
EFFICIENT ENERGY CONSUMPTION – INDUSTRY 4.0

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1. Efficient Energy Consumption with Digitalization
2. Flexible Energy Consumption with Digitalization

Efficient Energy Consumption Monitoring

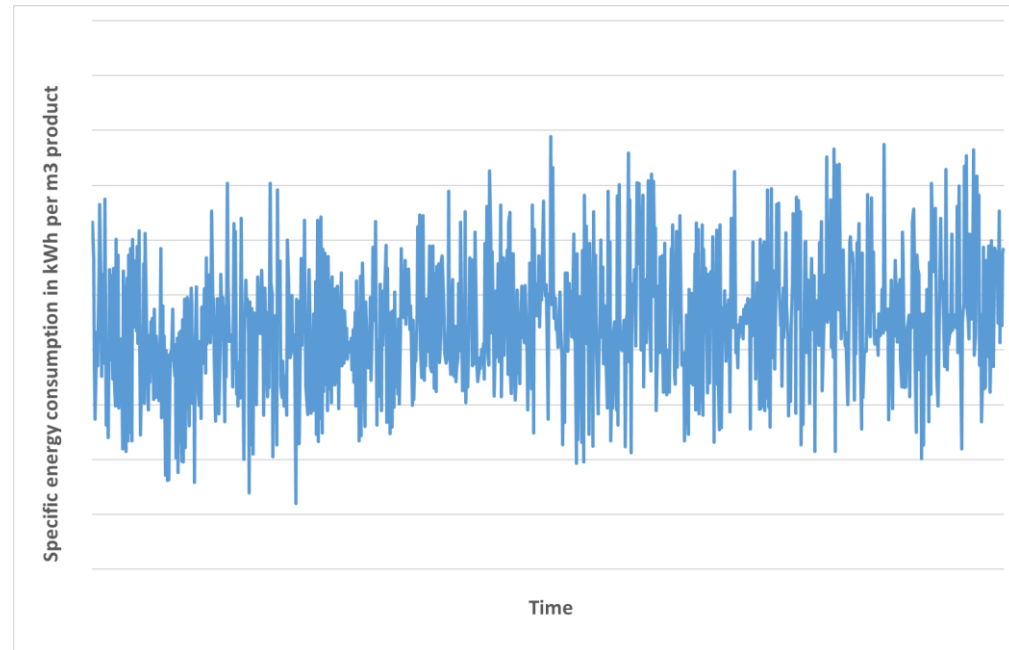
- Example: Plant with 0,75 GW power consumption by compressors (compressed air as educt)
- Different products, different production regimes applied
- Unknown: specific production costs (€/kg)



Efficient Energy Consumption

Model based optimization

- Example: Plant with 0,75 GW power consumption by compressors (compressed air as educt)
- Different products, different production regimes applied
- Objective: Optimization of Energy Efficiency based on Data Analysis



Efficient Energy Consumption

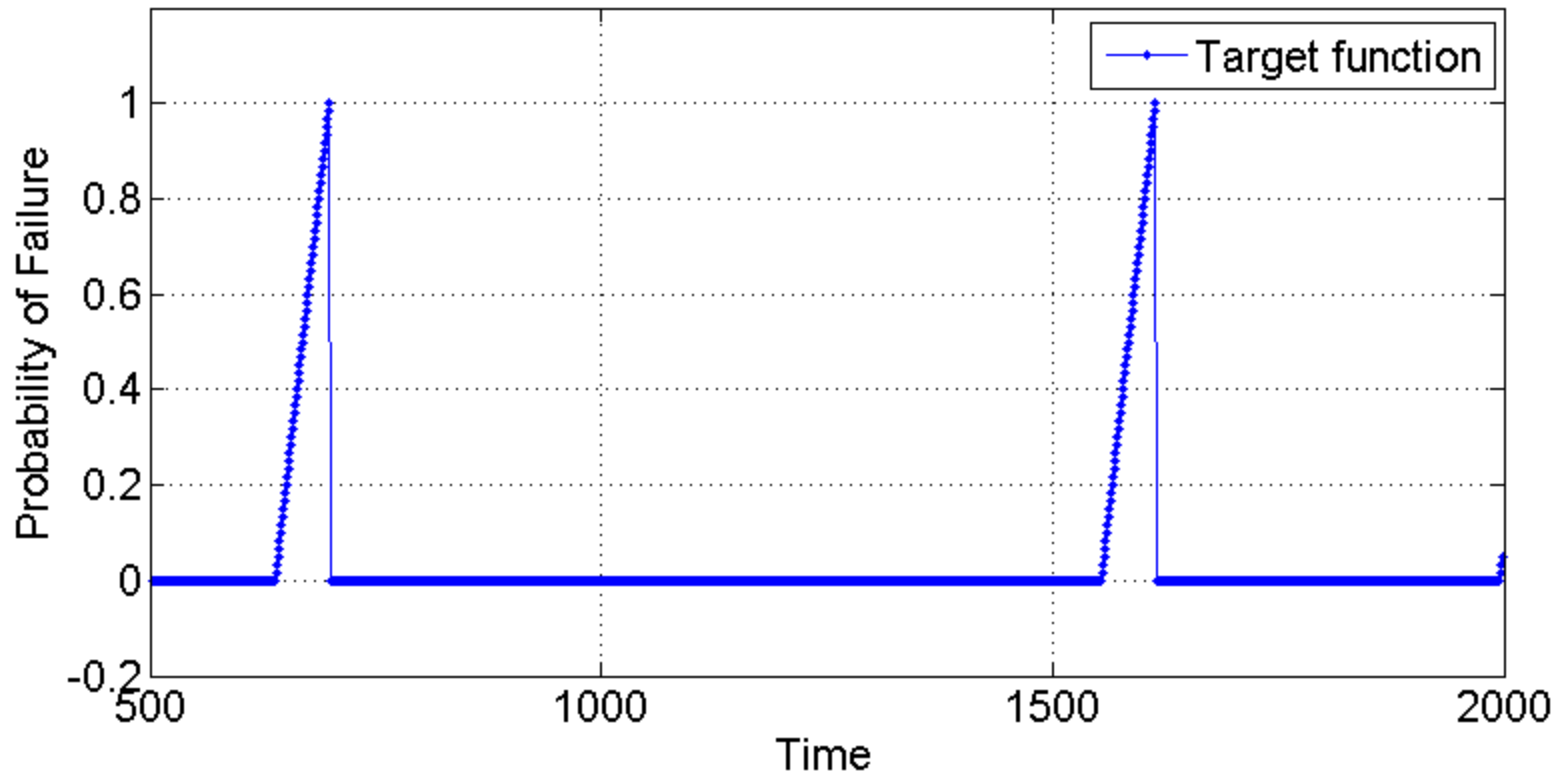
Reduction of inefficient unplanned shutdowns

- Example: Granulation (drying)
- Blocking of nozzles causes unplanned shutdowns (energy for drying wasted)
- Unplanned shutdown costs per year approx. 1 Mio €



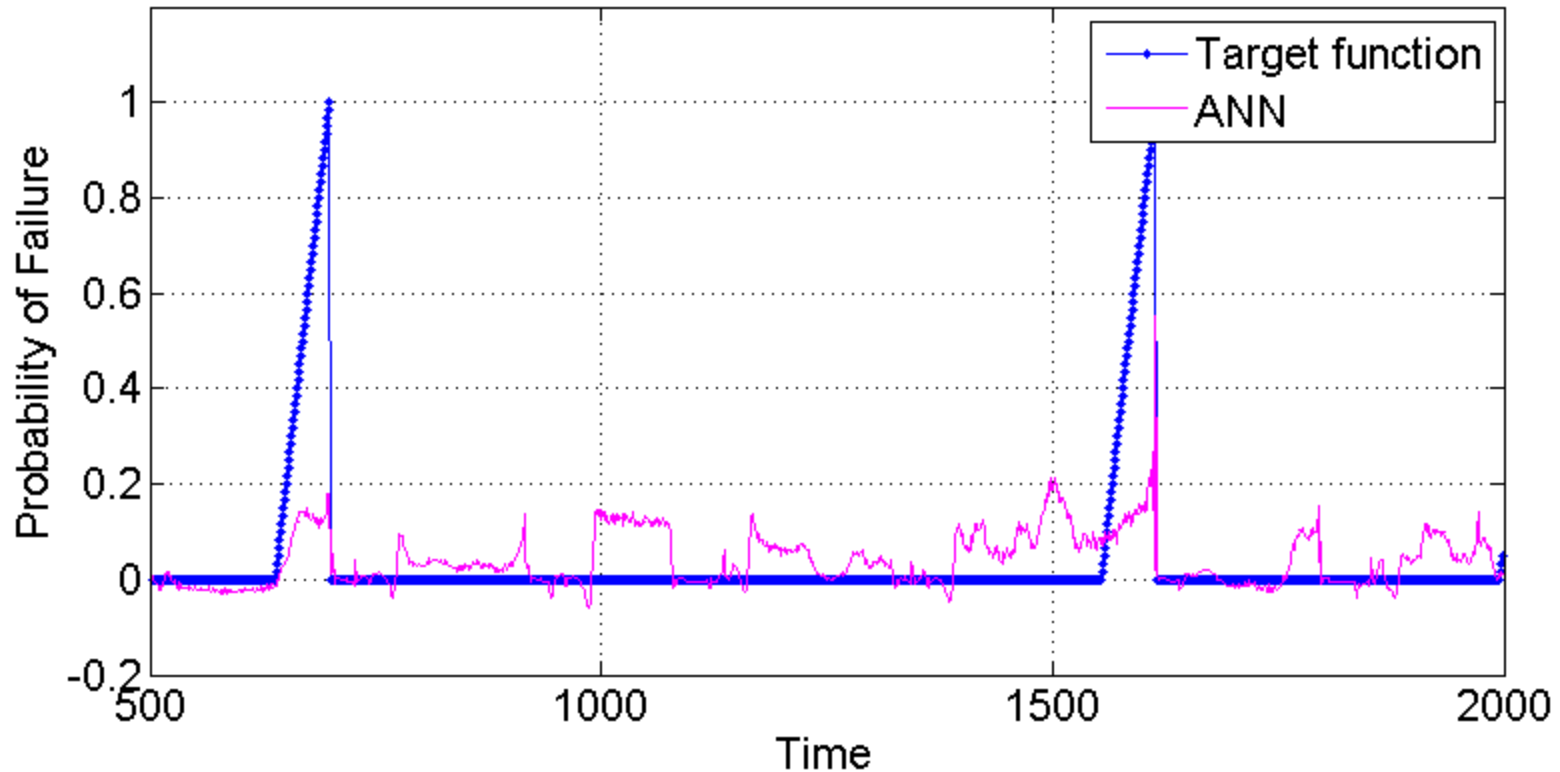
Efficient Energy Consumption

Reduction of inefficient unplanned shutdowns



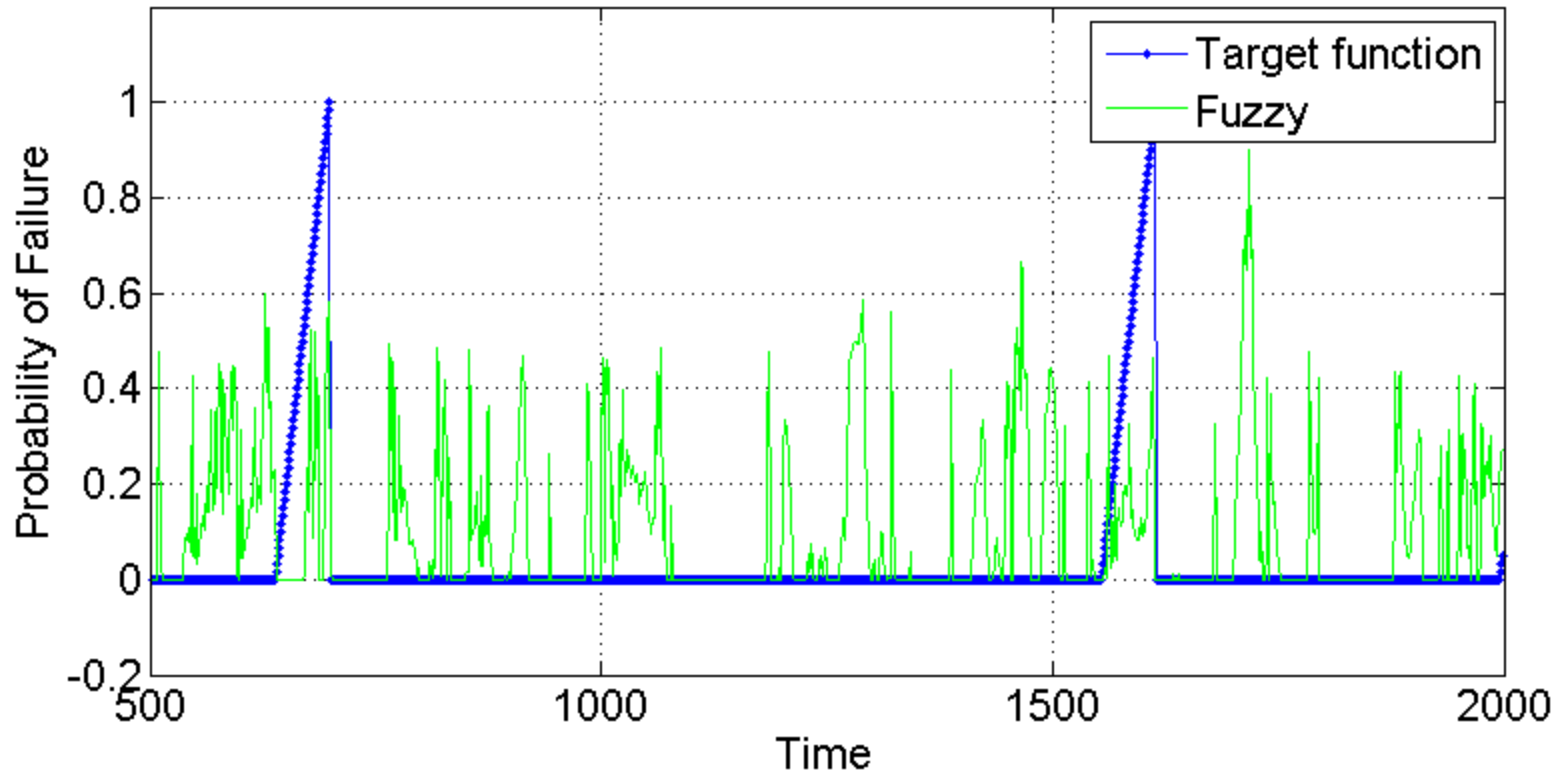
Efficient Energy Consumption

Reduction of inefficient unplanned shutdowns



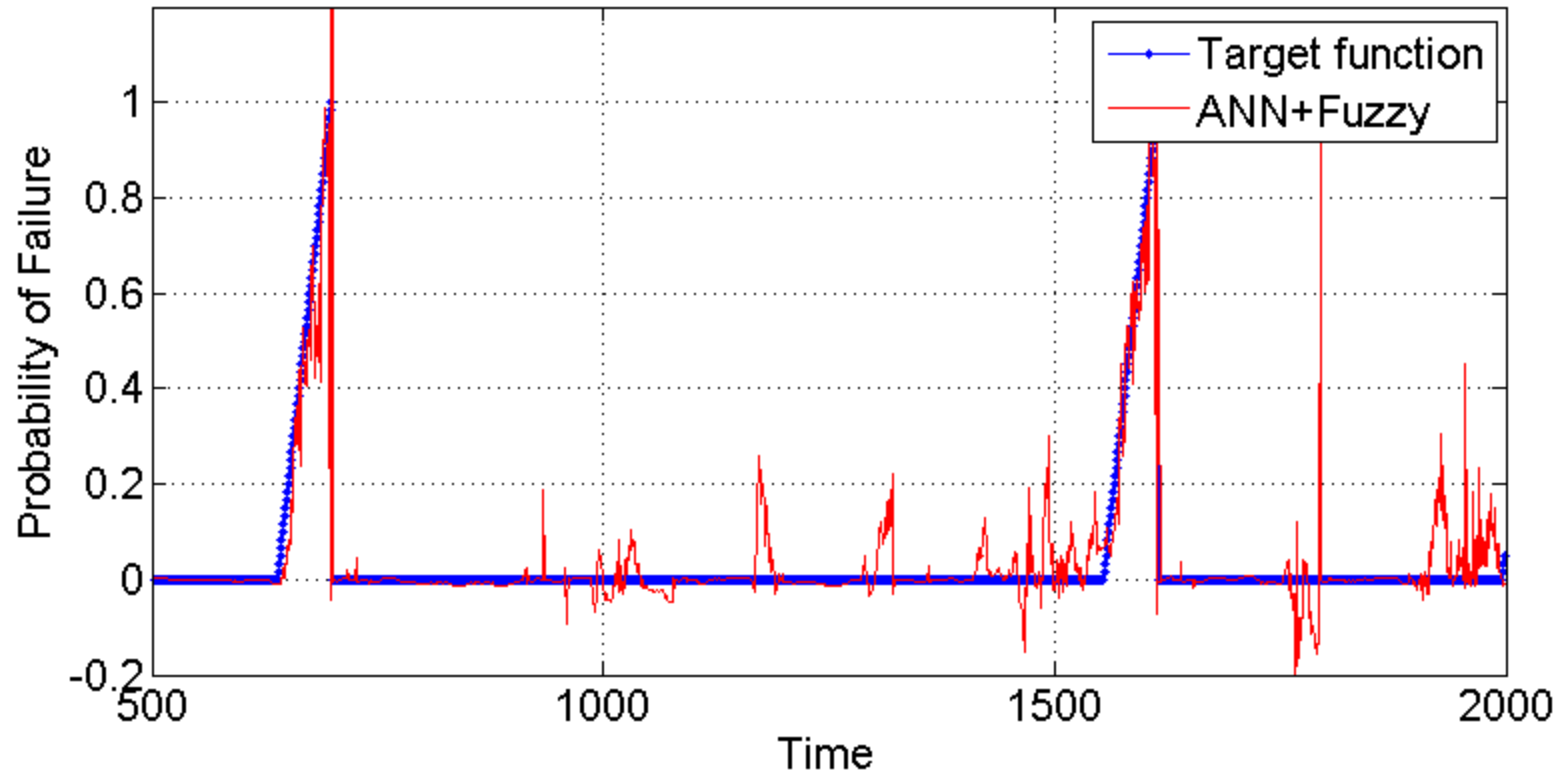
Efficient Energy Consumption

Reduction of inefficient unplanned shutdowns



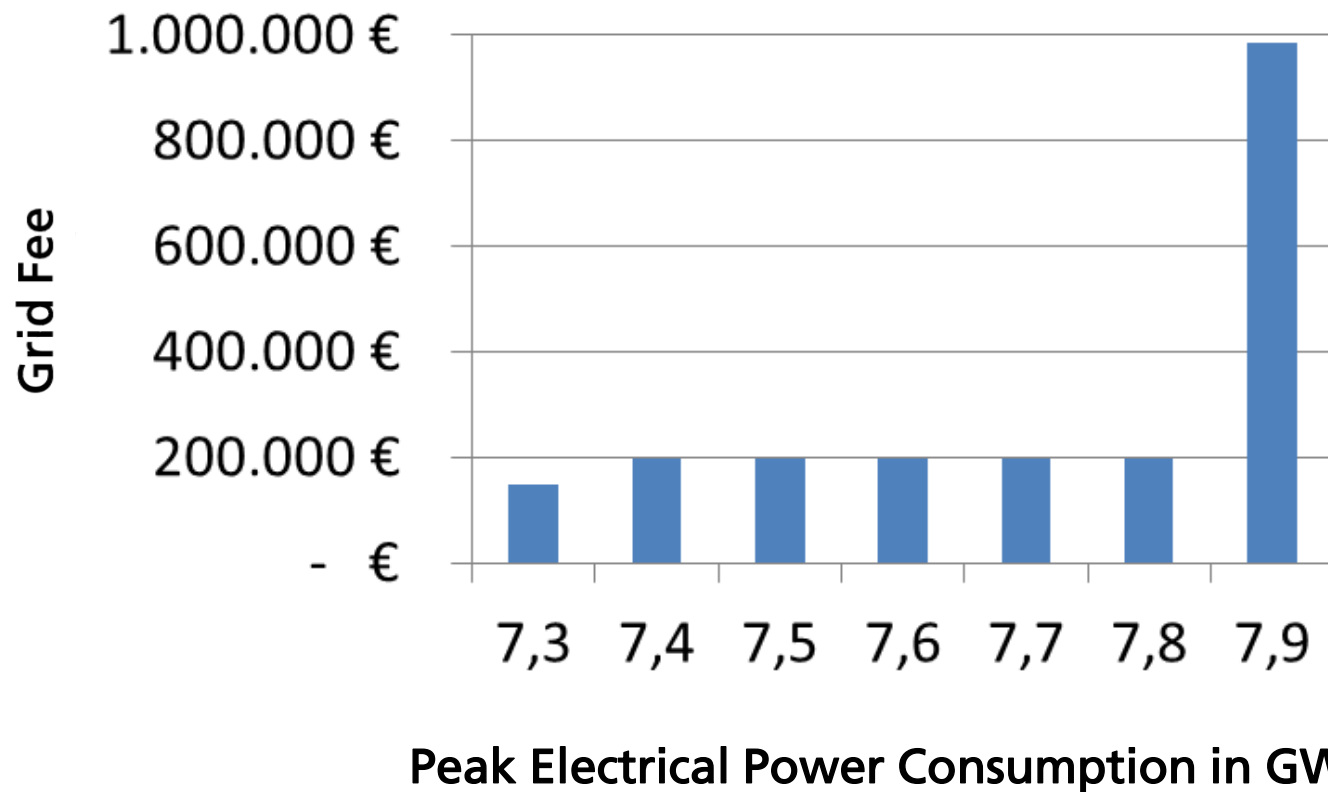
Efficient Energy Consumption

Reduction of inefficient unplanned shutdowns



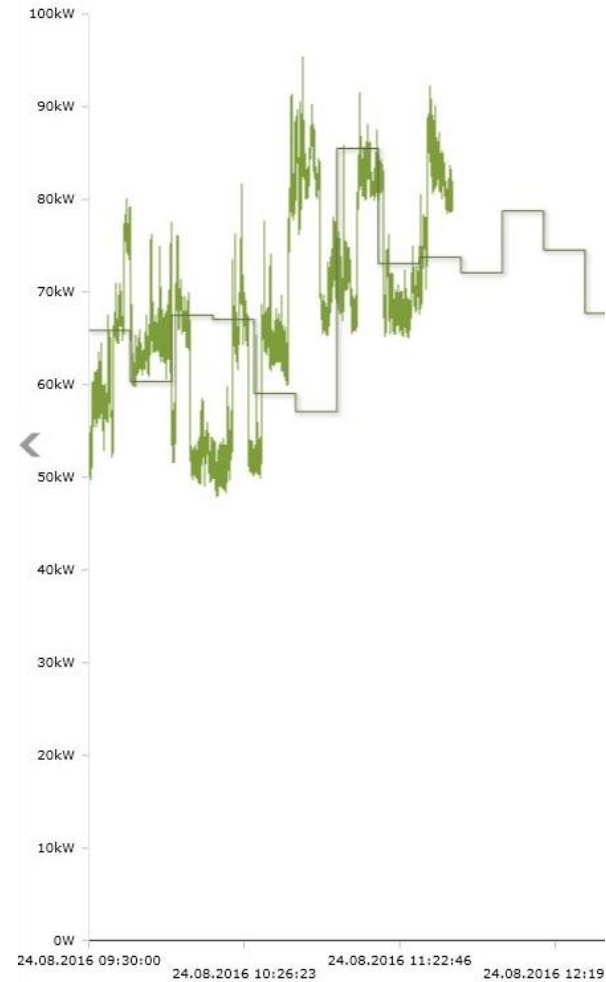
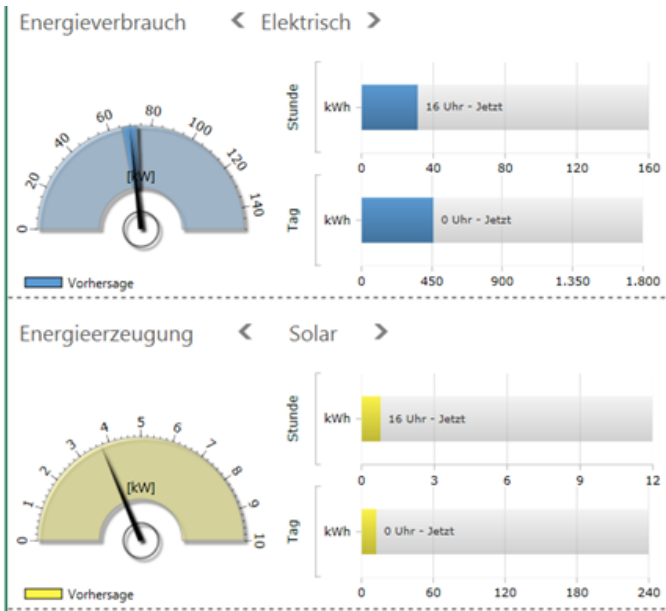
Flexible Energy Consumption

Motivation



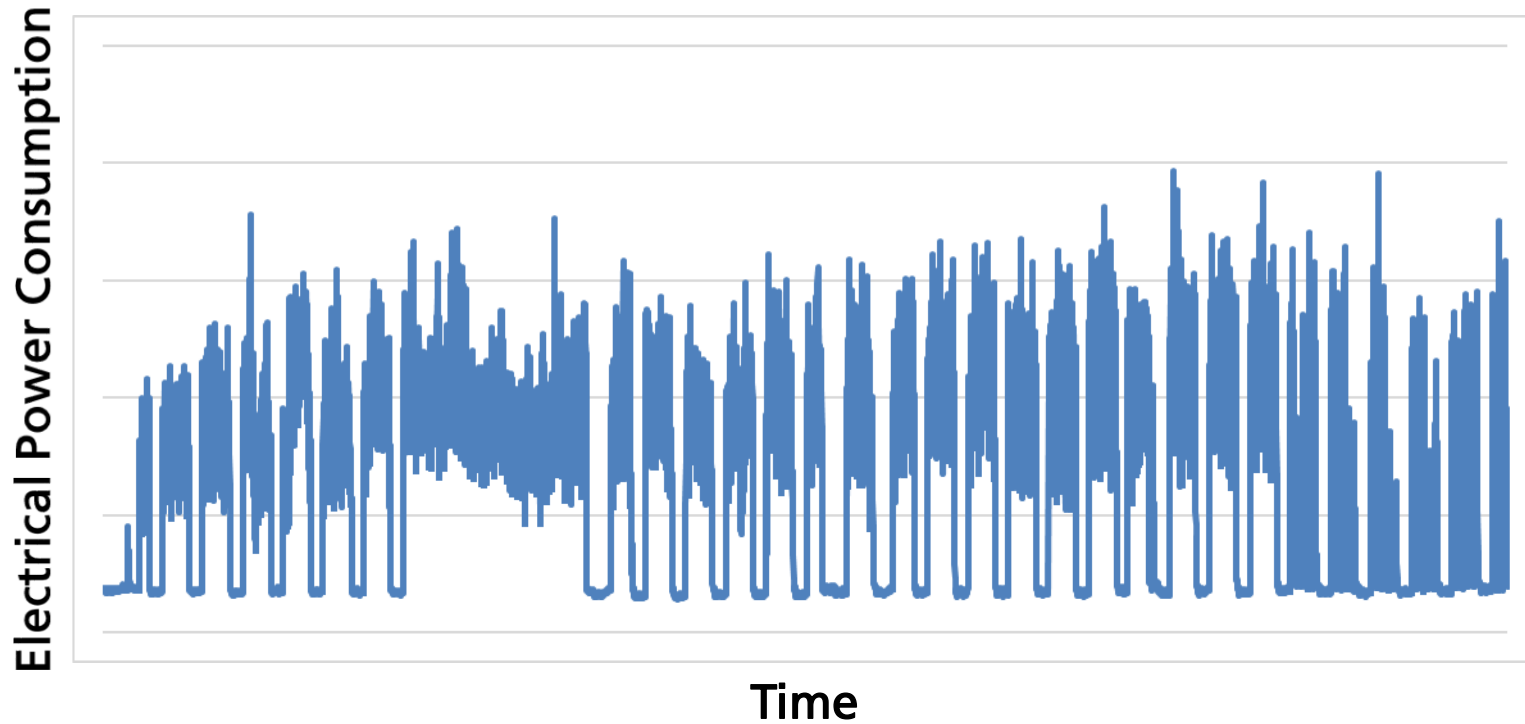
Flexible Energy Consumption

Forecast of Power Demand



Flexible Energy Consumption

Forecast of Power Demand for Batch Processes



Flexible Energy Consumption

Flexibilization of Continuous Processes (Mid Term)



- Demand side management for most continuous chemical plants very difficult, except: electrolysis and power-to-heat
- Existing equipment is not designed for flexible operation
- Kopernikus Project SynErgie (with Fraunhofer and Covestro, Linde, Voith)



Flexible Energy Consumption Modular Plant Design (Long Term)



Summary

1. Efficient Energy Consumption

- Monitoring of specific energy consumption
- Model based optimization of specific energy consumption based on data analysis
- Reduction of unplanned shutdowns by forecasts based on data analysis

2. Flexible Energy Consumption

- Short Term: Peak shaving of batch processes by forecasts based on data analysis
- Mid-Term: Flexibilization of continuous processes
- Long-Term: Modular Plants

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