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Energy Supply Systems in Baltic Sea Region

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LowTEMP training package - OVERVIEW

Introduction

- Intro Climate Protection Policy and Goals
- Intro Energy Supply Systems and LTDH
- Energy Supply Systems in Baltic Sea Region

Energy Strategies and Pilot Projects

- Methodology of Development of Energy Strategies
- Pilot Energy Strategies – Aims and Conditions
- Pilot Energy Strategy – Examples
- Pilot Testing Measures
- CO_2 emission calculation
- LCA calculation

Financial Aspects

- Life cycle costs of LTDH projects
- Economic efficiency and funding gaps
- Contracting and payment models
- Business models and innovative funding structures

Technical Aspects

- Pipe Systems
- Combined heat and power (CHP)
- Large Scale Solar Thermal
- Waste & Surplus Heat
- Large Scale Heat Pumps
- Power-2-Heat and Power-2-X
- Thermal, Solar Ice and PCM Storages
- Heat Pump Systems
- LT and Floor heating
- Tap water production
- Ventilation Systems

Best Practice

- Best Practice I
- Best Practice II

Prelude and motivation

This presentation

- will take a brief overview of the current situation of district heat (DH) in the BSR.
- is based on the findings of the LowTEMP partnership during the project duration (October 2017- March 2021).

The findings set the background into which low temperature district heating is to be introduced.

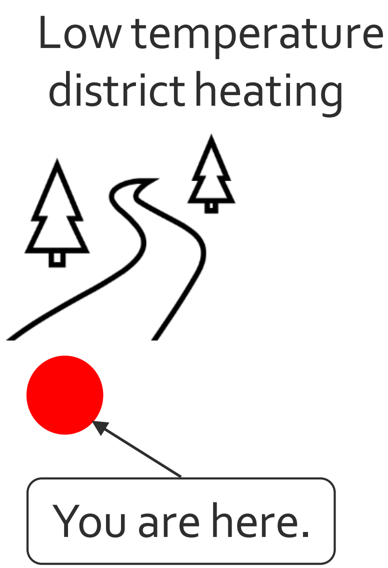

Figure 1: On our way. Source: Lea Hämäläinen/Thermopolis [1]

Content

- Basics of DH in Baltic Sea Region BSR
- Forms of ownership among DH companies
- DH generation
- Fuels in DH generation
- DH distribution
- Potential for LTDH
- Barriers for LTDH
- Conclusions

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Basic of DH in BSR

- DH has consolidated its position as **one of the most common** heating systems in the BSR.
- It competes against individual heating systems, such as individual boiler units (oil, solid fuels or gas) and heat pumps.
- DH is considered as an **efficient heating system** especially when heat distribution distances are short and when the heating power towards the pipeline length is high

››› DH is common in cities.

Basics of DH in BSR

Figure 2: Costumers connection to a DH network. Source: Thermopolis picture stock [1]

- DH is typically used both for **space heating** and **domestic hot water** preparation in BSR.
- The most typical DH system, used in the BSR, is a **closed system**, where the customers connect to the DH network via heat exchangers. Meaning the DH water does not circulate in the customers end systems e.g., in the heating network of a building.

Citizens served by DH in BSR countries, Source: Internal project report [2]

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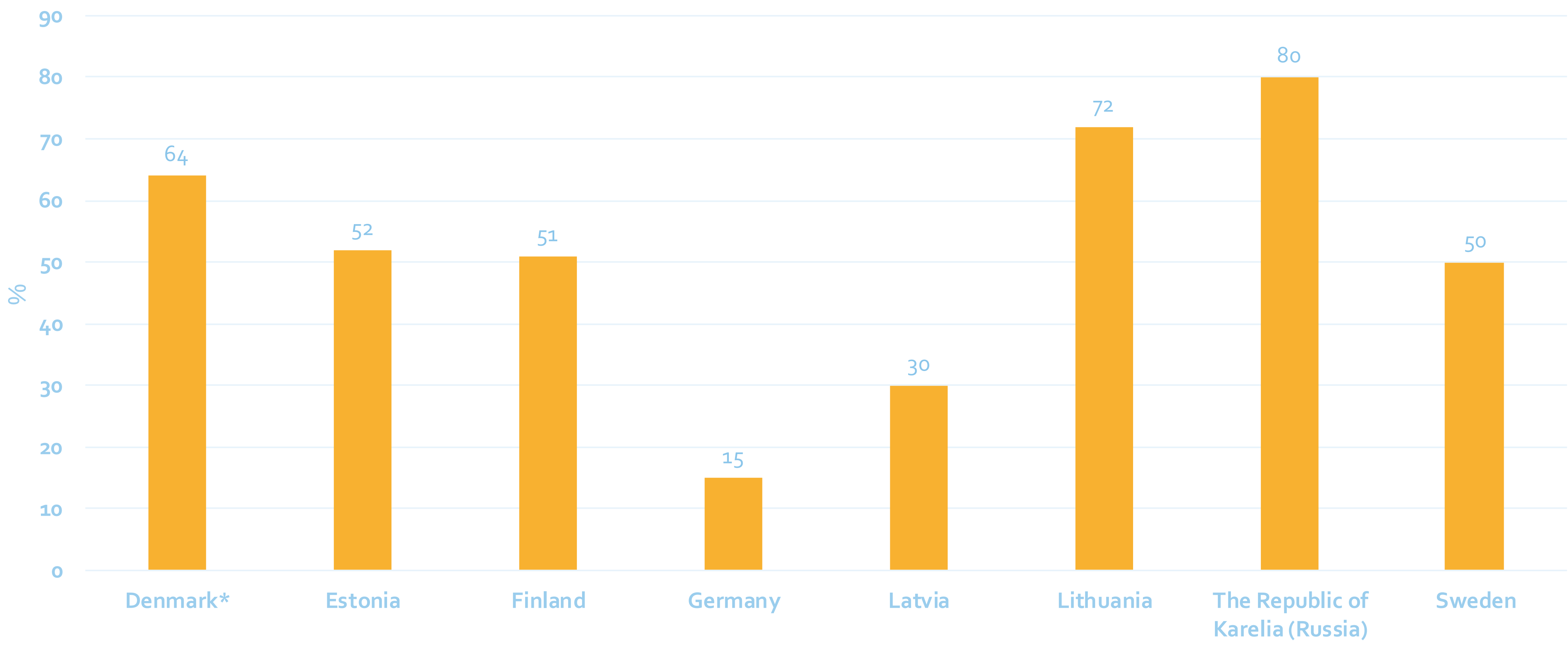

* Denmark: share among households

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Forms of ownership among DH companies in BSR

- When comparing the forms of ownership among DH companies in BSR similarities can be found.
- DH companies are often owned by municipalities.
- Other existing and prevalent forms of ownerships among operating DH companies are:
  - large transnational concerns,
  - large national energy companies,
  - cooperatives,
  - and other public or private companies.
- In some LowTEMP partner countries, municipalities have the possibility to regulate buildings to connect DH network.

Most common forms of ownership among DH companies in BSR Source: Internal project report [2]

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Country	Most common forms of ownership
Denmark	**Municipal** companies and cooperatives
Estonia	Private and **municipal** companies
Finland	**Municipal** and private companies
Germany	**Municipal** and private companies
Latvia	**Municipal** companies
Lithuania	**Municipal** companies
Poland	National, transnational and **municipal** companies
The Republic of Karelia (Russia)	Regional companies
Sweden	**Municipal** and transnational companies

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DH generation and use of storage in BSR

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DH is generated

- with base load, medium load, and reserve/peak load boiler units.
- in Combined Heat and Power units (CHP) in urban areas or heat only boiler units in the more sparsely populated areas and/or scattered along the DH network.

DH storage

- Short-term heat storages are used case-by-case
- Seasonal long-term heat storages are rather uncommon in the BSR.

Figure 3: Heat only boiler in a sparsely populated area. Source: Thermopolis picture stock [1]

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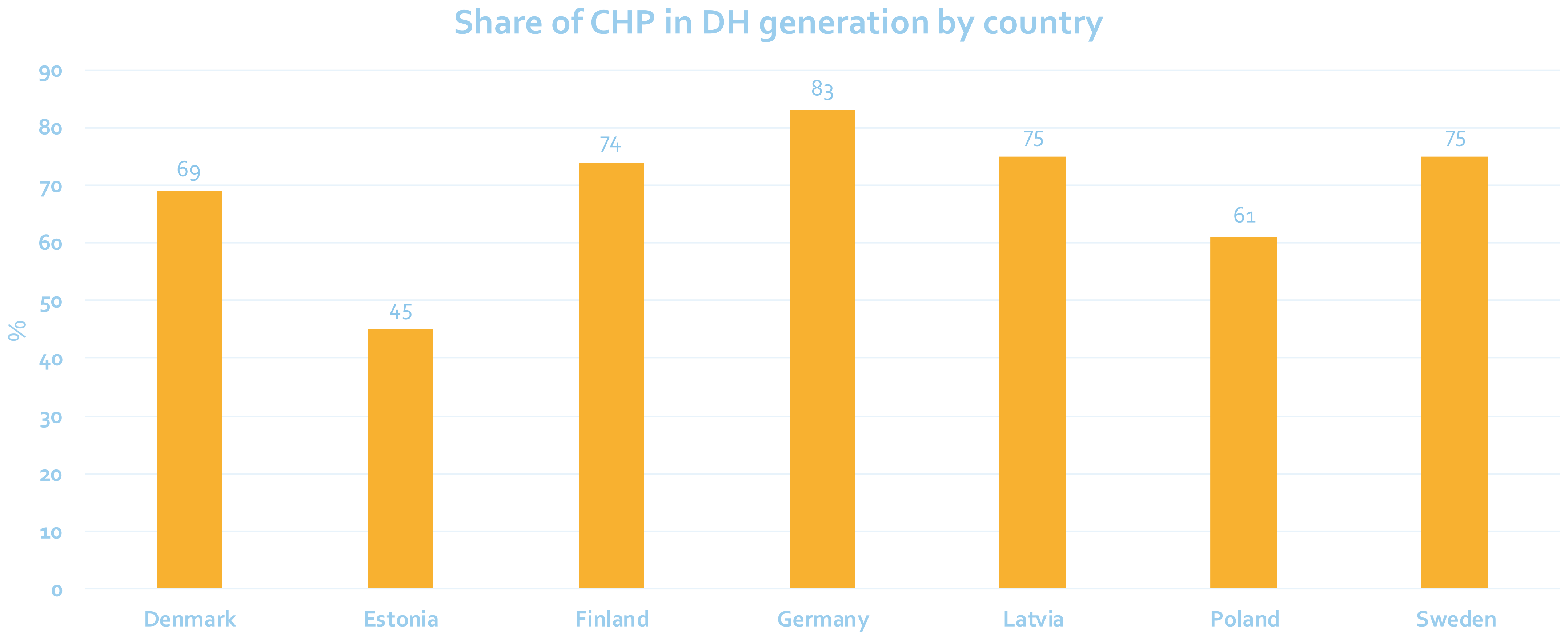
DH generation in BSR, Source: internal project report [2]



Fuels in DH generation in BSR

- In general, DH generation has been based on fossil and renewable fuels from three main categories:
  - solid fuels,
  - liquid fuels,
  - and gaseous fuels.

Figure 4: Woodchips. Source: Merja Järvelä/Thermopolis picture stock [1]

Examples of fuels by category in DH generation in BSR, Source: Internal project report [1]

Solid fuels	• Coal • Peat • Wood fuels • Municipal waste	• Black coal, brown coal • Milled peat, sod peat • Pellet, woodchips, bark • Recovered fuel
Liquid fuels	• Industrial waste liquour • Sewage sludge • Oil	• Heavy fuel oil, light fuel oil
Gaseous fuels	• Natural gas • Liquefied petroleum gas • Biogas	
Waste heat	• Industrial process (high temperature) • Industrial process (low temperature) • Urban waste heat • Combined Heat & Power	• Furnace, kiln • Cooling water • Wastewater heat recovery • Flue gas recovery

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Fuels by country in DH generation in BSR, Source: Internal project report [2]

Country	Most common fuels
Denmark	Biomasses (approx. 50 %) , natural gas (25%)
Estonia	Natural gas (57%), coal (31%)
Finland	Biofuels [including wood chips (18 %), industrial wood waste (10 %) and other biomasses (6 %)] (34 %) , coal (24 %),
Germany	Natural gas (43 % in cogeneration), natural gas (70% in heat only boilers), coal (40 % in cogeneration) and coal (4 % in heat only boilers)
Latvia	Natural gas (64 %), wood fuels (31 %)
Lithuania	Biofuels & municipal waste (64 %), wood fuels (31 %)
Poland	Coal (73 %)
The Republik of Karelia (Russia)	Oil (39 %), natural gas (38 %)
Sweden	Bioenergy (40 %), recycled energy [including surplus heat, waste incineration and smoke gas recovery] (43 %)

Surplus heat, recovered heat, heat pumps in DH generation in BSR

- Apart from these commonly acknowledged fuels, utilizable surplus heat e.g., surplus heat from industrial or urban processes has recently become a potential alternative for DH generation.
- Utilisation of surplus heat in large scale is in its early stages.
  - Denmark , Finland (8 % of DH is generated by heat recovery and heat pumps) and Sweden (43 % recycled energy, including surplus heat, waste incineration, and smoke gas condensation) have been considered as forerunners in waste heat utilization e.g., in using flue-gas condensation.
  - The environmental impact of CHP units decreases with the use flue-gas condensation.

Conclusions on the fuels in DH generation in BSR

- DH is currently based strongly on fossil fuels in BSR.
  - Especially larger cities have the tendency to be dependent on fossil fuels.
- Natural gas and coal are used extensively in BSR.
  - In addition, peat has a firm foothold in specific markets.
- Some countries have successfully converted their DH generation towards biomass driven generation.

DH distribution in BSR

Currently, DH networks are conventional networks in BSR.

- District heat is distributed by DH water.
- Steam based distribution techniques are rather occasional if not non-existing.
- Insulated steel pipes are most commonly in use.

Temperatures in DH networks

- Common supply temperatures vary between 70°C to 115°C.
- Common return temperatures vary between 45°C up to 65°C.
- Lower temperature levels apply to summer conditions, higher are related to winter conditions
- BSR countries have different temperature requirements for the DH grids (e.g., to prevent bacteria and scalding)

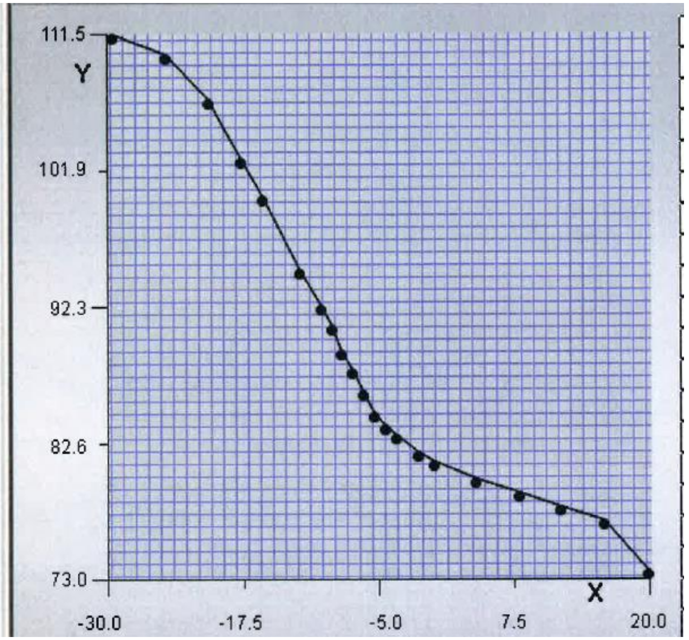

Figure 5: Example of DH supply temperature in relation to outdoor temperature. Y=supply temperature and X= outdoor temperature Source: Thermopolis picture stock [1]

Heat losses in DH networks

- Heat losses vary strongly in BSR.
  - More advanced DH networks have heat losses between 5-15%.
  - Old networks may have heat losses up to 30% or beyond.
- Replacing older pipes with better insulated new pipes is taking place for example in the Republic of Karelia (Russia).
- Optimizing the supply temperature for example in relation to weather forecasts is another emerging tool in DH heat loss control.
- Heat losses are smaller in heat dense areas (cities) and higher in sparsely populated areas.

Potential for LTDH in BSR

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STRENGTHS

- DH has a well-established position in BSR
- A large proportion of DH companies are municipally owned
- Low temperature supply meets the heat demand of low energy buildings

OPPORTUNITIES

- Utilizable low temperature waste heat sources
- Potential to decrease heat distribution-related heat losses
- Reduce dependency on fossil fuels
- Reduce combustion-based district heat generation

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Barriers for LTDH in BSR

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WEAKNESSES

- High investment costs on the demand side
- Diversity of building stock
- Lack of seasonal heat storages
- Undefined pricing models for waste heat

THREATS

- Demand side attitudes towards low temperature DH
- Lack of financing
- Political decisions
- Unexpected shutdowns of waste heat sources

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Conclusions

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- DH has a well-established position in BSR, and especially in cities it is among the most popular heating systems.
- DH generation in the BSR is still strongly fossil fuel oriented, even though the share of renewable energy sources has increased recently in several countries.
- The utilization of waste heat (e.g. waste heat from industrial processes) is under constant consideration in the BSR.
- There are existing heat storage methods in the BSR, however, the current heat storages are typically short-term heat storages.

References:

[1] Thermopolis picture stock contains pictures taken by Thermopolis employees, that can be used in the LowTEMP –project training materials.

[2] P. Sneck. Report on current energy supply framework conditions for LTDH in partner municipalities and regions. 2019. Unpublished internal report of LowTEMP, part of background material. Compilation based on partners answers to pdf questionary.

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