ENGINEERING TOMORROW

Danfoss Heating

Your partner for district energy solutions

DIGITALIZATION

ELECTRIFICATION

URBANIZATION

CLIMATE CHANGE

GLOBAL MEGA-TRENDS

transforming our world

ELECTRIFICATION

- Green energy will make electricity the largest energy carrier

- Increased need for storage capacity to deal with peak loads

- By 2040, 50% of all cars will be electric – ferries, trucks and other vehicles also going electric

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URBANIZATION

- Cities account for up to 70% of energy consumption and CO_2 emissions

- World population to reach 8.6 billion people in 2030

- By 2050, 70% will be living in cities

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DIGITALIZATION

- 90% of all data created in the past two years

- 1 million new devices coming online every hour

- Digitalization will drive customer value – eg. IoT will save USD 1 trillion a year in maintenance

CLIMATE CHANGE

- Greenhouse gasses increased by 50% since 1990

- Energy efficiency and renewable energy only ways to a low-carbon world

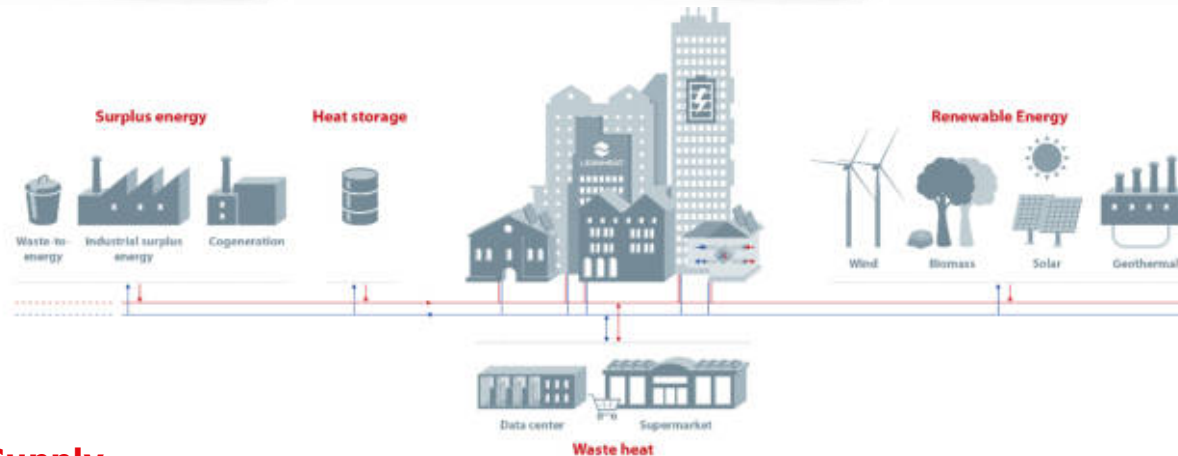- Energy efficiency deliver largest reductions in greenhouse gas

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Why District Energy with **Danfoss?**

Most sustainable approach	Mitigation of climate changes	Optimization solutions & optimal temperature control

Surplus energy

Waste-to-energy · Industrial surplus energy · Cogeneration

Heat storage

Renewable Energy

Wind · Biomass · Solar · Geothermal

Data center · Supermarket

Waste heat

Demand & Supply

❝ **We believe that District Energy is the most sustainable approach for mitigation of climate changes & improving energy efficiency by providing optimization solutions & optimal temperature control for both demand & supply side.** ❞

What District Energy **brings to users?**

| Energy efficiency | Decarbonization | Healthier environment |

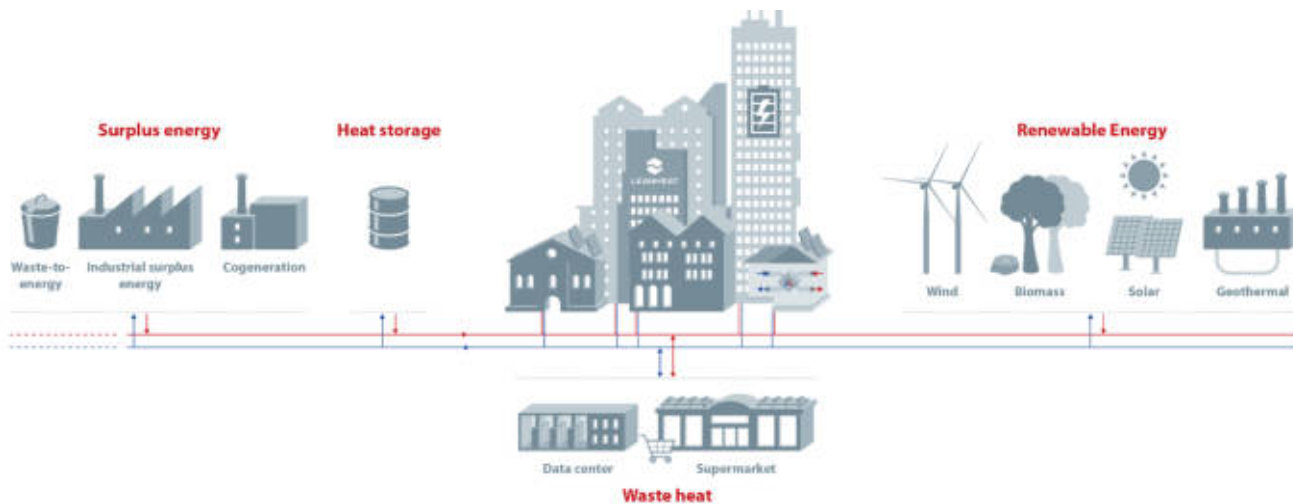
Up to

50%

plant efficiency increase

Up to

60%

less coal used in case of waste or geothermal heat used

Up to

30%

narticles and NOx reduction if centralised boilers are used

From single source to…

From fossil to…

From high temperature to…

MULTI-SOURCE

RENEWABLES & SURPLUS ENERGY

LOW TEMPERATURE DISTRICT HEATING

What are the district heating **generations?**

Temperatures

Efficiency

Heat sources

1G → 2G → 3G → 4G

1G / 1880-1930   2G / 1930-1980   3G / 1980-2020   4G / 2020-2050
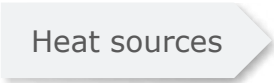
Same service but **lower temperature and higher efficiency**

Complex systems required new technologies

Temperature

Efficiency

Heat sources

1G → **2G** → **3G** → **4G**

Direct connection

Mixing loops

Substations with HEX and weather compensation

SCADA

Optimization & analytics

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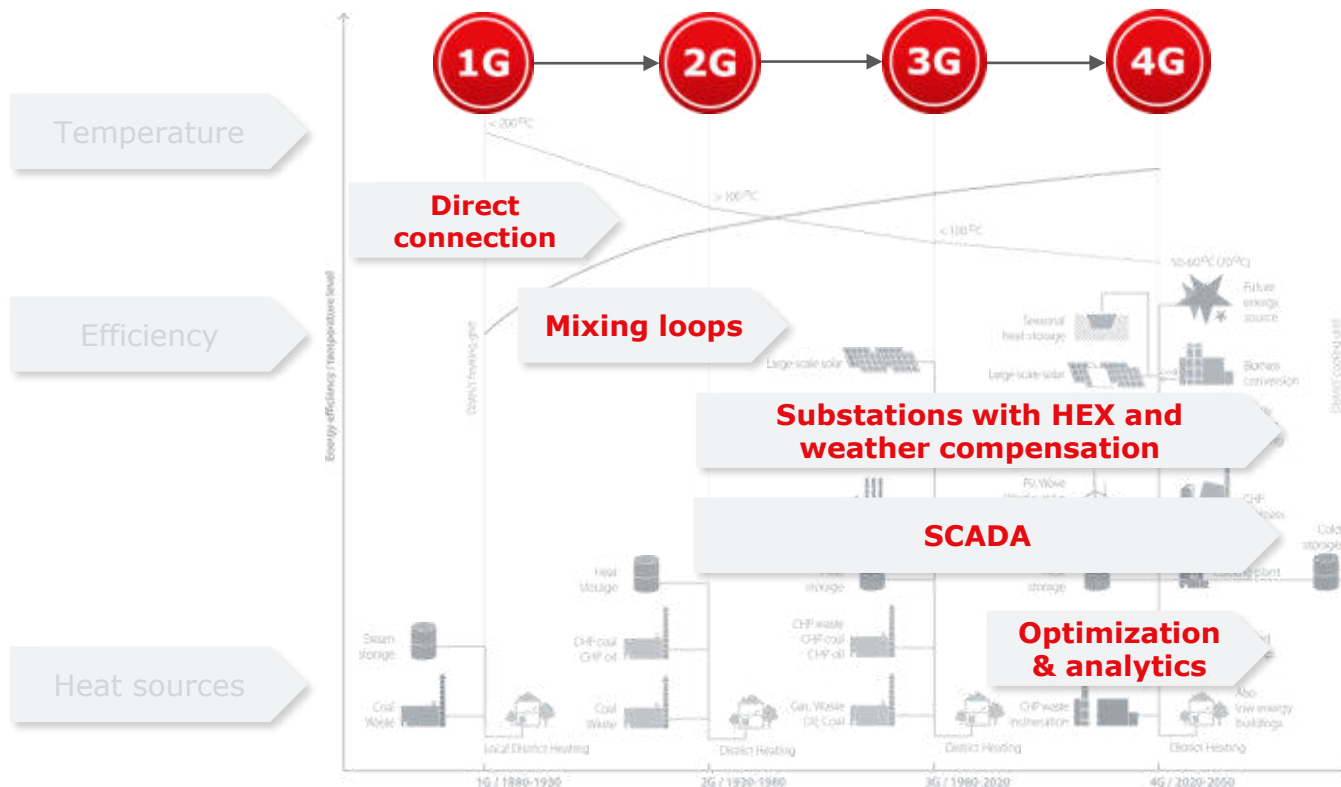
Commercial implications

- Source optimization
- Competitiveness
- Sustainability
- Demand planning
- Cost optimization

Technical implications

- ΔT optimization
- Pump optimization
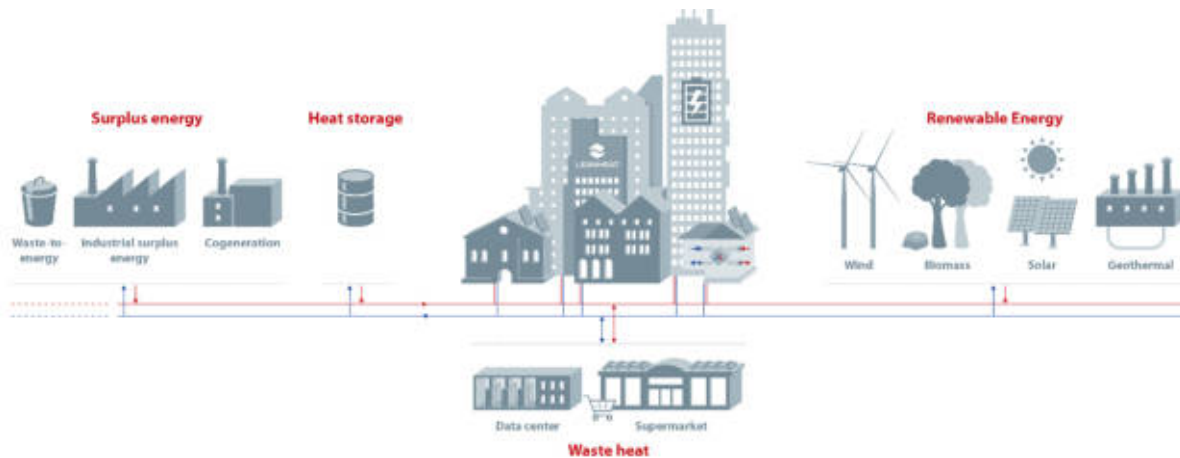- Peak load management
- Digitalization

MULTI-SOURCE

RENEWABLES & SURPLUS ENERGY

LOW TEMPERATURE DISTRICT HEATING

TOTAL COST OF OWNERSHIP

Complete operational **management** and **optimization** solution

Surplus energy · Heat storage · Renewable Energy

Waste-to-energy · Industrial surplus energy · Cogeneration

Wind · Biomass · Solar · Geothermal

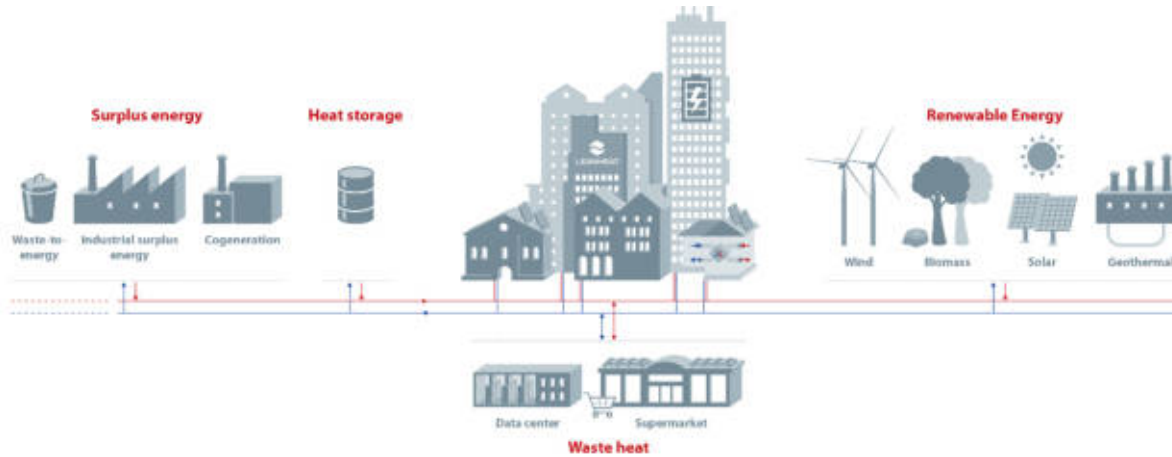Data center · Supermarket

Waste heat

District Energy optimization cycle

DEMAND **DISTRIBUTION** **PRODUCTION**

Complete operational **management** and **optimization** solution

Surplus energy

Waste-to-energy | Industrial surplus energy | Cogeneration

Heat storage

Renewable Energy

Wind | Biomass | Solar | Geothermal

Data center | Supermarket

Waste heat

District Energy optimization cycle

| *predict & optimize* demand side | **design & operate** your distribution with **optimal** thermal-hydraulic parameters | **produce energy** from sources with **best economy** |

| apply | simulate (verify) | learn |

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Understand and **optimize** your consumers

Traditional building

Heating curve + settings
T.ref = T.VK + (2,5 x VK x (T.rum.set.spare − 20)) + RI
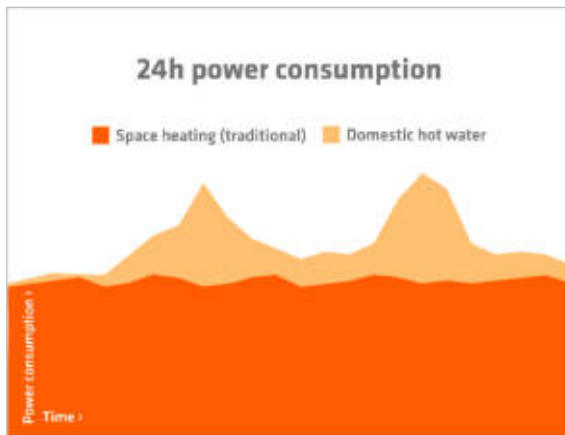
- Manual configuration
- Not predictive

AI-controlled building

- Indoor sensor data
- Weather data
- District heat data

Leanheat AI

- Adaptive (no configuration)
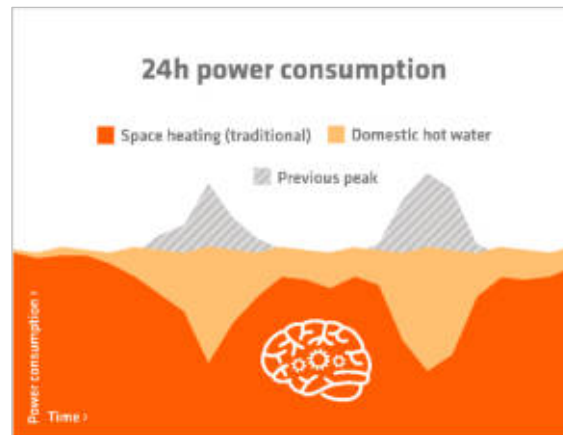- Predictive

Understand and **optimize** your consumers

Traditional building automation

Optimized by LeanHeat AI

Benefits

Cut peak power by **20%**
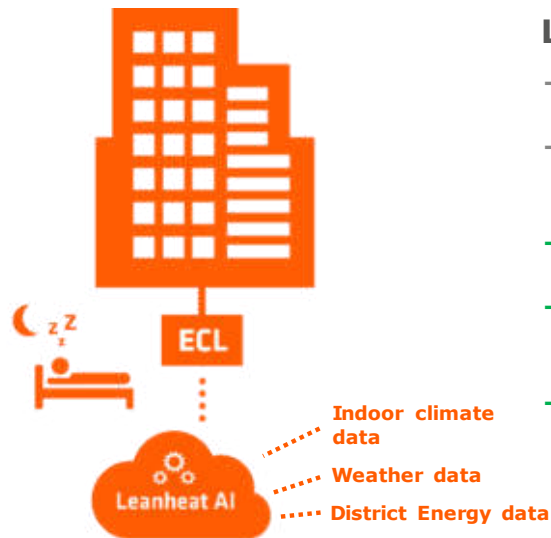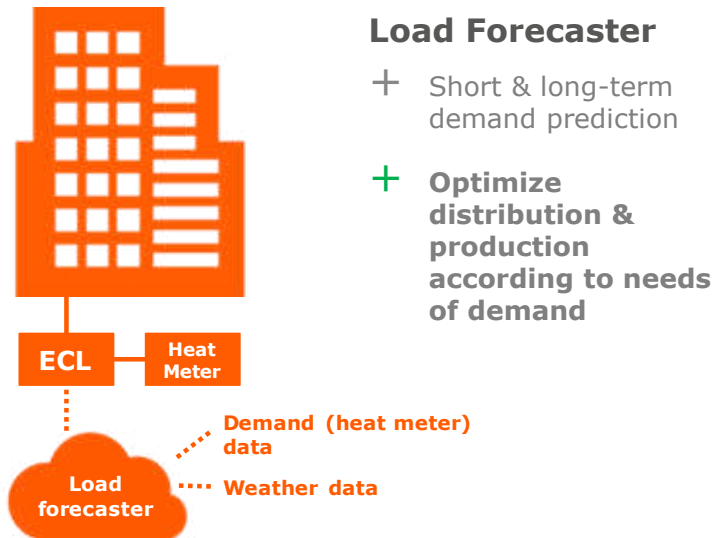
New products and services

Optimal production with demand response

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Predict and optimize your demand

DEMAND PREDICTION VS. DEMAND PREDICTION & OPTIMIZATION

Load Forecaster

+ Short & long-term demand prediction

+ **Optimize distribution & production according to needs of demand**

ECL — Heat Meter

⋯ **Demand (heat meter) data**

⋯ **Weather data**

Load forecaster

Leanheat AI

+ Short & long-term demand prediction
+ Auto-commisioning & self-adaptive

+ **Optimize demand side heating parameters**
+ **Optimize distribution & production according to needs of demand**
+ **Optimize demand by utilizing building thermal capacity for peak shaving**

ECL

⋯ **Indoor climate data**

⋯ **Weather data**

⋯ **District Energy data**

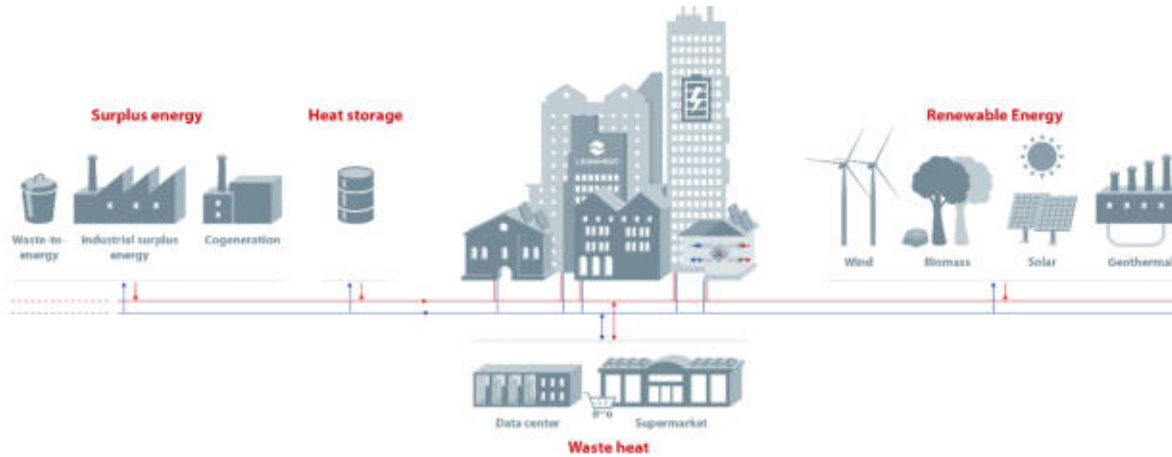**Leanheat AI**

> **" Knowing how your consumers will behave is the basis for optimal operation of your district energy system. "**

Complete operational **management** and **optimization** solution


District Energy optimization cycle

predict & optimize demand side	**design & operate** your distribution with **optimal** thermal-hydraulic parameters	**produce energy** from sources with **best economy**

| apply | simulate (verify) | learn |

Danfoss Energis

Energis is thermo-hydraulic modeling tool, developed specifically for use in District Energy systems to support your planing, design and operational processes.

- Effectively build and maintain district heating and cooling hydraulic network models.

- Simulate hydraulic and thermal conditions
- Optimize hydraulic conditions in the network
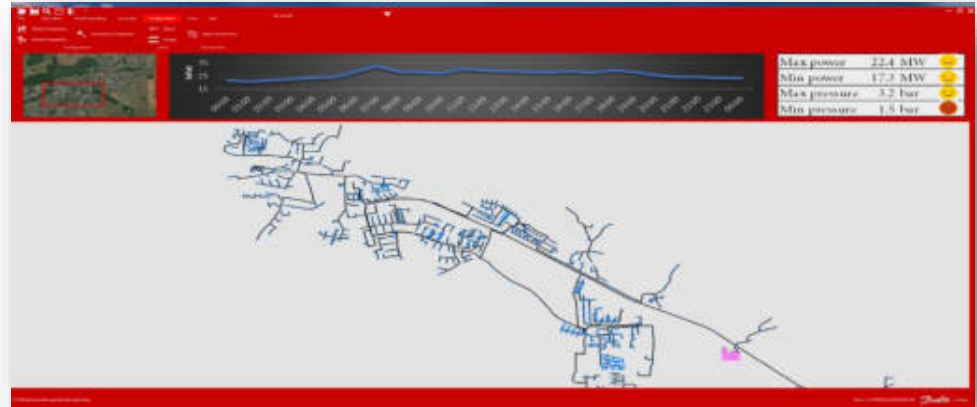
Design & operate your distribution optimally

Danfoss Energis as development & planning support tool

- Optimizations (in terms of design and investments value) of expansions, refurbishments and new connections

- Analysis of impact of expansion, refurbishments and new connections on the rest of the network in terms of temperature and pressure availability

- Development of contingency plans

- Database of knowledge about network

17 %
Investment reduction

Design & operate your distribution optimally

Danfoss Energis as operational support tool

- Calculate optimal hydraulic parameters and apply them (Energis with iNET)

- Overview of the temperature, flow and pressure at any point in the network (even where no real measurements exist)

- Overview of the composition of production sources at any point in the network

- Simulation of future conditions based on weather prognosis

- What-if analysis for daily operating challenges

- What-if analysis for critical events, preparation of alternative scenarios of response

- Planning of interventions with the goal of effective execution while at the same time sustaining the quality of services

Ensure **optimal and stable distribution**

iNET - Intelligent network balancing

Intelligent differential pressure and flow controllers with iNet function enable remote network balancing – solution for the changing conditions in the network

Heat consumption and primary network hydraulic conditions continually change due to:

| **Daily** change overs (morning/ evening) | **Seasonal** change overs (winter/ summer) | **Building renovations** (reduction in energy consumption) | **Network extensions** (increase of energy consumption) | **Heat sources dynamics** (switch in/out) |

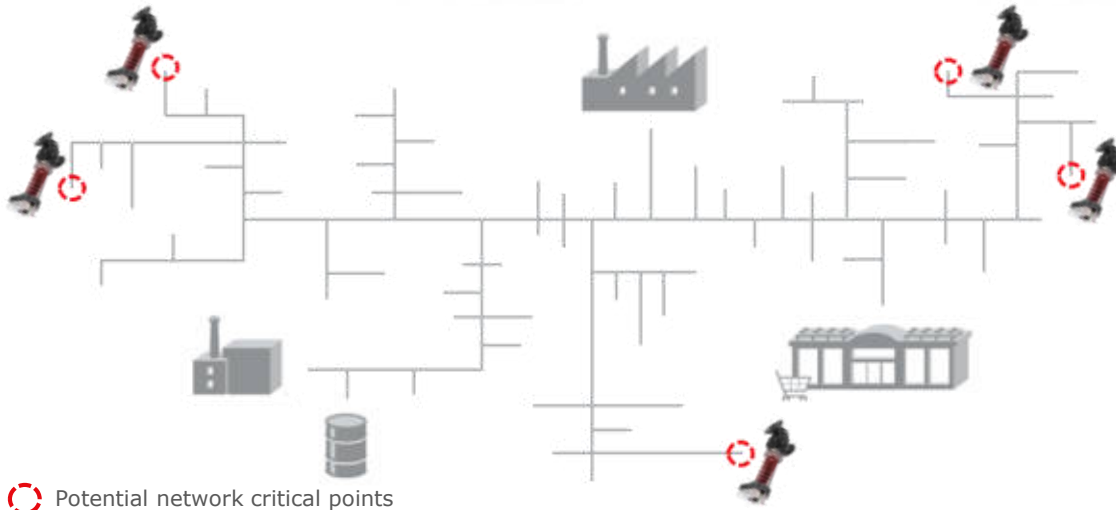# **Energis** with **iNET** - Intelligent network balancing

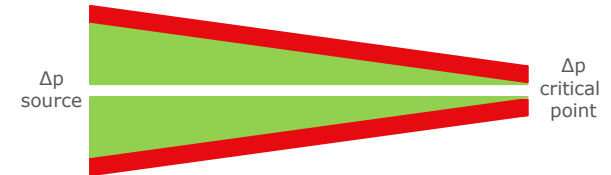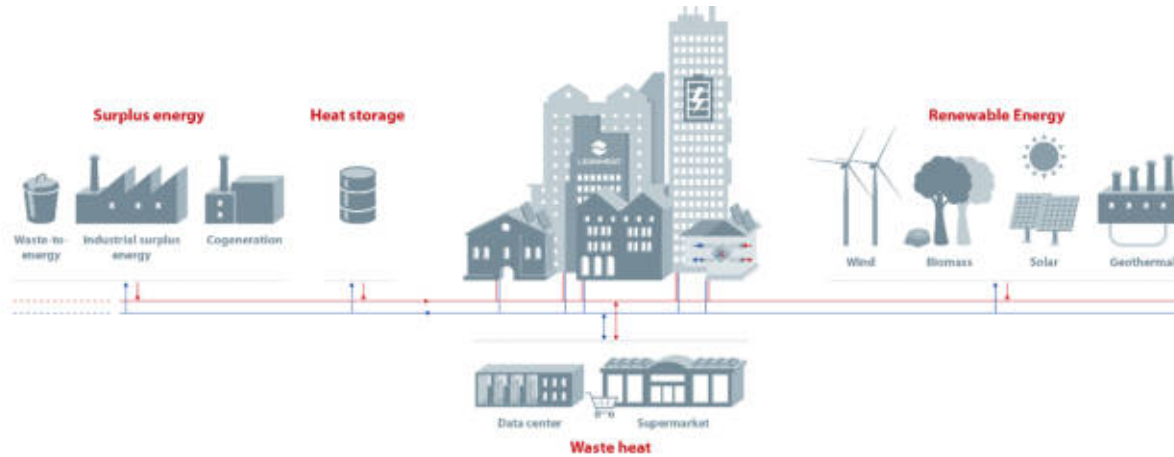|		
Remote adjustment of diff. pressure on branches or end points	Maximize utilization of heat accumulation in buildings and network	**Improved distribution stability**, lower pumping costs and return temperatures

Diff. pressure network diagram

Δp source

Δp critical point

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

Potential network critical points

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Complete operational **management** and **optimization** solution

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Heat storage

Renewable Energy — Wind, Biomass, Solar, Geothermal

Data center, Supermarket

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apply	simulate (verify)	learn

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Mentor Planner – Achieve more with Optimization and Planning

Mentor Planner supports the operation staff in the daily operation:

| To **reduce heat loss** in the district energy network	To suggest the most **economical operating schedule**	To collect all **relevant data**	To achieve **time savings**	To ensure the best possible **price of energy** and a reliable supply	To **develop** and maintain **the skills** of operating staff

DH forecast compared to actual heat consumption week 45 2016

Legend:
— FJV prognose MW
— FJV forbrug MW (NVP_FECAKF01)

X-axis: Time
Y-axis: MJ/s (0,00 to 500,00)
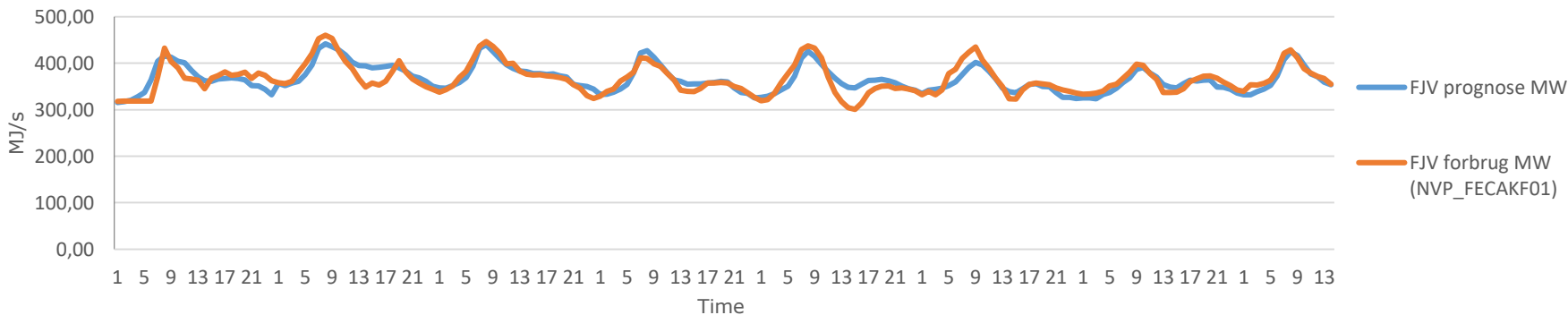
Mentor Planner – Achieve more with Optimization and Planning

Software application solutions for:

- Optimization of **Inlet Temperature** in district energy networks
- Optimization and Planning of **Heating and Power production**

Mentor Planner is a Tool for optimizing and planning:

Load Forecaster	Inlet Temperature Optimization	Heating and Power Production Optimization

Load Forecaster

- Based on historical data from the cooling network, weather data and day types (day/holiday)
- Combining SCADA real-time measurements and online weather forecast data
- Exact prediction of consumption in the district cooling network

Minimum of

95%

accuracy of energy usage prediction for today and five days ahead

Standard forecast — Shows **the total consumption** of the supply zone
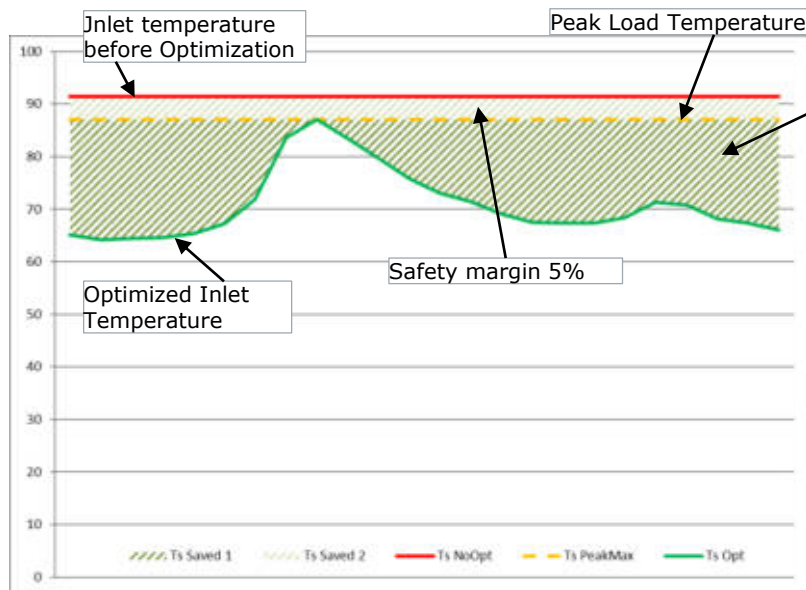
Extended forecast — Divides the heating network into any **number of zones**, each with a **separate energy projection and profile,** summed up to the total consumption of the coverage area

Inlet Temperature Optimization

Savings Potential:

- Big annual costs savings

- **Less maintenance and repair** of pipeline network due to optimized network balance (pressure, flow and temperature)

- Brings energy savings **according to EU requirements**

- Return On Investment between 1/2 to 2 years

Mentor Planner – Temperature Optimizing

Assumptions:

consumption forecast

Limitations:
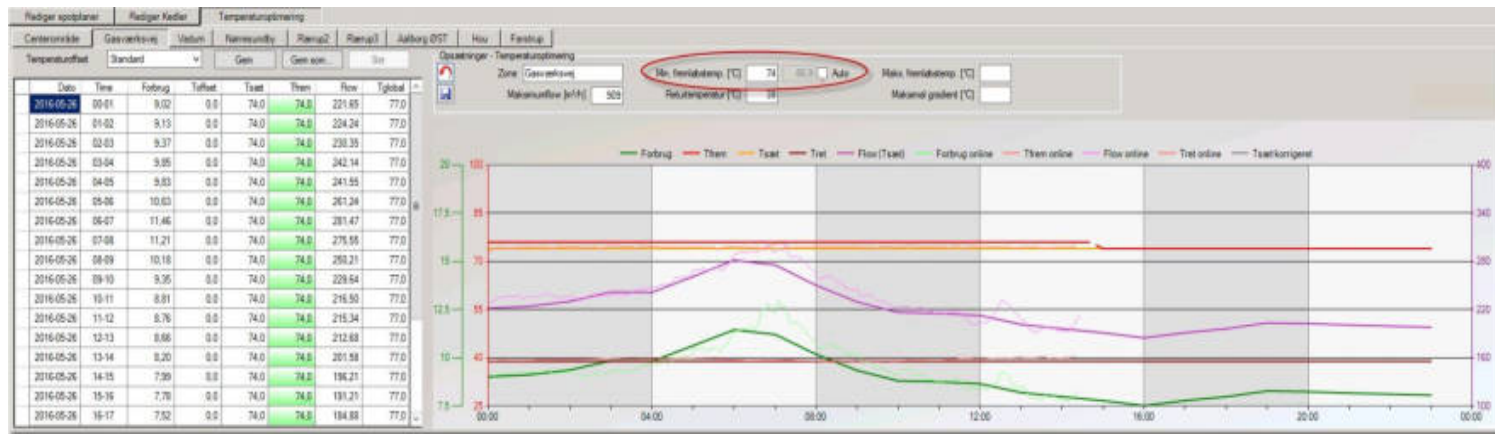
Maximum supply temperature

Maximum mass flow

Maximum gradient for change of supply temperature

Expected return temperature

Outcome:

Cost savings

Better use of ressources

Mentor Planner calculates the supply temperature based on **critical points** in the network

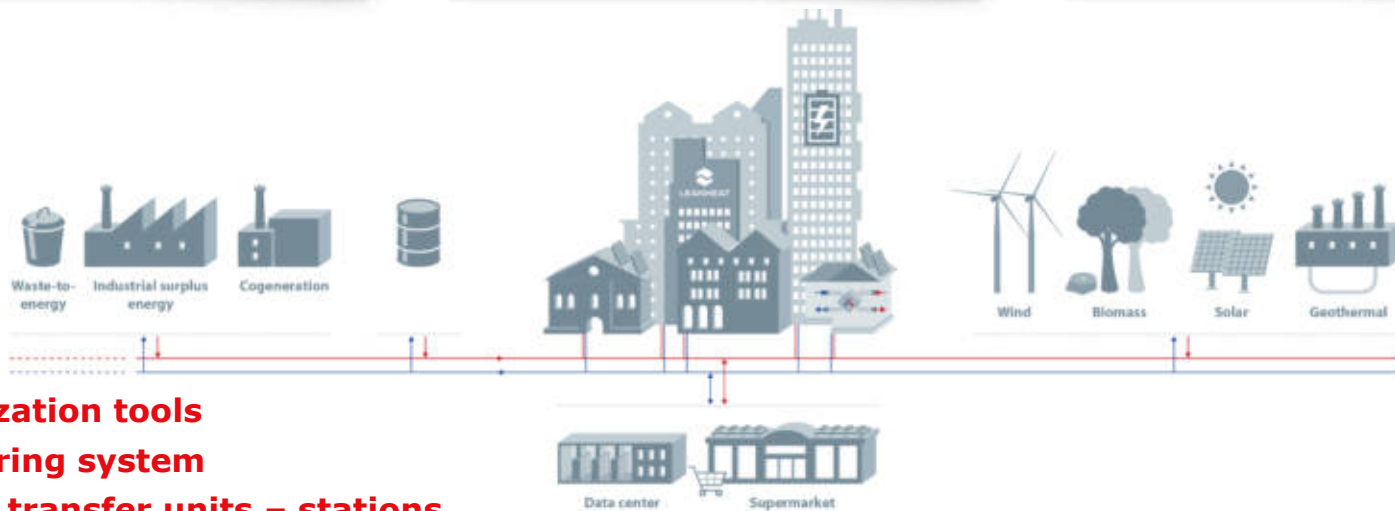# All on one screen

Danfoss Heating, your partner for…

Optimal plant operation	Optimal network operation	Delivering perfect service to your customers

- **Optimization tools**
- **Monitoring system**
- **Energy transfer units – stations**
- **Advanced control components**

Danfoss District Energy product portfolio
From components to optimization tools & services

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Danfoss, **your partner** for urban efficiency.

Thank you!

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