November 2026

False Economy: The hidden costs of omitting fabric efficiency

In-situ monitoring evidence from heat pump heated homes

MINERAL WOOL INSULATION MANUFACTURERS ASSOCIATION

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Context

At the time of writing, the National Energy System Operator[1] (NESO) has warned wind generation will fall below 10% capacity utilisation for over three days. Gas 'peaker' power plants would make up the shortfall. In the future, winter peak demand will grow as transport, industry and, most importantly for the size of the demand peak, home heating is electrified.

In the absence of long-term energy storage, gas power generation when the wind does not blow is the margin power provider in the dash to electrify. A proven route to lowering energy demand for heat is to improve the efficiency of the housing stock. Less demand means less generation we need to build, less exposure to international gas prices and fewer emissions. Government has chosen a different route with policy moving away from home insulation towards heat pumps and optimized tariffs.

Some argue that 'heat pumps can heat most homes and can offer savings for most households'. No doubt economic models can support these scenarios, but models can often assume average behaviours that fail in high-stress events. The 2008 financial crisis is one example and the UK Energy Supplier Collapse (2021) another. Governments pushed consumers to switch to cheap tariffs from challenger energy suppliers, assuming market competition equalled stability. When gas prices spiked, unhedged suppliers went bust, socialising billions in debt onto taxpayers and billpayers.

Compounding failures baked into the Warm Homes Plan's heat electrification policy can be easily imagined: A prolonged Dunkelflaute (10+ days of sub-zero temperatures, near-zero solar, low wind) coincides with a global natural gas price spike. Many fuel poor households in inefficient homes in this scenario have heat pumps and 'time-of-use' tariffs sensitive to wholesale energy prices. Electric vehicle charging, already growing competition for 'off-peak' electricity times[2], represents direct competition as batteries drain with no cheap time to recharge. Prices surge and households either self-disconnect or spiral into debt.

In this study, homes heated with heat pumps with inefficient fabric needed over twice the electricity for space heating, leaked heat at twice the rate and sat colder than homes with efficient fabric. In financial terms, well-installed building fabric insulation is a risk-free hedge. It permanently lowers space heating energy demand regardless of weather spikes, tariff structures, grid conditions, or load-shifting algorithm performance. In contrast, relying on dynamic tariffs in many homes with high energy dependency for warmth creates a fragile system that may require expensive state bailouts.

[1] See 14 Days Ahead Wind Forecast | National Energy System Operator
[2] See The emerging EV overnight demand peak - Claire Rowland - Energy Systems Catapult

The current policy direction

Government's Warm Homes Loan Scheme will support renewables but not insulation. The requirement to install basic insulation to access the Boiler Upgrade Scheme in England and Wales was removed, while support for solid wall insulation has collapsed in the Warm Homes: Social Housing and Warm Homes: Local Grant schemes. The Warm Homes Plan will instead deliver its objectives through Heat Pump, Solar PV and battery packages supported by commercial 'Time of Use' Tariffs.

Advocates for this shift variously argue: 'heat pumps can heat most homes', 'home fabric efficiency level does not impact heat pump efficiency', or that 'most homes can save on energy bills'. A recent report for the Committee on Fuel Poverty analysing live heat pump performance data from HeatpumpMonitor.org declared:

"Property age and insulation level do not appear to constrain heat pump efficiency."

The key audience were not convinced[3]:

'The Committee's view is that it is not good policy to put a large heat pump unit into a cold home; instead, it is better to insulate the home first.'

Study approach

Exploring the gap between these views is a challenge made harder by the evidence of poor-quality install of both insulation and heat pumps and the use of different datasets by those advocating for different outcomes. This study tackles this gap by using the same Heatpump-Monitor.org dataset preferred by advocates of the 'clean heat with smart tariffs' approach. This dataset represents a self-selecting group of heat pump installers voluntarily publishing data on their system's performance. Since these are highly informed consumers they are likely to have a strong focus on good system design, install and commissioning. It must be expected that this install quality is not likely to be represented across installations more widely where systems are not monitored.

While Heat pump performance such as Seasonal Performance Factor and Coefficient of Performance (SPF, COPs) is known, a real fabric efficiency Heat Loss Parameter (HLP, measured in W/m2K) can also be derived from the sensor data (indoor temperature, outdoor temperature, heat delivered) and homes categorised into 'good' 'mid' and 'poor' HLP groupings. A topline summary of results follows, with method, caveats and policy implications explored in the main text.

Topline results and insights:

- Homes with 'Poor' fabric efficiency (measured by a poor HLP) used 2.34x the space heating electricity per metre of floorspace in the home after adjusting for temperature.
- Homes with 'Poor' fabric efficiency were colder. On their coldest 10% of days, they averaged 19.76°C indoors versus 20.67°C.

[3] See Warm Affordable Fair CFP Annual Report 2026

- 'Poor' fabric efficiency homes lost heat twice as fast. A modelled six-hour heating switch-off lowered indoor temperature by about 0.8°C in both good and mid-efficiency rated homes, versus 2.1°C in poor-efficiency HLP rated homes.

- On the monitored winter's highest-demand day, the illustrative 24-hour average electricity demand for one million 100m² homes was 0.79 GW for good, or efficient, HLP homes and 1.44 GW for poor-efficiency HLP homes.

- Heat pump efficiency depends on how much work it has to do. Homes with good fabric and well-matched emitters (radiators) achieved an efficiency (measured by SPF) of 4.2 compared to 3.7 for poor fabric and poorly matched emitters.

- The sensor data available suggests that the 'thermal storage / flexibility' of the home's fabric is quantifiable in the same way that the capacity of hot water cylinders and batteries have a labelled 'capacity' rating. The proposed EPC Reform should capture this value.

These outcomes represent a 'best case' scenario given heat pump efficiency in this dataset almost certainly outperforms that achieved by the wider installation industry. Efficient fabric would have a much greater positive impact in homes where heat pumps don't perform as well.

Implications for future policy

If the task of the Warm Homes Plan is to deliver more comfortable and affordable homes, there is a significant risk that the current strategy may not deliver either. Rather, it risks leaving those with poor fabric efficiency subject to the vagaries of the energy markets. The 'savings' generated by on-site generation, storage and a load shifting strategy, and the availability of 'off-peak' tariffs to support this, may not combine for many to offset the additional heat they will need to buy to stay warm relative to a well-insulated home. Put simply, there is a major risk that the Warm Homes Plan delivers many colder homes which cost more to run.

Modelled assumptions about market predictability can store shocks. An electrically heated efficient home is resilient, an inefficient home vulnerable, to energy price volatility. Many inefficient homes on the grid will lead to energy system vulnerability.

It is often argued that, 'you don't have to improve your fabric when you install a boiler, why should you have to when installing a heat pump'?' History shows it made complete sense to improve fabric efficiency (as previous policy did) in a gas heating world as well. Domestic gas demand (weather adjusted) was reduced by 30% between 2005-2013 with fabric efficiency playing a key role. This step made us far more resilient to the 2022 energy crisis triggered by Russia's invasion of Ukraine. Conversely, the previous administration's decision to abandon its ambition to further cut building energy use by 15% by 2030 increased our vulnerability to the latest crisis.

"Jan 2027 bill increases are likely to hit households even harder than the last energy crisis in 2022…In the face of such unprecedented bill increases, it is hard to see a scenario where UK Government is not forced to reopen energy bills support between now and April 2027"

Chris Galpin, E3G UK Energy Policy Analyst[4]

[4] See Post | LinkedIn

The numbers in the live HeatPumpMonitor.org data:

- Support the Committee on Fuel Poverty report's conclusion that fabric efficiency should be improved before, or alongside, heat pump installation.
- Support the need for performance monitoring of both heat pump and fabric efficiency as the only route to robustly know install quality risk has been managed on occupants' behalf.
- Support the previous efforts to reduce heat demand in buildings and highlight the failure to follow through on the plan to further cut demand.

Method

This paper established an 'apparent heat loss parameter' (HLP) for sample properties on the HeatpumpMonitor.org platform. This is derived from sensor data recording indoor temperature, outdoor temperature, heat delivered and floor area, with the indicator able to separate building efficiency from occupant behaviour[5].

The HLP will be a function of insulation level along with orientation and solar effects, property size, detachment and exposure. The advantage of measuring HLP over 'self-reported insulation levels' or 'property age bands' is that surveys and visual inspections can miscategorise or overlook insulation install quality. By focusing on real performance data of both the home's fabric and the heat pump's performance, HLPs and SPFs remove these issues from the analysis.

Once home HLPs were established, homes in the dataset were placed in 'Good', 'Mid' and 'Poor' fabric energy efficiency groups. Homes were further classified on emitter (radiator) performance using the dataset. A proxy indicator for emitter output – how effectively the heating system gets heat into the house – was defined as the heat output of the heating system (measured in Watts) divided by the temperature difference between the heating circuit and the room temperature (measured in Kelvin)[6] during periods when the system is running at a stable temperature. Using this proxy, it is possible to create a combined indicator, normalised for the size of the house (measured in metres square), that represents the efficiency of the house, the effectiveness of the heating system and the amount of time the heating system is being used: three operational factors that impact heat pump efficiency.

[5] For each qualifying day, daily space heating (kWh) over 24 hours, divided by the measured indoor–outdoor temperature difference (K) and the floor area (m2), in W/K.m². Qualifying days additionally require room-sensor completeness of at least 90%, an indoor–outdoor difference of at least 10 K and at least 5 kWh of space heat; systems require at least 20 such days. 187 systems in the dataset qualify; the reported HLP is the median of the set of 24 hour results for the house. The method does include the effects of solar gains and this means the HLP varies between the shoulder season and core-winter days. The median value represents the HLP under the conditions of winter solar gains (Dec-Feb) i.e. the coldest days and the lowest solar gains. This is an appropriate metric when examining peak demand as well insulated homes that also benefit from solar gains at specific times during the day and in specific rooms may be more able to reduce demand without a discernible impact on comfort. This subsample is unbiased against the full 338 dataset (season SPF 4.00 versus 4.03, p = 0.62; cold-condition COP 3.03 versus 3.02, p = 0.73). Fabric classes use thresholds of <1 W/K.m² (good) and >1.4 (poor). An outdoor-only estimator — per-system regression of daily heat output on outdoor temperature, per m² — is computed alongside for comparison with methods that lack indoor temperature.

[6] The emitter output proxy (W/K) is analogous to any heat transfer coefficient and in this case represents the heat transfer coefficient of the heating system (pipes and emitters) and is given as heat_output/((flow temperature + return temperature)/2 – room temperature).

Results

Energy use and indoor comfort

Among homes with near-complete annual data, the 'poor' efficiency (poor-HLP) group used 2.39 times as much space heating and 2.34 times as much space-heating electricity per square metre after accounting for the different indoor and outdoor temperatures they experienced[7].

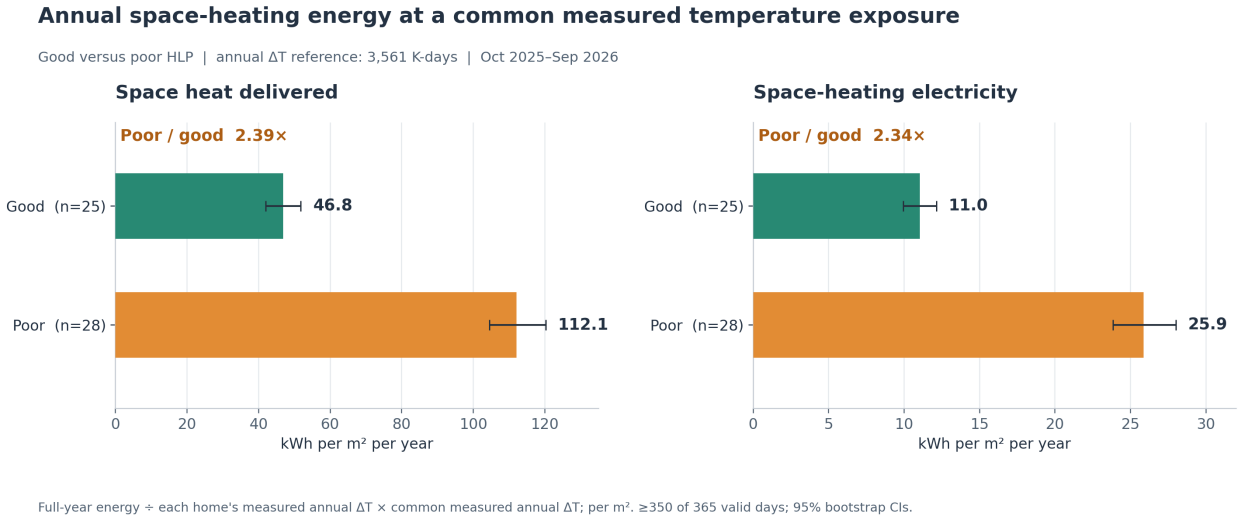


Figure 1. Annual heat and electricity at common temperature exposure.

On each home's coldest 10% of heating-season days, the poor-HLP group averaged 19.76°C indoors against 20.67°C in the good-HLP group[8].

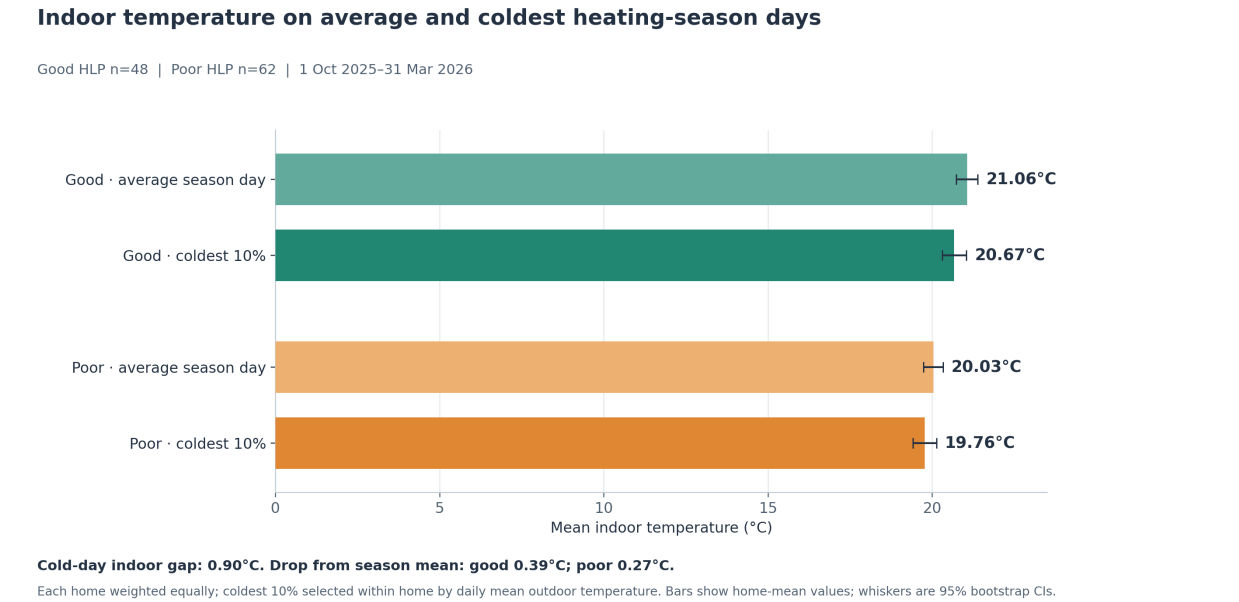


Figure 2. Indoor temperature on cold days.

[7] Annual comparison: 25 good-HLP and 28 poor-HLP homes with at least 350 valid days from October 2025 to September 2026. At a common measured 3,561 K-day indoor-outdoor exposure, heat was 46.8 versus 112.1 kWh/m² (ratio 2.39, 95% home-bootstrap interval 2.12 to 2.73); electricity was 11.0 versus 25.9 kWh/m² (ratio 2.34, interval 2.07 to 2.67). Observed, unstandardised ratios were 2.03 and 1.99. HLP partly uses delivered heat, so this is not independent proof of fabric causation. Source: the annual energy analysis.

[8] October 2025 to March 2026; 48 good-HLP and 62 poor-HLP homes. The coldest-day indoor-temperature gap was 0.90°C (95% home-bootstrap interval 0.39 to 1.41°C). Compared with each group's average heating-season day, good homes were 0.39°C cooler on coldest-decile days and poor homes 0.27°C cooler. The analysis pools emitter types and uses one indoor sensor per home. Source: the cold-day indoor temperature analysis.

Heat Pump Efficiency, Design and Commissioning

Poor-HLP homes used their heat pumps for space heating for 77.0% of observed wintertime, against 65.4% for good-HLP homes. A heat pump in a home where the fabric performance is measured to be well-performing, should not necessarily have a lower utilisation: this would mean it is not running optimally (i.e. continuously and modulating to run at the lowest viable temperature). These low utilisation rates may indicate that, even where the fabric is performing well, the system has been designed and commissioned based on surveys and assumptions that do not reflect the real fabric performance. This means that by measuring fabric performance, the heat pump could be set to run at a lower temperature but a higher utilisation rate and, by implication, a higher efficiency.

In this analysis, the combined effects of utilisation, insulation and emitters were tested by modelling Seasonal Coefficient Of Performance (sCOP) against HLP divided by (emitter output proxy * utilization rate)[9]. This showed that the sizing of emitters affects efficiency. Winter seasonal performance was better at 4.2 in the lowest HLP-to-emitter ratio quartile and worse at 3.7 in the highest.

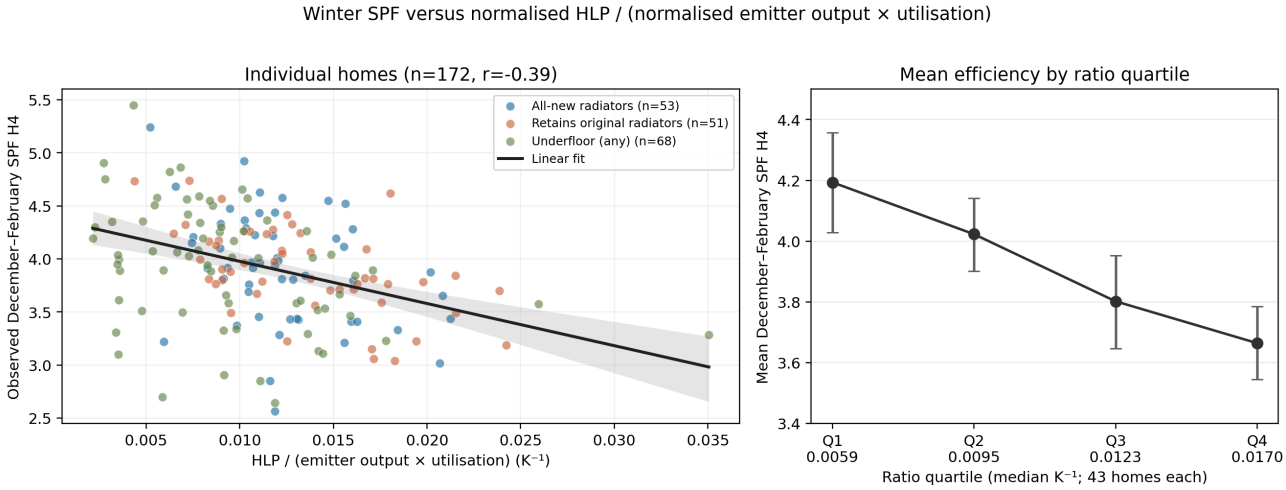


Figure 3. Efficiency against the heat loss to emitter ratio adjusted for utilisation.

[9] This combined metric is low when HLP is good (low), output proxy is low (high output for low temp) and utilisation is high and high when HLP is bad (high), output proxy is high (low output for high temp), low utilisation.

Home heating flexibility

In a modelled[10] six-hour heating switch-off starting at 21°C indoors and 0°C outdoors, indoor temperature falls about 0.8°C in good and mid-HLP homes and 2.1°C in poor-HLP homes. This shows a difference in potential for the heating system to 'coast' at peak demand times including cold periods with little wind (Dunkelflaute) where wholesale prices can remain elevated for 5-6 hour blocks or over multiple days.

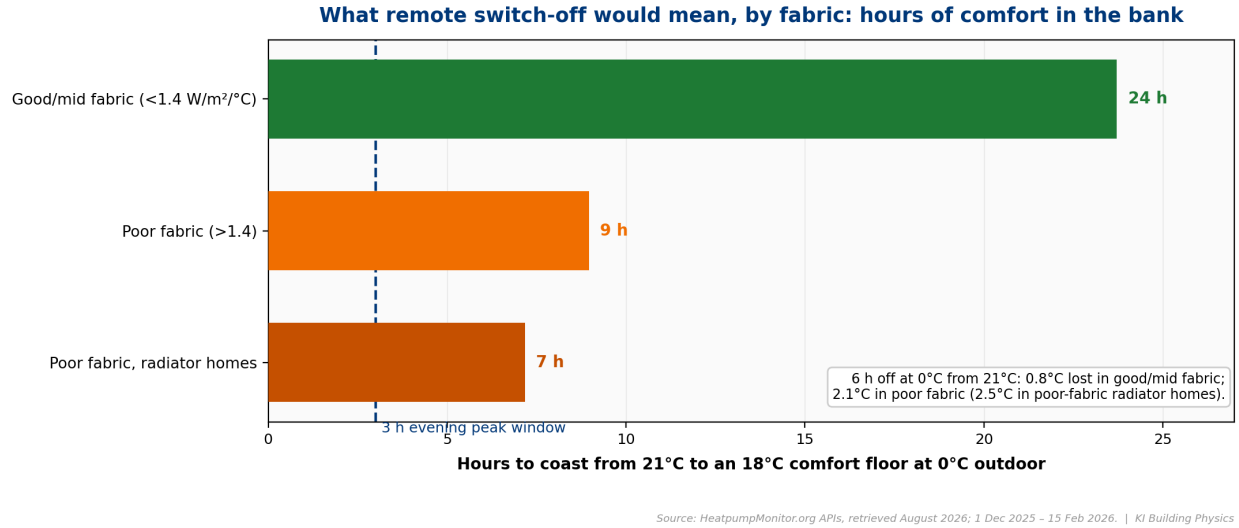


Figure 4. Modelled cooling during heating curtailment.

The EPC regime, whether based on SAP or HEM modelling of houses, already includes an assessment of thermal capacity. This analysis further suggests that home fabric thermal flexibility is quantifiable in the same way that the capacity of hot water cylinders and batteries can be given a capacity label[11].

Importantly, this capacity is 'cost free', in the sense that this is a built, physical feature of an existing home. In a similar way to when heat pumps run on electricity stored in a battery, the value of a home's fabric can be realised by the whole system and measured. This measured value could be allocated by EPCs such that households can be rewarded for a demand response without experiencing a discernible loss of comfort.

For example, it is arguable that the introduction of the HEM, if it is based on the same survey data as the SAP calculation, will not offer more trustworthy EPCs. However, the power and value of the HEM engine, provided it includes an accurate or measured representation of a house and its fabric, may yet be its ability to simulate the value to households of improvements to the house (such as well-installed insulation) that benefit the whole energy system.

[10] The model uses T drop = 21 × [1 - exp(-6/⍰)] with constant 0°C outdoors and no internal gains. Median measured cooling time constants were 154 hours in 11 good-HLP homes, 156 hours in 6 mid-HLP homes and 58 hours in 7 poor-HLP homes. Not every observed off-period lasted six hours. Source: the six-hour curtailment analysis.

[11] Further research is required comparing the metrics inferred from these data to EPC assessments and HEM models. If the HLPs in this dataset are better and the time constants between 21 and 18degsC are longer, measured thermal flexibility may be much more significant to the energy system than currently assumed.

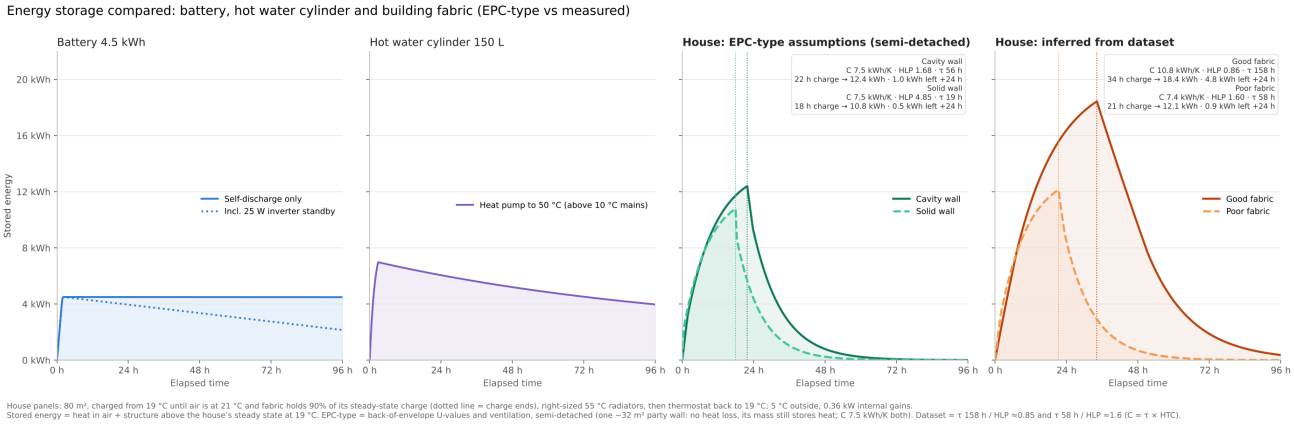


Figure 5. Energy storage compared: battery, hot water cylinder and building fabric (EPC-type vs measured).

On the question of whether households in this dataset were 'flexing' usage away from peak-demand times, the January electricity profile shows no clear collective evening load shift. During the 16:00–19:00 price peak, mean heat-pump use was 102% of adjacent-hour use in good-HLP homes and 95% in poor-HLP homes, although the reference Agile price was higher then. Individual tariff choices and responses are unknown[12].

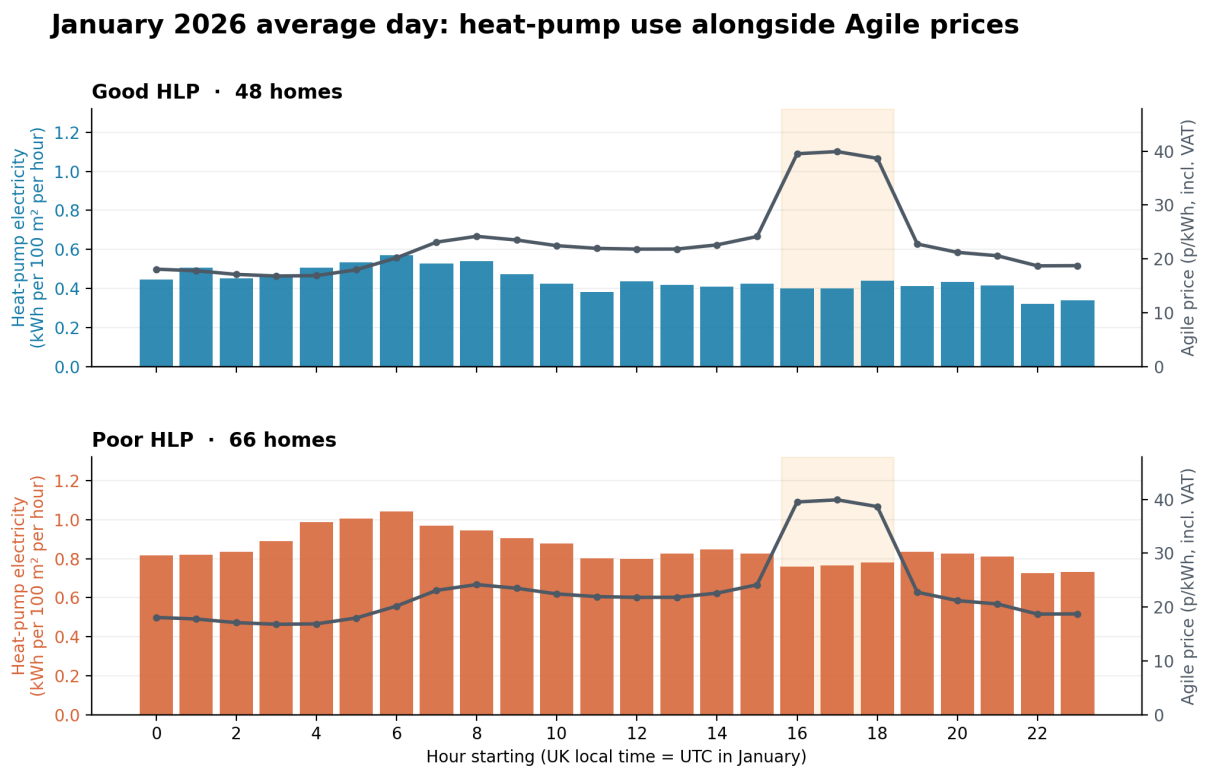


Figure 6. January electricity profile and reference Agile prices.

[12] January 2026; 48 good-HLP and 66 poor-HLP homes with at least 85% hourly coverage. Reference Agile price was 39.4p/kWh at 16:00–19:00 and 21.5p/kWh in the 13:00–16:00 and 20:00–23:00 shoulder hours. Peak-to-shoulder use ratios were 1.019 (95% home-bootstrap interval 0.962 to 1.078) and 0.953 (0.873 to 1.022). Tariff membership and region were unknown. Source: the January flexibility analysis.

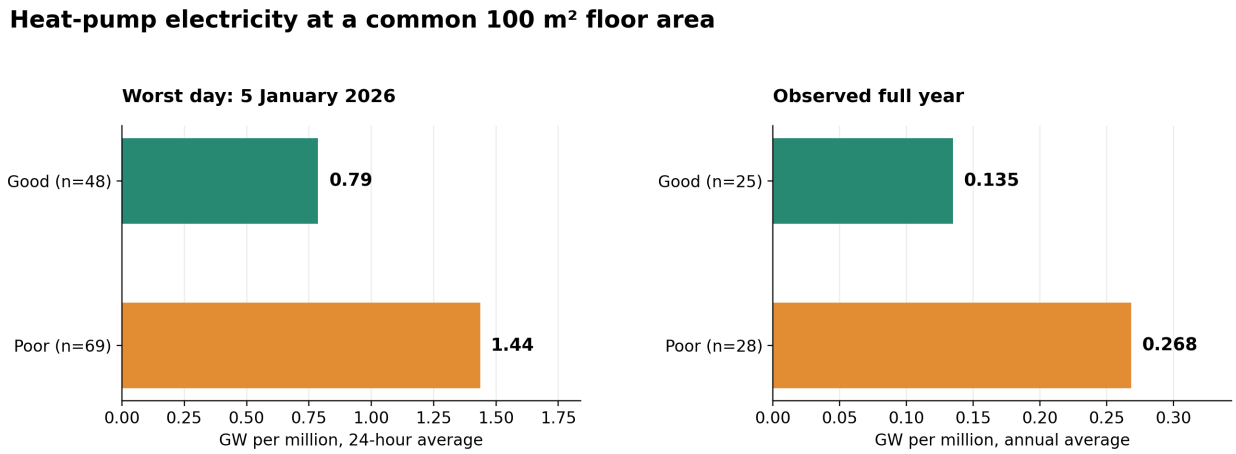
Additional worst-day demand – what 'energy system' impact if we don't improve home efficiency?

On the highest-demand day in the monitored winter, the 24-hour average grid demand for one million illustrative 100 m² sized homes is 0.79 GW for the good-HLP group and 1.44 GW for the poor-HLP group. This demonstrates that reducing winter peak demand offers huge cost savings in generation capacity the UK would not need to build and grid networks we would not need to reinforce:

"How we meet the need for electricity at times of low renewables and peak demand determines the cost of our future energy system. This 'peak heat' challenge is the biggest system innovation challenge for Net Zero"

Energy Systems Catapult[13]

The illustrative model shows the potential to lower winter peak demand for heat alongside shifting some of that remaining heat demand away from peak demand times.



Worst day: total heat-pump electricity. Year: space-heating electricity. The annual cohort is smaller; neither value is a coincident grid peak.

Figure 7. Winter-day and annual electricity demand.

[13] See Innovating to Net Zero 2026 - Energy Systems Catapult

Cold weather heat pump efficiency

Seasonal Performance Factors (SPF) were close to 4.0 in both fabric groups. On the coldest 10% of days, daily heat-pump efficiency (COP) averaged 3.24 in good-HLP homes and 3.14 in poor-HLP homes; on the coldest shared day it was 2.92 and 2.82. The poor group had a somewhat larger decline across the coldest 10% of days. The difference on the single shared day is less certain[14].

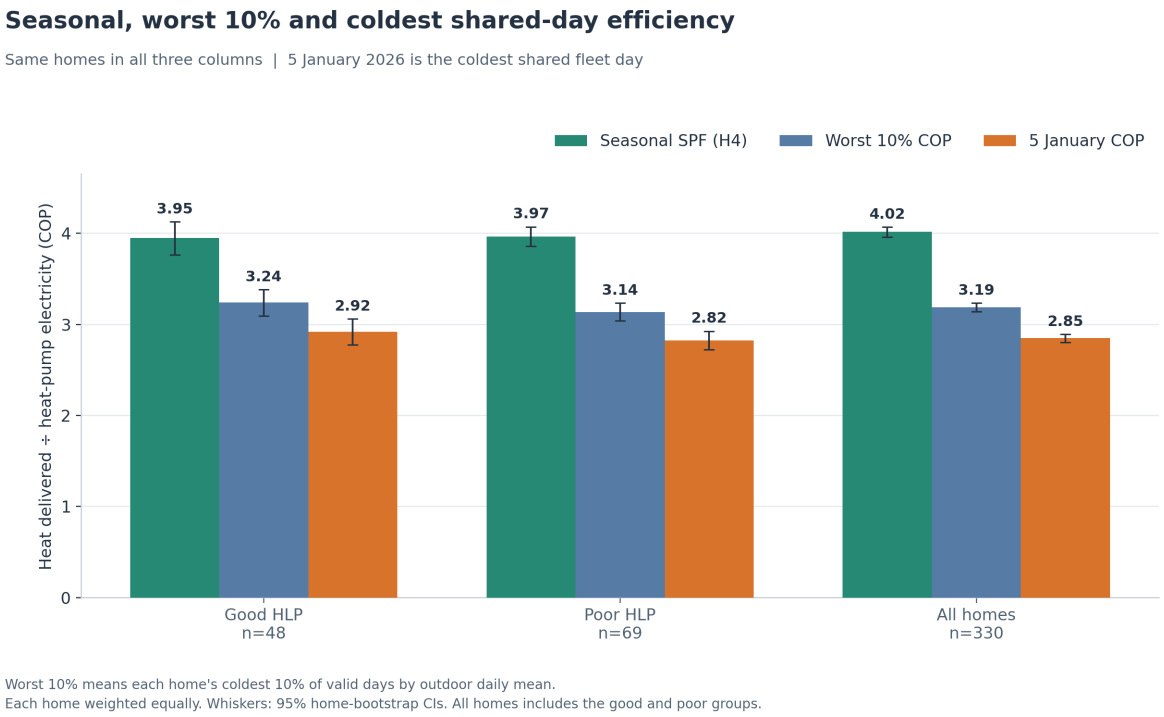


Figure 8. Seasonal and cold-weather efficiency.

[14] Matched homes with valid COP on 5 January 2026: n = 48 good, 69 poor and 330 overall. Seasonal SPF / coldest-decile COP / 5 January COP: 3.95 / 3.24 / 2.92 good; 3.97 / 3.14 / 2.82 poor; 4.02 / 3.19 / 2.85 overall. The poor group's extra coldest-decile COP fall was 0.12 points (95% home-bootstrap interval 0.03 to 0.22); the shared-day interval was -0.02 to 0.25. H4 includes hot water.

Discussion

A heat pump is part of a system alongside the home's fabric efficiency and emitters. Emphasising only whether heat pumps can operate at high seasonal efficiencies in all homes obscures multiple other components that make up home energy bills and a comfortable home. Those evident in this dataset include: higher heat and electricity per m^2 requirement, colder homes and faster heat loss on cold days in poorly insulated homes. Most of these real-world findings should not be revelatory given what we have learnt about the performance of homes over decades.

However, they present significant questions over the Government's retreat from supporting fabric improvements across its Warm Homes Plan policies, along with the lack of requirements for monitoring and measurement tools for heat pumps and fabric improvement. Robust monitoring is the only way to definitely show households a good job has been done.

By leveraging real time sensor data, AI analytics and the new Home Energy Model, Government can design policy to ensure households get robust recommendations for their homes to deliver a safe transition to electric heat. Steps in this direction are being made with the validation and certification of technologies (SMETERs) to measure heat loss due in early 2027, while these same technologies can also evaluate fabric thermal storage. An ideal heat pump survey install process is set out in the technical annex alongside current approaches.

Combining smart data insights with well-installed insulation and heat pumps allows homes to be warm and affordable for occupants while potentially allowing home fabric to act as thermal batteries shifting demand away from winter grid peaks. Failing to take such steps exposes households and the wider energy system to significant risk.

Recommendation 1:

Embed fabric improvements as a core option across all retrofit schemes - including the Warm Homes Loan Scheme - to support informed consumer choice

- **Action:** Include insulation as an eligible, core measure under all future retrofit schemes, including low-cost loans. Ensure consumers receive accurate, transparent guidance on the long-term costs, bill savings, and performance benefits and risks of different measure combinations.
- **Rationale:** Neglecting fabric improvements leads to sub-optimal outcomes for households, the energy system, and the wider economy. Households must be empowered to make an informed choice between up-front capital costs and long-term running costs, ensuring public funding delivers lasting bill reductions while mitigating future grid and system risks.
- **Regulatory Lever:** Design all new iterations of retrofit schemes to maximise consumer choice underpinned by accurate, real-world performance data (via SMETERs and revised EPCs).

Recommendation 2:

Shield fuel-poor households from tariff risk and bill shock by mandating a minimum thermal performance standard

- **Action:** Mandate "fabric co-deployment" across all future Warm Homes schemes targeting low-income households where a property's Heat Loss Parameter (HLP) exceeds 1.4–1.6 W/m2K. Introduce a "Thermal Decoupling Protection" standard across fuel-poor and social housing schemes, prohibiting the substitution of physical insulation with commercial time-of-use tariff optimisation.
- **Rationale:** Low-income households require the strongest protection against volatile energy prices, premature heating system replacements, and cold homes. High-per forming building fabric is the most reliable way to secure long-term bill savings, thermal comfort, and occupant well-being. In thermally leaky homes, pre-heating ahead of peak pricing periods is costly and ineffective, leaving vulnerable residents exposed to extreme wholesale price spikes or cold indoor temperatures during freezing spells.
- **Regulatory Lever:** Embed minimum HLP thresholds and fabric co-deployment requirements into scheme eligibility rules and PAS 2035 retrofit assessments for all fuel-poor and social housing funding streams, ensuring homes achieve sufficient thermal retention before heat pumps or time-varying tariffs are deployed.

Recommendation 3:

Introduce In-Situ Thermal Verification (SMETERs) into HEM and Future EPCs and Policy Design

- **Action:** Adopt Smart Meter Enabled Thermal Efficiency Ratings (SMETERs) into the EPC system to allow a measured Heat Transfer Coefficient to inform EPC grades. Allow SMETER informed EPC grades and measurements (HTCs) to support:
  - policy ambitions such as Minimum Energy Efficiency Standards & equivalent social housing EPC targets
  - post-retrofit fabric improvement sign-offs in capital retrofit schemes like the Social Housing Fund such as a minimum HTC target (a similar approach was part of early waves of the SHF)
  - verification of MCS heat pump surveys for 'able to pay' households on a voluntary basis alongside a requirement for capital schemes supporting heat pump install in fuel poor households.

- **Rationale:** All research indicates SAP / RdSAP assessments frequently misestimate actual heat loss. While desktop surveys may underestimate, or overestimate, heat loss, being wrong in either direction carries implications for households and, if happening at scale, the wider energy system.

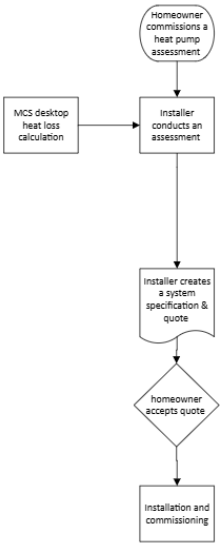
- **Regulatory Lever:** Introduce an in-situ performance verification step under the Microgeneration Certification Scheme (MCS), PAS 2035 linked to capital schemes and allow SMETER measurements to inform EPC grades. In situ measurement can be voluntary for able to pay schemes although householders should be made aware of the option and benefits while schemes supporting retrofit in fuel poor householders should have in situ measurement embedded.

Technical Annex

Heat Pump install - Risk allocation and system optimization

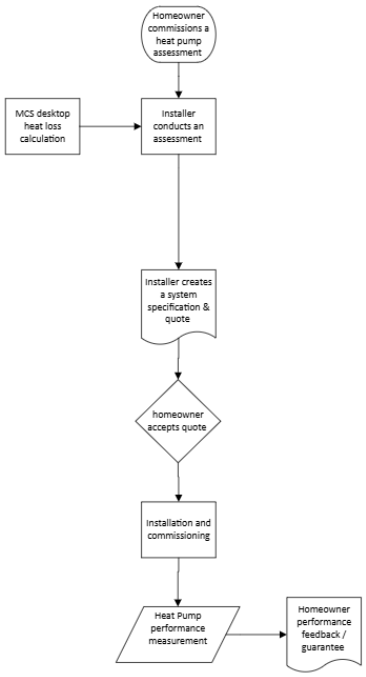
Heat Pump install process 1 – Misallocated risk, unoptimized system.

1. All heat pump performance risk remains with occupants
2. No measurement verification of MCS desk-top heat loss calculation
3. No effort to reduce heat loss or consider insulation measure options
4. No effort to consider smaller specification heat pump
5. No effort to manage fabric mould risk



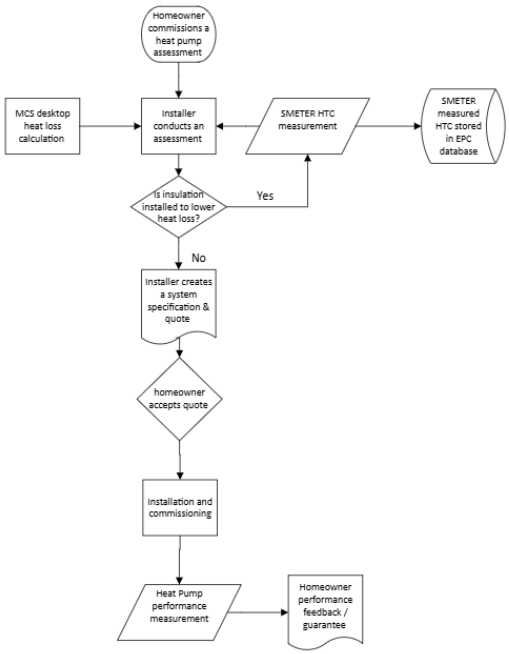
Heat Pump install process 2 – Risk transferred, unoptimized system.

1. Heat pump performance risk supported by guarantee Terms & Conditions
2. No measurement verification of MCS desk-top heat loss calculation
3. No effort to reduce heat loss or consider insulation measure options
4. No effort to consider smaller specification heat pump
5. No effort to manage fabric mould risk



Heat Pump install process 3 – Risk managed, optimized fabric & heat pump sizing.

1. Heat pump performance risk managed through:
   - o SMETER heat loss measurement
   - o Performance monitoring of heat pump
2. System optimized with known heat loss, fabric improvements & potentially smaller heat pump



About MIMA

The Mineral Wool Insulation Manufacturers' Association (MIMA) is a trade body providing an authoritative source of independent information and advice on non-combustible glass and stone wool insulation. We represent leading mineral wool insulation companies in the UK, promoting the benefits of mineral wool insulation and the contribution it makes to the energy efficiency of buildings and the comfort, health and safety of their occupants.

MIMA has a long-standing record of conducting research, advocating for policy, and developing high-performing mineral wool insulation systems which support the retrofit industry in closing gaps in performance between the design intent of energy efficiency measures and their actual performance in use.

Disclaimer
All examples, case studies, and references used in this paper were accessed prior to 20 November 2026 and have been used for illustrative purposes only. They are not an endorsement by MIMA of the commercial offers or approaches to building retrofit quoted.

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