

ENGINEERING  
TOMORROW

*Danfoss*

# Danfoss - Your partner in DH energy optimization

**Leif Jakobsen**

*Sr. Business Development Manager,  
Danfoss District Energy*

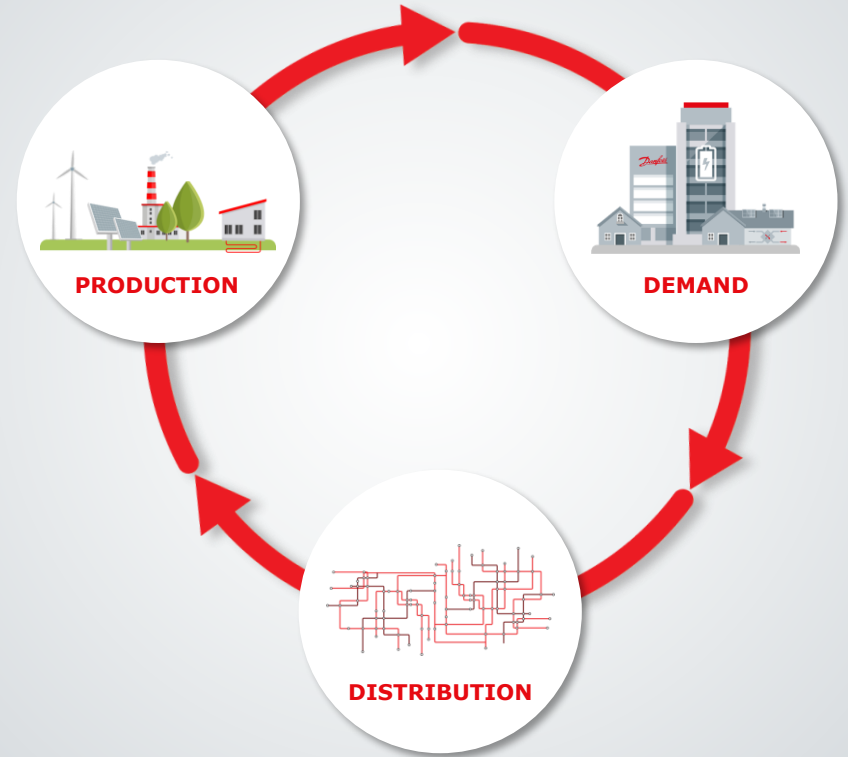


*"Demand prediction, artificial intelligence, and the use of a hydraulic model as a prerequisite for successful temperature and pressure optimization in District Heating systems."*



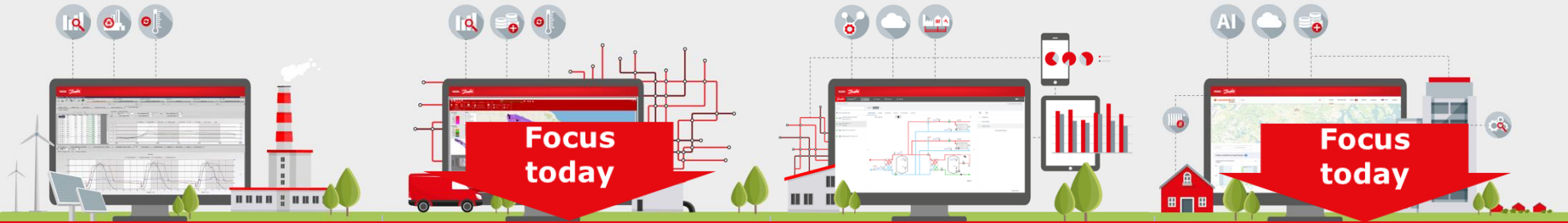
# Increase operational efficiency and reduce cost with smart, **end-to-end optimization**

**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

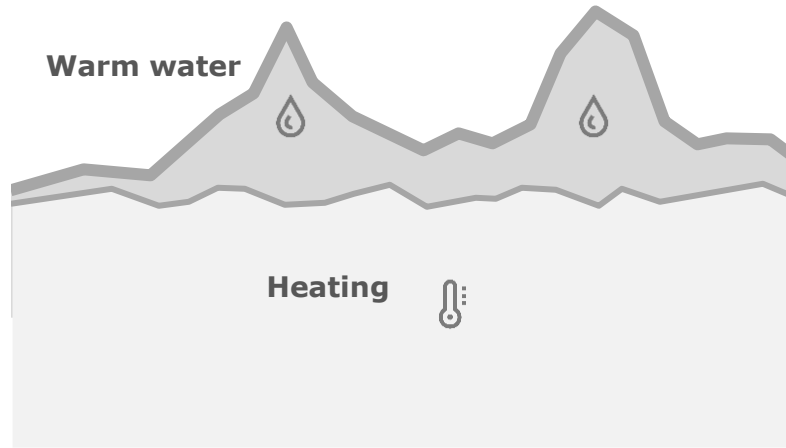
Automatic control based on:

- 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

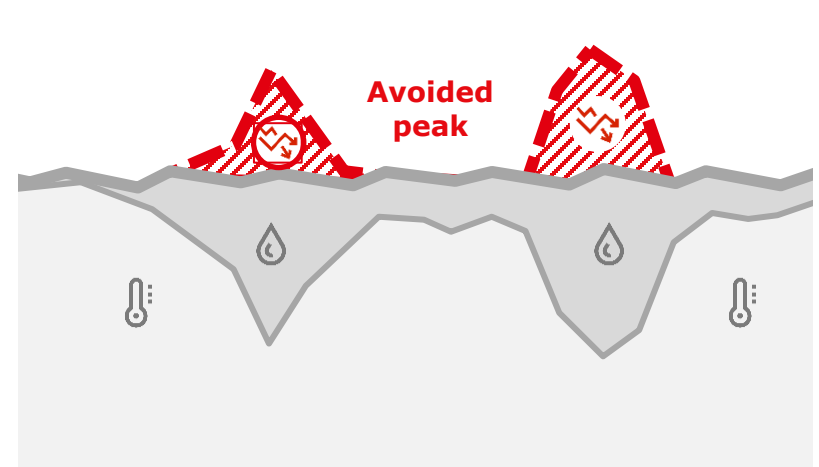


# Peak Shaving -> 20% lower peak power

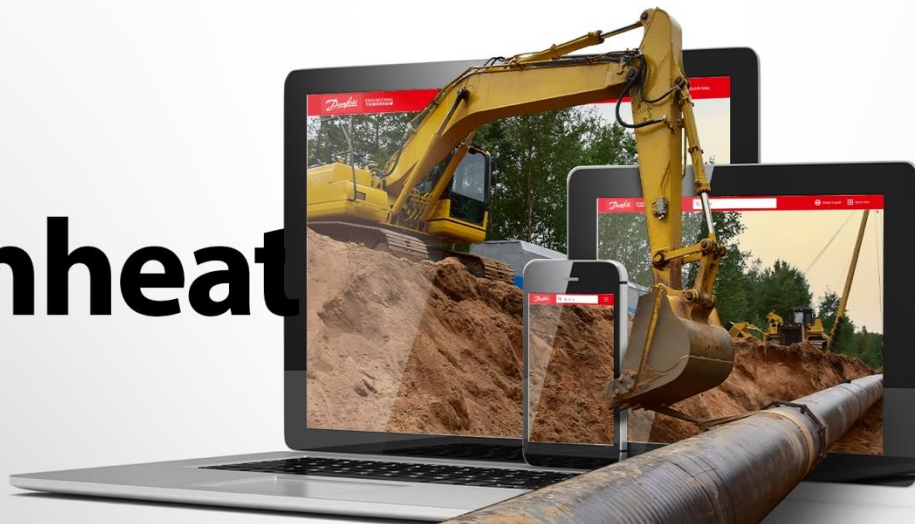
24H TOTAL POWER NEED  
TRADITIONAL HEATING CONTROL



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

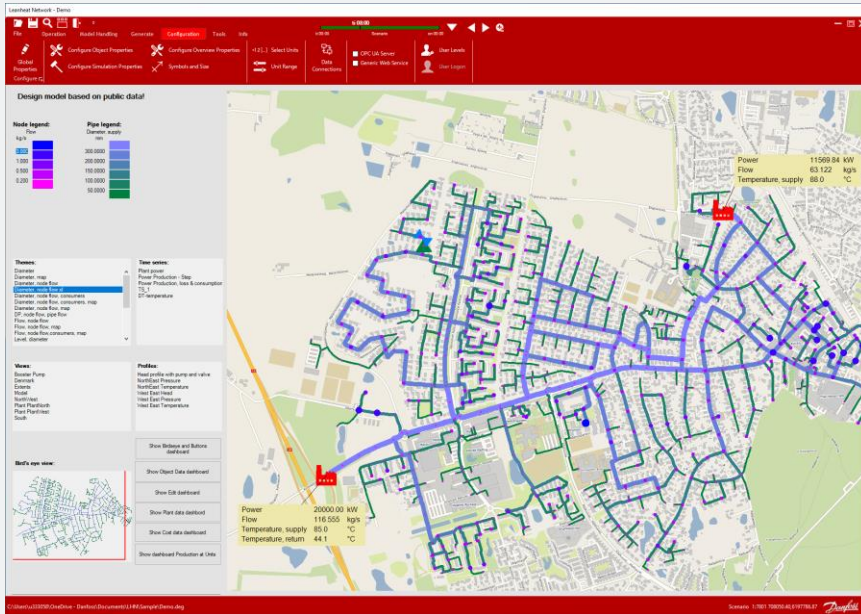
# Leanheat® Network Designer

LEANHEAT® NETWORK

HYDRAULIC ANALYSIS

FEATURES

HIGHLIGHTS



## Leanheat® Network as a planning/support tool

- 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"

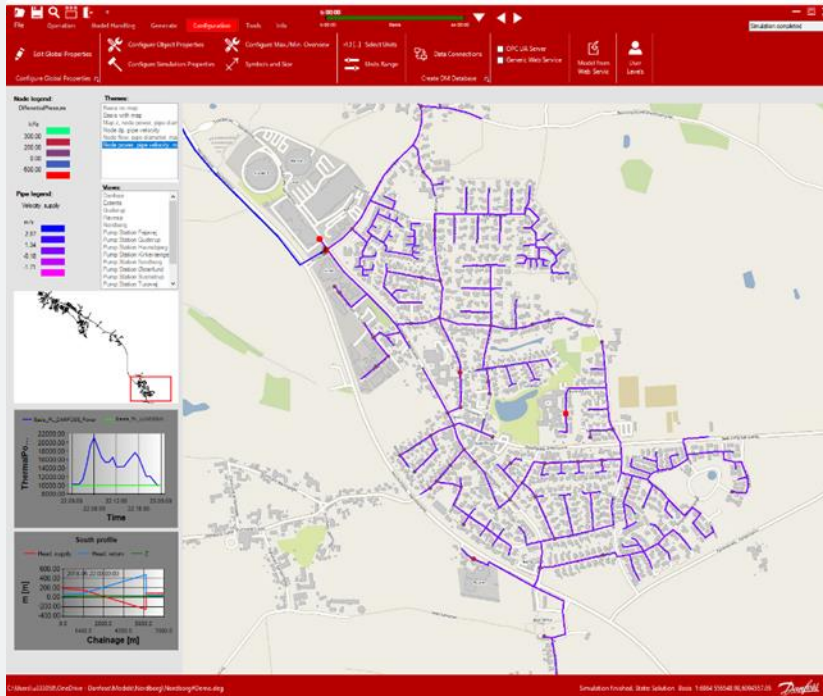


# Leanheat® Network Online

ONLINE

FEATURES

HIGHLIGHTS



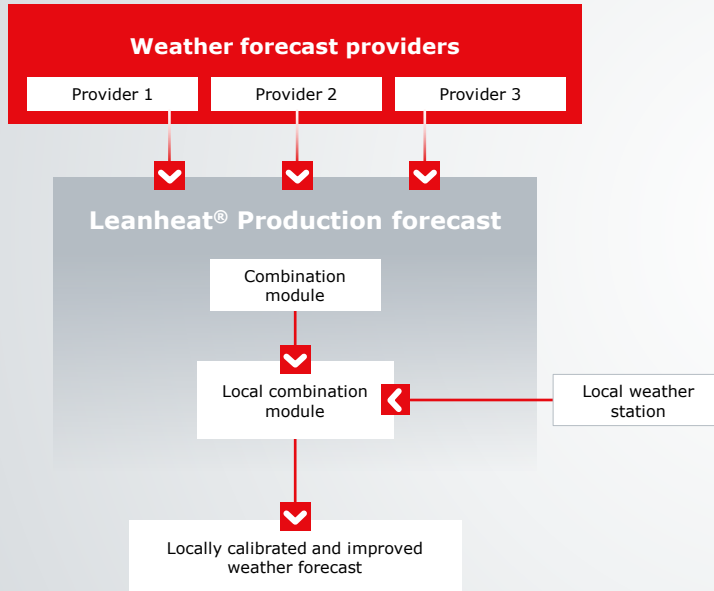
- Digital twin
- Overview of dynamic state of pipeline network, e.g. pressure, flow and temperature including state of devices.
- Possibility to follow the operational state back in time, now and in the near future
- Possibility to see the consequences of any interaction into the network. E.g. what happens 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

## 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

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

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.



### What is Temperature Optimization?

- Optimization of the supply temperature
- Reduction of the network heat loss



### What does TO offer?

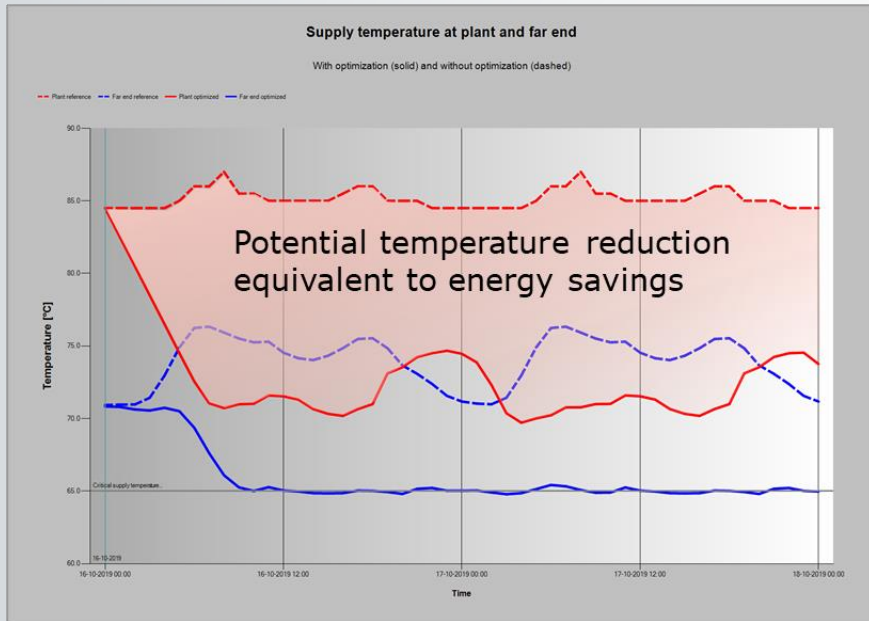
- Ability to predict the heat demand up to 5 days ahead
- Possibility to optimize the thermo-hydraulic balance of the distribution network
- Minimizing pressure fluctuations hence extending the lifetime of the network
- Considerable savings and reduction of carbon emissions

# 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

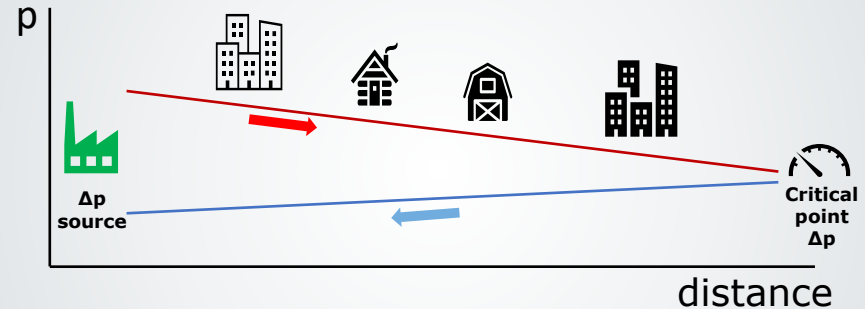
# Leanheat® Network

## 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

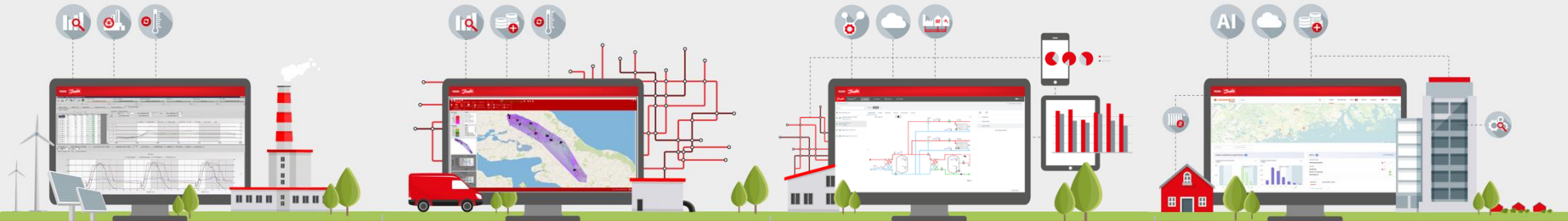


Pumping costs saving potential by adjustment of  $\Delta p$  at actual critical point in real-time

\*Differential pressure = Supply pressure – return pressure

# Danfoss Leanheat<sup>®</sup> software suite & services

## End-to-end energy optimization solutions



### Leanheat<sup>®</sup> Production (LHP)

- Load forecasting
- Data Driven temperature optimization
- Production optimization
- Production planning

### Leanheat<sup>®</sup> Network (LHN)

- Network design
- Online visualization of network operation
- Hydraulic supply temperature optimization
- Pressure optimization

### Leanheat<sup>®</sup> Monitor (LHM)

- Monitoring and control
- Easy data integration, extraction and interpretation
- Integrate devices with different protocols

### Leanheat<sup>®</sup> Building (LHB)

- Peak load optimization
- Energy optimization
- Customer engagement
- Return temperature optimization

Data API HUB

AI Engine 

#### Primary Side

(Planning, Network operation, Production)

#### Secondary Side

(Buildings)



**ENGINEERING  
TOMORROW**