

TAKING  
**COOPERATION**  
FORWARD



Second Train the Trainer session - Fundings, Economics and Financing  
Webmeeting, 18.06.2020



**Second Train the Trainer session:  
Heat Cost Comparison**



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# WHAT IS THE BENEFIT OF THIS TOOL?

This tool helps to compare the costs of a heat supply of DHS to individual heating systems.

## Possible applications for the tool:

1. As a **first rough profitability calculation** in the pre-planning stage
  - using prices of typical heating systems in my region to figure out if the DHS-system can be competitive
2. Getting heat customers in the stage of selling: either for **price comparisons in individual customer dialogues** or
3. **Presenting example calculations at public information events** to point out the advantages of DHSs.



# POTENTIAL USERS:

- 1) **Operators and planers:** For planning a DHS they need to know the price to be able to compete with the prices of individual heating systems and to convince potential customers,
- 2) **Regional Energy Agencies and consultants:** to provide assistance to operators, who are willing to realise a DHS and to convince potential customers,
- 3) **Customers:** with the help of this tool, a potential customer is able to see his/her financial advantage connecting to a DHS compared to an individual heating system



# HOW CAN WE MAKE THIS HEAT COST COMPARISON?

**1. Step:** to collect and determine basic data:

- Fuel prices, net heating value,

**2. Step:** different heating systems are defined and evaluated

**3. Step:** the results of the calculations concerning the respective heating systems are compared to each other



# STRUCTURE OF THE TOOL...

README | Explanatory notes | **Boundary conditions** | Heating system | DH system | Reference systems | Results | HelpSheet | Notes | +

## The sheets of the excel tool:

- 1) Boundary Conditions
- 2) Existing Individual Heating Systems (potential Customer)
- 3) District Heating Systems
- 4) Individual Reference Systems
- 5) Results



# BOUNDARY CONDITIONS



Base year: 2019

Currency used	EUR	Economic boundary conditions	Value	Unit
		Available capital (= max Equity)	4.000	[EUR]
		Loan interest rate	3%	[%]

Fuel data		Value	Unit
Fuel type	Parameters		
Biomass (pellets)	Net heating value	4,80	[kWh/kg]
	Fuel price (base year)	0,23	[EUR/kg]
	Averaged price development	1,0%	[%/a]
	Heat price (base year)	0,048	[EUR/kWh]
	Average heat price 20-years	0,053	[EUR/kWh]
Biomass (wood log)	Net heating value	1116	[kWh/m <sup>3</sup> (loose)]
	Fuel price (base year)	43	[EUR/m <sup>3</sup> (loose)]
	Averaged price development	1,0%	[%/a]
	Heat price (base year)	0,039	[EUR/kWh]
	Average heat price 20-years	0,042	[EUR/kWh]
Biomass (wood chip)	Net heating value	893	[kWh/m <sup>3</sup> (loose)]
	Fuel price (base year)	30	[EUR/m <sup>3</sup> (loose)]
	Averaged price development	1,0%	[%/a]
	Heat price (base year)	0,034	[€/kWh]
	Average heat price 20-years	0,037	[EUR/kWh]
Natural gas	Net heating value	11,33	[kWh/m <sup>3</sup> ]
	Fuel price (base year)	0,9	[EUR/m <sup>3</sup> ]
	Averaged price development	2,0%	[%/a]
	Heat price (base year)	0,079	[EUR/kWh]
	Average heat price 20-years	0,097	[EUR/kWh]
Oil	Net heating value	10	[kWh/l]
	Fuel price (base year)	0,65	[EUR/l]
	Averaged price development	2,0%	[%/a]
	Heat price (base year)	0,065	[EUR/kWh]
	Average heat price 20-years	0,079	[EUR/kWh]
Coal	Net heating value	8	[kWh/kg]
	Fuel price (base year)	0,45	[EUR/kg]
	Averaged price development	2,0%	[%/a]
	Heat price (base year)	0,056	[EUR/kWh]
	Average heat price 20-years	0,068	[EUR/kWh]
Electricity	Net heating value	1	[kWh/kWh <sub>e</sub> ]
	Fuel price (base year)	0,07	[EUR/kWh <sub>e</sub> ]
	Averaged price development	1,0%	[%/a]
	Heat price (base year)	0,067	[EUR/kWh]
	Average heat price 20-years	0,073	[EUR/kWh]

Notes
The Austrian energy agency suggests in 3) a value of 5,27 and 4,8 kWh/kg for dry and fresh matter respectively. In 1) Obtained minimum, maximum and average net heating values were 5,167, 5,389 and 5,278 kWh/kg respectively. In 2) a pellets price index from january 2006 onwards for Austria can be found. According to 2) the pellets price in Au 5 and 10 years) in 0,3 and 1,6 % respectively. In 8) 2.925 kg pellets (5,3 kWh/kg) cost around 900 EUR (gross price - incl. Transport) i.e. 0,058 EUR/kg (≈0,048 EUR, A net heating value for a specific wood mix can be calculated based using the excel tool published in 3). Exemplary v Actual and historic values for Austria can be retrieved from 4). Exemplary value corresponds to the product "Brennho
A net heating value for a specific wood mix can be calculated based using the excel tool published in 3). Exemplary v
The natural gas is a mixture of gases, with Methane as the predominant gas. Its net heating value is according to 11 Based on 9) gas tariff "SteirerKOMFORT" for private consumers with a gas demand up to 100.000 kWh/a the energy Further costs are the flat rate and the grid costs. The sum of these values is in net and gross 287 and 345 EUR/a resp charge".
Oil prices show a high fluctuation. Current and historic data on oil prices for Austria can be checked in 12). In 2019 th for the purchase of 3.000 l standard oil).
Exemplary value 8,06 kWh/kg for bituminous coal retrieved from 6). In 8) bituminous coal ("Steinkohle") vary between 0,5 and 0,7 EUR/kg (gross price, incl. Transport) depending on the minimum net heating value of 7,8 kWh/kg. Lignite ("Braunkohle") is cheaper but it has a lower net heating value. Prices and net heating value for lignite coal ca
The electricity costs in Austria (incl. Grid costs, taxes and duties) varies between 0,17 and 0,24 EUR/kWh <sub>e</sub> , depending company, location, ...). Here only the consumption dependent costs have to be included. Based on 10) electricity tarif demand till 100.000 kWh/a the energy price net and gross are respectively 0,0666 and 0,0799 EUR/kWh. Further cos in net and gross 297 and 357 EUR/a respectively. These have to be considered in the input cell "basic charge". Since be reduced (be partially considered). Here we assume 80 % of the basic charge for heating purposes.

# FUEL COSTS FROM THE PREPARATION QUESTIONNAIRE

Energy Source €/ kWh	HR	GE	IT	PL	SI	AT
Fuel oil	0,043-0,050 €/kWh	0,054 €/kWh	0,1051 €/kWh + VAT	0,096 €/kWh	0,071 €/kWh	0,06-0,1 €/kWh
Gas	0,028-0,04 €/kWh	0,0621 € /kWh	0,071 €/kWh + VAT	0,052 €/kWh	0,07 €/kWh	0,08 €/kWh
Wood chips	0,01375 €/kWh	0,063 €/kWh	0,021 €/kWh	0,016 €/kWh	0,022-0,025 €/kWh	0,029 €/kWh (w=30%)
Wood pellets	0,049 €/kWh incl. VAT 25%	0,061 €/kWh	0,0464 €/kWh + VAT (22%)	0,047 €/kWh		
Electricity	0,06-0,11 €/kWh (two tariffs, households)	0,305 € /kWh	0,1934 + VAT	0,14 €/kWh	0,14-0,16 €/kWh	0,08 (base costs) 0,2 (inkl. connection costs)



# HEAT COST COMPARISON TOOL - EXISTING HEATING SYSTEM

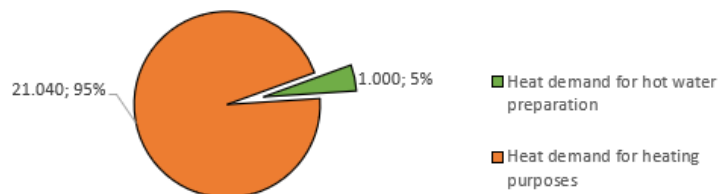


Fill in yellow colored cells, i.e. input cells -->  
Do not overwrite white cells formulas -->

## Input data: existing heating system

Input data: existing heating system						Notes
Heat demand definition			Parameters for the economic evaluation			
Description	Unit	Value	Description	Unit	Value	
<b>General data</b>			<b>Technical parameter</b>			
Fuel type	[-]	Oil	Installation lifetime	[a]	20	
Fuel consumption	[l/a]	2.900	<b>Economic parameters</b>			
Heat consumption	[kWh/a]	29.000	Basic charge	[EUR/a]	0	Notice that
Annual efficiency (Boiler, Heat pump, ...)	[%]	76%	Meter charge	[EUR/(kW.a)]	0	←
Heat demand (delivered)	[kWh/a]	22.040	Energy charge	[EUR/kWh]	0,080	
Full load operating hours	[h]	1.500	<b>Subsidy schemes...</b>			
Installed heat capacity	[kW]	15,0	on investment	[%]	0%	
<b>Domestic hot water preparation</b>			<b>Necessary investment</b>			
Number of residents	[resident]	2	Investment (without subsidy)	[EUR]	15.000	←
Specific heat demand for hot water preparation	[kWh/(resident.a)]	500	Invest to be financed	[EUR]	11.000	
Heat demand for hot water preparation	[kWh/a]	1.000	Equity	[EUR]	4.000	
Percentage of hot water heat demand covered by the heating system?	[-]	100%	Loan period	[a]	11	
			<b>Additional costs</b>			
<b>Main data - overview</b>			Maintenance costs	[EUR/a]	0	
Installed heat capacity	[kW]	15,0	Additional costs I	[EUR/a]	0	
Heat demand supplied by the main heating system	[kWh/a]	22.040	Additional costs II	[EUR/(kW.a)]	0	
Heat demand for hot water preparation	[kWh/a]	1.000				
Heat demand for heating purposes	[kWh/a]	21.040				

Heat demand supplied by the main heating system in kWh/a





# HEAT COST COMPARISON TOOL - DH SYSTEM



Fill in yellow colored cells, i.e. input cells -->									
Do not overwrite white cells formulas -->									
Input data: DH system			Notes						
Description	Unit	Value							
<b>Technical parameters</b>									
Annual heat demand	[kWh/a]	22.040	Annual heat demand and heat capacity demand are equal for all h "Heating system" sheet.						
Heat capacity demand	[kW]	15							
<b>Fuel mix</b>									
Biomass	[%]	100%	Fuel mix data is so far not relevant. The current version of the tool different heating systems						
Electricity	[%]	0%							
Fossil fuel	[%]	0%							
Thereof...									
Gas	[%]	0%							
Oil	[%]	0%							
Coal	[%]	0%							
<b>Economic parameters</b>									
Description	Unit	Value							
<b>Economic parameters</b>									
Basic charge	[EUR/a]	150	Notice that the energy charge refers to amount of heat purchased						
Meter charge	[EUR/(kW.a)]	35							
Energy charge	[EUR/kWh]	0,065							
<b>Additional costs</b>									
Additional costs I	[EUR/a]	0	If the DH connection have to be payed by the customer (e.g. no st yearly payment dependent on the installed capacity. Notice that tl yearly disbursements. We assume there are no additional costs						
Additional costs II	[EUR/(kW.a)]	0							



# REFERENCE SYSTEMS



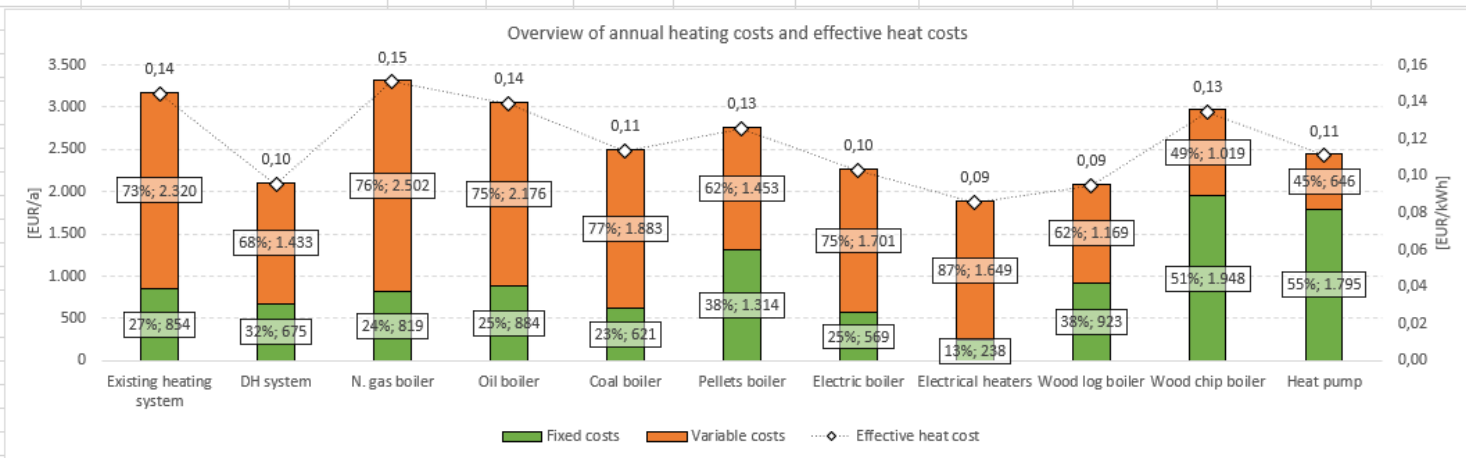
Description	Unit	Heating system								
		N. gas boiler	Oil boiler	Coal boiler	Pellets boiler	Electric boiler	Electrical heaters	Wood log boiler	Wood chip boiler	Heat pump
<b>Technical parameters</b>										
Heat demand to be supplied	[kWh/a]	22.040	22.040	22.040	22.040	22.040	22.040	22.040	22.040	22.040
Heat capacity demand	[kW]	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
Installation lifetime	[a]	20	20	20	20	20	25	20	20	15
<b>Fuel mix</b>										
biomass	[%]	0%	0%	0%	100%	0%	0%	100%	100%	0%
Thereof...										
Pellets	[%]	0%	0%	0%	100%	0%	0%	0%	0%	0%
Wood logs	[%]	0%	0%	0%	0%	0%	0%	100%	0%	0%
Wood chips	[%]	0%	0%	0%	0%	0%	0%	0%	100%	0%
Electricity	[%]	0%	0%	0%	0%	100%	100%	0%	0%	100%
fossil fuel	[%]	100%	100%	100%	0%	0%	0%	0%	0%	0%
Thereof...										
Gas	[%]	100%	0%	0%	0%	0%	0%	0%	0%	0%
Oil	[%]	0%	100%	0%	0%	0%	0%	0%	0%	0%
Coal	[%]	0%	0%	100%	0%	0%	0%	0%	0%	0%
Annual efficiency (heat production unit)	[%]	85%	80%	80%	80%	95%	98%	80%	80%	250%
<b>Economic parameters</b>										
Basic charge	[EUR/a]	287	0	0	0	238	238	0	0	0
Meter charge	[EUR/(kW.a)]	0	0	0	0	0	0	0	0	0
Energy charge	[EUR/kWh]	0,097	0,079	0,068	0,053	0,073	0,073	0,042	0,037	0,073
<b>Subsidy schemes...</b>										
on investment	[%]	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Necessary investment</b>										
Investment (without subsidy)	[EUR]	10.000	15.500	11.500	21.250	6.500	0	16.000	30.000	20.000
Invest to be financed	[EUR]	6.000	11.500	7.500	17.250	2.500	0	12.000	26.000	16.000
Equity	[EUR]	4.000	4.000	4.000	4.000	4.000	0	4.000	4.000	4.000
Loan period	[a]	6	11	7	17	2	1	12	20	15
<b>Additional costs</b>										
Maintenance costs	[EUR/a]	0	0	0	0	0	0	0	0	0
Additional costs I	[EUR/a]	0	0	0	0	0	0	0	0	0
Additional costs II	[EUR/(kW.a)]	0	0	0	0	0	0	0	0	0



# HEAT COST COMPARISON TOOL - RESULTS



Description	Unit	Local systems		Reference Systems								
		Existing heating system	DH system	N. gas boiler	Oil boiler	Coal boiler	Pellets boiler	Electric boiler	Electrical heaters	Wood log boiler	Wood chip boiler	Heat pump
Effective heating cost	[EUR/a]	3.174	2.108	3.322	3.059	2.504	2.767	2.270	1.887	2.092	2.967	2.441
Variable costs	[EUR/a]	2.320	1.433	2.502	2.176	1.883	1.453	1.701	1.649	1.169	1.019	646
Fixed costs	[EUR/a]	854	675	819	884	621	1.314	569	238	923	1.948	1.795
Thereof investment costs	[EUR/a]	854		532	884	621	1.314	331	0	923	1.948	1.795
Share fixed costs	[%]	27%	32%	24%	25%	23%	38%	25%	13%	38%	51%	55%
Share variable costs	[%]	73%	68%	76%	75%	77%	62%	75%	87%	62%	49%	45%
Effective heat cost	[EUR/kWh]	0,144	0,096	0,151	0,139	0,114	0,126	0,103	0,086	0,095	0,135	0,111
Effective heat cost ratio (System/DH)	[%]	151%	100%	158%	145%	119%	131%	108%	90%	99%	141%	116%

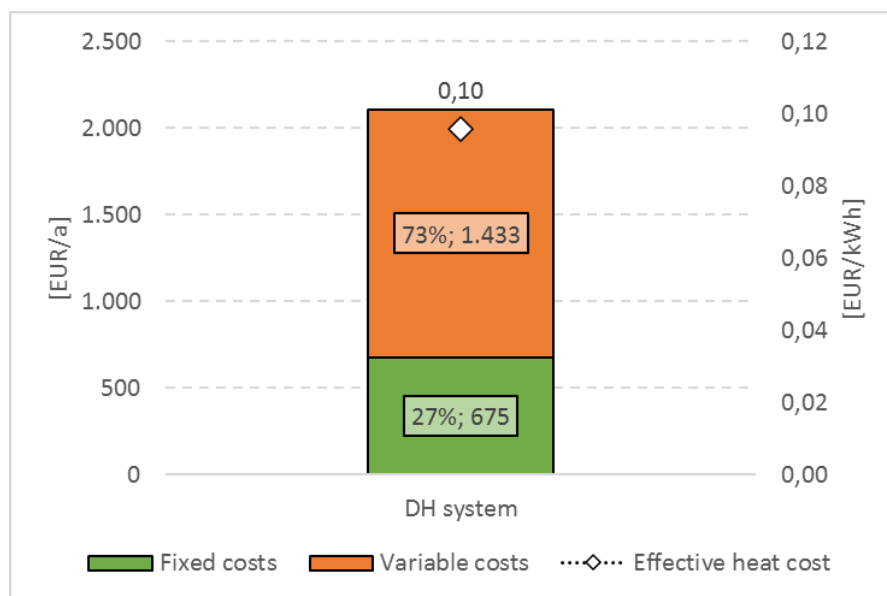


1. **Effective heating cost in EUR/a:** Defined as an average of the yearly cost for the next 20 years. Where we take into account...
  - Necessary investments (system as a whole)
    - Available capital (equity)
    - Necessary loan (annuity)
  - Lifetime of the installation. I.e. if appropriate, necessary reinvestment and installation rest value
  - Energy costs:
    - Basic charge [EUR/a]
    - Meter charge [EUR/(kW.a)]
    - Energy charge [EUR/kWh]
  - Maintenance and additional costs (to be introduced as constant yearly payments [EUR/a]).



2. **Effective heat cost in EUR/kWh:** Defined as the ratio between the effective heating cost in EUR/a and the yearly heat demand in kWh/a.

These two KPIs are calculated per each heating system.



# BE AWARE OF..

- **Simplified approach**
  - Estimation of the heat demand
  - Calculation of the heat costs
  - Use of netto prices
- **Relevance of the input data**
  - Influence on the results
  - Need of transparency: Where are the values coming from?
- **Tool is under development**
  - Do not focus on the quantitative results
  - Comments and suggestions are more than welcome



- Minor adjustments on...
  - tool structure (e.g. data inputs, ...)
  - terminology used
- CO<sub>2</sub> emissions as relevant KPI
- Inclusion of a CO<sub>2</sub> tax
- Further information research on input data (CO<sub>2</sub> emission factors, installation prices and typical efficiencies, energy prices, ...)



Follow up on previous example..

- Data of the potential heat customer
  - Heat produced by oil boiler
  - Fuel consumption  $\approx 2.900$  l
  - installed heat capacity = 15 kW
  - Hot water demand covered by main heating system (oil boiler)
- DH heat supply contract
  - Basic charge = 150 EUR/a
  - Meter charge = 35 EUR/(kW.a)
  - Energy charge = 0,065 EUR/kWh
  - DH connection is subsidized





# THANK YOU!



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