



# **Lessons Learned from Welsh Zero Carbon Case Studies**

**A Review of Post Occupancy Evaluation at Gwynfaen**

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## Gwynfaen (Swansea)

- 144 low carbon Homes
- Mixed-tenure + Community Hub
- EPC A (SAP 96 – 104)
- Green Placemaking
- Low operational carbon
- Low embodied carbon
- Welsh Timber
- Off Site Manufacturing
- Carbon measurement





# **codi** Specification

- **Air Source Heat Pumps**
- **Hot water cylinders**
- **2 x 5kWh Duracell batteries**
- **3 – 4 kwp of PV per home**
- **MVHR System**
- **Airtightness of 1.5 m<sup>3</sup>/h.m<sup>2</sup> @50Pa**
- **EV Charging – homes and communal**

**Customer Apps to control the heating, hot water and battery.**





# Lessons Learned – HWB Case Study

## Complex House Types

- **23 different house types created inefficiencies in design and delivery. Future projects will streamline layouts to improve cost-effectiveness and simplify construction.**

## Cladding Choices

- **Initial use of Welsh Larch caused detailing and performance issues, leading to a switch to Cedar with more robust design solutions.**

## Warranty Conflicts

- **Some innovative natural materials could not be approved by NHBC. This highlighted the need to balance innovation with warranty requirements.**

## MortgageAbility

- **Certain timber cladding specifications were rejected by lenders, showing the importance of early engagement with the mortgage market.**



# Lessons Learned – HWB Case Study

## Street Adoption Challenges

- **The Highway Authority did not accept the green-street layout, and this delayed the project by 20 months.**

## Tech Commissioning

- **Weak mobile signal on-site delayed the setup of energy systems, which require internet connection for commissioning. Future phases will install site-wide Wi-Fi.**

## Resident Onboarding

- **Greater support is needed for residents in setting up smart apps, understanding tariff options, accessing SEG payments, and understanding new home technologies.**



# Performance Measurement

**Gwynfaen was part funded by the Welsh Government's Innovative Housing Programme (IHP).**

**Requirement to measure and report back the energy and environmental performance of the homes for a 12-month period – so that lessons can be learned.**

**Data was gathered from 34 homes during 2024/25, with the consent of residents using environmental sensors and devices connected to the electricity supply of each property.**



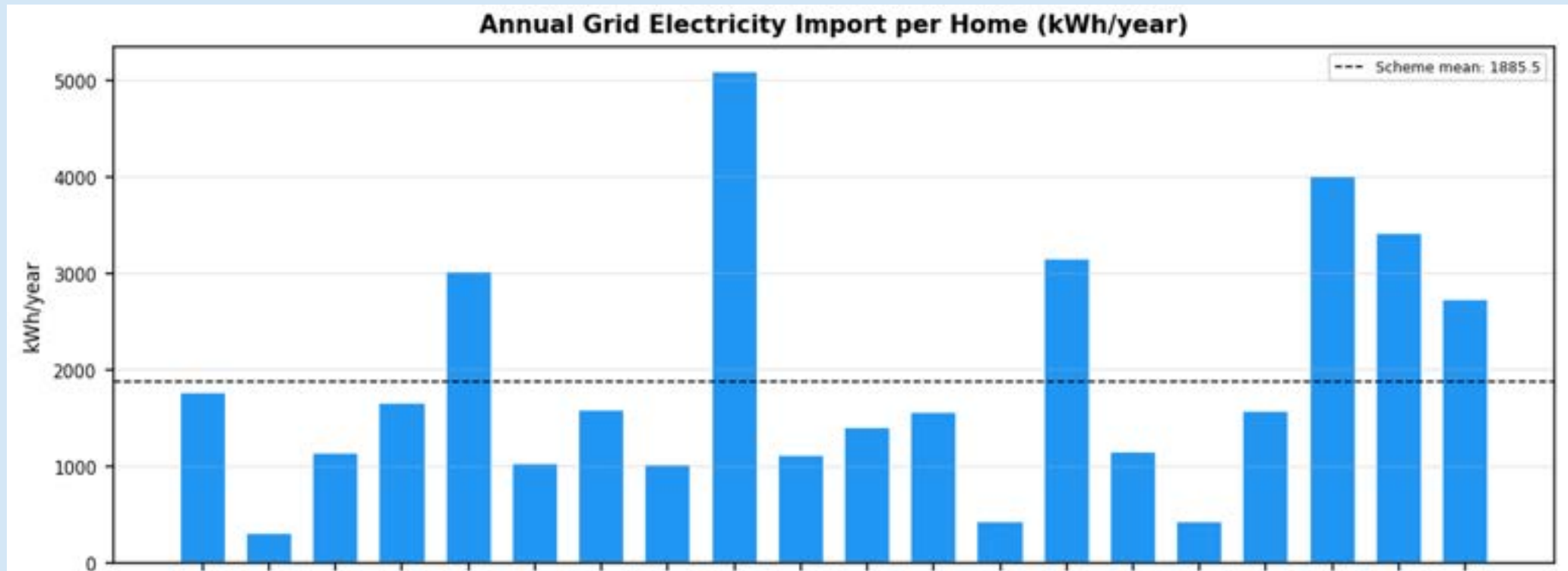
# Performance Measurement

Data on the following aspects has been collected over a 12-month period:-

- **Electricity Imported from the Grid for each home**
- **Electricity Exported to the Grid from each home**
- **Annual Heat Pump Consumption per home**
- **Solar Panel (PV) Generation per home**
- **Indoor Temperature**
- **Overheating Risk**
- **Air Quality / Ventilation (CO<sub>2</sub>) Concentration in each home**
- **Humidity (Moisture) in each home**



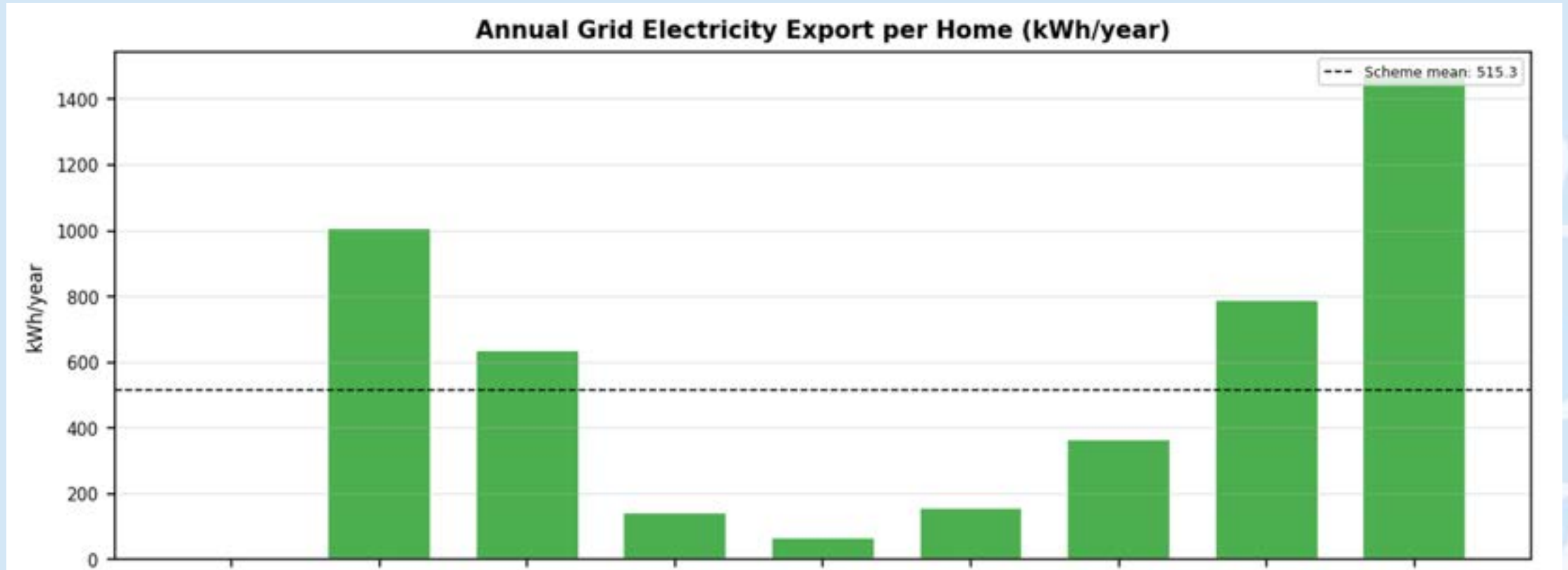
# Electricity Imported from the Grid for each home



Grid electricity import across 20 homes with sufficient data. The scheme average is 1885 kWh/year. The lowest consuming home uses 317 kWh/year while the highest uses 5096 kWh/year. These values represent a significant reduction over the typical electrical energy consumption for an electrically heated home in the UK of around 6–8,000 kWh/annum for medium sized homes. Likely due to the presence of on-site generation, low energy home design, and energy conscious behaviours.



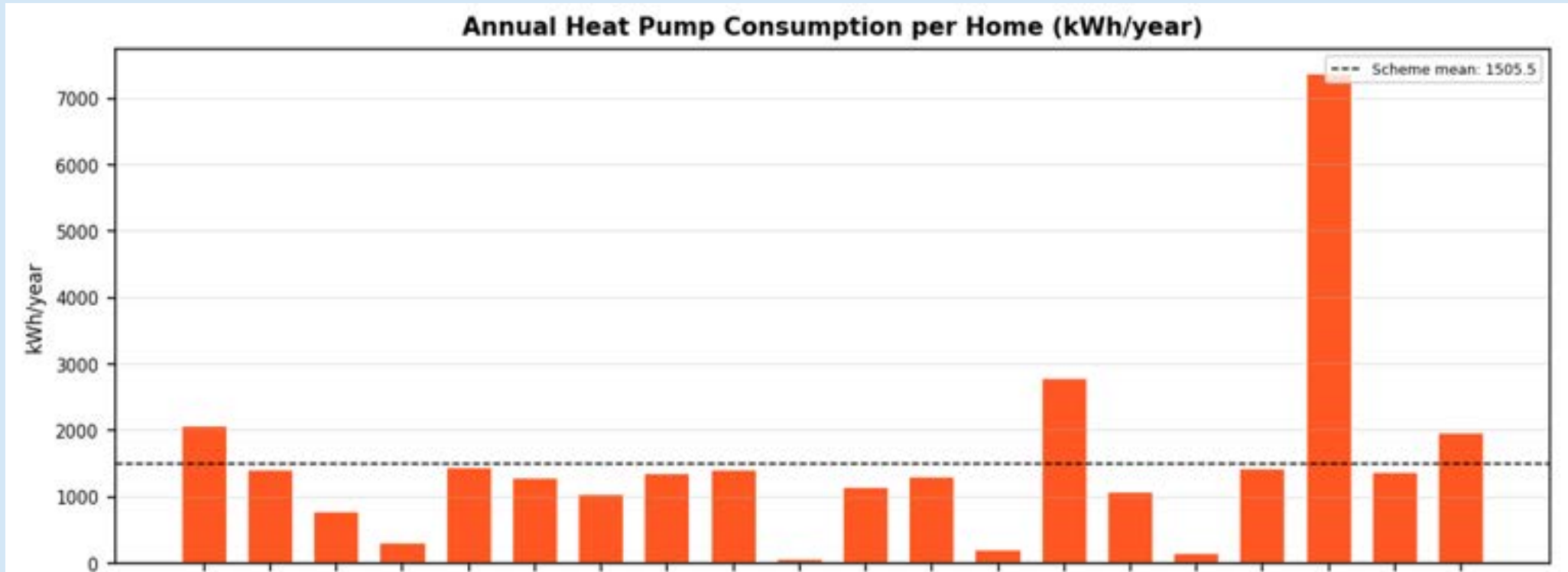
# Electricity Exported to the Grid from each home



Grid export is observed from a smaller number of homes, as expected, due to the presence of battery systems which are designed to maximise the on-site use of generated energy, minimising or eliminating export to the grid.



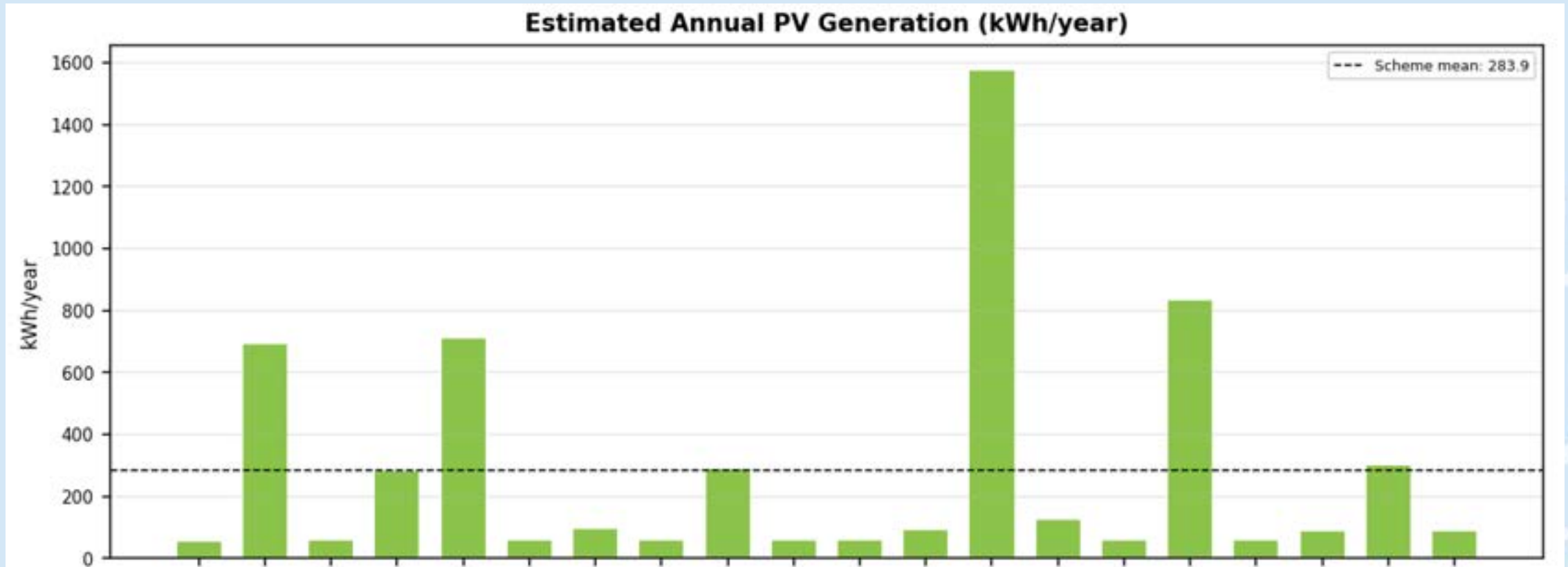
# Annual Heat Pump Consumption per home



Heat pump data is available across 20 homes. The scheme average is 1506 kWh/year. The range is 67 to 7375 kWh/year. 4 home(s) show very low heat pump usage (below 500 kWh/year). Homes with very low energy consumption may be due to under use of the heating system, a heating system problem, or a data monitoring error. The highest consuming home uses 7375 kWh/year, which is significantly above the scheme average and warrants investigation.

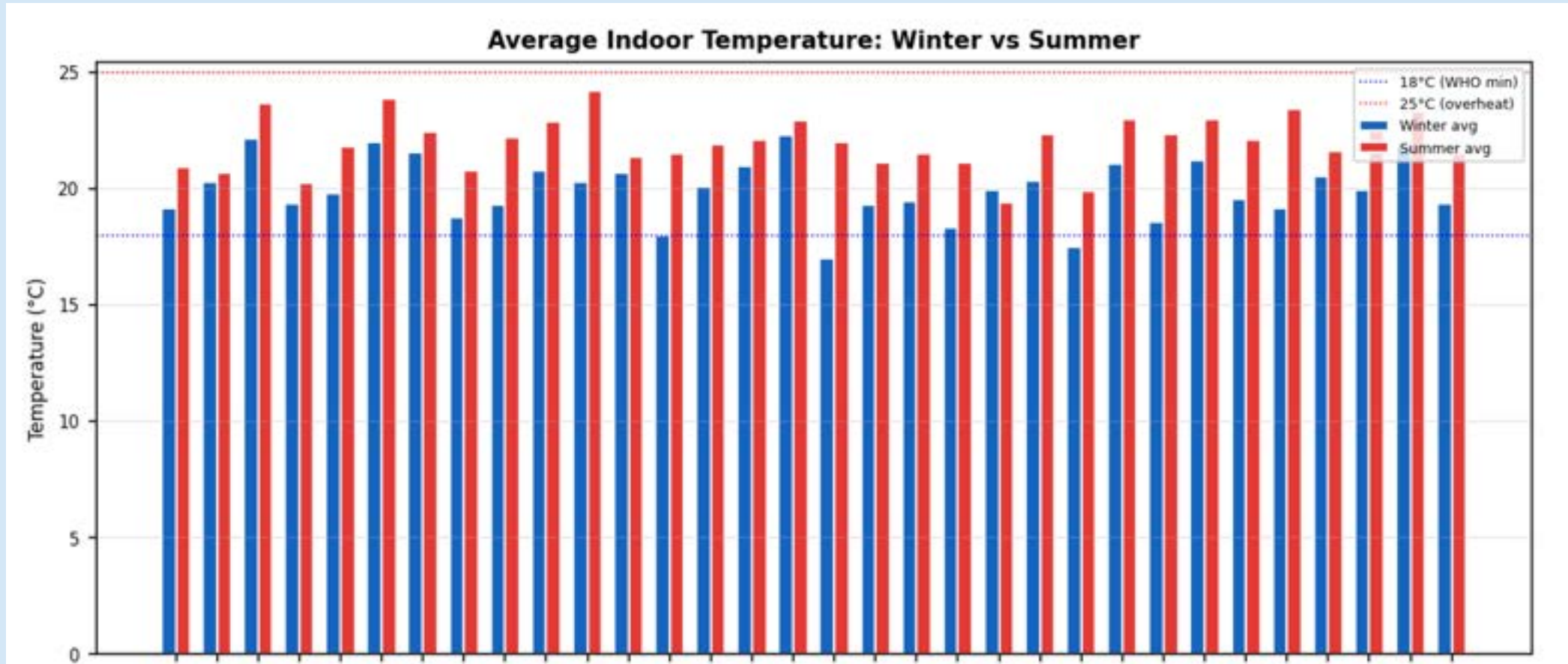


# Solar Panel (PV) Generation per home



PV generation is estimated from the combined PV/battery system monitor (sensor 3). The sensor records energy flowing from the system to the house (import) and from the house to the system for battery charging (export). PV generation is calculated as import minus export, representing the net solar contribution to the home. The scheme average is 284 kWh/year across 20 homes. The range is 58 to 1577 kWh/year.

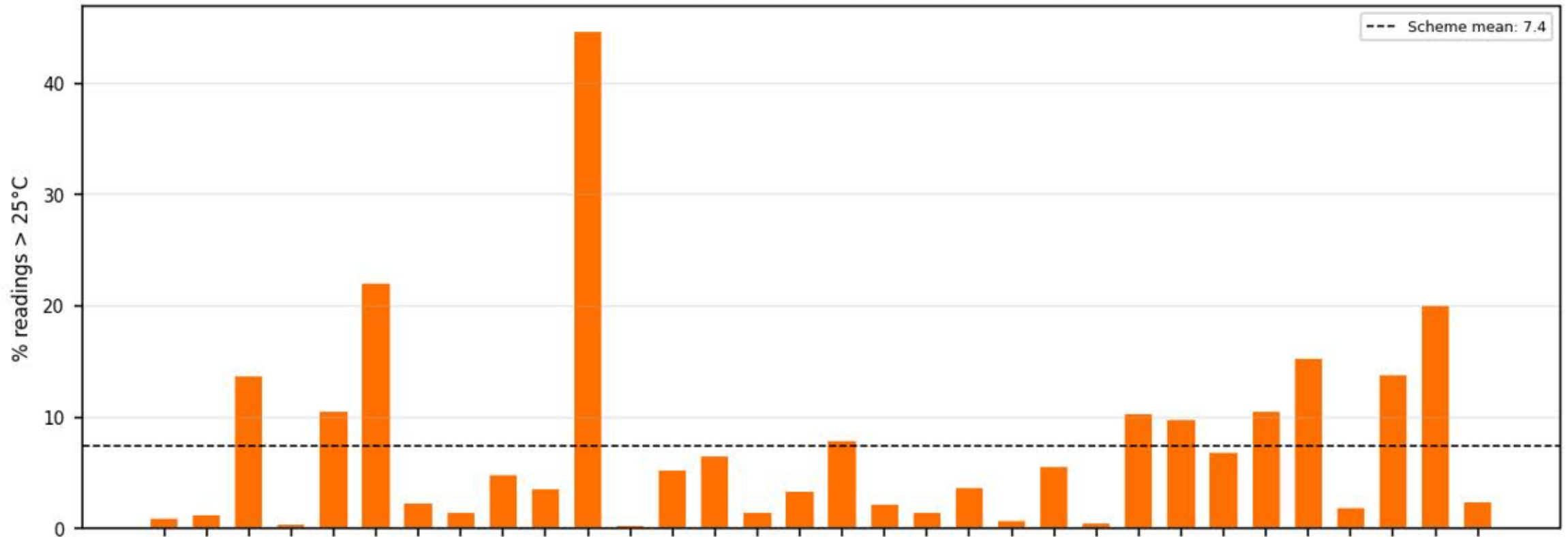
# Indoor Temperature



Average temperatures are good across the scheme with average winter indoor temperatures of 19.9°C and the average summer temperatures of 22.0°C, showing that ASHPs are generally heating homes well. 3 home(s) have average winter temperatures below the WHO recommended minimum of 18°C, suggesting potential underheating.

## Overheating Risk

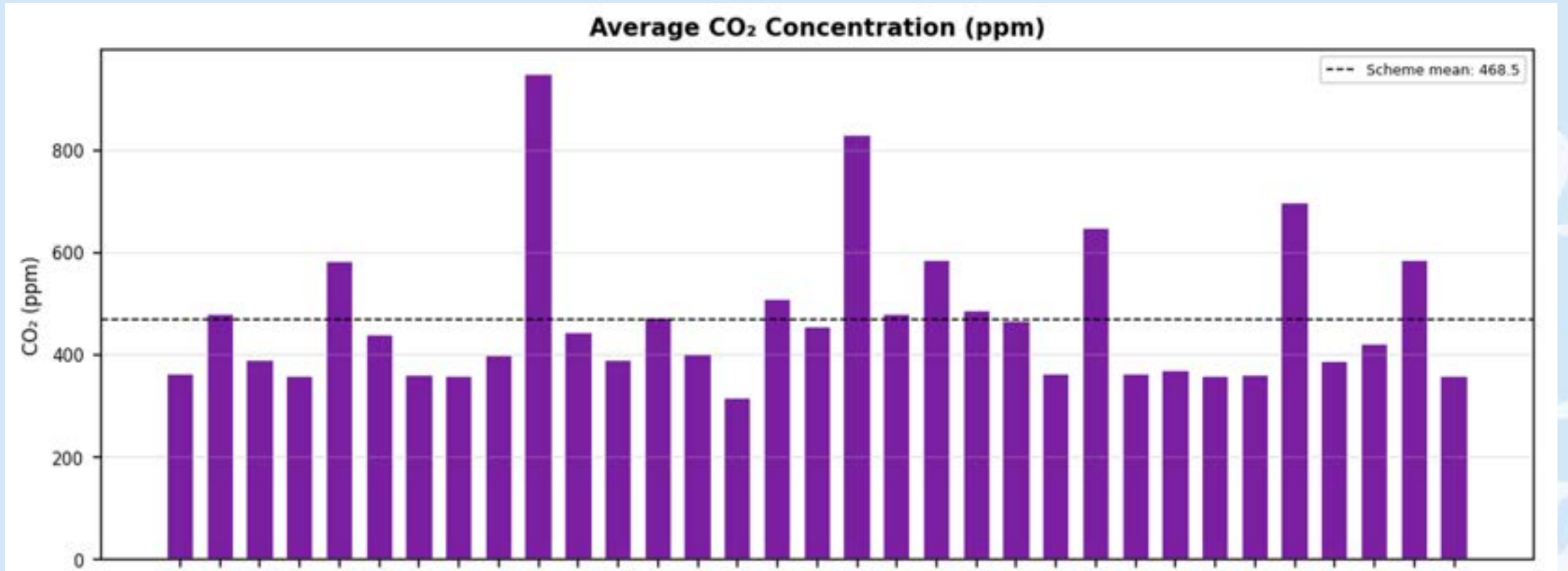
Summer Overheating: % of Readings Above 25°C



This chart shows the percentage of summer temperature readings exceeding 25°C for each home. The scheme average is 7.4%. The worst-performing home has 44.7% of readings above 25°C, suggesting significant overheating risk, and should be reviewed with the tenant if possible.

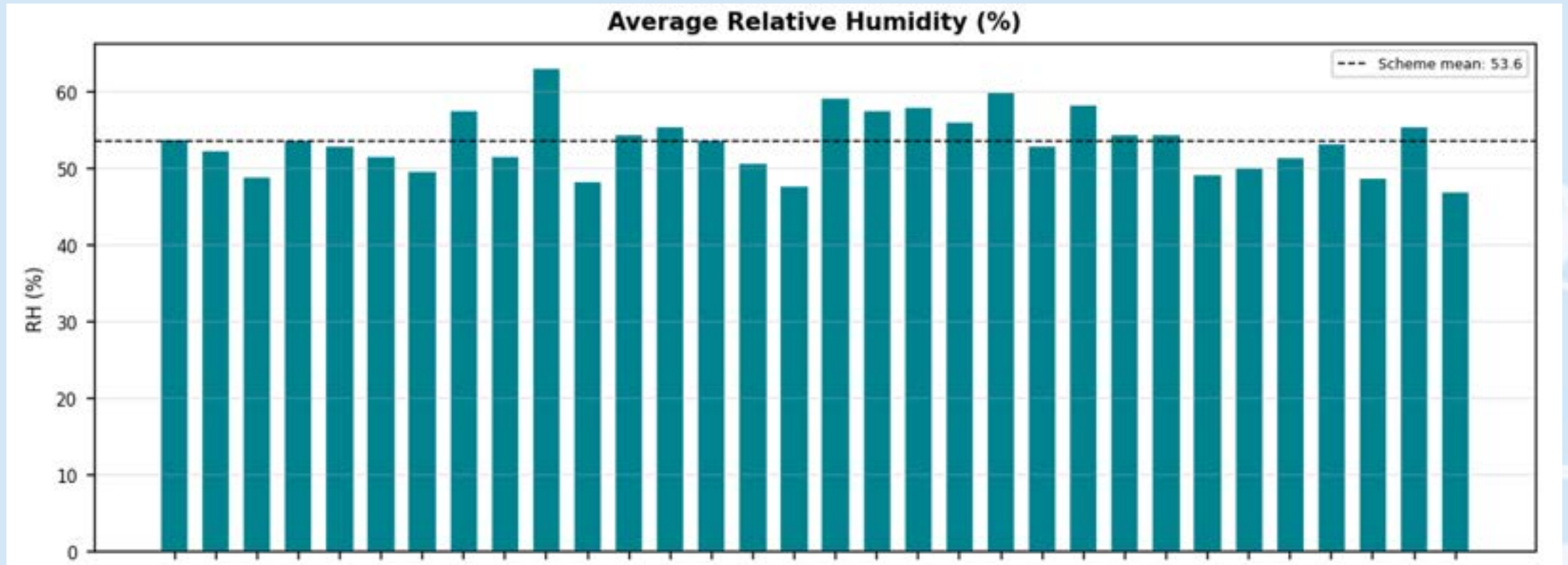


# Air Quality / Ventilation (CO<sub>2</sub>) Concentration in each home



CO<sub>2</sub> levels provide a proxy for ventilation effectiveness. Figures suggest that most homes are receiving effective levels of ventilation on average, with 0 home(s) showing elevated levels. Mechanical ventilation systems should be checked for operation, but elevated levels may also be down to a lack of operation of manual vents or windows by occupants.

# Humidity (Moisture) in each home

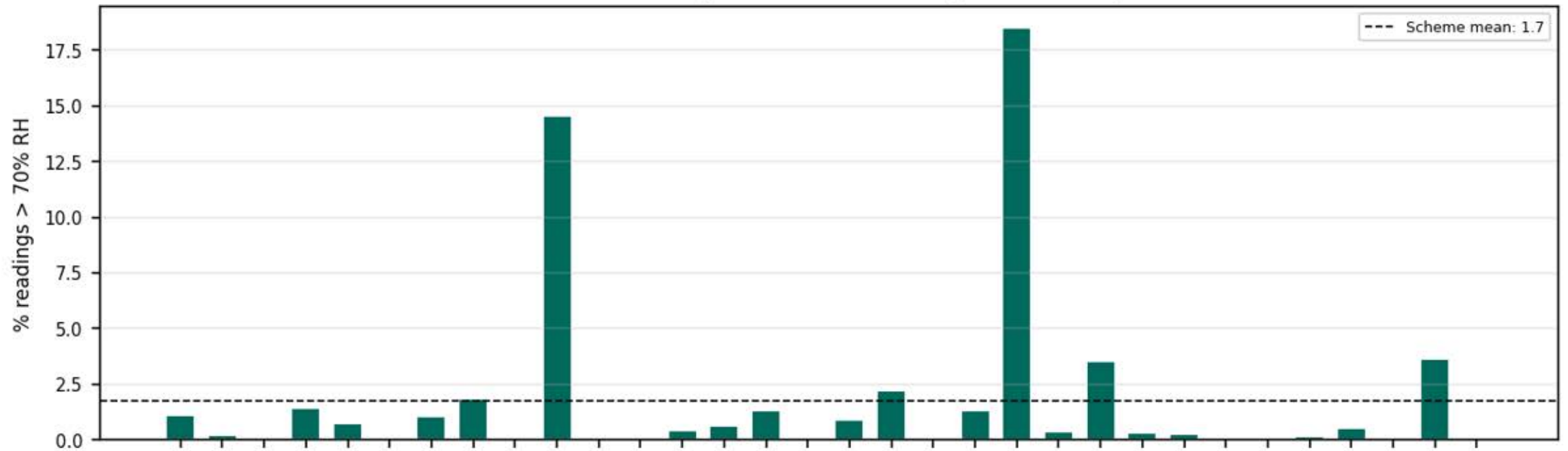


Relative humidity should ideally be between 40–60%. The scheme average is 53.6%. On average, 1.7% of readings exceed 70% RH, which is the threshold above which mould growth risk increases. Humidity levels are on average good across the board, though 2 home(s), as identified on the next page, warrant inspection for effective removal of moisture by ventilation systems.



# Humidity (Moisture) in each home

% of Readings Above 70% RH (Mould Risk)





# Performance Measurement

## Key Energy Findings / Conclusions

**Average annual grid electricity import: 1885 kWh (range: 317 – 5096 kWh) across 20 homes with sufficient data.**

**Average annual grid electricity export: 515 kWh (range: 0 – 1471 kWh) across 9 homes.**

**Average annual heat pump consumption: 1506 kWh (range: 67 – 7375 kWh) across 20 homes.**

**PV generation averages 284 kWh/year (range: 58 – 1577 kWh/year). These figures are lower than anticipated and a review of PV systems across the scheme is underway.**

**Average net grid consumption: 1370 kWh/year.**

**One home shows significantly elevated heat pump usage and warrant review**

**13 home(s) have insufficient energy data for meaningful analysis.**



# Performance Measurement

## Key Environmental Findings / Conclusions

- **Average winter indoor temperature: 20.0°C (range: 17.0 – 22.3°C).**
- **Average summer indoor temperature: 22.0°C (range: 19.4 – 24.2°C).**
- **3 homes have average winter temperatures below 18°C and should be reviewed.**
- **3 homes have more than 20% of summer readings above 25°C, representing significant overheating risk.**
- **Average CO<sub>2</sub> levels of 469 ppm suggest adequate ventilation performance.**
- **Average relative humidity of 53.6% is within the ideal 40–60% range.**
- **3 homes have more than 5% of readings above 70% RH and warrant inspection for effective moisture removal.**



# Performance Monitoring

## Estimated Cost & Carbon Savings

- **Estimated average annual electricity bill: £705 per home (based on average grid import of 1885 kWh/year at 26.5p/kWh plus standing charge).**
- **This represents an estimated saving of £1045 per home per year (60%) compared to the UK average household energy bill of £1,750.**
- **PV generation provides an estimated £75 of this saving per home per year.**
- **Average carbon saving from PV generation: 37 kgCO<sub>2</sub>/year per home (738 kgCO<sub>2</sub>/year across 20 homes).**

# Informed by Experience: Resident perspectives on new build low carbon homes

Dr Fiona Shirani, Cardiff University  
In collaboration with Stride Treglown

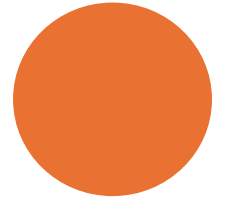
Funded via Place Based Impact  
Acceleration Account: The SWITCH to  
Net Zero Buildings

(Gwynfaen Images – Guy Traynor)



# Informed by Experience Collaboration

- Quality resident feedback is essential to creating homes which work
- Background in research with residents of initial IHP developments. How can research impact practice?
- Gwynfaen as an important site
- Interviews, drop ins and informal conversations with residents (ongoing)
  - Home and technology
  - Site and location
- Public engagement activities



# Design and layout

“The architects and the designers have **definitely thought about how people actually live**, more so than other designers and developments, I'd say.”

“It's a lot of glass, you know? And so there's light, which again, I think in turn, particularly during the winter months ... we've had some kind of like, dark and murky days. But I don't put the light on, you know, because **I've got a lot of natural light**. So yeah, it's lovely.”

“I think one of the worries I have is obviously the wooden cladding. **My worry is how that will uphold in years to come.**”



# Comfort

“Yeah, **the house is super comfortable**. You know, it's like I think one of the issues sometimes with new builds is that they're over insulated. I've never had condensation. There's no problem with any kind of feeling of damp or anything like that so. Yeah, **it's a comfortable home to live in**, yeah.”

“And that's the other benefit as well though with it because it's an eco-build, it does keep heat in... because it's holding in so much heat, **we're not using as much electricity. It's just retaining what we are using.**”

“So you do find even though you save money then in the summer, you've got to have some sort of air conditioning on because **it's too hot.**”



# Technology

“Having the electric boiler was very different lifestyle for me because obviously whilst there is the immersion side of it that you can turn on, it is a finite amount of hot water that's then got to essentially kind of top up. So **that's made us more mindful of our usage** in general.”

“Did take a hell of a lot of time to get my head around the apps and setting it all up and **that certainly would be one recommendation that, you know, they should provide a lot more information on.** The step-by-step process of setting all the apps up because it's not just one,”



# Bills

“I mean, if I moved in here without a battery, my bills would be more or less the same as they were with gas and electric in a new build. It's quite efficient anyway. It wouldn't have been obviously cheaper. **The battery makes it cheaper.**”

“I get great satisfaction in telling people that **my electricity bill last month was £20** and that's all I paid for utilities.”

“I think my monthly bill was £79. And I was paying £280 for gas and electricity combined in my previous property. So again it's, you know, it's not a significant, **it's an enormous saving** on the actual cost, you know and that has kind of you know **impacts then on quality of life.**”





# Health and wellbeing

“I had absolutely no idea how important it would be for me to live in a natural environment, you know, **surrounded by nature** and also in a house that has got **no maintenance** issues that I, I don't have to worry about fixing something or leaving it because I can't afford to get it fixed, which is the case in our old house. That it's comfortable that it's, you know, it's snug. I yeah, **I 100% think it's the, you know the property and the location have really contributed to improving my health and well-being.**”

“So knowing that things have been put in place to ensure that that quantity of water is accounted for, and we've got the flood lake just down the bottom there, outside the window. So there's lots of things in place. **So it was reassuring** to see all of that.”

(Image: <https://codicollections.co.uk/developments/gwynfaen>)

# Next steps

- Further engagement with residents
- Regular feedback to practice
- Supporting Tai ar y Cyd processes

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# LESSONS LEARNED - WELSH ZERO CARBON HWB

‘Delivering domestic solar  
pv at scale’



# Introduction

- Our vision
- Living our values
  - Major works programme for solar pv
- The challenges
- The solutions



*County Flats, Sandfields*

## Sustainable Homes

We will provide warm, energy – efficient homes to our customers with the aim of sustaining successful tenancies and homes tenants can be proud of.





*Changing our behaviours today, for the generations of tomorrow*



## Case Study

1639 Homes benefitting from solar panel systems in the past 12 months

Appropriately staffed delivery team

Framework

Target Energy pathways

Plot Blank

Route March



# THE SCALE UP CHALLENGES



## Procurement

Tenant refusal

Diminishing plot bank

Maintaining output

DNO delays and grid limitations

Physical restraint i.e trees overshadowing roof space

# THE SOLUTIONS

## Procurement

Tenant refusal's

Maintaining output

Diminishing plot bank

DNO delays and grid limitations

Physical restraint i.e trees overshadowing roof space

# Thank you

Any questions?



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