Improving Energy Efficiency In Buildings using PICV Solutions

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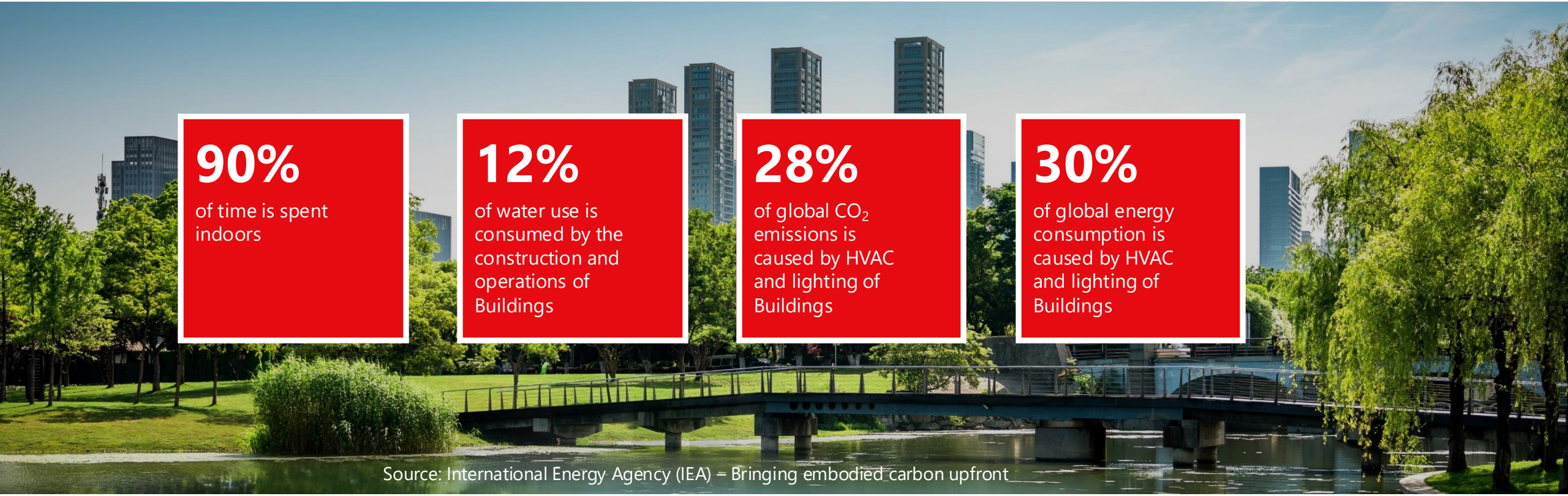
Why **Energy Efficiency** in Buildings matters

The **incovenient truth** about our buildings



Source: International Energy Agency (IEA) – Bringing embodied carbon upfront

The Key to **Smarter, More Efficient** Buildings

1

The upgrade of HVAC performance can deliver **between 15% and 38% energy savings** and achieve a return on investment within **1 to 3 years**. This should always be the first step due to its high cost-effectiveness, paving the way for further measures.

2

Investing in **HVAC improves** - on average - the **Energy Performance Certificate** by **1.0 class** for residential buildings and by **1.3 classes** for non-residential buildings, thereby increasing the commercial value of the building, improving health and comfort, and reducing energy bills.

3

HVAC alone **can deliver the savings necessary to comply with the EPBD's** Minimum Energy Performance Standards (MEPS) across Europe.

Danfoss Solutions - Commercial Buildings

Hydronic Balance

Definition of Hydronic balance:

A system is balanced if we have the right flow (rates) in the system, during full load and partial load conditions.

To ensure:

- Sufficient capacity at all loads
- Precise control of indoor temperatures
- Maximum efficiency of the system

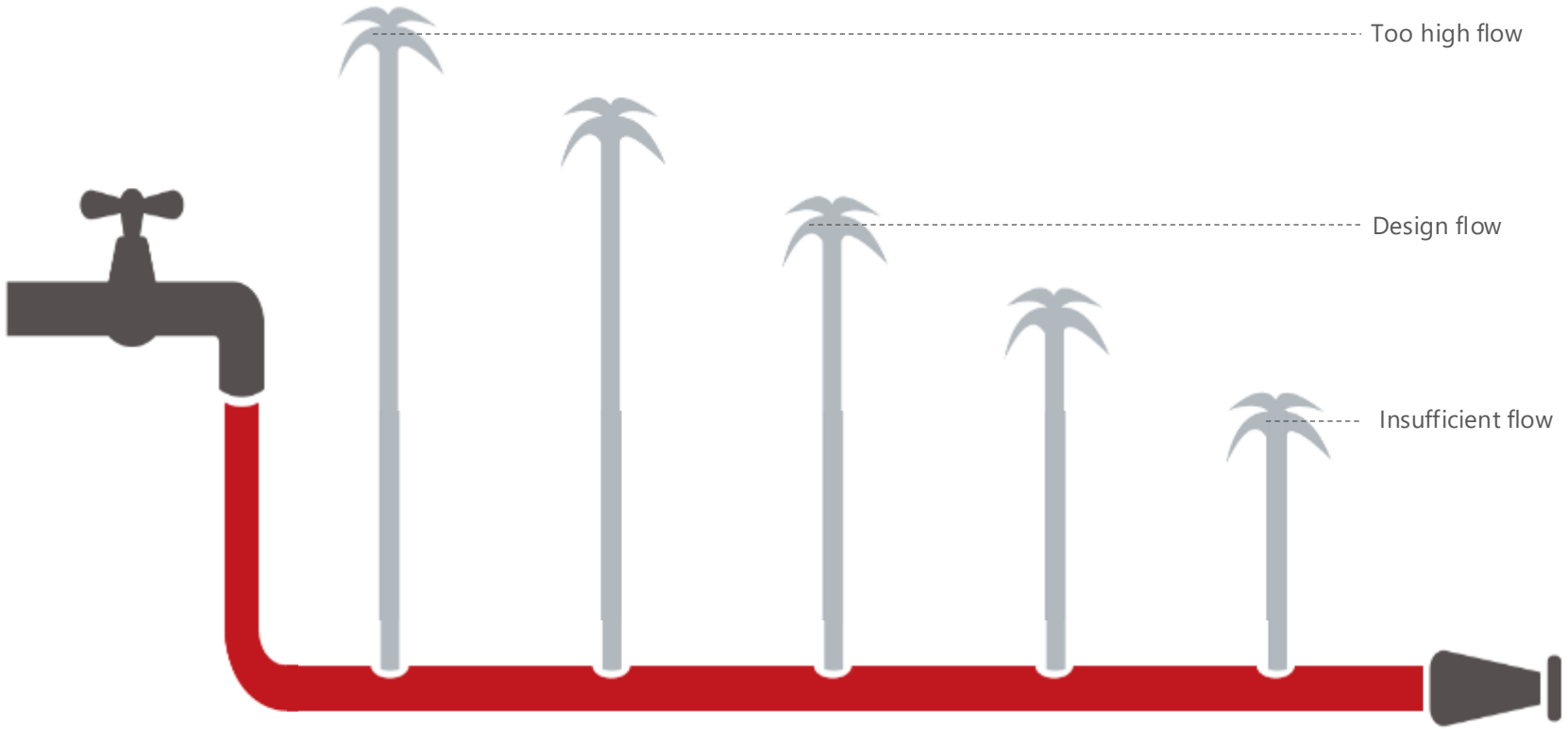
Ensuring hydronic balance in the system is a standard part of the commissioning procedures for HVAC systems

Why PICV

- Systems need to be **hydronically balanced** to ensure proper water distribution
- When **3-way valves** were commonly used manual balancing valves (**MBV**) could be used to **ensure balance in the system**
- When **2-way valves** were becoming more popular **differential pressure controllers** were introduced
- Currently the de facto standard in design is **PICV** which delivers
  - Easy and perfect balance at all loads
  - Precise control of temperatures
  - Maximum efficiency of the HVAC system

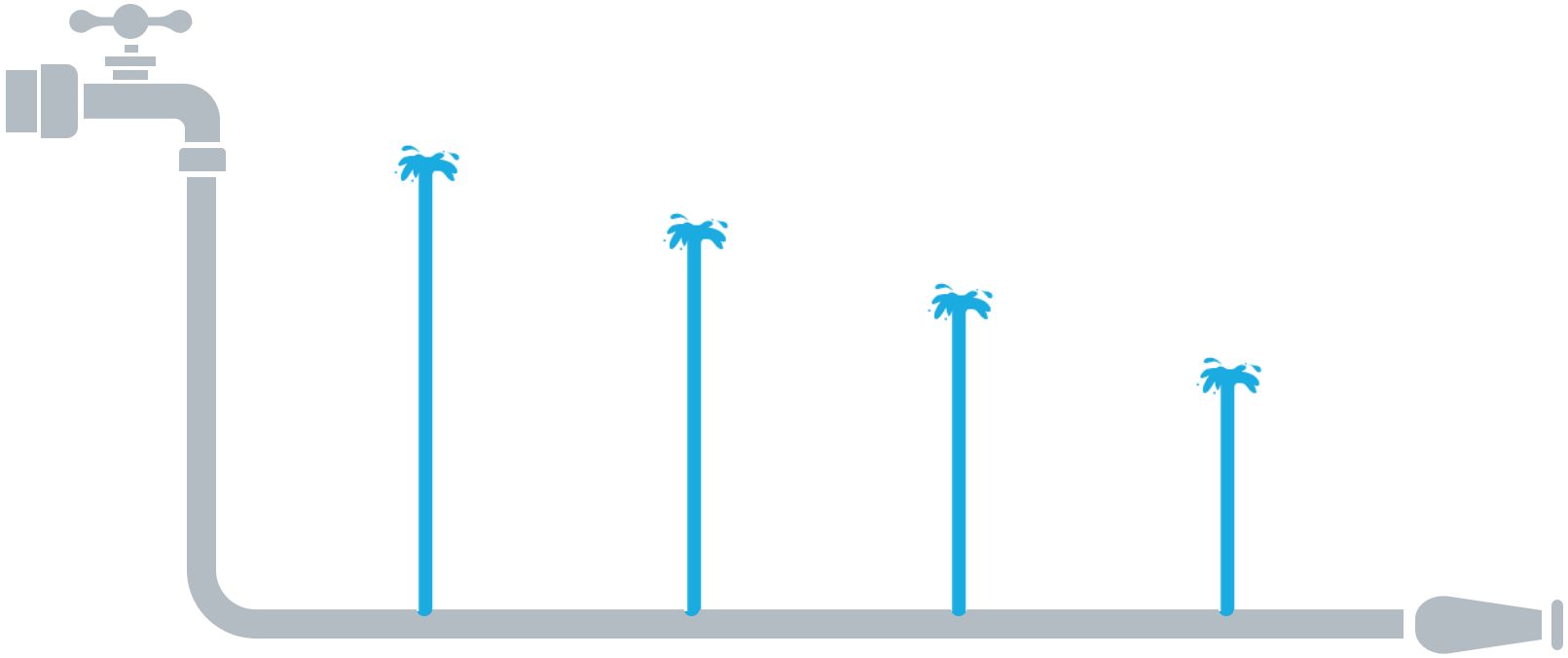
Daily practice

- Unbalanced system

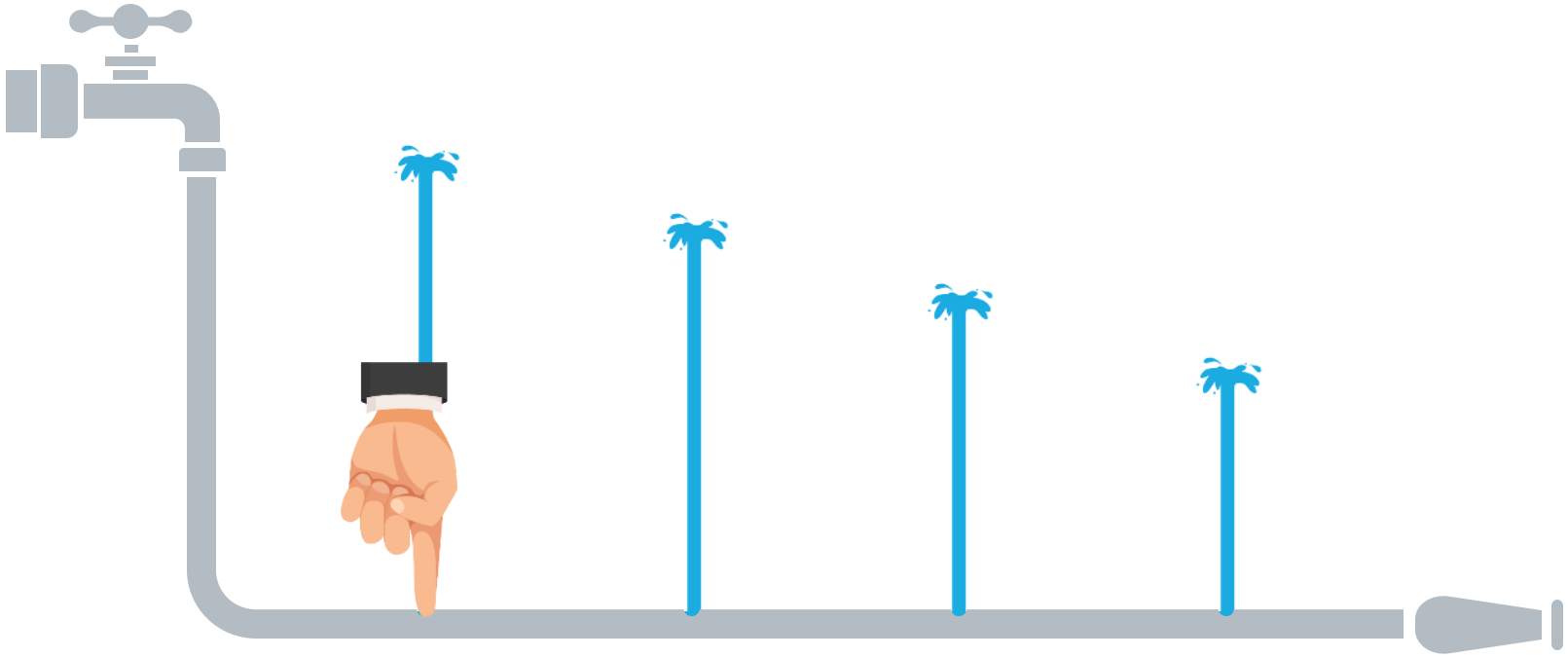


Hydronic balancing basics

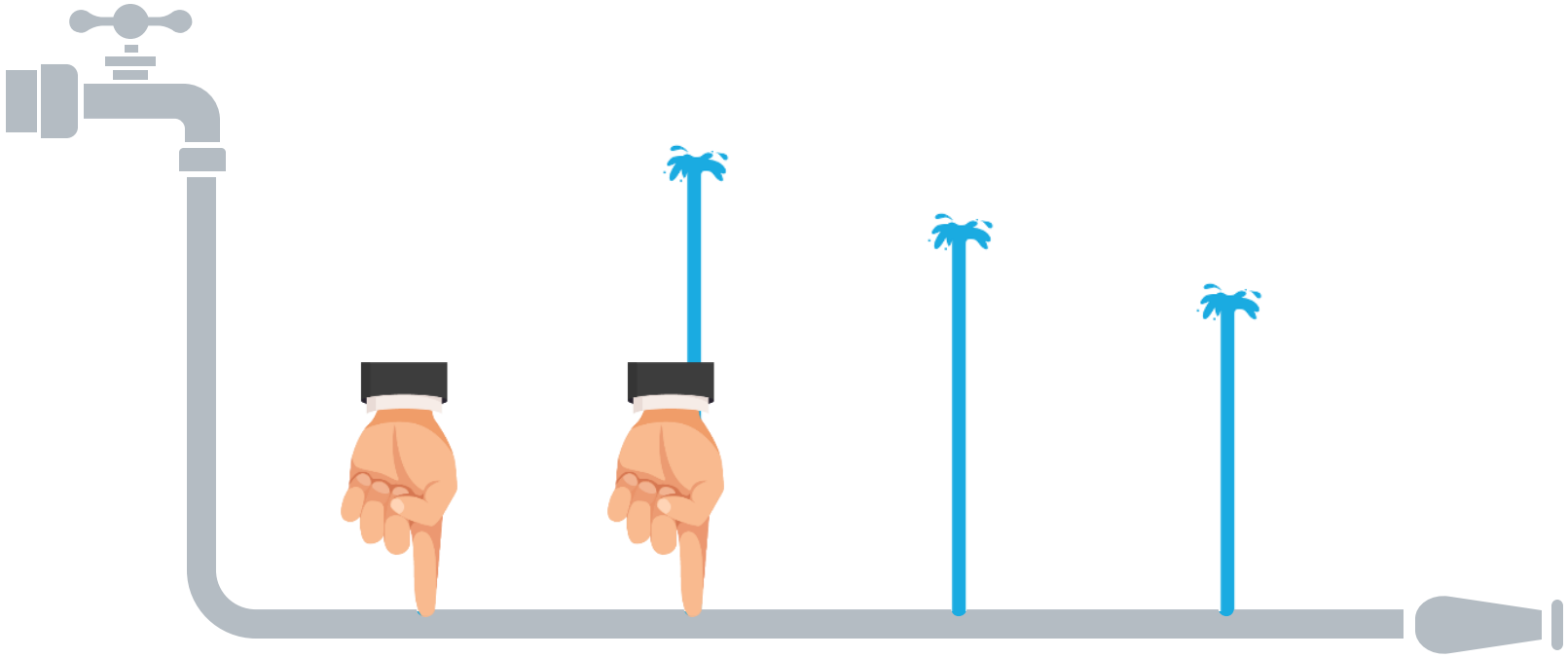
Hydronic balancing basics



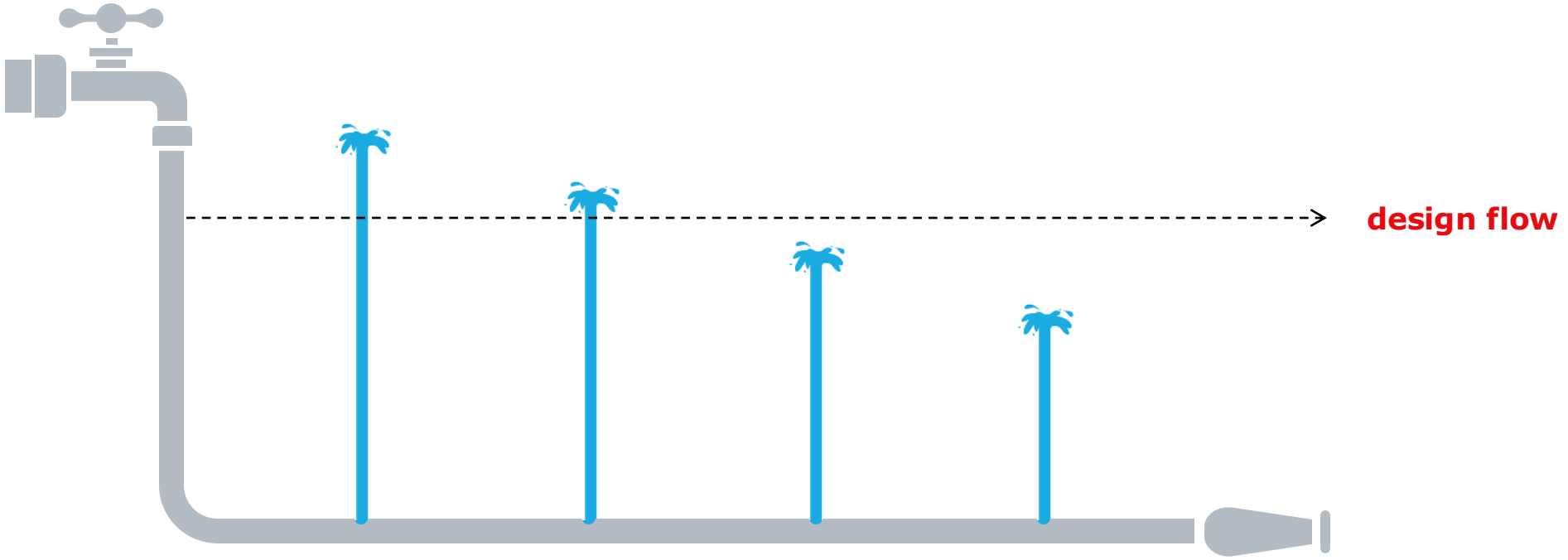
Hydronic balancing basics



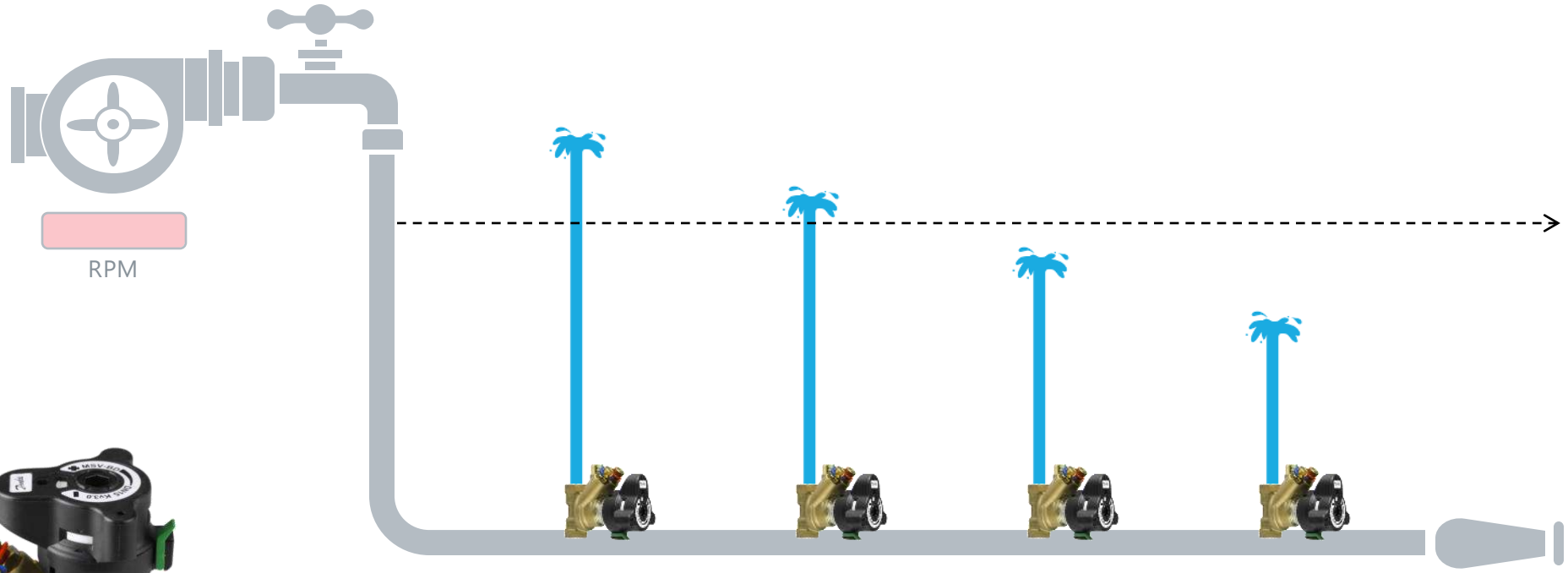
Hydronic balancing basics



Hydronic balancing basics

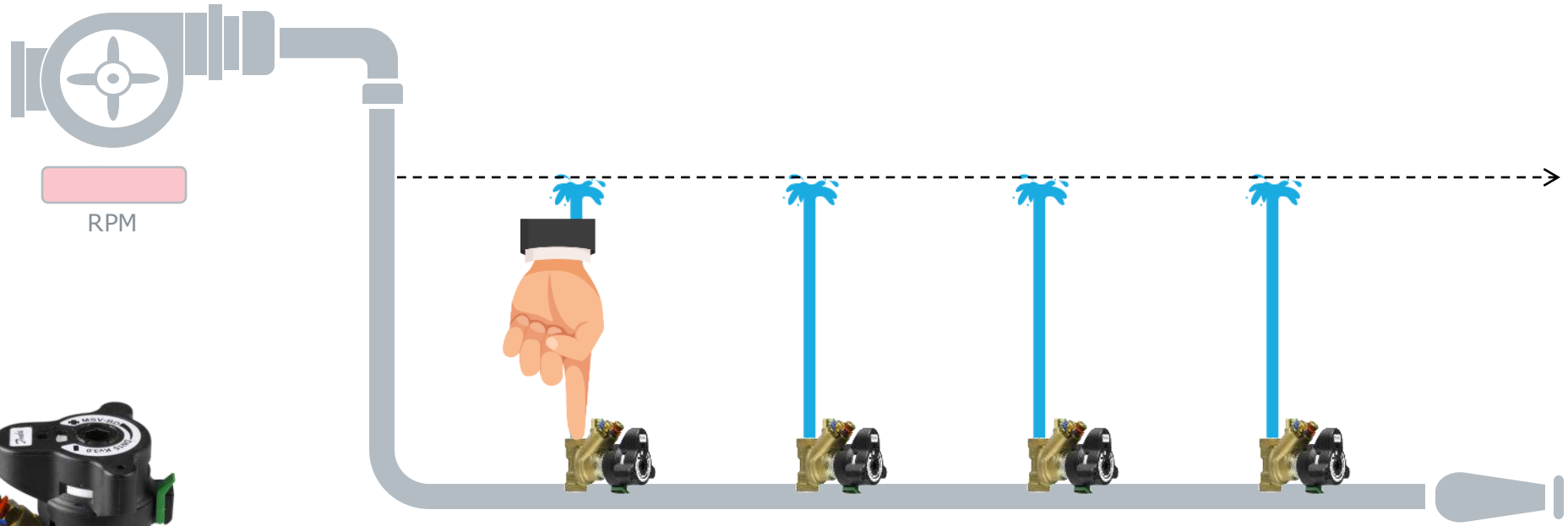


Static hydronic balancing



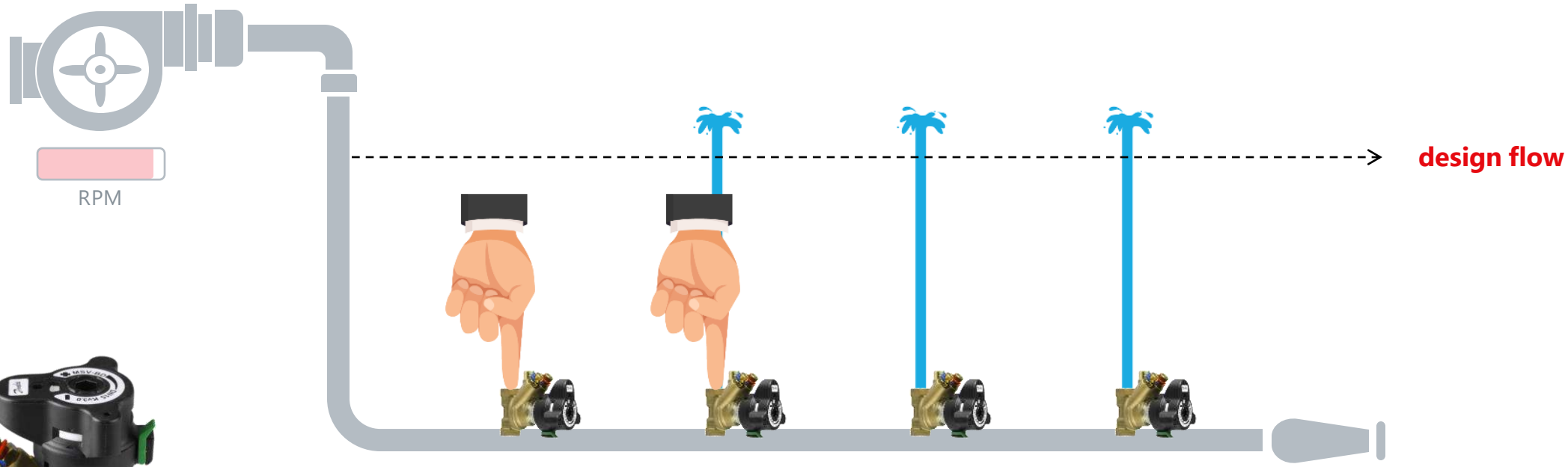
Manual Balancing Valve

Static hydronic balancing



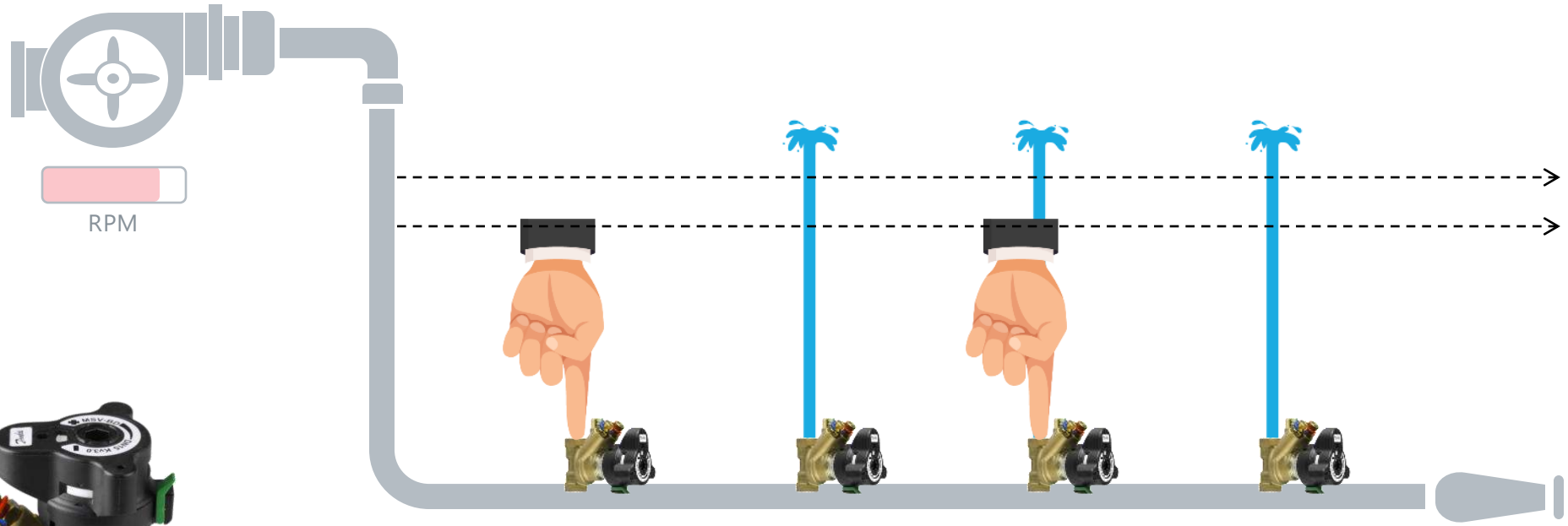
Manual Balancing Valve

Static hydronic balancing



Manual Balancing Valve

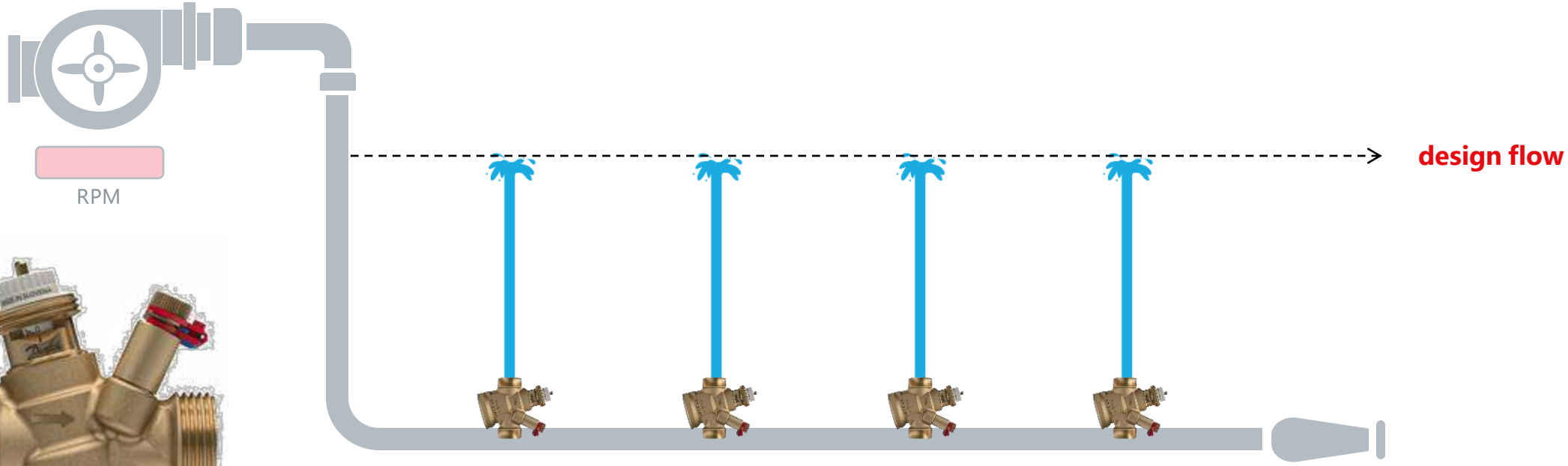
Static hydronic balancing



Manual Balancing Valve

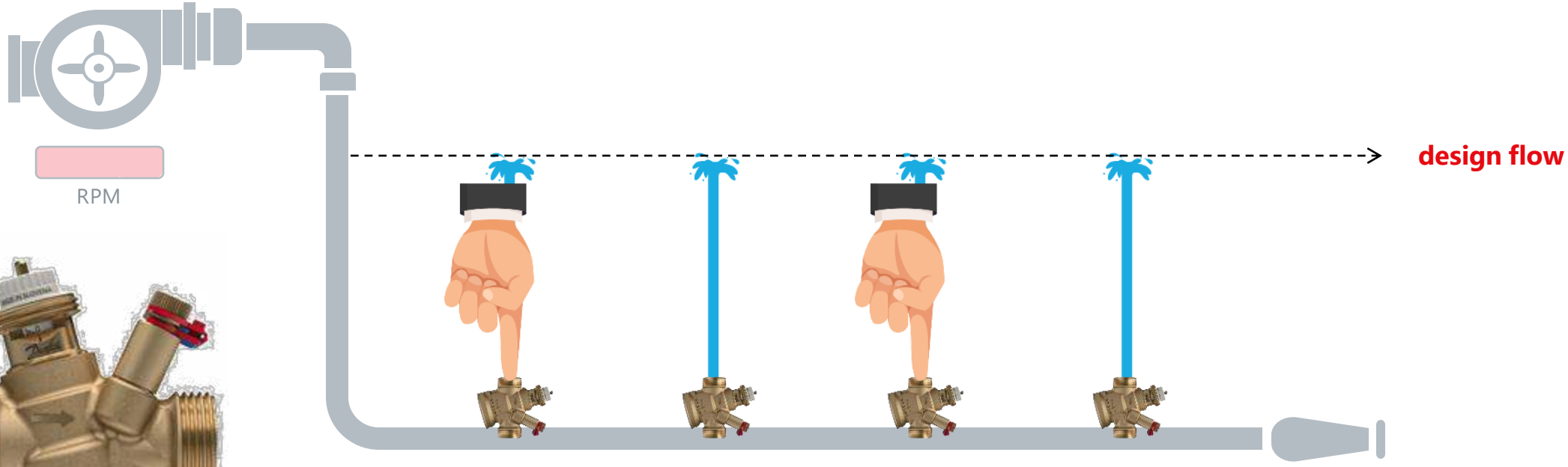
‘under flow‘ phenomenon

Dynamic hydronic balancing



Pressure Independent Control Valve

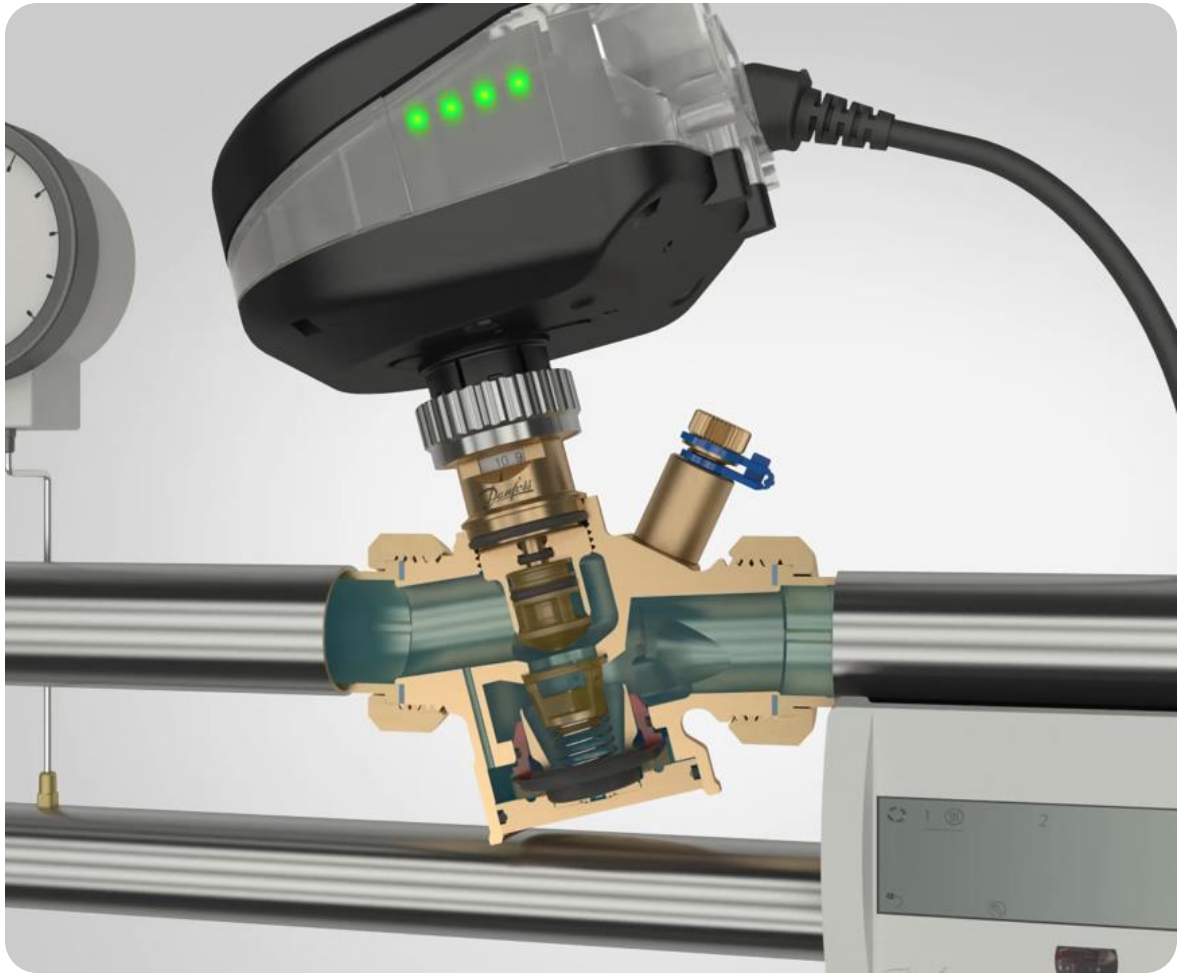
Dynamic hydronic balancing



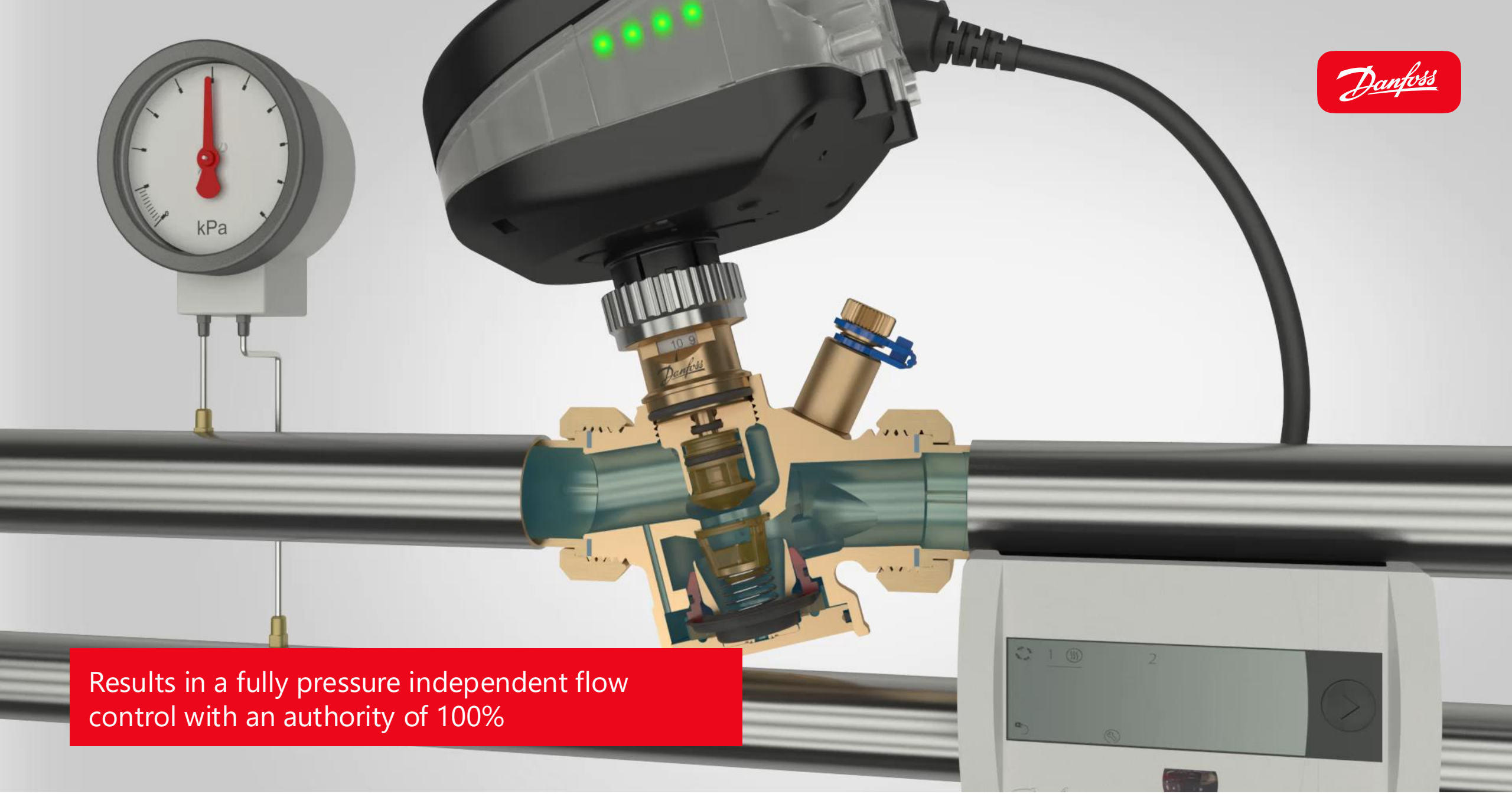
Pressure Independent Control Valve

The **technical principles** of AB-QM

- 2-in-1 valve design
- High accuracy control
- The control valve determines the actual flow
- The built-in differential pressure controller absorbs pressure fluctations
- The design flow is set as a % of the maximum flow
- This reduces the stroke of the control valve



Results in a fully pressure independent flow control with an authority of 100%



Results in a fully pressure independent flow control with an authority of 100%

HVAC – The Key to Smarter, More Efficient Buildings

Dynamic Hydronic Balancing ensures efficient energy distribution throughout the building

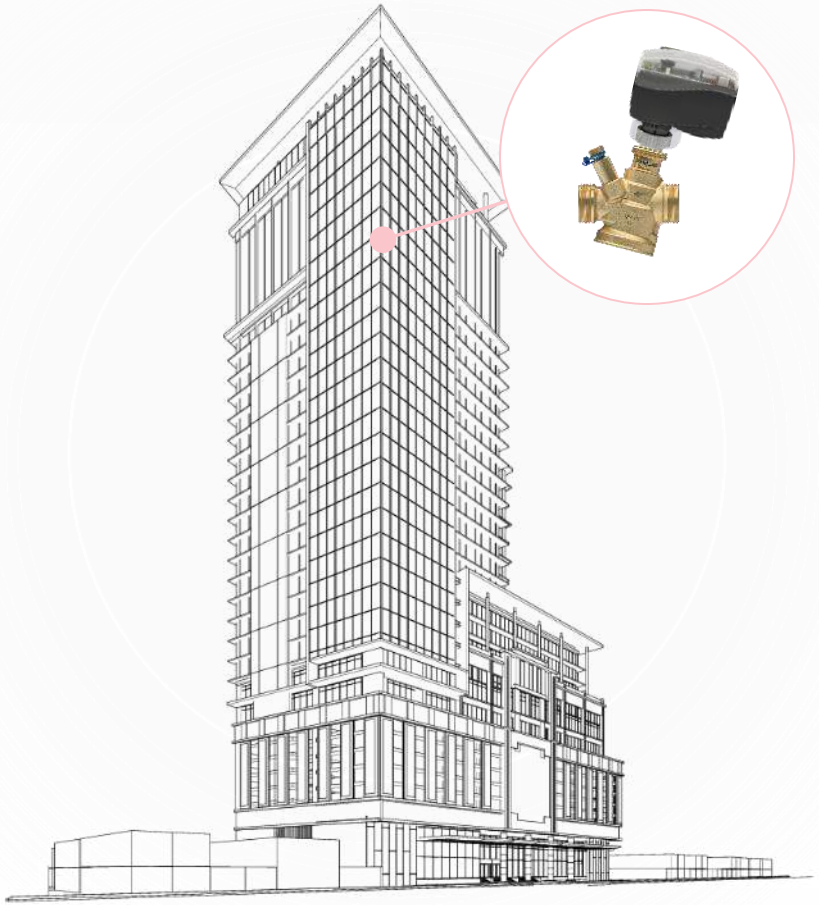
Modulating room temperature control adjusts heating and/or cooling according demand

Connectivity with Building Management Systems enables data-driven control of HVAC

HVAC hydronic systems with
On/Off vs. Modulating room control

AB-QM **on / off**

AB-QM **0-10V**

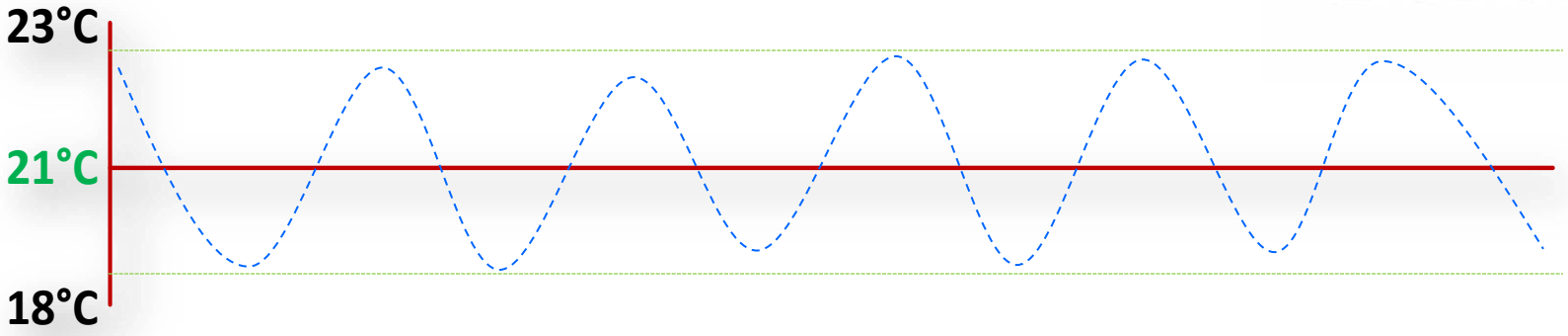


- Still fluctuating room temperature control as the valve is open or closed
- Higher pumping cost than needed to achieve the setting temperature in the room
- Lower efficiency of the cooling/heating system due to lower ΔT
- Higher energy bill and less comfort

- **Stable room temperature control as the valve is only open or closed according to demand**
- **Lower pumping cost to achieve the setting temperature in the room**
- **Higher efficiency of the cooling/heating system due to higher ΔT**
- **Lower energy bill and more comfort**

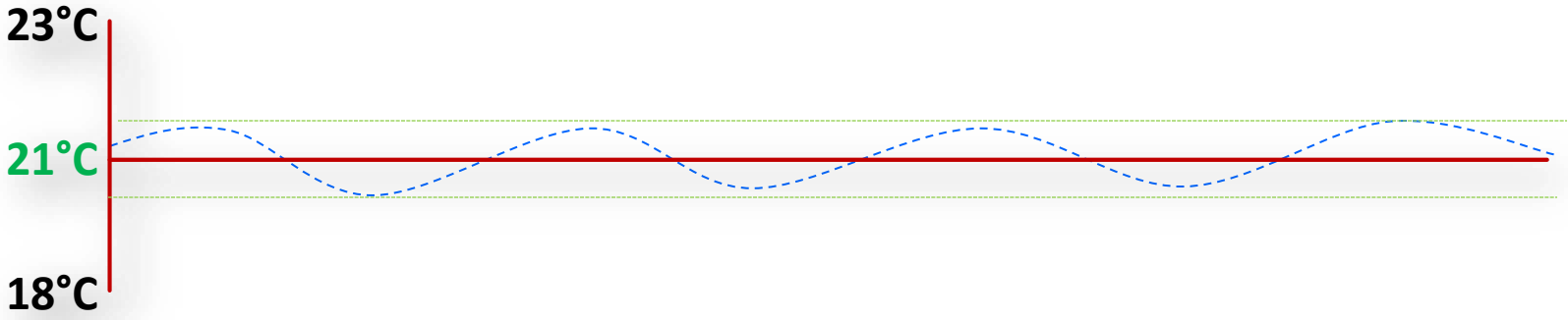
Control Performance

ON/OFF Control → **Discomfort**



$\Delta T = 5K$

Modulation – Proportional Control

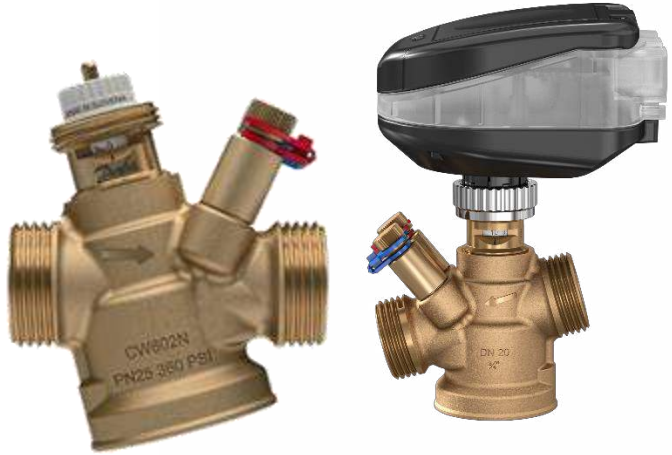


$\Delta T = 1K$

Not all PICVs are the same!

- Starting pressure
- Control characteristics
- Pressure dependency
- Hysteresis

- On-Off
- Modulating
- Digital



S

M

L

XL

New AB-QM 4.0
- future ready HVAC with **connectivity & data**

- Optimized for NovoCon® S digital IoT actuator
- Hydronic HVAC balance and control via Building Management Systems (BMS)
- Provides HVAC data for real time Active Energy Management
- Remote access for e.g.
  - predictive maintenance
  - continuous commissioning
- Cut down operational costs

Reliable and accurate PICVs are the enabler for HVAC 4.0 in smart buildings

New AB-QM 4.0
- Provide HVAC data with **high-accuracy digital actuators**

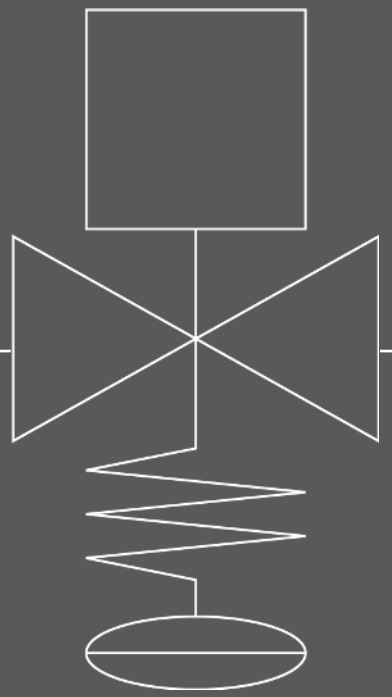
Accurate flow control

Lineair characteristic

Equal percentage characteristic

Low flow control

Precise



CO6, I/O device

Analog output (0-10V)

Ohmic inputs (2x ΩI)

Analog input (1x V/mA)

Heating<>Cooling change-over for 4-pipe systems

Bus-IoT actuator

BACnet MS/TP and Modbus RTU protocols

Provides system data to BMS

Auto baud rate detection and MAC adressing

Energy manager

Energy monitoring

Advance algorithms for energy management

Continuous commissioning

Integrated PID controller

AB-QM 4.0
- Actual energy consumption info with **temperature sensors**

AB-QM 4.0 + **NovoCon® S** + **Energy cable**

- Expand data and control features with supply and return pipe temperatures
- Calculate actual energy consumption
- Include ΔT measuring in the control
- Enabler for Active Energy Management to optimize system efficiency
  - E.g. Min. ΔT limitation
  - E.g. Min. or Max. return temperature limitation
  - E.g. Power limitation or control
- Enabler for fair energy cost allocation

> 10%

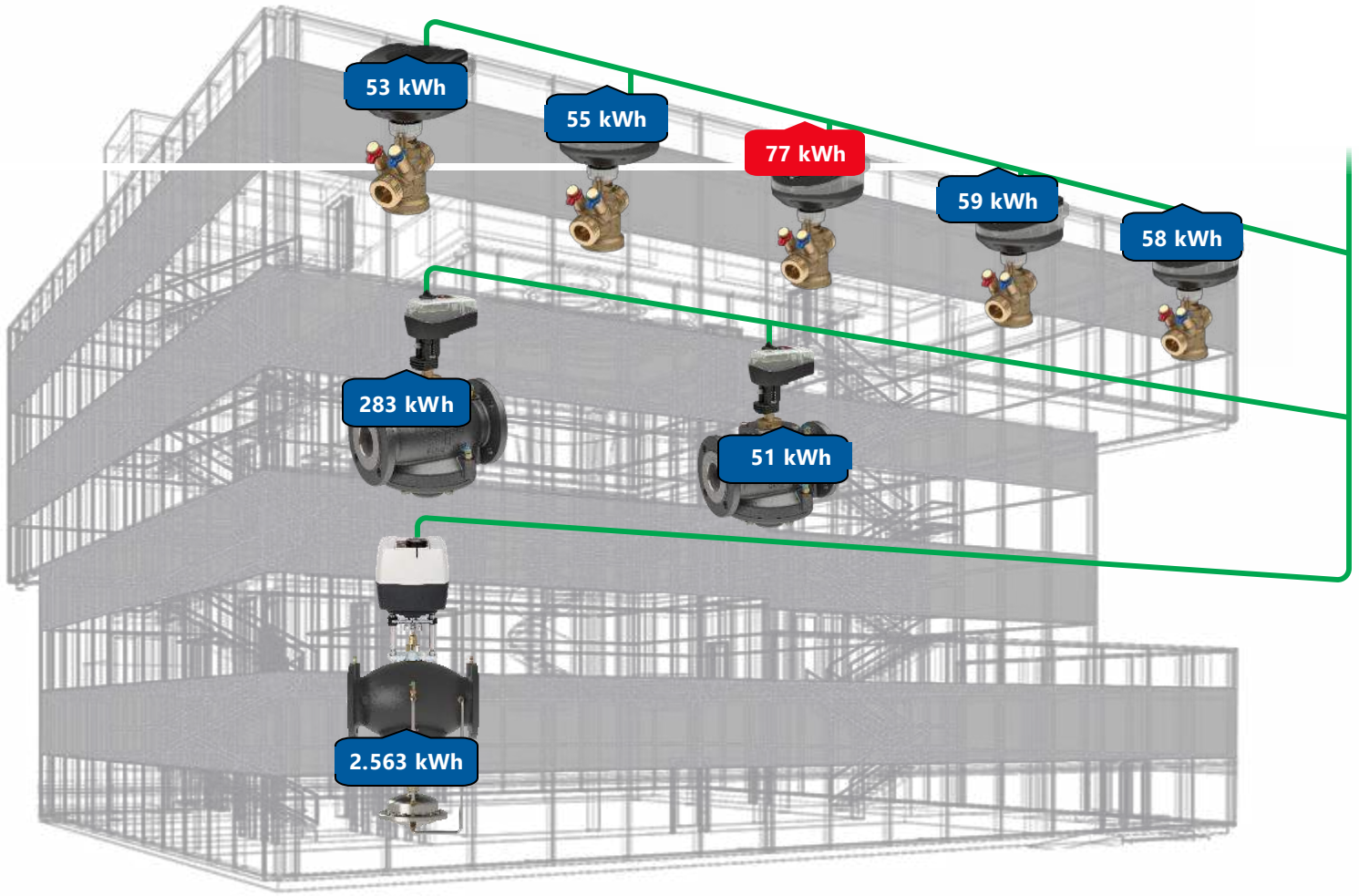
Energy saving with Active Energy Management

Solution for Energy efficient building – **Danfoss Digital Hydronics**

Technical specification

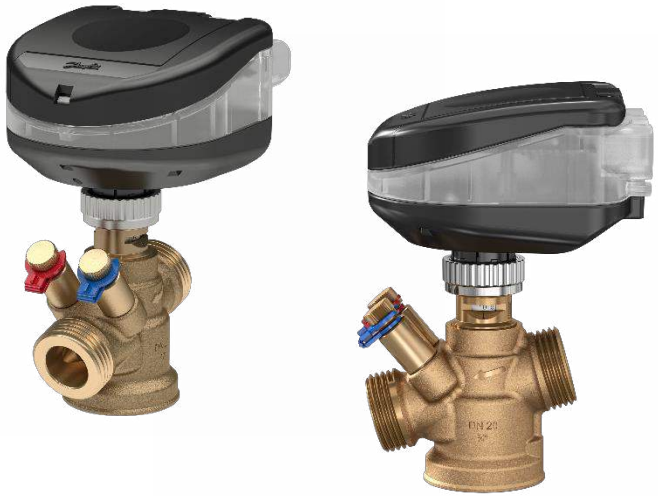
Energy manager

- **Energy monitoring**
- Energy analyzing
- Energy benchmark
- **Energy management**
- Energy management limitation (working with controller)
- Energy management control (working as stand-alone controller)

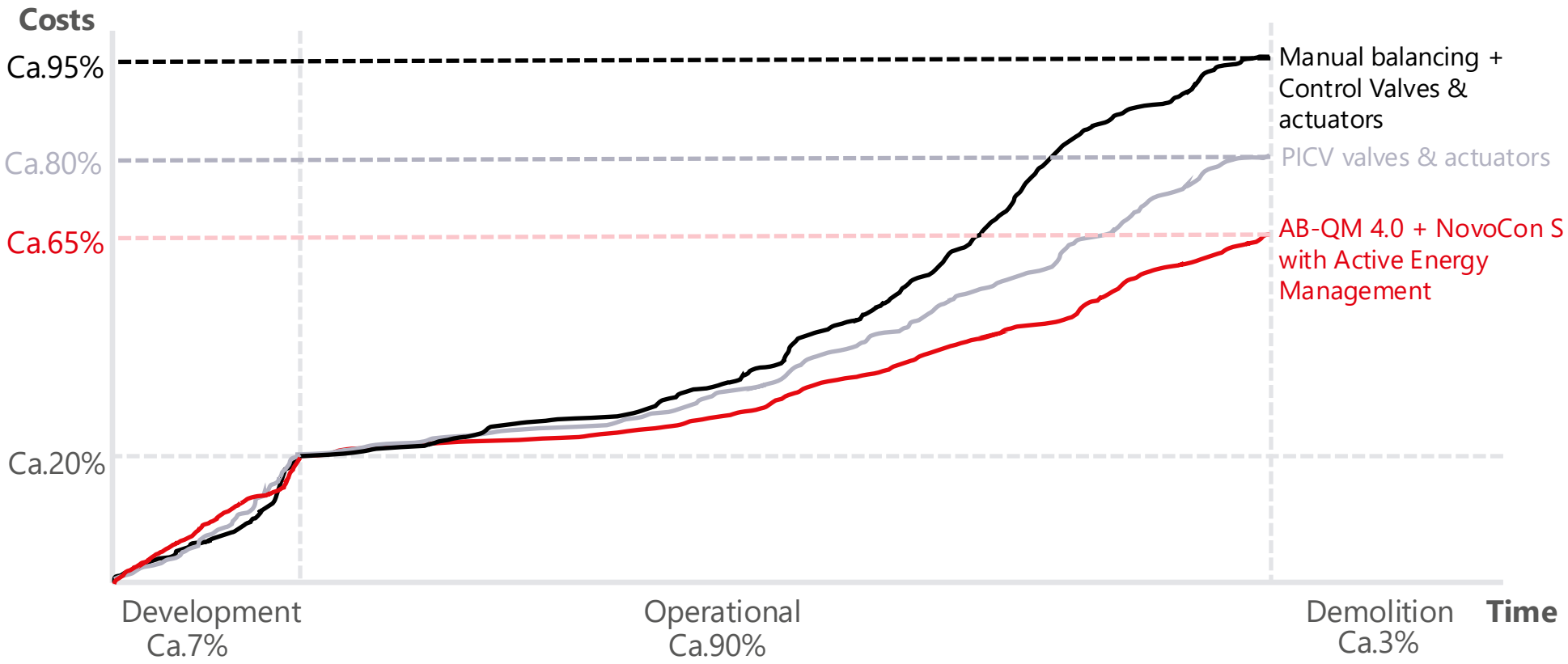


Six reasons to choose NovoCon®

1. Establishes the foundation; an **energy-efficient** HVAC system
2. **Cost savings** throughout the life cycle of the building
3. **Flexibility** when refurbishing the building
4. **Time savings** during installation, commissioning, and daily use
5. **Advanced** temperature control
6. Targeted and **predictive maintenance**



New AB-QM 4.0
- HVAC costs during a buildings lifecycle



- The use of PICVs provides costs savings due to increased energy efficiency in partial load conditions
- The use of AB-QM 4.0 with NovoCon S provides extra costs savings due to decreased costs for service & maintenance and Active Energy Management

How **Danfoss can** optimise building energy performance

→ Benefits of **Dynamic** hydronic balancing

- Effective and efficient distribution of energy
- Increase user comfort incl. less noise
- Lower energy consumption

→ Benefits of **modulating** room temperature control

- Stable temperatures improve comfort perception
- Allows reduction of heating setpoint or increase of cooling without impact on comfort perception
- Improves system efficiency and reduces energy consumption

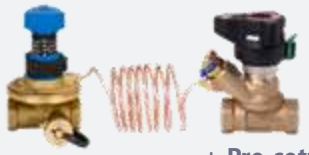
Heating and **cooling** control
Room temperature control

The control function is applied to the heat emitter (radiators, underfloor heating, fan-coil unit, indoor unit) at room level; for class D, one function can control several rooms.

	Radiator heating	Fan-coil / indoor unit
A High Energy Performance Balanced dynamically per emitter		 Digital actuator: **NovoCon® S**
B Advanced Energy Performance Individual modulating room control with communication	 Stand-alone: **Eco™** Zone-control: **Ally™**	 Digital actuator: **NovoCon® S**
C Standard Energy Performance Individual room control	 Gas-filled: **Aveo™, Aero™** Liquid-filled: **React™, Redia™, Regus™, Mio™, RAX, RAX-K, RA 506x**	 Modulating actuator: **AME 110NL/X** On/off actuator: **TWA-Q**
D Non Energy Efficient No or Central automatic room control		

Heating and cooling control
Hydronic balancing heating distribution

Hydronic balancing is applied to a group of heating emitters (heating panel, fan-coil unit or indoor unit) greater than 10.

		Radiator heating		Fan-coil / indoor unit	
A	**High Energy Performance**	Individual modulating room control with communication and occupancy detection		Dynamic valve: **RA-DV**	 PICV: **AB-QM 4.0**
B	**Advanced Energy Performance**	Balanced statically per emitter and dynamic group balance		Delta P control: **ASV-PV, ASV-P** partner valves: **ASV-BD, ASV-D** **+ Pre-setting valves and integrated valves as for class C**	 PICV: **AB-QM 4.0**
C	**Standard Energy Performance**	Balanced statically per emitter, and a static group balance		Pre-setting valves: **RA-N, RA-UN, RA-IN, RA-U, RA-UR** Pre-setting integrated valves: **RA-N, RA-UN**	 Delta P control: **ASV-PV, ASV-P** partner valves: **ASV-BD, ASV-D** Manual balancing valve: **MSV-BD, MSV-D, MSV-B**
D	**Non Energy Efficient**	No or statically balanced per emitter, without group balance		Fixed setting valves: **RA-FN, RA-G** Lockshield valves: **RLV, RLV-S RLV-KS, RLV-KD**	 Manual balancing valve: **MSV-BD, MSV-D, MSV-B**

Danfoss solutions for retrofits

Heating

Radiator heating

Dynamic valve:
RA-DV

Stand-alone:
Eco™

Zone-control:
Ally™

Pre-setting valves:
RA-N, RA-UN, RA-IN, RA-U, RA-UR

Pre-setting integrated valves:
RA-N, RA-UN

Gas-filled:
Aveo™, Aero™

Liquid-filled:
React™, Redia™, Regus™, Mio™, RAX, RAX-K, RA 506x

Delta P control:
ASV-PV, ASV-P

partner valves:
ASV-BD, ASV-D

+ Pre-setting valves and integrated valves as for class C

Fan-coil / indoor unit

Digital actuator:
NovoCon® S

PICV:
AB-QM 4.0

Digital actuator:
NovoCon® S

PICV:
AB-QM 4.0

Delta P control:
ASV-PV, ASV-P

partner valves:
ASV-BD, ASV-D

Manual balancing valve:
MSV-BD, MSV-D, MSV-B

Cooling

Fan-coil / indoor unit

Digital actuator:
NovoCon® S

PICV:
AB-QM 4.0

Digital actuator:
NovoCon® S

PICV:
AB-QM 4.0

Delta P control:
ASV-PV, ASV-P

partner valves:
ASV-BD, ASV-D

Manual balancing valve:
MSV-BD, MSV-D, MSV-B

Manual balancing valve:
MSV-BD, MSV-D, MSV-B


Danfoss

Why **Energy Efficiency** in Buildings matters

Let's **take up the challenge** to improve our buildings
- **now is the time!**

Source: International Energy Agency (IEA) – Bringing embodied carbon upfront
ECOFYS – Optimising the energy use of technical building systems