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HOW TO OPTIMISE THE OVER PRODUCTION OF PV ELECTRICITY INTO THE GRID?

Amsterdam, 25th September 2014

PROJECT PARTNERS

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Skelleftea Kraft AB (SKR)
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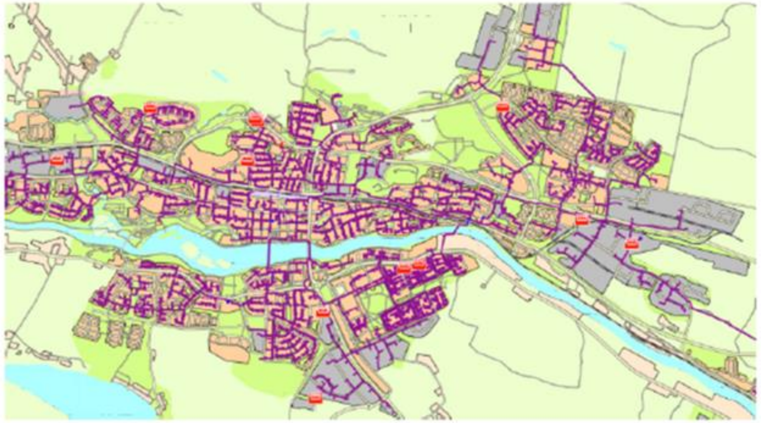
CONTENT

AIM

Development of *Cooperative Control Strategies* for Smart Cities´ Hybrid Energy Network Control System Solutions to optimize the synergies between the multiple energy grids



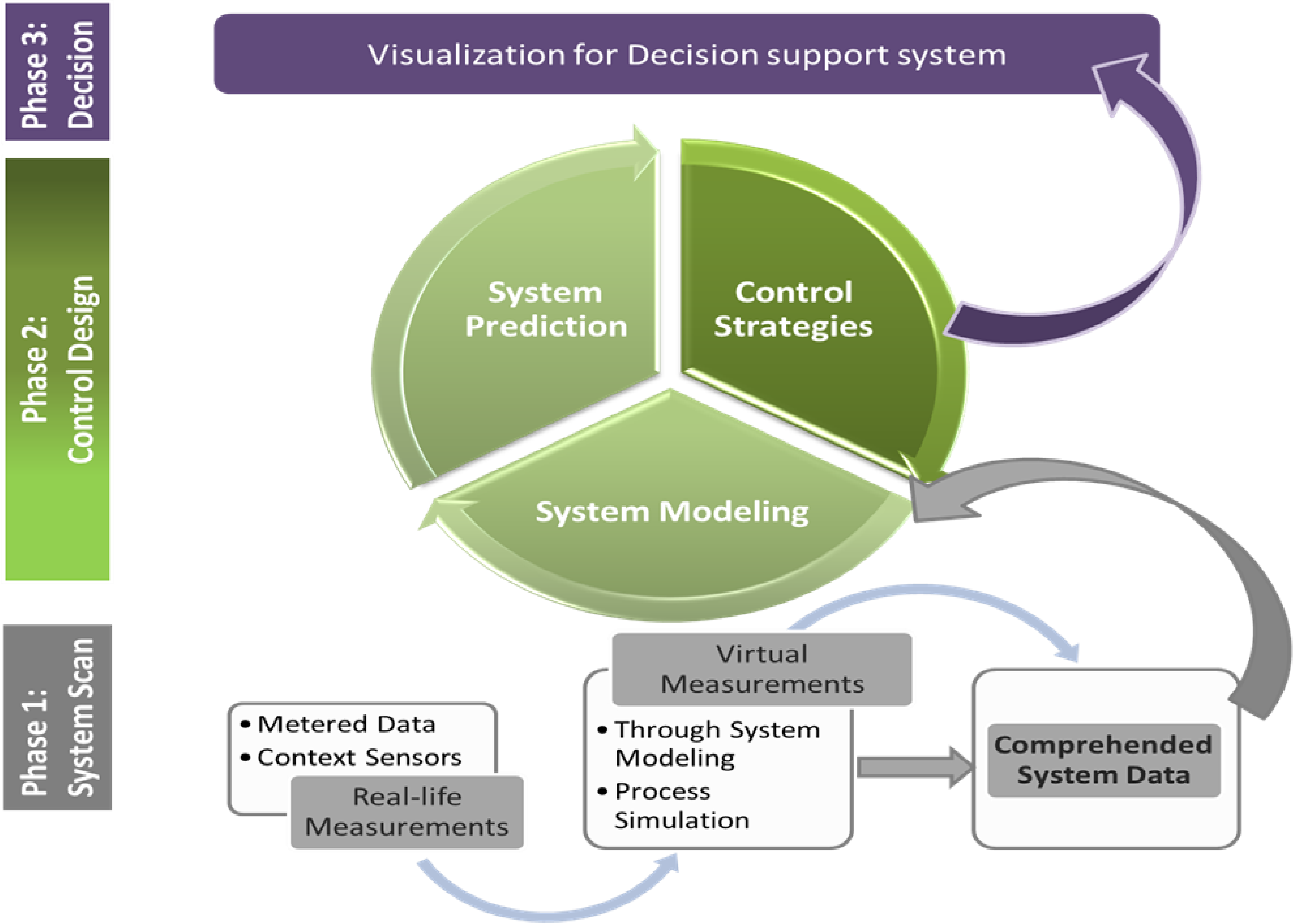
Skellefteå area in Sweden
(Note: District area network (purple), CHP and pellets/oil burner plants in (red)

Test Area in Ulm, Germany
(Overlaid of the roof solar potential analysis and the position of the PV systems and transformer station)

IMPACT

- Improve the profits for suppliers and prosumers
- Energy savings and
- Improvement of energy efficiency
- Environmental impact, e.g. CO_2 reduction
- Further economical and social impact

CONCEPT



Phase 3: Decision
Phase 2: Control Design
Phase 1: System Scan
Visualization for Decision support system
System Prediction
Control Strategies
System Modeling
Metered Data
Context Sensors
Real-life Measurements
Virtual Measurements
Through System Modeling
Process Simulation
Comprehended System Data

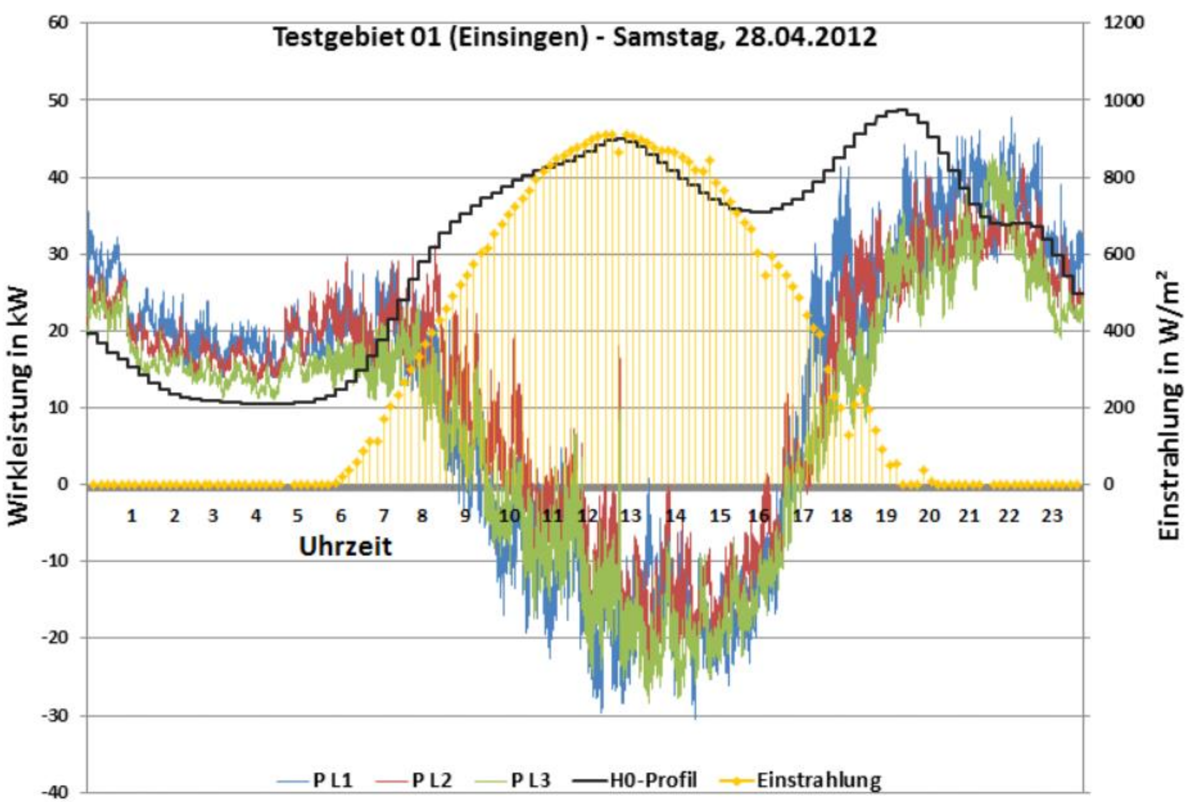
TEST SITE: ULM EINSINGEN

Situation 2013

Housed	133
PV Systems	21
Power	233 kWp
Load:	~747 MWh
PV:	~ 230 MWh

PV Fraction: 31%

- **Power flow at the LV transformer**



Messung an 8 Transformator-Abgängen im Sekundentakt

Gefördert Im Rahmen des EU FP7-Projekts ENDORSE

COUPLING POINTS

Def.: Technologies enabling a physical connection between different energy domains

Technology	Today	Tomorrow	Future
Electric Heater with PV	Electricity to heat		
Heat Pump with PV	Electricity to heat		
Demand Side Management		Load shifting	
Power to Gas			Electricity to gas
Biogas Bottle		Self generation Biogas to heat	Self generation Biogas to heat

➢ Any measure has an effect on the private customer, energy service provider, grid operater resulting in reduced bill and/or grid usage or even replace the grid

DESIGN OF CONTROL SETUPS

The following three control setups have been designed in order to represent and generalize the conditions present at the test sites in Skellefteå and Ulm:

- "*Cooperative green supplier*"
- "*Carbon-free heating*"
- "*Green Community*"

‚GREEN COMMUNITY'

Reflecting Demosite in Ulm

The "*Green Community*" control setup establishes a local energy balancing for active prosumers community.

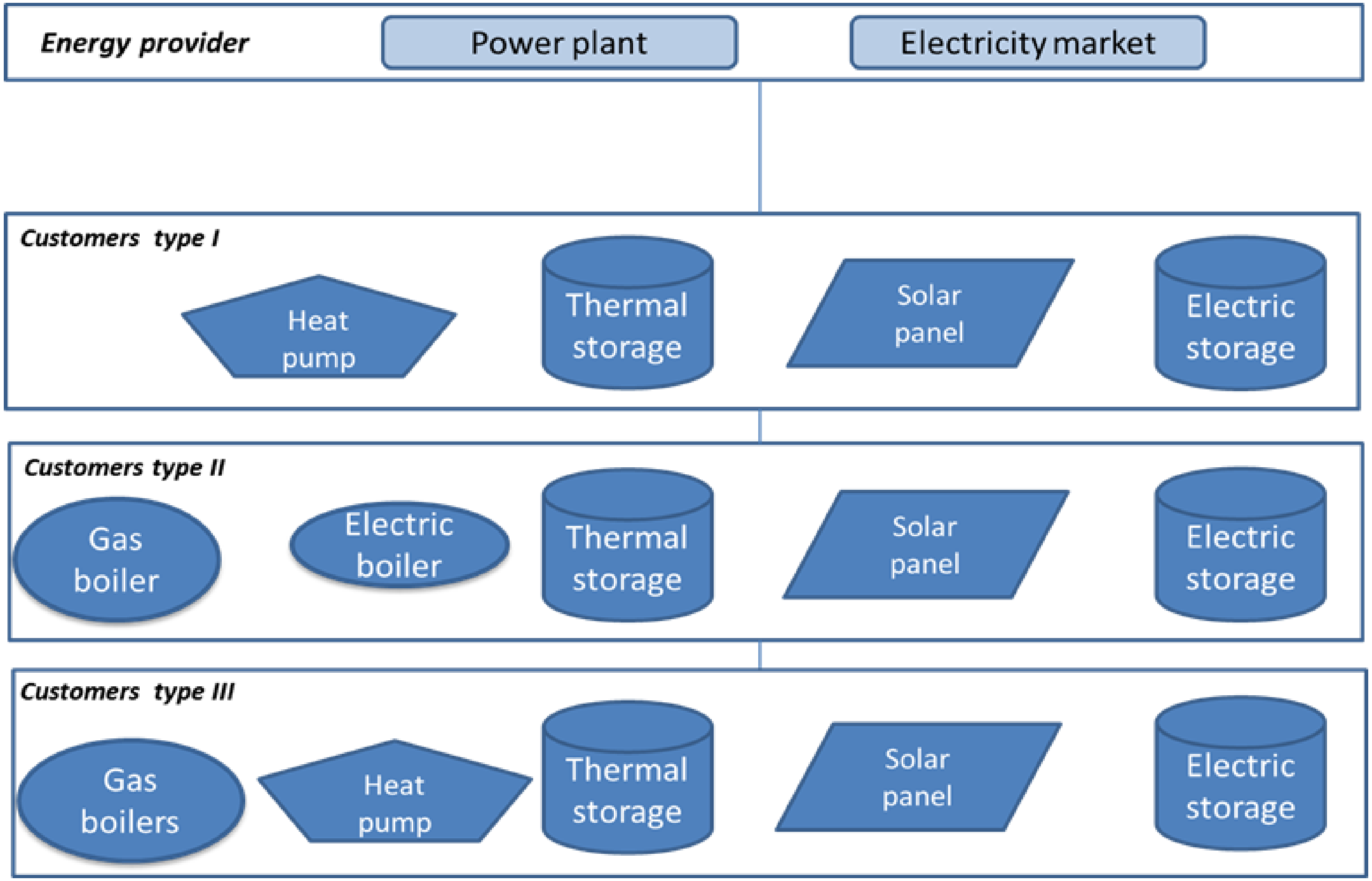
- All prosumers have solar panels, thermal and electric storage facilities.
- Additionally some of them have heat pumps and gas boilers; others just heat pumps, while a last group also maintains gas and electric boilers.
- The prosumers can exchange their electric energy, buy or sell electric energy, and buy gas from a gas provider.

Principal targets:

- to minimize the total amount of energy (gas and electricity) bought from the energy providers,
- to operate the community grid as sustainable as possible with local energy capacities.

➢ The market conditions asked for in this final setup are creative with aspect of hybrid grids, as here prosumers aim to create local community competing and/or cooperating with the grid operators for their benefits.

SYSTEM ARCHITECTURE FOR CONTROL STRATEGIES



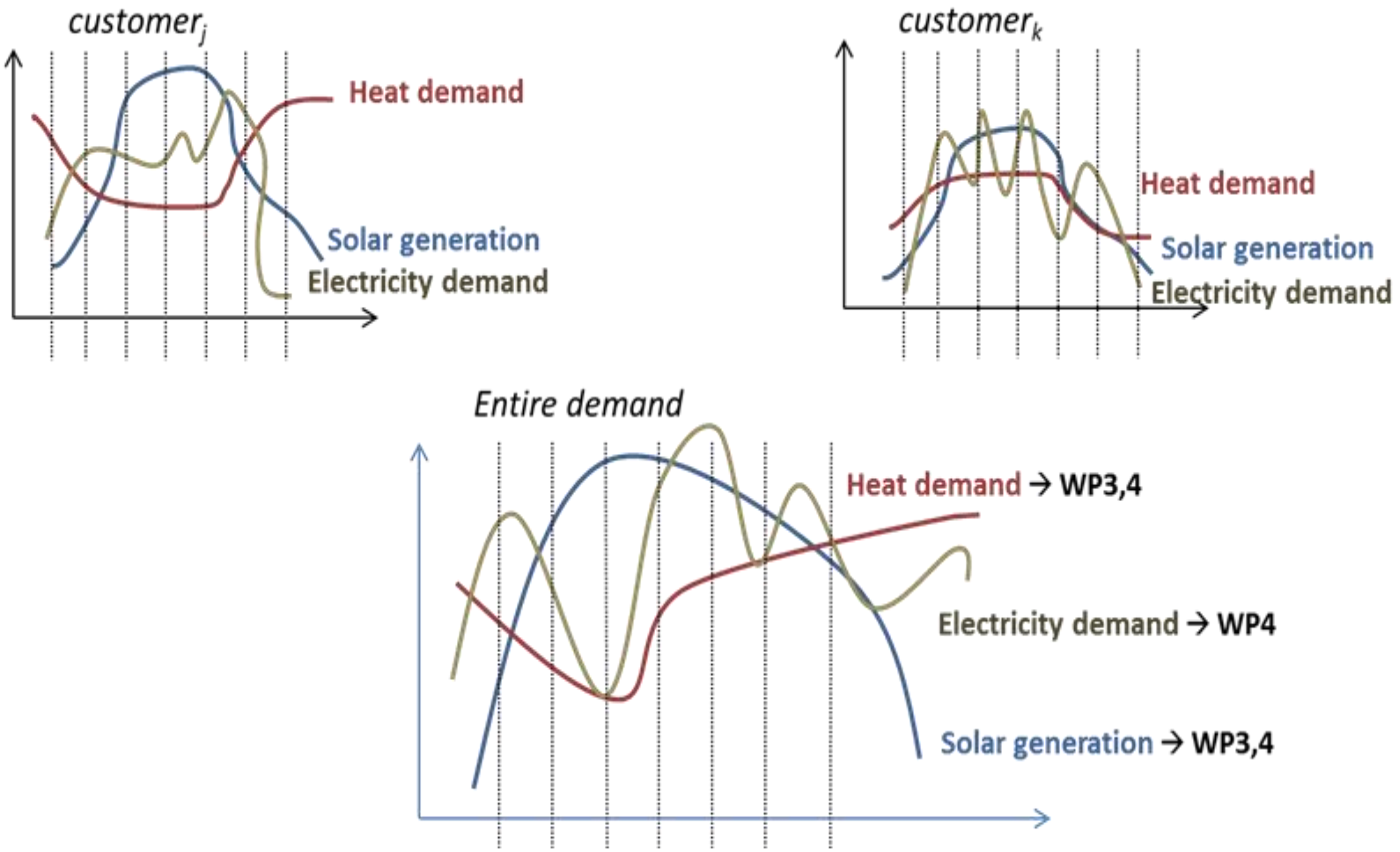
METRICS FOR CONTROL SETUP (1)

- Economic:
  - Economic and social benefits for community (members, and as the whole)
  - Distributed sustainability: minimization of energy bought from external grids (autonomy of local communities)
  - Cost reduction for investments, and maintenance on short, medium and long term
  - → sustainable cooperation model to ensure maintenance of grid infrastructure
- Socio-environmental:
  - Social awareness energy problems - increasing active customer participation in energy management activities
  - Sustainable operation as community: Addressing diversity of customer base forming a flexible and diverse enough community to act on flexible power surplus/ demand patterns
  - Environmental aspects for CO_2 minimization

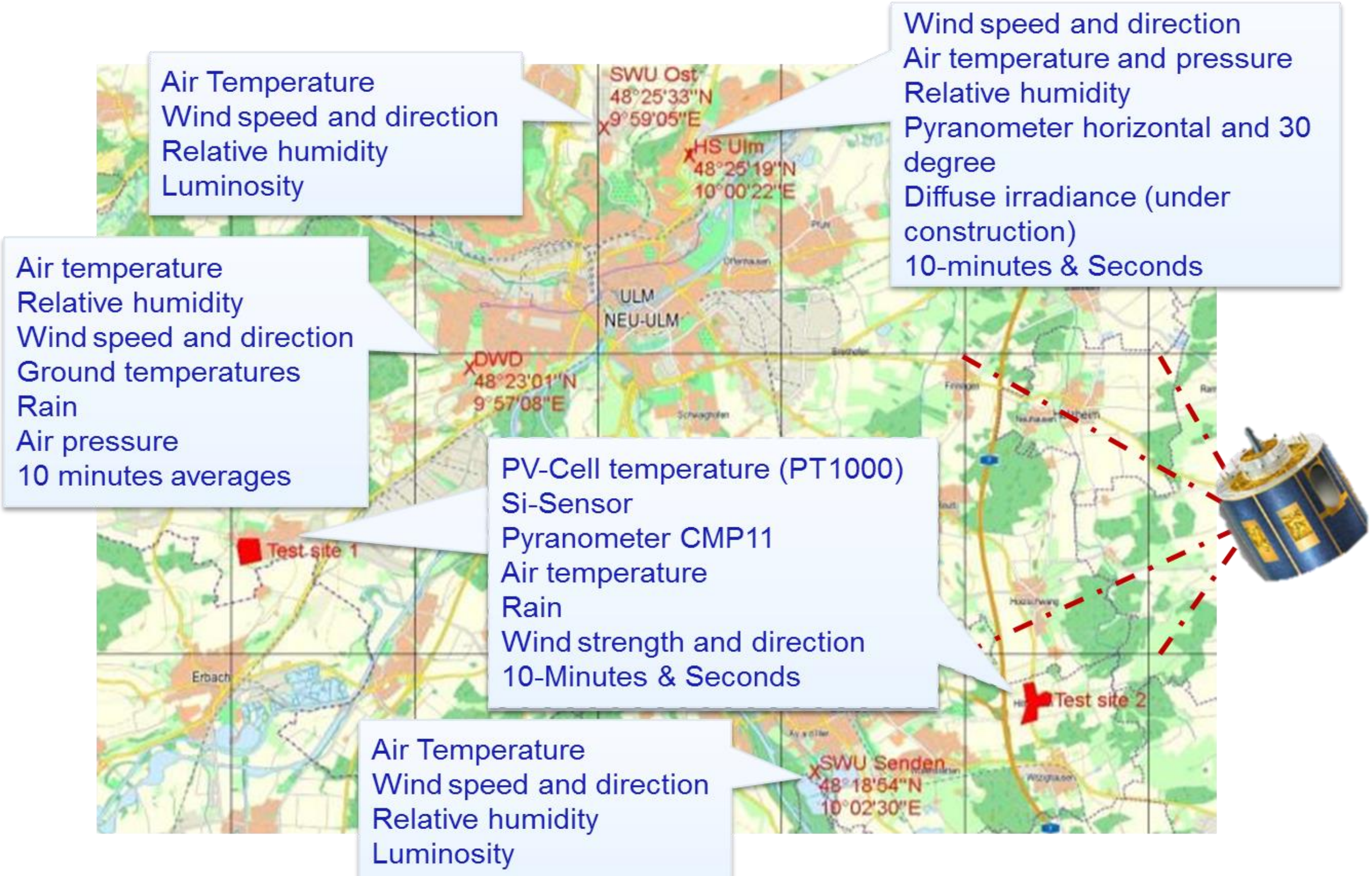
METRICS (2)

- Additional technical aspects:
  - Energy efficiency - exploitation of all energy sources available
  - Operation efficiency for infrastructure and local devices (self-production/ self-storage, shared storage)
  - Integration efficiency towards increasing RES penetration, reduction of energy losses, increase local consumption.
  - Reduced transmission capacities over community-connected substation (micro grid aspects)
  - Ensuring stability: power quality, voltage/ frequency stability
  - Limitation of ICT complexity while ensuring needed accuracy levels of data monitoring on grid and sophisticated context parameters (e.g. meteorological data, human behavior)

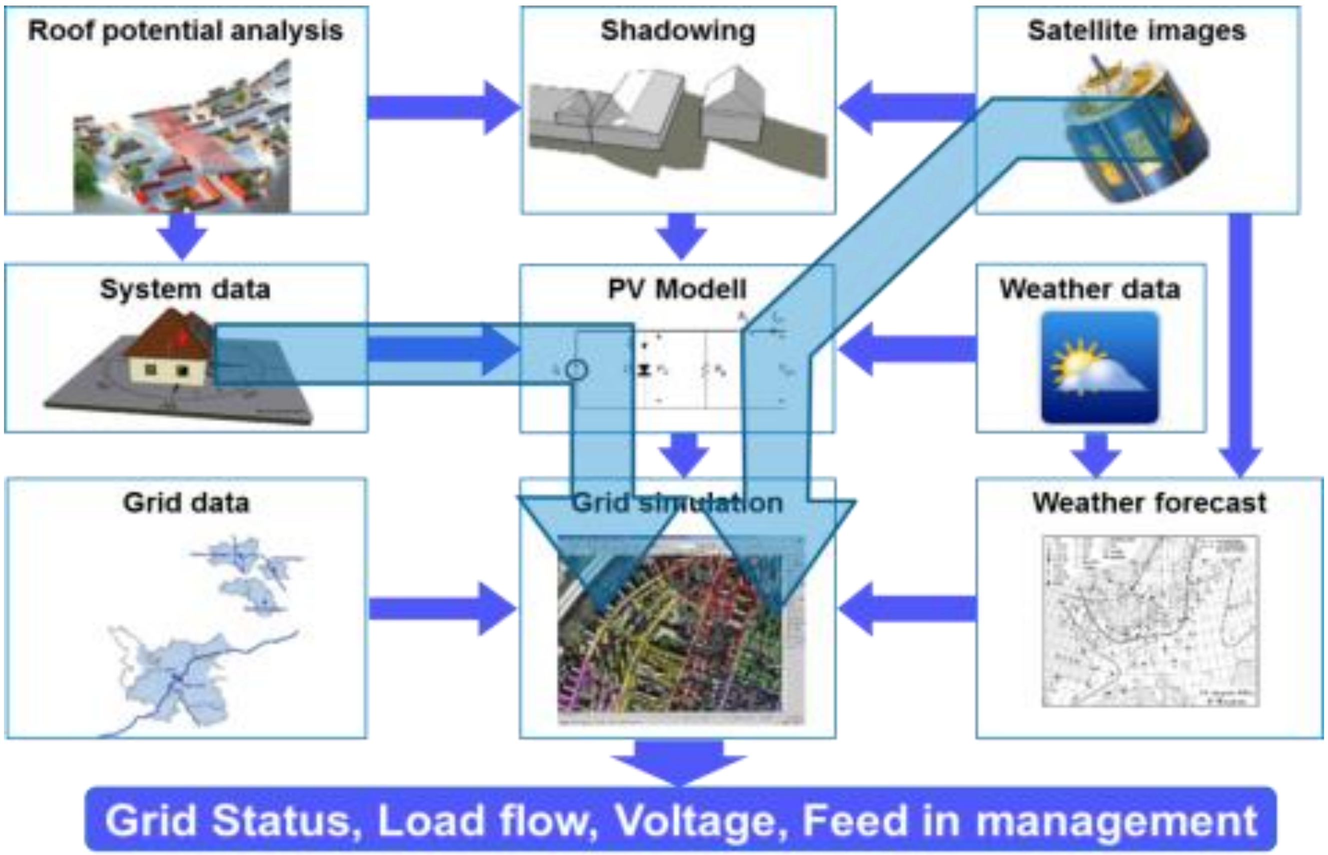
INPUT DATA NEEDED



MEASUREMENTS



DATA REQUIREMENTS



CONCLUDING REMARKS

To ensure the realization of efficient Operation of Hybrid Grids:

- A multi-faceted networks and flexible ICT
- Control and communication system across the entire hybrid value chain
- the connecting interfaces and processes between currently simultaneously and independently running energy networks have to be insured
- energy information network with strongly distributed system intelligence
- Standardization in ICT and business processes

Within the OrPHEuS project we are investigating the most critical aspects for control and communication system cooperation of energy system to realize a multitude of control strategies covering the European diversity in the energy landscape.

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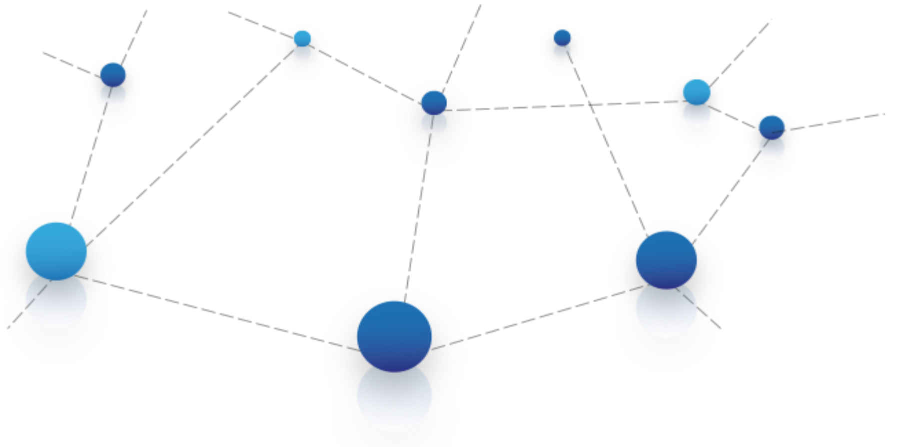

Thank you for your attention

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