Demand prediction, artificial intelligence, and the use of a hydraulic model as a prerequisite for successful temperature and pressure optimization in District Heating systems.
Increase operational efficiency and reduce cost with smart, end-to-end optimization

Danfoss Leanheat® is an innovative suite of end-to-end optimization solutions that harness the power of digitalization to help users in the entire district energy network increase operational efficiencies, decrease costs, and accelerate the green transition.
Danfoss Leanheat® software suite & services
End-to-end energy optimization solutions

Leanheat® Production (LHP)
- Load forecasting
- Data Driven temperature optimization
- Production optimization
- Production planning

Leanheat® Network (LHN)
- Network design
- Online visualization of network operation
- Hydraulic supply temperature optimization
- Pressure optimization

Leanheat® Monitor (LHM)
- Monitoring and control
- Easy data integration, extraction and interpretation
- Integrate devices with different protocols

Leanheat® Building (LHB)
- Peak load optimization
- Energy optimization
- Customer engagement

Data API HUB

AI Engine

Primary Side
(Planning, Network operation, Production)

Secondary Side
(Buildings)
Leanheat® Building

Leanheat control differences compared to traditional heating control

TRADITIONAL HEATING CONTROL

Manual control based on:

- Outside temperature
- Experience
- ...

- Inaccurate
- Manual maintenance
- Uneven indoor temperatures
- Wasted energy

LEANHEAT-CONTROL

Automatic control based on:

- Indoor temperature
- Weather forecasts
- Building thermodynamics
- Residents behavior

- Load forecasting
- Self learning and updating
- Fully automated
- Even indoor conditions
- Optimized energy efficiency
- Possibility to peak shaving and demand response
Peak Shaving -> 20% lower peak power

24H TOTAL POWER NEED
TRADITIONAL HEATING CONTROL

Warm water

Heating

Avoided peak

24H TOTAL POWER NEED
LEANHEAT CONTROL
Leanheat Network
Leanheat® Network - what it consists of?

**OFF-LINE**

LHN Designer

- Network Design
- Hydraulic Analysis

**OPTIMIZATION**

LHN Online

- Visualization of the temperature, flow and pressure at any point in the network
- Real time measurements from SCADA
- Load forecast (Weather Forecast)

LHN Optimizers

- Temperature Optimization
- Pressure Optimization
Leanheat® Network Designer

### LEANHEAT® NETWORK

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- Hydraulic and thermal simulations of states (pressure, flow and temperature) in district heating/cooling networks
- Design of new networks. Extension of existing networks
- Development of contingency plans
- Feasibility studies
- Detection of bottlenecks
- Making “What if scenarios”
Leanheat® Network Online

**Online Features**

- Digital twin
- Overview of dynamic state of pipeline network, e.g. pressure, flow and temperature including state of devices.
- Possibility to follow the operational state back in time, now and in the near future.
- Possibility to see the consequences of any interaction into the network. E.g. what happens when a valve is being closed, a pump started, or changes are made in the production.
- Unlimited access to real and virtual measuring points throughout the whole network.
- Operators will understand what happens in network.
**Leanheat® Load Forecaster**

**WEATHER FORECAST**

- **Weather forecast providers**
  - Provider 1
  - Provider 2
  - Provider 3

- **Leanheat® Production forecast**
  - Combination module
  - Local combination module
  - Local weather station
  - Locally calibrated and improved weather forecast

**LOAD FORECAST**

**HIGHLIGHTS**

- Software solution for locally optimized weather forecasts
- Accurate weather forecast improves heat demand forecasting, temperature optimization and production optimization
- By combining and weighting 2-3 weather forecast providers, accuracy is improved & reliability increased
- Measurements from a local weather station used for calibration and improvement of accuracy
Leanheat® Network Temperature Optimization

**TEMPERATURE OPTIMIZATION**

**HEAT LOSS REDUCTION**

**HIGHLIGHTS**

What is Temperature Optimization?
- Optimization of the supply temperature
- Reduction of the network heat loss

What does TO offer?
- Ability to predict the heat demand up to 5 days ahead
- Possibility to optimize the thermo-hydraulic balance of the distribution network
- Minimizing pressure fluctuations hence extending the lifetime of the network
- Considerable savings and reduction of carbon emissions

\[
\text{Heat loss} = \text{Constant} \ (T_{\text{media}} - T_{\text{soil}})
\]

where \(T\) is the temperature

Heat loss is reduced if average media temperature is reduced!

The basis for temperature optimization is a reduction of supply temperature.

\[
\text{Heat loss} = \text{Constant} \ (T_{\text{media}} - T_{\text{soil}})
\]
Leanheat® Network Temperature Optimization

TEMPERATURE OPTIMIZATION

HEAT LOSS REDUCTION

HIGHLIGHTS

› Reduce the annual supply temperature by app. 6 to 8°C
› Reduce the production cost up to 2%
› Minimize pressure and temperature fluctuations in the network
› Heat loss reduction makes it possible to add new customers without extending the network
› Considerable energy savings. Minimize carbon emission and protect environment
› Reduce maintenance and support of pipeline network
Leanheat® Network
Pressure optimization

- Pump costs reduction
  - Reduces pumping costs to minimum
  - Calculates the optimal pump setpoints for main pumps and booster pumps allowing sufficient differential pressures to all clients
  - Securing design pressures in selected points are not violated
  - Takes new operational conditions into account coming from SCADA or load forecast
  - Stability in operation

Diff. pressure* network diagram

Pumping costs saving potential by adjustment of Δp at actual critical point in real-time

* Differential pressure = Supply pressure – return pressure
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