

# GREEN HOME FESTIVAL

BROUGHT TO YOU BY THE 



# Debunking Heat Pump Myths in Pre-1919 Homes

With Barry Sharp,  
Renewable Heat

Wednesday 14 August  
@ 11.00am



# GREEN HOME FESTIVAL

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[greenhomefestival.co.uk](https://greenhomefestival.co.uk)

     #GHF24



# Introduction

- **What we mean by Pre 1919 Homes**
- **Why it's more of a problem for Scotland**
- **Why is it perceived to be bad**
- **How we are getting it wrong**
- **Why its isn't actually a problem and we should just really get on with.**
  
- **We are going also Chat to Bruce who lives in semi-detached pre 1919 house and has had a heat pump for 5 years about his experiences**



# Introduction

- Trading for nearly 10 years, but designing, installing and maintaining heat pump systems for over 20 year
- Designed & Installed over 1000 heat pumps
- 20 directly employed staff
- Including 5 apprentices





# What is pre-1919?

**The definition as per a google search!**

**Traditional buildings are usually defined as those constructed before 1919 using solid wall construction methods and materials, including wood and stone. Construction changed rapidly after this time as new materials and faster methods of construction were introduced.**

**In Edinburgh we may refer to them as Georgian or Victorian homes**







# What is pre-1919?



**AFFORDABLE WARMTH**  
NEXT STEPS FOR CLEAN HEAT IN SCOTLAND



TABLE 1. DESCRIPTION OF THE TWELVE 'TYPICAL HOMES' USED IN THE MODELLING

<b>1. DETACHED PRE 1919</b> SOLID WALLS FLOOR AREA: 257M2 NUMBER: 37,000		<b>2. DETACHED 1919-82</b> CAVITY WALLS 158M2 214,000	
<b>3. SEMI-DETACHED 1919-82</b> CAVITY WALLS 102M2 361,000		<b>4. MODERN SEMI-D POST 1982</b> CAVITY WALLS 98M2 121,000	
<b>5. MID-TERRACE HOUSE 1919-82</b> CAVITY WALLS 94M2 202,000		<b>6. BUNGALOW POST 1919</b> CAVITY WALLS 105 M2 256,000	
<b>7. CHALET-BUNGALOW PRE 1919</b> SOLID WALLS 57M2 271,000		<b>8. CHALET-BUNGALOW POST 1919</b> CAVITY WALLS 137M2 158,000	
<b>9. TENEMENT-FLAT (MID) PRE 1919</b> SOLID WALLS 82M2 240,000		<b>10. MODERN TENEMENT FLAT (MID)</b> CAVITY WALLS 68M2 208,000	
<b>11. FOUR-IN-BLOCK FLAT (GROUND) 1919-82</b> CAVITY WALLS 70M2 213,000		<b>12. FOUR-IN-BLOCK FLAT (TOP) 1919-82</b> CAVITY WALLS 70M2 213,000	



# What is pre-1919?

## SCOTTISH HOUSING FACTS

Total Scottish homes: 2,496,000

Detached - **576,000** (built pre-1919 = 122,000)

Semi-detached **494,000** (built pre-1919 =52,000)

Terraced **525,000** (built pre-1919 =64,000)

Tenement **587,000** (built pre-1919 =184,000)

Other flats **315,000** (built pre-1919 =58,000)

- Pre-1919 total: 479,000
- 1919-44: 273,000
- 1945-64: 518,000
- 1965-82: 548,000
- Since 1982: 677,000

Source: Scottish government, 2019

# 19.19% of Scottish homes



# Bad Perceptions



- **No insulation**
- **Big draughty windows**
- **Cold**
- **Open fireplaces**
- **Hard to heat**

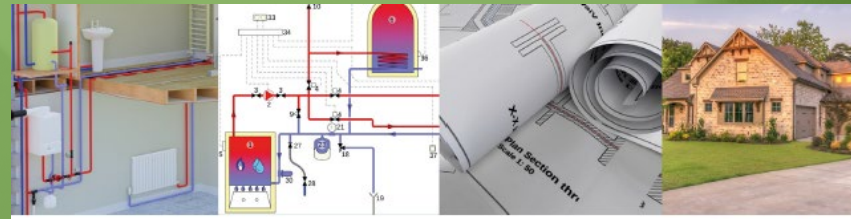


**kW is always kW\***

**\*Except when you measure it wrong**



# kW is a kW



DBSP Domestic Building Services Panel

# Domestic Heating Design Guide

Version 2020-01

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# Dalrymple Crescent



- **4-bedroom, 3 Public rooms**
- **172m<sup>2</sup>, c. 1860**
- **19.1kW (as per CIBSE)**
- **Not suitable for a heat pump**
- *(For refence, roughly speaking, the maximum we can do with one heat pump on single phase is 12kW~)*



# Why do I believe this is wrong?



# Stone Cold

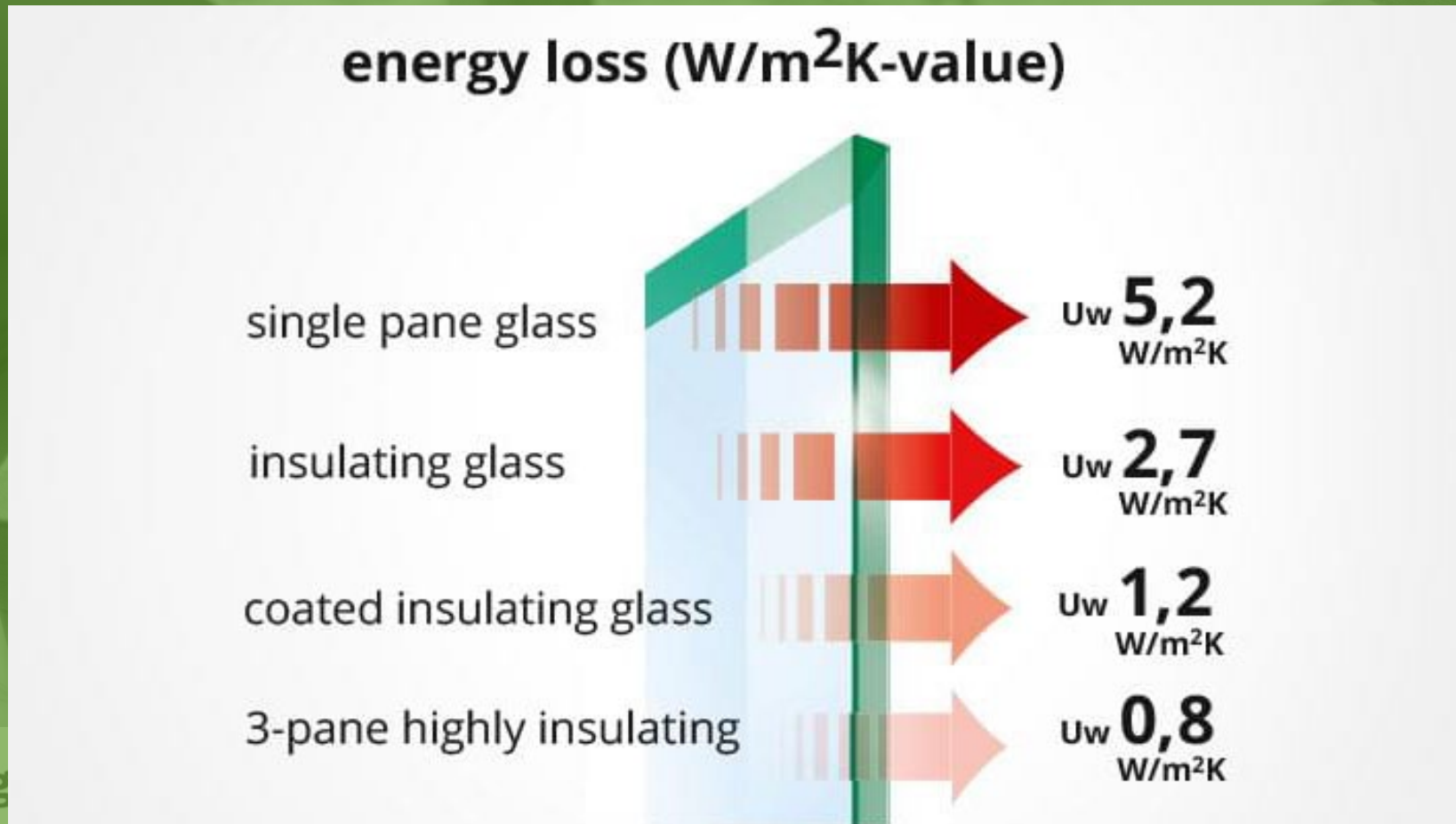


- **600mm thick sandstone walls**



# Stone Cold

**U Value measures the rate of heat transfer through a specific material (roof, walls, door, window, etc)**









# Stone Cold



Technical Conservation Group

## Technical Paper

*In situ* U-value measurements in traditional buildings –  
preliminary results

Prepared for Historic Scotland



# Stone Cold

## Lauriston Place, Edinburgh

19<sup>th</sup> Century tenement  
Stone - Craigleith

Five measurement locations with various  
wall finishes and thicknesses.  
Additional test on basement floor

**Figure 8: Lauriston Place**  
Front elevation (S), ground floor.

Wall thickness: 600mm  
External face: Ashlar  
Internal face: lath and plaster





# Stone Cold

## 4 The buildings

### **Figure 6: Victorian Villa, Cathcart, Glasgow**

N-W facing bedroom

Blonde sandstone

Wall thickness: 600mm

External face: rubble

Internal face: lath and plaster





# Stone Cold





# Stone Cold

Thus far, indicative U-values for 600mm masonry walls are as follows:

- Wall plastered on the hard:  $1.5 \pm 0.4 \text{ W/m}^2\text{K}$
- Wall with lath and plaster:  $1.0 \pm 0.3 \text{ W/m}^2\text{K}$
- Wall with plasterboard:  $0.9 \pm 0.1 \text{ W/m}^2\text{K}$



# Dalrymple Crescent

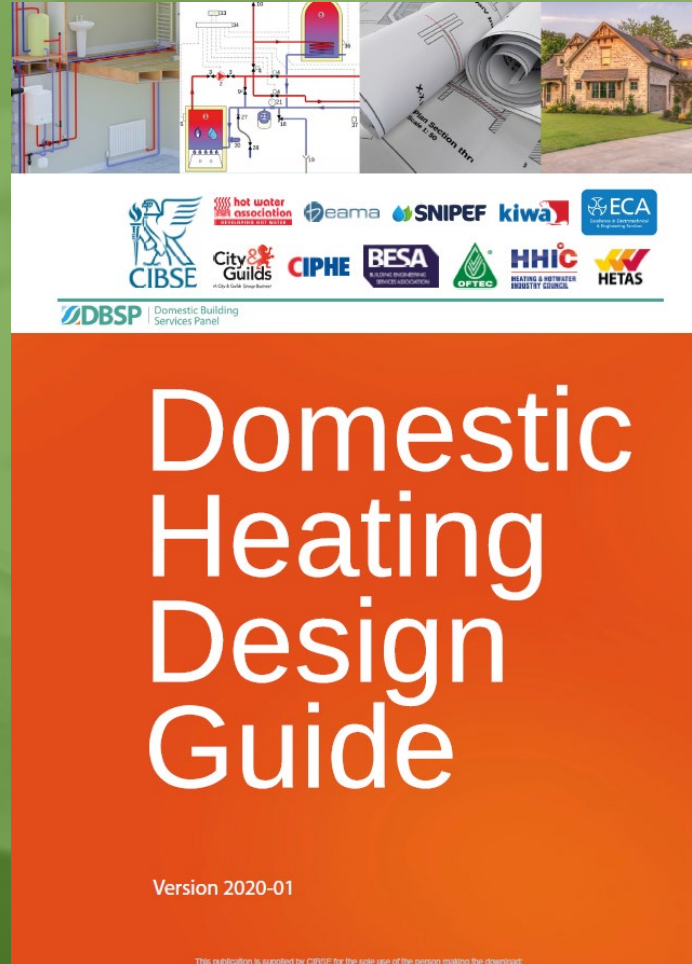


- **172m<sup>2</sup>, c. 1860**
- **4-bedroom, 3 Public rooms**
- ~~**19.1kW (as per CIBSE)**~~
- **15.1kW (Walls corrected)**
- ***Still not suitable for a heat pump***



# Blowing in the Wind

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# Blowing in the Wind

**Table 3.8** Recommended room design number of air changes per hour

Room	Category			Room	Category		
	A	B	C		A	B	C
Lounge/sitting room	1.5 <sup>†</sup>	1.0 <sup>†</sup>	0.5	Games room	1.5	1.0	0.5
Living room	1.5 <sup>†</sup>	1.0 <sup>†</sup>	0.5	Bedroom	1.0	1.0	0.5
Breakfast room	1.5	1.0	0.5	Bedsitting room	1.5	1.0	0.5
Dining room	1.5	1.0	0.5	Bedroom, including en suite bathroom	2.0	1.5	1.0
Kitchen	2.0*	1.5*	0.5*	Internal room or corridor	0.0	0.0	0.0
Family/breakfast room	2.0*	1.5*	0.5*	Bedroom/study	1.5	1.5	0.5
Hall	2.0	1.0	0.5	Landing	2.0	1.0	0.5
Cloakroom/WC	2.0*	1.5*	1.5*	Bathroom	3.0*	1.5*	0.5*
Toilet	3.0*	1.5*	1.5*	Shower room	3.0*	1.5*	0.5*
Utility room	3.0*	2.0*	0.5*	Dressing room	1.5	1.0	0.5
Study	1.5	1.5	0.5	Store room	1.0	0.5	0.5

**Note:**


Category A: Air change rates for older existing buildings (pre-2000). Those with several chimneys and/or subject to preservation orders may require greater infiltration allowance than shown above.

Category B: Air change rates for modern buildings (2000 or later) with double glazing and regulatory minimum insulation.

Category C: New (or existing) buildings constructed after 2006 and complying with all current building regulations.



# Blowing in the Wind



The screenshot shows the LOCO HOME RETROFIT website. At the top is the logo, which consists of a stylized house icon with yellow and blue geometric shapes and the text "LOCO HOME RETROFIT". Below the logo is a navigation menu with links for "Home", "About", "Make A Plan", "News", "Join", "Log In", and a user profile icon. The main content area features a large banner image of a stone building with the word "HOME" overlaid in white. Below this is a section with a photograph of a row of terraced houses on the left. To the right of the photo is the heading "SUPPORTING ENERGY CONSCIOUS HOME IMPROVEMENT IN GLASGOW" and a paragraph of text: "We're building a novel community-based approach to home energy decarbonisation. We aim to reduce the hassle of maintaining and improving homes while incorporating energy efficiency and decarbonisation measures." Below the text is a yellow button with a right-pointing arrow and the text "MAKE A PLAN". At the bottom of the page, there is a footer with the text "We're a co-operative and we're keen to have the involvement of householders, building professionals and local trades..." and the number "F24" on the right side.

**LOCO**  
HOME RETROFIT

Home About Make A Plan News Join Log In

## HOME

SUPPORTING ENERGY CONSCIOUS HOME IMPROVEMENT IN GLASGOW

We're building a novel community-based approach to home energy decarbonisation. We aim to reduce the hassle of maintaining and improving homes while incorporating energy efficiency and decarbonisation measures.

→ MAKE A PLAN

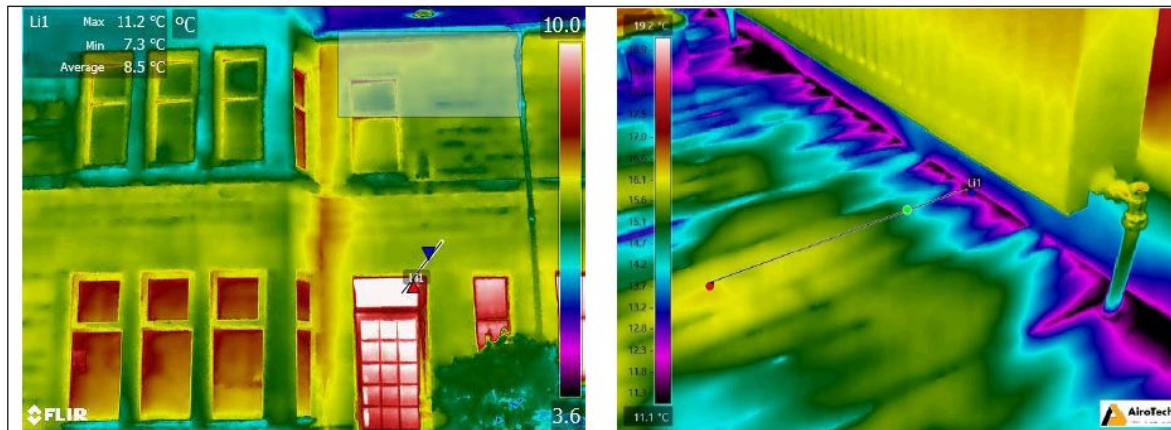
We're a co-operative and we're keen to have the involvement of householders, building professionals and local trades...

F24

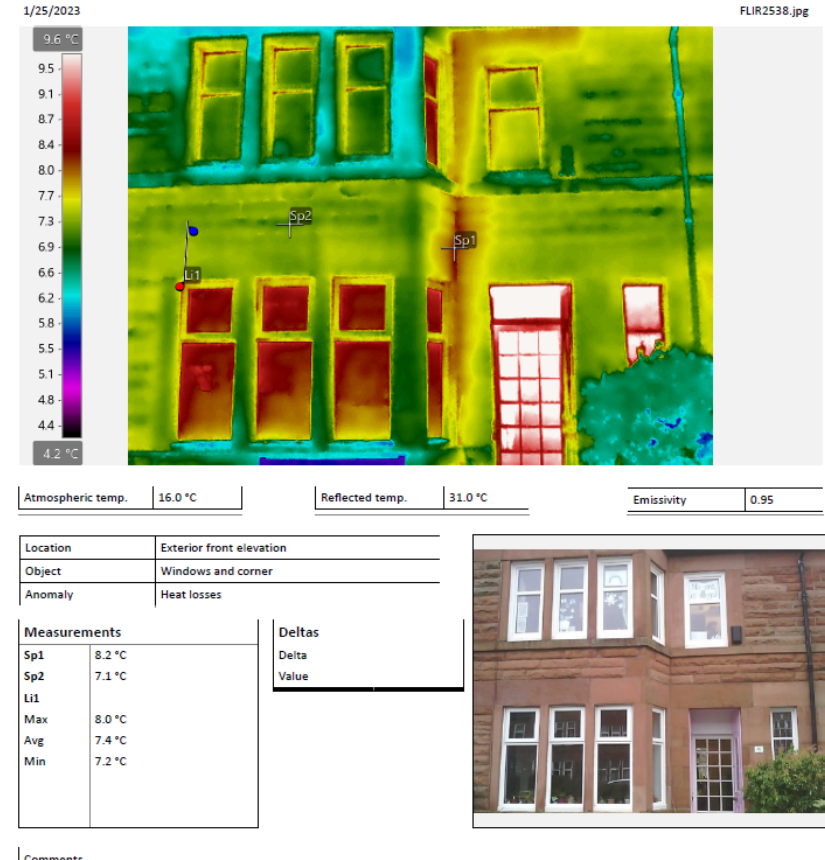


# Blowing in the Wind

## THERMOGRAPHY REPORT



### 5.1 - Image 1 External image of heat losses, front of the house





# Blowing in the Wind

**Air tightness testing, also known as an air leakage, air infiltration or air permeability testing is a test to indicate the cubic metres of air leakage per hour per square metre of external area of the building – (m<sup>3</sup>/hr. m<sup>2</sup>) – as per Part L of Building Regulations.**





# Blowing in the Wind



To convert the n50 number to  
Air Changes Per Hour roughly  
divide by 19 or 20

$$= 15.45 / 20 = 0.77\text{ACH}$$

Air leakage rate at 0 Pa, $q_0$ , [ $\text{m}^3/\text{h}$ ]	
Specific leakage rate (envelope) at 50 Pa, $q_{E50}$ , [ $\text{m}^3/\text{h}/\text{m}^2$ ]	15.45
Specific leakage rate (floor) at 50 Pa, $q_{F50}$ , [ $\text{m}^3/\text{h}/\text{m}^2$ ]	36.05
Effective leakage area at 50 Pa, $EA_{50}$ , [ $\text{m}^2$ ]	1.295



# Blowing in the Wind



**Table 3.8** Recommended room design number of air changes per hour

Room	Category			Room	Category		
	A	B	C		A	B	C
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# Dalrymple Crescent



- 4-bedroom, 3 Public rooms
- 172m<sup>2</sup>, c. 1860
- ~~19.1kW (as per CIBSE)~~
- ~~15.1kW (U Value Walls corrected)~~
- 13.1kW (Ventilation rate corrected)
- **Almost suitable for a heat pump**



# Multiplying Margins

- **Heat loss calculators were design for gas boilers**
  - **Gas was design for intermitting heating (on/off) so to allow for cold start 20% was added to the heat loss**
- **Ventilation loss are a factor of the total heat loss**
- **By using the wrong numbers at the start, we multiply out the error in the ventilation calculation. Twice.**



# Dalrymple Crescent



- **4-bedroom, 3 Public rooms**
- **172m<sup>2</sup>, c. 1860**
- ~~**19.1kW (as per CIBSE)**~~
- ~~**15.1kW (U Value Walls corrected)**~~
- ~~**13.1kW (Ventilation rate corrected)**~~
- **11.6kW (Removing margins and uplift)**

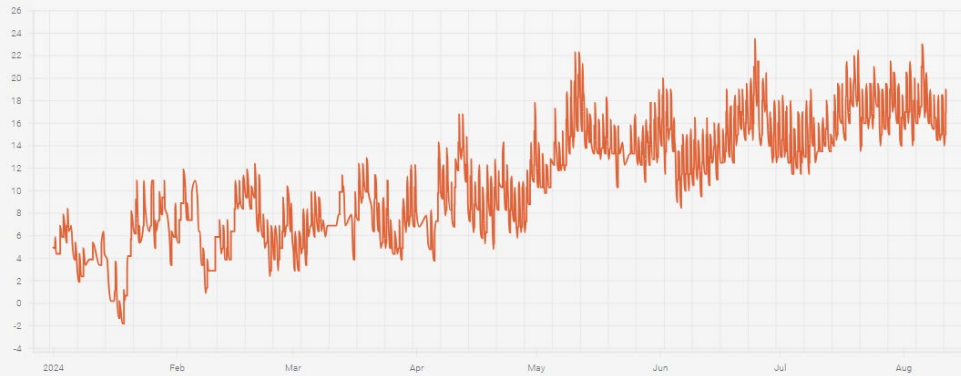


# The Proof

## History

Day Week Month Year Custom  
Year 2024

Show Points Zoom In Zoom out Export Expand



Current outdoor temperature (BT1)

Add Parameter

Clear All

## History

Day Week Month Year Custom  
Year 2024

Show Points Zoom In Zoom out Export Expand



Current outdoor temperature (BT1) Degree minutes

Add Parameter

Clear All

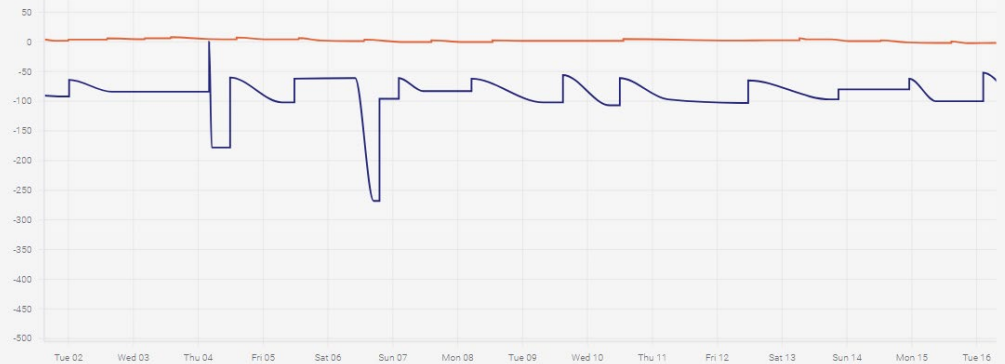


# The disclaimer..

## History

Day Week Month Year Custom  
Year 2024

Show Points Zoom in Zoom out Export Expand



Current outdoor temperature (BT1) Degree minutes

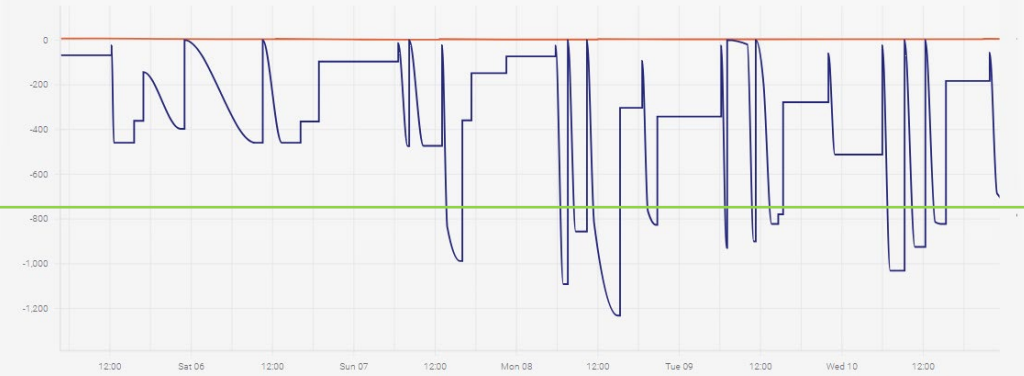
Add Parameter

Clear All

## History

Day Week Month Year Custom  
Year 2024

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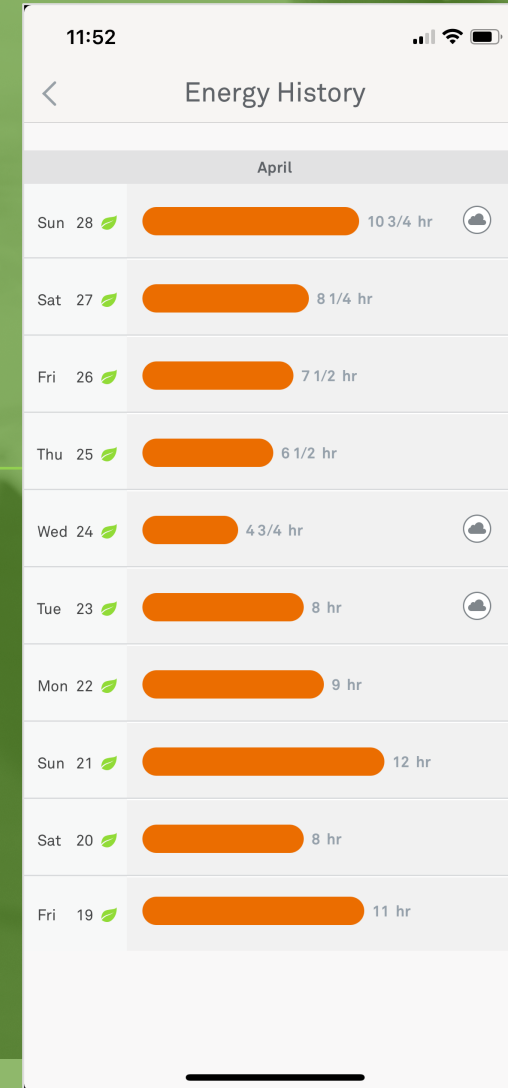
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Add Parameter

Clear All



# The disclaimer..





# Cardross, Dumbarton

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HeatpumpMonitor.org An open source initiative to share and compare heat pump performance data.




Here you can see a variety of installations monitored with OpenEnergyMonitor, and compare detailed statistics to see how performance can vary.


Stats time period Last 90 days 


If you're monitoring a heat pump with **Emoncms** and the MyHeatPump app, [login](#) to add your system.


Filter  Min days 72

To join in with discussion of the results, or for support please use the [OpenEnergyMonitor community forum](#).

 Top of the SCOPs

 Heatpump + Fabric

 Costs












Add fields 

Show systems with

MID metering (125)

Other metering (26)

Metering errors (11)

Location	Installer	Training	Source	Make & Model	Rating	Data length	COP ↓	DHW	Hx	MID	View
Sheffield	 Damon Blakemore		Air	Viessmann Vitocal 150A	10 kW	90 days	5.3		H4	<input checked="" type="checkbox"/>	  
Bristol	Rickman Heat		Air	Nibe F2050	9 kW	90 days	5.2		H3	<input checked="" type="checkbox"/>	 
Aylesbury	 Custom Renewables		Air	Viessmann Vitocal 150A	16 kW	90 days	5.0		H4	<input checked="" type="checkbox"/>	 
Cambridgeshire	TS		Air	Grant Aeron 3	13 kW	85 days	4.9	4.1	H2		 
Cairngorms National Park, Scotland	Tony Lake		Air	Panasonic J Series	7 kW	84 days	4.9	3.7	H4	<input checked="" type="checkbox"/>	 
Hitchin, Hertfordshire	 Libtek		Air	Vaillant Arotherm+	5 kW	83 days	4.8		H4	<input checked="" type="checkbox"/>	 
Market Drayton, Shropshire			Air	Samsung Gen 6	8 kW	90 days	4.8	2.5	H4	<input checked="" type="checkbox"/>	 
Aberdeenshire	 Aberdeen Air Source Heating Ltd.		Air	Vaillant Arotherm+	10 kW	90 days	4.7		H4	<input checked="" type="checkbox"/>	 
Gwynedd	 Bespoke Energy Solutions		Air	Vaillant Arotherm+	10 kW	85 days	4.7		H4	<input checked="" type="checkbox"/>	 
Leicester	 Jason Holme		Air	Vaillant Arotherm+	5 kW	90 days	4.7		H4	<input checked="" type="checkbox"/>	 
Foveran, Aberdeenshire	 Aberdeen Air Source Heating Ltd		Air	Vaillant Arotherm+	12 kW	90 days	4.6	3.5	H4		 
Cardross, Dumbarton	 Renewable Heat		Air	Nibe S2050	10 kW	89 days	4.6		H4	<input checked="" type="checkbox"/>	  
Newland, Dumfriesshire	 Mark Reed Arnold (self install)		Air	Samsung Gen 6	5 kW	86 days	4.5		H2		 



# Bragging rights.

**HeatpumpMonitor.org** An open source initiative to share and compare heat pump performance data.


























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Stats time period: Last 365 days

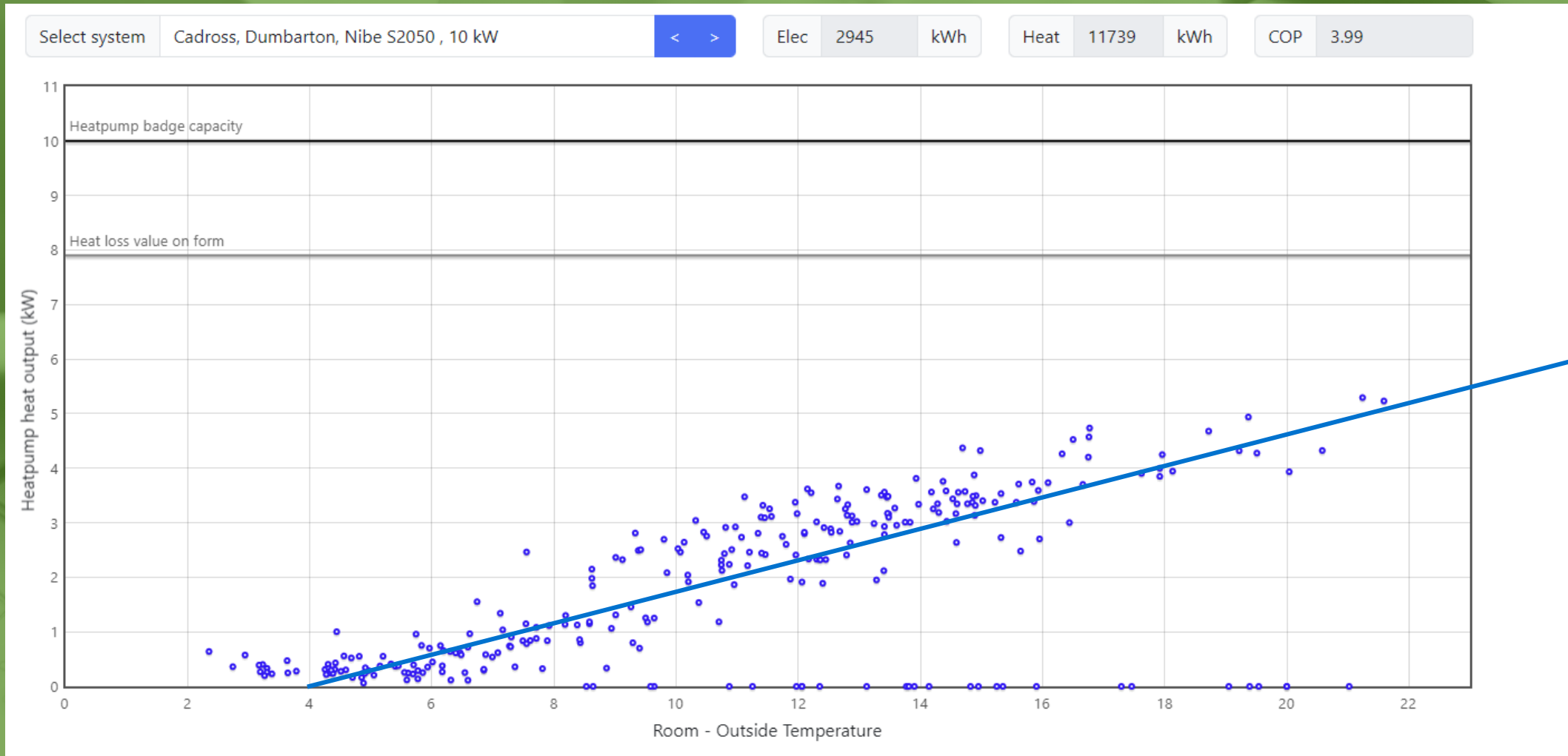
Filter: Min days: 290

Location	Installer	Training	Source	Make & Model	Rating	Data length	COP ↓	DHW	Hx	MID	View
Broxburn, West Lothian	 Renewable Heat (Barry Sharp)		Ground	Nibe S1155 PVT	12 kW	320 days	5.0	4.9	H4	<input checked="" type="checkbox"/>	 
Sheffield	 Damon Blakemore		Air	Viessmann Vitocal 150A	10 kW	319 days	5.0		H4	<input checked="" type="checkbox"/>	 
Bristol	Rickman Heat		Air	Nibe F2050	9 kW	319 days	4.7		H3	<input checked="" type="checkbox"/>	 
Mytchett, Surrey	 Heat Geek		Air	Vaillant Arotherm+	7 kW	354 days	4.6	4.2	H4	<input checked="" type="checkbox"/>	 
Stroud	Rickman Heat		Air	Vaillant Arotherm+	5 kW	335 days	4.5	2.4	H4	<input checked="" type="checkbox"/>	 
Leicester	 Jason Holme		Air	Vaillant Arotherm+	5 kW	297 days	4.5		H4	<input checked="" type="checkbox"/>	 
North Yorkshire	 Gavin Raitt		Air	Grant Aeron3	6 kW	361 days	4.4		H2	<input checked="" type="checkbox"/>	 

Left sidebar: Top of the SCOPs, Heatpump + Fabric, Costs, Add fields, Show systems with: MID metering (49), Other metering (7)



# Cardross, Dumbarton





# It's not just old homes...



**The Suburban Pirate** @suburbanpirate · Jul 20, 2023

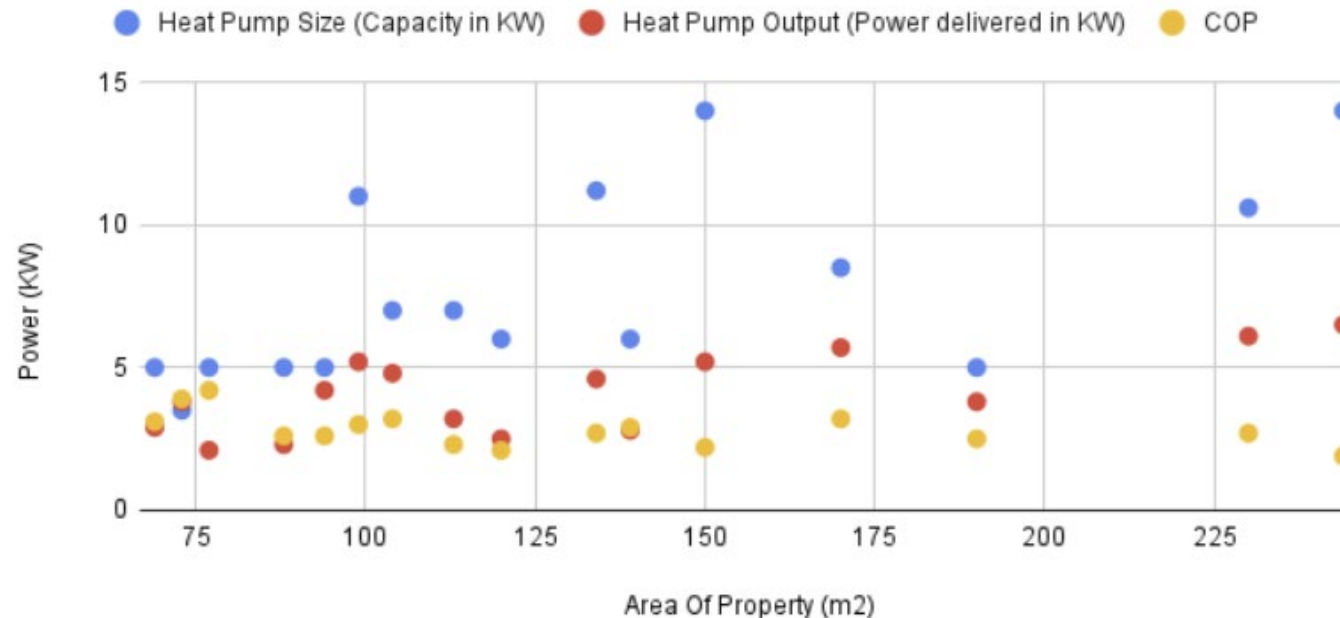


Replying to @suburbanpirate and @Openenergyyon

I added COP values on. Notice that COP is fairly flat with a slight uptick in the small heat pump cluster on the left.

## Heat Pump Size Vs. Heat Pump Output on Dec 14 2022 for a range of properties

Measured output (red) below heat pump capacity (blue) COP values (yellow)





# Fabric First?

Scottish Housing News

News - Insight - Jobs - Events - Podcast

LATEST | APPOINTMENTS | FUEL POVERTY | HOMELESSNESS | PRS | WELFARE

**The Housing & Social Care Accessibility Summit 2024**  
TICKETS AVAILABLE NOW

**We're shining a light on tenant and resident safety in social housing in Scotland**  
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## Why 'fabric-first' may be the wrong approach for retrofitting - podcast transcript

22 MAR 2024 | Reading time: 37 minutes

Home About Contact Content Research Integrity B&C Community Site

# BUILDINGS & CITIES

Start Submission

Reading: Fabric first: is it still the right approach? [Download](#) A+ A-

### Briefing Notes

## Fabric first: is it still the right approach?

Nick Eyre, Tina Fawcett, Marina Topouzi, Gavin Killip, Tadj Oreszczyn, Kay Jenkinson, Jan Rosenow

### Abstract

'Fabric first' describes an approach to improving the thermal performance of


**LABM**  
LOCAL AUTHORITY LEADERS & EXPERTS

THE LATEST | MAGAZINE ARCHIVE

# NET ZERO

## It's time for the industry to forget 'Fabric First' and focus on real decarbonisation

Date: 8 May, 2024



Neil Waite, Director of NetZero Collective argues that it's time for the industry to forget 'Fabric First' and focus on real decarbonisation.

The journey toward net zero, while still in its infancy, has at times felt like a marathon and a sprint, laden with challenges, evolving strategies, and a collective urgency that intensifies with each passing year.

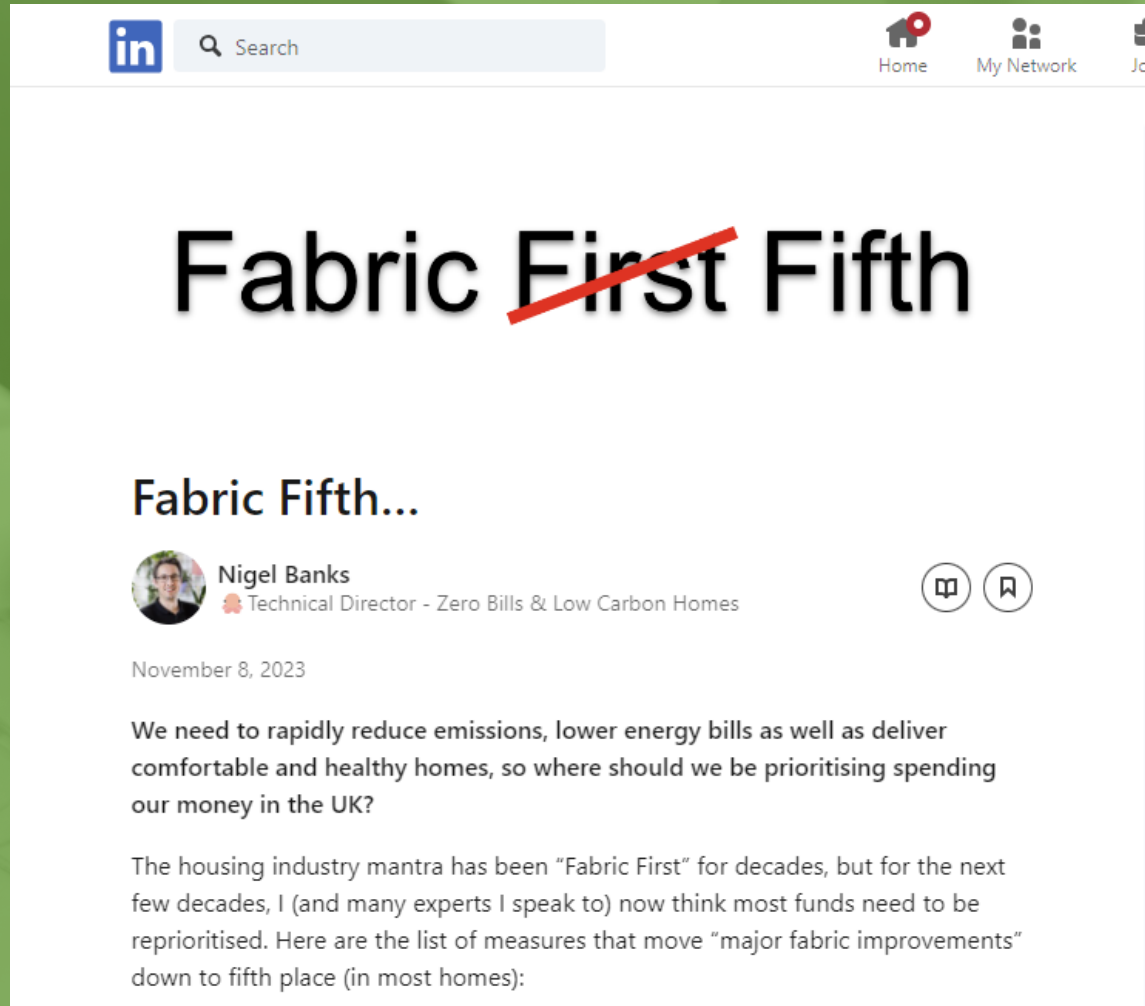
Government initiatives such as Social Housing Decarbonisation

Search

**Featured video**

Wavin UK - Aqua...

# Fabric Fifth



LinkedIn post by Nigel Banks, Technical Director - Zero Bills & Low Carbon Homes. The post title is "Fabric ~~First~~ Fifth". The text discusses the need to reduce emissions and lower energy bills, and lists measures for major fabric improvements.

**Fabric ~~First~~ Fifth**

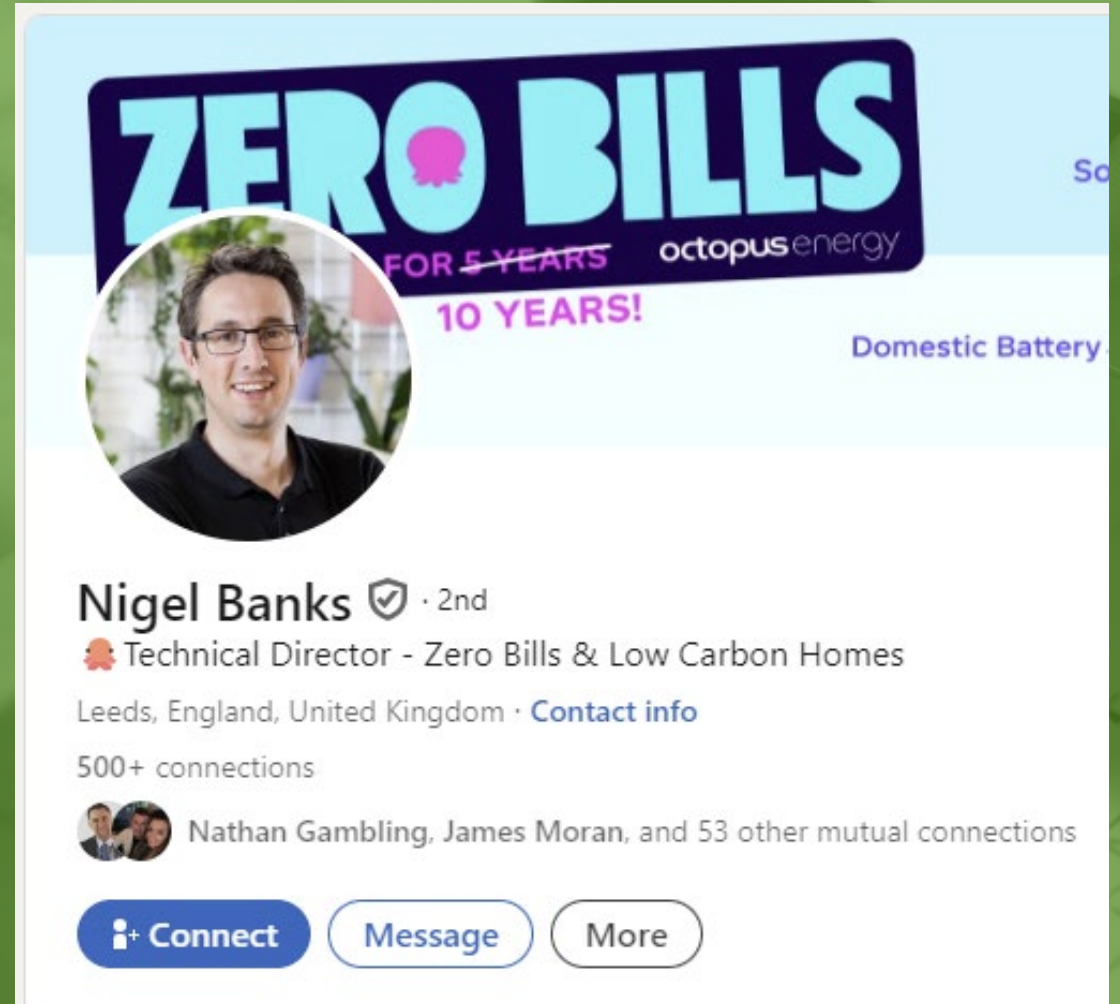
**Fabric Fifth...**

**Nigel Banks** Technical Director - Zero Bills & Low Carbon Homes

November 8, 2023

We need to rapidly reduce emissions, lower energy bills as well as deliver comfortable and healthy homes, so where should we be prioritising spending our money in the UK?

The housing industry mantra has been "Fabric First" for decades, but for the next few decades, I (and many experts I speak to) now think most funds need to be reprioritised. Here are the list of measures that move "major fabric improvements" down to fifth place (in most homes):



LinkedIn profile of Nigel Banks, Technical Director - Zero Bills & Low Carbon Homes. The profile features a banner for "ZERO BILLS FOR 5 YEARS 10 YEARS!" with the Octopus Energy logo and "Domestic Battery".

**ZERO BILLS**  
FOR 5 YEARS 10 YEARS!  
octopus energy  
Domestic Battery

**Nigel Banks** · 2nd  
Technical Director - Zero Bills & Low Carbon Homes  
Leeds, England, United Kingdom · [Contact info](#)  
500+ connections  
Nathan Gambling, James Moran, and 53 other mutual connections

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## BetaTalk - The Renewable Energy and Low Carbon Heating Podcast

Fabric Fifth - has SHDF Mismanagement Wasted Tax Payers Money?

JUNE 06, 2024   NATHAN GAMBLING BETATEACH   SEASON 9   EPISODE 14



Fabric Fifth - has SHDF Mismanagement Wasted Tax Payers Money?

BetaTalk - The Renewable Energy and Low Carbon Heating Podcast



00:00:00 | 01:08:46



1x

More Info

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# Fabric 5th

- 1. ASHP ASAP**
- 2. Get Smart**
- 3. Get Comfy and Measure**
- 4. Solar and Storage**
- 5. Fabric**



# Green Homes Festival's Fabric 5<sup>th</sup> Approach

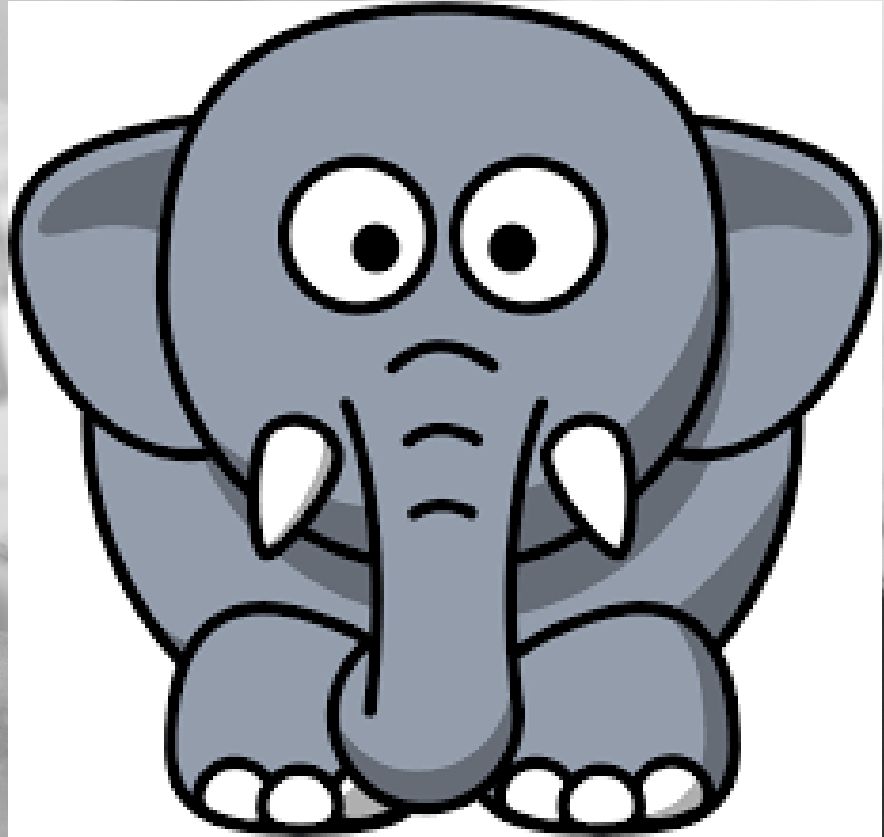
3. Get Comfy and Measure
2. Get Smart
1. ASHP ASAP
4. Solar and Storage
5. Fabric



# 43 Slides to make one point

- Old homes are **not hard to heat** as long as you tackle the low hanging fruit
  - Upgrade the window (if they are single glazed)
  - Draft proof the house
  - Insulated the loft
- We are probably overestimating the heat requirements of most homes





# Elephants in Tenement Flats

## SCOTTISH HOUSING FACTS

Total Scottish homes: 2,496,000

Detached - **576,000** (built pre-1919 = 122,000)

Semi-detached **494,000** (built pre-1919 =52,000)

Terraced **525,000** (built pre-1919 =64,000)

Tenement **587,000** (built pre-1919 =184,000)

Other flats **315,000** (built pre-1919 =58,000)

- Pre-1919 total: 479,000
- 1919-44: 273,000
- 1945-64: 518,000
- 1965-82: 548,000
- Since 1982: 677,000

Source: Scottish government, 2019

**35% of Scottish housing stock is Tenement or Flat**

**9.7% of Scottish housing stock is Tenement or Flat (pre-1919)**





# Elephants in Tenement Flats



**Tenement flats are not hard to heat,  
just hard to heat without gas.**



# Elephants in Tenement Flats

**Heat pumps might not be the solution,  
where do you fit the outdoor unit?**

- **The garden is communal**
- **They are too heavy to hang off walls at height**
- **Planning, building control**
- **On the roof? But who owns the roof?**



# Elephants in Tenement Flats

## Hydrogen?

**Periodic Table of the Elements**

Normal boiling points are in °C.  
SP = Triple Point.  
Pressure is listed if not 1 atm.  
Allotrope is listed if more than one allotrope.

Atomic Number, Boiling Point, Symbol, Name, Atomic Mass

1 IA 1A 1 H Hydrogen 1.008	2 IIA 2A 4 He Helium 4.003	3 IIIA 3A 5 B Boron 10.811	4 IVA 4A 6 C Carbon 12.011	5 VA 5A 7 N Nitrogen 14.007	6 VIA 6A 8 O Oxygen 15.999	7 VIIA 7A 9 F Fluorine 18.998	8 VIIIA 8A 10 Ne Neon 20.180	11 IB 1B 13 Al Aluminum 26.982	12 IIB 2B 14 Si Silicon 28.086	15 IIIA 3A 15 P Phosphorus 30.974	16 IVB 4B 16 S Sulfur 32.065	17 VB 5B 17 Cl Chlorine 35.453	18 VIB 6B 18 Ar Argon 39.948	19 VIIB 7B 19 K Potassium 39.098	20 VIII 8 20 Ca Calcium 40.078	21 VIII 8 21 Sc Scandium 44.956	22 VIII 8 22 Ti Titanium 47.88	23 VIII 8 23 V Vanadium 50.942	24 VIII 8 24 Cr Chromium 51.996	25 VIII 8 25 Mn Manganese 54.938	26 VIII 8 26 Fe Iron 55.833	27 VIII 8 27 Co Cobalt 58.933	28 VIII 8 28 Ni Nickel 58.693	29 VIII 8 29 Cu Copper 63.546	30 VIII 8 30 Zn Zinc 65.39	31 VIII 8 31 Ga Gallium 69.723	32 VIII 8 32 Ge Germanium 72.61	33 VIII 8 33 As Arsenic 74.922	34 VIII 8 34 Se Selenium 78.972	35 VIII 8 35 Br Bromine 79.904	36 VIII 8 36 Kr Krypton 84.80	37 VIII 8 37 Rb Rubidium 84.468	38 VIII 8 38 Sr Strontium 87.62	39 VIII 8 39 Y Yttrium 88.906	40 VIII 8 40 Zr Zirconium 91.224	41 VIII 8 41 Nb Niobium 92.906	42 VIII 8 42 Mo Molybdenum 95.95	43 VIII 8 43 Tc Technetium 98.907	44 VIII 8 44 Ru Ruthenium 101.07	45 VIII 8 45 Rh Rhodium 102.906	46 VIII 8 46 Pd Palladium 106.42	47 VIII 8 47 Ag Silver 107.868	48 VIII 8 48 Cd Cadmium 112.411	49 VIII 8 49 In Indium 114.818	50 VIII 8 50 Sn Tin 118.71	51 VIII 8 51 Sb Antimony 121.760	52 VIII 8 52 Te Tellurium 127.6	53 VIII 8 53 I Iodine 126.904	54 VIII 8 54 Xe Xenon 131.29	55 VIII 8 55 Cs Cesium 132.905	56 VIII 8 56 Ba Barium 137.327	57-71 VIII 8 57-71 Lanthanide Series	72 VIII 8 72 Hf Hafnium 178.49	73 VIII 8 73 Ta Tantalum 180.948	74 VIII 8 74 W Tungsten 183.85	75 VIII 8 75 Re Rhenium 186.207	76 VIII 8 76 Os Osmium 190.23	77 VIII 8 77 Ir Iridium 192.22	78 VIII 8 78 Pt Platinum 195.08	79 VIII 8 79 Au Gold 196.967	80 VIII 8 80 Hg Mercury 200.59	81 VIII 8 81 Tl Thallium 204.383	82 VIII 8 82 Pb Lead 207.2	83 VIII 8 83 Bi Bismuth 208.980	84 VIII 8 84 Po Polonium [208.982]	85 VIII 8 85 At Astatine 209.987	86 VIII 8 86 Rn Radon 222.018	87 VIII 8 87 Fr Francium 223.020	88 VIII 8 88 Ra Radium 226.025	89-103 VIII 8 89-103 Actinide Series	104 VIII 8 104 Rf Rutherfordium [261]	105 VIII 8 105 Db Dubnium [262]	106 VIII 8 106 Sg Seaborgium [266]	107 VIII 8 107 Bh Bohrium [264]	108 VIII 8 108 Hs Hassium [269]	109 VIII 8 109 Mt Meitnerium [268]	110 VIII 8 110 Ds Darmstadtium [269]	111 VIII 8 111 Rg Roentgenium [272]	112 VIII 8 112 Cn Copernicium [277]	113 VIII 8 113 Uut Ununtrium unknown	114 VIII 8 114 Fl Flerovium [289]	115 VIII 8 115 Uup Ununpentium unknown	116 VIII 8 116 Lv Livermorium [293]	117 VIII 8 117 Uus Ununseptium unknown	118 VIII 8 118 Uuo Ununoctium unknown
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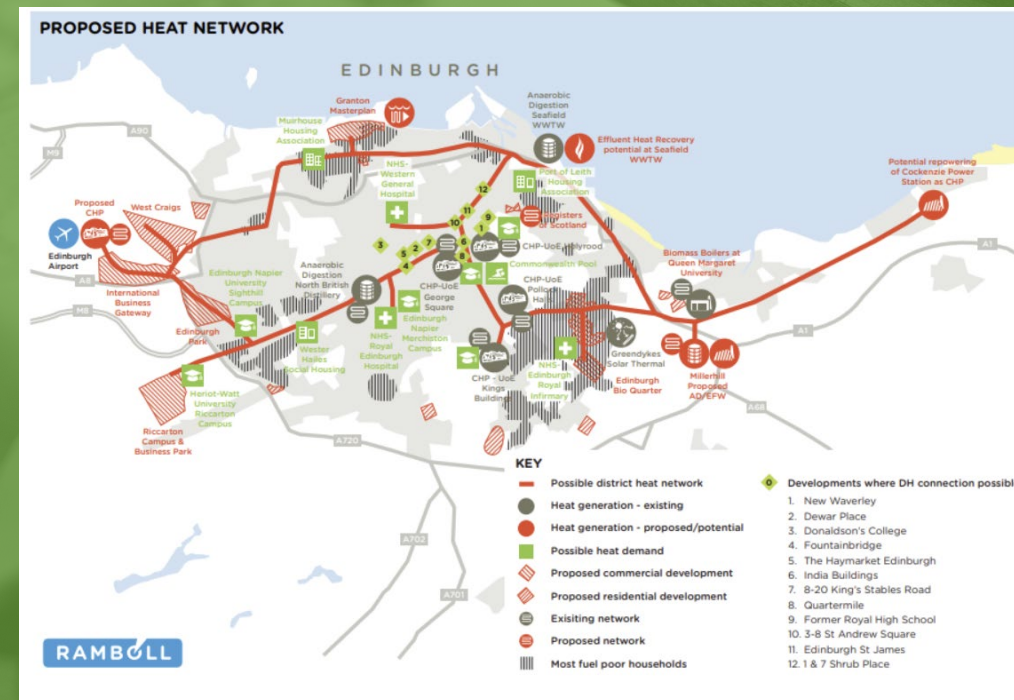
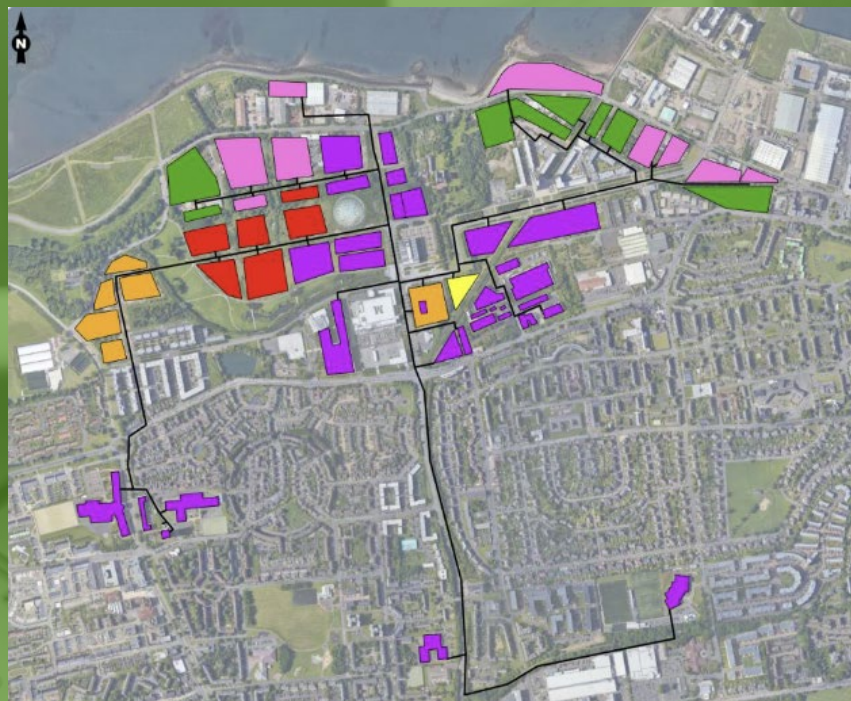
Legend: Alkali Metal, Alkaline Earth, Transition Metal, Basic Metal, Semimetal, Nonmetal, Halogen, Noble Gas, Lanthanide, Actinide

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# Elephants in Tenement Flats

## Heat Network?





# Elephants in Tenement Flats

## Heat Network with a heat pump?

Table 1: Classification of heat networks, adapted from [1].

Network type	Temperatures supply/return	Features
Ice network	0 °C / 12 °C	little widespread, more efficient than conventional cooling network
Cooling network	6 °C / 12 °C	large volume flows
Source network	6 °C - 15 °C / 3 °C - 6 °C	"classic" <b>5GDHC network</b> , little heat losses (but heat gains!)
Alternating-warm heat network	25 °C - 45 °C / 10 °C - 25 °C	is operated in winter as a normal heat network, in summer also cold supply
Low-temperature heat network (4th generation district heating)	70 °C - 90 °C / 50 °C - 70 °C	often in combination with solar thermal or central heat pump, "modern" heat network
High-temperature heat network (3rd generation district heating)	> 100 °C	currently (still) most widespread type of heat network, inefficient, difficult to decarbonize
Steam network (1st generation district heating)	< 200 °C	obsolete technology, but still in use in some cases, inefficient



# Elephants in Tenement Flats



## Heat Network with a heat pump?

The screenshot shows the Kensa Heat Pumps website. At the top left is the Kensa logo, a red circle with a white dot, followed by the text 'Kensa Heat Pumps' and 'A KENSA GROUP COMPANY'. To the right is a search bar with the word 'Search' and a magnifying glass icon. Further right is the phone number 'Call. 0808 588 1602' and a red button that says 'GET A QUOTE'. Below the header is a navigation menu with a home icon and the following items: 'Solutions', 'Heat Pump Products', 'Installers', 'Developers', 'Funding', 'FAQs', 'Knowledge Hub', 'About Kensa', and 'Our Vision'. The main content area features three 3D cutaway diagrams of buildings. The first diagram shows a single-story house with a ground loop heat pump system. The second diagram shows a two-story tenement building with a similar ground loop system. The third diagram shows a multi-story apartment block with a vertical heat pump system and ground loops.

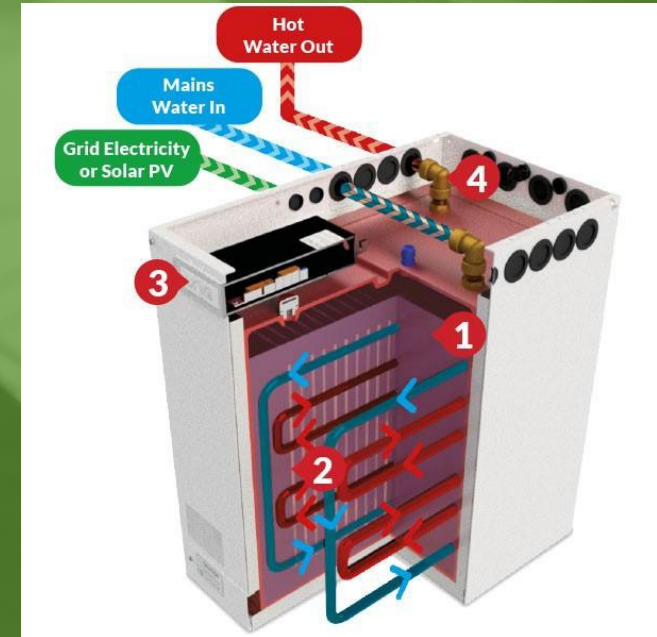


# Elephants in Tenement Flats

## Storage Heaters / SunAmp?

Failures in the past because of;

- **Uncontrollable heat**
- **Running cost**







# Elephants in Tenement Flats

Solar power [+ Add to myFT](#)

## Global glut turns solar panels into garden fencing option

Europeans find alternative location for cheap green technology with cost of rooftop installation so high







# Dalrymple Crescent

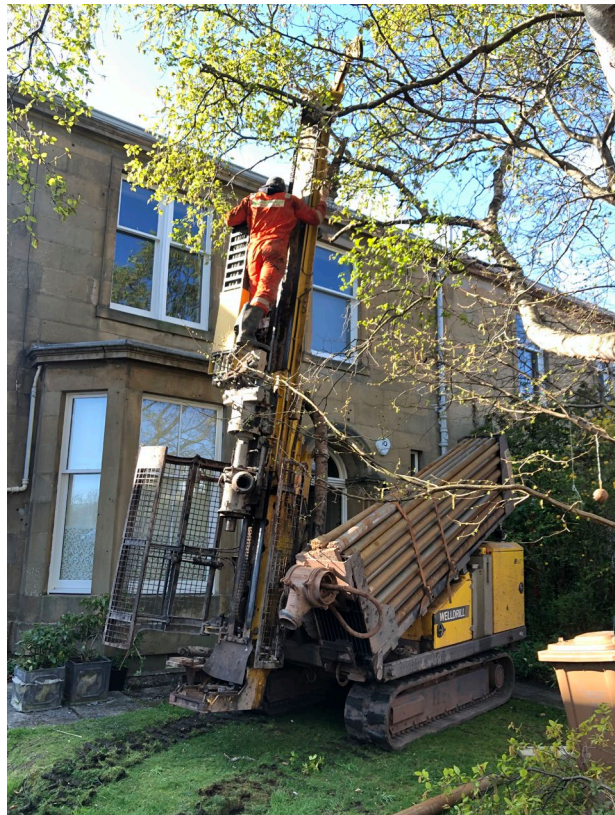
## Bruce Crawford







# Dalrymple Crescent





# Dalrymple Crescent



# Any Questions?