Workshop 3d:

Innovations to enhance building performance

Speakers: Rick Holland (Innovate UK)
Richard John (Knowledge Transfer Network)
Clare Hendry (Hastoe Group)
Luke Smith (National Energy Foundation)
Chaired by: Andrew Burke
Room: Cambridge Room

Workshop 3d:

Innovations to enhance building performance

Speakers: Rick Holland (Innovate UK)
Chaired by: Andrew Burke
Room: Cambridge Room

3D: Innovations to enhance building performance

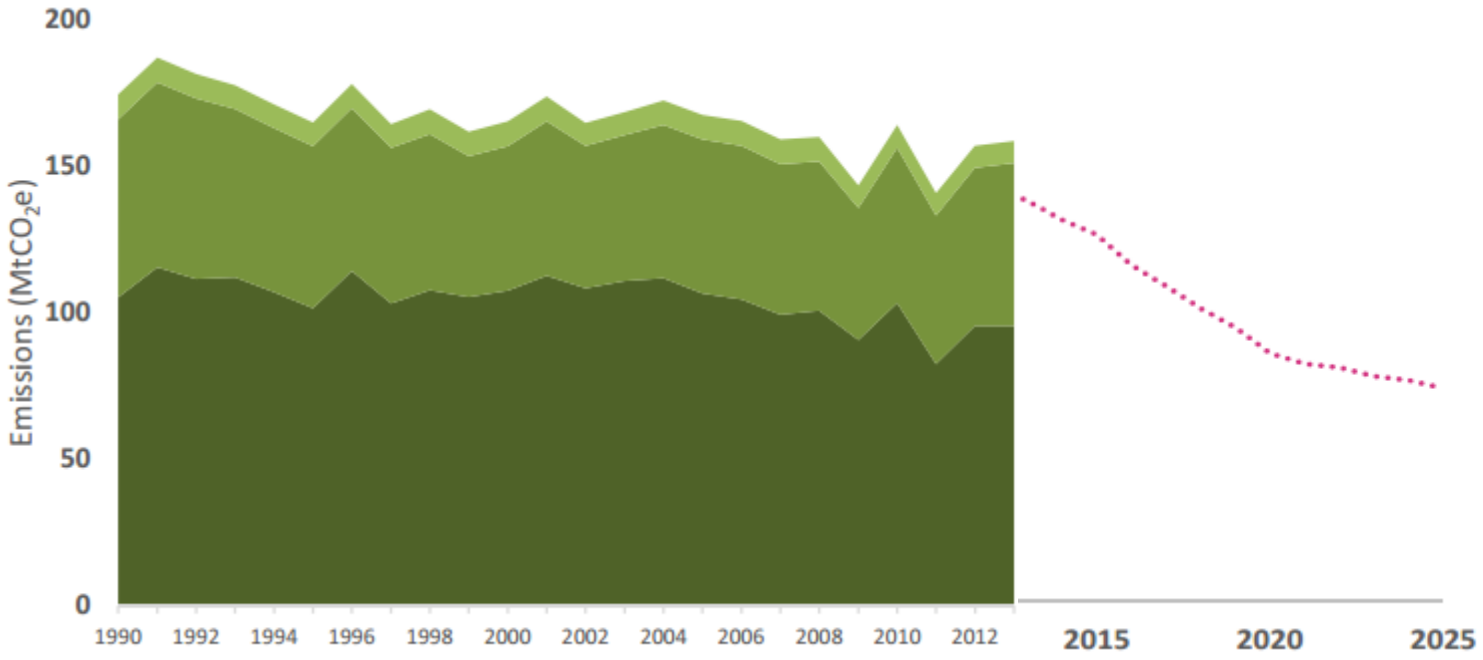
Rick Holland, CEng PhD
Lead technologist

Innovate UK

Context

Green Construction Board Low Carbon Routemap for the Built Environment

2015 Routemap Progress | Technical Report



Context

1. Retrofit of existing buildings

- Retrofit for the Future
- Scaling up Retrofit of Our Nation's Homes

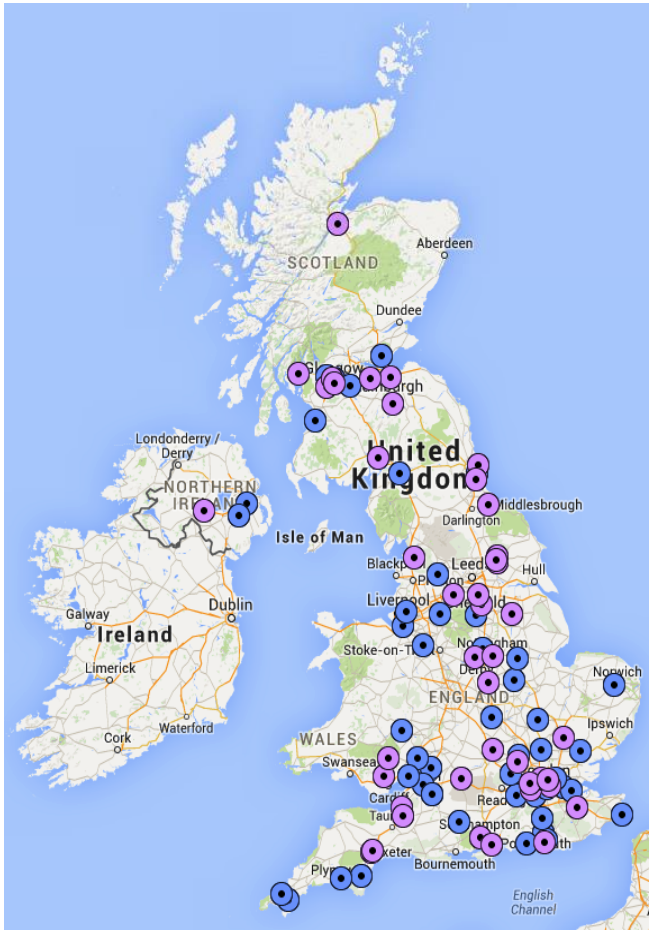
2. Low/zero energy new buildings

- Near Zero Energy Buildings by 2020

3. Buildings that operate as best they can

- Future Energy Management of Buildings
- Building Performance Evaluation

Building Performance Evaluation



https://connect.innovateuk.org/web/building-performance-evaluation

- £8m programme of research

- To understand the "Performance Gap“; the difference between the designed and actual energy usage

- Build knowledge and experience on how to create assets that perform at their best

Speaker #1

Clare Hendry

Sustainability Manager at Hastoe HA

www.linkedin.com/in/clare-hendry-3173aa20

Speaker #2

Luke Smith

Principal Energy Specialist at National Energy Foundation

www.linkedin.com/in/lsmith88

Speaker #3

Richard John

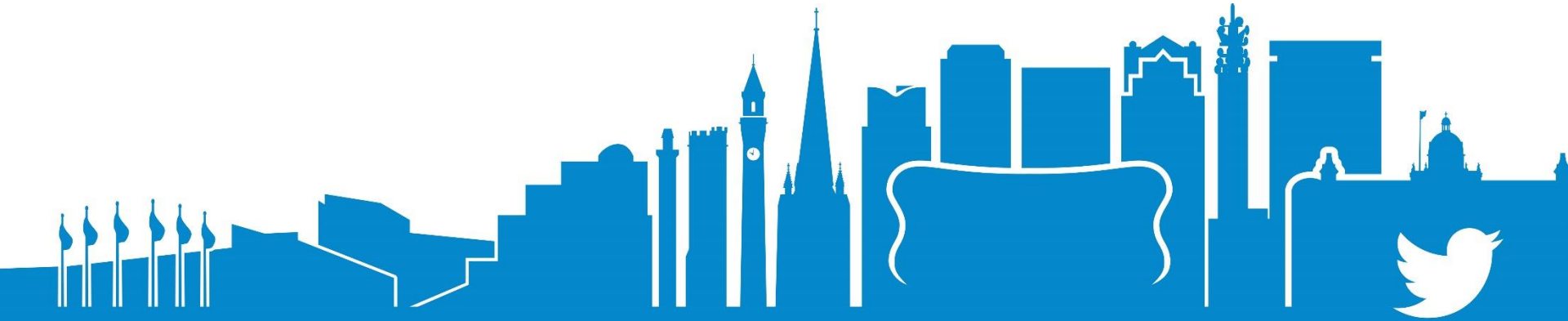
Business Manager at the Knowledge Transfer Network (KTN)

www.linkedin.com/in/richard-john-287b964

Workshop 3d:

Innovations to enhance building performance

Speakers: Clare Hendry (Hastoe Group)
Chaired by: Andrew Burke
Room: Cambridge Room

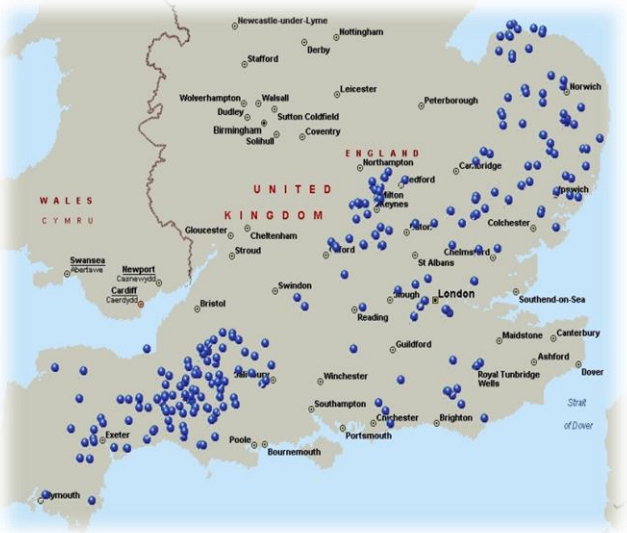


Wimbish Passivhaus

Clare Hendry
Sustainability Manager
Hastoe Group

About Hastoe

- Over 7000 homes
- West, south and east England
- 62 local authority areas
- Rent and shared ownership



- Affordable homes in rural communities
- Fuel poverty and environmental sustainability

Hastoe Group

Wimbish Passivhaus

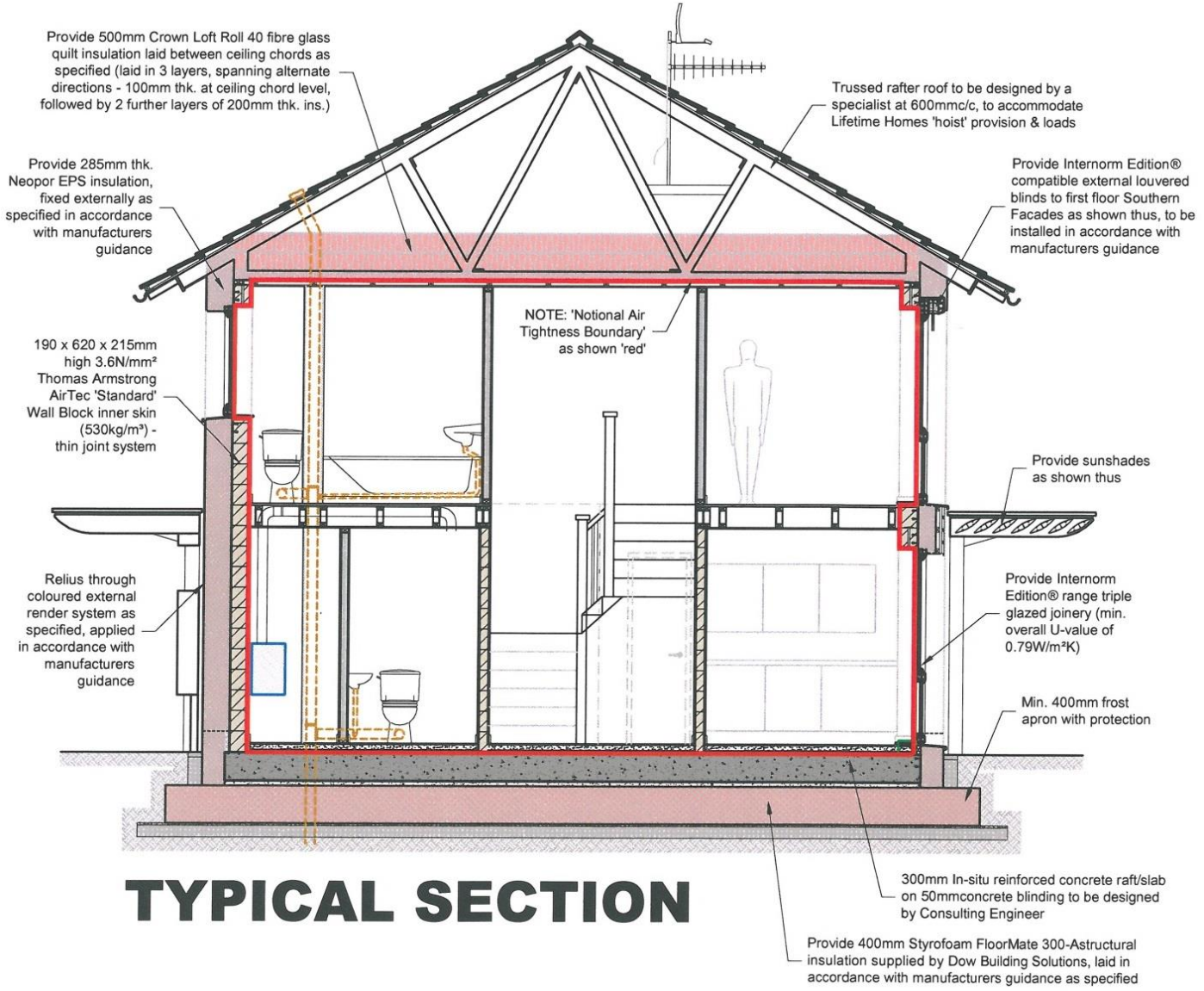
Hastoe Group

Why Passivhaus?

- North European low carbon building standard
- Low tech “passive” measures, e.g. super insulated
- High energy efficiency
- Combination of low carbon building with Code for Sustainable Homes
- Lower running costs and supporting greener lifestyles

Hastoe Group

Passivhaus



TYPICAL SECTION

Why Passivhaus for Hastoe?

- Innovation in sustainability
- Replicable design
- Approximately 25% of residents in fuel poverty but likely to be more
- 51% of residents struggling with energy costs
- Encourage take up in wider sector

greening Hastoe

Hastoe Group

Building Performance Evaluation

- Technology Strategy Board (Innovate UK)
- Funding for in-depth studies of domestic and non-domestic buildings
- Occupant Satisfaction
  - BUS survey; Interviews; Resident evenings; PhD studies
- Monitoring leading to performance analysis
  - Thermal comfort
  - Energy: £ & CO_2

Hastoe Group

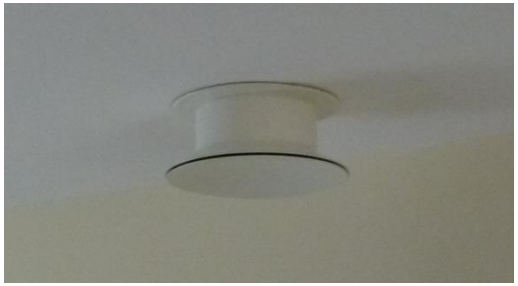
Wimbish M&E Systems

- MVHR
- Solar thermal & boiler supply heat to cylinder
- Cylinder supplies hot water and space heating via MVHR and Towel Rail.

Hastoe Group

Heating

- Lack of radiators aids the spacious feel
- Initial concerns over control
- Residents creative with heat generation – candles, soup, tumble dryer!



Ventilation - purpose

- Vital in an air-tight dwelling.
- Remove pollutants
  - odours, moisture, VOCs, Carbon dioxide
- Supply fresh filtered air
  - Air quality, health and well-being
- Deliver thermal comfort

Hastoe Group

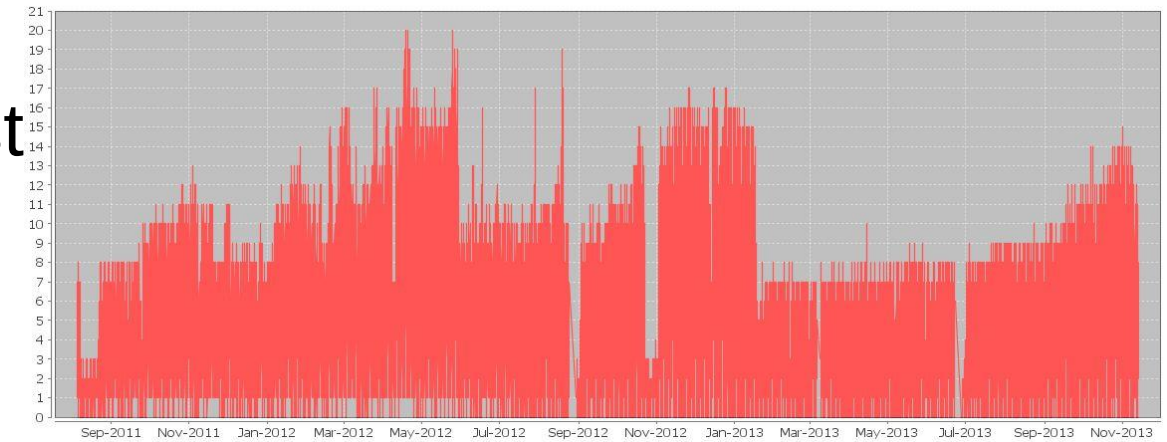
Ventilation – in-use

- Touch-screen controls:
  - Easy for some
  - But not for others
  - Not easy to explain all the settings
- Few use much of the capabilities
- Simpler controls, or none at all, may suffice
- Only turned off in one dwelling.

Hastoe Group

Ventilation - Filters

- Get blocked up
- Fan works harder to maintain air flow, using more energy
- Gets noisier
- Eventually air flow compromised, along with air quality, ability to deliver heat, and heat recovery effectiveness
- Filter replacement is a significant cost



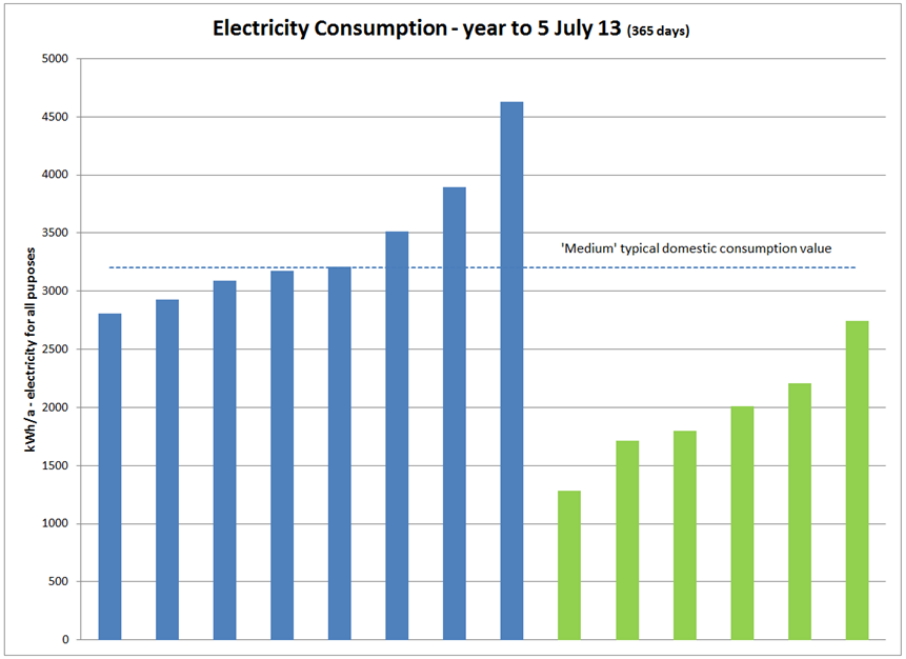
Blinds

- Control over solar gain
- Close in summer
- Open in winter
- Used more for privacy
- Design change in subsequent schemes

Hastoe Group

Electricity Use

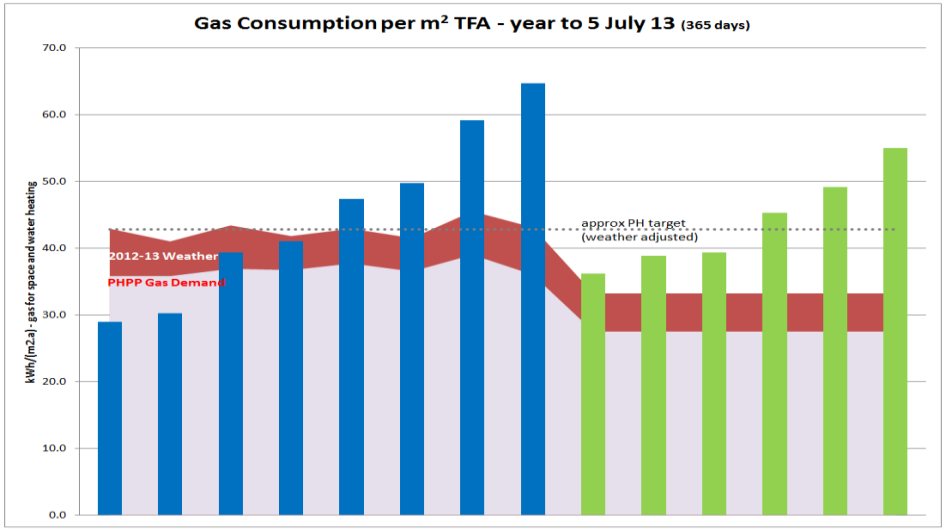
- PH Expectation: efficient appliances; conservatively used
- Consumption depends on occupant numbers
- Actually: typical UK figures – double Passivhaus, fails primary energy target.



Hastoe Group

Gas use – annual (per m²)

- Use varies
- Stand out - £120 total per year achieved
- Aligns with PH expectations allowing for weather
- Space heating demand reduced by other gains
- Solar may not be making expected contribution in all dwellings
- Fabric might not be quite as good as it ought to be.



Hastoe Group

Comfort in winter

- BUS survey: “never felt cold”
- Data confirms this, except:
  - Where windows open
  - Residents absent
  - MVHR filter issues
- Warm everywhere in the house - able to locate beds by windows.

Hastoe Group

Comfort in Summer

- Expectation that building fabric will keep the heat out
- And residents will:
  - Use blinds
  - Open windows at appropriate times for ventilation and to remove excess heat
  - Avoid heat-generating activities.
- Reality is that properties do get hot and residents do not always follow advice.

Hastoe Group

Passivhaus for residents

- Ordinary people
- Comfort – all year, whole house
- Healthy – contributes to well-being
- Very low heating bills
- Easy to live with
- Encourages sustainable living

Hastoe Group

Passivhaus for Hastoe

- High resident satisfaction
- Fuel Poverty – improbable in a Passivhaus?
- Improved ability to pay rent – zero arrears in rented properties
- Aspiration to reduce cost uplift of achieving PH with each scheme
- Maintenance considerations and budget implications

Hastoe Group

Recommendations - Client

- Clarity over
  - Expectations, including building performance
  - need for quality
- Ensure appropriate levels of supervision
  - retaining the architect or
  - appointing a suitably qualified Clerk of Works
- A traditional design-and-build contractual approach may not be ideal.

Hastoe Group

Recommendations - Design

- Settle the design early, involve all parties (including Asset Management)
- Focus on what works
  - for the occupants
  - for support and maintenance
- Assess sensitivity of the design to variations:
  - in occupancy
  - in behaviour patterns.

Hastoe Group

Recommendations - Build

- Resist any material or equipment substitution (or ‘value’ engineering)
- Where unavoidable, assess the consequences
- Require:
  - Workmen who understand the need for quality processes
  - The appointment one or more quality champions

Hastoe Group

Recommendations - Handover

- Only the essentials on move-in day.
- Detail for each household a couple of weeks later.
- Reinforce, especially as seasons change
- Encourage residents to ‘try it for themselves’ during the sessions
- Provide context-sensitive (what-to-do-if) advice
- Ensure support services understand how to get the best from the Passivhaus dwellings
- Repeat when the residents change.

Hastoe Group

Recommendations – In-use

- Conduct BUS Survey of occupant satisfaction
  - Valuable feedback
  - Research causes of adverse comment
  - Comparison with peers
- Ensure essential service actions, such as filter changes, are carried out in a timely manner
- Review resident understanding of how to get the best out of their Passivhaus homes:
  - Appliance choice and use
  - Avoiding (and purging) excess summer heat.

Hastoe Group

Recommendations - Maintenance

- Producing a set of standard details
- Designing fixing details for windows and doors so that they can simply be renewed by unbolting rather than cutting out
- Standardising MVHR systems with easy clean reusable filters.
- Tackling condensation in roof spaces/external walls
- Mould growth on external walls

Hastoe Group

Recommendations - BPE

- Has provided much valuable knowledge
- Know how to improve future developments
- BPE:
  - can range from very simple to comprehensive
  - what you do depends on what you hope to get out of it.
  - If you wish to understand any gaps and remedy them you will need data.
  - Need to budget for kit, installation, and analysis and reporting.

Hastoe Group

Wimbish Passivhaus Conclusions

- Delivers – confirms Passivhaus design is a proven approach
- Significant benefits in reduced heating bills, comfort levels (and theoretically health and well-being)
- Fabric-first Passivhaus is preferable to heavily technology-dependent approaches to zero-carbon housing.
- Hastoe remains committed to the Passivhaus approach – 20% of development, 13 schemes, 110 units achieved so far but future delivery will be challenging

Hastoe Group

Thank You

Wimbish BPE reports:

http://hastoe.com/page/760/Wimbish-passivhaus-performs--Hastoe-releases-results-of-two-year-study.aspx

chendry@hastoe.com

07540 122946

Hastoe Group

Workshop 3d:

Innovations to enhance building performance

Speakers: Luke Smith (National Energy Foundation)
Chaired by: Andrew Burke
Room: Cambridge Room

NATIONAL ENERGY FOUNDATION

Improving the use of energy in buildings

Innovate UK BPE Meta Analysis
Social Housing Projects

Luke Smith, National Energy Foundation

NHMF, January 2016

The National Energy Foundation

- **Not-for-profit independent** organisation working to promote the better use and supply of energy in buildings
- **Improving the use of energy in buildings**
- Provide services for **public** and **private** sector businesses to help reduce energy use and reduce carbon emissions
- Focus on **energy efficiency** and **sustainable energy**
- Support for **domestic** and **non-domestic** buildings

NATIONAL
ENERGY
FOUNDATION

NEF's work with RPs:

Why we work with RPs

- Very large impact potential (numbers and performance of stock)
- Aligned values
- Benefit to fuel poor
- Area-based catalyst
- Demonstration potential
- Research potential

NATIONAL ENERGY FOUNDATION

Background to the IUK BPE programme

About the NEF BPE Meta Data Analysis

Summary of findings and arising opportunities

NATIONAL ENERGY FOUNDATION

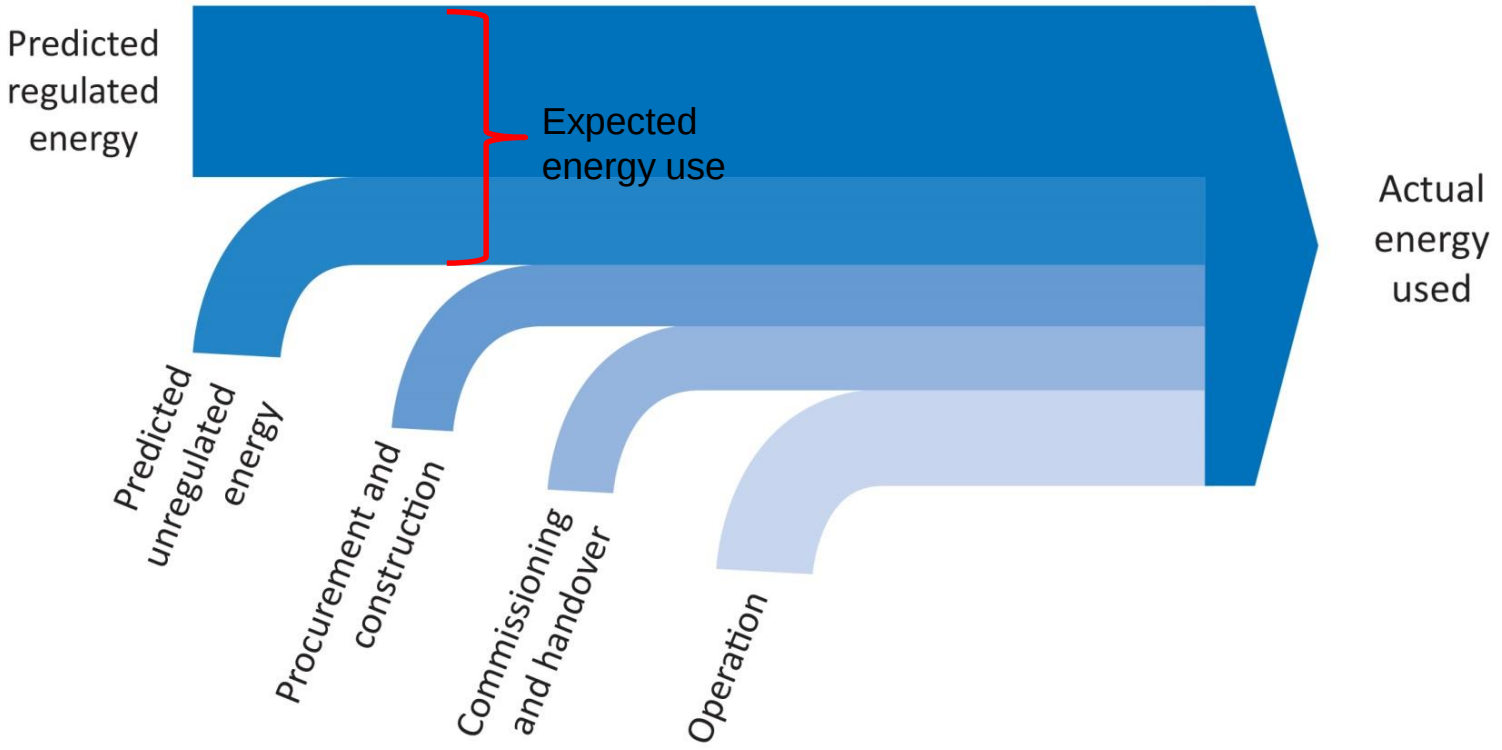
Innovate UK– Building Performance Evaluation Programme

2010 - 2014

- Over 100 new build projects + 3 refurb
- 49 non-domestic studies, 56 buildings
- 52 domestic studies, 366 dwellings
- Completion and early occupation / in-use
- Energy use typically 2.5 - 4.5 times predicted

NATIONAL ENERGY FOUNDATION

Why undertake BPE?



NATIONAL ENERGY FOUNDATION

Background to the IUK BPE programme

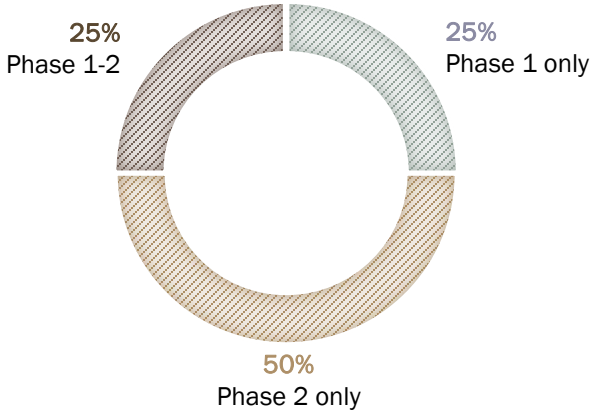
About the NEF BPE Meta Data Analysis

Summary of findings and arising opportunities

NATIONAL ENERGY FOUNDATION

NEF BPE Social Housing Meta Analysis

- 28 RP-led / Social Housing projects (54% of total) – 83 test dwellings
- Key success factors vs. practices which resulted in a significant performance gap
- Project by project review



Phase 1 – post completion and early occupation
Phase 2 – in-use and post-occupancy

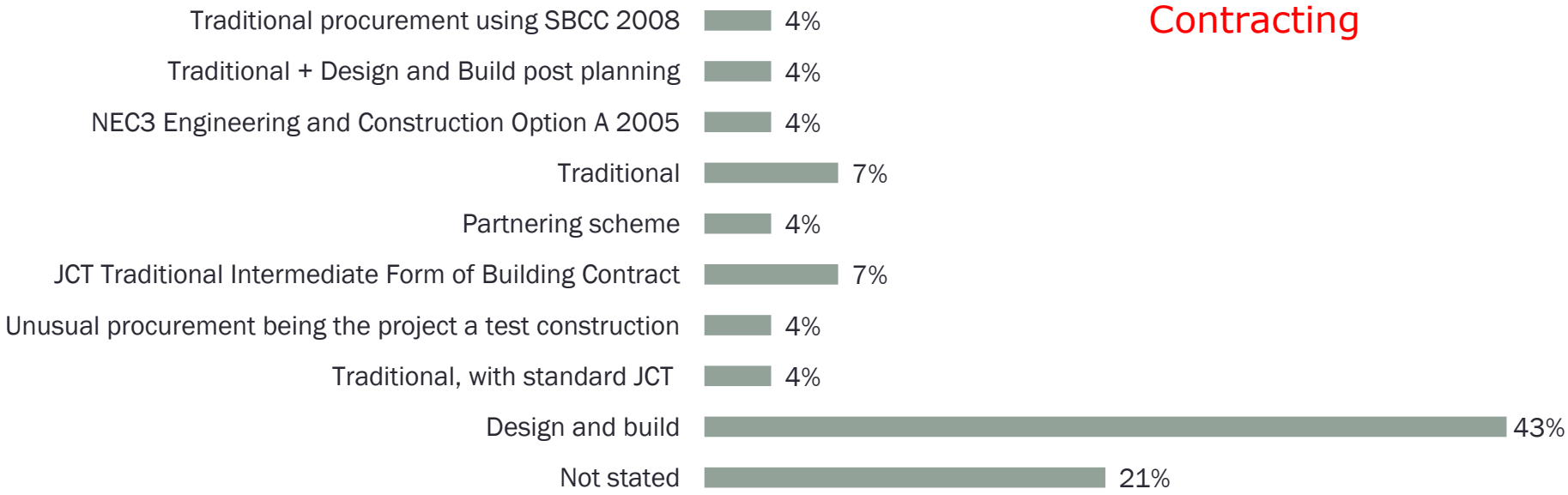
Context	Performance Gap	Process & Culture
> General data	> Energy performance assessment	> Procurement process
> Organisational data	> Fabric testing	> Design process
> Occupancy data	> Building services	> Construction process
> Property data	> Thermo-hygrometric comfort	> O&M process
> Construction data	> Indoor Air Quality	> Handover
> Building services		> Commissioning
		> Soft landings

✓ Aggregation of the findings

NATIONAL ENERGY FOUNDATION

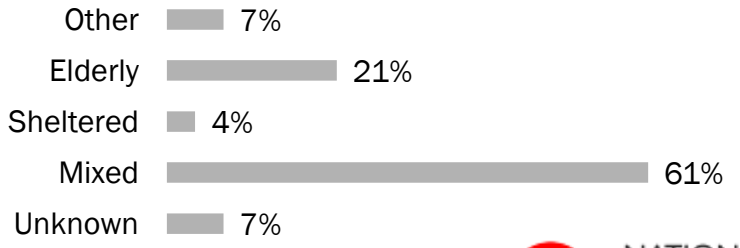
Context setting

Contracting



Tenure type

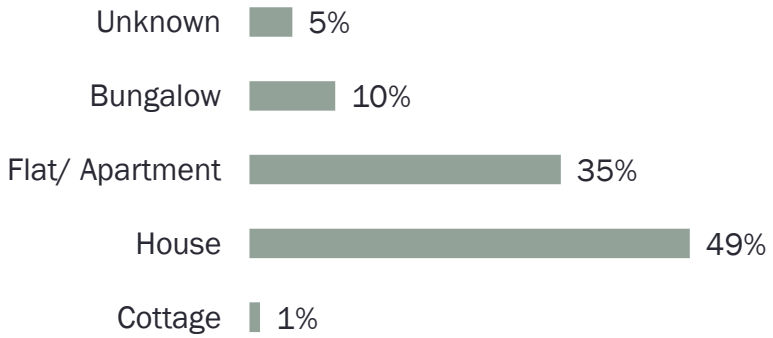
Occupancy type

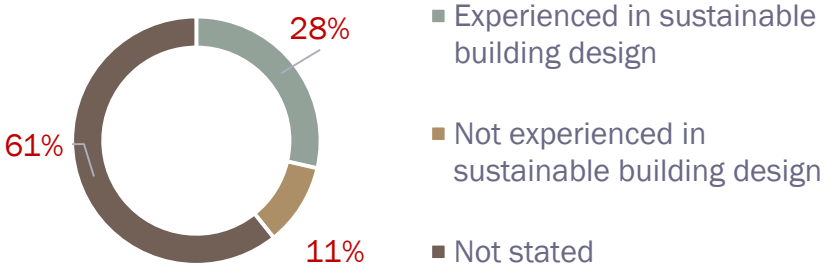


NATIONAL ENERGY FOUNDATION

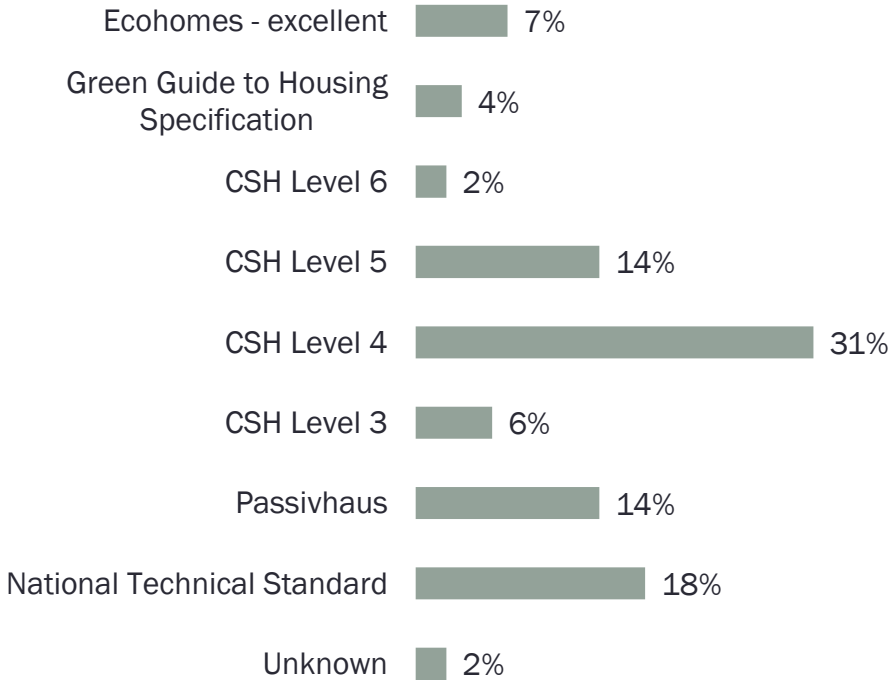
Property data

Property type





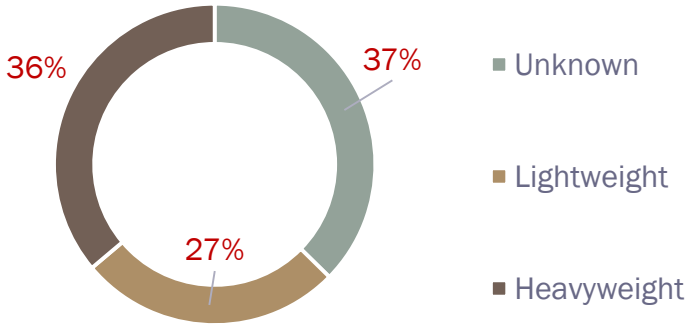
Construction Standard



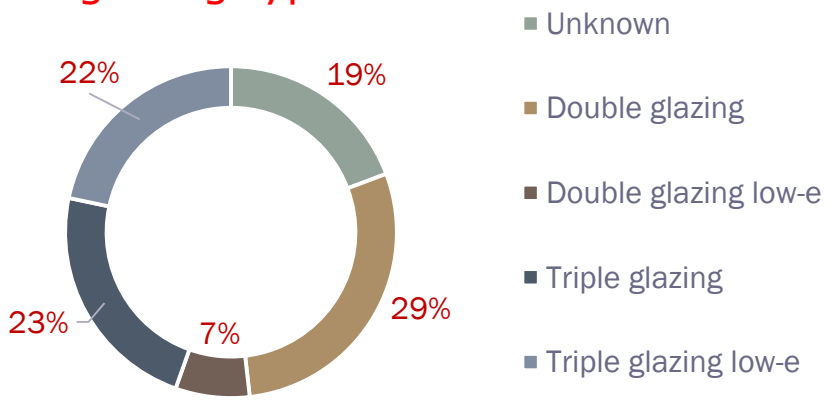
NATIONAL ENERGY FOUNDATION

Construction data

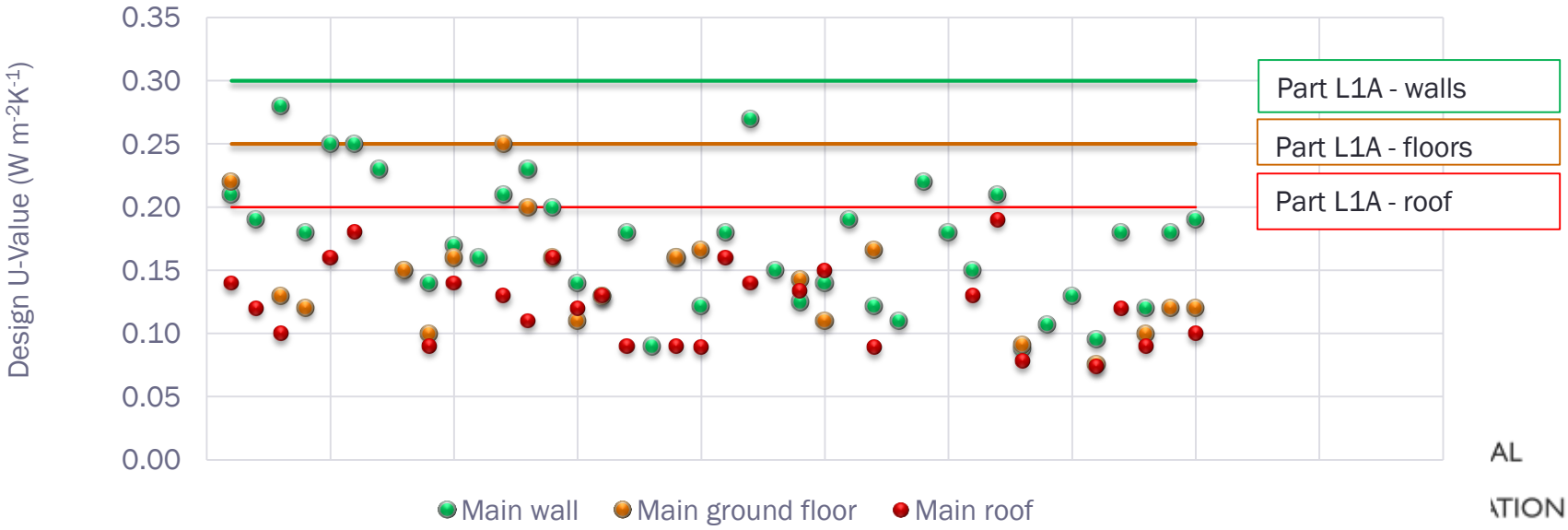
Building thermal mass



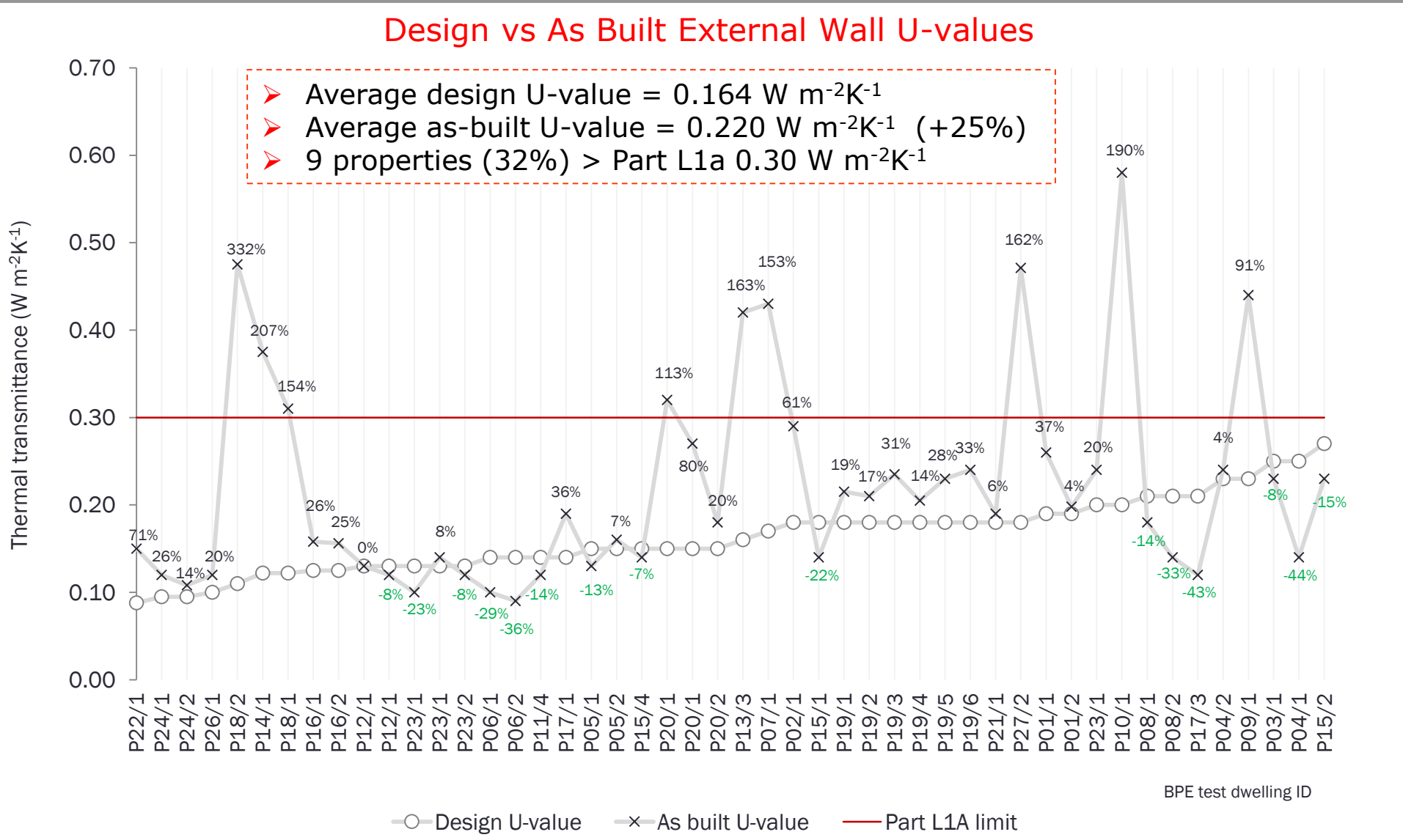
Main glazing type



As designed U-values

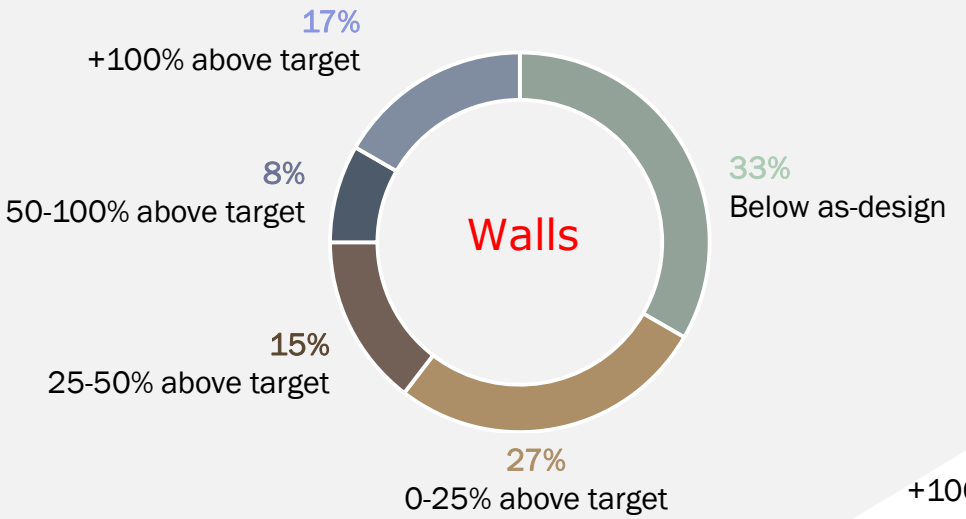


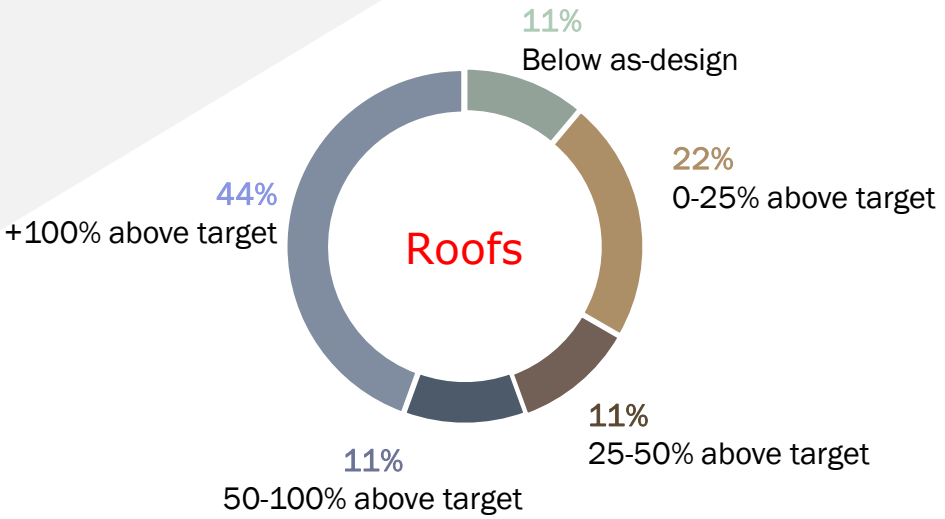
Fabric testing – building envelope



Fabric testing – building envelope

Performance gap frequency



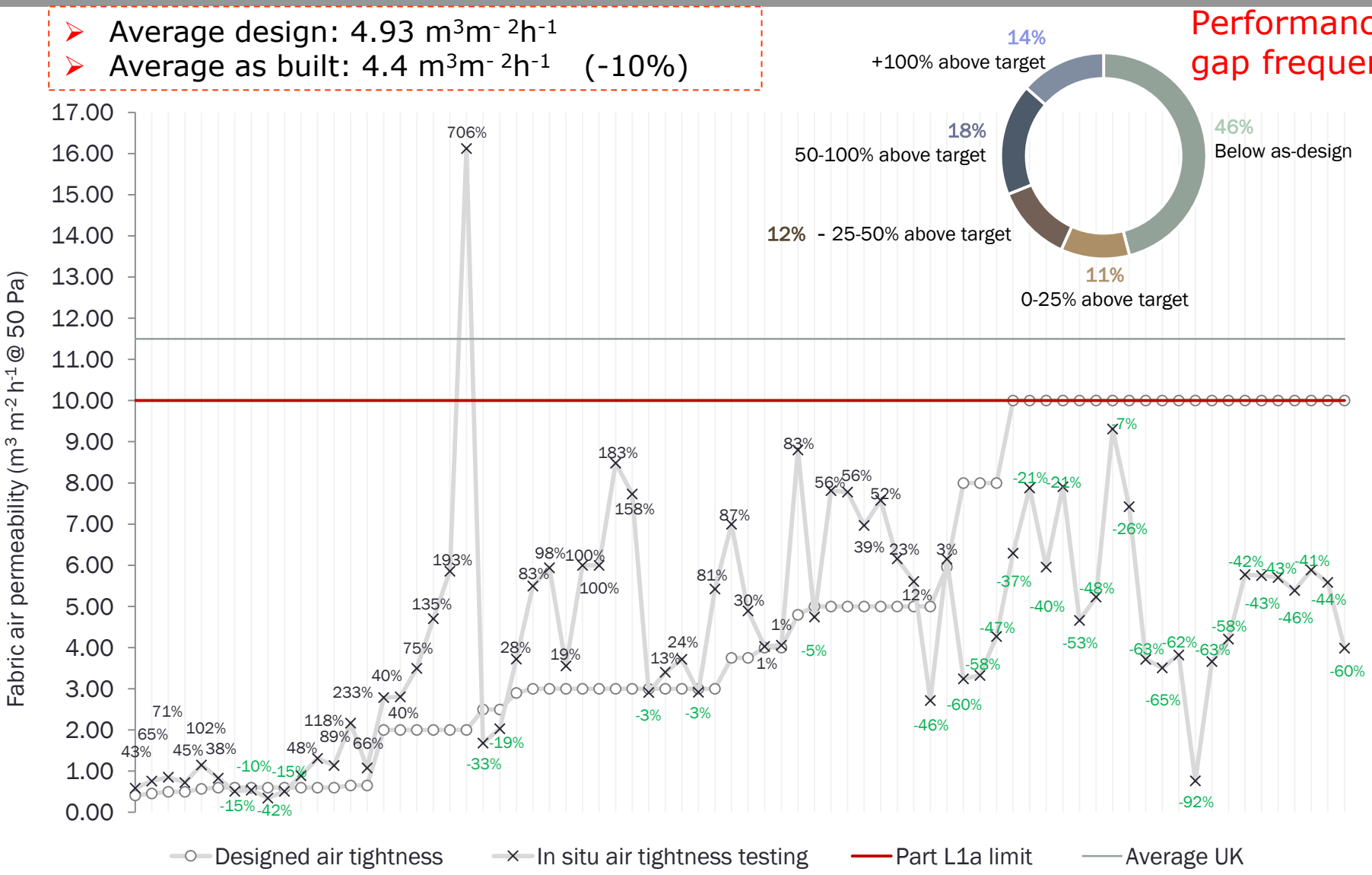


- 1 out of 9 as built met design U-value
- Lots of reporting of loft insulation disruption
- Improve insulation detailing on cold and warm roofs, dormers, etc.

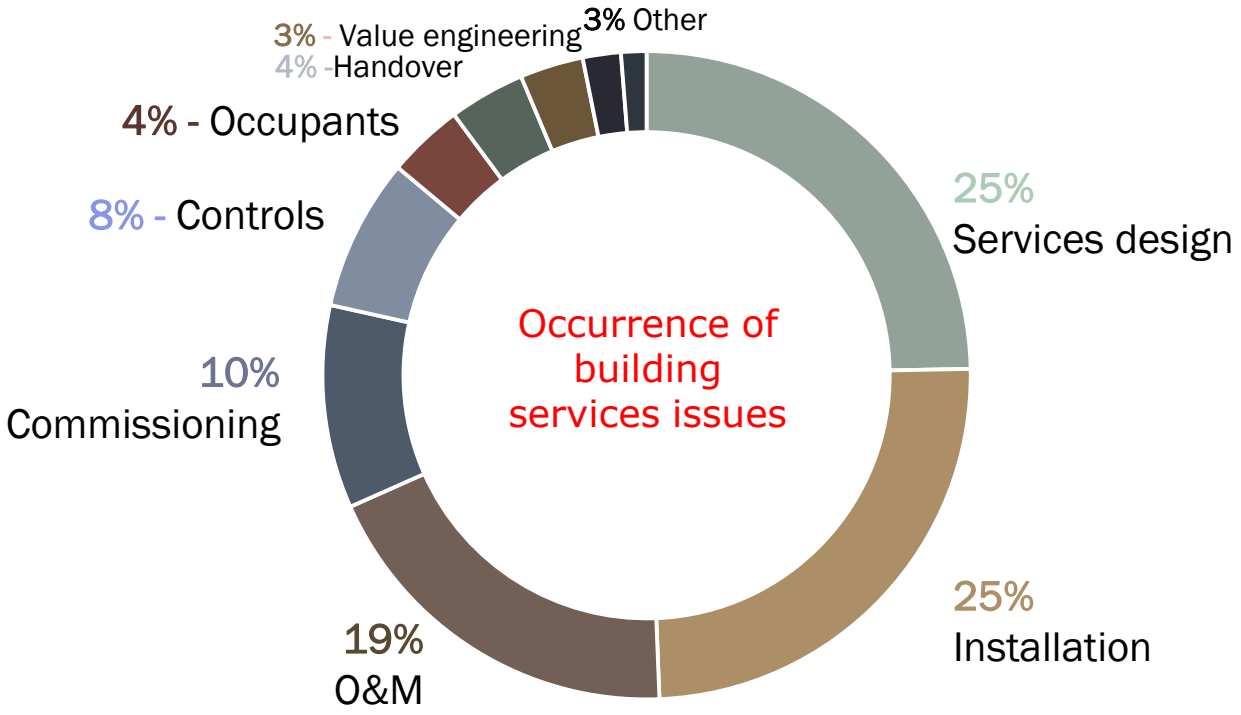
NATIONAL ENERGY FOUNDATION

Fabric testing – airtightness

- Average design: 4.93 $m^3m^{-2}h^{-1}$
- Average as built: 4.4 $m^3m^{-2}h^{-1}$ (-10%)



Energy system commissioning



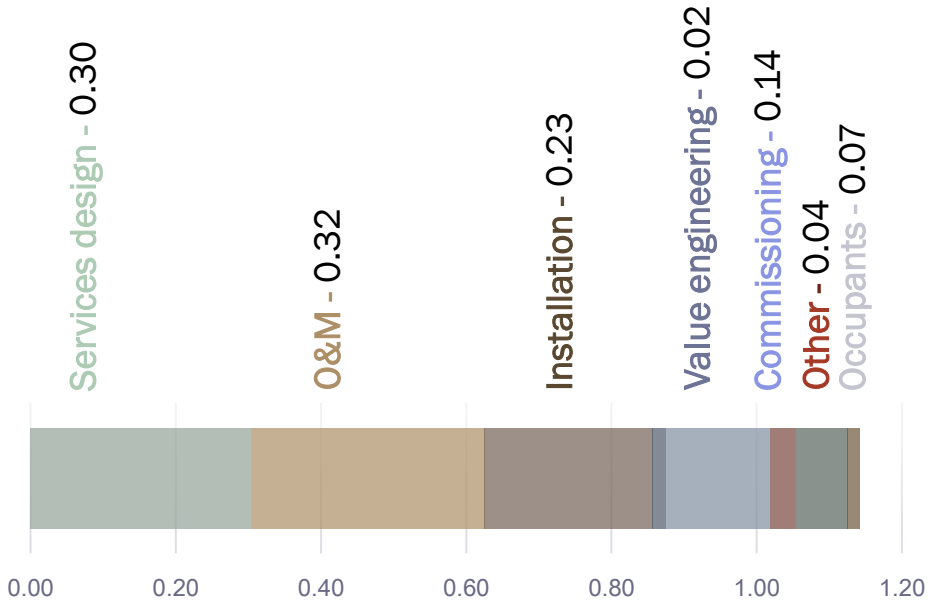
- Services design & installation: shortage of skills and training
- Maintenance: often neglected throughout the building service life
- Maintenance: crucial requirements for ongoing support after handover

NATIONAL ENERGY FOUNDATION

MVHR

Key issues per property with MVHR installed

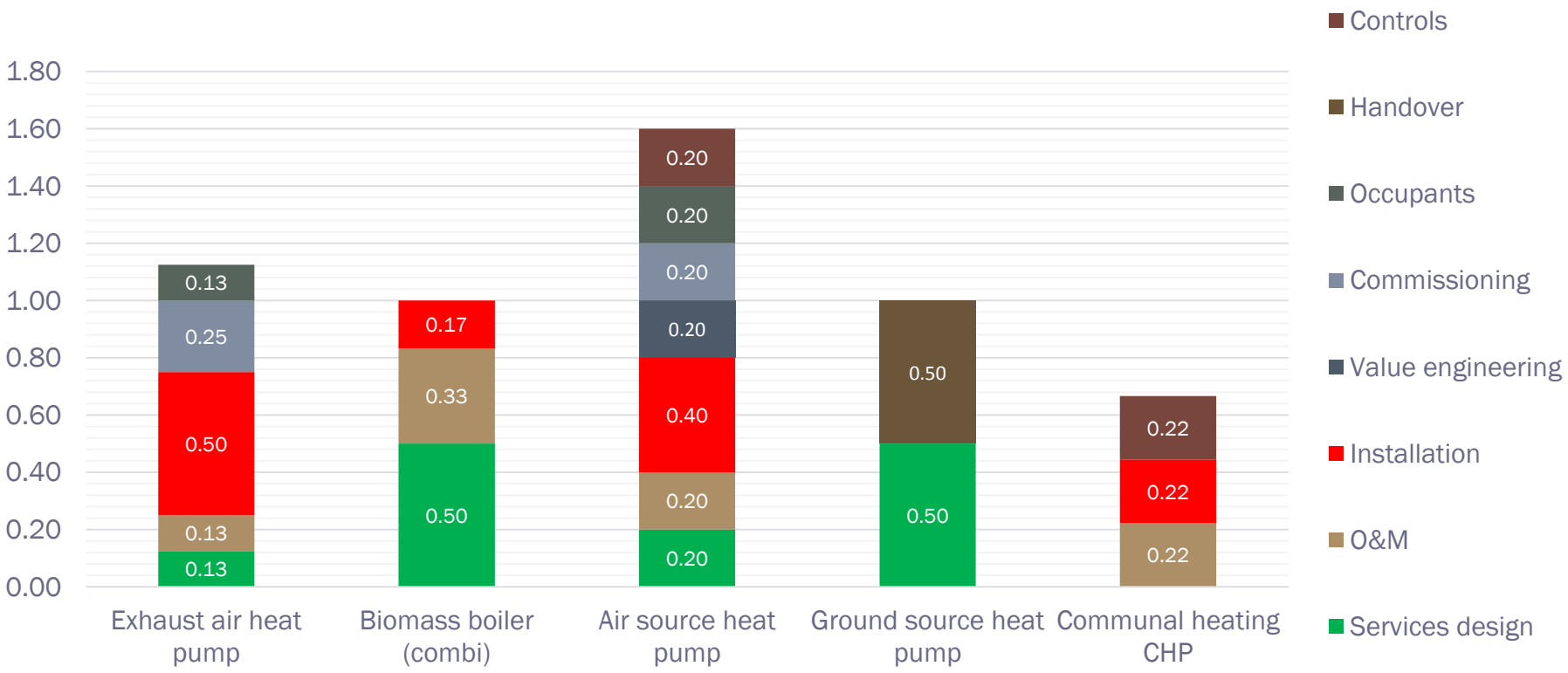
- 67% of the plots
- 1.14 issues per MVHR-equipped property
- Issues commonly reported: *unbalanced supply extract; blocked filters; occupants' interference (noise!); no access for maintenance;*
- Vulnerable households and ineffective maintenance regime a key issue
- Applicability in social housing is questionable…



NATIONAL ENERGY FOUNDATION

Space heating

Key issues per property - specified space heating energy systems



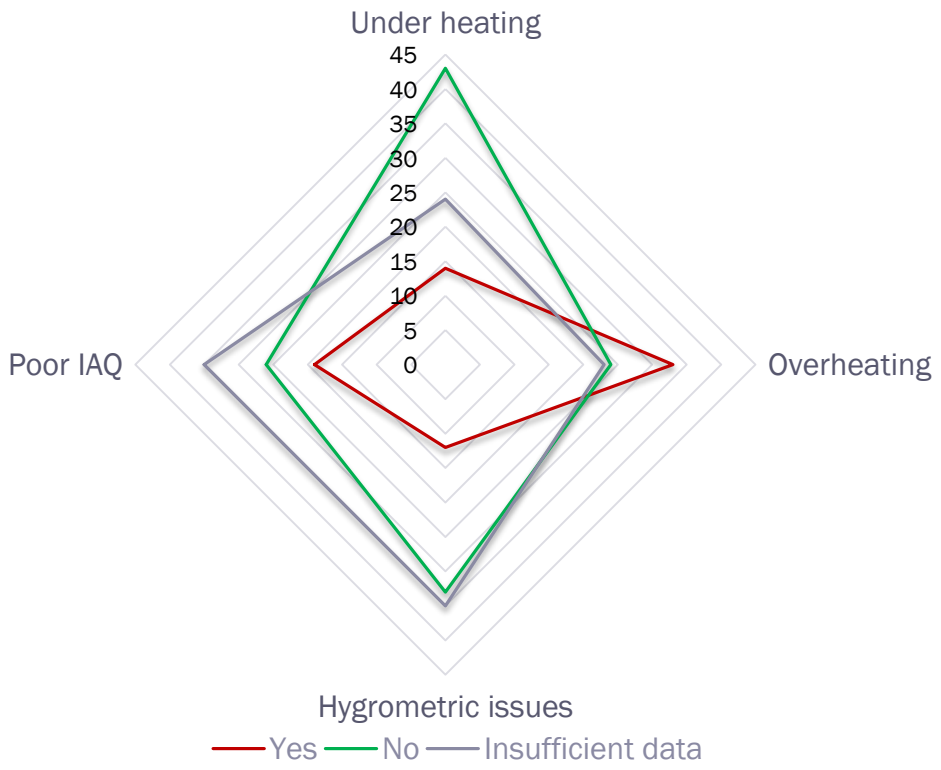
- Marginal occurrence of issues in conventional fossil fuel boilers
- Up to 1.60 issues per heat ASHP pump (8x installs)
- The industry copes well with established techs but relatively badly with newer technologies stressing the crucial need of training

NATIONAL ENERGY FOUNDATION

Discomfort and poor IAQ

Discomfort and poor IAQ occurrence across the BPE test dwellings

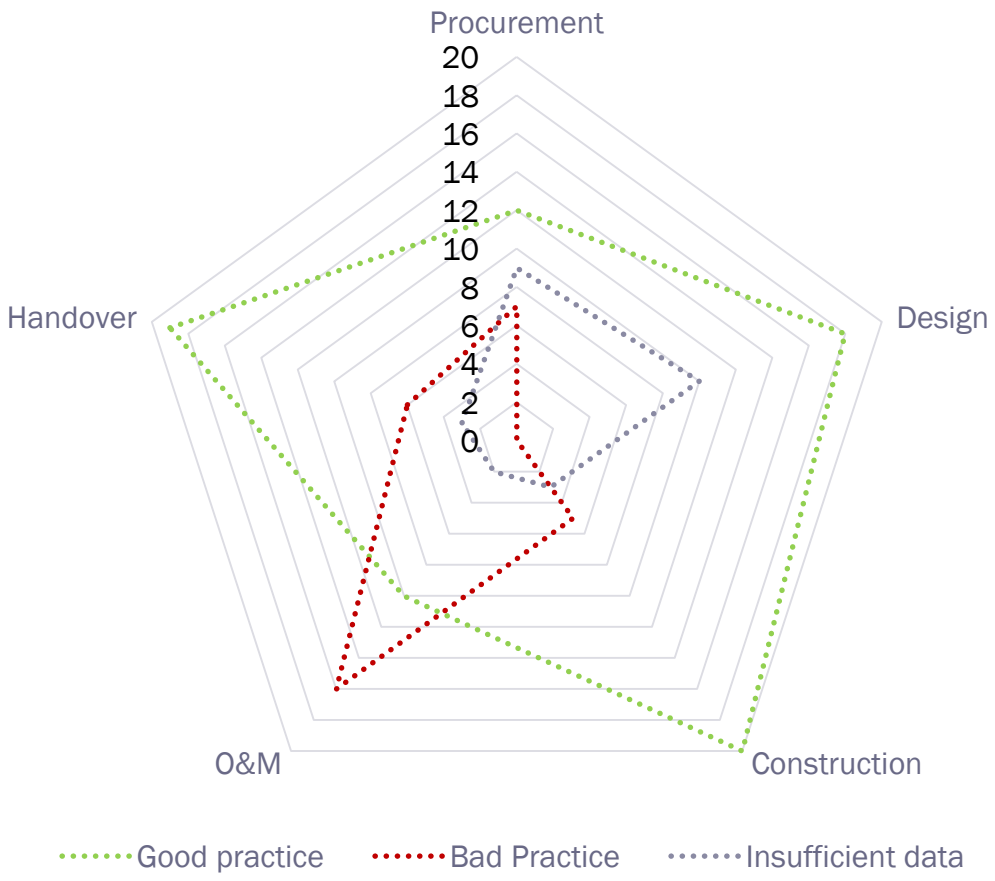
- Overheating: occupant window opening behaviour, sub-optimal building design and glazing specifications
- Poor IAQ: especially in mechanically ventilated buildings
- Low levels of underheating & discomfort: not widespread, good for fuel poverty



NATIONAL ENERGY FOUNDATION

Process & Culture

Process rating



Design: few issues. *Failure to recognise the importance of early design and specification decisions.*

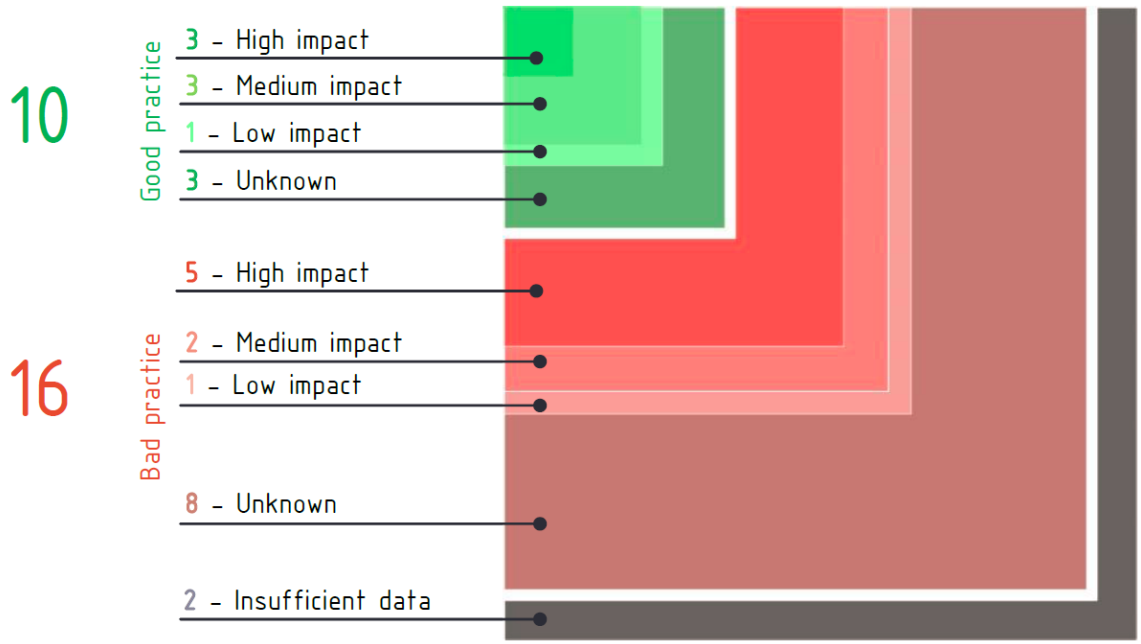
Construction: only 5 of the 28 projects reported that substantial problems occurred

Handover: generally positive induction and the way occupants are introduced to the building

NATIONAL ENERGY FOUNDATION

Process & Culture

Maintenance Impact Assessment



O&M:

- large number of problems
- ongoing occupant support is often missing
- Access to plant e.g. MVHR filters etc.
- What are the maintenance requirements exactly?
- Skills – complex arrays of technology
- Priority for RPs to address the performance gap

NATIONAL ENERGY FOUNDATION

Background to the IUK BPE programme

About the NEF BPE Meta Data Analysis

Summary of findings and arising opportunities

NATIONAL ENERGY FOUNDATION

Summary

- BPE essential to understanding and allowing us to bridge the performance gap
- Steep learning curve – BPE requires considerable planning and investment but is critical in improving processes and approaches
- New build problems can quickly become asset management problems!

Meta-analysis keywords. Created with wordle.net.

NATIONAL ENERGY FOUNDATION

Opportunities

- Awareness raising and staff training
- Soft landings
- Standardisation inc. commissioning processes
- Structured handover
- Knowledge transfer – design teams > contractors > hand over

NATIONAL ENERGY FOUNDATION

Summary

- Data handling is also key….

- iAIM IUK feasibility study with JRHT
- NEF and NES in partnership offering RPs an energy support service that fully integrates with traditional asset management practices.

National Energy Services

NATIONAL ENERGY FOUNDATION

NATIONAL ENERGY FOUNDATION

Improving the use of energy in buildings

Executive Report downloadable at:

www.nef.org.uk

or through

_connect

Thank you

luke.smith@nef.org.uk

NATIONAL ENERGY FOUNDATION