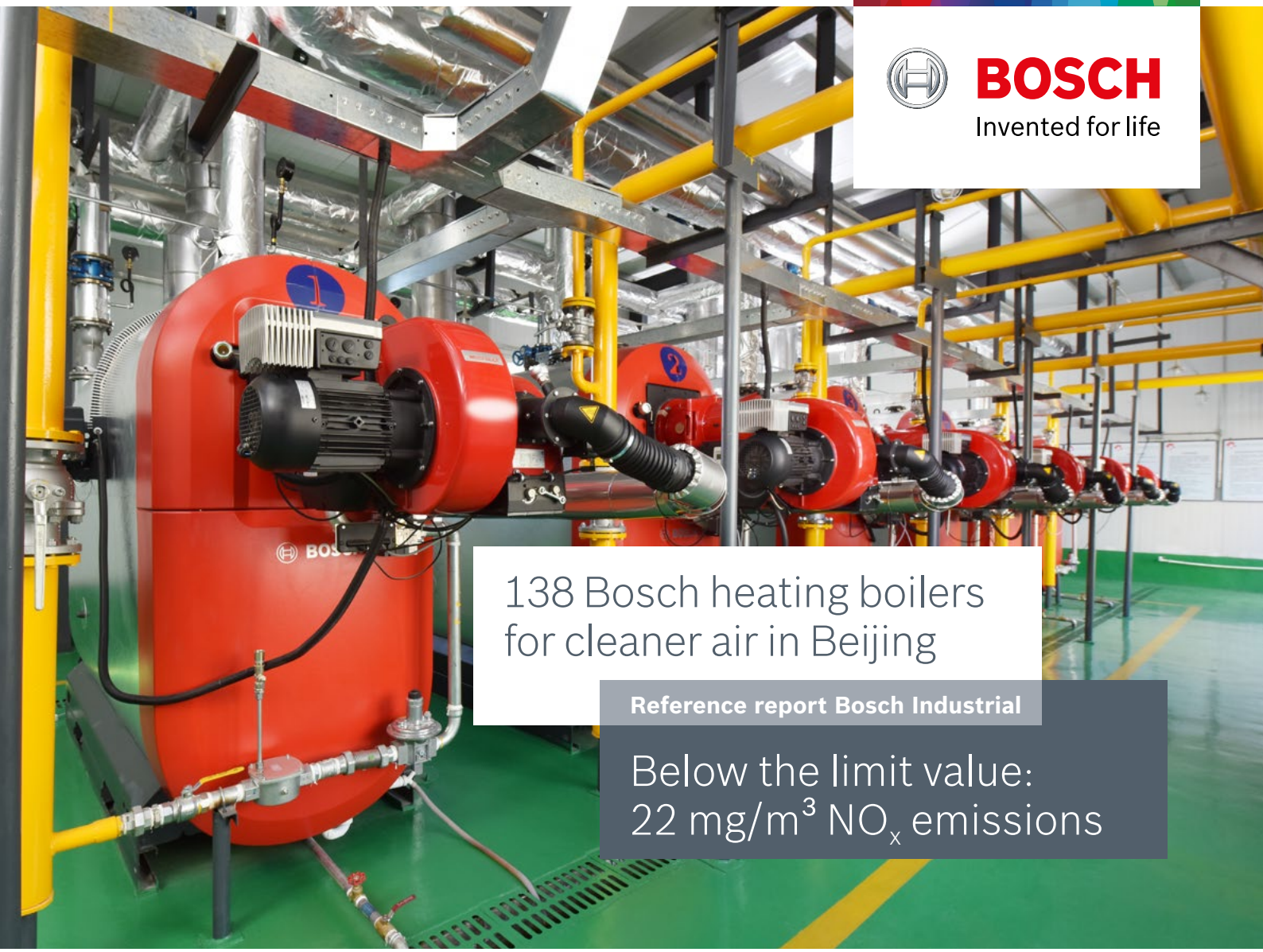


BOSCH
Invented for life

138 Bosch heating boilers for cleaner air in Beijing

Reference report Bosch Industrial

Below the limit value: 22 mg/m³ NO_x emissions

Air pollution control is currently a much-discussed topic in China, both in business and political circles. Megacities such as Beijing are responding particularly quickly and pragmatically. The measures taken by the Chinese government have resulted in China's emission control specifications being among the strictest in the world. In Beijing, the nitrogen oxide limit value for heat generation plants and power plants is only 30 mg/m³; by way of a comparison, the limit value in Europe is 100 mg/m³ (end of 2017). However, these numbers are not completely comparable; a slightly larger amount of excess air is stipulated for the measurements, which also marginally lowers efficiency. Despite this, the new limits present an enormous technical challenge to the manufacturers of heating and process heating systems, and the demand for heating systems with low NO_x emissions is rising. In addition, Beijing is offering operators financial incentives, encouraging them to also carry out a rapid decommissioning of older existing systems with critical emissions levels.

The major projects run jointly by Bosch Thermotechnology and Beijing Huaying Tianrun Energy Technology Co., Ltd. show that these emissions targets are not unreasonably ambitious. The Chinese company operates a large number of heating plants in the global metropolis and supplies heat to a large number of city districts. Bosch Thermotechnology has provided the perfect solution for renewing the heat generators and has supplied enhanced Uni Condens 6000 F heating boiler systems along with special burners with thermal post-combustion. These produce even lower emissions than the stipulated emissions limit values and use condensing technology to offer optimum efficiency.

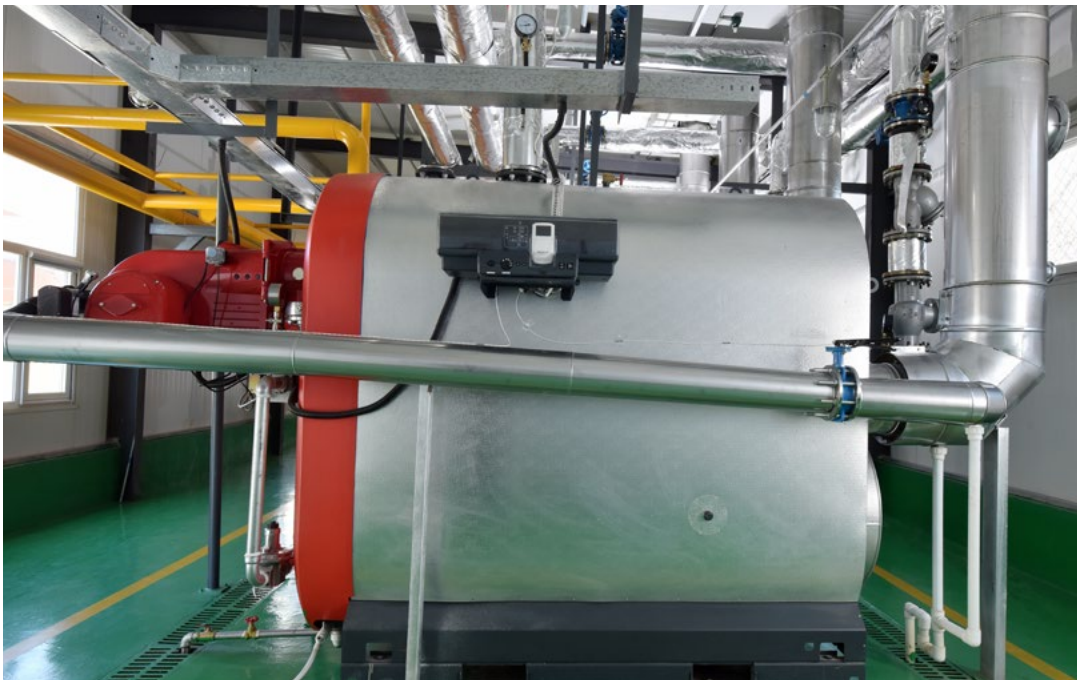
The boilers supply heat to multiple residential areas, all have an output of 1.2 MW. Certain factors had to be considered beforehand during the technical design phase, primarily the high air pollution in Beijing. Not all burner technologies are capable of reliably reducing nitrogen oxide emissions. Working together with

a well-known burner manufacturer, Bosch Thermotechnology developed an innovative solution. In addition to optimising the combustion chamber and control unit, it utilised recirculation technology, which is frequently adopted in industrial boilers. Recirculation technology is characterised by dirt-resistance and a high level of durability, and guarantees extremely low NO_x values in the flue gas, with a relatively low excess O_2 level of less than 3.5 percent: Depending on the set burner output, NO_x emissions are between 22 and 29 mg/m³ – an outstanding contribution to efforts to improve air quality and the environment. In March 2018, these low NO_x values and excellent efficiency levels were even confirmed by on-site measurements taken by the China Special Equipment Inspection and Research Institute (CSEI, http://www.cbpvi.org). The Institute is a partially state-owned Chinese organisation, comparable to the German TÜV.

Part of the Uni Condens heating boiler systems from the first order in 2016 – each boiler generates 1.2 MW heat.

The use of the advanced condensing technology enables the above-average efficiency values. It keeps the fuel consumption low, which helps to further reduce nitrogen oxide emissions. During the combustion process, carbon dioxide and water are produced in the heating boiler. In conventional heat generators, these substances escape through a chimney. In contrast, condensing boilers cool the flue gas and the vaporous water condenses. The latent heat, also known as “condensation heat”, is released and used for heating. The amount of condensation depends, among other things, on the return temperature – the lower the temperature, the higher the energy yield. Due to the fact that the boilers in Beijing are largely supplying heat to flats with underfloor heating, the return temperature is lower than that of radiator-heated flats. In addition, the intelligent water flow of the Uni Condens 6000 F utilises the full condensing potential. This leads to an extremely high standard efficiency of over 100 percent, as well as maximum energy utilisation.

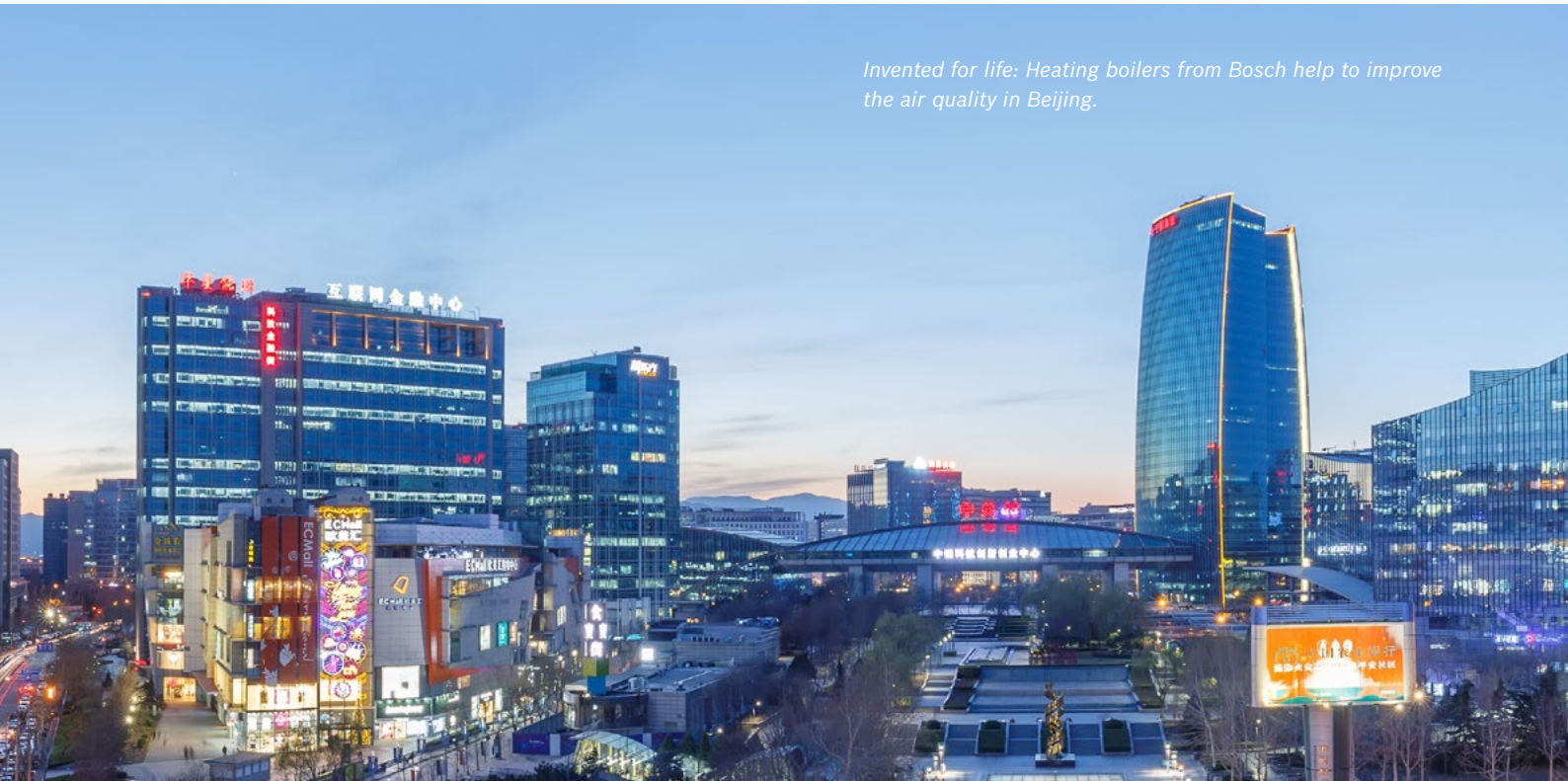
Just five months after the German/Chinese Bosch project team conducted an initial on-site inspection in 2016, the first 20 heating boilers were shipped from the factory in Gunzenhausen (Germany). “With the



Extremely low NO_x emissions: The optimised Bosch heating boiler system with recirculation technology.

boilers for Beijing, we have succeeded in meeting a specific demand in very little time. We developed an engineering solution for Beijing that is tailor-made to fulfil customer requirements following a method that is otherwise only used in industrial boilers," emphasised Sebastian Thönges, Head of International Product Management Commercial Boilers/Sales Support at Bosch Thermotechnology. The result speaks for itself: The new heating boilers require little space, achieve a standard efficiency of up to 110 percent, save up to 15 percent more fuel than their predecessors and, with under 30 mg NO_x emissions, produce less than the stipulated limit value for nitrogen oxide. This certainly explains why Beijing Huaying Tianrun Energy Technology Co., Ltd. ordered 53 more Uni Condens 6000 F boilers in 2017, of which nearly all are already in operation. And the success story continues with another major order in 2018: A further 65 low-emission Bosch heating boilers will similarly contribute towards a reduction of hazardous greenhouse gases, helping to improve air quality in Beijing.

Invented for life: Heating boilers from Bosch help to improve the air quality in Beijing.



Explanation of burner technologies

The lowest NO_x emissions levels tend to be achieved by reducing the flame temperature. In the Beijing project, two technologies were considered with this in mind: Duct burners and burners with flue gas recirculation systems. Duct burners require a large amount of excess air in order to lower the flame temperature. Firstly, this reduces efficiency, as the intake of cool excess air heats up and leaving the chimney without having taken part in the combustion process. Secondly, it can result in a build-up of pollutants and, in a worst-case scenario, in a malfunction of the burner. These are caused by both the high dust content in Beijing and coal deposits in the gas supply pipes, as coal gas was previously used for fuel in large areas of the city. This means that the combustion air that is used must be cleaned in a time-intensive and expensive process of air and gas filtration, which results in high costs for filters and filter maintenance. Burners with flue gas recirculation, however, use a portion of the boiler flue gas to reduce the flame temperature. Approximately 20 percent of the flue gas is returned to the burner via a valve control/recirculation system. This lowers the peak temperatures of the flame, significantly reducing thermal nitrogen oxide formation while increasing durability and minimising maintenance costs.

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