EAST RIDING OF YORKSHIRE COUNCIL

Exploring the Impact of Energy Efficient Measures on Health Outcomes in Rural Communities- a postnote

Background

Energy-efficient measures have emerged as a critical pillar of sustainable development, climate resilience, and public health improvement, particularly in low-income and rural settings. At their core, energy-efficiency initiatives involve optimising energy use to achieve the same output while reducing waste, emissions, and costs—a concept described as one of the most cost-effective strategies for reducing greenhouse gas emissions and supporting economic development (United Nations Environment Programme, 2015)

The **adoption of technologies** and energy-efficient practices, such as **solar panels, solar water heaters, air-source heat pumps**, energy-efficient cookstoves, enhanced insulation, and improved ventilation, can substantially improve the efficiency and effectiveness of household heating, ventilation, and power systems (International Energy Agency, 2015). These interventions reduce energy waste, lower emissions, and enhance thermal comfort, thereby contributing to improved living conditions and public health outcomes, particularly in **low-income and rural settings** (Department for Business, Energy & Industrial Strategy, 2013).

In many **rural communities**, patterns of energy use are shaped more by necessity than by choice. Housing stock is often older, poorly insulated, and disconnected from the national gas grid, compelling residents to rely on traditional fuels such as oil, coal, and biomass. for cooking and heating. This dependence contributes to persistent fuel poverty, in which households struggle to secure adequate and **affordable energy**. (Ministry of Housing, Communities & Local Government, 2022; Ofgem, 2023)

Box 1: Current Picture

- **2.2 million households** are in fuel poverty; rural areas are most affected (DBEIS, 2022).
- **Over 40% of rural homes** use oil, coal, or wood for heating (Baltruszewicz et al., 2022).
- Poor insulation contributes to **excess winter deaths**, especially in rural areas (National Institute for Health and Care Excellence, 2019).
- **Energy-efficient technology** uptake (e.g., heat pumps, solar) is **below 15%** in rural communities (English Housing Survey, 2023).

The absence of energy-efficient measures in cooking and household heating contributes significantly to a range of adverse outcomes, particularly in rural areas where reliance on traditional biomass and fossil fuels remains prevalent. This dependence exacerbates indoor air pollution—a major environmental health risk linked to increased respiratory illnesses, cardiovascular disease, and other long-term health conditions, especially among older adults, children, and individuals with pre-existing conditions (Baltruszewicz et al., 2022; UK Air Quality Statistics, 2023).

The growing need for sustainable, affordable, and health-conscious energy solutions in rural areas has placed energy efficiency at the forefront of policy and research discussions. Rural households often experience higher levels of fuel poverty due to poor insulation, outdated heating systems, and limited access to the national grid. Given **1**) the disproportionate energy burden on rural households, **2)** the potential of technologies such as air-source heat pumps, solar panels, and enhanced insulation to reduce this burden, and **3)** the broader relevance to public health and decarbonisation goals, it is important to investigate the role of energy-efficient measures in improving rural energy outcomes **(Box 2).**

Box 2: Study aims

- To investigate how the installation of energy-efficient measures, such as air-source heat pumps, solar panels, and enhanced insulation, can help reduce fuel poverty in rural households while contributing to decarbonisation efforts.
- To explore the potential health benefits of these measures, focusing on both physical health and mental wellbeing

Given the central role of energy-efficient measures in addressing rural energy challenges, this study aims to investigate their impact on both household energy security and resident well-being. The following research questions guide the investigation **(Box 3)**

Box 3: Research Questions

- How do energy-efficient measures affect fuel poverty in rural communities?
- What is the impact of energy-efficient measures on the physical health of residents (e.g., respiratory conditions, cardiovascular health)?
- How do energy-efficient measures contribute to improved mental health and wellbeing (e.g., reduced stress from energy costs, increased comfort)?

Methods

Data collection: April-July 2025 through Smart-Survey.

Data storage and analysis: Data was anonymised and stored in compliance with ERYC policies. Data cleaning and preparation for analysis were done as per Saunders et al., 2019.

Results

Participant numbers and locations

Representative sample across the Sampled Area (Figure 1 and Box 4).

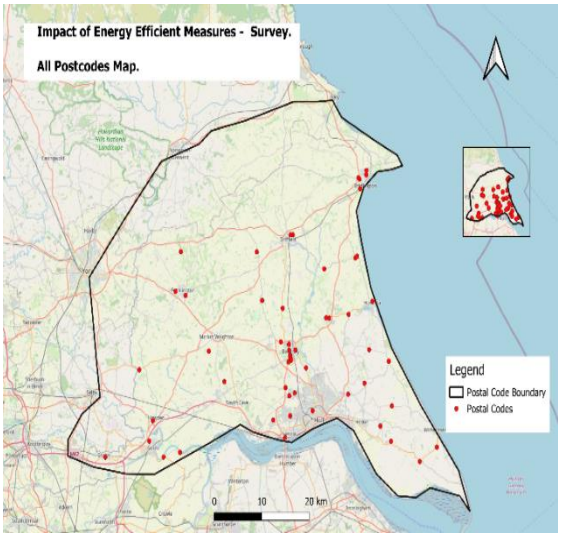

Figure 1: Maps including the postcodes from all survey respondents as red dots.

RQ1: How do energy-efficient measures affect fuel poverty in rural communities?

Gas and grid electricity are the primary energy sources used in respondents' households (Figure 2).

60.3% of respondents did not indicate whether they are likely to install energy-efficient measures in the **next three years** (Figure 5).

Financial support, such as **subsidies or loans**, is the most requested intervention to increase the adoption of energy-efficient measures in the community (Figure 7).

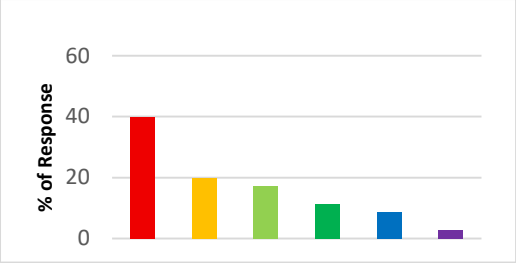

Figure 3: Household installation or upgrade of energy-efficient measures in home (from top to bottom): 1) No 2) Yes, but more than 3 years ago 3) Yes, in the last 3 years 4) They were already installed in the house when we moved in 5) No Answer / Not Applicable 6) Unsure

Perceived impacts of energy-efficient measures on quality of life include no noticeable change, some improvements, and, for a few respondents, significant benefits or negative effects (Figure 6). The lack of noticeable change for many may reflect that they do not currently have energy-efficient measures installed, making it difficult to relate to **potential benefits**

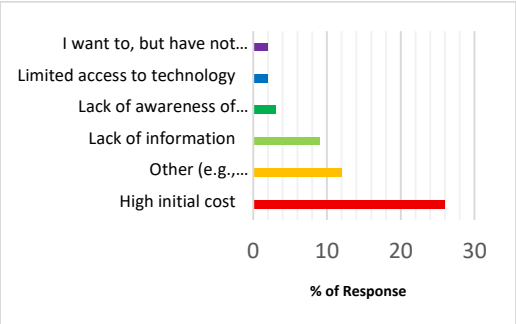

Figure 4: The high initial cost is the primary reason why respondents have not adopted energy-efficient measures.

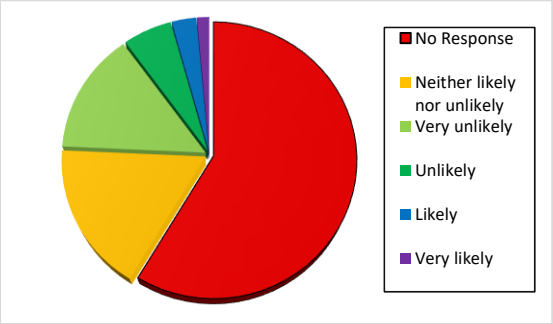

Figure 5: Likelihood of installing energy-efficient measures in the next 3 years (from top to bottom): 1) No Response / No sure — 60.3%, 2) Neither likely nor unlikely — 14.7%, 3) Very unlikely — 14.7%, 4) Unlikely — 5.9%, 5) Likely — 2.9%, 6) Very likely — 1.5%

Box 4: Participant demographics

- **70 residents** aged 18 and above participated in the study across multiple rural areas.
- **Housing types**: Most lived in detached (37%) or semi-detected homes (30%).
- **Ownership**: 79% of participants lived in privately owned homes.
- **Gender**: 52% female, 45% male, 3% identified as non-binary or preferred not to say.
- **Ethnicity**: 88% identified as White; others included Black British and Asian British.
- **Age distribution**: The Majority (61%) were aged between 45–74 years.
- **Disability status**: 68% reported no disability; common conditions included mental health and long-standing health issues.

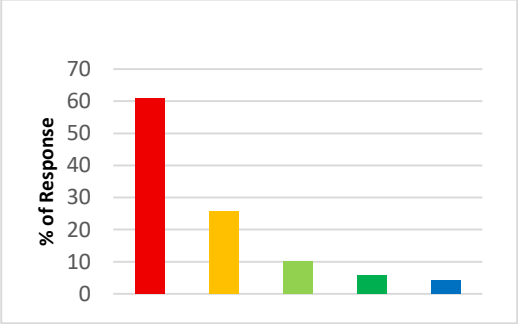

Figure 6: Changes in quality of life from energy-efficient measures (from top to bottom): 1) No Response / Blank — 61.0%, 2) No noticeable impact — 25.7%, 3) Somewhat improved quality of life — 10.0%, 4) Significantly improved quality of life — 5.7%, 5) Unsure — 4.3%, 6) Negative impact — 4.3%.

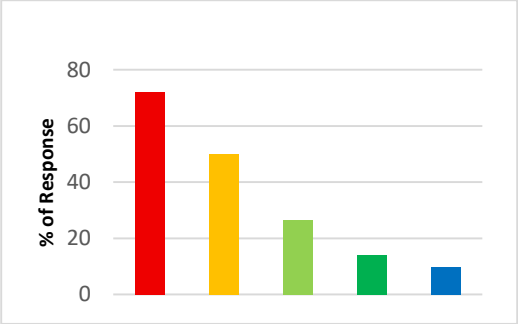

Figure 7: Helpful support and interventions for adopting energy-efficient measures (from top to bottom): 1) Financial subsidies or loans — 72.2%, 2) Access to affordable technology — 50.0%, 3) Community-based initiatives and training —

Box 5: Testimonials – The Impact of Energy Efficiency on Quality of Life

- **Financial Impact:** 'Reduced heating bills so therefore more disposable income'; 'Slashed energy bill by two thirds, relieving financial stress'; 'I can't afford to use the gas central heating unless the cold weather is extreme.'
- **Home Comfort and Living Environment:** 'Secondary double glazing Warmer Quieter'; 'Home is continuously warm, no cold to hot cycle'; 'Improved comfort with energy efficient measures'; 'Warmer and dryer house'.
- **Issues with Technology and Measures:** 'Old double glazing lets in drafts; cavity wall insulation no longer works. Place is very cold, except in summer'; 'The air source heat pump heating system is slow to respond...The bungalow is damp...consequently we have to run a dehumidifier most days and that is expensive.'
- **Community and Neighborly Impact:** 'My neighbour installed a wood burning stove in his ground floor extension which fills my house with soot and smoke... He is happy because he says he is saving a fortune on gas whilst he burns any rubbish he finds

26.4%, 4) Educational programs on health benefits — 13.9%, 5) Other — 9.7%.

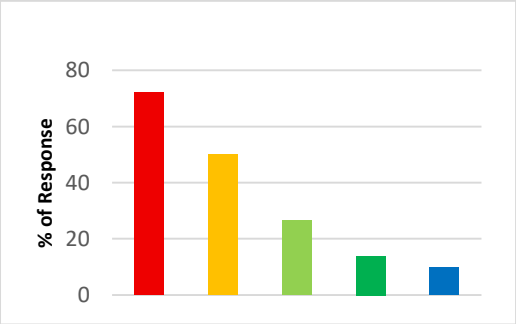

Figure 8: Challenges in maintaining energy-efficient measures (from top to bottom): 1) None — 22.2%, 2) High maintenance costs — 20.8%, 3) Lack of technical knowledge — 12.5%, 4) Limited access to repairs or support — 8.3%, 5) Other — 6.9%.

RQ2: What is the impact of energy-efficient measures on the physical health of residents?

Box 6: Testimonials – Other Suggested Support and Interventions

- **Improved Regulation and Installer Oversight:** 'Significant oversight of installers. Our East Riding based ASHP installer was a disaster. Trading Standards need to be fully up to speed on these systems and be willing to step in and pressure installers to rectify substandard installations.'
- **Responsibility of Landlords and Building Managers:** 'Building managers should explore solar panels or heat sink technology'; 'Educate the leaseholder that solar panels are a good thing for residents'; 'Convince the landlord?'
- **Direct Financial Support:** 'Grants'
- **Property-Specific Technical Guidance:** 'We are told our rooms in the roof are not suitable for insulation, except perhaps the exterior of the dormer roof and windows.'

28.2% of respondents reported **joint or muscle pains** in the last **three years** (Figure 9).

Improved health was the main health improvement reported by residents and in community health (Figures 11 and 12).

Respiratory problems and **joint or muscle pains** were the most prominent health issues experienced before the installation of energy-efficient measures**.** (Figure 10).

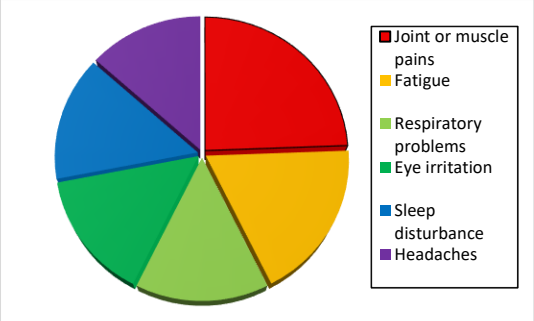

Figure 9: Health issues experienced in the last 3 years

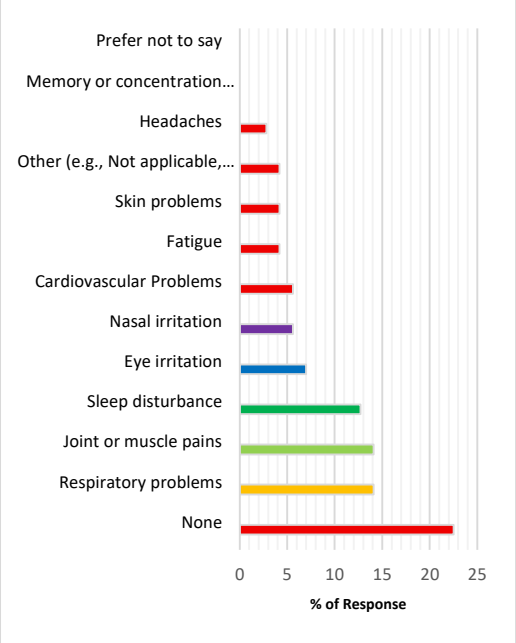

Figure 10: Health issues experienced before installation of energy-efficient measures

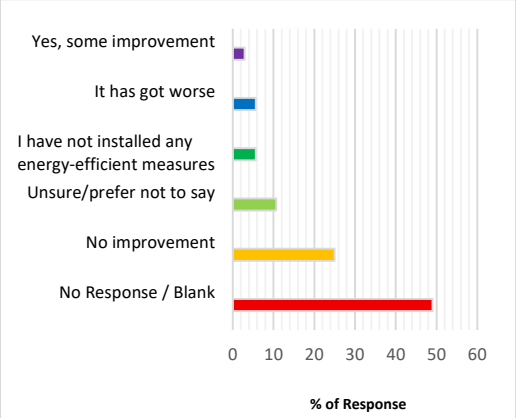

Figure 11: Perceived health changes in the last 3 years.

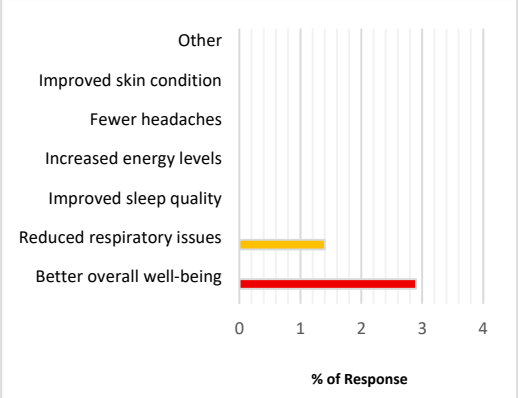

Figure 12: Specific health improvements observed (from top to bottom): 1) Better overall well-being — 2.9%, 2) Reduced respiratory issues — 1.4%, 3) Improved sleep quality — 0.0%, 4) Increased energy levels — 0.0%, 5) Fewer headaches — 0.0%, 6) Improved skin condition — 0.0%, 7) Other — 0.0%

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RQ3: How do energy-efficient measures contribute to improved mental health and wellbeing?

Improved air quality was the most predominantly perceived benefit, cited by nearly half (45.8%) of the survey respondents. (Figure 13)

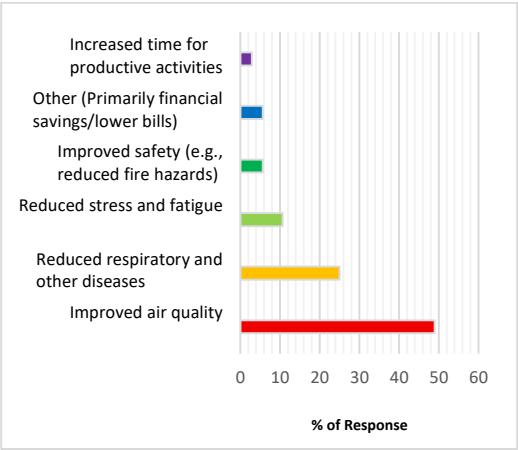

Figure 13: Perceived community benefits of energy-efficient measures: improved air quality (45.8%), reduced respiratory and other diseases (25.0%), reduced stress and fatigue (20.8%), improved safety (15.3%), other benefits including financial savings (15.3%), and increased time for productive activities (5.6%)

Box 7: Regression analysis. Our models show that:

- Adoption of energy-efficient measures (e.g., insulation, solar panels, heat pumps) is associated with lower household energy costs, which in turn eases fuel poverty, especially in rural areas where traditional fuels dominate.
- Reduced exposure to indoor air pollution and improved thermal comfort show potential correlations with fewer respiratory issues and better overall well-being, though measurable impacts are limited because many households have not yet installed the measures.
- Financial savings and improved home comfort from energy efficiency are linked to lower stress and fatigue, suggesting an indirect but positive effect on mental health.

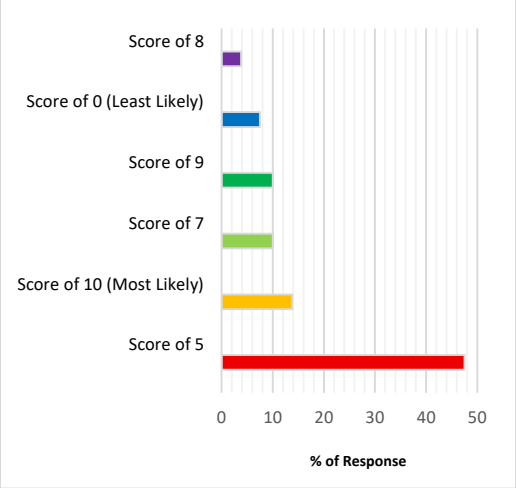

Figure 14: Likelihood of recommending energy-efficient measures.

Box 8: Main messages

- Improved financial well-being, resulting from reduced energy bills, is a primary driver of enhanced quality of life and reduced stress for those who have adopted new measures.
- A critical lack of trust and reliable information serves as a major non-financial barrier, with residents reporting negative experiences with contractors and difficulty finding independent, credible advice.
- The effectiveness of energy-efficient measures is not guaranteed; some households experience negative consequences, such as technical problems with new systems or the poor performance of older installations, which can worsen their living conditions.
- There is a clear need for systemic interventions, as individual action is often insufficient. Respondents overwhelmingly call for financial support, such as grants and loans, to enable broader adoption.
- Energy choices have a distinct community dimension, where the actions of one household can directly impact the health and comfort of neighbors, highlighting the need for policies that consider these external effects.

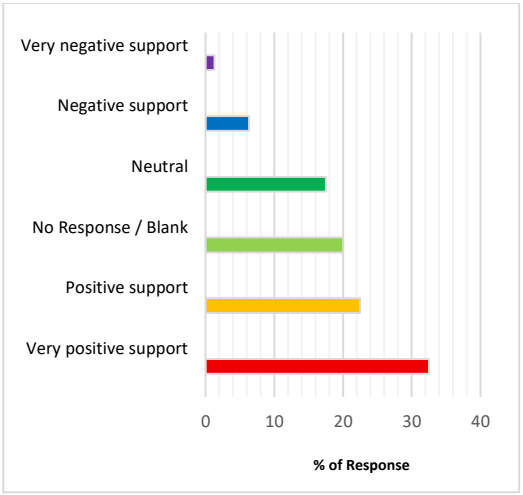

Figure 15: Perceptions of the environmental impact of energy-efficient measures.

Study Limitations

While the survey provides valuable insights into residents' experiences and perceptions of home energy efficiency measures, several limitations should be considered when interpreting the findings. Conducted over a nine-week period with 70 participants, the study's small sample size limits the generalizability of results across the wider East Riding of Yorkshire population. The concentrated age range of respondents further restricts analysis of generational differences in awareness, uptake, and perceived health impacts. Moreover, the relatively short data collection window may not capture seasonal variations in energy use, household comfort, or health outcomes.

As participation was voluntary, the study may also reflect self-selection bias, with individuals already engaged or interested in energy efficiency more likely to respond. The findings are therefore context-specific and may not directly translate to other regions with differing housing stock, socio-economic profiles, or policy frameworks. Additionally, reliance on self-reported data introduces potential recall and social desirability biases, which may affect the accuracy of responses regarding home conditions, energy use, and wellbeing.

Implications for Future Research

Future research should seek to broaden the sample size and demographic scope to enhance representativeness and capture diverse household experiences**.** Extending the survey duration across multiple seasons would yield a more nuanced understanding of how environmental conditions shape energy behaviours and health outcomes. Employing mixed-method approaches—including qualitative interviews, energy performance data, and in-home assessments—would strengthen the validity of findings and provide richer insights into lived experiences.

Comparative studies across different local authorities and housing contexts would further clarify how regional policies, building characteristics, and socio-economic factors influence the success of energy efficiency interventions. Such evidence would enable policymakers and housing agencies to design targeted, equitable strategies that not only improve energy performance but also address fuel poverty and associated health inequalities in rural and semi-rural communities.

Conclusions

- Financial Stress and Health: A clear link exists between financial relief from lower energy bills and improved mental well-being, indicating that economic benefits are a key pathway to health improvements.
- The High-Cost Barrier: The most significant obstacle to adopting energy-efficient measures is the high initial financial investment, which limits access for many households, particularly those with lower incomes.
- A Pervasive Information Gap: There is a notable lack of trusted, independent advice available to homeowners, which is compounded by negative experiences with contractors and a desire for better industry oversight.
- Risk of Negative Outcomes: The installation of energy-efficient measures is not without risk; some households report technical failures, poor performance of older systems, or unintended consequences like dampness.
- Necessity of Systemic Support: The findings strongly indicate that individual willpower is insufficient to drive change. There is an overwhelming demand for systemic support, primarily through financial subsidies and loans.
- Community-Level Impact: Energy choices have consequences that extend beyond the individual household, as the actions of one neighbor can directly affect the health and comfort of others in the community.

Recommendation

- Increase Awareness and Support: While most households report no clear health benefits, about 1 in 6 experience improved quality of life. Expanding outreach on non-health benefits, such as comfort and cost savings, may boost adoption.
- Address Barriers: Approximately 1 in 4 households encounter challenges in implementing improvements. Identifying specific obstacles through qualitative feedback will enable tailored local support and funding.
- Focus on Older Residents: Prioritize communication and support for the 45- to 74-year-old age group, as they represent the largest demographic and can significantly benefit from improved thermal comfort and lower utility bills.
- Conduct Further Research: The high percentage of "no answer" responses suggests

a need for more in-depth qualitative research to uncover latent concerns or benefits.

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