Demonstration of Storage Enabled Integration of Smart Buildings in a Smart Grid

Siemens AG | CT REE PET DEH-DE | July 2016

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Demonstration of Storage Enabled Integration of Smart Buildings in a Smart Grid - Outline

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The complex and heterogeneous energy system is changed by the influence of decentralized fluctuating renewable energy generation*

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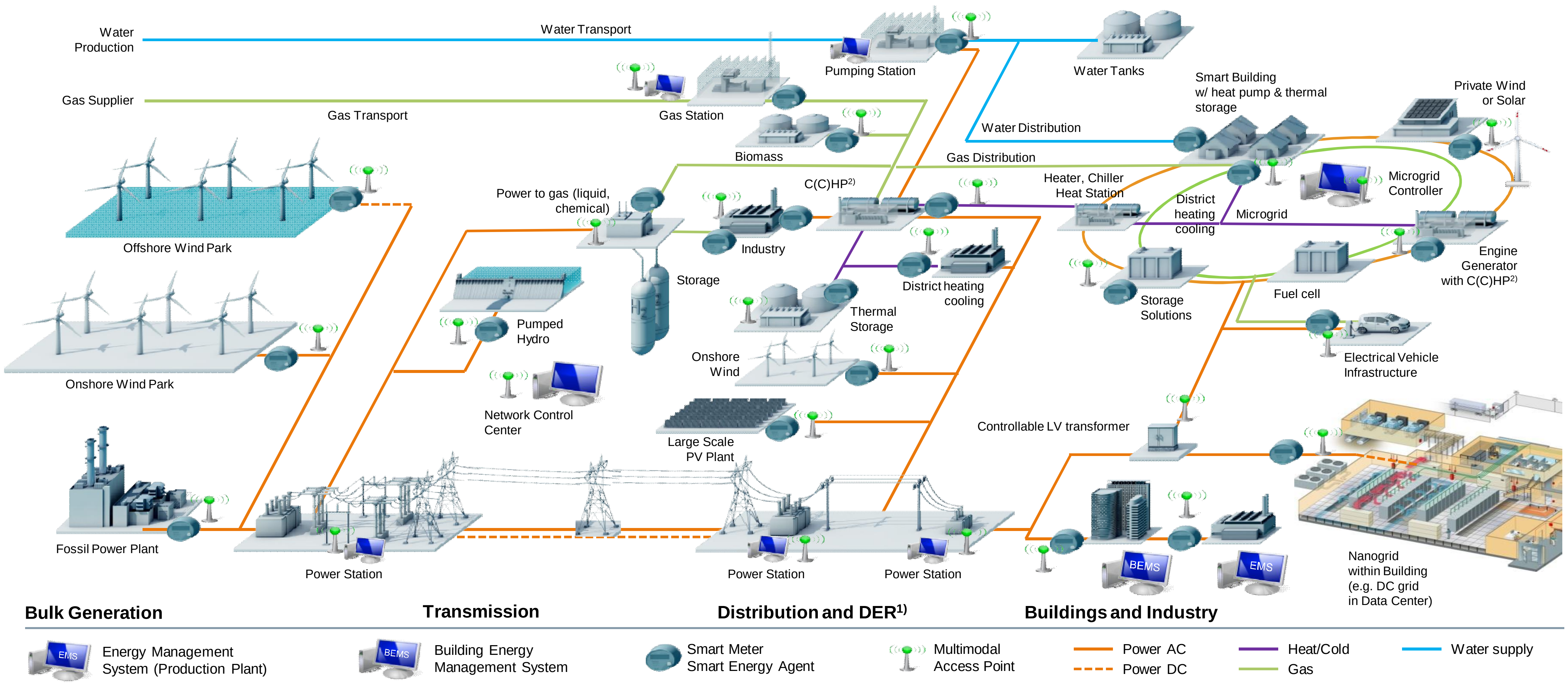

1) Distributed Energy Resources 2) Combined (Cooling) Heat and Power

* M. Metzger, CT REE PET

Electrical power supply in Europe relies on two distinct principles: Grid vs. Energy Supply / Spot Market*

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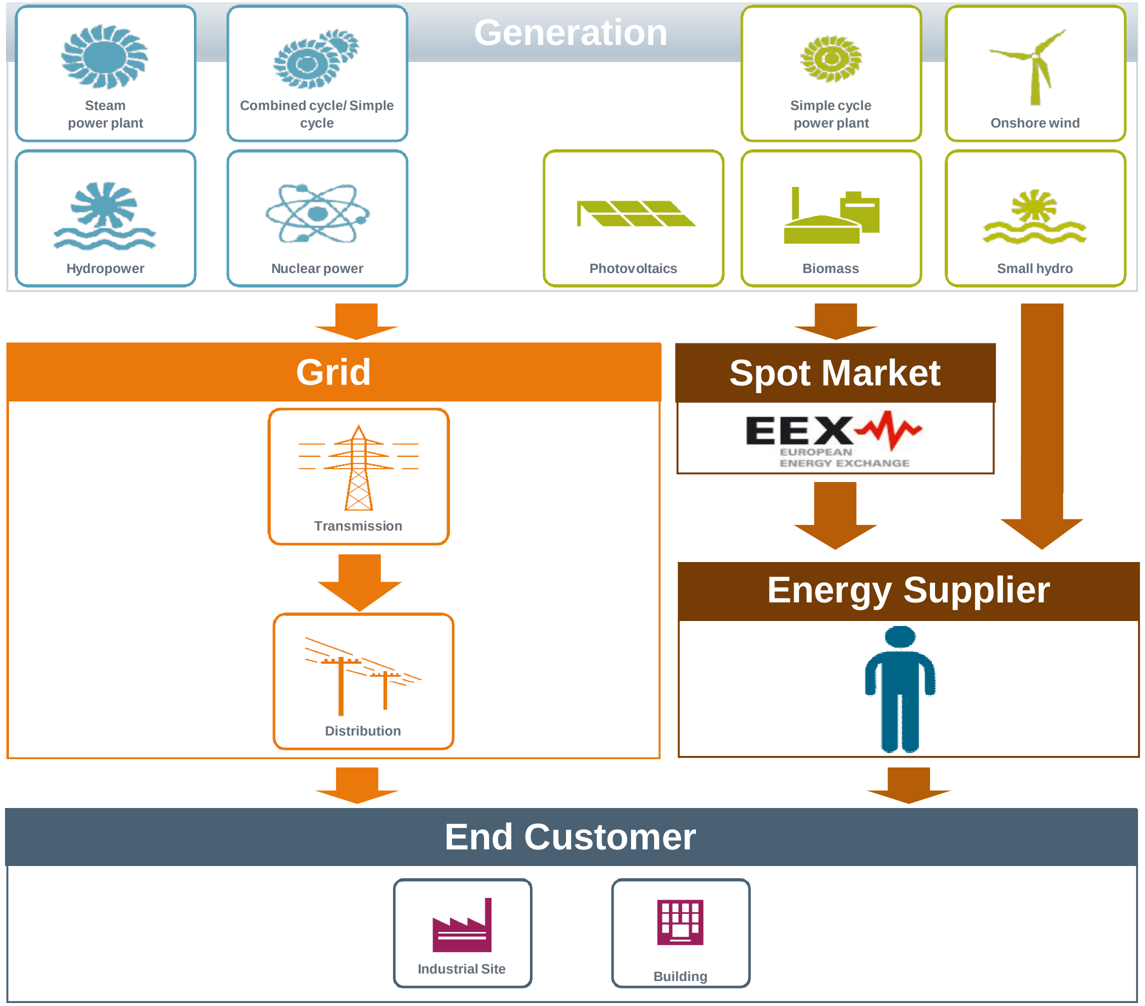


Grid

Transmission and distribution grid operators are responsible for grid stability.
Transmission and distribution grid operators have a monopoly.

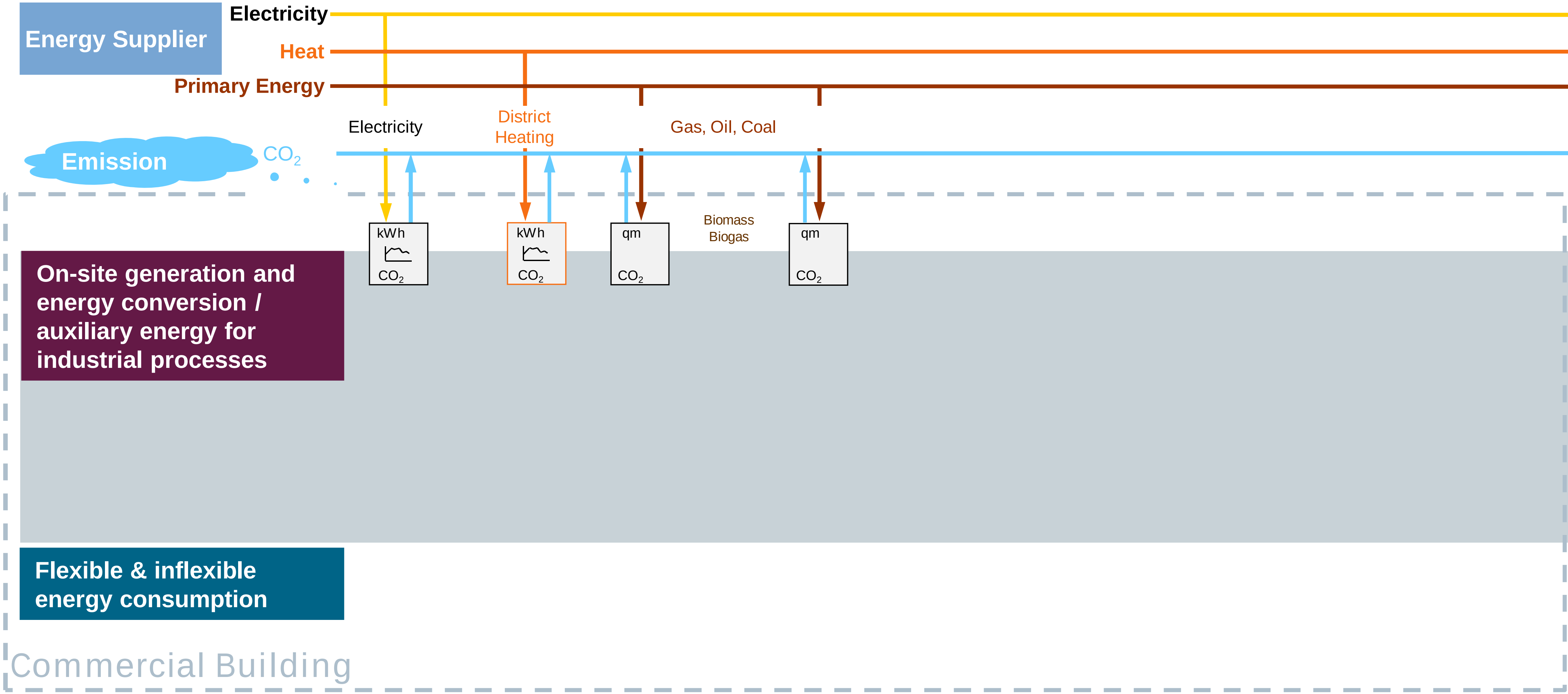
Energy Supplier

Energy suppliers are responsible for energy supply.
Energy suppliers are competitors.
A distribution grid is used by multiple energy suppliers.

The end customer can choose an energy supplier.

*based on Input from M. Weiss, EM MS S TIP

Future infrastructure at end customers provides flexibility with respect to the energy demand*



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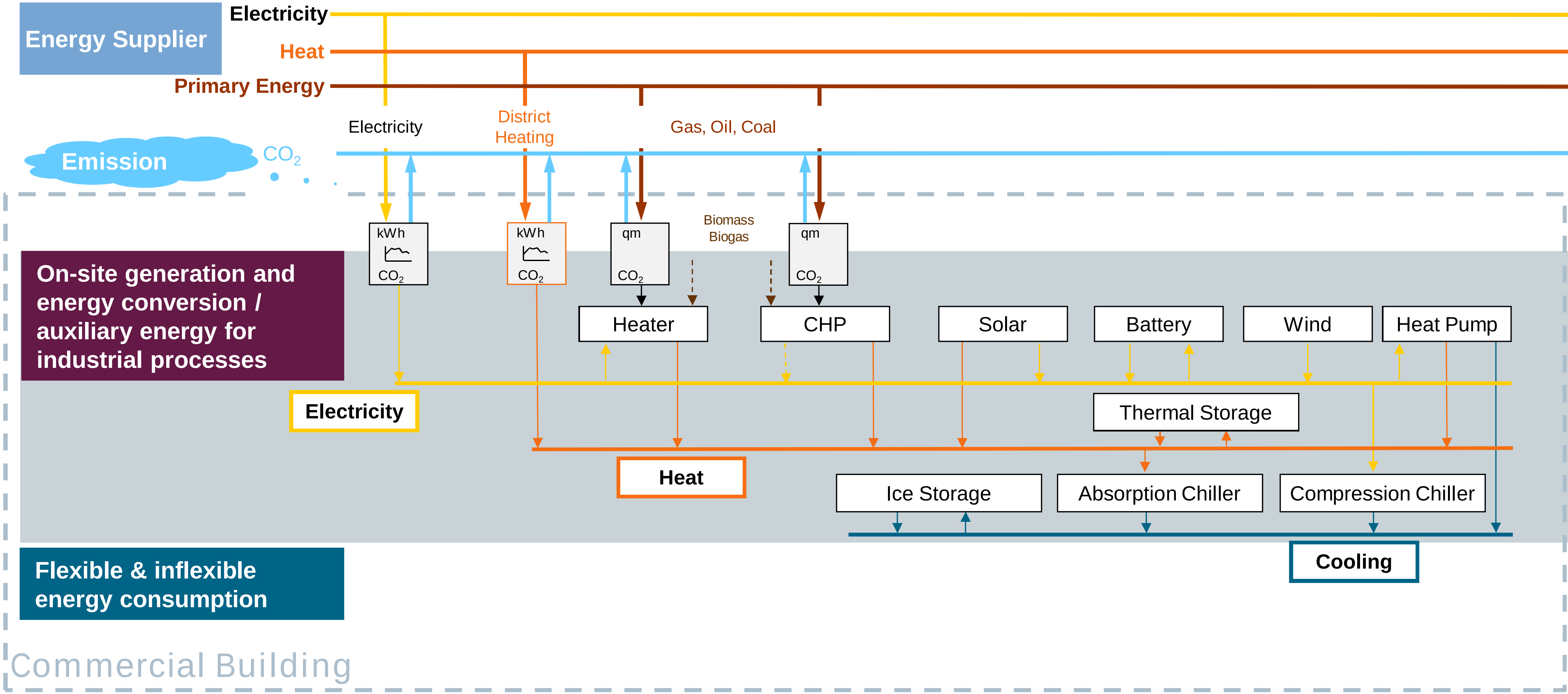

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Future infrastructure at end customers provides flexibility with respect to the energy demand* - Commercial Buildings

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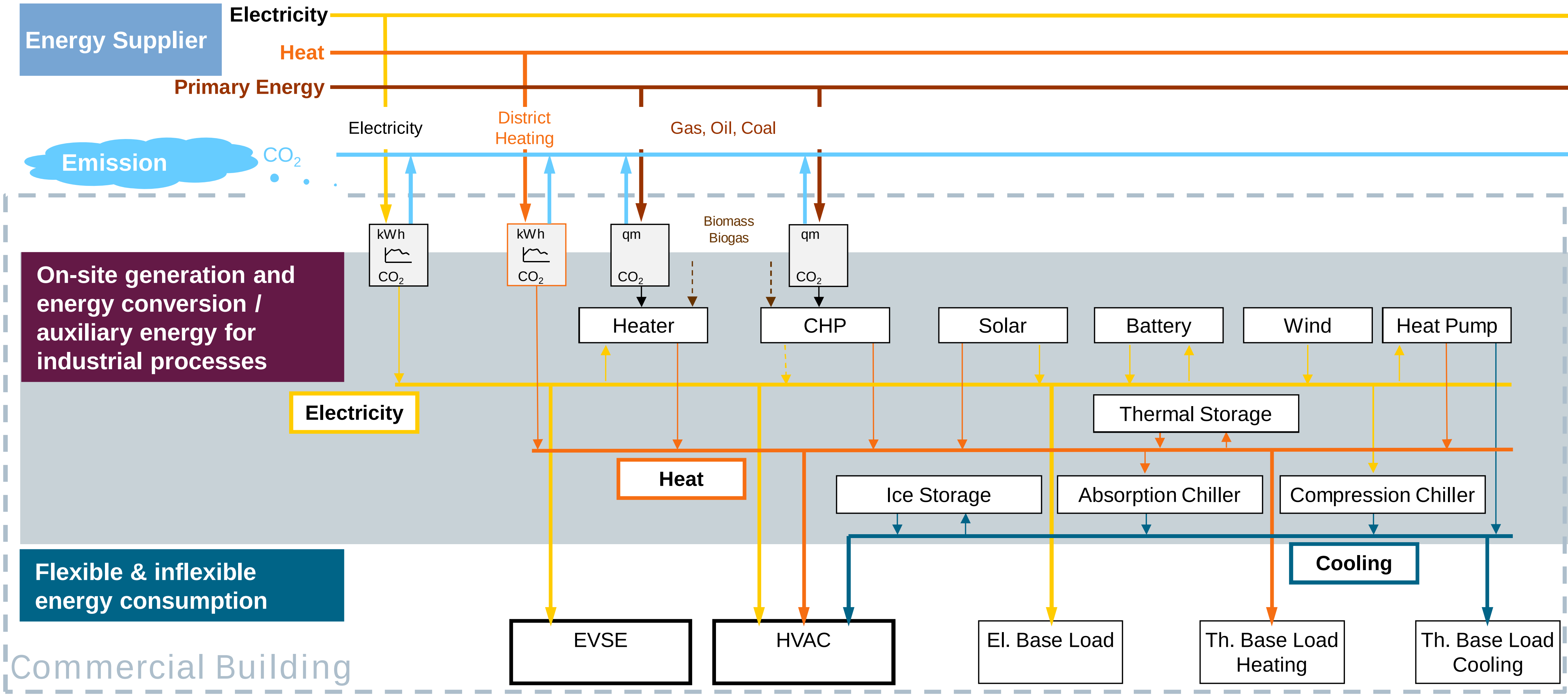

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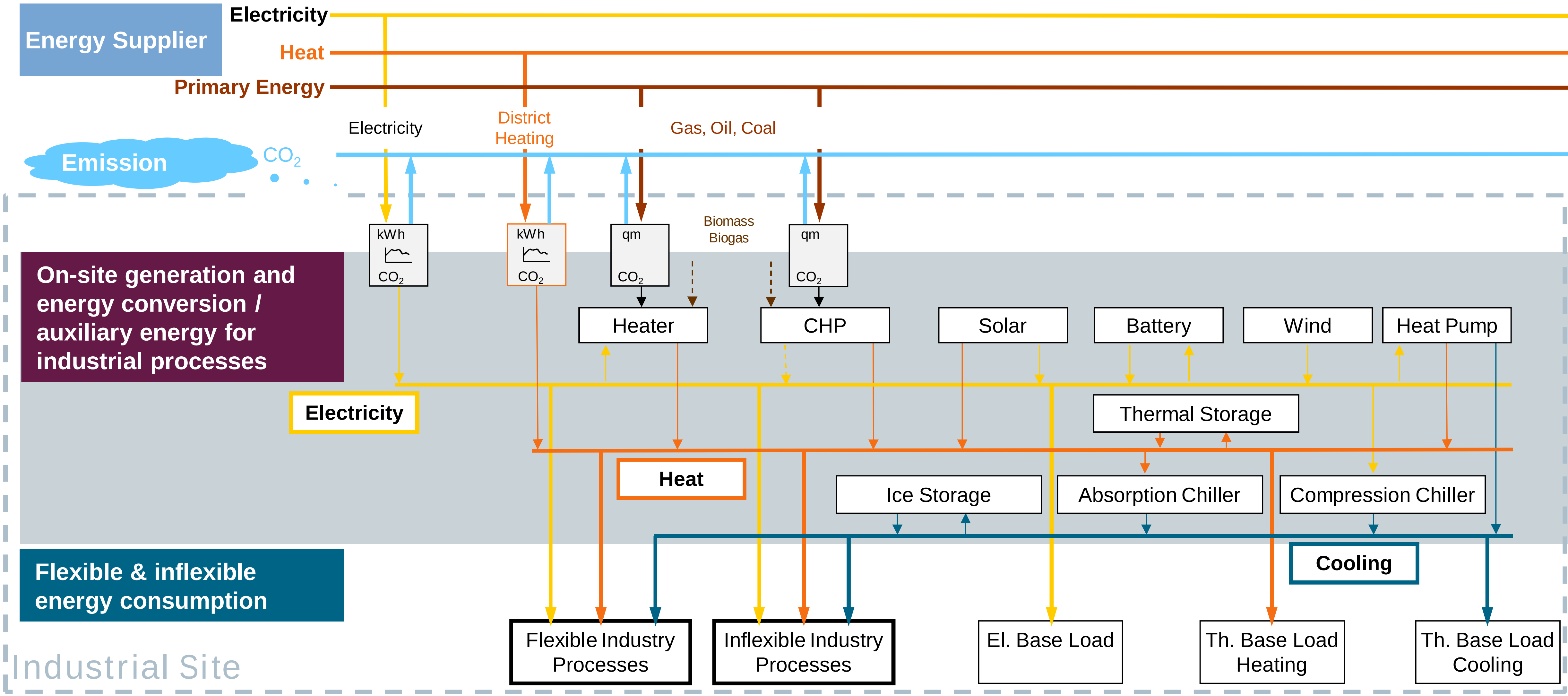
Future infrastructure at end customers provides flexibility with respect to the energy demand* - Industrial Automation



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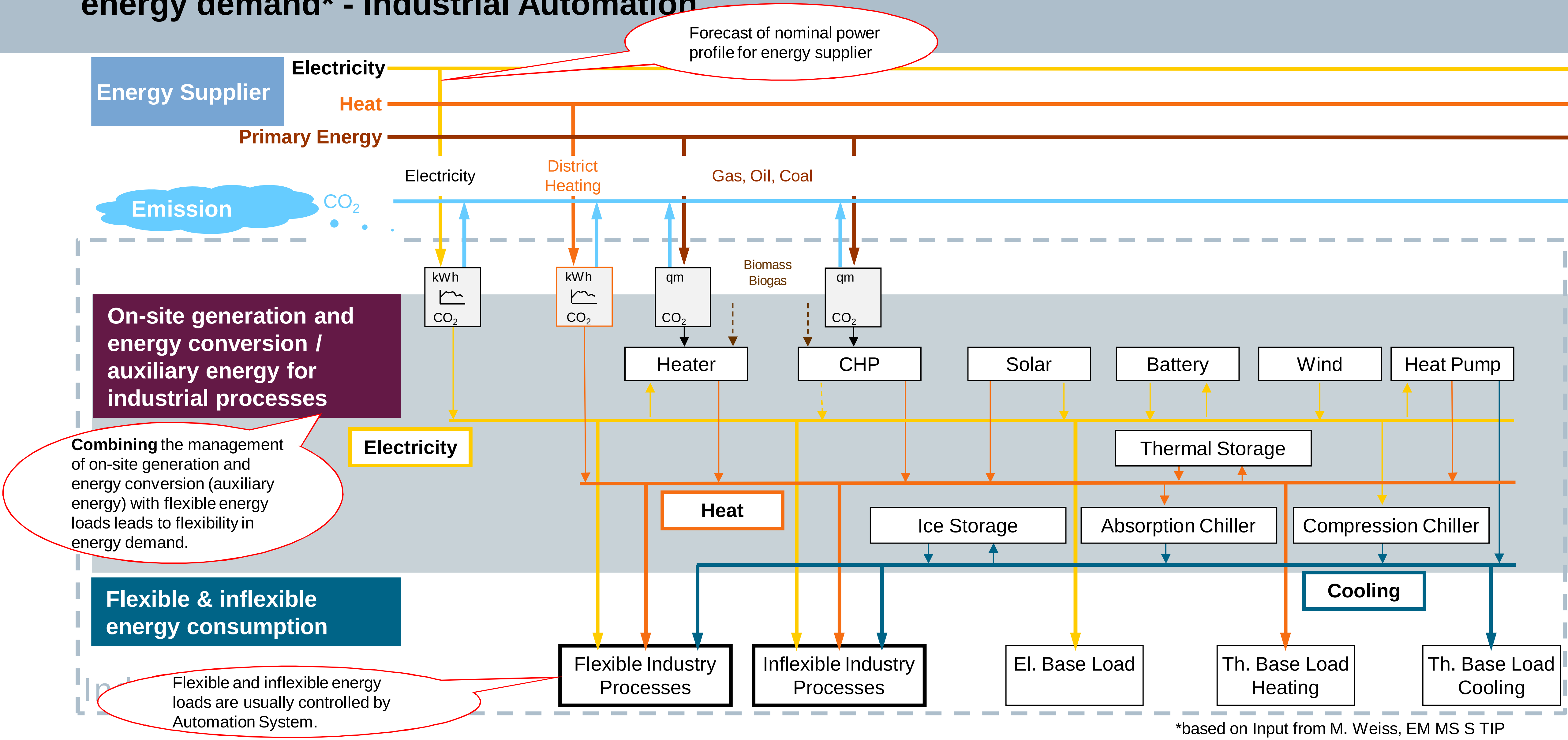

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Energy Management deals with multiple end-customer use cases with increasing complexity

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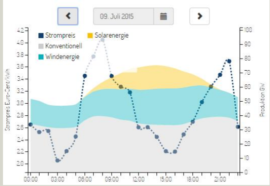
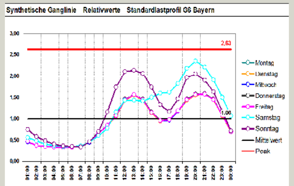
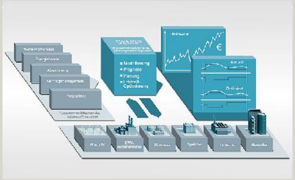
External Energy Demand Minimization	Energy Procurement Optimization		Participation at Energy Markets
Minimization of external energy demand	Dynamic Energy Prices	Prediction of Power Profile	Balancing power market
1	2	3	4
			
Energy efficient operation and maximum self-consumption	Electricity prices from EPEX Spot Day-Ahead	Replacement of standard load profiles	

A 2-stage approach for energy management realizes multiple use-cases and functions of a comprehensive Energy Management System

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1. Planning

Objective

- Optimize an energy schedule in advance
- Enable commercialization of flexibility
- Calculate nominal power profile at the point of common coupling

Input

- Dynamic energy prices
- Forecasts
- Revenue for flexibility
- Parameters of infrastructure

Key Partners

- Energy supplier
- Weather service
- Aggregator (Virtual Power Plant)

2. Online Energy Management

Objective

- Compensate for any deviations and/or any disturbances in the plan
- Adhere to the nominal power profile at the point of common coupling
- Manage the demand for flexibility

Input

- An optimized plan (from 1 above)
- Real-time measurements
- Forecasts (an update)
- Demand for flexibility

Key Partners

- Weather service
- Aggregator (Virtual Power Plant)

H2020 Project SENSIBLE "Storage-Enabled Sustainable Energy for Buildings and Communities" - The benefits of small scale storage integration will be shown with three demonstrators

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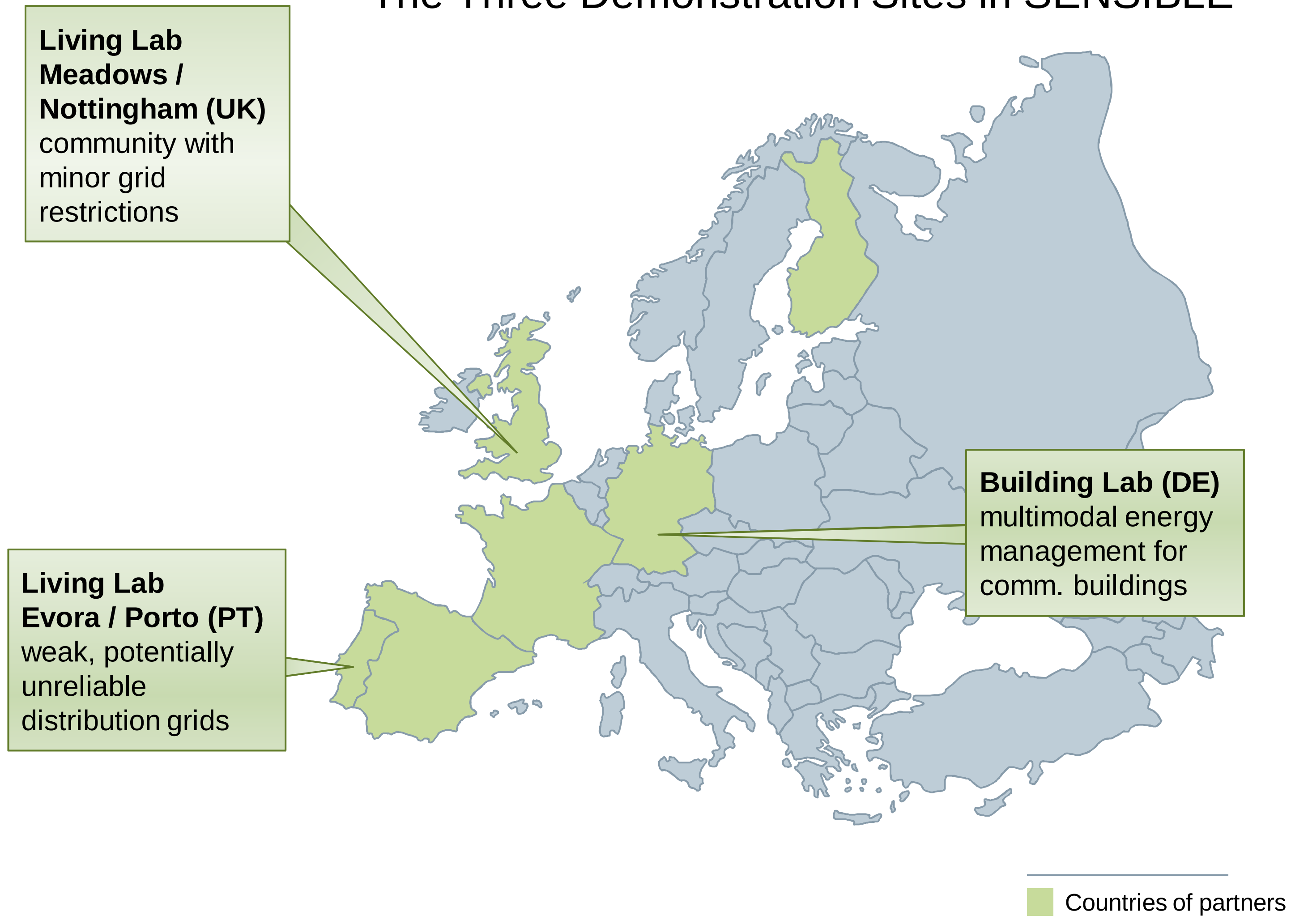
The Three Demonstration Sites in SENSIBLE



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H2020 Project SENSIBLE

- Duration 2015-2018, 15 partners
- 11.8MM € funding, 15 EU partners

Living Lab Meadows / Nottingham (UK)

Energy management and energy market participation of residential buildings and communities

Living Lab Evora / Porto (PT)

Power flow, power quality control and grid resilience in (LV) power distribution networks

Building Lab (DE)

multi-modal energy storage in larger buildings considering thermal storage, CHP, and different energy vectors (electricity, gas).

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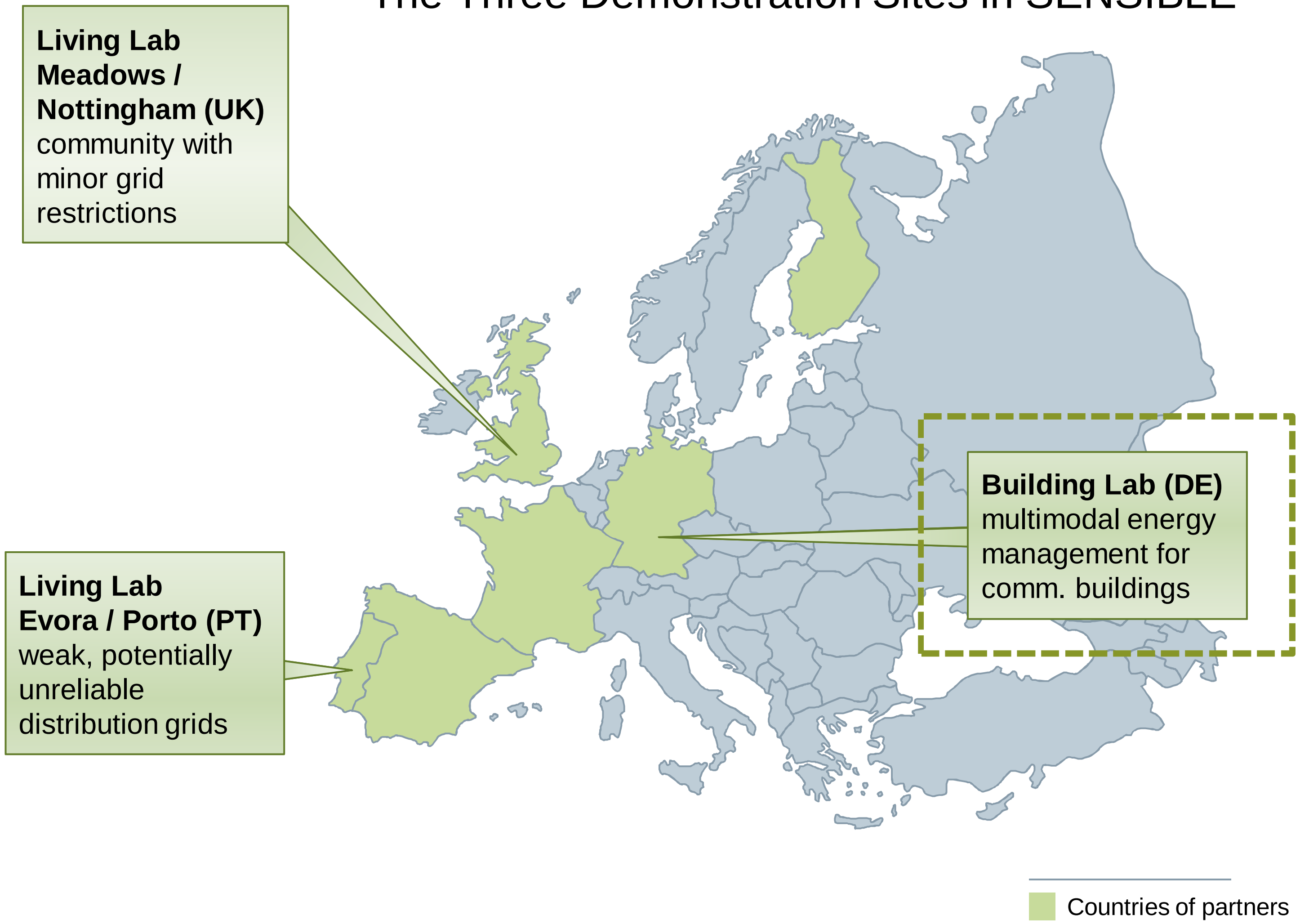

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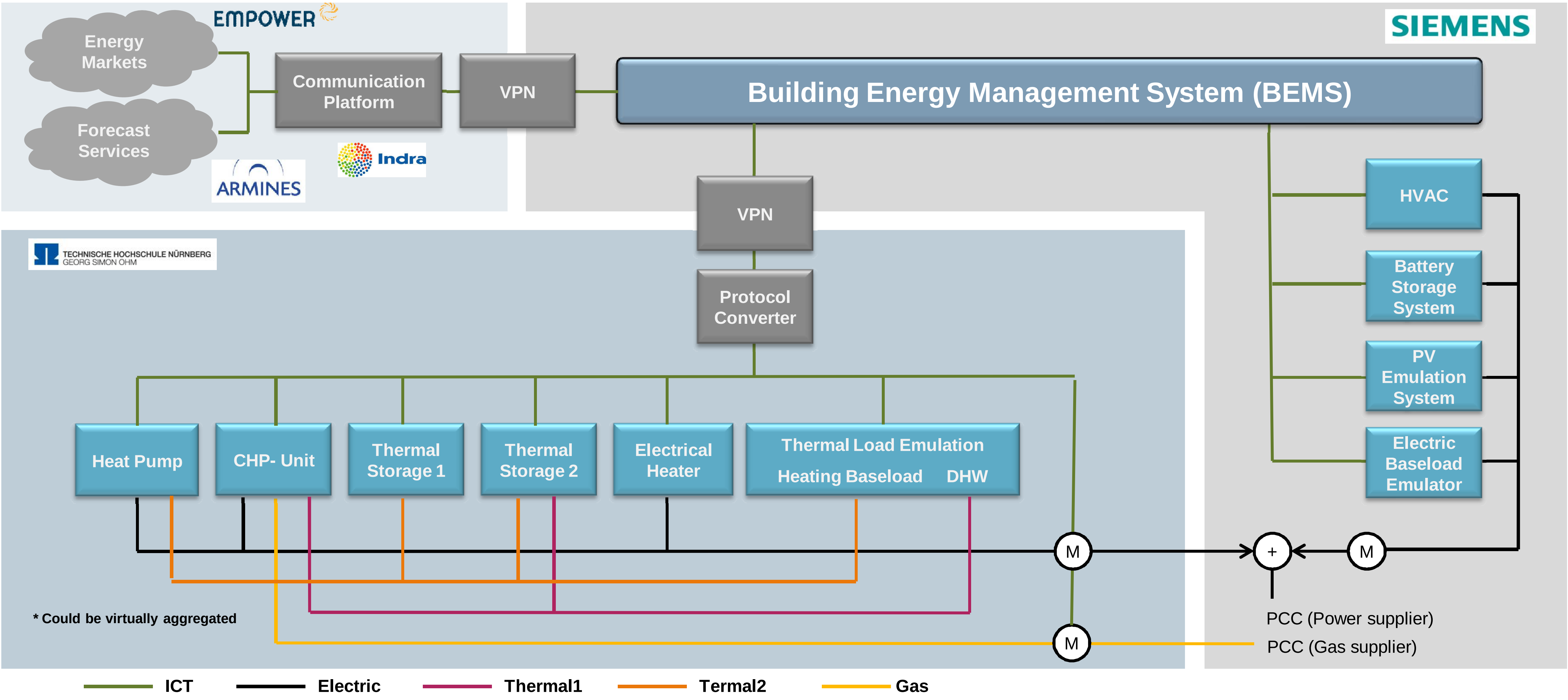
Multi-modal energy storage in larger buildings considering thermal storage, CHP, and different energy vectors (electricity, gas).

SENSIBLE multi-modal Energy Management Building Lab (DE) Demonstrator allows to emulate different scenarios for all use cases



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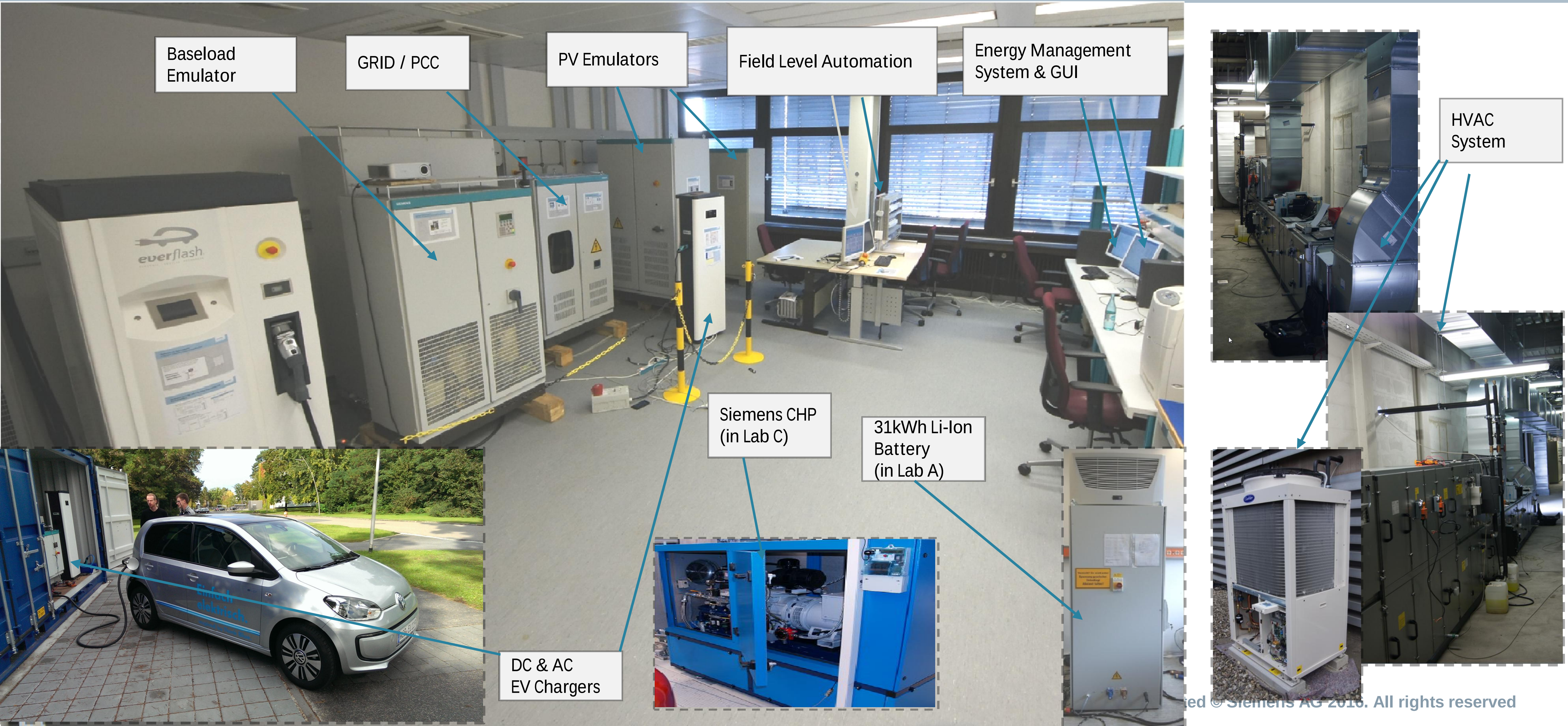
Multi-modal Energy Management Lab Demonstrator illustrates use case “Prediction of Power Profile” (Siemens)



Multi-modal Energy Management Lab Demonstrator illustrates use case “Prediction of Power Profile” (THN – Technische Hochschule Nürnberg)

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The thermal installation allows the demonstration and automatic adaptation of different operation modes for providing heat on different temperature levels

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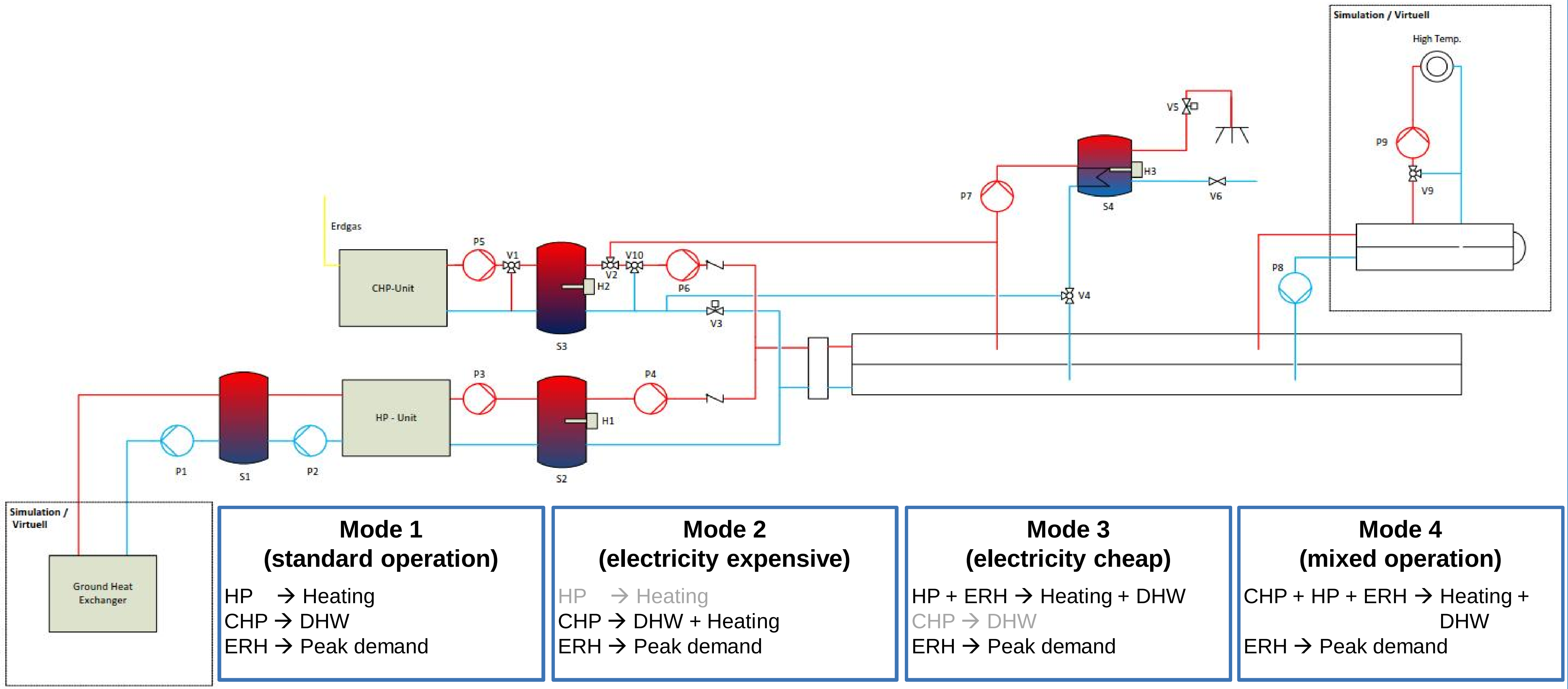
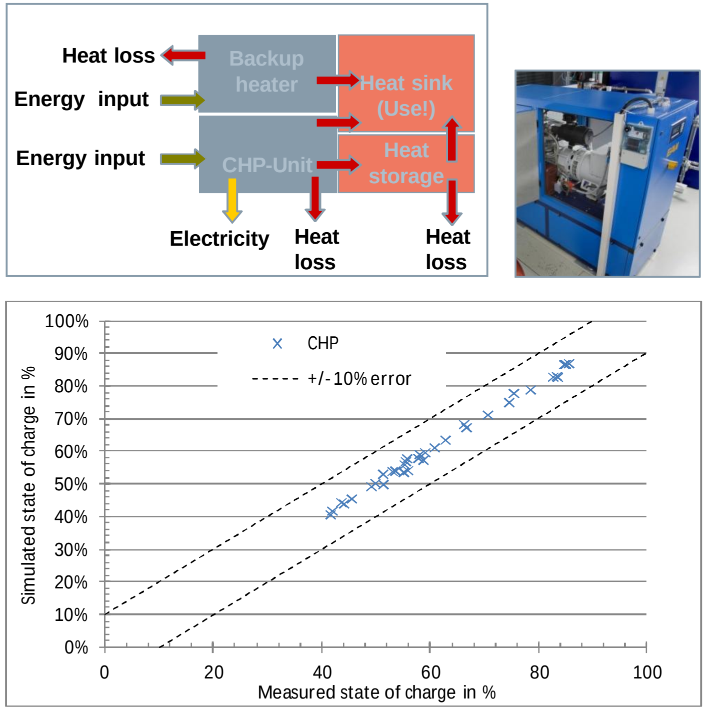


Mode 1 (standard operation)	Mode 2 (electricity expensive)	Mode 3 (electricity cheap)	Mode 4 (mixed operation)
HP → Heating CHP → DHW ERH → Peak demand	HP → Heating CHP → DHW + Heating ERH → Peak demand	HP + ERH → Heating + DHW CHP → DHW ERH → Peak demand	CHP + HP + ERH → Heating + DHW ERH → Peak demand

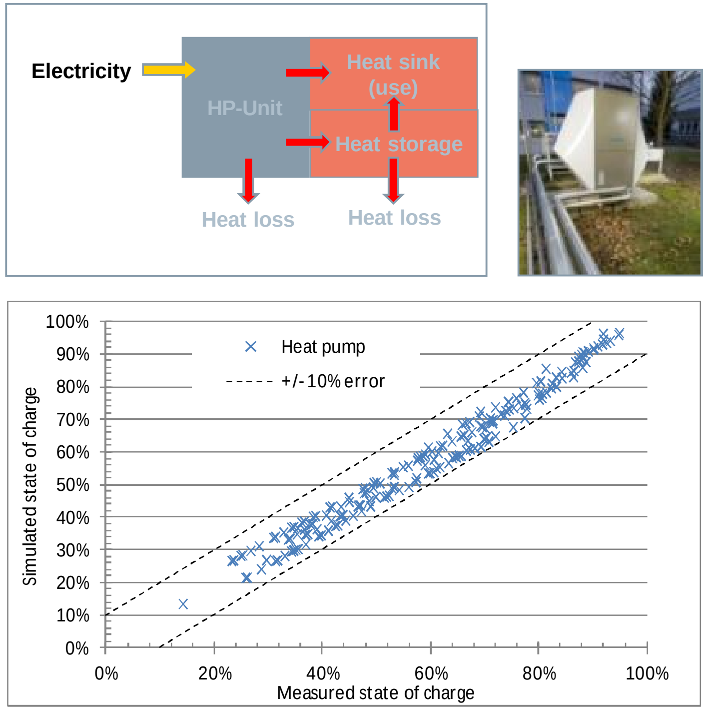
Model-based Energy Management and validation of thermal component models

- Energy Management System approach requires model-based forecasting
- Modeling of electrical, thermal components and (uncontrollable) loads:
  - Deriving physical models, identifying most relevant parameters
  - Extraction of real-time computable (general) automation models for optimizer
  - Model validation test on real hardware setup (incl. long term model accuracy test)
- ➢ Goal: Models and parameter sets for simple engineering and configuration (simplicity vs. accuracy)

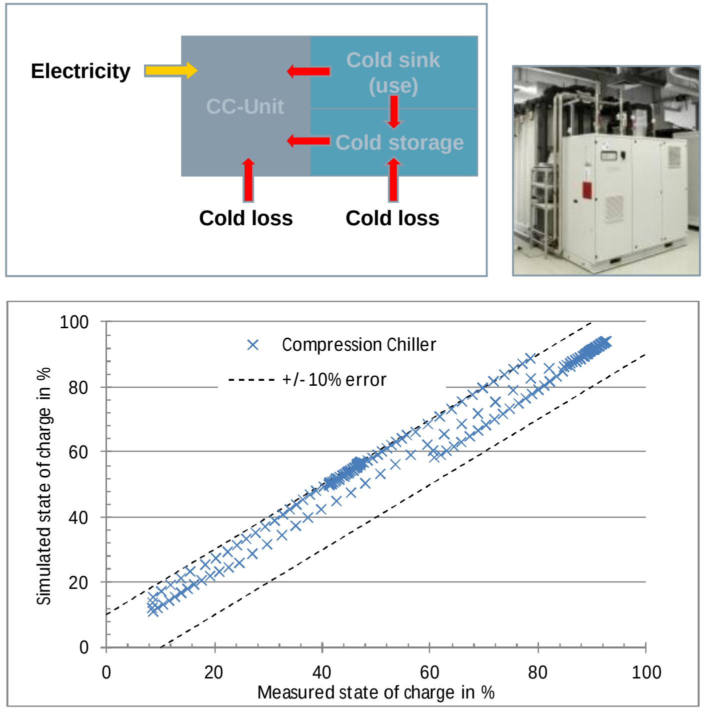
Parity Plot Example: CHP Unit



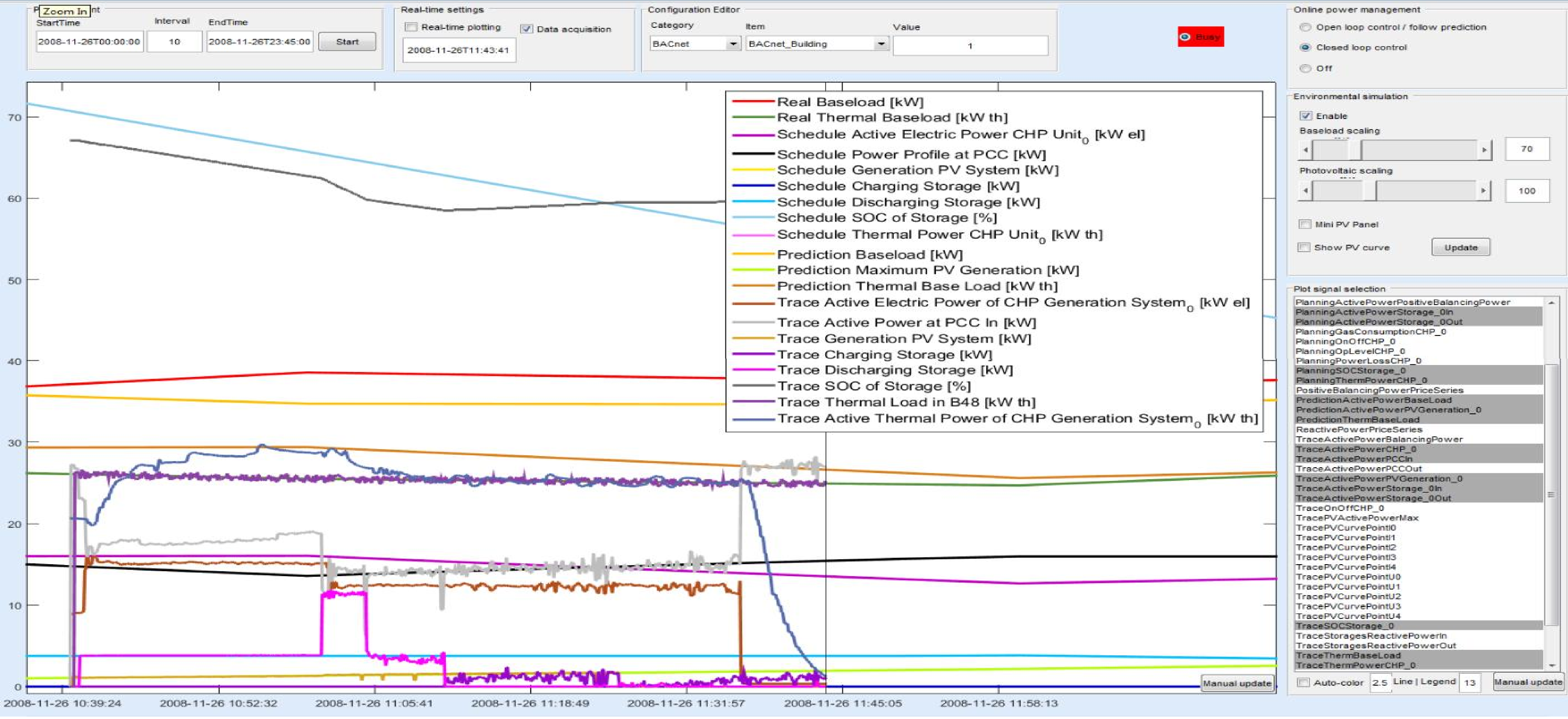
Parity Plot Example: Heat Pump



Parity Plot Example: Compression Chiller



Graphical User Interface for Demonstrator control and visualization



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Demonstration of Storage Enabled Integration of Smart Buildings in a Smart Grid - Thank you for your attention.

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Technology Field: Power and Energy Technologies

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