Building solutions for low-temperature heat supply

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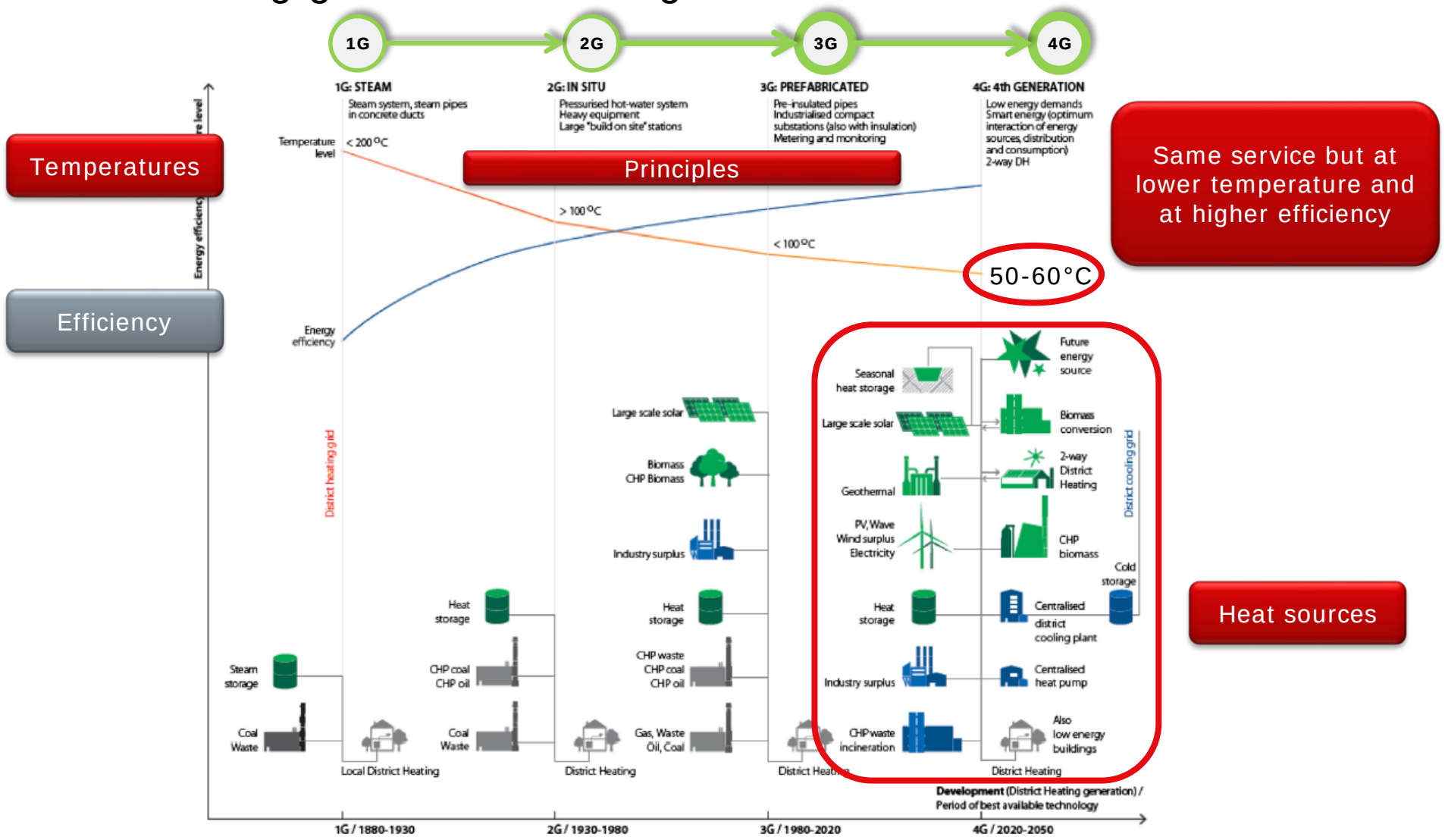
District heating generations – Mega trends



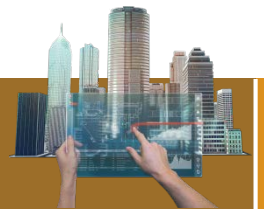
What are the complications of moving towards the 4GDH?

- The connected buildings need to be able to cope with low temperature supply
  - Well insulated
  - Low temperature radiators or floor heating

- Low temperature supply demands accurate control
  - For example 5°C less cooling of the supply than design (25°C) can lead to :
    - 9% increased distribution heat loss
    - 95% increased pumping costs

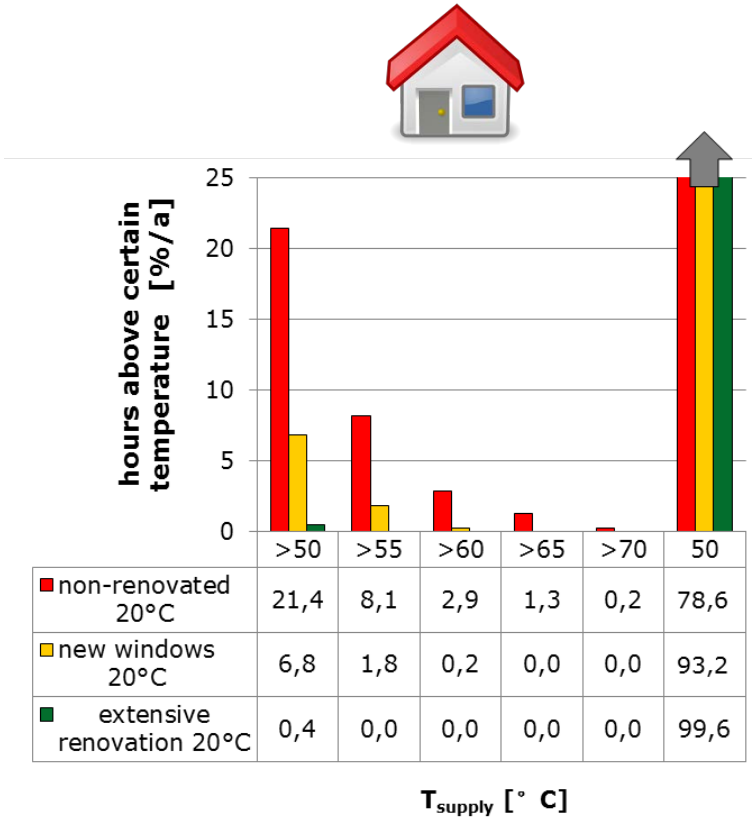
- We need to fulfill health standards
  - Legionella safe domestic hot water preparation

- Due to these it becomes very important to apply accurate and efficient control equipment at the buildings



Can all buildings be supplied by low-temperature heat supply?

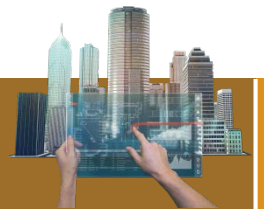
- Extensive research has been made into the viability of applying low-temperature district heating to existing single-family buildings
- The results show that even for non-renovated buildings 50°C supply temperature is sufficiently high for 78,6% of the year
- By only moderate renovations, new windows, the low-temperature supply can be used for 93,2% of the time
- This implies that already today low-temperature district heating could be achieved with a temperature boosting during the coldest periods



	>50	>55	>60	>65	>70	50
non-renovated 20°C	21,4	8,1	2,9	1,3	0,2	78,6
new windows 20°C	6,8	1,8	0,2	0,0	0,0	93,2
extensive renovation 20°C	0,4	0,0	0,0	0,0	0,0	99,6

Source: Brand. M, Svendsen. S, *Renewable-based low-temperature district heating for existing buildings in various stages of refurbishment*. Energy, 2013.

- Some buildings might need higher supply temperature
  - The solution could be to use local temperature boosters to boost the temperature at these buildings until they have been energy renovated

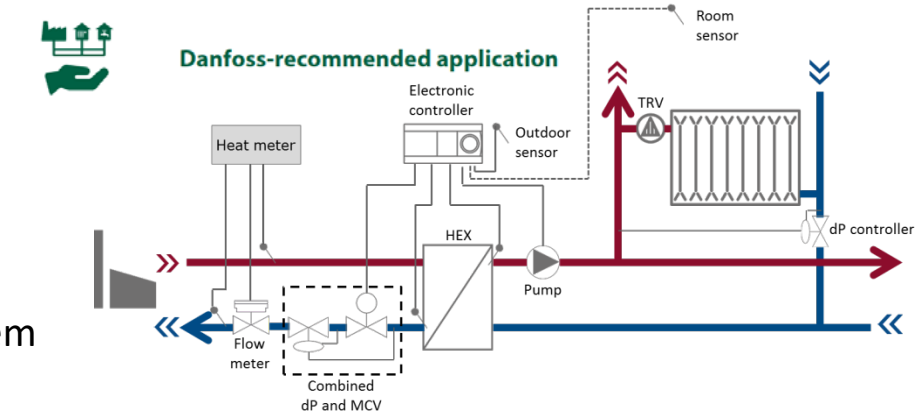


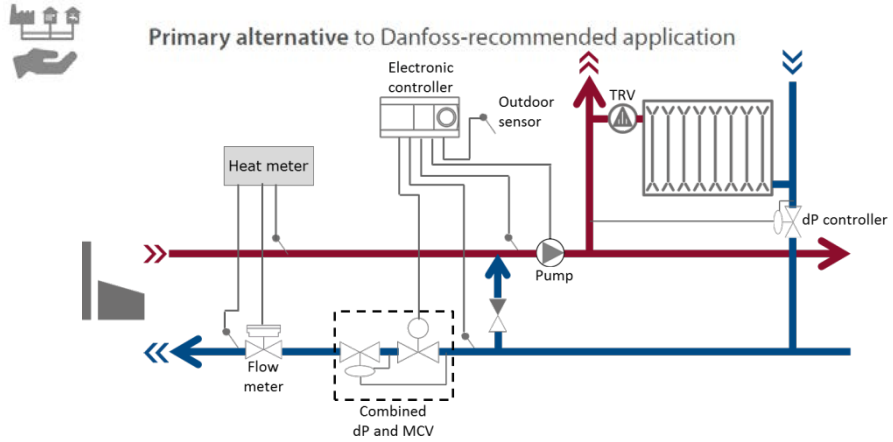
General heating interface solutions

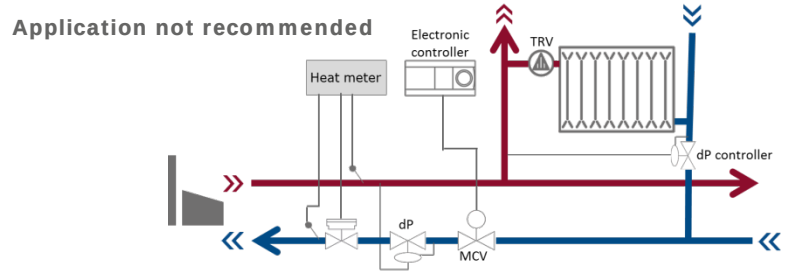
- Indirect consumer interfaces
  - The building heating system is connected to the district heating system via heat exchanger unit, which regulates the heating system supply temperature

- Direct connection with a mixing loop
  - The mixing loop has the purpose to adjust the supply temperature to the requirements of the building heating system

- Direct connection
  - The district heating supply runs directly into the building without any adjustments

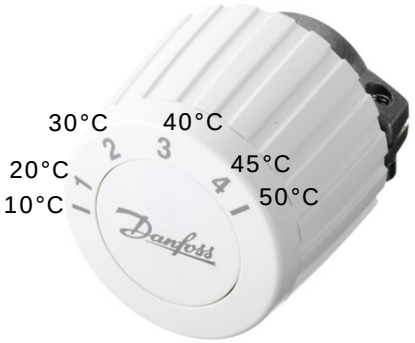






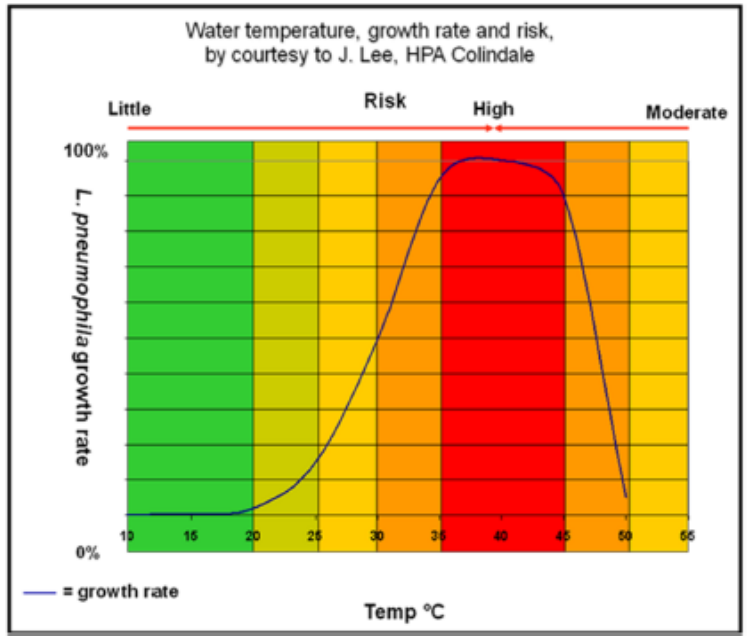
General concerns for the space heating systems

- Due to the importance of good control for the economics of the district heating system the following technologies should be carefully considered
- Thermostatic radiator valves (TRV) with a pre-setting function
  - Adjusts the supply to the demand
  - Minimizes the maximum draw off and consequently increases the hydraulic balance
- Return temperature limiters
  - To prevent inefficient utilization of the radiator
  - The valve closes if too high radiator outlet temperature is experienced
- Differential pressure controllers, to ensure good working conditions for the TRV's

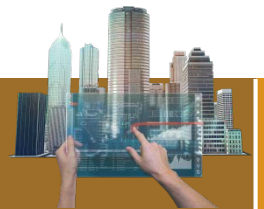


Domestic hot water systems

- Generally 45°C should be enough to fulfill all normal domestic hot water requirements
- With an efficient heat exchanger 50°C supply would be enough to achieve 45°C domestic hot water
- However 45°C is within in the optimal growth zone of the Legionella bacteria
- **Solution:** Instantaneous preparation!
  - No domestic hot water circulation
  - No storage of domestic hot water
  - Domestic hot water system volume < 3 liters
- During taping periods new fresh Legionella free water fills up the pipe volume
- During non-taping periods the water in the installation is cooled down to room temperature



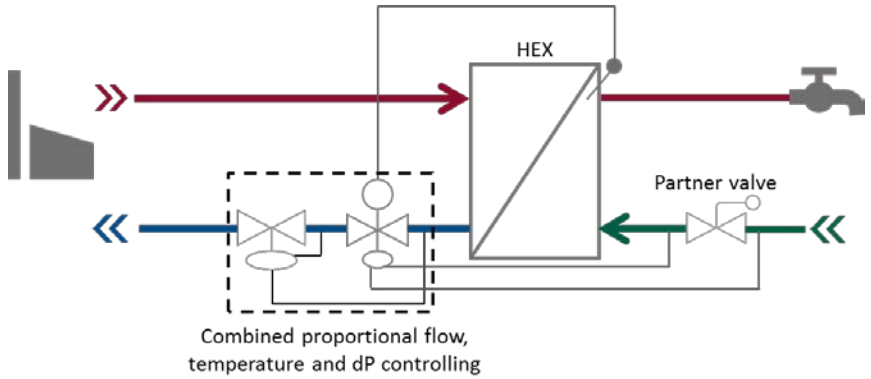
Source: Risiko des Legionellenwachstums in Abhängigkeit von der Temperatur nach [Exner09]



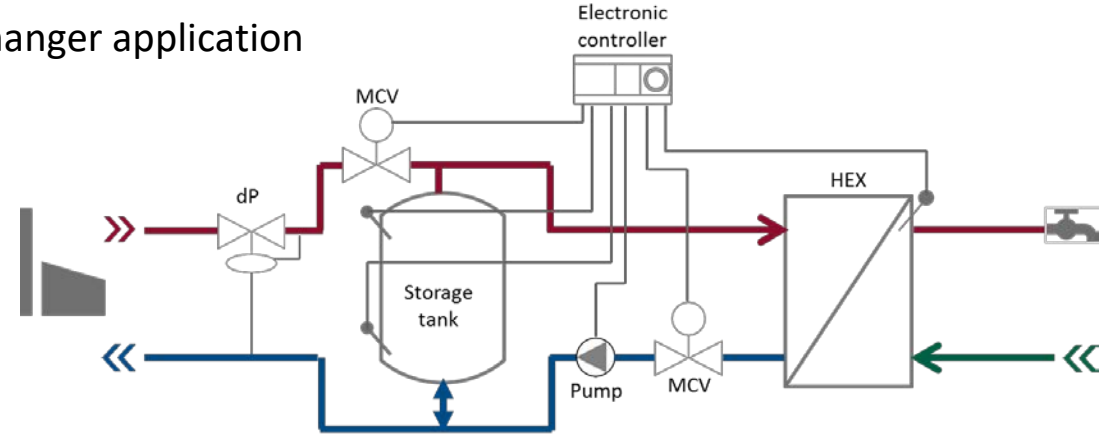
Domestic hot water applications

- In general there are two instantaneous applications for low-temperature district heating

- Instantaneous heat exchanger application
  - Higher network capacity requirements
  - Maximum cooling
  - Minimum heat loss
  - Inexpensive application



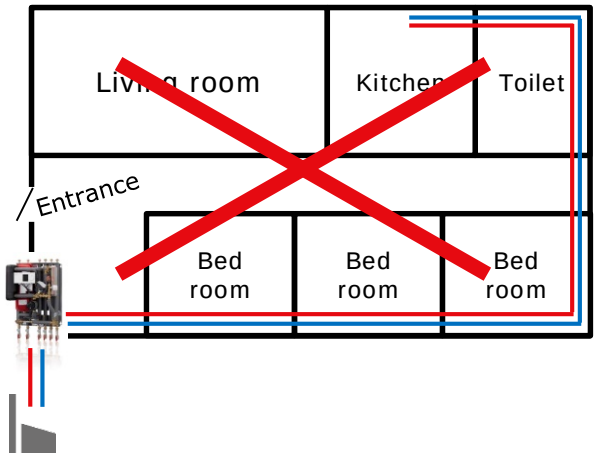
- Primary side storage tank and instantaneous heat exchanger application
  - Lower network capacity requirements
  - In general higher total heat loss
  - Expensive application

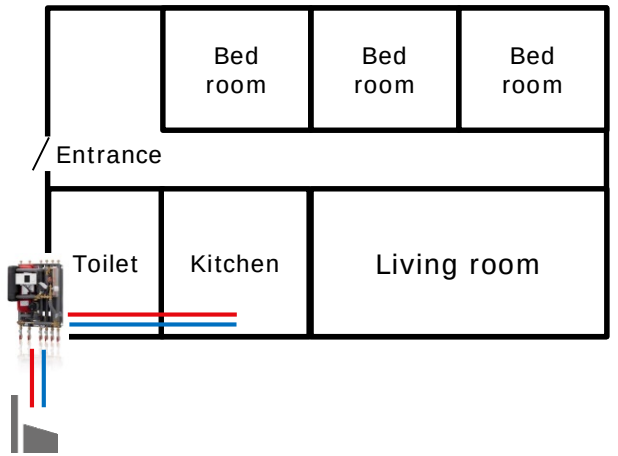


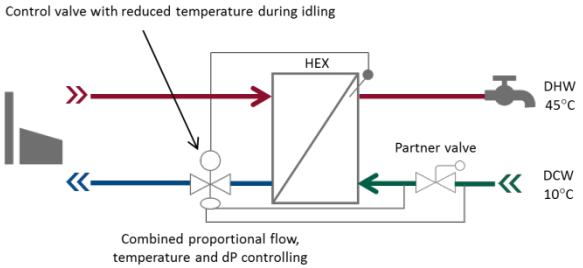
Domestic hot water waiting time

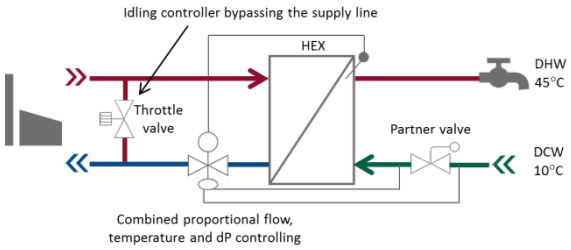
- With the elimination of domestic hot water circulation a new (old) issue emerges:
  - **People are in general impatient**

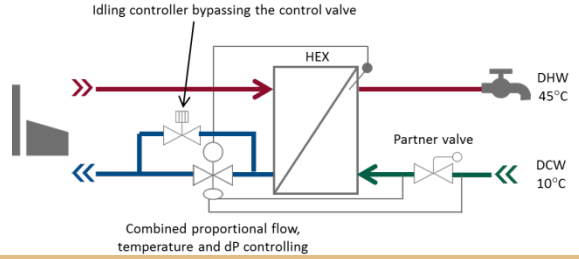
- To limit the waiting time for domestic hot water some aspects need to be considered:
  - a) Minimize the pipe distances and dimensions from the DHW unit to the taps and
  - b) To keep the supply pipe and/or the domestic hot water heat exchanger warm during non-tapping periods by using by-passes, on the primary side

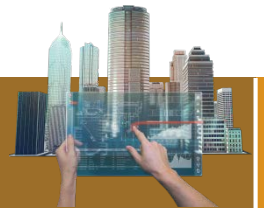




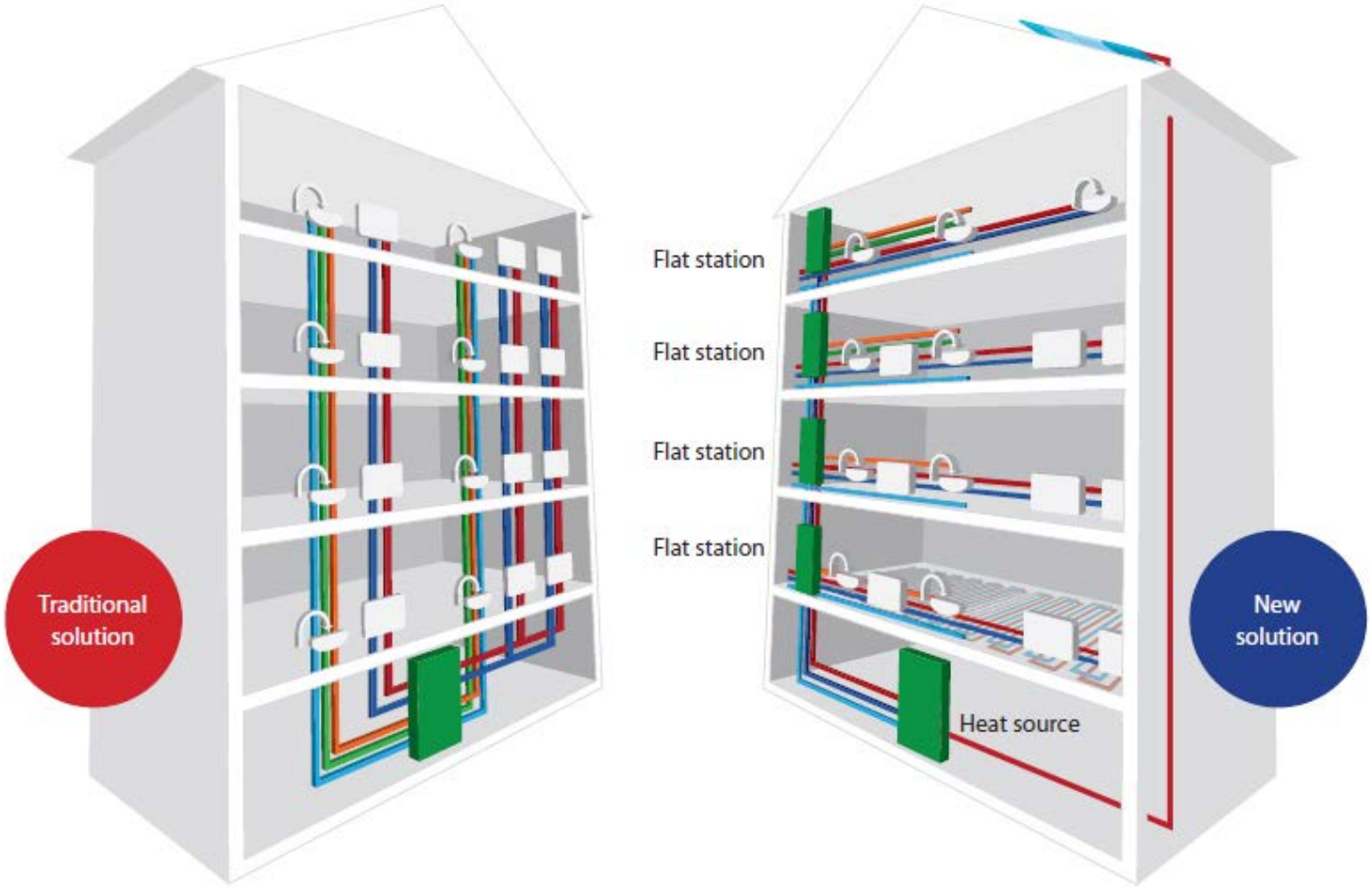








Can all buildings be supplied by low-temperature heat supply?



Conclusions

- It is clear that the industry is ready for the 4th generation district heating
  - All the necessary technologies are already available
  - It has been proven to work:
    - Lystrup, Sønderby and Albertslund in Denmark

- Benefits of bringing down the district heating supply temperatures are
  - Significant reduction of distribution heat losses
  - Increased potential to access local low temperature renewable heat sources

- The future of district heating as an energy efficient infrastructure is bright and will without doubt play a vital part towards achieving the ambitious goals of limiting the global climate change from human activities

Thank you for your attention

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