

# PEAR

# ENERGY EFFICIENT AUTOMATION AND CONTROL OF BUILDINGS

Energy Flexible Buildings, 26.9.2017

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Bundesministerium  
für Verkehr,  
Innovation und Technologie



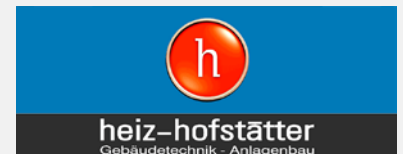
# CONTENT

- Basics Project PEAR
- The „Post am Rochus“ Building
- Building Systems modelling and potential for flexibility
- Accelerated testing of building controls

# THE PROJECT PEAR

- **Titel:** Test bench for energy-efficient automation and control of buildings
- **Primary Goal:** Significant reduction of the commissioning phase by developing a new “Controller-in-the-loop” method
- **Project frame:**
  - Funded by the Austrian Research Promotion Agency and the BMVIT within the „City of tomorrow“ funding frame
  - Project start November 2015
  - 3 Year duration
  - Project team
- **Demonstration Building:** “Post am Rochus”

Project Team



# „POST AM ROCHUS“ HEADQUARTER OFFICE BUILDING



© Post AG

## BUILDING INFORMATION

- Headquarter Office building + Shopping Centre
- Located in Vienna
- Gross Floor area: 48.000 m<sup>2</sup> approx.
- New building and refurbishment
- Opening on the 21th September 2017

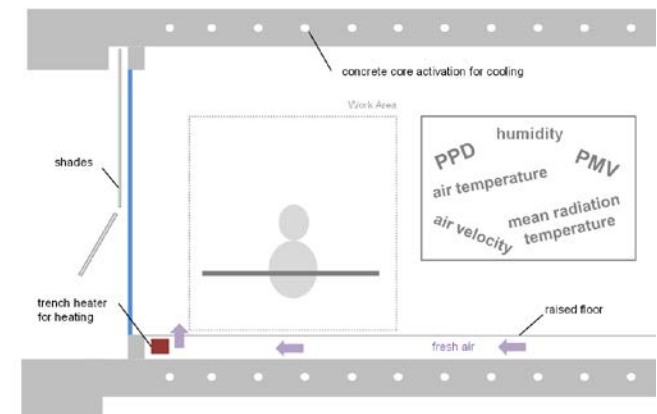
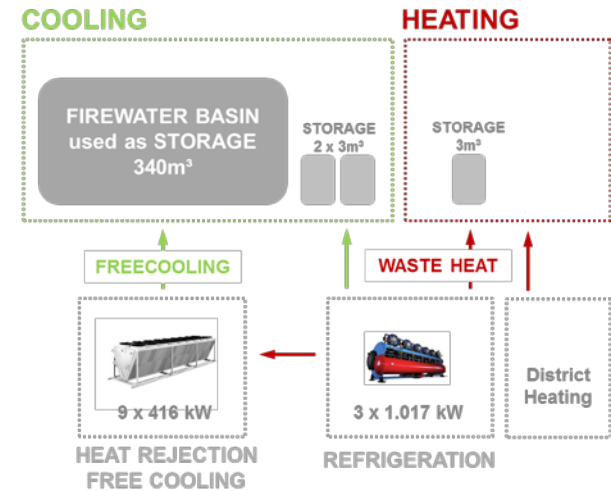
# „POST AM ROCHUS“ HEADQUARTER OFFICE BUILDING

## HVAC SYSTEM

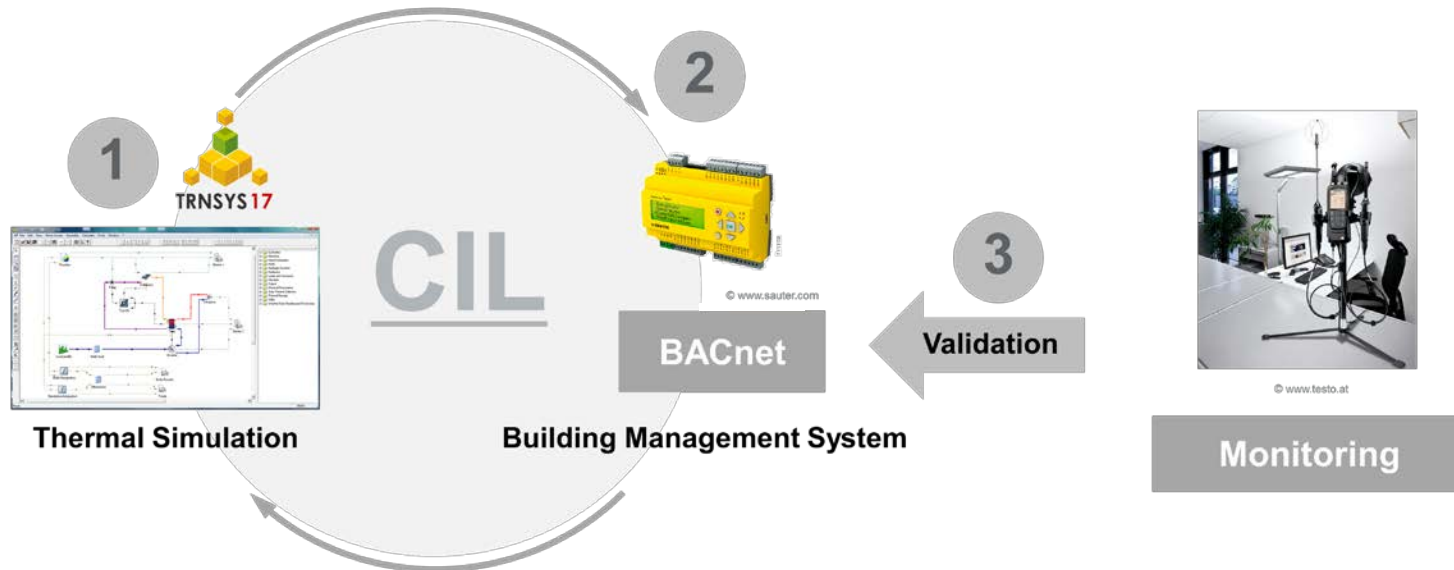
- District heating
- Compression chillers and dry cooler heat rejection
- FreeCooling Options: Heat Rejection + firewater basin used as storage
- Eight ventilation systems

## INDOOR CLIMATE

- Concrete Core Activation
- Trench heater
- Mech. ventilation



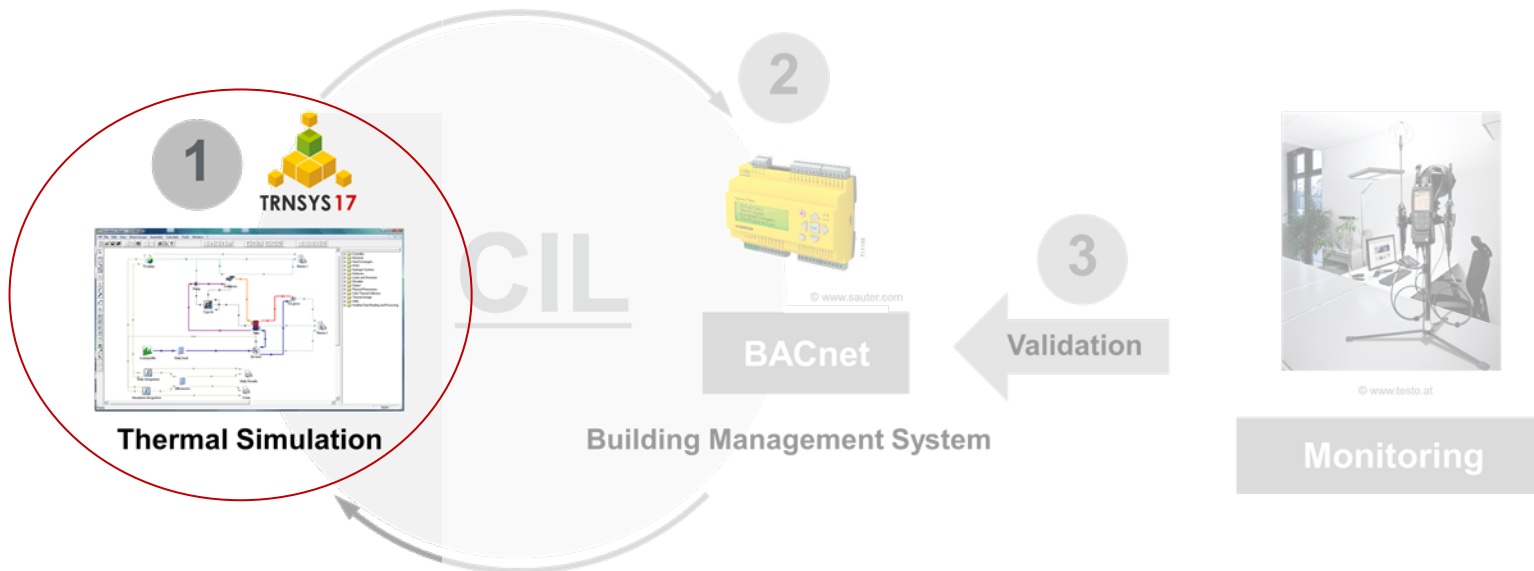
# PROJECT CONTENT OVERVIEW



- 1 Thermal Simulation** --- Scientific planning support, test different control strategies, setpoints for free cooling etc.
- 2 Hardware-in-the-Loop (HIL)** --- Review of the implemented control strategies for shortening commissioning phase
- 3 Validation** --- Validation of the simulation models and the Hardware-in-the-Loop method with monitoring data

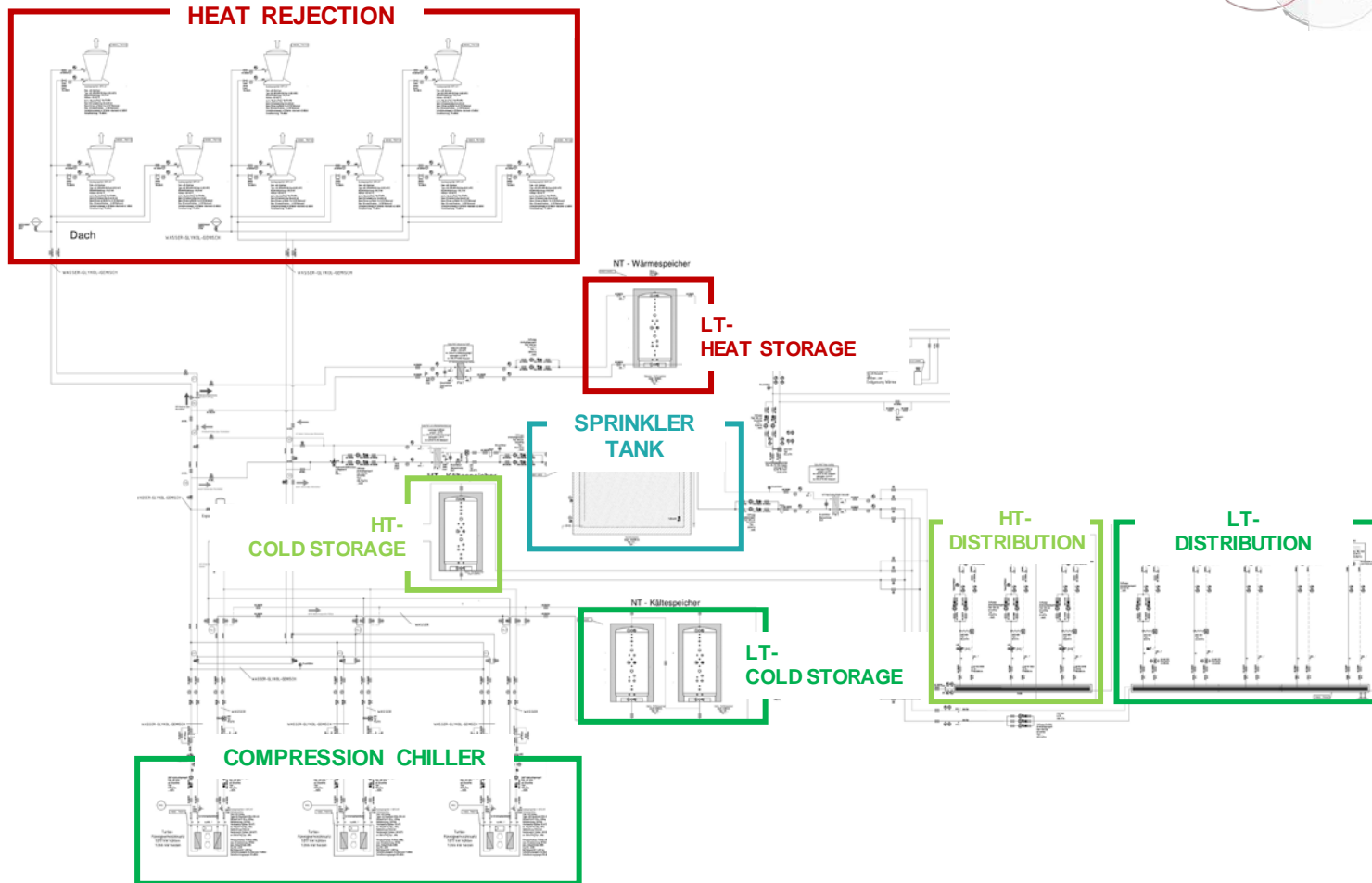
# 1 THERMAL SYSTEM SIMULATION

## SCIENTIFIC SUPPORT AN OPTIMIZATION OF BUILDING AUTOMATION STRATEGIES



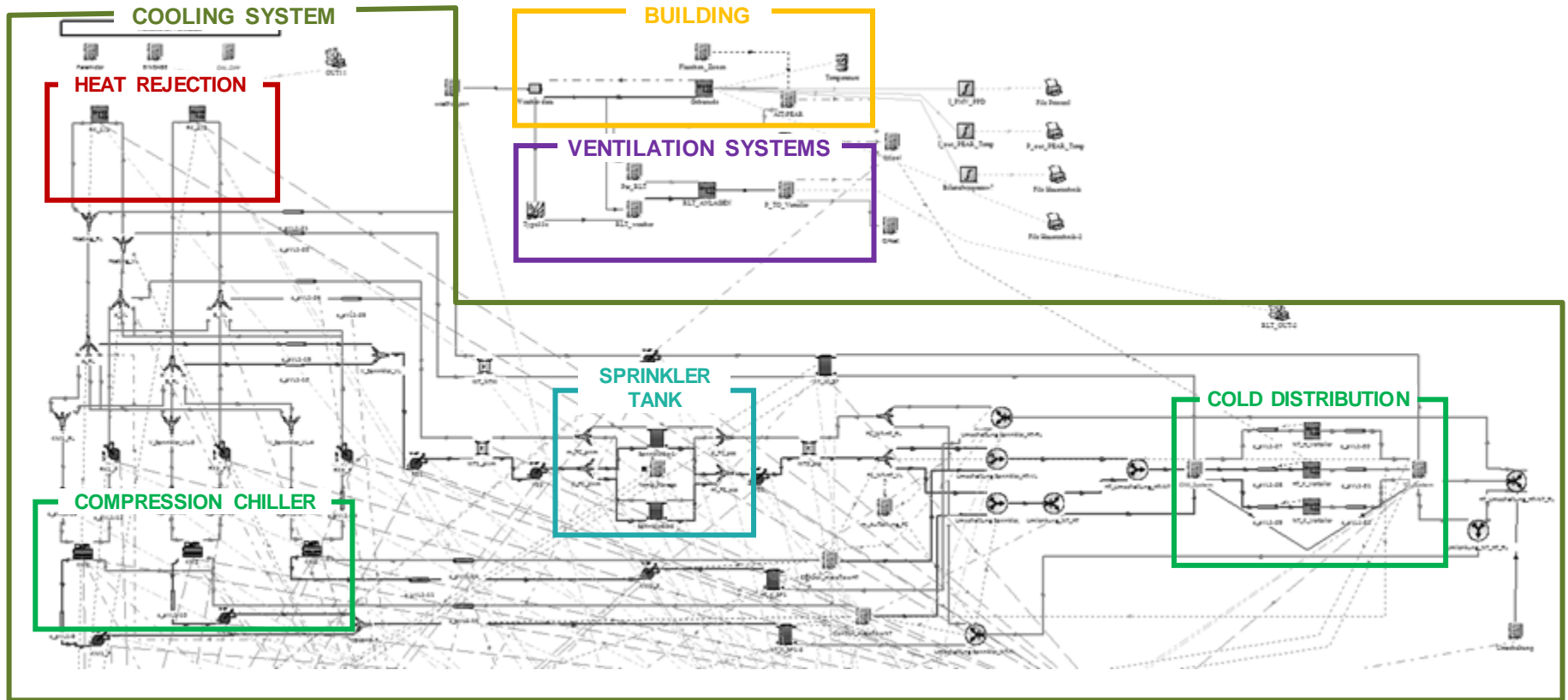
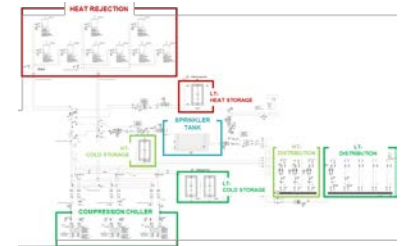
# SYSTEM SIMULATION

## SCHEMATIC OVERVIEW COOLING SYSTEM

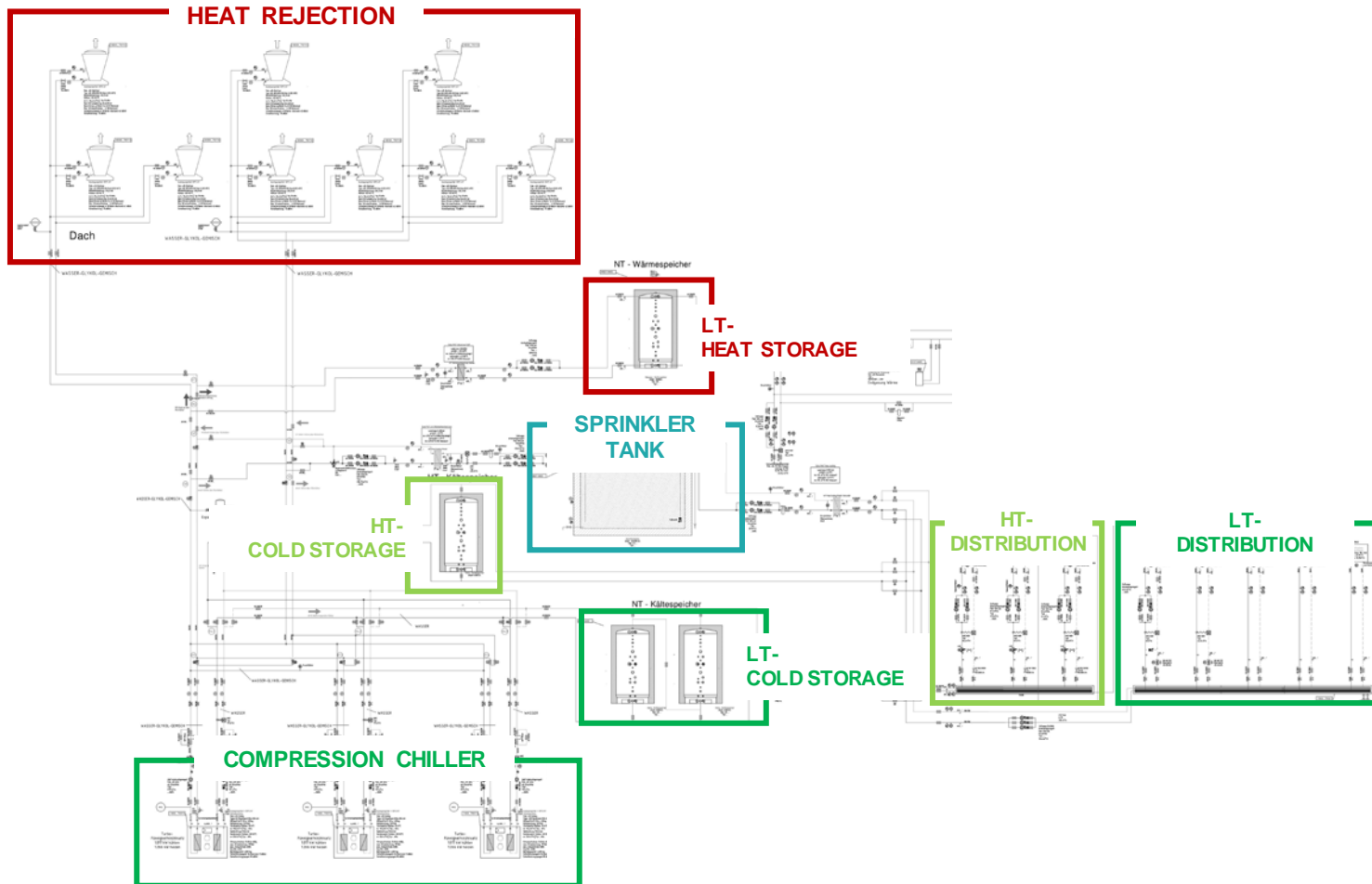




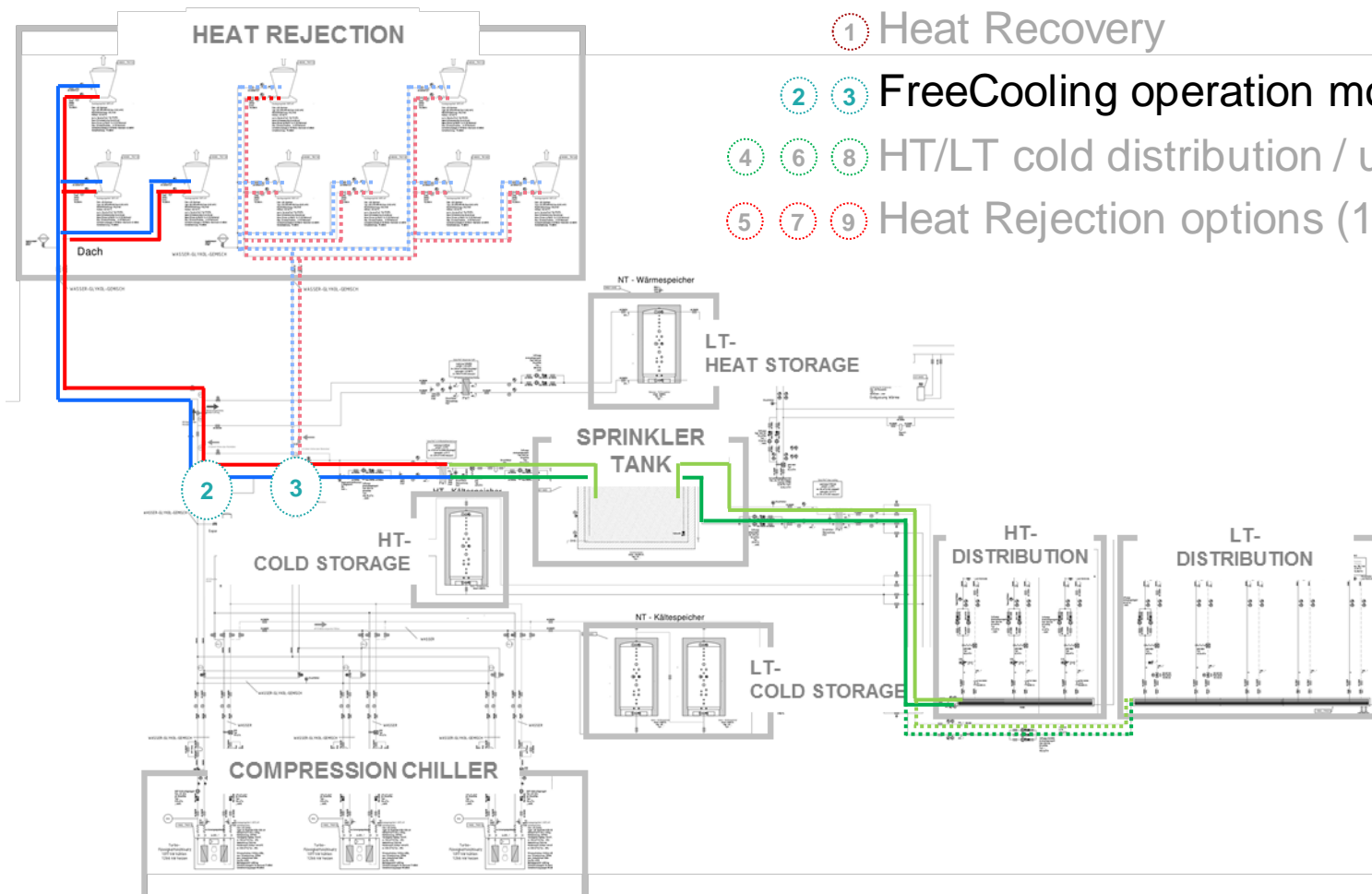
# THERMAL SYSTEM MODEL VISUALIZATION



# ACCESS POINTS BUILDING AUTOMATION



# ACCESS POINTS BUILDING AUTOMATION EXAMPLE: FREE COOLING OPTIONS



① Heat Recovery

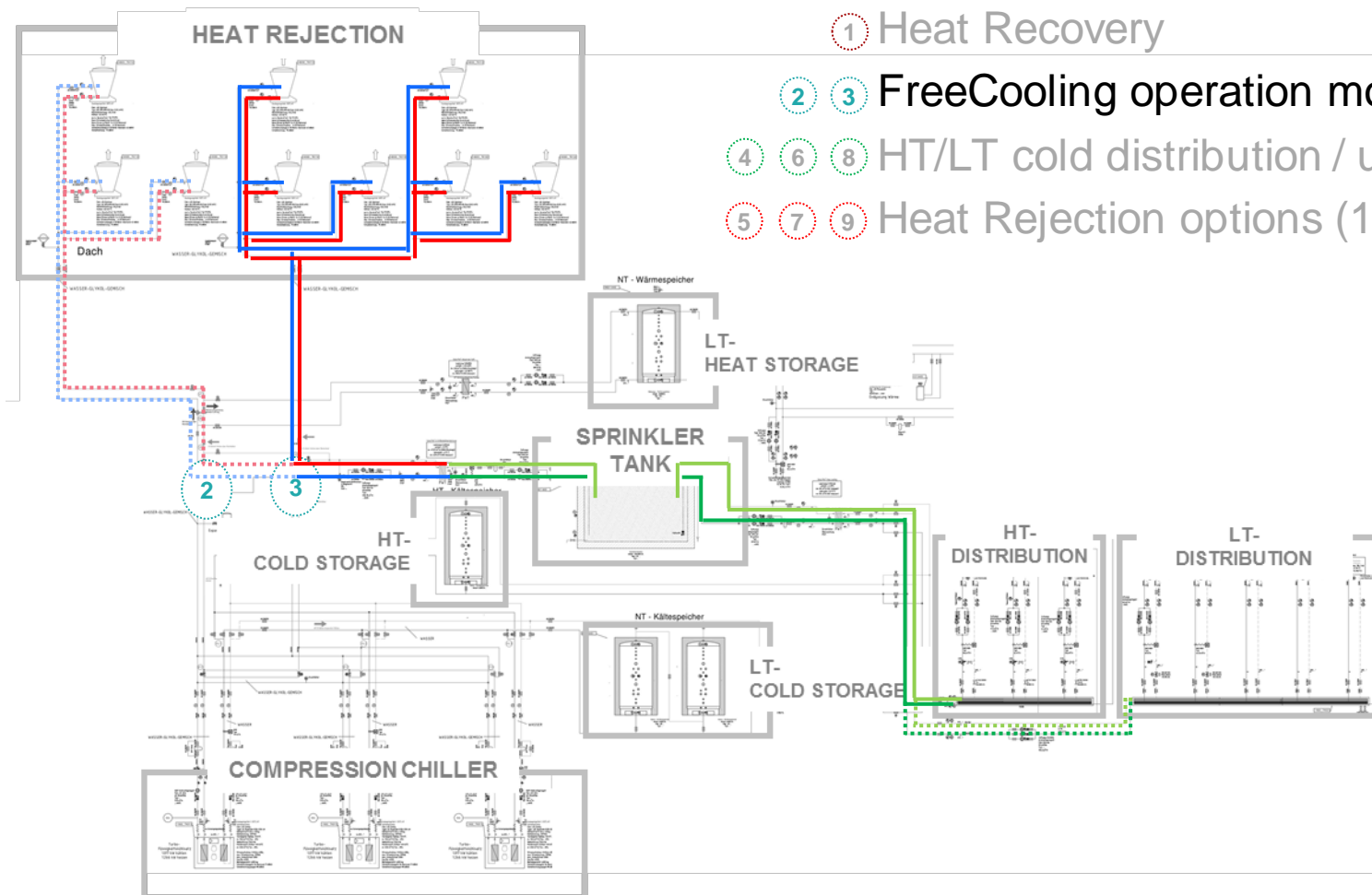
② ③ FreeCooling operation mode

④ ⑥ ⑧ HT/LT cold distribution / use

⑤ ⑦ ⑨ Heat Rejection options (1/3 // 2/3)

# ACCESS POINTS BUILDING AUTOMATION

## EXAMPLE: FREE COOLING OPTIONS



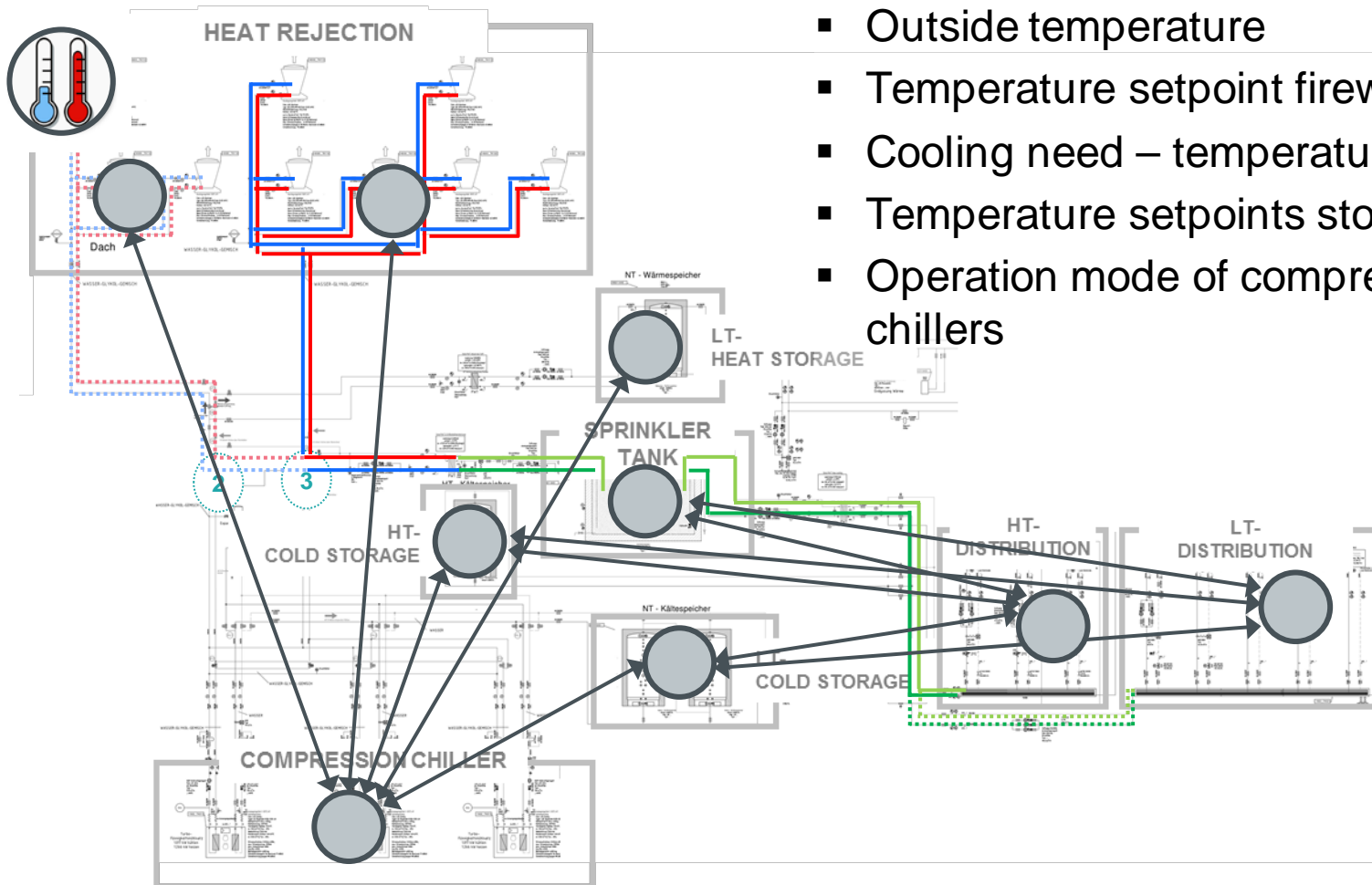
① Heat Recovery

② ③ FreeCooling operation mode

④ ⑥ ⑧ HT/LT cold distribution / use

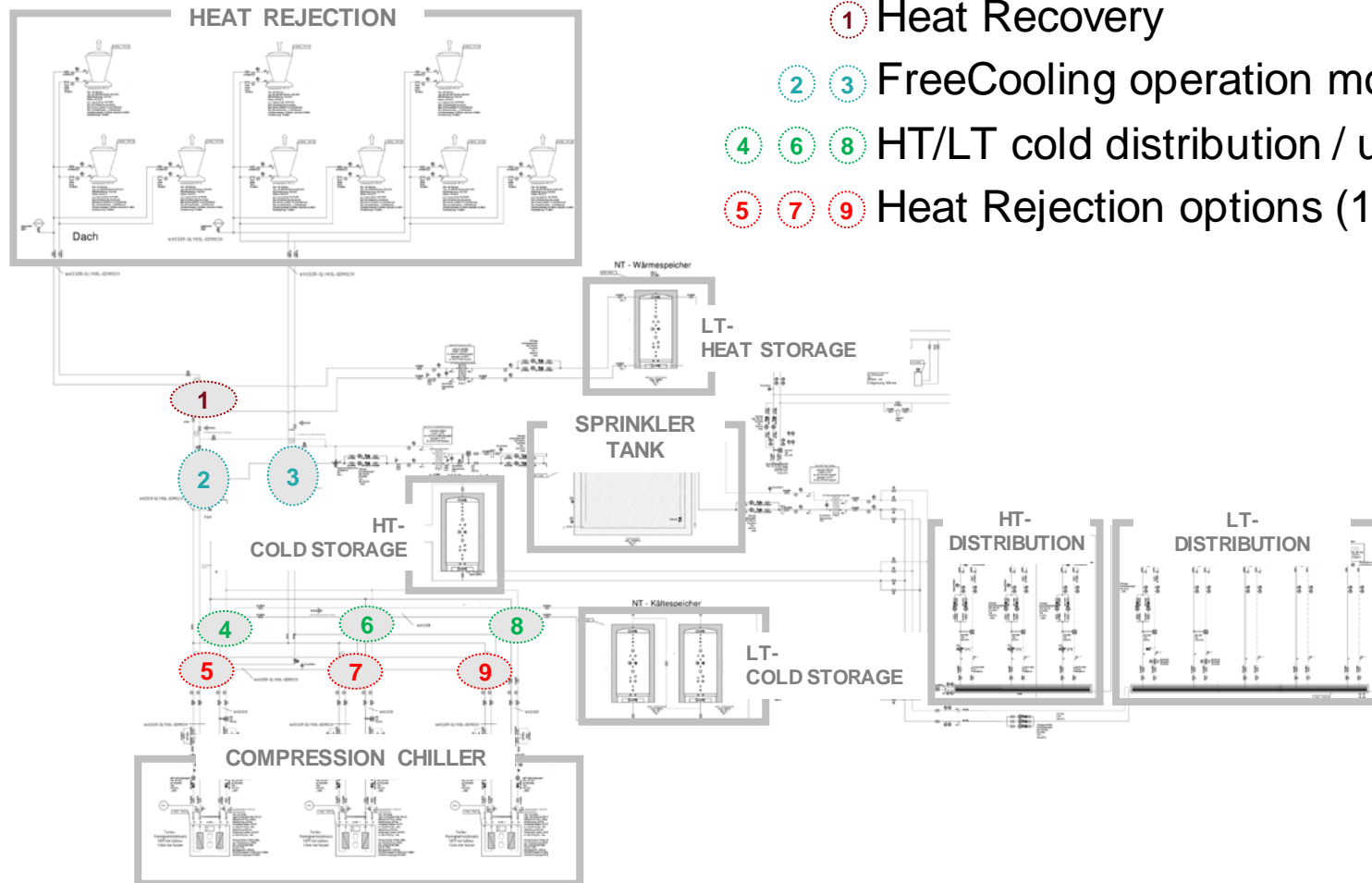
⑤ ⑦ ⑨ Heat Rejection options (1/3 // 2/3)

# ACCESS POINTS BUILDING AUTOMATION EXAMPLE: FREE COOLING OPTIONS



- Outside temperature
- Temperature setpoint firewater basin
- Cooling need – temperature / demand
- Temperature setpoints storages
- Operation mode of compression chillers

# ACCESS POINTS BUILDING AUTOMATION



① Heat Recovery

② ③ FreeCooling operation mode

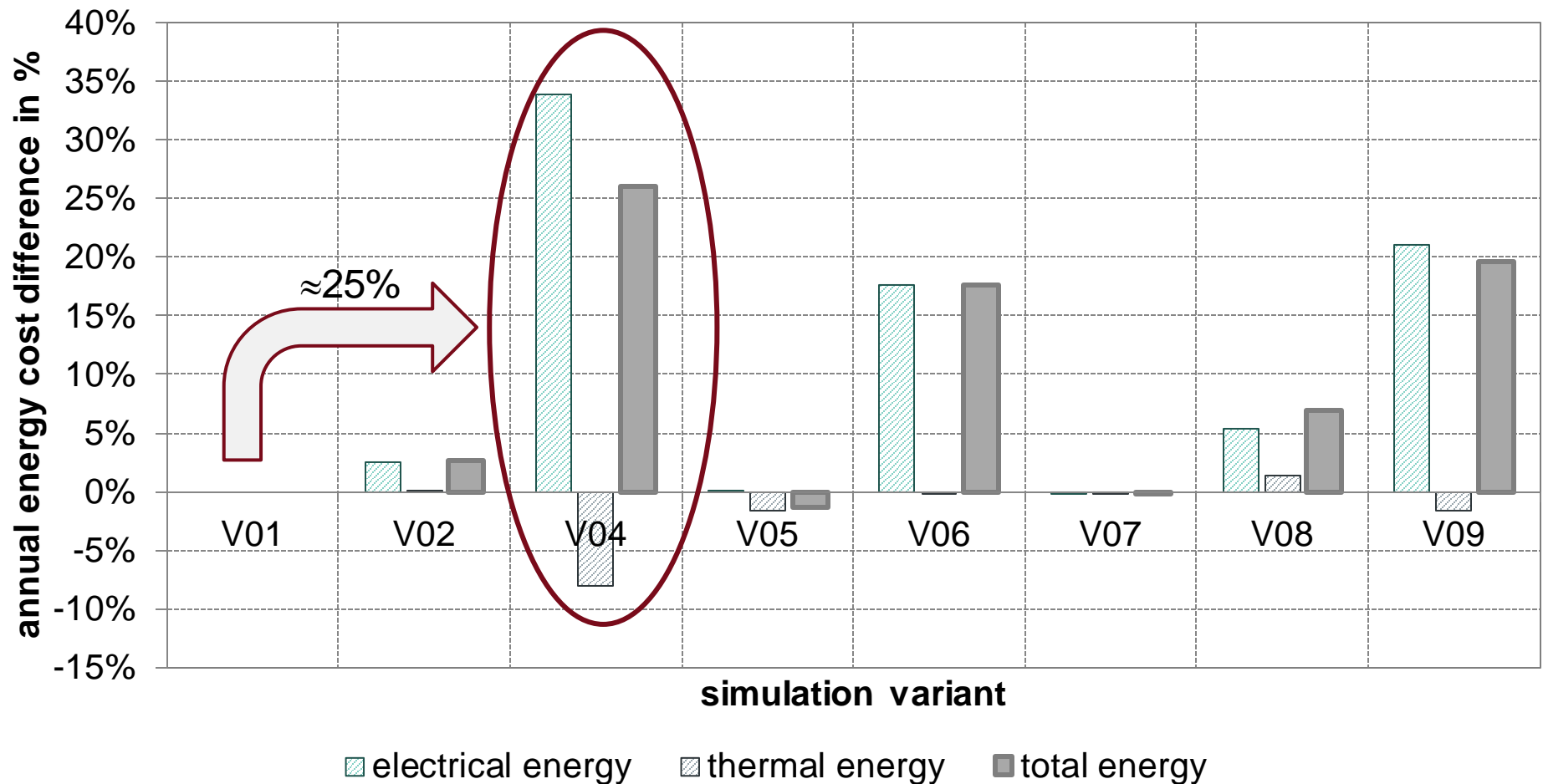
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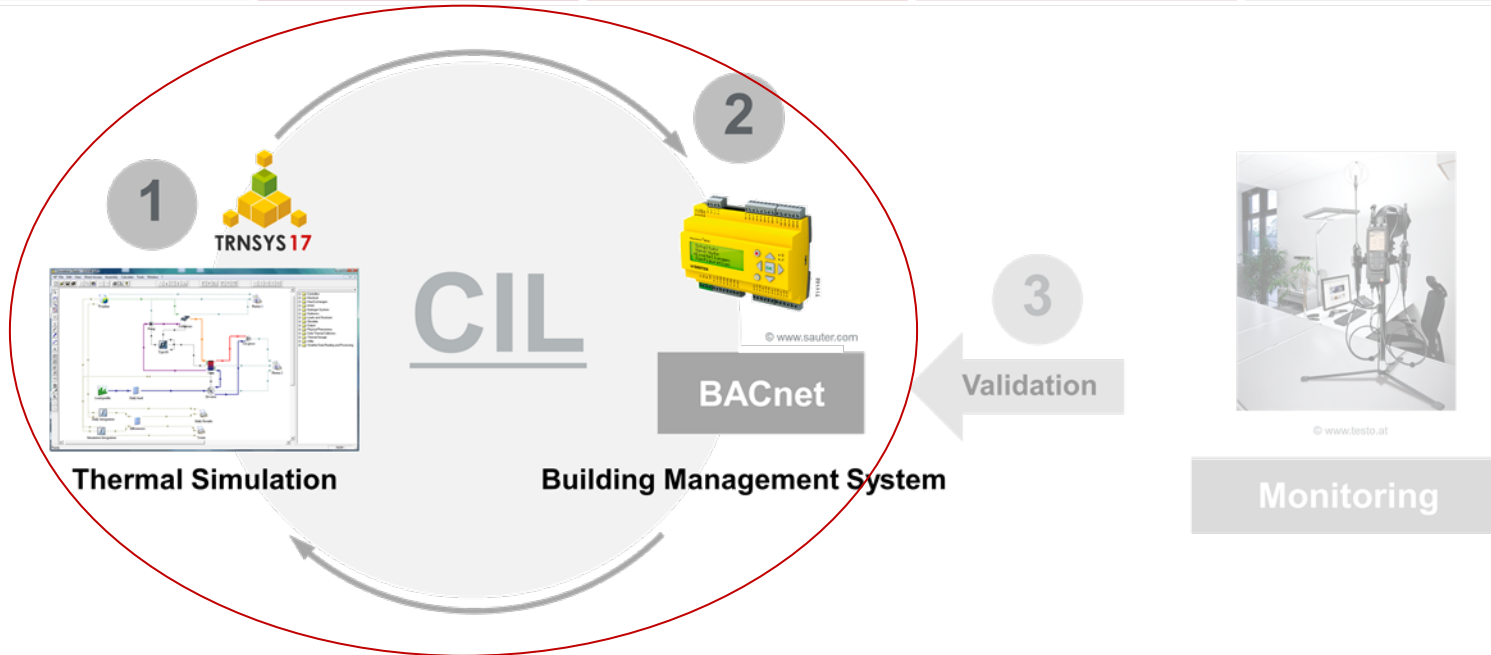
# THERMAL SYSTEM SIMULATION RESULTS: CONTROL STRATEGIES

Annual difference in terms of energy costs (related to V01)

(based on following costs: el. energy: 0.1055€/kWh, district heating: 0,06436 €/kWh)

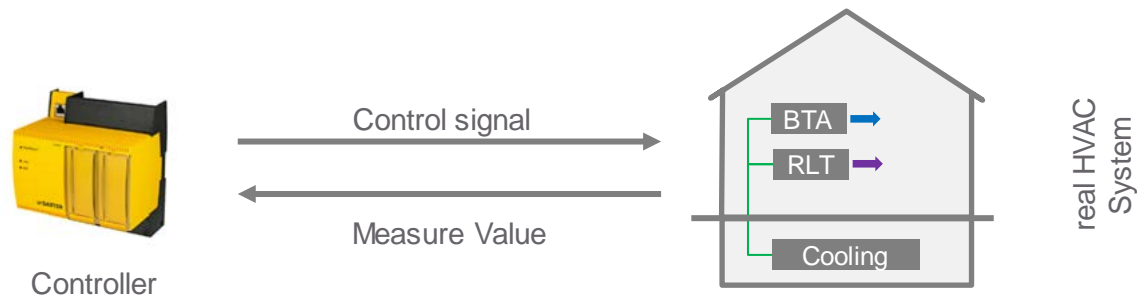


# 2 CONTROLLER IN THE LOOP (CIL) REVIEWING IMPLEMENTED CONTROL STRATEGIES FOR SHORTENING COMMISSIONING PHASE

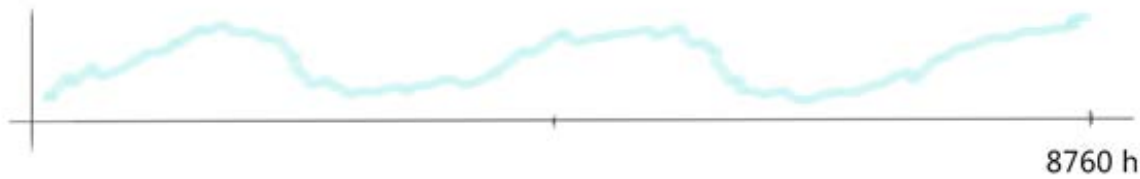




# PEAR – CIL: GOAL



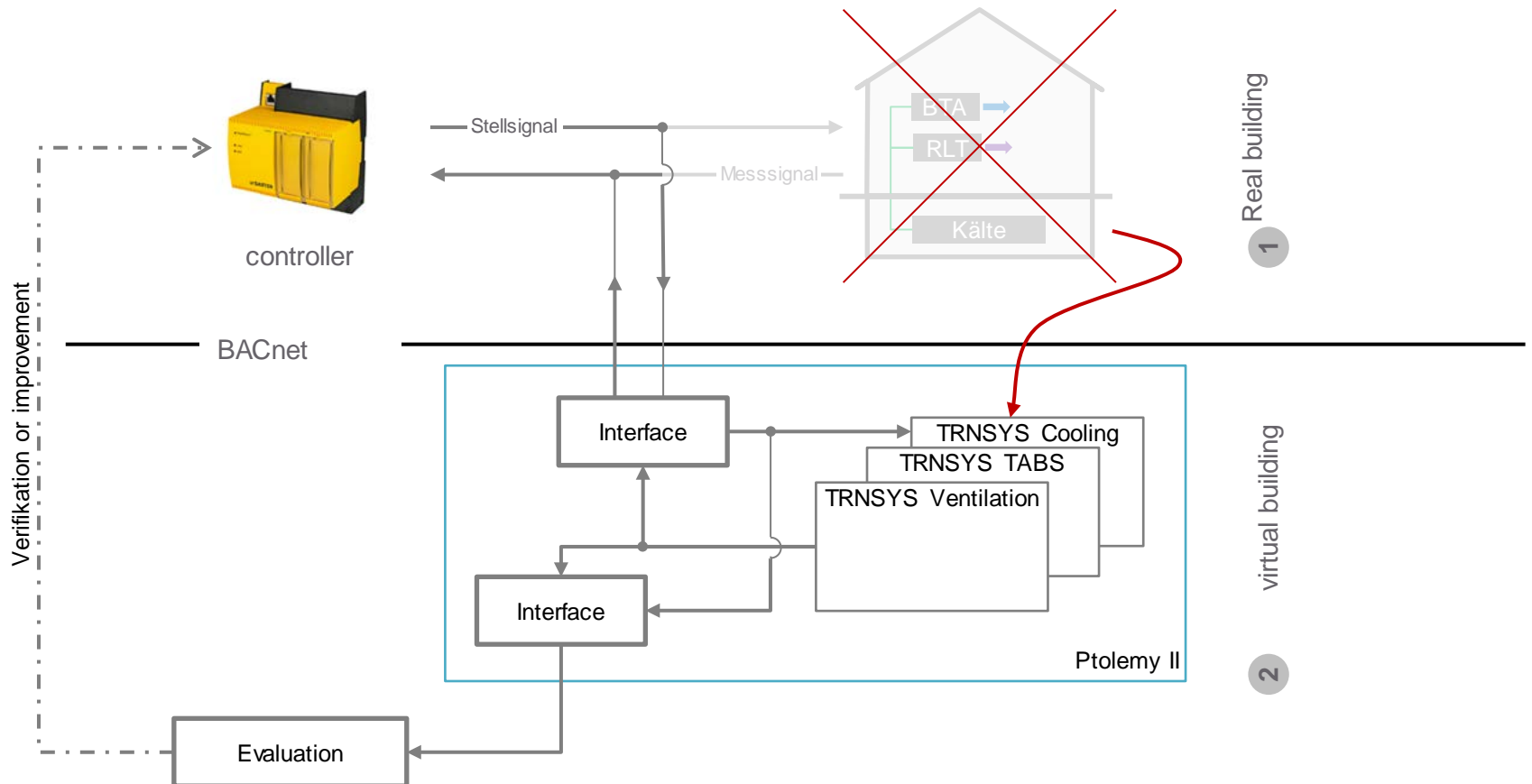
## 1 Real time coupling



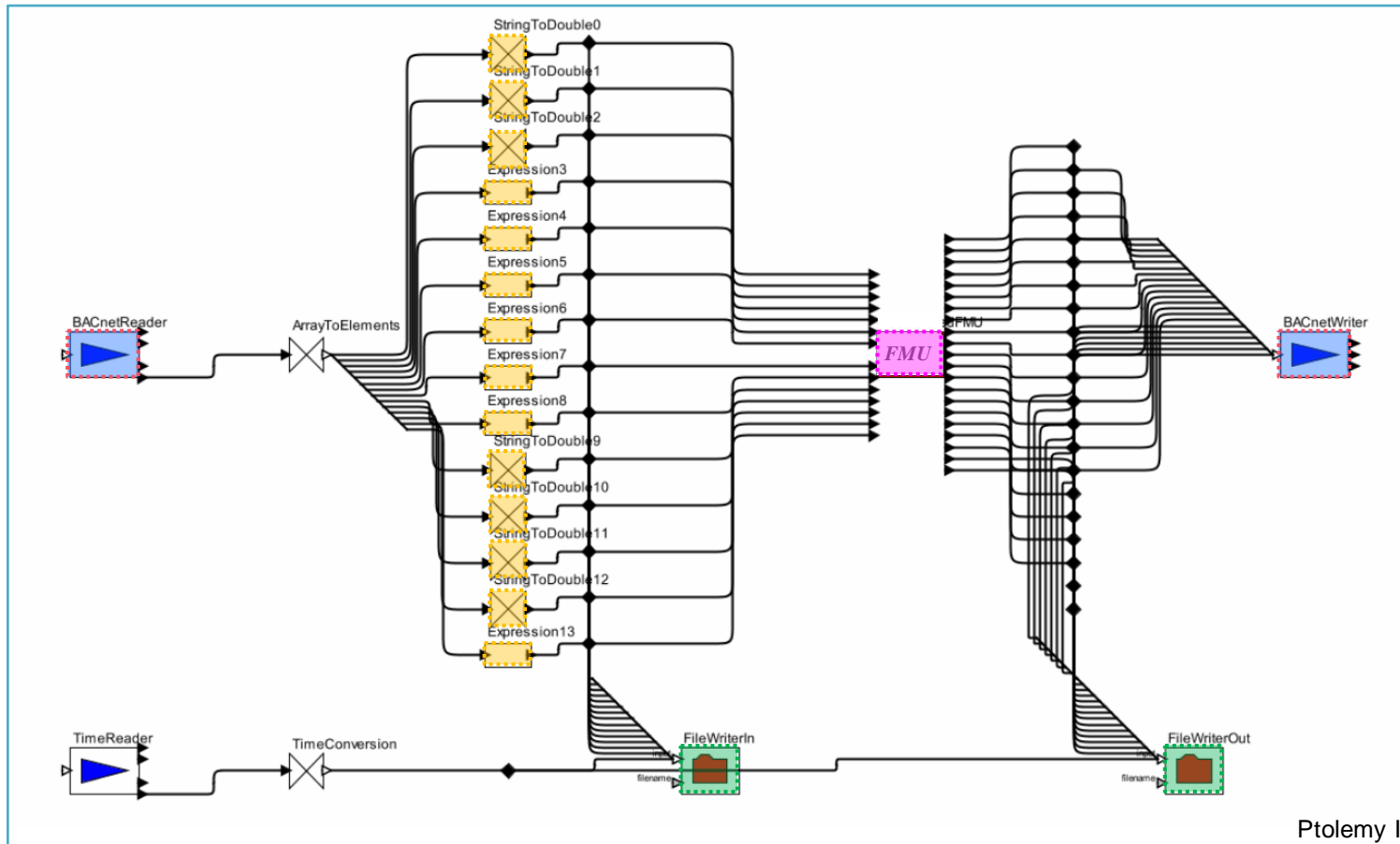
## 2 Accelerated Coupling



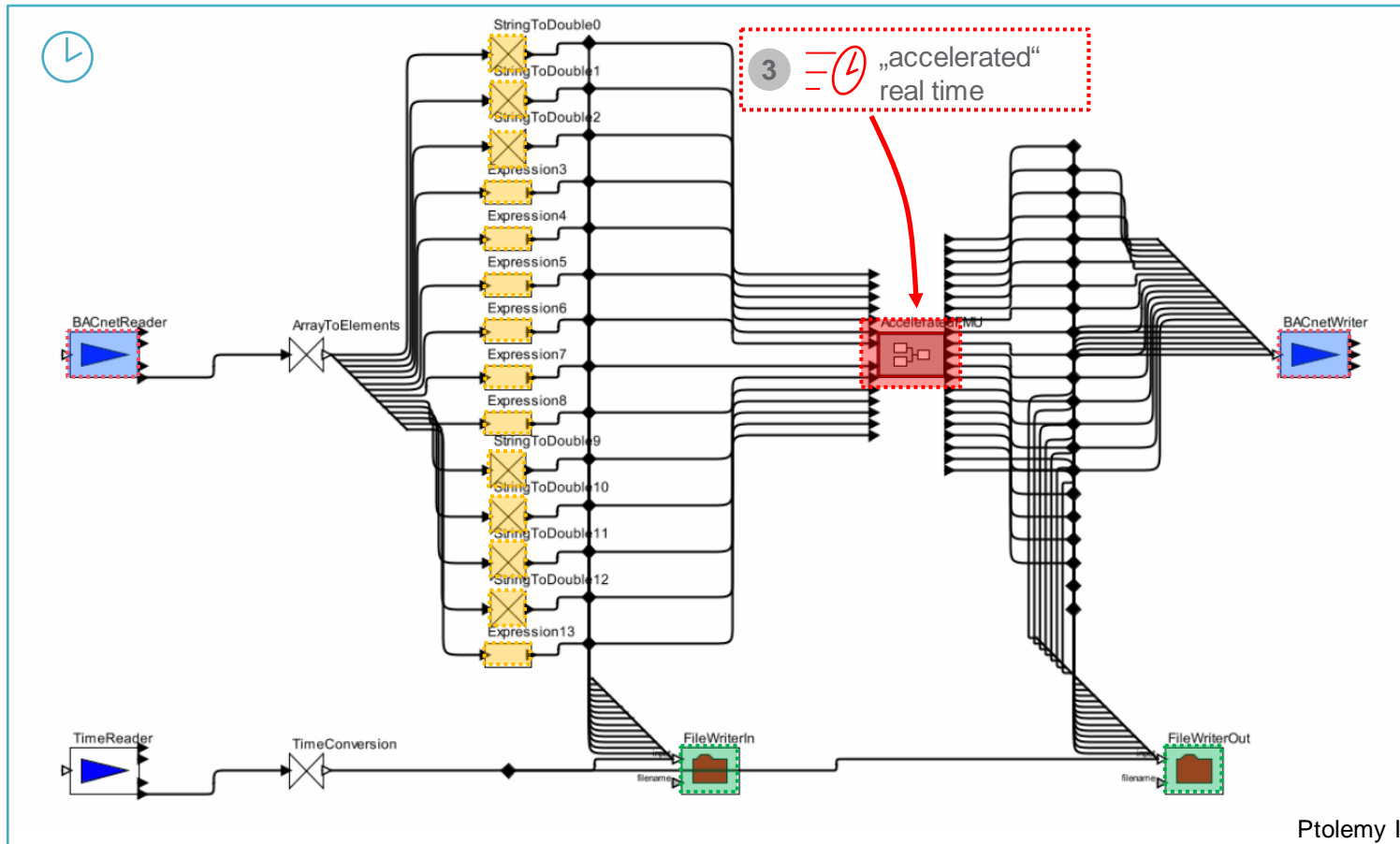
# PEAR - CIL – SIMULATION ENVIRONMENT



# CIL – SIMULATION VIA BCVTB IN PTOLEMY II



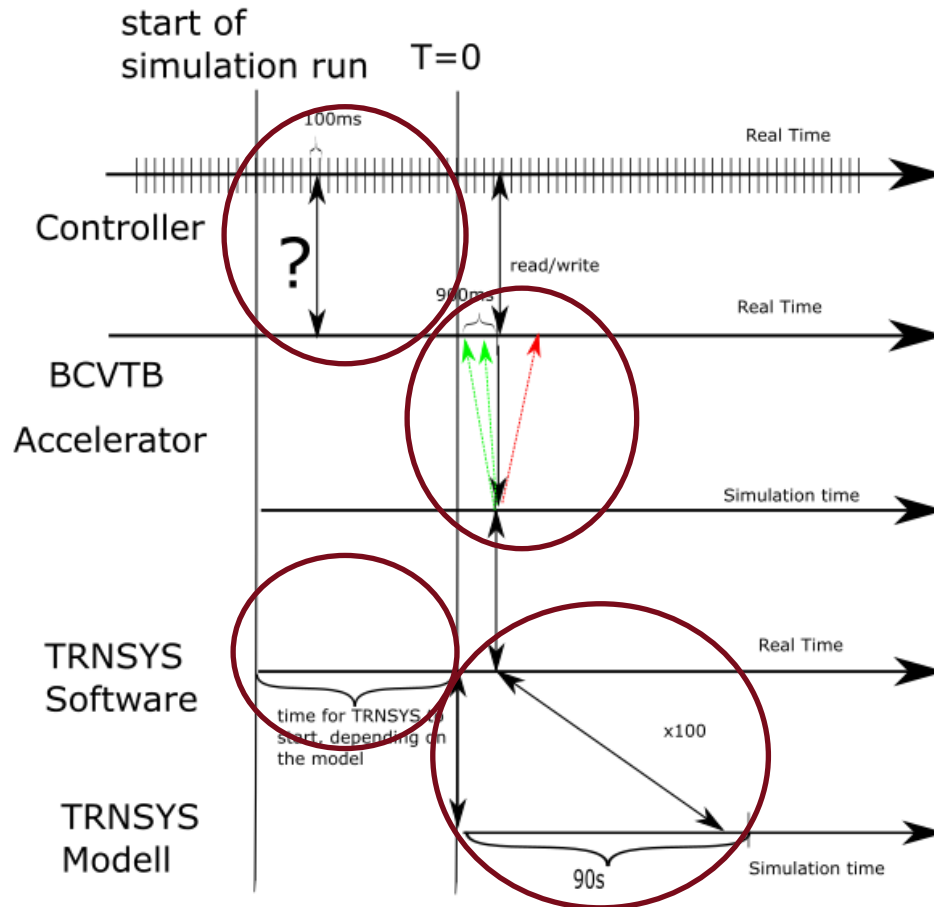
# CIL – SIMULATION - ACCERERATION



# CIL – SIMULATION COUPLING



# CIL – SIMULATIONSUMGEBUNG KOPPLUNG EINER RLT-ANLAGE



- the controller runs all the time with 100 ms sampling time
- TRNSYS needs to be started
- Each simulation time step can take any duration below 900ms
- The simulation model is running accelerated

# THANK YOU!

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