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Lowering supply temperatures: impact on district heating system component parameters (Case study of Maardu town, Estonia)

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4DH
4th Generation District Heating
Technologies and Systems

Opportunities to bring the Maardu old network closer to fourth generation networks

The transition of the old networks to the 4th generation is very important in terms of efficient use of energy resources, reliability and convenience of heat supply.

When building new networks, it is much easier to bring them closer to the fourth generation networks than to rebuild the old network.

Unfortunately, not everything depends on the network operator.

It is possible to replace the old depreciated pipes with poor thermal insulation, and in addition go a little closer to the low-temperature parameters, thus receiving bonuses in the form of low heat loss and the ability to use low-temperature energy sources.

This is possible by reducing the supply temperature to a certain extent, without changing anything in the network.

Opportunities to bring the Maardu old network closer to fourth generation networks

The Tallinn DH network is very complicated and long. The length is more than 426 km. The maximum heat load reaches up to 750 MW in winter. The amount of heat supplied into the network is ~2048 GWh per normalized year, consumption is ~1766 GWh, heat loss of the network is ~283 GWh (13,8%).

The united network of Tallinn and Maardu is supplied by 7 heat sources, three of which are combined heat and power plants CHP, operating on wood chips and waste, the rest are boiler houses running on natural gas. Six heat sources belong to the network operator Utilitas, the heat and power plant operating on waste, belongs to the state electric company Eesti Energia. Most of the heat is produced using renewable fuels, wood chips and waste.

At the moment, one of the boiler houses Mustamäe is being rebuilt into a heat and power plant operating on wood chips.

Opportunities to bring the Maardu old network closer to fourth generation networks

The Tallinn network also supplies heat to the Maardu satellite town network, located east of Tallinn, on a separate main line with a length of over 12 km. The maximum load of the Maardu network is 28-30 MW. The amount of heat supplied into the network is ~89 GWh per normalized year, consumption is ~63 GWh, heat loss of the network is ~26 GWh (28,9%).

At the beginning of its history, about 60 years ago, since 1959 the very high-temperature regimes 150/70 and 130/70 were used in the Tallinn DH network and for the present have been reduced to 120/65.

As a pilot project, we can consider the possibility of transition of the Maardu network, which receives heat via a separate pipeline, to lower temperature parameters.

In this paper, this opportunity is considered.

Opportunities to bring the Maardu old network closer to fourth generation networks

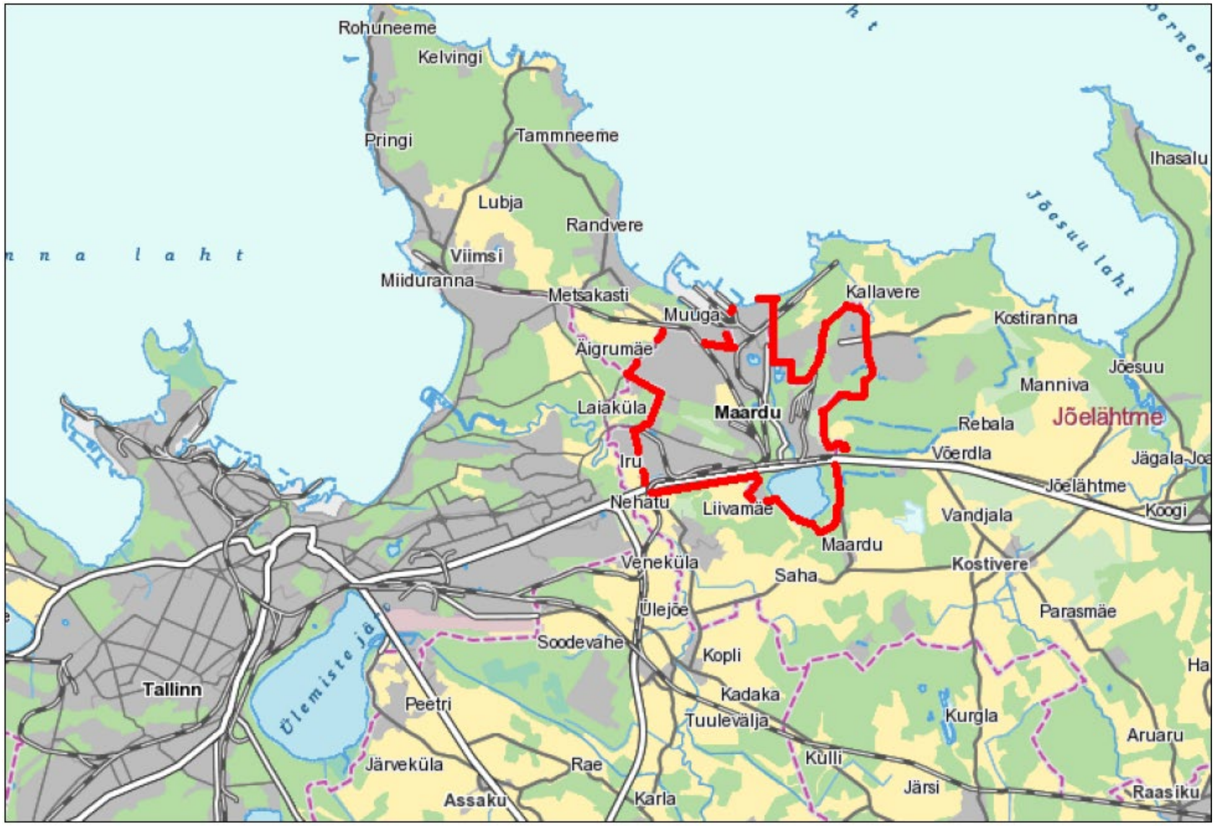
An assessment was made of how much we can still reduce the supply temperature, without changing anything and what limitations there are. The operator has no influence on the return temperature, as there are no mechanisms for this at the moment.

Substations belong to customers and we have the single-component tariffs for heat, take into account only the amount of heat sold in MWh because that we can not influence the return temperature level now.

In the near future, we plan to introduce multi-component tariffs that would stimulate lowering the temperature of return water.

That will reduce the water flow and create prerequisites for further lowering the temperature levels of water.

Maardu town



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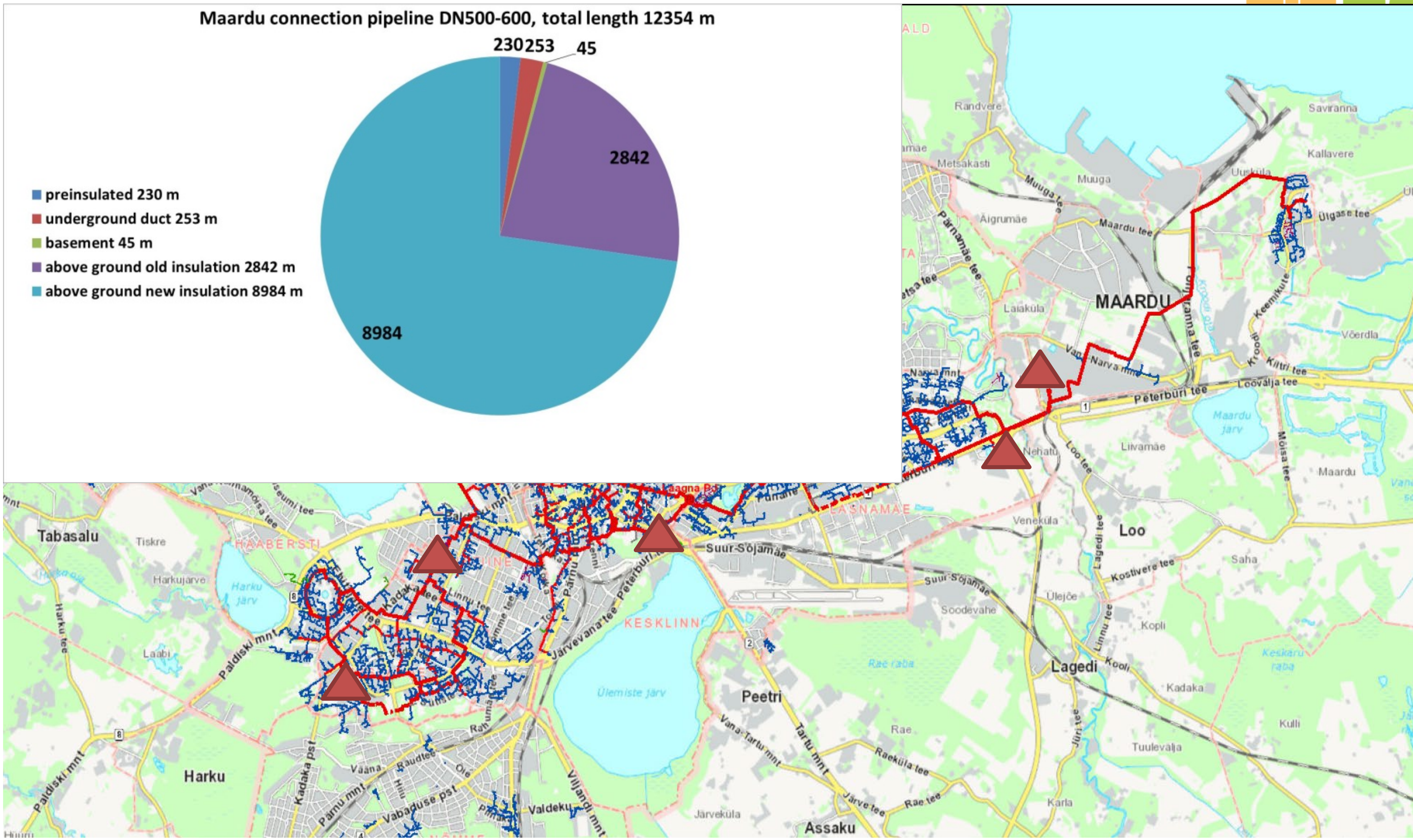
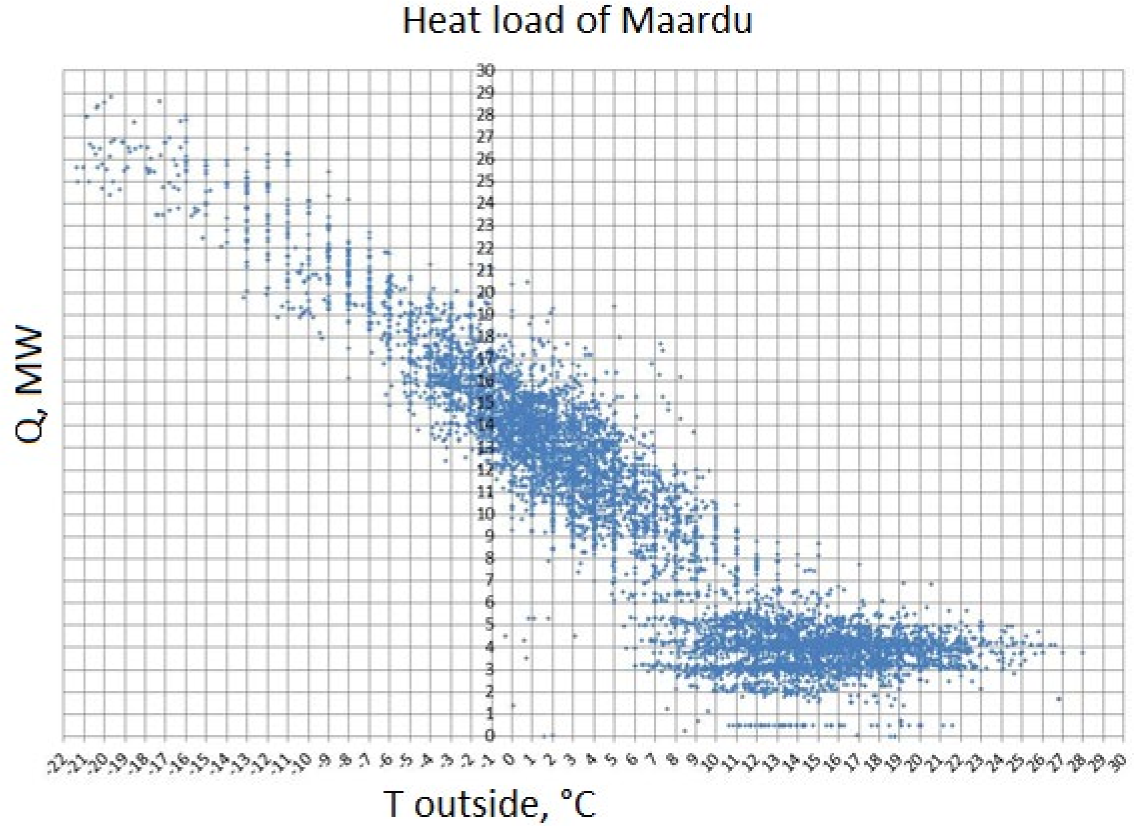
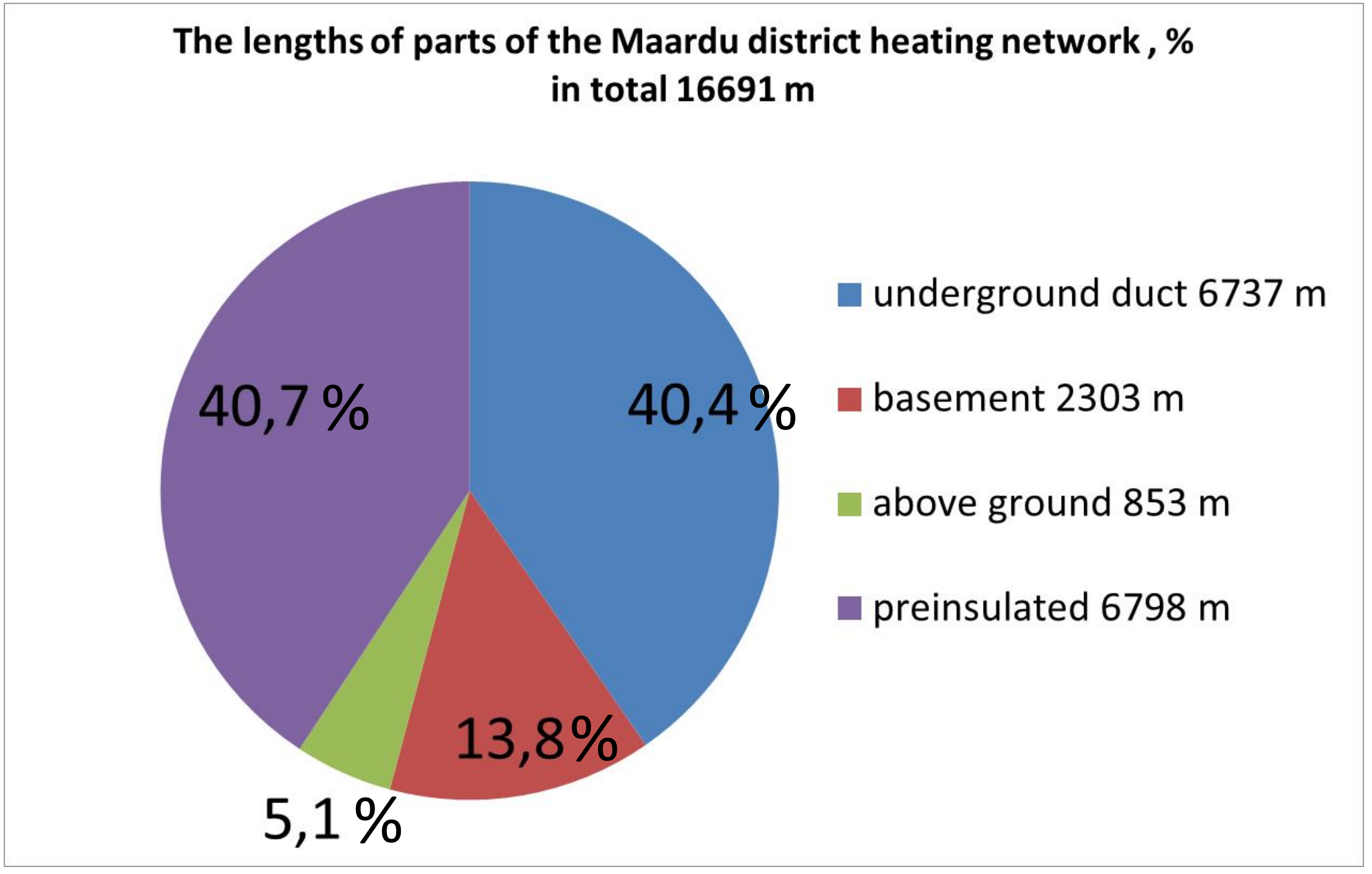
Maardu connection to main network



Heat load of Maardu network



Length of pipes in percentage



Calculation scenarios for lowering supply temperatures

Calculation scenarios	1scenario	2 scenario	3 scenario	4 scenario	5 scenario	6 scenario
Maximum at outdoor temperature -22°C	120/65	115/65	110/65	105/65	90/65	75 const/65
Strategy A average	79,8/50,5	74,8/50,5	69,8/50,5	64,8/50,5		
Strategy B average	79,8/50,5	79,1/50,5	78,4/50,5	77,8/50,5	76,6/50,5	75/50,5

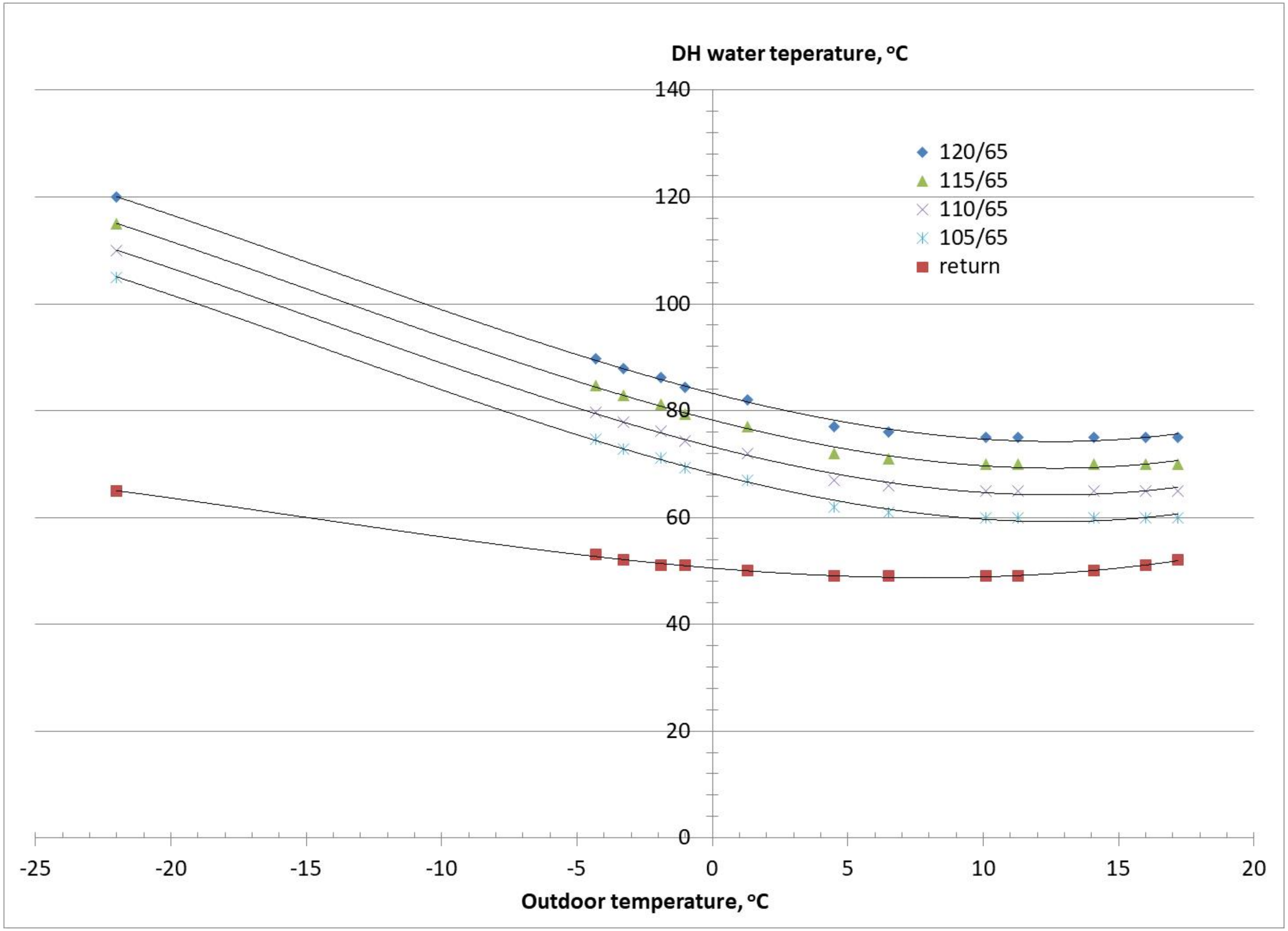
All hydraulic and thermal calculations are made using the Vitec Energy district heating network modelling software NetSim and actual data:

- Real production, consumers consumption and water temperatures data
- Valid climate data, outdoor temperature of last years
- Actual GIS maps data of united Tallinn-Maardu DH network
- Before calculations the model was calibrated according to valid production data

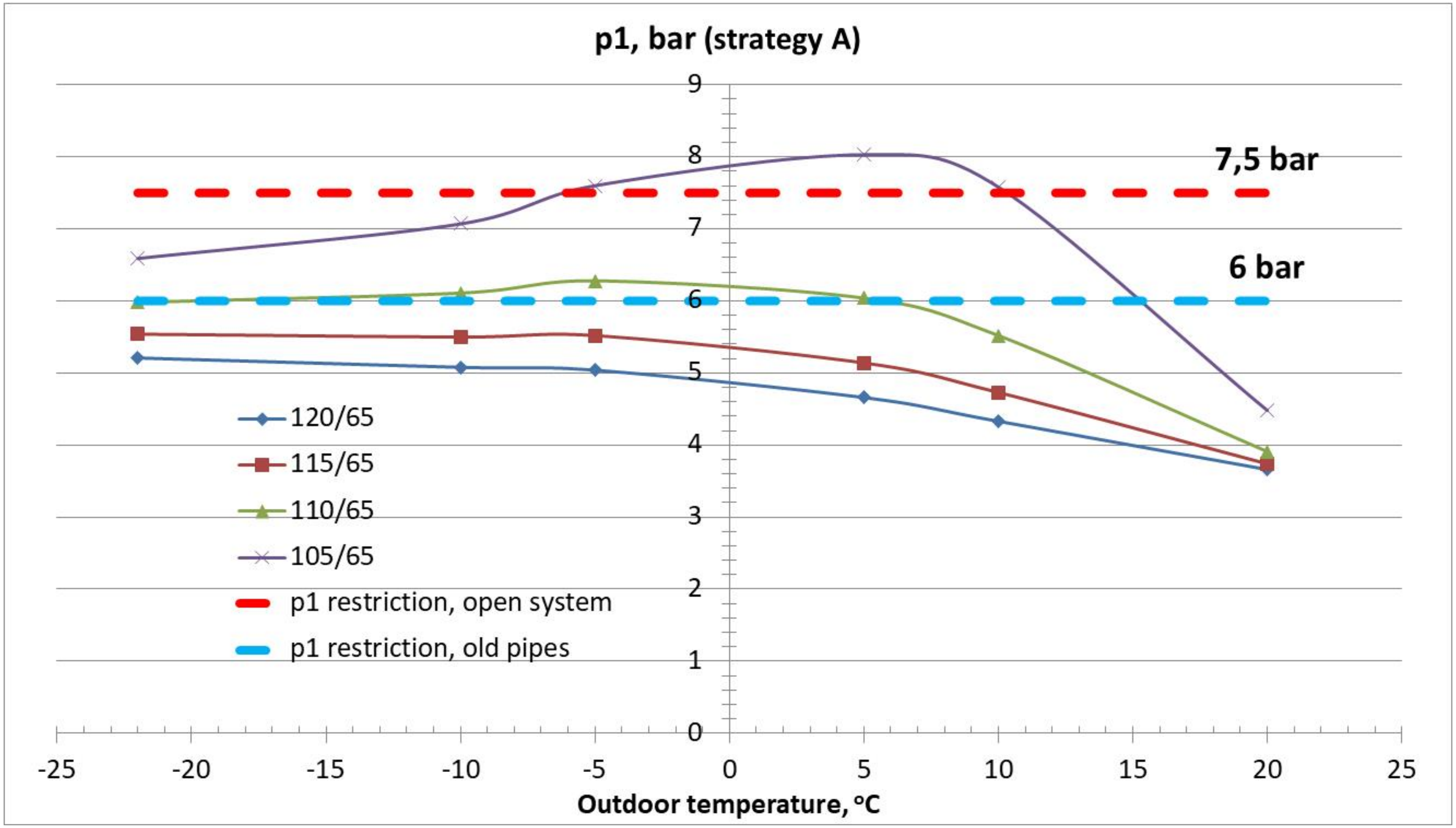
Restrictions

- Insufficient capacity of heat exchangers designed to higher temperature level 120/65 (we assume the presence of 10-20% power reserve in the substations heat exchangers)
- Inlet valves of consumers heat substations designed for lower flow
- Flow measurment part of heat meaters designed for lower flow
- Supply pressure limit 7,5 bar for open (hydraulically connected with network) consumer systems
- Supply pressure limit 6 bar for old pipelines in the underground concrete ducts (outside corrosion of pipes)
- May need new network pumps with bigger capacity

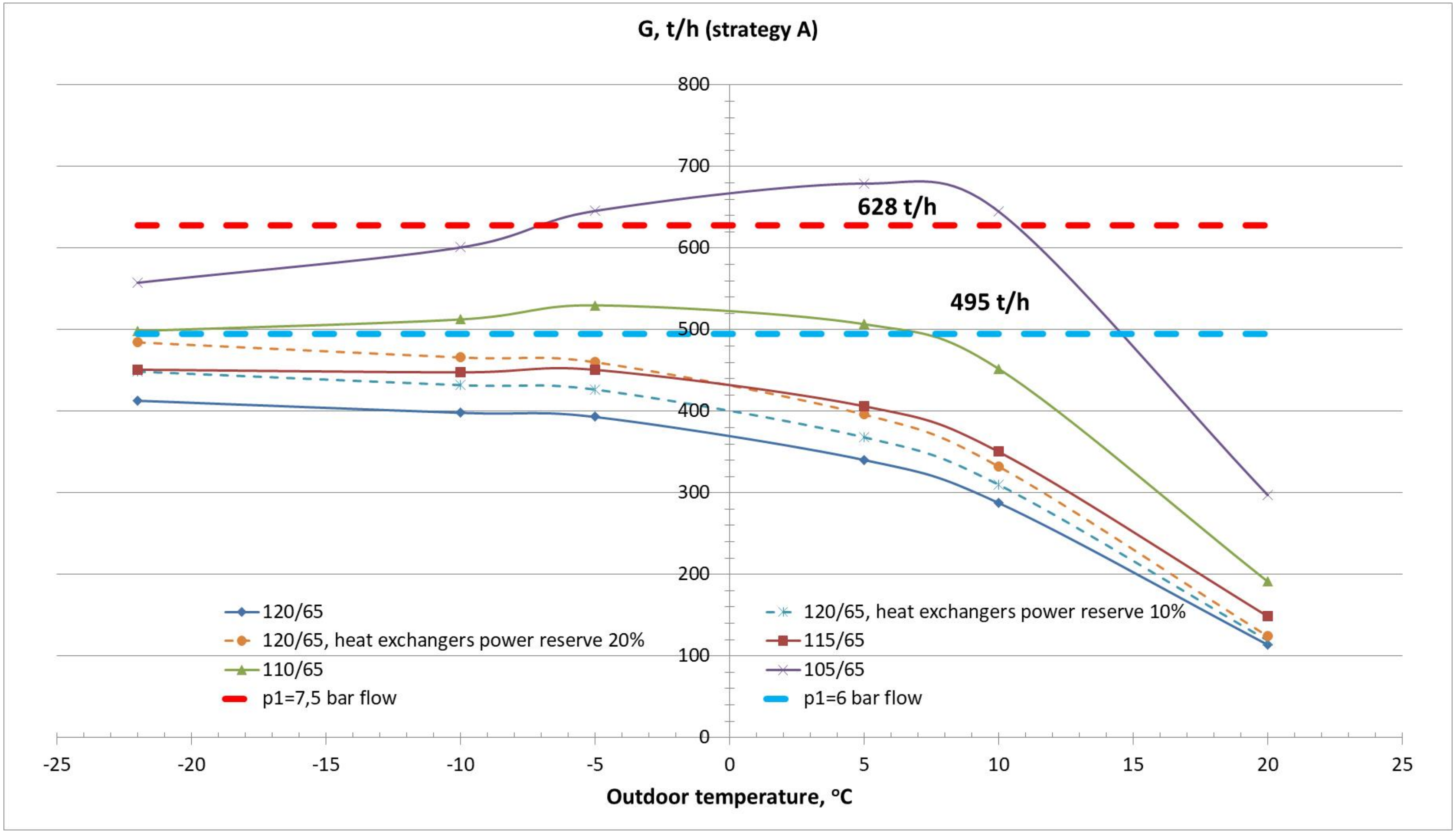
Strategy A temperatures



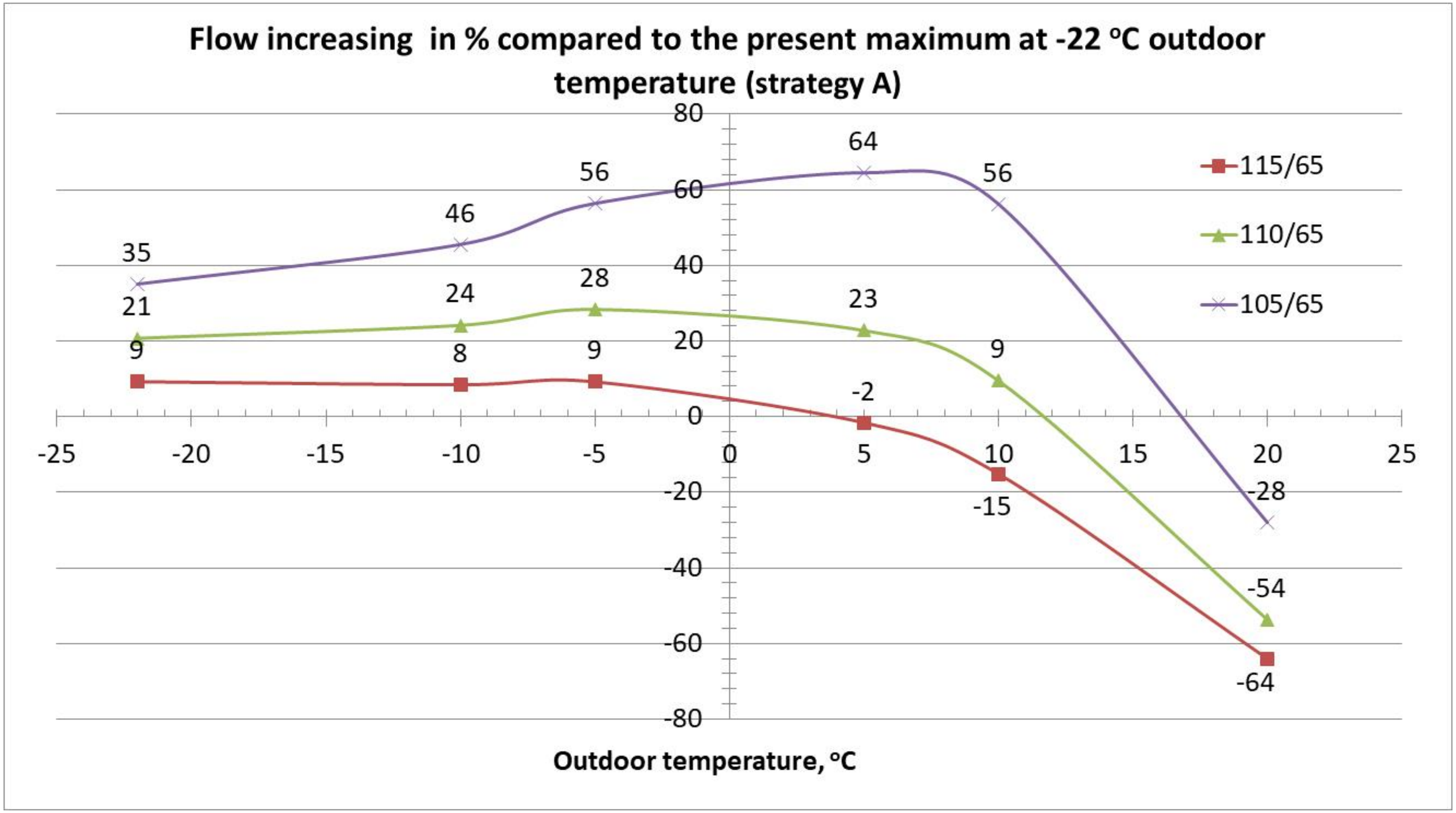
Supply pressure, strategy A



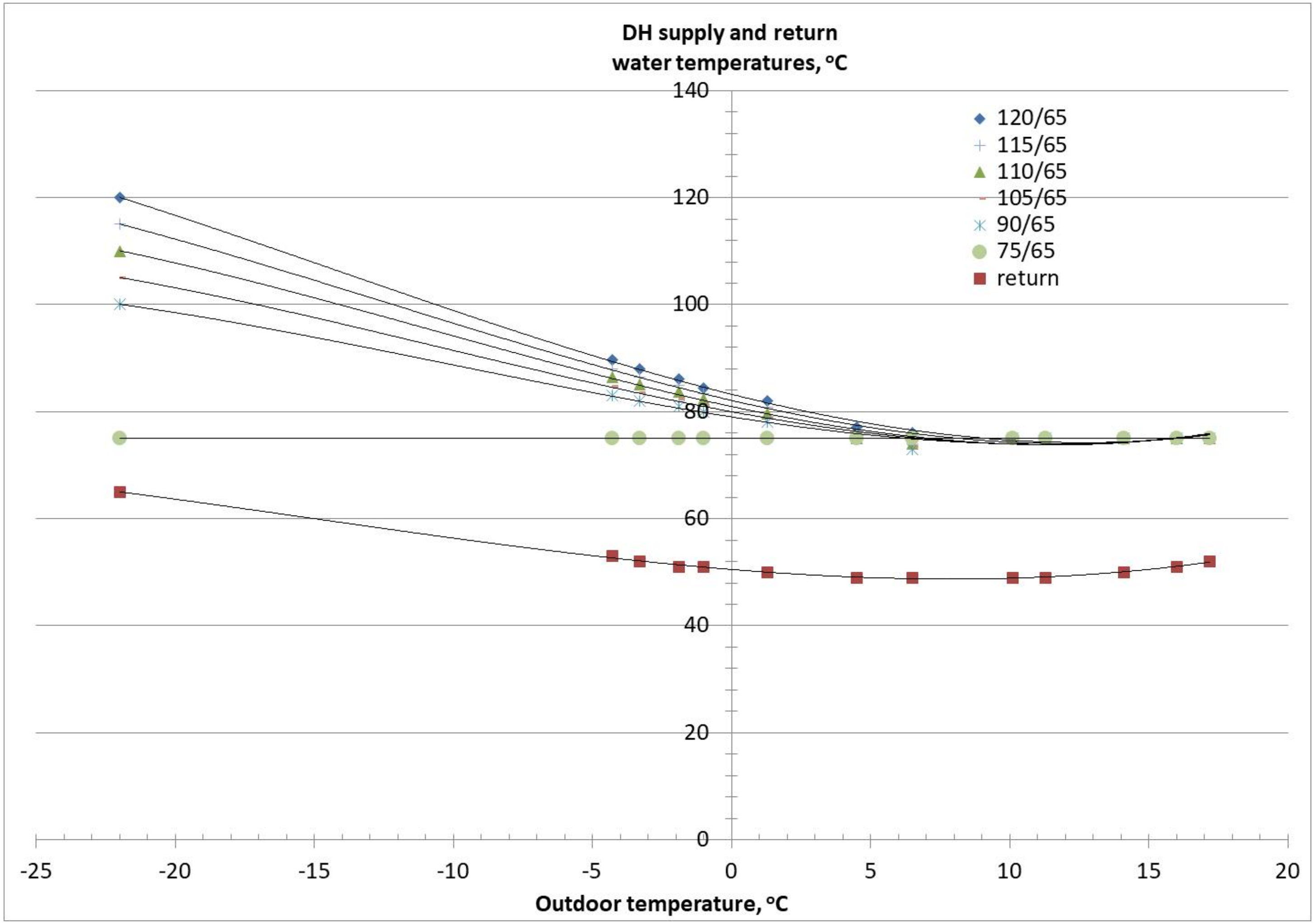
Flow, strategy A



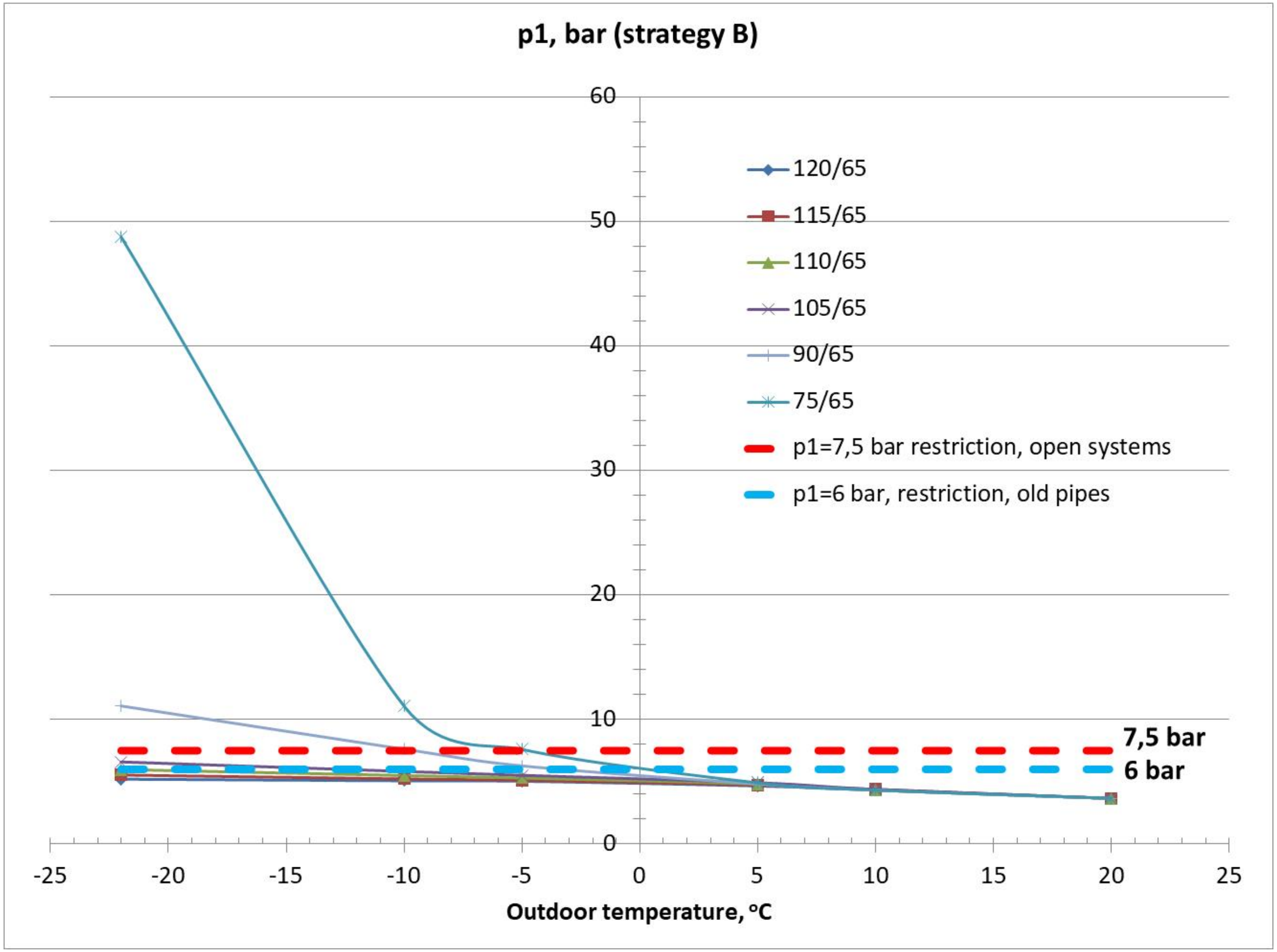
Flow increasing in %, strategy A



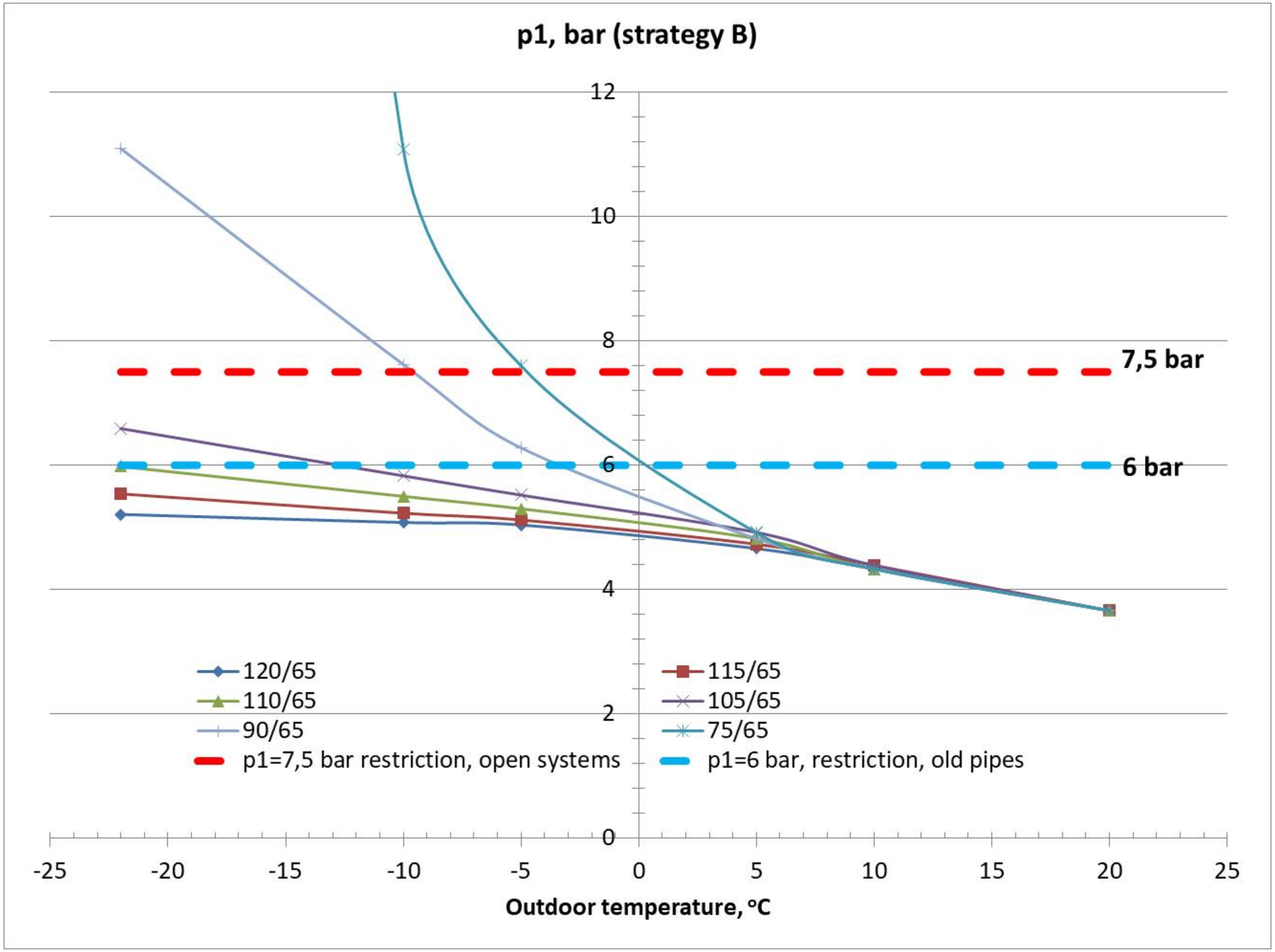
Strategy B temperatures



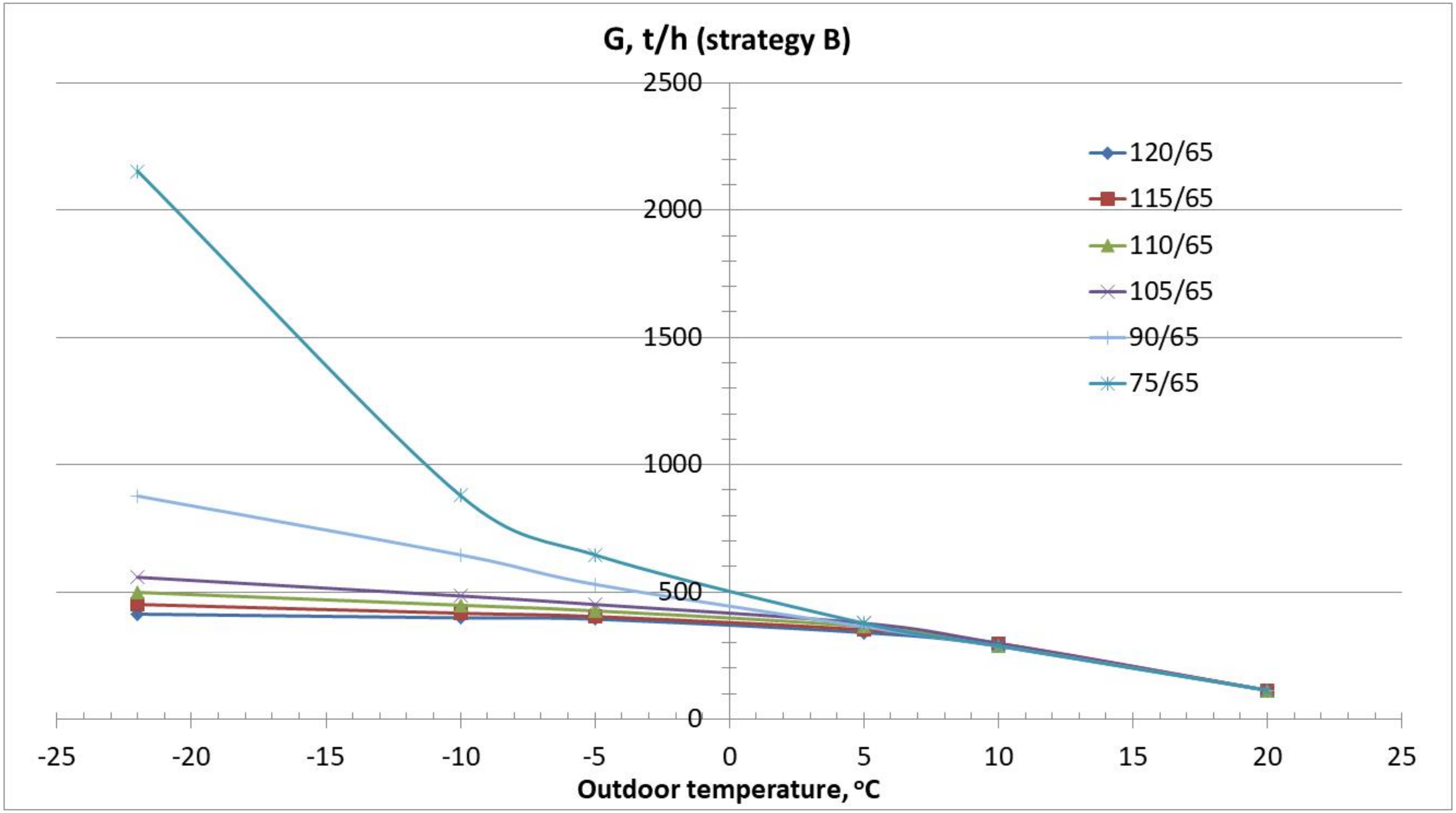
Supply pressure, strategy B



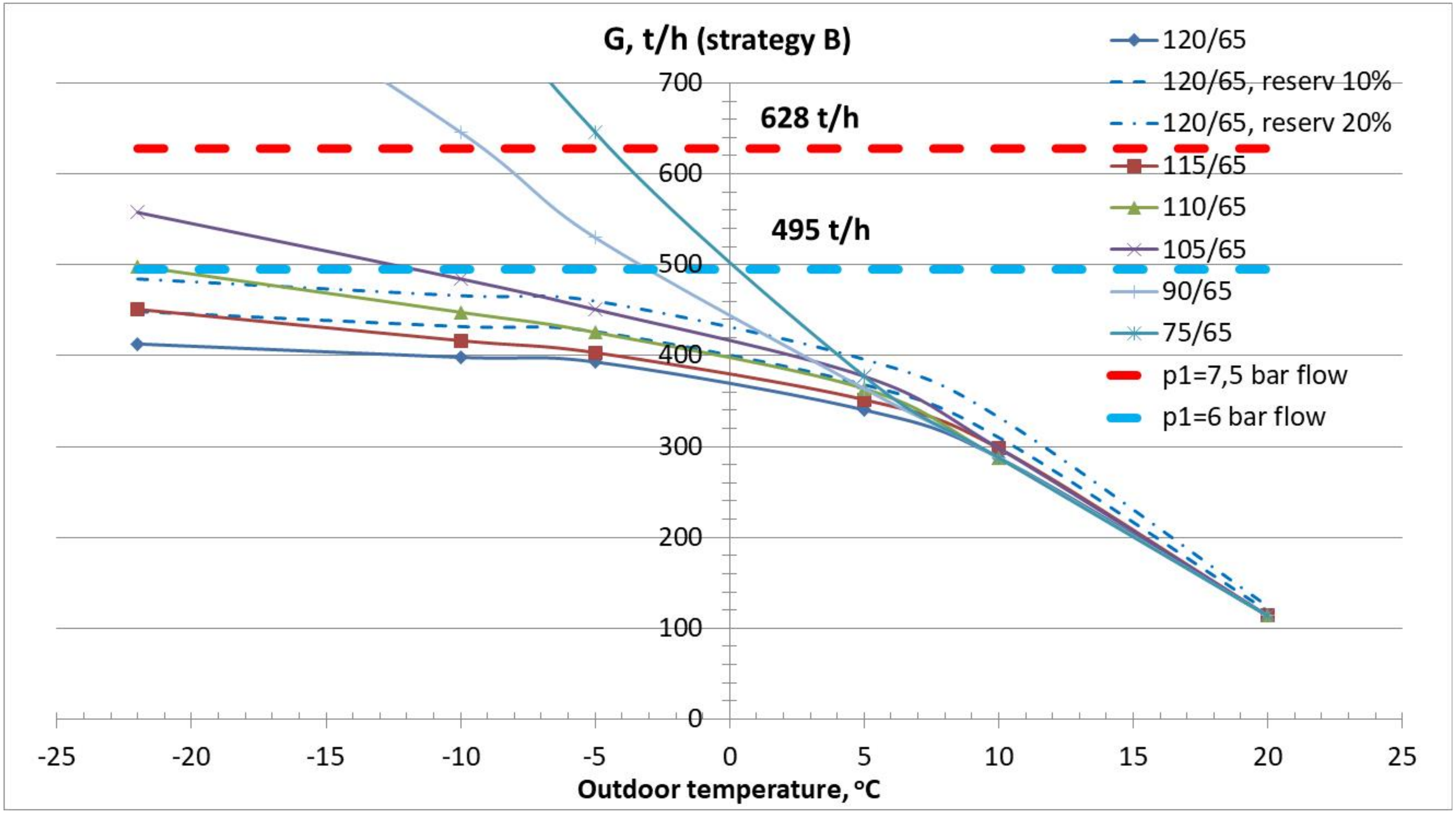
Supply pressure, strategy B



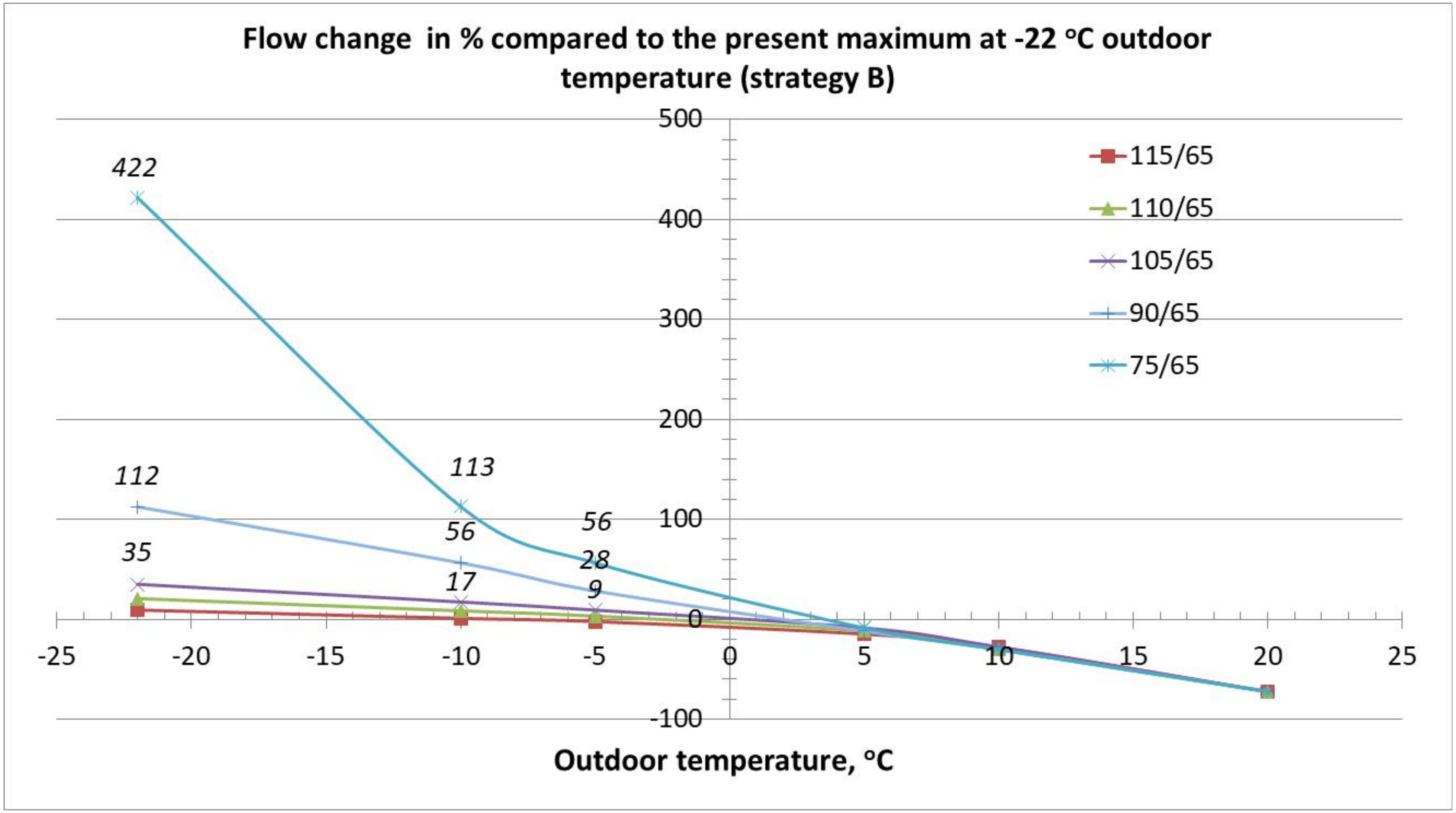
Flow, strategy B



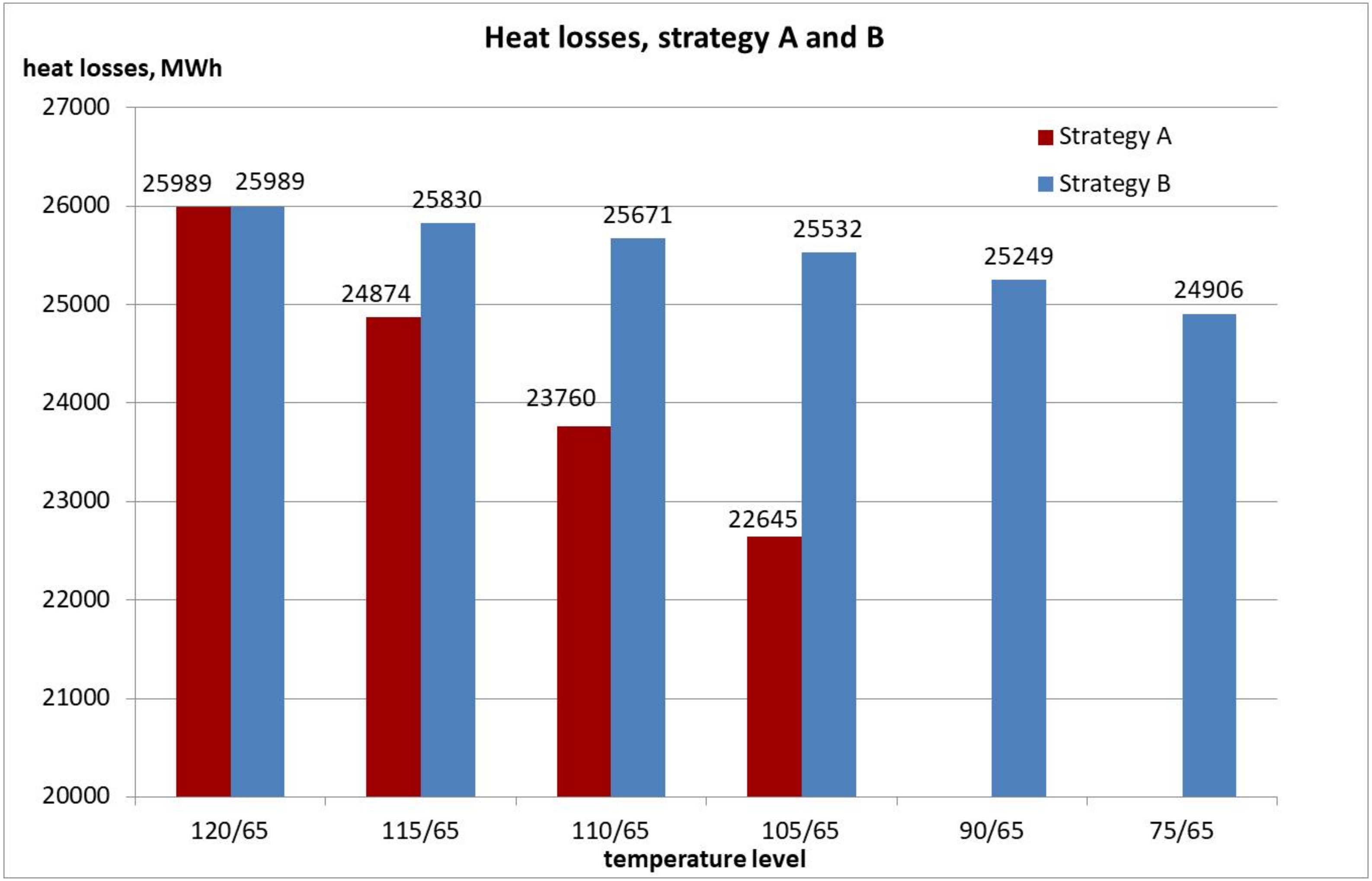
Flow, strategy B



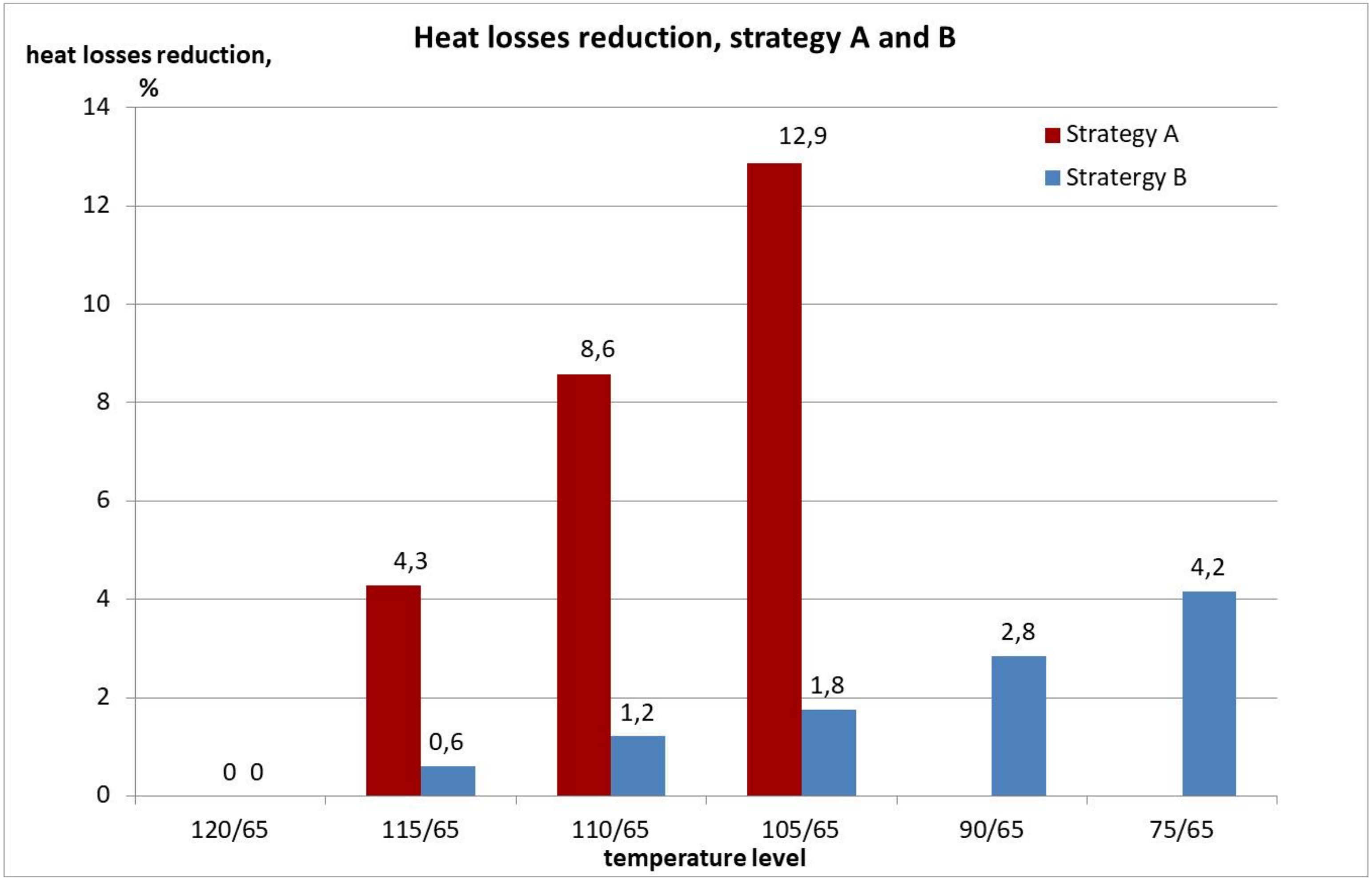
Flow change in %, strategy B



Heat losses, strategy A and B



Heat losses reduction in %, strategy A and B



Conclusions

- For the scenario B it is possible to lowering the temperature level from 120/65 to 110/65 (up to 10 degrees only during the heating period) without any pressure and flow restrictions and get the heat losses saving 318 MWh (1,2% from present 25989 MWh)
- For the scenario A it is possible to lowering the temperature level from 120/65 to 115/65 (up to 5 degrees during the all year) without any pressure and flow restrictions and get the heat losses saving 1115 MWh (4,3% from present 25989 MWh)
- All this temperature lowering will be possible if consumers substations heat exchangers have got the 20% capacity reserve in minimum
- Further lowering of the temperature levels will be restricted in addition to the heat exchangers capacity, also by pressure limits for old pipes 6 bar and consumers open substations 7,5 bar
- Possibilities to reduce temperature levels in old existing network are very restrictive

Thank you!!!