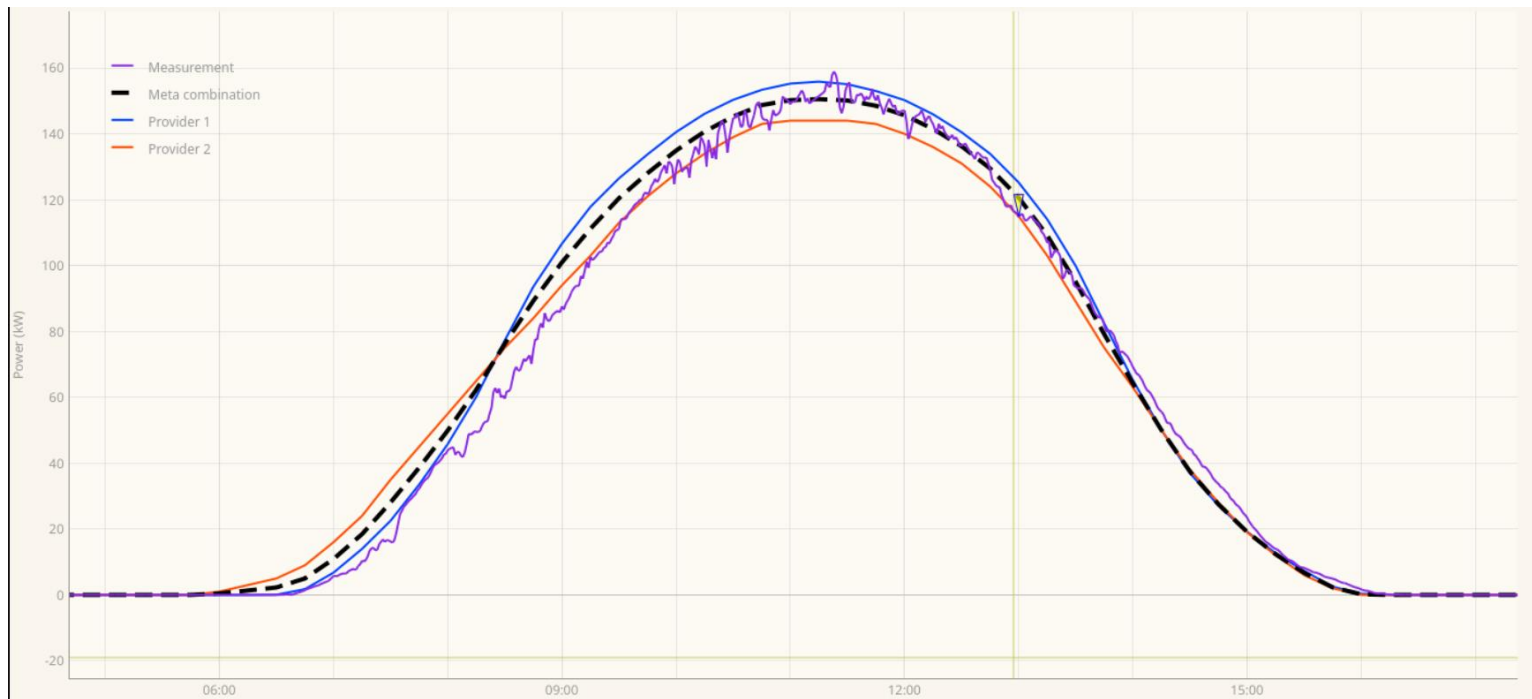
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VPPs- Combination of base power forecasts



VPPs- Forecast Combination

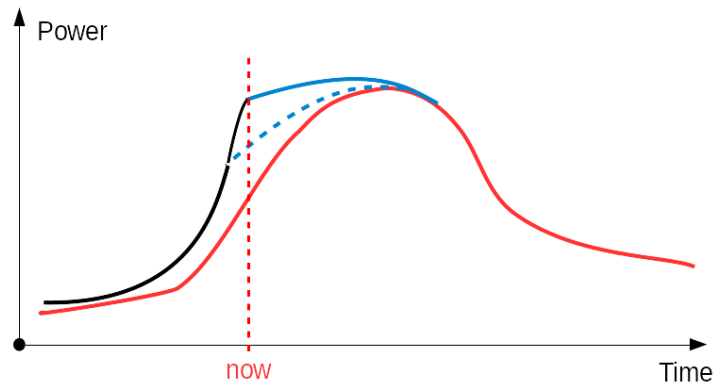
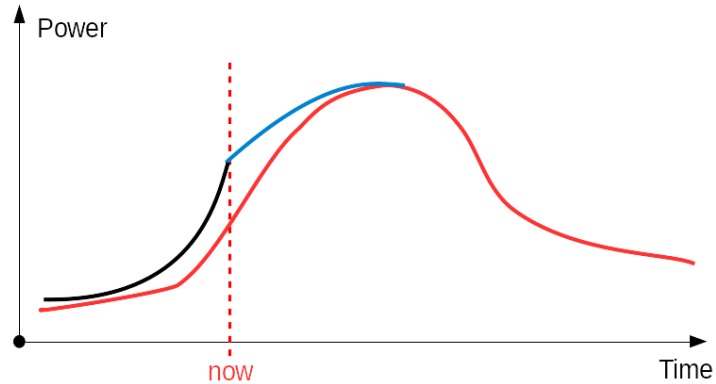


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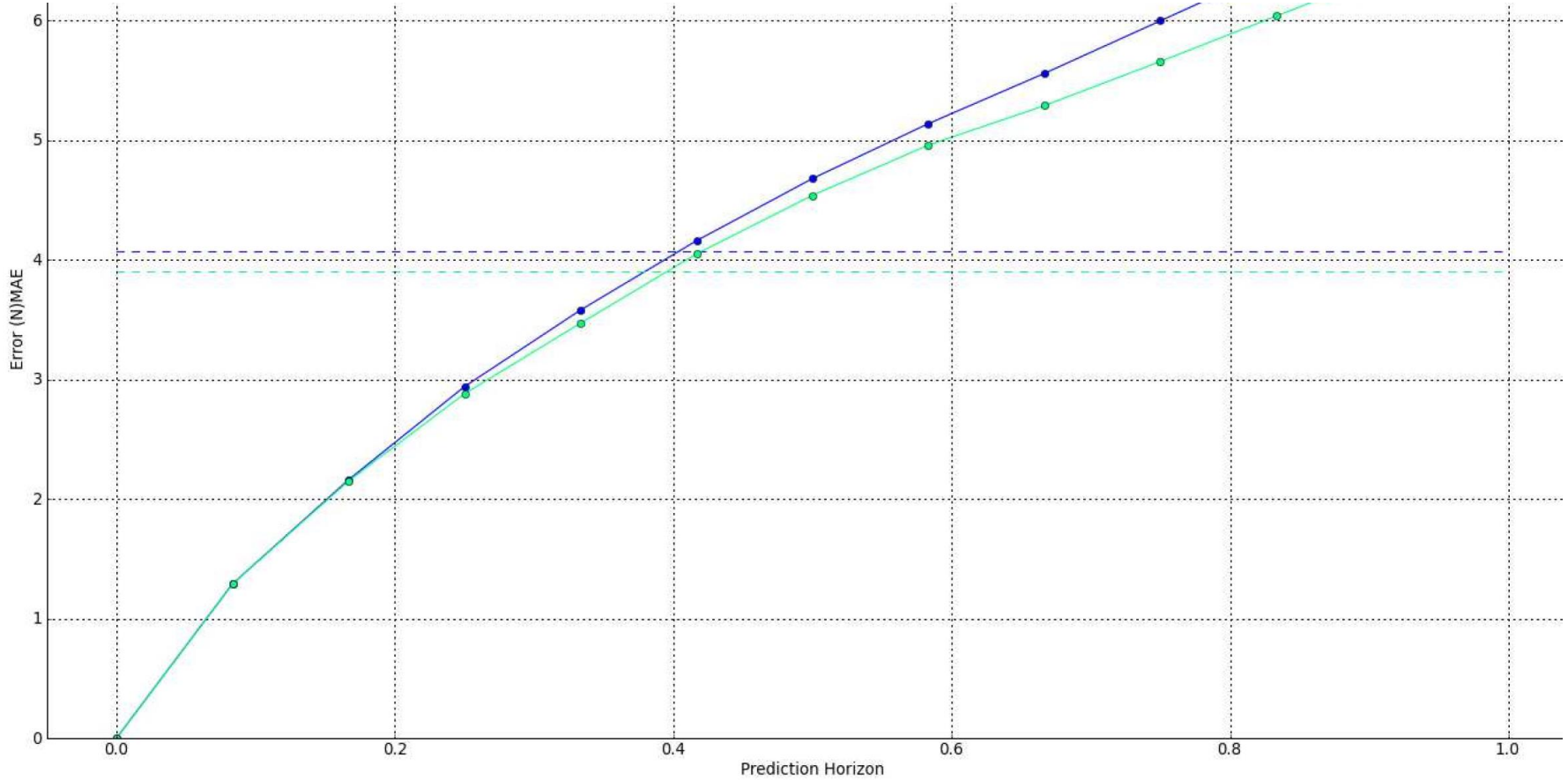
VPPs- Very short term forecast (up to 1 hour)

- Updates based on live measurements have an impact on **short-term forecast!**



- measurement
- base forecast
- latest short-term forecast
- - - previous short-term forecast

VPPs- Very short term forecast (up to 1 hour)



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Incorporating impact of real time field events

- Incorporating the impact of real time events at field (TSO curtailment, planned maintenance, etc.)





Thank you for your attention

Contact: varun.gaur@energymeteo.de