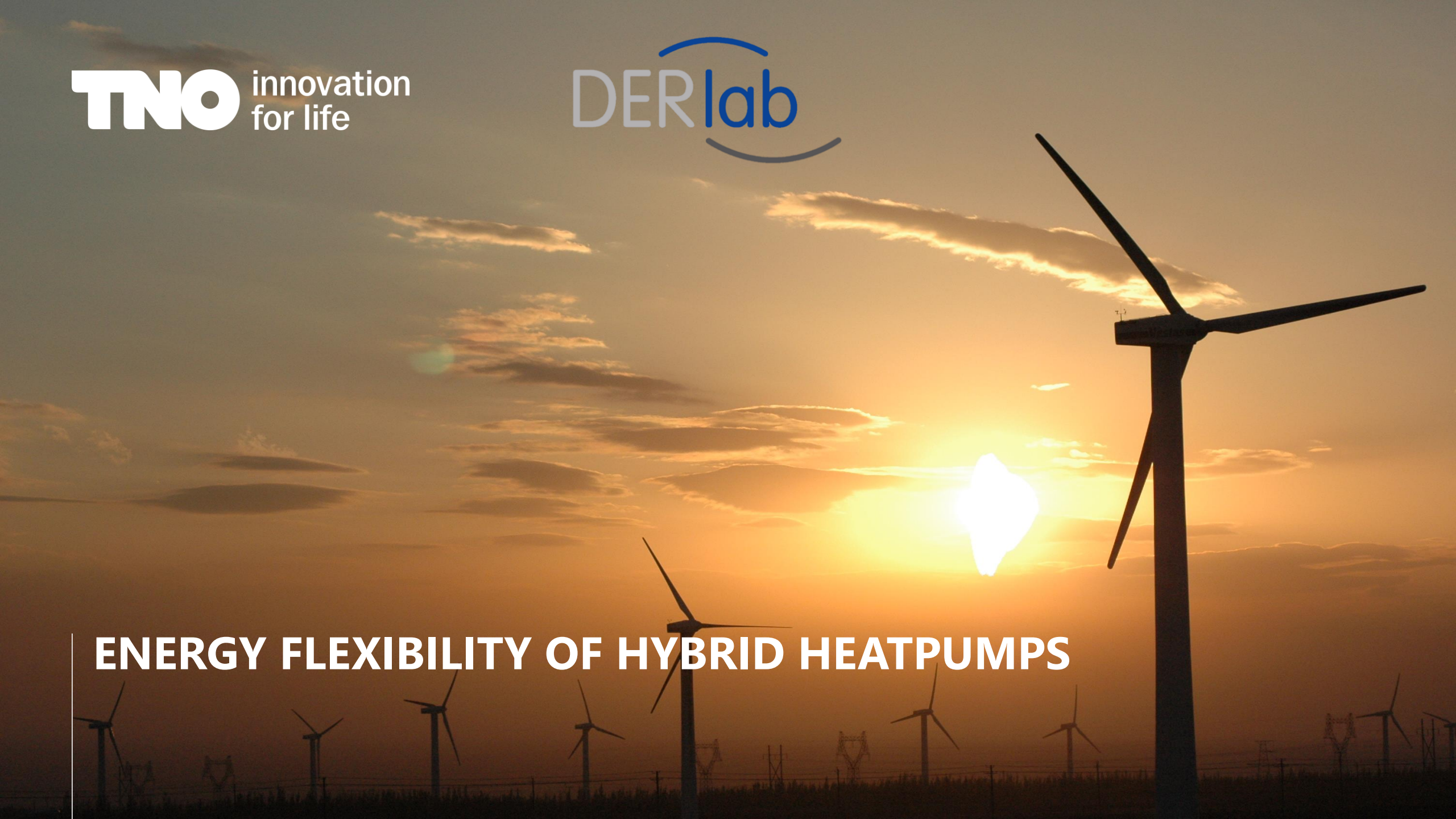


ENERGY FLEXIBILITY OF HYBRID HEATPUMPS

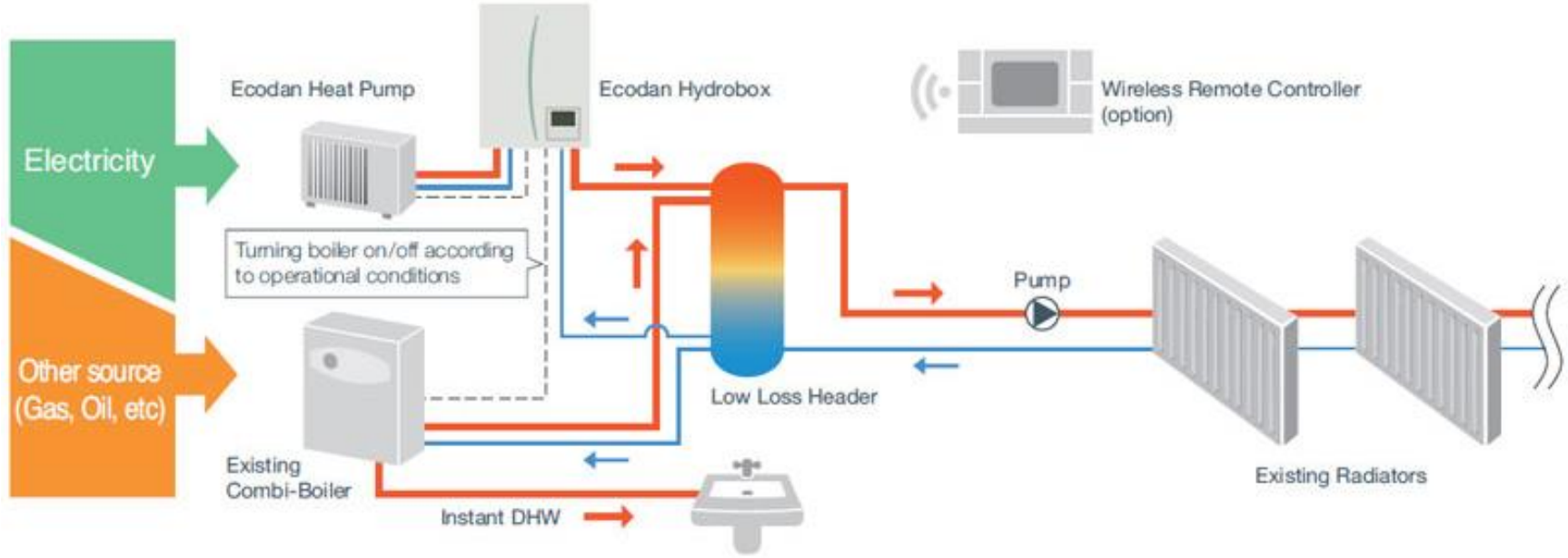
HOW DO WE HEAT OUR HOMES DURING AND BEYOND THE ENERGY TRANSITION?

- Heat networks?
- Green Hydrogen?
- Green methane?
- Heat pumps?
- Hybrid Heat pumps?

Is our electricity grid able to support this?

A HYBRID HEAT PUMP

- Combination of (existing) gas boiler and a heat pump.



http://www.envirogy-renewables.co.uk/services/air-source-heat-pumps/hybrid-system/

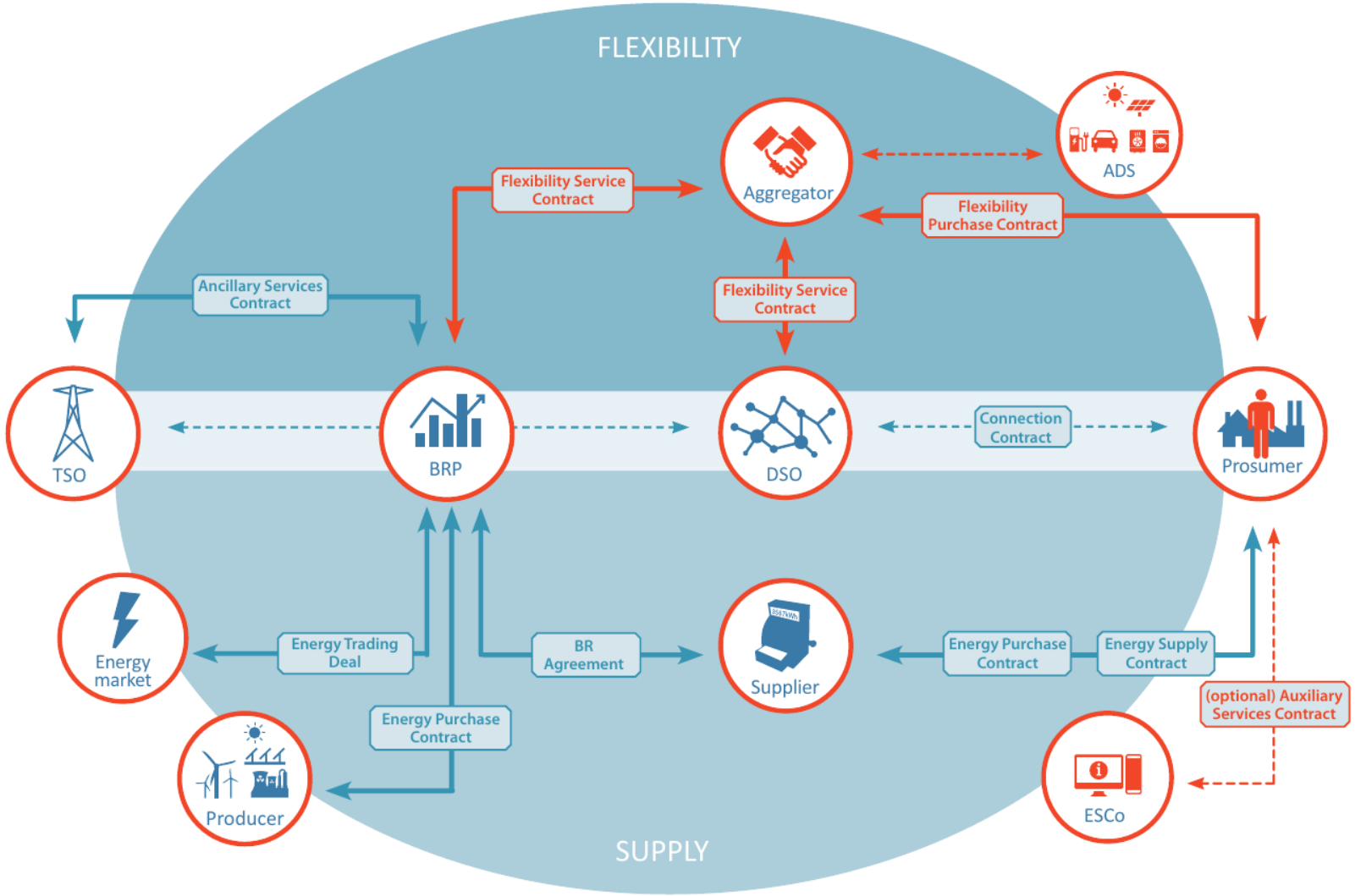
HYBRID HEAT PUMP CONTROL STRATEGY

- The heat pump controller needs to decide:
  - Use heat pump? At which power level?
  - Use gas boiler? At which power level?
  - Use a combination? At which power level?
- Depending on:
  - Heat demand (difference between room temperature setpoint and actual room temperature)
  - Outdoor temperature
  - User's comfort level
  - User goals, e.g. CO2 emission reduction or economic optimization
  - Buffer fill level
  - Demand Side Management

DEMAND SIDE MANAGEMENT WITH HYBRID HEAT PUMPS

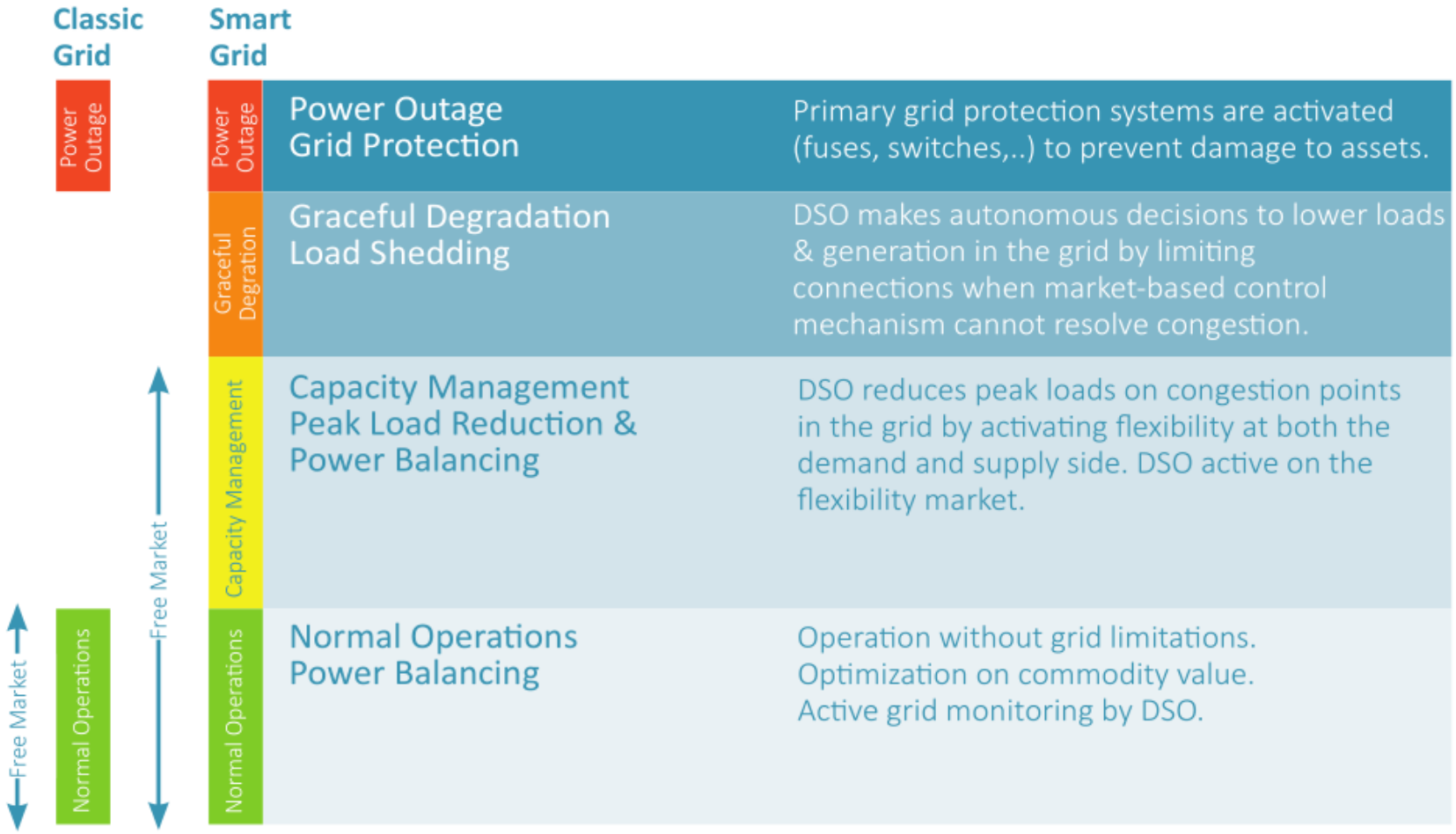
- Optimization for goals bigger than a single home situation.
  - Grid oriented optimizations, e.g. in times of a congested grid, switch to gas
  - Market oriented optimizations, e.g. in times of low energy prices, fill the heat buffer

DEMAND SIDE MANAGEMENT IN A BROADER PERSPECTIVE



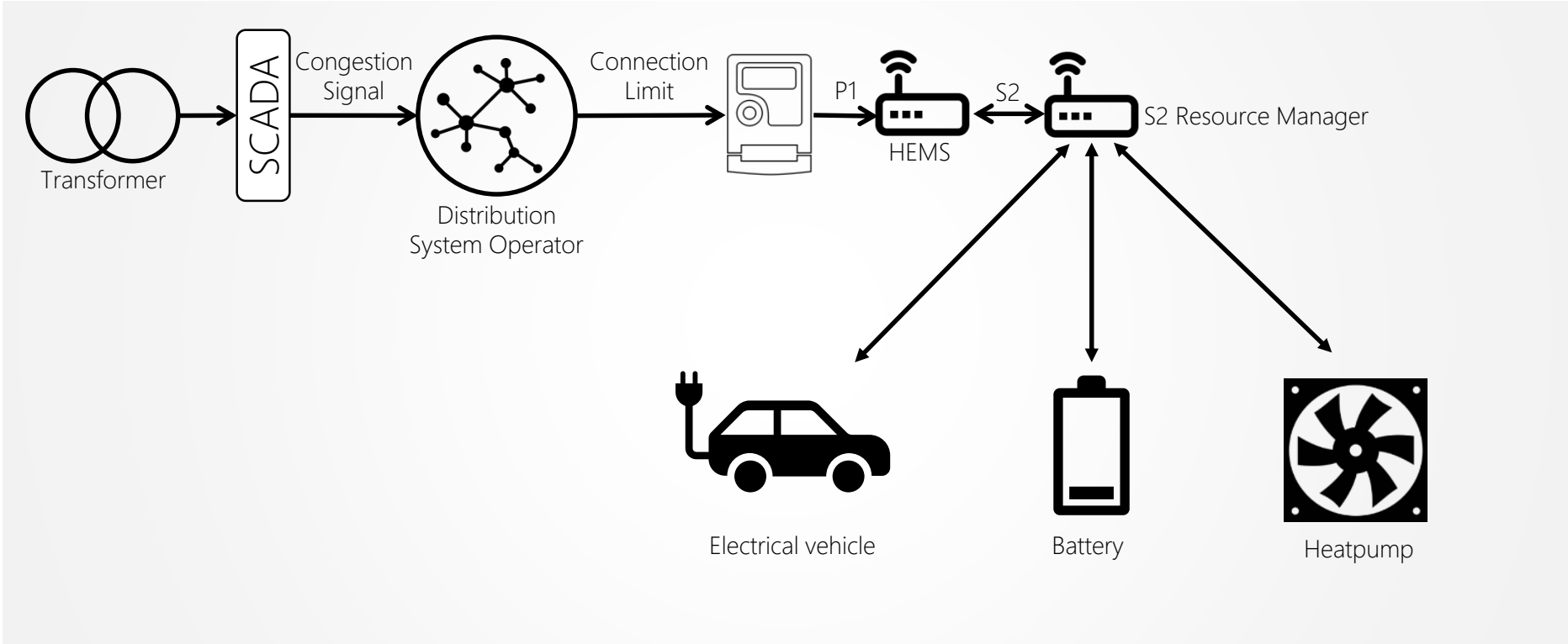
Source: USEF: THE FRAMEWORK EXPLAINED - RELEASE DATE: 2 NOVEMBER 2015

DEMAND SIDE MANAGEMENT IN A BROADER PERSPECTIVE



source: USEF: THE FRAMEWORK EXPLAINED - RELEASE DATE: 2 NOVEMBER 2015

CONNECTION BASED INDIRECT CONTROL ARCHITECTURE



FLEXIBILITY OF HYBRID HEAT PUMP

- Use a heat buffer to decouple heat demand from heat pump operation
- Use the modulation of the heat pump
- Switch between heat pump and gas boilir

- Smart Grid Ready
  - German 'standard'
  - Two voltage free contacts

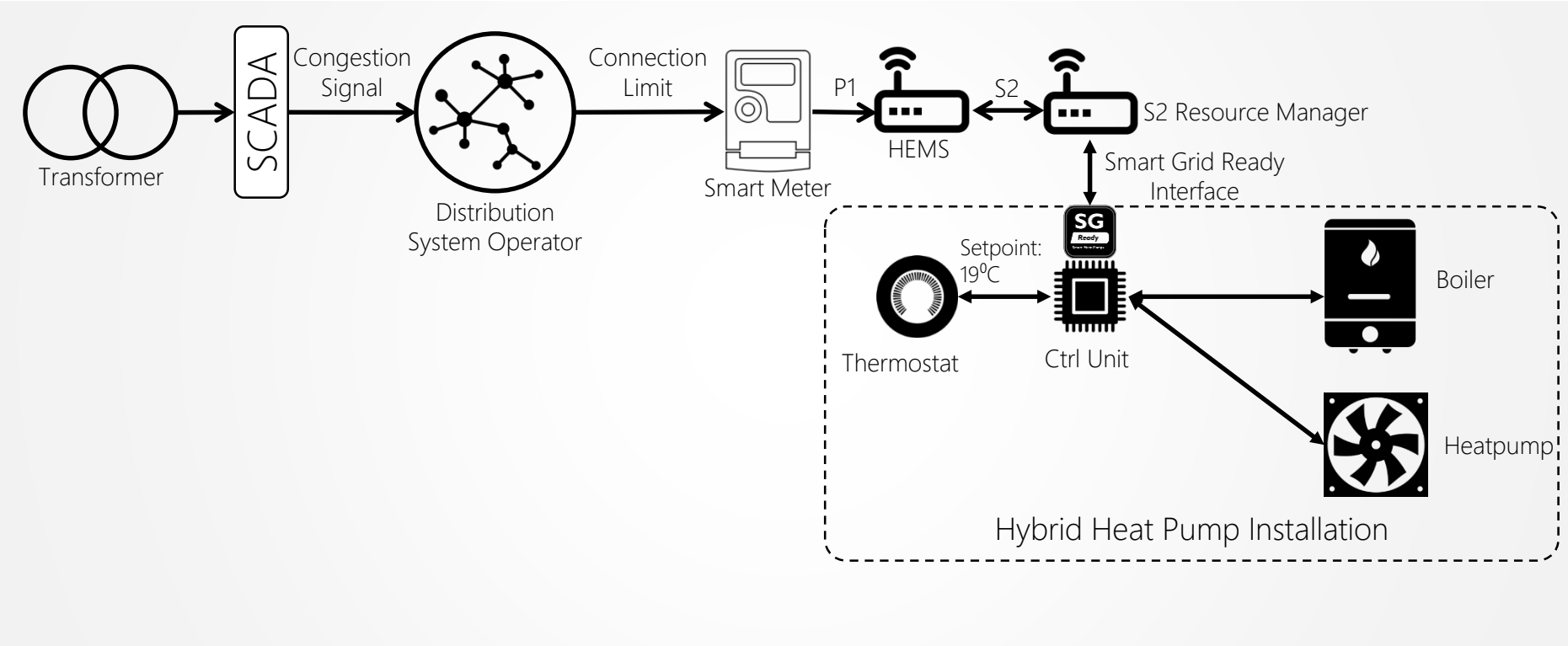
    00 normal betrieb

    01 compressor off

    11 ?

    10 ?

CONNECTION BASED INDIRECT CONTROL WITH SMART GRID READY



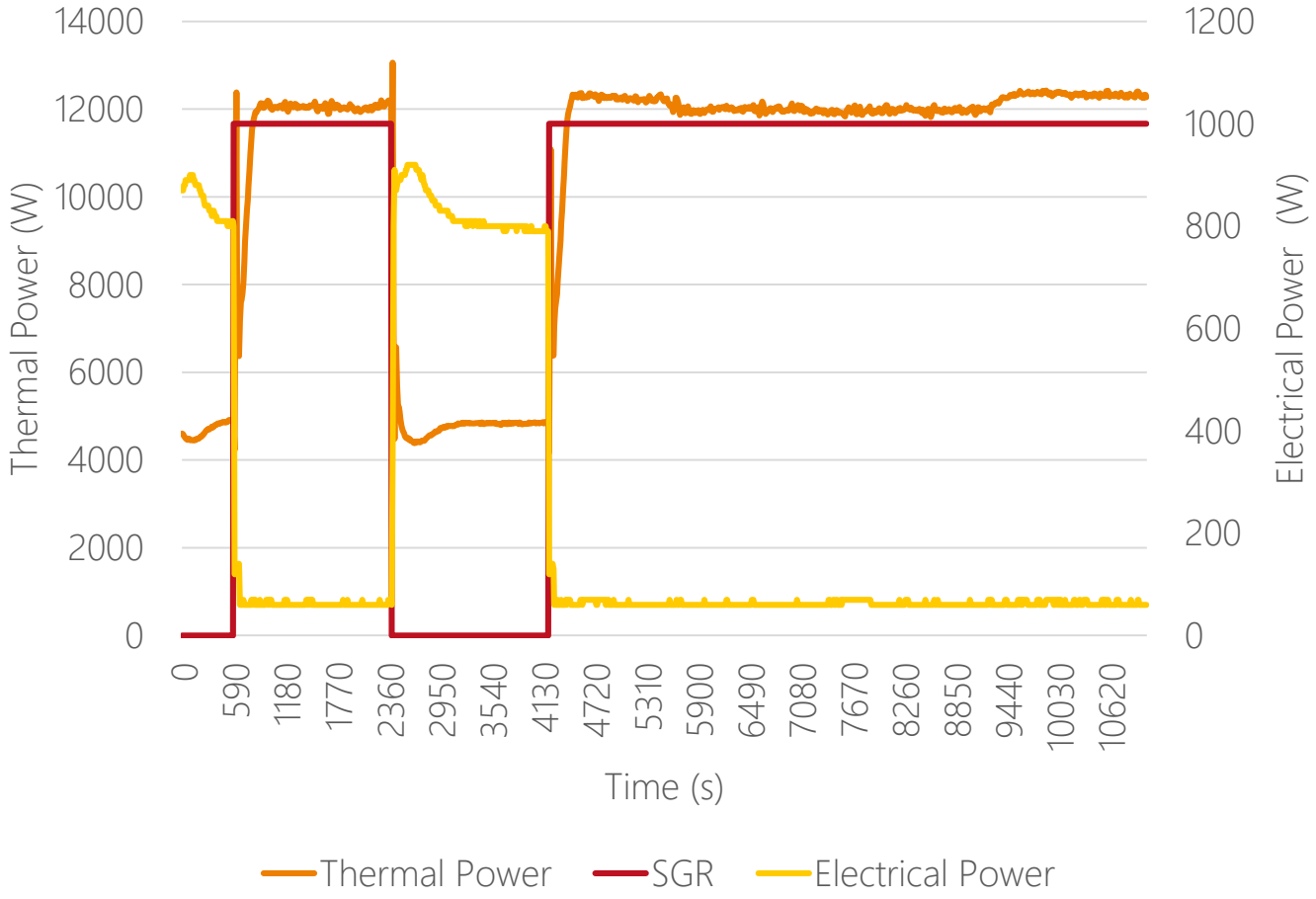
LAB TESTS

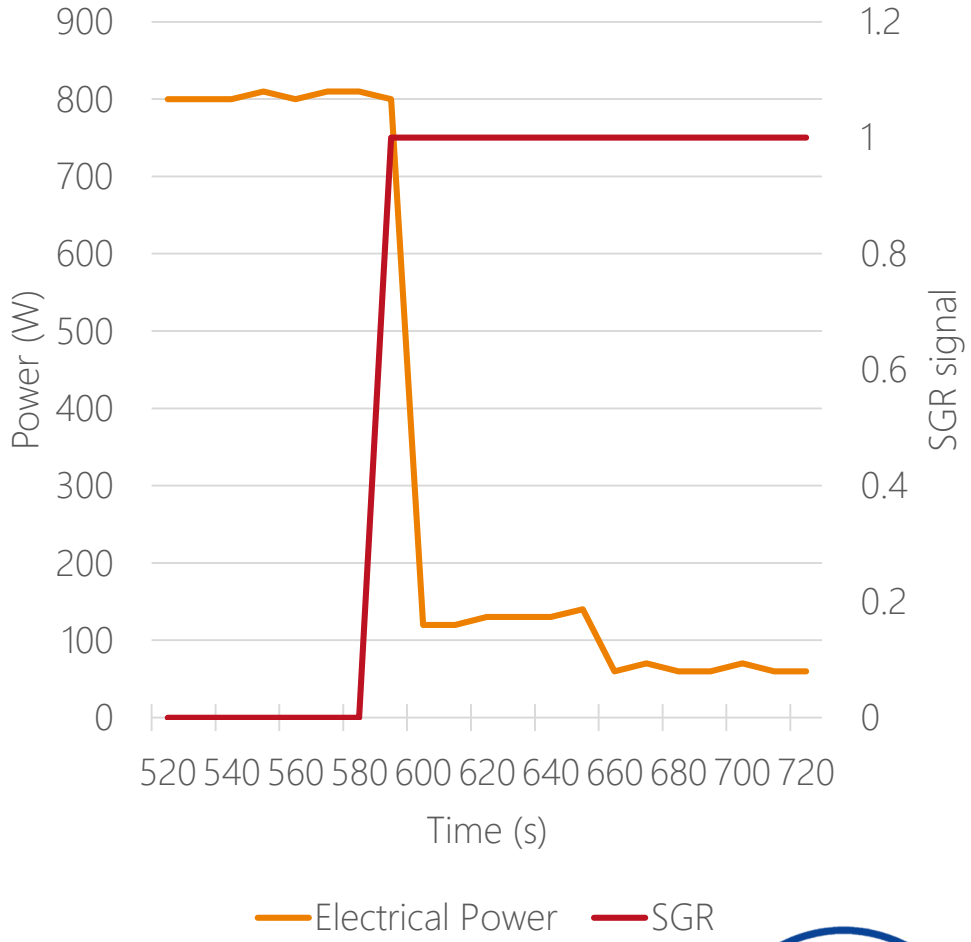
- Smart Grid Ready
  - Used to block the heat pump compressor, i.e. reduce electrical power consumption
- Test goal:
  - Find out what the Smart Grid Ready Response is
- Tested three devices
  - Daikin & Intergas
  - Techneco Elga
  - Vaillant AroTherm

HESI HYBRID ENERGY SYSTEM INTEGRATION FACILITY

DERlab

› RESULTS DAIKIN & INTERGAS





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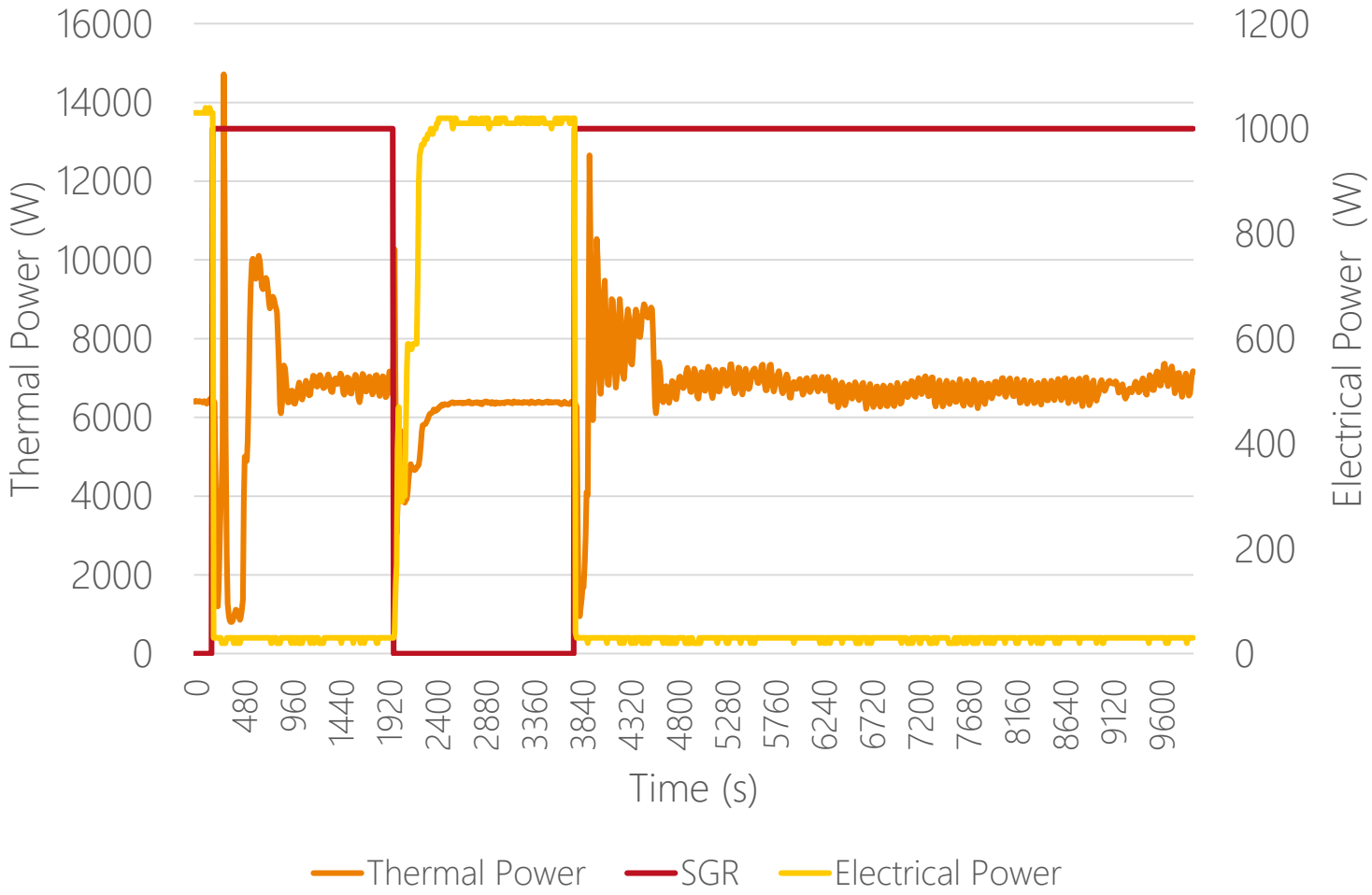
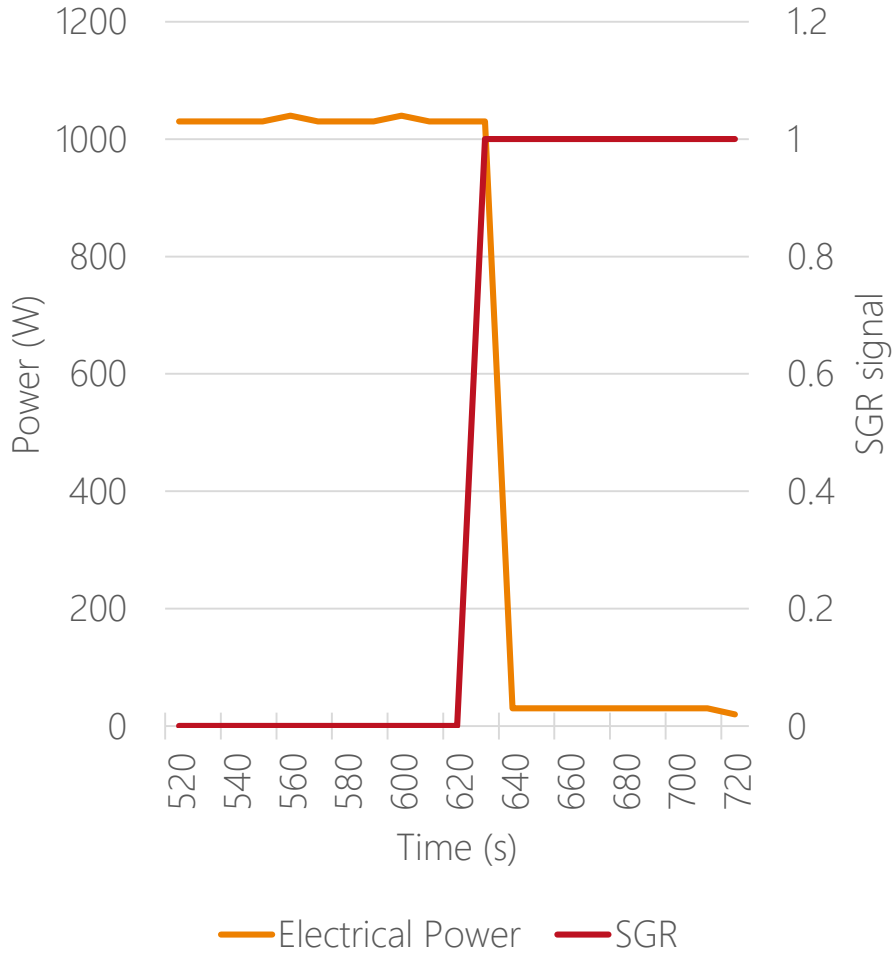
TECHNECO ELGA





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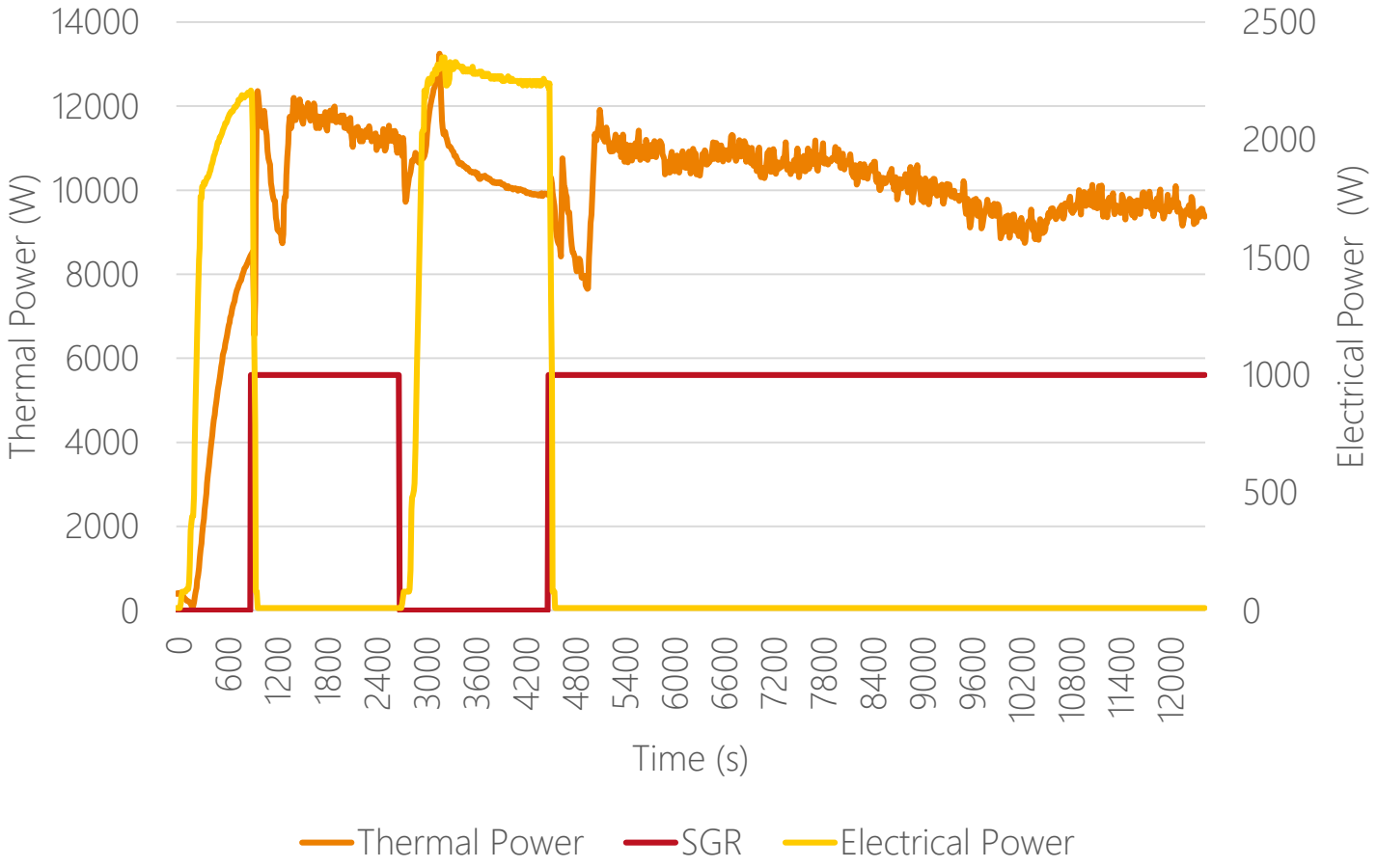
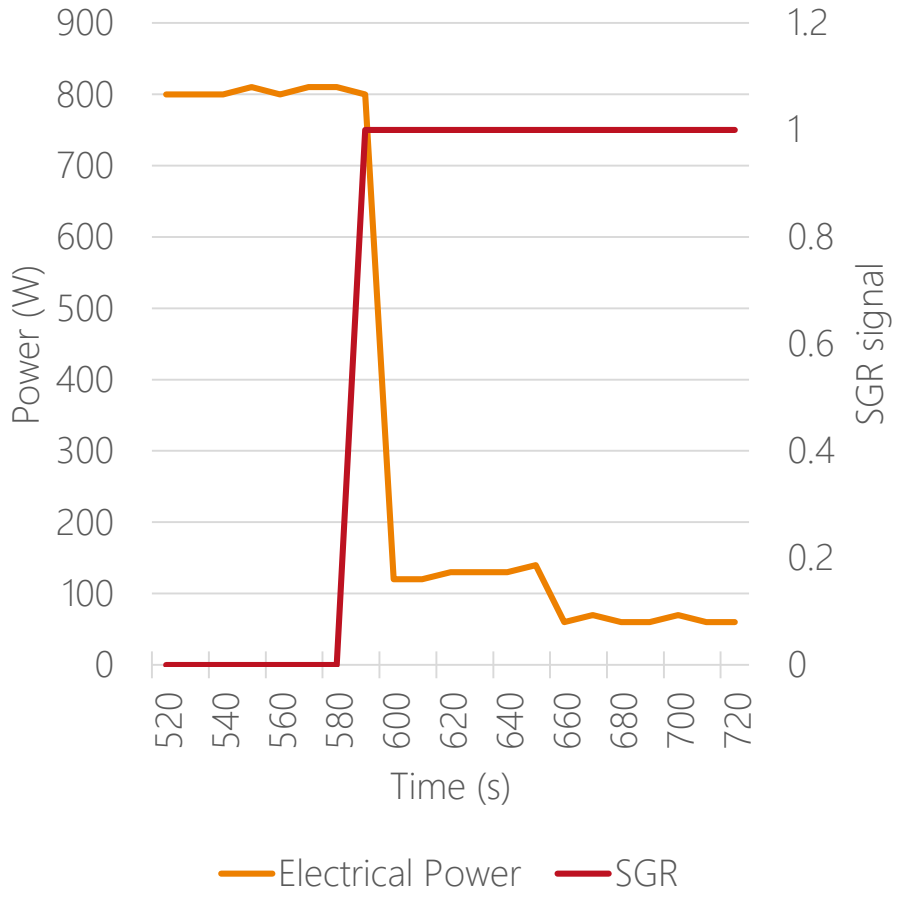
› VAILLANT AROTHERM





HESI HYBRID ENERGY SYSTEM INTEGRATION FACILITY

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HOW DO WE HEAT OUR HOMES DURING AND BEYOND THE ENERGY TRANSITION?

- Sure that the stress on the grid will increase.
- Uncertain what (market) models will be adopted to use flexibility.
- However, when flexibility of DERs will be unlocked more and more, DSO's want to have possibilities to use the flexibility for congestion management.
- The proposed architecture, using the smart meter in case of Graceful Degradation gives this possibility without preventing the flexibility form being used for other parties and goals.
- Currently available hybrid heat pump can already play a role.