LEADING THE WAY

CampusEnergy2022

Feb. 15-18 | Westin Boston Seaport District Hotel | Boston, Mass.

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

IMI Hydronic Engineering

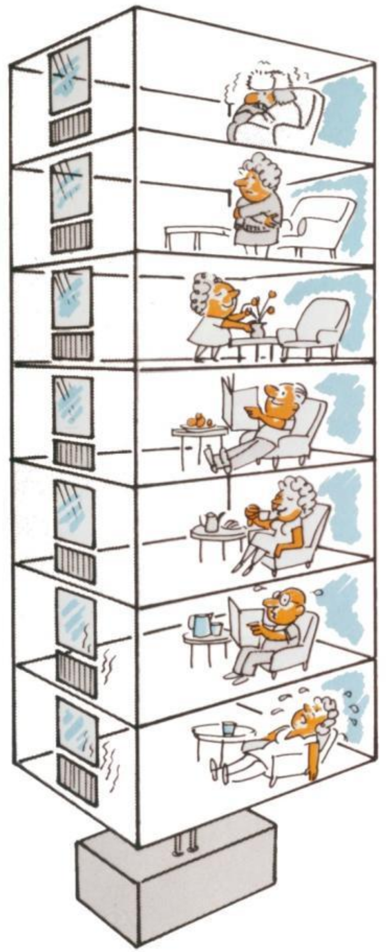
3 keys to optimize hydronic system

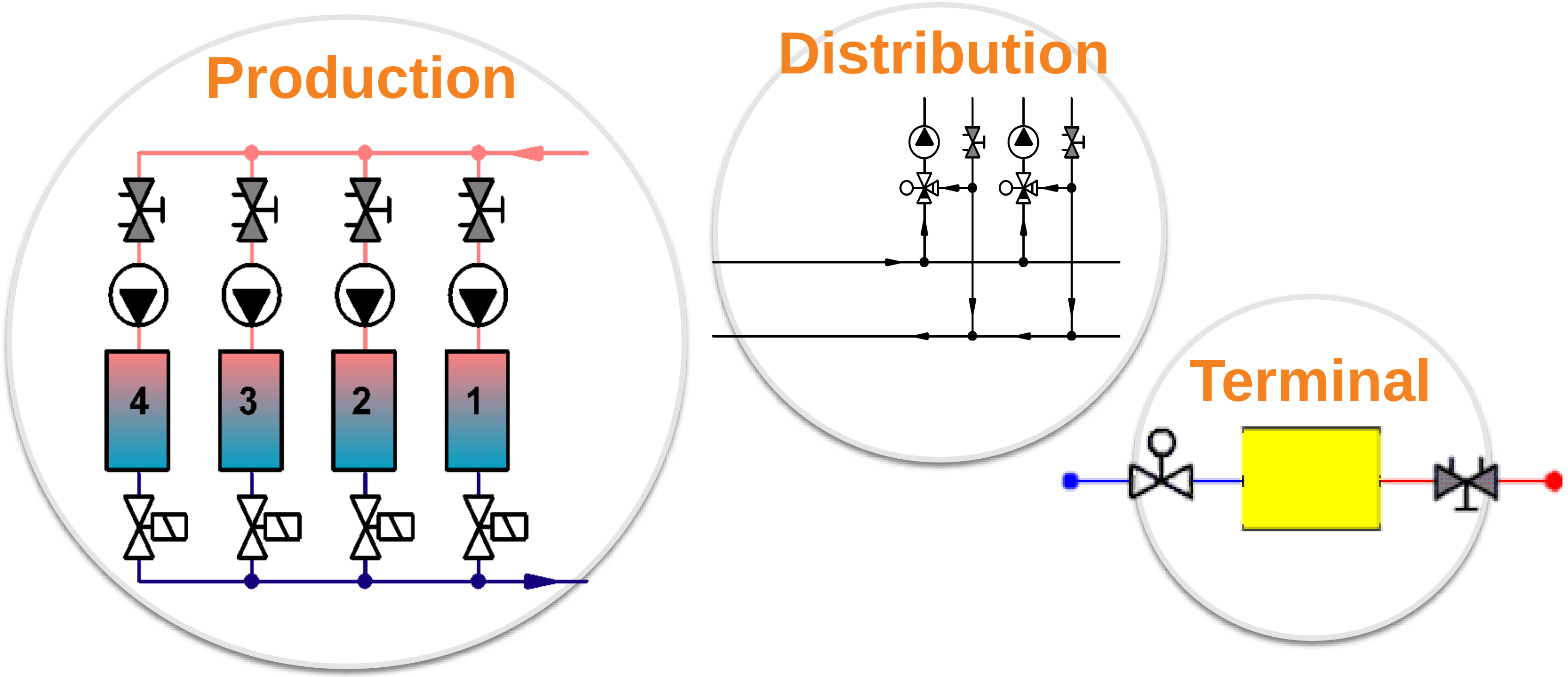
Breakthrough Engineering

HVAC Objective

1 Ensure the specified design conditions (Comfort/Process)

2 Achieve the first objective, ensuring the lowest energy consumption





About HVAC system

2°F of thermal deviation causes a
5-6% reduction in human efficiency

40% of the energy consumed in the world is used in buildings

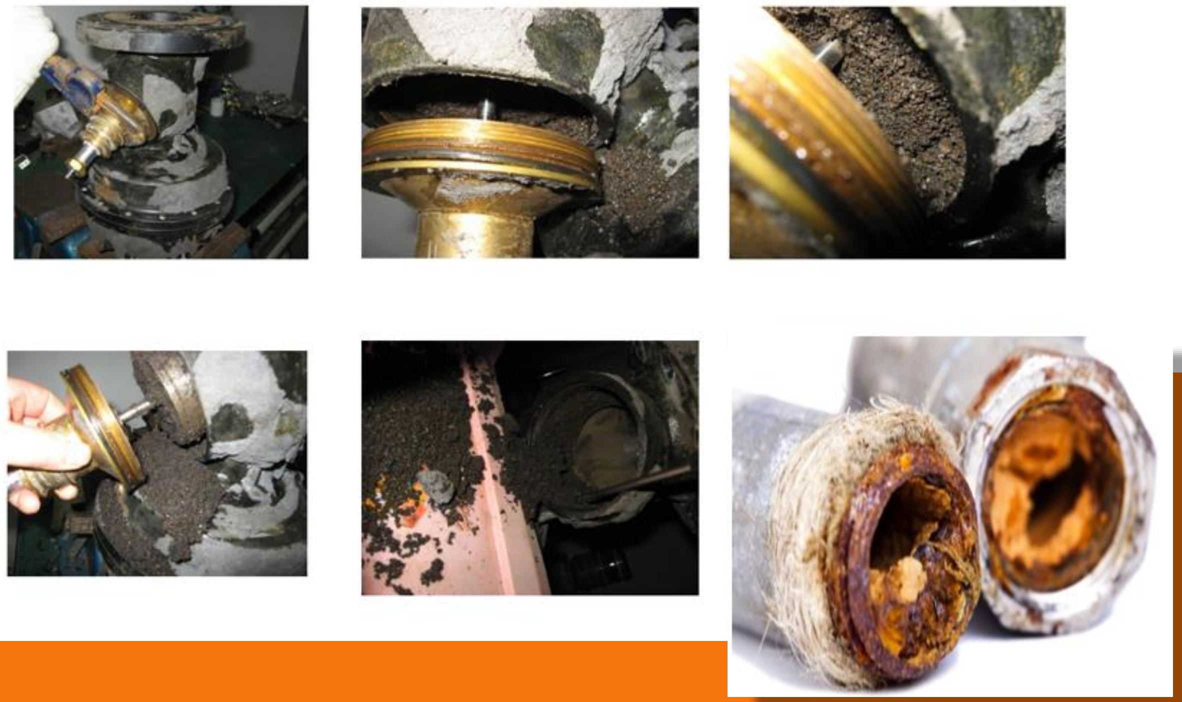
50% of this only in HVAC

Source: European Commission EPBD (point 6, pp1) & US Department of Energy's "Buildings Energy Data Book"

Sick building syndrome

System Noise

1. Air and dirt circulating in radiators and pipes
2. High flow speed or too high-pressure drop in valves



Operational risks

1. Energy fluctuations
2. Instability of temperature and humidity
3. User discomfort
4. Operational risk for critical areas such as operating rooms

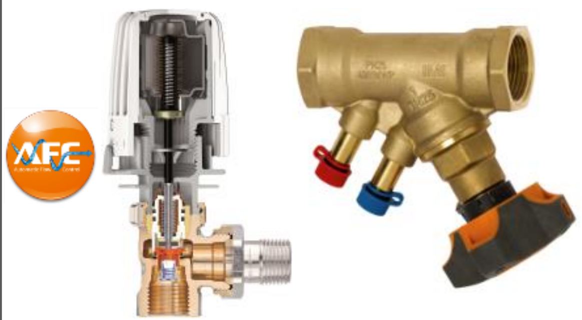
2°F
Too hot or too cold

6% a 11%
More energy consumption

3 fundamental steps in good HVAC

1 **Power required** at maximum conditions

Don’t spend more than you need to!



Save upto 35%

2 **Precise control** when the full design power is not required

We need <50% load 80% of the time!

On-off systems consume 7% more energy

3 Maintaining **optimal conditions**

Ensure the thermal efficiency and life cycle is maintained

1mm of dirt can overconsumption of up to 9%

Why worry about water flow?

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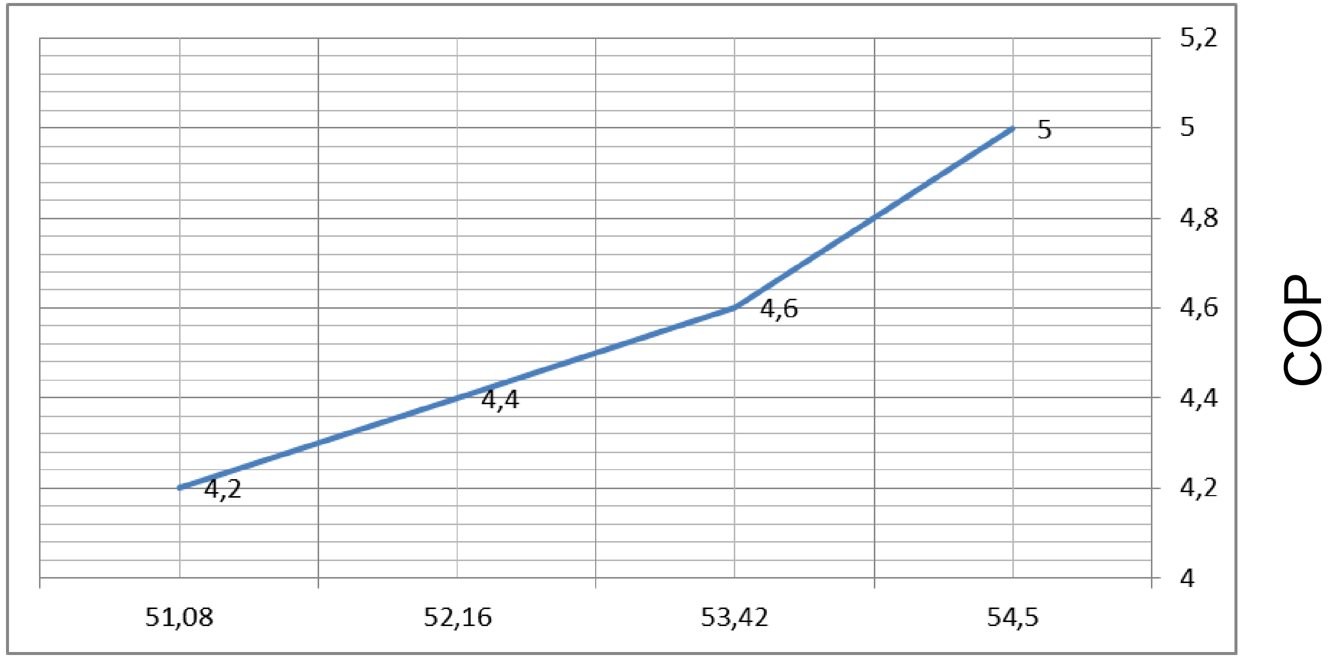
Overflow = Low ΔT

20gpm

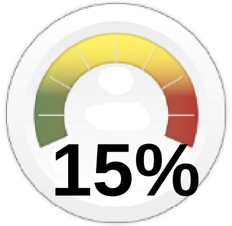
Design:
10GPM,
40°ΔT

Effect of a decrease of the return water temperature

Example :
Chiller: 200 tons *(703 kW)*
Water condenser temperatures: 85°F/95°F *(29.5°/35°C)*
Supply temperature of chilled water T_s : 45°F *(7°C)*



Return temp. chilled water T_r [°F]



A **reduction of return temperature of chilled water** can lead to a **15% drop of the COP**

Reasons

1. 3-way control valve
2. Supply air temperature depression
3. Warmer chilled water supply
4. Unbalanced system

IMI Hydronic Engineering

3 keys to optimize hydronic system

KEY 1

Setting the design GPM in each coil

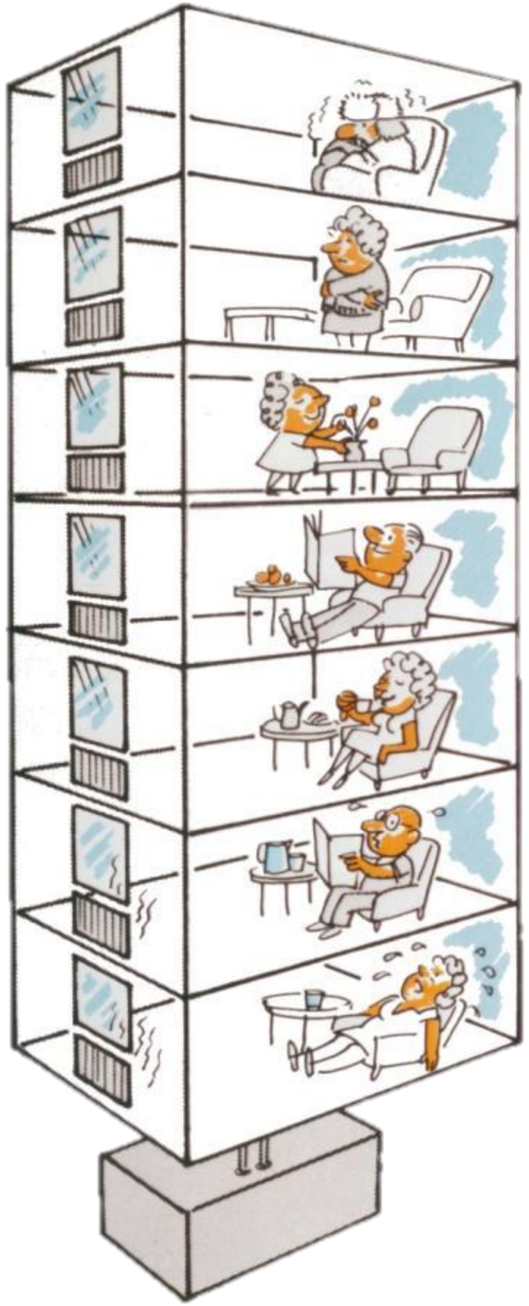
KEY 2

Maintain stable Δp across the control valve

KEY 3

Primary Flow should be ≥ Secondary Flow

Key 1:
Setting the design flow



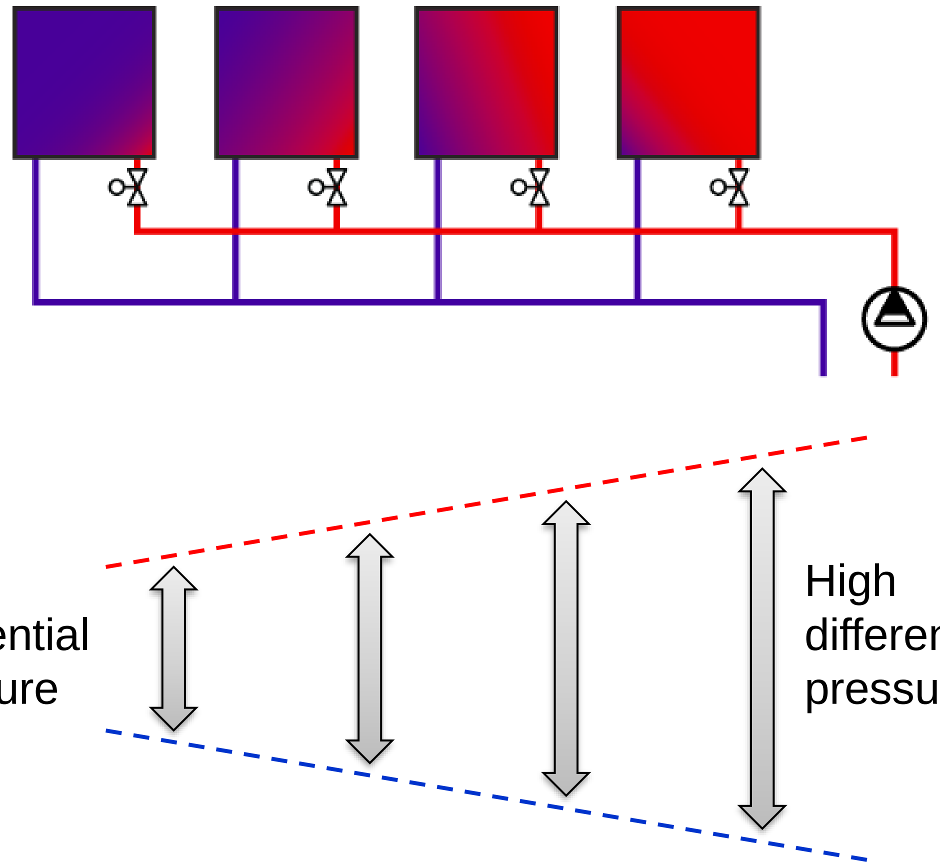
63°F

75°F

Without hydronic balancing

Underflow
= too cold

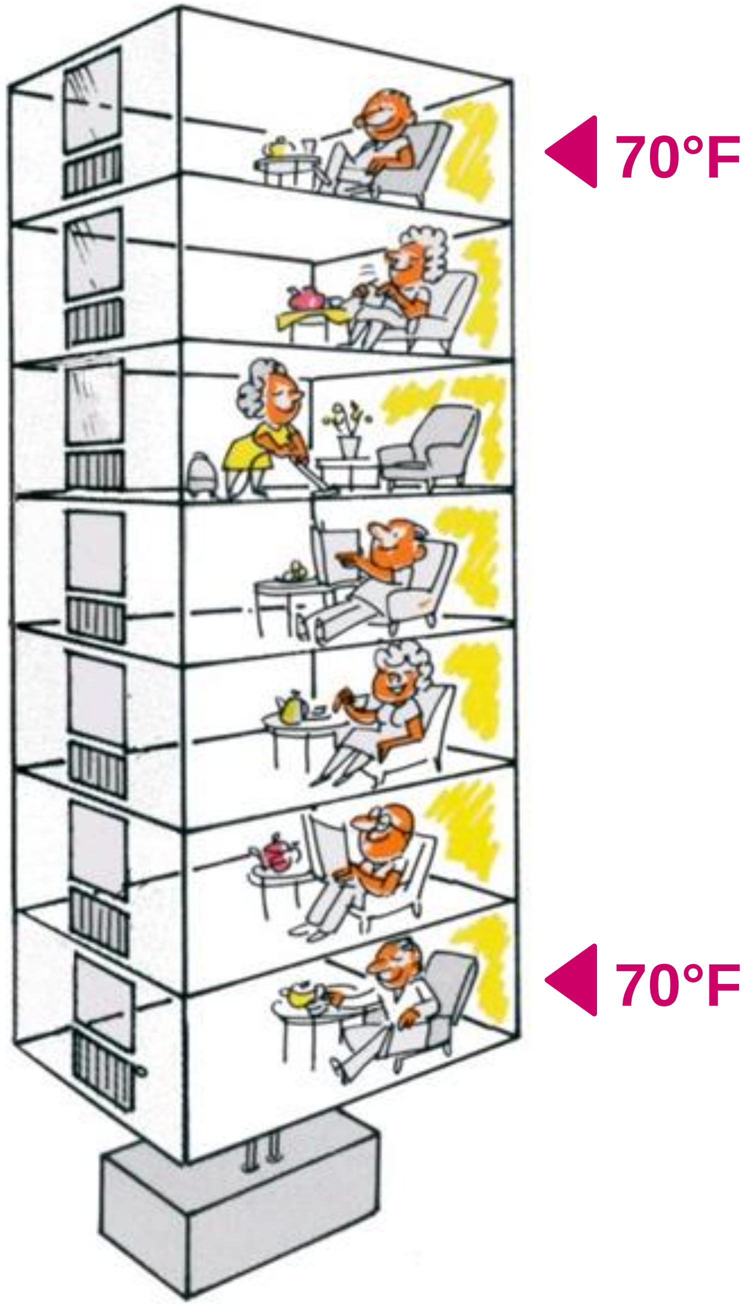
Overflow
= too warm



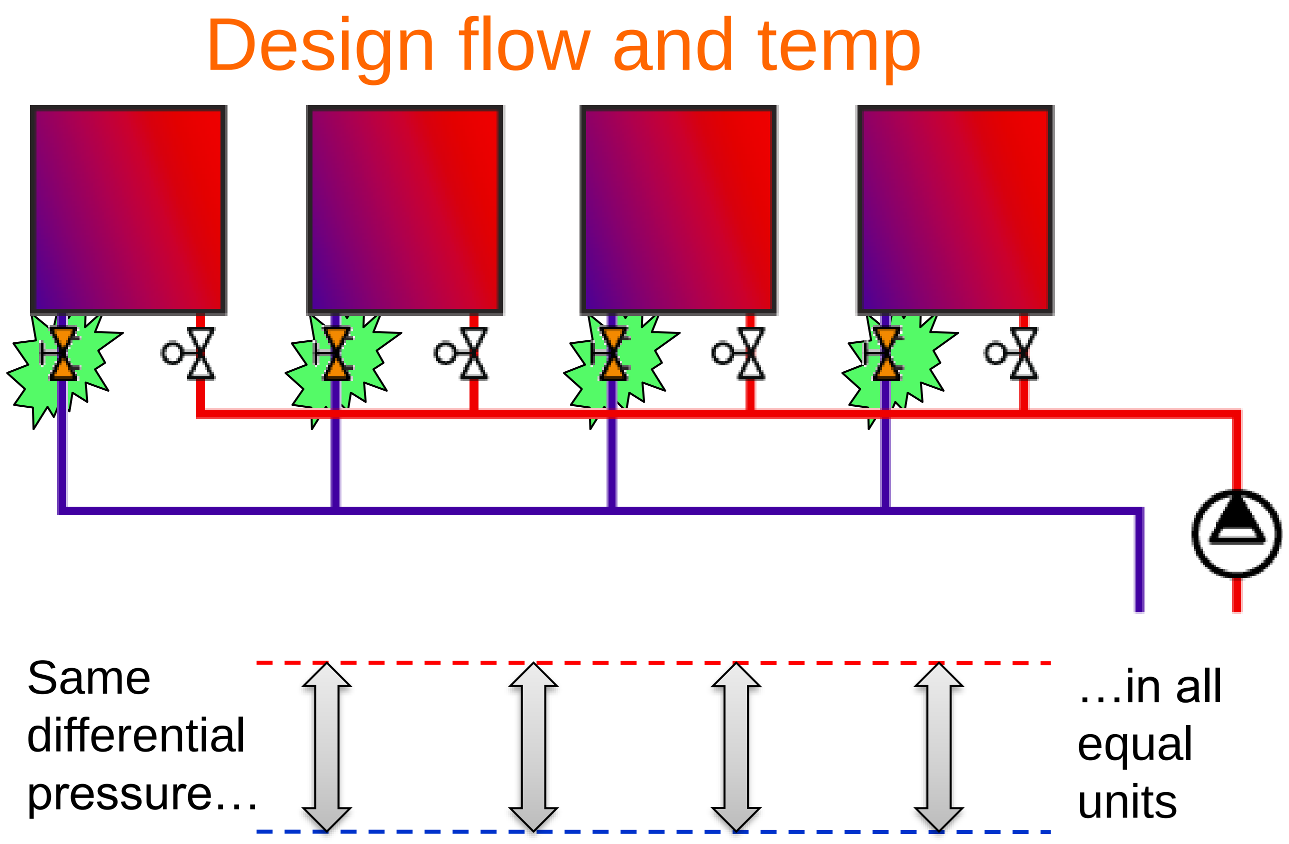
Low differential pressure

High differential pressure

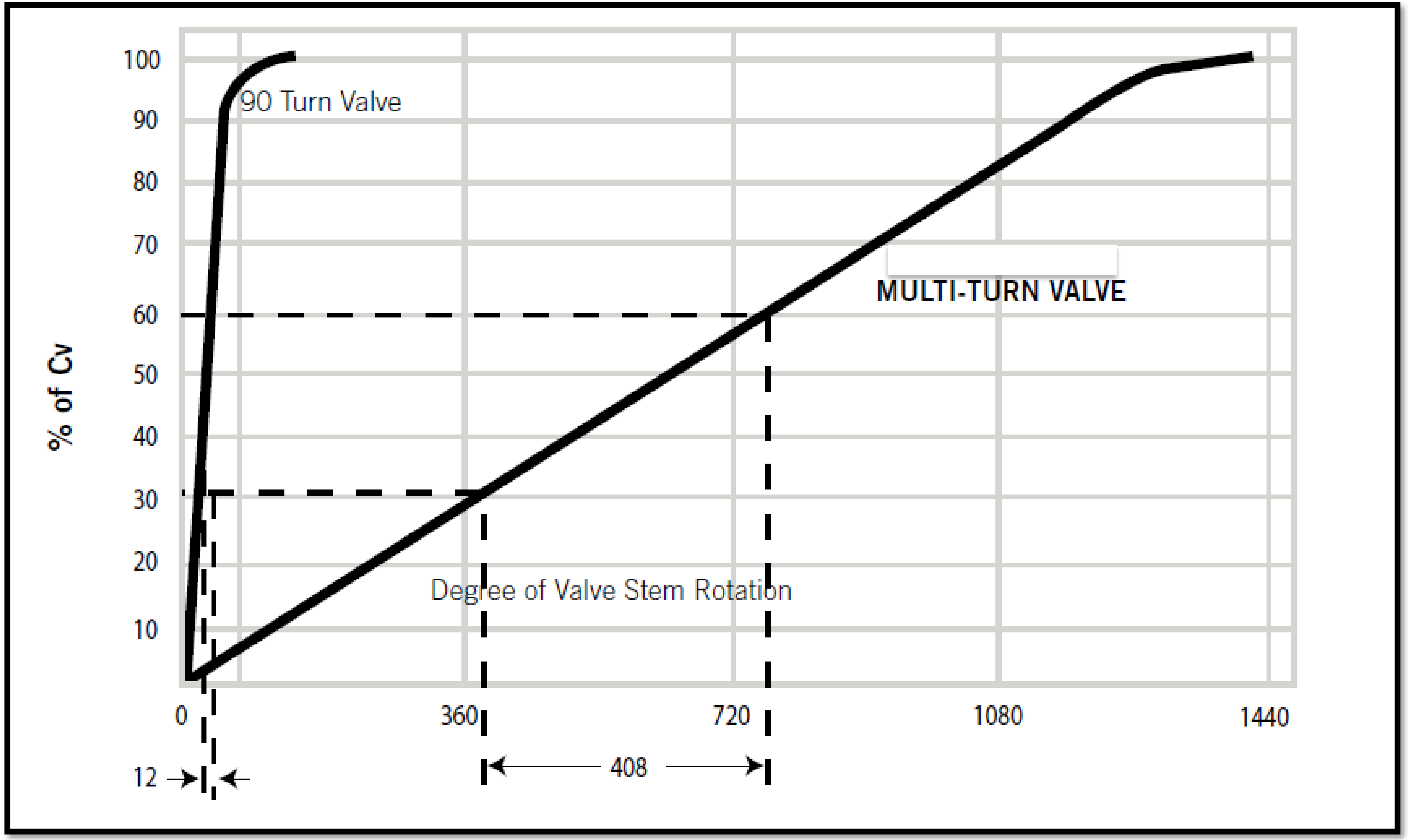
Key 1:
Setting the design flow



With hydronic balancing, all circuits gets design flow at the same time.

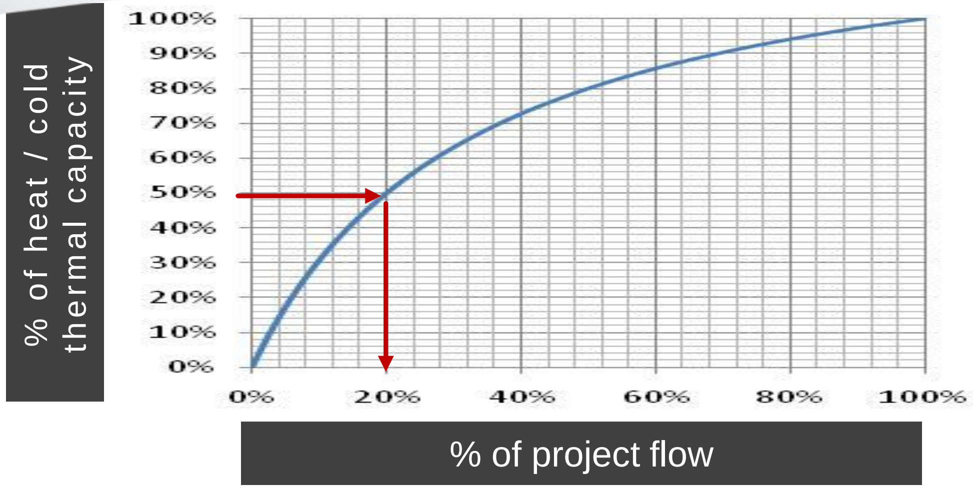


Key 1:
90° Turn Valve vs Multi-Turn Y Pattern Globe

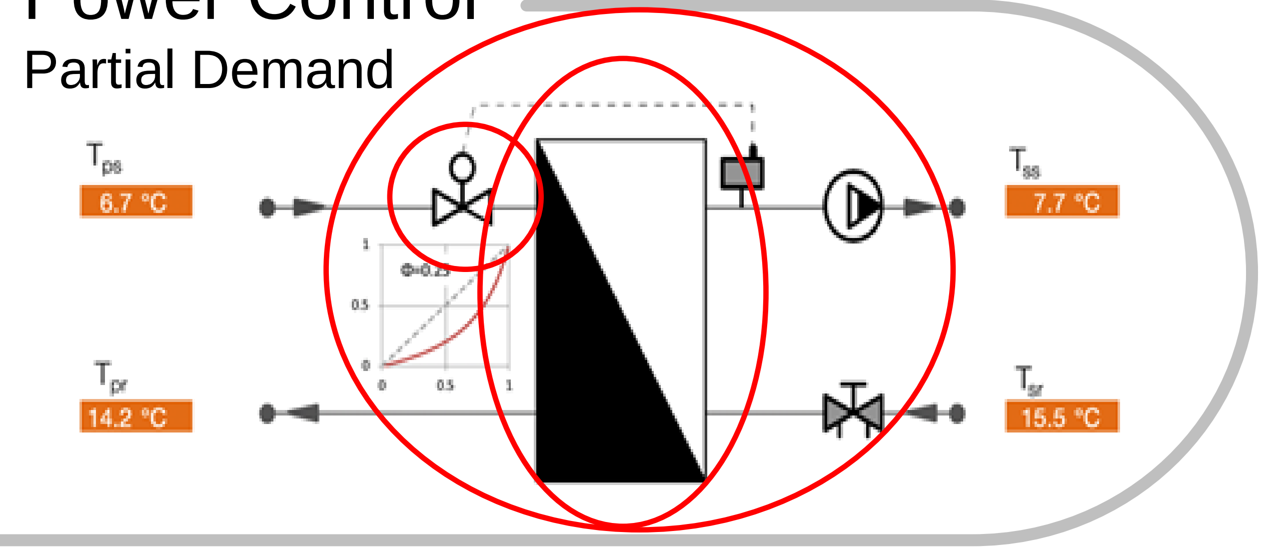


Key 2:
Differential pressure control

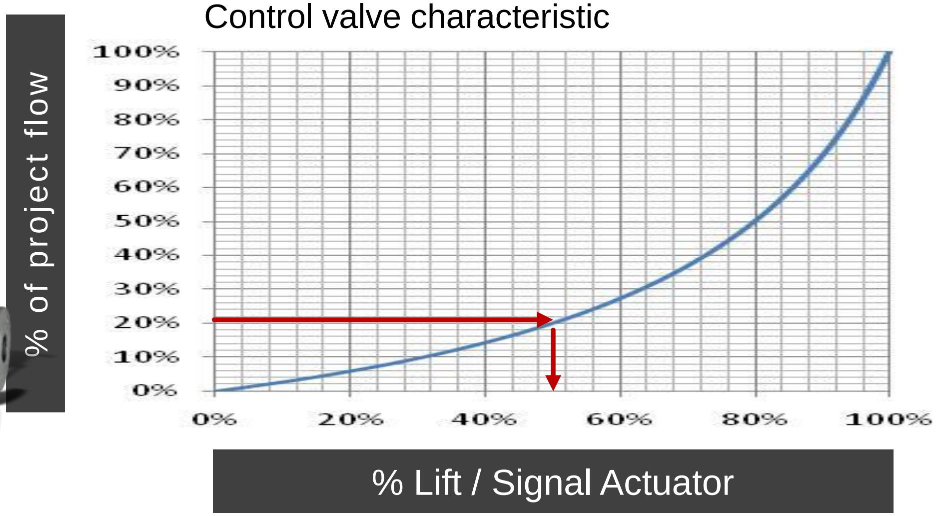
TERMINAL UNIT
Characteristic of a typical unit



Power Control
Partial Demand

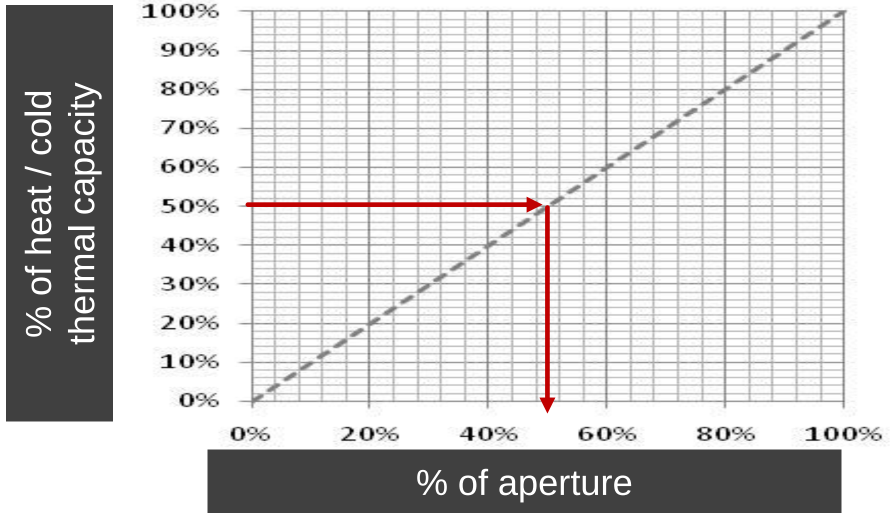


VALVE CONTROL
Control valve characteristic



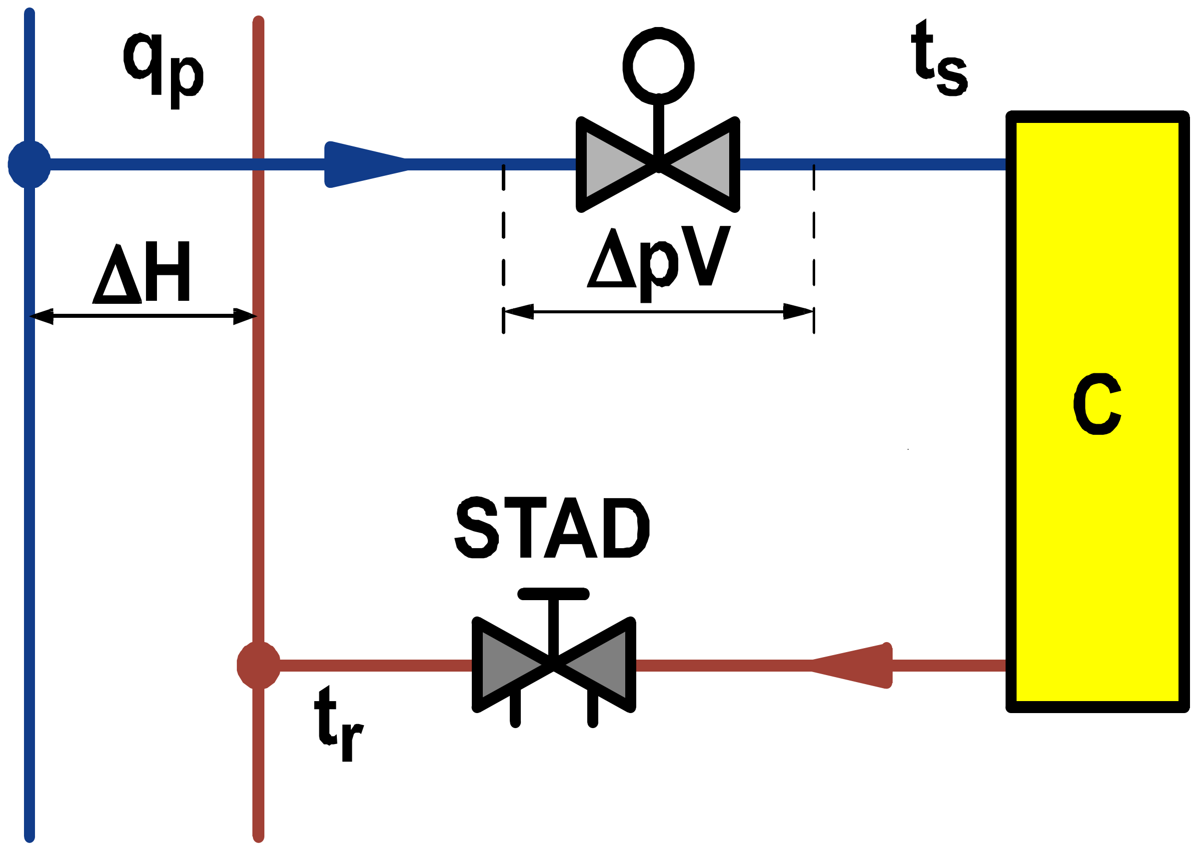
Harmony

Global Feature



Key 2:

Control valve authority



Constant as soon as the valve Cvs is chosen.

$$\beta = \frac{\Delta P_{Control\ valve\ fully\ open\ design\ flow}}{\Delta P_{Control\ valve\ fully\ shut}}$$

Variable, depends on flows in the piping,

thus also on the opening of all the other control valves.

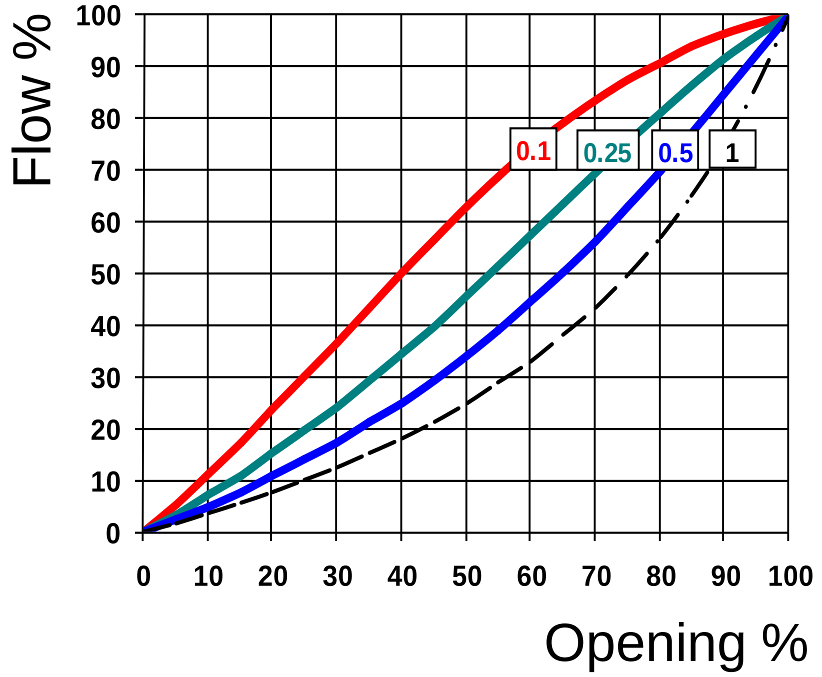
In a *variable* flow distribution,
the authority of a control valve is *variable*.

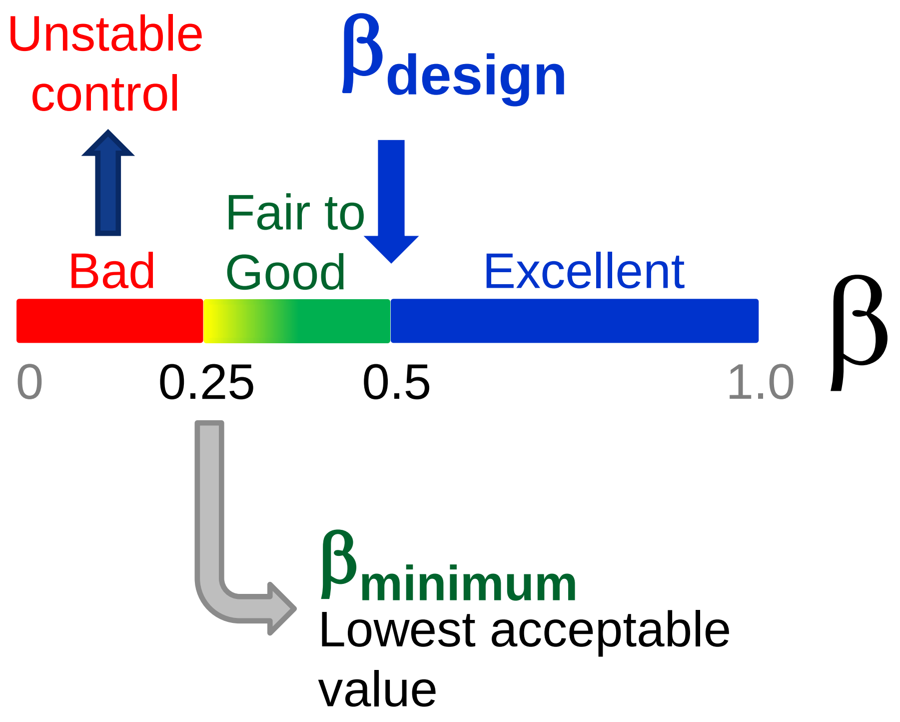
Key 2:
Distortion of valve characteristic

The lower the authority, the larger the Δp variations on the control valve, the larger distortion of the valve characteristic .

ASHRAE Handbook 2016 HVAC Systems and Equipment, Ch 47 (Valves)
The selection of the control valve pressure drop directly affects the valve authority and should be at least 25 to 50% of the system loop pressure drop (i.e., the pressure drop from the pump discharge flange, supply main, supply riser, supply branch, heat transfer coil, return branch, fittings, balancing valve, and return main to the pump suction flange).

Control valve with **Equal-percentage characteristic (EQM)**

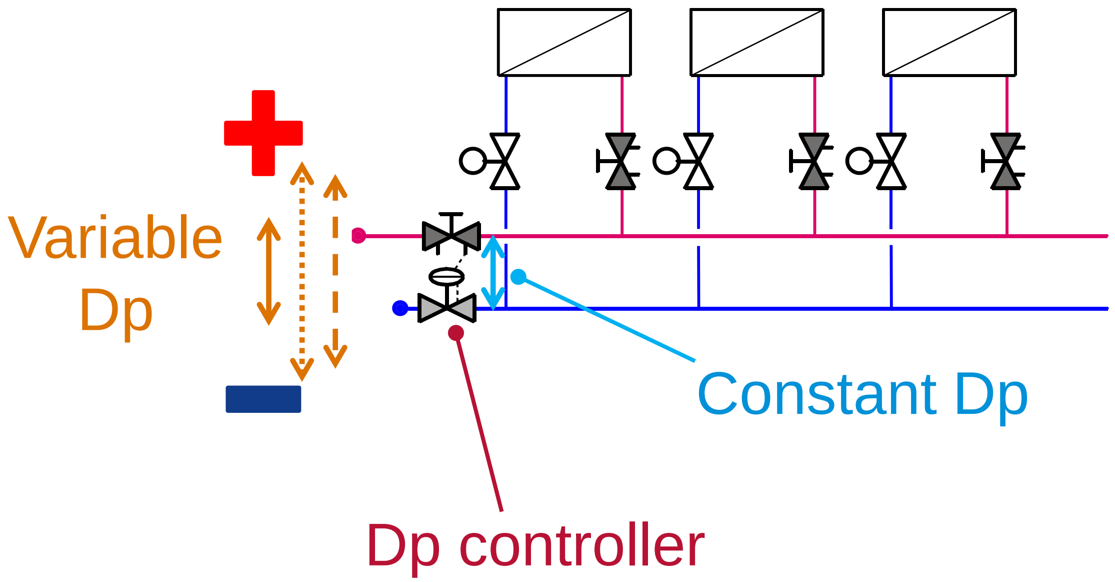




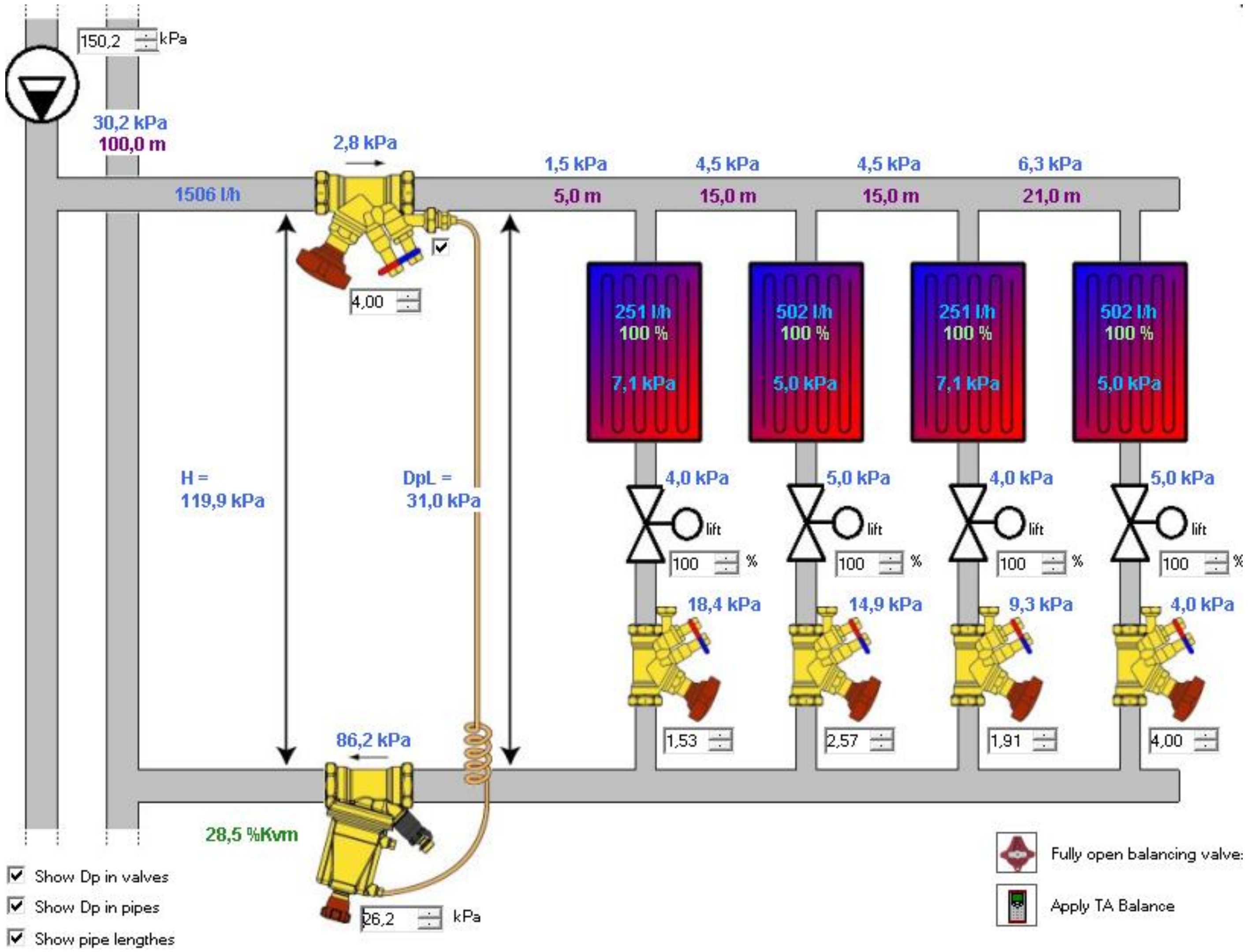
Why Differential Pressure Control?

1. Control valves work with improved authority, therefore their performance is improved
2. Noise in control valves is reduced or removed completely
3. Based on stabilized differential pressure across the circuit, the flow is limited

- ➢ Circuits are a pressure independent modules. Which means:
  - That the changes in other parts of the system do not affect the circuit
  - Large plants can be balanced module by module independently
  - New modules can be added to the system without rebalancing

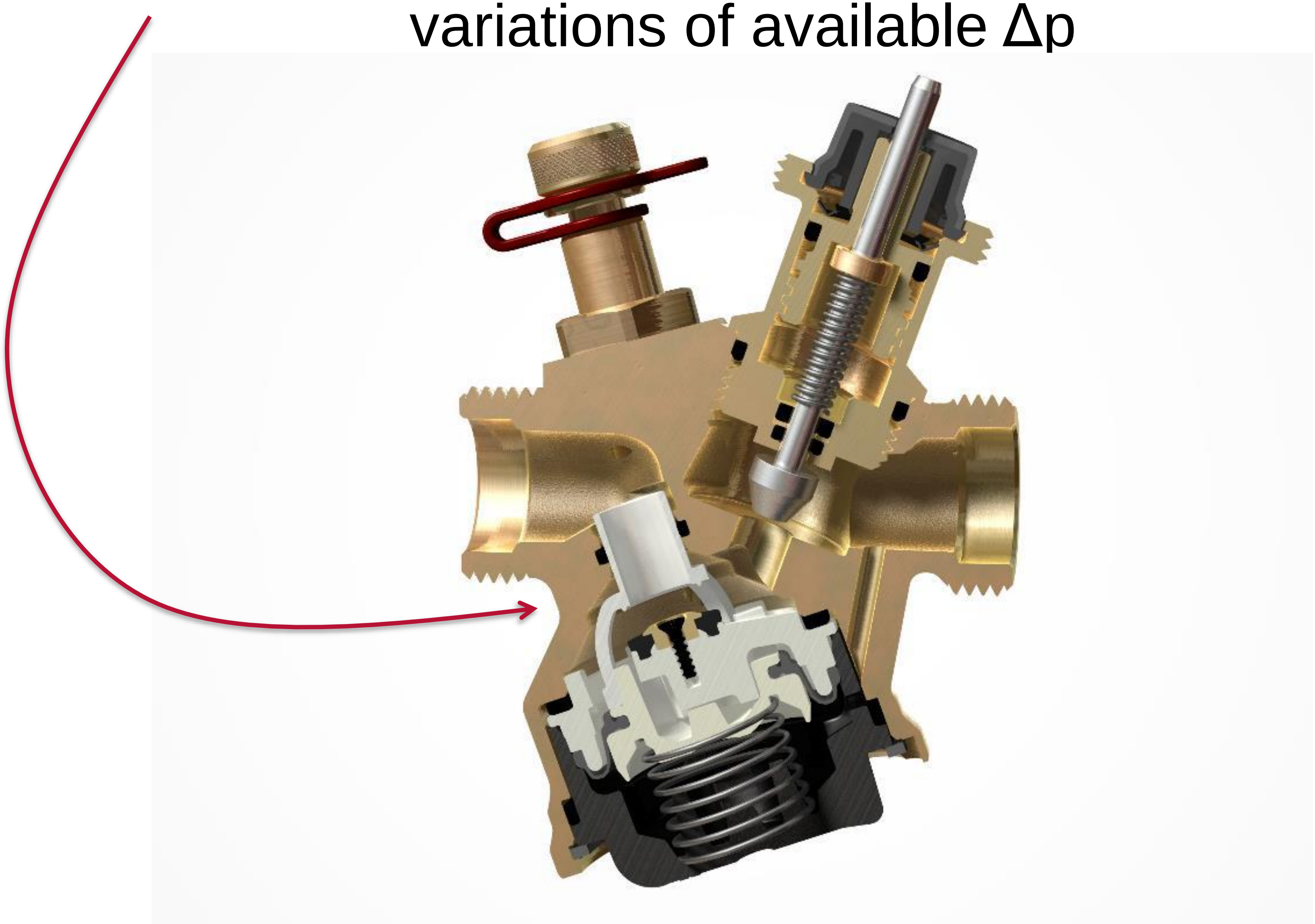


Arrangement



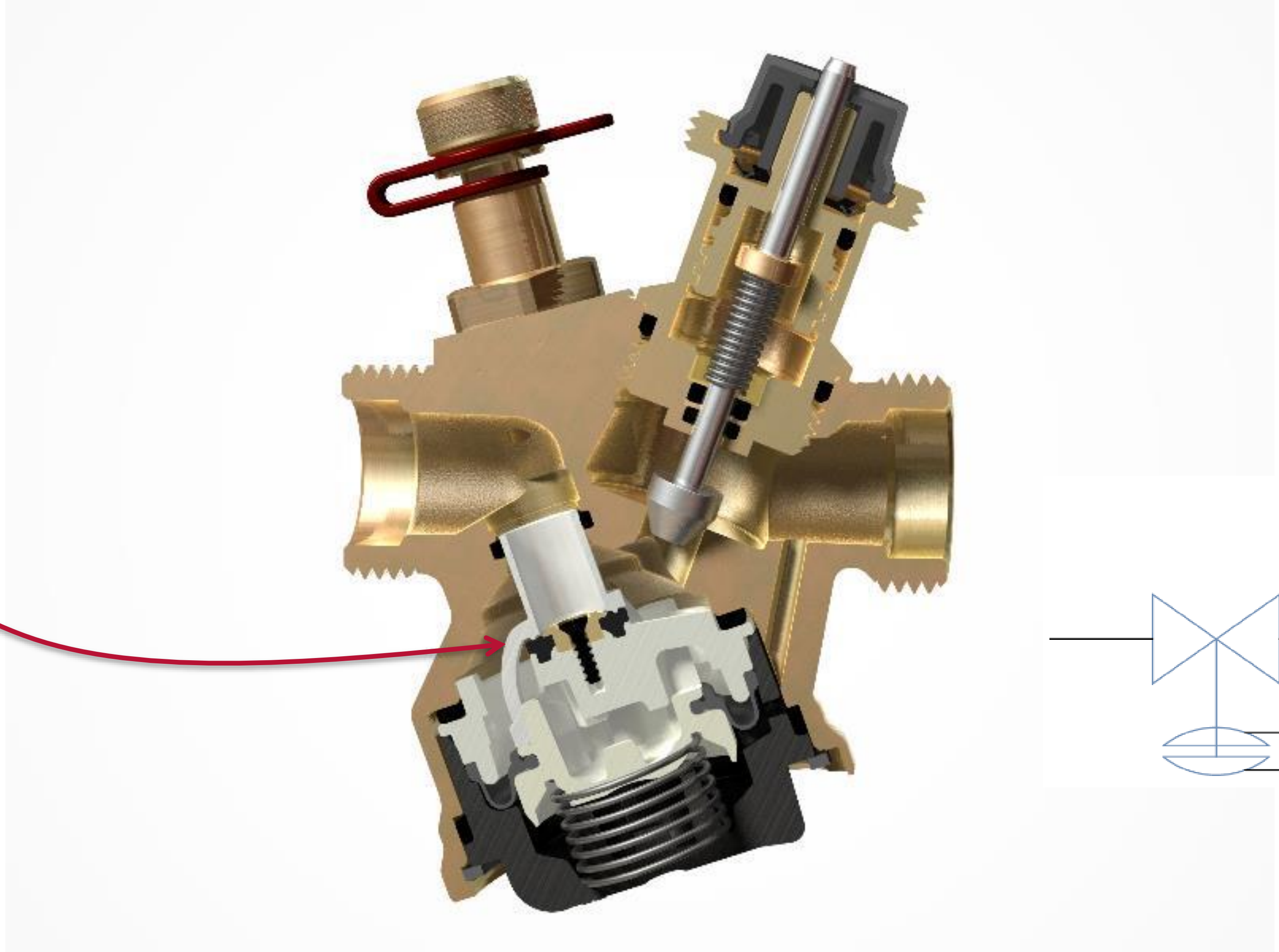
Pressure independent balancing & control valve

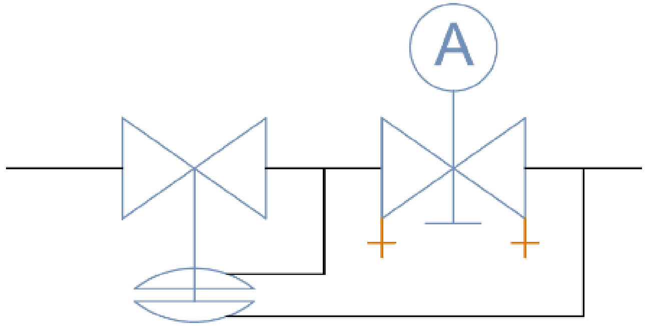
- The Dp controller compensates for variations of available Δp



Pressure independent balancing & control valve

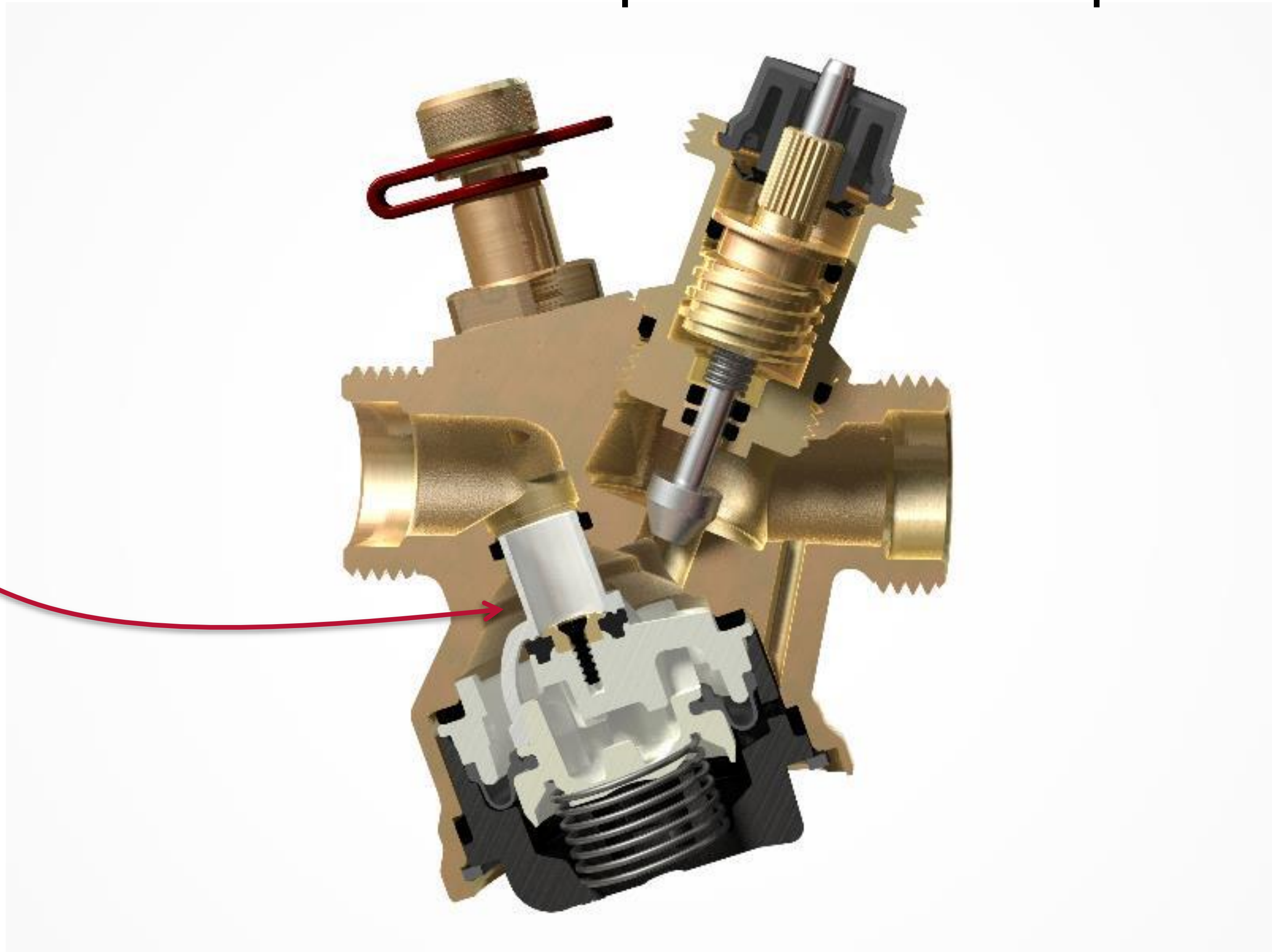
- The self-acting Dp controller readjusts its opening to maintain an almost constant Dp on the actuated control part.



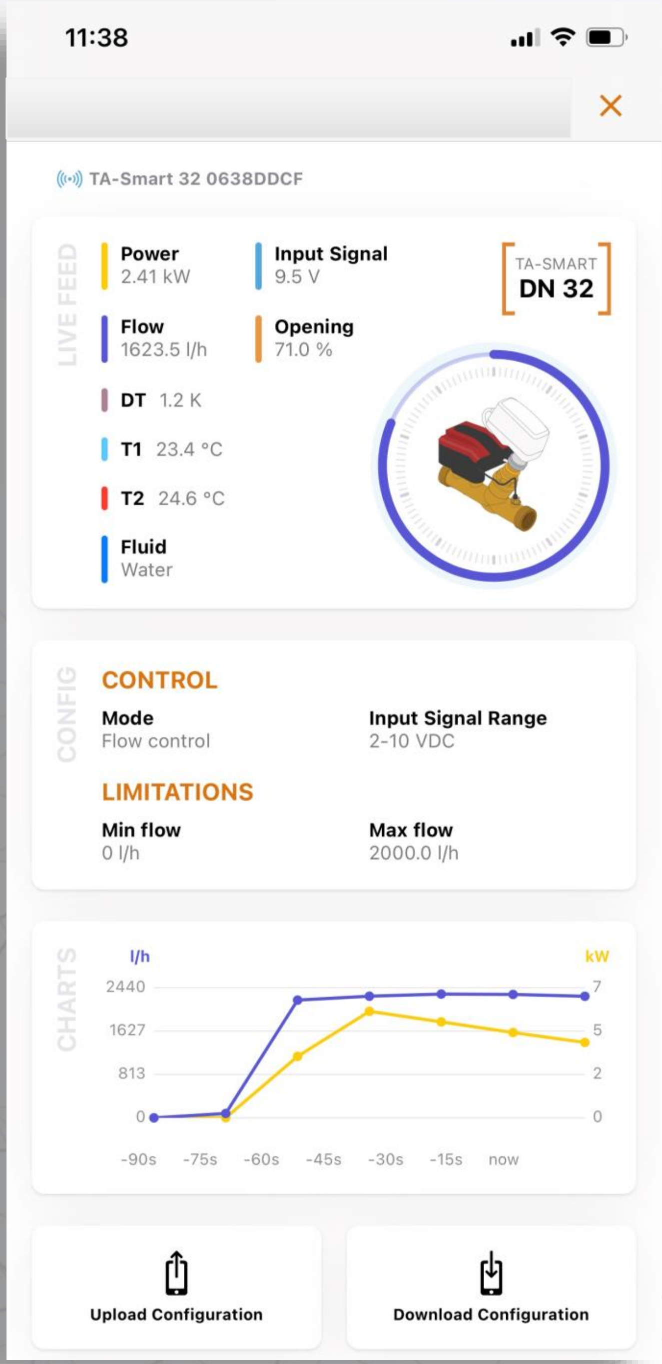


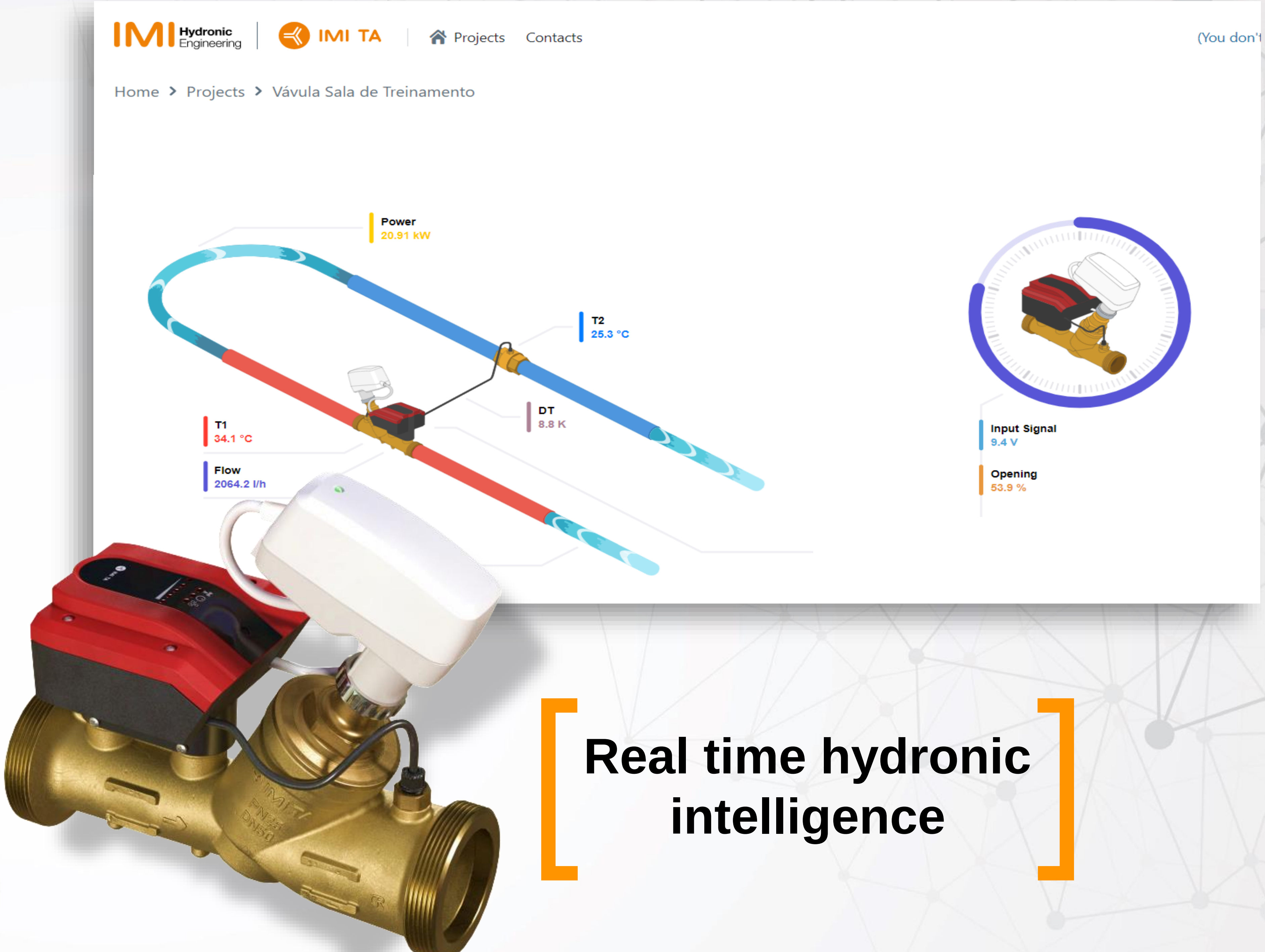
Pressure independent balancing & control valve

- The self-acting Dp controller readjusts its opening to maintain an almost constant Dp on the control part being adjusted.



Smart control valves



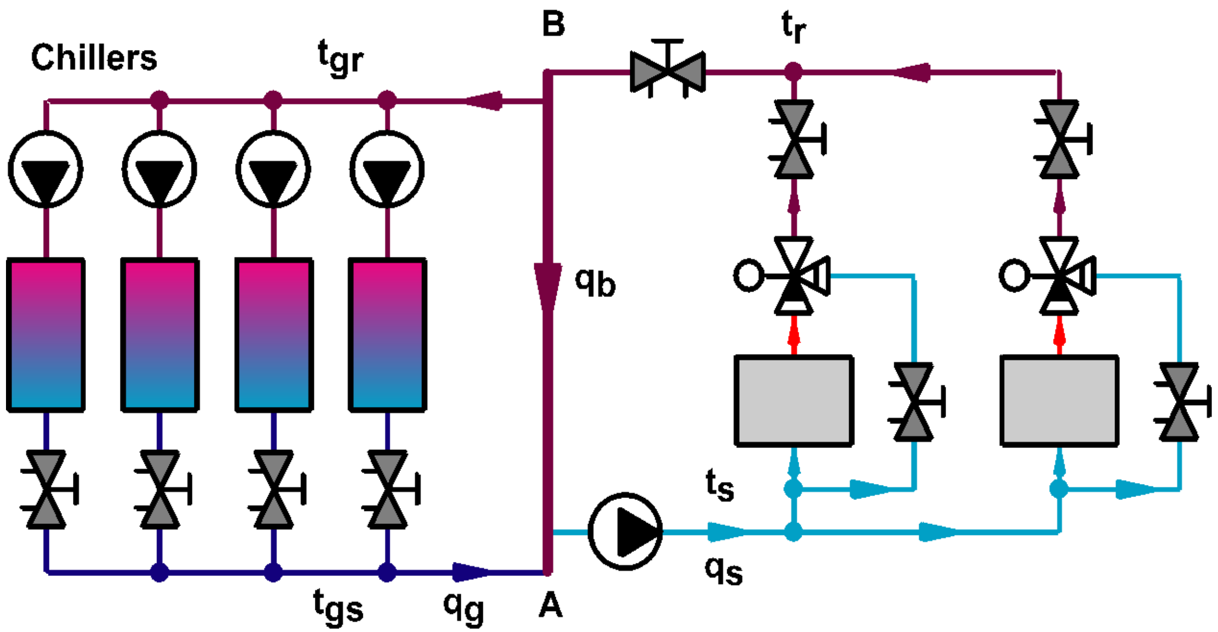


Real time hydronic intelligence

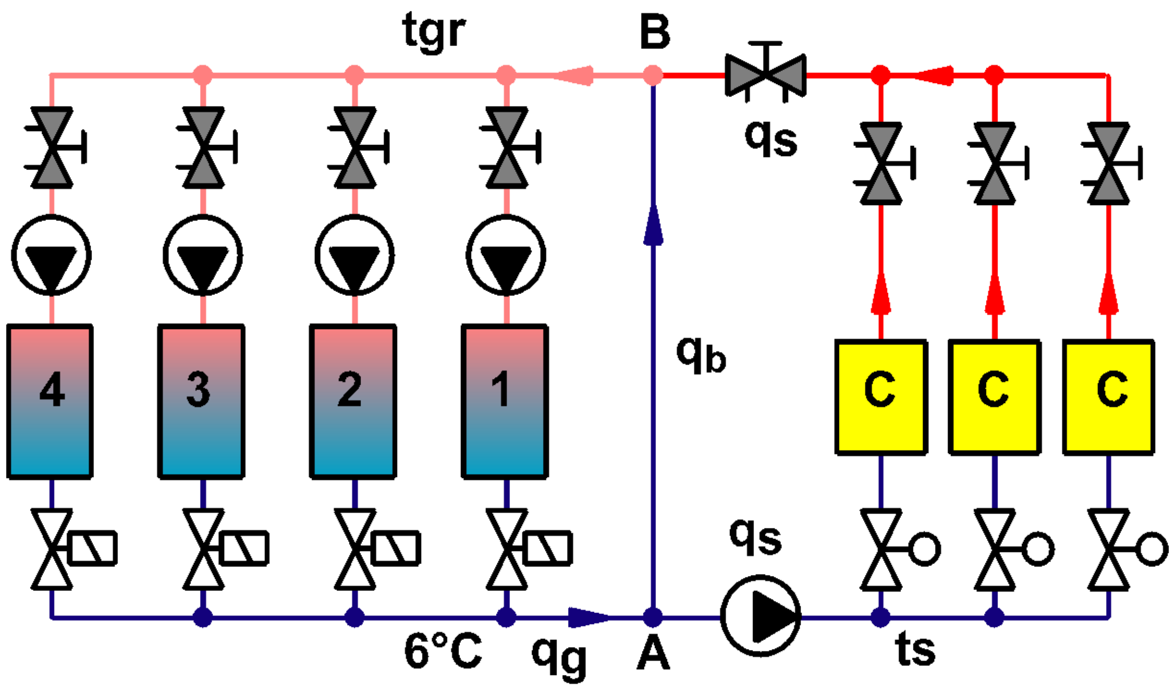
Key 3:

Primary Flow ≥ Secondary flow

Constant flow
in distribution



Variable flow
in distribution



Production and distribution must be balanced to ensure compatibility flow.

Lawton Public Safety Facility, Clay Coe, OK

100,000 sq. ft, 4 stories building, 350 working station

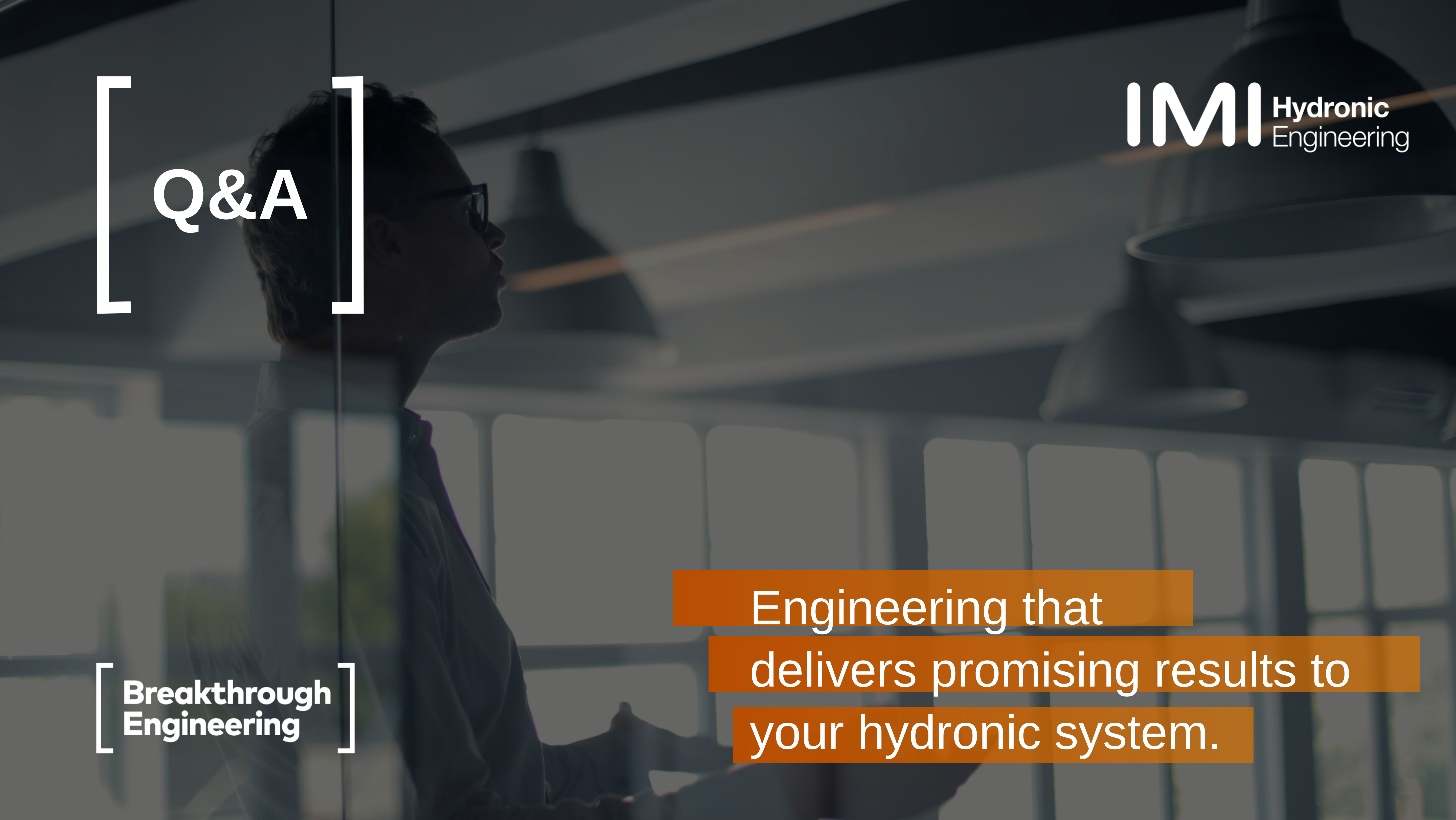
Original strategy:

- Control valves on each terminal
- VSP pump at constant DP control

Applied strategy for optimization:

- Manual balancing with control valves on each terminal
- DP controllers on each branch
- VSP pump at constant DP control

23% reduction in energy consumption
$19,341 in annual energy savings


Q&A
IMI Hydronic Engineering
Engineering that
delivers promising results to
your hydronic system.
Breakthrough Engineering