# R&D needs for large heat pumps

## and district heating and cooling

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AGFW | Energy efficiency association for heating, cooling and CHP

www.agfw.de

# Real laboratory on large heat pumps (LHP) in district heating

- **8 network partners coordinated by AGFW**
  - Construction, operation and analysis of 44 MW LHP
- **Project duration: 04.2021 - 03.2026**
- **Project volume: € 45 million of which € 21 million are funding**
- **LHP Power: 1.1 MW - 22 MW**
- **Refrigerants: ammonia & R1234ze**
- **Goal: Facilitate market ramp-up of LHP in Germany**

# Why real labs?

» **Successful implementation of the energy transition requires extensive practical knowledge**

- There is little detailed data available on the practice of newer technologies in Germany.
- In particular, the interfaces from law / technology and the environment have not been sufficiently researched

→ Real labs = systematic development of know-how in all relevant areas from idea to implementation

→ Real labs = prototypes for building blocks of the energy transition

# R&D questions of the real lab on large heat pumps

» **Economic and regulatory framework conditions?**

- adaptation of existing regulations? (regulatory learning)

» **Particularly efficient operating concepts of large heat pumps in heat grids?**

- prerequisites and monitoring concepts for minimizing GHG emissions?

» **How can large heat pumps in heat grids make an optimal contribution to sector coupling?**

# General R&D needs for LHP

» **Optimal integration of LHP into the overall energy system**

- minimizing greenhouse gas emissions
- minimizing cost
- minimizing resource consumption

» **Regulatory learning**

- adaptation of national and international legal frameworks to support optimal integration of LHP
- simplification of legal requirements for faster deployment

» **Power market research**

- ensure LHP use additional green electricity
- avoid LHP extending fossil fuel use
- optimal operational integration

# General R&D needs for LHP

- **Adaptation of district heating and cooling networks to LHP characteristics**
  - reducing required temperatures
  - integrating more excess heat
    - from industry
    - from server farms
    - from sewage water

- **Risk mitigation**
  - de-risking investment and operation of LHP for companies

- **Innovative production techniques for faster production**
  - modularization
  - standardization

# General R&D needs for LHP

» **Speeding-up LHP deployment**

- improve qualification of the workforce
- use of digital means to speed up training and quality assurance
- incentivize LHP / HP construction and maintenance as an attractive career
- redirect experts from fossil technologies to LHP

» **Ecological refrigerants**

- develop new refrigerants
- adapt existing LHP to ecological refrigerants
- improve use of existing ecological refrigerants (CO2, propane, ammonia..)

» **Improving heat pumps and their COP**

- technologies to reduce exergy destruction in LHP, e.h. batch processes
- more durable heat pumps, e.g. thermoacoustic heat pumps

# Operating Agent of IEA DHC


- **IEA DHC – The IEA technology collaboration programme on district heating and cooling**
  - since 1983
  - cost-shared research budget over 1.4 million USD / 3-year Annex
  - task-shared Annexes (so far): TS1 – TS7
  - www.iea-dhc.org

- **Annex XIII**
  - 8 projects finished or on the finishing line

- **Annex XIV**
  - project selection in progress

- **AGFW – Operating Agent / Programme manager of IEA DHC**
  - since 2012

# R&D needs for DHC

» **Theme 1: DHC in the post-fossil era with carbon-free energy sources**

- shift from fossil to greenhouse gas neutral sources in DHC production
- increase cogeneration for fuel use (fossil, nuclear, biomass)

» **Theme 2: Flexibility**

- control strategies, variable supply temperature, peak shaving, demand side management, load shifting and electrification

» **Theme 3: Digitalization**

- Use digitalization in DH to improve ecological and economical performance
- consider cybersecurity

# R&D needs for DHC

» **Theme 4: Business models**

- Adapting DH business to decarbonization, flexibility needs, uncertainty and expansion

» **Theme 5: Tariff structures**

- new pricing models for low temperature district heating and flexibility

» **Theme 6: Sub-stations**

- new generation of sub-stations for space heating and domestic hot water systems for low temperature district heating

# Add-on: A key R&D need for the energy sector in general

» **Unified scientific, realistic and comprehensive assessment system of climate change contributions of technologies**

- develop mandatory international standards
- based on IPCC assessments – and as realistic as feasible
- go beyond carbon dioxide – include all climate effects (direct and indirect)

- resolve contradictions
- minimize externalization
- improve data
- improve comparability
- reliably stop double counting and greenwashing

- certification of emissions reductions
- quality assurance and double bookkeeping to limit errors and minimize data manipulation
- continuous improvement and monitoring of the assessment system to keep up with science

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## ... any questions?


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