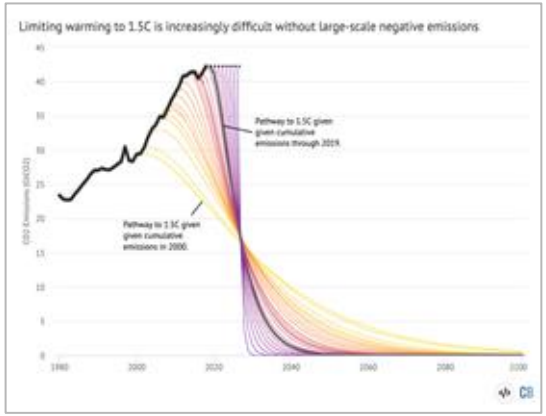
build it ABERDEEN CONSTRUCTION AND PROPERTY CONFERENCE

Retrofit at Scale, Healthy and Warm Homes



Matthew Clubb
Passivhaus Designer
Retrofit Coordinator.

mwclubb Architectural Design

Dr.Amar Bennadji
Associate professor
Senior Fellow of the High Education academy

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Content

- Why retrofit?
- RGU and research in Retrofitting
- How deep to retrofit?
- PAS 2035 - The new retrofit standard
- CO2 cut potentials
- Aberdeen opportunities
- RGU Building Retrofit Postgraduation Course

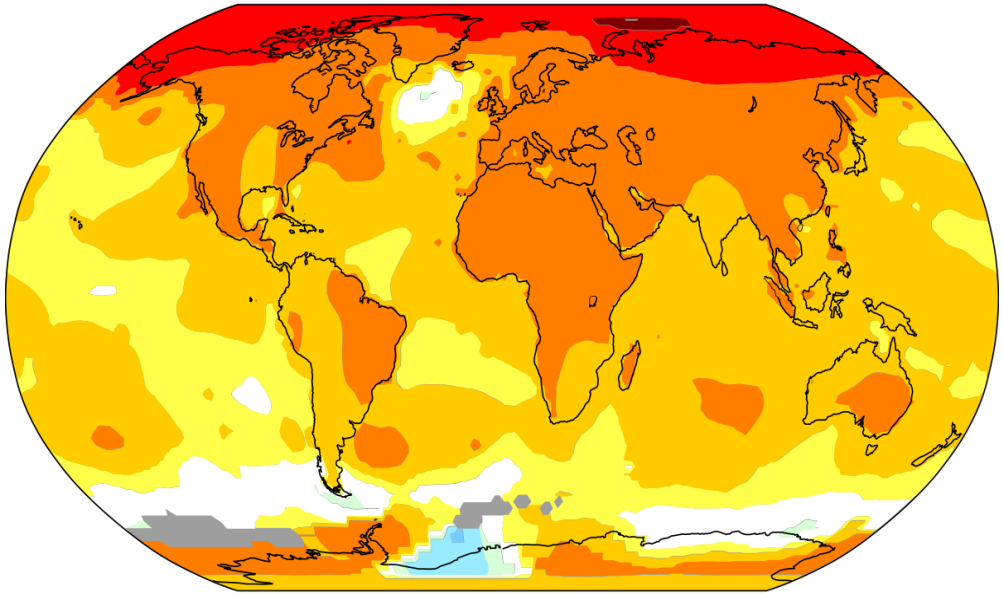
- 2deg warming = 2.9deg in Northern Europe

- 10% Increased rainfall

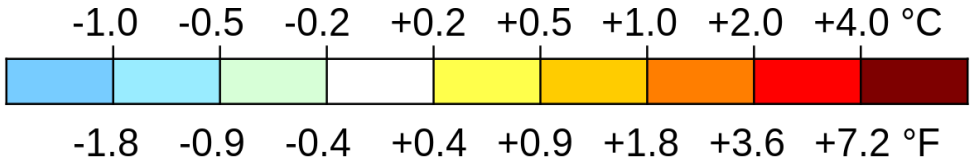
- Drought in the food chain

- 1 Billion Climate Change Refugees by 2050

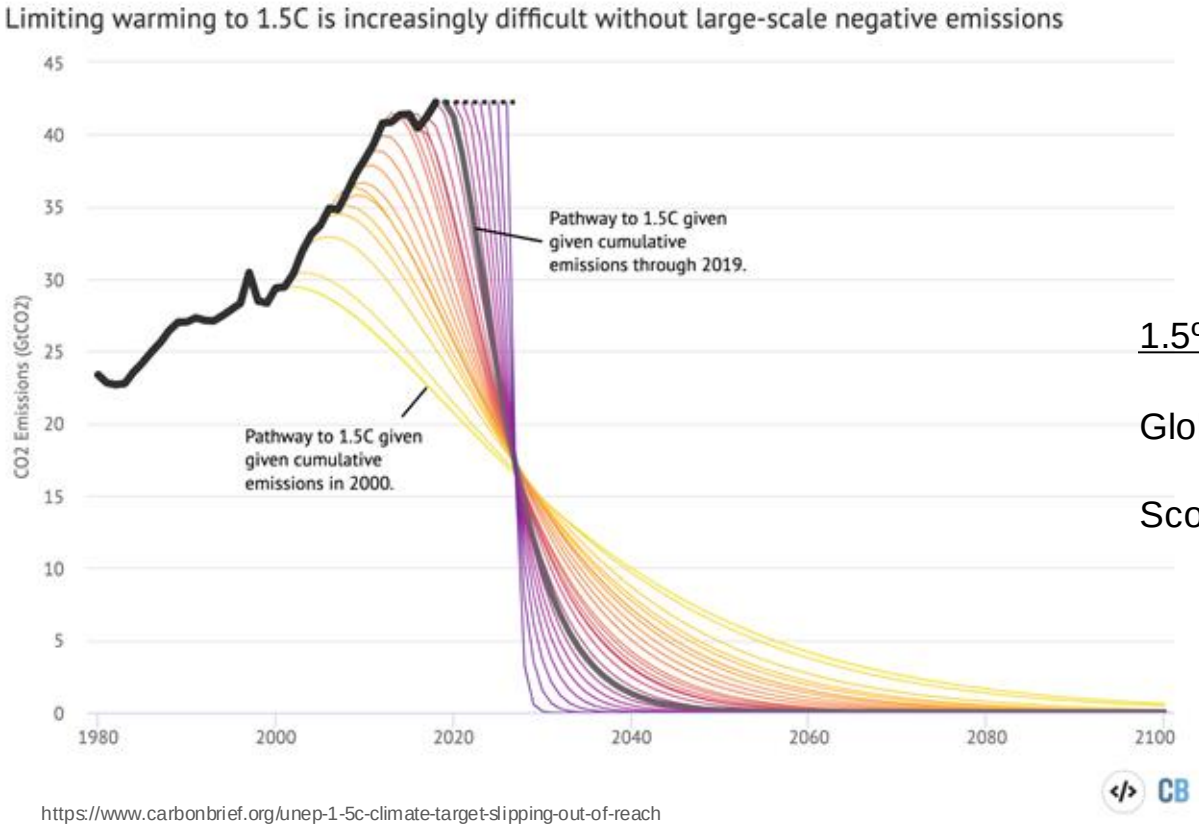
Temperature change in the last 50 years



2011-2021 average vs 1956-1976 baseline



Why Retrofit?



https://www.carbonbrief.org/unep-1-5c-climate-target-slipping-out-of-reach

1.5º Carbon Budget:

Global: 600Gt CO_2e

Scotland: 300Mt CO_2e

Global carbon emissions from buildings 1970-2010

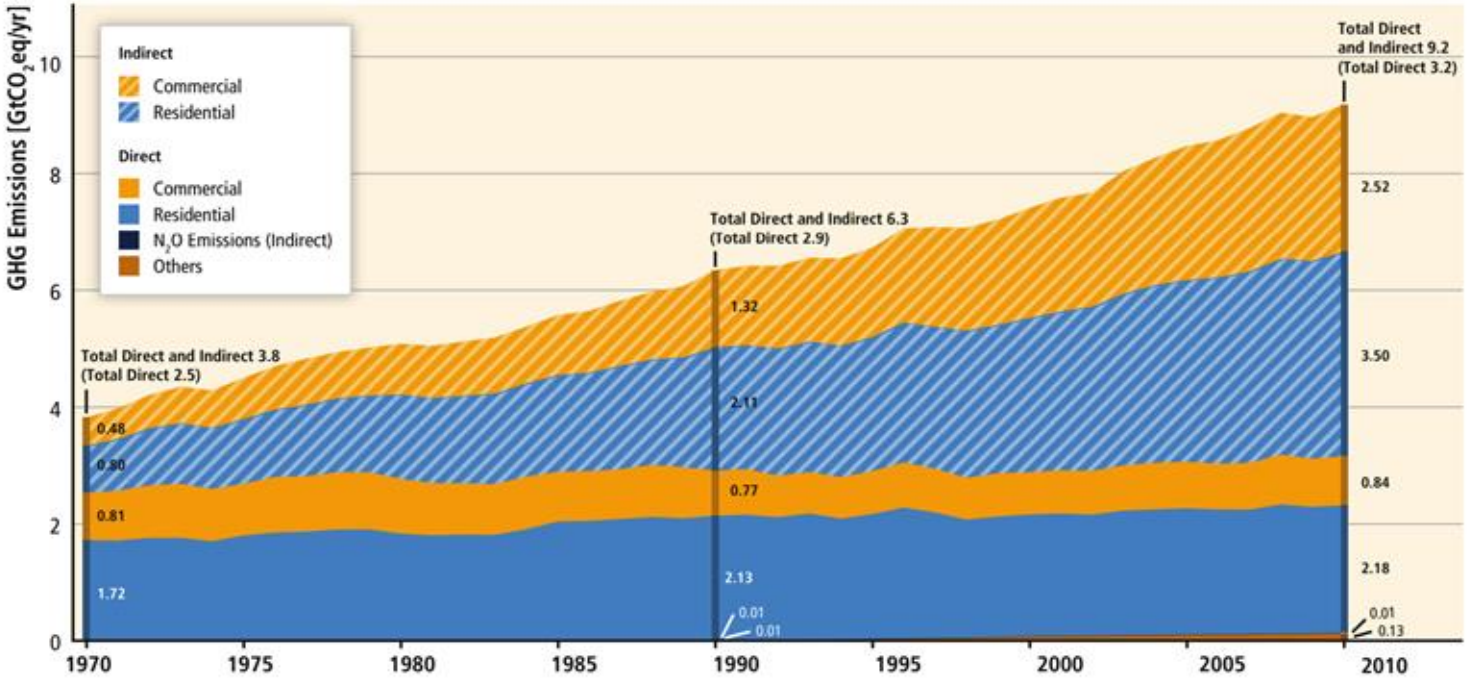


Figure 9.1 | Direct and indirect emissions (from electricity and heat production) in the building subsectors (IEA, 2012a; JRC/PBL, 2013; see Annex II.9).

https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter9.pdf

UK Carbon Emissions from Buildings

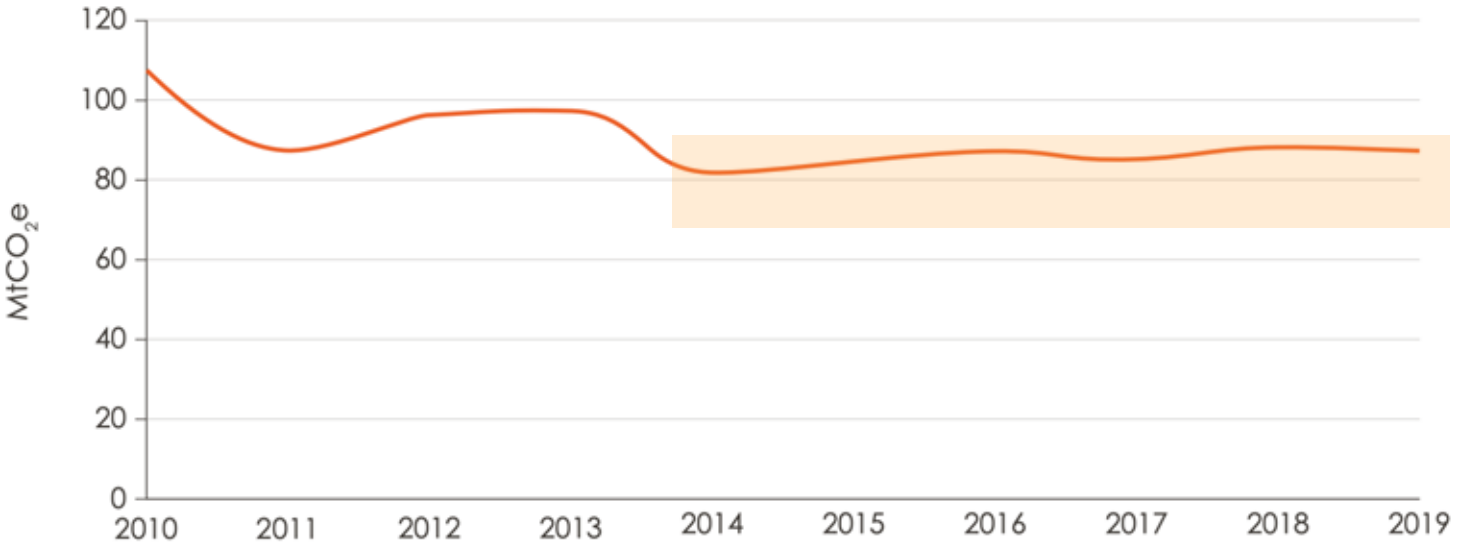
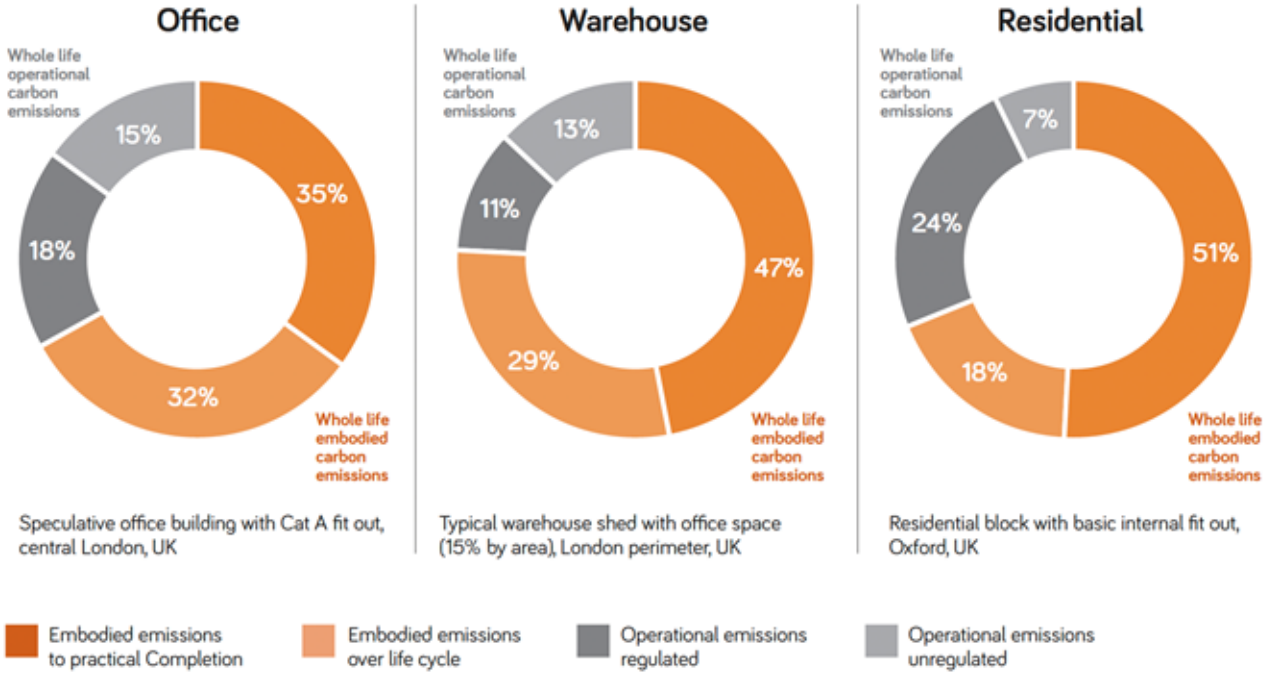


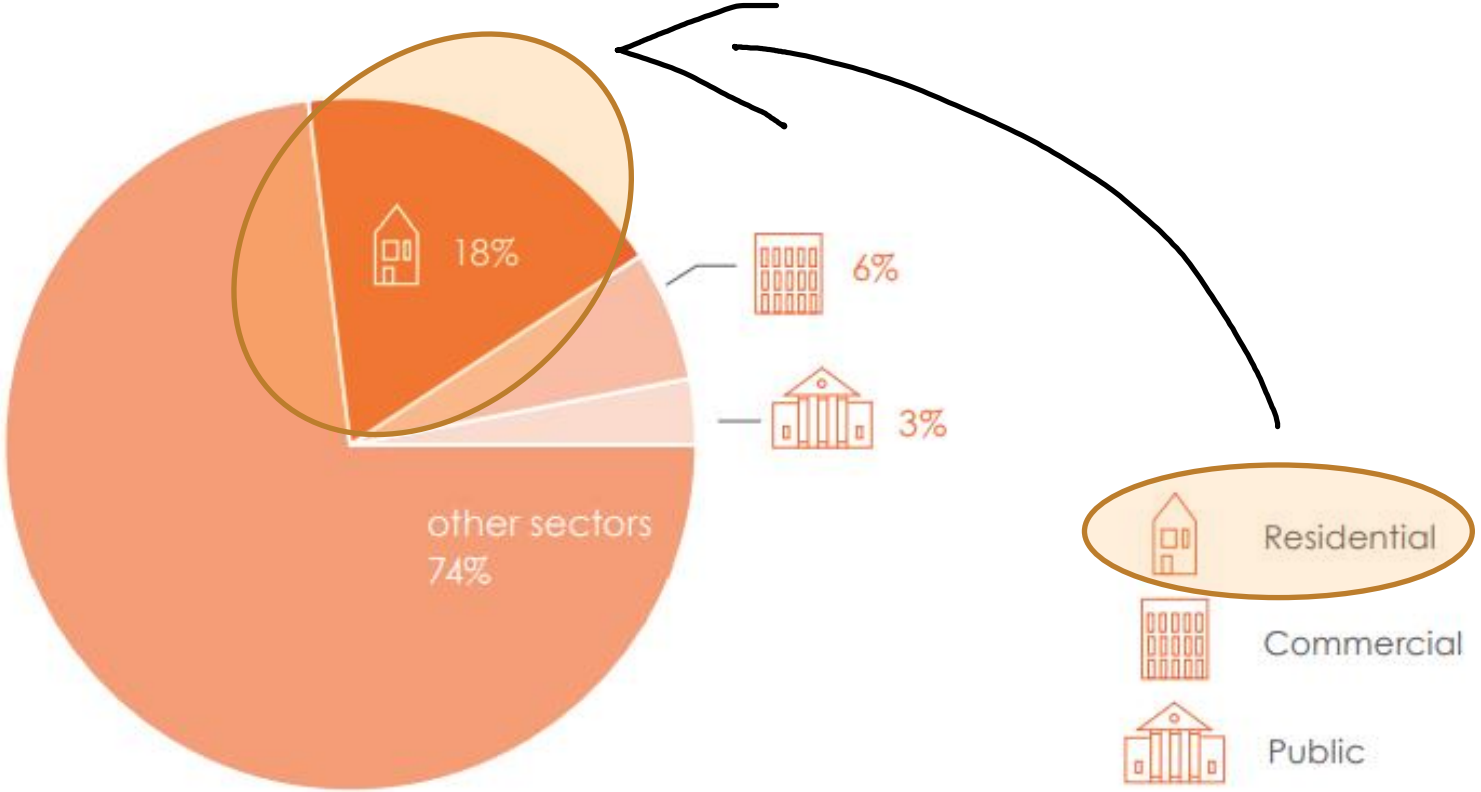
Figure 1.3 - Total annual emissions (direct and indirect) from UK buildings, 2010 to 2019, in $MtCO_2e$. Source: UKCCC, Progress Report to Parliament, June 2020

Total Lifecycle Carbon

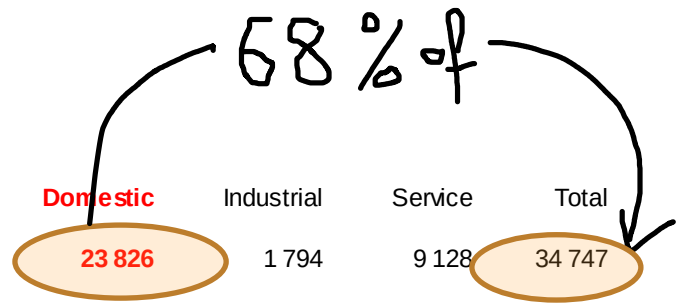


Pie charts illustrating indicative relationships between operational and embodied carbon emissions for three building typologies. The whole life figures have been calculated in line with the modular structure (modules A-C) of BSEN15978 as detailed in RICS PS., i.e. over a 60 years life cycle. Operational and embodied emissions are as estimated at design stage. Grid decarbonisation applied to emissions due to electricity consumption over the life of the building in accordance with the slow progression scenario in National Grid Future Energy Scenarios 2015. Diagrams: Sturgis Carbon Profiling/ RICS.

UK buildings CO2e emissions



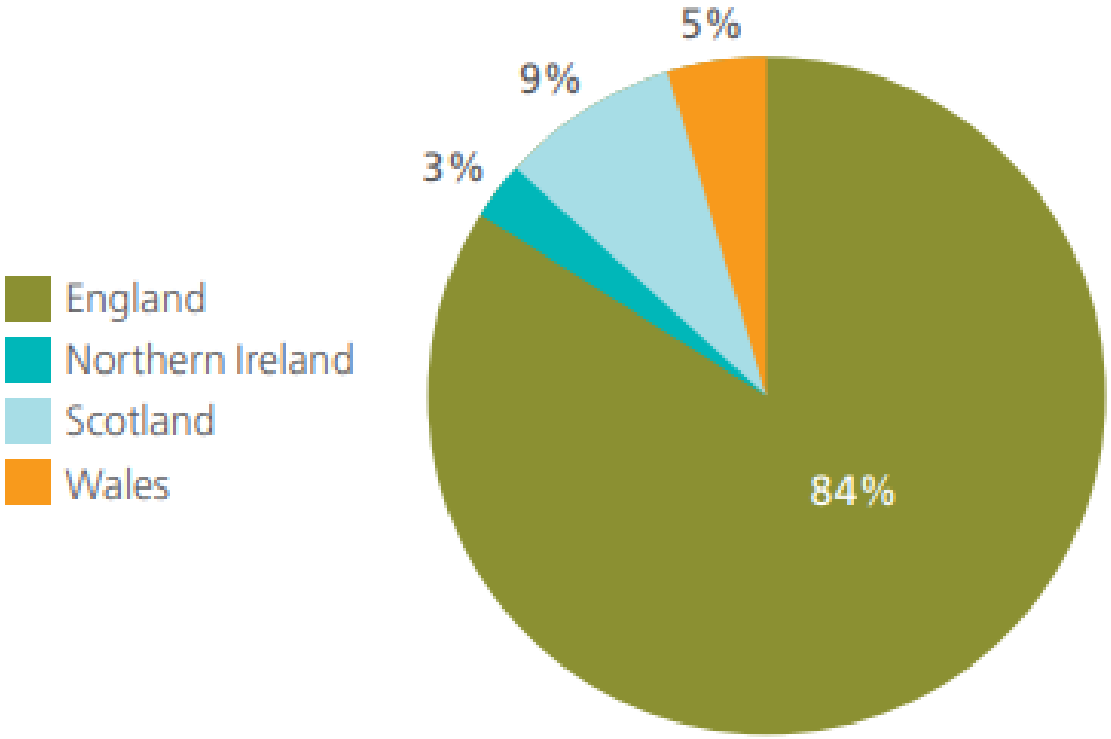
Energy consumption for space heating in housing



Units		Thousand tonnes of oil equivalent (ktoe)					
-							
Year		End use	Notes	Domestic	Industrial	Service	Total
	2020	Space heating		23 826	1 794	9 128	34 747
	2020	Water		6 726	0	1 286	8 012
	2020	Cooking/ Catering		1 132	0	1 969	3 101
	2020	Lighting/ Appliances		6 875	229	3 240	10 344
	2020	Process use		0	9 436	0	9 436
	2020	Motors/Drivers		0	2 683	0	2 683
	2020	Drying/Separation		0	1 643	0	1 643
	2020	Other non-transport	[Note 3]	0	5 116	2 839	7 954
	2020	Total		38 558	20 901	18 462	77 921

A

Distribution and description of housing in the UK



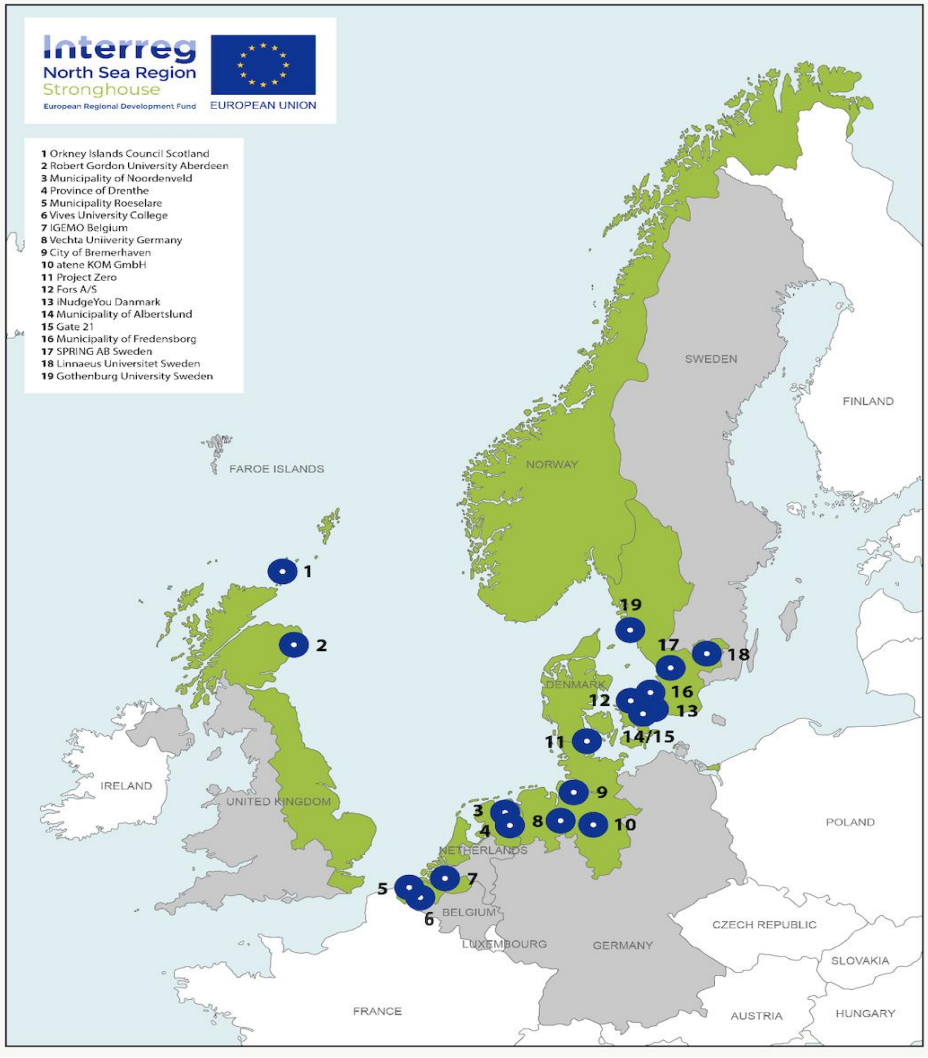
The UK housing stock (age and type)

	England	Scotland	Wales	Northern Ireland[1]	UK
Dwelling age					
Pre 1919	4,972	467	351	82	5,871
1919-1944	3,793	291	133	68	4,284
1945-1964	4,582	544	219	126	5,472
1965-1980	4,689	515	304	189	5,698
1981-1990[2]	1,895	194[3]	99	99	2,287[4]
Post 1990	4,019	452[5]	235	216	4923[6]
Dwelling type					
Terrace	6,669	534	376	221	7,829
Semi-detached	6,100	481	369	180	7,129
Detached	4,093	554	296	164	5,107
Bungalow	2,195	inc. within other categories	154	164	2,512
Flat	4,864	895	147	52	5,958

Stronghouse

Retrofitting existing building should be a global action.

26 EU partners including RGU Orkney Island council are tackling this issue through Stronghouse research project and education through a new Postgraduation course. Building Retrofit.



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Multi-criteria decision-making tool for thermal renovation

HOME

My home

My energy performance target

List of criteria to be selected

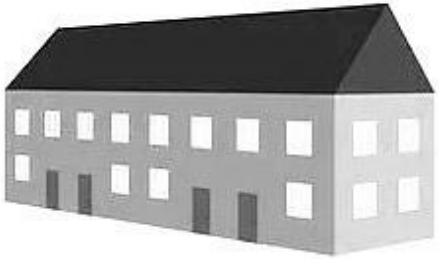
Set of criteria importance

Multi-criteria analysis results

Location | Type | Type of roof | Type of walls | Size of my home | Owner or tenant | Number of residents

Roof insulation | Facade insulation | Floor insulation | Windows | Ventilation type | Heating system | Renewable energy

I live in



○ Terraced house

○ Semi detached house

○ Detached house

Next step ›

Age Type and size of dwellings in the UK

Multi-criteria decision-making tool for thermal renovation

What is Possible for my Property

Do you want to save on energy and increase you comfort? You decide what is important to you. We say how you could do it and how much it will cost. Handy, right?

Select your location : ℹ

Aberdeen ⌄

Start ›

Multi-criteria decision-making tool for thermal renovation

HOME

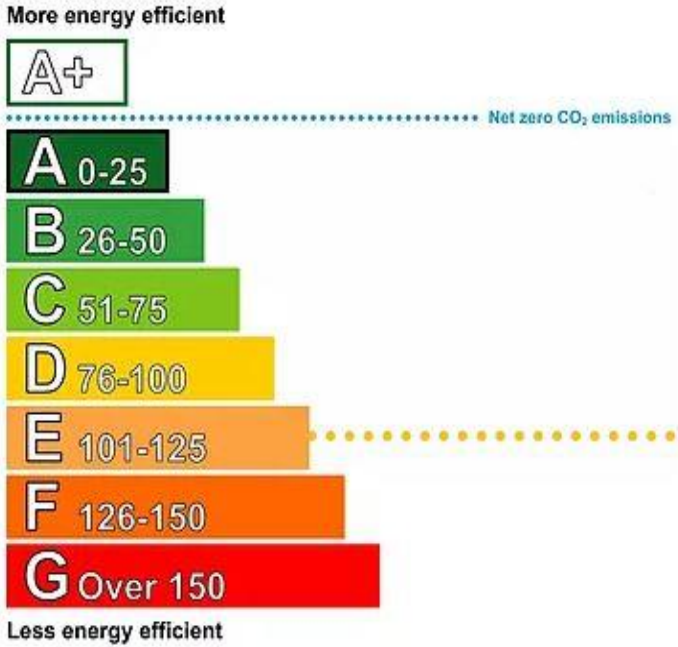
My home

My energy performance target

List of criteria to be selected

Set of criteria importance

Multi-criteria analysis results



My current energy performance

110 kwh/m2

My energy performance target

A +
A
B
C
D

< Previous step

Next step >

Multi-criteria decision-making tool for thermal renovation

HOME

My home

My energy performance target

List of criteria to be selected

Set of criteria importance

Multi-criteria analysis results

Which criteria are most important for you in the selection of thermal renovation solutions?

- [x] Investment cost
- [x] Available grants
- [ ] Payback period
- [x] CO2 reduction
- [x] Annual energy saving (kwh/year)
- [ ] Inconvenience caused by the thermal renovation
- [ ] Duration of the thermal renovation work
- [ ] Availability of Manpower
- [ ] Risk of the loss of building historic aesthetic features

< Previous step

Next step >

Multi-criteria decision-making tool for thermal renovation

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My home

My energy performance target

List of criteria to be selected

Set of criteria importance

Multi-criteria analysis results

You should provide a weight for each selected criterion

A weight may be given for a criterion from 0 to 100 .The weight 100 represents the maximum importance.

Investment cost	100
Available grants	80
Annual energy saving (kwh/year)	100
CO2 reduction	70

< Previous step

Next step >

Multi-criteria decision-making tool for thermal renovation

HOME

My home

My energy performance target

List of criteria to be selected

Set of criteria importance

Multi-criteria analysis results

Multi-criteria analysis results

Recommended solutions	Investment cost	Available grants	Annual energy saving (kwh/year)	CO2 Reduction (kg CO2 / year)	Order
Roof insulation R= 7,5 m2 k/W (about 30 cm of mineral wool)	€ 6 450	€ 950	3931 kWh / year	1097 kg CO2 / year	1
External wall insulation R=4.3 m2 k/W (about 14 cm of mineral wool)	€8 190	€1 380	2673 kWh / year	763 kg CO2 / year	2
Installation of energy efficient windows U ≤ 0.8 W/m2k	€ 14000	€ 2 900	4087 kWh / year	1167 kg CO2/ year	3

< Previous step

Governmental target

Government Targets

- All homes EPC C by 2033
- Strategy: EPC B by 2040

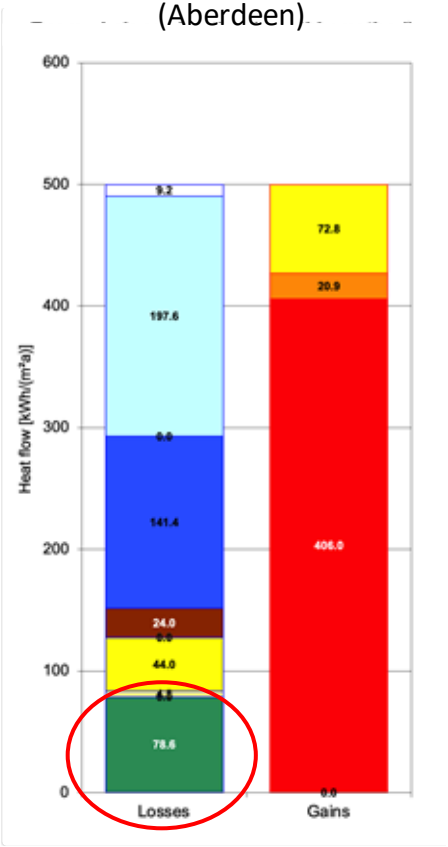
We need to go beyond government targets and some homeowners already want this.

25% of homes are in Fuel Poverty in Aberdeen

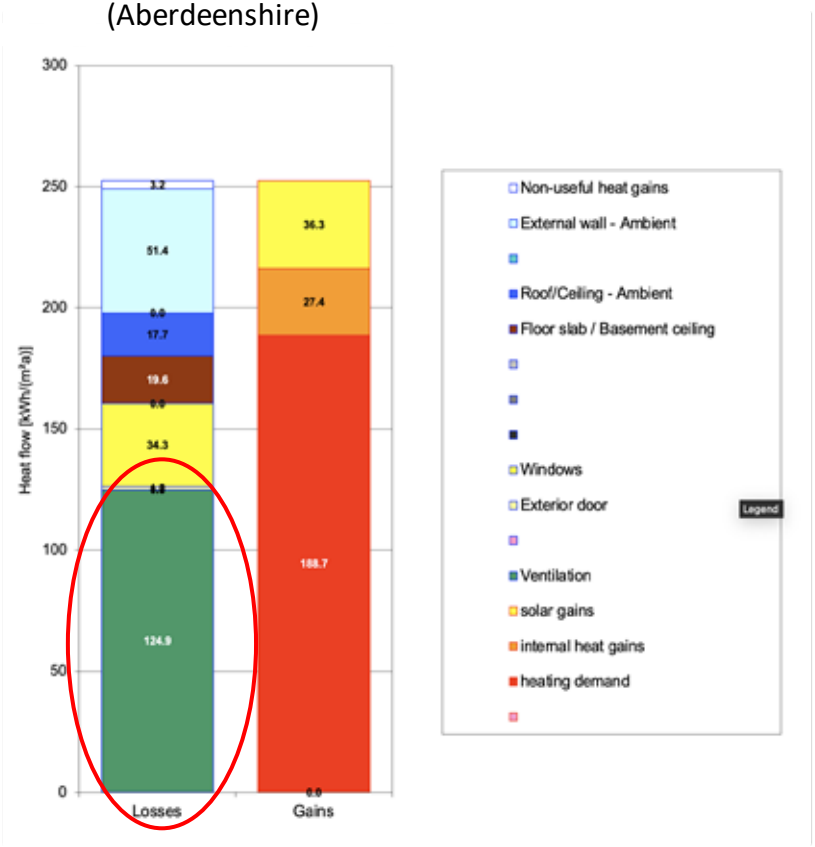
But every home is different

Energy Loss Examples

End Terrace Granite Villa (Aberdeen)



1970s Bungalow (Aberdeenshire)



Ventilation losses can be significant

PHPP Calculations Software

Deep retrofit versus Shallow retrofit

Deep retrofit

- → Reduced carbon emissions
- → Reduced renewable energy demand
- → Reduced peak load
- → Less grid storage required
- → Significantly lower energy bills
- → Improved health and comfort
- → Effective heat pumps

Shallow retrofit

- → Reduced carbon emissions
- → Large renewable demand
- → Large peak demand
- → More grid storage required
- → Little change in energy bills
- → Limited health benefits
- → Sub-optimal heat pump performance

Figure 1.12 - Comparison of percentage of energy demand reductions and associated co-benefits from shallow and deep retrofits.

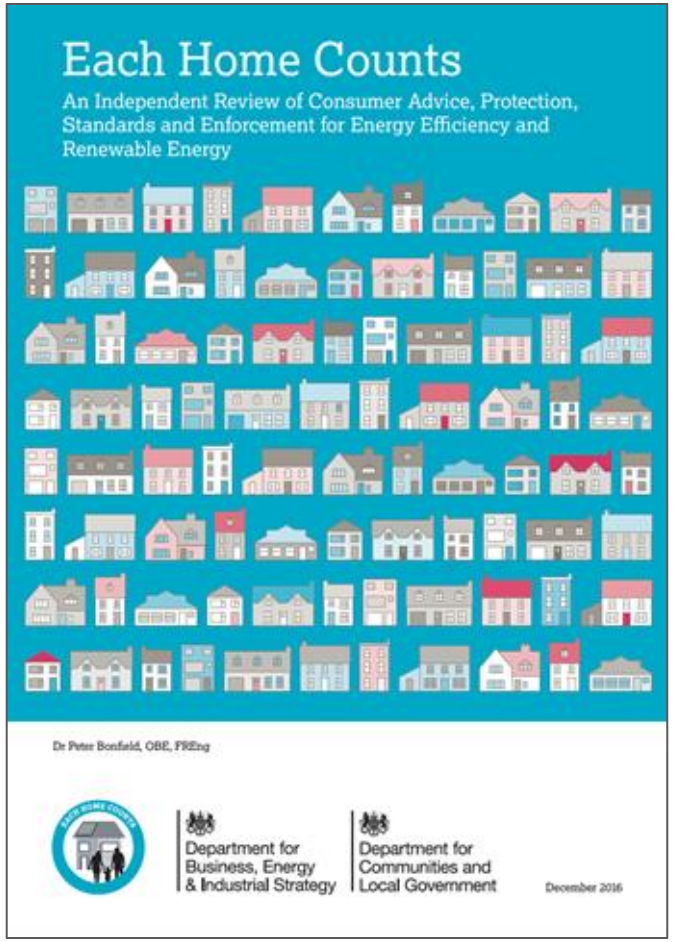
Government Review

Commissioned to investigate industry failings

Key recommendation:

A quality mark to:

- **A Consumer Charter**
- **A Code of Conduct**
- **Codes of Practice**



A new standard

PAS2035: Whole House Retrofit

- Quality Compliance Standard for Retrofit
- Occupiers are at the centre of the process
- Every project is assigned their own Retrofit Coordinator

Scottish Government are adopting

- Adopted for the Green Homes Grant Scheme
- Adopted for the ECO grants

PAS2030: Installation of measures

All work is lodged in the national TrustMark DataWarehouse

TRUSTMARK
Government Endorsed Quality

Whole House Retrofit process

Fabric First!

Insulation is the cheapest form of energy efficiency

Focus on the junctions to reduce thermal bridges

If you insulate, **you must ventilate**!

Mechanical ventilation systems can transform indoor air quality

Renewable Energy Systems

The last step!

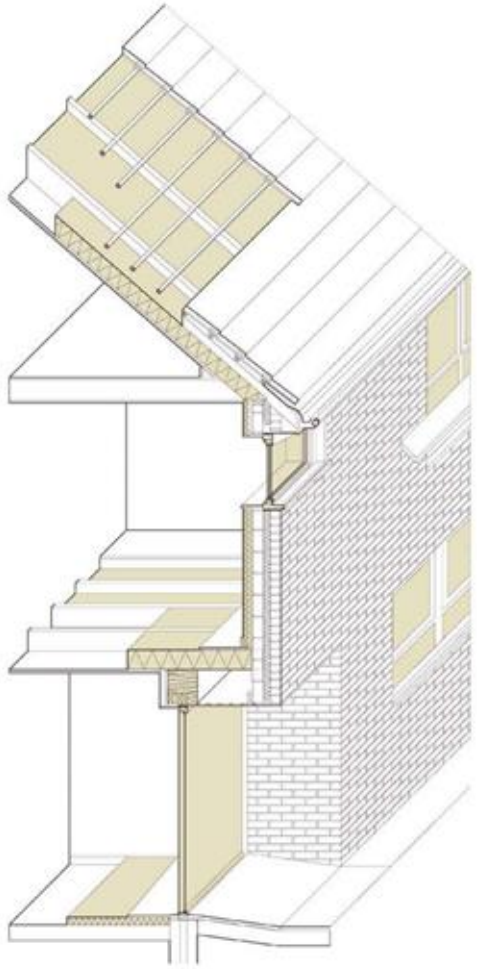
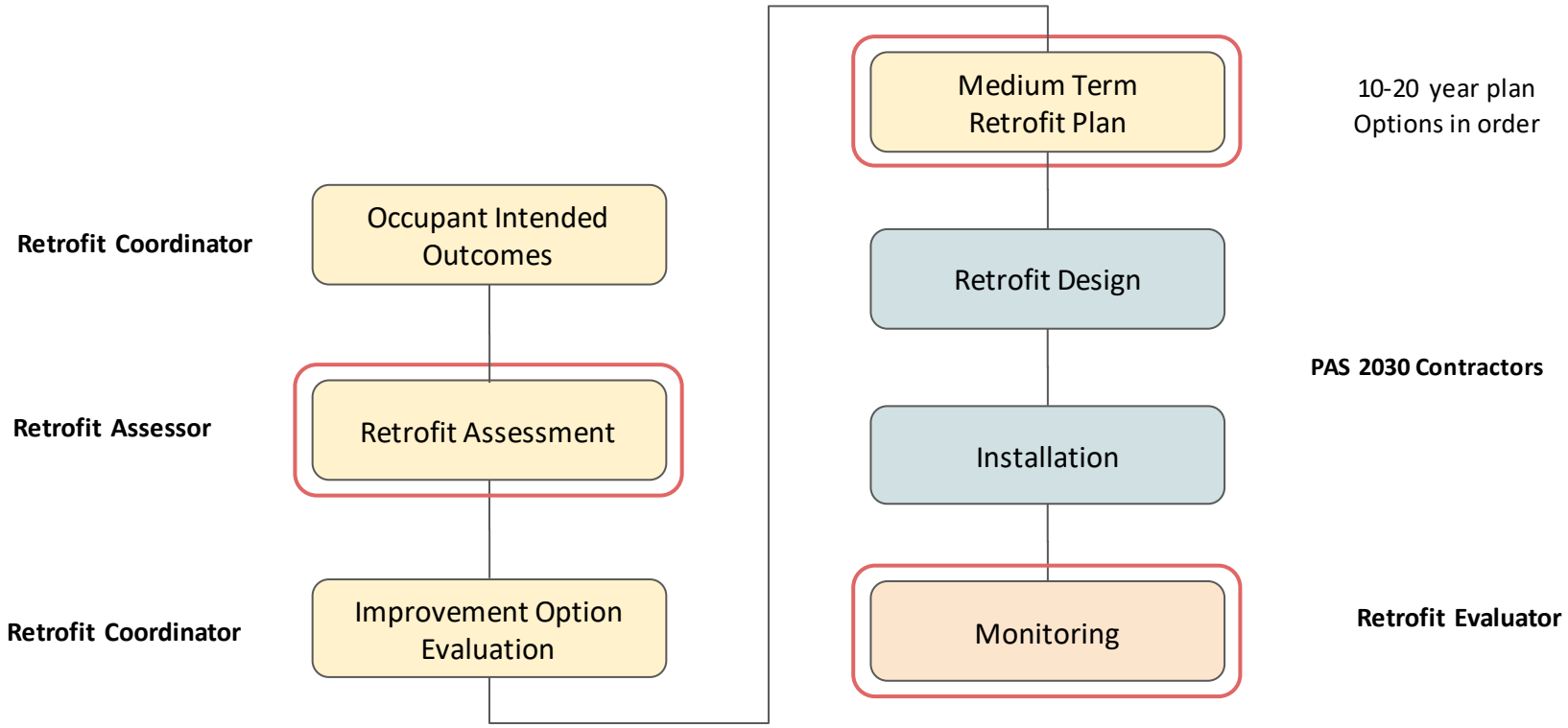


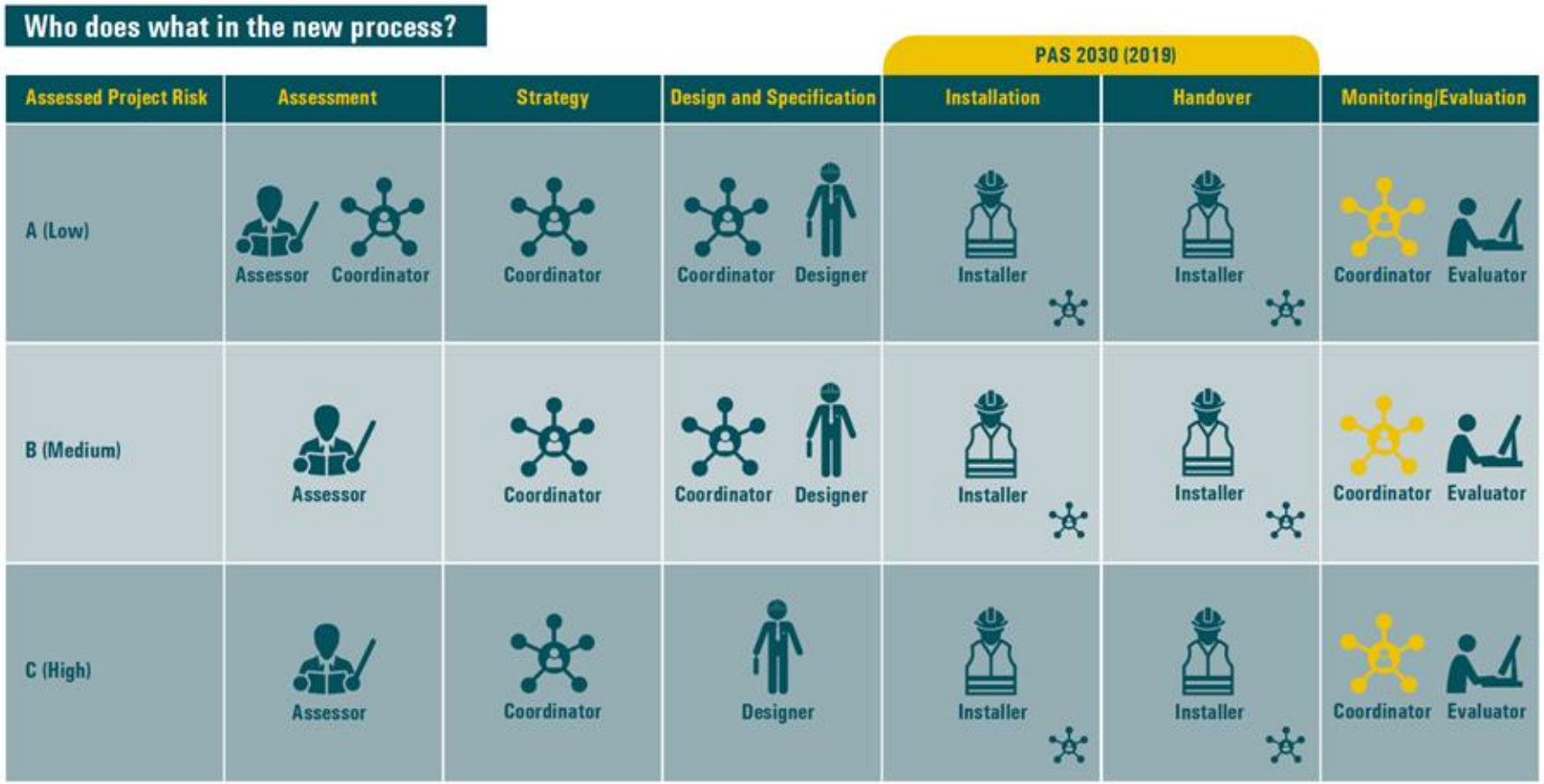
Figure 6.4 - Detailed section post retrofit, from: Baeli, M., 2013, Residential Retrofit: Twenty Case Studies. RIBA Publishing, London[43]

PAS 2035 Process

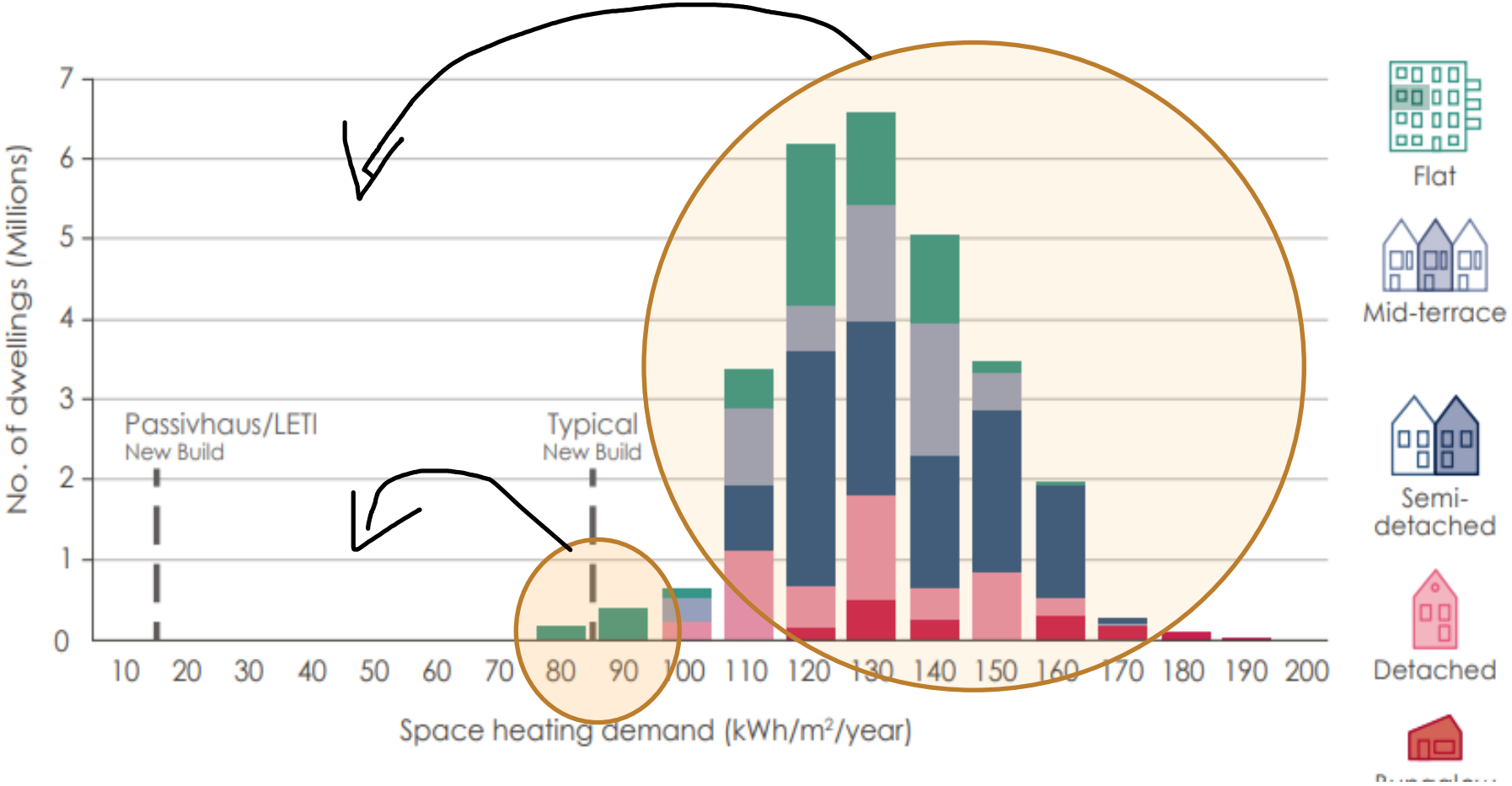


TRUSTMARK
Government Endorsed Quality

PAS 2035 Retrofit Roles

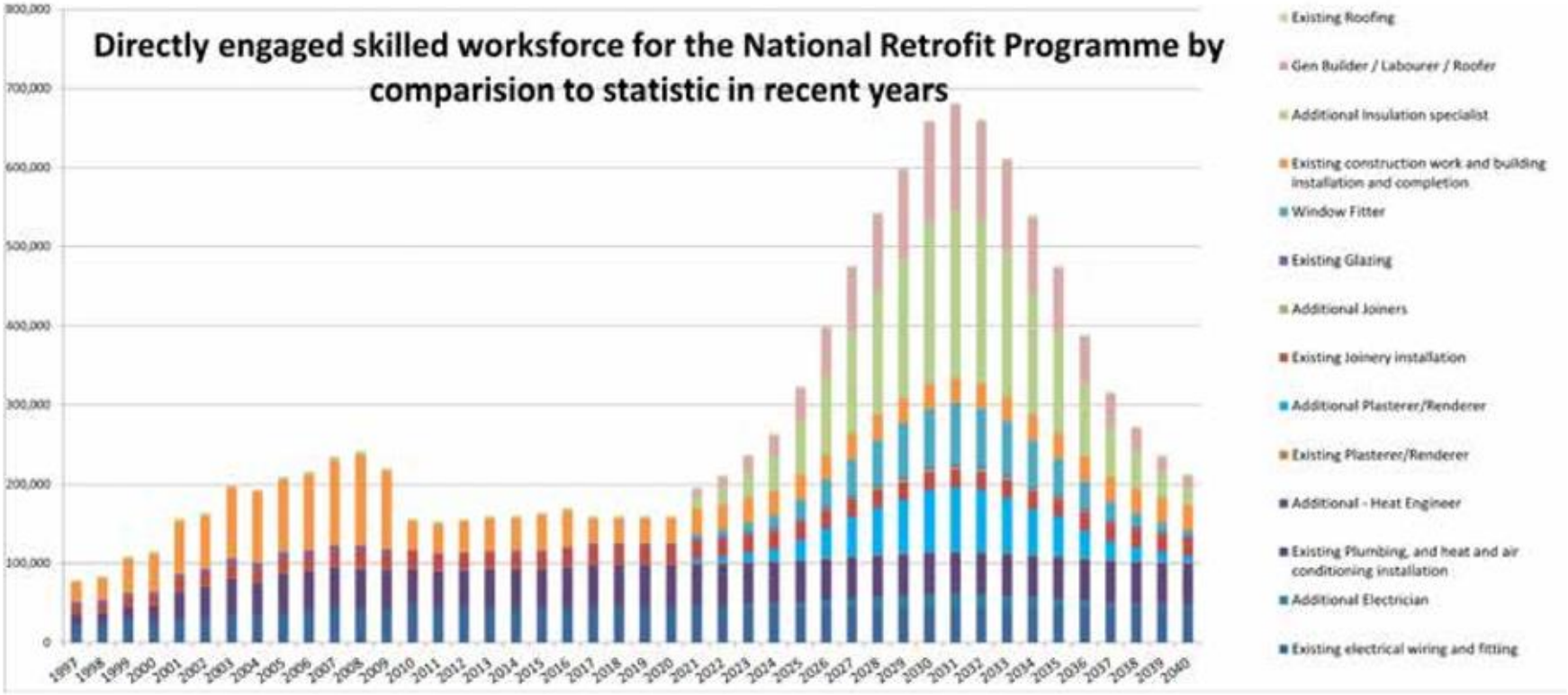


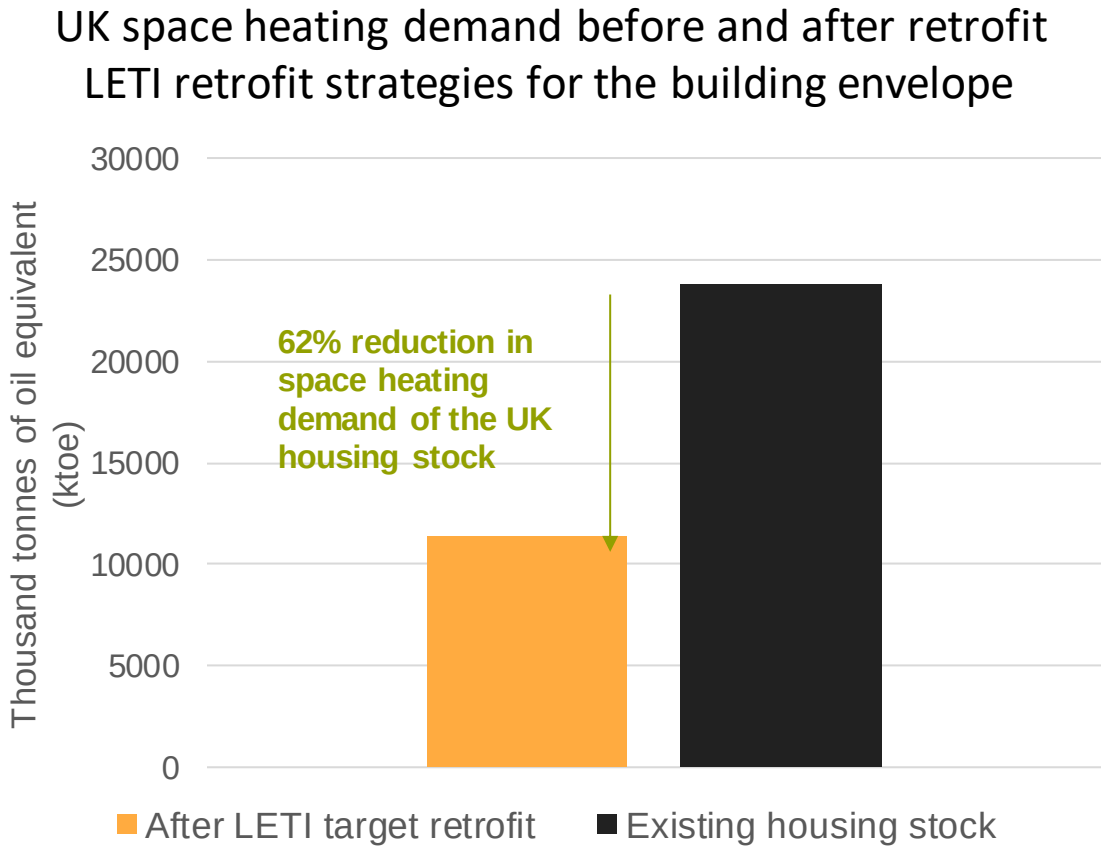
UK domestic space heating demand distribution.



Construction Leadership Council - National Retrofit Strategy

An additional 500,000 people needed in the sector



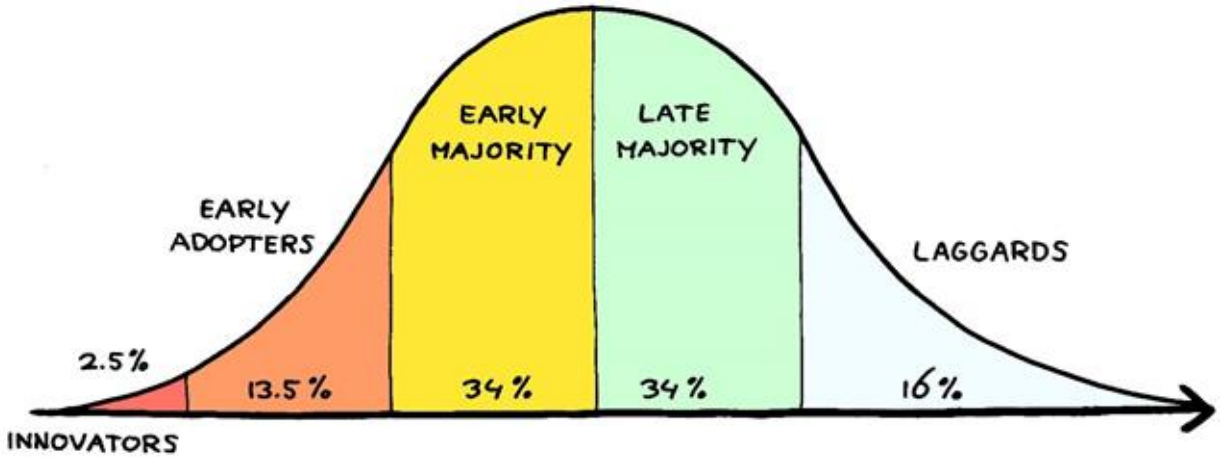

UK space heating demand before and after retrofit
LETI retrofit strategies for the building envelope
Thousand tonnes of oil equivalent (ktoe)
30000
25000
20000
15000
10000
5000
0
62% reduction in space heating demand of the UK housing stock
After LETI target retrofit
Existing housing stock

Aberdeen - What's the market?

- 100,000 homes
- Average EPC: C - so 50% are below the 2033 threshold
- If average retrofit cost: £20,000 (significantly higher for some properties)
- = £1,000,000,000 by 2033

Demand is already there

We need skills now!



New Post-graduation course

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Study | Life at RGU | Alumni & Supporters | Research | Business & Innovation

THE SCOTT SUTHERLAND SCHOOL OF ARCHITECTURE & BUILT ENVIRONMENT

Building Retrofit

PgCert

→ REGISTER INTEREST → APPLY

25%

Questions?

If you're interested in developing the retrofit market in Aberdeen please get in touch

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a.bennadji@rgu.ac.uk

www.mwclubb.co.uk

mwclubb | Architectural Design

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