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Enabling ancillary services from wind farms

WindEurope Summit, Hamburg 2016

Agenda

Discussion points

Ancillary Services

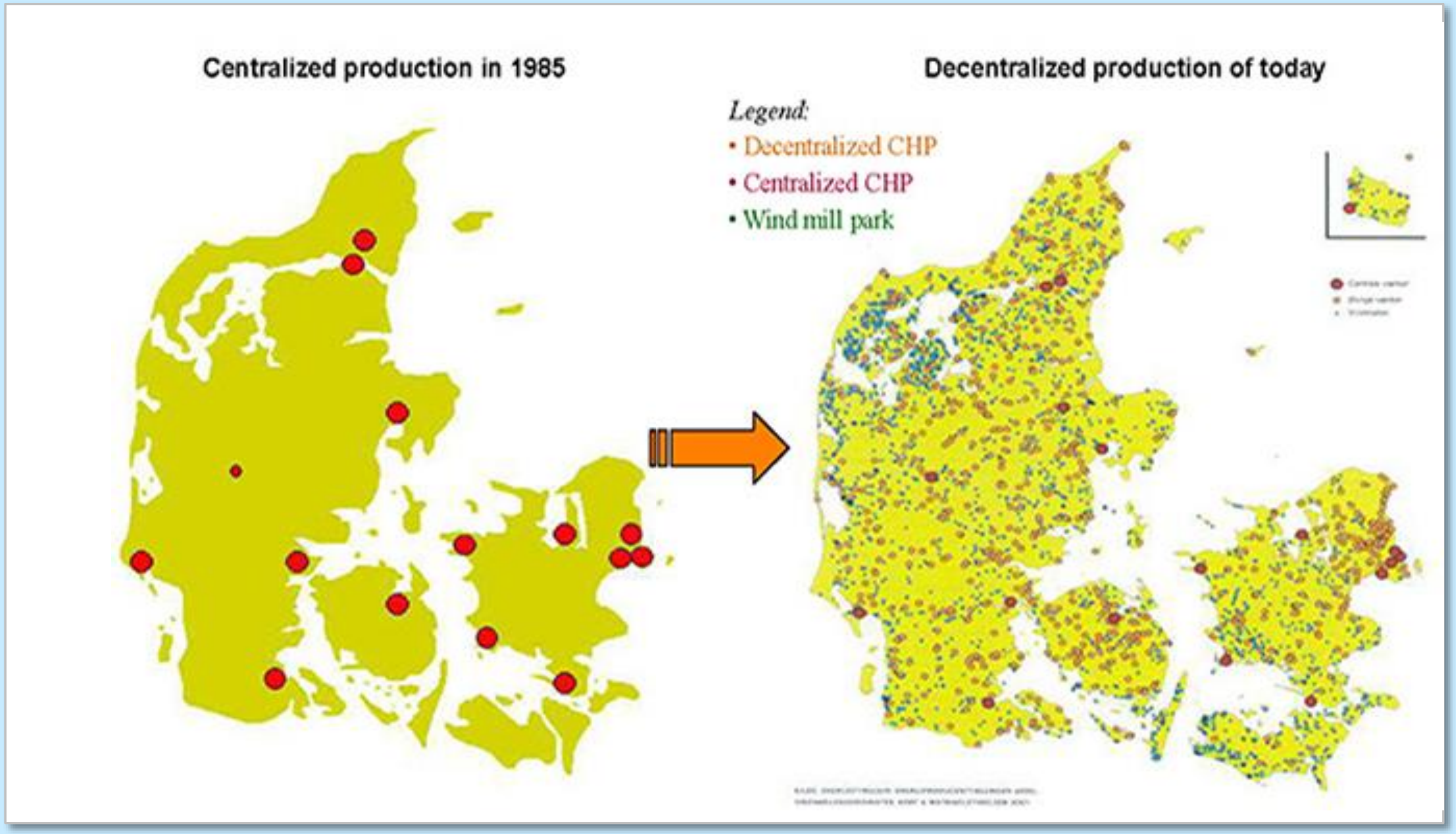
- Why and what

Wind turbines challenges and solutions to provide ancillary services

- Wind farms
- Fleet of farms

Example from real world implementations

Impact on market design

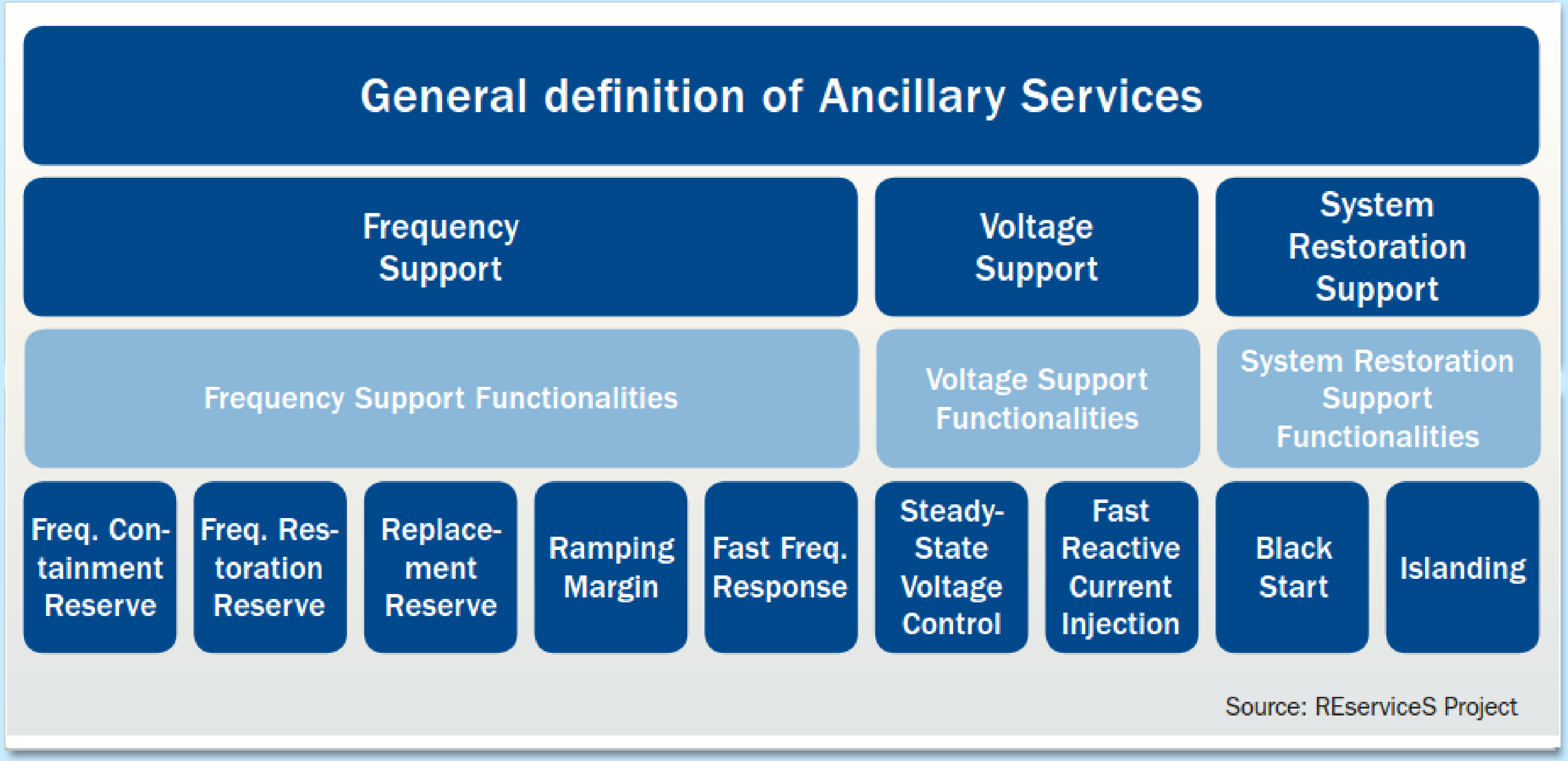


Ancillary services
What are they and why we need them

Why ancillary services

To maintain system stability and security of supply at all times

- Frequency regulation
- Voltage regulation
- Restore power after a blackout or grid collapse



Renewable energy resources have to develop functionality for providing the necessary system support.

Wind power challenges to provide frequency support functionalities

We are on the good track, however some technologies need to evolve while regulations have to change

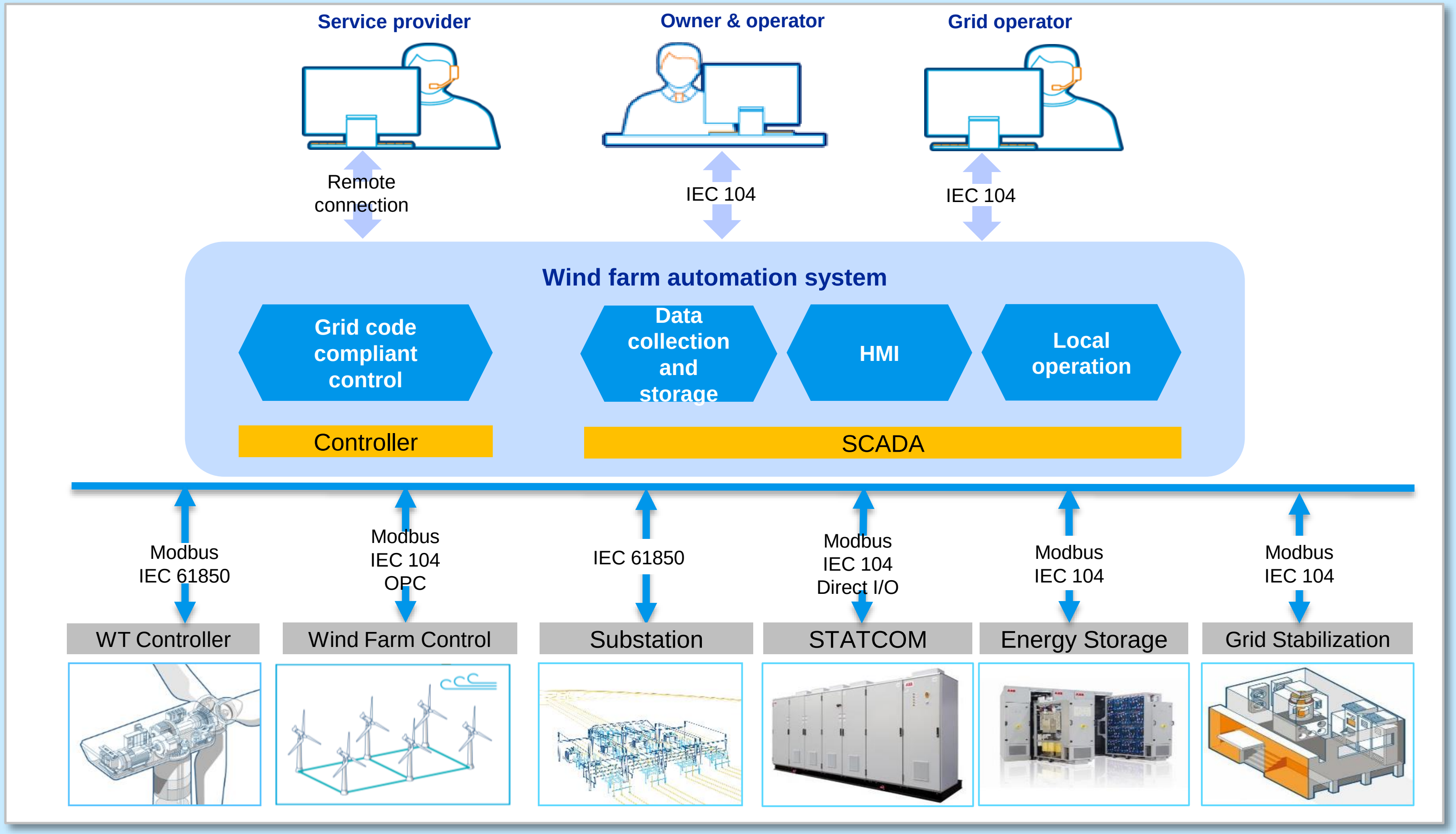
	Why	Status today	Further needs
Secure the inertia and fast frequency response	Inertia and frequency reserve depends on wind speed and control system settings	Solutions to provide inertia from wind turbines when wind blows Use of other technologies when no wind	Minimize risks of provision by aggregating with other technologies and locations Adapt market model
Provide ramping margin for longer times	Maximum ramping capacity and rate depends on wind availability	Control solutions to provide ramping margins when wind Combination with other technologies when no wind	Improve forecasting Larger scale aggregation Adapt the market model
Provide replacement reserve	Maximum capacity depends on wind availability	Forecasting solutions available Market model not suitable for running under max capacity	Minimize risk of provision with improved forecasting solutions Adapt the market model

Provision of voltage and black start support with wind power

Multiple technologies exists and holistic design is key for most economic solution

Holistic design and integration is key to reduce costs of the system

- Holistic design of the plant is needed to define the most economic solution
- Energy storage and grid stabilization technologies can provide blackstart capabilities when coordinated by the overall control system
- Integrated control of generation and electrical systems optimizes operation
- Standardization is key to define all interfaces and de-risk the project through holistic engineering

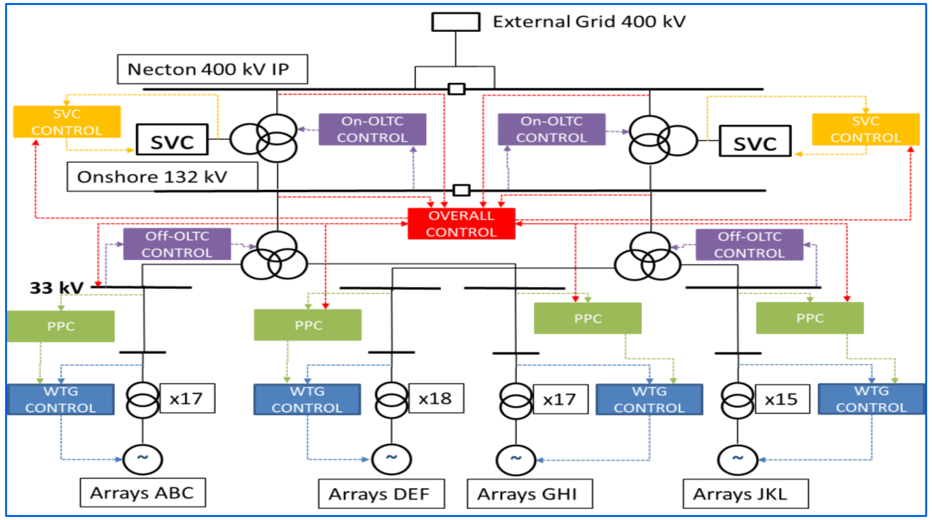


SCADA= Supervisory Control and Data Acquisition; STATCOM=Static Synchronous Compensator

Provision of voltage support with wind power

Examples of wind farm designs and voltage provision solutions

Design of offshore wind farm, UK



Design of the wind farm controller for voltage and reactive power provision at the point of connection with the grid

Consideration of the wind farm electrical design

Voltage regulation supports grid integration, UK

Reactive power compensation and grid code compliance solution using reactors (3x16 MVAr) and STATCOM (2x25 MVAr)

Enhanced power quality and seamless grid integration of a 210 MW wind farm

Provision of frequency reserve using renewable power plants

Aggregation in Virtual Power Plants increases the ability of renewable plants to provide ancillary services

Nextkraftwerke, Germany

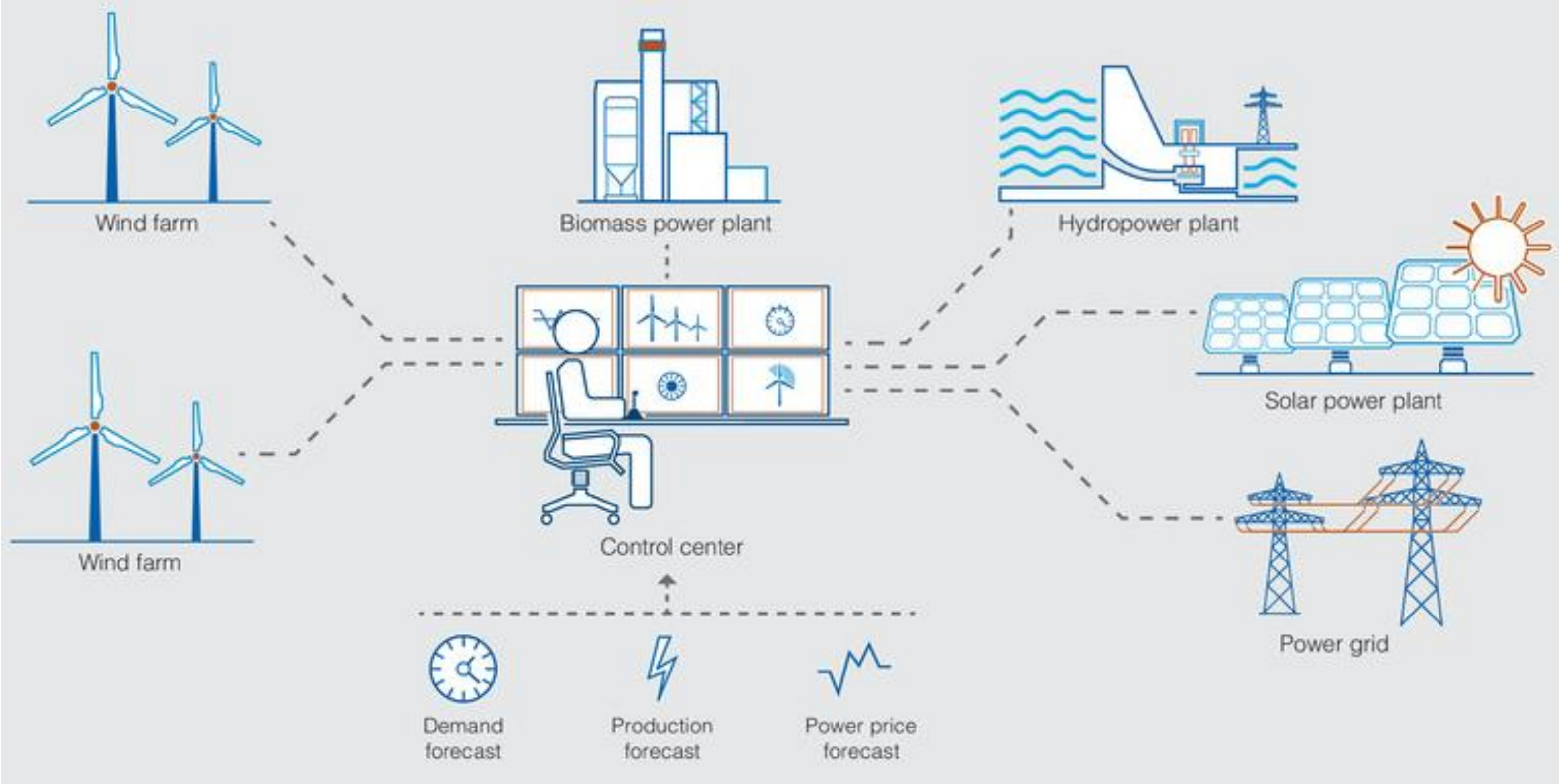
Aggregation of assets in virtual power plant (>3500 assets)

Provision of ancillary services to grid operators in Germany, Austria, Belgium , France, Netherlands and Poland

Prequalified Tertiary Capacity Reserve: 785 MW

Prequalified Secondary Capacity Reserve: 648 MW

Volume of power trading in 2014: 9 TWh



Provision of frequency reserve using renewable power plants

Fast and holistic optimization is key to ensure competitive offering for frequency reserves

Control system – the core of VPP

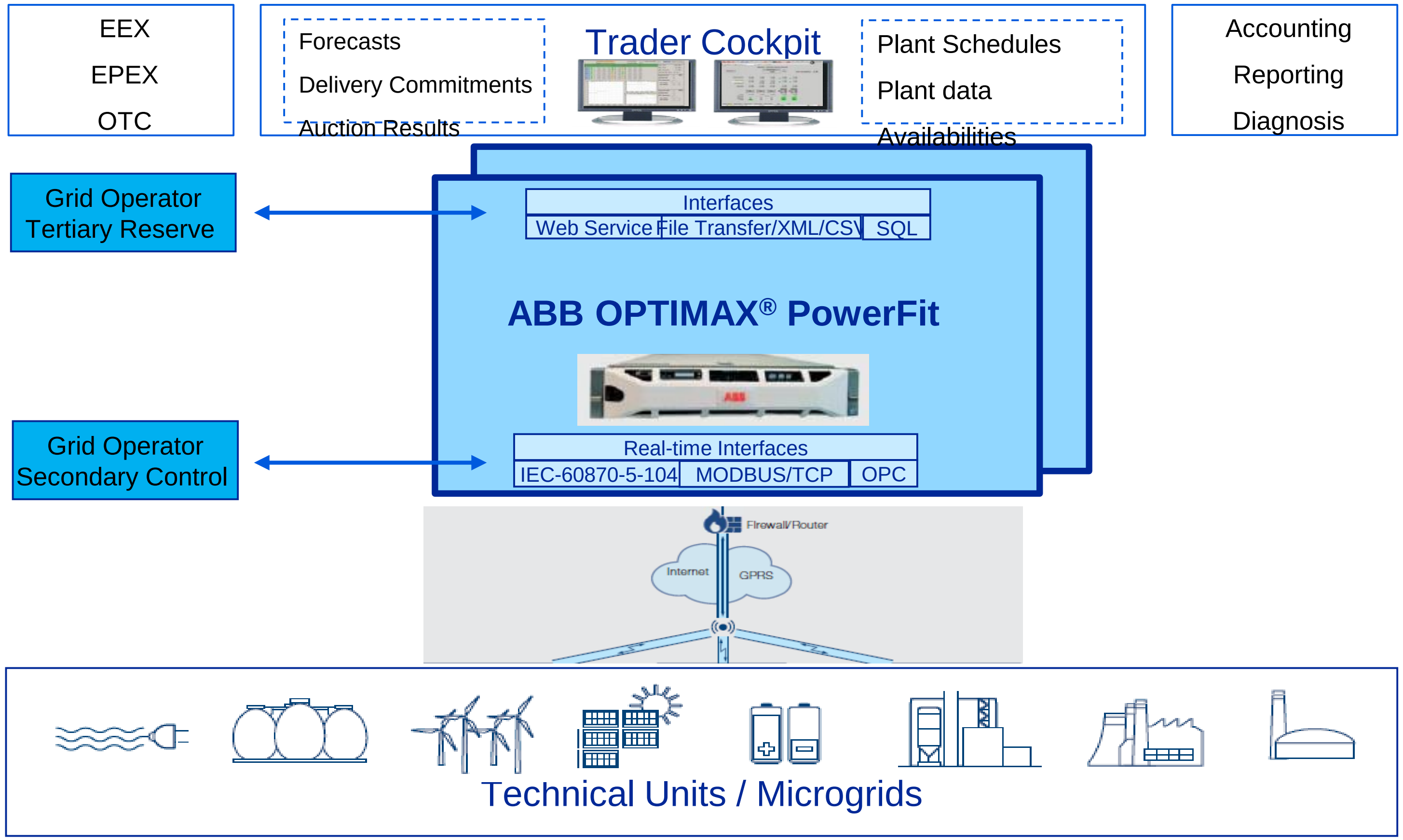
Control system is responsible for collecting data from all assets and calculate the optimal operation of the VPP

Real time industrial interfaces are used to interact with the assets

A powerful optimization solver ensure fast and optimal dispatch points to all the plants

Server redundancy ensure high availability of the system

Industrial grade cybersecurity protects the system from intruders



VPP=Virtual Power Plant

Status and outlook

Wind and other renewable plants have already features to support the system. Further developments are necessary to enable a seamless transition to the grid of the future.

Today

Wind (renewable) plants offer a range of services already:

- Voltage regulation as part of grid codes requirements
- Frequency regulation possible but limited e.g. synthetic inertia and advanced controls
- Power volatility, security of supply and energy trading risks can be mitigated through aggregation and bundling with other resources

Some (ancillary services) markets are already open to renewables

Future

A market open to all participants, including renewables and demand side

Specify the needed functions/products and not the technologies to deliver the products

Consider the aspects of new energy systems

- Dynamics of generation and demand
- Volatility of generation and demand
- Uncertainty of generation and demand

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