HOARE LEA

Overheating and current indoor air quality issues within residential sector

Building Services Forum

SALEH ABIYATI

MCIBSE, CENG, AMEI, MSC, BENG

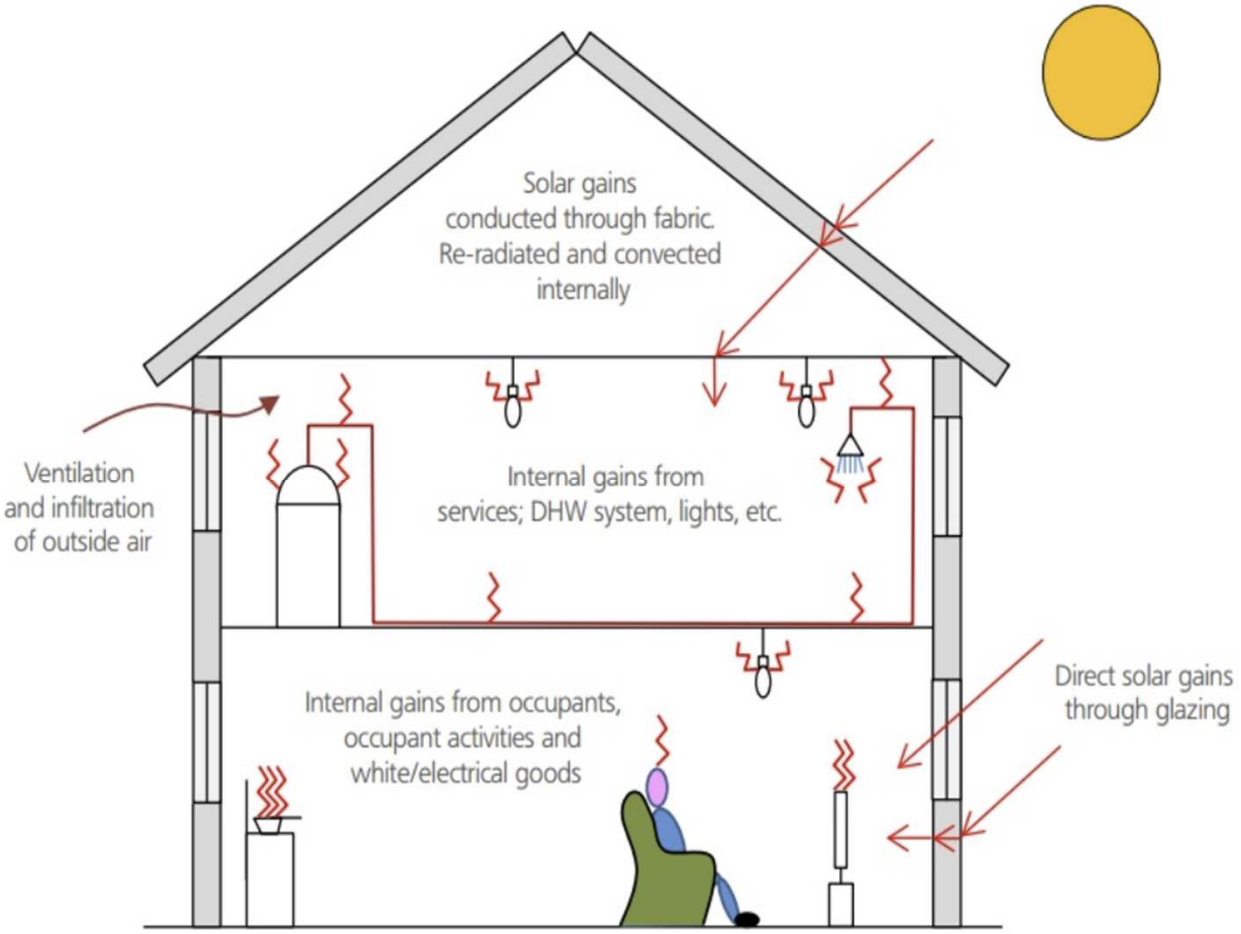
24/09/2025

HOARE LEA

Overheating

Understanding The Problem

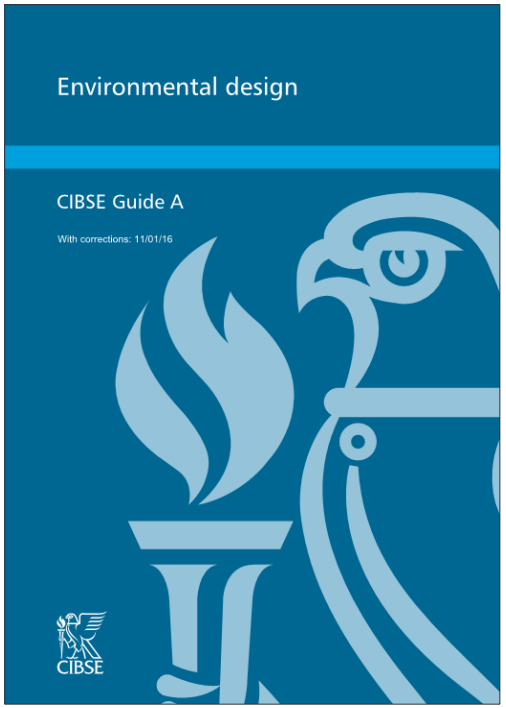
- What is overheating?
- Causes of overheating in buildings
- Smaller spaces, higher occupancy → higher internal loads
- Cooking, appliances, and lifestyle add heat
- Poor cross-ventilation in UK housing stock
- Climate change worsens risk
- Residential buildings: Occupant patterns & fabric impact
- Consequences: Discomfort, health risks, productivity losses

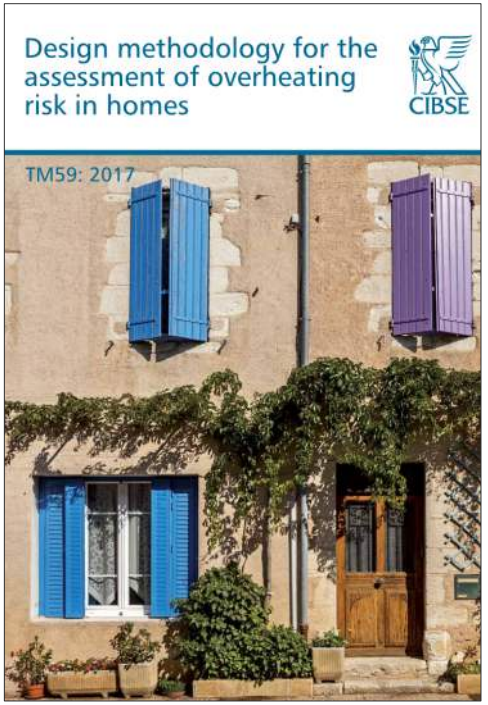


HOARE LEA

Standards / Guidance – Limited in Retrofit

Frameworks Built for New Build, Not Retrofit





HOARE LEA

Overheating and current indoor air quality issues

Current Challenges & Mitigations

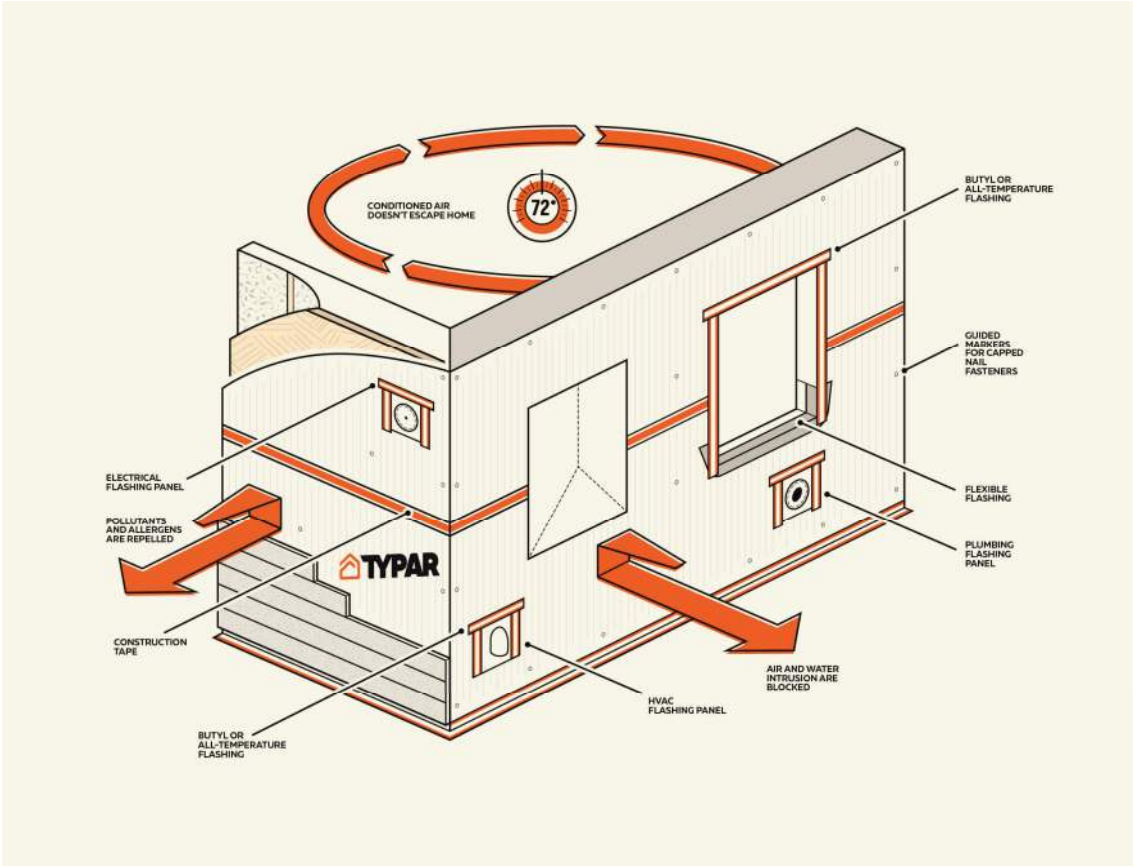
BUILDING SERVICES FORUM SEPTEMBER 2025

HOARE LEA

Balancing Energy and Wellbeing

Addressing Overheating and Indoor Air Quality in Residential Buildings

- Buildings contribute ~40% UK carbon emissions
- Retrofit essential but creates new challenges
- Focus: overheating & indoor air quality (IAQ)
- Balancing energy efficiency and occupant wellbeing



HOARE LEA

Unique Barriers vs New-Build Projects

Why Overheating & IAQ Are Harder in Existing Homes?

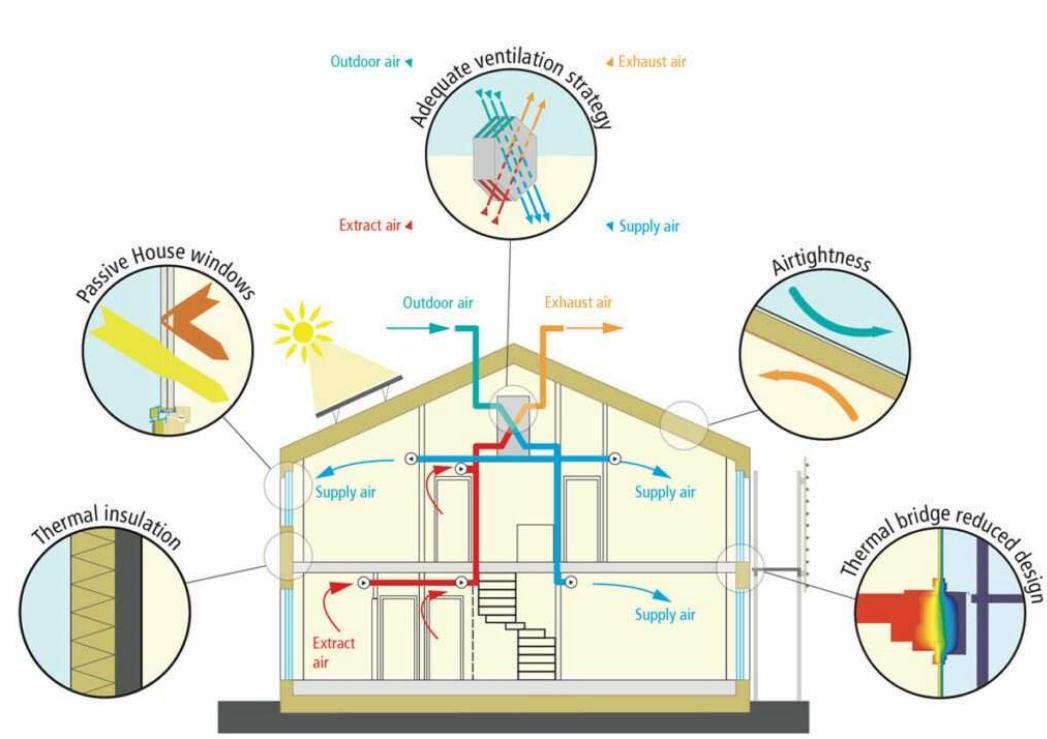
- Unintended airtightness from retrofit works → trapped heat & pollutants
- Limited façade/window changes (heritage & social housing)
- Cost & disruption for residents during works
- Split responsibilities between landlords, tenants, and contractors

HOARE LEA

The Airtightness Challenge: Energy Gains vs Ventilation Loss

How Reduced Air Leakage Impacts Indoor Air Quality and Comfort

- Airtightness reduces uncontrolled air leakage
- Reduced ventilation → pollutant buildup
- 40%+ retrofitted homes report IAQ/overheating issues
- Climate change increases overheating risks
- Occupant behaviour variability complicates solutions



HOARE LEA

Passive Design Strategies for Overheating Mitigation

Natural Ventilation, Shading, and Thermal Mass in Retrofit Contexts

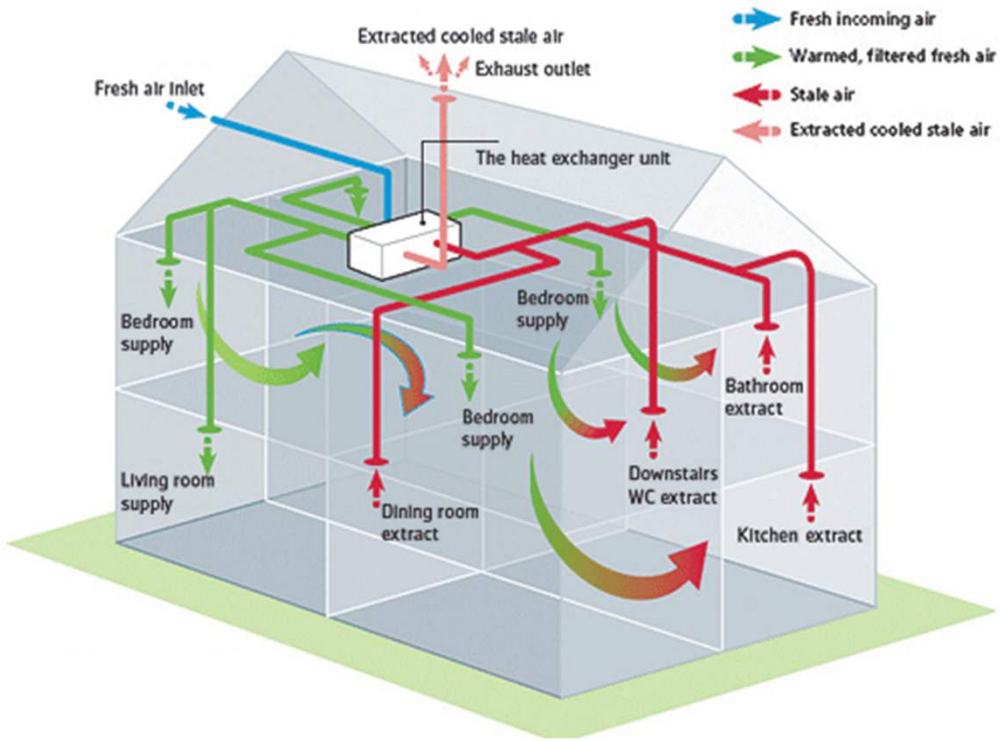
- Natural ventilation: cross and ventilation
- External shading devices reduce solar gains
- Thermal mass moderates indoor temperature swings
- Retrofit constraints: fixed windows, facade limitations

HOARE LEA

Mechanical Ventilation Solutions

MVHR, Demand Control, and Filtration for Healthy Interiors

- Mechanical Ventilation with Heat Recovery (MVHR)
- Demand Controlled Ventilation (DCV) optimizes airflow
- Air filtration/purification for pollution control
- Importance of commissioning and occupant education

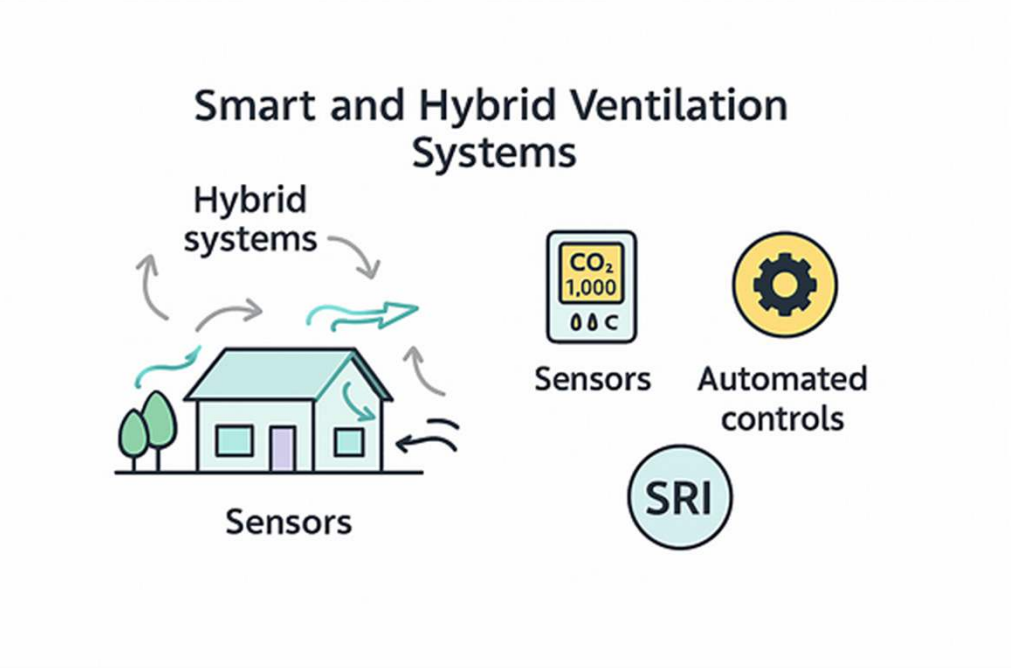


HOARE LEA

Smart and Hybrid Ventilation Systems: The Future of Indoor Comfort

Sensor-Driven Controls and Adaptive Environmental Management

- Hybrid systems combine passive and mechanical ventilation
- Sensors monitor CO2, temperature, humidity, VOCs
- Automated controls optimize comfort and energy use
- Enables proactive maintenance & occupant engagement



HOARE LEA

Emerging Retrofit Technologies & Approaches

Beyond Conventional Passive & Mechanical Strategies

- **Phase Change Materials (PCM):**

Absorb/release heat, reduce peak loads

- **Green & Blue Infrastructure:**

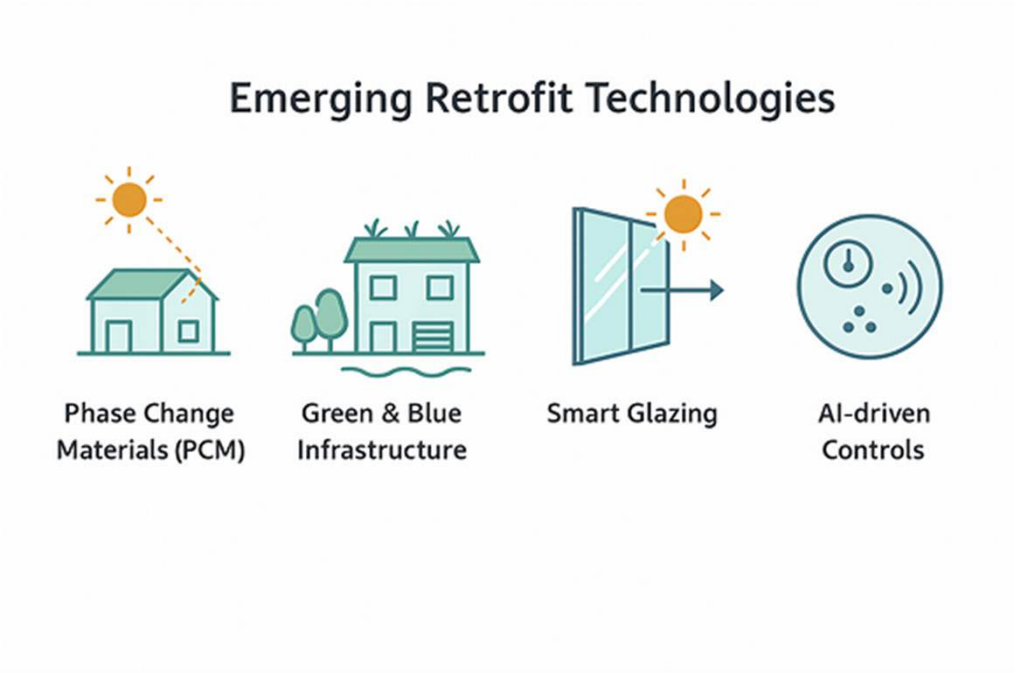
Roofs, façades, and water systems cool microclimates

- **Smart Glazing:**

Electrochromic or dynamic shading glass

- **AI-driven Controls:**

Occupancy and IAQ monitoring, adaptive ventilation

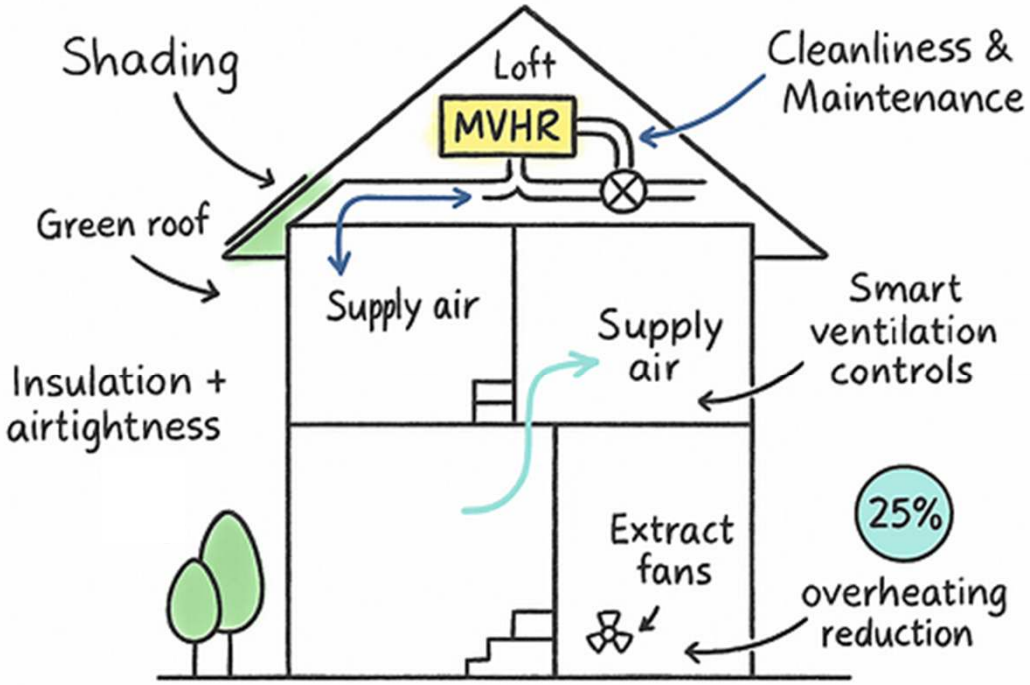


HOARE LEA

Real-World Successes in Retrofit

Demonstrating Improved IAQ and Overheating Reduction Through Technology

- Social housing retrofit: MVHR + shading → 30% IAQ improvement
- Mixed-use retrofit: smart ventilation controls → 25% overheating reduction
- Early building performance assessment and occupant engagement essential



HOARE LEA

Deep Dive – Lessons Learned

One Project Illustrating Overheating + IAQ Resolution

- **Baseline:**

Overheating complaints, high CO_2 levels in bedrooms

- **Intervention:**

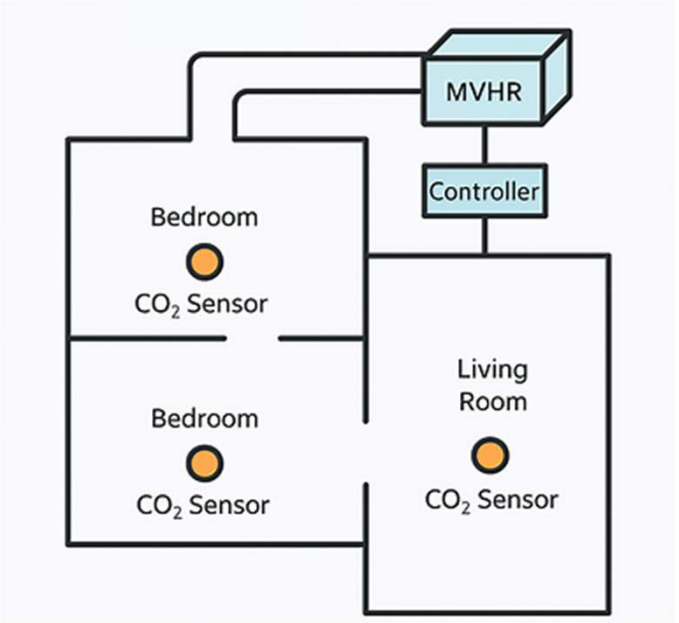
MVHR with external shading package

- **Results:**

30% IAQ improvement, 25% overheating reduction

- **Lessons Learned:**

Occupant behaviour (window use) still affected performance



HOARE LEA

Collaboration and Integrated Design: Overcoming Retrofit Challenges

Interdisciplinary Approaches and Digital Tools for Optimal Outcomes

- Legacy building constraints and cost pressures
- Occupant behaviour unpredictability
- Early interdisciplinary collaboration critical
- BIM and workshops support integrated design
- Aligning stakeholders reduces redesigns and risks

HOARE LEA

From Retrofit to New Build Standards

Applying New-Build Approaches, To Improves IAQ & Energy Efficiency

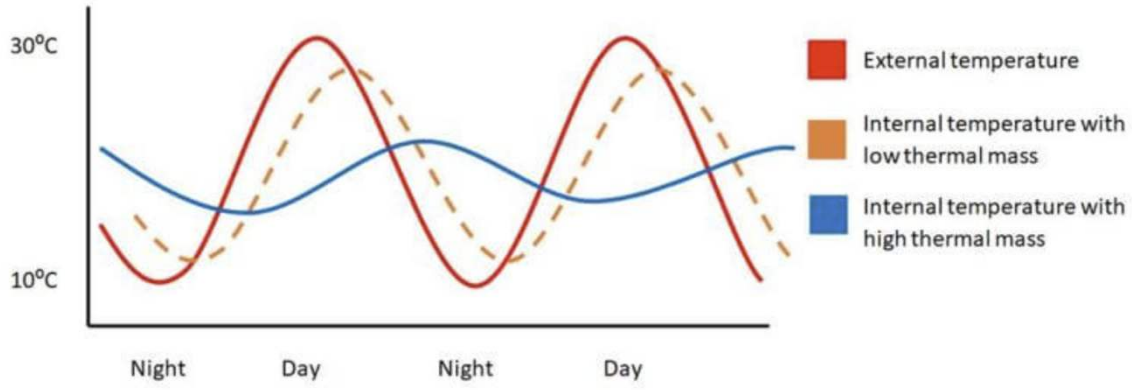
- Solar gain control (glazing ratios, shading devices) reduces overheating
- Early ventilation integration ensures comfort & IAQ
- Balanced airtightness + controlled ventilation = energy & health gains
- Aligns retrofit directly with Net Zero goals

HOARE LEA

Building Fabric & Thermal Mass Challenges

Insulation, Thermal Stability, and Heritage Constraints

- Poor insulation: Too hot in summer, too cold in winter
- Thermal mass helps stabilise internal temperatures
- Limitations in listed/heritage buildings restrict upgrades
- Retrofit must respect constraints while maximising gains



HOARE LEA

Overheating and current indoor air quality issues

Costing

BUILDING SERVICES FORUM SEPTEMBER 2025

HOARE LEA

The Cost of Retrofit Improvements

Balancing Budget, Performance, and Occupant Wellbeing

- **Fabric upgrades:**

Insulation, glazing, façade improvements — high upfror
but long-term savings

- **Ventilation systems:**

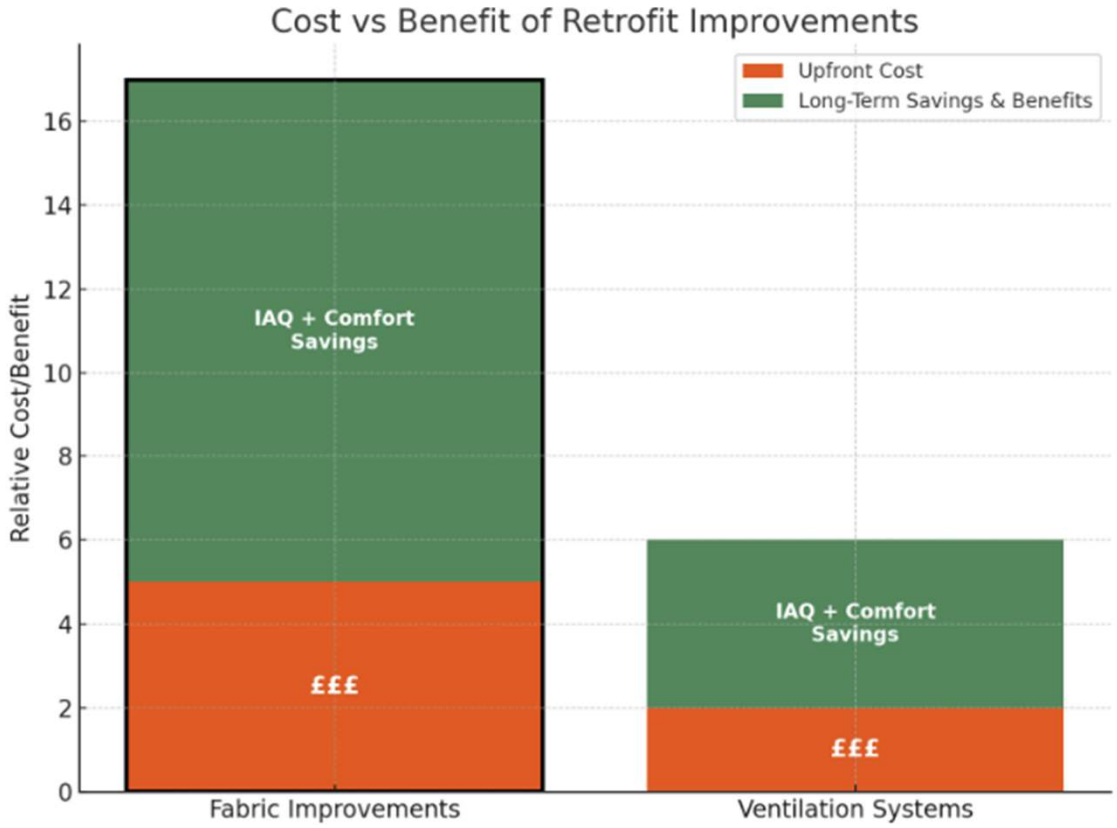
MVHR, cooling modules, AC — capital + operational costs

- **Developer hesitation:**

Tight budgets, perceived low ROI, market pressures

- **Early engagement:**

Design-stage discussions enable realistic cost planning



HOARE LEA

Overheating and current indoor air quality issues

Recommendation

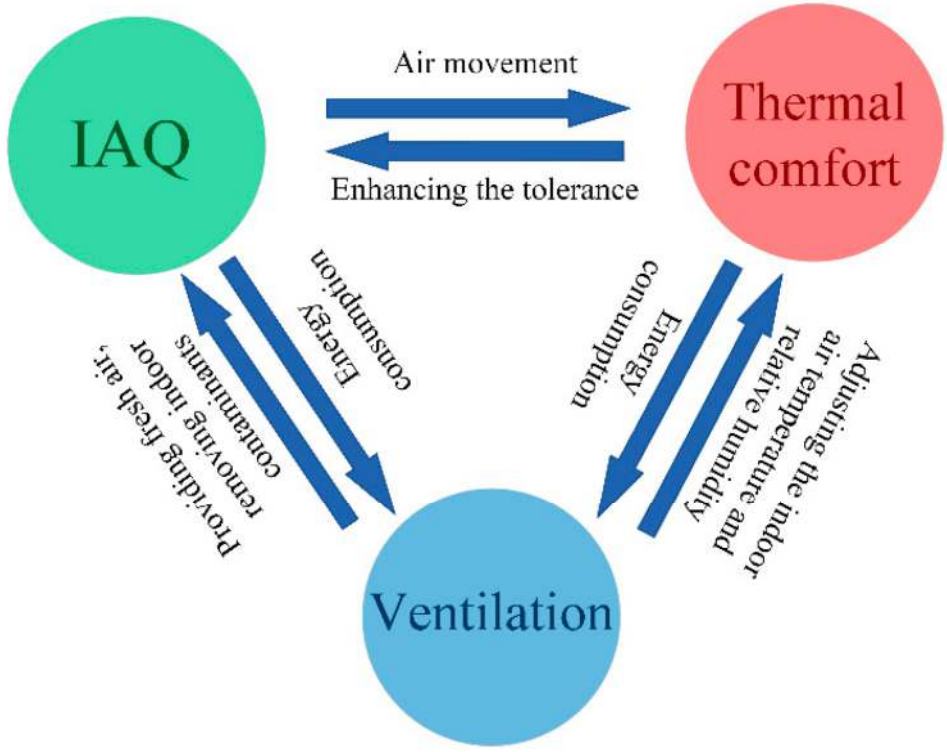
BUILDING SERVICES FORUM SEPTEMBER 2025

HOARE LEA

Building Physics Approach to Retrofit

Optimising Energy, Comfort, and IAQ Together

- Retrofit analysis must go beyond compliance
- Building physics: energy flows, ventilation, and occupancy interactions
- Reducing energy demand lowers overheating risks
- Better physics = better IAQ + resilience to climate change



HOARE LEA

Passive Retrofit Design Toolkit

Low-Energy Strategies for Overheating & IAQ Mitigation

- **Ventilation:**

Cross & stack ventilation, attenuated openings

- **Shading:**

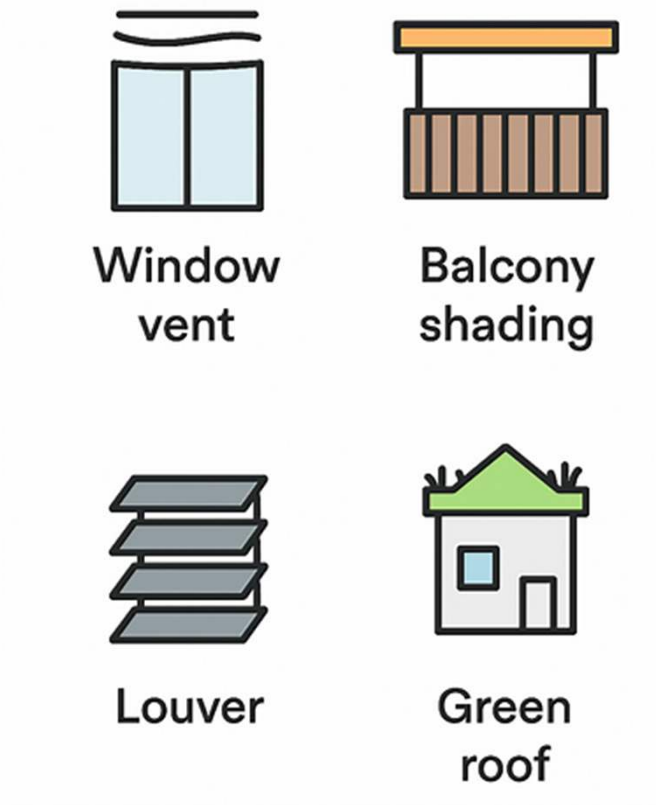
Louvers, blinds, sliding panels

- **Façade Design:**

Balcony overhangs, absorptive lining, acoustic ventilation

- **Microclimate:**

Green roofs, trees, external landscaping

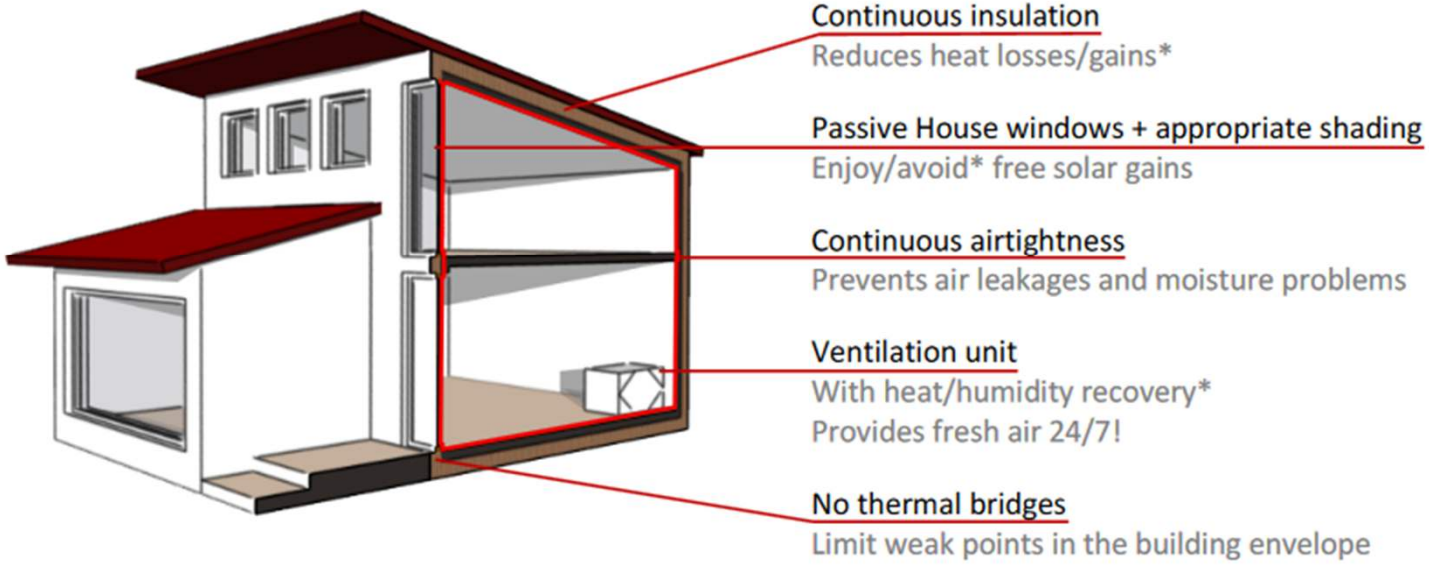


HOARE LEA

Mechanical Retrofit Options – Comparing Feasibility and Impacts

MVHR, Cooling Modules and Air Conditioning

- MVHR improves IAQ and reduces winter heat losses
- Cooling modules/AC mitigate extreme overheating events
- Smart controls minimise energy waste and enhance resilience
- Systems enable retrofits to meet Net Zero performance targets



HOARE LEA

Overheating and current indoor air quality issues

Summary

BUILDING SERVICES FORUM SEPTEMBER 2025

HOARE LEA

Summary and The Path Forward

Holistic, Collaborative Retrofit for Healthy, Low-Carbon Homes

- Overheating and IAQ are critical retrofit challenges
- Multi-layered approach: passive + mechanical + smart controls
- Collaboration and monitoring vital to success
- Retrofit delivers healthy, low-carbon homes fit for the future

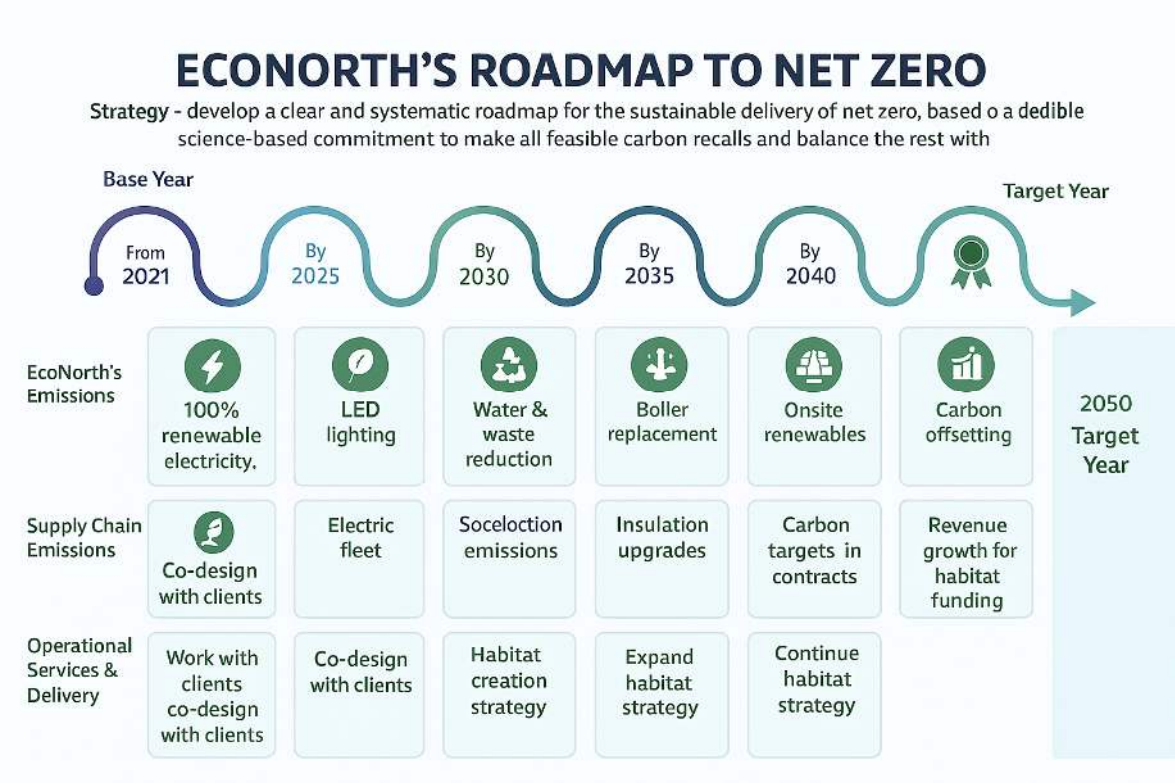
1. Conduct an assessment of existing conditions by a professional
2. Identify envelope upgrades
3. Identify mechanical system upgrades & electrification opportunities
4. Identify efficiency & electrification upgrades for appliances, lighting, & other equipment
5. Evaluate solar PV viability & consider battery storage
6. Develop implementation plan
7. Commission & monitor

HOARE LEA

Future Outlook: Net Zero Pathway

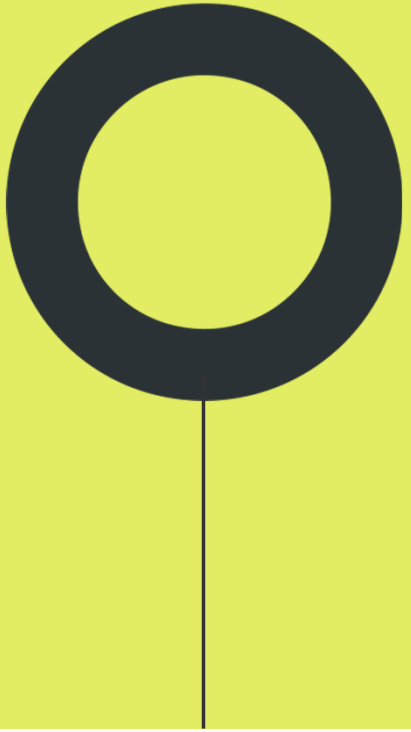
Aligning overheating & IAQ mitigation with climate and policy goals

- Net Zero 2050 targets driving retrofit innovation
- Shift from compliance → performance monitoring
- Health-led retrofit = climate resilience + occupant wellbeing

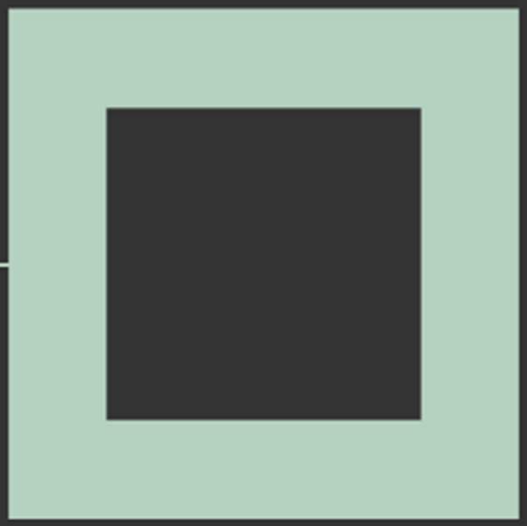


HOARE LEA

Any Questions?



HOARE LEA



Thank you.
hoarelea.com