

第8回スマートエネルギー・第4世代地域熱供給国際会議  
8th International Conference on Smart Energy Systems  
(2022年9月13日～14日 ハイブリッド開催)  
概要報告

特定非営利活動法人 環境エネルギー政策研究所

松原弘直

2023年3月27日

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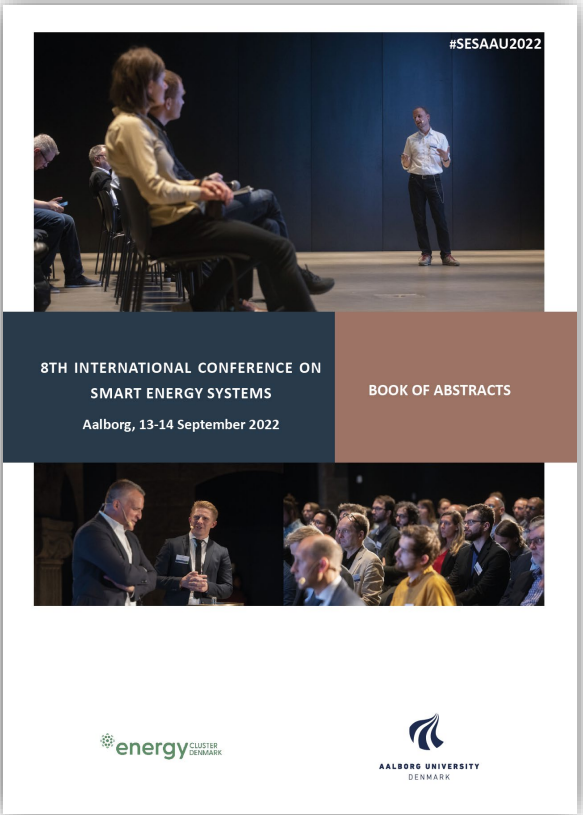
# 第8回スマートエネルギー・第4世代地域熱供給国際会議 2022年9月13日～14日(ハイブリッド開催)全体概要

## 8<sup>th</sup> International Conference on Smart Energy Systems

- スマートエネルギーシステム
- 第4世代地域熱供給
- 蓄エネルギー
- 再生可能エネルギー
- エネルギー効率化
- 電化

参加者：203名(リアル)+26名(オンライン)  
参加国：23カ国  
発表数：133

<https://smartenergysystems.eu/2022-2/>



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# 第8回スマートエネルギー・第4世代地域熱供給国際会議 全体セッション1(2022年9月12日)

“8<sup>th</sup> International Conference on Smart Energy Systems”

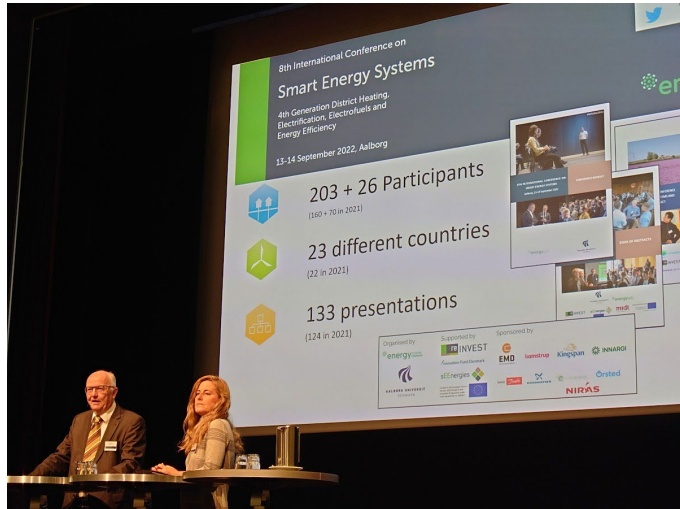
開会スピーチ：Henrik Lund(オールボー大学)&Glenda Napier(ECD)

基調講演1:Jesper Møller Larsen 「オールボー地域熱供給のグリーン化」

基調講演2:David Dupont-Mouritzen 「Power-to-Xによるグリーン転換」

基調講演3:Samir Abboud 「地域熱供給における地熱利用」

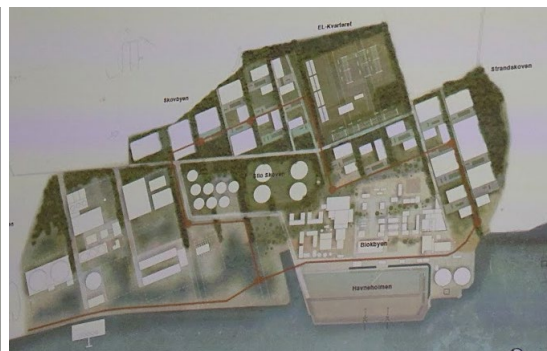
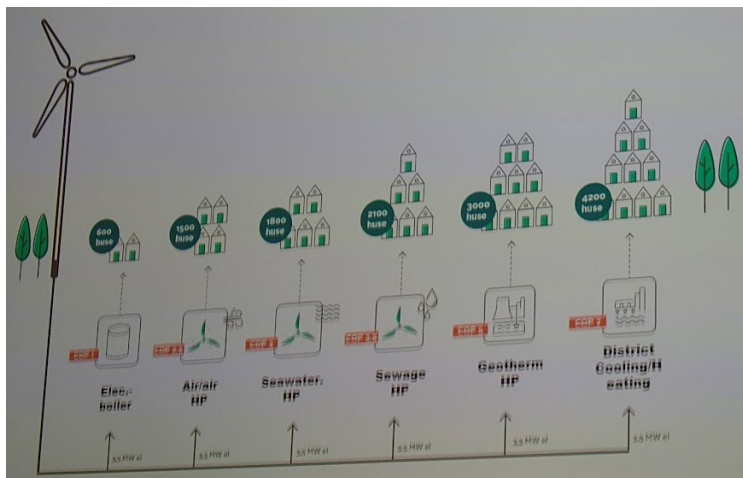
基調講演4:Sven Werner 「地域冷房の4世代と将来展望」



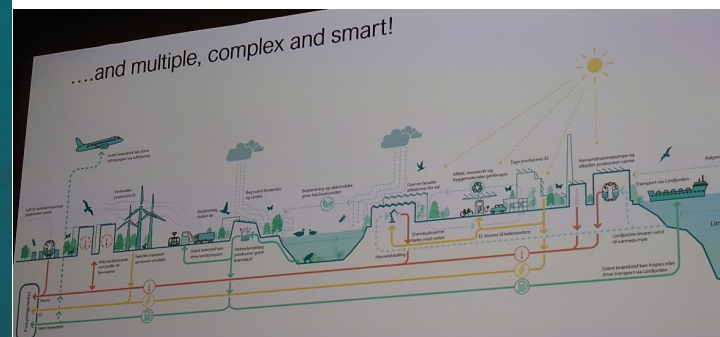
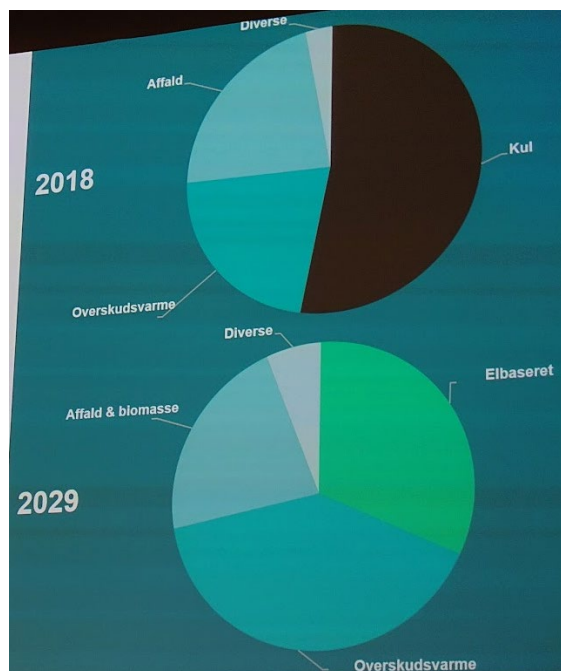
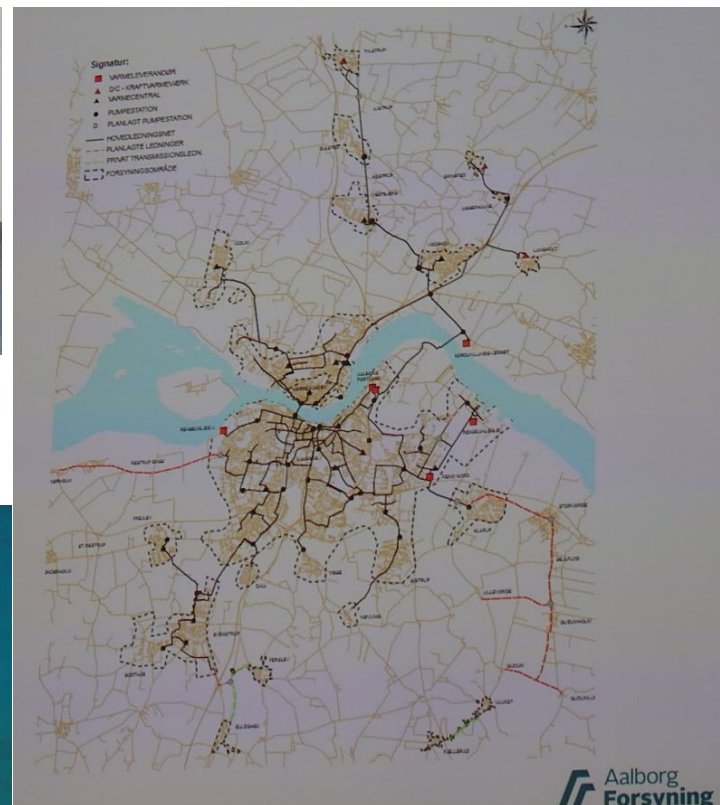


# 全体セッション1: 基調講演1

## Jesper Møller Larsen「オールボー地域熱供給のグリーン化」



Norbis Park



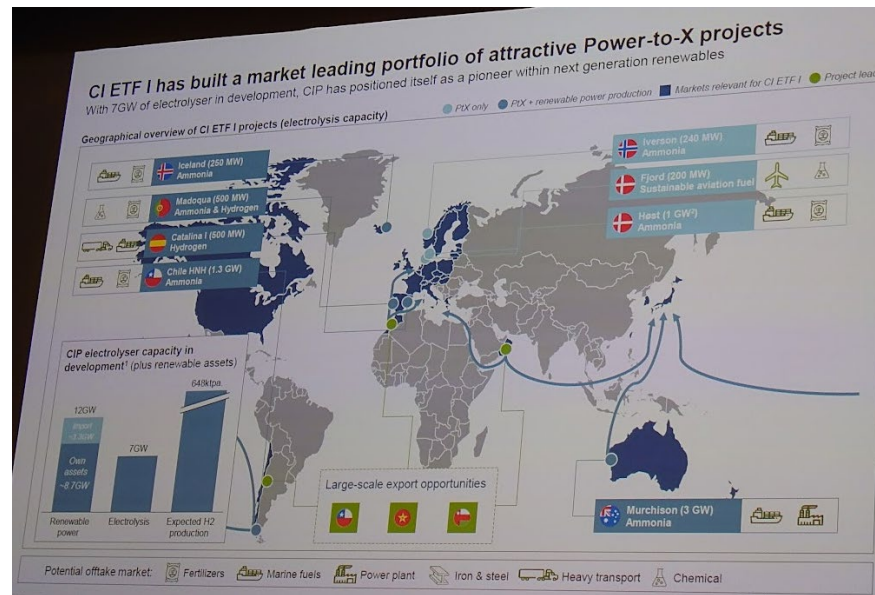
出所: オールボー地域熱供給

- オールボー市の自然エネルギー戦略2017
  - 石炭CHPを2028年までに廃止
  - 2050年までの脱化石燃料
- 達成方法:
  - 排熱利用の増加
  - 大規模な蓄熱槽の導入(柔軟性)
  - 新技術の実証と利用
  - 多様な技術の統合
  - スマートエネルギーシステム



# 全体セッション1: 基調講演2

# David Dupont-Mouritzen「Power-to-Xによるグリーン転換」



CI ETF I プロジェクトの全体像

### Decarbonisation of the shipping industry

**Potential for ammonia-driven ships**

- Since 1990 the shipping industry has increased CO<sub>2</sub> emission by 32% (EU)
- EU Parliament aims to reduce CO<sub>2</sub> emissions by 40% before 2030
- Starting in 2022 marine transport will be part of EUs Emission Trading System (ETS)

**Potential for ammonia as fuel**

- Ammonia is carbon-free and will not release CO<sub>2</sub> when burned off as motor fuel
- NOx can be removed from exhaust using SCR technology
- A stable large-scale production based on air, water and sustainable energy

Logos: MAERSK, DFDS, WARTSILA, Eidesvik, CIP

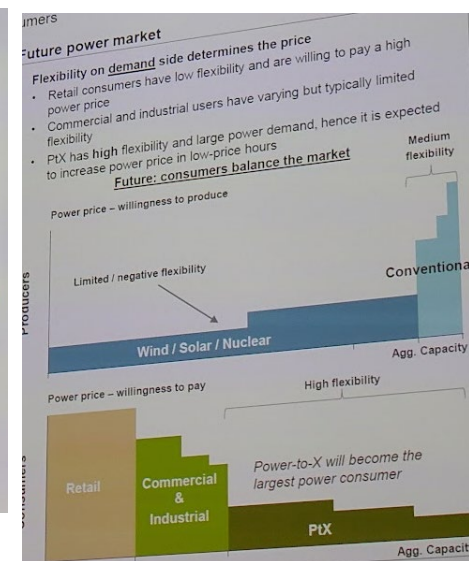
### Sector linkage – heat / cooling / water

**Sector linkage and synergies**

- CO<sub>2</sub>-free district heating for +15,000 households annually
- Cooling via water in same solution
- Local CO<sub>2</sub> reduction of approx. 40,000t annually
- Water for electrolysis process from waste water and technical water as back up

**CO<sub>2</sub>-reductions and energy optimization**

Logos: DIN FORSYNING



# 第8回スマートエネルギー・第4世代地域熱供給国際会議 特別セッション

## 1. Heat 4.0

## 2. RewardHeat

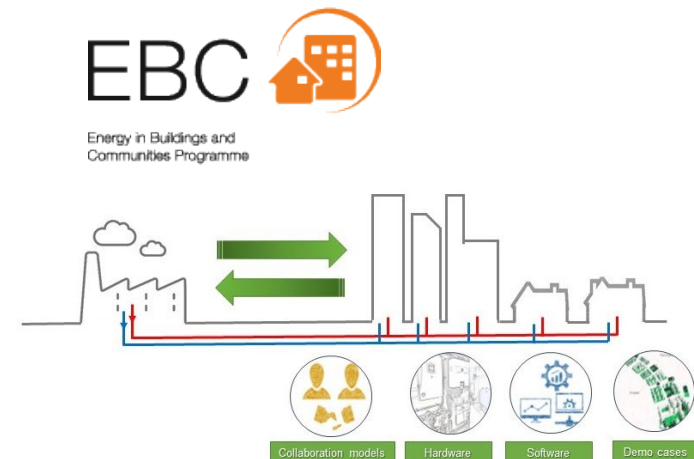
Technologies and management strategies of low- and neutral-temperature district heating and cooling grids

## 3. IEA DHC Annex TS4

Digitalisation of District Heating and Cooling

## 4. IEA EBC Annex 84

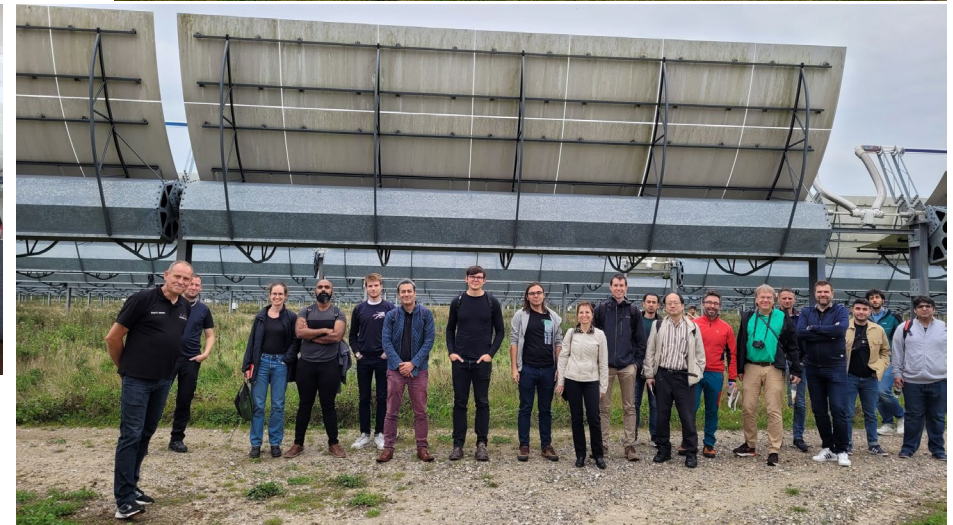
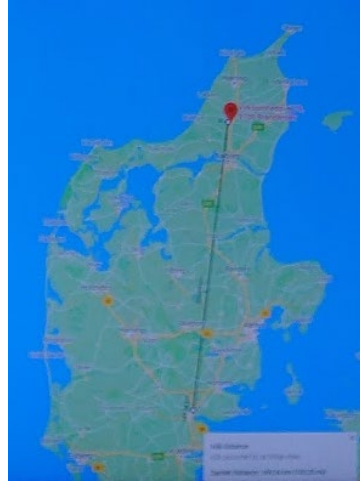
Demand Management of Buildings in Thermal Networks





# 第8回スマートエネルギー・第4世代地域熱供給国際会議 テクニカルツアー(1):Broenderslev 地域熱供給(Solar+Biomass)

## 太陽熱+バイオマスCHPによる自然エネルギー100%地域熱供給





# テクニカルツアー(1):Broenderslev 地域熱供給 太陽熱+バイオマスCHPによる自然エネルギー100%地域熱供給

## Distribution of district heating:

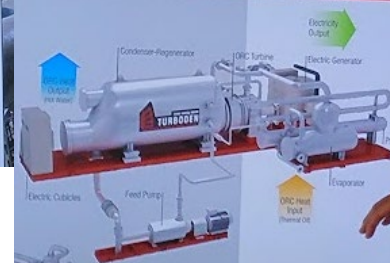
- 7 km. transmission lines
- 90 km. distribution lines
- 70 km. supply lines
- Volume: 2.000 m<sup>3</sup>



## Biomass – power plant – 2018/2021

### Biomass power plant:

- 2 x wood chip boilers: input 200 t/day => 20 MW heat into heat transfer fluid by exhaust gas of 950°C
- 2 x heat pumps for cooling exhaust gas to 12°C => 2,2 MW heat
  - Moist in woodchip 42% = 420 kg water/steam pr. 1 ton woodchips



## バイオマスプラント

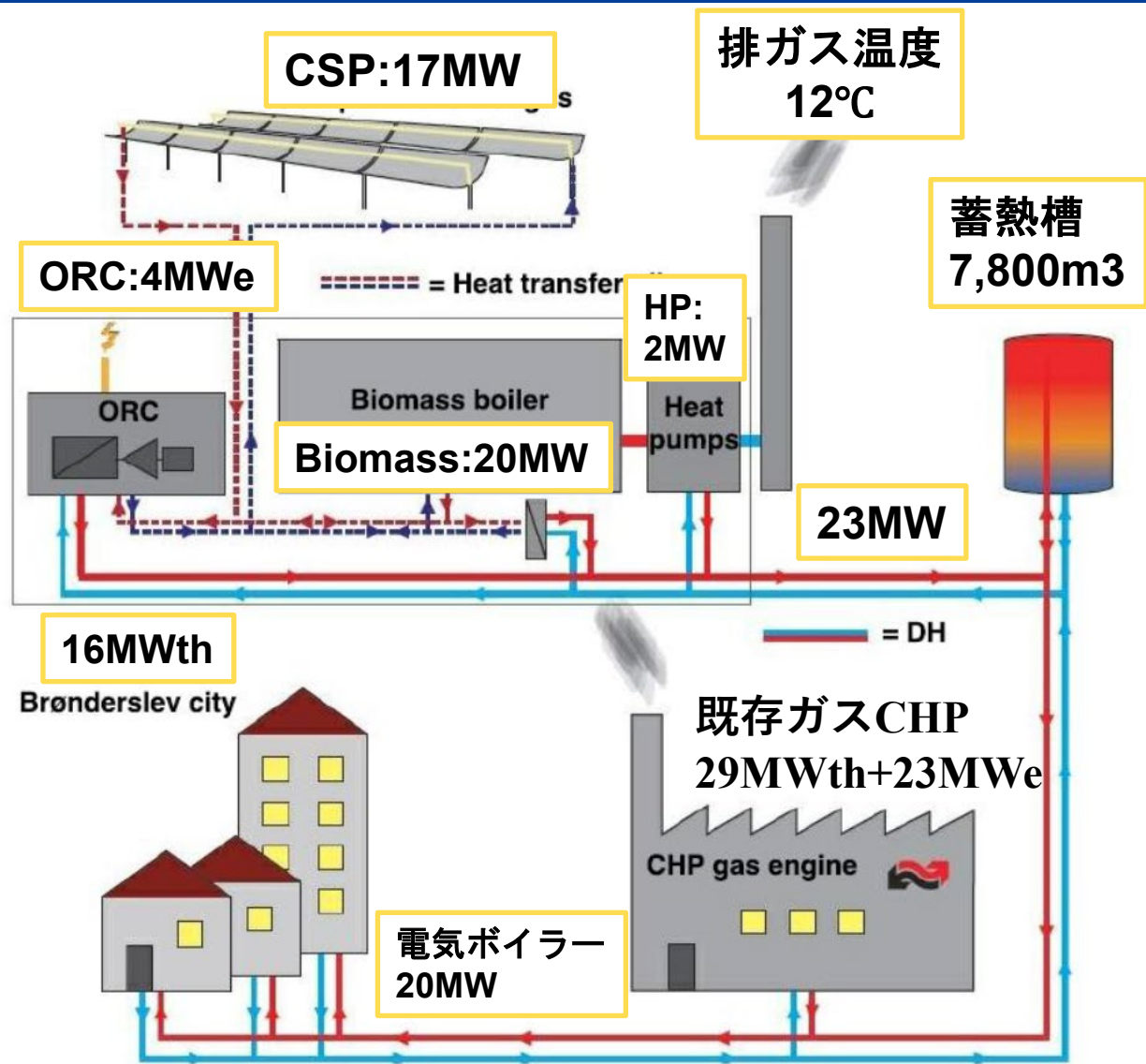
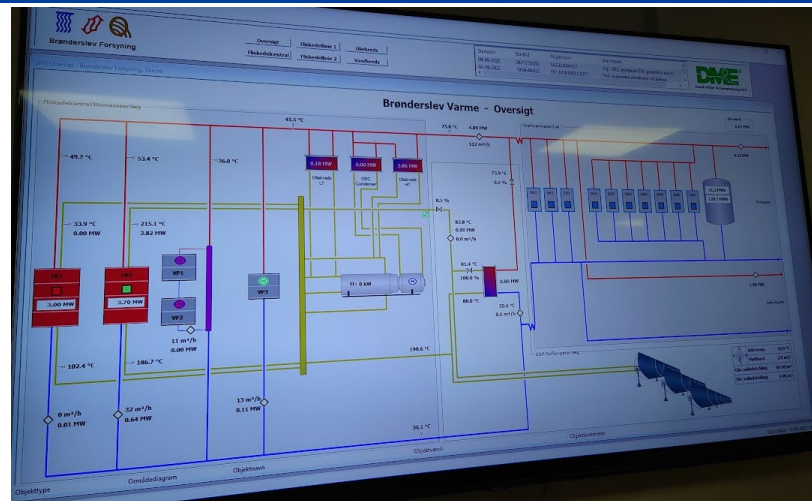
- ボイラー出力: 20MW(200t/d)
- ORC: 4MWe + 16MWth
- 潜熱回収HP: 2.2MWth
- 合計出力23MWth(熱効率114%)

## 太陽熱(CSP)プラント

- 集熱器 延長5km
- 27,000m<sup>2</sup>
- 出力:17MW
- 熱媒: Therminol 66



# テクニカルツアー(1): ORCによるCHPの最新事例 デンマーク北部Brønderslev町でのスマート地域熱供給



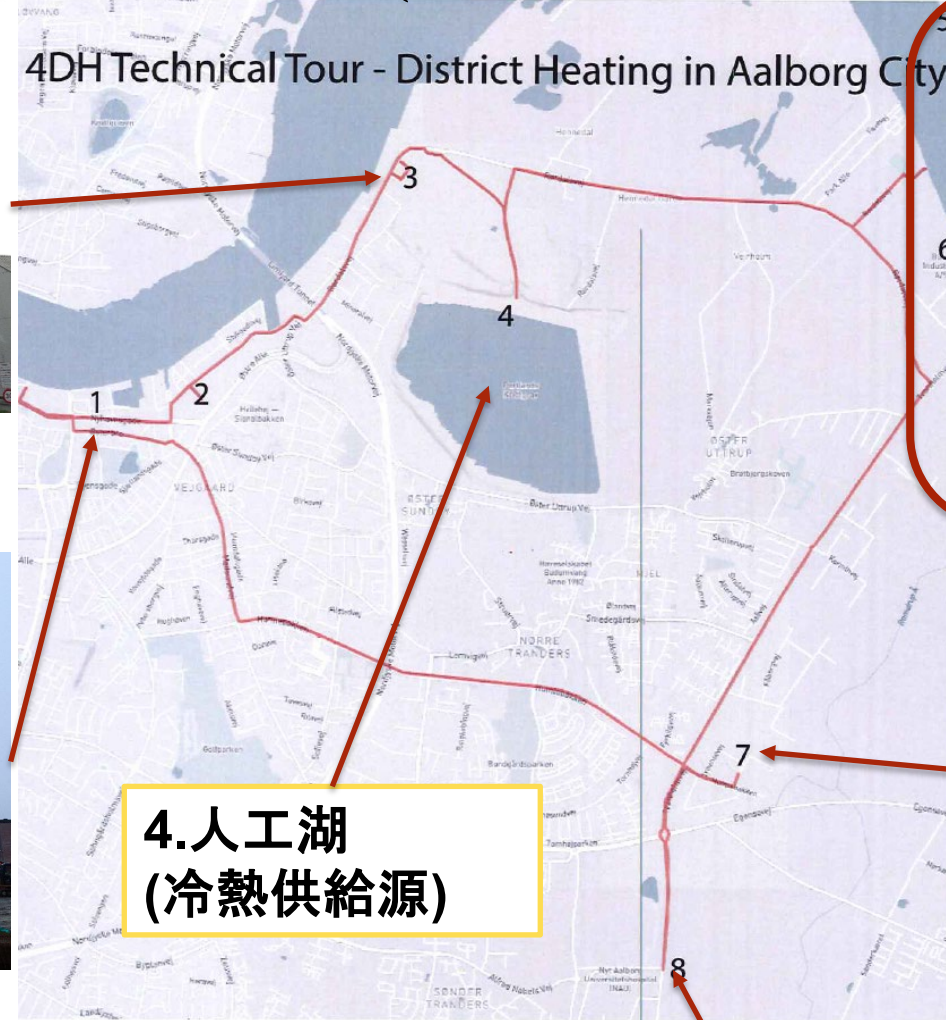
最大熱需要40MW(4600ユーザー)



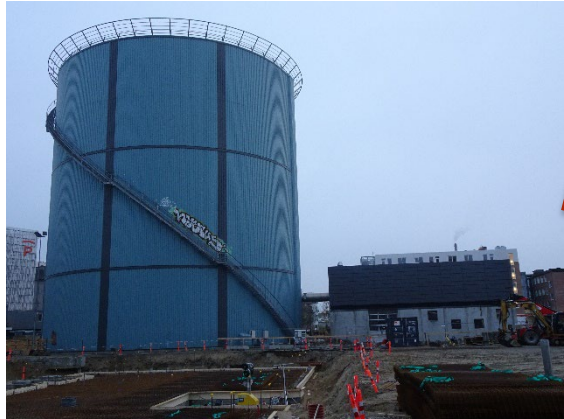
# テクニカルツアー(2): オールボー地域の地域熱供給システム

## オールボー地域熱供給会社 (34000ユーザー、最大需要800MW)

4DH Technical Tour - District Heating in Aalborg City



3.セメント工場の排熱  
(DHの約20%を供給)



1. 蓄熱槽(1.2万m3)と  
ポンプ室



5.石炭火力CHP(500MW)  
DHの約50%を供給



7.廃棄物CHP(60MW)  
DHの約25%を供給

4.人工湖  
(冷熱供給源)

8.大学病院  
(新規需要先)



# テクニカルツアー(2): オールボー地域熱供給の脱炭素化ロードマップ

- 2028年までの石炭CHPの廃止
- 2050年までの脱化石燃料(脱炭素化)

120 MW sea water heat pump (put out to tender)

海水熱源  
ヒートポンプ(120MW)

Increase in surplus heat from Aalborg Portland, PtX and others

排熱利用(セメント工場, PtX施設など)

Purchase of windmills and solar heating

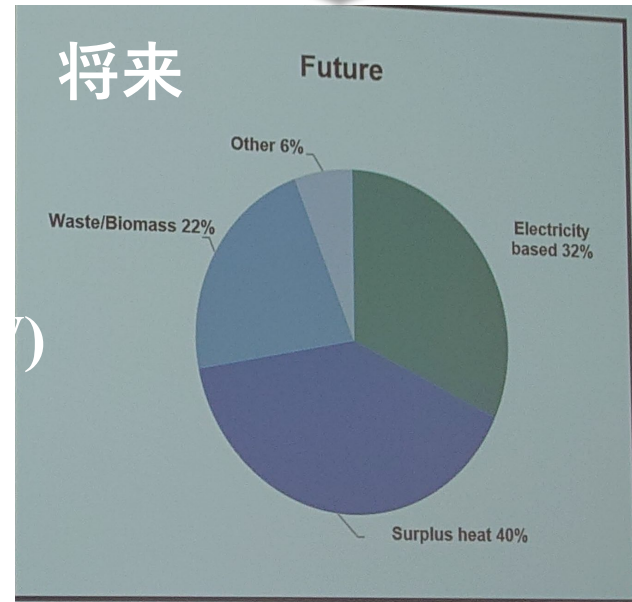
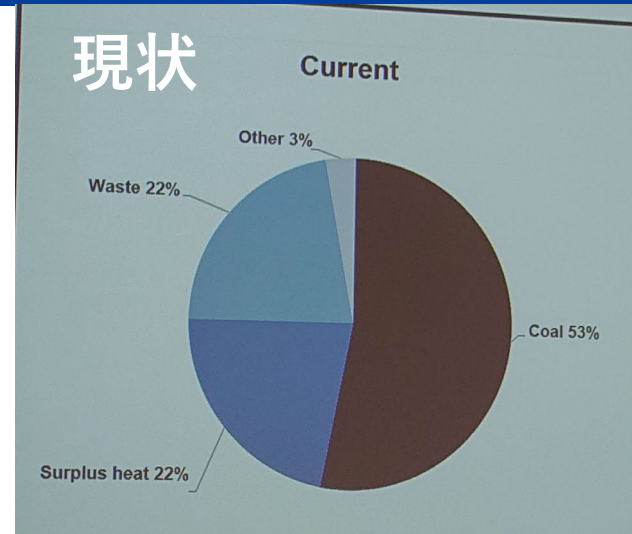
再エネ余剰電気

200,000 m3 storage tank (put out to tender)

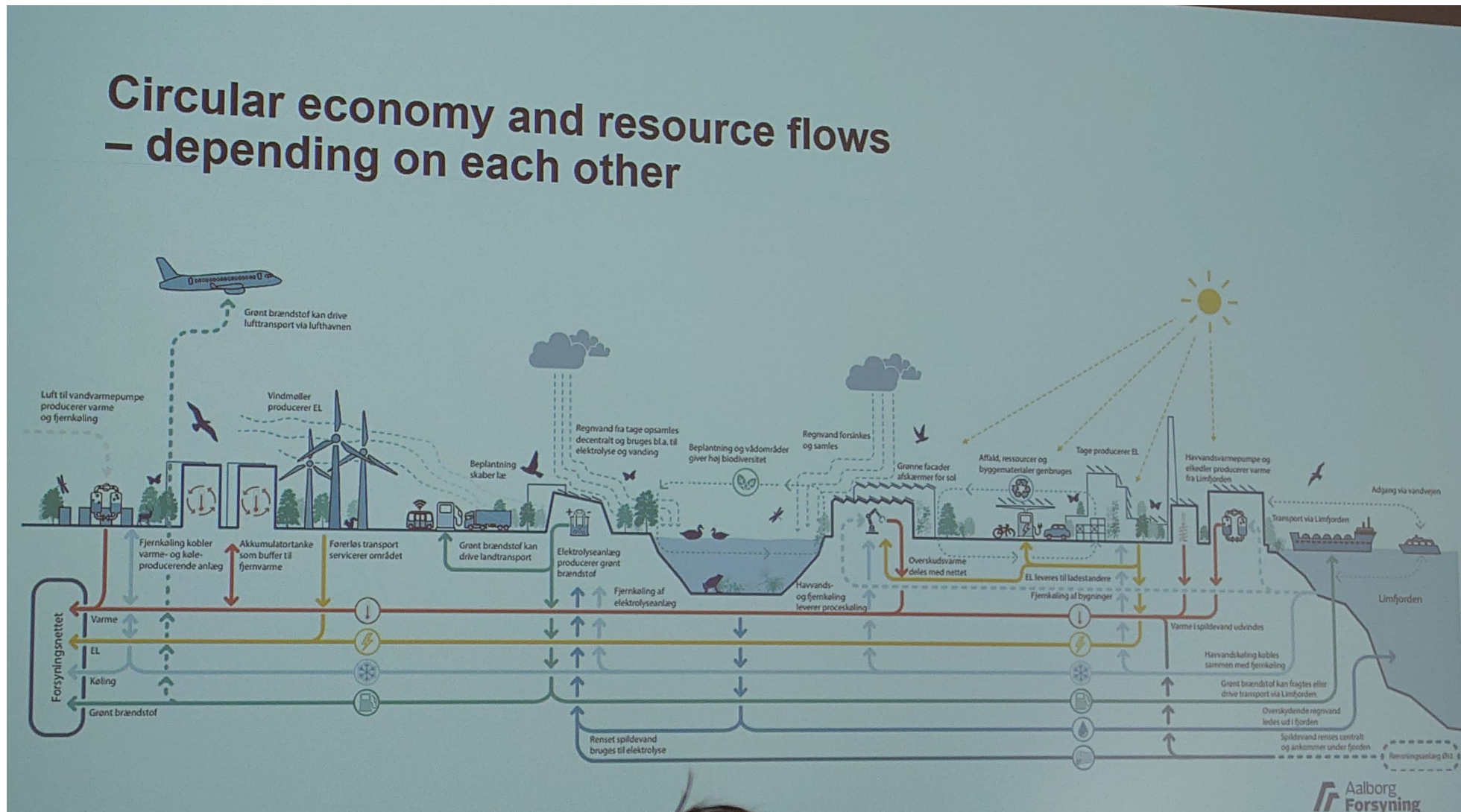
蓄熱槽(20万立米)

150 MW boiler (put out to tender)

電気ボイラー(150MW)



# テクニカルツアー(2): オールボー地域熱供給: 脱炭素化のフロー・イメージ





# テクニカルツアー(2): オールボー地域の地域熱供給システム

**Norbis Park: Facilitating development and testing, Business development, Partnership, Communicating knowledge and results, Symbiosis**



- Aalborg Utilities
- Vattenfall
- Kyoto Group
- Fjord PtX



# テクニカルツアー(2): オールボー地域の地域熱供給システム: 石炭CHP

- DHの約50%の熱を供給する石炭火力CHP(400MWe+400MWth)
- 2028年までに廃止予定



3号機のみ稼働中

STEAM TURBINE	
TYPE	STEAM DATA, 100% LOAD, COND. MODE
SERIAL NO./YEAR	VHP STEAM FLOW
GENERATOR POWER, COND. MODE	410.8 MW
GENERATOR POWER, BACK PRESS. MODE	339.6 MW
DISTRICT HEATING, BACK PRESS. MODE	422 MJ/S
DISTRICT HEATING, TEMPERATURES	38-45°C/75-99°C
SPEED	3000 rpm
SPEC. HEAT CONSUMPTION, 100% LOAD, COND.	6736.6 kJ/kWh
	CONDENSER PRESS.



# テクニカルツアー(2): オールボー地域の地域熱供給システム:蓄熱システム(実証中)

- Heatcube: 導入中の蓄熱システム(5,000MWh/年)
- 設備容量18MWh (出力5MW)

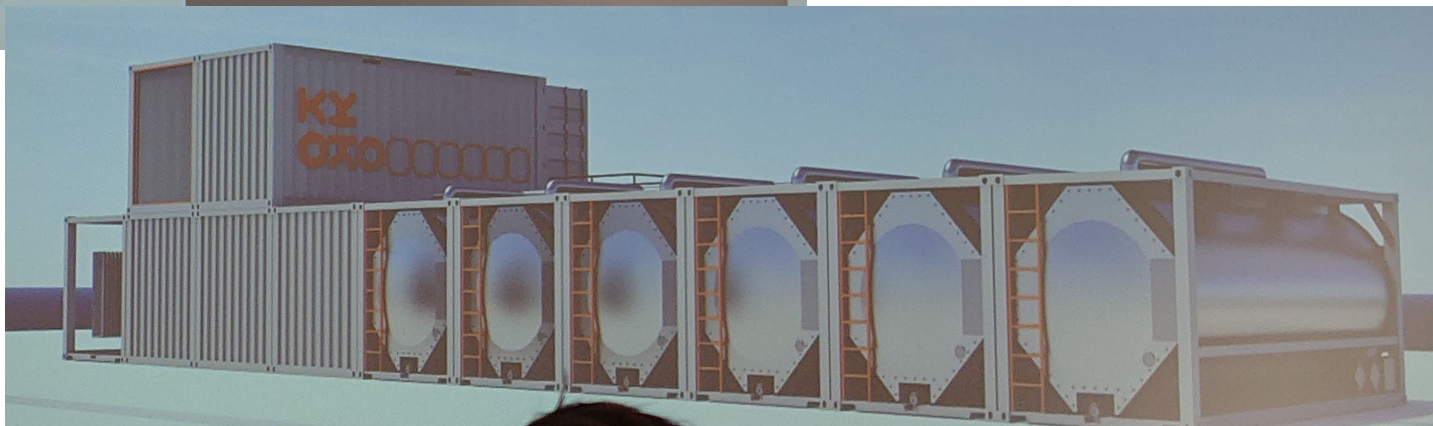
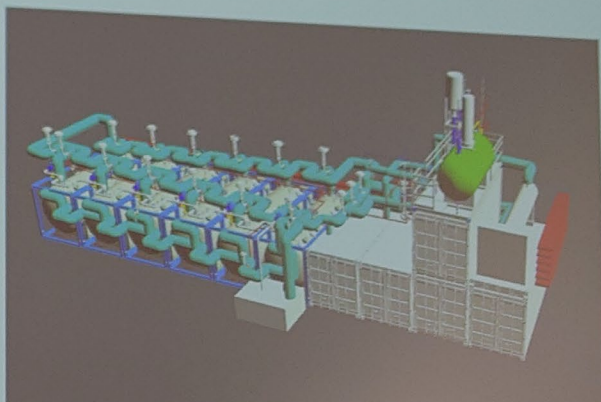
## Kyoto - HeatCube

### Overall purpose

Use the varying prices on electricity by warming a saline solution up to 150-450°C when the price is low and to use this heat when it is necessary to produce district heating.

### HeatCube consists of:

- 6 storage tanks containing 25 tonnes in each
- 5 containers for the steam generator, heat exchanger and a salt warmer.
- 1 bygning til transformer and electrical equipment





# テクニカルツアー(2): オールボー地域の地域熱供給システム: PtXシステム(計画中)

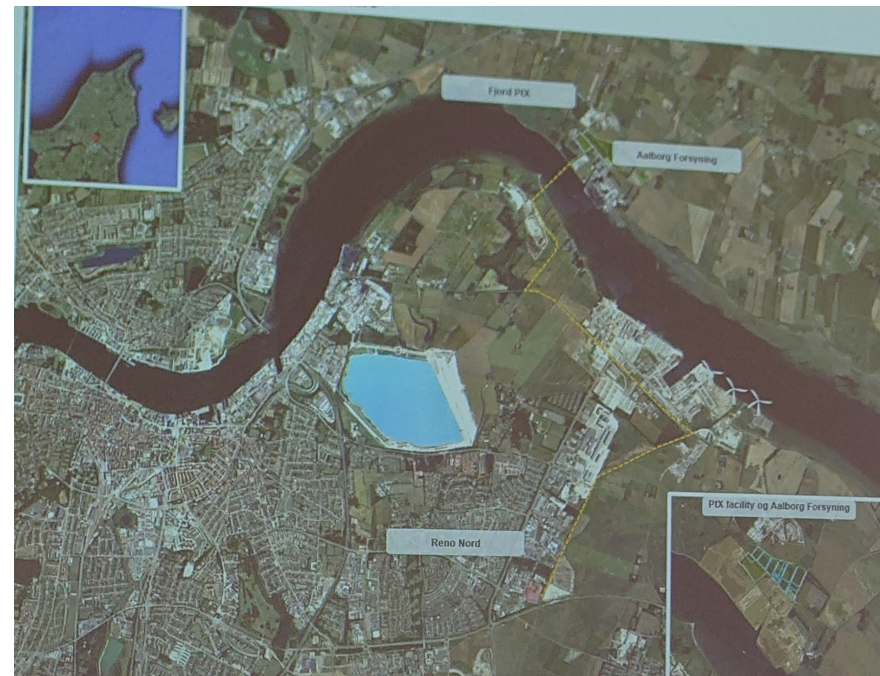
## Fjord PtXプロジェクト

### 年間生産量

- グリーン・e-メタノール: 13万トン/年
- 年間130GWhの排熱(オールボーDH熱需要の7%)
- CO<sub>2</sub>(18万トン/年)を再利用

### メリット

- 廃棄物焼却時のCO<sub>2</sub>を再利用
- 20~50MWの排熱利用
- 化石燃料をグリーンな合成燃料に転換
- “Green Test Centre”への誘致
- 50名の新たな雇用
- 柔軟な発電への対応
- プロセスでO<sub>2</sub>が発生(利用可能)





# 第9回スマートエネルギー国際会議(2023年9月) 9th International Conference on Smart Energy Systems

2023年9月12日～13日(コペンハーゲン・デンマーク)  
<https://smartenergysystems.eu/>

9<sup>TH</sup> INTERNATIONAL CONFERENCE  
ON SMART ENERGY SYSTEMS  
12-13 September 2023  
Copenhagen



Save the date!

## 9th International Conference on Smart Energy Systems

4th Generation District Heating,  
Electrification, Electrofuels and  
Energy Efficiency

12-13 September 2023  
Copenhagen



#SESAAU2023

We invite researchers and experts from industry and business to contribute to further enhancing the knowledge of smart energy systems, 4th generation district heating, electrification, electrofuels, and energy efficiency.

The Smart Energy System concept is essential for cost-effective 100% renewable energy systems. The concept includes a focus on energy efficiency, end use savings and sector integration to establish energy system flexibility, harvest synergies by using all infrastructures, lower energy storage cost as well as to exploit low-value heat sources.

As opposed to, for instance, the smart grid concept, which takes a sole focus on the electricity sector, the smart energy systems approach includes the entire energy system in its identification of suitable energy infrastructure designs and operation strategies. Focusing solely on the smart electricity grid often leads to the definition of transmission lines, flexible electricity demands, and electricity storage as the primary means of dealing with the integration of fluctuating renewable sources. However, these measures are neither very effective nor cost-efficient considering the nature of wind power and similar sources. The most effective and least costly solutions are to be found when the electricity sector is combined with the heating and cooling sectors and/or the transport sector. Moreover, the combination of electricity and gas infrastructures may play an important role in the design of future renewable energy systems, and the electrification of heating and transport – possibly through electrofuels – can play a pivotal role in providing flexibility and ensuring renewable energy integration in all sectors.

In future energy systems, energy savings and 4th generation district heating can be combined, creating significant benefits. Low-temperature district heat sources, renewable energy heat sources combined with heat savings represent a promising pathway as opposed to individual heating solutions and passive or energy+ buildings in urban areas. Electrification in combination with district heat is a very important driver to eliminate fossil fuels. Power heat, power to gas and power to liquid together with energy efficiency and 4th generation district heating create a flexible smart energy system. These changes towards integrated smart energy systems and 4th generation district heating also require institutional and organisational changes that address the implementation of new technologies and enable new markets to provide feasible solutions to society.

### Important dates 2023

14 April	<b>Deadline for submission of abstracts</b> (Additional upgrade to paper after the conference is optional)
24 April	<b>Reply on acceptance of abstracts</b>
24 April - 31 May	<b>Early registration</b>
1 June - 10 August	<b>Normal registration</b>
12 - 13 September	<b>Conference</b>

# CALL FOR ABSTRACTS

### Topics

Smart energy system analyses, tools and methodologies

Smart energy infrastructure and storage options

Integrated energy systems and smart grids

Institutional and organisational change for smart energy systems and radical technological change

Energy savings, in the electricity sector, in buildings and transport as well as within industry

4th generation district heating concepts, future district heating production and systems

Electrification of transport, heating and industry

The production, technologies for and use of electrofuels in future energy systems

Planning and organisational challenges for smart energy systems and district heating

Geographical information systems (GIS) for energy systems, heat planning and district heating

Components and systems for district heating, energy efficiency, electrification and electrofuels

Renewable energy sources and waste heat sources for district heating

### Conference fees

Early registration (for presenters with accepted abstracts):

- 375 EUR (attendance in Copenhagen)
- 275 EUR (virtual attendance)

Normal fee:

- 475 EUR (attendance in Copenhagen)
- 375 EUR (virtual attendance)

Additional fee for conference dinner (CPH): 100 EUR