# HEATman / HEAT 4.0

Digitally supported district heating



## HEATman – Implementing 4DH and SES

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/nnovation Fund Denmark







## HEATman – In the Context of SDG

It's all about the Sustainable Development Goals

DH targets the SDG 7, Affordable and Clean Energy

DISTRICT HEATING AND COOLING AND ...

- Affordable
  - Cooperative, common (, democratic) infrastructure
    => increasing the overall efficiency
    - => extremely economic in the long run
  - Clean
    - => by utilising waste energy from many sources
    - => by renewable energy
    - => by integration with other systems
- ... but also other SDGs

#### DH can be owned in common and run democratically

The Danish way of running cooperative infrastructure An important lection.











## The Digitalisation Agenda

The Digital Roadmap for DH&C (by DHC+ Technology Platform)

Conclusion and goals for further demands:

- Production-consumption control must be integrated
- Intelligent algorithms should be developed
- Need for business models and tariffs that benefit customers
- □ Power to operate by the DH, incl. customers installations
- Demand for self learning, thermo-hydraulic hybrid models
- ✓ Automated fault detection, animalities in data, leakage detection etc.
- ✓ Remote control and monitoring
- Building control, standardisation, contractual indoor climate services, models
- ✓ Cross-software interoperation, GIS, City-GML, tools, methods for planning
- Software development
- Infrastructure development
- Pilote/Lighthouse projects
- ✓ Data, privacy, GDPR and service provision
- ✓ Sector coupling
- Horizontal topics (big data, AI) ----- N/A-Blockchain





## The Context for HEATman

From 4DH to the digitally supported district heating and smart energy system







# HEAT 4.0: Budget and key values

Key Project figures

| Project title   | HEAT 4.0 Digitally supported Smart District Heating |
|-----------------|---|
| Project acronym | HEAT 4.0  |

| Project - start date (on the form: dd-mm-yyyy) | 01-11-18       |                     |                          |  |  |  |  |  |  |  |
|--|----------------|---------------------|--------------------------|--|--|--|--|--|--|--|
| Project - end date (on the form: dd-mm-yyyy)   | 01-11-21       |                     |                          |  |  |  |  |  |  |  |
| Duration                                       | 3 years        |                     |                          |  |  |  |  |  |  |  |
| Total Project budget                           | kr. 37.267.452 |                     |                          |  |  |  |  |  |  |  |
| Total IFD investment incl. overhead            | kr. 25.383.272 |                     |                          |  |  |  |  |  |  |  |
| IED invoetment stee                            | Project        | Industrial research | Experimental development |  |  |  |  |  |  |  |
|  | 68,11%         | 78,72%              | 28,19%                   |  |  |  |  |  |  |  |

| Total IFD investment excl. Overhead | kr.            | 20.692.286 |
|-------------------------------------|----------------|------------|
| Total IFD investment for overhead   | kr.            | 4.690.986  |
| Administrator                       | P1 - NIRAS A/S |            |





Please note: HEAT 4.0 is the first step towards the solutions platform HEATman



## HEATman - Partners

A product and service platform





## HEATman definitions

How HEATman sees the world?

#### HEATman simplifies the District Heating Concept to

- 1) Heat Demand for the district
- 2) Distribution of heat (and storage)
- 3) Production of heat

#### In the time scale, we cover from short to long term issues:

|      | Today<br>2019<br>Start | 2020 2021 2022 2023             | 2024 2     | 025         | 12026<br>Add | l <sup>2027</sup> | 1 <sup>2028</sup> | 2029<br>es to the | 2030<br>e time | 203<br>line | 31  203   | 32   | 2033   | 2034     | 2035 | 203  | 36   | 2037    | 2038<br>Finish |         |
|------|------------------------|---------------------------------|------------|-------------|--------------|-------------------|-------------------|-------------------|----------------|-------------|-----------|------|--------|----------|------|------|------|---------|----------------|---------|
| 10-1 | - 18                   |                                 |            |             | , (dd        | cubito ini        |                   | 00 10 11          |                |             |           |      |        |          |      |      |      |         | Inui           | 1-02-38 |
|      | Task                   |                                 |            |             |              |                   |                   |                   | 2024           |             |           |      |        |          |      |      | 2034 |         |                |         |
| 0    | Mode 👻                 | Task Name                       | - Duration | <b>v</b> 20 | 17 2018      | 2019 2020         | 2021              | 2022 202          | 3 2024         | 2025        | 2026 2027 | 2028 | 2029 2 | 030 2031 | 2032 | 2033 | 2034 | 2035 20 | 36 2037        | 2038    |
|      | *?                     | Daglig planlægning              | 1 day      |             |              | 16-12             |                   |                   |                |             |           |      |        |          |      |      |      |         |                |         |
|      | *?                     | Prædiktering drift              | 3 days     |             |              | 18-12             |                   |                   |                |             |           |      |        |          |      |      |      |         |                |         |
|      | *?                     | Revisionsplanlægning            | 365 days   |             |              |                   |                   |                   |                |             |           |      |        |          |      |      |      |         |                |         |
|      | *?                     | Hovedplan (Master plan)         | 1095 days  |             |              |                   |                   |                   |                |             |           |      |        |          |      |      |      |         |                | - /     |
|      | *?                     | Investeringshorizont            | 5000 days  |             |              |                   |                   |                   |                |             |           |      |        |          |      |      |      |         |                | CHAN    |
| /    | *                      | Energiaftaler (tilskud, skatte) | 1100 days  |             |              |                   |                   |                   |                |             |           |      |        |          |      |      |      |         |                | AULE/   |
|      | *?                     | Indgreb                         | 200 days   |             |              | 🔶 19-0            | 9                 |                   |                |             |           |      |        |          |      |      |      |         |                | Y       |
|      | *?                     | Indgreb                         | 500 days   |             |              |                   | 12-1              | 1                 |                |             |           |      |        |          |      |      |      |         | CE             | - Ser   |
|      | *?                     | Indgreb                         | 1100 days  |             |              |                   |                   | • د               | 2-03           |             |           |      |        |          |      |      |      |         | 100            |         |
|      | *?                     | Indgreb                         | 2000 days  |             |              |                   |                   |                   |                |             | 13-0      | 8    |        |          |      |      |      |         | ALL C          |         |







# HEATman – the toolbox for district heating companies

The best way to **understand HEATman** is to see it **as a toolbox with a lot of services, tools, software and solutions** that can be combines to serve the needs of district heating companies and the sector.

HEATman is a solution platform HEATman is a cooperation and partnership HEATman is a product HEATman is a way of thinking 4DH implemented







## That is how we do it







## HEATman – digitally supported Smart District Heating

Getting the whole together

#### , which is not necessarily easy to understand

... Examples explain



#### A simple tool example

#### Demand model service from cloud

**Need** by customer (DH, consultant, students, researchers ...): **Method:** We build a cloud service that provides various, competing demand modelling services, such as

- Degree day corrected demand as time series and plots
- Aggregated demand predictions as time series and plots
- Company demand prediction services by current partners
- Researchers demand prediction models implemented
- Student tools
- More to come

Status:

- ✓ Cloud and service infrastructure ready as development tool
- Business version and models not in place





## An intelligent DH Unit

Another simple example of a HEATman tool

#### Goal:

An intelligent DH unit

Implementation: Leanheat & Danfoss

Research: AU, DTU – Civ. Eng.

Testing by DH:

- Trefor Varme
- Brønderslev Forsyning
- Hillerød Varme







### State of art – System optimization Tool example 2 – STEP 1

#### **Current situation:**

Every optimization software works on one component

No coordination







# Optimization across the overall district heating <sub>Step 2</sub>

#### Goal:

We aim at enabling communication and cooptimization between DH components.

Infrastructure: DTU Management, NorthQ

Research: DTU Compute

Implementation: Enfor, EMD, Neogrid

#### Testing at DH:

- Trefor Varme
- Brønderslev Forsyning
- Hillerød Varme







## The involved tools



- The tools for
- Controlling
- Optimization
- Prediction
- Energy dealing
- Dimensioning
- Planning
- Long term planning





## Adding data-intelligence models

#### Goal:

We adopt data-intelligent models from e.g. Smart Meters in all involved DH components.

Research: DTU Compute

Implementation: Enfor, EMD, Neogrid

Testing at DH:

- Trefor Varme
- Brønderslev Forsyning
- Hillerød Varme







## Smart Energy System integration

#### More than a HEATman tool

#### Goal:

Electrification of DH

Implementation: EMD International

Research: DTU Compute

Testing by DH:

- Trefor Varme
- Brønderslev Forsyning
- Hillerød Varme







## HEATman – digitally supported Smart District Heating

Getting the whole together



#### A tool list (application version)

- ✓ Development cloud infrastructure in place
- ✓ Communication in OPC-UA Baseline data collection (ongoing)
- ✓ Case implementation (ongoing)
- Business cloud infrastructure
- **C**ross platform communication (ongoing) and optimization
- Data-intelligent cross-platform control
- Forecasting and Demand modelling
- Smart DH Unit
- □ Smart Buildings
- Electrification
- □ Leakage detection
- □ Baseline and screening
- □ Short and long term planning
- □ Values and export

more

EXTRAS: Extension of existing tools that was not plant and much





## HEATman – Perspectivation

Getting it together with the rest of the world

District heating and cooling is an important technology to implement SDGs HEATman is a tool to do so

HEATman can be adopted to other Utility Infrastructure NIRAS works on LEAKman, DRAINman and others

We expect first marked-ready HEATman tools by summer 2020. New tools will occur as work is going on

The HEAT 4.0 grant ends at February 2022

You will be able to experience all solutions at partner DH.



Source: http://sru.dk





### Almost out of context

HEATman has also the component "thermal storage" TES

We work extensively on the next generations PTES at an international level

Sorry for not having this subject included.









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#### HEATman – Not used

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http://slcontrols.com

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Source: http://plan.aau.dk