ML4Heat

Tools for the optimized operation of existing district heating networks based on machine learning methods

KT-ELEKTRONIK

Fraunhofer IOSB

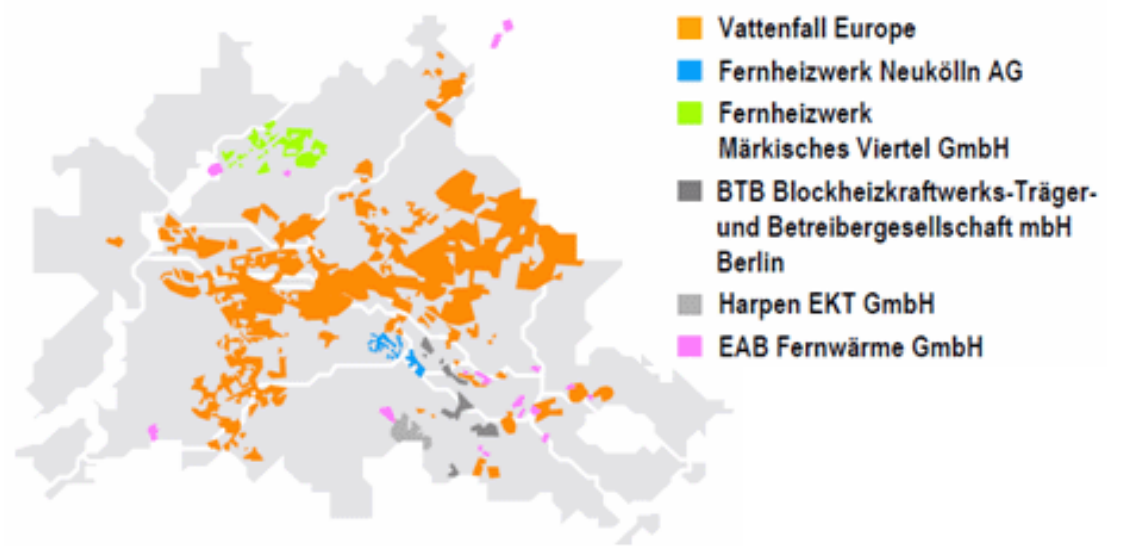
Project Outline

Associated Partners

- Vattenfall Wärme Berlin
  - 9.6 TWh annual heat supply (2018), ~30.000 substations (14.000 online)
- Fernheizwerk Neukölln AG
  - 420 GWh annual heat supply (2020), 1 380 substations (all online)

Fernheizwerk Neukölln AG FHW

VATTENFALL



District heating in Berlin
(Senatsverwaltung Berlin, 2010)

Goal:

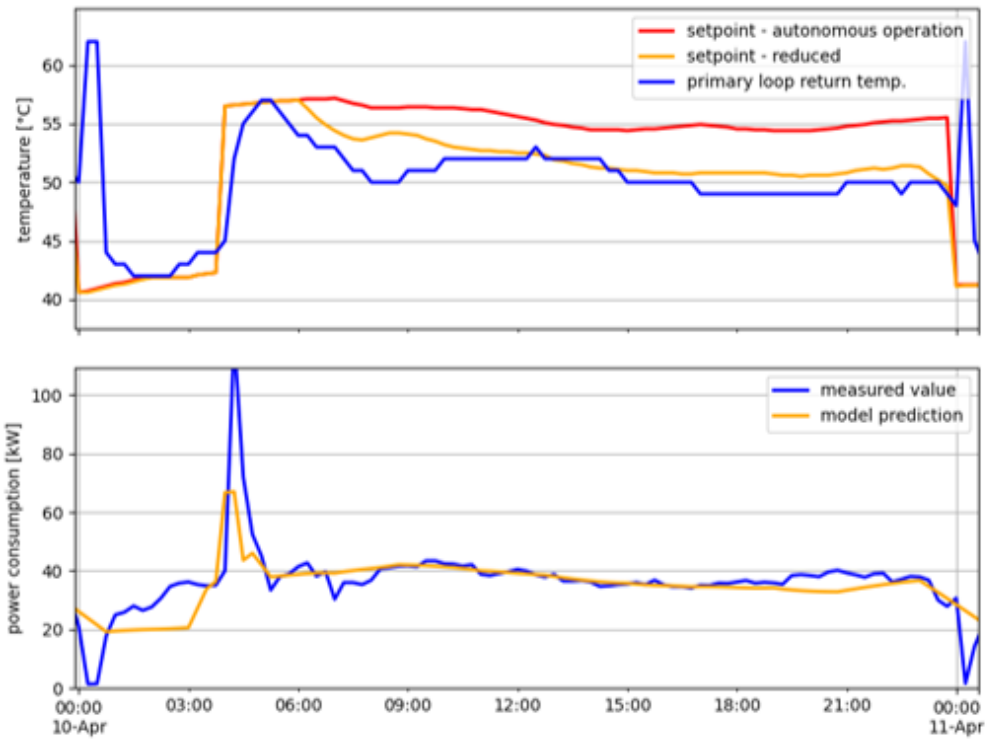
Tools for optimized operation on three different scales:

- **Substation**
- **Strand**
- **Network**

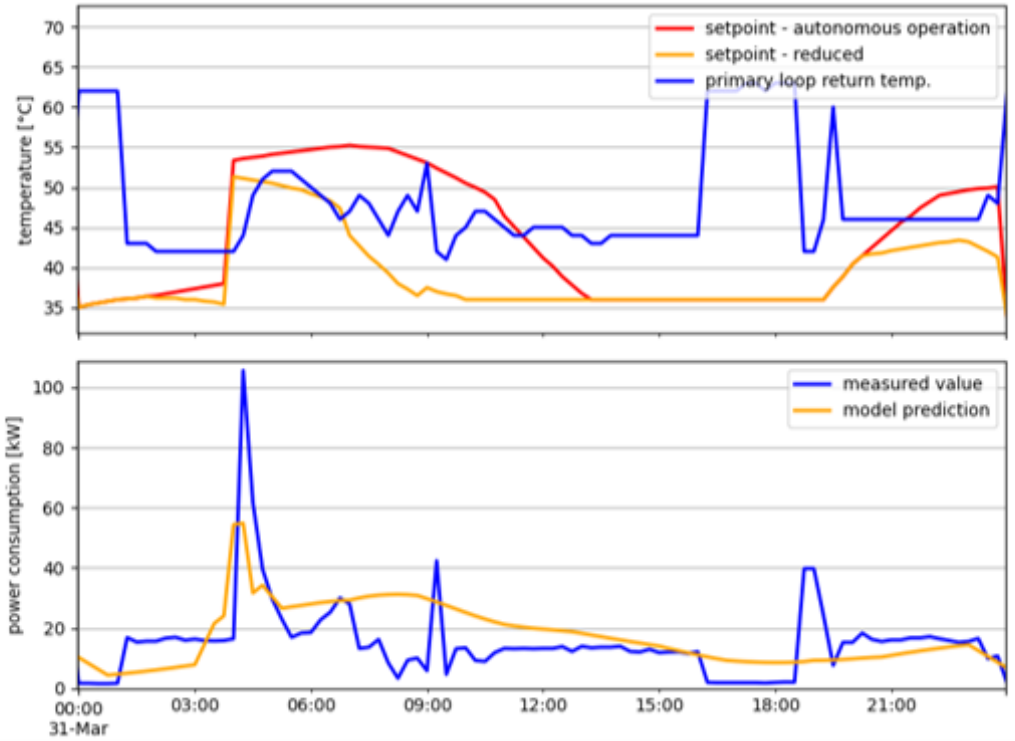
Substation Optimization

Substation Optimization

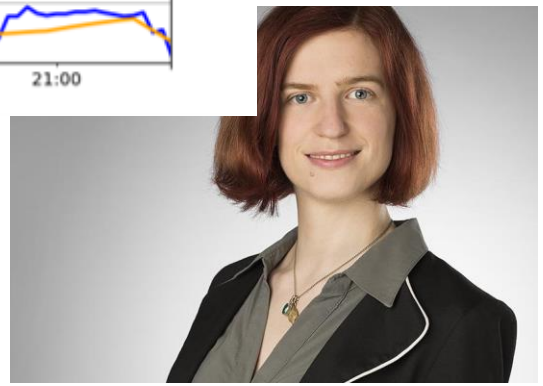
Secondary Temperature Level Optimization



Reduce primary loop return temp, maintain power



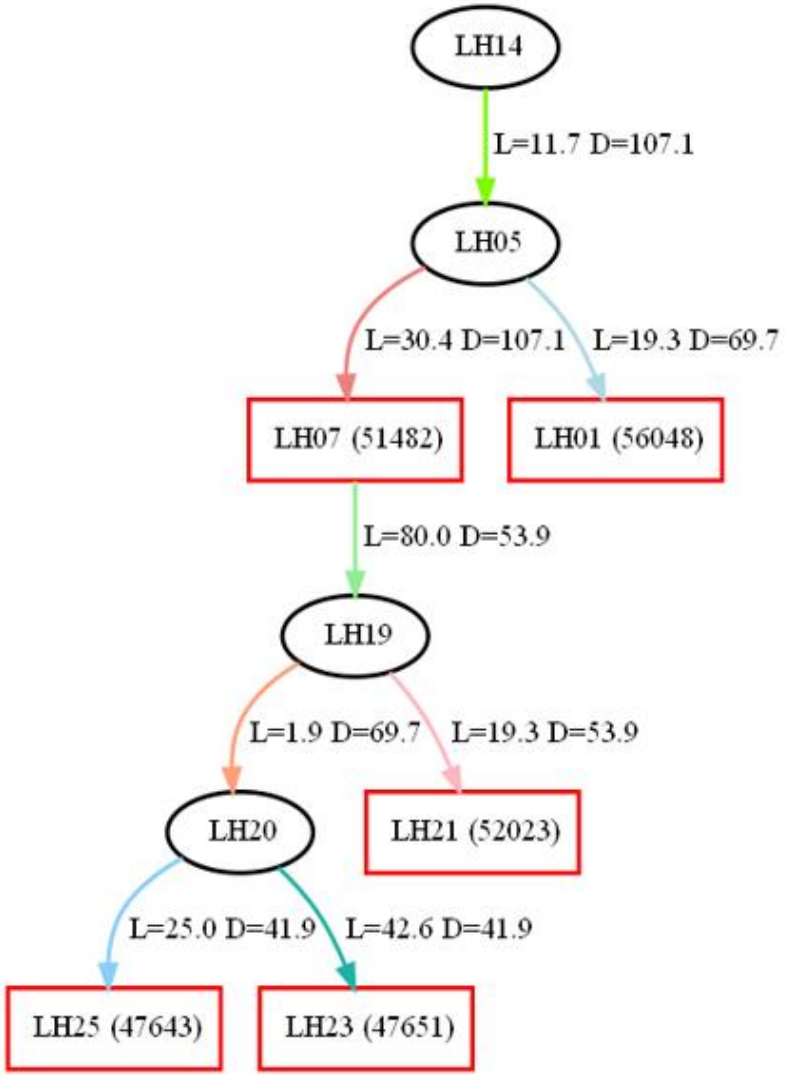
Reduce power



Strand Optimization

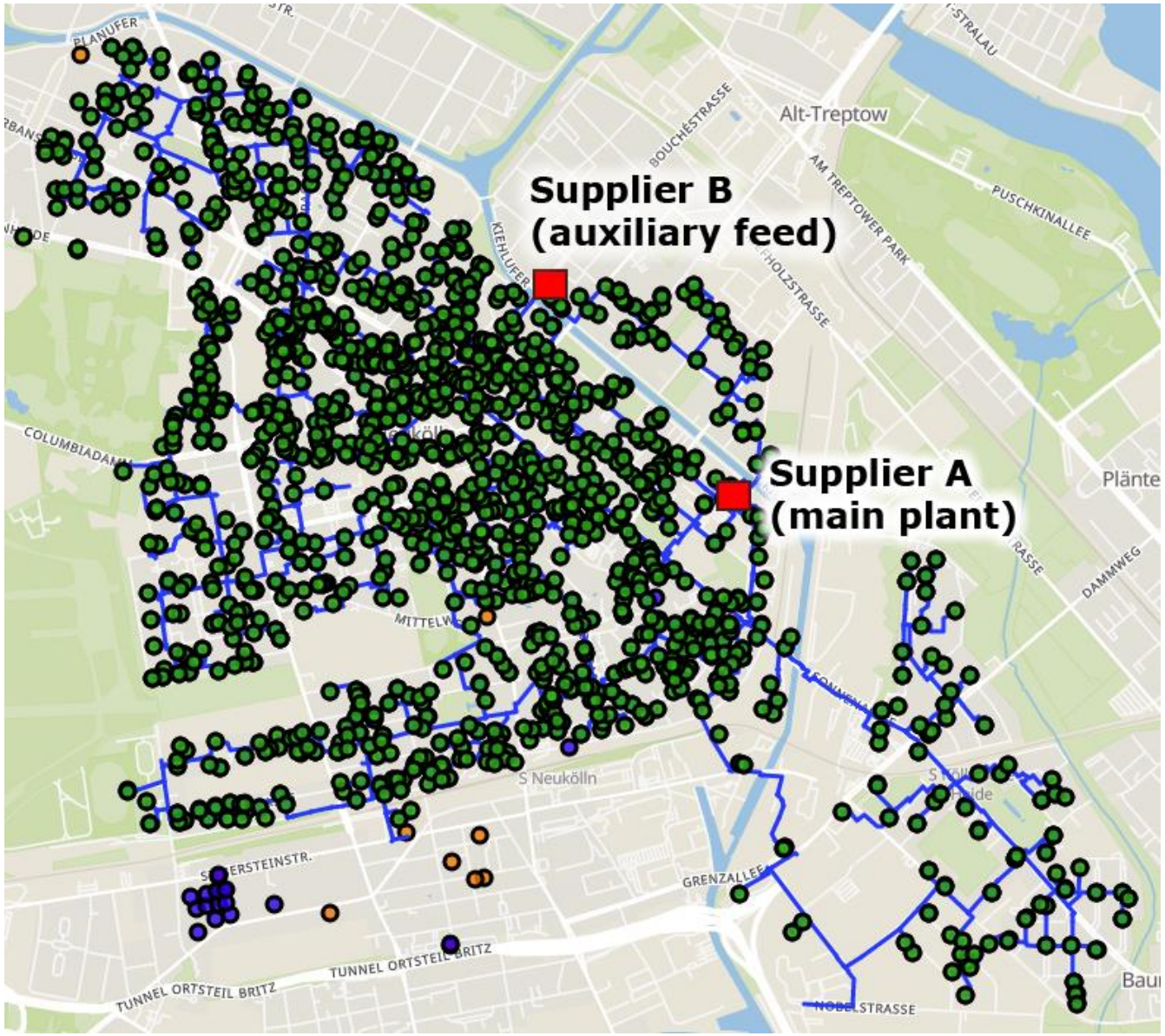
Strand Optimization

Heat Loss Analysis



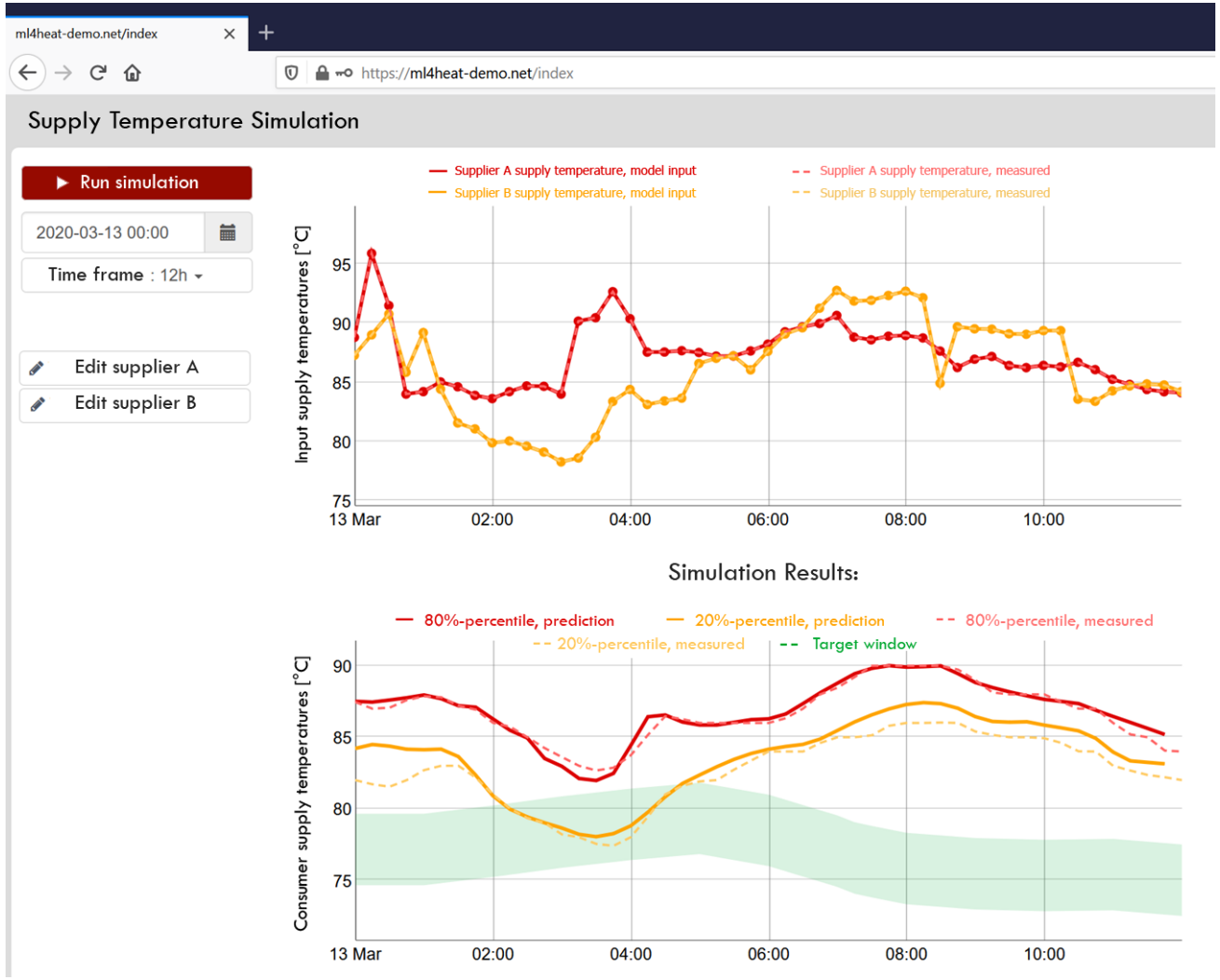
Network Optimization

Network Optimization



Network Optimization

Data-driven Supply Model



Data driven model:

- load prediction, return temperature prediction
- learned substation parameters (individual delays, heat losses, supplier affiliation)
- minimal physical assumptions
- no hydraulic information!

Model output:

- volume flow
- Substation supply temperatures

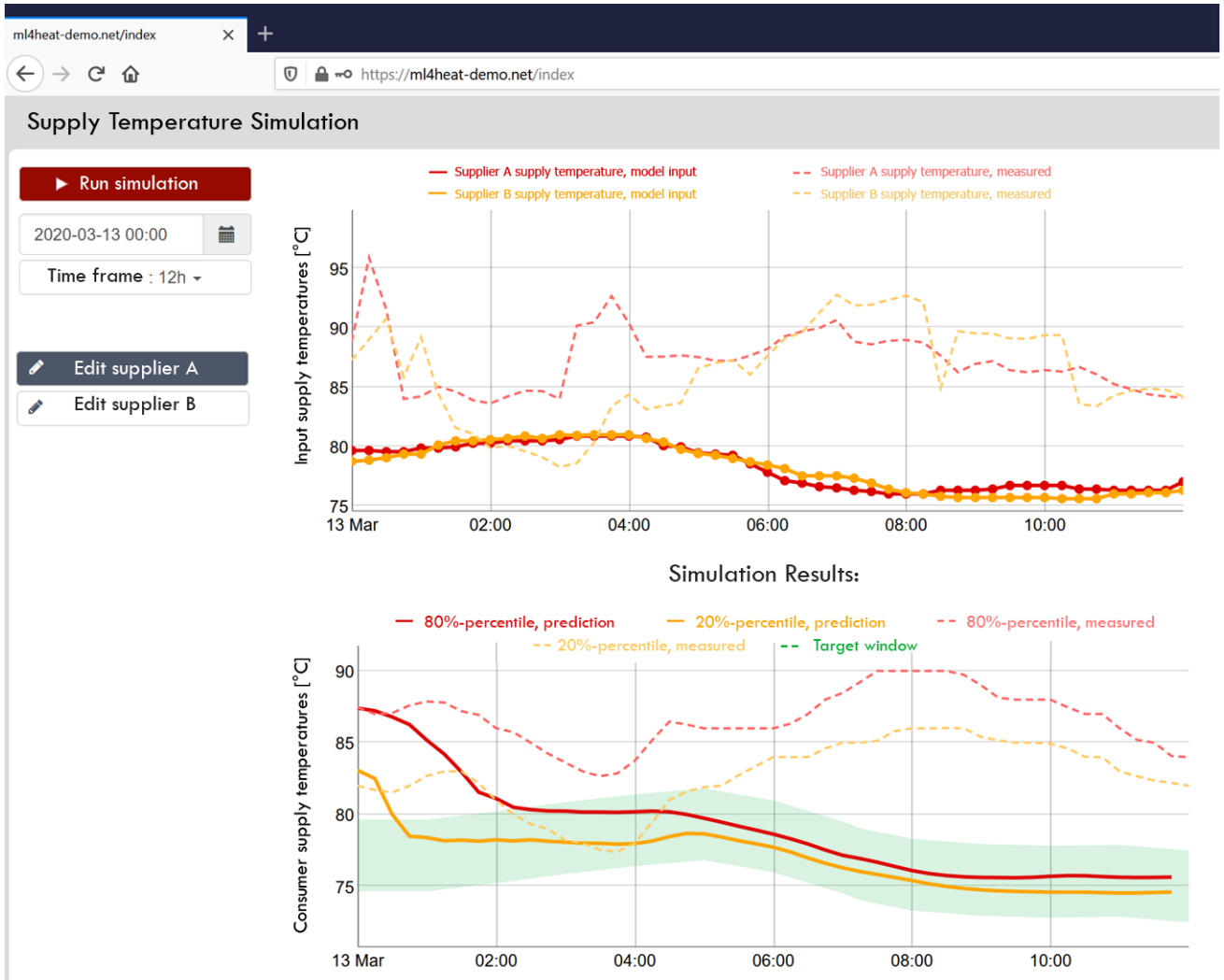
Network Optimization

Data-driven Supply Model

- model can reproduce historic supply data
- capable of predicting effects of different plant supply temperatures

Network Optimization

Data-driven Supply Model

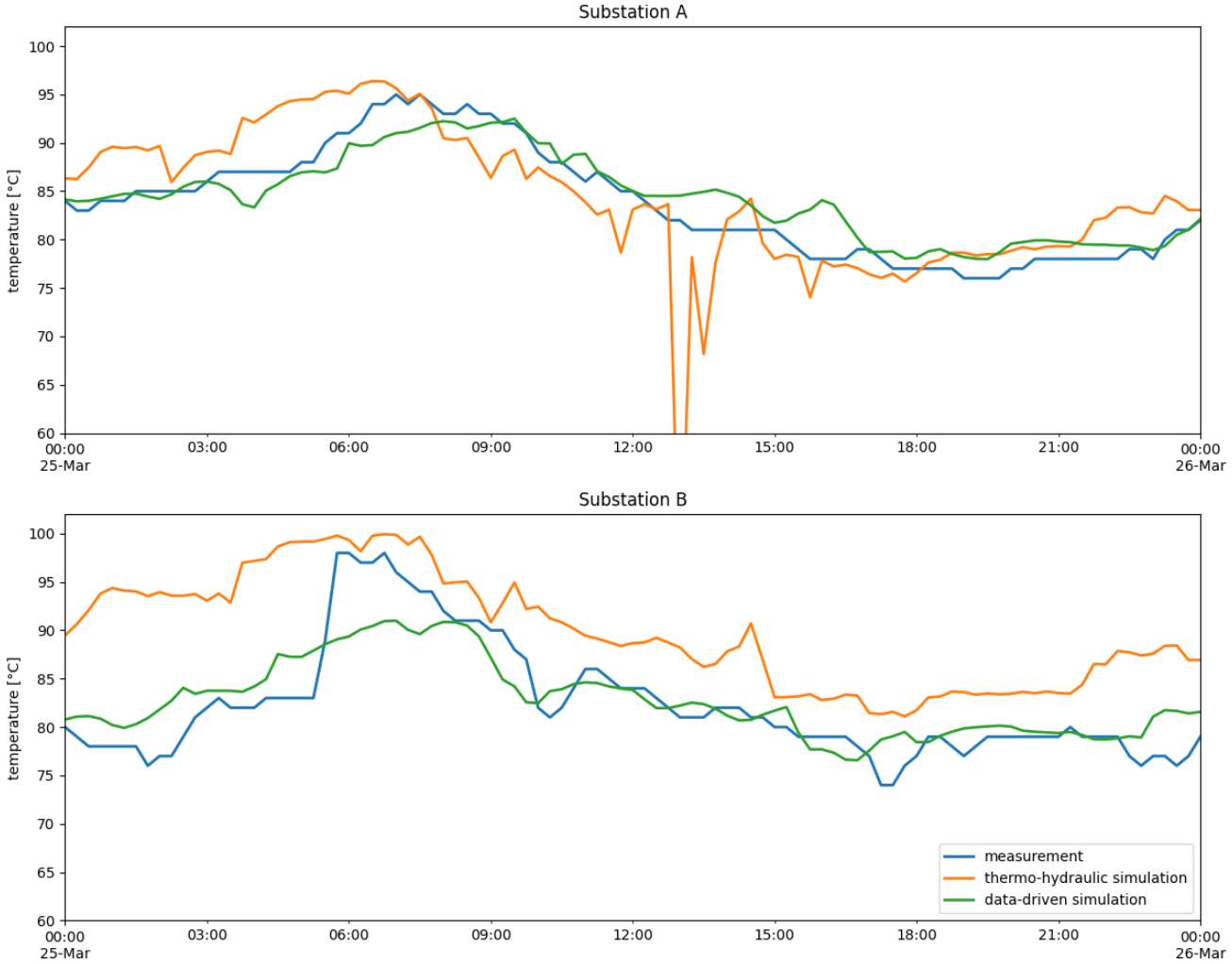


- model can reproduce historic supply data
- capable of predicting effects of different plant supply temperatures

Network Optimization

Data-driven Supply Model

Comparison with state-of-the-art thermo-hydraulic simulation:



Advantages:

- shorter runtimes
- no network model required
- Real-time plant manager guide

Disadvantages:

- no hydraulic analysis
- no abnormal operation scenarios

→ different use cases

Summary

Optimization on three different length scales

Substation:

- Predictive optimization of setpoints

Strand:

- Heat loss/leakage

Network:

- Data driven predictive simulation
  → Guide for plant manager

Funded through

Federal Ministry
for Economic Affairs
and Energy

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- Asia 500
- Americas 200
- Frankfurt am Main, Germany 1,600

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- More than 200 representatives

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- District heating and cooling, building automation
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- Food and beverages
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- Marine equipment
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Appendix