reflex

Thinking solutions.

Better water for heating and cooling systems. Better air for the environment.

Economical and environmentally friendly:
Heating and cooling with optimised system water

→ Enjoy energy savings of up to 10.6 %

→ Reduce CO_2 emissions

→ Increase operational safety

Reflex – the company

Contributing to the energy revolution is more than just lip service.

Reflex Winkelmann GmbH is a consistently forward-thinking company that is committed to sustainability and supporting the climate-policy goals agreed by the German Federal Government.

As a medium-sized company, we are already making our contribution towards providing energy-efficient and sustainable products with tried-and-tested technologies and pioneering innovations at the heart of what we do. With our comprehensive product range of vacuum spray-tube degassing systems in combination with sludge and dirt separators, we are already offering you — our customers — a product solution for optimally conditioning heating and cooling water.

The results and savings potentials listed here have been officially certified by TÜV Nord and are based on the simulation carried out by ifes GmbH.

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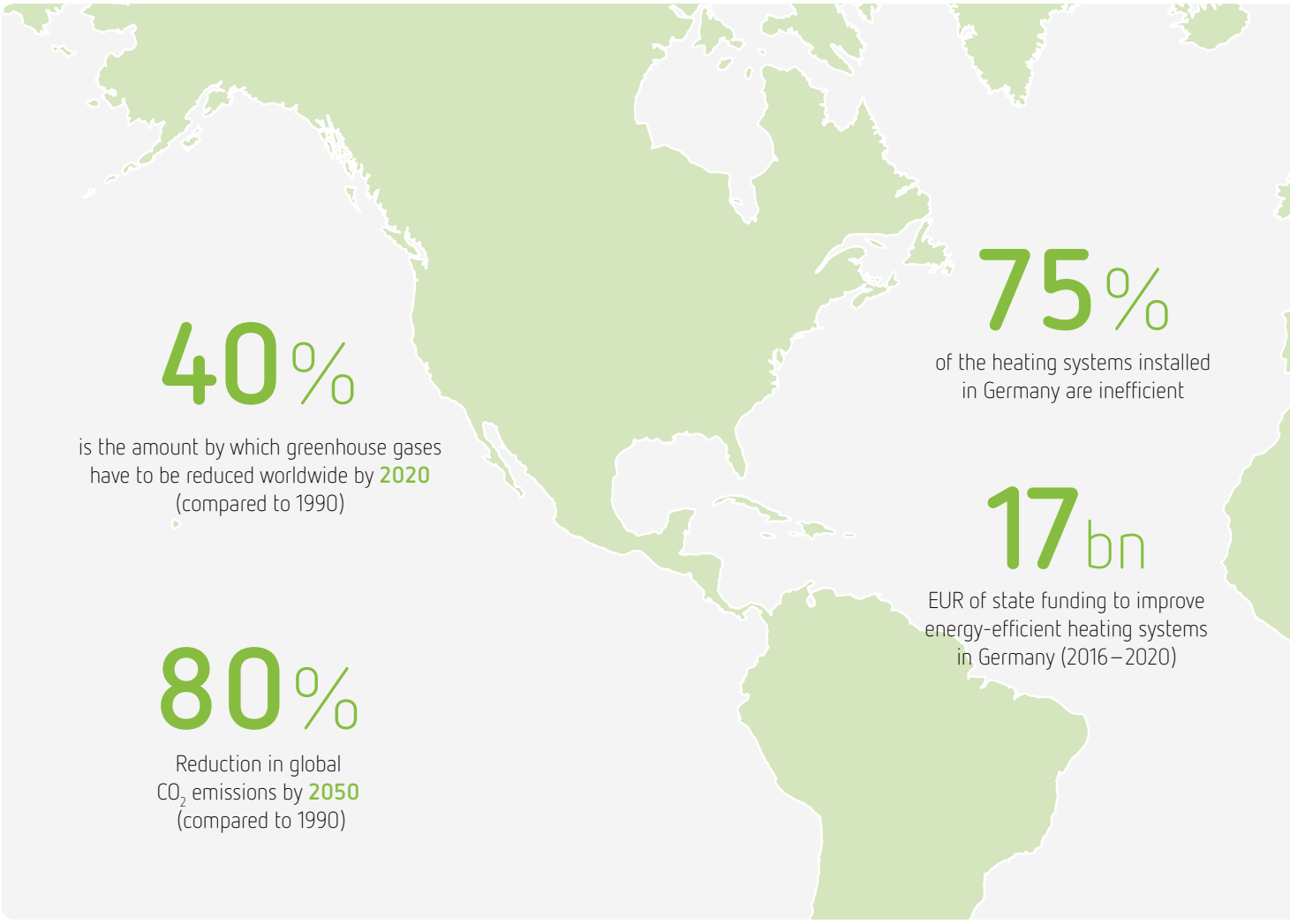
1 Challenges

A global task:
Reducing CO_2 emissions

This is a challenge that affects us all: over 35 billion tonnes of carbon dioxide (CO_2) generated through the use of energy pollutes new air and the climate year upon year. To put this into perspective, this weighs about as much as the entire water volume of Lake Maggiore. At the UN Climate Change Conference in Paris, all 195 member states agreed to limit global warming to as close to 1.5 degrees as possible compared to the pre-industrial period.* This means a drastic reduction in greenhouse gas emissions down to the levels that can be incorporated back into the natural cycle.

* Source: Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)

For this to be possible, it requires all participating countries to take action. The aim of the German climate policy, for example, is to reduce greenhouse gas emissions by at least 40 percent by 2020 compared to 1990 levels. By the year 2050, this reduction is targeted to reach 80 to 95 percent. Even in comparison to the situation in 2008, this still corresponds to an energy saving of around 54 percent. But establishing new energy sources alone is not enough to meet these targets. This means there is still a great deal more work to be done on efficiency-enhancing products and systems than ever before — an objective that Reflex is proudly supporting with every last bit of its innovative power.



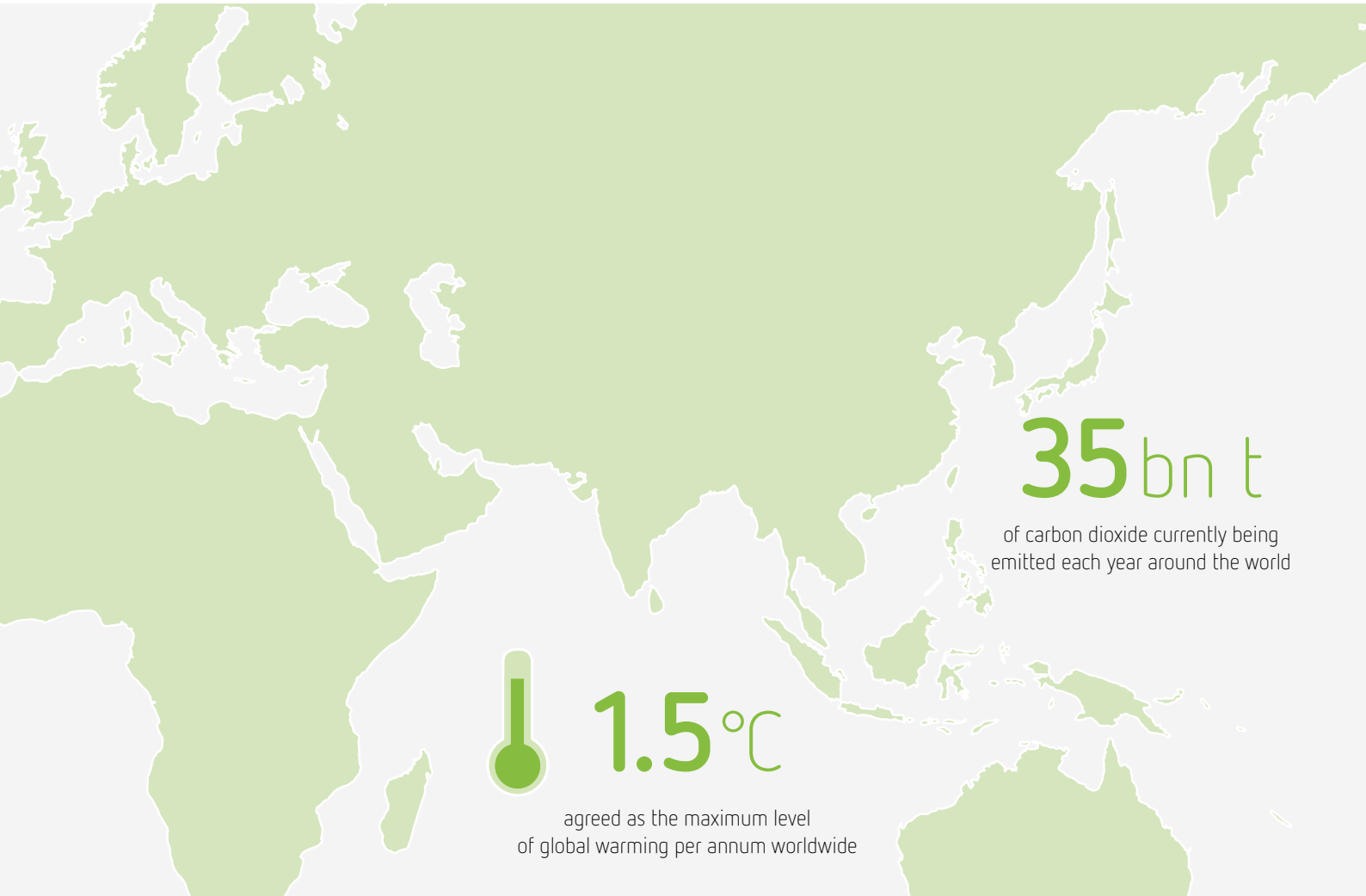
40%
is the amount by which greenhouse gases have to be reduced worldwide by **2020** (compared to 1990)

80%
Reduction in global CO_2 emissions by **2050** (compared to 1990)

75%
of the heating systems installed in Germany are inefficient

17 bn
EUR of state funding to improve energy-efficient heating systems in Germany (2016 – 2020)

The keys to success are contemporary, sustainable infrastructure investments. With this in mind, the German Federal Government launched an ambitious energy revolution programme back in 2010 that focuses on the strategic, long-term adjustment of Germany's energy and climate policies. The Federal Environmental Office supports this process with its own research into long-term scenarios, energy efficiency, the use of renewable energies, and monitoring the energy revolution. This work has seen it implement individual measures such as emissions trading, proofs of origin, and the Blue Angel certification for environmentally friendly products. What's more, the Federal Ministry for Economic Affairs and Energy is also offering 17 billion euros to support consumers, companies and local authorities as they implement measures to improve energy efficiency.



35 bn t

of carbon dioxide currently being emitted each year around the world

1.5 °C

agreed as the maximum level of global warming per annum worldwide

2 Greater **efficiency** Greater **climatic comfort** Lower **costs**

85%

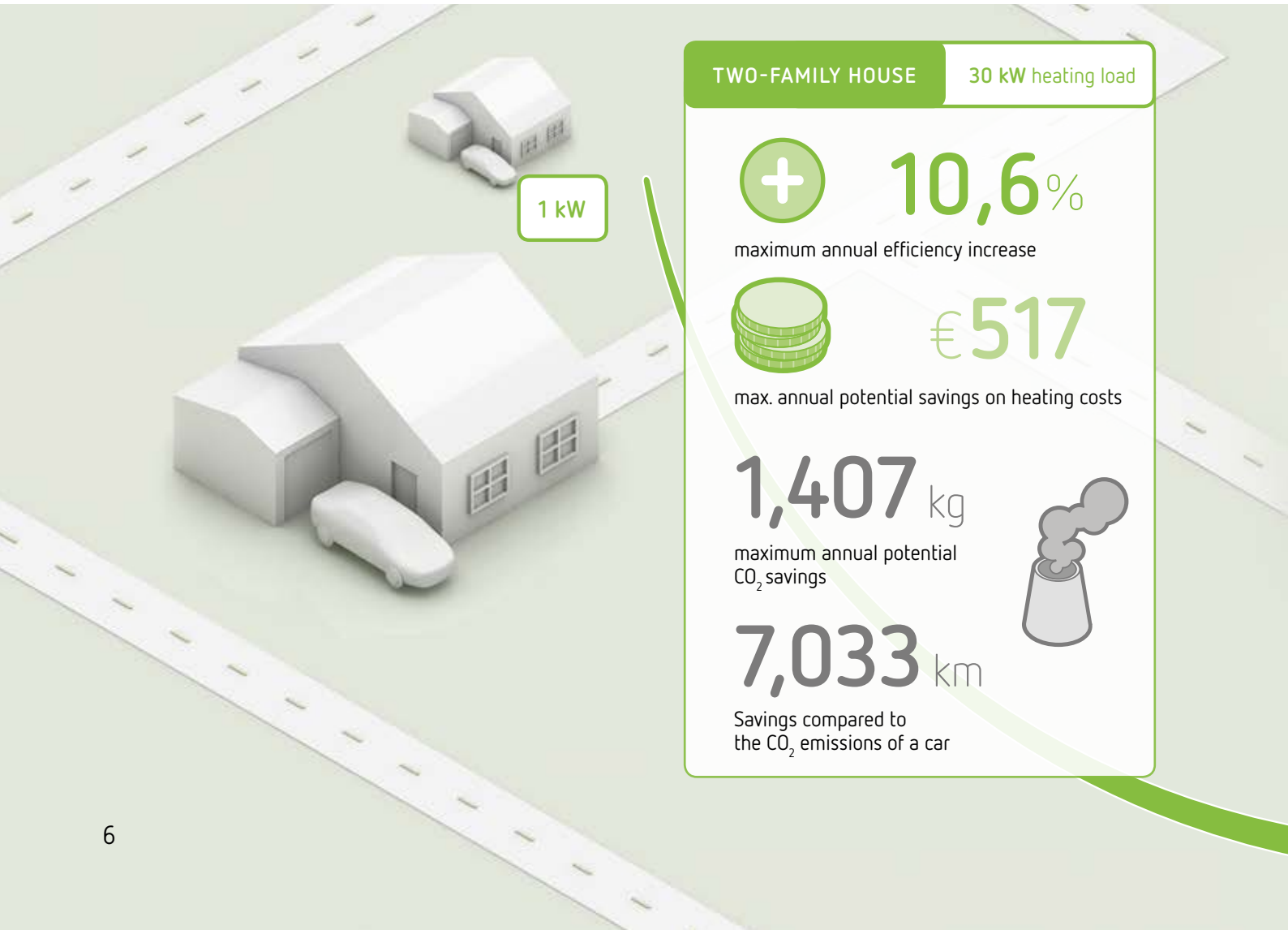
of energy in private households are used for heating and warm water supply

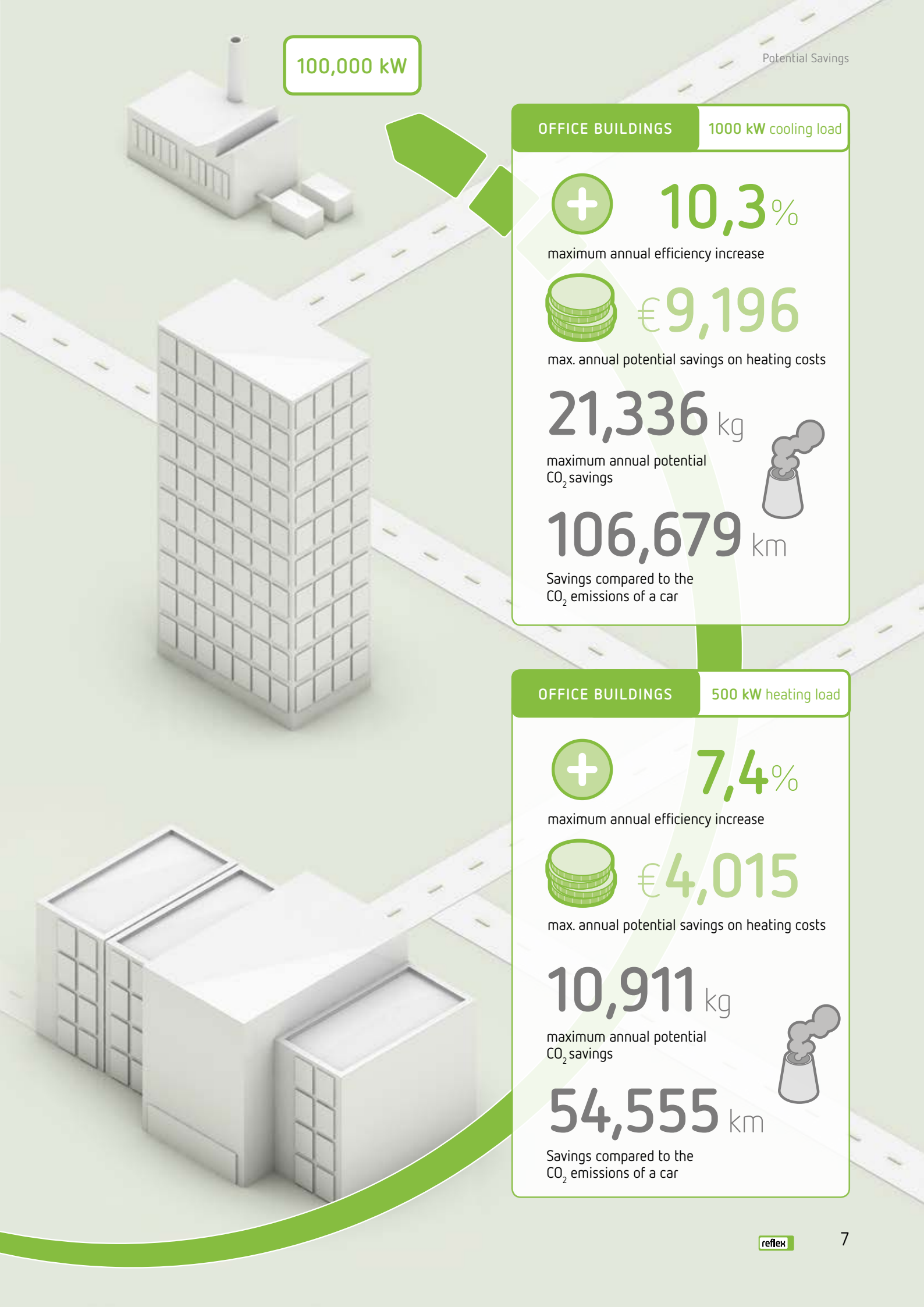
33 percent of CO_2 emissions in Germany come from heating systems. Around 40 percent of the national final energy is used in buildings, with private households spending as much as 85 percent of their energy on heating and warm water alone.

Greater efficiency means less environmental pollution, lower costs and therefore maximum climatic comfort. Reflex Winkelmann has a range of product solutions on the market that are capable of increasing the efficiency of water heating and cooling systems by up to 10.6 per cent. The results of the technological product potential were established independently by the ifes Institute (for applied energy simulation and facility management). TÜV Nord was then commissioned to perform an independent verification of the study, which confirmed the maximum achievable energy saving effects

Another big plus for the environment and efficiency is that the Reflex system not only reduces emissions and energy costs, but also saves on maintenance work and investment outlay.

This means everyone stands to benefit whether it's a private household, business or large-scale industry.





OFFICE BUILDINGS
1000 kW cooling load

10,3%
maximum annual efficiency increase

€9,196
max. annual potential savings on heating costs

21,336 kg
maximum annual potential CO_2 savings

106,679 km
Savings compared to the CO_2 emissions of a car

OFFICE BUILDINGS
500 kW heating load

7,4%
maximum annual efficiency increase

€4,015
max. annual potential savings on heating costs

10,911 kg
maximum annual potential CO_2 savings

54,555 km
Savings compared to the CO_2 emissions of a car

3 Background knowledge

Water quality makes all the difference:

The enemy of every system is **air** and its constituent **gases**

When it comes to heating and cooling systems, efficiency comes down to how much of the input power ends up hot or cold. Two key factors are at play here: first of all, the conversion of the supplied energy into the temperature control of the heat transfer medium (typically water), and secondly, the transport and — most importantly — delivery of heat and/or its absorption in cooling applications.

The essential prerequisite for the appropriate and efficient distribution of heating or cooling water flows is an uninterrupted flow of volume and mass into each part of the system. The enemy here is the air and all the different gases it contains, as gas bubbles inhibit the flow, interfere with the hydraulics and reduce the heat exchange in heating or cooling elements. The hydraulic balancing process loses its effect and can even lead to the failure of individual parts of the system depending on the gas and air inclusions. Worse still is that the oxygen within the air leads to corrosion and can lead to damage if it continues to enter the system in the long term.

The main components of air are nitrogen (78%) and oxygen (21%). Keeping things simple, these gases can be found in 10-degree water at a ratio of 62% nitrogen and 38% oxygen. System water always contains nitrogen and oxygen in dissolved form as a result of the filling and top-up water. Each of the two elements has a different effect. In large quantities, the water can no longer bind a gas and so it occurs freely in bubble form (nitrogen as a main cause of the aforementioned air problems). The solubility of nitrogen in water is dependent on the temperature and the pressure. The lower the pressure and the higher the temperature, the less nitrogen can be bound by water.

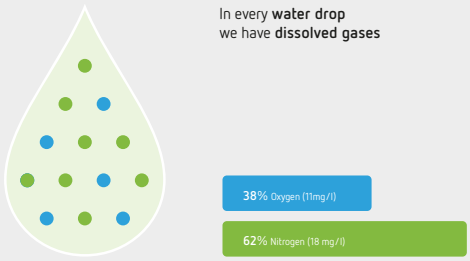
As an inert gas, nitrogen is not consumed in a chemical reaction; instead, it remains in the system water permanently where it can continue to accumulate. High points and relatively calm spots tend to favour the precipitation of nitrogen bubbles, which means that these areas can be prone to disturbances and disrupted circulation.

What's more, nitrogen has far poorer thermodynamic properties in contrast to pure water as a heat transfer medium. The specific heat capacity of water is on average about four times above that of nitrogen, while its thermal conductivity is about 20 times higher. To reach the target temperatures on the receiver side, more work in the form of energy is therefore to be expended depending on the nitrogen concentration involved. The system will therefore continually try to offset itself depending on the parameter settings by means of a longer or higher supply of energy. In other words, energy is ineffective, costs are rising, and climatic comfort is decreasing.

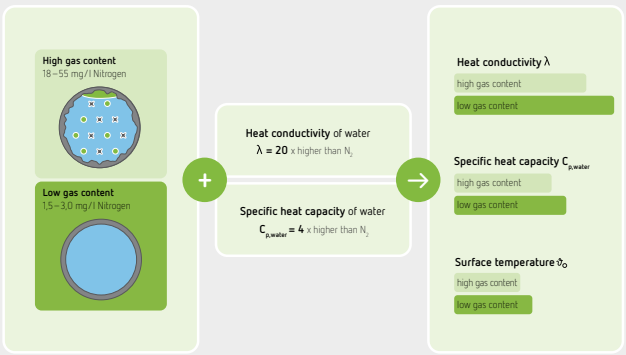
At an appropriate pH value, the acid corrosion can be ignored and the content of dissolved oxygen in the water determines the corrosion. The particles formed in the chemical reactions can deposit on the inside of the piping and act as an insulating layer. If the process continues to repeat itself through the typical mechanisms of the air and gas entries described in the following chapter, this can lead to a reduction in heat transfer as well as to corrosion phenomena and damage to system parts after just a few years of operation.

Composition of water

Simplified illustration of released oxygen and nitrogen gases in filling water at 10°C

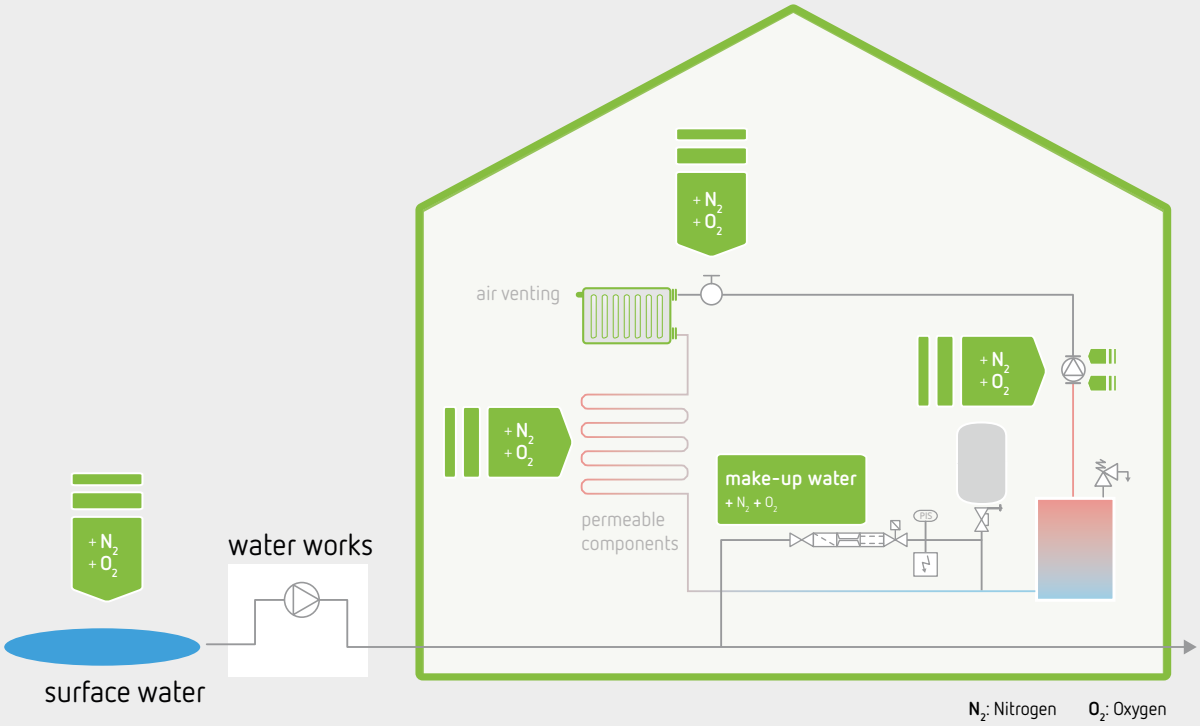


Energetic characteristics for high-gas and low-gas media



Air balance of a heating system

Schematic representation of air and/or gas entries into a system



Here's how air gets into the system:

- **Through filling and water make-up**
  Potable water naturally contains 18 mg/l nitrogen and 11 mg/l oxygen.
- **Through residual air when refilling and topping up**
  After repairs, for example. Studies show a strong charge in the filling water, which is far above the natural value of the drinking water and therefore has other causes.
- **Through permeable system components**
  In comparison to traditional building materials such as steel and copper, a considerable amount of air can diffuse into the system through plastic and rubber tubes.
- **Through chemical reactions**
  Corrosion and decay can cause gases to be released. In some systems, for example, large amounts of nitrogen and methane are detected in the system water.
- **Through drawing in air**
  In the case of a pressure maintenance malfunction, for example. Air frequently penetrates its way into the system as a result of the minimum operating pressure not being reached. This is why, in the event of any air problems, you should always check the exact function and setting of the pressure maintenance.

Water heating and cooling systems are watertight. No water heating and cooling system is gas-tight.

4 Solutions

Water as the most essential system component:
Vacuum spray-tube degassing with patented pressure relied control resolves the gas problem

With the Servitec vacuum spray-tube degassing system, Reflex has developed a technology for optimal conditioning of the system water. This makes use of the physical behaviour of gases in liquids as described in the Henry law (named after the English chemist William Henry). This defines the solubility behaviour of gases in a liquid as follows:

The concentration of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid.

In other words, if the partial pressure of the gas above the liquid increases, the number of particles dissolved in the liquid also increases. If the partial pressure decreases, then the gas particles diffuse out of the liquid.

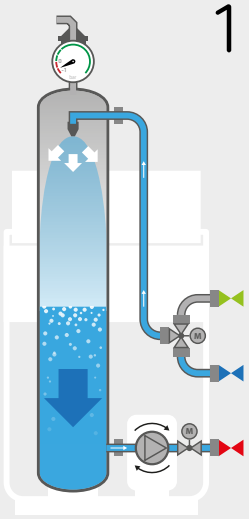
In order to exploit this effect, a vacuum is created in the Servitec spray tube. The combination of spraying and the large contact surface within this sphere leads to the release of the dissolved gases, which are dissipated via an automatic air vent. This process of under-saturation is only necessary for part of the system water due to its high efficiency. As a result, only a partial flow of the content water is taken from the system and degassed in the Servitec vacuum before being returned to the system almost gas-free. An ingenious control concept combined with patented, automatic control systems ensures optimum system operation regardless of the internal pressure conditions.

The degassing process takes place in cycles, the sequence of which can be programmed and therefore adapted to suit requirements. A cycle comprises four phases:

Negative pressure is generated

1

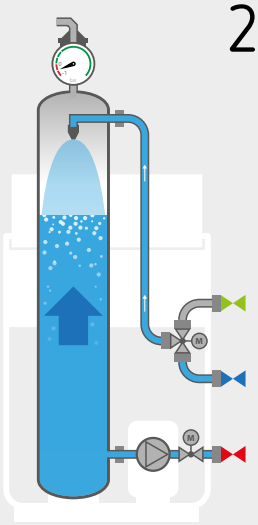
The pump discharges more water than can be supplied via the injection nozzle. This creates negative pressure / a vacuum.



Start of the degassing process

2

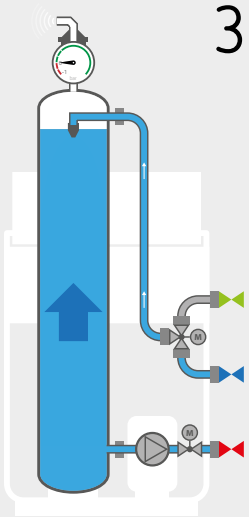
The released gas is extracted from the medium by means of the vacuum created and the fine spraying process.



End of the degassing process

3

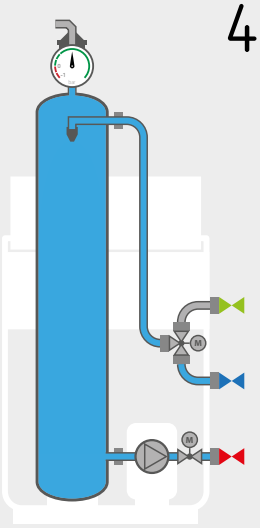
The pump switches off. Water continues to be sprayed until the vacuum spray tube is completely full. All of the released gases and microbubbles are now removed over the automatic air vent.



Down time

4

System pressure starts to build up again in the spray tube. The system water located in the spray tube contains virtually no gas and is pumped back into the network in the next cycle. This is where the unsaturated medium absorbs new gases from the system once again, thereby steadily reducing the gas concentration in the system water.



The Servitec vacuum spray-tube degassing process always degases part of the volume flow. Depending on the device classification and system performance, this amounts to between 0.05 and 15 percent of the main volume flow. Nevertheless, because of the high efficiency of up to 90 percent and the achievable saturation level of almost zero, the Servitec can degas an extraordinarily large water content and, above all, reduce the oxygen content of the water make-up to a minimum.

The impact of a Servitec system is therefore already apparent shortly after being installed, as evidenced by the improvement in the system characteristics. Air and gas influences are reduced, while hydraulics and heat transfer are improved. Practical applications and examples show that partially functioning and even completely failed system parts can be restored to full functionality after implementing vacuum spray-tube degassing. This involves a self-contained system that simply needs to be integrated into the existing heating and cooling system. The systems are integrated into the main volume flow and only require only a simple electrical supply.

Flexibility in all dimensions:
The Servitec and separation technology product range

The Reflex range offers reliable protection against gas and debris problems in small and large systems. The standard selection covers system volumes of up to 220 m³ and can be integrated into existing buildings with ease.

Plug-and-play functionality makes commissioning the Servitec systems both straightforward and reliable. What's more, a range of special systems is also available for larger system volumes.

The entry of gas and oxygen is a progressive process that is reduced to a minimum thanks to Reflex Servitec vacuum spray-tube degassing. Furthermore, this technology is also responsible for reducing pollution levels. We always recommend the use of Reflex's cutting-edge dirt and sludge separators in water heating and cooling networks — especially in old and existing plants.

SERVITEC

NEW

60°C

Standard/GL

Servitec Mini

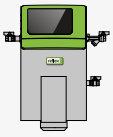
70°C

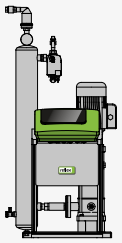
Control Basic

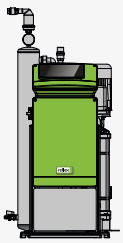
Servitec 25
Servitec 35
Servitec 60
Servitec 75
Servitec 95

Control Touch

Servitec 35
Servitec 60
Servitec 75
Servitec 95
Servitec 120 Mag
Servitec 120 Lev







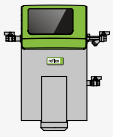
70°C
Glycol

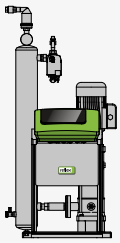
Control Basic

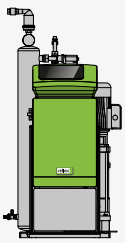
Servitec 25 GL
Servitec 60 GL
Servitec 75 GL
Servitec 95 GL

Control Touch

Servitec 60 GL
Servitec 75 GL
Servitec 95 GL
Servitec 120 GL Mag
Servitec 120 GL Lev







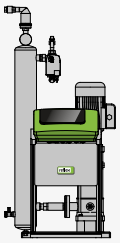
90°C

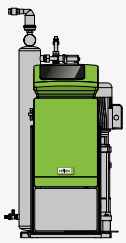
Control Basic

Servitec 60
Servitec 75
Servitec 95

Control Touch

Servitec 120 Mag
Servitec 120 Lev





SEPARATORS

	Brass		Steel	
	Horizontal	Vertical	Welded connection	Flange connection
Exvoid **Exvoid T** Automatic vent		 T 1/2" / 3/8" 110 °C/180 °C		
Exvoid Microbubble separator	 A22–2" 110 °C/180 °C	 A22–1" V 110 °C/180 °C	 A60.3–A329.9	 A50–A300
Exdirt Dirt and sludge separator	 D22–2" 110 °C	 D22–1" V 110 °C	 D60.3–D329.9	 D50–D300
Dirt and sludge separator with magnet	 D22–2" M 110 °C	 D22–1" V–M 110 °C	 D60.3R–D329.9R	Magnetic insert (Optional)  D50R–D300R
Extwin Combined microbubble, dirt and sludge separator	 TW22–1" 110 °C	 TW22 V 110 °C	 TW60.3–TW329.9	 TW50–TW300
Combined microbubble, dirt and sludge separator with magnet	 TW22–1" M 110 °C	 TW22 V–M 110 °C	 TW60.3R–TW329.9R	Magnetic insert (Optional)  TW50R–TW300R

Practice underpinned by science:
Simulation demonstrates potential savings of over ten per cent

CFD
=
"computational fluid dynamics"
(gas freedom and cleanliness)

The combination of vacuum spray-tube degassing and separation technology has very much stood the test of time as a real problem solver and guarantor for gas-free operation in water heating and cooling systems. Experience clearly demonstrates that this technology is the only real way forward when it comes to hydraulics functioning properly and systems working efficiently on a long-term basis.

In a bid to substantiate these findings with scientific evidence, ifes GmbH was commissioned to examine the increase in efficiency facilitated by Reflex degassing systems in water heating and cooling systems. This independent institute is one of the most renowned establishments for innovative climate and energy concepts for sustainable real estate. The focus of the simulation was on the assessment of the effects of nitrogen inclusions on the heat transfer as well as on dirt and sludge particles in the heating and cooling medium on a wide variety of system variants. The relevant technical and chemical basic data for these investigations is from the TU Dresden as yet another independent scientific institution. As part of a dynamic system and CFD simulation, various system variants with and without Reflex degassing were investigated in terms their efficiency. Incidentally, CFD stands for the tried-and-tested method of 'computational fluid dynamics'.

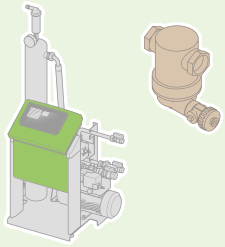
With the help of the thermal simulation, a load profile was generated that shows hourly values of the heating and cooling load over the course of the year for an example building. The CFD simulations were used to investigate the effects of nitrogen inclusions and corrosion deposits on heat transfer. Using different heat exchangers, various nitrogen concentrations and dirt deposits in the heating and cooling system, their effect on heat transfer was simulated for a variety of systems and configurations. Optimally adjusted pressure maintenance was always assumed. Taking into account the results of the CFD simulation, the dynamic system simulation ultimately formed an overall building including all influences. The result is the consumption of energy throughout the year depending on the quality of the heat transfer and the required heating and cooling capacity for that particular example building. All calculations for the case of heating and cooling can be transferred to existing systems both physically and in terms of content.

SINGAPORE GREEN BUILDING PRODUCT
SGBC
VERY GOOD

Two example calculations confirm the huge potential savings afforded by the Reflex system:

ONE FAMILY HOUSE

15 kW
Heating load



vacuum degassing system and **dirt and sludge separators** with magnet

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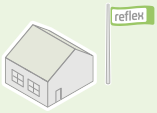


6.5 %

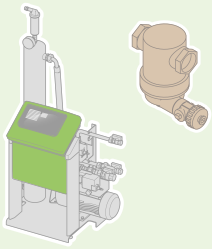
max. increase in efficiency in simulated result

based on the primary energy of the heat generator

In a typical existing one family house with 15 kW radiator heating, the use of Servitec vacuum degassing, Reflex pressurisation maintenance, and dirt and sludge separators can save around 2000 kilowatt hours of heating energy or 500 kilograms of carbon dioxide per annum. This corresponds to a maximum increase in efficiency of 6.5 percent.

TWO FAMILY HOUSE

30 kW
Heating load



vacuum degassing system and **dirt and sludge separators** with magnet

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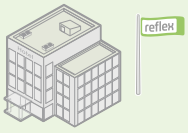


10.6 %

max. increase in efficiency in simulated result

based on the primary energy of the heat generator

The effects of the Reflex system in the simulation of a conventional existing two family house with modern, low-consumption, low-temperature underfloor heating are even more pronounced: For a system with 30 kW heating, this represents a saving of around 6300 kilowatt hours of primary energy or 1.5 tonnes of carbon dioxide per annum. The increase in efficiency therefore amounts to a maximum of 10.6 percent.

Similar advantages can also be seen in cooling systems. The cold water system of an office building with a 7/14°C cooling machine, a panel cooling system and 1000 kW of power served as a basis for the calculation. In order to increase efficiency, the model system has a vacuum spray-tube degassing system in combination with a Reflex pressure maintenance system and a dirt and sludge separator. From an economic point of view, this combination pays for itself in the sense of maximum optimisation possibilities in around just 16 months. Furthermore, the annual potential CO_2 savings for this building amount to approximately 21 tonnes.

Taking all of the existing buildings in Germany as a basis, the possible potential savings are achieved through the use of a comprehensive Servitec vacuum spray-tube degassing system in combination with Reflex products for pressure maintenance and dirt and sludge separators. This could reduce emissions of carbon dioxide by up to 15 million tonnes per annum. In more concrete terms, this equates to the amount of CO_2 emitted by around three coal power plants in Germany.

5 Confirmation

Independent evaluation of the simulation results by TÜV Nord

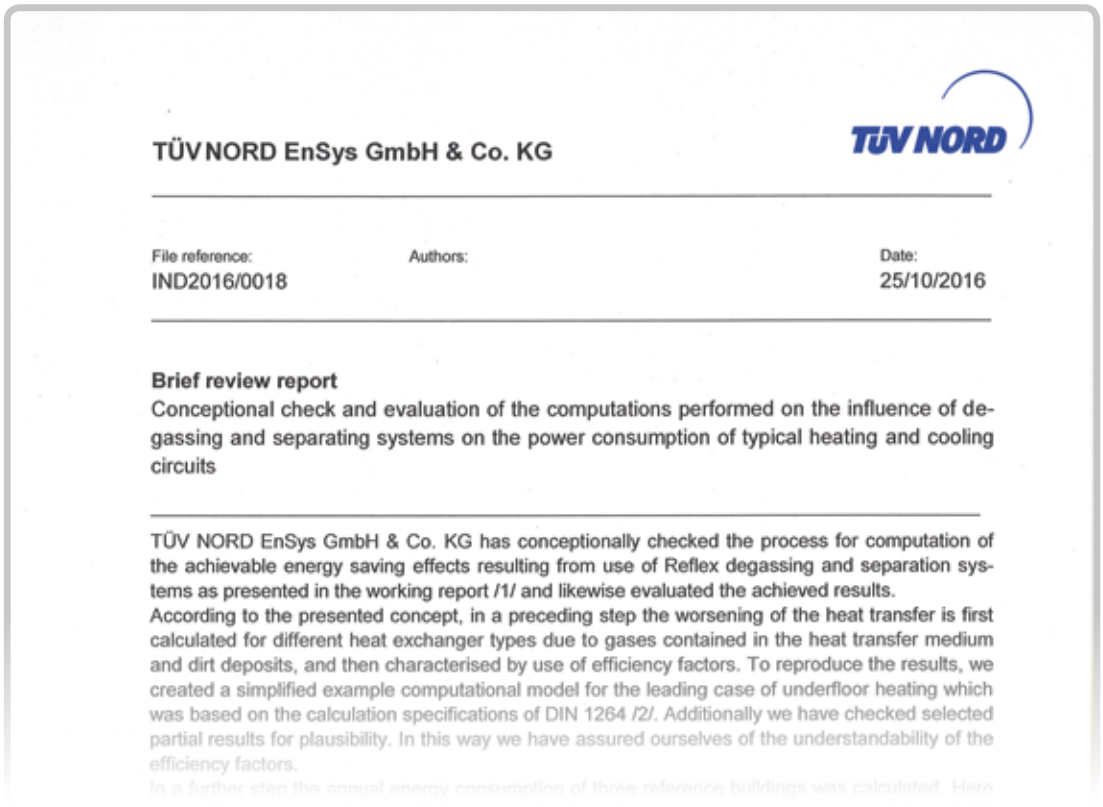
According to the findings report by ifes GmbH on "the evaluation of the use of Reflex degassing systems to increase the efficiency of water heating and cooling systems by means of dynamic systems and CFD flow simulations", TÜV Nord was also commissioned to conduct an independent conceptual assessment and evaluation.

This assessment looked at the three key aspects of the study:

1. Determining a representative thermal load profile.
2. Determining efficiency factors, which make it possible to compare different system conditions with regard to the nitrogen and dirt content.
3. Calculating the annual energy consumption for two heating and one cooling model depending on the nitrogen and dirt content with the Reflex products in use.

The calculation concept for the increase in efficiency achieved with Reflex components was generally found to be suitable. The same also applies to the calculation values of the efficiency factors within the framework of the CFD flow simulation.

As a result, it has been confirmed by an independently certified body that the degassing and separation technology used by Reflex is capable of achieving the determined saving effects. The calculated potential savings shown here are to be interpreted as an upper threshold.



TÜV NORD EnSys GmbH & Co. KG

TÜV NORD

File reference: IND2016/0018

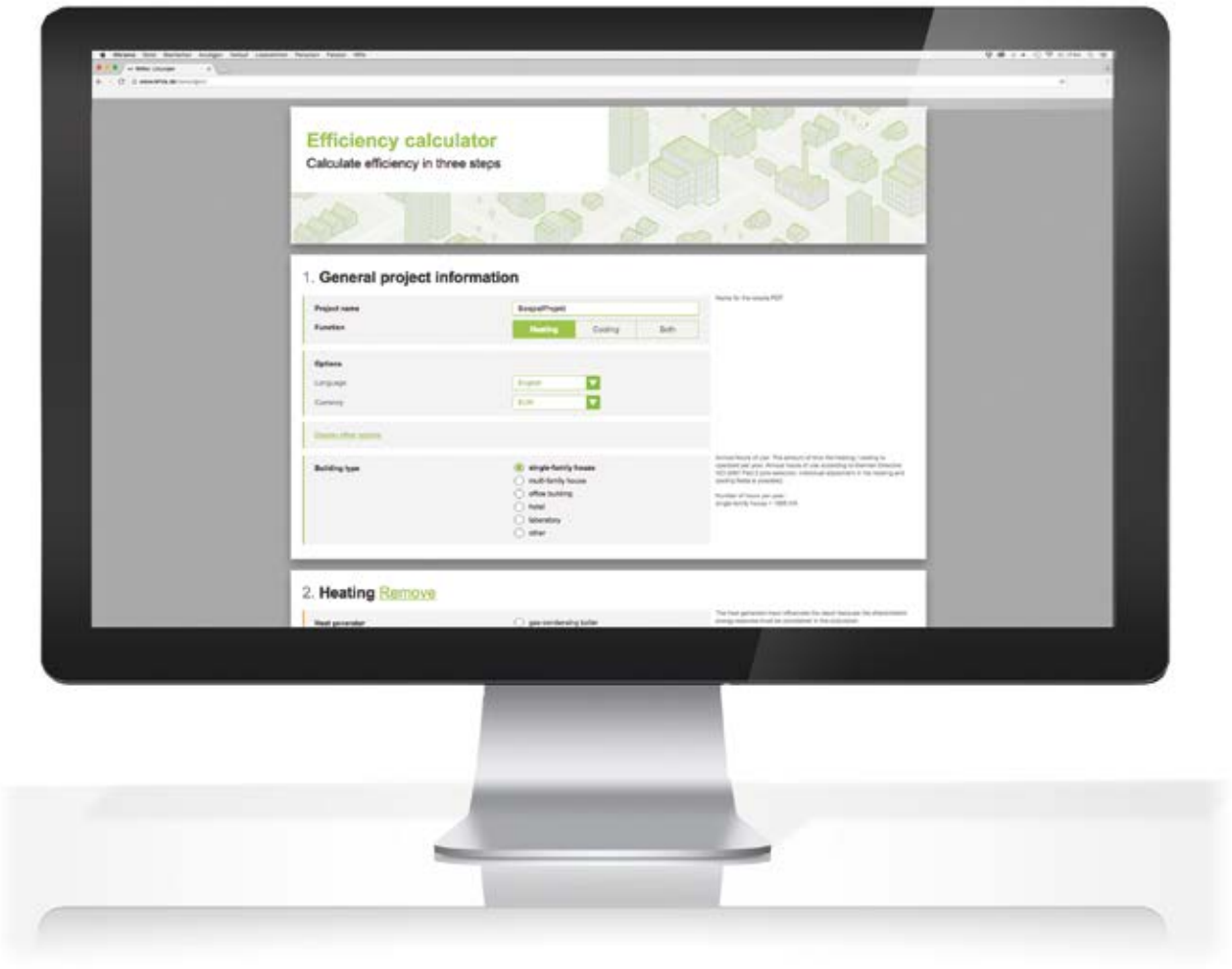
Authors:

Date: 25/10/2016

Brief review report

Conceptional check and evaluation of the computations performed on the influence of degassing and separating systems on the power consumption of typical heating and cooling circuits

TÜV NORD EnSys GmbH & Co. KG has conceptionally checked the process for computation of the achievable energy saving effects resulting from use of Reflex degassing and separation systems as presented in the working report /1/ and likewise evaluated the achieved results.
According to the presented concept, in a preceding step the worsening of the heat transfer is first calculated for different heat exchanger types due to gases contained in the heat transfer medium and dirt deposits, and then characterised by use of efficiency factors. To reproduce the results, we created a simplified example computational model for the leading case of underfloor heating which was based on the calculation specifications of DIN 1264 /2/. Additionally we have checked selected partial results for plausibility. In this way we have assured ourselves of the understandability of the efficiency factors.
In a further step the annual energy consumption of three reference buildings was calculated. Here



Here's what your system can do

Get rid of the guesswork with the new efficiency calculator

What potential energy savings are hiding away in your system? Whether you're running a heating, cooling or combi system, the new Reflex energy efficiency calculator involves just a few steps to show you how much you could improve system efficiency by thanks to innovative pressure management, degassing, dirt prevention and removal. It will even tell you how to significantly reduce your costs and resource consumption.

Using the online tool is easy: simply enter the most important parameters for your system — such as the type of heat generator and building type — to calculate the increase in energy efficiency when using the recommended Reflex products, the annual cost savings, and the necessary investment costs. It will also show you the extent to which these measures contribute to reducing harmful greenhouse gases and thereby protect the climate.

Scan the code
to get started with
your calculation.

Notes

PR1712en / 9126468 / 03-17 / 2.000
Subject to technical modifications

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