



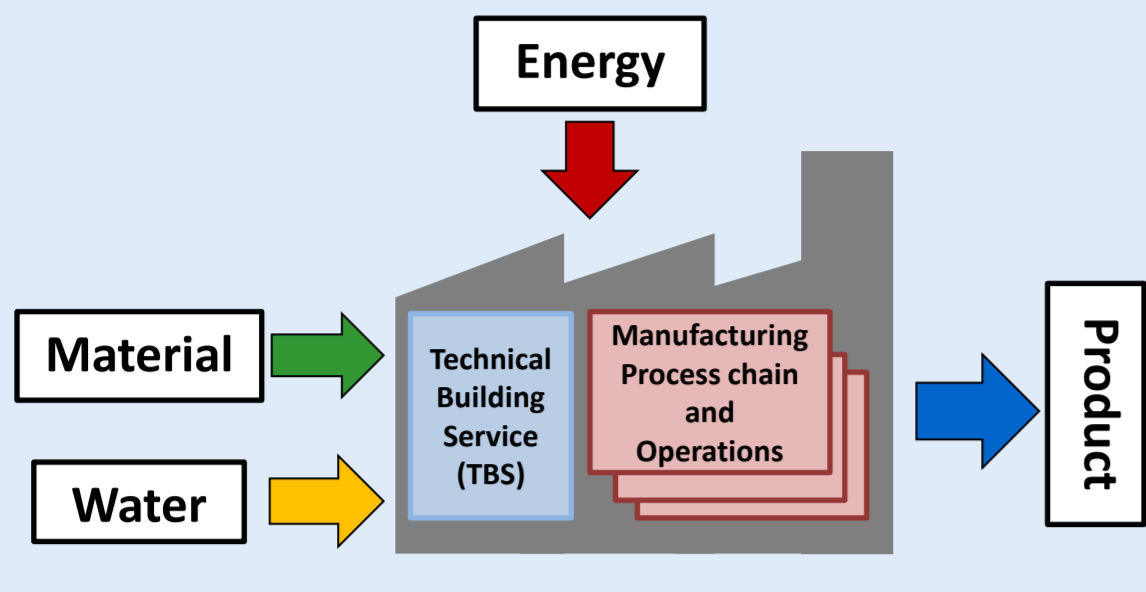
Energy Monitoring and Smart Grid Application in Manufacturing

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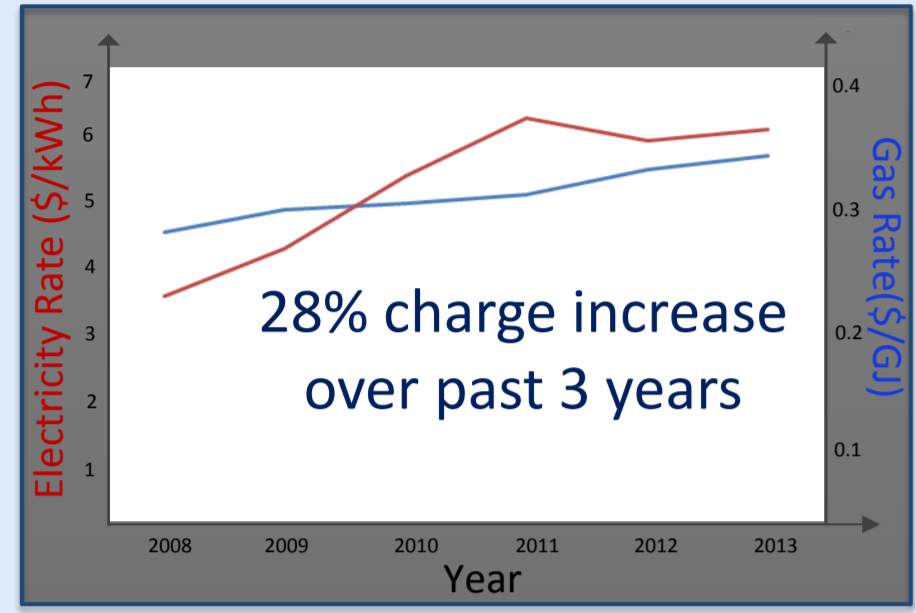
BACKGROUND

Energy is a critical input for manufacturing plants



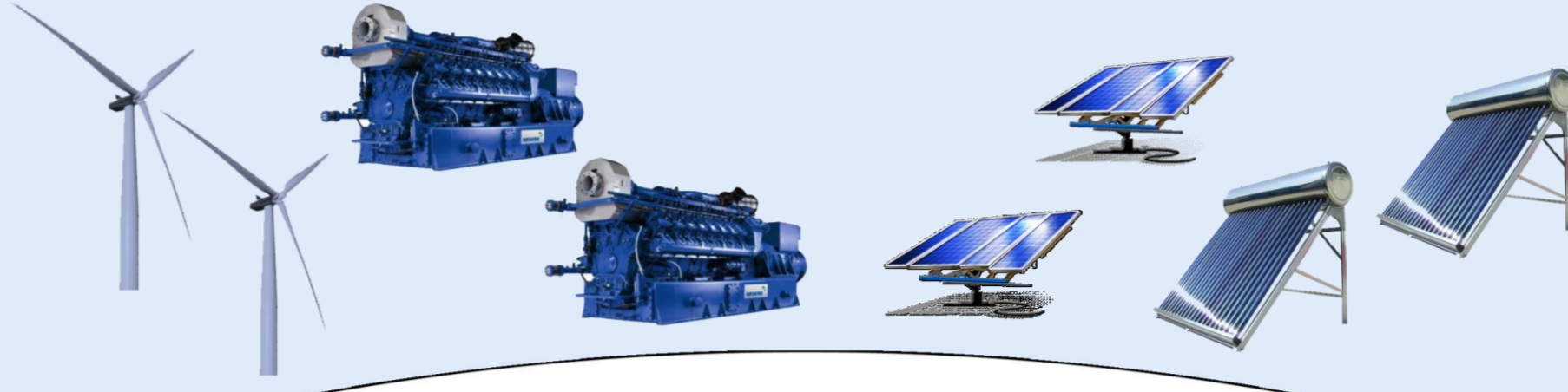
Challenges

- Rising Energy Charges
- Irreversible Environmental Impacts

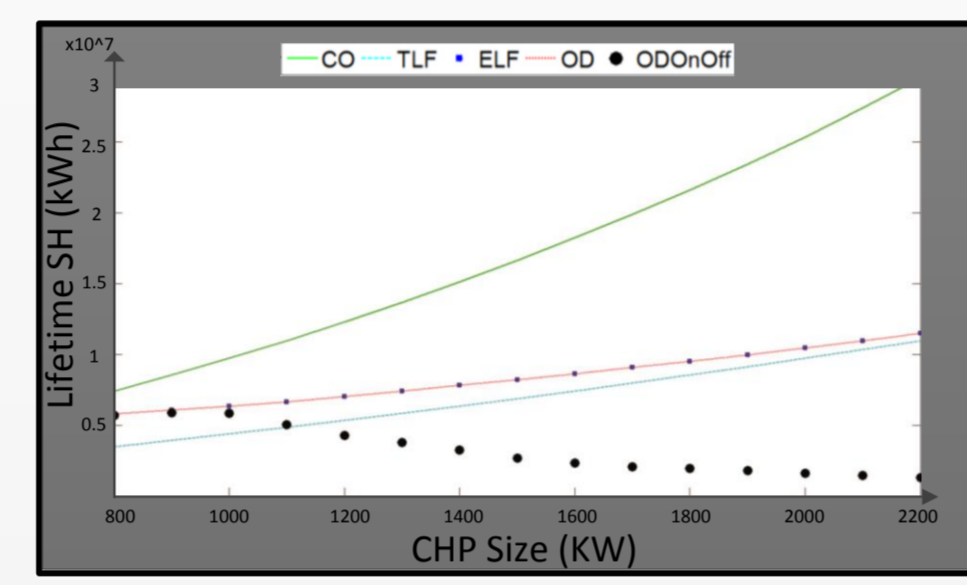
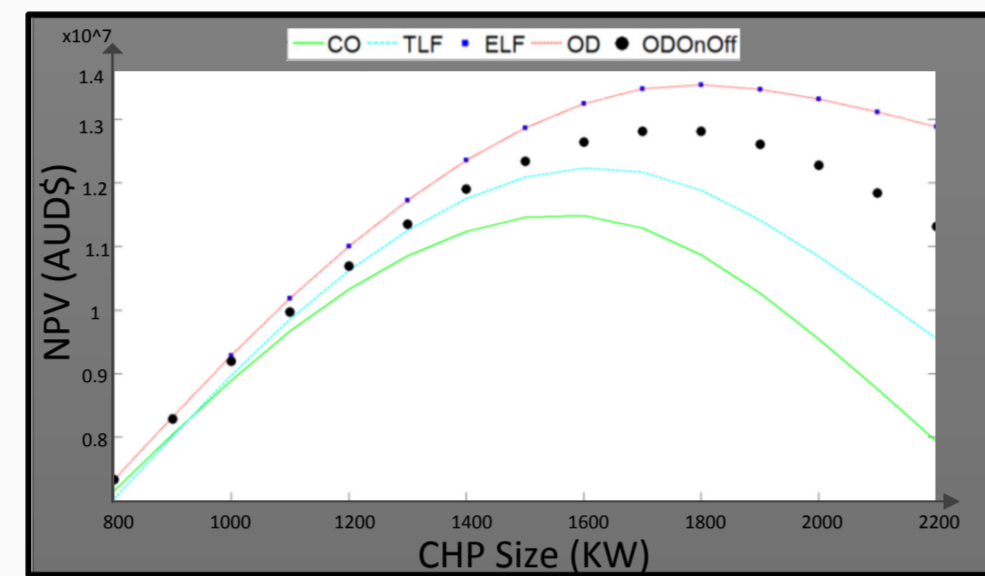


POTENTIAL SOLUTION

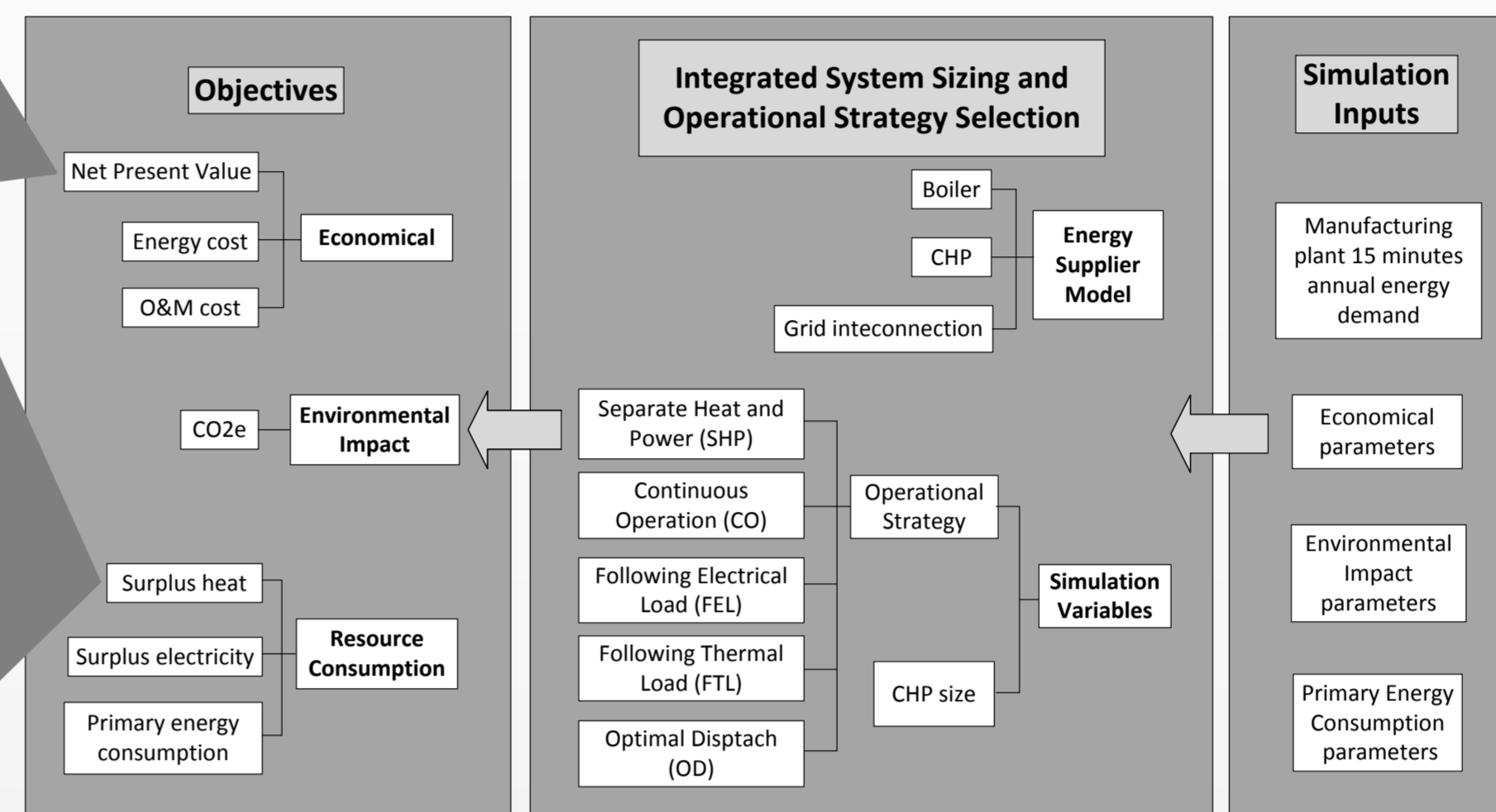
Maximum Added Value by Minimum Resource Consumption
On-site Energy Generation Through Application of Clean Energy Technologies



- Optimal CHP sizing based on operational strategy



- More realistic feasibility study



2% NPV improvement
7.7% Energy saving
53,000 AU\$ annual saving on surplus energy

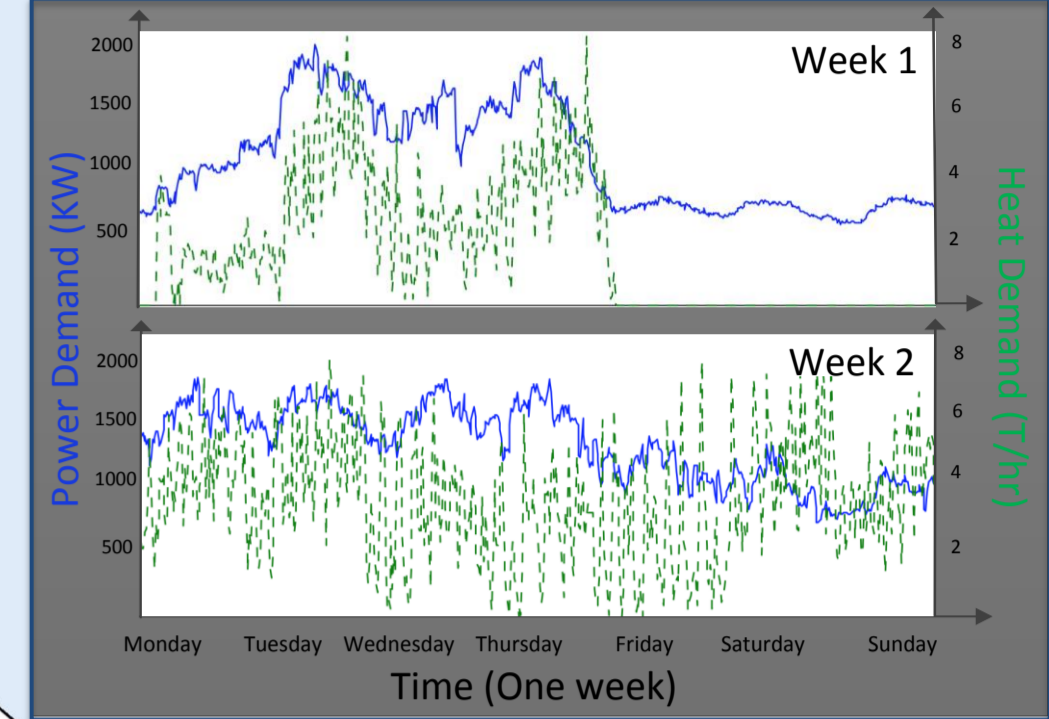
PROBLEM STATEMENT

Mismatch Between Expected System Effectiveness and System Outcome at the Utilization Stage

- Efficiency Gap
- Economic Effectiveness Decline

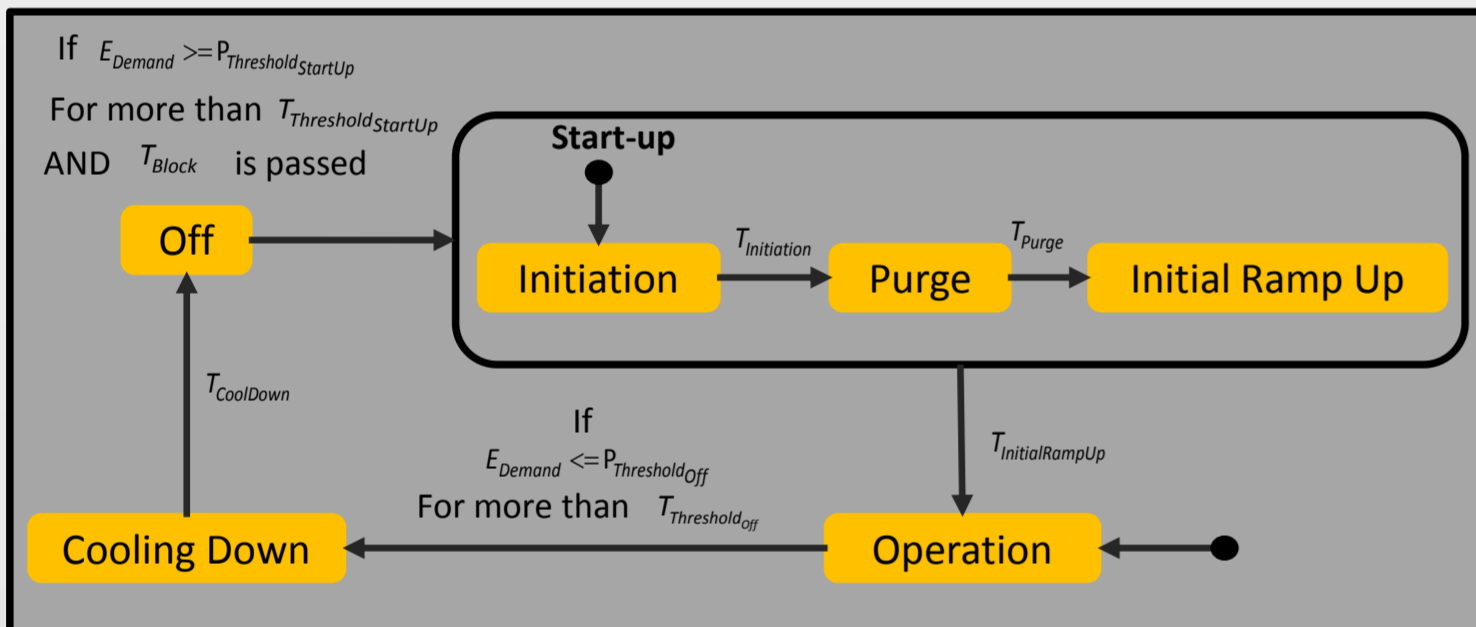
Reasons

- Operating Environment Fluctuations
- Uncertain Energy Market and Regulations
- Complex and Dynamic Operating Environment

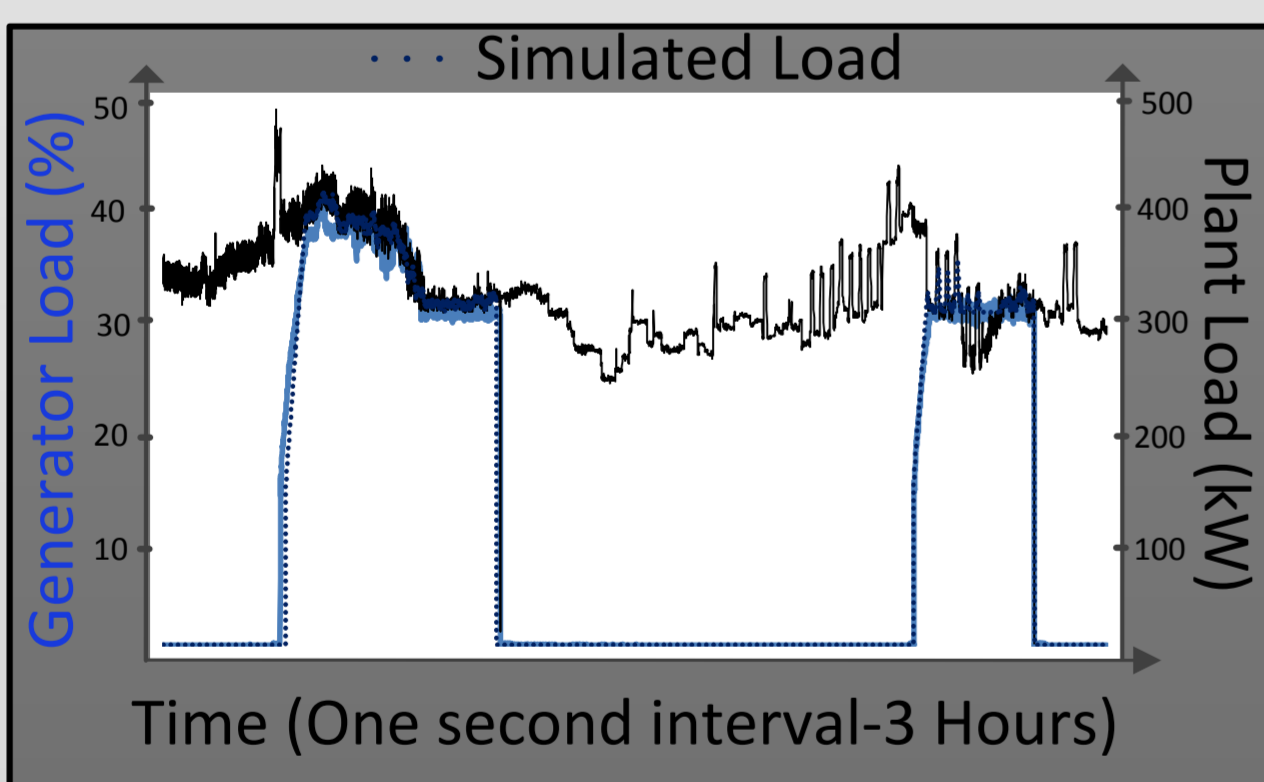


② Reactive Modelling of On-site Energy System Components

- Operational states, constraints and transient characteristics coverage
- Reliable and accurate models



- Covers mechanical integrity and operational behavior
- Address specific real-time application requirements

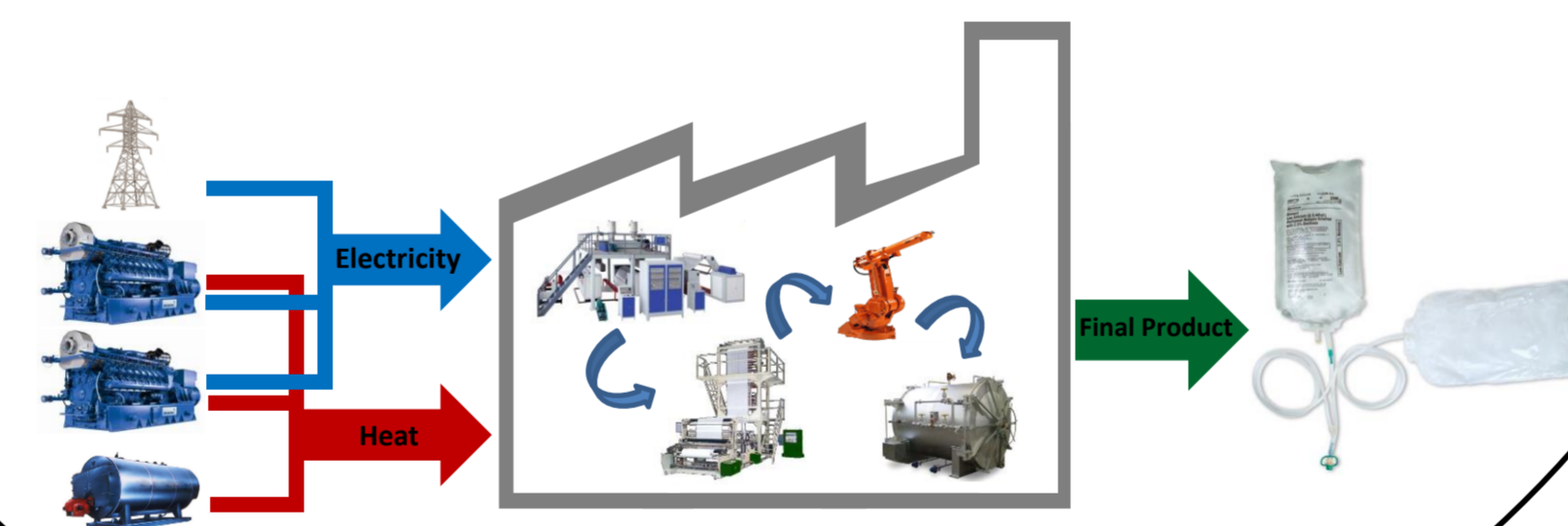


92% Model accuracy
Seconds resolution
Reactive

CASE STUDY



- Baxter Healthcare is a global manufacturer of medical products across 60 countries and is in operation since 1963 with a manufacturing plant in Sydney.
- The primary products manufactured in this facility are sterile water solutions.
- On-site energy system consists, engine based CHP systems, grid interconnection and boiler.



① Optimal Selection of CHP Systems

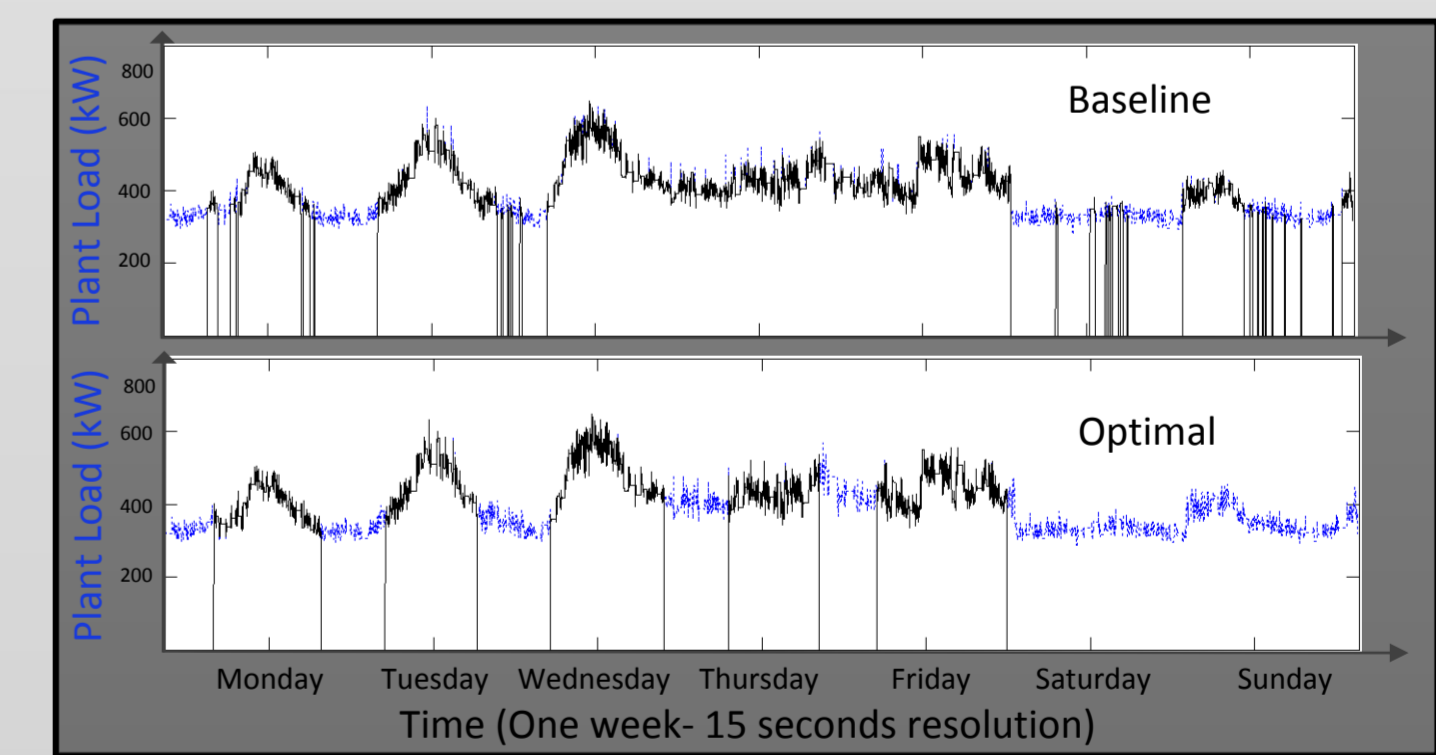
- Integrated sizing and operational strategy selection
- Coverage of energy demand fluctuations

OBJECTIVES

Optimal and Reliable Design and Operation of Clean Energy Technologies within Manufacturing Plants

1. Optimal System Configuration
2. Real-time Operation Management

12% Operational cost reduction
Optimal CHP scheduling



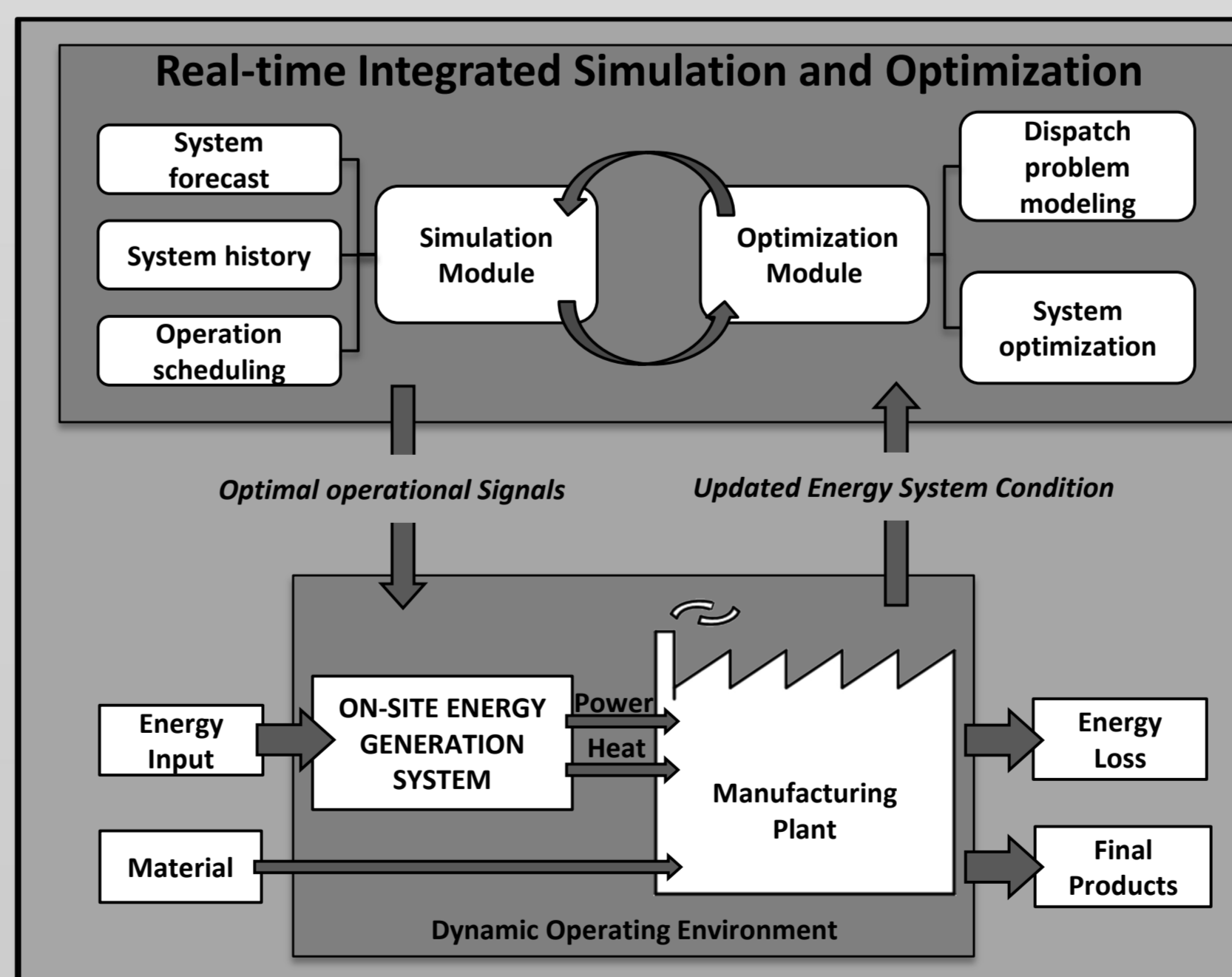
- Continuous operation management and optimal scheduling
- Timely response to operating environment dynamics
- Iterative operation to track a changing optimum as closely as possible

OUTCOMES

- Development of integrated CHP sizing and operational strategy selection.
- Comprehensive problem modeling for real-time application.
- Development of real-time operation management strategy.

③ Real-time Operation Management

- Integrated simulation and optimization modules
- Real-time optimization



Publications

- "Advanced On-Site Energy Generation towards Sustainable Manufacturing," Re-engineering Manufacturing for Sustainability, 2013
- "The optimal selection of on-site CHP systems through integrated sizing and operational strategy," Applied Energy, 2014
- "Integrated Material and Energy Flow Analysis towards Energy Efficient Manufacturing," Procedia CIRP, 2014
- "Reactive modelling of on-site energy system components for real-time application," IEEE, Intelligent Energy and Power Systems, 2014

CONCLUSION

- Comprehensive system configuration can increase utilization of integrated assets.
- Real-time optimization enables optimal and reliable integration of clean energy technologies within operating manufacturing plants.

