



CLARION
HOUSING

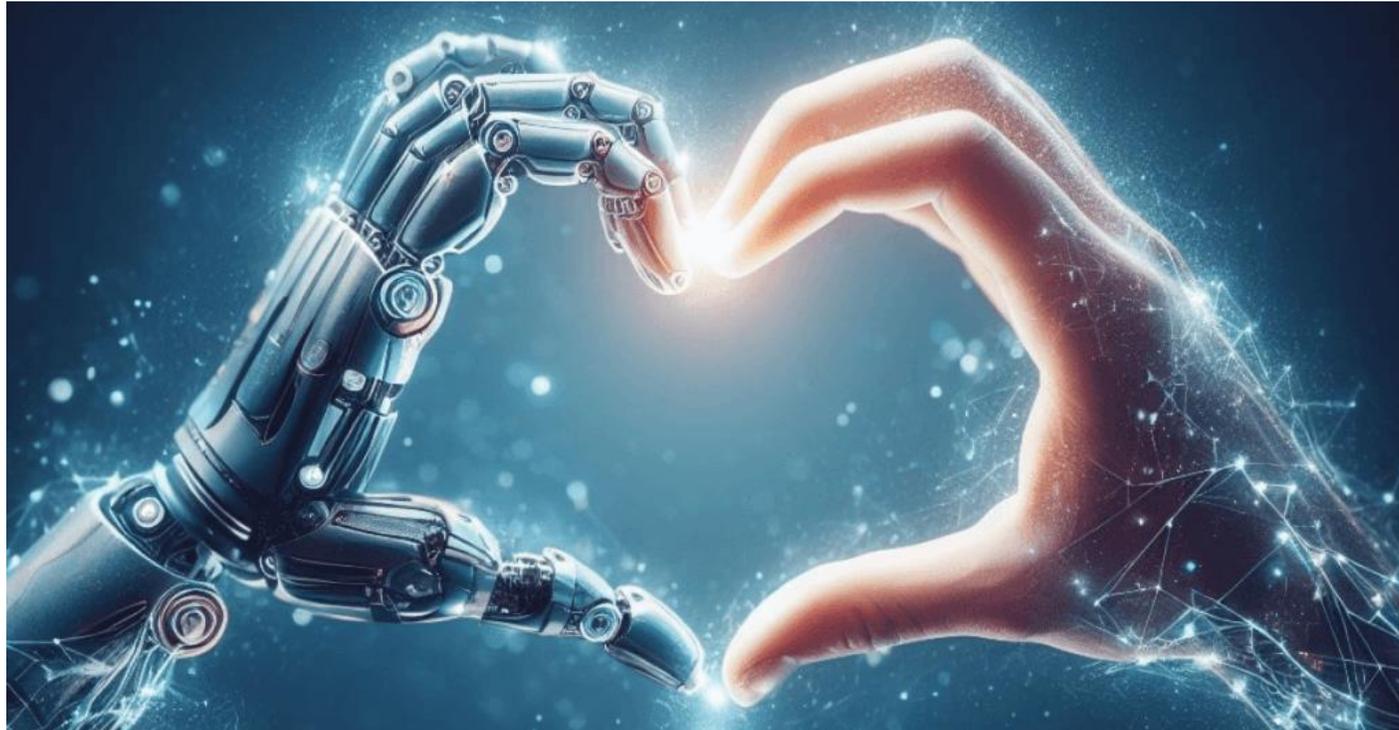
Building Performance Evaluation: making retrofit deliver real outcomes

24th February 2026

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Welcome

A Clarion perspective on the Warm Homes Plan





Healthy Homes – Capturing Social Value

Documented Health Improvements from Sector POE Studies:

- Children's asthma symptoms reduced or disappeared
- Allergies improved
- Reduced NHS demand: fewer GP visits, reduced medication
- Mental health and wellbeing improvements (warmer, affordable homes reduce stress)

Framing Retrofit Beyond Carbon

- Health intervention** unlocks cross-sector partnerships: NHS, public health, social care
- Stronger case for funding and policy support
- Residents relate to health benefits more directly than carbon reduction

What BPE Needs to Capture:

- Pre-retrofit health status (respiratory conditions, allergies, mental health)
- Post-retrofit health outcomes at 6 and 12 months
- NHS visit frequency and medication changes
- Resident-reported wellbeing and quality of life

The Clarion Opportunity:

- Sufficient scale to evidence health outcomes robustly
- Contribute data to sector-wide health case for retrofit
- Demonstrate value proposition is 3-4x greater for fuel-poor households with health conditions
- Influence policy and future funding through credible evidence



The problem: modelled ≠ lived reality



The Performance Gap Is Real—and costly

Modelled energy savings ≠ Actual energy savings for residents

Heat pumps running inefficiently, bills higher than promised

Unintended consequences: overheating, poor air quality, worsened damp and mould

Resident dissatisfaction leading to complaints and Housing Ombudsman referrals

The Warm Homes Plan context

Unprecedented scale and pace of retrofit delivery

Public funding accountability—we must prove outcomes

Risk of "install and move on" culture under time pressure

Regulatory expectations: RSH Consumer Standards, BS40101, Awaab's Law, PAS 2035 monitoring requirements

BPE is how we close the loop between what we design, what we build, and what residents actually experience not just at POE

What BPE is (and isn't)

The established framework:

STAGE 1:

DESIGN-STAGE EVALUATION

Energy modelling and predicted performance
Specification quality review (fabric-first, systems sizing)
Define success criteria upfront

STAGE 2:

POST-CONSTRUCTION EVALUATION

As-built testing (airtightness, thermal imaging)
System commissioning (heat pumps, MVHR, controls)
Installation quality assurance
Fix defects while contractor is still on site

STAGE 3:

POST-OCCUPANCY EVALUATION (12-24 months)

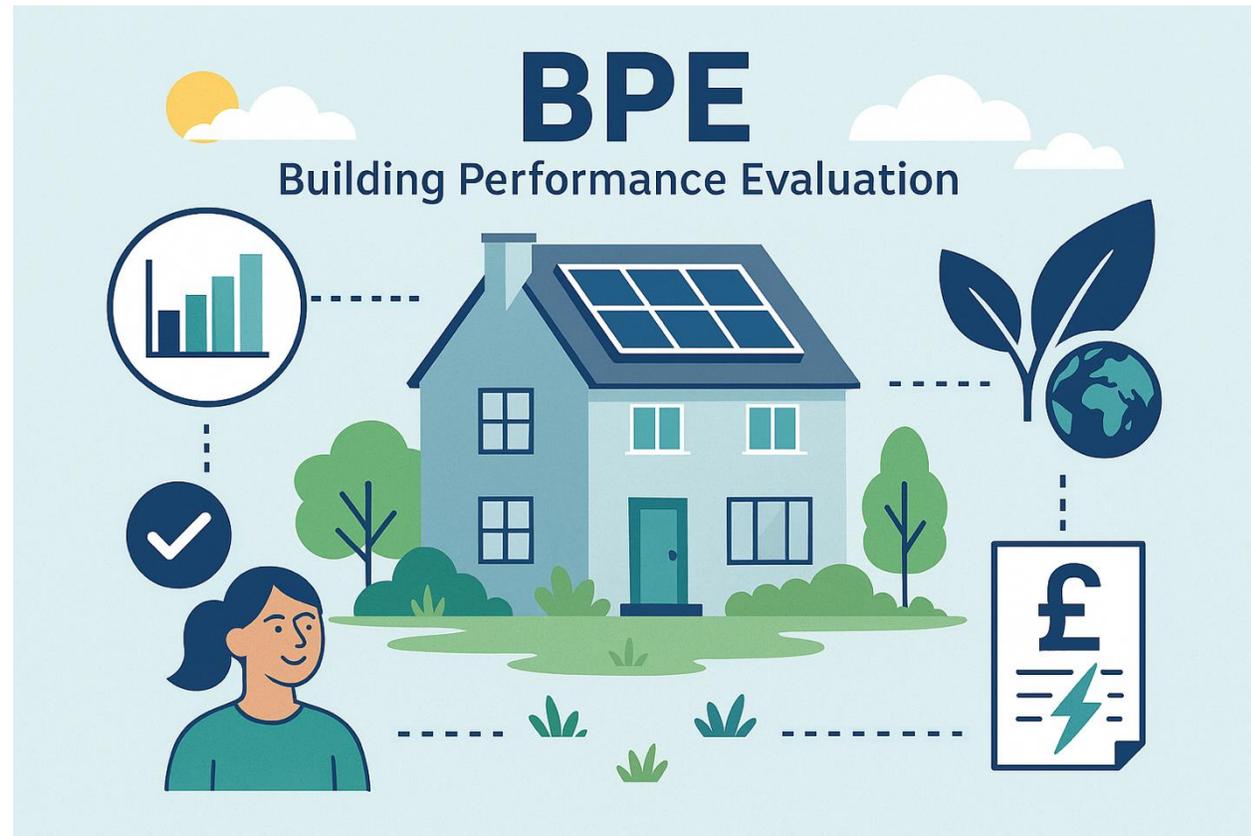
Technical monitoring: energy, comfort, indoor air quality
Occupant feedback: satisfaction, usability, health impacts
Performance gap analysis: actual vs. predicted
Feed learning back into design for next phase

Two Integrated Perspectives:

Technical Performance: Energy, comfort, system efficiency

Occupant Experience: Satisfaction, bills, health, wellbeing

Measurement only makes sense if we define what ‘good’ looks like first — what are we comparing against?”



Pilots to programmes

We're implementing BPE across different projects and scales: 4 Examples

Project 1: Snodland Retrofit Pilot (10 homes)

Full three-stage BPE with intensive monitoring

Solar PV + battery + air source heat pump

Near-zero bill promise—monitoring validates actual performance

Learning: Three-stage approach catches different issues at each point—saves expensive post-occupancy fixes.

Project 2: Bromley IoT Baseline (800 homes)

Establishing "before" data across whole neighbourhood prior to solar installation

Temperature, humidity, energy use monitoring

Creates baseline for later retrofit impact measurement

Gold standard data for future performance gap analysis

Learning: Baseline data is essential—you can't prove impact without knowing the starting point.

Project 3: Bromley Solar at Scale (1,300 homes)

Roof replacement + PV installation programme

Stratified BPE approach:

Proportionate evaluation at scale

Learning: Different technologies need different BPE approaches—solar is simpler to monitor than whole-house retrofit.

Project 4: Chelsea Sutton Ground Source Heat Pump

Complex technology requiring intensive evaluation

Full BPE to de-risk before scaling



10 Homes Zero Bills Retrofit



GSHP In Flats - Regeneration



IoT Devices



Solar PV & Battery





Monitoring Outcomes from Sustainable Homes Programme

Room,
Humidity,
Air Quality,
Heat Loss



Look Back to Look Ahead

Temperature and comfort

	How do you feel about the temperature of your home in the winter?	How do you feel about the temperature of your home in the summer?	How do you feel about the overall comfort of your home?	How do you feel about the temperature controls in your home?
H1 – IR	Comfortable	Comfortable	Very comfortable	Difficult to use
H2 – IR	Too cold	Hot	Very uncomfortable	Very difficult to use
H3 – Electric	Comfortable	Comfortable	Ok	Adequate (timer setting difficult)
H4 – Electric	Comfortable	Comfortable	Comfortable	Adequate
H5 – Electric	Comfortable	Comfortable	Comfortable	Very easy to use (timer setting difficult)
H6 (B) – ASHP	Comfortable	Comfortable	Very Comfortable	Easy to use
H7 (B) – ASHP	cold	Too hot	uncomfortable	Very difficult to use

Qualitative data on comfort

ASHP power consumption vs PV power generation



Energy Performance of the Fenland SHDF Demonstrator properties

Comparing PV generation with ASHP consumption in 13 properties



What goes wrong

Installation defects

Poor workmanship: EWI window seals, rooflines, thermal bridging
Heating systems not commissioned properly (wrong flow temperatures, incorrect settings)
Inadequate ventilation design or no ventilation strategy at all

Resident behaviour not considered

Assumed behaviours don't match reality
Systems too complex—residents can't use them optimally
Lack of ongoing support leads to misuse and dissatisfaction

One-Size-Fits-All approaches fail

No two homes or households are the same
Generic solutions ignore occupancy patterns, health needs, property specifics
Fabric-first principles ignored—installing heat pumps before insulation = higher bills

No follow-up or Quality Assurance

Reliance on contractor self-certification
No independent validation of outcomes
Problems identified too late (after defects period) or never identified at all

Unintended consequences

Overheating: Improved insulation without overheating mitigation

Poor air quality: Tighter buildings without adequate ventilation—CO₂ and humidity build-up

Worsened damp and mould: Poorly designed retrofit creates moisture issues

Bills not reducing: Performance gap means running costs higher than promised—resident fuel poverty not alleviated

BPE identifies these issues early when they're still fixable.

Clarion lessons

1. Resident Engagement is Non-Negotiable

- Early, transparent, ongoing communication—not just leaflets
- Face-to-face education on using new systems (heat pumps, MVHR, controls)
- Check-ins at 6 months and 12 months minimum
- Takes two heating seasons for residents to fully understand their homes
- Word of mouth from satisfied residents is the most powerful trust-building tool

2. Comparator Data is Gold

- Collect comprehensive pre-retrofit data: energy bills, internal conditions, resident health status
- Understand real-world starting point, not just modelled assumptions
- Enables robust "before and after" comparison

3. Install Monitoring as Standard

- Sensors for temperature, humidity, CO₂, energy use (disaggregated where feasible)
- Simple systems that don't depend on resident WiFi—works in the background
- Visual feedback residents can understand (not complex dashboards)

4. Three-Stage Evaluation Catches Different Problems

- **Design-stage** finds specification issues (undersized heat pumps, inadequate ventilation)
- **Post-construction** finds installation defects (airtightness failures, commissioning errors)
- **Post-occupancy** finds performance gaps (actual vs. predicted) and usability issues

Lessons continued

Lesson 0: Apply Established Frameworks, Don't Reinvent

BPE methodology exists—BS40101, Good Homes Alliance, RIBA, CIBSE, BSRIA, PAS 2035. Use it.

Residents are there! Speak to them! Use them!

The challenge isn't lack of guidance—it's lack of application in social housing. Clarion is making sector-recognised BPE methodology operational at scale.

Lesson 1: Start Small, Scale Smart

Pilots (Snodland, GSHP) de-risk innovation → Technology trials test approaches → Programmes (Bromley) deliver at scale with proportionate BPE

Lesson 2: Baseline/Comparator Data is Essential

You can't measure impact without knowing the starting point—Bromley IoT demonstrates this

Lesson 3: Different Technologies Need Different BPE

Solar PV requires simpler monitoring than whole-house deep retrofit with heat pumps and MVHR

Lesson 4: Place-Based Approaches Enable Better BPE

Neighbourhood scale (Bromley) = richer data, easier engagement, community learning effects and buy in

Lesson 5: Scale Requires Proportionate BPE—Monitoring

- 100% basic monitoring across all homes
- 10-20% enhanced monitoring on representative sample
- 2-5% deep-dive case studies for qualitative insights

Lesson 6: Resident Engagement Varies by Project Stage

- **Pilots** = co-design and deep involvement
- **Scale programmes** = efficient handover, accessible ongoing support, feedback loops, demonstrations

Lesson 7: BPE Must Feed Back into Design

Learning that doesn't change practice is wasted learning—create continuous improvement loops. Every design.

Lesson 8: BPE Protects Investment and Reduces Risk

Identifies underperforming measures early, prevents costly remediation, validates ROI, reduces complaints

A Framework for the Warm Homes Plan



STAGE 1: DESIGN & BASELINE (Before Works)

- Energy modelling and performance predictions
- Specification quality review (fabric-first, correct systems sizing)
- Define success in tangible resident terms: £/month bills, °C temperatures, air quality, satisfaction targets.
- Baseline monitoring deployment (energy, internal conditions, resident surveys)
- Identify homes for enhanced monitoring (stratified sampling)

STAGE 2: POST-CONSTRUCTION QUALITY ASSURANCE (At Completion)

- Airtightness testing and thermal imaging
- System commissioning validation (heat pumps, MVHR, controls)
- Installation quality inspection—-independent checking, not just self-certification
- Resident handover: face-to-face demonstration of systems, simple instructions
- Fix defects before resident's experience problems

STAGE 3: POST-OCCUPANCY EVALUATION (12-24 Months)

3A: Technical Monitoring

- Energy consumption and system performance
- Indoor environmental quality (temperature, humidity, CO₂)
- Performance gap analysis (actual vs. predicted)

3B: Occupant Feedback

- Satisfaction surveys at 6 and 12 months
- Comfort and usability assessments
- Bill impact verification—did bills reduce as promised?
- Health impacts (respiratory conditions, wellbeing)

3C: Analysis & Learning

- Identify high and low performers—understand why
- Remediate issues (while in warranty if possible)
- Document lessons for next phase
- Share learning with sector

CONTINUOUS IMPROVEMENT LOOP

- Findings feed into Stage 1 design for next projects
- Specifications updated based on evidence
- Contractor management and training improved
- BPE becomes business-as-usual

Alignment with Good Homes Alliance, BS40101, RIBA POE, PAS 2035.

What to measure and When?



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Metric	Pre-Retrofit Baseline	Immediate Post (Commissioning)	6 Months	12 Months
Energy Use (kWh)	✓	✓	✓	✓
Energy Cost (£)	✓	-	✓	✓
Temperature (°C)	✓ Winter baseline	✓ Commissioning check	✓	✓
Humidity (%)	✓	✓	✓	✓
CO ₂ (ppm)	✓	✓	✓	✓
Resident Satisfaction	✓ Current experience	-	✓	✓
System Usage	✓ Behaviour patterns	-	✓ Observation	✓
Defects/Issues	-	✓ Snagging	✓	✓
Health Impacts	✓ Baseline (asthma, allergies)	-	✓	✓

Risks and Mitigation

Risk	Impact	Mitigation
Resident refusal to participate	Incomplete data, can't validate outcomes	Transparent consent process; explain benefits; opt-in incentives; ensure data privacy
Technology failure (sensors, connectivity)	Data gaps, monitoring failure	Select robust, proven technology; avoid WiFi dependency ; maintenance contracts
Data overload without insight	BPE becomes tick-box, no learning	Dedicated analytics resource; clear KPIs; regular review meetings; action plans from findings
Cost and resource constraints	BPE scaled back or dropped	Phase approach; start small; demonstrate ROI from pilots; blend with planned maintenance budgets
Supply chain resistance	Contractors unwilling to be monitored	Build BPE into contract specifications; frame as quality assurance, not blame culture
Performance doesn't meet targets	Resident dissatisfaction, wasted investment	Rapid response protocols ; rectification procedures; honest communication with residents
Internal silos prevent integration	BPE data doesn't inform decisions	Cross-departmental governance; embed in asset management strategy; senior leadership buy-in

Asset Management Integration

- BPE data informs stock investment planning
- Identify which measures work best for which property archetypes
- Build learnings into specifications for future Warm Homes Plan waves

Planned Maintenance Alignment

- Treat retrofit as enhanced planned maintenance (not separate project)
- Combine BPE with cyclical inspection programmes
- Roof replacements = opportunity for solar PV at minimal marginal cost

Repairs and Complaints Feedback Loop

- BPE identifies potential complaints **before they escalate**
- Proactive response to underperforming installations
- Cross-departmental visibility of post-retrofit performance
- Evidence base for compensation and redress decisions

Performance Reporting and Assurance

- BPE metrics feed into board assurance reporting
- Demonstrate RSH Consumer Standards compliance (homes safe, decent, energy efficient)
- Evidence for future funding bids (SHDF, Warm Homes Plan future waves)

Resident Services and Engagement

- Ongoing relationship with residents—not "install and move on"
- Check-ins build trust and identify issues early
- Resident feedback shapes service improvement





Phase 1: Pilots and Proof of Concept (Current)

- Establish methodology, test monitoring technologies, refine resident engagement protocols

Phase 2: Scale with Proportionate BPE (2025-2026)

- **Bromley Solar Programme (1,300 homes):** Stratified monitoring approach
- 100% basic monitoring | 10% enhanced monitoring | 2% deep-dive case studies
- Efficient resident engagement at scale
- Build internal capacity: training for Resident Engagement Officers, Retrofit Coordinators, data analysts

Phase 3: Embed as Standard Business-As-Usual (2027+)

- BPE becomes standard specification for all Warm Homes Plan retrofit projects
- Automated data flows into asset management systems
- Continuous improvement loops: learning feeds back into design and specifications
- Sector leadership position: publish learnings, contribute to best practice, share data

Early Wins to Demonstrate Value:

- Identify and fix defects before 12-month defects period ends
- Build resident trust through visible responsiveness
- Capture evidence for "health as retrofit outcome" narrative for cross-sector partnerships



The future

For Our Residents:

- ✓ Homes that deliver what we promised—warmer, healthier, more affordable
- ✓ Early identification and fixing of problems
- ✓ Trust that Clarion will respond when things don't work as intended

For Our Assets:

- ✓ Evidence-based investment decisions—know what works for which property types
- ✓ Longer-lasting retrofit installations—catch defects early
- ✓ Avoid costly remediation work after warranties expire

For Our Organisation:

- ✓ Protect millions in retrofit investment—validate ROI
- ✓ Reduce complaints and Housing Ombudsman referrals
- ✓ Demonstrate RSH Consumer Standards compliance
- ✓ Access future Warm Homes Plan funding streams with proven track record

For the Environment:

- ✓ Verified carbon reduction—not just modelled predictions
- ✓ Real-world performance data to refine approach and accelerate net zero

For the Sector:

- ✓ Lead by example and share learning
- ✓ Build collective case for retrofit as health intervention
- ✓ Contribute to policy development through credible evidence



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