

Environmentally friendly, reliable, affordable.

The IGWP field and laboratory measurements provide important facts and figures of Gas Absorption Heat Pumps.

# Lab and field tests of Robur Gas Absorption Heat Pumps

IGWP - Initiative Gaswärmepumpe - Gas Heat Pump Initiative\*

The European institutions are increasingly focusing on achieving the environmental objectives of reduction in CO<sub>2</sub> emissions. International initiatives -such as the Kyoto Protocol- and European measures -such as the 20-20-20 strategy- are marking the European Roadmap. Significant carbon emission reductions are also planned by EU-Member States until 2020 and there are plans for an 80% reduction in primary energy consumption in the heat market by 2050. Apart from an increase in the share of renewables, these targets also require the use of innovative, efficient technologies. The Robur Gas Absorption Heat Pumps (GAHP) can offer a major contribution to achieving the above climate protection targets.

## What is IGWP

The German association IGWP - Initiative Gaswärmepumpe (Gas Heat Pump Initiative) was founded in 2008 by the leading utilities and heating manufacturers with the intent of supporting the development of the gas heat pumps technology to market maturity. The typical applications of gas heat pumps are multi-family homes as well as tertiary and commercial buildings -especially existing buildings, where natural gas is by far the most popular source of energy. The study -based on laboratory and field tests measuring efficiencies and primary energy shares of gas heat pumps of selected manufacturers- has been commissioned by IGWP.

## Test measurements - Objective

The Robur GAHPs have been tested at the German Engler-Bunte-Institute (EBI) of the Karlsruhe Institute of Technology (KIT) by the HLK Stuttgart GmbH. The field test measurements have been carried on in two phases. In the first test phase, the main objective was in the study of the consistency of GAHPs efficiency data. In the second test phase, a comprehensive analysis of systems concerning the efficiency in operation under practical conditions was included. As part of the IGWP activity Robur Gas Absorption Heat Pumps have been installed at 9 locations in Germany and tested under real operating conditions.

## 1 Annual efficiency: comparison of lab and field tests

At first stage, the GAHP efficiencies and primary energy ratios (PERs) provided by the manufacturer Robur and recorded at a test facility in accordance with VDI 4650 (Sheet 2) were subsequently corroborated in the field. The efficiencies measured under practical conditions have demonstrated the potential of this technology.



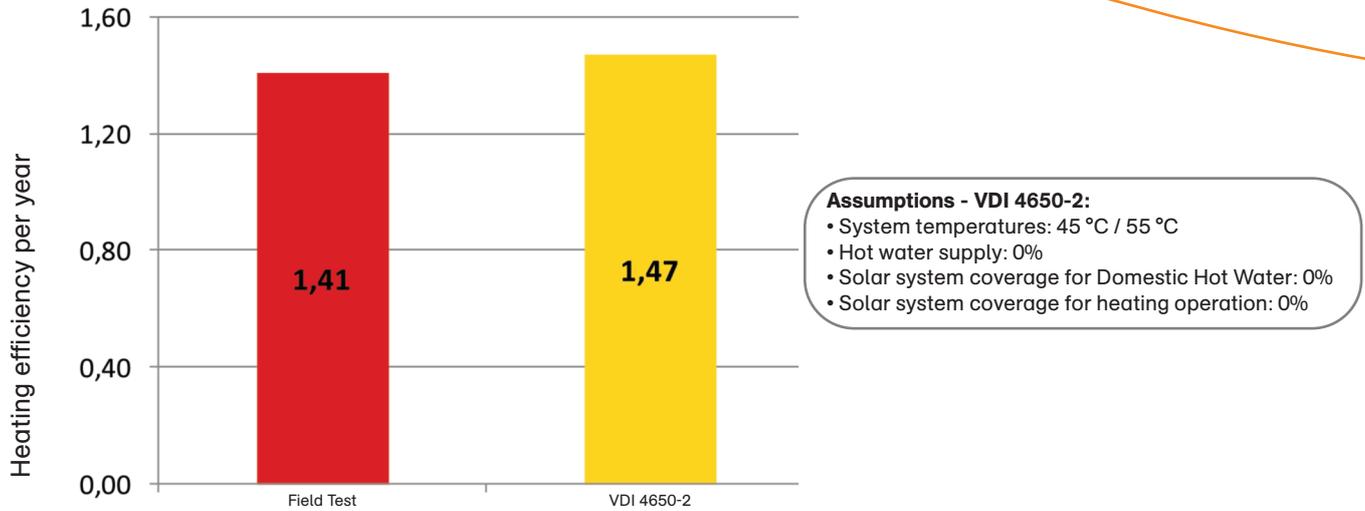
### Field Test

<b>Type</b>	Robur GAHP GS
<b>Energy Source</b>	Ground source
<b>Terminal</b>	Radiators (45 °C/55 °C)
<b>Domestic Hot Water</b>	no
<b>Circulation</b>	no

\* **Contractor:** IGWP Initiative Gaswärmepumpe c/o E.ON Ruhrgas AG.

Robur Gas Absorptions Heat Pumps + air source renewable energy have been tested at the Engler-Bunte-Institut (EBI) of the Karlsruher Instituts für Technologie (KIT) by the HLK Stuttgart GmbH.

# 1. ROBUR GAHP, heating only



**Pic. 12:** Efficiency of Robur GAHP, field vs. lab test - data measured according to VDI 4650-2

### Results of the evaluation with standard values

At second stage, the results of the environmental assessment of Robur GAHP in refurbishing a 6-FH building have been compared to conventional systems, such as gas condensing boilers with and without solar systems. The measurements are carried on taking into consideration the following criteria:

- The non-renewable primary energy consumption and the share of renewable energy;
- The CO<sub>2</sub> emissions.

### 2. Primary energy and share of renewable energy

Considering the case of 6-FH building (s. pic. 37) and compared to gas condensing

boilers without solar system, Robur GAHPs report the lowest primary energy demand values, lower by 25 kWh/m<sup>2</sup> per year. The two GAHP versions considered (namely air- and ground-source) achieve the highest share of renewable energies: the air-source GAHP version about 23% and the ground-source GAHP version about 28%. On the contrary, the investment option with a gas condensing boiler offers no integration of renewable energies. Where GAHPs are used for refurbishing residential building stock, they offer considerable ecological benefits because they achieve substantial primary energy savings while increasing the share of renewables.

### 3. CO<sub>2</sub>- Emissions

The CO<sub>2</sub> emissions of the two GAHP versions (s. pic. 38) are by far lower than those of the gas condensing boilers with and without solar system. With a ground-source GAHP the CO<sub>2</sub> emissions can be reduced by over 3,000 kg per year compared to a gas boiler.

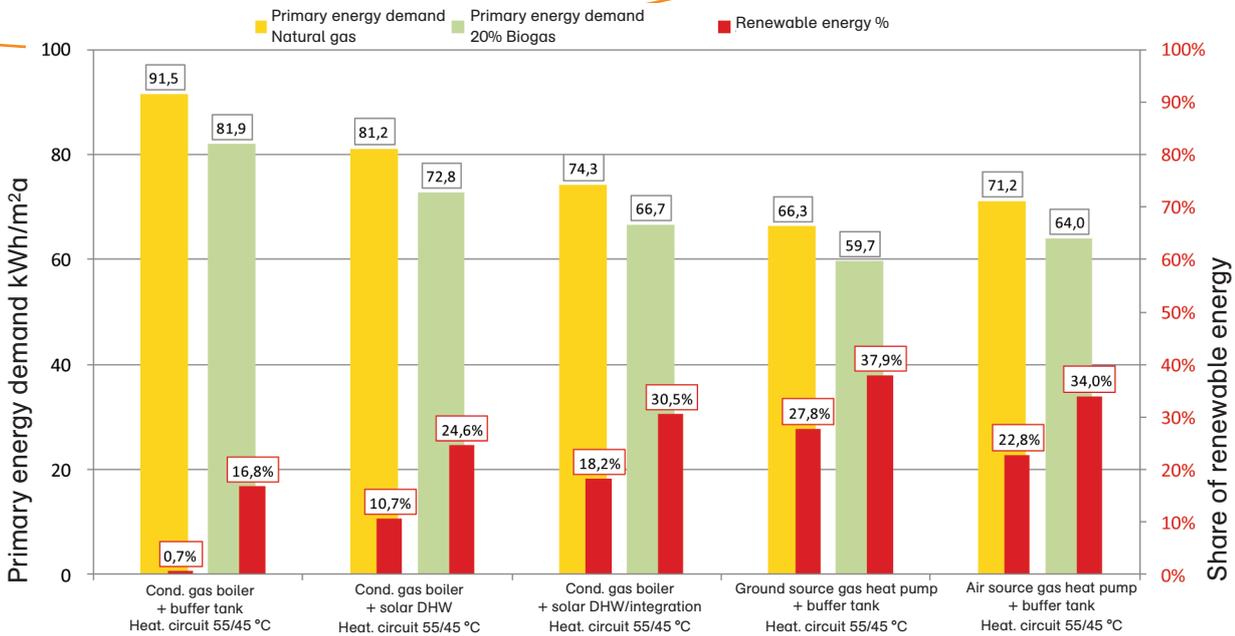
### Results

The field tests generally confirmed the reliability and the operational safety of Robur GAHPs as well as overall customer satisfaction. The efficiencies and primary energy ratios (PERs) recorded at test facilities in accordance with VDI 4650 (Sheet 2) were subsequently corroborated in the field. The efficiencies

measured under practical conditions have demonstrated the potential of this technology. What speaks in favour of the GAHP technology is the fact that, thanks to its high efficiency and the integration with renewable energy sources, it can reduce primary energy consumption as well as CO<sub>2</sub> emissions while at the same time increasing the share of renewables (in accomplishment of current legislation of EU-Member States) at a reasonable expense in tomorrow's heating market.

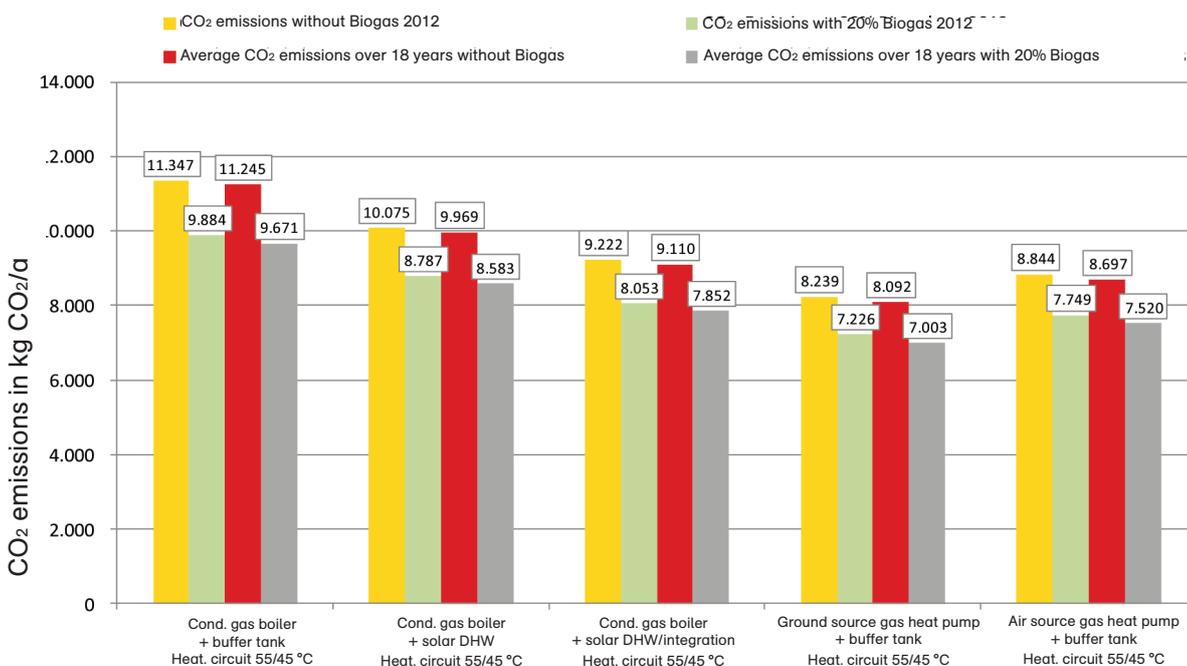
<b>Refurbished 6-FH Robur GAHP vs. gas condensing boilers</b>	
Primary energy saving	Up to 27%
CO <sub>2</sub> emissions reduction	Up to 27%
Increase in renewable energy rate	from 0.7% up to 28% (natural gas) from 0.7% up to 38% (biogas)

## 2. Non-renewable primary energy demand and renewable energy share in the refurbished 6-FH



**Pic. 37:** Non-renewable primary energy demand and renewable energy of Robur GAHP in comparison to condensing versions with / without solar heating, refurbished 6-FH

## 3. CO<sub>2</sub> emissions in refurbished 6-FH



**Pic. 38:** CO<sub>2</sub> emissions Robur GAHP in comparison to condensing versions with / without solar heating, refurbished 6-FH