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Controls providing flexibility for the customer **increase comfort and save energy**

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Controls providing flexibility for the customer increase comfort and save energy

Increasing energy prices, together with more demands for comfort lead to further development of DH consumer end technologies. This development involves better controlling and metering possibilities for the individual consumer, so unnecessary heat supplied to the consumer is not wasted. Maximum individualisation of the heat supply is becoming more feasible than ever. In the case of blocks of flats, this brings about thermostatic radiator valves and a district heating unit for the individual flats, the flat station. And blocks of flats include a huge energy-saving potential, as they traditionally make up a big part of the DH consumers in most cities. In the former Eastern bloc countries, they constitute the majority of consumers.

One of the main advantages of the district heating system is its excellent flexibility in utilising waste heat and CHP, as well as most kinds of primary energy sources. It is relatively easy to replace one fuel type with a new one, in case of fuel shortage, or for the purpose of reduction of fuel costs and environmental straining.

Another kind of flexibility is involved with the consumer end of the DH system. The heat supplied from the DH system to the consumer should match the heat demand of the individual consumer as much as possible. Any difference between the consumer heat demand and the heat supplied makes up an energy-saving potential. The energy savings can be obtained by means of local control equipment (temperature and balancing controls).

In theory, it may be possible to design a constant flow heating system with perfect radiator dimensions in a block of flats. In reality, it is not possible to avoid overheating without local automatic controls, for the following reasons: the flows can not be balanced; the dh temperatures are not precise; the insulation effect of a room differ from preconditions; the wind one day is from the south and the next day from the north; the heat balance is influenced by electrical installations and persons in the room; the residents differ in their preferences about indoor temperature (Fig.1), etc. For instance, elderly people and parents to babies

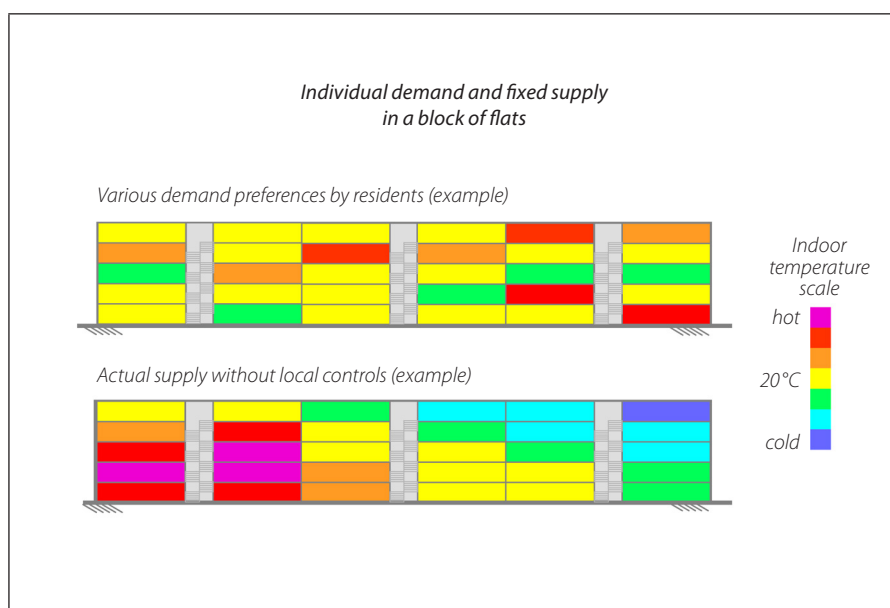


FIGURE 1: In theory, it may be possible to adjust the heat supply to the heat demand without local controls – but not in reality. The figure shows the room heat supply, but the same principle applies to the hot tap water supply.

may choose higher indoor temperatures, whereas lower temperatures are preferred in bedrooms.

In case of heating systems without local controls, it is necessary to overheat one part of the building to ensure that all residents in another part of the building get sufficient heat. This results in huge energy losses related to high indoor temperatures, the so called open window losses

(Fig.2). This design was chosen in many Eastern regions in times with low fuel prices. In later periods of recession, the heat supply was limited, leaving some of the residents with very cold rooms. In this case, an even dispersion of the scarce heat would have improved the average comfort level considerably.

Comfort level is an important factor involved with energy consumption. Economic growth results in increased

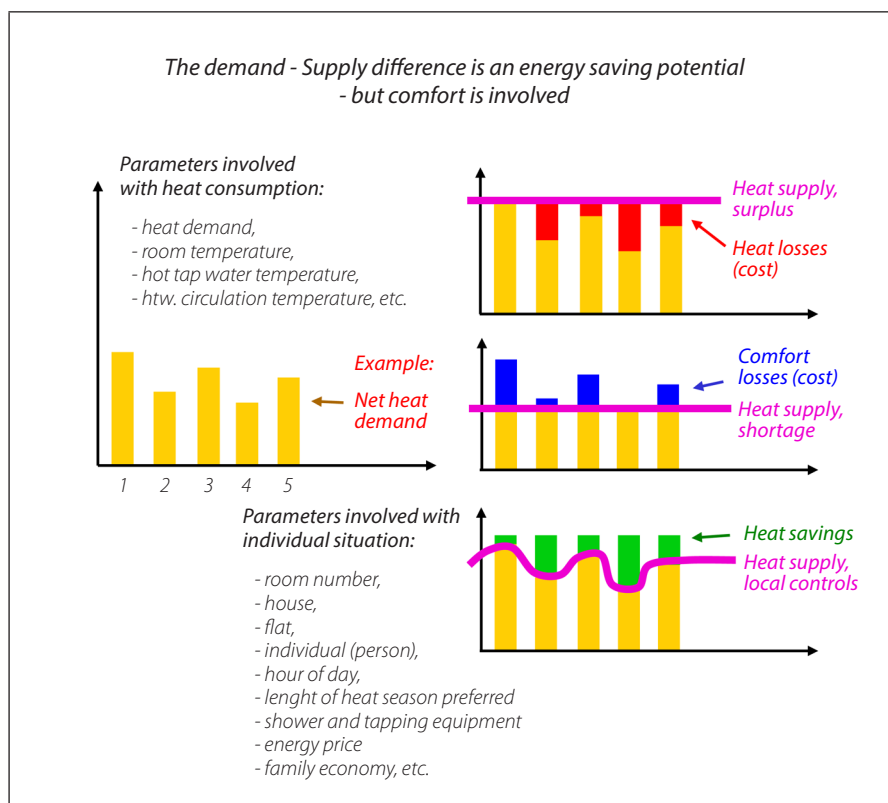


FIGURE 2: Individual needs for heat should be met with individual controls. Otherwise, either comfort, heat, or both, are lost. Note that several parameter alternatives exist on both axes.

demands of comfort, which in case of non-controlled systems leads to a rapidly increasing heat consumption (Fig. 3).

The saving potential of local automatic controls would be underestimated, if the "first sight" savings were not

adjusted according to the development (left side of Fig. 3). The correct reference basis is what the heat consumption of the obsolete system would have been in the future. These conditions, together with increasing energy prices, can make investment in

local automatic controls far more feasible than at first sight.

The most common examples of increasing comfort demands are the available higher indoor temperatures, elongated heating seasons, more air ventilation, and a stable suitable hot tap water temperature. The literature includes extensive formulas for, for instance, how indoor comfort depends on indoor air temperature, draught, radiation, humidity, air dust and chemical composition.

The purpose of automatic control equipment is to fit the heat supply to the individual consumer demands, with a minimum of losses. It is important to distinguish between different levels of individualisation of the control (Fig. 4). The traditional Eastern regional designs are found in the left side of the figure, while the best control quality is found in the right side of the figure.

This design involves thermostatic valves on all radiators and a substation with a heat meter for every flat, the so called Flat Stations. This design allows each family to optimise the indoor comfort and hot tap water preparation with the heat cost from time to time, providing maximum energy savings (Fig. 5).

Evaluation of the energy-saving potential of local automatic controls only becomes credible when also considering the comfort level. Energy

saving data have to be cleaned for differences in comfort level. If the comfort level were not considered, the most efficient energy savings would be obtained by simply turning off the heat! No controls needed! But as far as the future brings increasing demands for comfort as well as energy savings, a maximum individualisation of controls is the most relevant issue.

Another important effect of the flat station design is that the authorities relatively quickly can obtain optimal energy savings by raising the energy price during energy crises. It should be kept in mind that building distribution systems are normally constructed for the purpose of lasting several decades, while energy crises can occur within unexpectedly. This is especially relevant for many European countries which rely on imported primary energy.

The third important effect of the flat station system design is that installations are maintained, as their condition influence the consumer's bill directly. Experience shows that jointly owned substations hidden in cellars are poorly maintained, causing unnecessary losses and too high return temperature in the DH pipe network.

As for the riser pipe system, the basement is filled with hot tap water and room heating pipes connected to several riser pipe pairs drilled up through the floor and ceilings of flats (Fig. 6). According to the literature, the HTW system heat losses are bigger than the net heat for preparing the HTW.

As for the flat station system, the basement only includes DH pipes connected to one DH riser pipe pair in each staircase.

All HTW and room heating pipes are placed inside the flats, usually behind nice-looking skirting boards. (Hydraulic separation and/or a main heat meter in the basement is still an option, if required).

As for the riser pipe system, the HTW and circulation pipes are kept hot all the time, causing considerable pipe heat losses, and, by the way, the risk of hygienic problems may be increased (Fig. 7). Only 20 – 30 % of the HTW and circulation pipe heat losses is utilised for room heating, the rest are final losses.

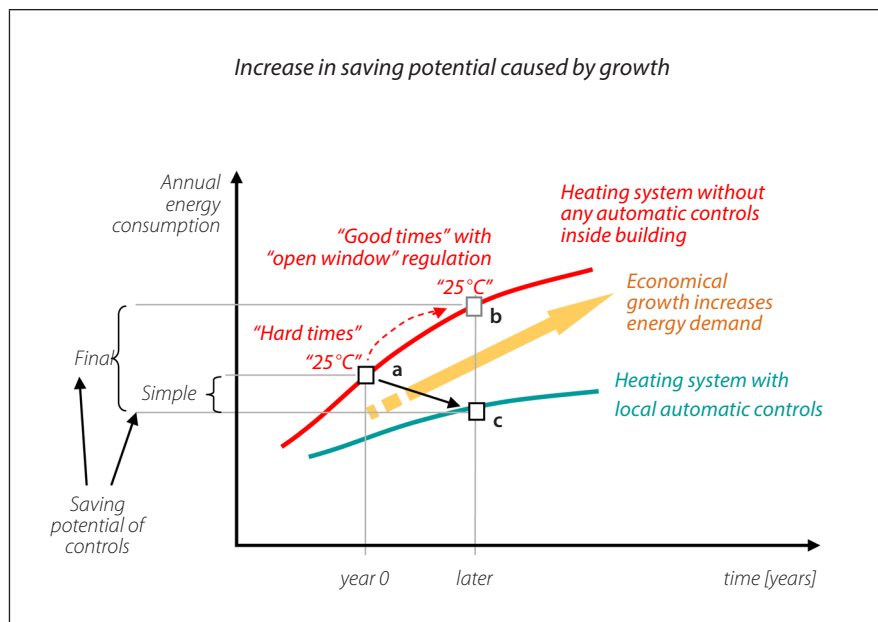


FIGURE 3: Within unregulated systems, economic growth results in a substantial increase in heat consumption and an increased saving potential through local automatic controls. The leftmost side of the figure indicates a tempting underestimation of the final savings potential.

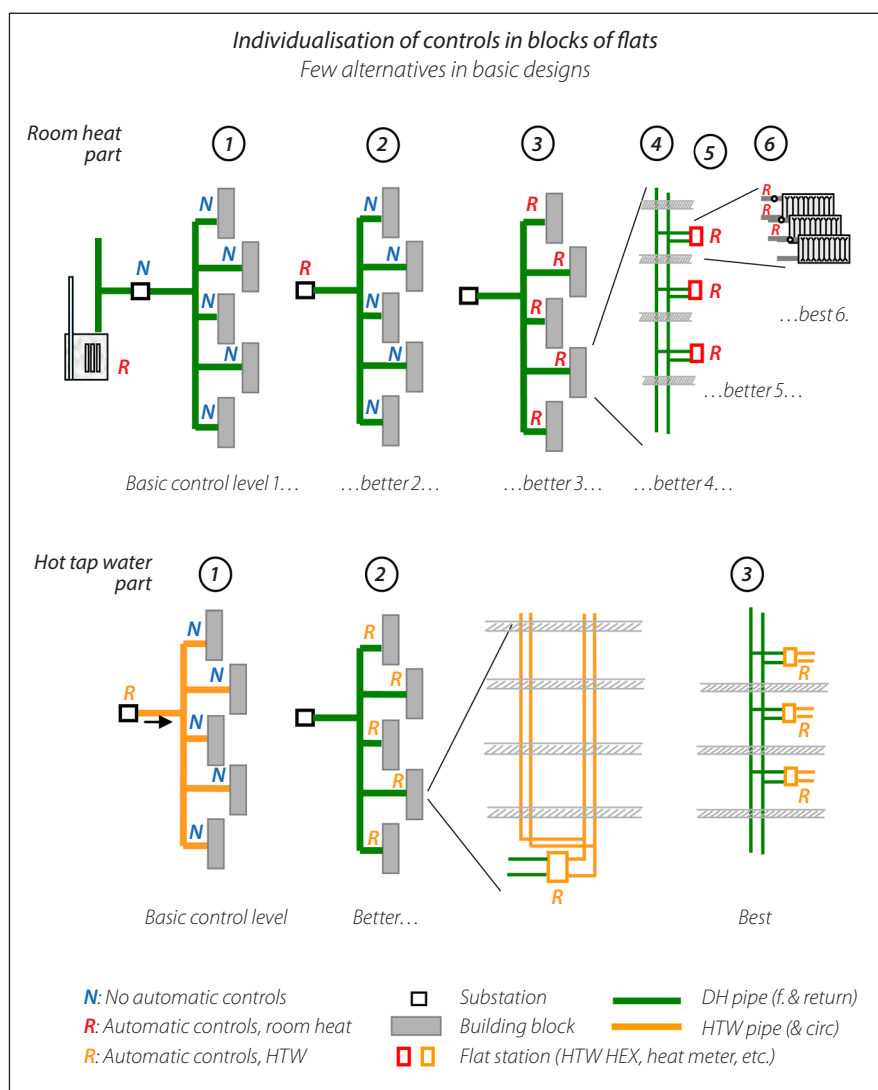


FIGURE 4: There are several levels of individualisation of control equipment. They heavily influence both the energy consumption and the comfort level.

As for flat station systems, the HTW pipes are mostly idle, and most families would not utilise a circulation pipe, or only shortly according to a timer function. Even if the total length of pipes is slightly larger in case of flat station systems, the heat losses are lower due to operation time of the different parts of the system (Fig. 8). And as for investment, it is more convenient to lay horizontal pipes inside flats than to drill riser pipes through concrete floors.

The piping makes it possible to make individual adjustments of the room heating season. A resident on the top floor would typically prefer the longest heating season. In riser pipe systems, this would keep all risers hot for an extra 500 hours. In case of flat station systems, this makes no difference. An example of energy savings related to individualisation and comfort demand.

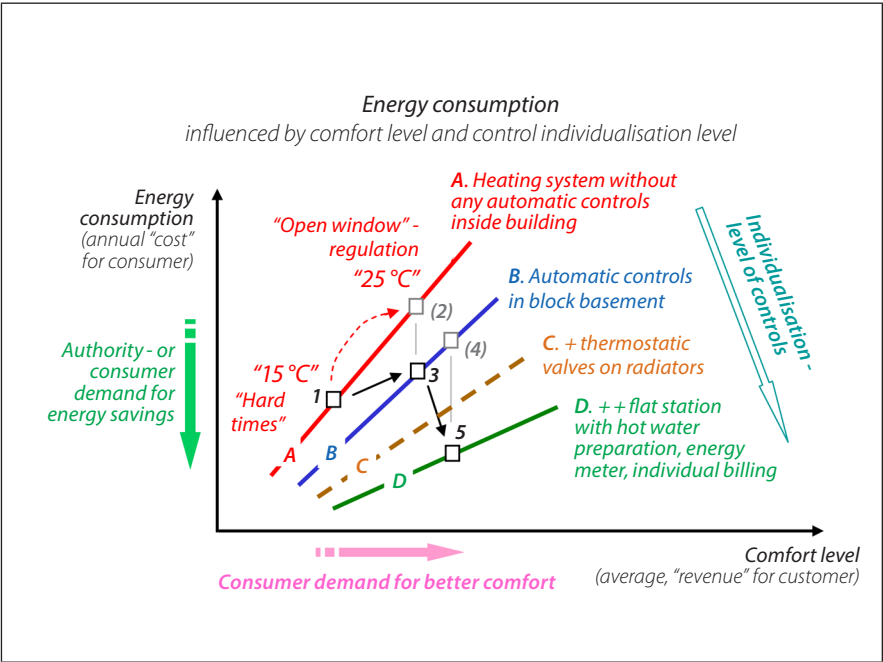


FIGURE 5: The increasing demand for both comfort and energy savings urge the individualisation of automatic controls. The most reliable energy savings are achieved in a system where the individual consumer is allowed to optimise comfort and energy cost (system D).

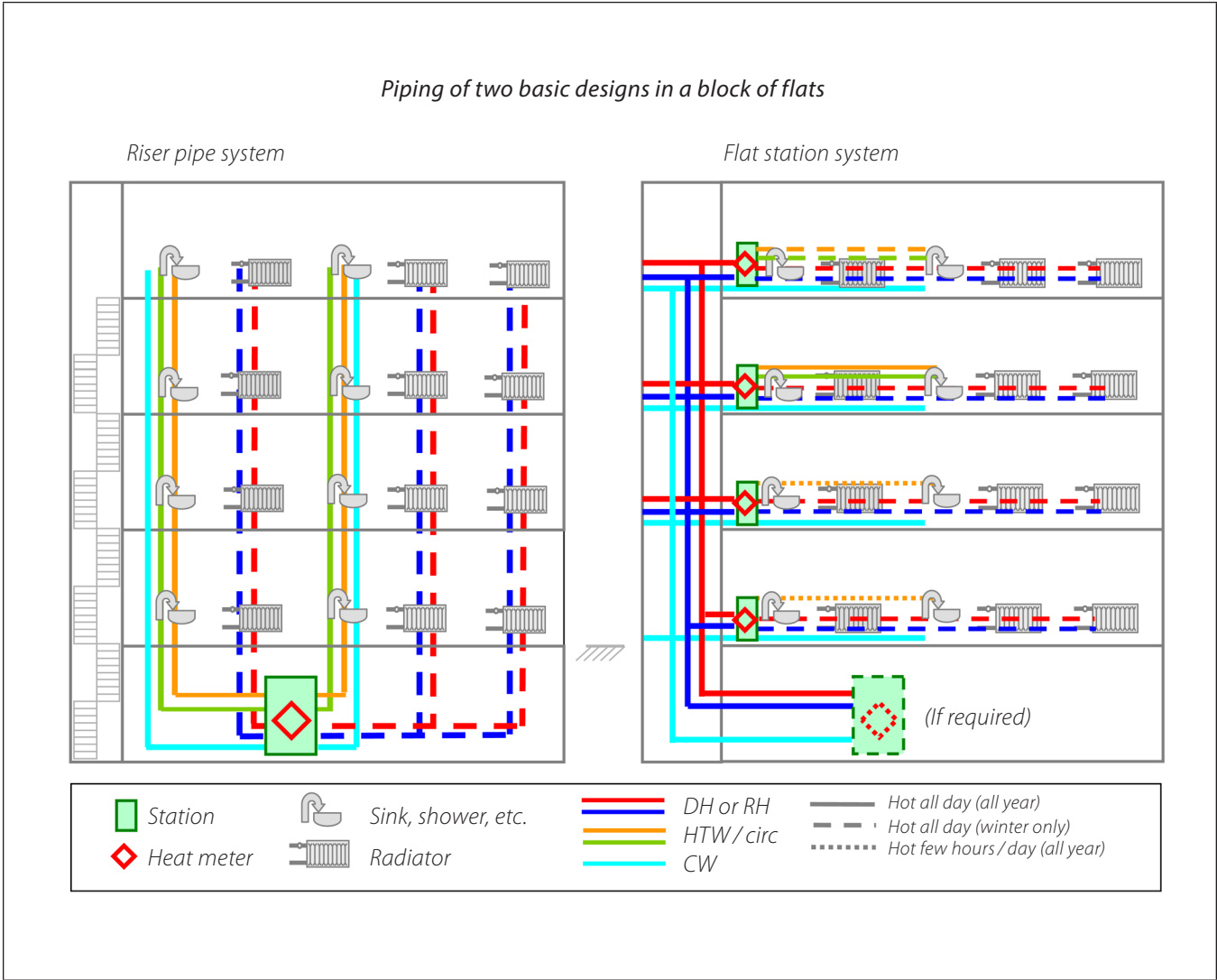


FIGURE 6: Principal geometrics and operation modes in case of two basic designs of heat supply system.

According to measurements of a few groups of houses in Denmark between 1991 and 2005, individual billing resulted in savings of 15 – 30 %. Savings of 15 %, out of an energy cost of EUR 1,000 per year, would generate EUR 1,500 for the consumer over the next ten years, provided that energy prices are fixed. But energy prices will probably not stay constant for long - as it is with the demand for comfort in many countries.

The flat station design principle is an important opportunity for energy saving activities in the near future.

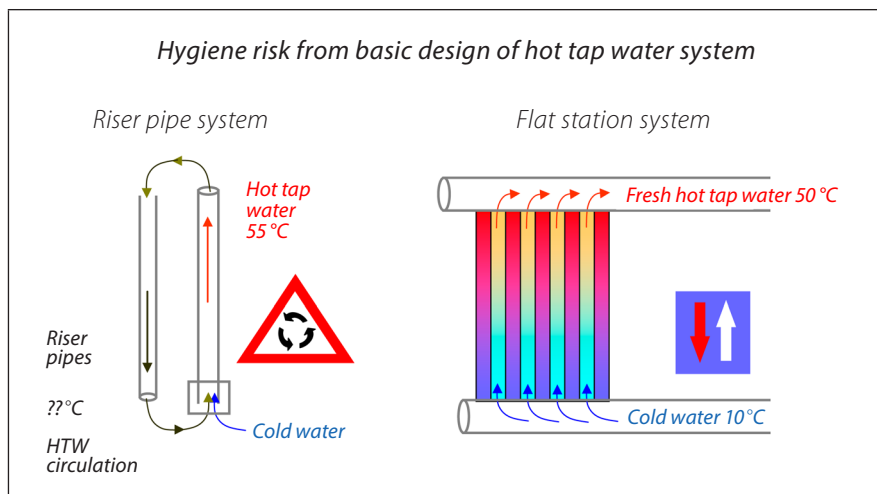


FIGURE 7: The Flat Station System decreases the risk of hygiene problems in the hot tap water, as it is prepared immediately before consumption, in a one-way flow. In riser systems, the water may flow in a loop for days, through or past pipes with inexpedient temperatures.

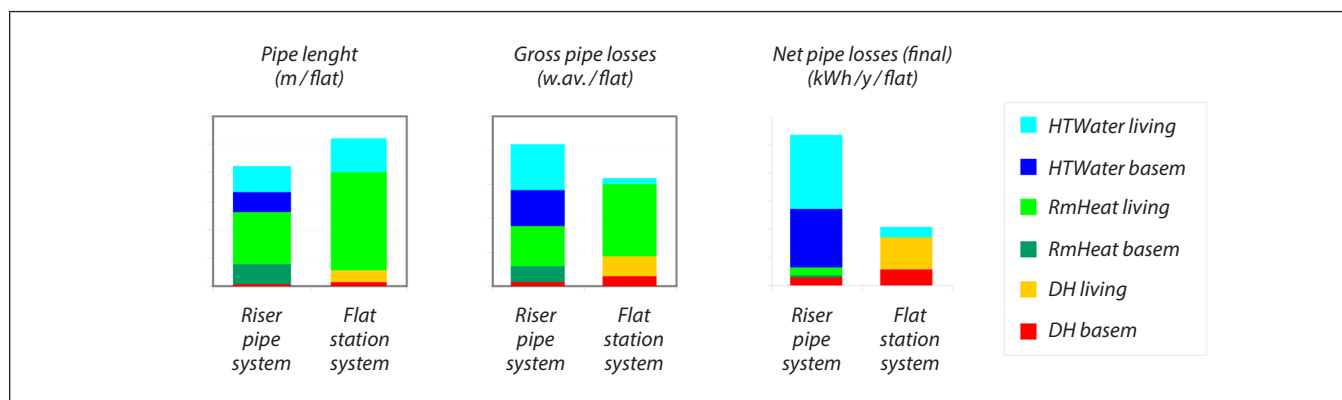


FIGURE 8: Comparison of pipe lengths and pipe heat losses for a riser pipe system and a flat station system. Operation time in different parts of the system strongly influence the final heat losses. The example concerns a four-storey building with flats of 120 m² each.





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