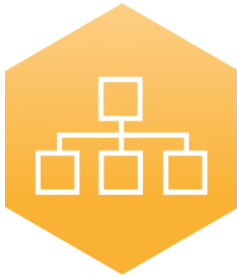


4th Generation District Heating Technologies and Systems  
2nd Annual Conference 21 August 2013



# Welcome



  
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## 4DH

4th Generation District Heating  
Technologies and Systems

## Introduction

The 4DH Research Centre:

What and Who are 4DH ..?

4GDH concept and research:

What are we doing during these 6 years..?

Today's agenda:

Annual Conference and Consortium  
meetings

  
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## 4DH

4th Generation District Heating  
Technologies and Systems



# What and who are 4DH?

- Strategic Research Centre financed by the Danish Research Council and the partners
- Universities and Industry including manufactories, consultants and DH companies
- International partners



# The long-term Objective of Danish Energy Policy



Expressed by former Prime Minister Anders Fogh Rasmussen in his opening speech to the Parliament in 2006 and in several political agreements since then:

**To convert to 100% Renewable Energy**



Prime minister 16 November 2008:  
**"We will free Denmark totally from fossil fuels like oil, coal and gas"**



Prime minister 16 November 2008:  
**"... position Denmark in the heart of green growth"**



# Background



District heating has an important role to play in future Sustainable Energy Systems:

- Energy efficiency
- Renewable energy and waste
- System integration of wind etc.

District heating technology has to be further developed (4GDH):

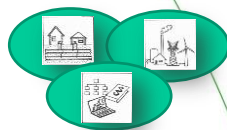
- Low energy buildings
- Low temperature sources
- Low Grid losses



# Aim and Objectives



The **Aim** is to assist in the development of 4th Generation District Heating Technologies and Systems (4GDH).



**Objectives:**

- Scientific platform for research activities
- Societal understanding of the role of District Heating
- Further additional national and international projects



# Why 4<sup>th</sup> Generation ?



## First Generation (1880-1930):

Steam as heat carrier. Is today in use in e.g. Manhattan, Paris and partly in Copenhagen.



## Second Generation (1930-1970):

Pressurised hot water as heat carrier with temperature above 100 C. Can be found today in older parts of current water-based systems.



## Third Generation (1970-present):

Pressurised water with temperatures below 100 C. Used in replacements in Central and Eastern Europe and all extensions in China, Korea, Europe, USA and Canada.



## Three pillars

# 4DH

4th Generation District Heating  
Technologies and Systems

### Supply:

Low temperature District heating



### Production:

Renewable Systems Integration



### Organisation:

Planning and Implementation



## Supply:

Low temperature District heating

Grids and components:

- low-temperature district heating systems based on renewable energy.
- new knowledge of the hardware and software technologies of the new generation of district heating systems
- existing energy renovated buildings and new low-energy buildings.

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Technologies and Systems



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## Production:

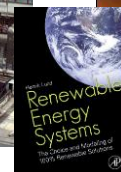
Renewable Systems Integration

Production and system integration:

- the development of energy systems analysis tools, methodologies and theories
- scenario building of future sustainable energy systems.
- The aim is to identify the role of district heating systems and technologies in various countries

# 4DH

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Technologies and Systems



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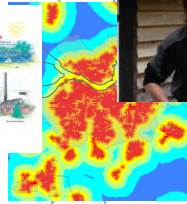
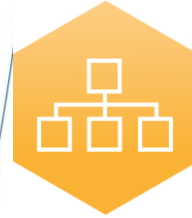
## Organisation: Planning and Implementation

### Planning and implementation:

- further development of the planning and management systems
- spatial analysis and geographical information systems (GIS) as a tool for planners and decision-makers.
- organisation and design of specific public regulation measures including ownership, tariffs, reforms etc.

# 4DH

4th Generation District Heating  
Technologies and Systems



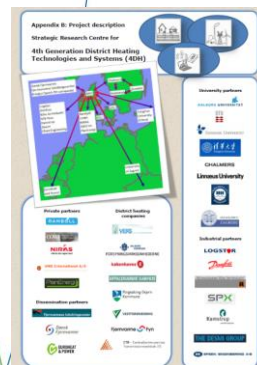
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## International Dimension

### International Partners:

- Tsinghua University, China
- Chalmers, Halmstad and Linnaeus universities, Sweden
- Zagreb, Croatia
- Euro Heat and Power

First result:  
Heat Road Map Europe  
First pre-study



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# Interdisciplinary

## PhD courses

At the different participating universities

## Management activities:

International collaboration, Consortium activities and dissemination

## 4GDH concept:

Further development of the concept.

# 4DH

4th Generation District Heating Technologies and Systems



# Consortium meetings

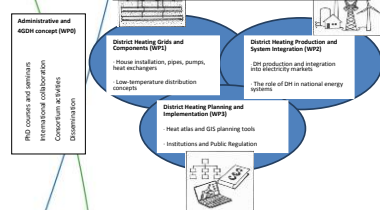
- Conference on 4GDH Technologies and Systems (Public)

- Status and administrative meetings (4DH Participants)

6-year project (2012-2017) with on-going dissemination.



Activity	Start	End	Responsible	Status
Administrative and 4GDH concept (WPs)	2012	2017	...	...
4GDH Technologies and Systems Conference	2012	2017	...	...
...	...	...	...	...



# 13 PhD projects

Strategic Research Centre for 4th Generation District Heating Technologies and Systems



- PhD 1.1. Heating of existing buildings by low-temperature district heating**
- PhD 1.2. Supply of domestic hot water at comfort temperatures without Legionella**
- PhD 1.3. Conversion of existing district heating grids to low-temperature operation and extension to new areas of buildings**
- PhD 1.4 Minimising losses in the DH distribution grid**



- Ph.D. 2.1: Energy Scenarios for Denmark**
- Ph.D. 2.2 Thermal storage in district heating systems**
- Ph.D. 2.3 Distributed CHP-plants optimized across more electricity markets**
- Ph.D. 2.4 Low-temperature energy sources for district heating**
- Ph.D. 2.5 The role of district heating in the Chinese energy system**



- PhD 3.1: Strategic energy planning in a municipal and legal perspective**
- PhD 3.2: Price regulation, tariff models and ownership as elements of strategic energy planning**
- PhD 3.3: Geographical representations of heat demand, efficiency and supply**
- PhD 3.4: Geographical representations of renewable energy systems**



## Publications

Bent Ole Søren Madsen: *Optimering af en energiforsyning i forbindelse med et nyt byggeri*. *Journal of Building Services Engineering Research and Technology*, 2012, 3, 209-220. DOI: 10.1080/17513758.2012.661111

Bent Ole Søren Madsen: *Optimering af en energiforsyning i forbindelse med et nyt byggeri*. *Journal of Building Services Engineering Research and Technology*, 2012, 3, 209-220. DOI: 10.1080/17513758.2012.661111

Bent Ole Søren Madsen: *Optimering af en energiforsyning i forbindelse med et nyt byggeri*. *Journal of Building Services Engineering Research and Technology*, 2012, 3, 209-220. DOI: 10.1080/17513758.2012.661111

Lone M. Andersen, J.K. Skovgaard: *SMART ENERGY CITY: A case study*. *Energy*, 2012, 45, 100-108.

Bent Ole Søren Madsen: *Optimering af en energiforsyning i forbindelse med et nyt byggeri*. *Journal of Building Services Engineering Research and Technology*, 2012, 3, 209-220. DOI: 10.1080/17513758.2012.661111

## Presentations

Heide Højgaard: *From smart electricity systems to smart energy systems: The sustainability triangle*. *Heat Roadmap Europe 2050*, Copenhagen, August 2012.

Bent Ole Søren Madsen: *Optimering af en energiforsyning i forbindelse med et nyt byggeri*. *Journal of Building Services Engineering Research and Technology*, 2012, 3, 209-220. DOI: 10.1080/17513758.2012.661111

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## HEAT ROADMAP EUROPE 2050

Fast track version of the EU7

- Aalborg University
- Technical University of Denmark
- University of Applied Sciences
- University of Gävle
- University of Jyväskylä
- University of Luxembourg
- University of Northumbria
- University of Twente
- University of Warwick
- University of York





## 4<sup>th</sup> Generation District Heating - Second Annual Conference

**Theme: Combined heat and power plants  
- now and in the future**

**21 August 2013**

**Aalborg University Copenhagen  
A.C. Meyers Vænge 15, 2450 Copenhagen SV  
Room B1/1.008**



### Programme

**Wednesday 21 August 2013**

**09.30-10.00 Breakfast and registration**

**10.00-10.20 Welcome and Introduction to the theme of the second annual 4DH conference**  
Professor Henrik Lund, Aalborg University, Head of the 4DH Research Centre

**10.20-10.50 District Heating in China - now and in the future**  
Assistant Professor Yu Wang and PhD Fellow Weiming Xiong, Institute of Energy, Environment and Economy, Tsinghua University  
This presentation will show the current status and trends of urbanisation and heating in China, characteristics and problems of centralised heating and district heating in urban areas, and the development of new heating technologies in China.

# Biomass Resources



**10.50-12.20 Biomass and waste resources for energy purposes**  
**Waste resources now and in the future**

Senior Researcher Marie Münster, Technical University of Denmark

The incineration of waste with CHP production contributes with a significant amount of heat in the existing district heating grid. The availability of waste as a resource is also important when assessing the role of district heating in future energy systems. Changes may be found in the local availability of different waste types and other ways of utilising waste resources may prove feasible in the long term.

#### How to get the most out of the biomass

Professor Leif Gustavsson, Linnaeus University, Sweden

This presentation analyses how to get the most out of limited biomass resources to reduce CO<sub>2</sub> emissions. The presentation is based on Swedish studies of district heating and building construction.

#### Prioritising biomass in the sustainable 'Smart Society'

Professor Henrik Wenzel, University of Southern Denmark

In a Danish renewable energy system, the transport sector's demand for hydrocarbon fuels becomes dimensioning. The long-term carbon balance of our agricultural soil has to be respected in the overall system design, and this becomes decisive to our prioritisation of biomass in the final sustainable 'smart society'.

#### Panel debate and questions to the three presenters

Chair: Anders Dyrrelund, Senior Market Manager, Rambøll

**12.20-13.30 Lunch**

# Large CHP plants



## 13.30-15.00 The current challenges and future role of large power plants and CHP plants

### Development of the Danish power and district heating systems from 2020 to 2035

Peter Meibom, Head of Analysis Group, The Danish Energy Association

A scenario analysis of the development of the Danish power and district heating systems in the period 2020-2035 is presented. The focus will be on how the existing tariff and support schemes influence the investment decisions in the central and decentralised district heating areas.

### Plans and strategies of the large Danish district heating companies

Jesper Møller Larsen, Head of Department, Aalborg Forsyning, Varme

The large district heating companies play an important role in managing the present level of CHP production and eliminating coal in the energy supply in Denmark. However, major challenges exist in terms of maintaining low prices and a high degree of supply security. This presentation will give a brush-up on the challenges and the on-going process in the large Danish district heating companies.

### The role of CHP and power plants in 100% RES systems and smart energy systems

Ass. Prof. Brian Vad Mathiesen, Aalborg University, Deputy Head of the 4DH Research Centre

The design and concept of smart energy systems are crucial to the large-scale integration of renewable energy and particularly in 100% renewable energy and transport systems. In this presentation, the role of CHPs and power plants such as integrated electricity, heat, transport and gas systems is presented.

### Panel debate and questions to the three presenters

Chair: Jan Strømvig, General Manager, Fjernvarme Fyn

## 15.00-15.30 Coffee break

# Small CHP Plants



## 15.30-17.15 The future role and current challenges of small CHP plants

### The survival of CHP plants in the future

Jesper Koch, Head of Grøn Energi

This presentation describes the future of CHP plants based on a recent analysis of the CHP plants' supply strategies, including a plan for how many CHP plants are to be closed down by 2020. Finally, observations will be made concerning a potential capacity market for CHP.

### Distributed CHP plants in present and future electricity markets

Anders N. Andersen, Head of Department, EMD International

A transition needs to be initiated from "First Generation distributed CHP" helping only to reduce fuel use - towards "Next Generation distributed CHP" making the integration of fluctuating production from renewable energy sources less costly (on a macro-economic scale), when these plants participate in both wholesale markets and balancing markets.

### Small CHP plants and heat pumps

Niels From, Engineer, PlanEnergy

In the coming years, many heat pumps will be installed at small CHP plants. The presentation will discuss different heat sources and how to integrate the heat pumps in the small CHP plants with a focus on the cold and the warm sides of the heat pump.

### Regulation framework for CHP and wind power integration

Professor Frede Hvelplund, Aalborg University

The present regulation does not ensure the existence of the CHP capacity needed. Furthermore, the present Nordpool power market and the present energy taxation erode the economy of wind power ending up in too high PSO payments. Therefore, it is necessary to establish a regulation system that both keeps the CHP plants alive and integrates wind power with CHP and the heat market.

### Panel debate and questions to the four presenters

Chair: Jan Eric Thorsen, Director, DEN Application Centre & HEX Research, Danfoss

