Source: Glen Dimplex

Heat pumps and high rise homes:

Case studies from across Europe

ehpa
european
heat pump association

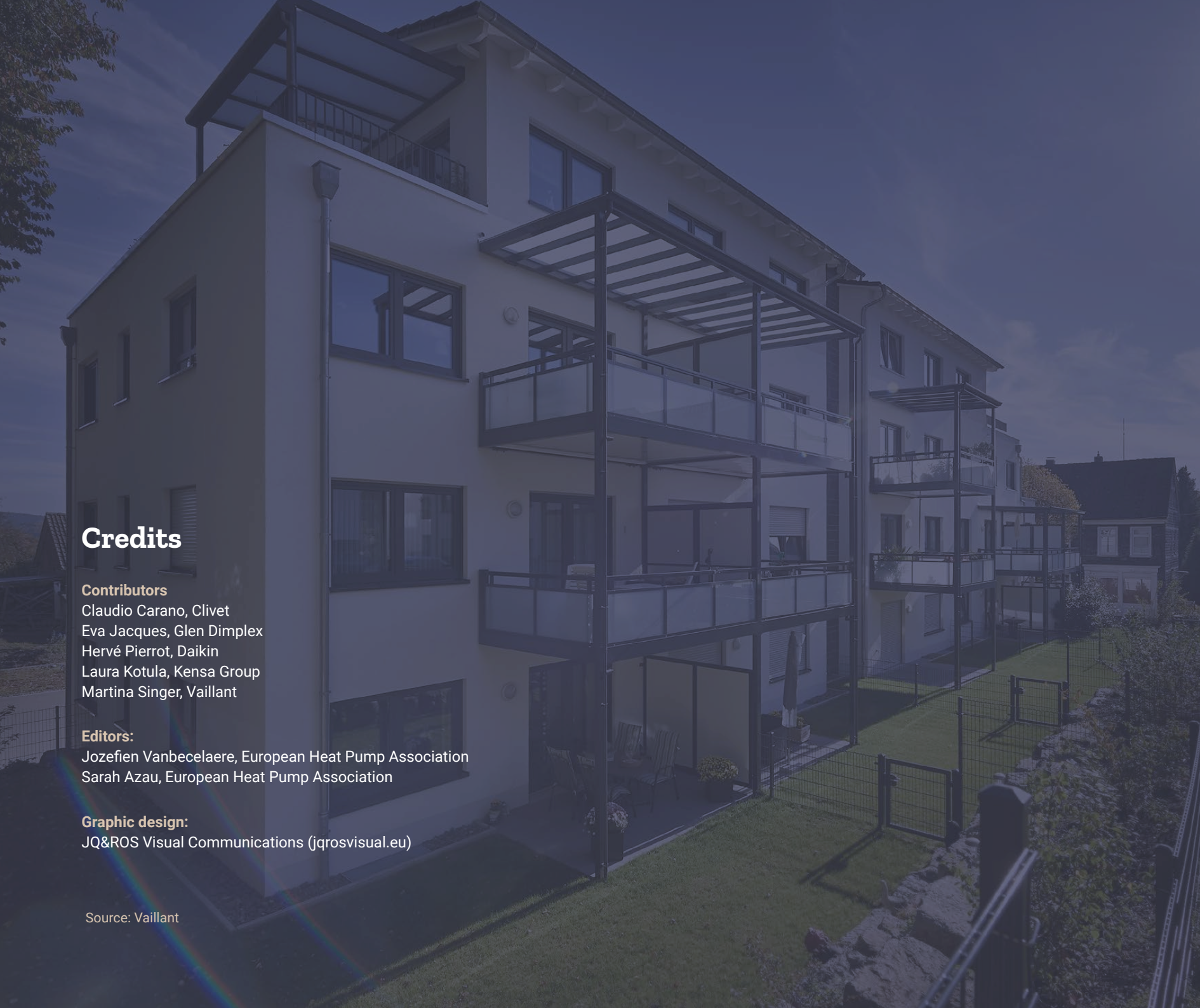

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Table of contents

1.

Introduction

Marek Miara
Coordinator Heat Pumps,
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The perception of heat pumps by policy- and lawmakers has changed significantly. They are now overwhelmingly in favour of heat pumps as a solution for the decarbonisation of heating in the housing sector. Strategies to reach climate neutrality point to heat pumps as to the key solution. This means heat pumps have a key role to play in reaching the EU's net zero by 2050 target, as well as boosting European energy independence.

Multi-family buildings come in all shapes and sizes – much more than single-family buildings. This results in more numerous and complex solutions which may be implemented to cover heating demand and domestic hot water needs. Consequently, choosing the most appropriate solution is a much more difficult task. The case studies presented in this booklet show the variety of buildings and of the available solutions.

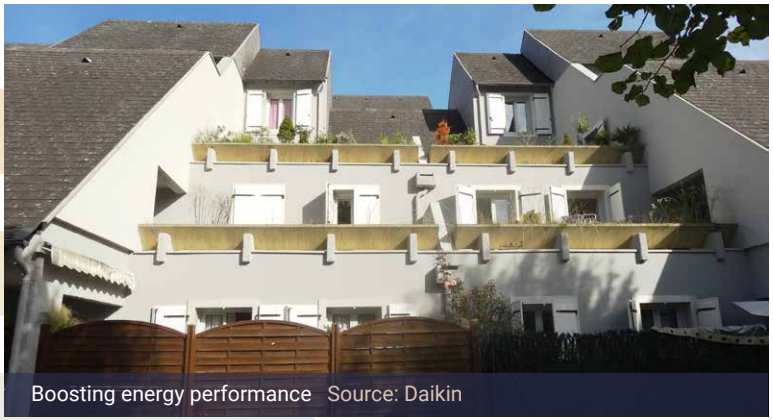
At the outset, the most important fact is that it is possible. Heat pumps are and can be implemented in multi-family buildings. This is the case for new or retrofitted buildings, and even for buildings where no energy savings measures have been taken. No doubt, it´s always better to cut the heating needs of the building, but it is not always possible in the short term. Sometimes even small changes to the heat distribution system (for example partially swapping out old radiators) can significantly improve the future efficiency of a heat pump system.

Room with a view – Ostend, Belgium Source: Vaillant

Tackling fuel poverty Source: Kensa Group

A pre-wired solution for safe and speedy heating Source: Dimplex

A sea-centred project Source: Clivet



Boosting energy performance Source: Daikin

Room with a view Source: Vaillant

Despite the positive trend overall, there are still several obstacles to overcome in order to fully implement heat pumps in multi-family buildings, particularly in existing and non-retrofitted ones. These obstacles are both technical and non-technical in nature. On the technical side, it can be difficult to provide the required heating capacity and supplied temperature, or access the source of heat. Investment costs and a complex ownership structure in some apartment buildings are an example of non-technical obstacles.

The solutions presented in this report show the variety of the possible applications of heat pumps in multi-family buildings. Various heat sources, several hydronic systems, different level of centralisation, hybrid solutions or heat pump only variants, as well as a variation in covering domestic hot water. All these differences stress the need to find the right solution for each building, as well as the range solutions already out there.

To allow a wider implementation of heat pumps in multi-family buildings there is a need for more standardisation. Owners of such buildings, as well as the housing industry, need robust, tested and well-established solutions to be able to react quickly to the change from fossil fuel technologies towards heat pumps and to reduce the investments costs.

I am convinced that the examples presented in the booklet will be an encouraging inspiration for a number of decision makers and will contribute towards a broader application of heat pumps, while helping us at the same time to reach the necessary climate targets. ■

2.

Policy recommendations

This report shows that heat pumps can help all sorts of homes and buildings – as well as industries – swap fossil fuels for a clean, sustainable solution which boosts energy independence.

In terms of apartment buildings specifically, it is crucial to improve awareness that heat pumps work for all application and building types, including high rises. National and local authorities should ensure they communicate clearly to building owners, housing associations, developers and and inhabitants.

It is also essential that the EU policy framework – the rules and regulations which impact heating and cooling choices – contains the right elements to support heat pumps.

The EU has a plan for getting off fossil fuels, REPowerEU. This plan proposes increasing the EU's headline 2030 target for renewables from 40% to 45%. To reach this, it focuses on faster permitting procedures and doubling the rate of deployment of heat pumps by 2026. It also refers to measures to integrate geothermal and solar thermal energy in modernised districts and communal heating systems. REPowerEU emphasises the need to accelerate the heat pump roll-out through dedicated financing and fiscal incentives, and by ending subsidies for fossil fuel boilers and targeting these to heat pumps.

The European Heat Pump Association (EHPA) supports the ambition shown in REPowerEU.

To ensure heat pump deployment grows and the REPowerEU targets are met, EHPA calls for long-term ambition on heat pumps to be spelled out by decision-makers. This should be reinforced through consistent policies.

It's also essential to boost skills and training, as well as R&D.

Another key request is to make clean heating the financially most attractive choice. As long as clean heating is more expensive than fossil fuel heating, heat pump subsidies have to be continued with a long-term vision.

These asks are brought together under the 'accelerator' initiative that EHPA is currently developing with others, and which will be shared with the European Commission as input to its upcoming heat pump action plan, due by the end of 2023. ■

Hot water heat pumps in an intelligent system Source: Glen Dimplex

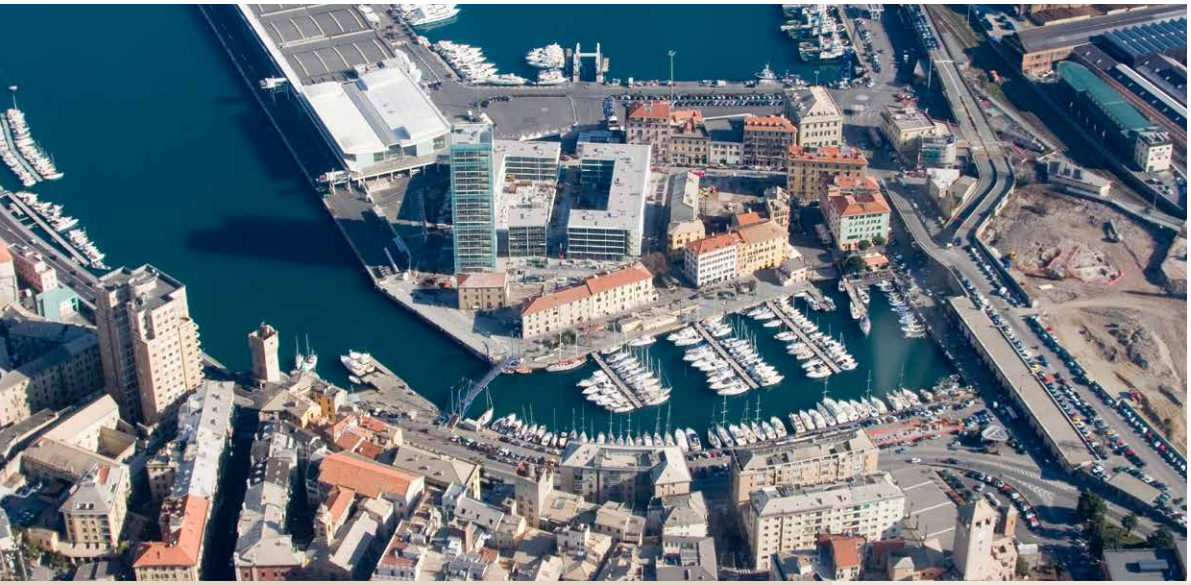
3.

Case studies from across Europe

A sea-centred project

Savona, Italy

Photos: Clivet



Heating system

Clivet water to water heat pumps for the hotel, including domestic hot water; Clivet ELFOEnergy water to water heat pumps for the commercial and residential; ELFOFresh ventilation units and air handling units for the hotel shared areas; Clivet hydronic terminal units; ELFOControl devices for individual system management.

Capacity: 7,400 kW

Temperature: 35-55°C

No. apartments: 103, plus a hotel with 96 rooms and a conference centre, 20 offices, 31 shops

COP: Up to 6.4

Refrigerant: R410A

More info: https://www.clivet.com/documents/10125/b4efa6b4-8a66-44db-9042-f68273c445f5

In Savona in north-west Italy, the Spanish architect Ricardo Bofill was commissioned to design a new residential and commercial district. The idea was to revamp the dock area of the town and give it a new lease of life, as planned by investors and local authorities.

The space, known as the 'Complesso della Torre', was to include a 19 storey apartment block, a courtyard and a commercial space with a hotel, 31 shop units and 20 office units.

Inspired by the complex's portside location, Bofill designed the two buildings to reflect the town's historic links to the sea.

The sea's presence in the new complex would be more than simply symbolic. It would also have a crucial technical role: providing the energy for the air conditioning and domestic hot water of the entire project via a heat pump system.

This could work because sea water has a fairly consistent temperature – from 14°C in winter to 24°C in summer – and because the complex is situated right by the sea.

Sea water is drawn up through a concrete duct, protected by an intake grill and a shut-off damper, into a 60 m³ settling tank, which isolates dust from the water and stabilises the water level. It then flows to strainers and three exchangers made from titanium steel, which resists salt water corrosion. Water is then returned to the sea with a difference in temperature which is kept to 3°C in order to respect marine life.

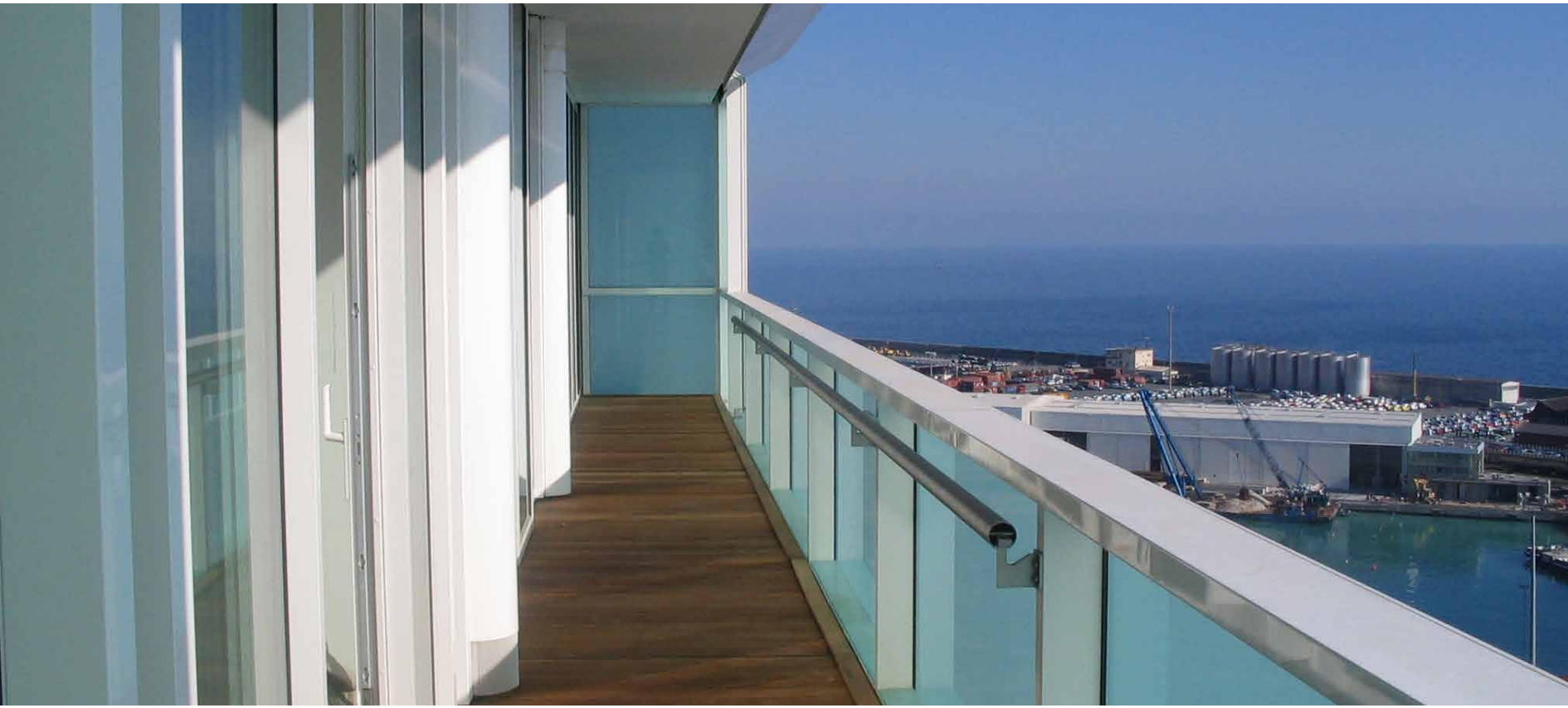
The load side of the heat exchangers is the water loop, with a reverse return design, that feeds the water-to-water heat pumps.

In the case of the hotel, there are two central heat pumps, 400 kW each, for cold and hot water and domestic hot water at 55°C. These are connected to 190 fancoils or ducted terminal units. Ventilation is provided by four air-to-air stand-alone heat pumps complete with thermodynamic heat recovery and four additional air handling units.

Flats, offices and shops are served by 150 local water-to-water heat pumps, connected to more than 680 duct type terminal units.

This way, each flat and shopping unit is independent on heating and cooling operation, with direct energy accounting on its own electricity meter. This is especially valuable since the buildings' glass façades meant different spaces have different heating and cooling needs throughout the day and night.

Another advantage of using the ocean-thermal heat pump system was that it takes up less space than gas boilers and pipes. What's more, the system saves around 70% on the costs of gas heating over a year – coming to around €2.5 million saved over the 15 year life cycle, including both energy and maintenance burdens. Finally, the environmental benefits are significant: the system produces zero direct CO_2 emissions and almost halves those indirect. ■



Heat pumps in harmony with nature

Bornem, Belgium

Photos: Clivet

Heating system

3 ELFOEnergy Ground Medium² WSH XEE2 40.2 geothermal heat pumps with water-circuit change over.

Capacity: 420 kW

Temperature: 35°C

No. apartments: 58

COP: 4.5

Refrigerant: R410A

More info: https://www.clivet.com/en/barl-lo-project

In northern Belgium, between Brussels and Antwerp, lies the commune of Bornem. In 2021, a new block of apartments was built there, in the middle of a leafy green park.

The 'Barl'lo' complex consists of three sustainable four-storey blocks with flats of various sizes covering a total of 8,400 m², designed by architectural firm Binst Architects.

To meet Belgium's requirements on new buildings, three central geothermal heat pumps were installed, connected 150 metres underground and equipped with a water changeover.

To maximise the efficiency of the system, the water temperature for underfloor heating is set at 35°C.

Domestic hot water is produced separately in each flat with water-to-water heat pumps using the Clivet heat pump as the source.

Thanks to his system, the complex has achieved one of Flanders' highest ecological standards, the BEN standard, meaning the building is almost energy neutral and the energy it still uses is green.

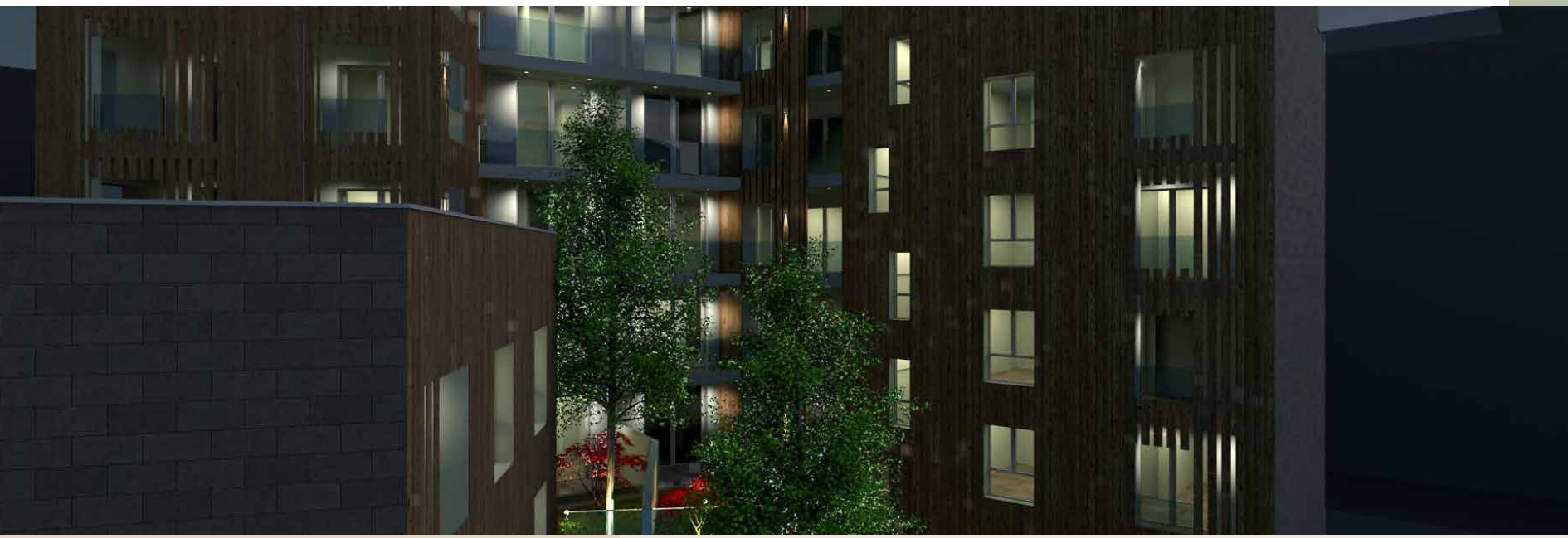
The complex is therefore sustainable in terms of both the landscape, with its green roofs and biodiversity gardens, and the environment. ■

"The three blocks of flats are equipped with geothermal heat pumps, underfloor heating and high thermal insulation. The heat pumps provide heating in winter and cooling in summer by exploiting groundwater. Thanks to the Natural Cooling function, groundwater is used in summer to fully fit with cooling needs without activating the refrigeration circuit." - **Guido Hendrickx,** business development manager at Clivet distributor Thercon Belgium.

Comfort and sustainability align

Milan, Italy

Photos: Clivet



Heating system

SPHERA Clivet recessed split-type high efficiency inverter heat pump, ELFOFresh air purifier (large apartments); ELFOPack units that heat, condition, produce domestic hot water, renew and purify the air (smaller apartments).

Capacity: 120 kW

Temperature: 35°C

No. Apartments: 21

Refrigerant: R410A

More info: https://www.clivet.com/en/casaverdenoce

It takes careful planning to come up with a truly environmentally sustainable building. The aim with the CasaVerdeNoce building in Milan was to use sustainable and easily recyclable materials. The idea was to guarantee efficiency, low environmental impact and high living comfort but low management.

While the municipality of Milan prescribes central solutions in multi-family buildings, here an independent solution per apartment was chosen, to provide heating, cooling and domestic hot water production at higher energy efficiency. Furthermore, all apartments have photovoltaic electricity.

In terms of heating and cooling, all larger apartments are equipped with a full inverter air-to-water heat pump, split-type with recessed indoor unit. This provides heating and cooling to the underfloor system, with additional domestic hot water.

The ventilation system for air renewal and purification, humidity control and thermodynamic energy recovery eliminates more than 95% of fumes, dust, viruses, bacteria and polluting particles.

Smaller flats each have a compact multi-functional air-to-air heat pump providing heating, cooling and domestic hot water, as well as renewing and purifying the air. The units use mechanical ventilation ducts for heating and air conditioning, to simplify the system. There are electronic filters which purify the outside air with an efficiency greater than 99.9% and which provide an active thermodynamic recovery of the energy contained in the exhaust air.

The system can be managed remotely from a tablet to customize the settings.

As a result, CasaVerdeNoce has zero local CO_2 emissions and an energy class of A3/A4, on top of the local energy saving scale. ■

Boosting energy performance

Lourdes, France

Photos: Daikin

Heating system

Daikin Altherma 3 low temperature single phase R-32 heat pumps.

Capacity: Phase 1 60 HP 4-6 kW (260 kW); phase 2 72 HP 4-6 kW (316 kW)

Temperature: 55°C for the water leaving the heat pump

No. apartments: 197 flats

Refrigerant: R-32

In Lourdes, south-west France, the owners of a social housing complex decided to embark on a huge renovation project. Their aim was to reduce the building's energy consumption and tenants' energy bills.

The complex is divided into several buildings, containing 197 apartments in total, situated on the side of a hill. The poorly insulated buildings, which had electric heaters and hot water tanks, had an energy rating of F. The aim of the renovations was to get this up to C, and drastically reduce greenhouse gas emissions.

The project entailed adding insulation, changing the windows, and replacing the heating system in each apartment.

For the heating, the owner opted for the installation of air-to-water heat pumps. This was because there was no gas connection nearby, and it would have been expensive to transport it to the top of the hill, but also because of the desire to move towards a more sustainable solution.

To reach their energy performance goals, the owner went for a heat pump running on R-32, a refrigerant with low global warming potential.

Due to the importance of this project and the fact that the work was being carried out in an occupied site, the renovation work was divided into three phases. The units installed were.

Daikin Altherma 3 low temperature single phase R-32 heat pumps and wall units in two different sizes.

The Daikin Altherma heat pumps only provide heating. Hot water is provided via an independent domestic hot water tank in each apartment.

The outdoor units are connected to a hydraulic module installed in the kitchen of the apartments and to new low temperature radiators.

Almost all the apartments have balconies (98%). It was therefore easy to install the outdoor units there. Some of these units were concealed behind acoustic boxes, also supplied by Daikin.

As the housing units were initially equipped with electric radiators, the installers had to create all the relevant piping and connections for each apartment.

The project is set to be finished in 2023. ■

Easy installation for faster finish

Weiden in der Oberpfalz, Germany

Photos: Daikin

Heating system

Factory sampled 4x Daikin Altherma 3 H HT cascade.

Cost: €105,000

Subsidies: 25% (up to 35% if renovation)

Capacity: 50.68 kW

Temperature: 42°C

No. apartments: 30

COP: 3.05

Refrigerant: R-32

The finalisation of a newly built block of 30 apartments in Weiden in der Oberpfalz, in south-eastern Germany was able to be sped up thanks to an energy module pre-installed by Daikin.

With those modules, which combine Daikin Altherma high temperature heat pumps and domestic hot water tanks, only minor work is required by installers on site.

A single module has a maximum heating capacity of 26-102 kW and is suitable for up to 40 residential units. In this example, the heating load of the 30 apartment building is 37.3 kW.

One of the biggest advantages of such modules is their ease and rapidity of installation, making them especially advantageous in times when trained installers are in short supply. The complete module was connected at 09:34 AM, lifted to position at 09:39 AM and finally put on the foundation at 09:42 AM. So, the whole thing only took ten minutes!

Hot water is provided for 80 people through a separate central water station.

Each module is completely enclosed to protect against external access. The exterior design is customisable to match the colours, materials, and roof shape of the building. This renewable solution saves space in the building, and when it comes to end of life, replacement of the unit is very easy and does not require interior works.

Each Daikin energy module includes hydraulic and electrical interior fittings, antifreeze valves for each heat pump and there is the option of a heating and circulation pump and additional sound insulation measures.

The process of installation of a module is simple: firstly, the module is prefabricated, then there is some preliminary work on-site such as getting the right authorisations from local authorities; noise expert opinion; information to an energy supplier; building a foundation for the energy module and laying the necessary connection lines sch as a connection duct between the energy module and the building foundation. Then, the energy module is installed and connected.

There is also the option of a Daikin Care package, which includes initial installation by Daikin service technician; annual maintenance; a warranty extension of up to 10 years; troubleshooting by a Daikin service technician in the event of a malfunction and remote monitoring and maintenance of Daikin devices. ■

A specialised system with hidden heat pumps

Sartrouville, France

Photos: Intuis

Heating system

Air source intuis global system Heat Pump ZéPAC + HRC and 3000L tank for sanitary hot water.

Capacity: 80 kW x 3 = 240 kW

Temperature: Space heating up to 55°C and water heating up to 65°C

No. apartments: 63 units

COP: Approximately 3.5

Refrigerant: R290

More info: https://www.youtube.com/watch?v=73E609SsBw8

For a new block of 63 apartments in Sartrouville, just outside Paris, developer Nexity was looking for a heat pump alternative to gas.

It was important that the heat pump units, to be installed on the roof, were low enough so as not to be visible from outside the building. Another key requirement was that high-temperature hydraulic radiators could be used, to avoid the additional costs of a traditional gas installation.

Group intuis (part of Glen Dimplex) provided a solution which was able to meet all of these requirements: an air source and centralised heat pump system.

The size of the system was determined using specialised software. A central heat pump system, integrated into the building, was selected. This has three monobloc units on the roof and a controller in the basement. Once the technical details had been approved, installation of the outdoor units, which had been specially adapted to fit discreetly on the roof, started in September 2021. This was followed by the installation of the indoor unit in the basement in February 2022.

One of the main strengths of this system is the indoor control unit which can be used to manage the heating and hot water requirements together, and so avoids oversizing the installation. The domestic hot water and heating coupling is managed smartly, so that domestic hot water needs are prioritised before the system switches to space heating. There is an equal distribution of effort between the outdoor units. Operation is 100% thermodynamic down to -20°C, meaning there is no need for gas or direct electric back up. The very low noise level – at around 62 dB(A)decibels - was also an extremely important factor in the customer's decision-making process.

This centralised heat pump solution is highly efficient and economical to run. It copes well with minus temperatures and offers the benefits of a high-temperature system, meaning that it can be used for new build and retrofit application, with a range of emitters. It also means it manages water temperature effectively to protect against water-dwelling bacteria. Additionally, it uses R290, a natural and therefore environmentally friendly refrigerant.

This heat pump solution is 'cascaded', with multiple heat pumps working together, meaning that there is a heat pump back up if required, with an electric boiler available to be used as a last resort.Skilled specifiers oversaw the installation and commissioning to ensure high-quality delivery, and servicing and maintenance are carried out by after-sales teams; given that it is a monobloc solution, no refrigerant inspections are required. ■

"Initially, this was a pilot project for Nexity, but given the success with this development, it became a textbook solution which has been replicated, proving that it is easily scalable and that Nexity are ready for the new RE2020 French Building Codes, and even RE2025 (due to come into force after 2025)" - **Myriam Cilleros,** Marketing Director - Groupe intuis.

Full renovation and new, clean heating

Hemer, Germany

Photos: Glen Dimplex

Heating system

Dimplex LA 40TU.

Installed Capacity: 40 kW

Temperature: 35°C

No. apartments: Nine apartments with up to 110 square metres

Retrofitted: Insulation, underfloor heating and external stairwell

More info: https://dimplex.de/en/node/509

When you're looking for a new flat to rent, the heating costs matter. In Germany's western Sauerland region, non-profit housing association Hemer eG knew this, and made sustainable and affordable heating a priority when renovating a residential building in Hemer.

It decided to put in nine decentralised ventilation heat pumps, one per apartment – covering 616 m² of living space - to be used both for ventilation and for hot water from recovered waste heat. A modern air-to-water heat pump provided central underfloor heating. These replaced the old water heater and gas condensing technology.

> *"The house was built in 1952 and was half empty, That's why we carried out a full refurbishment and rebuilt the staircases."* - **Peter Meyer,** spokesman for the Board of Directors of Hemer eG.

The aim was to protect the climate, increase security of supply and strengthen regional value creation at the same.

> *"The flats, which range in size from 50 to 110 m², have been fully rented again since the first 'groundbreaking' of the project. In addition, the tenants feel very comfortable in their new home, also due to the good indoor climate,"* - **Peter Meyer**.

The advantages of the compact hot water ventilation system made it easy for the installer: no new hot water pipes had to be laid through the entire building; instead, preparation and extraction are each located within one flat. This also greatly reduces energy losses. The short distances also made it unnecessary to install circulation pipes. ■

Hot water heat pumps in an intelligent system

Dublin, Ireland

Photos: Glen Dimplex

Heat pump

Edel hot water heat pump.

Temperature: 60°C water

No. apartments: 382

COP: approximately 3.5

Retrofitted: R290

When so much can be done via a phone app, why not apartment services too? This was a developer's thinking when planning a 382 apartment complex in Dublin, Ireland.

Developer Twinlite wanted to offer tenants an app for all their needs, from signing tenancy agreements, to booking classes at the onsite gym and arranging parcel delivery. They wanted apartment services and utilities to have the same level of connectivity and easy, convenient access as the rest of the building. The other goal was highly efficient, renewable and affordable energy.

To meet these twin aims, Glen Dimplex proposed the Edel hot water heat pump. This would be incorporated into a system featuring direct electric panel heaters, smart electric thermal storage heaters and mechanical ventilation with heat recovery (MVHR).

This solution is ideal for large residential developments as it avoids the overheating often associated with traditional centralised heating systems.

The 200 litre Edel pump, which has an efficiency of over 300%, uses external air delivered through a ducted system to an air source heat pump integrated into a single unit alongside a hot water cylinder.

The heat pump recovers heat from the external air, which is used to raise the temperature of the water in the cylinder to the standard 60°C.

For space heating, Dimplex XLE Smart Storage Heaters and Q-Rads were chosen. The XLE stores heat using cheaper off-peak electricity and uses a smart function to extract the heat when it is required using an inbuilt fan. Q-Rad direct electric panel heaters supplement this function during the day if the demand requires it. To maximise the comfort levels and provide fresh, ambient air in the apartments, the developers wanted mechanical ventilation with heat recovery (MVHR). A Dimplex Control app allows tenants to manage their heat management system in their apartment and control their energy use.

This solution is not only efficient to run, but affordable in terms of upfront costs and easy to install as it can be fitted by electrical and plumbing contractors rather than requiring specialist installers. The connectivity across the system also means faults can be diagnosed and localised remotely. Maintenance is minimal and no annual checks are required for this solution. Additionally, it is aesthetically appealing; the MVHR and Edel heat pump can be installed in a service cupboard and there are no visible pipes or pipe entries.

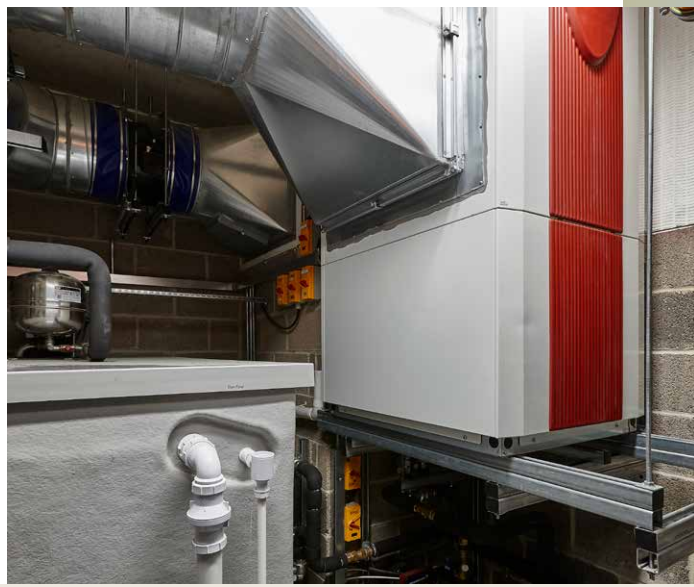
"By incorporating all heating, hot water, ventilation and control requirements into one low carbon energy solution from one supplier, Twinlite gained more control over the planning and installation. We were able to design the solution to fit the specification for the building and deliver a compliant energy system that will benefit the owners, tenants, and environment throughout its lifecycle. This type of solution is suitable for new build but also equally viable for retrofit, especially where installing a full heat pump solution may not be feasible or practical for economic or technical reasons", - **Conor Jackson,** Glen Dimplex Ireland, Business Development Manager - Heating & Ventilation.

The complex was finalised in February 2020. ■

A pre-wired solution for safe and speedy heating

Poole, UK

Photos: Glen Dimplex



Heating system

Zeroth Energy System.

Temperature: 25°C

No. apartments: Nine

Refrigerant: R410A

A former restaurant and bar were to be demolished in Poole, on the UK's south coast. Their replacement? A nine apartment development that would bring a modern urban feel to the town's quayside.

Bespoke housebuilder Acorn Property Group wanted to deliver a project that would help transform the area in a sustainable way. Traditional heating systems did not meet the carbon performance requirements for the building and the restrictions on what could be installed on the exterior limited the options for suitable low carbon alternatives. Thermal & Acoustic Solutions Ltd, specialists in building regulations and compliance, were contracted to work with Acorn, and looked to Glen Dimplex for support.

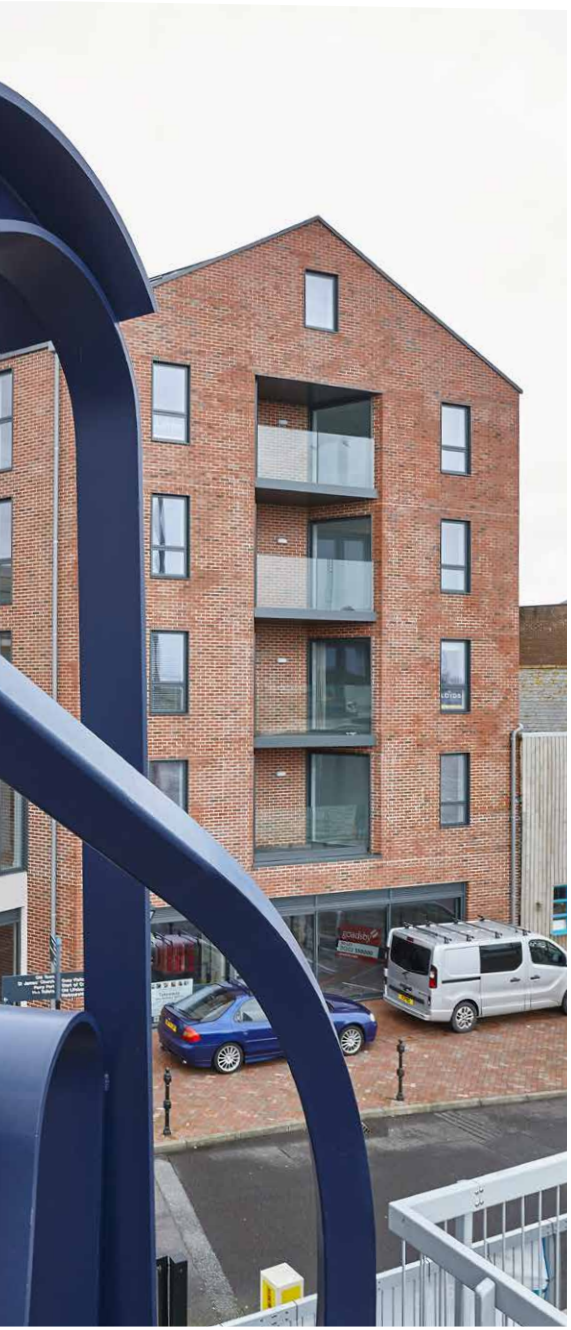
The Zeroth Energy System was designed by Glen Dimplex with key residential developers. The ambient network system of water-to-water heat pumps can provide hot water, heating, and cooling to the apartments whilst minimising heat distribution losses common to traditional heating systems.

The central loop of the Zeroth Energy System is designed to run at 25°C, a significant reduction from the 80°C of a traditional high-temperature system, reducing heat loss by up to 90%. Addressing heat loss through intelligent design significantly improves the energy efficiency of the system.

The final design of the Zeroth Energy System for Harbour Lofts has in-apartment water-to-water heat pumps which take energy from a central ambient loop, supplied by a central plant of internally installed air source heat pumps (ASHP) and buffer tanks to help meet the acoustic and aesthetic requirements of the project. Radiators and underfloor heating provide space heating within each apartment. The high efficiency of the system means less energy is needed to distribute heat throughout the building, as temperature uplift happens locally, at the in-apartment unit. The potential to install air source heat pumps in the plant room has eliminated the need for any externally mounted units on the building.

What's more, the Zeroth Energy System arrives pre-plumbed and pre-wired to ensure speedy installation without the requirement for a specialist contractor, making it an ideal solution for new build and retrofit. It can be operated by users via a range of well-known smart control options.

The Zeroth Energy System offers designers considerable freedom through its capability to incorporate a broad range of options from plant to emitter. Through reductions in the heat loss of a building, the system presents the end-user with lower energy bills and access to low-carbon energy. Service and maintenance are hassle-free; the main focus is the central plant and access to individual apartments is not generally required. ■



Tackling fuel poverty

Blackburn, UK

Photos: Kensa Group

Project type:

Retrofit, replacing gas.

Technology: 6 kW Shoebox GSHPs & SGLA x 84 deep boreholes

Subsidies: RHI

Temperature: Heating and hot water up to 65°C

No. apartments: 183 - three tower blocks

COP: 3.84 (for an individual Kensa Shoebox heat pump)

Refrigerant: R134a

More info: https://www.kensacontracting.com/together-housing-daisyfield/

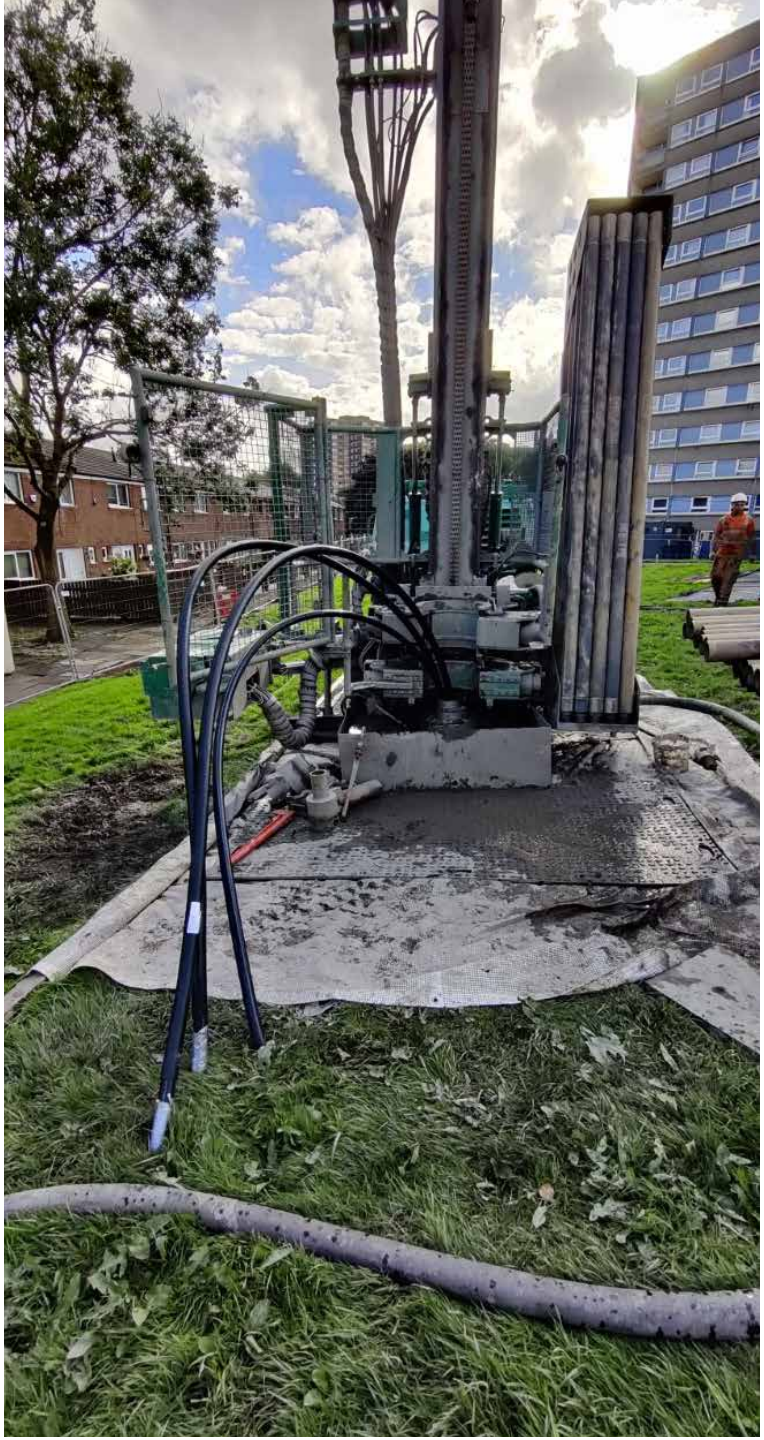
Since 2018, Kensa Contracting and Together Housing have been on a mission to tackle fuel poverty and reduce the carbon footprint of over over 1,500 homes in the social landlord's property portfolio. As part of this programme - the largest of its kind in the UK to date – Kensa has already retrofitted multiple sites in Yorkshire and Lancashire with ground source heat pumps. Residents are reaping the benefits of increased comfort levels and lower heating costs.

As part of this ongoing partnership, Together Housing and Kensa Contracting undertook a major heat pump scheme at Daisyfield Towers – installing ground source into 183 flats across three high-rise tower blocks in Blackburn. The £4.6 million (€5.2 mn) housing upgrade scheme, which will significantly reduce carbon emissions and household heating bills, also proved the space-saving potential of medium-depth boreholes.

Replacing gas and confronting fuel poverty

The Daisyfield Towers were heated by old and obsolete gas boilers, which Together Housing was keen to decommission and replace with efficient and environmentally-friendly Kensa ground source heat pumps. The aim was to maintain the residents' comfort and safety, save money on heating bills, and move away from fossil fuel reliance.

The project is estimated to produce lifetime CO_2 savings of 6,556 tonnes (based on SAP10 carbon factors). This equates to removing 1,416 cars from the road for a whole year, or 278,955 bags of waste being recycled instead of landfilled.



Feedback from the client has been very positive and residents were happy that gas was being removed from their homes.

The installation of Shoebox heat pumps & Shared Ground Loop Arrays

Individual Kensa Shoebox ground source heat pumps were installed inside each property, linked to a radiator system, which was upgraded where necessary. The Shoebox model is compact, quiet, and highly efficient; perfect for flats where space is at a premium, as it can be fitted inside airing cupboards or kitchen cabinets. Generating heat at the point of use, the system produces hot water temperatures up to 65ºC for domestic hot water and is as quiet as an average fridge freezer.

The Kensa Shoebox heat pumps are linked to an array of Shared Ground Loop boreholes drilled underneath the green spaces and car parks adjacent to the tower blocks. Shared Ground Loop Arrays are an innovative and highly effective form of decentralised district heating. The system collects the energy from the underlying rock and distributes it at ambient temperature to the heat pumps, which is upgraded for use in the flats. It also heats communal areas within the tower blocks, and a ground-floor café.

Testing the potential for medium-depth boreholes

In total, 84 boreholes were drilled across the Daisyfield site, totalling 16,146m of boreholes. A combination of favourable ground conditions and borehole configuration offered the opportunity to trial increasing drilling depths to 300m, as part of Kensa's ongoing investigations into the viability of medium-depth boreholes.

Projects are often ruled unsuitable if there is insufficient space to install the required number of standard depth boreholes (between 100m and 200m). Medium-depth boreholes of between 300 and 400m allow more pipe to be installed in the ground for the same amount of ground-level surface area, increasing the amount of energy absorption possible and creating a system that can sustain a higher heat load.

Kensa's successful trials in this area could increase the percentage of both new-build and retrofit developments that are viable for ground source.■

Kensa Group

Tripling energy savings

Thurrock, UK

Photos: Kensa Group

Project type:

Retrofit, replacing storage heaters.

Technology: Shoebox ground source heat pumps and Shared Ground Loop Array

Subsidies: SHDF

Temperature: Heating and hot water up to 65°C

No. apartments: 273 - three tower blocks

COP: 3.84 (for an individual Kensa Shoebox heat pump)

Refrigerant: R134a

More info: https://www.kensaheatpumps.com/news-blog/flagship-renewable-heating-upgrade-project-breaks-ground-in-essex/

In a ground-breaking project with the local authority of Thurrock in eastern England, three high-rise tower blocks had their storage heaters replaced with Kensa ground source heat pumps that are three times more energy-efficient and set to reduce fuel bills by over 50% for some Thurrock residents

The project, delivered by Kensa Contracting demonstrates the potential for ground source heat pumps on Shared Ground Loop Arrays to rapidly and affordably decarbonise properties with multiple dwellings at scale.

273 storage heaters across three tower blocks in Chadwell St Mary's, Thurrock will be replaced with Kensa ground source heat pumps inside each flat.

Over 34% of all emissions in the UK are attributed to the provision of heat. The installation of the low-carbon heating systems at Chadwell St Mary's is expected to provide a 70%+ reduction in carbon emissions. Over the life cycle of this installation, the total emissions saving of the heat pumps is projected to be 7,080 tonnes of CO_2 based on SAP10 carbon factors. This is the equivalent of taking 1,540 cars off the road for a whole year, significantly improving local air quality and reducing the carbon footprint of the residences.

The project is set to secure 40-50% savings on residents' annual energy bills, a significant benefit considering over half of the recipients have been identified as currently at risk of experiencing fuel poverty.

"This trailblazing heating solution is the first of its kind for Thurrock Council. The old storage radiators and hot water systems in each of the 273 flats have been replaced with a significantly better, cost-effective and greener solution."
- **Cllr Luke Spillman,** Cabinet Member for Housing.

"This is great news for our residents – it will help us better support our residents and tackle fuel poverty by driving down fuel bills and keeping our homes warmer and greener."

Dr Stuart Gadsden, Commercial Director of Kensa Contracting, said:

"Ambitious, large-scale projects like this one undertaken by Thurrock Council are key to meeting the UK government's targets of 600,000 heat pump installs per year by 2028. More than 80% of UK homes will still be in use in 2050, so it is clear that existing buildings will have to undergo significant improvements/ deep retrofitting to meet the challenge of decarbonisation.

"Ground source heat pumps on Shared Ground Loop Arrays are proven to provide the lowest carbon, lowest running costs and lowest whole-life cost solution, especially for heating high-rise developments. These systems help housing providers lower their environmental impact and future-proof their assets, whilst protecting their tenants from fuel poverty." ■


MuoviTech

Kensa Group

Retrofitting a tower block with minimal disruption

Enfield, UK

Photos: Kensa Group

Project type:

Retrofit, replacing electric underfloor heating.

Technology: Kensa 6 kW Shoebox GSHP & SGLA

Subsidies: RHI

Temperature: Heating and hot water up to 65°C

No. apartments: 400–8 tower blocks

COP: 3.84 (for an individual Shoebox heat pump)

Refrigerant: R134a

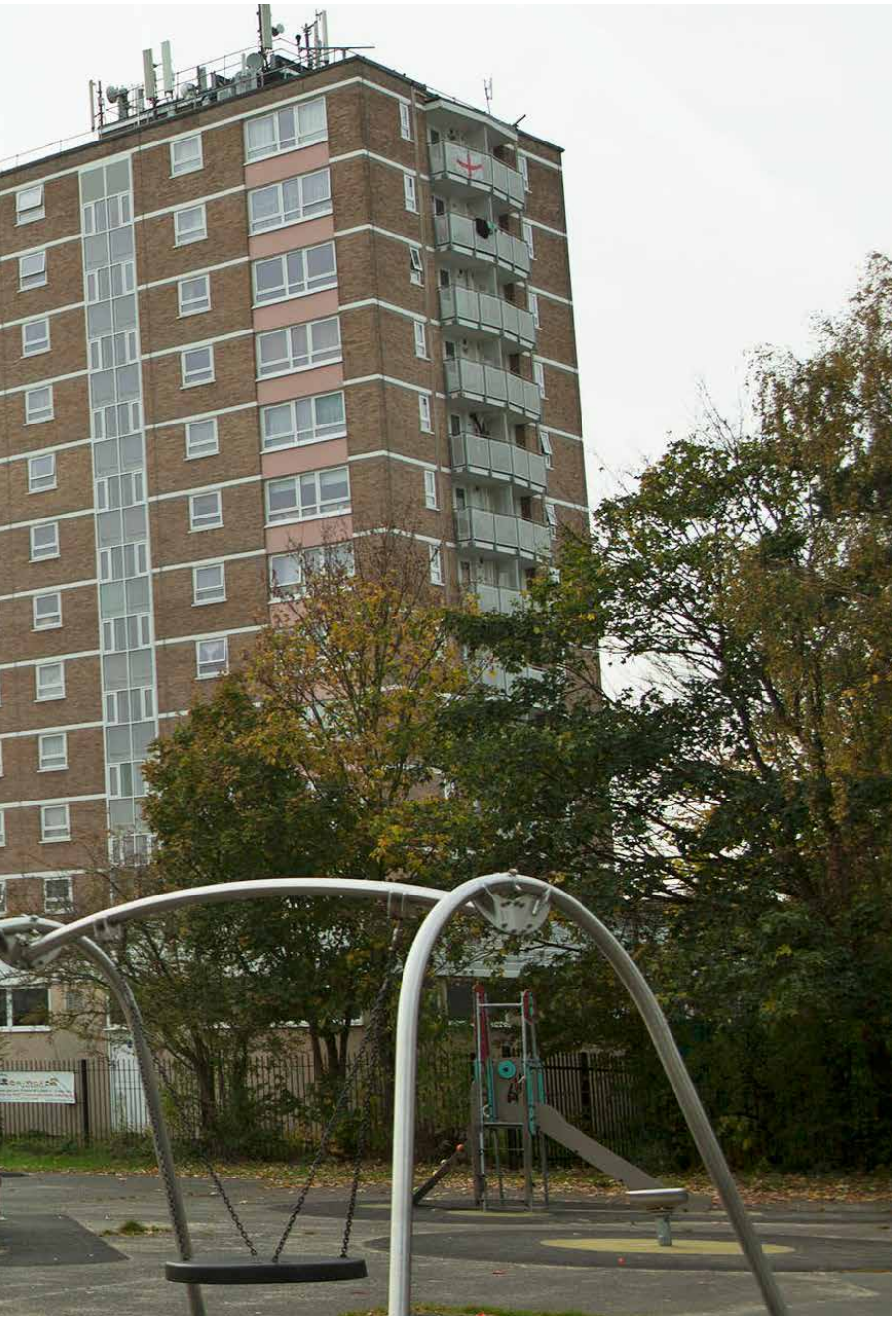
More info: www.kensacontracting.com/case-studies-enfield/

In a busy part of Greater London, eight tower blocks, containing 400 flats in total, had their electric underfloor heating systems replaced with ground source heat pumps. Heat pumps were installed by Kensa Contracting with ENGIE for Enfield Council. The heat pump system was England's largest of its kind, and pioneered the installation of the technology in tower blocks.

In practical terms, 20,700 metres of boreholes were drilled in eight months and over 50,000 metres of pipework were installed in the ground – providing around two thirds of the heat from the ground for all these flats for at least the next 100 years.

The work was completed in under a year and all tenants remained in their flats for the duration of the project. The award-winning heating upgrade, which replaced electric underfloor heating, has resulted in residents' energy bills reducing by 30-50%.

It means tenants are now fully in control of their own heating and hot water and that maintenance costs significantly reduced for Enfield Council. In terms of sustainability, around 773 tonnes of carbon emissions are saved per year thanks to this upgrade.



The properties at Enfield are classified as general needs accommodation and Kensa Contracting had to work with a range of residents including the elderly, families with young children, and those with mental health issues. All of these groups of residents have their own set of challenges. Kensa has learnt that a robust tenant liaison process in partnership with the landlord allows for individual resident needs to be handled well.

The heavily built-up areas of Greater London in which the blocks are situated meant Kensa had to develop rigorous traffic management and delivery plans. This lowered the impact of the works on surrounding areas to a manageable level whilst ensuring emergency services had access to all buildings at all times.

The projects involved a large number of workmen on site, covering all aspects of the job i.e. drilling, trenching, header pipework installation, riser installation and internal installations. It was run to a very tight schedule and consequently Kensa appointed sufficient on-site management resource to ensure these deadlines were met.

The Shared Ground Loop Array at Enfield features 16 shared ground loop systems serving the eight tower blocks. Each system typically consists of clusters of seven boreholes serving individual heat pumps installed within the flats of half a tower block.

Renovation with mini heat pumps

Innsbruck, Austria

Photos: ALPENLÄNDISCHE, Florian Scherl

Heating system

3 kW.

No. apartments: 48

COP: 4

Refrigerant: R410A

More info: Systemlösungen für die Wohnungswirtschaft I Die richtige Wahl für Neubau und Sanierung (vaillant.at)

In summer of 2022, the general refurbishment of an apartment building in Innsbruck in the Austrian Alps began. The developers were Alpenländische Gemeinnütziger Wohnbau, who wanted to renovate 48 residential units on four floors.

The main aim was to achieve achieve sustainability through energy efficiency in buildings. This was to reduce energy costs, but also to reduce climate impact. For the first time, geoTHERM 3 kW “mini” heat pumps from Vaillant were used as a high-performance compact solution for the refurbishment of homes. This is a potential technological milestone in the retrofitting of old buildings in the future.

In the 48 apartments, a switch was made from individual boilers to a heat pump-boiler combination for hot water and heating as part of the thermal refurbishment.

The mini heat pumps meet all the criteria requested by the planners: a decentralised solution with high heat output and comparatively low energy requirements. This not only saves CO_2, but also keeps operating costs low in the future and makes their billing particularly simple.

The compact design of the mini heat pump also became an important factor in the renovation project. Each residential unit had different spatial requirements, and the installation of the new hot water and heating appliances was carried out individually.

"Heat pumps are in high demand - especially among private homeowners. But because tenants and owners of apartment buildings are increasingly looking for ways to switch to renewable energy, our mini heat pump as a compact, decentralised hot water heating solution is a really interesting alternative for the future. The Fennerstrasse project will show just how much potential there is in the technology, which could serve as an important blueprint for renovating old buildings in the future," - **Josef Kurzmann,** Sales manager project busines, Vaillant.


Alpenländische
Alpenländische

"For this purpose, a large heat pump on the roof runs the collected energy with a flow temperature of only 20°C Celsius through the stairwells in a circulation system. In this way, the geoTHERM mini heat pumps installed in each apartment only have to increase the heat by a few degrees," - **Wolfgang Schösser,** building services engineer.

By comparison, if the Fennerstrasse building were to rely on district heating supplied via the basement, the supply temperature would be 80°C and there would be high circulation losses.

The Vaillant mini heat pump system is designed for maximum heat demand and can be installed directly in individual apartments - even if they are equipped with radiators. This makes the system ideal for a multi-apartment building with very low heating requirements and normal hot water needs. The wall-mounted unit hardly differs from a gas boiler in size and appearance and is particularly quiet, at only 38 decibels in heating mode.

Together with a space-saving hot water storage tank, the geoTHERM mini also ensures a high level of hot water comfort.

All those involved in the project agree that the mini-heat pump technology will provide valuable services in renovation projects in the future. ■

Room with a view

Ostend, Belgium

Photos: Vaillant

Heating system

Five wall-mounted gas condensing boilers ecoTEC plus VC 1206; eight air-to-water heat pumps areTHERM plus monobloc VWL 125/6A S2; buffer tanks allSTOR plus.

Cost: +/- €130,000

Subsidies: 0€

Capacity: 600 kW with gas condensing boiler and 96 kW with air/water monobloc heat pumps

No. apartments: 118

COP: 5.4

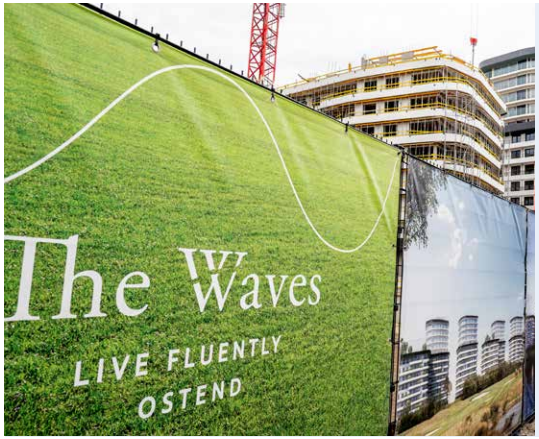
Refrigerant: R290

More info: **Dutch:** https://www.vaillant.be/consumenten/ons-advies/getuigenissen/the-waves/
French: https://www.vaillant.be/particuliers/nos-conseils/temoignages/the-waves/

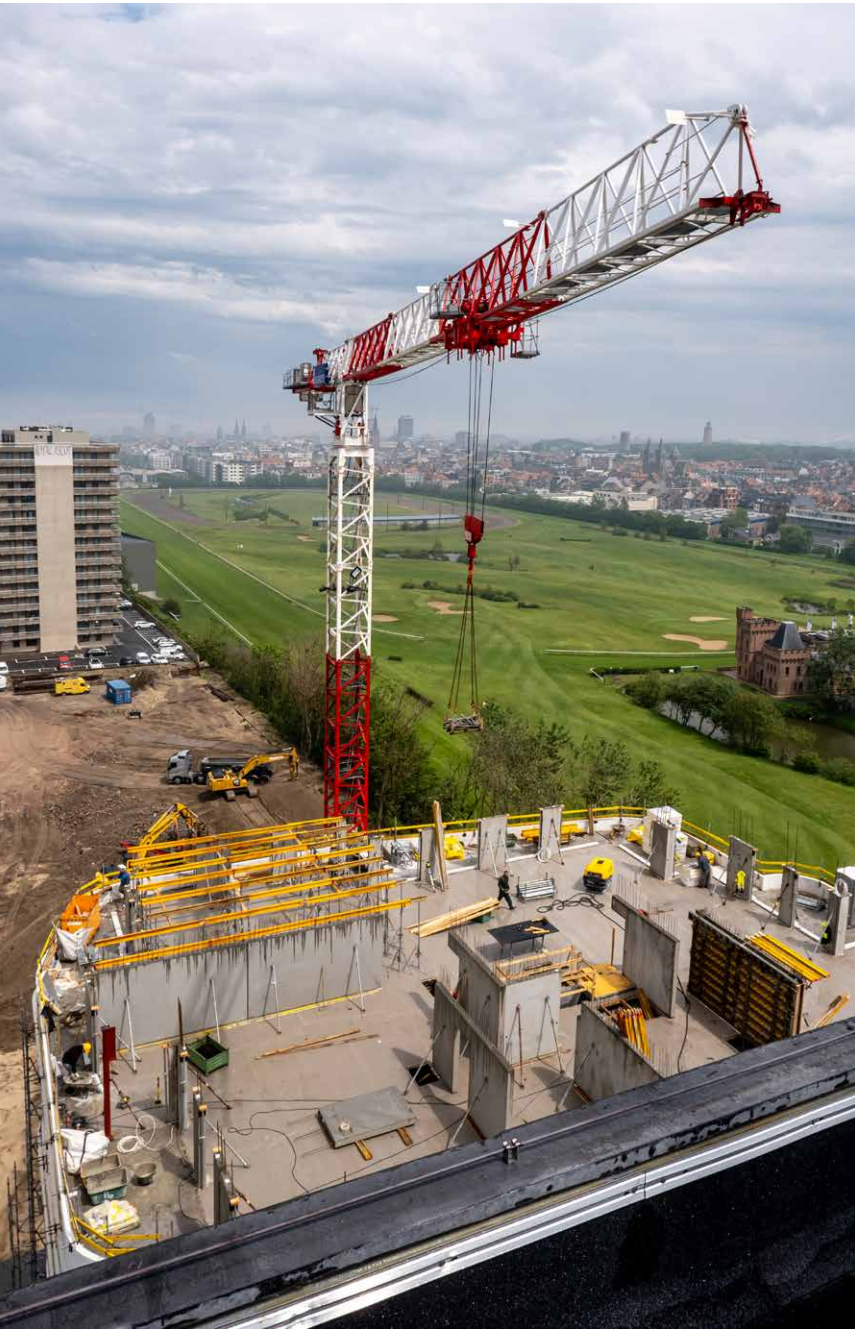
In the centre of Ostend, on Belgium's coast, a new building project is underway. The Waves complex will be made up of four buildings, the first of which, 'Sea', is nearly complete. In a special room on top of the 14 storey block is a hybrid air-gas heat source, which will provide heating and sanitary hot water for the 118 flats and commercial spaces below.

The room contains five Vaillant ecoTEC gas condensation boilers, an exhaust duct and two allSTOR plus reservoirs, of 1,500 and 2,000 litres.

The large reservoir is connected to eight air-water aroTHERM plus heat pumps which sit on the roof, outside the building, will the smaller one is connected to the town's heating network. This will allow it to use the waste heat from Ostend's incinerator and industries.



"The installation went smoothly, despite the height [...]. We put the buffer tanks without insulation in the boiler room. They were then installed on the roof. The Vaillant heat pumps and boilers are light and compact: we placed them on the roof with a crane and then moved them manually to the ideal location. The modular composition of the Vaillant infrastructure made it very easy for us to manage and set up everything." - **Dennis Vanlandeghem**, project manager from installer company Vermote.



Each resident controls the temperature of his or her flat with a thermostat, while a heat meter records consumption.

The project may seem simple, but it requires an ingenious, efficient and perfectly sized installation. During a test visit to several flats, the hot water from the tap immediately reaches the desired temperature.

> *"The system constantly injects a minimum amount of hot water to each floor of the building. This means that when you turn on the tap, you get hot water almost instantly,"* - **Dennis Vanlandeghem**.

In addition, the heat output of the heat source was calculated according to the needs of the fully occupied building.

In this way, substantial savings can be made on the total installed power for the production of hot water, and residents are relieved of all worries and enjoy maximum comfort," emphasises Leandro Depaepe, Account Manager for North West Flanders at Vaillant. "In addition, they save space in their often cramped storerooms, because they do not have to install a gas condensing boiler. Finally, not having to install a flue for each flat also saves space for the project.

Buffer tanks play an essential role in ensuring that heat pumps and gas boilers work together. The air-to-water heat pumps work at a lower temperature. The return water from the combined loop first passes through the heat pumps' buffer tank. It then flows into the small buffer tank connected to the Vaillant ecoTEC plus wall-mounted gas condensing boilers, where it is heated further if necessary. Vaillant has calculated the size of the buffer tanks to ensure sufficiently long operating times for the heat pumps and boilers.

In addition, Vaillant has a fully modular control system that can be expanded as required. All this ensures that the different energy sources (gas boilers, heat pumps) work together smoothly. ■


Vaillant

Energy efficiency and maximum comfort

Madrid, Spain

Photos: Vaillant

Heating system

Cost: Drilling: €480,000
Technical room: €450,000
Underfloor heating & fancoils: €400,000

Subsidies: 0€

Capacity: 500 kW

No. apartments: 89 flats

COP: 4.7

Refrigerant: R407c

More info: https://www.vaillant.es/arquitectos-prescriptores/proyectos-de-referencia/geotermia-en-cascada-en-villaverde-via-celere/

When the 89 apartment project in the Spanish capital got the green light, the starting point was the need for a highly energy-efficient air conditioning system that would provide maximum comfort.

This led to the choice of a geothermal system with low levels of total energy. Vaillant's extensive experience in this technology meant it could confidently propose highly efficient solutions and high quality, reliable material.

To achieve the desired level of efficiency, geoTHERM VWS 460/3 geothermal generators were proposed (totalling 500 kW in generation), with a four-pipe generation scheme, which means the system can provide cooling and heating simultaneously to different areas of the building on demand.

It was also necessary to install underfloor heating, which is the best way to achieve high levels of comfort and efficiency.

Vaillant completed the system with four energy buffers for storage (one for heat, one for cold and two for domestic hot water), all controlled with a Vaillant management panel.

The cooling buffer storage, with a capacity of 4,000 litres, is sufficient to cover the cooling demands in Madrid, given the low humidity of the area in summer. On the other hand, maximum use is made of the borehole temperatures to cool as much as possible in this way without the need to use the geothermal generators.

The heat buffer storage, with a capacity of 4,000 litres, sufficient to cover the heating loads by fan coils and at a temperature of 35-45°C, which allows a high performance of the generators.

The domestic hot water accumulator, with two tanks of 5000 litres capacity each, was designed to accumulate sanitary water at low temperatures. During the cooling season the domestic hot water load is reduced to practically zero since when there is a cooling demand, the domestic hot water demand is met for free.This is because the domestic hot water storage works as the evaporator of the geothermal system for cooling output. The system is based mainly on transferring heat from one storage tank to another, thus achieving considerable energy savings.

The generation power needed to cover the system demand is distributed in 10 high efficiency Vaillant VWS 460/3 geothermal generators, sized in such a way that they will start and stop depending on the demand and alternating so that each one of them has the same operating hours.

Therefore, even if the hot water demand is covered, 10 generators are available to cover the heating demand.

Having addressed the energy supply for air conditioning the houses, the developers' attention turned to the issue of ventilation. A ventilation system with double-flow air recovery was chosen. An autonomous controlled mechanical ventilation system with heat recovery per dwelling, with air outlet from kitchens and bathrooms and supply to bedrooms and living rooms.

This project is a pioneer in Spain for integrating energy efficiency systems into high-rise residential buildings, achieving consumption levels well below those usually achieved in the standard construction of this type of buildings. While the initial cost is higher than in traditional systems, the low consumption generation system and a solution for heat recovery in ventilation more than make up for it. ■

Green buildings with a geothermal heat pump

Ennepetal, Germany

Photos: Vaillant

Heating system

Brine/Water HP geoTHERM + eloBLOCK (electrical wall hung boiler) + 2.000 liter buffer tank.

Cost: €70,000 (without drilling)

Subsidies: Only subsidy on interest rate of loan

Capacity: 46 kW

Temperature: Flow/Return 35/30°C

No. apartments: 12

COP: 4.4

Refrigerant: R410a

More info: https://www.vaillant.de/heizung/produkte/referenzen/mehrfamilienhauser/12-we-neubau-in-ennepetal/

In Ennepetal, North Rhine-Westphalia in western Germany, a private investor built three apartment buildings to help ease the tough local housing market. What's more, one of the new residential buildings is also being used as a reference project, to see how to achieve energy efficiency in the most economical way. It uses heat pumps.

The three new buildings contain 34 residential units altogether (16, 12 and 6 units respectively). The masonry is made of 24 mm sand-lime bricks with a 12 cm thick thermal insulation composite system and there is triple glazing. However, these measures alone were not sufficient to achieve the energy efficiency target.

"The investor was very much concerned with the issue of urban development in his home town, because 80% of property costs are incurred during the operating phase, the topic of 'energy consumption' then played a decisive role, particularly with regards to the economic viability and ultimate recouping of the investment," - **Janet Kaya,** architect of developers Frey & Frey in Ennepetal.

"The heat pump is convincing: *investors see the advantages of using regenerative energy sources, for example, for the sale of the apartments. When it comes to renting, in turn, not only the initial investment but also the follow-up costs during operation come more to the fore.*" - **Janet Kaya,** architect.

In order to reach that target - the 'KfW Efficiency House 55 standard' - ten possible system configurations were compared.

In this particular case, the planners chose the option based on a geoTHERM brine/water heat pump with an output of 46 kW. An eloBLOCK electric wall heater secures peak loads and drinking water hygiene. A multi-functional storage tank with a capacity of 2,000 litres serves as a heat buffer to ensure sufficient hot water supply. Room heat is distributed via a panel heating system with a flow/return temperature of 35/30°C. All living spaces are also ventilated in a controlled manner.

This approach massively saves operating costs. A further benefit is that everything comes from a single source. Thus, the various system components are perfectly matched to each other - from the heat pump to the supporting electric heating to the identical control system. ■

ehpa
european
heat pump association

The **European Heat Pump Association (EHPA)** represents the European heat pump sector.

EHPA works to shape EU policy that allows heat pumps to become the number one heating and cooling choice by 2030 and a key part of a future decarbonised Europe.

EHPA advocates and communicates to policy-makers and to our members. EHPA organises high level events and is involved in multiple projects.

EHPA coordinates the Heat Pump Keymark – a European certification scheme.

More: ehpa.org

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