

July 2025



Example images

ORP Retrofit CASE STUDY - PV and battery systems

This case study is part of a range of technology focussed studies, analysing data collected across the Welsh Government's Optimised Retrofit Programme (ORP).

PV and battery systems - Introduction

July 2025

Purpose

The Optimised Retrofit Programme (ORP) is a Welsh Government funded social housing retrofit programme, open to Registered Social Landlords (RSLs) and local authorities (LAs) in Wales, to install a variety of home decarbonisation measures in existing social housing stock.

As part of ORP funding, landlords have been required to install energy and environmental monitoring systems to homes being provided with retrofit measures, to allow large scale study of how these measures support decarbonisation, reduce energy bills, and provide better environments for residents.

The Welsh Government ORP data monitoring specification delivered to landlords, required data from energy meters and environmental sensors to be standardised, and published to the Welsh Government data portal, developed and operated by xRI.

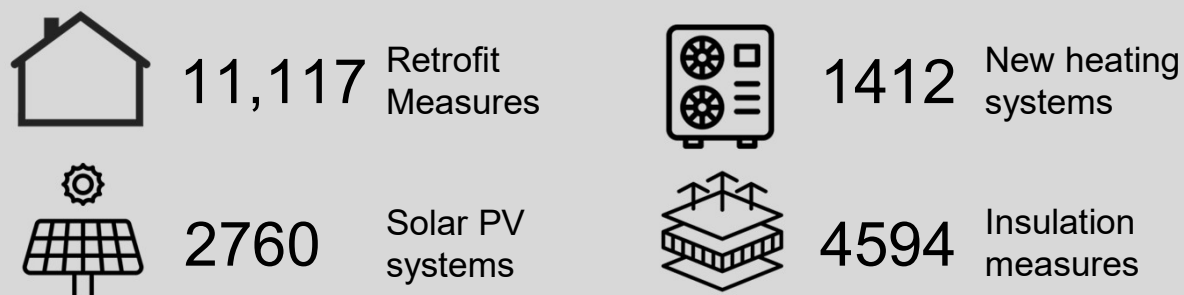
This case study is based on that received data, and forms part of a series of technology focussed case studies. Case studies are designed to be updated annually, as increased amounts of data are received.



The Optimised Retrofit Programme in numbers

The Optimised Retrofit Programme has been operating since 2018, providing over £200M to social housing landlords to support retrofit to over 16,000 homes. Based upon the latest information and data collected from ORP funded landlords:

Top date, Welsh Government have supported the installation of:



To date, xRI have received data across:



PV and battery systems - Key findings summary

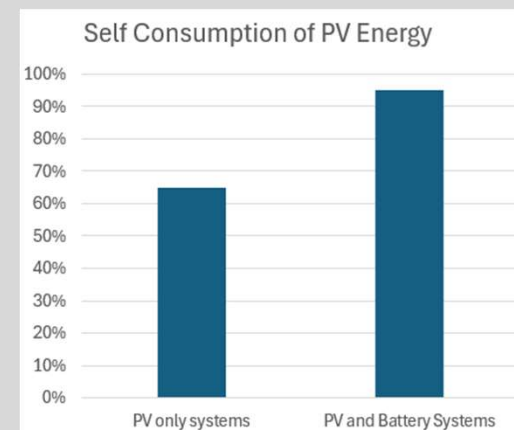
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PV and battery systems

Landlords have been funded to install over **2760** new PV and battery systems across homes under ORP.

xRI have collected data from over 300 installations to date, showing that:

- PV installations generate on average around **2350kWh** per annum per home.
- **PV-only** installations typically result in residents using **65%** of the energy generated by their PV systems, with the remainder being exported to the grid, in turn offsetting **£430/year** in electricity bills, and **190kg** of carbon emissions per home.
- Installation of **battery systems** typically see residents' self-consumption of PV energy increase to over **95%** of PV energy generated, offsetting **£650/year** in electricity bills, and **293kg** of carbon emissions per home, based on 2025 baseline energy figures.
- PV only systems contribute over **30%** of household energy demands on average, while PV and Battery systems typically increase this to over **45%**.
- Data indicates that on average battery systems are **cycling around once per day**, in-line with typical modes of operation for PV-self consumption, or variable tariff energy arbitrage that also maximise battery life-span. However, 30% of installed battery systems appear to be under-utilised, suggesting monitoring, installation, or commissioning issues. Landlords should check review performance of system following a period of use to ensure effective operation to maximise benefits to tenants.



2760 installed PV systems across ORP, providing an estimated:

6450MWh of renewable energy generation per year.

£1.82M per year savings on energy bills

1125 tonnesCO2 emissions per year.



Average PV system size

2.9kW

PV system size range

1 - 28kW



Average battery system size

5kWh

Battery system size range

1 – 23kWh

PV and battery systems - Introduction

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PV and battery systems

Solar PV is now relatively well established and understood decarbonisation technology that social landlords have used for some years, to reduce carbon emissions, and resident's energy bills.

Rooftop solar PV systems offer a clean, renewable way to generate electricity, but with growing adoption, some areas are facing local grid capacity issues, meaning landlords and district energy network operators are facing increasing challenges in installing PV at scale across housing portfolios.

In-home battery systems are becoming an increasingly popular addition to PV installations to mitigate some of these problems, as well as increased value to residents.

By storing excess solar energy for use later in the day, batteries increase how much renewable electricity is used on-site (self-consumption), reducing energy costs for residents, and unwanted export of electricity to energy networks.

This can be especially beneficial for social housing residents, who are more vulnerable to rising energy prices.

Smart energy management and time-of-use tariffs are making batteries even more valuable. Homes can now charge their batteries when electricity is cheapest—often overnight—and use that stored energy during peak hours. Even homes without solar can benefit from this approach.

PV and battery systems can be configured in various ways in homes with regards cabling and control systems, with new installation increasingly being designed, delivered and installed as a single eco-system.

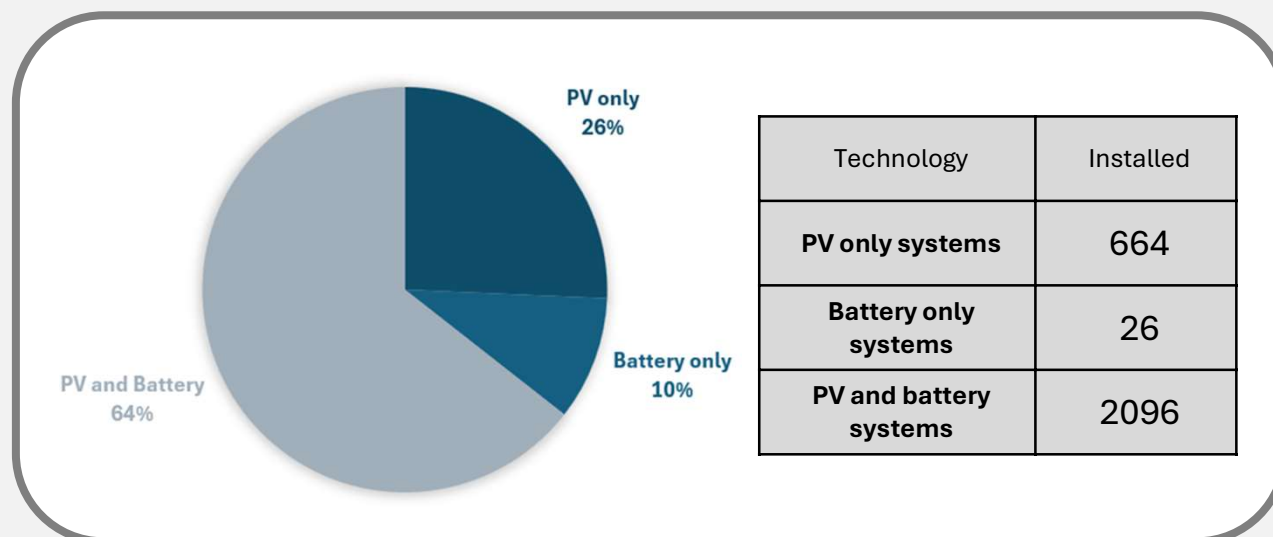
PV and battery charge/discharge data has been collected independently in some cases, while only a combined whole-system charge/discharge metering data received in others.

Analysis of these types of data is indicated in charts on the following pages.

Data used for this study:

- Energy metering – PV generation
- Energy metering – Battery charge and discharge
- Energy metering – Grid import and export
- Energy metering – Consumer unit consumption
- Retrofit project information

PV and battery systems installed under ORP



Figures based on latest scheme data provided by funded landlords.

PV Generation

The below graph represents the amount of energy generated by 154 installations across ORP.

Across ORP the average installed PV system size is **2.9kW**. Known geographical PV performance data indicates this should generate around 2320kWh / year in Wales.

ORP installations range from around **500kWh/a** to over **7000kWh/a**, with an average of **2380kWh/a**, indicating that installed ORP PV systems are operating effectively.

Key metrics:

Energy generation (kWh/a)

The amount of renewable energy generated by PV panel systems per year.

Cost and Carbon data:

Electricity energy cost*: **28.06 p/kWh**

Grid CO2 emissions intensity**: **125 gCO2e/kWh**

* Ofgem Wales average price cap figure; March 2025

** UK average 2024

The data in this graph represents:

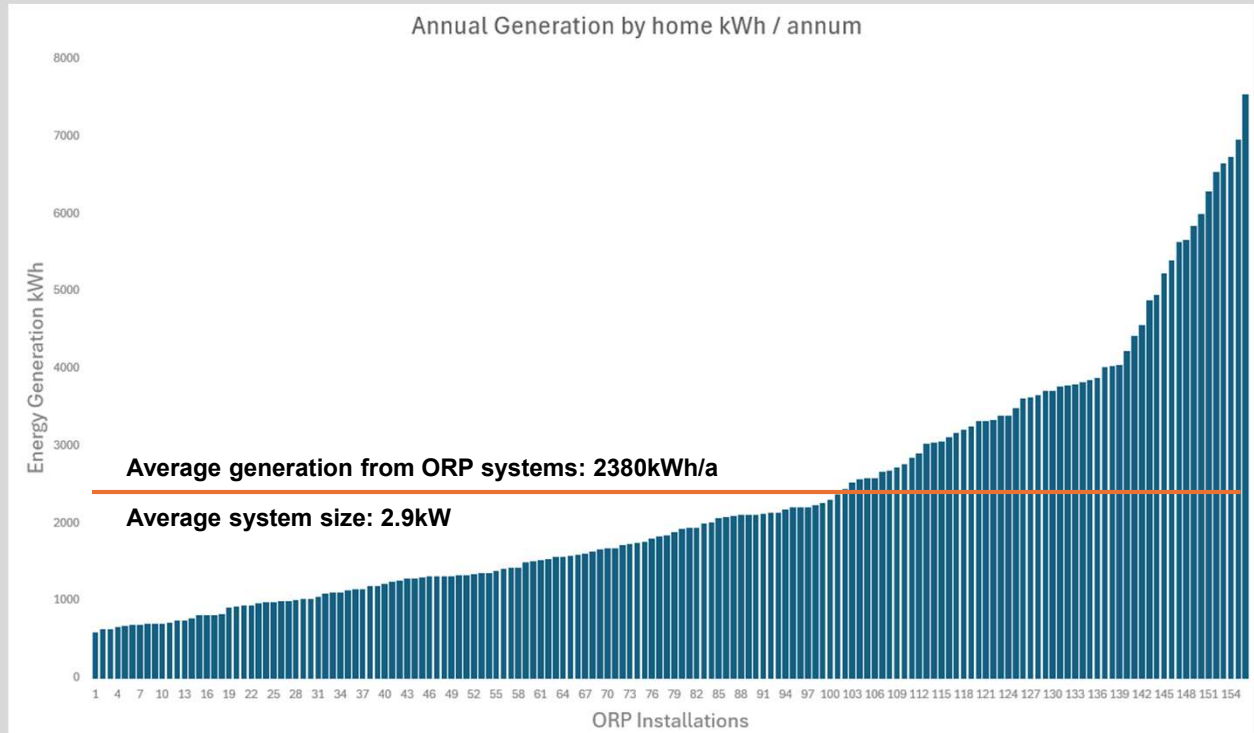
376MWh/year of energy generated across 154 systems.

Based on this evidence, ORP's 2760 installed PV systems generate approximately

6450MWh of electricity per year.

This equates to the offsetting of **£1.82M** of electricity from residents' energy bills, and

810 tones of CO_{2e} per year, based on 2025 energy cost and carbon figures.



Key metrics:

Battery activity (kWh/a)

The amount of energy cycled through a battery system per year. Measured in kWh.

Self consumption %

The percentage of renewable energy generated by PV's, used within the home.

The data in this graph represents:

101MWh/year of energy cycled through batteries across 53 systems.

Based on this evidence, ORP's 2122 installed battery systems provide the storing and release of **4080MWh** of electricity per year, maximising the self-consumption of PV generated energy, or allowing residents to buy energy when it is cheaper to reduce energy bills.

This equates to **£1.16M** of standard flat rate grid energy, and **510 tonnes of CO_{2e}** of offset grid carbon emissions.

Battery Activity

The below graph represents the energy charged and discharged from battery installations per year. Batteries charged and discharged **1923kWh** per annum on average, indicating good levels of daily activity of **5.25kWh/day**, around **85%** of the average ORP PV system's generation, supporting residents to maximise self consumption of PV.

The left-hand side of this graph indicates that around 30% of installations may not be operating optimally. This data output could be caused by a number of reasons including, accidental isolation, incorrect wiring, or being commissioned into the wrong mode for the intended application, resulting in under-usage.

