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How can retrofit help with the current energy crisis and reaching net zero?

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DEEP retrofit
literature review



Core Cities
retrofit



Thin IWI
retrofit



Sustainable Behaviour

Insights to understand how people can make more sustainable, healthier choices in their home, work, and travel decisions.



Sustainable Buildings

Research for more sustainable buildings based around building physics, building performance evaluation, operational steady state, and dynamic energy modelling, and hygrothermal simulations.



Sustainable Urban Environments

Exploring air quality, heat islands, embodied carbon, and environmental monitoring to promote healthier, more sustainable cities and communities.



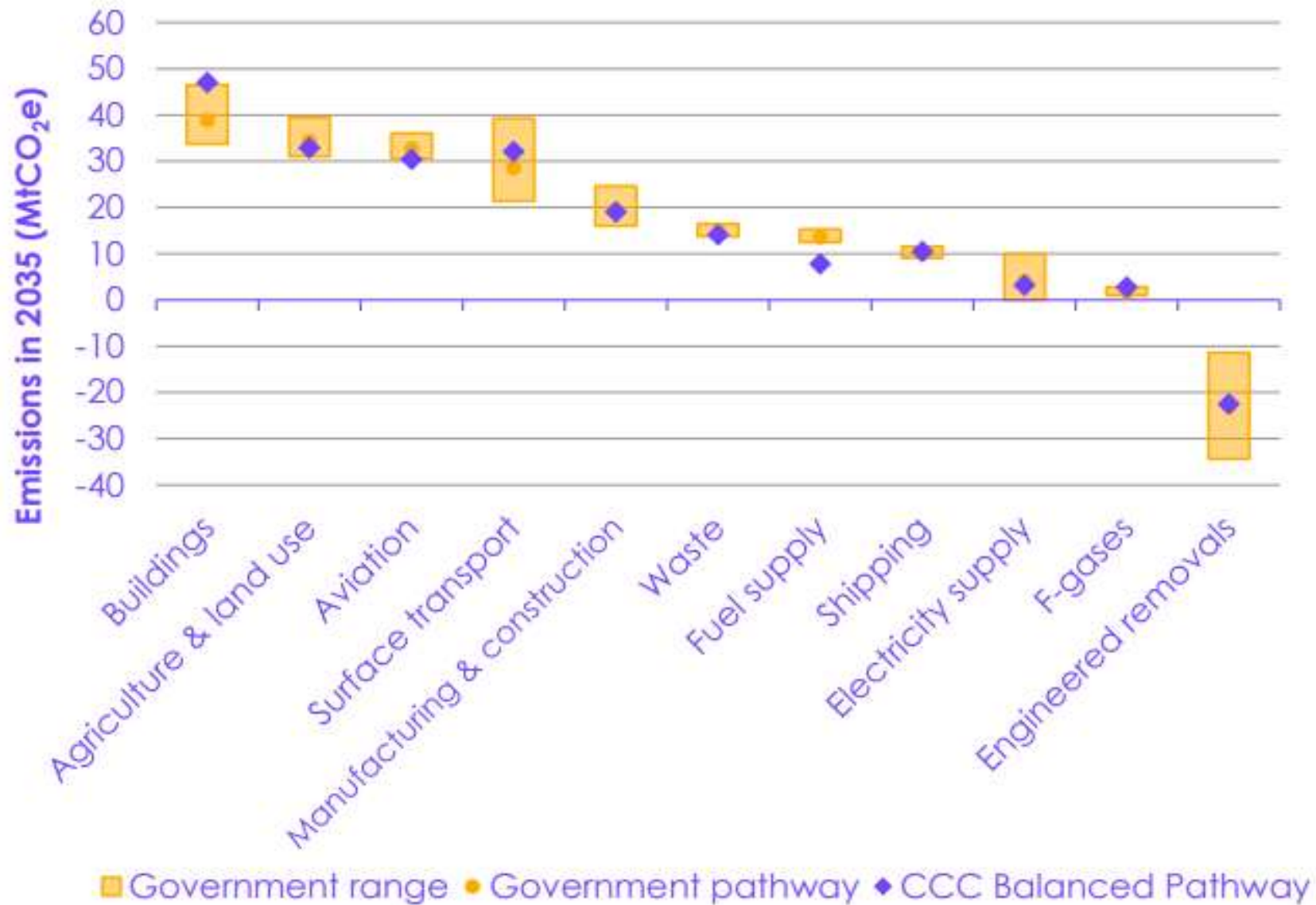
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Department for
Energy Security
& Net Zero

Why are buildings important (unique?) for climate action?



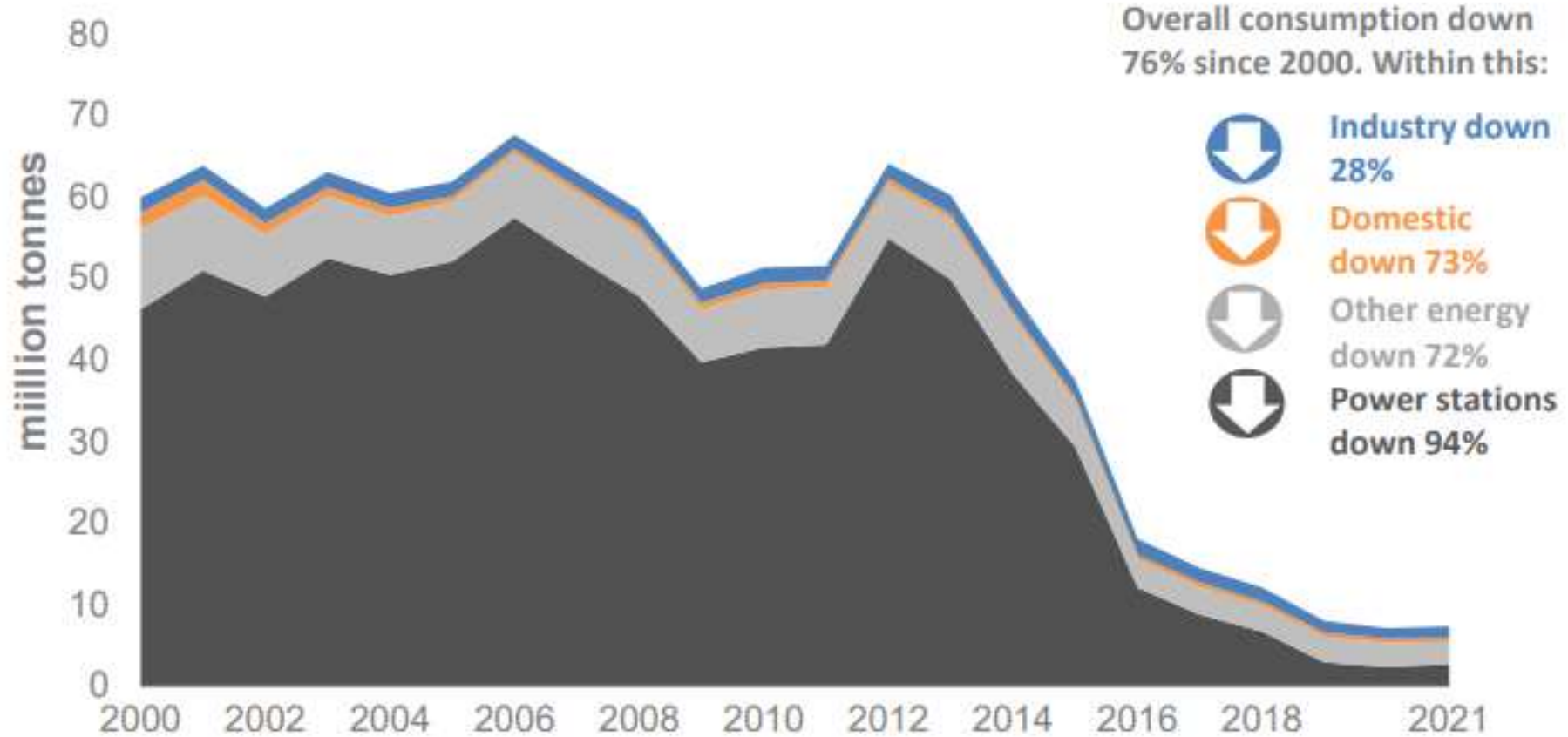


How have we decarbonised?



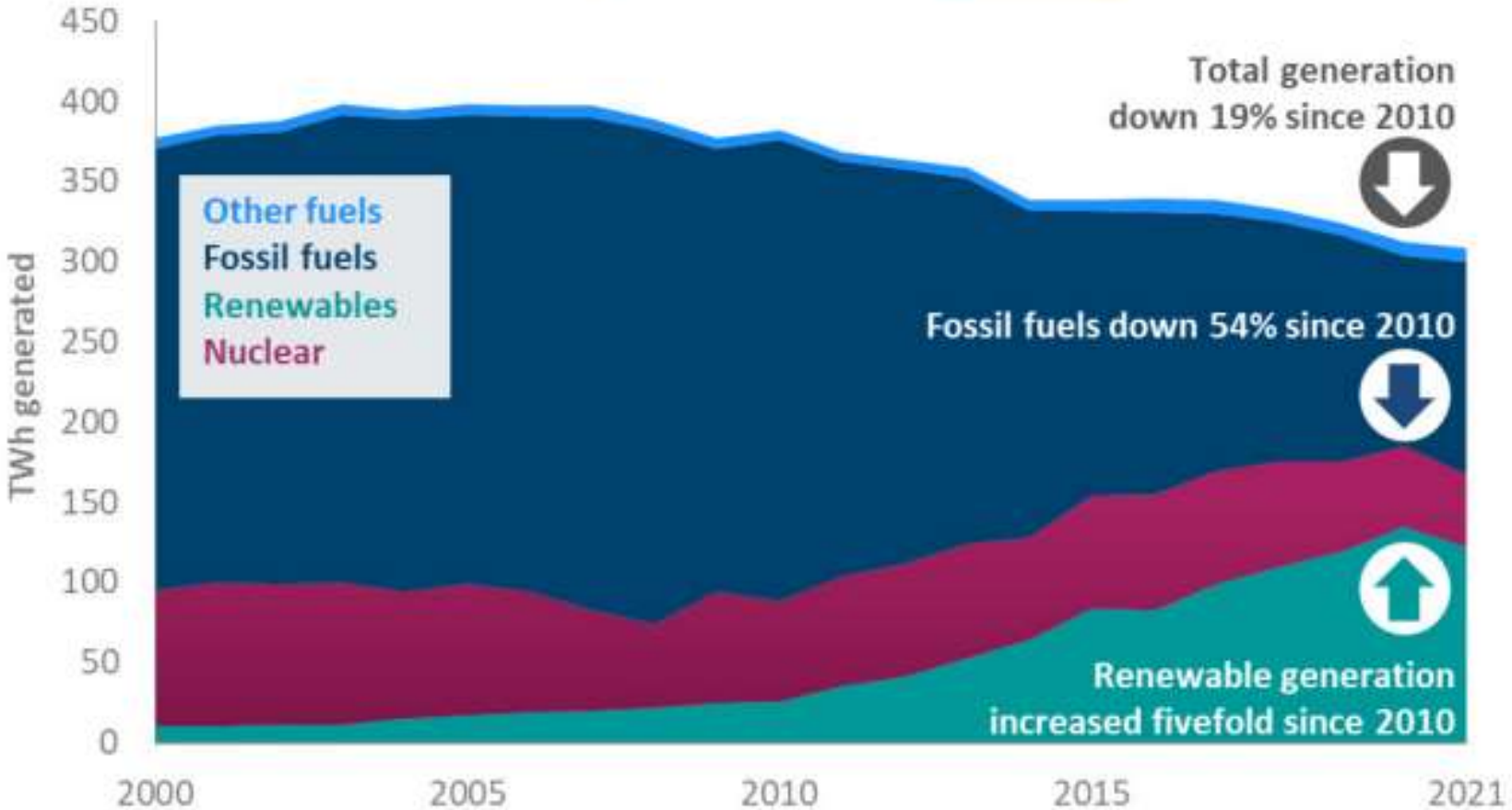
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Chart 2.3 Coal consumption, 2000 – 2021 ([Table 2.2](#))



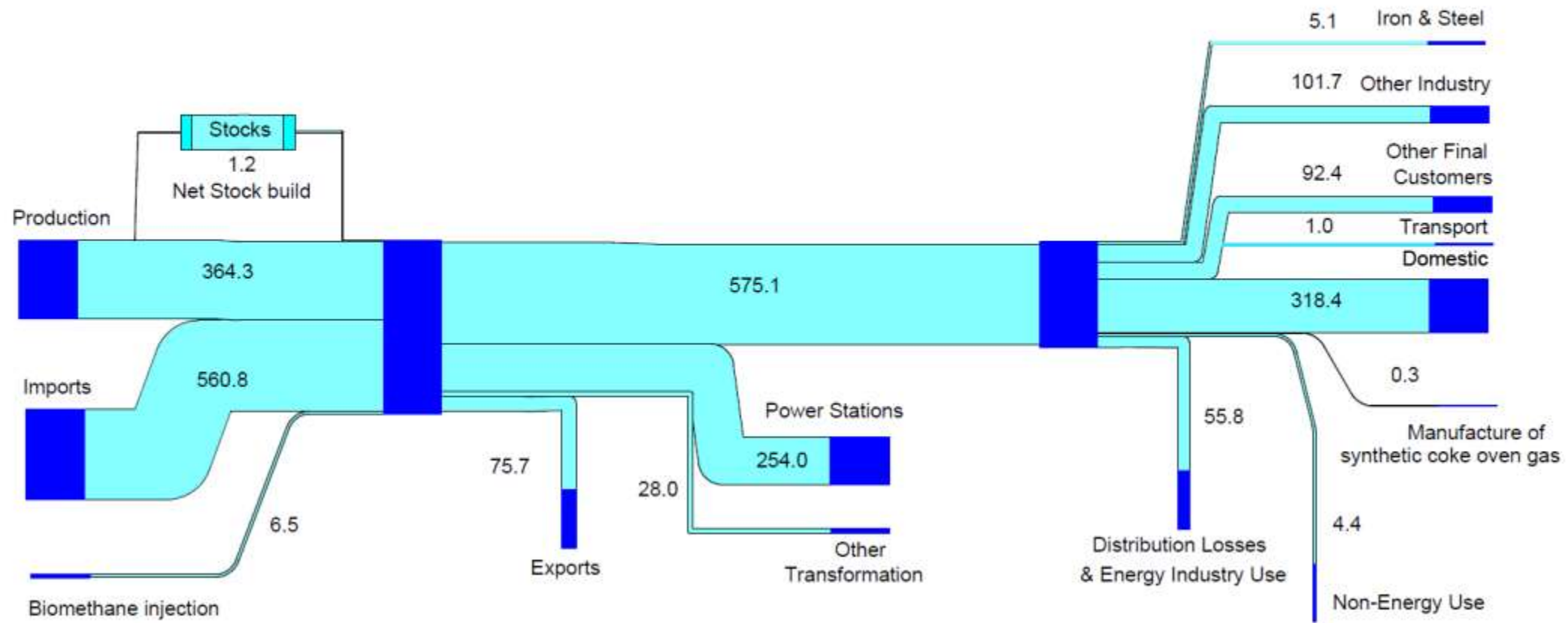
Electricity is the easy bit...

Chart 5.3 Electricity generated by fuel, 2000 to 2021 (Table 5.6)



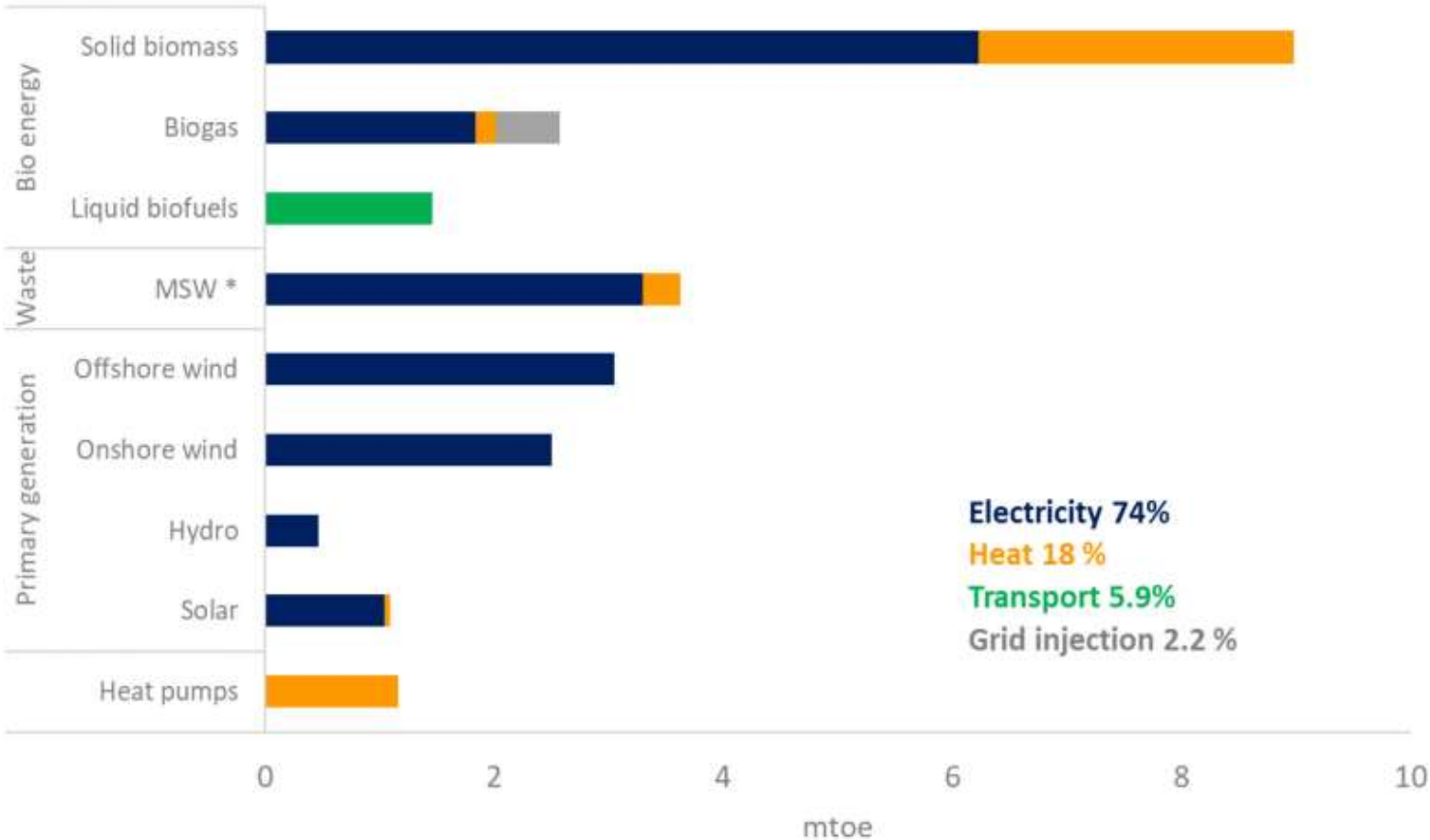
Gas still allowed to heat new homes until 2035

Natural Gas Flow Chart 2021 (TWh)



Getting heat from renewables is hard

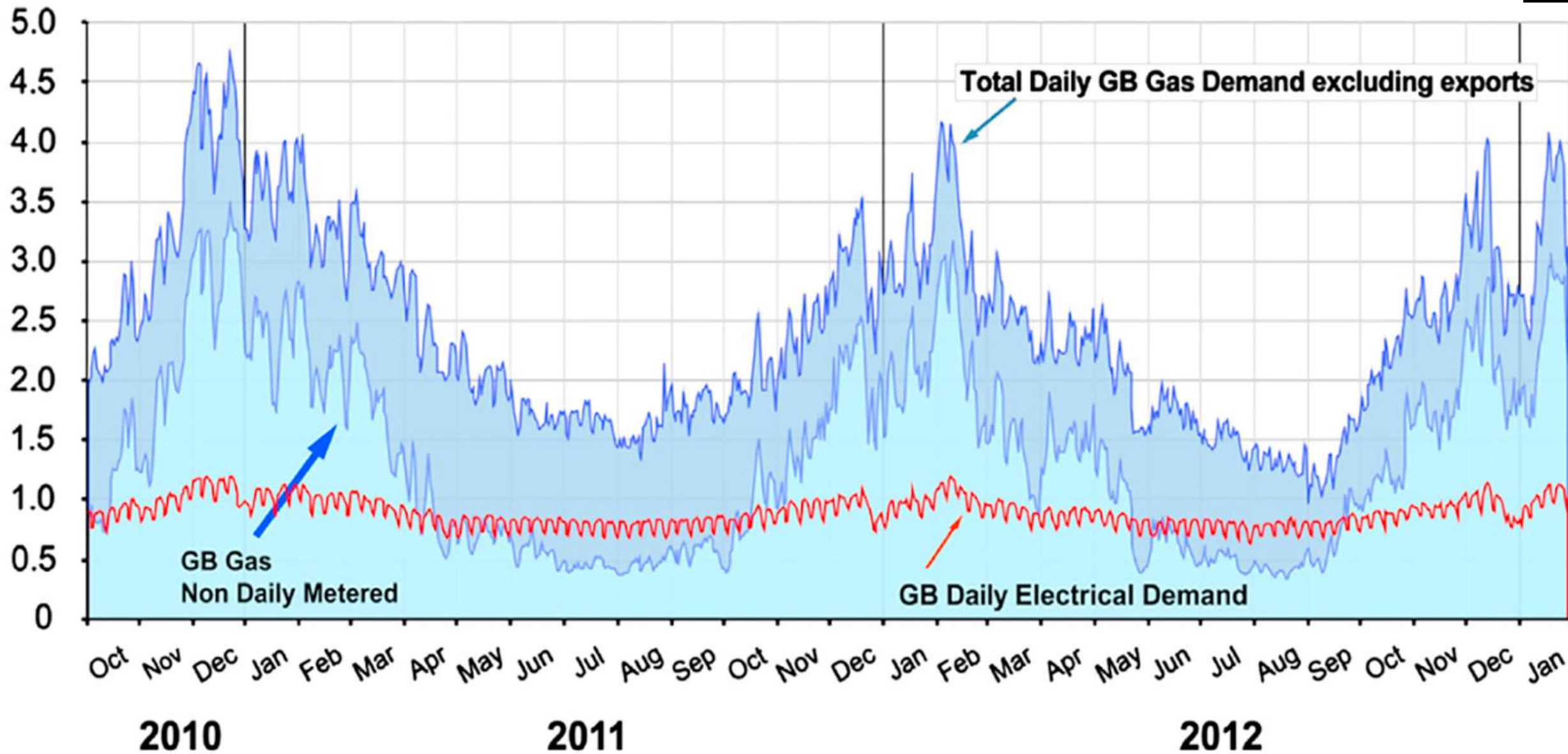
Chart 6.1 Use of renewable fuels, 2021 (Table 6.4)



Can we use low carbon electricity to heat our homes?

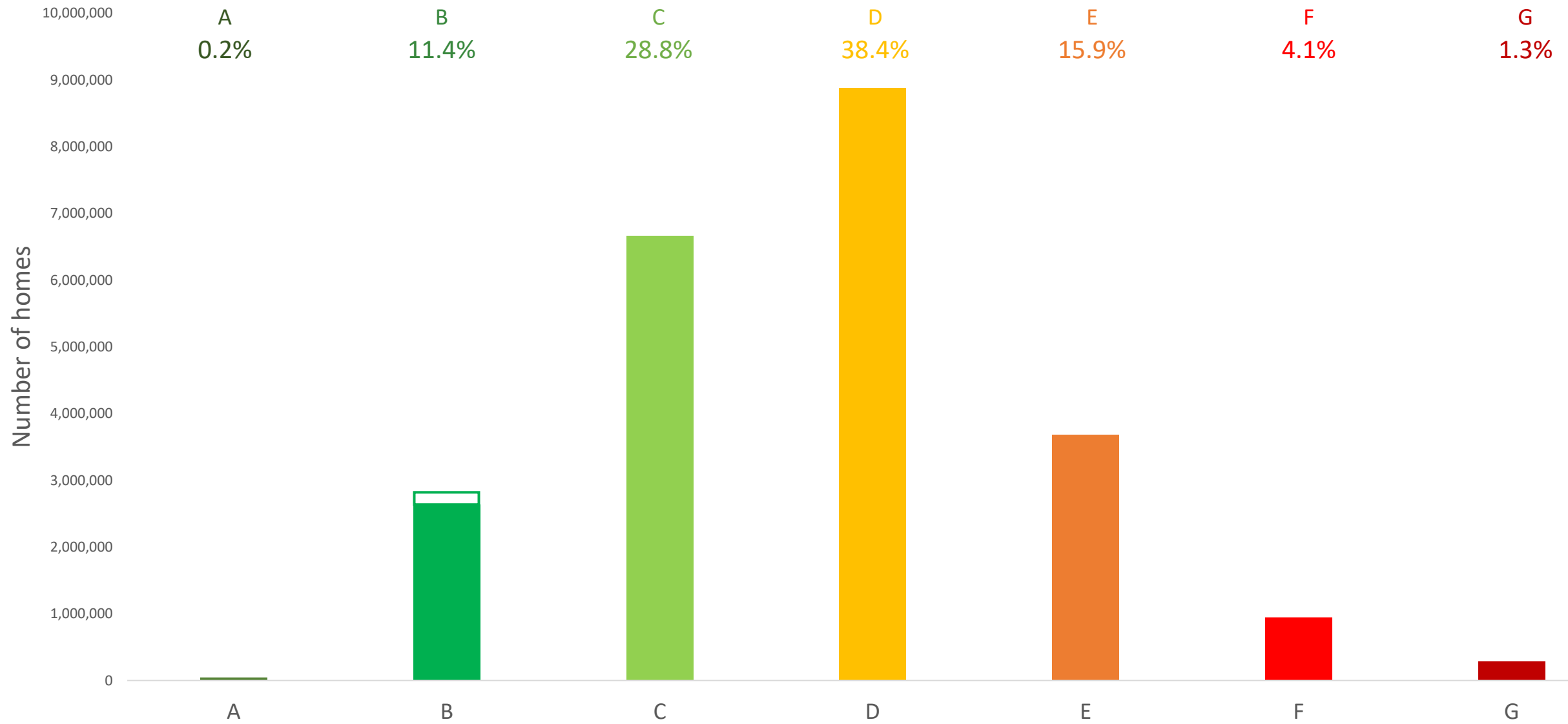


TWh per day



Can we just build more energy efficient homes?

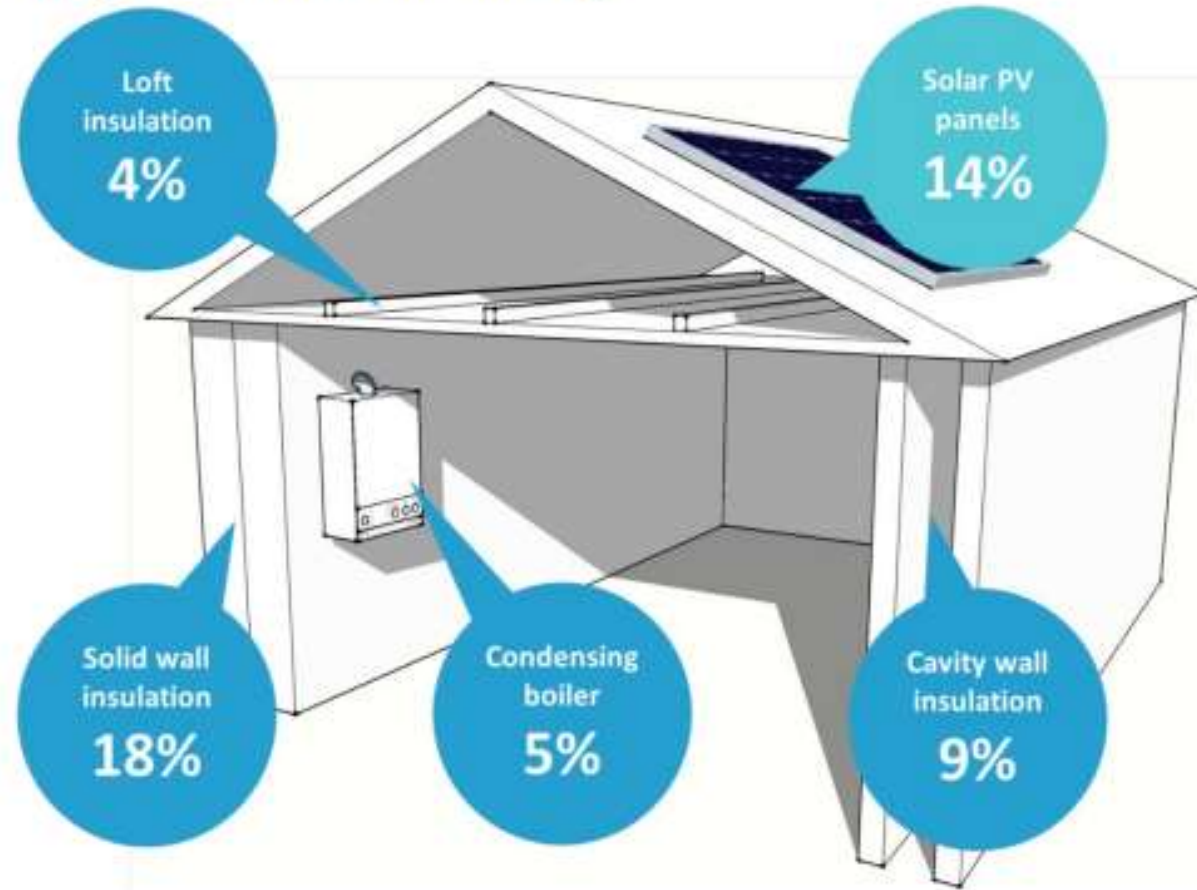




How do we make existing homes more energy efficient?

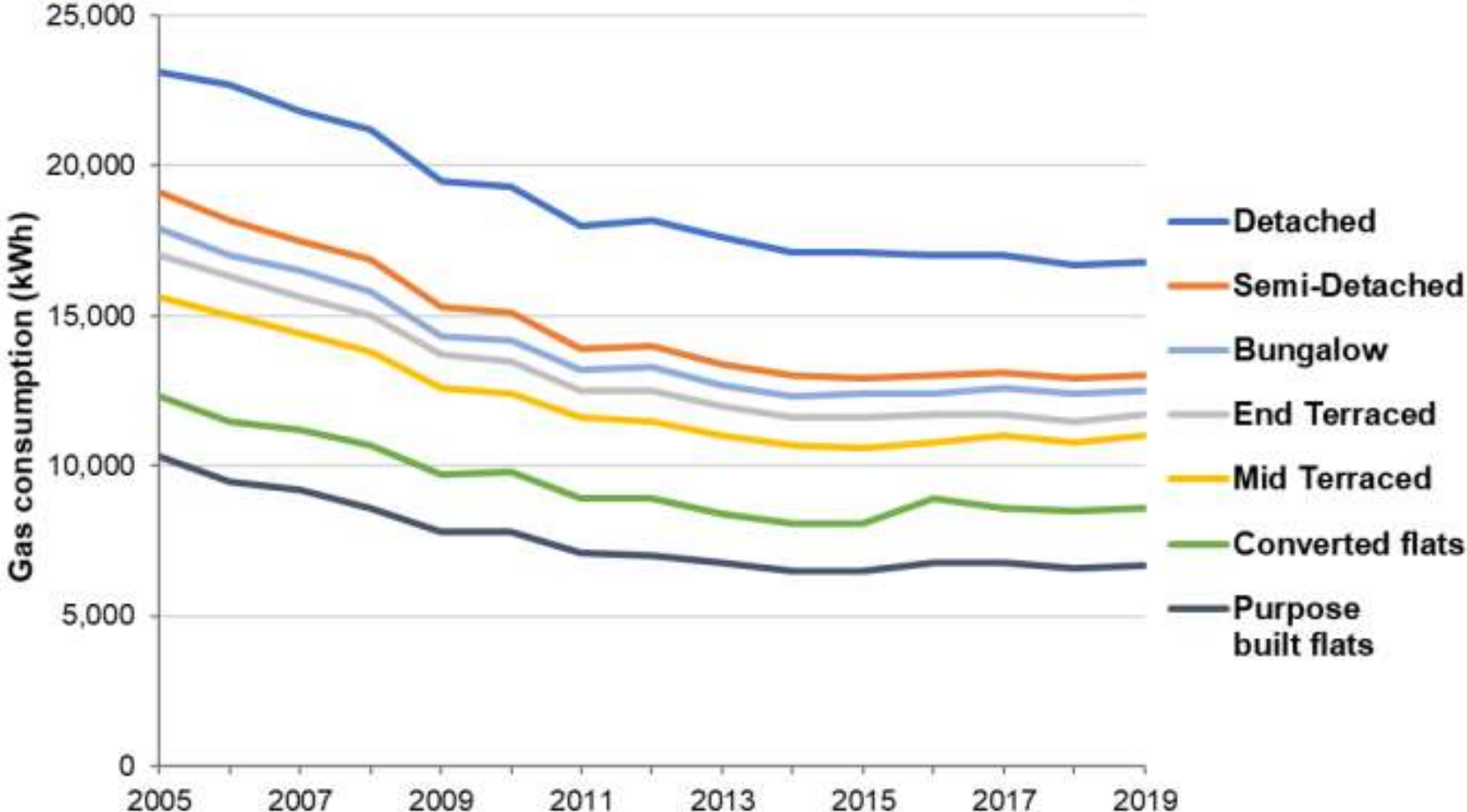


**Typical gas savings in 2019 from measures installed in 2018, England and Wales
(electricity savings are shown for Solar PV)**

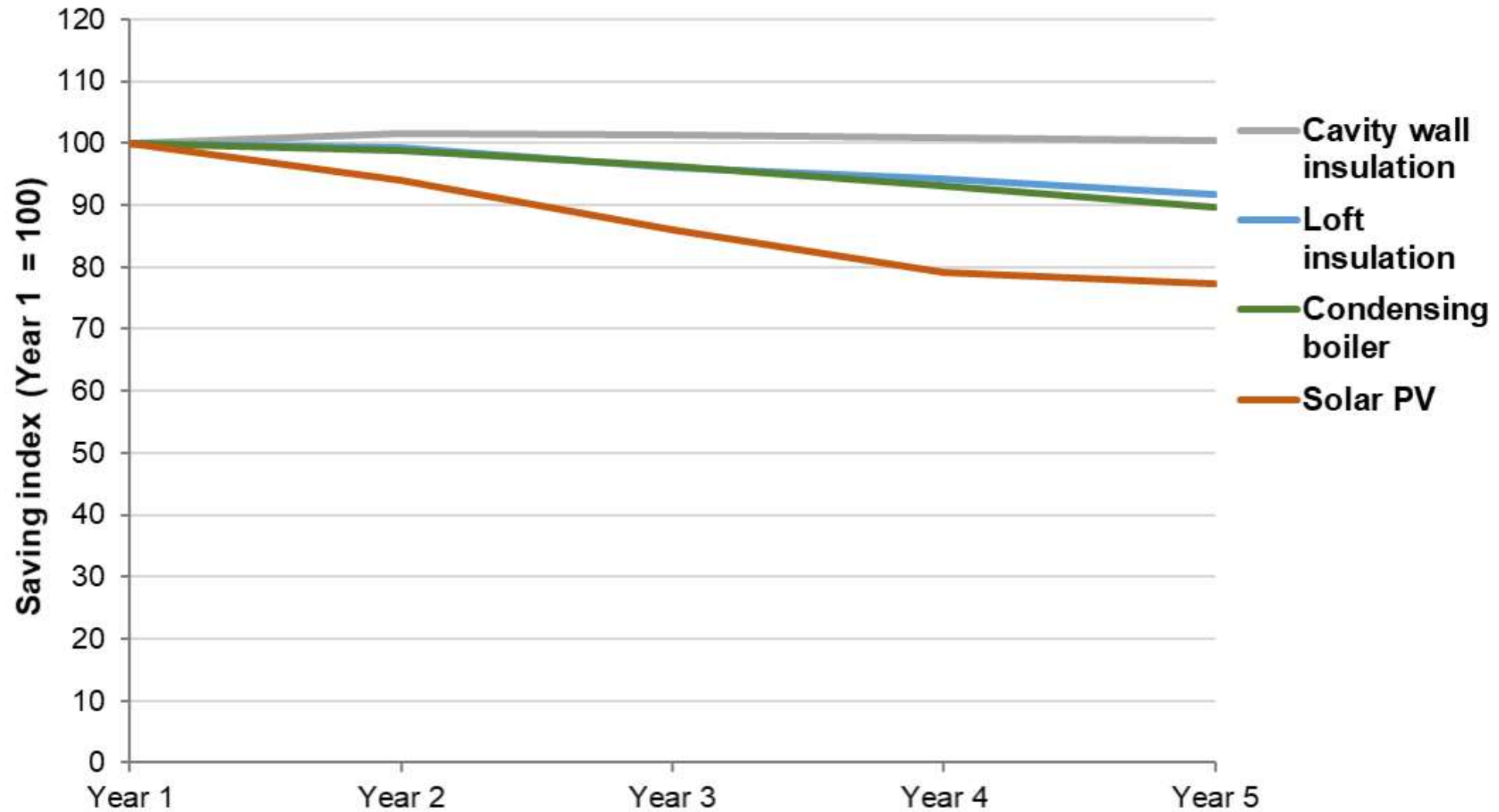


Retrofitting means we are using less per home, but we have stagnated

Figure 2.5: Median annual gas consumption over time by property type, England and Wales, 2005 – 2019



The benefit of retrofit deteriorates over time



	Cost per home	Annual Savings	Payback
Cavity wall insulation	£ 1,500 - £2,500	£ 180	8 years
Solid wall insulation	£ 15,000 - £ 30,000	£ 360	40 years
Loft insulation	£ 1,000 - £ 3,000	£ 80	30 years
Floor insulation	£ 4,000 - £ 6,000	£ ?	50 years + +?
New windows	£ 7,000 - £ 10,000	£ ?	50 years + +?
Gas Boiler	£ 2,000 - £4,000	£ 100	30 years
Air source heat pump	£ 8,000 - £ 15,000	£ ?	50 years + +?
Ground source heat pump	£ 10,000 - £25,000	£ ?	50 years + +?



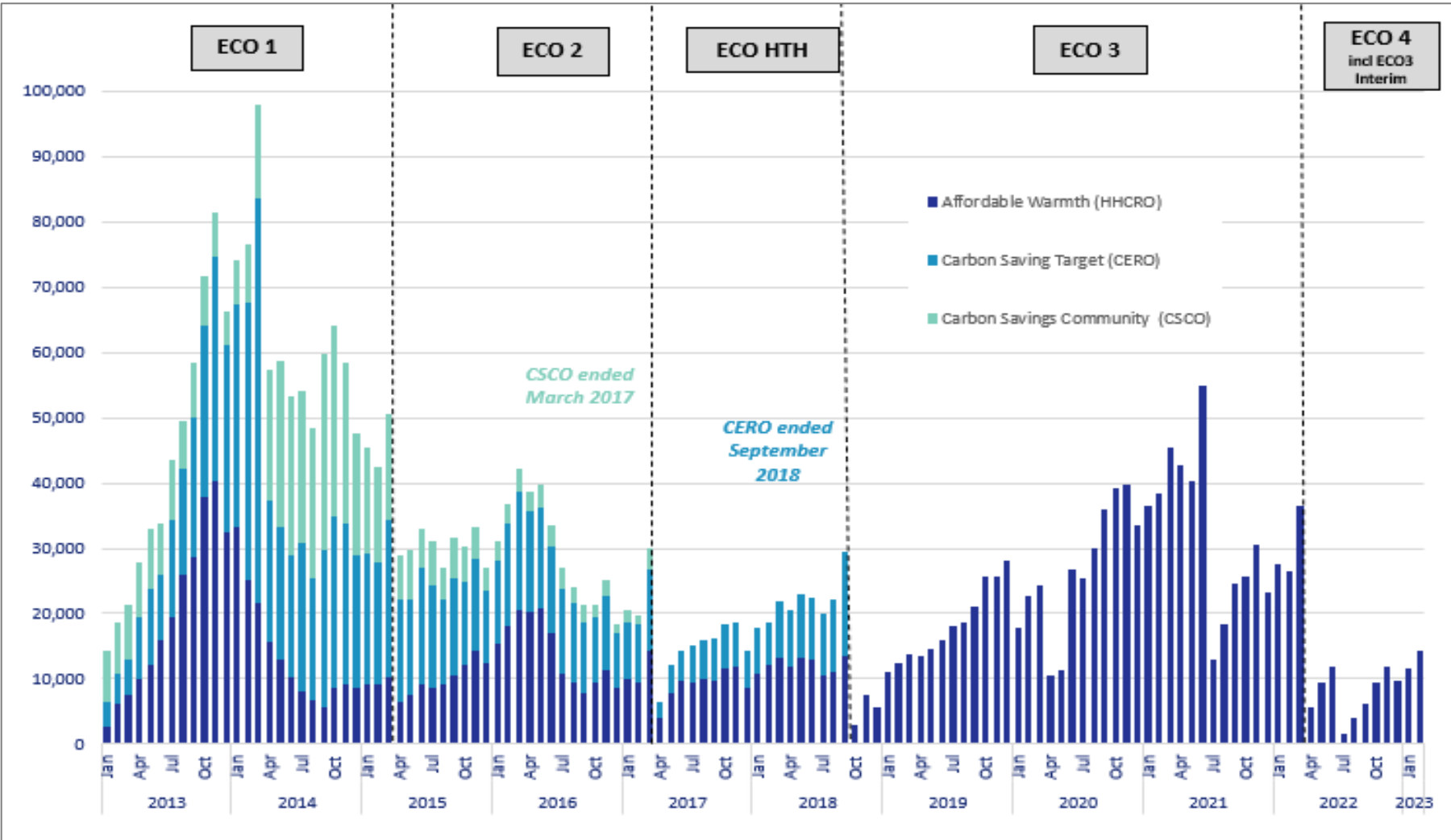
This a market failure, so needs intervention

Table showing top five 'category one hazards' found in homes in England

'Category 1' Hazard	Number recorded	Annual cost to NHS	Total cost to mitigate hazard	Payback (years)	Annual savings to society if hazard mitigated
Excess cold	836,000	£857million	£6billion	7	£15.3billion
Falls on stairs	1.048million	£219million	£1.3billion	6	£1.7billion
Falls on the level	410,000	£104million	£350million	3	£258million
Falls between stairs	181,000	£51million	£229million	4	£280million
Dampness	75,000	£38million	£269million	7	£96million



Policy had been slowing down

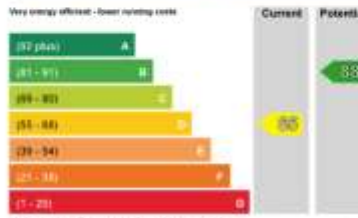


EPC targets are the key policy drivers

ENERGY PERFORMANCE REPORT (EPR)

Property address: 1 BERKELEY AVENUE	Assessor's accreditation number: STRO006650
Postcode: LS8 3RH	Assessor's name: Stroma Training 16
Unique Property Reference Number (UPRN):	Phone Number:
Total Floor Area: 70	Email Address:
Date of assessment: 25/07/2022	IRPH: 0000-0000-0000-0000

Energy Efficiency Rating



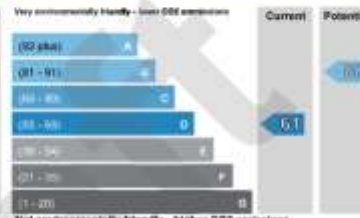
The graph shows the current energy efficiency of your home, the higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations outlined.

Current primary energy use per square meter of floor area: 281 kWh/m² per year

The assessment does not take into consideration the physical condition of any element. Assumed means that the insulation could not be inspected and an assumption has been made in the methodology based on age and type of construction.

Carbon Dioxide (CO2) Emissions Rating



The energy we use for heating, lighting and power in homes produces over a quarter of the UK's CO2 emissions. If you were to install the recommendations you could reduce the CO2 amount by 2,305 tonnes per year.

You could reduce emissions even more by switching to renewable energy sources.

Your homes heat demand

For most homes the very majority of energy costs derive from heating the home. Where applicable, this table shows the energy that could be saved in this property by insulating the loft and walls, based on typical energy use.

Annual heat demand	Existing dwelling	Impact of loft insulation	Impact of cavity wall insulation	Impact of solid wall insulation
Space Heating (kWh)	11,199	212	0	4,307
Water Heating (kWh)	1,850			

The Energy Performance Report was produced using Stroma Certification's RSAP+ government approved RdSAP 9.92 software.

Energy Saving Advice Service

A centralised government-funded telephone advice service run by the Energy Saving Trust is available to offer you impartial energy-saving advice on 0300 123 1234.

The advice provided is free of charge, calls are charged at the standard national rates. You can also access a knowledge base online by visiting www.energysavingtrust.org.uk

Contact Details

Green Deal Helpline 0845 621 11 11 ext. 607
greendeal@stroma.com
www.stroma.com/certification

Stroma Certification, 4 Pioneer Way, Colketford, WF16 9GU

[Back](#)

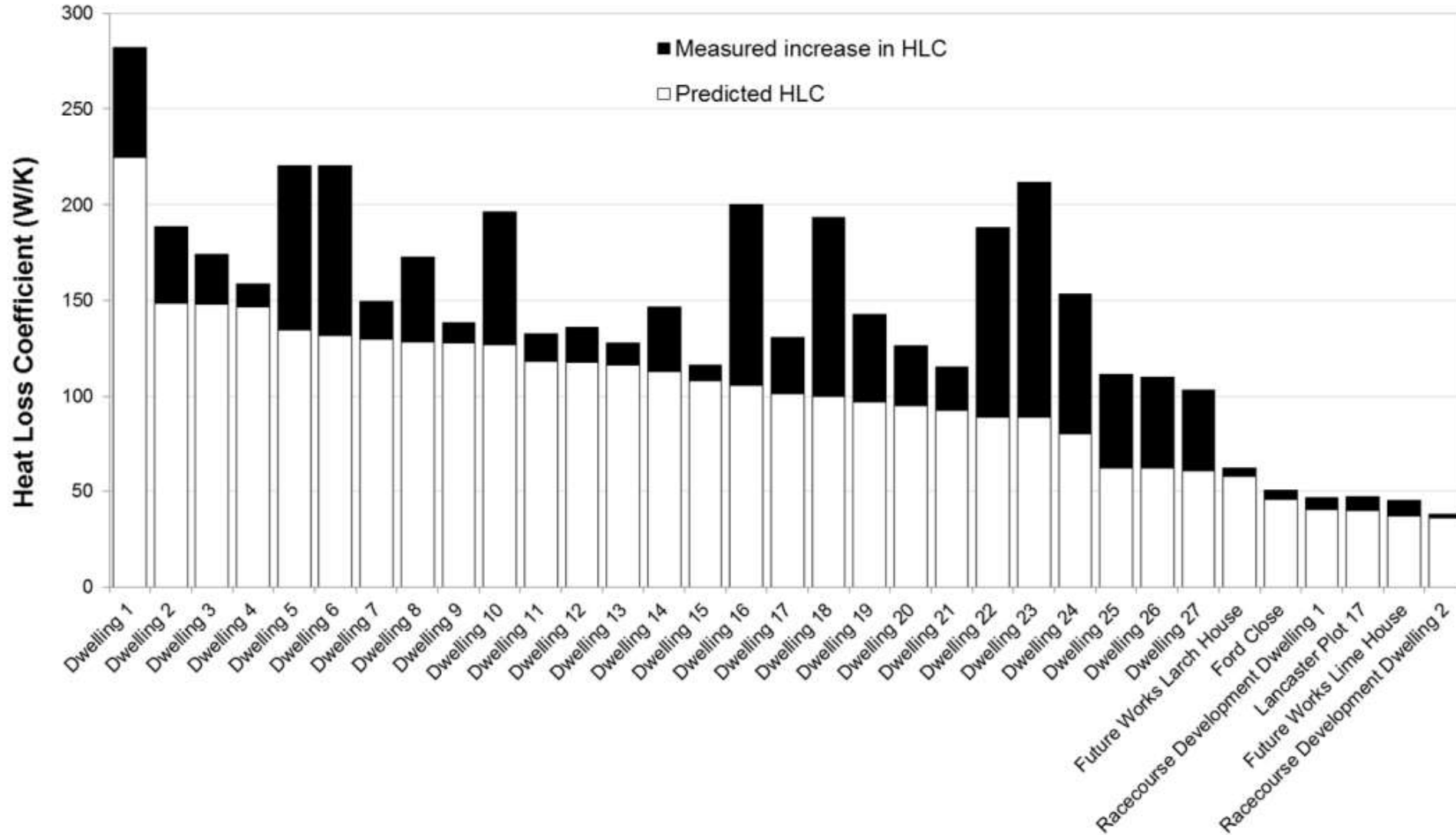
11 EPCs for LS7 4LZ

If your property does not have a valid EPC, you can [get a new energy certificate](#).

Address	Energy rating	Valid until
Flat 2, 80 Harrogate Road, LEEDS, LS7 4LZ	D	1 November 2019 EXPIRED
Flat 3, 80 Harrogate Road, LEEDS, LS7 4LZ	D	31 May 2032
Flat 4, 80 Harrogate Road, LEEDS, LS7 4LZ	E	22 April 2024
94a, Harrogate Road, LEEDS, LS7 4LZ	D	3 September 2029
94c, Harrogate Road, LEEDS, LS7 4LZ	D	23 April 2023
94d, Harrogate Road, LEEDS, LS7 4LZ	E	26 May 2025
94e, Harrogate Road, LEEDS, LS7 4LZ	D	27 November 2029
Flat 8, The Old Police Station, LEEDS, LS7 4LZ	C	20 February 2019 EXPIRED
Flat 9 The Old Police Station, 106a, Harrogate Road, LEEDS, LS7 4LZ	C	20 March 2029
Flat 10 The Old Police Station, 106a, Harrogate Road, LEEDS, LS7 4LZ	C	20 March 2029
Flat 11 The Old Police Station, 106a, Harrogate Road, LEEDS, LS7 4LZ	C	20 March 2029



Performance gap can be as high as the EPC error



LSI Research project



Heat Pump Ready

User behaviour for domestic heat pumps



RHINOS

Uptake of high density heat pumps



H21 project

Understanding the perception of hydrogen heating in the UK



"We'd be doing our bit for climate change, and possibly the whole world would follow"

Leeds Beckett University research is exploring customers views on a hydrogen gas network for the first time.

Download the social sciences report now at h21.green



Tridrogen

Engaging people about hydrogen trials



Leeds Beckett Research – New build homes

Billingley New Build

Measuring the performance of new low carbon homes



Hy4Homes

In Use monitoring of a trial 100% Hydrogen home.



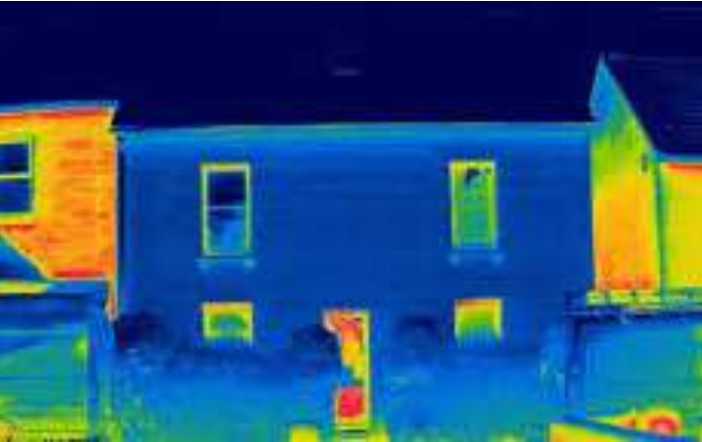
WIKI house

Life Cycle Assessment (LCA) of modular homes



DEEP Retrofit

Establishing the risks and benefits of retrofitting solid walls & how to improving retrofit models



Department for Business, Energy & Industrial Strategy

UKGBC Retrofit Toolkit

Standardising neighbourhood retrofit evaluation



WDH retrofits

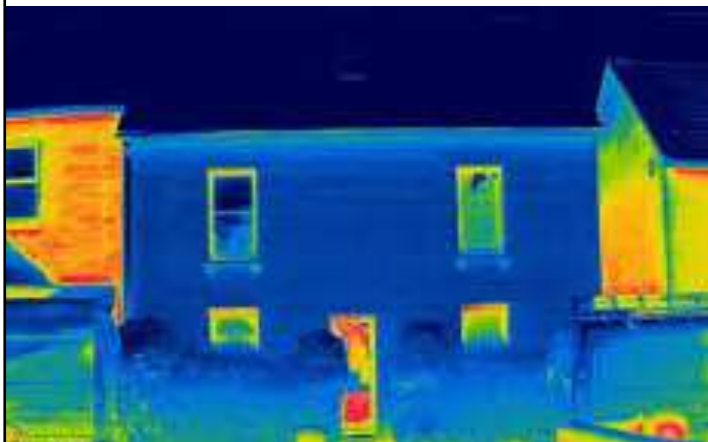
Post Occupancy Evaluation (POE) of low carbon retrofits for Wakefield District Housing



Low carbon homes: Retrofit

DEEP Retrofit

Establishing the risks and benefits of retrofitting solid walls & how to improving retrofit models



Department for
Business, Energy
& Industrial Strategy

WDH retrofits

Post Occupancy Evaluation (POE) of low carbon retrofits for Wakefield District Housing



Low carbon homes: Toolkits & Innovation

UKGBC Retrofit Toolkit
Standardising neighbourhood
retrofit evaluation



Ofgem Technical Advisory Panel
Supporting energy efficiency
innovations



Low carbon product evaluation

Thin Internal Wall Insulation

Evaluating the performance & risks
of internal wall insulation



Department for
Business, Energy
& Industrial Strategy

Insulated eaves ventilator

Developing, testing & patent



Smart meters & energy data

SMETER

Validating the performance of in-use energy data assessments



Department for
Business, Energy
& Industrial Strategy

SERL

Using Smart meters to investigate energy efficiency of homes



SMART ENERGY
RESEARCH LAB

UNIVERSITY RESEARCH FOR PUBLIC GOOD

New Building Performance Evaluation tools

Pulse

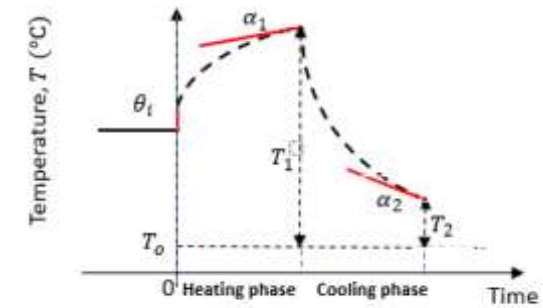
Validating the use of novel air tightness technology



Department for
Business, Energy
& Industrial Strategy

QUB PhD

Validating the use of rapid whole house heat measurements technology



14 DEEP Retrofit case studies

41 Retrofits

- 7 Airtightness
- 4 Loft
- 4 Room in roof
- 5 Glazing
- 12 Ground floor
- 1 Internal wall (IWI)
- 3 External wall (EWI)
- 1 Hybrid wall (IWI & EWI)
- 4 Whole house approach



Link to DEEP retrofit research project introduction video

<https://youtu.be/VX-ZYjZKrL4>



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DEEP Retrofit research design

Case studies



Laboratory tests



Modelling



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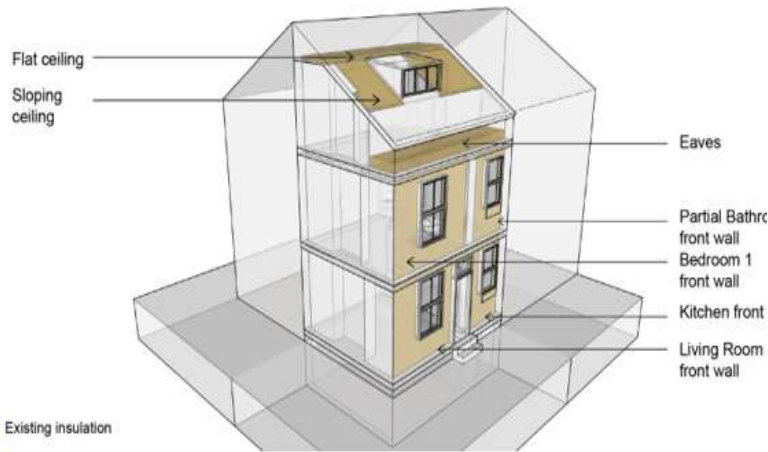


Figure 1-6 Stage 1: Insulation already in the property prior to the retrofits (17BG.B)



Figure 1-7 Stage 2: Roof retrofit to Bedroom 2 (17BG.A.R)

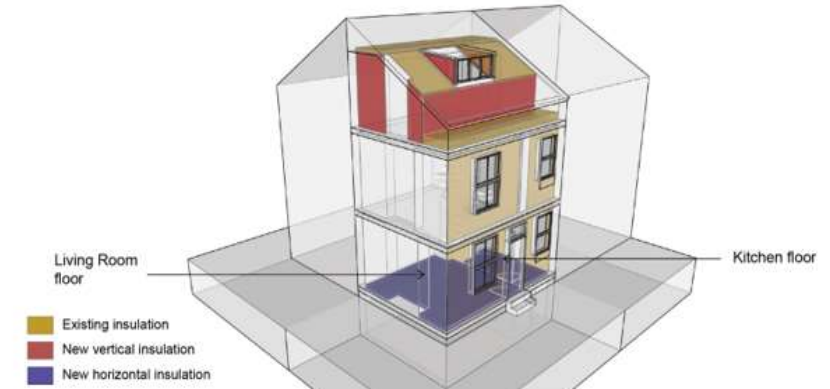


Figure 1-8 Stage 3: Floor retrofit to Kitchen and Living Room, (17BG.A.R.F)

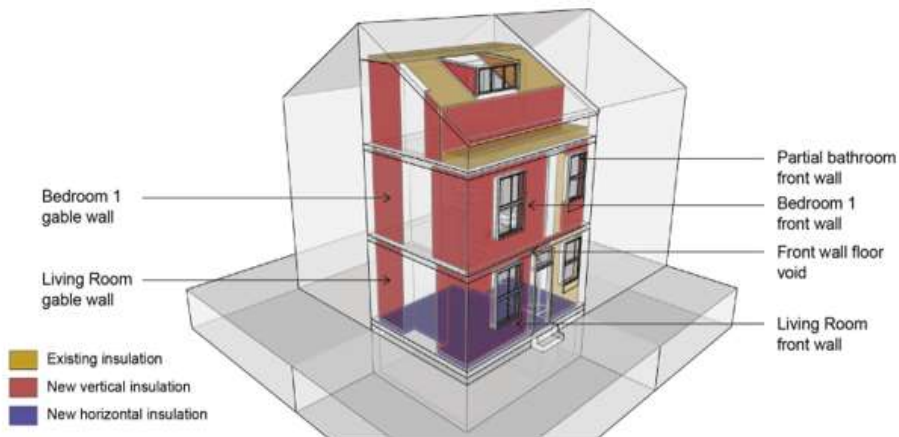


Figure 1-9 Stage 4: IWI retrofit to ground and first floor external walls (17BG.A.R.F.W)

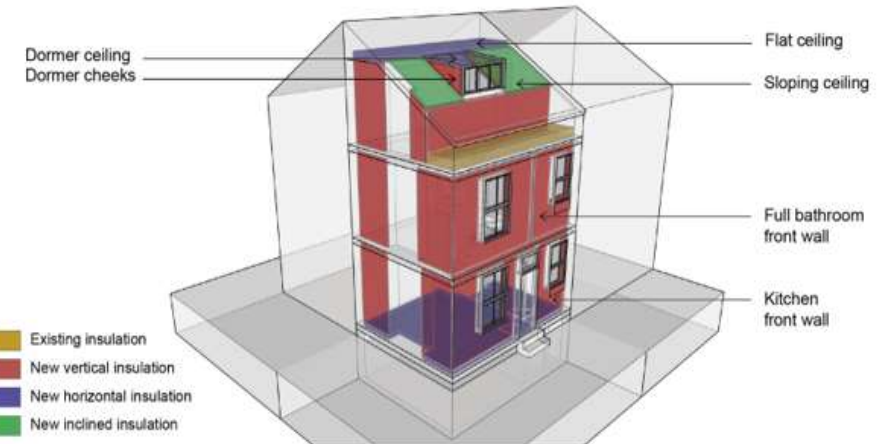


Figure 1-10 Stage 5: Whole house approach retrofit (17BG.WH)

DEEP Retrofit case studies methods

43 Coheating tests & over 50 QUB tests

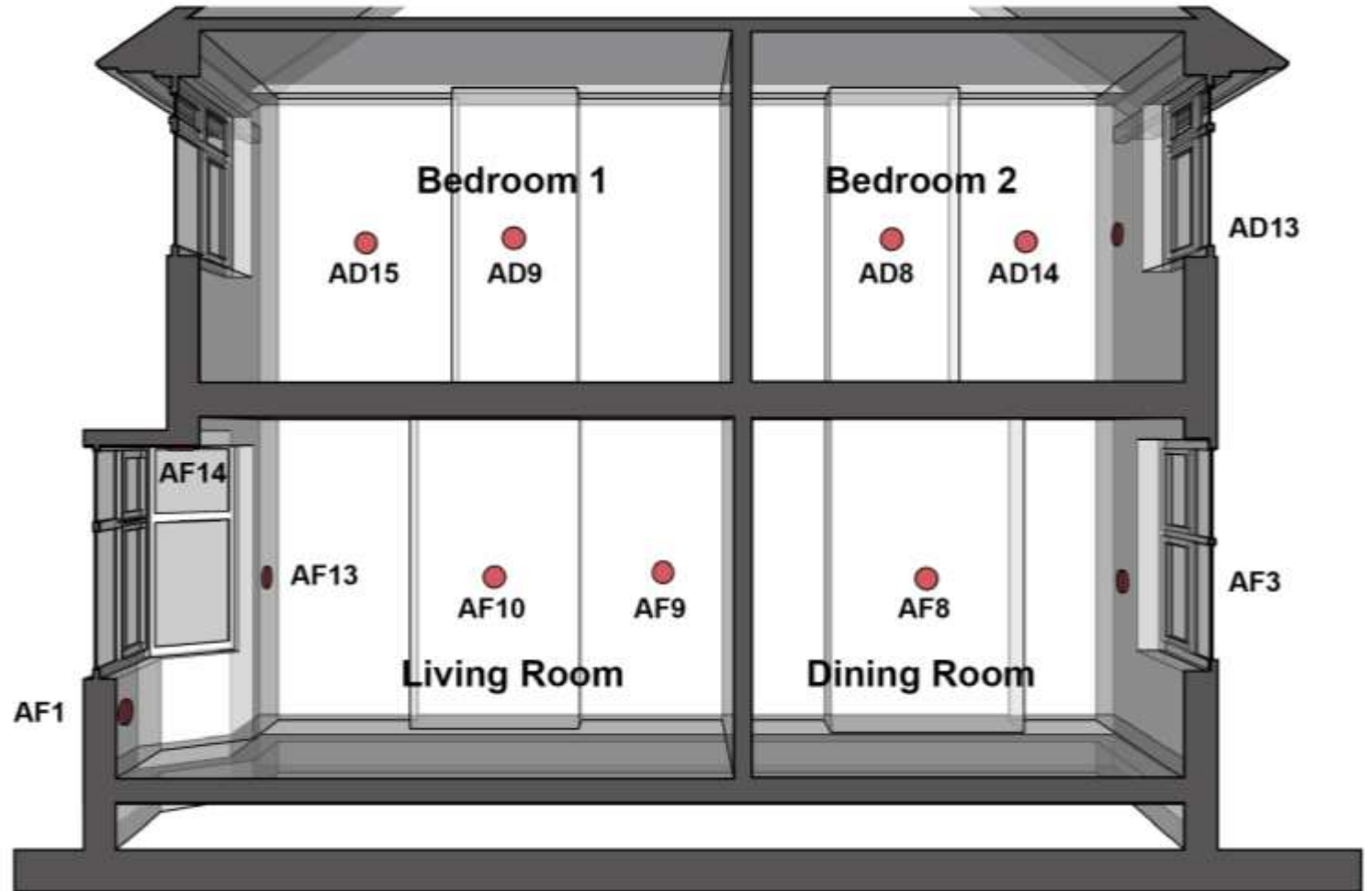
- Whole house heat loss or Heat Transfer Coefficient (HTC)
- Compare pre vs. post retrofit HTC
- Compare measured vs. modelled HTC



DEEP Retrofit case studies methods

410 Heat flux density measurements

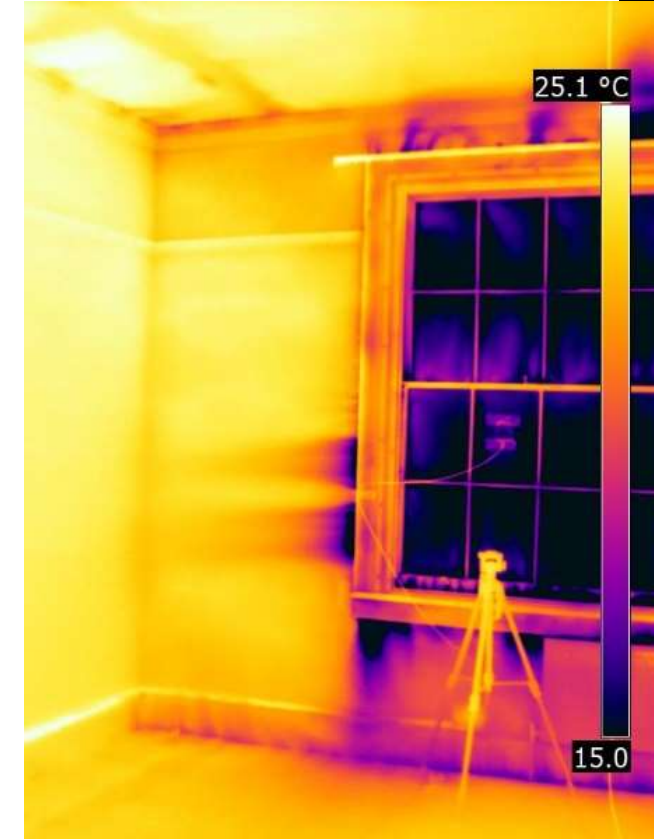
- U-values ($W/m^2.K$)
- Compare pre vs. post retrofit U-values
- Identify the performance gap & the modelling gap



DEEP Retrofit case studies methods

118 blower door tests & 77 pulse tests

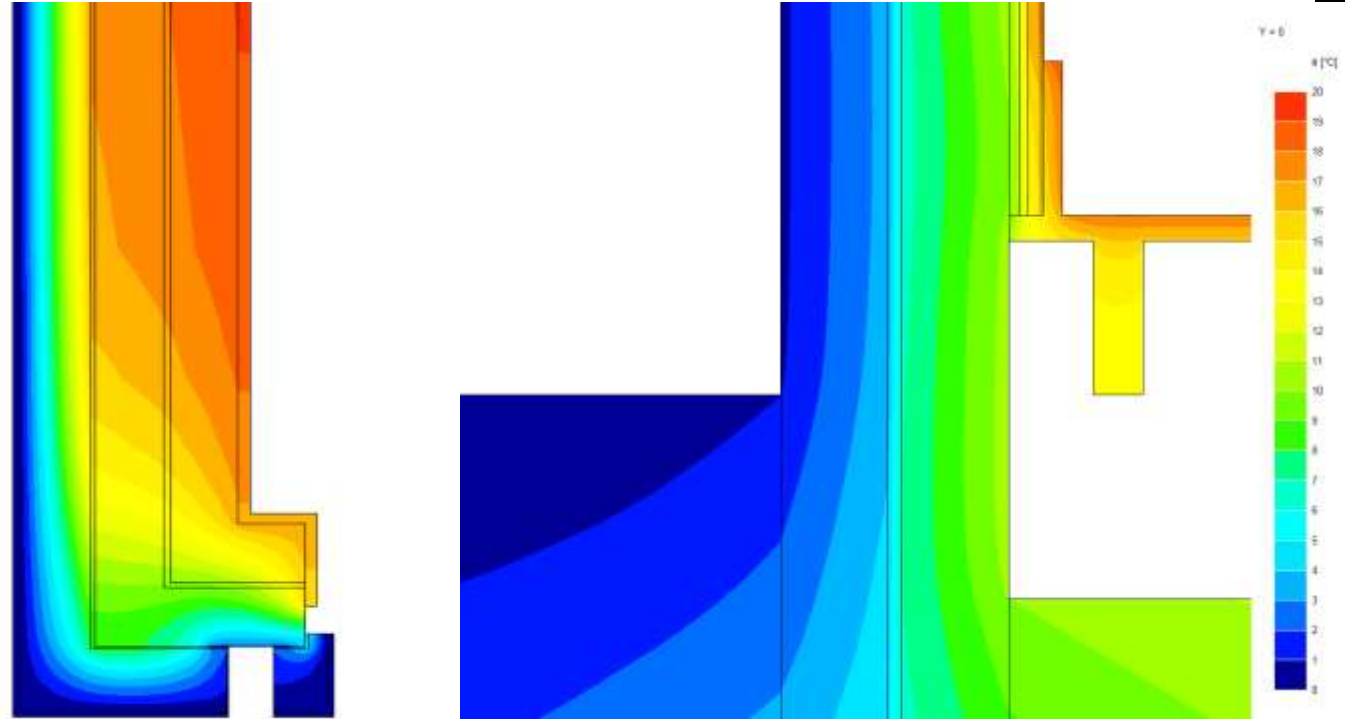
- Mean air permeability ($\text{m}^3/\text{m}^2@50\text{p}$ & ACH)
- Compare pre vs. post retrofit airtightness
- Compare measured vs. default RdSAP assumptions
- Air leakage detection & thermography
- 11 homes Co pressurised



DEEP Retrofit case studies methods

116 Junctions modelled

- Thermal bridging software (TRISCO)
- Compare pre vs. post retrofit thermal bridging heat loss (γ -values and ψ (Ψ) values)
- Compare and pre vs. post retrofit surface condensation risk via temperature factor (f_{RSi})
- Evaluate severity of discontinuities



1. EPC accuracy

Findings

RdSAP default inputs do not capture the variability of homes' construction or occupants, and this contributes to the prebound effect.

Recommendation

RdSAP inputs could more comprehensively and accurately reflect building characteristics and occupants.



2. Is PAS2035 worth it?

Findings

Whole house approach retrofits have lower risks than piecemeal retrofits but may have similar fuel bill reductions and higher costs.

Recommendation

Guidance and models could inform which retrofit measures, installation techniques, and interactions have high or acceptable risks.



3. EPC Band C

Findings

Only solid wall insulation is likely to bring solid walled homes up to an EPC band C, or significantly reduce condensation and overheating risks.

Recommendation

Retrofit policy mechanisms should better reflect the significance of solid wall insulation in achieving broader policy goals.



4. Measuring energy savings

Findings

Coheating tests in DEEP had an average uncertainty of 6% and was able to identify significant differences in 13 of 27 cases.

Recommendation

Use of smart meter data which have uncertainties above 15% are not likely to be able to give house-by-house savings, so alternative approaches are needed.



Conclusions

The DEEP retrofit project could have significant impact on retrofit policy and industry practice

- Identifies how models can be improved
- Quantifies the significance of solid wall insulation
- Provides recommendations on how to implement the whole house approach and adopt risk-based approaches to retrofits in solid walled homes

22 DEEP reports to be published in July 2023 (launch event sold out)

Preliminary launch at the Building Centre Retorfit23 exhibition in London on 14th June



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