

# Production Based Energy Management Tools for the Food Processing Industry

1<sup>st</sup> Colloquium of the Munich School of Engineering  
“Sustainable Energy Supply for the Future”

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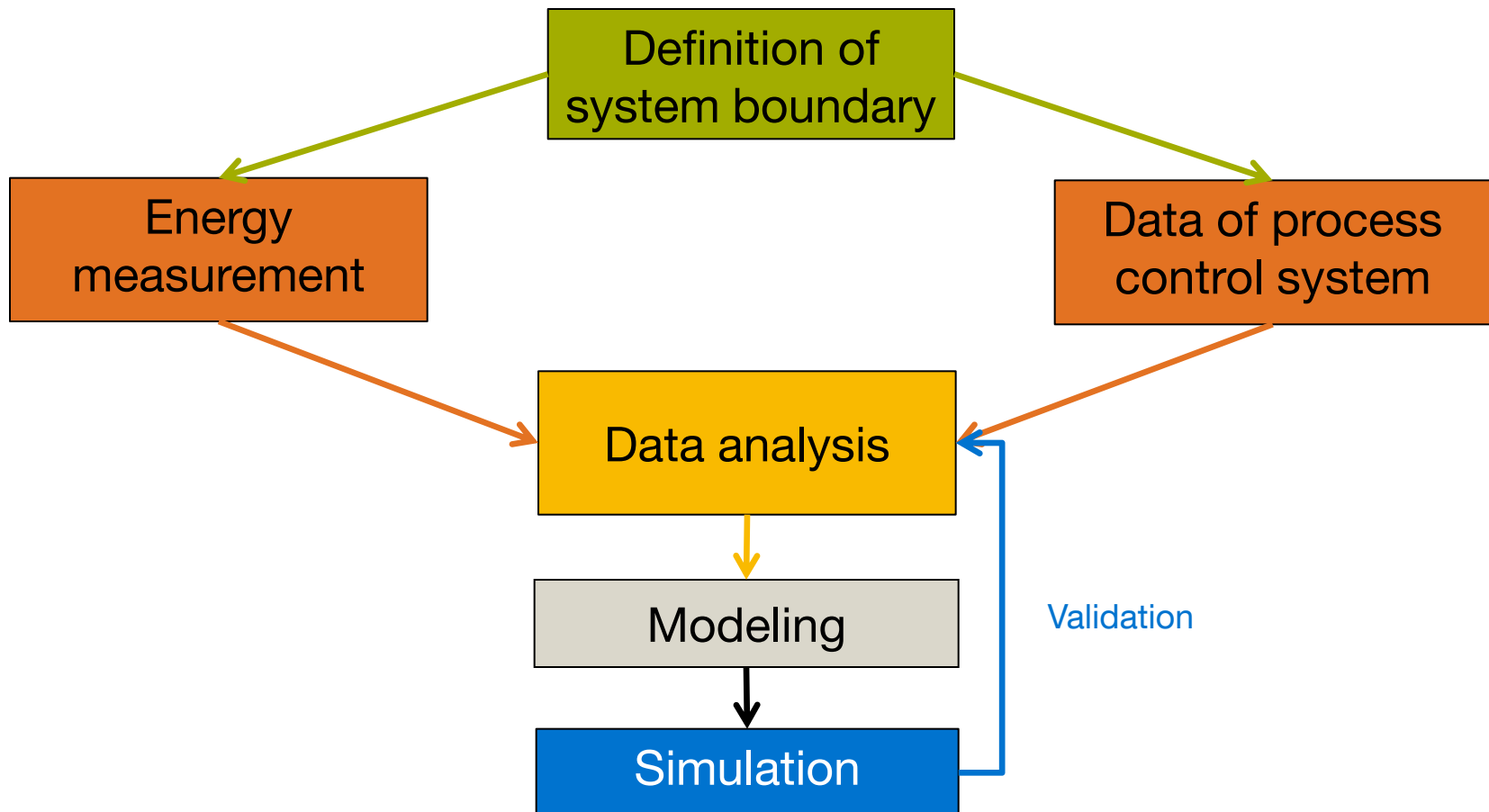
Chair of Food Packaging Technology

Prof. Dr. rer. nat. Horst-Christian Langowski

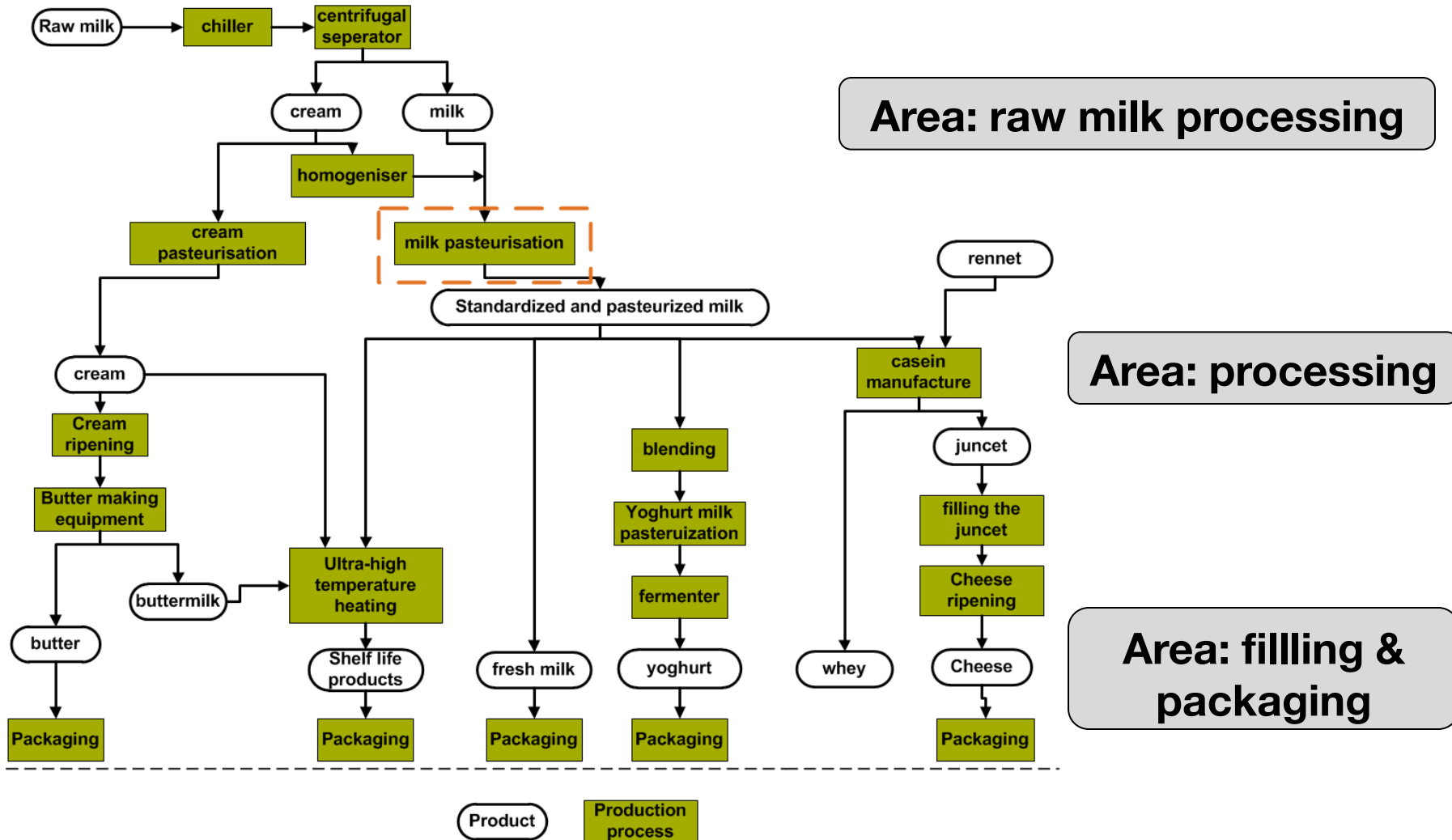
# Approach of the production based energy management

- Plant data capture and data analysis
- Establishing measuring points for energy monitoring and energy performance analysis
- Development of models for describing and forecasting the plants demand for energy
- Structured analysis of manufacturing schedules
- Compliance with manufacturing and technological boundary conditions

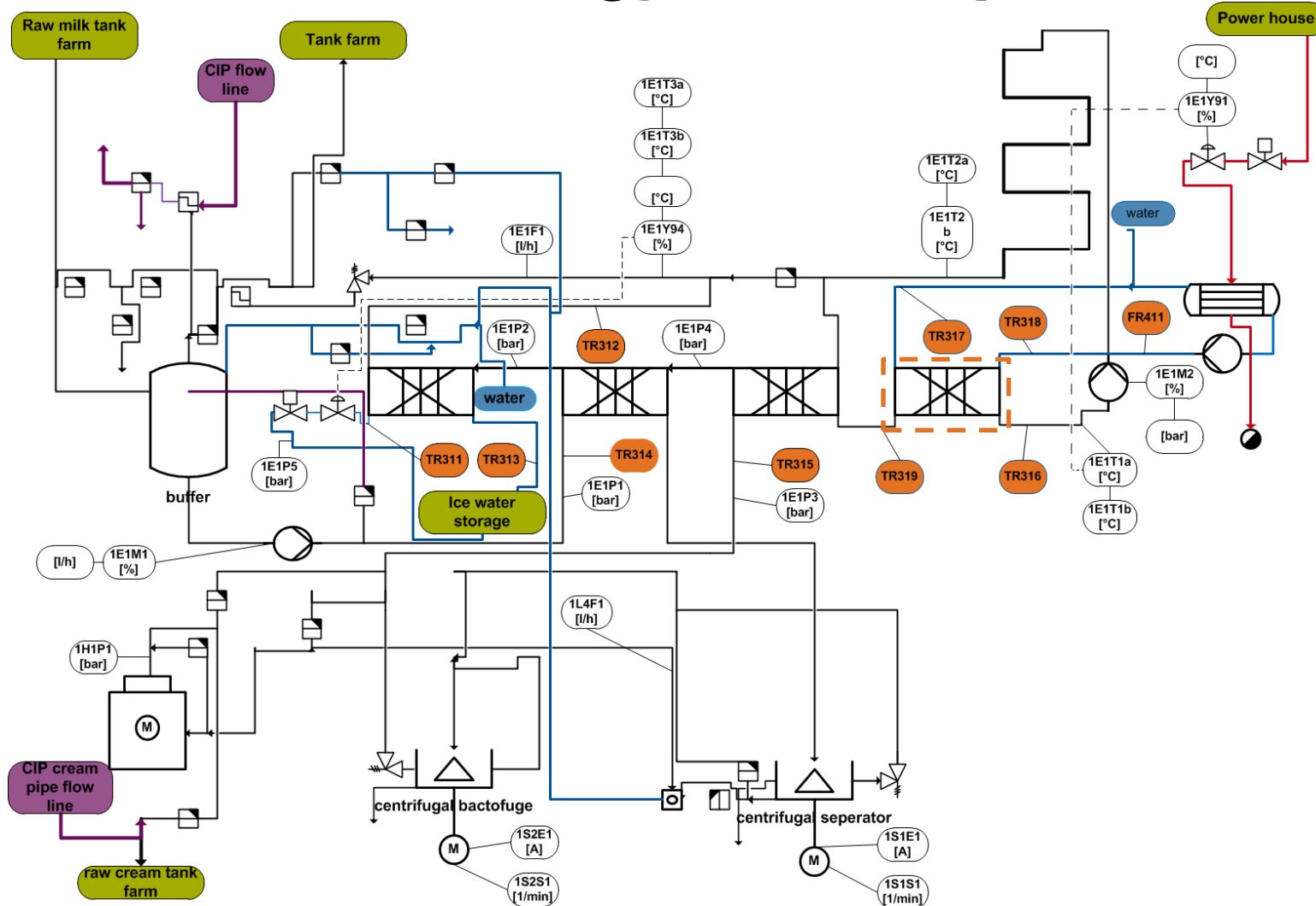
# Methods of the production based energy management



# Overview of energy consumption units

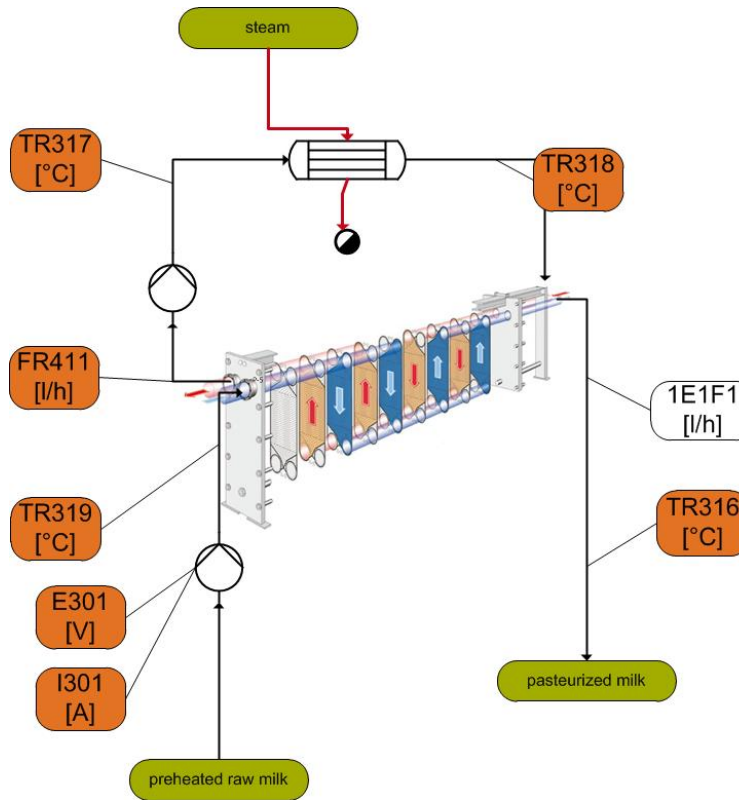


# Overview of energy consumption units



# Measurement methods

Temperature measurement:  
 -PT 1000 surface temperature sensors  
 -data logging system



Flow measurement:  
 -Clamp-on ultrasonic sensor  
 -data logging system

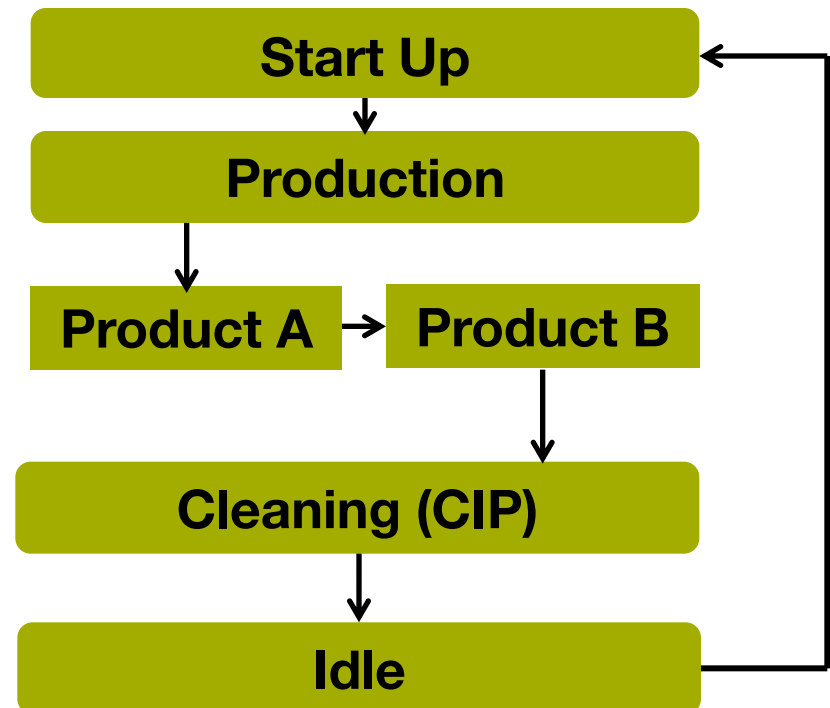
Electrical power:  
 -Clamp ammeter  
 -Measuring at the switching cabinet of each consumer

Process control system:  
 -Using sensor values of the control system  
 -SQL data base storage

# Energy based phase tracking

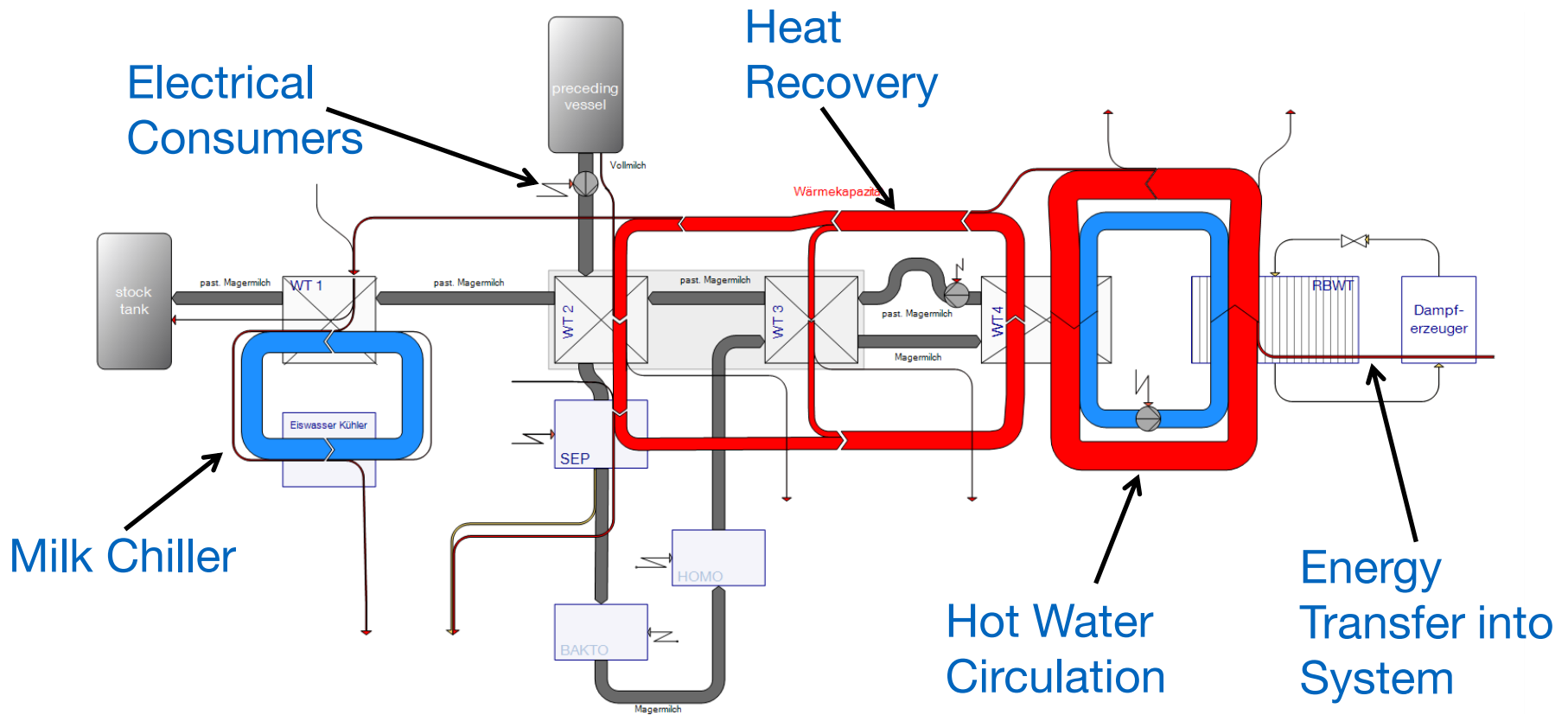
Classification of the plant status into phases

**Production Process**



➔ Calculation of production based green indicators

# Visualisation of the stationary energy flow by a Sankey diagram



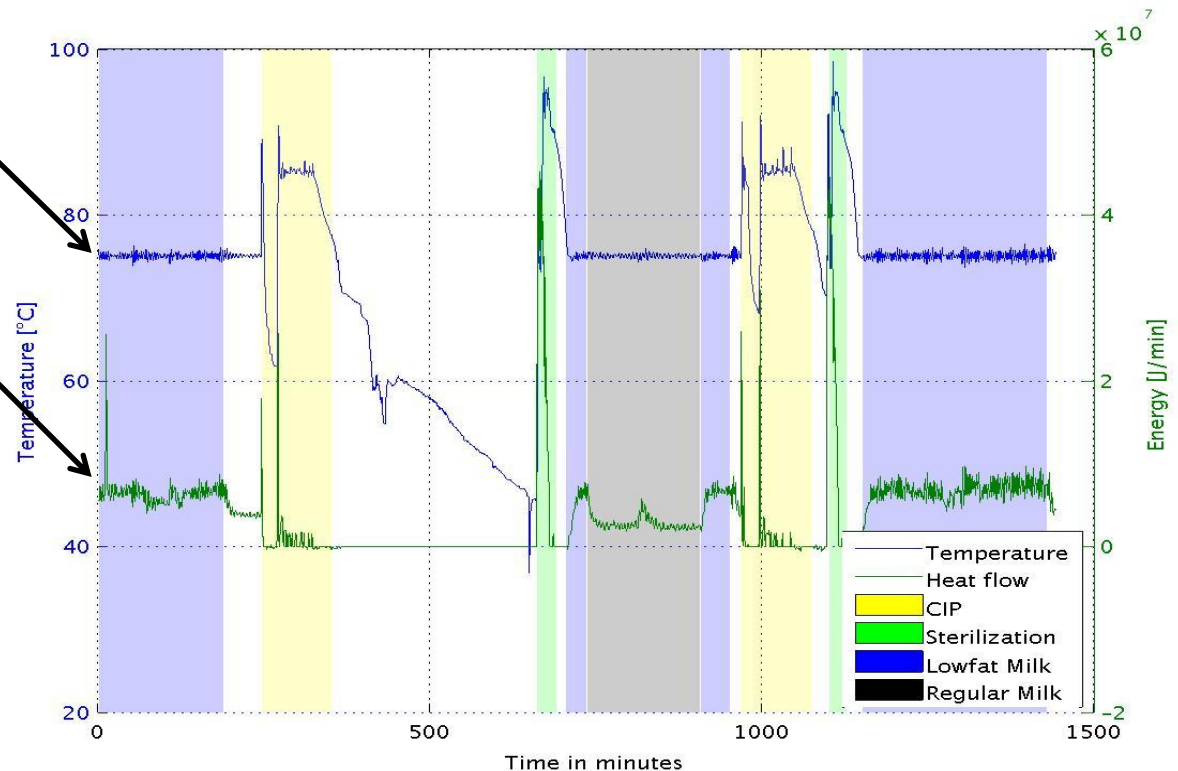


# Production based as-is analysis: graphical approach, time series

Pasteurization  
Temperature

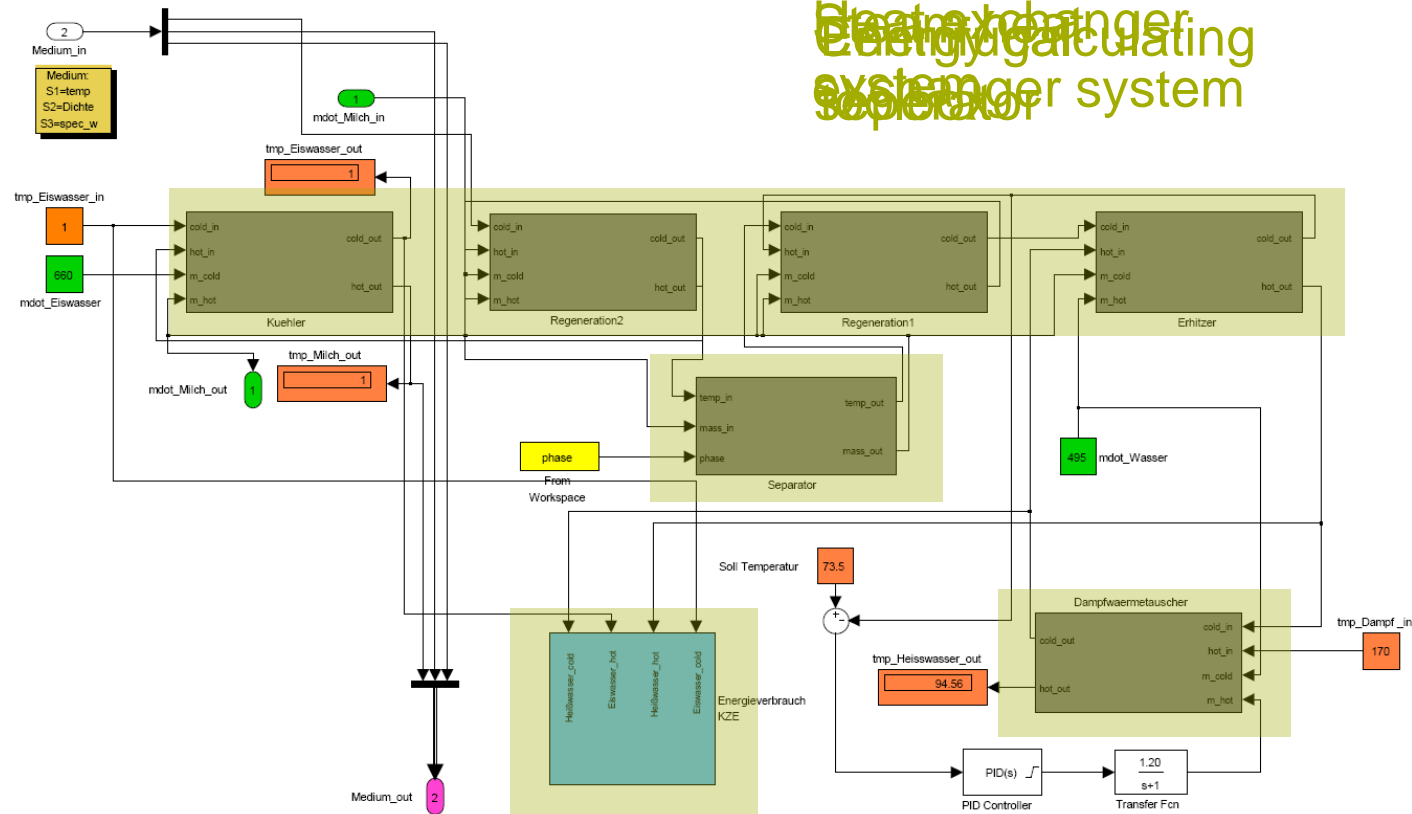
Heat Transfer  
Hot Water  
Circulation

- Diagnostic function for historical data
- Time behaviour of the process
- Calculation of phase based energy key indicators



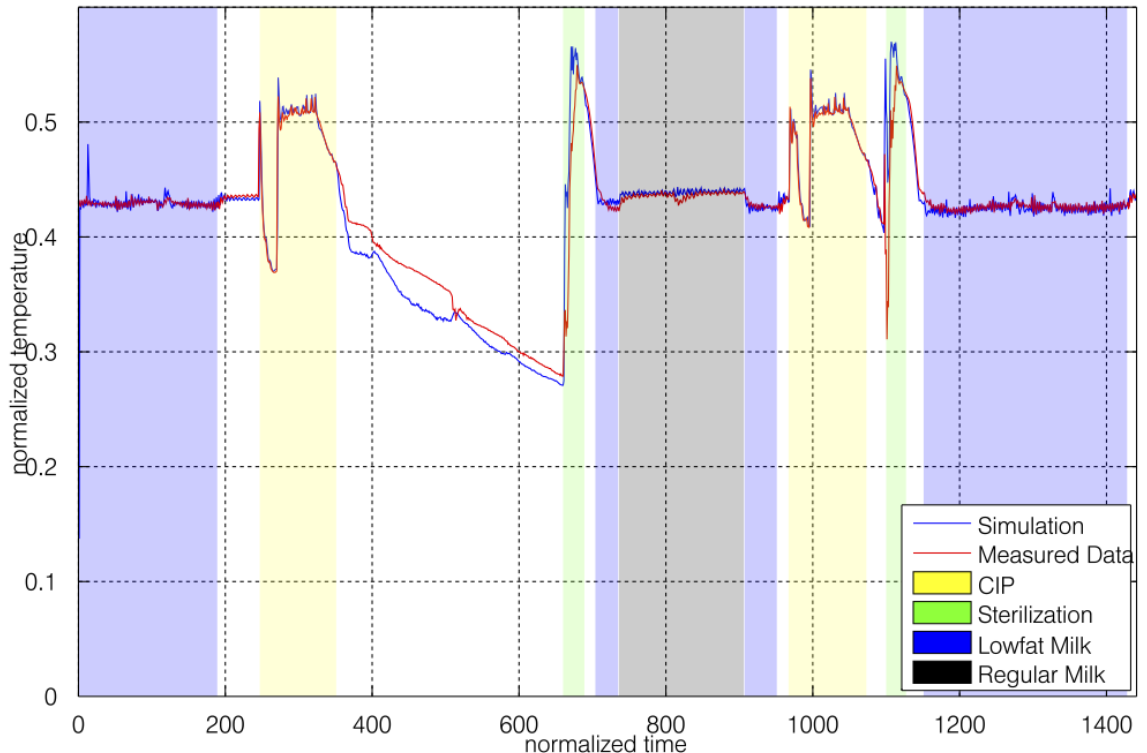
# Energy based process simulation – component library

Electrolytischer  
Energieerzeugendes  
systemer system  
separator



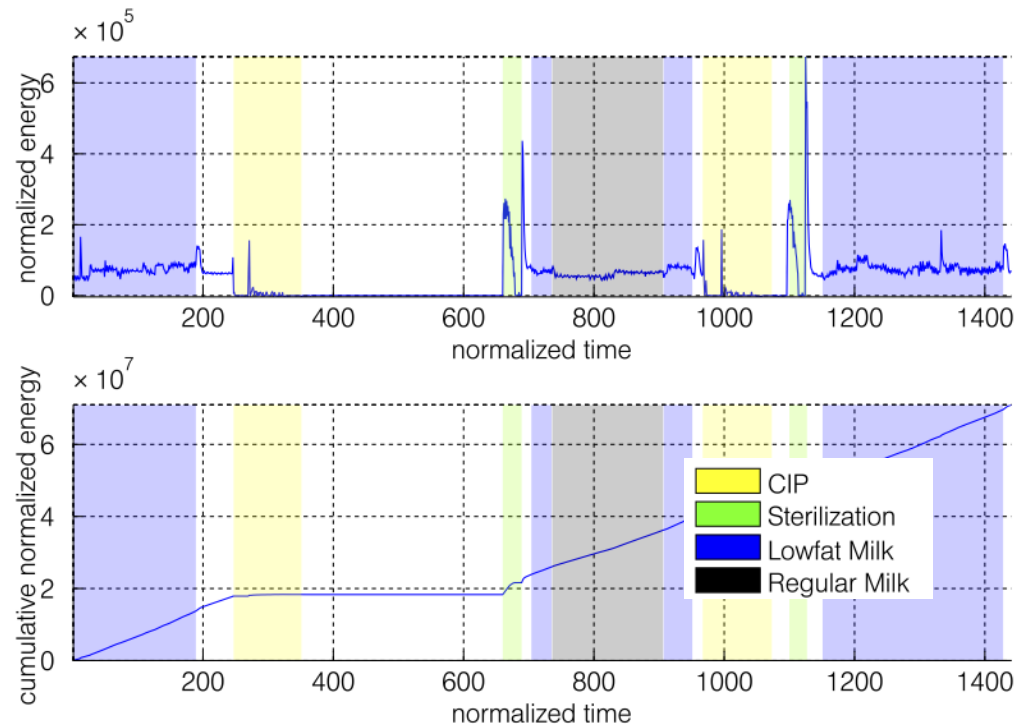
# Energy based process simulation – model validation

- Blue curve: simulation data
- Red curve: measured data
- Validation results show a good accordance
- Simulation recognizes the different process phases
- Simulation of the time response



# Energy based process simulation – energy plot with forecasting function

- Calculated energy by the toolbox
- Energy consumption of the simulation process
- Identifying energy key indicators of each phase
- Simulation helps to forecast the energy demand for a production process
- Testing new production schedules



# Next steps

- Simulation of technical optimization
- Analyzing the manufacturing schedules
- Modeling an optimization approach for production scheduling
- Validate the optimized schedules with the process simulation
- Integration of green production indicators into an MES

# Thank you for your attention

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