Fuel consumption and emissions reduction through advanced microgrids control system

Petra Piclova
Renewable Energy Segment Manager
ComAp a.s.

Outline

- About ComAp
- Hybrid Microgrids - the future power system?!
- How to reduce fossil fuel consumption?
- Emissions production
- Microgrid control optimization
- Case study
- Lessons learnt
- Conclusion

ComAp

Numbers

ComAp, the leader in power generation and engine control, provides tailored, customer - oriented solutions to a wide range of industries in hundreds of locations around the world.

29 Years of Experience

400+ Employees

55 Million EUR Turnover in 2019

13 Subsidiaries

21 Offices

60+ Distributors

ComAp
The heart of smart control

ComAp Subsidiaries

How to reduce fossil fuel consumption?

- **The influences on the real diesel consumption are many**

Internal:

- Diesel gen-set age, running hours and operational history of loading, quality of combustion process, etc.

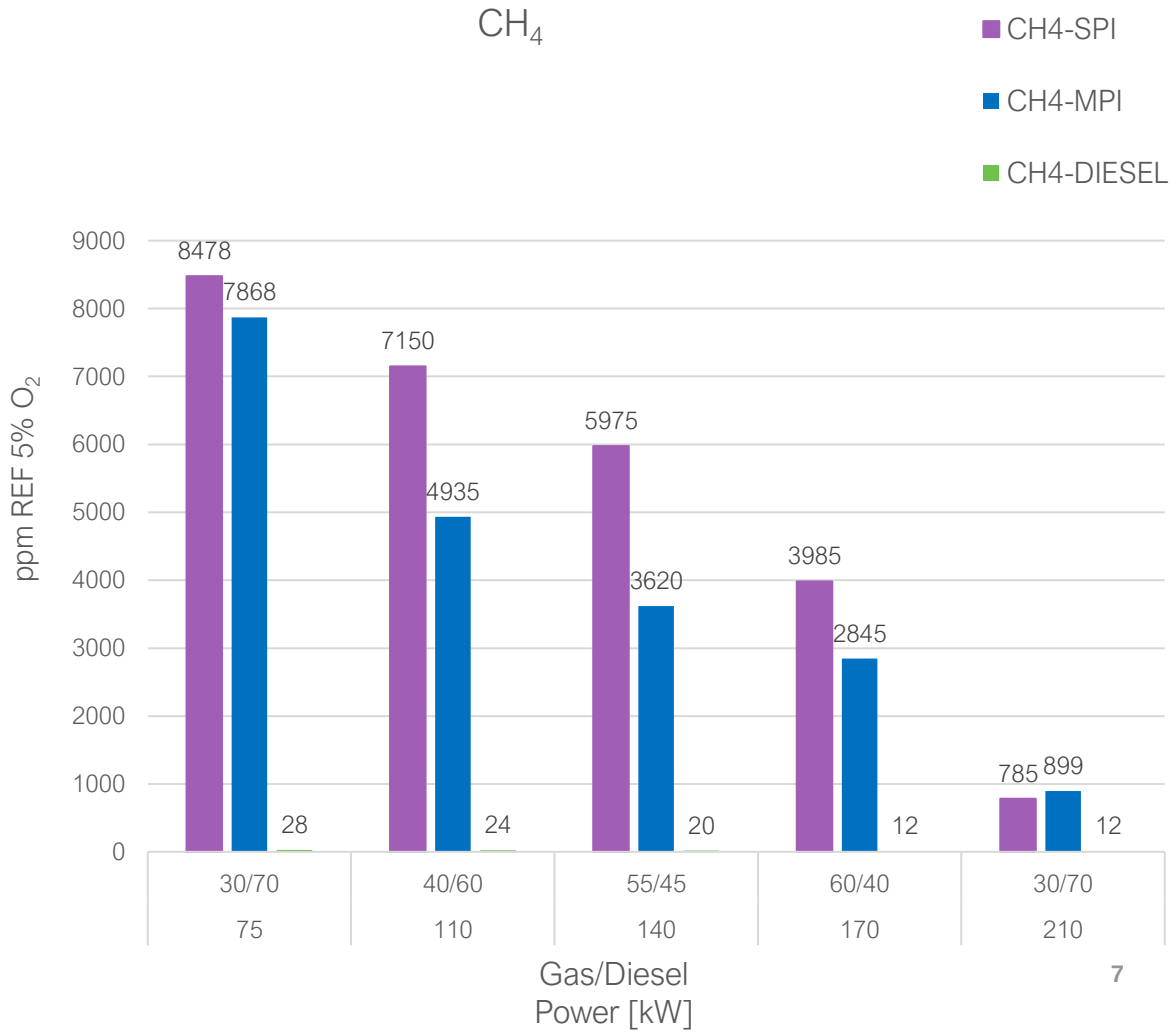
External:

- Altitude, temperature, fuel quality, etc.

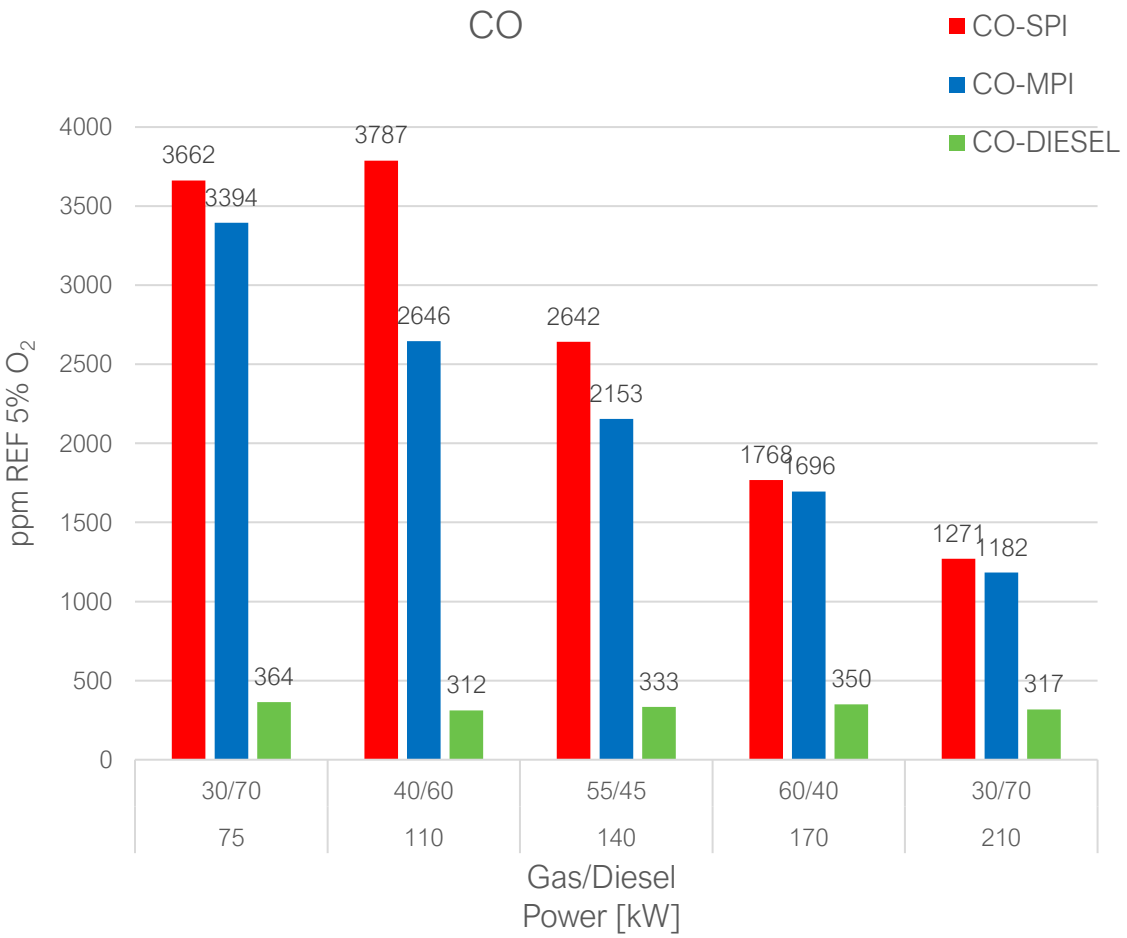
- **Advanced Power Management (optimum loading level of gen-sets can save 5% of fuel)**
- **Load and weather predictions avoid unnecessary starts and stops (gen-sets overloading and underloading within allowance)**
- **Correct sizing of BESS and its reaction times is crucial for peak-shaving**

Emissions production

- There are many other emissions produced at the combustion process…CH4, NOx, SOx, CO, HC, PM, …
- CO_2 emission production should not be the only criterion!
- The CO_2 volume increases proportionaly to the volume of burnt fuel
- CH_4 (released when gas is burnt) is far more harmful for the environment than CO_2



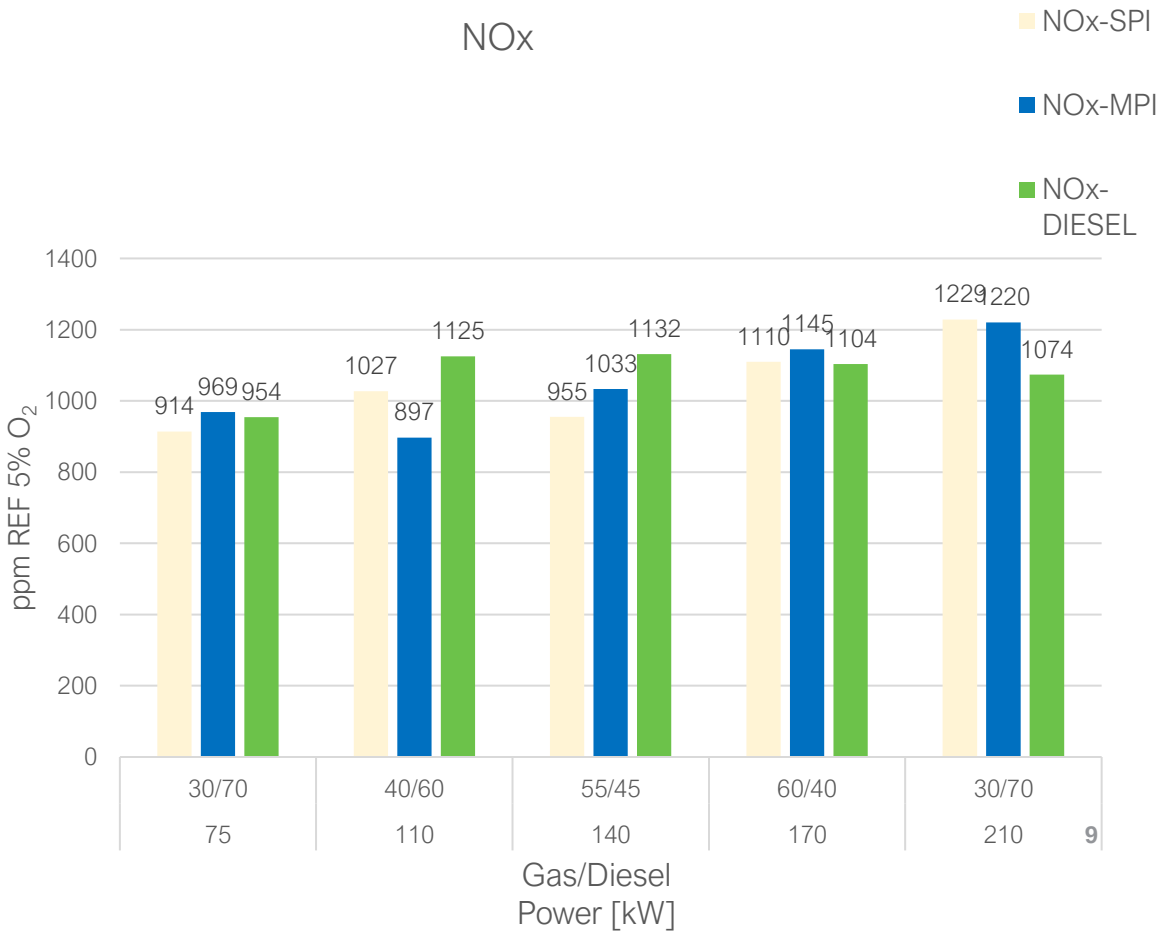
Emissions production



- **CO is a toxic gas produced at imperfect combustion**
- **CO is produced at cold starts, therefore the avoidance of unnecessary starts is paramount**
- **he higher the gen-set loading, the lower the volume of CO production**

Emissions production

- **To comply with the emission standards, gen-sets are built for optimized stable NOx production at all loading levels**
- **Gas and diesel burning process emit similar amount of NOx emissions**
- **The gen-set design has 6 times higher impact on the emissions production than is the influence of fuel**



Hybrid microgrid control optimization

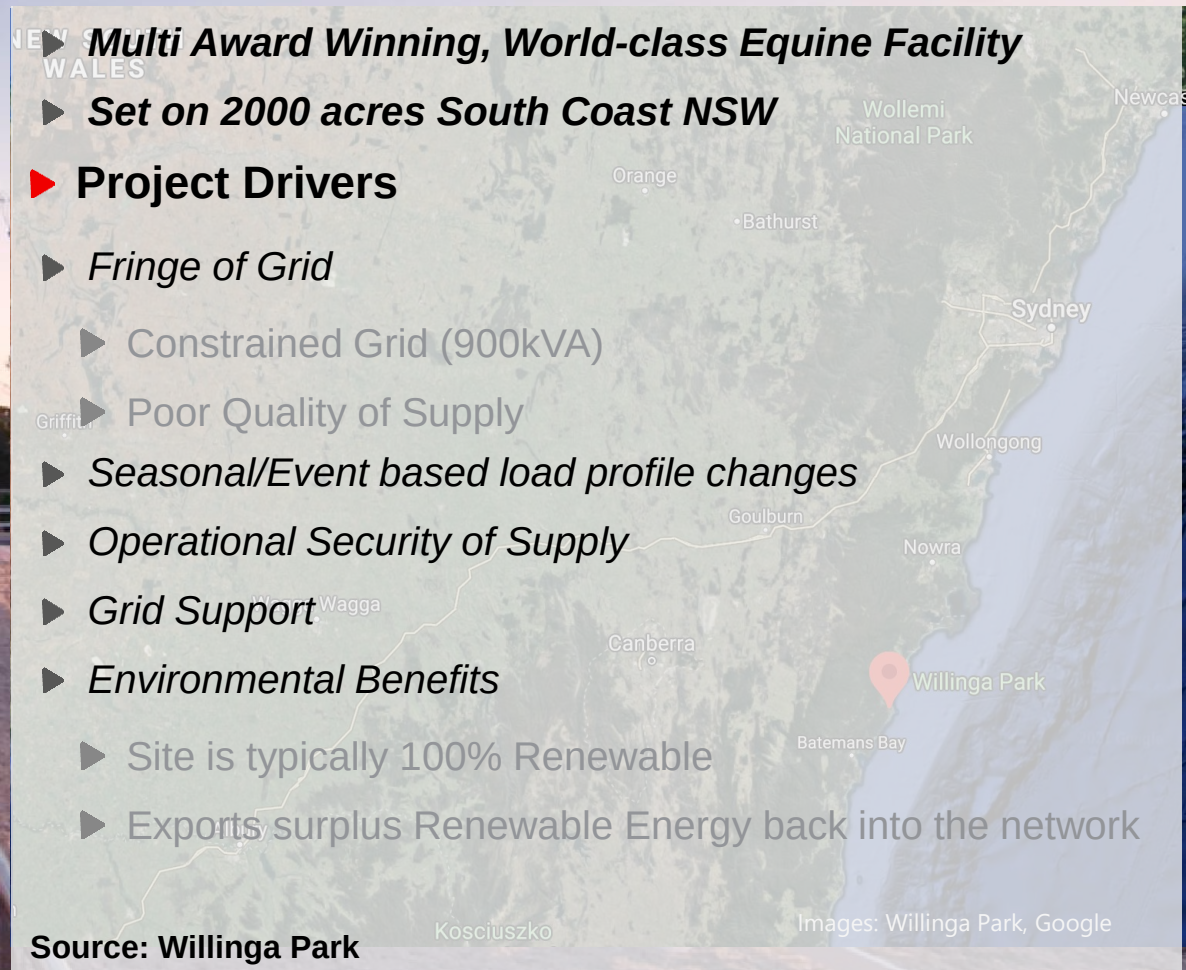
- Load predictions based on long-term consumption data acquisition
- Weather predictions for DSR reduction
- Energy consumption optimization through load analysis
- High-power BESS (Battery Energy Storage System) for peak-shaving
- Neural networks for algorithm improvement
- The bias of high Dynamic Spinning Reserve

ComAp
The heart of smart control

WILLINGA PARK

CASE STUDY Fringe of Grid Hybrid Microgrid Willinga Park Equestrian Centre

- ***Multi Award Winning, World-class Equine Facility***
- ***Set on 2000 acres South Coast NSW***
- **Project Drivers**
- *Fringe of Grid*
  - Constrained Grid (900kVA)
  - Poor Quality of Supply
- *Seasonal/Event based load profile changes*
- *Operational Security of Supply*
- *Grid Support*
- *Environmental Benefits*
  - Site is typically 100% Renewable
  - Exports surplus Renewable Energy back into the network



Source: Willinga Park

High Level Technical Overview

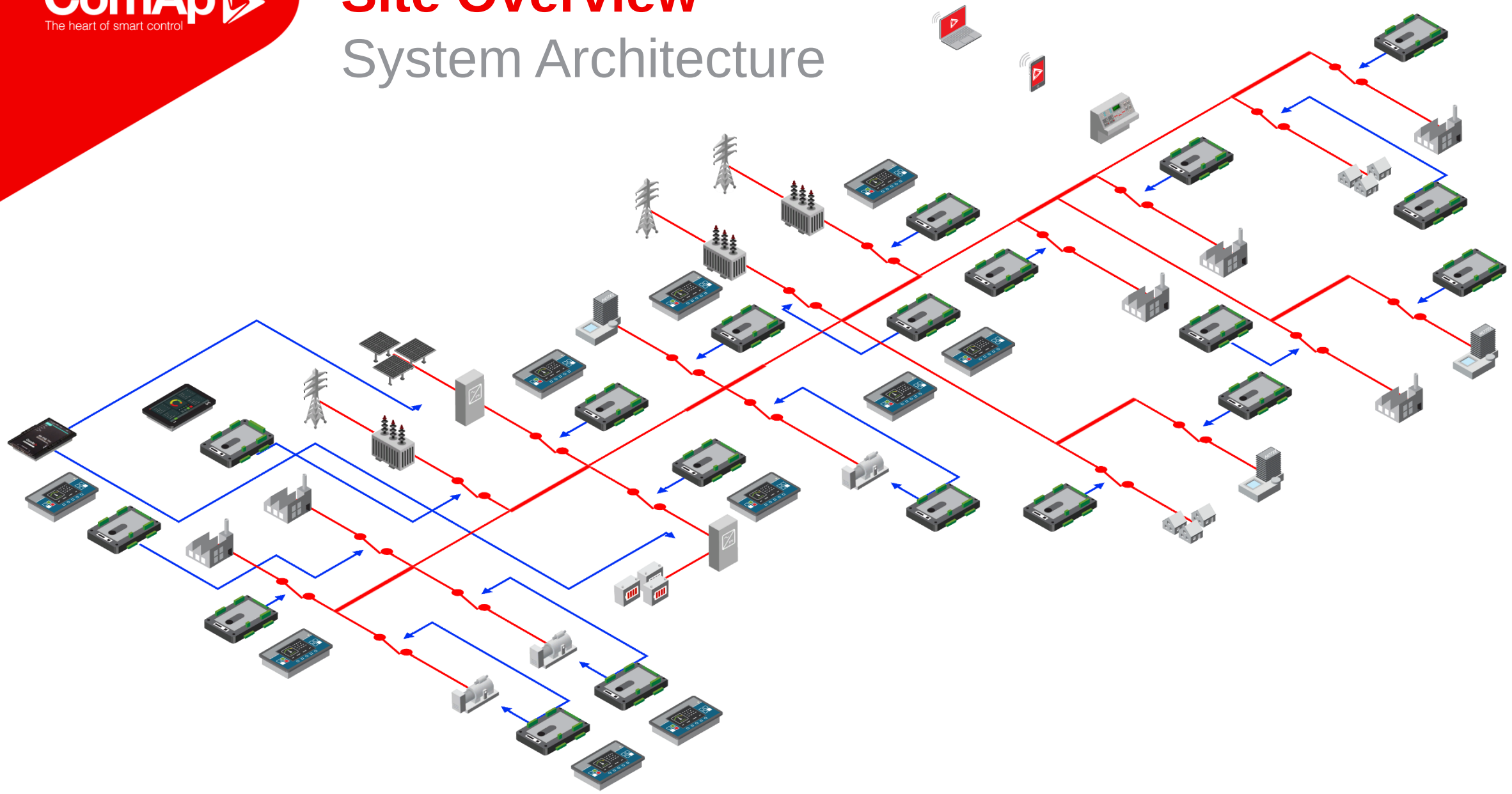
- **Hybrid System Details**
  - *Behind the Meter – Solar + Battery + Diesel Hybrid Plant*
    - 500kW Controlled PV
    - 300kW Uncontrolled PV
    - 500kW / 2.2MWHr Battery Storage System
    - 3MW of Diesel Generation
  - *Key Equipment*
    - ComAp – Hybrid, Generator & Remote Controls
    - SMA – Solar Inverters
    - Tesla – BESS (Powerpack2)
    - MTU Detroit – High Speed LV Diesel Generators

- **Modes of Operation**
  - *On-Grid Normal Mode*
    - Diesel Off, PV Export & BESS for stability & shifting
  - *On-Grid Event Mode*
    - Max PV, BESS for stability, Diesel to Peak-Shave
  - *Off-Grid Normal Mode*
    - BESS Grid Form, Max PV, Diesel (Charge Only)
  - *Off-Grid Event Mode*
    - Diesel Gen Grid Form, PV in Fuel Offset, BESS S/R & Frequency Support

ComAp
The heart of smart control

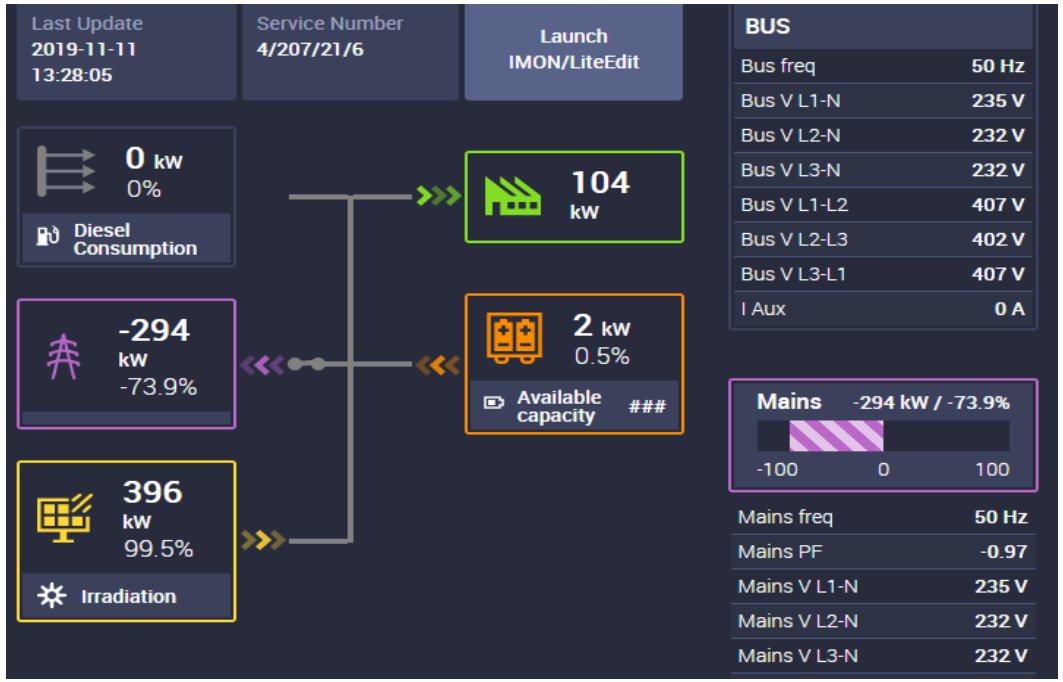
Site Overview

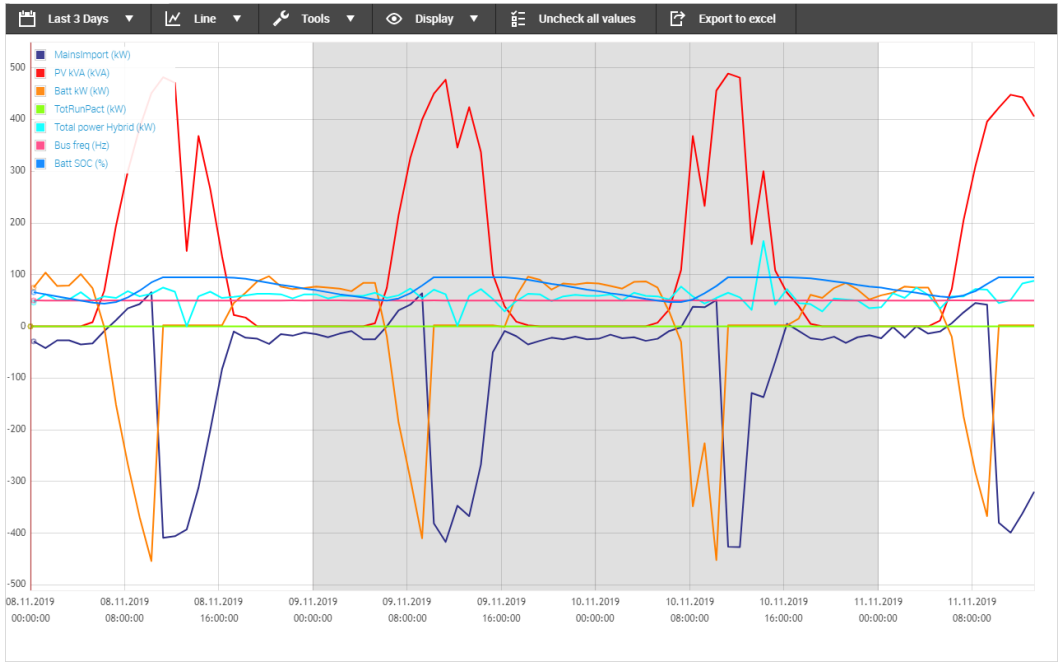
System Architecture



Key Results

- Scalable, reliable and cost-effective behind-the-meter microgrid
- Lower costs of energy
- Net export on site
- More than 95% of yearly consumption covered from renewable energy resources
- Energy security has allowed additional construction and expansion of the site





Lessons learnt

- Site analysis prior to the system upgrade is crucial for correct site design
- On-grid electricity tarrifs should be obtained to optimize the site dispatch
- Network charges avoided and additional revenue gained from FiT and LCoE reduction
- BESS charge cycles can be delayed to eliminate mains import
- Replicable solution for various different sites

Conclusion

- Higher renewable energy yields should not be accomplished through PV/wind/BESS oversizing
- Unnecessarily high Dynamic Spinning Reserve and concurrent renewables output limitation is a matter of past
- Smart utilization of under and overloading capabilities of gen-sets, load and weather predictions should improve the control algorithm
- Droop control should be avoided as it is not an efficient control scheme for a combination of various energy resources
- Real-time consumption data collection can be exploited for maximized fuel savings
- Artifical intelligence might become an option for long-term control algorithm improvement

Thank you for your time

The heart of smart control

Petra.Piclova@ComAp-Control.com