

2<sup>nd</sup> International Conference on

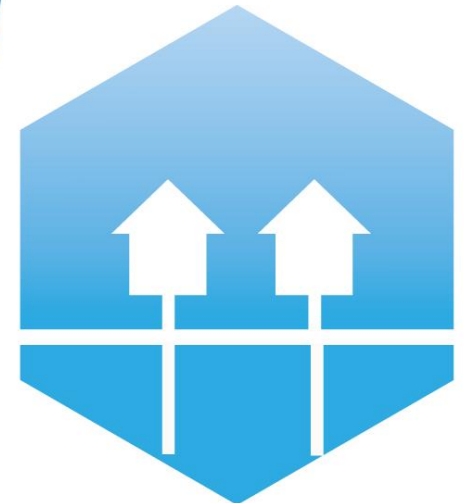
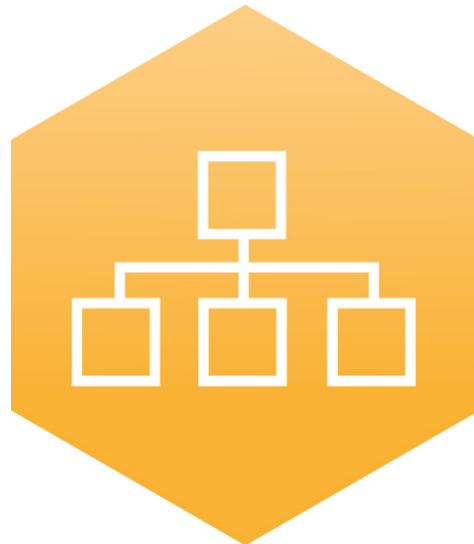
# Smart Energy Systems and 4<sup>th</sup> Generation District Heating

26-29 September 2016 · NORDKRAFT · Aalborg



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# Welcome



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# 4DH

4th Generation District Heating  
Technologies and Systems



#SmartEnergySystems & #4DH

# 4DH

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



290 Participants



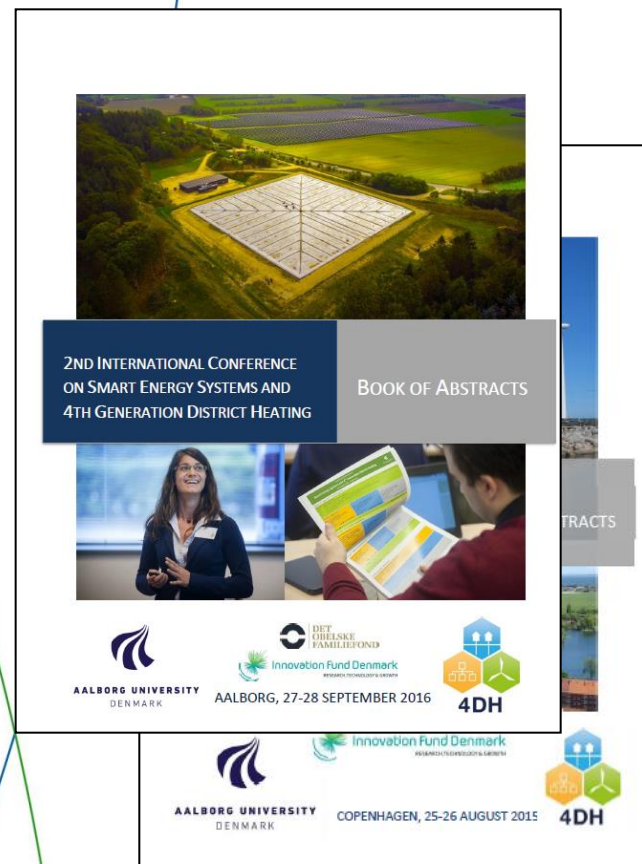
20 different countries



120 presentations

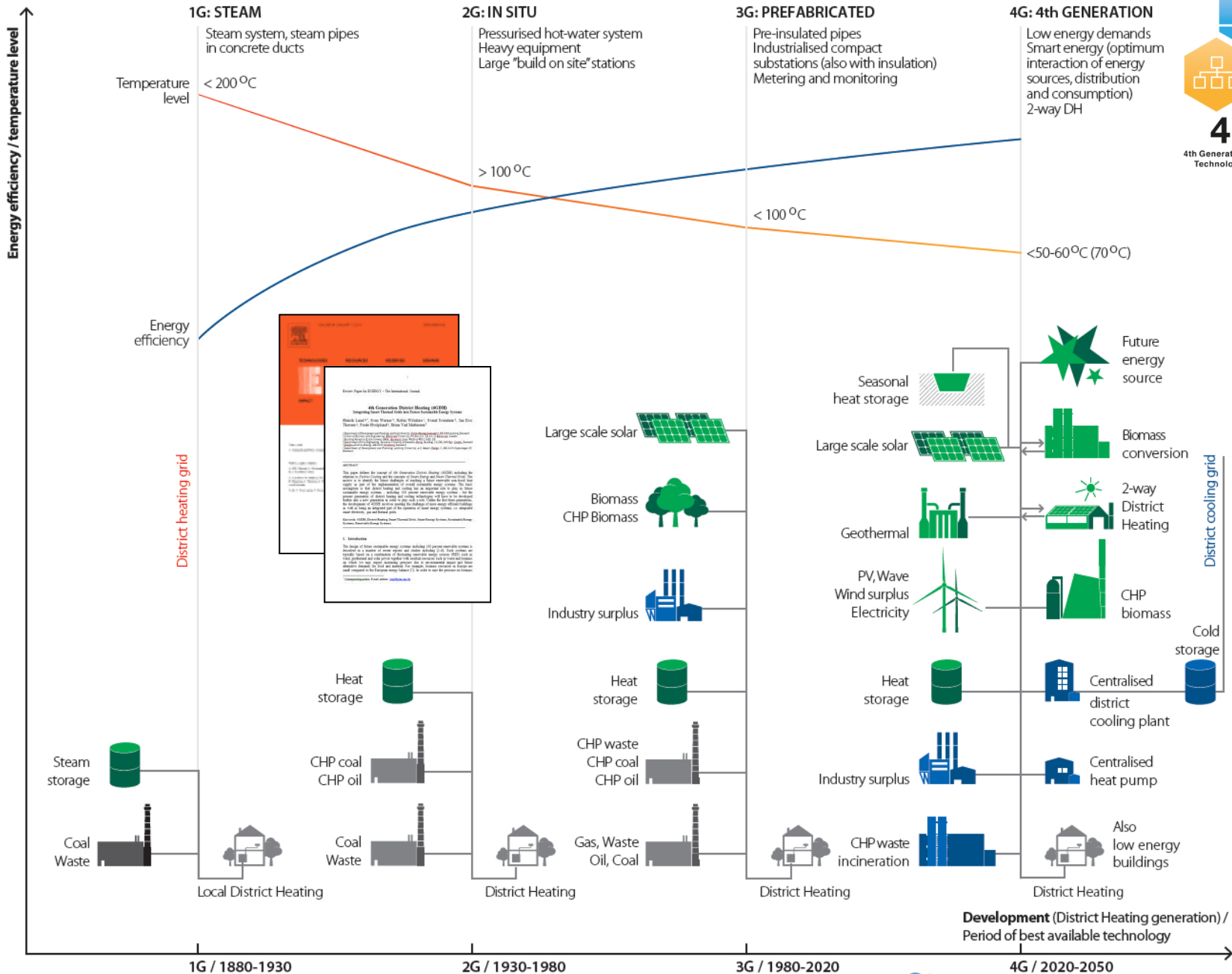


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A

# 4DH

4th Generation District Heating  
Technologies and Systems

## Three pillars

### Supply:

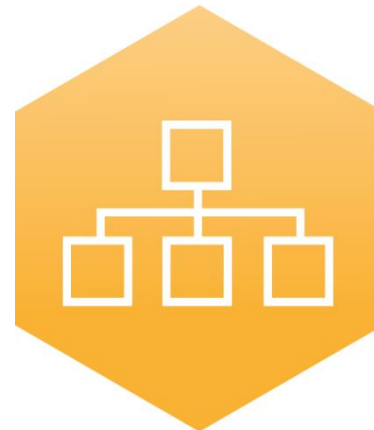
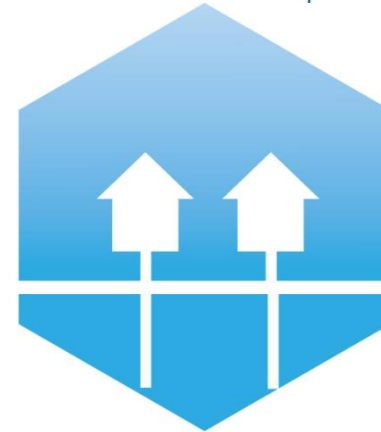
Low temperature District heating

### Production:

Renewable Systems Integration

### Organisation:

Planning and Implementation



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# Smart Energy Systems



[www.energyplan.eu/smartenergysystems/](http://www.energyplan.eu/smartenergysystems/)



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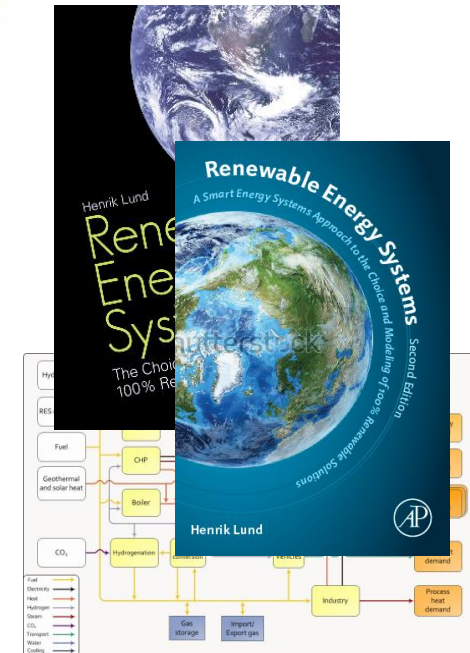


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# Smart Energy Systems

The key to cost-efficient 100% Renewable Energy

- A sole focus on renewable **electricity (smart grid)** production leads to electricity storage and flexible demand solutions!
- Looking at renewable electricity as a part **smart energy systems** including heating, industry, gas and transportation opens for cheaper and better solutions...



**Power-to-Heat**

**Power-to-Gas  
Power-to-Transport**



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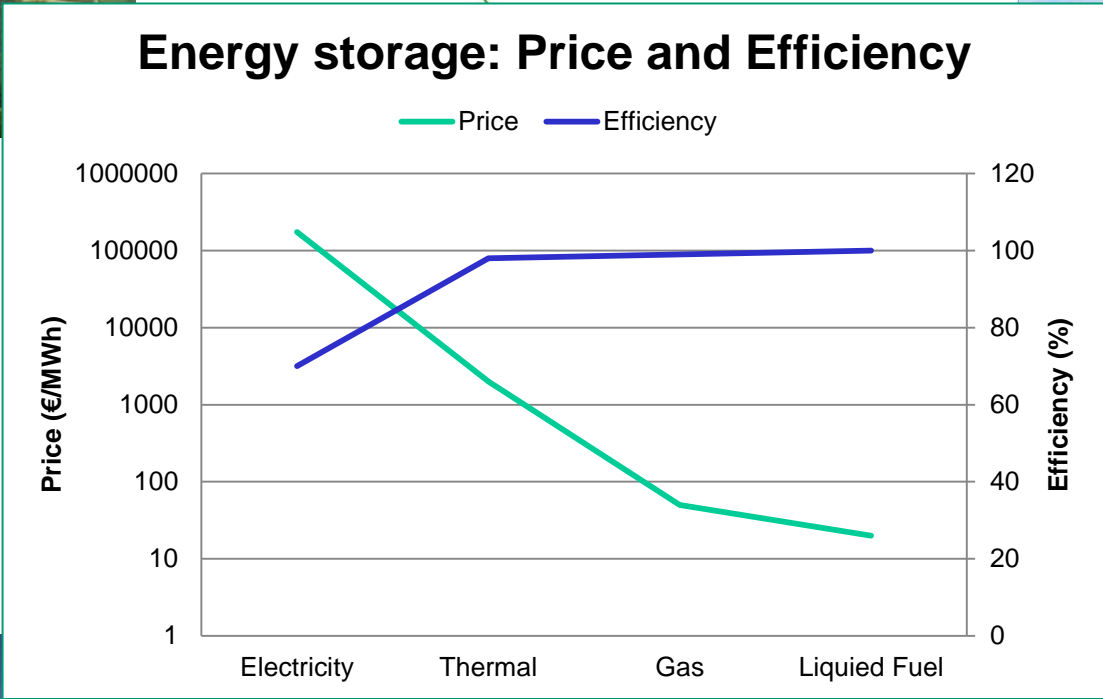
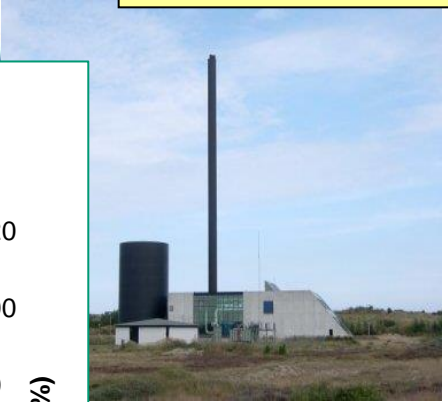
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# Energy Storage

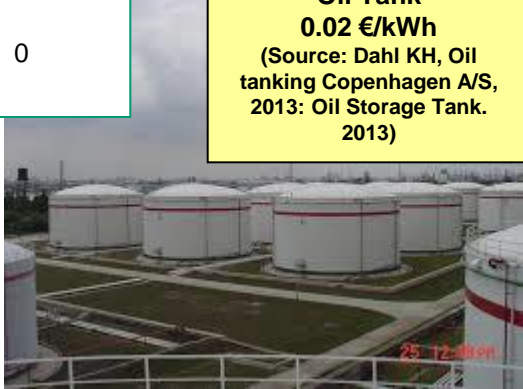
**Pump Hydro Storage**  
**100 €/kWh**  
(Source: Goldisthal Pumped Storage Station, Germany, [www.store-project.eu](http://www.store-project.eu))



**Thermal Storage**  
**1-4 €/kWh**  
(Source: Danish Technology Catalogue, 2012)



**Oil Tank**  
**0.02 €/kWh**  
(Source: Dahl KH, Oil tanking Copenhagen A/S, 2013: Oil Storage Tank. 2013)



**Natural Gas Underground Storage**  
**0.05 €/kWh**  
(Source: Current State Of and Issues Concerning Underground Natural Gas Storage. Federal Energy Regulatory Commission, 2004)





# Thermal Storage

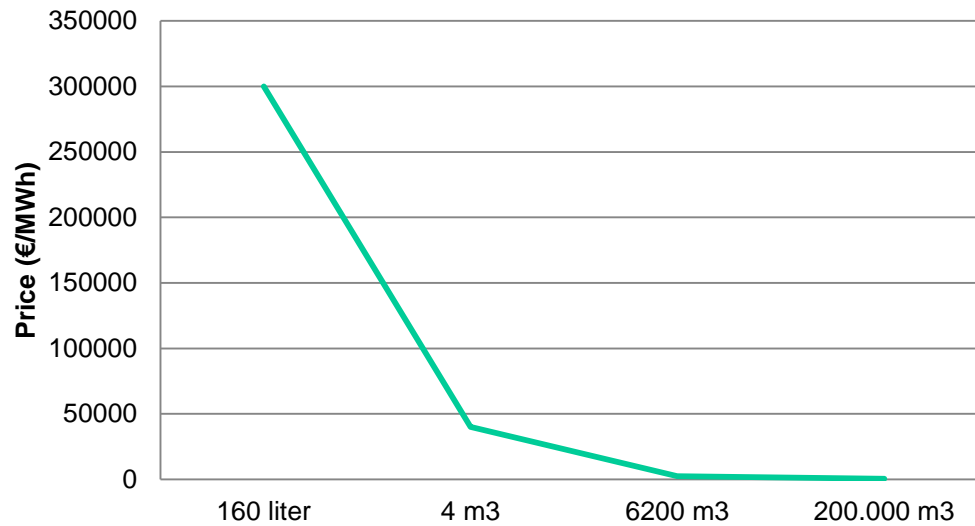
**0.16 m3 Thermal Storage**  
**300.000 €/MWh**  
(Private house: 160 liter  
for 15000 DKK)



**6200 m3 Thermal Storage**  
**2500 €/MWh**  
(Skagen: 6200 m3  
for 5.4 mio. DKK)



### Thermal storage: Price and Size



**4 m3 Thermal Storage**  
**40,000 €/MWh**  
(Private outdoor: 4000 m3  
for 50,000 DKK)



**200,000 m3 Thermal Storage**  
**500 €/MWh**  
(Vojens: 200,000 m3  
for 30 mio. DKK)









# Heat Roadmap Europe

**Heat Roadmap Europe 2050**

## GIS Mapping: Many Heat Sources

- Urban areas (Heating Demands)
- Power and Heat Generation
- Waste Management
- Industrial waste heat potential
- Geothermal heat
- Solar Thermal
- the study indicates that the **market shares for district heating for buildings can be increased to 30% in 2030 and 50% in 2050.**



**HEAT ROADMAP EUROPE 2050**


FIRST PRE-STUDY FOR THE EU27



  
 Aalborg University  
 David Connolly

**HEAT ROADMAP EUROPE 2050**

SECOND PRE-STUDY FOR THE EU27



By


Aalborg University  
 David Connolly  
 Brian Vind Mathiesen  
 Poul Albert Døstergaard  
 Bernd Möller  
 Steffen Nielsen  
 Henrik Lund

Halmstad University  
 Urban Persson  
 Sven Werner

Ecofys Germany GmbH  
 Jan Gröninger  
 Thomas Boemans  
 Michelle Bosquet

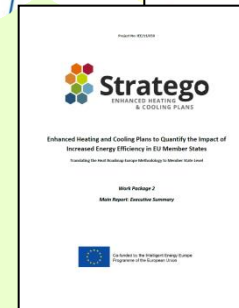
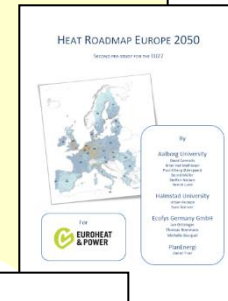
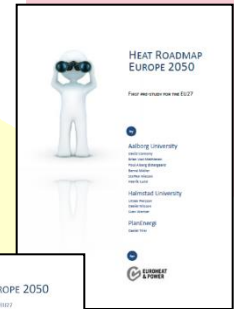
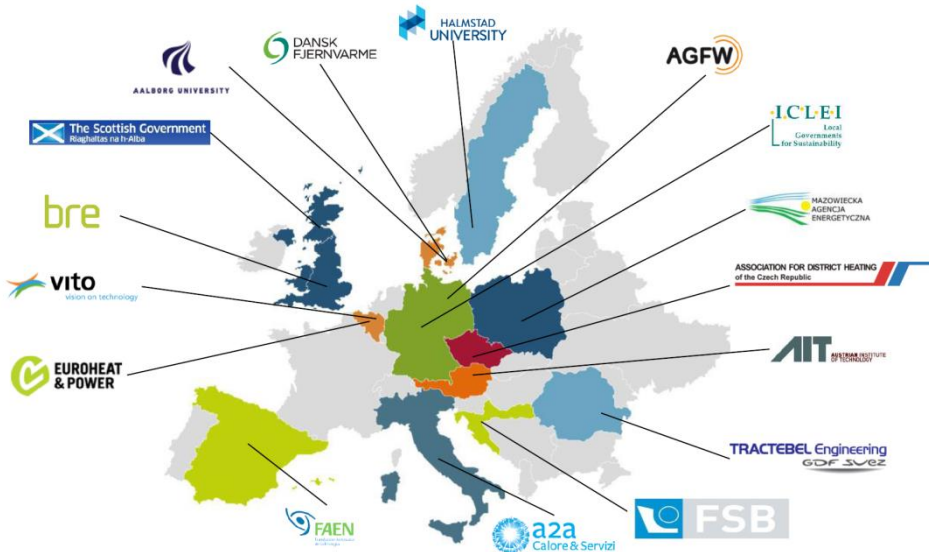
PlanEnergi  
 Daniel Trier

For

  
 EUROHEAT & POWER

# STRATEGO WP2

## Enhanced National Heating and Cooling Strategies



Co-funded by the Intelligent Energy Europe Programme of the European Union



**Heat Roadmap Europe**  
2050



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# 2<sup>nd</sup> International Conference on Smart Energy Systems and 4<sup>th</sup> Generation District Heating

26-29 September 2016 · Aalborg



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## Tuesday 27 September 2016 · Overall programme

08:00-09:00 Registration and breakfast "KEDELHALLEN" GROUND FLOOR, LEVEL 1

09:00-10:30 EUROPEAN DISTRICT HEATING DEVELOPMENTS - 1st plenary session chaired by Brian Vad Mathiesen

09:00 Opening speech by Henrik Lund

09:15 Plenary keynote by Paul Voss: 4DH and the European Energy Transition: A Match Made in Brussels?

09:45 Plenary keynote by David Connolly: Heat Roadmap Europe: Moving from European to Member State Heating and Cooling Strategies

10:15 Questions and discussion

PLENARY ROOM 6.1-6.3, LEVEL 6

10:30-11:00 Coffee break

ROOMS 6.1 and 6.3, LEVEL 6

Parallel sessions 1-5	11:00-12:30 ROOM 4.3.02, LEVEL 3 Session 1: Smart Energy Systems Chair: Anders Dyrelund Session keynote and co-chair: Fabian Levihn Katarzyna M. Luc Peter Sorknæs Peder Vejsig Pedersen Hongwei Li	11:00-12:30 ROOM 6.2, LEVEL 6 Session 2: Future district heating production and systems Chair: Anders N. Andersen Session keynote and co-chair: Stefan Holler Miika Rämä Kenneth Hansen Jan-Bleicke Eggers Patrick Reiter/Hannes Poier	11:00-12:30 ROOM 6.3, LEVEL 6 Session 3: Energy planning and planning tools Chair: Ralf-Roman Schmidt Session keynote and co-chair: Neven Duić Alessandro Capretti/Matteo Pozzi Ivar Baldvinsson Xavier Dubuisson Richard P. van Leeuwen	11:00-12:30 ROOM 6.1, LEVEL 6 Session 4: Low-temperature district heating grids Chair: Tom Diget Session keynote and co-chair: Steen Schelle Jensen Giorgio Bonvicini Robert Schneider Christian Engel Christian S. Jørgensen	11:00-12:30 ROOM 6.8, LEVEL 6 Session 5: Low-temperature district heating and buildings Chair: Dagnija Blumberga Session keynote and co-chair: Erik Ahlgren Yasameen Al-Ameen Peter Heßbrüggen Luyi Xu Jelena Ziemele
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12:30-13:30 Lunch

"KEDELHALLEN" GROUND FLOOR, LEVEL 1

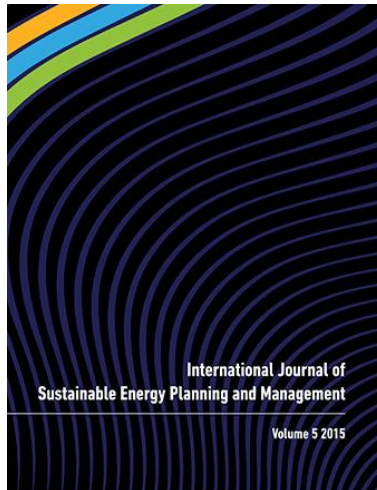
Parallel sessions 6-10	13:30-14:45 ROOM 4.3.02, LEVEL 3 Session 6: Smart Energy Systems Chair: Anders Dyrelund Session keynote and co-chair: Gorm B. Andresen Charlotte Marguerite Sebastian Bykuć David Drysdale	13:30-14:45 ROOM 6.2, LEVEL 6 Session 7: Future district heating production and systems Chair: Sven Werner Session keynote and co-chair: Oliver Martin-Du Pan Gunnar Lennermo Henrik Pieper Richard Büchele	13:30-14:45 ROOM 6.3, LEVEL 6 Session 8: Energy planning and planning tools Chair: Ingo Weidlich Session keynote and co-chair: Bernd Möller Lars Grundahl Malte Schwanebeck Pablo Puerto	13:30-14:45 ROOM 6.1, LEVEL 6 Session 9: Low-temperature district heating grids Chair: Carsten Bojesen Session keynote and co-chair: Peter Jorsal José Castro Flores Soma Mohammadi Sofia Akhlaghi/Sofia Carlson	13:30-14:45 ROOM 6.8, LEVEL 6 Session 10: Low-temperature district heating and buildings Chair: Svend Svendsen Session keynote and co-chair: Jan Eric Thorsen Maria Jangsten Martin Crane Xiaochen Yang
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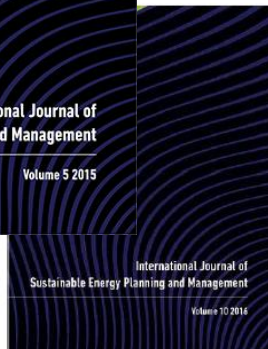


# Paper-flow: 2 Special Issues



Special Issue with Papers Based on Abstracts from the First International Energy Systems and 4<sup>th</sup> Generation District Heating in 2015

International Journal of Sustainable Energy Planning and Management, Vol 10 (2016)

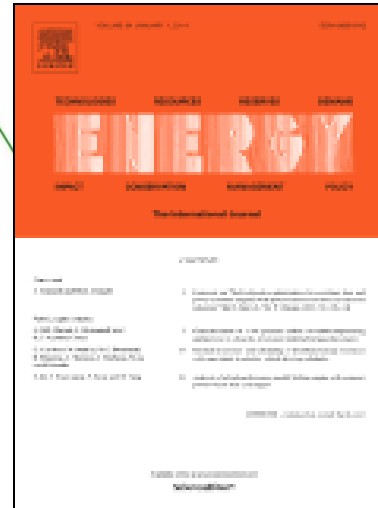


*Smart energy systems and 4th generation district heating*  
Poul Alberg Østergaard, Henrik Lund, Brian Vad Mathiesen

*Comprehensive Assessment of the Potential for Efficient District Heating and Cooling and for High-Efficient Cogeneration in Austria*  
Richard Büchele, Lukas Kranzl, Andreas Müller, Marcus Hummel, Michael Hartner, Yvonne Deng, Marian Bons

*A genetic algorithm technique to optimize the configuration of heat storage in DH networks*  
Amru Rizal Razani, Ingo Weidlich

*Smart energy systems applied at urban level: the case of the municipality of Bressanone-Brixen*  
Matteo Giacomo Prina, Marco Cozzini, Giulia Garegnani, David Moser, Ulrich Filippi Oberegger, Roberto Vaccaro, Wolfram Sparber



Special Issue Volume 110 (1 September 2016)  
on Smart Energy Systems and 4th Generation District Heating

*Smart energy systems and 4th generation district heating*  
Henrik Lund, Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen

*Smart energy systems and 4th generation district heating*  
Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen

*Linking heat and electricity in the transition towards future Smart Energy Systems*  
Henrik Lund, Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen, Gianluigi Lo Basso

*Impact of grid-orientated distributed cogeneration on the minutes reserve market and the operating mode impacts on CO2 emissions*  
Henrik Lund, Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen, Arjuna Nebel

*Optimization of multi-generation systems for designing flexible multi-generation systems*  
Henrik Lund, Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen, Marie Münster, Fredrik Haglund

*Impact of the constraints and potential contributions regarding wind curtailment in district heating*  
Henrik Lund, Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen, Xiliang Zhang

*Optimization of substations for low-temperature district heating with no Legionella risk, and low temperatures*  
Henrik Lund, Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen, Xiliang Zhang

*Optimization of substations for low-temperature district heating with no Legionella risk, and low temperatures*  
Henrik Lund, Neven Duic, Poul Alberg Østergaard, Brian Vad Mathiesen, Xiliang Zhang

*Replacing critical radiators to increase the potential to use low-temperature district heating – A case study of 4 Danish single-family houses from the 1930s*  
Dorte Skaarup Østergaard, Svend Svendsen

*System dynamics model analysis of pathway to 4th generation district heating in Latvia*  
Jelena Ziemele, Armands Gravelsins, Andra Blumberga, Girts Vigants, Dagnija Blumberga

*Complex thermal energy conversion systems for efficient use of locally available biomass*  
Jacek Kalina

*Current and future prospects for heat recovery from waste in European district heating systems: A literature and data review*  
Urban Persson, Marie Münster

*Mapping of potential heat sources for heat pumps for district heating in Denmark*  
Rasmus Lund, Urban Persson

*Industrial surplus heat transportation for use in district heating*  
J.N.W. Chiu, J. Castro Flores, V. Martin, B. Lacarrière

*European space cooling demands*  
Sven Werner

*Optimal planning of heat supply systems in urban areas*  
Valery A. Stennikov, Ekaterina E. Iakimetc

*Ringkøbing-Skjern energy atlas for analysis of heat saving potentials in building stock*  
Stefan Petrović, Kenneth Karlsson



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# Awards for Best Presentation Junior and Senior



# Sponsors




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1: Nordkraft, conference

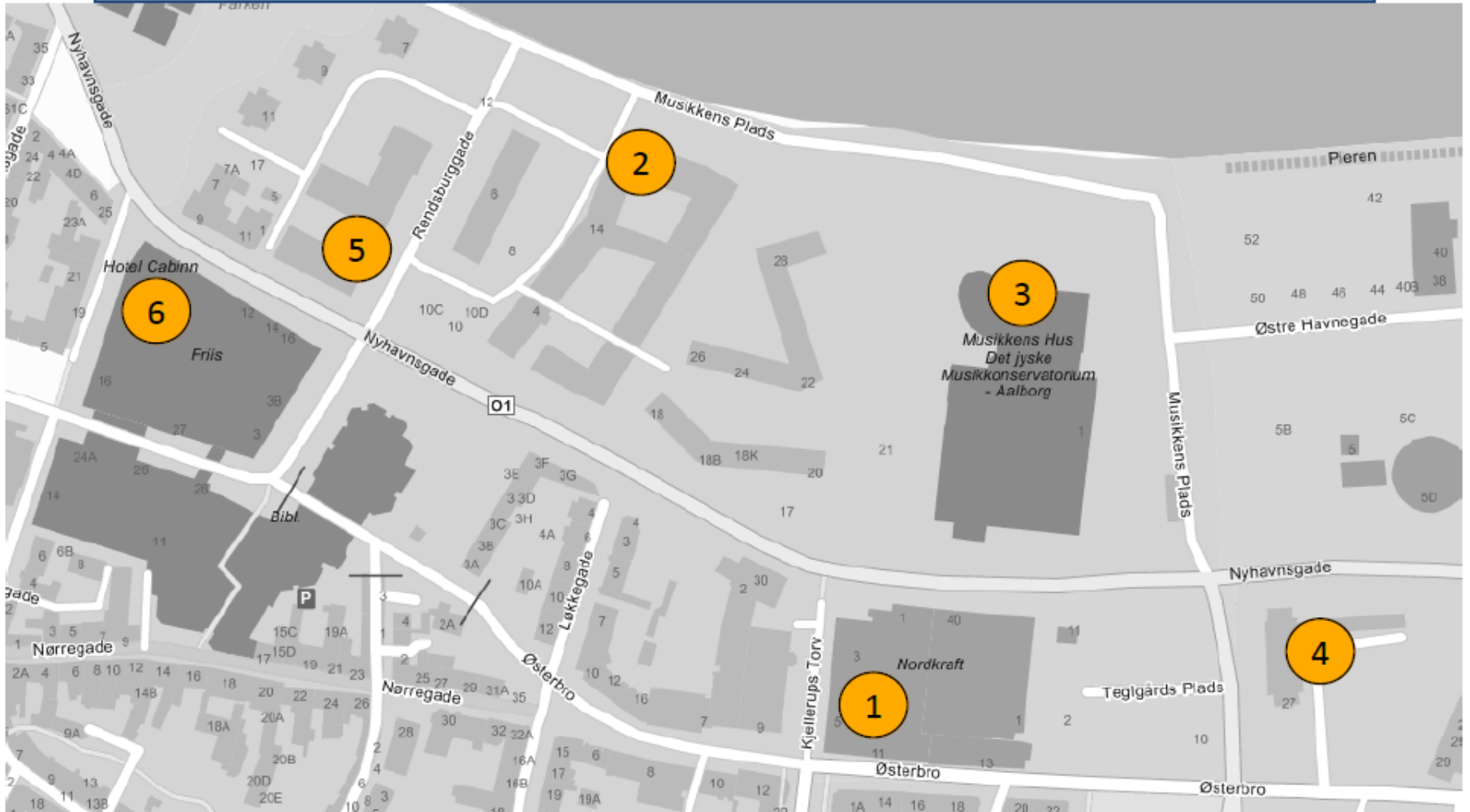
2: Auditorium 3.107, video premiere

3: Musikkens Hus, conference dinner

4: Hotel Aalborg

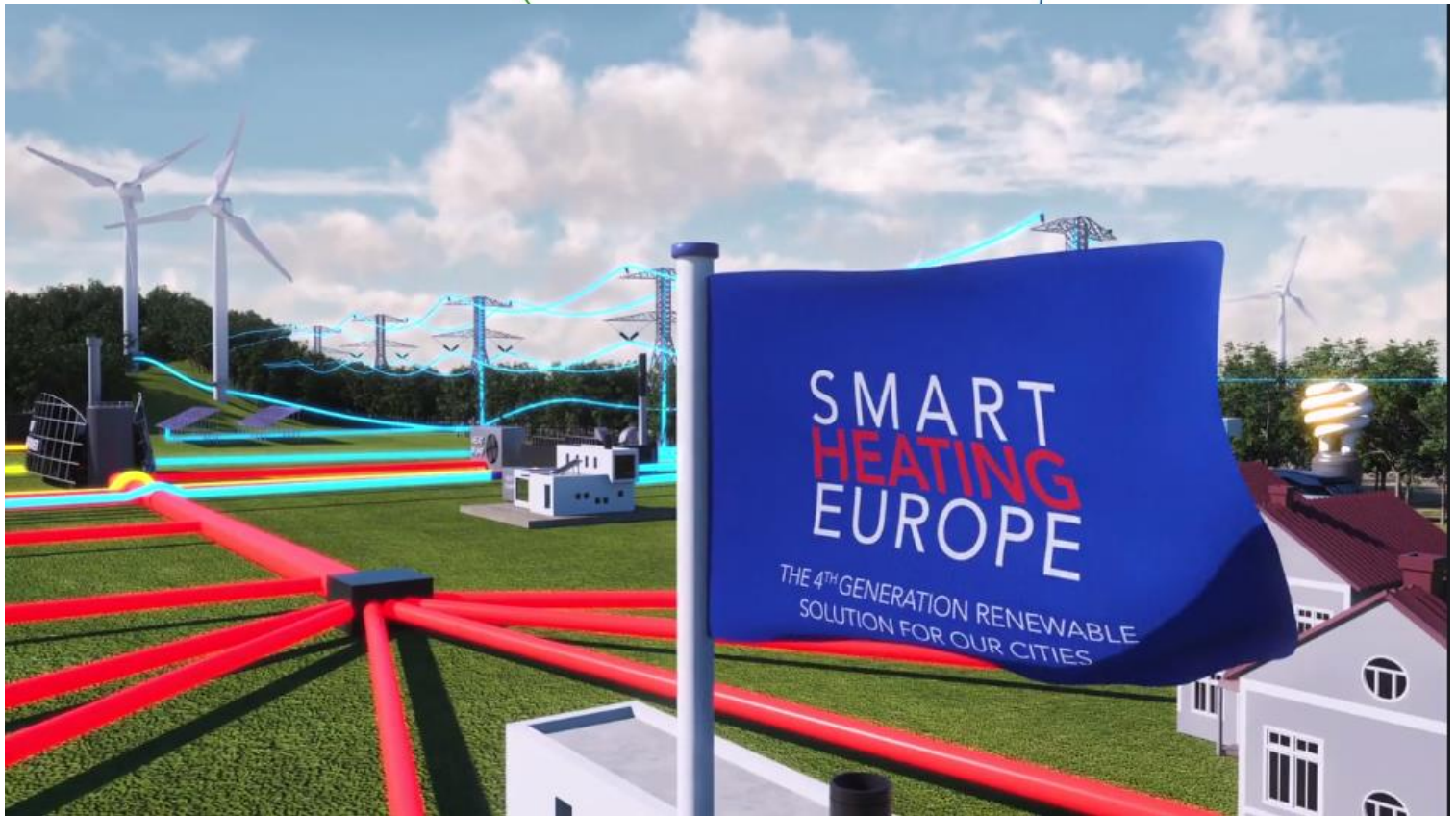
5: First Hotel Aalborg

6: CABINN Aalborg Hotel





# New Video: World Launch



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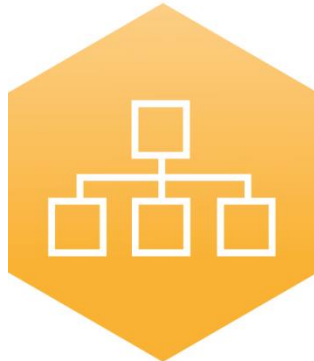
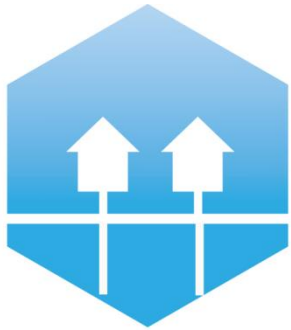
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Next year:

3rd International Conference on  
**Smart Energy Systems and  
4<sup>th</sup> Generation District Heating**  
12-13 September 2017 · Copenhagen



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Location: The National Museum in Copenhagen



See more and sign up at  
[www.4dh.dk/conferences](http://www.4dh.dk/conferences)



  
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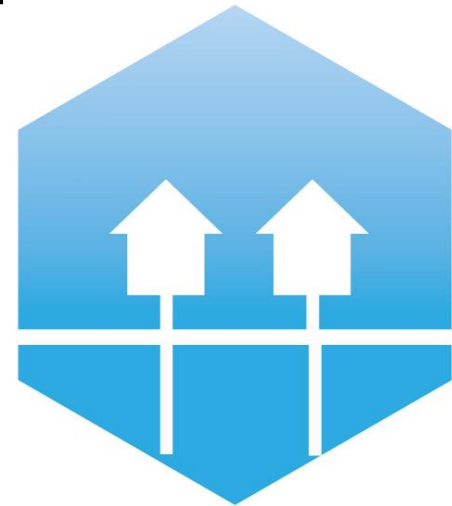
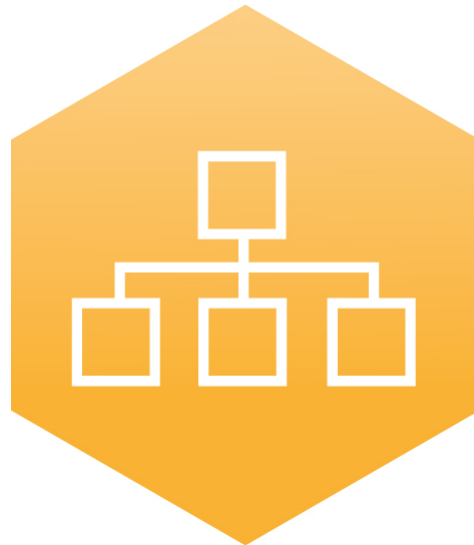
# Smart Energy Systems and 4<sup>th</sup> Generation District Heating

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# Thank you!



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