

**CNIT (National Inter-University
Consortium for Telecommunications)**



**ZERO CARBON FUTURE:
CHALLENGE AND OPPORTUNITY
FOR RESEARCH AND INDUSTRIAL
APPLICATIONS**

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Summary:

- CNIT presentation
- Natural environment
- Renewable sources and grid stability
- Virtual Power Plant
- Authority Requirements
- Integration of discipline
- VPP Example
- Conclusion

CNIT (National Inter-University Consortium for Telecommunications)



- Founded in 1992;
- Partner: 37 Universities and 6 CNR Centres;
- 4 National Laboratories (Photonic, Multimediality, Radar, Cybersecurity);
- About 1400 employees (University members) + 103 direct employees;
- Objective: transfer technology between research (University, public research Center) and industrial applications;
- Strong and wide cooperation with many industrial companies;
- Very active in UE projects (...Fp7, H2020,...);
- Budget about 23M€/year.

Natural Environment: Renewable and Low Carbon Energy (1/3)

- ❑ Atmospheric CO₂ has increased by 38% (Met Office, 2014).

- ❑ This increase in CO₂ creates climate change:
 - Higher temperatures: the planet's average surface temperatures has risen by 0.89°C between 1901 and 2012
 - Changing rainfall: data suggests changes in precipitation. E.g. the UK, winter rainfall is increasing and summer rainfall is decreasing, while in North America heavy rainfall events have become more intensive



Natural Environment: Renewable and Low Carbon Energy (2/3)

- Changes in nature: altered temperatures has led to changes in the seasons, and this causes issues for wildlife
- Sea Ice: melting sea ice does not only cause sea level rise as it is already on the sea, but it does have effects on the climate. Sea ice helps to keep the polar regions cool and its bright surface reflects 80% of sunlight back into space. If this ice melts, the exposed ocean instead absorbs 90% of sunlight and can cause a further rise in sea temperatures (NSIDC, 2015)



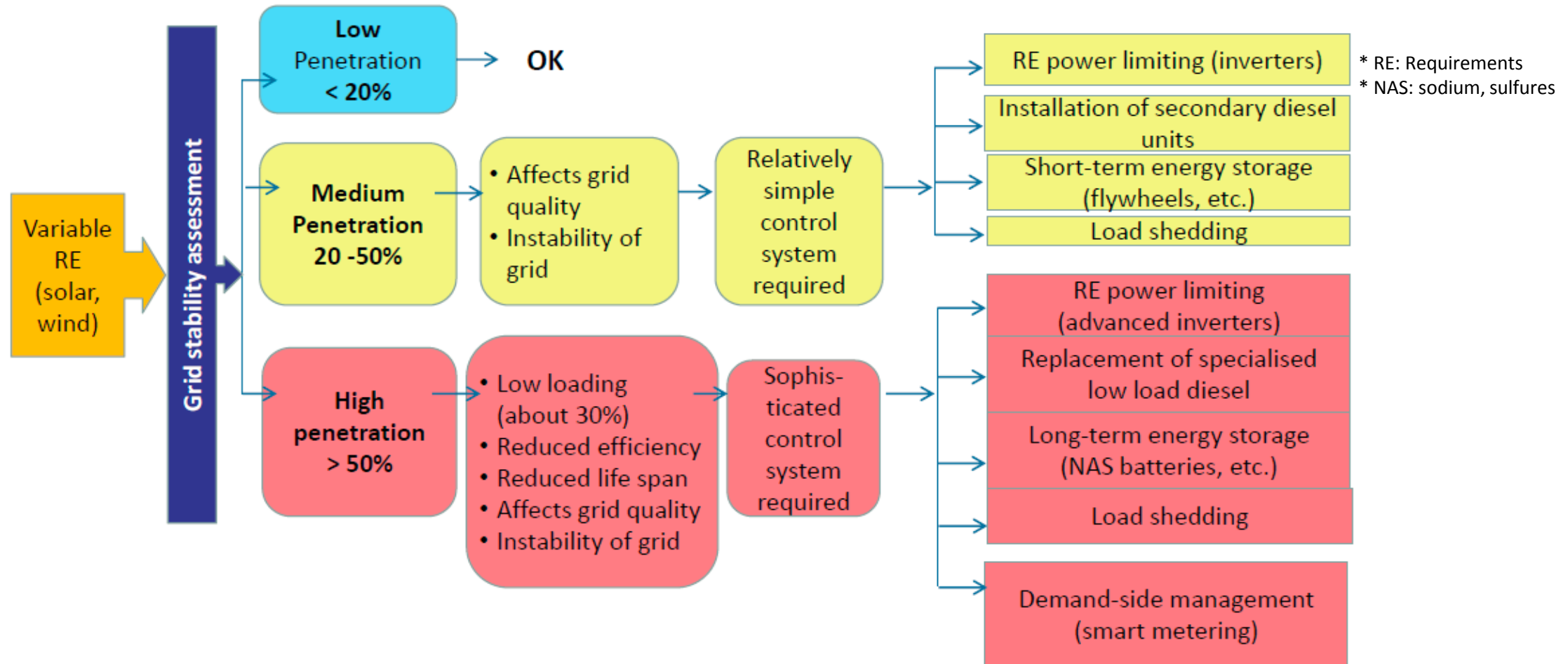
If the world fails to act, temperatures could rise by over 4°C. A rise of 2°C would cause severe effects, a higher increase could be catastrophic (Wicks, 2008).

Natural Environment: Renewable and Low Carbon Energy (3/3)

- ❑ One solution is to cover the energy demand from renewable sources
- ❑ Renewable energy sources are naturally replenished and should not run out
- ❑ Unfortunately also the renewable sources have some contraindications:
 - Zero-impact illusion: every type of energy utilization for electricity generation has environmental consequences, including renewable energies
 - manufacture processes
 - aesthetic impact
 - use of large areas of land
 - impact on the eco-system
 - Grid stability negative impact: Electricity supply must meet electricity demand at any moment in time. If not, blackouts will happen. Frequency and voltage control are needed to fine-tune this equation. Rapidly changing renewable power supply could create serious problems



Renewable Sources and Grid Stability



If the penetration is high, it is required to adopt adequate countermeasures to ensure the grid stability. In addition to the conventional measures, the Virtual Power Plant approach can have a significant role in the future.

Virtual Power Plant and other distributed entities 1/3



- ❑ **Virtual Power Plant (VPP)** aims at smoothly integrating a high number of renewable energy units into existing energy systems. It does so by offering flexibility coming from all networked units (e.g. ramping up and down power production and power consumption on short notice for frequency control). Additionally, power traders within a Virtual Power Plant are able to use live data to enhance forecasting and trading of renewable energies. As a result, Virtual Power Plants gradually take over the role of traditional power plants – selling their output on wholesale markets and assuming responsibility for a balanced grid.

Virtual Power Plant and other distributed entities 2/3

- ❑ **Demand-Response** is a change in the power consumption of an electric utility customer to better match the demand for power with the supply. Demand response seeks to adjust the demand for power instead of adjusting the supply.

- ❑ **MicroGrid** is a localized grouping of electricity sources and loads that normally operates connected to and synchronous with the traditional centralized electrical grid.
 - Microgrid is based on well-known statistical properties and local management operations and can disconnect and function autonomously as physical and/or economic conditions dictate.
 - By this way, it paves a way to effectively integrate various sources of distributed generation, especially Renewable Energy Sources.
 - It also provides a good solution for supplying power in case of an emergency by having the ability to change between islanded mode and grid-connected mode.

Energy Optimization for Industrial Enterprises

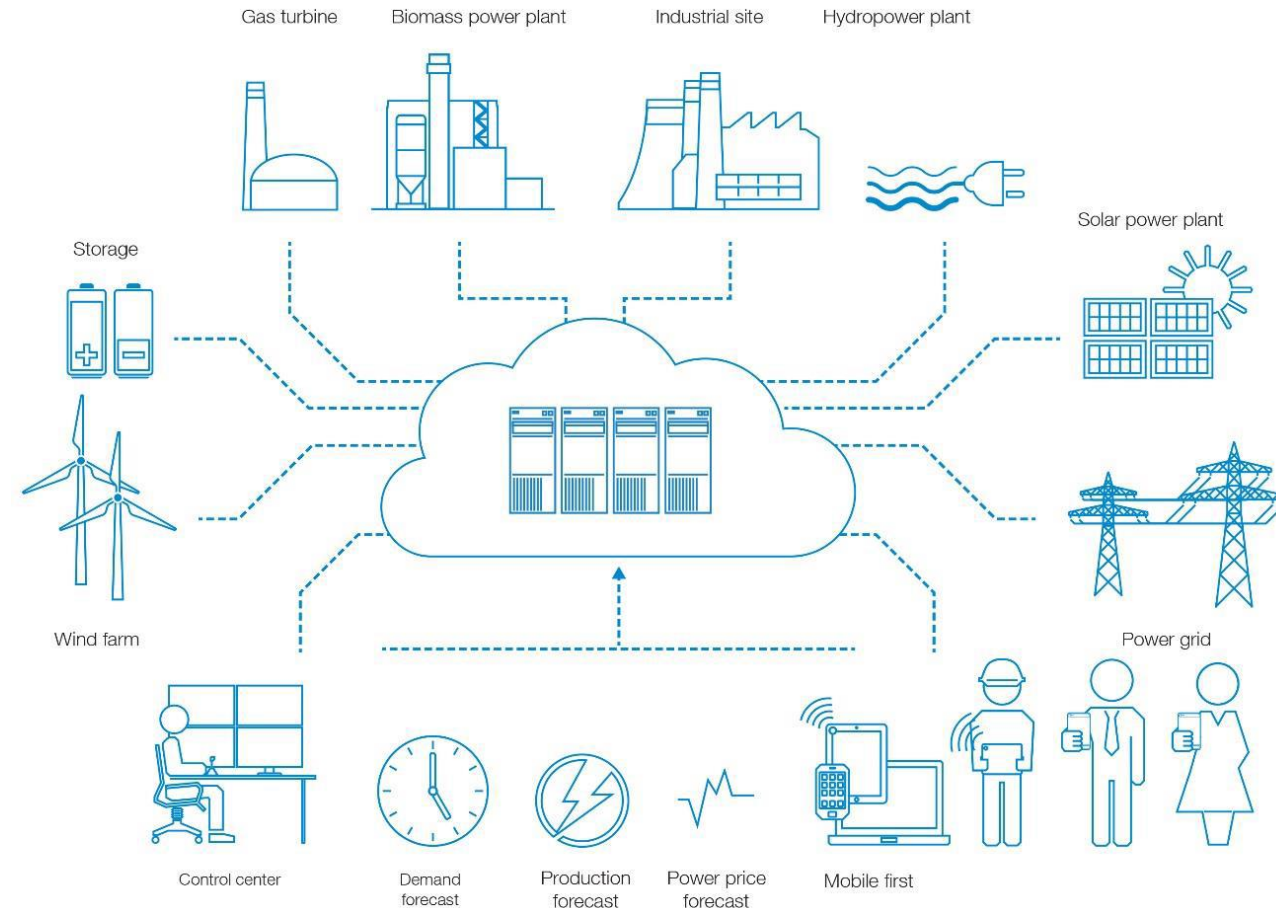
Central Power Optimization of companies with multiple site locations

Situation

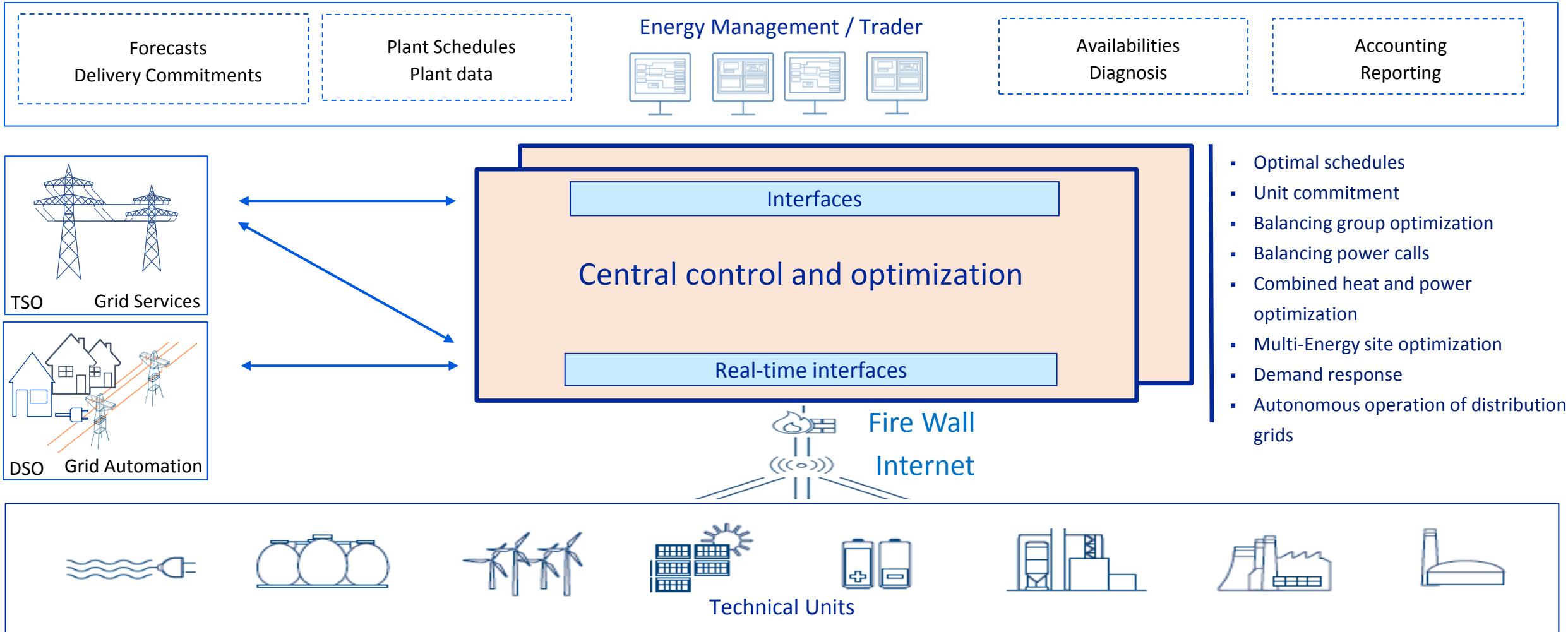
- Multiple Sites
- Customer Generation in place
- Customer Consumption in place
- Energy Supply from an Energy Provider

Challenge

- Optimal energy supply and consumption strategy



VPP General Structure

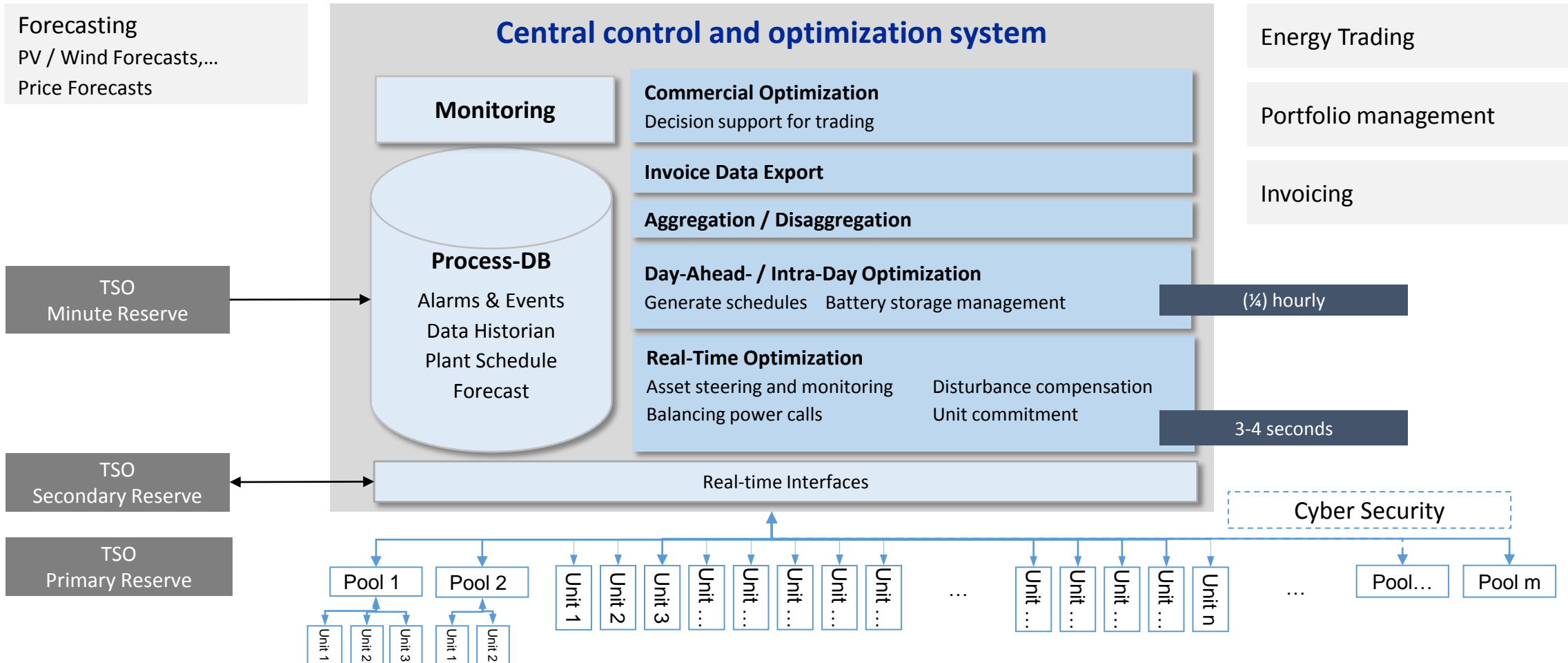


Authority Requirements 1/2

Capability to manage a VPP as a single plant means to generate the rules of the specific country Authority code such as:

- Minimum requirements for the distributed generation;
- Participation to primary frequency control;
- Voltage and/or reactive power control according to dispatcher request;
- etc.

Authority Requirement 2/2



INTEGRATION OF DIFFERENT DISCIPLINES

- AUTOMATION AND PROCESS CONTROL
- INTELLIGENT NETWORKING
- CYBER SECURITY
- INTELLIGENT/PREDICTIVE ANALYSIS
- LOCAL AND GLOBAL TERRITORIAL INFORMATION
- REMOTE SENSING AND WEATHER FORECAST
- BIG DATA ANALYSIS
- RELIABILITY AND RESILIENCE
- PROCESS SIMULATION
- DISASTER PREVENTION-RECOVERY
- INNOVATIVE BUSINESS IDEA (BALANCING POWER VS LUCRATIVE TRADING BY ENERGY MARKET)
- COST CONTROL AND PROCESS OPTIMIZATION
- NEW PROFESSIONAL PROFILES (TRAINING)

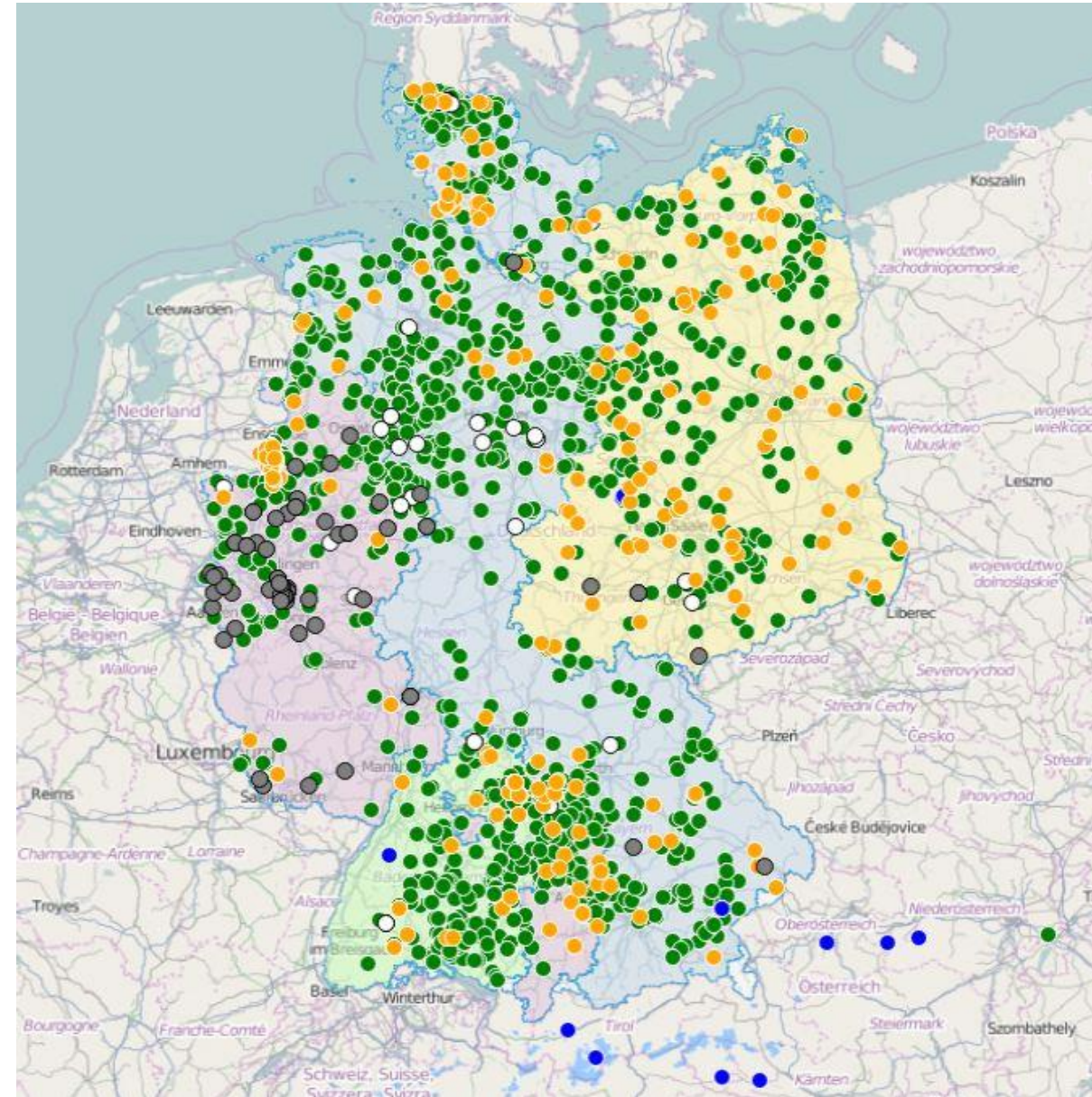
VPP Example: Next Kraftwerke (2/2)

Geographic Distribution

Germany, Austria, and on the boundary with
Nederland and Luxemburg

Legenda

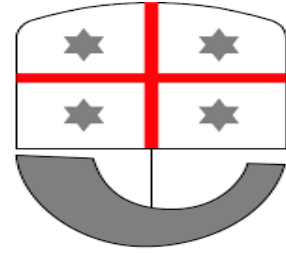
- Solar
- Wind
- Hydro
- Biomass
- Other



CONCLUSION

- The present Energy Market is in a transition phase brought on by increasing generation from different renewable sources.
- The power market of the future will be more diverse, more fragmented, more volatile and predominantly decentralized.
- New efficient system operation for innovative business idea joint with many spread over controllable units will appear.
- Finally the integration of many different disciplines will create new professional capabilities.
- Specific country Authority rules are in a progress phase.
- The involvement of industrial and end-user partner with research contribution will be fundamental.

SOME RELEVANT PARTNERSHIP:



REGIONE LIGURIA



COMUNE DI GENOVA



Ministero della Difesa



Many Partnerships are also with international research institutions.

THANK YOU FOR YOUR ATTENTION