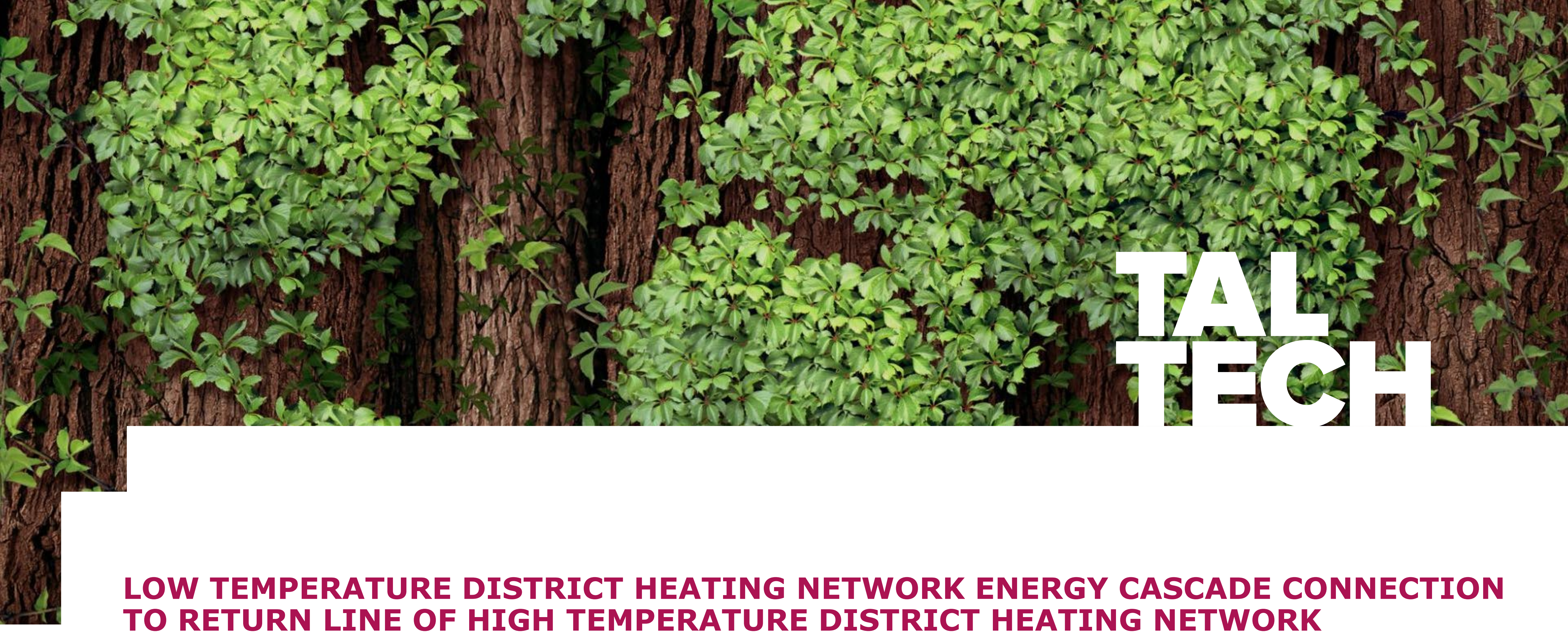

LOW TEMPERATURE DISTRICT HEATING NETWORK ENERGY CASCADE CONNECTION TO RETURN LINE OF HIGH TEMPERATURE DISTRICT HEATING NETWORK

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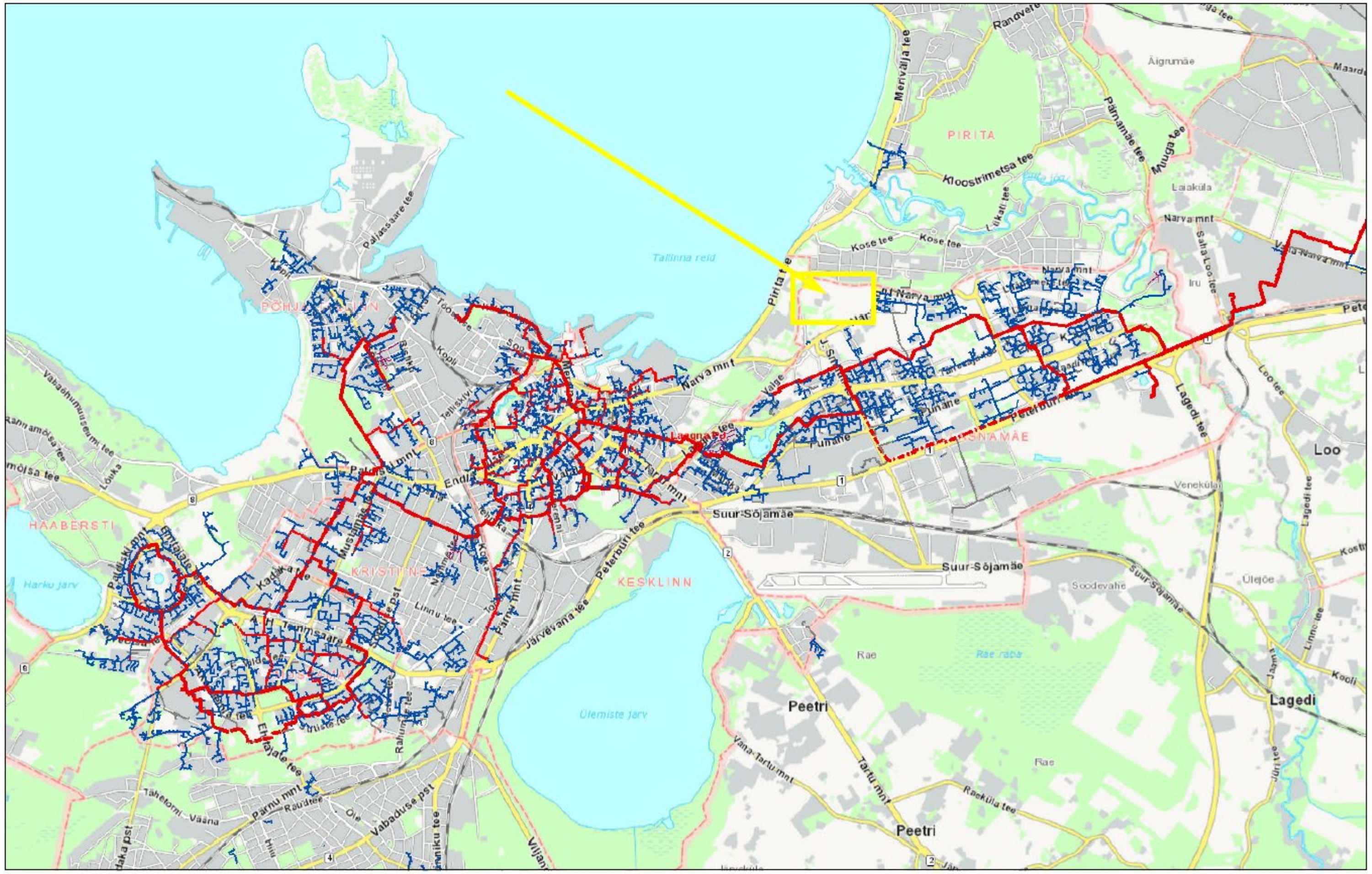
DISTRICT HEATING IN TALLINN, ESTONIA

- Population ca 430 000
- District Heating network from 1956
- Length: 430 km
- ca 70% share of DH
- ca 40% pre-insulated pipes, other in concrete channels
- Age of DH network: 24,6 years
- Heat losses: 13,8%
- Temperature graphic: 115 ^{0}C / 70 ^{0}C
- District Cooling in development stage

REAL OBJECT – LAHEKALDA DISTRICT

- Area: 17 ha
- Development 180 000 m^2
- 37 buildings (mainly flat houses)
- Floor heating + hot water
- Heating capacity 15 MW

LOCATION OF LAHEKALDA DISTRICT



september 9, 2019

1:50 000
0 1 2 4 km

PURPOSED LTDH SOLUTION

- Main DH network: **HTDH**
- Local DH network in Lahekalda area: **LTDH**
- HTDH: 115 ^{0}C / 70 ^{0}C, average temperature of return line 40-50 ^{0}C
- LTDH: 65 ^{0}C / 35 ^{0}C
- Two direct connection options compared:
  - Mixing shunt (return flow from consumer is mixed with supply of DH)
  - Shunt with pumping station (return flow of HTDH is used as a supply flow for LTDH and if needed, additional flow of HTDH supply pipeline is added)
- Techno-economical aspects of these connection options were analysed (heat consumption, electricity consumption, water flow and pressure, additional investments and costs of heating)
- Return temperature decreases in HTDH, caused by LTDH network integration

EXPERIENCE IN OTHER COUNTRIES

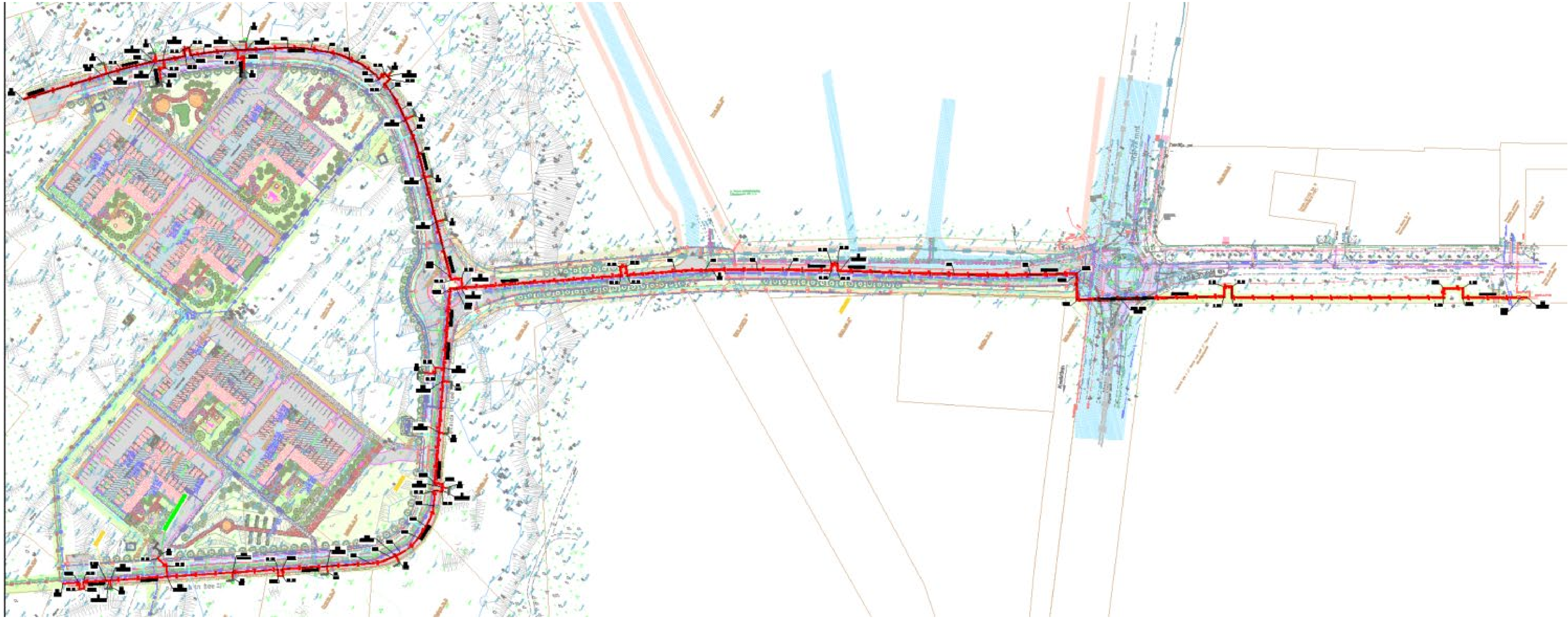
- An LTDHN case study, where heat is supplied from the return pipe of a large DH combined with solar collectors
- Analysis of the case study, where the temperature of return water is increased using a heat pump in order to be subsequently used in LTDH. The economic aspects of this type of solution, including the tariff system, have been examined for Vienna, Austria
- These studies have shown that there is a prospect of using this approach for connecting well-established DH systems to small LTDHN
- Two arrangements have already been tested successfully through pilot projects in Denmark: mixing shunt and 3-pipe connection shunt
- Two types of connections were analyzed: one-stage heat exchanger that uses a mixture of the main DHS return and supply flows and two-stage heat exchanger that is fed by both the main DHS return and supply flows.

EXPERIENCE IN OTHER COUNTRIES

- The economic aspects of this type of solution, including the tariff system, have been examined for Vienna, Austria
- Two arrangements have already been tested successfully through pilot projects in Denmark.
- The first demonstration project for indirect connection was launched in the UK, Nottingham
- An LTDHN case study, where heat is supplied from the return pipe of a large DH combined with solar collectors in Chemnitz, Germany
- Modelling: analysis of the case study, where the temperature of return water is increased using a heat pump in order to be subsequently used in LTDH (Seoul, Korea)

These studies have shown that there is a prospect of using this approach for connecting well-established DH systems to small LTDHN

PERFORMED TWO DIFFERENT DESIGN PROJECTS

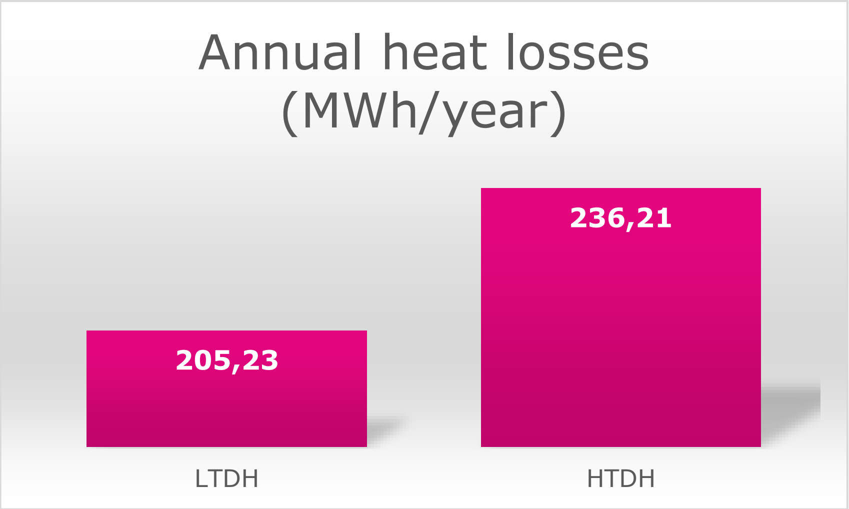


CALCULATIONS (IMPACT ON HTDH NETWORK)

- Avrage ambient temperature (during heating season): +2,3 ^{0}C
- Temperature of supply pipeline, HTDH: +84
- Temperature of return pipeline, HTDH: +35
- Temperature of supply/return pipelines, LTDH: 37 ^{0}C / 26 ^{0}C
- Parameters of HTDH network (with avrage ambient temperature):
  - Capacity: 123,5 MW
  - DH water flow: 874,9 kg/s
- **Temperature of return line of HTDH will decrease by 0,39 ^{0}C** (from 49,7 ^{0}C to 49,31 ^{0}C)

CALCULATIONS OF HEAT LOSSES

- Initial data:
  - Heating period 260 days / year
  - Hot water every day
  - Average air temperature for heating period: -1,5 ^{0}C
  - Average air temperature for non heating period: 14 ^{0}C
  - Price of DH in Tallinn: 57,12 EUR / MWh
- Disantvatages
  - Small increase of pipe diameter
  - Additional pumping inside LTDH network
- Adnvatages
  - Smaller length of pipes (absence of compensators)
  - Smaller insulation thickness



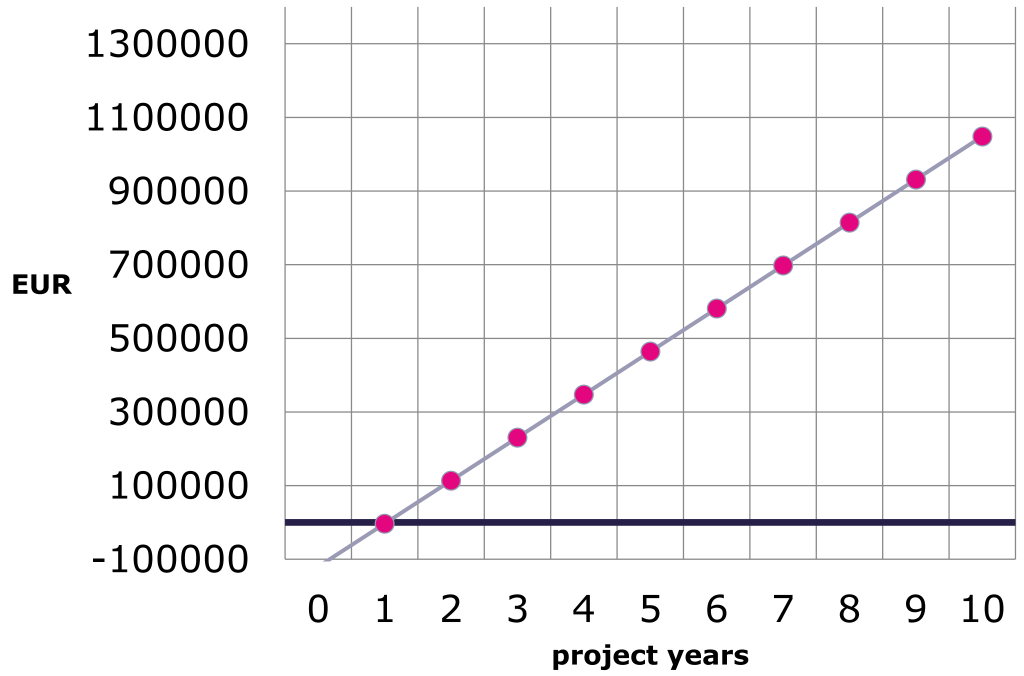
INPUT DATA FOR ECONOMICAL CALCULATIONS

- Additional costs
  - Shunt with pumping station (investment) + annual electricity supply + maintenance
  - Heating substations (bigger heat exchangers; Increase of heating substations price less than 0,1% of building price)
  - DH network pipe sizes
- Savings
  - HTDH return pipeline temperature decrease (impacts efficiency of CHP)
  - Heat losses
- Impact on all parties
  - Developer (pays for construction of DH network + heating substations)
  - Consumer (pays for heating energy based on consumption in MWh)
  - DH operator (investments in pumping station)

WINNERS AND LOSERS

Developer	Consumer	DH operator
Additional investments: LTDHN in comparing with HTDN: 50 000 EUR Bigger heat exchangers: 20 000 EUR	No benifits (tariff in Estonia): consumer pays for MWh	Benifits: return temperature reduction 145 000 EUR Additional investments: pumping station
Benifit: In case developer sells heat energy to consumer - lower heat losses	Benifit: in case of bonus tariff system - lower tariff for consumed heat	Benifits: in case DH operator sells to consumer - lower heat losses

Discounted cashback for solution implementation



CONCLUSIONS

- Existing situation
  - No interest for developer (bigger investments) and consumer (same DH price)
  - Interest for DH operator (payback time 1,5 years)

- Possible win-win-win situation
  - Changing the tariff system (cheaper price for consumer) + smaller primary energy factor
  - Part of investment cost for construction of DH pipelines and heating substations covered by DH operator (the investments for developer would not be bigger compared to HTDH)
  - Explain to society why LTDH is needed and useful

THANK YOU FOR YOUR ATTENTION!

QUESTIONS?