THE HYDRONIC ENERGY EFFICIENCY FACTBOOK

Breakthrough Engineering

IMI PNEUMATEX
IMI TA
IMI HEIMEIER

HVAC systems can provide major and immediate savings

Environmental concerns, legislation and rising energy prices are dramatically increasing the need for efficiency in buildings.

Buildings consume 40% of the world's energy, with HVAC systems accounting for 50% of this consumption. As a significant player in the HVAC industry, we know that it is essential for us to make a difference. Therefore, we are committed to innovating energy-saving solutions to reduce the impact of HVAC systems on the environment.

Environmental
PROTECTION
Leading it
Living it

IMI PNEUMATEX

Pressurisation & water quality leader

IMI TA

Balancing, Control & Actuation leader

IMI HEIMEIER

Thermostatic control leader

Building infrastructure

You can reduce system's energy consumption by improving the infrastructure of the building with new insulation, windows etc. This has a major effect but involves very heavy investment with a long pay-back time. In addition, after this work is finished the entire HVAC system will have to be readjusted.

HVAC System

Optimizing hydronic distribution in the HVAC system reduces energy consumption and improves the control and delivery of comfort. This is the most cost-effective solution, and the effects are immediate and substantial. In fact, optimizing the hydronic distribution of an existing system can on average reduce its energy consumption by up to 30%.

People behavior

You can change the way people use the building – but this is difficult and unpredictable. If the system doesn't deliver the comfort people require, they will adjust it themselves. More often than not this involves quick and drastic ups and downs in heat or cooling and leads to unnecessary energy wastage. If the system is correctly set to start with, it would positively influence the way people manage their HVAC system and as a consequence will reduce the energy consumption.

Optimize hydronic distribution with action in 3 key areas

Supply T°C

Design flow

Production

Boiler/chiller efficiency is directly influenced by the return water temperature of the system and by any dirt or air particles present in the water. IMI Hydronic tackles these problems by enabling the system to work efficiently at the ideal temperature. Our pressurization and water quality solutions ensure there are no deposits on heat exchangers and that optimal thermal transfer can be achieved.

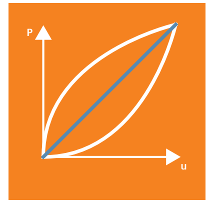
Distribution

Most pumps work with an over flow and too high a pump head. And if the system is not properly pressurised, there is a high risk of pump cavitation.
IMI Hydronic has what it takes to meet both challenges. Our flow adjustment and differential pressure solutions enable optimization of variable speed pumps, and our pressure maintenance devices protect the pump from cavitation. These solutions can reduce electrical pump consumption by 40%.

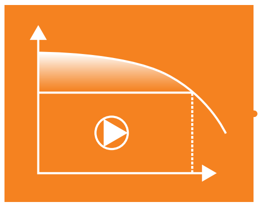
Dissipation

The slightest differences in room temperature can have a huge impact on energy efficiency. If the room temperature in a heating system is 1°C (1.8°F) too high, it can cause energy wastage of between 6 and 11%. 1°C (1.8°F) too low in a cooling system can lead to energy wastage of between 12 to 18%. IMI Hydronic delivers the required precision every time. With our hydronic balancing expertise and solutions, and our full range of thermostatic controls, no area of the building is over heated or under cooled.

Room temperature

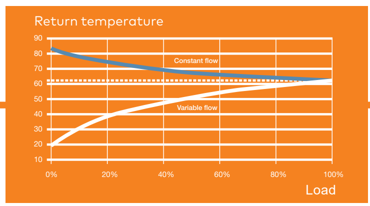


Load output



The type of control and the balancing procedure directly influences the global flow and the pump head

Return T°F



The choice of control mode, 2 way or 3 way valves and on/off or modulating control, directly influences the return temperature for the boiler

20 insights
that create countless opportunities

The facts in this book are of invaluable assistance when talking about the benefits of hydronic HVAC optimization.

You can use them in a wide range of contexts. For example they can help you to show savings potential, or talk about environmental benefits and illustrate how quickly hydronic distribution pays off.

Production

System optimization in Production

Fact

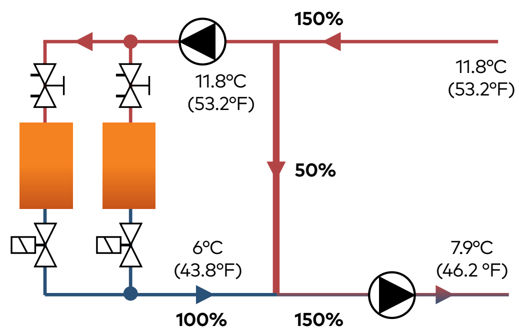
N°1

Lowering the chiller water supply temperature by **1°C (1.8°F)** decreases the efficiency by **4%**.

When the distribution pump is oversized and the system is unbalanced, the distribution requires more flow than the production can provide. This creates a mixing point between return water and supply water, at the outlet of the bypass between the production and the distribution sides.

In cooling, due to this flow incompatibility, the supply water temperature is higher than expected per design, and the terminal units cannot deliver their full load capacity, creating discomfort for the occupants.

Decreasing the set-point of the production units can compensate for this incompatibility, but at the cost of higher energy consumption. Chiller manufacturers' technical literature indicates extra energy use of approximately 4% for every 1°C (1.8°F) that the chilled water supply temperature is lowered.



Reference case: Citate Administrativa in Minas Gerais (1.5°C (2.7°F) supply temperature set-point increase after balancing = 6% higher efficiency) BRAZIL

Fact

N°2

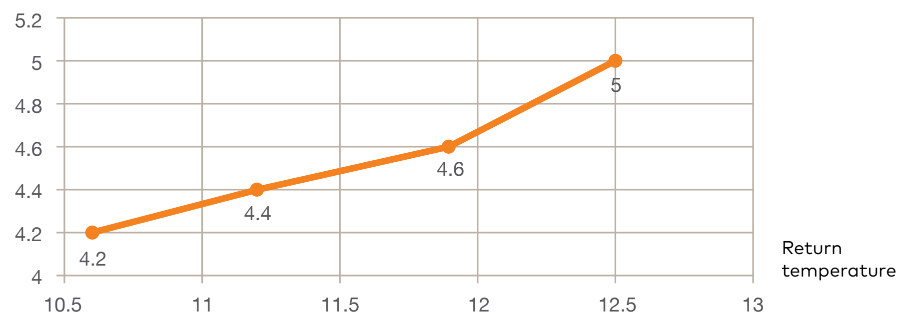
A lower chiller return (inlet) temperature can impact the COP significantly, reducing it by up to **15%**.

A lower return temperature than design can result from different hydronic failures, such as:

- A non-controlled flow passing through a bypass pipe and creating a mixing between cold water supply and the return.
- The use of 3-way control valves instead of 2-way, when 2-way is possible.
- A non-balanced plant resulting in terminal units working with universal overflow.
- A pump head set-point that is not well adjusted.

A lower return temperature reduces the temperature difference $\Delta T = Ts - Tr$ (Ts: Supply temperature; Tr: Return temperature), and then the log mean difference between the fluid and the refrigerant, significantly affecting the COP (Coefficient Of Performance) by up to 15%.

Effect of return temperature on chillers COP (*)



(*) Software chillers manufacturer simulation

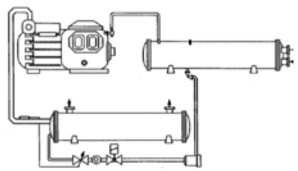
Fact

N°3

In cooling systems, the "fouling factor" (dirt deposit) can affect chiller efficiency by up to **5%** and pressure drop by up to **10%**.

In heat exchanger applications, deposits of dirt on the internal surface of the pipe acts as insulation, affecting the heat transfer and the pressure drop. This increase in pressure drop will affect the electrical pump consumption.

The thermal impact of fouling is often expressed in terms of fouling resistance, Rf, which can be approximated by: $Rf = \delta/\lambda f$ with δ as the thickness, and λf the thermal conductivity(*).



Simulated with chiller software manufacturer

Fouling thickness in. (mm)	0 in. (0 mm)	0.007 in. (0.17 mm)	0.01 in. (0.35 mm)
COP	2.84	-2.5%	-5.3%
Evaporator Dp (at equivalent chiller load output)	53 kPa	+3.1%	+8.7%

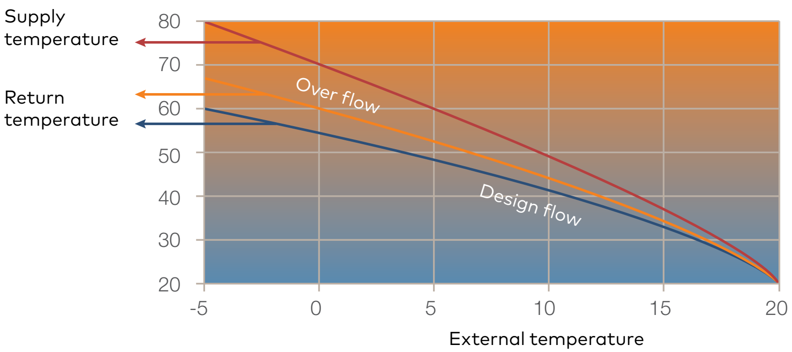
(*) Publication: Online "Heatexchanger-fouling.com"

Reference case: Centralized cooling system for apartments building in Nanjing (China). Big impact of dirt deposit on Chiller Capacity (14% decrease of power consumption after cleaning the evaporator)

Fact

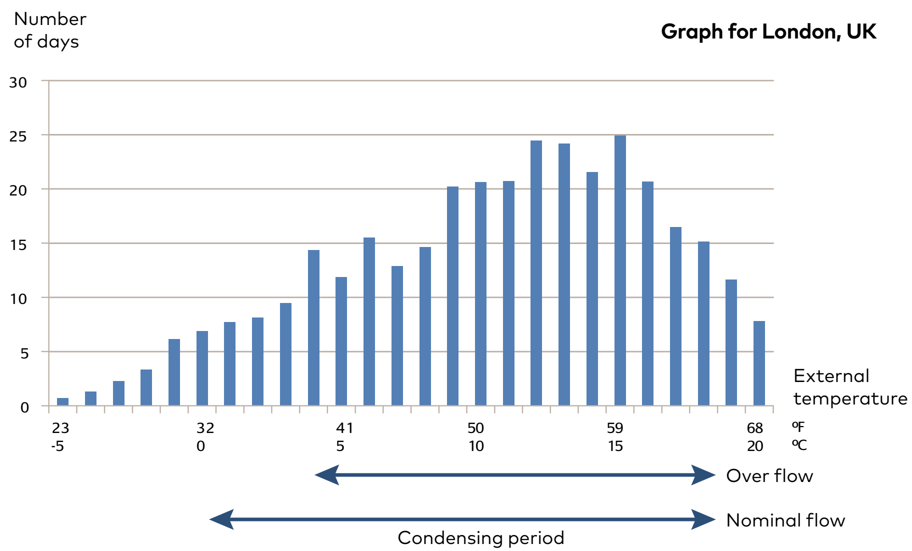
N°4

Overflow can reduce the condensing period by up to **20%** thereby significantly impacting condensing boiler efficiency.



To achieve high efficiency in condensing boilers, the return water temperature needs to be kept below the vapor dew point in exhaust gases, and thus ΔT has to be kept high. This is achievable only by keeping stable and accurate modulating control of variable flow in terminal units, and by avoiding overflows due to an unbalanced system.

In a system working over-flow, the return temperature is higher than normal. The number of days of condensing capacity is then reduced by up to 20%. Considering energy saving of 15% due to condensing technology, the impact of overflow is estimated at 3% of the boiler energy consumption.



Reference case: Empalot France (12.3% due condensing boiler efficiency and better room control)

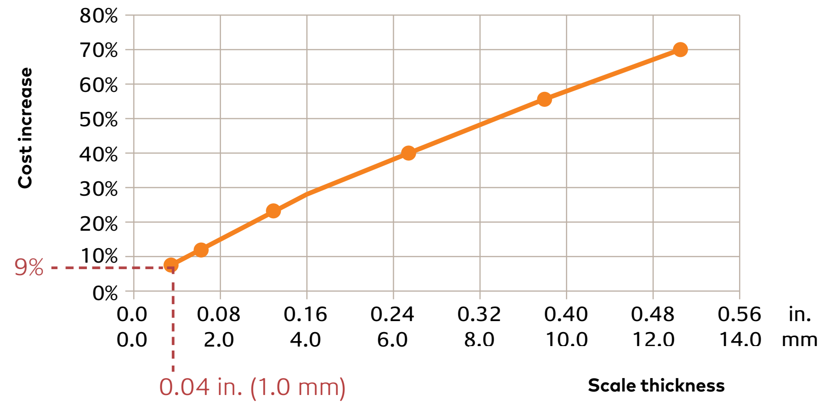
Fact

N°5

0.04 in. (1 mm) of scale deposit leads to boiler energy overconsumption of up to **9%** (*).

A poor pressure maintenance system (due to bad sizing, quality issues etc.) spends most of its time regularly providing fresh water to compensate for leakages in the safety valves (as a result of over-pressure). The fresh water contains scale that deposits mainly on the hottest surfaces (boiler exchanger) of the heating system.

This deposit acts as an insulation, affecting the heat transfer and the pressure drop. This creates a loss of boiler efficiency and then a higher energy consumption. In addition, a thermal cavitation is locally created by the scale deposit, causing significant damage to the boiler. Alongside the scaling, the fresh water contains oxygen that creates corrosion – and thus magnetite dirt deposits – throughout the heating system.



(*) Results of tests made by University of Illinois and the U.S. Bureau of Standard

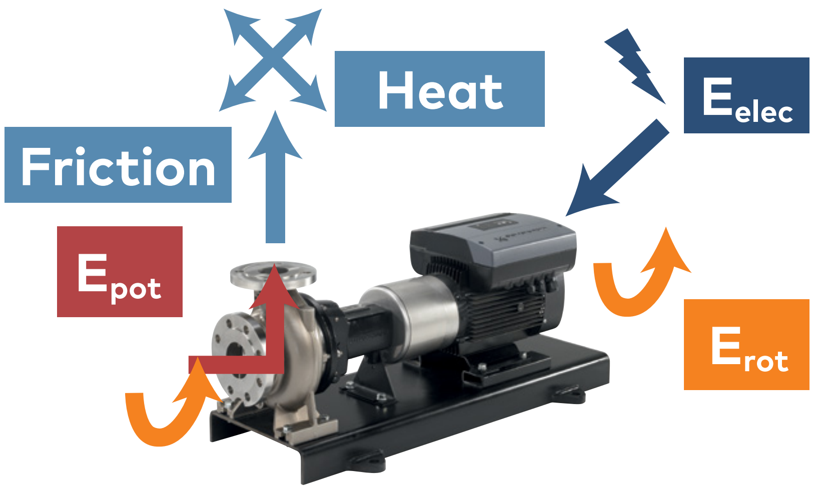
Distribution

System optimization in Distribution

Fact

N°6

In cooling systems, electrical pumping costs (constant flow distribution) represent **7%** to **17%** of the total cooling energy consumption.



The pumping power consumption is directly proportional to the water flow, the pump head and the efficiency of the pump and the motor. In cooling, the energy provided to the pump itself and transferred to the water has to be compensated by the chillers. Therefore pumping energy needs to be paid twice in cooling: at the pump and at the chiller!

$$\text{Electrical pump consumption} \approx C_0 + \frac{\text{Pump Head x Flow}}{\text{Overall Pump efficiency}}$$

An estimate of the electrical pump consumption, compared to seasonal energy consumption of the plant working at constant flow, is given by the formula below :

$$C_{pr} = \frac{H}{\Delta T_c} \times \frac{0,235}{S_c \times \eta_p \times \eta_m} \times (COP + \eta_m) \approx 3,34 \times \frac{H}{\Delta T_c}$$

With:
C_{pr}: Pumping cost in % of the cooling consumption
H: Pump head (ft WC)
η_p: Pump efficiency
η_m: Motor efficiency
S_c: Ratio between the average seasonal cooling load and the maximum necessary load
ΔT_c: Nominal water temperature difference in °F

Example:
For H= 82 ft WC(25 mWG=250 kPa)and ΔTc= 5.5°C (9.9°F) the pumping cost represents 15.2% of the total cooling energy consumption (Sc=0.4; ηp=0.75; ηm=0.92; Seasonal COP=3)

Remark: In heating, recent research demonstrates that pump consumption represents 1.5% of the energy consumption in buildings such as offices, schools, hospitals in Sweden. "Efficiency of building related pump and fan operation," PhD thesis by Caroline Markusson, Chalmers University of Technology, May 2009

Fact

N°7

When comparing a non balanced with a balanced system, electrical pumping cost can be reduced by **40%**.

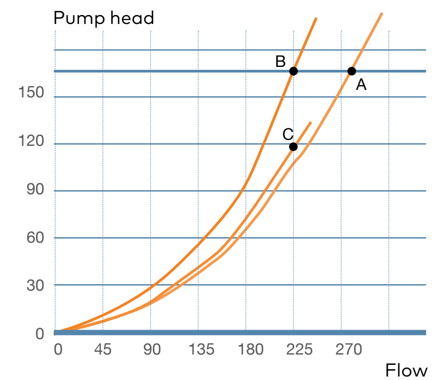
Pumping costs are proportional to the product of the pump head by the flow. Unbalanced systems typically run with a higher than necessary total flow to compensate for local underflows. It is quite common to observe that flow in distribution is 50% over than the design value (*).

Proper balancing also makes it possible to optimize the set-point of the variable speed pump (savings on pump head depend very much on projects, but pumps are always oversized by at least a 10% safety factor taken by design engineers).

Considering a plant working at 30% over flow and only 10% over pump head, balancing the system produces savings on pumping energy of 40%.

Example:

A. Non-balanced system: Pump consumption 12.8 kW
B. Balanced system: Pump consumption 10.2 kW (-20%)
C. Balanced system and pump head adjustment: Pump consumption: 7.31 kW (-43%)



Reference case: Hammarplast Consumer factory (61%) SWEDEN, Citate Administrativa in Minas Gerais (21%) BRAZIL, Pfizer (31%) France.
(*) **Source:** Investigation by Costic (French Research and Training Centre in HVAC), published in CFP Journal April-May 2002.

Fact

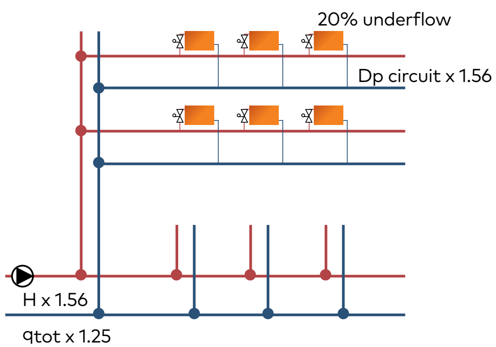
N°8

Increasing the total pump head to compensate for an underflow of 20% to some terminal units, creates an increase of 95% in the overall electrical pump consumption for the system.

It is quite common that people increase the total pump head to compensate underflow in some parts of the system.

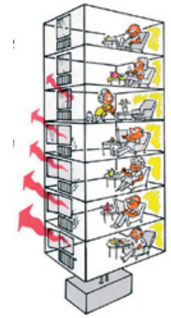
To compensate an underflow of 20% in some terminal units, the total flow should be increased by 25% (0.8x1.25 = 1). Since the pressure drop of the system increases with the square of the flow, the pump head must be increased by 56% (1.25x1.25) to provide the required flow increase.

Such an increase of pump head is usually obtained by changing the pump impeller or by installing a more powerful one. Considering pump and motor efficiency remain the same, as electrical pumping costs are proportional to the product of the pump head by the flow, this situation will create overconsumption of 1.25x1.56 = 1.95, so 95% higher than the normal consumption.



Remark: Instead of changing the pump, some people use the back-up pump running in parallel with the pump they normally use. This also results in overconsumption.

Fact N°9



A well-balanced heating or cooling system can provide energy savings of up to 35%.

By nature, terminal units (fan coil, radiator, AHU) close to the pump work in overflow, creating underflows in others terminal units. For instance, in heating systems, it is common that rooms close to the boiler room (thus close to the pump) are in overflow and consequently overheated, whereas rooms further away reach the temperature with difficulty.

Room temperature deviation can easily reach 2°C to 4°C (3.6°F to 7.2°F). This situation also leads to a higher total flow than required and therefore increases electrical pump consumption and poor load transfer at interfaces. Normally this results in putting more production units (boilers, chillers) into operation than would normally be necessary, and affects the efficiency of condensing boilers or the chillers COP.

Together these different effects can create overconsumption from 10% up to 35%!

Heating calculation example	
Average room temperature deviation: 2°C (3.6°F)	Energy impact: 12% to 22% (Fact N°12)
Pump overconsumption: 40% (Fact N°7)	Energy impact: 0.2% to 0.6%
Lower condensing boiler efficiency	Energy impact: 1% to 3% (Fact N°4)
	Combined impact : 13.1% to 24.8%
Cooling calculation example	
Average room temperature deviation: 1°C (1.8°F)	Energy impact: 12% to 18% (Fact N°13)
Pump overconsumption: 40% (Fact N°7)	Energy impact: 2,8% to 6,8% (Fact N°6)
Lower Average Chiller efficiency (COP):	Energy impact: 5% to 15% (Fact N°1)
	Combined impact : 18.7% to 35.0%

Reference case: Tianjin Saixiang Hotel (31%) CHINA, Sundsvall (15%) SWEDEN, Empalot (12.3%) FRANCE, Various office buildings of the Dutch government (10%).

Fact

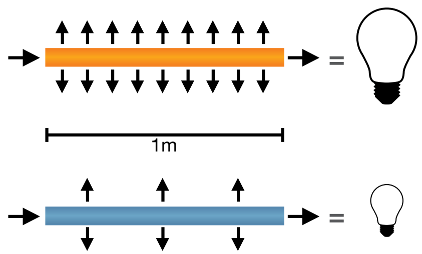
N°10

Increasing water temperature by **1°C (1.8°F)** results in **3%** higher pipe heat losses.

To compensate for hydronic problems and too low or too high room temperature, it is quite common for supply water in the HVAC system to be increased (in heating) or decreased (in cooling). This will create overheated or overcooled rooms in the most favored part of the building.

It will also impact the heat losses or heat gains of the pipes reducing the global efficiency of the HVAC system. In heating, considering an average water temperature of 50°C (122°F) and an external pipe temperature of 20°C (68°F), the heat losses increase by 3% for each 1°C (1.8 °F) higher than design. To compensate a room temperature 1°C (1.8 °F) too low, the temperature of the water must be increased by approximately 4°C (7.2°F) (depending on the design conditions), meaning that pipe heat losses will increase by **12%**!

$$P_m = \frac{\Delta T}{40} \times \left(3 + 5 \times \frac{de}{3{,}5 + 0{,}0036 \times \frac{I}{\lambda}}\right)$$



Simplified formula for pipe heat loss calculation

With:

- P_m: Pipe heat losses per meter (W/m)
- ΔT: Temperature difference between water and ambient temperature
- de: Pipe external diameter (mm)
- I: Insulation thickness (mm)
- λ: Insulation conductivity (W/m.K)

Unit Conversions:

- ΔT: 1°C= 1.8°F
- de, I: 1 mm= 0.004 in
- λ: 1 W/m.K = 0.578 BTUH/ft °F

For online heat loss calculator in US units please visit: http://checalc.com/calc/inshoriz.html

Fact

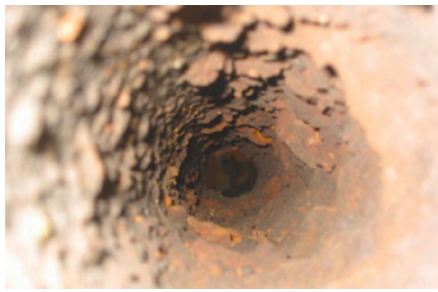
N°11

Due to corrosion and dirt deposit in pipes, electrical pumping costs increase by up to **35%** (*) during the first working years of a heating or cooling system.

Pipe pressure drops (often called linear pressure drops) depend on:
- The pipe internal diameter
- The pipe roughness
- The water (heat transfer fluid) density and viscosity
- The flow

The presence of oxygen due to poor pressure maintenance creates corrosion. Dirt deposits (due to bad water quality and a too-low water flow velocity in some parts of the plant) consistently alter the pipe roughness by 15% to 70% during the first years, and by 150% to 240% (**) after 20 to 50 years. To compensate for this increase in pressure drop, the pump head needs to be increased by the same amount, causing the electrical pump consumption to increase.

For example: (*) Considering a pipe pressure drop representing 50% of the total pressure drop of the system, an increase of 70% of the pipe pressure drop directly impacts the electrical pump consumption by 35%, to achieve the same flow.



Internal view of 4» (DN 100) pipe due to corrosion

(**) Source: Result publish by Utah State University, Pr Rahmeyer

Dissipation

System optimization in Dissipation

Fact

N°12

In heating systems, the room temperature being 1°C (1.8°F) too high costs **6%** to **11%** of the annual plant energy consumption.

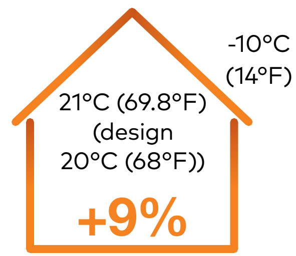
In heating, the overconsumption of a building is directly linked to the temperature difference between the room temperature and the outdoor temperature.

This overconsumption can be estimated by the following formula:

$$S\% = \frac{100}{S_c \times (t_{ic} - t_{ec} - ai)}$$

S%: Energy overconsumption expressed in % for 1°C (1.8°F) increase in the room temperature
S_c: Ratio between the average seasonal heating load and the maximum necessary load
t_{ic}: Design room temperature in °F
t_{ec}: Design outside temperature in °F
ai: Internal heat gain expressed in degrees of influence on the room temperature in °F

Example:
For t_{ic} = +20°C (68°F),
t_{ec} = -10°C (14°F), ai = 2°C (3.6°F) and S_c = 0.4
Energy overconsumption S = 9%



Stable and accurate room temperature control provides comfort for people and it is one of the most effective ways to reduce building energy consumption.

Reference case: MOL (27% energy saving) HUNGARY

Fact

N°13

In cooling systems, the room temperature being 1°C (1.8°F) too low costs **12%** to **18%** of the annual cooling plant energy consumption.

In cooling systems, if the room temperature is, for instance, 23°C (73.4°F) instead of 24°C (75.2°F) (1°C (1.8°F) too low), it creates an overconsumption directly linked to the load on the building (internal and external heat gain).

This overconsumption can be estimated by the following formula:

$$S\% = \frac{180}{S_c \times (t_{ec} - t_{ic} + ai)}$$

S%: Energy overconsumption expressed in % for 1°C (1.8°F) decrease in the room temperature
S_c: Ratio between the average seasonal cooling load and the maximum necessary load
t_{ic}: Design room temperature in °F
t_{ec}: Design outside temperature in °F
ai: Internal heat gain expressed in degrees of influence on the room temperature in °F

Example:
For t_{ic} = +23°C (73.4°F), t_{ec} = 35°C (95°F), ai = 4°C (7.2°F) and S_c = 0.4
Energy overconsumption S = 16%

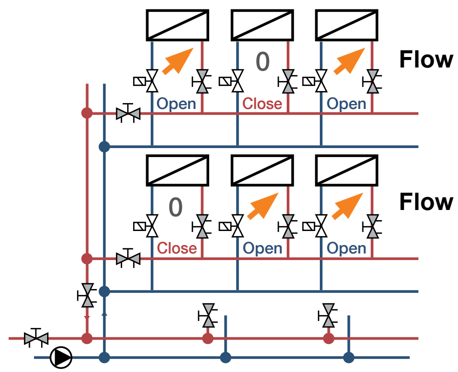
Stable and accurate room temperature control provides comfort for people and it is one of the most effective ways to reduce building energy consumption.

Fact

N°14

Interactive On-Off control systems create an over consumption of up to **7%**.

In variable volume systems using 2-way control valves in On-Off control mode, when some valves are closed the pipe pressure drop decreases and by consequence, available pressure for the circuits still open increases significantly. This creates an overflow, modifying the electrical pump consumption and the return temperature to the chillers or the condensing boilers. At 50% of the load, an On-Off system could provoke an over flow up to 50%(*) higher than the normal flow. During the cooling season this creates pump overconsumption up to 3% (*) of the total cooling energy cost. The return temperature is also affected by 1.5°C to 2°C (2.7°F to 3.6°F) at 50% load, creating a decrease of the chiller's COP by up to 4% (Fact 2). These two aspects make an interactive On-Off control system to create up to 7% energy increases, to which can be added the overconsumption due to room temperature deviation. The adapted balancing procedure should be applied to achieve the correct flow for all terminal units and avoid hydronic interactivity.



(*) Mathematical modelization (Hydronic College, Jean Christophe Carette)

Reference case: University building renovation (Hong Kong, China) 21% COP improvement.

Fact

N°15

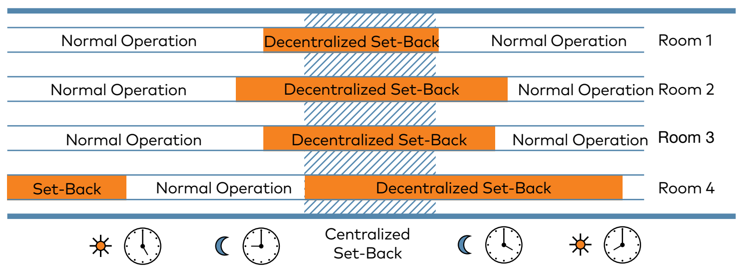
Combining centralized set-back programmes with local set-back devices enables energy savings of up to **20%**.

Energy can be saved by reducing (heating) or increasing (cooling) the room temperature during the non-occupancy period or during the night. The longer the set-back period, the higher the energy saving. Energy savings obtained thanks to set-back temperature could be estimated by:

$$E_{saving}\ \% = 100 - \frac{t_{setback} \times (100 - (T_{set} - T_{setback}) \times E_{saving\ (1°C)}) + t_{set} \times 100}{24}$$

$t_{setback}$ (hours): Period during set-back temperature
t_{set} (hours): Period of set temperature
$T_{setback}$ (°F): Set-back temperature
T_{set} (°F): Set nominal room temperature
$E_{saving\ (1.8°F)}$ (%): Energy saving for 1°C (1.8°F) lowering the room temperature

Considering a room maintained at 20°C (68°F) from 8 am to 6 pm (10 hours) and a set-back temperature 3°C (5.4°F) lower (17°C (62.6°F)) during the rest of the day (14 hours) and considering each degree representing a saving of 10% (Fact N°12), the energy saving can be estimated in % at: **17.5% (*)**



(*) Remark: this percentage does not take into consideration the impact on the efficiency of the producer (boiler, heat pump...) working at full load after the set-back period to reach the set temperature.

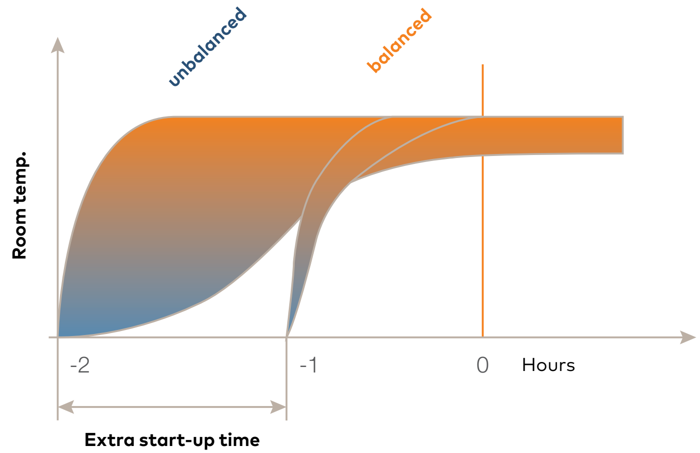
Publication: "The energy saving potential of E-Pro" (Heimeier)

Fact

N°16

Each additional hour of start up time, starting earlier than necessary, costs 1.25% more of total heating energy consumption.

An unbalanced system makes startups difficult, with some rooms taking a substantially longer time to reach the target temperature from the set-back level. This situation forces people to startup their system earlier than necessary, thus increasing energy consumption. For some hydronic failures, if the startup needs to begin 1 hour earlier than normal, the added energy consumption will be: **1.25% (*)**



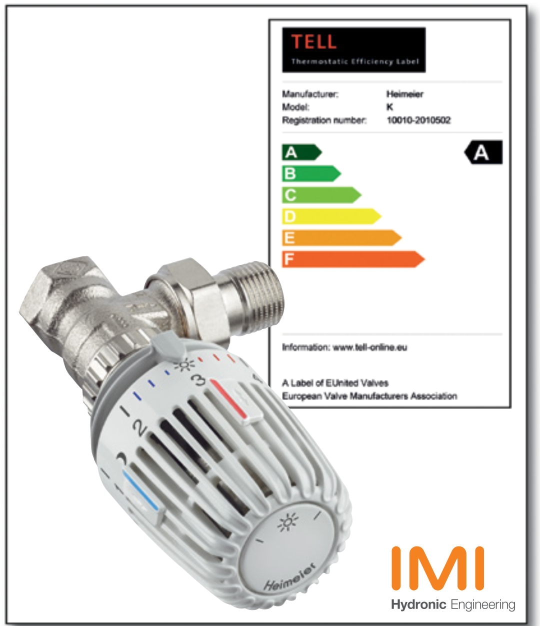
In some buildings, due to difficulty in reaching the comfortable room temperature after the set-back temperature period, a decision is made to cancel the programming functionality of the controller – resulting in up to **20%** energy waste!

(*) Considering formula on the fact N° 15

Fact

N°17

Compared to manual valves, accurate thermostatic radiator valves provide energy savings of up to **28%**.



Taking into account, the thermal behavior of individual house, external weather condition during the heating season, type of boiler and people behavior, the University of Dresden has conducted a study demonstrating the impact of using Heimeier thermostatic radiator valves compared to manual ones.

Considering:
- Heating system design at 90°C/70°C (194°F/158°F)
- An insulated building following German standard 1982
- A condensing boiler

the energy saving is estimated at 28%, when comparing thermostatic valves with manual valves.
With a system design at 70°C/55°C (158°F/131°) the saving is 19%.

Energy Saving System	Boiler				Thermal Insulation Standard
	Low Temperature	Condensating	Low Temperature	Condensating	
%	8,08	9,54	13,08	15,53	1977
	15,98	19,01	21,26	28,38	1982
	70°C/ 55°C		90°C/ 70°C		
	Temperature level				

Based on Dynamic software simulation

Study: Technical University of Dresden, Institute of Power Engineering, Chair of Building Energy System and Heat Supply

Fact

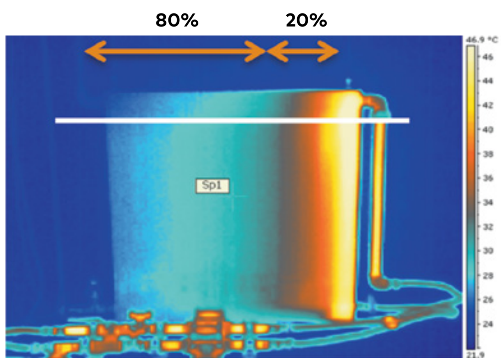
N°18

Air build-up in radiators can dramatically reduce the power output of a unit by up to **80%**.

The presence of air in water must be minimized not only to reduce corrosion and noise, but its presence also reduces emissions from terminal units.

The thermal picture (see picture example) shows that the creation of air pockets prevents water circulation in the radiator and dramatically affects the load output.

To compensate for discomfort created by lower radiator emissions, users increase the outlet temperature on the boiler and the pump velocity. This significantly impacts the energy consumption of the heating system (facts N°4, N°8, N°12).



Air effect on radiator power output (*)

(*) Thermal measurement from Institute "Karel de Grote Hoge School"

Fact

N°19

Replacing old thermostatic heads (1988 or before) with modern ones, can achieve energy savings of up to **7%**.

Dresden University (Germany) has conducted research to investigate the energy savings potential from replacing thermostatic heads older than 1988 with "new" thermostatic heads. As a result of these investigations, it can be stated that reductions in room temperature can be achieved by replacing existing thermostatic heads with new ones (no target room temperatures undershot, less overheating, greater adherence to target values). This improvement in room temperature control provides energy savings depending on design temperature condition, as indicated in the table below:

Design temperature	Energy Saving
90°C/70°C/20°C	7%
70°C/55°C/20°C	5%

(*) TUD, Institut für Energietechnik, Professur für Gebäudeenergietechnik und Wärmeversorgung (Dresden University study)

Fact

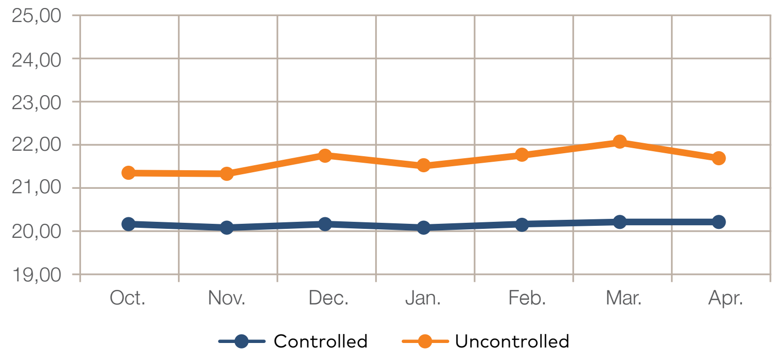
N°20

Installing individual room temperature control for under floor heating systems can provide energy savings of up to **20%**.

The curved lines in the picture show that the nominal values of operational room temperatures in main usage zones are very close to the 20°C (68°F) set point, in the case of individual room temperature control.

The values for cases where the system is not equipped with an independent local control device show an operational room temperature that is approx. 2.7°F- 3.6°F (1.5 - 2 K) higher. (extract of the study mentioned below).

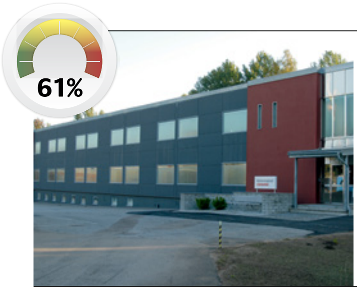
This room temperature deviation impacts the energy consumption by up to 20%! (Fact N°12)



Study: Energy and Costs Savings by Re-Fitting Individual Room Temperature Control Systems for Floor Heating by Joachim Plate (Managing Director of the Association for surface heating and surface cooling in Germany).

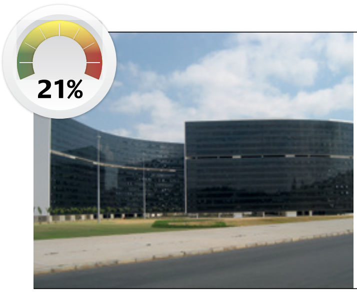
There are savings to be made in nearly every HVAC system

IMI Hydronic Engineering uses hydronic distribution expertise to reduce energy consumption in systems all over the world



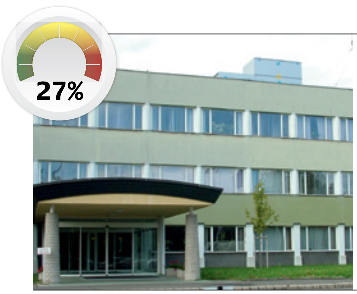
Hammarplast Consumer AB, Sweden
Industrial Cooling system
Pumping energy saving 61%

By balancing the chilled-water system to achieve better regulation of flow, IMI Hydronic reduced pumping energy usage by over 61%, and stabilized cycle times leading to higher productivity.



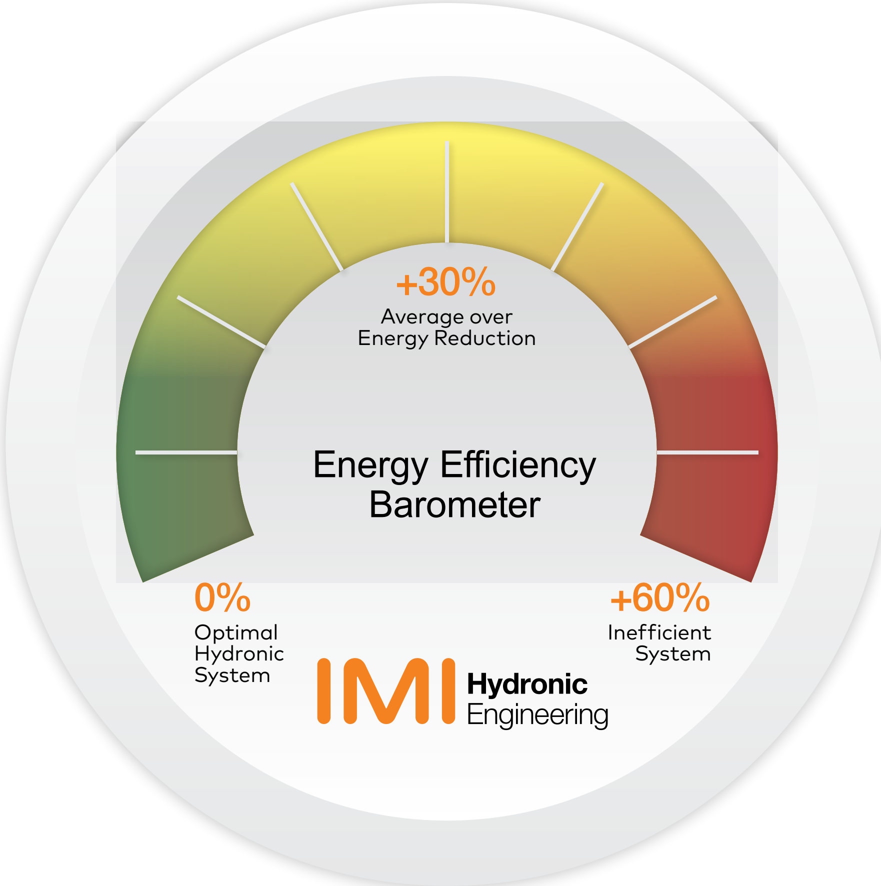
Cidade Administrativa, Brazil
Office cooling
Pumping energy saving 21%

With the help of IMI Hydronic's expertise in system balancing and meeting efficiency targets, the Brazilian state government was able to cut pumping energy consumption by an impressive 21%.



MOL Hungarian Oil and Gas Corporation, Hungary
Office HVAC system
Pumping energy saving 27%

Working closely with the HVAC designer from the outset, IMI Hydronic provided technical advice and assistance from the initial design phase, through to the system balancing process – resulting in a renovated system that delivered 27% energy savings.



See more cases on
www.imi-hydronic.com/en/cases

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