



UNIVERSITY OF
BIRMINGHAM

HEALTHY HOMES WORKSHOP

25th September 2026

Birmingham Botanical Gardens

In collaboration with



Indoor HABitability during the Transition to Net Zero Housing Hub



UK Research
and Innovation

NIHR
National Institute for
Health and Care Research



Medical
Research
Council



Engineering and
Physical Sciences
Research Council



Natural
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West Midlands
Combined Authority



Sandwell
Metropolitan Borough Council



Department
for Environment
Food & Rural Affairs



WM-NET ZERO

A Health-centred Systems Approach Towards Net-Zero:
Transforming Regional Climate Mitigation Policies



The WM-NetZero project is supported by Wellcome Trust (227150_Z_23_Z) under the
Advancing climate mitigation policy solutions with health co-benefits in G7 countries
scheme.



Housekeeping

- Tea breaks 11:15am and alongside afternoon workshop
- Lunch 12:30pm
- Toilets are located to the right of the stage area
- No fire alarms test due – if it goes off leave via nearest exit and meet at the bandstand in the main gardens.
- No smoking/vaping venue
- Flip charts, post-its and pens available for workshops.
- Inclusivity is key – everyone's view is welcome!

Agenda

WM-NET ZERO

Time	Session/Topics
9:30	Coffee/Tea + Registration
10:00	Welcome and introduction
10:10	Housing Policies and Health Modelling
11:00	Tea/Coffee
11:30	Net Zero Neighbourhood Projects
12:30	Lunch + photo
13:30	Workshop: Retrofit programmes and evaluation plans
	Tea/Coffee (available alongside workshop)
15:00	Closing remarks
15:10	Close

Summary of Day 1

1. Net Zero can improve health — but the benefits depend on how we get there.
2. The best outcomes come from balancing carbon, clean air, less noise and more physical activity.
3. Use a whole-systems approach — considering people, behaviour, barriers and enablers — to turn health benefits into reality.

Introduction to Day 2

WM-NET ZERO

- UK Government target: **NZ emissions** by 2050
 - ✓ Housing sector – 21% GHG emissions
 - ✓ UK homes are not fit for future
 - ✓ **Large-scale energy retrofits needed**
 - ✓ 80% of the existing 29 million homes will be around in 2050.
- Opportunity to realize the health co-benefits of the net zero transitions in the housing sector



Housing is a foundational social determinant of health that shapes physical and mental well-being across a person's entire life!

Aim of workshop

- Showcase learning from work on housing sector
- Seek input, feedback and recommendations from our stakeholders
- How can we help you? Explore future priorities and collaboration opportunities - interactive session
- Network

SESSION 1: HOUSING POLICIES AND HEALTH MODELLING

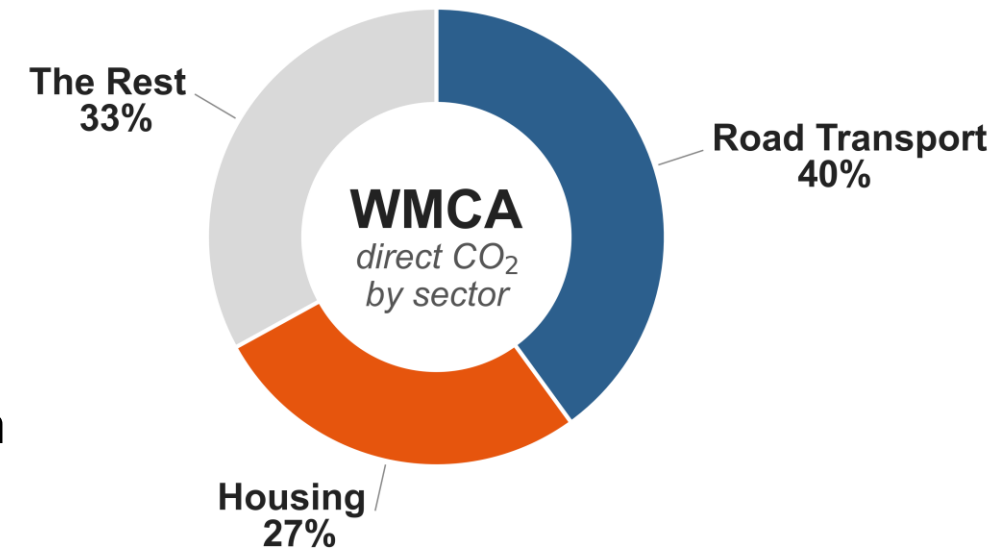


HOUSING AND HEALTH - OVERVIEW & POLICY BACKGROUND

Joe Day

Housing's Environmental and Health Impacts Today

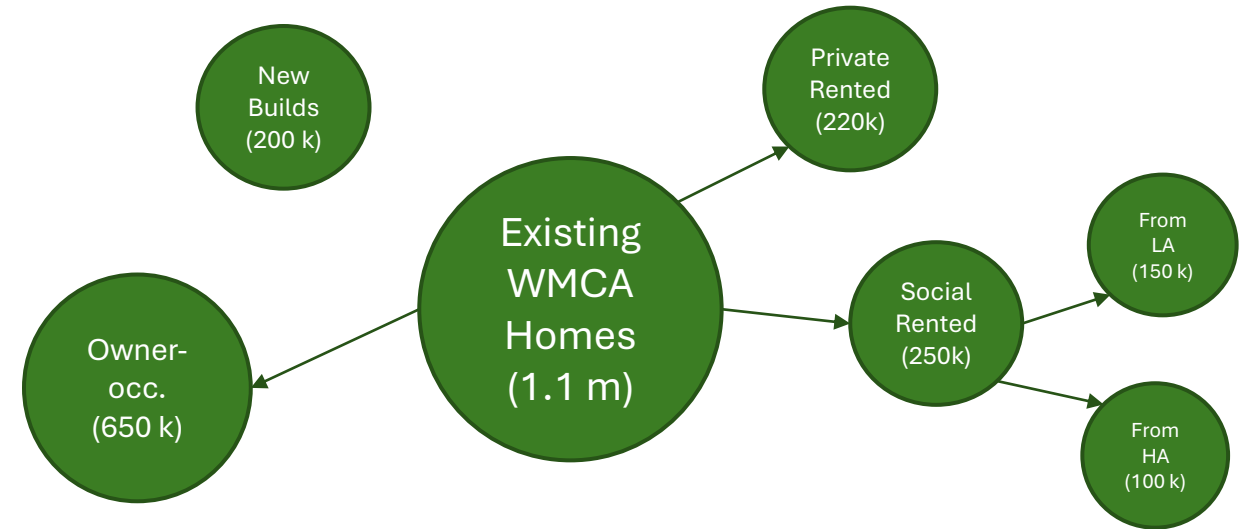
- 2.3 million tonnes of direct CO₂ emissions from housing (2nd largest emitting sector in WMCA after transport)
- Health risk exposures from housing:
 - **Poor indoor and outdoor air quality** from fuel combustion
 - **Cold temperatures in winters** from fuel poverty and poor thermal efficiencies of buildings
 - **Overheating in summers** from inadequate building design lack of cooling measures
 - **Damp and mould** from inadequate ventilation and poor thermal efficiencies of buildings



What could the region's housing sector look like in 2036?

WM-NET ZERO

- ~85% of houses will already have been built
- Homes vary in size, shape, tenure and construction period (archetypes can be defined)



Pre-WW1 terrace



Interwar terrace



Interwar semi



Post-WW2 low rise flats

Housing Policy Context

- Key foci on new energy efficient homes, improved housing quality, tackling cost of living, reducing dependence on imported fossil fuels, smoke control areas, smart local energy systems and place-based approaches.



Key Policy Documents

- Heat & Buildings Strategy (2021)
- British Energy Security Strategy (2022)
- Warm Homes Plan (2026)
- Clean Power Action Plan (2024)
- Climate Change Committee's 7th Carbon Budget (2025)
- National Grid's Future Energy Scenarios (yearly)
- WMCA's Regional Energy Strategy and Second Five-Year Climate Change Plan
- LA Housing and Climate Change Strategies



Key Targets

- 450,000 heat pumps installed a year by 2030
- No firm date for gas boiler phase-out in existing homes
- 1.5 million new homes and Future Homes Standard (2027)
- Stricter EPC standards for rentals (min. C by 2030)



Key Funding and Drivers

- Clean Heat Market Mechanism, Boiler Upgrade Scheme and Green Heat Network Fund
- Reform to electricity pricing and planning permission
- Warm Homes Plan (£15 billion this parliament) and Devolved Retrofit Pilot (£130 million)

Housing Scenarios Working Group

Organisation	What they brought to discussions?
PIRG	Energy sector career, grassroots community action and lived-experience
Energy Capital (WMCA)	Regional policy context (especially Second Five-Year Climate Change Plan), wider energy system view and program delivery experience
City-REDI	Technoeconomic expertise and knowledge of historic pace of interventions
WM-Net Zero Researchers	Air quality expertise, health modelling expertise and systems thinking

Policy review



Long List



Short List

Housing Scenario Possible Interventions

WM-NET ZERO

Health outcome and reason for improvement

Category of intervention(s)

	Ambient AQ (reduced gas burning)	Indoor AQ (better air flow)	Cold (less heat loss)	Overheating (less heat gain)		
Fabric	+	+ / -	+ +	+ / -	Large Positive Impact	+ +
Heating or Cooling Systems	+ +			+ +	Small Positive Impact	+
Ventilation Systems		+ +			Potential Mixed Impact	+ / -
Micro- generation						
Behaviour Change	+	+	+	+		

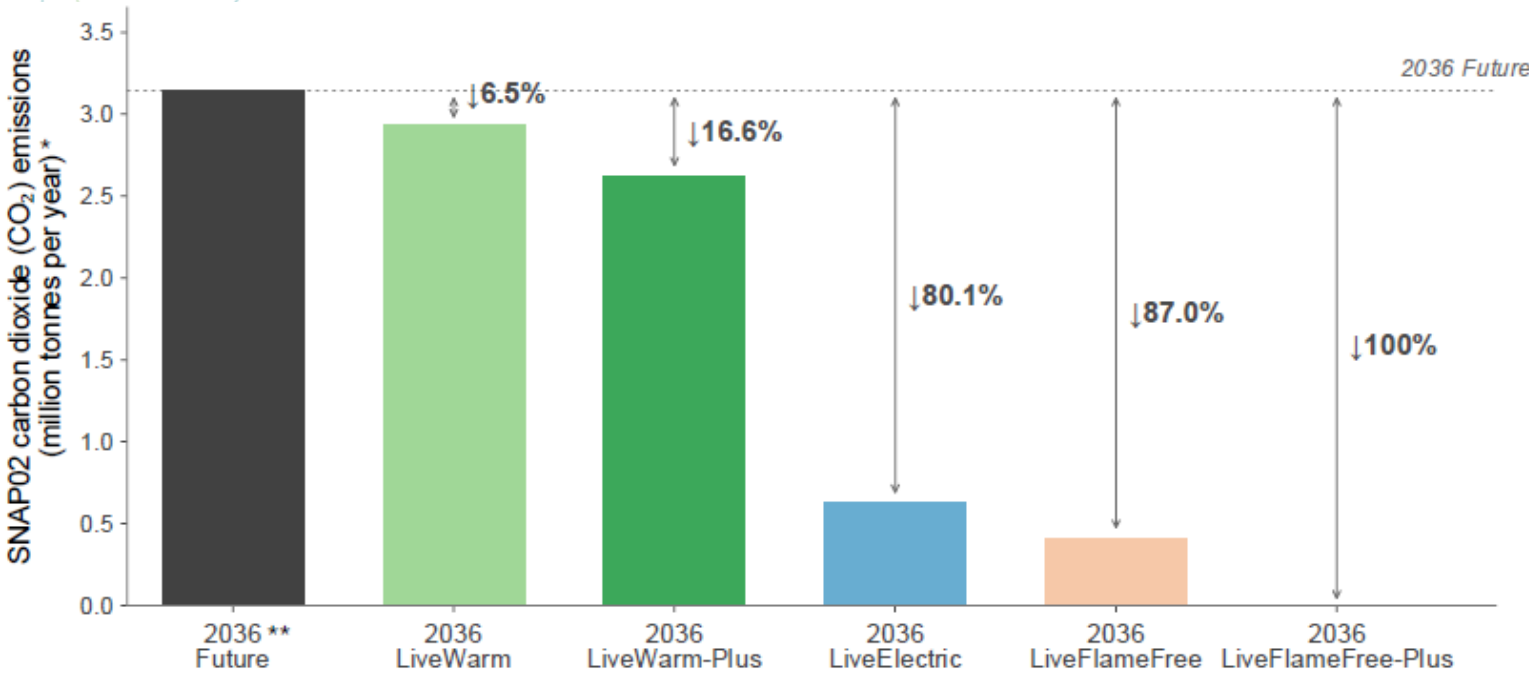
Final Housing Scenarios

Scenario	Description
2036 Future	Homes are slightly more energy efficient than today. New homes have high environmental standards. Older homes are heated by gas and new commercial developments add emissions.
2036 LiveWarm	Older homes have had their lofts and walls insulated, reducing the amount of gas required to heat them.
2036 LiveWarm-Plus	All homes have had improvements to their energy efficiency through extensive insulation and modern gas boilers with controls.
2036 LiveElectric	Electrically powered heat pumps are rapidly installed in homes, entirely replacing gas boilers and removing their emissions.
2036 LiveFlameFree	Combustion of all fuels in homes is phased out, alongside a rapid adoption of heat pumps, eliminating all domestic emissions.
2036 LiveFlameFree-Plus	Combustion of all fuels in homes and public or commercial buildings is phased out, eliminating their emissions.

Further Scenarios

- Additional AQ scenarios:
No woodburning
Low carbon district heat networks (Birmingham City Council)
Bespoke scenarios and use-cases can be co-developed
- Additional exposure pathways:
Noise pollution
- Cold in winters
Overheating in summers
Indoor air quality
- Flooding

Housing Scenarios – Emissions Results



	NO ₂	PM _{2.5}
2036 LiveWarm	3.0%	0.3%
2036 LiveWarm-Plus	7.5%	0.8%
2036 LiveElectric	36.1%	4.0%
2036 LiveFlameFree	40.6%	75.5%
2036 LiveFlameFree-Plus	100.0%	100.0%

Emission reduction relative to 2036 Future (%)

* SNAP02 refers here to residential and commercial/institutional combustion;

** The 2036 Future SNAP02 projection uses more disaggregated sector-specific scaling factors than road transport scenarios, and housing CO₂ additionally includes residential wood-burning emissions.

- Heat electrification reduces NO₂ more than PM_{2.5}

Housing Scenarios – AQ Health Summary

WM-NET ZERO

Clean heating in all buildings will cut 2.9 million tonnes CO₂, save 190 lives and £6.6 million health system costs.

Regional Actions

Clean heating in all homes, businesses and civic buildings

Clean heating in all homes

Upgrade gas boilers to heat pumps in homes

Insulate all homes

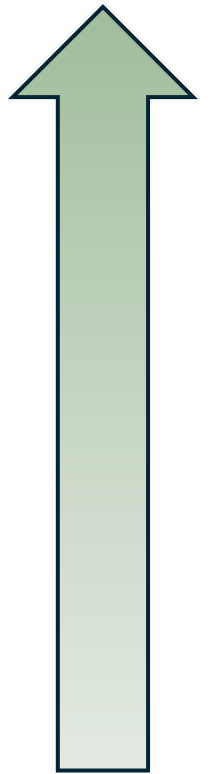
Insulate older homes

More efficient homes

2036

National Climate Action

Outdoor AQ health benefits





CLIMATE HEALTH EXPLORER & HOUSING SCENARIOS DEMO

James Hall

Housing Scenarios – Health Results

Scenario	Lives Saved vs. 2036 Future	Health Care Costs Saved vs. 2036 Future
2036 LiveWarm	No detected change	No detected change
2036 LiveWarm-Plus	6	No detected change
2036 LiveElectric	45	£0.1 m
2036 LiveFlameFree	95	£4.1 m
2036 LiveFlameFree-Plus	190	£6.6 m

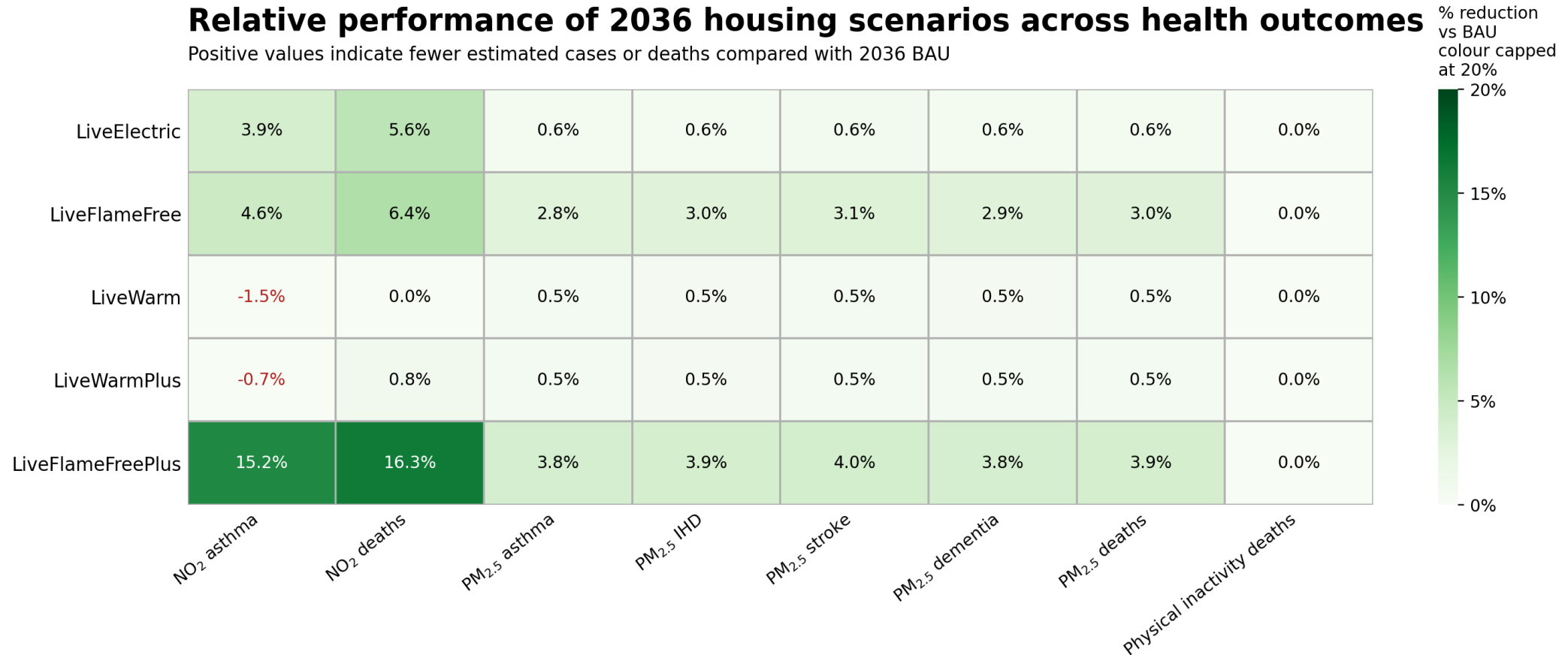
- These numbers are for outdoor air quality (PM_{2.5} and NO₂) exposure pathways only
- FlameFree scenarios have greater health savings as more PM_{2.5} associated morbidities

Housing Scenarios – Reductions in attributable burden

WM-NET ZERO

Relative performance of 2036 housing scenarios across health outcomes

Positive values indicate fewer estimated cases or deaths compared with 2036 BAU

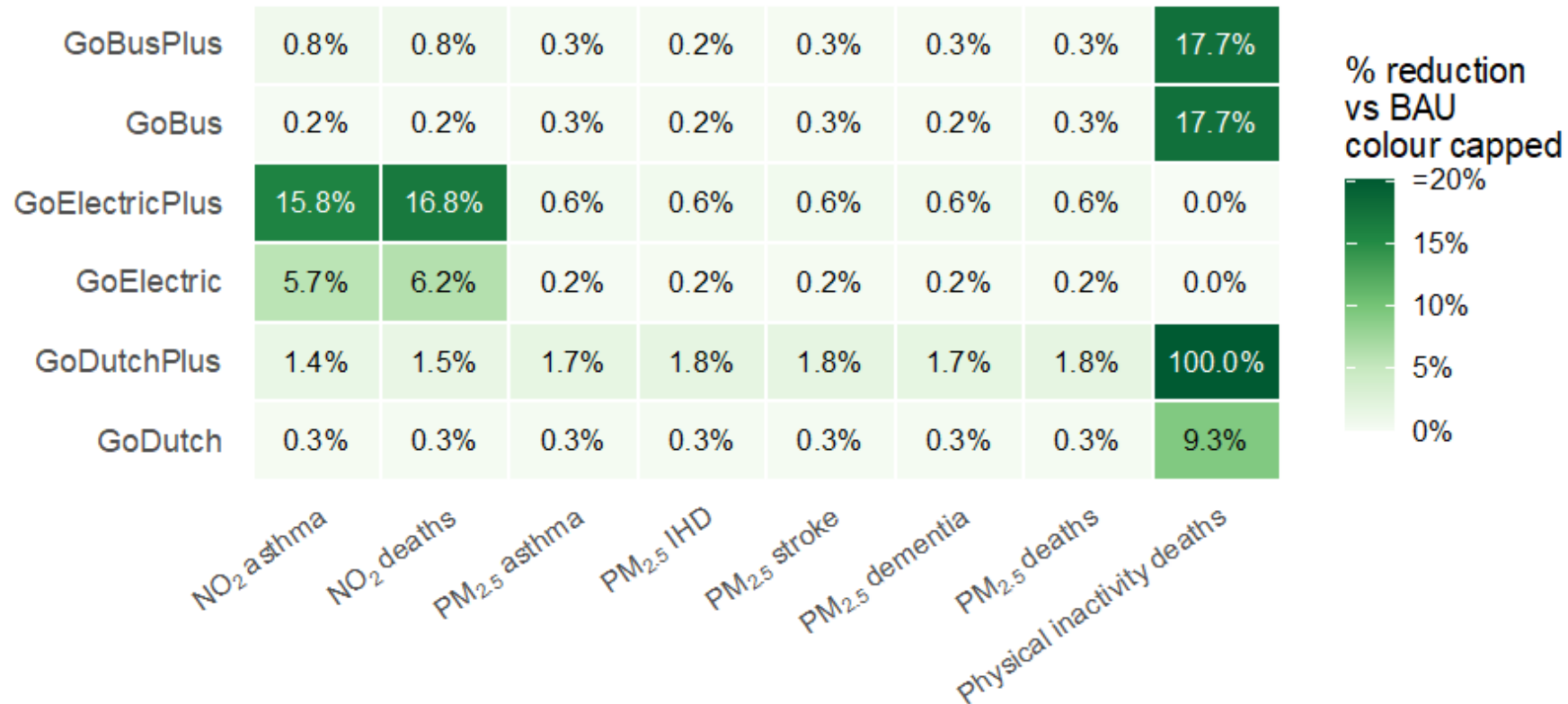


Transport scenarios – Reductions in attributable burden

WM-NET ZERO

Relative performance of 2036 scenarios across health outcomes

Positive values indicate fewer estimated cases or deaths compared with 2036 BAU



Scenario comparison of attributable burden

WM-NET ZERO

Relative performance of 2036 transport and housing scenarios across health outcomes

Positive values indicate fewer estimated cases or deaths compared with 2036 BAU



- Transport model shift scenarios offer significant reduction in mortality from physical activity improvements
- FlameFree scenarios have greater health savings as fewer air quality associated morbidities across both pollutants
- Moving forward adding noise and temperature will change dimension of results

Future Housing Work – INHABIT project

WM-NET ZERO

- The Climate Health Explorer will subsequently be updated with results from our INHABIT Hub
- INHABIT is producing scientific evidence on the health co-benefits of the UK's net zero transition in housing.
- We will be evaluating existing interventions, as well as developing policy scenarios to evaluate, which can then all feed into the Explorer

“Everyone in the UK lives in healthy homes that are fit for the future”

TEA & COFFEE BREAK

SESSION 2: NET ZERO NEIGHBOURHOODS

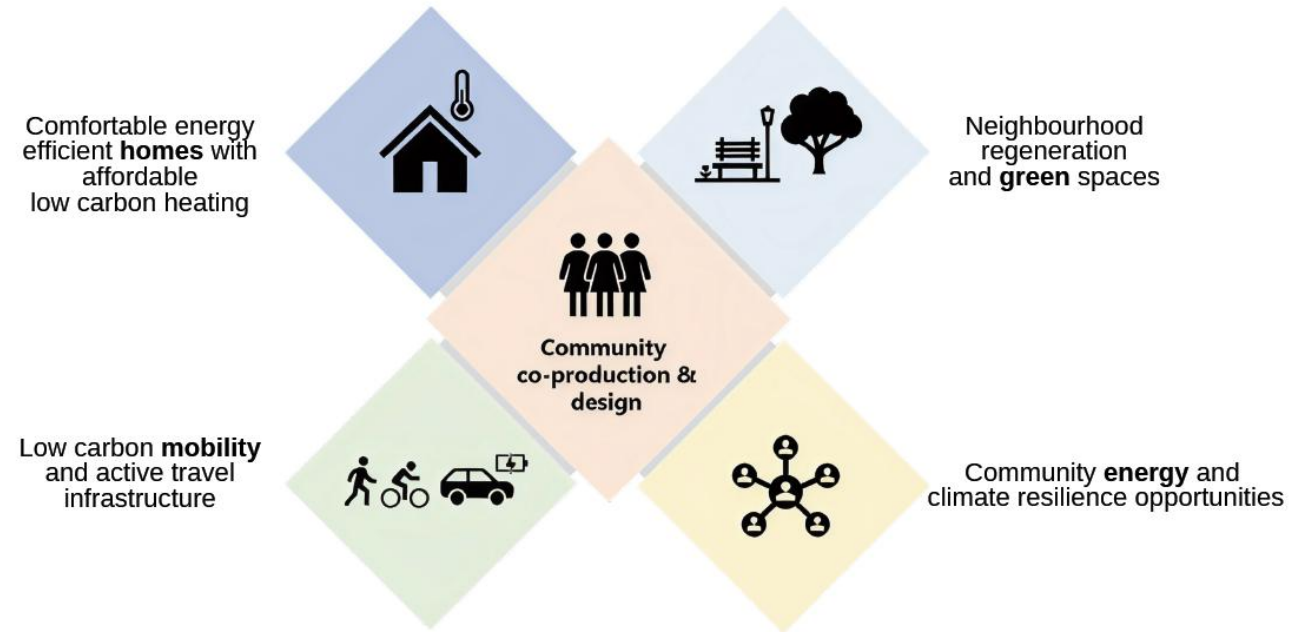


INTRODUCTION

Carlo Luiu

The Net Zero Neighbourhood initiative

- The West Midlands Combined Authority Net Zero Neighbourhoods (NZNs) programme to tackle fuel poverty and climate change
- NZNs can be understood as place-based experiments and test beds for innovation
- Holistic approach to net zero with the idea of empowering communities to shape the decisions that affect their neighbourhoods



Holistic approach to net zero neighbourhood (WMCA – Energy Capital)

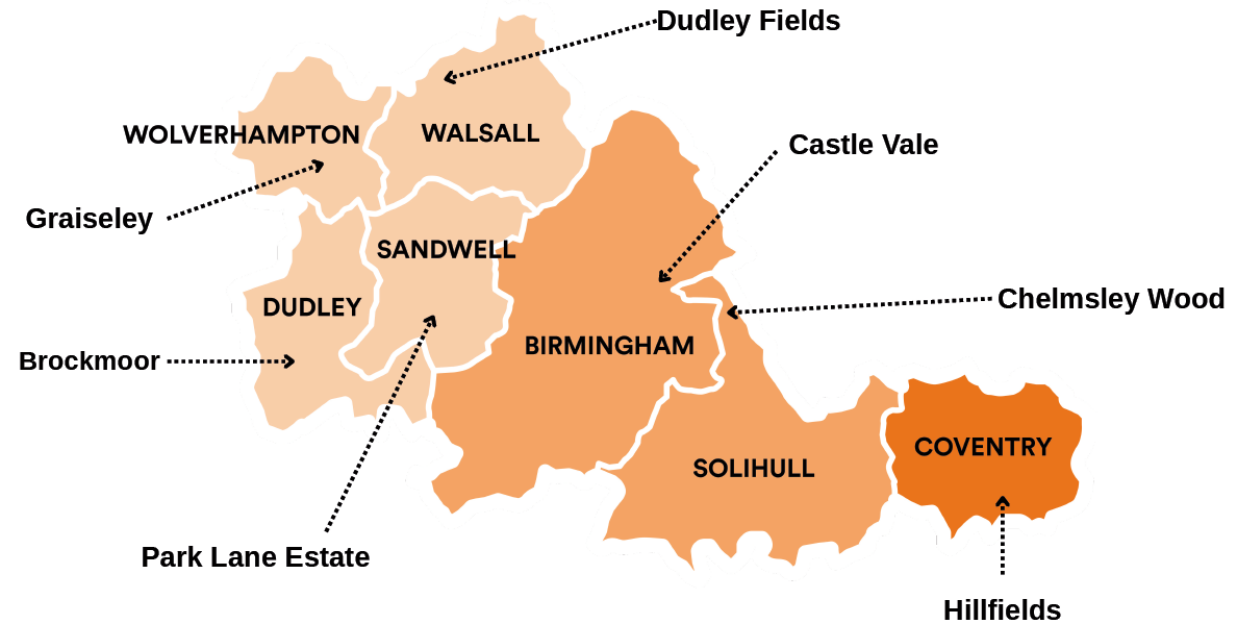
The Net Zero Neighbourhood initiative

Two rounds of funding:

- DESNZ -> £1.65M Dudley NZN
- DESNZ -> £3M for other six NZNs (Local Net Zero Accelerator Programme)

All NZN locations are characterised by:

- High deprivation levels
- Fuel poverty
- Low health standards
- Poor energy standards



NZN locations within the West Midlands region

Our contribution to the Net Zero Neighbourhood initiative

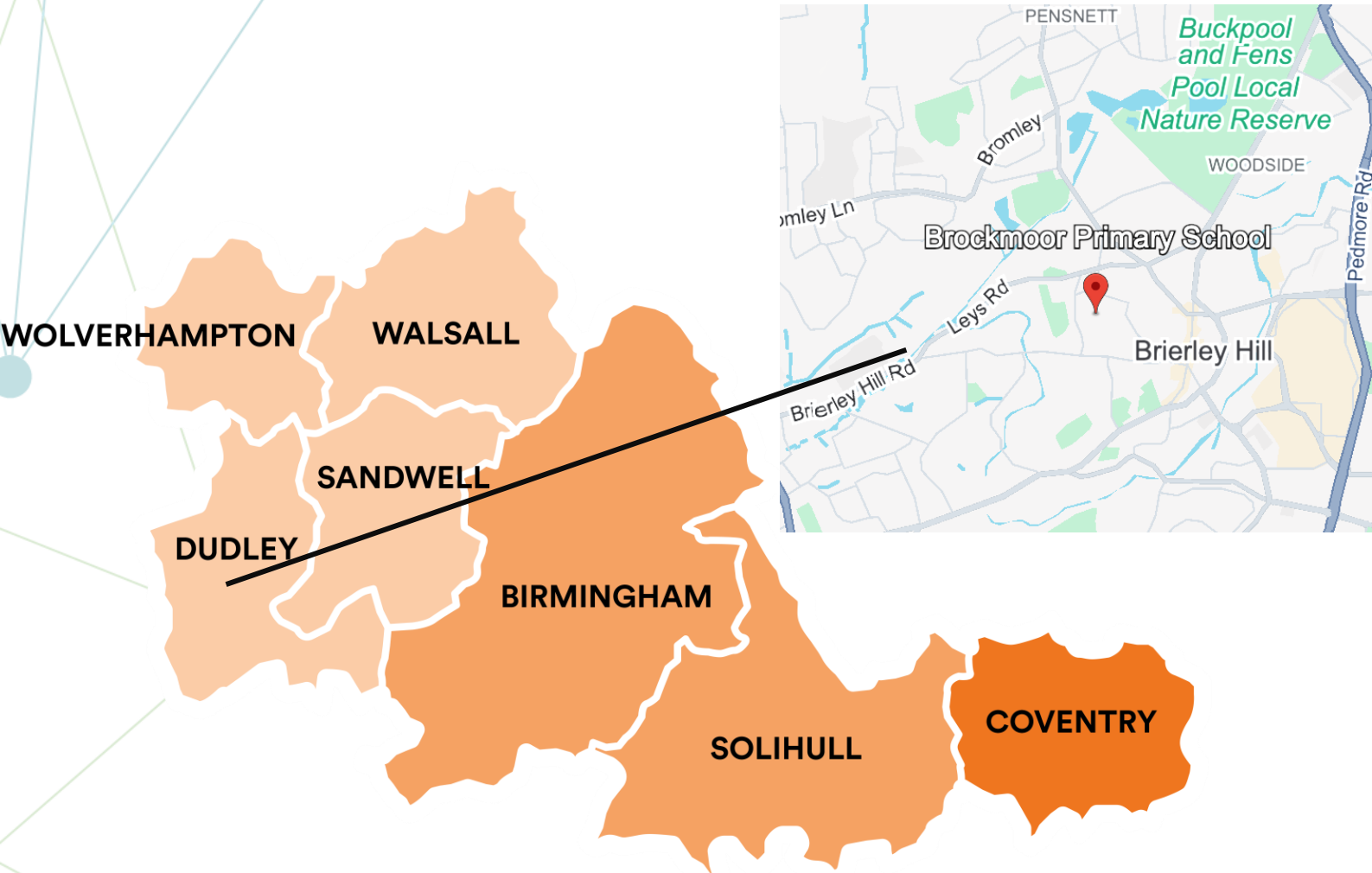
- Air quality monitoring (indoor and outdoor)
- Energy modelling
- Community ambassadors
- Governance



INDOOR AND OUTDOOR ENVIRONMENT OBSERVATIONS

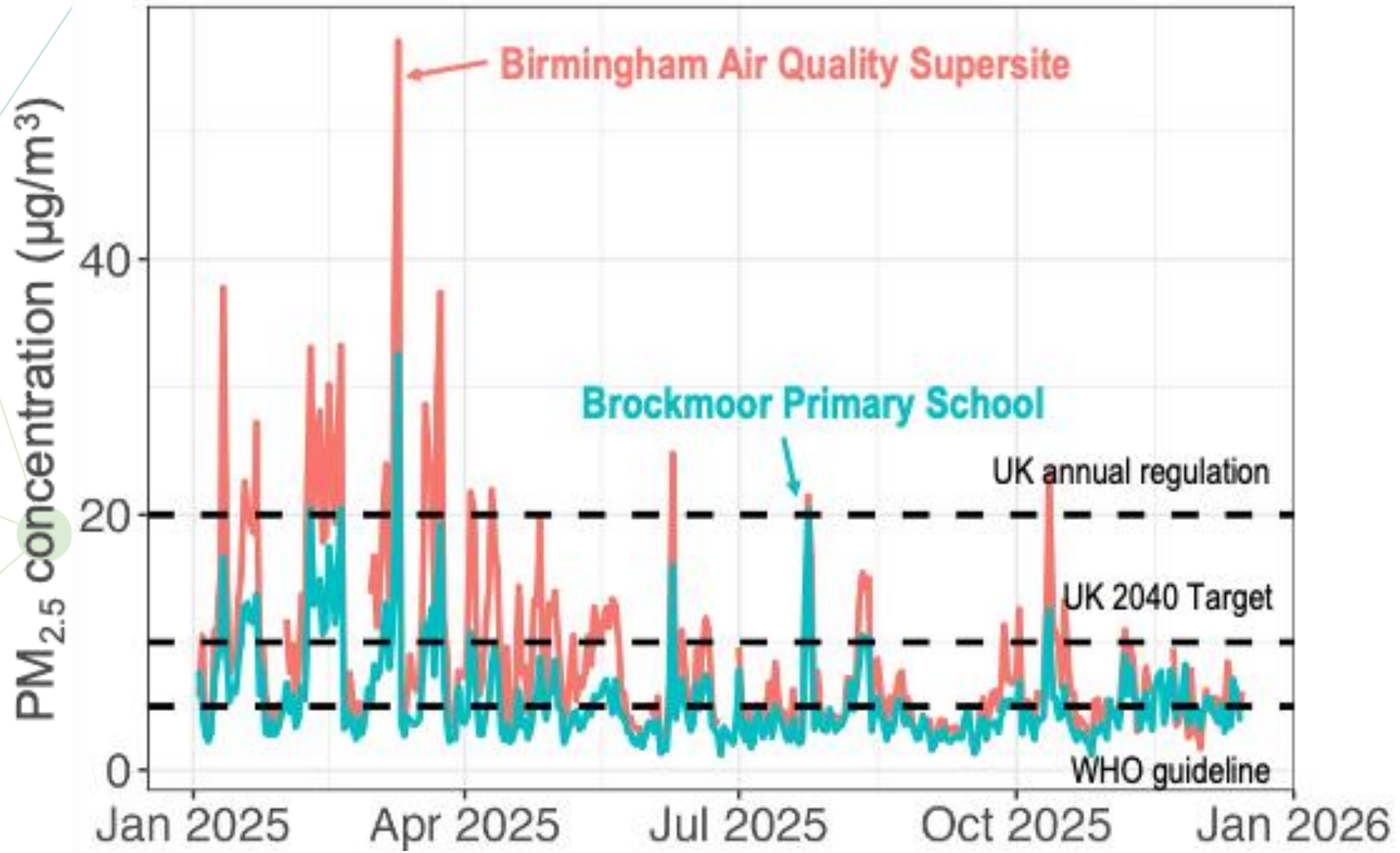
Yuqing Dai

Brockmoor fieldwork (Outdoor)

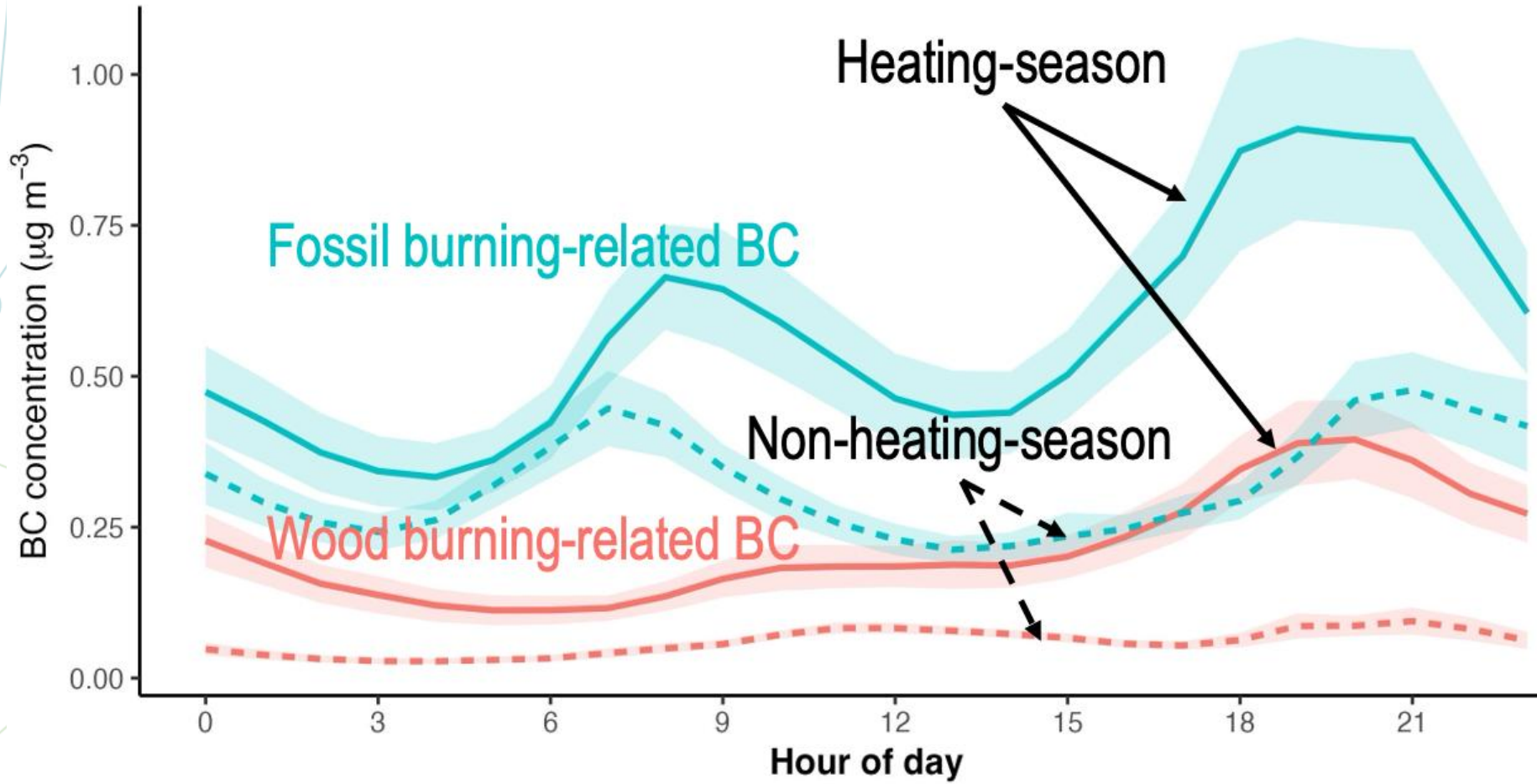


- Air quality monitoring site: **PM, Black Carbon, temperature**
- Six air quality sensors near street: **PM, NO₂, O₃, temperature, relative humidity**
- 2025-2026

Brockmoor fieldwork (Outdoor)



Brockmoor fieldwork (Outdoor)



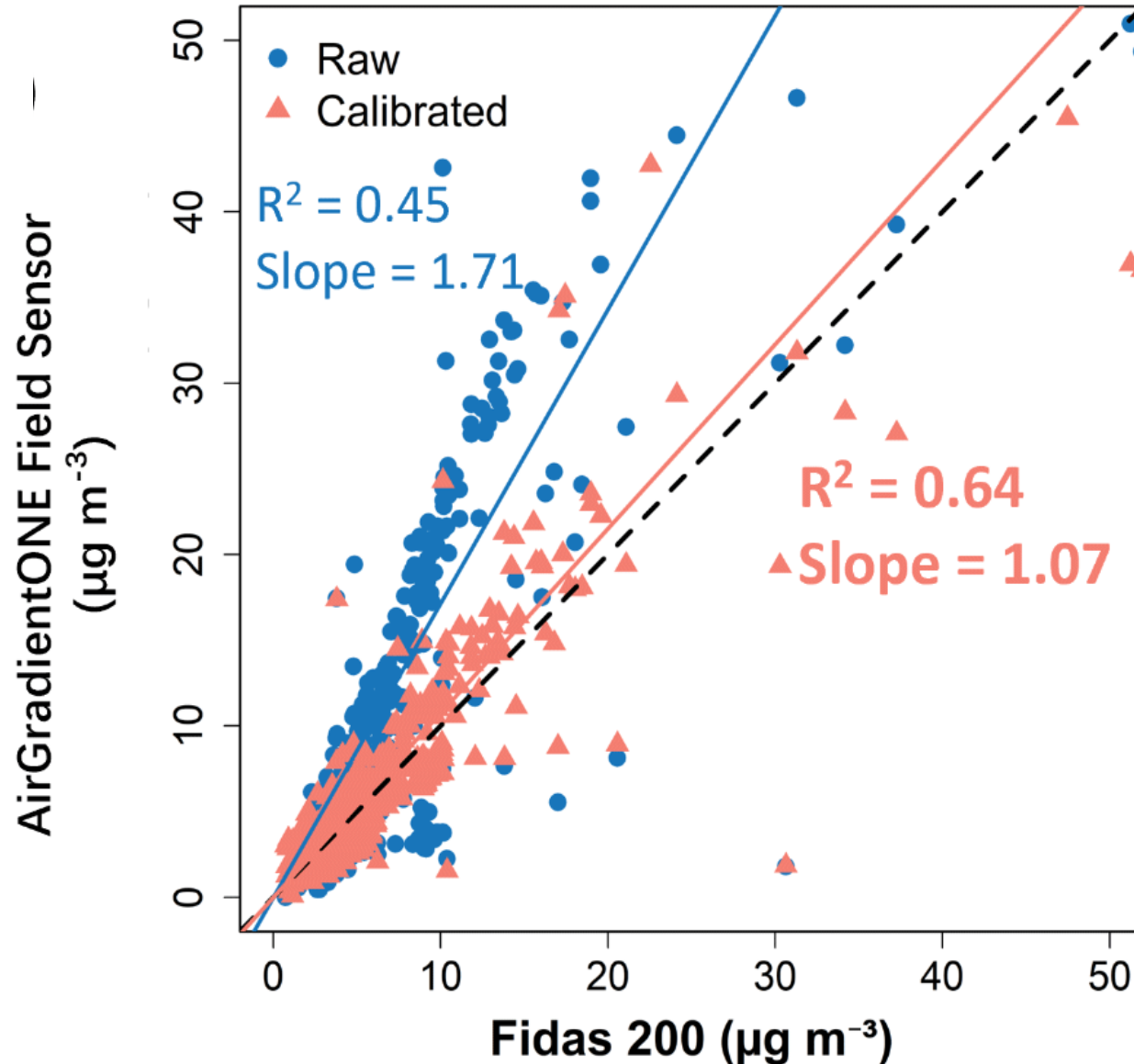
- Fossil-fuel BC: morning and evening peaks
- Wood burning BC: rises in the evening during the heating season.

Brockmoor fieldwork (Indoor)



- Indoor measurement
- 34 homes in Dudley
- PM_{2.5}
- CO₂ (ventilation)
- Temperature
- Relative humidity

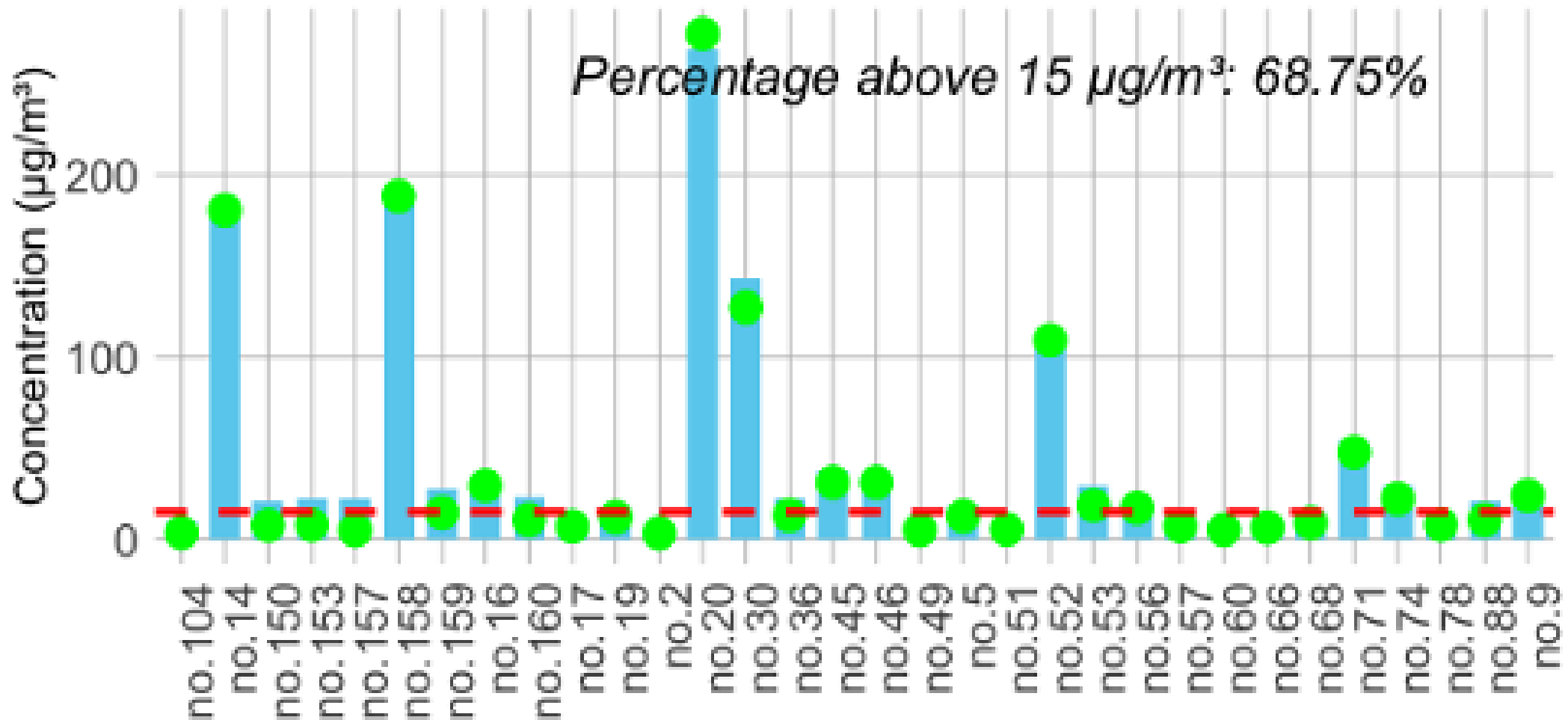
Sensor calibration



- Sensor needs to be calibrated before deployment.
- Calibration improves sensor performance and increases confidence in monitoring.

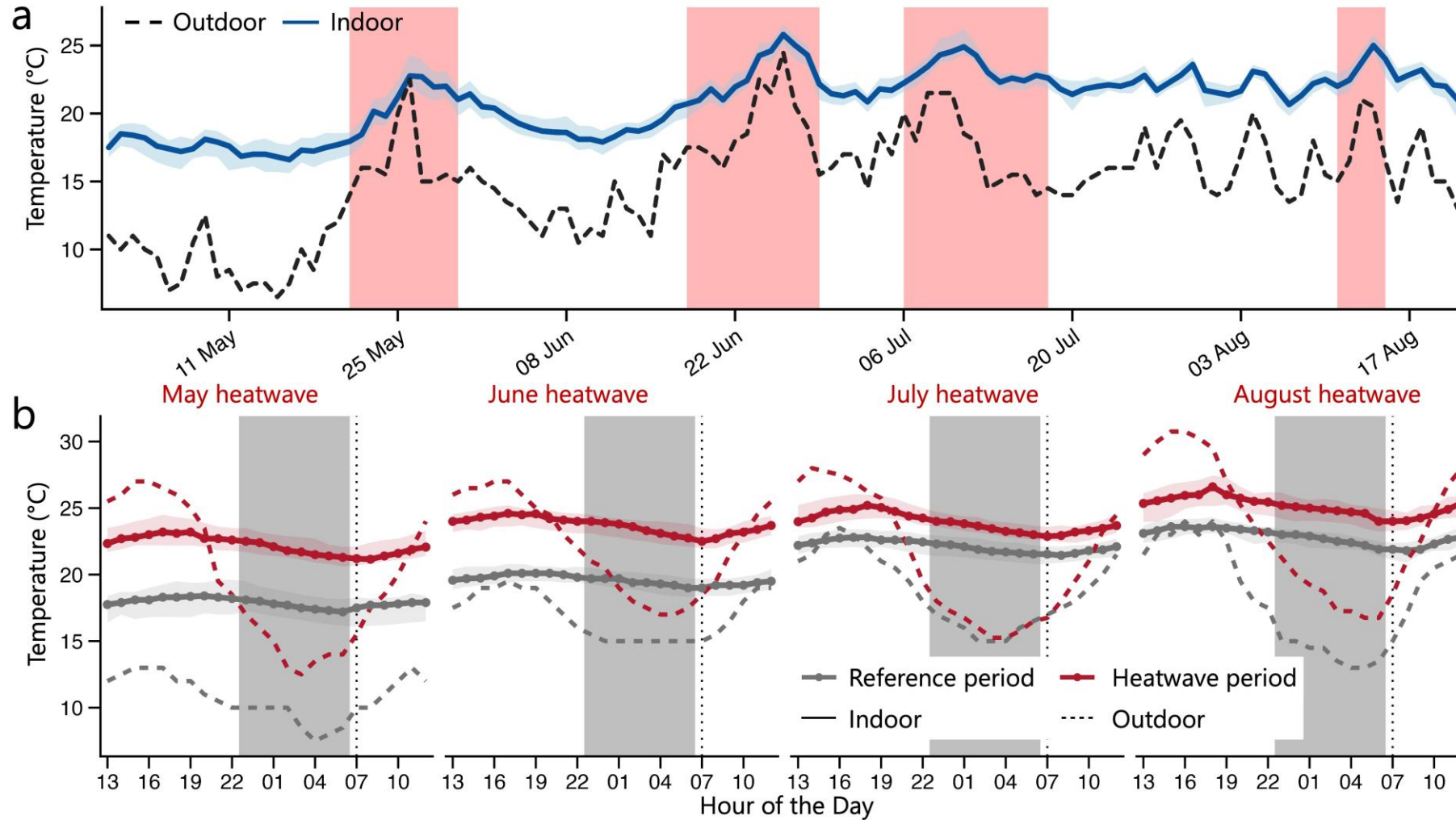
Qian et al., AMT, 2026

Mean/Median PM2.5 (Whole Measuring Period)



- Indoor PM_{2.5} is usually lower than outdoor levels, but some homes have very high levels.

Indoor Temperature



- Overheating becomes more common during heatwaves.
- Indoor temperatures consistently above reference-period levels.
- Indoor temperatures remain high overnight, even when outdoor temperatures cool substantially.

Retrofits impact on indoor environment

Example retrofit measures



Insulation

Reduce heat loss,
improve airtightness



Windows

Higher performance
glazing and tighter frames



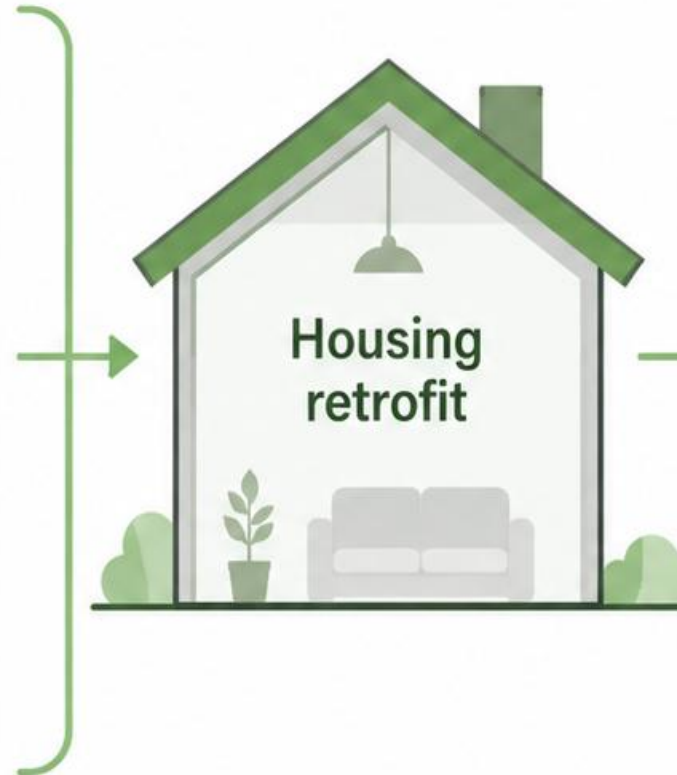
Ventilation

Mechanical ventilation
(e.g. MVHR)



Heating

More efficient
heating systems



Potential effects on indoor conditions



Temperature



Often improves
thermal comfort



Relative humidity



Can increase
or decrease



CO₂



Depends on
ventilation and
occupancy



PM_{2.5}



Depends on
ventilation, outdoor
infiltration, and
indoor sources

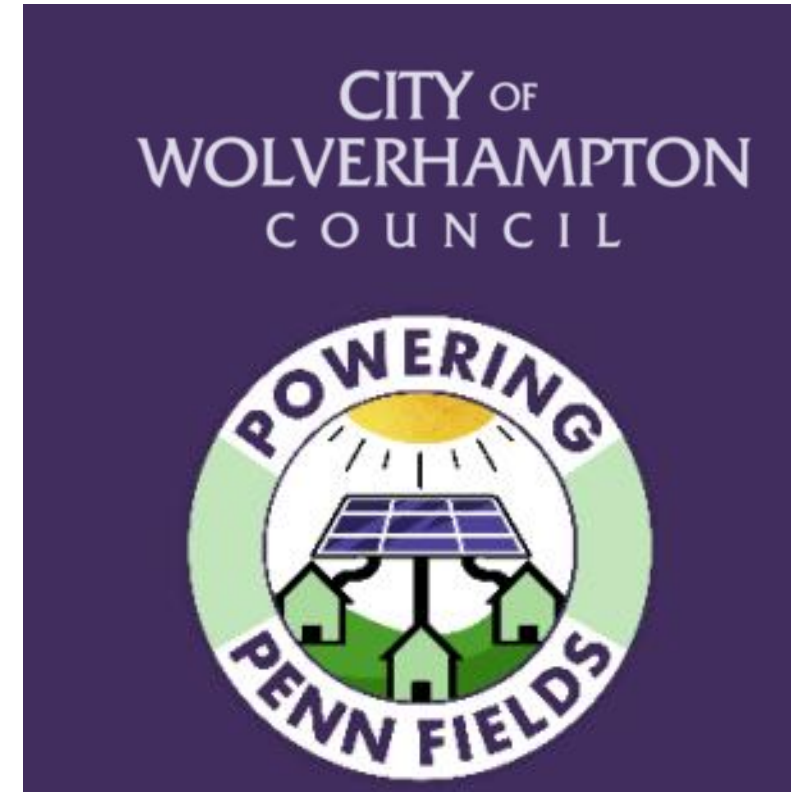
POWERING PENN FIELDS, WOLVERHAMPTON

Joe Day, Adijat Adeyinka, Oliver Thomas

Powering Penn Fields – Overview

City of Wolverhampton Council has secured £545,000 to:

- Engage the community and co-create a neighbourhood vision
- Collect data on energy use, air quality, and health
- Explore community solutions to reduce energy costs and improve wellbeing
- Develop a business case to inform policy and funding



The Gujarati Association, Wolverhampton
Connecting our community

The WM-NetZero project is supported by Wellcome Trust (227150_Z_23_Z) under the Advancing climate mitigation policy solutions with health co-benefits in G7 countries scheme.



Powering Penn Fields - Engagement

WM-NET ZERO

Reached hundreds of residents over last 12 months achieving:

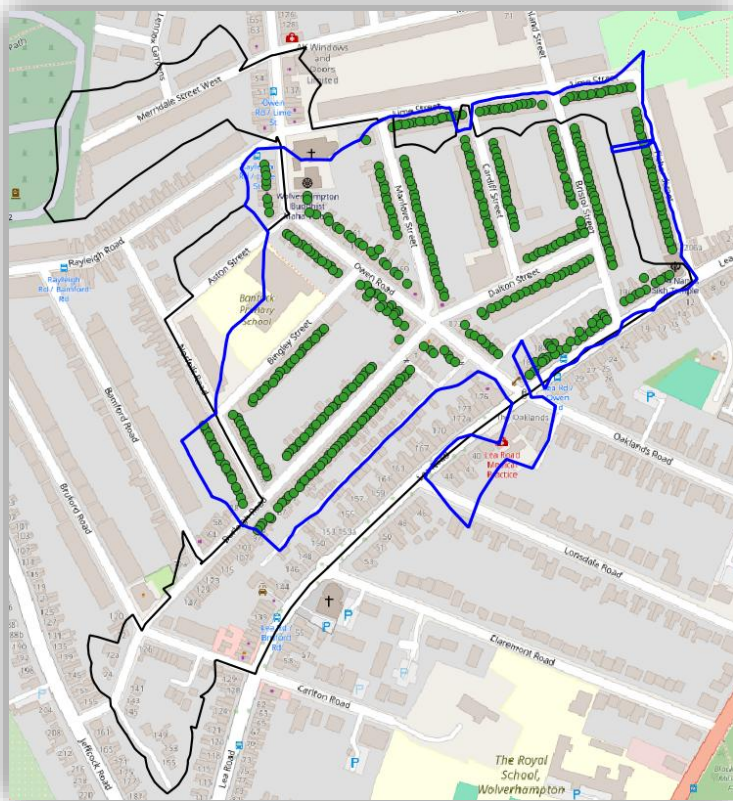
- 48 home energy advice visits and free energy efficiency measures
- 19 free retrofit assessments
- 40 homes shared energy data
- 11 homes had an air quality sensor installed
- Shopping voucher rewards for sharing data
- Early results helped us understand local needs while supporting residents to reduce energy use and improve air quality



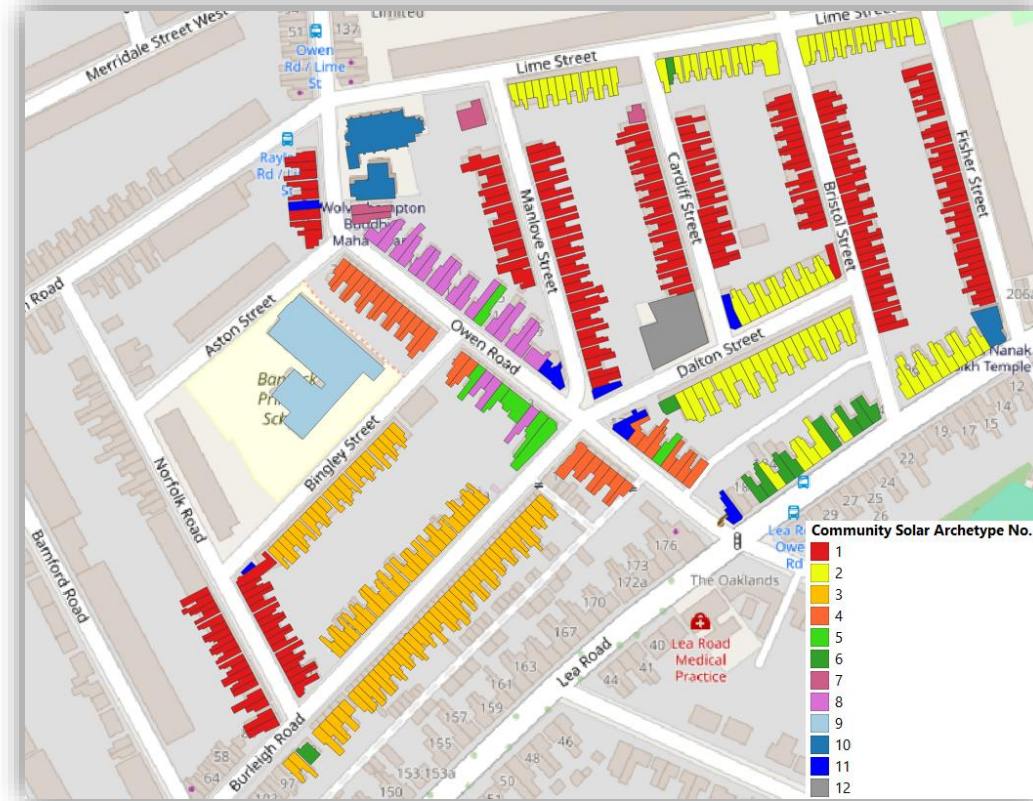
Demonstrator Home (rendered)

Powering Penn Fields – Building Model

WM-NET ZERO



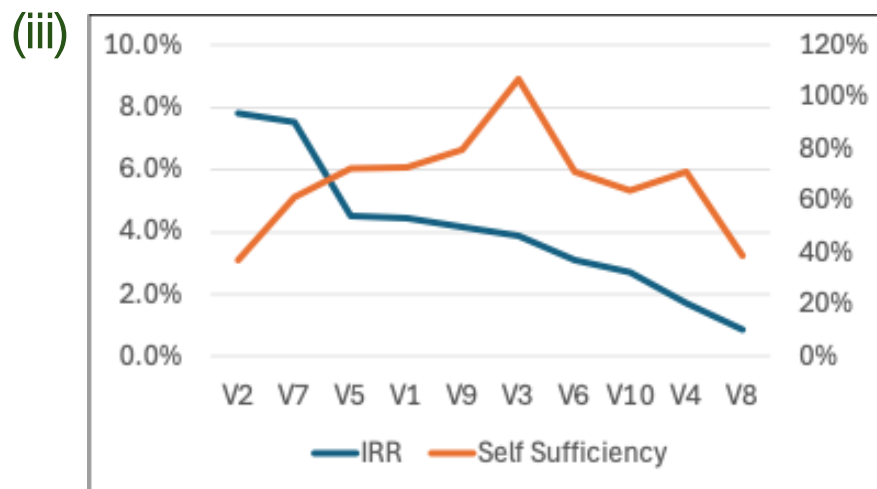
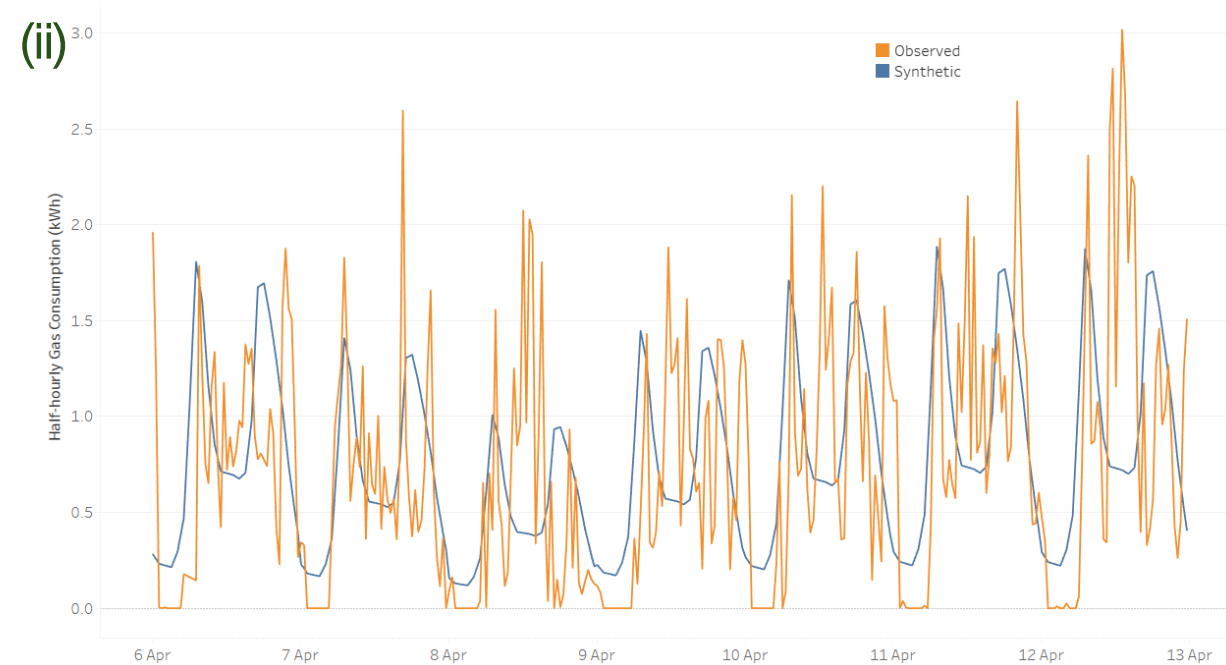
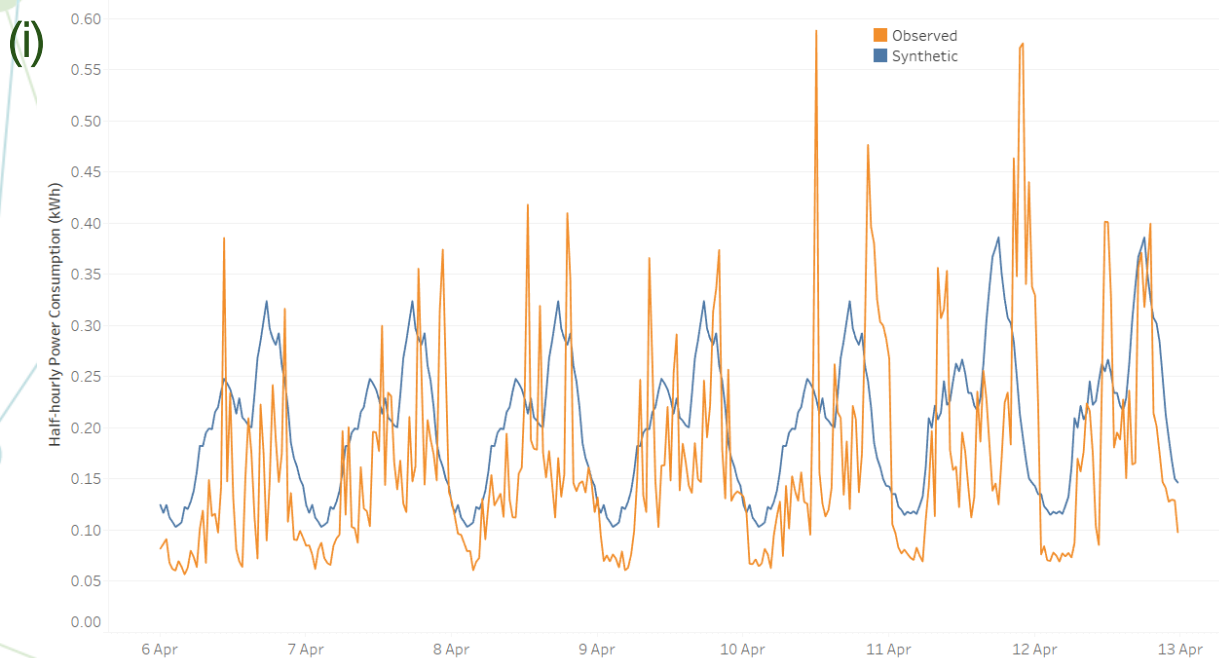
Neighbourhood substation
(blue) and LSOA (black)



12 building archetypes for the Faraday Tool and
Graham Oakes Ltd technoeconomic model

Powering Penn Fields – Energy Model

WM-NET ZERO



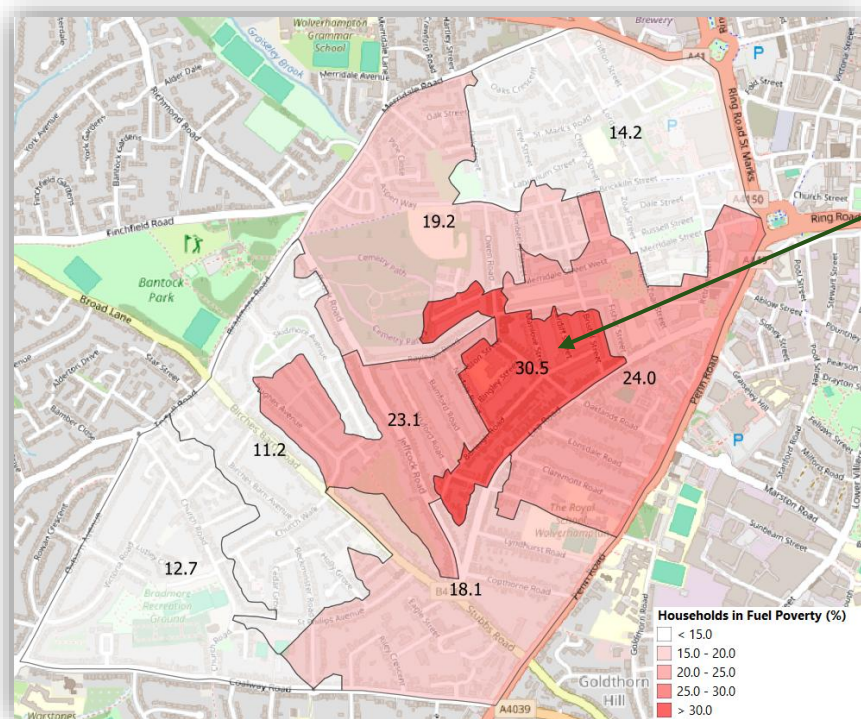
- (i) Observed vs. Synthetic Electricity Demand
- (ii) Observed vs. Synthetic Gas Demand
- (iii) IRR vs Self Sufficiency for Different Configurations of Low Carbon Technologies (LCTs)

The WM-NetZero project is supported by Wellcome Trust (227150_Z_23_Z) under the Advancing climate mitigation policy solutions with health co-benefits in G7 countries scheme.

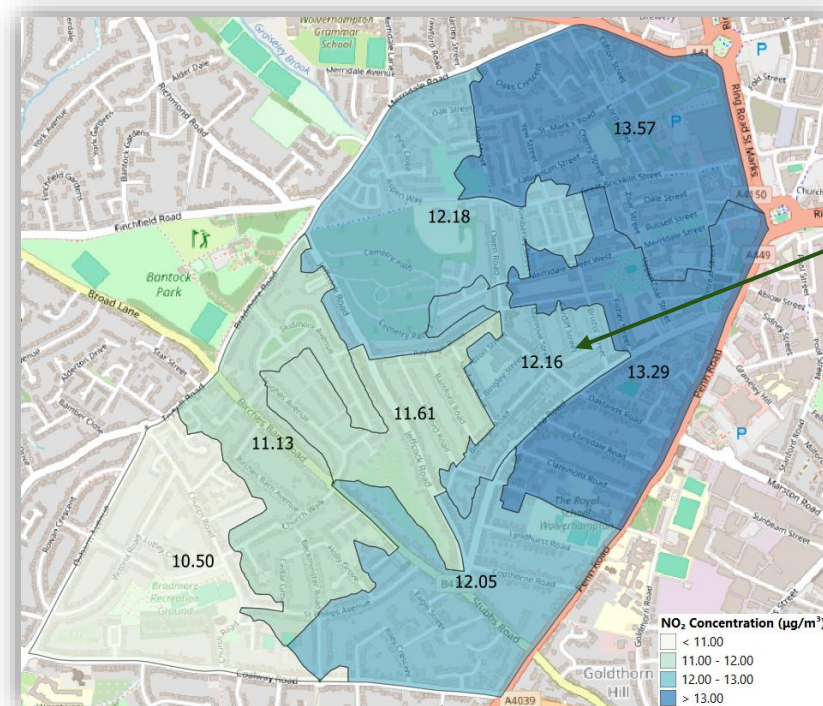


Powering Penn Fields – Health Benefits

WM-NET ZERO



Percentage of households in fuel poverty in Graiseley ward.



Mean annual NO₂ concentration in Graiseley ward (> WHO 10 µg/m³ limit).

- Climate Health Explorer: 4 attributable deaths + 3 childhood asthma cases from NO₂
- LCTs would reduce fuel poverty and NO₂ concentrations from gas boiler emissions

INSIGHTS FROM COMMUNITY AMBASSADORS

Shobhit Arya, Lucy Whittle, Jefrin Selvin

Highlights of Brockmoor



Hardware Retrieval

Collecting indoor air quality monitors from households.



Consent Collection

Supporting household informed consent collection.



Feedback Reports

Preparing resident-facing indoor air quality feedback reports.



Community Engagement

Listening to residents and understanding local experiences.



WM-NET ZERO



Community Outreach

Connecting with local community organisations and partners.



Community Events

Supporting the Brockmoor Community Climate Celebration.



Climate Engagement

Supporting the Climate Pledge stand and children's activities.



Local Partnerships

Dudley Council support helped facilitate consent collection and engagement.

Highlights of Castle Vale

WM-NET ZERO



Engagement

Circus event at Youngstaars Community Hub, Castle Vale (7 Feb 2026) drew almost 35 families into a conversation about the study.

Consent forms signed

Families curious about indoor air quality left their details (15-20 showed interest), then signed consent forms to take part.

Sensors deployed

Air quality sensors installed in participating homes as a result of the engagement. In 21 homes sensors were deployed successfully.

Feedback & repairs

Feedback gathered and repairs/troubleshooting completed for the residents.

Local Partnership

Birmingham City Council Supported in organizing event and scheduling sensors deployment.





GOVERNANCE OF NET ZERO NEIGHBOURHOODS

Carlo Luiu

Demonstrators as experiments

WM-NET ZERO

- Flexible and adaptive approach to governing that uses provisional frameworks to test and revise interventions based on real-world results
- Particularly well-suited to understanding complex and interconnected issues such as climate change and the transition to net zero



Who we spoke to

WM-NET ZERO



Combined
Authority (4)



Local
Authority (18)



Community
organisations &
Think Tank (6)



Delivery
partner (2)



Semi-structured interviews
with governance actors

Focus

- NZN drivers, motivations and expectations
- Approach used to conceive and deliver the NZN plans
- Data expectations and intended use
- Stakeholders' engagement
- Key challenges and lessons learnt

Project design: similar pathways, different journeys

Same programme logic, same funding framework, same stated challenge to address – but projects unfolded differently in terms of governance processes and design

Project structure – e.g. rationale behind site locations

- Alignment with holistic approach/ building on existing initiatives/ under-engaged communities in climate initiatives

Institutional arrangements – e.g., resource mobilisation and shape of project teams

- Existing consortium from past or external projects/ dedicated project manager/ tendering processes

Community engagement – e.g., who has delivered community engagement

- In-house team/ consultants/ embedded local organisations

Different trajectories – similar challenges

WM-NET ZERO



Reaching communities

Establish presence (without trusted intermediaries)

Climate action is not a priority for residents involved

Political volatility around climate narratives (local, national, global)



Trust building

Distrust arising from previous retrofit schemes

Misinformation and uncertainty around technologies (e.g. heat pumps, solar)



Sustaining delivery

Engagement fatigue

Resource-intensive delivery for council teams

Programme timelines misaligned with the time needed for trust-building and engagement

Underlying tension between experimentation VS delivery

Projects' experimentation and adaptation to local circumstances are affected while operating within funding frameworks based on predefined targets, deadlines and reporting requirements

Implications for transferability and scalability

Scaling up and replicability are often mentioned as key elements of urban experimentation - What is scalable, what is replicable?

Technical components

Housing, transport, green space infrastructure

Standardised processes and resources

Scale up with a proportional increase in materials and workforce

Social components

Community engagement

Tailored process based on trust and personal relationships

Scale up can imply dilution of relationships and uptake

Place and embeddedness matter - Places are not a neutral container, but a set of pre-existing, unevenly distributed assets that experimentation draws on but cannot quickly manufacture, and therefore, designs are not straightforwardly transferable

Implications for transferability and scalability



Project design and delivery

Build realistic time buffers into project timelines to account for internal approvals, funding processes, and activity roll-out

Plan for resources to have a constant on-site presence from Council to build trust and access to community members

Consolidate assessment, design, and installation stages to reduce resident fatigue and drop-out.



Community engagement

Route engagement through trusted local community organisations and community champions to build trust and project buy-in

Lead with community events rather than traditional cold outreach approaches (door-knocking and dropping leaflets)

Embed show homes to let residents experience home energy improvements firsthand and build trust in unfamiliar technologies

DISCUSSION

Add your organisation
to the

National Retrofit Directory



A free, public, searchable Directory of everyone involved in
housing retrofit.
Including manufacturers, installers, researchers, policy teams, community
organisations and many more.

Why add your organisation?



Increase visibility



Find partners &
opportunities



Shape the map



Support a shared
resource

Please take **10 minutes** to add your organisation!



**NATIONAL
RETROFIT HUB**



UNIVERSITY OF
SURREY



UNIVERSITY OF
BIRMINGHAM

LUNCH + PHOTO

WORKSHOP: EXPLORING RETROFIT PROGRAMME EVALUATION

WM-NET ZERO



James Hall
University of Birmingham



Mike Davies
UCL

Agenda [13.30-15.00]



1.Introduction to workshop [Mike]

2.Setting the scene:

- Overview of Warm Homes Plan other key policies [Joe]
- Brockmoor Net Zero Neighbourhood: From Demonstrator to Delivery Model [Helen]

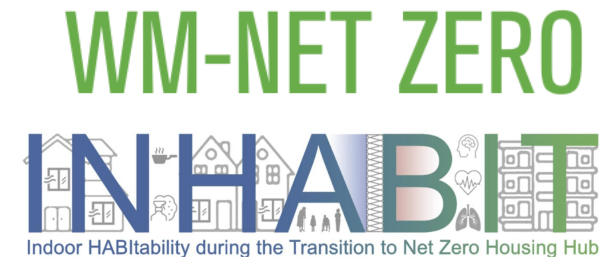
3.Interactive session [James]

Aims of workshop

Aim: To understand what is already happening and to present what we can offer to support evaluation plans: what is the Defra requirement?

- What are LAs/WMCA doing?
- What's ideal?
- What is needed?
- What can we do to support?

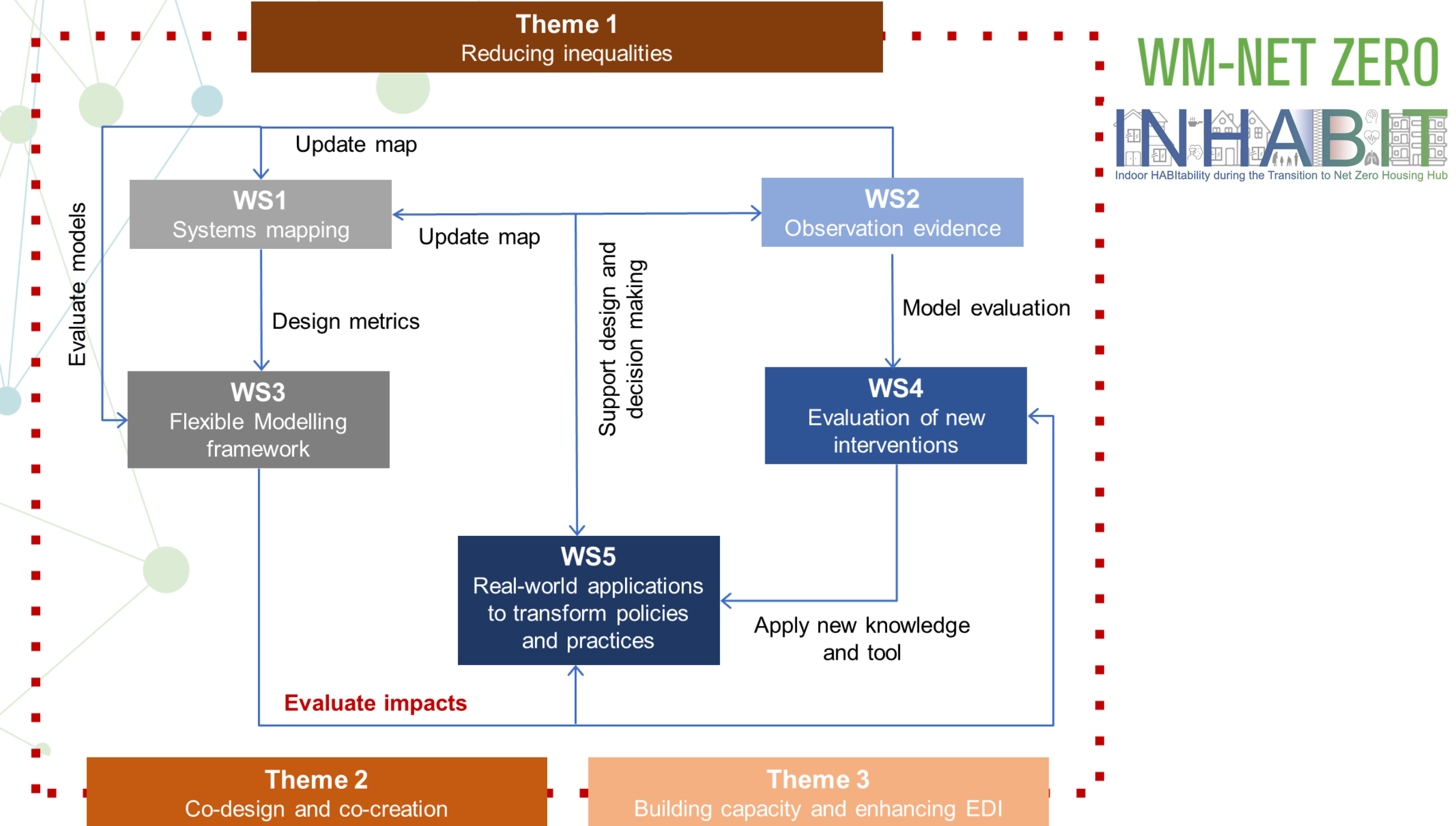
Brief overview of the INHABIT project



The INHABIT Hub aims to produce scientific evidence and policy-relevant solutions to realise the health co-benefits of the UK's net zero transition in housing. Our main objectives include:

- Establishing and growing a transdisciplinary hub to become an International Centre of Excellence that pioneers the improvement in indoor environments and health as the housing sector transitions to net zero.
- Developing a systems understanding of retrofits' impacts, through observations and modelling, focusing on indoor environment, health and inequalities to promote health-centred actions.
- Creating a collaborative learning space to boost stakeholders' and researchers' skills in transdisciplinary research and net zero delivery.
- Co-producing example retrofitting projects that integrate net zero considerations with health and address inequality.





WM-NET ZERO



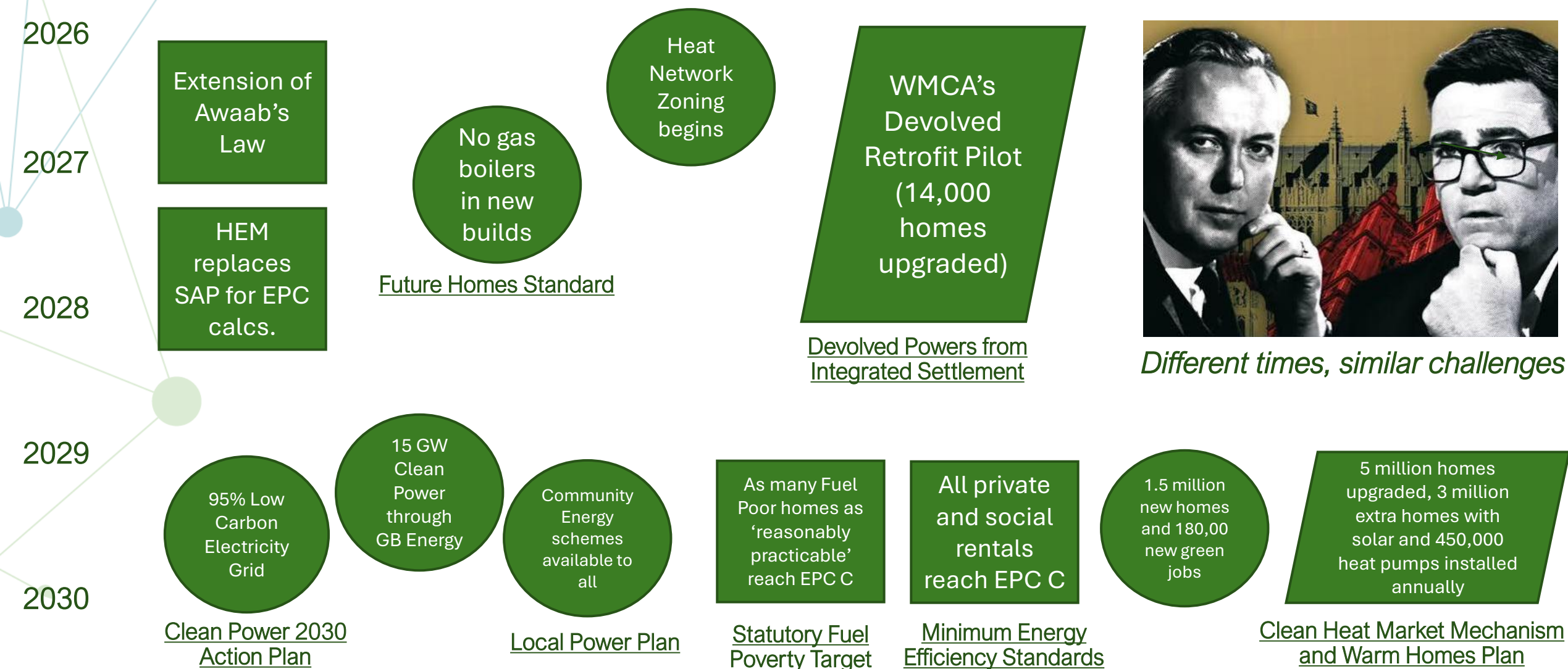
OVERVIEW OF WARM HOMES PLAN AND OTHER KEY POLICIES

Joe Day

Key Housing and Energy Policies

- Homegrown low-carbon power, electrified heat and healthier homes

WM-NET ZERO



Different times, similar challenges

Warm Homes Plan - Overview



- Published in January 2026. **£15 billion** public funding:
 - £5.0 billion** for low-income schemes
 - £2.0 billion** for consumer loans
 - £2.7 billion** Boiler Upgrade Scheme
 - £1.1 billion** for Heat Networks
 - £2.7 billion** for innovative finance
 - £1.5 billion** other funding
- Key targets:
 - 450,000 heat pumps** installed annually by 2030 (125,000 in 2025)
 - 4.5 million homes** with solar panels by 2030 (1.6 million in 2025)
 - 5 million homes** reached by 2030 (includes 2.9 million by EPC MEES)
- Key messages:
 - ++ Electrification of heat and heat networks (more certainty)
 - ++ One banner for schemes and advice (more consistency)
 - ++ Slight shift of policy costs from bills onto general taxation
 - ~~ Slight shift from deep insulation to solar and batteries (end of fabric first?)
 - ~~ Health features although more detail required



Case study:

West Midlands Combined Authority's Net Zero Neighbourhoods demonstrator programme



Open event at the Brockmoor NZN demonstrator home. Courtesy of WMCA.

The West Midlands Combined Authority (WMCA), in collaboration with its seven constituent local authorities and partners across the public, private, and academic sectors, is delivering a Net Zero Neighbourhoods demonstrator programme. This initiative trials a place-based approach to the energy transition, aiming to generate the data necessary to unlock private sector investment and drive regional clean growth.

The programme was developed by WMCA and expanded under the DESNZ Local Net Zero Accelerator (LNZA), which supports locally led green growth backed by private finance. With LNZA development funding and investment via the Buildings Retrofit Pilot, WMCA is developing six additional Net Zero Neighbourhoods. In phase one, the

goal is to retrofit a minimum of 350 homes across pilot sites. Building on learnings from this phase—covering engagement, co-design and monitoring of holistic outcomes (including emissions and bill savings) – WMCA will look to scale its reach with support from private sector investment.

WMCA's approach centres around four pillars: domestic retrofits, local clean energy generation, improved green spaces, and enhanced low-carbon and active travel options.

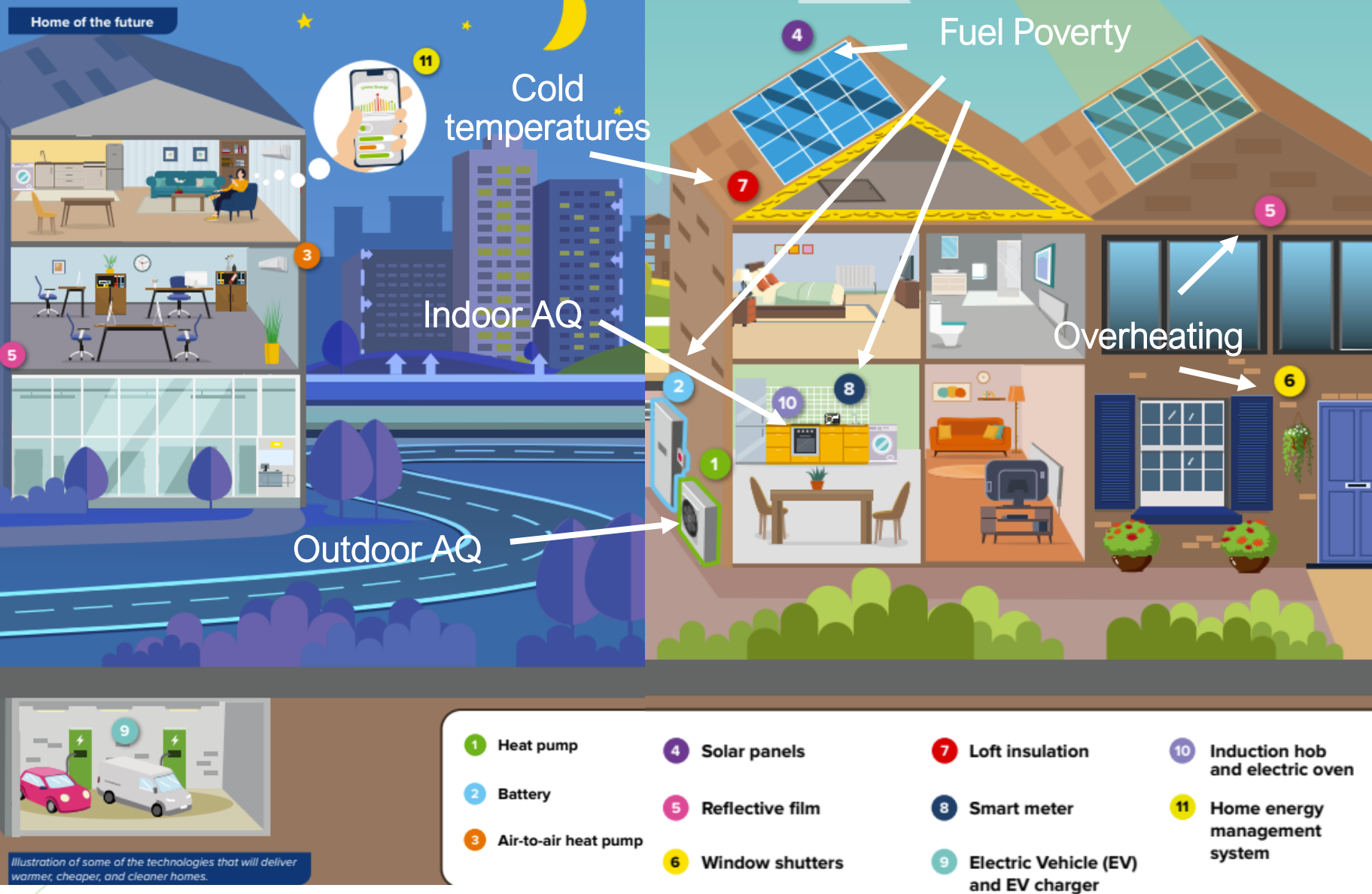
All interventions are co-designed with residents to ensure local needs shape decarbonisation efforts. By working collaboratively with local authorities and communities, WMCA aims to establish a blended finance model for retrofit delivery by 2028.

George Simms, Head of Net Zero Homes and Communities at WMCA, commented:

"We believe a place-based approach is the most effective and equitable way of delivering a clean energy transition. When change is shaped around the needs of our communities, this generates a level of engagement that is essential for attracting the finance we need to build on public sector investment and create greater scale. Partnership working with our local authorities, third sector organisations, the private sector and communities can ensure that the benefits of the transition are seen where they are needed most."

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Measures address direct and indirect health risks in housing

Warm Homes Plan - Evaluation

- Lessons from ECO4 and GBIS (up to 30,000 homes substandard insulation)
- Boiler Upgrade Scheme:
Follow-up Surveys (thermal comfort, temperature but not AQ or damp/mould)
AQ impacts monetised in Cost-Benefit Analysis (£350 million by 2030)
- Warm Homes Grants:
Scheme data (installed measures), resident surveys (including physical and mental health), retrofit co-ordinators (PAS2035), bespoke primary and secondary sources.
- Data from home monitors to support real grassroots stories that go beyond targets:
Community groups
Citizen science
School projects

"I received loft and wall insulation or got an induction hob, and my bills fell / winter evening temperature increased / NO₂ levels reduced by X".



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BROCKMOOR NET ZERO NEIGHBOURHOOD: FROM DEMONSTRATOR TO DELIVERY MODEL

Helen Langley, Dudley Council



BROCKMOOR NET ZERO NEIGHBOURHOOD

FROM DEMONSTRATOR TO DELIVERY MODEL

WHAT IS BROCKMOOR?

A defined neighbourhood in Dudley, West Midlands

307 Properties within
neighbourhood boundary

134 Homes
Included in Phase 1

Brockmoor is a neighbourhood within Dudley and the West Midlands Combined Authority region.

The demonstrator focused on a defined neighbourhood boundary of around 307 properties, with Phase 1 activity targeting 134 eligible homes (EPC <C, existing interventions, build type).

Alongside housing improvements, the programme tested wider interventions across community spaces, transport routes, green infrastructure and local energy opportunities.

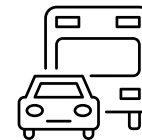
The project explored how coordinated investment at neighbourhood level could support a more sustainable, lower-carbon future through improvements to:



Homes



Energy



Transport &
Mobility



Green
Infrastructure



Community
Priorities

A place-based demonstrator designed around one neighbourhood, multiple interventions and shared outcomes.

BROCKMOOR AT A GLANCE

Outputs: what was delivered

COMMUNITY ENGAGEMENT & CO-DESIGN	BUILT ENVIRONMENT & ENERGY SYSTEMS	BUSINESS & FINANCIAL MODELLING	TRANSPORT & MOBILITY PLANNING	GREEN INFRASTRUCTURE & PUBLIC REALM	MONITORING, EVALUATION & LEARNING
Continuous community activities built trust and visibility, including events, door-to-door engagement, and educational sessions.	Delivered housing upgrades and installed low-carbon infrastructure like solar PV and battery storage across 56 homes.	Combined blended funding sources and developed commercial models to scale neighbourhood programmes effectively.	Researched local movement and safety, proposing traffic calming and connectivity improvements aligned with residents.	Enhanced neighbourhood with park improvements, walking paths, benches, and wildlife support installations.	Collected data via surveys, sensors, and analysis to evaluate programme success and inform future actions.

The programme delivered across homes, people, streets, green space, data and funding - not housing alone.

OUTCOME AREAS: WHAT CHANGED?

The evaluation looked beyond delivery activity

Brockmoor generated evidence across several outcome areas, helping to show what changed for homes, residents and the wider neighbourhood.

Some outcomes are indicative and need longer-term monitoring, but Brockmoor created a much richer evidence base than a traditional output-led project.

Carbon reduction

Lower modelled emissions from fully retrofitted homes.

Fuel poverty and affordability

Reduced modelled energy costs in fully retrofitted homes.

Health, comfort and internal conditions

Early evidence of improved temperatures, humidity, damp/mould risk and indoor air quality in monitored homes.

Community pride and identity

Residents reported stronger pride in place and increased use of improved public spaces.

Civil society and local capacity

Friends of Brockmoor Park became a formally constituted, self-sustaining group.

Safety, movement and public realm

Local transport and green space improvements responded to resident priorities.

Data and decision-making

Sensor data revealed issues that would not have been visible through EPC analysis alone.

COMMUNITY ENGAGEMENT AND CO-DESIGN

Building trust, participation
and local ownership

Outputs: what was done

FIVE MAJOR OUTDOOR COMMUNITY EVENTS

SIX ROUNDS OF DOOR-TO-DOOR ENGAGEMENT

DROP-IN SESSIONS

SHOW-HOME VISITS

HEAT PUMP EDUCATION SESSIONS

FRIENDS OF BROCKMOOR PARK ACTIVITY

LOCALLY BASED DUDLEY MBC POINT OF CONTACT
SUPPORTING RESIDENTS THROUGH THE PROCESS



Outcomes: what changed

102 of 134 eligible properties
engaged, an engagement
rate of 76%

Stronger trust and confidence among
residents

Increased participation from households
with known or identified vulnerabilities

Increased pride of place

Friends of Brockmoor Park revitalised into
a formally constituted, self-sustaining
community organisation

**Community engagement and co-design
was not a communications workstream.
It was core delivery infrastructure**

BUILT ENVIRONMENT AND ENERGY SYSTEMS

Improving homes, energy
performance and local generation

Outputs: what was done

56 homes
received
housing works

Delivery across
social housing,
owner-occupied
and private
rented homes

Fabric
improvements,
ventilation and
low-carbon
heating measures
installed

Solar PV and
battery storage
installed across
homes and
community
assets

109 kwp solar
PV and 198 kwh
battery
storage installed
across the
neighbourhood

Brockmoor
primary school
and the old star
pub included in
local energy
activity

Non-domestic
decarbonisation
roadmaps
developed for
albion works

Outputs: what changed

Average space heating demand improved
from 116 to 53 kwh/m²/year

53% average improvement in
space heating demand

56% average reduction in modelled
carbon emissions

74% average improvement in
modelled energy costs

All fully retrofitted homes
achieved EPC C or above

Sensor data indicated improved internal
conditions in monitored homes

HEALTH, COMFORT AND AFFORDABILITY

Early evidence of better internal conditions

Brockmoor generated evidence on how retrofit and energy improvements may affect comfort, affordability and health-related conditions.

Important caveat

These findings are valuable, but longer-term evaluation is needed to evidence sustained health, fuel poverty and affordability outcomes at scale.

The programme combined:

- Sensor data suggested retrofitted homes were less likely to be cold
- Monitored homes showed improvements in temperature and humidity
- Reduced humidity helped lower conditions associated with damp and mould risk
- University of Birmingham indoor air quality monitoring found significant PM2.5 reductions in five of seven homes with sufficient data
- Nearly half of surveyed residents felt their ability to maintain comfortable temperatures in cold weather had improved
- Fully retrofitted homes showed a modelled annual energy cost improvement from £1,286.43 to £349.29

The early evidence is positive, but future programmes need longer monitoring periods to prove lasting resident impact.

WHAT DID NOT WORK WELL ENOUGH?

Brockmoor should not be replicated as-is

The evaluation shows that Brockmoor delivered important benefits and learning - future programmes should not simply copy the Dudley delivery model.

Brockmoor validated the potential of place-based decarbonisation, but also showed that future programmes need a different delivery model.

Traditional contracts and grant structures constrained flexibility

Funding and delivery timelines compressed early mobilisation

Community engagement, baselining and programme design needed more protected time upfront

Housing became dominant because of funding structures and delivery pressures

Workstreams were not always as integrated as the original model intended

Neighbourhood-scale delivery created some operational and financial inefficiencies

Long-term outcomes could not be fully evidenced within the project timeframe

Commercial finance models need more scale, time and investment to become replicable



RECOMMENDATIONS: SET THE PROGRAMME UP DIFFERENTLY

Design the model properly before
delivery starts

Future programmes should be set up with clearer structure, flexibility and evidence requirements from the outset.

The set-up phase is not administration. It determines whether the programme can deliver, adapt and evidence value.

Future programmes need to:

Define the project scope clearly, even within a place-based vision

Establish a clear intervention logic before delivery starts

Agree which outcomes will be measured at project, programme and regional level

Build monitoring and evaluation into delivery from day one

Allow more time for mobilisation, engagement and baselining

Use contracts and funding mechanisms that support innovation, co-design and iteration

Avoid rigid waterfall delivery models where resident priorities and workstream learning may need to shape the programme

DESIGN FOR RESIDENT VALUE

Maximise benefits beyond installation

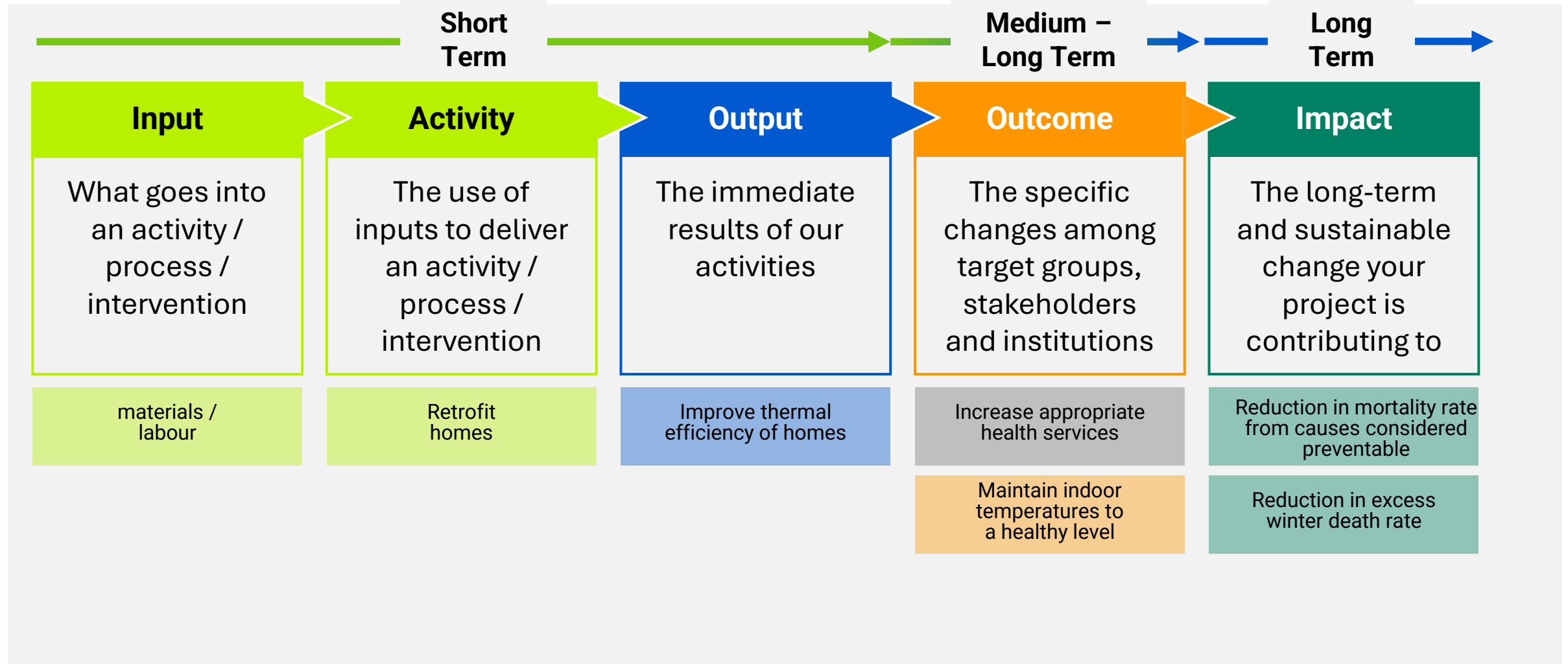
Future programmes need to focus on the resident experience before, during and after delivery.

The value of a Net Zero Neighbourhood is not only in the measures installed, but in how residents experience and benefit from the change.

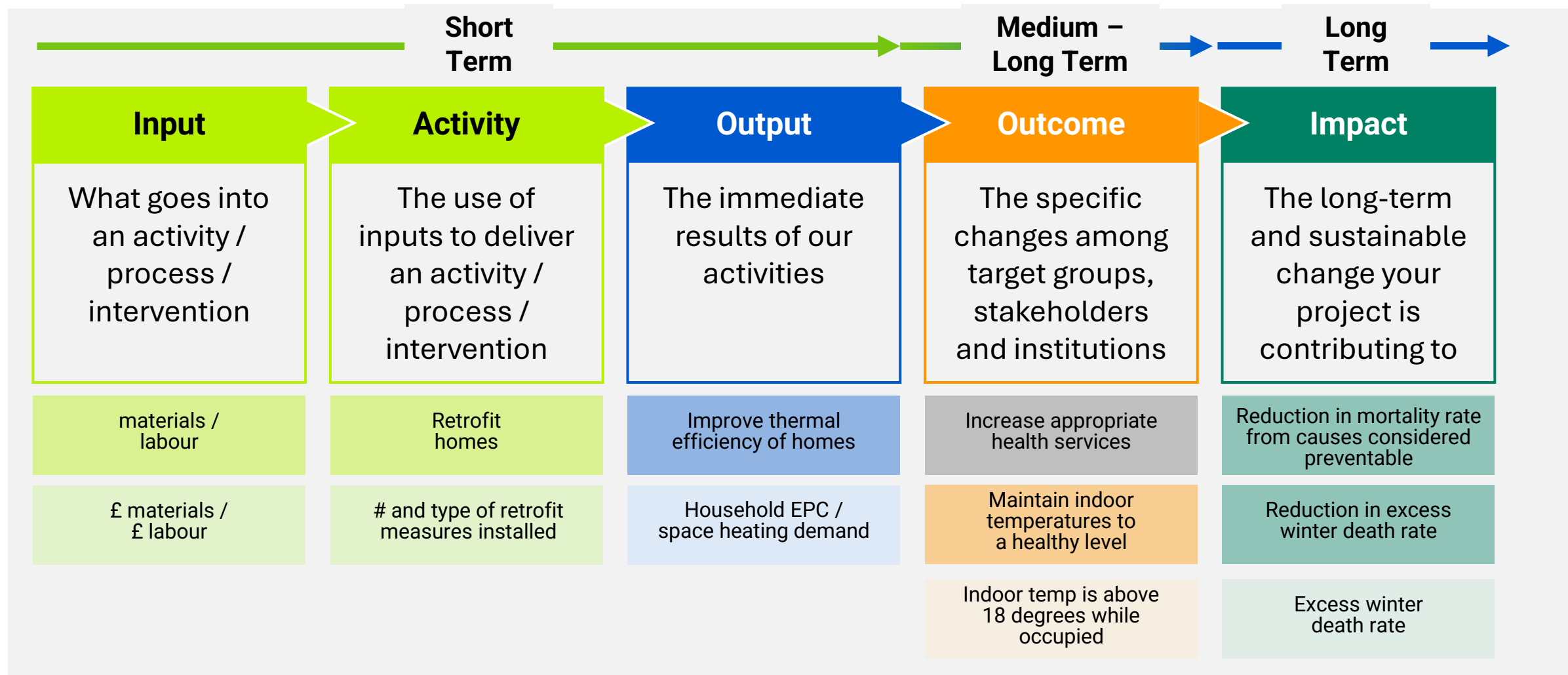
Recommendations:

- Treat support for new technologies as a process, not a one-off handover
- Build in aftercare for heat pumps, solar PV, batteries and ventilation
- Help residents understand how to use new systems effectively
- Use public realm and green space investment to make benefits visible to the wider neighbourhood
- Design programmes to support comfort, affordability, health, pride and safety
- Maintain community engagement and co-design beyond initial recruitment
- Support local groups where they can create long-term neighbourhood capacity

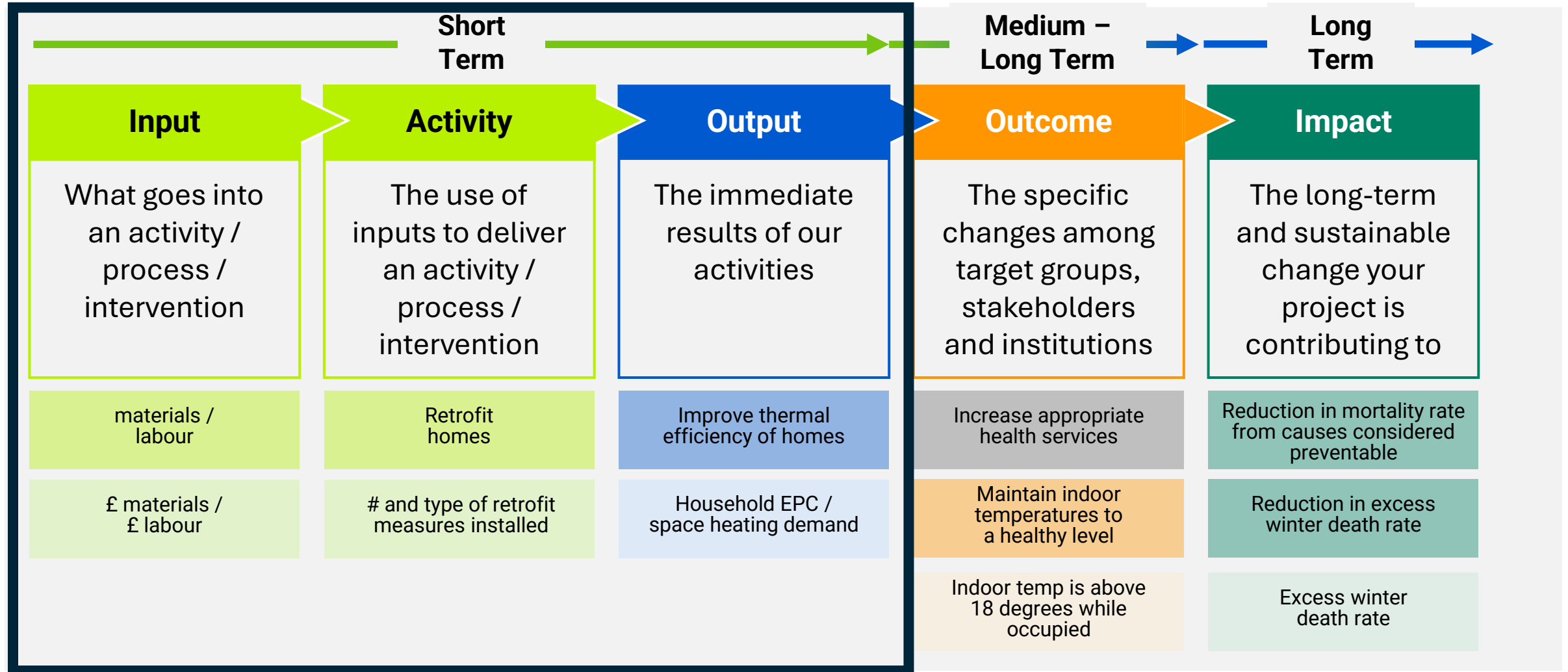
Logic Model and Outcome-Based Design



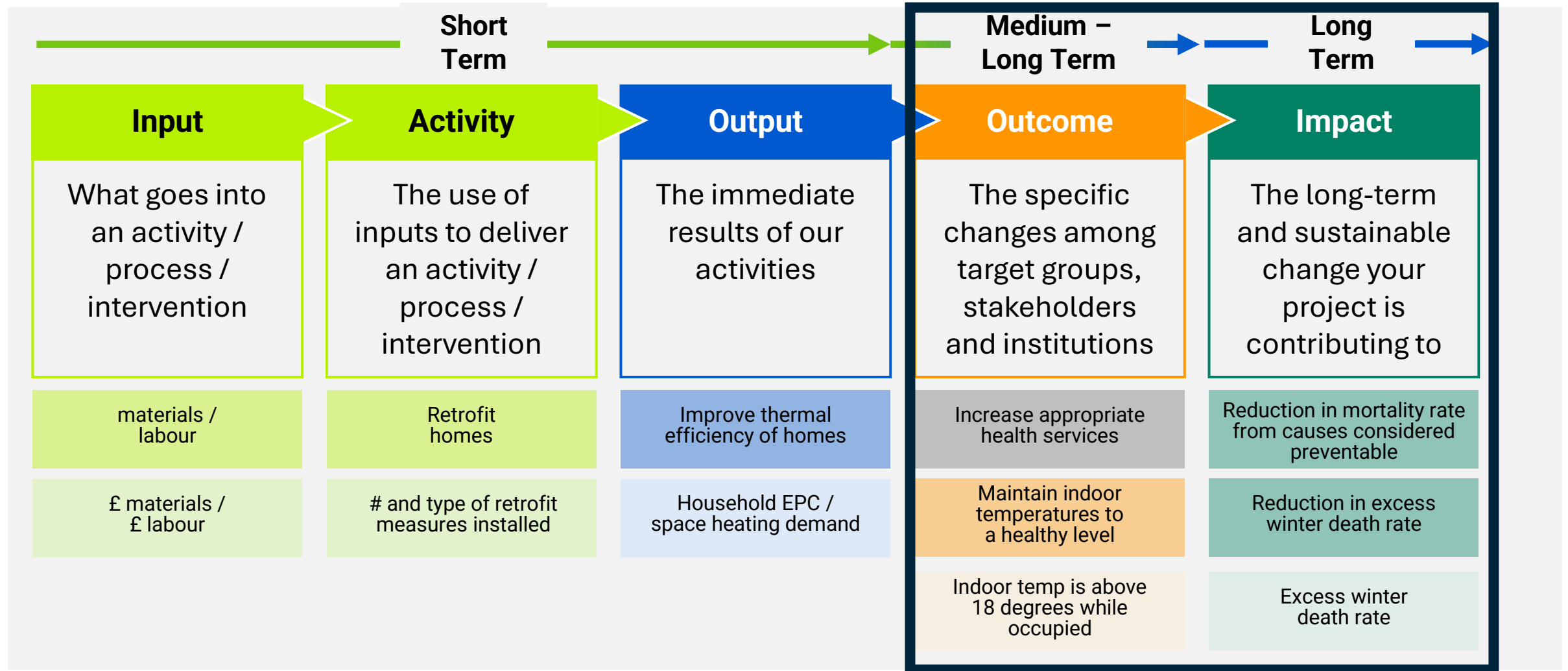
Logic Model and Outcome-Based Design: Measurement and Evaluation



Logic Model and Outcome-Based Design: Measurement and Evaluation



Logic Model and Outcome-Based Design: Measurement and Evaluation



Logic Model and Outcome-Based Design: NZN Programme

	Fuel Poverty	Carbon Emission Reduction	Electricity Grid Capacity	Differences in Health Outcomes are Reduced	Resilient to Natural Disasters
Built Environment					
Green Spaces					
Low Carbon Mobility					
Local Energy Infrastructure					







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INTERACTIVE SESSION

Interactive Session



Considering air quality and health in retrofit programme evaluation plans

Questions to discuss [45 mins]:

- i. How is IAQ and health currently considered in NZN/retrofit programme evaluation?
- ii. How can fieldwork and modelling (e.g. climate health explorer, IAQ sensors, health surveys etc) provide health and IAQ insights for NZN programme / retrofit evaluations, and hence policy?
- iii. What are we not currently doing / what is not currently included the climate explorer or other fieldwork/observations protocols, but could help with evaluation?

Group reflections / feedback [15 mins] – 1-2mins per table, key points, focus on (iii)

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FINAL REMARKS

Final Remarks

- Real-world observations
- Integrated modelling framework
- Systems understanding
- Thank you!

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Indoor HABitability during the Transition to Net Zero Housing Hub



Indoor HABItability during the Transition to Net Zero Housing Hub

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A Health-centred Systems Approach Towards
Net-Zero: Transforming Regional Climate
Mitigation Policies

Thank you for your attention!

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Get involved and stay connected

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