

Europe China
Heating Initiative (ECHI)

GAS CONDENSING TECHNOLOGY: KEY FOR EFFICIENCY AND CLEAN AIR IN CHINA





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Foreword

The Chinese Government is pursuing an ambitious energy policy. Its core elements include increasing energy efficiency and fundamentally reducing emissions, to improve air quality. Gas condensing boilers, the advanced technology described in this brochure, help to achieve these policy goals.

Why? Firstly, because these boilers allow to use natural gas instead of coal. This is important, because gas usage significantly reduces the emissions of air pollutants and CO₂, compared to coal. Secondly, because state-of-the-art condensing technology uses natural gas very efficiently and helps to have cleaner air: a new condensing boiler reduces nitrogen oxides emissions by up to 75 % and is up to 20 % more efficient, compared with older, non-condensing appliances.

Gas condensing is an important technology, promoted by the Europe-China Heating Initiative (ECHI). The Initiative gathers 11 leading European manufacturers, which are active on the Chinese market for heating appliances. These companies manufacture highly efficient and renewable-based heaters, as well as components for heating.

This brochure gives an overview of the gas condensing technology, demonstrating its specific benefits for energy efficiency, air quality and emissions reduction in China.



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FROM COAL TO GAS

The strategy for China is to move from coal to gas

At the core of the Chinese government ambitious energy policy is the strategic move from coal to gas. Until now, China has obtained some 60 percent of its energy from burning coal. Coal is used in industrial processes, for power generation, district heating, and still as domestic fuel in some places. Of all energy sources, the combustion of coal produces the highest CO₂ emissions per kWh of useful heat; therefore, it is considered to be particularly damaging to the climate. As other countries, the Chinese Government intends to reduce the use of coal drastically – given crucial concerns about global warming.

Another equally important reason for replacing coal by other energy sources is the extremely high particulate

matter (PM) and nitrogen oxides (NO_x) emissions in urban areas, which seriously endanger the health of the inhabitants. Together with the industrial extraction of coal, the emissions from coal-fired district heating are another main cause of the extreme smog conditions in China's major cities. China has already been converting its heating from coal to gas for two decades. However, this process is a long way from completion, and is currently being stepped up.

This is possible, not least because more large Chinese cities are being connected to the rapidly expanding gas network. Together with the expansion of natural gas powered district heating networks, the Chinese Government is also basing distributed heating on natural gas.



State of the art of distributed heating

In many Chinese cities, the natural gas network is expanding in both developing areas and already built-up areas. Decentralised heaters powered by natural gas are being used for this purpose. Over 90 percent of the Chinese gas boiler market uses conventional technology. Most of the appliances used are wall-mounted low-temperature boilers: they are relatively inexpensive but cannot reach the highest efficiency levels. These low-temperature boilers have an efficiency of less than 85 percent.

In Europe, where the main source of energy is natural gas, legislators have decided to promote the very efficient condensing technology, thanks to which boilers can reach efficiency values above 90 %. Changes in the legislation, occurred in 2015, set very high efficiency requirements for gas boilers and de facto made the use of condensing technology mandatory in almost all types of buildings.

Up until then, low-temperature technology accounted a large share of European sales of heating boilers. The European gas boiler market is about 4.5 million heaters per annum (2016).



State-of-the-art gas condensing technology in comparison to conventional gas boilers

Compared to conventional gas-fired boilers, gas condensing technology is up to 20 percent more efficient, because it uses the latent heat of the flue gas.

How does condensing technology work? The combustion of natural gas produces hot flue gas and steam, which escape through a chimney, and their energy content cannot be used by conventional boilers. These flue gases reach temperatures of 180 degrees Celsius and even higher in some cases. On the other hand, a condensing boiler uses the latent heat of the flue gas, which is bound in steam. The flue gas, together with the steam are passed through a heat exchanger on their way back to the heating system. If the steam comes into contact with the cool return flow, the steam condenses and gives the heat it contains to the cool return flow. The return flow is warmed by the heat contained in the flue gas. The flue gas temperatures of a properly working condensing boiler are usually between 50 and 60 degrees and do not exceed 60 degrees Celsius. The flue gas can be conducted through flue gas systems made of plastic.

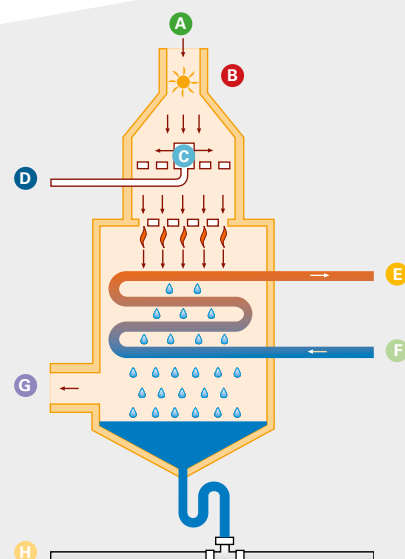
The condensate produced by this process can be safely conducted into the waste water. This is because condensate is mostly water, which does not contain toxic materials; moreover, while being lightly acidic, condensate does not corrode metal sewage pipes, because it is released in very small quantity and because it is always mixed in pipes, with much larger quantities of domestic hot water.

Today's condensing boilers are not only very energy efficient; they also reduce emissions of Nitrogen Oxides (NO_x), compared with older non-condensing appliances. NO_x emissions are an important concern for cities, because they are a source of pollution. A state-of-the-art condensing boiler reduces NO_x emissions by up to 75 %, compared with non-condensing models.

Condensing boilers with full premix burners allow indeed to reach the highest levels of performance for boilers and can achieve efficiency levels above 90 %. A different technology, boilers with heat recuperators, allow as well for higher efficiency than standard boilers, but cannot reach the top levels of performance in energy efficiency and NO_x emissions.

- A Air
- B Blower
- C Gas valve
- D Natural gas
- E Heating feed
- F Heating return flow
- G Flue gas
- H Condensate outflow

Diagram of a condensing appliance



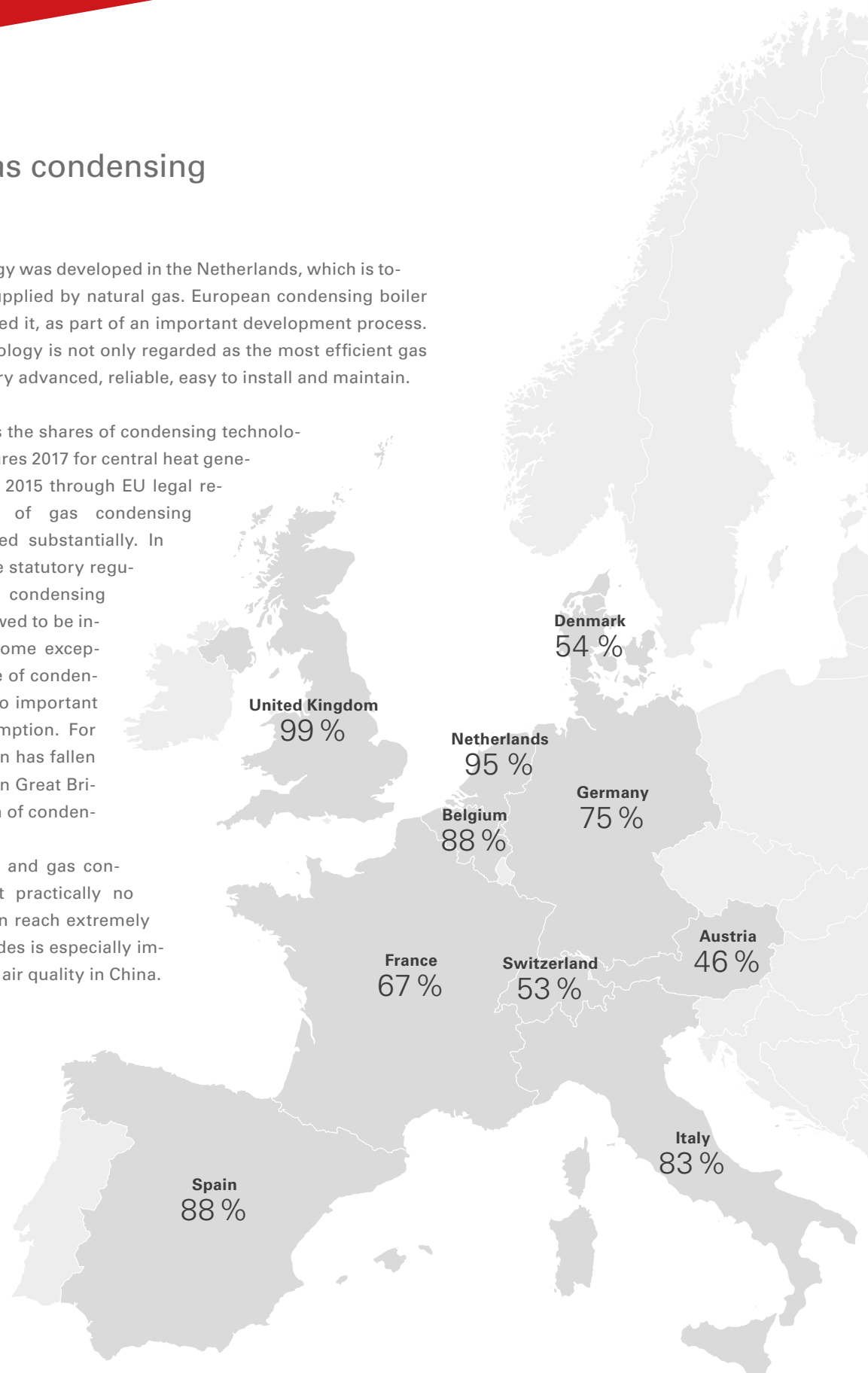


Europe and gas condensing technology

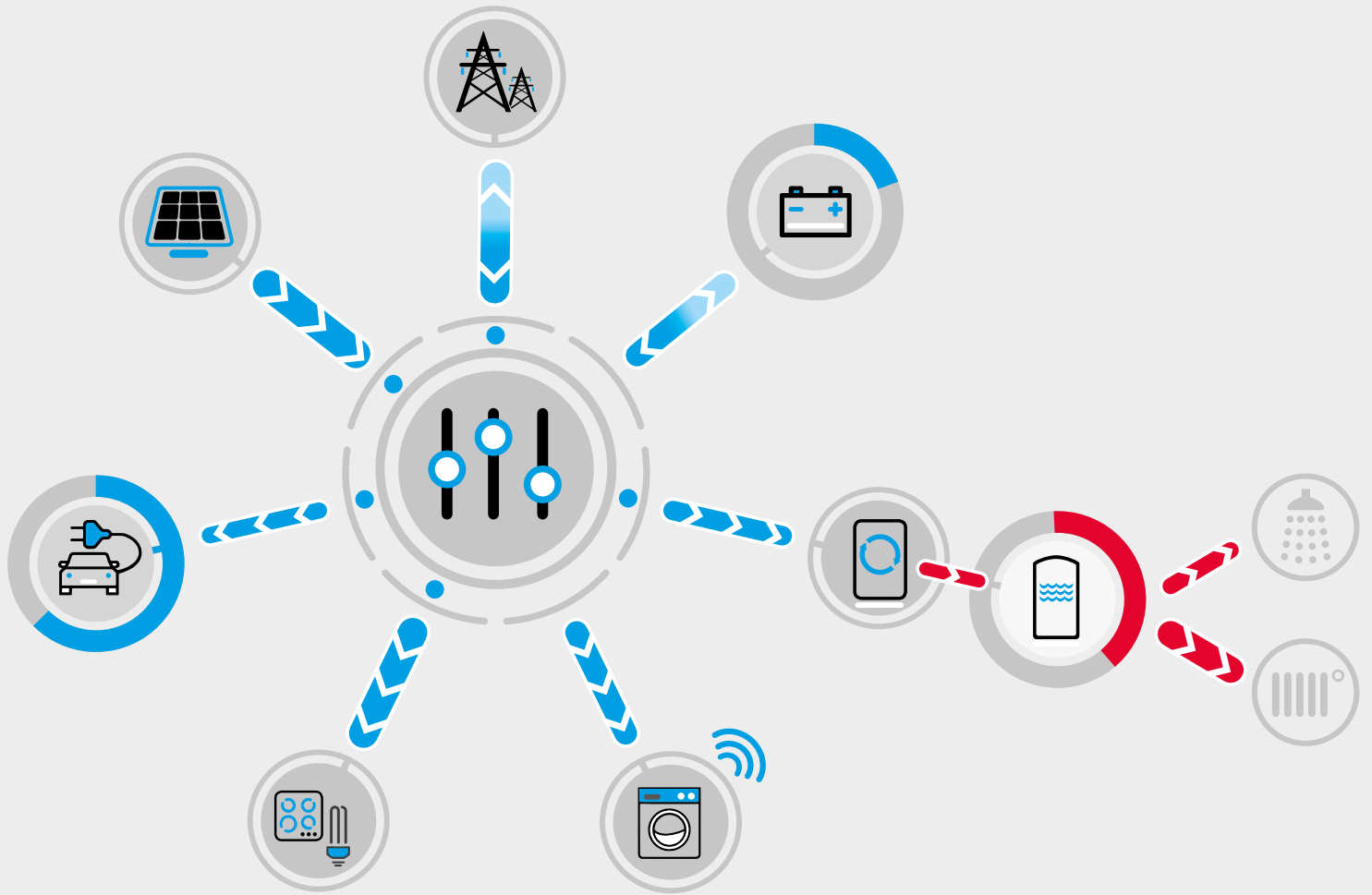
Gas condensing technology was developed in the Netherlands, which is today almost completely supplied by natural gas. European condensing boiler manufacturers perfected it, as part of an important development process. So gas condensing technology is not only regarded as the most efficient gas technology but also as very advanced, reliable, easy to install and maintain.

The European map shows the shares of condensing technology as part of the sales figures 2017 for central heat generators. In particular since 2015 through EU legal requirements the shares of gas condensing technology have increased substantially. In any case, according to the statutory regulations, as a rule, only condensing technology has been allowed to be installed since 2015 with some exceptions. The strong advance of condensing technology has led to important reductions in gas consumption. For example, gas consumption has fallen by more than 20 percent in Great Britain since the introduction of condensing technology.

The fact that natural gas and gas condensing technology emit practically no particulate matter and can reach extremely low levels of nitrogen oxides is especially important to the question of air quality in China.



Market share of
condensing technology
in Europe



Gas condensing as a smart heating system

Gas condensing as a smart heating system

In addition to the advanced gas condensing technology itself, heating manufacturers also offer digitalisation of the entire heating system. The manufacturer provides an Internet interface for such systems, which is connected to the heating system. The Internet interface connects to the manufacturer's server, through which incidents and maintenance dates can be logged. Remote settings can also be made to optimise the heating system.

A smart heating system provides additional efficiency advantages over conventional technology. Indeed, according to a recent study by ITG, the Institute for Technical Building Equipment in Dresden, a smart control of the heating system may add up to 15 % efficiency (Source: ITG, 2017). For example, it enables the operating times of the heating system to be synchronised with the presence and absence of the residents. Local weather data can also be input, and used to optimise the heating operation. The ease of use of such a heating system offers another advantage: the heating system can be controlled from a smartphone.

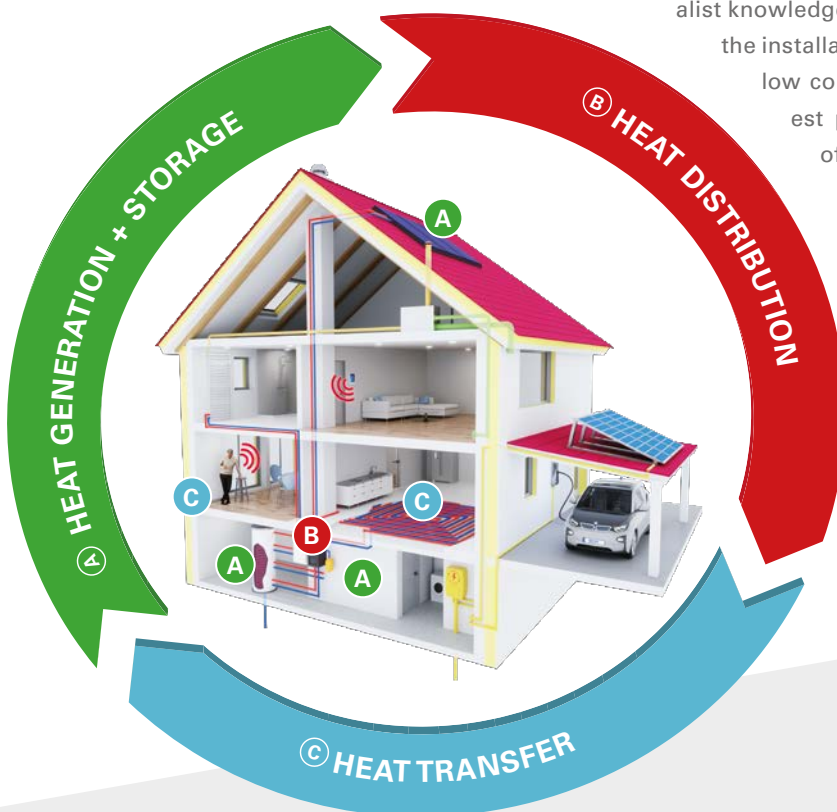
REQUIREMENTS

Technical requirements for the use of condensing technology

A heating system consists of the heat generator (condensing boiler), the heat distributor (hydraulics/pumps), and the heat emitter (radiator/underfloor heating). Condensing technology works very well also in new buildings. It has low system temperatures. The condensing technology low-temperature system is combined with a state-of-the-art hydraulic system. The high-efficiency pumps heating circulation pump and circulation pump prescribed in Europe since 2013 can consume even 80 percent less electricity than conventional heating pumps. In new buildings, the heat is usually emitted by underfloor heating.

Condensing technology is also suitable for use in renovation and energy modernisation of buildings. Old conventional boilers are replaced by gas condensing boilers. In modernisation projects, the system has to be hydraulically balanced, and optimal temperatures have to be achieved in the hydraulic system. And this is not the only specialist knowledge that installers need to have. For example, condensing systems may need that an air intake be set up within the old house chimney. True, this may be easier in China than in Europe, because most Chinese chimneys are in single-family buildings, which are simpler to retrofit than larger, collective flue ducts. However, performing these operations requires specific procedures, some of which are currently missing in China, for example a certificate system for flue gas pipes.

These operations require also that installers have a specialist knowledge. This will be important, to well perform the installation and periodic servicing, which will allow condensing technology to deliver its highest performances. European manufacturers offer training to installers, to this aim.



All components of a heating system



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BDR THERMEA GROUP



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SIEMENS



VAILLANT GROUP



Converting from coal to gas is a very effective strategy, to fundamentally reduce particulate matter and nitrogen oxides emissions, as well as to achieve increased energy efficiency. The gas condensing technology, reliable and already fully established in the European market, is a key technology to use this clean energy source, natural gas, most efficiently. Promoting further condensing technology on the Chinese market would bring greater energy efficiency and important emissions reductions.



ISH China & CIHE, 6 – 8 May 2019 Beijing, China

In the past two decades, ISH China & CIHE has developed into one of the industry's most important platforms and the largest HVAC and plumbing exhibition in Asia. The 23rd edition is scheduled to be held from 06 – 08 May 2019 and will cover the latest cutting-edge HVAC energy-saving products, technologies and solutions.

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