Status and perspectives of district heating in Slovenia

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SZE – Slovenian Energy Association

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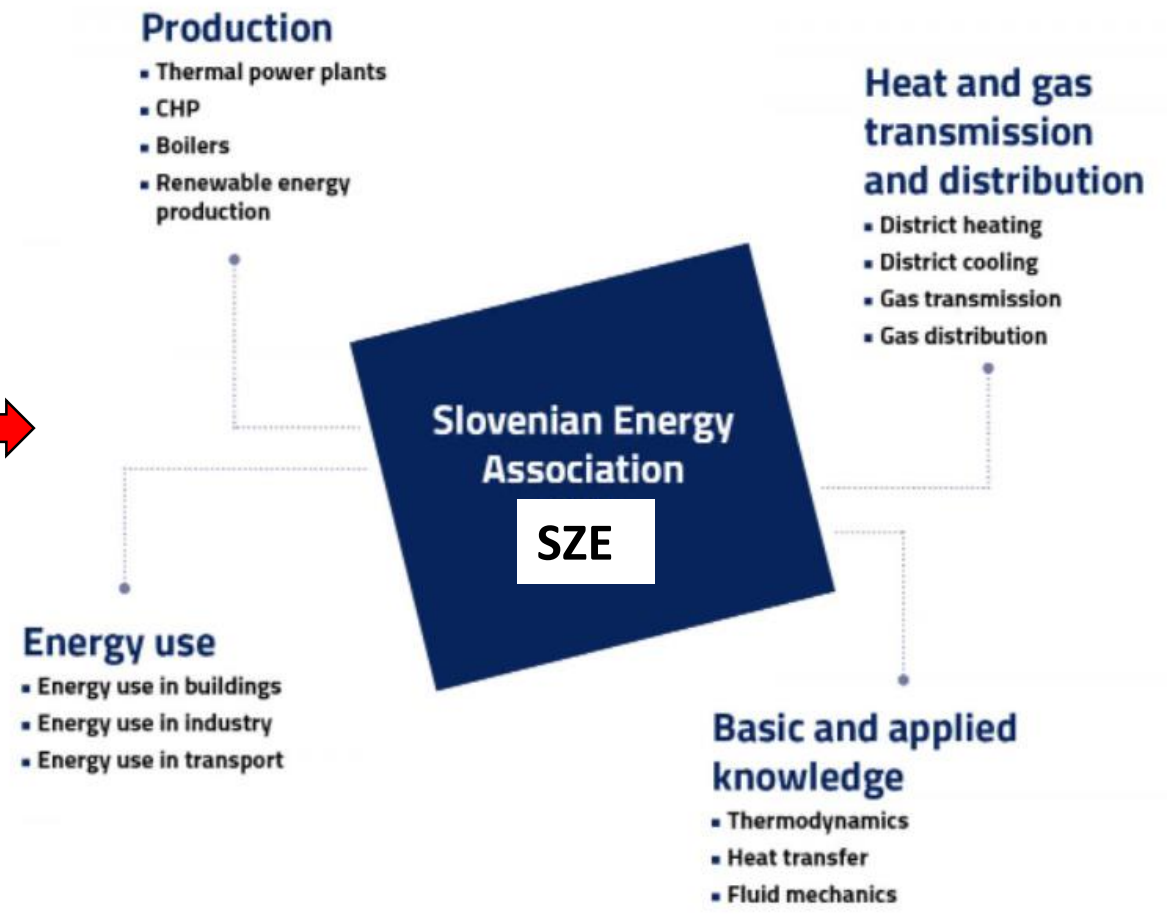
SDDE
SLOVENIAN DISTRICT ENERGY ASSOCIATION

1998 - 2008

SZE Slovensko združenje za energetiko
Slovenian Energy Association

2008

Heat Pumps



History of DH in Slovenia

Velenje

1959 - 1st District heating system in Slovenia

today – 260GWh heat capacity, 12.300 customers

Ljubljana

1961 - 2nd District heating system in Slovenia

today – 1100 GWh heat capacity, 27.000 customers

Present situation of DH

Supply of district heating provided by:

- **111** district heating systems,
- in **68 municipalities** (of total 212 in Slovenia)

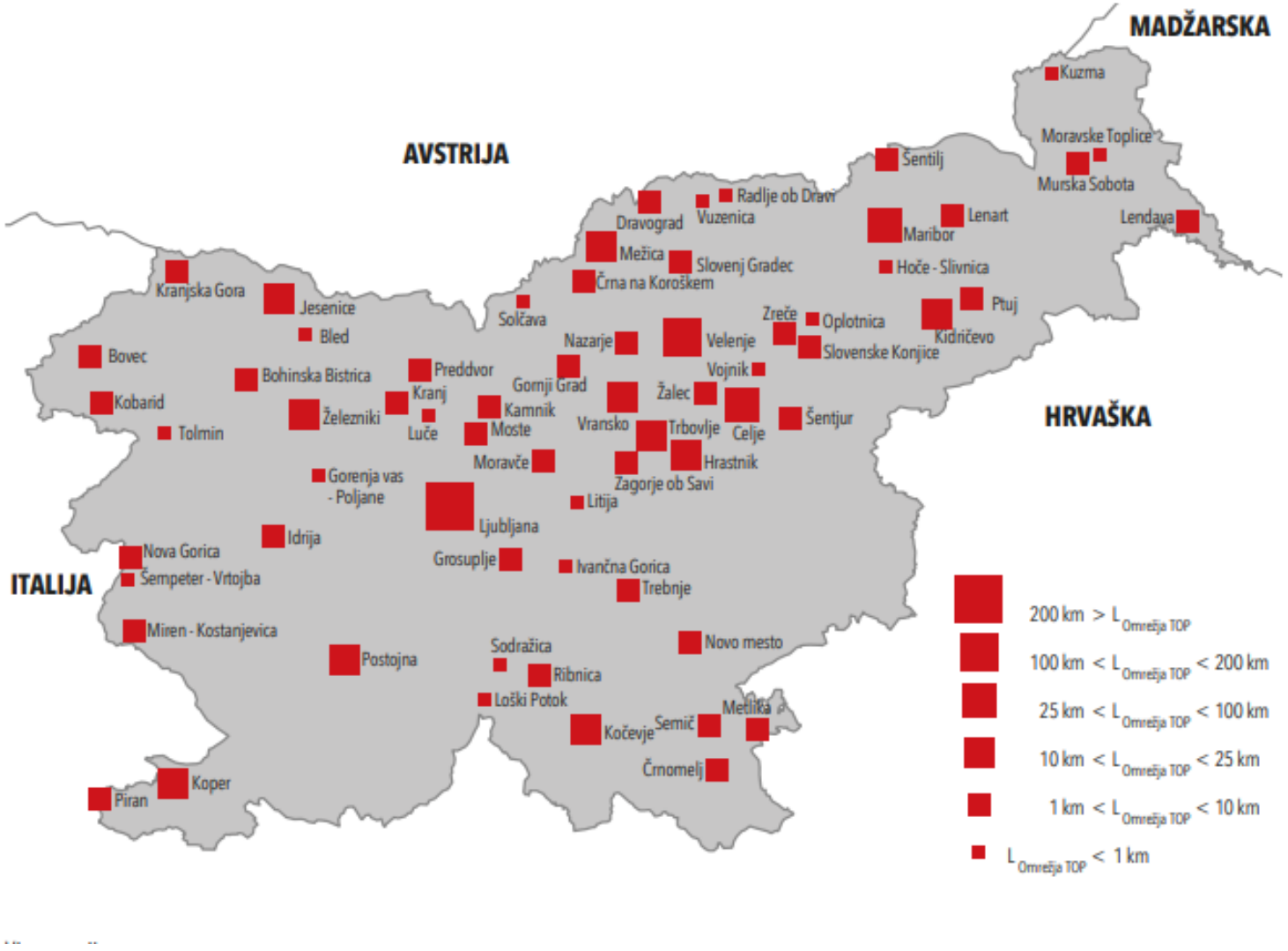
Production for the supply of district heating:

- **2.390 GWh of heat**
- **79% produced heat in CHP**

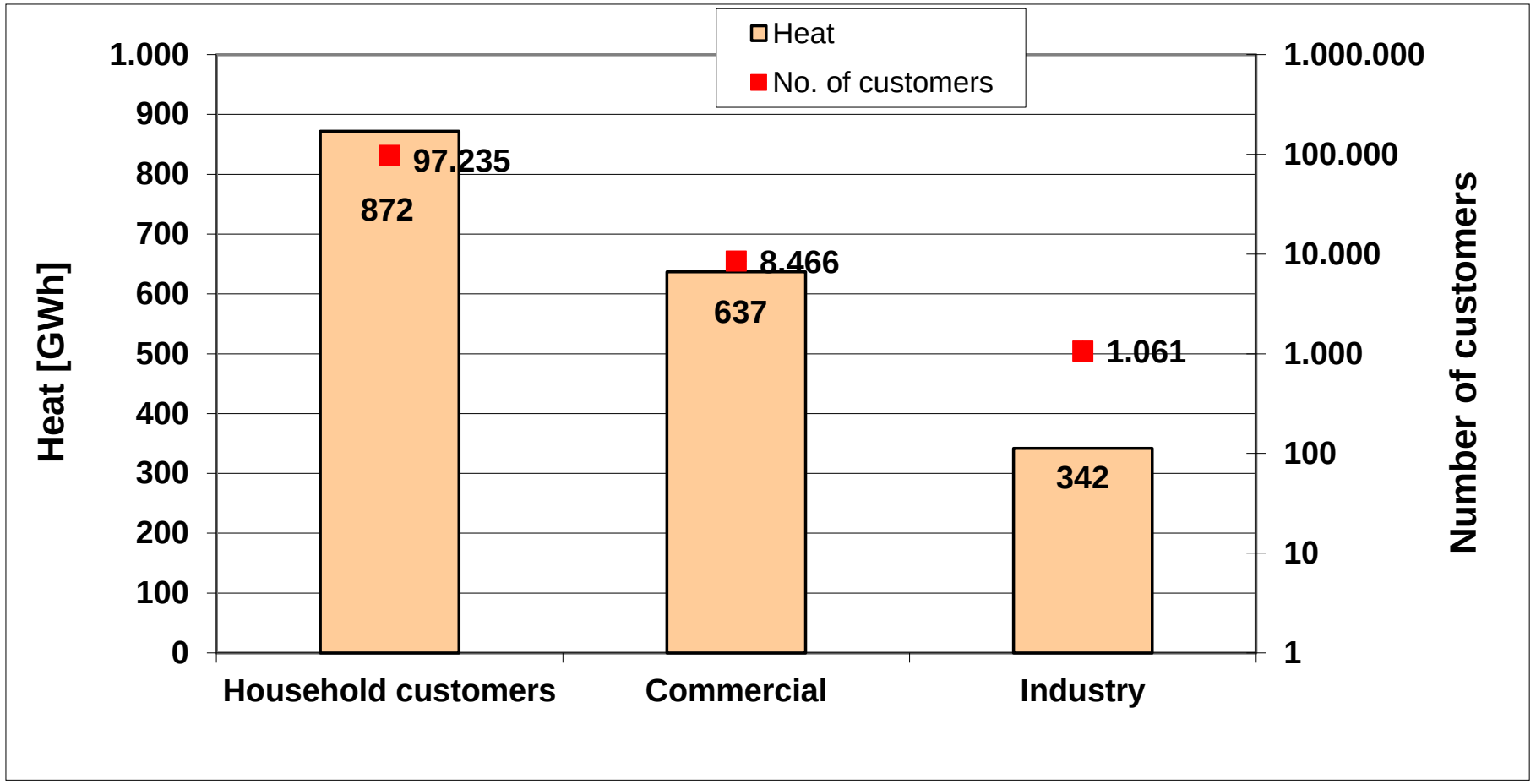
Supplied customers:

- **97.235 households** (heat for sanitary hot water and central heating),
- **9.475 non-household customers** (industrial processes, space heating of commercial buildings, offices)

Present situation of DH

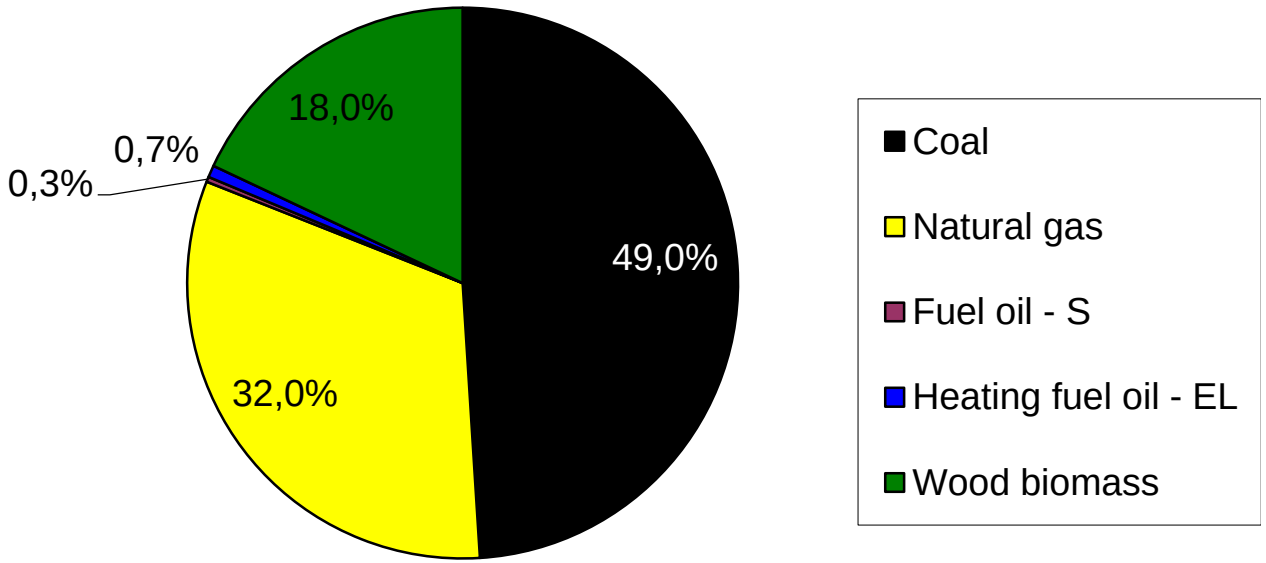


Present situation of DH



Present situation of DH

Structure of the primary energy use for DH supply



Present situation of DH

DH network

- District heating networks are installed in **68 municipalities** in total length of **908 km.**

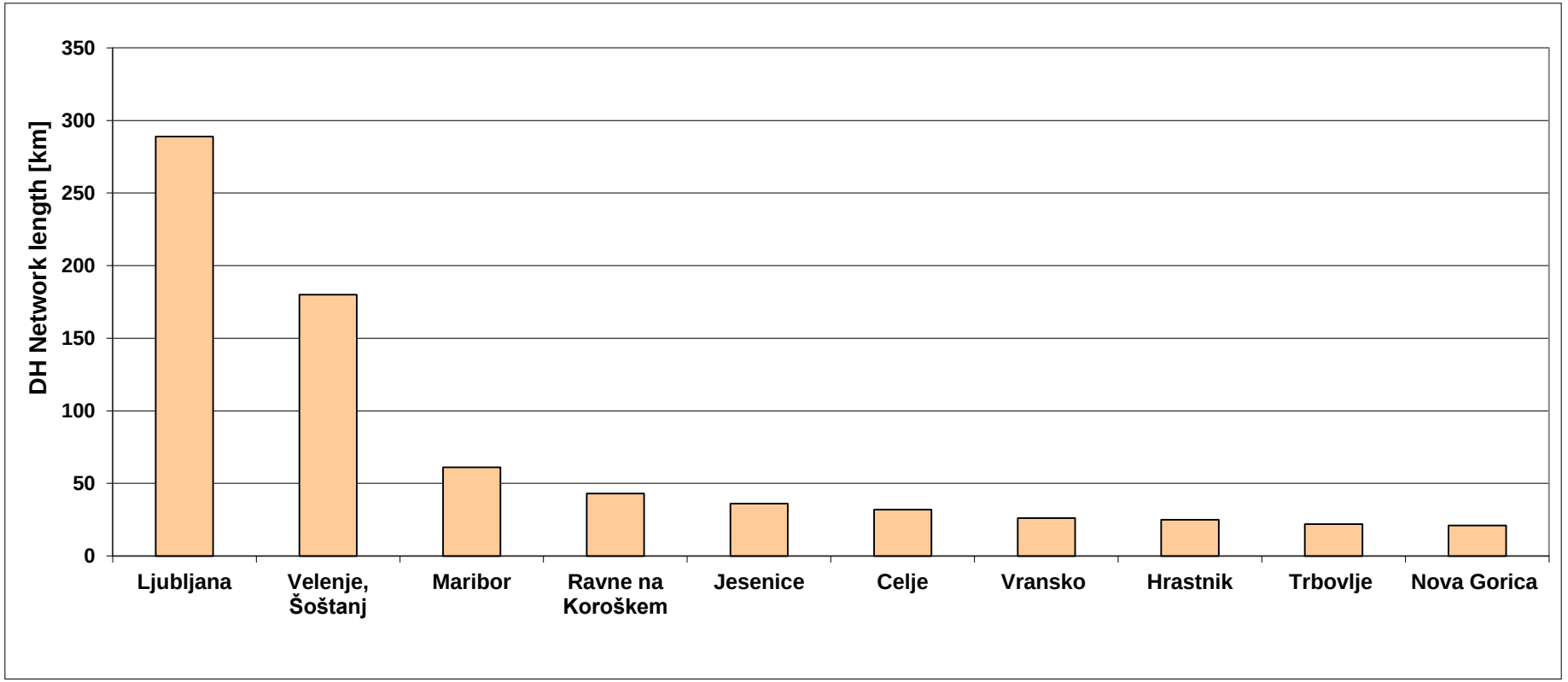
- 97% of the total network length is designed for **hot water** primary and secondary DH supply while

- 3% of the total network length is designed for **steam** DH supply

DH systems with the longest networks:

- **Municipality Ljubljana**, (289 km)
- **Municipality Velenje and Šoštanj**, (180 km)
- **Municipality Maribor** (61 km)

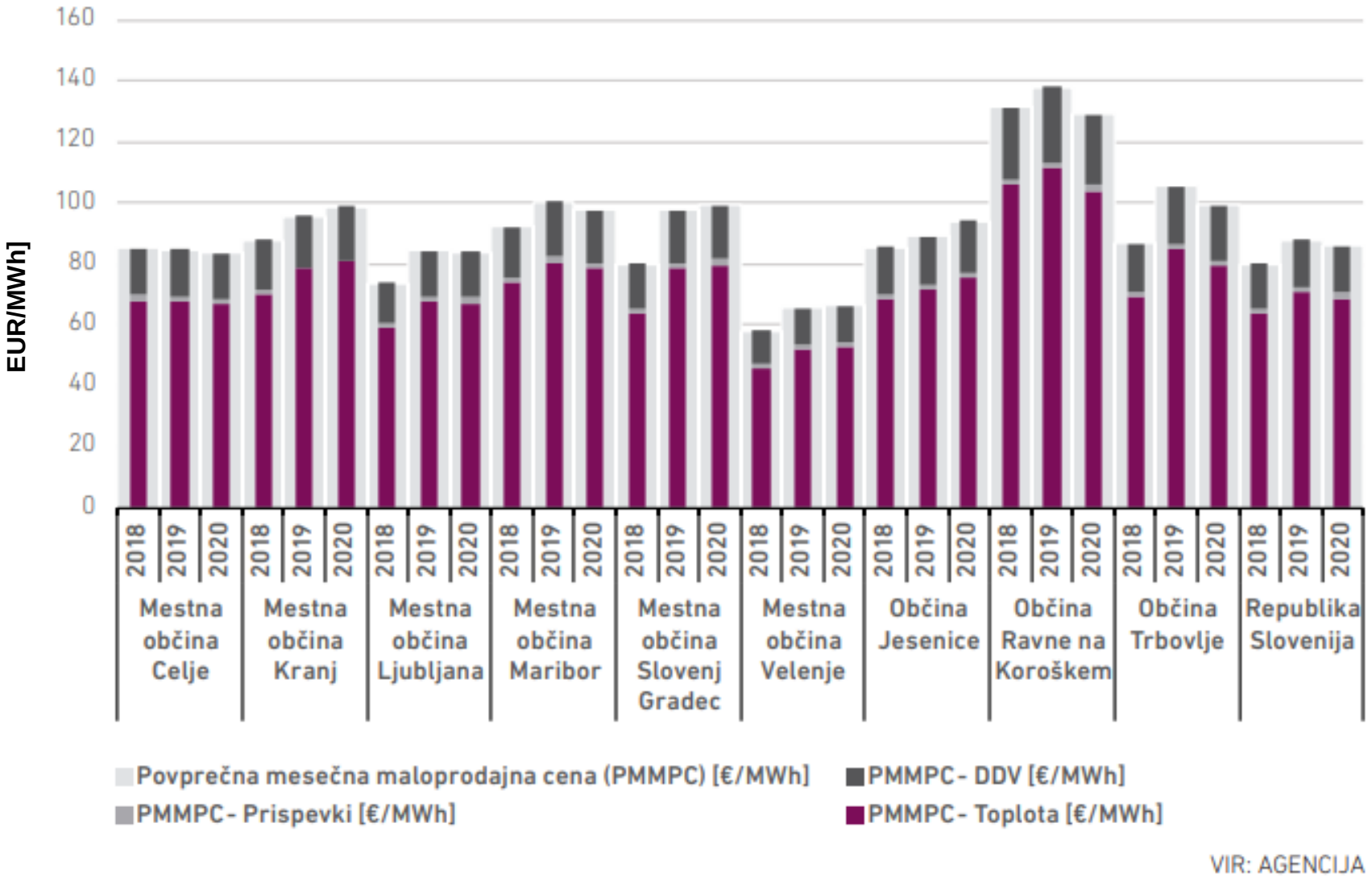
Present situation of DH



Present situation of DH

Heat energy price

Average selling price of district heating for households



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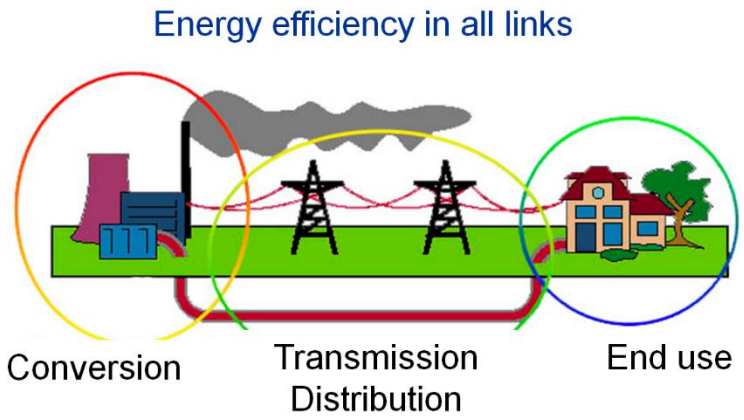
Future developments of DH in Slovenia according to – NEPN (Integrated National Energy and Climate Plan)

- Increase share of district heat in total heat demand to approx 35% (present 11%)
- Decrease heat losses (present approx. 14%)
- Decrease water losses
- Increase heat production in CHP
- Transition to 4th generation of DH (lower supply temperature)
- Decrease of return temperature
- Low or no-carbon energy sources (Geothermal, Heat pumps, RES, waste)
- Combination of DH and DC
- **New, more fair heat price model**

Fit to 55 (by 2030) related to DH

Green Transition

- Higher energy efficiency in all links of energy supply chain
- Higher share of RES
  - Biomass
  - Geothermal
  - Solar
  - Wind Power to heat



- Green fuels (hydrogen?)

Role of DH in Fit to 55

- Primary energy factor **PEF=primary energy/final energy**
  of DH can be < 1
- Possibility to adapt to most of RES
- Significant decrease of emissions
- Wood biomass needs to be relocate from individual users (problem of low efficiency and solid particles) to DH systems
- Wood biomass must be not just burned but used in CHP

DH can contribute to the reduction of air pollution very significantly!

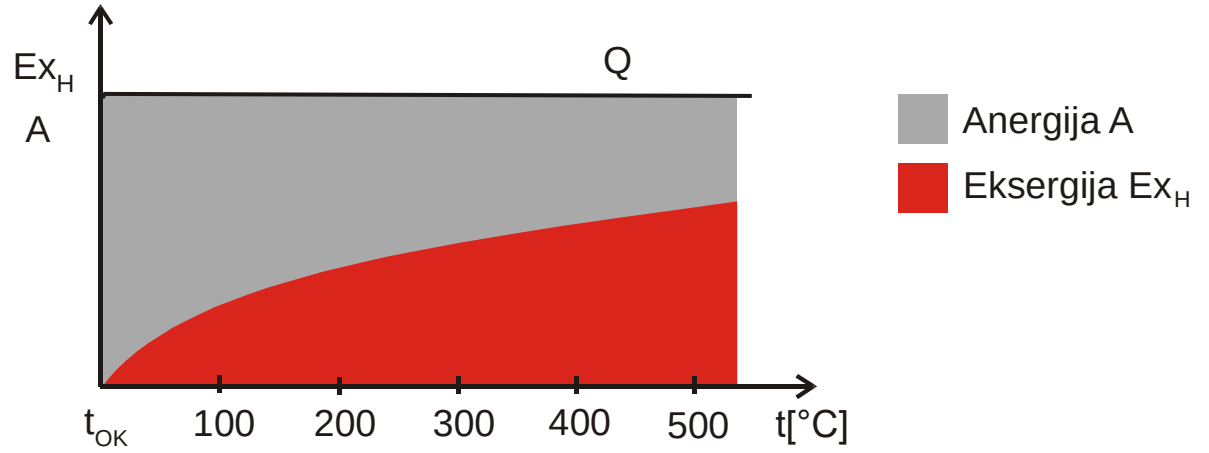
Heat quality as a basis for the price of thermal energy

Heat quality = Exergy

Exergy value of energy represents its quality!

Energy = Exergy + Anergy - Rant (1953)

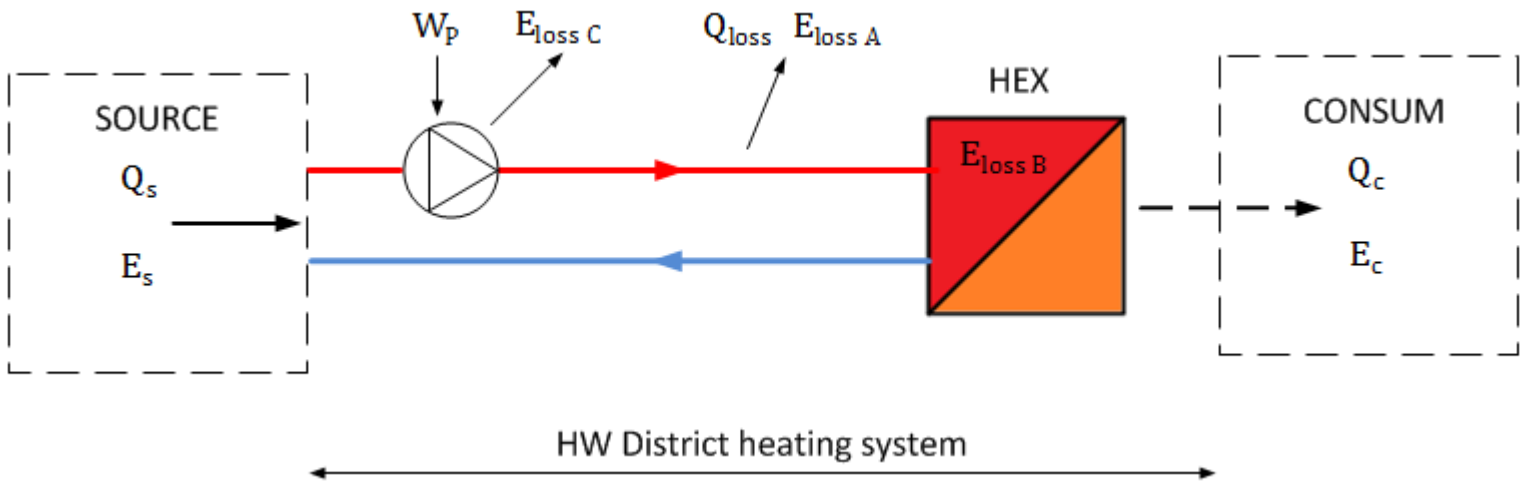
E= Ex+ A



In 1955, Rant stated that the selling price of heat based on enthalpy difference was inappropriate.

He proposed the introduction of the heat exergy value as the basis for determining the price of heat.

District heat quality

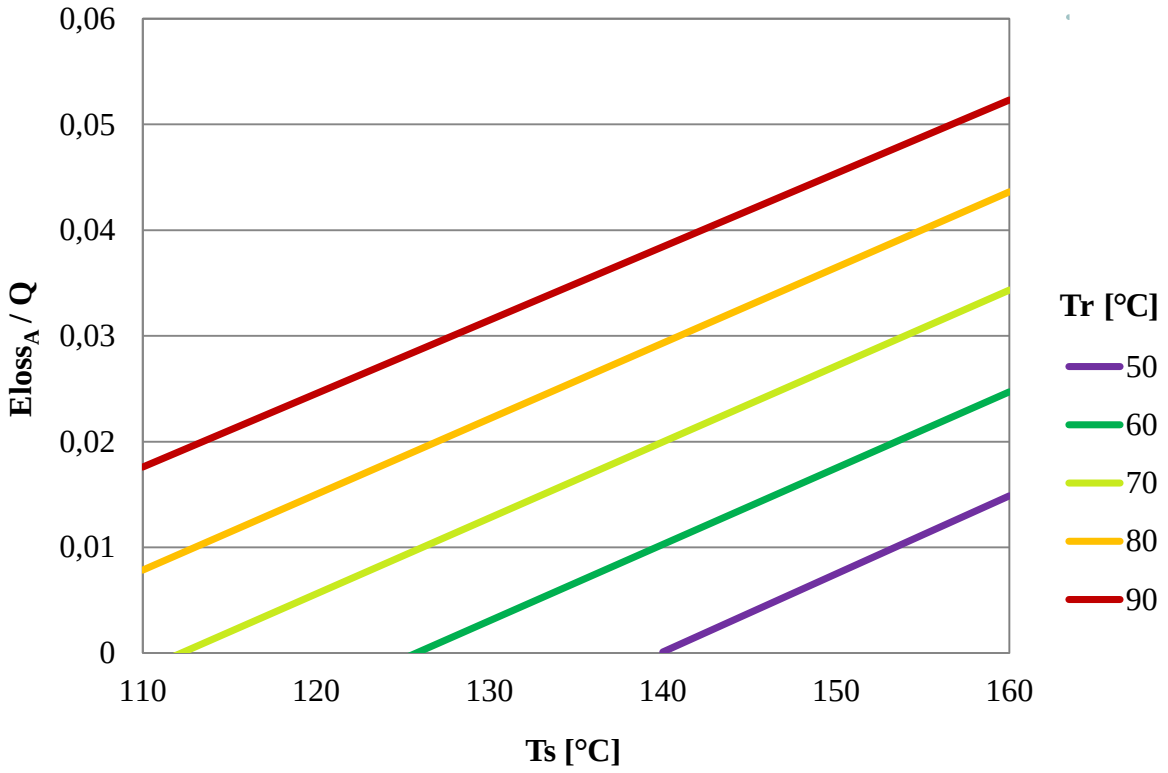


$$E_c = E_s - E_{lossA} - E_{lossB} - E_{lossC}$$

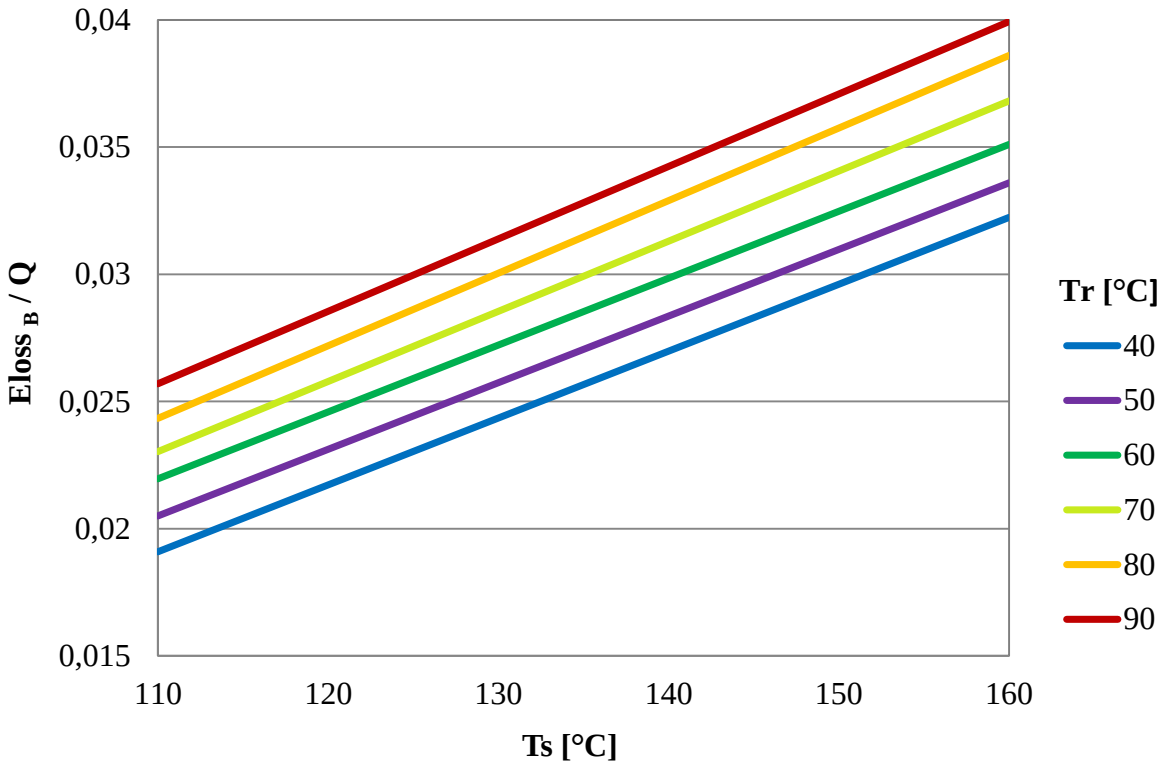
$$\mathrm{E_{lossA}} = \frac{\mathrm{T_w - T_a}}{\mathrm{T_w}} \mathrm{Q_{loss}} = \mathrm{E_{Q_{loss}}} \qquad E_{lossB} = T_a \frac{T_w - T_{wc}}{T_w T_{wc}} Q_c \qquad E_{lossC} = \frac{T_a}{T_w} W_p$$

DH system Velenje

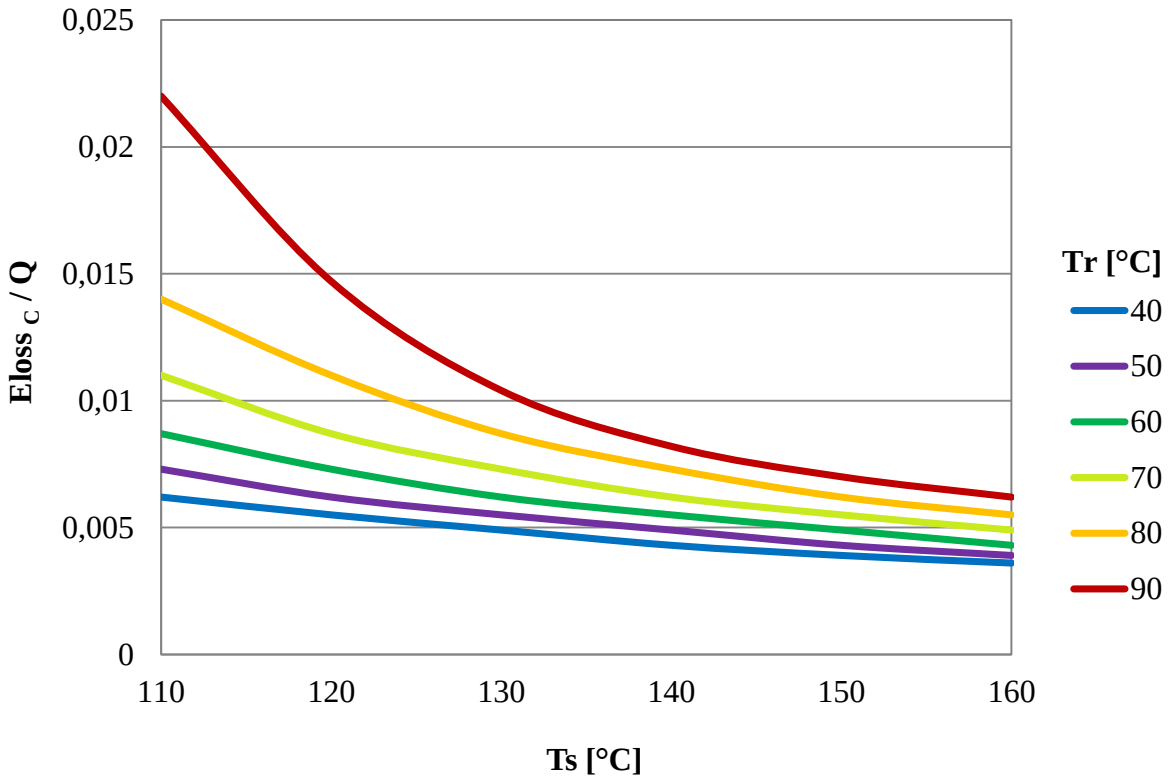
Exergy loss due to heat loss



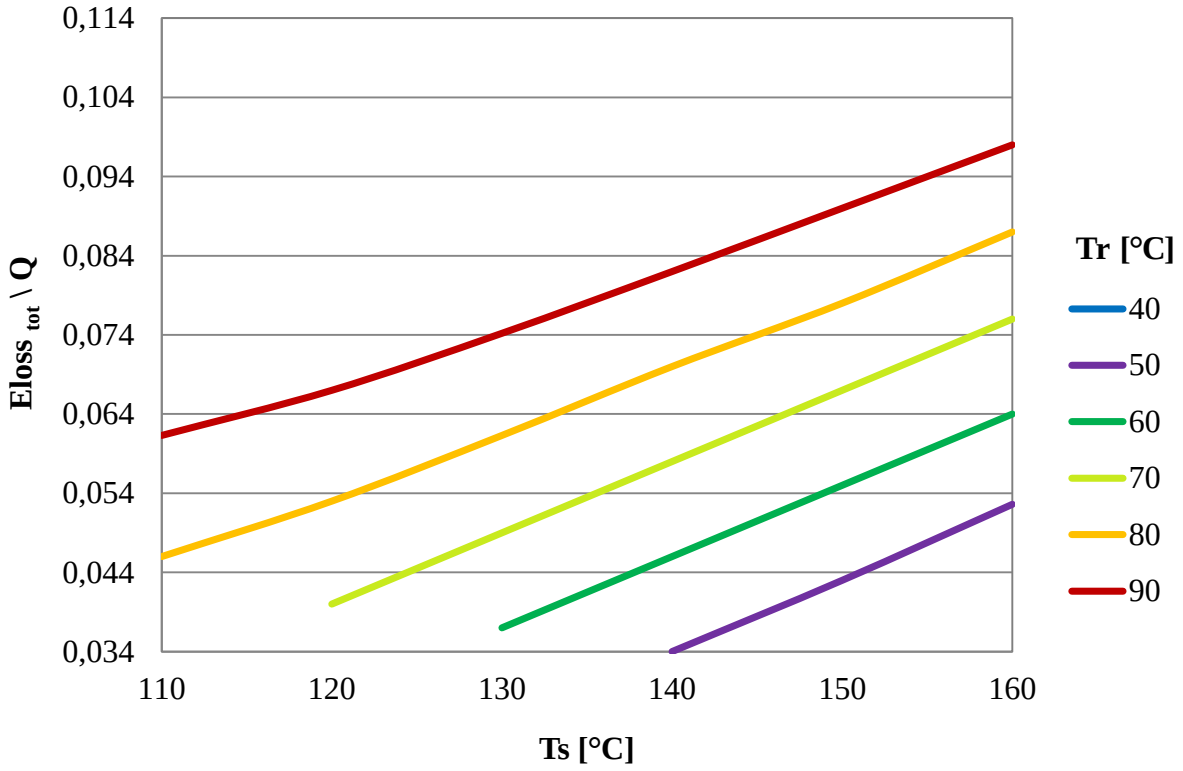
Exergy loss due to heat transfer



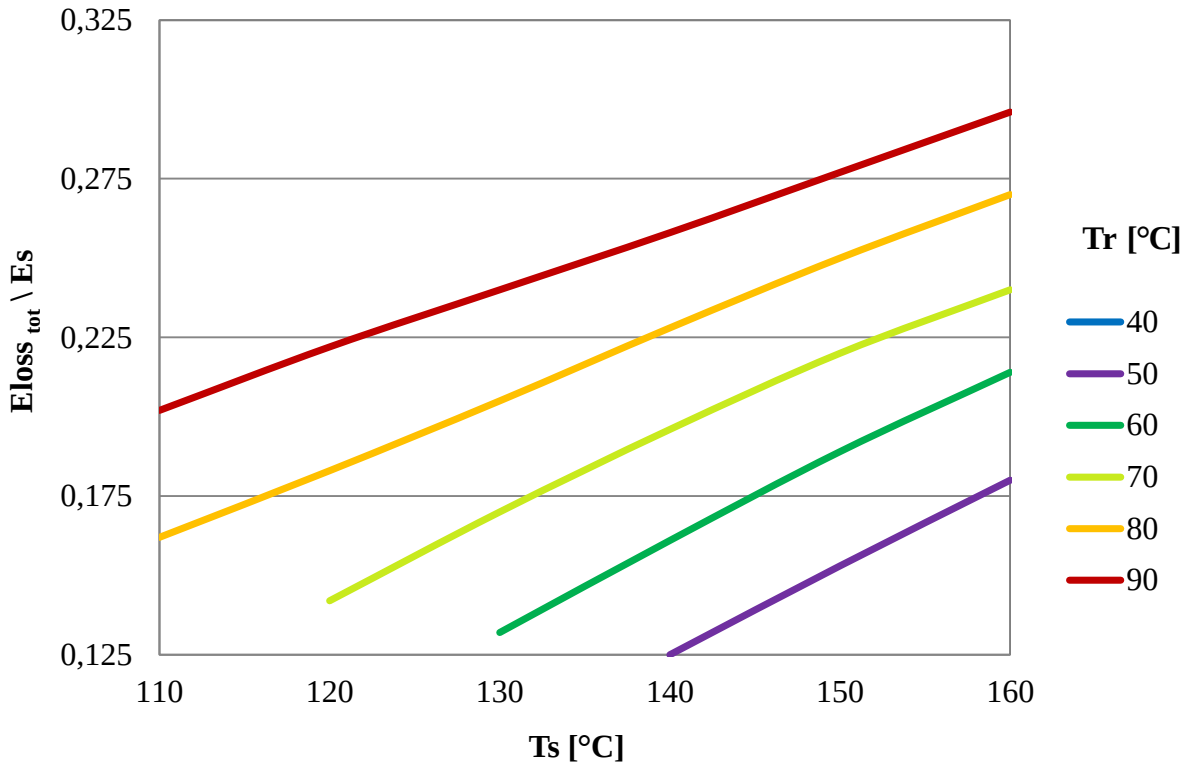
Exergy loss due to supplied electrical energy



Ratio of total exergy loss and total supplied heat



Ratio of the total exergy loss and total supplied exergy of heat



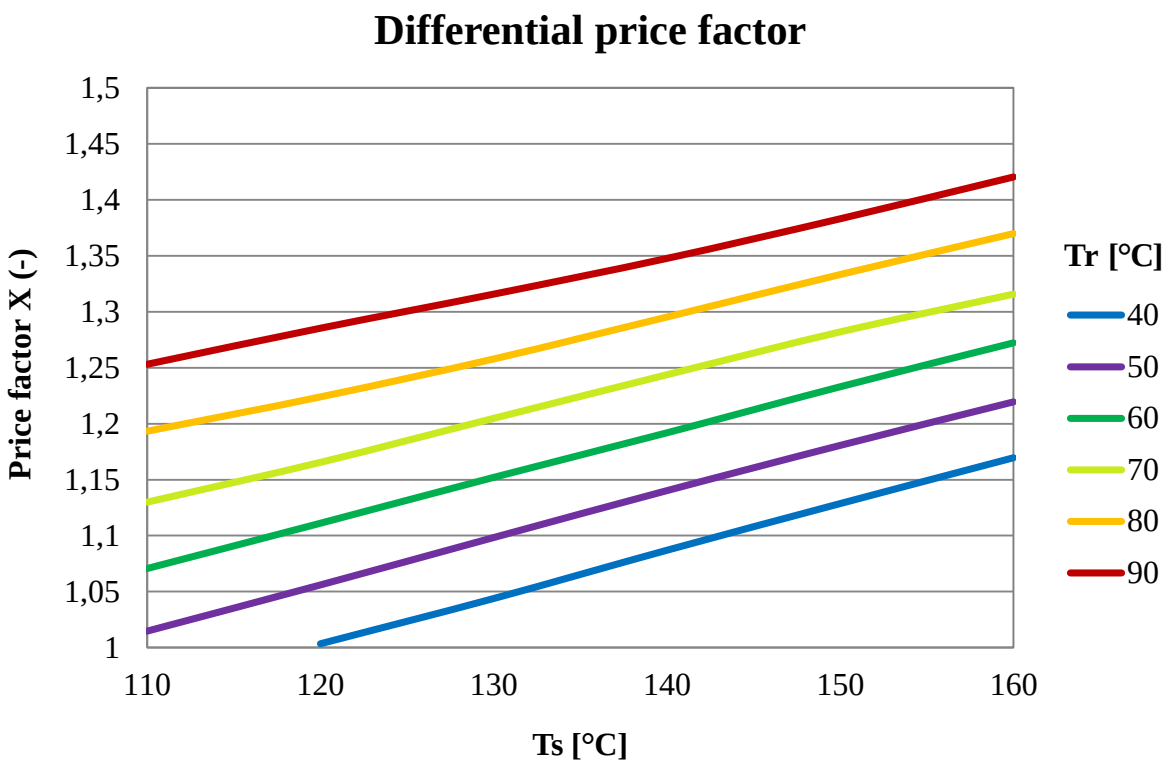
Price factor of thermal energy

$$C_i = c \cdot \left\{ X_i + \frac{(X_i - X_n)}{n-1} \right\} \qquad i=1\ldots n\text{-}1$$

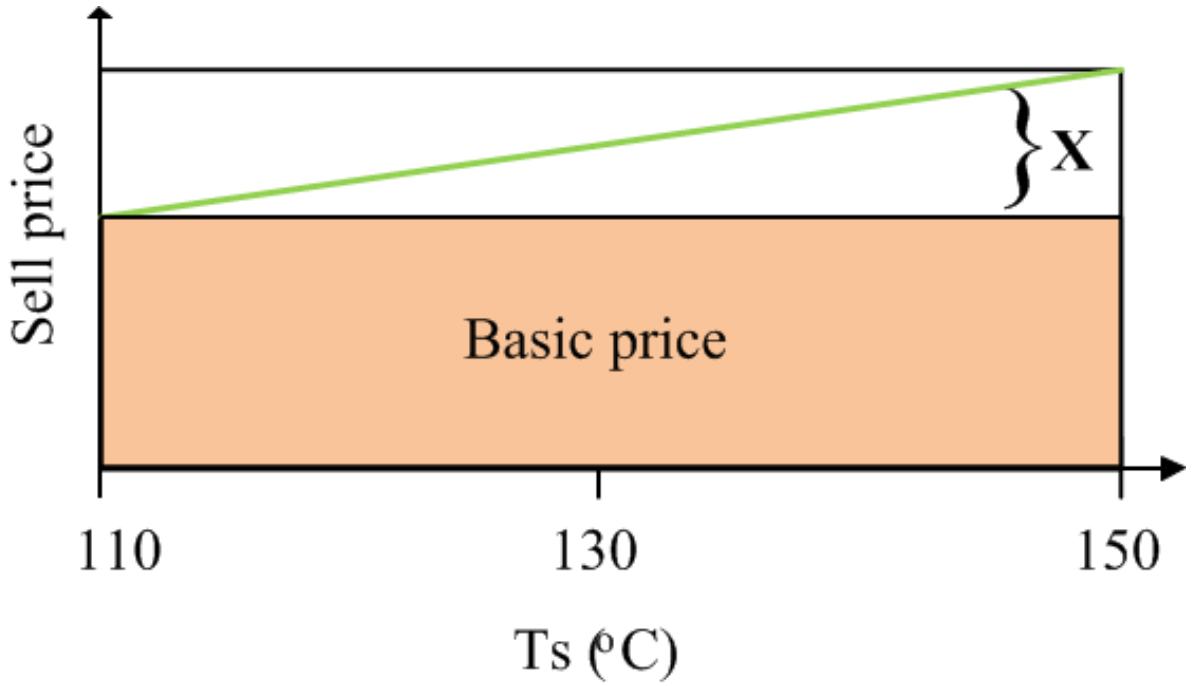
$$\left(\sum_{m=1} X_m - (n-1) \cdot X_n \right)$$

$$X = \frac{1}{\left(1 - \frac{E_{loss}}{E_Q} \right)}$$

Differential price factor



Sell price of thermal energy depending on its quality



Conclusions

Model of heat energy sell price based on differential price factor was implemented in DH system Velenje.

Results:

-Lower heat cost for individual consumer (for building heating - lower temperature heat)

-Higher heat cost for industrial consumer (higher temperature heat)

Industrial consumers decreased required temperature of heat approx 20^{o}C.

Decreased heat losses approx. 12%!

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