

Future microwave heating for homes

With Professor Sean Smith,
University of Edinburgh

Monday 14 August
@ 2.00pm



Professor Sean Smith

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University of Edinburgh



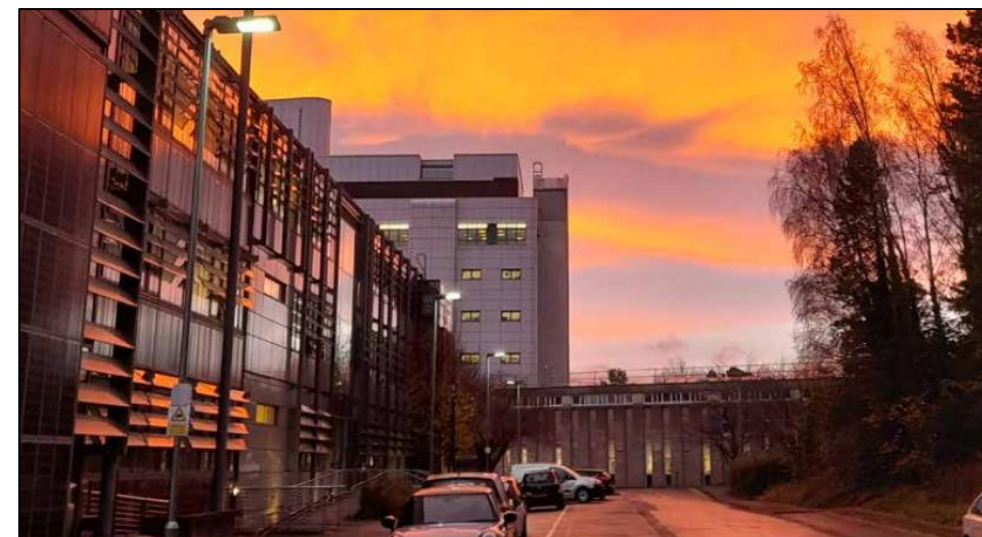
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Overview

- Global and Futures Scene Setting
- Current Net Zero Targets
- UK and Scottish Housing Stock
 - ZEST Report & Archetype Retrofit Approach
 - Skills & Delivery
 - Combination of Heating Systems for Housing
 - Heat Wayv
 - Future Pilots
 - Scaling Up
 - Summary



The quickening need for ‘Manhattan Project #2’ process for climate emergency response

The Scale

The scale of infrastructure changes and retrofit programme may appear daunting but also provides the opportunity for transformational approaches to how we enable processes and delivery to meet the needs of current and future generations.

11 million homes per annum for 2050 targets. Unlike previous individual country economic and environmental approaches the global synergetic demand for low carbon project works by so many countries in parallel suggests that previous route map processes to delivery are unlikely to prevail. Both Italy and Germany identified this issue, even before the current

Above

Complexity and bespoke nature of non-domestic retrofit even for buildings constructed during the last decade

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Winter Edition 2023, RIAS Quarterly

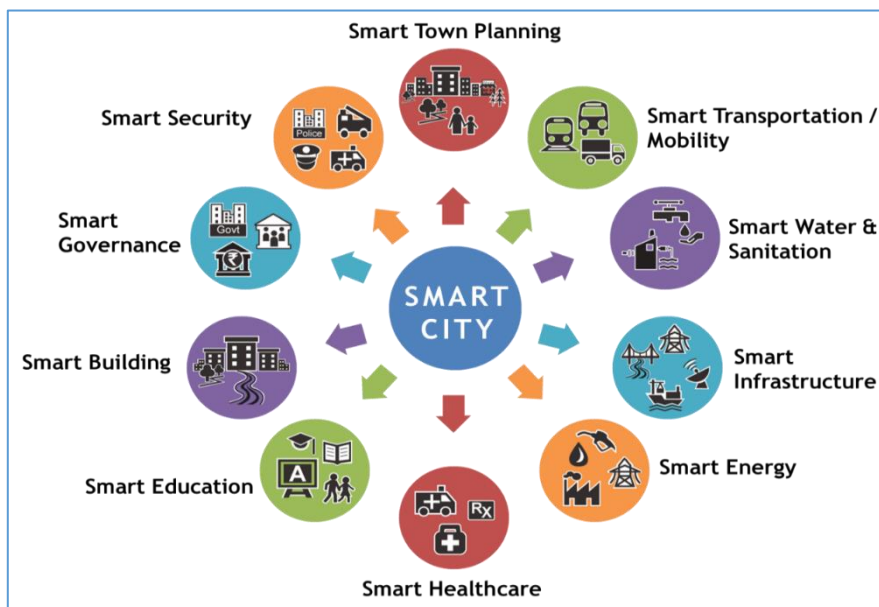
<https://www.rias.org.uk/about/rias-quarterly>

Centre for Future Infrastructure

Sustainable Infrastructures *Supporting Net-Zero Approaches*

- *Green energy futures*
- *Low carbon construction systems*
- *Technical & safe solutions*
- *Circular economy*
- *Lasting 'Horizon' positive legacy factors*
- *Design for Future Disassembly (DFD)*

Digital & Data Rich Infrastructure *Delivering Smart Cities and Regions*



New and Retrofit Infrastructure *Developing Innovations*

- *Resilience for climate change habitats*
- *Large modular infra solutions*
- *Adaption and renewal*
- *Integrated approaches*
- *Systems engineering for future energy, water and transport*

Can only be achieved and fully delivered through integration of engineering with:
Policy – Society – Business – Data – Health – Environment – Skills - Arts



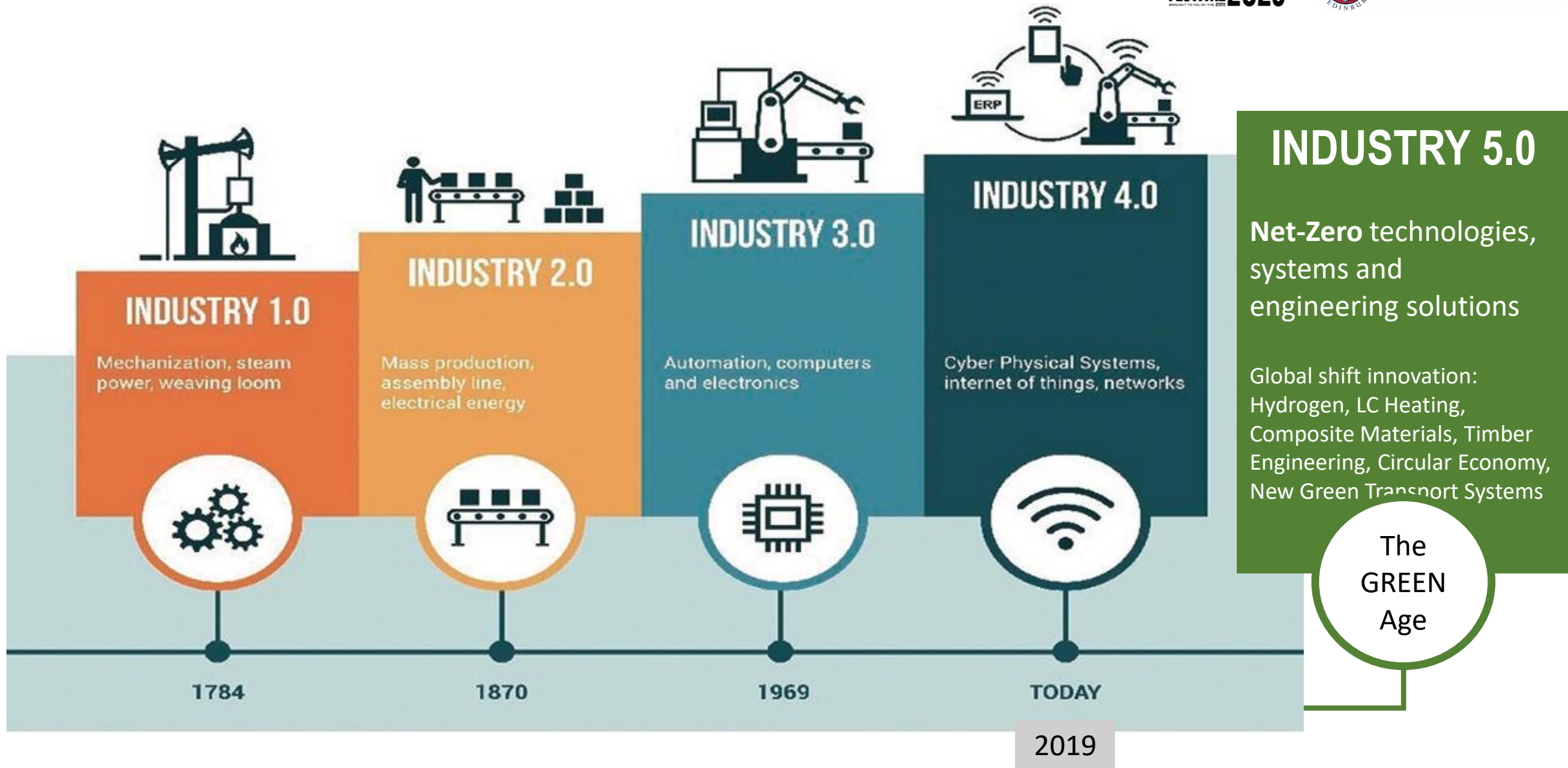
“During the next 20 years the world will spend over \$100 trillion on buildings, transport and infrastructure”

Professor Sean Smith HON FRIAS, BSc, PhD, FIOA, FRSA

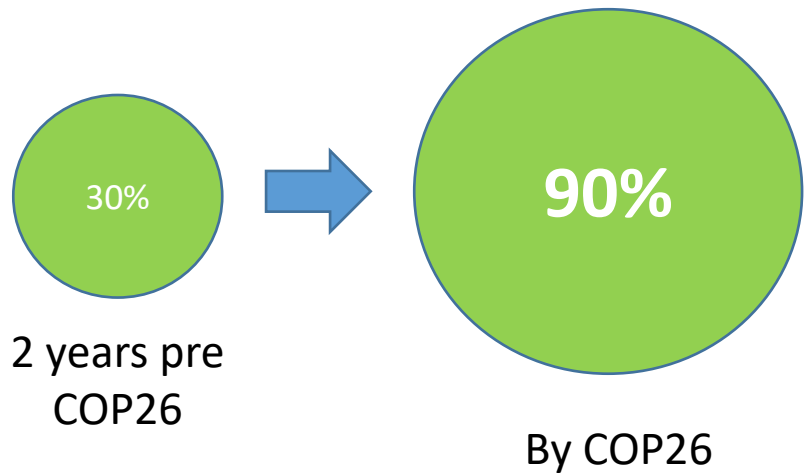
OUR FUTURE

THE FUTURE....

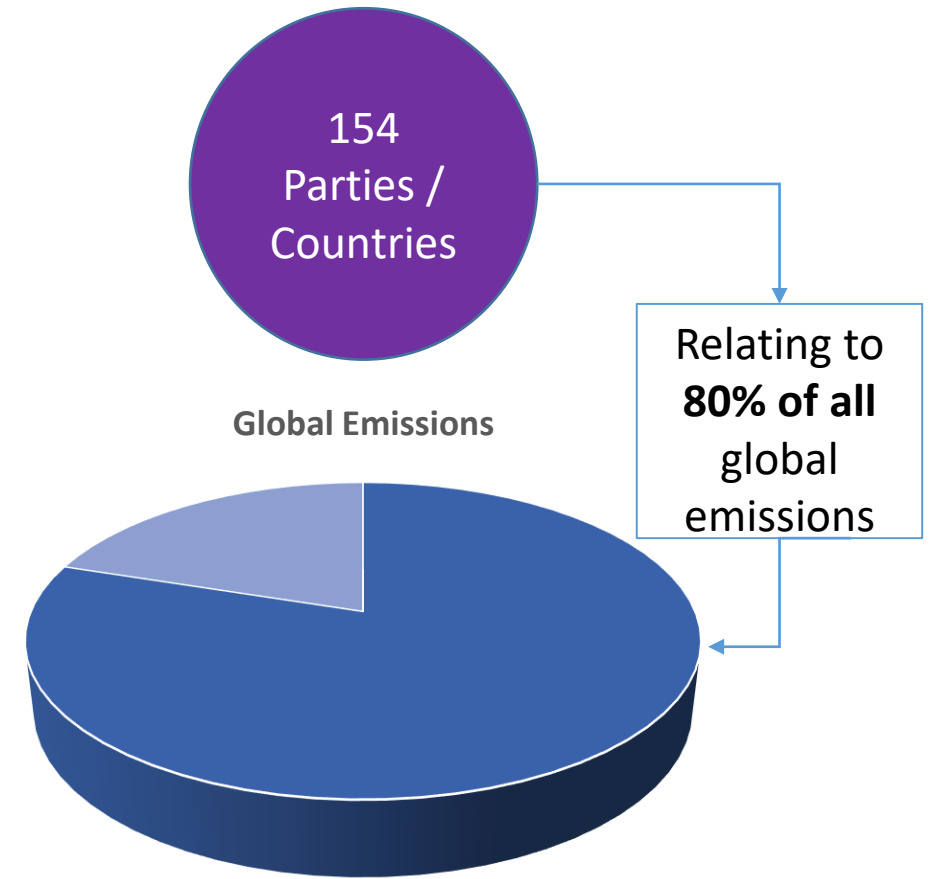
- Scaling up
- Global growth
- Global demand on materials / resources
- Synergetic demands by many countries
- Skills supply
- Consumer trust
- Optimising delivery for net zero



Net Zero Commitments by Countries/Parties



New National Net Zero Targets



Net Zero & Other targets:

Scotland	2024/25 (new build non-fossil fuel)
City of Edinburgh	2030
Scotland	2045 Net Zero
United Kingdom	2050
England	2050
Northern Ireland	2050
Wales	2050
EU	2050

Scotland's Emissions

Housing	14%
Transport	25%

Existing Homes (South East Scotland)

- 720,000 existing homes in SE Scotland region
- Requires retrofitting 32,000 / year
- 820 homes per week
- Rural areas often use oil and LPG heating (high CO2e emissions)

2100 = 11.3 billion



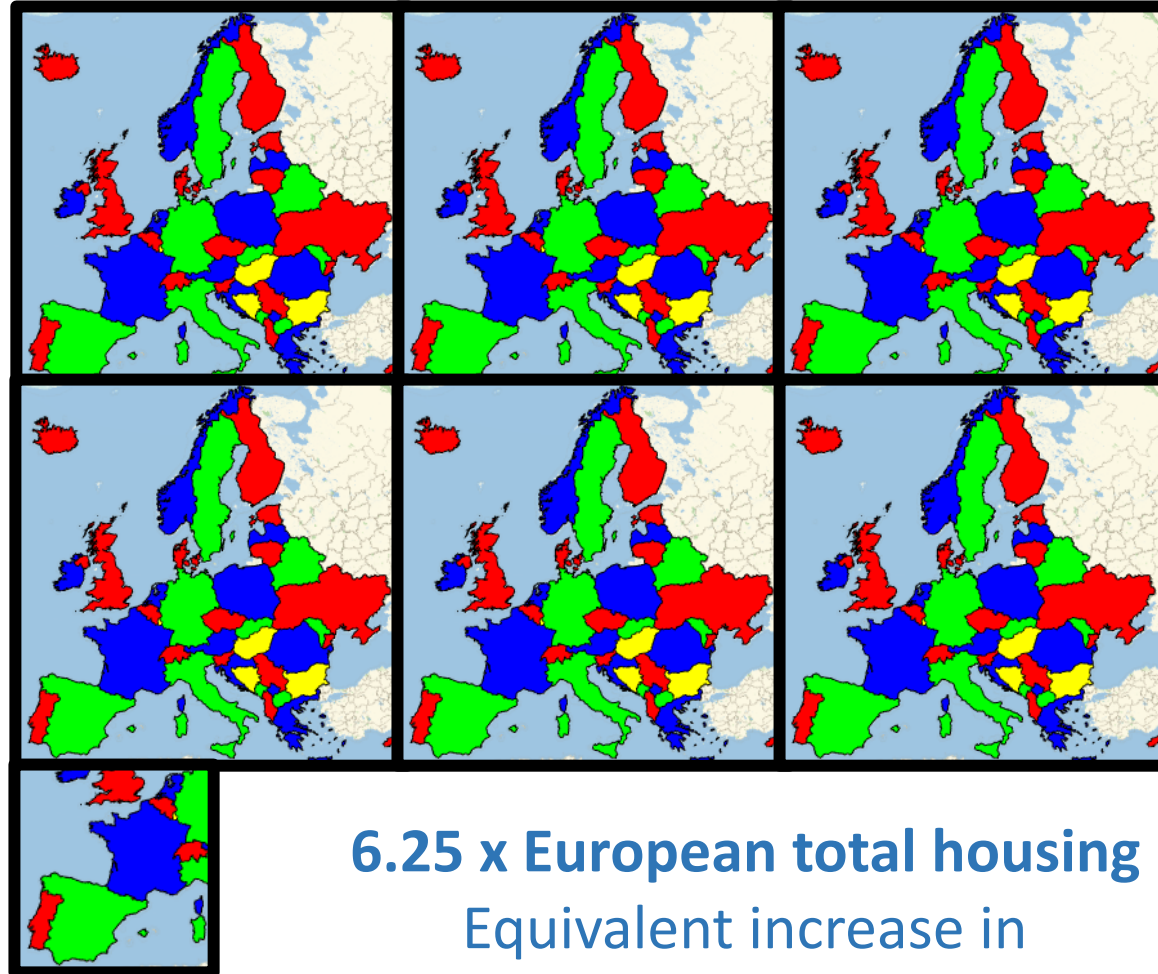
2020 = 7.8 billion

Future Housing Needs

- Global Household 'average size' ranges from 2.1 to 4.8
- Next 80 years – 3.5 billion increase in population
- Probably need to build **1.2 billion new homes**
- Increase in living longer, divorce rates, single households
- **PLUS 800 million** new homes for 'existing needs' over next 80 years
- **= 2 billion new homes to be built in 80 years**

By Year 2100....

Globally to build 2 billion homes AND all related infrastructure



- 29 countries
- 570 M population
- 320 M homes

- Schools, hospitals, offices, industry, infrastructure

6.25 x European total housing
Equivalent increase in
global housing need in next 80 years

PLUS +
Schools
Hospitals
Infrastructure
Offices
Industry
Etc. etc..

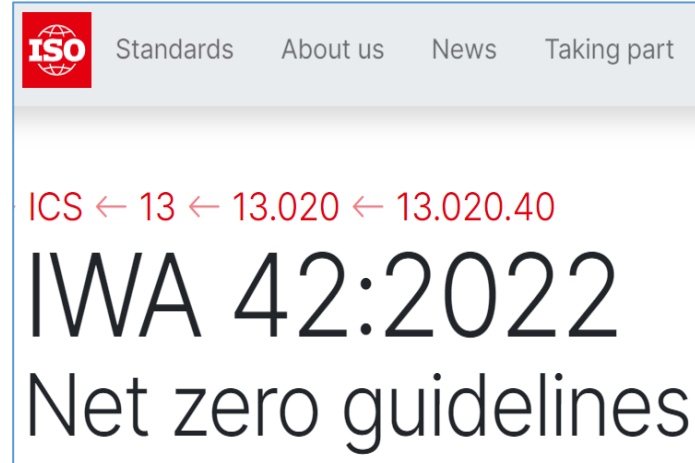
A Sustainable Built Environment must be a global priority
Carbon Design
Materials
Construction
Life of building
Future Disassembly

Some publications:

MISSION ZERO

Independent Review
of Net Zero

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1128689/mission-zero-independent-review.pdf



ISO Standards About us News Taking part

ICS ← 13 ← 13.020 ← 13.020.40

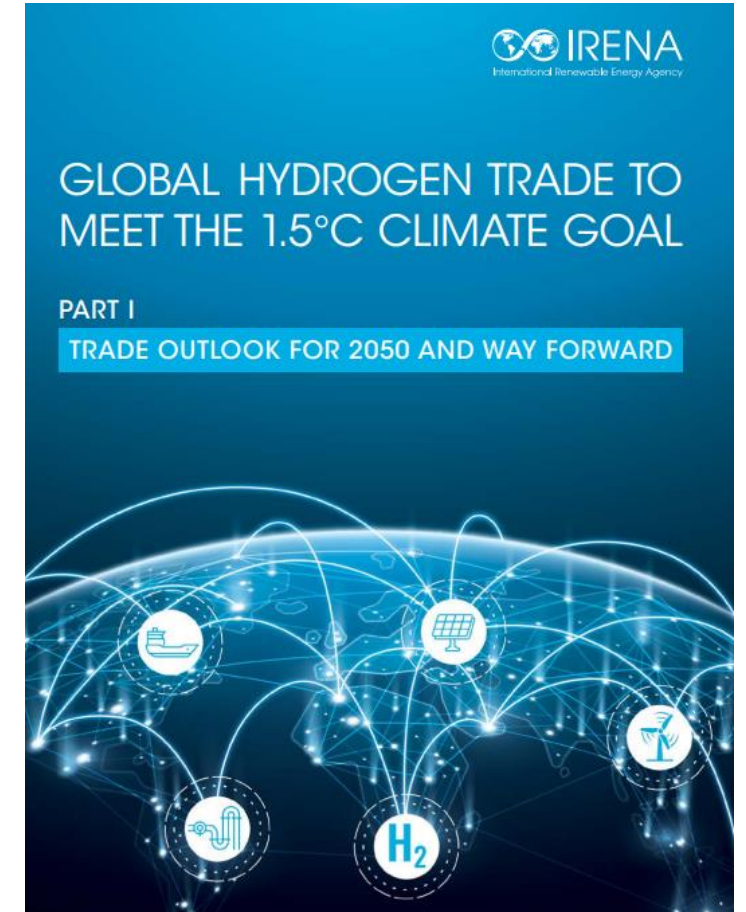
IWA 42:2022

Net zero guidelines

Net Zero Guidance

- IWA Uses 2018 as baseline
- IWA 50% reduction by 2030

<https://www.iso.org/standard/85089.html>



IRENA
International Renewable Energy Agency

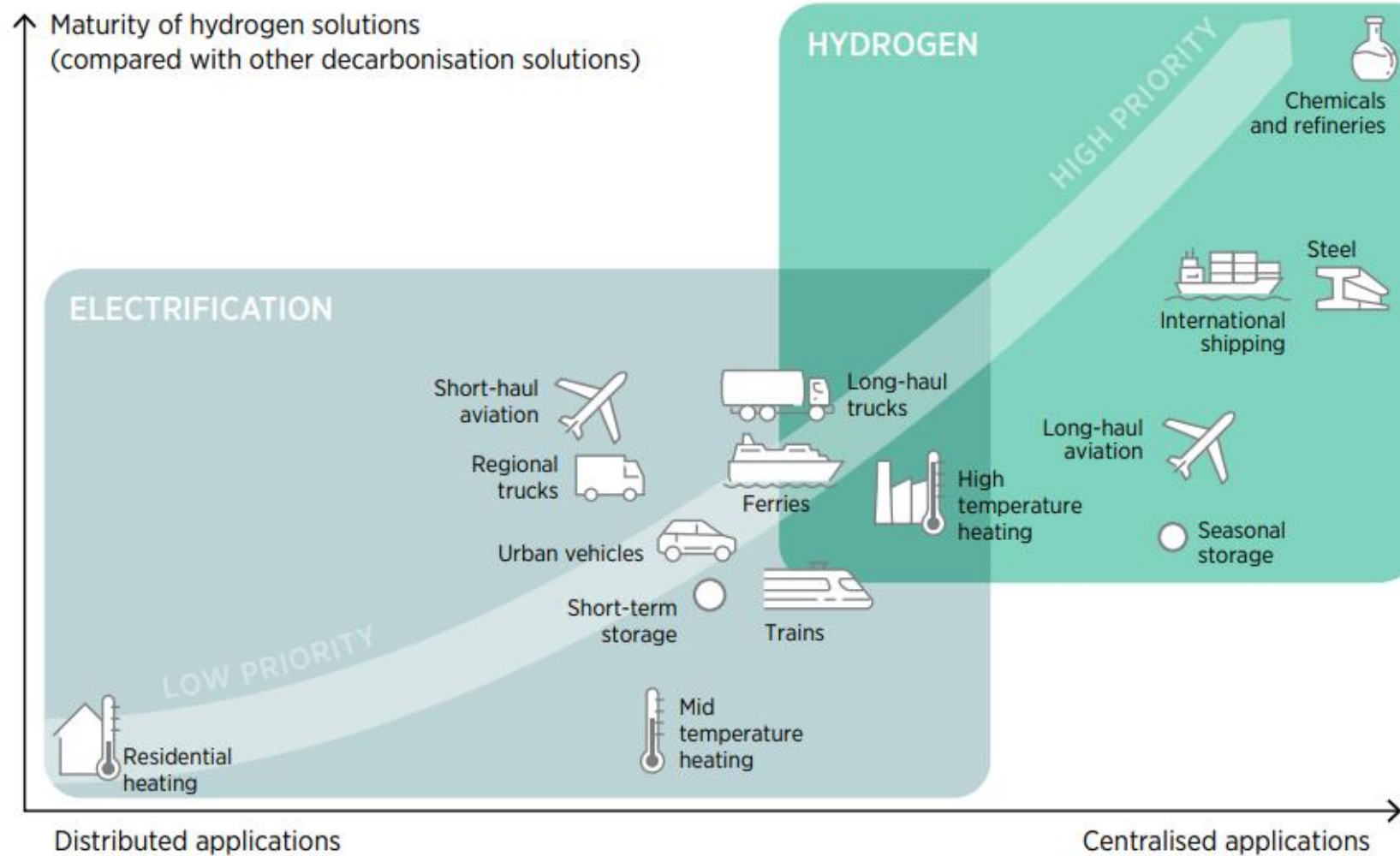
GLOBAL HYDROGEN TRADE TO MEET THE 1.5°C CLIMATE GOAL

PART I
TRADE OUTLOOK FOR 2050 AND WAY FORWARD

The cover features a blue background with a glowing globe and various icons representing energy and trade, including a ship, a solar panel, a wind turbine, and a hydrogen molecule (H₂).

https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jul/IRENA_Global_hydrogen_trade_part_1_2022.pdf

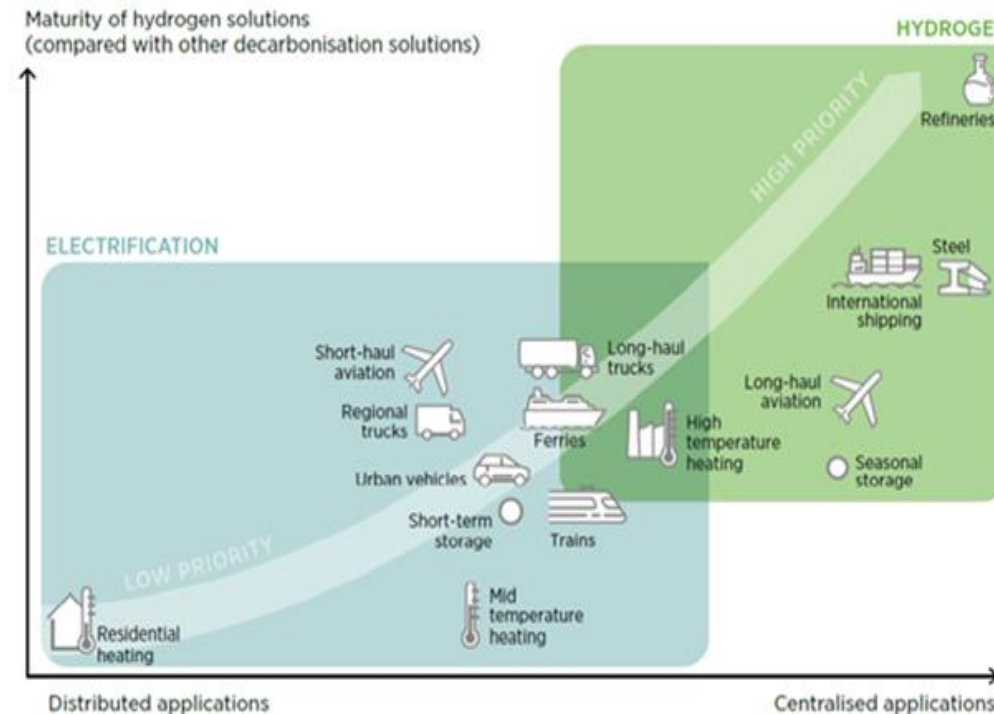
FIGURE 1.2. Priority settings for hydrogen applications across the energy system



Hydrogen is still in an ‘infancy stage’ for housing and according to recent report [IRENA 2022] is the least developed of all sectors and the wider needs and applications of hydrogen are more suited to industrial sites.

Furthermore the existing street pipework infrastructure, existing gas pipes in homes and boilers would all require to be replaced if hydrogen was incorporated above 20% of gas content within existing gas networks. This would add considerable delays, costs, increased embodied carbon and emissions.

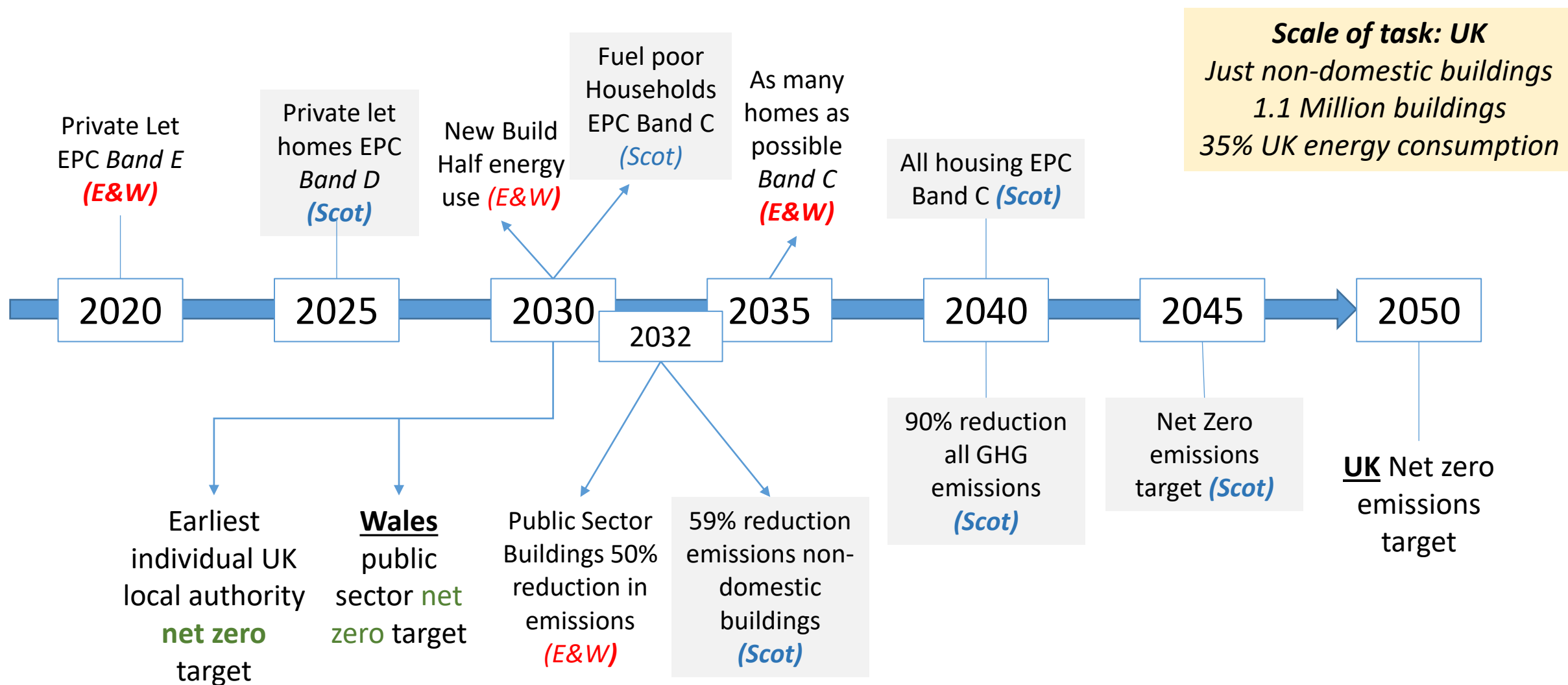
Even if hydrogen was utilised in existing gas networks up to 20% of total gas content it would only deliver 7% emissions reduction.



Potential Future Focus for Hydrogen

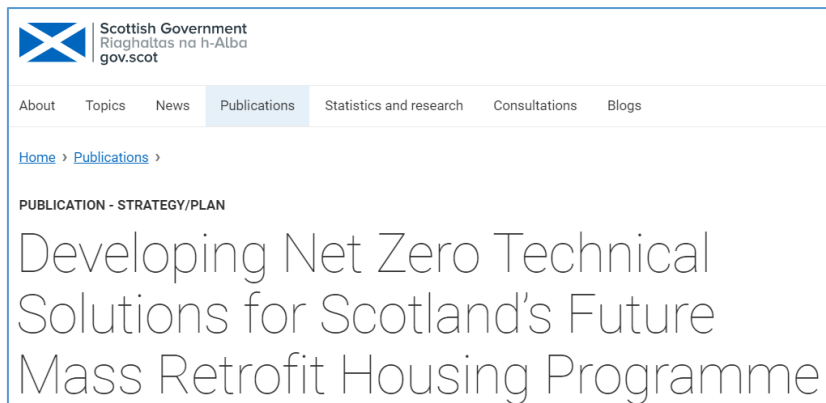
- Industrial
- Large scale commercial
- Vehicles HGVs / Buses
- Large new build housing estates
- Remote locations – energy self sufficiency

Timeline: Future EE Measures and Net Zero Policies



Retrofit of Buildings – ZEST Report

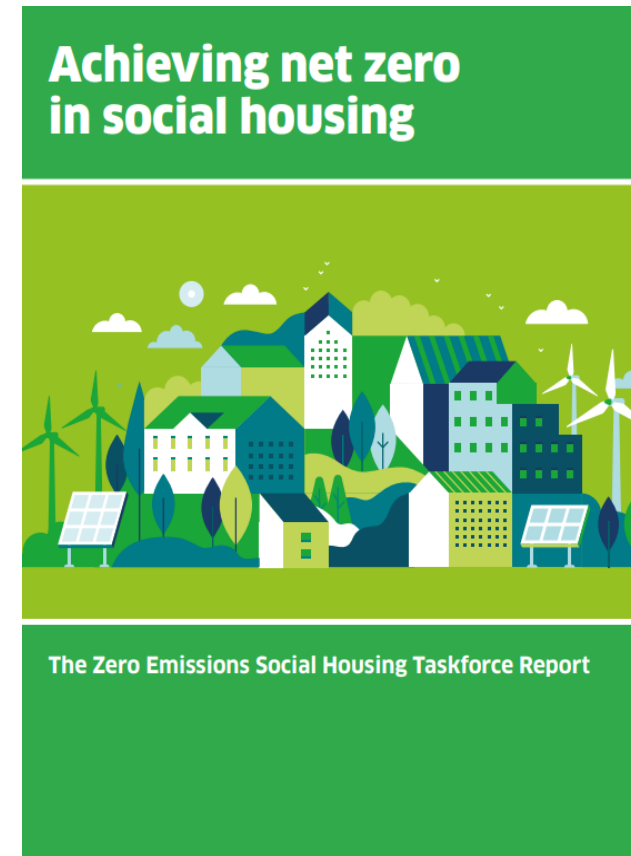
- Joint LA and HAs led report
- Strong focus on ‘Fabric First’
- Reduce fuel costs & fuel poverty
- Readiness for future energy systems
- Planning for Archetype approaches (*Mass retrofit approach for economies of scale*)
- Align property portfolio with Archetypes



<https://www.gov.scot/publications/developing-net-zero-technical-solutions-for-scotlands-future-mass-retrofit-housing-programme/>

PUBLICATION - INDEPENDENT REPORT

Achieving net zero in social housing:
Zero Emissions Social Housing
Taskforce report



<https://www.gov.scot/publications/achieving-net-zero-social-housing-zero-emissions-social-housing-taskforce-report/>

Retrofit of Buildings

Scotland - to hit the net zero target by 2045 requires to retrofit **123,000 homes** per year

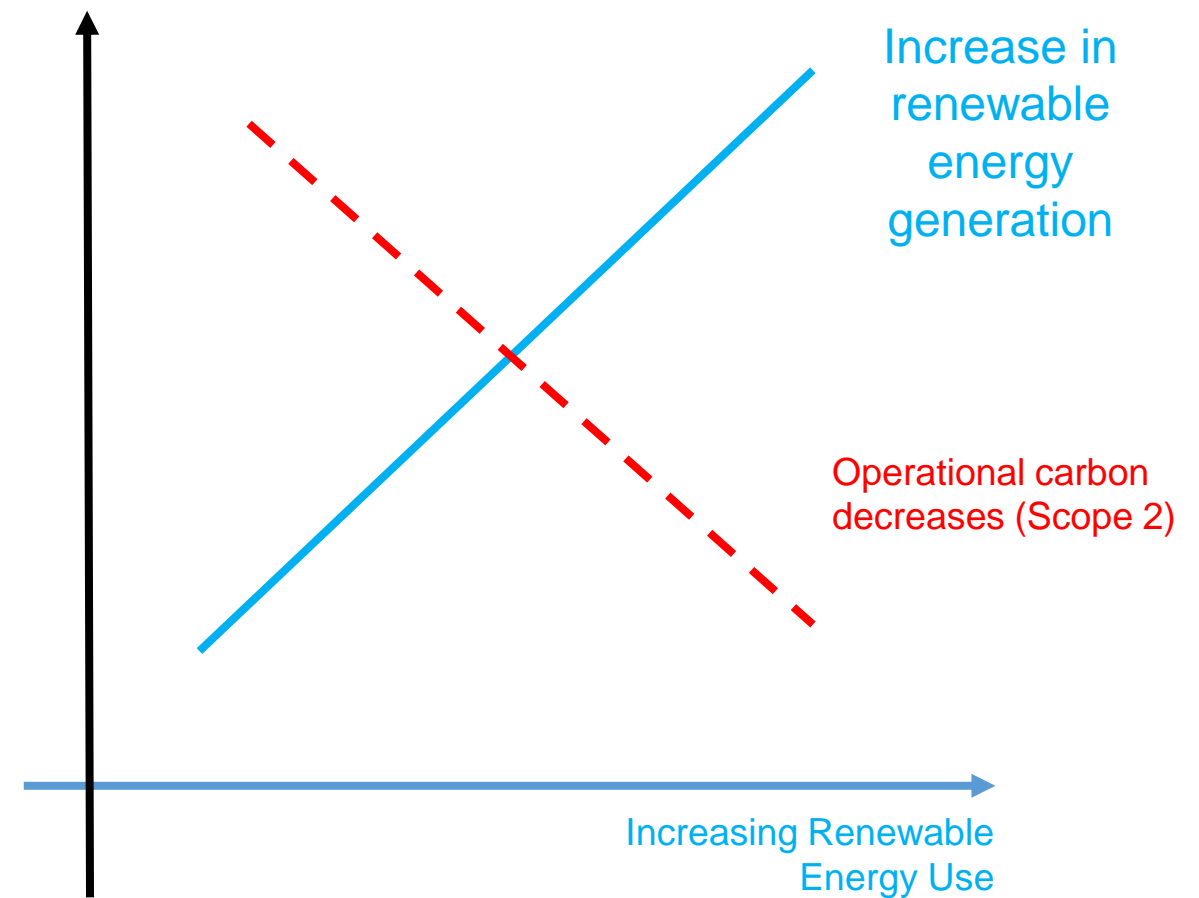
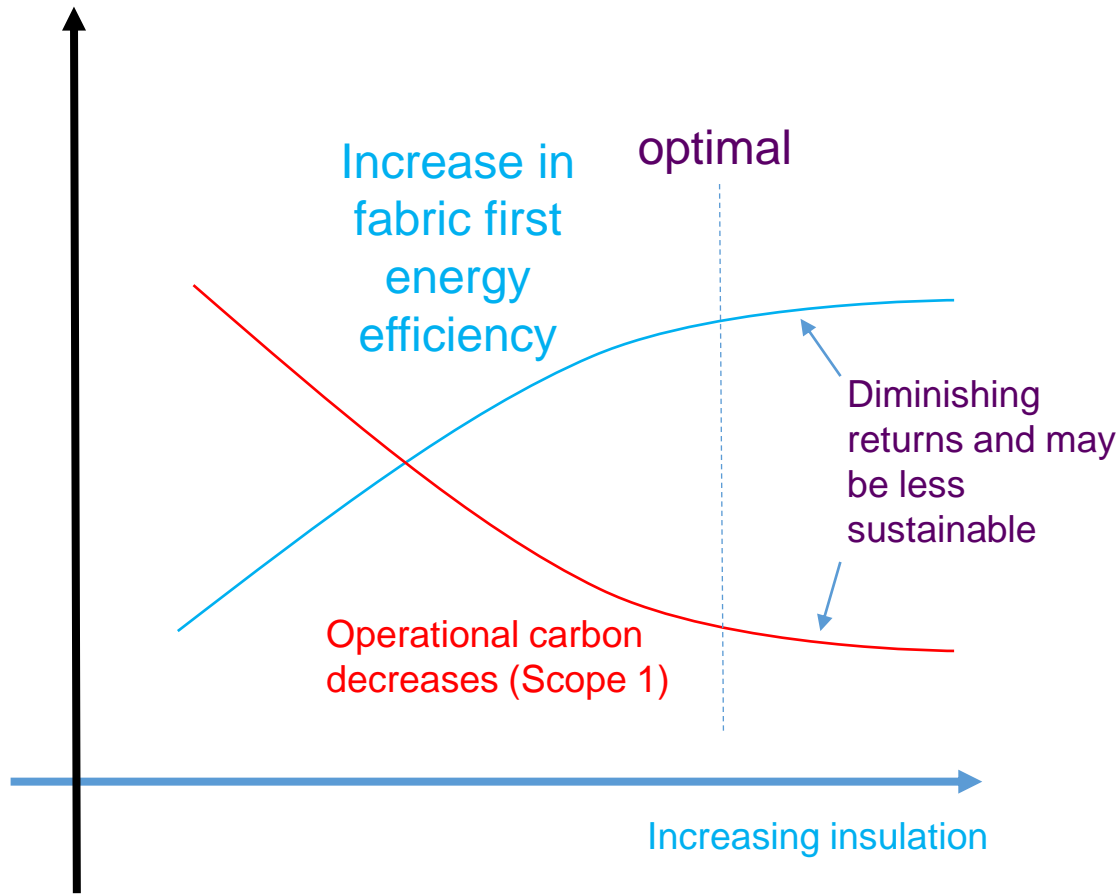
2050 Net Zero targets

- England retrofit needs: **850,000 homes** per year
- Europe retrofit needs: **11 million homes** per year



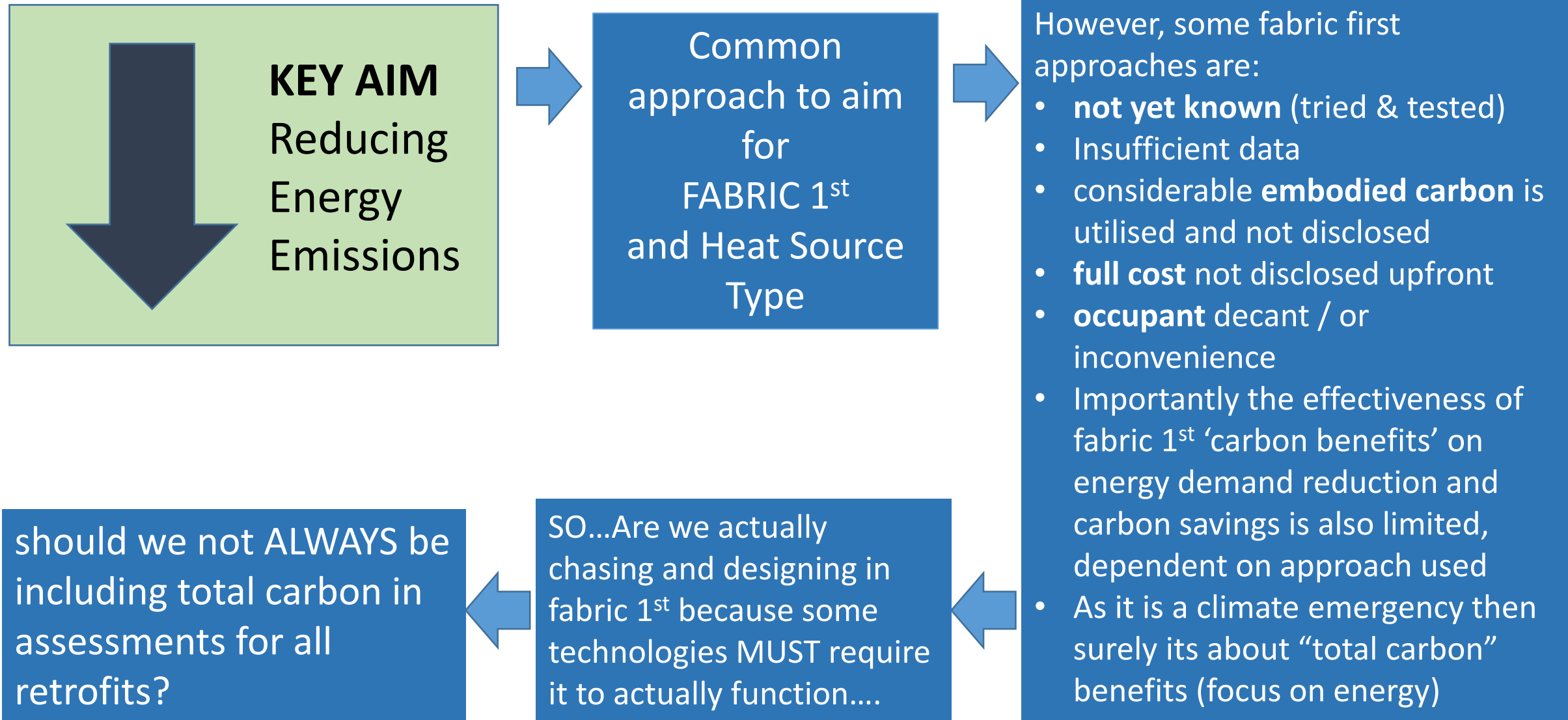
Parallel synergetic demand on similar construction and low carbon heating systems across so many countries will place high demand pressures and result in increased costs, particularly as the **UK is very dependent on importing such energy systems.**

Significance of Emission Scopes 1 & 2



The effectiveness and optimisation of renewable energy 'heat' source for your building is interlinked to the effectiveness of the fabric first energy efficiency BUT... not for all systems

Heat Energy Emission Reductions



UK Housing Archetypes



Source: BRE Trust: The Housing Stock of The United Kingdom

Source: Timber Trades Journal

Lower Carbon Heating Systems

Heat Pumps

- Can work effectively provided the fabric first energy efficiency measures are suitable
- Main focus on houses not flats
- Where they do work well on specific archetypes – this could be made more public to support wider and faster roll out
- Some systems not working effectively

Community Heating

- Have been used on retrofit and new build
- Often costs are higher on retrofit and unchartered services issues
- Requires multi stakeholder involvement and considerable planning

Heat Storage Systems

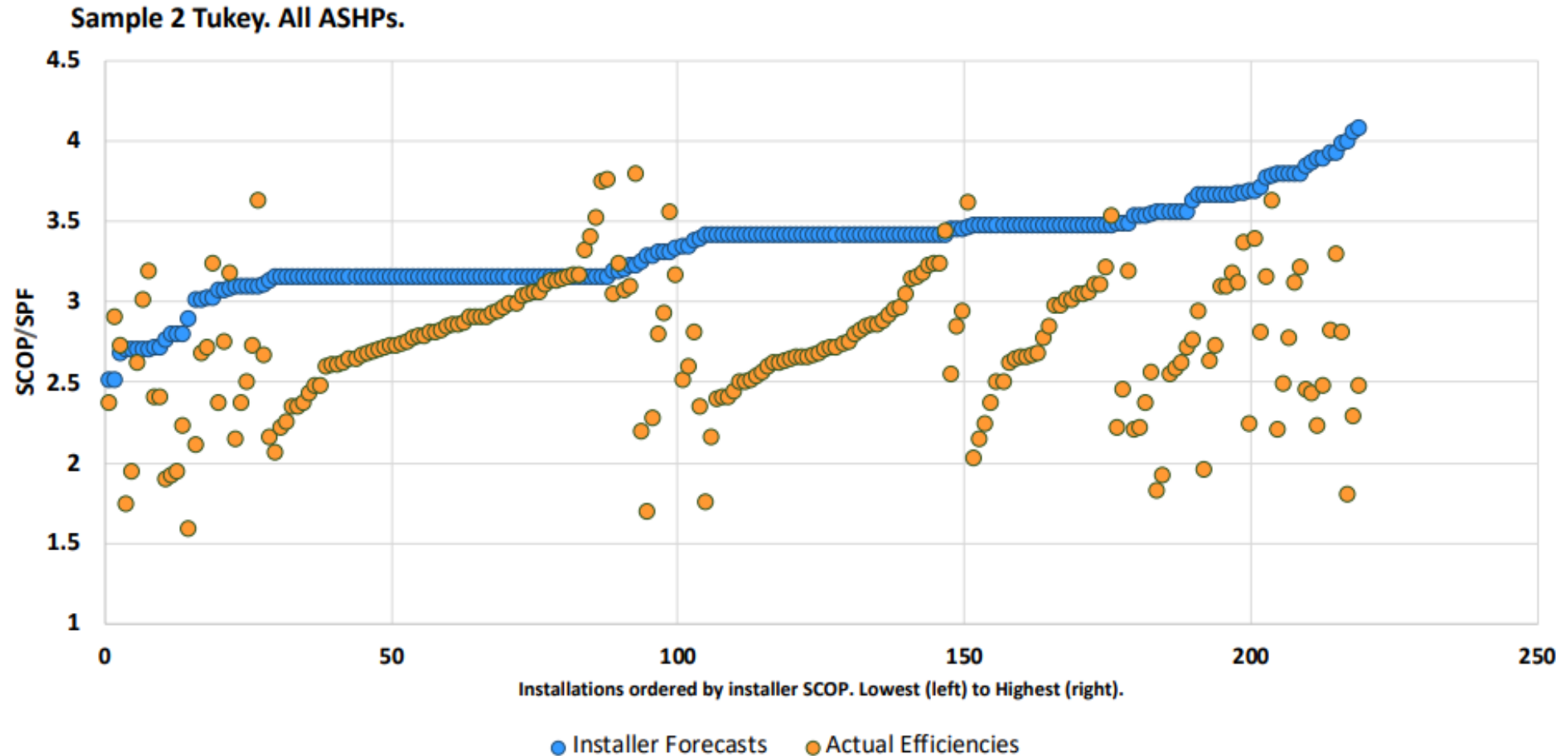
- Can work effectively and may often be linked to other systems such as PV etc..
- Despite being on market for a while not yet moving at pace required

Direct Electric

- Can work effectively but often not given same support by government as other technologies
- New systems coming to market
- Consumers need more choice

The heating system chosen has relationship to the building archetype, location, required energy efficiency measures, integration to building services, optimising comfort for occupants, ease of use and overall reduction in carbon.

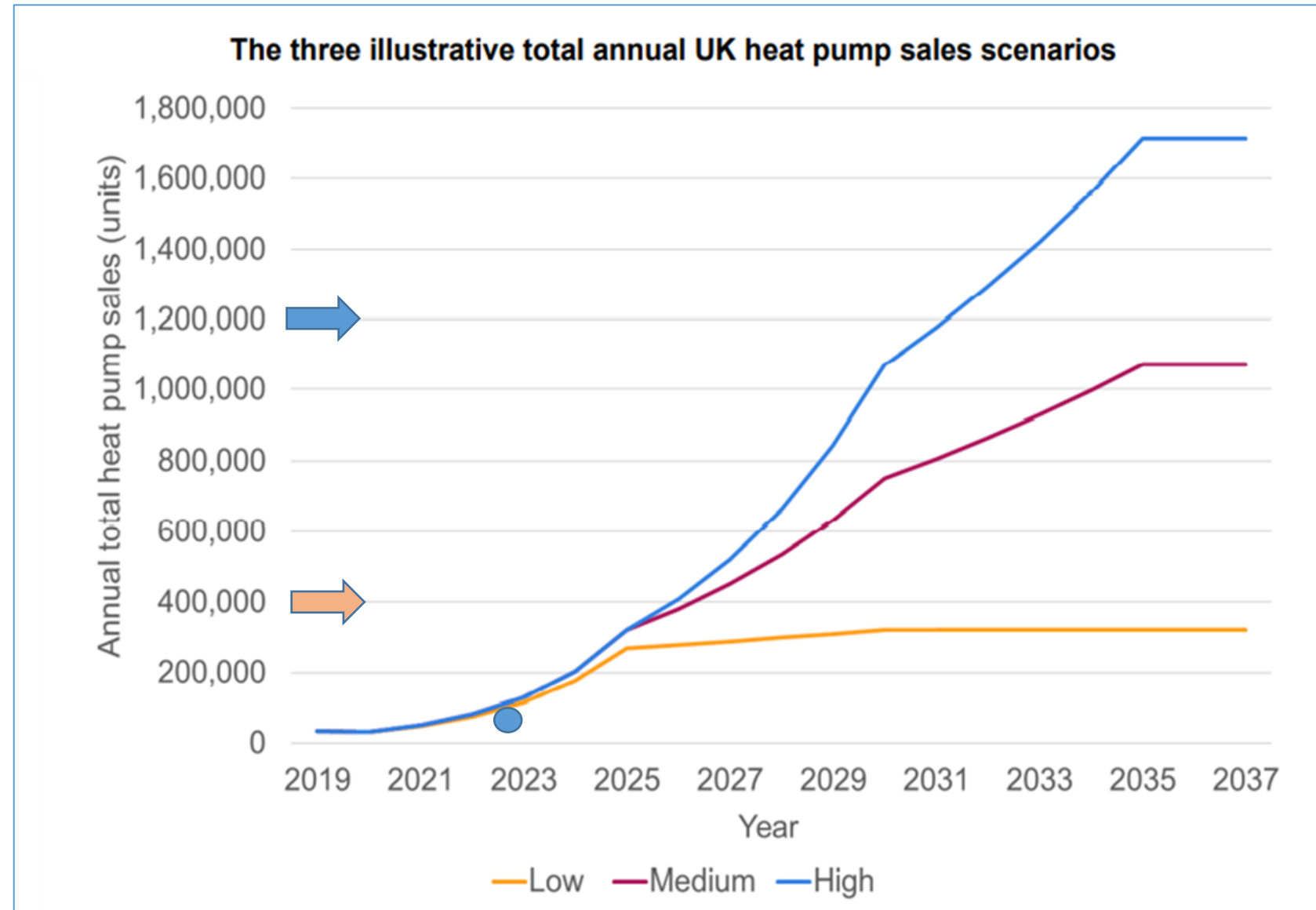
Heat Pumps – Forecast outputs versus Actual outputs



Seasonal Coefficient of Performance (SCOP)

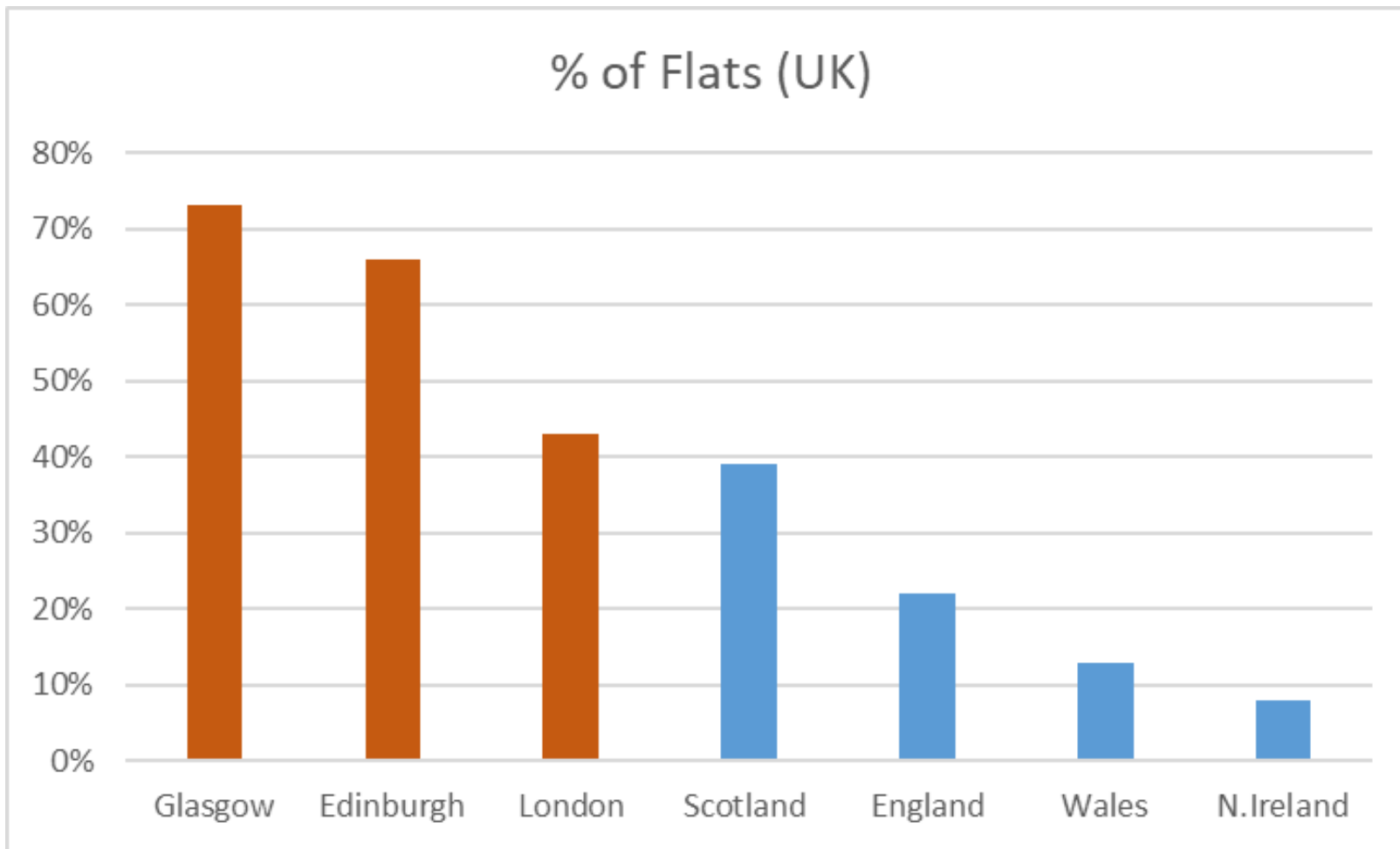
Heat Pumps – UK delivery

- Low, Medium and High growth delivery projections (UK Gov)
- Current gas boiler replacement and new 1.2 million/year
- Takes 3-4 times longer to install heat pump
- + prep work and fabric retrofit for Heat Pump
- So is a more realistic annual target 400k per annum



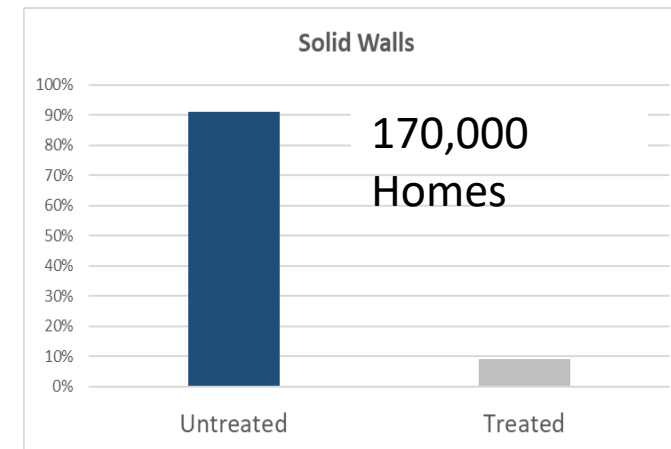
UK – Housing Stock & Flats

% of Flats (UK)

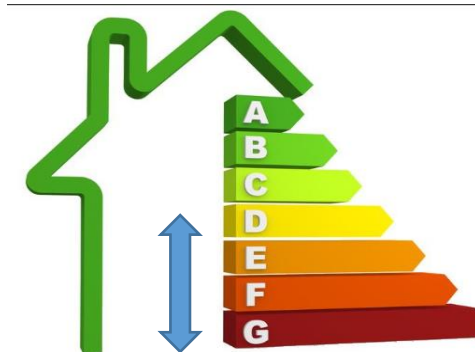


- 5.4 million households in England
- 1.2 million households in Scotland

Edinburgh & Glasgow



Stone buildings with
84% of homes EPC D-G





UK based energy technology company, bringing to market the worlds first microwave space and hot water boiler

HEAT WAYV Microwave heating



Expected 2025 after
full pilot trials 2023-24

Heat Wayv - Heating Technologies (1)

- Simple and straight forward to install
- Installation time (half a day)
- Non specialist works
- Fit and forget technologies *
- Easy to comprehend for consumer / occupant
- To use as and when needed (instant)
- No prior works required
- No water tanks required
- Links to existing heating infrastructure (radiators, pipework)
- Low carbon / circular economy solution

HEAT WAYV
Microwave heating



Heat Wayv - Heating Technologies (2)

- Highly efficient, safe & zero-carbon in use
- Easy installation by existing heating engineers
- Forecasted: cost benefits, lower purchase, installation, running and maintenance costs versus other technologies
- Operate & performs the same as an existing gas combi boiler, delivering expected heat levels and operational performance
- Can be used with battery storage and solar systems to leverage better energy tariffs, reducing fuel poverty
- Unique IP supported by patents and registered designs

HEAT WAYV

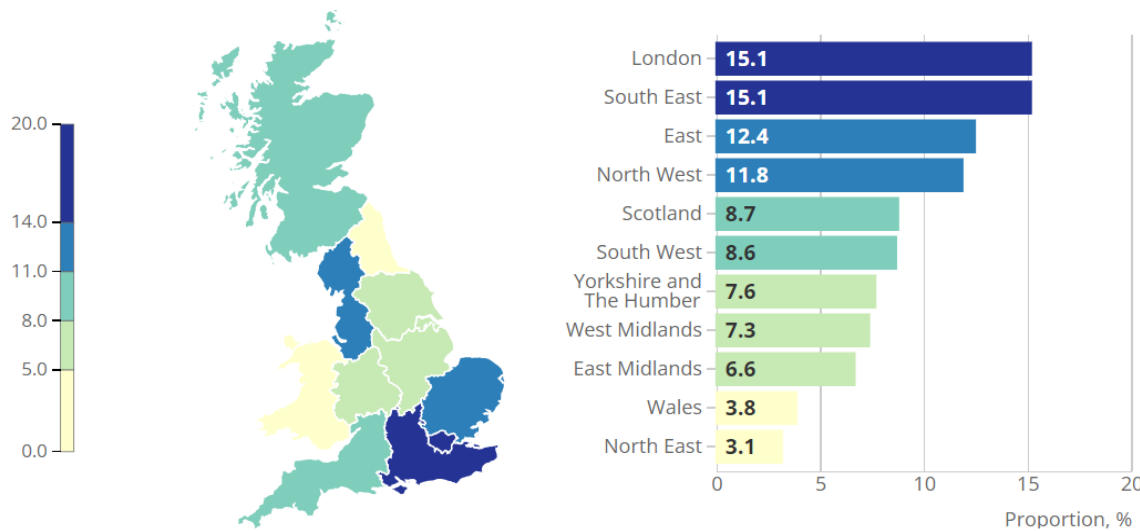
Microwave heating



UK Skills Supply Factors

UK Construction sector age groupings % of workforce								
	16-19		20-24		25-49		50+	
	Constr	UK	Constr	UK	Constr	UK	Constr	UK
2004	4.2	6.4	9.1	7.9	59.9	44.2	26.9	41.5
2009	3.5	6.4	9.2	8.2	60.4	43.6	26.9	41.7
2014	2.0	6.0	8.1	8.3	60.2	42.2	29.6	43.7
2018	2.2	5.5	7.9	7.9	57.6	41.1	32.3	45.5

UK Construction sector proportion of UK workforce across English regions, Scotland and Wales



SE Scotland

- 30% of future construction activity in Scotland next 20 years
- 16% of Scottish workforce
- Requires to double skills supply in electricians and 50% increase in plumbers

Electric Vehicle Growth - SE Scotland

Additional new sector growth such as installation of EV charging points (switch from petrol/diesel to EV and hybrid vehicles) introduces a further demand on electrical skills sector.

- If 400,000 homes are **houses**
- And 50% have potential for 'easy / practical' EV charging point installation
- Then 200,000 homes to be fitted with EV charging points
- At current take up of EV cars increasing each year – Average 11,000 installation a year required over 18 years.



Summary - Addressing Net Zero Delivery

- Will require a combination of heating systems across the UK
- No one system fits all
- Better monitoring, feedback and guidance on new heating systems working well with specific archetypes could support faster and more reliable roll out
- Pattern Book (Handbook) of archetype options in public domain
- Industry skills sector supply is limited
- Need to optimise productivity of delivery and skills availability
- Government policy should avoid locking into one technology which may not serve all housing, diverse communities and could prevent a “just transition”

Future is multi
diverse heating
systems

Archetype
approaches to
support mass roll
out

Skills are limited in
supply

Avoiding policy
“lock-in” for single
technologies

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