SIEMENS
Ingenuity for life

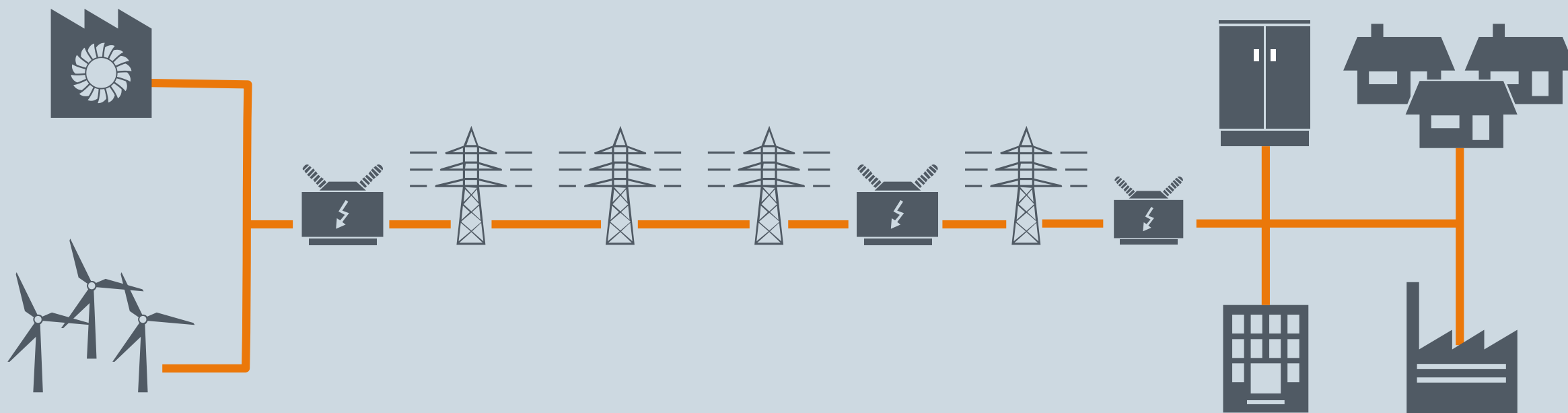UNLOCK THE FULL ENERGY POTENTIAL

Microgrids
Emerging Microgrid Technologies

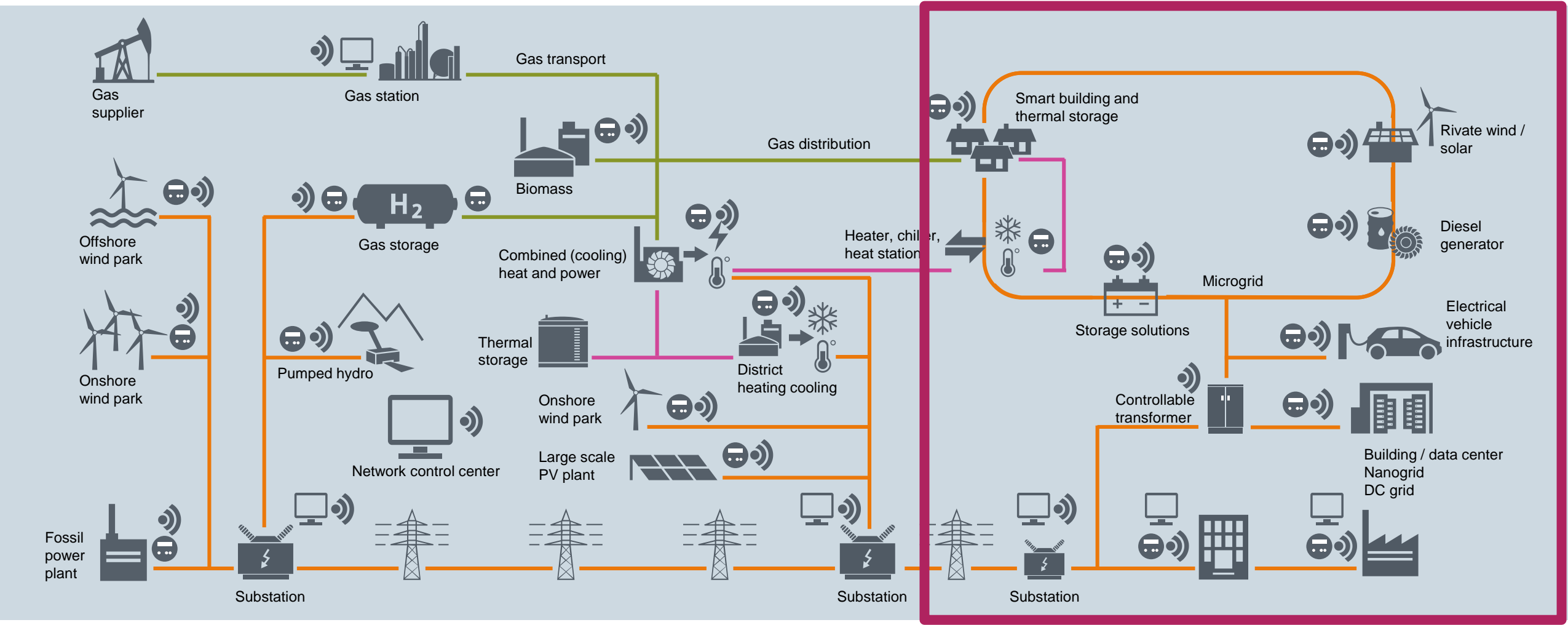Petru Ruset I Division Country Lead EM

www.siemens.com/future-of-energy

Two major trends are enforcing each other and are driving the transformation of the energy world

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Local resilience

Storage

Engine

H₂

Distribution platforms

01100
011010
010110

Data hubs

Transactive energy

Adaptive protection

Digital substation

Energy efficiency

District heating and cooling

Analytics

Distributed energy systems

Digitalization

Distributed, closed-loop control

e-Mobility

Microgrid

Cyber security

Dynamic Line Rating

Customer engagement

Photovoltaics

Onshore wind

Small power plant

Renewables and conventional

Peer-2-peer energy

New business models

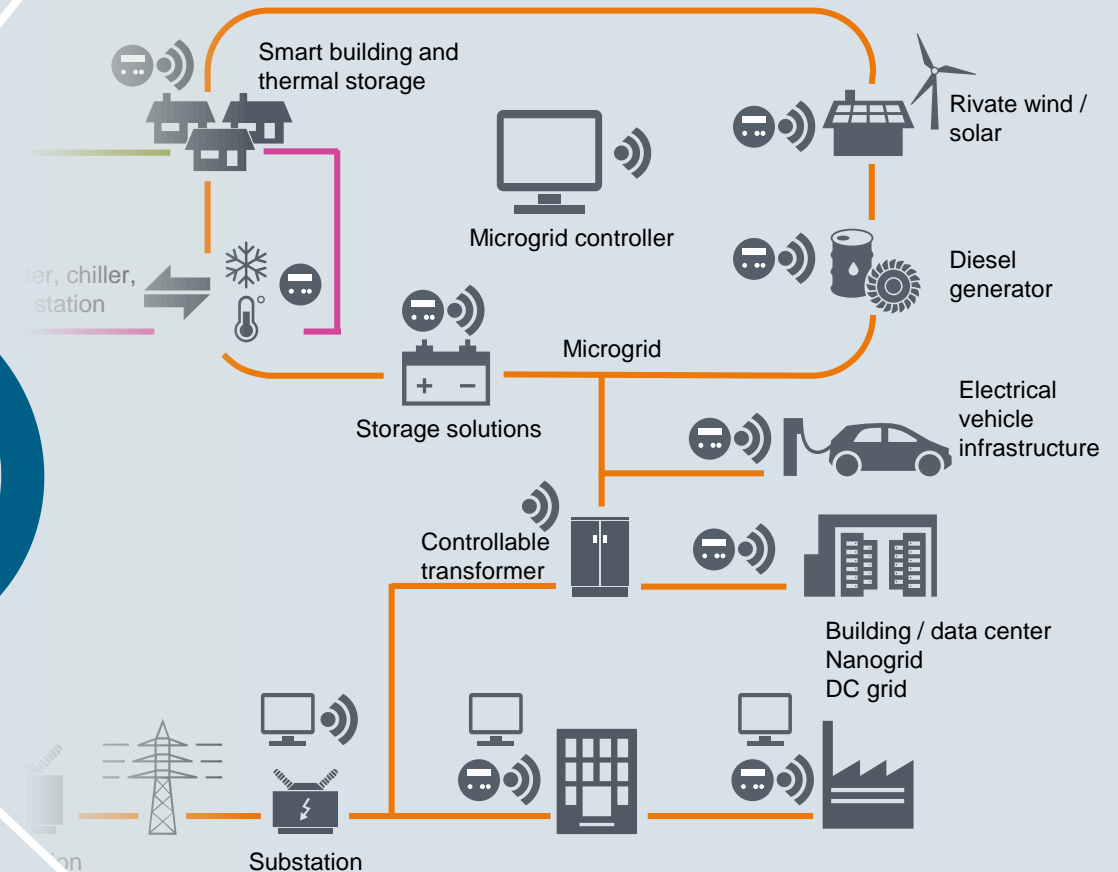# From centralized, unidirectional grid …

BUCHAREST 2018 SYMPOSIUM ON MICROGRIDS

…and bidirectional energy balancing in Decentralized Energy Systems

- **Increased Reliability**
- **Reduced Energy Costs**
- **Improved Grid Resilience**
- **Lower Emissions**
- **Enhanced Control**
- **Financed Solutions**

Smart building and thermal storage

Rivate wind / solar

Microgrid controller

Diesel generator

...er, chiller, ...station

Microgrid

Storage solutions

Electrical vehicle infrastructure

Controllable transformer

Building / data center Nanogrid DC grid

Substation

BUCHAREST 2018 SYMPOSIUM ON MICROGRIDS

Decentralized Energy systems and Microgrids have 3 major value propositions to be quantified and monetized
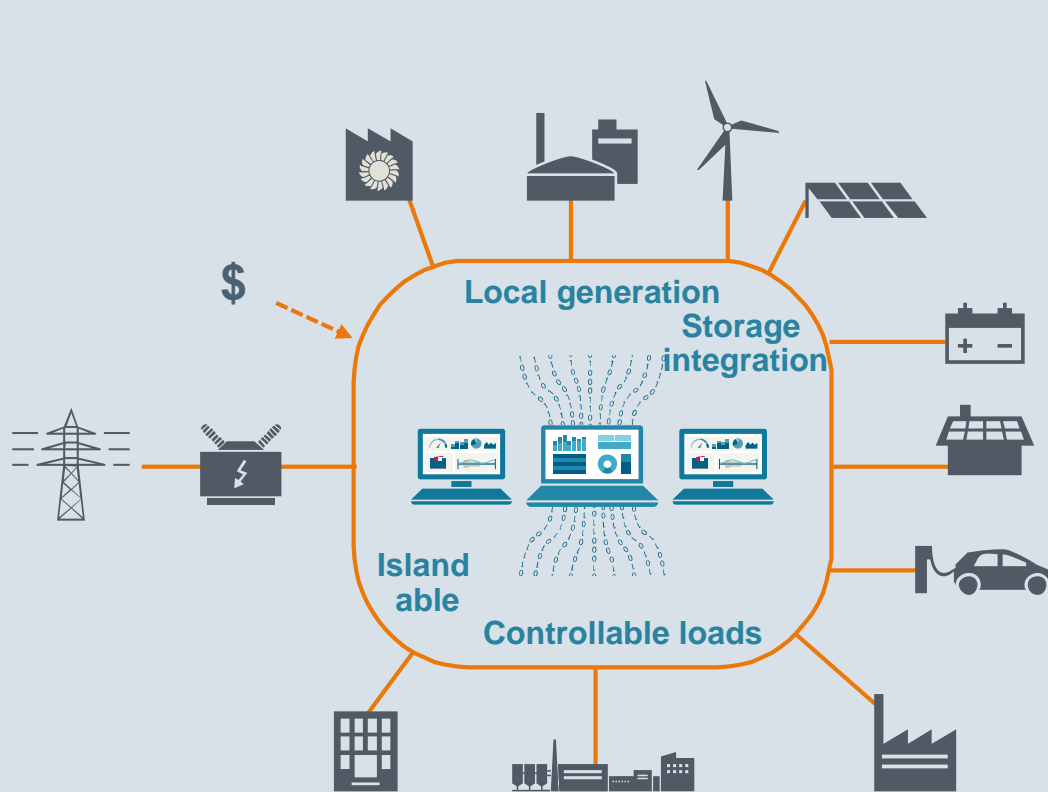
Economic & Energy efficiency
- Capex vs Opex
- Distributed generator control
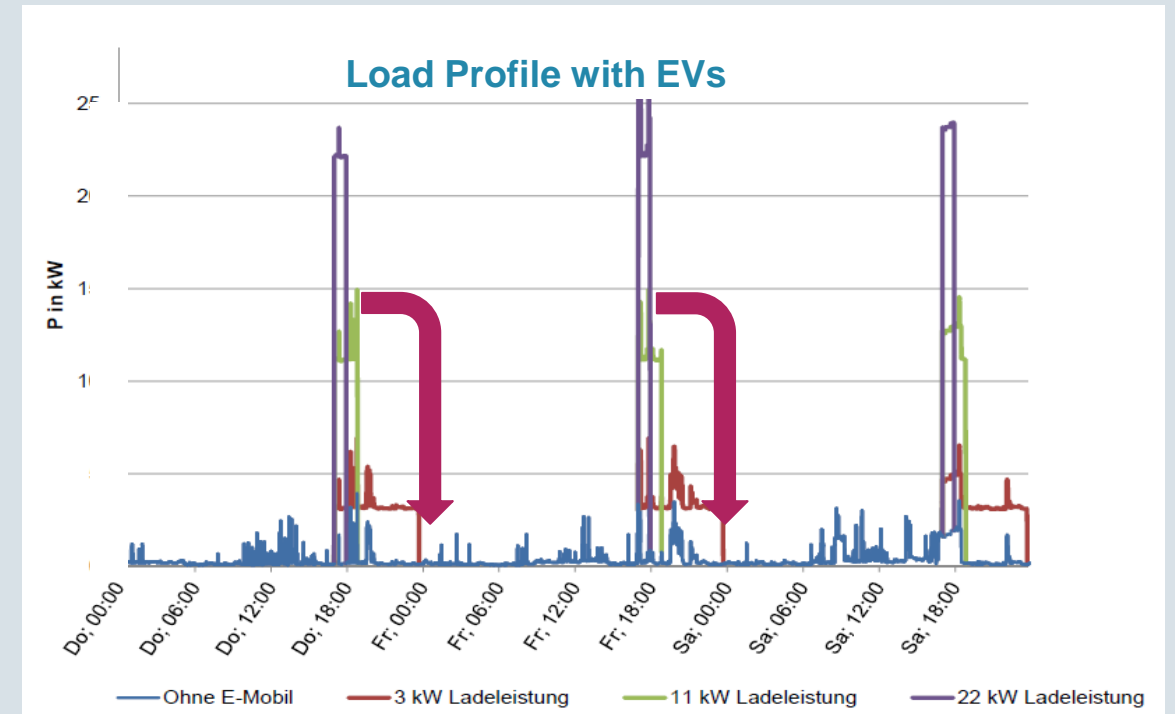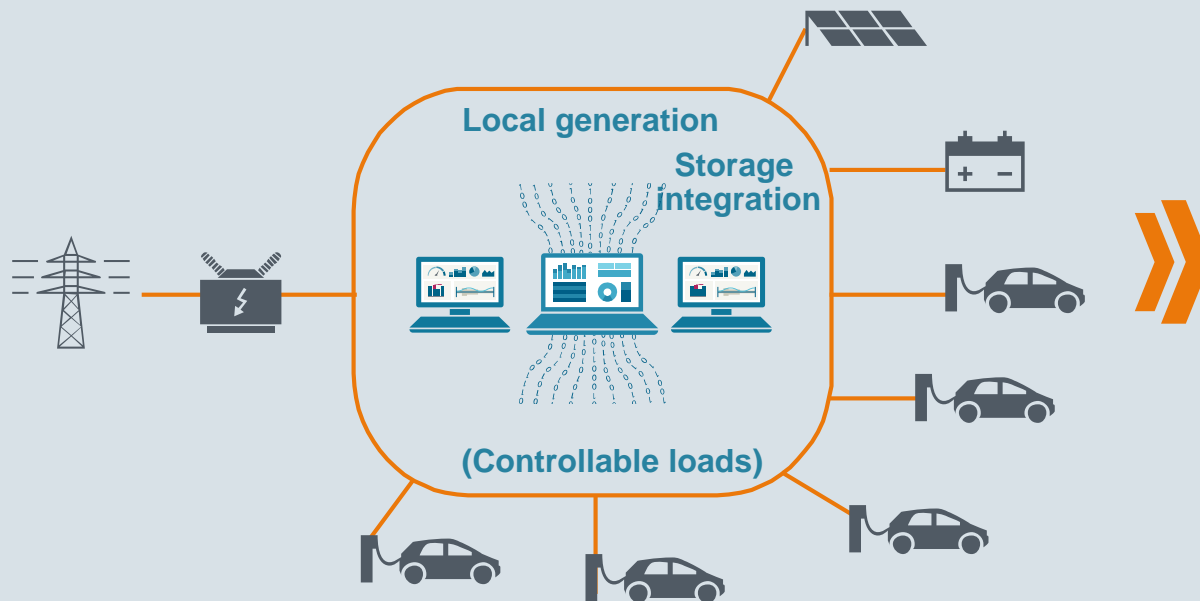- Load / storage control

Reliability, resilience
- Black start
- Network synchronization
- Online Control via HMI / Grid Monitoring and Control
- Enhanced SCADA functionality

Sustainability
- Generation / load forecast
- Dynamic grid constraint consideration using state estimator function
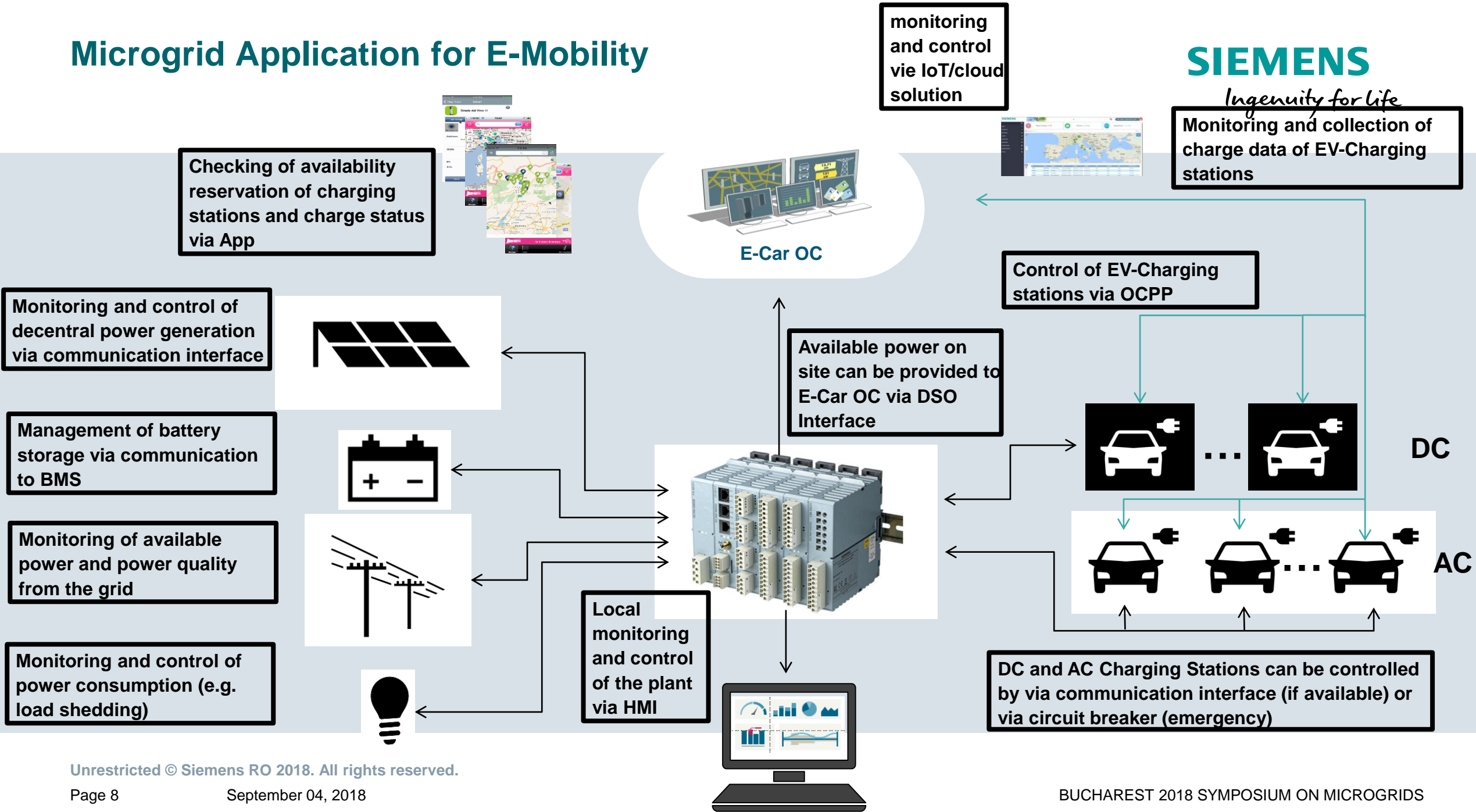
Local generation
Storage integration
Island able
Controllable loads

Solution for grid/load problems
E.g. Loading of E-cars in semipublic areas/park houses

Peak shaving function with an Electrical Storage System

Microgrid Application for E-Mobility

monitoring and control vie IoT/cloud solution

Monitoring and collection of charge data of EV-Charging stations

Checking of availability reservation of charging stations and charge status via App

E-Car OC

Control of EV-Charging stations via OCPP

Monitoring and control of decentral power generation via communication interface

Available power on site can be provided to E-Car OC via DSO Interface

Management of battery storage via communication to BMS

DC

Monitoring of available power and power quality from the grid

AC

Local monitoring and control of the plant via HMI

Monitoring and control of power consumption (e.g. load shedding)

DC and AC Charging Stations can be controlled by via communication interface (if available) or via circuit breaker (emergency)

Microgrid Show Case and Test Laboratory
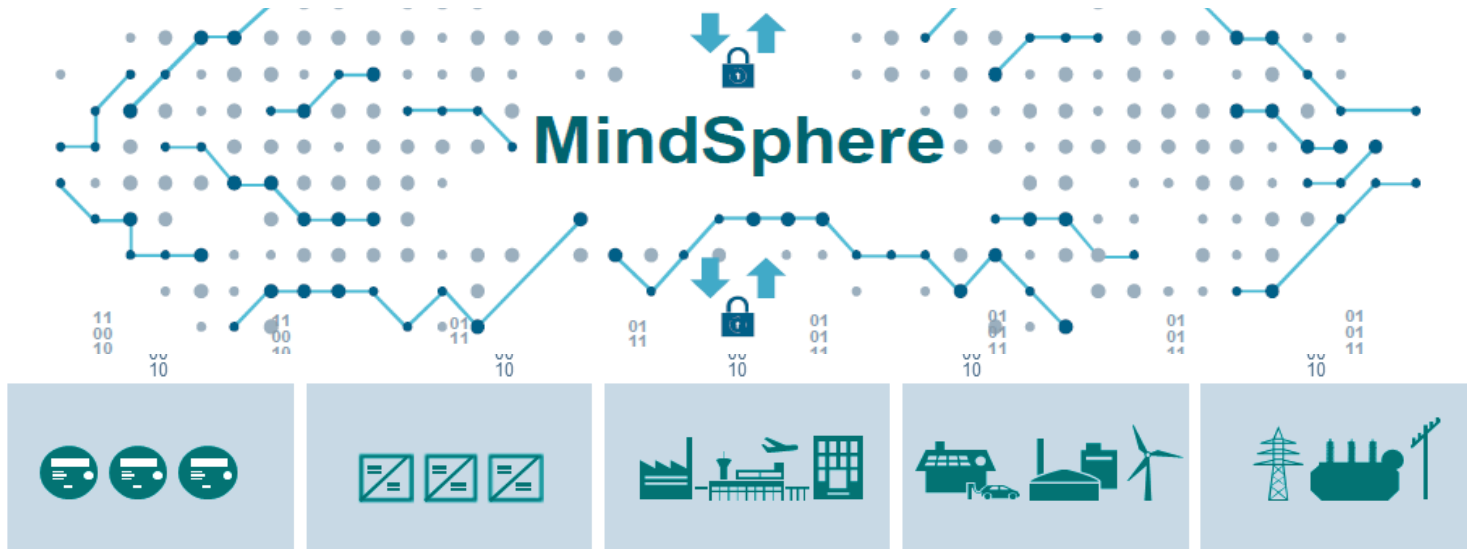## Erlangen / Germany
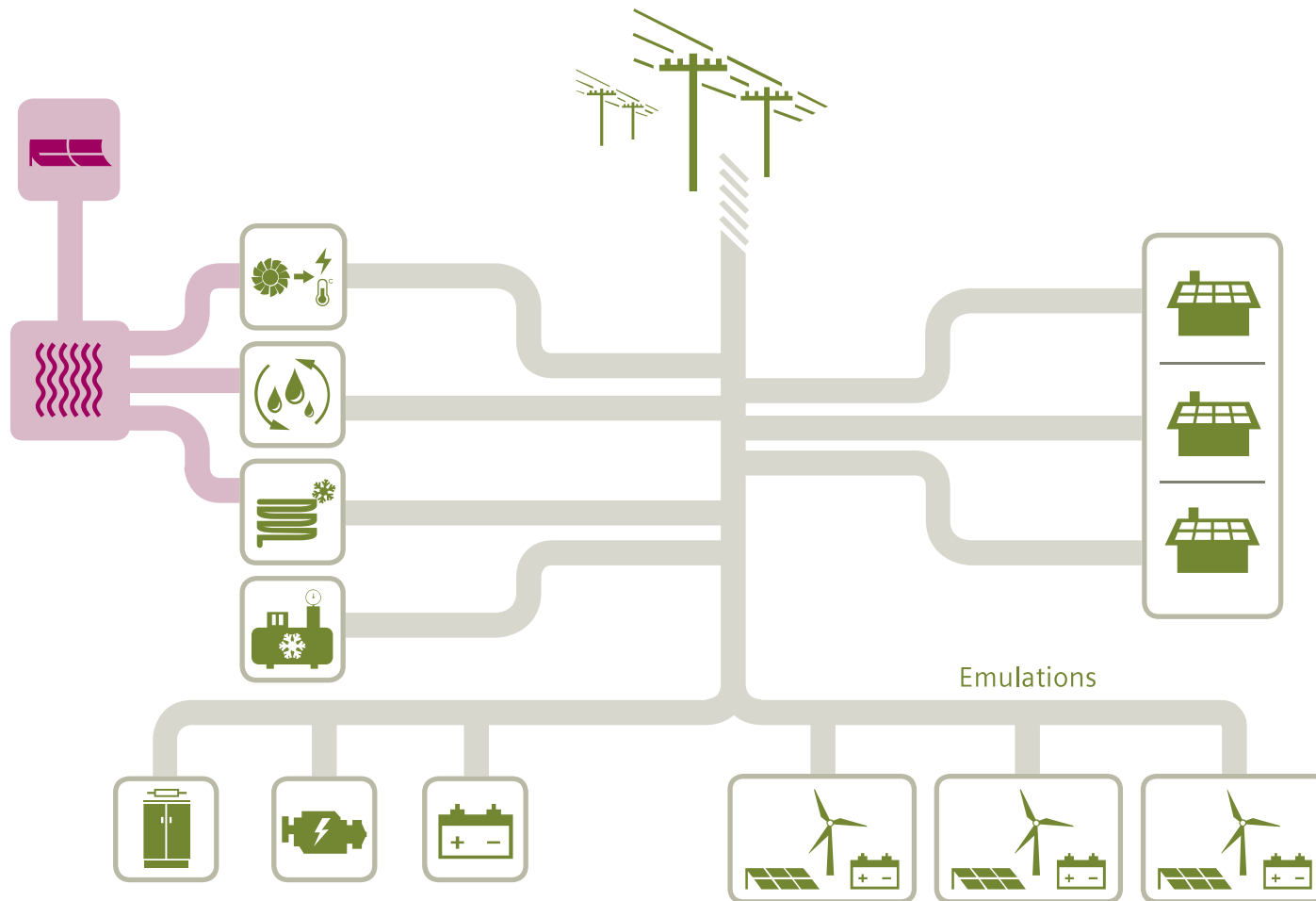
Built-in equipment for "electrical" microgrid:

- Diesel emulation (synchronous generator)
- Battery storage systems incl. inverters
- Adjustable loads
- Inverter-based emulation systems
- Controllable distribution transformer
- Circuit breaker
- Synchronization and protection relay

Emulations

EnergyIP – Powered by MindSphere
Flexible scalable platform and even more smart grid applications

EnergyIP MDM
Meter Data Management

EnergyIP
Analytics Suite

EnergyIP Prepay
Prepaid Energy Solution

EnergyIP DEMS
Demand Response & Virtual Power Plants

EnergyIP DEOP
Distributed Energy Optimization

EnergyIP EEA
Energy Efficiency Analytics

EnergyIP MTM
Market Transaction Management

EnergyIP SDM
Substation Device Management

MindSphere

- Powerful IoT-platform for management of data from millions of distributed assets in near a real time
- Efficient IT-OT integration between IT-applications and field devices
- Utility data model to interpret data from energy assets
- Bi-directional, closed-loop communications

- **No CAPEX, less risk with Software as a Service. Running in a virtualized public data center e.g. AWS**

EnergyIP DEOP
Performance Monitoring and Decentralized Energy Optimization
for PV Plants, Wind Parks, Commercial Centers, Campuses and Microgrids
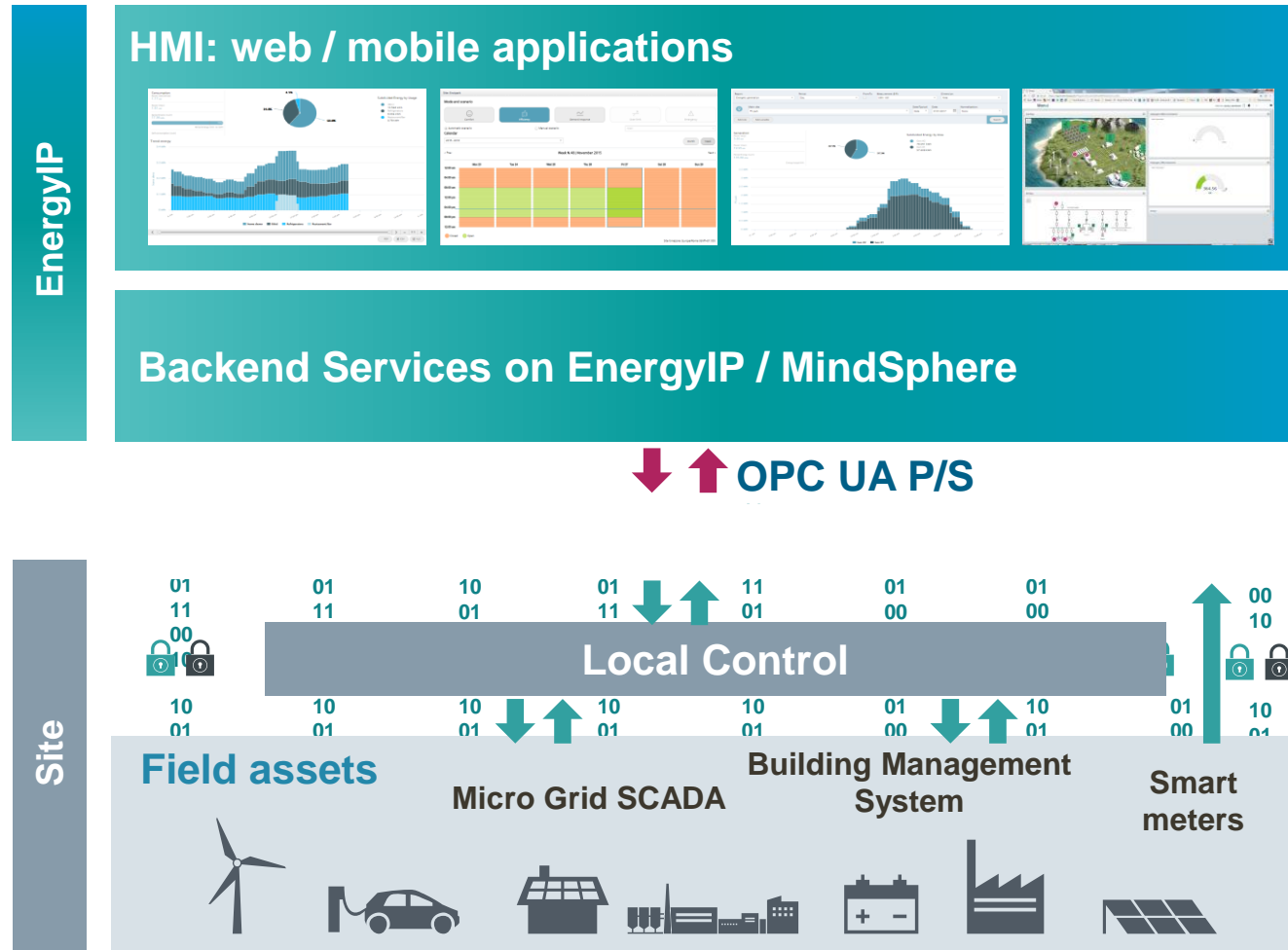
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Transparency & Energy KPIs

- Geo/Energy/Tech navigation
- Support of geo maps
- Electric/Thermal/Gas monitoring
- Dashboards & Reporting
- Alarming based on triggers and KPIs

DER Performance Monitoring

- Generation forecast of PV/Wind based on weather forecast data
- Performance monitoring vs. historical data / benchmark
- Financial reporting

Micro-Grid Optimization

- Simple rules based load management
- Self-consumption optimization (Load+ Battery +PV)
- Optimal Scheduling based on units constraints & costs

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High Level System Architecture

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EnergyIP

HMI: web / mobile applications

Backend Services on EnergyIP / MindSphere

⬇⬆ **OPC UA P/S**

Site

Local Control

Field assets

Micro Grid SCADA

Building Management System

Smart meters

Monitoring of multiple asset types

- Grid, building, generators, storage, loads, sensors, actuators …

Several connectivity options
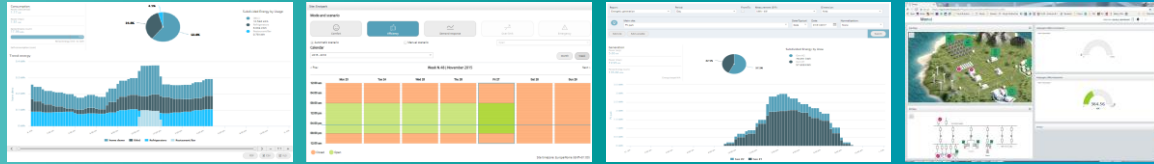
- OPC UA P/S as primary communication protocol.

Integration with Siemens Portfolio

- PSS DE simulation tool for Distributed Energy System
- SICAM MG Controller
- E-car OC for EV infrastructure management
- Desigo CC for Building Management

Micro-Grid
\ Control Integration

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EnergyIP

HMI: web / mobile applications

Backend Services on EnergyIP / MindSphere
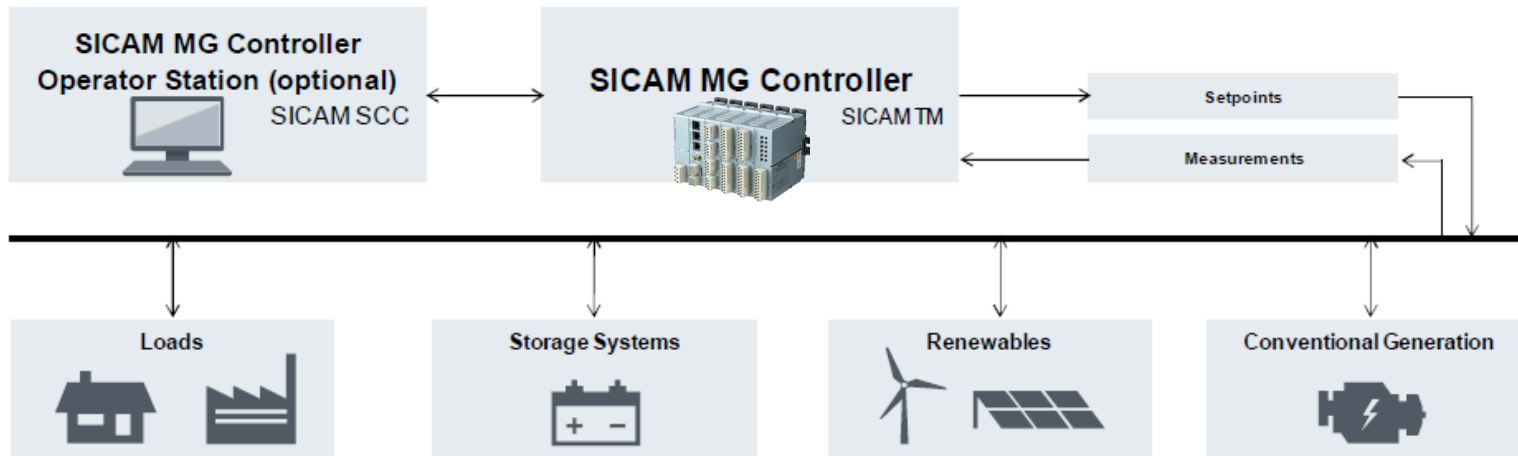
EnergyIP

- Micro-Grid performance monitoring
- Optimal scheduling
- Optimal set-points curves

SICAM MG Controller
Operator Station (optional)
SICAM SCC

SICAM MG Controller
SICAM TM

Setpoints

Measurements

Loads

Storage Systems

Renewables

Conventional Generation

SICAM MG Controller

- Primary / Secondary control
- Black-Start
- Network synchronization

Demand-Response & Aggregation
\ Integration with DEMS
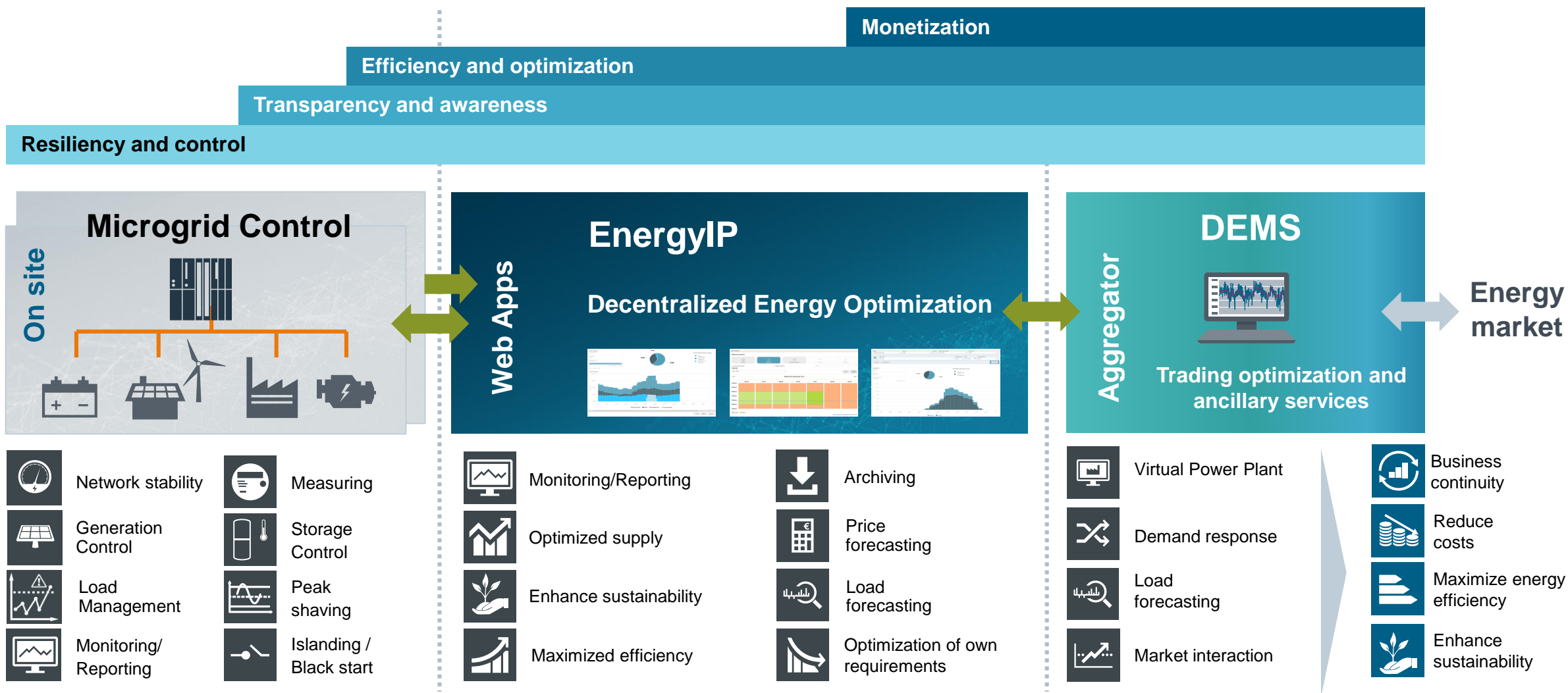
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Monetization

Efficiency and optimization

Transparency and awareness

Resiliency and control

On site

Microgrid Control

Web Apps

EnergyIP

Decentralized Energy Optimization

Aggregator

DEMS

Trading optimization and ancillary services

Energy market

Network stability	Measuring	Monitoring/Reporting	Archiving	Virtual Power Plant	Business continuity
Generation Control	Storage Control	Optimized supply	Price forecasting	Demand response	Reduce costs
Load Management	Peak shaving	Enhance sustainability	Load forecasting	Load forecasting	Maximize energy efficiency
Monitoring/ Reporting	Islanding / Black start	Maximized efficiency	Optimization of own requirements	Market interaction	Enhance sustainability

Summary

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Microgrid is the ultimate application for the smart energy trend that will dominate the energy sector in the next decades in versatile applications:

- **Distributed Energy**

- **Renewable Energy**

- **Energy storage**

- **Load Management for E-Cars (EV)**

- **Communication**

- **Big Data**

Contact

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