ENGINEERING
TOMORROW

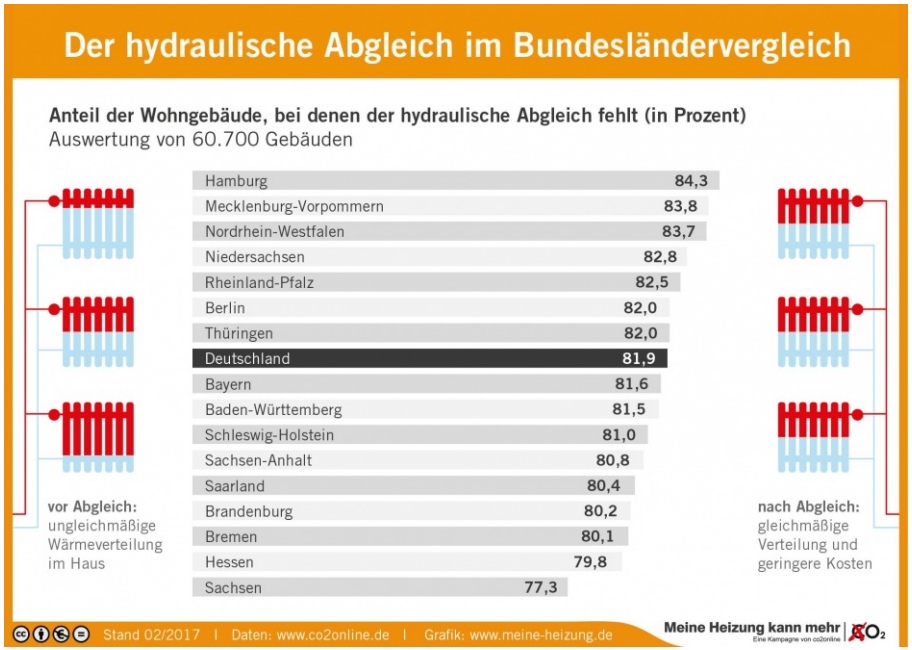
Hydronic Balancing and Control

How to overcome the global challenge of reducing energy use in multifamily housing

eceee paper 5-235-17

May 2017

Introduction



~80% of multi family houses in Europe have heating systems with

- ❑ **poor** hydronic balance and
- ❑ often **inadequate** room temperature control.

The result is higher than optimal energy consumption.

[Example Germany: CO2online survey: 81,9% *]

*missing hydronic balance

How much energy is wasted?

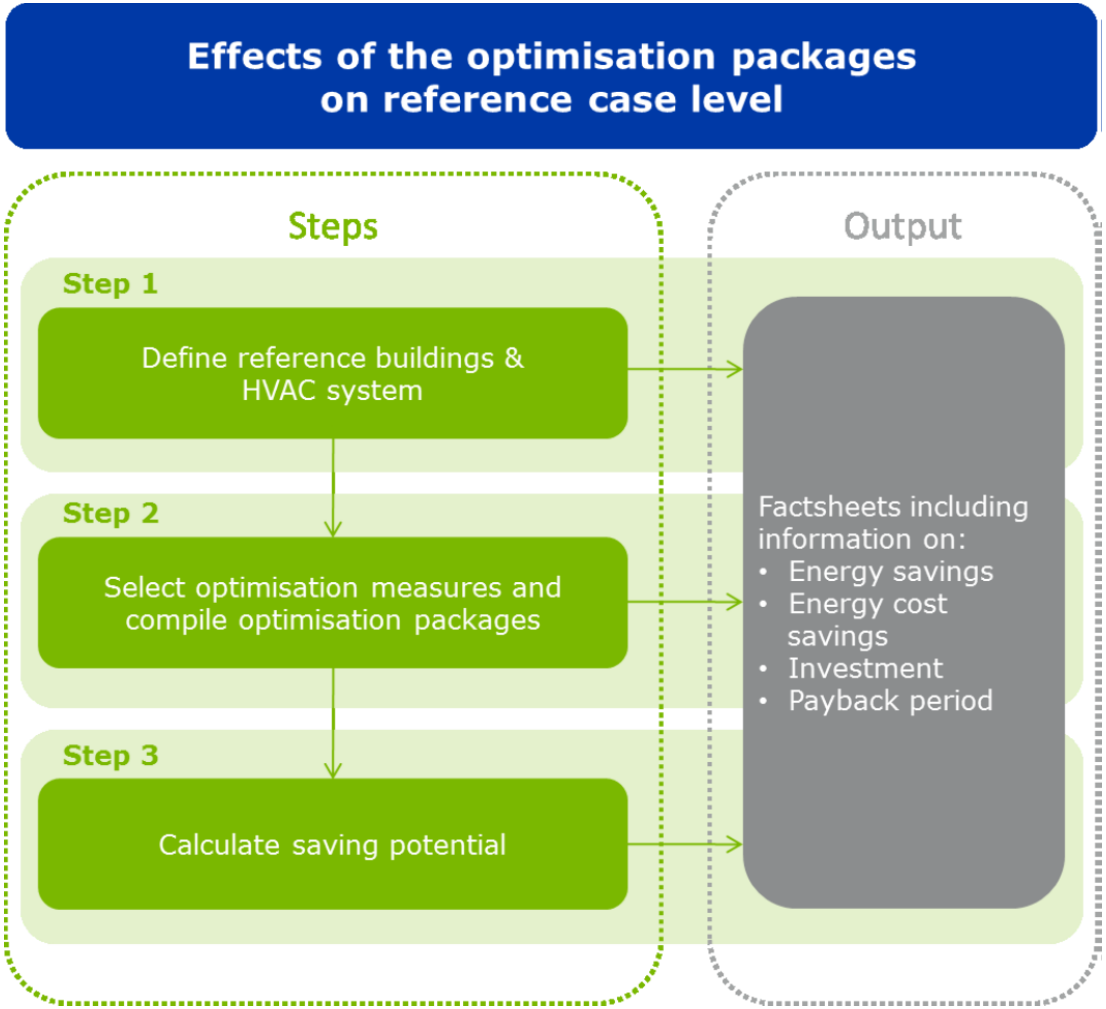
Research – Ecofys study (2017)

calculates energy savings potential for 8 reference cases:

- 2 optimization packages
  - Get the basics right
  - High performance
- single improvement measures

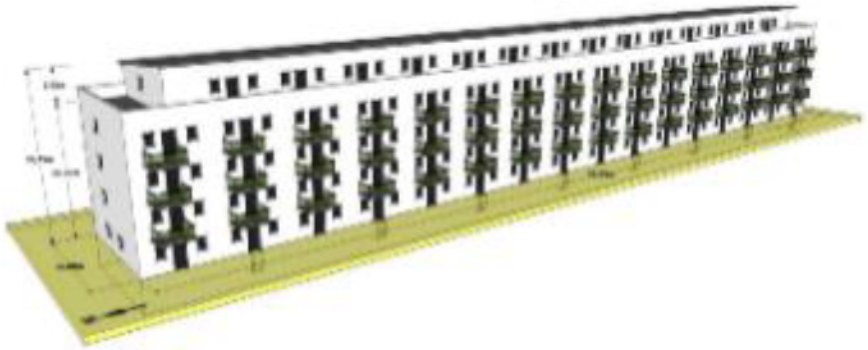
According to

- DIN V 18599 (energy quantities necessary)
- EN 15232: 2012 (Impact of BAC's)
- EN 15316-2:2007 (Impact of hydronic balancing)



Research – Multi-family house

Single measures



Balancing related single measures:

- 10% savings from automatic balancing
- 10% savings from reduced system temperatures

Hydronic balancing is enabler to adjust system temperature:

- in case of insufficient heat supply to one or more radiators and building units, it is not necessary to increase the supply temperature, if instead the system is dynamically balanced.

15% energy savings

correspond to 15.9 MtCO2 emission reduction

Confirming research in practise

Real cases - Methodology

M&V tools used to increase confidence level of savings data:

- Observation period: Heating season
- Data source: Central heat meter readings
- Data provider: Building administrators
- Data normalization: Heating Degree-day method

Energy consumption compared between

- Year before TBD modernization vs
- after TBD mod. period (1-3 years)

Real cases – Milano, Italy

TBS modernization: automatic balancing valves, installed 2014

Reference TBS condition (before):

- 5 buildings, common station, modernized
- Thermostatic valves on radiators
- No balancing

Trigger: tenant´s complaints about noise

Reference period:

- ❑ 2013/14

Observation period:

- ❑ 2014/15
- ❑ 2015/16

Specific consumption before	0,71 [MWh/HDD]
Avg. specific consumption after	0,64 [MWh/HDD]
Energy savings [%]	**11%**
Avg. yearly energy cost saving [€]	12.595 [€]
Investment costs	26.400 [€]
Pay back time	**2,1 years**

Real cases – Szczecin, Poland

TBS modernization: automatic balancing valves, installed 2005

Reference TBS condition (before):

- Radiator thermostatic valves
- Manual balancing valves
- Heat cost allocation (2003)
- Modernized building envelope (insulation, 2004)

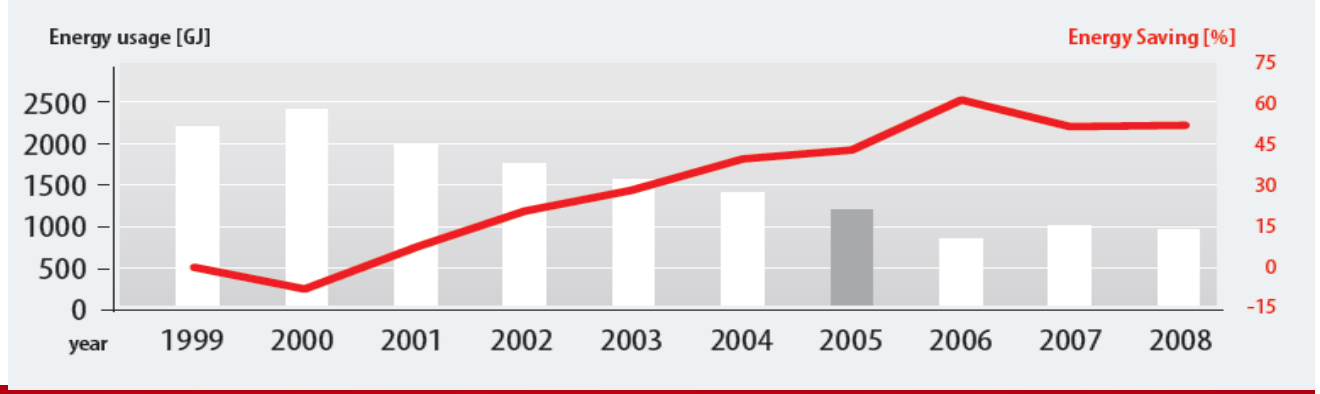
Reference energy consumption (HDD)	1.236 GJ
Avg. y. energy savings after (HDD)	960 GJ
Energy savings [%]	**22%**

Reference period:

- 2005

Observation period:

- 2006, 2007, 2008

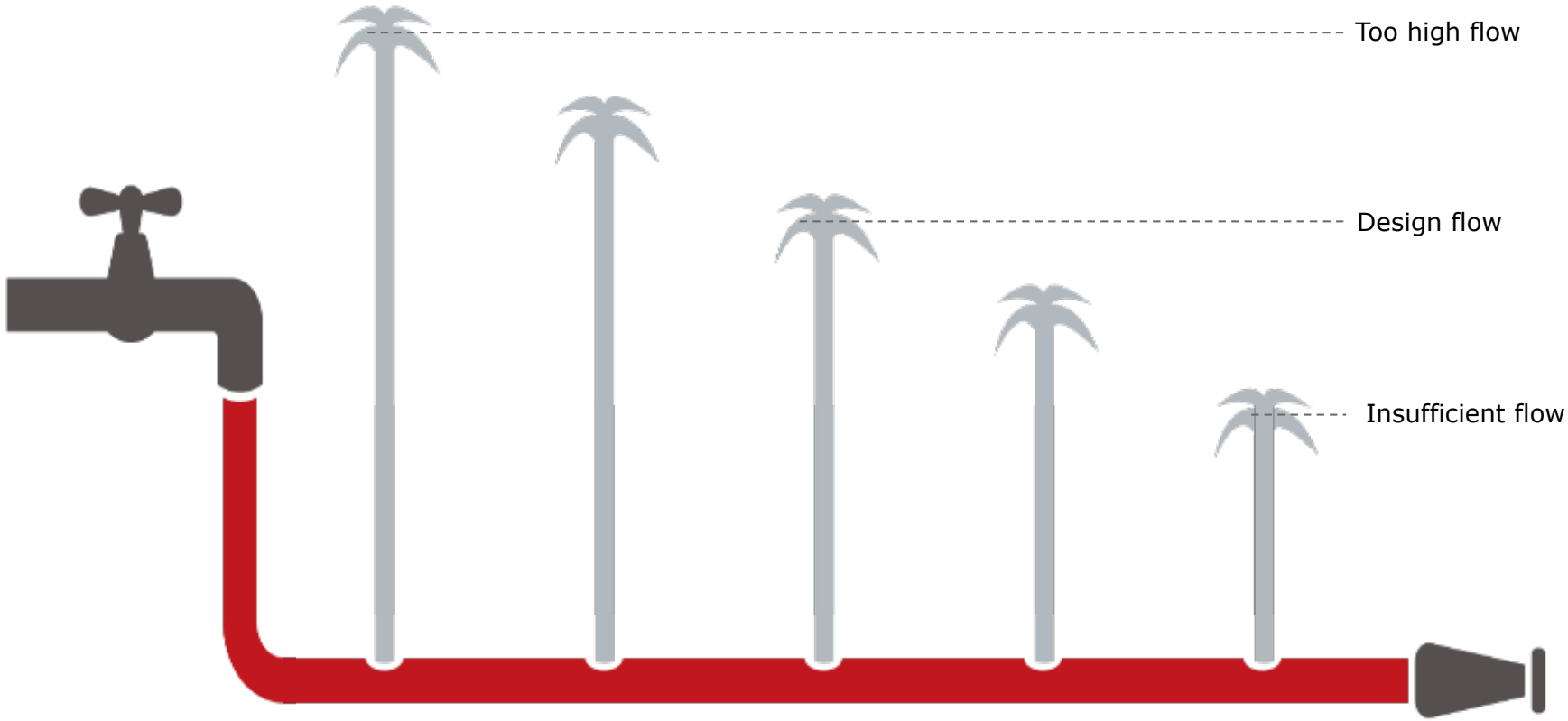


Technical background

Unbalanced system

Technical background

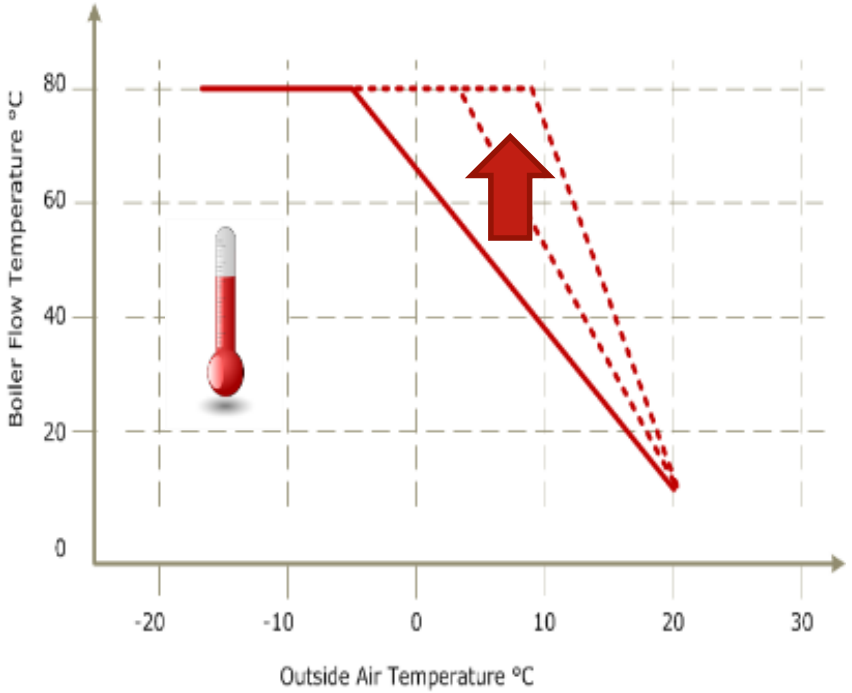
Unbalanced system

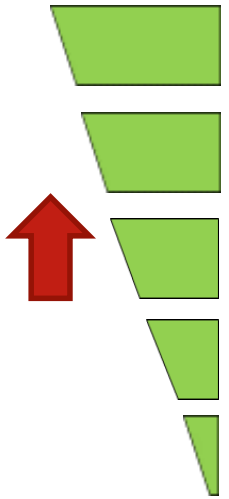


Technical background

Typical way of solving complaints

Adjusting heat curves or increasing the pump head

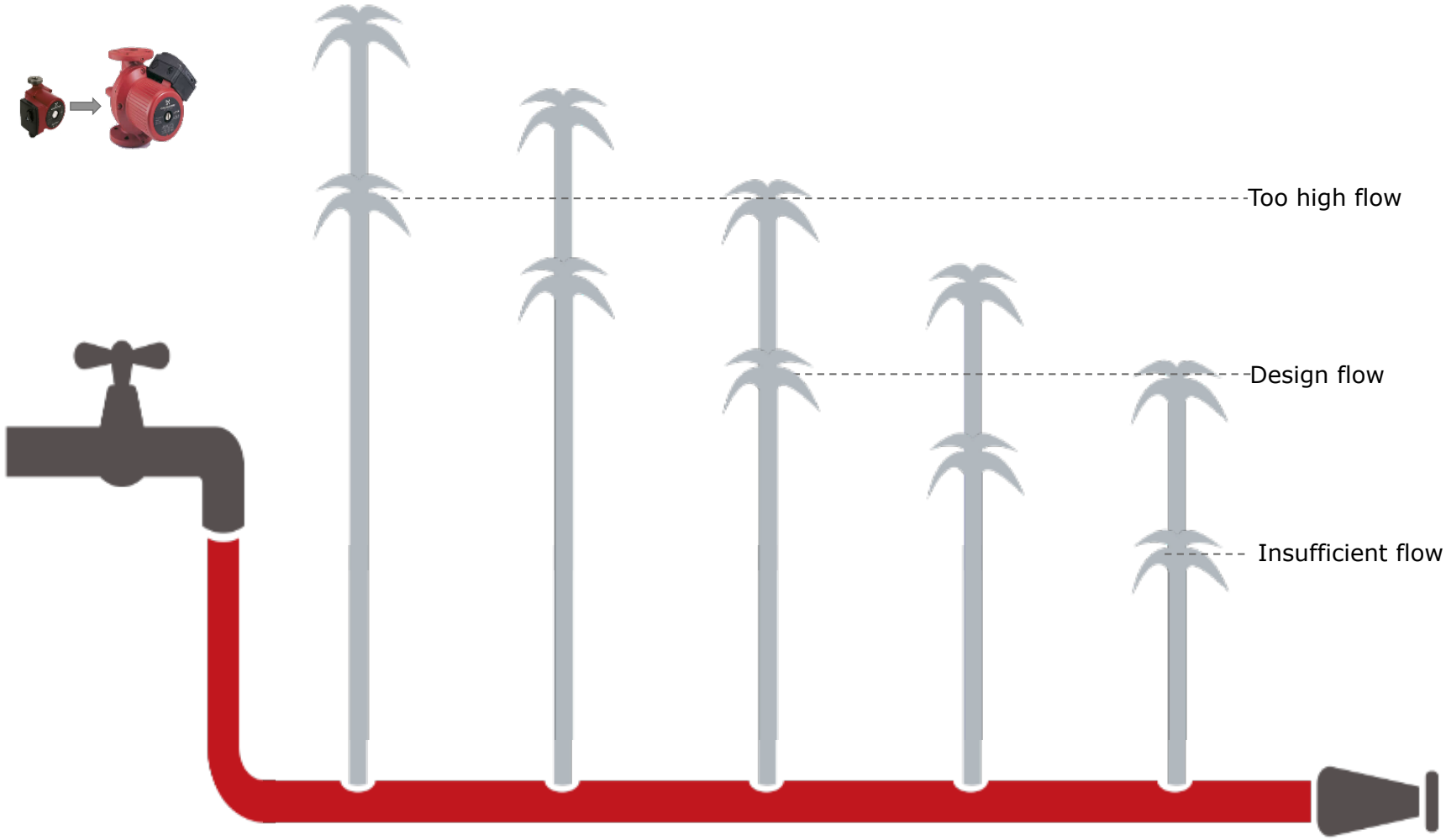




- Both „work-arounds“are neither efficient nor reliable solution!

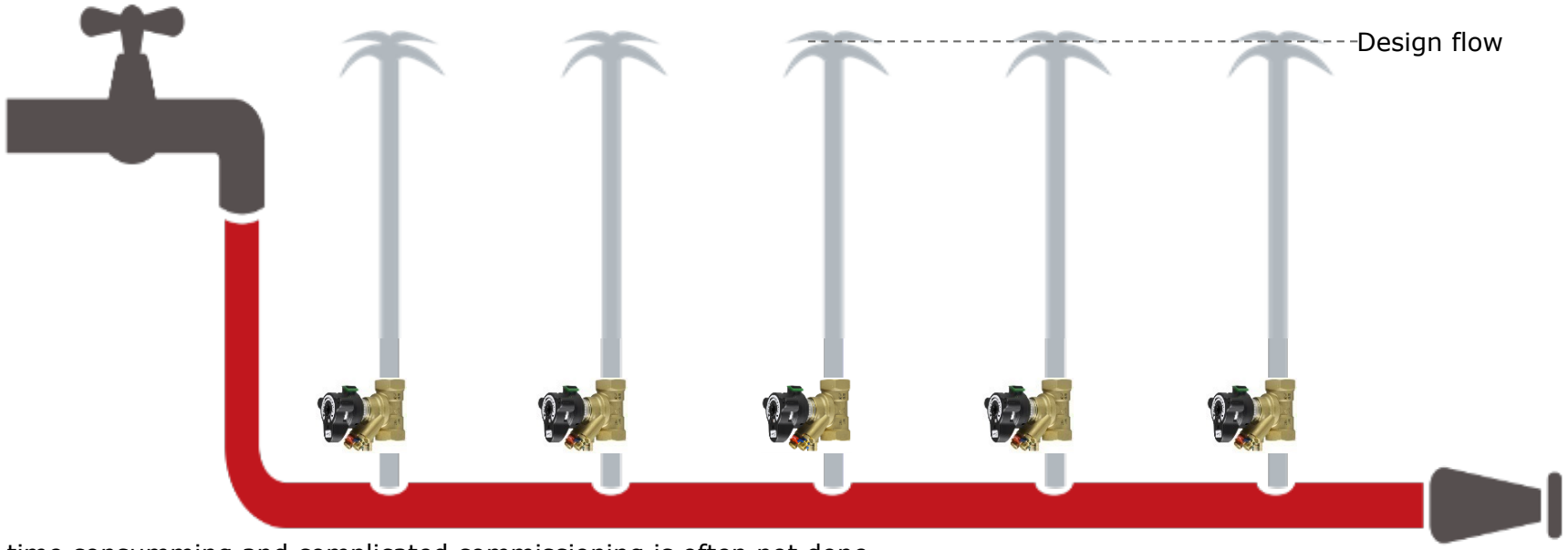
Technical background

Typical way of solving compaints



Technical background: design load

Correct design flows can be achieved by static balancing*



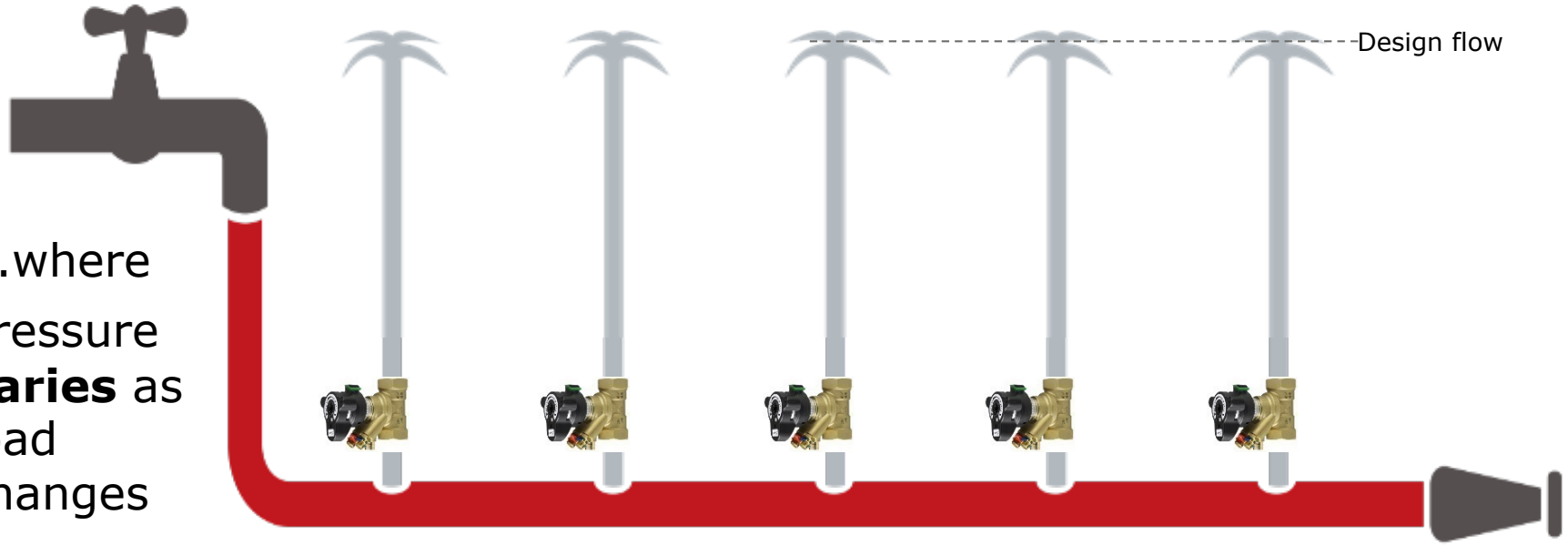
* time consumming and complicated commissioning is often not done

Technical background: partial load...

Individual room control...

...makes system dynamic...

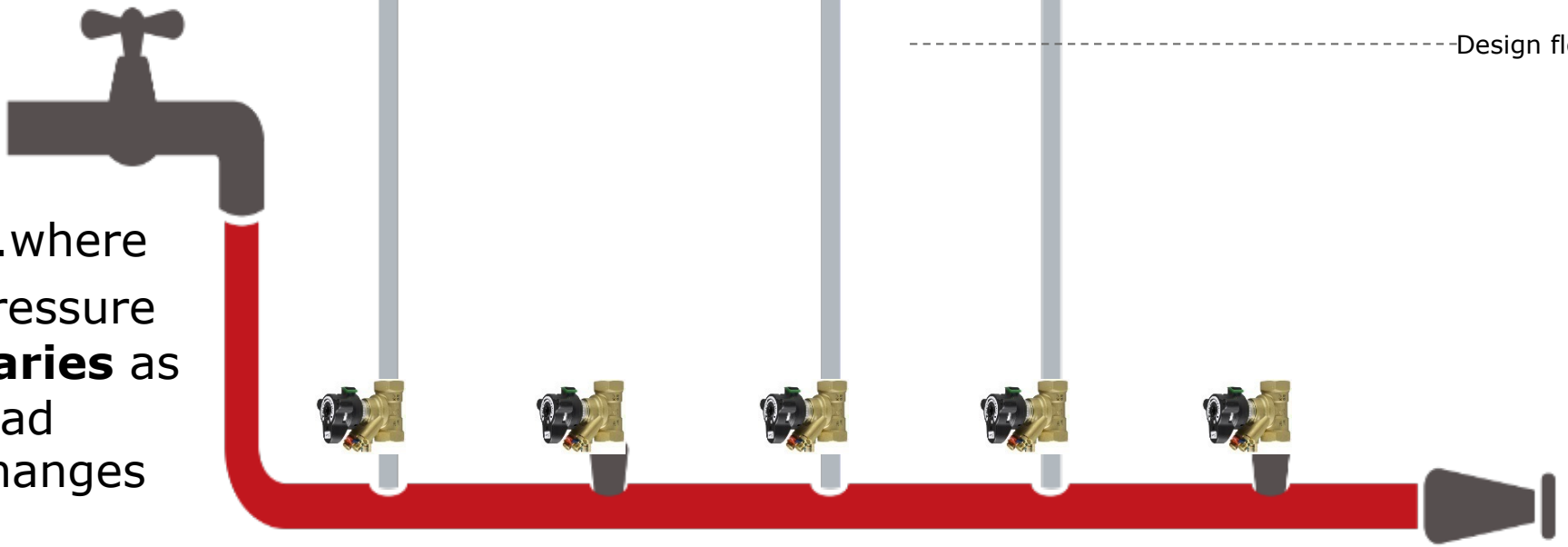
...where pressure **varies** as load changes



Technical background: partial load...

needs individual room control...

...which creates dynamic system...



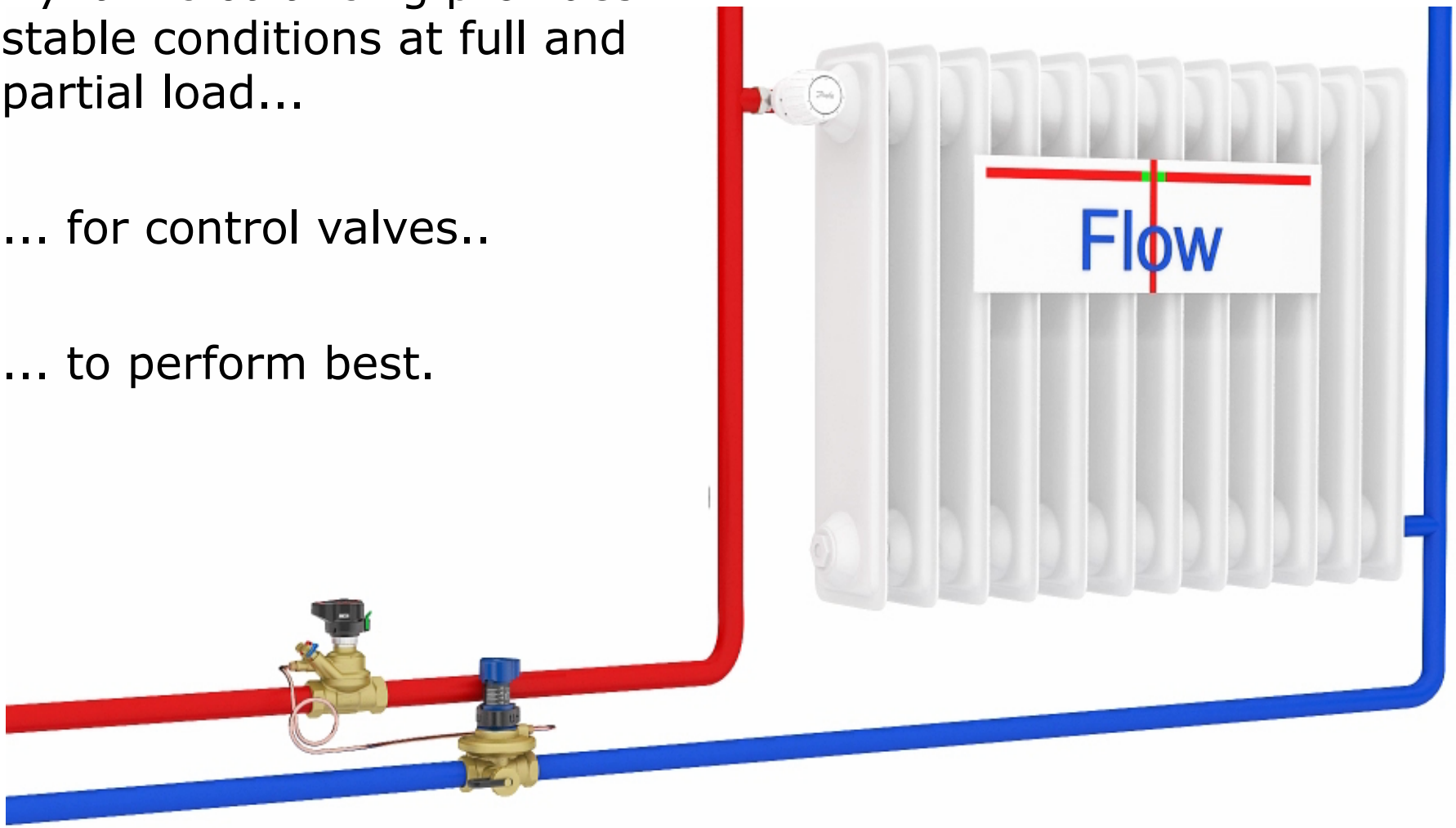
...where pressure **varies** as load changes

Technical background

Dynamic balancing provides stable conditions at full and partial load...

... for control valves..

... to perform best.

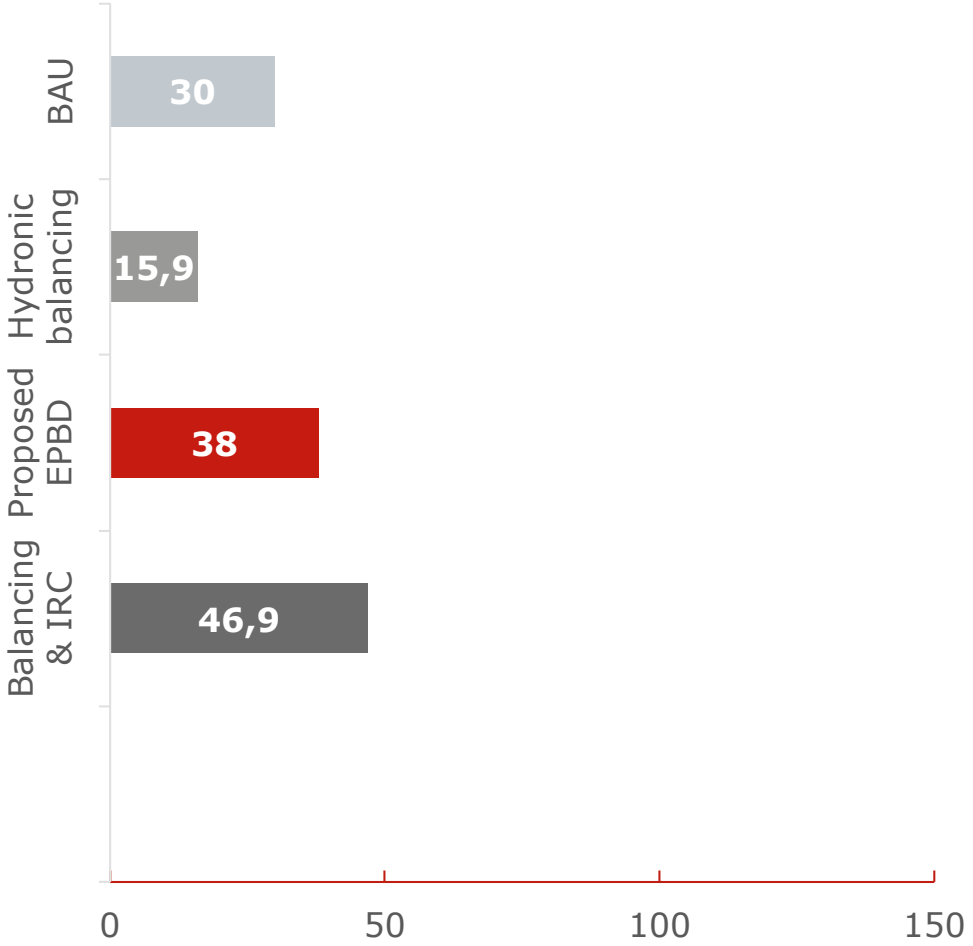


Impact on EU building stock until 2030

15% energy savings contributes to:

- **15.9 $MtCO_2$** emission reduction
- **6 bln EUR** energy cost savings

...assuming 50% of buidling stock to be renovated by 2030

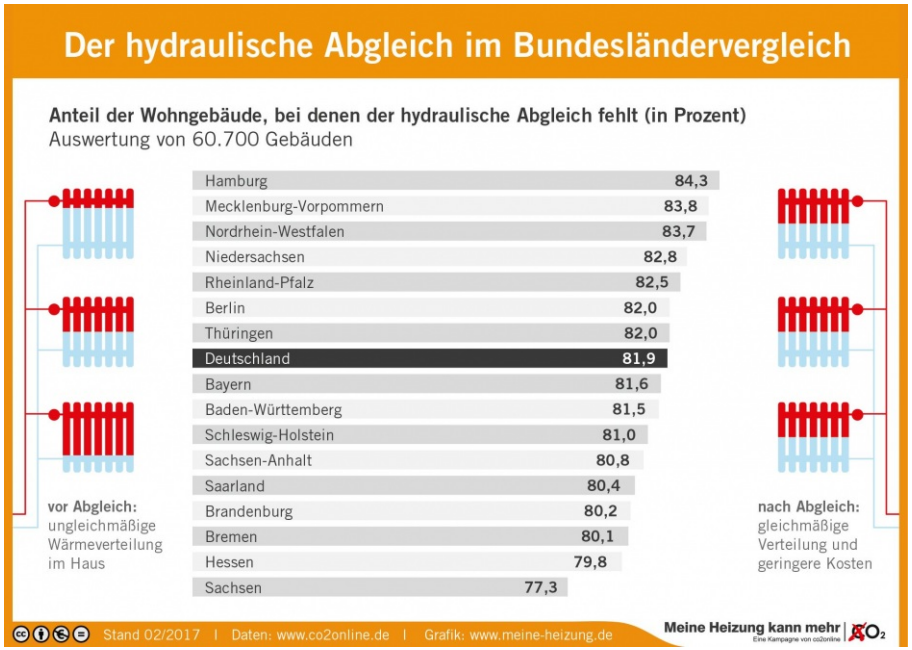


Conclusion

Putting end-users in control is key for rationale energy use:

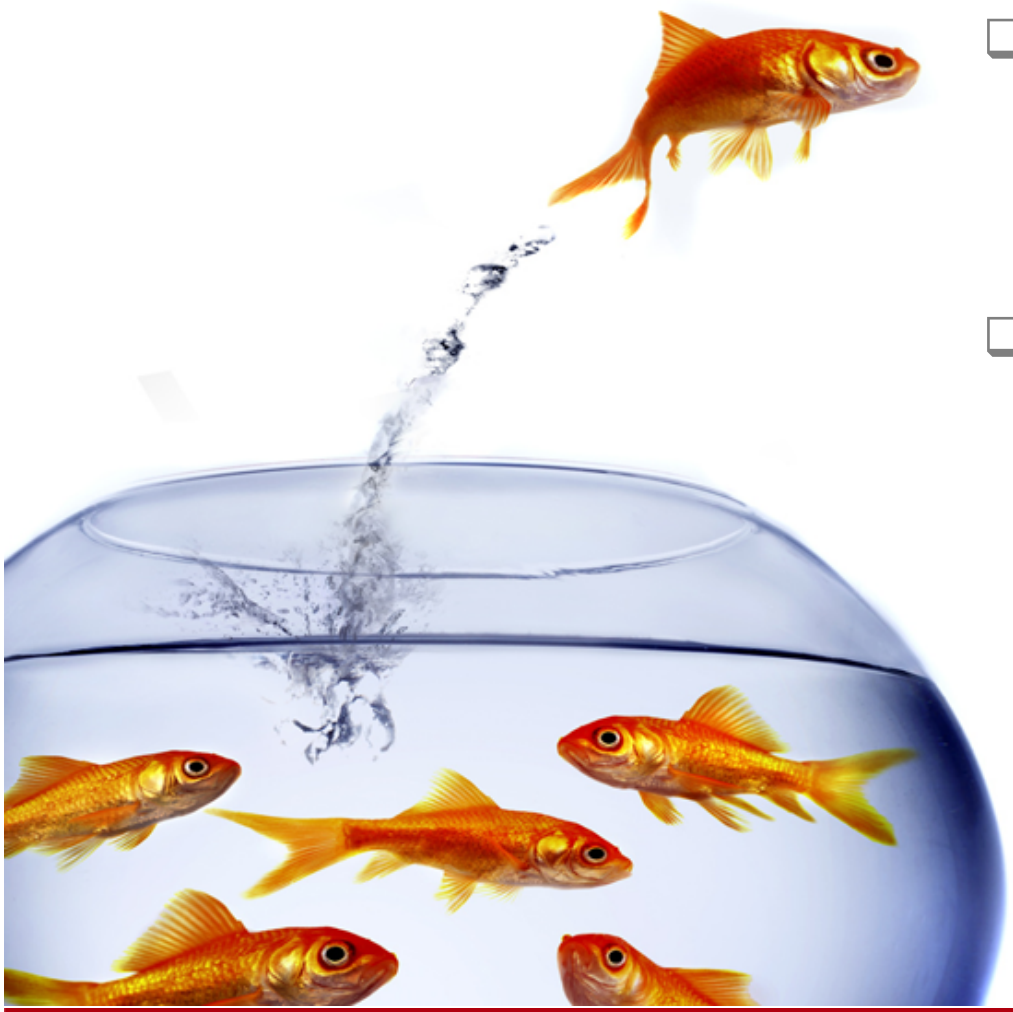
- Transparent heat consumption information (EED)
- Empowerment to react to energy consumption information -> **Individual room control**
- Heating system enabled to provide desired temperature in all parts of building -> **Hydronic balance** (Prerequisite)

Current state



[Example Germany: CO2online survey: 81,9% buidings do not have hydronic balance]

Opportunity to make a difference



- New EU legislation should address existing barriers for control of energy flows
- Push for implementation: short payback, no-regret options
  - e.g. individual room temperature control and automatic hydronic balancing
  - Suggest to be made mandatory
  - Deadline for implementation

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http://www.danfoss.com/buildingefficiency/