Presentation to the Morningside Community Councils

Conservation and Adaptation: The challenge of insulating our houses for greater energy efficiency.

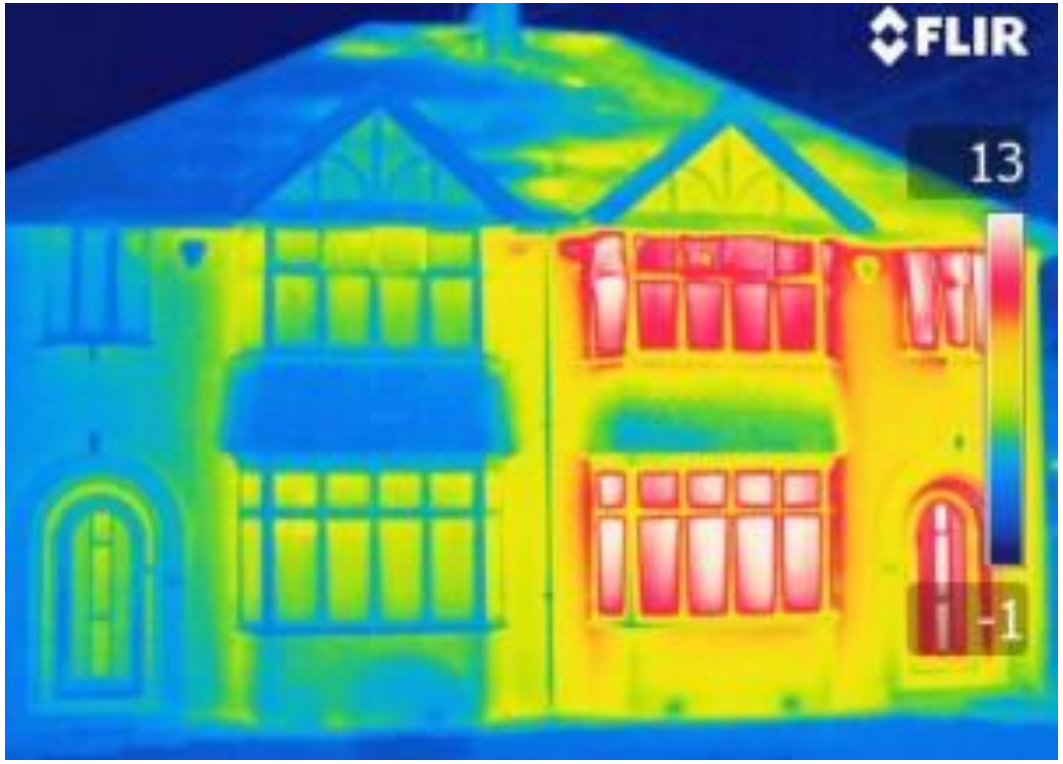
Douglas Rogers – Community councillor

Marchmont & Sciennes Community Council

Introduction

The following slides are grouped as:

- 3-7 Current programs seeking to support the Net Zero target
- 8-9 Reasoned response and other agencies
- 10-11 Understanding the units and the Fabric First philosophy
- 11-15 How the insulation in our houses could be improved
- 16-17 What these improvements might achieve and conclusions



An infrared image of a pair of semi-detached houses, one fully insulated

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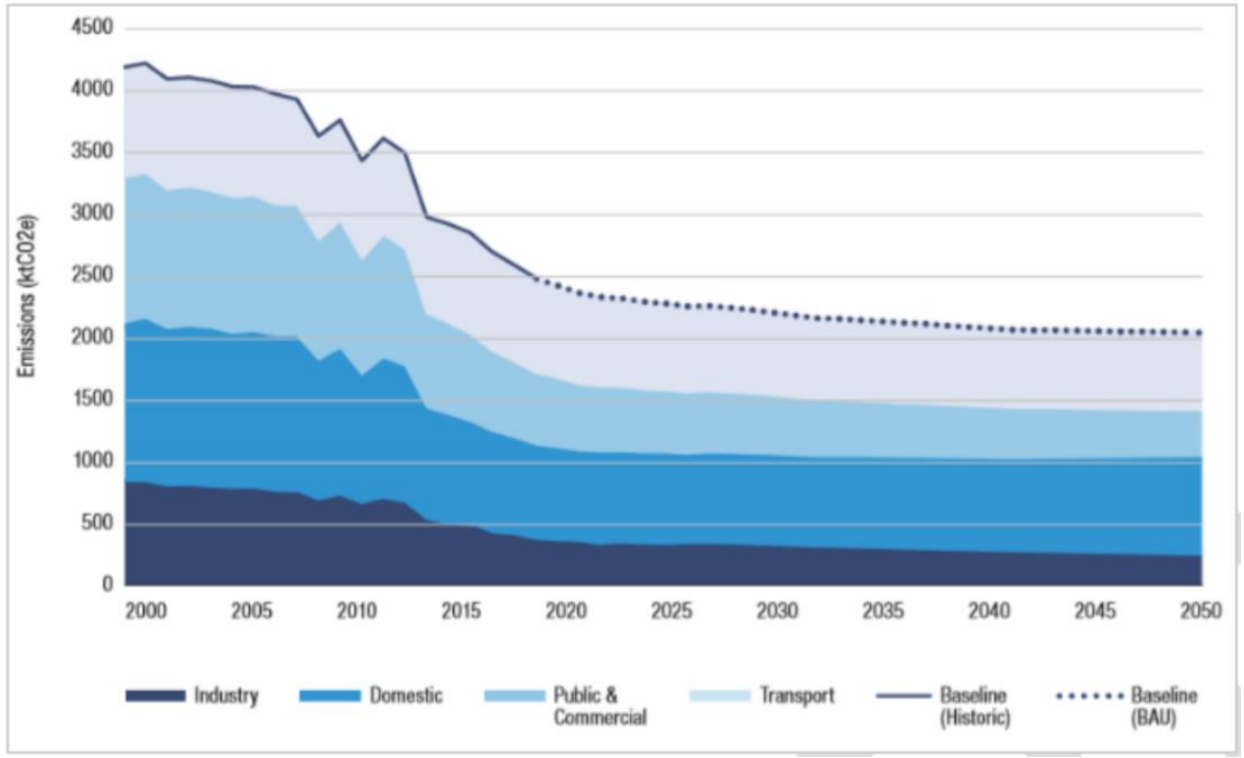
How can we meet the 2030 Net Zero target for Edinburgh?



Cumulative emissions reduction potential by scenario.
From A Net-Zero Carbon Roadmap for Edinburgh.

From Net-Zero carbon roadmap

- 40% reduction since 2000 now is:
  - 31% from transport
  - 29% from domestic housing
  - 23% Public & commercial
  - 17% industry
- 9% projected reduction by 2030
  - Decreased domestic emissions offset by building new houses and flats
- Acceleration of carbon reduction programmes is required to meet the Net Zero target!

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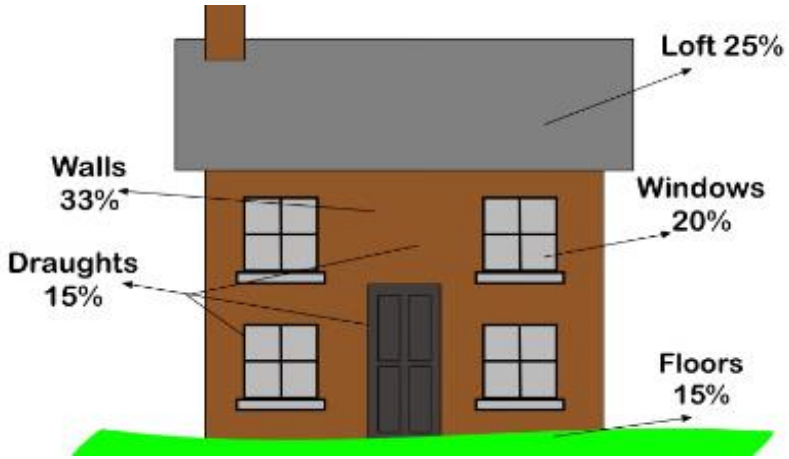
So what can we do?

Insulate our houses?

Evidence in a Cambridge research paper on houses with improved insulation, showed some benefit initially but no significant energy saving after 5 years:

- We insulate first for comfort – so reduced settings drift back
- Then to reduce bills – but only when our bills are too high
- Finally to reduce our carbon footprint



Heat loss ratio from uninsulated house

How can we ensure that houses are better insulated?

Through legislation?

- Houses must be let or sold with an EPC rating certificate
- An EPC rating of C for properties relet after 2025 and all by 2028
- Aim to have all buildings have an EPC rating of C by 2035
- Building regulations set insulation standards for retrofit

By providing grants and loans?

- Loans available for insulation upgrades listed on EPC certificate
- Grants for heat pumps and some insulation improvements

There is still not enough incentive to insulate to the high standard we require to meet Net Zero!

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Who is doing what in the Council?

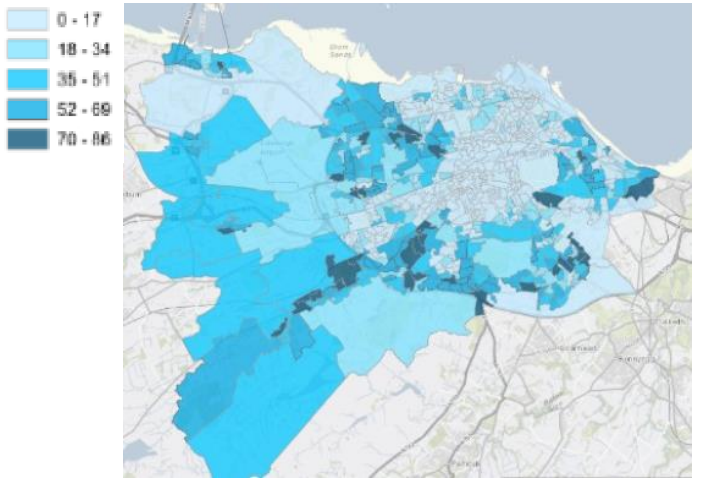
City of Edinburgh council's Conservation & Adaptation work

- First working group held 15th August: Second on 1st September
- Instigated by the planning committee – lead by Councillor Hal Osler
- Survey results analysed by Dr Lee of Edinburgh University with detailed analysis
- Historic Environment Scotland presented solutions to problems associated with insulating listed buildings

The category 'B' listed Georgian corner block that was fully double-glazed with no detrimental impact to the aesthetics of the building

City of Edinburgh's Local Heat and Energy Efficiency Strategy

- First working group – 4th September: Further working groups not yet announced
- Funded through Scottish Government - Programme Development officer Kyle Drummond
- Stage one to analyse houses and other buildings now complete – Stage two to formulate a delivery plan
- Refined LHEES and Delivery Plan to be brought to Policy & Sustainability Committee in December 2023
- The Changeworks charity used multiple sources of data to identify areas down to 100m square zones:
  - Areas of fuel poverty and social deprivation – affordable housing run through councils and housing associations
  - Sites suitable for fitting photo-voltaics on roofs of single houses and in public spaces
  - Areas within conservation zones
  - Houses and flats suitable for heat pumps and potential locations for shared ground based heat sources
  - Access to data to remain restricted due to privacy concerns



Solar PV potential in Edinburgh

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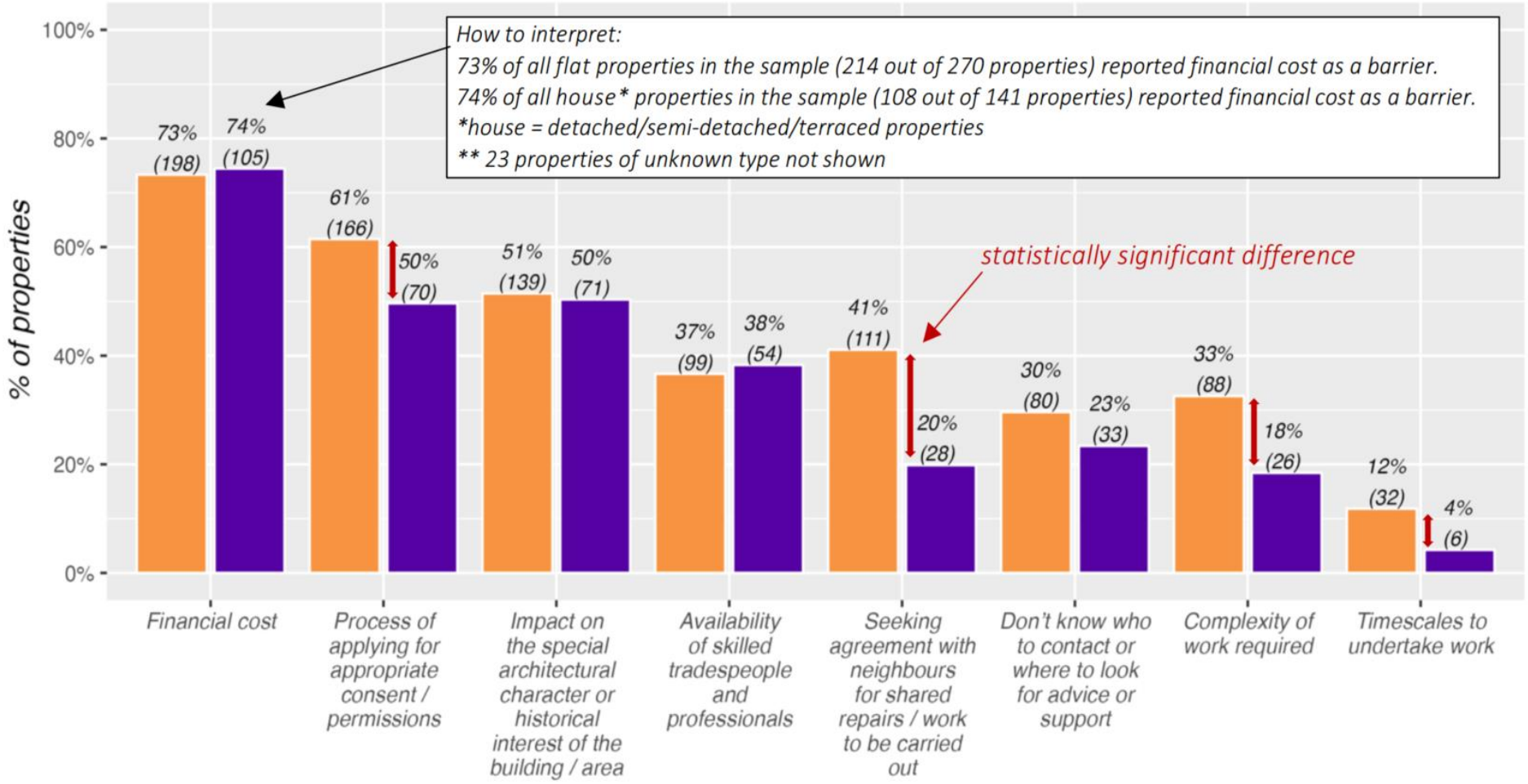
Key takeaway from Conservation & Adaptation survey



Analysis of Responses to the City of Edinburgh Council Public Consultation.

Dr W. V. Lee
University of Edinburgh
21st August 2023

property type

Flat House

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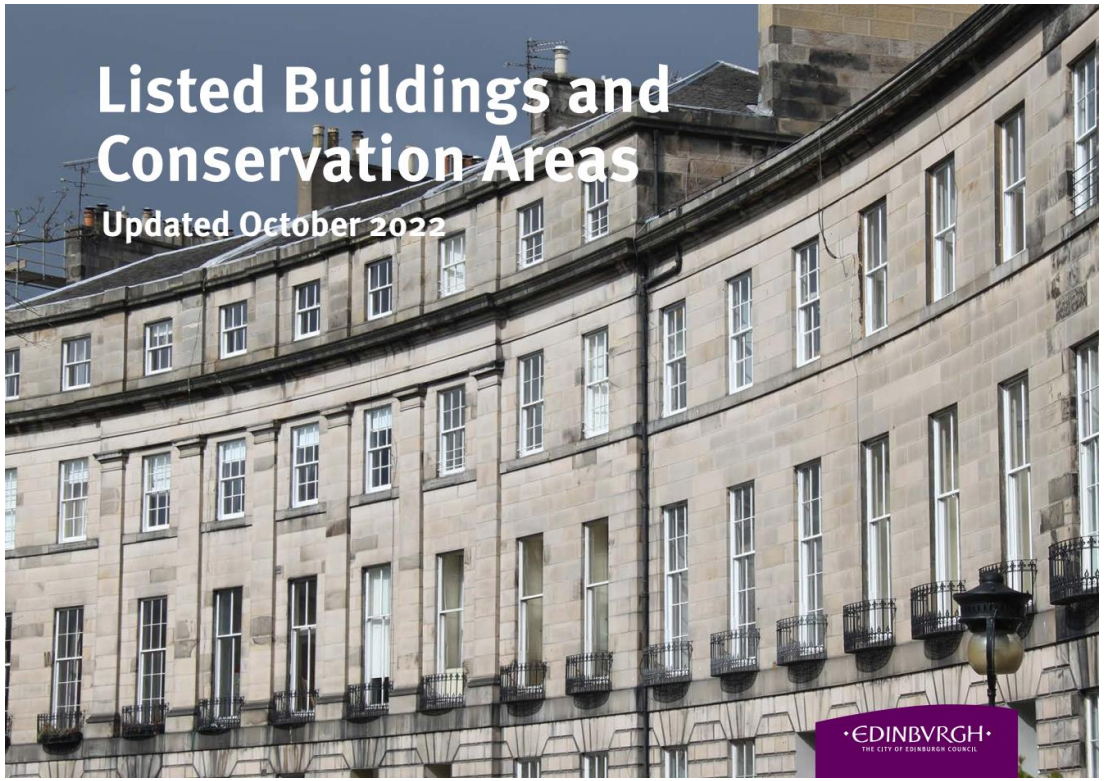
A reasoned response to the Conservation & Adaptation programme.

My take on what needs to happen now

- A leaflet prepared to be distributed to all householders in conjunction with other departments to give broad advise on reaching the necessary standard
- Planning guidance to be updated and written around leaflet not other way round
- The planning guidance to be split into two – one specifically for conservation zone properties
- Allow like for like replacements for windows in looks but not necessarily function
- Provide library of standard methods supported by the Council for retrofitting to a high standard
- Mandate for forced ventilation as part of wall insulation upgrade



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What other initiatives are there?

The University of Edinburgh – Climate Change Institute

- Survey evaluation
- Analysis of current practices
- Workshops on meeting NetZero

The Engine Shed and Historic Environment Scotland

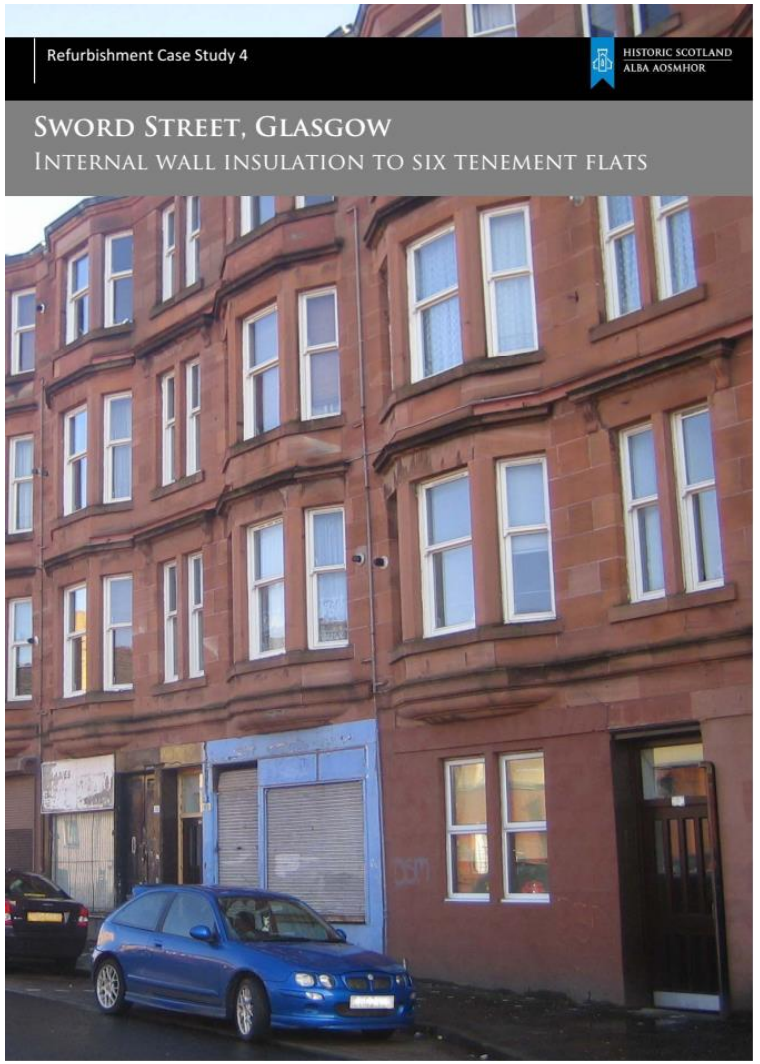
- Courses and information
- Refurbishment case studies and other documents
- Limited resources – HES has three employees

Edinburgh Building Retrofit and Improvement Collective

- Seeking to encourage community cooperation

Home Energy Scotland and WarmWorks

- Grants and loans for householders
- Insulation and heating upgrades for the vulnerable



Why we need to understand U values

The EPC rating system was designed as an assessment method and not to impose common standards. More useful are:

- Building regulation minimum U values
- EnerPHit maximum heat loss standard for retrofit
- Aim for total energy usage over year

Calculating annual heat loss through each element is calculated as below

Heating_demand = (Uvalue*area*degree_days*24/1000 / floor_area) kWh/m^2/yr

- U value is heat loss per square meter per degree difference
- Degree days is sum of temperature difference inside and outside for each day, summed over the full month or year
- Now multiply by 24 and divide by 1000 to get units right and divide by floor area

Heat is lost also through air exchange through natural or forced ventilation

Heating_demand = (Constant*volume*ACH*degree_days*24/1000) kWh/m^2/yr

- The Air Changes per Hour (ACH) is at least 1 for old houses
- Constant = 0.33; (= Specific Heat * density * units correction)
- ACH depends on location. For homes it should be between 0.35 and 1
- For schools, ACH = 6; For other public spaces, between 2 and 4.

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
24°C	325	415	484	617	618	515	549	507	413	289	251	272	**5256**
22°C	265	353	424	555	556	459	487	447	351	229	191	210	**4530**
20°C	206	291	364	493	494	403	426	387	289	171	134	151	**3809**
18°C	148	229	304	431	432	347	364	327	228	117	83	96	**3106**
16°C	96	168	244	369	370	291	302	267	168	70	41	52	**2438**

Degree days per month averaged over last 3 years for Edinburgh Airport

Type of element	Average U-value for all elements			HES case study results achieved
Maximum U-values	Heated buildings	Unheated buildings	Element	
Wall (Solid)	0.3 W/m2K	0.22 W/m2K	0.7 W/m2K	0.15 80mm cellulose (RCS16) 0.19 80mm WFB (RCS 6) 0.22 100mm hemp (RCS 4) 0.29 100mm cellulose (RCS4) 0.3 50mm bonded bead (RCS 35) 0.32 50mm bonded bead (RCS 4) 0.32 50mm Aerogel Board (RCS 4)
Floor	0.25 W/m2K	0.18 W/m2K	0.7 W/m2K	0.7 80mm WFB (RCS 2) 0.5 100mm lime concrete (RCS 22)
Pitched roof (insulation between ceiling ties or collars)	0.25 W/m2K	0.15 W/m2K	0.35 W/m2K	0.2 280mm sheep's wool (RCS 2) 0.2 250mm hemp board (RCS 3)
Flat or pitched roof (insulation between rafters or roof with integral insulation)	-	0.18 W/m2K	0.35 W/m2K	0.14 100mm WFB (RCS 20)
Windows, doors, roof lights	1.6 W/m2K	1.6 W/m2K	3.3 W/m2K	0.6 double secondary glazing (RCS 1) 1.5 Single Secondary glazing (RCS 1) 0.4 aerogel blanket to shutter (RCS 1) 2.4 polycarbonate secondary glazing (RCS 2) 1.9-2.9 slim profile glazing (Technical Paper 20) 0.8 10mm aerogel blanket to door (RCS 10)

Maximum U-values applicable to the conversion of historic, listed or traditional buildings from Scottish Government's Building Standards Technical Handbook (Domestic) with reference to Historic Environment Scotland Case Studies' and Technical Papers' results.

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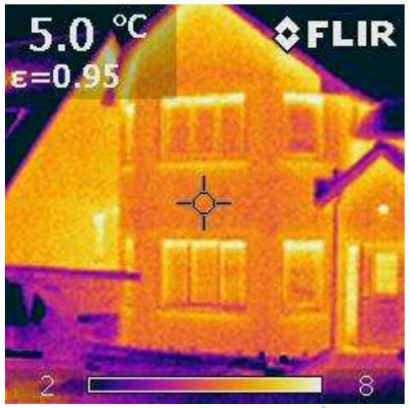
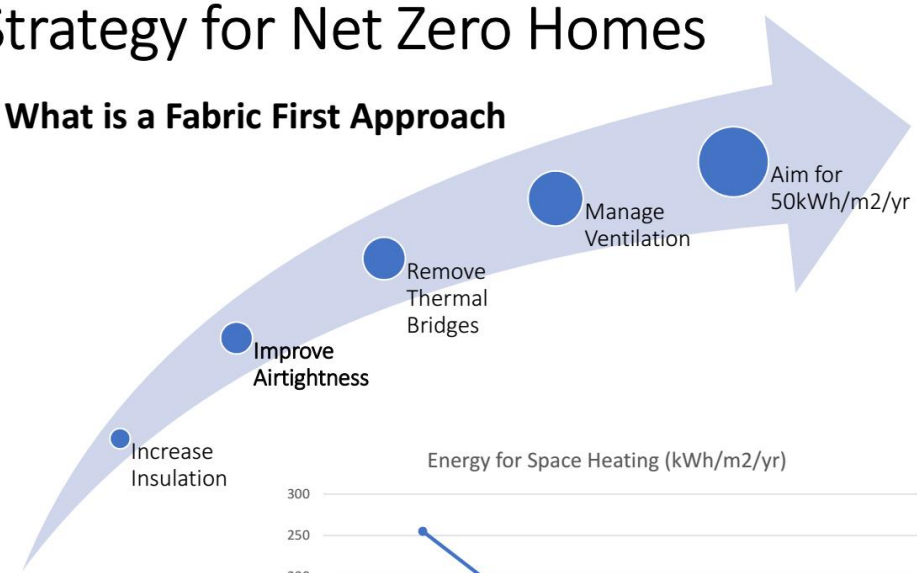
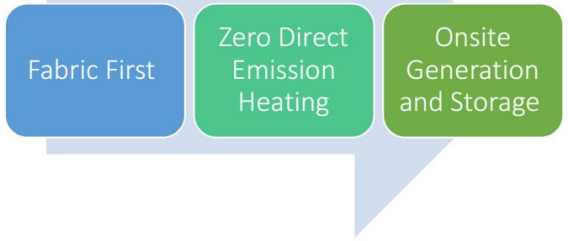
The fabric First approach

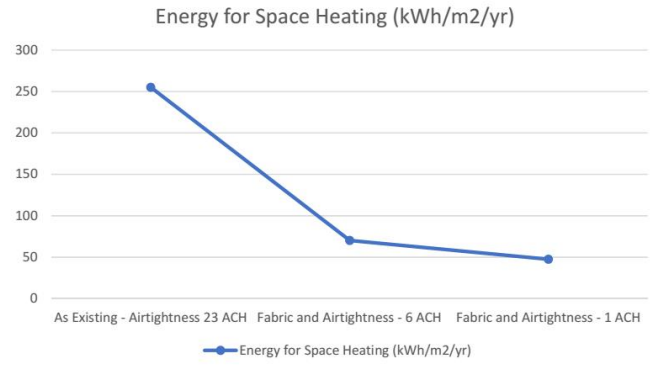
Preferred Retrofit Strategy for Net Zero Homes



What is a Fabric First Approach







We need to concentrate on stopping the heat escaping!

- Insulation first
- Resolve thermal bridges
- Seal the house and use forced ventilation with heat exchanger
- Go beyond the EPC ratings

Link group Housing association strategy for NetZero.

- Fabric First approach
- Target 50kWhr/m^2/yr
- Note: EnerPHit is 25kWhr/m^2/yr

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Infiltration – its not the cold air getting in it's the hot air getting out!

There are some obvious culprits:

- Open chimneys
- Poorly fitting windows and doors
- Gaps in floorboards

Retrofit draught proofing

- Brush seals on sash windows
- Foam seals on door jams
- Bottoms of doors less easy to seal
- Chimney sheep to block chimneys

Or should we be replacing our doors and windows to include double seals?

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Windows – thin double glazing is this enough?

Window details from planning guidance + thin-double glazed

Glazing units only	Glass	Cavity	Overall	U value
Heritage 3/4/3	3 mm	4 mm	10mm	1.9 W/m^{2}K
Heritage 4/4/4	4 mm	4 mm	12 mm	1.8 W/m^{2}K
Heritage 4/6/4	4 mm	6 mm	14 mm	1.4 W/m^{2}K
Heritage 4/8/4	4 mm	8 mm	16 mm	1.1 W/m^{2}K

What the October 2022 planning guidance says

- Replacement windows: "*should be designed to replicate the original details including materials, design and opening method*"
- Improving thermal efficiency: "*Heavy curtains and traditional shutters can be used to help reduce the amount of heat which escapes from the building*"
- Replacement Narrow profile glazing: "*a cavity gap of 6 mm between two 4mm glass panes will usually be acceptable*"

Achievable U values for complete installation

- Double glazing with low-E coating 1.2 W/Km^2
- Derated if not vertical to 1.4 W/Km^2
- Triple glazing with low-E coating 0.8 W/Km^2
- Velux pentuple glazing 0.5 W/Km^2
- EnerPHit: 0.8 W/Km^2 normally required

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Roofs and ceilings – not always easy to insulate.

Most Edinburgh rooves are mainly flat with pitched front aspect.

- Flat rooves can be “Hot decked” with insulation under the roofing felt
- Gabled roofs need to be insulated from inside – air space must be ventilated by using porous membrane under slates
- A U value of 0.2 W/Km^2 can be achieved with an insulation thickness of 150mm to 210mm depending on material used

For houses with gabled roofs, achieving a low U value can be easily achieved then by adding extra layers of rockwool insulation.

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Walls – much more difficult.

What are our walls mostly built of?

- Stone between 600mm and 900mm thick
- Lathe and plaster wall lining on battens

How can we insulate them?

- Inject insulation behind wall lining
- Apply insulation on top of wall lining
- Fit insulation into new framework

What are the problems?

- Preserving complex cornices and skirtings
- Controlling the moisture level in the walls

Injecting polystyrene insulation behind wall lining

Hemp board insulation between timber framing

Historic Scotland Refurbishment case study 4

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Forced heat-transfer ventilation

Why install heat recovery ventilation?

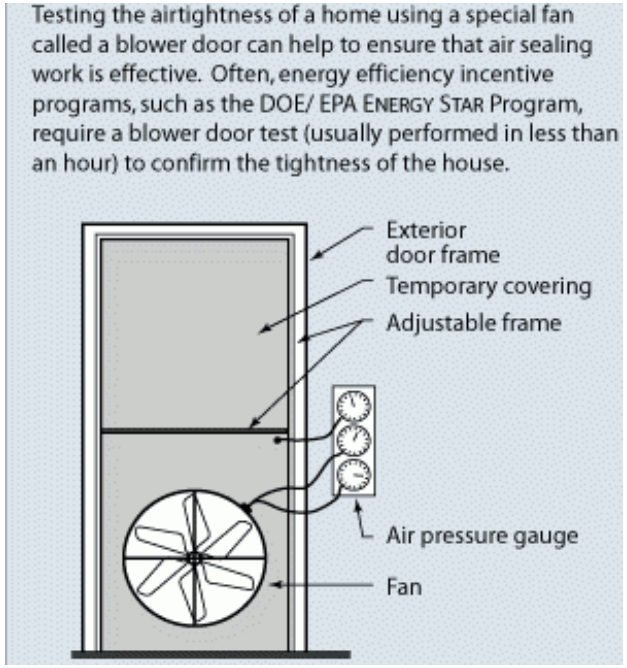
Infiltration is a major cause of heat loss in buildings.

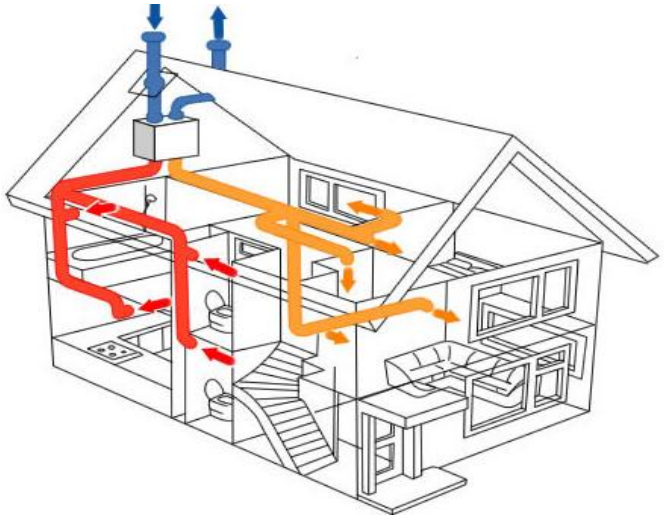
- Buildings require regular changes of air so once the house is sealed, forced ventilation systems with heat recovery are required.
- Ventilation is especially important in old stone buildings as moisture penetrates through the walls.

What is required?

The building must first be checked for air-tightness

- The EnerPHit standard requires less than 0.6 air changes per hour with the fan fitted into a doorway.
- Heat exchange units are now readily available that will work in one room or throughout the house.





Air flow through house

Full house heat exchange ventilation unit

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Using my house as an example 1860 terraced - floor area 139m²

	Current			Workable		Just possible	
Element	Area	U value	Demand	U value	Demand	U value	Demand
Walls	52	1.6	44.9	0.3	8.4	0.2	5.6
Windows	22	2.4	28.6	1.1	13.1	0.8	9.5
Doors	3	1.4	2.4	1.4	2.4	1.0	1.7
Ceiling	69	0.3	9.2	0.2	6.6	0.2	5.5
Floor	69	0.5	18.6	0.2	7.5	0.2	7.5
Ventilation	375*	1#	66.4	0.8#	53.1	0.5*0.3$	10.0
Total heating			170		91		40

Notes: 376* House volume; 0.8# Air Change Ratio; 0.5*0.3$ with heat recovery of 70%

Currently – 170 kWhr/m²/yr – 3106 degree days - 18°C average

- Thin double glazing, insulated loft and draught proofing

Workable – 91 kWhr/m²/yr – Heating demand per square metre

- Insulate walls, upgrade windows loft and floor, reduce draughts

Just possible – 40 kWhr/m²/yr – Still above EnerPHit standard

- Triple glazing, deep wall insulation and heat recovery ventilation

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The elephant in the room

The main problems

- An EPC rating of C is not sufficient
- 2030 is only 7 years away
- The planning regulations are a major barrier
- Old stone houses require ventilation
- The disruption caused is not easy to tolerate

How can we best improve our insulation?

- Do it once and do it well – never compromise
- Be opportunist – insulate along with maintenance
- Work with others to keep down costs

And also the elephant questions

- Where are the skilled workers to do this?
- Where is the money going to come from?
- How will we all be encouraged to do this?