RETROFIT CASE STUDY

Retrofit case study: Terraced flat, Queen's Park

April 2023

MORGAN SINDALL PROPERTY SERVICES

ZERO CARBON 2040 Westminster Climate Action

City of Westminster

Contents

About the Retrofit case study

This 'Retrofit' case study outlines how Westminster City Council and Morgan Sindall Property Services retrofitted a one-bedroom terraced flat in Queen's Park. It outlines the approach taken, the measures implemented and the expected benefits.

We used the home to pilot and test energy saving measures that we hadn't used in our social housing before, and to learn how we could roll these measures out to more of our homes. While the measures we implemented here may vary to other homes, the principles remain the same – retrofitting your home delivers significant energy savings while improving home health and comfort.

The case study complements our **'Retrofit how-to guides'** which provide simple practical advice on a range of retrofit measures commonly proposed in Westminster. The guides help householders and developers find effective and sensitive ways to upgrade existing buildings to improve their energy performance, reduce energy costs and cut carbon emissions.

One-bedroom flat in Victorian terrace, Queen's Park

Recently retrofitted throughout with **£40,000** energy-efficiency improvements made over **4 weeks**.

Details | Amenities

Property Type
Victorian terrace

Bedrooms
x1

Tenure
Council home

Year/decade built:
1890

Bathrooms
x1

Living space
50 sqm

Before retrofit | After retrofit

Energy Performance Rating
D EPC rating

Annual energy bills*
£££ £1,400

Home comfort
Cold, draughty

Carbon emissions
CO_2 2.5 tonnes

*At October 2022 energy prices. 'After' figure is based on energy modelling and actual costs will be monitored and reported.

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Recently retrofitted throughout with **£40,000** energy-efficiency improvements made over **4 weeks**.

Before retrofit | **After retrofit**

Energy Performance Rating

B EPC rating

Annual energy bills*

£ Near zero

Home comfort

Warm, comfortable

Carbon emissions

0 tonnes

*At October 2022 energy prices. 'After' figure is based on energy modelling and actual costs will be monitored and reported.

Details | **Amenities**

Queen's Park Primary School
0.2 miles

Westbourne Park station
0.5 miles

Queen's Park Station
0.5 miles

Paddington Recreation Ground
0.6 miles

Part 1

Whole home approach

Whole home approach

We took a 'whole-home' approach to the retrofit. This meant looking at the home and building as a whole and creating a plan that ensured all elements met an appropriate standard. It also enabled us to ensure that upgrades worked well together and that we could achieve high energy savings in the most cost-effective manner.

While we implemented all measures at once, whole home retrofit can be phased as time and budget allows.

A qualified retrofit assessor considered the following elements of the home when developing the whole home retrofit plan:

Building fabric | **Heating system** | **Energy source**

Step 1 – reducing the home's energy demand

What is it?

Measures to reduce heat loss through walls, ceilings, floors, windows and doors.

This includes draught proofing, insulation and improvements to windows and doors.

How effective is it?

Improving building fabric is in most cases the most effective action you can take.

In a typical household, over half of the fuel bill is spent on heating. Reducing heat loss can cut energy bills substantially. In the show home we cut energy demand by over half.

Cost

Varies significantly from simple draughtproofing costing under £1 per metre, to double or triple glazing windows costing £300 to over £1,000 per window.

Issues to consider

- Check our planning **how-to retrofit guides** to determine whether you need planning permission
- Focus on walls, floors and ceilings that face outdoors. Insulating internal walls, and party walls, floors and ceilings is generally unnecessary as neighbour homes provide insulation.
- Seek specialist advice and installation to prevent moisture and ventilation problems.

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Step 2 – switching to electric heating

What is it?

For most homes an electric-powered heating system will be a heat pump or electric storage heater.

How effective is it?

Switching from gas to electric heating is very effective in reducing your carbon footprint.

Cost

An air source heat pump can cost between £7,000 to £13,000. You may also need to replace your radiators.

The Boiler Upgrade Scheme provides a £5,000 grant towards the cost of an air source heat pump.

Issues to consider

- Prioritise building fabric improvements to reduce energy demand first. This means your new heating system can be smaller and more cost-effective.
- Weigh up increased cost of electricity vs gas
- Check our planning **how-to retrofit guides** to determine whether you need planning permission
- Switch from gas to electric cooking to get off the gas grid completely.

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Step 3 – generating electricity on-site

What is it?

In Westminster the number one option to generate renewable energy is photovoltaic solar panels.

How effective is it?

Solar panels can be very effective in reducing the amount of electricity you need to buy from the grid, particularly when coupled with battery storage.

Cost

- An average domestic solar PV system is around £5,500.
- Batteries can cost anywhere between £2,000 to £7,000.
- You can generate income from sale of excess energy to the grid.

Issues to consider

- Check our planning **how-to retrofit guides** to determine whether you need planning permission
- Consider getting battery storage so you can store energy when it is generated and then use it later in the day or night.

Part 2

Building fabric

Insulation and ventilation

Cost
£9,000

Energy bill savings*
£269 / year

Carbon saving
612kg / year

A large proportion of heat in homes is lost through the roof, external walls and the floor. Insulation is one of the best ways to save energy and works by creating a layer that reduces heat loss.

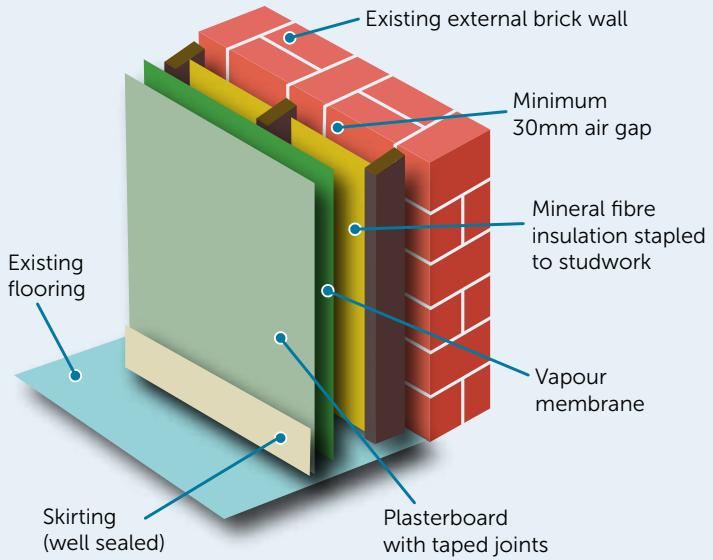
There was no need to insulate above the ceiling or the party walls, as the flats above and to each side act as insulation. Combined these measures will reduce heat demand by 40%.

- Wall insulation
- Floor insulation
- Smart air bricks
- Ventilation

Wall insulation

The home has solid brick walls so cavity wall insulation was not an option. To insulate the walls, we chose internal wall insulation as it would not affect the external appearance of the property or terrace. This is a particularly relevant consideration for homes in conservation areas.

Insulation was fixed to the walls in the front room and the bedroom. We used a SWIP system which followed the stud method. 100mm insulated studs were fixed to the walls and 100mm thick insulation was fitted between them. This was then covered with a moisture proof plasterboard and decorated.



*At October 2022 energy prices.

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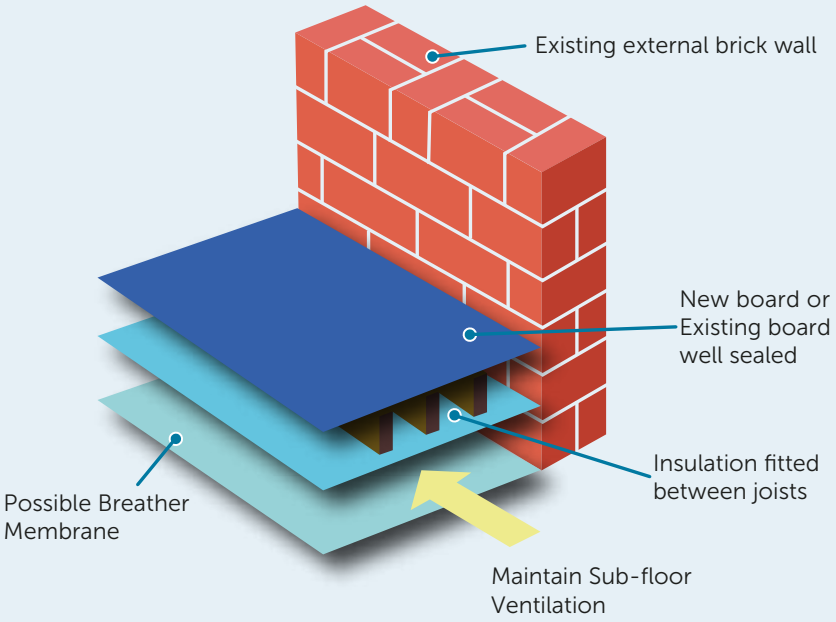
- Wall insulation
- **Floor insulation**
- Smart air bricks
- Ventilation

Floor insulation

We insulated under the floors to help reduce heat loss through the floor. This was possible because the home has a 'suspended floor' with a space below the floorboards that we filled with 100mm of Rockwool Flex insulation.



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- Floor insulation
- **Smart air bricks**
- Ventilation

Smart air bricks

We also added smart air bricks at the front and back of the home. Air bricks allow a flow of fresh air underneath the floor.

The smart air bricks from AirEx use humidity and temperature sensors to determine when to open and close, ensuring underfloor humidity is controlled while reducing unnecessary heat loss.

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- Floor insulation
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- Ventilation

Ventilation

Controlled ventilation helps to keep the home fresh, dry and healthy by extracting stale air and letting fresh air in when needed.

We installed extraction fans in the kitchen (pictured) and bathroom to remove unwanted damp, stale air. The home already had a positive input ventilation which provided controlled supply of fresh clean air.

The fan installed in the kitchen is a NUAIR Faith, while a NUAIR Cyfan was installed in the bathroom.

*At October 2022 energy prices.

Windows and doors

Cost
£5,000

Energy bill savings*
£102 / year

Carbon saving
232kg / year

Making windows and external doors energy efficient, including draught proofing, helps cut down on heat loss and reduces energy use.

In this home we used a combination of replacing windows and doors, where feasible, and installing secondary glazing. These will reduce heating demand by 15%.

- **Secondary glazing**
- Double glazed windows
- Air-tight door

See our **guide to retrofitting windows**

Secondary glazing

While this home is not in a conservation area, the majority of Westminster homes are, meaning you may require planning permission to replace your windows. As an alternative, we fitted secondary glazing to the living room and the bedroom which is a simple and affordable way to save energy in the home. It also has the added benefits of improved soundproofing and enhanced security.

The bespoke secondary glazing from North London Glazing is made from slim aluminium frames that have been made to match the original windows, including shape and colour. They are designed to allow easy access to the original windows for ventilation and cleaning and are fitted with 4mm eco glazing

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- **Double glazed windows**
- Air-tight door

Double glazed windows

In the kitchen and bathroom we replaced the windows with bespoke new double-glazed units supplied by City Restorations.

Double glazing is formed by two window panes separated by a gap filled with air to create insulating barrier.

Replacing both the glazing and frames is generally the most costly option and in some instances will require planning permission.

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- **Air-tight door**

Air-tight doors

We also replaced the back door with a new insulated and well-fitted GRP composite door. This door is air-tight when closed, eliminating draughts.

*At October 2022 energy prices.

Part 3

Heating system

Heating system

Cost
£13,000**

Energy bill savings*
£55 / year

Carbon saving
851kg / year

Insulating the home and improving the windows reduced heat loss and lowered heating demand by over half.
This meant when we came to replace the heating system we were able to choose a smaller system than would otherwise be required – lowering upfront and ongoing costs.

The existing gas boiler was replaced with an air source heat pump. We also fitted a hot water cylinder, new radiators and heat controls. A waste water heat recovery system was installed under the bath to capture some of the heat the otherwise would go down the drain. The new heating system will reduce carbon emissions by over 850kg a year.

Air source heat pump

Waste water heat recovery

See our **guide to retrofitting an air source heat pump**

Air source heat pump

The heat pump is located outside at the back of the home. The pump works by taking heat from the outside air and compressing it to a higher temperature. The heat is transferred to water which is used for heating and hot water in the home. It works like a fridge or freezer but in reverse. It runs on electricity and is much more efficient than gas – producing three times as much heat energy than it consumes in electricity.

The system installed includes 5KW Vaillant Arotherm Air to Water heat pump, a Valliant 150L heat pump cylinder and Stelrad K2 and K3 radiators.

*At October 2022 energy prices.
** after £5,000 grant from the Boiler Upgrade Scheme

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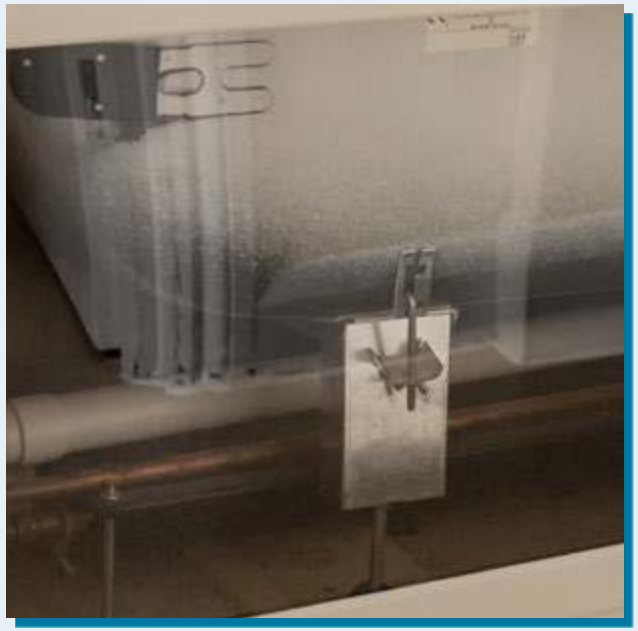
Air source heat pump

Waste water heat recovery

Waste water heat recovery

We fitted a small device below the bath called a waste water heat recovery unit. The unit – supplied by Recoup – works by recovering the heat that would usually be lost down the drain when showering. The warm waste water is used to pre-heat fresh cold water coming into the home, cutting down on the energy used to heat water.



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Part 4

Energy generation

Energy generation

Cost
£8,000

Energy bill savings*
£1,058 / year

Carbon saving
802kg / year

Solar panels can be used to generate electricity in the home. The panels work by capturing the sun's energy and converting it to electricity.

Combined with insulation, new windows, the heat pump – and battery storage – we expect the solar panels to reduce the home's requirements for electricity from the grid to near zero.

Solar panels

Battery storage

Solar panels

At this home, there are eight 405W Canadian Sola Mono solar panels installed on the roof.

Together they will generate approximately 3300 kWh of electricity per year – enough to power the air source heat pump as well as the other electrics (lighting and appliances) in the home.

See our **guide to retrofitting solar panels**

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Solar panels

Battery storage

Battery storage

To make the most use of the electricity generated by the panels a 5kW Huawei battery has been fitted at the property. The battery can store excess electricity to be used later, generating more savings. The battery is in a small storage cupboard at the front of the home.

*At October 2022 energy prices.

Part 5

Impact of the show home

Impact of the show home

During summer 2022 we opened the show home for tours, and received well over 300 visitors including council tenants, homeowners, landlords, and officers from London boroughs and housing associations. Feedback was overwhelming positive with attendees now more likely to insulate, undertake window improvements, install solar PV.

> It was enormously helpful. In 10 minutes I could see and understand the improvements and the technology, which would have taken me several hours of research on the internet.
>
> Susan, Little Venice resident.

The show home won the "Best Net Zero Carbon Initiative" award at the 2023 National Housing Maintenance Awards. The judges said:

> It was a great use of technology combined with a customer focussed approach. Show home tours engaged residents resulting in fewer refusals, with carbon, project costs and energy costs all being reduced, improving the quality of environment and showing clear benefits to residents."
>
> National Housing Maintenance Awards Judges.

We continue to learn more about the show home, with smart sensors and technology being used to monitor all elements of the home over a 12 month period. This will mean we can compare 'real world' outcomes against manufacturer promises, and will help inform our ongoing investment in improving the Council's housing stock. We are also applying feedback and lessons to the retrofit advice and support we provide residents of all tenures.

Part 6

Advice and support

Advice and support

Things to consider:

- **Take a whole house approach** – Develop a retrofit plan that incorporates all elements of your home including building fabric, heating system and energy source. You don't have to implement everything at once, but a comprehensive plan will help you direct your investment to the most impactful measures and ensure that that all measures work well together.
- **Check Planning requirements** – Check whether you require planning permission for your home improvements. This will depend on the type of dwelling, whether your home is a listed building or in a conservation area, and what exactly you plan to do. Our **'how to retrofit' guides** are good place to start.
- **Specialist advice** – Get specialist advice and have your works carried out by competent, skilled tradespeople who work to high standards of technical competence. You can find suppliers through programmes like the government-endorsed **TrustMark** quality scheme.
- **Get freeholder permission** – if you are a leaseholder, check what freeholder permissions you require. Westminster City Council leaseholders should check **www.westminster.gov.uk/housing/leaseholders** for the most up-to-date advice.

Visit our Home Energy Savings Hub for up-to date information on advice and support available to retrofit your home **www.westminster.gov.uk/home-energy-savings**

Glossary

Glossary

Air source heat pump – A low carbon heat source that transfers heat from the outside air to water, which is used to heat your home via radiators or underfloor heating. It can also heat water for your hot taps, showers and baths.

Battery storage – A device that stores the energy generated from solar panels, to be used when your home's energy demand is higher than what the solar panels are producing (e.g. after sunset).

Building fabric – The structural materials that your home is built of such as walls, roofs, internal surfaces, floors, stairs and landings and all doors and windows.

Double glazed windows – A window that has two panes of glass that form a sealed unit to reduce heat loss and noise pollution.

Energy source – The way that energy is obtained.

EPC – Energy Performance Certificates tell you how energy efficient a building is and give it a rating from A, very efficient, to G, inefficient.

Heating system – The way your home is heated – commonly radiators supplied with hot water from a gas boiler.

Insulation – Materials that create a barrier to stop or slow heat from escaping your home.

Retrofit – Retrofitting is the process of upgrading an existing building to improve its energy efficiency.

Retrofit assessor – Someone qualified to survey your home and make recommendations on how best to improve its energy performance.

Smart air bricks – A modern ventilation brick that controls air flow using sensors that monitor temperature and humidity.

Solar panels – Rooftop devices which absorb energy from the sun and convert them into electricity or heat.

Ventilation – The movement of fresh air into or around a room or building.

Waste water heat recovery system – A device that extracts heat energy from waste water before it disappears down the drain.

Whole home approach – Developing a retrofit plan for the whole home or building, rather than looking at measures individually.