Fact Sheet on the Cost Assessment for Heating & Cooling technologies

Background document to the corresponding database

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Abstract

Within the Fair-Heat project as part of the Inventory works a task was dedicated to the collection of cost data for the most relevant Heating &Cooling decarbonisation and ex-tension technologies, including building scale measures (including thermal retrofitting, passive cooling measures, new building scale supply units (mainly heat pumps) and adopted heat distribution (where necessary) and / or technologies for connection to district heating networks) as well as district heating scale measures (including supply units, such as geo-thermal and solar thermal energy, ambient heat and waste heat sources, large scale heat pumps, storages and costs for network extensions).

This concise Fact Sheet on the Cost Assessment of Heating & Cooling technologies:

- presents the outcomes of that cost assessment for building scale measures and related supply technology options
- provides for district heating scale measures background information on the comprehensive dataset that has been compiled for that purpose. Here the Fact Sheet informs on the underlying data structure, and it provides background information on the data presented in that database.

The outcomes of this cost assessment will be used as input for further model-based analyses in the Fair-Heat project, which aims to examine the distributional effects of climate mitigation costs, particularly related to the decarbonization of residential heating and cooling systems.

1 Background and Purpose of this Fact Sheet

Within the Fair-Heat project as part of the Inventory works a task was dedicated to the collection of cost data for the most relevant Heating &Cooling decarbonisation and extension technologies, including building scale measures (including thermal retrofitting, passive cooling measures, new building scale supply units (mainly heat pumps) and adopted heat distribution (where necessary) and / or technologies for connection to district heating networks) as well as district heating scale measures (including supply units, such as geothermal and solar thermal energy, ambient heat and waste heat sources, large scale heat pumps, storages and costs for network extensions).

This concise Fact Sheet on the Cost Assessment of Heating & Cooling technologies has **a two-fold aim**:

- On the one hand, **it presents the outcomes of that cost assessment for building scale measures and related supply technology options**, cf. section 2.
- On the other hand, **for district heating scale measures it provides background information on a comprehensive dataset** that has been compiled for that purpose. Here the Fact Sheet informs on the underlying data structure, and it provides background information on the data presented in that database, cf. section 3.

The outcomes of this cost assessment will be used as input for further model-based analyses in the Fair-Heat project, which aims to examine the distributional effects of climate mitigation costs, particularly related to the decarbonization of residential heating and cooling systems.

2 Outcomes of the cost assessment for building scale measures

The outcomes of the cost assessment for building-scale measures and related supply technology options are summarised in Table 1 below. Please note that all costs are expressed in EURO as of 2024. Moreover, required investment is defined according to the formula expressed below:

*Investment = specific cost factor for heat supply per GFA * GFA ^ (1 + cost factor exponent GFA) + specific cost factor heat supply per kW * Installed kW ^ (1 + cost factor exponent kW).*

Thereby, GFA stands for ground floor area. The first term defines costs depending on the heated gross floor area and the second based on the installed capacity. The values defined here need to be specified per m2 or per kW, respectively.

Technology option	p min	p max	Specific cost factor heat supply per GFA	Cost factor exponent GFA	Specific cost actor heat supply per kW	Cost factor exponent kW	Specific cost factor if no central district heat supply	Specific cost factor per 1C temperature reduction	Cost factor exponent temp reduction per GFA	max distribution temperature	O&M cost per investment
Unit:	kW	kW	Euro/m2 GFA	-	Euro/kW	-	Euro/m2 GFA	Euro/(K m2 GFA)	-	Celsius	[Euro/Euro/yr]
Heat district heat urban	25	10000	0	0	2777	-0,666	298,13	19,88	-0,53	85	0,0200
Oil central condensing	15	10000	0	0	2145	-0,462	298,13	19,88	-0,53	65	0,0350
Unused gas collective condensing	10	10000	0	0	1703	-0,220	150,00	10,00	-0,53	85	0,0250
Gas central condensing	15	10000	0	0	1703	-0,441	298,13	19,88	-0,53	85	0,0250
Wood central log	15	50	0	0	2559	-0,350	298,13	19,88	-0,53	85	0,0450
Wood central chips	100	10000	0	0	5407	-0,447	298,13	19,88	-0,53	85	0,0600
Wood central pellets	20	200	0	0	3462	-0,350	298,13	19,88	-0,53	85	0,0600
Electricity local convector	3	10000	0	0	501	0,000	0,00	0,00	-0,53	0	0,0000
Geothermal central heat pump (air/water)	5	1000	22500	-1	2435	-0,200	298,13	19,88	-0,53	57	0,0083
Geothermal central heat pump(groundwater/water)	5	1000	22500	-1	2435	-0,200	298,13	19,88	-0,53	57	0,0083
Hybrid heat pump air/water gas	25	10000	0	0	5387	-0,432	298,13	19,88	-0,53	85	0,0100
Geothermal central heat pump soil	5	1000	22500	-1	2435	-0,200	298,13	19,88	-0,53	57	0,0083

Table 1: Overview on costs and performance by technology options for building-scale measures and related heating and cooling supply (Source: e-think database)

Note: GFA … ground floor area

3 Background information on the corresponding District Heating and Cooling database

Various datasets – including the comprehensive technology catalogue from the Danish Energy Agency (DEA), data and information provided by the International Energy Agency, International Renewable Energy Agency (IRENA), etc. – all related to technology cost data have been compiled, compared and validated.

From the comparative assessment it has been concluded to make use of the DEA Database, cf. https://ens.dk/en/analyses-and-statistics/technology-data-generation-electricity-and-district-heating as default reference for the underlying purpose. To derive a technology- and timewise (2030/2040) complete database, where necessary assumptions as well as extrapolations or interpolations, respectively, have been taken to fill data gaps. Here colour coding informs on the underlying source or approach, respectively.

The derived database informs on the cost and the technical performance of various supply, expansion and network technology options, including their development over time (2030, 2040). Below we provide further information on the data sources and how this is marked in the database, the abbreviations used as well as some general remarks.

Next to that, Figure 1 shows the underlying structure of the District Heating & Cooling Database and the underlying technology options.

Data sources and related notes

	Danish Energy Agency (DEA) Database, cf. https://ens.dk/en/analyses-and-statistics/technology-data-generation-electricity-and-district-heating
	Several assumptions
	Extrapolation/Interpolation
	Not Applicable
	Values in €/MWh (Storage CAPEX)

Abbreviations:

GNR	Generation
STO	Storage
CHP	Combined Heat and Power
LTDH	Low Temperature District Heat
CAPEX	Capital expenditures
OPEX	Operation expenditures
ORC	Organic Rankine Cycle

Notes:

- All cost data is expressed in real € as of 2020

- For generation (GNR) technologies that produce electricity only expressed values refer to electricity generation
- For generation (GNR) technologies that produce heat only expressed values refer to heat generation
- For CHP Technologies that produce both electricity and heat expressed capacity and efficiency values refer to the electricity part (e.g., capacity in terms of electricity)
- For storage (STO) technologies expressed cost data refers to the stored energy
- For energy network technologies expressed cost data refers to the energy transmitted or distributed
- Data on Low Temperature District Heat (LTDH) Combined Heat and Power (CHP) plants is only available for small/medium capacities that make use of the Organic Rankine Cycle technology
- The heating demand of the process (e.g., biogas digestor) represents an internal energy use within the plant complex. It is consequently covered by internally making use of the produced heat (stemming from burning gas or biomass) in a boiler.

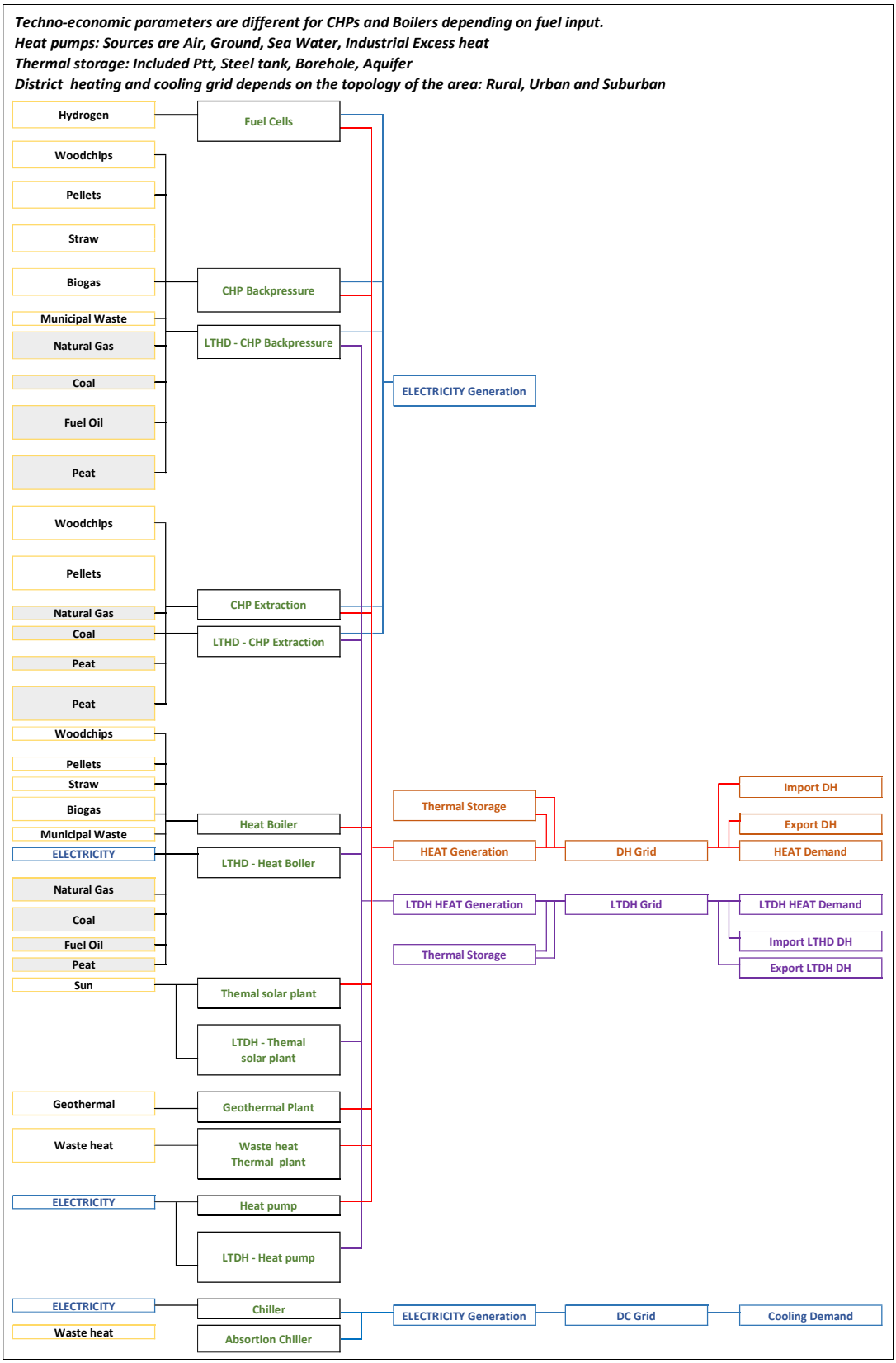

Figure 1: Structure of the District Heating & Cooling Database and the underlying technology options