Hardware in the Loop Evaluation of a Hybrid Heating System for Increased Energy Efficiency and Management

Gregor Schumm



Matthias Philipp[a], Florian Schlosser[a], Jens Hesselbach[a], Timothy G. Walmsley[b], Martin J. Atkins[b]

a: Universität Kassel; b: Energy Research Centre, University of Waikato

Agenda

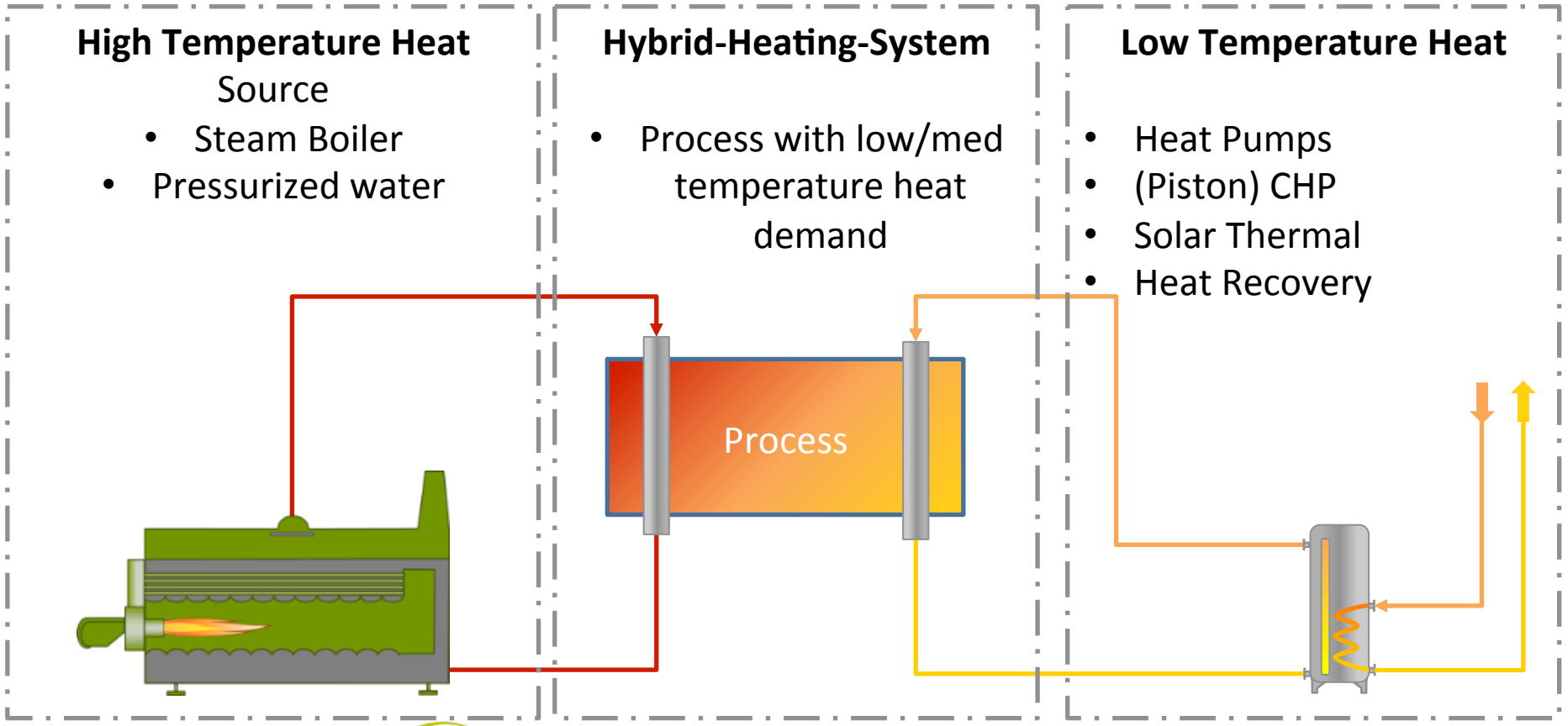
"Hardware in the Loop Evaluation of a Hybrid Heating System for Increased Energy Efficiency and Management"

1. Hybrid Heating System (H^2S)
   - Basic Idea
   - Motivation
   - Retrofitting the pasteurization process
   - Design and control
2. Hardware in the loop evaluation of the H^2S
   - Prototype Testing Facility
   - Scenario 1 – Heat Pump integration
   - Scenario 2 – Demand Response Management

HYBRID HEATING SYSTEM (H^2S)

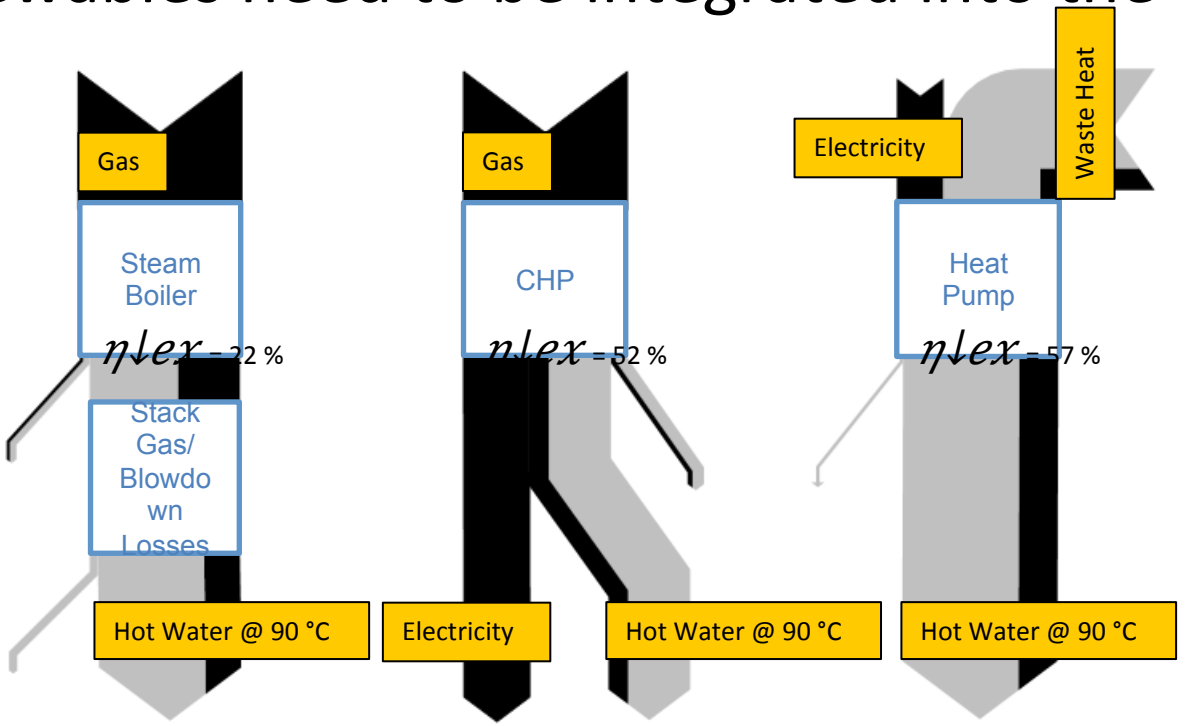
Idea of a Hybrid Heating System

- Systems supplied from two different heat sources
- Controlled ratio of both sources



Motivation for Hybrid Heating Systems

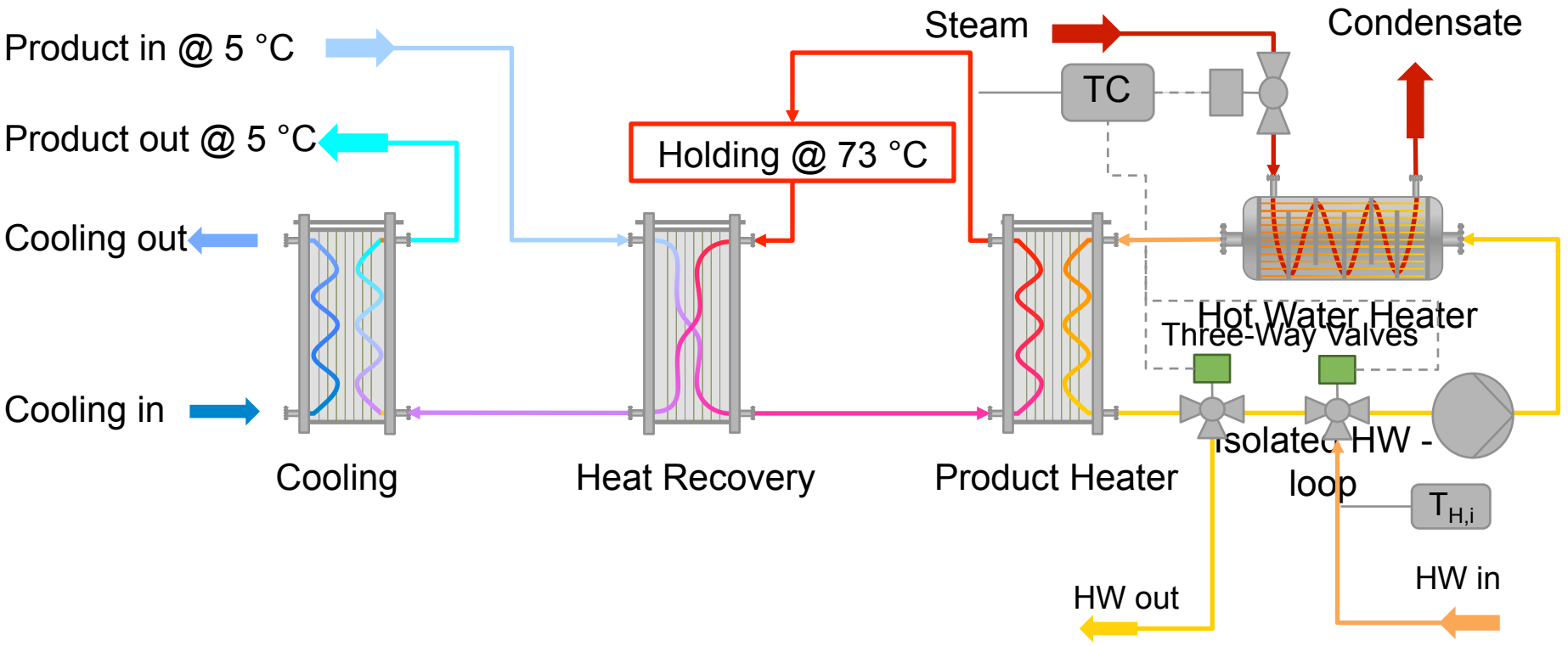
- Efficient technologies need low temperature heat sinks
- Energy transition needs new heating concepts
- Intermittent renewables need to be integrated into the production



HOT WATER INTEGRATION & HYBRID-HEATING

Pasteurization

➢ Hot Water Integration



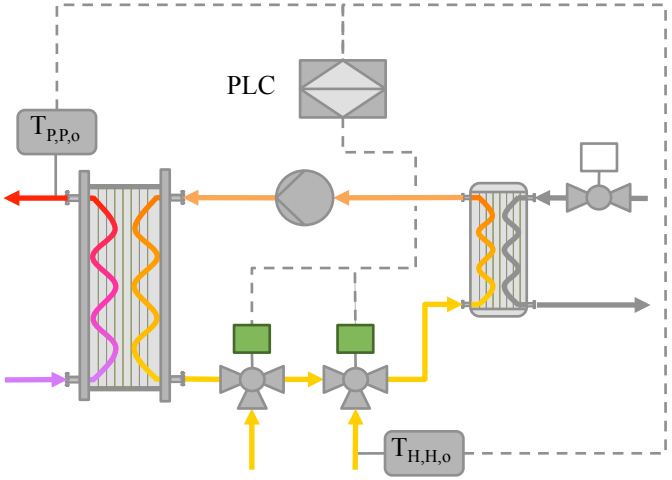
Development of the H^2S control

Targets:

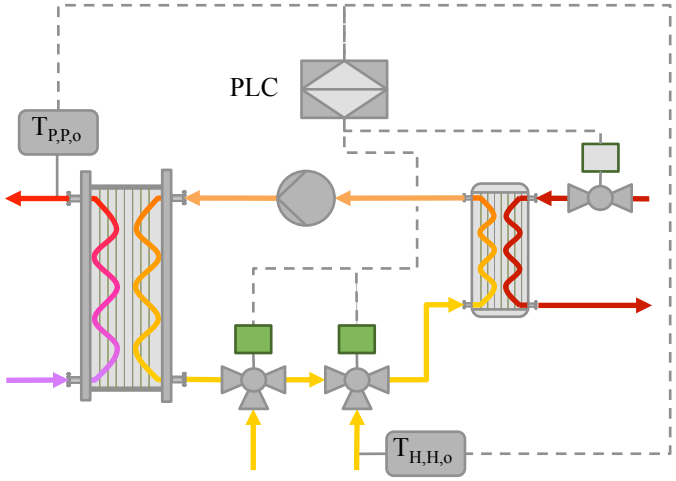
1. Safe production
   - **Reach target temperature at any time**
2. High degree of HW integration
3. Balancing heat demand and supply

Control Strategies for heat supply

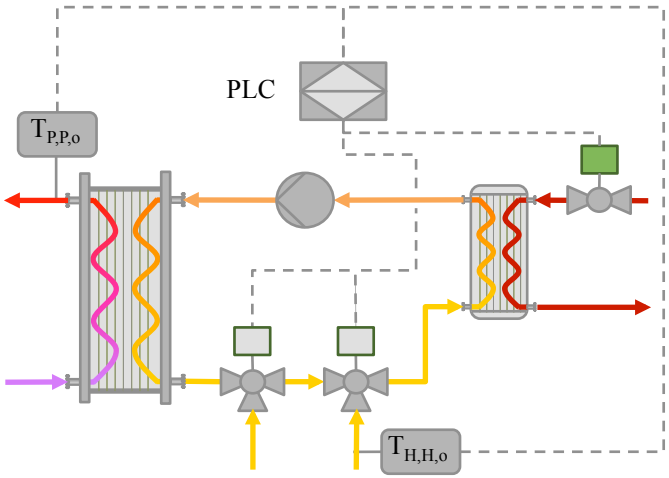
R1: Hot Water (HW)



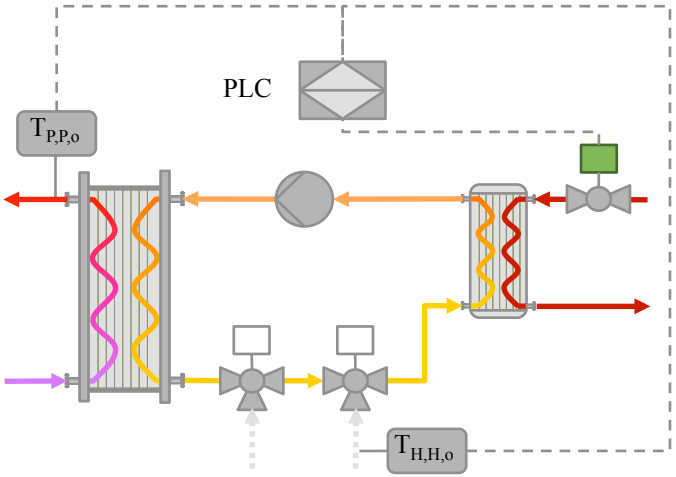
R2: Steam fixed, HW regulated



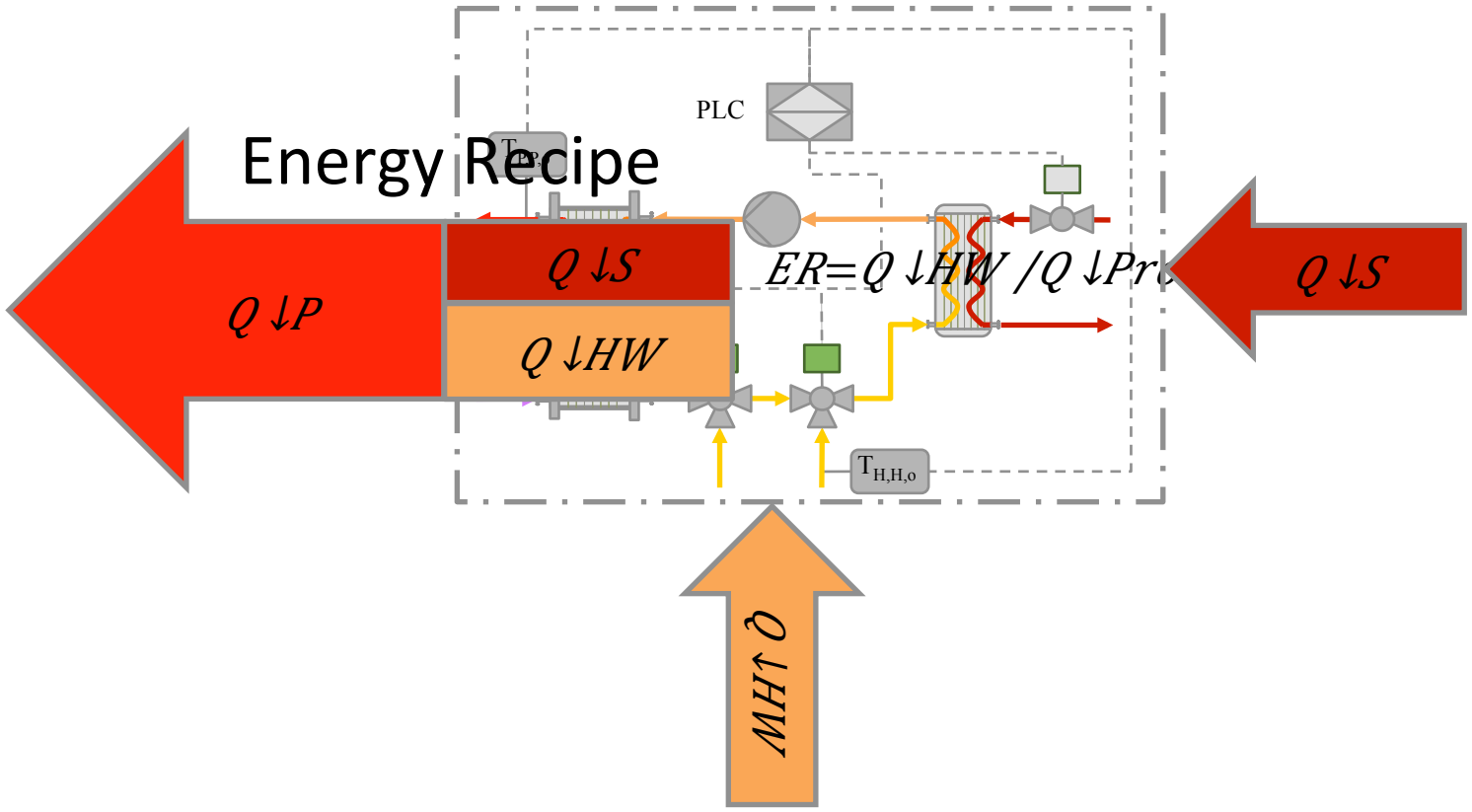
R3: HW fixed, steam regulated



R4: Steam



Command variable for control strategy setting and Hot Water integration



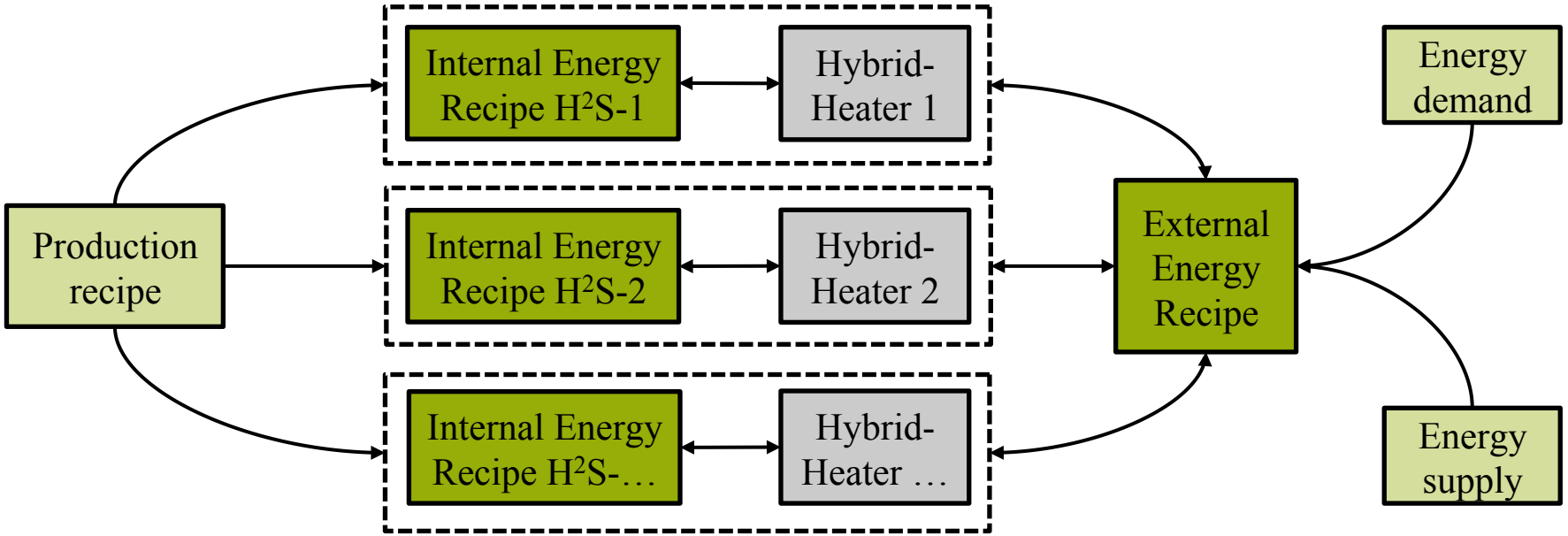
ER algorithm

- safe production

$$ER\downarrow in = Q\downarrow HW, possible / Q\downarrow Production$$

- Hollisitic optimization of the heat demand

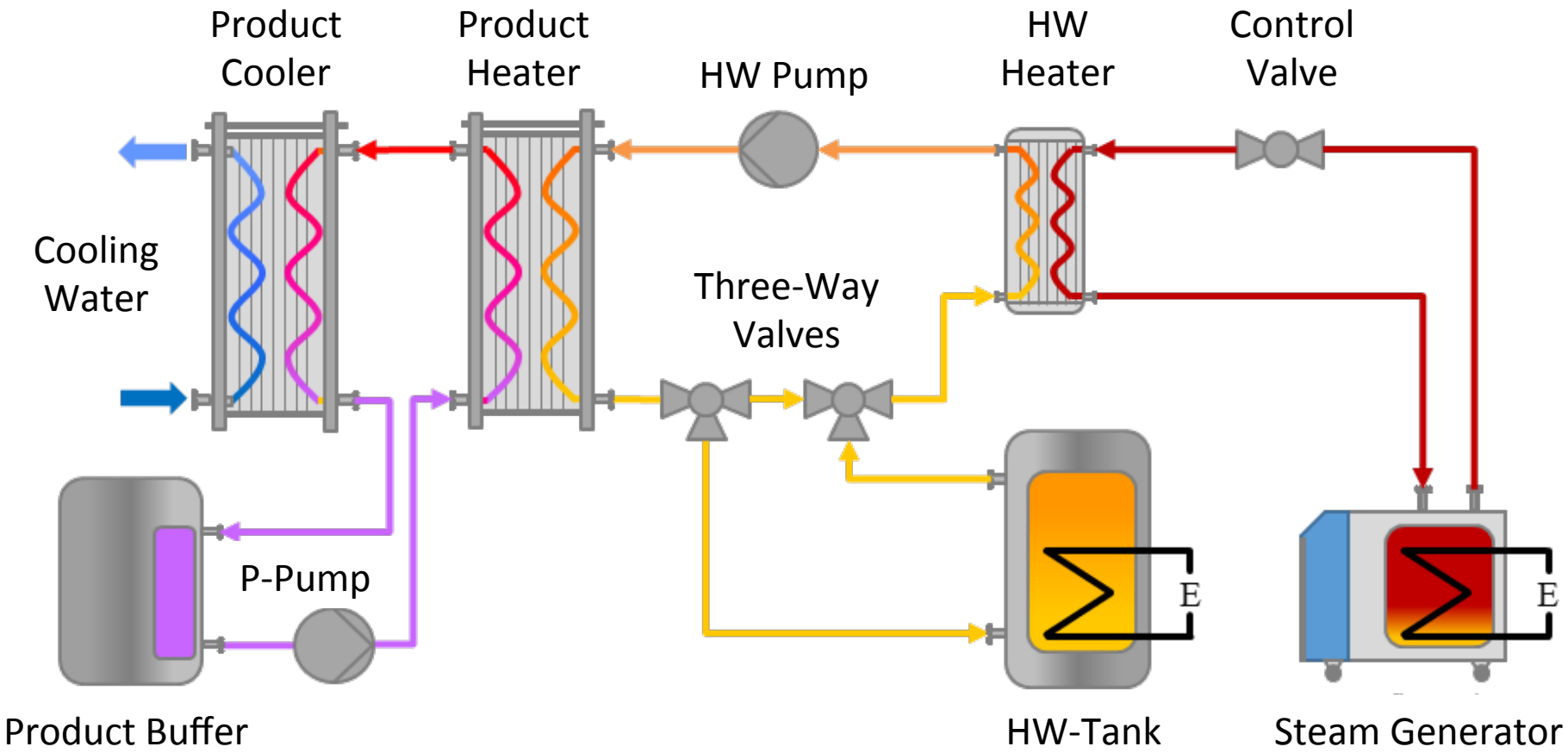
$$ER\downarrow ex = Q\downarrow HW, available / Q\downarrow Produ$$



PILOT PLANT – FUNCTIONAL TEST

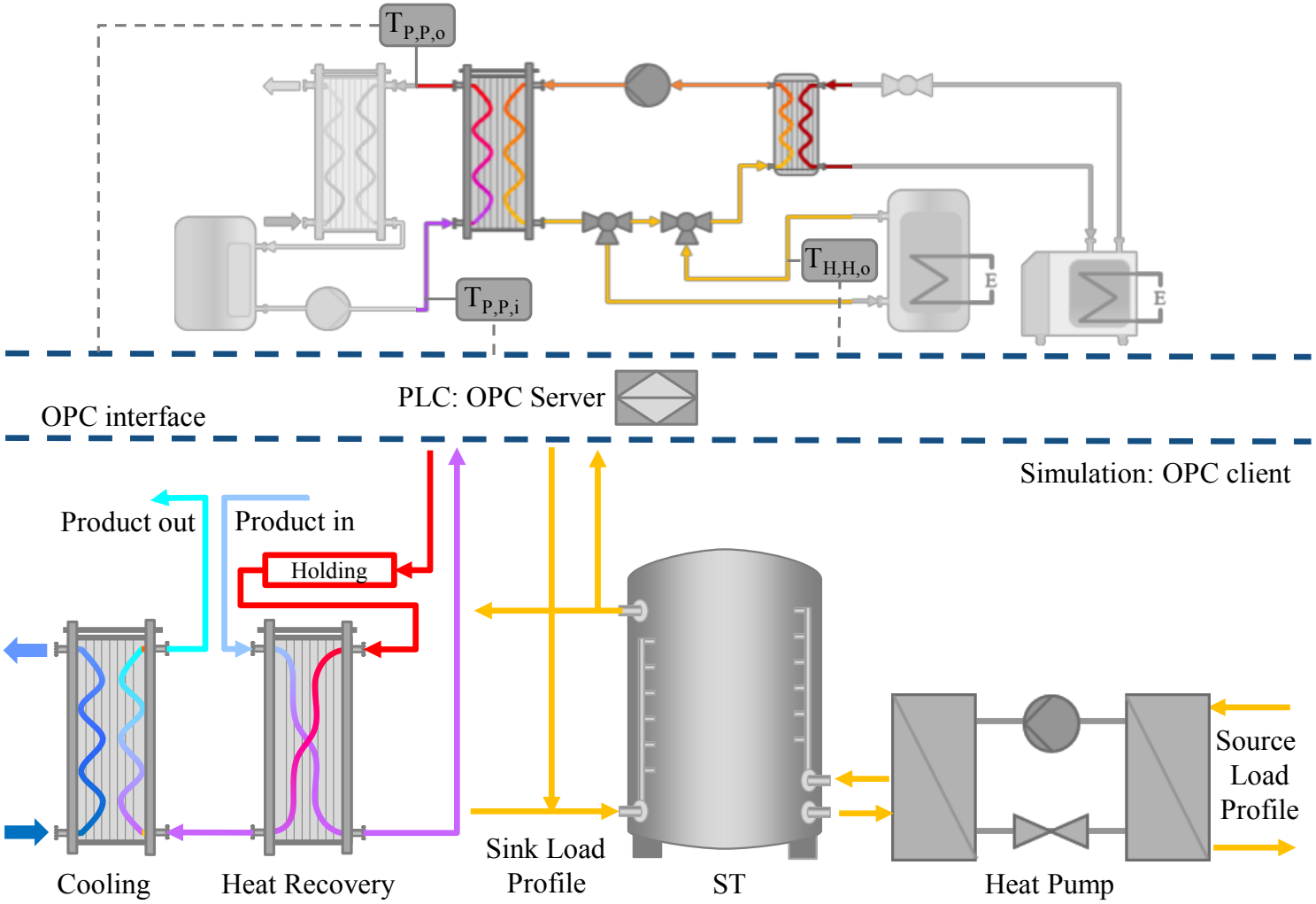
Testing Facility

Hydraulic components and connections

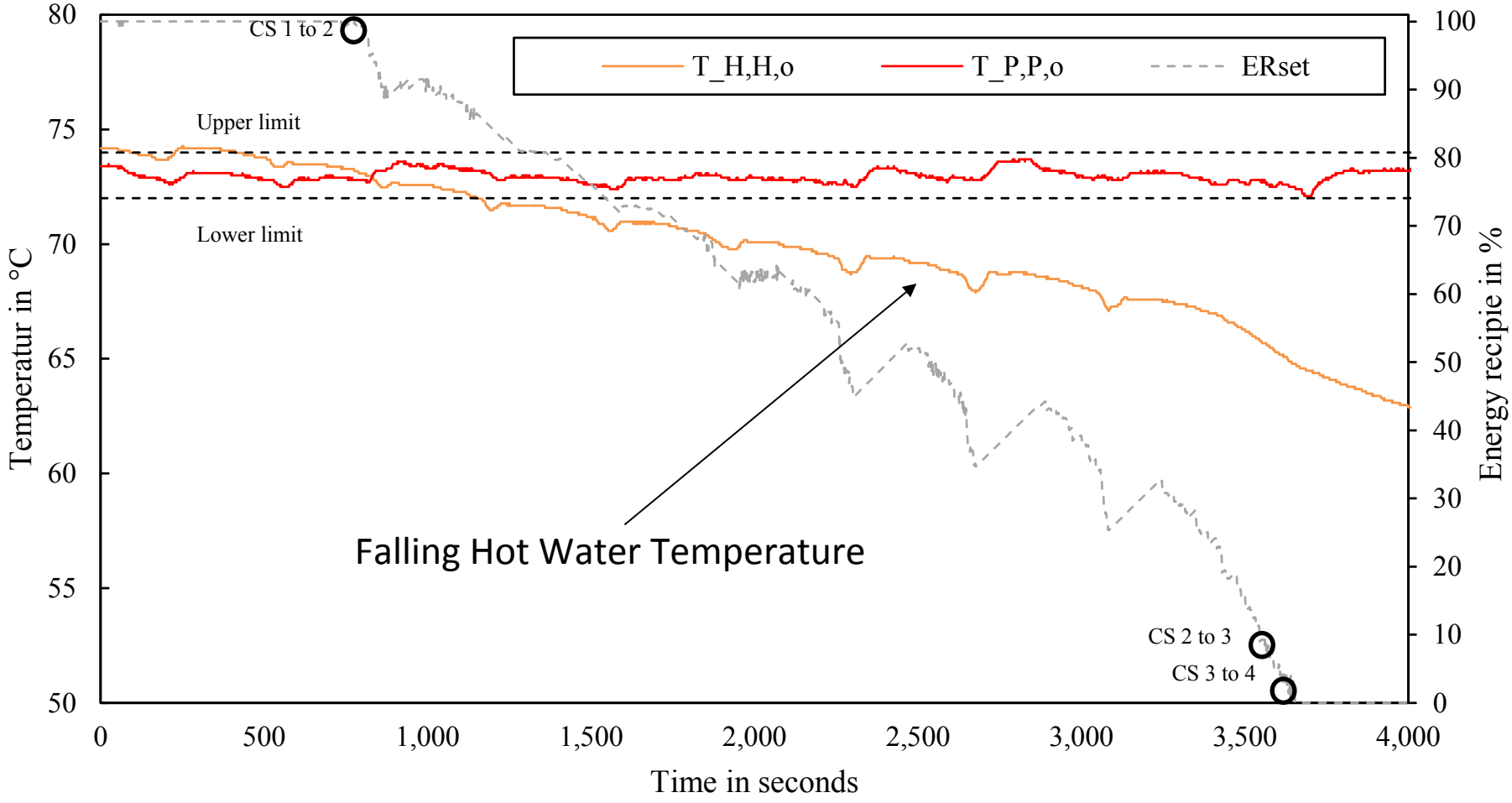


SCENARIO 1 – HEAT PUMP INTEGRATION

HiL Configuration for Scenario 1

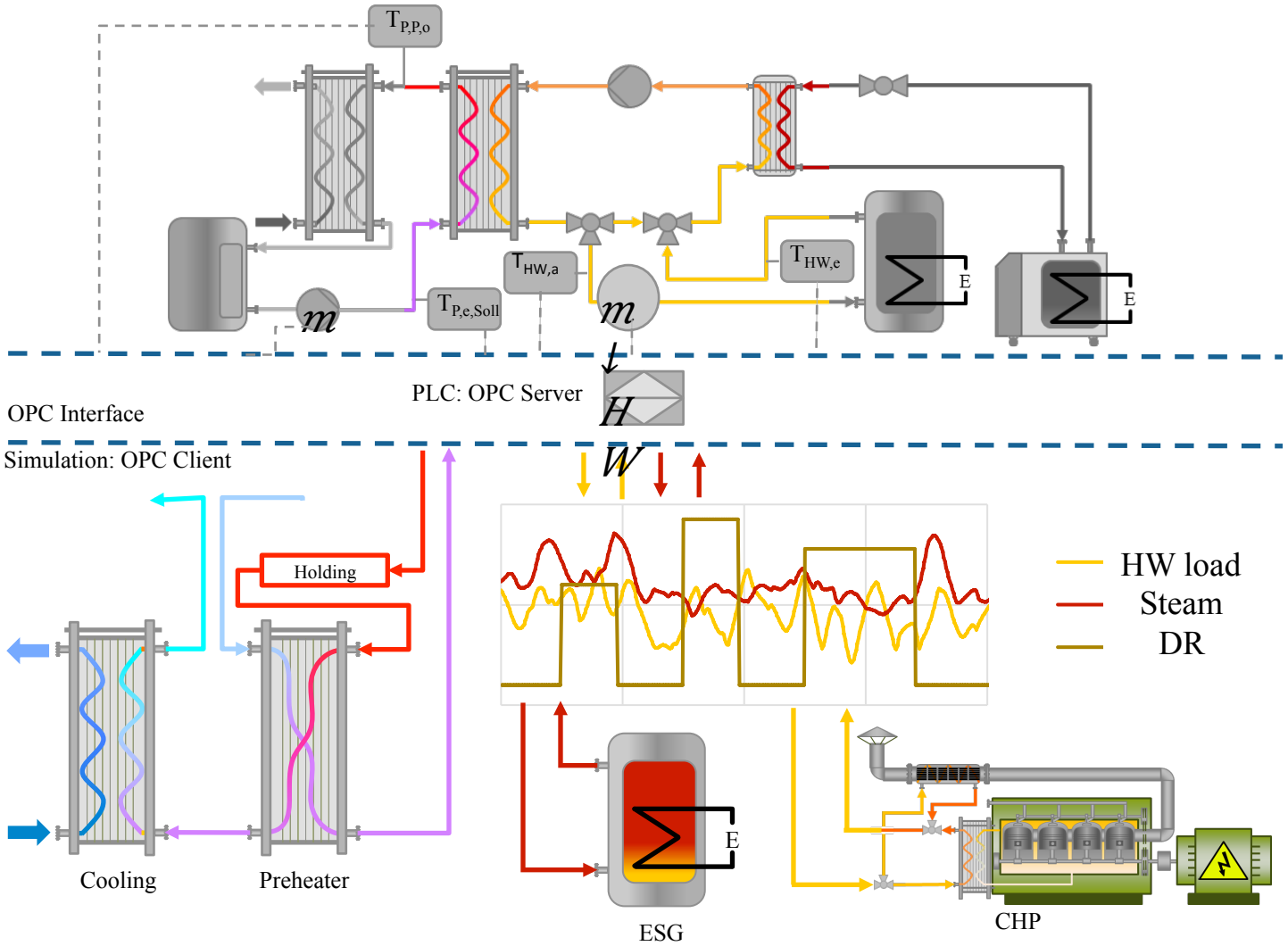


Heat Pump Scenario
Falling Hot Water Temperature

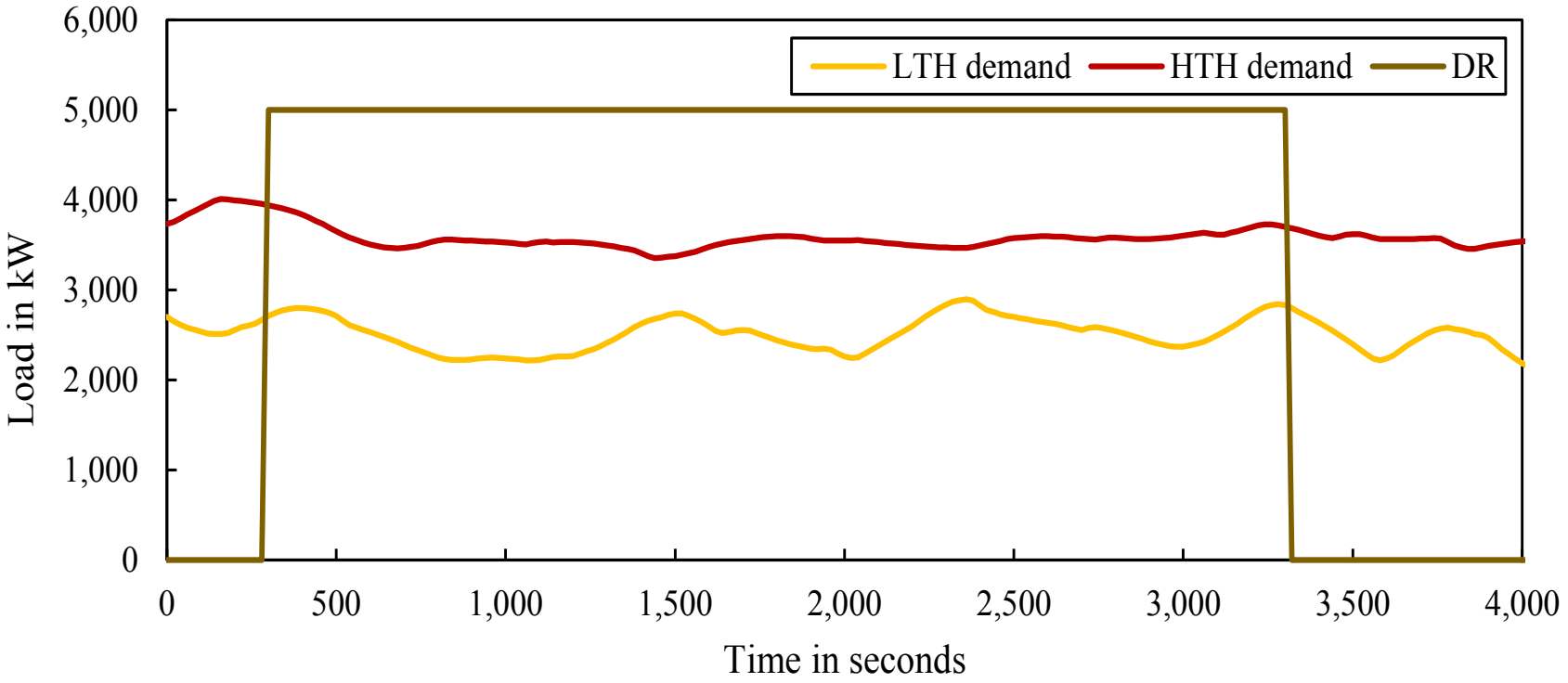


SCENARIO 2 – DEMAND RESPONSE

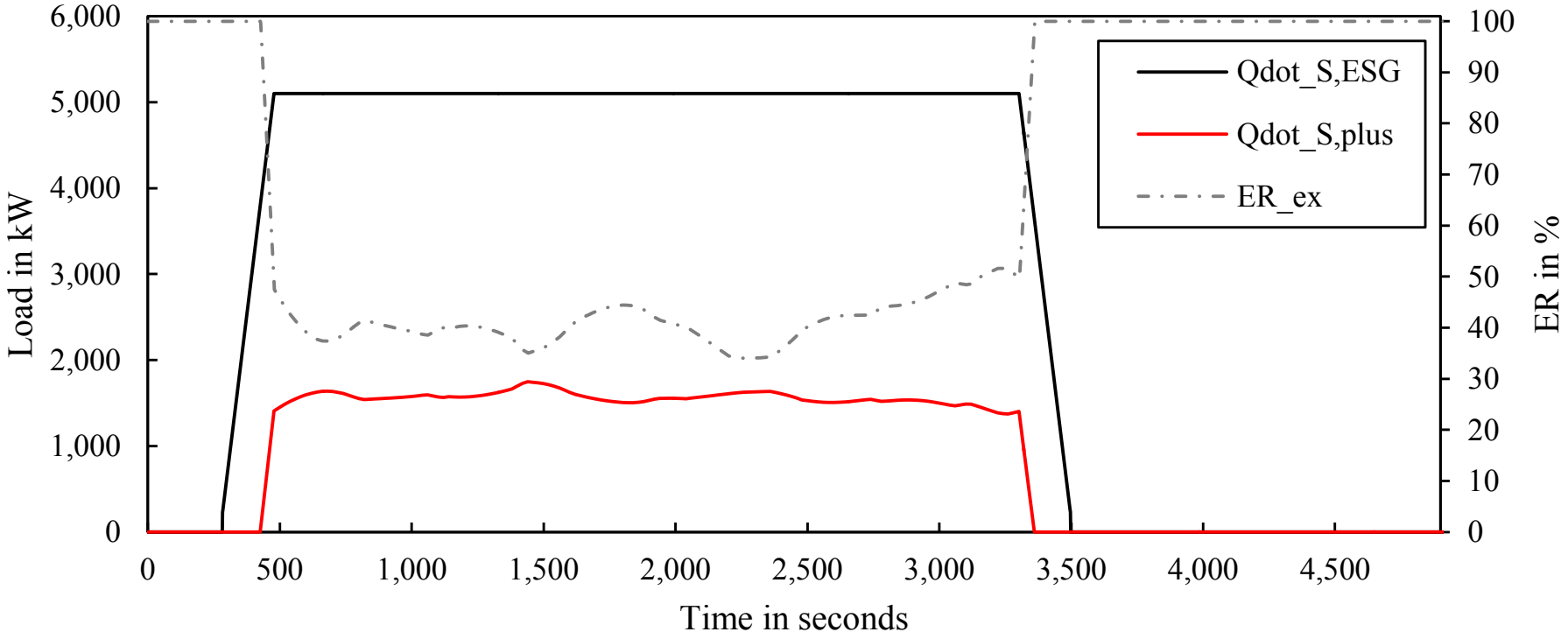
HiL-configuration for Scenario 2



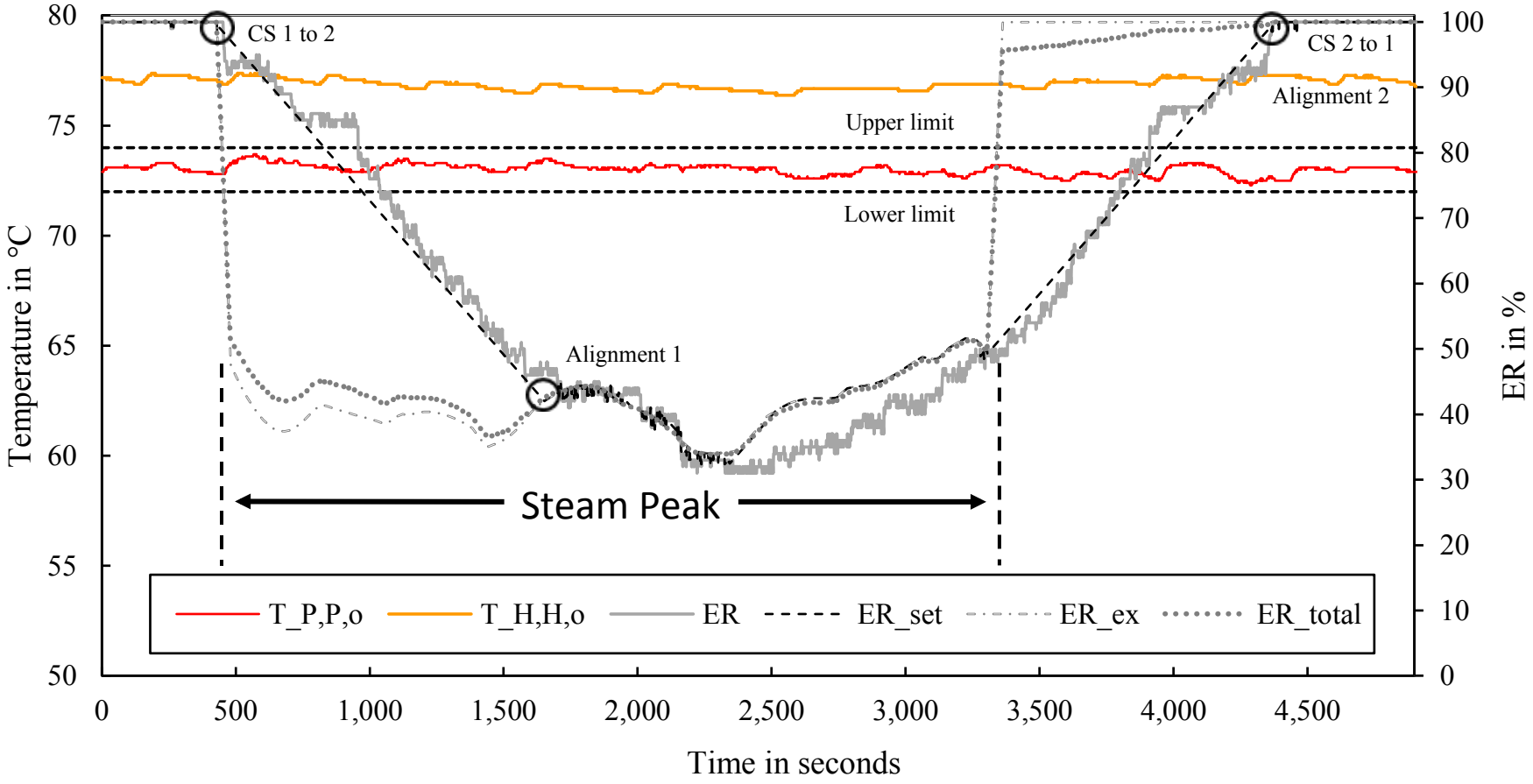
Demand Response Profile



Resulting Steam Surplus



Demand Response Scenario



Benefits from Hybrid-Heating-System

- Integration for low temperature heat
  - Heat pump
  - CHP
  - Solar thermal
  - Heat Recovery
- Balancing Energy Demand
  - Load Management by Demand Response
    - Electrical steam generator
    - Reduced CHP
  - Constant Hot Water Demand
- Optimized Hot water grid

Thanks for your attention…
Questions?

Teile dieser Präsentation gehören zu den Projekten: „ Klimafreundliche Lebensmittel durch KWK-gerechte Produktionsprozesse“ und „Systemische Kopplung von Wärmeströmen zur Senkung des CO2 –Abdrucks in der Nahrungsmittelindustrie“
Diese Projekte (HA-Projekt-Nr.: 415/14-05, HA-Projekt-Nr.: 411/14-01) werden im Rahmen von Hessen ModellProjekte aus Mitteln der LOEWE – Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz, Förderlinie 3: KMU-Verbundvorhaben gefördert.

LOEWE Exzellente Forschung für Hessens Zukunft
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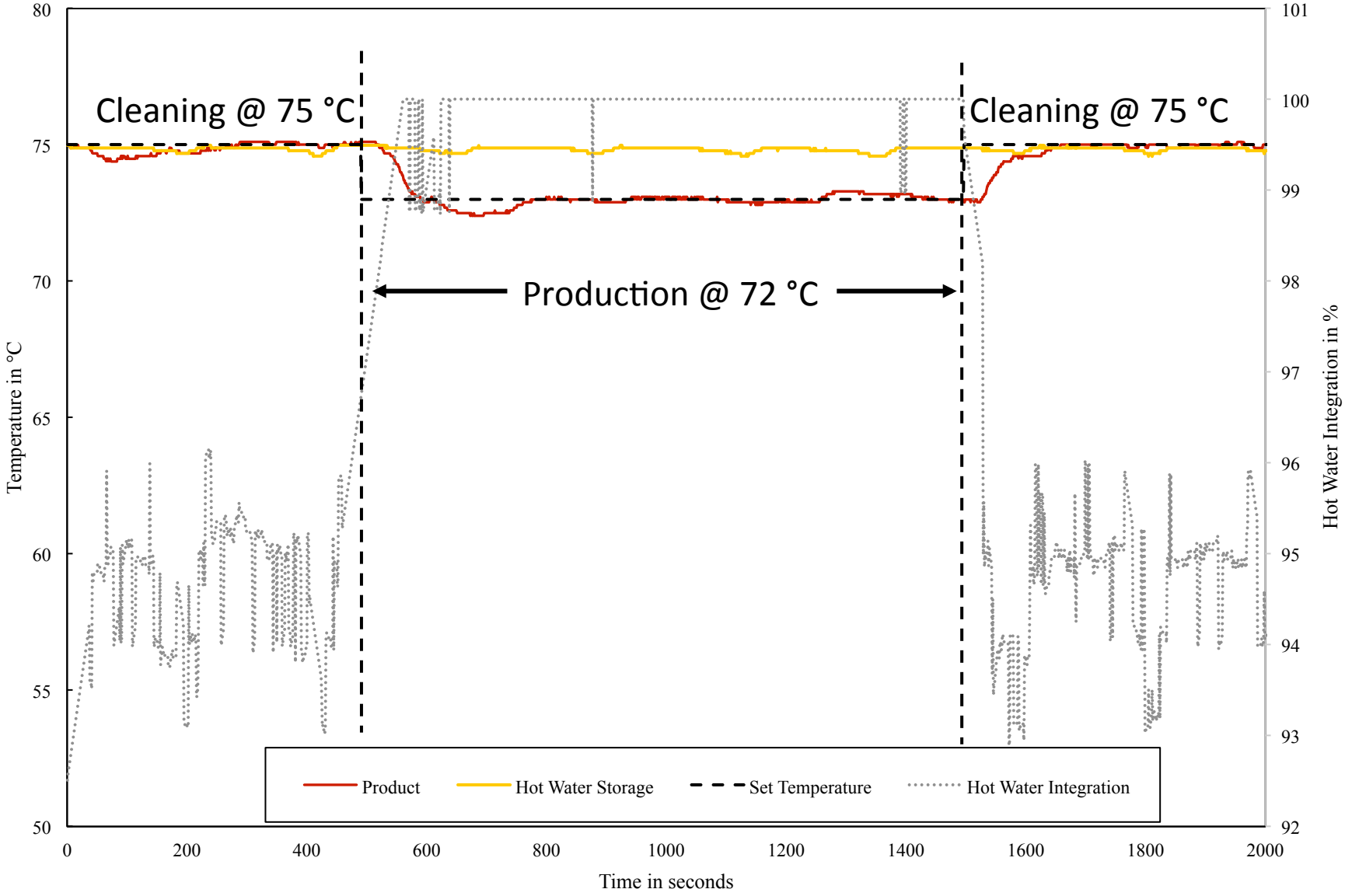
HESSEN Hessisches Ministerium für Wirtschaft, Energie, Verkehr und Landesentwicklung

Teile dieser Präsentation gehören zum Projekt: „Energie- und Klimaeffizienz durch intelligente Kopplung von Energieströmen”
„Die Förderung des Vorhabens erfolgte aus Mitteln des Bundesministeriums für Ernährung, Landwirtschaft und Verbraucherschutz (BMELV) aufgrund eines Beschlusses des deutschen Bundestages. Die Projektträgerschaft erfolgte über die Bundesanstalt für Landwirtschaft und Ernährung (BLE) im Rahmen des Programms zur Innovationsförderung.“

Gefördert durch:
Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz
Bundesanstalt für Landwirtschaft und Ernährung
Innovationsförderung. PT PROJEKTTRÄGER IN DER BLE
aufgrund eines Beschlusses des Deutschen Bundestages

Changes in set Temperature



Benefits from Heat Pump integration