Heat Pumps in Renovation | Vol. 1

The most flexible technology when renovating any kind of building
EHPA is a Brussels based industry association which aims at promoting awareness and proper deployment of heat pump technology in the European market place for residential, commercial and industrial applications. EHPA provides technical and economic input to European, national and local authorities in legislative, regulatory and energy efficiency matters.
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Dear readers,

There are several reasons suggested as to why heat pumps should be used in residential buildings.

First and foremost, they provide heating, domestic hot water and cooling in an ecologically friendly as well as economical way. Moreover, a wide range of studies consider heat pumps as a key technology on the way to energy system transition and targeted CO₂ neutrality. Therefore, in the future CO₂ reduced energy system, heat pumps are set to play a major role in providing the heat for space heating and domestic hot water in the residential sector. Furthermore, the implementation in new residential buildings is particularly straightforward, typically equipped with a low-temperature underfloor heating system. In fact, in several European countries, heat pumps are already the predominant heating technology in the newly built houses and this trend continues to rise.

The real challenge concerning reaching the goals related to climate change and higher energy efficiency, however, is to secure heating in existing residential buildings. Despite the fact that there are several technological solutions that allow the implementation of heat pumps in existing buildings, the number of end consumers choosing heat pumps when replacing an old heating system is still low.

In the current discussion regarding the applicability of heat pumps in existing buildings, there are two main arguments against. The first one is the assumed high heating supply temperature that allegedly leads to the poor performance of heat pumps and consequently to exclusion criteria. The second one, related to the first, is the need for a comprehensive energetical retrofiting of the building before the installation of the heat pump.
Nowadays, there are plenty of examples of efficient heat pumps work in not-retrofitted or only partly retrofitted houses.

For example, the German Fraunhofer ISE Institute examined sixty air-to-water and ground source heat pumps under real operation conditions in existing buildings in their newest field test. Their extensive measurement setting and high frequency data acquisition system allowed for detailed analyses of the efficiency of the systems, including the temperatures of the heating system.

The two main outcomes from this investigation were:

- The average efficiency of the systems is quite high; coincidently the efficiency results mirrored the results from the project in newly-built residential houses conducted 10 years before.

This indicates the positive development of the technology and the installations processes.

- Measured average heating system temperature for space heating in examined houses is lower than generally expected. The majority of heat for space heating is not delivered in the days with the lowest outside-air temperatures. This explains the relatively low average heating systems temperatures and high average efficiency of the systems (see graph). In other words, the highest supply temperatures and the relatively low efficiency during lowest outside-air temperatures play only a minor role for the average seasonal efficiency.

Additionally, the real maximal supply temperature was lower than the designed heating system temperature. That fact might be explained by milder than normative weather conditions.
during the year the study was carried on, general oversizing of the radiators in older buildings and a lower energy demand thanks to renovation measures applied to the house envelope.

Concerning the ecological assessment of heat pumps, it can be stated that heat pumps or their efficiency may be judged in various ways depending on the CO\textsubscript{2} electricity intensity in a particular country or region. The same rule equally applies to economic evaluation.

Taking the efficiency reached during the field test performed in the last 15 years in Germany as a basis for the evaluation, it is clear that heat pumps perform very well under real operation conditions and that in most cases they ensure significant CO\textsubscript{2} savings compared to natural gas boilers for both new and old buildings. All in all, heat pumps do their job to satisfy thousands of users in European residential buildings while contributing to a less CO\textsubscript{2} future. And yes, also in the renovation sector!

Dear Reader, in this brochure you will discover several examples of successful heat pumps installations in the renovation sector. For me, they are all very inspiring, albeit they are not the ultimate proof of the applicability of heat pumps in existing buildings. The real evidence is the thousands and thousands of heat pumps running in all over Europe every day. They may not be as spectacular as the examples before you, but each day they save the CO\textsubscript{2} emissions and make their users happy at their homes.

Dr.-Ing. Marek Miara
Coordinator Heat Pumps
Fraunhofer-Institut für Solare Energiesysteme ISE
Challenger, the Bouygues Construction head office, is located in Guyancourt (30 hectares field property in West of Paris). Its 6 buildings were constructed in 1988. These represent approximately 67,000 m² in total area and offer working space for 3,200 employees. Renovation started in 2010 and was completed in 2012. 150 million Euros have been invested in increasing energy performance, environmental sustainability and employees’ satisfaction.

Mr. Martin Bouygues, CEO of Bouygues Construction mandated a total renovation of the total area of 67,000 m² of the company’s HQ called Bouygues Challenger. This was in order to be recognized both on a national and international level by receiving 3 certificates related to energy and environment, namely: the French Thermal Efficiency HQE, the USA Green Building LEED Certification and the UK BREEAM Environmental Certification. Success in renovation depended on preserving the original infrastructure and increasing user comfort.

At that time, LG was the only supplier who was prepared to develop MULTI V Water Variable Flow and other innovative solutions. Partnership with Bouygues allowed LG to test validation on-site in order to prove Bouygues LG’s capability and responsiveness for this project.

LG Solutions, namely, MULTI V Water AC SMART Premium and Modbus Interface allowed Ferro engineers to reach more than the initial target of renovation for Bouygues Challenger. The original installation was designed for 1,200 m³/h of water flow rate. After commissioning and starting up, water flow dropped to rates...
“Thanks to the partnership of Bouygues and LG, the total energy consumption of the building has dropped to 21 kWh/m² per year. I appreciate the outstanding performance by LG which exceeded our expectations,” says Philippe Metges, Managing Director of Bouygues.

between 200 m³/h and 300 m³/h. Bouygues claimed that auxiliaries have reduced up to 75%, as opposed to the originally targeted rate of 50%.

Initial renovation target was 31kWh/m²/year, but the actual result after the renovation reached near zero, thanks to AC SMART and BMS that stopped our ducted units. Thanks to the effort of all stakeholders and LG, Challenger project was highly successful.

Thanks to work led by LG and R&D, LG was awarded as the Innovative Supplier in 2014. Variable Water Flow allowed us to achieve beyond what had been planned for Bouygues Challenger and made it the first positive energy site in Europe. The system caused a reduction in energy consumption and is partly responsible for making Challenger a positive energy building.
### Technical details of the application

<table>
<thead>
<tr>
<th><strong>Carbon savings:</strong></th>
<th>Approx. 420t/yr (~70%)</th>
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</thead>
<tbody>
<tr>
<td><strong>Heating capacity:</strong></td>
<td>308 x 3 kW + 56 x 6 kW (1.26 MW)</td>
</tr>
<tr>
<td><strong>Storage capacity:</strong></td>
<td>364 x 9 kWh (3.28 MWh)</td>
</tr>
<tr>
<td><strong>Heating source:</strong></td>
<td>Individual heat pumps (Kensa Shoebox) and heat batteries (Sunamp UniQ) connected to a shared open-loop ground-source system.</td>
</tr>
<tr>
<td><strong>Supplied temperature:</strong></td>
<td>Space Heating up to 55°C and Water Heating up to 65°C.</td>
</tr>
</tbody>
</table>

By Sunamp

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**Picture 1:** The towers in Sunderland
**Picture 2:** The Sunamp UniQ heat battery in place
**Picture 3:** The Kensa Shoebox HP with the UniQ heat battery in the background

Source: Sunamp
When faced with the dilemma of how to completely remove the gas supply and replace old gas combi boilers without decanting residents from 364 apartments in a tower block, Gentoo Housing turned to energy services supplier Engie for advice.

To complicate matters, any new system would have to be easy to use and fit into the limited space available in each home, which ruled out installing traditional unvented cylinders and their associated pipework.

The answer was an integrated system combining Sunamp’s super compact, phase-change material based UniQ heat batteries and Kensa’s Shoebox Heat Pumps, the quietest and smallest ground source heat pumps available in the UK, controlled by a smart, easy to use interface from Switchee.

This fully integrated system is fed communally but managed locally, providing residents with greater individual levels of control and comfort, and lower running costs.

Building safety has improved, as there is no longer any potential risk of gas related explosion, and the risk of carbon monoxide poisoning and legionella disease has been eliminated. Maintenance costs are considerably reduced as there is no longer any need for annual gas safety tests and certification, or cylinder safety checks. Carbon emissions will be reduced by an estimated 420 tonnes, or nearly 70% per year.

The Sunamp / Kensa partnership solution has enabled gas supply to be removed for the first time in an occupied high-rise building in the UK, with minimum disruption. The same system can equally be applied and bring the same advantages to lower density housing, such as a street of terraced homes.
Greibich Installations GmbH is a specialist building services company based in Amstetten, Austria. In 2017, the business took the decision to refurbish its 800 m\(^2\) premises, comprising 400 m\(^2\) office space and 400 m\(^2\) cooled warehouse, home to thirty staff in total.

Far more than a cosmetic exercise, management took the opportunity to totally re-think the way the building functioned, including looking afresh at heating, cooling and CO\(_2\) emissions.

With this in mind, all the original windows were removed and replaced, along with the entire heating and cooling system, including an old gas boiler and air conditioning units. In their place, ceiling-mounted cooling and ventilation were installed across the premises.

To provide the improved way of heating and cooling for this sizeable building, Greibich specified two Vaillant flexoTHERM 197/4 heat pumps from Vaillant Group Austria, accompanied by 14 m\(^2\) of solar panels. This state-of-the-art technology now provides pleasant working conditions, regardless of climatic conditions, for those sitting at their desk or moving stock in the warehouse.

Apart from transforming the experience of working at Greibich, the changes have had a considerable impact on the bottom line. Before the refurbishment, the company's annual heating and cooling costs were around € 6,500. This has since been reduced by 60% to € 2,600. On top of this, the new system has reduced CO\(_2\) emissions by an excess of 15 tons.
“This project illustrates the great potential savings when a building of this size changes from an old to a modern heating system,” commented Thomas Hanke, manager for market development and communication at Vaillant, Austria.

### Facts & Figures

<table>
<thead>
<tr>
<th>Kind of object:</th>
<th>Office and warehouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating System:</td>
<td>2 Vaillant brine-water heat pumps flexo- THERM 197/4</td>
</tr>
<tr>
<td>Heating area:</td>
<td>800 m²</td>
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<tr>
<td>Cooling area:</td>
<td>400 m²</td>
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<td>Energy costs saving:</td>
<td>€ 3,900 p.a.</td>
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<tr>
<td>CO₂ savings:</td>
<td>15.18 tons</td>
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<td>Year of installation:</td>
<td>2017</td>
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By Vaillant
Simon Lacey, Regional Managing Director for ENGIE’s Places & Communities division, comments:
“One of the key reasons this project has been a resounding success is that all parties have a shared vision which centres on improving lives, and we have worked collaboratively to achieve this goal for the residents of Enfield. We’re delighted to have been recognised for taking a proactive approach in tackling fuel poverty and hope to replicate this model across the country, so more people can live in sustainable homes without breaking the bank."

**Technical details of the application**

- **Installed heating capacity:** approximately 1.2 MW
- **Ground Source Heat Pumps installed:** Kensa 3kW and 6kW Shoebox
- **SCOP:** approximately 3.0
- **Refrigerant:** R134a
- **Heating Source:** Closed-loop boreholes to a total depth: 20,700 metres (100 boreholes drilled to depths of over 200 m)
- **Supplied temperature:** 50°C to space heating (radiators) and > 60°C achieved in a domestic hot water tank using GSHP only
Completed in October 2018 the UK’s pioneer of domestic district ground source heat pump systems, Kensa Contracting, delivered England’s largest shared ground loop array heat pump system with ENGIE.

400 flats over eight tower blocks in the London borough of Enfield were retrofitted with individual Shoebox heat pumps manufactured by Kensa Contracting’s sister company Kensa Heat Pumps and connected to the largest collection of ‘district’ arrays of its kind.

The Shared Ground Loop Array System is sub-divided into 16 “micro-districts” consisting of clusters of seven boreholes, supplying half a tower block each.

Delivered in under a year all work was achieved while tenants remained in situ. This system architecture allows residents to select their own energy supplier to access the best available electricity tariff. The resulting heating upgrade led to a significant reduction in residents’ energy bills, (falling by 30–50%) with an estimated 773t CO₂ saving per annum.

The shared nature of the ground array design also reduces drilling costs, ordinarily the most cost-prohibitive aspect of a ground source heat pump installation. Ensuring funding through the Energy Company Obligations (ECO) Scheme and the Government’s Non-Domestic Renewable Heat Incentive (RHI) and securing Enfield Council quarterly payments for 20 years.

With typically two-thirds of the heating sourced from the ground, the borehole installations will provide an infrastructure which will deliver an affordable heat and hot water solution for the Enfield tower blocks for generations.

One of the great strengths of this system is its flexibility and scalability. Shared ground loop systems can feature in developments of just two properties (micro-district) while this project clearly demonstrates how the concept can be scaled up to much larger systems.

Project Accolades
- District Heating Project of the Year (H&V News Awards 2019)
- Featured in the Mayor of London’s Climate Action Week program 2019
“A Thermia geothermal system in Nida Social Housing was installed in 2013. It delivers heating and hot water with high performance rates. Basically, it requires no maintenance and provides great savings in comparison to LPG or district heating.”

Žalvyris Plaktonis, UAB “Neringos energija” manager

Technical details of the application

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<td>Heating capacity</td>
<td>38.4 kW</td>
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<tr>
<td>COP</td>
<td>4.09</td>
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<tr>
<td>Refrigerant</td>
<td>R 407C</td>
</tr>
<tr>
<td>Heating source</td>
<td>10 Boreholes x 100 m</td>
</tr>
<tr>
<td>Supplied temperature</td>
<td>+40 °C</td>
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Curonian Spit is a 97 km long and 0.4 – 4 km wide strip of land between the Baltic Sea and the Curonian Lagoon, which was formed more than 5000 years ago by sea waves and currents, sand and wind. The exceptional landscape of the Curonian Spit is the sloping sand dunes.

The flora of the Curonian Spit National Park consists of about 900 species of plants; there are about 40 species of mammals and 300 species of birds. It is a permanent habitat for woodpeckers, thrushes, skylarks, flycatchers. The most impressive bird species are grey herons, sea eagles and great cormorants.

Nida Social Housing is located in Nida, the administrative centre of the municipality, which is the westernmost point of Lithuania and has about 1200 permanent residents.

It is a complex of 5 houses with 25 family apartments. 4 of the apartments are for civil servants and the rest are for those Nida residents who are in need of social housing. The total heating area is 1250 m².

The choice to use Thermia ground-source heat pump to provide all the heating and hot water via geothermal energy was made and funded by the local municipality. The installer of the system is the local distributor of Thermia, UAB “Naujos Idejos”.

The use of heat pumps is an innovative and creative way of thinking green and will contribute to reducing CO₂ emissions in the years to come, achieving large cost savings. Nida Social Housing project is a small example of how environment-friendly solutions can be used for heating in such a fragile environment. Nida belongs to UNESCO and its survival to the present date has been made possible only as a result of human efforts to combat the erosion of the Spit. The maximum goal would be to shift to renewable energy heating in all of the Peninsula.
The Greater Manchester Smart Community Demonstration Project was a collaborative project developed by the Greater Manchester Combined Authority (GMCA) and Japan's New Energy and Industrial Technology Development Organisation (“NEDO”), in collaboration with a range of partners, including three Greater Manchester Housing Associations, Hitachi Ltd, Daikin Industries Ltd, Mizuho Bank, Electricity Northwest and central Government (BEIS) – an example of a multi-national partnership project between government, industry and academia.

The rationale for the project was to develop and deliver a pilot within the social housing sector across Greater Manchester to trial the implementation and use of Air Source Heat Pumps (HP) at scale and test the effectiveness of Demand Response (DR)* in the social housing sector. The energy demand shift from one heat pump would have a negligible impact on the energy system, compared to the impact of aggregating demand shift across multiple properties.

The demonstration comprised a large-scale field trial, replacing old inefficient heating systems in 550 social housing properties across Wigan, Bury and Manchester with a range of cutting-edge electrical and hybrid air-source heat pumps (HPs); developing an energy aggregation system and ICT platform.

Reported overall satisfaction level with new heating system

Reported overall satisfaction vs date of installation

* Demand Response (DR) is about shifting consumer demand for electricity in real-time, through various methods, including financial incentives and behavioural change.
to control and coordinate the electricity usage of the HPs collectively; reducing electricity usage during peak periods, and testing the effectiveness of this reduction as a system to potentially trade in the electricity market. We believe that this project represents the largest field trial of aggregation of demand shift using heat pumps in Europe.

The project successfully demonstrated that a significant amount of energy could be saved through collective DR across a large number of social housing properties. Each DR activation resulted in accumulated energy demand reduction of between 50 kW and 320 kW depending primarily on the external temperature during the activation and the number of properties involved in each DR event. There is currently little evidence of heat pumps as a large scale retrofit DR solution. This demonstration project enabled the development of a further understanding of the challenges these systems present and some solutions to those challenges.

“I wanted my house to be always warm so I wasn’t prepared to sacrifice comfort for cost. I was shocked how much I have saved. I knew nothing about renewables or HP beforehand. Now I can tell all my neighbours, friends and family about them and their benefits.”

Technical details of the application

Number of heat pumps by Daikin: 540
117 Hybrids (5 kW, 8 kW – 32 kW boiler)
253 Splits (4 kW, 6 kW, 8 kW)
170 Monoblocs (5 kW, 7 kW)

Demand Response (DR) target: 200 kW
Constructed in 1991, the Meridian Cove is an 11-store, 125 unit, concrete frame residential building in Vancouver’s Fairview neighbourhood. Like many condos, the south and west facing units in particular require cooling during the summer; by contrast, the north and east facing units are hard to keep warm in the winter.

For this project, the .2.0 was chosen; a combined air conditioning and heat pump unit that can cool rooms in the summer, heat them in the winter, and dehumidify all year round. The heat pump air conditioners are a unique through the wall product that functions without the need of an outdoor compressor unit, thereby saving money on installation costs.

Mounted on an exterior wall, the INNOVA .2.0 simply requires two duct holes of 162 mm each (6.4 in). To minimize their aesthetic appearance, the duct holes are disguised by vent covers that are available in many different styles and colours to fit the building exterior.

For this type of installation, the following models have been chosen:
- .2.0 + FCU with integrated fancoil
- .2.0 Elec with integrated electric heater
- .3.0 condensation vaporizer

The option .2.0+FCU integrates into one single body both an air-conditioning system for summer cooling and winter heating, and a fancoil for winter heating with hot plant water.

The option .2.0 Elec includes an integrated electrical heater for colder climates or in applications where the floor area exceeds 700 m². In this version, the heat pump is integrated with a 1 kW...
THE PRODUCT

SIMPLE
No outdoor unit.
It can be easily installed even by inexperienced operators

SAFE
It uses low refrigerant quantity in an airtight circuit

EFFICIENT
DC Inverter compressor.
It modulates the power to the real comfort needs, increasing the energy efficiency

electric resistance heater that intervenes automatically when outdoor temperatures are low.

With .3.0 condensation vaporizer the water condensate is atomized by an innovative system using piezoelectric cells, and afterwards expelled by a microfan.

“The INNOVA equipment is certainly worth it. It is quiet and you can run it in cooling mode only, without using the compressor. Removing excess humidity from the air is another big advantage. There are few other options available that are so efficient and look good.”

Meridian Cove resident

QUIET OPERATION
Super silent speed 27dB(A)

EASY CONTROL
Touch screen display
Remote hand set
WIFI

By innova renewing energies
When Heiner Wockel got the rare opportunity to make a permanent residence in what was a holiday cottage in a quiet lakeside idyll, he was quickly reminded of the difference between the kind of home people tolerate while on vacation and a place people live in permanently.

The house, with commanding and uninterrupted views of the Lister Dam, needed major refurbishment to bring it up to the standard of a modern building. Wockel invested in new windows, floors, staircase and a brand new electrical system. But perhaps the most fundamental change was to the heating and hot water system.

Like many holiday properties, this one used out-dated and energy-guzzling electric storage heaters and vintage air conditioning. Switching to oil or gas was an option but would have meant not only unattractive boilers and pipes, but also sacrificing space in the garden for ugly fuel tanks.

The chosen solution was a very compact 7kW Vaillant aroTHERM Split air-to-water heat pump, which provides 75% of the cottage’s energy from the ambient air.

Outside the pump operates, even at full load, at a whisper-quiet 47 dB when measured 3 m away, which is no louder than a standard refrigerator. Inside, the indoor unit is fitted comfortably into a small 2 m² utility room, leaving space for a washing machine. Underfloor heating circuitry was milled into the existing floor and not only ensures an even distribution of heat but also doubles as a passive cooling system, eliminating the need for air conditioning.

Wockel calculates that the heat pump was no more expensive than a new oil or gas-fired condensing boiler.
“The ecological benefit of this heat source is priceless,” according to Heiner Wockel. “We obtain 75 percent of our energy from the ambient air, and only need to supply a quarter in the form of electricity as drive energy. And for this we will later install a photovoltaic system on the roof.”

**Facts & Figures**

- **Kind of object:** One-family house
- **Heating System:** 1 aroTHERM Split 7 kW
  Wall-hung module MEH
- **Heating & cooling area:** 140 m²

By **Vaillant**
The building:
Originally a single apartment with 250 m² of ground floor and 200 m² of only partially livable garret. Since the requalification with enlargement, the owner has obtained two apartments with a gross area of 250 m² on the ground floor and of 225 m² on the first floor.

Insulation:
Wooden roof with 10 cm of wood insulation, and 10 cm of wood fiber insulation. Walls in porous brick with 12 cm of Polyurethane 120 foam coat. Aluminium frames with thermal break double glazed windows, with low emissivity film and sound film.

System:
The old boiler was replaced with a complete system that guarantees not only heating and hot domestic water production, but also cooling, summer dehumidification, air renewal and purification. The heat pump provides heating and hot domestic water production to the ground floor apartment, where radiators were maintained and an old air conditioning system was already present. On the first floor, the heat pump provides heating and cooling with radiant floor. The plant on the first floor is completed by Clivet’s heat pump unit for air renewal and purification and summer dehumidification with thermodynamic heat recovery and electronic filtration. The entire system of the two apartments is managed by Clivet’s management and control system.
Picture 1 & 2: Single-family house before and after requalification

Picture 3 & 4: Clivet heat pump installed in the technical room instead of old boiler and tank

Picture 5 & 6: Clivet air renewal and purification unit in false ceiling + supply air grille in the living area

Source: Clivet
"We are very satisfied with the Innova 2.0 units, both for their aesthetics, for their performance, and for their ease of control: in fact, thanks to the integrated touch screen controls, the air conditioners can be easily programmed by our guests."

David Munson – director of the Whittlebury Hall Conference, Training Center and Hotel
Located near Silverstone, the prestigious Whittlebury Hall Conference, Training Center and Hotel offers its guests, in addition to 5 “Executive” suites, 50 “Club” rooms and 159 “Standard” rooms, ample space for leisure and a wide range of modern facilities for catering and for the management of corporate events, conferences, exhibitions and training courses.

On the occasion of its recent renovation, the design team chose to replace the heating system of the existing rooms with heat pump air conditioners without external unit ..2.0 of INNOVA. The heat pump air conditioners have been chosen for their great potential in upgrading the energy efficiency of existing buildings thanks to their simplicity of installation, the safety of the hermetic refrigeration circuit, the high energy savings, the significant improvement in real and perceived comfort and the integrated dehumidification and summer cooling functions. INNOVA 2.0, which brings together in one body (inside) the evaporating part and the condensing part, usually divided into two distinct units (one internal and one external), is connected to the outside exclusively through two discrete holes of 162 mm in diameter. This way, it is allowed to fully comply with all the architectural and aesthetic requirements indicated by the Whittlebury Hall, such as the perfect cleaning of the facades, made possible also by the possibility of painting the external grids of the same dark red colour as the exposed bricks.

The INNOVA heat pump air conditioners without outdoor unit ..2.0 have proved to be very fast to install. This feature has allowed the installation of air conditioners during the day in the absence of guests, proving decisive to avoid inevitable “room down” that they would cause severe economic and image damage to the structure.

The Wi-Fi integrated in every single machine has allowed both to connect all the units without communication cables (ideal situation in such a complex redevelopment), and to manage all the machines directly from the reception thanks to a software developed by Innova specifically for the hotel industry.
Turning a family home into an energy-neutral home with Panasonic air-to-water

Sinne Technyk recently installed Panasonic heat pump and photovoltaic panels in a house in Oudemirdum in Friesland, the Netherlands. Due to this combination, the owners now have an energy-neutral home and benefit from a more comfortable indoor climate.

The house has a surface of 14 by 10 meters with an annual gas consumption of 1800 to 2200 cubic meters per year. “The owners of this house have asked us to make it more sustainable. The aim was to realize an energy-neutral home and reduce the usage of gas to zero,” explains Leo van der Molen of Sinne Technyk. “That makes a heat pump an interesting option.”

With the comfort of the customers and neighbours in mind, a silent Aquarea T-CAP heat pump was chosen. “The Aquarea T-CAP is a very quiet unit by itself. The heat pump is equipped with three silent modes, with which the noise production can be further reduced during the night, for example.

Another important argument is the ease of use. Due to a touchscreen, the Panasonic heat pumps are very user-friendly,” says Van der Molen.

The Aquarea T-CAP is powered by solar panels. A total of 24 Panasonic HIT KURO solar panels of 325Wp each were installed in combination with a SolarEdge inverter equipped with optimizers. “We believe that these are the best quality solar panels currently available on the market. Thanks to their high efficiency per m², the panels provide the largest amount of power and also have a long lifespan.”

Just like in this case, we have advised Panasonic products. “Our experience is that the customer likes to opt for quality and prefers to pay a bit more for a high-quality solar panel or heat pump,” says Van der Molen. “The products of Panasonic are high end but offer a higher quality than other solutions. The price-quality ratio is, therefore, considerably better.”

Technical details of the application

<table>
<thead>
<tr>
<th>Heating capacity:</th>
<th>12 kW</th>
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<td>COP:</td>
<td>4.74</td>
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<td>Heating source:</td>
<td>Underfloor heating</td>
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The aim was to realize an energy-neutral home and reduce the usage of gas to zero.”
Leo van der Molen, Sinne Technyk
“By opting for a total solution, we can achieve low energy consumption. In this project, we opted for an LG R32 Monobloc. Besides, LG’s Monobloc has interesting subsidy benefits for the end-user of the building,” Martin van der Voort, Key Account Manager at Centercon
The upgrade of heating and cooling systems has been identified as a top priority to achieve the European climate and energy goals. It also offers a major opportunity to improve the indoor air quality in buildings which has a major impact on the well-being and the productivity of people living and working in buildings. The BREEAM certification is one of the leading sustainability assessment methods for master-planning projects, infrastructure and buildings. It recognises and reflects the value in higher performing assets across the built environment’s lifecycle, including the measurable energy consumption in the building.

**SUSTAINABLE COOLING SOLUTION:**

- Four business units of offices spread over three floors in the distribution centre DCAM Amsterdam Park in the Port of Amsterdam.
- Full integration of cooling and heating with a monobloc air to water heat pump running with R-32 refrigerant and indoor climate systems in the form of underfloor heating and fan coils units. Coupled with a heat recovery system to recover the heat from the cooling system to provide hot water.
- Controlled by the Center Smart Energy Controller, a building automation system that allows for remote monitoring of temperature and power and gives the user insight into energy consumption.

**BENEFITS:**

- The combination of system integration and energy-saving sustainable solutions ultimately led to the BREEAM certification, recognizing the building’s climate-friendly performance.
- The “all-in-one” solution providing heating, cooling and hot water makes sure that the big heating and cooling loads in the building are met under all circumstances with minimal energy consumption.
- The air to water heat pump technology used for cooling, heating and hot water supply benefits from the Dutch government’s subsidy for energy-efficient heating and cooling technologies. The end-user, therefore, sees the total cost of ownership reduced right from the start and throughout the system’s lifecycle thanks to reduced energy bills.
The EU funded Heat4Cool project proposes innovative, efficient and cost-effective heating and cooling solutions to optimize the integration of six technologies (adsorption heat pump, PCM storage batteries, SCI-BEMS, Solar PV, Solar thermal, heat recovery from sewage water) at building and district level, to meet net-zero energy standards.

The project will showcase four different retrofitting solutions, three of them will be focusing on residential buildings where the new innovative systems will be monitored and controlled through the SCI-BEMS (self-correcting intelligent building energy management system). The SCI-BEMS will take into account weather forecast, energy demand and will be able to interact with the end-user allowing him/her to identify and maintain the best comfort conditions, as well as remotely control the HVAC system.

One of the case studies is the historic residential pilot site in Chorzów (Poland), composed of 12 apartments. The main sources of heat for space heating and DHW are the natural gas boilers, while space cooling is not required.

As part of the retrofitting project, a direct current driven heat pump with 30 kW heating capacity and integrating a 36 kWh PCM storage, 8 PCM storage batteries for a total thermal storage of 96 kWh, (four new boilers, 41 radiators all connected to the new heating system) and 43 solar PV modules for a total peak capacity of 14.19 kWp have been installed and integrated into the heating system.

Renovation of the historical palace in Chorzów with heat pumps – Heat4Cool project

Integrating advanced technologies for heating and cooling at building and district level

The Project has received funding from the European Union’s Horizon 2020 program for energy efficiency and innovation action under agreement No. 723925.
Technical details of the application

- Heating capacity: 30 kW
- COP: 4.34 at A7 W35
- Refrigerant: R134a
- Heating source: air to water
- Supplied temperature: 55 °C

Picture 1 (above):
Historical façade of the Polish demo site

Picture 2 (below):
DC heat pump installed in Chorzow

Picture 3 (right): PV modules installed on the roof
Source: Heat4Cool project
Technical details of the application

Heating capacity: up to 50 kW
Cooling capacity: up to 40 kW
COP: hot 3.3 – cold 2.7 – combined 6
Refrigerant: CO₂ (R744)
Heating source: Electricity
Supplied temperature: up to 150 °C
The EU funded SunHorizon project aims to develop heat pump solutions (thermal compression, adsorption, reversible) that will act properly coupled with advanced solar panels (PV, thermal, hybrid) providing heating and cooling for residential and tertiary buildings. During the project five technology packages (TP) will be designed and demonstrated in eight different demos across EU climates (Germany, Spain, Belgium, Latvia) in small and large scale buildings. Moreover, a cloud-based monitoring platform will be realized for the development of data driven algorithms and tools for predictive maintenance and optimize the TP’s management.

One of the demo sites is situated in Berlin. It is a residential building with two apartments located in the town center. Currently, the heat demand of the building is covered by standard gas boilers for the DHW and trough radiators for the space heating.

During SunHorizon project, a technology package composed by 20 kW thermal compression heat pump and 14 m² high vacuum solar thermal panels, properly connected with a 2 m³ stratified thermal storage, will be installed to cover the whole heating demand with an estimated primary energy savings of 70%. The main schematics highlights are:

- Parallel operation of solar panels and heat pump.
- Possible direct use of solar heat at high temperature on the cold return line from the radiator space heating circuit.
- DHW solar preheating from accumulated solar heat in the thermal storage.
- Use of only one outdoor fan coil (instead of two) to operate the heat pump unit during the heating season and to dissipate excess heat from the solar collector.

At this stage no results are available. The TP will be tested firstly in laboratory and then installed in September 2021 for one-year monitoring.

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